

Waterstof voor Maritieme Toepassingen

Congres "Waterstof the next level !"
7 December 2020 – Alexander Saverys

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CMB



BOCIMAR



BOCHEM



DELPHIS

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92 ships

- ✓ 35 Capesize
- ✓ 5 Post-Panamax
- ✓ 2 Kamsarmax
- ✓ 7 Ultramax
- ✓ 27 container ships
- ✓ 9 chemical tankers
- ✓ 2 LR2's
- ✓ 5 H2



CMB.TECH : Hydrogen for the Industry



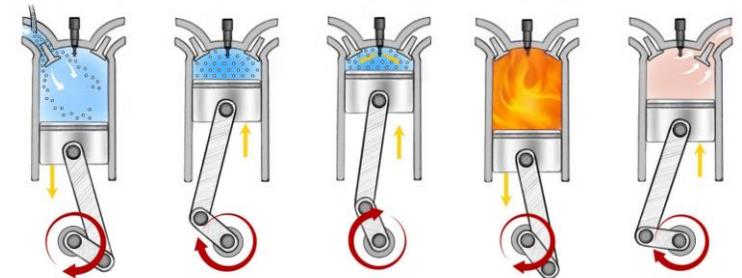
CMB.TECH was founded in 2016 with the development of the **Hydroville**, the world's first hydrogen powered passenger ferry



CMB.TECH's core technology is the **hydrogen internal combustion engine (H2ICE)** :



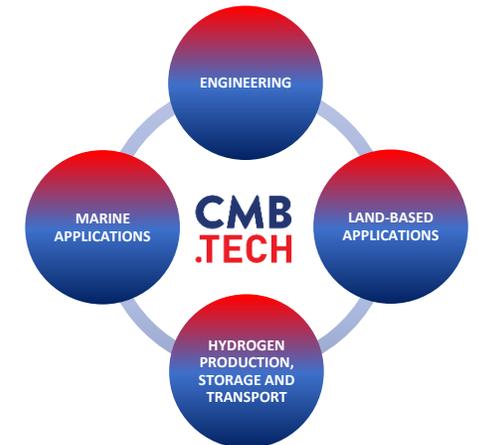
CMB.TECH's team consists of 40 **highly skilled engineers** supported by the commercial, financial and operational teams at CMB

