

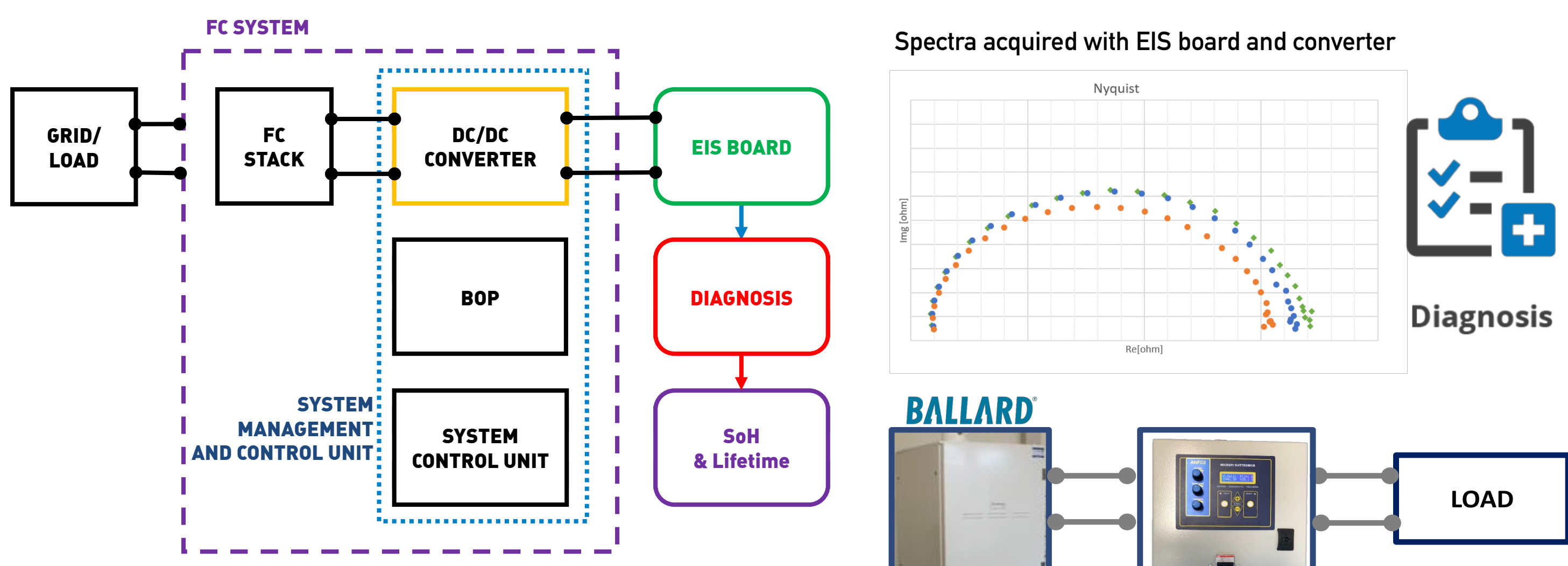


Real operation pem fuel cells HEALTH-state monitoring and diagnosis based on dc-dc COnverter embeddeD Eis

PROJECT OVERVIEW

Embedded On-line tool based on Electrochemical Impedance Spectroscopy (EIS) for advanced Fuel Cells Monitoring, Diagnosis and Lifetime Tool (MDLT).

The tool performs EIS-based condition monitoring of FC stacks and isolates 5 stack faults.

