



HOCHSCHULE  
RAVENSBURG-WEINGARTEN  
UNIVERSITY  
OF APPLIED SCIENCES

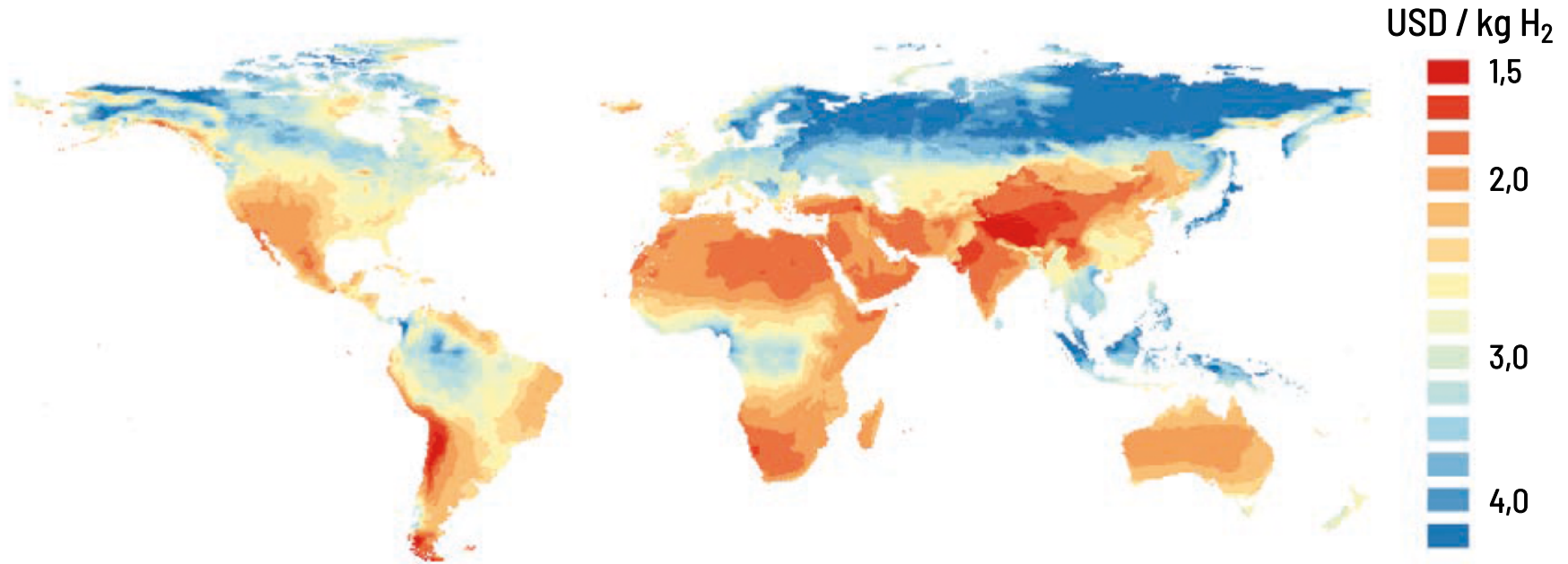
# HYDROGEN IN TRANSPORTATION

WMF NANCY 18.06.2022

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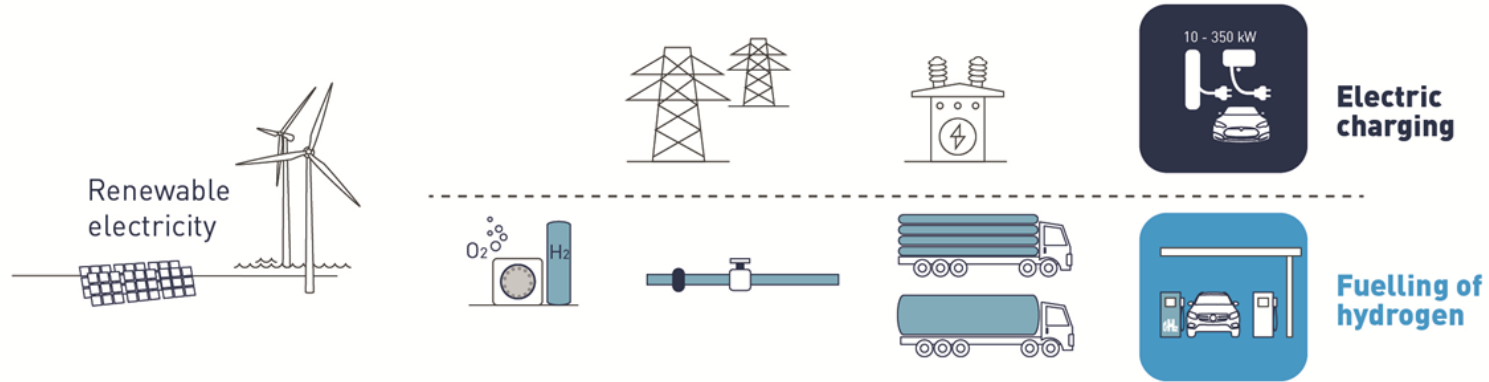