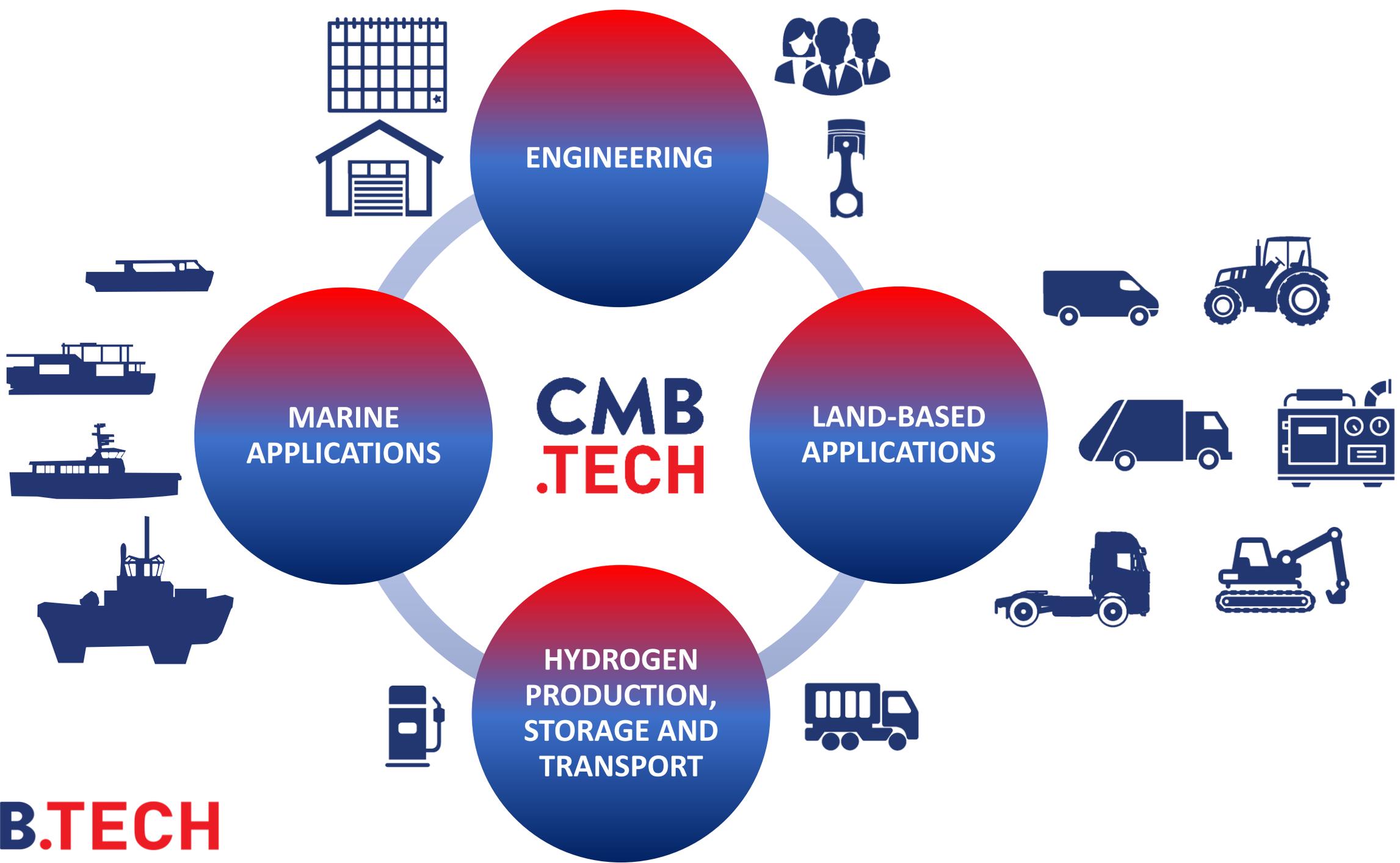


CMB.TECH has offices in **London, Antwerp, Hamburg and Tokyo**

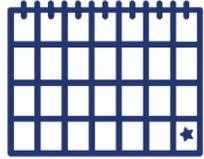


CMB.TECH operates in **4 divisions**





Engineering team and facilities



25 years of experience as engineering and design team with a proven track record in the automotive industry

