Fuel Cell Based On-board Power Generation [FCGEN] (277844)

Jazaer Dawody, Volvo Technology

Project & Partnership description

Project name:

Fuel Cell Based On-board Power Generation

Project acronym: (**FCGEN**)

Programme: Seventh Framework programme of the European union

Project coordinator: Jazaer Dawody, Volvo Technology

Grant agreement no. : (277844)

Start date: 2011-11-01

End date: 2014-10-31

Project budget : 10 338 414 €

FCH JU contribution: 4 342 854 €

Partners

- Volvo Technology AB (Volvo), Sweden
- Powercell Sweden AB (Powercell), Sweden
- Forschungszentrum Juelich GMBH (Jülich), Germany
- Institut Jozef Stefan (JSI), Slovenia
- Centro Ricerche Fiat SCPA (CRF), Italy
- Institut fuer Mikrotechnik Mainz GMBH (IMM), Germany
- Johnson Matthey PLC. (JM), United Kingdom
- Modelon AB (Modelon), Sweden

Project targets in relation to the AIP/MAIP

Project objectives

- To develop and demonstrate a proof-of-concept complete fuel cell based 3 $kW_{(net\ el.)}$ auxiliary power unit in a real application, on-board a truck**.**
- *To further develop key components and subsystem technologies that have been advanced by the project partners in previous collaborations and move them closer towards commercially viable solutions.*

Issues	**3 kW Diesel APU**
Durability (hours)	20000
Cost (Euro/kW)	≤ 1000
Efficiency	≈ 30%
Weight (kg)	125
Volume (L)	300

Project achievements in relation to the AIP/MAIP

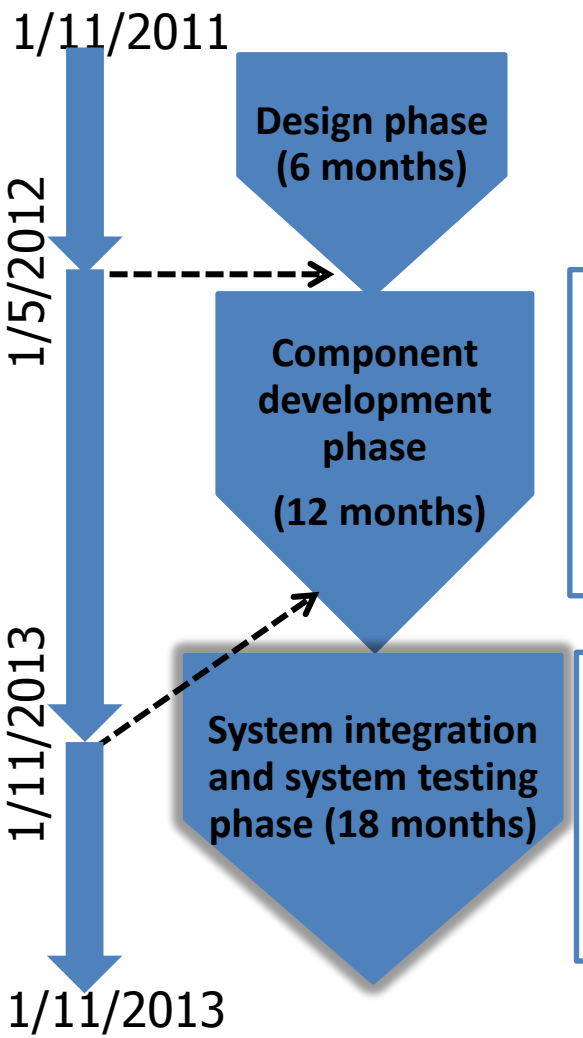
Relevance to MAIP targets, Topic: 3.4.1, 2008 – 2013

- Demonstrations of increased efficiency of on-board power generation and reduced emissions and local pollutions.
- Research, development and proof-of-concept demonstration of APU systems for on-board power generation.
- Demonstrated feasibility of using logistic fuels.
- Demonstrated fuel processing technology for logistic fuels.
- Defined requirements for fully integrated systems in the specific application.

