

SINCE

2008

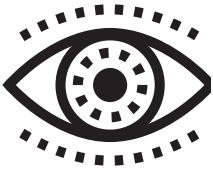
EXPERIENCE IN
HYDROGEN
COOLING



HYDROGEN - COOLING - POWER



Think KUSTEC



Our Vision

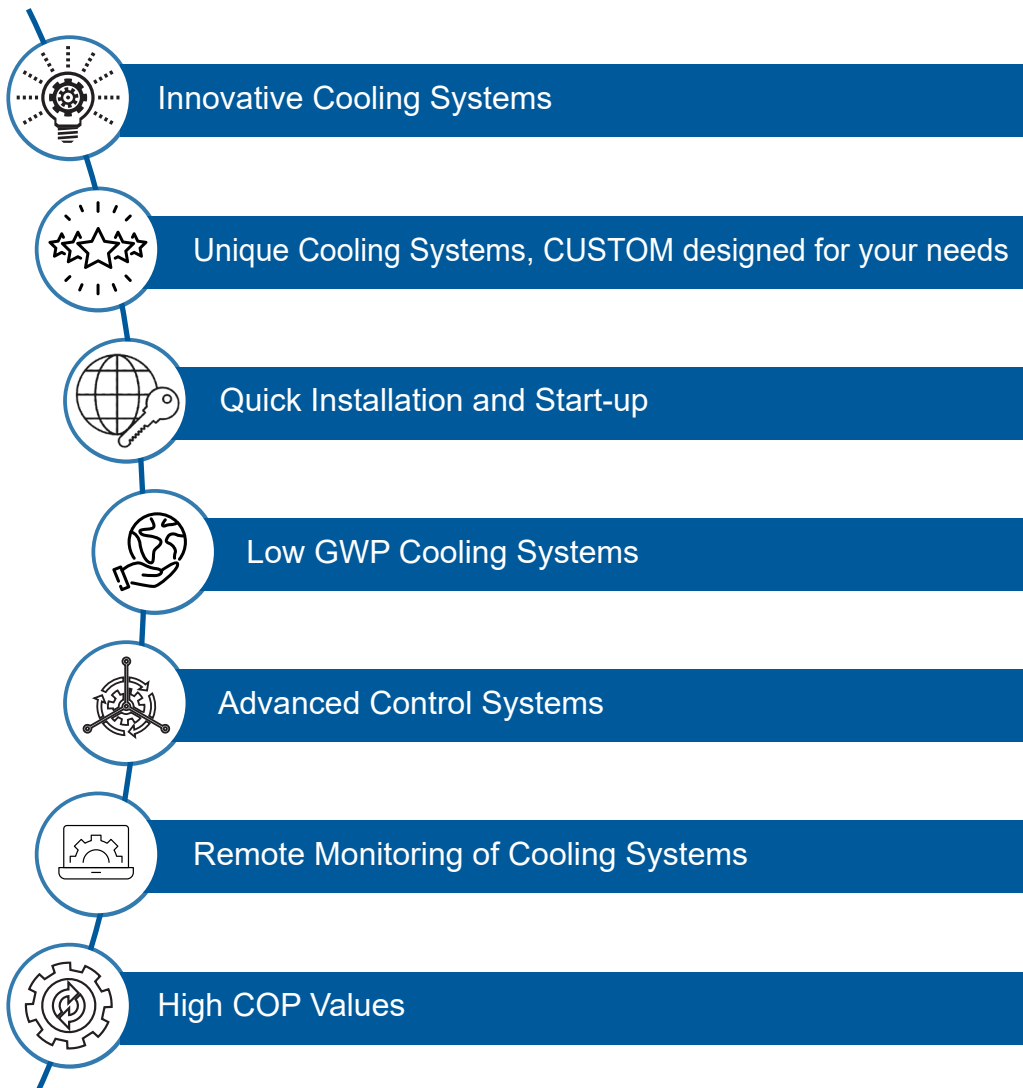
We believe our first responsibility is the innovation of cooling systems. Our priorities are to provide our customers with optimized cooling systems, to follow the UN's environmental SDG's and to foster the worldwide development of hydrogen vehicle industry.



Our Mission

We develop innovative cooling systems for our customers and standardize the worldwide hydrogen vehicle industry using low GWP refrigerants.

Efficient and Reliable Cooling Systems are an important part of Manufacturing Technologies, thus we provide:

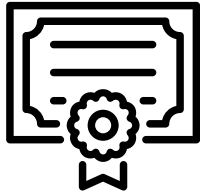


We deliver cooling concepts for Hydrogen Refuelling Stations for the futuristic sustainable mobility!



-  Since 2006 Cooling Systems Experience
-  Professional Technicians
-  International Engineers
-  Worldwide Partners

KUSTEC Quality Certificates



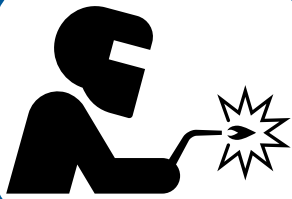
Management System Certificate

- EN ISO 9001:2015
- SCC 2011
- BMLFU-KK-Nr. 45



Fluorinated Greenhouse Gases Regulations 2009

- Section 4, Paragraph 1, Ordinance BGBl. II No. 2/2011
- Federal Ministry for Agriculture and Forestry, the Environment and Water Management



Brazing Process Testing

- EN 14276-1:2020
- EN 13585



- Expert in Handling Natural Refrigerants
- SAE J2601 Hydrogen Filling Protocol



KUSTEC delivered more than 263 cooling systems for the 685 existing Hydrogen Refuelling Stations worldwide, according to the 2021 statistics. A total percentage of 38% of the worldwide Hydrogen Refuelling Stations.



