

# Nye energibærere

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MARINTEK

Energiøkonomisering i fiskeflåten, Ålesund 26-27. nov 2008

# Tema for presentasjon

- Skipsfartens energiforbruk og miljøutfordringer
- Alternative drivstoff, LNG – bakgrunn, status, egenskaper
- Infrastruktur og teknologi
- Norsk nærskipsfart, eksempelskip

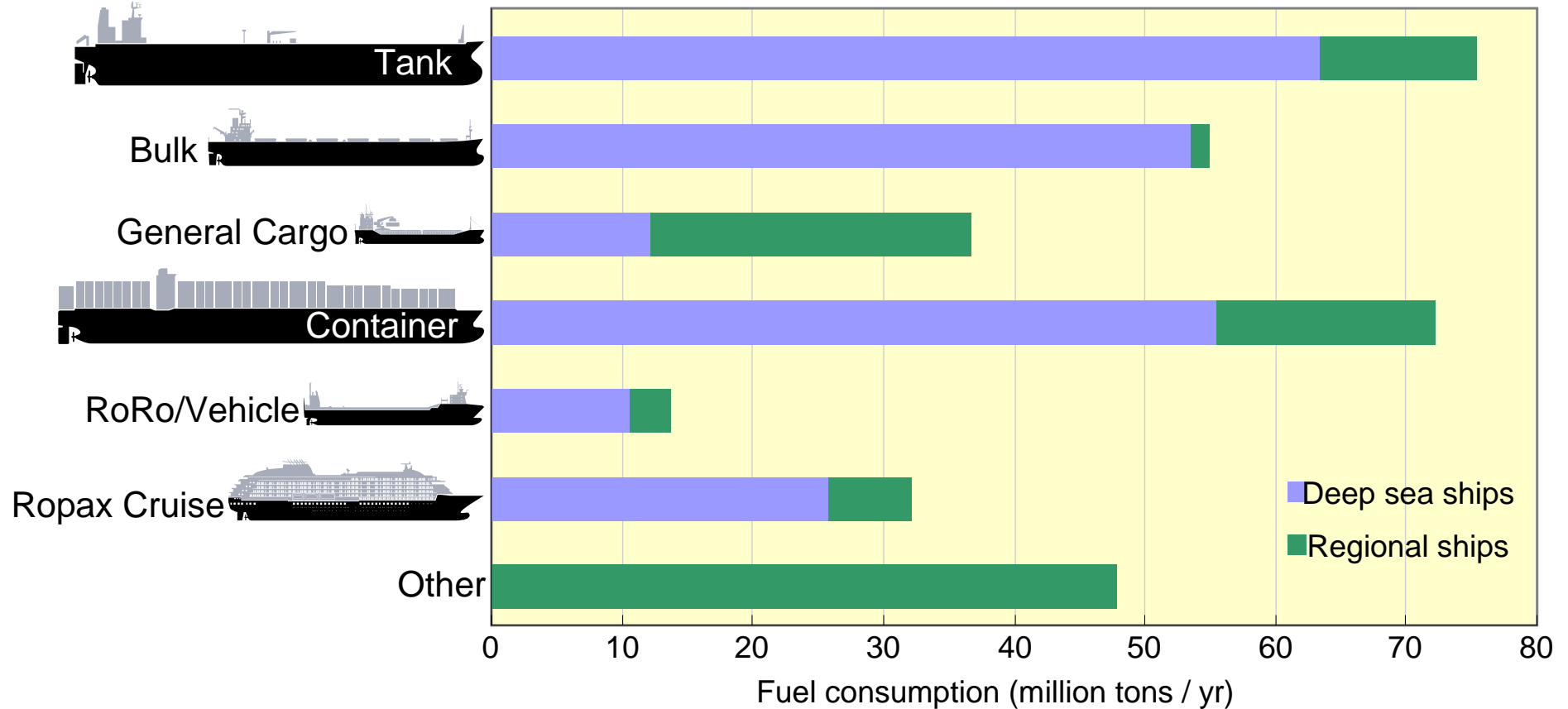
# Maritim transport - drivstoff

Maritime transport er i dag helt avhengig av fossil energi.  
De fossile energikildene er en endelig ressurs.  
Er det alternativene til fossil energi?



Hvordan ser forbruket ut i dag?

