

Reduce costs and emissions

Baumüller Marine Solutions

be in motion

Practical solutions for a clean future



Emissions-free drive solutions

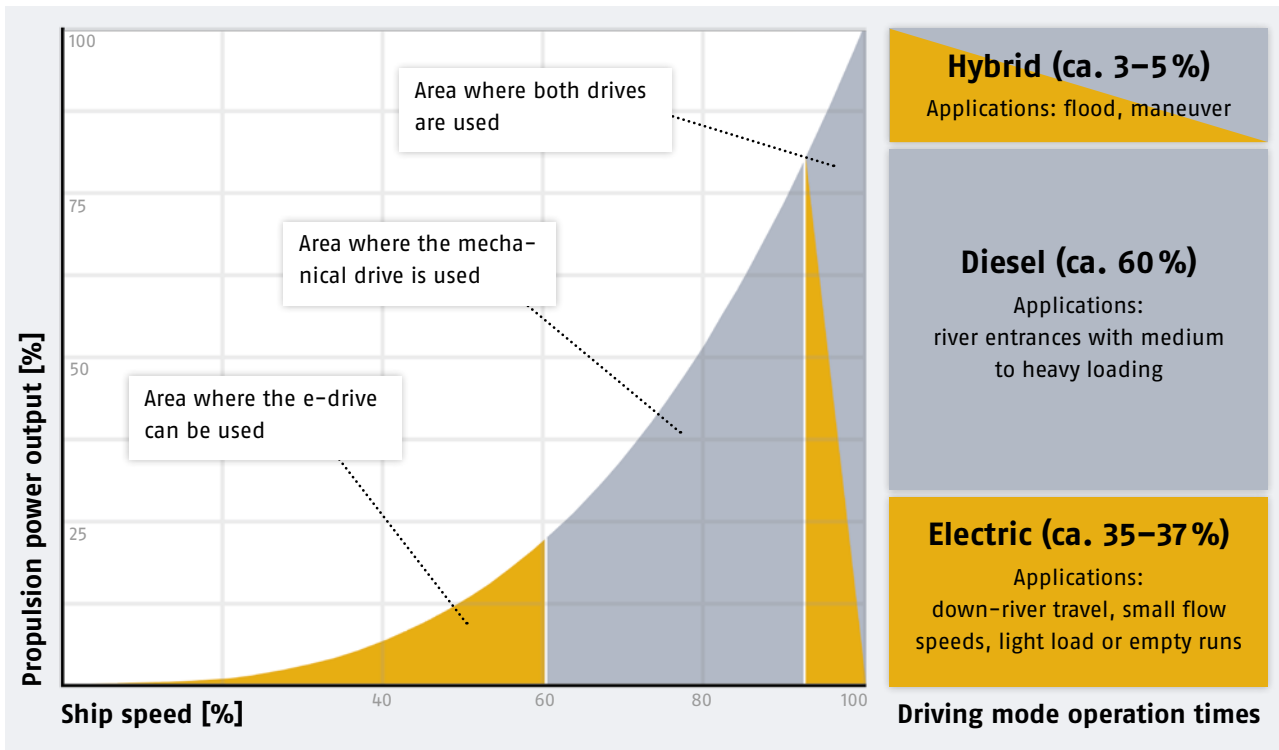
Baumüller has been active in the electromobility sector for many years: The family-owned company, with just under 1,900 employees, supplies electric motors and complete drive systems for ships, wheel loaders and other commercial vehicles. And the goal is always to reduce emissions.

“Electromobility has been a resounding success in commercial vehicles and mobile working machines”. This self-confident statement from Andreas Baumüller, Managing Shareholder of the Baumüller Group, appeared in the Handelsblatt business newspaper in July 2019.

Our projects in this sector are manifold: A hybrid ferry on the River Weser is driven by Baumüller technology, also an electrical ferry in Taiwan as well as the first compact loader with rechargeable lithium-ion battery.

The major advantage of Baumüller is that we have expertise acquired from 90 years of industrial electric drive technology. Although e-mobility solutions clearly differ from those in industrial applications, Baumüller's development and production skills can nonetheless be used here optimally.

Conventional drives: Designed for load peaks



Conventional diesel drive systems for ships are designed for maximum load. However, on average, only 2% of the route is covered under full load. In hybrid drive systems the power of the diesel motor can be reduced and so the overall efficiency is improved.

Driving within the optimum speed range not only reduces emissions but also fuel consumption.

Your advantages with a pure e-drive (fully electric system)

- **Highly energy-efficient** – lower consumption than with classic solutions
- **Fully practical** – due to quick charging concepts and state-of-the-art rechargeable battery technologies
- **Low noise** – minimum noise impact
- **Emissions-free** – no CO₂ emissions
- **For the fun of driving** – from zero to 100 in a few seconds

Your advantages with a hybrid drive (combination of diesel/hydraulic and e-drive)

- **Optimized drive solution** – up to 30 percent fuel saving and noise reduction
- **Powerful** – enormous increase in efficiency
- **Automatic energy recovery** – battery charges itself automatically thanks to recuperation
- **Quickly charged** – not dependent on charging stations
- **For large distances** – thanks to the combustor, large ranges are possible

