



TOPSOE FUEL CELL
RETWINING ENERGY



Eberspächer



JÜLICH
FORSCHUNGSZENTRUM



DESTA - European Solid Oxide Fuel Cell Auxiliary Power Unit EGVIA

Reduction of CO₂ emissions from Heavy-Duty Trucks

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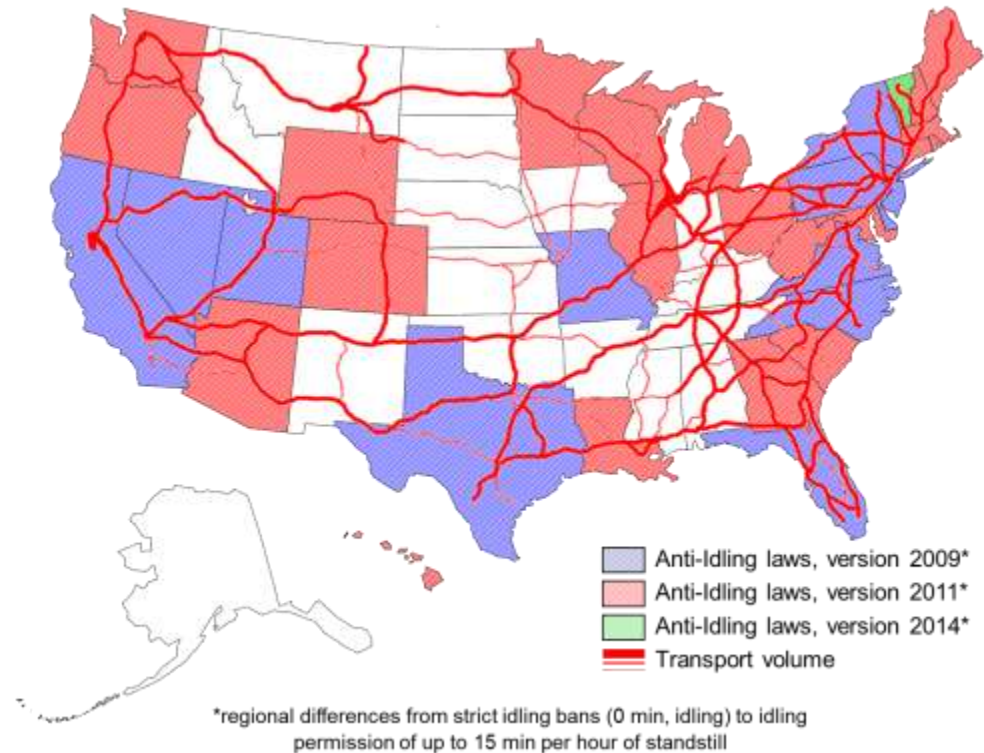
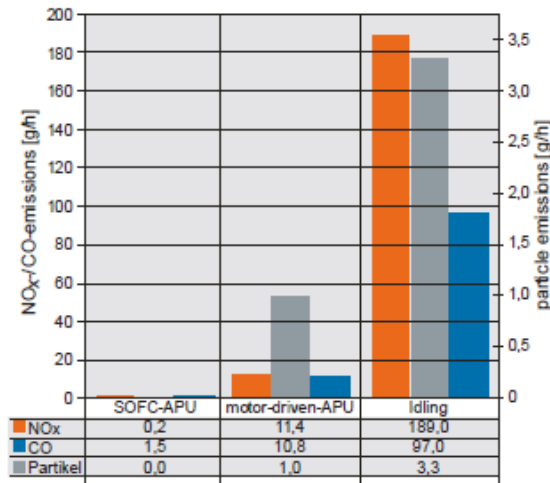


The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for the Fuel Cells and Hydrogen Joint Technology Initiative under grant agreement n° 278899

