PricewaterhouseCoopers

Invest in Iceland Agency

Northern Sea Route

January 2009

Private & confidential

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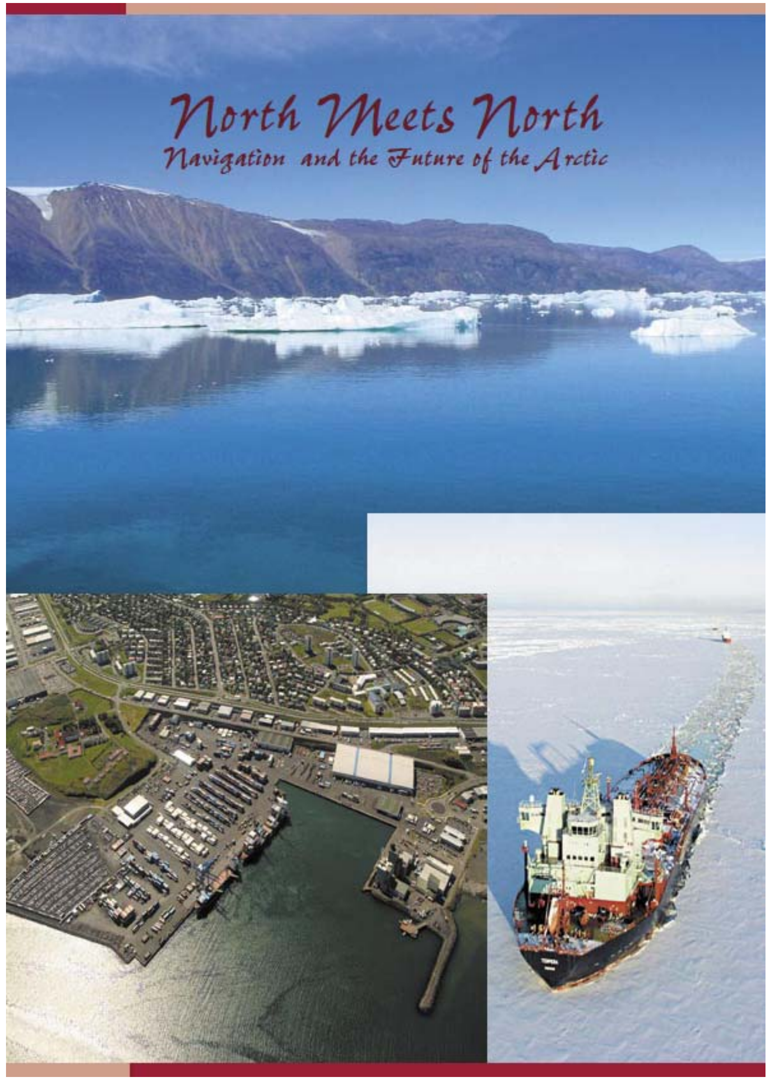
Opportunities in the Arctic Ocean

Research shows that a shipping route, making use of ice-class merchant vessels, across the Arctic Ocean can bring considerable changes to routes in the Northern hemisphere.

In this respect, a transhipment port in the North Atlantic is seen to shorten the Arctic voyages of ice-class container vessels, and a transhipment port located in Iceland could service both the east coast of North America and Northern Europe.

Several initiatives have concentrated on the feasibility and impact of the opening of the route. In 2005, a working group established by the Minister for Foreign Affairs, under the auspices of the Ministry for Foreign Affairs, published the North Meets North report on the opening of the Northern Sea Route and its significance for Iceland.

Based on the conclusions from these research initiatives, the potential for Iceland seems large, and additional research, in close cooperation with industry players and experts will have to deepen the understanding on the potential.



Opportunities in the Arctic Ocean

Navigation via the Northern Sea Route requires for the authorities in Iceland to provide for the port area that can handle the ice-class vessels and the related transhipment container volumes.

Private terminal operators will need to be attracted to load and unload the vessels and handle the transhipment activities. Individual shipping lines and/or consortia will operate the ice-class vessels on scheduled services via the Northern Sea Route.

The potential of the Northern Sea Route should therefore be clearly demonstrated, not only to the Icelandic authorities, but also to the different (inter-)national industry players that interact in the process of moving containers over sea.

Financial feasibility of a transhipment hub in Iceland

Building upon the gained knowledge on Iceland and bringing to bear extensive experience and network in ports and shipping industry, PwC was selected to work closely with IIA and other Icelandic stakeholders on the various aspects of a cooperation opportunity.

PwC was requested to focus on facilitating the process between IIA and a potential partner. The assistance being focussed on enhancing the options of the project, PwC's initial scope of work was on ensuring for optimal flow of documentation between the parties involved.

Dubai World is Dubai's flag bearer in global investments. As a holding company it operates a highly diversified spectrum of industrial segments. Its portfolio includes amongst others:

- DP World, one of the largest marine terminal operators in the world, with 44 terminals and 13 new developments across 28 countries. The company constantly invests in terminal infrastructure, facilities and people, working closely with customers and business partners to provide quality services, when and where customers need them;
- Economic Zones World or Jafza International, as pioneers in the development and operation of large commercially-operated free zones around the world they offer the depth of knowledge, experience and expertise that is critical to ensure the smooth planning, development and management of the potential type projects.

Dubai World was selected as the first potential partner to meet, and a joined delegation of IIA, Icelandic subject matter experts and PwC presented the opportunity to both Dubai organisations.

The discussions provided confirmation on the required next steps in the assessment: A detailed business case is required in order to understand the financial viability of operating container traffic via the Northern Sea Route with a hub in Iceland.

Financial feasibility of a transhipment hub in Iceland

The financial feasibility assessment therefore concentrates on the following topics:

- The cost drivers of a Northern Sea Route crossing;
- A comparative financial analysis of container traffic via the Northern Sea Route versus a sailing via the Current Shipping Route;
- Conclusions on the ability to downsize the fleet when using the Northern Sea Route;
- Financial information on cost saving opportunities per TEU.

A sensitivity analysis on the main perceived cost drivers adds robustness to the conclusions.

The financial feasibility assessment for a transhipment hub in Iceland is predominantly based on desk research and builds on existing data collected from different sources.
Aker Arctic was however requested to prepare a new transit study. In this study two arctic container carrier concepts (5,000 and 12,000 TEU) are sketched and their economical aspects and transit speeds through the Northern Sea Route are estimated. Both vessel concepts will utilise sufficiently ice strengthened hull and podded propulsion system together with Aker Arctic DAS™ ship concept.

Feasibility of a transhipment hub in Iceland

The feasibility to generate new transhipment activities in Iceland from container traffic via the Northern Sea Route largely depend upon the rationale used by the transport industry with regards to the opening of new routes.

The decision driver(s) for a shipping line to start a Northern Sea Route service are distilled from the market place and integrated in the (financial) analysis so to provide the required and conclusive evidence for detailed discussions with the industry.

The strength of Iceland as a transhipment hub is also largely depending upon the advantages of such a stop versus a direct sailing to the final port of destination. The specific characteristics of sailing an ice-class vessel during the entire route versus partial use of such vessel in combination with a classic container vessel on the last leg have therefore been analysed. To this purpose, Rotterdam is being assessed as a direct call option versus Iceland for North Atlantic container volumes.

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Main findings

- At an ice-class ship building cost premium of 30% over conventional openwater vessels, the Northern Sea Route shows to be more advantageous than the Current Shipping Route.
  Main cost savings relate to: reduction in costs due to shorter sailings, lower capital costs due to reduced ice-class fleet size and avoidance of Suez transit charges.

- However, based on their latest research, Aker Arctic provided that the ice-class ship building cost exceeds that of an openwater vessel by 167% (5,000 TEU vessel) and 134% (12,000 TEU vessel), creating a cost disadvantage vis-à-vis the Current Shipping Route.

- The potential of the Northern Sea Route is driven by several variables, next to the thickness and amount of ice covering the Arctic. Changes in these variables can impact the outcome of the business case significantly. The variables with the most important impact are:
  - ship building cost;
  - fuel price/consumption;
  - Suez transit charges

- Comparison of the transhipment hub potential of Iceland vs. Rotterdam currently shows a very slight cost advantage for Iceland on the sea leg. Changes in the main variables (cfr. supra) may further increase this competitive position. When assessing this potential, other aspects need to be taken into account as well (significant developments required in Iceland, switching costs of shipping lines,…)

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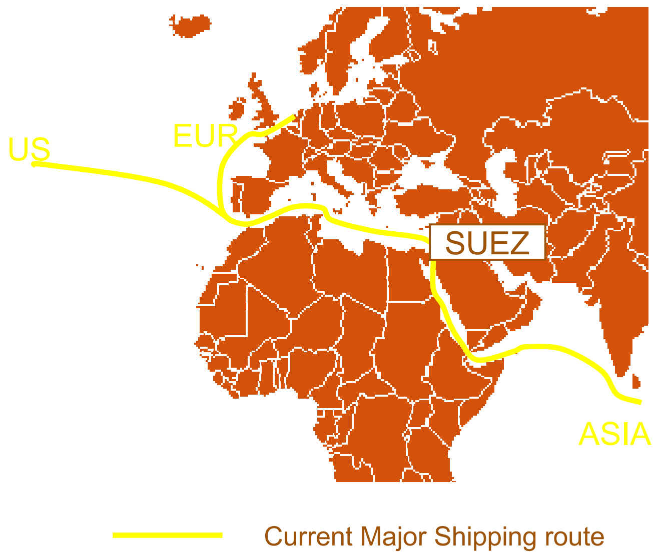
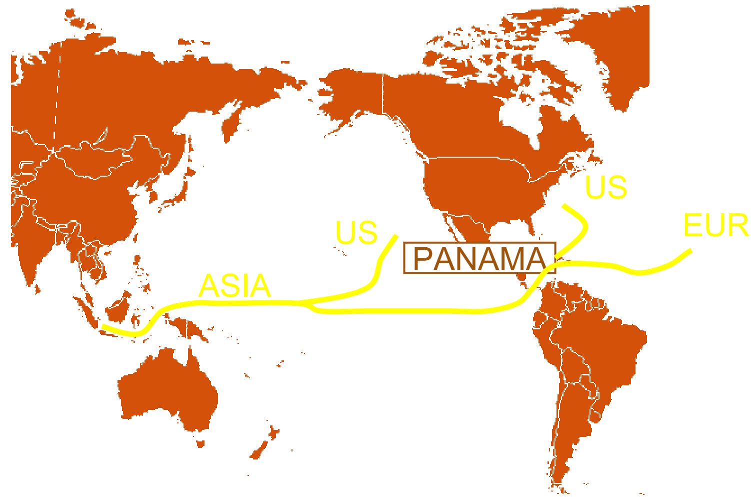
Far East trade
As is

The major shipping routes between the Far East and the Atlantic pass through the Suez and the Panama canal.



16,000 to 18,000 ships pass through the Suez canal annually

The Suez canal is suitable for ships with a draught up to 19m (container ships with a maximum capacity of 12,000 TEU)



14,000 to 15,000 ships pass through the Panama canal annually

The Panama canal is suitable for ships with a draught up to 11.3m (container ships with a maximum capacity of 5,000 TEU)

Source: Suez Canal Authority; Panama Canal Authority

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Changes in operating environment
Key assumptions

Projections based on scientific research indicate continued warming and melting of ice in the Northern Hemisphere

The mean temperature in the Arctic could rise by as much as 3 to 9°C in the next hundred years

The melting process evolves much faster than anticipated. Northern crossings are expected between 5-7 years.

Innovations in maritime technology allow to build ice-class ships

Satellites can generate data with regards to ice floes and cracks

Distance between some ports in EUR/US and Asia are much shorter when sailing over the North Pole

Ice-class container ship Norilsk Nickel

Source: North meets North

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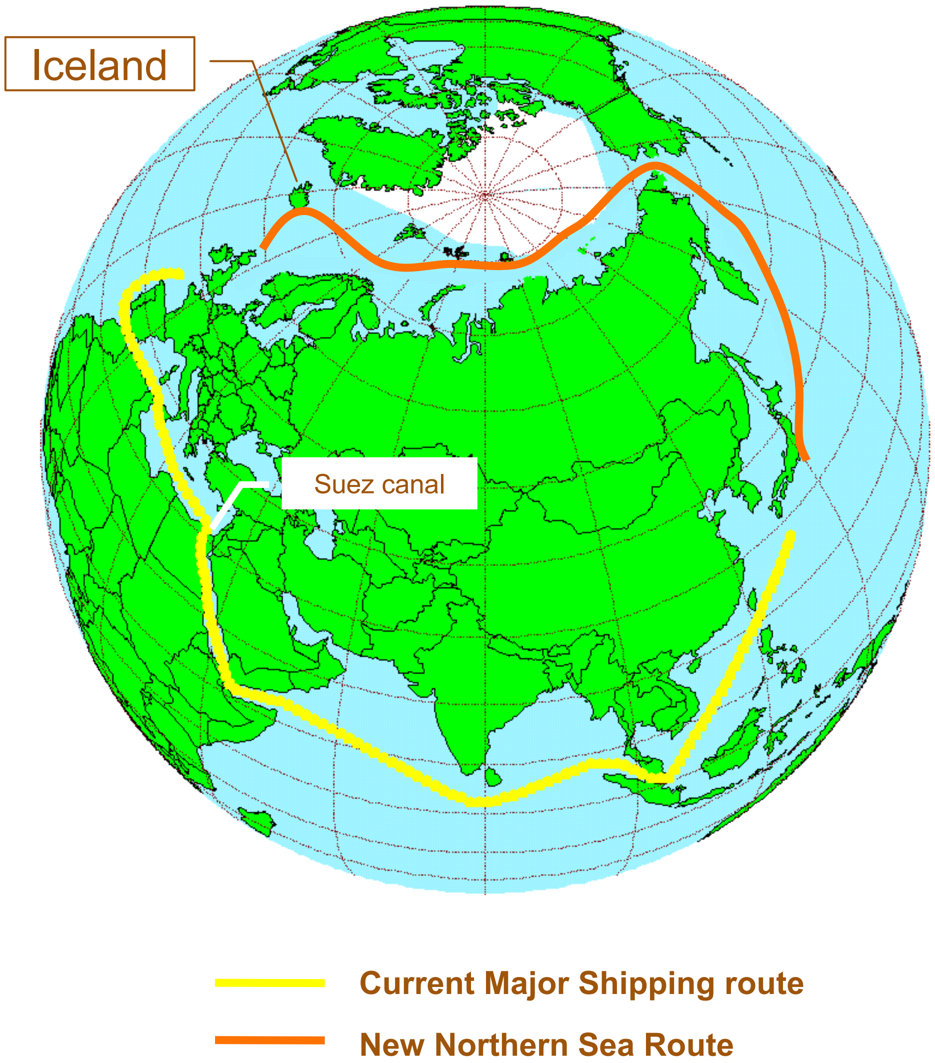
Far East trade
To be scenario

Risen temperatures in the Arctic & innovations in maritime technology allow ice-class ships to sail over the North Pole

Traditional transportation corridors between the Pacific and the North Atlantic via the Suez Canal and the Panama Canal are nearing maximum capacity

The difference in distances between some ports suggest advantages and commercial opportunities for regular sailings via the Northern Sea Route, even though seasonal ice affects parts of the route.

The Northern Sea Route could be open for international shipping earlier than predicted.



COST & TIME SAVINGS

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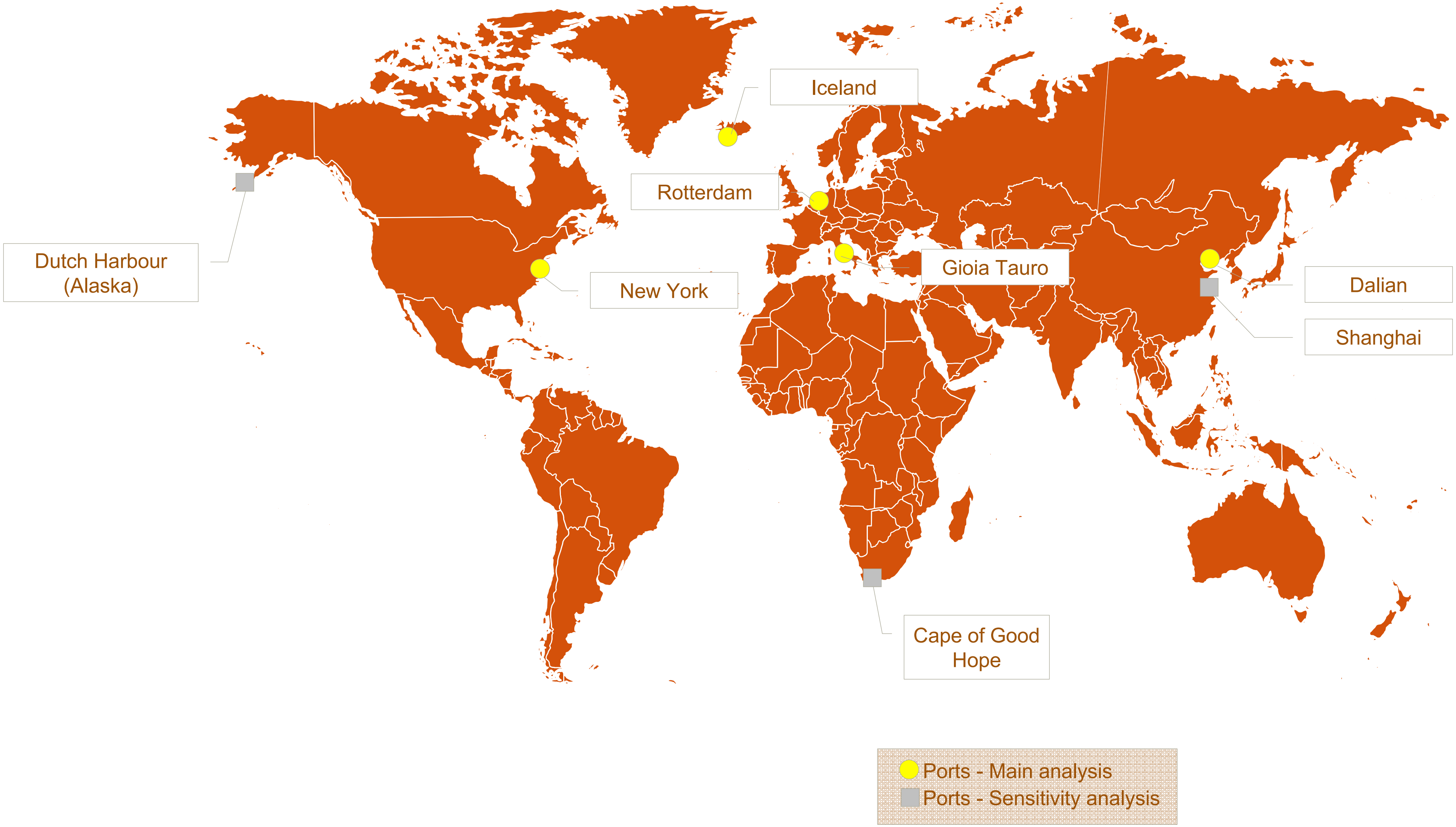
Location of ports used in the analyses



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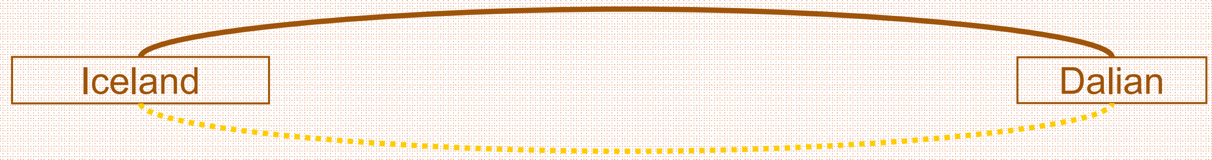
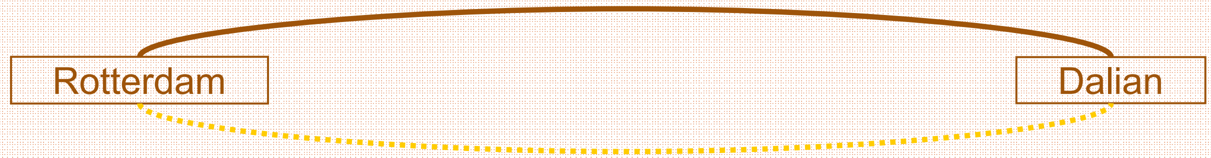
5 business cases are assessed to determine the competitive position of the Northern Sea Route

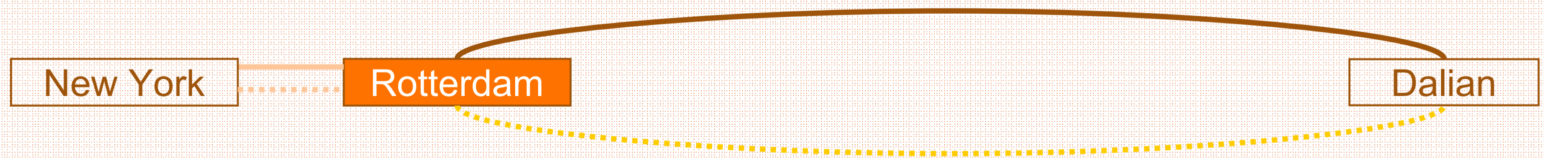
Case 1: comparison of Northern Sea Route vs. Current Shipping Route from Iceland



Case 2: comparison of Northern Sea Route vs. Current Shipping Route from Rotterdam



Case 3: comparison of Rotterdam as a hub via Northern Sea Route vs. Current Shipping Route



Northern Sea Route

Current Shipping Route

Ice-class ship

Openwater ship

“Feeder” vessel

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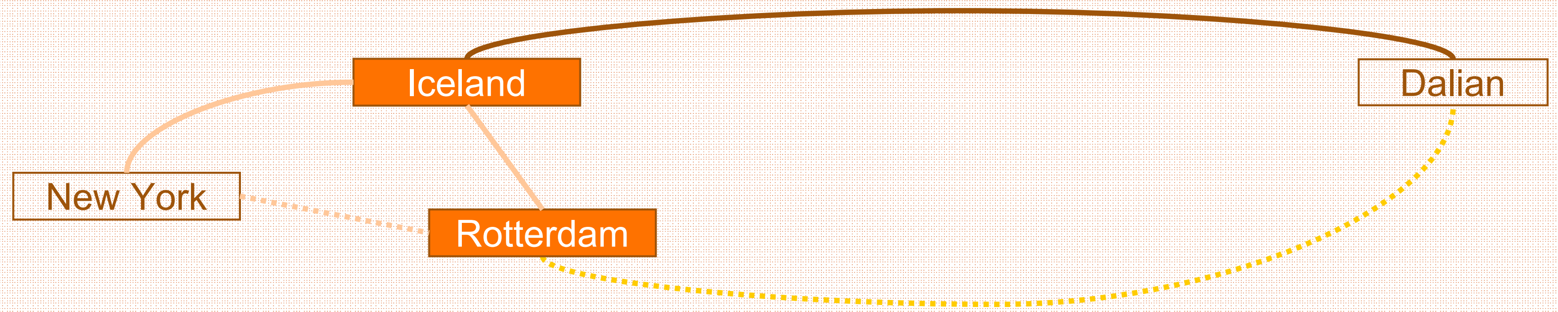
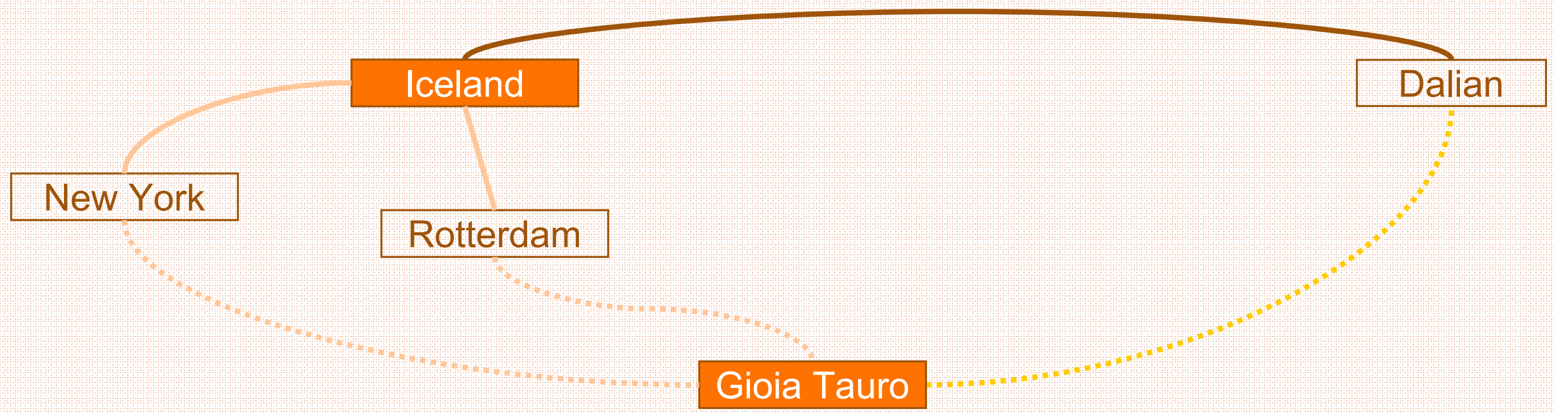
5 business cases are assessed to determine the competitive position of the Northern Sea Route (cont'd)

Case 4: comparison of Iceland vs. Rotterdam as a transhipment hub for US & predominantly EUR trade



Case 5: comparison of Iceland vs. Gioia Tauro as a transhipment hub for EUR & predominantly US trade



Northern Sea Route

Current Shipping Route

Ice-class ship

Openwater ship

"Feeder" vessel

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5 business cases are assessed to determine the competitive position of the Northern Sea Route (cont'd)

Cases 1 to 3 show the impact of Northern Sea Route sailings:

- The container volumes to and from Iceland would not justify scheduled sailings by 5,000 or 12,000 TEU vessels. Case 1 therefore predominantly provides a theoretical insight.
- Case 2 compares direct sailings from Rotterdam to a China destination and therefore allows drawing conclusions on the relative strength of the Northern Sea Route for mainland Europe traffic to Asia.
- In case 3 Rotterdam is used as a transhipment hub since US trade is added to the equation.

Cases 4 and 5 make a direct comparison between transhipment hubs in Iceland versus existing hubs in Europe:

- The analysis uses Reykjavik as the example port location in Iceland. The outcome is applicable to other port locations in Iceland too.
- When assessing a situation whereby transatlantic container volumes predominantly originate from Europe, Rotterdam is used as a hub.
- Under the assumption that most of the cargo comes from the US East Coast, the transhipment hub is located in Gioia Tauro.

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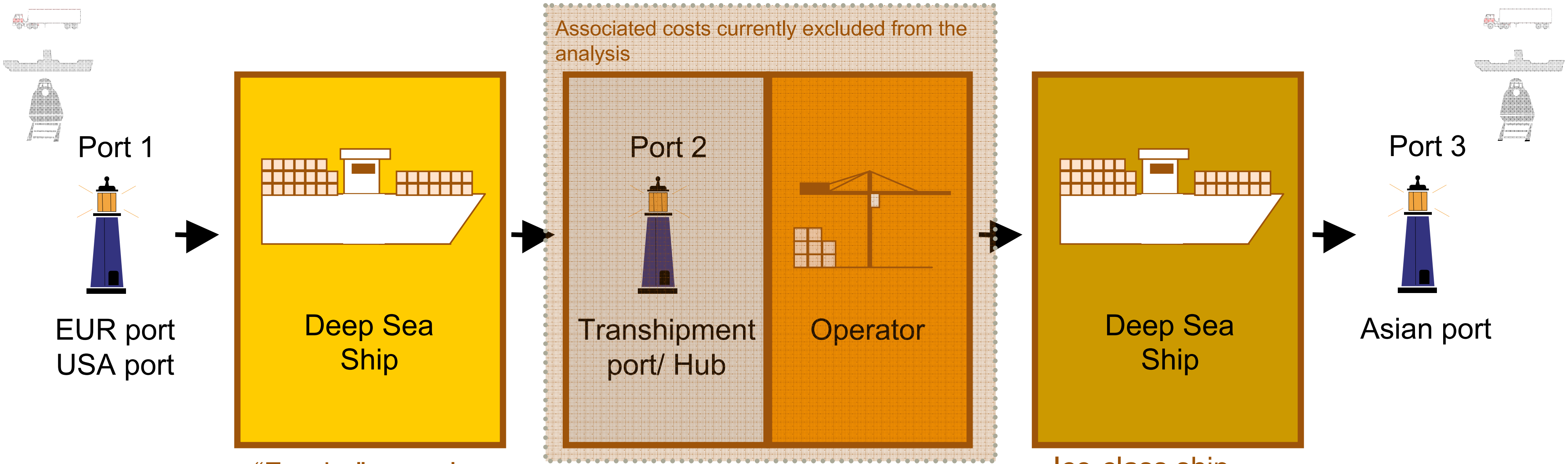
Methodology

Comparison of the costs related to transporting a Twenty-foot container via the Northern Sea Route versus the Current Shipping Routes on a 5,000 TEU ship and a 12,000 TEU ship

Included are:
- Ship-related costs (operational & capital expenditures)
- Suez transit charges (for the Current Shipping Route)

Excluded are transit fares for Northern Sea Route

Currently, the analysis is performed with abstraction of Container Handling Costs & Port Call Costs since they are not the differentiating factor in this set-up. They typically represent less than 10% of the total supply chain costs per TEU.



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Methodology (cont'd)

- The analysis is made based on the assumption to offer a service level of 3 sailings per week.
- Consequently, the needed number of ships is calculated based on a round-trip time calculation, depending on vessel speed and distances, as well as port loading/unloading time*
- Costs for sea legs that are operated with a "feeder" vessel, use a cost per TEU based on charter & fuel costs.

