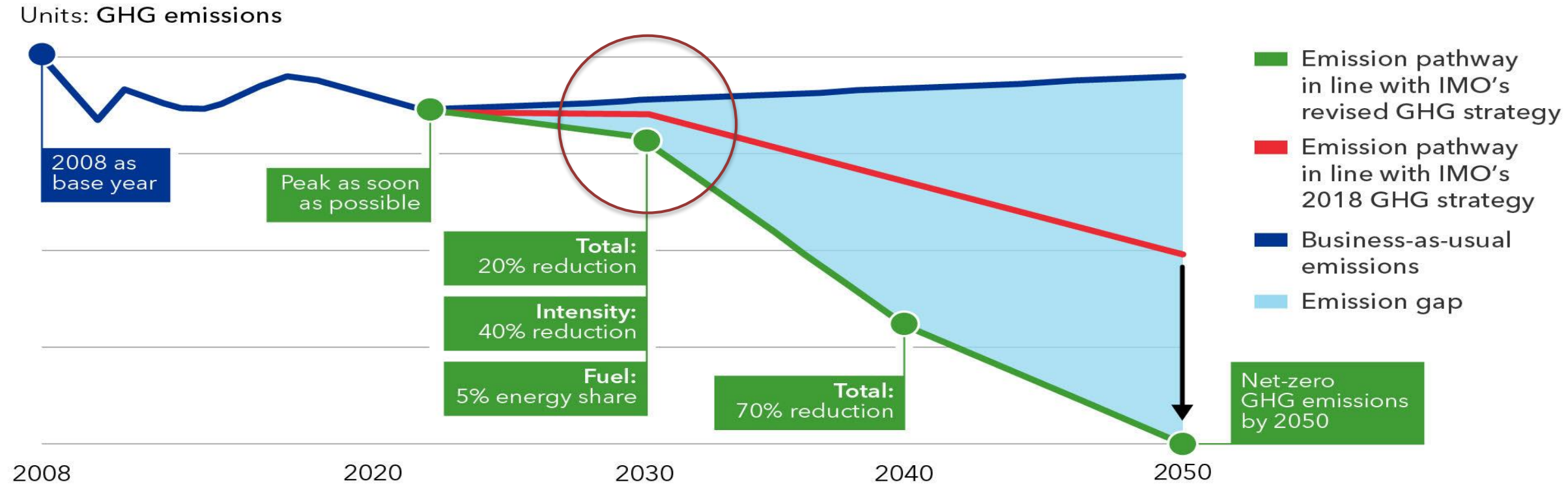
SANMAR
SHIPYARDS

STEPPING INTO AN ALATERNATE & ELECTRIFYING AGE FOR TOWAGE

Seychelles Maritime Week – 24-26 September, 2024

Drivers and Regulations for Decarbonisation

Outline of ambitions and minimum indicative checkpoints in the revised IMO GHG Strategy



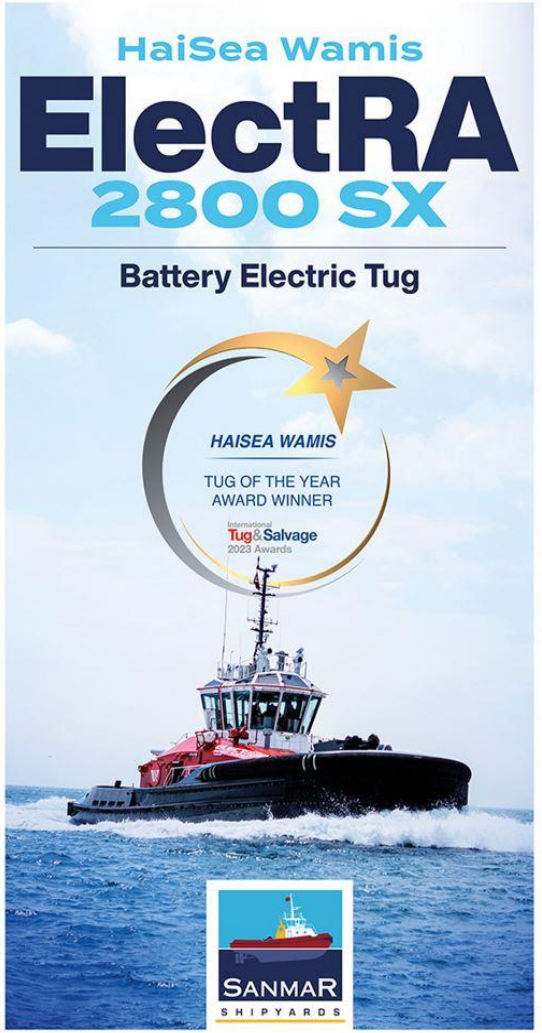
Total: Well-to-wake GHG emissions; **Intensity:** CO_2 emitted per transport work; **Fuel:** Uptake of zero or near-zero GHG technologies, fuels and/or energy sources

In July 2023, the IMO completed the first revision of its greenhouse gas (GHG) strategy, significantly strengthening the ambitions for international shipping compared with the initial goal for a 50% GHG reduction by 2050. Taking 2008 as a baseline, the revised strategy now aims to reduce well-to-wake GHG emissions by 20% in 2030, by 70% in 2040, and to reach net-zero 'by or around' 2050.

