ENGINEERING TOMORROW

Turning emission mitigation into growth

Energy efficiency, hybridization & digitalization in action

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Let’s untap the potential of the marine sector

- Existing technologies can reduce energy consumption and emissions from ships by up to 75% (IMO)
- Better use of energy can increase the sector’s efficiency and competitiveness
- Digitalization opens new opportunities for performance optimization and compliance with emission limits
- Alternative fuels – Electrification – Hybridization – Digitalization: are to great extent influencing efficiency & emissions

Marine & Offshore - High diversity

Marine

Ocean-sea-lake-river going vessels carry cargo or passengers and operate scheduled route from harbor to harbor.






Passenger ships, mega yachts, river vessels, cruise, tourist boats, container ships, RoPax, general cargo, LNG/LPG carriers, tankers, work vessels, other special vessels.

Offshore

Vessels are built and equipped for special work in offshore areas.






Seismic, subsea, offshore support, wind farm supply, platform supply, anchor handling, multi purpose, jack-up offshore rig, oil-rig, floating production, storage and offloading.

Work boats, dredgers, crane vessels, fishing, coastguard, naval, ocean fishing, other special vessels

Marine & Offshore application areas: Power generation, power conversion, power supply, propulsion, machine room, heating & cooling, ventilation, water handling, air conditioning, deck machinery, winches, cargo handling, cranes, pumps, purpose specific equipment for work processes.

Energy efficiency and hybridization

Less emissions

100%

Less greenhouse gas emissions on electric production

100%

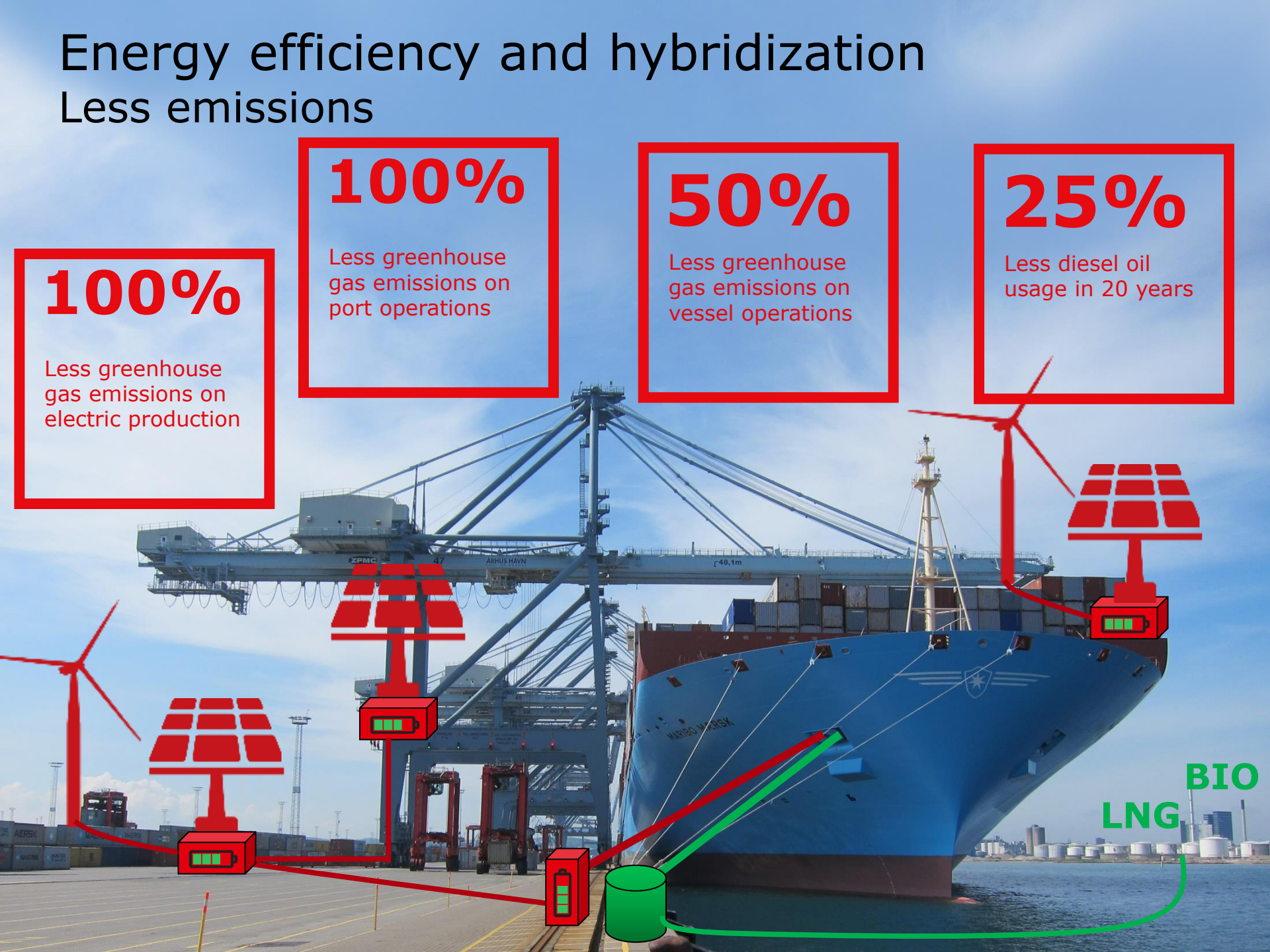
Less greenhouse gas emissions on port operations

