DESTA - Demonstration of 1st European SOFC Truck APU

278899

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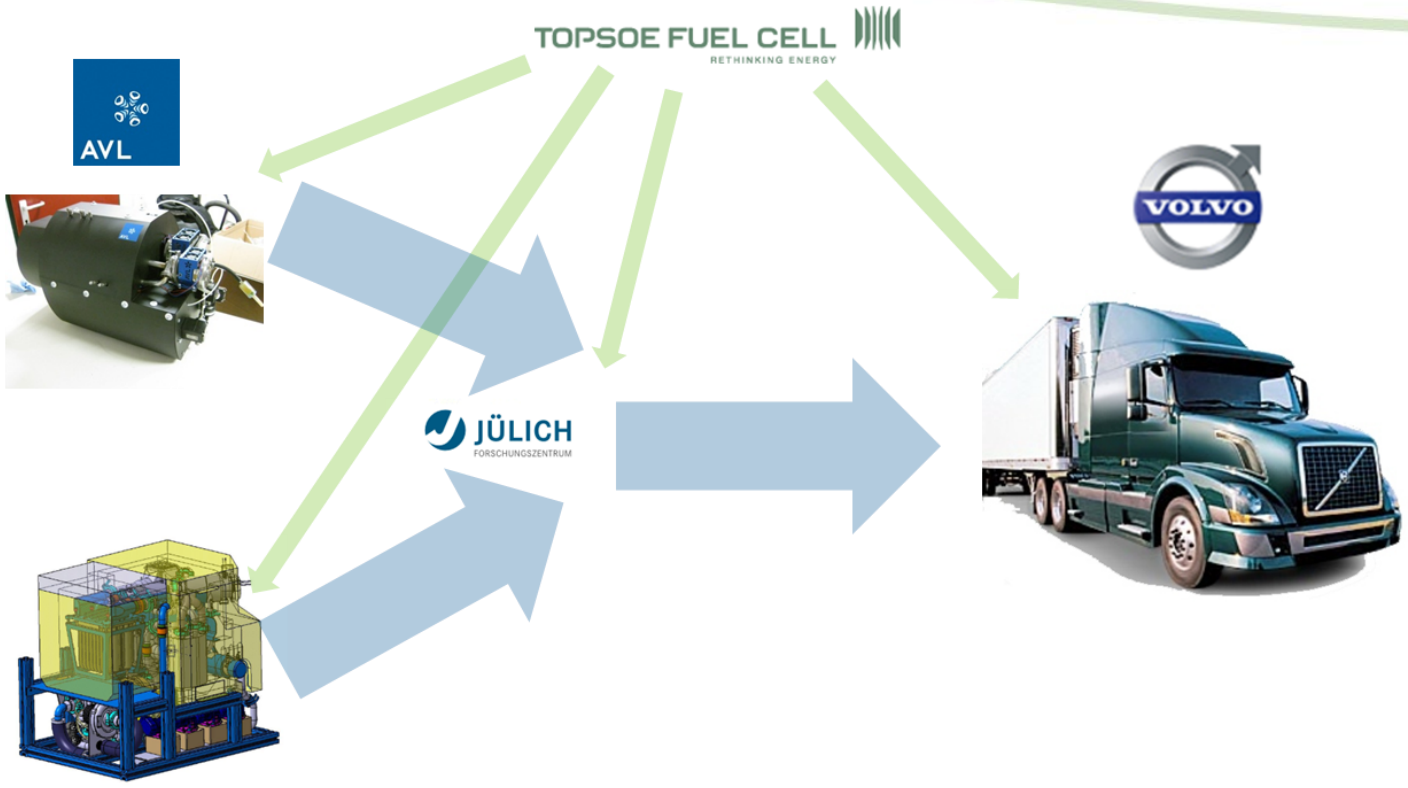
Project and Partnership

General Overview

- Demonstration of 1st European SOFC Truck APU
- 36 months (+6 months recommended in project review)
- Total Budget: €9.841.007, FCH JU Contribution: 3.874.272
- Consortium:
  - AVL List GmbH (Coordinator) - AT
  - J. Eberspächer GmbH & Co KG – DE
  - Topsoe Fuel Cell A/S – DK
  - Volvo Technology AB – SE
  - Forschungszentrum Jülich GmbH - DE