Input values base case:

Distances

Current shipping routes						
Nautical miles	Rotterdam	Dalian	Shanghai	Reykjavik	New York	Gioia Tauro
Rotterdam	-	10,947.0	10,409.0	1,265.0	3,275.0	2,378.0
Dalian	10,947.0	-	538.0	11,505.0		8,639.0
Shanghai	10,409.0	538.0	-	10,967.0		8,101.0
Reykjavik	1,265.0	11,505.0	10,967.0	-	2,464.0	
New York	3,275.0			2,464.0	-	4,209.0
Gioia Tauro	2,378.0	8,639.0	8,101.0		4,209.0	-

Northern sea route						
Nautical miles	Rotterdam	Dalian	Shanghai	Reykjavik	New York	Gioia Tauro
Rotterdam	-	8,327.0	8,865.0	1,265.0	3,275.0	2,378.0
Dalian	8,327.0	-	538.0	7,362.0		8,639.0
Shanghai	8,865.0	538.0	-	7,900.0		8,101.0
Reykjavik	1,265.0	7,362.0	7,900.0	-	2,464.0	
New York	3,275.0			2,464.0	-	4,209.0
Gioia Tauro	2,378.0	8,639.0	8,101.0		4,209.0	-

Source: Aker Arctic; North meets North; PwC Research (Searates)

* 48 hours is used in the analyses

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Methodology (cont'd)

Speeds

	Openwater ship	
	5,000 TEU	12,000 TEU
knots	19.83	19.83

	Ice-class ship - average winter		Ice-class ship - severe winter	
	5,000 TEU	12,000 TEU	5,000 TEU	12,000 TEU
knots	15.46	13.53	14.84	12.79

	Ice-class ship - openwater	
	5,000 TEU	12,000 TEU
knots	19.00	19.00

Source: Aker Arctic; Expert interviews

Fuel

		Ice-class ship				Openwater ship	
Fuel consumption		Average winter		Severe winter			
		5,000 TEU	12,000 TEU	5,000 TEU	12,000 TEU	5,000 TEU	12,000 TEU
HFO	tons/day	234.79	353.08	236.67	356.19	224.66	325.14
MDO	tons/day	2.35	3.53	2.37	3.56	2.25	3.25

HFO = Heavy Fuel Oil; MDO = Marine Diesel Oil

HFO fuel price	USD/ton	200
MDO fuel price	USD/ton	550

Source: Aker Arctic; PwC Research; Expert interviews

Ship Profiles

		Ice-class ship		Openwater ship	
	UNIT	5,000 TEU	12,000 TEU	5,000 TEU	12,000 TEU
Name of ship	/	Aker Arctic Container	Aker Arctic Container	Openwater 5,000 TEU	Openwater 12,000 TEU
DWT	tons	70,000.00	170,000.00	67,145.00	156,907.00
GRT	tons	N/A	N/A	54,437.00	170,974.00
Draft	m	N/A	N/A	13.60	15.50
Suez transit charges	USD	-	-	222,714.00	412,329.00
Insurance cost	USD/year	292,000.00	547,500.00	109,500.00	233,600.00
Operational cost	USD/year	3,540,500.00	4,161,000.00	3,540,500.00	4,161,000.00

Source: Aker Arctic; Expert interviews; Leth Agencies; PwC Research

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Methodology (cont'd)

Ship Profiles

		"Feeder ship"	"Feeder ship"	"Feeder ship"
	UNIT	**2,945 TEU**	**6,655 TEU**	**95,80 TEU**
Name of ship	/	Livorno Express	Hanjin Budapest	Xin Los Angeles
DWT	tons	43,715.00	80,855.00	107,200.00
Draft	m	N/A	N/A	15.00
Charter cost	USD/day	33,190.20	47,079.54	60,686.90
HFO	tons/day	101.78	230.00	250.00
MDO	tons/day	1.02	2.30	2.50
Speed	knots	21.00	24.00	24.00
Capacity	TEU	2,945.00	6,655.00	9,580.00

Source: Shipping lines

- Dependent on TEU volume for the "feeder" leg, the appropriate feeder ship profile is used in the analysis

The analysis of the business case builds upon previous research including the North meets North report

One of the key enabling factors with regards to potential of the Northern Sea Route is the design by the Finnish shipbuilders Aker Arctic of a new type of double-acting vessel that has the same open sea characteristics as other ships in its class combined with the breaking capacity of a powerful ice-breaker.

Operations with such ships have proved effective and there is nothing now preventing the use of this design in producing large container vessels for shipments in the Arctic Ocean. The North meets North report indicates that the cost of building these ships is estimated at around a quarter more than similar conventional, openwater vessels that are not designed for sailing in icy conditions.

Discussions at the initial phase of this project with Icelandic experts on Northern Sea Route feasibility, indicated a 30% premium for constructing an ice-class vessel.

The construction cost being a key input parameter of the business case, the PwC analysis starts from this 30% value.

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Construction cost of 5,000 TEU & 12,000 TEU openwater vessels has been calculated based on 2007 order activity

CELLULAR SHIPS: DELIVERIES AND ORDERS - YEAR 2007

	Deliveries			Orders		
Size range	**no.**	**teu**	**$m**	**no.**	**teu**	**$m**
› 10,000 teu	7	96,124	1,252	134	1,659,092	21,814
7,500 / 9,999 teu	34	300,516	3,054	78	673,778	9,648
6,000 / 7,499 teu	27	181,630	2,134	39	257,014	3,833
5,250 / 5,999 teu	5	29,112	376	9	49,950	855
4,800 / 5,249 teu	36	179,333	2,138	17	84,060	1,289
4,000 / 4,499 teu	29	125,836	1,572	13	491,995	7,674
3,500 / 3,999 teu	19	68,034	978	16	57,880	1,020
3,000 / 3,499 teu	12	40,340	550	9	30,790	504
2,500 / 2,999 teu	38	102,966	1,629	51	134,553	2,463
2,000 / 2,499 teu	5	10,515	216	12	25,912	508
1,750 / 1,999 teu	13	23,683	425	14	25,194	548
1,500 / 1,749 teu	41	69,283	1,329	15	25,729	548
1,250 / 1,499 teu	22	29,425	572	59	81,956	1,625
1,000 / 1,249 teu	50	54,725	984	27	28,362	660
750 / 999 teu	42	37,796	776	11	10,336	222
500 / 749 teu	20	13,563	270	2	1,396	32
TOTAL	**400**	**1,362,881**	**18,255**	**606**	**3,637,997**	**53,243**

Prices shown at delivery correspond to contractual prices at the time of order

Source : BRS-Alphaliner

12,000 TEU

Average price per ship =
21,814m USD / 134 ≈ **160m USD**

5,000 TEU

Average price per ship =
1,289m USD / 17 ≈ **75m USD**

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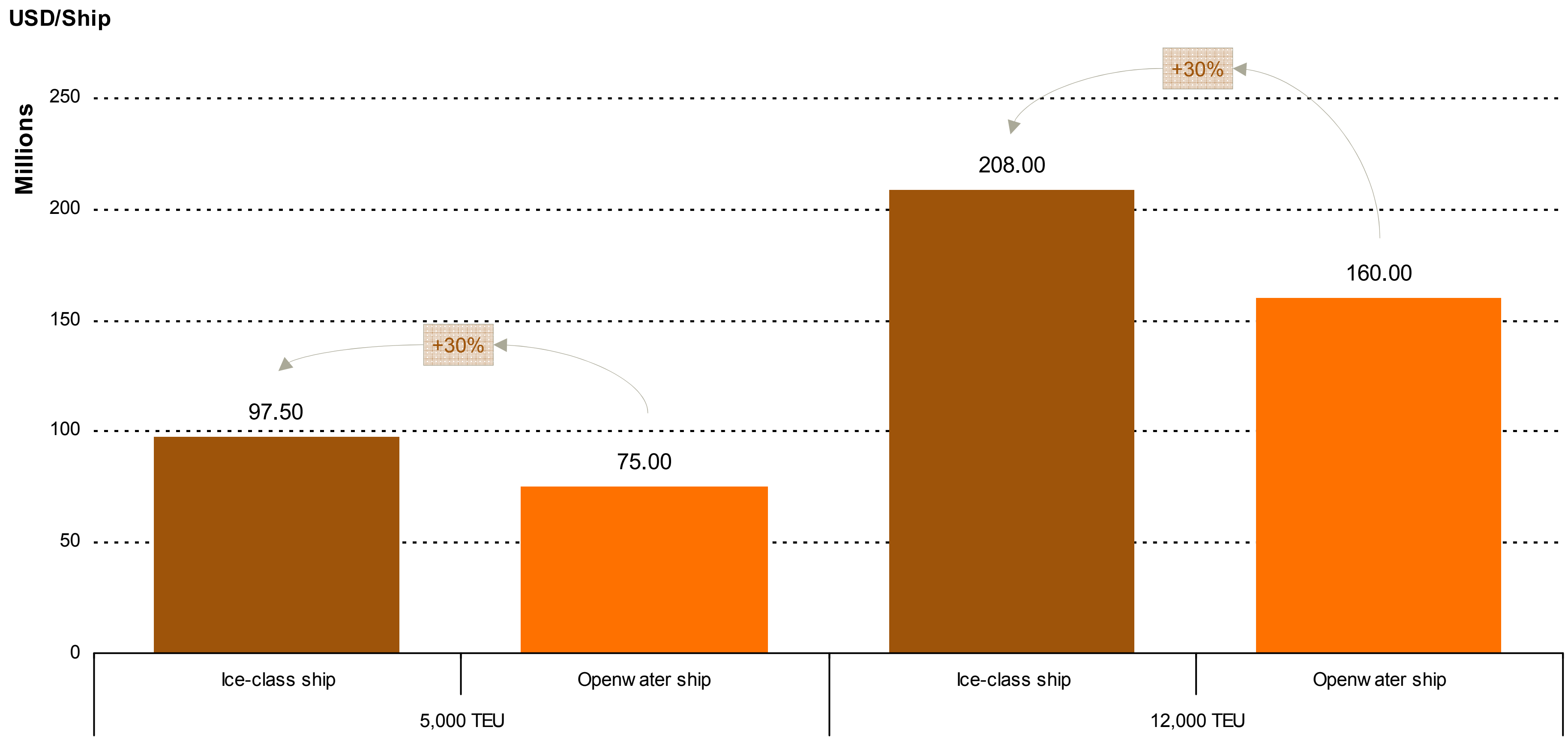
Assuming a 30% premium for constructing an ice-class vessel, the analysis is performed for each of the 5 assessed cases



Source: BRS-Alphaliner; North meets North

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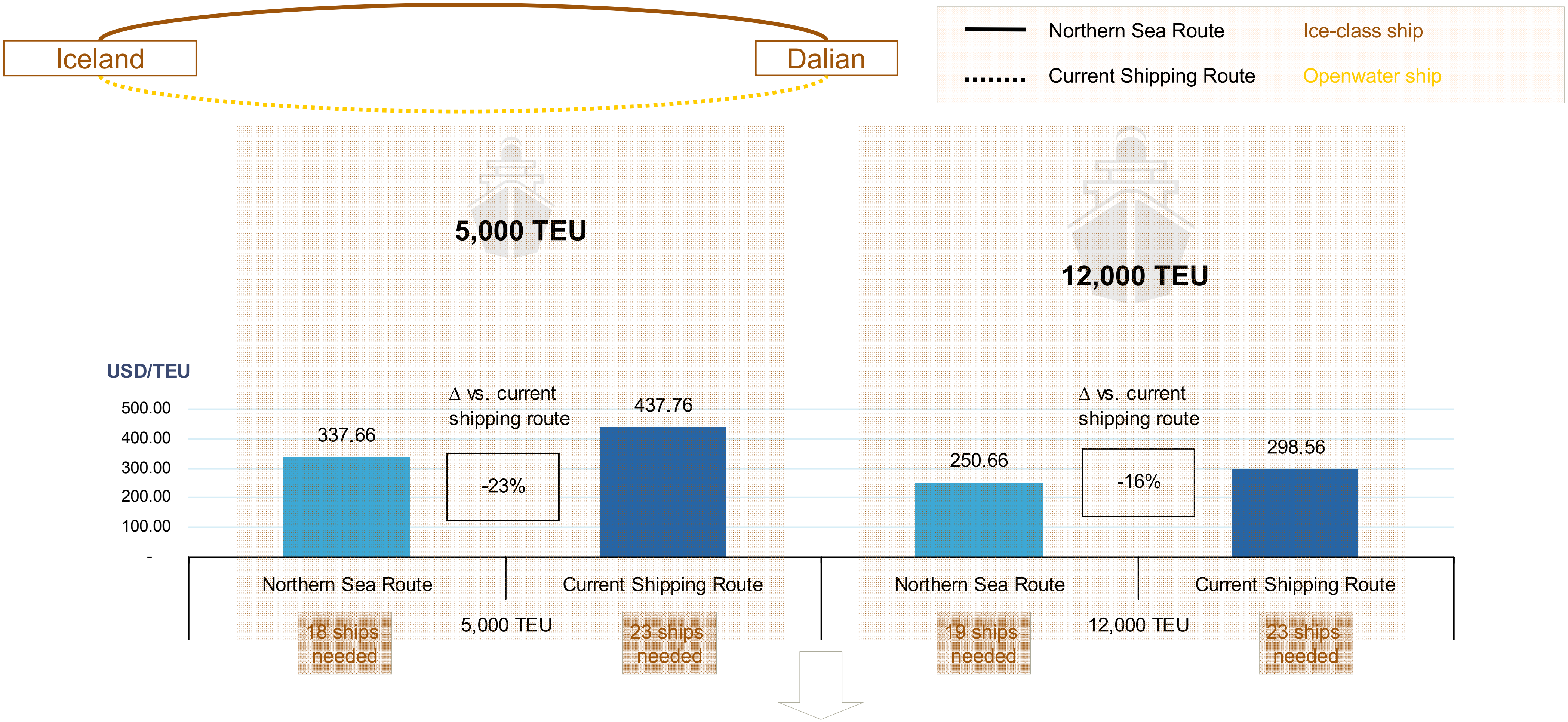
Ice-class ship building premium of 30%

Case 1: Iceland-Dalian



- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be more advantageous by as much as 23%
- The 12,000 TEU openwater ship is able to reap more economies of scale than the 12,000 TEU ice-class ship since the latter is slower through the ice than its 5,000 TEU peer

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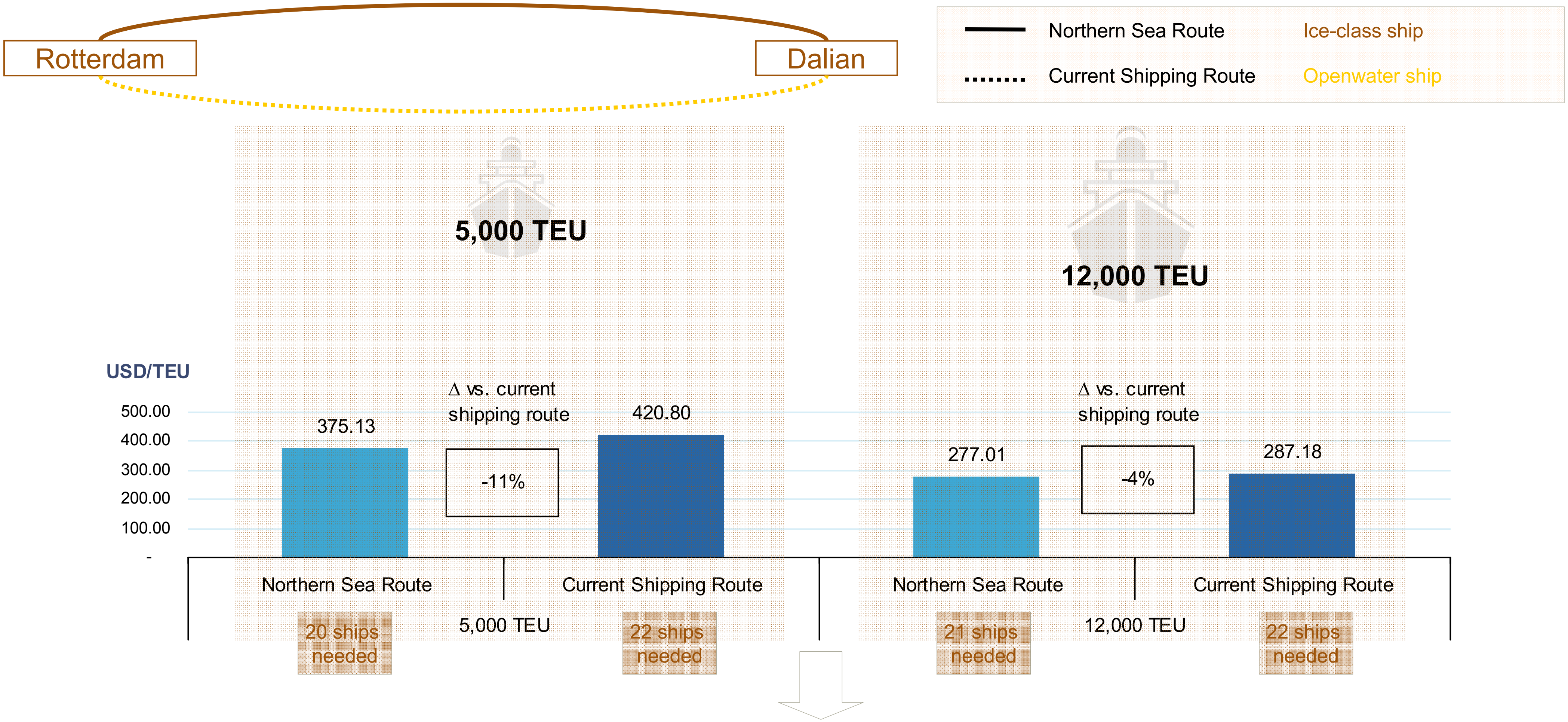
Ice-class ship building premium of 30%

Case 2: Rotterdam-Dalian



- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be more advantageous by as much as 11%
- Compared to Iceland (Case 1), the advantage of the Northern Sea Route over the Current Shipping Route decreases by more than 10%, but is still firm

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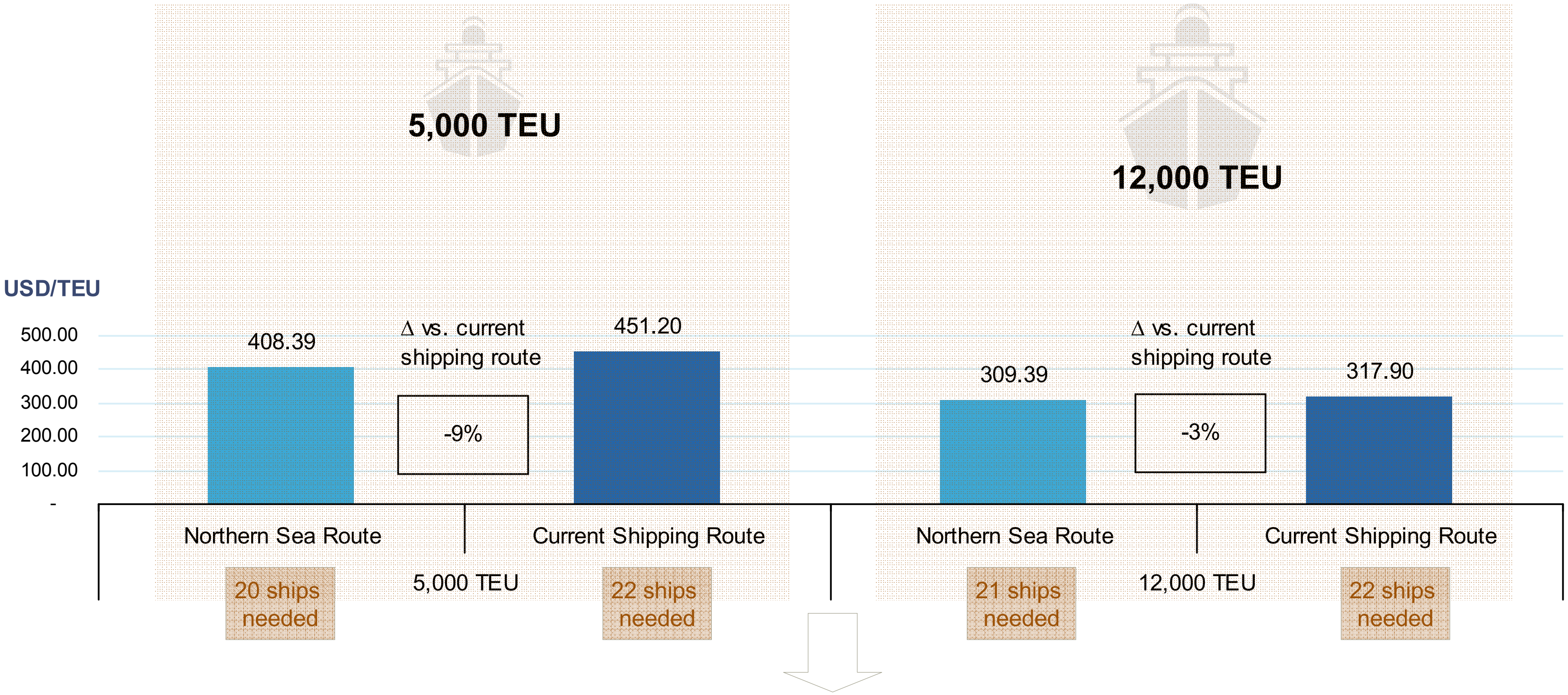
Ice-class ship building premium of 30%

Case 3: New York-Rotterdam-Dalian

Hub

Northern Sea Route
Current Shipping Route

Ice-class ship
Openwater ship
"Feeder" vessel



- In line with current trade figures, the US East Coast - Asia trade (New York) is assumed to account for 20% of the volume, and the EUR - Asia trade (Rotterdam) contributes 80% of the volume
- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be more advantageous by as much as 9%

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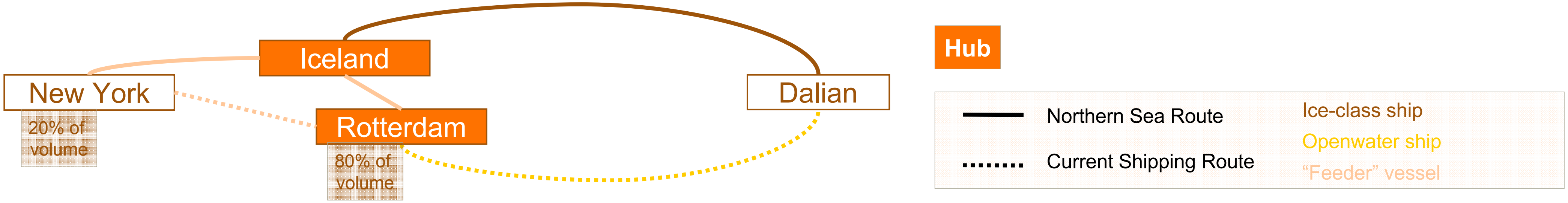
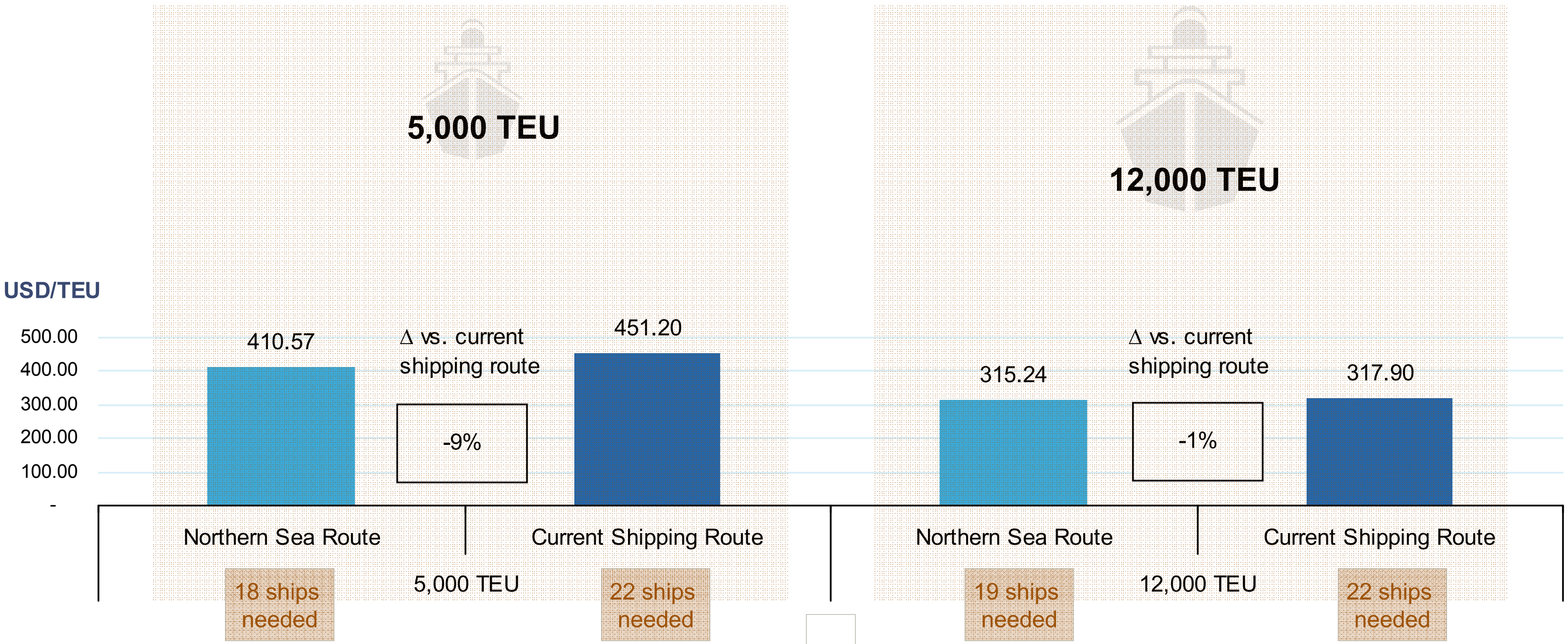
Ice-class ship building premium of 30%

Case 4: New York/Rotterdam-Iceland-Dalian





- This case assesses the position of Iceland versus Rotterdam as a hub for US (New York) and EUR (Rotterdam) trade.
- In line with current trade figures, the US East Coast - Asia trade (New York) is assumed to account for 20% of the volume, and the EUR - Asia trade (Rotterdam) contributes 80% of the volume
- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be more advantageous by as much as 9%

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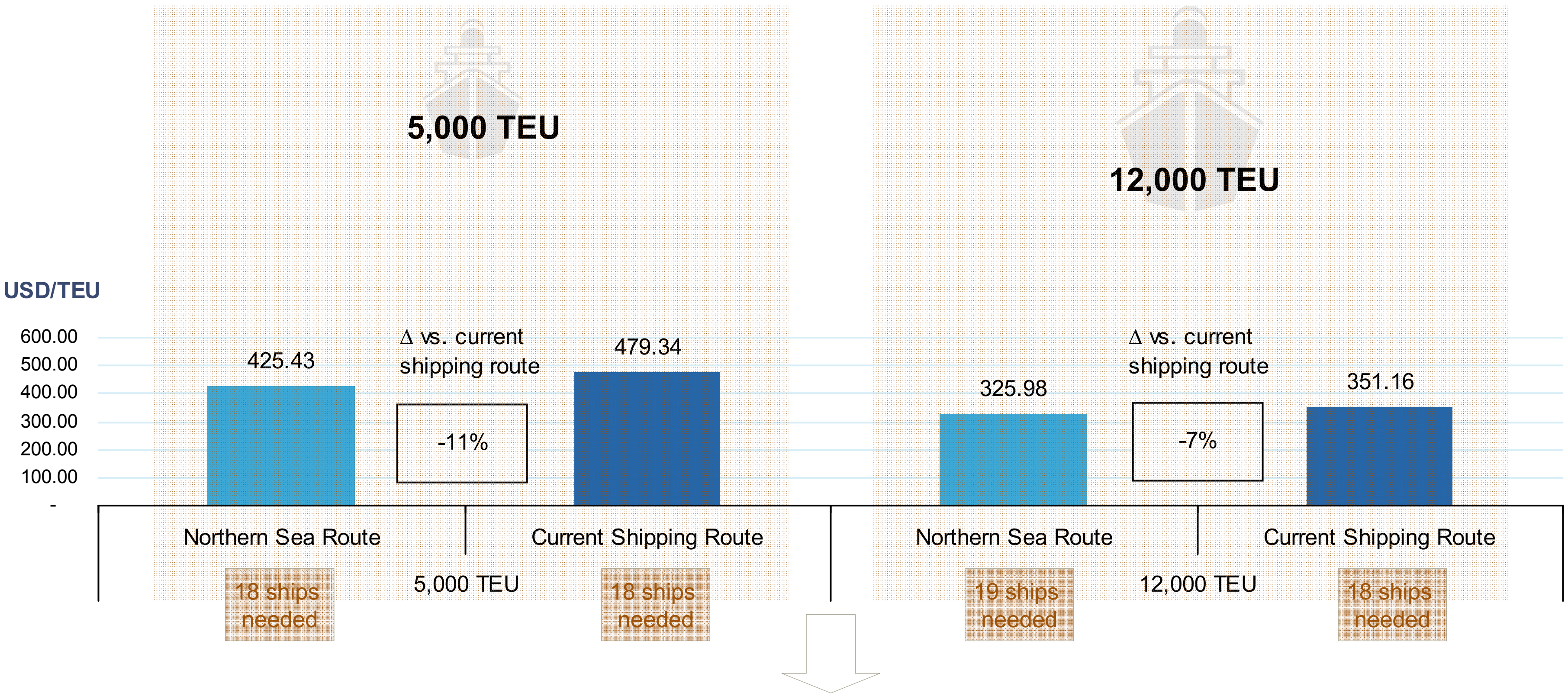
Ice-class ship building premium of 30%

Case 5: New York/Rotterdam-Iceland/Gioia Tauro-Dalian



- This case assesses the position of Iceland versus Gioia Tauro as a hub for US (New York) and EUR (Rotterdam) trade
- The US East Coast - Asia trade (New York) now contributes 80% of the volume, and the EUR - Asia trade (Rotterdam) is limited to 20% of the volume
- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be more advantageous by as much as 11%

