LNG FUEL

What's current & What's Next

Tony Teo, Business Development Director
January 2012

MANAGING RISK

Agenda

Background

Existing Short Sea Shipping

Future Ships

Background - Environment

Geiranger Fjord

Are ships built today prepared for stricter air pollution regulations?

1st Gas fuelled Ferry, January 2000 Prototype

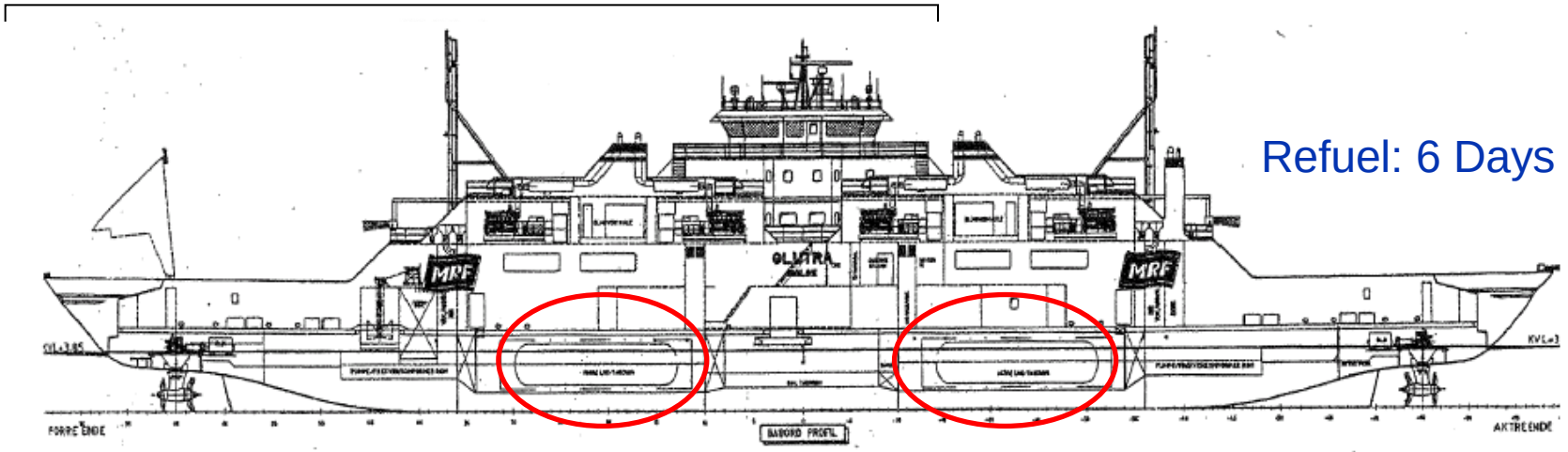
- Capacity: 300 pax and 96 cars
- Engines:4 Mitsubishi Engs. @ 2 bars
- Speed: 12 knots

RULES FOR CLASSIFICATION OF
SHIPS
NEWBUILDINGS
SPECIAL EQUIPMENT AND SYSTEMS ADDITIONAL CLASS
PART 4 CHAPTER 13
GAS FUELLED ENGINE INSTALLATIONS
JANUARY 2007
CONTENTS PAGE
DET NORSKE VERITAS

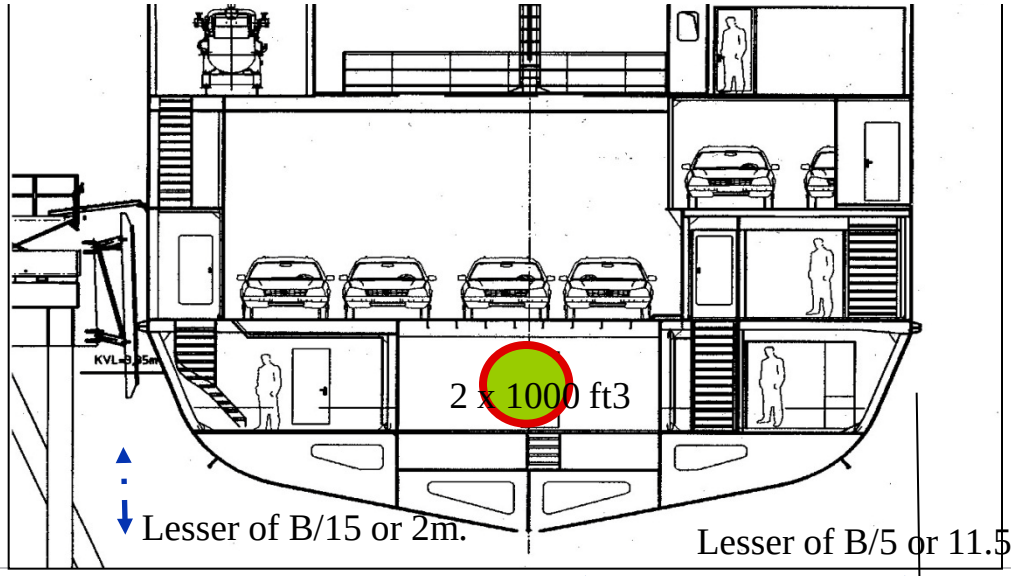
International Gas Fuel Code:

- 2000 DNV Rules
- 2006 Initiated in IMO
- 2009 IMO Interim Guidelines (w/similar DNV Tech contents)
- 2010 Other Class issue Rules
- 2014 IGF Guidelines

“GLUTRA”



Refuel: 6 Days



12 more Ferries ordered from 2007

- Capacity: 587 pax / 212 cars
- Speed: 21 knots with 2x16 cyl, 3530kW + 2x12cyl, 2650kW
- Engine: Rolls Royce, Bergen

Passenger Ferries, 2009

Capacity: 600 passengers

Engines: 2 x 6 cyl., 380 kw Mitsubishi

Max Speed: 12 knots

Tank Size: 1000 cu ft

Refueling: 7 days

Refueling time: 1 hour

“Tide King”
“Tide Queen”
“Tide Princess”

Tank Room Arrangement

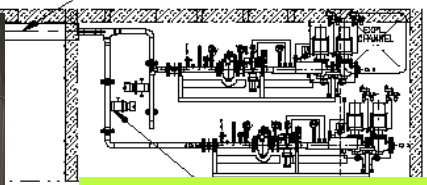
VACUUM INSULATED TANK

- VENTILATED,
- GAS DETECTION,
- BILGE WELL ALARM

COLD BOX, Gas: +15 C

DUCT PIPE - GAS LINE,

- VENTILATED,
- GAS DETECTORS



Block / Bleed valve

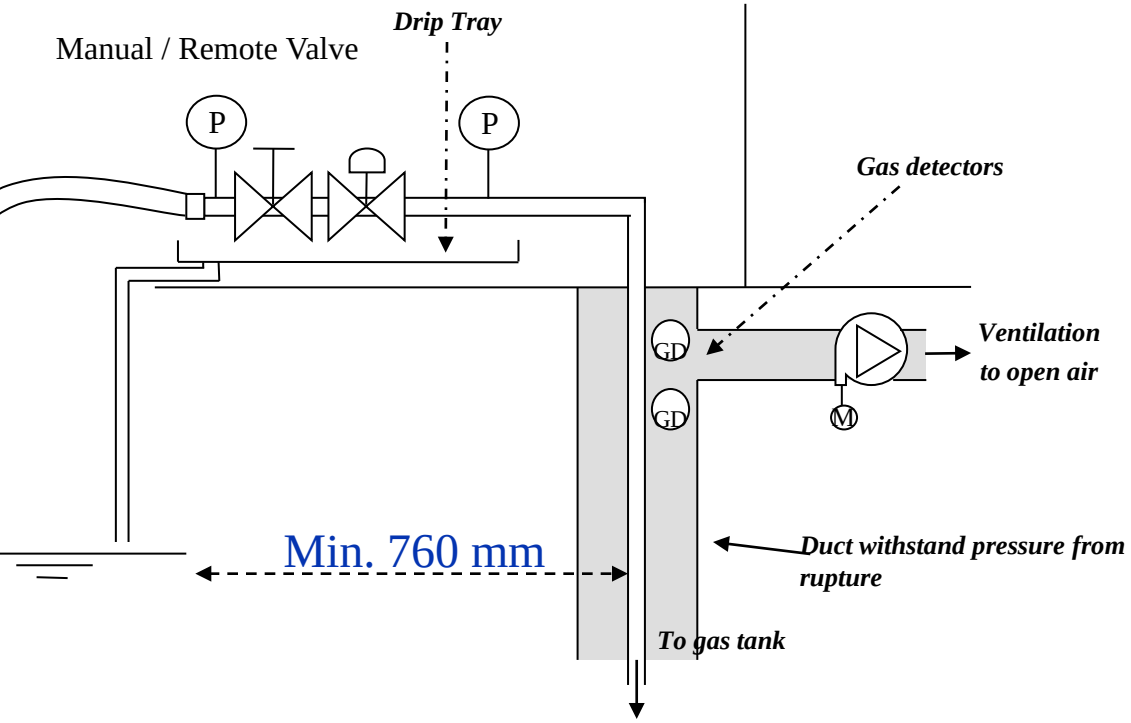
VALVE ARRANG. IN COLD BOX

TANK SADDLE

WATER VAPORIZER IN/OUT

MAINTAINS TANK PRESSURE

Bunkering Arrangement & Piping



- Operational procedures
- Emergency procedures

Requirements:

- Means for draining fuel at completion
- Lines arranged for inerting and gas freeing
- Gas line color coded
- Electrically bonded to hull

OSVs with Wartsila DF Engines, 2003

- Reduction in NOx emission = 20,000 cars

"LADY VIKING"

"VIKING ENERGY"

"STRIL PIONEER"

High Speed Light Crafts

- **Builder:** Myklebust yard, Norway
- 3 Norwegian CG patrol crafts
- **Power Generation**: DF (Gas + Diesel)
- **Max Speed**: 20 knots, Range: 7 days

Owner: Buquebus, Montevideo

1000 pax ferry, Argentina/Uruguay

GE LM 2500 Gas Turbine

50 knots

4 RoRo ship on Order, 2008 & Coaster 2011

Fish Farm Product Vessel

Engine: RR Bergen.

Dwt: 2000 tonnes

Tank: 90m3