## low-cost green electricity → H<sub>2</sub> – generation (depending on location)



Source: IEA analysis based on wind data from Rife et al. (2014), NCAR Global Climate Four-Dimensional Data Assimilation (CFDDA) Hourly 40 km Reanalysis and solar data from renewables.ninja (2019).

# Germany: infrastructure set-ups

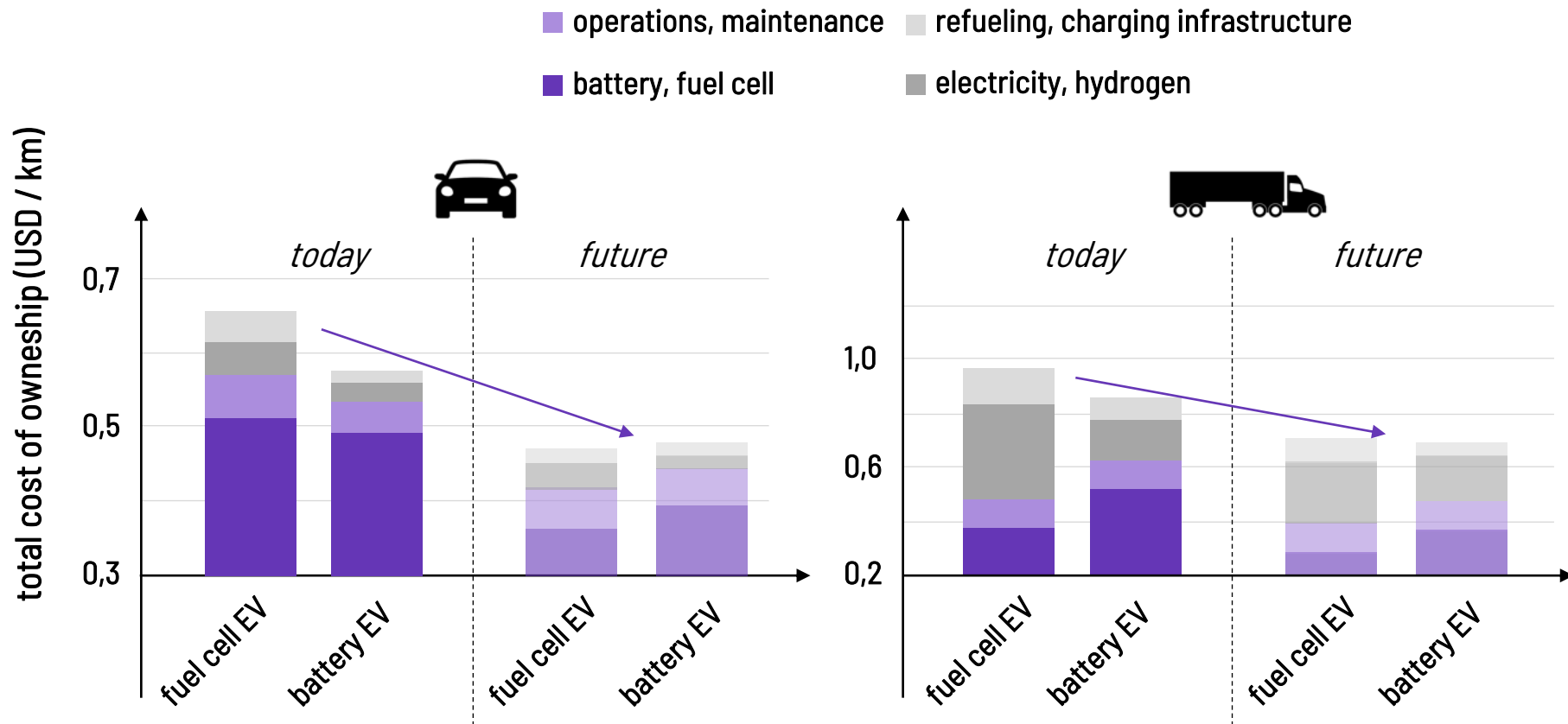


## investments in infrastructure for 20 mio vehicles



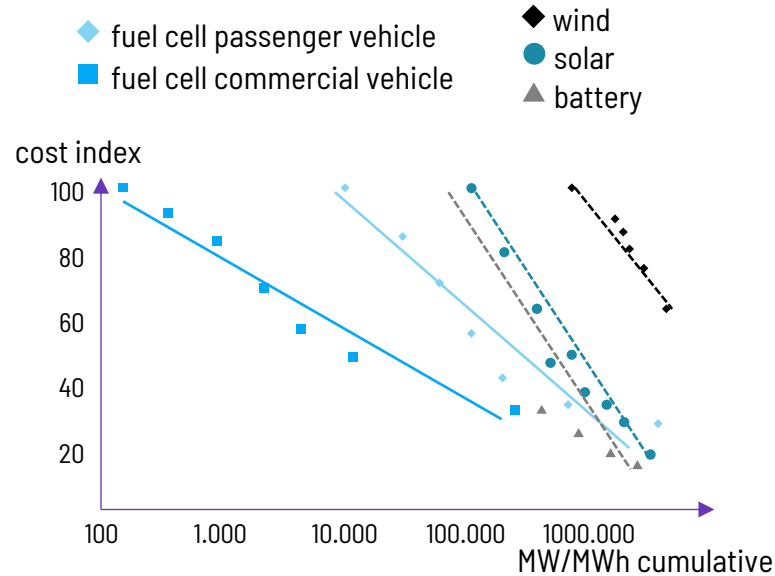