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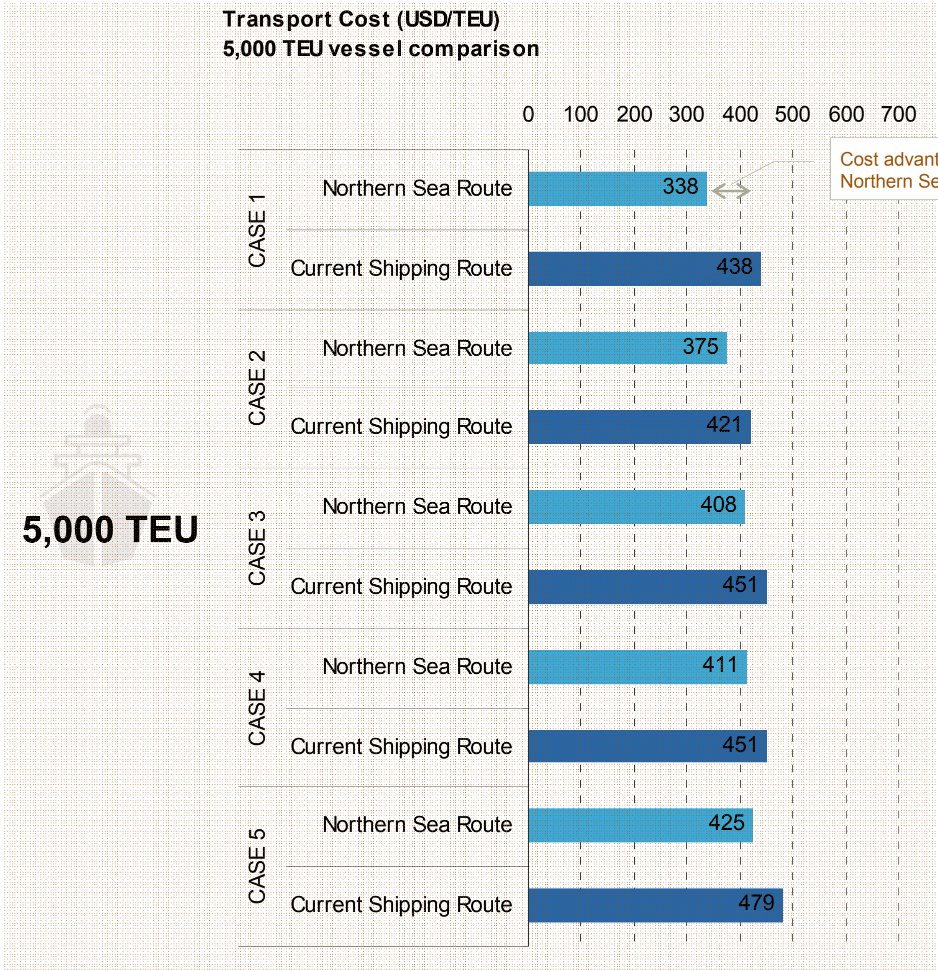
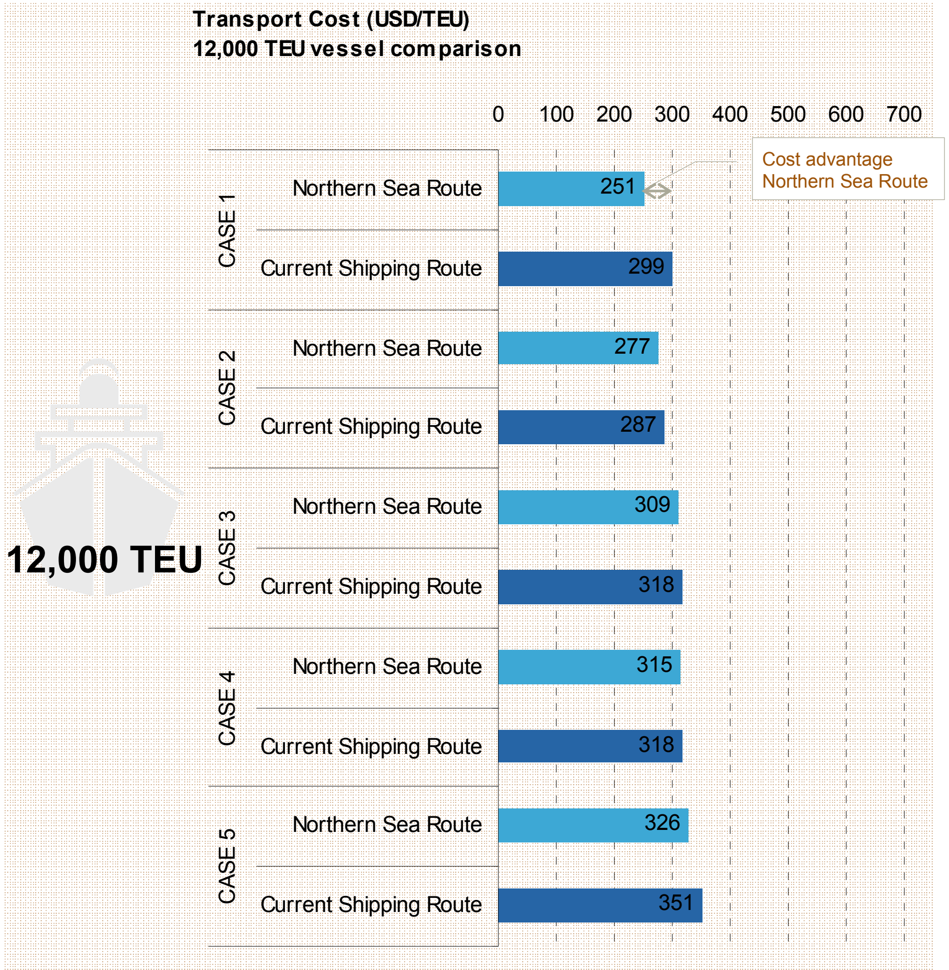
Ice-class ship building premium of 30%

In all of the assessed cases, the Northern Sea Route shows to have a cost advantage over the Current Shipping Route





With a 30% more expensive ice-class ship, cost advantages of the Northern Sea Route mount up to 100 USD/TEU for the 5,000 TEU case and 48 USD/TEU for the 12,000 TEU case

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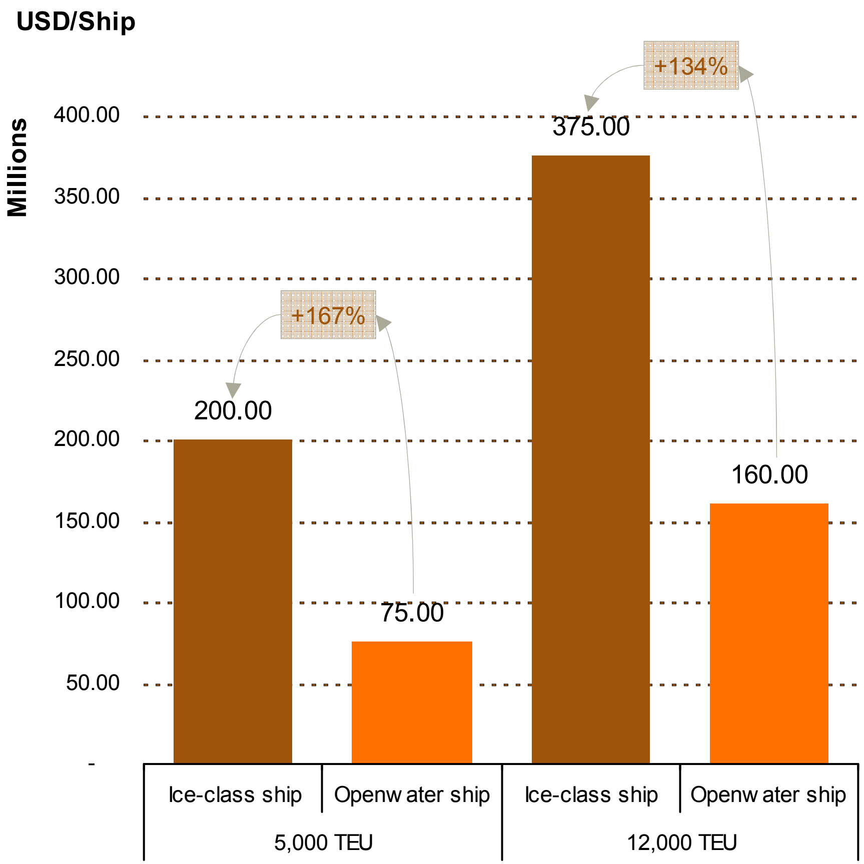
However, the latest Aker Arctic cost data estimates the ice-class ship building cost to be significantly higher



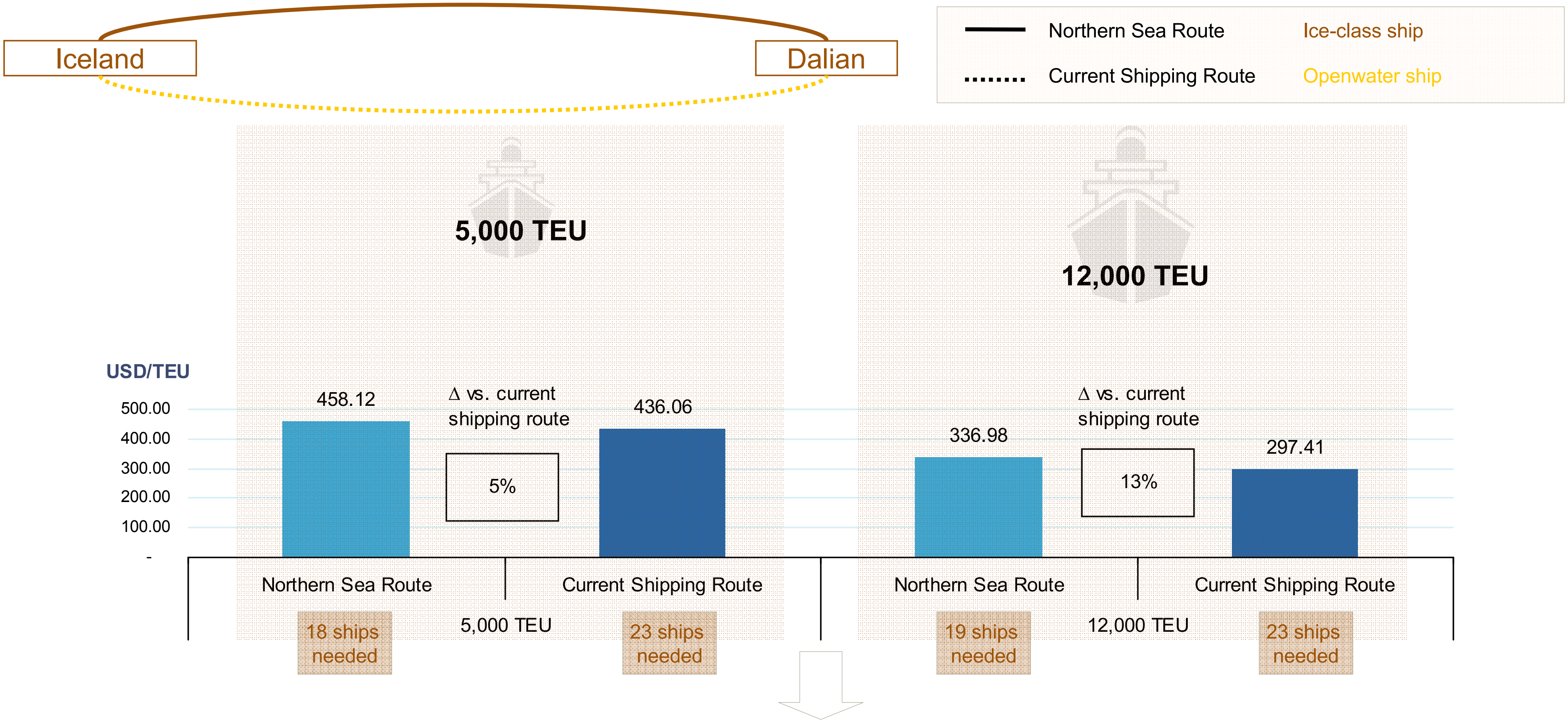
- Based on Aker Arctic information, the ice-class container vessels show to be significantly more expensive than the openwater equivalents
  - **167% more expensive** (200 mUSD vs. 75 mUSD) for the **5,000 TEU** version
  - **134% more expensive** (375 mUSD vs 160 mUSD) for the **12,000 TEU** version
- Roughly 50% of the price difference can be allocated to the hull (more steel, more work, higher grade, not optimized for standard production lines, etc.) and 50% to the specific machinery (propulsion, etc.) needed

The cases are re-assessed based on this (more expensive) ice-class ship capital cost.

Source: BRS-Alphaliner; Aker Arctic

Draft for discussion purposes

Case 1: Iceland-Dalian



- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be **less advantageous** by as much as 13%
- The 12,000 TEU openwater ship is able to reap more economies of scale than the 12,000 TEU ice-class ship since the latter is slower through the ice than its 5,000 TEU peer

Draft for discussion purposes

Case 1: Iceland-Dalian
Ability to downsize the fleet

5,000 TEU

	Northern Sea Route		Current Shipping Route	
Travel time 1-way:	440.35h	Travel time 1-way:	580.14h
Loading/unloading time:	48.00h	Loading/unloading time:	48.00h
Total 1-way trip time:	488.35h	Total 1-way trip time:	628.14h
Total 1-way trip time:	20.35 days	Total 1-way trip time:	26.17 days
Total round trip time:	40.70 days	Total round trip time:	52.34 days
Sailings per vessel/year	8.97	Sailings per vessel/year	6.97
3 sailings per week = 156 sailings per year		3 sailings per week = 156 sailings per year	
Amount of ships needed	17.93	Amount of ships needed	22.37
	≈18 ships		**≈23 ships**

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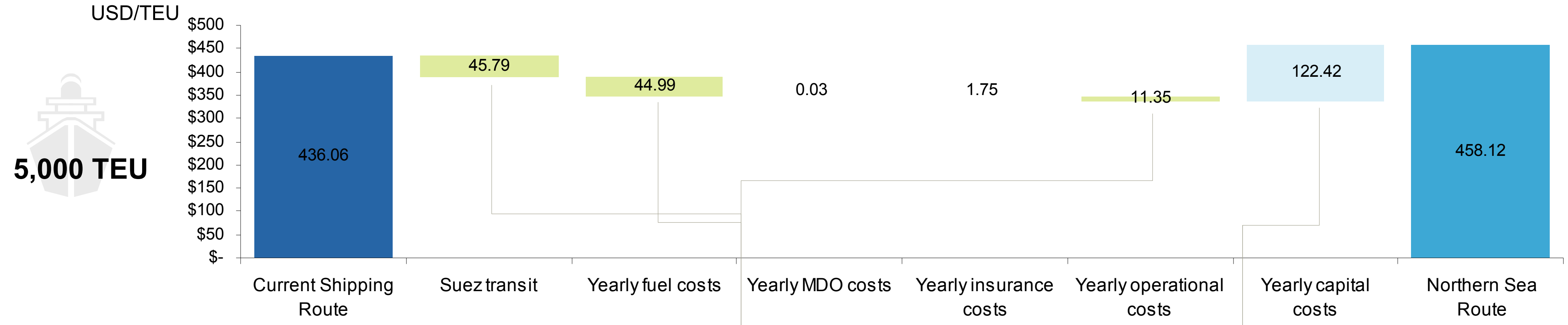
12,000 TEU

	Northern Sea Route		Current Shipping Route	
Travel time 1-way:	480.72h	Travel time 1-way:	580.14h
Loading/unloading time:	48.00h	Loading/unloading time:	48.00h
Total 1-way trip time:	528.72h	Total 1-way trip time:	628.14h
Total 1-way trip time:	22.03 days	Total 1-way trip time:	26.17 days
Total round trip time:	44.06 days	Total round trip time:	52.34 days
Sailings per vessel/year	8.28	Sailings per vessel/year	6.97
3 sailings per week = 156 sailings per year		3 sailings per week = 156 sailings per year	
Amount of ships needed	18.83	Amount of ships needed	22.37
	≈19 ships		**≈23 ships**

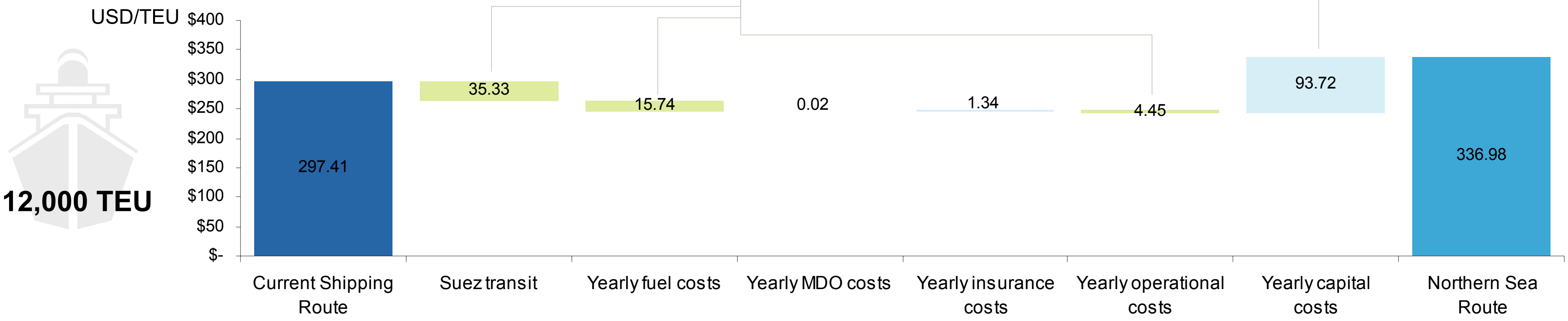
Draft for discussion purposes

Case 1: Analysis of underlying cost differences

While avoidance of Suez transit charges, reduced fuel costs and slight operational cost savings show to have a positive impact on the Northern Sea Route costs per TEU, the higher capital costs make the picture turn bad.

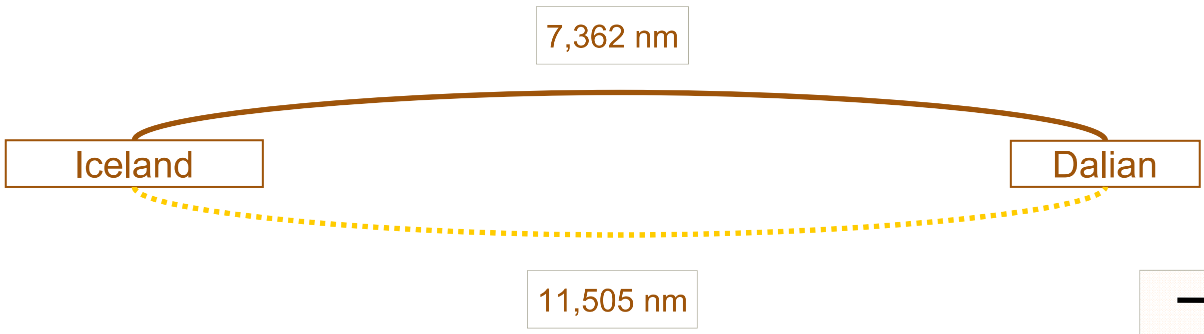


Significant cost savings for Northern Sea Route < Major cost increase for Northern Sea Route



Draft for discussion purposes

Case 1: Comparative overview Northern Sea Route – Current Shipping Route



———	Northern Sea Route	Ice-class ship
....	Current Shipping Route	Openwater ship

	Northern Sea Route	Current Shipping Route
5,000 TEU	▪ **18 vessels** needed for 3 sailings per week ▪ Price per vessel: 200m USD → Total CAPEX investment: **3,600m USD**	▪ **23 vessels** needed for 3 sailings per week ▪ Price per vessel: 75m USD → Total CAPEX investment: **1,725m USD**
12,000 TEU	▪ **19 vessels** needed for 3 sailings per week ▪ Price per vessel: 375m USD → Total CAPEX investment: **7,125m USD**	▪ **23 vessels** needed for 3 sailings per week ▪ Price per vessel: 160m USD → Total CAPEX investment: **3,680m USD**

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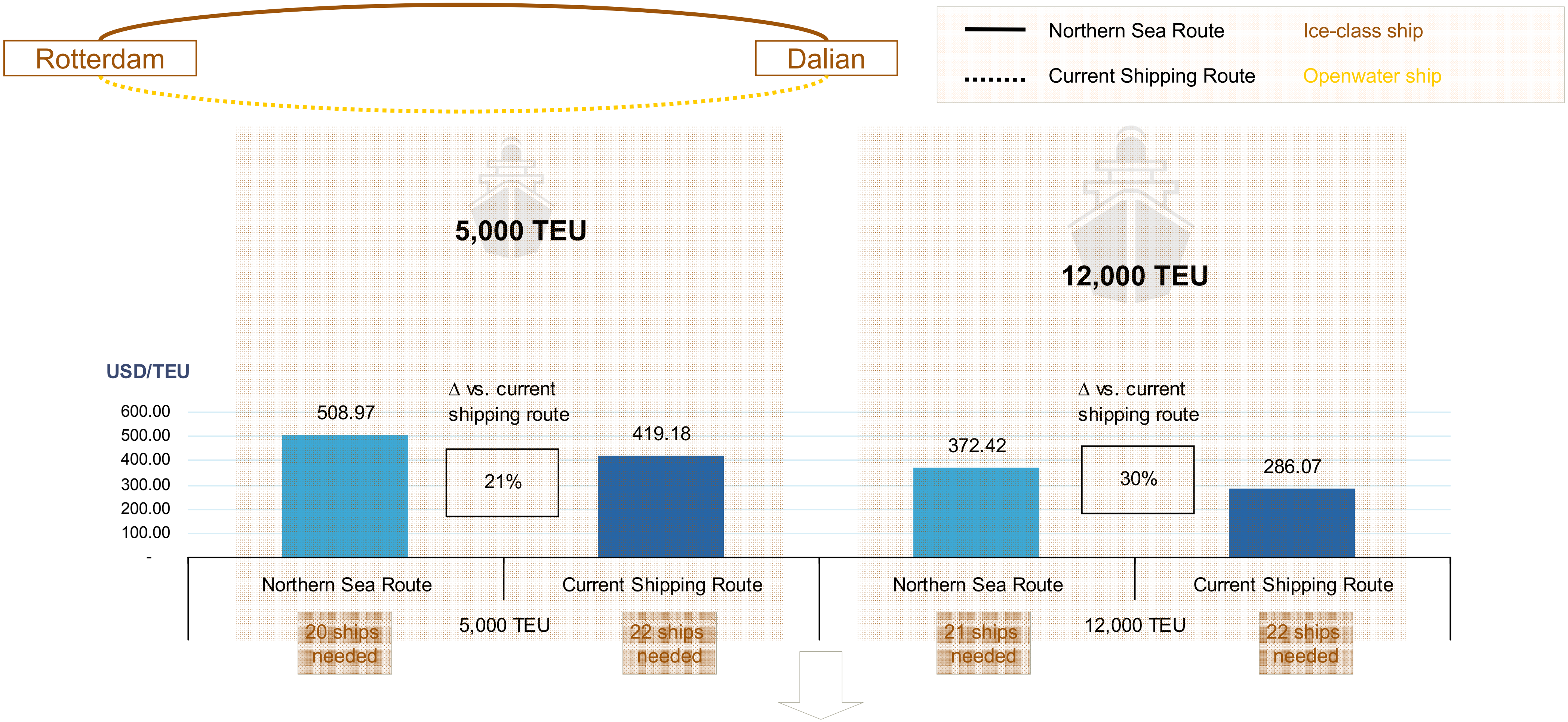
Case 2: Rotterdam-Dalian



- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be **less advantageous** by as much as 30%
- Compared to Iceland (Case 1), the disadvantage of the Northern Sea Route over the Current Shipping Route increases by more than 15%

Draft for discussion purposes

Case 2: Rotterdam-Dalian
Ability to downsize the fleet

5,000 TEU

	Northern Sea Route		Current Shipping Route	
	▪ Travel time 1-way:	491.14h	▪ Travel time 1-way:	552.00h
	▪ Loading/unloading time:	48.00h	▪ Loading/unloading time:	48.00h
	▪ Total 1-way trip time:	539.14h	▪ Total 1-way trip time:	600.00h
	▪ Total 1-way trip time:	22.46 days	▪ Total 1-way trip time:	25.00 days
	▪ Total round trip time:	40.70 days	▪ Total round trip time:	50.00 days
	▪ Sailings per vessel/year	8.12	▪ Sailings per vessel/year	7.30
	3 sailings per week = 156 sailings per year		3 sailings per week = 156 sailings per year	
	▪ Amount of ships needed	19.20	▪ Amount of ships needed	21.37
		≈20 ships		**≈22 ships**

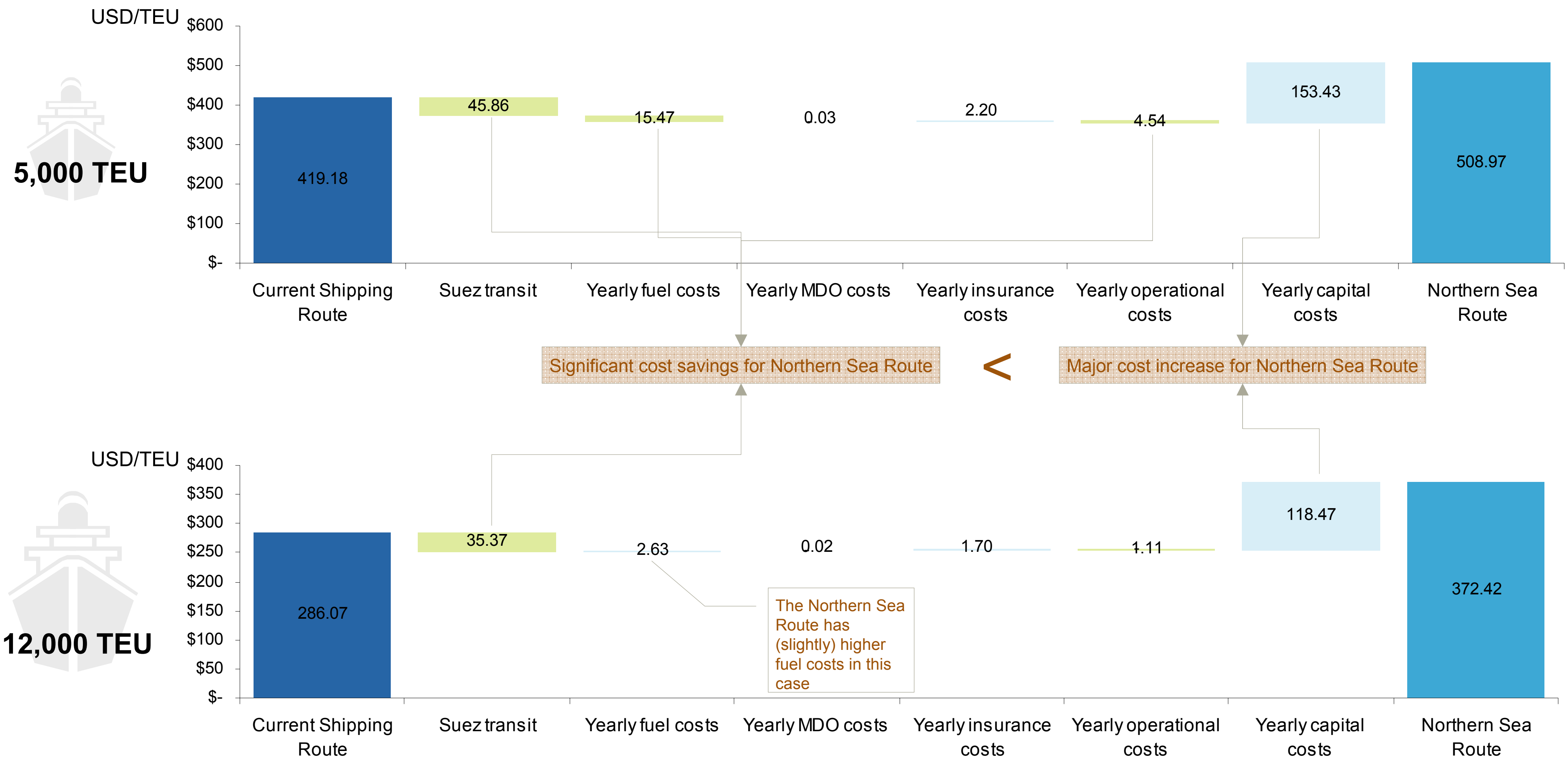
12,000 TEU

	Northern Sea Route		Current Shipping Route	
	▪ Travel time 1-way:	531.51h	▪ Travel time 1-way:	552.00h
	▪ Loading/unloading time:	48.00h	▪ Loading/unloading time:	48.00h
	▪ Total 1-way trip time:	579.51	▪ Total 1-way trip time:	600.00h
	▪ Total 1-way trip time:	24.15 days	▪ Total 1-way trip time:	25.00 days
	▪ Total round trip time:	48.29 days	▪ Total round trip time:	50.00 days
	▪ Sailings per vessel/year	7.56	▪ Sailings per vessel/year	7.30
	3 sailings per week = 156 sailings per year		3 sailings per week = 156 sailings per year	
	▪ Amount of ships needed	20.64	▪ Amount of ships needed	21.37
		≈21 ships		**≈22 ships**

Draft for discussion purposes

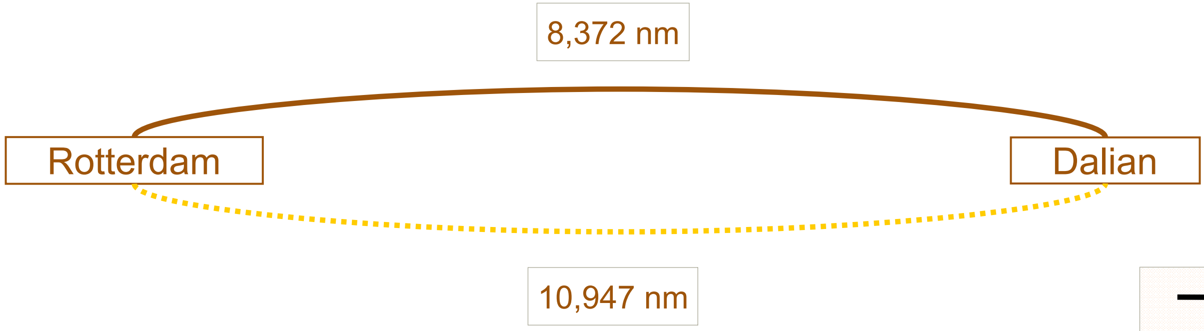
Case 2: Analysis of underlying cost differences

Similar to case 1; avoidance of Suez transit charges, reduced fuel costs and slight operational cost savings show to have a positive impact on the Northern Sea Route costs per TEU, however the higher capital costs make the picture turn bad.



