

Distributed
Production
of Hydrogen
and Power
for Sustainable
Mobility





Distributed Production of Hydrogen and Power for Sustainable Mobility

The project team is developing an innovative technology for Cogenerating Hydrogen, Heat and Power (CH2P) using a high-temperature fuel cell that works with a solid oxide material fed by methane rich gases



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735692. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation program, from Hydrogen Europe and N.ERGHY.



HORIZON 2020
EU Framework Programme
for Research and Innovation



EPFL

HYGEAR



Building the new generation of refueling stations to empower Europe's transition to hydrogen-based mobility

#hydrogeneconomy #hydrogen #energytransition
#greenmobility #EU2050 climate strategy #FCHJU



CH2P for the Hydrogen R-Evolution

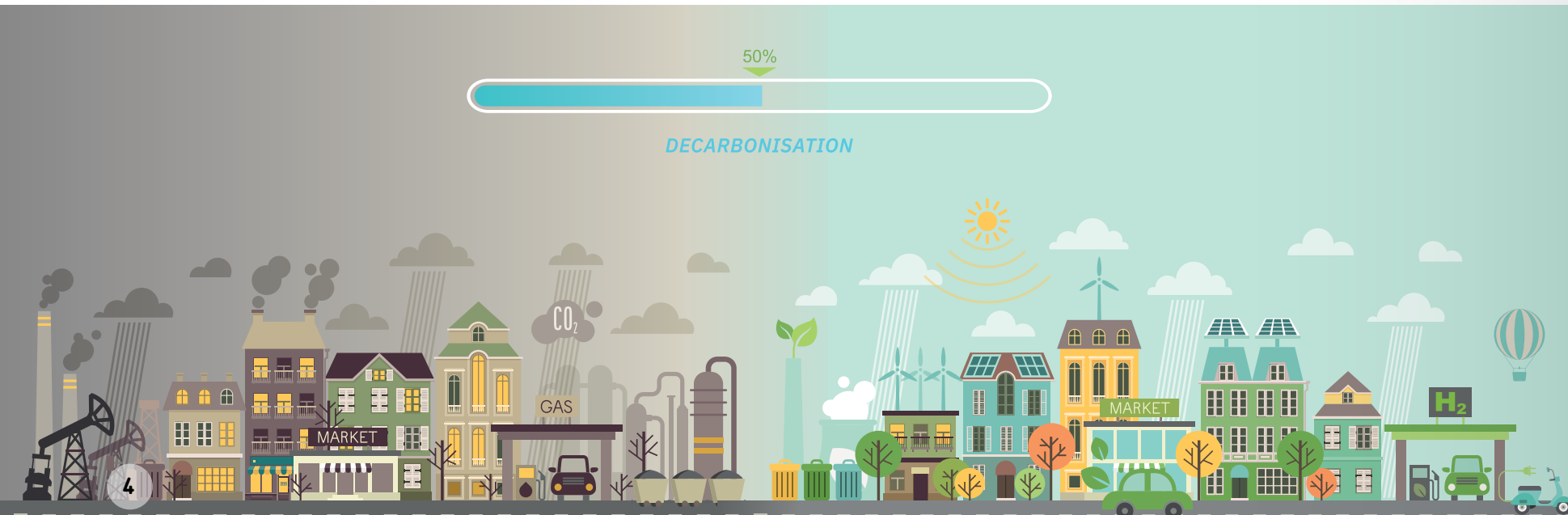
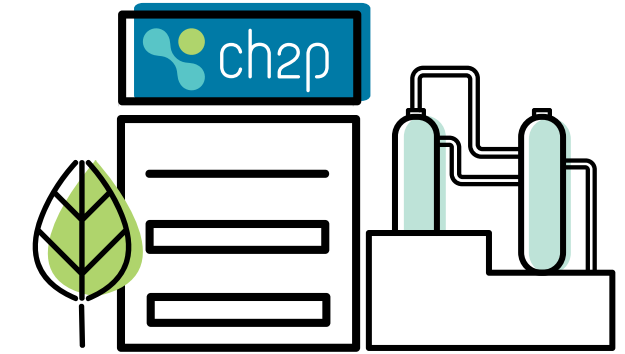
Today hydrogen is the best and only choice for large-scale decarbonization of key segments in the transport, industrial and residential sectors.