Type: RoRo/Containers

Main Engine: RR Bergen 35:40, V12, 5250 kw, 15 knots

Capacity: 94 TEU, Tanks: 430 m3

Ferry Terminal and LNG Storage & Refueling Area (Bergen)

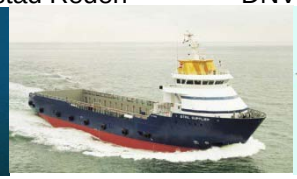
DNV Track Record

(24 in operation, 20 on order, 1 conversion)



Ships in operation

Year	Type of vessel	Owner	Class
2000	Car/passenger ferry	Fjord1	DNV
2003	PSV	Simon Møkster	DNV
2003	PSV	Eidesvik	DNV
2006	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2008	PSV	Eidesvik Shipping	DNV
2009	PSV	Eidesvik Shipping	DNV
2009	Car/passenger ferry	Tide Sjø	DNV
2009	Car/passenger ferry	Tide Sjø	DNV
2009	Car/passenger ferry	Tide Sjø	DNV
2009	Patrol vessel	REM	DNV
2009	Car/passenger ferry	Fjord1	DNV
2010	Patrol vessel	REM	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Patrol vessel	REM	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Car/passenger ferry	Fosen Namsos Sjø	DNV
2011	PSV	DOF	DNV
2011	Car/passenger ferry	Fjord1	DNV
2011	PSV	Solstad Rederi	DNV

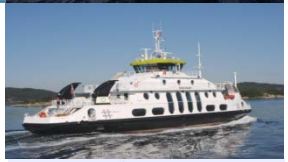




Confirmed orderbook

Year	Type of vessel	Owner	Class
2012	General Cargo	Nordnorsk Shipping	DNV
2012	PSV	Olympic Shipping	DNV
2012	PSV	Eidesvik	DNV
2012	PSV	Eidesvik	DNV
2012	Ro-Ro	Sea-Cargo	DNV
2012	Ro-Ro	Sea-Cargo	DNV
2012	High speed RoPax	Buquebus	DNV
2012	PSV	Island Offshore	DNV
2012	PSV	Island Offshore	DNV
2012	PSV	REM	DNV
2013	General Cargo	Eidsvaag	DNV
2013	Ro-Ro	Norlines	DNV
2013	Ro-Ro	Norlines	DNV
2013	Car/passenger ferry	Torghatten Nord	DNV
2013	Car/passenger ferry	Torghatten Nord	DNV
2013	Car/passenger ferry	Torghatten Nord	DNV
2013	Car/passenger ferry	Torghatten Nord	DNV
2013	Patrol vessel	Finish Border Patrol	DNV
2013	Tug	Bukser og Berging	DNV
2013	**Tug**		