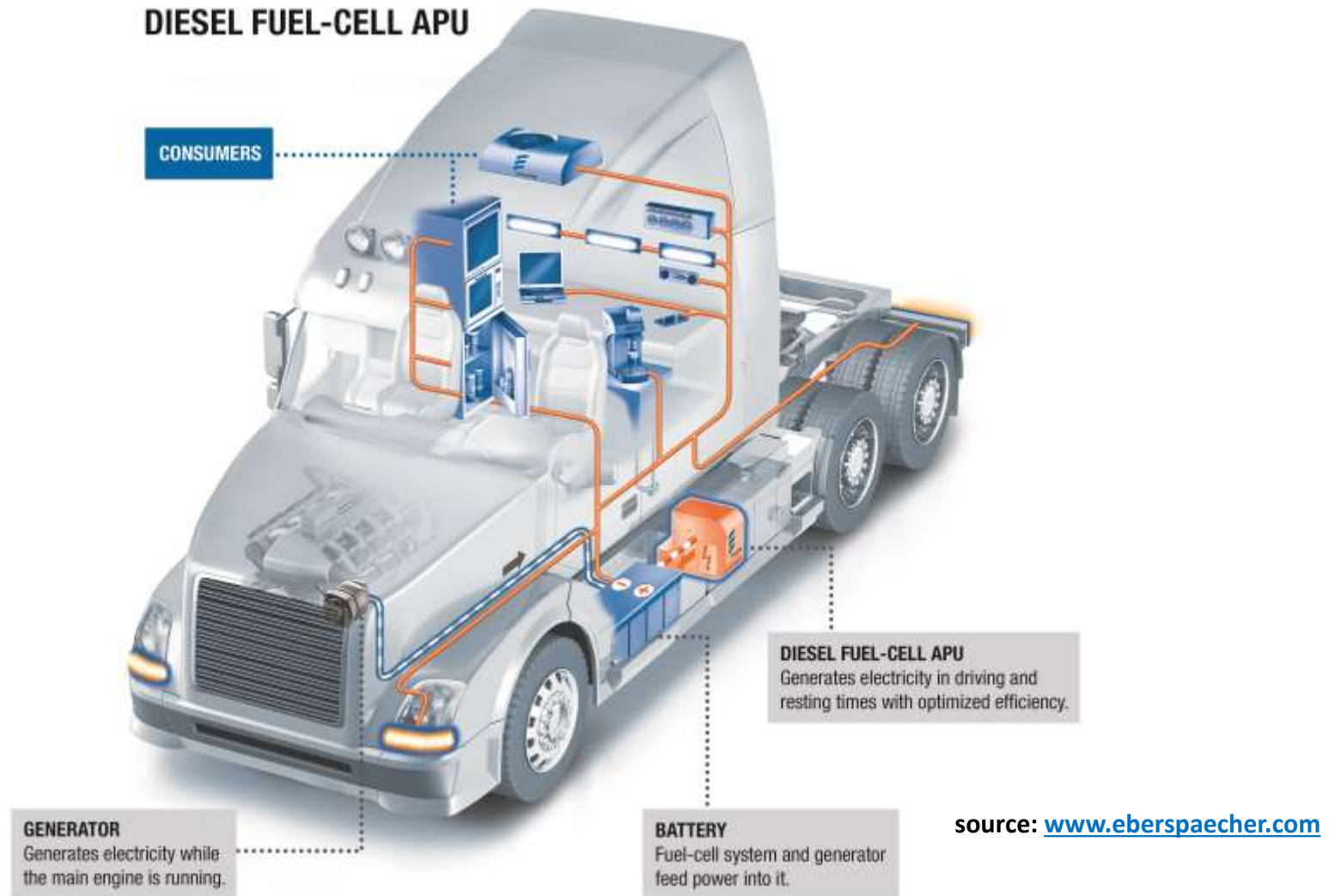
Rechberger, AVL, DESTA Coordinator

Motivation

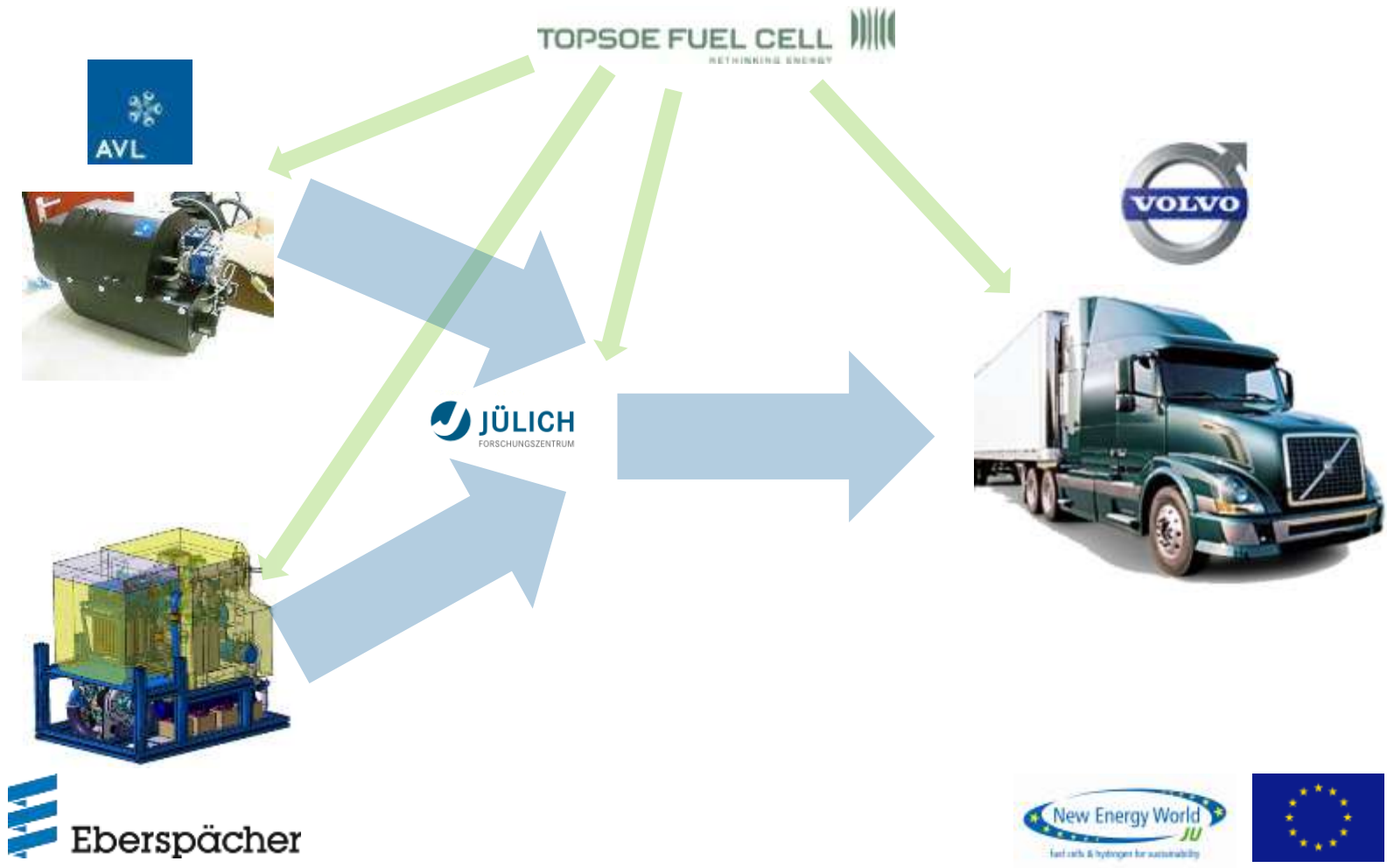
- Anti idling regulations
- Fuel cost savings
- CO2 credits
- 5min idling ban
- low noise, increased comfort