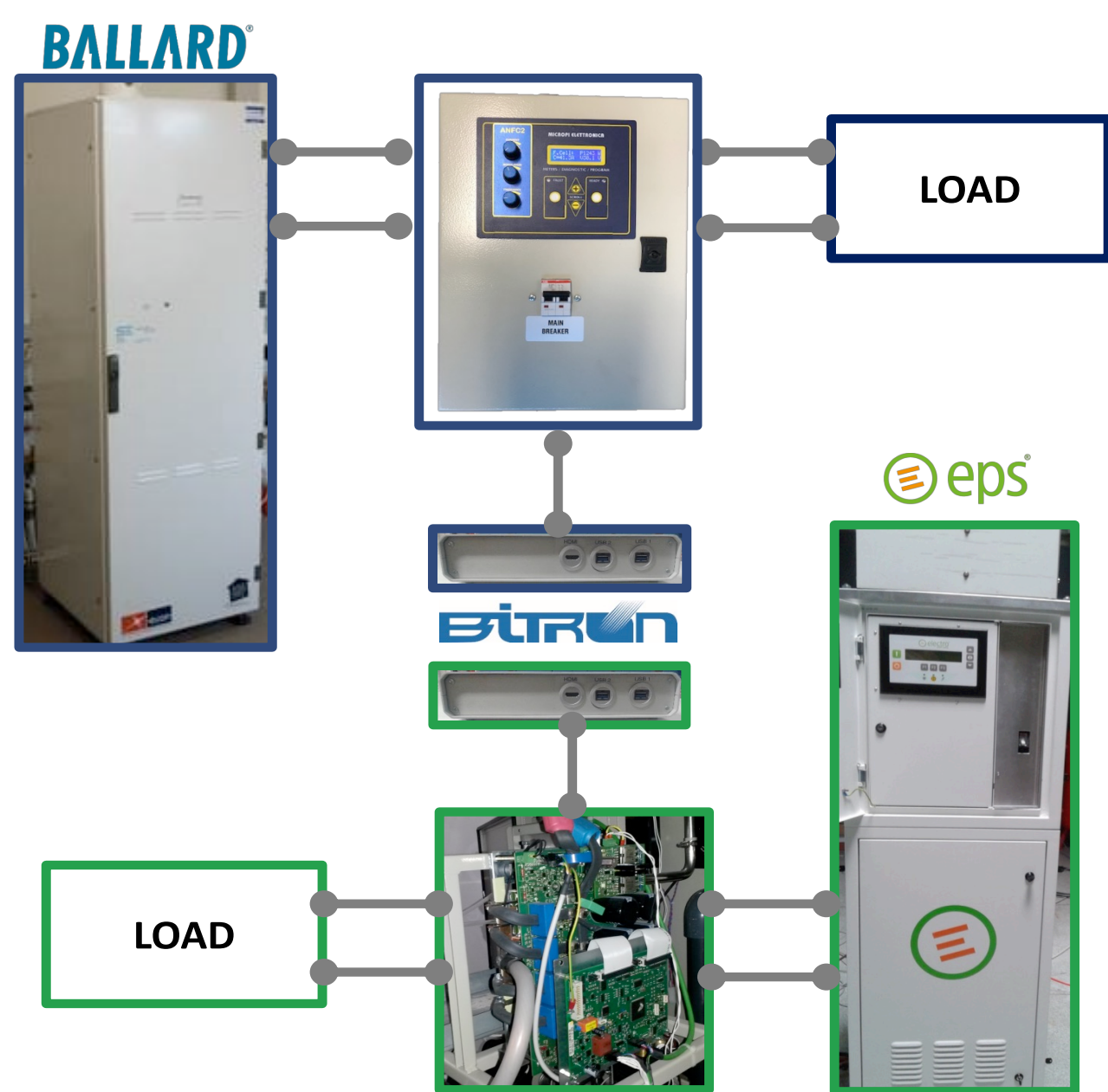
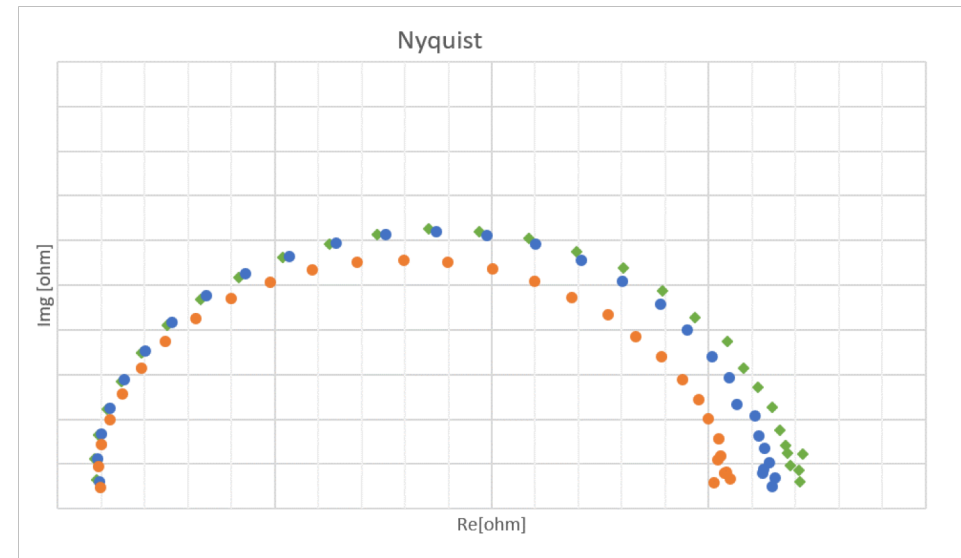


EIS board cost < 500€ (3% of TCO)

USEFUL GUIDELINES for companies to implement EIS board on industrial FC systems:

- NEW DC/DC converter designed to interact with the EIS board.
- ADAPT AVAILABLE converter to allow the communication with the EIS board.