In 2021, 142 Hydrogen Refuelling Stations went into operation worldwide, where KUSTEC delivered a total of 45 cooling systems, representing a 31.6% of the market. 37 new hydrogen stations were opened in Europe, 89 in Asia, and 13 in North America according to the 14th annual assessment of H2stations.org, an information service of Ludwig-Bölkow-Systemtechnik (LBST).

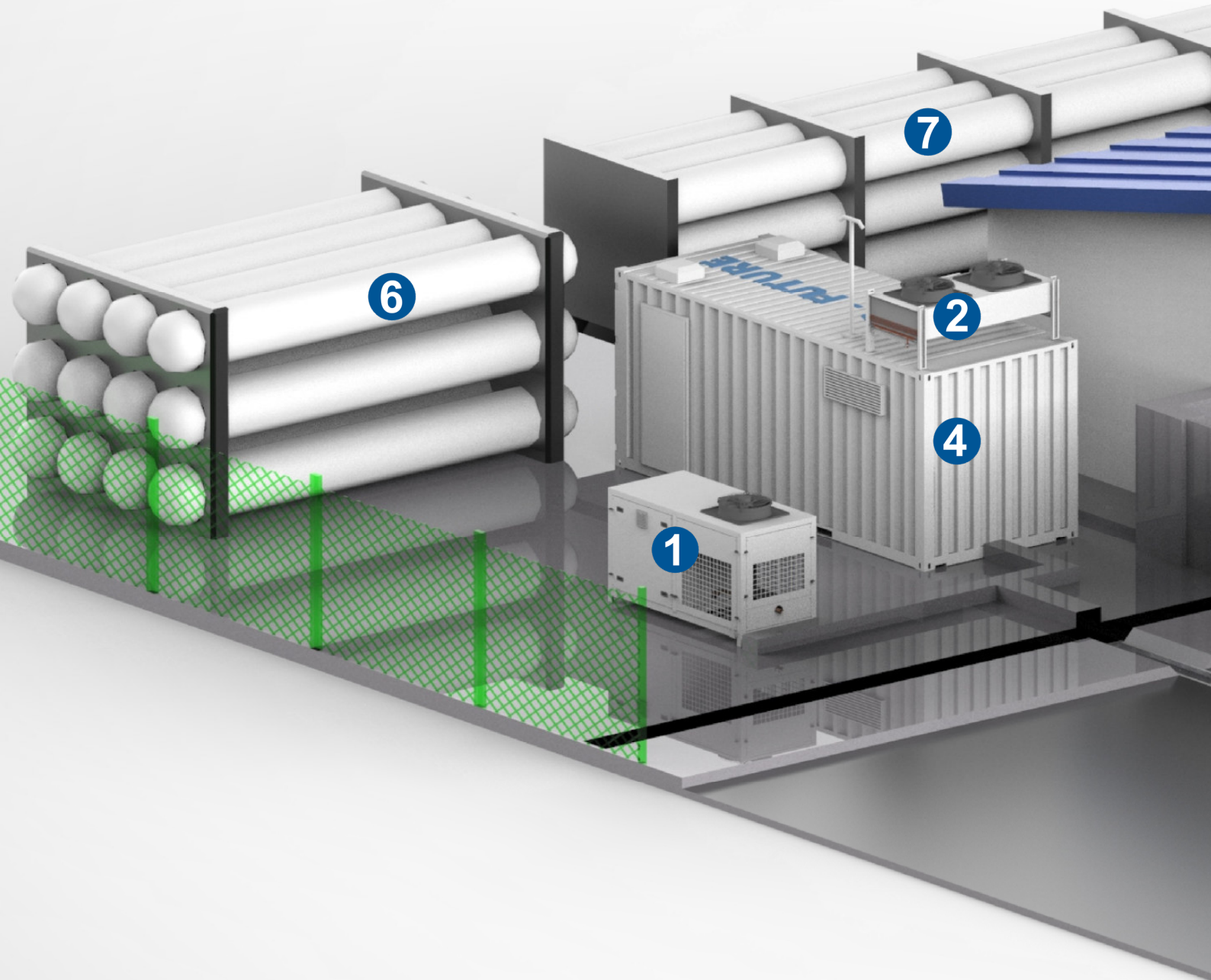
Europe had 228 hydrogen stations at the end of last year, 101 of which are in Germany. France is still second in Europe with 41 operating stations, followed by the UK with 19, Switzerland with 12, and the Netherlands with 11 stations.

At the end of 2021, there were 363 hydrogen stations in Asia, 159 of them in Japan, and 95 in Korea. Unlike most other countries, the 105 Chinese hydrogen stations in the LBST database are used almost exclusively for the refuelling of buses or truck fleets. Korea recorded the most openings in 2021 with 36 new filling stations and is increasingly expanding the infrastructure for all fuel cell electric vehicles.