50%

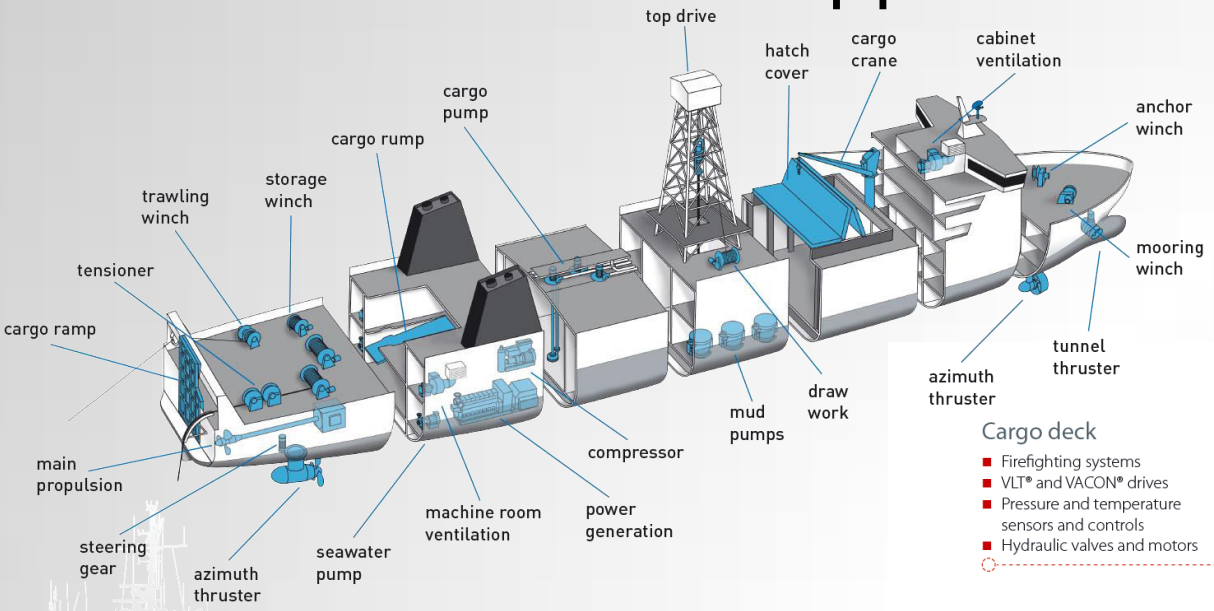
Less greenhouse gas emissions on vessel operations

25%

Less diesel oil usage in 20 years



Marine & Offshore applications



Danfoss Drives IXA

Cargo deck
- Firefighting systems
- VLT® and VACON® drives
- Pressure and temperature sensors and controls
- Hydraulic valves and motors

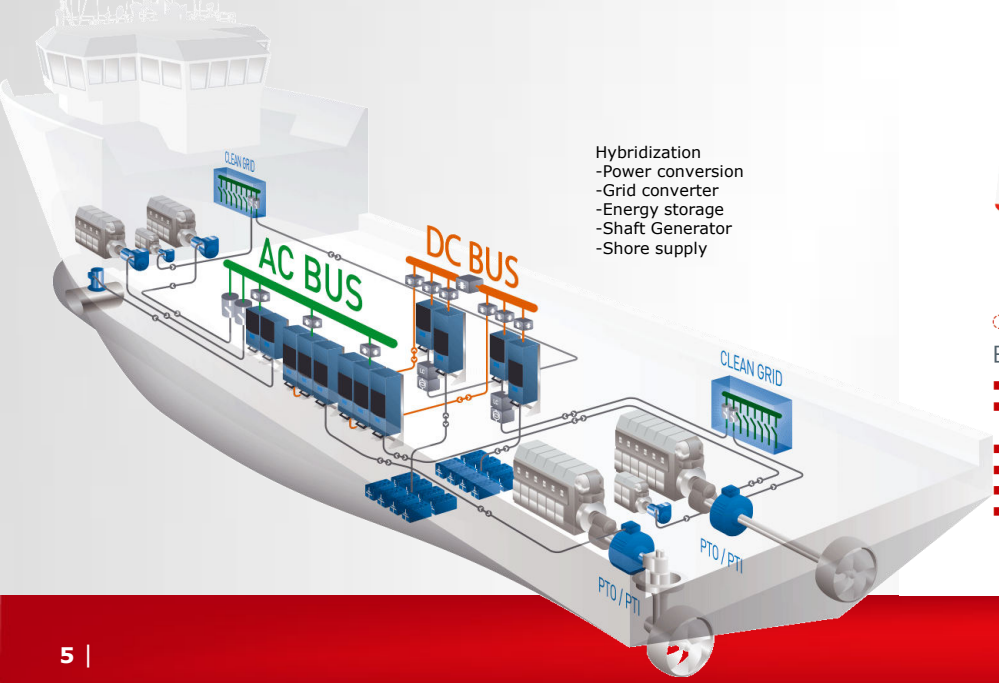
Accommodation
- Control valves for air-conditioning
- Firefighting systems
- VLT® and VACON® drives
- Floor-heating systems

