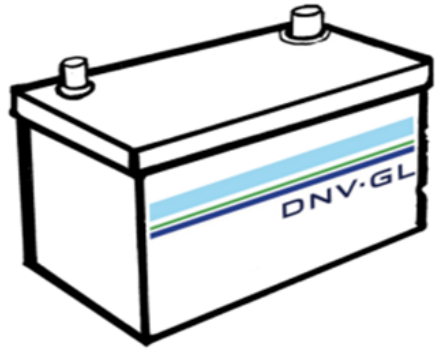
Maritime Battery Safety Standards

Albatts Webinar

Sverre Eriksen

19 January 2021



DNV GL class role for Maritime batteries

- We **classify, certify, verify and test** against regulatory requirements, standards and recommended practices
- We develop new **rules, standards and recommended practices**
- We **qualify new technologies** and operational concepts
- We give **expert advice** on safety, technology, data management, efficiency, performance, and risk management

DNV GL Classed and pre classed vessels with batteries











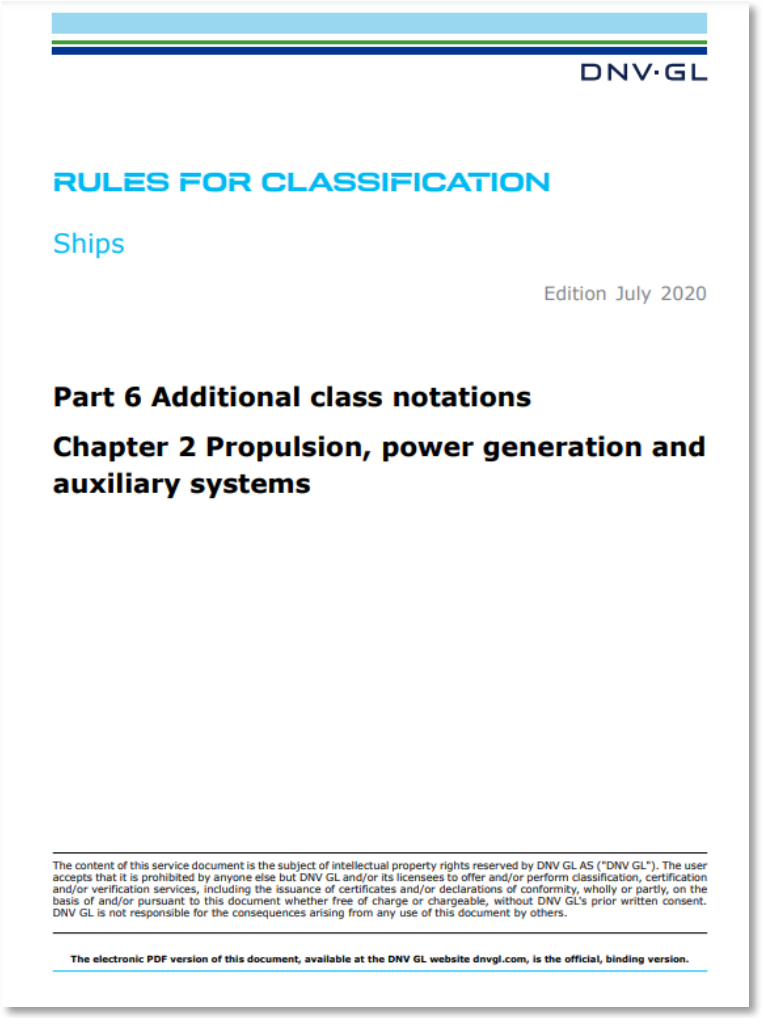








Sec.1 Battery Power



DNV·GL

RULES FOR CLASSIFICATION

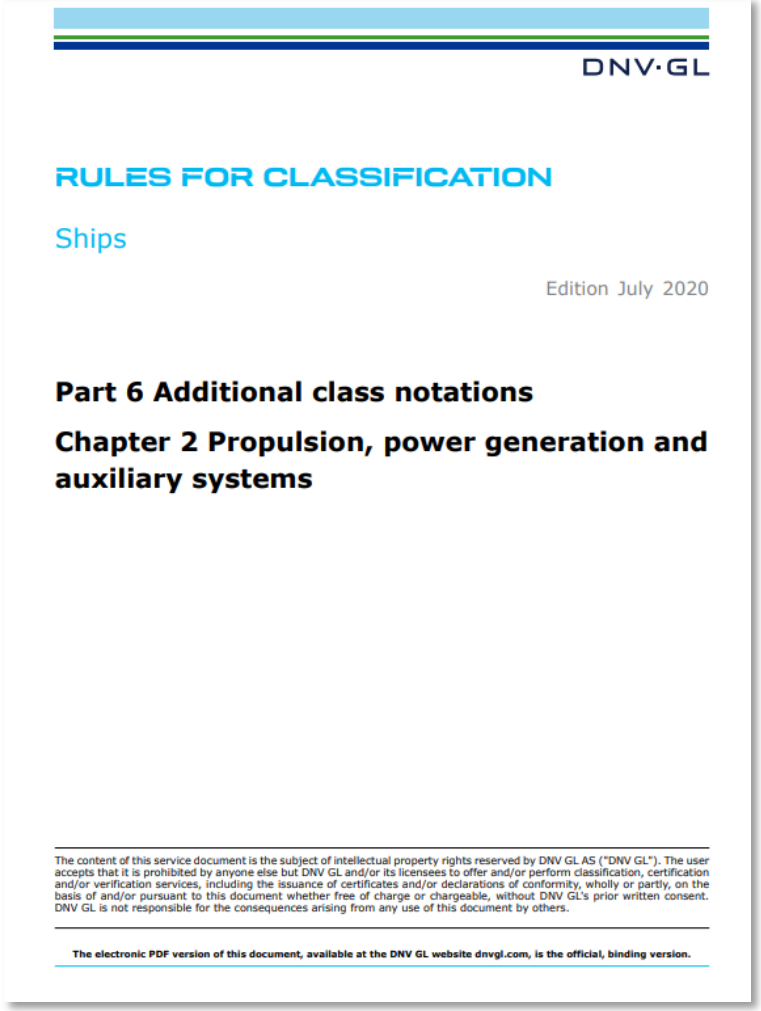
Ships

Edition July 2020

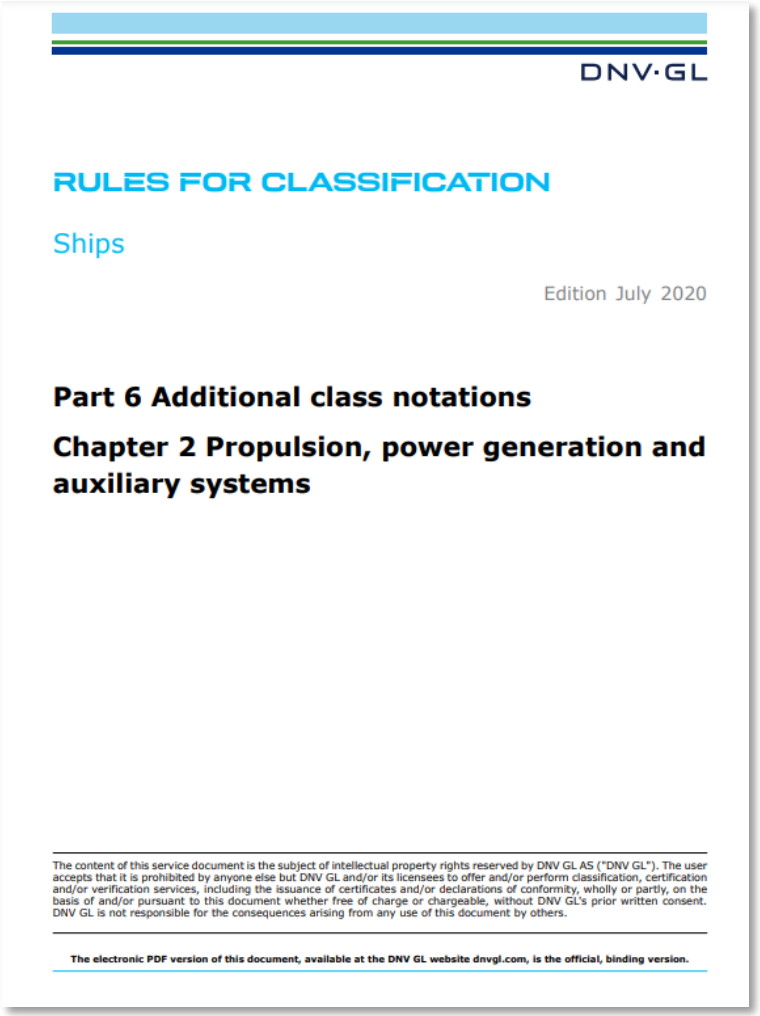
Part 6 Additional class notations

Chapter 2 Propulsion, power generation and auxiliary systems

Sec.1 Battery Power



Sec.1 Battery Power



DNV·GL

RULES FOR CLASSIFICATION

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Chapter 2 Propulsion, power generation and auxiliary systems

