Norway-Japan Maritime Green Innovation Seminar

4th June, 2015

KAWASAKI Environment-friendly New engine technology

Yosuke NONAKA

Diesel Engine Dep't. Machinery Div.

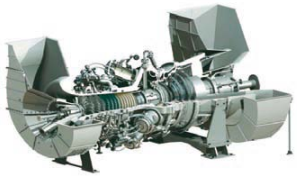
Kawasaki

Powering your potential

Kawasaki Heavy Industries, Ltd.





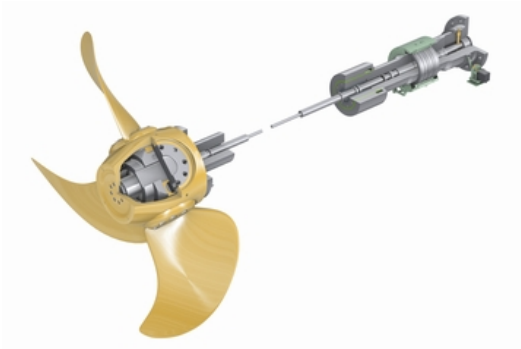




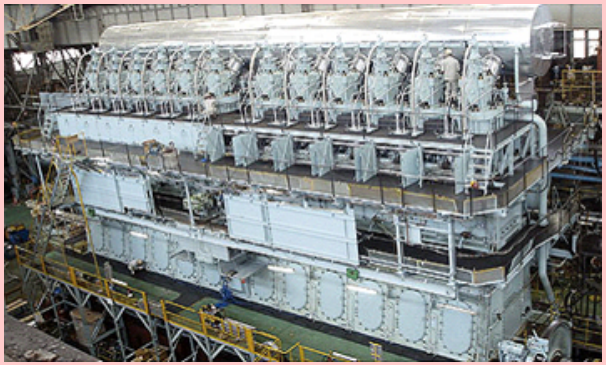





Kawasaki Marine Machinery

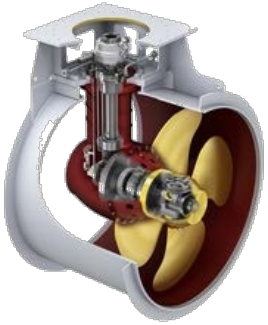


Controllable pitch propeller



KAWASAKI-MAN B&W
2 stroke diesel engine

KAWASAKI
Marine gas engine



Side thruster

Azimuth thruster
(Rexpeller®)

Marine steam turbine
&
Reduction gear

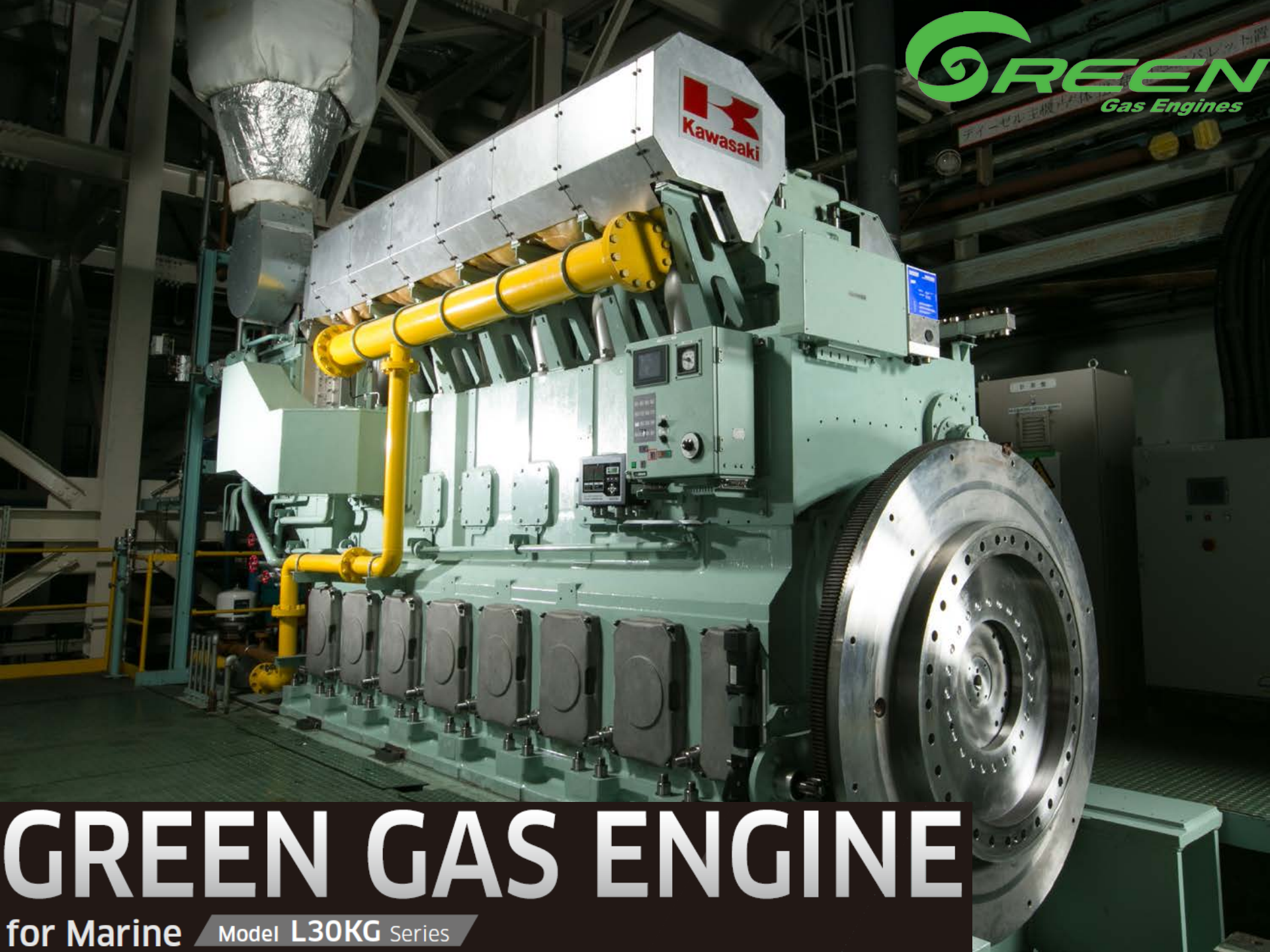
Marine Boiler

Today's Agenda

Environment-friendly new engine technology

- **Green Gas Engine for Marine**
- **K-ECOS (Kawasaki Ecology and Economy System)**
- **K-GET(Kawasaki Green Eco Turbine)**