Vision



DESTA Project



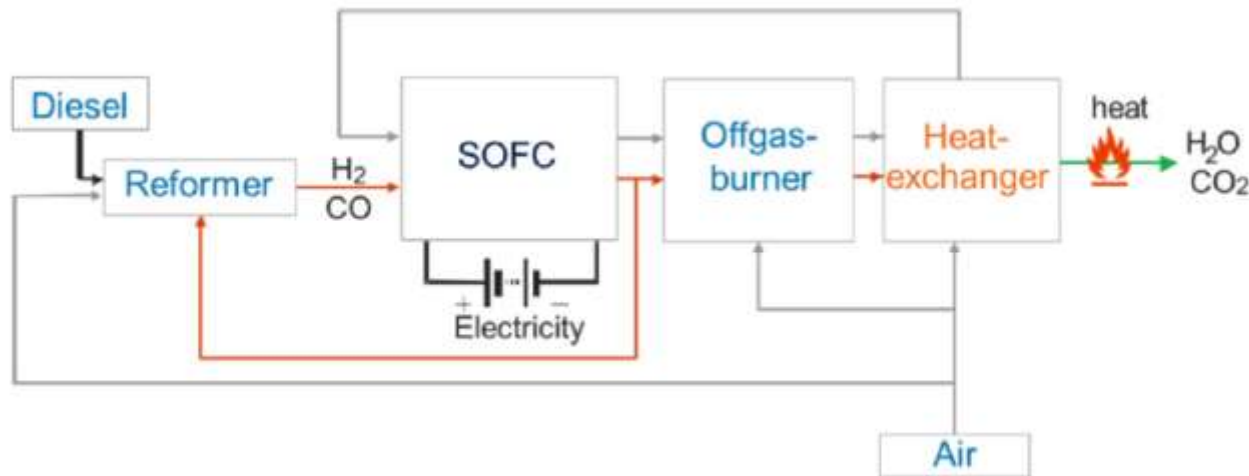
SOFC- APU- components

Reformer: Synthesis of hydrogen-rich fuel out of diesel and ambient air (CPOX)

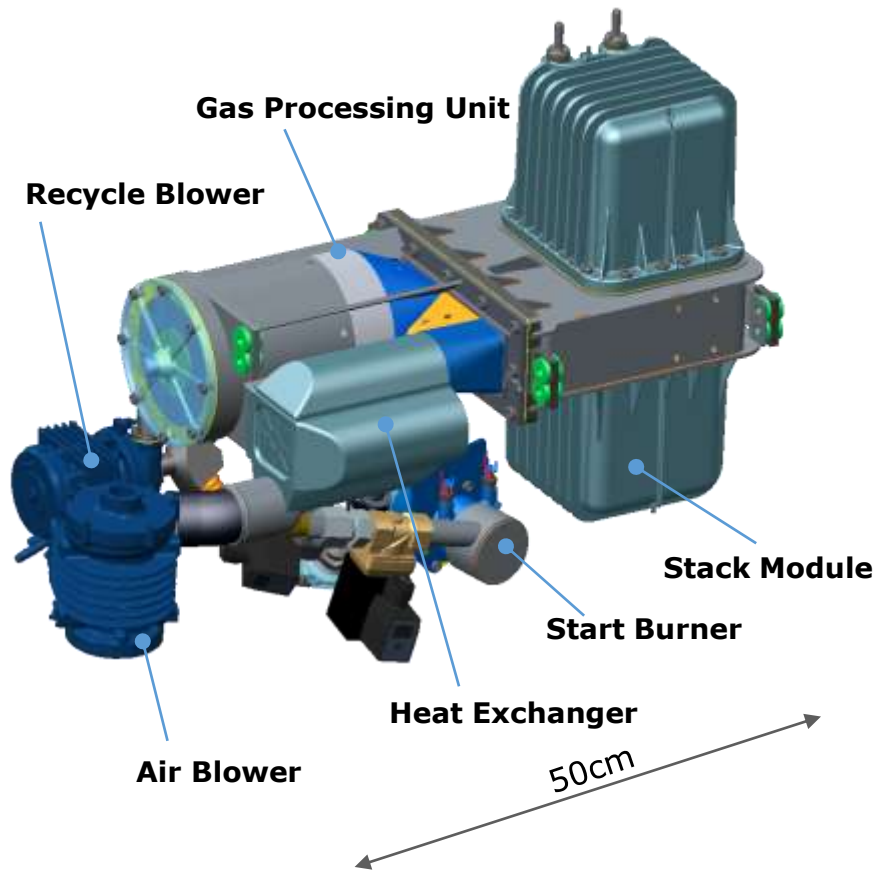
SOFC-Stack: Electrochemical conversion of syngas and air

