



AMBARTEC
HyCS-TECHNOLOGY



**Energie und
Wasserstoff speichern
kompakt,
effizient, nachhaltig**

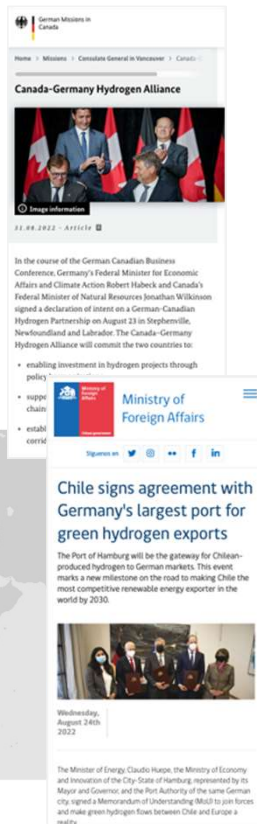
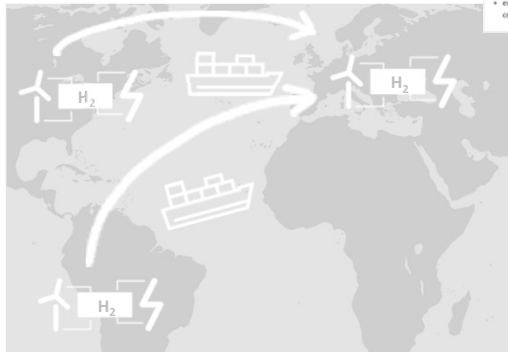
Energy Summit Freiberg
22.06.2023



How Does Green H₂ Get to Europe?

Europe needs H₂ import

Europe strives for CO₂ neutrality. Only 1/3 of the Green H₂ required in the future can be produced inside the EU.



Today's solutions are not satisfying

Liquid H₂ (LH₂)

- Low efficiency (cooling to -253°C, boil-off-losses)
- High investment costs for new infrastructure

Ammonia

- Low efficiency
- Difficult to get pure H₂ again
- Difficult to handle, poisonous

LOHC

- High energy demand for offloading/H₂-separation
- Environmentally hazardous

Our vision

We make **H₂-transport simple, cost-effective and safe** by using existing container transport infrastructure.

We **reduce** the consumption of clean **water for electrolysis** in sunny arid countries **by 90 %**.



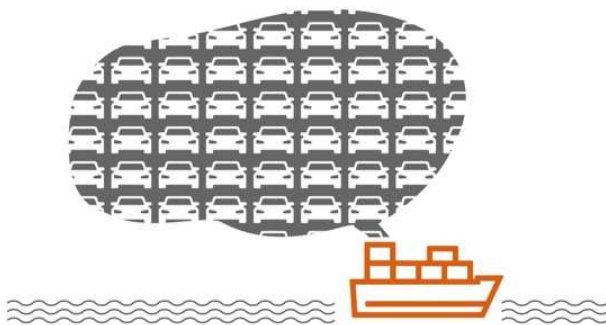


How to Get Ships CO₂-Neutral?

The maritime sector is one of the major CO₂-emitters

- Worldwide shipping causes as many CO₂ emissions as the whole of Germany.
- Heavy fuel oil: massive air pollution

An average **cruise ship** emits as much **CO₂** per day as almost **84,000 cars**.



Potential alternatives are not satisfying

Liquefied natural gas (LNG)

- Improves air quality, but low impact on climate gas reduction

Ammonia

- High energy demand for production
- Poisonous and difficult to handle

Green Methanol

- High energy demand for production
- Low energy density per kg

Pressurized H₂

- Space consuming
- Certification challenging

Our vision

- **Sustainable fuel solutions for ships** with AMBARtec's HyCS®-Technology together with maritime partner Liberty Pier.
- We make **maritime green energy** supply simple and safe.