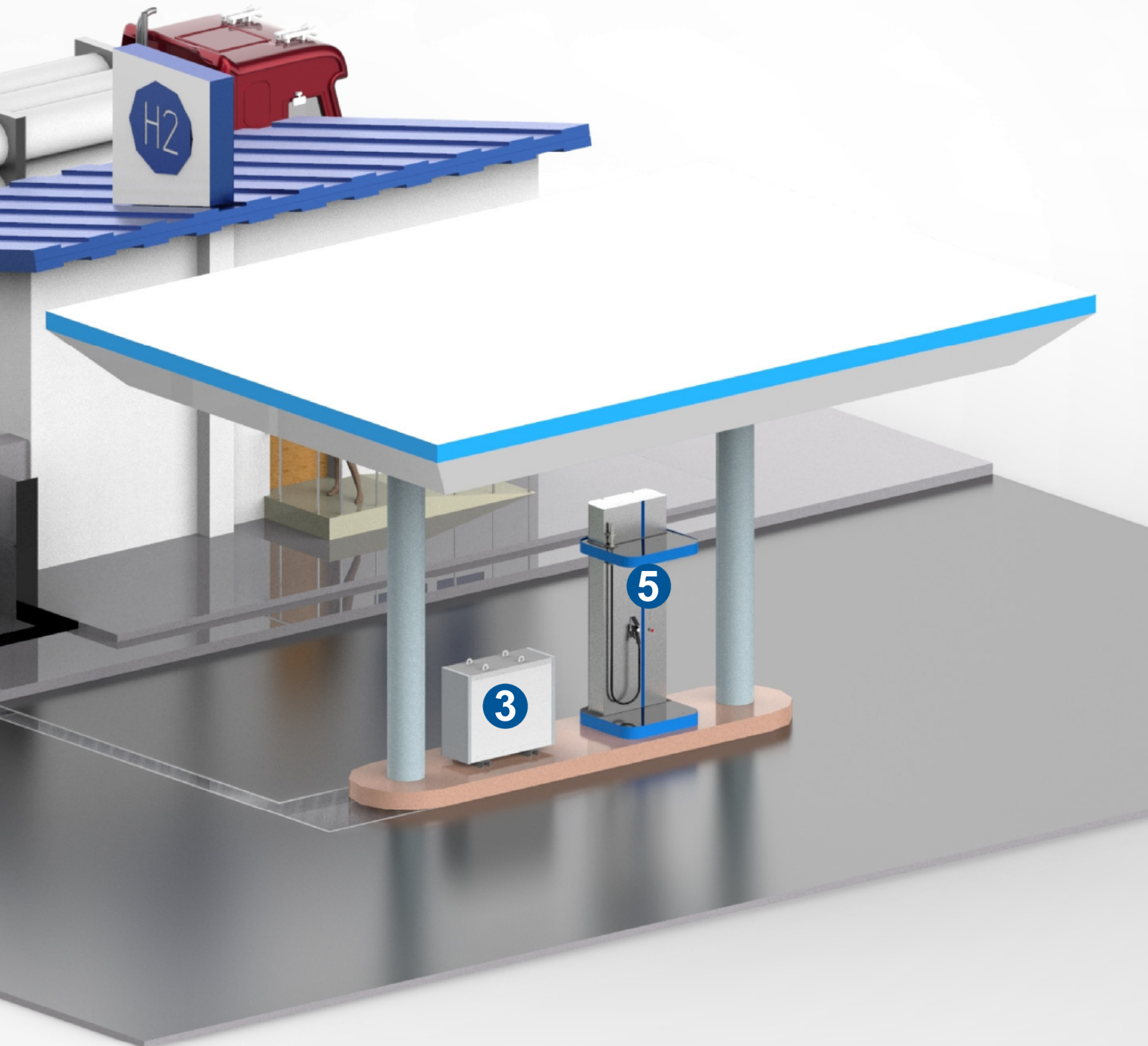
The majority of the 86 hydrogen stations in North America continues to be located in California with 60 operating stations. In 2021, 11 new filling stations went into operation there.

Planning

KUSTEC designs your cooling system taking care of the detail, thinking of the whole.



