

DESTA - Demonstration of 1st European SOFC Truck APU 278899

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www.esta-project.eu

PROJECT OVERVIEW - DESTA



- **Demonstration of 1st European SOFC Truck APU**
- Call topic: SP1-JTI-FCH.2010.1.5: Auxiliary Power Units for Transportation Applications
- Start date and end date: 01.01.2012-30.06.2015
- Budget:
 - total budget: € 9,871,006
 - FCH JU contribution: € 3,874,272

- Consortium overview:




- Overall purpose of project: The main objective of DESTA is the demonstration of the first **European Solid Oxide Fuel Cell (SOFC) Auxiliary Power Unit (APU)** for trucks. The SOFC technology offers significant advantages compared to other fuel cell technologies because of its compatibility with conventional road fuels.
- Stage of implementation: **85%**



PROJECT TARGETS AND ACHIEVEMENTS

AIP target	Project Target	Current status/achievements	Expected final achievement
Proof of feasibility logistic fuels	System operation on standard US Diesel fuel (15 ppm S)	accomplished	
Demonstration, fuel processing for logistic fuels			
RQ definition for integrated systems in application	RQ-Report, facing all influences of application environment	accomplished	

PROJECT TARGETS AND ACHIEVEMENTS

AIP target	Project Target	Current status/achievements	Expected final achievement
Cost below € 1,000/kW for automobile application	Cost study for series application	In work (WP4)	difficult to reach
Electric efficiency of ~35% for automotive applications	~35% eff. on standard US Diesel fuel	accomplished	
Anticipated lifetime $\geq 20,000$ h (for automotive)	lifetime verified in long-term tests & with statistical methods	In work (WP4)	≤ 5000 h

PROJECT TARGETS AND ACHIEVEMENTS

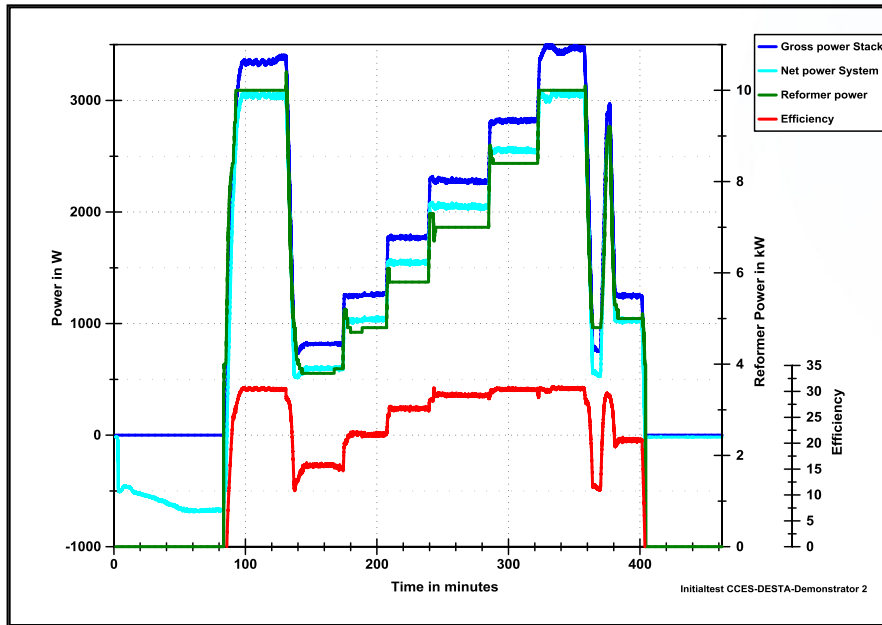
AIP target	Project Target	Current status/achievements	Expected final achievement
reliability figures (MTBF, availability) according to requirements	Reliability investigation	analyses under way (WP4)	
Emission reduction to less than current rules and regulations	CO2 reduction of 75 % compared to engine idling of a heavy-duty truck	In Work (WP5), final vehicle test	

Technical TARGETS AND ACHIEVEMENTS

- **Maximum electrical power $\geq 3\text{kW}$**
- **Operation on conventional road diesel fuel**
- Expected lifetime verified in long-term tests and with statistical methods to reach $>20,000\text{h}$
- **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 $\sim 30\text{min}$
- **Noise level $\sim 65\text{dB(A)}$**

