NYK LOGISTICS & MEGACARRIER

Advanced Technologies for Shipping

One-day International Workshop on Sustainable Transportation and Energy
6th August, 2009

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Monohakobi Technology Institute

NYK LOGISTICS & MEGACARRIER

Comparison Table for Required Energy

193kJ / ton・km

494kJ / ton・km

3,452kJ / ton・km

21,662kJ / ton・km

※Source：MOLIT, The survey on transport energy 2007

NYK's CO2 Emission

Remark: Emission data of other companies on 2007

		2007	2008	2013
NYK only	Operating ship	512ships	489ships	
	CO2 Emission	16.97mil.ton	16.74mil.ton	
NYK Group	Operating ship	(794ships)	(836ships)	(890ships + α)
	CO2 Emission	(abt.23mil.tom)		

Company	CO2 Emission
Nippon Steel	63.05mil.ton
JFE Steel	62.53mil.ton
Sumitomo Metal	23.67mil.ton
Kobe Steel	18.05mil.ton
Taiheiyo Cement	14.54mil.ton
Nippon Oil	10.18mil.ton

Electric Power	CO2 Emission
Tokyo Electric	94.52mil.ton
Chubu Electric	57.57mil.ton
J Power	45.25mil.ton
Tohoku Electric	33.73mil.ton
Chugoku Electric	27.40mil.ton
Kansai Electric	27.07mil.ton
Kyushu Electric	22.55mil.ton
Hokuriku Electric	20.16mil.ton
Hokkaido Electric	14.16mil.ton

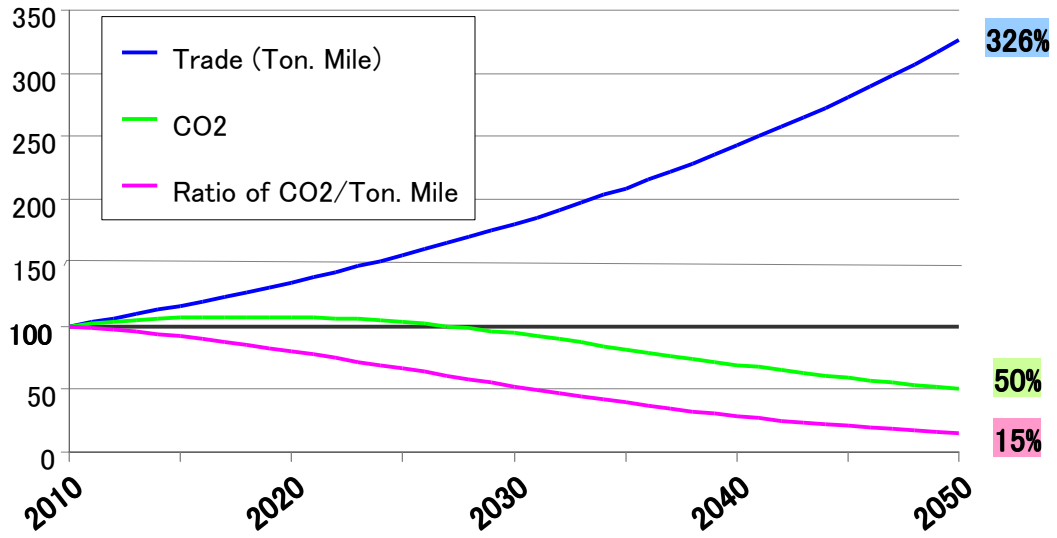
GHG Reduction

<Assumption>

1. The growth of International Trade Volume: 3% p.a. (326% in 2050)

2. The target of reducing CO2 by 2050 : 50% less than current level

➡ The emission of CO2/Ton･Mile must be 85% less in 2050



- **Some Rules/Guidelines will be decided in the coming MEPC59**

NYK LOGISTICS & MEGACARRIER

Special Environment PJ: NYK Cool Earth Project Starts in April 2008

NYK's CO_2 Reduction Targets

Long-term Vision: Contribute to global effort to cut greenhouse gas emissions to 50% by 2050.

Reduction Target: Achieve a reduction of at least 10% per ton-mile consumption basis by 2013, compared with the level in fiscal 2006.

NYK will earmark ¥70 billion over six years to this project, with a focus on the development of innovative, environment-oriented equipment and technologies that curb greenhouse gas emissions.

NYK will take the lead in international environmental policy discussions as they regard shipping operations.

NYK will reshape existing business models.

What can we do now ?