Winches
- VLT® and VACON® drives
- Hydraulic valves, motors and control systems

Engine room
- VLT® and VACON® drives
- Pressure and temperature sensors and controls
- IXA emission sensors
- Fluid controls
- Firefighting systems
- Hydraulic pumps, valves and motors

Utilities
- High-pressure pumps
- VLT® and VACON® drives
- Pressure and temperature sensors and controls
- Fluid controls
- Refrigeration controls
- Firefighting systems

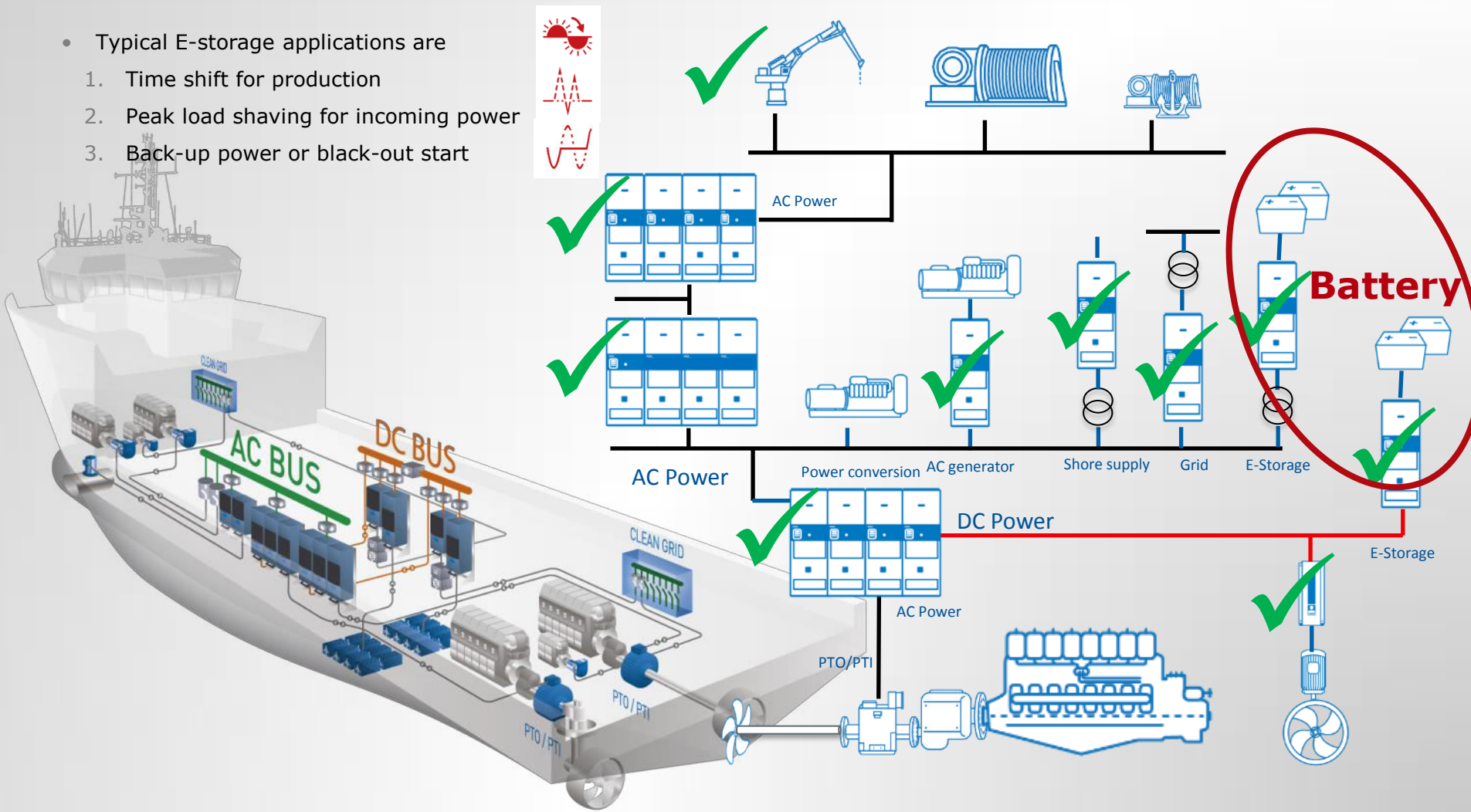
Thrusters
- VLT® and VACON® drives
- Pressure and temperature sensors and controls
- Firefighting systems
- Hydraulic valves and motors



Hybridization
-Power conversion
-Grid converter
-Energy storage
-Shaft Generator
-Shore supply

