

PEMBeyond

PEMFC system and low-grade bioethanol processor unit development for back-up and off-grid power applications

Project coordinator:

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Background and motivation

- Telecom back-up and off-grid power is one of the strongest markets for fuel cells today
 - Competitive total cost of ownership (TCO) especially in long back-up (several days) or completely off-grid applications
- Need for reliable, cost-competitive and environmentally sustainable solutions growing
 - Low quality bioethanol fuel would allow use of locally produced and sustainable fuel also in developing countries
- Relatively high investment cost and fuel logistics key challenges slowing market penetration

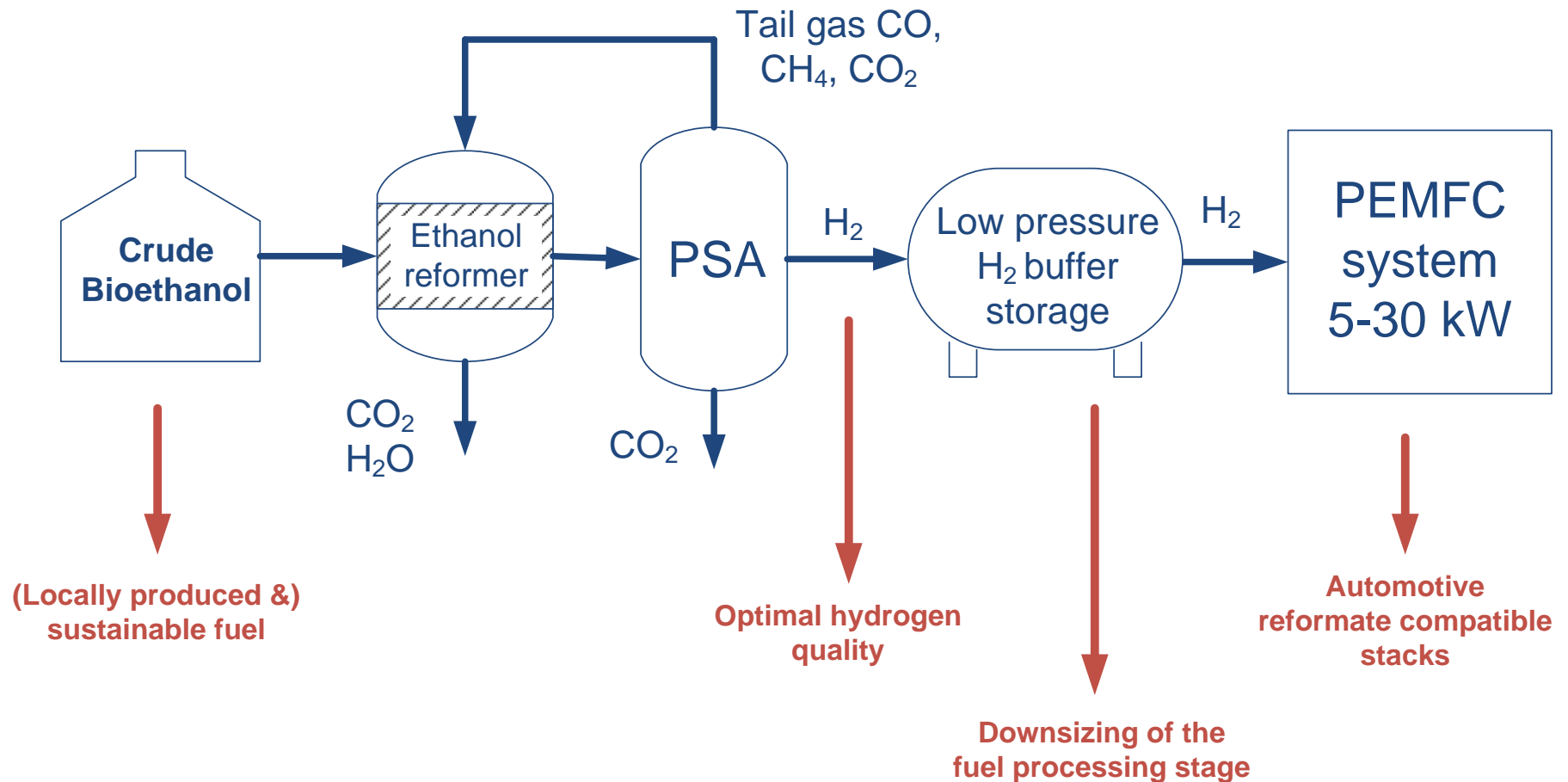


ElectraGen™ - ME backup power system installed at a base station in East Timor

Objectives

- Developing an integrated PEM fuel cell based power system for stationary back-up and off-grid power generation, that is
 - Using crude (80-95%) bioethanol as primary fuel
 - Cost-competitive (complete system < 2 500 €/kW @ 500 units)
 - Energy-efficient (> 30% overall system efficiency)
 - Durable (> 20 000 hours system lifetime in continuous operation)
- Laboratory testing and limited field trial (~1000 hours)
- A roadmap to volume production one of main project deliverables

Overall concept



Main outcome

- Applications / End users
 - Long back-up and off-grid power (mainly telecom in developing countries)
 - Power production and grid stabilization for micro grids
- In addition to the complete system, development of separately utilizable subsystems is another main outcome of the project
 - PEMFC system for back-up/off-grid application using low-grade hydrogen fuel
 - Low-cost, state-of-the-art PEMFC stack for various applications
 - Crude bioethanol processor unit (reformer + PSA) for distributed H₂ generation

Main system specifications

Fuel Cell System:

- Electric net output: 7 kW / 48 V DC
- Start-up time: few ms (buffered by Li-ion battery)
- Efficiency: > 45%

Bioethanol processor:

- Product H₂ feed: 0.135 kg/h (corresponds to ~2 kW net output)
- Start-up time: < 45 min (buffered by hydrogen storage)

Complete system prototype:

