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## The enhanced Modal split model (Task 2.2)

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$$P(i|V) = \frac{\partial \ln G(e^V)}{\partial V_i} \int_a^b \epsilon \Theta + \Omega \int \delta e^{i\pi} = \{2.7182818284\}$$

# Presentation Outline

- Background
  - Objectives
  - Anticipated Impacts
  - Market picture and Fuel Prices
  - Effects to Ro-Ro operators
  - Costs for shippers
  
- Modelling Modal shifts
  - Methodology
  - Process
  - Modular approach
  
- Initial findings
  - The most important parameter
  - Case studies
  
- First Conclusions and Next Steps

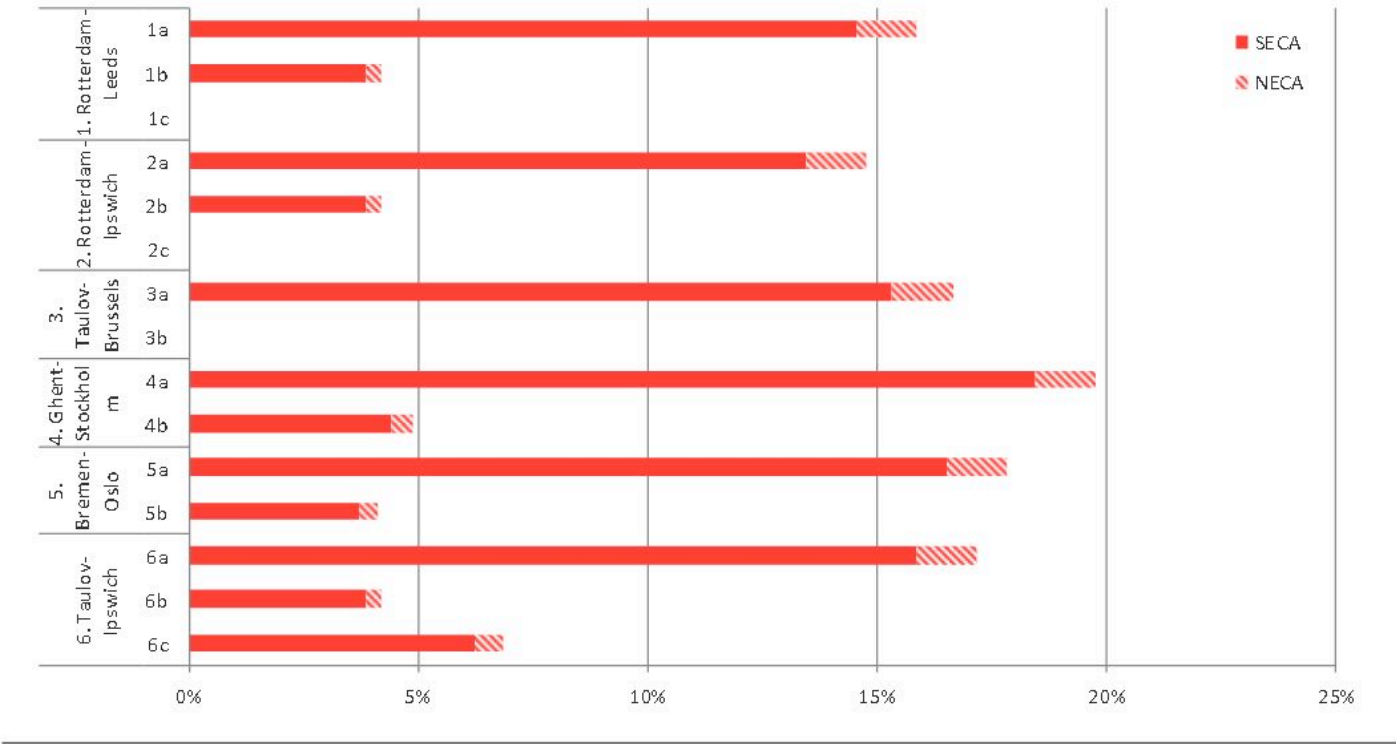
# **Objectives:**

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

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

# 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)

# Press releases **before** the new limit

## SECA SHUTS DOWN TRANSFENNICA IBERIAN SERVICE

The Dutch-owned short-sea shipping line Transfennica (part of the Spliethoff Group) has announced that it is to cease its "Motorways of the Sea" ro-ro service between Bilbao, Portsmouth and Zeebrugge at the end of this month (December).

The decision is a direct result of the introduction of stricter new low-sulphur emission controls from 1 January 2015 in the Baltic Sea, the Kattegat, the North Sea and English Channel. A further SECA extends in a 200 nautical miles wide belt along the coasts of the USA and Canada.

## SECA requirements lead to new European rail link

**CARRIERS:** Railway company ERS is opening a new route in Europe in light of rising customer demand following the implementation of new sulphur regulations. Many customers and countries are willing to change their mode of transport in order to save money.

## DFDS closes Sassnitz-Klaipeda connection

Publication date: 2013-08-30

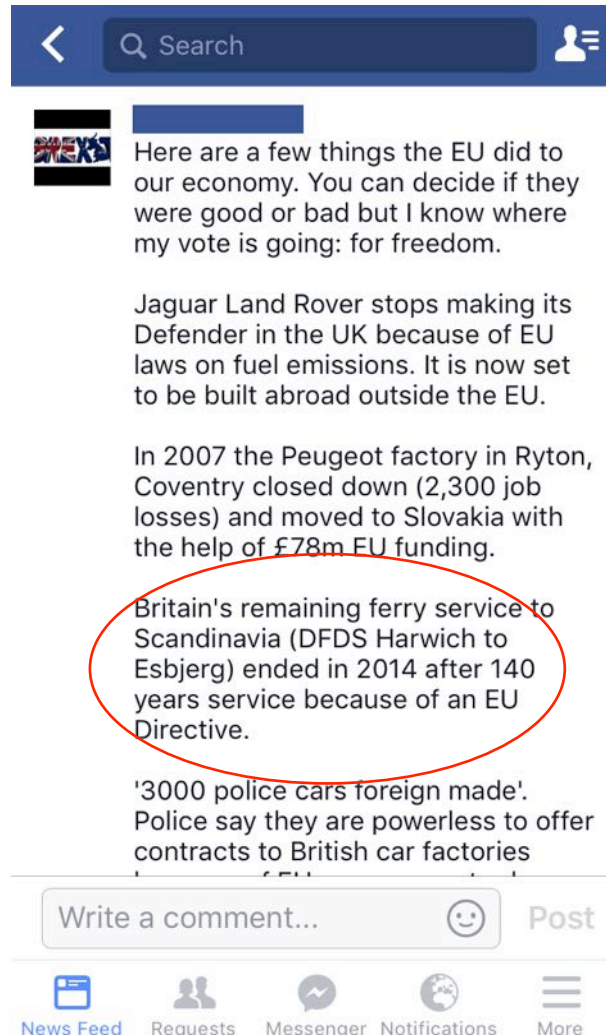
Tags: maritime, germany, denmark, lithuania



**DFDS Seaways has decided to close the ferry service between Sassnitz, Germany and Klaipeda, Lithuania with effect from the end of September.**

Previously a busy connection, the route has over the years become economically unviable. As Vice President of DFDS, Anders Refsgaard, stated: "We have fought hard to get new customers and improve revenue and profit, but unfortunately without success". He added, that with the outlook on continued decline in profits, and in light of the new sulphur regulations to be introduced from 1 January 2015, the company does not believe that it will be possible to turn the tide on the crossing.