NYK Cool Earth PJ: Development of 50% Eco Pure Car Carrier

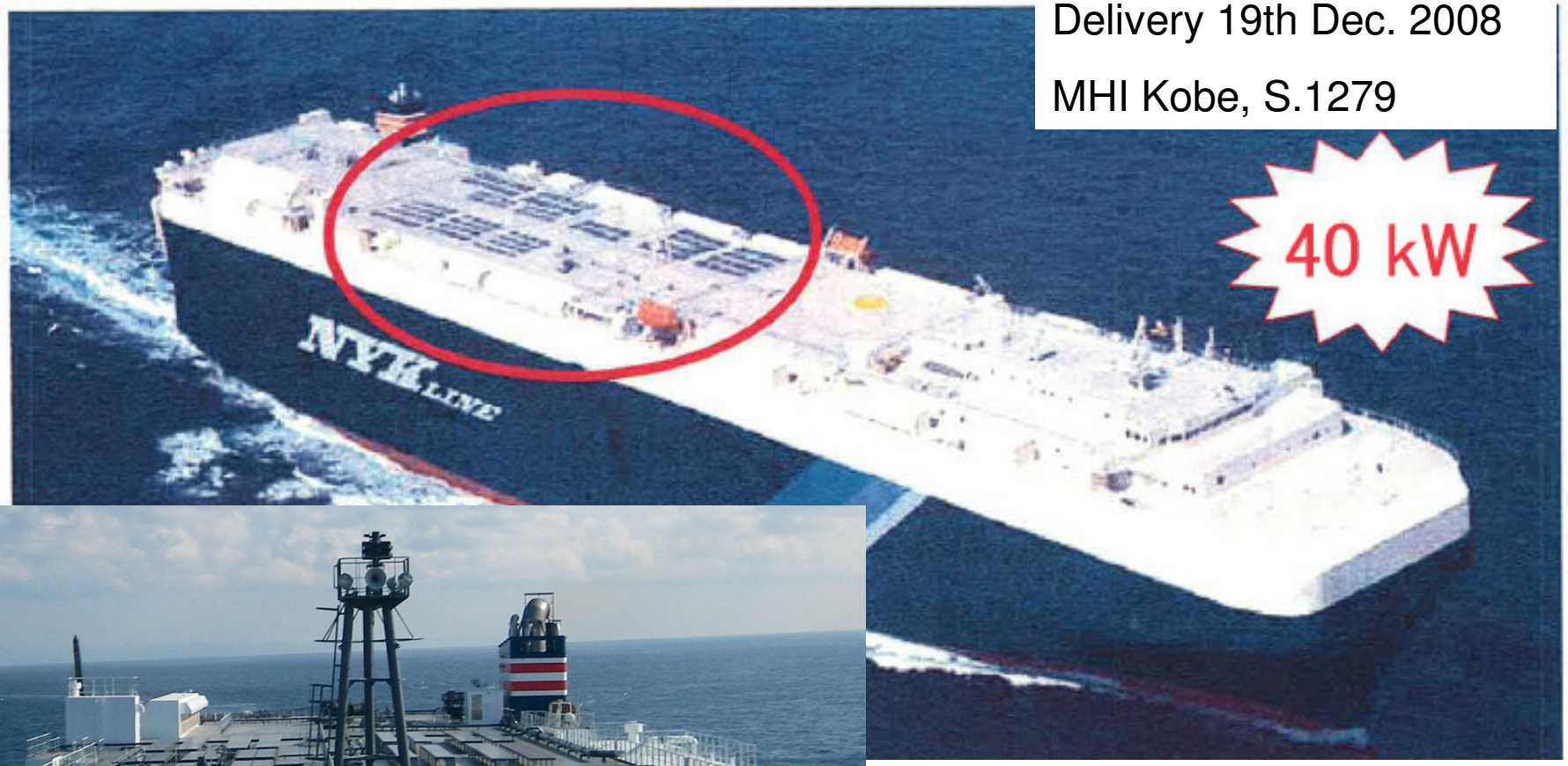
Development of 30% Eco Container Carrier

What can we do now ?

