

ZERO

**a roadmap towards the
zero emission vision**

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WALLENIUS MARINE



The cargo



The cargo



Image: Bruce Williams

The cargo



The cargo



m/v FIDELIO

Built: 2007

Length: 227.8

Yard: DSME

Beam: 32.3

Engine power: 16 000 kw

Kapacity: 8,000 bilar

Speed: 20 kn

Crew: 18



E/S ORCELLE, our vision for the future

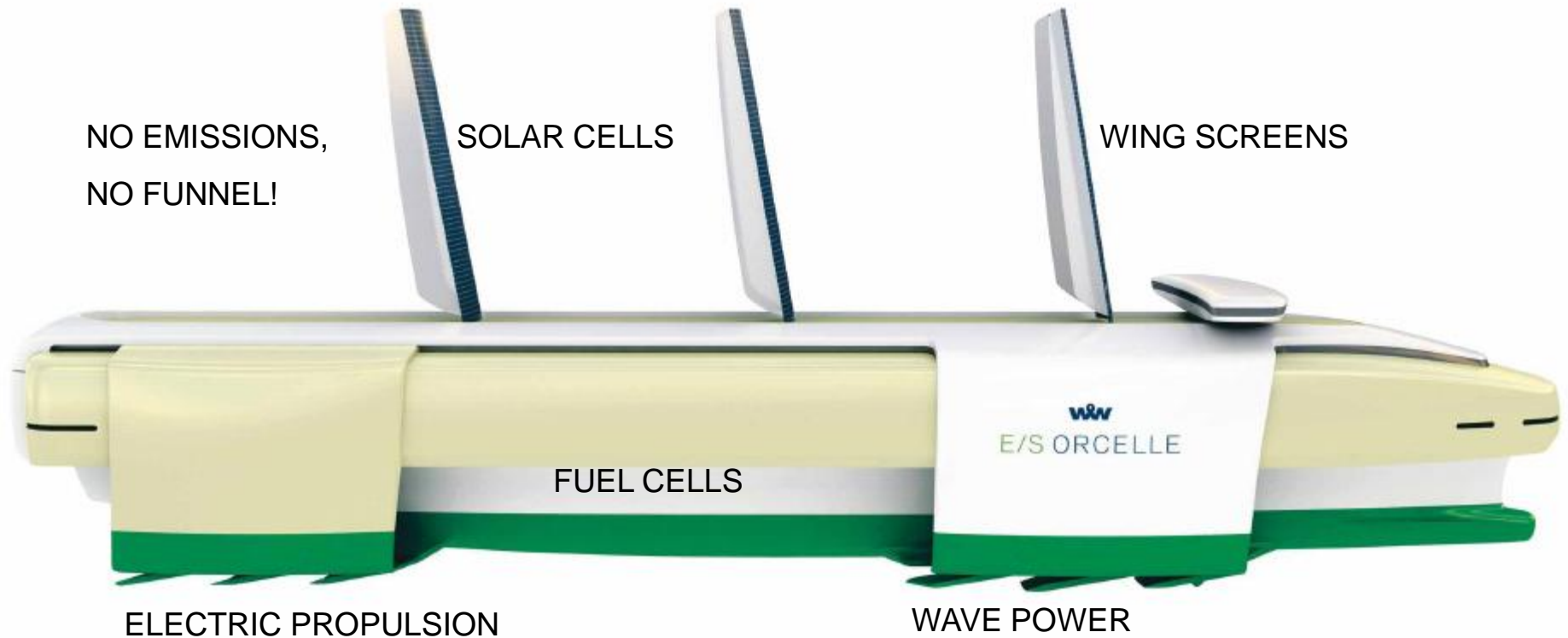


HYBRID TECHNOLOGY
(Energy Accumulation)

NO EMISSIONS,
NO FUNNEL!

SOLAR CELLS

WING SCREENS



www.walleniusmarine.com

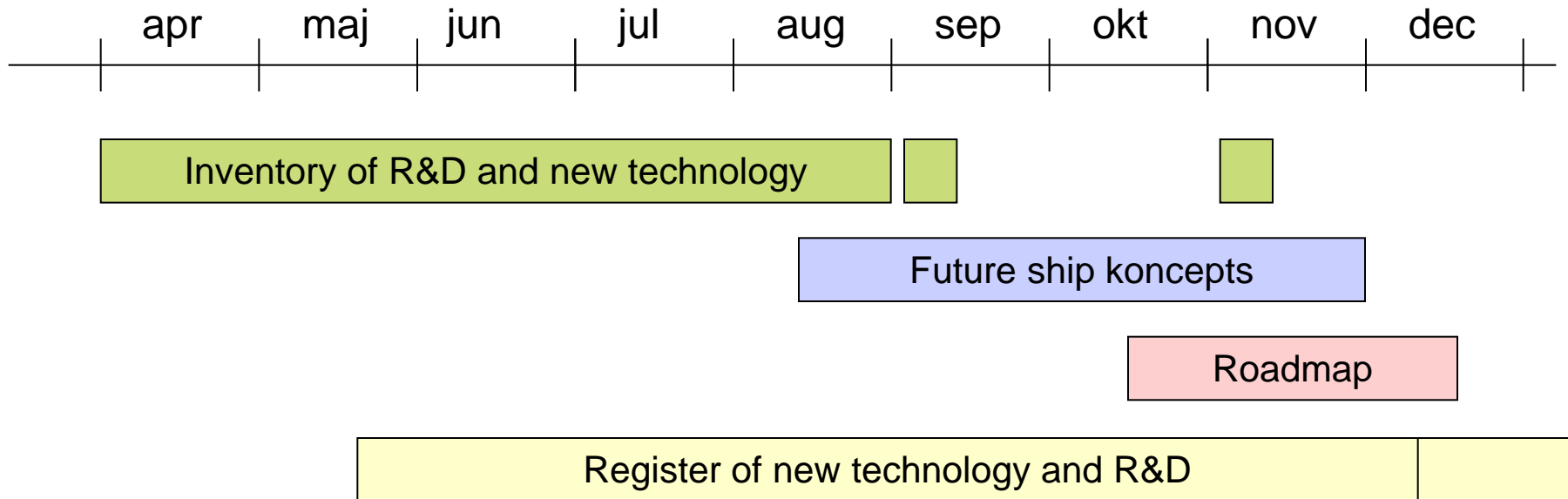


The ZERO Project - Objectives

- Roadma
- Basis for planning of R&D
- 2 Future ship concepts

- Purpose: Better basic conditions for realising Wallenius vision of an emisson-free ship