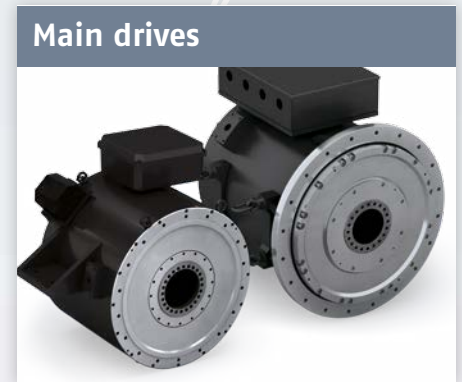
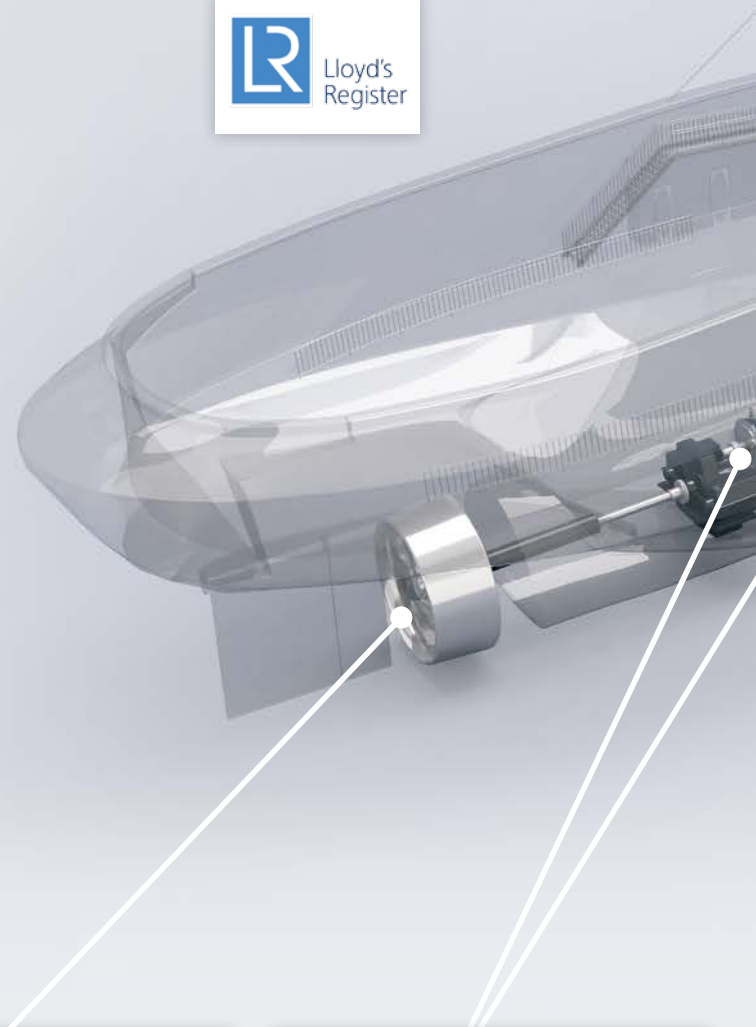
Manufacturer-independent drive systems from a single source

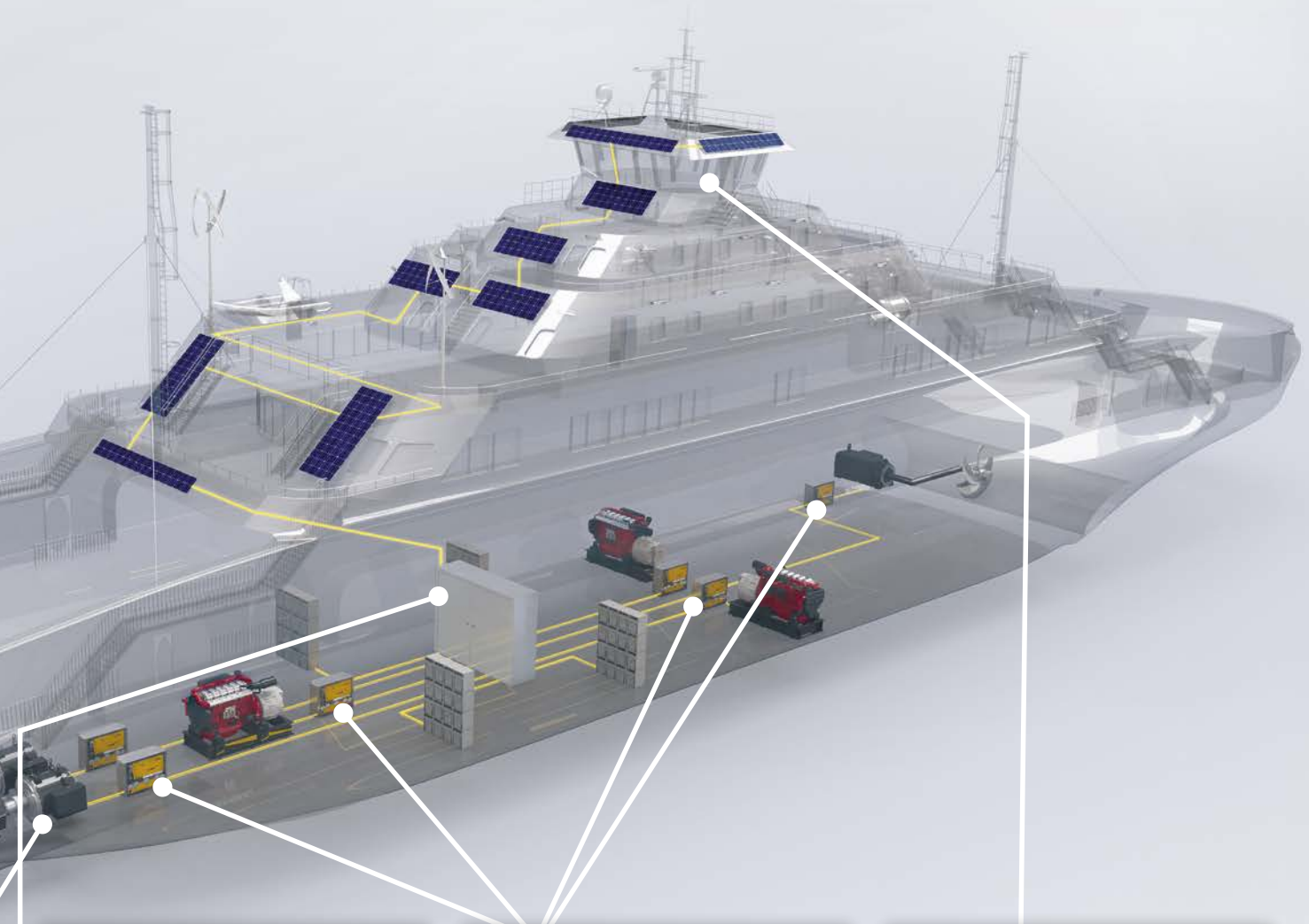
Baumüller now supplies **ferries, inland waterway vessels, yachts**, etc. worldwide with its solutions and thus brings a wide range of experience to the outfitting or retrofitting of ships and offshore vessels.