# Status 2007 Fuel consumption by ship category



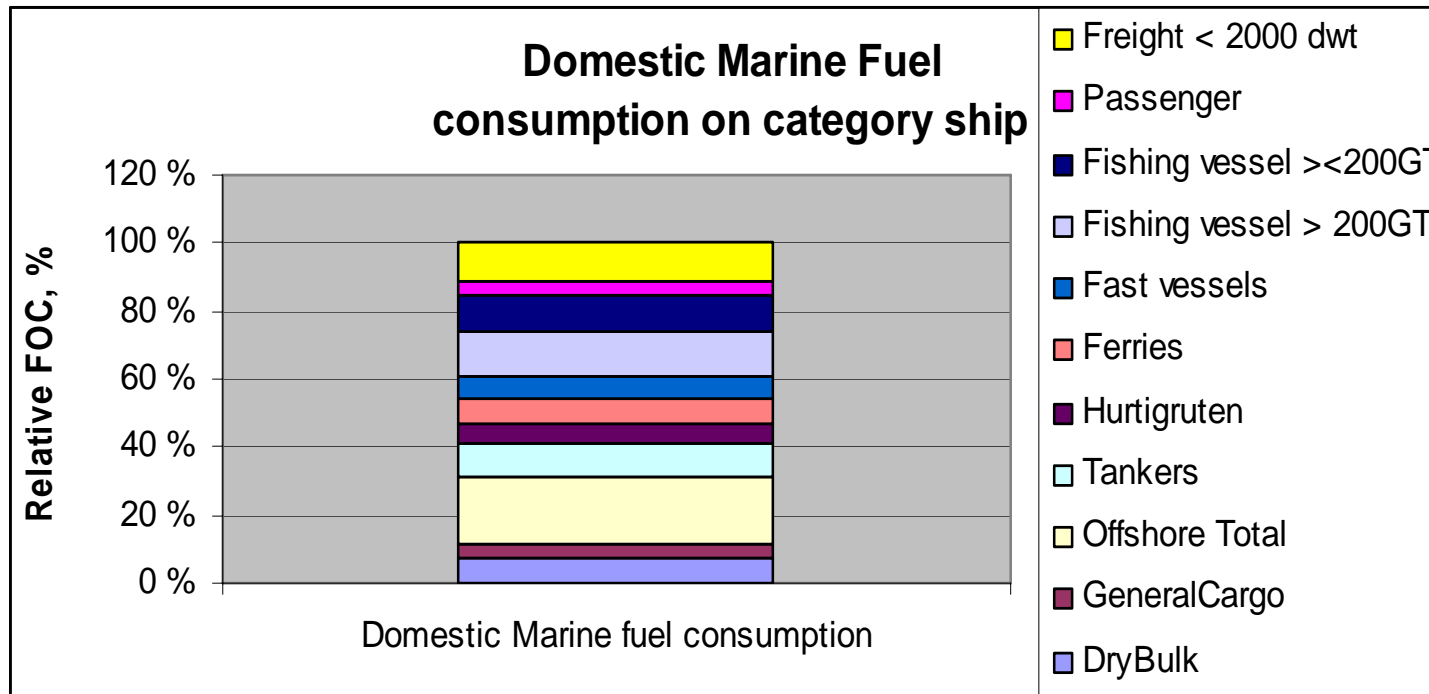
The total fuel consumption: 333 mill ton/year (3.3% of the world fossil fuel oil consumption)

Deep sea: 220 mill ton/year

Regional: 113 mill ton/year

# Norwegian Domestic Marine Fuel Consumption

Year:	2007	Mill litre	Mill tonn
Total domestic consumption of marine fuels		1462,4	1,26



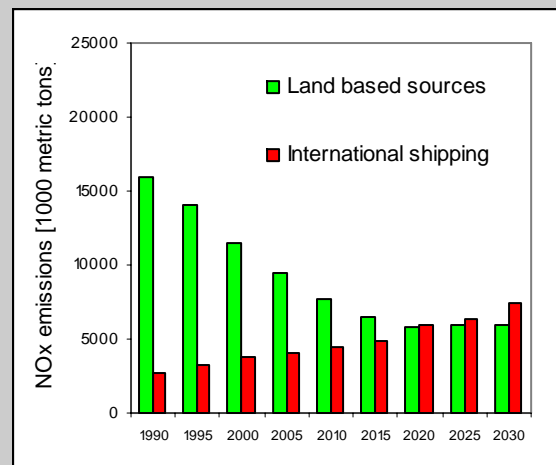
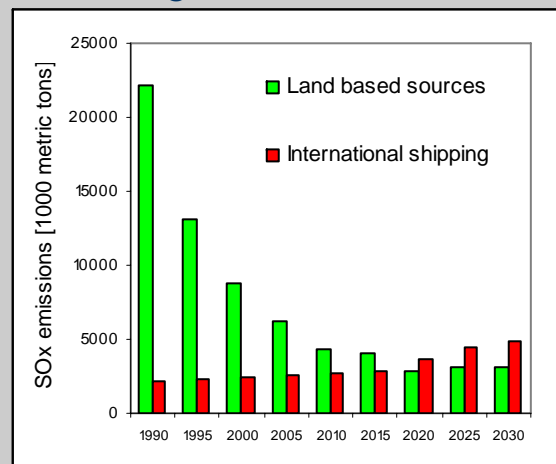
# Harmful emissions