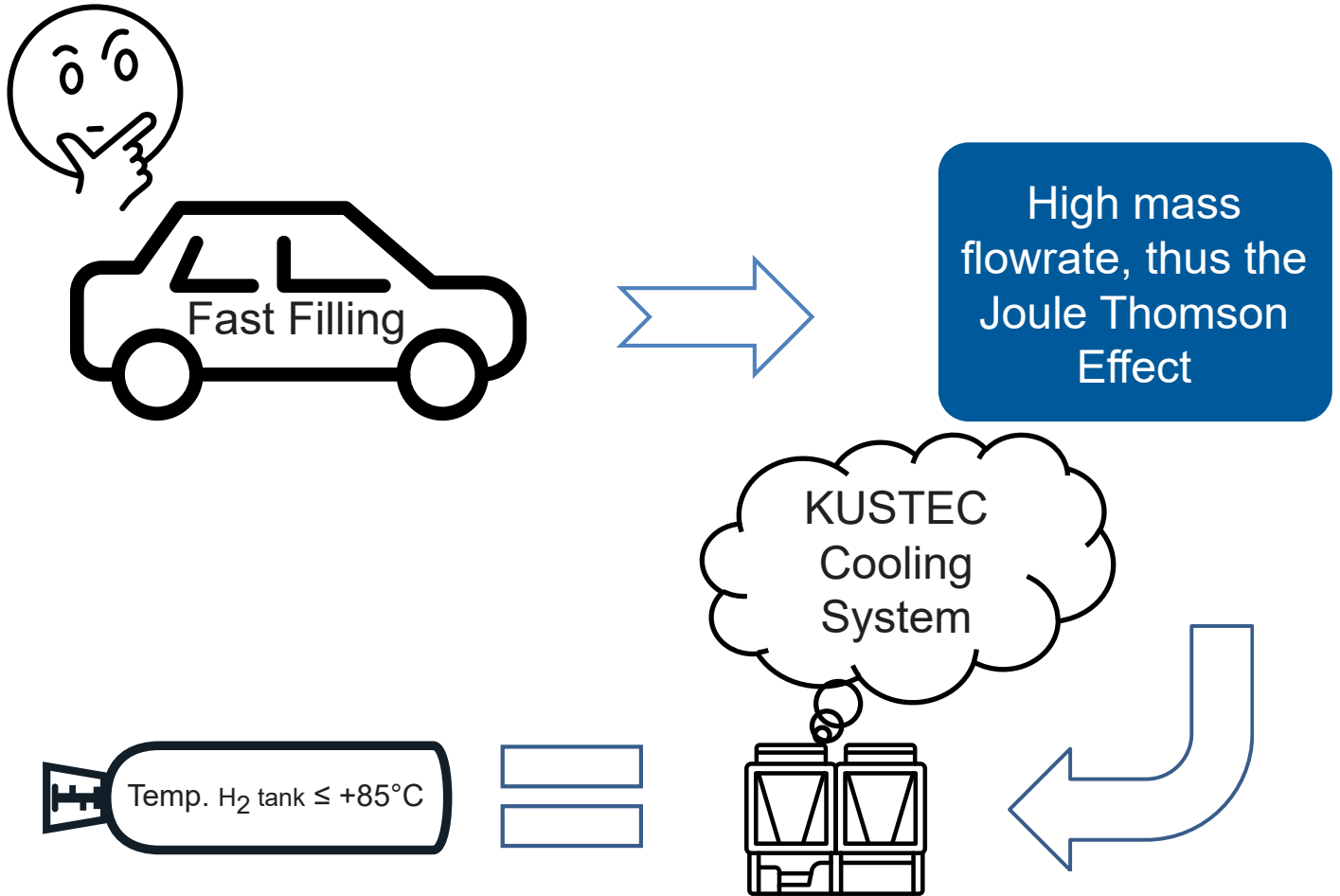
- 1 KUSTEC Cooling System
- 2 KUSTEC Air heater
- 3 KUSTEC Aluminium Block, the H₂ heat exchanger!



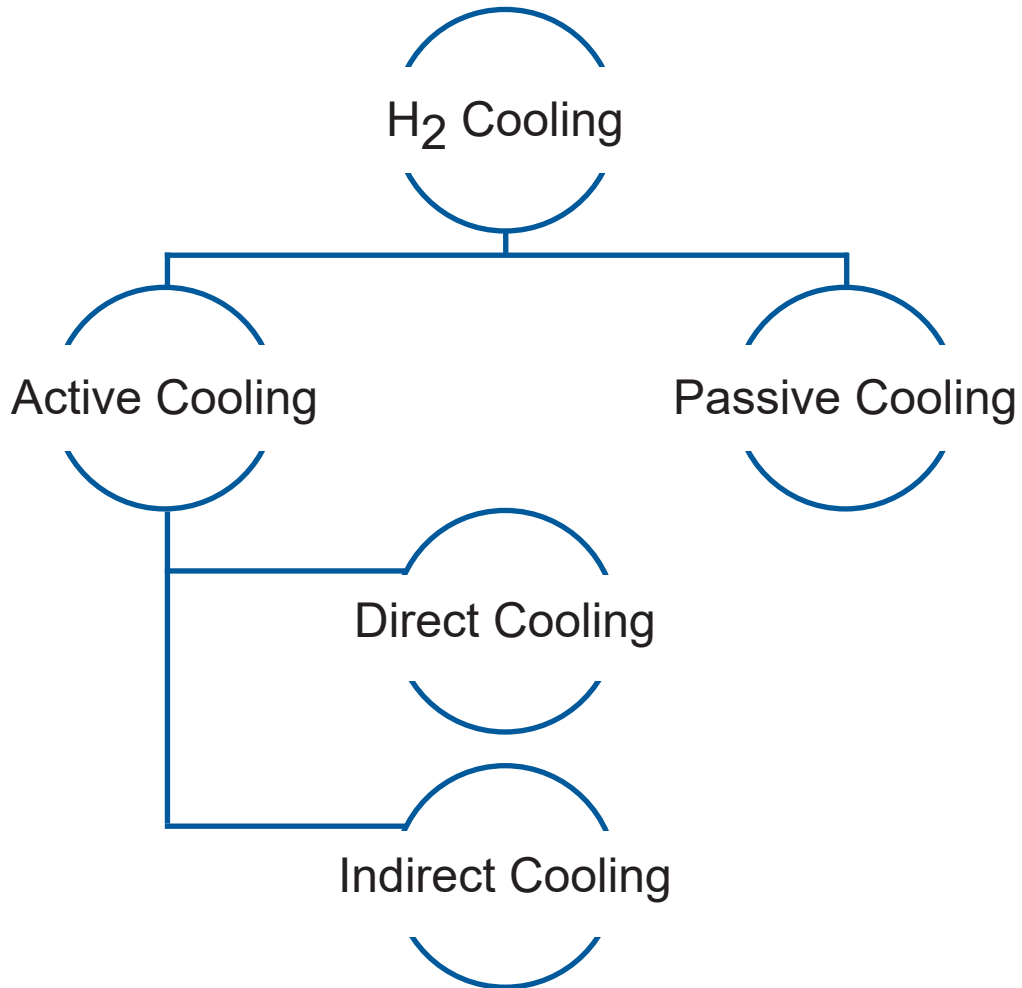
- 4** Container H₂ Compressor
- 5** Dispenser
- 6** Middle and High pressure H₂ - Tanks
- 7** Hydrogen supply

Cooling Systems Summary

Why H₂ Cooling?!

