



# TECO2030

## the Pathways to DECARBONIZATION



December 2020

The pathway to ZERO IMPACT EMISSION shipping



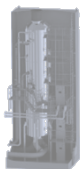
# CLEANTECH FOR THE MARITIME & HEAVY INDUSTRY



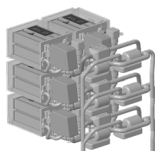
Providing technology, naval architecture, 3D Scanning, reversed engineering, automation and electronics, project management, installation, chemicals, maintenance, upgrades, ship repair, and services for clients in the marine and offshore industries



The Group serving approx. 500 ships worldwide on a yearly basis, been involved in more than 130 scrubber systems and more than 100 ballast water treatment systems since 2014



**TECO 2030 Future Funnel:** Current Future funnel consists of De-Sox system which comply with IMO 2020 regulations. Future developments PM/Black Carbon, NOx & CCS will be integrated to the existing system. Possible to fully integrate Engine Performance & Optimisation system



**TECO 2030 Fuel Cell:** Entered into a development agreement with AVL for purpose built hydrogen PEM Fuel Cell for Maritime and Heavy Industry (long durability and high power density)



**TECO 2030 Ballast Water Treatment System,** powered by BioSea with full Turnkey solutions

## TECO GROUP CLIENTS

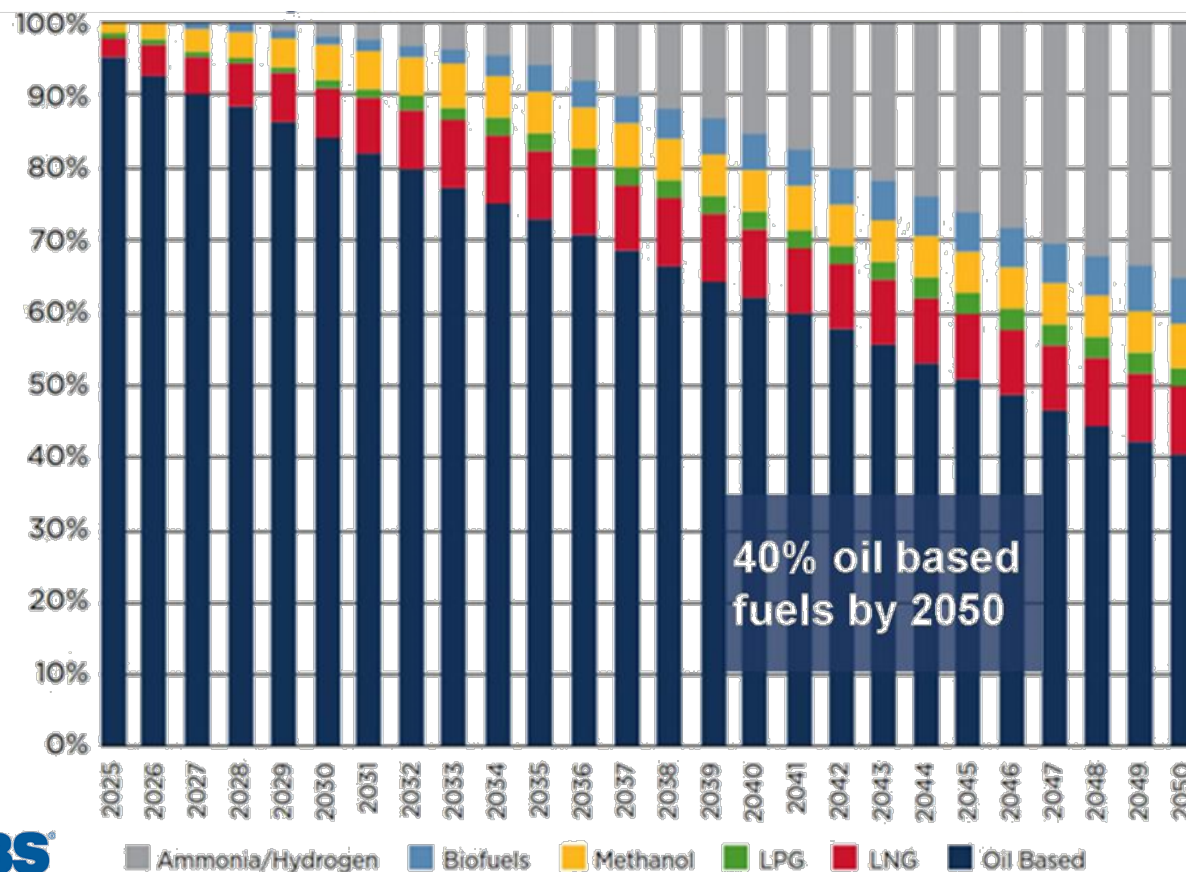


The pathway to ZERO IMPACT EMISSION shipping





# PROJECTED FUTURE MARITIME ENERGY MIX



Even under current plans, 40% of all vessel will be powered with fossil fuel engines by 2050

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# TECO 2030 FUTURE FUNNEL



[FUTURE FUNNEL VIDEO](#)

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# EMISSION CHALLENGES BY FOSSIL FUEL COMBUSTION



Sulphur Oxide (SOx) reduction



Nitrogen Oxide (NOx) reduction



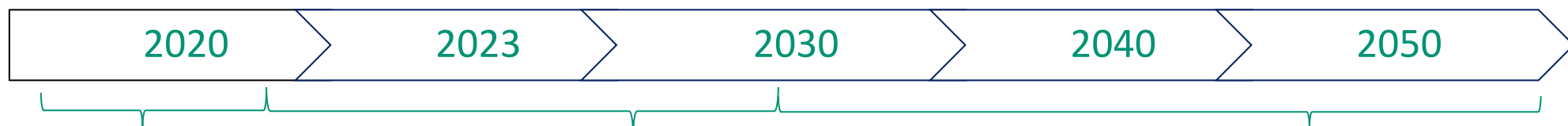
Particulate Matter (PM) reduction



Black Carbon (BC) reduction

Carbon Dioxide (CO<sub>2</sub>) reduction

## FUTURE FUNNEL ADAPTATION SCHEME



### Future Funnel Gen0

- SOx reduction eq. LSFO (0.1%<sub>s</sub>)
- 3% lower CO<sub>2</sub> emission compared to the LSFO
- Up to 94% PM reduction

### Future Funnel Gen1

- Remove Particulate Matter and Black Carbon for expected rules in 2023
- Upgrade for TIER III NOx legislation
- Integrate a Carbon Capture and Storage System, EEXI and IMO 2030 goal.