Example: Solar Power Generating System

Delivery 19th Dec. 2008

MHI Kobe, S.1279



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Thank You

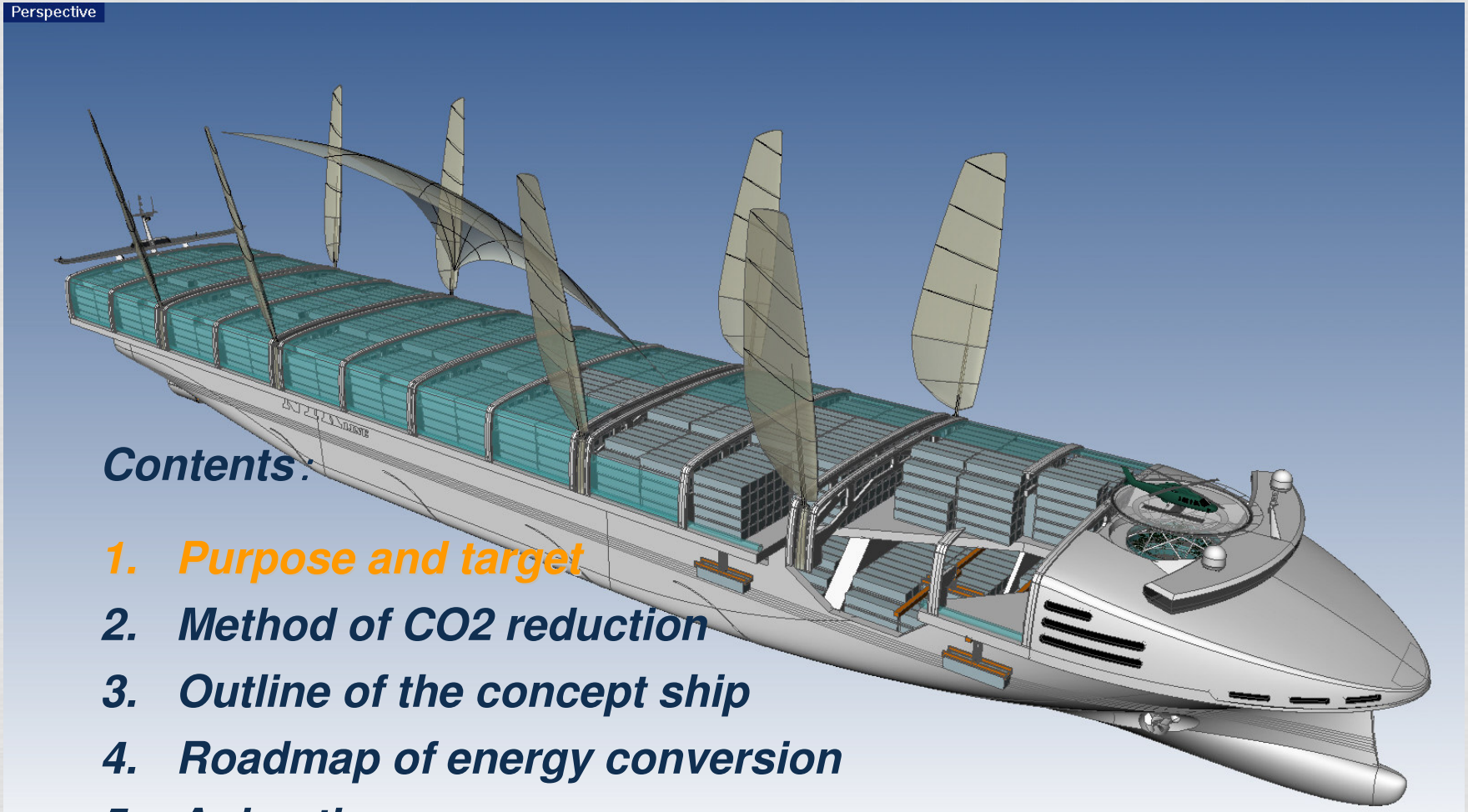
2010 2020 2030

NYK Super Eco Ship 2030
- our concept ship in the future

6th August, 2009

NYK Line／MTI

2010 2020 2030

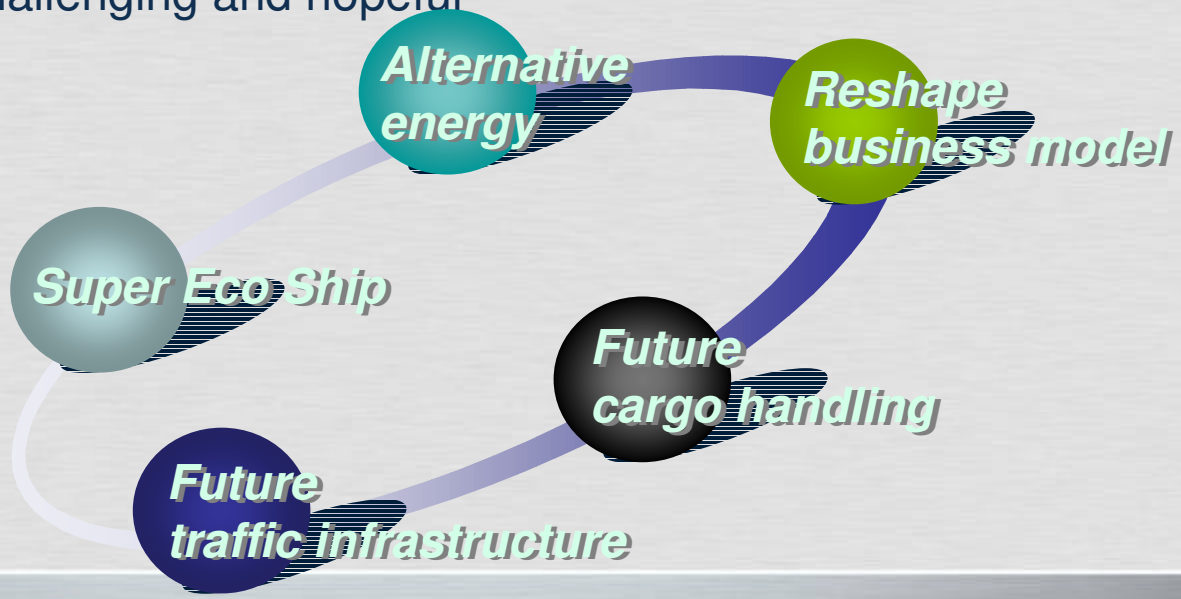


Contents :

1. Purpose and target
2. Method of CO2 reduction
3. Outline of the concept ship
4. Roadmap of energy conversion
5. Animation

Purpose and Target

- To make it clear what NYK need to technically develop in the long term including alternative energy
- To lead to think future system of shipping, such as cargo handling and traffic infrastructure
- To appeal to young engineers/students in the world that the development of the future ship is challenging and hopeful

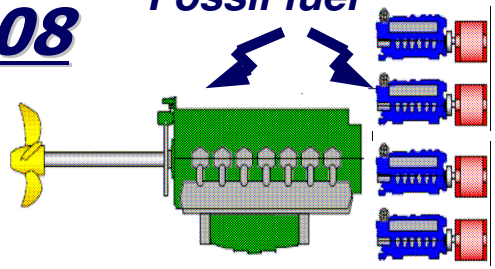


2010 2020 2030

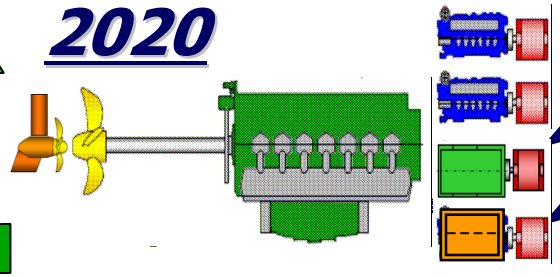
Road to "Emission Zero"

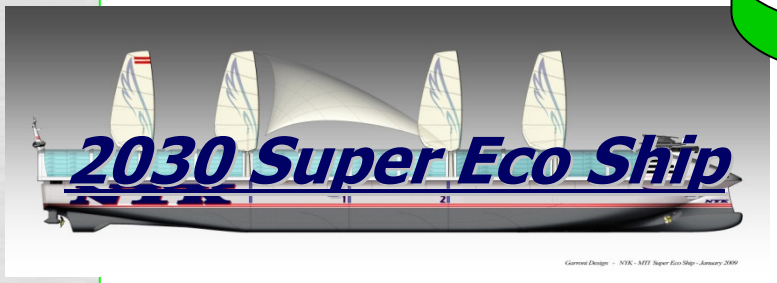
2008

Fossil fuel

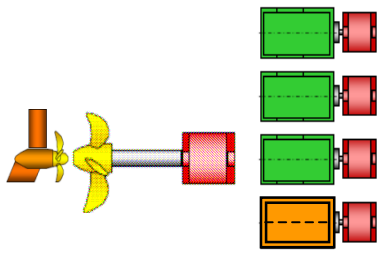


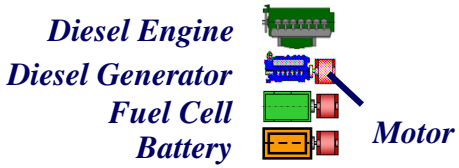
2020





2050 Emission Zero





1. Purpose and target
2. **Method of CO2 reduction**
3. Outline of the concept ship
4. Roadmap of energy conversion
5. Animation