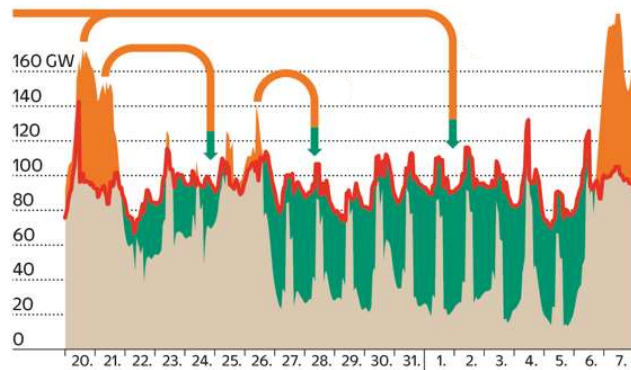




No Sun – No Wind. Where Does the Energy Come From?

Renewables are not always available

How can we store power surpluses from wind and sun to compensate the dark lull?



Source: Energy Brainpool

Potential alternatives are not satisfying

Electric battery

- Low energy density
- material constraints (e.g. rare-earth elements)

Pressurized H₂

- Space consuming
- Hazardous (permitting challenge)

H₂ caverns

- Only few available
- Require H₂ grid connection for users and producers

Our vision

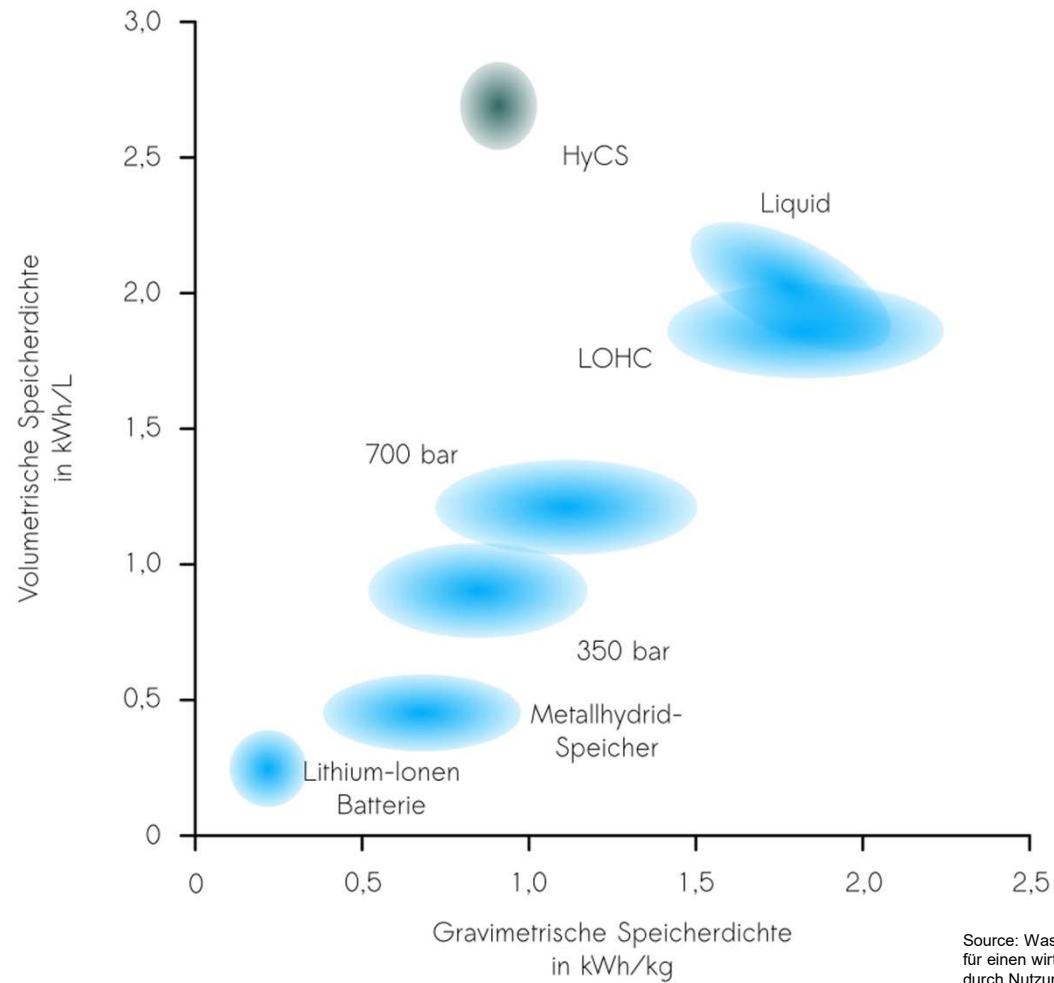
- We make mid- to long-term **energy storage cost efficient and safe.**
- We support local energy storage by **transportable units.**