Baumüller has specially adapted its products and certified them for shipbuilding. The DST2 high-torque motors, for example, are equipped with wing-mounts that make it much easier to integrate into the ship's design. The **DST2 marine motors** are available with outputs from 3 to 1150 kW and nominal speeds between 100 and 1500 min⁻¹.

The **rudder propeller** is powered e.g. by the powerful and dynamic three-phase current synchronous motors from the DS2 series with up to 300 kW. In addition, recognized manufacturers such as Danfoss, Omron, STW and Eaton are used for project components.

In addition to components and systems, the Baumüller Group offers project planning expertise and service concepts with a global service network and is thus a long-term partner for the entire life cycle of ship drives.





System engineering



Inverters



Visualization & software



Switch cabinets



Controllers



System optimization

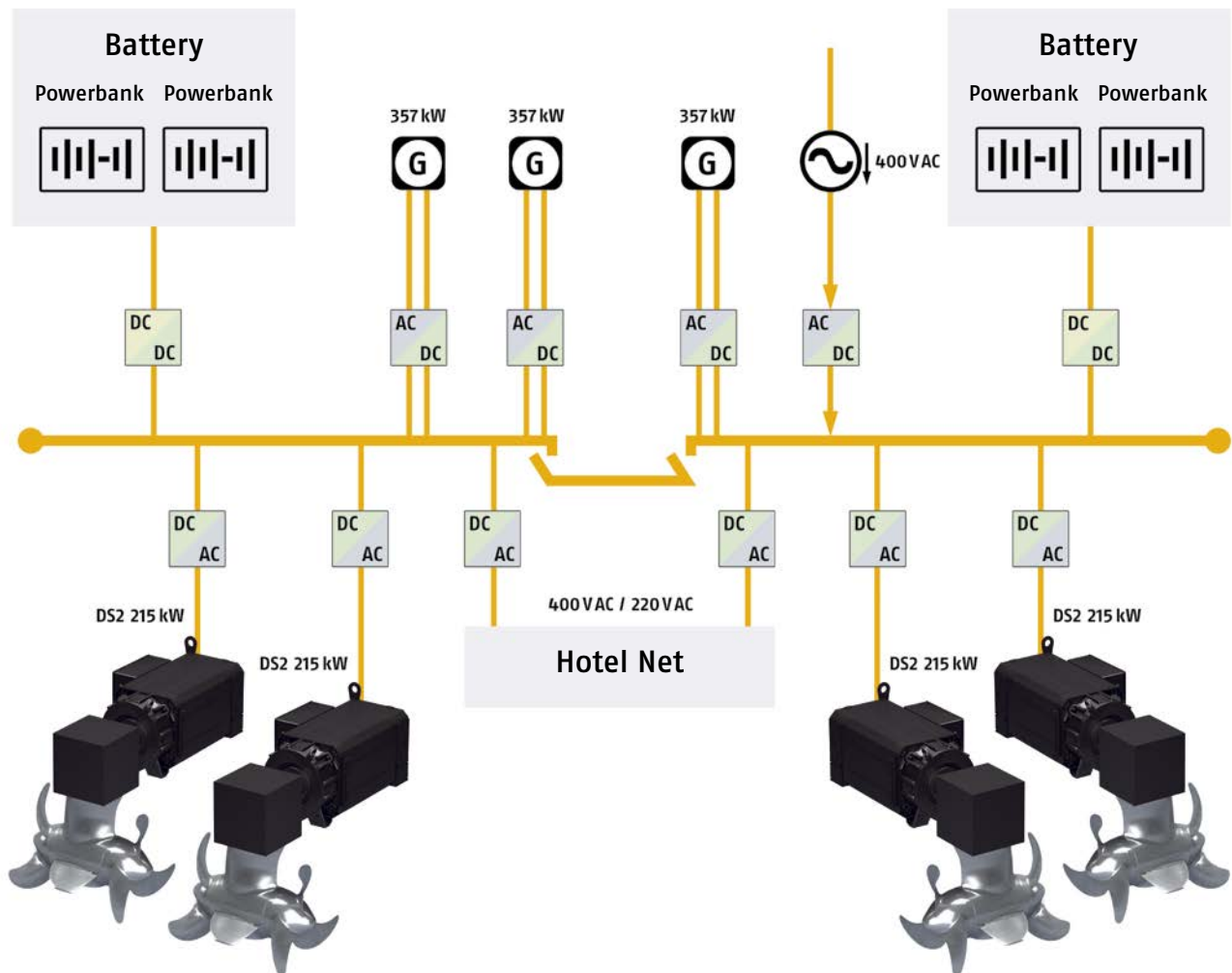


Hybrid drive system for more efficiency