Draft for discussion purposes

Case 2: Comparative overview Northern Sea Route – Current Shipping Route

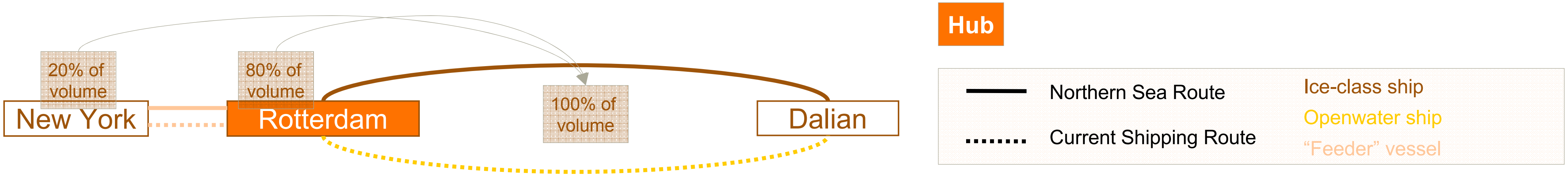


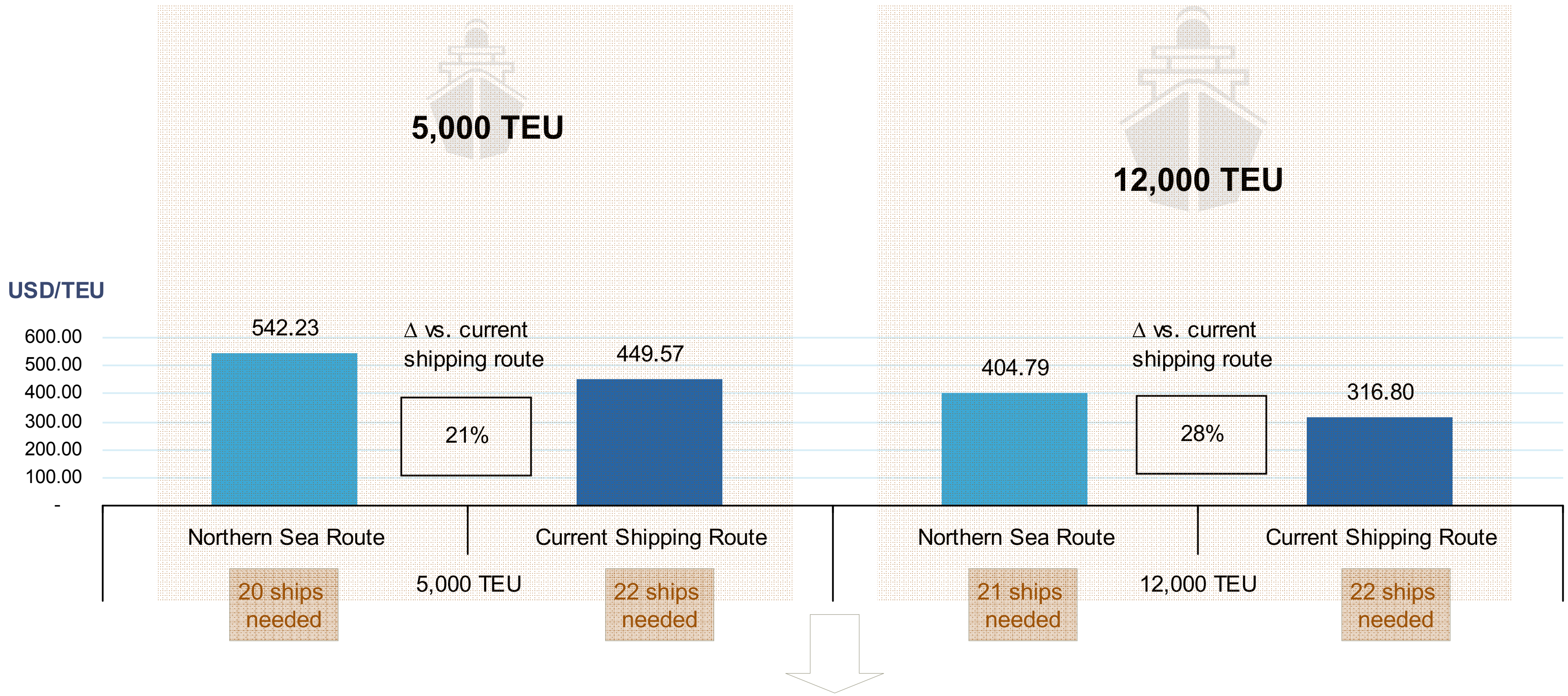
———	Northern Sea Route	Ice-class ship
....	Current Shipping Route	Openwater ship

	Northern Sea Route	Current Shipping Route
5,000 TEU	▪ **20 vessels** needed for 3 sailings per week ▪ Price per vessel: 200m USD → Total CAPEX investment: **4,000m USD**	▪ **22 vessels** needed for 3 sailings per week ▪ Price per vessel: 75m USD → Total CAPEX investment: **1,650m USD**
12,000 TEU	▪ **21 vessels** needed for 3 sailings per week ▪ Price per vessel: 375m USD → Total CAPEX investment: **7,875m USD**	▪ **22 vessels** needed for 3 sailings per week ▪ Price per vessel: 160m USD → Total CAPEX investment: **3,520m USD**

Draft for discussion purposes

Case 3: New York-Rotterdam-Dalian





- In line with current trade figures, the US East Coast - Asia trade (New York) is assumed to account for 20% of the volume, and the EUR - Asia trade (Rotterdam) contributes 80% of the volume
- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be less advantageous by as much as 28%

Draft for discussion purposes

Case 3: New York-Rotterdam-Dalian
Ability to downsize the fleet

5,000 TEU

	Northern Sea Route		Current Shipping Route	
Travel time 1-way:		491.14h		552.00h
Loading/unloading time:		48.00h		48.00h
Total 1-way trip time:		539.14h		600.00h
Total 1-way trip time:		22.46 days		25.00 days
Total round trip time:		40.70 days		50.00 days
Sailings per vessel/year		8.12		7.30
3 sailings per week = 156 sailings per year	/			
Amount of ships needed	=	19.20		21.37
		≈20 ships		**≈22 ships**

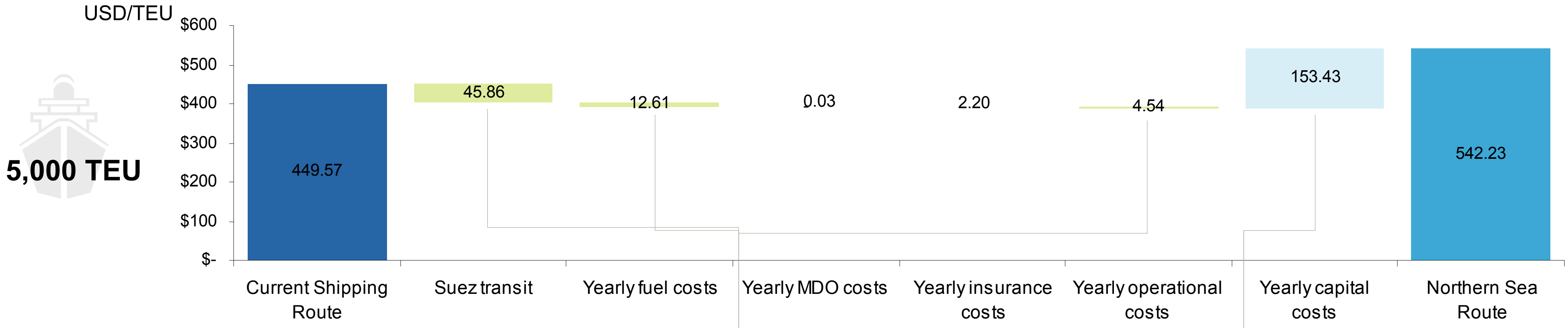
12,000 TEU

	Northern Sea Route	Current Shipping Route
Travel time 1-way:	531.51h	552.00h
Loading/unloading time:	48.00h	48.00h
Total 1-way trip time:	579.51	600.00h
Total 1-way trip time:	24.15 days	25.00 days
Total round trip time:	48.29 days	50.00 days
Sailings per vessel/year	7.56	7.30
3 sailings per week = 156 sailings per year		
Amount of ships needed	20.64	21.37
	≈21 ships	**≈22 ships**

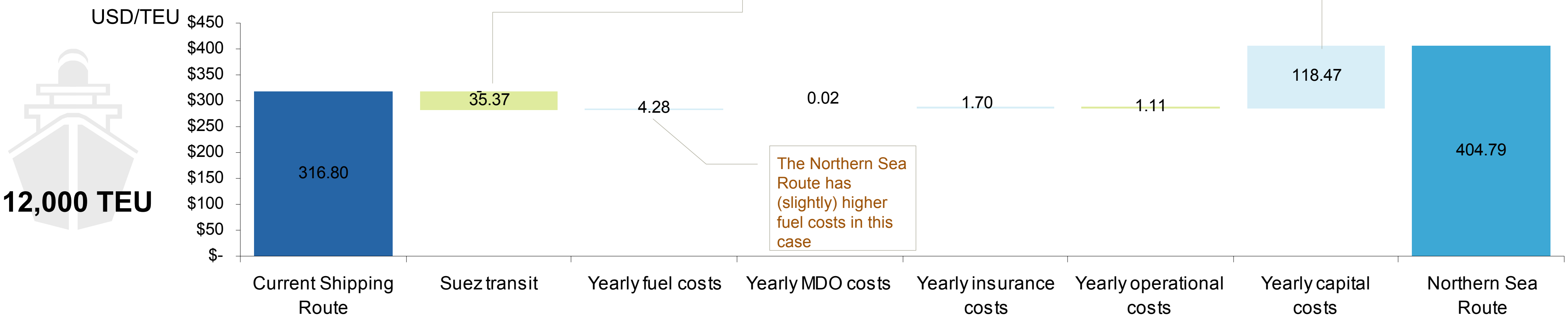
Draft for discussion purposes

Case 3: Analysis of underlying cost differences

While avoidance of Suez transit charges and reduced fuel costs (5,000 TEU vessel size) show to have a positive impact on the Northern Sea Route costs per TEU, the higher capital costs make the picture turn bad.

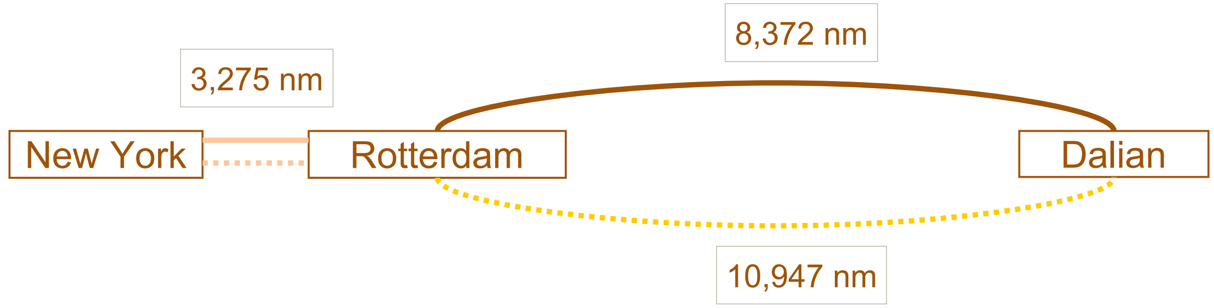


Significant cost savings for Northern Sea Route < Major cost increase for Northern Sea Route



Draft for discussion purposes

Case 3: Comparative overview Northern Sea Route – Current Shipping Route

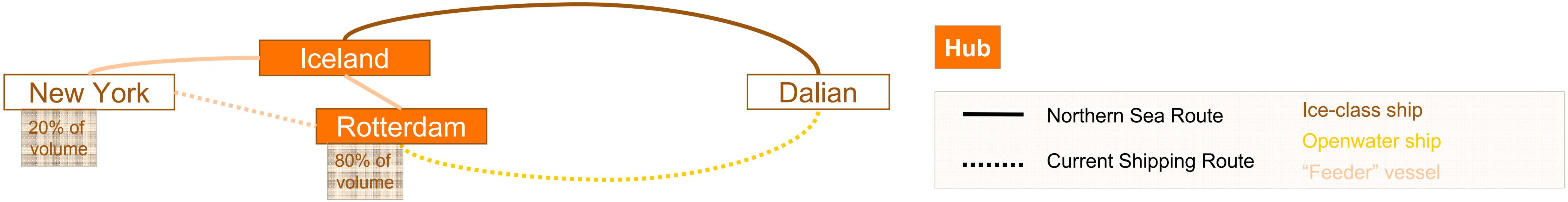


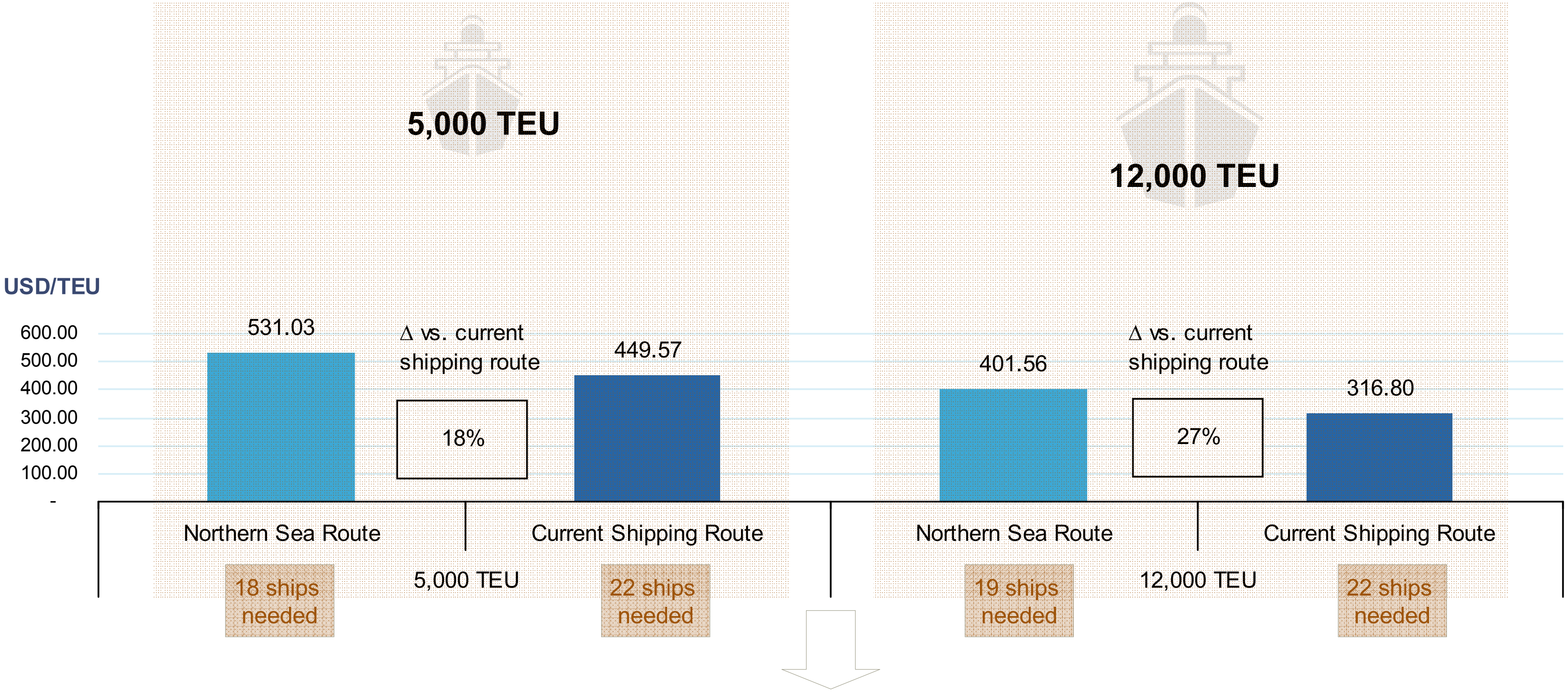
Solid	Northern Sea Route	Ice-class ship
Dotted	Current Shipping Route	Openwater ship
		"Feeder" vessel

	Northern Sea Route	Current Shipping Route
5,000 TEU	▪ **20 vessels** needed for 3 sailings per week ▪ Price per vessel: 200m USD → Total CAPEX investment: **4,000m USD**	▪ **22 vessels** needed for 3 sailings per week ▪ Price per vessel: 75m USD → Total CAPEX investment: **1,650m USD**
12,000 TEU	▪ **21 vessels** needed for 3 sailings per week ▪ Price per vessel: 375m USD → Total CAPEX investment: **7,875m USD**	▪ **22 vessels** needed for 3 sailings per week ▪ Price per vessel: 160m USD → Total CAPEX investment: **3,520m USD**

Draft for discussion purposes

Case 4: New York/Rotterdam-Iceland-Dalian





- This case assesses the position of Iceland versus Rotterdam as a hub for US (New York) and EUR (Rotterdam) trade.
- In line with current trade figures, the US East Coast - Asia trade (New York) is assumed to account for 20% of the volume, and the EUR - Asia trade (Rotterdam) contributes 80% of the volume
- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be less advantageous by as much as 27%

Draft for discussion purposes

Case 4: New York/Rotterdam-Iceland-Dalian
Ability to downsize the fleet

5,000 TEU

	Northern Sea Route		Current Shipping Route	
	Travel time 1-way:	440.35h	Travel time 1-way:	552.00h
	Loading/unloading time:	48.00h	Loading/unloading time:	48.00h
	Total 1-way trip time:	488.35h	Total 1-way trip time:	600.00h
	Total 1-way trip time:	20.35 days	Total 1-way trip time:	25.00 days
	Total round trip time:	40.70 days	Total round trip time:	50.00 days
	Sailings per vessel/year	8.97	Sailings per vessel/year	7.30
	3 sailings per week = 156 sailings per year		3 sailings per week = 156 sailings per year	
	Amount of ships needed	17.93	Amount of ships needed	21.37
		≈18 ships		**≈22 ships**

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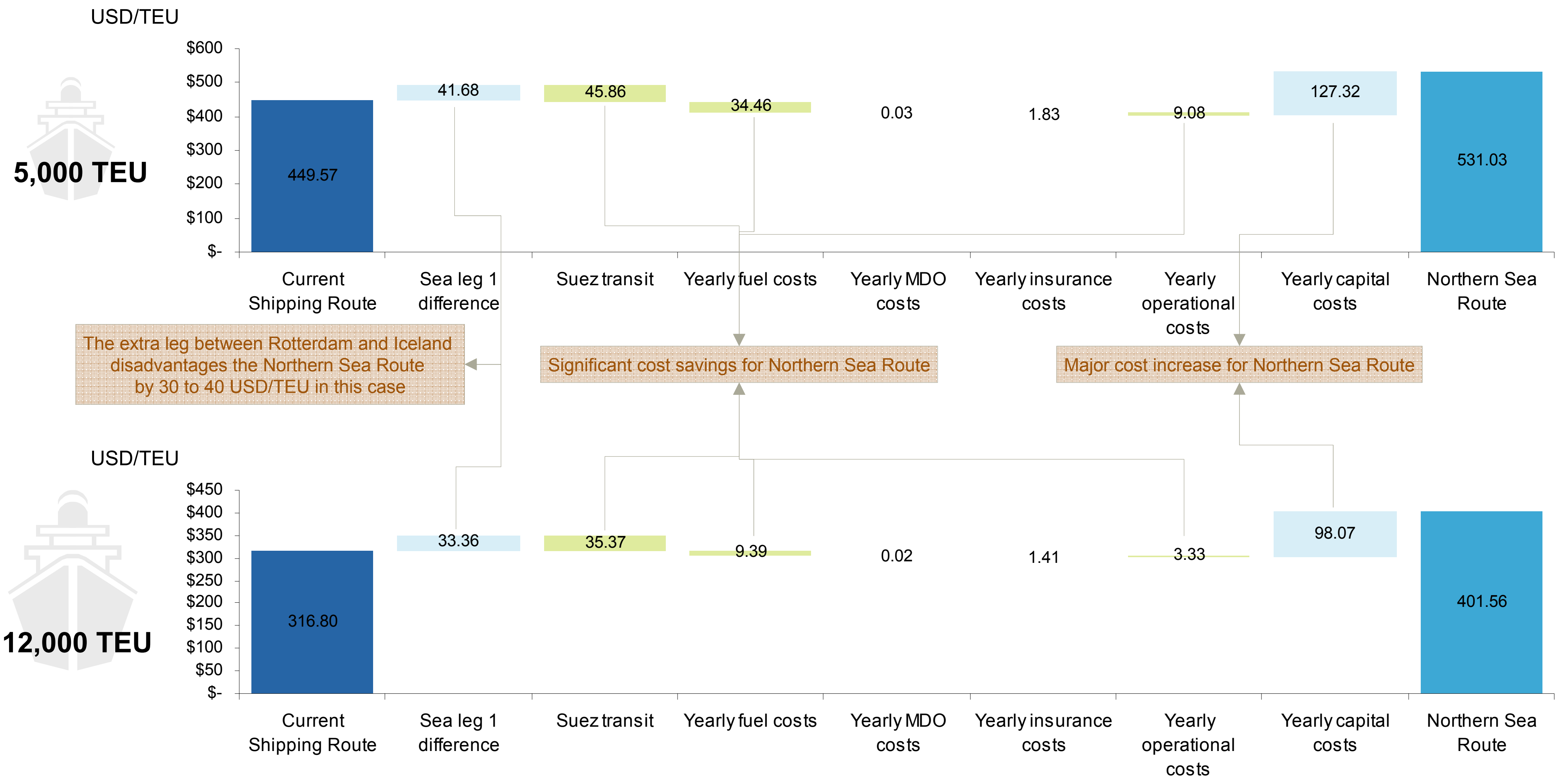
12,000 TEU

	Northern Sea Route		Current Shipping Route	
	Travel time 1-way:	480.72h	Travel time 1-way:	552.00h
	Loading/unloading time:	48.00h	Loading/unloading time:	48.00h
	Total 1-way trip time:	528.72h	Total 1-way trip time:	600.00h
	Total 1-way trip time:	22.03 days	Total 1-way trip time:	25.00 days
	Total round trip time:	44.06 days	Total round trip time:	50.00 days
	Sailings per vessel/year	8.28	Sailings per vessel/year	7.30
	3 sailings per week = 156 sailings per year		3 sailings per week = 156 sailings per year	
	Amount of ships needed	18.83	Amount of ships needed	21.37
		≈19 ships		**≈22 ships**

Draft for discussion purposes

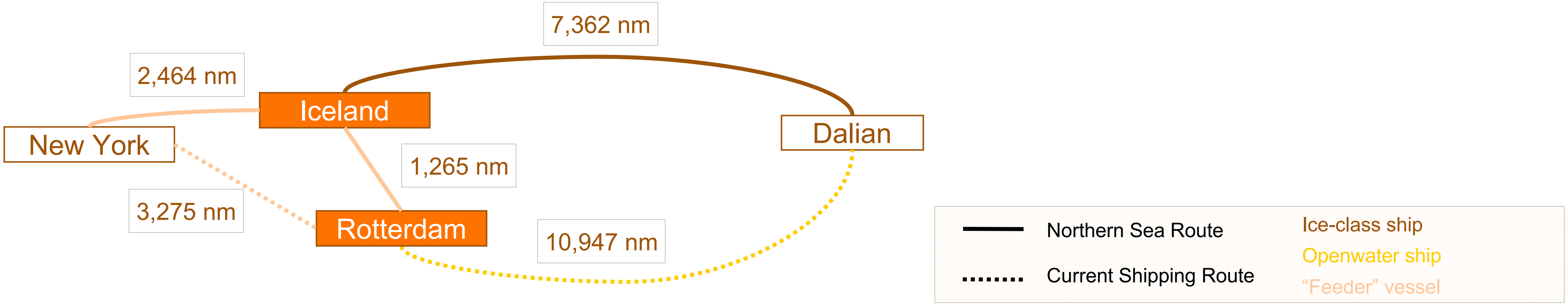
Case 4: Analysis of underlying cost differences

While avoidance of Suez transit charges and reduced fuel costs show to have a positive impact on the Northern Sea Route costs per TEU, higher costs on the “feeder” sea leg and especially higher capital costs make the picture turn bad.



Draft for discussion purposes

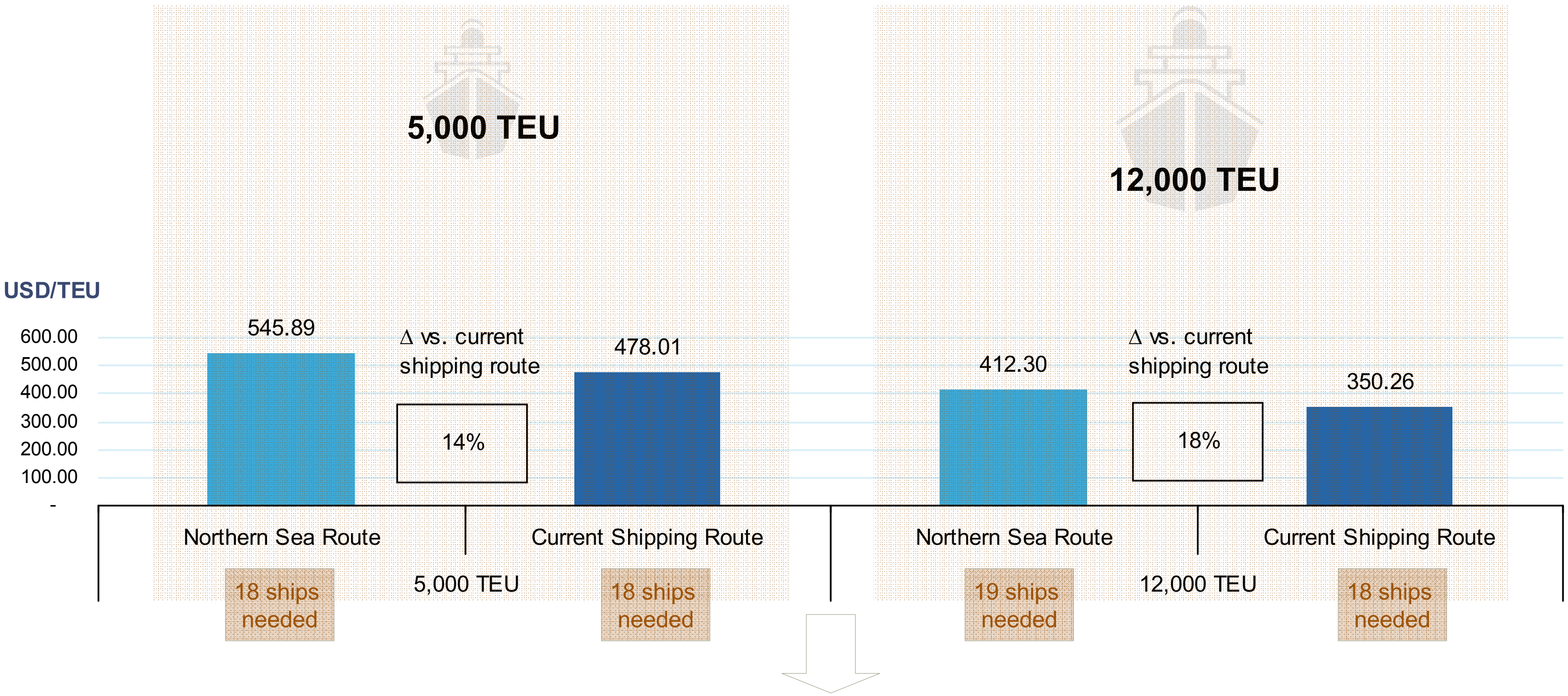
Case 4: Comparative overview Northern Sea Route – Current Shipping Route



	Northern Sea Route	Current Shipping Route
5,000 TEU	▪ **18 vessels** needed for 3 sailings per week ▪ Price per vessel: 200m USD → Total CAPEX investment: **3,600m USD**	▪ **22 vessels** needed for 3 sailings per week ▪ Price per vessel: 75m USD → Total CAPEX investment: **1,650m USD**
12,000 TEU	▪ **19 vessels** needed for 3 sailings per week ▪ Price per vessel: 375m USD → Total CAPEX investment: **7,125m USD**	▪ **22 vessels** needed for 3 sailings per week ▪ Price per vessel: 160m USD → Total CAPEX investment: **3,520m USD**

Draft for discussion purposes

Case 5: New York/Rotterdam-Iceland/Gioia Tauro-Dalian



- This case assesses the position of Iceland versus Gioia Tauro as a hub for US (New York) and EUR (Rotterdam) trade
- The US East Coast - Asia trade (New York) now contributes 80% of the volume, and the EUR - Asia trade (Rotterdam) is limited to 20% of the volume
- In the 5,000 TEU & 12,000 TEU case, the Northern Sea Route cost per TEU shows to be more advantageous by as much as 18%

Draft for discussion purposes

Case 5: New York/Rotterdam-Iceland/Gioia Tauro-Dalian
Ability to downsize the fleet

5,000 TEU

	Northern Sea Route		Current Shipping Route	
	Travel time 1-way:	440.35h	Travel time 1-way:	435.62h
	Loading/unloading time:	48.00h	Loading/unloading time:	48.00h
	Total 1-way trip time:	488.35h	Total 1-way trip time:	483.62h
	Total 1-way trip time:	20.35 days	Total 1-way trip time:	20.15 days
	Total round trip time:	40.70 days	Total round trip time:	40.30 days
	Sailings per vessel/year	8.97	Sailings per vessel/year	9.06
	3 sailings per week = 156 sailings per year		3 sailings per week = 156 sailings per year	
	Amount of ships needed	17.93 **≈18 ships**	Amount of ships needed	17.22 **≈18 ships**

12,000 TEU

	Northern Sea Route		Current Shipping Route	
	Travel time 1-way:	480.72h	Travel time 1-way:	435.62h
	Loading/unloading time:	48.00h	Loading/unloading time:	48.00h
	Total 1-way trip time:	528.72h	Total 1-way trip time:	483.62h
	Total 1-way trip time:	22.03 days	Total 1-way trip time:	20.15 days
	Total round trip time:	44.06 days	Total round trip time:	40.30 days
	Sailings per vessel/year	8.28	Sailings per vessel/year	9.06
	3 sailings per week = 156 sailings per year		3 sailings per week = 156 sailings per year	
	Amount of ships needed	18.83 **≈19 ships**	Amount of ships needed	17.22 **≈18 ships**

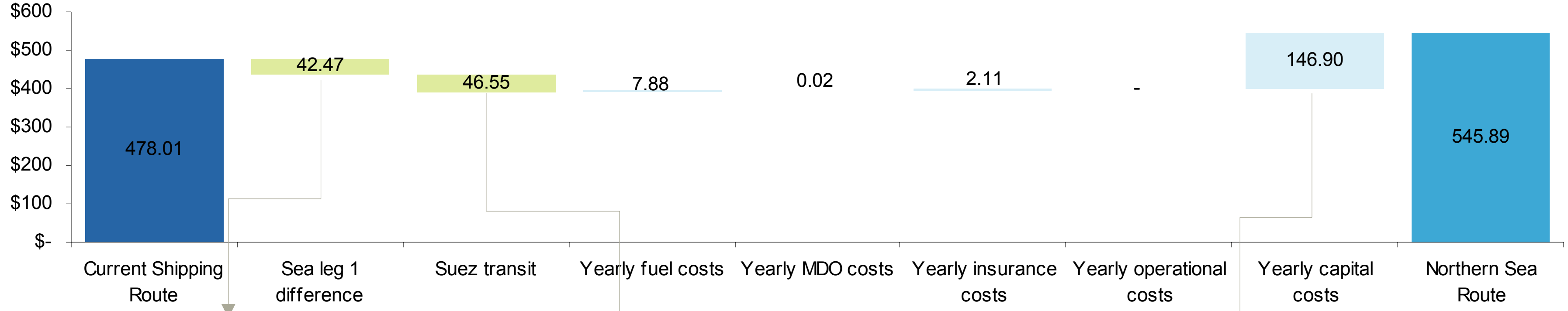
Draft for discussion purposes

Case 5: Analysis of underlying cost differences

While costs savings on the "feeder" sea legs & avoidance of Suez transit charges have a positive impact on the Northern Sea Route costs per TEU, the higher capital costs make the Northern Sea Route more expensive

USD/TEU

5,000 TEU



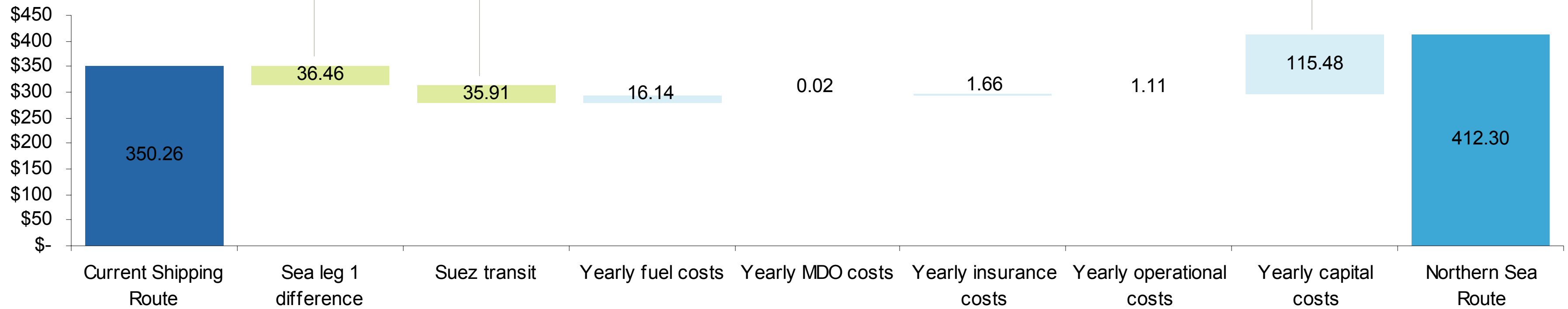
The location of Iceland shows to have an advantage over Gioia Tauro vis-à-vis New York & Rotterdam