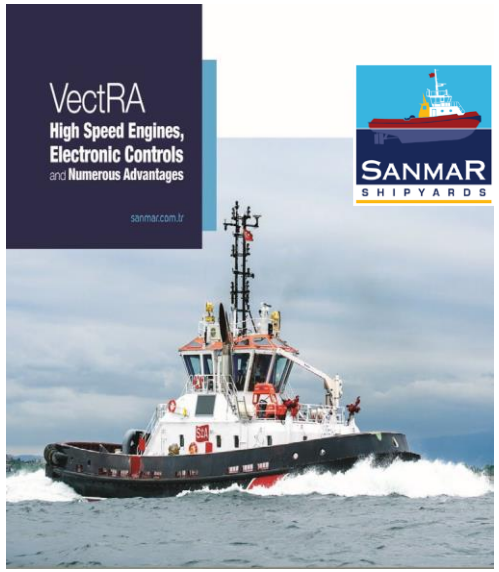
Source: DNV - Energy Transition Outlook 2023 – Maritime Forecast to 2050

Propulsion Alternatives for Tugs

- Diesel (ULSFO) with exhaust after-treatment (IMO Tier III)
- LNG (dual fuel or pure lean burn gas engines)
- Hydrogen / Ammonia / Methanol / Biomass fuels
- **Battery Electric**
- Others?



Leading the way with World firsts and ITS awarded tugs



Breaking new ground – Methanol Fuelled (Escort) Tugs

- The *RAsalvor 4400-DFM* escort tugs (2) will measure 44 metres in length with over 115 tonnes of bollard pull. They'll be Canada's most powerful escort tugs to date and have been customized to meet the demanding operational and environmental requirements for this project.
- World's first large purpose-built high bollard pull methanol fuelled tugs when they enter service in 2025 and will provide significant environmental benefits to further reduce greenhouse gas (GHG) emissions and underwater radiated noise.
- Equipped with a mechanical cross link system between the azimuth thrusters to enable a single engine to drive both propellers. They will also be equipped with main engine driven shaft generators to satisfy the vessel's normal electrical needs. These features will allow the crews to optimize engine loading and significantly reduce fuel consumption and running hours of the main engines and gensets – further reducing emissions.
- Additionally, KOTUG is having the hulls of both tugs coated with a graphene paint to reduce biofouling and enhance hull-smoothness which reduces underwater radiated noise and makes the vessels more fuel efficient.

NB. Using conventional methanol as a marine fuel can **reduce SOx** and **particulate matter emissions** by more than **95%**, and **NO**× by up to **80**% compared to conventional marine fuels. Conventional methanol can reduce **CO_2 emissions** during combustion by up to **15** % compared to conventional fuels. The use of e-methanol and biomethanol can be carbon neutral on a lifecycle basis, providing a "future-proof" pathway to global and industry decarbonization goals.

ElectRA Series

Partnering for sustainability - the next generation of harbour tugs

POWERED BY

SANMAR

Corvus Energy

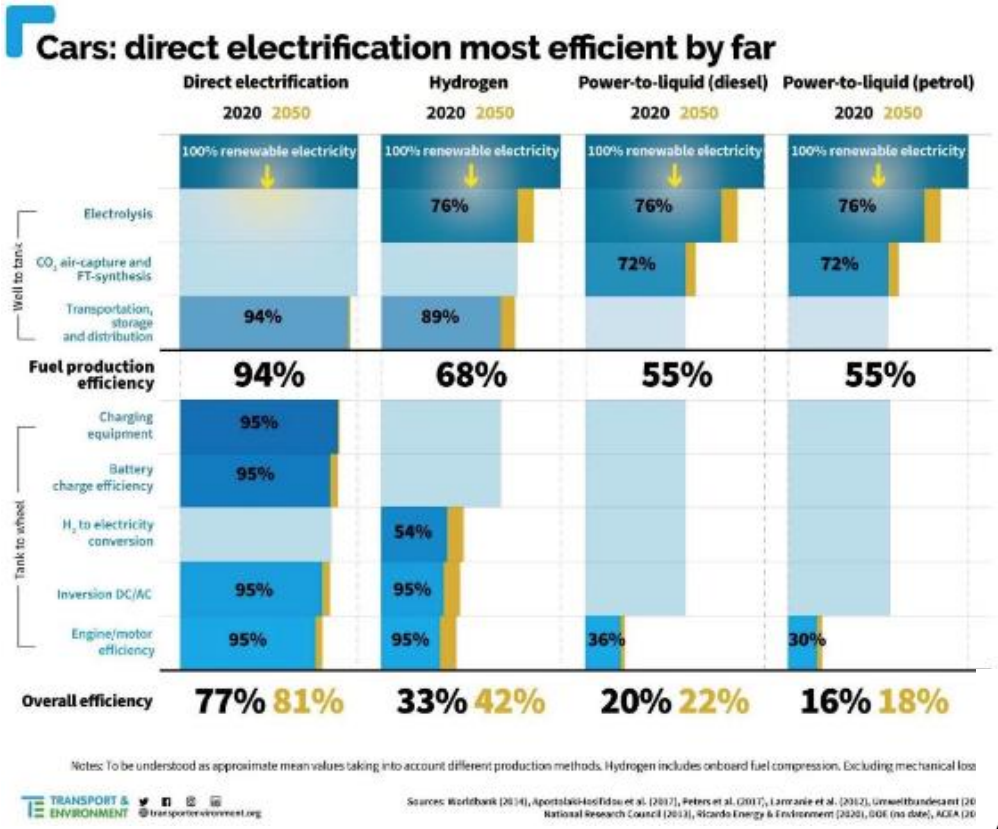
ROBERT ALLAN

Net Zero Goal

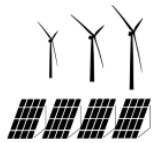
What are the important points we should consider?
What decisions should we make?

