

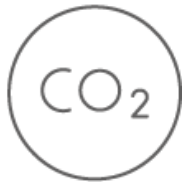
# ReVolt

The unmanned, zero emission short sea ship of the future

29 June 2016

## DNV GL: Ambitions for the shipping industry

CO<sub>2</sub> emissions



900

million tonnes  
per year

**Ambition:**

**60 % reduction in CO<sub>2</sub>  
emissions**

Freight cost



7-11%

of cargo value

**Ambition:**

**Maintain or reduce  
present freight cost levels**

Lives lost at sea



900

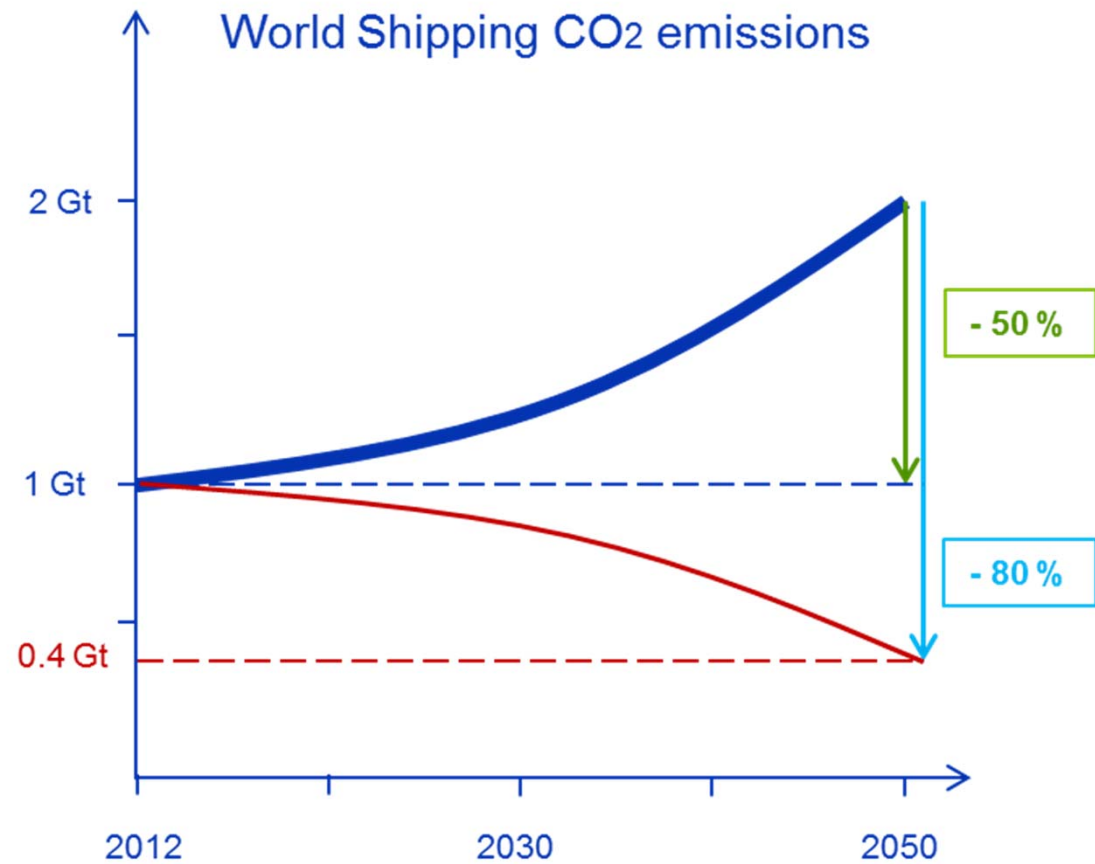
ship accident  
fatalities per year  
Average 2003-2012

