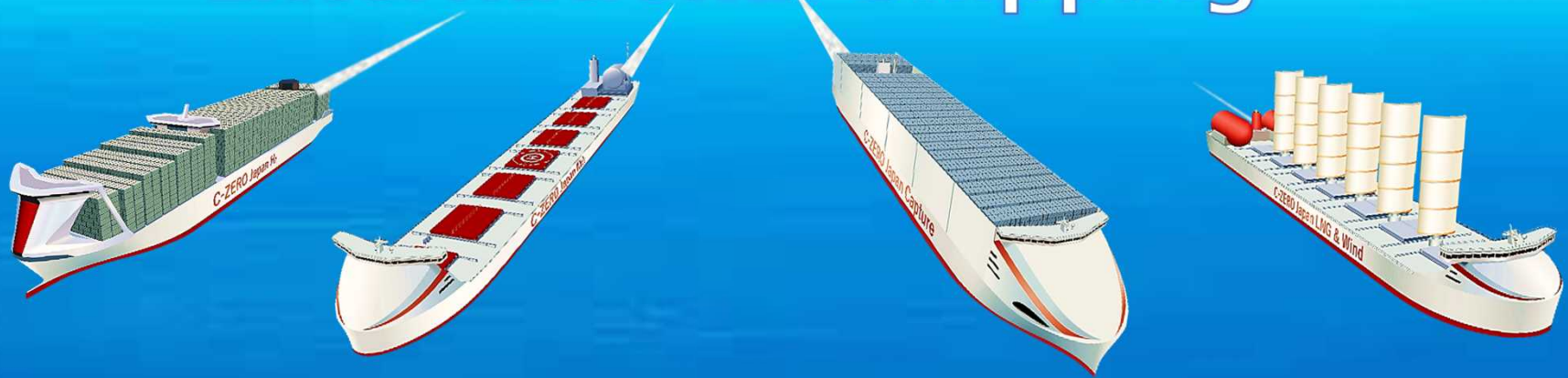


# Roadmap to Zero Emission from International Shipping

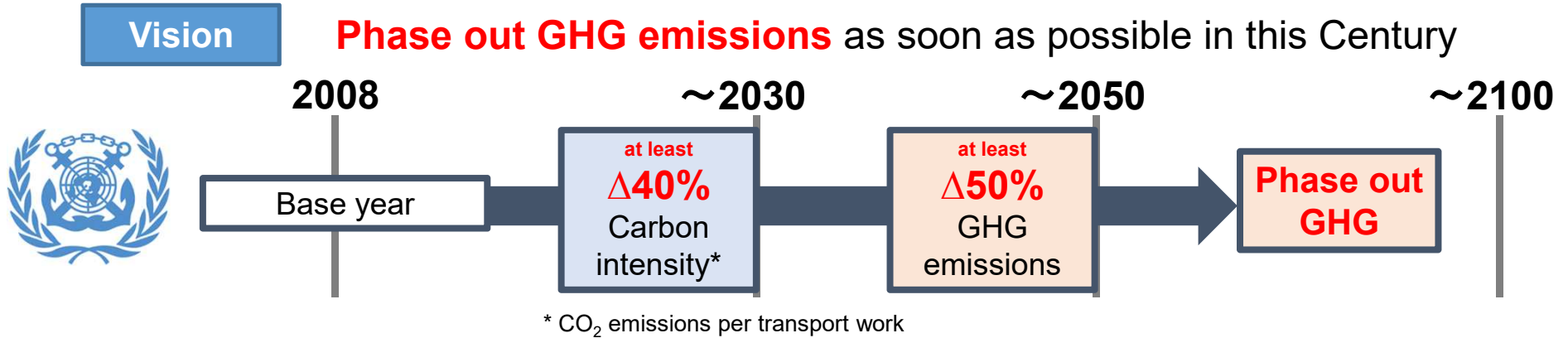


## Shipping Zero Emission Project March 2020



# 1. Background

## IMO's initial GHG Reduction Strategy (Apr 2018)



## “Zero-Emission Project” in Japan

### Toward the 2030 target:

- ✓ Developed a proposal of a new global framework to improve energy efficiency of existing ships (being proposed as EEXI to IMO in 2019, aiming at adoption no later than 2023).