Summary



GREEN
Gas Engines

GREEN GAS ENGINE

for Marine Model L30KG Series

Green Gas Engine for Marine

Type approved by DNV·GL

L30KG				
No. of Cylinder	6	7	8	9
Bore [mm]	300			
Stroke [mm]	480			
Speed [rpm]	750			
Rated Power [kW](*)	2670	3115	3560	4005

L30KG

Pure Gas Engine

covers 2.6 ~ 4.0 MW

* Based on ISO3046. Without attached pumps

Base Engine KG-18V for stationary

Electrical Output	**7800/7500 kW (50/60Hz)(*)**
Generating Efficiency	**49.5 % (*,**)**
NOx Emission	**<200 ppm (O2=0%) Appr. 0.8 g/kWh**

Total Sales Number of Unit: 75 Units

Total Capacity: 568MW

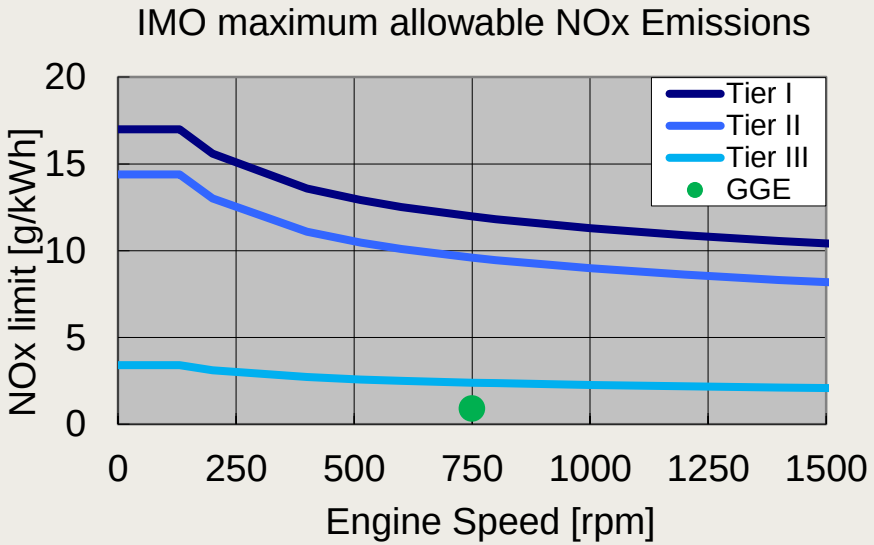
As of March 2015

* Based on ISO 3046-1
Without attached pumps

** With KAWASAKI specified Lub. oil
Tolerance for warranty +5%

Efficiency & Cleanness

Specific Fuel Gas Consumption	**7200 kJ/kWh(*,**)**
NOx Emission	**< 1.0 g/kWh** **Well below IMO Tier3 limit**
SOx Emission	**≒ 0** **LNG has almost no Sulphur.**



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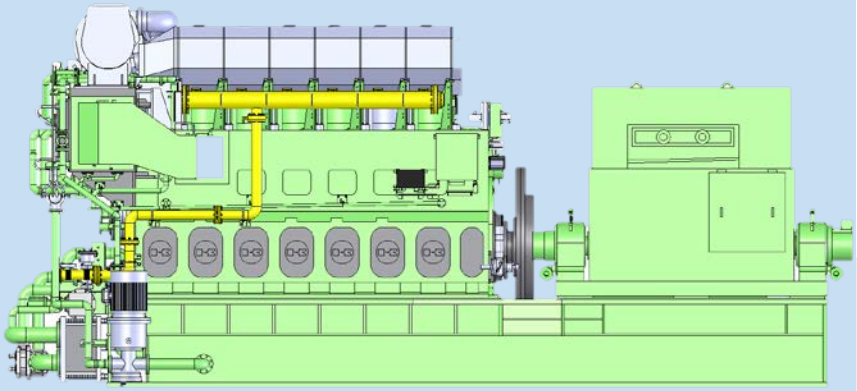
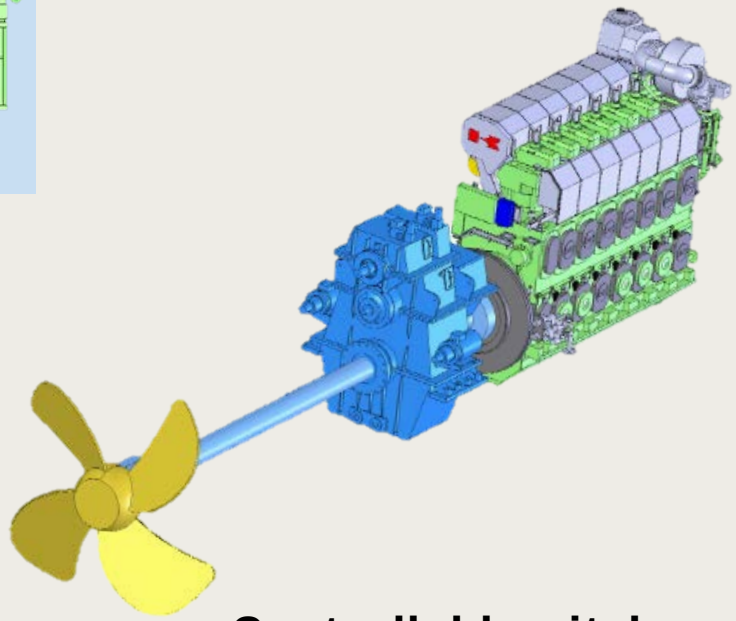
Application