Planned conversion

Year	Type of vessel	Owner	
2011	Car/passenger ferry	Fjord1	DNV

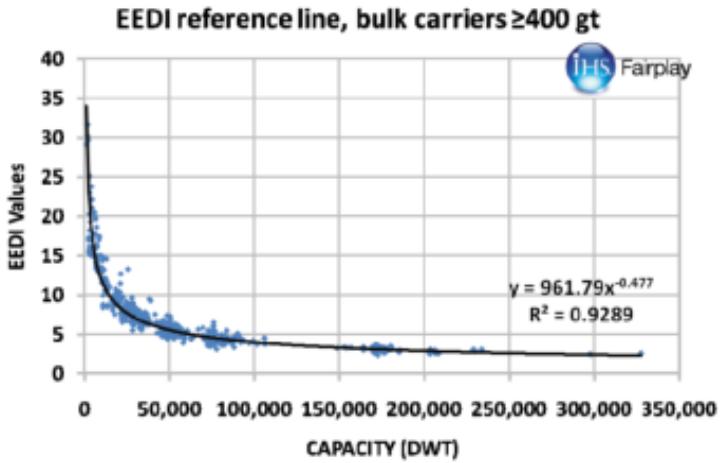







New requirements to Energy Efficiency from 2013

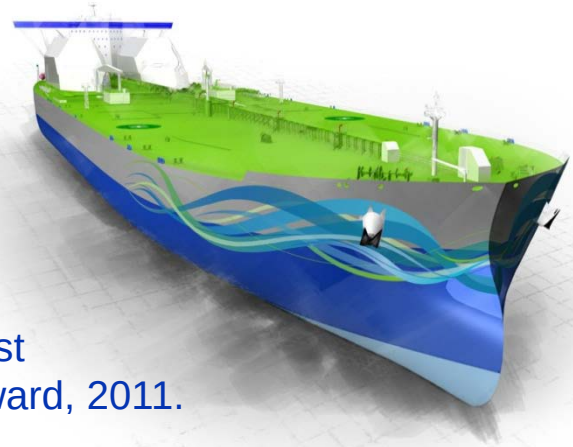
- Apply to **new ships above 400 GT**:
  - **Building contract** on or after **1 January 2011** or
  - **Keel laid** on or after **1 July 2013** or
  - **Delivery** on or after **1 July 2015**



- The index is defined as:
  grams CO_2 / capacity * nautical mile

$$\text{Attained design } CO_2 \text{ index} = \frac{\text{Environmental cost}}{\text{Benefit for society}}$$

DNV extraordinary innovation projects



Lloyd's List
Global Award, 2011.

TRIALITY, VLCC Concept

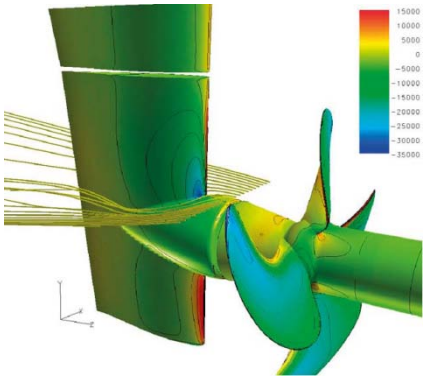
Objectives

Concept: Reduced fuel consumption and efficient operations.