Technology is in place ✓ Integration Hybridization

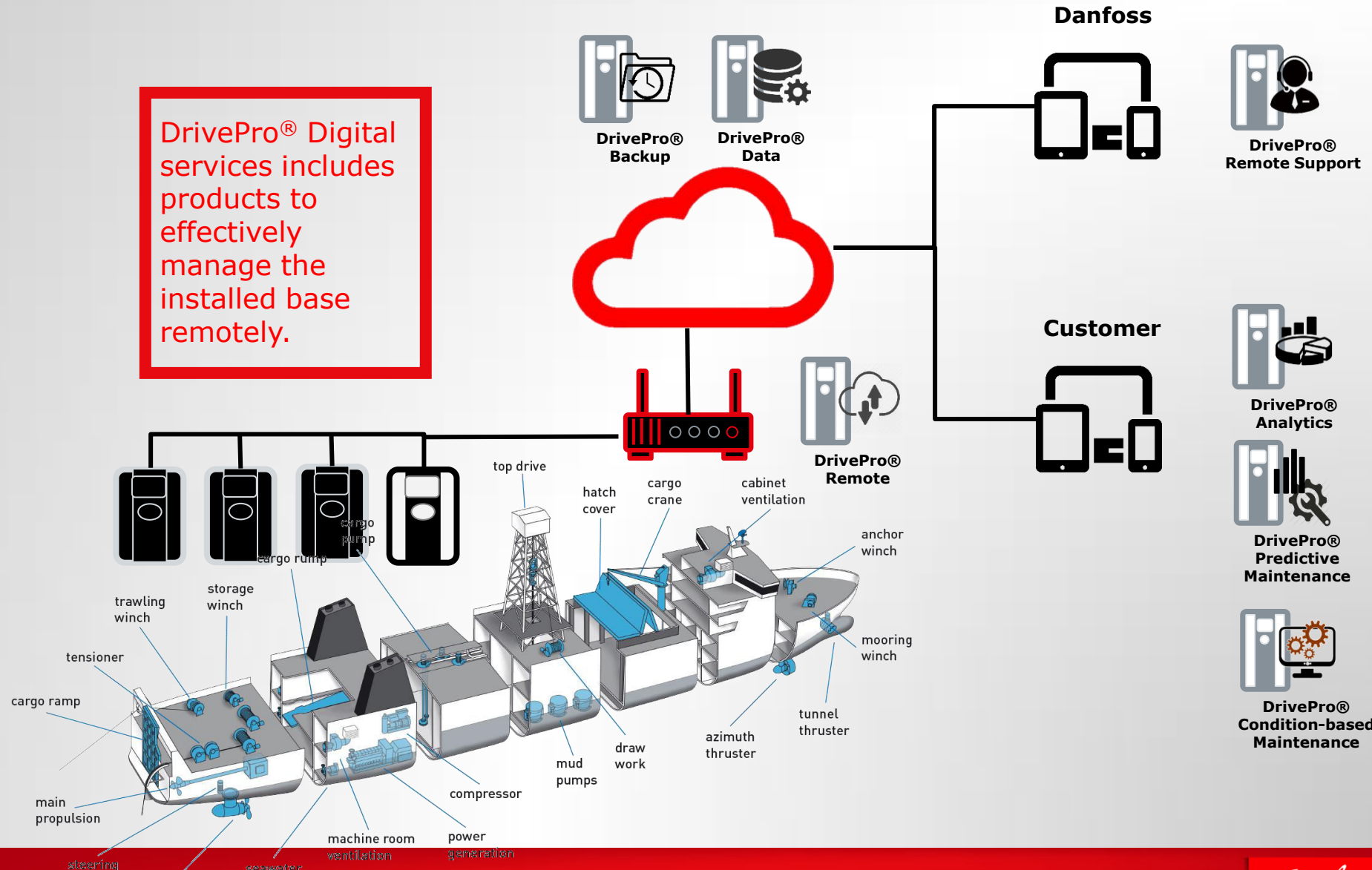
- Typical E-storage applications are
  1. Time shift for production
  2. Peak load shaving for incoming power
  3. Back-up power or black-out start



Digitalization

Digital solution I: DrivePro® Digital Services

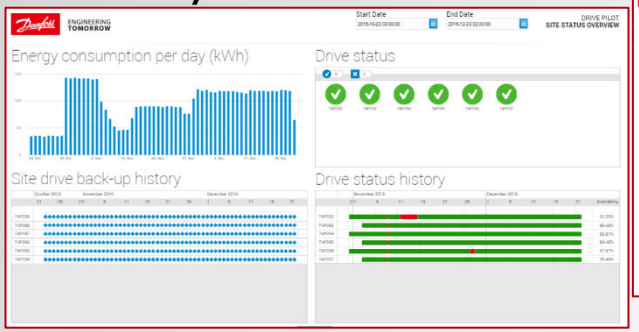
DrivePro® Digital services includes products to effectively manage the installed base remotely.