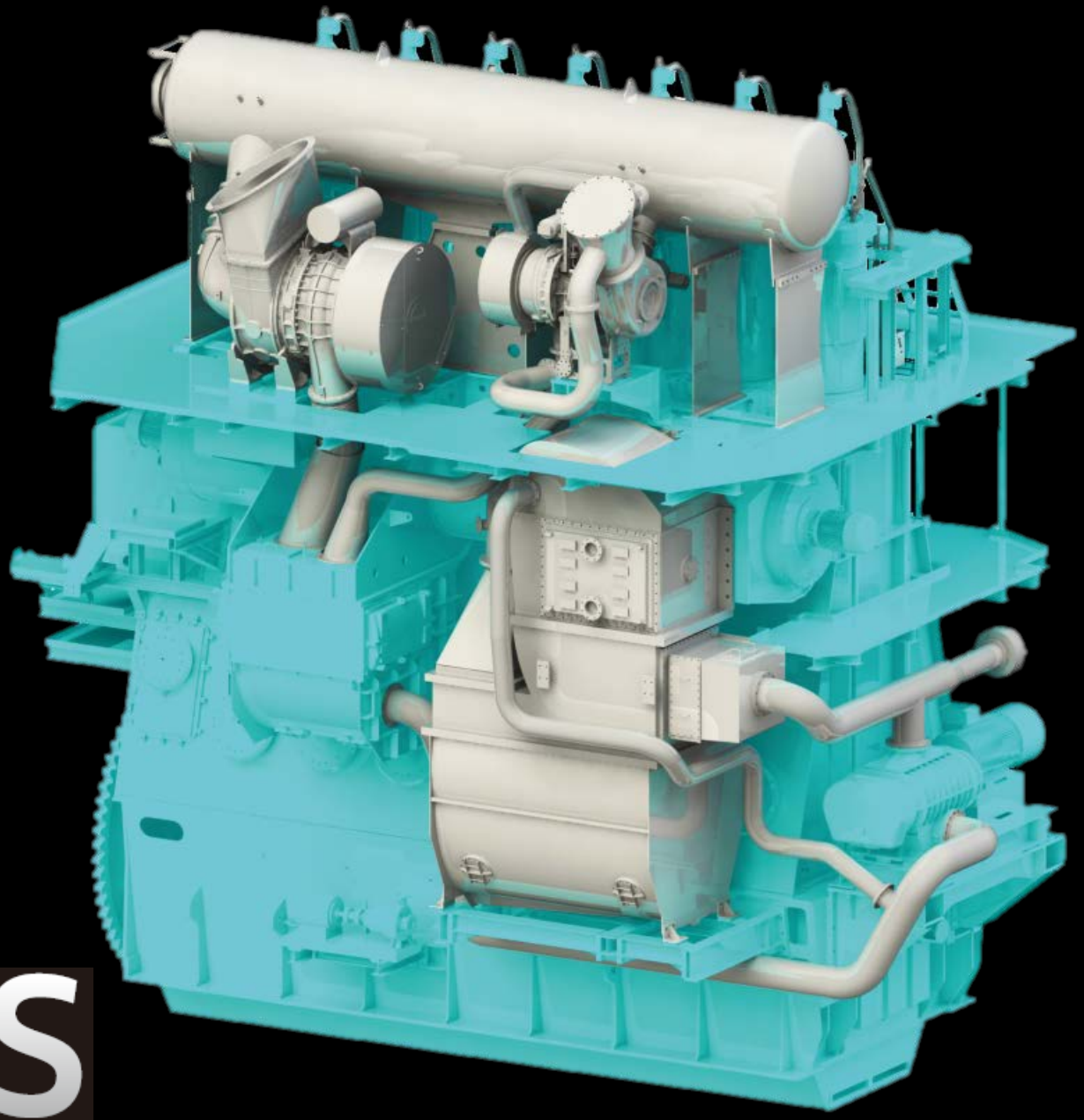
Genset Package

Gas Valve Unit



Controllable pitch propeller

***KAWASAKI* can engineer your propulsion system and electric generation using its own products.**



K-ECOS

Kawasaki Ecology and Economy System

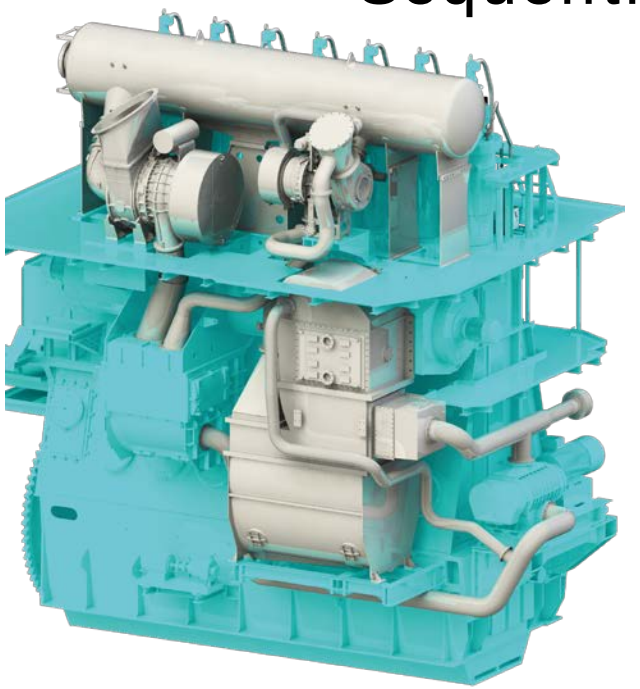
What is K-ECOS

K-ECOS
Kawasaki Ecology and Economy System

K-ECOS is a system:

to comply with IMO NOx Tier3 regulation,
equipped with

Water Emulsified Fuel supply system,
Packaged EGR system,
Sequential Turbocharger system.