# Some surprising evidence ahead of Brexit referendum...



# But were they right in predicting?

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

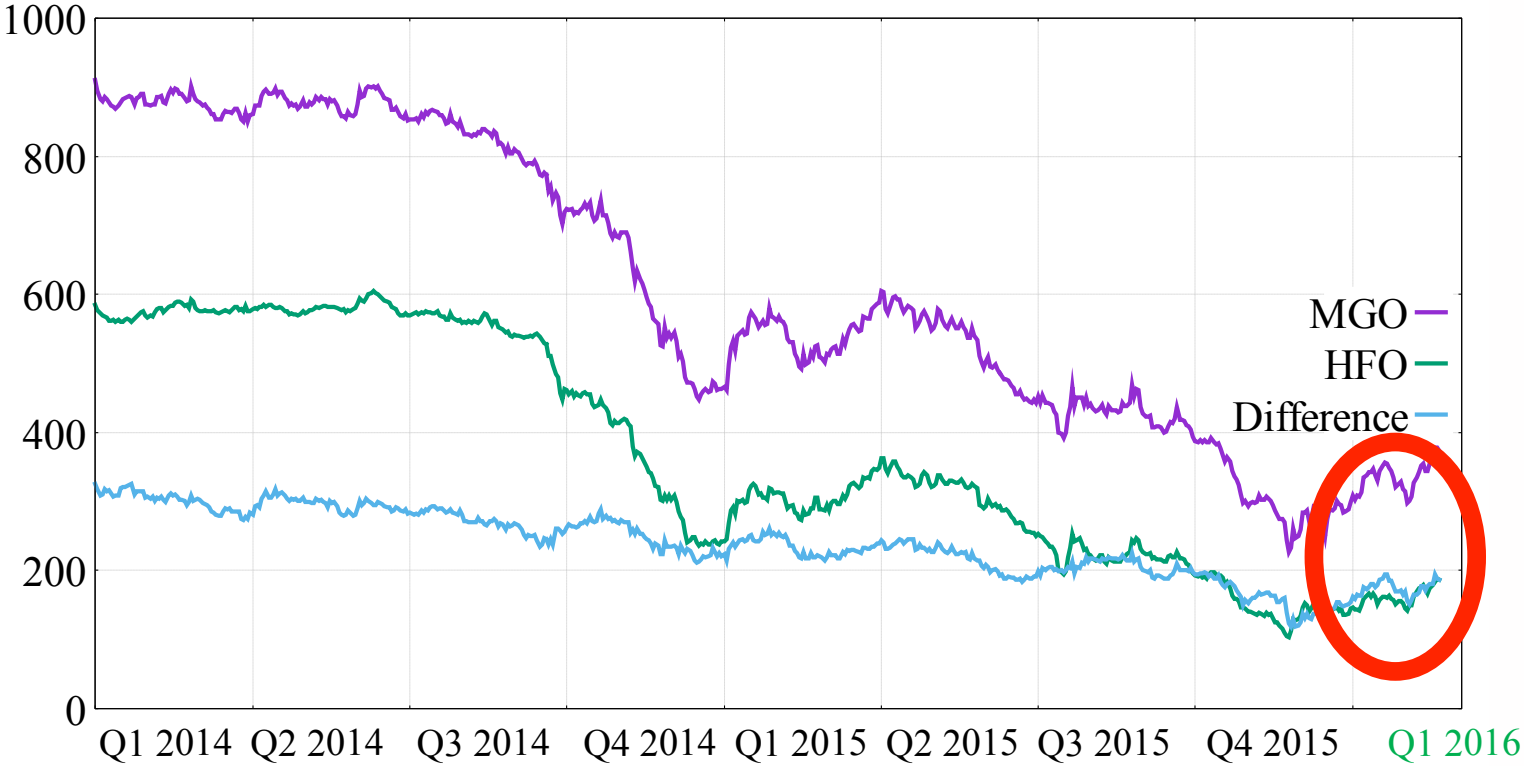
*By Charlie Bartlett from London*

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

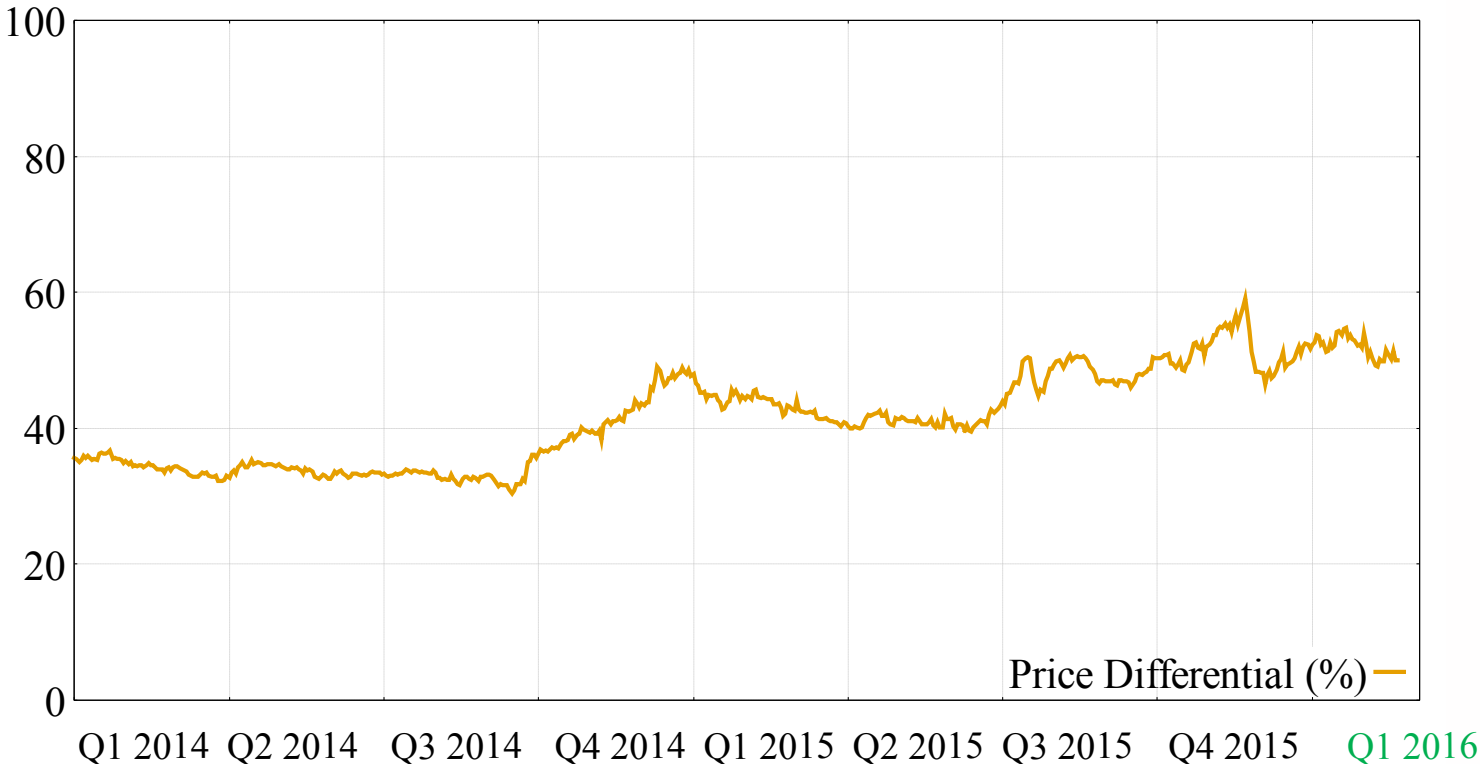


The absolute price differential would gradually decrease  
 Fuel prices have started going up in 2016



# Fuel Price Differential: MGO-HFO (%)

## How much more expensive is MGO?



In % terms, MGO is becoming more expensive  
As HFO dropped at a higher rate

## Ro-Ro vs Road Transport competition

- The competitive position of Ro-Ro shipping in comparison with road transport became worse, since the difference in fuel price has become smaller.
- The fuel price difference decreased from around \$1,240 (HFO-diesel) to around \$900 (MGO- diesel) per tonne of fuel
- the first available evidence shows that Ro-Ro shipping has largely been able to cope with the fuel price increases. Some of the largest Ro-Ro operators report outstanding financial figures over 2015.

Source: SECA Assessment: Impacts of 2015 SECA marine fuel sulphur limits .First drawings from European experiences. CE Delft

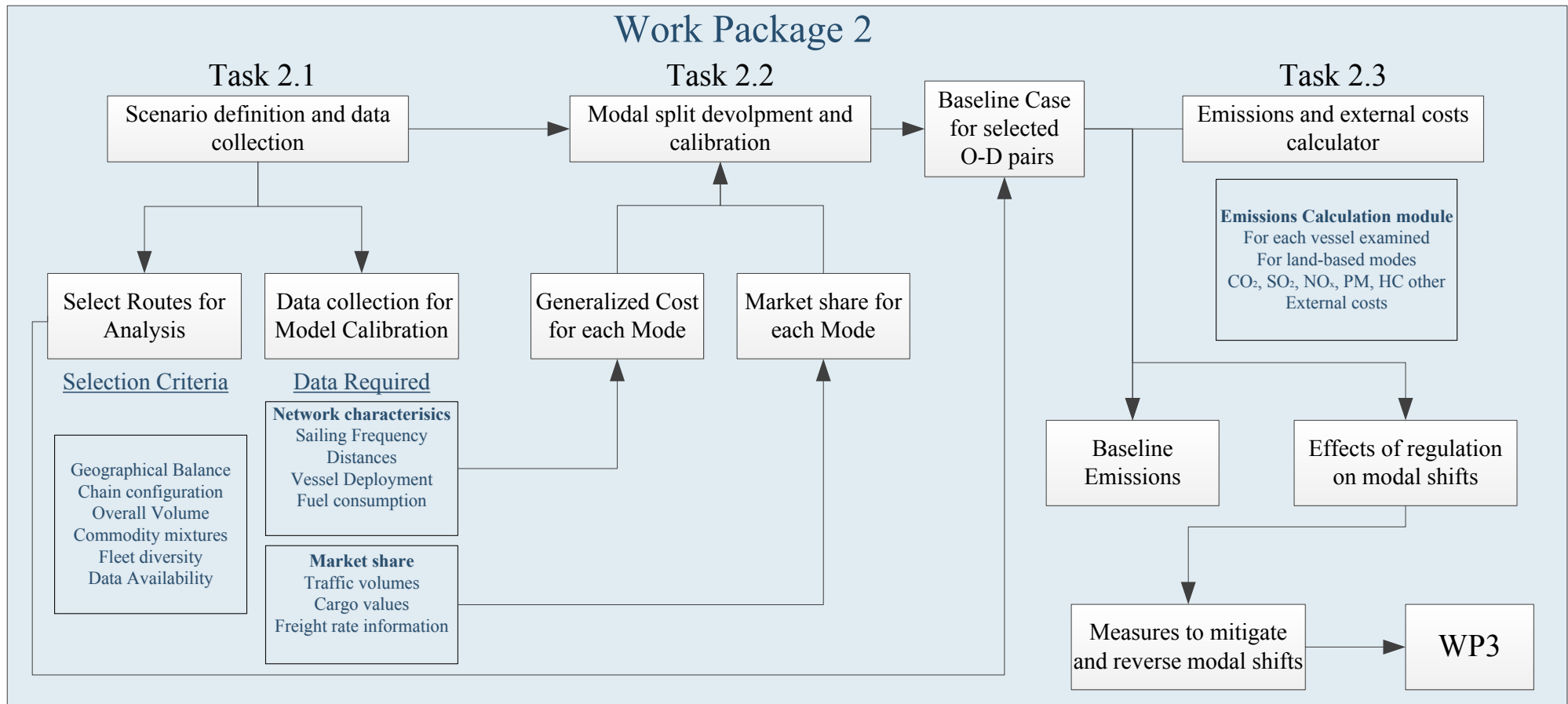
# Cost to shippers

- Shippers **would see increased fare rates** due to the SECA regulation
- Even though **MGO is now cheaper than what HFO was** before the new limit, **shippers would pay even less if HFO was still allowed**
- Changes from ship operators on service may affect mode choice for shippers
- Reliability of certain services is at higher risk
- Is it possible to isolate the effects of the new limits from certain events that also affect mode choice? Including:
  - Low fuel prices
  - Competitive services shutting down
  - An overall change in transport demand