Off-gas Burner: Conversion of unused fuel gas, reduction of emissions

Start-up burner: Careful heat up of the system



AVL SOFC APU GenIII System

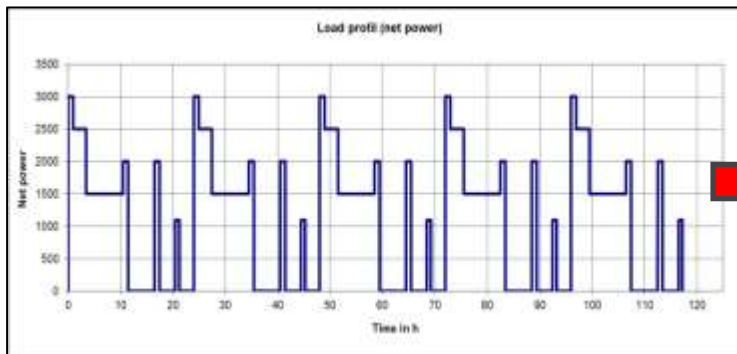


SYSTEM FEATURES:

- ✓ Platform up to 5kW_{el}
- ✓ Multifuel design
- ✓ Efficiency - diesel: 40%
- ✓ Efficiency - ethanol: 55%
- ✓ Package suitable for vehicle integration

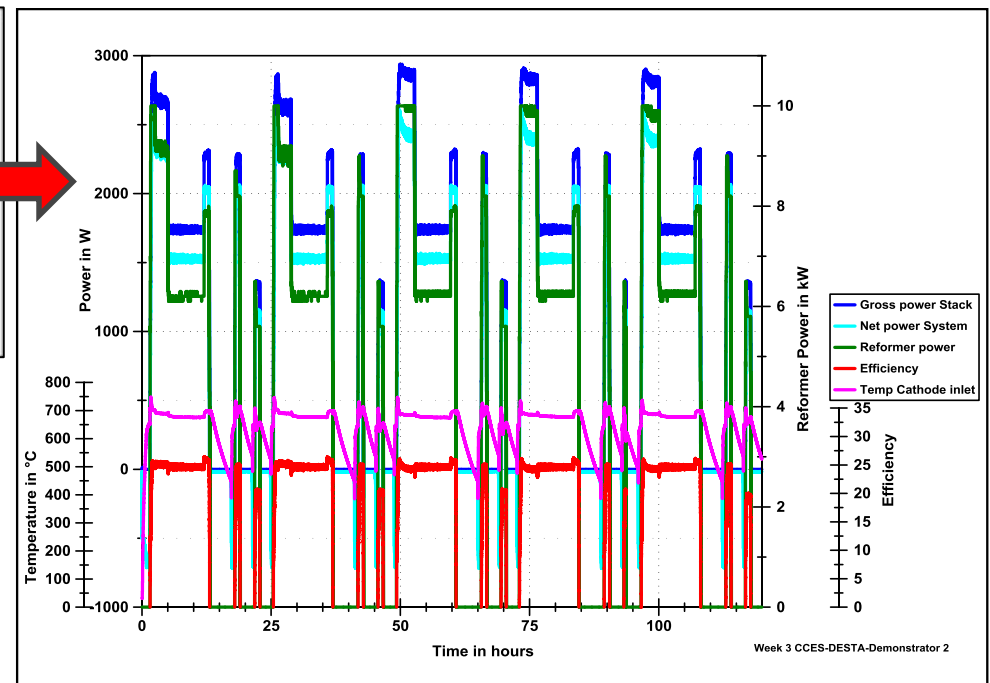
Week cycling Tests

DESTA test cycle as „electrical power demand of a trucker in one week“ with day breaks and a night break. One Coldstart, 14 warmstarts per week and 5 different load levels.