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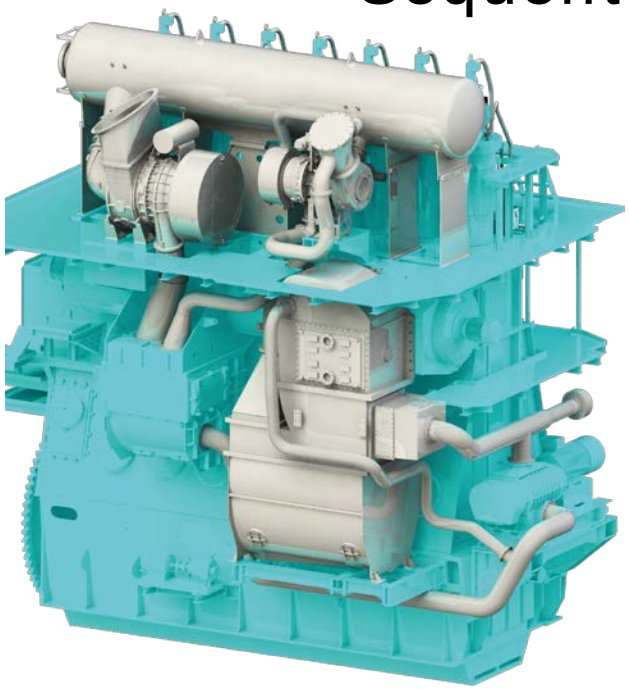

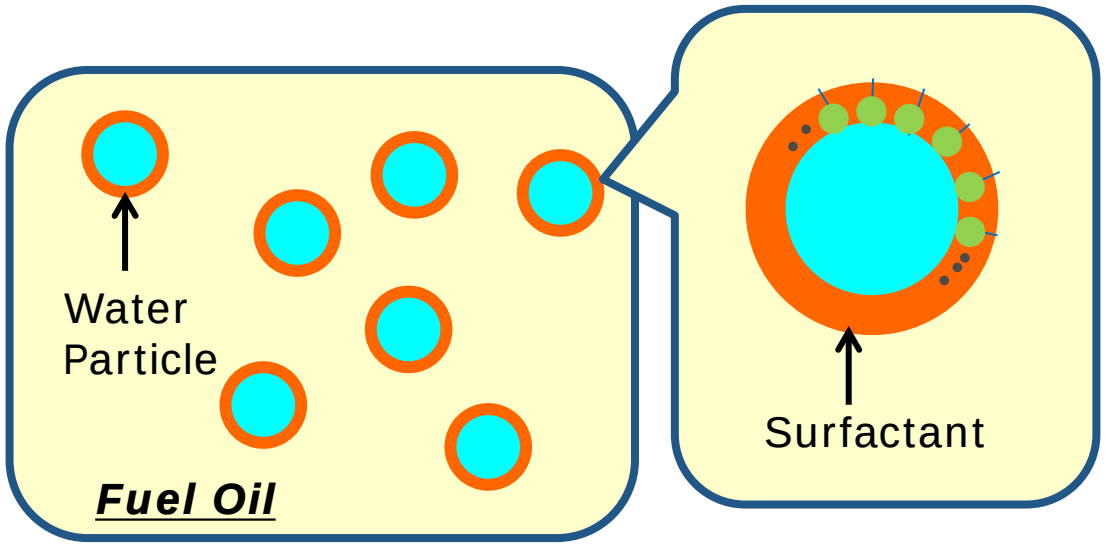

Water in Oil (W/O) Emulsion

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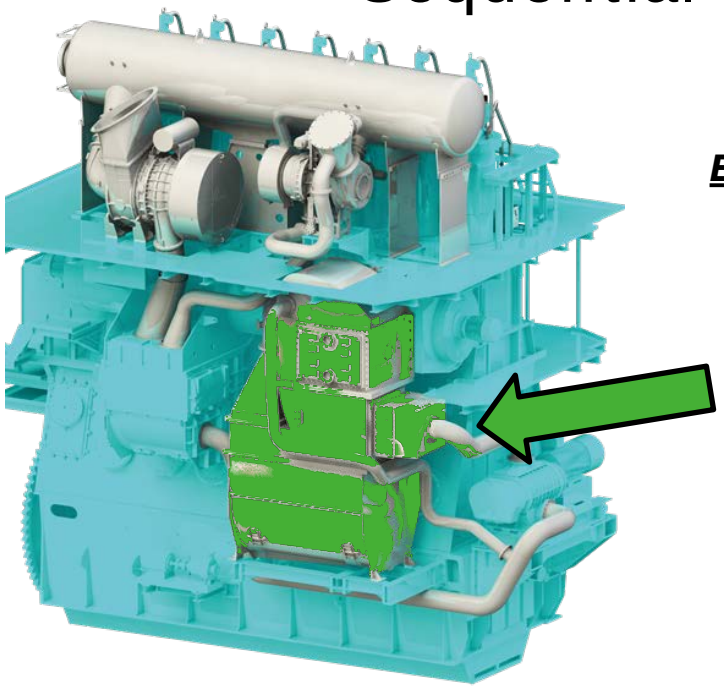