source: „Comparative Analysis of Infrastructures: Hydrogen Fueling and Electric Charging of Vehicles”, Robinius et al

# total cost of vehicle ownership



source: iea.org/hydrogen2019

# industrialization of fuel cell production → reduced costs

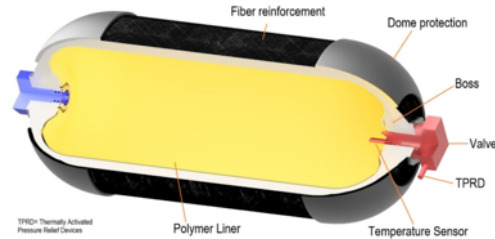


source: [Hydrogencouncil](https://hydrogencouncil.com)

- reduced costs through industrialization
- better performance through improved assembly technology und QA

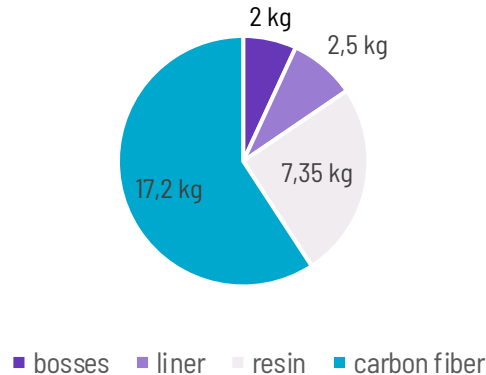
# pressure vessels: material content and low-cost carbon fiber