Energy Density

Volumetric energy density

- 10x higher than in electric batteries
- 2 ... 3 x higher than in other H₂ storage systems



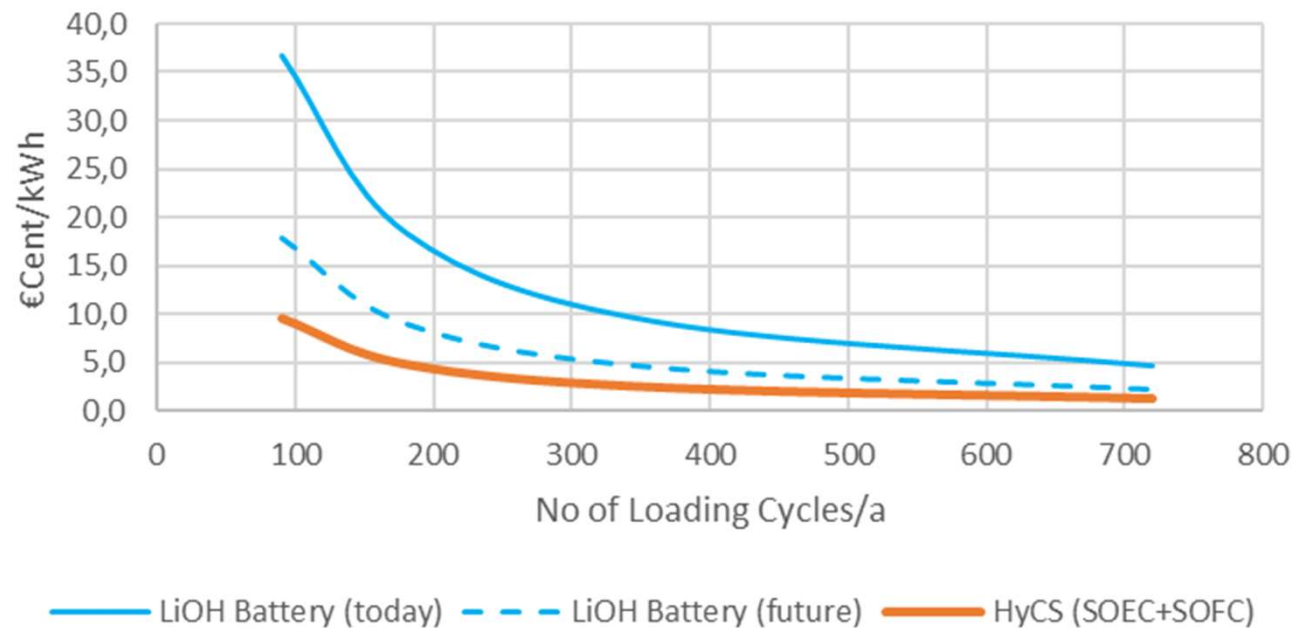
Source: Wasserscheid, P. et al.: Neue Option für einen wirtschaftlichen Betrieb von Wasserstoffzügen durch Nutzung der LOHC-Technologie? – Abschlussbericht zum kleinen Forschungsprojekt (Zuwendungsbescheid Nr. 07 05 / 89375 / 130 / 2017 vom 2.3.2017); HyCS®: AMBARtec



Cost of Power Storage lowered by HyCS[®]

