FCCF-APU

Fuel **C**ells operating on **C**onventional **F**uels
as **A**uxiliary **P**ower **U**nit for battery electric vehicles

ERA-NET Transport Electromobility+ Programm Kick-off,
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Electromobility + FCCF APU
FUEL CELL OPERATING ON CONVENTIONAL FUELS AS AUXILIARY POWER UNIT

WS Reformer GmbH

CHALMERS

Serenergy
The Power of Simplicity

Fraunhofer ISE

IMPACT COATINGS

borit

Fraunhofer ICT

Danish Power Systems

Federal Ministry of Economics and Technology

Outline

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FUEL CELL OPERATING ON CONVENTIONAL FUELS AS AUXILIARY POWER UNIT

- Motivation of the project
- Goal and scope of the project
- Project structure

Motivaton

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- Battery electric vehicles allow for driving without any local emissions in particular in urban area
- This is of high interest for commuter cars as well as for local transportation vans.
- An important draw back may be the short operating range.
- Although operating ranges of 40 to 80 km are regularly sufficient for above applications, this range is significantly reduced if energy of the battery is used for other purposes than propulsion
- In particular energy use for heating ventilation and air conditioning together with vehicle lightning may have a strong negative effect
- A second power source on board to supply theses consumers thus can help to
  - Increase the effective operating range
  - Render the operation of the BEV more reliable.

Motivation

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- The challenges for this on-board power generator are:
  - to maintain the low noise and pollutant emission levels of the BEV as much as possible;
  - to avoid generating another infrastructure burden that hinders the market introduction.
  - to offer easy and convenient use.

Basic requirements	State-of-the-art APU concepts			Proposed APU
	ICE	Hydrogen PEMFC	SOFC with CPO reformer	HT-PEMFC with steam reformer
Uses available fuel	Yes	No	Yes	Yes
Low noise emission	No	Yes	Yes	Yes
No emission of NO_2 and particulate matter	No	Yes	Yes	Yes
Start-up in few minutes	Yes	Yes	No	Yes
Frequent start-up shutdown possible	Yes	Limited	No	Yes

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Motivation

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- Comparing the requirements to possible approaches of APU systems revealed:
  - that a fuel cell system approach is most suitable to maintain low noise and pollutant emissions
  - that a conventional fuel with an exiting infrastructure for its distribution should be used to allow for fast market introduction;
  - that this will require a reformer on-board
  - that SOFC solution, though in principal well suited for operation with reformate, will have difficulties in withstanding frequent start-stop cycles
- Thus the strived for solution with diesel or petrol steam reformer inline of an HT-PEMFC should be most the suitable solution.

Goals and Scope

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- The goal of the project is to develop a demonstration unit of an APU in particular for urban transport vans.
- The following technical goals shall be demonstrated

Property		Target Value
Net power output		3 kW_{el}
Weight		< 150 kg
Volume		< 225 l
Efficiency	during operation	≥ 28% electrical energy to fuel (LHV)
	eff. incl. start-stop	≥ 25% electrical energy to fuel (LHV)
Target price		12,000 €/pc mass production

- As a prerequisite water autonomous operation is required

Goals and Scope

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- The project targets the experimental development of the components required to built the demonstrator
- That means that existing components shall be modified to suite the requirements of the project
- Major issues concern
  - the system design,
  - the development of a lighter and more resilient stack and
  - the development of a steam reformer for petrol and diesel

Goals and Scope

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System design

(WS Reformer, Serenergy, Fraunhofer ISE)

- The elaboration of a suitable system design is crucial for the realisation of the demonstrator
- Some important points need to be worked on
  - Water autonomous operation of the system including the steam reforming subsystem
  - Heat management
    - Heating of the system during start-up
    - Heat withdrawal for vehicle heating purposes
    - Heat rejection
  - Interfaces to the vehicle system
- In order to have sufficient time solutions for current commercial systems will be developed right from the beginning and transferred to the new system components upon their completion.

Goals and Scope

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Development of an improved stack
(Serenergy, Danish Power Systems, Borit, Imapct Coatings, Fraunhofer ICT, Chalmers)

- The development has two goals
  - To render the HT-PEMFC technology more resilient against transient condensed water exposure during start-up and shutdown as well as against impurities from the reformate
  - To make the stack lighter and compacter
- The first issue shall be addressed by changes to the MEA e.g.
  - Water repellent electrode structure
  - Sulphur tolerant catalyst and/or electrode structure
- The second point by introducing metallic bipolar plates
- Using these new components the improved stack shall be realised subsequently

Goal and Scope

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Reformer

(WS Reformer, Fraunhofer ISE)

- The current reformer system needs to be adapted for the use in the system
  - Use of heat recovered from the fuel cell
  - Water management
  - New catalyst system allowing for the reformation of low sulphur content Diesel
  - Catalyst selection for petrol reforming