AVL TOPSOE FUEL CELL RETHINKING ENERGY JÜLICH FORSCHUNGSZENTRUM Eberspächer VOLVO DESTA

Project Strategy & Setup



Project Objectives

Objectives of DESTA:

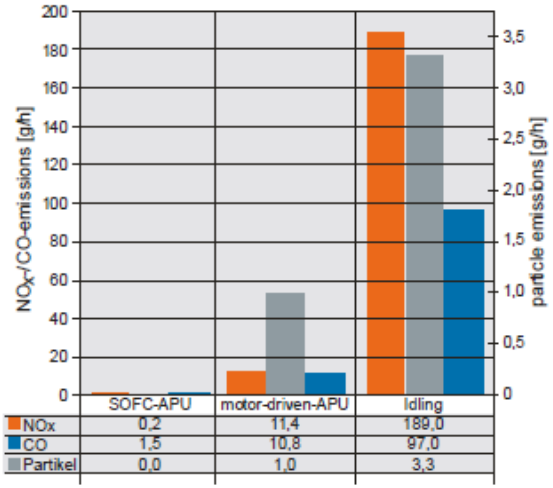
- **Demonstration of the first European SOFC APU on a Volvo HD truck**
- **1 year testing of 6 APU systems (3 of Eberspächer and 3 of AVL)**
- **Development and assembly of the final DESTA SOFC APU system, merging the most promising approaches of AVL and Eberspächer SOFC APU concepts**
- **Significant improvements of SOFC stacks operated on diesel fuel**

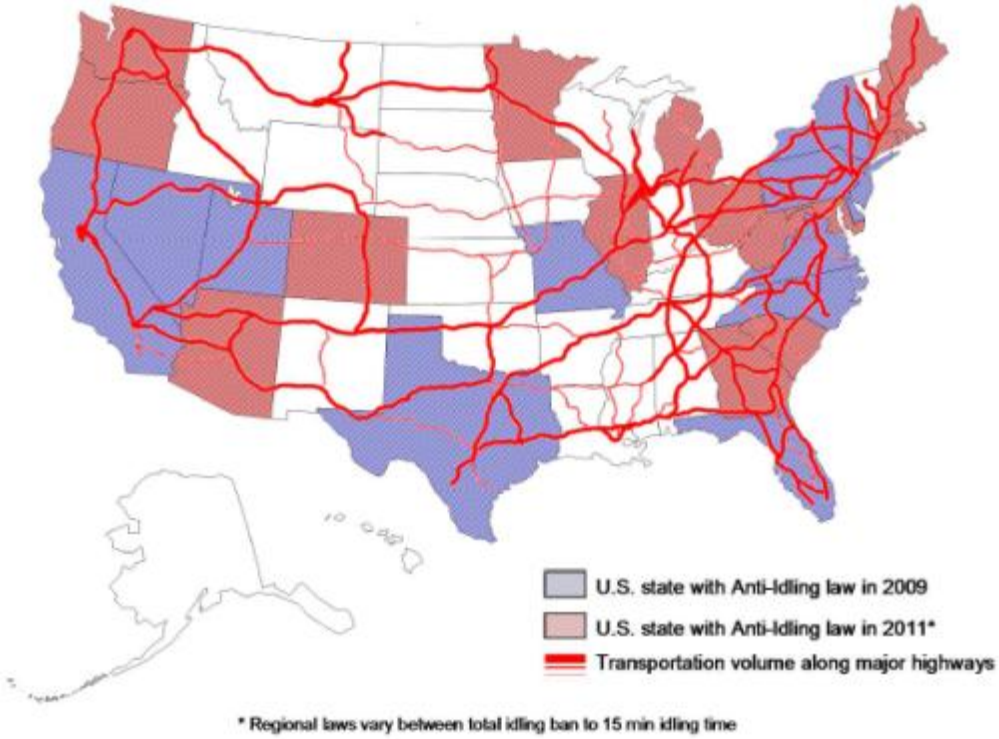
Technical targets:

- **Maximum electrical power ≥3kW**
- **Operation on conventional road diesel fuel**
- **Expected lifetime verified in long-term tests and with statistical methods to reach >20,000h**
- **System electrical net efficiency around 35%**
- **System volume and weight below 150L and 120kg**
- **CO2 reduction of 75 % compared to engine idling of a heavy-duty truck**
- **Start-up time of ~30min**
- **Noise level ~65dB(A)**