**Ambition:**

**90 % reduction in  
fatalities in shipping**

Ungraded

## Requirements for emissions reduction



Ungraded

## Emissions reductions by more than 80%

Well to propeller efficiency



Energy Requirement

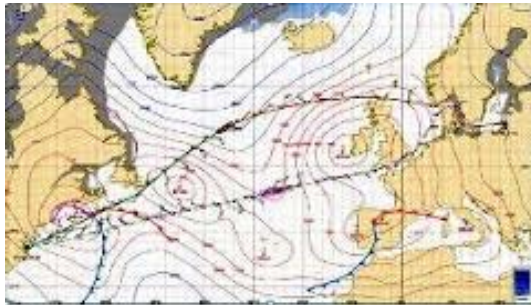


LCA emissions

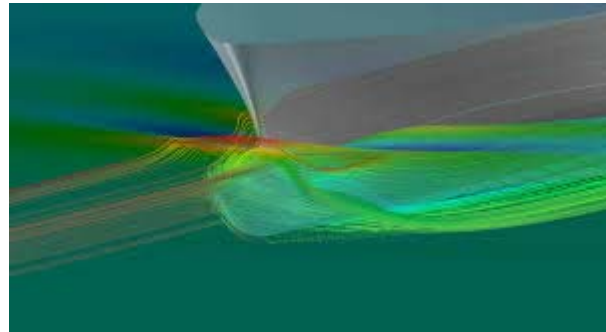
CO2 Emissions/Work Carried Out

Ungraded

## Reduction of Energy Required



Weather Routing



Hydrodynamic optimization



Trim optimization



Reduce resistance



Reduce fouling

Ungraded

## Minimization of energy required

---



Size and speed

$$\text{Admiralty Coefficient , } C = \frac{\Delta^{\frac{2}{3}} V^3}{sp}$$

## Energy Efficiency

Extraction  
and Refining



90%

Transport  
and storage



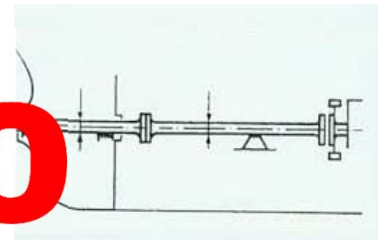
99%

Combustion



40%

Transmission



98%

Propulsion

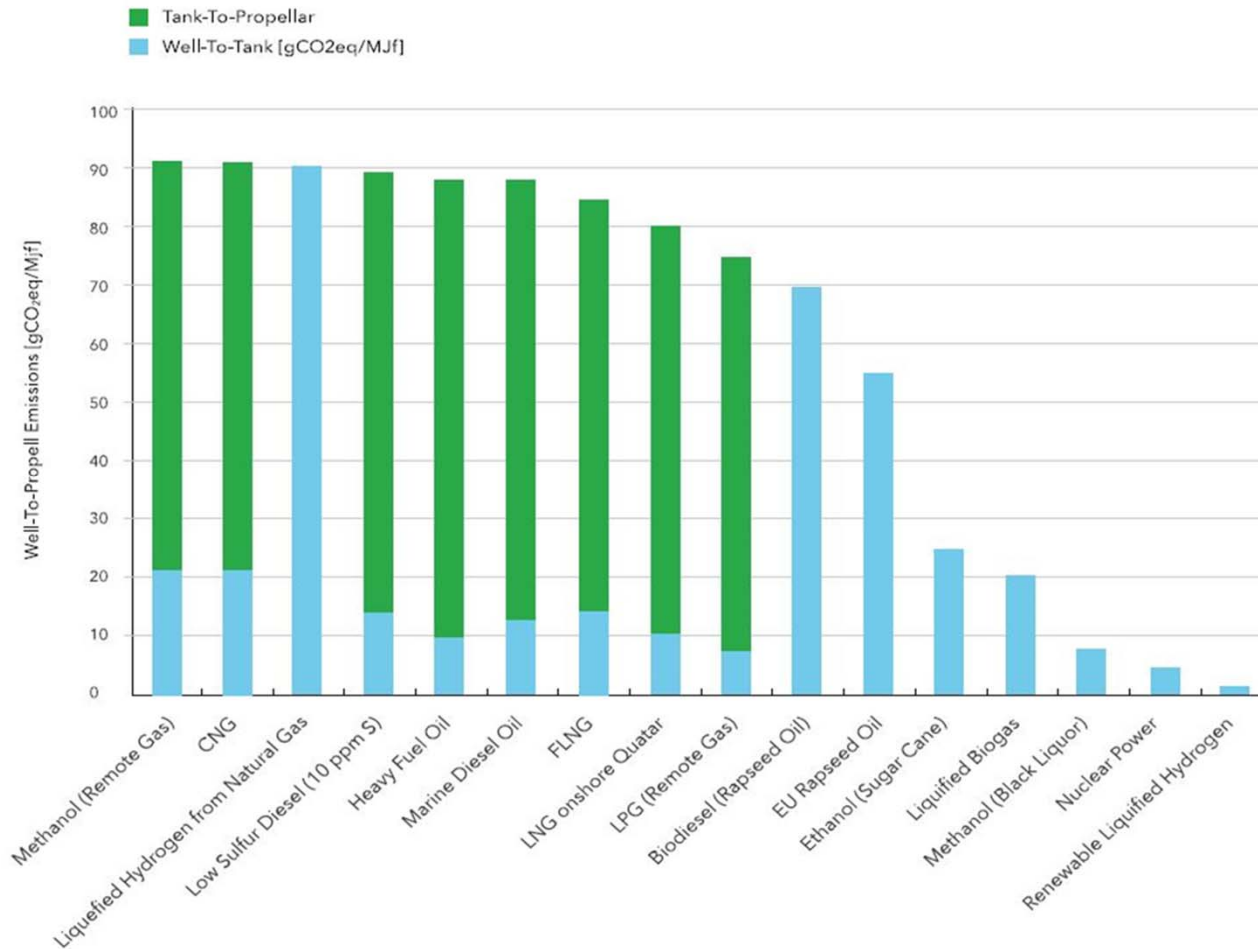


65%

200%

Ungraded

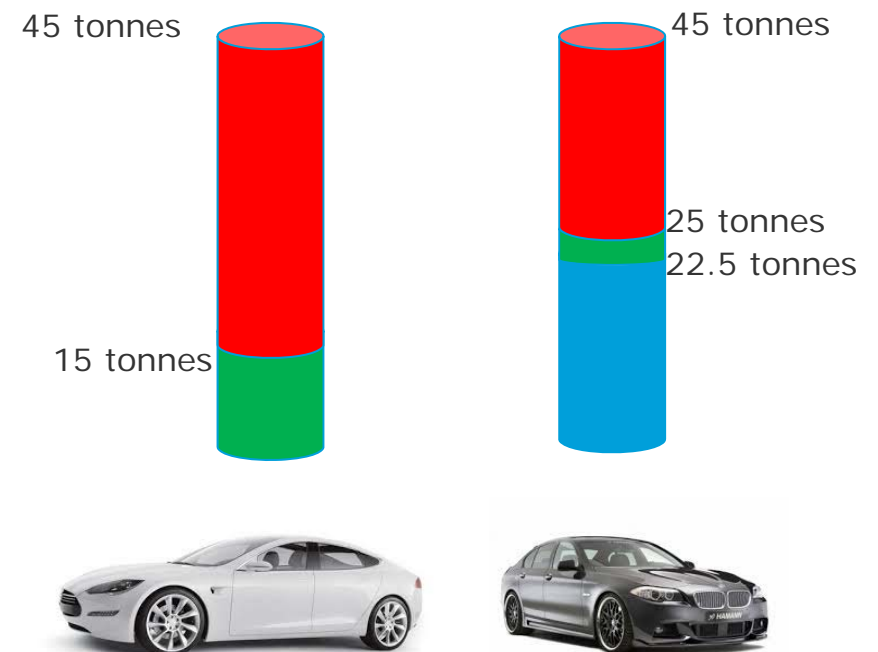
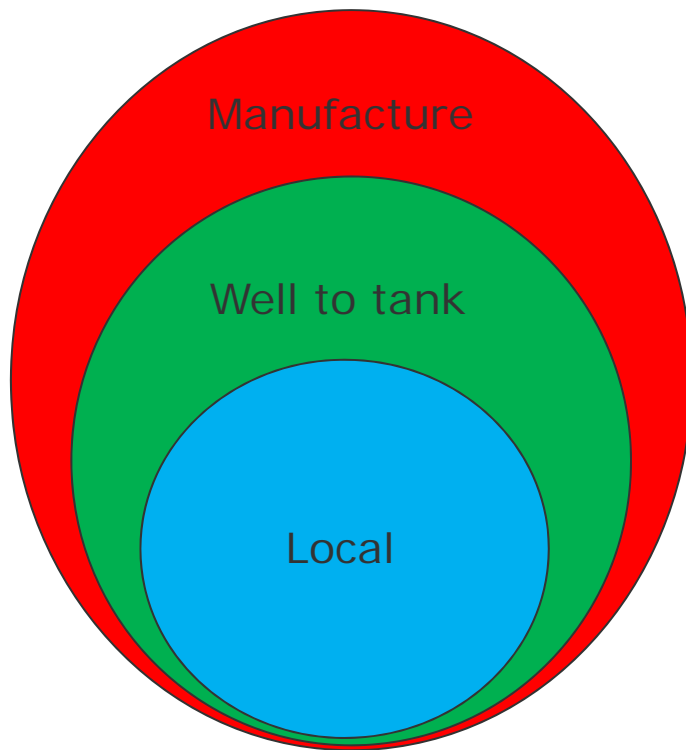
## Well to tank GHG emissions of alternative fuels