## Pollutions from ships

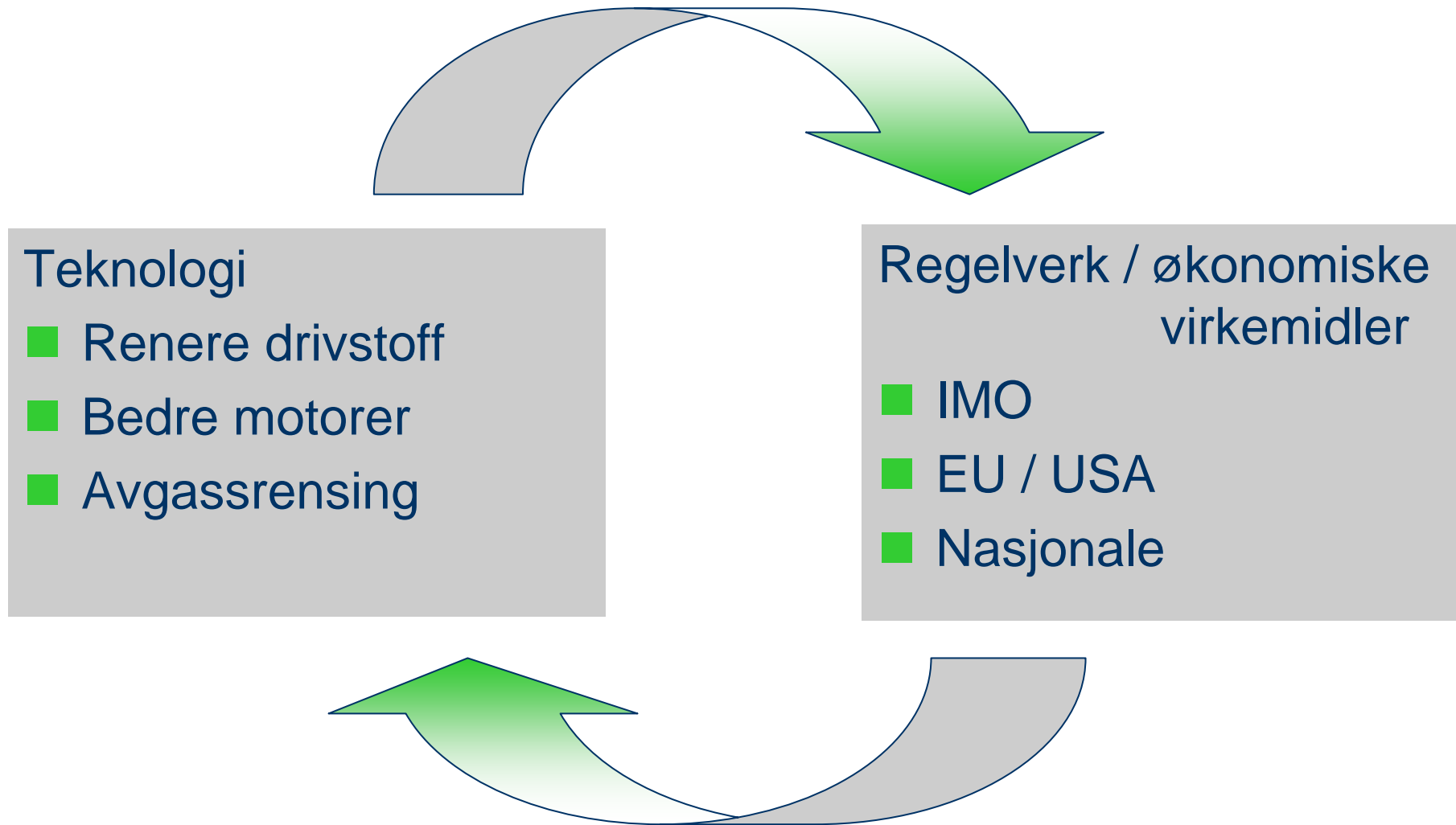
- NO<sub>x</sub>
- SO<sub>x</sub>
- VOC
- PM
- Micro organism in ballast water
- Oil and chemical spill
- ...



## Prognoses from EC



# Reduksjon i avgassutslipp fra skip





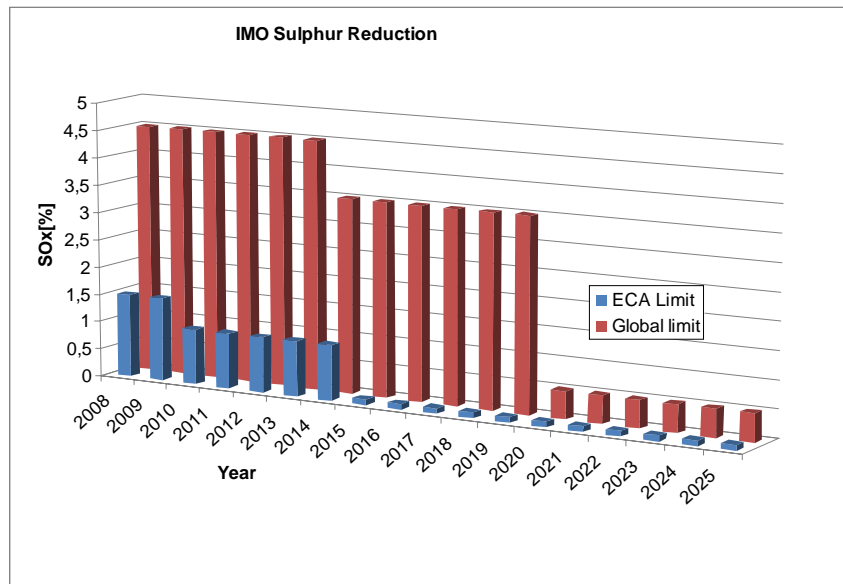
# Skadelige utslipp til luft er hovedutfordringen

Nye strengere utslippsgrenser for svovel og NOx fra IMO

# IMO - Future limits of harmful emissions from ships

## MEPC - 57th session: 31 March – 4 April 2008

### Stricter IMO limitation on SOx



### Global sulphur limitations

- Global cap from 4,5% to 3,5% effective from 1. January 2012
- Global cap from 3,5% to 0,5% effective from 1. January 2020