Means to Reduce the Emissions

A. REDUCTION OF POWER

- Reduction of weight
- Reduction of power for ships own use
- Reduction of frictional resistance
- Reduction of wind resistance
- Increase propulsion efficiency
- Increase motor efficiency
- Development of hull form

B. USE OF NEW TECHNOLOGY FOR POWER GENERATION

- Fuel cells
- Alternative fuels such as H2 and LNG

C. USE OF RENEWABLE POWER SOURCES

- Solar power
- Wind power

2010 2020 2030

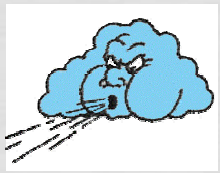
Reduction of CO2 Emissions

Total Cut ▲ 69 %

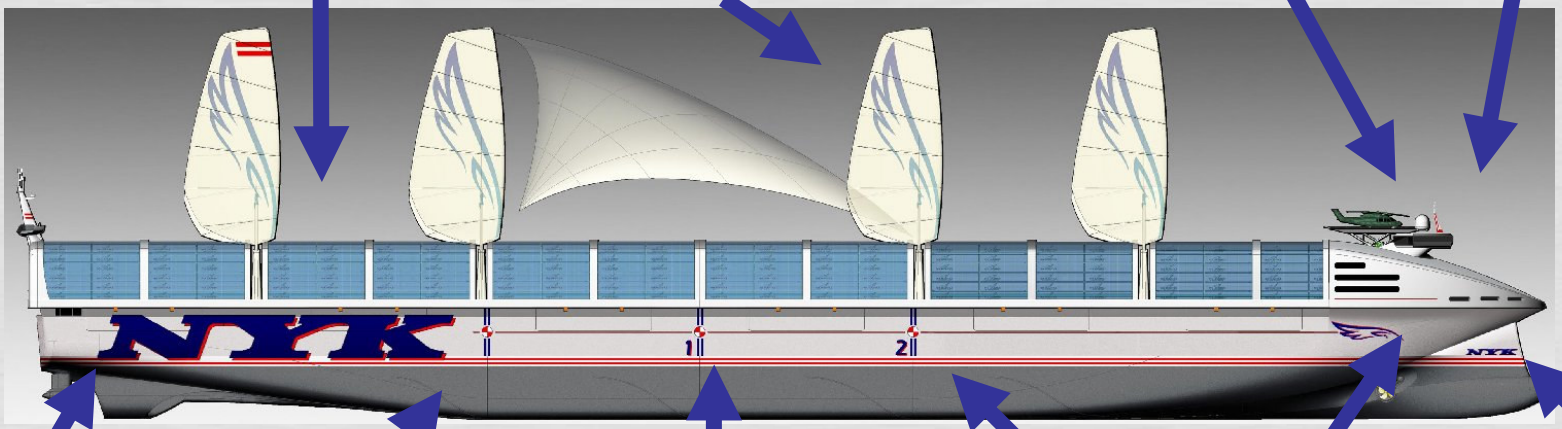
Solar power 2 %

Wind power 4 %

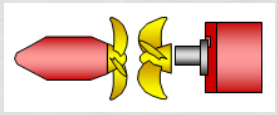
Reduced power for ship use 2 %



Wind resistance 1 %



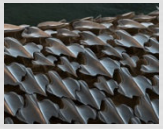
Propulsion efficency 5 %



Superconductivity 2 %

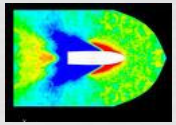
Weight savings 9 %

Hull friction 10 %



Fuel cells 32 %

Hull form optimization 2 %



Aug. 09

Super Eco Ship

NYK LINE Monohakobi Technology Institute ELOMATIC Garroni Design

2010 2020 2030

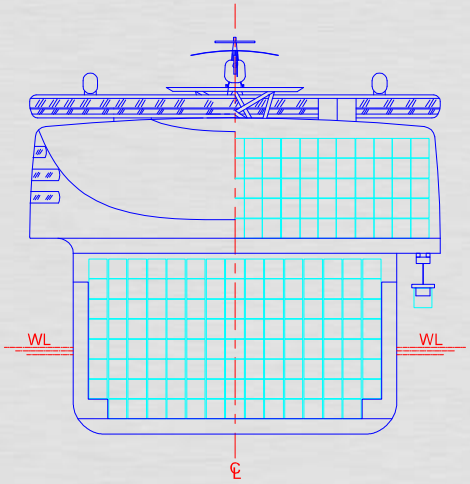
REDUCTION OF WEIGHT

REDUCTION OF SHIP'S WEIGHT

- NEW MATERIALS ▲3,000 ton
  - Extra high tensile steel and alloys
  - Composites
- NEW STRUCTURAL SOLUTIONS ▲5,000 ton
  - Enclosed hull girder
- MACHINERY WEIGHT ▲3,000 ton
  - Fuel cells
- OUTFITTING WEIGHT +/- 0 ton
  - To offset outfitting weight increase (sail, solar panel, self crane, etc.) by hatch cover less

REDUCTION OF DEADWEIGHT

- No ballast ▲6,000 ton
- Less fuel carried ▲2,500 ton
- Lighter containers ▲8,000 ton

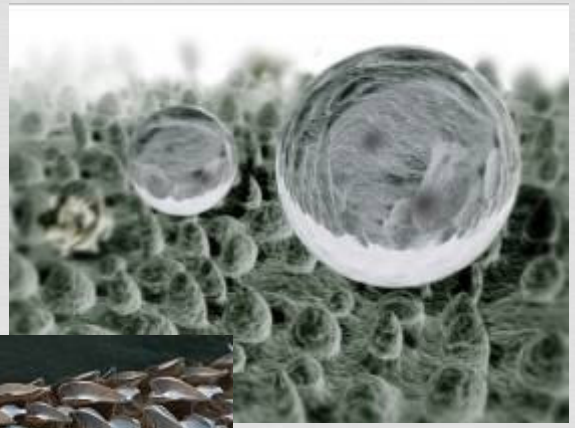


Total reduction of weight	**▲20%**
Reduction of CO2 emission	**▲9%**

Frictional Resistance

Hull Coatings

- Biofouling can increase the frictional resistance up to 15%
- Fouling release paints represent the latest method
- Coatings utilizing nanotechnology adapt ideas from the nature. Promising ones include shark skin and super-hydrophobicity, employed by the lotus leafs