Significant cost savings for Northern Sea Route

Major cost increase for Northern Sea Route

USD/TEU

12,000 TEU



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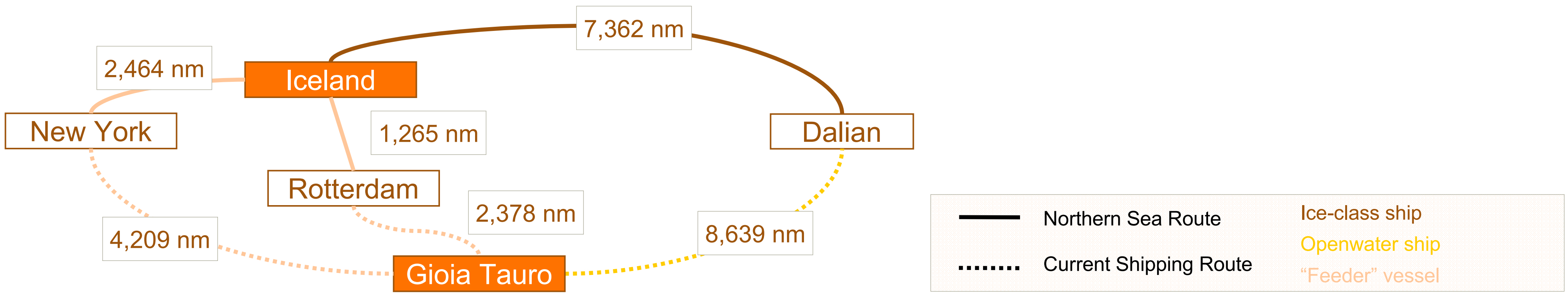
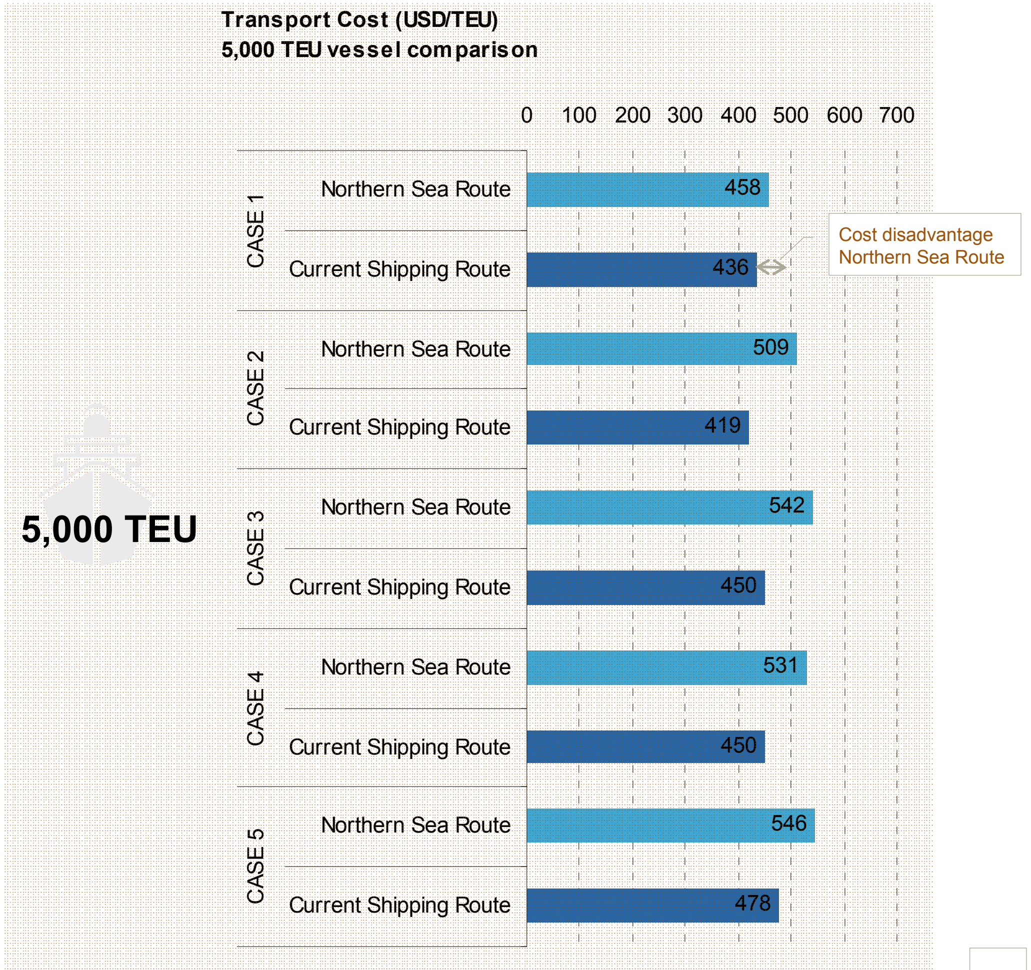
Case 5: Comparative overview Northern Sea Route – Current Shipping Route

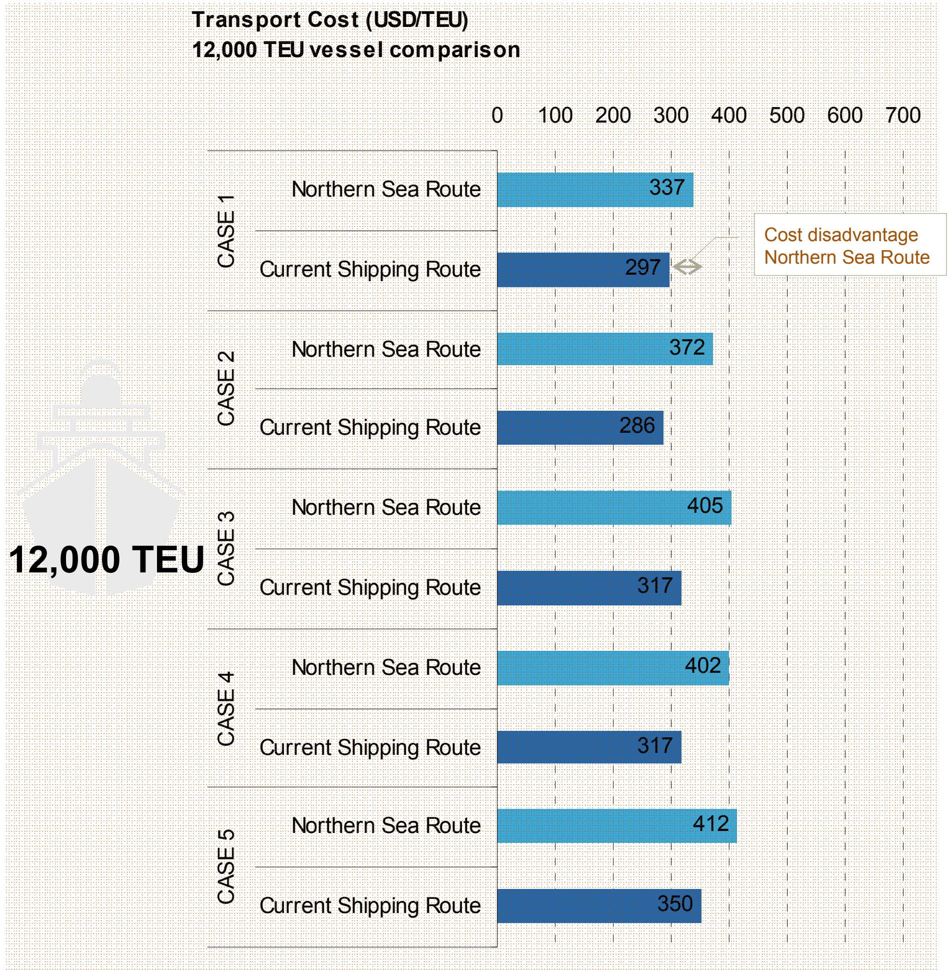


	Northern Sea Route	Current Shipping Route
5,000 TEU	▪ **18 vessels** needed for 3 sailings per week ▪ Price per vessel: 200m USD → Total CAPEX investment: **3,600m USD**	▪ **18 vessels** needed for 3 sailings per week ▪ Price per vessel: 75m USD → Total CAPEX investment: **1,350m USD**
12,000 TEU	▪ **19 vessels** needed for 3 sailings per week ▪ Price per vessel: 375m USD → Total CAPEX investment: **7,125m USD**	▪ **18 vessels** needed for 3 sailings per week ▪ Price per vessel: 160m USD → Total CAPEX investment: **2,880m USD**

Draft for discussion purposes

Using the ship building cost provided by Aker Arctic, the Northern Sea Route has a cost disadvantage over the Current Shipping Route in all of the assessed cases.





With Aker Arctic ice-class ship building cost data, the disadvantages of the Northern Sea Route mount up to 90 USD/TEU for the 5,000 TEU case and 88 USD/TEU for the 12,000 TEU case

Draft for discussion purposes

Business case
Conclusions

- Given the ship building cost provided by Aker Arctic, the Northern Sea Route has no advantage over the Current Shipping Route in all of the assessed cases

- Depending on the assessed case, the Northern Sea Route entails savings in fuel costs, Suez transit charges, feeder legs and operational (fuel) costs. However, despite the fact that fewer vessels are needed to offer the same service level of 3 sailings per week, the higher capital costs related to ice-class ship building neutralize the advantages and create a cost disadvantage vis-à-vis the Current Shipping Route.

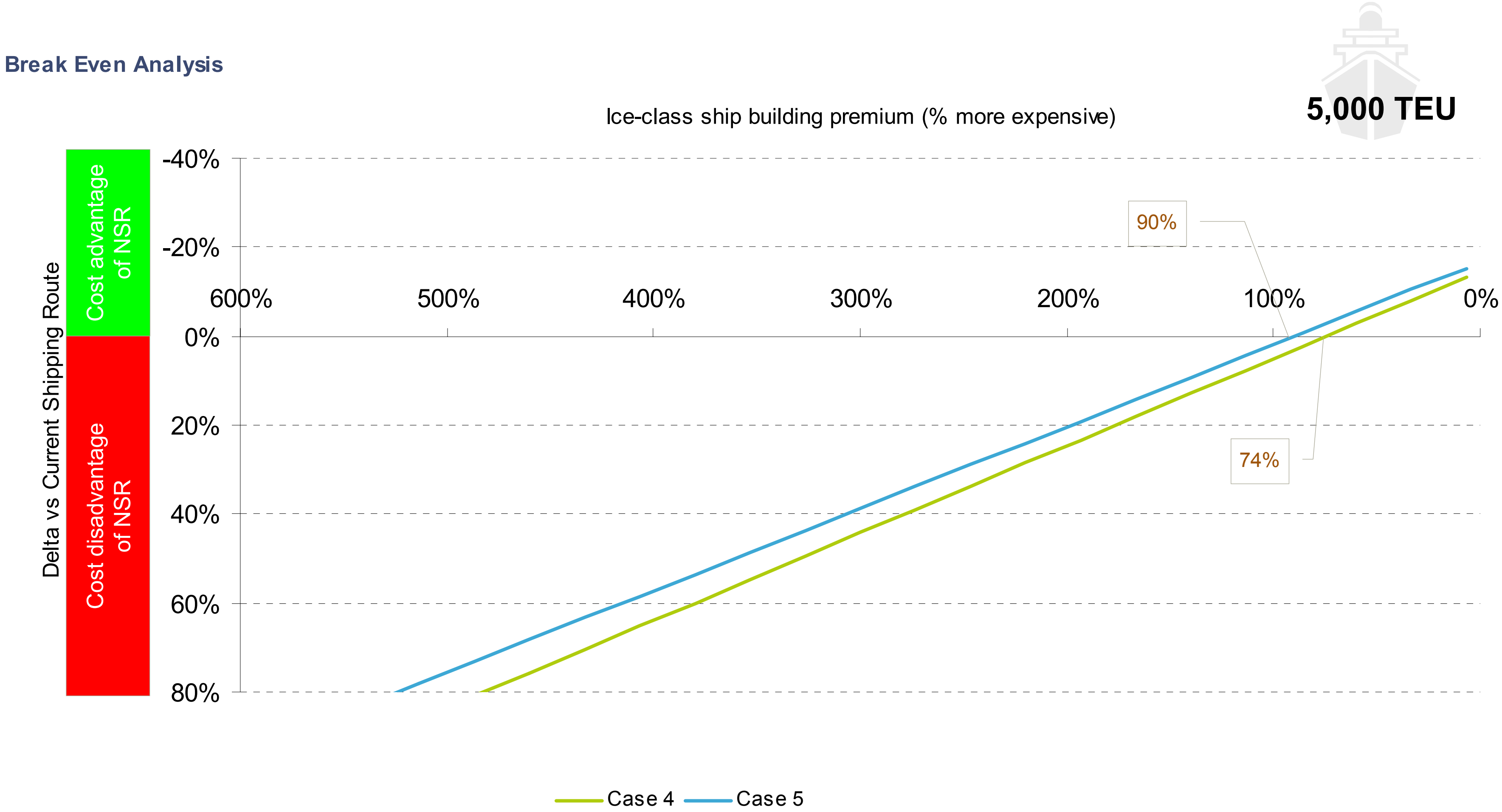
- The potential of the Northern Sea Route is driven by several variables. A break-even analysis is performed on 3:
  - ship building cost;
  - fuel price;
  - Suez transit charges

- This way, the importance of each variable can be isolated in order to locate the turning points at which the Northern Sea Route starts to become advantageous.

- Next to the break-even analysis, the effect of the following changes in the operating environment is tested:
  - Changing climate conditions:
    - Severe winter conditions instead of average winter conditions;
    - Further (accelerated) melting of the ice, i.e. distance within ice minus 50%;
  - Positioning of a hub in Dutch Harbour (Alaska) for the Northern Sea Route;
  - Use of the Cape of Good Hope route, instead of passing through the Suez Canal

Draft for discussion purposes

Break-even analysis
Ship building cost

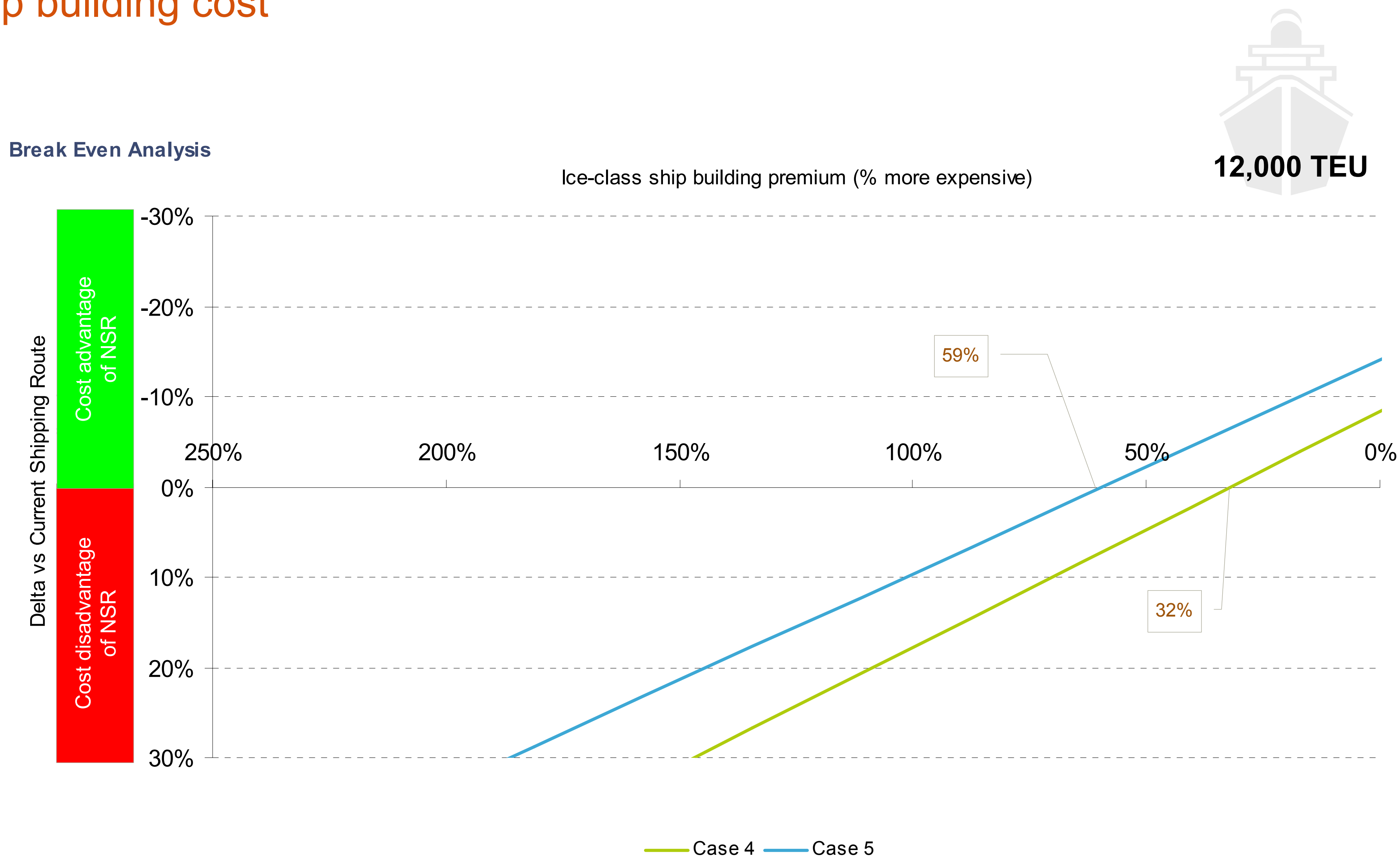


- At an ice-class ship premium of 74% over the openwater vessels; case 4 and case 5 will be more advantageous when sailing over the Northern Sea Route.

Note: the break even analyses for cases 1 to 3 can be found in appendix

Draft for discussion purposes

Break-even analysis
Ship building cost

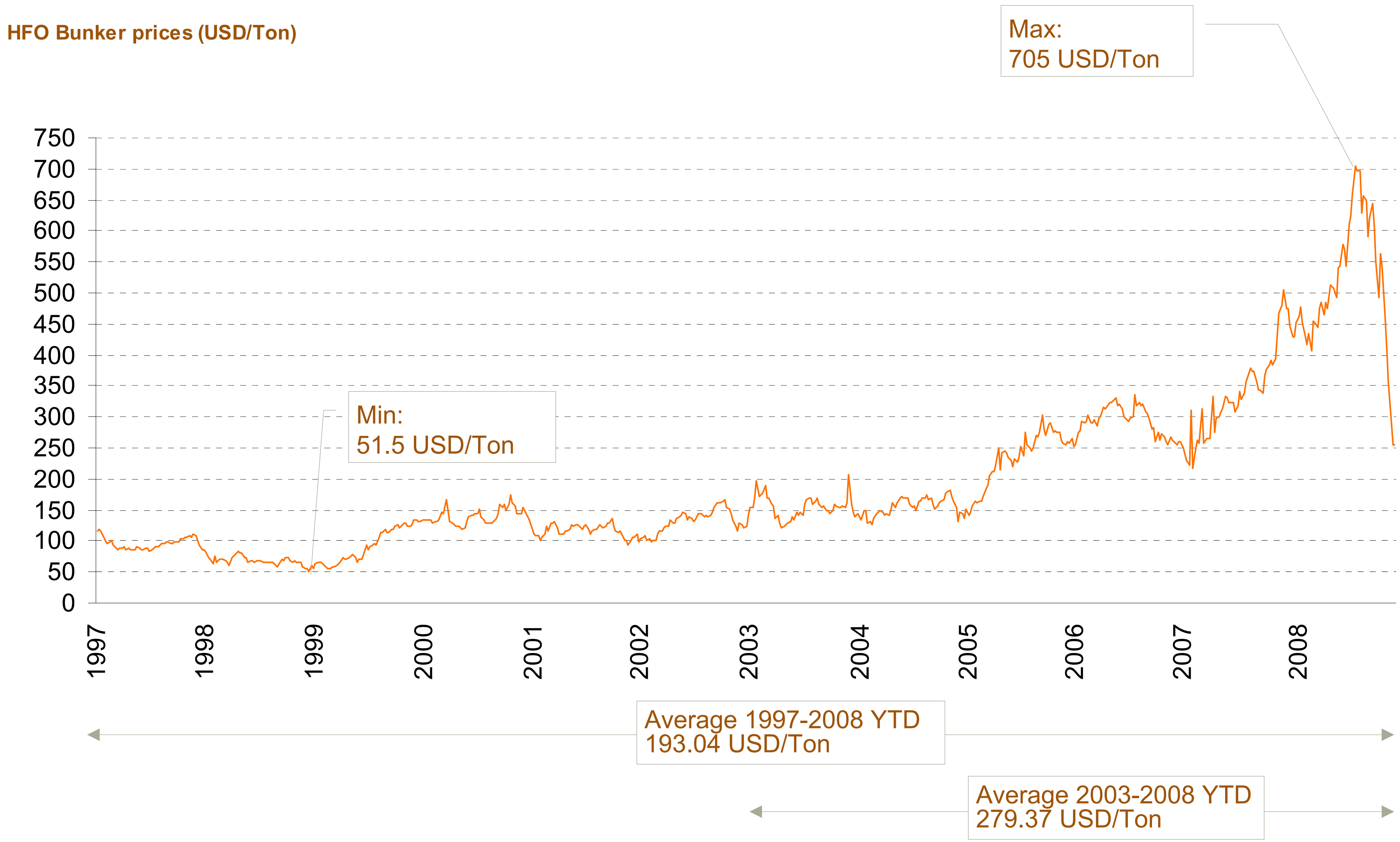


- At an ice-class ship premium of 32% over the openwater vessels; case 4 and 5 will be more advantageous when sailing over the Northern Sea Route.

Note: the break even analyses for cases 1 to 3 can be found in appendix

Draft for discussion purposes

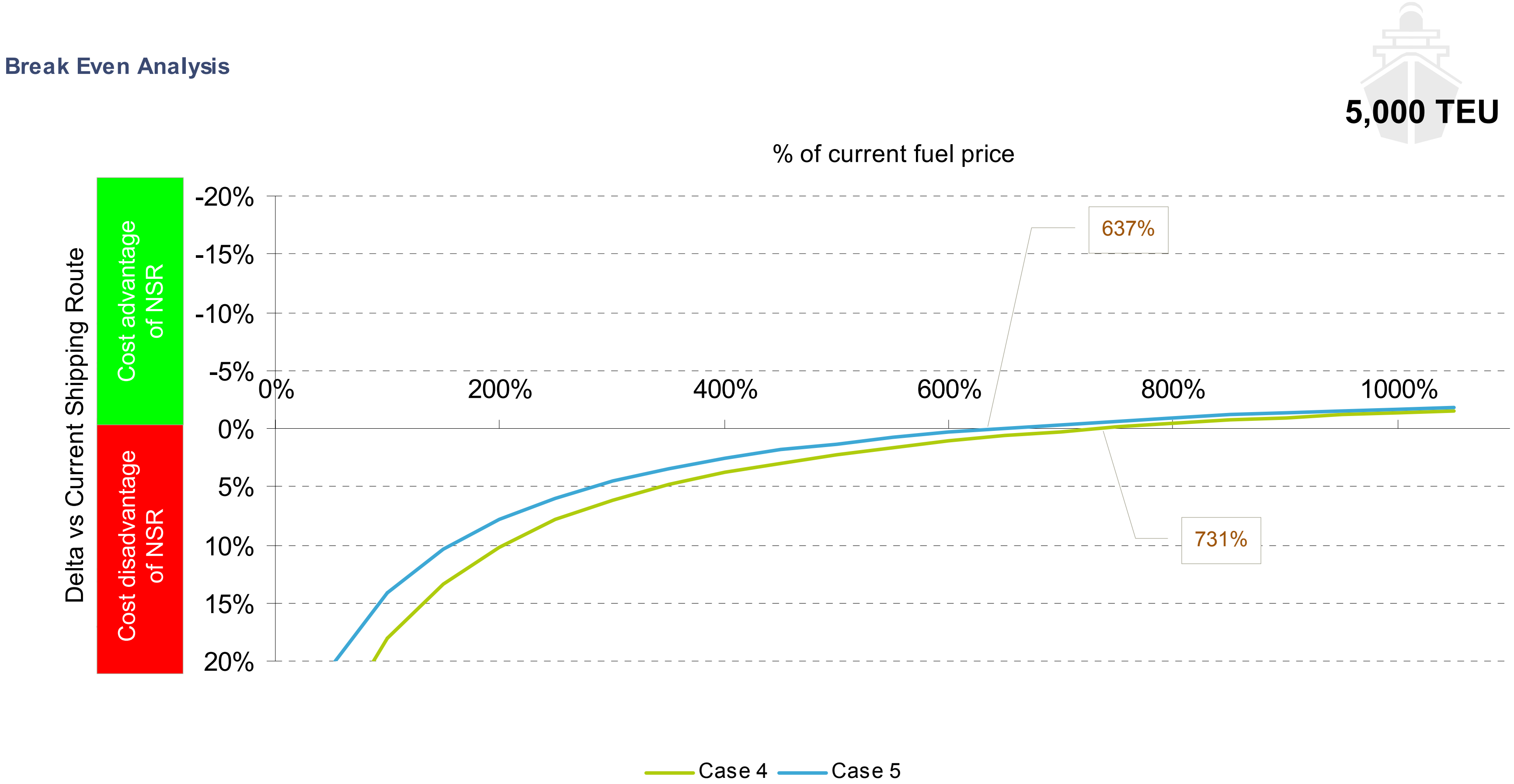
Over the last 10 years, (HFO) fuel prices have been fluctuating heavily



Source: Independent Container Lines

Draft for discussion purposes

Break-even analysis
Fuel price

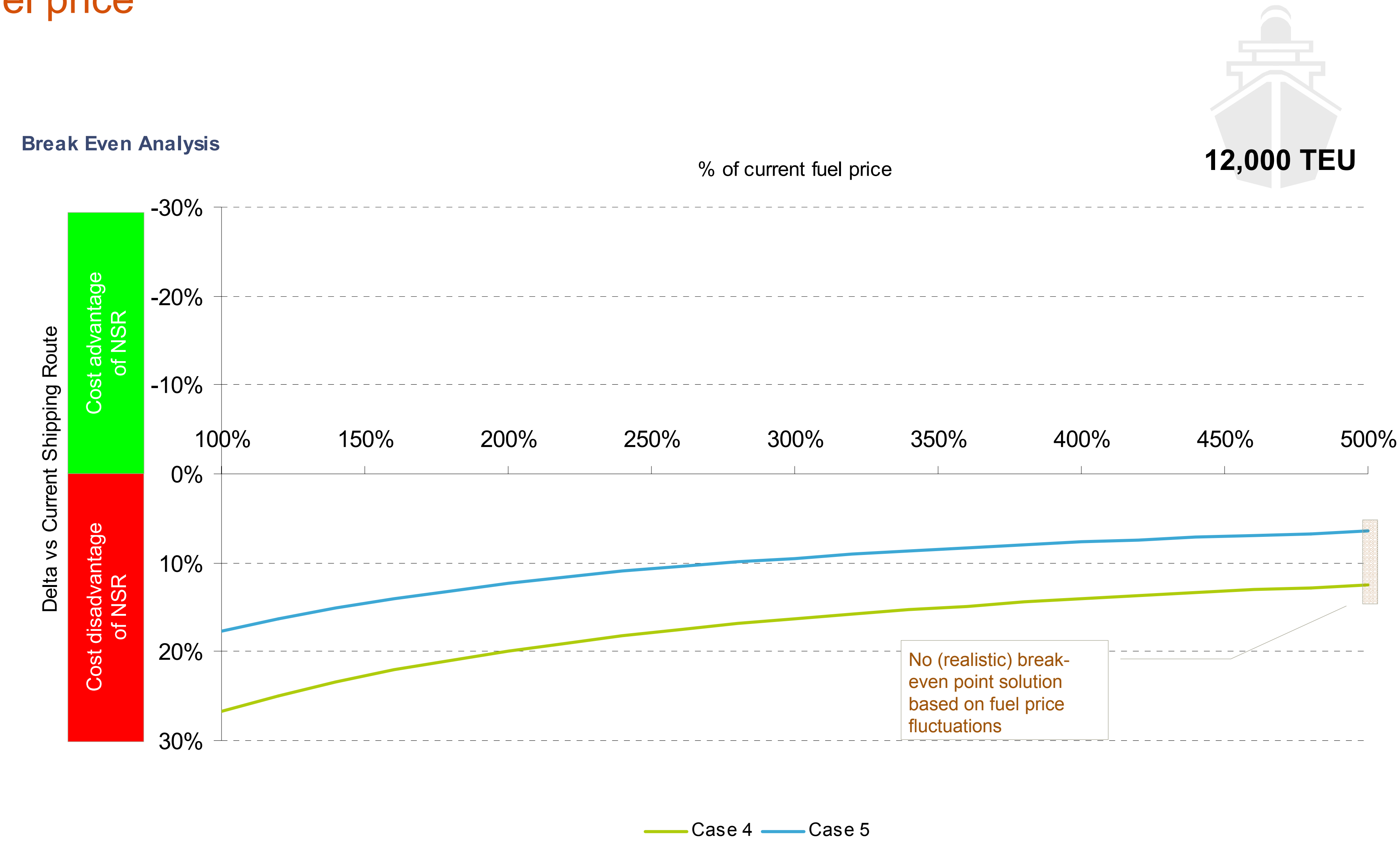


- If fuel price increases 631% (which would mean an HFO price of 1,463 USD/Ton), the Northern Sea Route becomes cost competitive on case 4 and 5

Note: the break even analyses for cases 1 to 3 can be found in appendix

Draft for discussion purposes

Break-even analysis
Fuel price

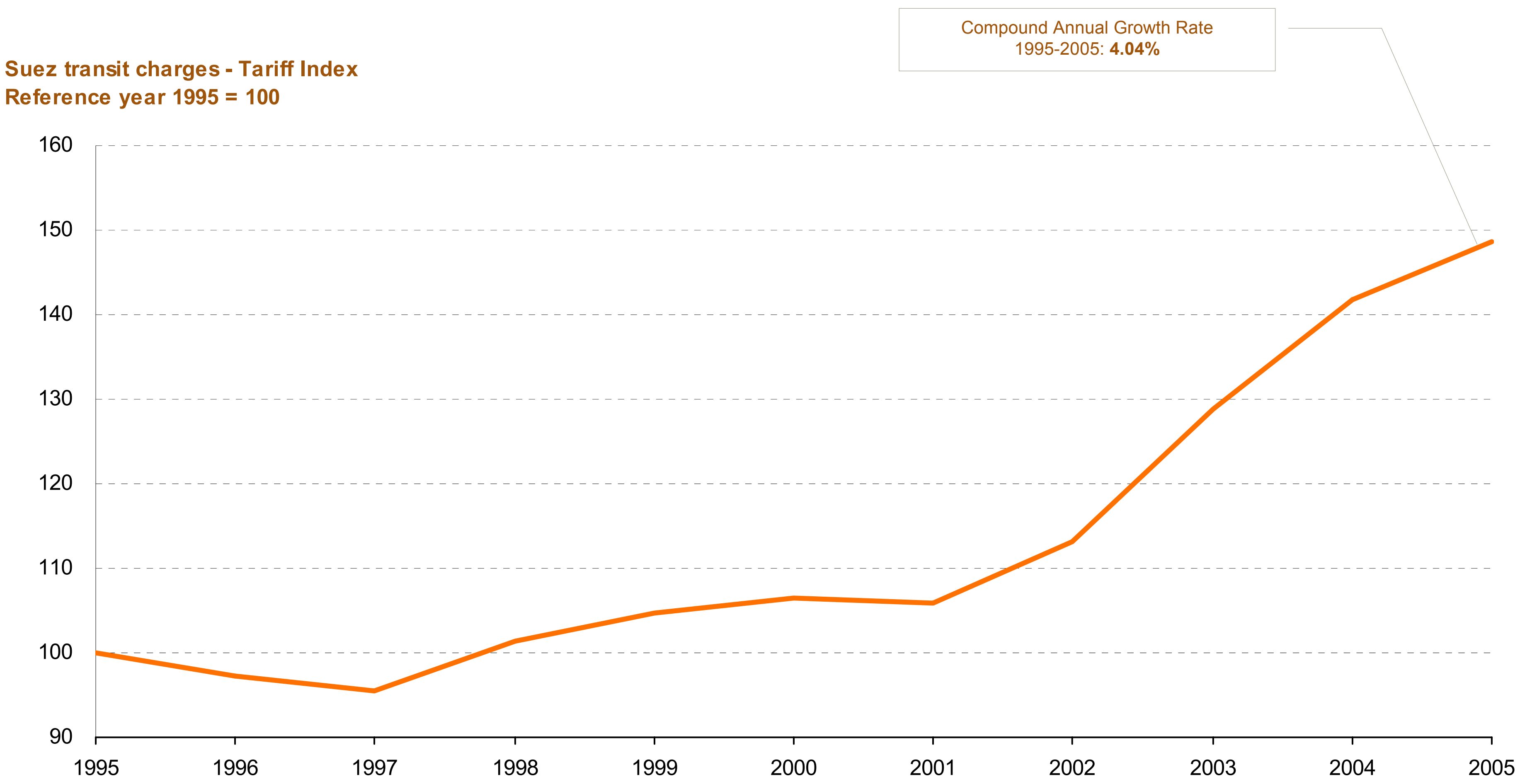


- Contrary to its 5,000 TEU peer, the 12,000 TEU version has no realistic break-even point based on fuel price fluctuations at which the Northern Sea Route becomes cost competitive.