Last year targets

Initial versus actual workflow

Actual **Initial**



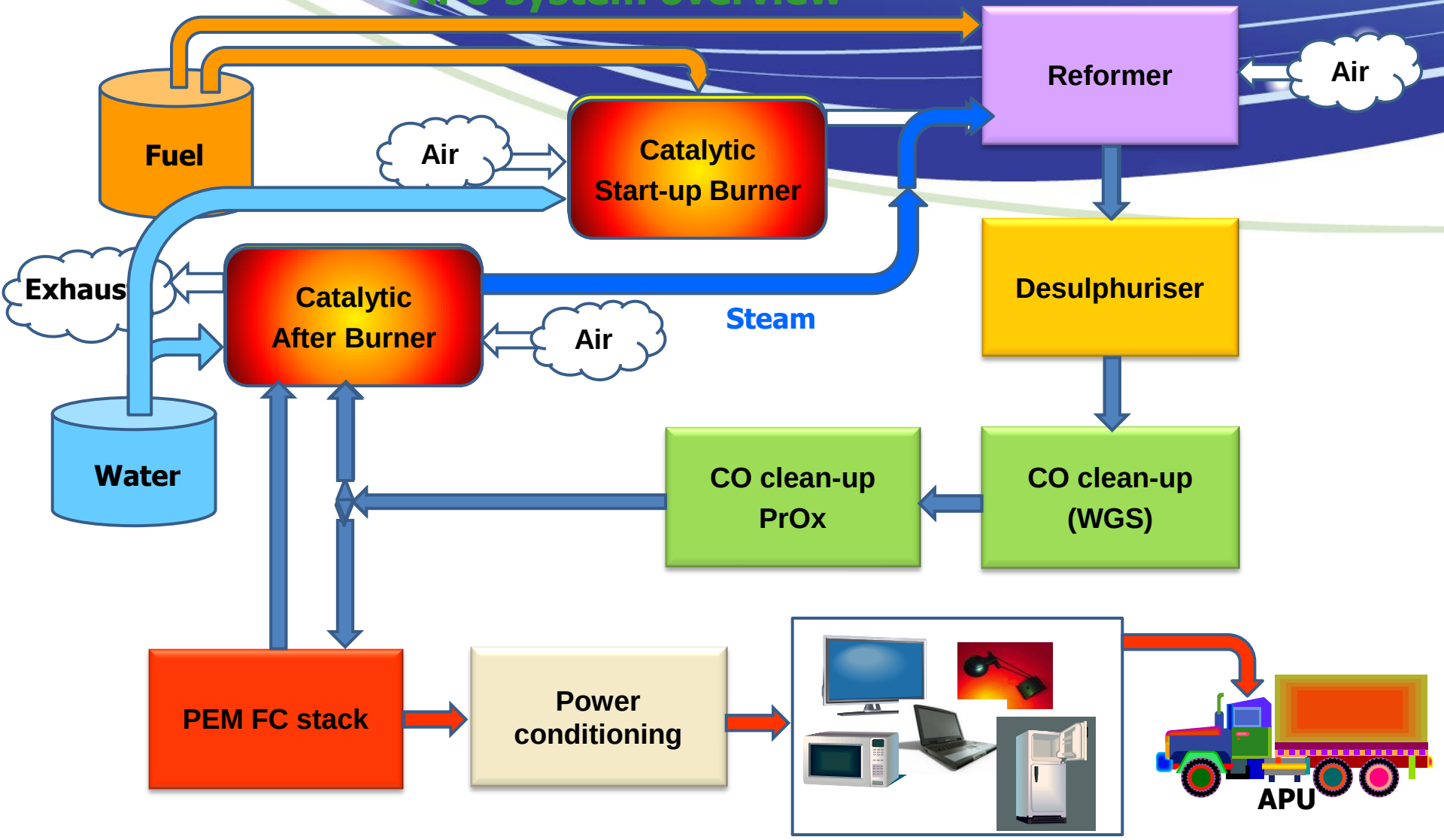
- System design
- Vehicle interface and communication
- Control system architecture

- Component manufacturing and testing
- BoP component purchasing, optimization and testing
- CS development and testing
- Component and CS optimization

- Fuel processor integration and testing
- APU system integration and testing in laboratory
- APU performance demonstration on-board a vehicle

