

# Implementation in real SOFC Systems of monitoring and diagnostic tools using signal analysis to increase their lifeTime

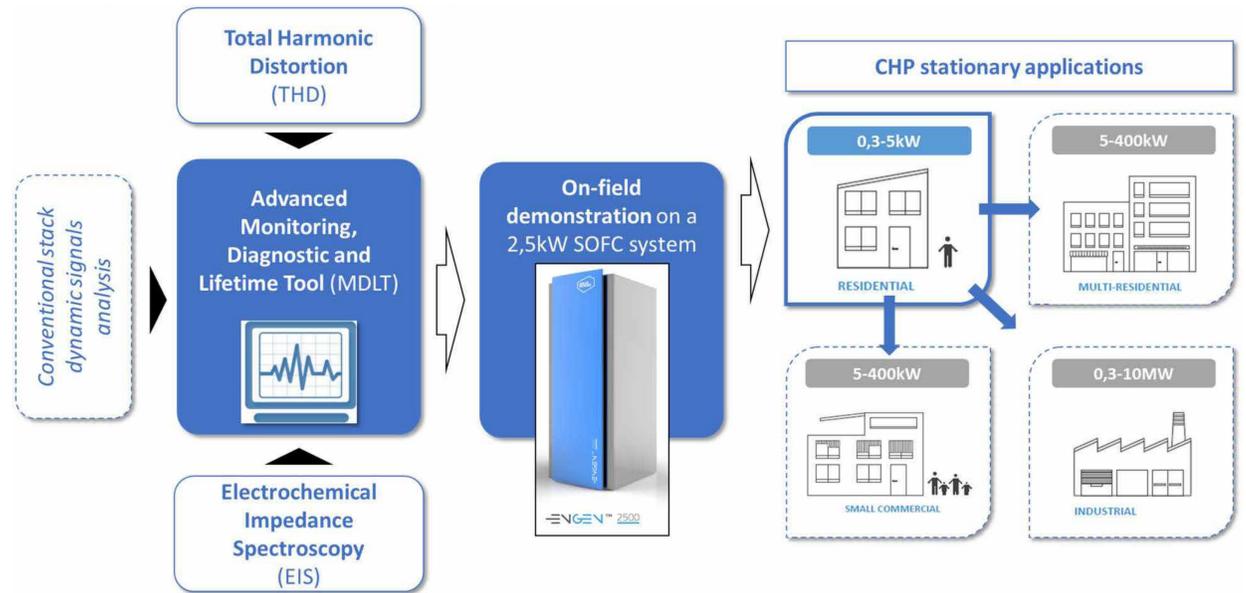


**START DATE** January 2017  
**DURATION** 36 months  
**WEBSITE** www.insight.eu



## OVERVIEW OF THE GOAL

The INSIGHT project aims at developing a Monitoring, Diagnostic and Lifetime Tool (MDLT) for Solid Oxide Fuel Cell (SOFC) stacks. To achieve a cost-efficient and robust solution, two advanced complementary techniques will be exploited, Total Harmonic Distortion (THD) and Electrochemical Impedance Spectroscopy (EIS), in addition to conventional stack dynamic signals analysis. The project will implement prediction methodologies and demonstrate their effectiveness by on-field tests on a real micro-Combined Heat and Power ( $\mu$ -CHP) system for residential applications (ie small power, typically 2,5kW electric).