Dependency on
number of loading cycles

Total Cost of Power Storage
Storage Capacity: 10 MWh, Discharging Power: 500 kW



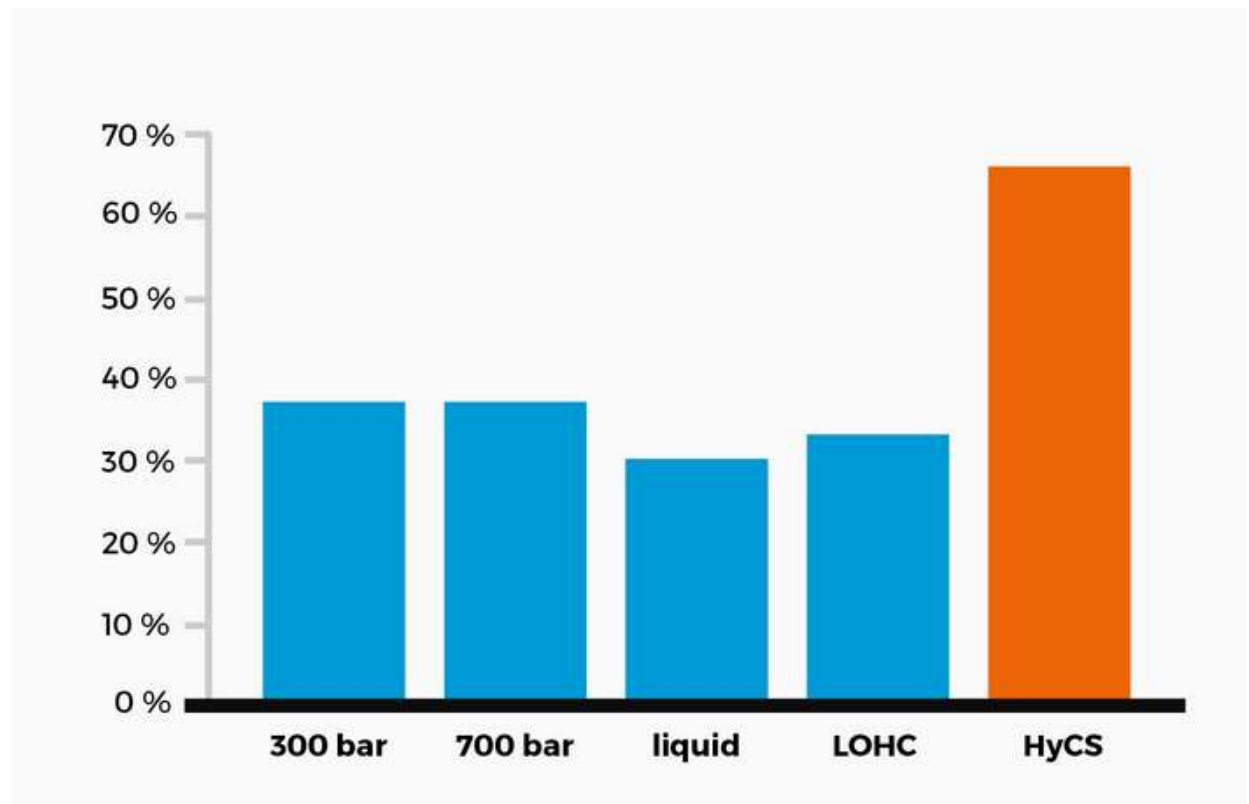