The ZERO Project – Project plan



Register of new technology and R&D

Hull concepts
Longer and narrower Vessel
Wider Vessel
Catamaran
Trimaran
Pentamaran
Air Cavity System
Hull materials
Aluminium
FRP
Propulsors
Fixed pitch propeller
Controllable pitch propeller
Foils
POD
Voith-Schneider
Contrarotating propellers
Pre-Swirl Stator
Friction reduction
Low-friction paint
Air bubbles

Engines - combustion engines
Dual-fuel engines
Gas engines
Heat recovery
Exhaust Gas Recirculation, EGR
Scavenger Air Moisturizing, SAM
Selective catalytic reduction , SCR
Scrubbers
Engines - others
Hybrid
Electric
Gas turbines
Steam turbines
Stirling engines
Fuel cells
Equipment, interior fittings
Energy saving technologies for the habitat
Solar-, wind- and wave power
Solar cells
Solar heat
Sails / wings
Flettner rotors
Kites

Windmills
Wave power
Biofuels
Methanol
Ethanol
Biodiesel
Biologic diesel
Biogas
Synthetic fuels
Hydrogene
Biochar
Pellets
Fossile fuels
Liquefied Natural Gas, LNG
Energy storage
Batteries
Flywheels
Others
Carbon hydrates cracking to hydrogen
Transformation of carbon dioxide into carbon-neutral liquid fuels
Skin friction elimination
IGBT Converter

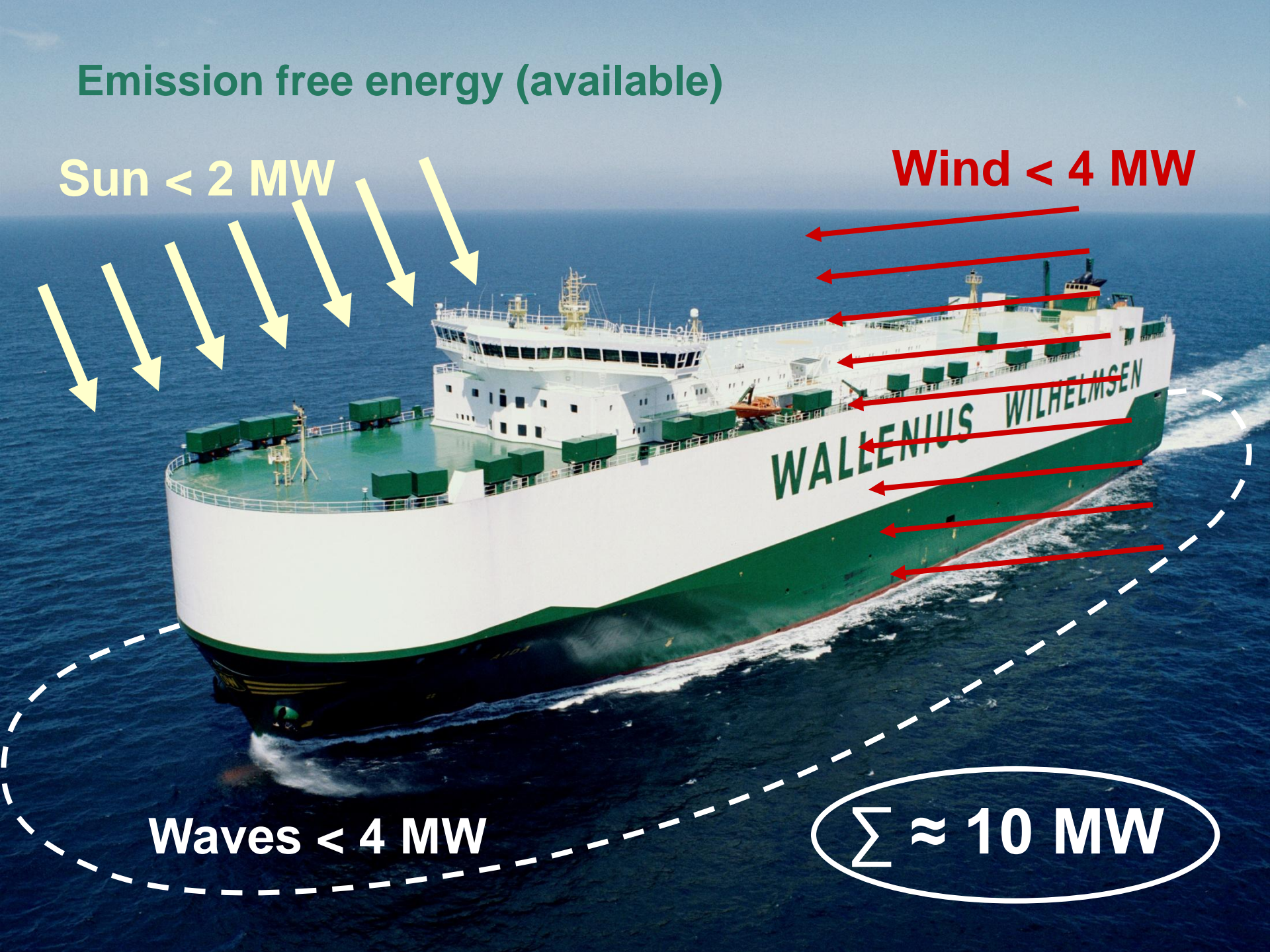
Emission free energy (available)