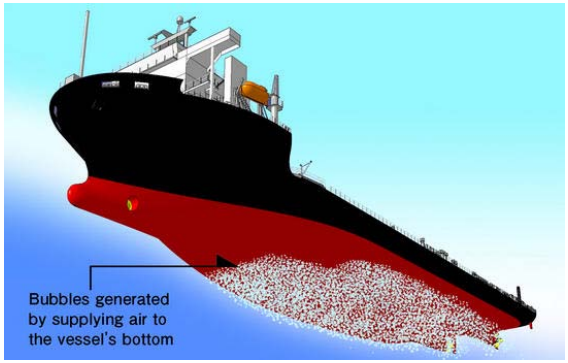
Hull Features

- 14.5 knots => Wide hull form w/twin skeg
- 20 % less Ballast
- Flipper fins

Oshima's Seaworthy Bow



Integrated Rudder & Propeller



Air lubrication

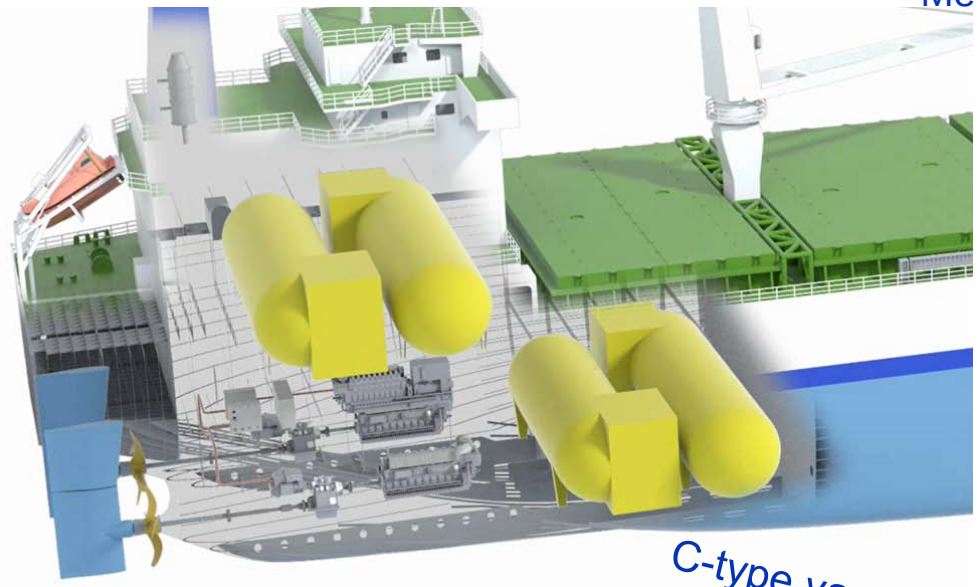
LNG fuelled

SO_x and PM reduction => 100%
CO_2 reductions => 50%

Clean working environment

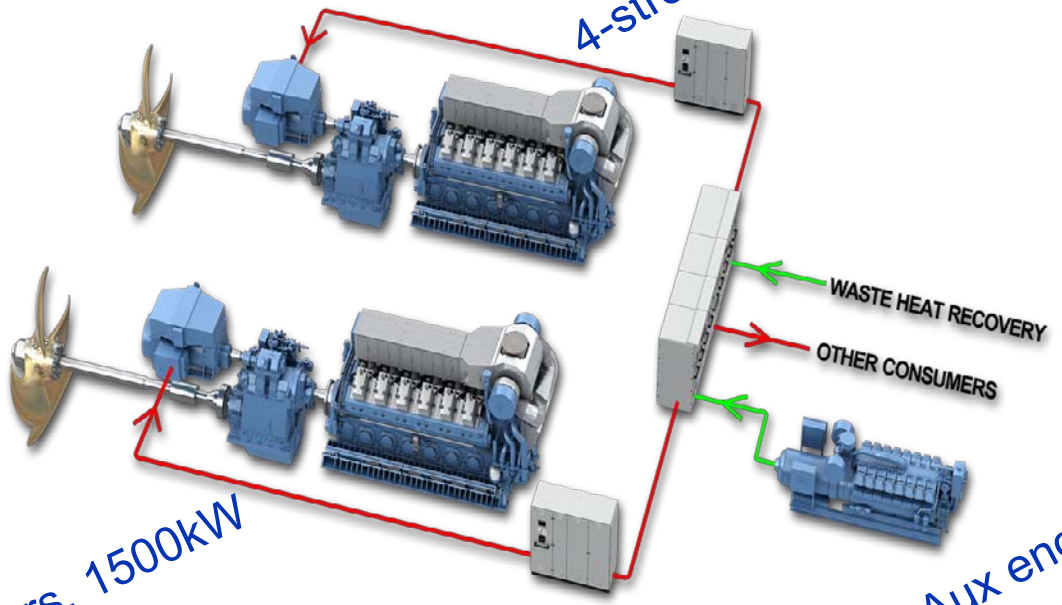
No oil pollution risk

Tank Location:
Gas tanks have large energy content
Protection from:
- Ship side / bottom
- External fire
- Mechanical impact