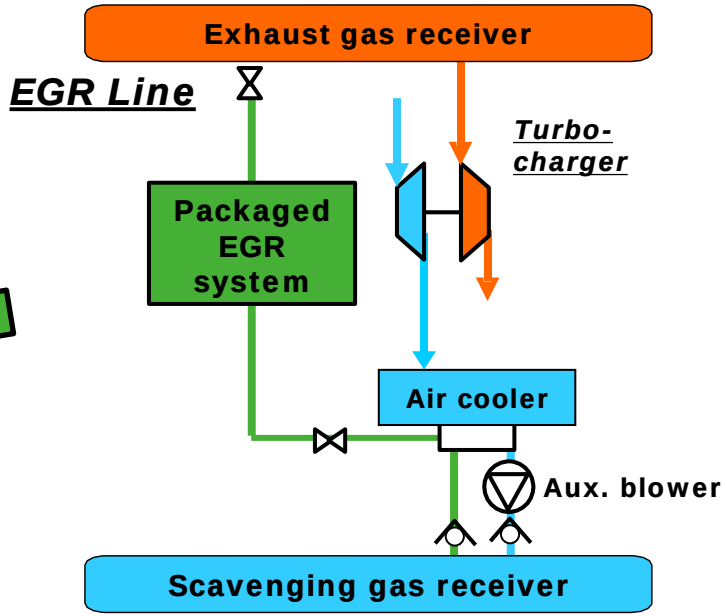

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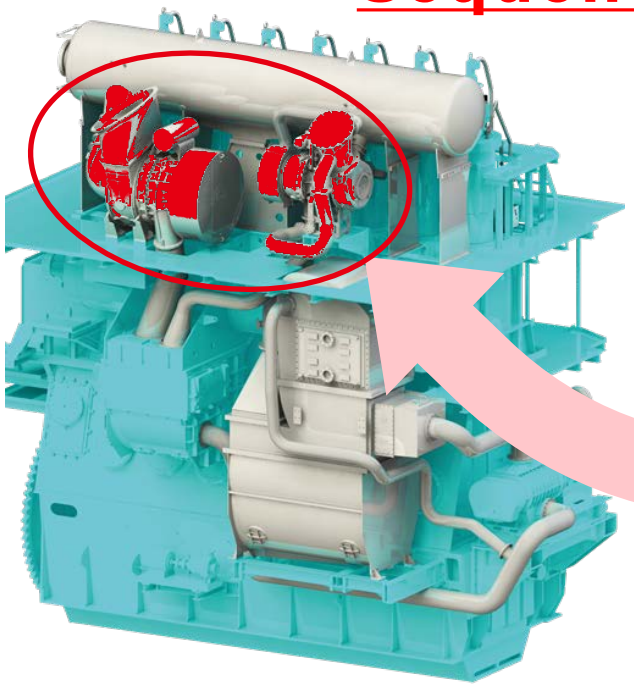
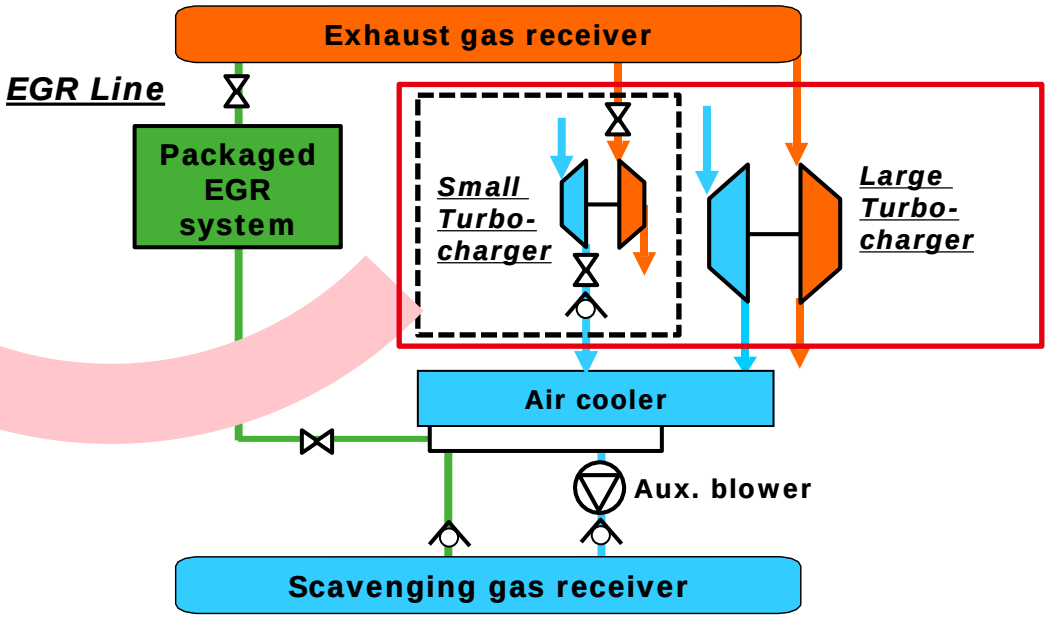
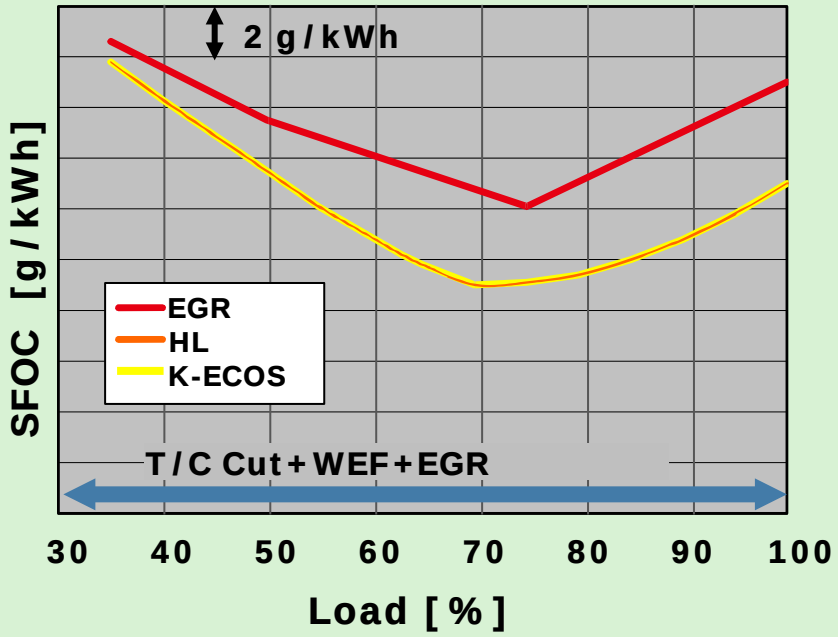


