Magna Steyr

IPHE Industry & Policy Forum

Guido Bartlok
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VISION
ISSUES IDENTIFIED
ACTIONS NECESSARY BY INDUSTRY & GOVERNMENT

VISION

- **Hydrogen**, which is generated with power from renewable energy sources has the potential to mitigate within the **sector coupling** emissions in the sectors mobility, heat generation and chemical industries and considerably to drive highly **innovative vehicles**.

- The FCEV market has a window of opportunity to **establish itself over the next 20-25 years** as a long term mobility solution.

- Without **renewable hydrogen and fuel cell trucks**, the 2030 climate targets for heavy duty vehicles will not be met cost-effectively.

- The lower efficiency of the hydrogen pathway compered to BEV is offset by lower **surplus electricity** costs.

- The **potential for labor market and value creation** in the field of hydrogen is enormous and must be systematically established in the interests of the industry and its employees.

To be the worldwide leading, brand independent engineering and manufacturing partner and provider of innovative solutions for the mobility of the future.

HYDROGEN SYSTEM – MARKET OPPORTUNITIES

Car market: Strong growth of a niche (<1% market share in 2030)

Total cost of ownership of vehicles in this segment is dominated by depreciation.

... the zero-emission solution suitable for everyday use, high driving resistance and high daily range demand

Quote BMW

Commercial vehicles & busses: OEMs & cities signal interest

Zero emission **urban passenger transportation** & **cargo transport**

communities, and cities driving demand

Most active OEM: Hyundai, Nikola, Daimler, Toyota, MAN, Scania

Non-automotive business: Promising additional opportunity

Wide product range possible from stationary FCs, ships, (auxiliary-) power for planes, haulers, material handlers,

Players: Linde, Liebherr, Plug-Power, Walmart[2]…

Key advantage vs. passenger car market: centralized H_2 infrastructure possible

In addition to car market opportunities for diversification with commercial vehicles & busses as well as with non-automotive applications.

MAGNA'S FCREEV

What was achieved?

Vehicle Targets

- Zero emission ✓
- Long driving range ✓
- Fast refueling time ✓
- All wheel drive ✓

PROJECT PARTNERS:

PM PROTON MOTOR Fuel Cells · Power Systems
TU WIEN TECHNISCHE UNIVERSITÄT WIEN
HyCentA
bmvit
FFG

FCEVs combine long range, fast refill and accessibility to zero-emission zones.

Ability to access zero-emission zones will become a key feature for usability of powertrains.

FCREEV POWERTRAIN – VISUAL BOM

Electric Drivetrain
E-Motor
Inverter
Gearbox
Drive shafts

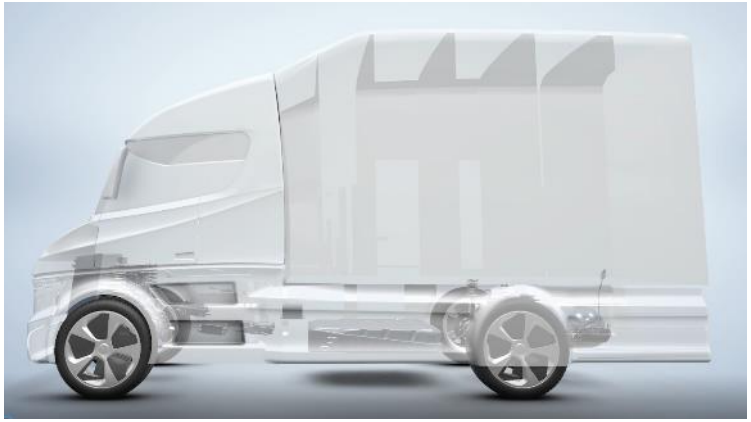
HV System
HV Battery
DC/DC Converter
Charger
HVDU
HV-Heater
HV-Climate Compressor
HV Wiring

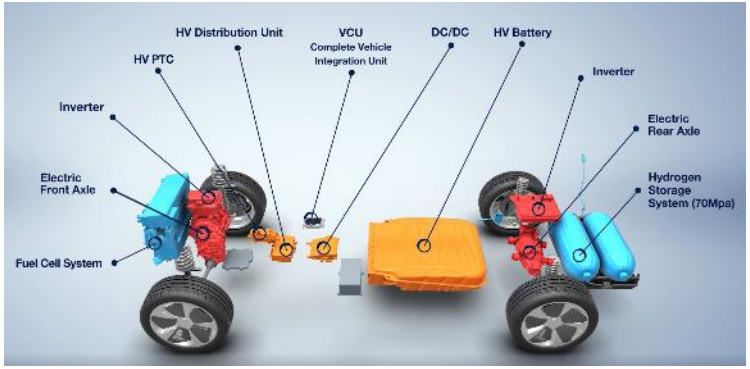
Miscellaneous
VCU – Vehicle Control Unit
HMI (Human Machine Interface)
…

