

# Operational measures to reverse the negative effects of the 0.1% sulphur limit on Ro-Ro shipping

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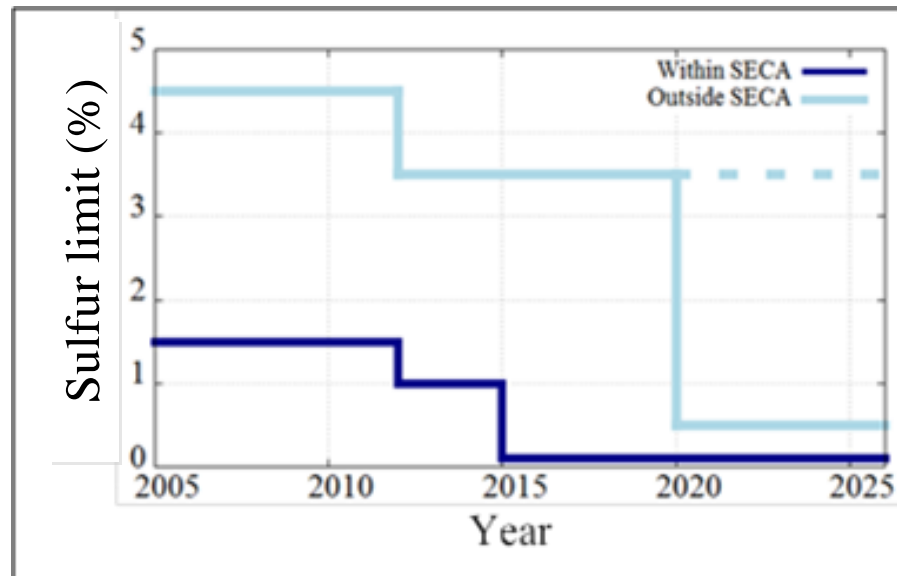
$$P(i|V) = \frac{\partial \ln G(e^V)}{\partial V_i} \int_a^b \epsilon \Theta^{\sqrt{17}} + \Omega \int \delta e^{i\pi} = \{2.7182818284\} \chi^2 \Sigma! \gg \infty$$

# Presentation Outline

- Background
  - Effects to Ro-Ro operators
  - Anticipated Impacts
  - Market picture and Fuel Prices
  - Modelling modal shifts
- Measures from the Ro-Ro operator
  - Speed reduction
  - Sailing frequency
  - Technology
- Next Steps
  - Policy measures
  - Environmental implications of new limit

# Background

- As of January 1st 2015:



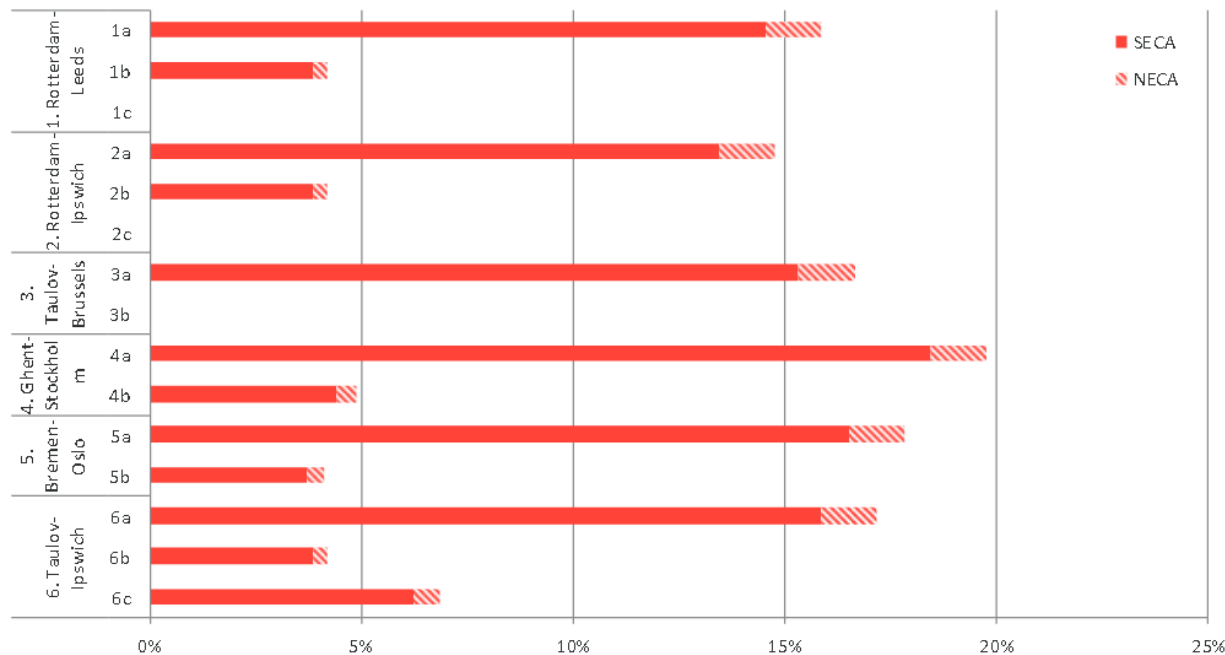
|              | Year      |           |           |                 |
|--------------|-----------|-----------|-----------|-----------------|
| Areas        | 2005-2012 | 2012-2015 | 2015-2020 | 2020 (or 2025)- |
| Within SECA  | 1.5       | 1         | 0.1       | 0.1             |
| Outside SECA | 4.5       | 3.5       | 3.5       | 0.5             |

