AutoRE

Automotive deRivative Energy system

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PROJECT OVERVIEW

Project Information	
Call topic	FCH-02.5-2014 – Innovative fuel cell systems at intermediate power range for distributed combined heat and power generation
Grant agreement number	671396
Pillar (Horizon 2020)	Energy
Start date	01/08/2015
End date	31/07/2018
Total budget (€)	4,464,447.25
FCH JU contribution (€)	3,496,947
Other contribution (€, source)	871,885 Swiss Fr (~796,850€), State Secretariat for Education, Research and Innovation of the Swiss Confederation
Stage of implementation	40% project months elapsed vs total project duration, at date of November 1, 2016
Partners	Alstom Power Ltd (100% GE-owned), General Electric (Switzerland), Daimler AG, NuCellSyS, Helbio, University of Split, Tuscia University, SINTEF

PROJECT SUMMARY- Objectives

General Objectives

To create the foundations for commercialising an "automotive-derivative" fuel cell system in the 50 to 100 kWe range, for combined heat and power (CHP) in commercial and industrial buildings.

Specific Objectives

a) To build and validate a first 50 kWe prototype CHP system

b) To develop system components allowing the levelised cost of electricity (LCOE) to reach grid parity

c) To create the required value chain from automotive manufacturers to stationary energy end-users

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PROJECT SUMMARY- Why automotive-derivative fuel cells?

Reducing first and maintenance costs by leveraging on the two markets: a concept applied in gas turbines for decades……

A Quantas Boing 747-400 powered by the GE CF6-80C2
(source: www.geaviation.com)

LMS6000 PD (derived from CF6-80C2), installed at Toronto airport for CHP
(source: www.powerauthority.on.ca)

Aeroderivative gas turbines: different markets, same core system

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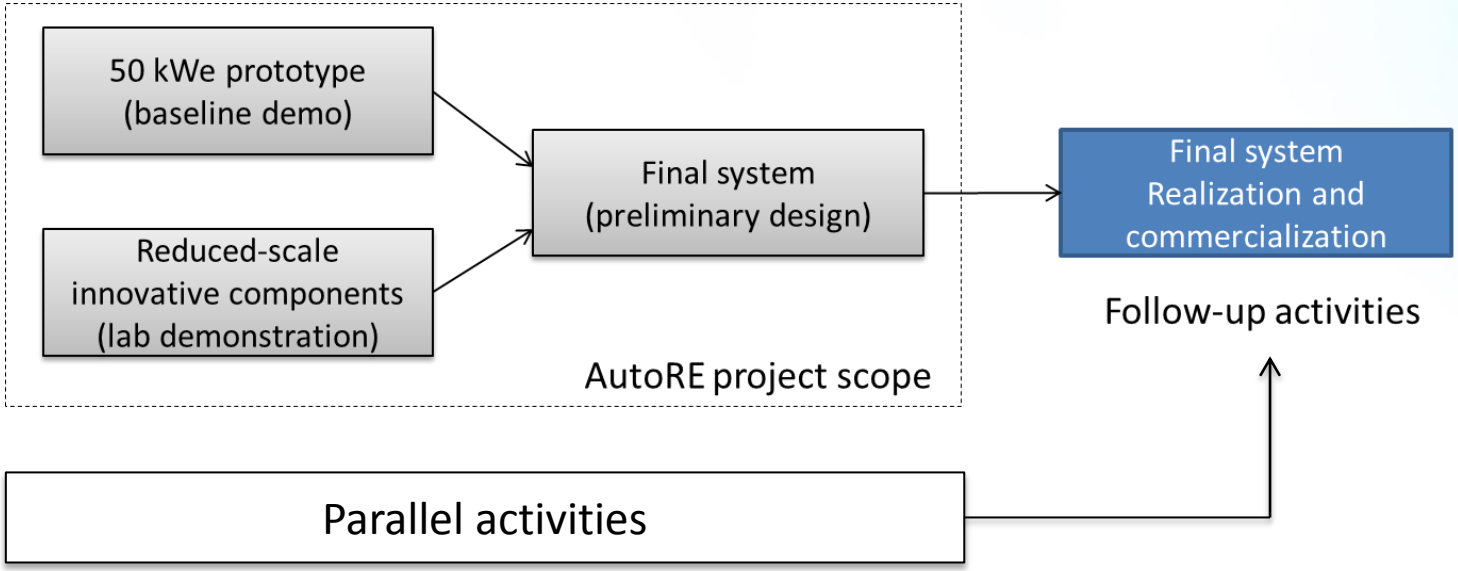
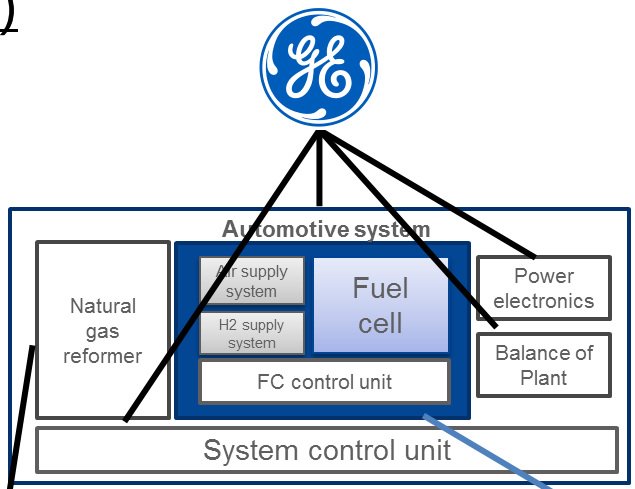
PROJECT SUMMARY- Approach