### SECA (Sulphur Emission Control Area) limitations

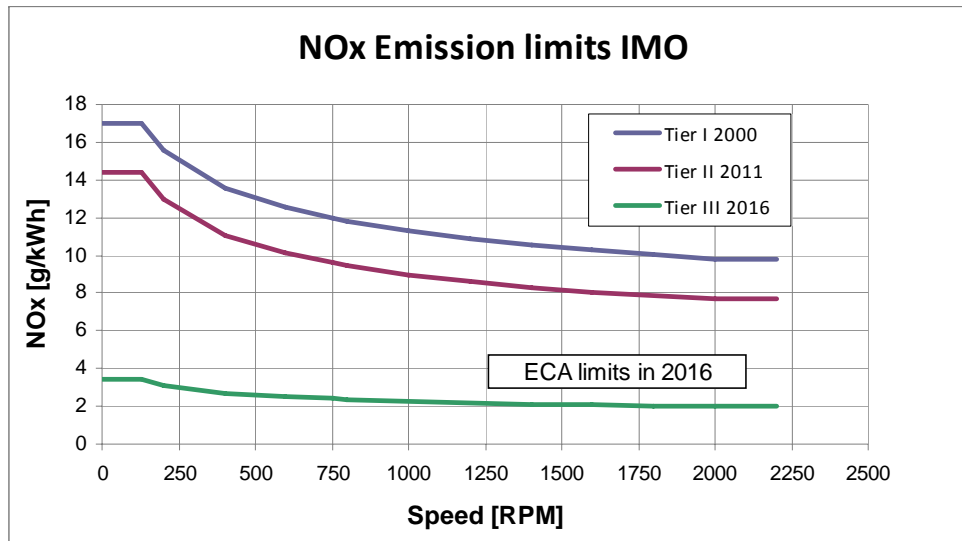
- New sulphur limit from 1,5% to 1,0 % effective from 1. March 2010
- New sulphur limit from 1,0% to 0,1 % effective from 1. January 2015

PM (Particulate Matters) regulated indirectly by the sulphur reduction

# IMO - Future limits of harmful emissions from ships

## MEPC - 57th session: 31 March – 4 April 2008

Stricter IMO limitation on NO<sub>x</sub>



Global NO<sub>x</sub> limitations

- Tier II ⇒ 20% reduction of today's limit for new ships after 1. January 2011

SECA becomes Emission Control Area (ECA) from 1. January 2016

- SO<sub>x</sub> limit of 0,1% fuel sulphur (as in SECA)
- NO<sub>x</sub> Tier III ⇒ 80% reduction from today's limit (new ships)

# IMO - Future limits of harmful emissions from ships

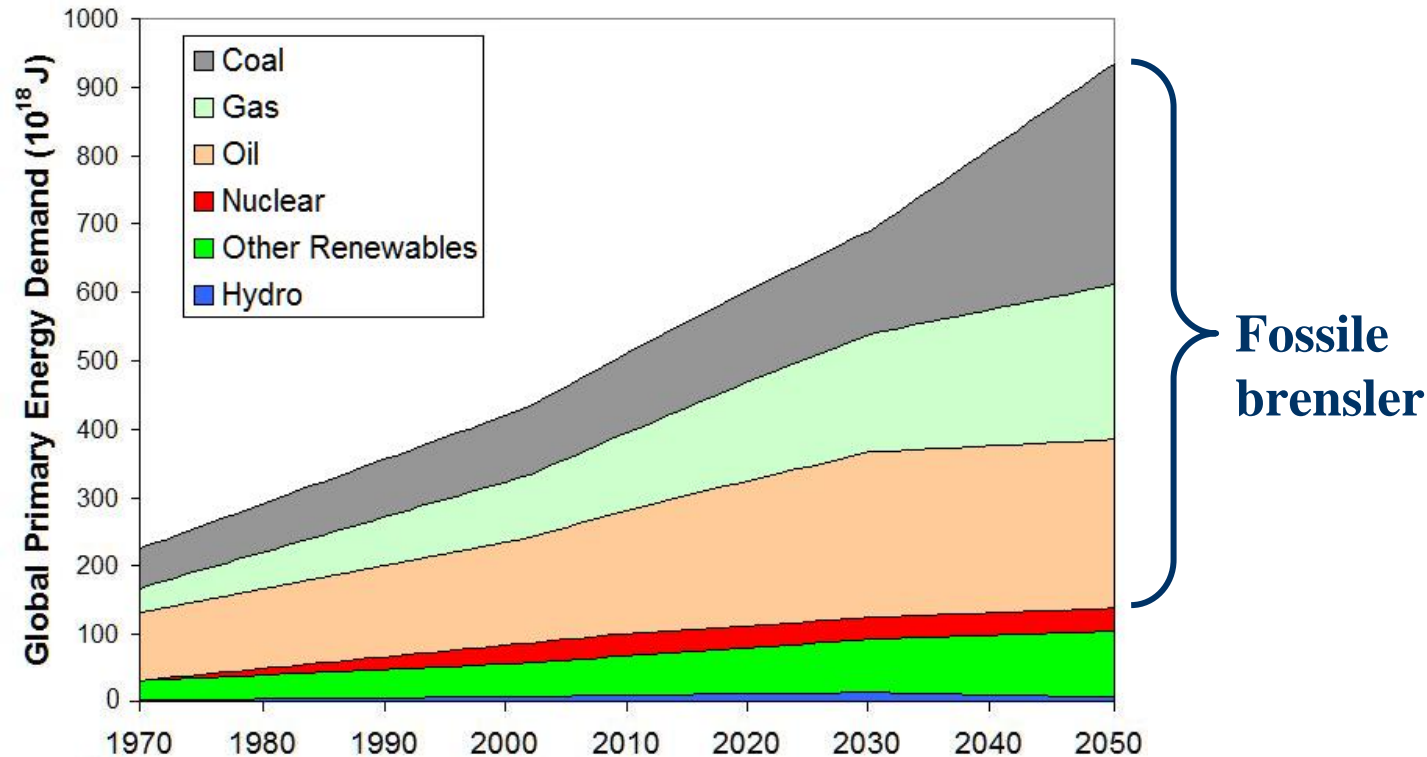
## MEPC - 57th session: 31 March – 4 April 2008

