KEYTECH4EV Newsletter – Aug, 2017

Development and Demonstration of Key Technologies for Low-cost Electric Vehicle Platforms

About KEYTECH4EV

The project's ambition is to develop key technologies for the integration and build-up of a hybridized demonstration vehicle with a cost-optimized and CO_2-free powertrain based on fuel cell and battery technology.

Intensive cost analyses based on a Toyota Mirai deep-dive benchmark indicate (for the timeframe 2020-30) that a fuel cell - battery hybrid will reach lower cost than a pure battery EV or a pure fuel cell EV (with very small battery). After full industrialization (2030+) of fuel cell technology to large-scale volumes, AVL expects significantly lower cost of a fuel cell EV (for ranges above 400km).

Key facts

Project start: Feb 1, 2017

Duration: 3 years

Budget: EUR 5.809.285

Partners: AVL List, MAGNA STEYR Engineering, Hoerbiger Ventilwerke, ElringKlinger, TU Graz, TU Vienna, HyCentA & IESTA

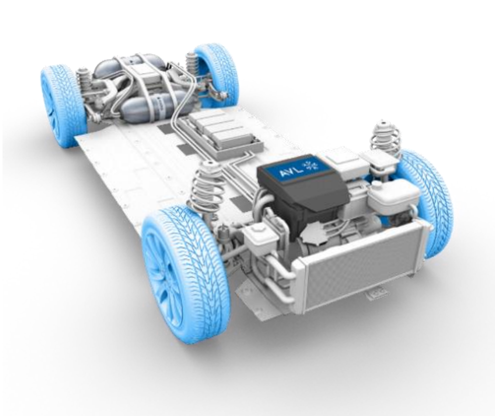
The vehicle should reach the following targets:

- Energy efficiency compared to 2.5 L gasoline (equivalent) per 100 km
- Reduction of powertrain cost by 15%
- Zero CO_2
- Reduction of the fuel cell degradation rate by 50%
- Range above 600 km
- Drivability targets like comparable series type vehicles

Vehicle platform

The VW Passat GTE was chosen as the vehicle platform for all development activities within the flagship project KEYTECH4EV. The pre-existing battery infrastructure (battery pack, battery cooling and plug-in charging incl. corresponding power electronics) will be utilized, whereas all other powertrain components will be replaced by KEYTECH4EV technology to create an innovative electrified powertrain (e-motor, power electronics, fuel cell system, control hardware and software).

Table 1: Vehicle specifications



Vehicle platform	VW Passat GTE
Vehicle curb weight	1746 kg
Vehicle gross weight	2182 kg
Battery size	9.9 kWh
Battery power / weight	85 kW / 125 kg
Fuel cell system power	~60 kW
e-drive power	110 kW
Hydrogen tank capacity	5.3 kg
Hydrogen refilling time	approx. 3 min
Hydrogen consumption	0.85 kg /100 km
Driving range	>600 km (NEDC, 5 kg H_2 incl. battery-only driving range)

Fuel cell system

Table 2: Fuel cell system specifications

Fuel cell stack gross power	70 kW
FC stack power density	5 kW / L
FC stack module weight	<35 kg
FC system net power	~60 kW
FC system efficiency	~48-60%

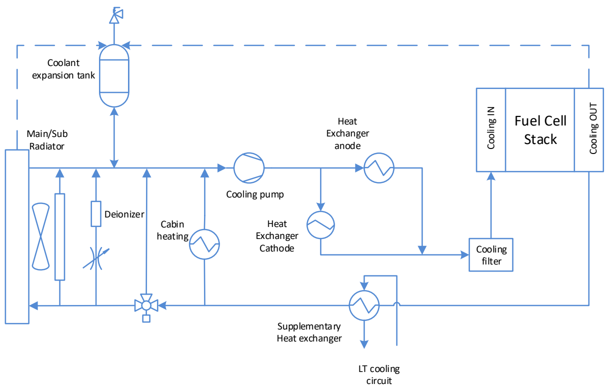
More information

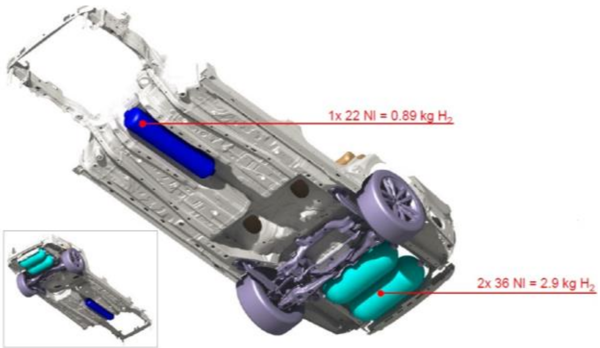
- ElringKlinger NM5 fuel cell stack based on metallic bipolar plates is used with the aim of meeting cost targets, increasing performance and minimizing degradation
- Lifetime tests for more than 8,000 hours showed very low degradation rates of the stack platform
- In parallel ElringKlinger develops an automotive stack platform capable of providing up to 150 kW gross power, which will be available in 2018
- Honeywell will supply the fuel cell air compressor (model from Honda Clarity Fuel Cell) for KEYTECH4EV
- Hoerbiger and HyCentA develop a novel injector/ejector unit to effectively recycle unused hydrogen via a jet pump principle
  The injector, nozzle and ejector are optimized for hydrogen compatibility and are currently evaluated using 3D CFD calculations in order to optimize the flow area. The electric valve driver, which operates the injector, will be integrated into the FCCU to precisely control the hydrogen flow rate in the stack at each operating point.

In order to establish a functional and efficient fuel cell system that is capable to provide maximum power under all environmental conditions, AVL defined the overall fuel cell system and electrified powertrain layout. AVL's comprehensive dynamic fuel cell system simulation with RT- and HiL-capability allows the selection of appropriate components based on operation requirements. Furthermore, AVL started the development of the Fuel Cell Control Unit, including hardware definition, instrumentation and actuator control, development of operating, energy and control strategies as well as the software. Additionally, fuel cell SoH-monitoring using AVL THDA methodology is implemented into the FCCU functionality and the fuel cell DC/DC boost converter.

Thermal management system

AVL and IESTA designed a cooling system based on vehicle specifications, environmental conditions and heat loads for the KEYTECH4EV demonstrator using optimized components and innovative control strategies, which enables to achieve higher performance targets in critical cooling situations compared to conventional design.





Tank system

MAGNA and HyCentA are developing the hydrogen storage system for the KEYTECH4EV demonstrator. Additionally, new key-parts of the hydrogen storage vessel, in particular a plastic liner as hydrogen permeation barrier, an advanced winding process and design of the composite vessel for the center tunnel as well as the boss as connection to the system valve are currently under development. Particular focus of the new vessel design is to reduce the tank system cost by design simplifications, reduced parts count and faster assembly/manufacturing times.

What's next?

- Specification and selection of all fuel cell system components based on dynamic fuel cell simulation
- Fluid dynamic calculation of hydrogen recirculation system
- Final fuel cell system design and packaging studies
- Built-up of fuel cell system for comprehensive testing and calibration
- Definition of pneumatic hydrogen storage system layout and final tank packaging
- Simulation of the heat management system to define fluid dynamics, flow balancing and heat flows
- Material compatibility analysis and material selection of cooling system components
- Implementation of safety concept and measures

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