Fuel Cell System
Fuel Cell Stack (60-150KW, OEM in-house)
DC/DC Converter
Air Compressor (5 – 30 KW)
Recirculating Pump
Water separator, humidifier
Sensors, diagnostics
Valves, piping, water pump, cooler
Water- Deionizer
FCCU - Fuel Cell Control Unit

Hydrogen Storage System
Type IV high pressure vessels
Lightweight aluminum frame
Piping
On-tank valves incl. TPRD & sensor
Pressure regulator unit
Filling receptacle incl. IR interface
HSCU-Hydrogen Storage Control Unit

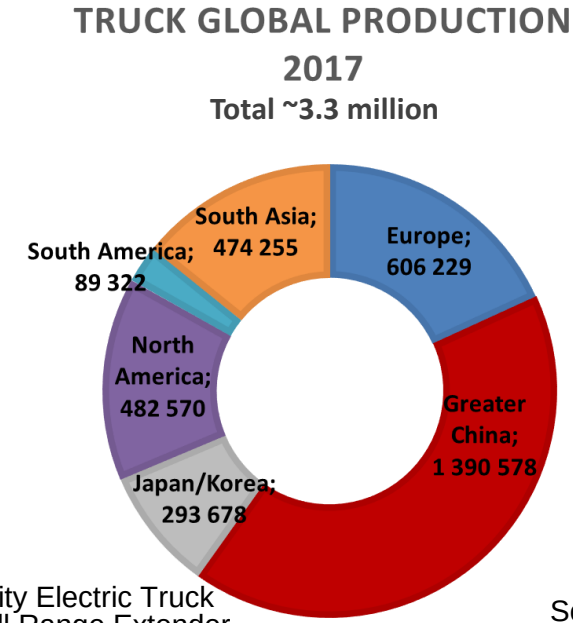
Magna Business



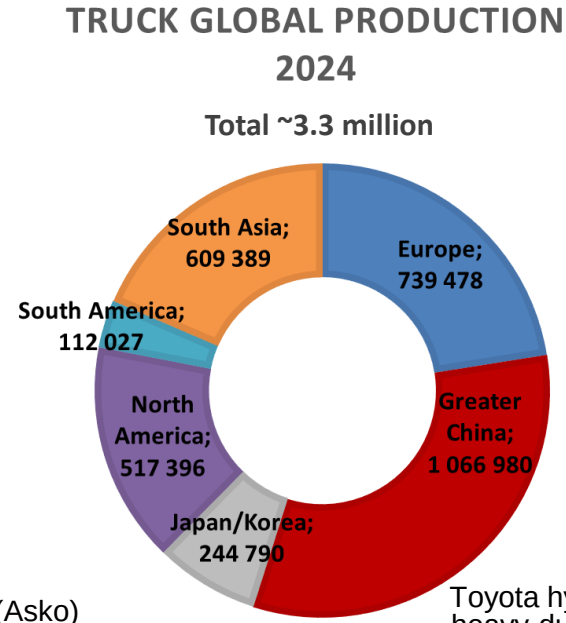


GLOBAL TRUCK PRODUCTION FORECAST (all propulsions)

MAGNA



Source: IHS October 2018



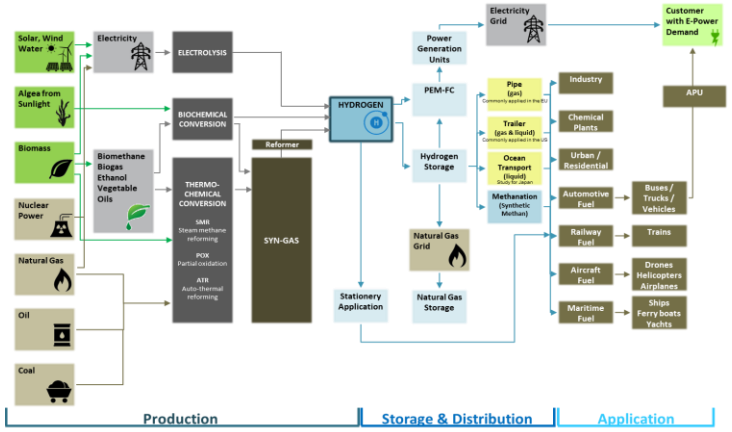
Renault Maxity Electric Truck with Fuel Cell Range Extender