### Possible new Emission Control Area (ECA)

- Baltic Sea
- North Sea
- West coast of USA
- Gulf of Mexico
- Tokyo Bay



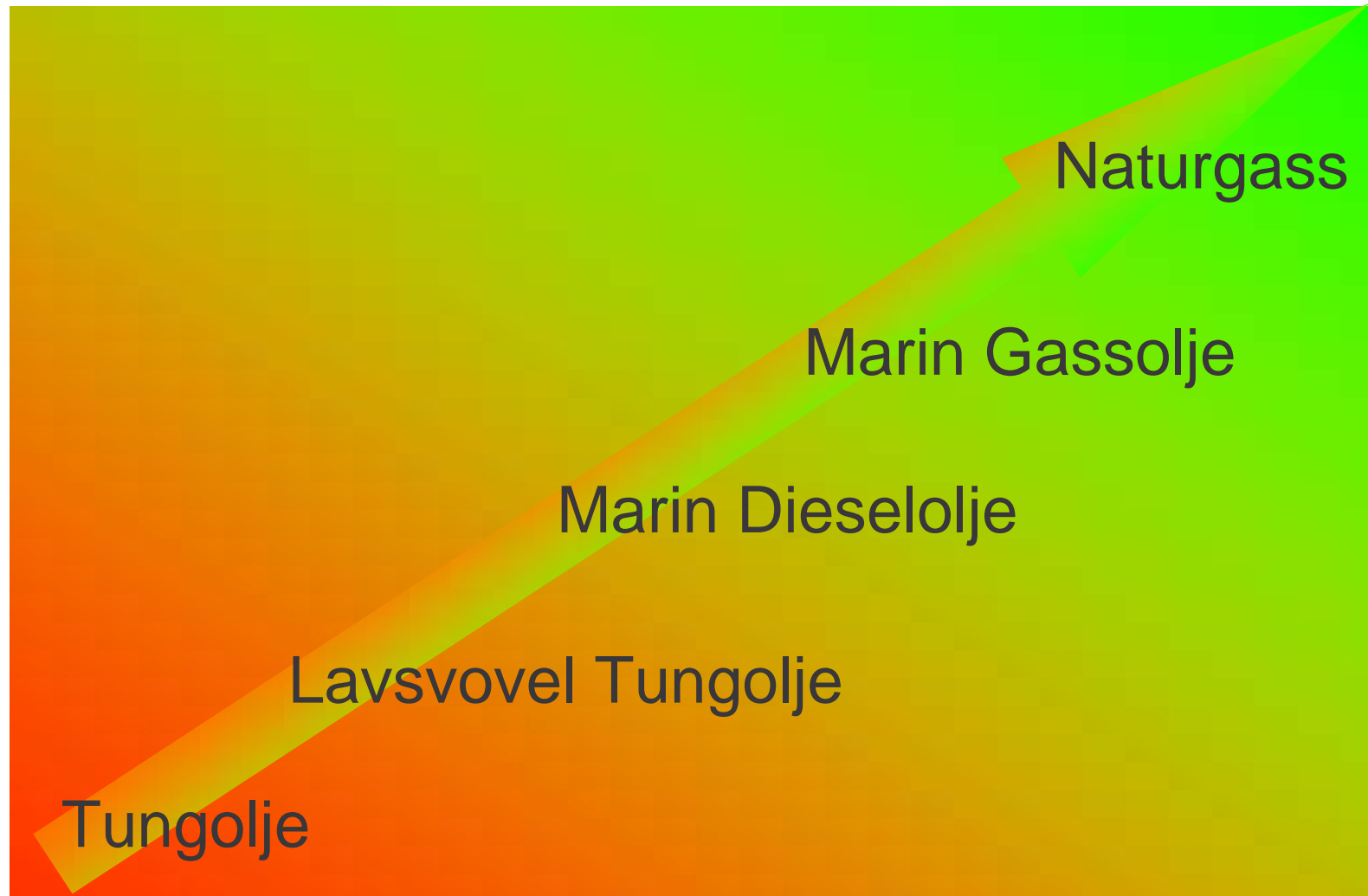
# Bunkers for skip i et 50 års perspektiv?



Kilde: IEA

Vi tror energikilden til skip vil være basert på fossile kilder i lang tid, men at drivstoffet vil bli renere enn i dag

# Renere drivstoff



**H2**  
**BIO**

# Renere drivstoff

## Renere drivstoff

- Mindre svovel og nitrogen
- Mindre aske
- Mindre sot
- Mer forutsigbare egenskaper
  
- Mer hydrogen

## Fordeler

- Mindre partikler og svoveloksider
- Mindre CO<sub>2</sub>
- Større mulighet for optimalisering av forbrenning
  
- Forenkler NO<sub>x</sub> tiltak som EGR, SCR, m. fl.

# Er naturgass (LNG) et reelt alternativ?



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Hva er miljøgevinsten?

Hva med investeringskostnader for gasskip og prising på LNG?