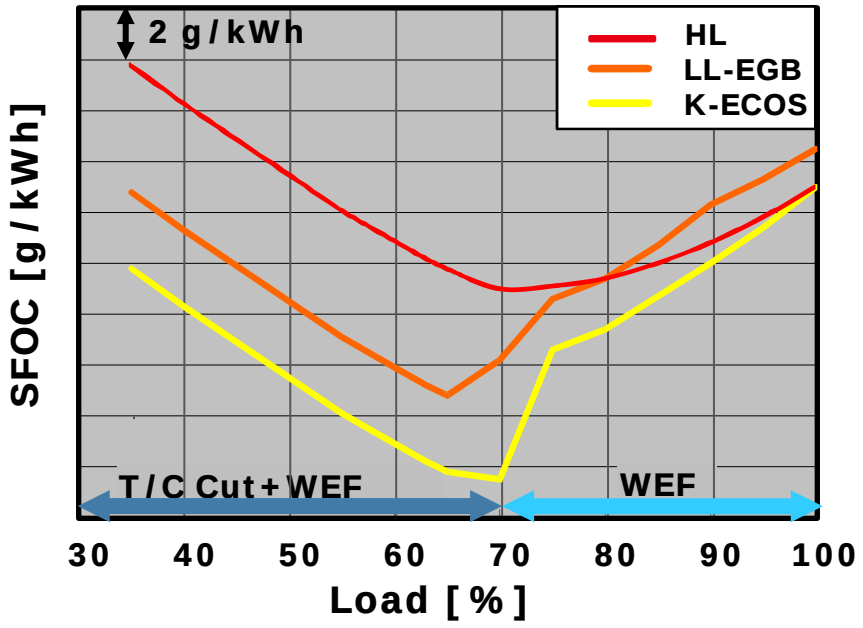


Feature of K-ECOS

K-ECOS
Kawasaki Ecology and Economy System

In ECA	Outside of ECA
Thanks to all the equipment, compliance with IMO NOx Tier 3 and same SFOC as conventional engine are achieved.	Thanks to WEF and Sequential TC, SFOC is reduced by 4% as conventional engine.



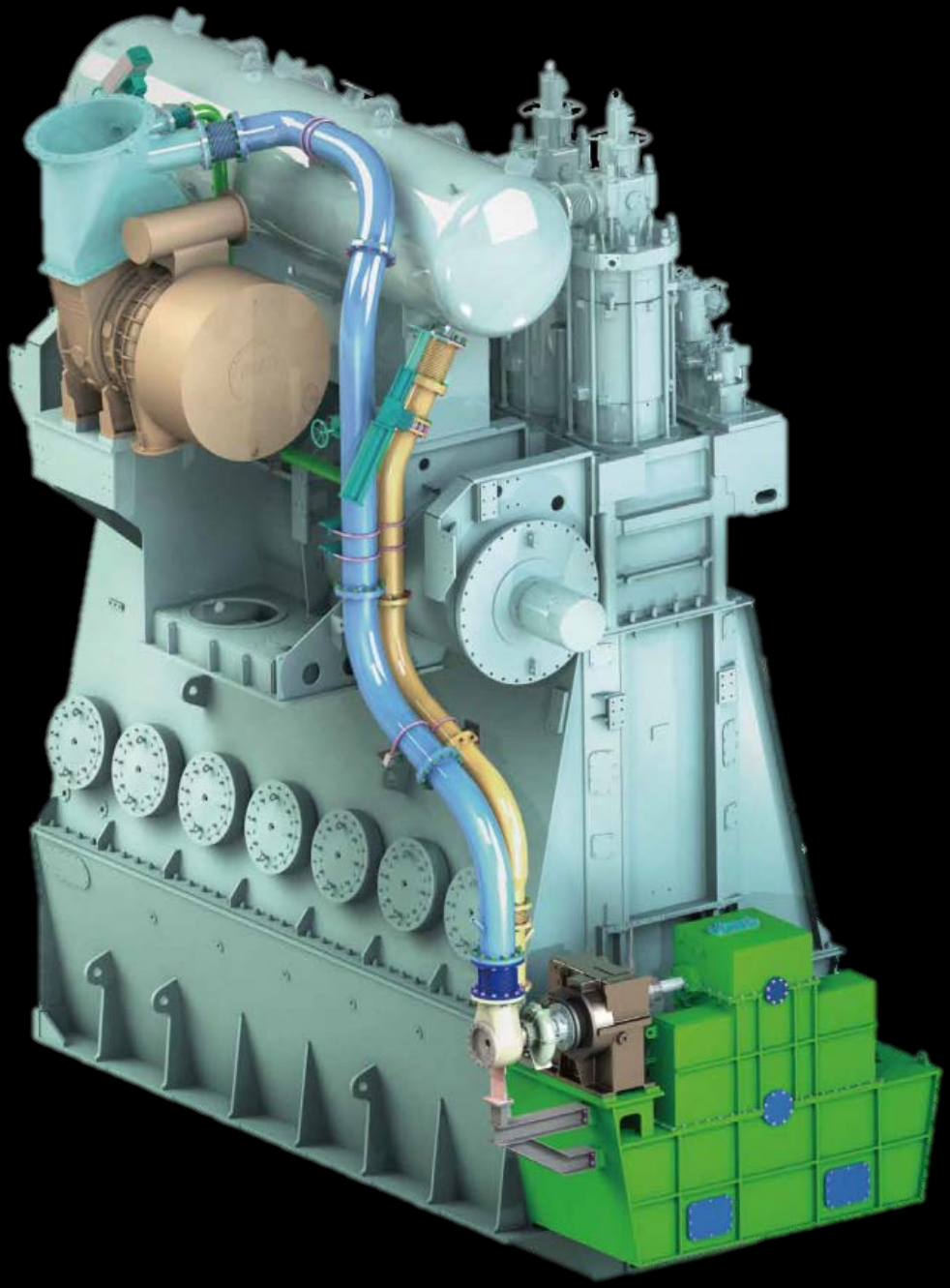


Service test with K-ECOS

K-ECOS
Kawasaki Ecology and Economy System

Ship owner	K-Line
Shipyard	Japan Marine United
Ship type	Pure car carrier (7500 cars)
Ship delivery	February 2016
Main engine	KAWASAKI-MAN B&W 7S60ME-C8.2
Engine delivery	June 2015