To achieve the EU ambition of reducing global greenhouse gases by 80% before 2050, emissions need to decrease drastically. **This requires hydrogen.**

In the transport sector, Fuel cell electric vehicles (FCEVs) are zero tailpipe emission vehicles that are ready for market deployment. Yet, FCEVs lack a capillary infrastructure of refueling stations. CH2P aims at overcoming this barrier by building a transition technology for early infrastructure deployment of HRS.

About CH2P

The **CH2P project** will demonstrate an innovative technology for hydrogen refueling stations (HRS) and charging of electric vehicles. The CH2P system is a technology that provides a novel solution for **alternative fuels infrastructure** operating with higher efficiency, lower costs and reduced environmental footprint.



Objectives

CH2P's **primary objective** is the **multiple generation of hydrogen, power and heat** using novel Fuel Cells operating with solid-oxide technology (SOFC) fueled by methane-rich gases (natural gas or bio-methane). An SOFC is an electrochemical conversion device that produces electricity directly from oxidizing a fuel. Advantages of SOFC include:

high combined heat and power efficiency

long-term stability

fuel flexibility

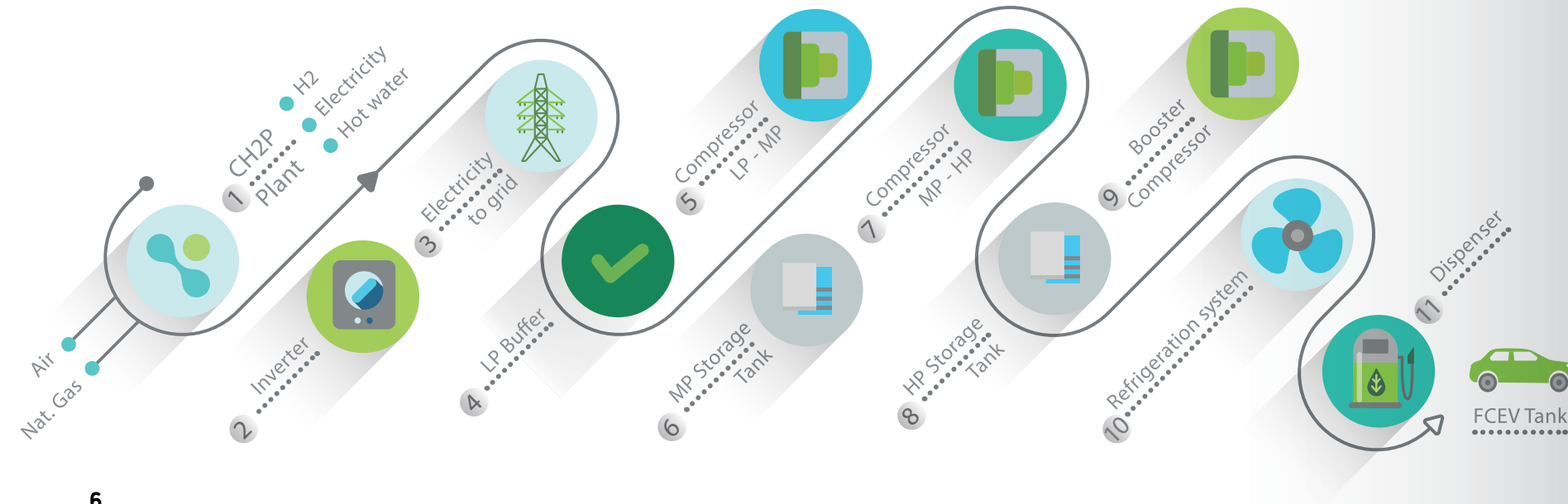
low emissions

relatively low cost

These advantages result in lower costs for the end users and other benefits such as lower maintenance and lower environmental impact.