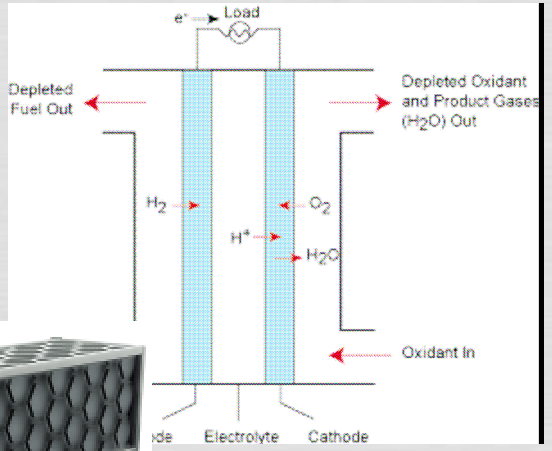


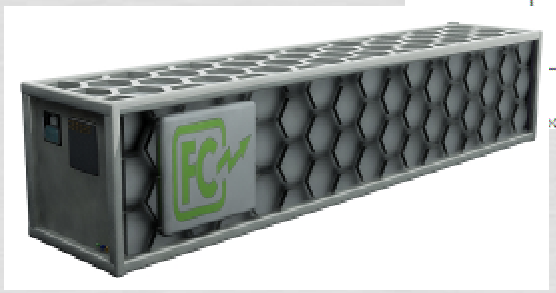
Air lubrication methods

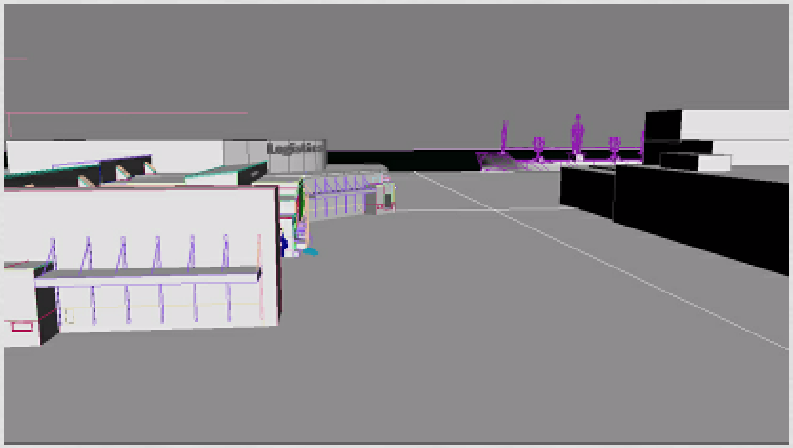
- Friction can be reduced by decreasing the wetted hull surface.

Power Generation with Fuel Cells

- Converting chemical energy directly to electricity.
- Fuel cells are located inside container units.
- Enables power optimizing for each voyage and shifts all maintenance to shore.







Efficiency enhancement through WHR

- Waste Heat Recovery of low and high temperature cooling waters is implemented in order to maximize the efficiency.