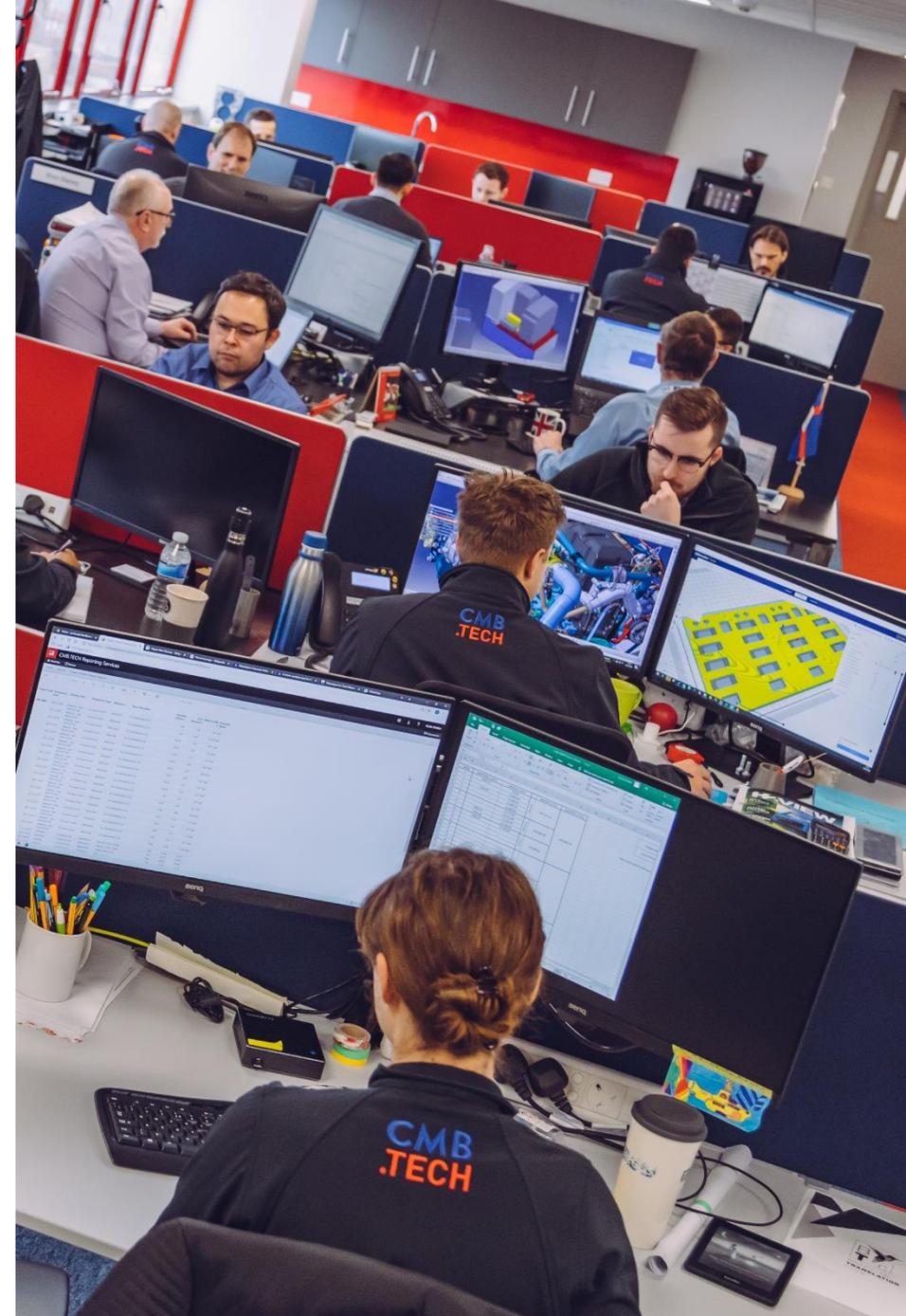


15 years of experience in engineering of low carbon solutions



Facilities include:

- Dyno test facilities
- Engine build workshops
- Prototyping
- Electrical & electronics build lab
- Fabrication
- Model studio



Green H2 and NH3 can decarbonize shipping

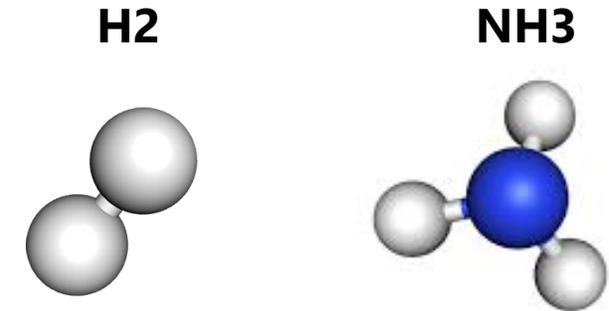
- Green hydrogen (H2) and ammonia (NH3) can decarbonize shipping

- How ?

- Mass production of green H2/NH3
- Lower the price of green H2/NH3
- Develop applications that can use green H2/NH3
- Develop and lower the cost of H2 storage
- Develop safety barriers for NH3 (toxicity)