Ungraded

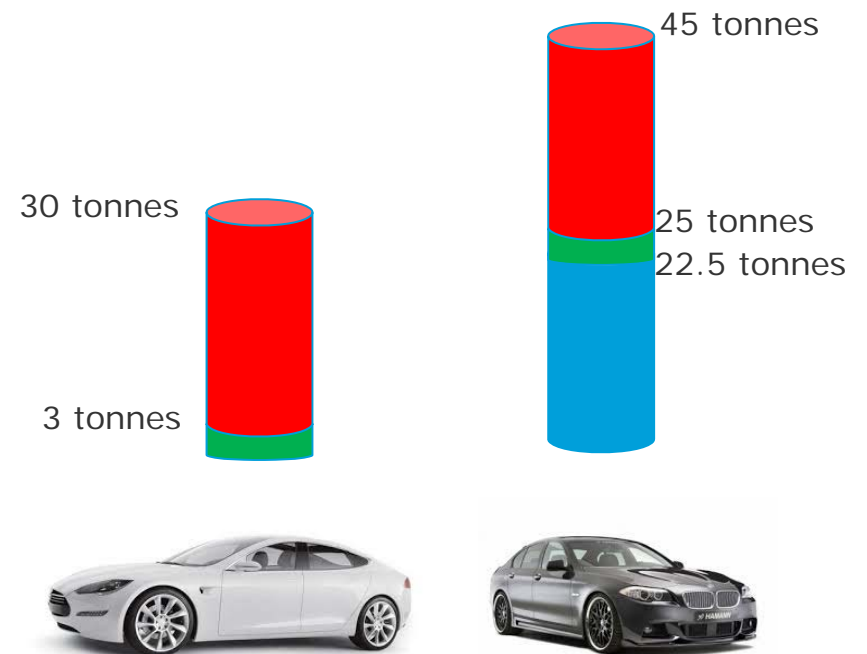
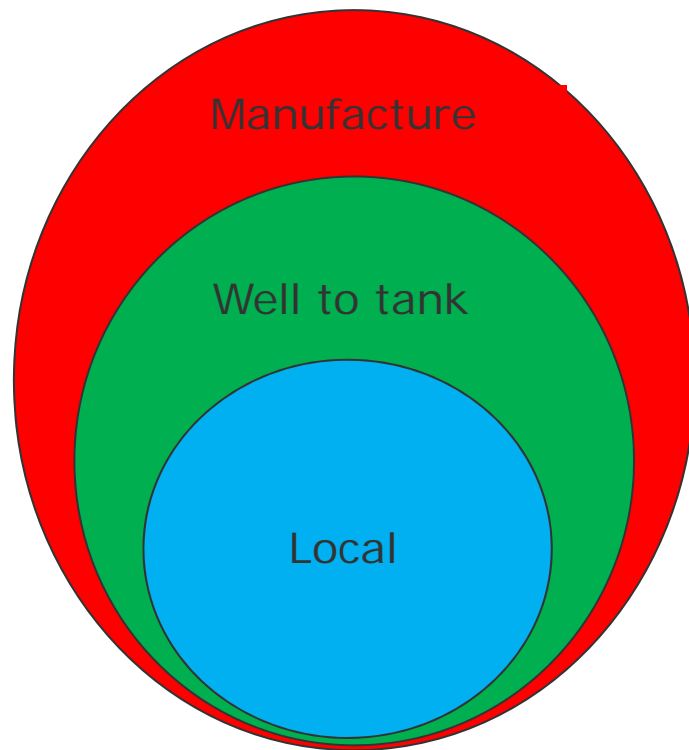


## CO2 Emissions from electric cars (Europe)



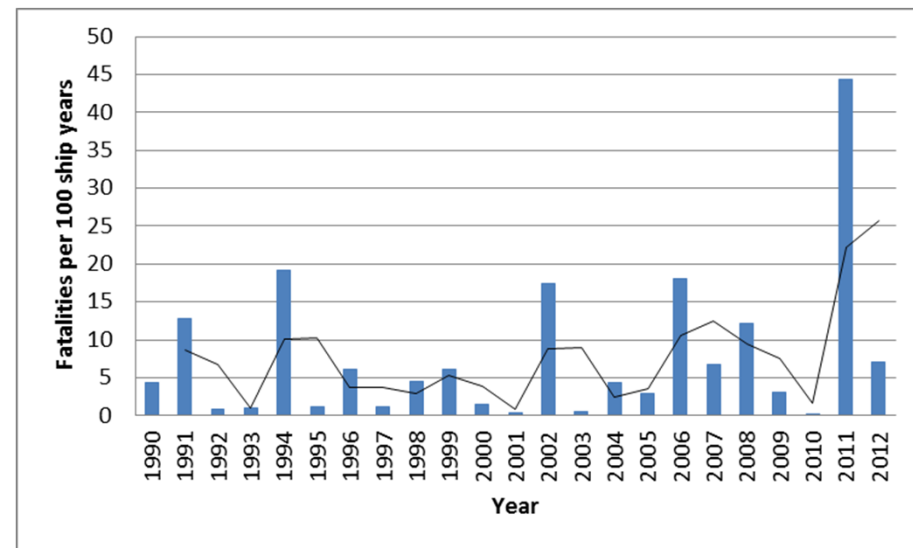
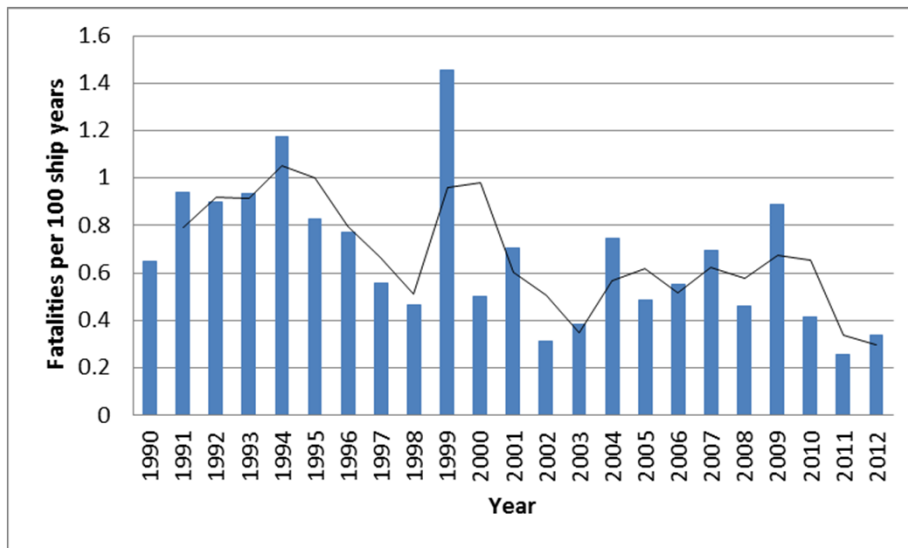
Ungraded