### Future Funnel Gen2

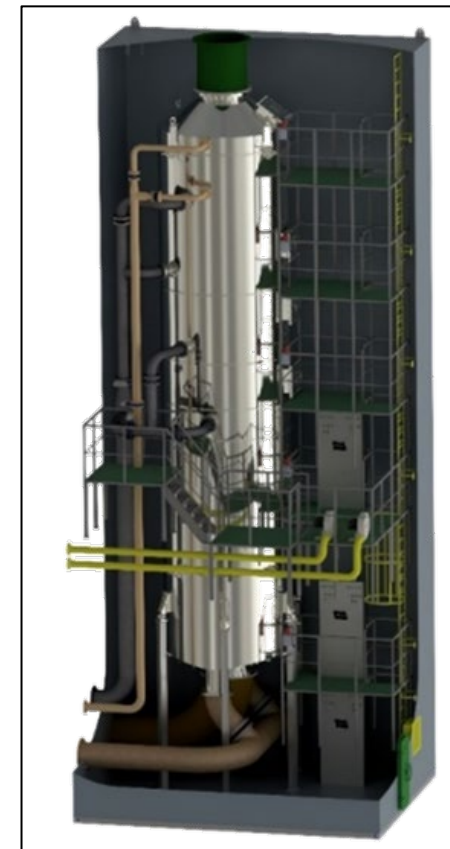
- Enable ZERO IMPACT EMISSIONS

All future developments can be integrated into existing systems

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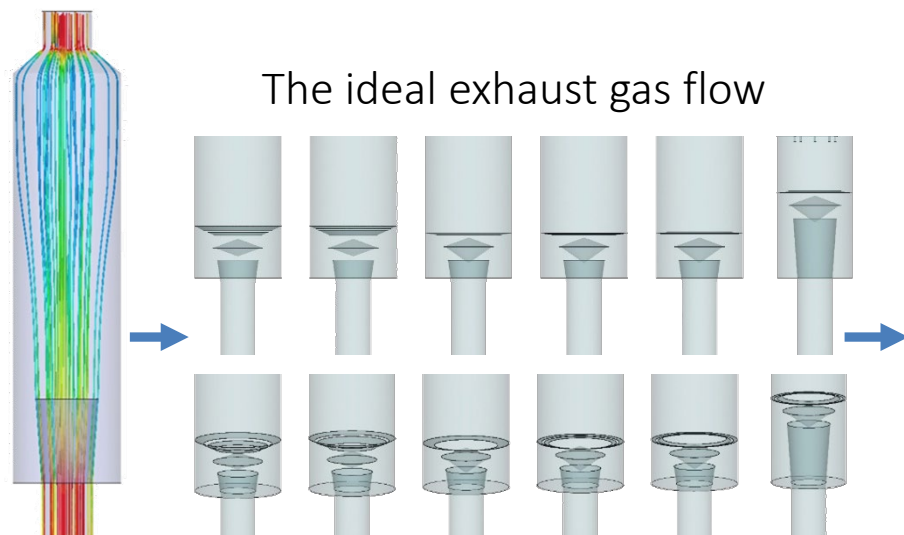
# WHY CHOOSE FUTURE FUNNEL?

- Adaptable for future emission legislations (EEXI/BC/PM)
- High SO<sub>x</sub> removal efficiency up to 99.9%
- Low CAPX and OPEX
- Open-loop, hybrid, closed and hybrid ready systems
- Adaptable design to all ships and all engine types
- High Quality, low complexity approach
- Full turnkey solution; 3D scanning, engineering and prefabrication, installation, and commissioning through TECO affiliates



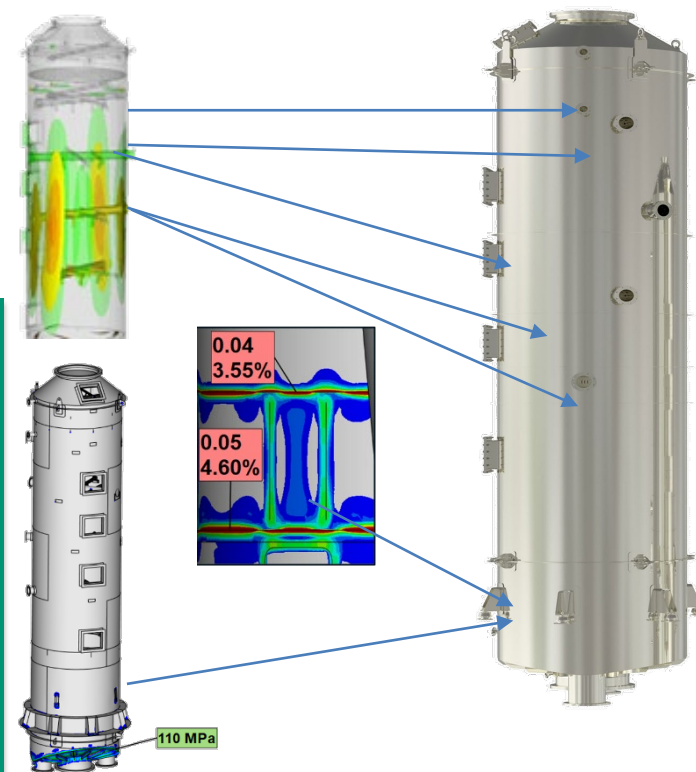
# FUTURE FUNNEL - GEN 0 DESIGN

- Operated on worst operating conditions as basis
- Lessons learned from 130 + scrubber installations incorporated in the design
- Total design effort equal to 20 years of realistic operation
- Competitive package CAPEX and predictable OPEX for all engine sizes
- Simulated with computational Fluid Dynamics (CFD), Thermal Shock (LCF), Eigen-frequencies & vibration (HCF) and Finite element modeling (FEM)