Solar Power

Particulars

- 31,000 m2 on covers and sails
- Soft and clear solar panel

Irradiation

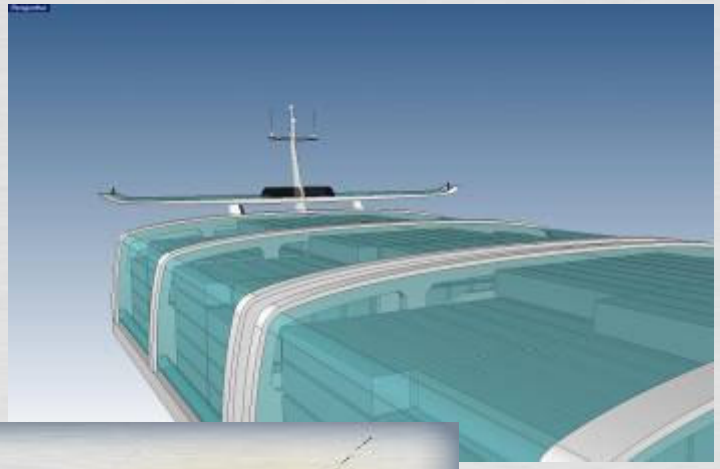
- Average 250W/m2（Peak 1,400W/m2）

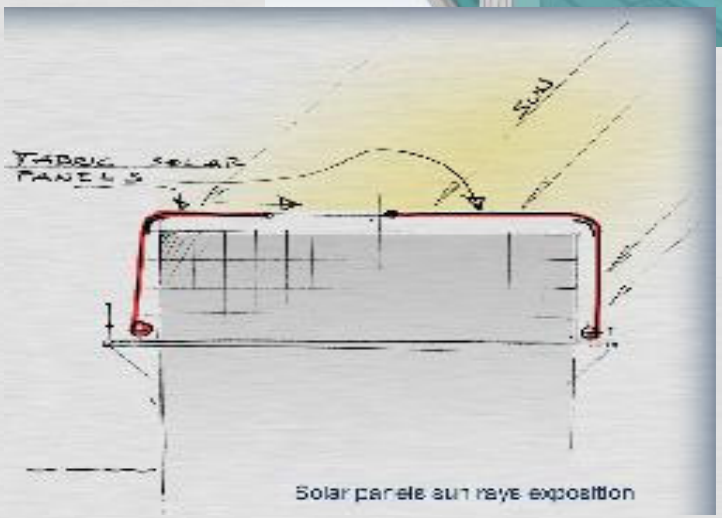
Conversion factor

- 2030 - 30%（current 16% for ship）

Energy

- Average 1～2MW

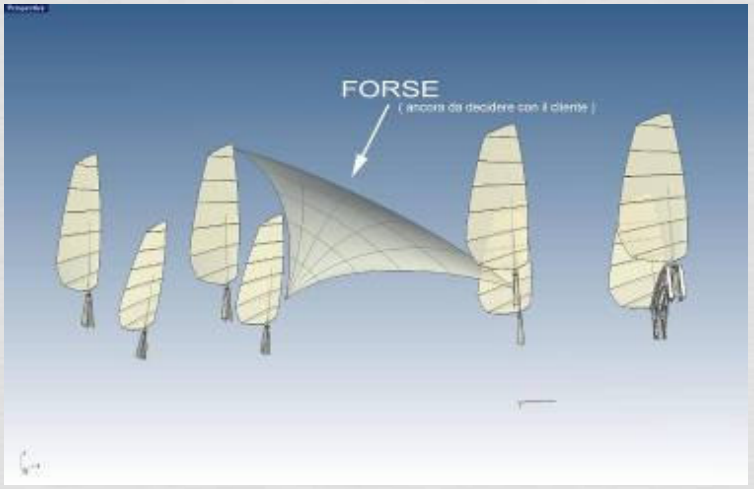




Sails

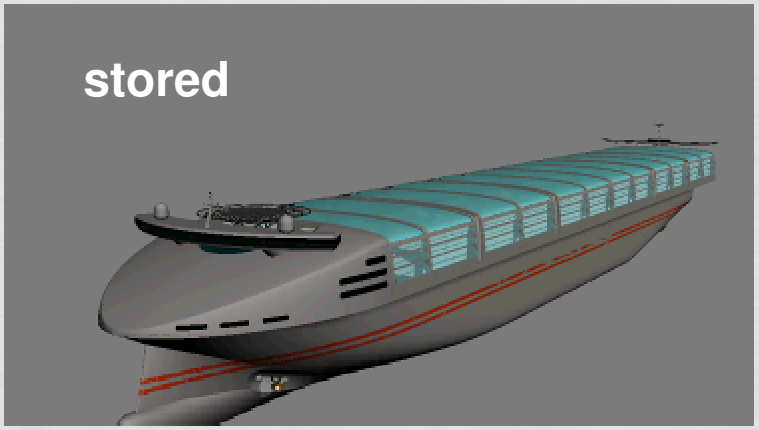
Specifics

- Air foil with high aspect ratio, rounded tip is most efficient.
- Solar cells on foils
- Foils can be taken down when the wind conditions are not favorable in order to avoid wind resistance.