Sec.1 Battery Power

DNV·GL

Sec.1 Battery Power

Sec.1 Battery Power

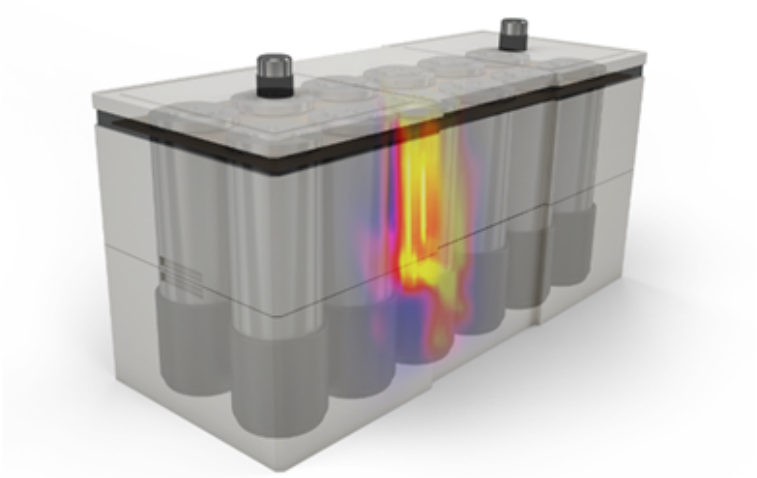
Sec.1.4 Battery system certification

4.1.2.6 The design of a module should prevent propagation of a thermal event from the first cell to another cell. Alternatively, as a minimum, a system shall be designed such that a fire in one cell may spread within that module but will not propagate to another module. The amount of off-gas considered in analysis shall be dependent on the number of cells which release off-gas. Demonstration of system capability with respect to either approach shall be verified by testing as defined in [4.2.2] in accordance with one of these two options:

1. No propagation between cells within a module.
2. No propagation between modules - with or without an extinguishing agent.

Design option 2 is only accepted where the sum of the cells that propagate in the module is limited to 11 kWh.

Modules that are designed to limit propagation of a thermal event within a cell block or a sub-unit of cells shall be assessed on a case by case basis.



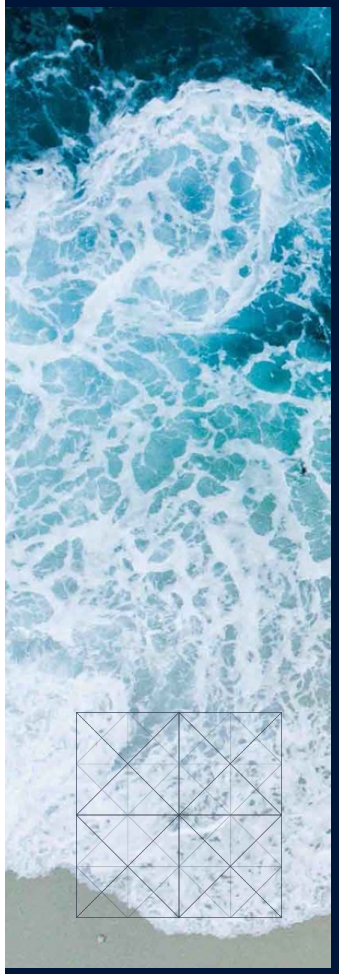
Maritime Battery Safety Standards

DNV GL Maritime Classification

MCANO381@dnvgl.com

www.dnvgl.com

SAFER, SMARTER, GREENER



KONGSBERG

INTEGRATED SOLUTIONS

Energy Storage today and in the future

21/01/2021

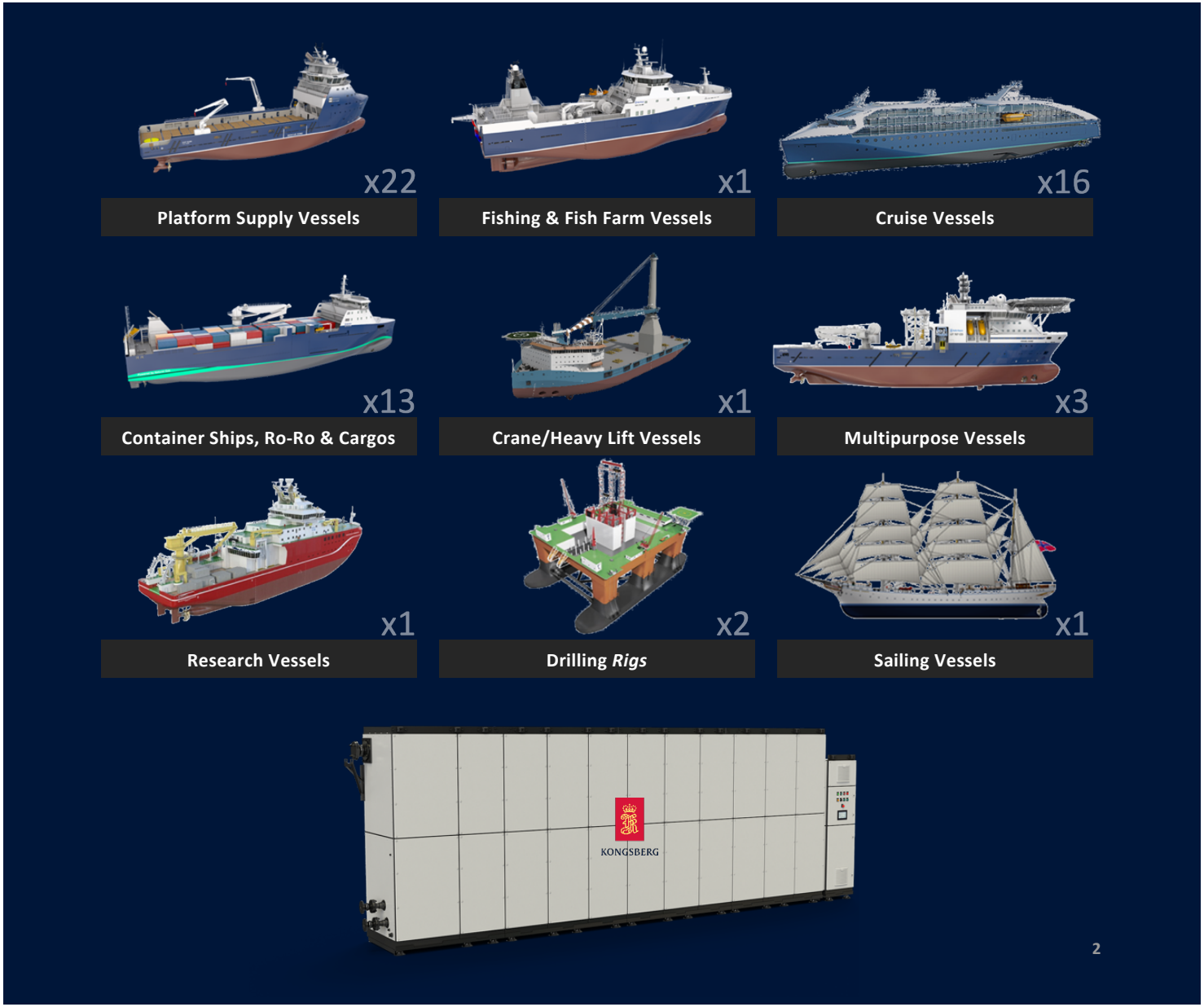
Stian Ramm Manger
Technical Product Manager – Energy Storage

KONGSBERG

Our History

Since 2012, 91 battery-hybrid solutions have been delivered to 60 vessels operating in different market segments.