Project achievements in relation to the AIP/MAIP

APU system overview



Project achievements in relation to the AIP/MAIP FP system

Jülich, IMM, JM, Powercell, JSI and Volvo

- **Catalytic Start Burner (CSB):**
  - Successful verification of the functionality of the CSB and heat exchanger array.
- **Reformer:**
  - Optimized catalyst delivered by JM
  - Reactor design, optimization and testing with logistic diesel by Jülich
  - Further system optimization was needed to secure PEM quality reformate.
- **Desulphuriser**: ZnO pellets provided by JM, reactor design and manufacturing by IMM and on-going work for the development of new structure ZnO
- **Water Gas Shift (WGS) and Preferential Oxidation(PrOx):**
  - Catalyst coating by JM
  - µ-reactor technology for WGS & PrOx from IMM
  - Testing of single WGS and PrOx as well as WGS + PrOx with BoP-components from JSI
- **Catalytic After Burner (CAB)**:
  - Optimized catalyst delivered by JM
  - Reactor design and system testing for anode off gas oxidation and steam generation by Jülich

Project achievements in relation to the AIP/MAIP
Fuel Processor (FP) development

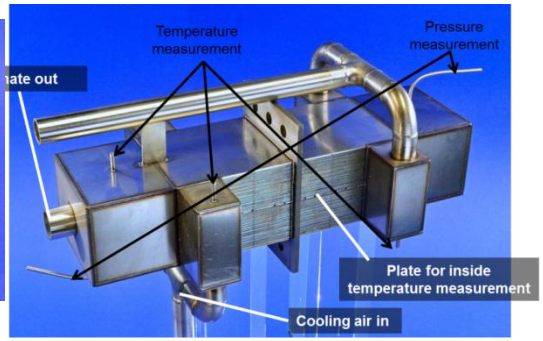
FP components ready for system integration

Desulphurizer (DS)

IMM + JM

Water gas shift (WGS)

IMM + JM

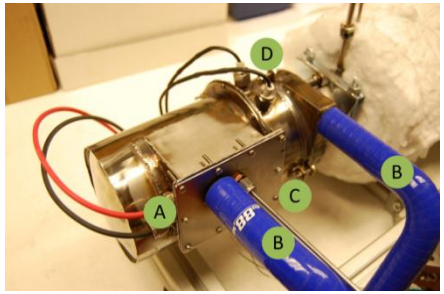


Reformer

Jülich + JM

Catalytic start burber (CSAB)

Powercell

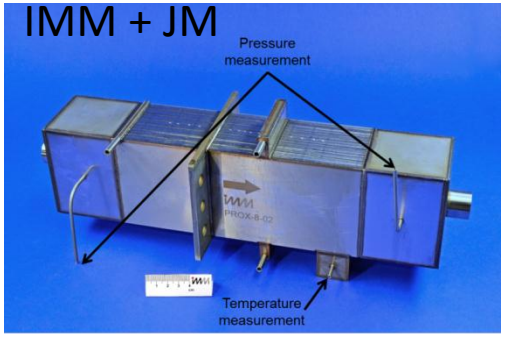


Catalytic after-burner (CAB)

Jülich + JM

Preferential oxidation (PrOx)