C-type vacuum insulated tanks,
total capacity 2,700 m^3 => 17,000 Nm

Machinery Arrangement

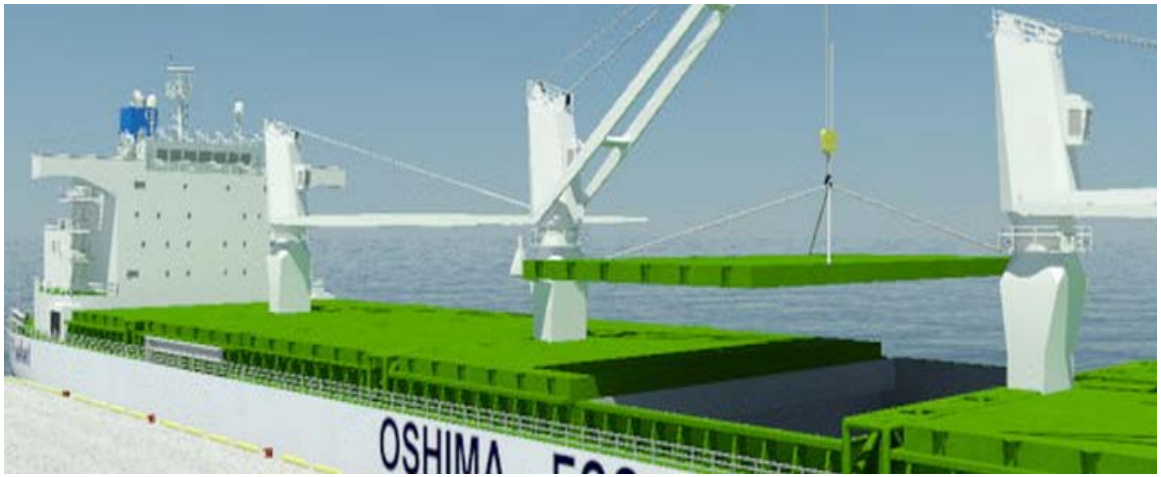


Operational flexibility

All electric deck machinery

Large capacity electric jib cranes, 4 x 75t

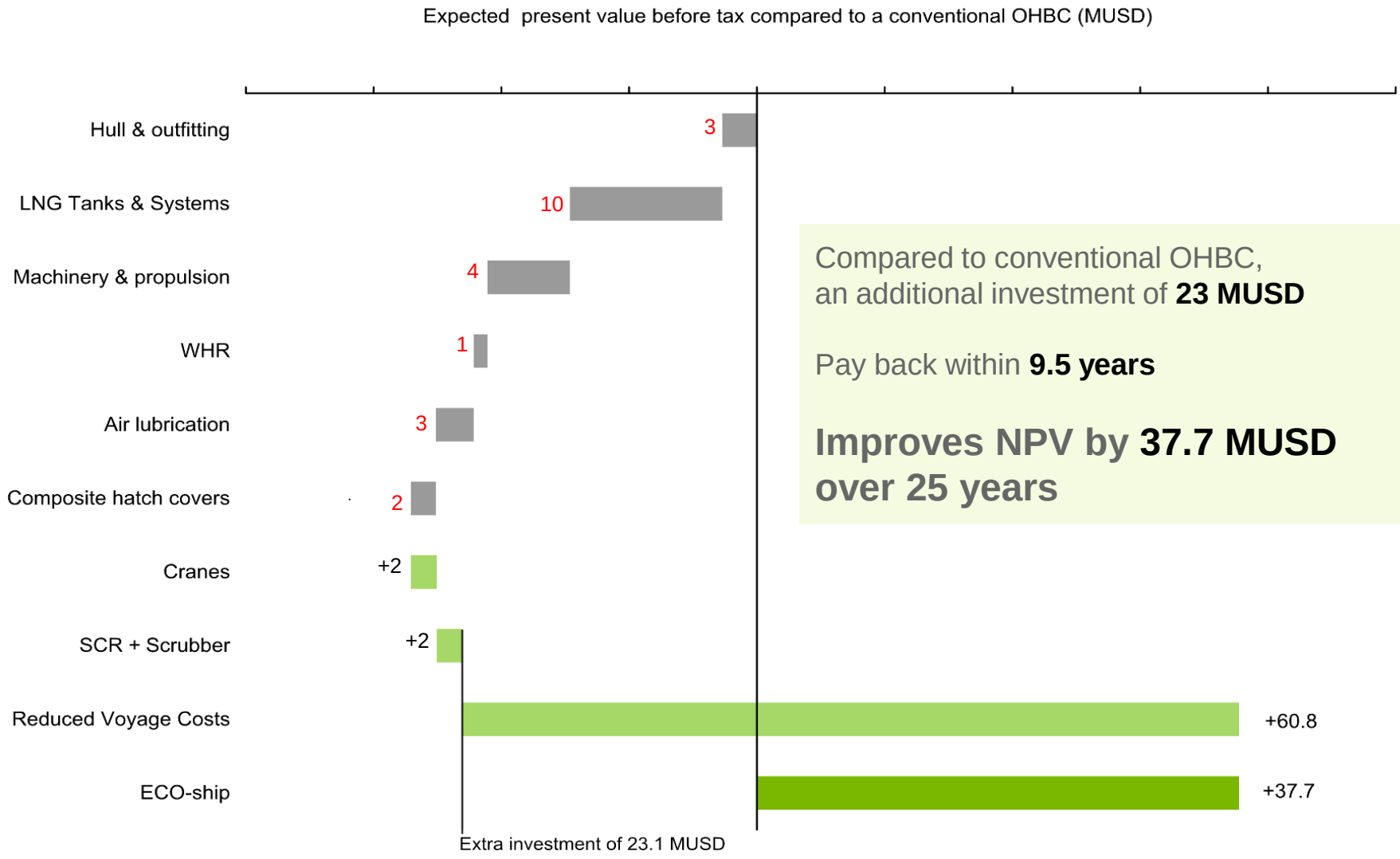
- High cargo handling efficiency
- Reduced energy consumption (15 -20%)
- Less noise
- No pollution