Spectra acquired with EIS board and converter



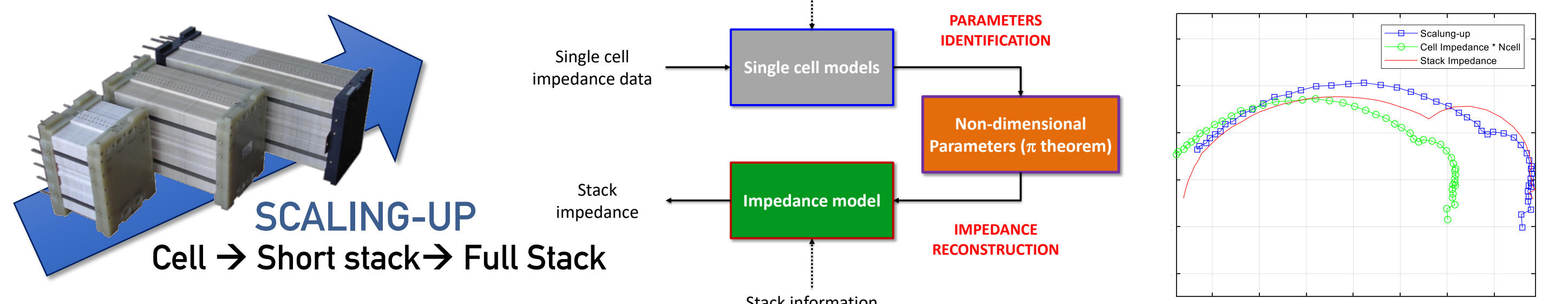
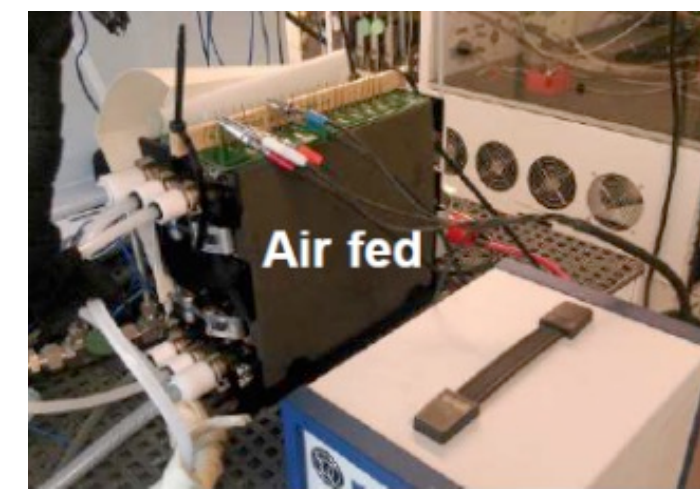