Sun < 2 MW

Wind < 4 MW

Waves < 4 MW

$\Sigma \approx 10 \text{ MW}$



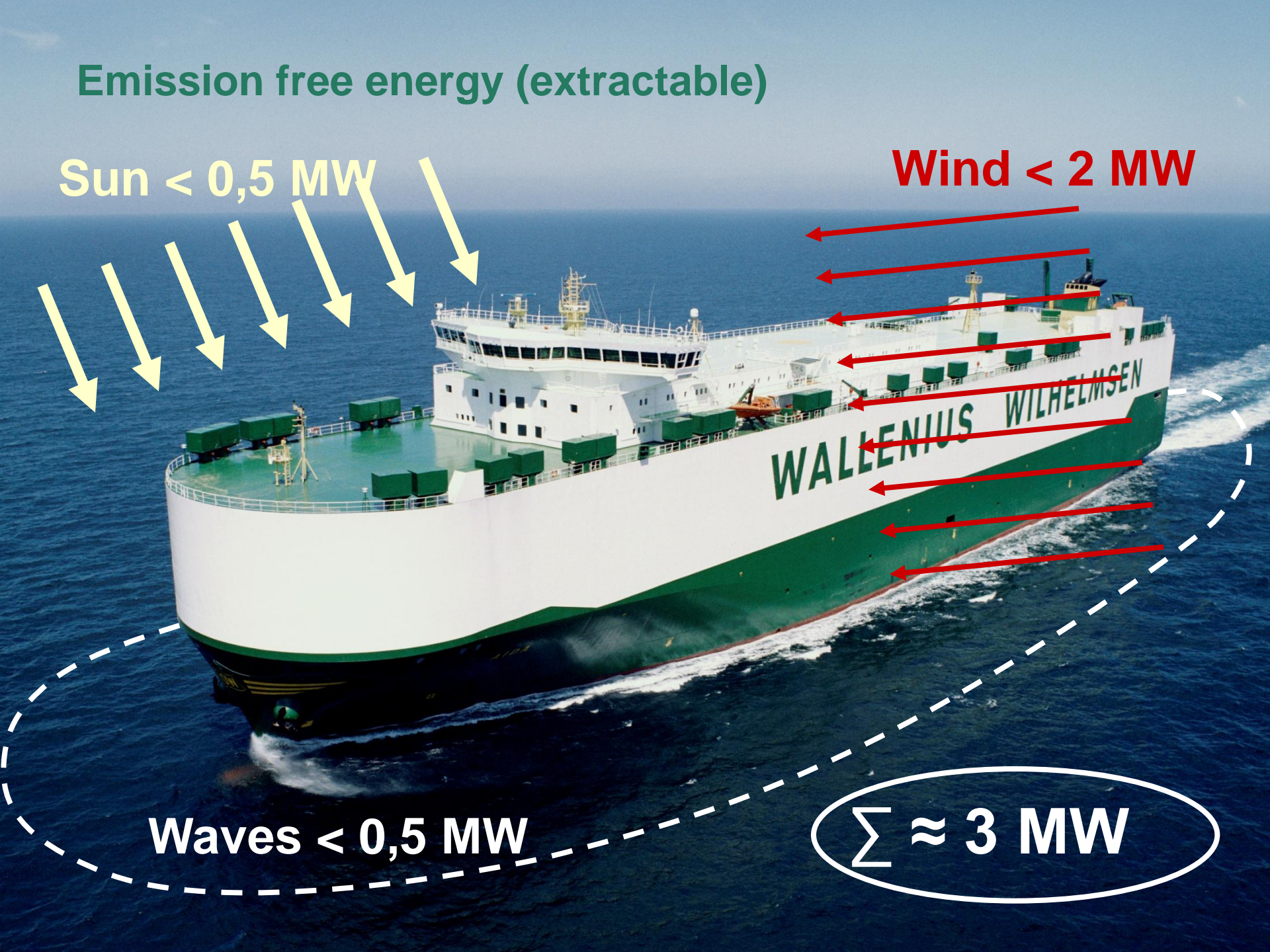
Emission free energy (extractable)