Note: the break even analyses for cases 1 to 3 can be found in appendix

Draft for discussion purposes

Over the period 1995 – 2005, the average tariff to cross the Suez Canal has increased by 4% annually



Source: RK Johns & Associates; PwC Analysis
Note: 2005 data only covers January to August

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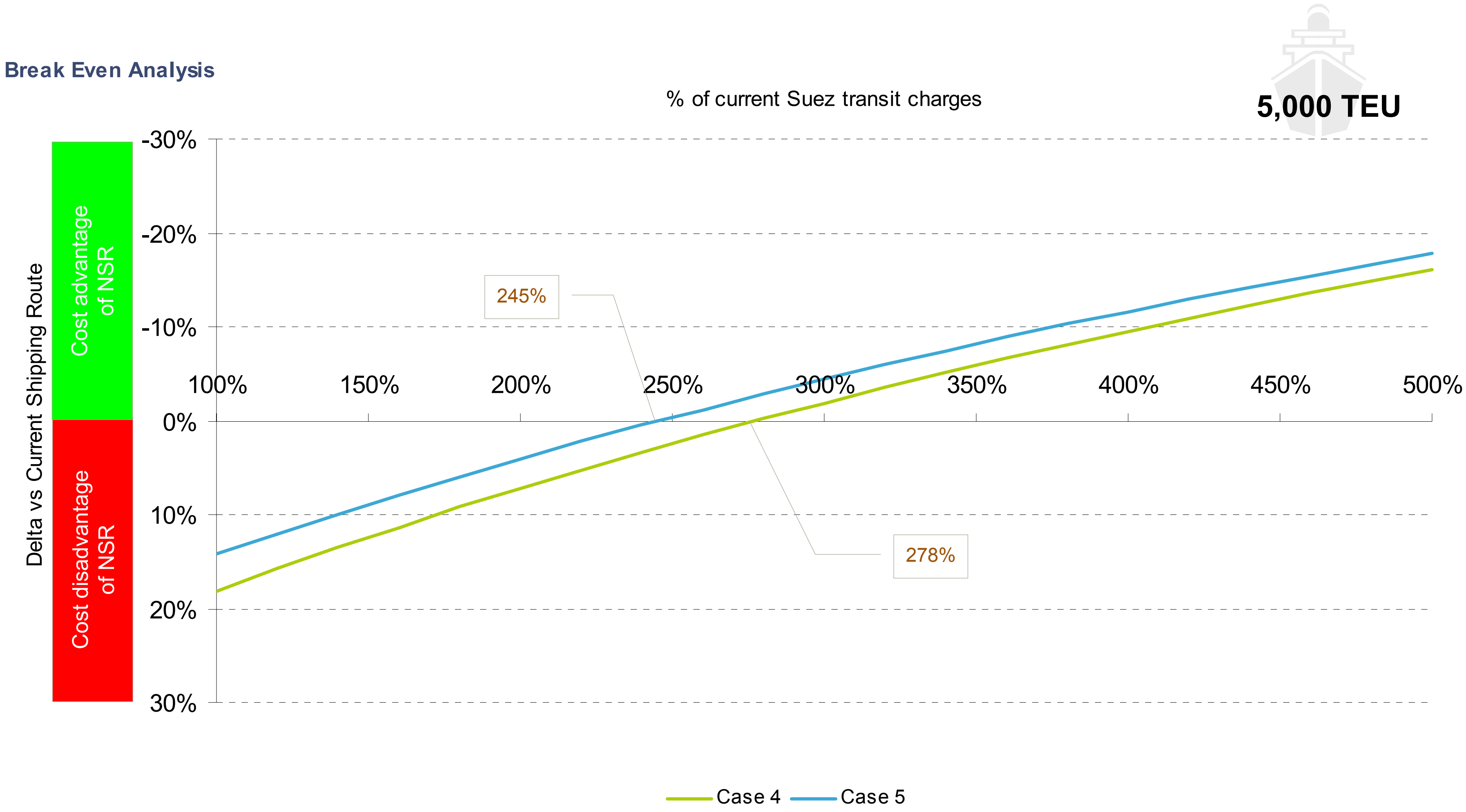
Break-even analysis
Suez transit charges



- Assuming that the Suez tariff continues to increase with 4.04% p.a., it would take 27 years to reach the break-even point for case 4 (278% of current tariff).

Note: the break even analyses for cases 1 to 3 can be found in appendix

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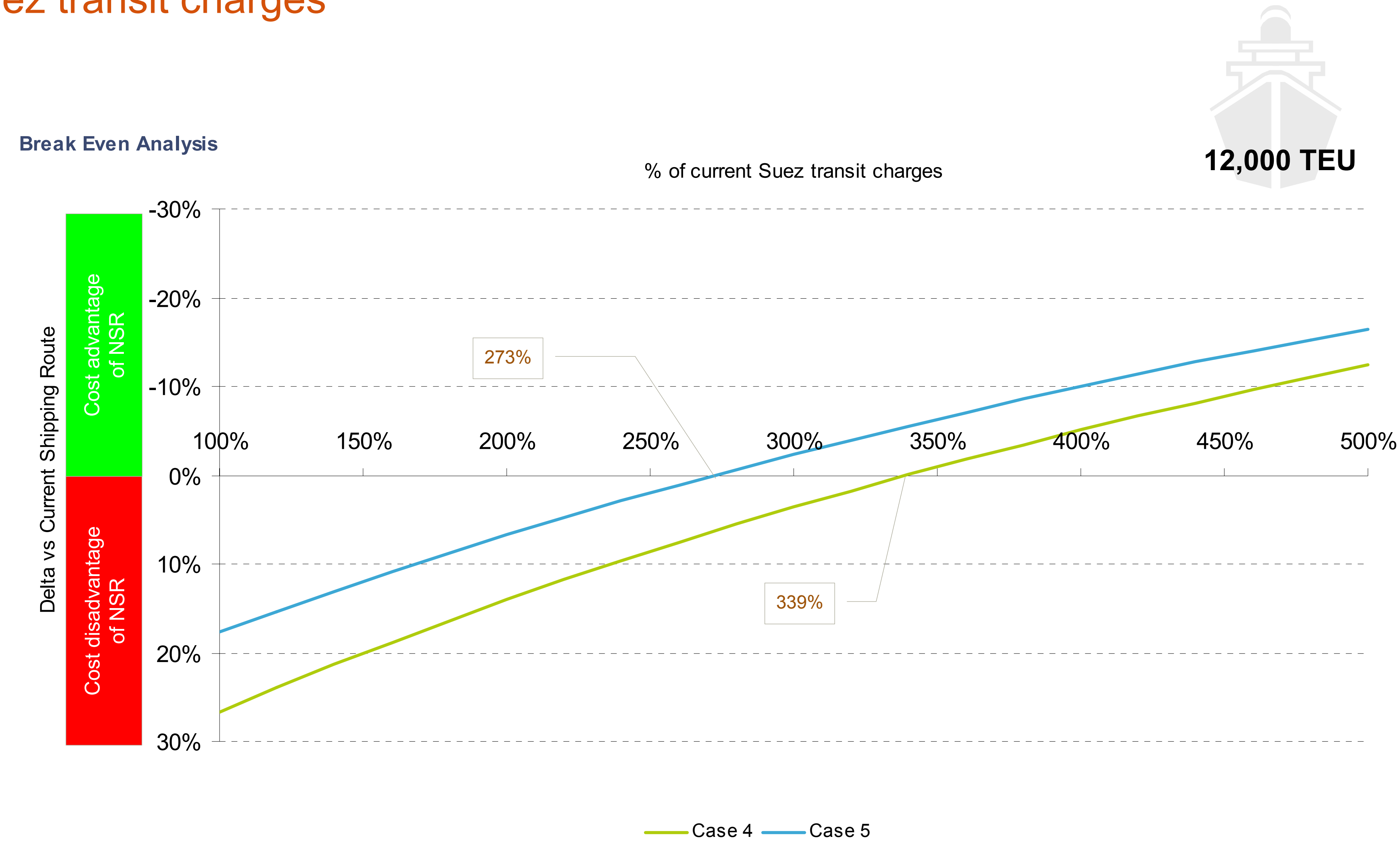
Break-even analysis
Suez transit charges



- Assuming that the Suez tariff continues to increase with 4.04% p.a., it would take 32 years to reach the break-even point for case 4 (339% of current tariff).

Note: the break even analyses for cases 1 to 3 can be found in appendix

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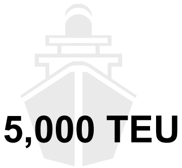
Break-even analysis
Conclusions

5,000 TEU



- For case 4 and 5 to break-even, and hence the Northern Sea Route to become competitive, the following changes in variables are needed:
  - A 5,000 TEU ice-class vessel can be max. 74% more expensive than the 5,000 TEU openwater equivalent
  - An very high increase in fuel price of 631% (which would lead to a 1,463 USD/Ton price for HFO)
  - An increase in Suez transit charges of 178%

12,000 TEU

- For case 4 and 5 to break-even, and hence the Northern Sea Route to become competitive, the following changes in variables are needed:
  - A 12,000 TEU ice-class vessel that is max. 32% more expensive than the 12,000 TEU openwater equivalent
  - Fuel price shows to have no (realistic) value at which the break-even point is reached
  - An increase in Suez transit charges of 239%

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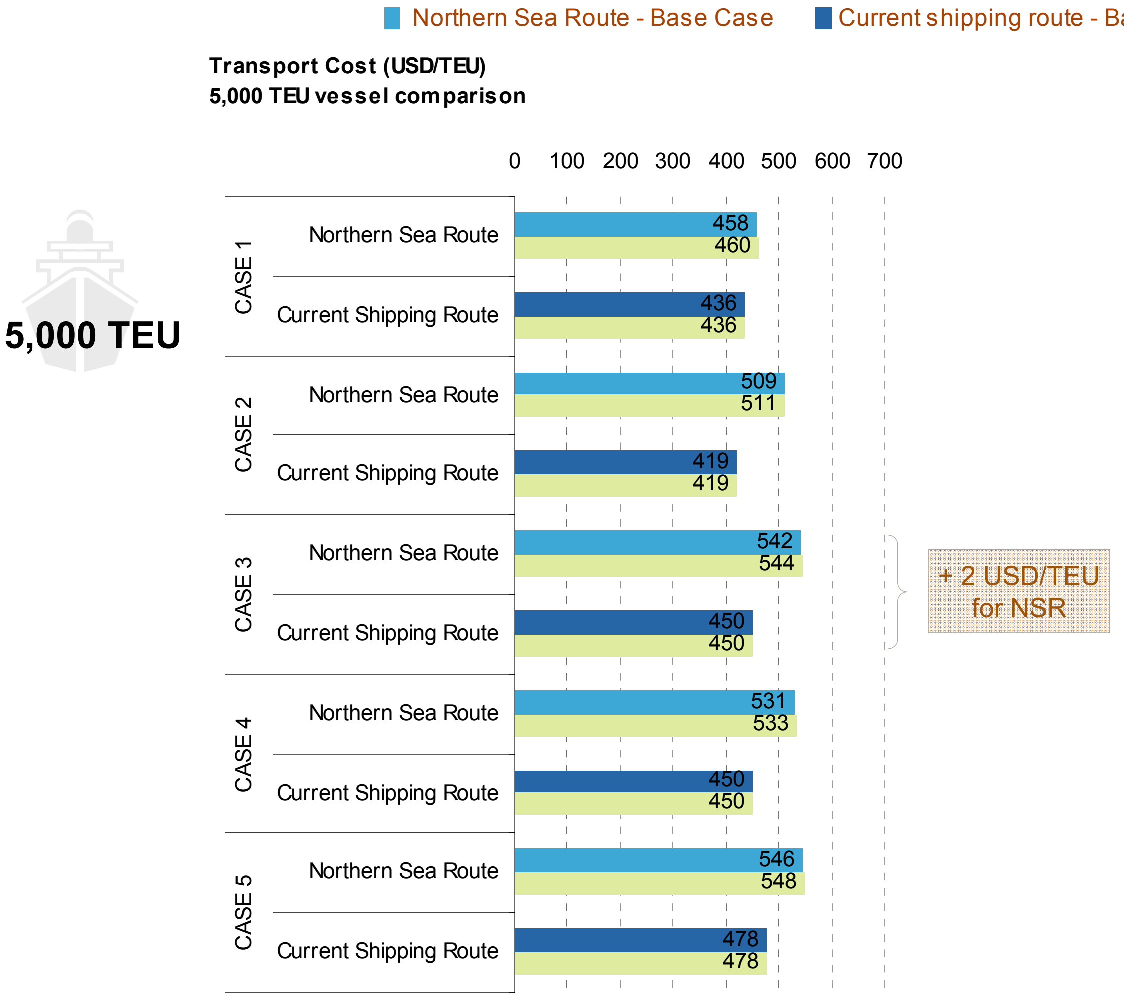
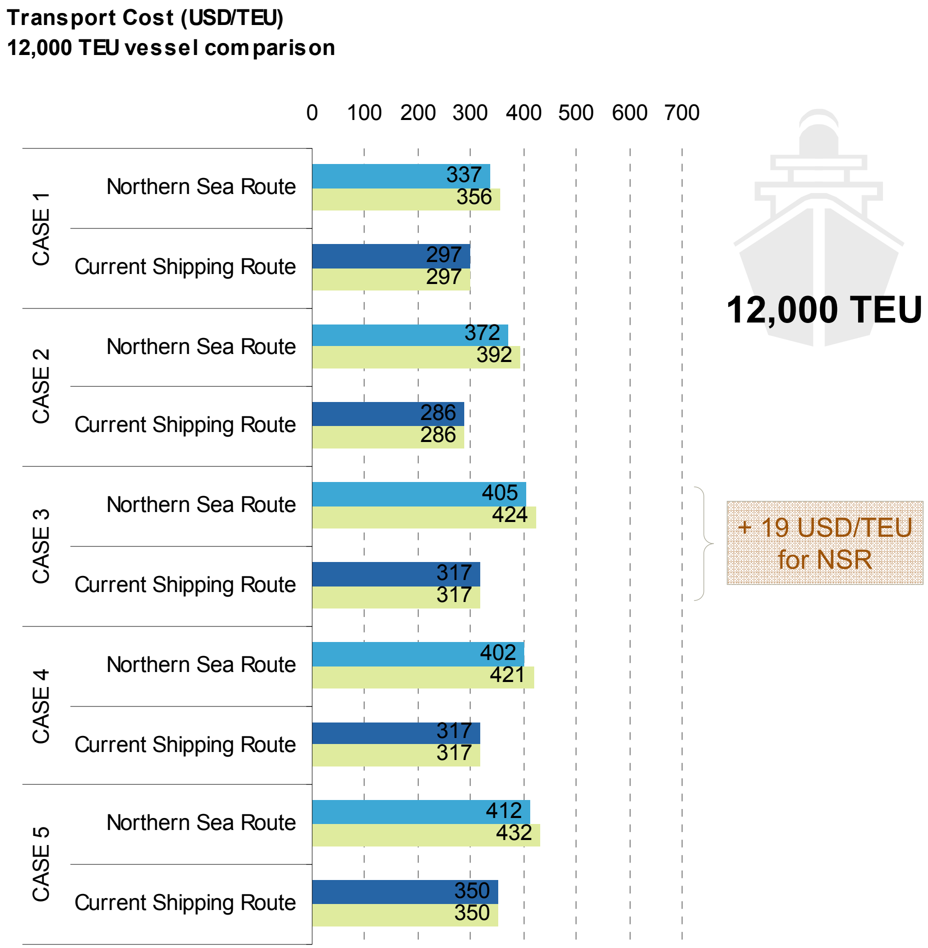
Changes in the operating environment
Severe winter conditions slow down sailing speeds in icy conditions





In the 5,000TEU case, costs per TEU increases with 2 USD; whereas the 12,000 TEU cases see an increase of 19 USD/TEU.

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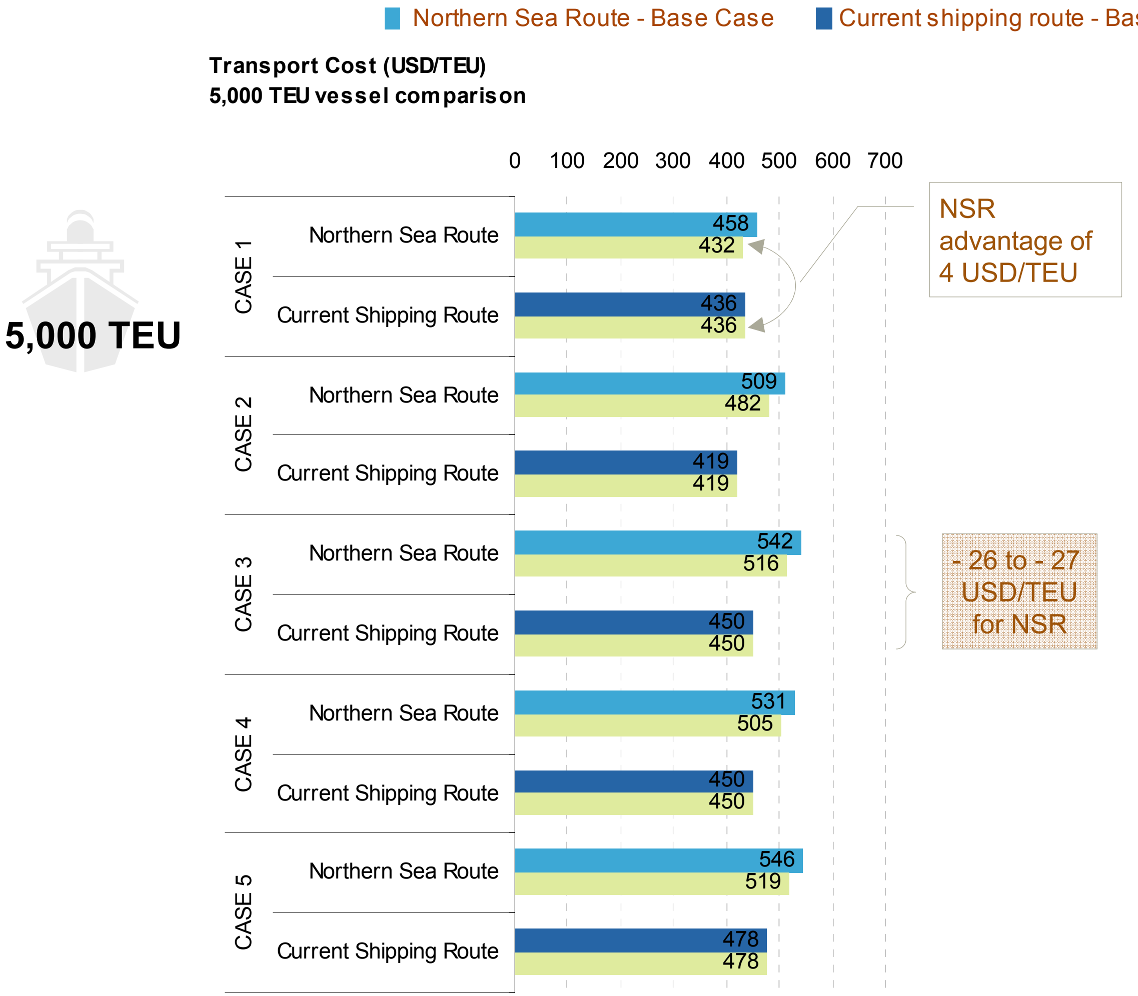
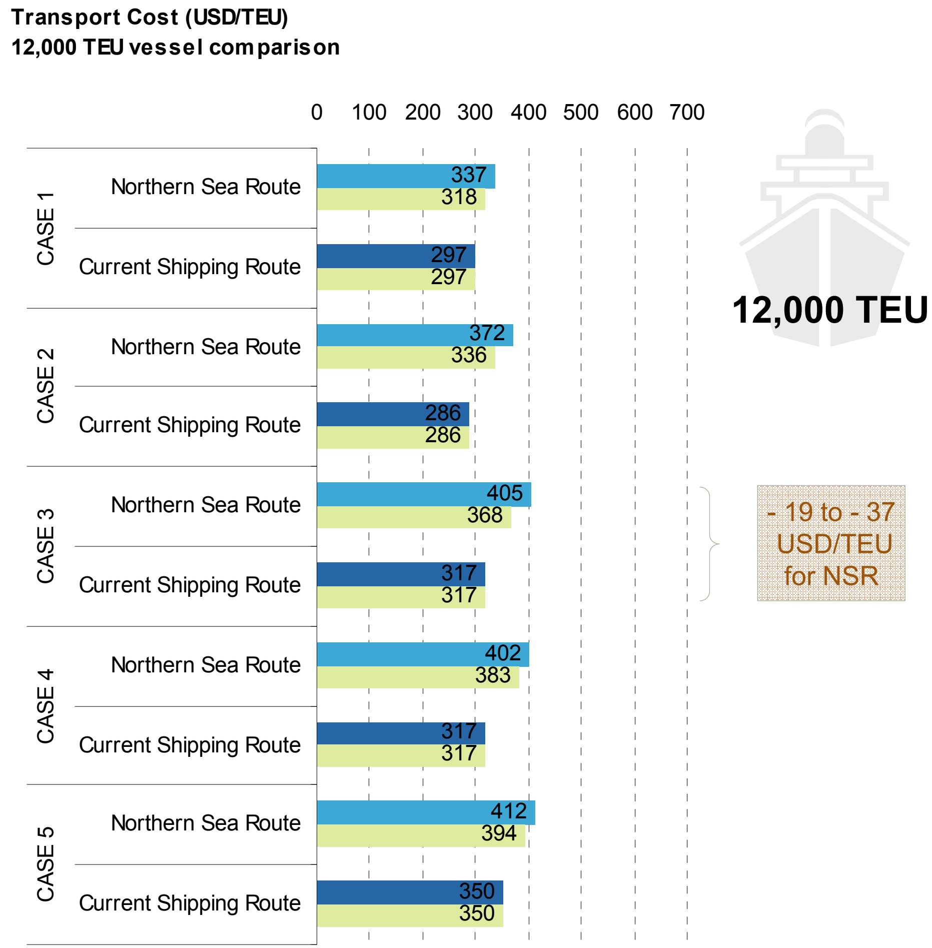
Changes in the operating environment
Reduction of distance to be crossed through the ice by 50%





Reduction of the ice-mass by 50% has a positive impact on the NSR of 19 to 37 USD/TEU. However, only in Case 1 for the 5,000 TEU ship the Northern Sea route becomes more advantageous than the Current Shipping Route (by 4 USD/TEU).

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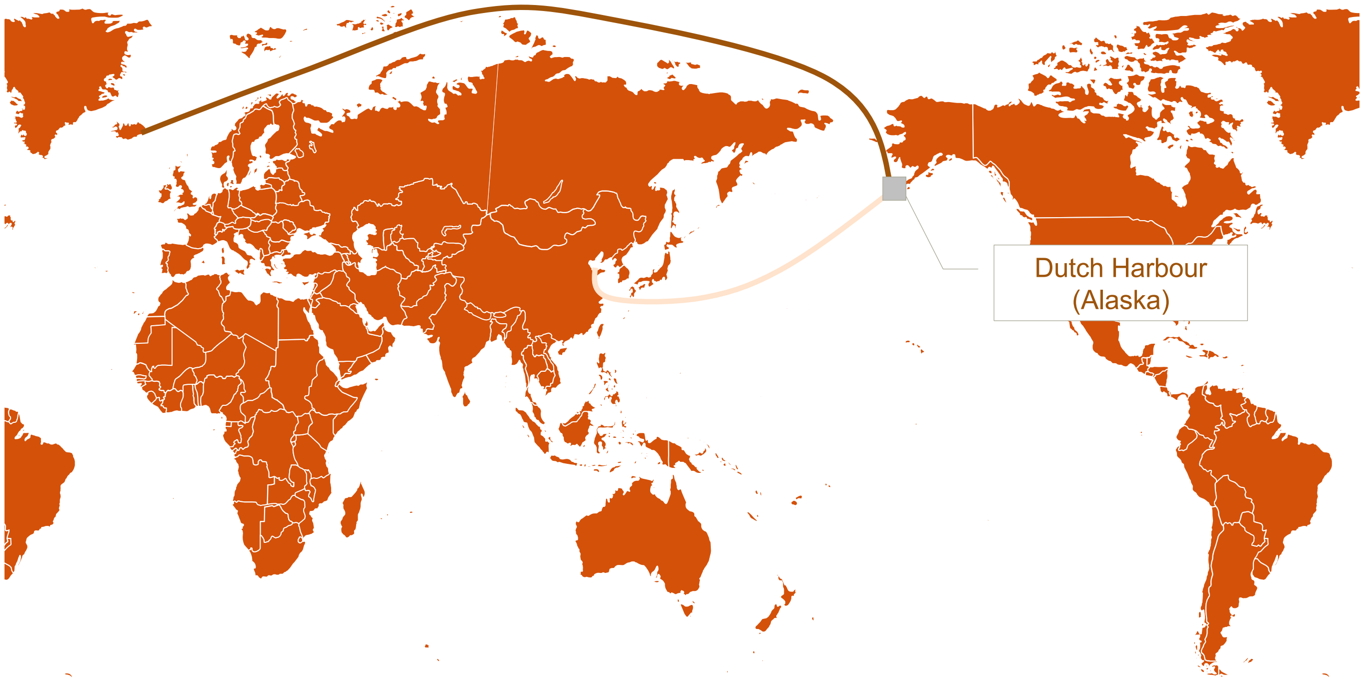
Changes in the operating environment
Hub in Dutch Harbour – Alaska



- Positioning a hub in Dutch Harbour Alaska reduces the distance of the leg to be covered by the ice-class ship to 4,963 nm instead of 7,362 nm, thereby reducing the number of ships needed
- However, an extra unloading/loading takes place and the containers still need to be transported to Shanghai/Dalian by another (openwater) ship

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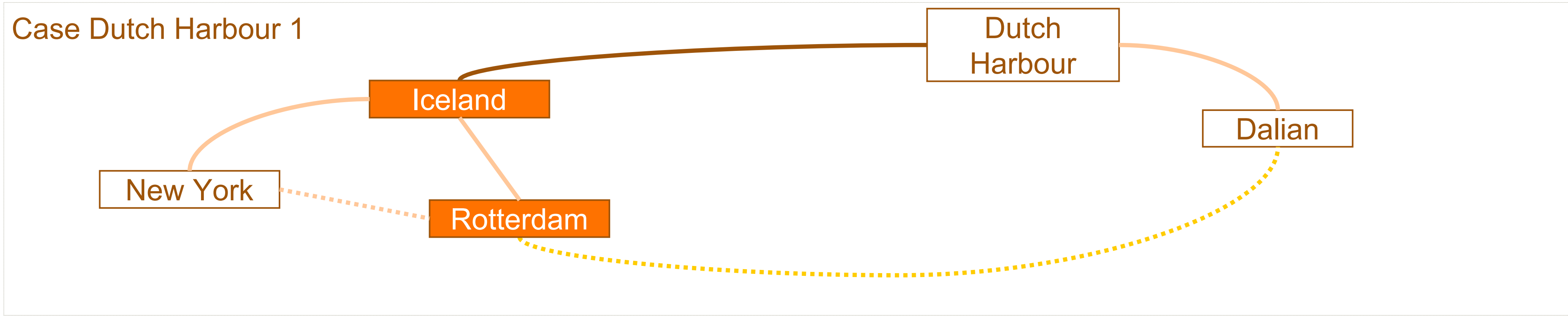
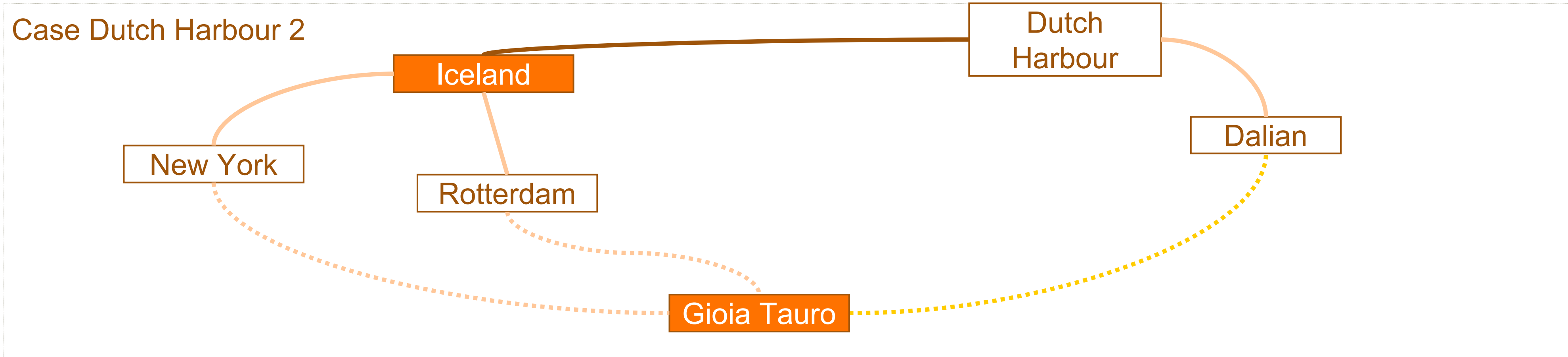
Changes in the operating environment
Hub in Dutch Harbour – Alaska (cont'd)





