HOPPE

The leading fluid control expert for automated and connected onboard systems

HOPPE MARINE

PROVEN SYSTEMS - DIGITAL SOLUTIONS

KEY FACTS

75
Years marine experience

8
Offices worldwide

250 +
Employees worldwide

24 / 7
Service availability

7,000 +
Ships equipped

1,400 +
MAIHAK Performance Systems installed

1,500 +
Valve Remote Control Systems installed

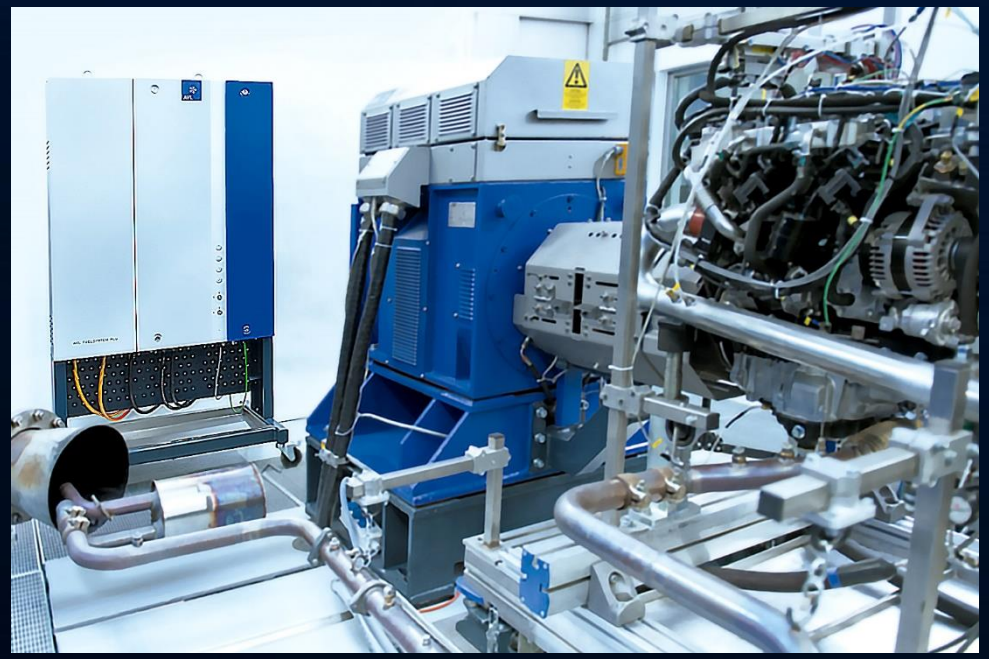
2,000 +
Roll Reduction Systems Installed

2,500 +
Anti-Heeling Systems installed

250,000 +
Tank and draught sensors installed

About me

- Mechanical engineer with 17 years of experience in automotive engine development & testing
- Almost three years of experience in maritime business
- Ship enthusiast since ever….



HOPPE 70 SEVENTY YEARS

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Hoppe Marine: Family owned and independent

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Hoppe MIoT
Maritime Internet of Things

Ganzheitliche Energie- und Messdatenerfassung an Board.

YOU CAN'T

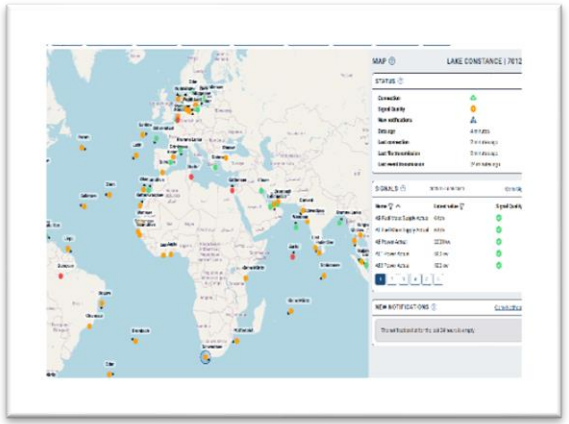
OPTIMIZE

WHAT YOU DON'T

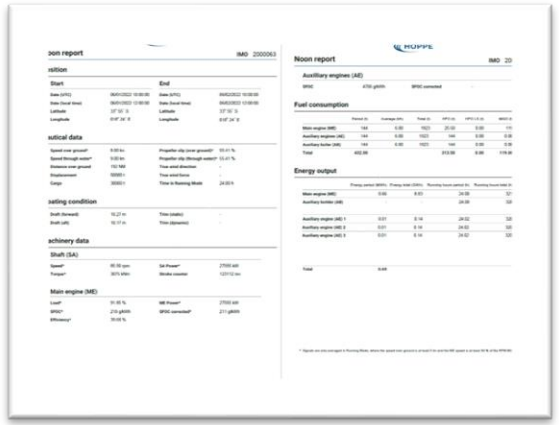
MEASURE

Why? – Reasons for High Frequency Data acquisition

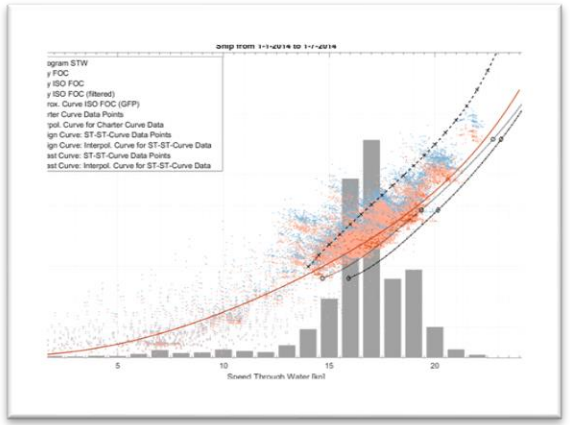
Why do our Customers decide for MIoT System Digitalization



STRATEGIC



COMPLIANCE & REPORTING



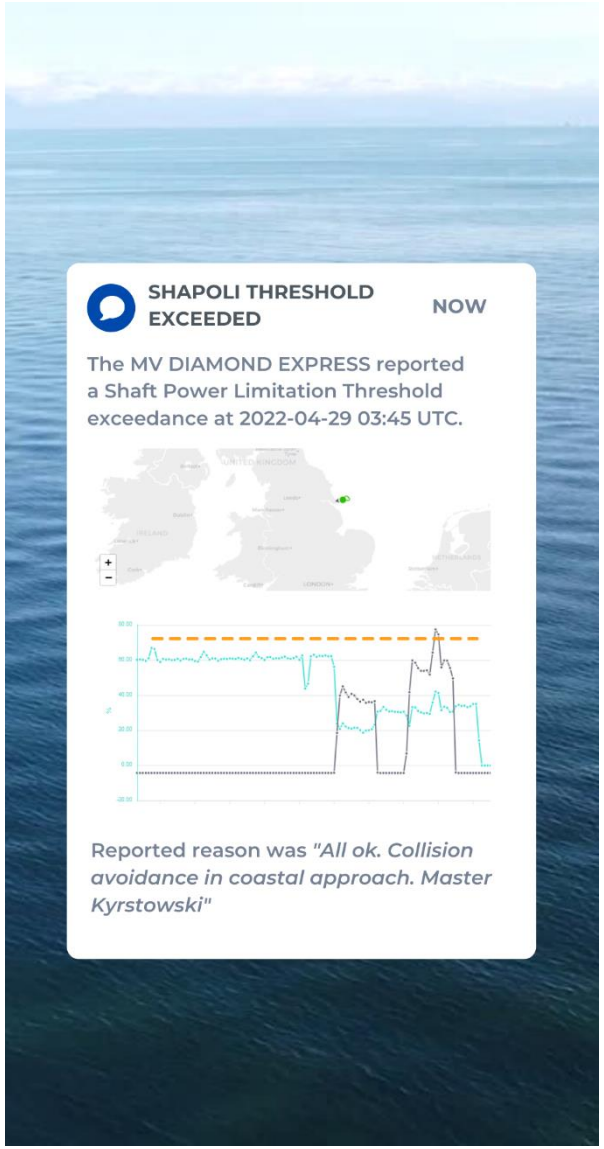
OPTIMIZATION

Essential prerequisite: High Quality Data

STRATEGIC

FLEET CONNECT

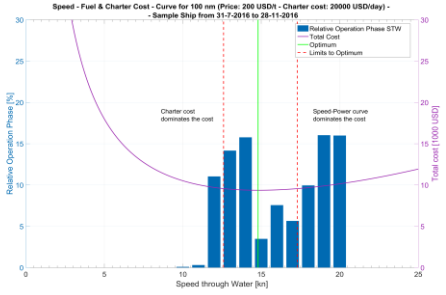
- Vessel digitalization for efficient fleet management
- The **connectivity** saves service costs and reduces total cost of ownership