The ideal exhaust gas flow

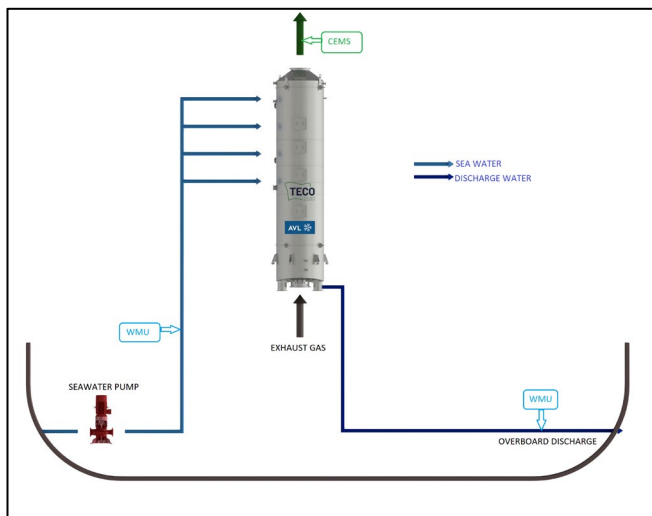
- Stable and robust design
- Suitable for dry run
- Tested to avoid deformation and cracks
- Simulation of worse cases
- Vibration safe design
- Low back-pressure <15mbar
- High exhaust uniformity (UI>0.95)
- High efficiency of PM and SO<sub>2</sub> absorption





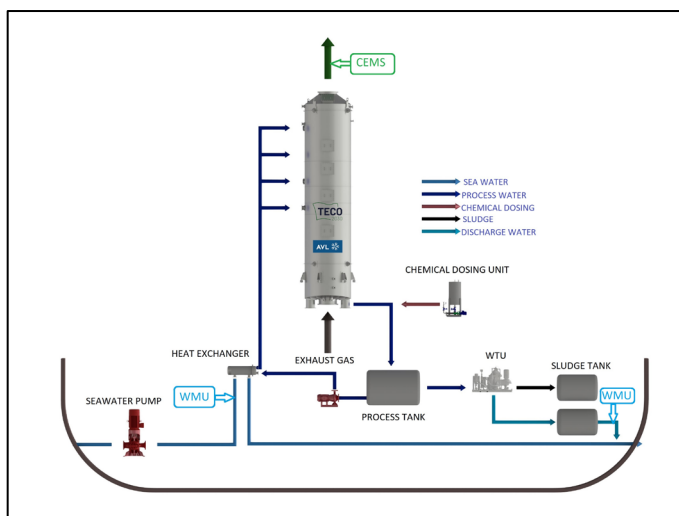
# FUTURE FUNNEL - GEN 0 PROCESSING OPTIONS

- Sulphur from the exhaust gas mixes with sea water inside the tower.
- pH, Temperature, Turbidity and PAH are constantly monitored by Water Monitoring Unit (WMU).
- Clean exhaust gas is monitored continuously by Continuous Emissions Monitoring system (CEMS).



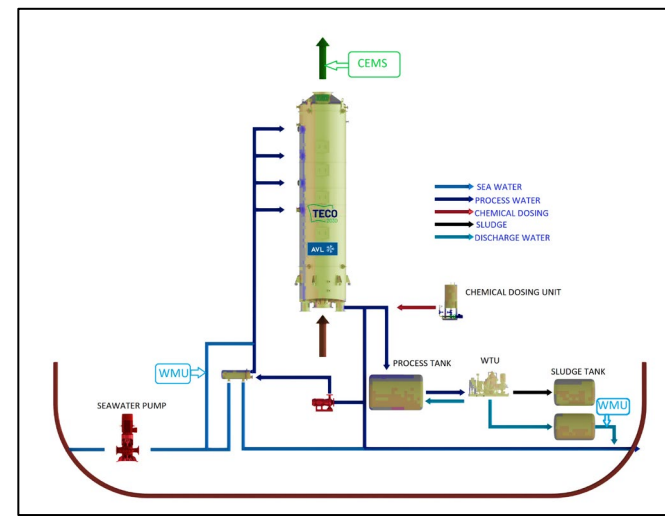
Open Loop System

- Sulphur in the exhaust gas dissolves in the process water pumped from the process tank.
- Alkali is added in the process water to maintain the alkalinity for scrubbing.
- Process water will be cleaned by the water treatment unit.
- Clean exhaust gas is monitored continuously by Continuous Emissions Monitoring system (CEMS).