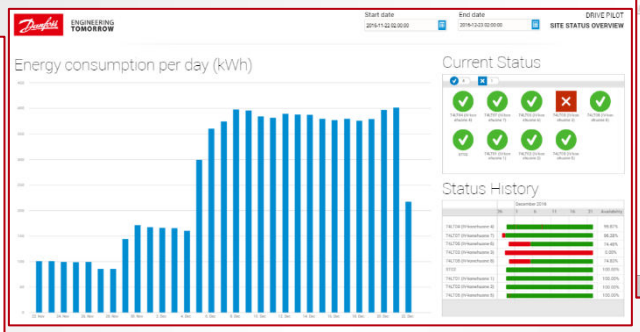
Digital solution I: DrivePro® Digital Services

View into airconditioning (1 year online operation)

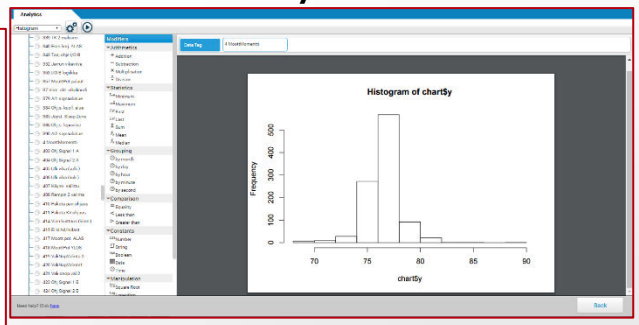
System level



Production level

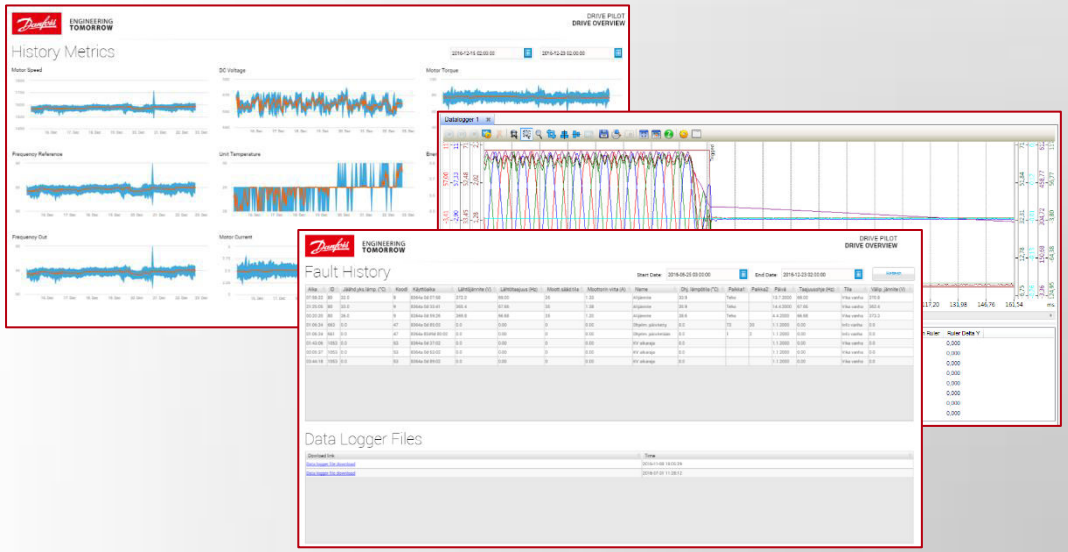


Analytics



Drive level

Parameter level



Digitalization

Today

We communicate with vessels via VHF DSC, satellite & mobile phones, internet. We have AIS tracking and data from vessel to vessel and to shore, etc.
→ Digitalization in marine is not so far a way
Vessels are talking to you – but individual equipment is still hiding behind EMS, PMS, and bridge systems, and we don't see it remotely online.

Tomorrow

Vessel's intelligent computer calls to mobile device *"Hi skipper, how is your morning at seaside coffee bar, I can see you on camera and you have taken quite strong coffee this moning. Don't worry we are on energy balance and on time, you can step on board after two hours at 9:05 when approaching Kiel's North lock. We are in one hour changing from autonomous & long haul engine mode to battery propulsion mode, please see emission report. Last night's energy covering system problem is fixed and ventilation adjusted so that charging to propulsion batteries was successful. Vessels status 100% OK."*

Vessels are more intelligent and sensing other vessels and shore team.

Digitalization

Digital solution II: Marine Emission Monitoring

The recent decisions on international air emission regulations on ships call for robust digital solutions which can provide the necessary overview on the ship's emission performance on both the ship and ashore.

→ Need to ensure compliance and a level playing field

It is reality…

Photo: Thomas Borberg/Polfoto/Arkiv

IMO agrees on global sulfur directive from 2020

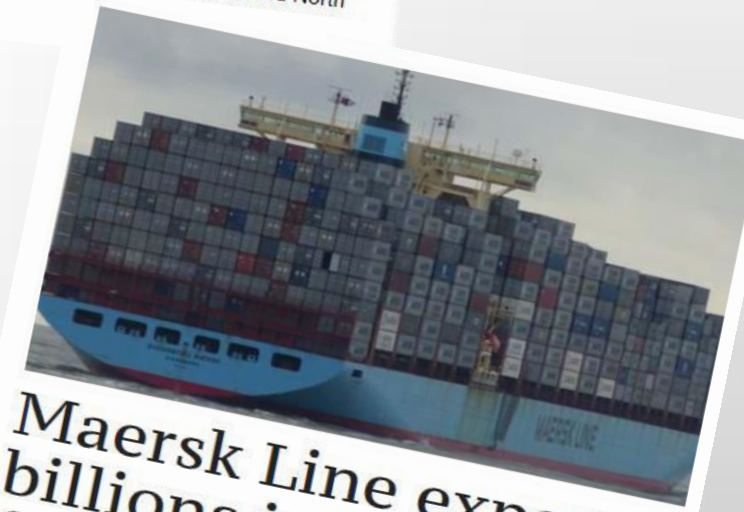
CARRIERS: On Thursday, the IMO agreed that ships' fuel may not contain more than 0.5 percent sulfur starting in 2020. The agreement will reduce sulfur pollution from shipping by more than 80 percent, according to the Danish Ministry for Food and the Environment.

