



**HIGH PRESSURE HYDROGEN VALUE CHAIN**

# **HYGHER THROUGH ENERGY EFFICIENCY AND CIRCULARITY**

**UNIVERSITY OF LJUBLJANA, 15.04.2026, ONLINE**



**Clean Hydrogen  
Partnership**



**Co-funded by  
the European Union**

The project is supported by the Clean Hydrogen Partnership and its members.

- ***About HYGHER project***
- ***Energy efficiency in HYGHER***
- ***Circularity in HYGHER***

HYGHER project aims to demonstrate the feasibility of an **innovative, cost-efficient, safe and reliable high-pressure hydrogen value chain** for large scale deployment.

Its ultimate goals are:

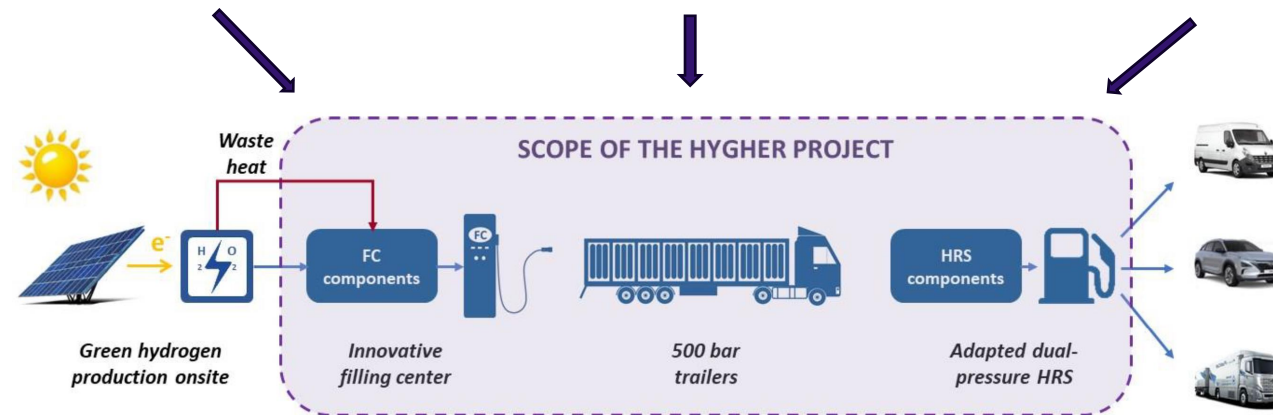
- Transition to clean energy sources for hydrogen compression and distribution
- Increase of energy efficiency and reduction of environmental impacts while following strict safety requirements