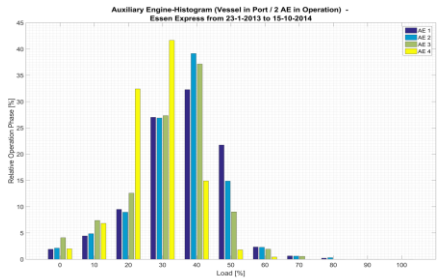
COMPLIANCE AND REPORTING

- The company sees increasing **reporting and compliance tasks** and would like to be well prepared.
- Necessary data acquisition and logging for reporting (EU MRV, ETS, Ballast Water e.g.)

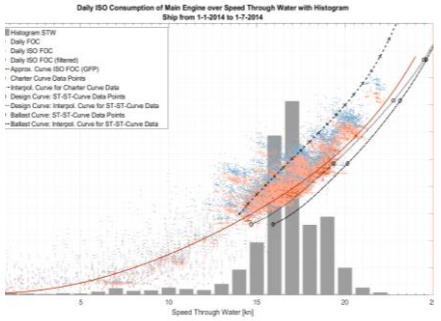
ECONOMIC SPEED



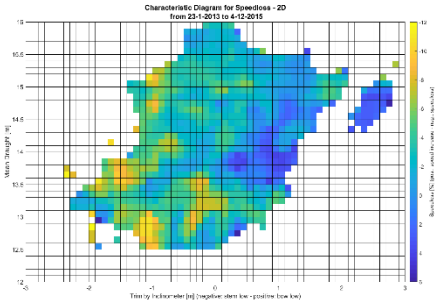
GENERATOR LOAD



SPEED CONSUMPTION



TRIM OPTIMIZATION



MIOT DATA COLLECTION

AS PRECONDITION FOR **OPTIMIZATION**

HIGH QUALITY DATA AQUISITON

Extreme Weather Warnings

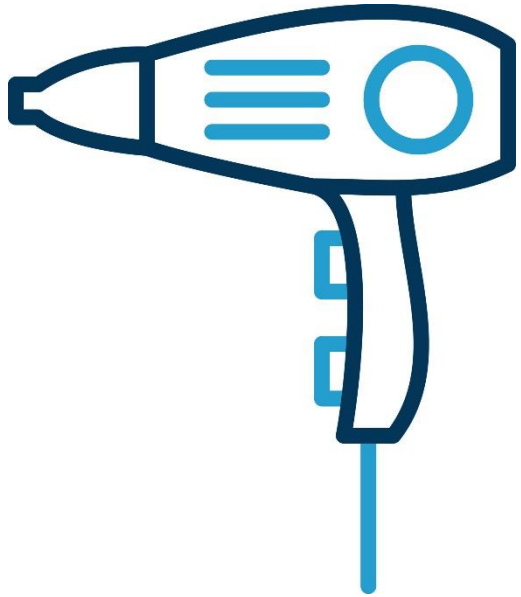
Earthquake Forecasts

Medical Technology

E³ - Energy Efficiency Emissions

How well do I know my energy consumers?

Electric Flow Heater:
18,000 Watts



Hair Dryer:
1,600 Watts

LED Light Bulb:
4 Watts

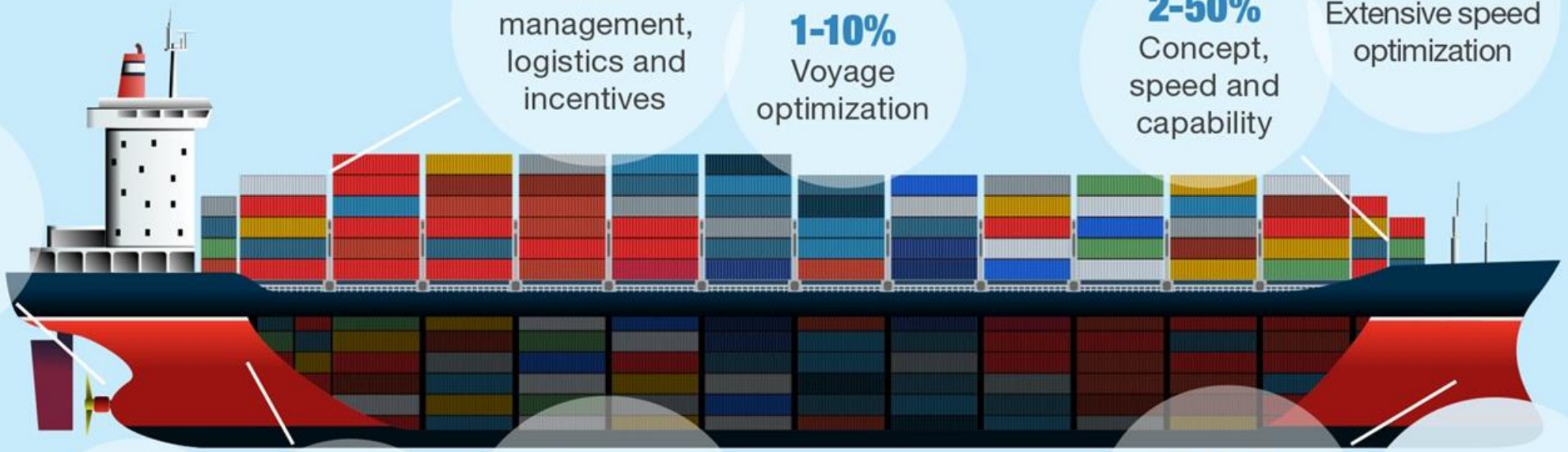
155 000 $

Yearly Costs For one Cooling Water Pump

120 kW * 365 days *24 h * 180 g / kWh = 190 MT → 190 MT * (500$/MT fuel costs + 3,10 tons CO2/MT * 100$/ MT CO2 Certificates) = 155 000 $

A wide variety of design, operational and economic solutions

Achieving the goals of the Initial IMO GHG Strategy will require a mix of technical, operational and innovative solutions applicable to ships. Some of them, along with indication on their approximate GHG reduction potential, are highlighted below.