## CO2 Emissions from electric cars (Norway)

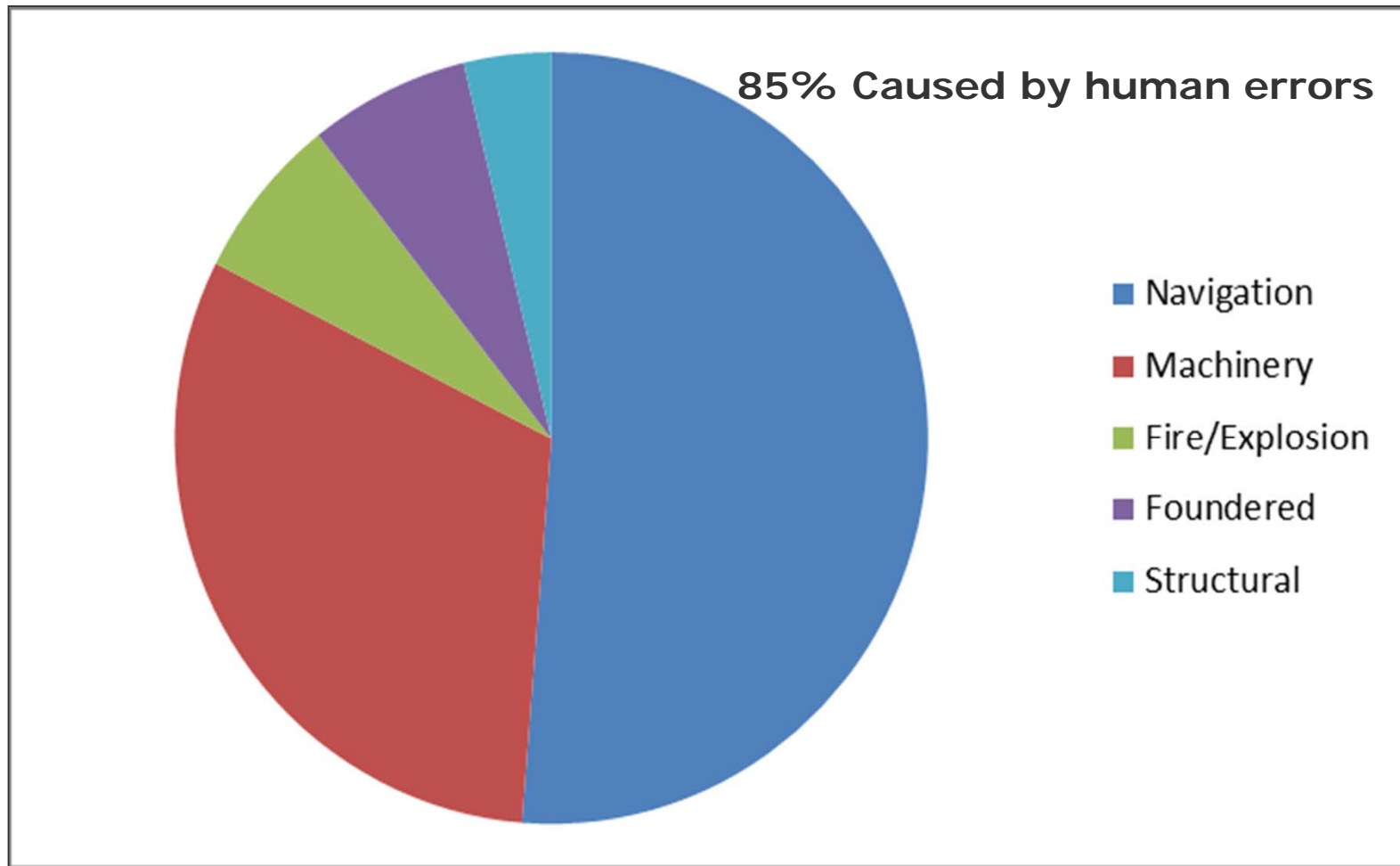


Ungraded

## Safety in shipping

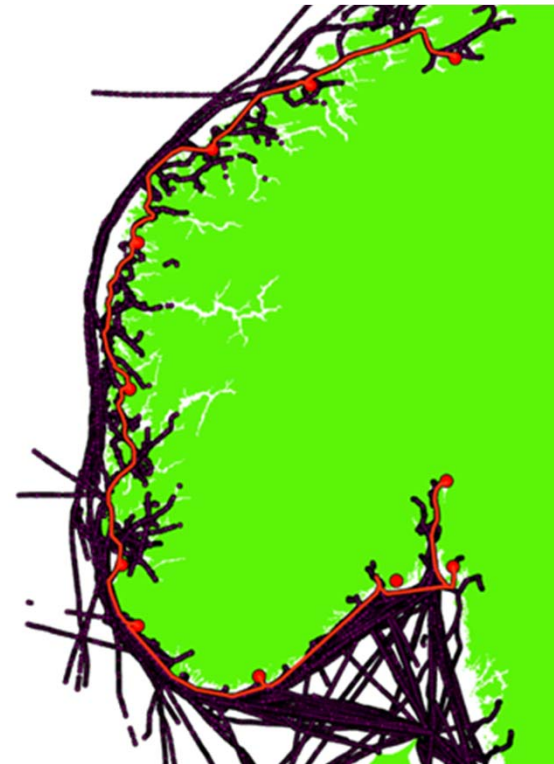
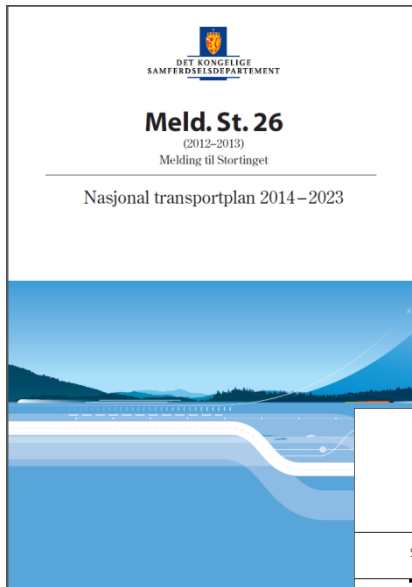