## Effects to Ro-Ro operators

- Ship operators can either use low-sulphur fuel, or retrofit vessels with scrubber systems
- MGO is more expensive, while scrubbers increase overall fuel consumption, and require significant capital costs
- Increased operating costs could lead to changes in
  - vessel deployment
  - frequency of service
  - sailing speed
  - existence of certain routes
- Some of the additional costs will be passed over to clients through the Bunker Adjustment Factor (BAF – fuel surcharges)

# Anticipated impacts from studies

Figure 23: Percentage cost increase in sea-based costs due to SECA and NECA in 2015 for ro/ro routes



Source: The impact on short sea shipping and the risk of modal shift from the establishment of a NOx emission control area in the North Sea (North Sea Consultation Group, 2013)

# What actually happened

Stena Line records 16% yearly growth on North Sea route



Stena Britannica sails between the UK port of Harwich and the Hook of Holland in the Netherlands

DFDS Wraps Up Record Year, Expects Higher Revenue in 2016



Image Courtesy: DFDS

Danish shipping and logistics company DFDS posted a profit of DKK 1.07bn (USD 151m), up by 89pct when compared to last year's DKK 571 million.

For the full-year 2015, the group reported revenue increase of 5% to DKK 13.5bn. Organic revenue growth, adjusted for route closures and acquisitions, was 7% mainly driven by 7% higher freight shipping volumes and 8% more passengers. In the fourth quarter, organic revenue growth was 10%.