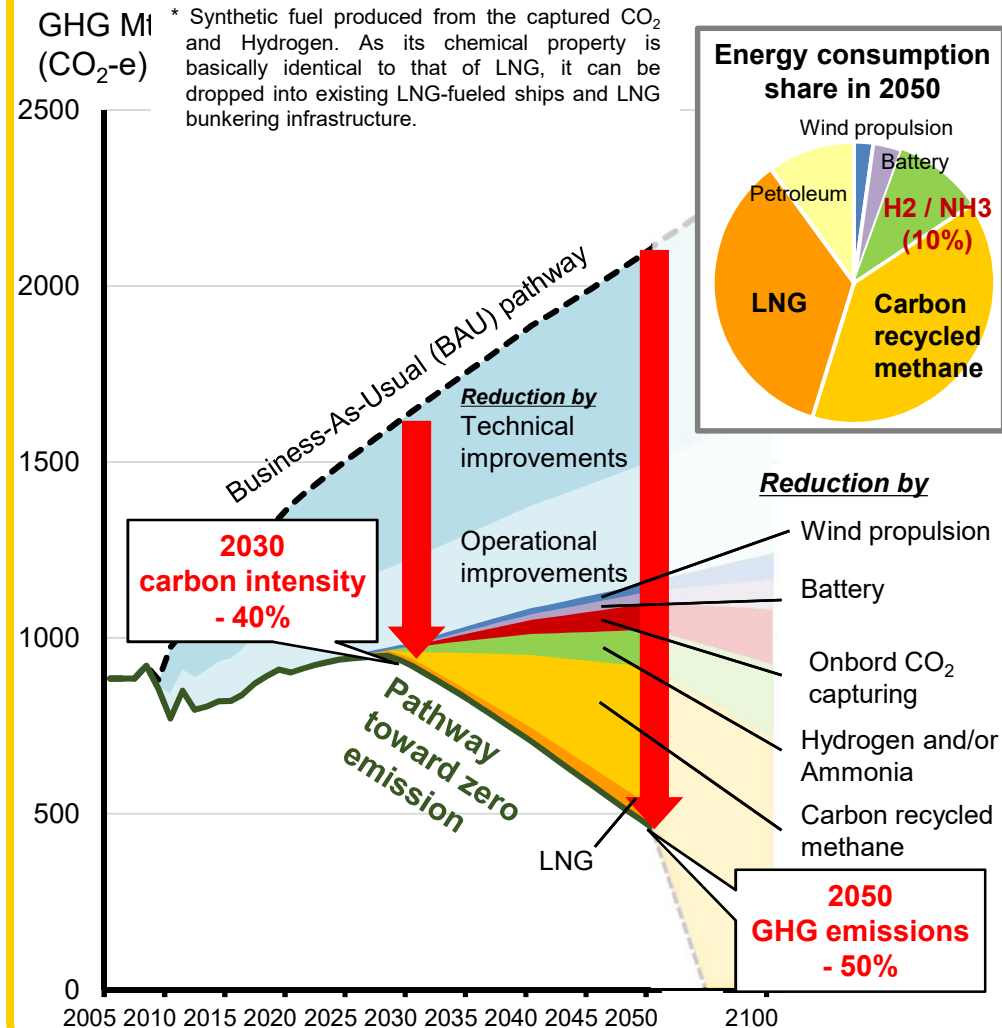
### Toward the 2050 target and beyond:

- ✓ Developed a roadmap to zero-emission from international shipping, released in March 2020
  - Estimated **future GHG emissions** from international shipping up to 2050 on BAU basis.
  - Researched and examined **feasibility of innovative technologies and alternative fuels**
  - Developed **emission reduction pathways and milestones** aligned with the IMO's Strategy
  - Developed concept designs of **ultra-low/zero emission ships**
  - Identified **necessary actions**: R&D challenges, regulations, incentive schemes, etc