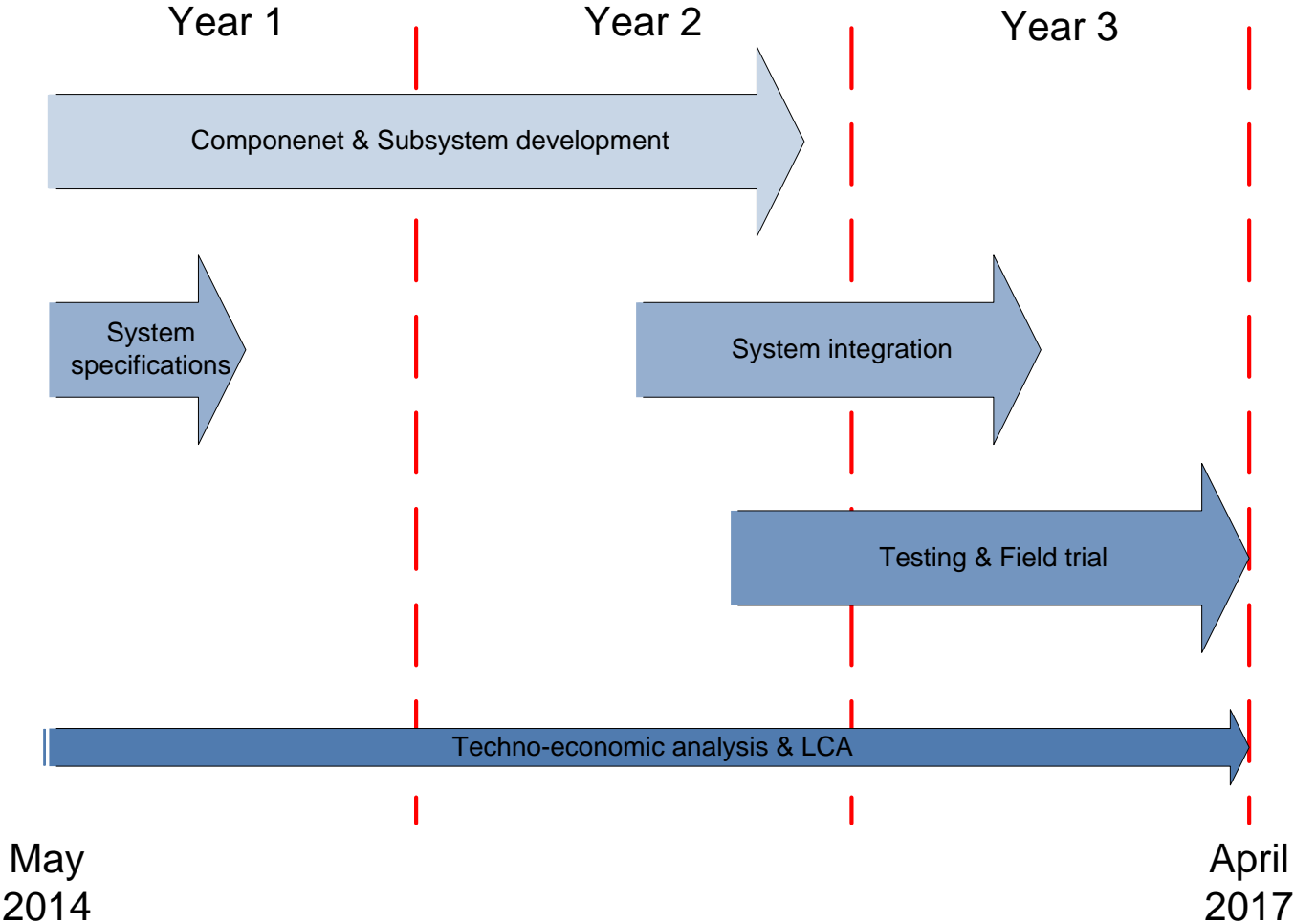
- Electric net output: > 5 kW / 48 V DC (for 3.3 h continuous, after that 2 kW)
- Efficiency: > 30%
- Fuel consumption: 1 kg/h bioethanol
- Back-up time: 7 days (with 170 kg ethanol vessel)
- Physical footprint: 10ft. ISO container
- Ambient temp range: -20 - + 40 °C

Project consortium

1. VTT Technical Research Centre of Finland
 - Project coordination
 - Complete system integration
 - PEMFC freeze-tolerance and low-quality H₂ solutions
 - Testing and field-trial
 - Environmental analysis (LCA)
 2. PowerCell Sweden AB (Sweden)
 - PEMFC stack development
 3. Genport srl (Italy)
 - PEMFC system development
 - Techno-economic analysis
 4. Fraunhofer ICT-IMM (Germany)
 - Bioethanol reformer development
 5. University of Porto (Portugal)
 - H₂ purification (PSA) development
- Project volume
 - 4,6 M€ total budget / 378 person-months total
 - 3 years, May 2014 – April 2017



Project schedule



Industry Advisory Board

- Participation absolutely non-binding
- Annual workshops for invited companies
 - 1st workshop 'Fuel Cells in Telecom' 23.9.2014 in Espoo Finland
 - 2nd workshop in Italy in late April or early May 2015
 - 3rd workshop tentatively planned in Sweden 2016
- Main goal to reach bidirectional exchange of information, results and feedback regarding PEMBeyond project and fuel cell back-up systems in general

Summary

- The objective is to develop an integrated PEM fuel cell based power system for extended back-up and off-grid power generation
 - Low-grade bioethanol as primary fuel
 - H₂ quality optimization one of key tasks
 - As an outcome also several independently usable subsystems
- Possibility for relevant industry to continue following the project progress in annual workshops