Northern Sea Route

Current Shipping Route

Ice-class ship

Openwater ship

"Feeder" vessel

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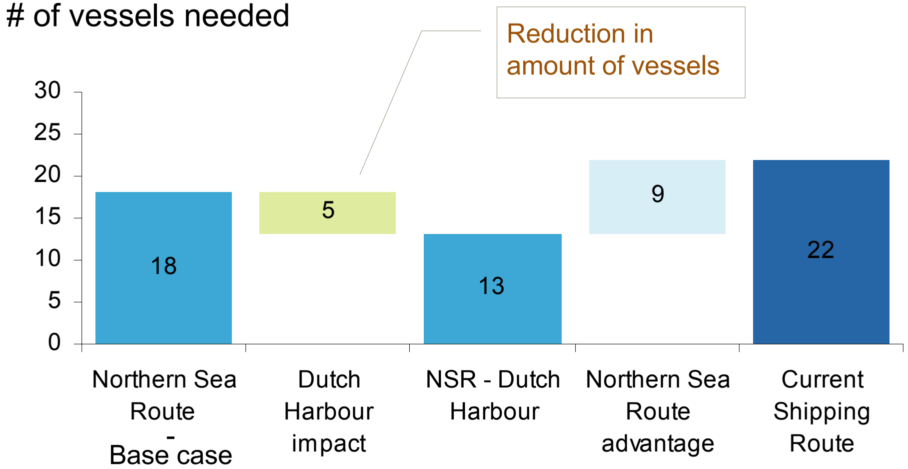
5,000 TEU

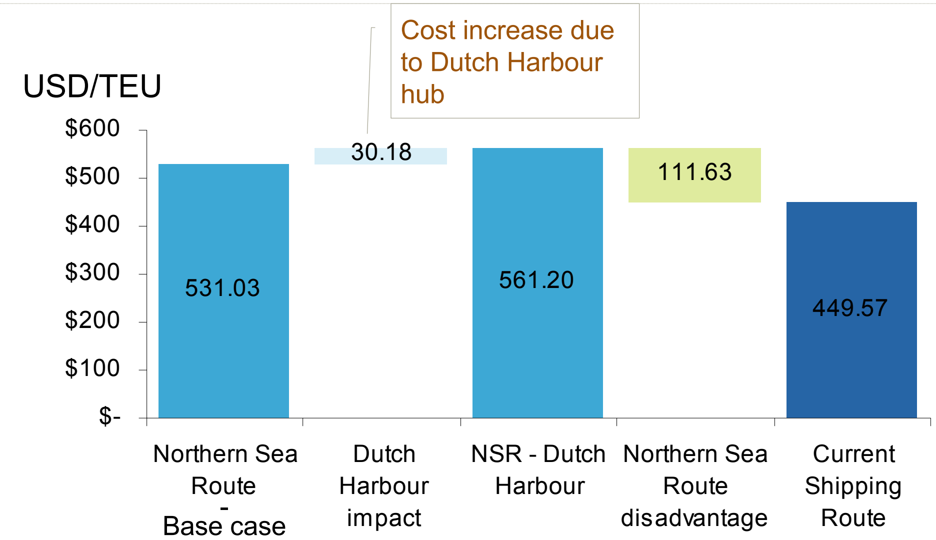
Changes in the operating environment
Hub in Dutch Harbour – Alaska (cont'd)

Case Dutch Harbour 1

of vessels needed

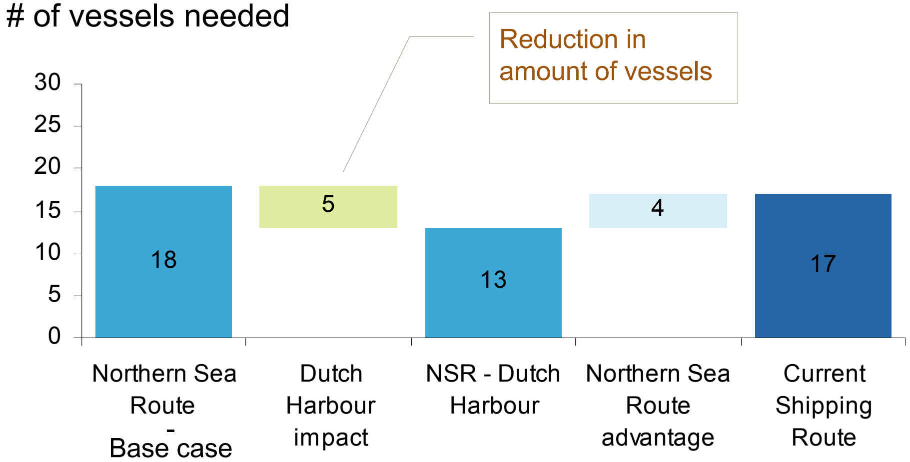


USD/TEU

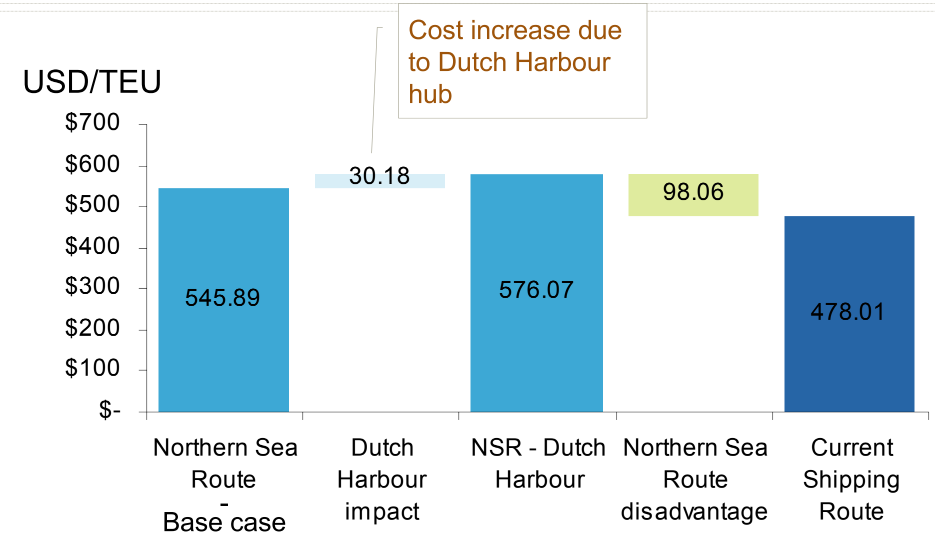


Case Dutch Harbour 2

of vessels needed



USD/TEU



- Positioning a hub for the ice-class ships in Dutch Harbour – Alaska will allow to offer the same service level with a smaller amount of vessels (from 18 vessels to 13 vessels)
- However, this does not weigh up to the cost increase related to the additional loading/unloading and openwater sea leg

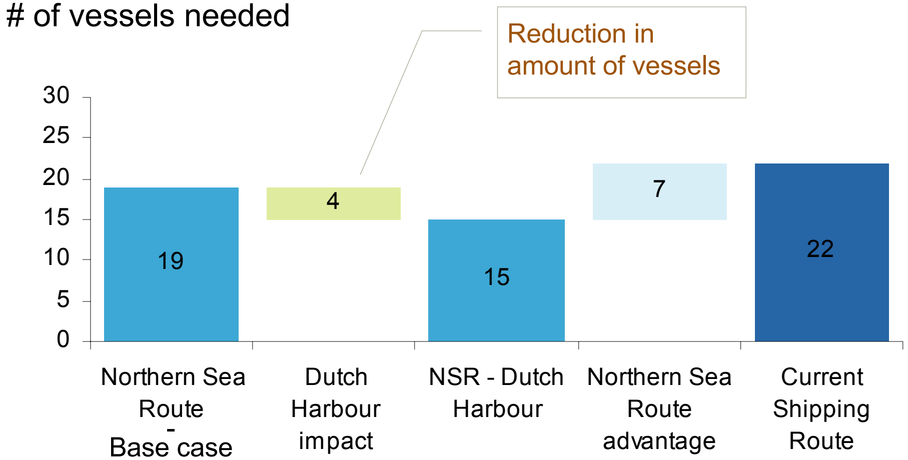
Draft for discussion purposes

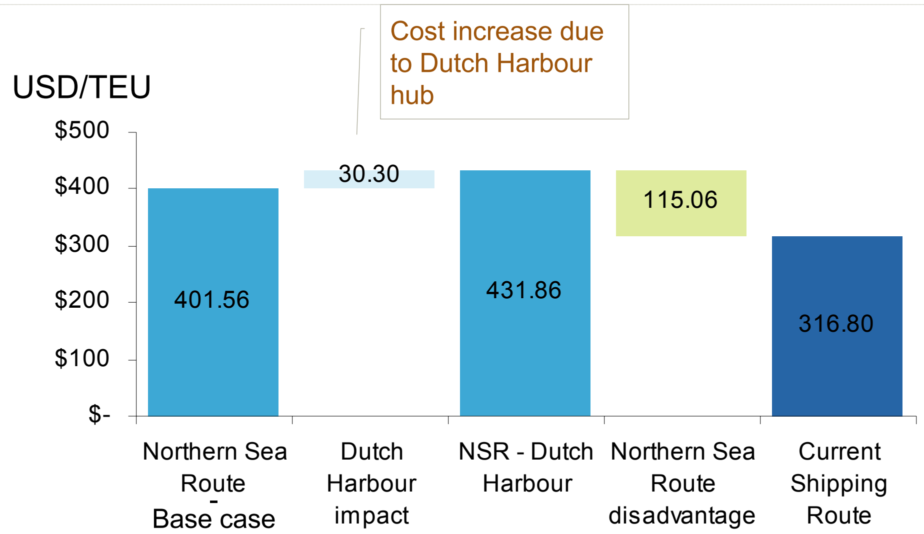
12,000 TEU

Changes in the operating environment Hub in Dutch Harbour – Alaska (cont'd)

Case Dutch Harbour 1

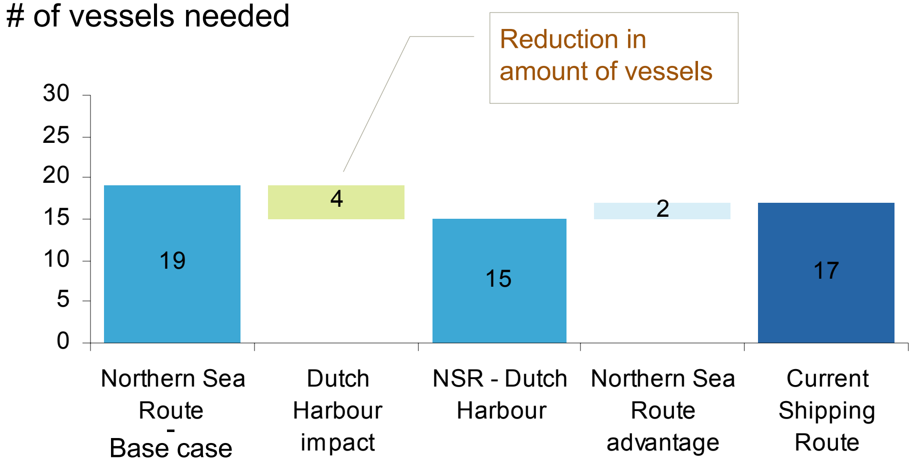
of vessels needed

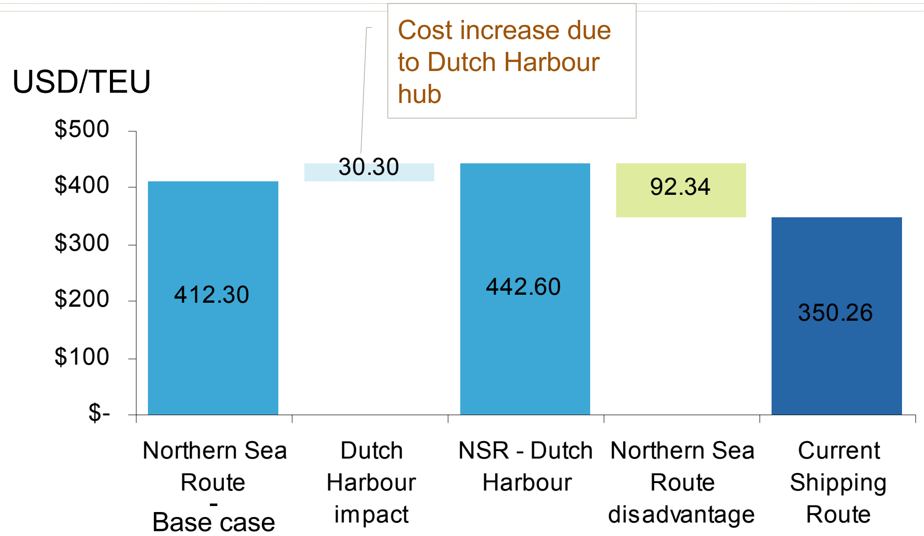




Case Dutch Harbour 2

of vessels needed



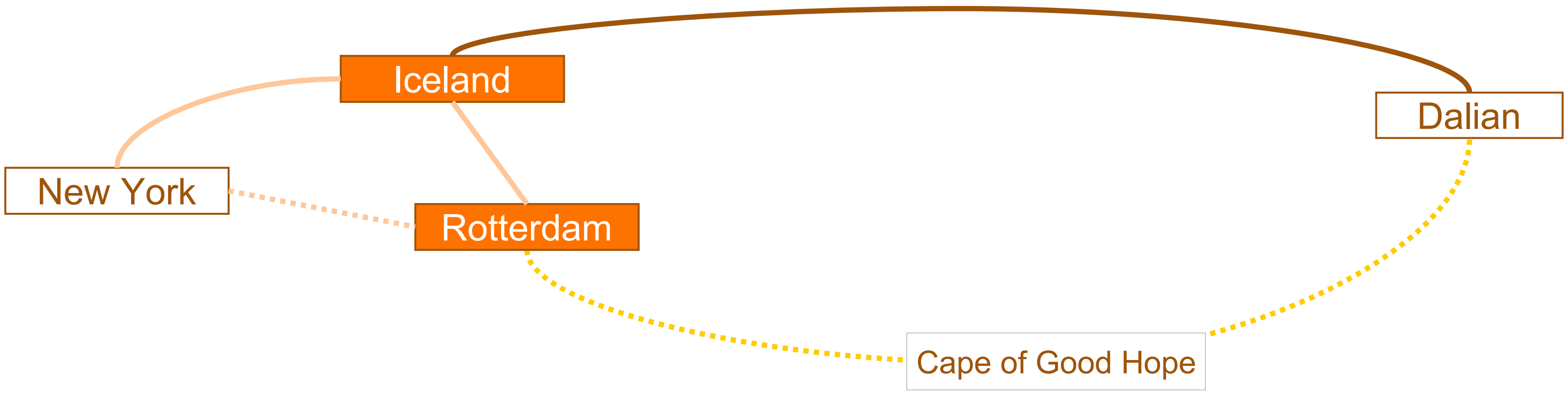


- Similar to the 5,000 TEU version, positioning a hub for the ice-class ships in Dutch Harbour – Alaska will allow to offer the same service level with a smaller amount of vessels (from 19 vessels to 15 vessels)
- However, this does not weigh up to the cost increase related to the additional loading/unloading and openwater sea leg

Draft for discussion purposes

Changes in the operating environment
Cape of Good Hope

- Instead of crossing the Suez Canal for the US/EUR – Asia Trade, the Current Shipping Route cost is calculated based on a sea leg passing by Cape of Good Hope
- Currently, an increase is seen in the traffic following this route, due to the piracy threat present in front of the Somalia Coast & the Gulf of Aden
- This increases the distance Rotterdam – Dalian with 3,480 nm to 14,427 nm



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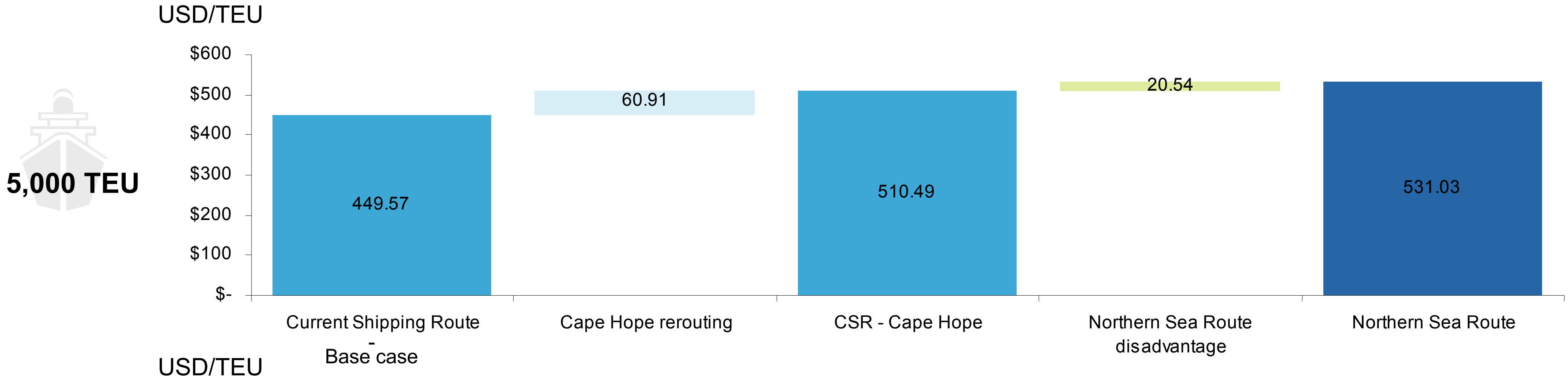
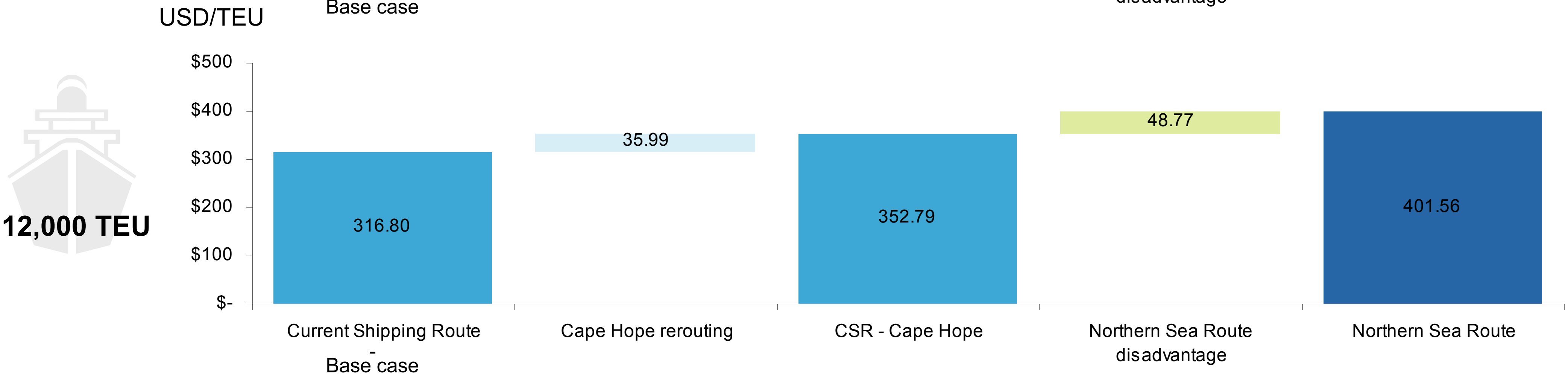
Changes in the operating environment Cape of Good Hope (cont'd)





- Although a rerouting of the Current Shipping Route by Cape of Good Hope adds significant cost and hence improves the competitive position of the Northern Sea Route, the Current Shipping Route still remains more advantageous.

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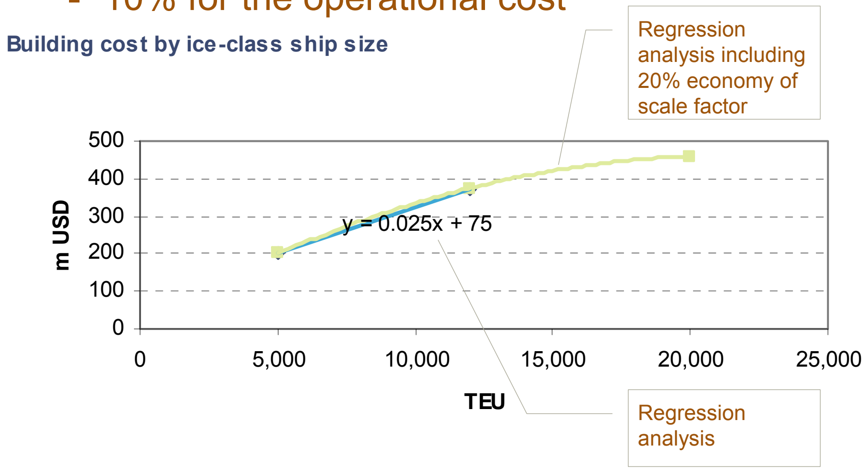
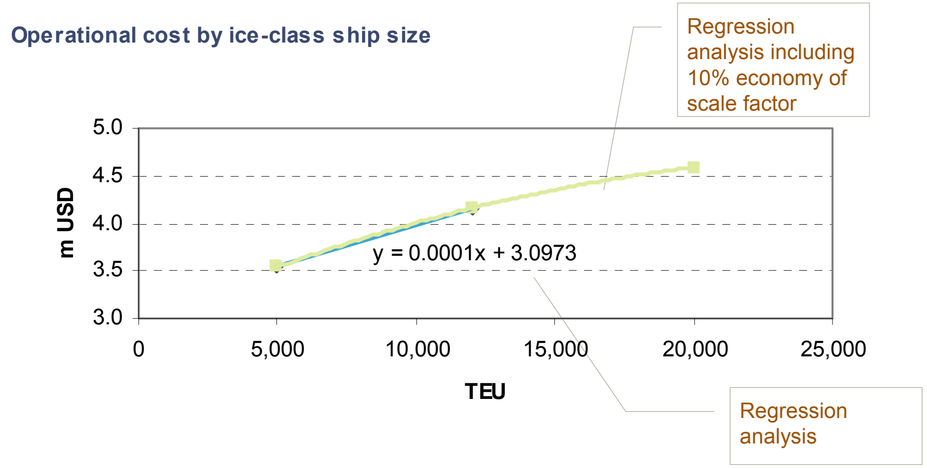
Changes in the operating environment
Comparison of a 20,000 TEU ice-class vessel over the Northern Sea Route vs. a 12,000 TEU openwater vessel on the Current Shipping Route

- All of the cases are revisited, taking a 20,000 TEU ice-class vessel over the Northern Sea Route.
- Since currently the Suez canal is only capable to handle 12,000 TEU vessels (Suezmax), the comparison is made with a 12,000 TEU openwater vessel on the Current Shipping Route.

- For calculating the ice-class 20,000 TEU ship building cost as well as operational costs (excl. fuel), a regression analysis has been used. Next to this, an economy of scale factor was taking into account. This factor amounts up to
  - 20% for the ship building costs
  - 10% for the operational cost



20,000 TEU ice-class ship building cost: 460m USD

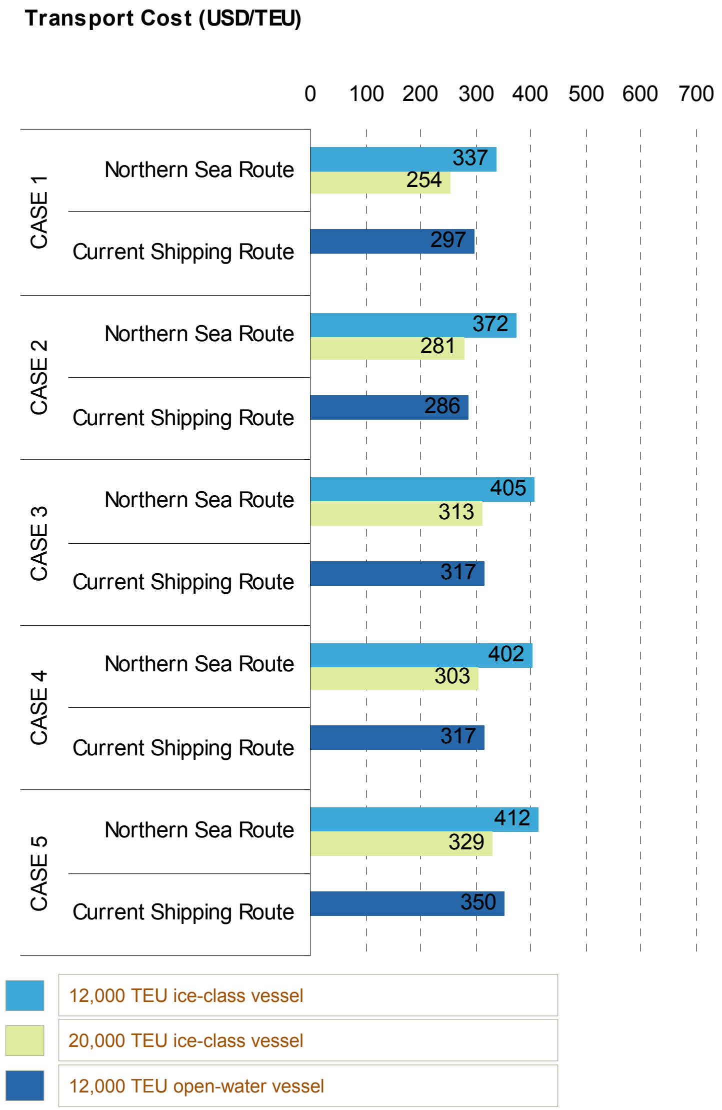


20,000 TEU ice-class yearly operational cost: 4.6m USD

- fuel costs have been scaled based on ship size, taking 20% economies of scale into account

Draft for discussion purposes

Changes in the operating environment
Comparison of a 20,000 TEU ice-class vessel over the Northern Sea Route vs. a 12,000 TEU openwater vessel on the Current Shipping Route (cont'd)



USD/TEU	Current Shipping Route - 12,000 TEU	Northern Sea Route - 12,000 TEU	Δ	Northern Sea Route - 20,000 TEU	Δ
Case 1	297.4	337.0	13%	254.1	-14.6%
Case 2	286.1	372.4	30%	280.8	-1.8%
Case 3	316.8	404.8	28%	312.9	-1.2%
Case 4	316.8	401.6	27%	302.9	-4.4%
Case 5	350.3	412.3	18%	329.4	-6.0%

Cost disadvantages on Northern Sea Route range from 13 to 30%

The 20,000 TEU ice-class vessel leads to (slight) cost advantages for the NSR.

The economies of scale generated by deploying a 20,000 TEU ice-class vessel show to render the Northern Sea Route more competitive, however not leading to a vast advantage over the Current Shipping Route

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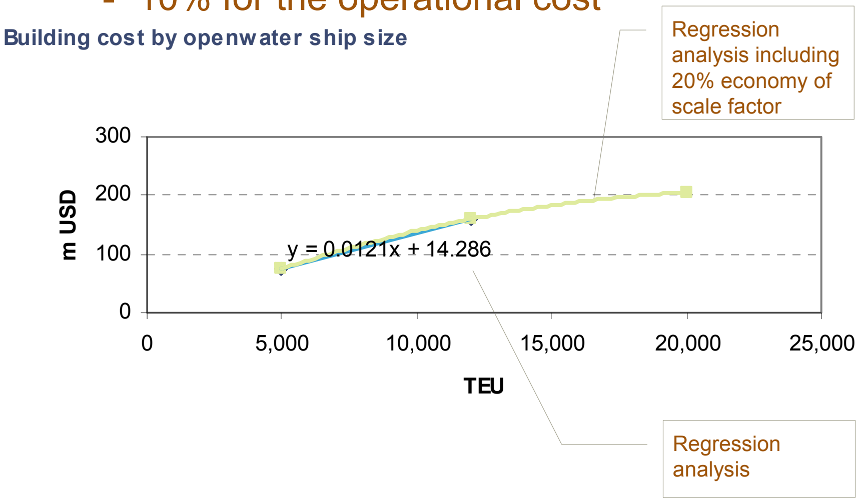
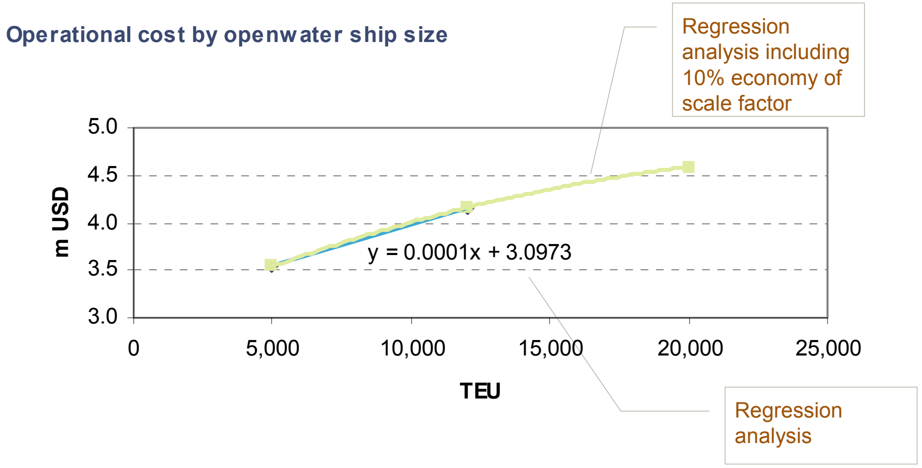
Changes in the operating environment
Comparison of a 20,000 TEU ice-class vessel over the Northern Sea Route vs. a 20,000 TEU openwater vessel on the Current Shipping Route passing by Cape of Good Hope

- The comparison is made between 20,000 TEU vessels on the Northern Sea Route and the Current Shipping Route
- Since currently the Suez canal is only capable to handle 12,000 TEU vessels (Suezmax), the 20,000 TEU openwater vessel has to sail by Cape of Good Hope

- For calculating the openwater 20,000 TEU ship building cost as well as operational costs (excl. fuel), a regression analysis has been used. Next to this, an economy of scale factor was taking into account. This factor amounts up to
  - 20% for the ship building costs
  - 10% for the operational cost





20,000 TEU openwater ship building cost: 205m USD

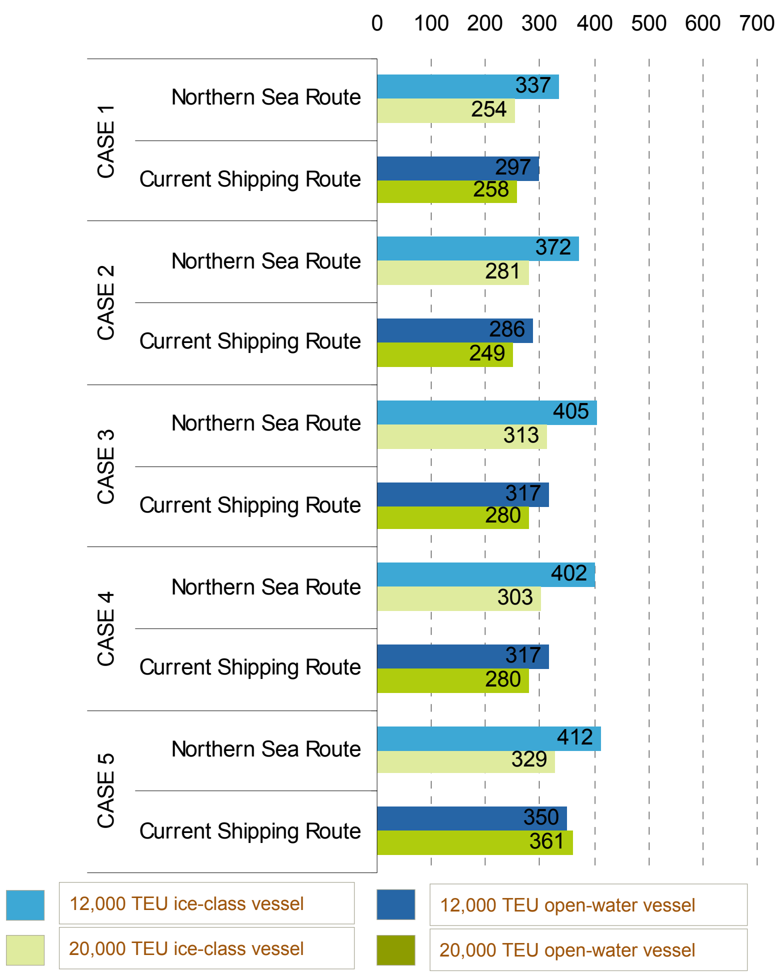
20,000 TEU openwater yearly operational cost: 4.6m USD

- fuel costs have been scaled based on ship size, taking 20% economies of scale into account

Draft for discussion purposes

Changes in the operating environment
Comparison of a 20,000 TEU ice-class vessel over the Northern Sea Route vs. a 20,000 TEU openwater vessel on the Current Shipping Route passing by Cape of Good Hope (cont'd)

Transport Cost (USD/TEU)



USD/TEU	Current Shipping Route 12,000 TEU	Northern Sea Route 12,000 TEU	Δ	Current Shipping Route 20,000 TEU	Northern Sea Route 20,000 TEU	Δ
Case 1	297.4	337.0	13%	258.2	254.1	-2%
Case 2	286.1	372.4	30%	249.3	280.8	13%
Case 3	316.8	404.8	28%	280.3	312.9	12%
Case 4	316.8	401.6	27%	280.3	302.9	8%
Case 5	350.3	412.3	18%	360.7	329.4	-9%

Cost disadvantages on Northern Sea Route range from 13 to 30%

The 20,000 TEU comparison leads to cost advantages for the NSR in some cases

The Northern Sea Route is able to capture more of the economies of scale by deploying 20,000 TEU vessels on the route. However, this does not lead to a vast advantage in all of the cases.