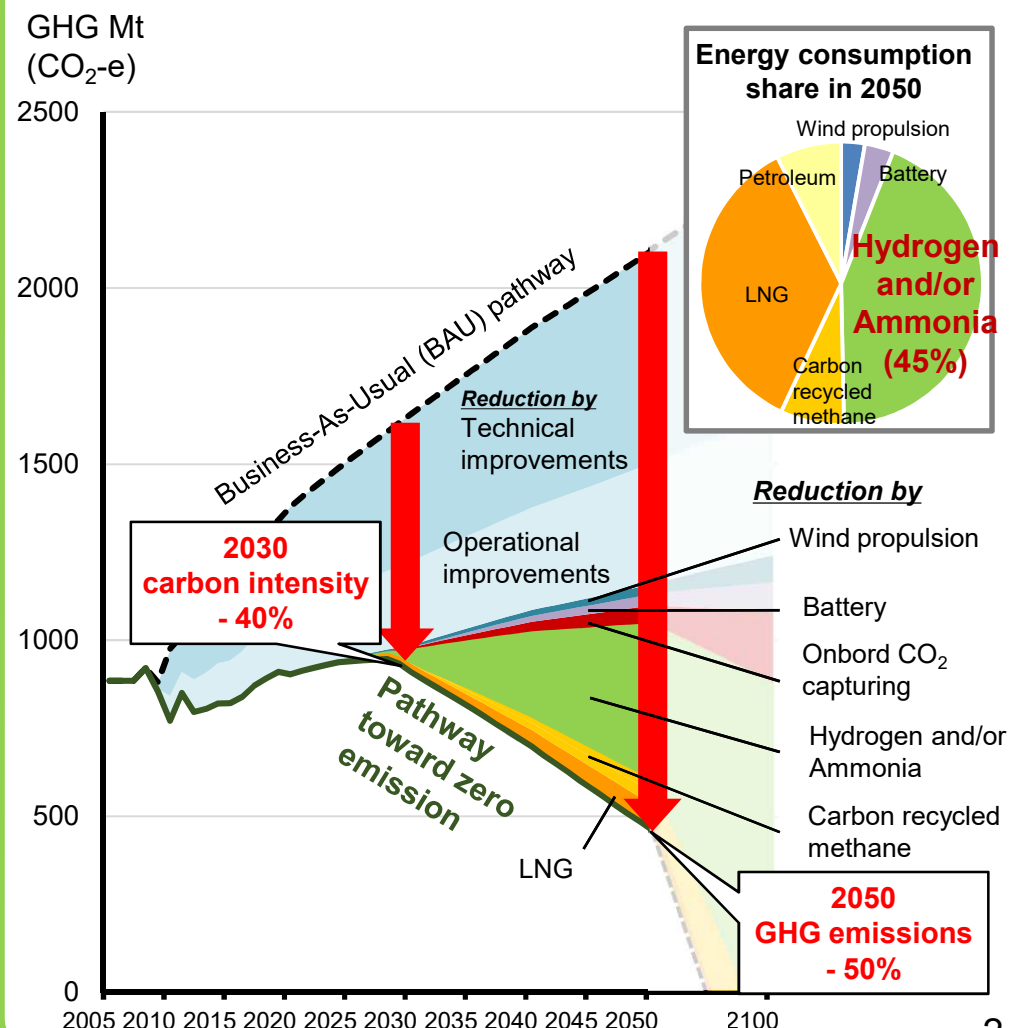
# 2. Emission pathways toward 2050 and beyond

- ◆ Acknowledging uncertainties in future energy supply scenarios, **two feasible emission reduction pathways**, aligned with the GHG reduction targets set out in the IMO Strategy, are developed.