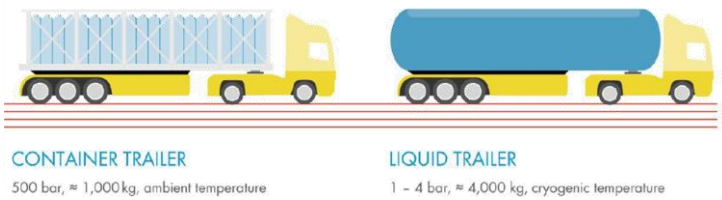
Scania Fuel Cell Truck (Asko)

Toyota hydrogen Fuel Cell heavy-duty Truck Concept

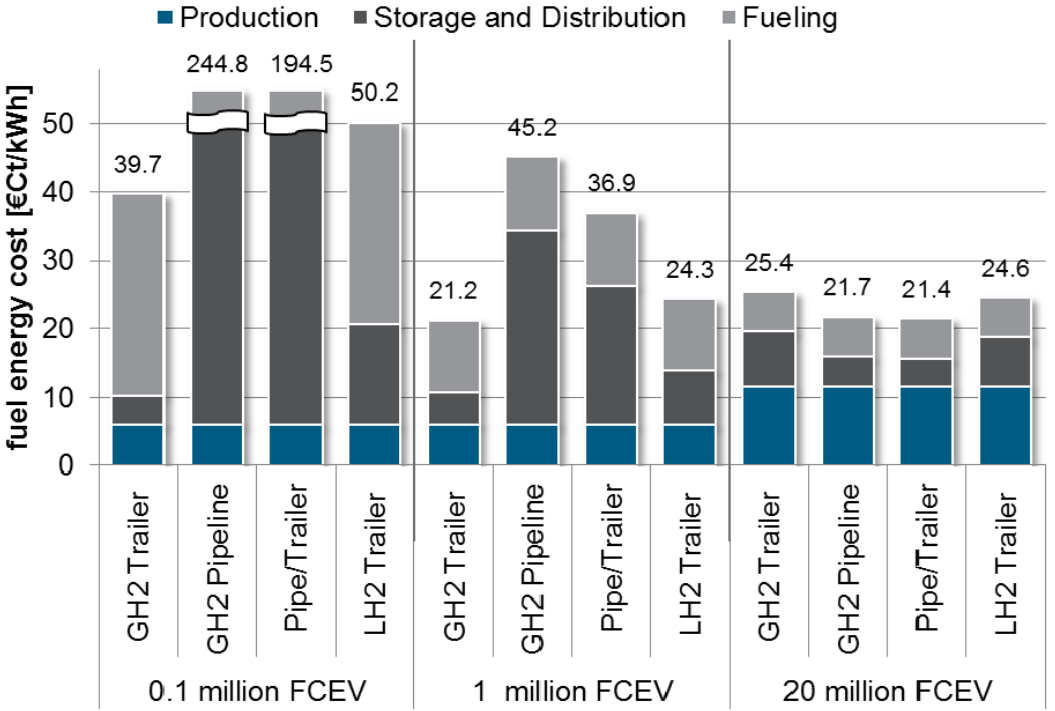
TCO of HD trucks is and will be dominated by fuel cost.

SUPPLY CHAIN OF HYDROGEN





Example for Germany



Source: SHELL international

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TODAY’S FILLING STATION AT URBAN AREA

High frequented filling stations on highway and urban areas.

- Multiple fuel dispensers continuous **parallel operation**.
- **~4 min average filling** duration for gasoline or diesel.

There will certainly be no less traffic in the future.

COMPARISON HIGH POWER CHARGING VS H2 REFUELING

BEV @ 400 V

max. 150 kW @ 400 V

~40 min recharging time
for 100 kWh battery

BEV @ 800 V

max. 300 kW @ 800 V

~20 min recharging time
for 100 kWh battery

H_2 @ 70 MPa

~5 min refueling time
for 6 kg H_2 *

Source: MAGNA STEYR R&D

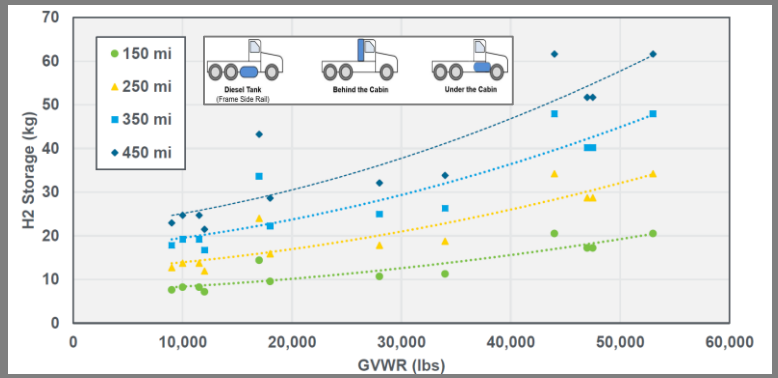
* ~100 kWh usable (free heating)

For charging of a Kia Soul **EV** with 22kWh à 0.80€/kWh and **2 vehicles per hour** the owner of the charging station has a **turnover of 35.20€ per hour** per charging column. **FCEV:** At an average refueling volume of 4.5kg hydrogen and a price of 9.50€ per kg, the theoretical **turnover is 256.50€ per hour.**

Consider the business of a station owner!