Power – Power Efficiency of H₂-Systems

Electrolizer – Storage – Re-Electrification

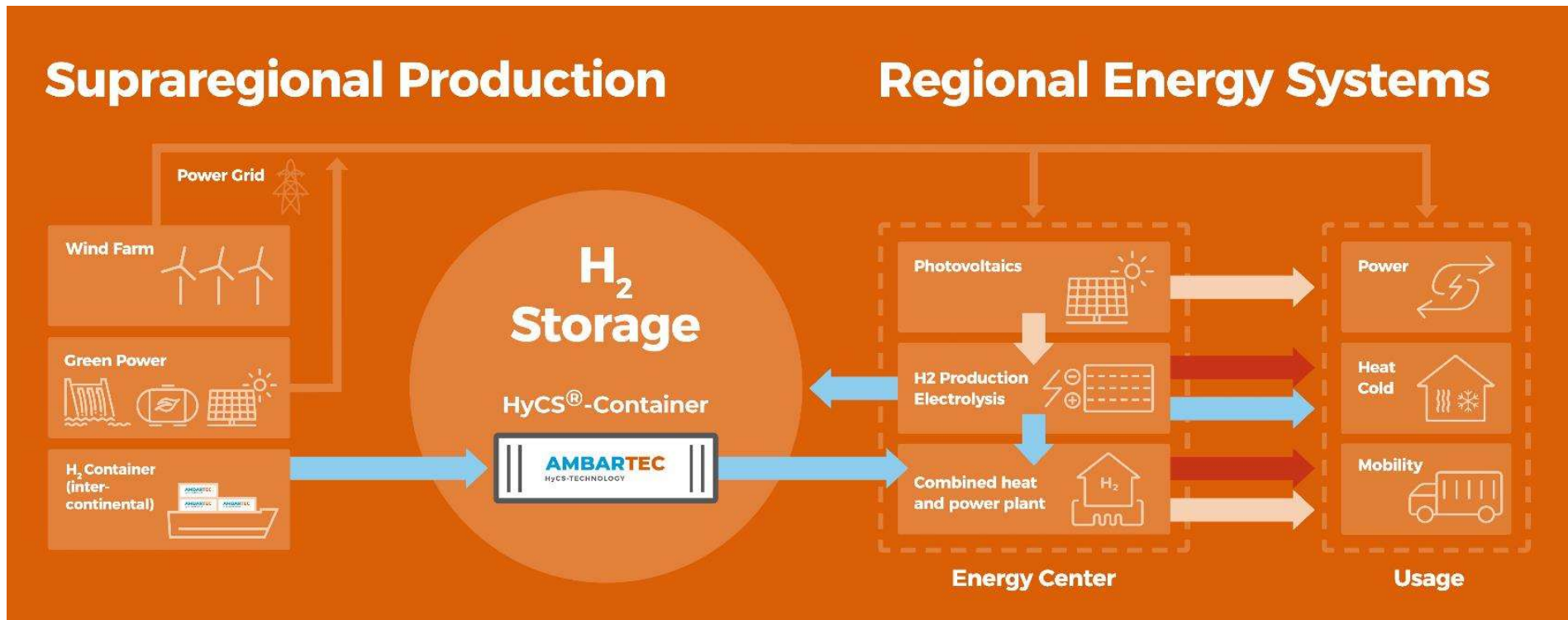
HyCS®-Potential for the highest Power to Power efficiency