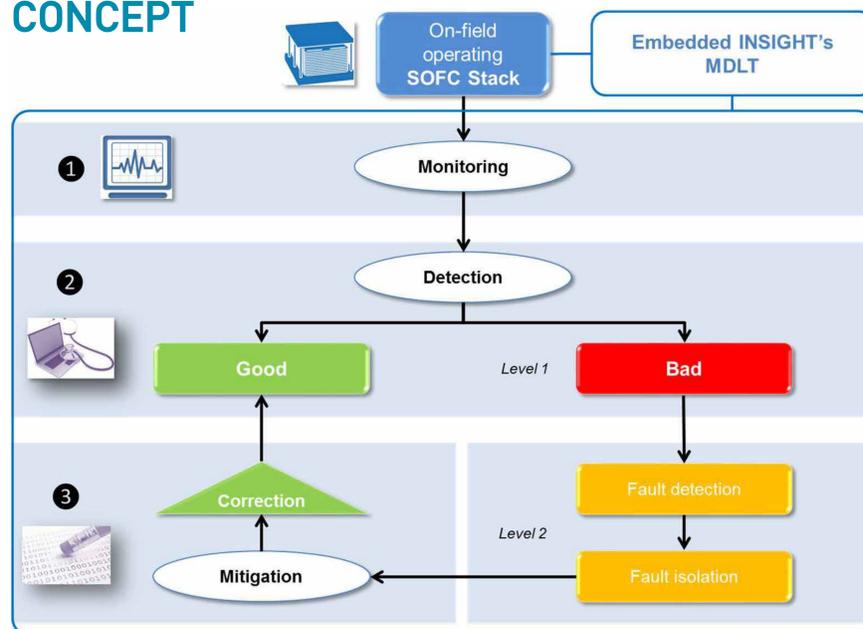
## MAIN OBJECTIVES

To implement an advanced **Monitoring, Diagnostic and Lifetime Tool** to prolong SOFC lifetime by 5% and increase availability by 1%.

To develop the **hardware for the implementation** of advanced Monitoring, Diagnostic and Lifetime algorithms on real SOFC system with **low cost** (less than 3% of system cost).

To identify control actions able to **mitigate** the impact of both **degradation mechanisms and faults** on performance and durability of SOFC.

## CONCEPT



INSIGHT concept to prolong the stack State-of-Health (SoH), hence prolonging Lifetime and increasing the SOFC system's availability.

The INSIGHT project will develop both hardware components and algorithms to monitor, detect and finally correct defects that can occur in SOFC stacks. This will help to increase the durability and reliability of SOFCs systems, and at the same time decrease their total cost of ownership, by decreasing the needs to change the stacks and thus the maintenance costs.

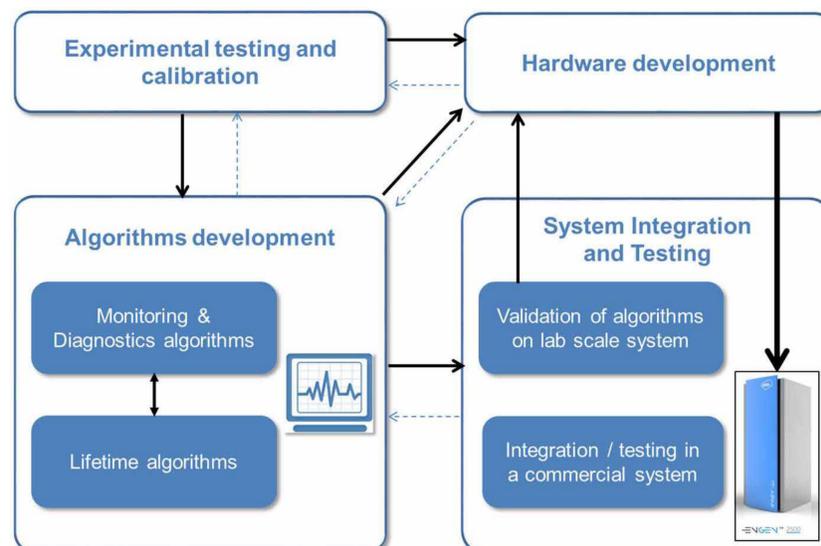
To achieve and maintain a good State of Health (SoH) of the stack over long operating time, the INSIGHT concept is based on the following steps:

**Monitoring:** it will generate a set of data, which needs to be further analysed and treated.

**Detection** and isolation of faults based on two levels of diagnostics using EIS / THD and conventional stack signals analysis applied on the set of data provided by monitoring.

**Mitigation and correction:** it will apply corrections or mitigation strategies on the degraded system to recover a good SoH or at least increase its remaining operating time upon conditions which are not nominal but still acceptable.

## METHODOLOGY



INSIGHT's methodology overview (solid lines mean inputs, dotted lines mean feedback).

The INSIGHT project will implement methodologies merging experimental approaches and mathematical techniques to develop two types of algorithms:

- algorithms suitable for monitoring, fault detection and isolation, aiming at identifying the metrics of major interest ;
- algorithms to estimate stack SoH and lifetime, supported by modelling tasks linking the degradation to its causes.

The coupling of both types of algorithms on-board will allow proposing mitigation strategies to recover a good, better, or at least stabilised SoH of the stack. The so-called Monitoring, Diagnostic and Lifetime Tool (MDLT) will be firstly validated on a laboratory scale system. This MDLT will be embedded into a hardware made of a single board, which will be coupled to the power electronic and finally integrated into a commercial  $\mu$ -CHP system, the EnGen<sup>TM</sup> 2500 from Solid Power. This modified system will be tested on-field to be representative of the real future operation.

## PARTNERSHIP



HTceramix SA, a SOFCpower subsidiary