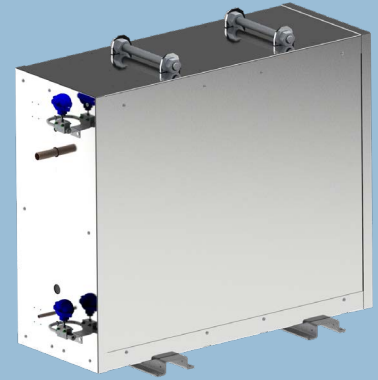
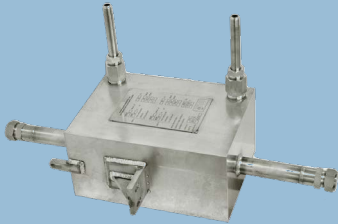


Types of Cooling Systems



Cooling Systems Summary

Types of Cooling Systems



Direct Cooling

- DHE*
- Full cooling capacity
- Direct expansion

Indirect Cooling

- DHE*
- Full cooling capacity
- Additional Glycol cycle
















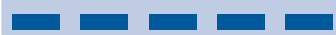
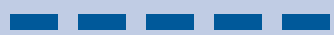
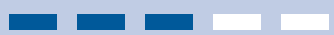
Passive Cooling

- Alu Block HE**
- Reduced cooling capacity
- Direct expansion

* DHE - Diffusion Bonded Heat Exchanger

** Alu Block HE - Aluminium Block Heat Exchanger

Types of Cooling Systems

	Direct Cooling	Indirect Cooling	Passive Cooling
Size of Heat Exchanger			
Size of the Chiller System			
Energy Consumption			
Connection Load			
CAPEX			
B2B Fillings Rate			
Product Name	Racoon Eagle	Chiller	H ₂ ercules H2PCU

Annex:

Biggest / Highest

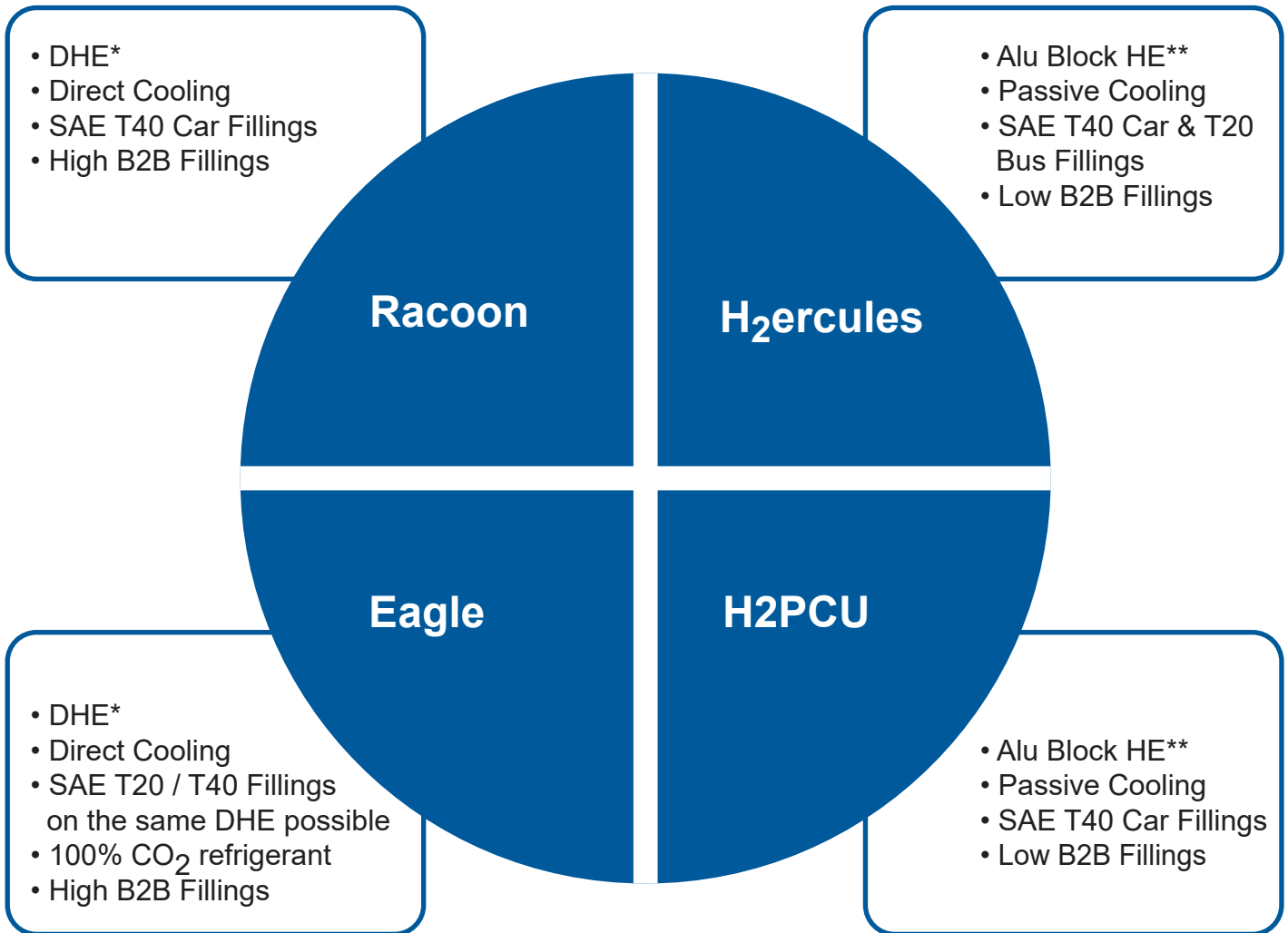


Lowest / Smallest



Cooling Systems Summary

KUSTEC Standard Cooling Systems

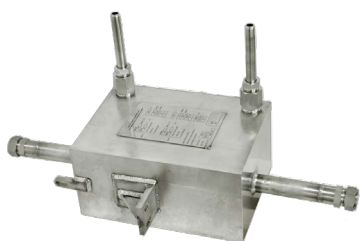


* DHE - Diffusion Bonded Heat Exchanger

** Alu Block HE - Aluminium Block Heat Exchanger

KUSTEC Cooling Systems

DHE vs. Alu Block HE

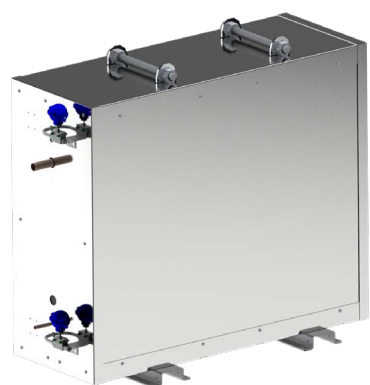


DHE

Diffusion Bonded Heat Exchanger

H₂ is cooled directly through a DHE.

- Anytime availability of required Cooling Capacity
- Unlimited B2B Fillings
- Compact Heat Exchanger
- Higher electrical Connection Load



Alu Block HE

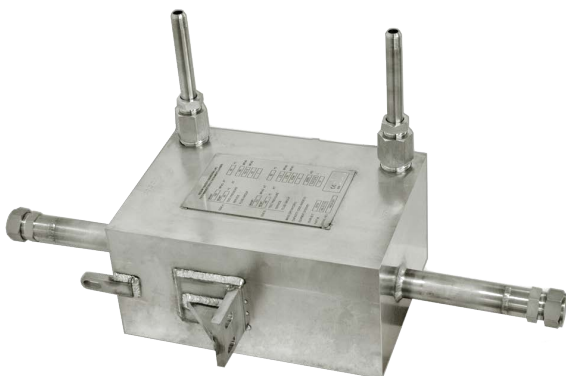
Aluminium Block Heat Exchanger

H₂ is cooled indirectly through an Alu Block HE, which is cooled via a Refrigerant Cycle.

- High Heat Capacity
- Smaller Cooling System
- Limited B2B Fillings

Hydrogen Cooling System: „Racoon 45“

Racoon 45 is used where high performance is required, delivering over 45 kW cooling capacity.



Hydrogen Pre-Cooling Heat Exchangers realize many advantages for hydrogen fuelling, including virtually infinite B2B filling capability and significant savings due to low weight and fluid inventory. As a result, they fit within a small footprint such as dispenser cabinets.

The cascade system is capable of delivering the required cooling capacity at anytime. This ensures:

- High B2B fillings, without recovery time
- A very compact Hydrogen cooling system, since a “diffusion bonded heat exchanger” is used

The Racoon is a cascade refrigeration system, using the refrigerants R449A and R744 (CO₂).

Design conditions: 45kW cooling power at -39°C evaporation temperature and a condensation temperature of 47°C.

KUSTEC’s control system, specially customized for Hydrogen cooling, guarantees high efficiency and reliability.

Electronically controlled valves and transmitters, in addition to the frequency inverters allow full control over the system.

Separate versions are available for the European and American markets accordingly.

Technical data



Cooling Capacity: 45 kW



Connection Load: ~ 50 kW



Temperature Protocol: T40 / MC Protocol



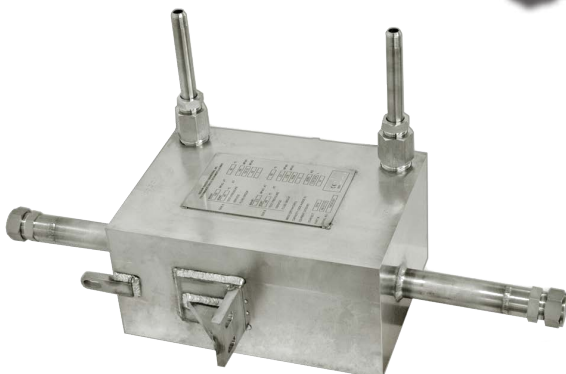
Refrigerant: R449A + R744



Application: Cars

Hydrogen Cooling System: „Eagle 45 EU 0D“

Eagle 45 is a low GWP booster cooling system operating with a R744 refrigerant.