## Safety in shipping



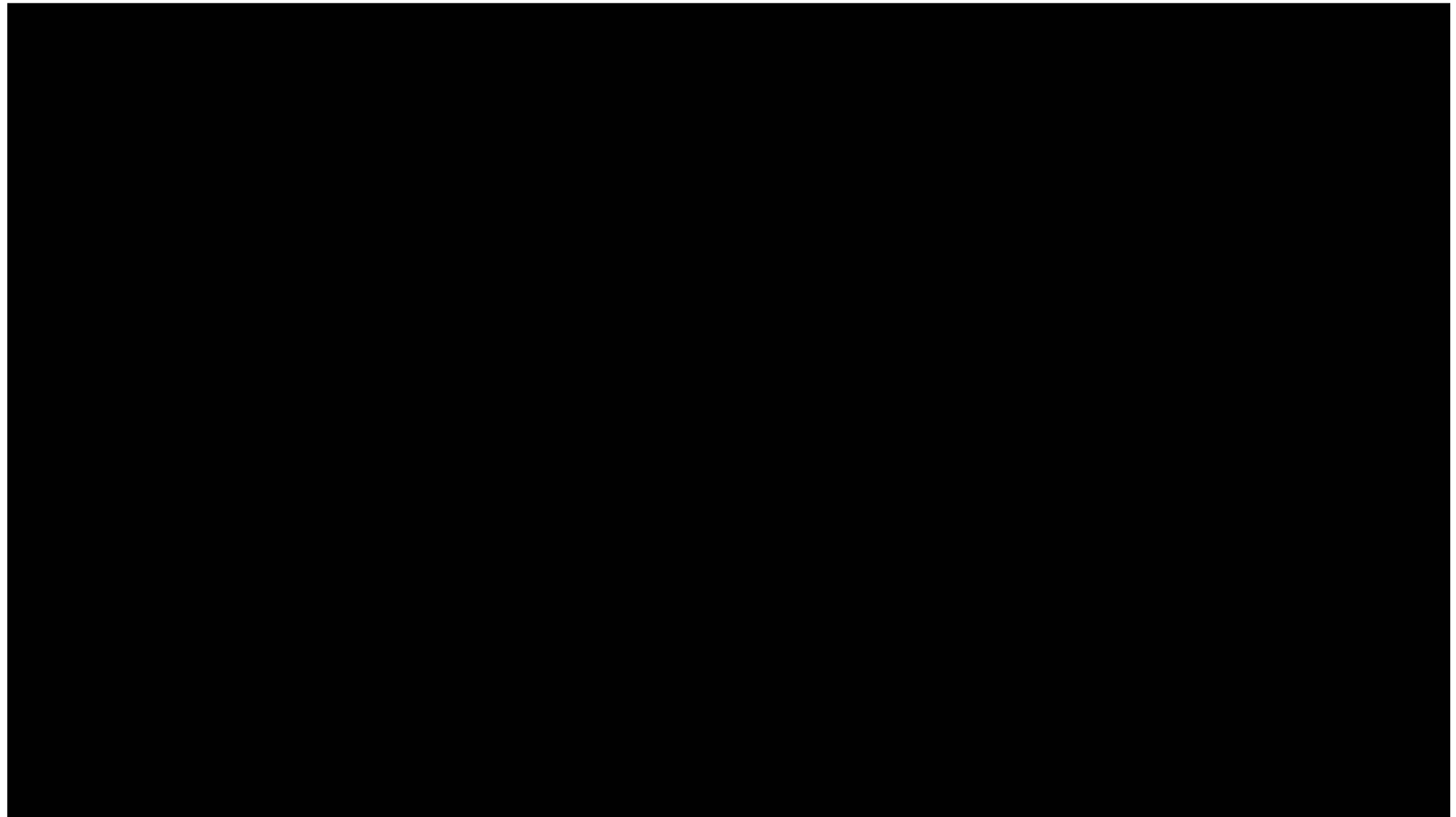
Ungraded

## Concept ship selection



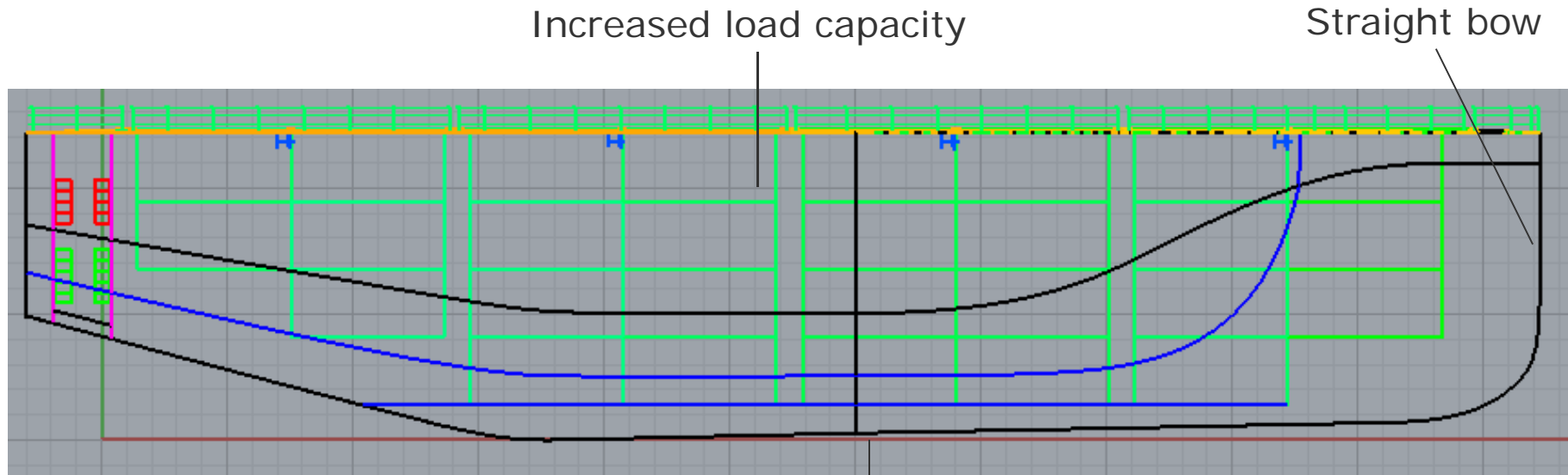
General cargo vessels represent 23,4% of the total number of ships.