Sun < 0,5 MW

Wind < 2 MW

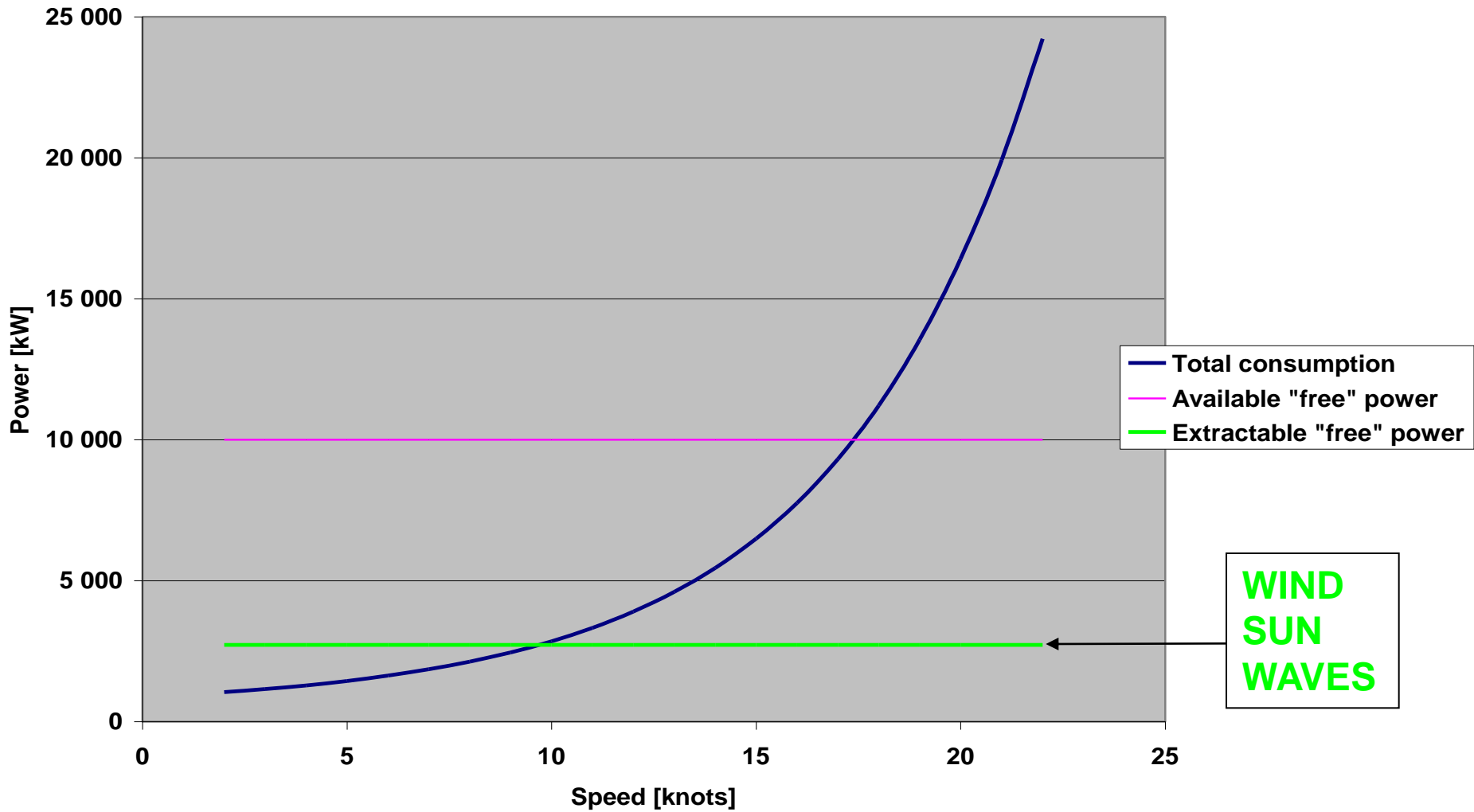
Waves < 0,5 MW

$\Sigma \approx 3 \text{ MW}$



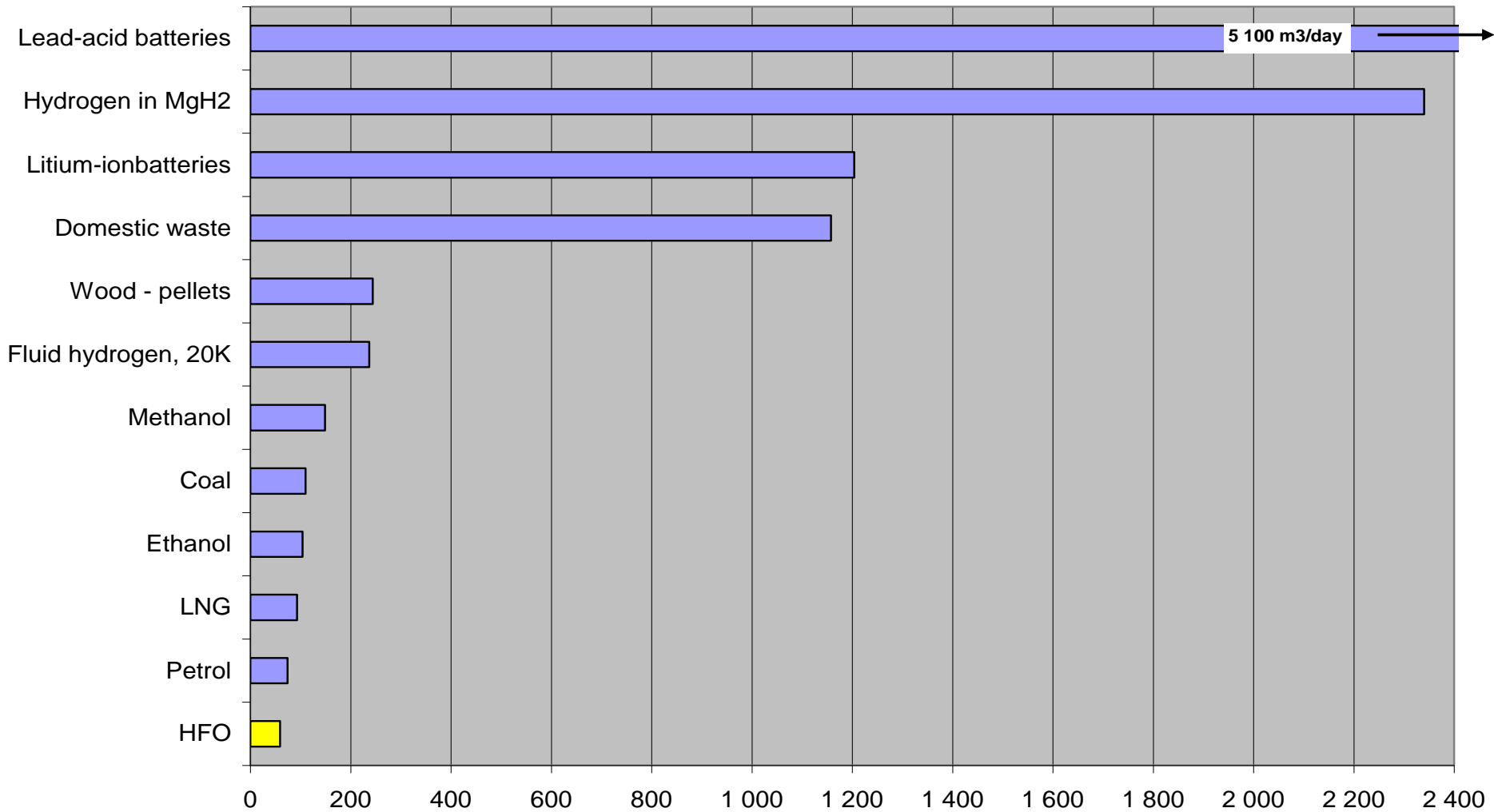


Speed – power (8000 cars PCTC)