Hydrogen Refuelling Stations

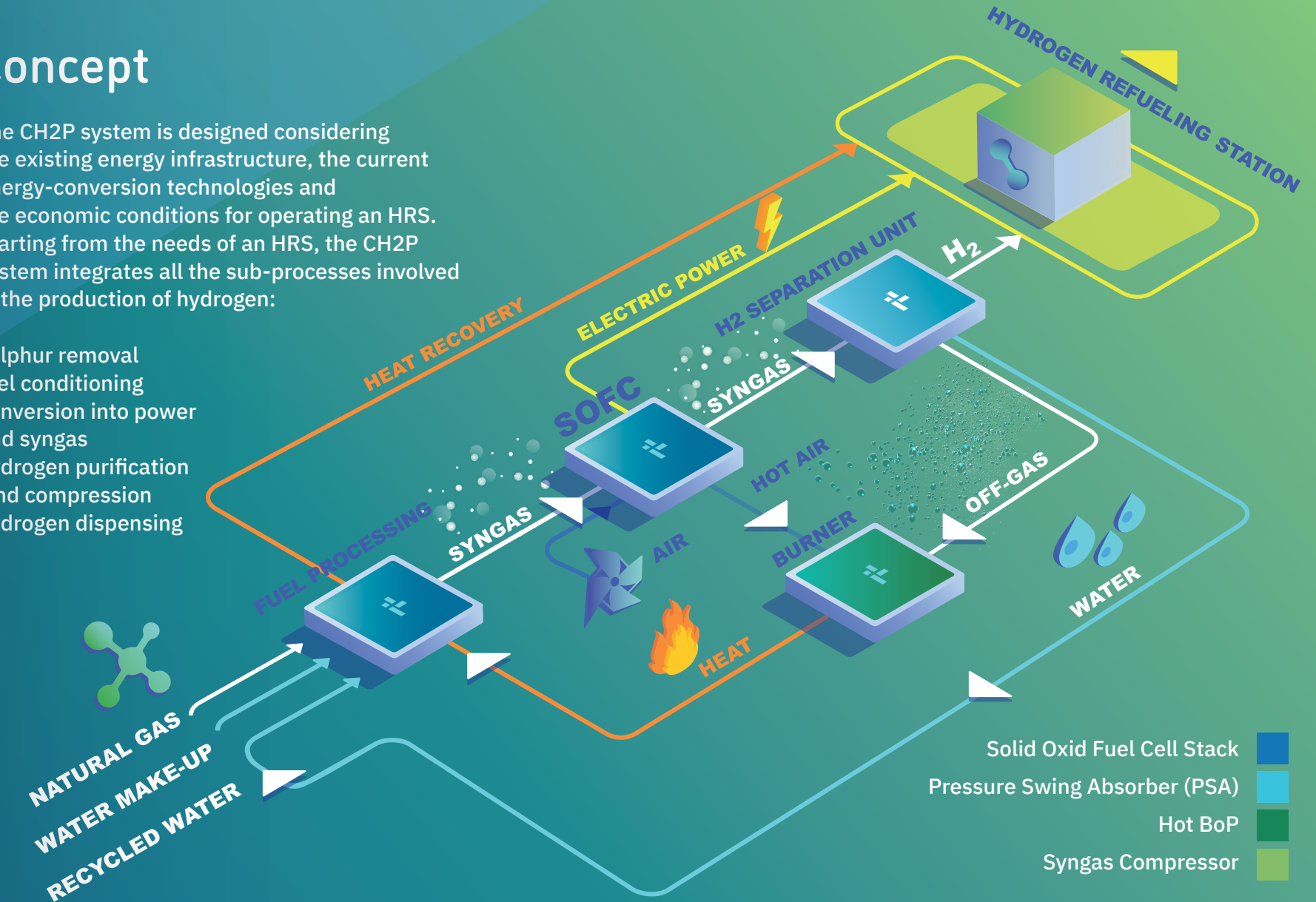
The next generation of HRS will be integrated in existing fuel retail stations. This means that CH2P systems will be installed at sites that have a convenience shop, a car wash and sell conventional fuels and potentially electricity for battery electric vehicles as well as hydrogen.