Closed Loop System

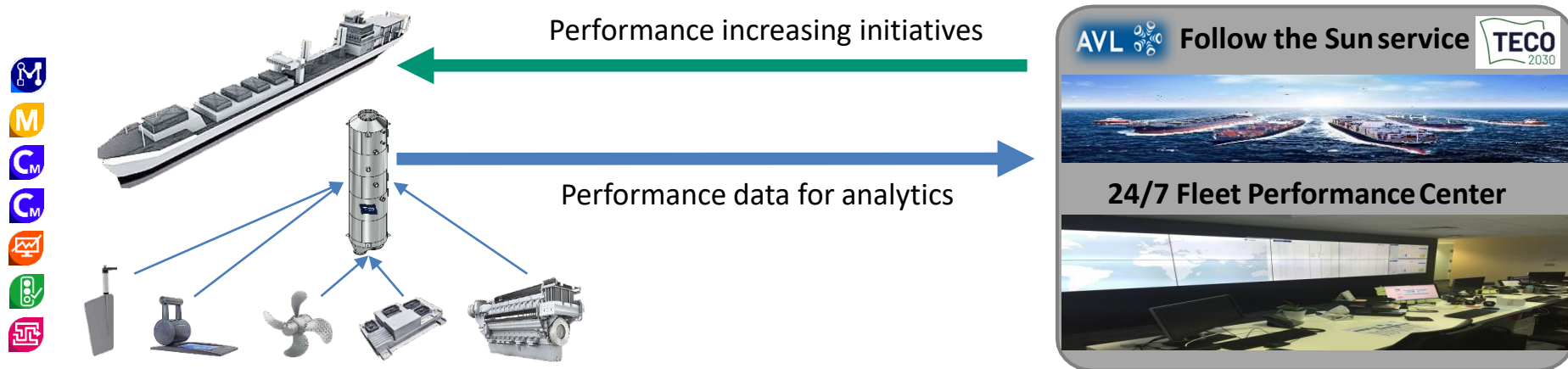
- Hybrid scrubber system can run in both closed or open loop mode.
- No need of chemicals in open loop mode.
- Flexible operations in low alkaline waters.



Hybrid System

# FUTURE FUNNEL - REAL TIME DATA ANALYTICS

- TECO Future Funnels are equipped with the capabilities of Data-Analytic Driven Real Time Simulation and Diagnosis tools enabling vessel specific performance improvements.
- Each installation can offer full vessel analytics with regular efficiency improvement options reports



# ENGINE PERFORMANCE OPTIMIZATION SYSTEM

## Expert Condition Monitoring System

- for all Large-Bore Engines (2-/4-strokes)
- for all Fuels (HFO, MDO, Gas, ...)
- for all Applications
- for Newbuilds and Retrofits



More than 125 installations on

- Car Carriers
- Container Vessels
- Crude Oil Carriers
- RoPAX Ferries
- Cruise Liners
- Locomotive
- Power Plants

Permanent evaluation of engine behavior with regards to reliability, performance and emissions

Operators benefit from early fault detection, avoidance of sever engine damages & fuel savings (up to 3 %)



Flexible system concept allow integration of other components and integration into other systems.

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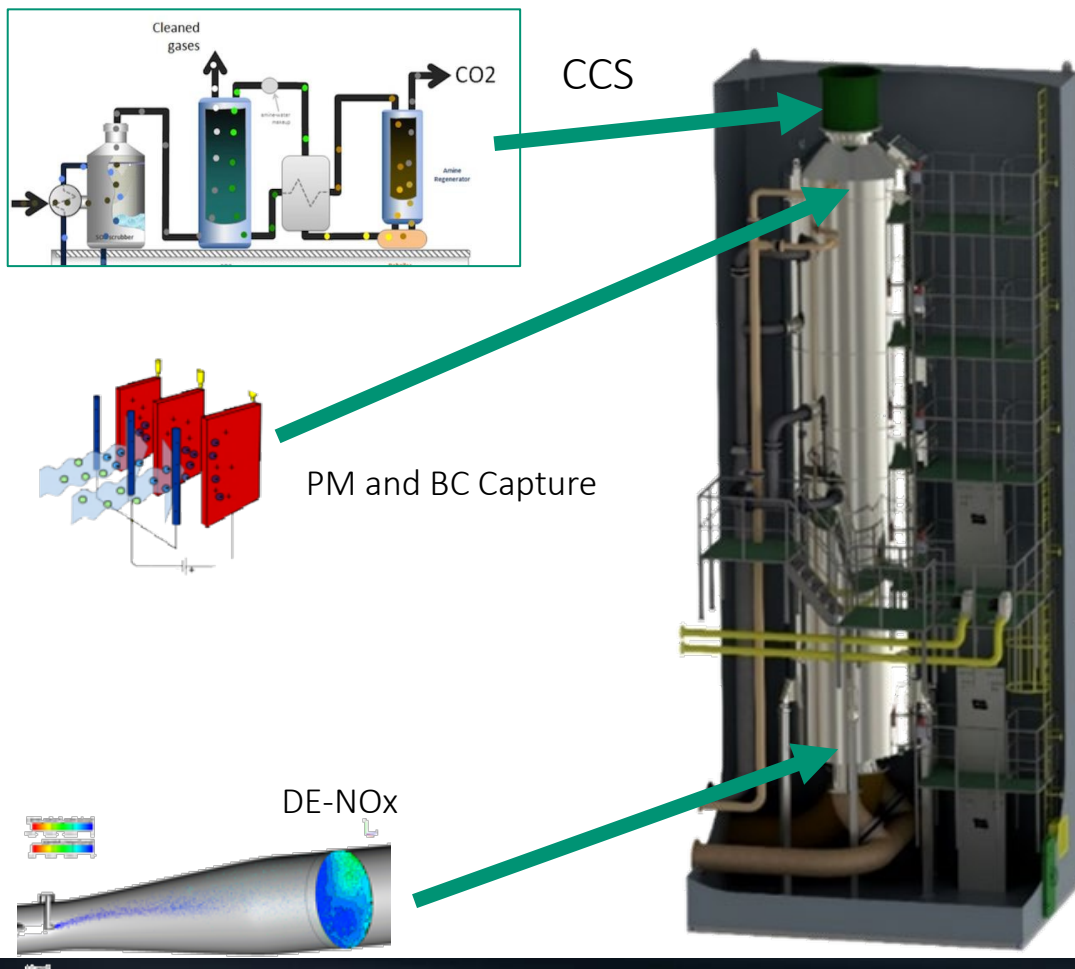
# PRODUCTION OF FUTURE FUNNEL IN EUROPE



TECO Future Funnel produced in Germany to the highest quality European standards.