5-50% Fleet management, logistics and incentives

1-10% Voyage optimization

2-50% Concept, speed and capability

up to **75%** Extensive speed optimization

5-15% Power and propulsion systems

50-90% Full electric

35% Bio-LNG/LPG

90% Biofuel 3rd generation

80-100% Hydrogen and other synthetic fuels

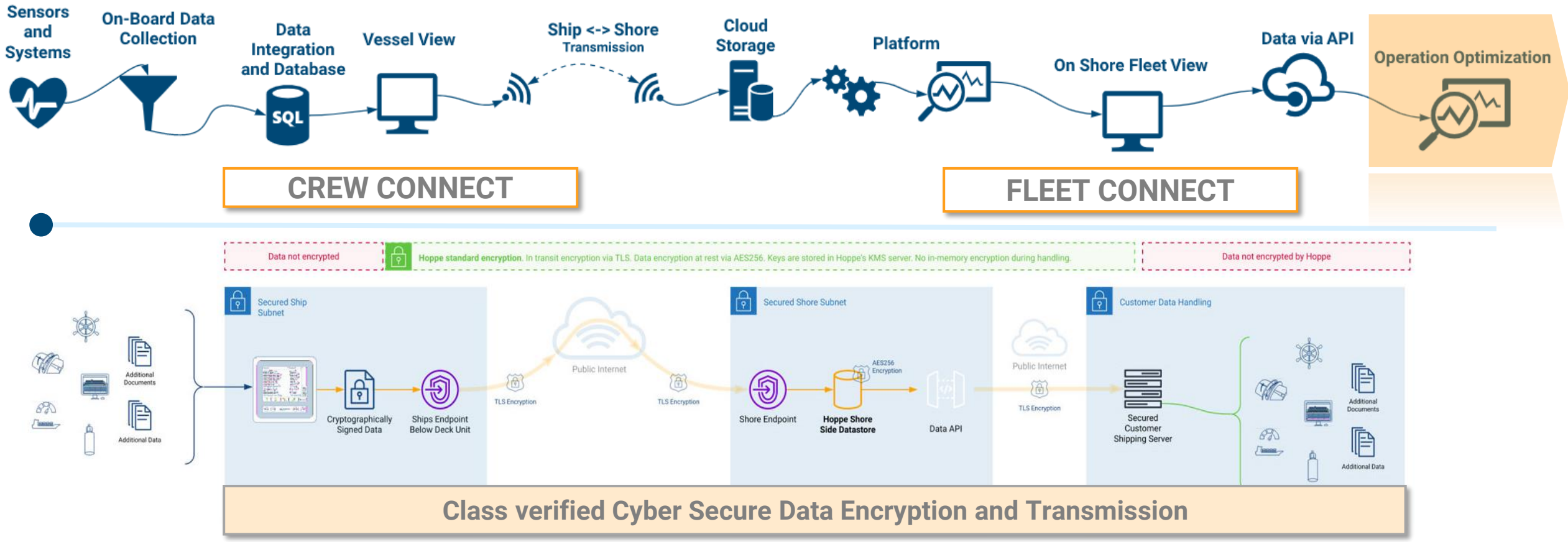
1-10% Energy management

2-20% Hull and superstructure

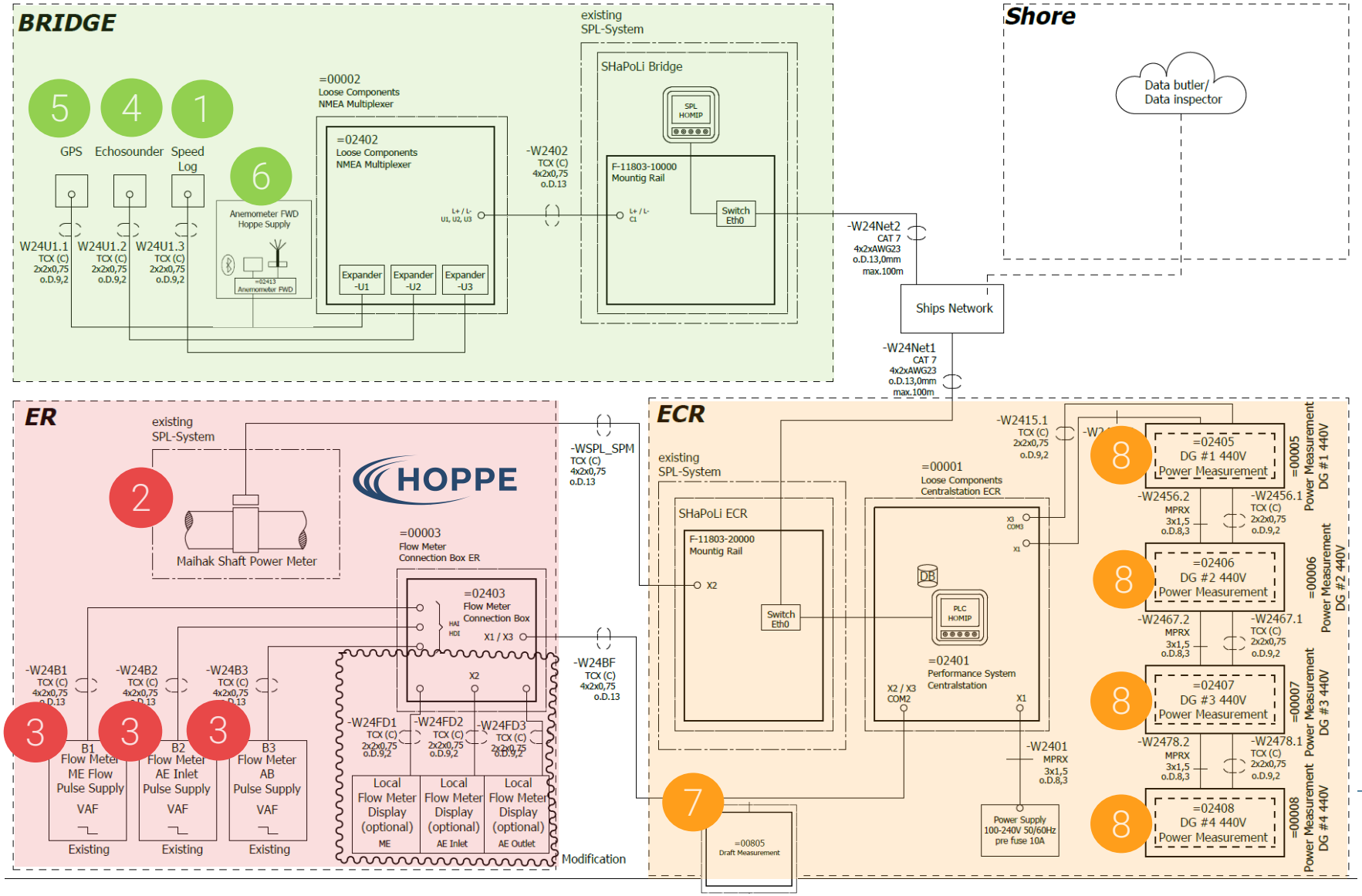
5-25% Hull biofouling management

How Ship to Shore works

The Data Highway



On Board – System Overview



Order by relevance:

1. Speed through water
2. Shaft Power Meter
3. Fuel Consumption
4. Depth, Rudder Angle e.g.
5. Heading, SOG, GPS
6. Wind
7. Draft
8. Energy Measurement
9. Dynamic Draft and Trim
X. Emission Monitoring

On Board

From a Technical Perspective of Data Integration

Groups Devices	Signals	Supported Protocols and Signal Types	Maker / Partner
Nautical			

ECDIS / VDR / Autopilot	All available standard NMEA 0183 - sentences	• Serial RS485/422 NMEA 0183:
		  • IEC61162-1 (4800bps)
		  • IEC61162-2 (38400bps)
		• Ethernet / LAN 10/100 Mbit:
		  • IEC61162-450
		  • UDP
		Necessary NMEA buffer or multiplexer for NMEA signal acquisition will be supplied.
			Furuno • Transas • Kongsberg • Raytheon • Consilium • Raymarine • Sam Electronics • Saab • Sperry Marine • Veinland • Transas • SAM Electronics • JRC • ChartWorld • Wärtsilä • Yokogawa • Interschalt • DanElec • Tokimec