## P&O breaks Channel freight record in 2015

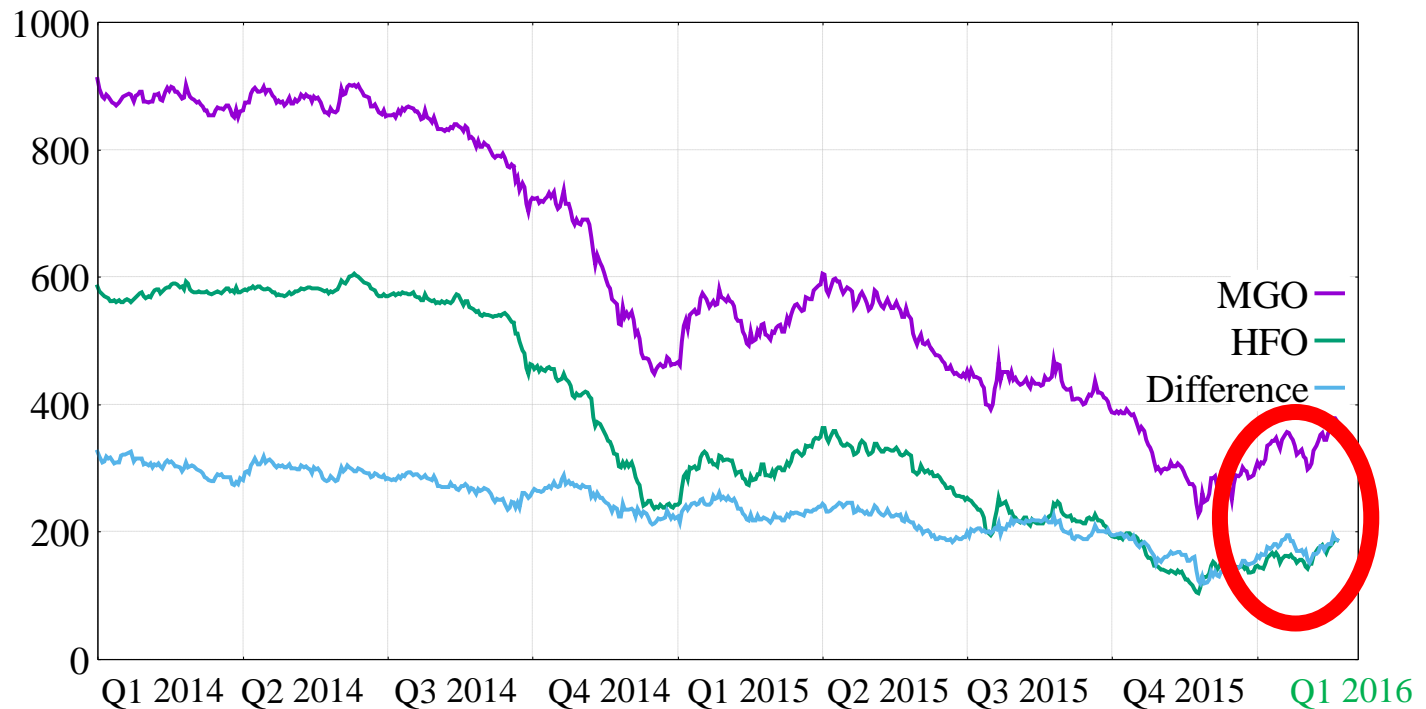
By Charlie Bartlett from London

P&O Ferries transported more freight between Dover and Calais in 2015 than any other year in its "modern history," amounting to 1,340,317 trucks.

The result is a 22% year-on-year increase over 2014, and is due in part to disruptions at the channel tunnel, which caused a 172% year-on-year increase in HGVs on its separate Teesport to Zeebrugge route throughout the month of July. The group pressed a sixth ship back into service on the English Channel that month in order to increase capacity.



## Actual Fuel prices



The absolute price differential would gradually decrease  
 Fuel prices have started going up in 2016

# The RoRoSECA project

- 2 year project
- Funded by the Danish Maritime Fund (DMF)
- Case studies with DFDS
- New decision making tools










# Current DFDS network

- 18 Routes (22 links)
- ~38 vessels
- Up to 535 departures/week, 13 countries, 30 ports
- 4 main areas
  - North Sea (9 Routes, 20 vessels)
  - Baltic Sea (5 Routes, 7 vessels)
  - Cross-Channel (3 Routes, 6-7 vessels)
  - Mediterranean (1 Route, 1-2 vessels)

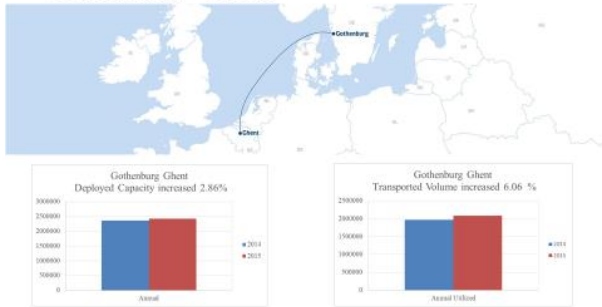


## Route selection criteria

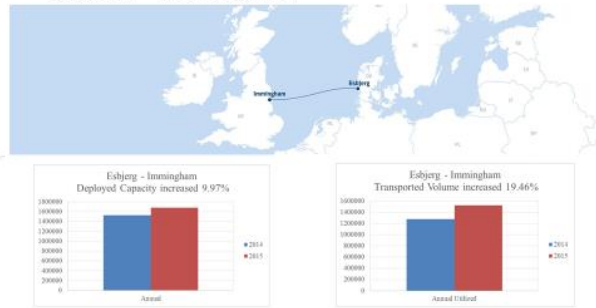
|                        |  |                                  |
|------------------------|--|----------------------------------|
| • Geographical balance |  | Proportion by Region             |
| • Chain configuration  |  | By Sailing Distance & Frequency  |
| • Volume               |  | By Vessel and Route Capacity     |
| • Commodity mixture    |  | Cargo type and value             |
| • Vessel types         |  | Ro-Ro, Ro-Pax, Cruise, abatement |
| • Data availability    |  |                                  |