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# FUTURE FUNNEL GEN 1 – DEVELOPMENT



Remove Particulate Matter and Black Carbon for expected rules in 2023

Upgrade for TIER III NOx legislation for NECA Areas

Integrate a Carbon Capture and Storage System for EEXI efficiency rating improvement expected in 2023

## FUTURE PROOF VESSEL OPERATION

The platform will enable the shipowner to reduce emissions to air, comply with current and future legislations while gaining required efficiency index rating.

The operational data from the system can be monitored by TECO.

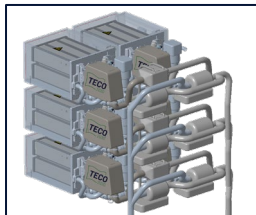
Continuous efficiency optimization through benchmark simulations and engine optimization options.



# STRATEGIC PARTNERSHIP WITH AVL

AVL is the world's largest independent company for the development, simulation and testing of powertrain systems for ships engines, cars, construction and commercial vehicles, as well as large engine applications for power plants, trains, mining and other heavy machinery. 2,- Billion EUR in sales in 2019, 10% of yearly sales goes back to into R&D, 11 500 employees, HQ Graz, Austria.

The company has decades of experience in the development and optimization of powertrain systems for all industries. As a global technology leader, AVL has extensive experience in design, development, simulation and testing of ship engines on behalf of engine OEM (original equipment manufacturer) operating in our sector.



TECO 2030 Marine Fuel Cell



Tractor | Vehicle



Construction



Racing



TECO 2030 Future Funnel



Marine

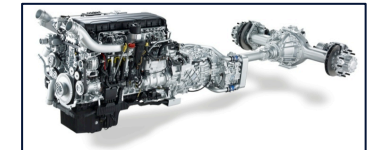


Power Plants



Commercial Vehicle

## Powertrain Engineering



## Development Platform



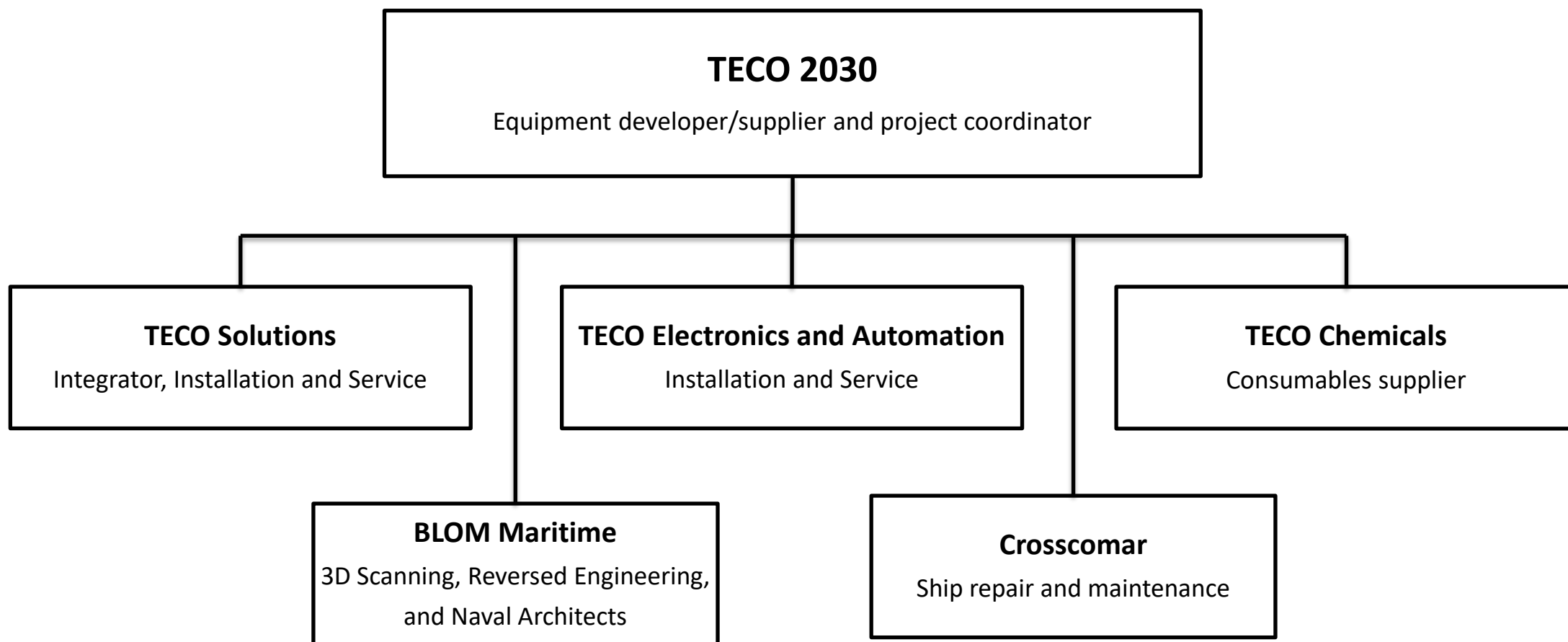
## Simulation & Testing

All IP and PATENTS developed is owned 50/50 with TECO/AVL. All commercial right belongs 100% to TECO 2030 ASA Group of companies

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# TECO 2030 TURNKEY INSTALLATION AND AFTERSERVICE



# TURNKEY INSTALLATION/SERVICE PARTNER

## TECO Solutions

- Specialists in marine system integration on vessels in service, alongside or/and in dry dock.
- Provides all-inclusive package including planning, project management, material delivery, logistics, installation, surface treatment, problem solving and assistance with commissioning
- Operating since mid 1990s with a crew of approximately 300 technicians TECO Solutions have amassed a wide variety of experience installing systems in the Cruise, Merchant and Offshore sectors
- Installing system components along with all associated, foundations, piping and electrical materials
- Comprehensive company structure with key positions in Manning, Purchasing, Project Management, HSEQ and Sales.