1,5 kg H<sub>2</sub> @700 bar / 33 l / 30 kg

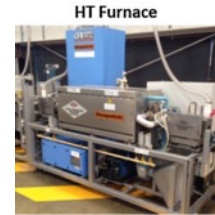


source: ecs-composite

Pressure Vessel 700 bar @ 30 kg



Creel

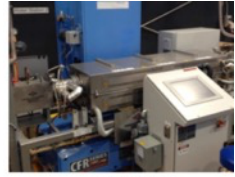


HT Furnace



Oxidation Ovens

Surface Treatment, Sizing



LT Furnace



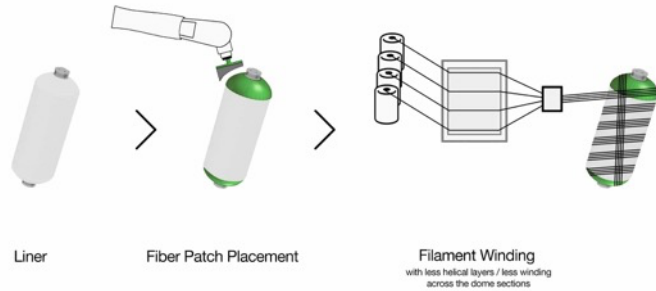
Winding

source: Carbon Nexus

cost reduction of carbon fibers:

- digitalisation of equipment (sensors and actuators)
- adjustable manufacturing parameters
- optimized heating
- new precursors

# pressure vessel: improved design and large volume production



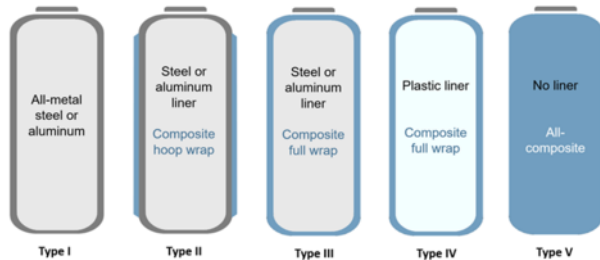
source: Cevotec

optimized fiber alignment



source: Roth

Upscaling of manufacturing



source: CW

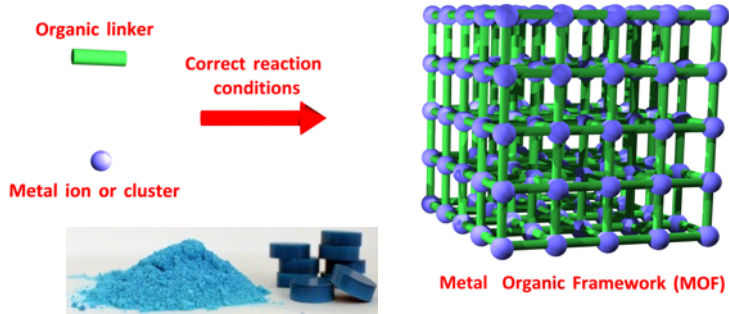
removal of the liner



source: ITA

Multi-Filament-Wound Pressure Vessel  
180 rovings simultaneously

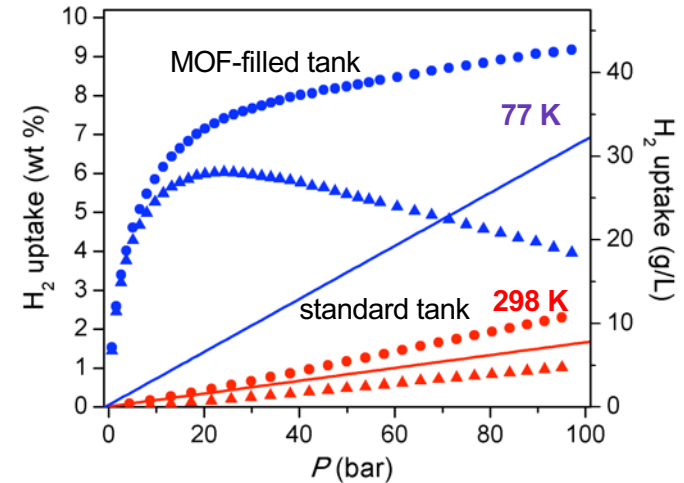
# new materials: metal organic frameworks



H<sub>2</sub> can stick on MOF surfaces, lowering operating pressure, increasing capacity.



The lower pressures could enable non-cylindrical tanks and simpler safety systems.





## conclusions

- fuel cell vehicles exploit cost cutting potentials of BEV components
- industrialisation of fuel cell and H<sub>2</sub> tanks towards large volume production necessary
- PGM-reduced or -free fuel cell
- optimized design for components, e.g. composite tanks
- research in new material solutions:
  - materials offering improved properties
  - materials with low carbon footprint
  - materials for circular economy



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THANK YOU  
FOR  
YOUR ATTENTION