- Efficiency comparison of e-fuels and battery electric solutions
- Available electric infrastructure
- Shore charging power/Cold-ironing power AC or DC
- How to categorize battery electric vessels
- New Challenges-New Opportunities to reach greener solutions
- ElectRA 2800 Test and Sea Trial Experience

Efficiency Well to Propeller



Electric vs Hydrogen
Same Energy Comparison



100 kWh

electricity

Tesla Model 3

Consumption 18.45 kWh/100 km
80% efficiency

433 km
Distance traveled

100 kWh

electricity

Efficiency of electrolysis - 65%
Efficiency of packing - 95%
Efficiency of transport (100 km) - 94%

58 kWh

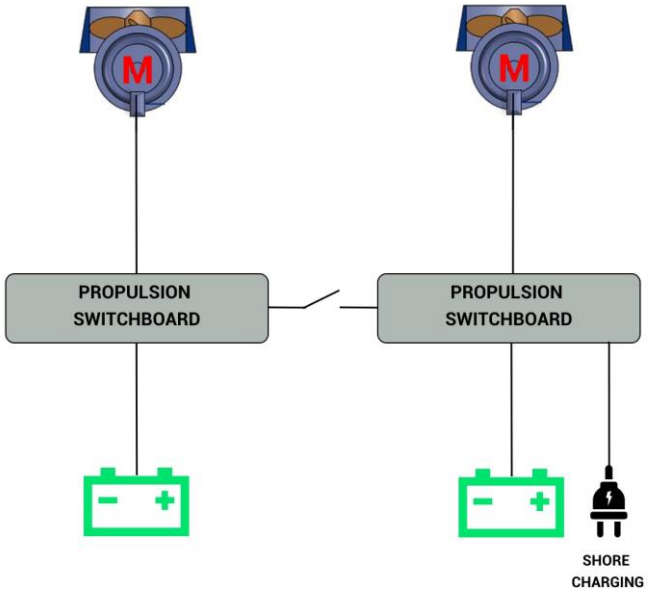
1.73 kg H2

Toyota Mirai

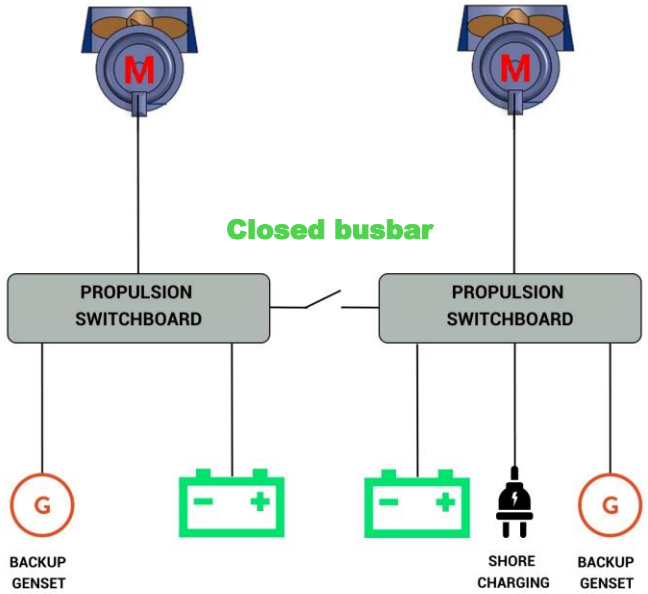
Consumption 1.02 kg H2/100 km

170 km
Distance traveled

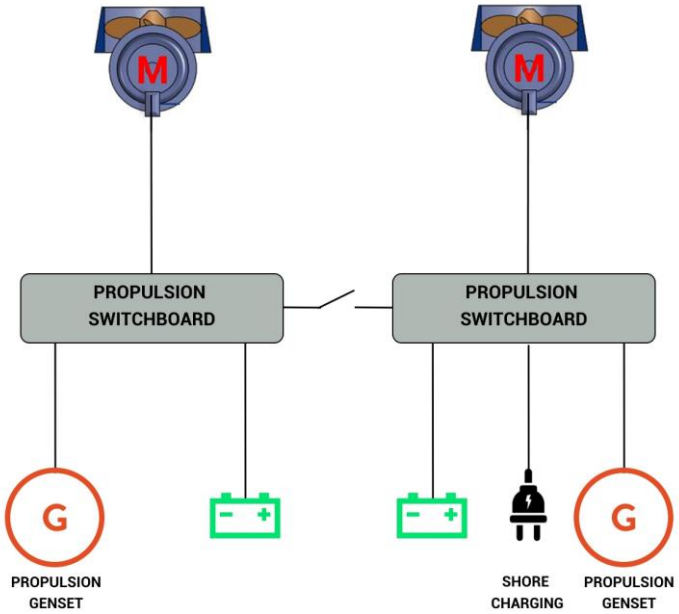
Battery Electric Vessel Types



BEV (Battery Electric Vessel)



