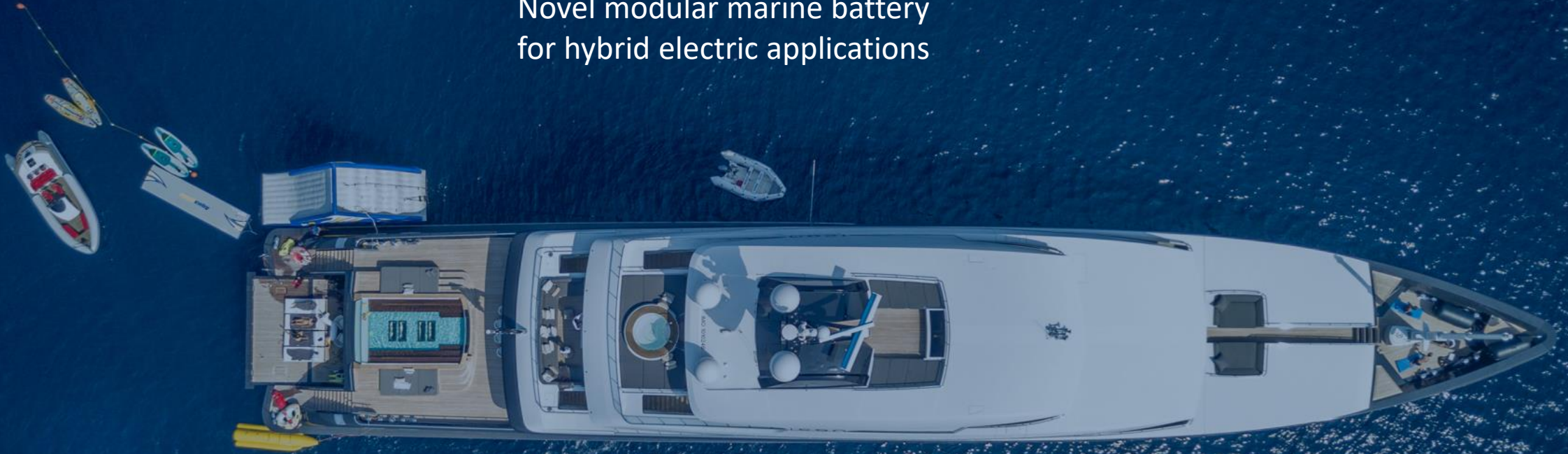


EASy Marine®

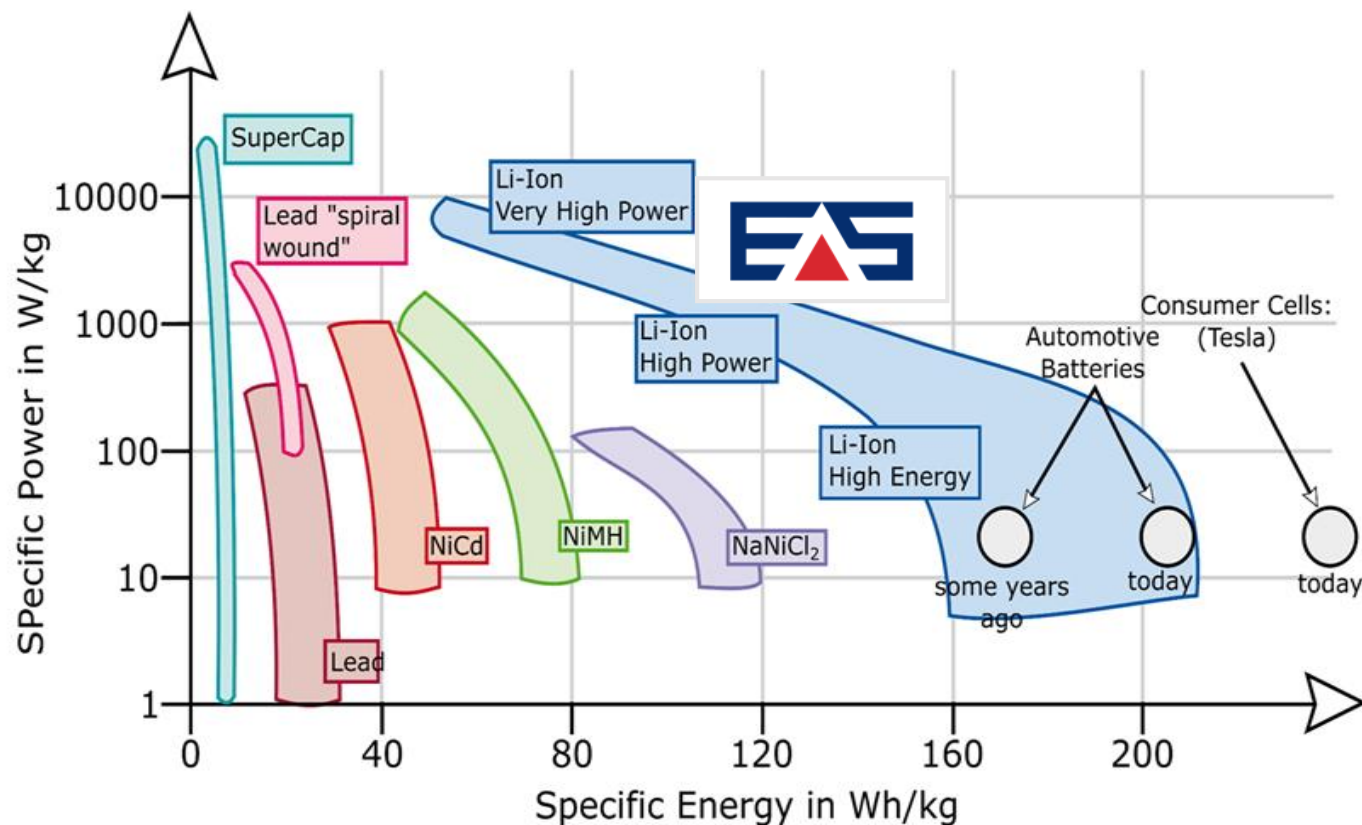
Novel modular marine battery
for hybrid electric applications



EAS Batteries GmbH

Dr. Frank Diehl
Greece – September, 2019

EAS market positioning



Focus on LFP and high power (>25C)

One diameter (60mm) and two lengths (130mm and 203mm) – extremely sturdy

Very flexible electrode production line with low start up costs

Separate power and energy anodes, separators and electrolytes per application

Own battery development and production capabilities with own battery portfolio with integration capabilities into complete system solutions

Focus on non road mobile machines and other industrial applications

EAS Cell Portfolio



7.5Ah NCA / 3.6V UHP
Ultra High Power



10Ah NCA / 3.6V HE
High Energy



22Ah LFP / 3.2V HP
High Power



40Ah LFP / 3.2V HP
High Power

Stainless steel construction avoids corrosion and provides shock resistance

Simple connections ease operational use and provide low resistance interface

High maximum pulse discharge to meet exceptional peak demands

Large cell size reduces the number of interconnections and the demand on management system