Energy Storage Systems (ESS) represent 100+ MWh of delivered energy (completed and ongoing projects)



Energy Storage

Important product for increased efficiency and emission reduction

- In the recent years, we have seen a focus on green technology in the Norwegian marine industry, however this has picked up speed also outside of Norway.
- Battery plays an important part in decarbonizing the marine industry. Not only are and will they be used alone as an energy provider, but it also enables and robustifies using alternative fuels such as LNG, Hydrogen, ammonia etc.
- New players are coming in within manufacturing, but also established suppliers are evaluating taking a larger share of the wallet in the marine market.
- Different energy storage solutions is needed for different vessel segments
- Kongsberg has it's own ESS solution named SAVe Energy. Now we are adding two more ESS solutions to our product portfolio the SAVe Power and SAVe Energy +.

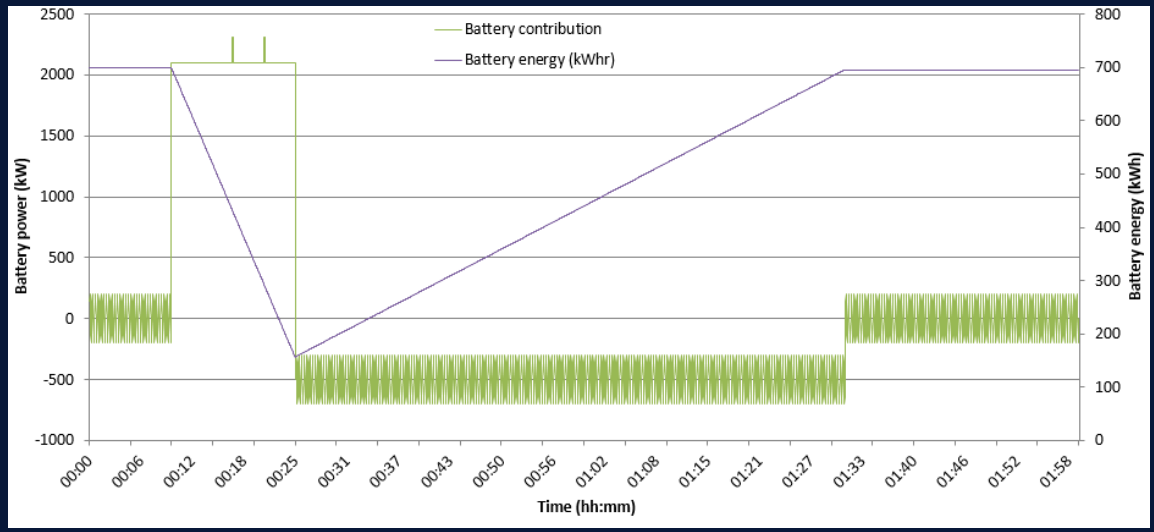
Dominant Energy	Equal	Dominant Power
SAVe Energy +	SAVe Energy	SAVe Power
High energy density	Space efficiency	Optimized

KONGSBERG

Energy Storage

Marine Applications

- Peak Shaving
- Spinning reserve
- Zero Emission
- Blackout recovery
- Enhanced load sharing



Energy Storage

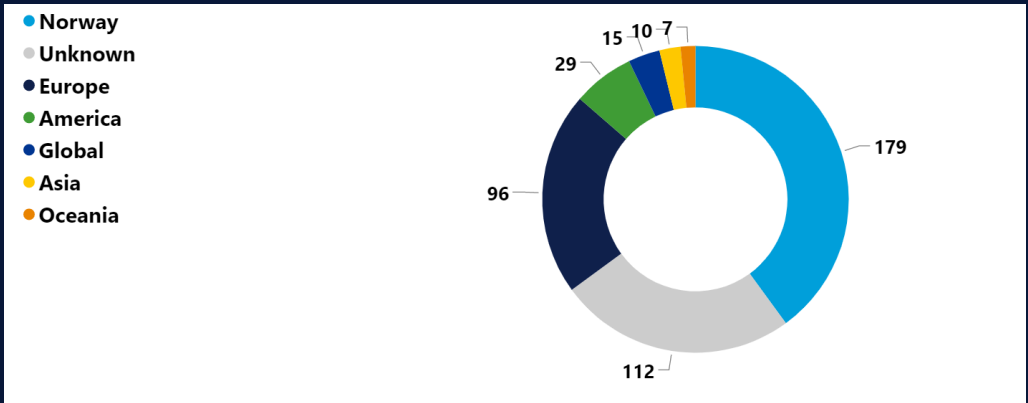
Future shipping

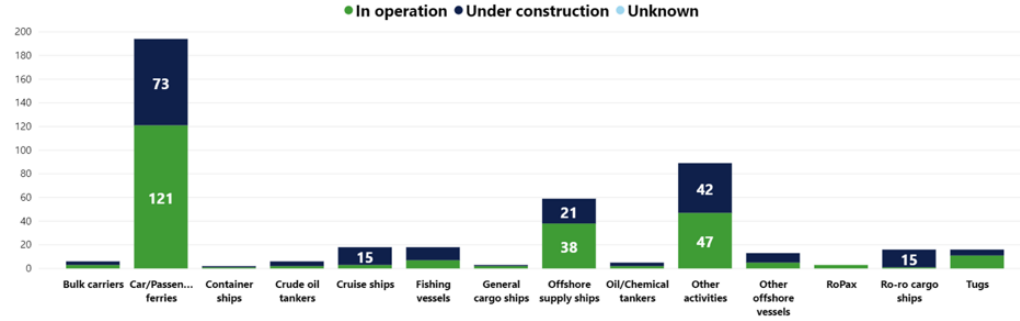
- Energy Storage on every third ship in the world
- Enabler of alternative fuels such as hydrogen
- Reduced maintenance
- Autonomous shipping

Energy Storage

Market Geography

- Europe leading the energy storage introduction in marine
- Important for Europe to be less dependent on the big Asian suppliers





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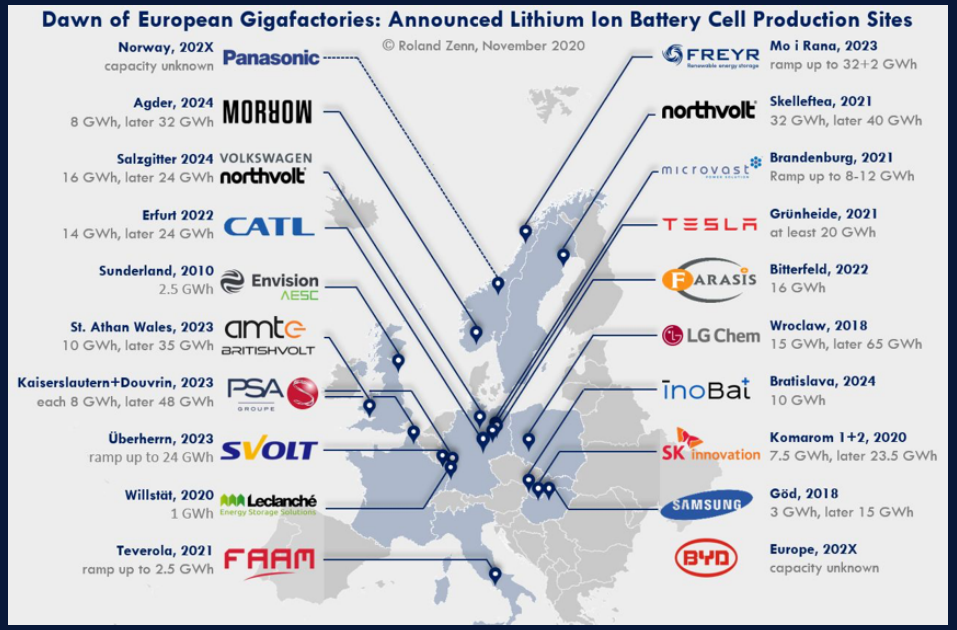
Energy Storage