All K-ECOS functions were confirmed on Shop test in May 2015

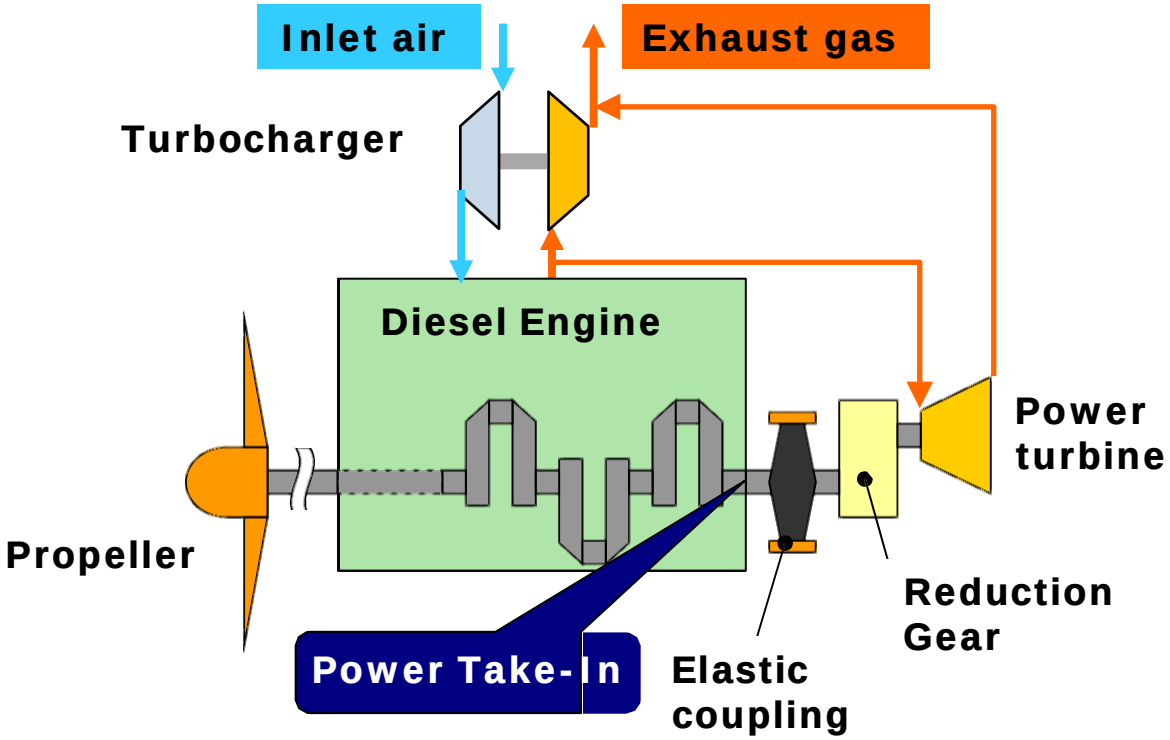


K-GET

Kawasaki-Green Eco Turbine

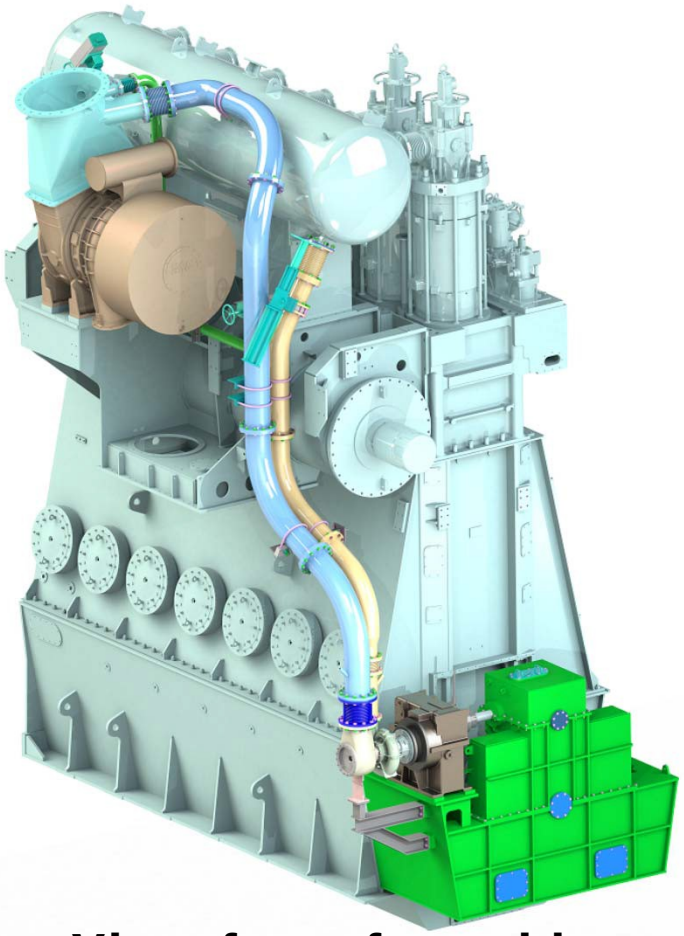
What is K-GET

K-GET is a waste heat recovery system:
converting waste heat into power by Power turbine and utilizing it as propulsion power.