# Transported volume and deployed capacity 2014 vs 2015

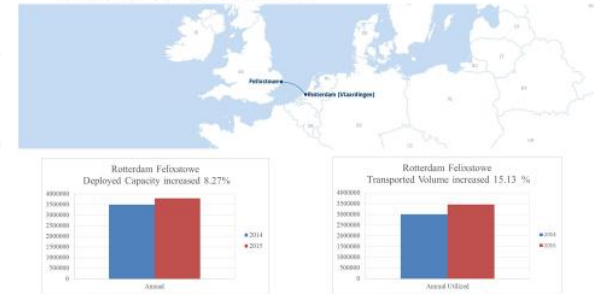
**Gothenburg – Ghent**



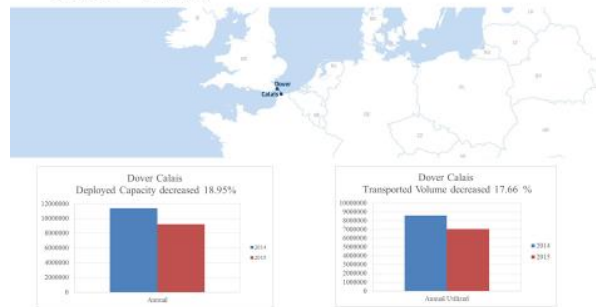
**Esbjerg – Immingham**



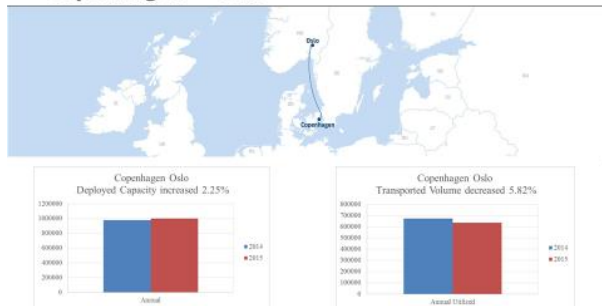
**Rotterdam – Felixstowe**



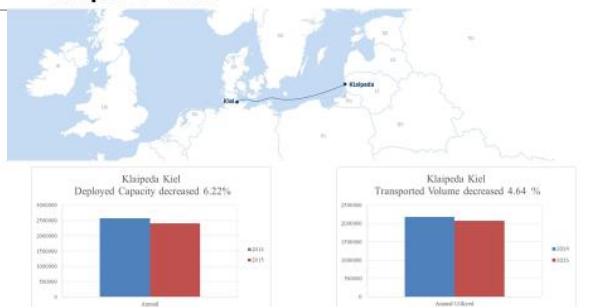
**Dover – Calais**



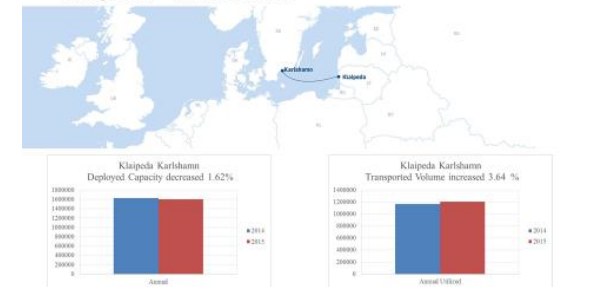
**Copenhagen – Oslo**



**Klaipeda – Kiel**



**Klaipeda – Karlshamn**



# Summary of new market picture

| Route                   | Year         | Trips Total  | Transported<br>Cargo<br>Volume<br>change (%) | Cargo<br>Rate<br>change<br>(%) | Revenue<br>Change<br>(%) | Annual<br>Fuel<br>Cost<br>Change<br>(%) |
|-------------------------|--------------|--------------|--|--------------------------------|--------------------------|---|
| Gothenburg<br>Ghent*    | 2014<br>2015 | 553<br>569   | 6.06   | -5.62                          | 0.09                     | -52.89                                  |
| Esbjerg<br>Immingham    | 2014<br>2015 | 512<br>580   | 19.46  | -0.5                           | 18.85                    | -15.29                                  |