## Experience on MSC and GNV vessels

- EGCS installations on MSC Orchestra, Musica, Poesia, GNV Majestic (GRE Piping) and contracted installation on GNV La Superba (GRE and SMO piping)
- Steel/Repair work on MSC Armonia, Fantasia and Preziosa



Experienced installation company with more than 100 EGCS and 40 BWTS installations

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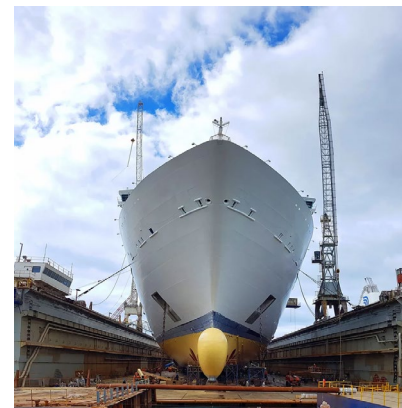
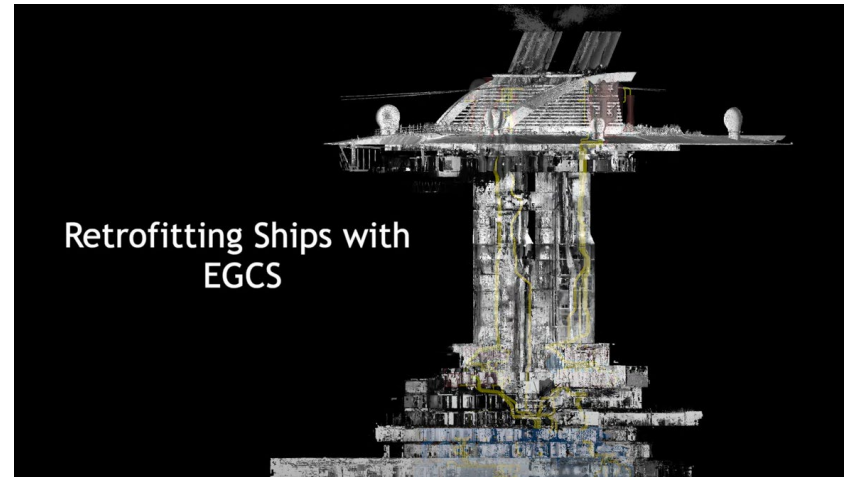
# TURNKEY SCANNING & ENGINEERING PARTNER

## BLOM MARITIME

- Locations for 3D Laser scanning in 6 places around the world.
- Completed more that 126 EGCS retrofit engineering projects for a variety of makers and clients like Frontline (26) and Maersk Line (34), NCL, CCL and RCCL
- BLOM has 50+ engineers and naval architects and perform virtual engineering at high standards

## Experience on MSC and GNV vessels

- Participated in 3D Laser scanning on the Musica Class MSC Cruise vessels.
- Executed scanning and retrofit engineering for 5 GNV vessels
- Quoted the EGCS retrofit project for MSC Lyrica class



Experienced company with more than 150 retrofit engineering project completed

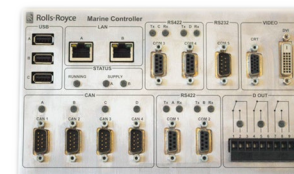
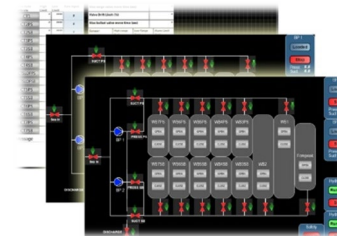
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# ELECTRONICS AND AUTOMATION PARTNER

## TECO Electronics AS

- Highly skilled service engineers in the field of maritime electronics and automation.
- On-site services with highly skilled service engineers. All personnel has offshore operations experience and equipped with a selection of electronics spares to tackle the basic on-site repair.
- Highly advanced diagnostic tools for pinpointing problems in a larger system, even in obsolete and poorly documented automation systems.
- Specialized in retrofitting Marine Automation Systems, either redesign or system replacement. As example IAMCS systems from makers like Norcontrol/Kongsberg, Autronica, Lyngsö, ABB, Siemens amongst others.
- Redesign and implementing existing functions to a new platform enabling enhanced functionality, increased maintainability at reduced cost.
- Specialized in repairing printed circuit boards (PCB). Capabilities and spares on stock inhouse for repair.
- Supplied calibration- and test equipment to the marine industry for more than **20 years**. (comply with E0 regulations)



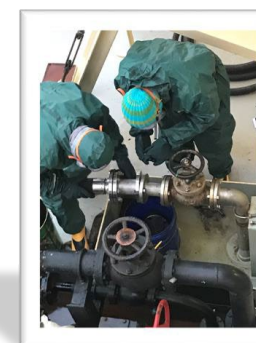
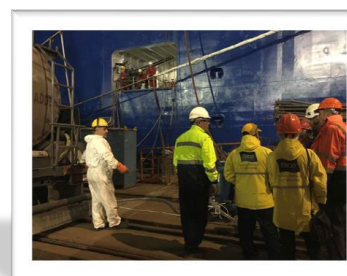
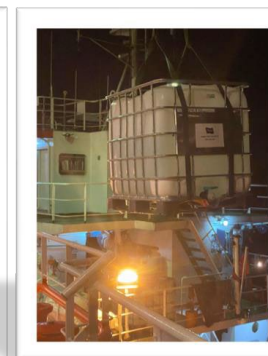
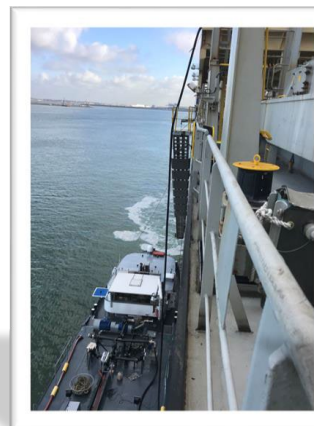
More than 30 years of experience in the field of marine electronics and automation