Speedlog	Speed Trough Water • Distance through Water (with SPM) • Slip through Water (with SPM)		
GPS	GPS Position • Course Over Ground • Distance over Ground • Slip over Ground (with SPM)		
Echosounder	Water Depth / Keel Clearance		
Anemometer	Wind Direction Rel / True • Wind Speed Rel / True • Wind Speed Max		
Rudder Indicator	Rudder Angle • Rudder Angle Max • Rudder Activity	• NMEA or: • 0/4-20mA • 0-10V • +-10V, +-12V, +-15V • Syncro	
Motion Sensor	Roll Angle • Roll Period • List Angle • Accelerations X,Y,Z • Pitch Angle • Pitch Period • Trim Angle • Dynamic Trim (with Draught Sensors) • Period Ratio	• UDP, NMEA serial protocol	**Hoppe Marine (HOSIM 2)**
Electronic Inclinometer	Roll Angle (max) • Roll Period • List Angle • Pitch Angle (max) • Pitch Period • Trim Angle • Comfort Level		**Hoppe Marine**

Performance Monitoring Sensors			
Shaft Power Meter (SPM)	Shaft Power • Shaft Speed • Shaft Torque • Shaft Energy Counter • Main Engine Power • Main Engine Speed • Main Engine Torque • Main Engine Energy Counter • Main Engine Running Hour Counter • Main Engine Load • Main Engine Light Run • Main Engine SFOC (with Flowmeter)	• RS485/422 (Modbus or NMEA) • Ethernet (Modus TCP or NMEA UDP) • 0/4..20mA • 0-10V • Pulse	**Hoppe Marine • MAIHAK** • Kyma • Lemag / Chris Marine • Brolich • Datum • Kongsberg • Means • VAF • Trelleborg • BMT
Flowmeter (Volumetric + Massflow)	Volume Flow • Mass Flow • Density • Temperatur • Counter	• RS485/422 (Modbus) • Ethernet (Modus TCP) • 0/4..20mA • 0-10V • Pulse	**Hoppe Marine** • Endress+Hauser • Krohne • Kral • Emerson • Aquametro • VAF • SAAKE • Tricor / KEM • GEA • Alfa Laval • ABB • Nitto Seiko • Tokico
Autoflushing Filter	Flushing volume counter • Flushing counter	• Pulse	Boll & Kirch
Tank Content / Draft Measurement			
Draft Measurement	Draft FWD, AFT, MID • Draft PP • Dynamic Draft (with Motion Sensors)	• Modbus TCP / IP • OPC UA • RS422/RS485	**Hoppe Marine**
Tank Content Measurement	Tank Volume • Tank Mass • Tank Filling Height • Tank Density	• Modbus TCP / IP • 4-20mA • RS422/RS485	Pleiger • Panasia • Musasino • Hamla

On Board Data Collector

Data Acquisition – Embedded iPC

Data Sources

- Hoppe MIoT Ready Sensors
- Hoppe DPS

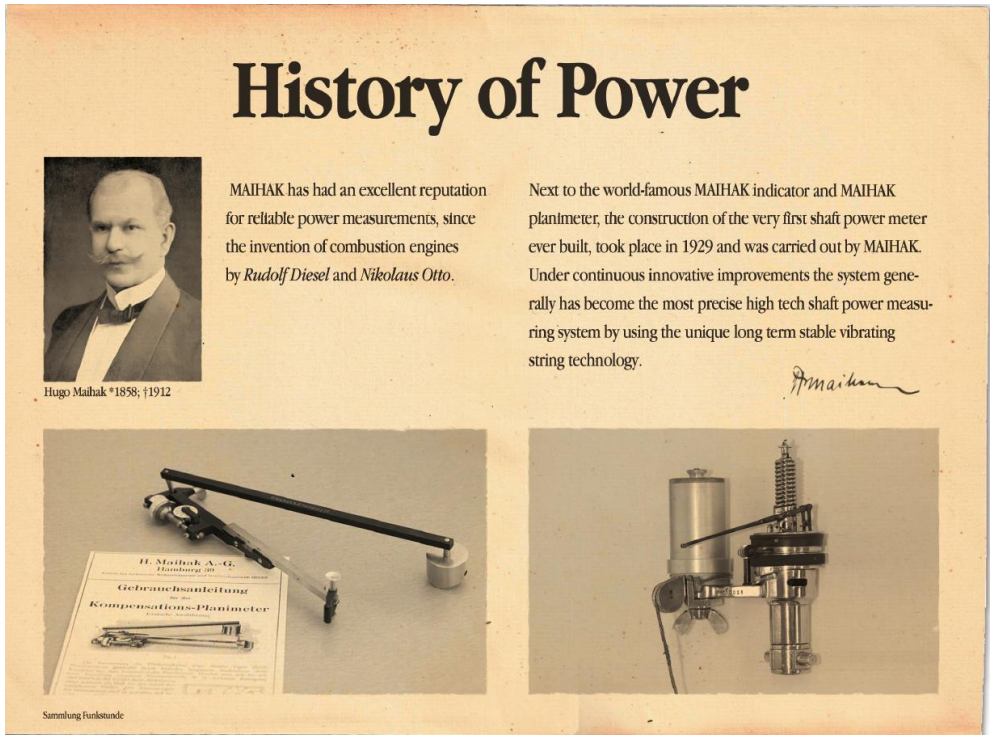
- NMEA 0183 over IP
- NMEA 2000 over IP
- MODBUS TCP
- OPC-UA
- MQTT

Sensors

Energy Monitoring

MAIHAK Shaft Power Meter

History, Design and Measuring Principle



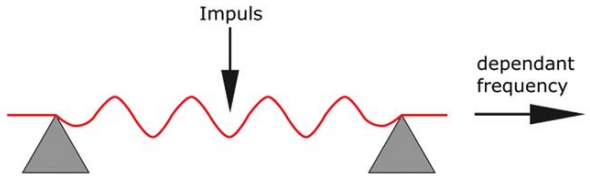
History of Power

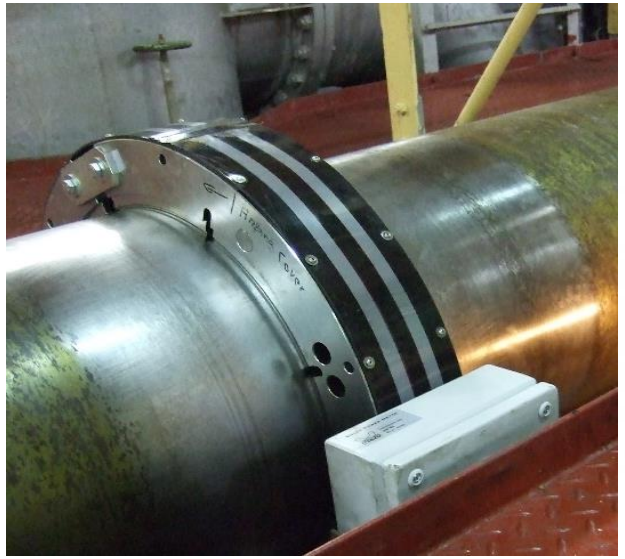
Hugo Maihak *1858; †1912

MAIHAK has had an excellent reputation for reliable power measurements, since the invention of combustion engines by *Rudolf Diesel* and *Nikolaus Otto*.

Next to the world-famous MAIHAK indicator and MAIHAK planimeter, the construction of the very first shaft power meter ever built, took place in 1929 and was carried out by MAIHAK. Under continuous innovative improvements the system generally has become the most precise high tech shaft power measuring system by using the unique long term stable vibrating string technology.