With a hybrid drive, the ship's propellers are powered electrically by converter-fed synchronous motors which receive their energy from battery and diesel generators, e.g. LNG, diesel, fuel cells, etc. Numerous advantages make the combination of diesel and electric motors particularly attractive for shipping. Along with a significant reduction in fuel consumption in moving bodies of water, this system also reduces noise and vibrations by up to 28 percent.

Example of hybrid-electric system construction



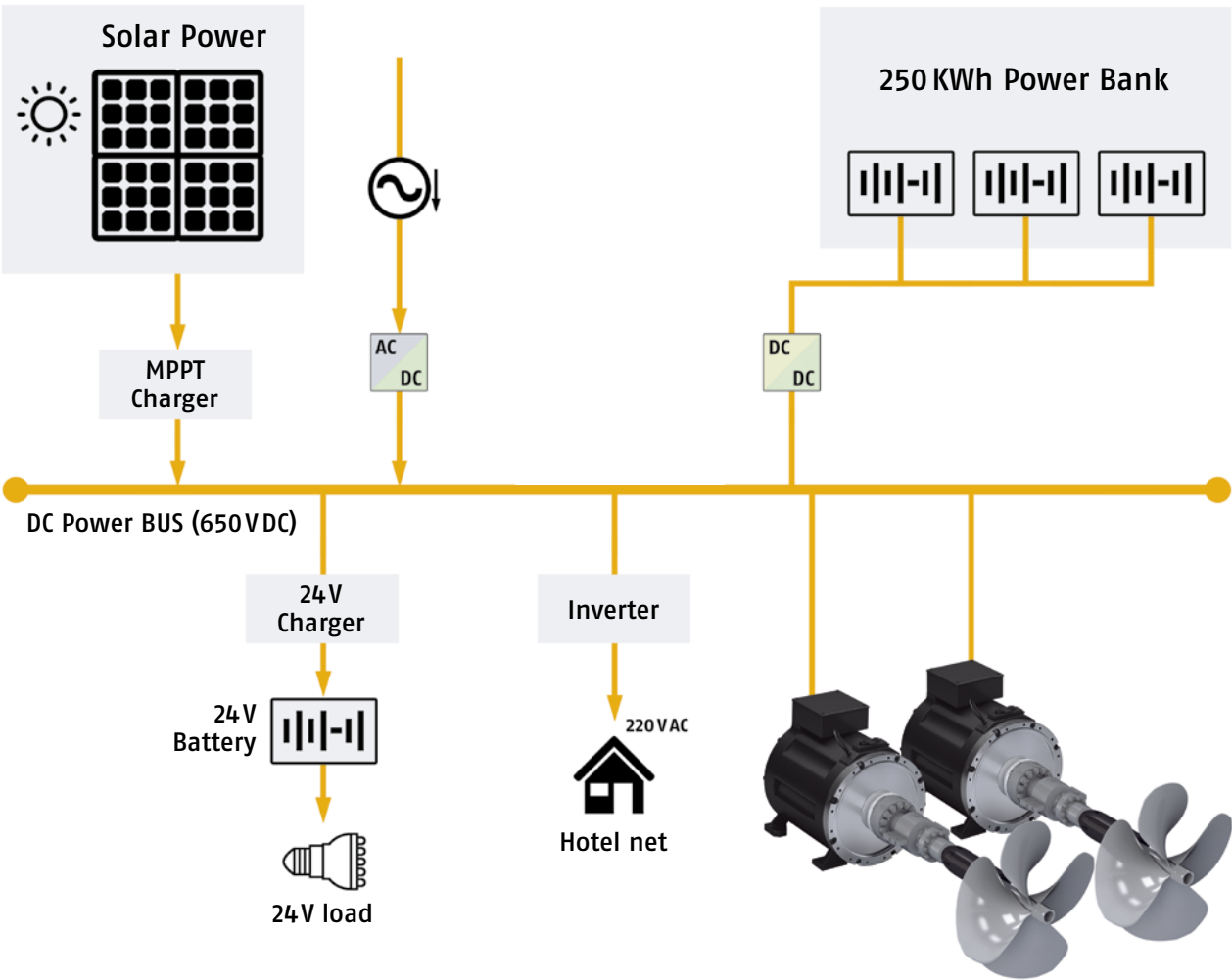
Video and case study for the project are available here: www.baumueller.com

All-electric and emission-free: E-ships with battery-powered drive



Quiet and completely free from fine particulates, these are the main advantages of a fully-electric or battery-run e-drive for ships and boats. The motors are run completely with rechargeable lithium-ion batteries, without diesel any engines. Baumüller undertakes the complete engineering, from the drive dimensioning to the power management.