Precondition:
Lifting synergies of the whole process chain





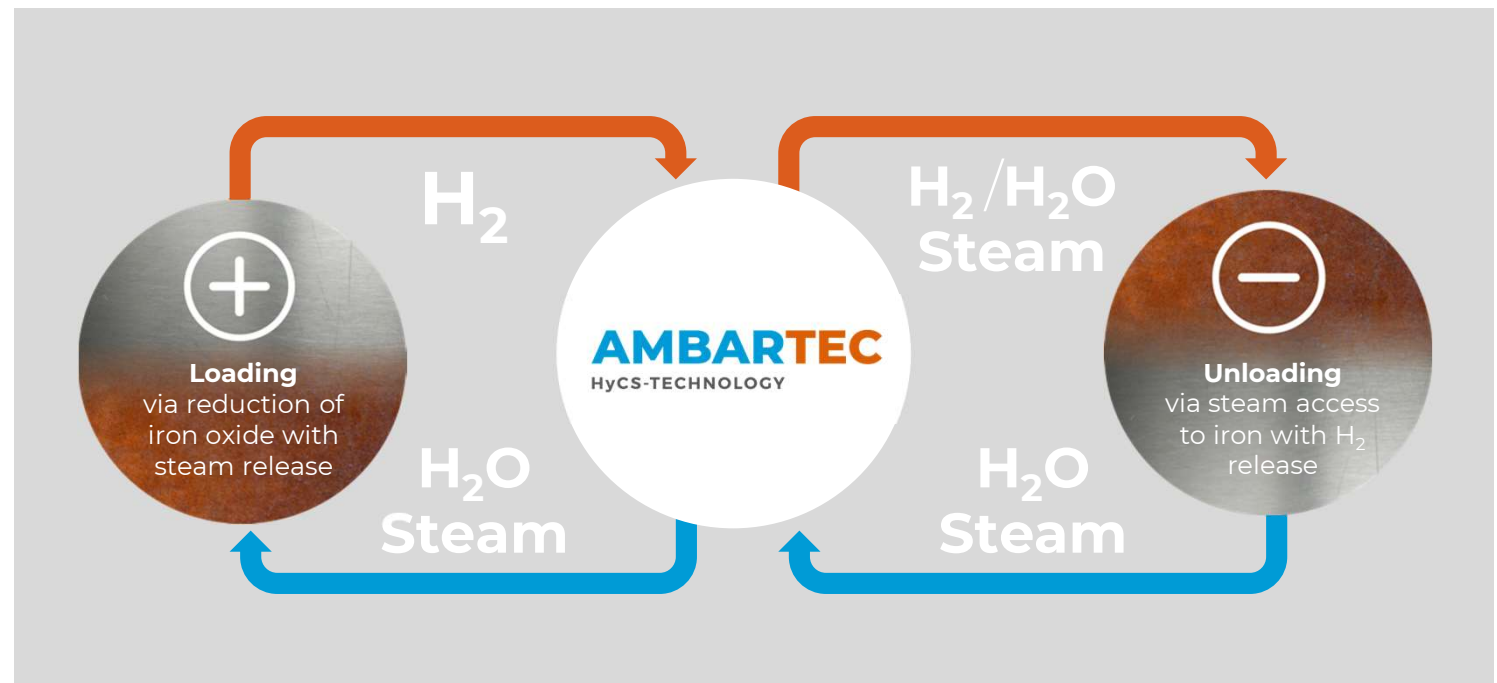
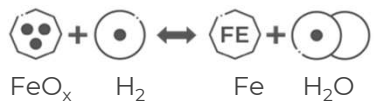
HyCS[®] in Remote Energy Systems



Iron Reduction and Oxidation in a Container

Hydrogen Compact Storage Technology

Our innovative HyCS[®]-Technology is based on a well known reverse chemical process.



Fe-Storage Elements



Benefits



Our HyCS[®]-Technology is ...

Compact

- Up to **900 kg of H₂ in a 20-foot container** – **2 to 4 times more** than other systems
- Use of existing infrastructure (ship, rail, road)

Efficient

- **50 % less electricity** and **90 % less water** in combination with H₂ electrolysis
- Charge / discharge in 30 mins
- **No cooling required**, no H₂ evaporation

Sustainable

- Iron as storage medium is widely available
- **Non-hazardous** – easy permitting
- Long lifetime (no degeneration)

Lowest total
cost of
ownership



Company

AMBARTEC
HYCS-TECHNOLOGY

Team and Pilot Facility



HyCS[®]-Products: Storage Units

H₂compact 100

Storage Capacity: 250 kWh/7,5kg H₂

H₂compact 1000

Storage Capacity : 3 MWh/90 kg H₂

Available in 10/23

H₂compact 6000 – 20' Container

Storage Capacity : 20 MWh/600 kg H₂,
up to 10 bar, weight: <18 t

Available in 06/24

H₂compact 6000 Plus – 20' Container

Storage Capacity: 30 MWh/up to 900 kg H₂,
up to 100 bar, weight: 32 t

Available in 09/24

Large Scale Units on request



Customer Acquisition

Wide range of marketing activities:

- Own booth and keynote speeches on relevant international fairs and exhibitions
- Member in international networks
- Press releases and Articles in trade journals
- Social Media and Website activities

Our Partners:



Projects





Be Part of Our Success.

**Thank you for
your attention.**

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