- Using well-known technologies for setting a «baseline» demo for further improvement
- Developing innovative solutions at lab-scale and assessing the related benefit



PROJECT SUMMARY- Approach

50 kWe baseline demo in Rugy (UK)



NG Reformer

helbio

FC automotive system:

DAIMLER

NUCELLSYS
THE FUEL CELL SYSTEM COMPANY

Innovative, Lab-scale and desktop activities

- SLM-based heat exchangers: GE (lead)
- Pd-based membranes for H2 purification: SINTEF (lead)
- Fuel cell stack operated on reformate: NucellSys+Helbio
- Modelling, diagnostic and RAMS: U[illegible]lit- [illegible]iv. Tuscia, GE

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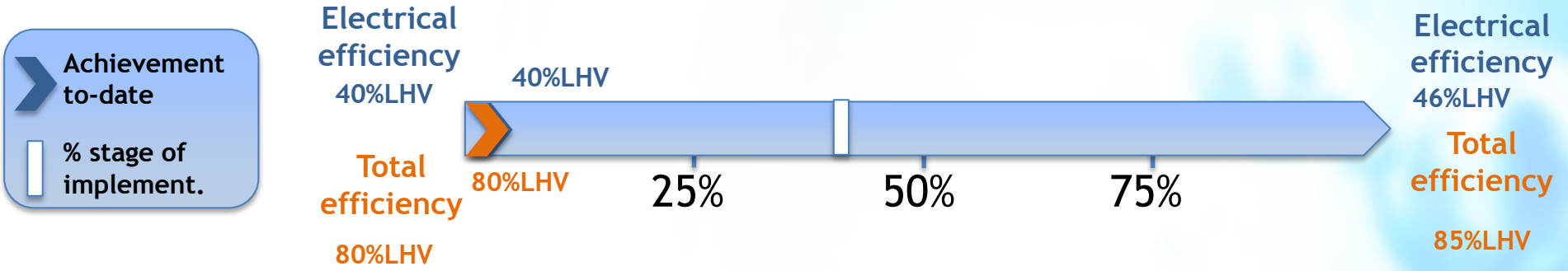
PROJECT PROGRESS/ACTIONS - Efficiency