# 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)

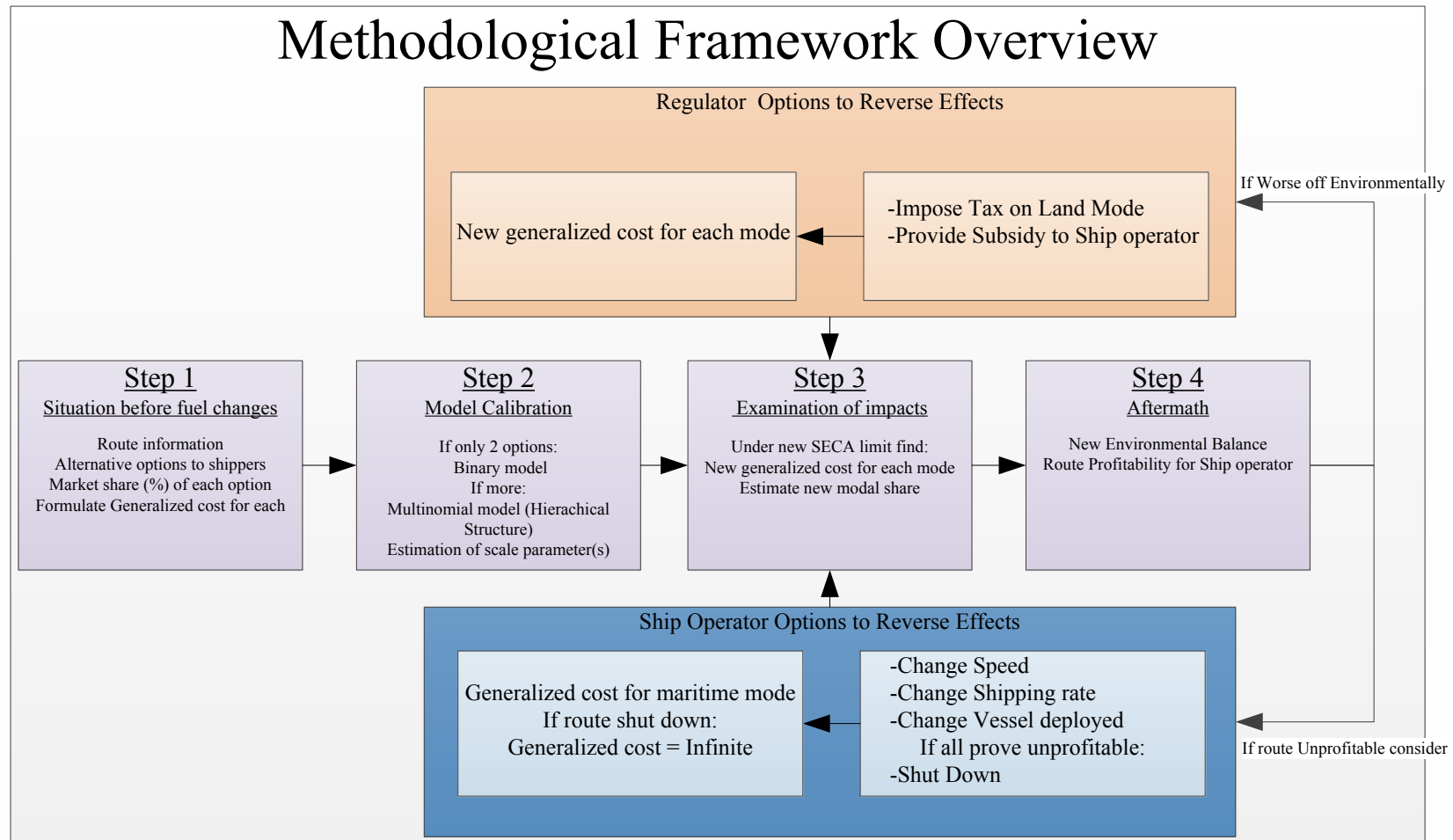
# Objectives of WP2



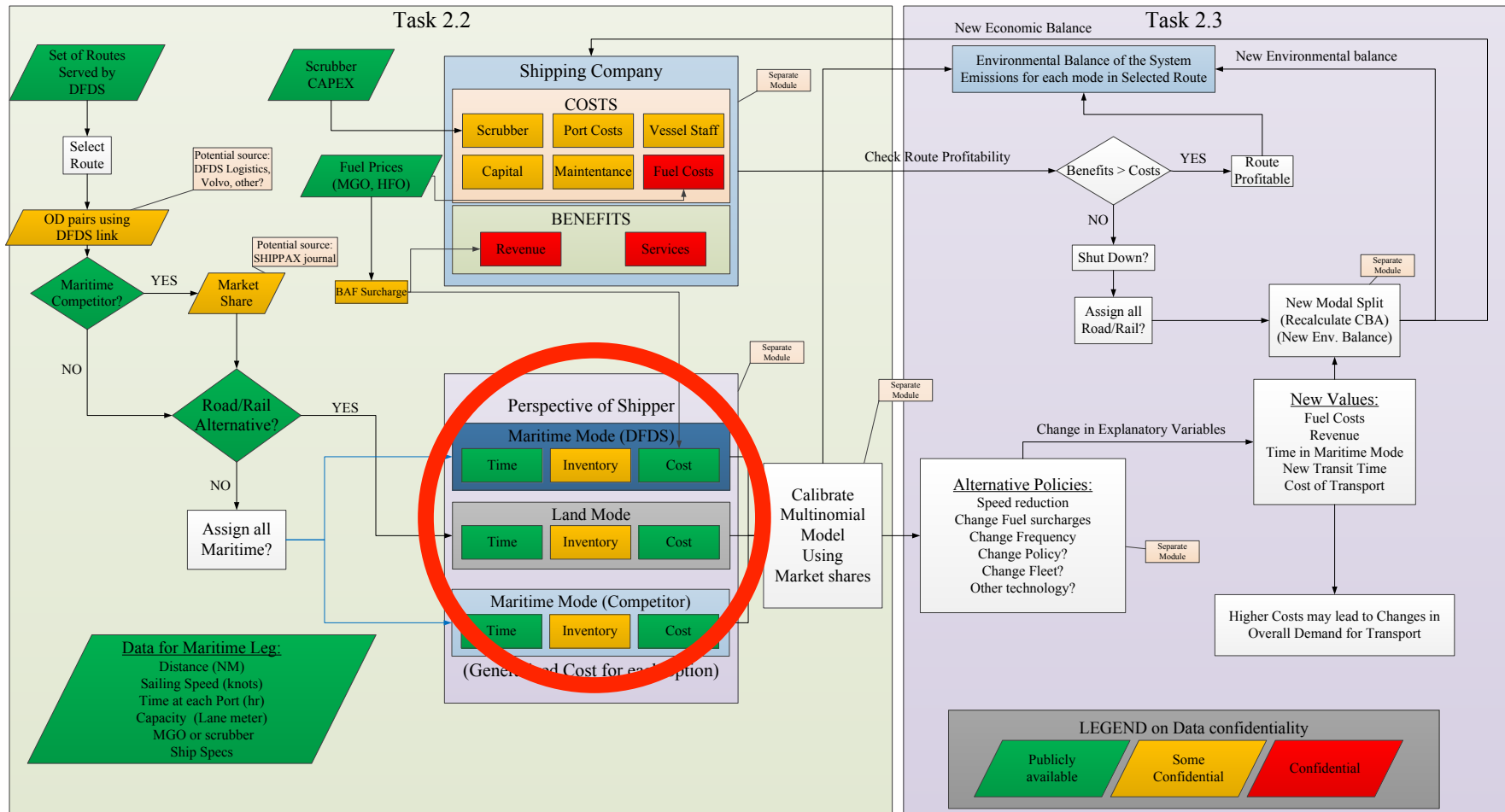
# Methodology

- First Year
  - Identify Routes for examination
  - Gather necessary data
  - Estimate Benchmark scenarios (emissions, shares, costs)
  - Calibrate model
  - Consider different scenarios based on fuel prices
- Second Year
  - Policy measures to reverse effects
  - Operators measures (speed reduction, frequency, fleet etc)

# Linking the various modules together



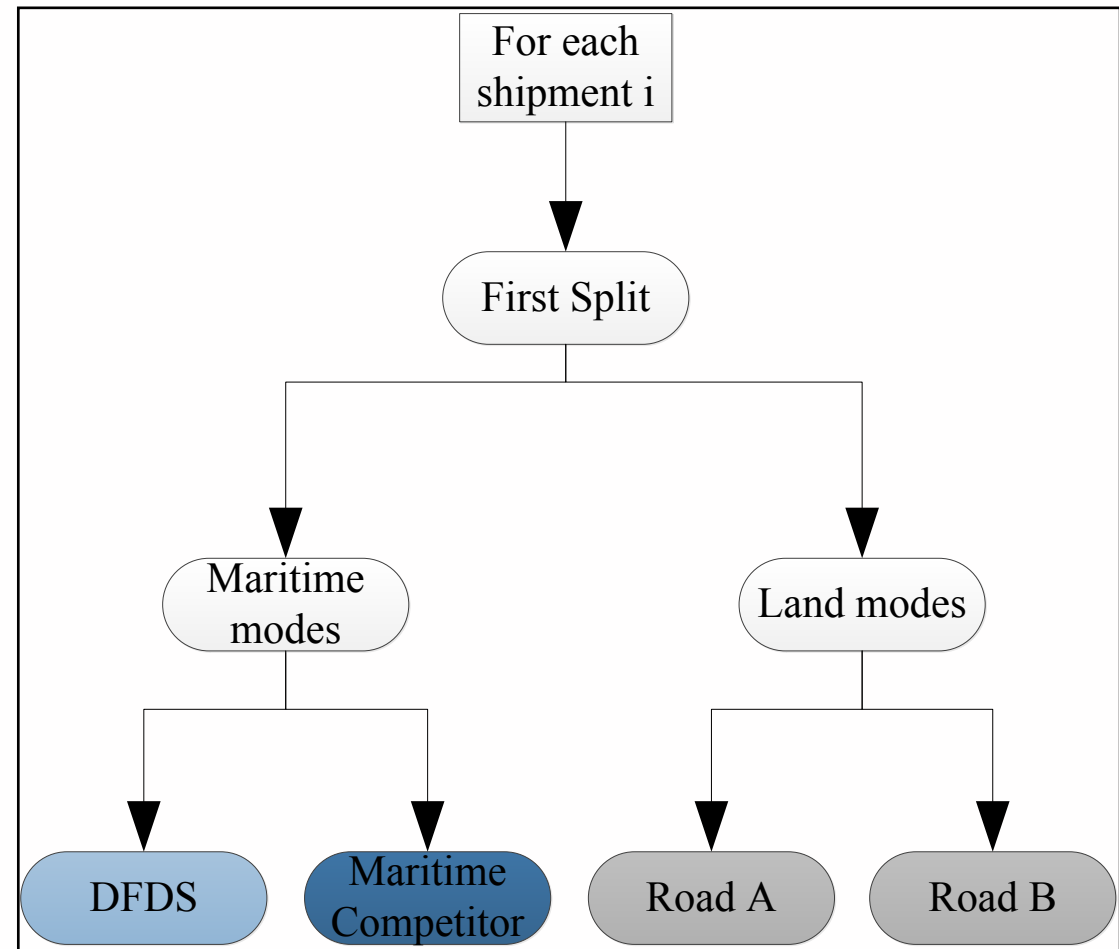
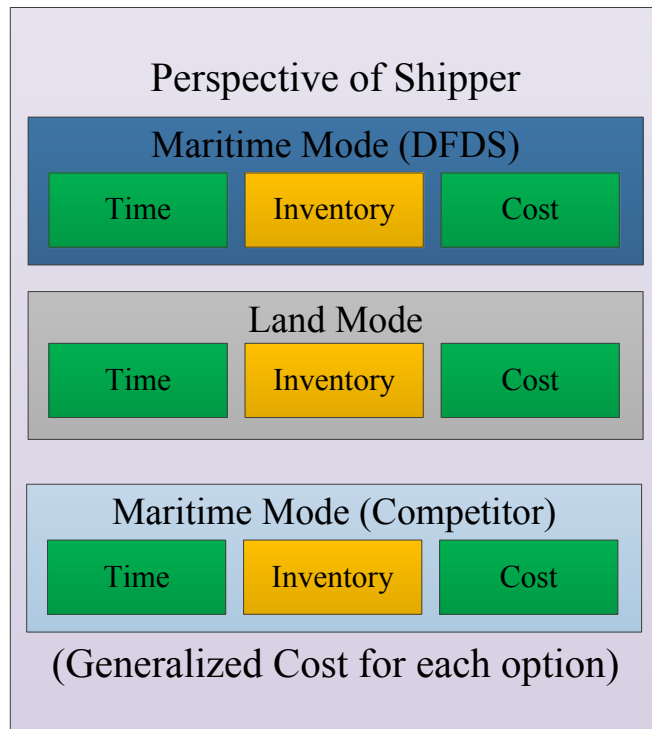
# Methodological Framework





# Perspective of the Shipper

- General Case – Hierarchical Structure



# A Modal shift logit model

- Probability of selecting mode  $i$  is

$$P_i = \frac{e^{-\lambda \cdot GC_i}}{\sum_{i=1}^2 e^{-\lambda \cdot GC_i}}$$

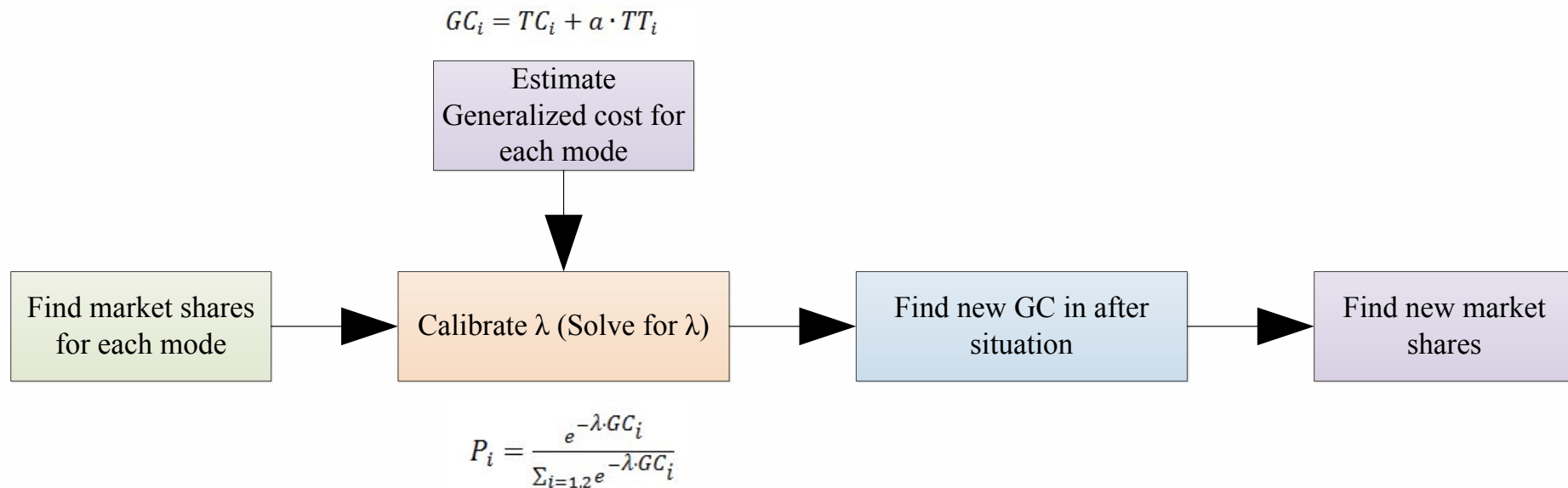
Where  $GC_i$  is the Generalized Cost of mode  $i$ :

$$GC_i = TC_i + a \cdot TT_i$$

Where  $TC_i$  is the Travel Cost (€/lm),  $TT_i$  is the Travel Time (hours),  $a$  is the value of time (€/lm\*hours)