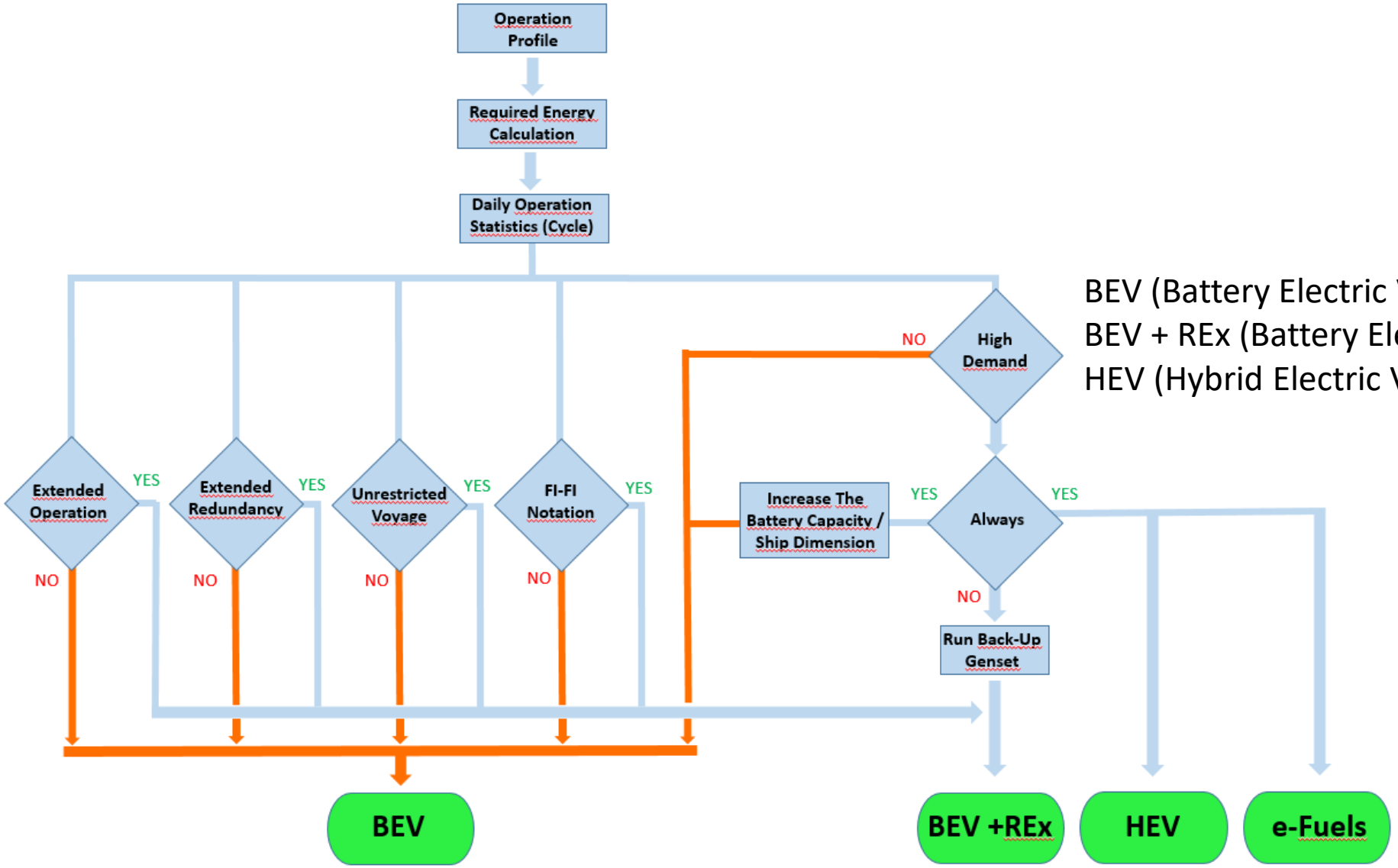
BEV + REx (Battery Electric Vessel + Range Extender)



HEV (Hybrid Electric Vessel)

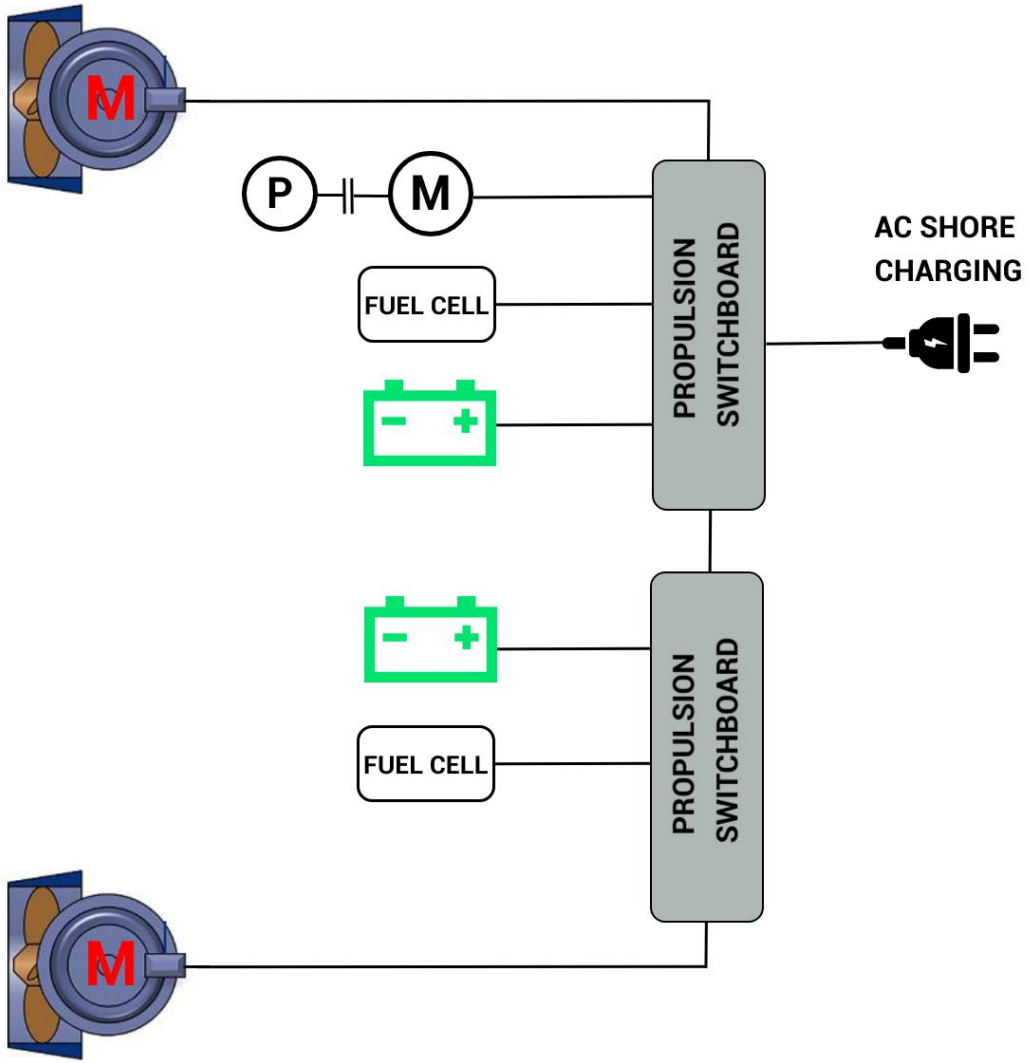
WHEN ALL OPERATIONS ARE DONE ON BATTERIES;
THEY ARE BOTH EMISSION FREE SOLUTIONS

Which is The Right Choice?