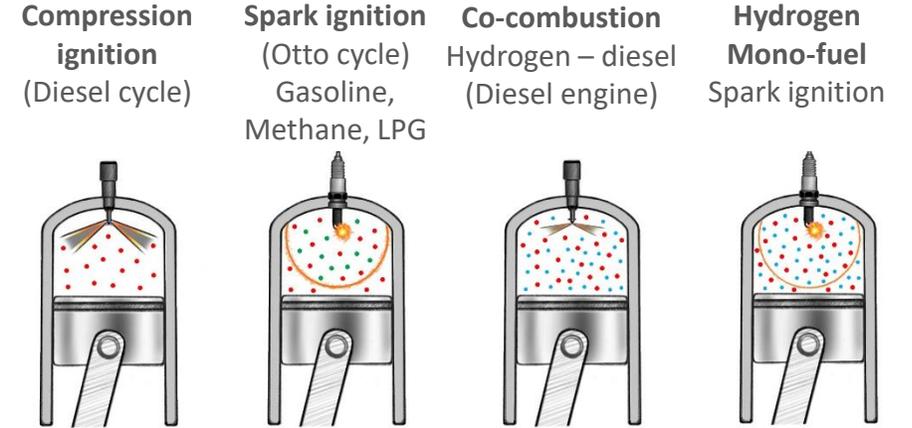
- **CMB's view :**

- **Compressed hydrogen for smaller ships/applications where frequent refuelling is possible**
- **Ammonia for larger vessels needing longer range/autonomy**

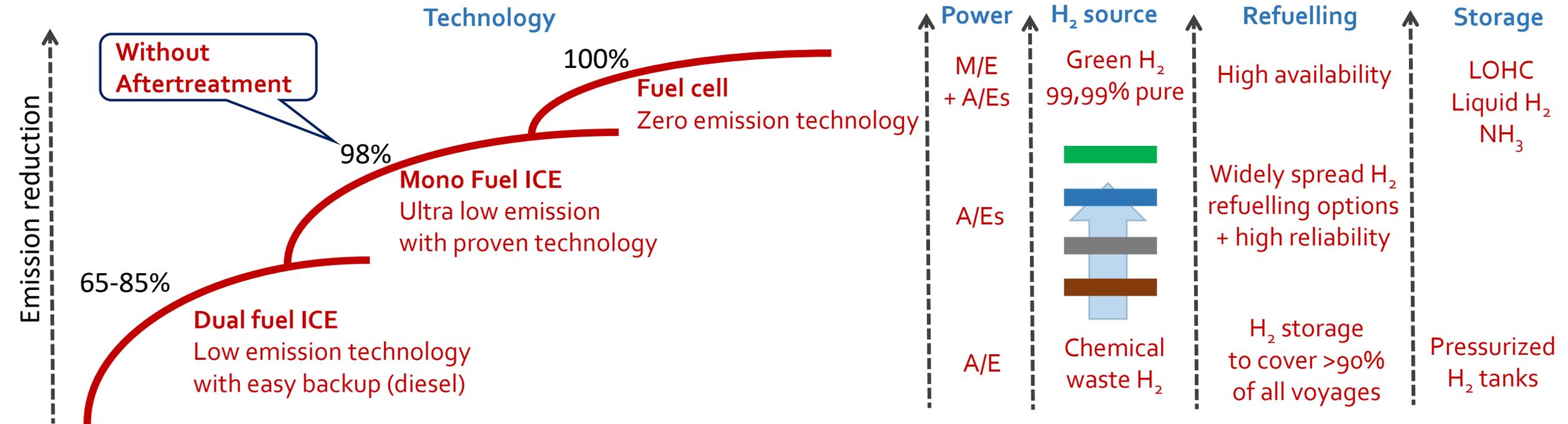


H2ICE technology

- There are two types of Hydrogen Internal Combustion Engines (H2ICE)
 - Dual fuel diesel-hydrogen engines
 - Monofuel hydrogen engines (spark-ignited)
- The H2ICE is a green, reliable and affordable technology
 - **GREEN** : burning hydrogen emits no CO2
 - **RELIABLE** : dual fuel technology allows for 100 % diesel back-up; mono-fuel hydrogen engines are robust, tried and tested technology
 - **AFFORDABLE** : H2ICE is only 10-30 % more expensive than regular diesel engines and much cheaper per kW than hydrogen fuel cells (high speed engines 100 USD per kW vs. 1.000 USD per kW for PEM fuel cells)



Heavy industries (such as shipping) require incremental innovation instead of disruptive innovation



➔ Dual fuel technology is a first step towards the zero emission goal, while the service can be guaranteed as one always can rely on diesel