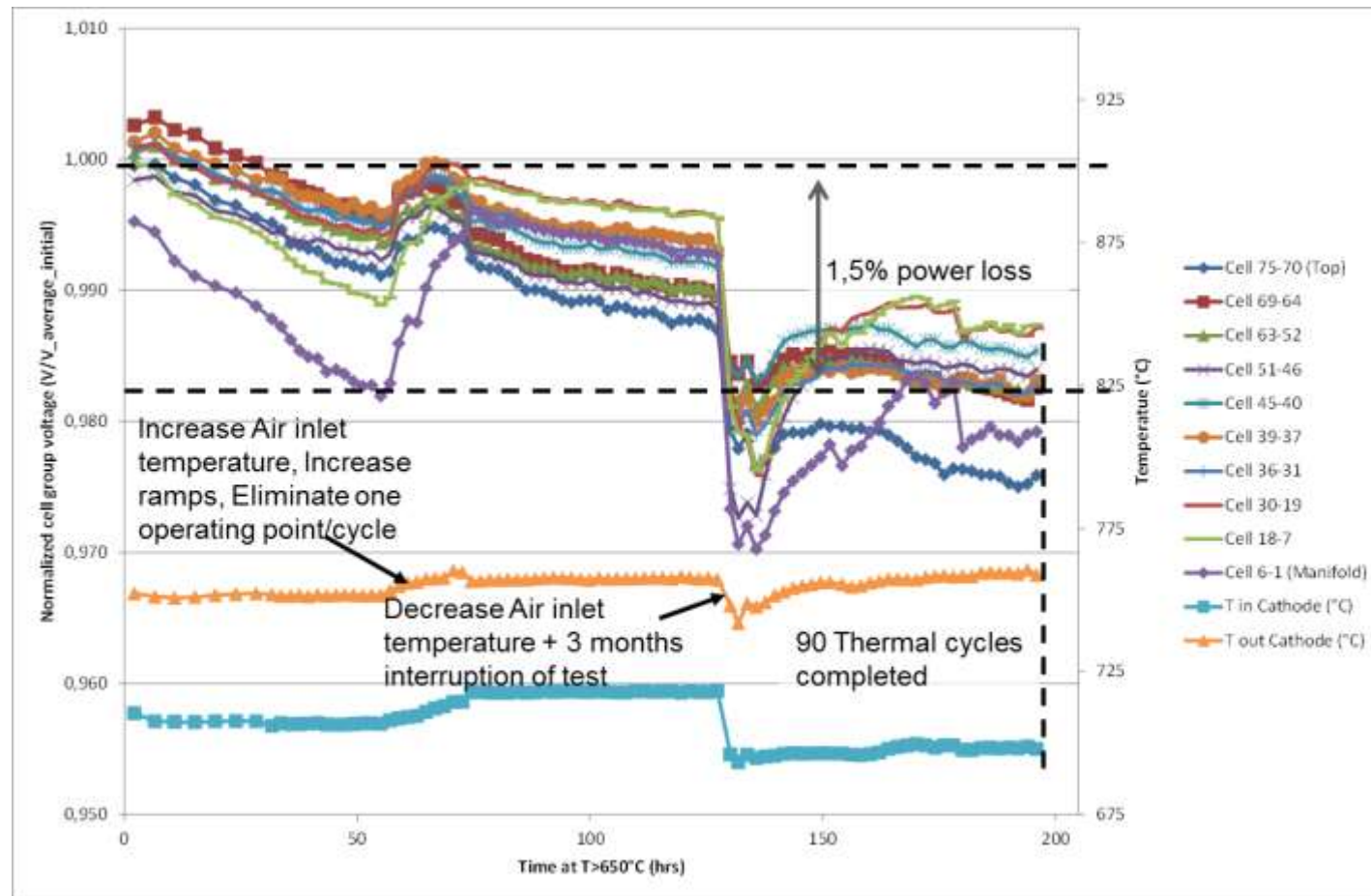


APU systems show:

perfect power request alignment
large power modulation
short reaction time



Thermal cycling test of Stacks



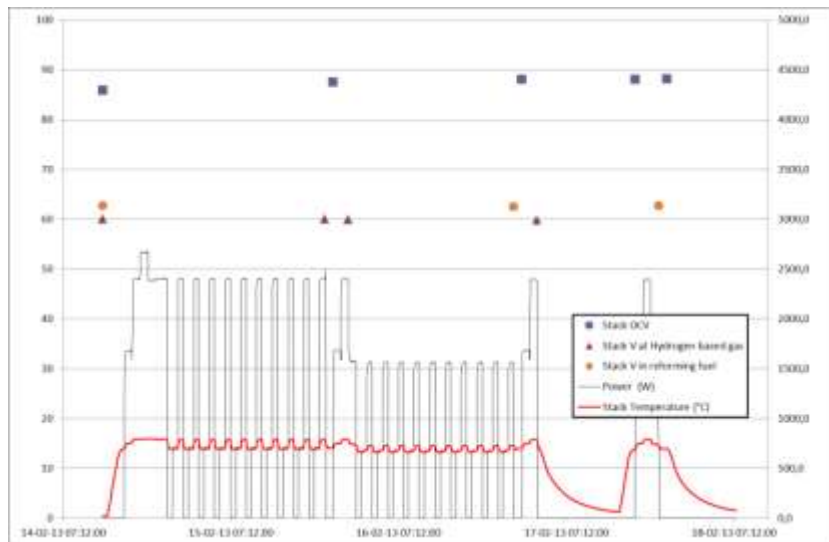
1.5% power loss after 90 aggressive thermal cycles!