MEDIUM & HEAVY DUTY FC ELECTRIC TRUCKS

Estimated amount of hydrogen storage needed to achieve a desired range for each representative truck, plotted as gross vehicle weight rating (GVWR)



Source JEECS-16-1096; Kasr

Source: Toyota

Source: COOP

Source: MAGNA

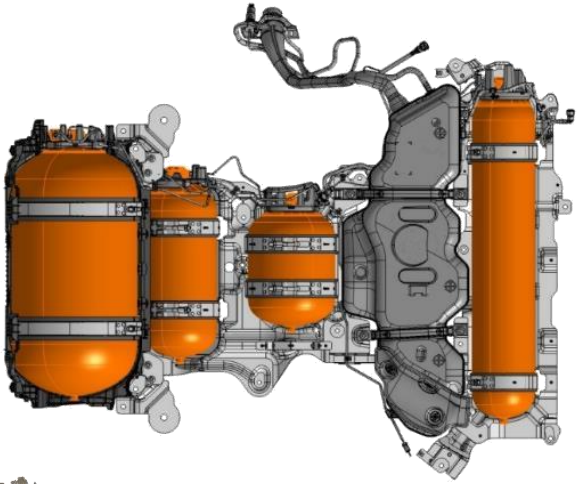
Moreover, in contrast to modern high-pressure vessels, cryogenic liquid hydrogen storage tanks do not require expensive and energy-intensive carbon fibers.

SCOPE OF DEVELOPMENT AND DELIVERY

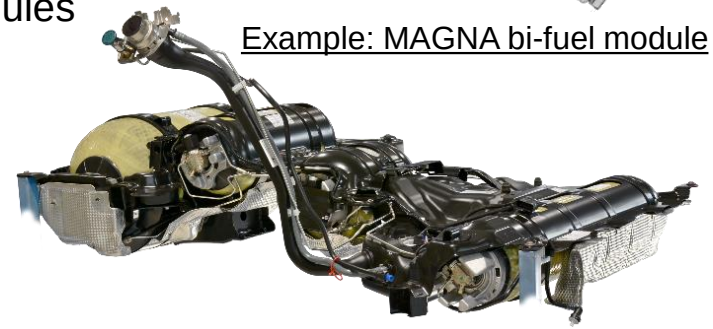
- **System development**, qualification, validation & certification

- Functional and geometric **integration** of systems

- Quality assured supply of **fully assembled** fuel storage modules
  - Vessels and valves
  - Fueling Nozzle
  - Electrical lines & pressure pipes
  - Crash & heat protection elements
  - Module frame supporting complete vehicle performance (crash, durability, NVH)



Example: MAGNA bi-fuel module



OEM's prefer supply of complete storage modules ready for plug and play.

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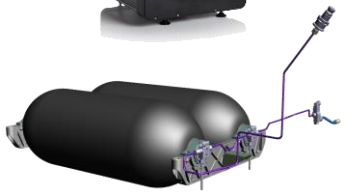
ACTIONS NECESSARY BY INDUSTRY

- Development and demonstration of **key technologies** for **low-cost electric vehicle** platforms
  - Increasing the **energy efficiency** (Optimize FC powertrain & operating strategy, Optimize FC stack & energy management)
  - Increase **durability** of Fuel Cell
  - Reduce **costs for onboard Hydrogen storage**



- Development of zero emission **mobile charging stations** with the purpose of charging E-Vehicle`s in the field → Mobile Hydrogen Powerbank

- Development and demonstration of suitable Hydrogen **refueling stations for** large hubs of **HD-Trucks**

- Powertrain technologies like BEV & FCEV require an **adaption of the production** concept.

It needs more innovation and technological progress in shaping the energy transition.

ACTIONS NECESSARY BY GOVERNMENT

- To meet the emission goals, **rollout plans** must coordinate the deployment of FCVs and hydrogen infrastructure, geographically and over time.

- MAGNA holds a continuation of the FCH JU would be useful, since it is necessary as a system supplier to **rely on competent suppliers**.
  By the way business and science merge internationally and to minimize by funding the development risks, the **FCH JU is an ideal platform**.

- **Training** of specialists **for this new industry** is needed. The **promotion** of universities and scientific institutions in this context is also in the interest of MAGNA in the project implementation.

- **Global harmonization** of technical codes, regulations and standards.

DRIVING **EXCELLENCE.**
INSPIRING **INNOVATION.**