BEV (Battery Electric Vessel)
BEV + REx (Battery Electric Vessel + Range Extender)
HEV (Hybrid Electric Vessel)

New Challenges - New Opportunities



Harbor tugboat concept;

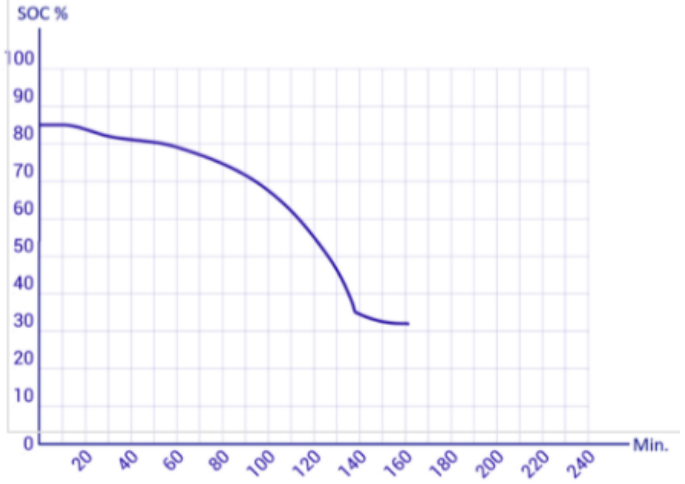
- New generation batteries with higher energy density
- Fuel Cells with lower price and higher lifetime
- Alternative fuels with
  - High energy density
  - Less preparation and conditioning equipment
  - High safety levels

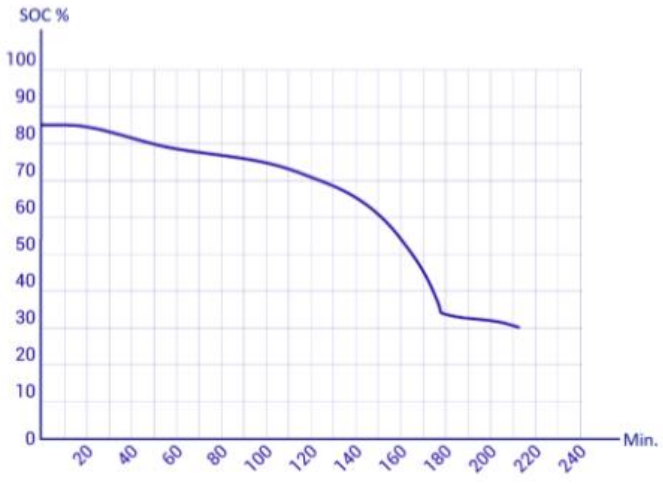
Why is the operation profile so important?

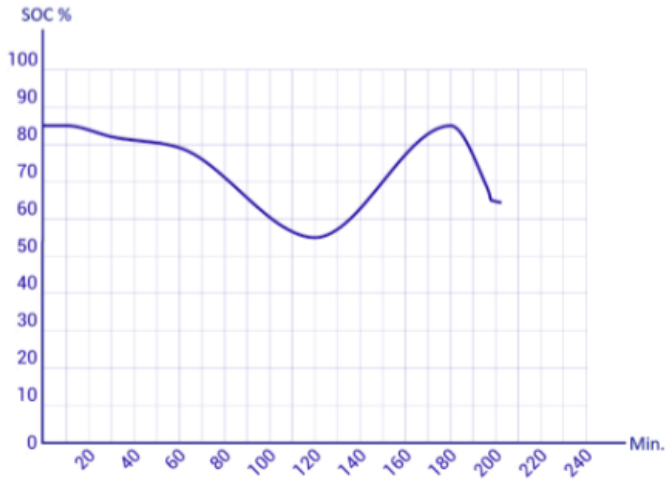
Base Operational Profile				
3 cycles/day				
Desciription		Power (kW)	Duration (minutes)	Energy (kWh)
Warm up at dock		86	10	14
Transit	to vessel 6 knots (Mob)	258	20	86
	Transit with vessel 6 knots	258	30	129
Assist	avarage load 20%	860	60	860
	avarage load 50%	2150	15	538
	avarage load 80%	3440	2	115
	load 100%	4300	1	72
Return to the dock 6 knots (Demob)		258	20	86
Securing		215	3	11
	Operation Period (Minutes)		161	
	Required Energy for one operation			1910
	Installated Battery Capacity			3616

Operational Profile 1				
3 cycles/day				
Desciription		Power (kW)	Duration (minutes)	Energy (kWh)
Warm up at dock		86	10	14
Transit	to vessel 6 knots (Mob)	258	45	194
	with vessel 6 knots	258	60	258
Assist	avarage load 20%	860	45	645
	avarage load 50%	2150	15	538
	avarage load 80%	3440	2	115
	load 100%	4300	1	72
Return to the dock 6 knots (Demob)		258	30	129
Securing		215	5	18
	Operation Period (Minutes)		213	
	Required Energy for one operation			1982
	Installated Battery Capacity			3616