NOx zones will be reality by 2021

CARRIERS: The IMO has agreed on stricter requirements for vessel emissions of nitrogen (NOx). Starting in 2021, new vessels must trim 75 percent of their nitrogen emissions when sailing in the Baltic and North seas.

MSC: Sulfur requirements will cost us more than USD 2 billion a year

CONTAINER: The decision to implement global sulfur requirements in 2 will cost container carrier MSC more than USD 2 billion anually. The new environmental requirements put significant pressure on container carriers, says CEO Diego Aponte.



Maersk Line expects billions in costs from new sulfur directive

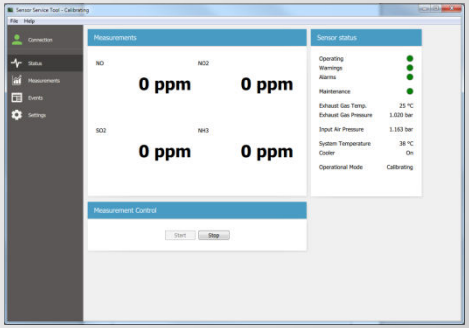
CONTAINER: At Maersk's container carrier alone, the new IMO requirements for less sulfur in fuel from 2020 will results in costs totaling billions of dollars, Maersk Line tells ShippingWatch, calling for methods to enforce the global sulfur directive.