Battery production in Europe the coming years

- Major increase in cell production in Europe mainly caused by EV demand
- This competition is leading to cost reduction on cell and module level
- Raw materials and sustainability focus is very important for European energy storage manufacturers



KONGSBERG

Energy Storage

Energy Storage skillset for maritime market

- Energy storage knowledge
  - Safety
  - Electrical capabilities and limitations
  - Mechanical design of rack and modules
  - Cell topologies
- Electrical skills
  - Power Electronics
  - Electrical integration of energy storage
  - External faults impact on energy storage
- Software development for both internal safety- and integration aspects
- Deep chemical and production skills not as important for maritime market as the market will be dominated by mass production

ALBATTS WEBINAR | 19.01.2021

Job roles and skills

ABB Marine & Ports Electric. Digital. Connected

Tomas Tengnér, Global Product Manager

ABB: the pioneering technology leader

What (Offering)	**Pioneering technology**		
	Products	Systems	Services & software
For whom (Customers)	**Utilities**	**Industry**	**Transport & Infrastructure**
Where (Geographies)	**Globally**		
	Asia, Middle East, Africa	Americas	Europe
	~$28 bn revenue[1]	~100 countries	~110,000 employees*

[1]SOURCE: Annual Report 2019 published financial results
* About 110'000 as of July 1, 2020

Marine & Ports at a glance

Vision

Electric. Digital. Connected.

Values

Team

> 2000 employees

Global footprint

- **26 countries**
- **6 HBUs**

China, Singapore, Finland, Norway, Sweden and US

- **20 LBU's**

6 in AMEA, 9 in Europe and 5 in Americas

Marine Solutions

- **Propulsion Solutions**
- **Electric Solutions**
- **Digital Solutions**
- **Services**

Ports Solutions

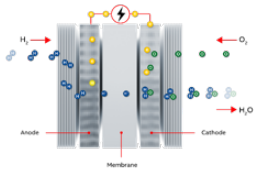
- **Crane Automation**
- **OCR and Process Automation**
- **Port Electrification**
- **Services**

Core Business in Marine - electric systems, Azipod® propulsion and automation

Core solutions and Innovations

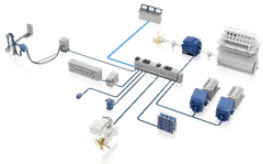
Brigde solutions

Digital Solutions



Fuel cell solutions

Azipod® propulsion



MV AC and Onboard
DC Grid electric systems

Battery Solutions

Automation

Marine Services

Vessel segments

Cruise

Offshore

Ice breaking vessels

LNG tankers

Passenger Ferries

Zero emission operation – solutions

Short sea shipping driving environmental goals, “test bed” for deep sea shipping

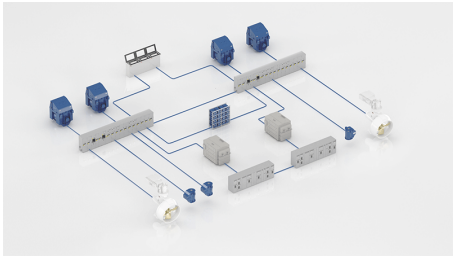
Charging technology

Electric charging

Onboard DC Grid™

Electric power solution

– Modular system



Batteries

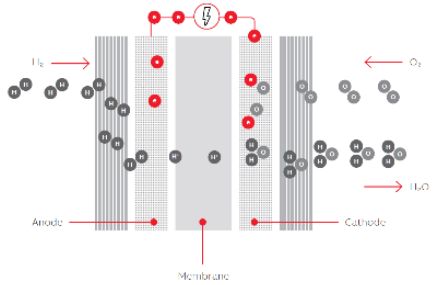
Clean, flexible

– Energy storage functions

Fuel cells

Clean and flexible

– Energy production function



Electric. Digital. Connected.

ABB’s technologies are redefining the future, bringing new levels of reliability, efficiency and sustainability.

Electric

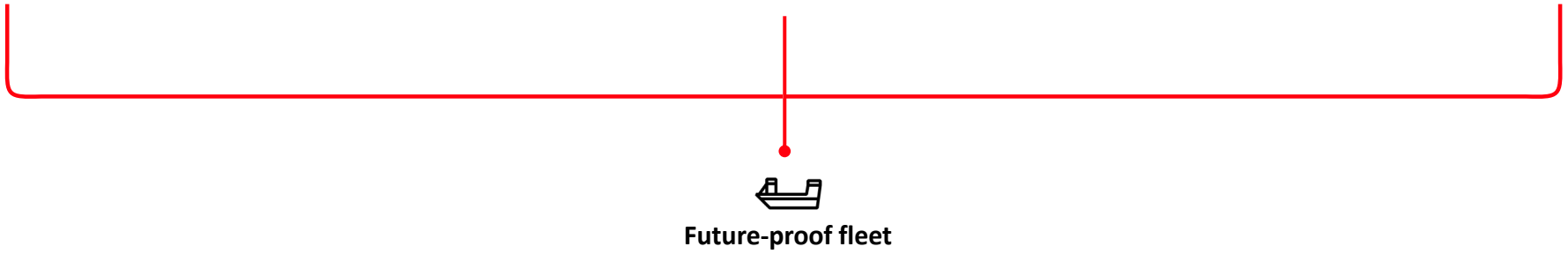
The electrical backbone, integrated with automation and control systems, is already transforming the industry to truly collaborative and automated operations.