CMB.TECH hydrogen projects



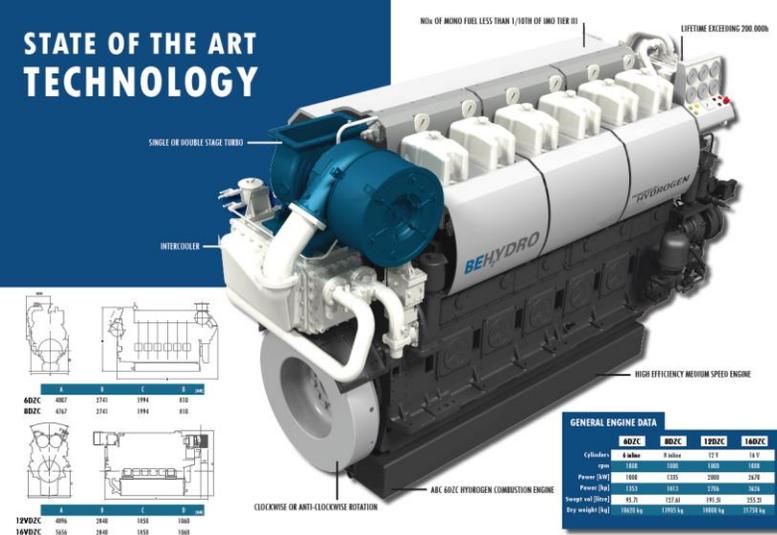


Hydroville

Launched November 2017

Hydroville is the first certified passenger shuttle that uses hydrogen to power a diesel engine.

STATE OF THE ART TECHNOLOGY



MINI OF MONO FUEL LESS THAN 1/10TH OF IMO TIER III

LIFETIME EXCEEDING 200,000

SINGLE OR DOUBLE STAGE TURBO

INTERCOOLER

BEHYDRO

HIGH EFFICIENCY MEDIUM SPEED ENGINE

CLOCKWISE OR ANTI-CLOCKWISE ROTATION

ABC 60ZC HYDROGEN COMBUSTION ENGINE

GENERAL ENGINE DATA				
	60ZC	80ZC	120ZC	140ZC
Cylinders	6 valve	8 valve	12 V	14 V
rpm	1000	1000	1000	1000
Power (kW)	1610	2225	3200	3670
Power (hp)	2175	3000	4300	5000
Stroke (mm)	85.70	107.00	105.00	105.00
Dry weight (kg)	1800 kg	1900 kg	1800 kg	2100 kg

60ZC 4007 2740 1994 810

80ZC 4257 2740 1994 810

120ZC 4000 2840 1950 1000

140ZC 5050 2840 1950 1000

Launched September 2020

Medium speed engine development
(1-> 2.66MW power range)

Dual fuel H₂-diesel as well as mono fuel H₂



HydroBingo

Delivery Japan Q1 2021

Shuttle (80pax) for the Japanese coastal waters. Powered with 2x 400kW hydrogen diesel combustion engines

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Hydrotug ***Delivery Q3 2022***

Hydrotug is a tractor tug built for the port of Antwerp. The vessel has 2x 2MW hydrogen diesel engines and 400kg of H₂ storage for daily use.



HydroCat

Delivery Q2 2021

Hydrocat is CTV (Crew Transfer Vessel) to be used for offshore wind parks in the North Sea

NH3 Bulker

Delivery China Q3 2023

210.000 dwt bulker powered by dual fuel ammonia-diesel engine



NH3 6.000 TEU

Delivery China Q4 2022

6.000 TEU ice class 1A high reefer container ship powered by dual fuel ammonia-diesel engine



Mobile shore power solution

In tendering with Port of Rotterdam

A BeHydro medium speed gen-set will be used to supply a large sea going ship with clean shore power.



Hydrogen Power Barge

Concept study ongoing

Mono fuel BeHydro gensets and hydrogen storage are installed on a barge to provide clean energy to ships. The barge can also be used for refuelling.