Danfoss IXA's emission sensor

Advanced software algorithms that ensure optimum performance

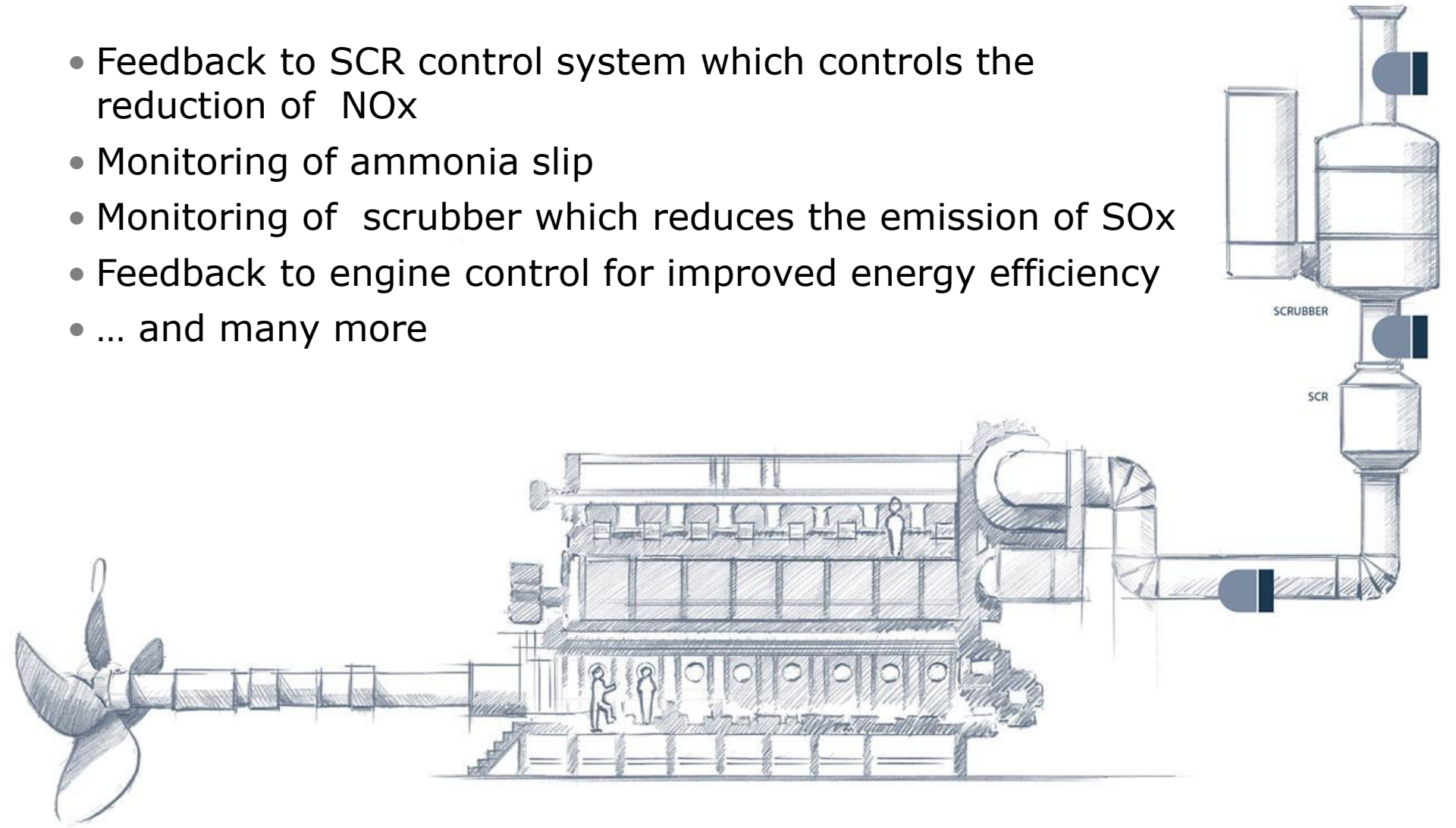
Remote operation with third party SW

Remote operation with Danfoss IXA SW



Applications

- Feedback to SCR control system which controls the reduction of NOx
- Monitoring of ammonia slip
- Monitoring of scrubber which reduces the emission of SOx
- Feedback to engine control for improved energy efficiency
- … and many more



Digitalization of emission data

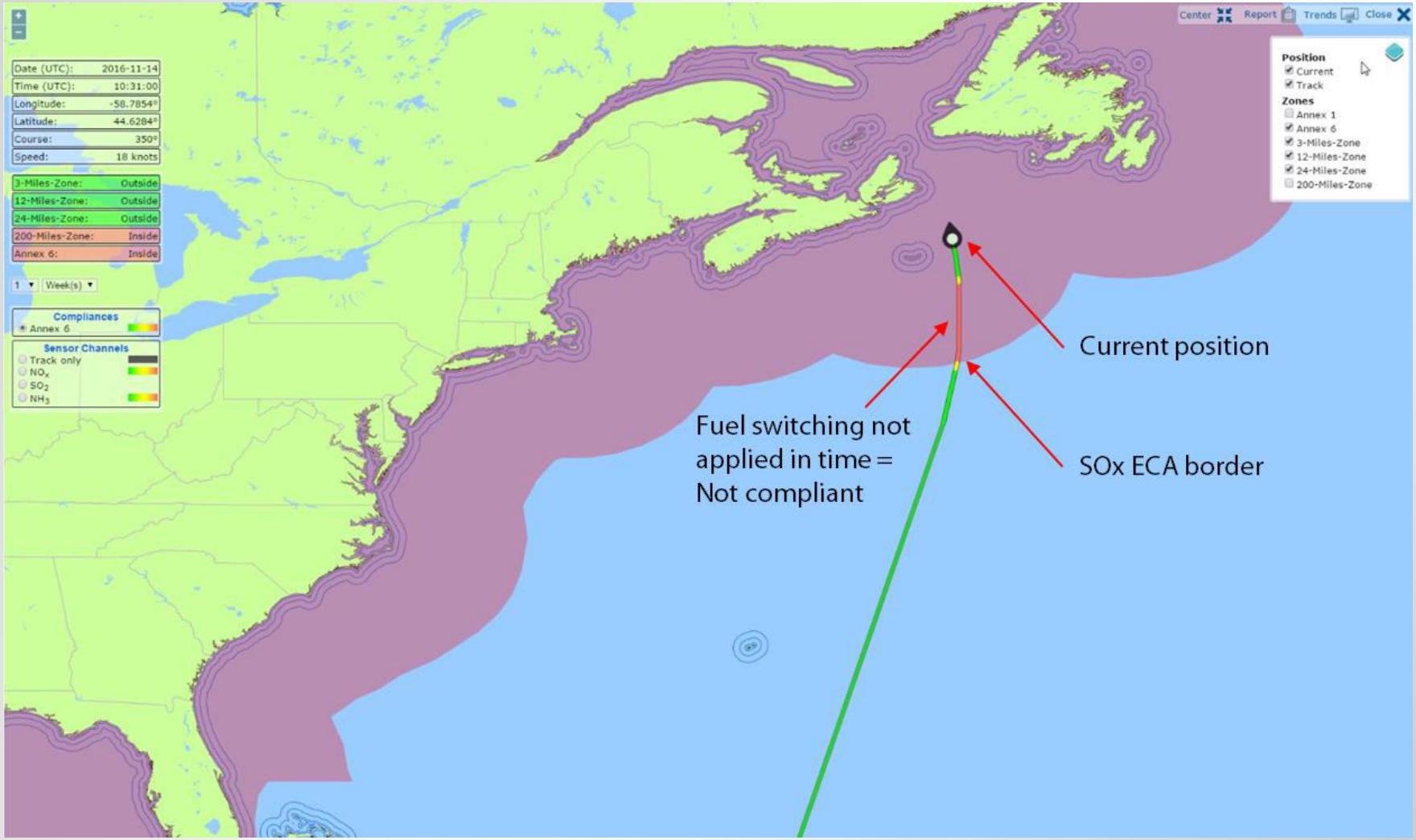
- **Access live data** from our sensors through mobile network or satellite uplink
  - Live data available in the engine control room and on the bridge
  - Live data available for technical staff on shore