Digital

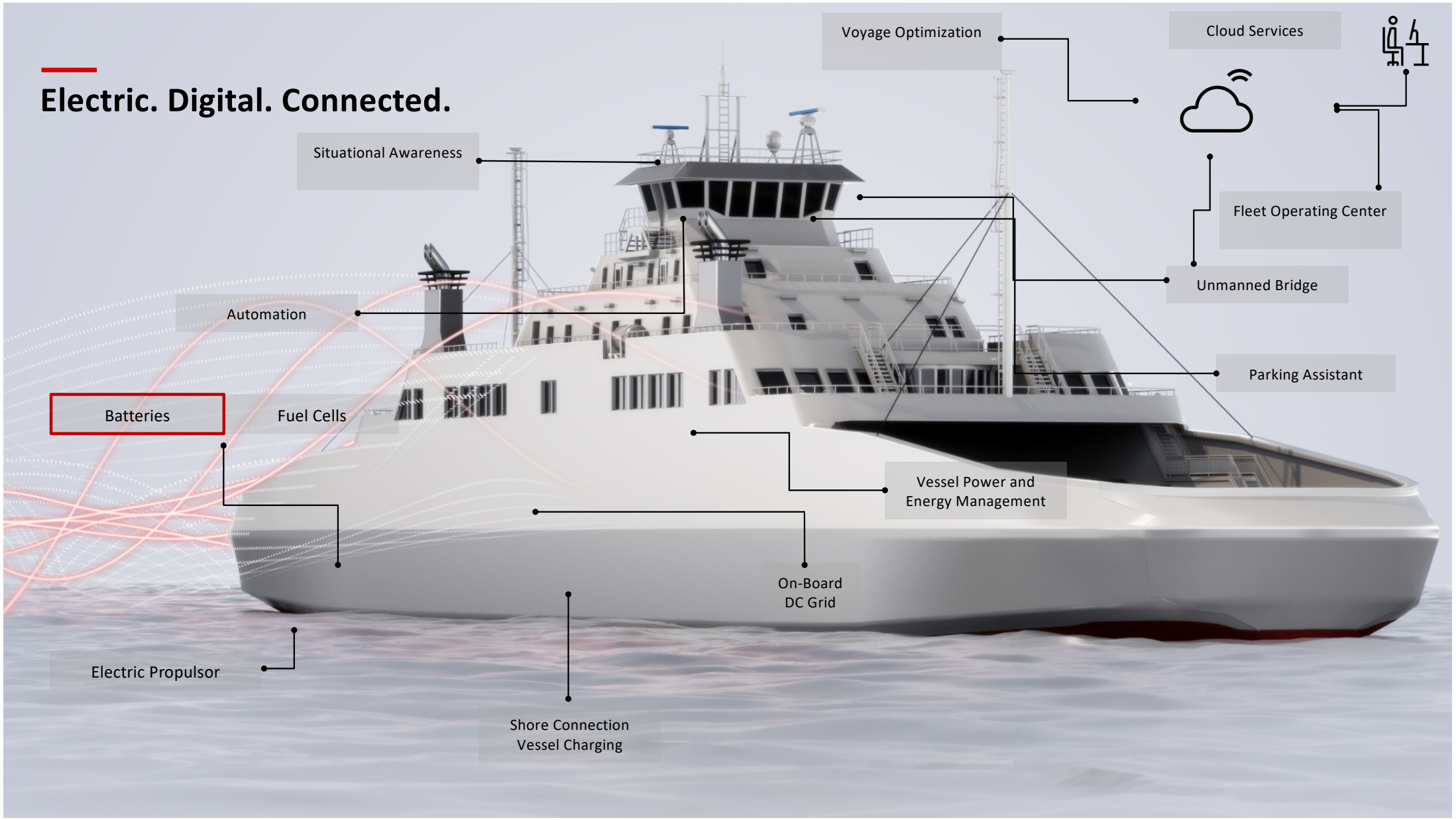
Digital solutions on board a vessel transmit data in real time, giving a comprehensive overview of the ship’s performance to teams on board and ashore.

Connected

Connectivity makes it possible to exploit advanced analytics that feed into tools for energy efficiency and maintenance optimization.

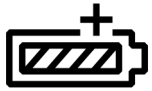


Electric. Digital. Connected.

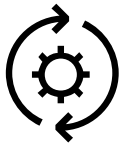


Battery-specific expertis

Domain-knowlege needed

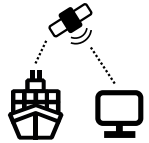


- Electro-Chemistry
- Performance
- Aging
- Charaterization



- Modelling
- Optimization
- State estimation
- Advanced Control system development

- Safety – electrical & fire safety
- Power Electronics & DC protection
- Electronics and communication



- Data analysis
- Diagnosis
- Prognosis
- Artificial intelligence

My background

- Grown up in Leksand, Sweden. Far from sea.
- 2005 – 2009 M.Sc. Energy System Engineering (2005-2009), Umeå university, Sweden
  Thermodynamics, Physics, Chemistry, Electrical engineering … a generalist education
- E-mobility enthusiast, Early EV conversions
- 2009 M.Sc. Thesis Wireless power transfer, ABB Corporate Research
- 2009-2017: Scientist/Senior Scientist ABB Corporate Research
  - Modular multilevel converters for ESS, new topologies, simulations
  - Battery testing, characterization, lab manager
  - State estimation, ESS control (for grid), Flash charging
  - Inventor/co-inventor of ~10 granted patents
- 2017 – 2020: Global Product Specialist / Global Product Manager, ABB Marine

General needs

General needs

- More versitile work force
- Broader competence needs than before





ABB

albatts

Alliance for Batteries Technology, Training and Skills

Alliance for Batteries Technology, Training and Skills
2019-2023

ALBATTS WORKSHOPS – JANUARY 2021

Co-funded by the Erasmus+ Programme of the European Union

What is **ALBATTS**?

- 4-year (2019-2023) Erasmus+ funded project
- Blueprint for Sectoral Cooperation on Skills in Battery sector
- Contributes to the electrification of transport, green energy and environmental goals in Europe
- Gathers demand and supply sides of competences in the battery value chain

Co-funded by the Erasmus+ Programme of the European Union

What is **ALBATTS**?

- Identification of skills and job roles needs
- Enabling education sector to provide education and training for the future workers and specialists needed by the battery sector
- Covers the battery life cycle - batteries developed for and used in both stationary and mobile applications

Co-funded by the Erasmus+ Programme of the European Union

Partners

Skellefteå municipality

AIA Automotive Industry Association

atec

eupportunity

MERINOVA Technology Centre

vamia

VSB Technical University of Ostrava

ACEA European Automobile Manufacturers Association

APIA Asociația Producătorilor și Importatorilor de Automobile

Corvus Energy

efacec

U.PORTO Universidade do Porto

HE3DA

ISCN International Software Consulting Network

northvolt

Realize it

Spin360

Univerza v Mariboru

Vaasan yliopisto University of Vaasa

Vestland fylkeskommune

Co-funded by the Erasmus+ Programme of the European Union

Job roles & skills – Desk Research I

Desk research reports were released in 2020, focusing on:

- Technologies and Stakeholders
- Information on **job roles and skills** as presented in job advertisements
- **Operation, service and maintenance**

The next steps will include:

- Desk research II (2021), III (2022) and IV (2023)
- Surveys
- Workshops

Co-funded by the Erasmus+ Programme of the European Union

ALBATTS Latest Results

- D4.1 Intelligence in Stationary and Industrial Battery Applications – Desk Research Report (August 2020)
- D5.1 Intelligence in Mobile Battery Applications – Desk Research Report (August 2020)
- D3.3 Desk Research and Data Analysis (November 2020)

- Please join our survey: https://stakeholders.project-albatts.eu/s/survey2020
- Please register to our other workshops: https://www.project-albatts.eu/en/listnewsevents

Co-funded by the Erasmus+ Programme of the European Union

Job roles & skills – Desk Research I

Basic skills needed to fully understand the operation of a battery system:

- Electrical & fusing
- Mechanical skills
- Communication protocols
- Electronics
- Software

Co-funded by the
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of the European Union

Job roles & skills – Desk Research I

Three types of repairs:

- Emergency repairs when operating offshore
- Repair in docks
- Service

- A basic understanding of **high voltage** will be needed for all operations
- If a high voltage certification process could be developed, it could really help ensure an adequate level of **safety** for repair & maintenance operations

Co-funded by the Erasmus+ Programme of the European Union

Job roles & skills – Desk Research I

New skills needed for both OEM Service Engineers and Service Engineers of System integrators:

- Data analytics
- Remote guidance and support
- Digital tools and software for remote operations

Other less technical new skills needed for Service Engineers will be

- Proactive dialogue with end customer and intermediates
- Negotiation skills for handling warranty claims and service incidents
- Understanding of legal matters and contracts
- Basic maritime law

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albatts
Alliance for Batteries Technology, Training and Skills

To get involved with the albatts stakeholders group:

Stakeholder registration **here**

Follow us on:

Web: https://www.project-albatts.eu

LinkedIn: LinkedIn

Facebook: Facebook

Twitter: Twitter (@ALBATTS1)

Mail: info@project-albatts.eu

Thank you

Presenter

Contact: kari.valkama@merinova.fi

Co-funded by the Erasmus+ Programme of the European Union

Maritime industry on the way to zero emissions!

