DESTA – Demonstration of 1st European SOFC Truck APU

278899

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www.desta-project.eu

PROJECT OVERVIEW - DESTA

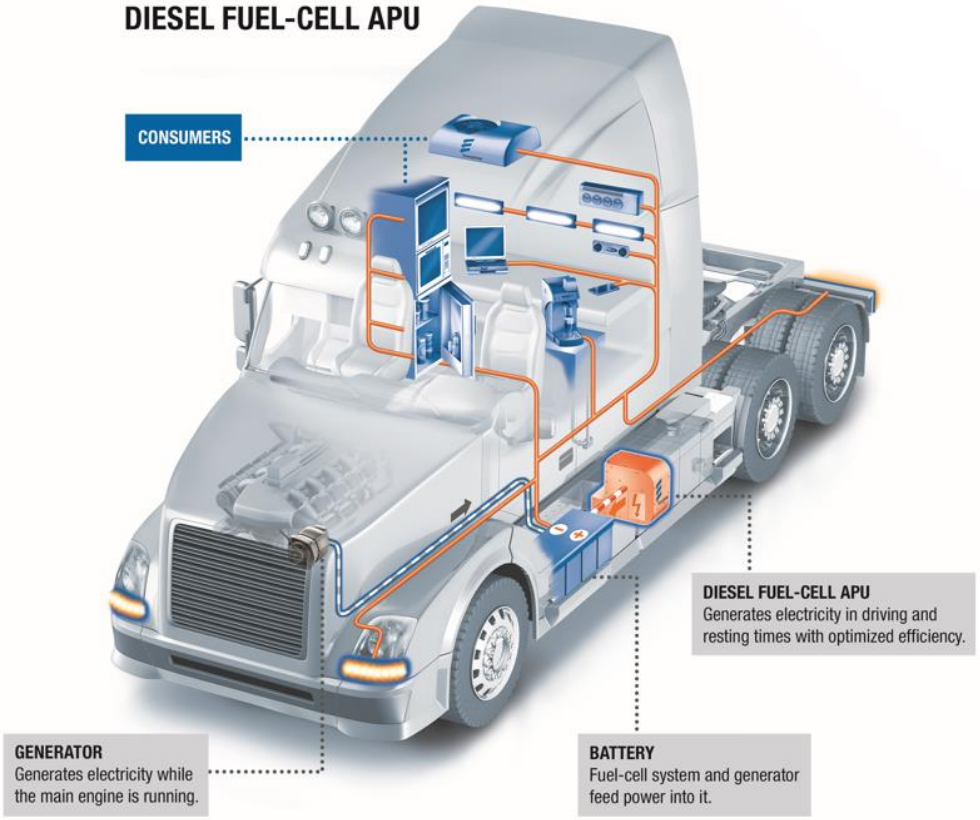
- **Demonstration of 1st European SOFC Truck APU**
- Call topic: SP1-JTI-FCH.2010.1.5: Auxiliary Power Units for Transportation Applications
- Start date and end date: 01.01.2012-30.06.2015
- Budget:
  - total budget: € 10,441,618,80
  - FCH JU contribution: € 3,874,272
- Consortium overview:

AVL Eberspächer JÜLICH FORSCHUNGSZENTRUM VOLVO TOPSOE FUEL CELL RETHINKING ENERGY

until 15.10.2014

- 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: **100%**

Motivation



source: www.eberspaecher.com

- 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 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
- Integration and test of DESTA SOFC APU in a Volvo Truck

PROJECT TARGETS AND ACHIEVEMENTS

AIP Target	Project Target	Current status	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	
Cost below € 1,000/kW for automobile application	Cost study for series application	Partly accomplished	1,500€/kW possible, further reduction only with lower stack cost

PROJECT TARGETS AND ACHIEVEMENTS

AIP Target	Project Target	Current status	Expected final achievement
Electric efficiency of ~35% for automotive applications	~35% eff. on standard US Diesel fuel	accomplished	~30% eff. on standard US Diesel fuel in the truck, > 30% in laboratory
Anticipated lifetime ≥ 20,000h	lifetime verified in long-term tests & with statistical methods	Partly accomplished	Up to 2,000 APU operating hours shown, equivalent to 8,000 hours lifetime
reliability figures (MTBF, availability) according to requirements	Reliability investigation	Not analyzed	Too less statistical data generated
Emission reduction to less than current rules and regulations	CO2 reduction of 75 % compared to engine idling of a heavy-duty truck	accomplished	