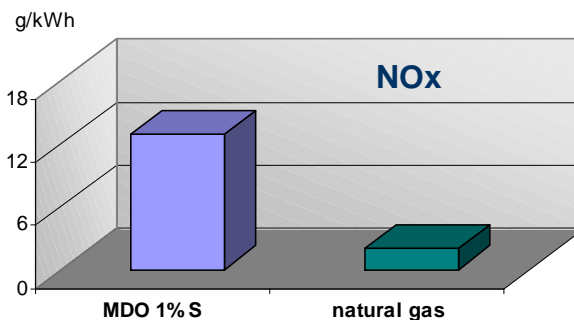
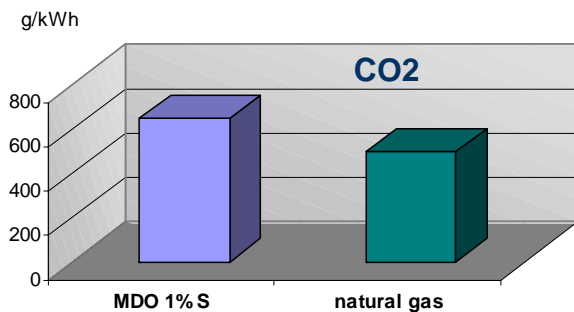
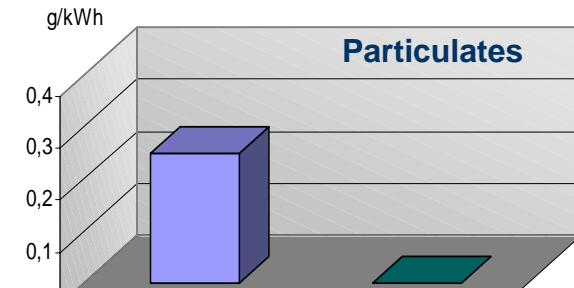
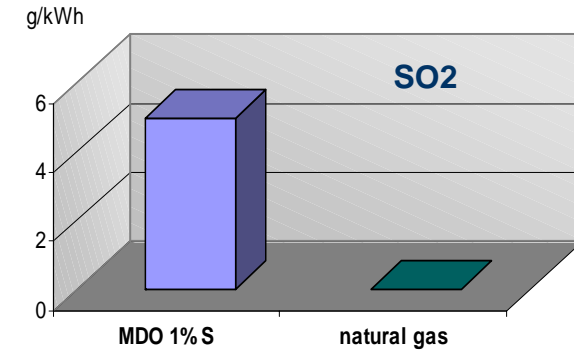
Hva med tilgjengelighet på LNG?

Hvilke erfaringer har vi så langt?

# Exhaust emission - Natural gas vs MDO

- Sulphur emission is eliminated
- Particulate matters is close to zero
- CO<sub>2</sub> is reduced by 26%  
Due to unburned methane the net reduction of greenhouse gases are in the range of 0% -15%
- NO<sub>x</sub> is reduced by 80-90%

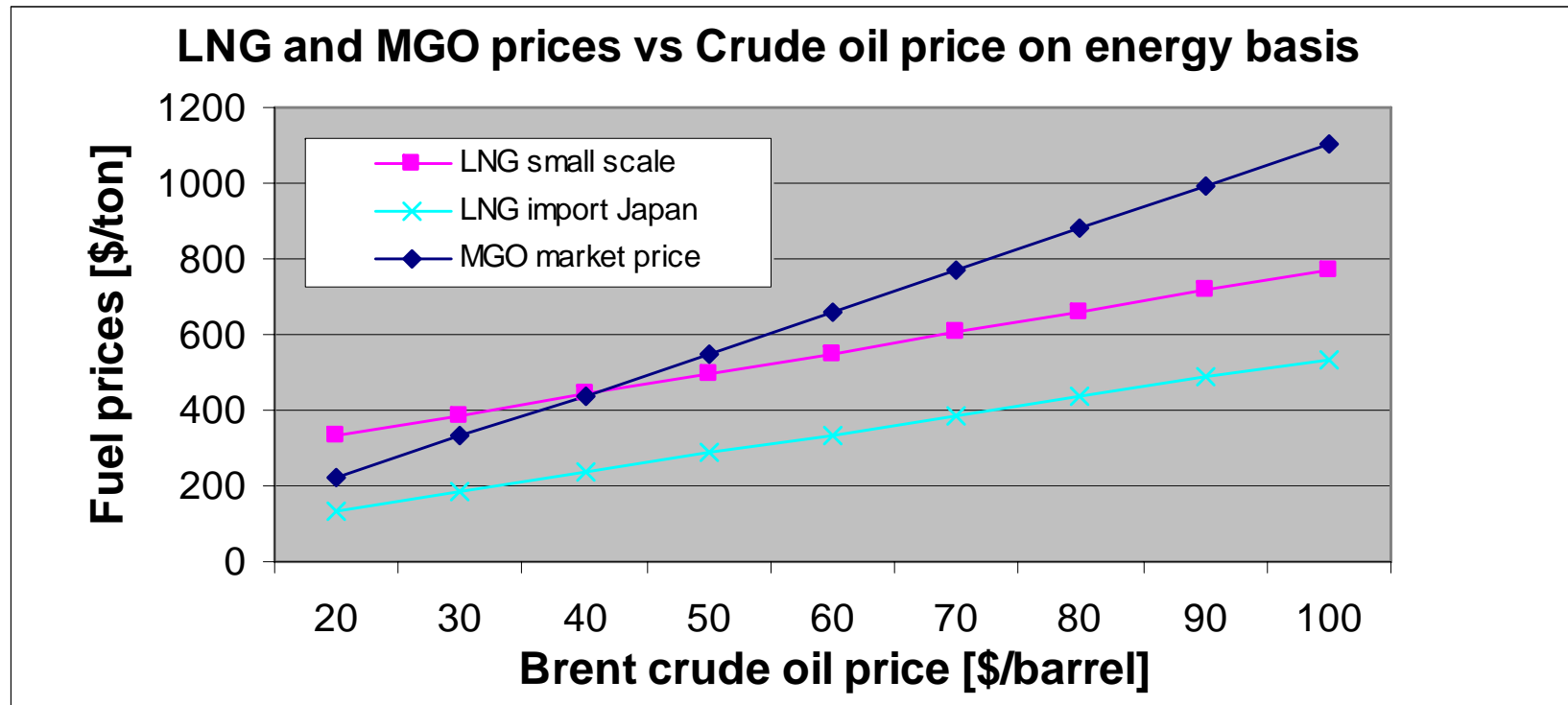
Source: Rolls-Royce Marine



# Hva med investeringskostnader for gasskip?

- LNG drevne skip har høyere investeringskostnader,
  - +10-15% av totale investeringskostnader
- Disse kostnadene må forsvares ved lavere driftskostnader
- Viktige faktorer for å få god økonomi
  - Gasspris
  - Avgiftsreduksjon, NOx, S,
  - Andreavgifter? CO2 avgift, Mineralolje avgift
- Finansiering, NOx fondet