Sammlung Funkstunde





MAIHAK

Torque and Horsepower Meter

Receiver MDS. 2

The transducer frequencies are determined by reference to the adjustable frequency of a comparison wire under observation of a cathode-ray tube. The torque-proportional values can be read off from a neutral scale.

Fig. 1: Receiver MDS. 2

Fuel Consumption Measurement

Measuring Principle

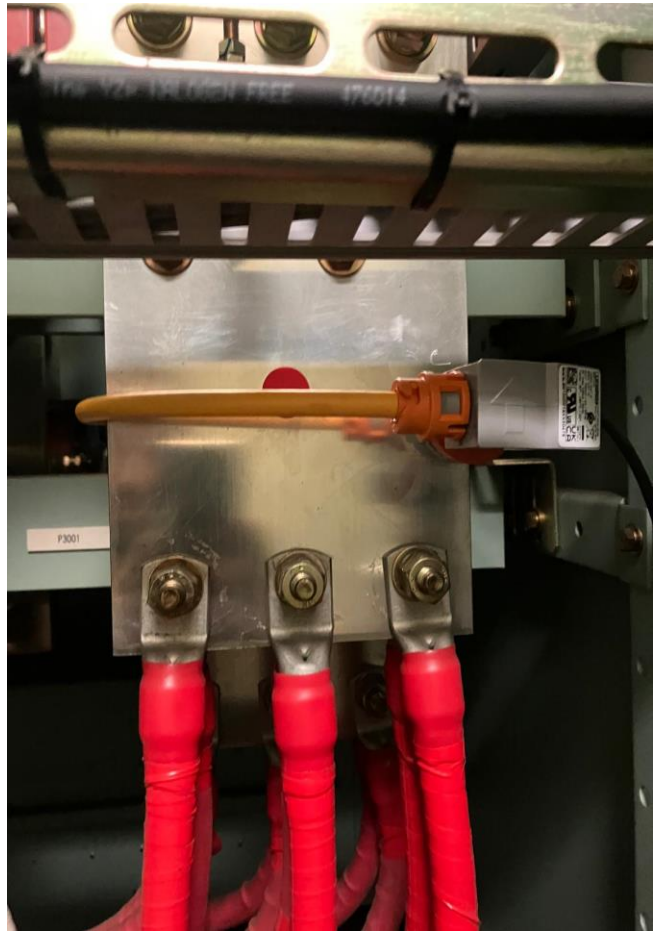
Coriolis Mass Flowmeter

- True mass flow measurement.
- Multi-parameter measurement, while measuring the mass flow, the volume flow, additional temperature, and density can be obtained at the same time.
- Very high accuracy for mass flow measurements.
- Highly accurate density measurement.
- Unaffected by pressure, temperature, and viscosity.
- Easy to install, clean, and maintain, no inlet and outlet sections required.

Theory of Coriolis - Flow Measurement

Electrical Power Monitoring (Rogowski Coils)

Electrical Power Measurement for individual or combined loads
(e.g. single fans or reefer junction boxes)



Sources

- Auxiliary Generators
- Shaft Generators
- Shore Power / Cold Ironing
- Fuel Cells / Battery Systems

Consumers

- Reefer Containers
- Cargo Pumps
- Refrigeration Systems
- Air Conditioning Systems
- Engine Room / Cargo Hold Fans

Upcoming: CEMS

Continuous Emission Monitoring System

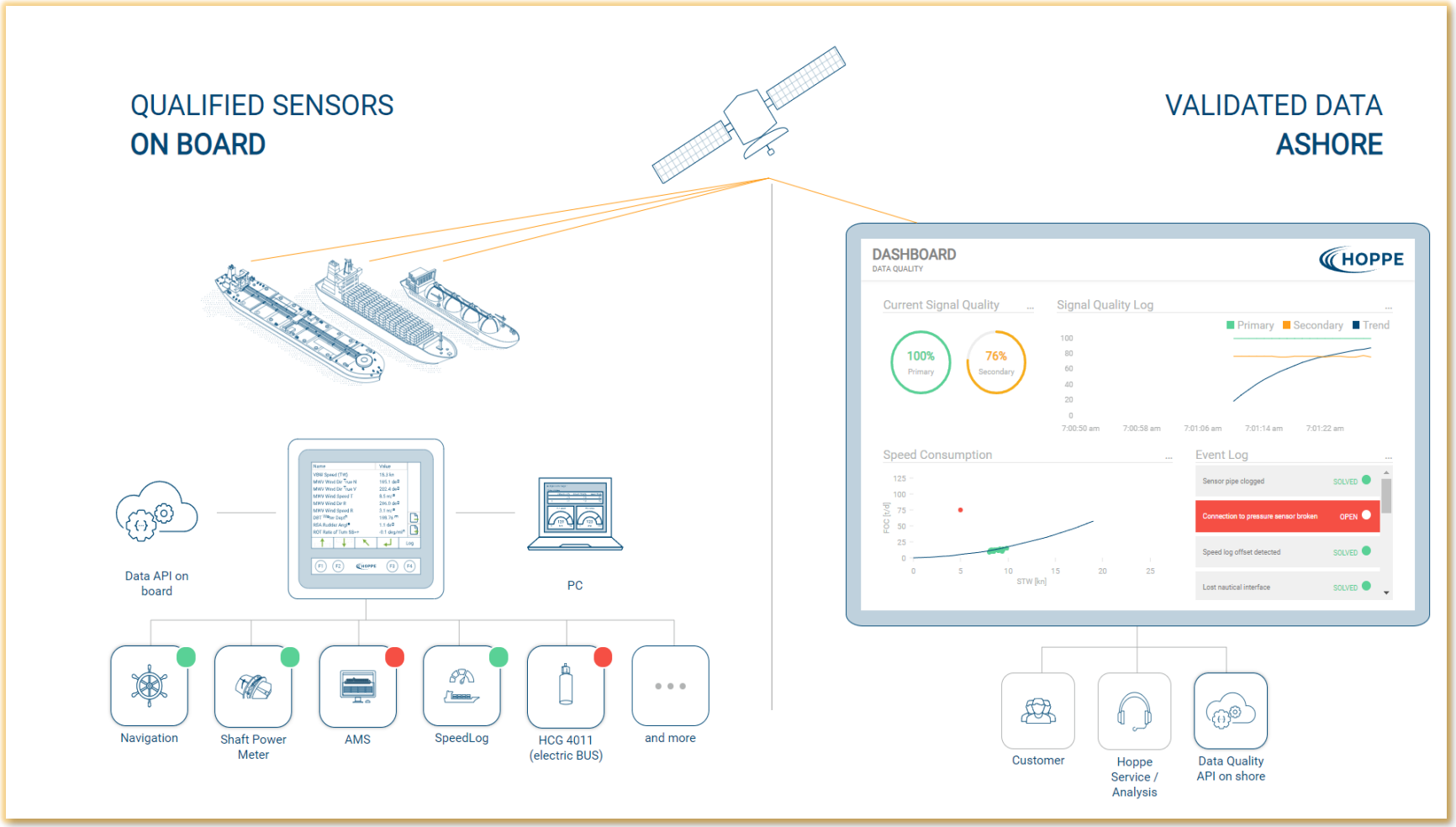
Infrared Gas Analyzer for direct CO_2 / GHG Measurement

Key Features

- $CO_2/N_2O/CH_4$ concentration including mass flow detection
- SO_2/CO_2 concentration for scrubber applications

Features	Flow Meter (Coriolis Type)	Direct CO2 Measurement
Accuracy	Good	High
Consideration of residuals	Yes	Yes
Consideration of fuel quality (heat value and carbon intensity)	Conditionally	Yes
Consideration of fuel consumption over individual legs of the journey	Yes	Yes
Consideration of the specific consumer (ME, AE, Boiler)	Yes	Yes

How to ensure Data Quality?