Example of the structure of an all-electric system



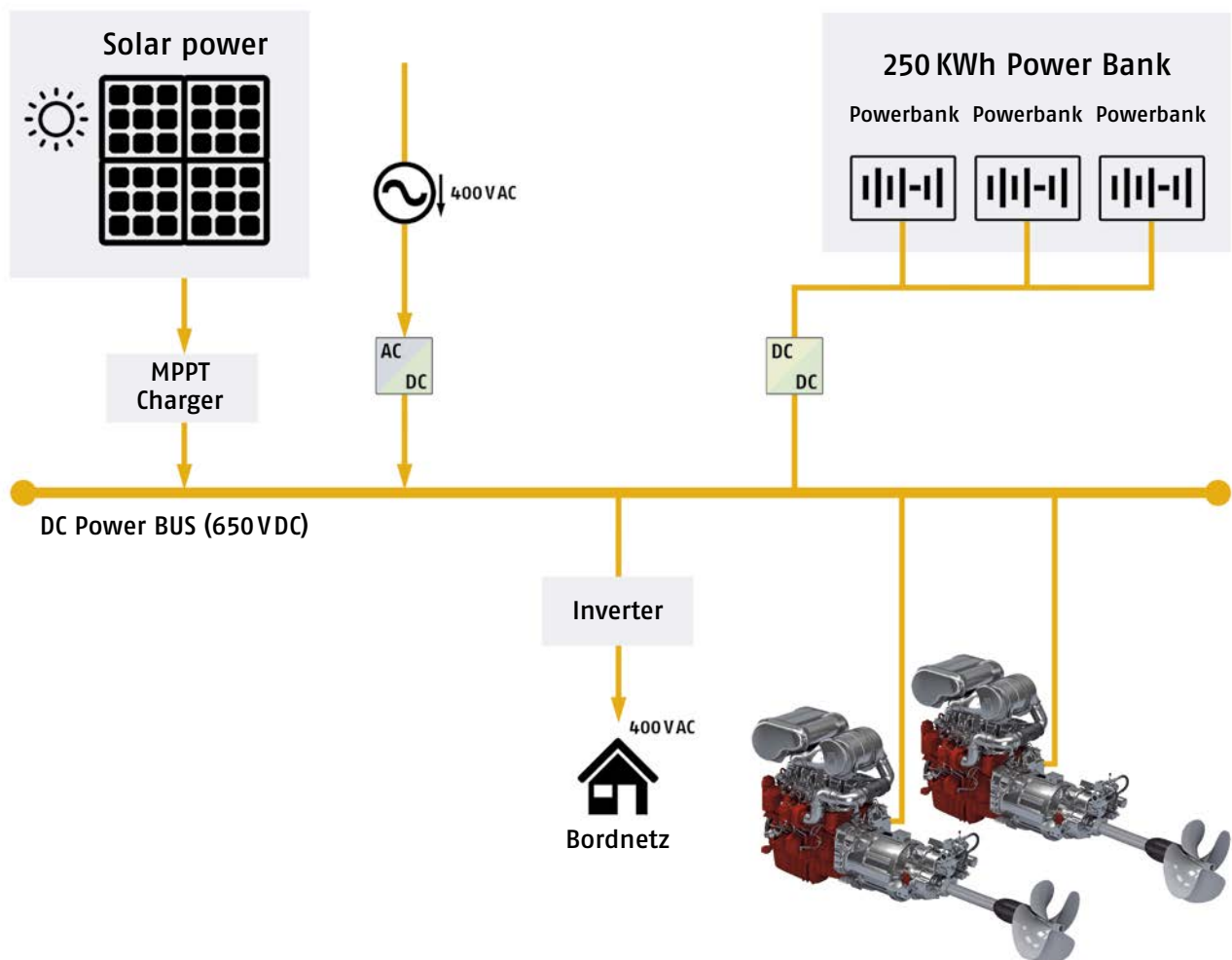
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Optimum efficiency – e-ships with parallel hybrid drive

In a parallel hybrid ship's drive the diesel engine and electric motor are connected in series. The output and the torque are added. The electric motor can be connected and disconnected. The combustion engine is kept at a very good efficiency. The actuator absorbs the load peaks and also generates energy.

Example of hybrid-electric system construction



Video and case study for the project are available here: www.baumueller.com

The flexible e-drive system as a modular solution



System engineering and commissioning of prototypes

Implementation of the individual e-drive concept based on the system module from concept to series production



Control system

The control system is based on DNV-GL approved components and can be extended flexibly.

- Interfaces: CAN2.0B, Modbus, EtherCat



Drives for propulsion, thrusters, generators

- Electric motor with high performance
- Water-cooled
- from direct drive to PTI/PTO and Z-drive



Converters

- Mobile four-quadrant converter
- Water-cooled
- Nominal power 50–350 A
- Nominal voltage AC 400/500V; DC 750V
- Variable implementation as motor converter, AFE or M-Grid converter



Battery

- Use of different battery types depending on requirements of the load profile
- Nominal voltage 200–700V
- Interface with battery management systems of common battery manufacturers



DC/DC converter

- Mobile converter for connecting HV batteries to DC link
- Water-cooled
- Nominal power up to 400 A



Weltweiter Service

With our wide range of offerings in the areas of service, maintenance and retrofits, we ensure the reliability and productivity of your machine throughout the lifecycle of your system.