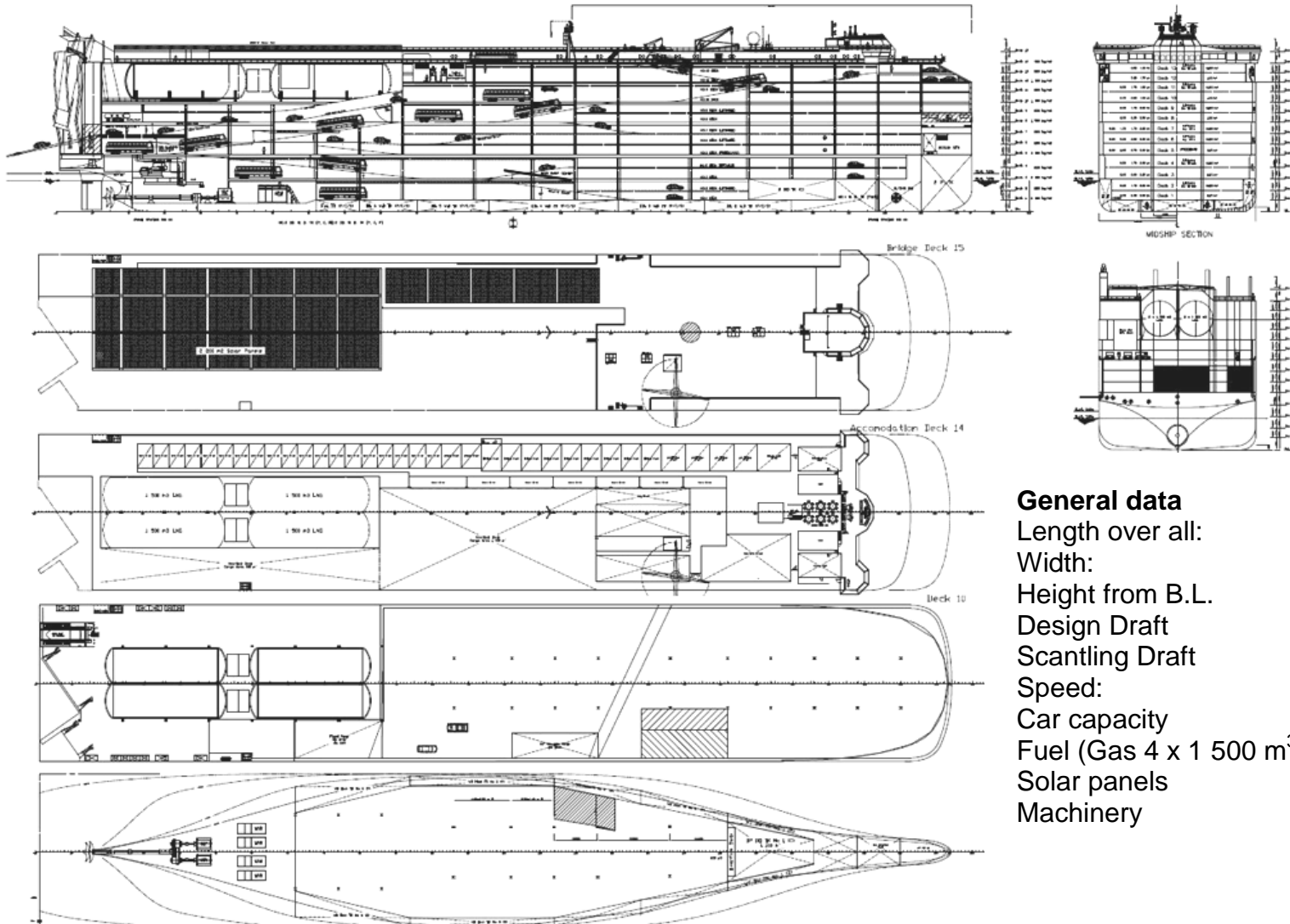




Energy storage – m³/day, PCTC @ 19 knots



Solana – Emission neutral



General data

Length over all:	230.00 m
Width:	39.00 m
Height from B.L.	47.60 m
Design Draft	7.80 m
Scantling Draft	9.60 m
Speed:	16.00 knots
Car capacity	8 550 CEU
Fuel (Gas 4 x 1 500 m ³)	3 000 ton
Solar panels	2 200 m ²
Machinery	Hybrid electric CarboNext Fuel cells Electric engine