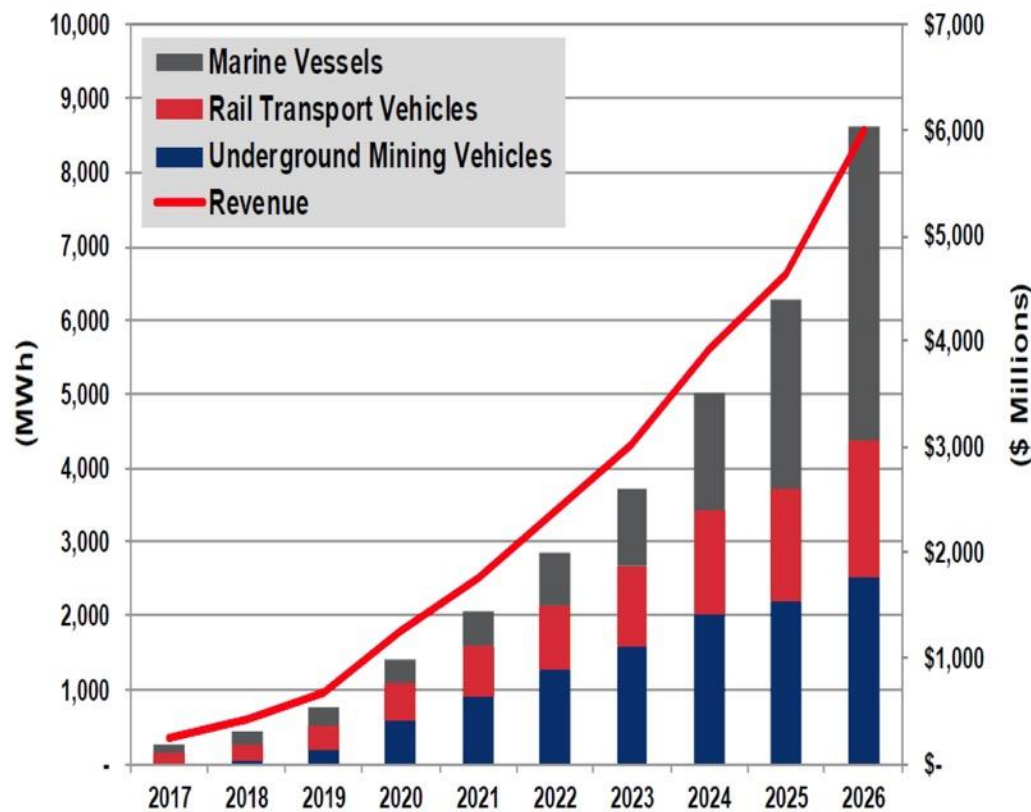
SAFETY FIRST



Made in Germany

EAS Market Focus

Chart 1.1 Non-Automotive Transportation Advanced Battery Pack Energy Capacity and Revenue by Sector, World Markets: 2017-2026



(Source: Navigant Research)

1. Marine Vessels
2. Underground Mining Vehicles
3. Rail Transport Vehicles

Special focus on hybrid electric applications to capitalize on the excellent high power cell characteristics.

Main EAS market focus – starting with a specialized marine 38V marine module in 2018/2019.

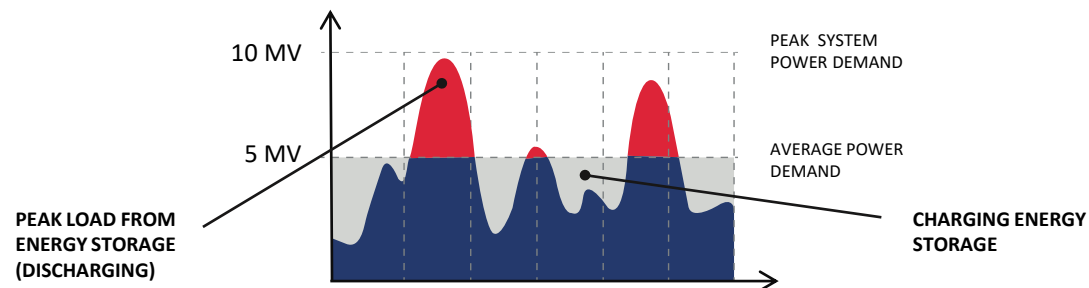
6 billion USD market by 2026

EASy Marine® Applications

SPINNING RESERVE

LOAD REDUCTION

PEAK SHAVING



FULL ELECTRIC FERRIES

HYBRID FERRIES

ELECTRIC CRANES

MATERIALS HANDLING

Performance
needs

HIGH ENERGY

HIGH POWER

FULLY
ELECTRIC

SPINNING
RESERVE
(HYBRID)

SHORE
STATIONS
(FAST
RECHARGE)

ENERGY
RECAPTURE

Use cases

FAULT RIDE
THROUGH
(HYBRID)

LOAD-LEVELING
(HYBRID)

PEAK SHAVING/
TRANSIENT LOAD
MANAGEMENT

PROPULSION

Applications



Advantages of hybridization

UNLIMITED RANGE

Range extender via liquid fuel such as diesel, H2, etc.



MOST EFFICIENT USE OF DIESEL FUEL

Sweet spot only operation



FREEDOM OF DESIGN

New and more efficient ship designs possible



SAVINGS

Fuel, generators power, maintenance, back-up systems, torque for efficient propeller, etc.