Driving Force

- 8 foils x 500 m2
- Driving force corresponding average 2.5 MW

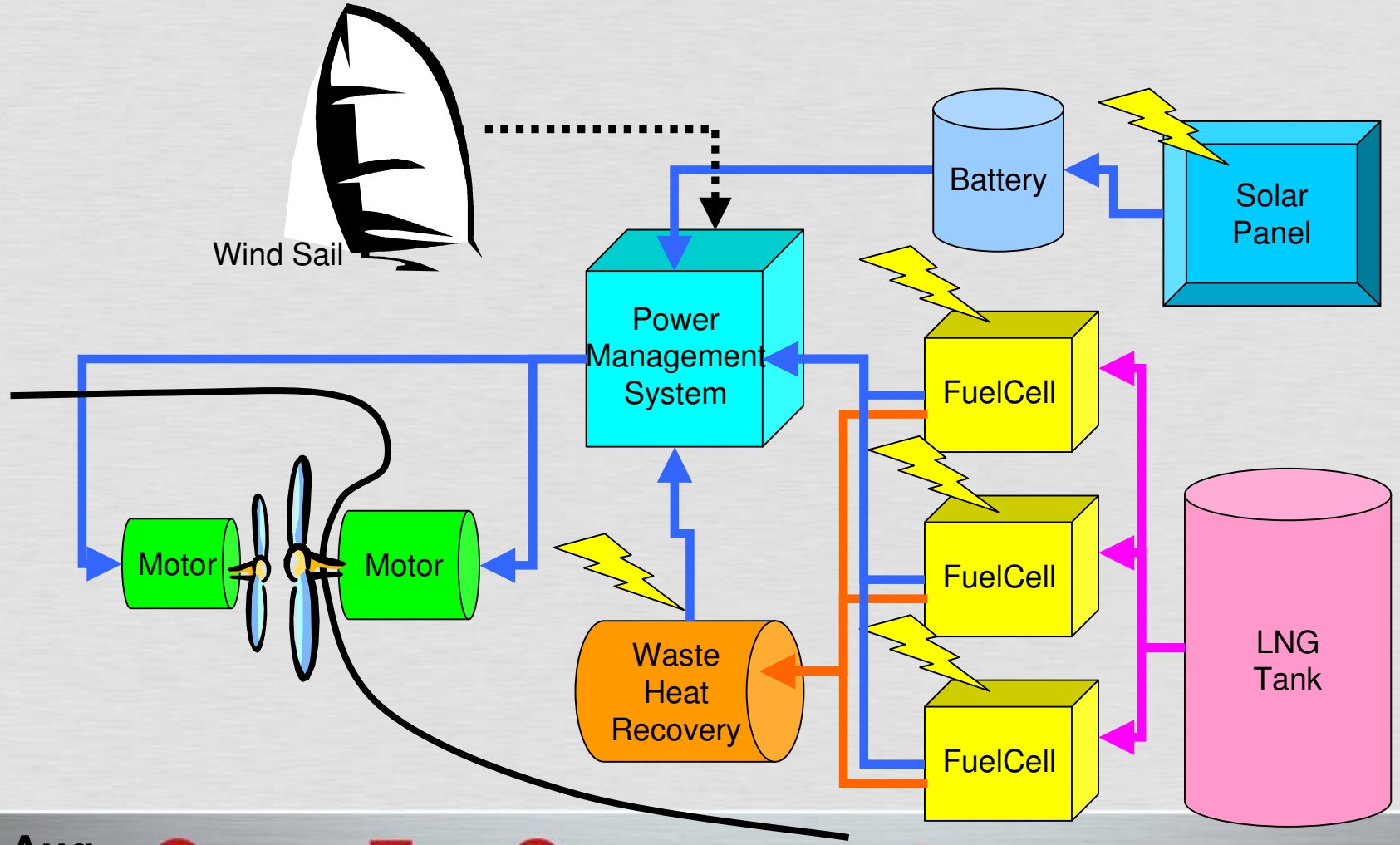


1. Purpose and target
2. Method of CO2 reduction
3. **Outline of the concept ship**
4. Roadmap of energy conversion
5. Moving image

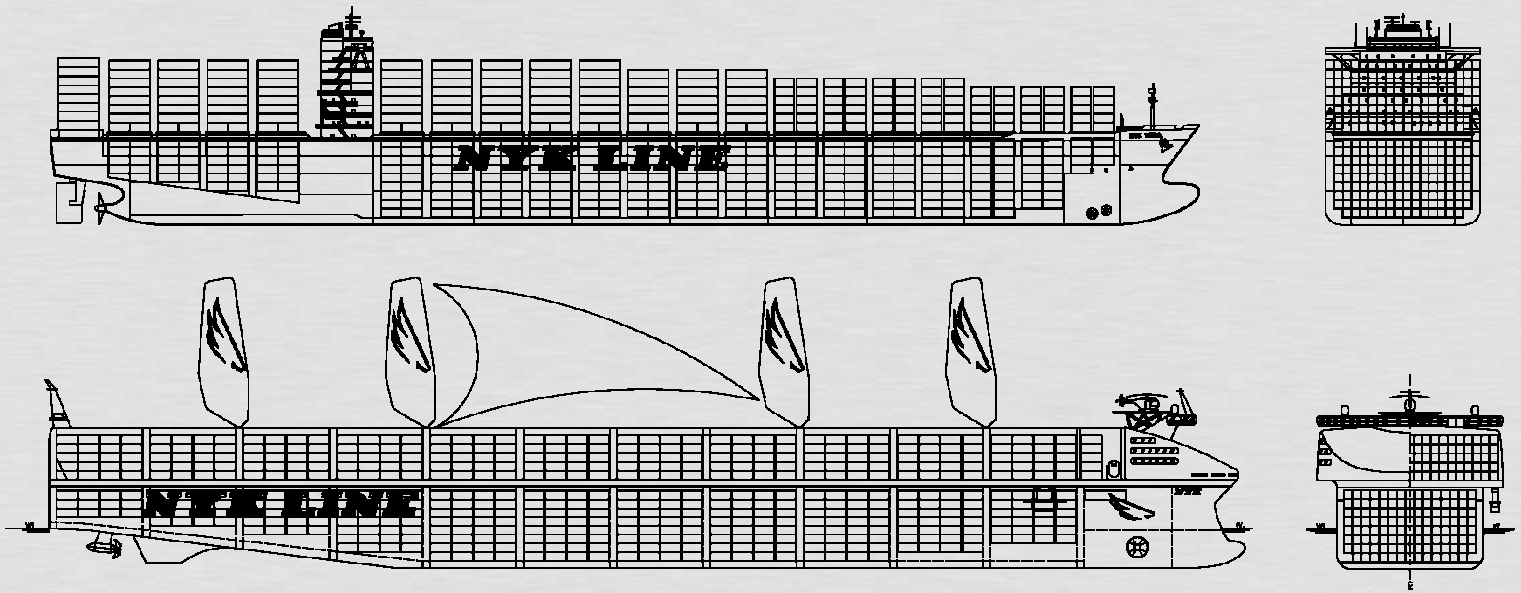
Ship's Particulars

8,000 TEU / 25 knots Basis	MV "NYK VEGA" (built in 2006)	Super Eco 2030
Length	338m	353m
Width	45.8m	54.6m
Design Draft	13.0m	11.5m
Required Power	Diesel Engine (HFO)	Fuel Cell (LNG)
	64MW	40MW
Renewable Energy	None	Solar : 1-2MW
		Wind : 1-3MW
CO2 Emission	195g/TEU-mile (100)	62g/TEU-mile (31)

Power Generation Plant



Increase of Max Loadable Capacity



- By switching fuel cells from a diesel engine, loadable space increases from current 91% to 97%