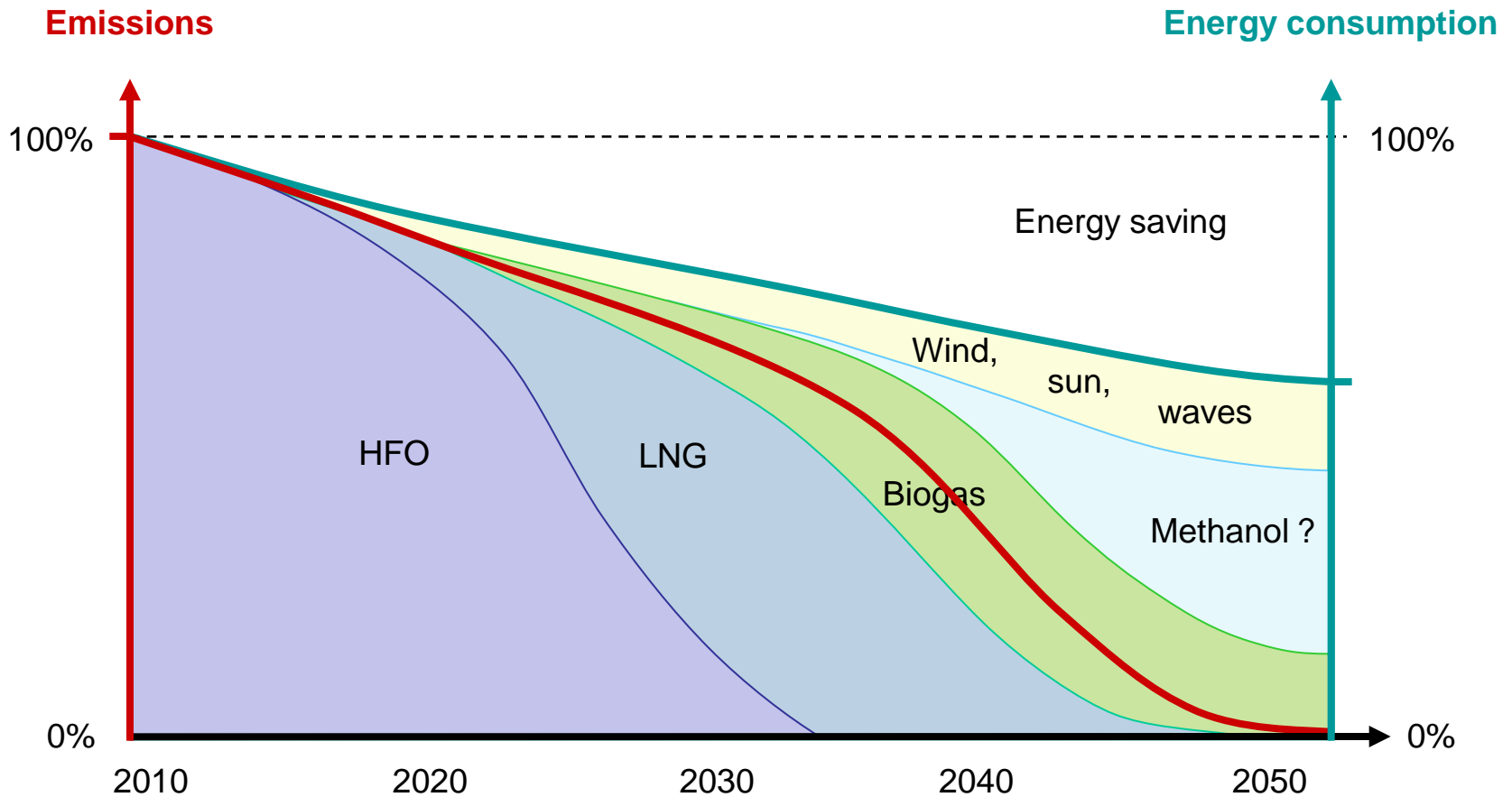
Solway – Emission free



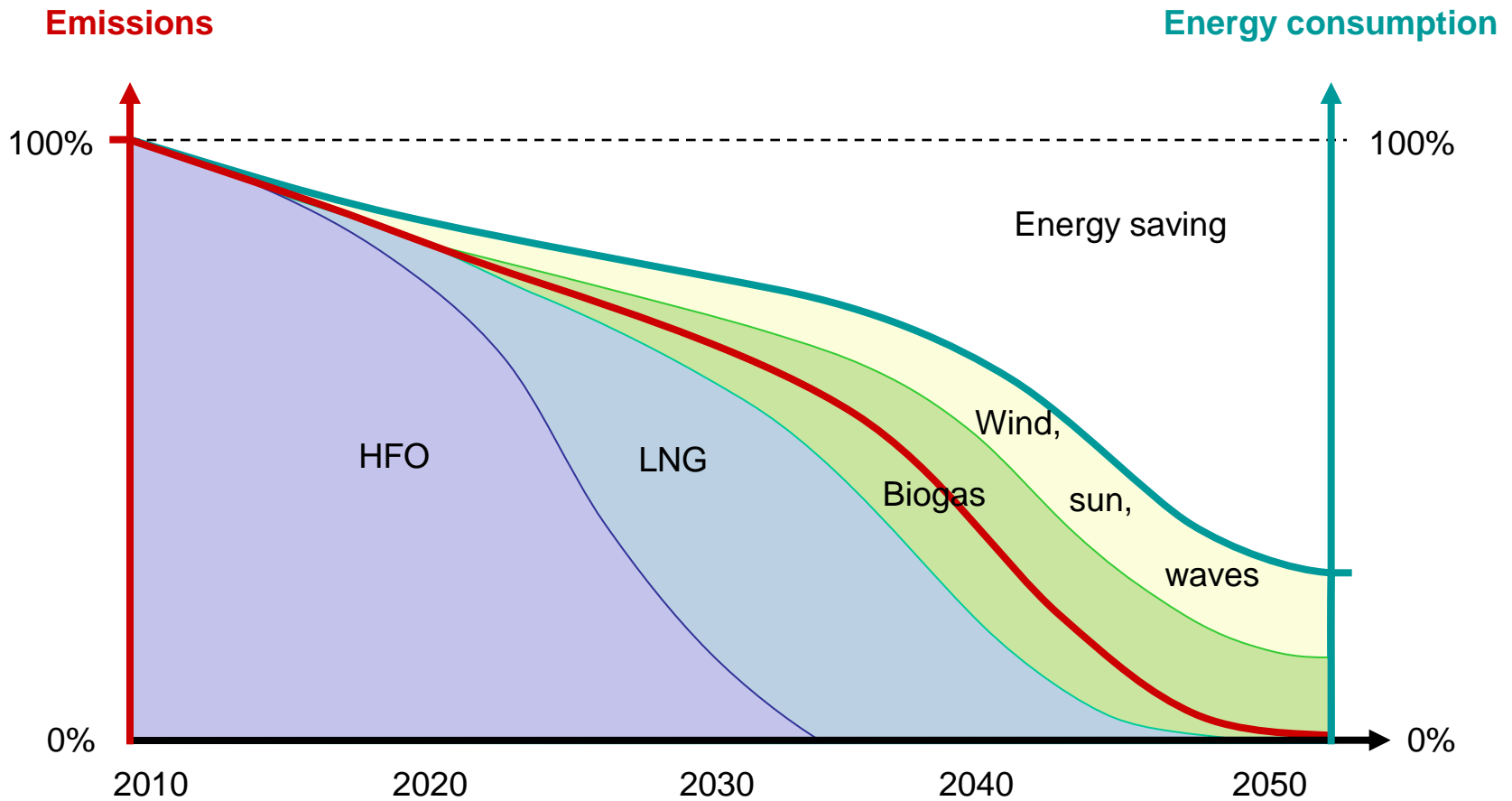
General data

Length over all	160.00 m	Sail area	4 200 m ²
Width	40.00 m	Solar panels	4 000 m ²
Air Draft	56.00 m	Battery	300 MWh
Design Draft	6.00 m	Machinery	Electric (Fuel cells)
Scantling Draft	13.00 m		
Speed (average)	10.50 knots		
Car capacity	3 550 CEU		

Roadmap for energy consumption, energy carriers and emissions (new ships)



Roadmap for energy consumption, energy carriers and emissions (new ships)





Roadmap – Conclusions

It is fully possible to build an emission free ship today, with existing technology.



Roadmap – Conclusions

It is NOT only about new technology!

Roadmap – Conclusions

The emission free ship can be realized only through a combination of:

- Reducing the energy consumption
- Adapting new ways of sailing and operating the ships.
- Making use of emission free or emission neutral energy sources.
- Introducing new technology in a number of areas.
- Reviewing current requirements and constraints, for example speed and limitations on size.

Therefore, in the roadmap all these areas are addressed.

Roadmap

Roadmap for....:

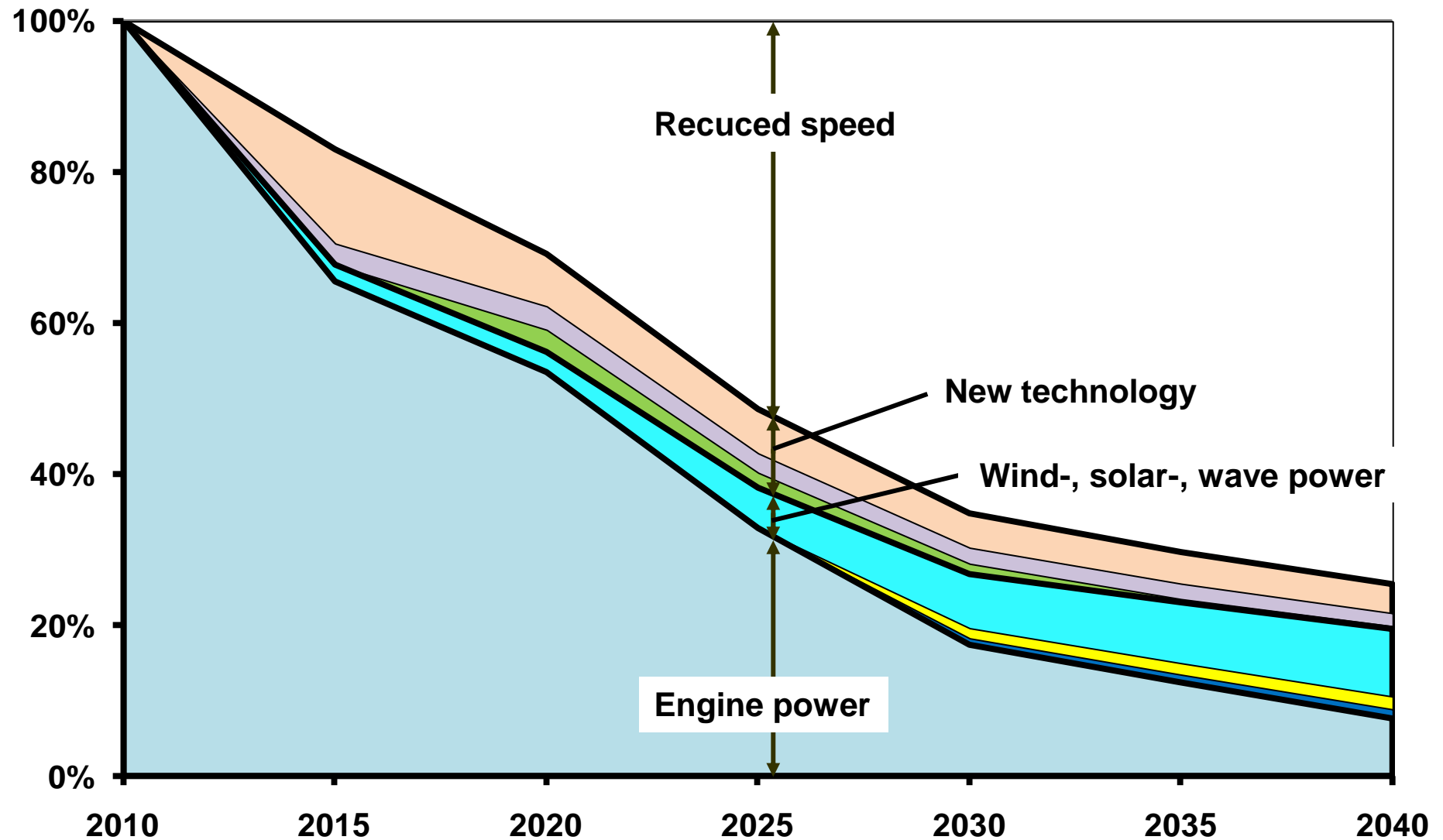
- operation
- energy carriers
- technology
- Wallenius ships
- energy consumption
- emissions
- Wallenius Marine competence