# Price level LNG vs Marin Gas Oil (MGO)



At high crude oil price LNG has a significant price margin to Marin Diesel Oil (MDO)

# Small scale distribution of LNG




Covering the coast of Norway

- LNG source - base load LNG or receiving terminals or small scale LNG production
- LNG could be further distributed by truck or rail way or distributed by locale pipeline.



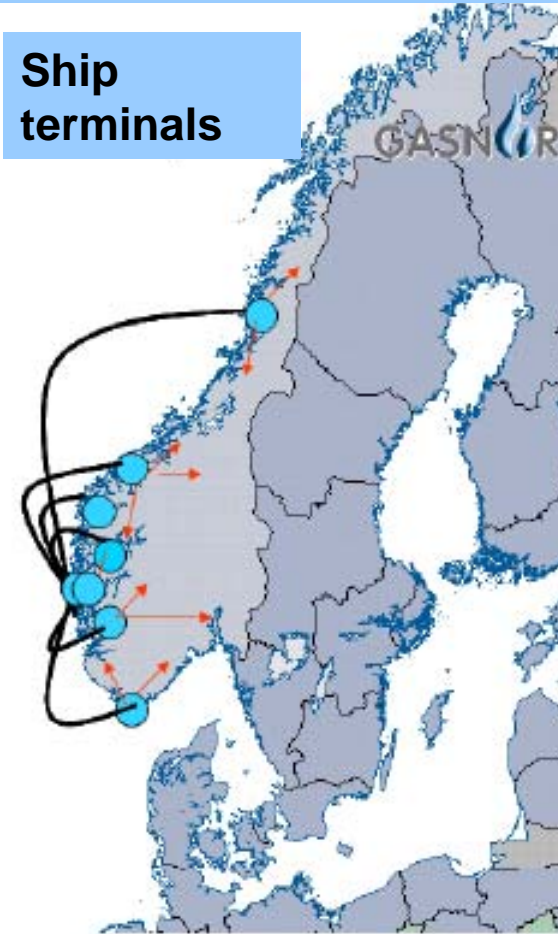



## LNG distribution in Norway

Truck terminals 



Ship terminals 



LNG production plant 

Source: Gasnor



Small scale LNG production -100 ton/day

Extended production capacity – 200 ton/day (2007)





Pioner Knutsen 1000 m3 LNG carrier  
Loading at the LNG plant



LNG truck loading



# LNG truck – Vacuum isolated (56m<sup>3</sup>)



# Receiving terminal 1500 m<sup>3</sup>





# Gasnor New LNG vessel 1. quarter of 2009

7500 CBM LNG / ETHYLENE / LPG CARRIER



ANTHONY VEDER



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# LNG bunkering station at ferry berth