1. *Purpose and target*
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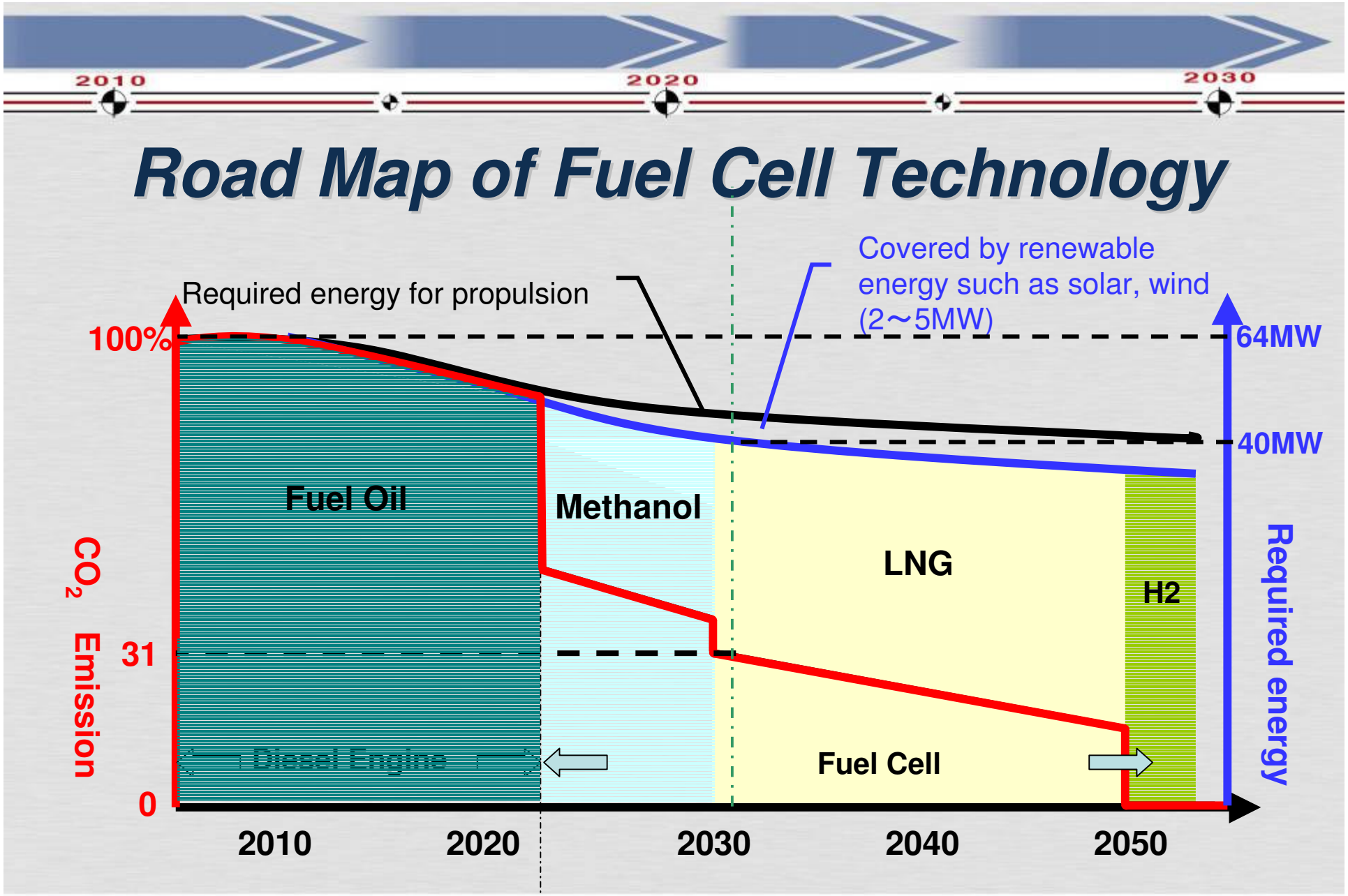
4. ***Roadmap of energy conversion***
5. *Animation*


2010
2020
2030
Road Map of Fuel Cell Technology
Required energy for propulsion
Covered by renewable energy such as solar, wind (2～5MW)
100%
64MW
40MW
Fuel Oil
Methanol
LNG
H2
Required energy
CO2 Emission
31
0
Diesel Engine
Fuel Cell
2010
2020
2030
2040
2050
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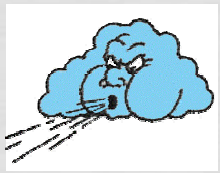
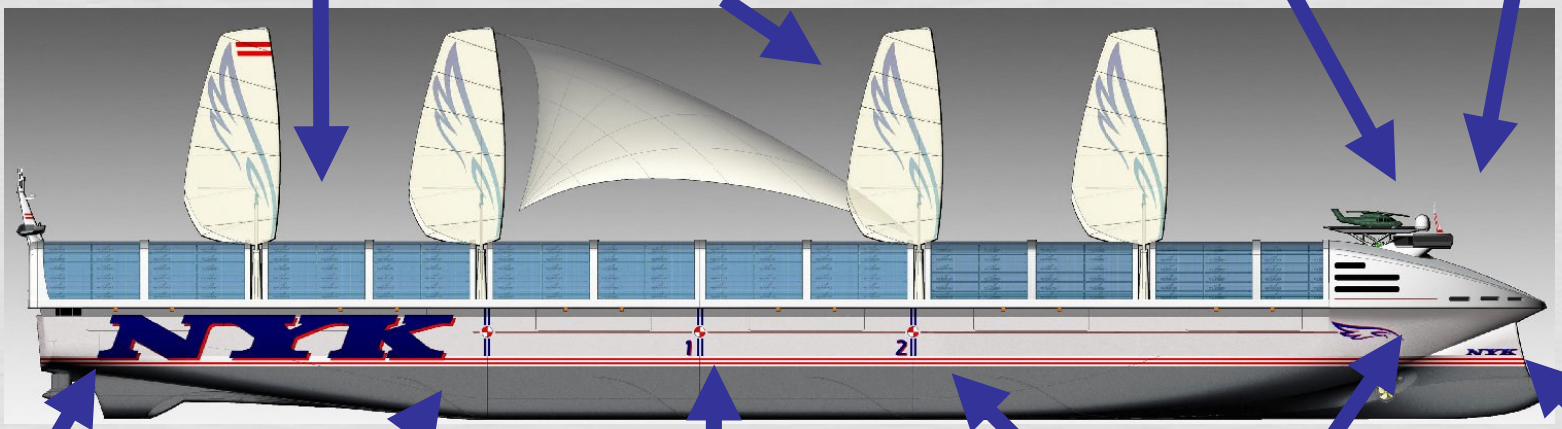
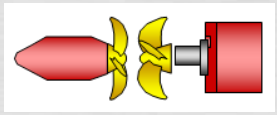


Wind resistance 1 %



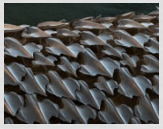
Propulsion efficency 5 %



Superconductivity 2 %

Weight savings and hull form 9 %

Hull friction 10 %



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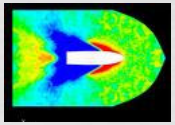

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