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# CHEMICAL SUPPLY PARTNER

## TECO Chemicals

- Extensive knowledge and experience in supplying Caustic Soda, Urea, Sodium thiosulphate, Sodium sulfite, Magnesium powder/slurry, raw material and cleaning chemicals
- Supply from barge, truck or IBC with high grade quality chemical resistance hoses
- Dedicated work force, specialized to secure a safe operation, with license for handling Hazardous substances
- TECO Chemicals can provide long range suitable hoses and additional pumping machine to handle high/long distance supply, required for vessels or delivery points



Worldwide supply network combined with competitive offerings

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# SHIP REPAIR AND MAINTENANCE PARTNER

## Crosscomar

- Reputable ship repair & marine service company offering an integral repair service, in all Spanish ports.
- headquarters are presently located at Algeciras
- Experienced workforce ready for immediate mobilization and will complete the work when ships are at anchorage, alongside or on voyage
- Our experience covers the following fields:
  - Steel work ( renewal/repair of steel, ballast, hatch and load test of cranes and derricks. Piping fabrication and repairs and installation ).
  - Engine (repair of ME & AE engines , boiler and more)
  - Workshop fabrication (steel structures, pipelines, sea fastenings etc.)
  - Tank/Cargo Hold cleaning and painting.
  - Underwater/diving repair works
  - Turbo, service, balancing, micro-blasting and repair of T/C's
  - Load test and certifications
  - Anchor & chains



Strategically located in Algeciras/Gibraltar



# TECO 2030 SPEAKS TOMORROW



## VIRTUAL FORUM DECARBONIZING SHIPPING

### DECEMBER 15TH

06:00 AM MIAMI | 12:00 HAMBURG  
15TH OF DECEMBER, 2020

**REGISTER FOR FREE!**

#### MAIN SPONSOR



#### OTHER SPONSORS



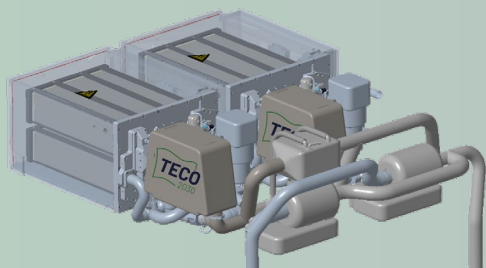
#### MAIN MEDIA PARTNERS



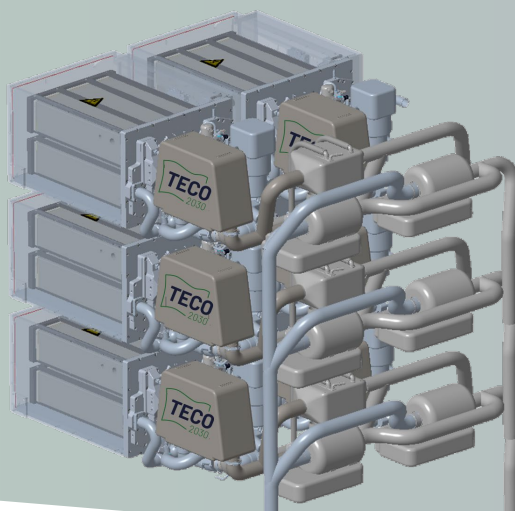
TECO 2030s Tore Enger will speak on the Virtual Forum – Decarbonizing Shipping 15<sup>th</sup> December

# TECO MARINE FUEL CELL

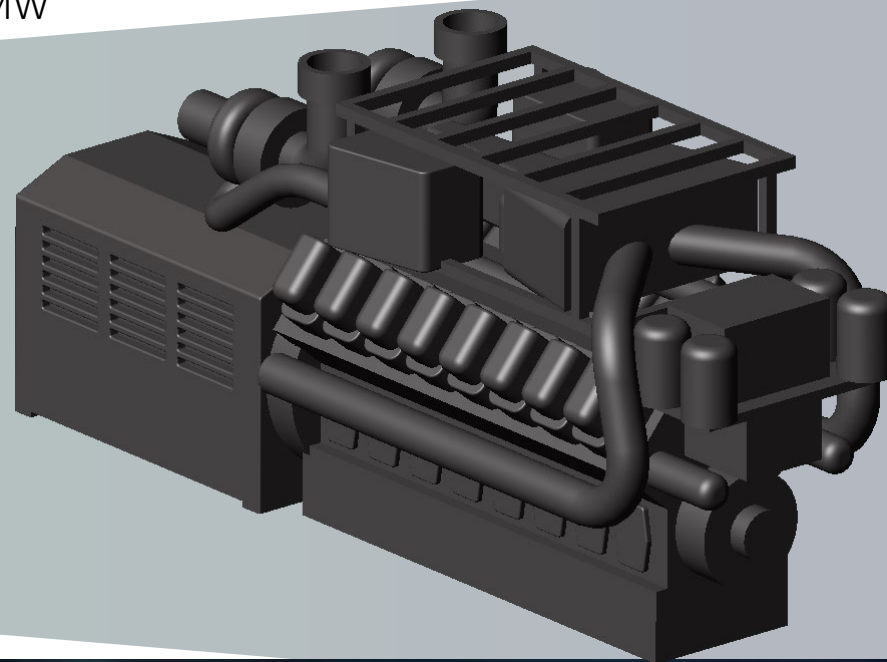
- Efficiency: Peak FC efficiency of 56% vs. peak engine genset efficiency of 48%
- Dynamic Response: Similar to a large diesel engine while using only a small battery pack for start-up
- Redundancy: FC potential loss of fraction of effect vs. diesel engine being binary
- Components: FC consist of approx. 500 vs. diesel engine consisting of approx. 2,200
- Installation size: Current prospect portfolio ranges from 400kW to 25MW