Lars Ole Valøen
CTO

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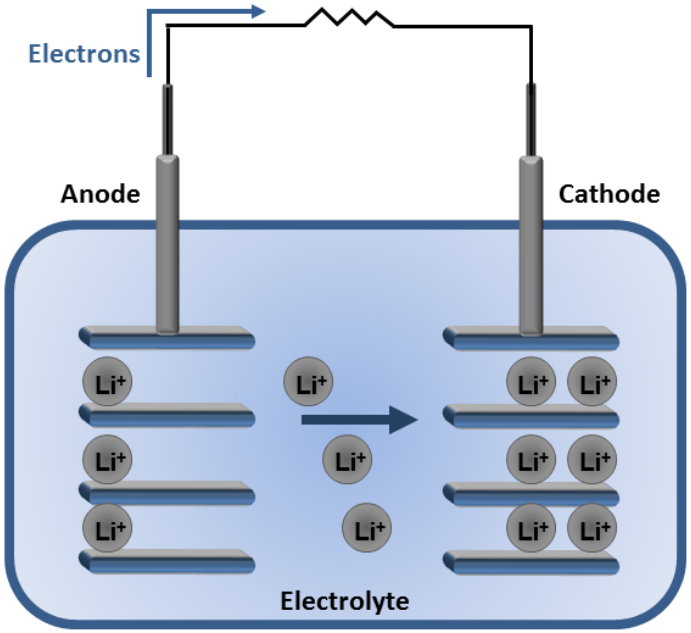
Corvus Energy

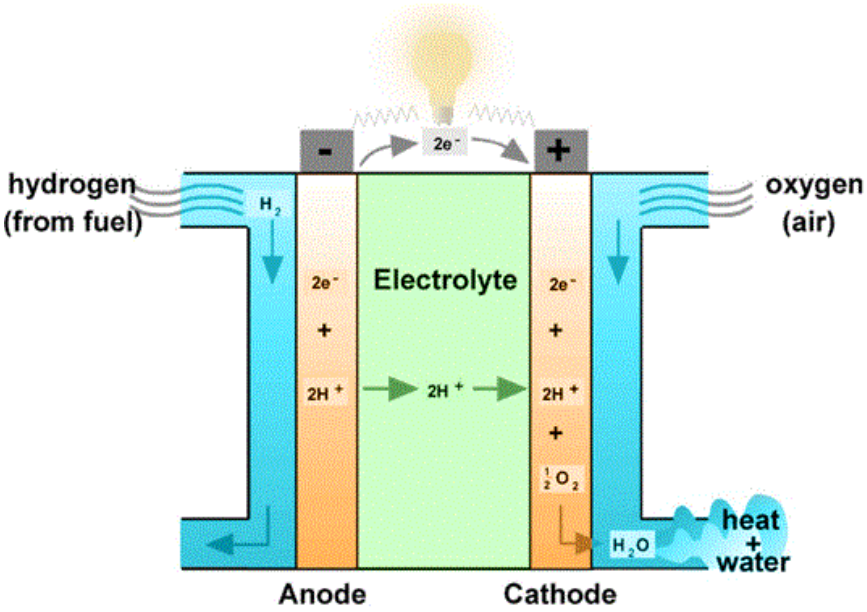
Corvus Energy

Electrochemistry at work

Battery



Battery with continuous refill (fuel cell)



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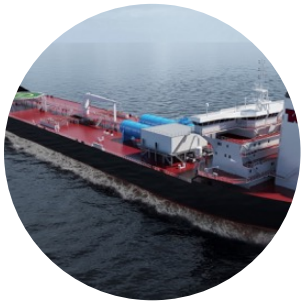
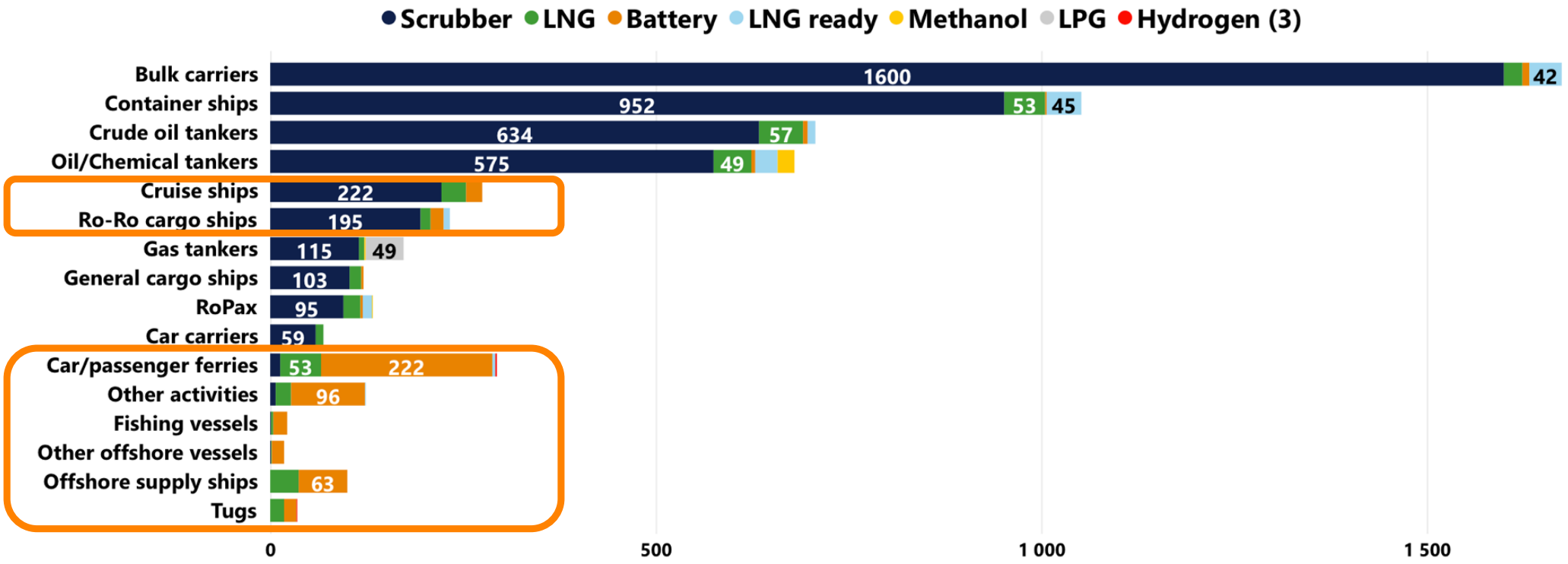
Reported/Estimated savings per vessel type



Car ferry Fully electric	PSV Hybrid	Fishing Vessel Hybrid	Shuttle Tanker Hybrid
80%	35-50%	50-75%	35-50%
100%	15-20%	20-25%	20-25%
95%	15-20%	20-25%	20-25%
95%	30-40%	30-40%	30-40%

Corvus Energy

Total number of ships (in operation and on order)