OPTION TO SAIL FULLY ELECTRIC

harbour cruise, hotel load support, meeting regulations



USE OF EXISTING INFRASTRUCTURE

No additional charging infrastructure on land necessary, sail where you want

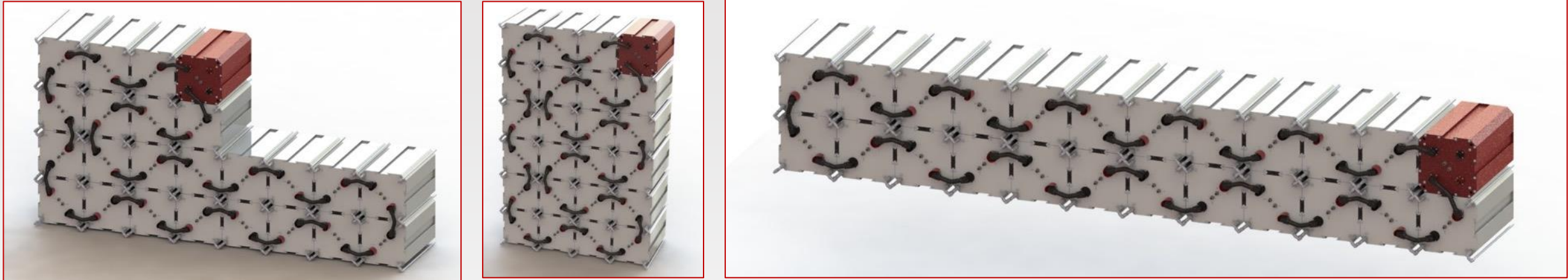


FIT FOR FUTURE

Getting ahead of the industry learning curve of becoming electric, cement important partnerships



Flexibility & Serviceability (System level)



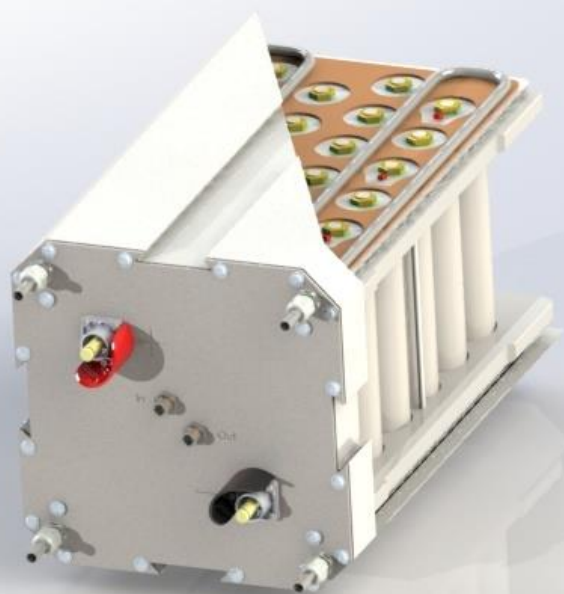
Configuration examples for 922 V DC strings (24 modules) incl. BDU