- $\lambda$  is a scale parameter that acts as a weight attached in the choice. The larger the value, the greater the implication of a change in cost in one of the modes

# Process of estimating the impacts of SECA



# Calibration, Simulation, Sensitivity Module

1	New cartor - time:	DFDS	other maritime	Truck
2	Cart	Time	Time cart	Cart
3	29.61333333	30.61428571	323	0.157265166
4	generalized cart	DFDS Gen cart	Other maritime Gen Cart	Gen cart
5	29.7705985		34.6434927	49.48
6	COMPOSITE COST MARITIME:	-5.6328952		
7	PREDICTION MODAL SHARES			
8	firstsplit	ALL MARITIME	ROAD	
9	57.2766266		42.7233734	
10				
11	secondarysplit	DFDS newshare	other maritime newshare	ROAD
12	29.92750022	27.34912637	42.7233734	Change in each mode:
13	e.g	52.25080806	47.74919194	DFDS new other ma ROAD
14				-2.4725 5.74913 -3.276626596
14	From Calibration of the Model Sheet			
15	FIRST SPLIT lamda11	0.005319467	f9	
16	lamda2 firstsplit dfdr/maritime	0.018334768	c16	
17	lamda2 firstsplit truck1-truck2	0.000368733	c22	
21				
22				
23				
24				
25				

Route	Sailing Speed (knots)	Default	17.48	Change	17	Value (flm)	Ship Leg Distance (NM)	Time (hours)	Time at port Origin	Trans
Gøttenburg - Ghent	Speed (knots)	Default	70							
Sailing Distance (NM)	577									
Commodity 1	577					49.3697479	2			
Commodity 2	577					47.9417647	2			
Commodity 3	577					40.79831933	2			
Commodity 4	577					42.22689076	2			
Commodity 5	577					45.09403361	2			
Commodity 6	577					39.3697479	2			
Commodity 7	577					38.65546218	2			
Commodity 8	577					39.65546218	2			
Commodity 9	577					39.3697479	2			
Commodity 10	577					38.05546218	2			