## The improvements are achieved through

### Advanced hydrogen compression

### High-capacity tube trailers

### Comprehensive value chain integration



# SUSTAINABILITY - TWO VIEWS ONE GOAL

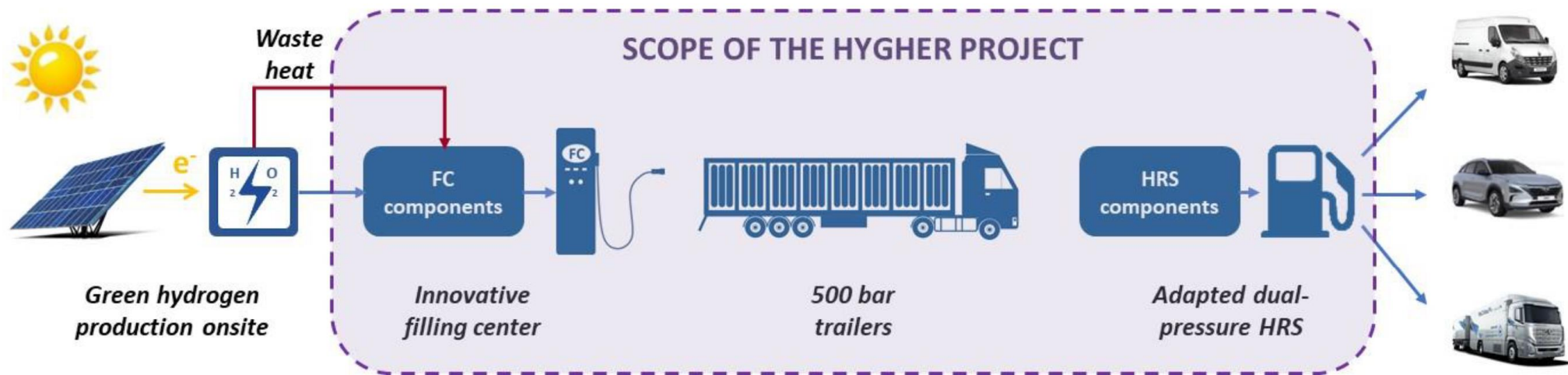


## Energy efficiency

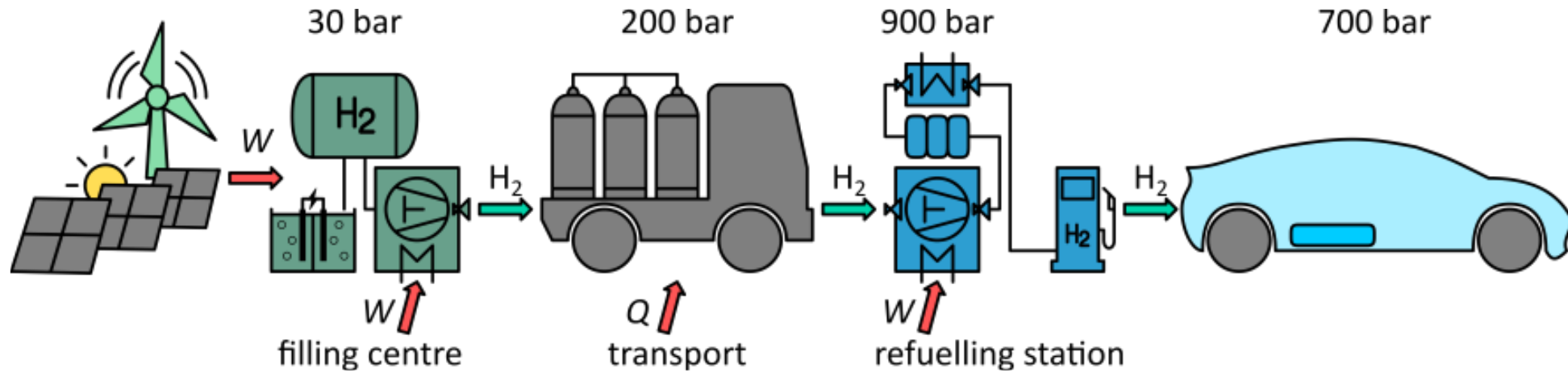
- Waste heat utilisation
- Increased transport capacity
- Optimized cascading system

## Circularity and material efficiency

- Metal hydride compressor
- TYPE IV pressure vessels
- Tube trailer



# ENERGY EFFICIENCY



**500 bar supply chain innovations**

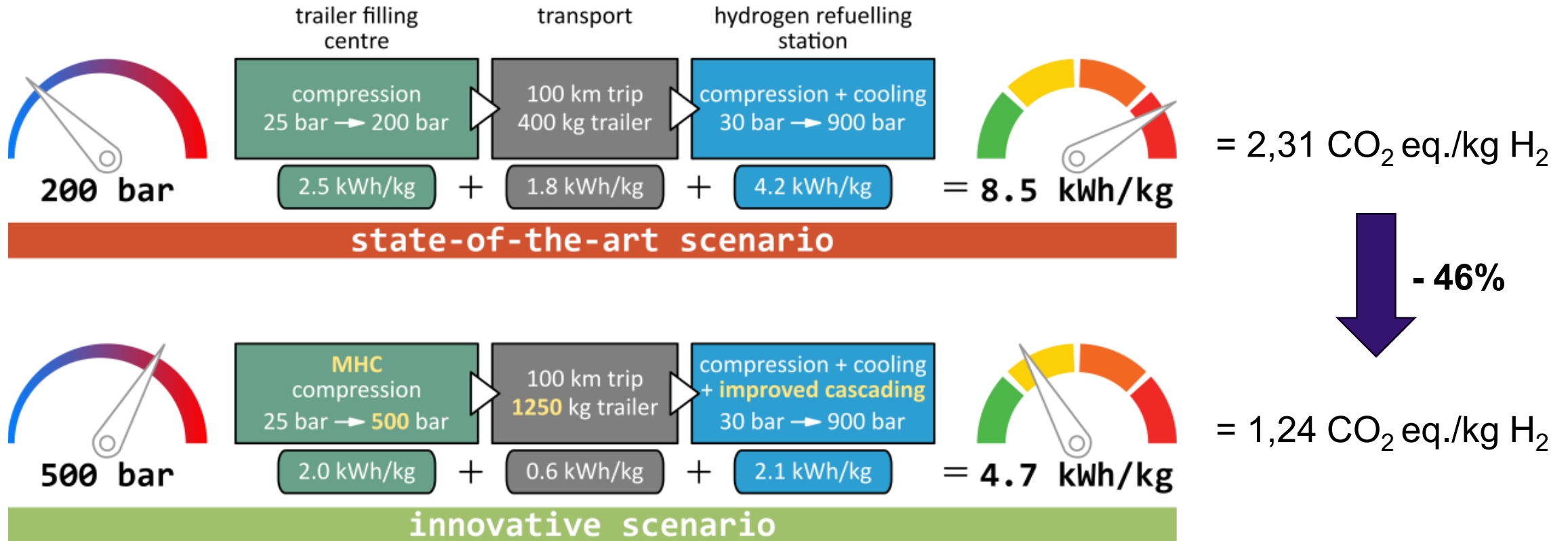
**Metal Hydride Compressors (MHC)**  
Utilize waste heat from on-site H<sub>2</sub> production for compression

**Type IV Composite Trailers**  
Carrying 3× more hydrogen than traditional steel vessels

**Optimized Cascading Storage**  
Enabling direct H<sub>2</sub> transfer from trailers to vehicles without intermediate storage