Live Demo

CO_2 Emission Legislation

Carbon Intensity Indicator - CII

CII Correction Factors – CO_2 Emission Legislation

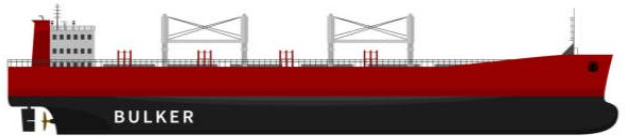
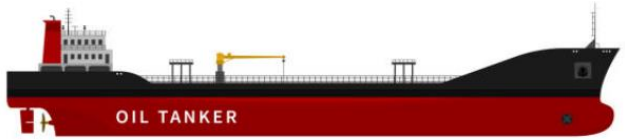
Referring to MEPC.355(78) - Specific energy expenditures allowed to be deducted in CII calculation

$$CII_{\text{Ship}} \triangleq \frac{\sum CF_j \cdot \{FC_j - (FC_{voyage,j} + TF_j + (0.75 - 0.03_{yi}) \cdot (FC_{electrical,j} + FC_{\text{boiler},j} + FC_{\text{others},j}))\}}{fi \cdot fm \cdot fc \cdot fi_{\text{VSE}} \cdot Capacity \cdot (D_t - D_x)}$$

- CF_j Fuel mass to CO2 conversion factor
- FC_j Total fuel consumption
- $(FC_{electrical,j} + FC_{\text{boiler},j} + FC_{\text{others},j})$ *Cargo related energy expanditures*

CII Correction Factors – CO_2 Emission Legislation

Referring to MEPC.355(78) – Reefer, Reliquefaction & Refrigeration Plant

Vessel Type	Cargo Cooling	Cargo Heating	Cargo Handling	Estimated share for energy expenditures
	✗	✗	✓ fivse	
	✗	✓	✓	
	✓	✓	✗	
	✓	✗	✗	

WHAT ?

DOES THE CUSTOMER CAN EXPECT

Information Services

Holistic Approach for Crew and Vessel Management Support in Terms of Fleet Optimization

Operative

CREW CONNECT

Strategic

FLEET CONNECT

Crew Connect - Operative

A web-based application

- Visualization of live operational data and warning messages
- User and access management for individual configuration and thresholds
- High resolution graphs for all primary signals
- User documentation and raw data download
- Optional: Report generation with operational KPIs including nautical and machinery data

Fleet Connect - Strategic

Service Connection

- Data transmission and cloud storage in accordance with highest data security standards.
- Onboard REST-API for integration of eLog's and reporting tools.
- Basic access to Fleet Connect Service Portal

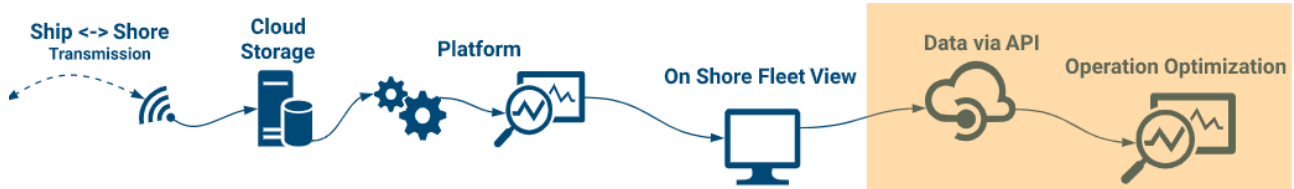
Data Butler

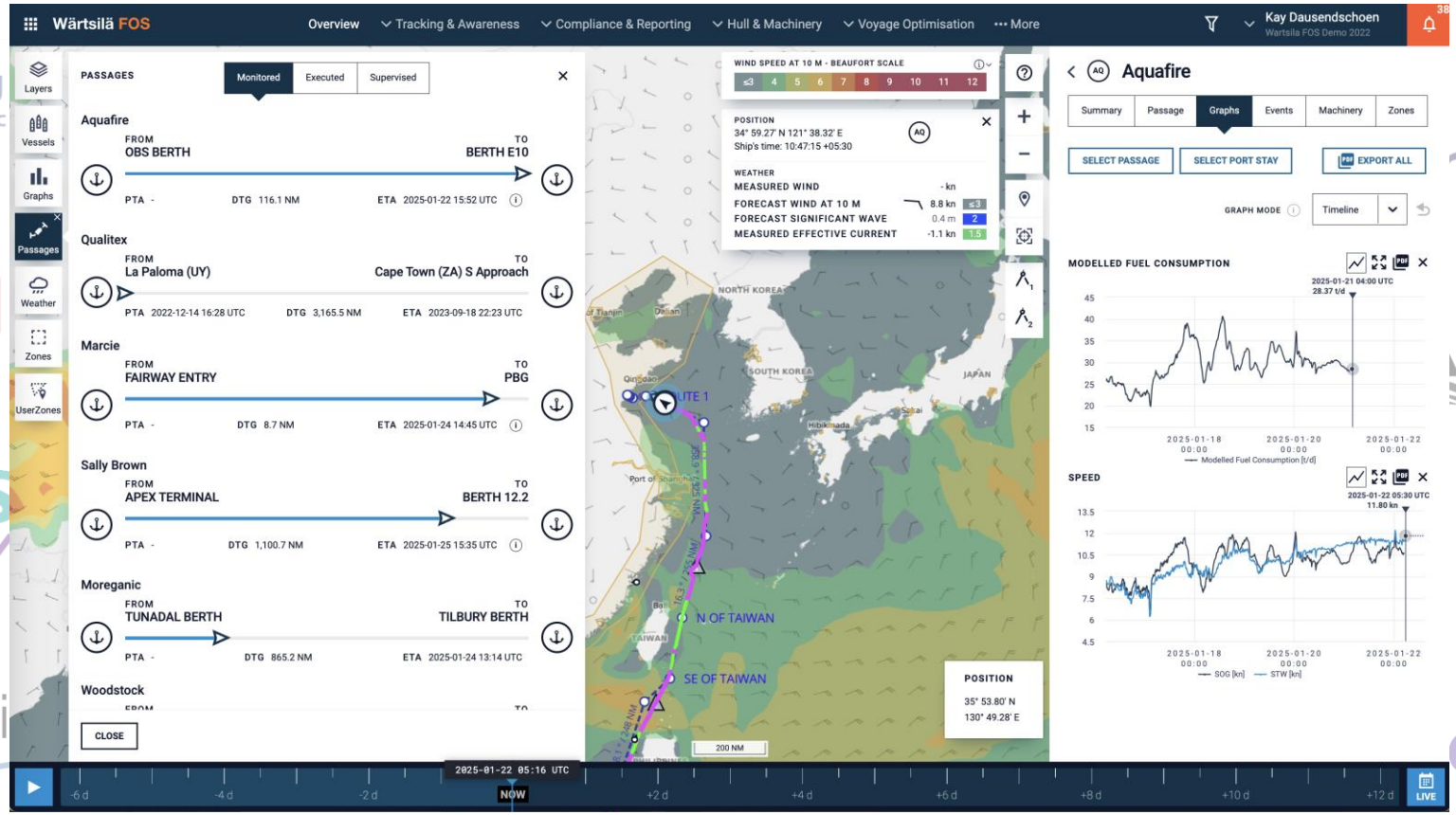
- Including scope of Service Connection
- Backup Protection with unlimited data storage.
- Continuous connection evaluation
- Onshore REST-API for integration of analysis platforms and in-house databases.
- Access to additional modules in Fleet Connect Service Portal

Data Inspector

- Including scope of Data Butler
- Continuous connection, system and data evaluation with proactive troubleshooting
- Fully customizable email notifications for operational data
- Optional subscription for predefined .pdf reports included.
- Access to all modules in Fleet Connect Service Portal

Experts in Analysis





NAUTILUS powered by Danelec

bestship

ankeri

SIEMENS energy

NJORD

deepsea

Propulsion Analyti

TOQUA

Hoppe Maritime Internet of Things

- **Optimized Fuel Efficiency** – Continuous monitoring of engine performance, propulsion efficiency, and fuel consumption allows for real-time adjustments, reducing fuel costs and emissions.
- **Improved Voyage Planning** – Real-time environmental and operational data enhance route optimization, leading to safer and more efficient navigation.
- **Regulatory Compliance** – Automated data logging ensures accurate reporting for emissions regulations and performance standards.
- **Data-Driven Decision Making** – The integration of AI and analytics provides actionable insights, improving overall fleet management and operational efficiency.