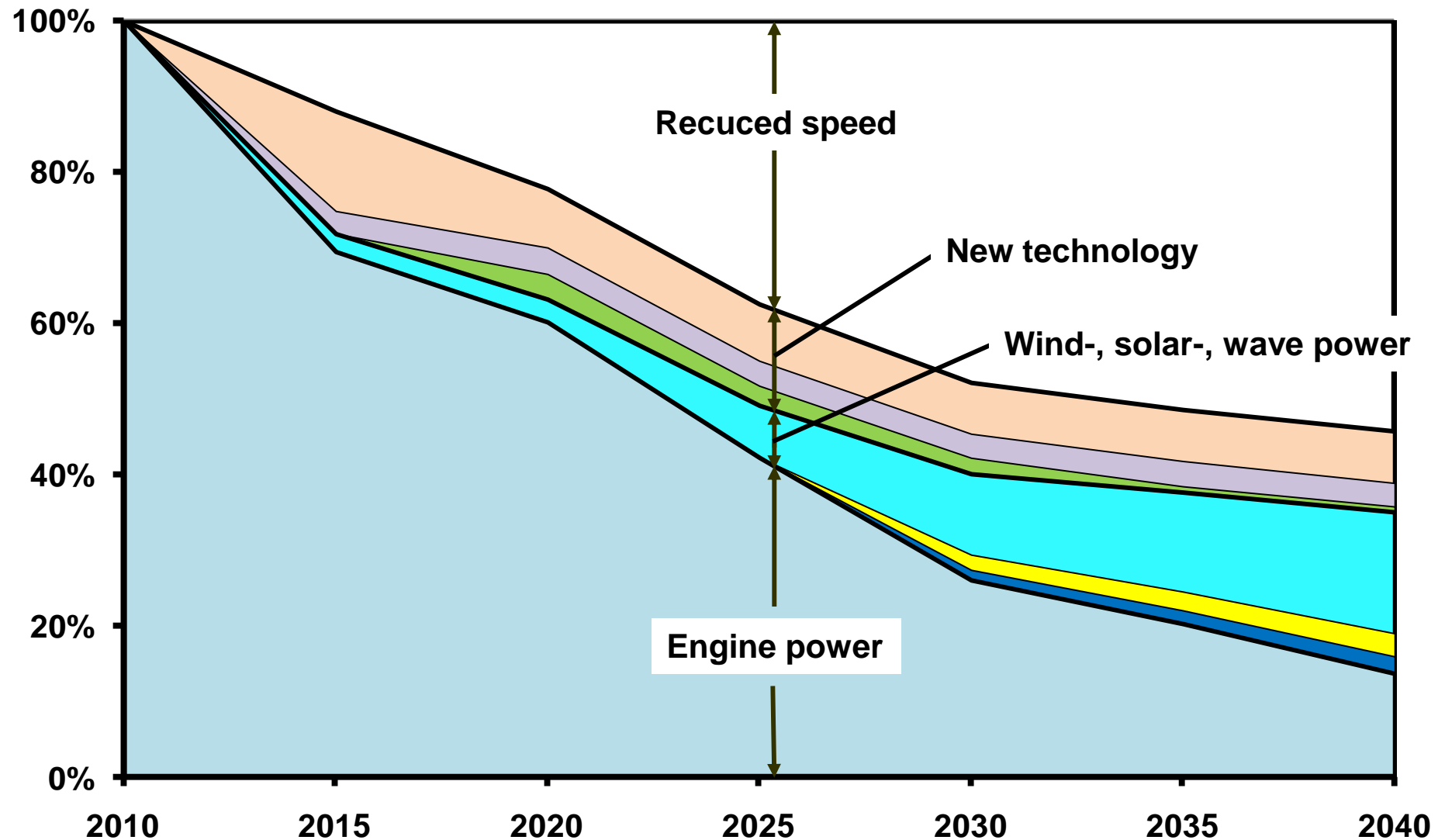
Roadmap for Wallenius ships

	2010	2015	2020	2025	2030	2035	2040
Design speed [knots]	18	17	16	14	12	11	10
Primary energy carrier	LSFO	ULSFO	LNG	LNG	Biogas	Biogas	Methanol
Secondary energy carrier	MGO	LNG	Biogas	Biogas	Methanol	Methanol	Batteries
Machinery	Single shaft, direct drive, one engine	Single shaft, direct drive,	Single shaft, direct drive,	Hybrid, electric	Hybrid, electric	Hybrid, electric	Hybrid, electric
Primary driver	Two stroke diesel	Four stroke diesel	Gas engine	Electric motor	Electric motor	Sails	Sails
Secondary driver 1		Electric motor	Electric motor	Sails	Sails	Electric motor	Electric motor
Secondary driver 2		Wing sails at bow	Wing sails at bow		Foils	Foils	Foils
Auxiliary 1	Four stroke diesels	Combustion engine	Combustion engine	Combustion engine	Combustion engine	Combustion engine	Fuel cells
Auxiliary 2	Shaft generator	Shaft generator	Shaft generator	Solar heat gensets	Fuel cells	Fuel cells	Solar heat gensets
Auxiliary 3					Solar power	Solar power	Solar power
Propulsor	1 FPP	CRP	CRP	1 large FPP	1 large FPP	1 large FPP	1 large FPP