Ungraded



Ungraded

## Energy requirement



Speed = 6 knots

Inclined keel – ballast free design

Calm Water: 53 kW @ 6kts =  
Toyota Yaris

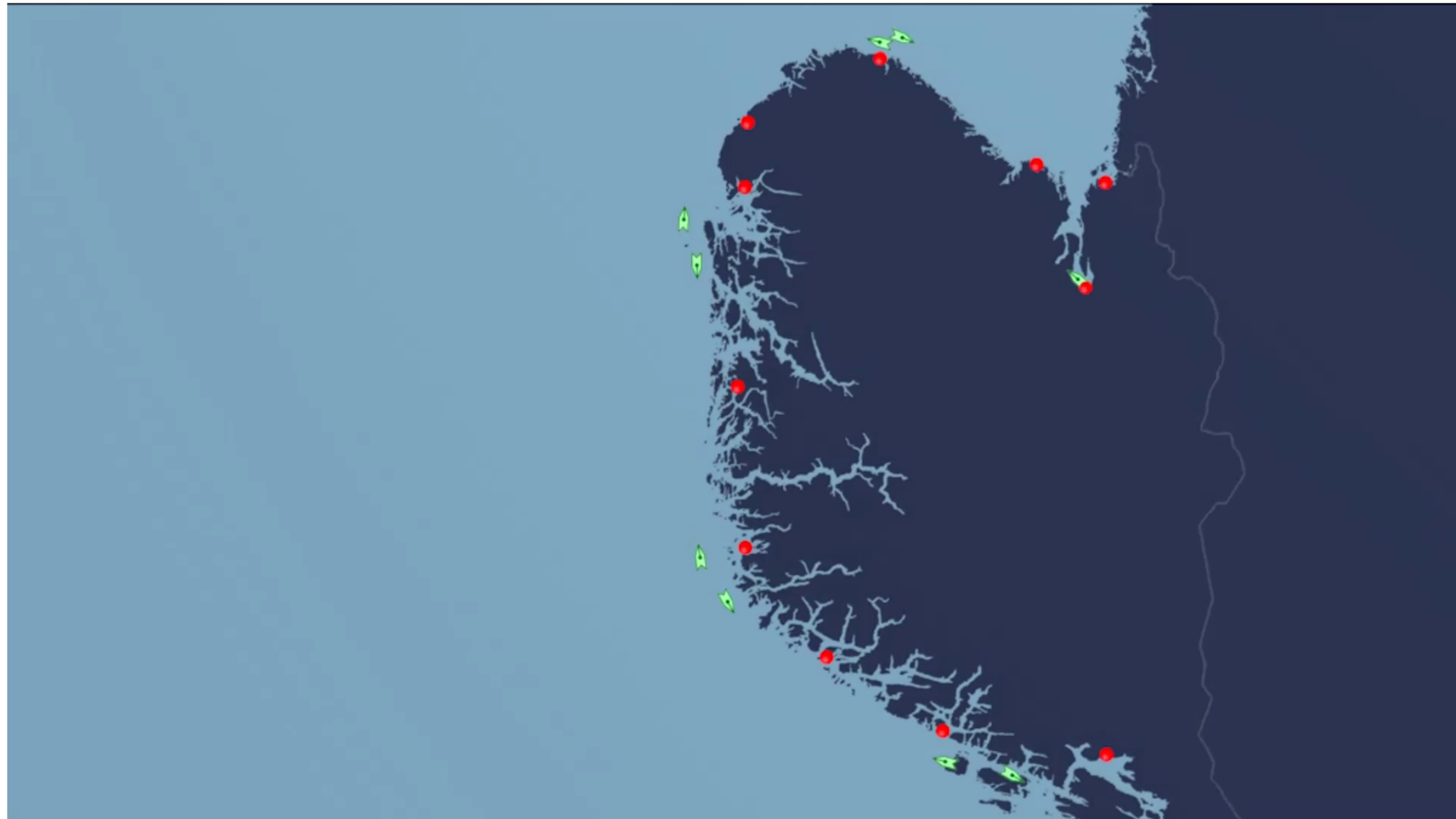
Average weather: 132 kW @ 6kts  
= BMW 5 Series