Project Achievements - Stack Optimization



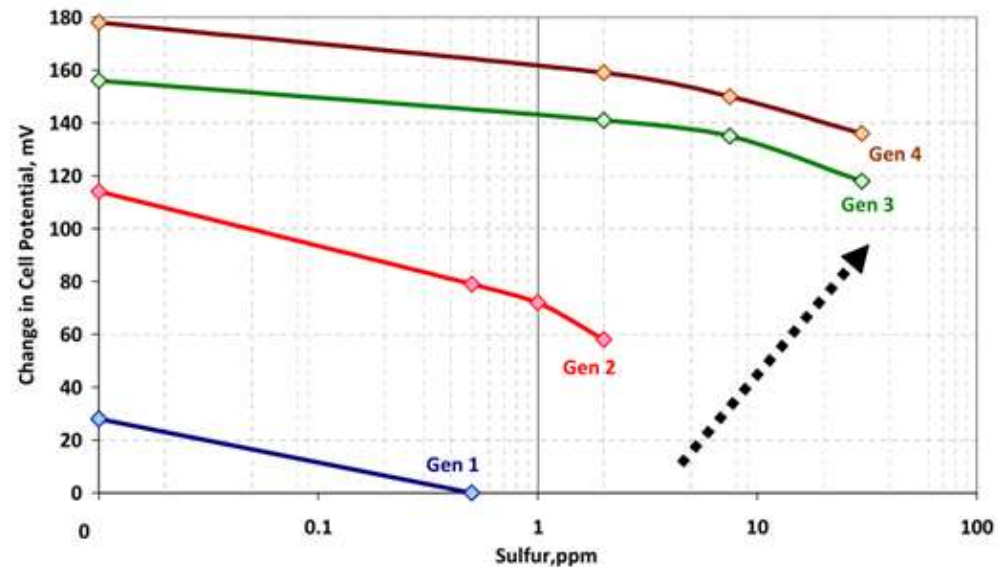
Robustness testing

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

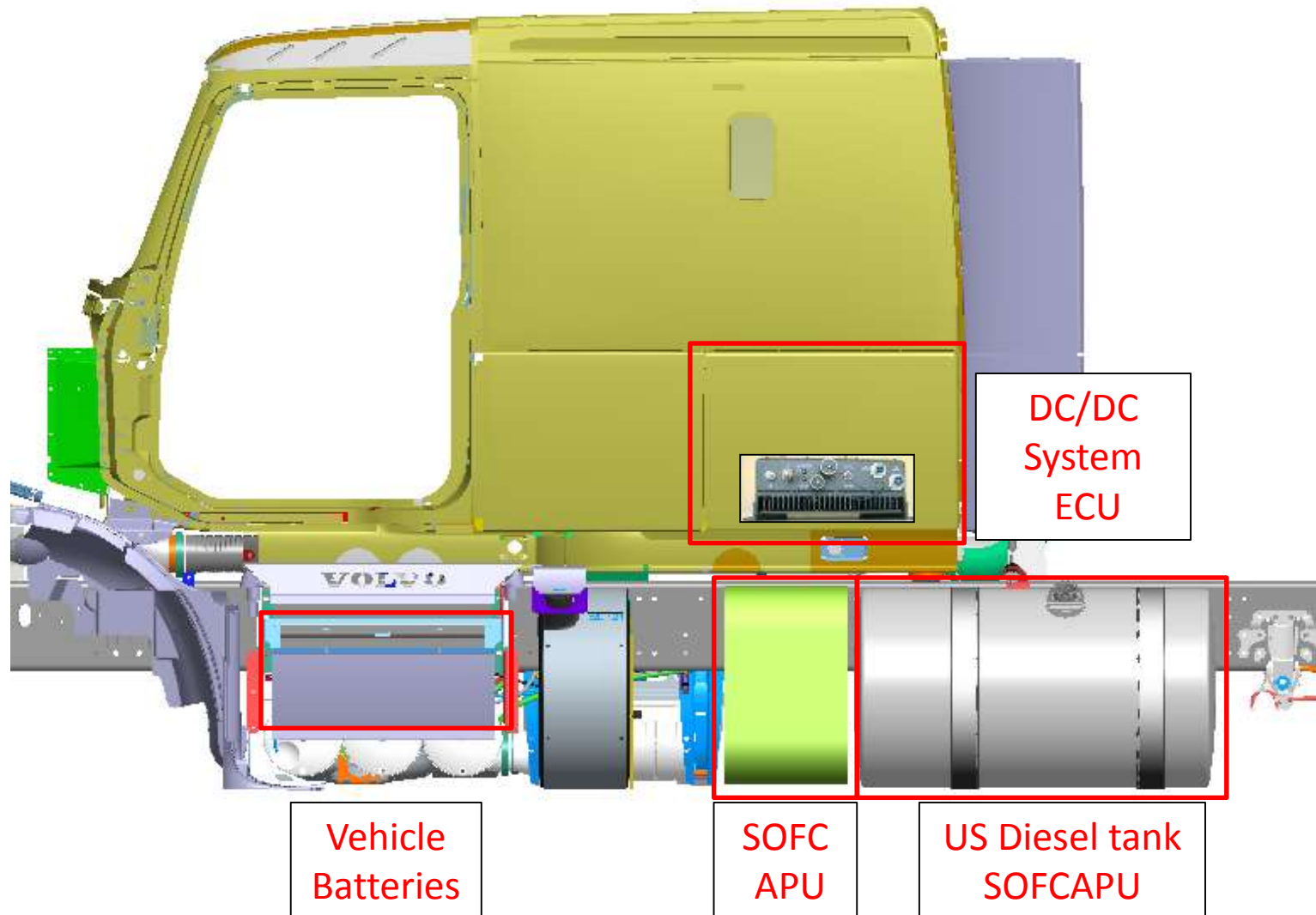


Sulfur testing

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



Packaging for DESTA Demonstration



DESTA SOFC APU



new DESTA truck APU developed:

customer fitted system
gas processing unit involved
power electronics involved
Volvo Truck integration in autumn 2014



source: www.eberspaecher.com

APU-Integration in a Volvo Truck



Vehicle demonstration



- ✓ **APU integrated into Volvo HD truck**
- ✓ **5 weeks intensive vehicle tests**
- ✓ **24h anti-idling missions simulated**
- ✓ **test drives with hot APU >2.500km**

Technical objectives	Unit	Planned	Achieved	
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	71	↓
max. start-up time	min.	30	< 70	✗
Operation on conventional road diesel fuel				✓

Conclusions

- Technical breakthroughs with operation on US diesel fuel with efficiencies of 30%, 3kW net power, noise <55dB(A) and weight/volume ready for vehicle integration
- Successful vehicle integration and field testing of SOFC based APU systems
- In overall >70% reduction of Idling CO₂ emissions demonstrated

Thank you for your attention!

more information: www.esta-project.eu



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