Technical TARGETS AND ACHIEVEMENTS

APU Systems from Eberspächer

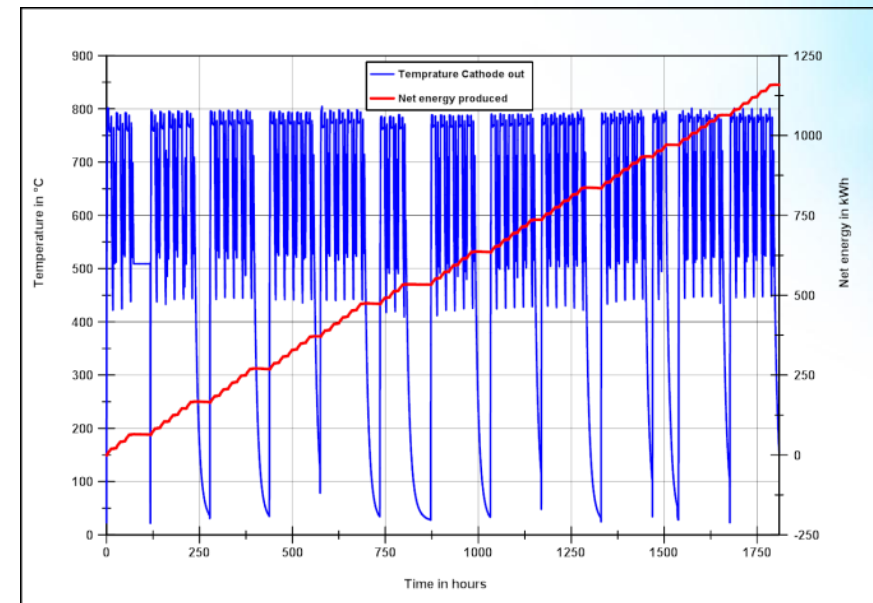


Long term cycling of 3 systems:

17 weeks of cycling

1,184 h with current drawn

1,624 kWh electrification



Operation with US-Diesel:

electrical Power (gross): 3.4 kW

electrical Power (net): 3.0 kW

→ Efficiency: 30 %

Technical TARGETS AND ACHIEVEMENTS

DESTA SOFC APU



source: www.eberspaecher.com

- System volume and weight below 150l and 120kg
- Noise level ~65dB(A)

Technical TARGETS AND ACHIEVEMENTS

Next steps for project finalization in June 2015:

- Integration testing of complete System in Lab
- Final vibration test of complete System
- Integration of an active System in the truck
- Final system demonstration on driving VOLVO truck



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 and closure of TOFC caused major problems and delays (12 months extension of WP2 benchmark testing)
- delayed build up of new test laboratory at CCES
- Latest TOFC stack generation leads to integration problems on AVL side
- **Closure of Topsoe Fuel Cell**

MITIGATION

- Closure of TOFC

- Knowledge shared to operate the systems
- All stacks and deliverables already delivered
- Truck demonstration will be done with TOFC stacks
- The project will be finalized without TOFC
- Other stack alternatives are under investigation

- Project delays

- All major project targets including truck demonstration can be achieved within 6 month project extension (till June 2015)

Problems and Risks

Remaining Risks:

- **APU lifetime**
 - limited amount of stacks and no spare stacks available
 - degradation due to sulfur (testing with US Diesel fuel)
 - Unknown vehicle environment
- **System electrical efficiency around 35%**
 - Efficiency of Fuel Cell System around 35%, Power electronics only on 80%, this will limit the total eff. into the prototype
- **Startup time of ~30 min.**
 - Thermal limits of the stacks need a conservative heat up strategy around 1h

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

- Joint workshop DESTA-FCGEN-SSH2S
 - Open workshop in Torino to share experiences on mobile Fuel Cell Systems
- German founded project ENSA III
 - Large exchange of knowledge on Eberspaecher side
- Austrian founded project ASYS II
 - Knowledge out of DESTA is basis for AVL in the new R&D Project
- Exchange of stack specification in stack development projects
 - METSAPP (EU), METSOFC (EU), NextGenMSC (GER), ReliveCAT (AT), ELTSECCS (AT)

HORIZONTAL ACTIVITIES

Safety, Regulations, Codes & Standards

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

DISSEMINATION ACTIVITIES

Dissemination & Public Awareness

- Project identity for consistent communication of project material
- Project website: www.desta-project.eu
- Joint APU dissemination activity 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

DISSEMINATION ACTIVITIES

Dissemination & Public Awareness

- Presentations at highly relevant conferences
 - EFCF 2014
 - F-Cell 2014
 - 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), ASYS I (AT), RELIVE CAT (AT), EUDP (DK)

EXPLOITATION PLAN/EXPECTED IMPACT

- DESTA has made first truck APU prototype systems available for real vehicle demonstrations. The systems are operated on real road diesel fuel, reach 35% efficiency and fit the packaging requirements of the truck industry. All the targets are completely in line with the FCH JU MAWP.
- The TRL level from fuel cell APU systems has been increased from TRL3 to TRL6
- A commercialization for the main HD truck market is intended to start 2017/18 by Eberspächer

EXPLOITATION PLAN/EXPECTED IMPACT

- AVL is committed to supply commercial APU products to small scale/niche market applications within the next 3 years
- For the next stage larger demonstration projects are required to raise awareness of the technology (should be added as topic in 2015/16)
- further R&D is required towards cell/stack robustness, sulfur/impurity tolerance, low cost stack design and manufacturing
- As a spin-off application a lot of interest has been raised to use SOFC APU systems also integrated into hybridized powertrains. This should be addressed in the next MAWP update.

Contact information

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