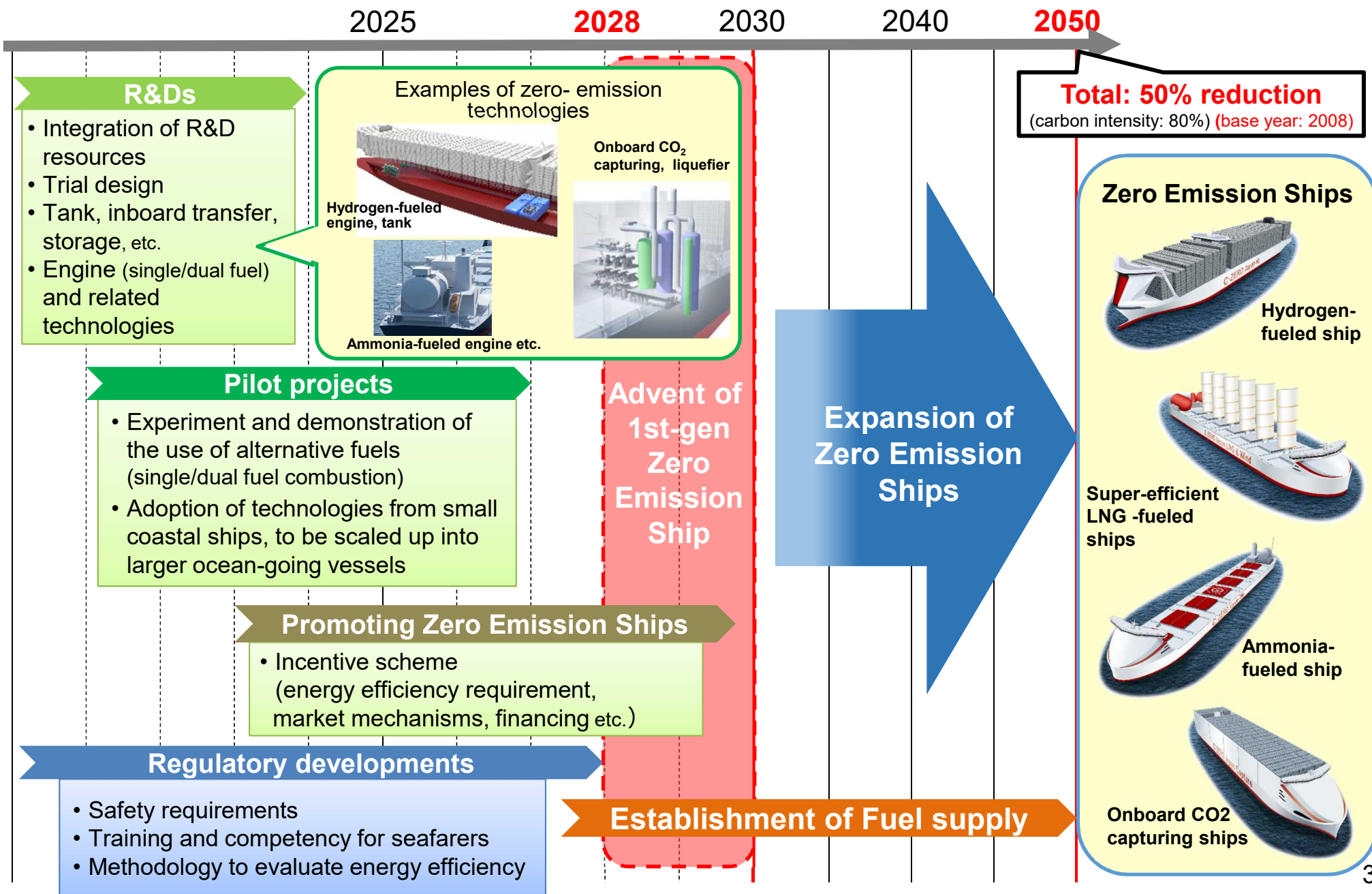
## 1. LNG to Carbon-Recycled Methane\*



## 2. Expansion of Hydrogen / Ammonia



# 3. Roadmap to Zero Emission from International Shipping





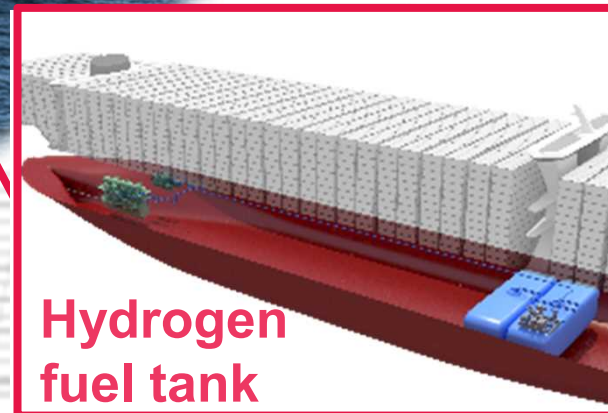
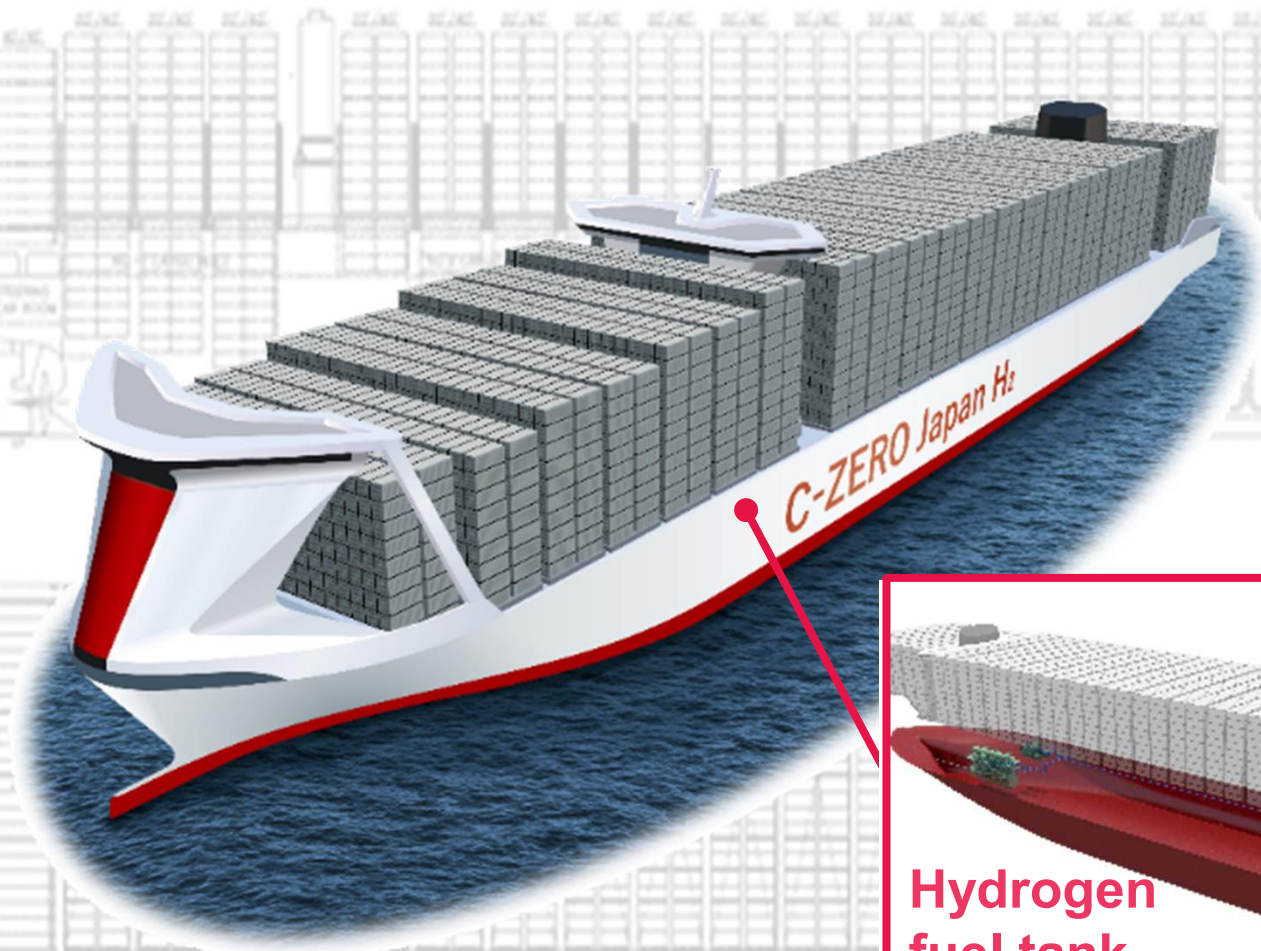
## 4. Concept Design of Zero-Emission Ships

### Hydrogen-Fueled Ship: C-ZERO Japan H<sub>2</sub>

- Hydrogen fuels generate no GHG.
- Already being developed and utilized in on-land sector in Japan.

#### Specifications

Total length	399.90 m
Ship length	383.00 m
Total width	61.50 m
Depth	33.00 m
Fuel tank capacity	30,000 m <sup>3</sup>
Containers	21,000 TEU
Reefer plugs	1,100 TEU
Designed speed	22.5 knots
Cruising range	11,500 NM
Main engine	60,000 kW
Power generator	5000kW × 3