Baumüller's modular system

Hybrid and electrical ferries



Max. total installed power:

200 kW – 2 MW (complete system)

max. 600 kW each propeller

650 – 750 VAC

Performance by Baumüller:

genset consulting, pre-design studies

Products:

powerMELA, DST2, DS2, generator, cabinets, propulsion software, PLC, HMI, lever

Interfaces to:

batteries, solar, fuel cells, diesel, Z-drives, hydraulics, PTO/PTI gearboxes

Hybrid working boats



Max. total installed power:

200 kW – 2 MW (complete system)

max. 600 kW each propeller

650 – 750 VAC

Performance by Baumüller:

genset consulting, pre-design studies

Products:

powerMELA, DST2, DS2, generator, cabinets, propulsion software, PLC, HMI, lever

Interfaces to:

batteries, solar, fuel cells, diesel, Z-drives, hydraulics, PTO/PTI gearboxes

Hybrid cargo ships for rivers and short sea



Max. total installed power:
200 kW – 3.5 MW (complete system)
max. 2 MW each propeller
650 – 750 VAC

Performance by Baumüller:
genset consulting, pre-design studies

Products:
powerMELA, DST2, DS2, generator, cabinets,
propulsion software, PLC, HMI, lever

Interfaces to:
batteries, solar, fuel cells, diesel, Z-drives,
hydraulics, PTO/PTI gearboxes

Yachts, fishing and patrol vessels



Max. total installed power:
600 kW – 3 MW (complete system)
max. 2 MW each propeller
650 – 750 VAC

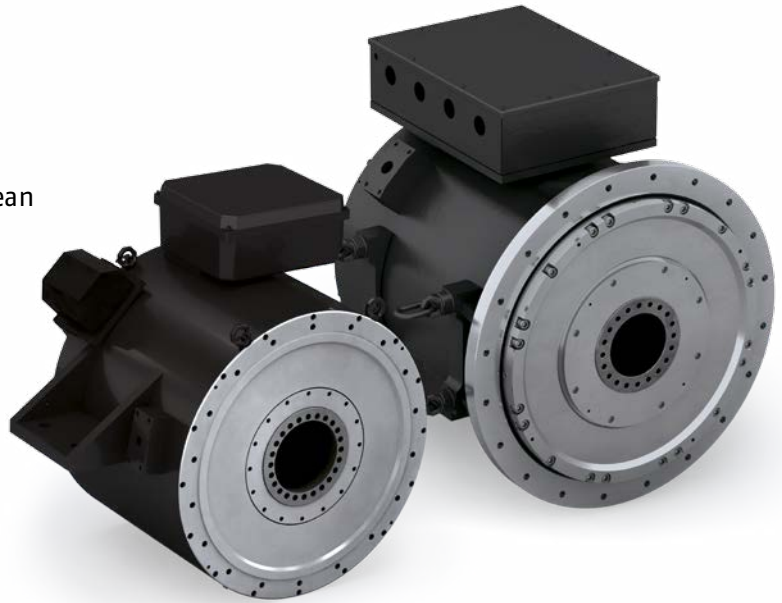
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Products for Marine: DST2 135-560 – The powerful high-torque motors

- Very good smooth running characteristics
- Energy-efficiency is maintained through wide speed/load range
- Suitable for sophisticated direct drive technology
- High torque at low velocities
- Low-noise
- Water cooling in a stainless steel design
- Compact and robust design
- Smooth housing surface – easy to keep clean
- Permanent field high-torque motors
- IP54 type of protection
- Encoders: Resolver, SinCos (option), digital encoder (optional)
- Other encoders on request



Types of cooling



DST high-torque motors are available in water-cooled versions.

Spectrum

Capacity

Torque

Acceleration



DST2 135-560 – Technical data

Typ	P _N		n _N [min ⁻¹]	M ₀		M _{0MAX}	
	[kW]	[hp]		[Nm]	[lbf ft]	[Nm]	[lbf ft]
DST2-135	2.7-60	3.6-80	175-1500	140-580	103-427	325-1110	240-819
DST2-200	5.5-126	7.4-169	150-1000	310-2030	229-1497	790-4450	583-3282
DST2-260	20-225	27-302	150-750	1130-4760	833-3510	2410-9800	1778-7228
DST2-315	16-285	21-382	100-600	1200-8600	885-6343	3330-18400	2456-13571
DST2-400	92-530	123-711	100-300	8800-18600	6490-13718	14800-31600	10915-23305
DST2-560 *	435-1150	583-1542	100-300	14800-39500	10916-29134	29900-79800	22053-58857

Special motors up to 3.5 MW on request

Subject to change. The values specified are maximum values.
For details, please refer to the relevant technical documentation.