Remove Option

What do you want to do in the Calibration Stage

Remove Other Maritime Mode

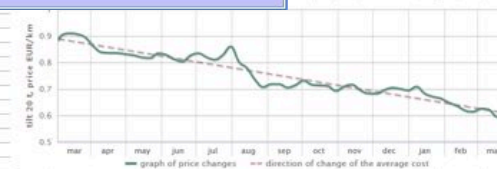
Remove All Road Modes

Add Road Mode 2

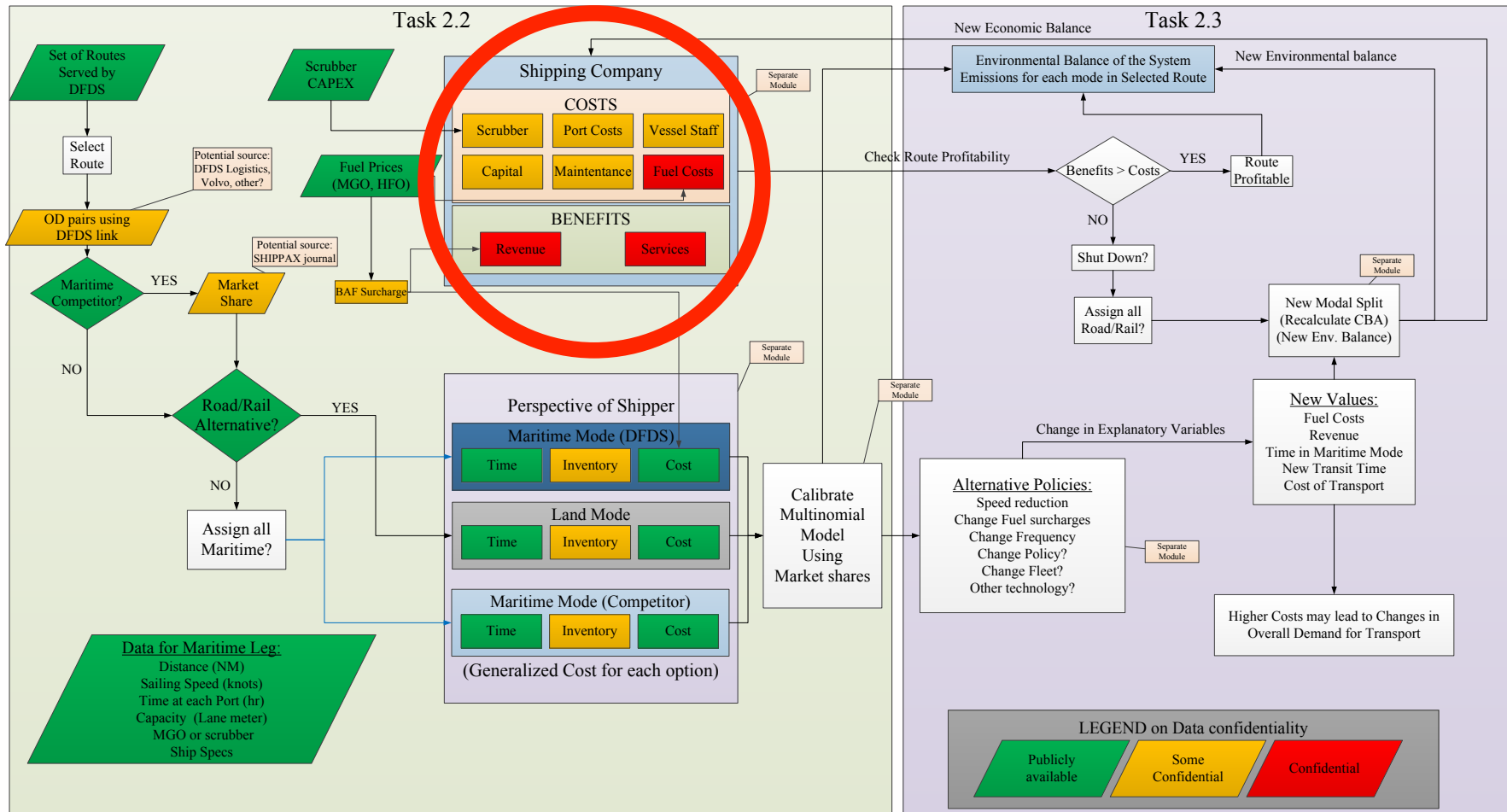
Restore Default

Go

Basic Value (DKK/2 TEU* 1TEU - 6m)	Basic Value (Dkk/flm*km)
0.40959	0.03413

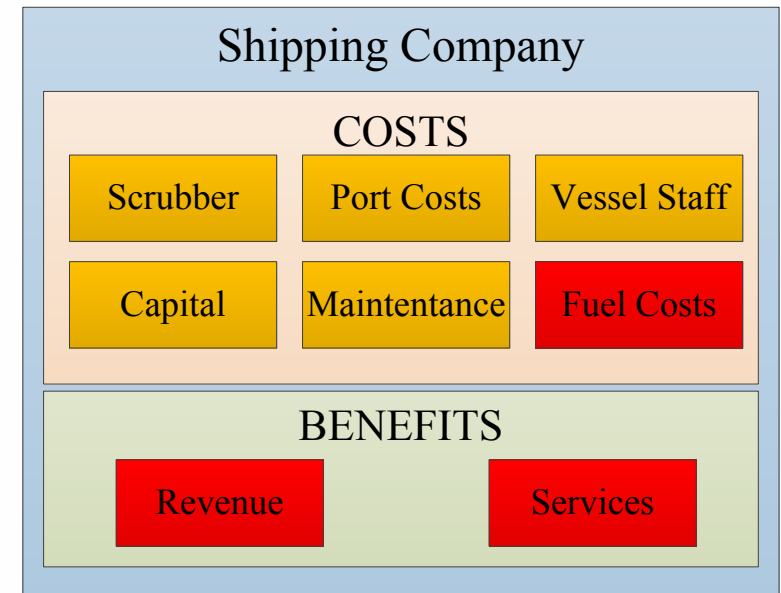


# Process

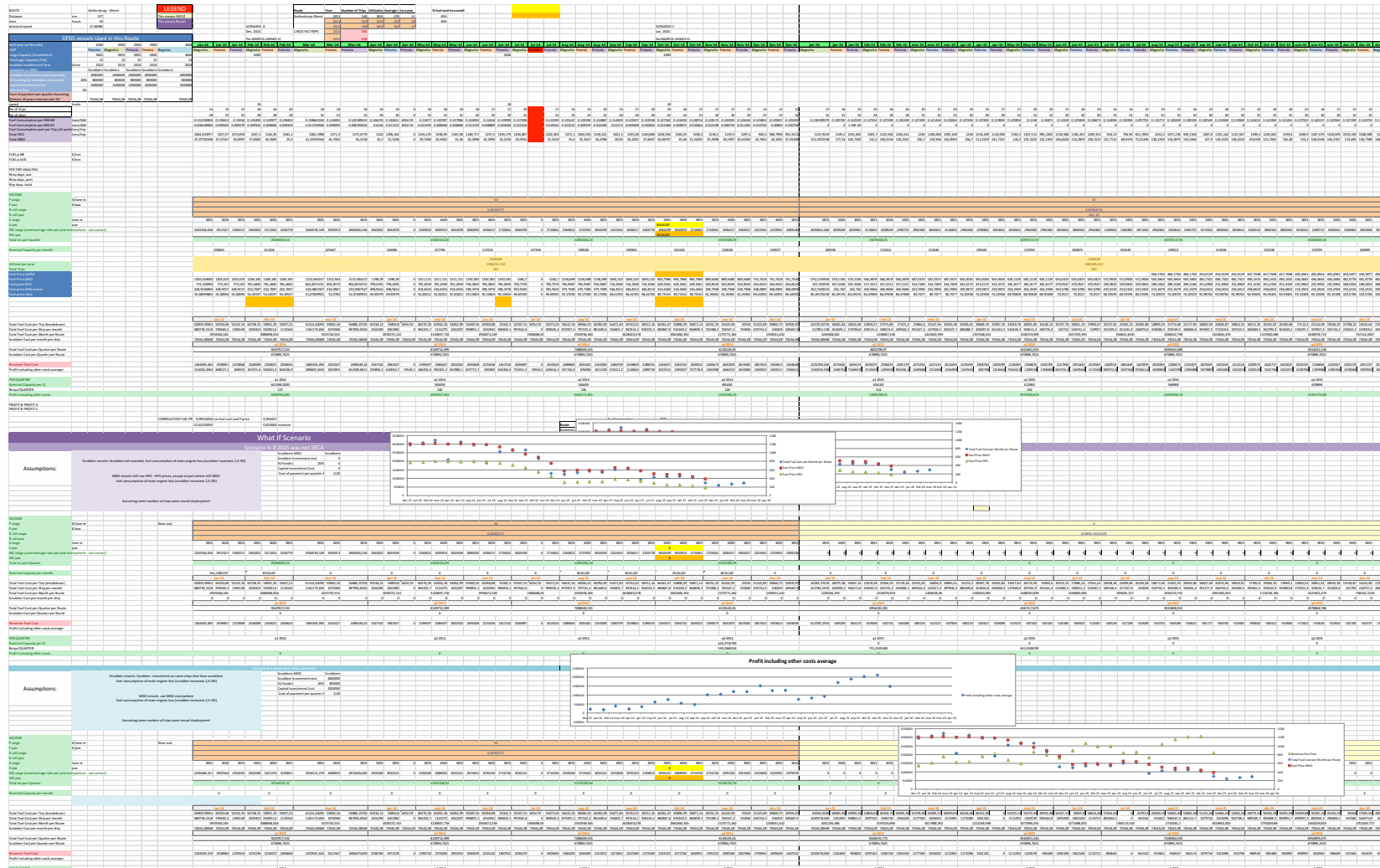


# Perspective of the Shipping Company

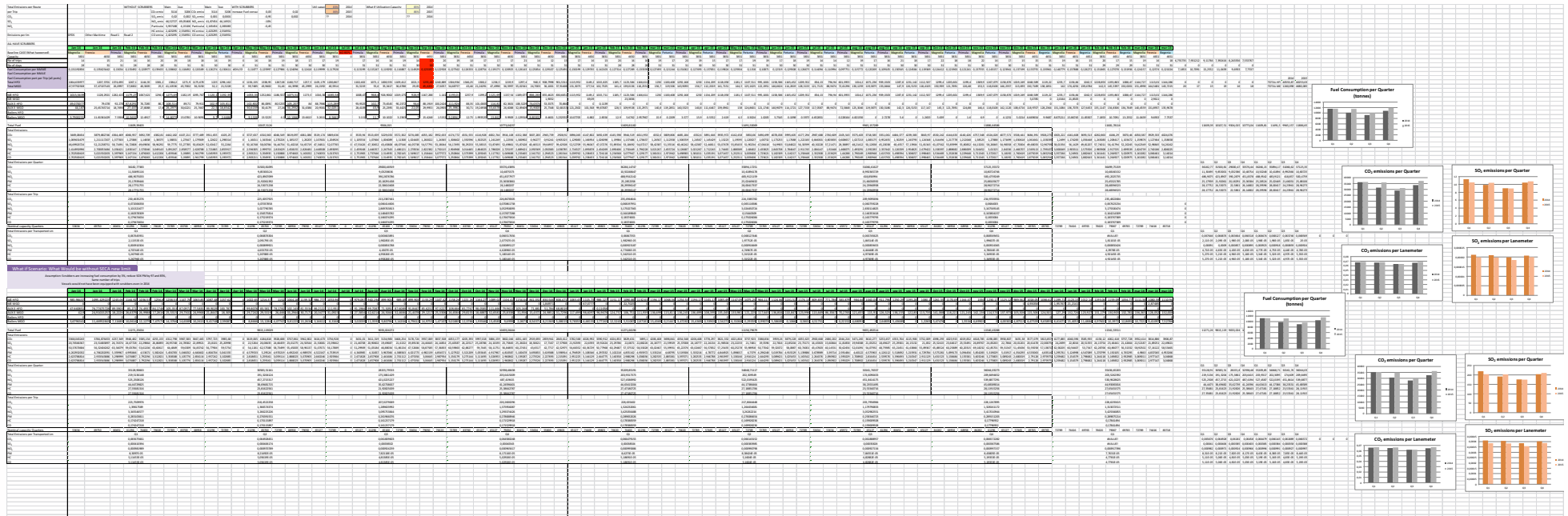
- Identify Revenue with a given Transport Demand
  - Passengers
  - Freight Rate for Cargo
  - Miscellaneous (Food, Drinks, Casino etc.)
- Identify Costs
  - Fuel
  - Port
  - Staff
  - Maintenance
  - Other
- Formulate Profitability Function
  - If Route non-profitable, consider shut down
  - Re-run modal split



# Economics Module (Fuel Costs, Revenue, Before, After, and at what-if)



# Environmental Module (Emissions before, after, and at what-if)





# Initial Findings 2014-2015

- Gothenburg – Ghent (DFDS, + maritime, + only Road)
- Dover – Calais (DFDS + Eurotunnel)
- Klaipeda – Kiel (DFDS + only Road)

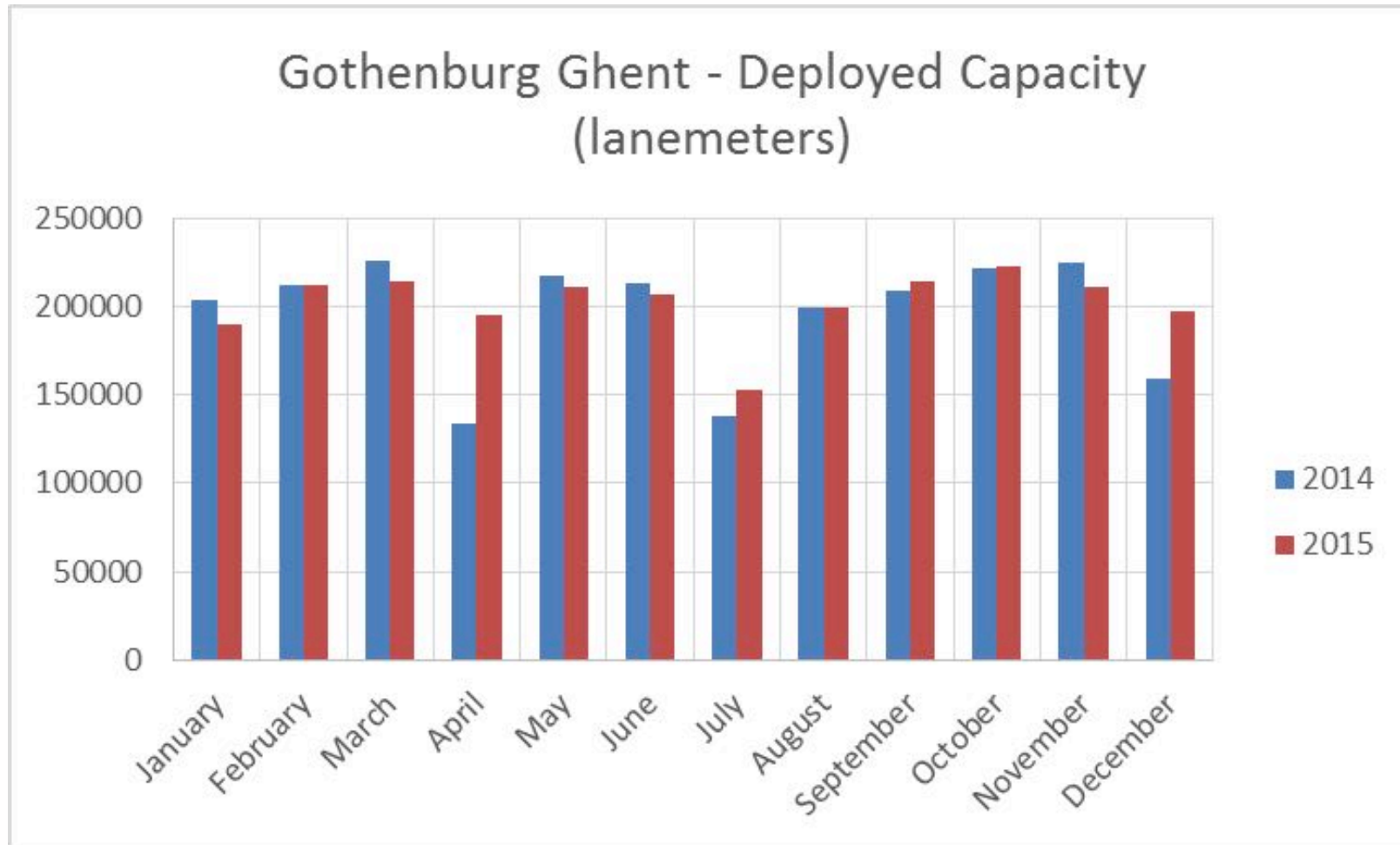
# The most important component

- **Transportation Cost** is the most important component of Generalized Cost
- **Time** is crucial for **very high value** cargoes, and high depreciation rates
- Model predicts small increases of market share of maritime options due to lower freight rates
  - E.g. The probability of selecting a maritime Option increases
  - Without the fuel requirement, freight rates would be even lower
- Routes that improved more, are also more vulnerable if fuel prices increase
- Importance of time can be key to introduce mitigating measures (WP3)

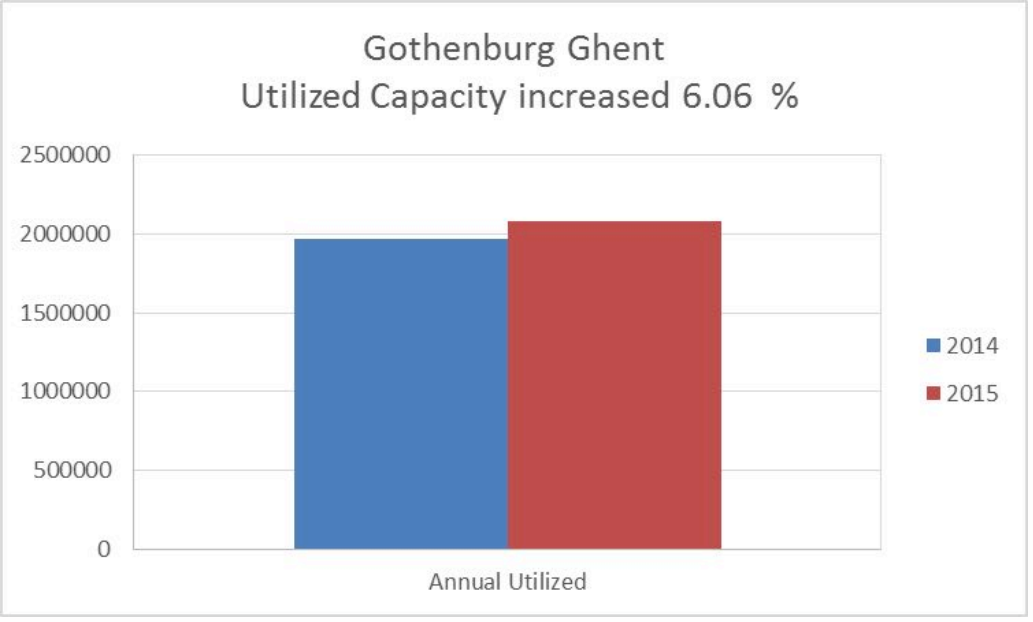
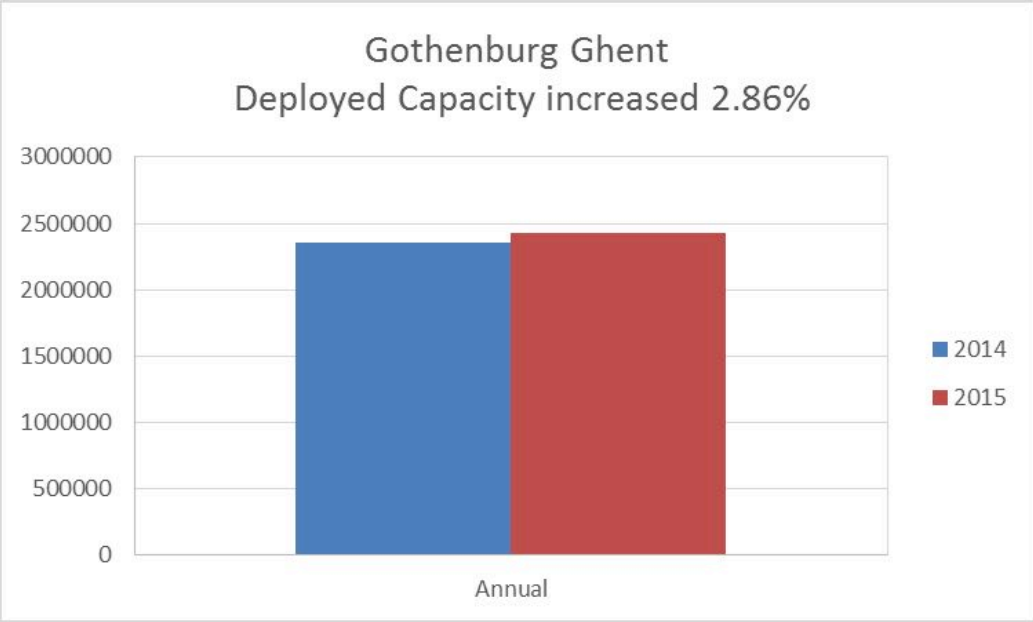
# Gothenburg – Ghent (What happened)