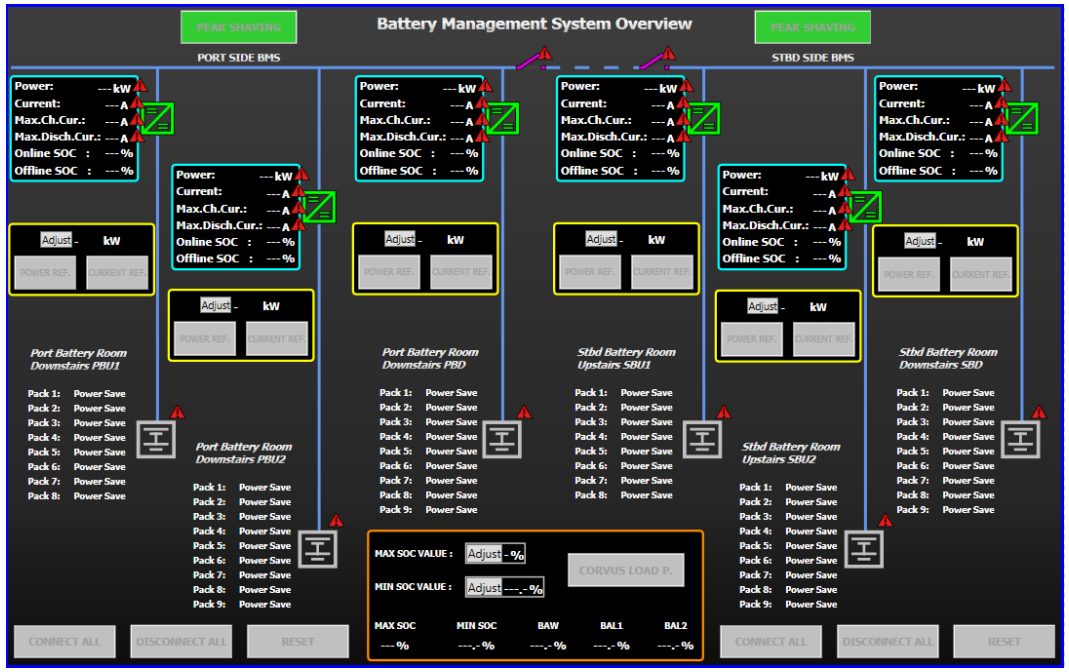
Operational Profile 2 (Running the backup gensets)				
3 cycles/day				
Desciription		Power (kW)	Duration (minutes)	Energy (kWh)
Warm up at dock		86	10	14
Transit	to vessel 6 knots (Mob)	258	20	86
	with vessel 6 knots	258	30	129
Assist	avarage load 20%	860	60	860
Backup Generator is started (charging)		1625	40	1083
Assist	avarage load 50%	2150	15	538
	avarage load 80%	3440	2	115
	load 100%	4300	1	72
Return to the dock 6 knots (Demob)		258	20	86
Securing		215	3	11
	Operation Period (Minutes)		201	
	Required Energy for one operation			1910
	Installated Battery Capacity			2486