Concept

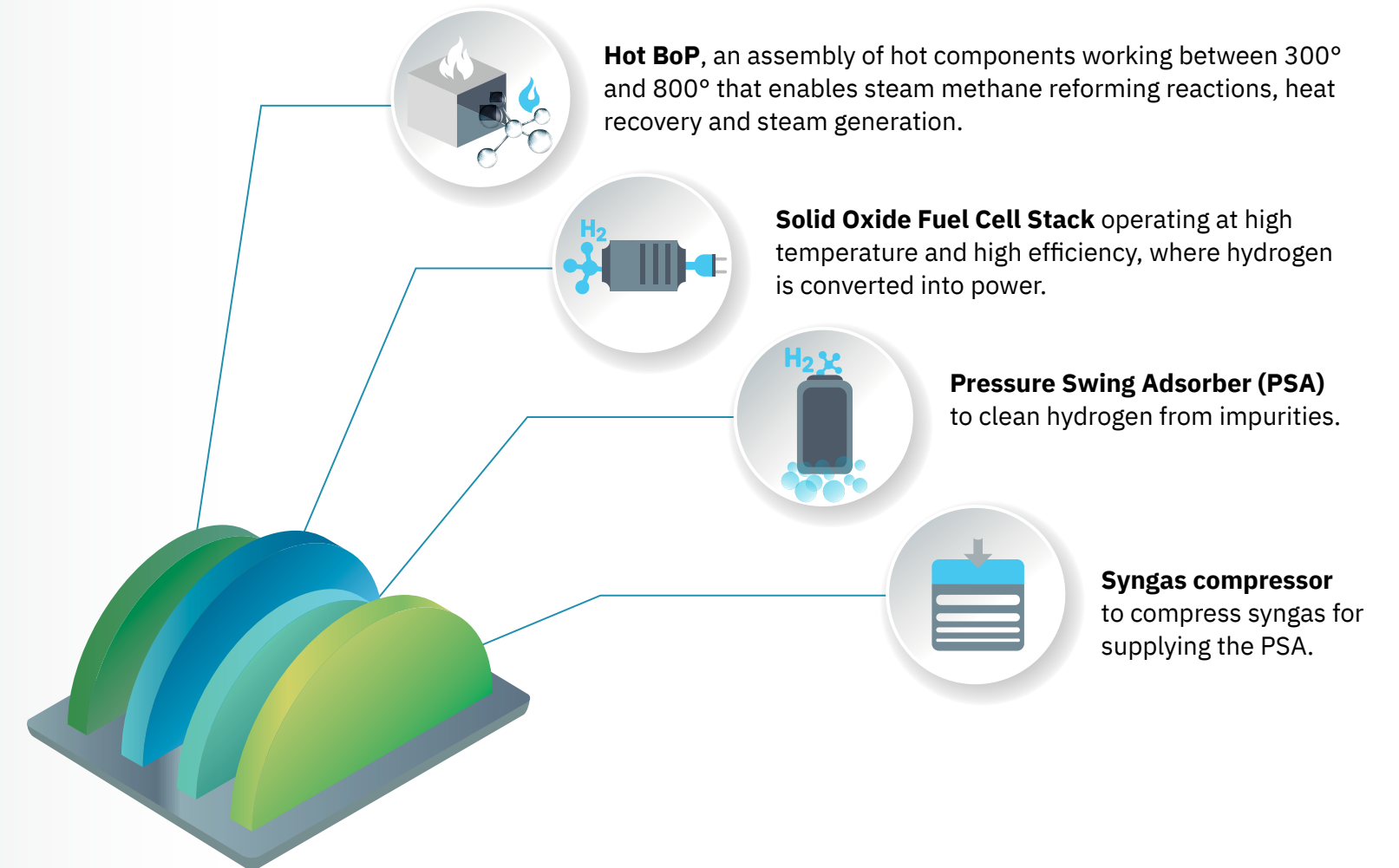
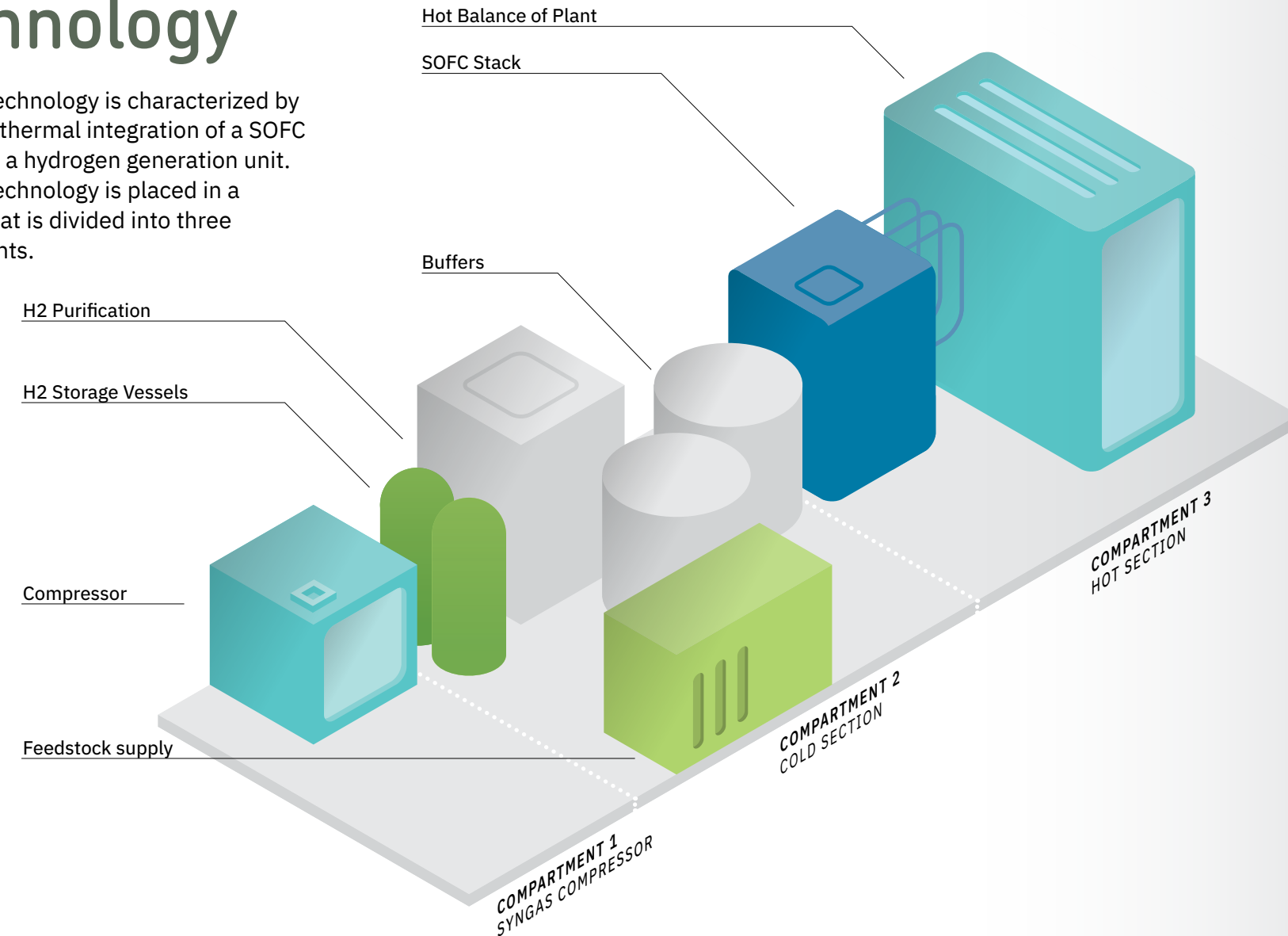
The CH2P system is designed considering the existing energy infrastructure, the current energy-conversion technologies and the economic conditions for operating an HRS. Starting from the needs of an HRS, the CH2P system integrates all the sub-processes involved in the production of hydrogen:

- sulphur removal
- fuel conditioning
- conversion into power and syngas
- hydrogen purification and compression
- hydrogen dispensing



Technology

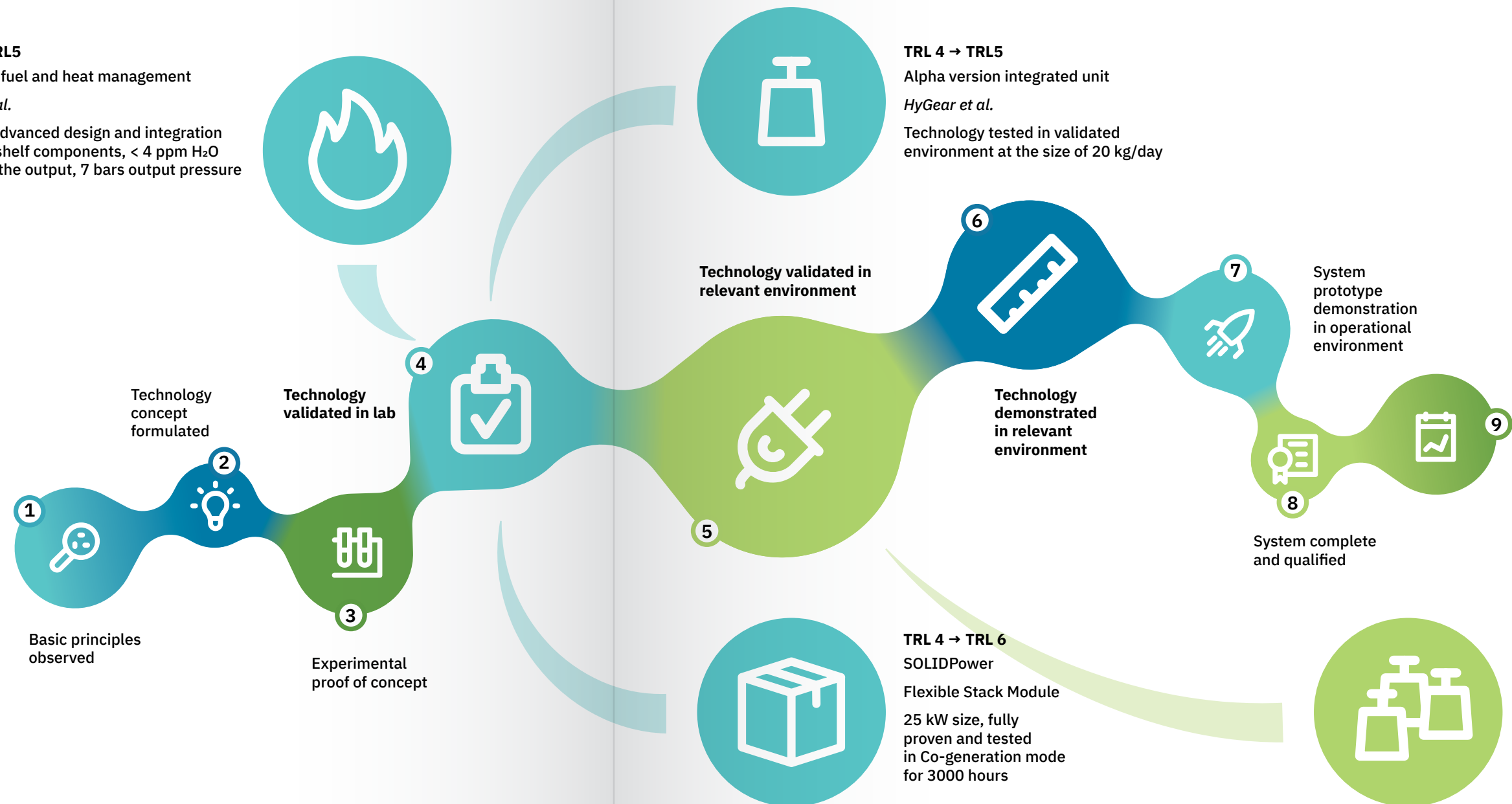
The CH2P technology is characterized by the optimal thermal integration of a SOFC system with a hydrogen generation unit. The CH2P technology is placed in a container that is divided into three compartments.