*) on request
Subject to change

Custom-fit and customer-specific: From electric motor to complete drive system

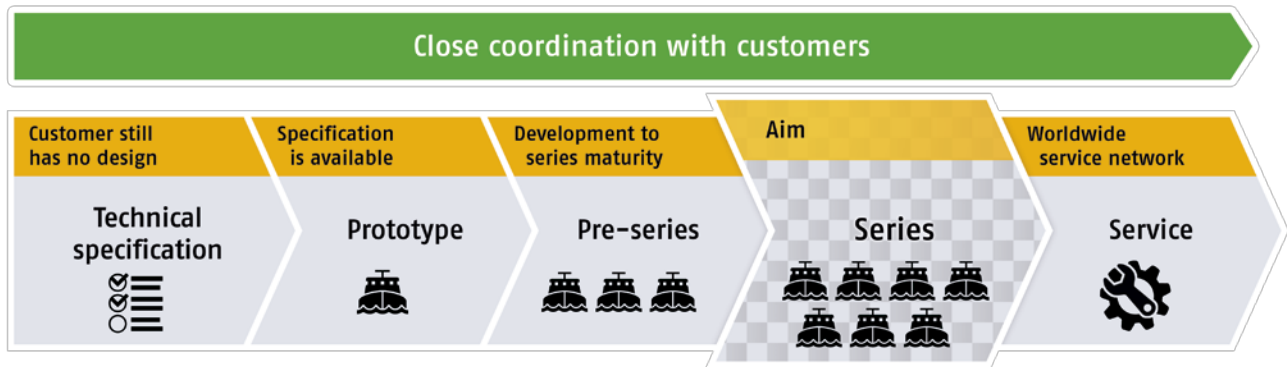
Baumüller offers exactly the service you need – from individual motors and components to the complete drive system with self-regulating energy

and battery management. We support you with tailored solutions that you need for your project.

Baumüller is a partner to shipyards, system integrators and ship owners and is itself also a supplier of complete systems.



Partnership from specification to prototype to series production
We accompany on every step of your way into the electric future.



Our advantages

- **Experience:** Many successfully implemented projects
- **Future-oriented:** Efficient and high-performance hybrid and electrical drives
- **Expertise:** High-quality and reliable products in shipbuilding
- **Fast and customer-oriented decision paths:** Experience and advantages of a global, successful and innovative family company with tradition
- **Global service**
- Production-ready **design and development** of prototypes all the way to pre-production to over 40 locations globally – all from a single source

Marine services on the high seas

BAUDIS is an IoT-compatible diagnostics and communication system. It enables simple networking of machines and systems via the internet and intelligent analysis of data. One particular positive point: The system can be used independently of the manufacturer of the automation components and the sensors and can also easily be retrofitted.

With the Baumüller BAUDIS IoT system both local and remote versions are available. If the customer opts for the local version the data recorded in the drive is analyzed directly on site. If the remote option is preferred, the data is uploaded to a cloud solution and is archived and analyzed either centrally at the customer's location or externally at a freely selectable service provider's location.