# 2014 vs 2015 Gothenburg Ghent



# 2014 vs 2015 Gothenburg Ghent



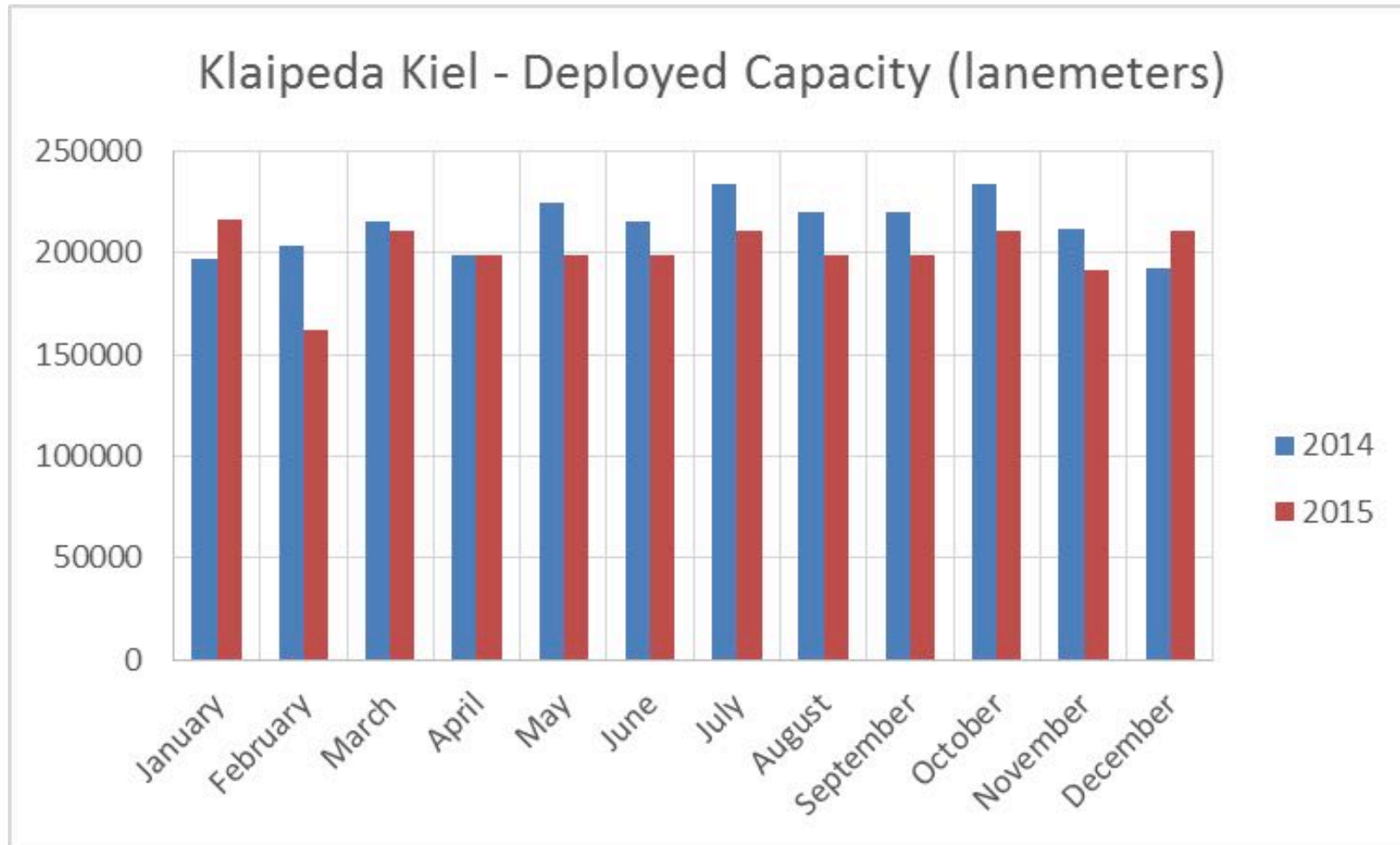
# Gothenburg Ghent

- Increased Deployment
- Increased Utilized Capacity
- Increased number of trips
- Fuel costs is a **high** component of overall costs in this route
- Freight rates **decreased**

# Klaipeda – Kiel (What happened)

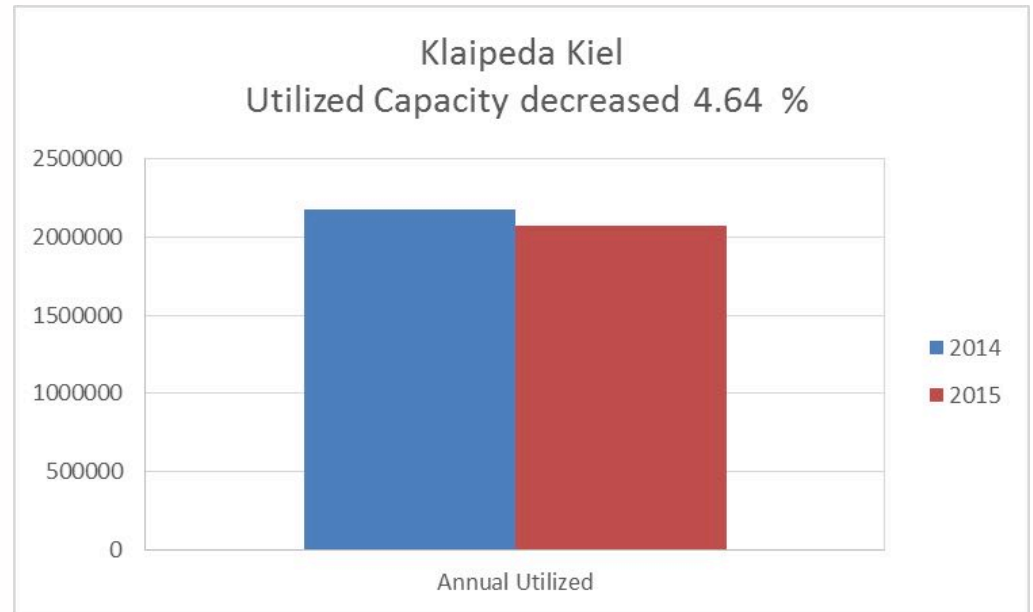
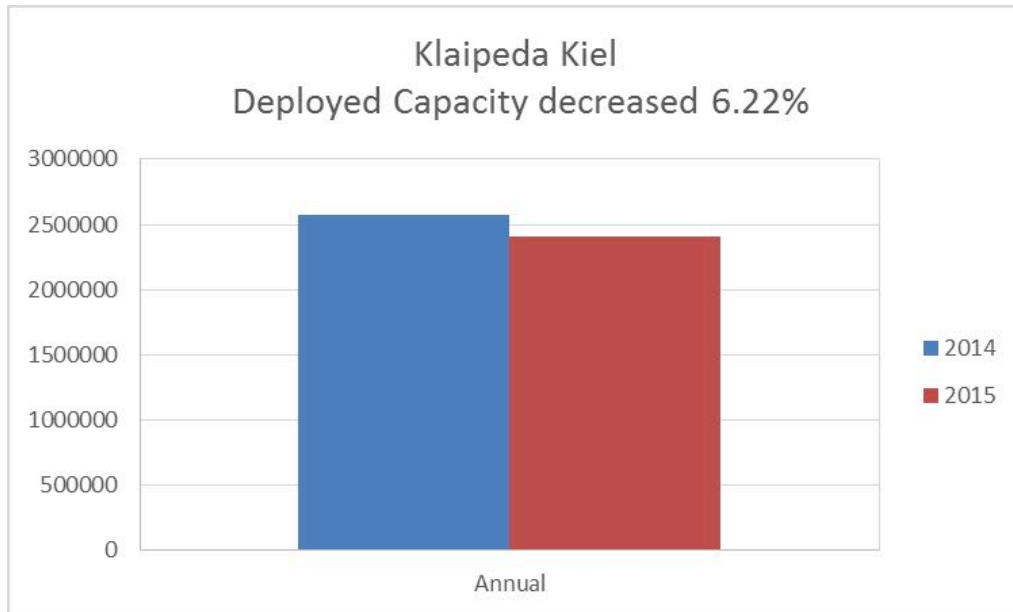


