

e-Forum Ενέργειας 2020
14 Ιουλίου 2020

Το υδρογόνο ως ενεργειακός φορέας

ΘΑΝΟΣ ΣΤΟΥΜΠΟΣ – ΜΑΝΟΣ ΣΤΑΜΑΤΑΚΗΣ
ΕΚΕΦΕ «ΔΗΜΟΚΡΙΤΟΣ»



DEMOKRITOS



Hydrogen as Energy Carrier I

- Storage of Renewable Energy (solar, wind...) in the Form of Hydrogen via Electrolysis
- Use of Hydrogen in NG grids and Industry
- Re-electrification of Hydrogen for Stationary and Mobile (Transport) Applications via the Use of Fuel Cells...



Hydrogen as Energy Carrier II

- The technology (Hydrogen & Fuel Cells) exists (production, storage, safety, use in stationary applications and vehicles (FCEVs, buses, trucks, trains...))
- The issue of infrastructures remains open...



Hydrogen Fueling and Electric Charging of Vehicles in Germany

2018, JULY, 12TH | JOCHEN LINSEN, MARTIN ROBINIUS, THOMAS GRUBE,
MARKUS REUSS, PETER STENZEL, KONSTANTINOS
SYRNANIDIS, DETLEF STOLTEN

6th Hellenic Forum for Science Technology and Innovation, Athens Greece

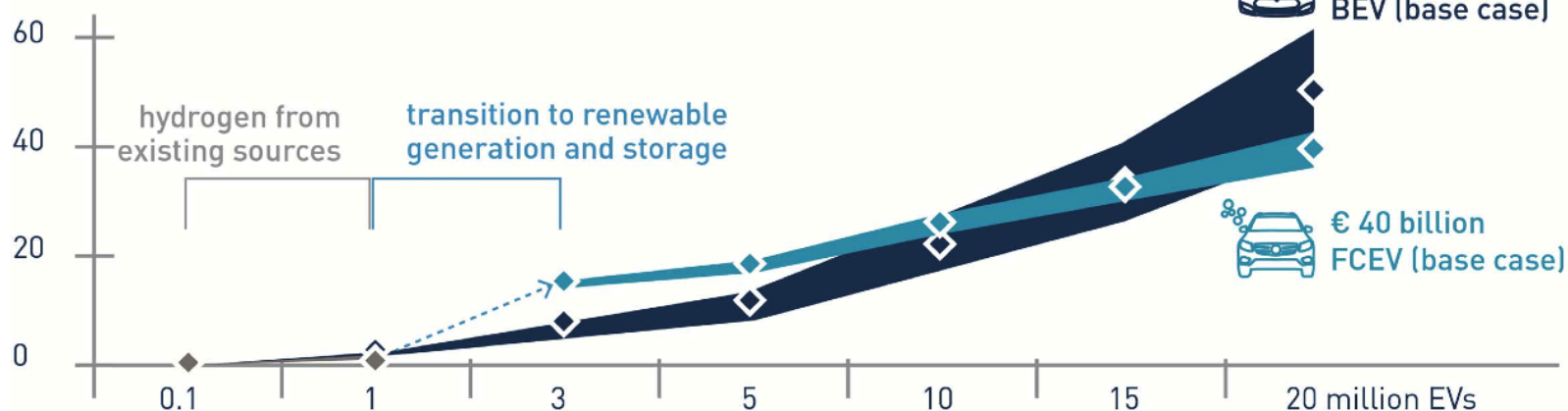
j.linszen@fz-juelich.de

Institute of Electrochemical Process Engineering (IEK-3)

Cumulative Investment

Infrastructure Roll-Out

cumulative investment [€ billion]



€ 51 billion
BEV (base case)

€ 40 billion
FCEV (base case)