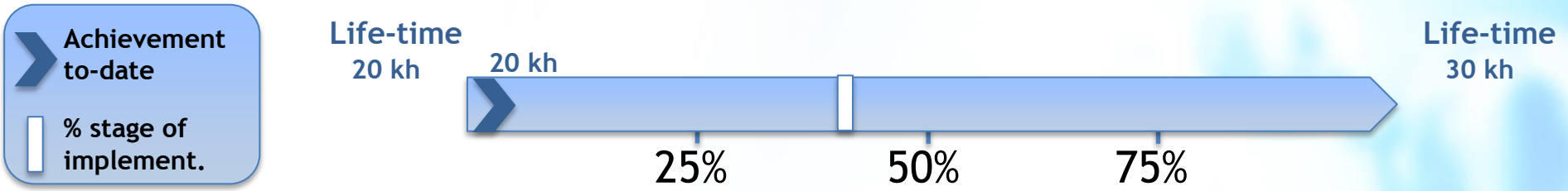
Initial values will be confirmed through the 50 kW «baseline» demo (to be commissioned in June 2017)

Aspect addressed	Parameter (KPI)	Unit	SoA 2016	FCH JU Targets		
				Call topic	2017	2020
Efficiency	Electrical efficiency	%LHV	35%-43%	46%	42-55%	42-55%
	Total efficiency	%LHV	80%	82%	NA	NA

Future steps:

- *To establish "start value" of 40% LHV efficiency (80%LHV total efficiency) in the 50 kW "baseline" prototype*
- *To validate membrane performance (at lab-scale level) and estimate resulting system efficiency*
- *To optimise system engineering for improving total efficiency (heat exchanger optimization)*

PROJECT PROGRESS/ACTIONS - Stack life-time



Aspect addressed	Parameter (KPI)	Unit	SoA 2016	FCH JU Targets		
				Call topic	2017	2020
Stack life-time	Life-time	Hours	20,000	>30,000	NA	NA

- *Durability of automotive stack in stationary applications is unknown.*
- *Experience with bus driving cycles allows for expecting >30,000 hours*

Future steps:

- *To validate expected degradation rate in the 50 kW "baseline" prototype*
- *To utilize proprietary degradation models for estimating life-time in stationary applications*

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SYNERGIES WITH OTHER PROJECTS AND PROGRAMMES (Selected)

Interactions with projects funded under EU programmes	
SAPPHIRE (FCH JU)	*AutoRE will use methodologies and protocols developed within SAPPHIRE (i.e. degradation mechanisms, accelerated test protocols, diagnostic methods) AutoRE will concentrate on the specific fuel cell stack, and extend them to the entire system.*
GIANTLEAP (FCH JU)	*Discussions on-going on the organisation of a joint workshop between GIANTLEAP and AutoRE on diagnostics, prognostics and fuel cell health management and controls*
ReforCELL (FCH JU)	*Knowledge gained in the ReforCELL on porous stainless steel-supported membrane modules is directly applied in AutoRE to measure the H_2 permeation properties and the effect of contaminating gases of Pd-based membranes*
Interactions with national and international-level projects and initiatives	
Fuel Cell Lab and FC SMARTGEN (Italy)	*The experience gained in simulating fuel cell systems in these projects is exploited in AutoRE to model the fuel cell prototype, the final system as well as possible alternatives*

DISSEMINATION ACTIVITIES

Public deliverables:

- D1.6 Preliminary engineering solutions for integration of membrane and innovative SLM-based solutions
- D4.2 Report on alternative configurations modelling
- D4.6 Report on the CHP operation in an energy management environment
- D4.7 Report on innovative technical solutions for improving business case

Conferences/Workshops

- 1 organised by the project (planned, M32-April 2018)
- 3+ conferences planned for attendance

Social media

Publications: 3

- Facci et al., 2016. Numerical assessment of an automotive derivative CHP fuel cell system. The 8th International Conference on Applied Energy – ICAE2016 and in press at Energy Procedia.
- Peters, T.A., Stange, M., Bredesen, R., 2016. Pd-based membranes as key-enabling technology for H_2 production, recovery and purification, in Proc. World Hydrogen Energy Conference 2016 (WHEC2016, June, 13-16, 2016), Zaragoza, Spain.
- Peters, T.A. et al., 2016. Palladium (Pd) membranes as key enabling technology for pre-combustion CO_2 capture and hydrogen production, in Proc. 13th International Conference on Greenhouse Gas Control Technologies (GHGT-13, November 14-18, 2016), Lausanne, Switzerland.

Patents: 0

- One patent on 3D printing for heat exchangers under consideration

Thank You!

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