IMM + JM

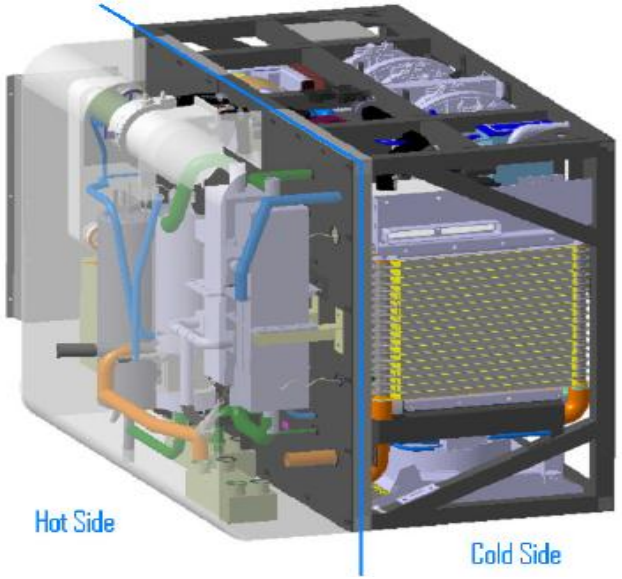


Project achievements in relation to the AIP/MAIP

BoP optimization and System integration

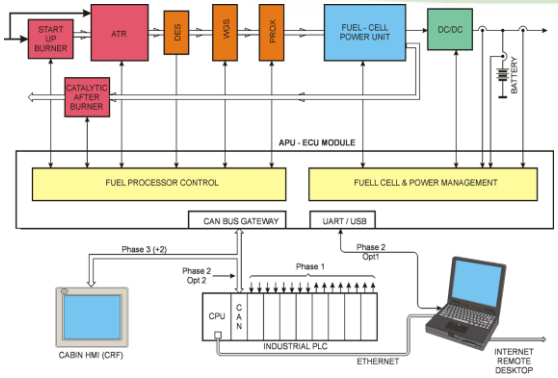
Powercell

- ✓ Market screening, purchasing and testing of BoP sub-system (air, coolant, and process water) components.
- ✓ Development of a CAD system packaging. The compact APU box consists of a hot side part for FP reactors and a cold side part for FC sub-system and BoP components.



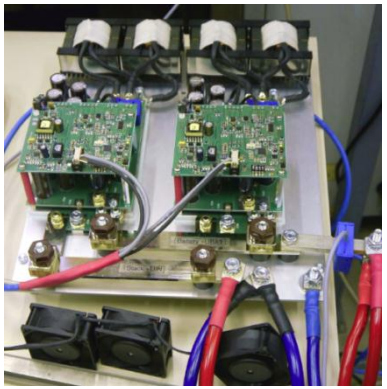
Project achievements in relation to the AIP/MAIP
Control system and power conditioning
JS!

- Control system:
  - 4-level hierarhical structure
  - 19 dedicated control function blocks
  - 15 PID control loops
  - 58 sensors, 36 actuators (8 valves, 28 pumps, compressors, etc.)
  - Comprehensive HMI for APU commisioning and testing



- Power conditioning
  - Supply all APU BoP actuators
  - Convert variate stack output voltage to battery-bus voltage level
  - Provide APU power complying to high safety standards
  - Protect FC stack from failures/disturbances on load side

DC/DC converter

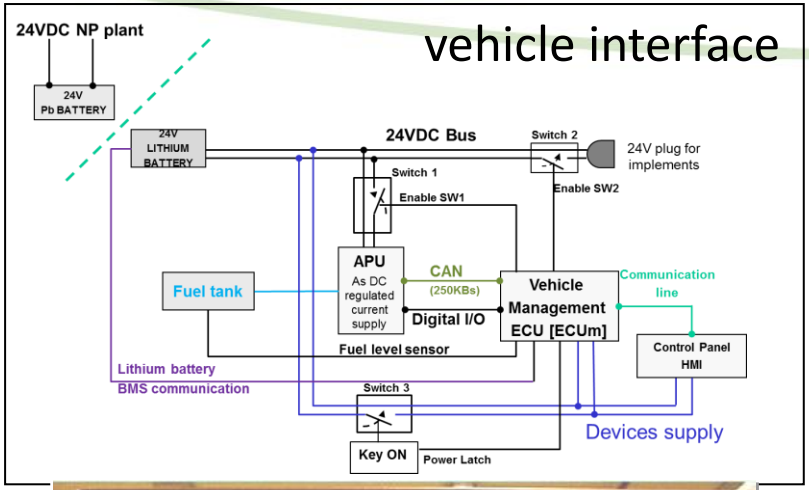


Project achievements in relation to the AIP/MAIP

Vehicle interface and Communication

CRF, JSI

- Vehicle interface details specified according to the preliminary APU integration safety analysis and the components progress.
- The communication dataset has been defined and the HMI has been implemented on a NI touch panel.
- Demonstration vehicle prepared and physical position for the APU defined.



Expected project achievements at the end of the project

- Successful demonstration of power generation via the FCGEN APU on-board an IVECO long distance tuck (STRALIS) at stand still conditions with fuel efficiency slightly below 30% and NO_x, NMHC, CO and sulphur species emissions < 1 ppm.
- The developed system will not achieve the cost, weigh and volume targets, but will be able to provide guidelines and possible technical solutions to reduce the system cost, volume and weigh in next generation prototype.

Bottlenecks, risks and problems

- As it was difficult to find all optimal BoP components in the market and due to the lack of experiences at the supplier's sites to develop BoP components for FC-APU for mobile applications, it is likely that some of these components will fail during the prototype testing and prevents the project from achieving some of the objectives and targets.

Many thanks to the fantastic ECCEN working team

Many thanks to your kind attention

14