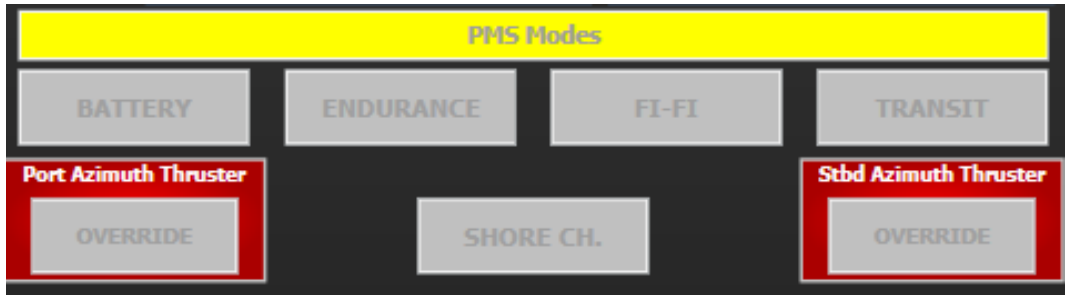






Working Modes / New Terms





- Battery Mode/Silent Mode

Only Batteries

- Endurance Mode-Range Extender

In case of emergency or very low SOC% level.
Backup Generator + Batteries

- Fi-fi Mode

All power sources are connected/online

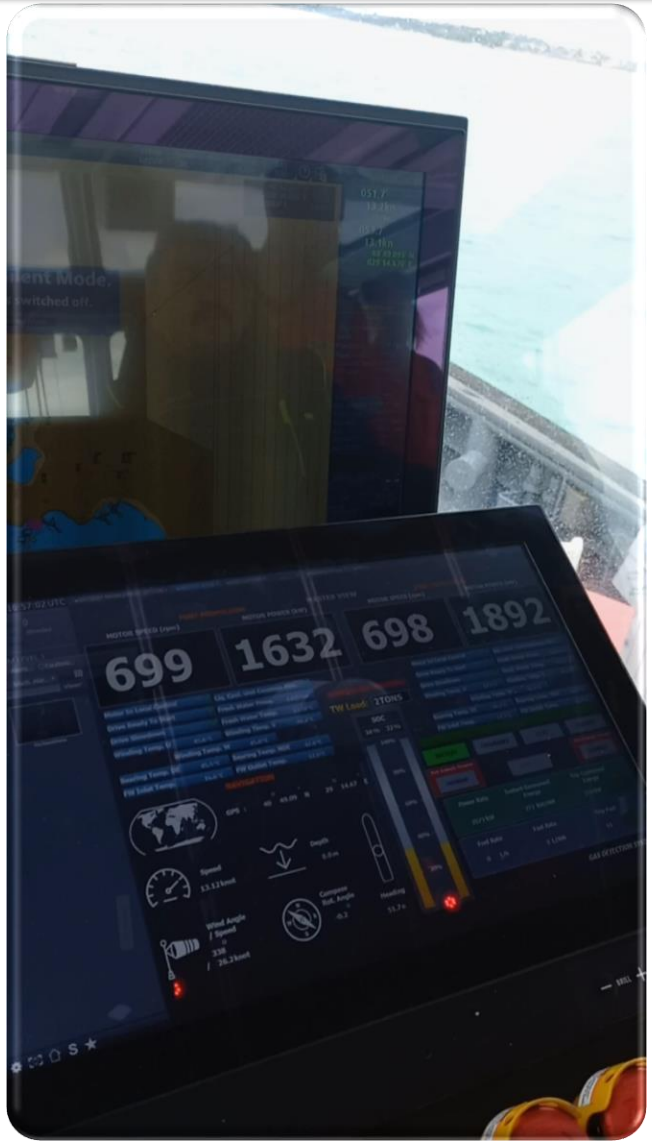
Two backup generators + Batteries

- Transit Mode

Only Backup Generators

- Shore Charging Mode

Some Figures from Trials



BE QUIET TO HEAR ELECTRA!

Sea Trial 1	**8.04.2023**
Sea Trial 2	**15.04.2023**
Sea Trial 3	**18.04.2023**
Sea Trial 4	**19.04.2023**
Sea Trial 5	**25.04.2023**
Sea Trial 6	**26.04.2023**
Sea Trial 7	**27.04.2023**
Sea Trial 8	**7.05.2023**
Sea Trial 9	**9.05.2023**
Sea Trial 10	**13.05.2023**

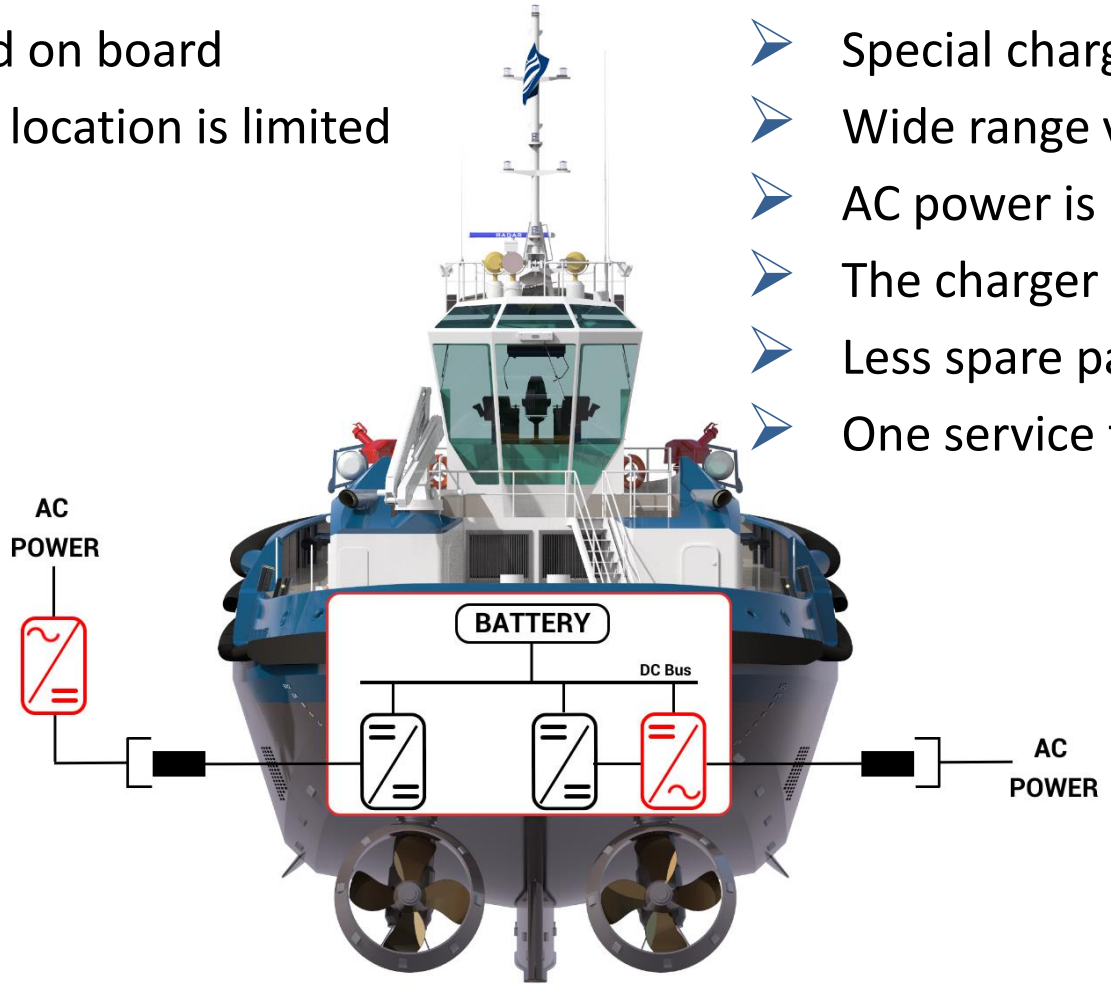
	ElectRA 2800		
Power Source	Only Battery	Only Backup Generators	Only One Backup Generator
Bollard Pull (TBP)	70	35	20
Speed (knots)	13,5	11,5	9,5