H2 freight locomotive

Feasibility phase

A 1MW freight locomotive will be retrofitted with 30kg of hydrogen storage to reduce emissions





Maritime & public H₂ Refuelling Station

Delivery Q1 2021

CMB is developing the first maritime & public H₂ refuelling station which is equipped with a 1.2 MW PEM electrolyser and 500bar tube trailer filling station

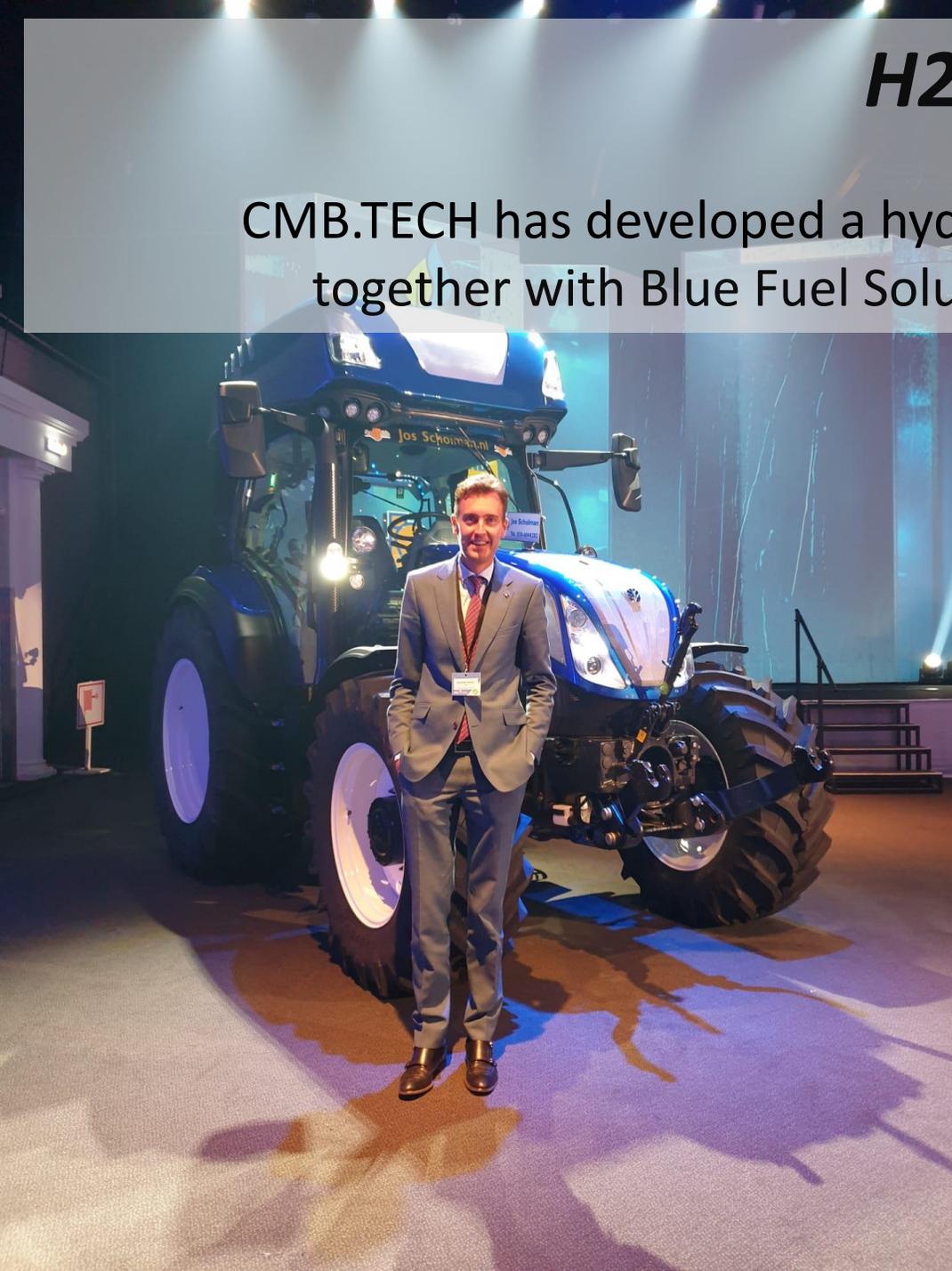
A unique combination of a public and marine refuelling station



H2 fuelled tractor

Launched October 2020

CMB.TECH has developed a hydrogen powered tractor together with Blue Fuel Solutions and New Holland



Green NH₃ production facility

Concept study

Construction of a 1,000,000 tonnes green NH₃ plant, 200 MW electrolyser and H₂ powered back-up generator unit in Namibia





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