| Rotterdam<br>Felixstowe | 2014<br>2015 | 1514<br>1637 | 15.13  | 0.5                            | 15.71                    | -24.34                                  |
| Copenhagen<br>Oslo      | 2014<br>2015 | 687<br>702   | -5.82  | 1.58                           | 4.28                     | -9.36                                   |
| Klaipeda<br>Kiel*       | 2014<br>2015 | 611<br>615   | -4.64  | -7.71                          | -8.89                    | -30.05                                  |
| Klaipeda<br>Karlshamn   | 2014<br>2015 | 717<br>710   | 3.64   | -2.32                          | 3.73                     | -22.99                                  |
| Dover<br>Calais         | 2014<br>2015 | 6210<br>4994 | -17.66                                       | 9.36                           | -18.04                   | -50.35                                  |

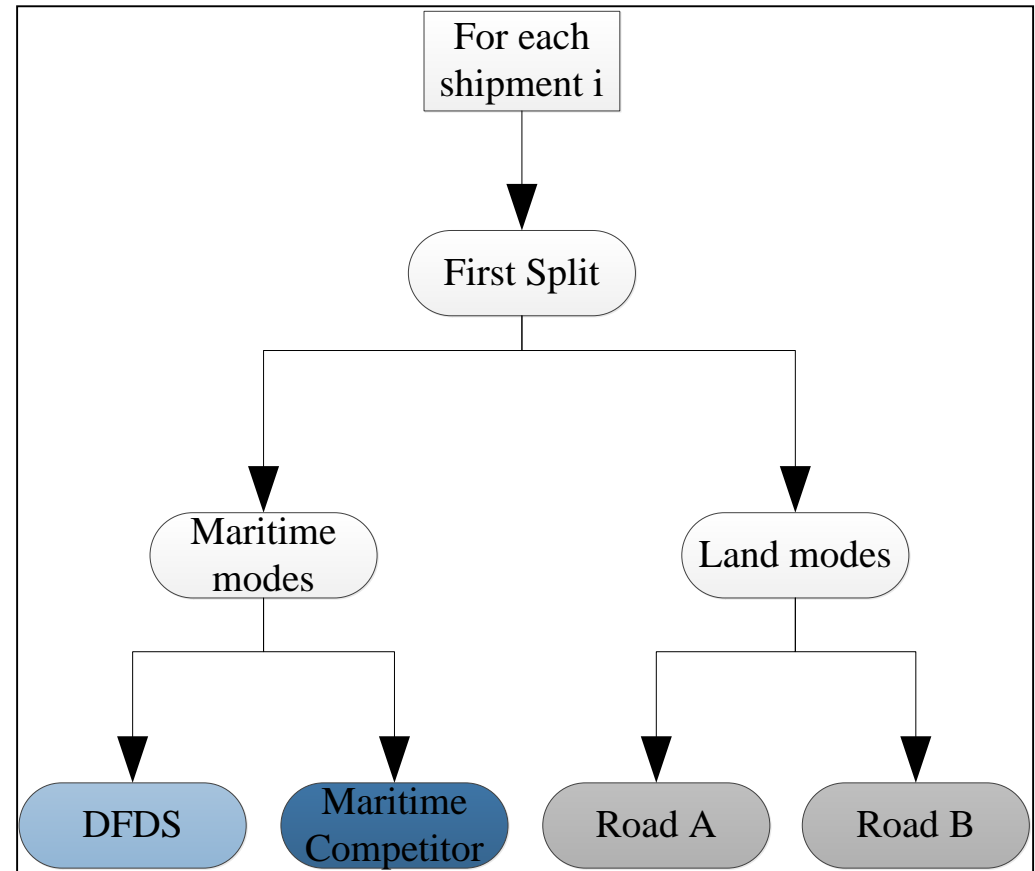
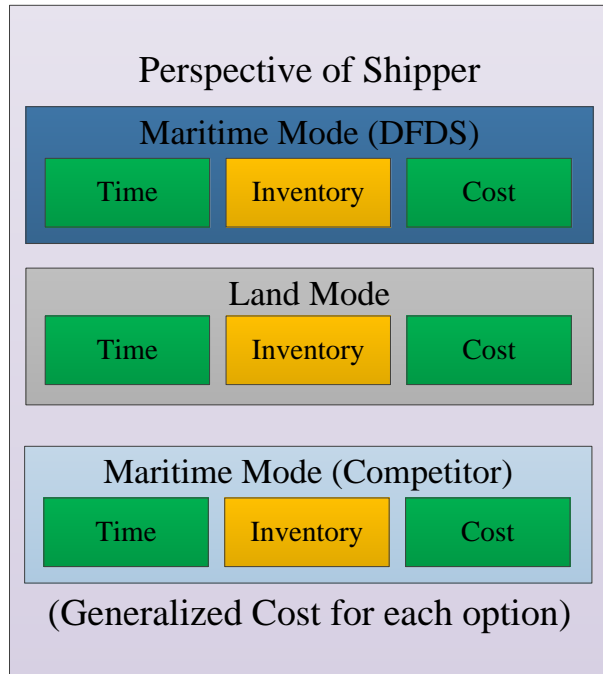
## **Objectives:**