	ElectRA 2800	Bogacay
Power Source	Battery	Main Engine+Genset
Measurement Location	Noise Level(dB)	
Wheelhouse	46	64
Messroom	42	62
Fwd Winch Area	65	70
Aft Winch Area	70	84
Engine Room	66	103
Switchboard Room	64	72
Propulsion Room	85	94

Electric Infrastructure

DC Connection System

- Less Space Required on board
- The vessel charging location is limited



AC Connection System

- Special charge station is not required
- Wide range voltage and frequency use
- AC power is mature and available in all ports
- The charger is on board
- Less spare parts
- One service for all converters and chargers

Example: 1000 kWh Battery Group

Charge / Discharge	Power	Duration (Min.)
1C	1000kW	60
3C	3000kW	20
6C	6000kW	10

ElectRA Deliveries (7 delivered, 7 in the order book)

Highest Number of Electric Tugboat Construction

- 3x **ElectRA 2800** for HaiSea Marine DELIVERED
(28m, 70ton, **5240 kWh** but can be upgraded to 6MWh)

- 2x **ElectRA 2300SX** for SAAM Towage DELIVERED
(23m, 70ton, **3616 kWh** battery capacity)

- 1x **ElectRA 2300SX** for Sanmar own fleet / Yılport Turkey DELIVERED
(23m, 70ton, **1808 kWh** but can be upgraded to **3616 kWh**)

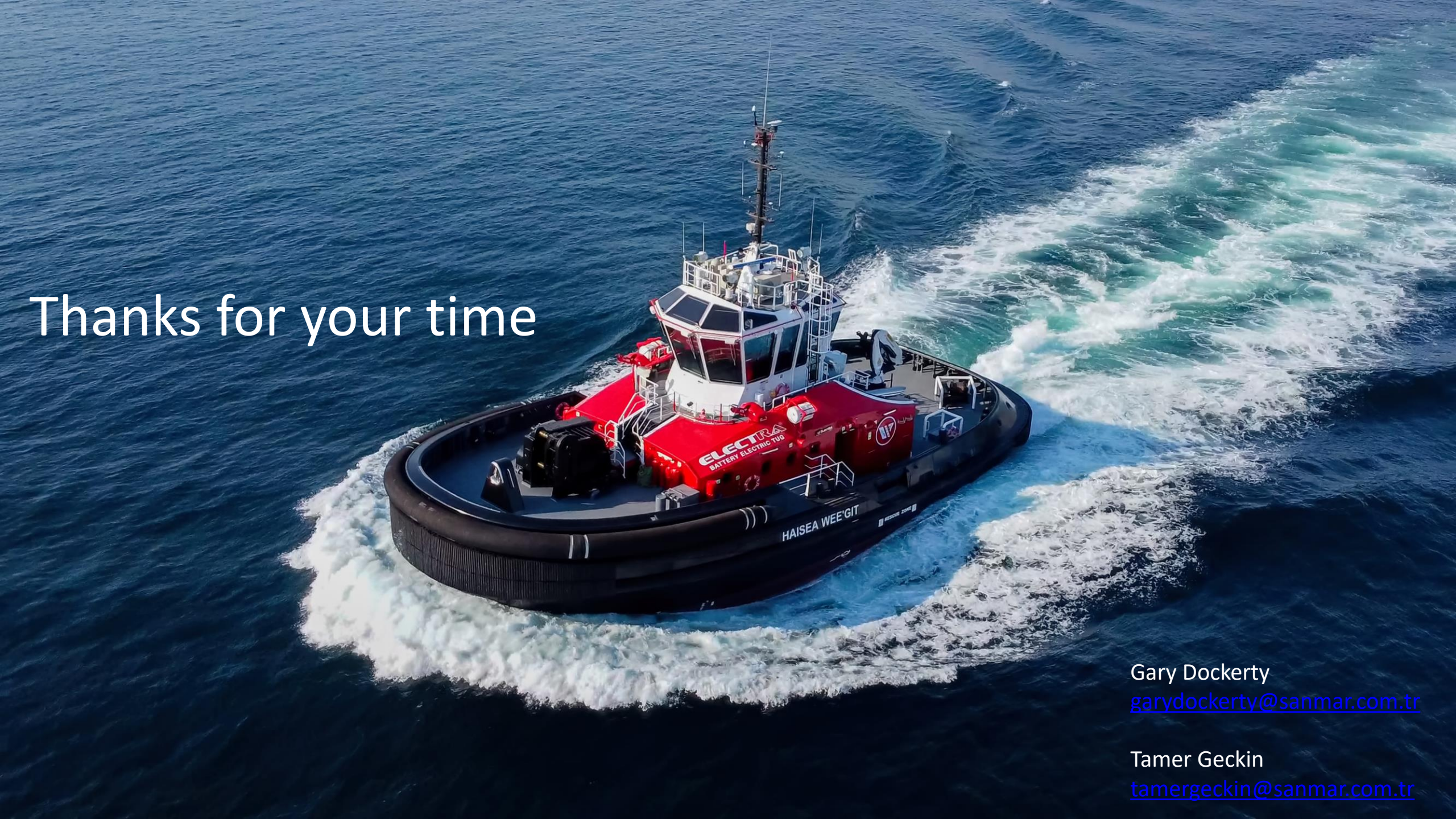
- 1x **ElectRA 2200SX** for Bukser og Berging DELIVERED
(22m, 45ton, **1720 kWh** battery capacity)

- 4x **ElectRA 2500SX** for BOTAS / Turkey
(25m, 70ton, **5000 kWh** battery capacity)

- 1x **ElectRA 2500SX** for SAAM Towage,Chile
(25m, 70ton, **3616 kWh** but can be upgraded to 5MWh)

- 2x **ElectRA 2500SX** on a speculative basis
(25m, 70ton, **1808 kWh** but can be upgraded to **3616 kWh**)

Thanks for your time



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