Ungraded

## New Logistics Solution

---



Ungraded



## Energy Requirement



400.000 MWh



55.000 MWh

Ungraded

## Energy Efficiency

Extraction  
and Refining



90%

Transport  
and storage



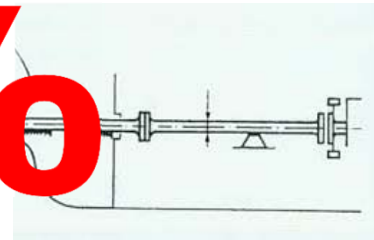
99%

Combustion



40%

Transmission



98%

Propulsion



65%

**20%**

Hydro Power &  
transmission



90%

Charging



99%

Battery



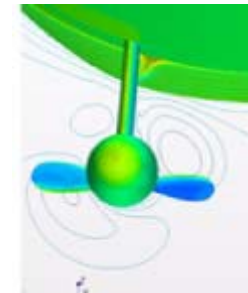
95%

Transmission



95%

Propulsion

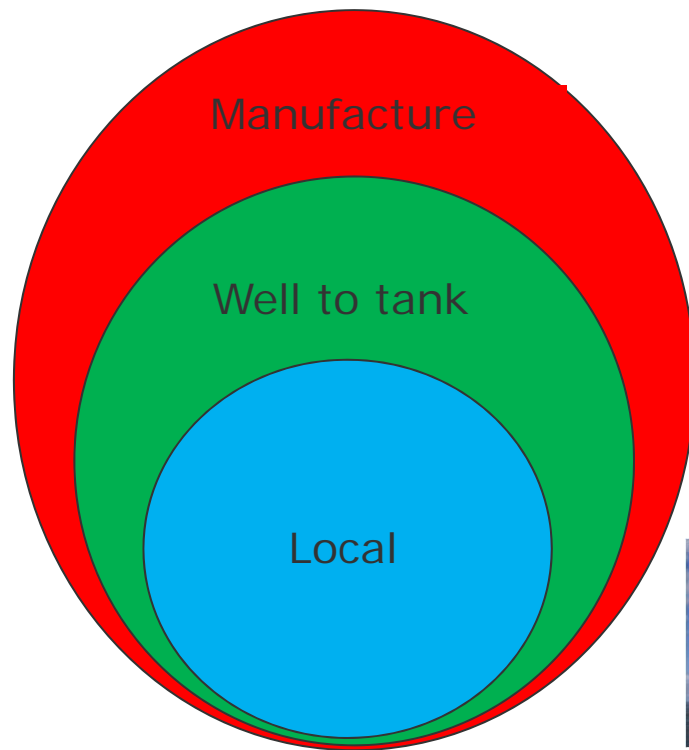


80%

**60%**

Ungraded

## LCA CO2 emissions (Norway)



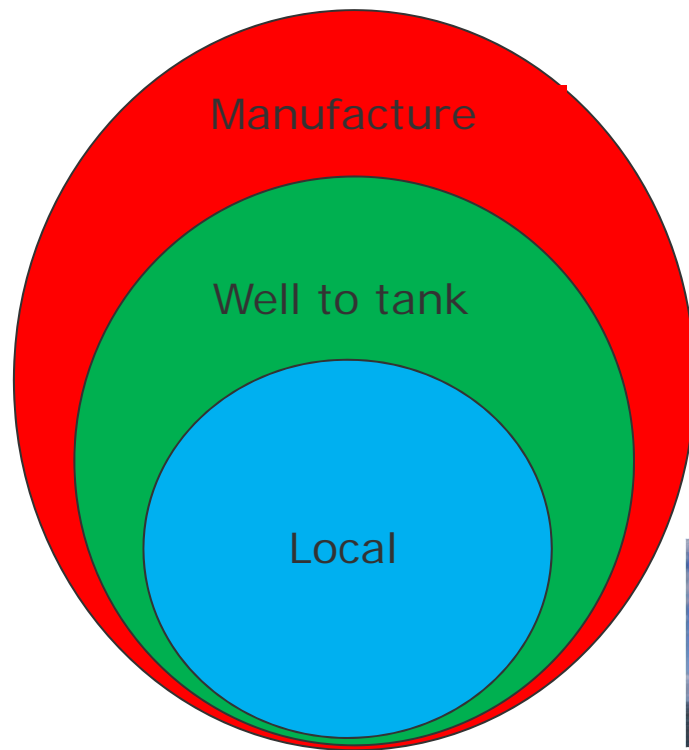
CO<sub>2</sub> reduction > 95%

5000 t  
2000 t



Ungraded

## LCA CO2 emissions (Europe)



CO<sub>2</sub> reduction > 85%

20000 t  
12000 t



Ungraded

## DNV GL: Ambitions for the shipping industry

CO<sub>2</sub> emissions



900

million tonnes  
per year

**Ambition:**

60 % reduction in CO<sub>2</sub>  
emissions

Freight cost



7-11%

of cargo value

**Ambition:**

Maintain or reduce  
present freight cost levels

Lives lost at sea



900

ship accident  
fatalities per year  
Average 2003-2012

**Ambition:**

90 % reduction in  
fatalities in shipping

Ungraded

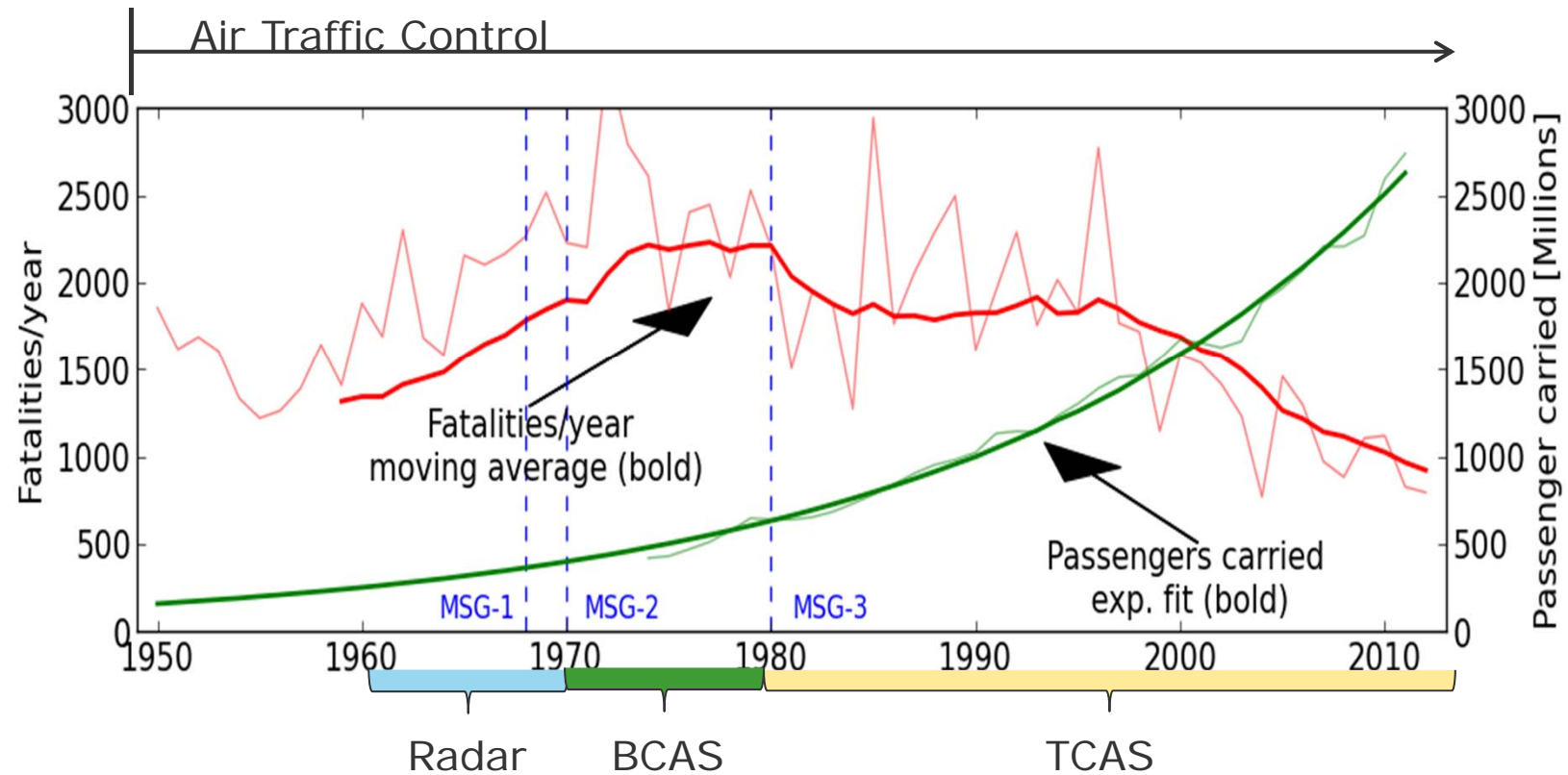
# Safety



Ungraded



## Safety



Ungraded

## DNV GL: Ambitions for the shipping industry

CO<sub>2</sub> emissions



900

million tonnes  
per year

**Ambition:**

60 % reduction in CO<sub>2</sub>  
emissions

Freight cost



7-11%

of cargo value

**Ambition:**

Maintain or reduce  
present freight cost levels

Lives lost at sea



900

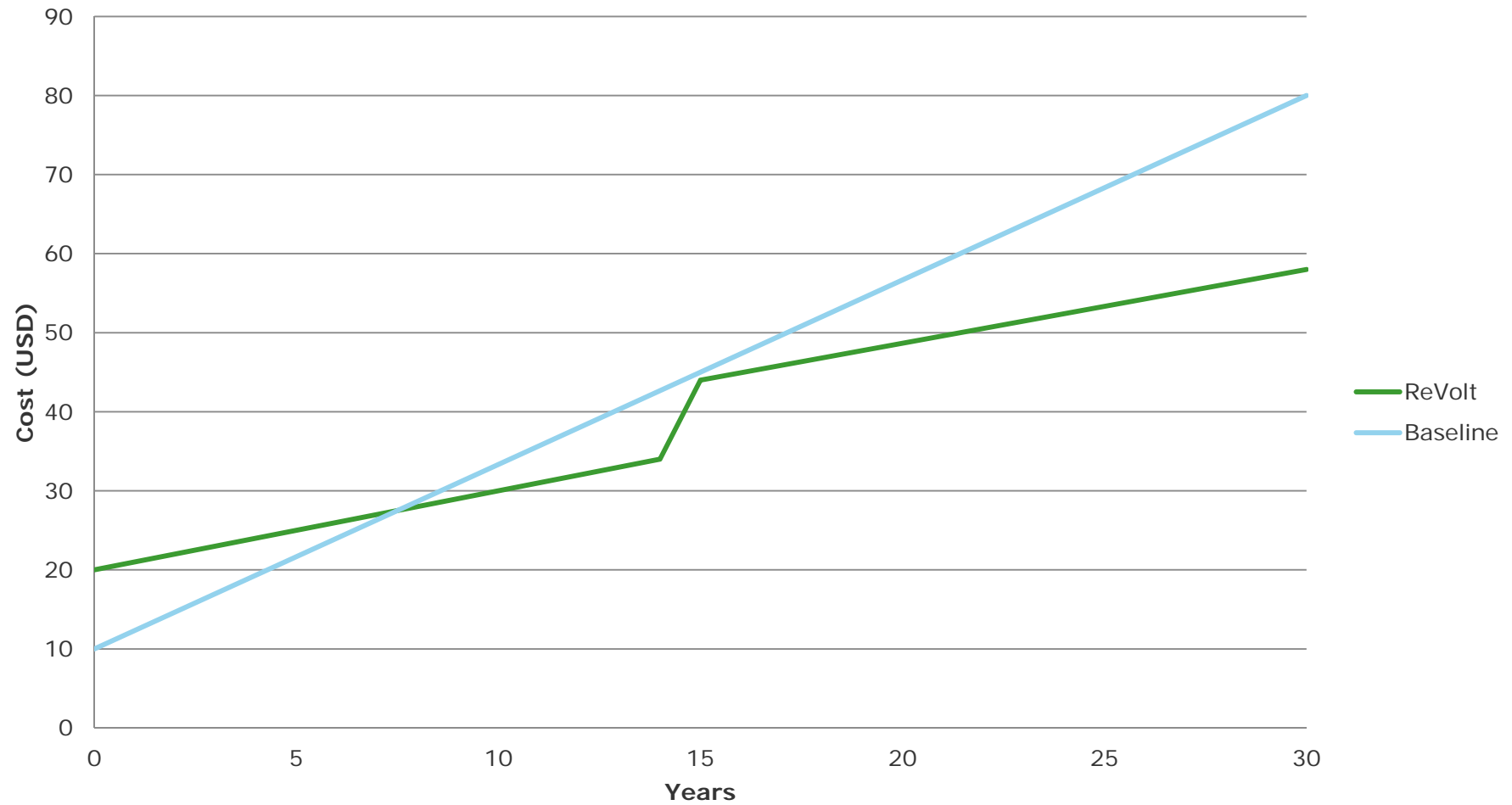