Hydrogen Pre-Cooling Heat Exchangers realize many advantages for hydrogen fuelling, including virtually infinite B2B filling capability and significant savings due to low weight and fluid inventory. As a result, they fit within a small footprint such as dispenser cabinets.

Eagle 45 is a special hydrogen cooling system with a low GWP.

Like the Racoon, the Eagle is designed to work with a diffusion bonded heat exchanger, and provide the required cooling capacity for high B2B fillings following the SAE J2601 hydrogen refuelling standards.

Eagle 45 is designed to work at high ambient temperatures, till 45°C, thus the condenser works as a gas cooler at high temperatures.

It delivers 43kW cooling power at -40°C evaporation temperature and 40°C ambient temperature.

KUSTEC's control system, specially customized for Hydrogen cooling, guarantees high efficiency and reliability. The valves are electronically controlled while the compressors are coupled to inverters to ensure full system control.

Separate versions are available for the European and Australian markets accordingly.

Technical data



Cooling Capacity: 45 kW



Connection Load: ~ 126 kW



Temperature Protocol: T40 / MC Protocol



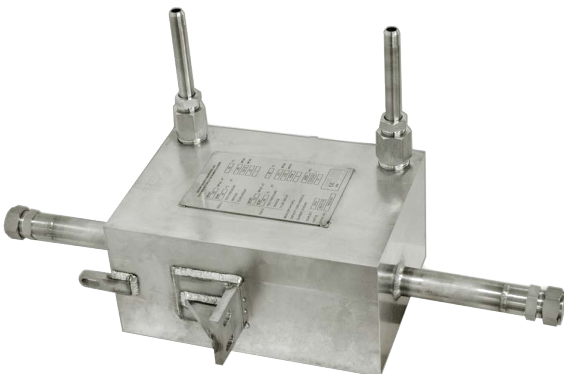
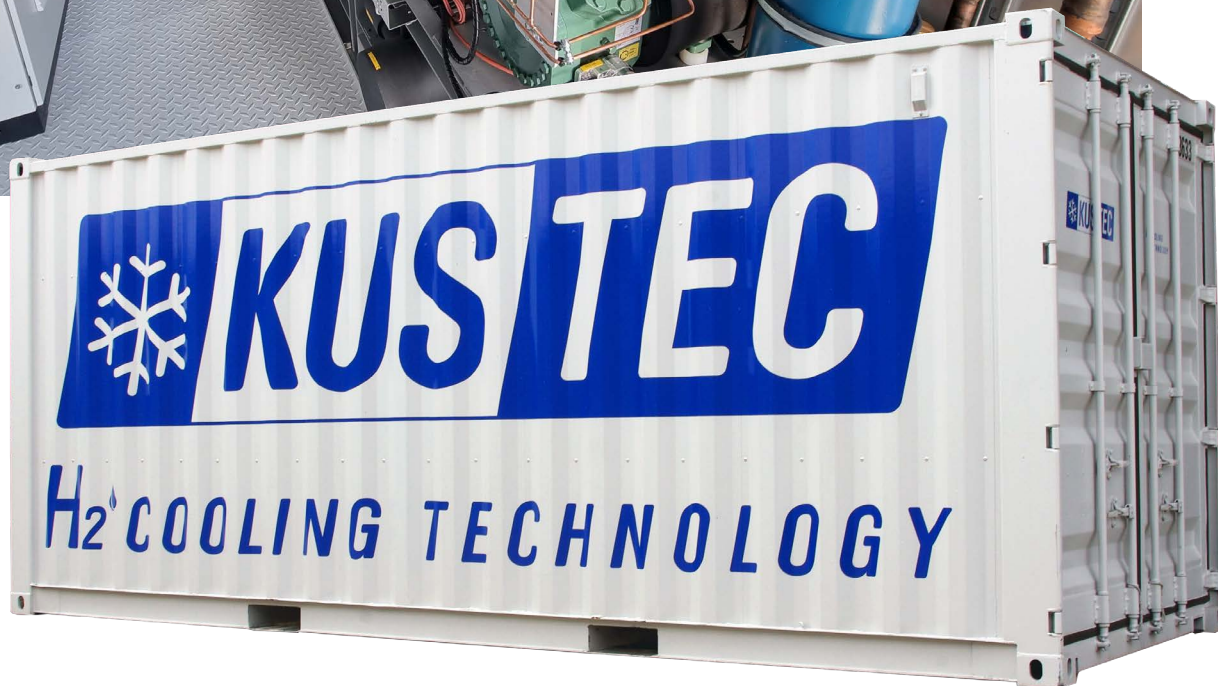
Refrigerant: R744



Application: Cars

Hydrogen Cooling System: „HRS T20 direct CO2“

Designing a Hydrogen Refuelling Station for Buses and Cars. Our 2 in 1 solution for Hydrogen refuelling housed in a soundproof 20 ft ISO-Container, designed to meet all your refuelling needs.



Hydrogen Pre-Cooling Heat Exchangers realize many advantages for hydrogen fuelling, including virtually infinite B2B filling capability and significant savings due to low weight and fluid inventory.

As a result, they fit within a small footprint such as dispenser cabinets.

KUSTEC Hydrogen cooling power!

Our standardized 2 in 1 solution for buses and cars' fuelling. The system is designed for cooling an infinite back to back number of vehicles with a diffusion bonded heat exchanger.

A CO2 (R744) refrigerant booster system is used, thus allowing a flexible fuelling mode and a low GWP system following the Sustainable Development Goals.