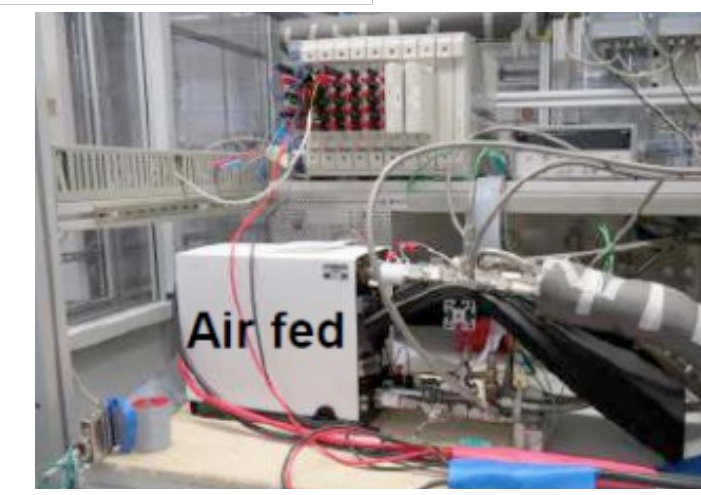
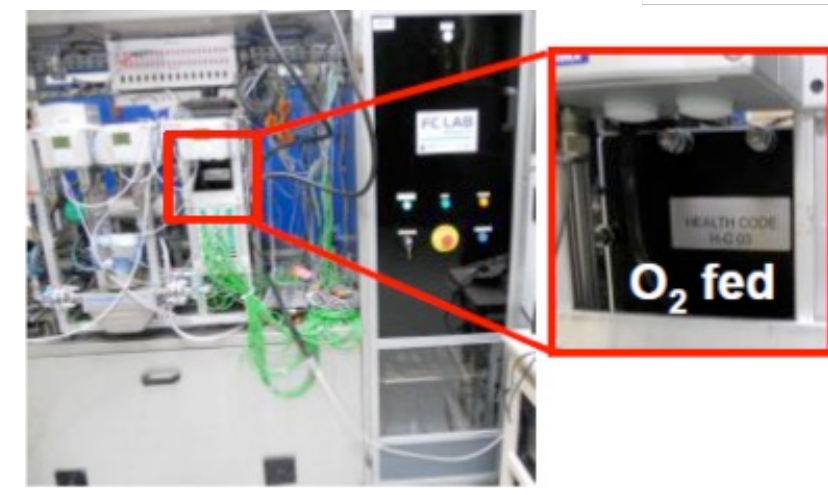
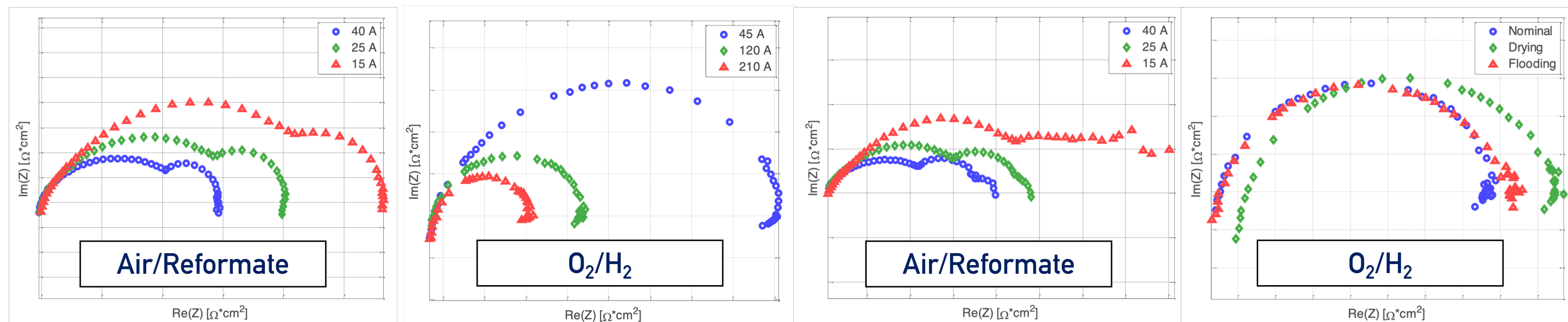
EIS SPECTRA MEASUREMENTS