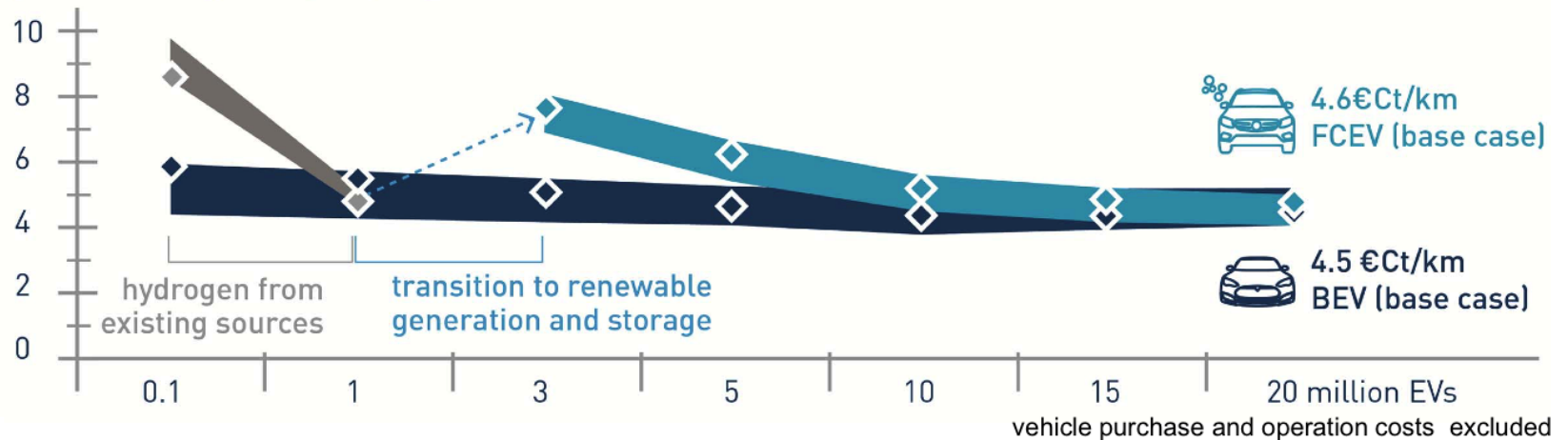
- Hydrogen more expensive during the transition period to renewable electricity-based generation
- High market penetration: battery charging needs more investment than hydrogen fueling
- For both infrastructures investment low compared to other infrastructures



Investment [€ billion]	
Renewable electricity generation scenario	374
Electric grid enhancement plan 2030	34
Federal transport infrastructure plan 2030	265
Hydrogen fueling infrastructure	40
Electric charging infrastructure	51

Comparison of Mobility Costs

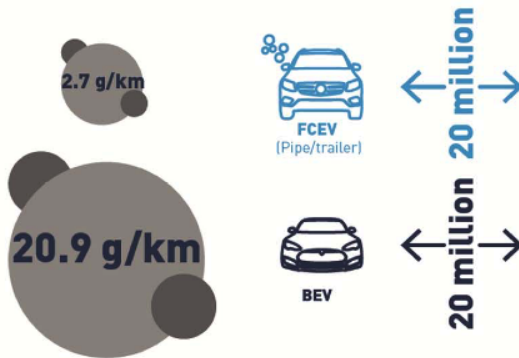
specific mobility costs [€Ct/km]



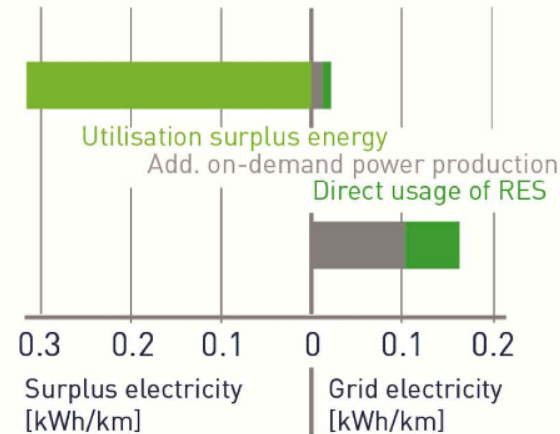
- For small vehicle fleets, i.e. 0.1 million cars, BEV fuel costs are significantly lower compared to FCEVs.
- Increase for hydrogen between 1 and 3 million cars results of switching to exclusive utilization of renewable energy for hydrogen production via electrolysis
- Mobility costs per kilometer are roughly same in the high market penetration scenario at 4.5 €Ct/km for electric charging and 4.6 €Ct/km → the lower efficiency of the hydrogen pathway is offset by lower surplus electricity costs.

CO₂ Emissions & Electricity Demand

CO₂ emission per km



Specific electricity demand



- Efficiency of charging infrastructure is higher, but limited in flexibility and use of surplus electricity
- Fueling infrastructure for hydrogen with inherent seasonal storage option
- Low specific CO₂ emissions for both options in high penetration scenarios with advantage for hydrogen, well below the EU emission target after 2020: 95 g_{CO₂}/km