Motivation

- Anti idling regulations
- Fuel cost savings
- CO_2 credits
- low noise
- 5min idling ban





APU requirements in HD truck application

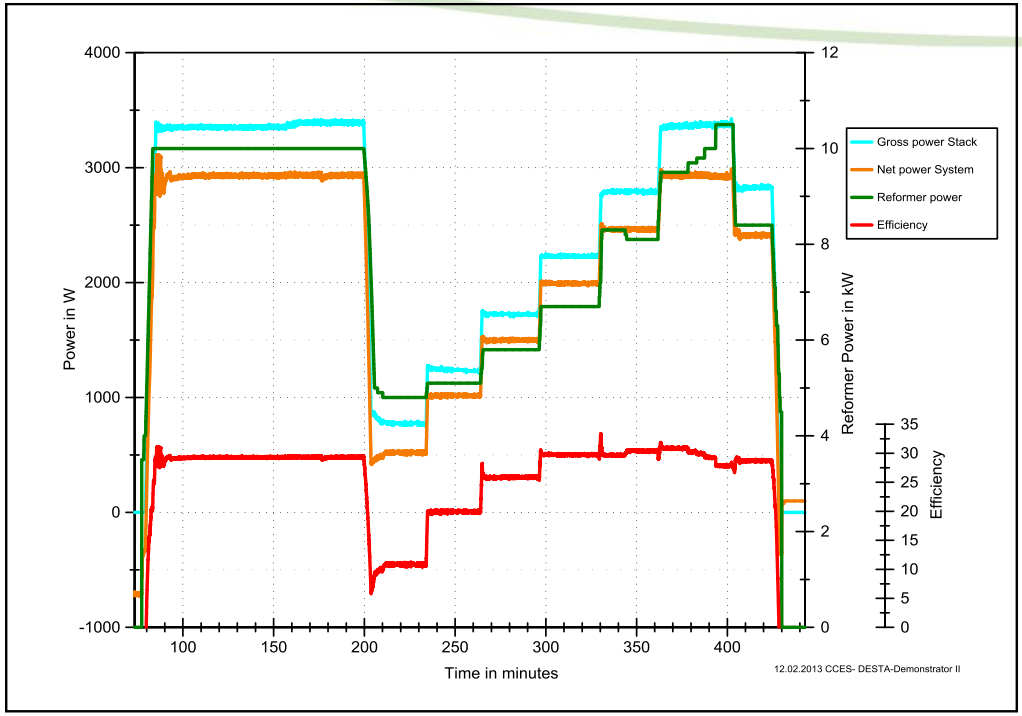
- Weight and volume
  - Weight– less load, increased fuel consumption
  - Volume – less space for other frame components, e.g. diesel tanks
- Environmental
  - Shock and vibrations, temperatures, salt spray, gravel etc
- Electrical
  - Supplied by 12 V lead-acid battery system
    - (exposed to cranking, load-dumps, operation voltage range 8-16V)
  - Limited start-up energy from vehicle batteries

➔ Comprehensive Specification Document (D1.1) developed!

APU System Development and Testing @Eberspächer

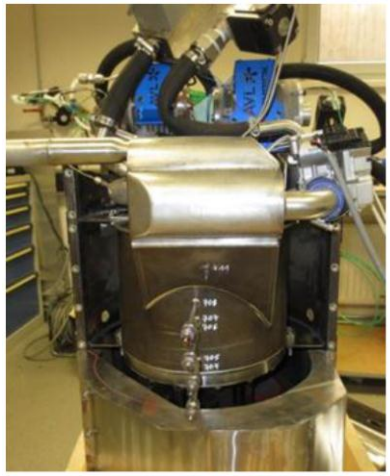
Eberspächer

Operation with US-Diesel:

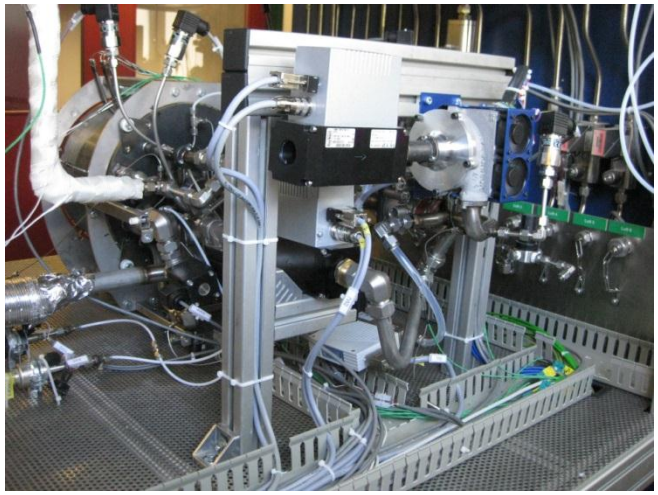


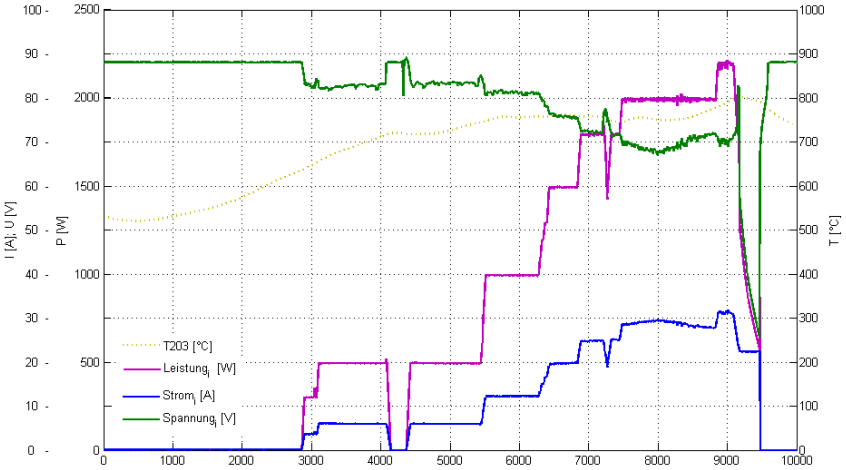
- 3 APU System built up and tested
- electrical Power (gross): **3,4 kW** @ **10 kW** Diesel input
- electrical Power (net): **3,0 kW** @ **10 kW** Diesel input → Efficiency: **30 %**

APU System Development and Testing @AVL



- 3 systems built-up and tested (ongoing)
- Test results reached so far:
  - 2.5kW power output
  - 30% efficiency
  - operation on ULSD
  - >55dB(A) noise
  - vibration test (outside of DESTA)