Overall, **MIoT data collection** transforms vessel operations by increasing efficiency, reducing costs, and ensuring compliance while supporting sustainability goals.

GLAD TO CONNECT.

Uwe Altenbach

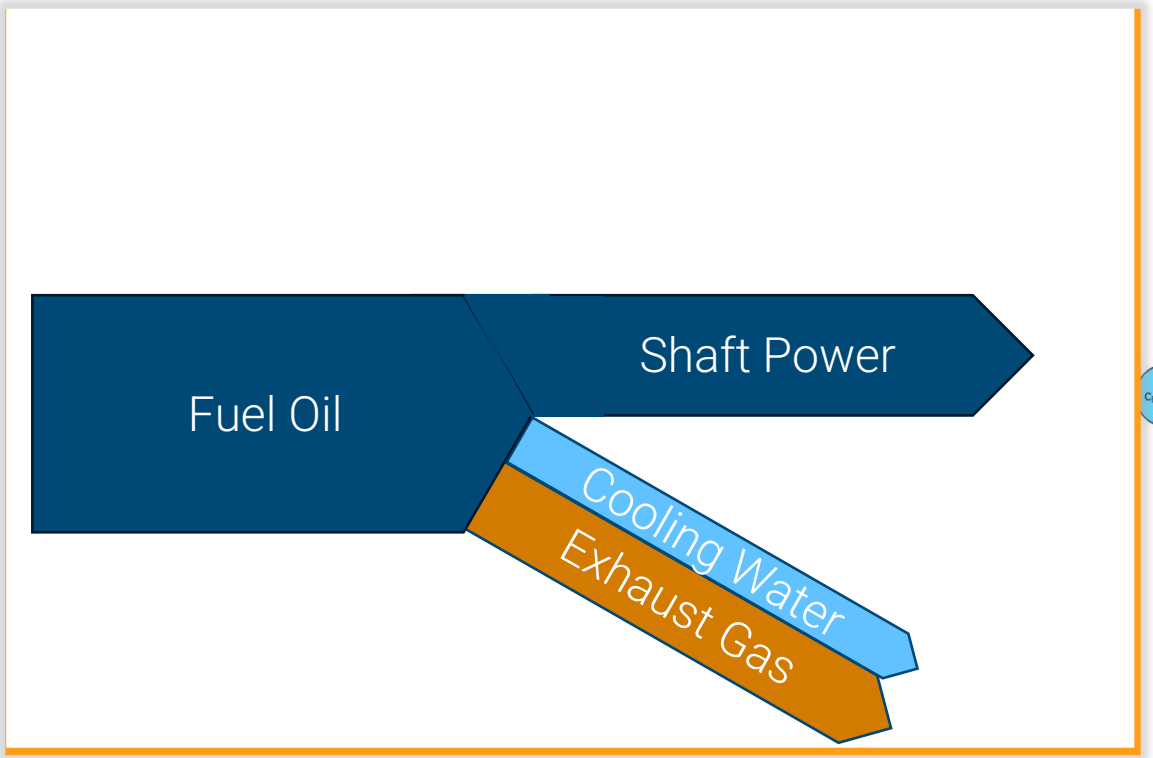
Sales Manager
u.altenbach@hoppe-marine.com

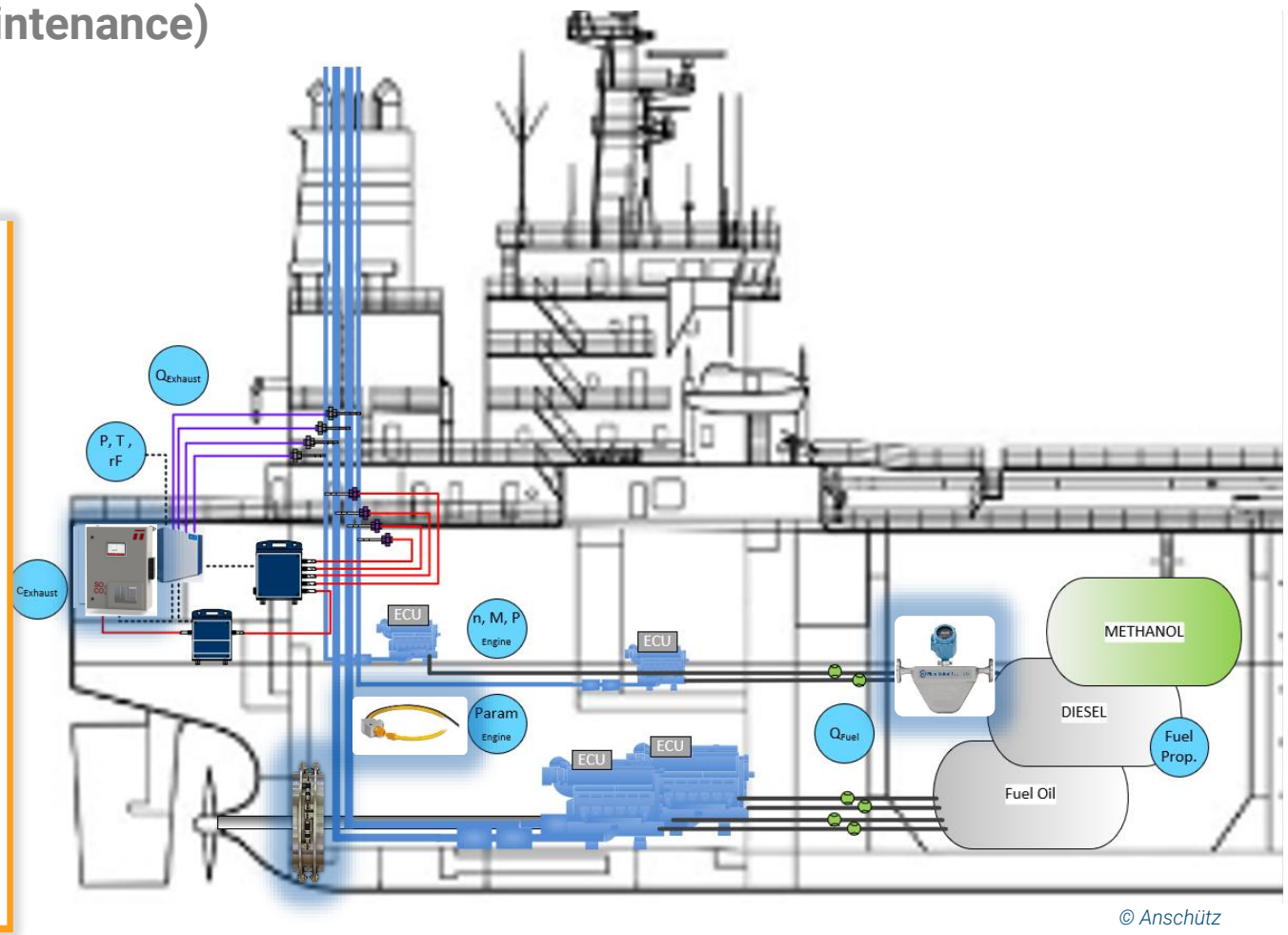
What´s next ?