# 2014 vs 2015 Klaipeda Kiel



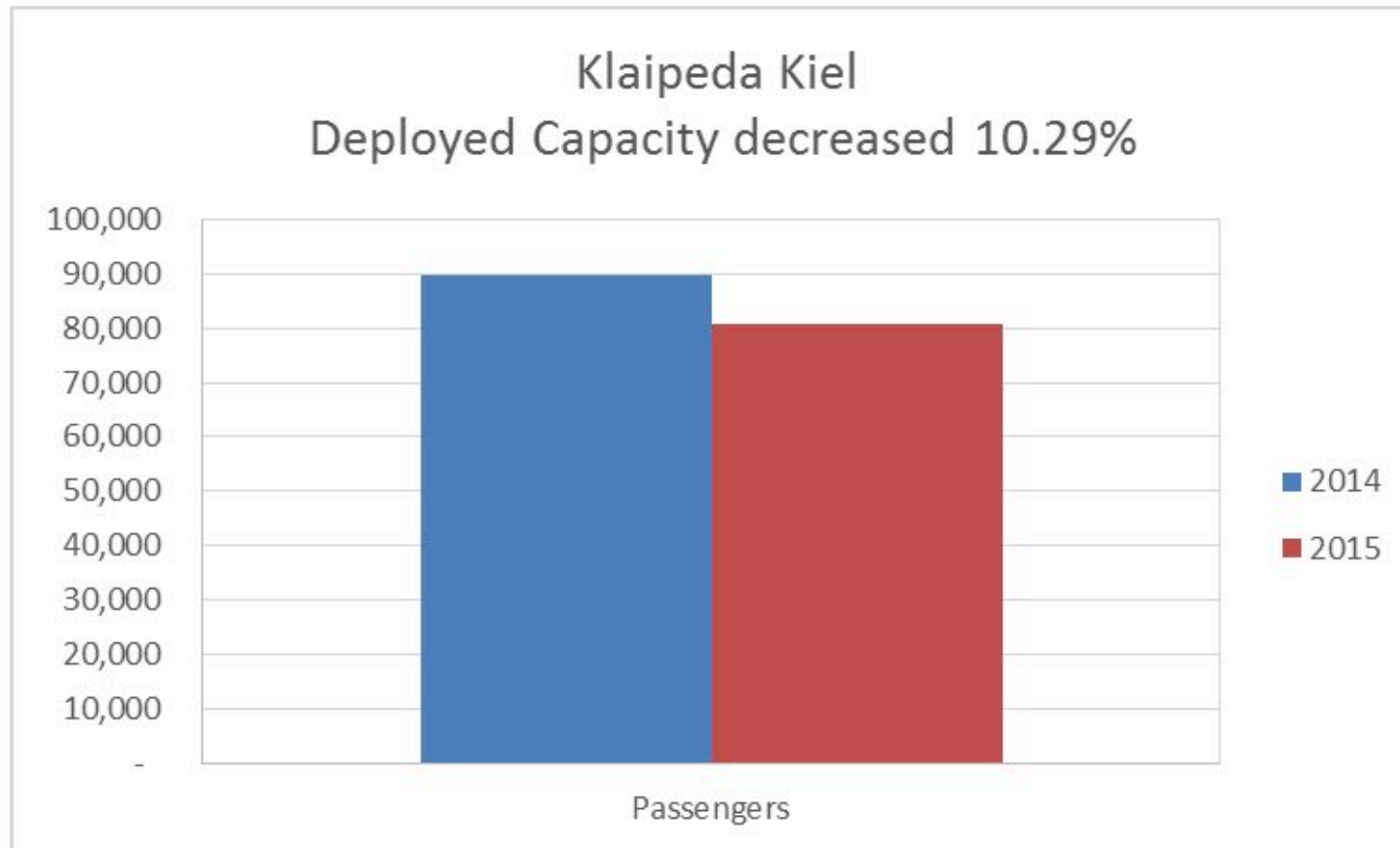


# 2014 vs 2015 Klaipeda Kiel



# 2014 vs 2015

## Klaipeda Kiel - Passengers



# Klaipeda Kiel

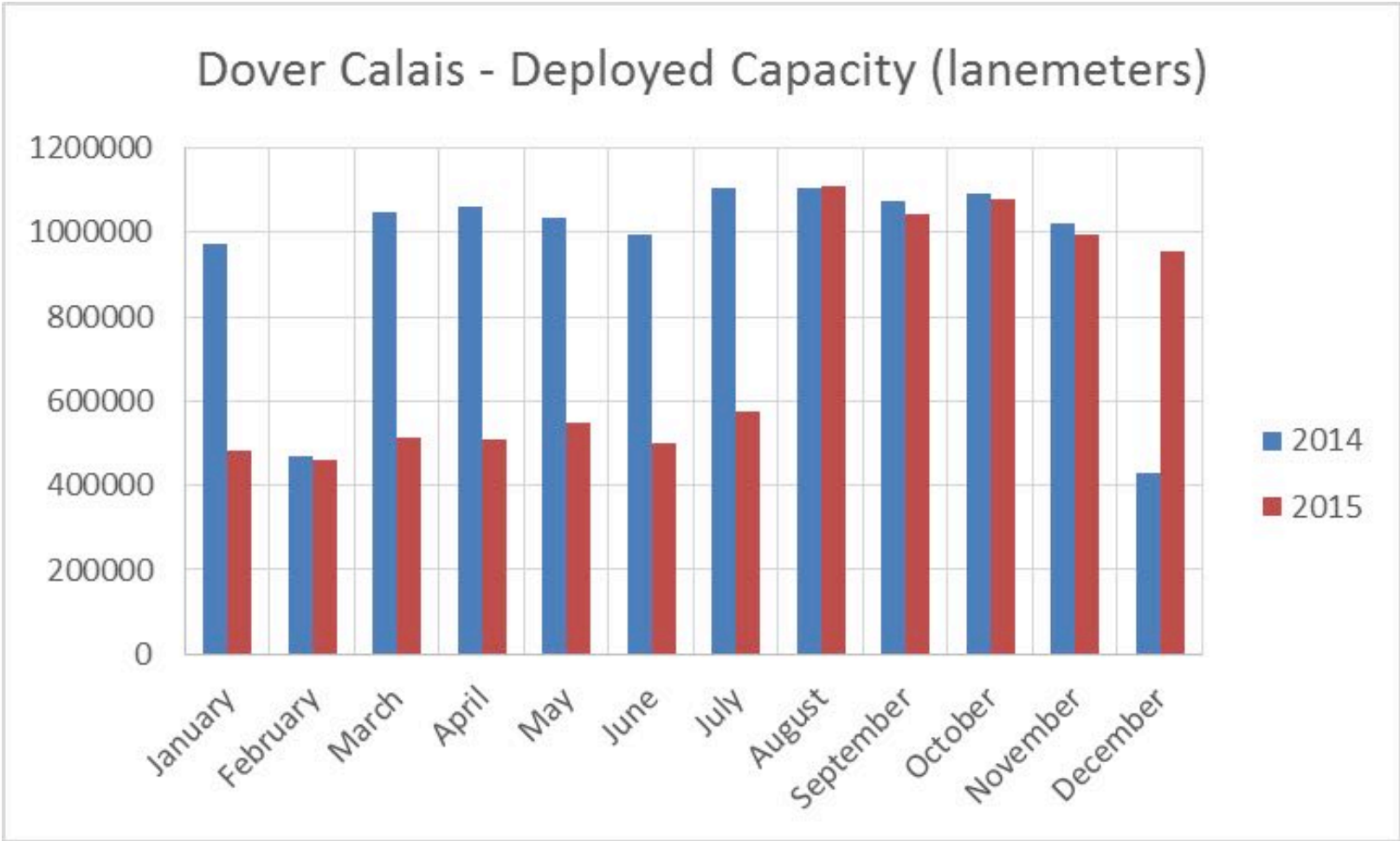
- Decreased Deployment
- Increased Utilized Capacity per ship, overall utilized capacity decreased
- Fuel costs is not as high component of overall costs in this route
- Freight rates **decreased**
- Overall this route appears **more robust** to changes