Excellence

CH2P aims at advancing the available technologies for producing hydrogen into an innovative prototype for cogenerating hydrogen and electricity. At a first stage, the alpha-prototype (the first version of the CH2P system) will be tested at HyGear. At a second stage, the improved beta-prototype assembled together with the alpha-prototype (the second version of the CH2P system) will be tested in the operational environment at Shell Technology Centre in Amsterdam. Depending on the final testing results, CH2P is targeting higher maturity of the technology reaching a pre-commercial phase for the beta prototype of the system.

TRL 4 → TRL5
Downdraft fuel and heat management
HyGear et al.
Based on advanced design and integration of off-the-shelf components, < 4 ppm H₂O content at the output, 7 bars output pressure



Value Proposition

CH2P has the plan to realize a high temperature co-generative system producing hydrogen and power in a flexible way. The value of the CH2P technology:



01- Higher efficiency

System efficiency is higher than 66%, the initial project target



02- Reliability

Production of hydrogen and power to always match demand side management



03- Cost competitiveness

Hydrogen price below 4,5 €/kg versus the actual 9,5€/kg average price in the EU



04- Modularity

40 kg/day technology integrating 2 modules of 20 kg/day



05- Lifetime

Lifetime of 40.000 hours and around 10 years (with module changeouts)



06- High performance

Hydrogen purity level 99,999% with H2O content <2 ppm and CO content <200 ppb to be compliant with the use in hydrogen cars