ship accident  
fatalities per year  
Average 2003-2012

90 % reduction in  
fatalities in shipping

Ungraded



## Freight cost



Ungraded

## DNV GL: Ambitions for the shipping industry

CO<sub>2</sub> emissions



900

million tonnes  
per year

**Ambition:**

60 % reduction in CO<sub>2</sub>  
emissions

Freight cost



7-12 %

of cost of value

**Ambition:**

Make it possible to reduce  
present freight cost levels

Lives lost at sea



900

ship accident  
fatalities per year  
Average 2003-2012

90 % reduction in  
fatalities in shipping

Ungraded

## Barriers: Autonomy



Ungraded

## Project case: AAWA

- **Areas of focus:**

- Technology
- Safety and security
- Societal & legal acceptance
- Economy and business models

- **DNV GL focus:**

- Class requirements and assurance of safety and performance



- **Partners:**



Rolls-Royce



Turun yliopisto  
University of Turku



TAMPERE  
UNIVERSITY OF  
TECHNOLOGY



Ungraded

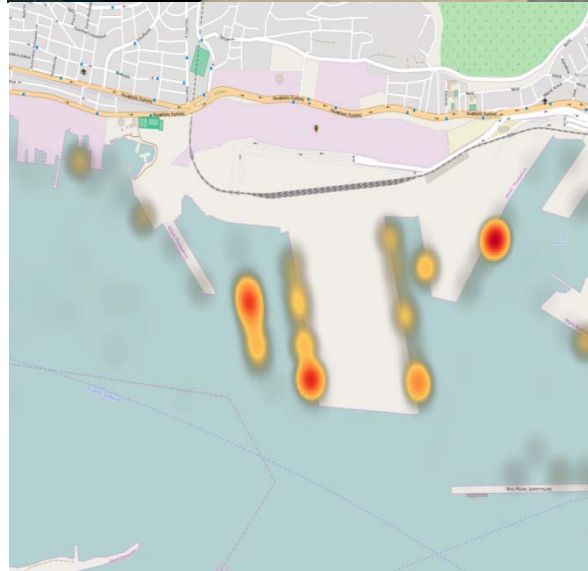


## Barriers: Charging Infrastructure



Ungraded

## Project case: Re-Charge



Ungraded

- **Infrastructure for the ReVolt concept**
- Shore-based power for hybrid and electric vessels
- **AIS data analysis:**
  - Best-case locations
  - Capacity requirements
  - Barriers for implementation
  - Funding and cost



## Conclusions

---

- Addresses sustainability challenges in shipping
- Requires changes in regulation and infrastructure

# Thank you for your attention

**Bjørn Johan Vartdal (PhD)**  
bjorn.johan.vartdal@dnvgl.com  
+4797682660

**[www.dnvgl.com](http://www.dnvgl.com)**

**SAFER, SMARTER, GREENER**

Ungraded