# Dover – Calais (What happened)



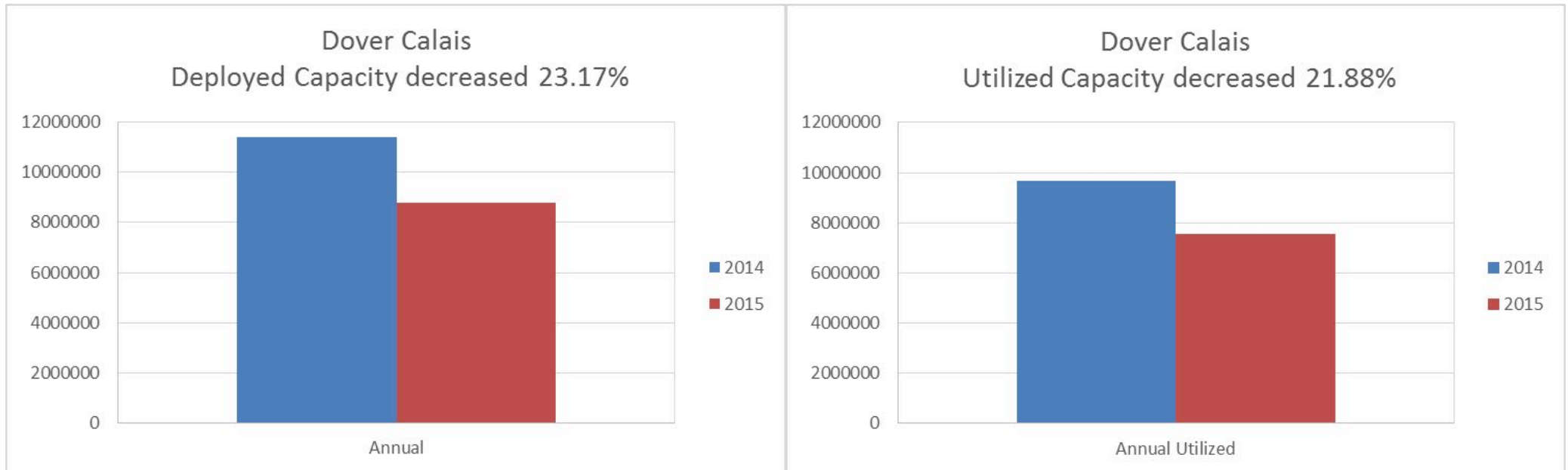
# 2014 vs 2015

## Dover Calais

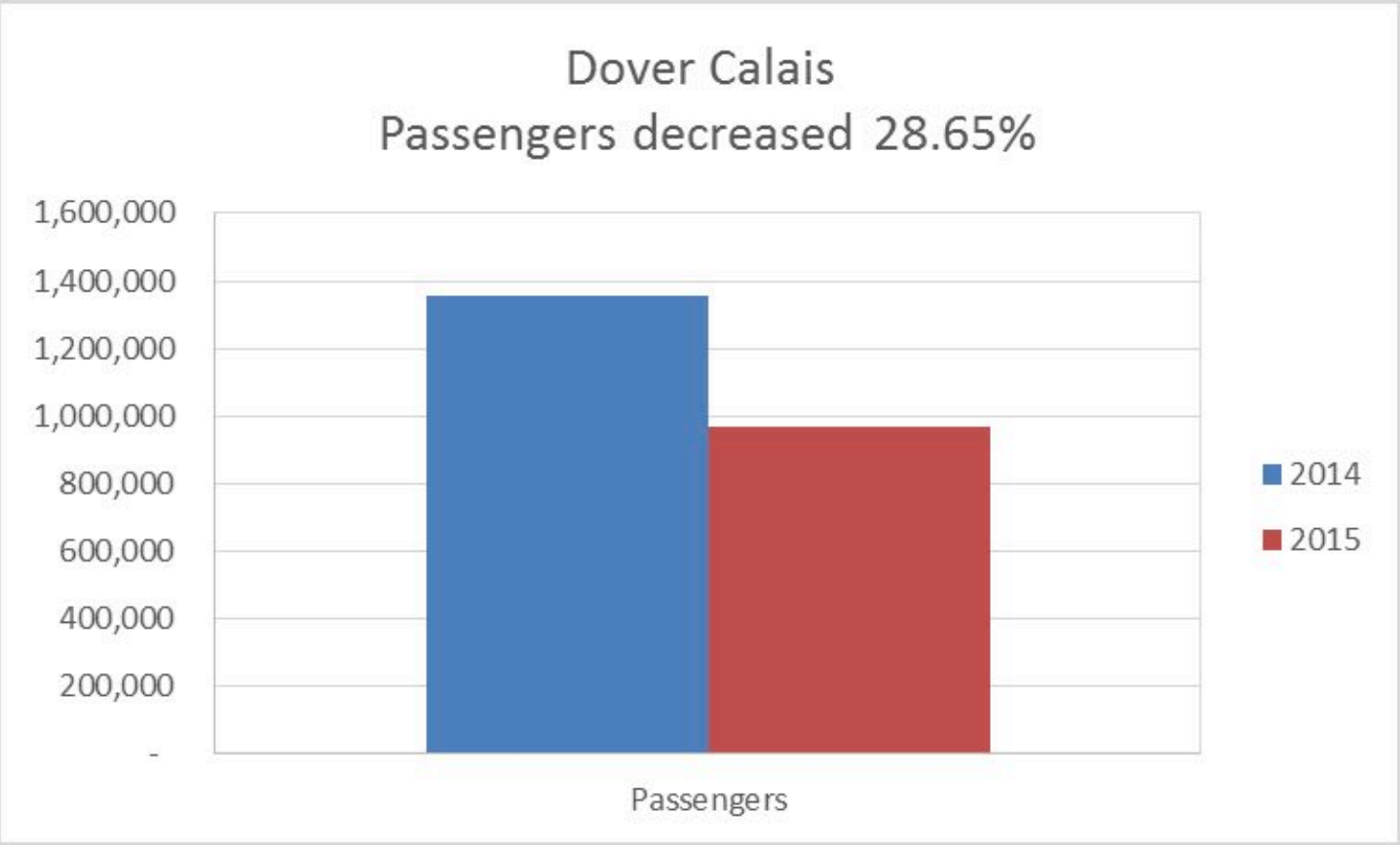


# 2014 vs 2015

## Dover Calais

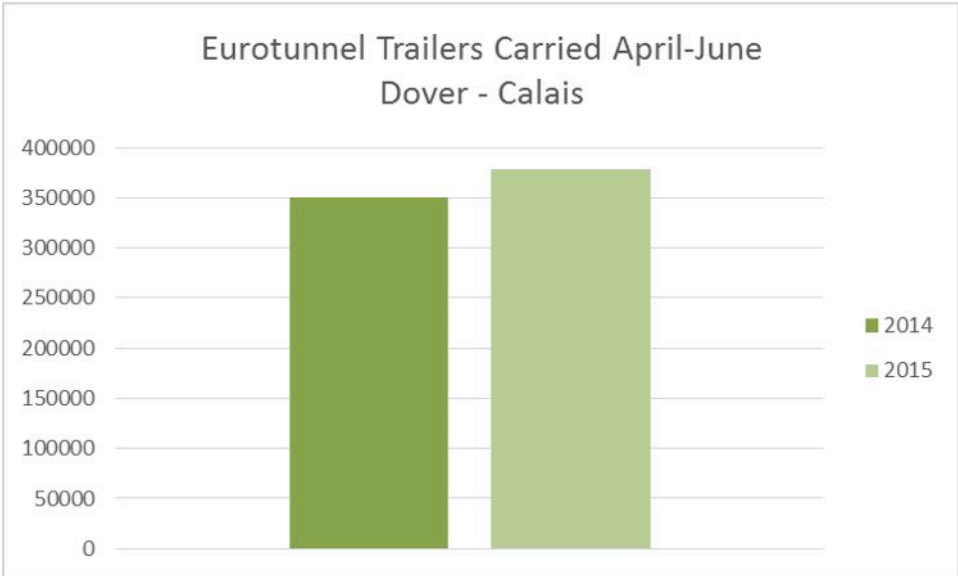
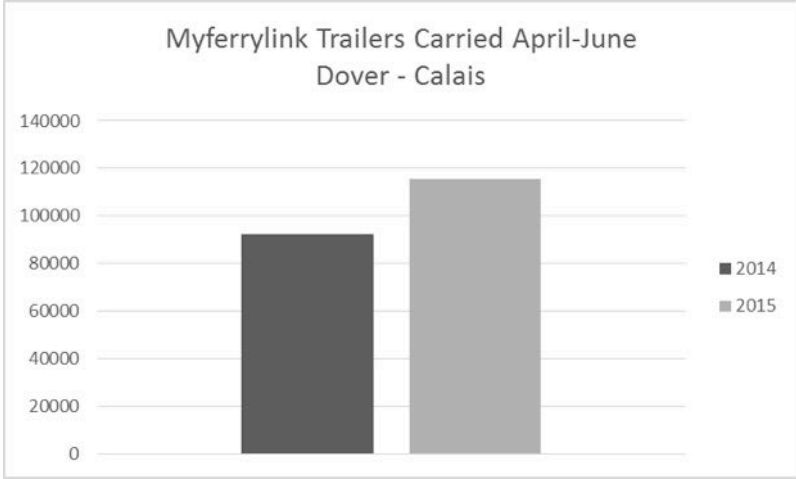
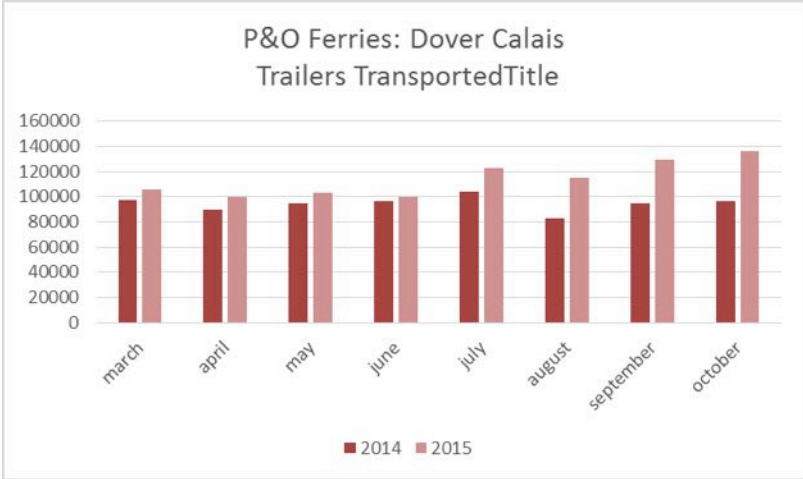


# 2014 vs 2015 Dover Calais



# 2014 vs 2015

## Dover – Calais: Other Options (Source: SHIPPAX)





# Dover Calais

- Decreased Deployment considerably in 2015
- Increased Utilized Capacity per ship, overall utilized capacity decreased
- Fuel costs is not as high component of overall costs in this route
- Freight rates marginally increased
- Overall this route was affected by external events
- P&O increased trailers transported
- Eurotunnel did not extend the lease to myferrylink
- Transport Demand has increased in all modes

# Ongoing analysis

- Marseille – Tunis route (unaffected by SECA) also shows increase in traffic
- Routes that benefitted most from low fuel prices, are also more susceptible to a fuel increase
- Increased in travel demand of some routes can be attributed to closures of competing services
- Lack of precise data requires certain sensitivity analyses to be conducted
  - Market Shares
  - Breakeven Distance
  - Freight Rates for Road Transport

## **Sensitivity Analyses – Variations on:**

- Market Share for each Option
- Cargo Value
- Depreciation rate
- Freight rate per Im
- Change in Haulers' Transport Cost
- Fuel Case 1: What actually happened (force use MGO with actual prices)
- Fuel Case 2: What would happen if HFO still allowed (Actual prices)
- Fuel Case 3: What would happen if MGO prices returned to 2014 levels

# Gothenburg - Ghent

Gothenburg - Ghent									
	<i>Road only</i>			<i>via Maritime I - DFDS</i>			<i>via Maritime II (Gothenburg - Kiel)</i>		
	Share (%)	Distance (km)	Total Time (h)	Share	Road Distance (km)	Total Time (h)	Share	Road Distance	Total Time (h)
<b>Baseline (2014)</b>	39-49	1600±300	23±2	24-30	100-300	38±2	21-29	600-800	22±2
	<b>New Road Share</b>		$\lambda_{1(\text{road-Maritime})}$	<b>New DFDS Share</b>		$\lambda_{2(\text{DFDS-Maritime})}$	<b>New Mar 2 Share</b>		
<b>Fuel Case 1 (actual 2015)</b>	<b>-0.22%</b>			<b>+1.23%</b>			<b>-1.02%</b>		
	IQ: -0.37:-0.06			IQ: 1.09:1.56			IQ: -1.21:-0.95		
<b>Fuel Case 2 (HFO 2015)</b>	<b>-0.63%</b>		0.0052±0.0035	<b>+1.68%</b>		0.018±0.007	<b>-1.05</b>		
	IQ: -0.44:-0.08			IQ: 1.38:2.15			IQ: -1.67:-0.76		
<b>Fuel Case 3 (MGO 2014)</b>	<b>+0.58%</b>			<b>-1.02%</b>			<b>+0.44%</b>		
	IQ: 0.05:0.25			IQ: -1.05:-0.49			IQ: 0.37:0.80		

# Klaipeda - Kiel

Klaipeda Kiel						
	<i>Road only</i>				<i>via Maritime - DFDS</i>	
	Share (%)	Distance (km)	Time (h)		Road Share	Road Distance (km) Time (h)
<b>Baseline (2014)</b>	39-49	1600±300	23±2			100-300 28±2
	<b>New Road Share</b>			$\lambda_{(road-Maritime)}$	<b>New DFDS Share</b>	
<b>Fuel Case 1 (actual 2015)</b>	<b>-0.29%</b>					<b>+0.29%</b>
	IQ: -0.29:-0.08					IQ: 0.08:0.29
<b>Fuel Case 2 (HFO 2015)</b>	<b>-0.73%</b>			0.012±0.05		<b>+0.73%</b>
	IQ: -0.64:-0.16					IQ: 0.16:0.64
<b>Fuel Case 3 (MGO 2014)</b>	<b>+0.93%</b>					<b>-0.93%</b>
	IQ: 0.18:0.96					IQ: -0.96:-0.18

# Dover - Calais

Dover Calais						
	<i>Maritime DFDS</i>				<i>Eurotunnel</i>	
	Share (%)	Distance (km)	Time (h)		Road Distance (km)	Time (h)
<b>Baseline (2014)</b>	39-49	1600±300	23±2		100-300	28±2
	<b>New DFDS Share</b>			$\lambda_{(road-Maritime)}$	<b>New Eurotunnel Share</b>	
<b>Fuel Case 1 (actual 2015)</b>	<b>-4.8%</b>				<b>+4.8%</b>	
		IQ: -8.3:-3.3				IQ: 3.3:8.3
<b>Fuel Case 2 (HFO 2015)</b>	<b>-3.6%</b>			0.015±0.05	<b>+3.6%</b>	
		IQ: -6.9:-1.7				IQ: 1.7:6.9
<b>Fuel Case 3 (MGO 2014)</b>	<b>-5.3%</b>				<b>+5.3%</b>	
		IQ: -9.1:-3.6				IQ: 3.6:-9.1

# Mitigating and Reversing Measures that will be examined in year 2

- Ship operator measures:
  - Speed reduction in certain routes
  - Change of sailing frequency
  - Changes in fleet deployment
  - Different freight rate structure
  - Alternative technologies including LNG as fuel
  - Changes in nominal capacity of a vessel
  
- Policy measures
  - Internalization of external costs
  - Adaptation of ECO bonus systems for hauliers choosing SSS modes
  - Subsidies for retrofits
  - Tax levy on competing modes
  - Other measures recommended by the ESSF
  - New modes entering market

# Conclusion

- Maritime shares (proportion) would increase due to observed low prices
- Maritime shares would have increased further if HFO was still allowed
- Maritime shares would drop at fuel levels of 2014 using MGO
- Routes that benefitted most from low fuel prices, are more vulnerable to a fuel increase
- Increased travel demand of some routes can be attributed to closures of competing services
- Profitability of ship operator is masking the negative effects of the regulation
- When fuel prices increase, what measures can be used to revert modal shifts?
- Find out more.... in year 2!!





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**Thank you for your attention**