07- In field testing

At Shell Technology Centre Amsterdam



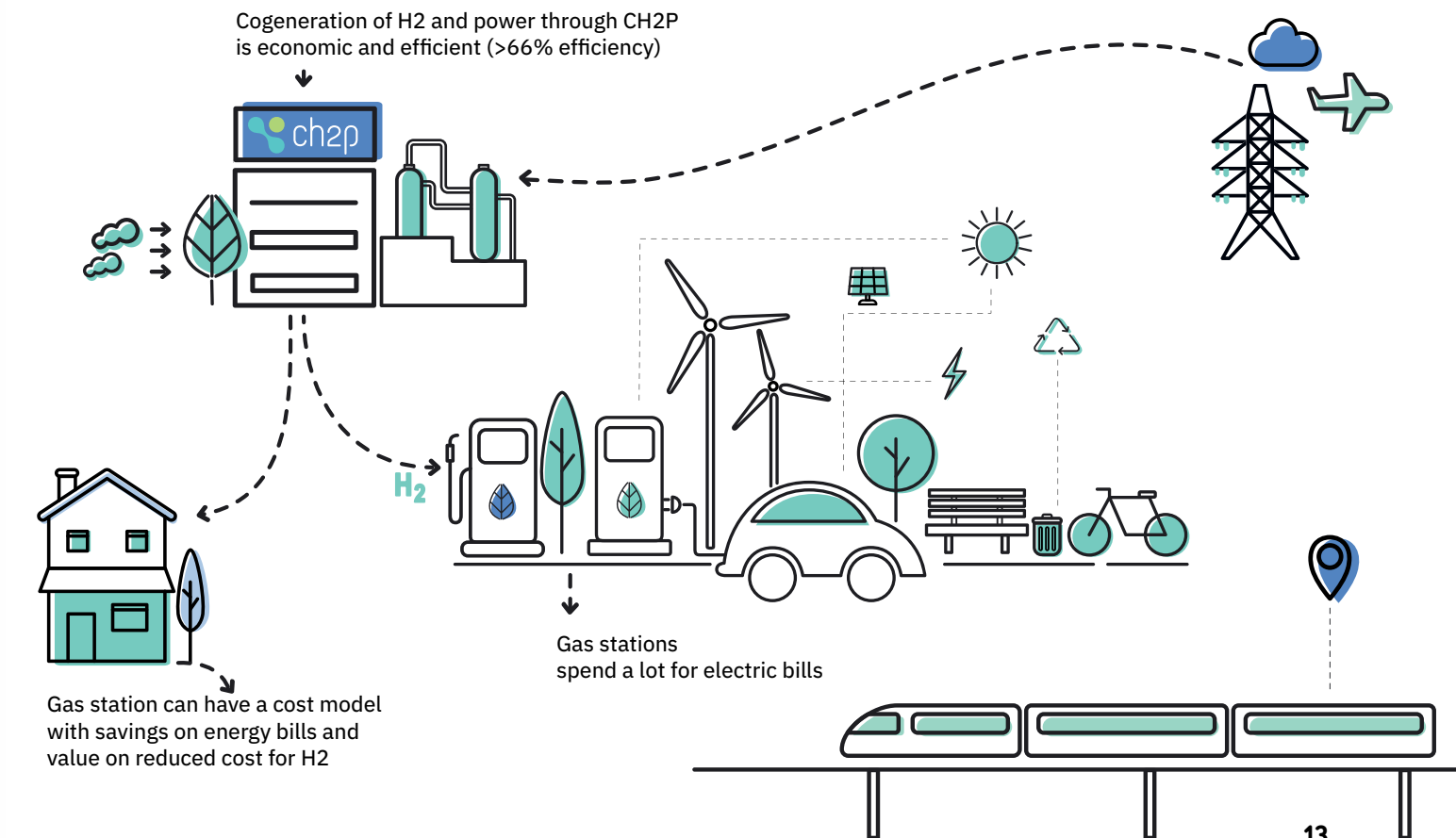
08- Sustainability

Life Cycle Analysis on environmental impacts and costs

CH2P and the “inverse” model of hydrogen cost

When an electrolyser is producing hydrogen, the cost of hydrogen is depending on the cost of electricity. CH2P has an inverse cost model: **the higher the cost of electricity from the grid, the lower the cost of hydrogen produced at the station.**

- 1 CH2P generates hydrogen and power from methane
- 2 The electric power can be used by the refueling station, for self consumption and for charging electric vehicles
- 3 Cost of electric power from the grid is saved, with lower cost of electricity at the station
- 4 The higher the cost of electricity from the grid, and higher the savings
- 5 The projected cost of hydrogen is then reduced proportionally



CH2P is currently designed for hydrogen refueling stations

Customers

The targeted customers are oil and gas companies that are currently looking for innovative technologies to address the nascent market of hydrogen and electric mobility.

Other potential customers



Electricity providers



Building/Feedstock industry



Chemistry industry



Glass industry



Logistic industry



Microelectronics industry



Steel industry

Users

The main users of CH2P are drivers of fuel cell electric vehicles and battery electric vehicles. These can be:



Ships



Taxi fleets



Shipment fleets
courier, tracks



Individual car drivers
electric and hydrogen



Bus fleets

Usage Scenarios

Four different use cases have been defined for the CH2P-system, ranging from minimum production of hydrogen and power to full power and hydrogen production.

The use cases that the CH2P-system addresses are:



H2 production for the station
Power production for **CH2P system**



H2 production for the station
Power production for the **HRS station**



H2 production for the station
Power production for **export to the grid**



H2 production for the station
Power production for **charging electric vehicles**



The CH2P consortium is composed by seven European partners from five different partners in Europe. The consortium is highly interdisciplinary: it consists of three SMEs, a large enterprise and three research institutes that combine their complementary skills and infrastructures to develop and test the CH2P system.

www.ch2p.eu
made by Minimolla Design
eco-compatible inks on Fsc paper



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