Composite Hatch covers

- 50% weight reduction
- Easy handling by deck crane
- Less maintenance

Financial Analysis



Compared to conventional OHBC,
an additional investment of **23 MUSD**

Pay back within **9.5 years**

Improves NPV by 37.7 MUSD over 25 years

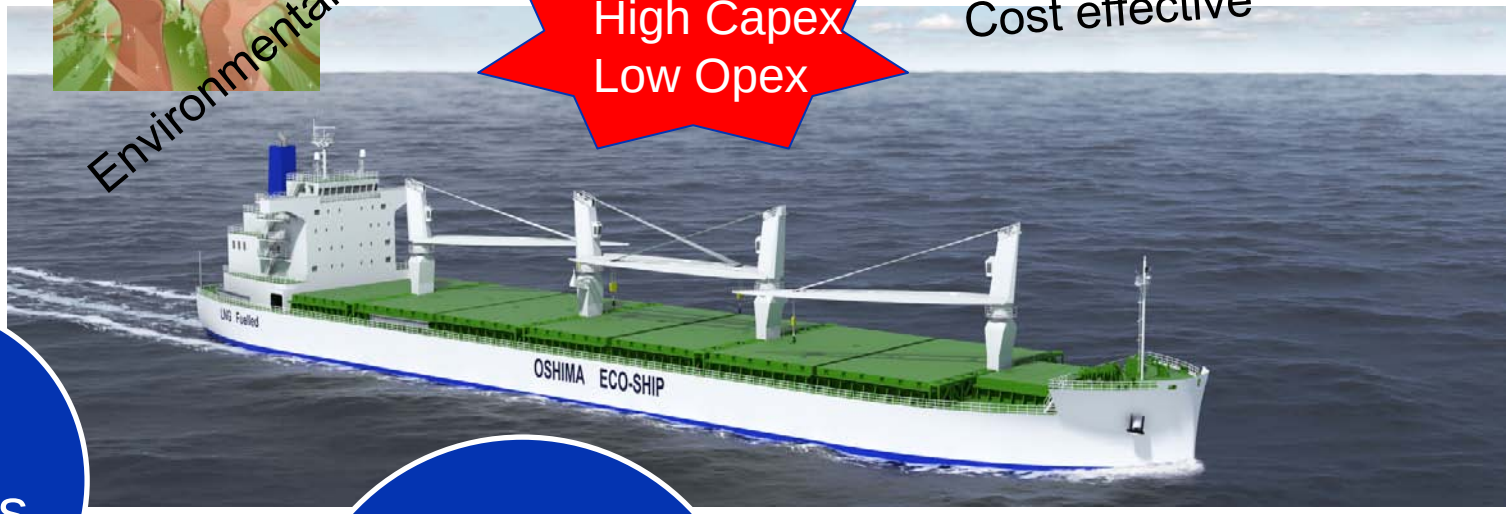
Summary

High re-Sale value

Cost effective

Environmental efficiency

High Capex
Low Opex



$38M
Savings

100% SOx
100% PM
90% NOx
50% CO2

Energy efficient

Flexible operation

Safeguarding life, property and the environment

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