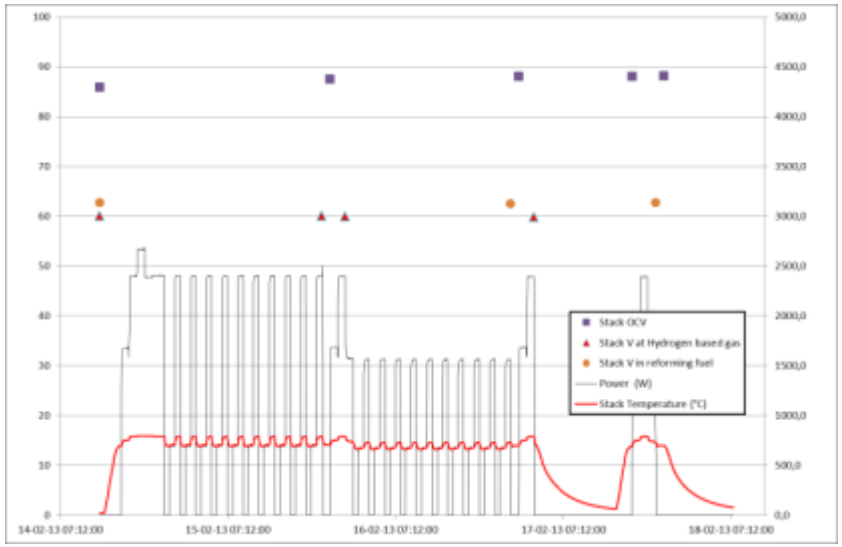




Project Achievements - Stack Optimization

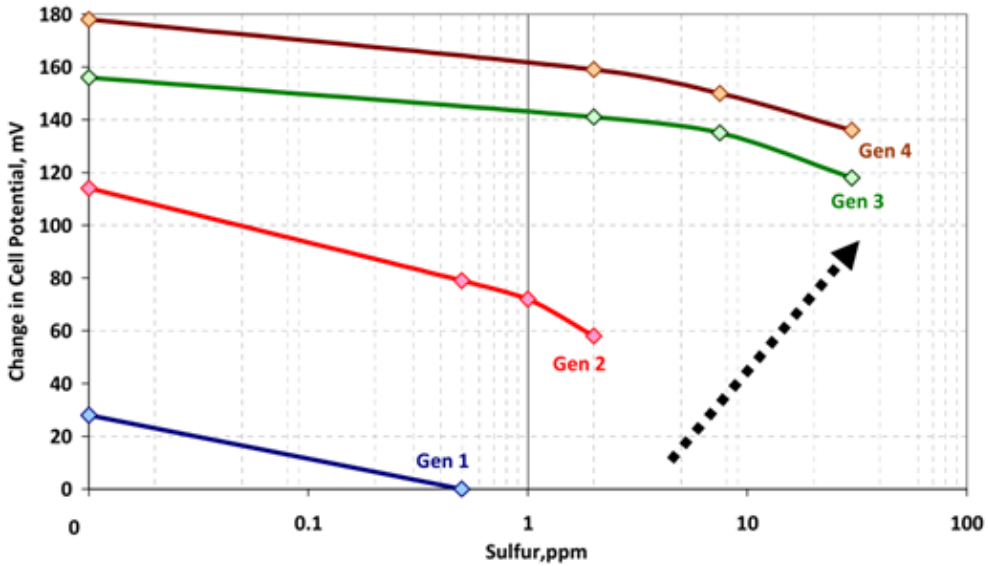
Robustness testing

- 10 cycles in H2 based fuel
- 10 cycles in fuel designed to create large thermal stresses.
- Stack voltage unchanged