Hydrogen  
fuel tank

## 4. Concept Design of Zero-Emission Ships

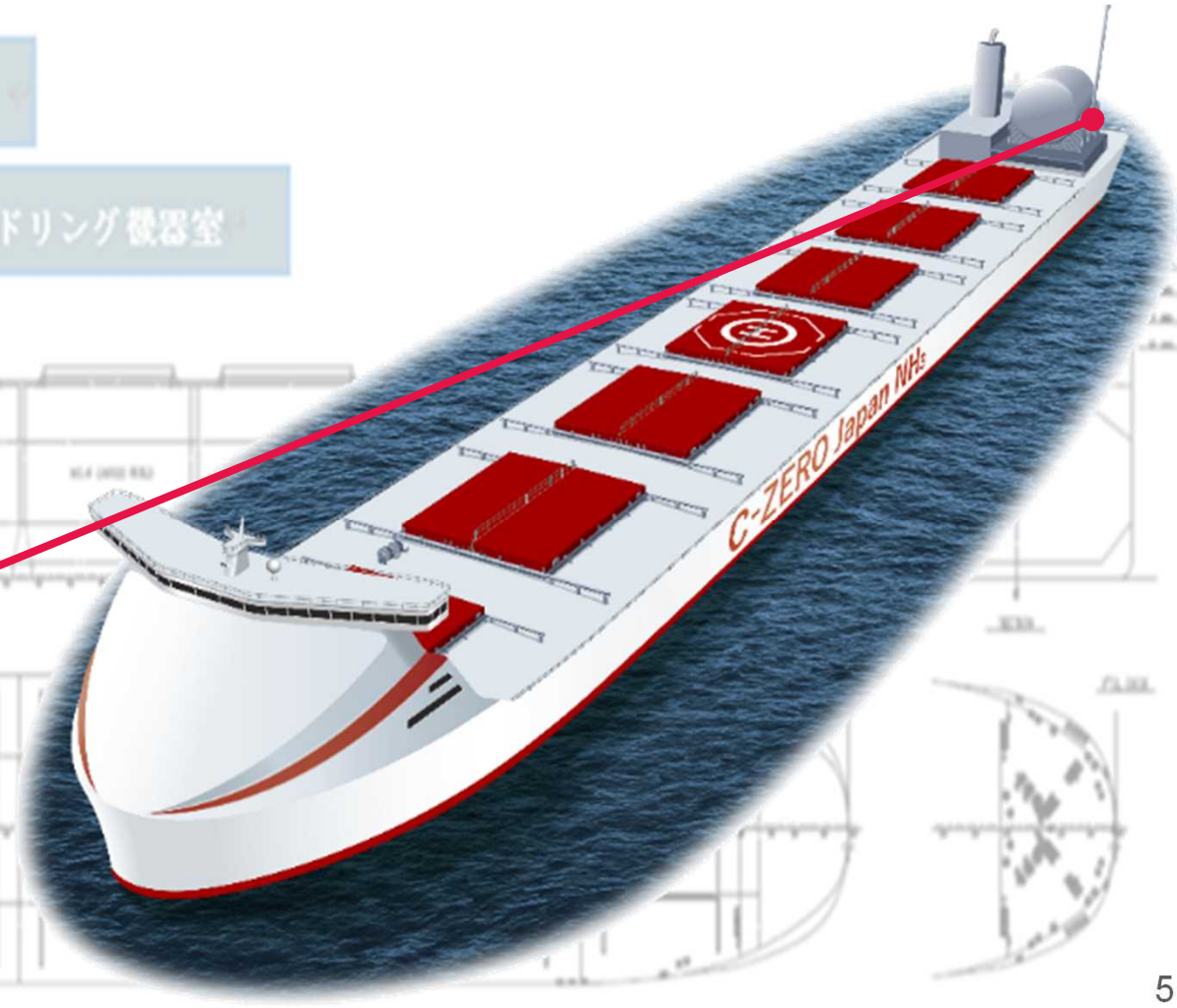
### Ammonia-Fueled Ship: C-ZERO Japan NH<sub>3</sub>

- Ammonia fuels generate no CO<sub>2</sub>
- Although toxicity should be addressed, less challenge in fuel storage

#### Specifications

Total length	233.00 m
Ship length	225.50 m
Total width	32.26 m
Depth	20.10 m
Fuel tank capacity	1,550 m <sup>3</sup>
Deadweight	81,000 DWT
Designed speed	14.2 knots
Main engine	9,660 kW
Power generator	600kW × 3