2200+ EIS spectra for stacks (10%) and cells, 25% in nominal and 75% in faulty operations

Nominal spectra set the monitoring reference

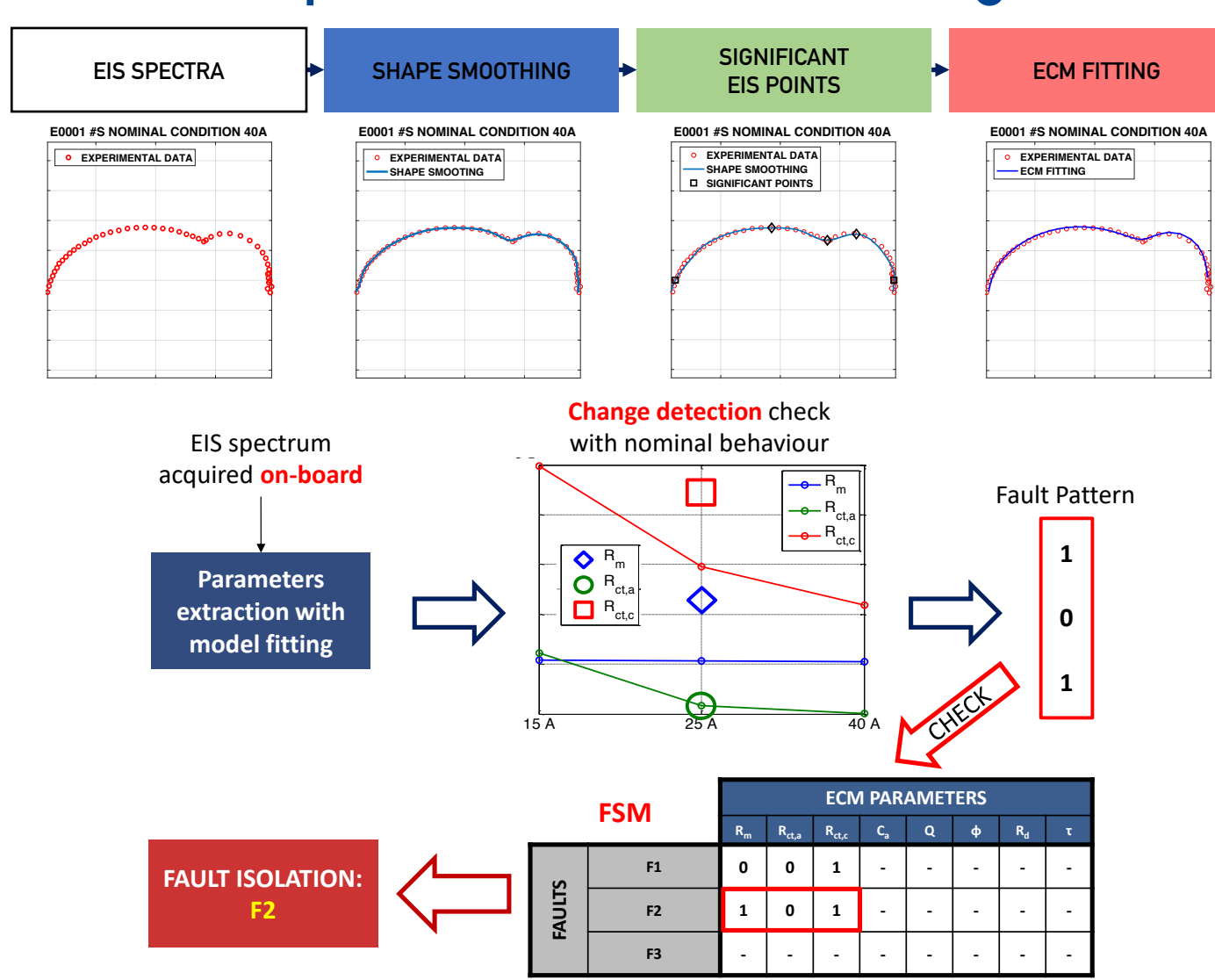
Faulty spectra drive the setting of faults isolation algorithm

- Faults**
- fuel starvation
 - air/O₂ starvation
 - flooding/drying
 - CO contamination (only air-fed)
 - sulphur poisoning (only air-fed)