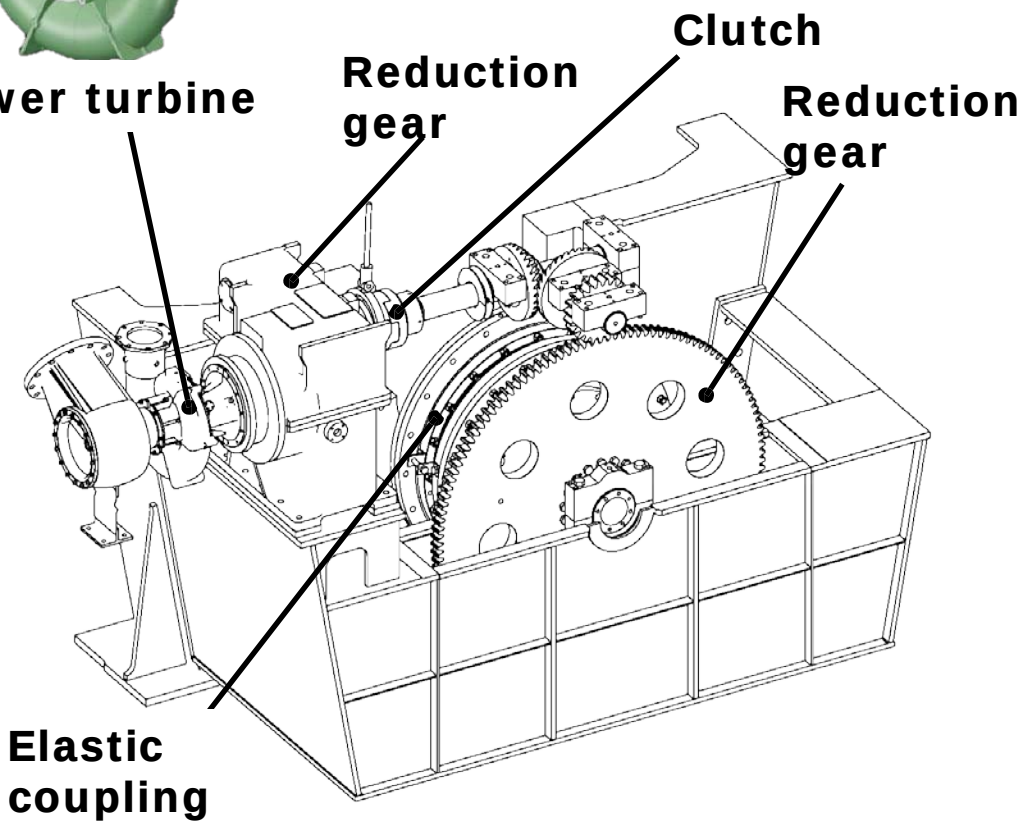


Structure of K-GET

K-GET
Kawasaki-Green Eco Turbine

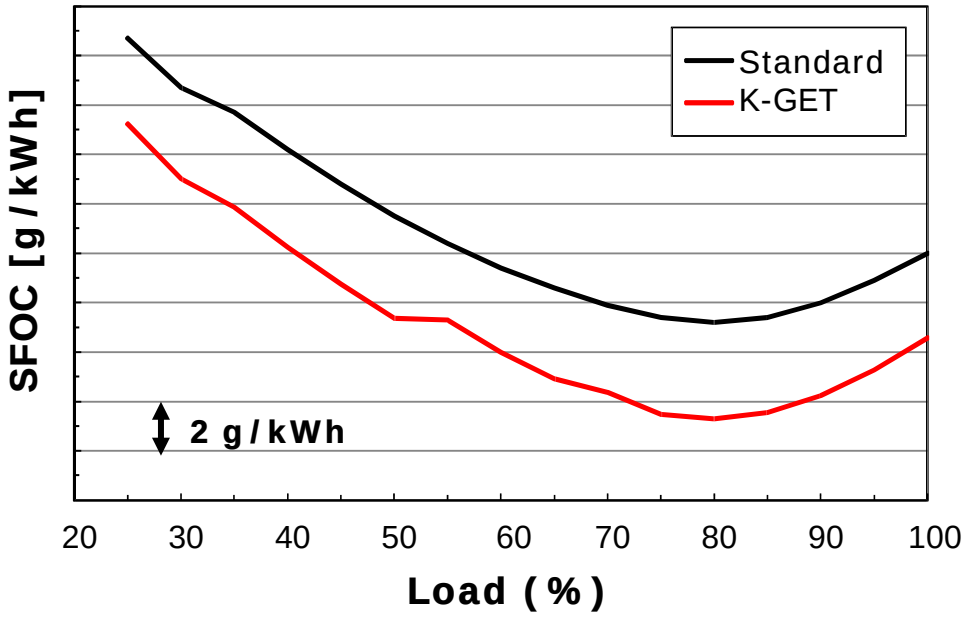


View from fore side



K-GET Power Transmission

Shop trial with K-GET



6S50ME-B8.2 7,730kW x 108min-1
ISO Condition, LCV=42,700 kJ/kg

Planned power turbine output (= improvement of main engine SFOC) has already been checked.
(SFOC of -2～-3%)

Service test with K-GET

K-GET
Kawasaki-Green Eco Turbine

Ship owner	Taiwanese ship owner
Shipyard	Kawasaki Heavy Industries
Ship type	Bulk carrier
Main Engine	6S50ME-B8.2
Engine delivery	May 2014
Ship delivery (Test start)	January 2015

Summary

- **Kawasaki Green Gas Engine realizes lowest fuel consumption and cleanness for marine application.**
- **With K-ECOS, Compliance with IMO NOx tier3 and fuel consumption as present at the same time.**
- **With K-GET, waste heat can be utilized for various kinds of vessel.**
- **Kawasaki will continue developing new technologies to answer calls for more environment-friendly marine vessels.**

Kawasaki, working as one for the good of the planet

“Global Kawasaki”

Any questions, please contact

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Kawasaki
Powering your potential