**Ammonia  
fuel tank**





## 4. Concept Design of Zero-Emission Ships

### Super-Efficient LNG-Fueled Ship: C-ZERO Japan LNG & Wind

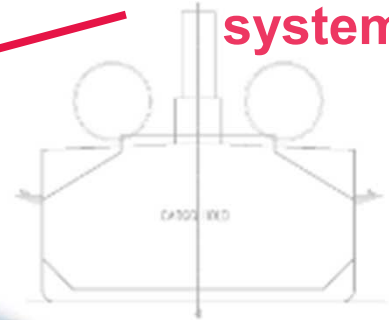
- Achieving 86% CO<sub>2</sub> reduction by maximizing the synergy of LNG and energy saving technologies
- Capable of Zero-Emission by transition to carbon-recycled methane

Hybrid contra-rotating propeller



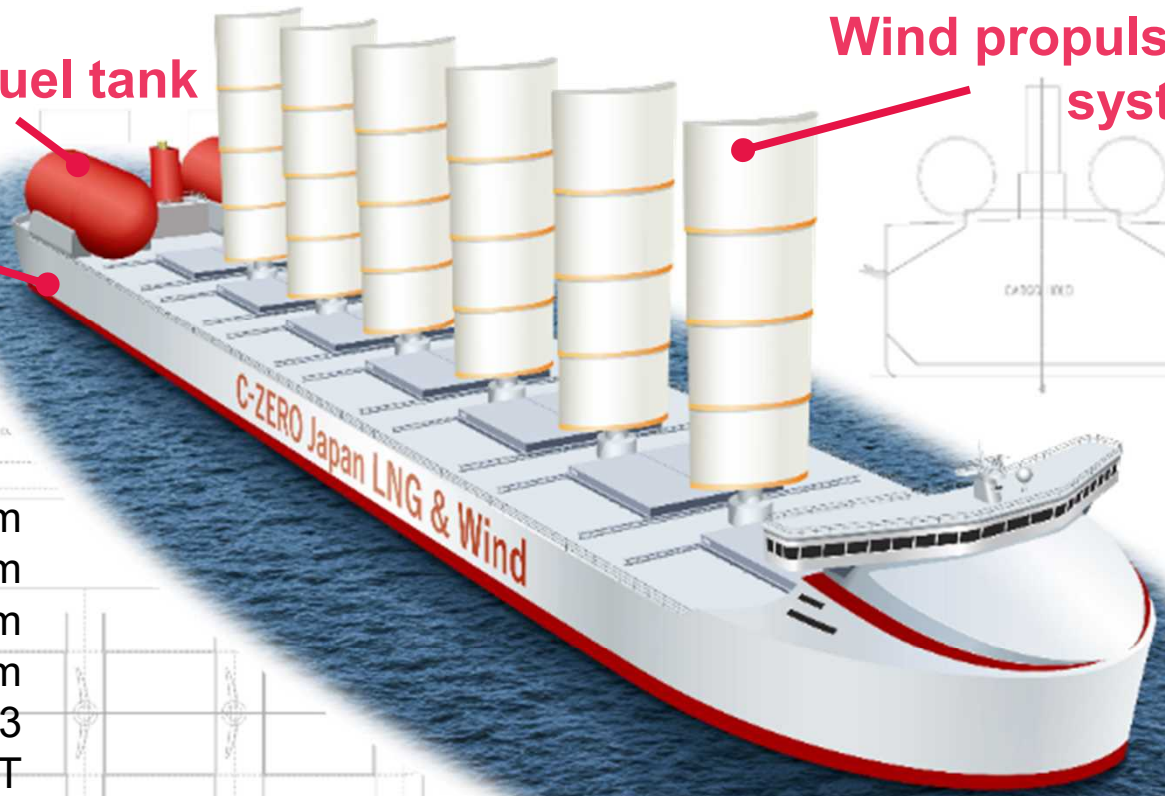
LNG fuel tank

Wind propulsion system



#### Specifications

Total length	229.00 m
Ship length	225.00 m
Total width	42.00 m
Depth	20.60 m
Fuel tank capacity	3,800 m <sup>3</sup> × 3
Deadweight	102,000 DWT
Designed speed	11.5 knots
Propulsion motor	1,750 kW × 2



## 4. Concept Design of Zero-Emission Ships

### Onboard CO<sub>2</sub> Capturing Ship: C-ZERO Japan Capture

- CO<sub>2</sub> capturing from exhausted gas has already been proven in energy sectors, similarly applicable to onboard ships
- Capable of Zero-Emission regardless of the ship's fuel type