### **Understand the wider implications of the new limit..**

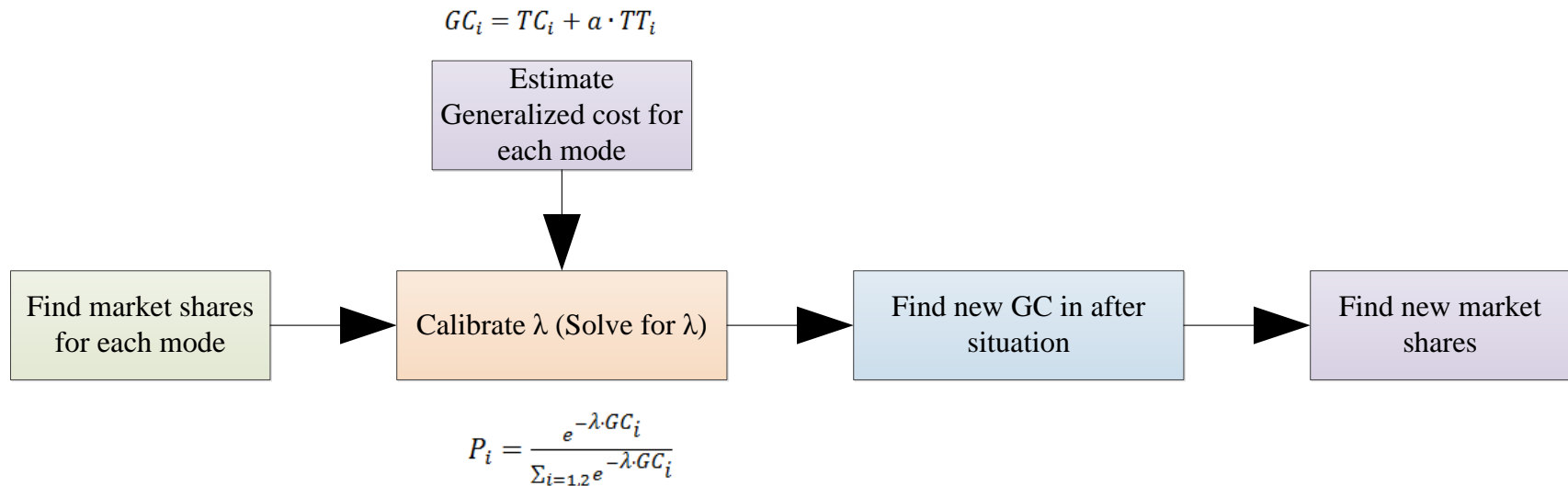
- On SECAs (is the environmental improvement significant?)
- How is Short Sea Shipping affected
- Model modal shifts
- Identify the negative impacts of the regulation
- Propose measures to mitigate and reverse these

# Modal Shifts based on generalized cost of transport

- General Case – Hierarchical Structure



# Process of estimating the impacts of SECA



## Scenarios on Fuel Price

- **Case 1: What actually happened (MGO with actual prices)**
- **Case 2: What would happen if MGO prices returned to 2014 levels**
- **Case 3: What would happen if HFO still allowed (Actual prices)**