EASy to fit

EASy to operate

EASy to maintain

Certificates on module level



DNV-GL

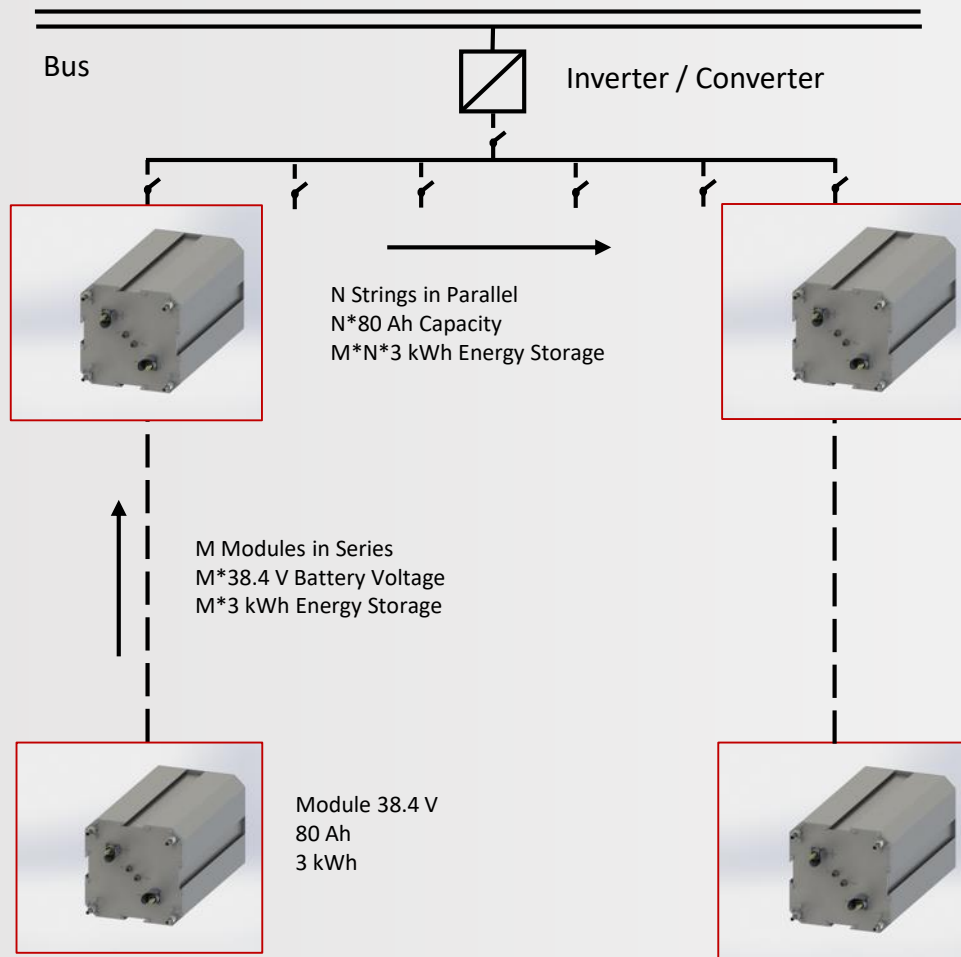
UN 38.3

EN62619

EN62620



System Flexibility – Electrical Design



Battery system voltage of up to 1,500 V by connecting up to 36 modules in series is possible

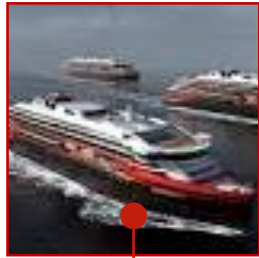
Energy storage capacity of a single series string up to 110 kWh at 1,500 V

Power capability of string with a voltage of 1,500 V

- continuous 500 kW
- peak (5 s) 1.3 MW

Battery system capacity can be expanded without limitation in steps of 80 Ah

EASy Marine® - Developed to your requirements



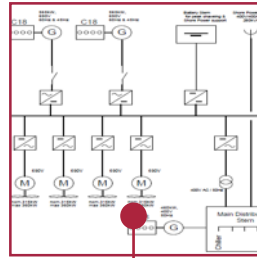
Application requirement

User, ship operator



System requirement

Customer (shipyard, integrator) and EAS



System layout

Partner (shipyard) and EAS



System integration

Partner and EAS



Battery layout

BMS, cooling, electrical layout - EAS



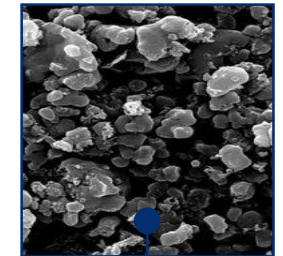
Module

EAS competence made in Germany



Cell

EAS competence made in Germany



Material

EAS supplier – more than one internally certified supplier for each critical material