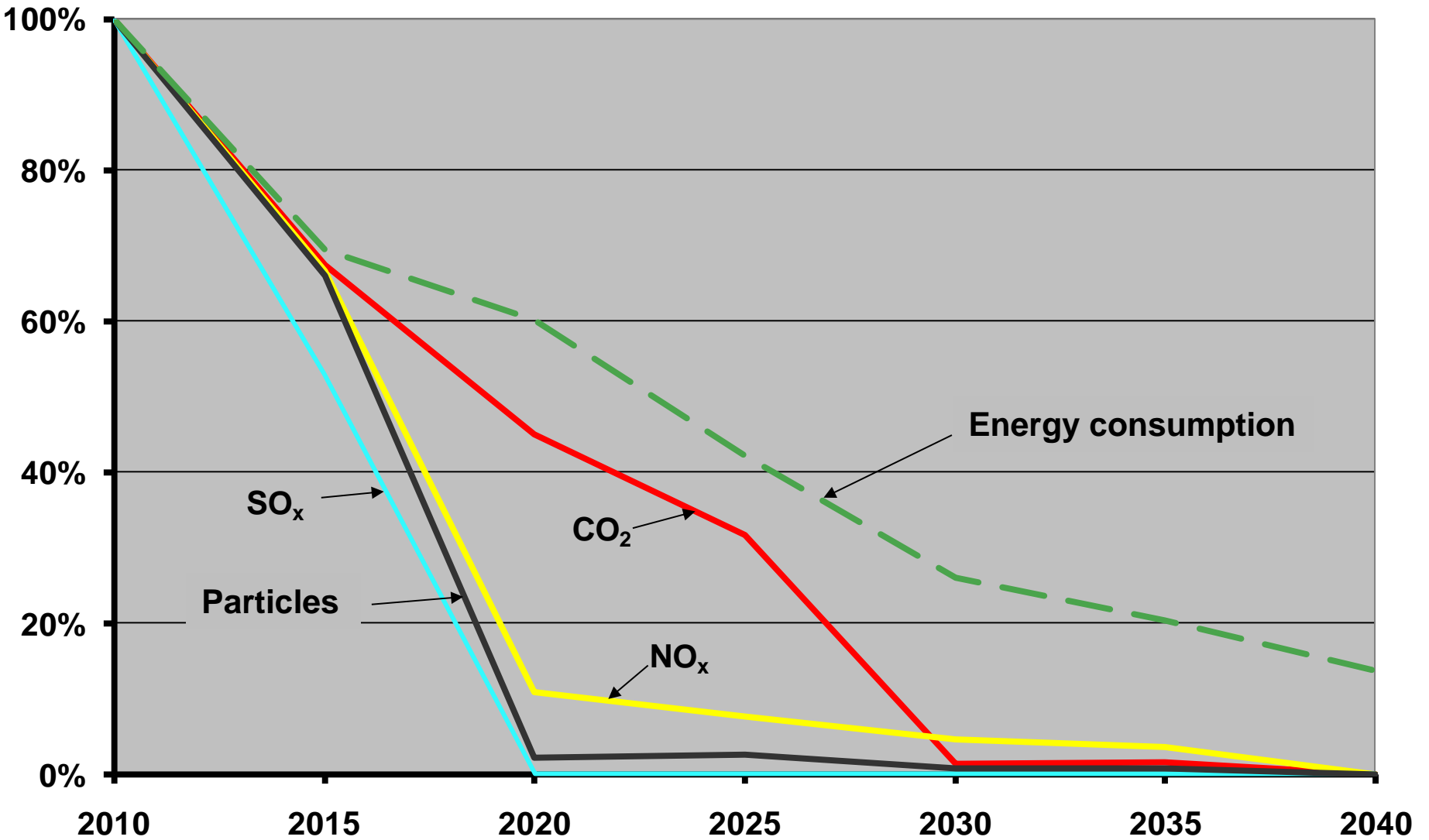
Roadmap for energy consumption – ships



Roadmap for energy consumption – fleet

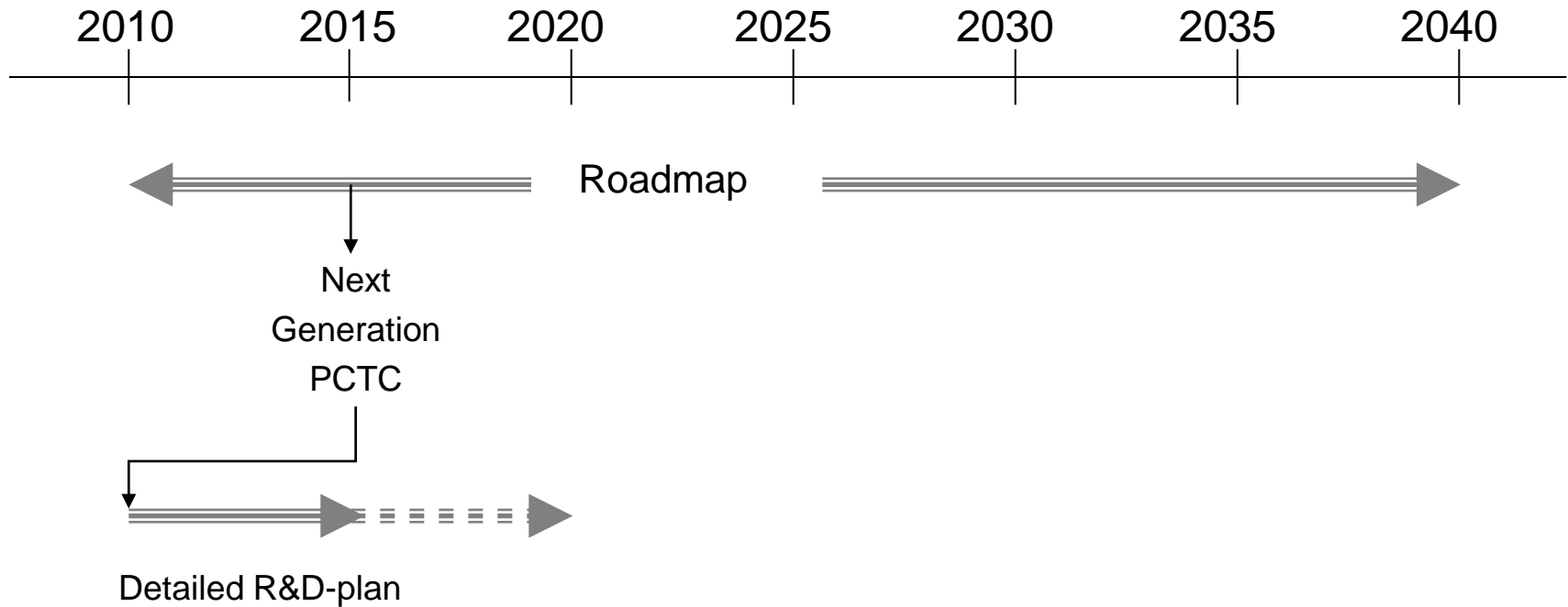


Roadmap for emissions – fleet



Roadmap – Status

- Scenario
- Basis for development of next ship generation
- Basis for planning of R&D (5-10 years)



PROJEKT ZERO (Zero Emission ROro)