Future Outlook / Advanced Data Engineering

CEMS - Continuous Emission Monitoring System

The Enabler for Holistic Energy Balancing (Maintenance)





© Anschütz

Hoppe Maritime Internet of Things

Powertrain Development

What goals are pursued?

Engine Base Calibration

- Injection and Ignition Timing
- Variable Cam Positioning
- Emission optimization
- Torque Model
- Air Flow Determination

Advanced Calibration

- Intake Air Temperature Model
- Oil Dilution Model
- Exhaust Gas Temperature Model
- **Drivability**

Hoppe Maritime Internet of Things

Powertrain Development

Why - Math based Models in Engine Control Units?

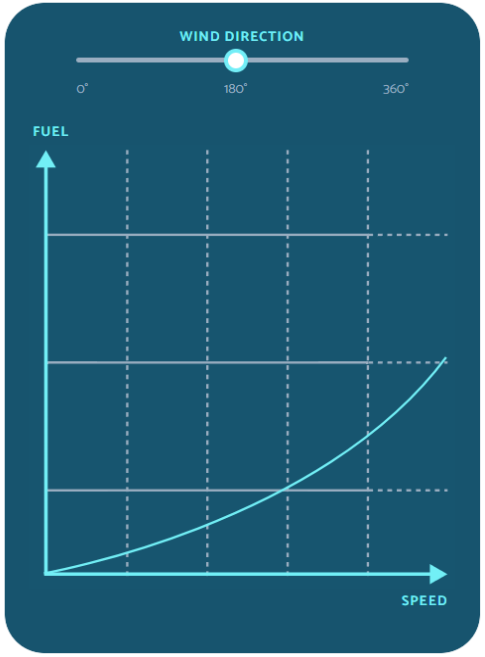
- Description of physical correlations
- Substitution of Sensors
- Engine / Component Protection
- Condition based and predictive Maintenance

Hoppe Maritime Internet of Things

Advanced Data Engineering

Why - Math based Models in Vessels Energy Data?

- Description of physical correlations for Data Plausibilisation
- Substitution of Sensors
- Engine / Component Protection
- Condition based and predictive Maintenance



A ship Kernel models all conditions

While always providing confidence scores

- Wave height
- Wave direction
- Salinity
- Wind speed
- Wind direction
- Water temp
- Current speed
- Current direction
- Draft
- etc.

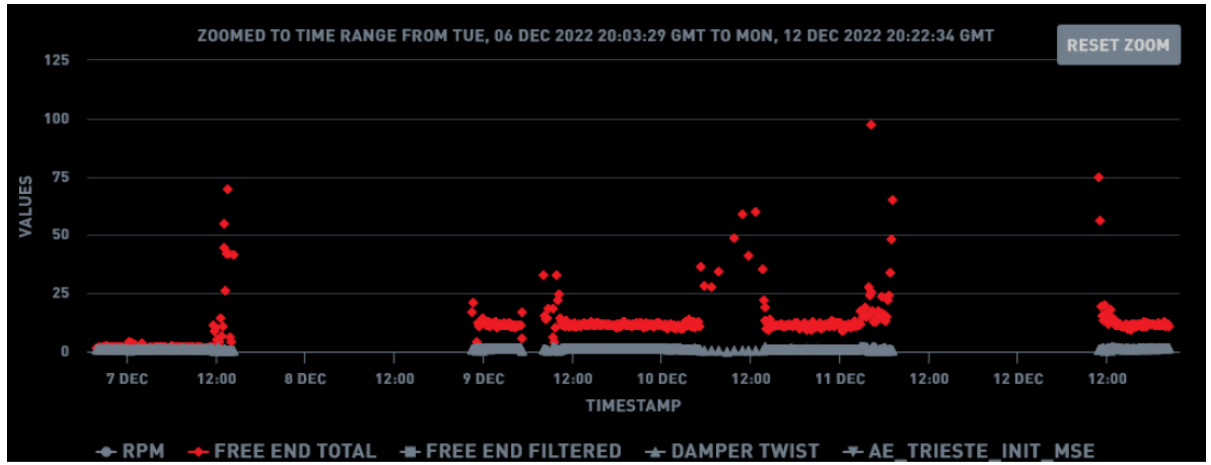
Stop limiting your analysis to reference conditions. Go beyond 'good' and 'bad' weather. Go beyond Beaufort numbers. Model all parameters exactly. Bring your analysis and optimizations to the next level. Model all possible conditions and scenarios, with the peace of mind that uncertain predictions will be flagged by low confidence scores.

Product | Ship Kernels | Toqua

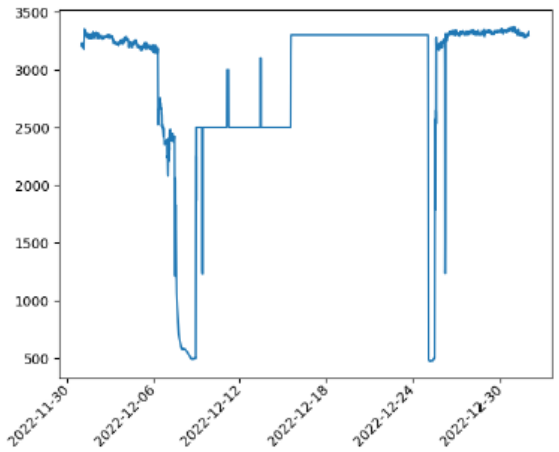
Hoppe Maritime Internet of Things

Advanced Data Engineering - Example

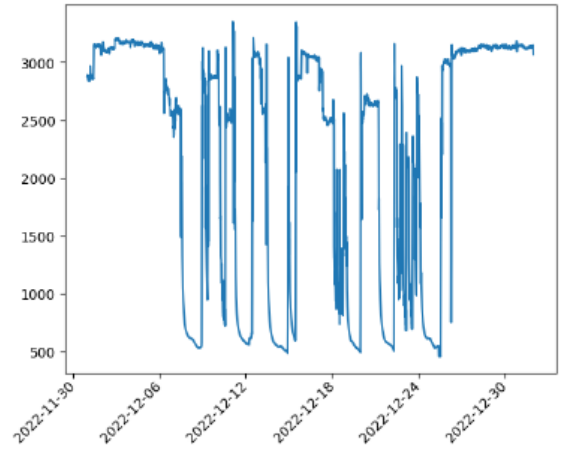
Example - Suspected misfiring events via main engine´s torque damper sensor.



Data Analysis of exhaust gas temperature was used to prove the anomalities



ME Exh. Gas Temp. Cyl9



ME Exh. Gas Temp. Cyl8

Hoppe Maritime Internet of Things

- **Optimized Fuel Efficiency** – Continuous monitoring of engine performance, propulsion efficiency, and fuel consumption allows for real-time adjustments, reducing fuel costs and emissions.
- **Improved Voyage Planning** – Real-time environmental and operational data enhance route optimization, leading to safer and more efficient navigation.
- **Regulatory Compliance** – Automated data logging ensures accurate reporting for emissions regulations and performance standards.
- **Data-Driven Decision Making** – The integration of AI and analytics provides actionable insights, improving overall fleet management and operational efficiency.
- **Predictive Maintenance** – High frequency data can help to predict the early detection of potential machine failures, reducing unplanned downtime and maintenance costs.

Overall, **MIoT data collection** transforms vessel operations by increasing efficiency, reducing costs, and ensuring compliance while supporting sustainability goals.

GLAD TO CONNECT.

Uwe Altenbach

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