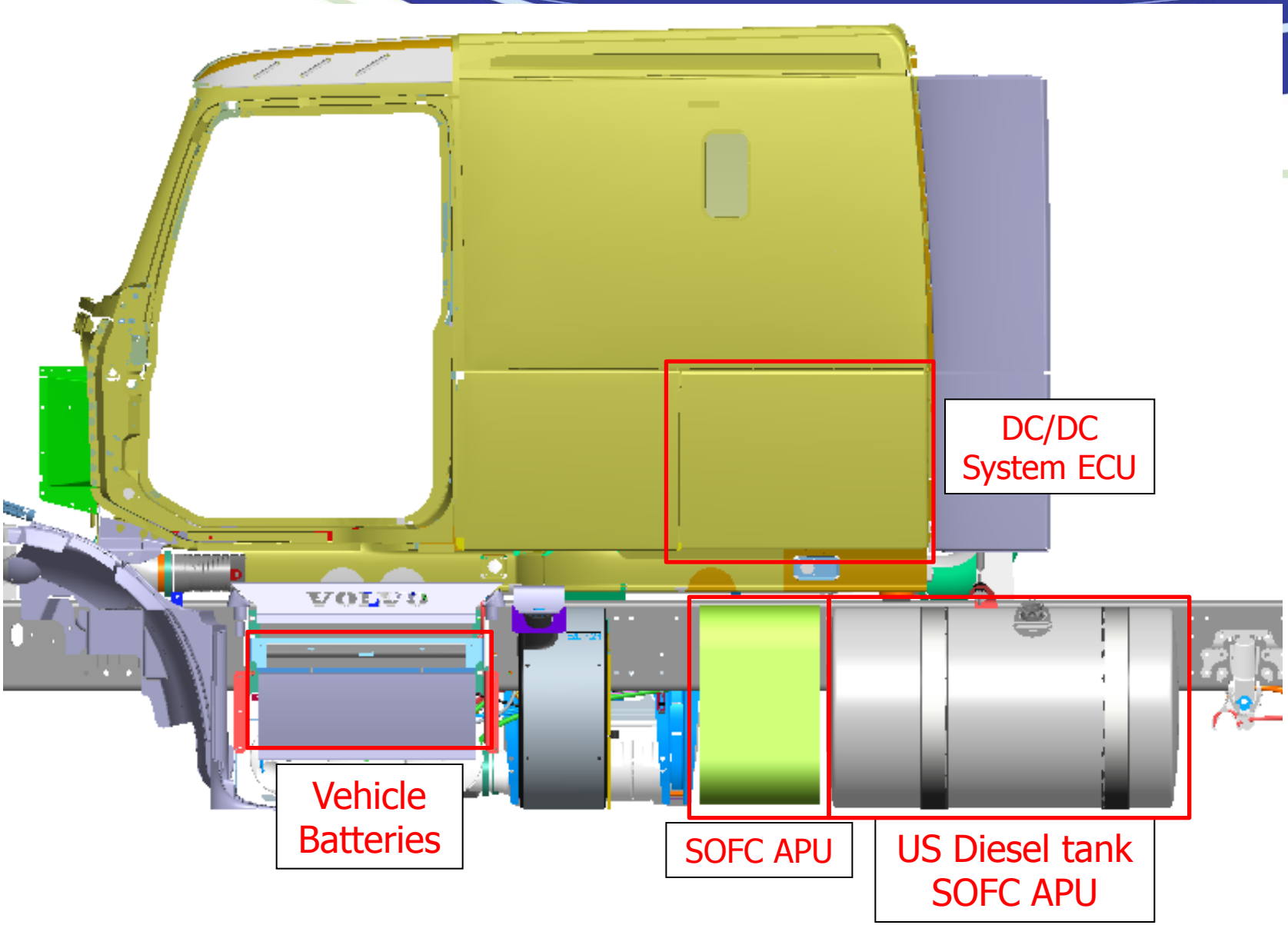


Sulfur testing

- Testing at TOFC on simulated CPO reformate with controlled levels of sulphur.
- Stepwise improvements of sulphur tolerance verified in stack tests.



Packaging study for DESTA Demonstration



Accomplishments

Major Accomplishments:

- Definition of HD truck APU requirement specifications
- Packaging size reduction achieved to enable vehicle integration
- Build up and test of 6 APU systems
- Operation on US road diesel, 3kW net power, 30% efficiency & low noise achieved
- 17 stacks delivered to CCES and AVL
- significant improvement of SOFC stacks towards sulfur tolerance, thermal- and load cycles
- Test vehicle defined and ready for import (from US)

Problems and Risks

Problems occurred:

- Necessity of 2 stacks to reach the 3kW power demand caused additional design iterations and delays
- change of the interconnect design caused delays
- Upgrade of the AVL SOFC APU from 1 to 2 stack configuration caused major problems and delays (3 months extension of WP2 benchmark testing)
- delayed build up of new test laboratory at CCES

Remaining Risks:

- limited amount of stacks
- long term behavior of systems and stacks
- degradation due to sulfur and other contaminants
- environmental influence on system operation (e.g. low temperature, vibration…)
- different behavior of the vehicle demonstration system compared to the actual laboratory systems

Alignment to AIP/MAIP

Expected AIP Outcome	DESTA contribution
Proof of feasibility of using logistic fuels	accomplished
Demonstration of fuel processing technology for logistic fuels	accomplished
Definition of RQ for fully integrated systems in the specific application	accomplished
Cost below € 1,000/kW for automobile application	is be adressed in WP4 (difficult to reach!)
Electric system efficiency (LHV) in the range of ~35% for automotive applications with logistic fuel	accomplished
Anticipated lifetime according to application requirements (≥ 20,000h for automotive)	is adressed in WP4
Anticipated reliability figures (MTBF, availability) according to application requirements	is adressed in WP4
Emission reduction to less than current rules and regulations under development	is adressed in WP5 (final vehicle test)

Cross-cutting Issues

Safety, Regulations, Codes & Standards

- collaboration with JRC to contribute to standardized test methods for SOFC stacks
- collaboration initiated with FCGEN

Dissemination & Public Awareness

- Project identity for consistent communication of project material
- Project website: www.desta-project.eu
- Joint APU dissemination activity planned with FCGEN & SSH2S
- Press release at project start
- SAE Paper „Fuel Cell Auxiliary Power Units for Heavy Duty Truck Anti-Idling" SAE 2013-01-2470
- Presentations at highly relevant conferences
  - COMVEC (Commercial vehicle engineering congress) 2013
  - SOFC XIII, 2013
  - WHTC 2013
  - Fuel Cell Seminar 2012, 2013
- Exhibition of SOFC APU systems at the Fuel Cell Seminar 2012 & 2013
- Collaboration with EU/national projects: METSAPP (EU), ENSA III (D), ASYSI (AT), RELIVE CAT (AT), EUDP (DK)

DESTA contact

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