Why EASy Marine®

HIGHEST POWER IN CLASS
5C Constant – 15C Peak



LOWEST PRICE PER kW
<250 EUR/kW on system level for constant power



MOST FLEXIBLE ARCHITECTURE
Module based, no rack

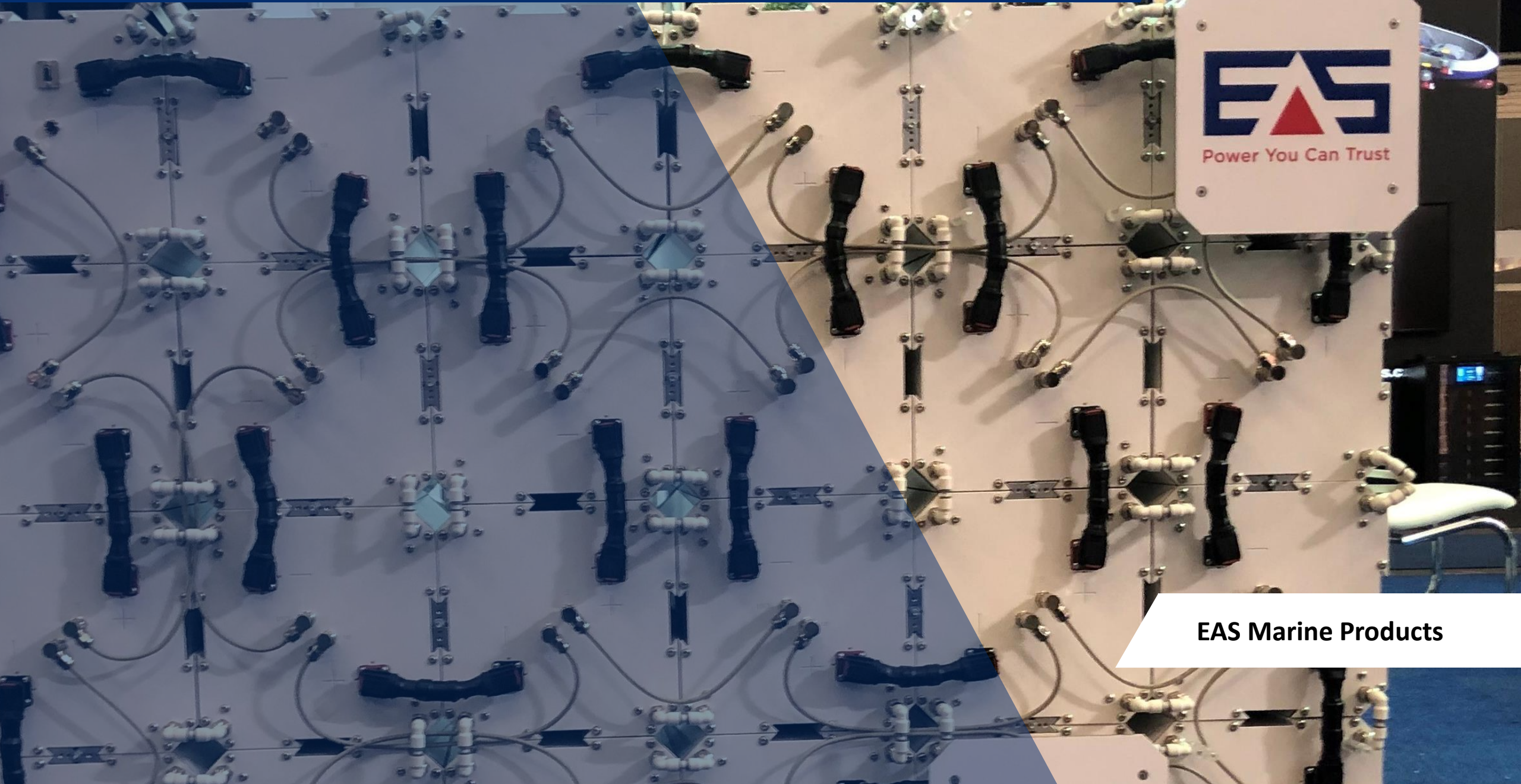


VERY SAFE AND RELIABLE CHEMISTRY
No fire, no propagation, highly enduring cells



VERTICALLY INTEGRATED COMPANY
Cell, cell block, battery system → one stop shop





EAS Marine Products



Submarine – TKMS & Uboat Worx



Marine - Planet Solar

RACE FOR WATER

A FOUNDATION TO PRESERVE WATER



POWER YOU CAN TRUST

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+49 3631 46703-213