Hojkar et al. (2025), Improving energy efficiency and environmental footprint of hydrogen supply chain by upgrading to 500 bar technology

# ENERGY EFFICIENCY



Hojkar et al. (2025), Improving energy efficiency and environmental footprint of hydrogen supply chain by upgrading to 500 bar technology

## What is circularity?

**Circularity** is a principle where **materials, products, and resources are kept in use for as long as possible.**

→ It uses strategies like **reuse, repair, remanufacturing, and recycling** ✓

→ Replaces the traditional **linear model** of *take* → *make* → *waste*. ✗

## **Main concepts:**

- Reducing the need for virgin resource extraction
- Using Ecodesign to decrease the amount of:
  - needed materials
  - generated waste
- Keep the materials circulating at their highest value for as long as possible (through reuse and recycling)

# CIRCULARITY - SELECTED SUBSYSTEMS

*Subsystem 1 (S1)*

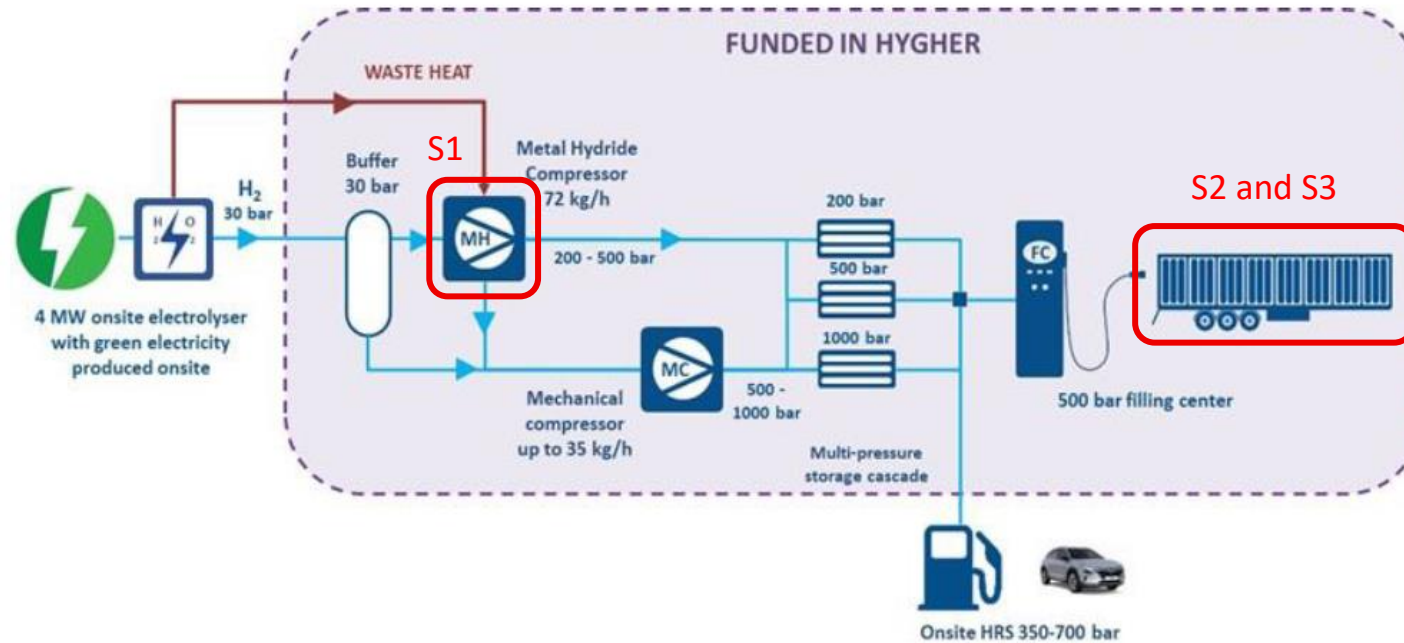
**Metal hydride compressor**

*Subsystem 2 (S2)*

**Type IV pressure vessels**

*Subsystem 3 (S3)*

**Tube trailer**



## *Subsystem 1 (S1)*

### **Metal hydride compressor**

- Metal hydrides:
  - Regeneration is desirable
  - No rare earth materials
- Waste heat utilisation is highly desirable, especially if combined with an on-site electrolyser
- Modular design:
  - Easy maintenance
  - Easier disassembly -> easier to recycle

## *Subsystem 2 (S2)*

### **Type IV pressure vessels**

- Commercial recycling -> downcycling
- Experimental recycling technologies offer high retention of properties
- Reuse through recertification
  - Weakend by safety concerns and economic reasons

## *Subsystem 3 (S3)*

### **Tube trailer**

- The most common reuse option is stationary storage application
- Majority of the trailer (chassis, tyres, container) can be reused although more likely scenario is recycling

The logo for Hygger, featuring a stylized white 'h' with a circular arc above it, followed by the word 'ygger' in a lowercase, rounded font. The entire logo is set against a background of two hydrogen dispensing stations at dusk.

# Hygger

**QUESTIONS?**



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THANK YOU FOR  
YOU ATTENTION!



For further information  
and to follow our project  
progress visit  
[www.hygher.eu](http://www.hygher.eu)



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