Reduce costs and emissions

Baumüller Marine 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.

Emissions-free drive solutions

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.

Fuel cells

Source: Proton Motor Fuel Cell GmbH

Side drives and main drives

Main drives
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.

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

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

www.baumueller.com
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 V AC

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 V AC

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 V AC

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 V AC

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
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

**DST2 135–560 – Technical data**

<table>
<thead>
<tr>
<th>Typ</th>
<th>$P_n$ [kW]</th>
<th>$P_n$ [hp]</th>
<th>$n_n$ [min$^{-1}$]</th>
<th>$M_0$ [Nm]</th>
<th>$M_0$ [lbf ft]</th>
<th>$M_{0\text{MAX}}$ [Nm]</th>
<th>$M_{0\text{MAX}}$ [lbf ft]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DST2–400</td>
<td>92–530</td>
<td>123–711</td>
<td>100–300</td>
<td>8800–18600</td>
<td>6490–13718</td>
<td>14800–31600</td>
<td>10915–23305</td>
</tr>
</tbody>
</table>

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
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
BAUDISO

Engineering Services Germany

Owner Onshore

Remote Guidance Tool

Services

Database

Visualization

Geo Features

Remote Support

Process Support

Data Warehouse

Fleet Operator
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.
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 D52 main motors
200 kW each

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: Ærøxpressen

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

Your contact person for ship drives at the Baumüller Group:

Baumüller Anlagen Systemtechnik GmbH & Co. KG
Ostendstraße 84, 90482 Nürnberg
Stefan Krahn, +49 (0) 911 54408-703
E-Mail: emobility@baumueller.com