Statistics from Maritime Battery Forum

Corvus Energy

Project Count – Corvus Energy

400 Projects

>3 000 000 operating hours

300+ MWh

110
Car and Passenger ferries

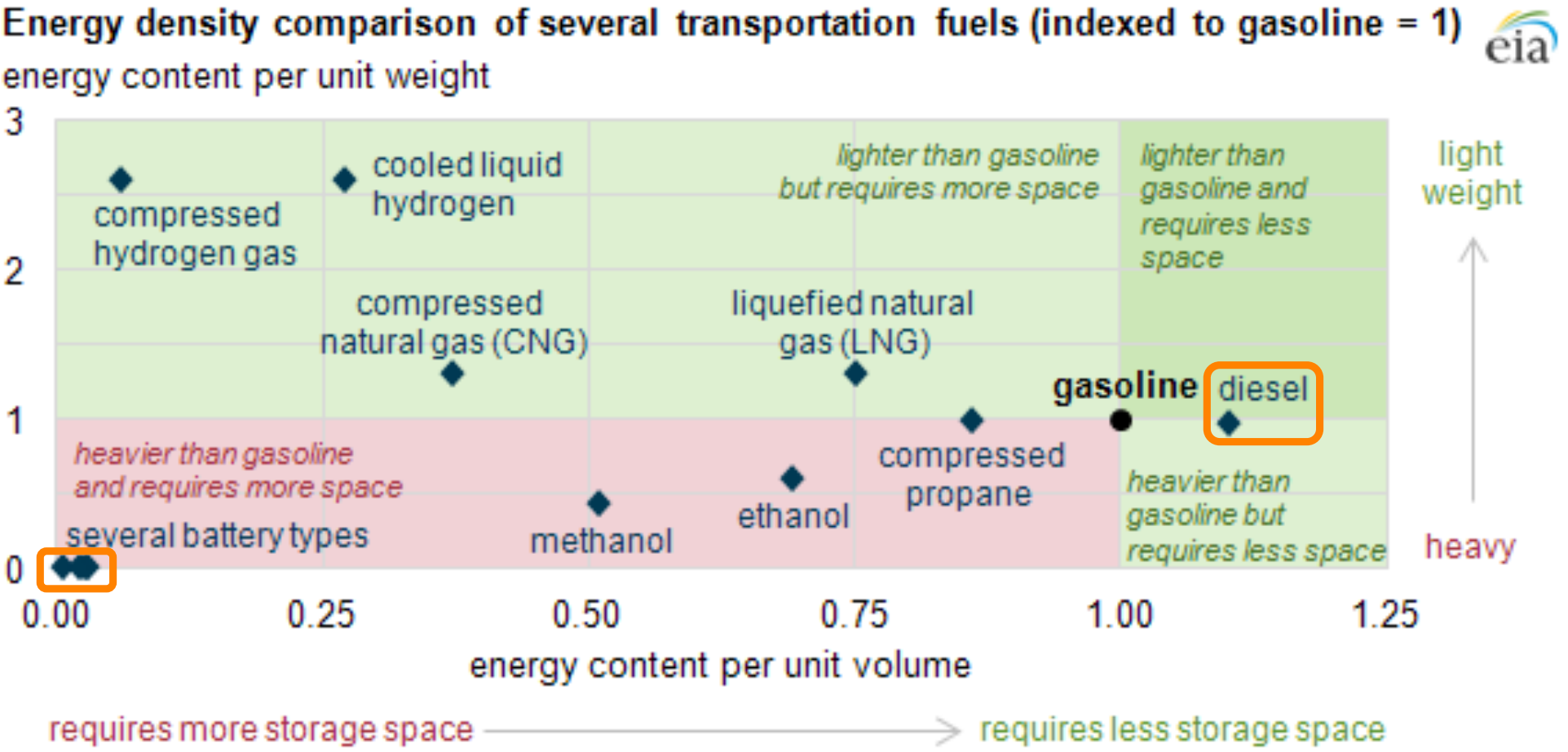
25
Cruise and Yachts

62
Offshore and Subsea

59
Tugs/ Workboats/ Fishing/ Research

23
Merchant vessels

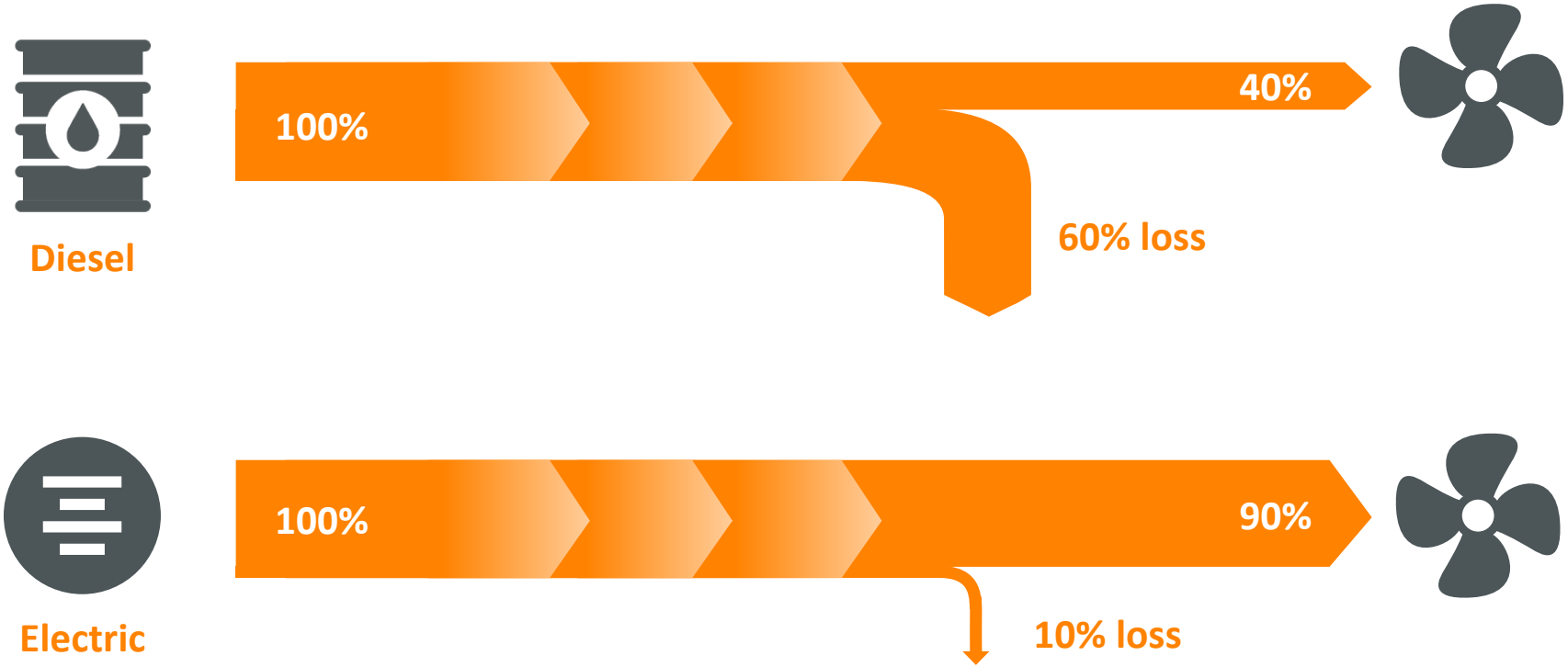
142
Ports / Shore stations ++

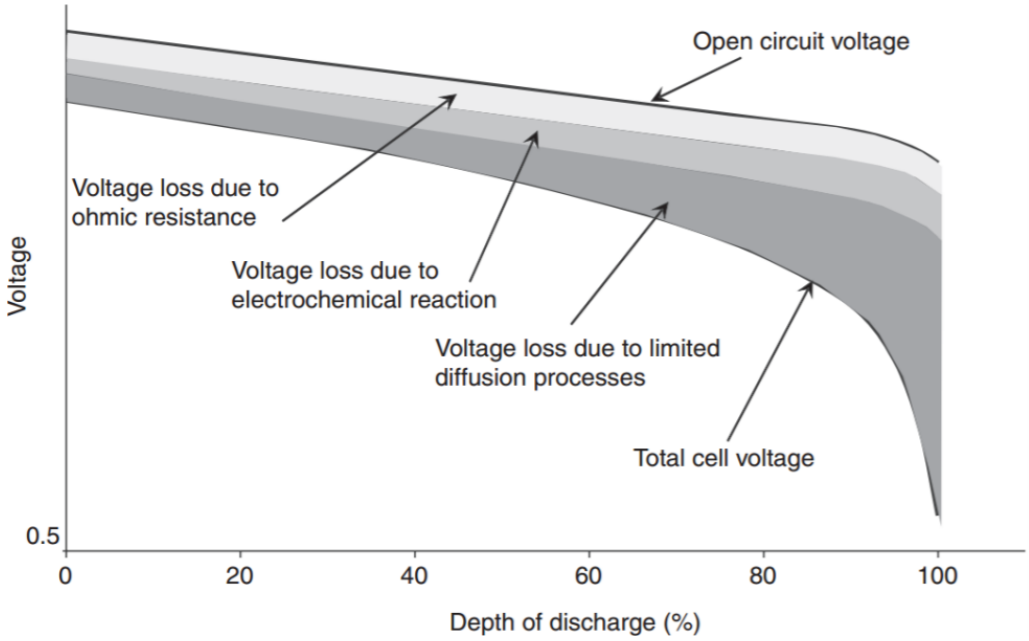


Source: U.S. Energy Information Administration, based on the National Defense University.