Full Report Available

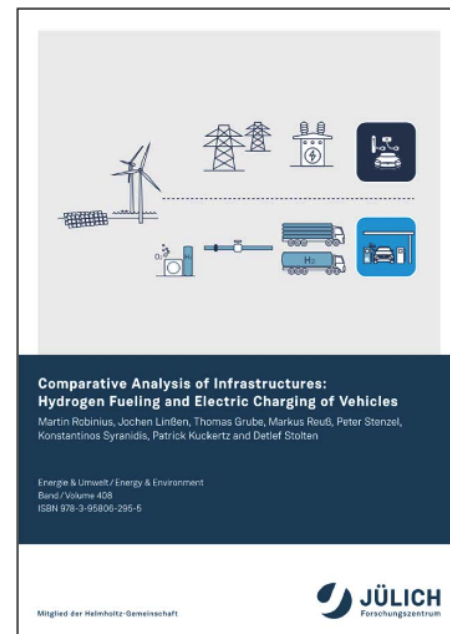


<http://hdl.handle.net/2128/16709>

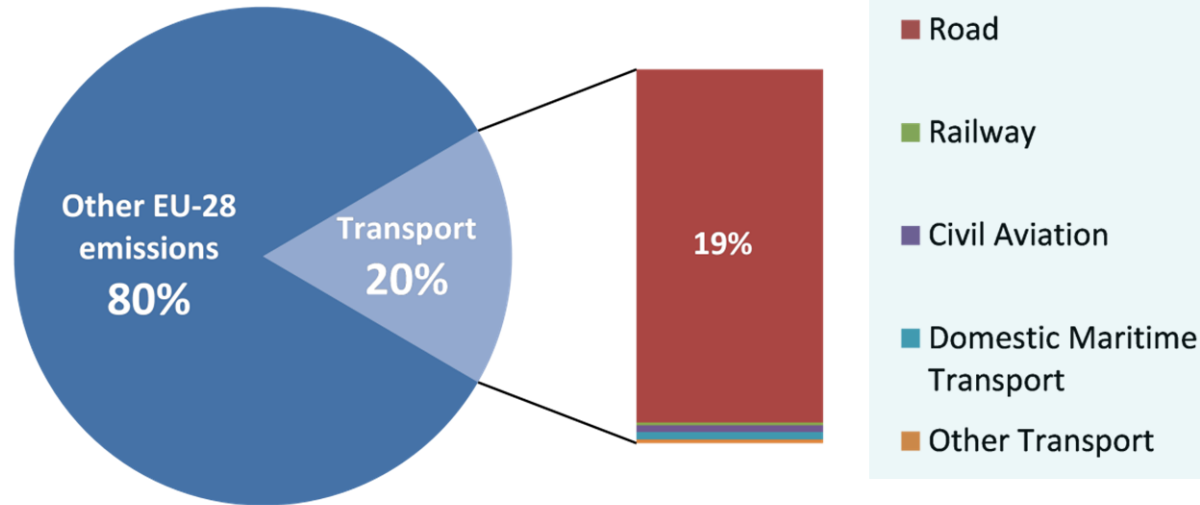
Project team:

Martin Robinius, Jochen Linßen, Thomas Grube, Markus Reuß, Peter Stenzel, Konstantinos Syranidis, Patrick Kuckertz and Detlef Stolten

Funded by



NEED FOR NEW INFRASTRUCTURES

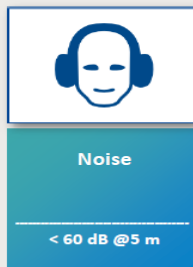
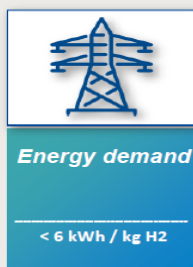