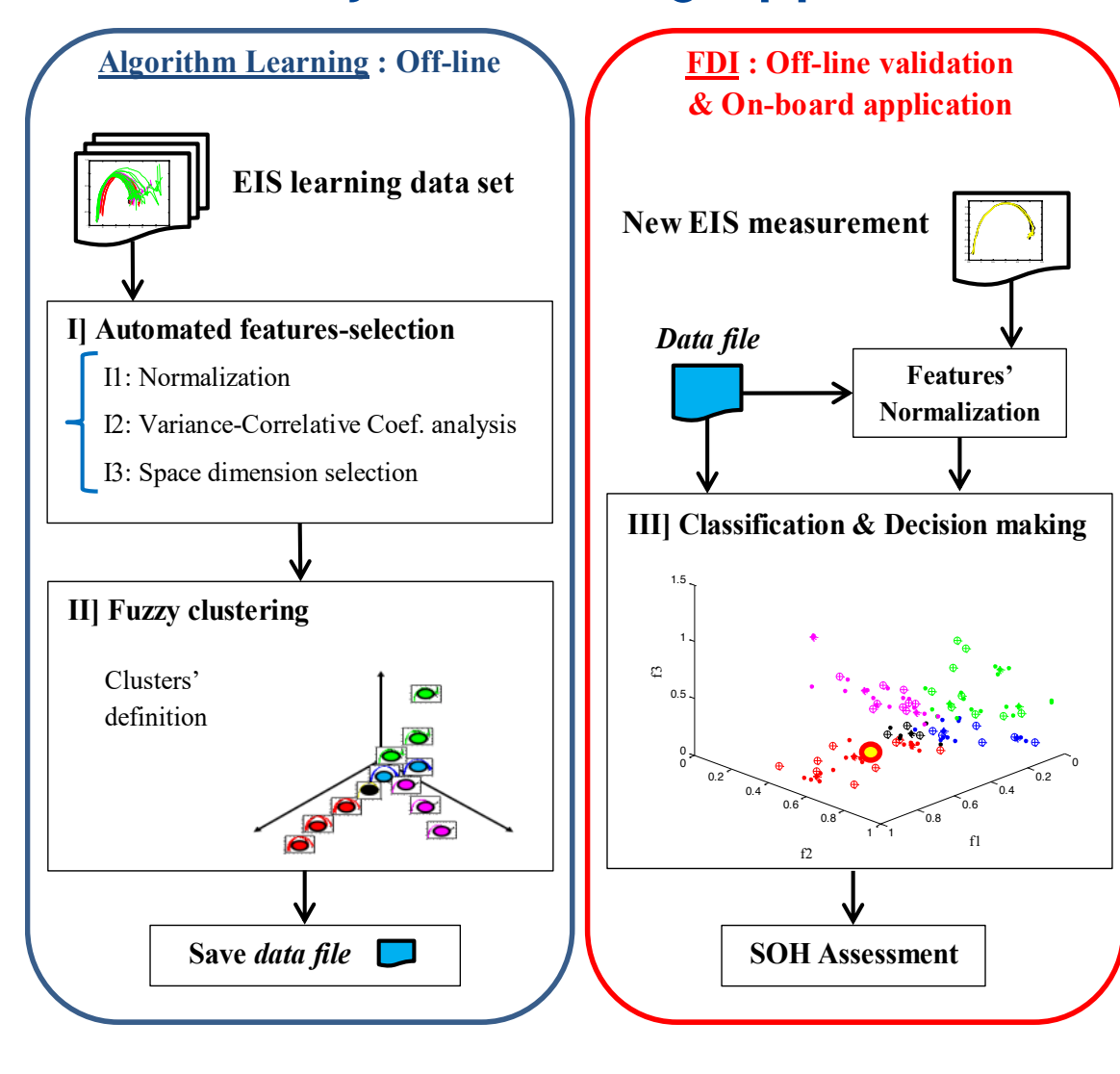


DIAGNOSTIC ALGORITHM TOOLS

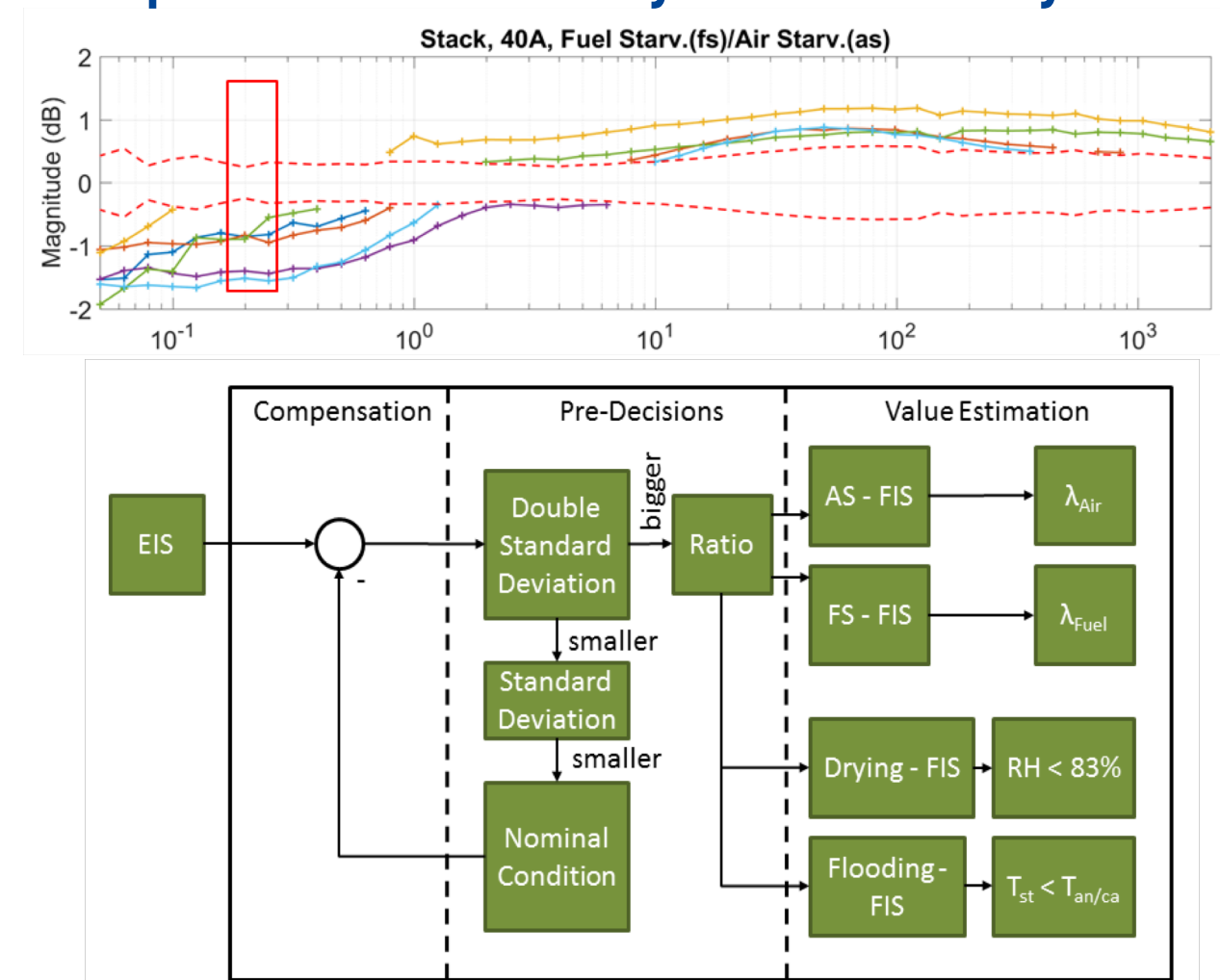
Equivalent Circuit Modelling



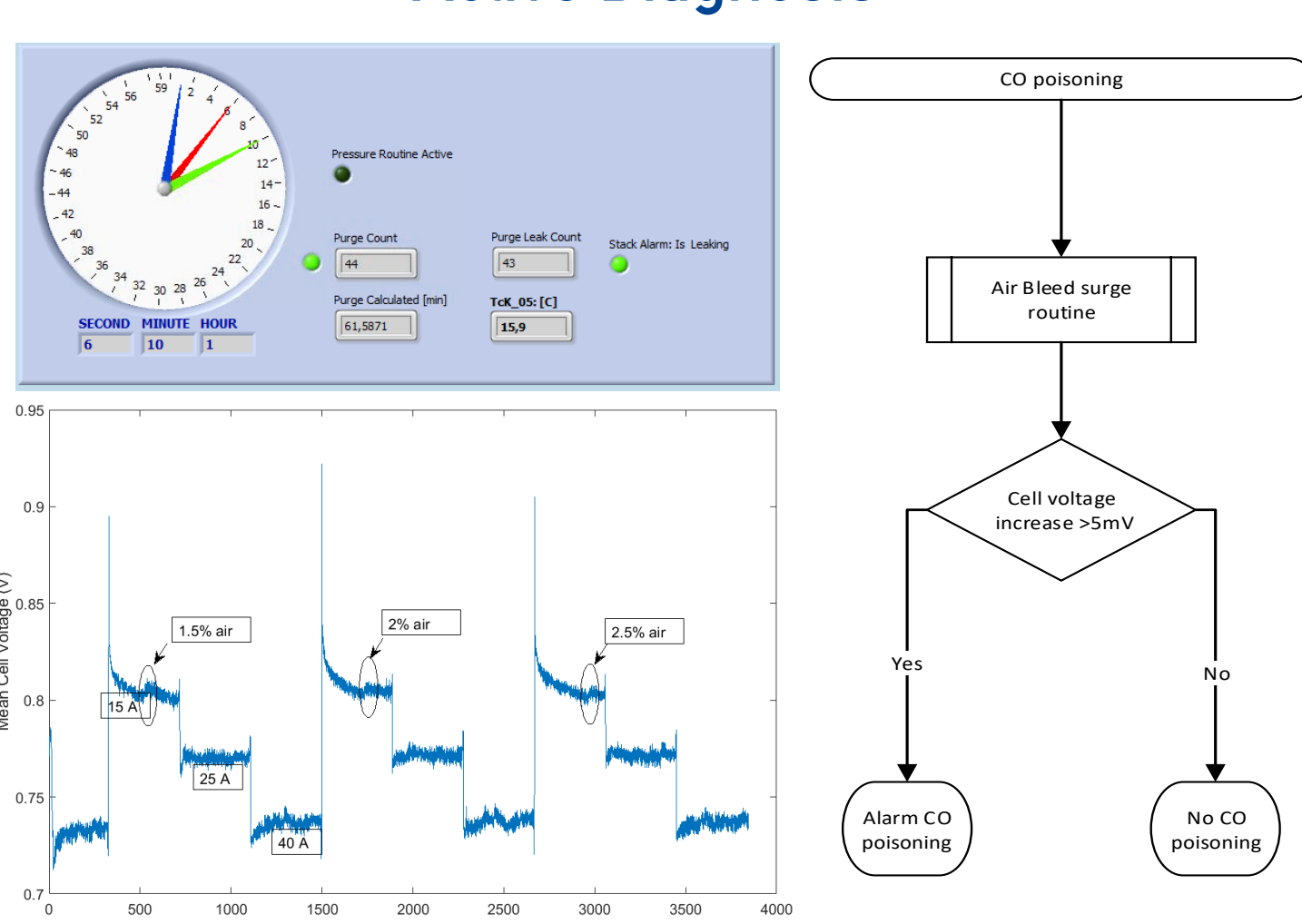
Fuzzy Clustering approach



Adaptive Neuro Fuzzy Inference System



Active Diagnosis

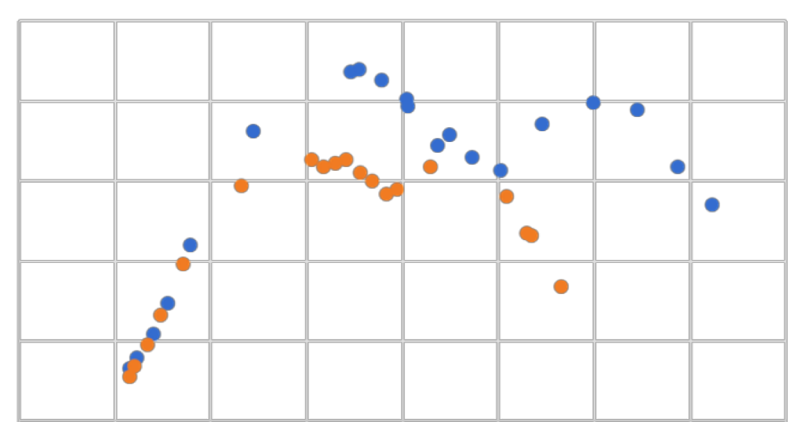


TESTING

Ballard Europe μ-CHP system



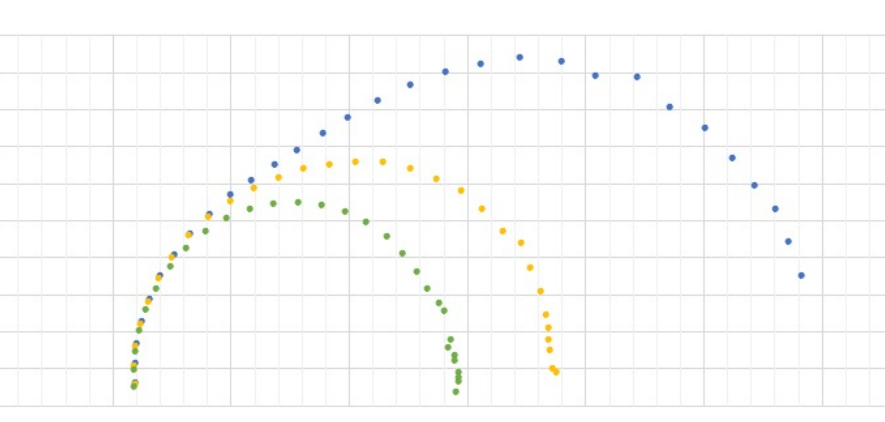
Power	1.3 kW
Coolings	Water cooled
Reactants	Air & Reformate
Applications	Residential μ-CHP



EPS backup/energy system



power	3 kW
Coolings	Water cooled
Reactants	Oxygen & Hydrogen
Applications	Backup electric power H ₂ as energy buffer



BITRON EIS Box



EIS board (TRL 6)
EIS board has been prototyped (proto 2) ready to be engineered for system embedding.

Converter (TRL 6)
Conventional HW is modified/re-engineered to allow flexibility and multiple market choice for manufacturer strategies.

Algorithms (TRL 5)
Detection and Isolation of 5 faults in stacks fed with Air+Reformate / O₂+H₂.

IMPACT

HEALTH-CODE outcomes will:

- increase electrical efficiency and durability of the different fuel cells used for power production;
- contribute to reduce degradation by implementing the monitoring and diagnostic tool;
- lead to a reduction of total cost ownership (TCO) by increasing the FC system efficiency;
- contribute to improve grid stability in the future by applying stationary fuel cells together with energy storage; the EPS backup system has grid interface for H₂ & O₂ production and can support grid balancing.

INFO

- Call topic: FCH-02-3-2014: Stationary FC system diagnostics: development of online monitoring and diagnostics systems for reliable and durable fuel cell system operation
- Project dates: 01/09/15 – 31/12/18
- Total project budget: 2.358.736€
- Coordinator: University of Salerno (I)



www.pemfc.health-code.eu

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