Goals and Scope

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Demonstrator

Fraunhofer ICT, WS Reformer, Serenergy,

- The demonstrator shall demonstrate the feasibility of the APU system
- It will contain the improved stack and the reformer subsystem
- The demonstrator shall be able to operate self-sustained if controlled from the outside
- The performance of the demonstrator shall be tested and evaluated

Structure

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- The technical work in the project is divided into six work packages
  - WP 1: System Integration
  - WP 2: MEA Development
  - WP 3: Metallic Bipolar plates
  - WP 4: Stack development
  - WP 5: Reformer Development
  - WP 6: Demonstrator development
- During a first phase of the project three major issues will be addressed
  - System design, in particular water autonomous operation and heat management (WP 1)
  - Development of an improved stack including its components (WP 2 through 4)
  - Development of the reformer (WP 5)
- In the last phase of the project stack and reformer will be integrated into a demonstrator using the system design which will have been developed.

Structure

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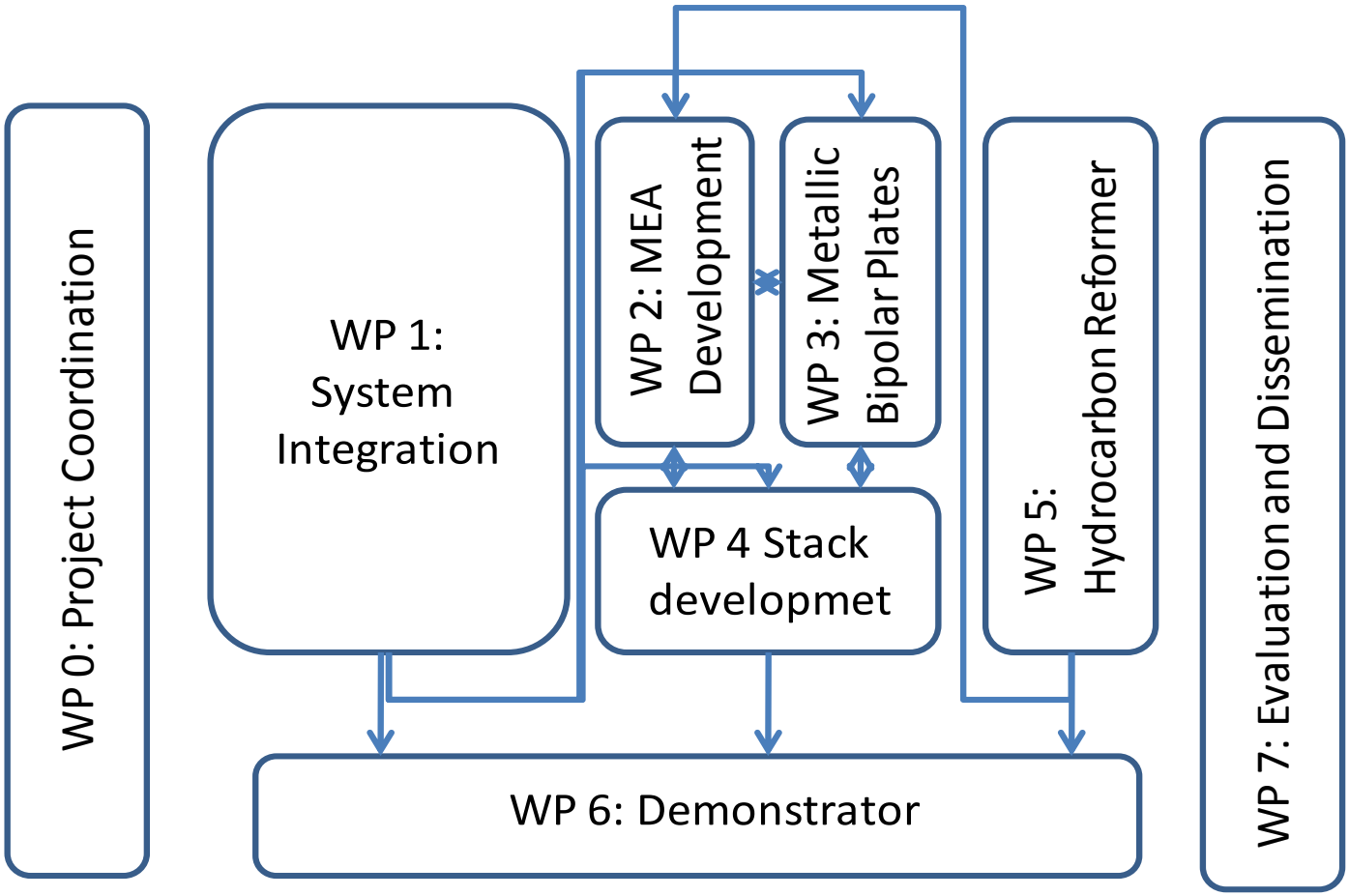
- Additional work packages concern the management of the project and the evaluation and dissemination of its results



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Thank Your for Your attention!

Questions?

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