Compression solutions for HRS

Performance and reliability

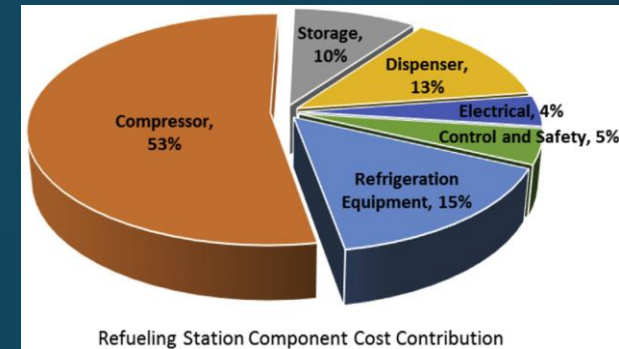
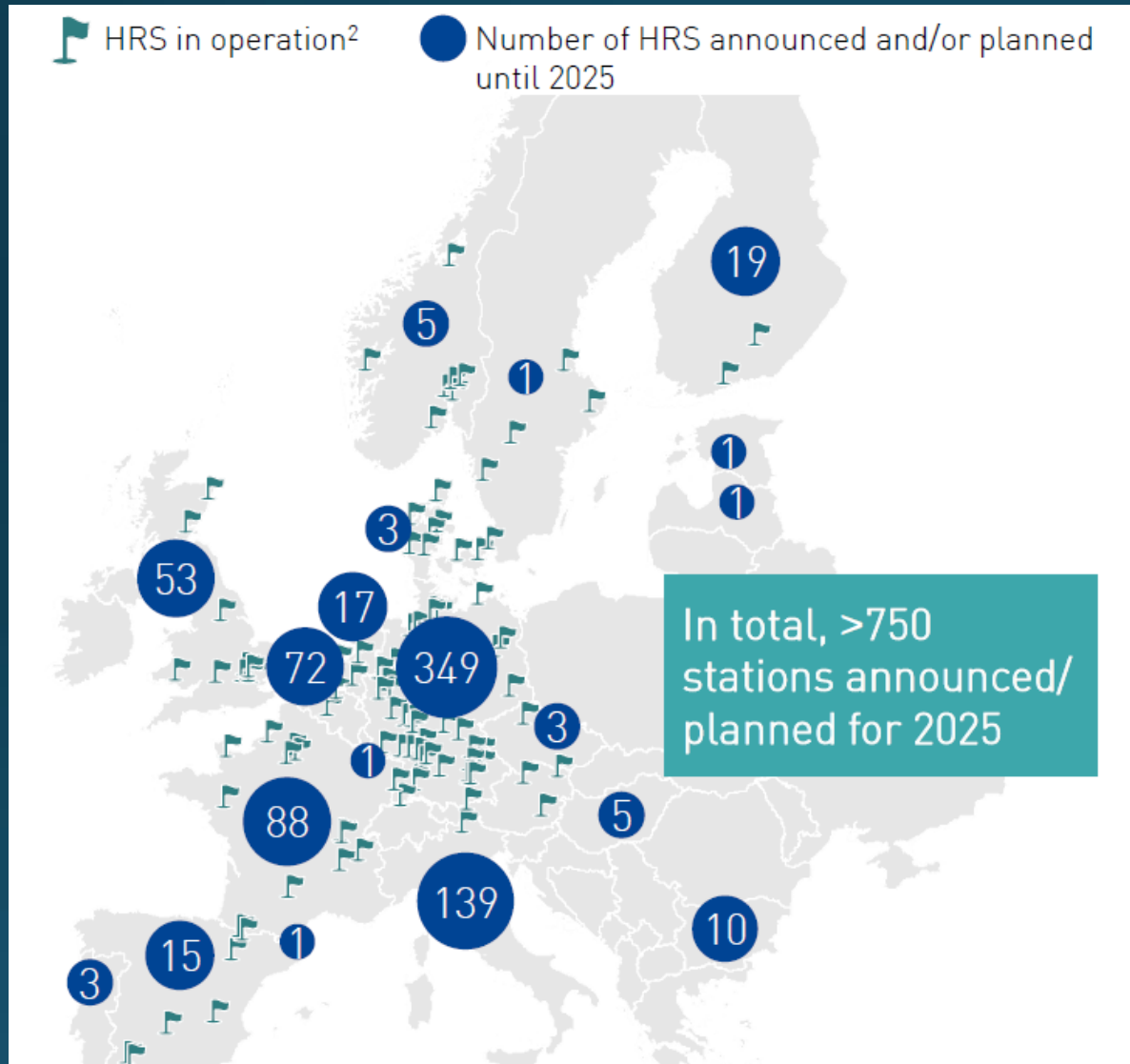


Goals



Need of compression

The market

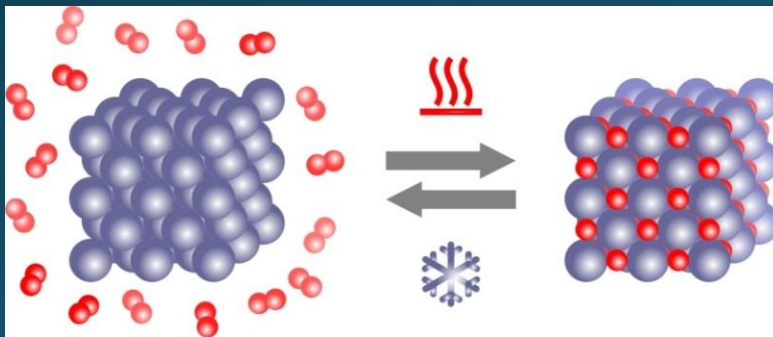


The envisaged main market for the MHC is the one of Hydrogen Refuelling Station (HRS):

The size of the Total Addressable Market in Europe for HRS and Hydrogen Vehicles has been assessed by the European Commission in the COM (2017) 652 final document

A NEW TECHNOLOGY FOR H₂ COMPRESSION

A noise free hydrogen compression system based on metal hydrides using only water as the cooling / heating medium achieving hydrogen pressures > 350 bar



Metal hydrides basic principle

UNIQUE ADVANTAGES



ZERO NOISE LEVELS

ability to install Hydrogen Refueling Stations (HRS) in residential areas



VERY LOW O&M COSTS

use only cheap, low-grade thermal energy; do not include mechanical parts



LOW ENVIRONMENTAL IMPACT

no use of Critical Raw Materials; can be driven only by RES or/and Waste Heat



MODULARITY, AVAILABILITY & RELIABILITY

modular product with high availability and reliability



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