FCH JU Grant Agreement no.:	**256776**
Project acronym:	**Premium Act**
Project title:	**Predictive Modelling for Innovative Unit Management and Accelerated Testing Procedures of PEFC**
Funding scheme:	**Collaborative Project**
Area:	**SP1-JTI-FCH.3 Stationary Power Generation & CHP**
Start date of project:	**01.03.2011**
Duration:	**36 months**
Project Coordinator:	**CEA – Sylvie Escribano** **Tel: +33 4 38 78 94 06 - Fax: +33 4 38 78 94 63** **E-mail: Sylvie.escribano@cea.fr**

D6-1 - Premium Act highlights (1st year)

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V0	11/02/2011	S. Escribano	Project Sheet for public FCH-JU web-site
V1	12/03/2012	S. Escribano	Project Fiche for public FCH-JU web-site
V2	11/05/2012	S. Escribano	Project Slide for public FCH-JU web-site
V3	31/10/2012	S. Escribano	Integration of the documents in the Project Deliverables Template

D6-1 - Premium Act highlights (1st year)

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1. PROJECT SHEET PREMIUM ACT (02/2011)

First public information delivered to FCH-JU and available on the public web at the very beginning of the project:

PREdictive Modelling for Innovative Unit Management and ACcelerated Testing procedures of PEFC (PREMIUM ACT)

Premium Act

Project reference: Grant agreement n° 256776
Call for proposals: FCH JU 2009 - 1
Application Area: stationary FC systems
Project type: research
Topic: SP1-JTI-FCH.2009.3.1: Fundamentals of fuel cell degradation for stationary power applications
Contract type: Collaborative Project
Start date: 01 March 2011 **End date:** 28/02/2014
Duration: 36 months
Project cost: € 5.4 million **Project funding:** € 2.5 million

Coordinator:

1	CEA - LITEN	France

Contact: Mrs Sylvie ESCRIBANO **E-mail:** sylvie.escribano@cea.fr

Other participating organisations:

2	IRD FUEL CELLS A/S	Denmark
3	POLITECNICO DI MILANO	Italy
4	DLR	Germany
5	ICI CALDAIE	Italy
6	JRC IE	European Commission
7	SOPRANO	France

Summary:
Premium Act is an ambitious project on the durability of PEFC (Polymer Electrolyte Fuel Cells), targeting one of the main hurdles still to overcome before successful market development of stationary fuel cell systems. PEFC systems are now very near, or even already comply with market requirements for cost and performance. But durability targets, up to several tens of thousands of hours, are much more difficult to reach.
Premium Act proposes a very innovative approach, combining original experimental work on PEFC systems, stacks and MEAs (Membrane Electrodes Assembly), including locally resolved studies of components durability, components characterisation using the most advanced techniques in order to quantify ageing phenomena, and an original mechanistic, multi-scale modelling approach able to take into account materials degradation processes and all reactions occurring and competing at each instant in a PEFC.
These combined experimental and modelling tools will provide understanding of the fundamentals of degradation, with new insight on the coupling of degradation mechanisms in PEFC components, thus enabling the consortium to innovate on:

- operating strategies, enhancing lifetime of given MEAs in a given stack and system,
- the design of a lifetime prediction methodology based on coupled modelling and composite accelerated tests experiments.

Premium Act will establish this innovative approach on two strategic fuel cell technologies for stationary markets: DMFC power generators and CHP systems fed by reformate hydrogen, both sharing similar MEA materials. This will show that the strategy is adaptable to the multiple PEFC requirements and give a competitive edge to European providers of stationary fuel cell systems.

2. PROJECT FICHE PREMIUM ACT (03/2012)

Second public information delivered to FCH-JU, including a text description of the project from objectives to impact, a descriptive figure of the project tasks and a figure with the consortium logos.

FCH project template

PREdictive Modelling for Innovative Unit Management and ACcelerated Testing procedures of PEFC (PREMIUM ACT)

Premium Act

1- **Key Objectives of the project**

A general objective is to contribute to the improvement of stationary PEFC systems durability, one of the main hurdles to overcome before successful market development, knowing that the target required is 40000h.

Premium Act specific objectives are to propose a reliable method to predict lifetime, to benchmark components and to improve operating strategies of real systems, in order to reach the following achievements:

- **Relative prediction of durability -** the ranking of durability predicted between different MEAs is in agreement with ranking obtained in real conditions;
- **Absolute prediction of durability -** the method is successful in predicting the observed lifetime with reduced testing duration thanks to accelerated tests;
- **Innovative unit management strategies** – the strategies allow a measurable durability increase in the stacks and systems of the industrial partners without negative impact on the customer needs' fulfilment.

2- Challenges/issues addressed

Main issue is the durability of fuel cell system for micro Combined Heat and Power applications.

It is necessary to first identify and understand the causes of fuel cells degradation in real conditions. Degradation is mainly related to the degradation of the Membrane Electrodes Assemblies (MEAs), core of the fuel cells where electrical power is produced. This degradation is double: decrease of the electrical power with time and degradation of the components. As multiple factors induce degradation (materials used for the catalysts or for the membrane, operating conditions such as cell temperature, gases composition), it is also necessary to understand the link between the different degradation mechanisms.

The challenges of Premium Act are related to the approach which is to combine specific experimental and modelling tools to study the degradation at different scales from fuel cell performance down to microstructure of materials.

Additional issue is the consideration of two strategic fuel cell technologies for stationary markets: DMFC (Direct Methanol Fuel cell) power generators and CHP systems fed by reformate hydrogen.