- **Documentation** and compliance
  - Generate MRV reports
  - Create emission overview across fleets, voyages, time periods etc.
  - Generate report for authorities
  - Transfer data to “the cloud” for further analysis (big data)

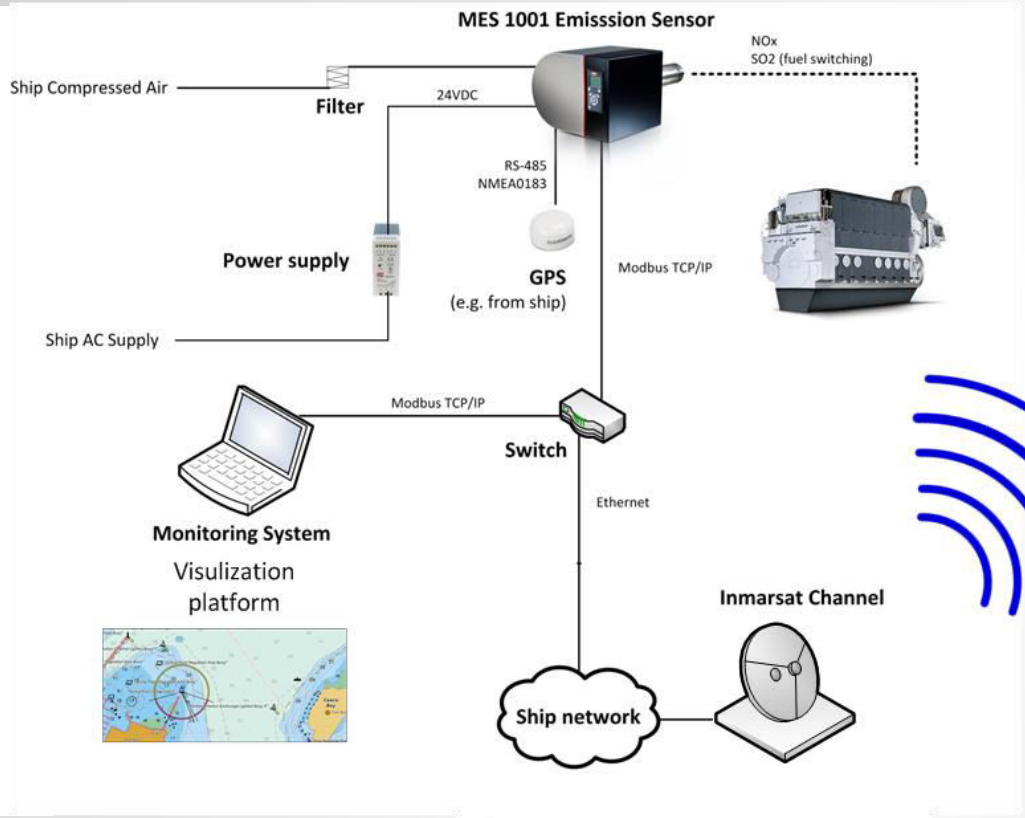
- **Optimization**
  - Reduce urea consumption in SCR applications
  - Avoid ammonia slip induced fouling of the exhaust system in SCR applications
  - Optimize fuel switch-over process
  - Optimize emission performance across fleets

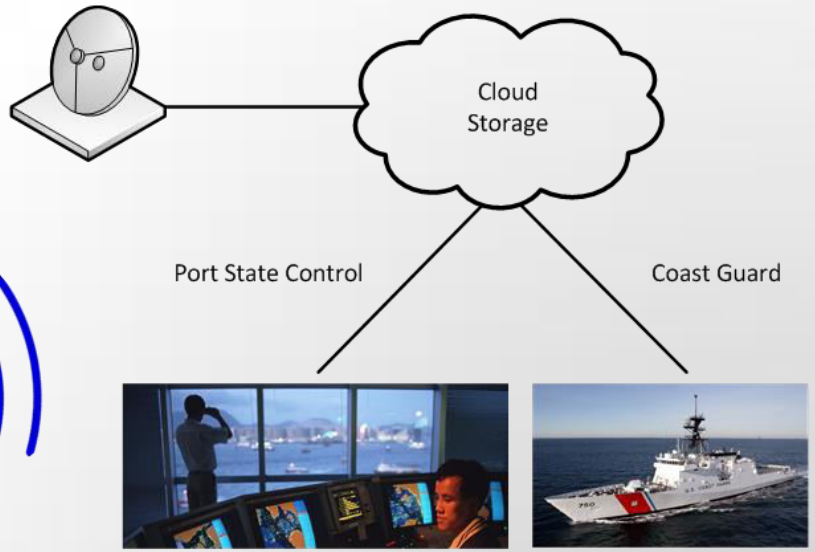
- Third-party digital monitoring platforms can easily access sensor data.

Emission SOx compliance case



Infrastructure





Conclusions

Opportunities for the maritime sector:

- → Emission mitigation is a **growth** factor
- → Opportunity to leverage digitalization for **compliance**
- → Marine = **high-tech industry** with promising future, presenting opportunities for younger generations
- → Digitalization will enable us to **do even more with less**

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