Capacity: 2x 500m<sup>3</sup> LNG

LNG transferred by pump

Filling time for the large LNG ferries about two hours

Refuelled every third night



# Natural gas as fuel for ships - experience



The first LNG ferry Glutra 2000



Two Supply Vessels 2003

Two new supply vessels on order



Series of five LNG car ferries 2007

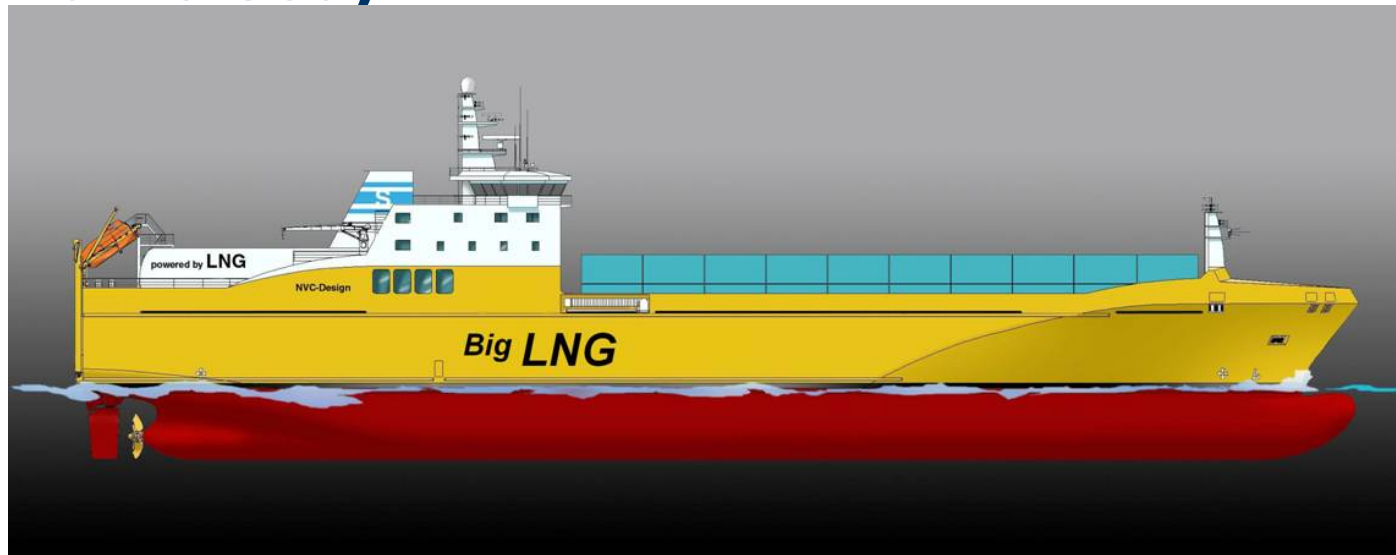
Seven new ferries will be ordered



Three navy vessels on order

# R&D program – LNG fuelled ships

## Example RoRo Freight ship (fixed route in Baltic sea)



### Main challenges:

- Location of LNG storage tanks
- High cost level

### Cost level (estimate)

- Building cost Heavy fuel operation: about 25 mill €
- Additional cost for LNG propulsion (gas only): about 2 mill € (+8%)

# LNG powered RoRo freight ship (gas only)

Gasdrift (LNG) er et reelt miljøvennlig alternativ  
Men naturgass er en fossil energikilde



# BIP prosjektet "Nyfrakt"

En nasjonal dugnad innen maritim næring.  
Skape en ny generasjon kystflåte.

- Kosteffektiv
- Miljøvennlig
- Sikker
- Pålitelig

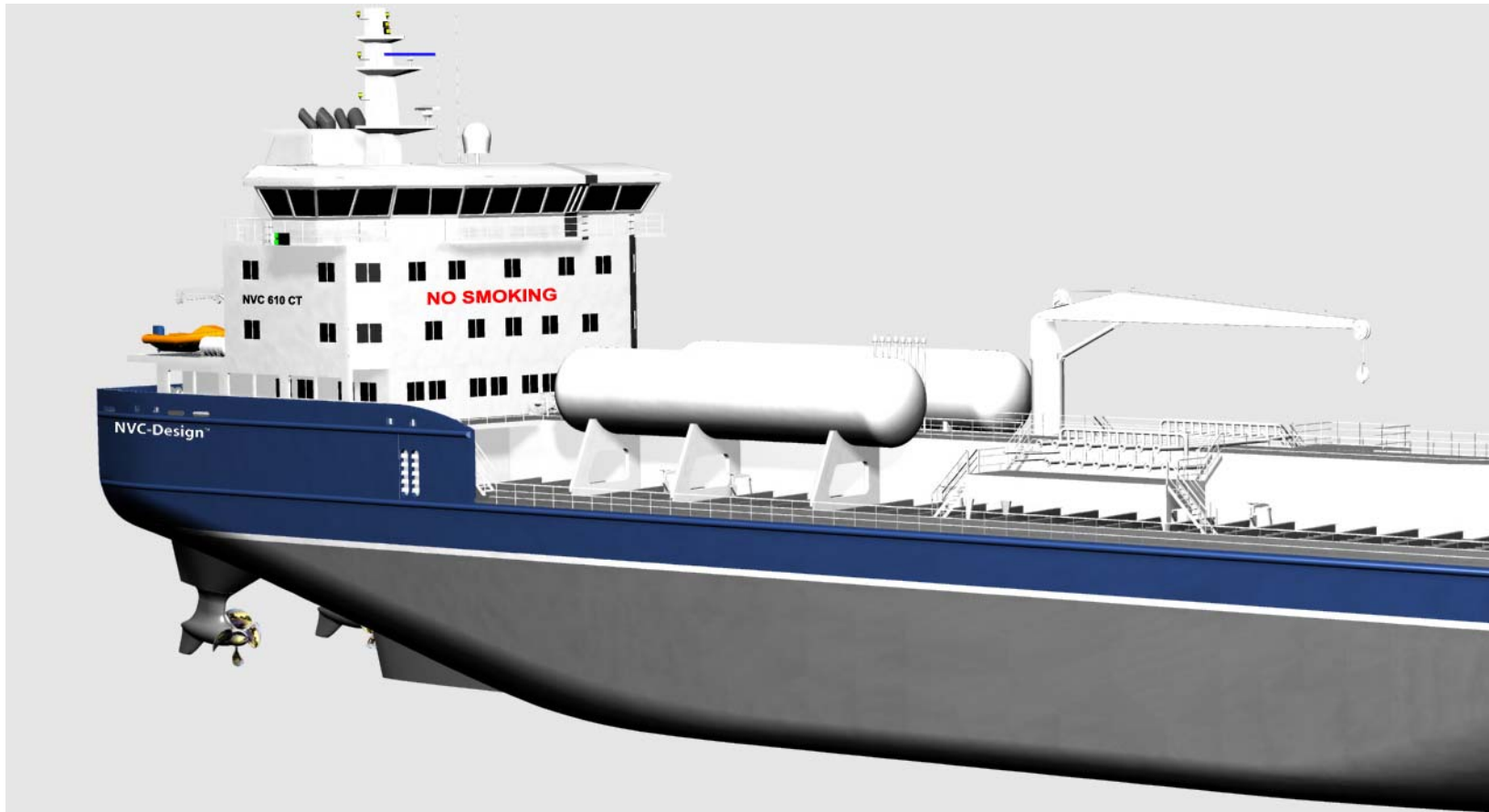
Last fra land til sjø!





# Sterk fokus på alternative drivstoff

## LNG Fuelled Projects



Ja!

LNG er et reelt alternativ

Takk for  
oppmerksomheten

NO<sub>x</sub> < 2 g/kWh  
SO<sub>x</sub> = 0  
PM = 0  
CO<sub>2</sub> = lower  
\$

[www.marintek.sintef.no](http://www.marintek.sintef.no)