The system is capable of fuelling at T20 temperature protocol up to 120g/s of 350bar Hydrogen for buses, and cars at T40 temperature protocol up to 60g/s at 700 bar.

Technical data



Cooling Capacity: 145 kW



Connection Load: ~ 230 kW



Temperature Protocol: T20 / T40



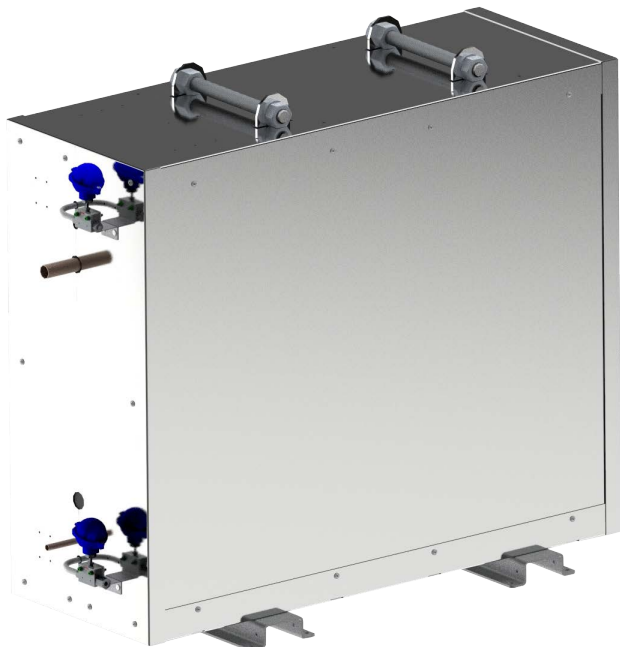
Refrigerant: R744



Application: Cars / Bus and heavy duty vehicles

Hydrogen Cooling System: „H2PCU Compact“

The **H2PCU** offers a high cooling capacity with low power usage due to the Aluminium Block HE, thus reduced investment costs.



The Aluminium Block has a high thermal mass, which is an advantage at stations where highly intermittent refuelling is planned.

In the **H2PCU** cooling system, hydrogen flows through an Aluminium Block HE, which is pre-cooled via the cooling system refrigerant. Thus, the Aluminium Block provides the advantage of simultaneous Active and Passive cooling!

The system proves most worthy for one dispenser hydrogen stations.

The high mass and heat capacity of the Aluminium Block Heat Exchanger allows to have a cooling unit with low connection load values!

The nominal operating points of the system are: $t_c=45^{\circ}\text{C}$; $t_o= -40^{\circ}\text{C}$, delivering the cooling capacity as per the SAE J2601 hydrogen refuelling standard.

As a KUSTEC cooling system, the advanced control system ensures optimizing operational points to maximize COP, thus efficiency.

Separate versions are available for the European, American and South Korean markets accordingly.

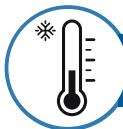
Technical data



Cooling Capacity: 15-24 kW



Connection Load: 24-36 kW



Temperature Protocol: T40



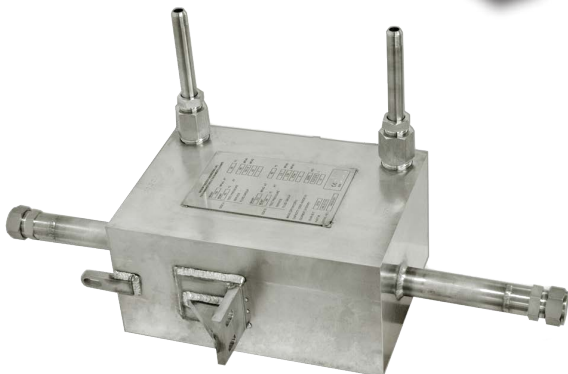
Refrigerant: R452A



Application: Cars / Forklift

Hydrogen Cooling System: „Mobile Cooling“

Considering a mobile Hydrogen Refuelling Station?



Hydrogen Pre-Cooling Heat Exchangers realize many advantages for hydrogen fuelling, including virtually infinite B2B filling capability and significant savings due to low weight and fluid inventory.

As a result, they fit within a small footprint such as dispenser cabinets.

On our mission to support the global Hydrogen Refuelling Stations development, we designed a mobile Hydrogen Cooling System. It entails a compact cooling system delivering the required cooling capacity at a 30°C ambient temperature with a 2.4m x 1.5m footprint.

KUSTEC customized the system to deliver the customers' requirements at a minimal cost. Thanks to our team of specialized engineers and technicians, we supplied two versions of the system.

EU Version is available.

Technical data



Cooling Capacity: 59 kW



Connection Load: ~ 35 kW



Hydrogen flowrate: 100g/s @ 0°C



Refrigerant: R449a



Application: Railway

You need Cooling



has the Solution



KUSTEC
Kälte- und Systemtechnik GmbH
Strassfeld 5, A-3441 Freundorf
Tel: +43 2274 44109
E-Mail: office@kustec.at
www.kustec.at

The description of the possible areas of application of our products as well as the technical data and values are of a general nature only and do not imply that a specific product can be used under all conditions in the respective area of application. In this respect, the named area of application is not a binding performance description or intended use. Due to the many environmental variables and their influences, you as the customer must check whether the product is suitable for your specific area of application. We will be glad to assist you with advice.

© 2022 KUSTEC Refrigeration and System Technology GmbH. All rights reserved.

HYDROGEN-EN-05.22