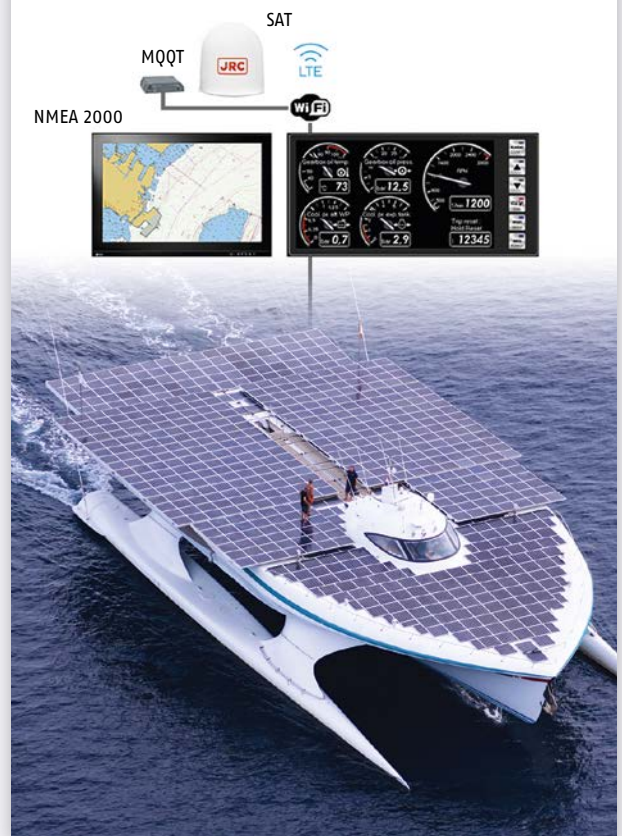
Data handling with BAUDIS IoT

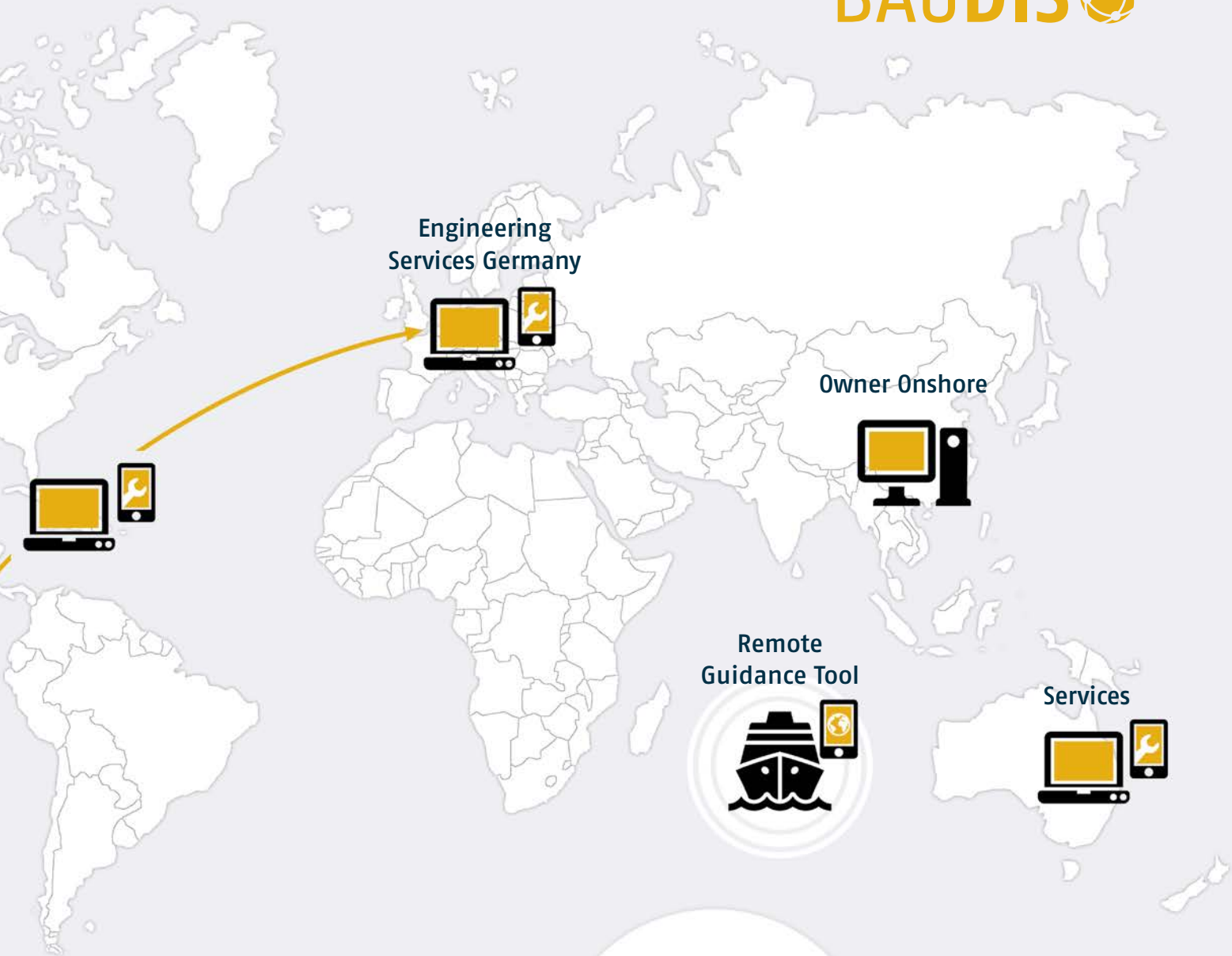
With the Baumüller solution the data are distributed by the BAUDIS IoT Box, which forwards the data to an internal PC, a server or a cloud, depending on the chosen version (local or remote). This evaluates the data and informs or warns the user if necessary. This system can be retrofitted with sensors with scalable performance and can be realized independently of the drive manufacturer. It can also be expanded gradually in line with needs. The BAUDIS IoT Box can be installed by the customer. The software is configured by Baumüller experts. One-time licensing fees are incurred for this and a service package can be offered on request.

The advantages at a glance:

- 24/7 monitoring
- Use independent of the manufacturer
- Reduction of unplanned interruptions
- Scheduled maintenance measures
- Time and cost savings

All around the world with Baumüller as a reliable partner





Over 80 ships and boats successfully electrified

We are the experts in the complete drive system: From control unit to battery management. Past implementations have included e.g. hybrid cargo ships for inland waterways and coastal applications, hybrid work ships, as well as hybrid and electrical ferries. Whether original equipment or a remotORIZATION – our marine drives impress with their lower environmental impact, improved maneuverability and space-saving installation compared to classic diesel drives.

Visualization, control and energy management



Battery, control room



Diesel-electric drive systems



Drive system designed entirely by Baumüller



References

Hybrid: Ferry Farge

Year of manufacture 2017
Length 59 m
Width 14 m
Maximum speed: 14 km/h
Capacity: 32–34 passenger cars,
6 semis, up to 249 people;
Drives: 4x DS2 main motors
200 kW each



Picture: Irene Neumann

Fully electric: Qi-Fu No.1

Year of manufacture 2017
Length 25 m
Width 6.5 m
Capacity: up to 150 persons;
46 bicycles
Motors: 2x 2 powerMELA® systems,
each with 150 kW



Hybrid: Ærøxpresen

Year of manufacture 2019
Length 49.36 m
Width 12.50 m
Draft 1.92 m
Drives: 2x Scania DI16
8-cylinder diesel motors,
2x drive units 450 kW



Diesel-electric: Trischen



Year of manufacture 2019
Length 22 m
Width 7.5 m
Work ship
Diesel-electric drive system,
2x drive units DST2 225 kW

Diesel-electric: MS Emmerich



Year of manufacture 2020
Length 38 m
Width 8.0 m
WSA work ship
Diesel-electric drive system,
2x diesel Scania
2x drive units DST2 225 kW

Diesel-electric: Opal



Year of manufacture 2015
Motors:
2x DST2-315Y0, 144 kW
Battery capacity: 460.8 kWh
2 generators 1x 150 kW, 1x 130 kW

Hybrid: Roro Terra 2

Year of manufacture 2014
Length 135 m
Width 11.45 m
Draft 4.30 m
Tonnage 1090 t
Motors 2x Caterpillar type C18,
Hybrid Baumüller DST2-400
2x 285 kW



Diesel-electric: Spido Marco Polo

Year of manufacture 1995
Refit 2017
Motors:
2x DS2-200K0 generator 2x 75 kW



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