TECO Fuel Cell System 400 kW



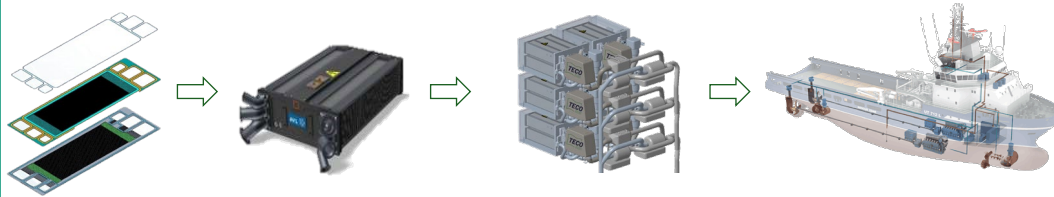
TECO Fuel Cell System 1.2 MW



1.2 MW Diesel Genset

# AVL FUEL CELL DEVELOPMENT

## Integration & Application Development – From Cell to Vessel

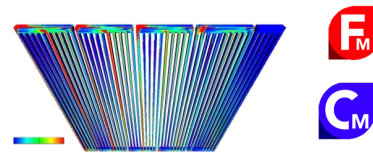


## Fuel Cell System Development

PEM + SOFC



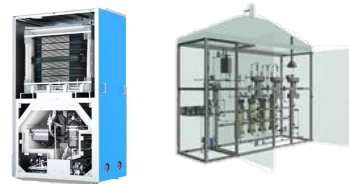
## Fuel Cell Simulation Tools



## Fuel Cell Test Systems



## Energy Storage & H<sub>2</sub>/Synfuel Production



Hydrogen Council

"AVL aspires to contribute to the rise of a complete hydrogen ecosystem for new mobility and energy solutions. We strongly believe in a much broader use of hydrogen as a major energy carrier to transform our energy system towards renewable resources such as wind and solar."

**PROFESSOR HELMUT LIST**

Chairman & CEO, AVL

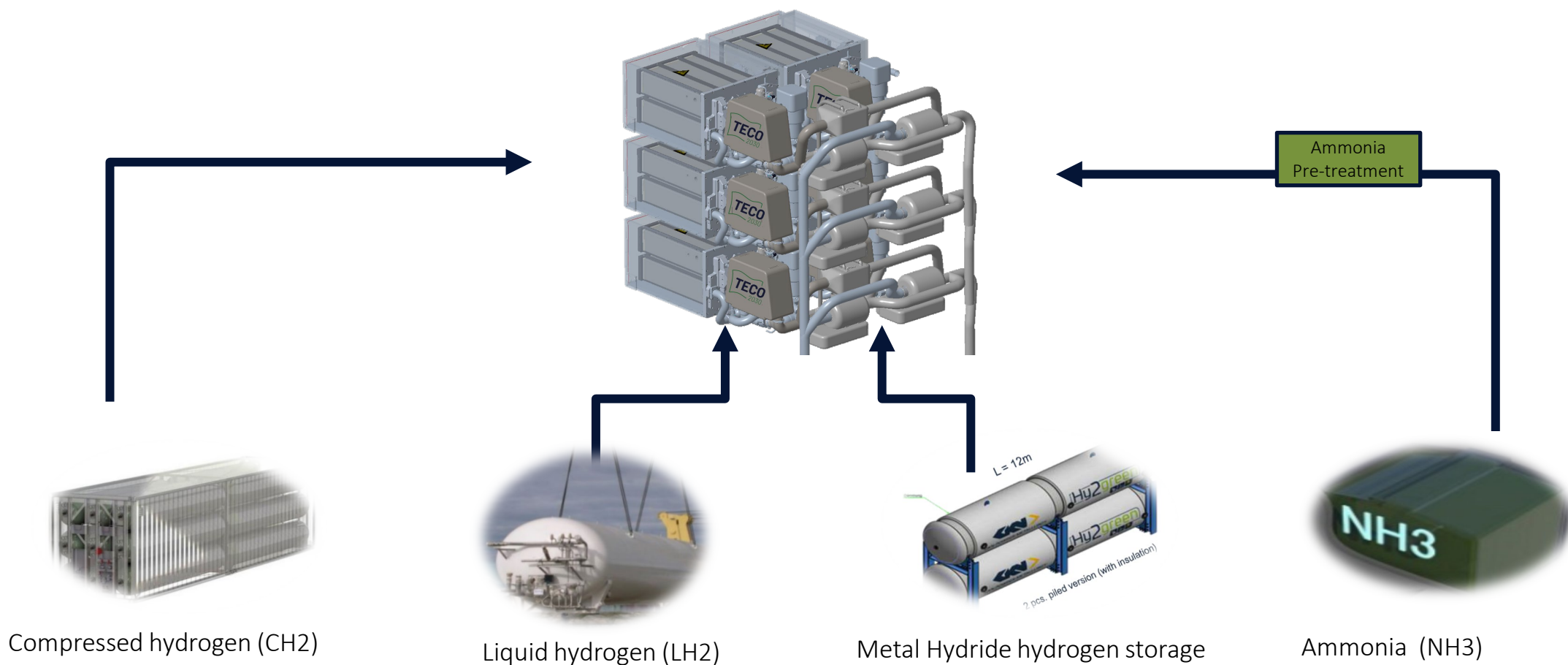
## Fuel Cell test center

- Fuel cell system test rigs (up to 400kW)
- Test rigs for all subsystems & components
- Capacity up to 20 test rigs

AVL owns 4 times more fuel cell patents than all competitors combined  
450 engineers in fuel cell powertrain, testing and simulation



# FLEXIBLE FUEL APPROACH



TECO 2030 can deliver full or partial turnkey projects in combination with partners to provide tailor made solutions fitting for each project.

# Powering the maritime industry's towards less emission

Call Oslo + 47 977 71 422  
Call Miami + 1 305 833 6510  
Call Singapore + 65 9634 1744



[post@teco2030.no](mailto:post@teco2030.no)

thank you

[www.teco2030.no](http://www.teco2030.no)

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