# Effects of Speed on fuel consumption

Gothenburg – Ghent (Normal sailing time 32 hours)

| Ship   | Hours at berth | Hours sailing | Weekly fuel consumption (tonnes) | Reduction (%) |
|--|----------------|---------------|----------------------------------|---------------|
| Baseline Sailing Speed <b>18.06 knots</b>                              |                |               |                                  |               |
| Ship A   | 38             | 130           | 294.354                          | NA            |
| Ship B   |                |               | 305.564                          |               |
| Ship C   |                |               | 270.198                          |               |
| Ship D   |                |               | 277.407                          |               |
| Increase Trip by <b>1 hour</b> , New Sailing Speed <b>17.26 knots</b>  |                |               |                                  |               |
| Ship A   | 32             | 136           | 264.585                          | -10.11        |
| Ship B   |                |               | 273.453                          | -10.51        |
| Ship C   |                |               | 245.181                          | -9.26         |
| Ship D   |                |               | 253.777                          | -8.52         |
| Increase Trip by <b>2 hours</b> , New Sailing Speed <b>16.53 knots</b> |                |               |                                  |               |
| Ship A   | 26             | 142           | 240.315                          | -18.36        |
| Ship B   |                |               | 247.638                          | -18.96        |
| Ship C   |                |               | 222.784                          | -17.55        |
| Ship D   |                |               | 231.167                          | -16.67        |
| Increase Trip by <b>3 hours</b> , New Sailing Speed <b>15.86 knots</b> |                |               |                                  |               |
| Ship A   | 20             | 148           | 191.740                          | -34.86        |
| Ship B   |                |               | 196.167                          | -35.80        |
| Ship C   |                |               | 177.715                          | -34.23        |
| Ship D   |                |               | 185.196                          | -33.24        |

# Effects on cargo volumes, revenue, fuel cost

Gothenburg – Ghent (Normal sailing time 32 hours)

| Baseline Sailing Speed <b>18.06 knots</b>                              |                             |                           |
|--|-----------------------------|---------------------------|
|  | Transported lm              | Cost of Fuel (€)          |
| Fuel Case 1  | 42331                       | Confidential              |
| Fuel Case 2  | 39533                       |                           |
| Fuel Case 3  | 43724                       |                           |
| Increase Trip by <b>1 hour</b> , New Sailing Speed <b>17.26 knots</b>  |                             |                           |
|  | $\Delta$ Transported lm (%) | $\Delta$ Cost of Fuel (%) |
| Fuel Case 1  | -0.05                       | -9.98                     |
| Fuel Case 2  | -0.36                       |                           |
| Fuel Case 3  | -0.11                       |                           |
| Increase Trip by <b>2 hours</b> , New Sailing Speed <b>16.53 knots</b> |                             |                           |
| Fuel Case 1  | -0.1                        | -18.32                    |
| Fuel Case 2  | -0.7                        |                           |
| Fuel Case 3  | -0.15                       |                           |
| Increase Trip by <b>3 hours</b> , New Sailing Speed <b>15.86 knots</b> |                             |                           |
| Fuel Case 1  | -0.16                       | -34.99                    |
| Fuel Case 2  | -0.76                       |                           |
| Fuel Case 3  | -0.21                       |                           |

# Effects of new sailing frequency

Esbjerg – Immingham (Normal frequency 6 sailings per week)

|             | New sailing frequency | New Transported Im | New capacity utilization | $\Delta$ Revenue (€) | $\Delta$ Fuel Cost (€) |
|-------------|-----------------------|--------------------|--------------------------|----------------------|------------------------|
| Fuel Case 2 | 5                     | 29060              | 96.86                    | -112273              | -33579                 |
| Fuel Case 3 | 7                     | 34475              | Conf                     | 39897                | 16569                  |

Klaipeda – Kiel (Normal frequency 7 sailings per week)

|             | New sailing frequency | New Transported Im | New capacity utilization | $\Delta$ Revenue | $\Delta$ Fuel Cost |
|-------------|-----------------------|--------------------|--------------------------|------------------|--------------------|
| Fuel Case 1 | 6                     | 26900              | 97.36                    | -32419           | -28172             |
| Fuel Case 2 | 6                     | 25950              | 96.19                    | -25082           | -57093             |