Corvus Energy

Loss diagram



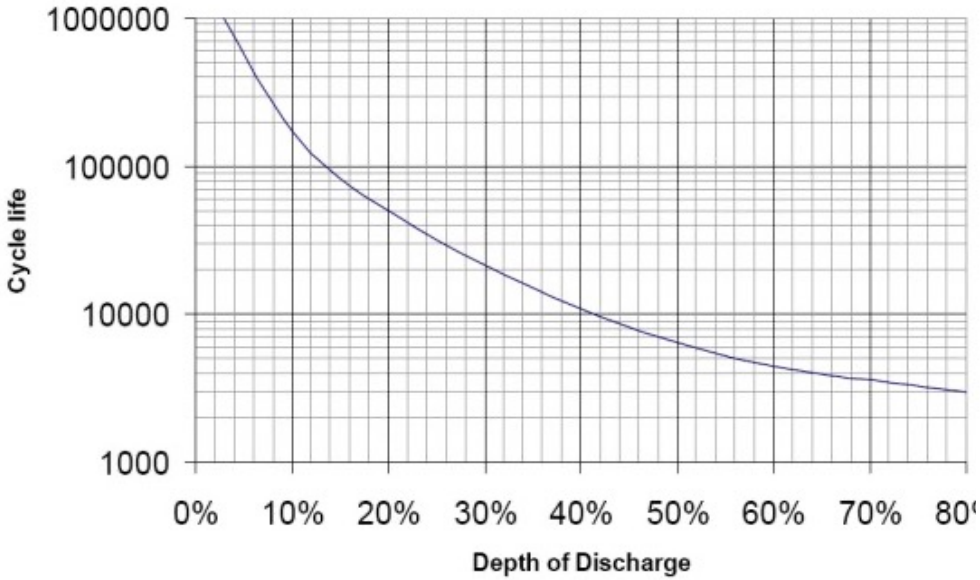


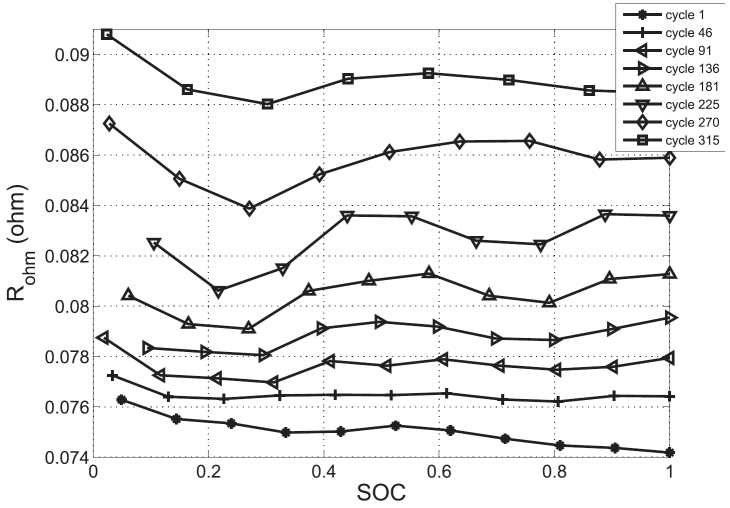
$$E_{battery} = E_{OCV} - IR - \eta_{reaction} - \eta_{diffusion}$$

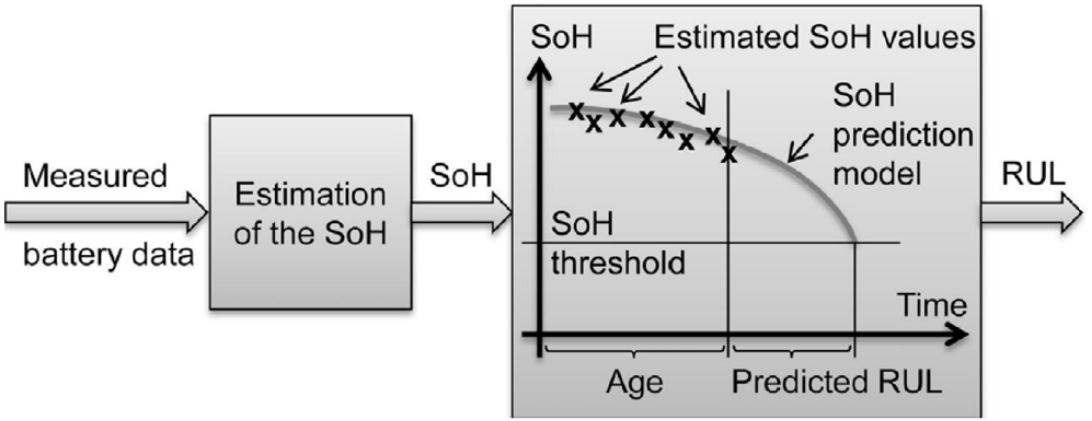
(Temperature dependent)

Corvus Energy

Battery lifetime estimation







Battery life

Battery systems

- How do we estimate SOC? SOH?
- Electrochemistry & usage pattern – what size of the battery system is needed to do the required work? For how long? Is it economically viable?
- How much cooling is needed?
- What happens if you short circuit the battery system? A cell? A module?
- What kind of service is expected for the battery?
- Batteries & autonomy – What is required to support autonomous operation?

Corvus Energy

ESS connected to cloud. Near real time monitoring

Top 3 Job Roles which require core ESS knowledge:

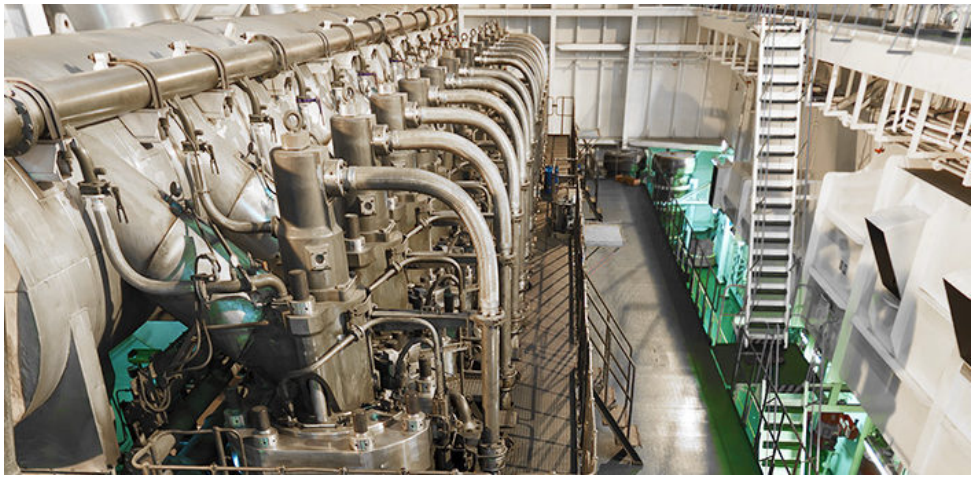
1. Engineering + R&D
2. Technical Sales
3. Customer Applications & Customer Service

Trends in required skills & knowledge

1. Market understanding, - adaptibility and cost focus in an continuously growing battery market
2. Abililty to learn, adapt and utilize digital tools and new technology within all job roles and in all employee generations
3. Interdisciplinary collaboration, i.e. between digital, R&D and traditional engineering

Corvus Energy

Installation space & tools



Machine room

Battery room

VS

Corvus Energy

Means of travel

Service engineer traditional means of travel

Service engineer future means of travel

Concluding remarks

- Maritime industry is on its way back to sustainable propulsion
- Electrification & zero emissions has a huge impact on skills needed
  - Battery systems are virtually maintenance free
  - ⇒ Ideal for autonomous operation
- Deep electrochemistry knowledge becoming a key skill set for R&D
  - Model-building & digital twin construction
- Move from on-ship to over the air service
  - Computer & programming skills