Technical TARGETS AND ACHIEVEMENTS

The 1st European SOFC Truck APU was successfully demonstrated (06/2015)

Technical objectives	Unit	Planed	Achieved	Status
Max. start-up time	min	30	< 70	🔴
Max. Electric power (net)	kW	3.0	2.9	🟢
System electrical net efficiency (approx.)	%	35	29	🟡
Diesel consumption (3 kW, net)	l/h	0.86	0.95	🟢
Volume	l	186	178	🟢
Weight	kg	150	160	🟡
Noise level	dB(A)	65	58	🟢
CO_2 reduction compared to engine idling of a heavy-duty truck	%	75	73.5	🟡
Operation on conventional road diesel fuel (US Diesel)				🟢

Problems and → Mitigation

Project Delay

- 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 (24 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

→ All major project targets including truck demonstration have been achieved within 6 month project extension (till June 2015)

Closure of TOPSOE FUEL CELL

→ 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

Major Risks for next Steps

- Technology Cost
  - The cost for HD Truck applications need to be further reduced from 1,500€/kW to 1,000€/kW
  - This can be achieved with MSC metal supported stack
  - ► **Development of new low cost MSC stack platforms should be accelerated!**
- APU lifetime
  - Lifetime needs to be improved from 2,000hrs to 6,000hrs
- Startup time of ~30 min.
  - With ASC stacks a start up time below 60 min. is very difficult. This issue can be completely solved with MSC stacks!
  - ► **Development of new low cost MSC stack platforms should be accelerated!**

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

- Joint workshop DESTA-FCGEN-SSH2S
  - Open workshop in Torino to share experiences on mobile Fuel Cell Systems
- German funded project ENSA III
  - Large exchange of knowledge on Eberspächer side
- Austrian funded 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
- Collaborative workshop with FCGEN & SSH2S projects performed

DISSEMINATION ACTIVITIES

- Dissemination & Public Awareness – Selected Highlights
  - 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 and end
  - SAE Paper „Fuel Cell Auxiliary Power Units for Heavy Duty Truck Anti-Idling" SAE 2013-01-2470
  - Presentations at highly relevant conferences
    - EFCF 2014
    - F-Cell 2014
    - COMVEC (Commercial vehicle engineering congress) 2013
    - SOFC XIII, 2013
    - WHTC 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

- Dissemination of the DESTA achievements with the truck industry in US and EU (including OEMs and large fleet operators)
- Preparation of additional demonstration projects with truck OEMs and fleet operators to raise the awareness for this technology at critical decision makers
- Further analyses of the business case compared to existing solutions and updated by regulatory changes for anti-idling.
- Continuation of the development to improve key performance indicators and reduce costs:
  - Improve the efficiency to around 40%
  - Improve the robustness and lifetime to 5.000hrs
  - Further reduction of system costs by DtC and DtM measures
  - **Investigate the application of new metal-supported SOFC stack technology which offers a significantly reduced cost potential than in DESTA used ASC technology.**
  - Reduce the start-up time to below 45min by system improvements and/or alternative stack technology (MSC)
- Dissemination of the results to policy makers (e.g. Department of Energy, US) to show the CO2 reduction potential of this technology and to elaborate tax credit incentives and CO2 bonus systems to support market introduction.
- Investigation of early markets for this technology like special purpose vehicles. This vehicle category is not as cost sensitive as the commercial heavy duty truck industry and therefore market entry is much easier and bears less risk. Successful roll-out of a commercial product in this market will also accelerate the heavy duty mass-market. Discussions with first OEMs have already been started and especially AVL is performing at the moment >5 demonstration projects within this market segment.
- AVL believes that a commercial product for special purpose vehicles might be available in the timeframe 2017-18. Depending on market entry support (CO2 credit system, tax incentive system,…) commercial roll-out to the heavy duty truck market might start in the timeframe 2018-2020.
- Evaluate the possibility to place a larger field-test of APU systems installed in heavy duty trucks and/or busses under the FCH JU 2.
- Investigation of smaller APU systems (<2kW) with OEMs for the US and European market for anti-idling and night-city logistic vehicles.