Dover – Calais (Normal frequency 99 sailings per week)

|             | New sailing frequency | New Transported Im | New capacity utilization | $\Delta$ Revenue | $\Delta$ Fuel Cost |
|-------------|-----------------------|--------------------|--------------------------|------------------|--------------------|
| Fuel Case 1 | 75                    | 131724             | 94.63                    | -56039           | -58844             |
| Fuel Case 2 | 75                    | 130760             | Conf                     | -74580           | -119255            |

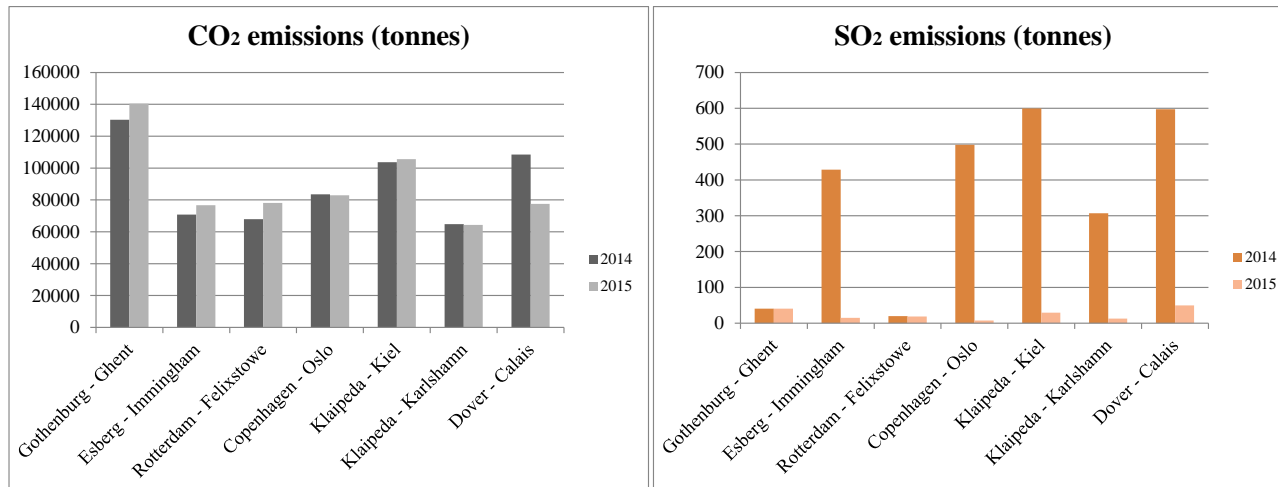
## Payback period of scrubbers

- DFDS has retrofitted 18 of its vessels.
- In the examined routes there are 9 vessels running on low-sulphur fuel
- Assumed a retrofit on the ship with the highest fuel consumption (Ro-Ro)

| <i>Fuel prices</i> | <i>HFO (€/ton)</i> | <i>MGO (€/ton)</i> | <i>Annual Savings<br/>(M€)</i> | <i>Payback period<br/>(years)</i> |
|--------------------|--------------------|--------------------|--------------------------------|-----------------------------------|
| December 2015      | 135                | 304                | 1.21                           | 4.3                               |
| October 2015       | 237                | 480                | 1.731                          | 2.9                               |
| November 2014      | 590                | 880                | 1.998                          | 2.4                               |
| February 2014      | 803                | 1212               | 2.825                          | 1.3                               |

- Considering the global cap coming in 2020, perhaps waiting is an option
  - Different fuel price differential
  - Newer technologies
  - New subsidies to operators may come

# Environmental Impact of new sulphur limits 2014 vs 2015



## Conclusion and further work

- **Freight Rate** is the most important component
- **Time** is **not crucial**, except for high-value cargoes. Speed reduction can help in times of high fuel prices
- Changes in sailing frequency can help with capacity utilization rates
- Technology investments depend on fuel prices, and returns are currently delayed
- **Profitability** of ship operator is **masking the negative effects** of the regulation – a happy coincidence
- Requirements for policy measures to mitigate potential modal shifts

## Thank you - Questions?

The work presented has been in the context of the project:

**"Mitigating and reversing the side-effects of environmental legislation on Ro-Ro shipping in Northern Europe"**

**funded by the Danish Maritime Fund.**

**See more: [www.roroseca.transport.dtu.dk](http://www.roroseca.transport.dtu.dk)**

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