3- Technical approach/objectives

The technical approach has been built on technical tasks interconnected in the right way to complete the challenging objectives described above.

First step is to identify and understand the causes of degradation, particularly of Membrane Electrode Assemblies, in real conditions (with a focus on the accelerating features). These conditions are thus reproduced on small devices to estimate MEAs' lifetime. Then, analyses are conducted on the components, to elucidate how their microstructure or their properties are degraded during fuel cell operation.

In parallel, multi-physics models are developed to enable the description of the phenomena appearing during the ageing at the different scales of the cell and for different conditions, considering as well the decrease of the electrochemical performance as the alteration of the MEA materials features (catalysts, electrodes and membranes); models validation being conducted through specific single cell tests.
The core technical part of the project will be to combine all the information coming from the experimental tests or analyses and from the modelling to propose and validate **relevant accelerated tests able to couple various degradation factors** and to assess different MEAs' lifetime more rapidly than with normal tests. Final expected outcomes are **operating strategies able to improve the lifetime** of the systems considered and a **methodology to predict the life time of their MEAs**.

4- Expected socio and economic impact

The project contributes directly to the development of the European fuel cell activities at least related to the three industrial partners involved.
Premium Act aims at developing a methodology adaptable to the multiple PEFC technologies for the improvement of systems durability. In this sense, the success of the project should help to overcome one of the main bottlenecks preventing fuel cells market development for European providers of stationary fuel cell systems and will contribute to cross cutting issues relevant for European R&D and fuel cell industry development. Thus, reliable systems corresponding to the technical specifications of the energy global market could be widespread, which will change the end-user habits towards the stationary energy management and will help to reduce greenhouse gas emission.

The project also deals with education by involving post-doctoral researchers, PhD and MSc students in activities at CEA, DLR & POLIMI. To have the best impact as possible on the PEFC early market community, results and data collected in the project will be disseminated through scientific papers & conferences but also with a **Public workshop on "Characterization and quantification of MEA degradation processes" organized at CEA/Grenoble the 26 & 27th September 2012.**
This project could otherwise contribute to Safety, Regulations, Codes and Standards for future standards definition thanks to project outcomes on traditional and accelerated testing & on degradation models.

5- Information (in a separate text box)

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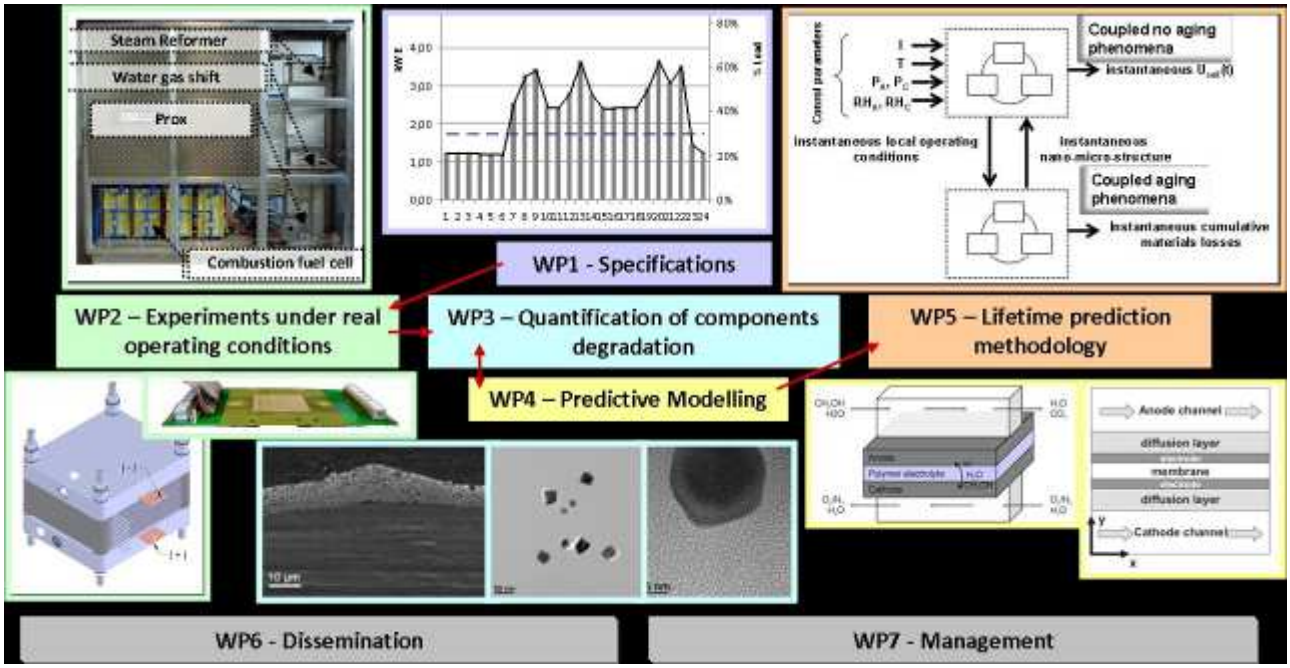
5	ICI CALDAIE	Italy
6	JRC IE	European Commission
7	SOPRANO	France

Project website: https://www-premiumact.cea.fr *but non public web-site at the moment*



PremiumAct_image

PremiumAct_partners

3. PROJECT SLIDE PREMIUM ACT (05/2012)

Third public information delivered to FCH-JU for dissemination
"FCH JU project slide_PremiumAct.pptx" requested for information and FCH-JU dissemination activities (sent 11/05/2012).