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A single factor decision is no longer possible when comparing current and the Northern Sea Route.

The potential for Iceland to function as a transhipment hub is largely dependent upon the international shipping companies to decide on capitalising the perceived value of the Northern Sea Route.

In order to assess the probability, understanding the decision rational of the lines is instrumental.

One key decision factor typically drives the selection process for new routes: Steaming Time

- All other things being equal, shipping lines will opt for the route with the shortest steaming time
- Routes with equal steaming time are assessed on additional factors such as:
  - Service level
  - Safety
  - Environmental controls
  - Additional costs
  - Bottlenecks and congestion points
  - Et cetera

Only few characteristics of both routes correspond as a result of the passage through ice. The comparison of the Northern Sea Route and the Current Shipping Routes is consequently subject to a multi-attributes analysis. Steaming time savings alone do not drive the decision in this case.

The total cost of operating the Northern Sea Route in comparison to the that of the current routes will prevail as decision factor. The Northern Sea Route, being a new option to container carriers, will require significant advantages, ie savings, for the lines to consider the option.

The business case calculations allow concluding that such advantage is not available under base case assumptions.

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Shipping lines select the most cost efficient hub based on port calling costs

Confronted with multiple call options within a range, the **choice for alternative port of call (port A or port B) is typically based upon a combination of elements:**

- Port calling costs
- Quality and availability of infrastructure:
    - Rail connectivity
    - road connectivity and especially frequencies (having impact on time)
    - Container Freights Stations (CFS)
    - Et cetera

In an assessment of transhipment alternatives, the connectivity infrastructure clearly is of a secondary order and costs drive the decision.

Port calling costs can differ significantly, as they are the sum of a wide variety of charges:

- Harbour dues
- Towage assistance
- Mooring/Unmooring
- Sea/River pilotage
- Harbour pilotage
- VTS dues
- Reporting
- Light dues
- Quay dues
- Agency fees
- Helm dues
- Dues on goods
- Harbour police
- Waste disposal

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Background

The strength of Iceland as a transhipment hub is largely depending upon the advantages of such a stop versus a direct sailing to the final port of destination.

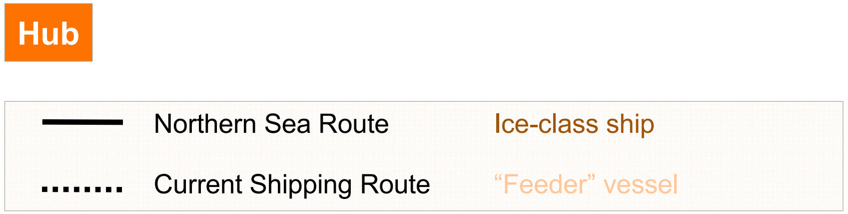
The specific characteristics of sailing an ice-class vessel during the entire route versus partial use of such vessel in combination with a classic container vessel on the last leg have therefore been analysed.

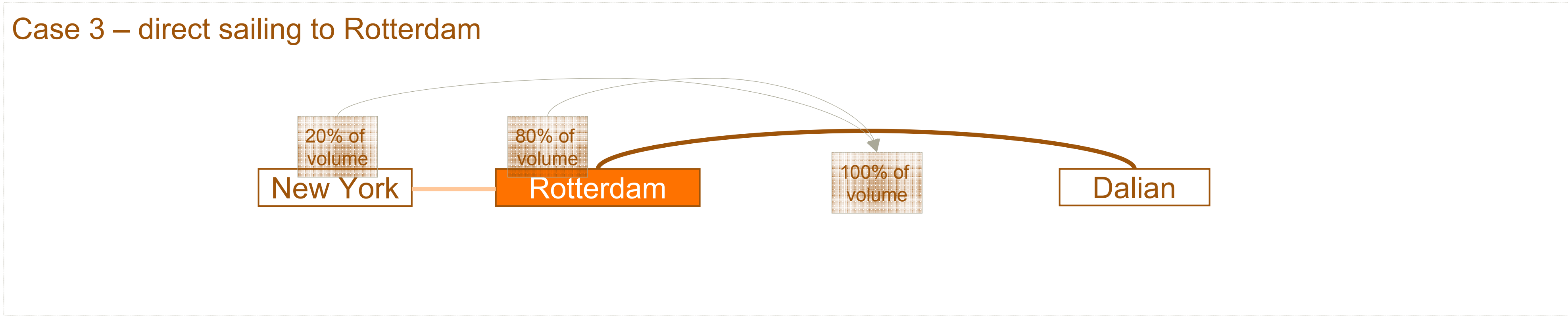
To this purpose, Rotterdam is being assessed as a direct call option versus Iceland for North Atlantic container volumes.

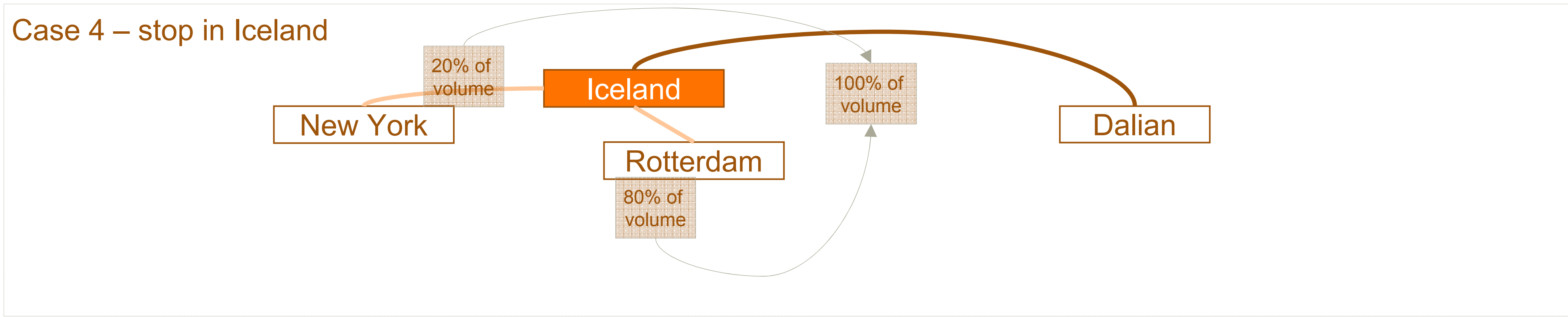
As schematically represented on the following slide, this comparison coincides with comparing the Northern Sea Route parts of Case 3 (direct sailing) and Case 4 (stop in Iceland) that have already previously been analyzed.

Draft for discussion purposes

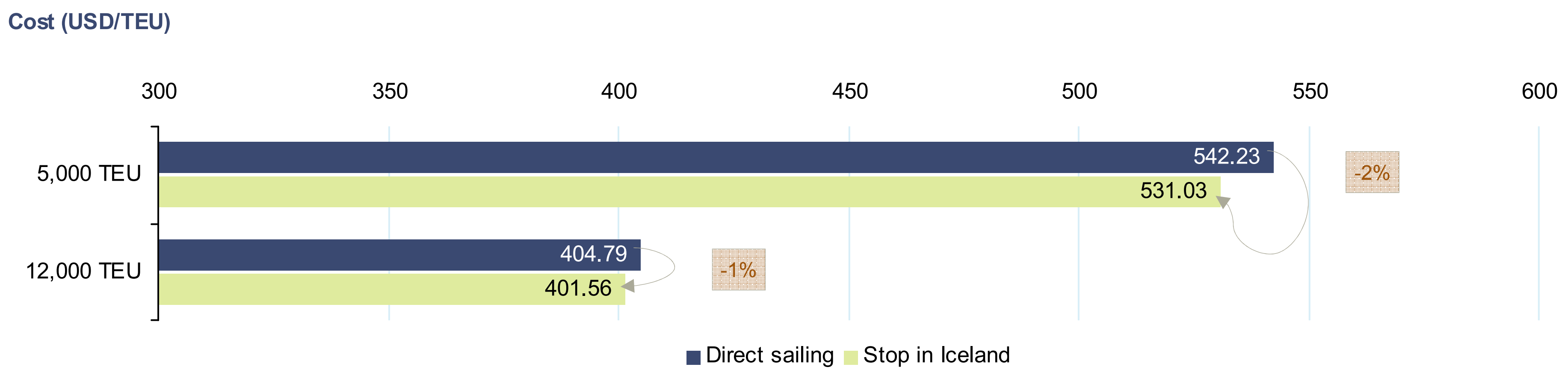
Business cases to assess the advantages of a stop in Iceland versus a direct sailing.







The stop in Iceland shows to have a 1 to 2% advantage over a direct sailing to Rotterdam.



- The analysis shows that a stop in Iceland shows to be 1 to 2% cheaper per TEU than a direct sailing to Rotterdam
- Therefore we can conclude that if changes in some parameters occur which would make the Northern Sea Route significantly more advantageous than the the Current Shipping Route (like for example a reduction in ice-class ship building cost; an increase Suez transit charges, an accelerated melting of ice,…), Iceland would be a more advantageous location than Rotterdam to position a transhipment hub

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Other aspects to take into consideration

- This analysis makes abstraction of Port Calling Costs. To compare the full cost picture, Port Calling Costs should be added to the equation. 1% and 2% leaves however little margin to Iceland to deviate from the Port Calling Costs level levied at Rotterdam

- Furthermore, while Rotterdam is a fully developed operational port with all of the infra- and suprastructure needed for a transhipment hub, most of these aspects still have to be developed in Iceland.
  Large investments are needed by public and/or private parties.

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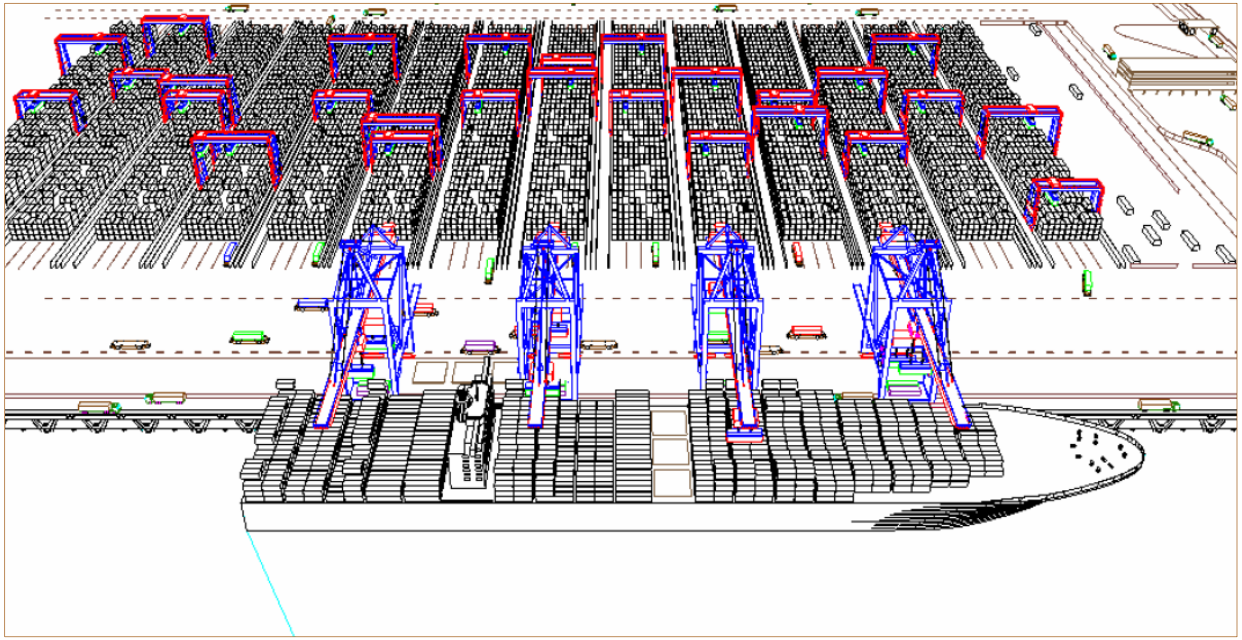
Critical success factors of a transhipment hub

Transhipment hubs exist and grow as a result of two constituents:

- Hub and Spoke networks whereby regionally based, often smaller size transhipment volumes, to and from outports are brought together on large mother ships by smaller feeder vessels
- Relay or Interlining activities where transhipment at key network ports results from the crossing of main deep-sea vessel strings.

The most important critical success factor for an international container hub is its central geographic location on the route of the main line.

Any deviation from the main line requires the mother vessel to make a detour resulting in additional time and cost or makes the ship less productive.



Other success factors for the development of a transhipment hub include:

- Accessibility: draft, tidal independent,
- Best practice most productive container handling terminal,
- Business environment - availability of ancillary facilities including ship repair services.

Terminal specifications are driven by vessel size developments

Increasing vessel dimensions impact not only on the water side of the port on technical parameters such as :
- depth of water;
- the channel and turning basin widths and diameters;
- bollard strengths;
- quay lengths;
- dock and ship fends;
- tug requirements.

Terminal operations are often also impacted in terms of:
- high yard densities
- increased productivity on quay cranes & yard operations
- challenging and changing labour practices to allow for peak and low activity manning
- need for continuous equipment and technology improvements
- constant optimisation of terminal operating and administration systems

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Terminal specifications are driven by vessel size developments (cont'd)

Dimensions of the approach channel and basin:

• Channel depth	18	m
• Channel width	450	m
• Depth alongside quay	16	m
• Turning basin	650	m

Parameters are subject to nautical effects, of tide current, windage, bends et cetera.

Dedicated or tailored terminals are required with specific infrastructure and suprastructure to handle large transhipment vessels:

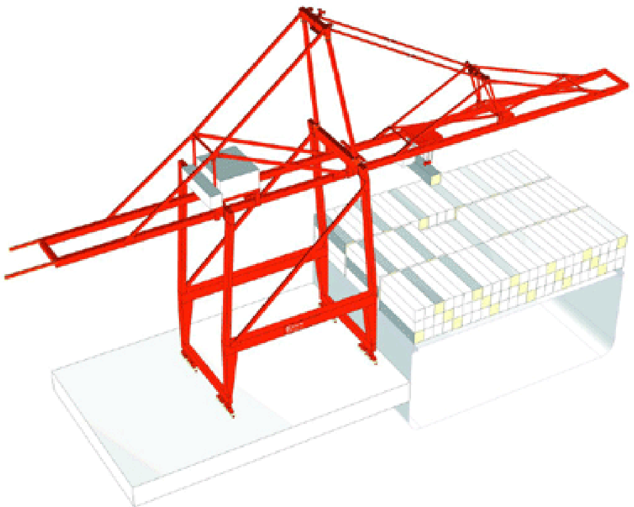
- Adapted bollard strength and spacing
- Strengthened fenders
- Limited importance on land access
- Total dependency on ship-to-ship function with greater container interchange compared to ship-to-shore handling

• Quay length:	800	m
• Yard surface:	40	ha
• Associated terminal capacity		
	1,200,000	TEU (min)
	2,600,000	TEU (max)
• Associated terminal productivity		
- Quay	1,500	TEU/meter (min)
	3,300	TEU/meter (max)
- Yard	30,000	TEU/ha (min)
	65,000	TEU/ha (max)

Draft for discussion purposes

Terminal specifications are driven by vessel size developments (cont'd)

- High productivity crane systems:
  - Crane lift height 42-47 m above the rail
  - Crane outreach 23 rows
  - Air draft of 62-67 m
  - #/ 12,000 TEU vessel 6 cranes
  - Dedicated cranes for feeder vessels and ice-class vessel to accommodate loading and unloading of 3 weekly sailings



- Stack equipment depending on selected technology:
  - Terminal tractors
  - Forklift trucks
  - Empty container handlers
  - Loaded container handlers
  - Reach stackers
  - Straddle carriers
  - RTG-cranes
  - Automatic stacking cranes

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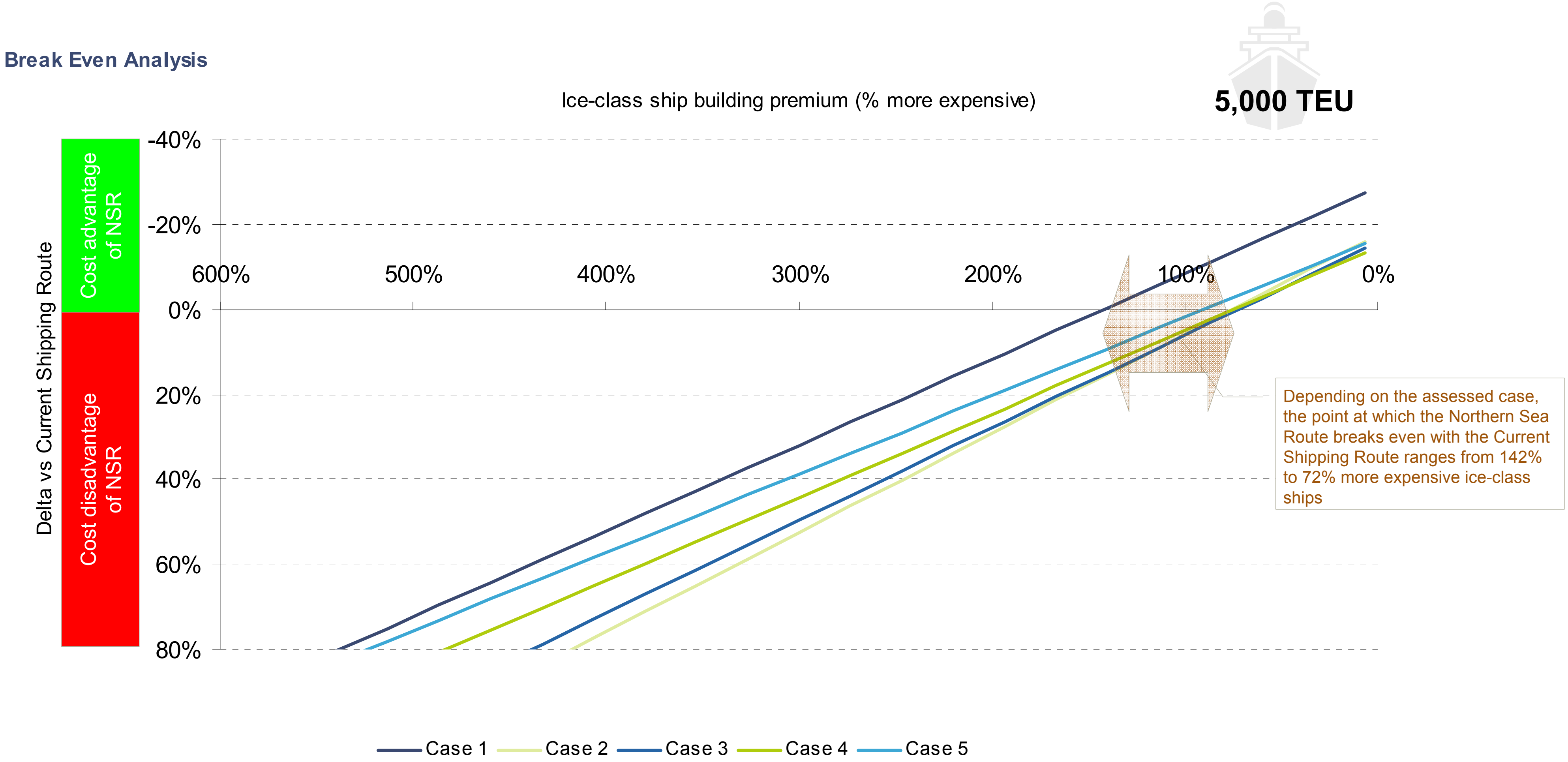
Break-even analysis
Ship building cost



- At an ice-class ship premium of 72% over the openwater vessels; all of the assessed cases will be more advantageous when sailing over the Northern Sea Route.

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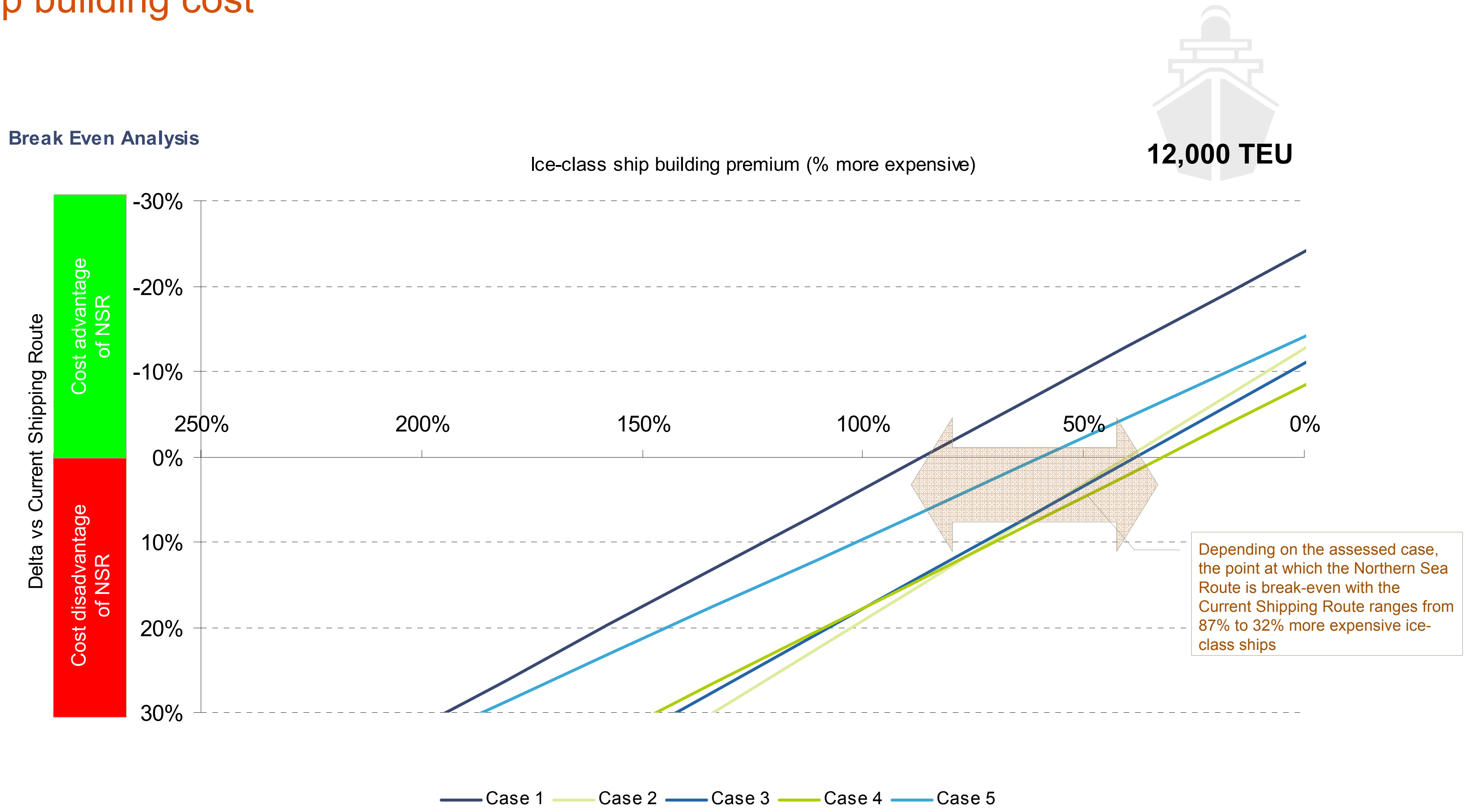
Break-even analysis
Ship building cost



- At an ice-class ship premium of 32% over the openwater vessels; all of the assessed cases will be more advantageous when sailing over the Northern Sea Route.

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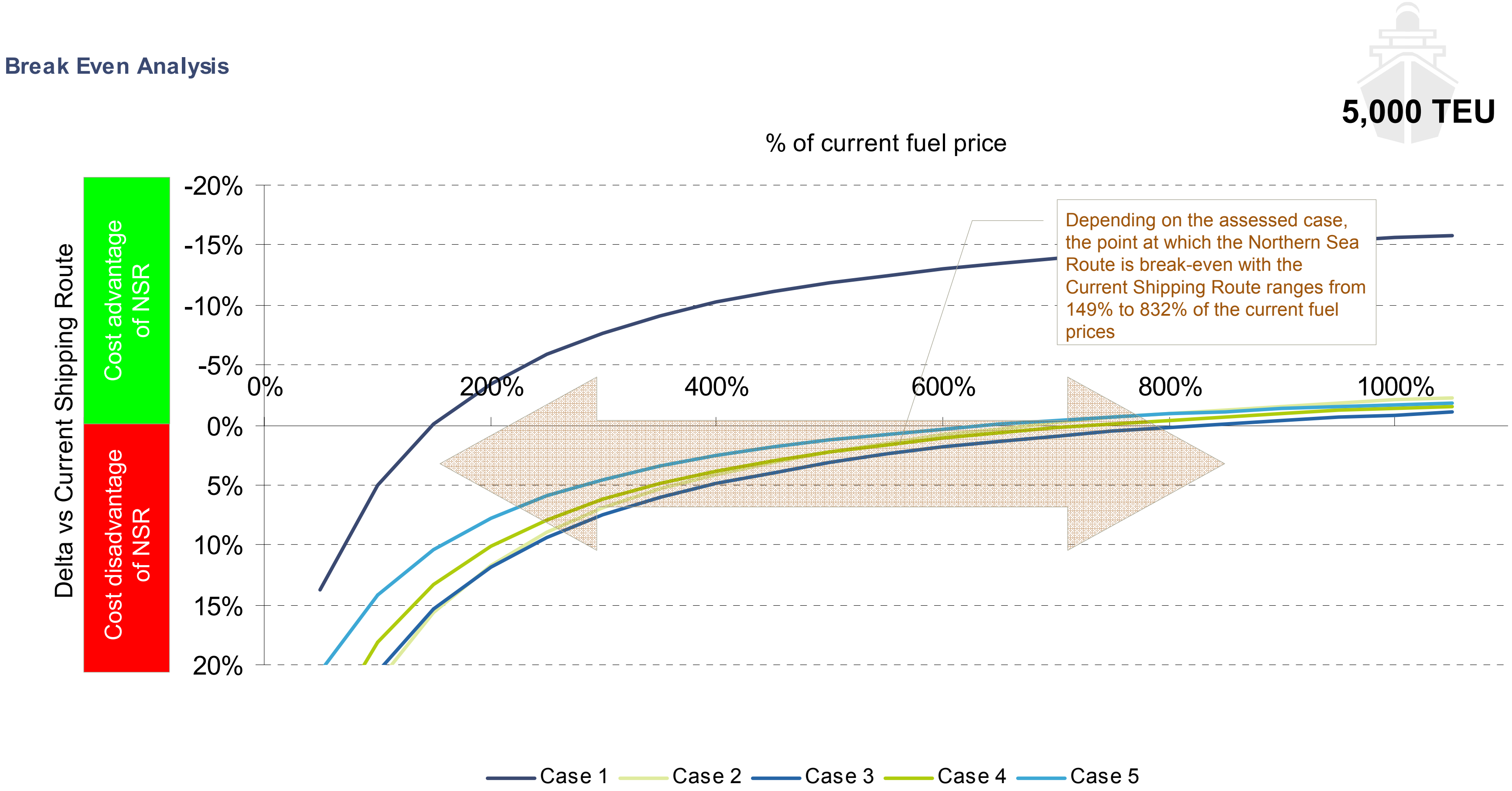
Break-even analysis
Fuel price



- A 49% increase in HFO would mean that the price would amount up to 298 USD/Ton (base case: 200 USD/Ton). In the light of the fuel price evolution in the past years (cfr. supra), this can be considered as a realistic scenario
- A 732% increase in HFO would mean that the price would have to amount up to 1,665 USD/Ton (i.e. a (very) high increase of 1,465 USD/Ton).

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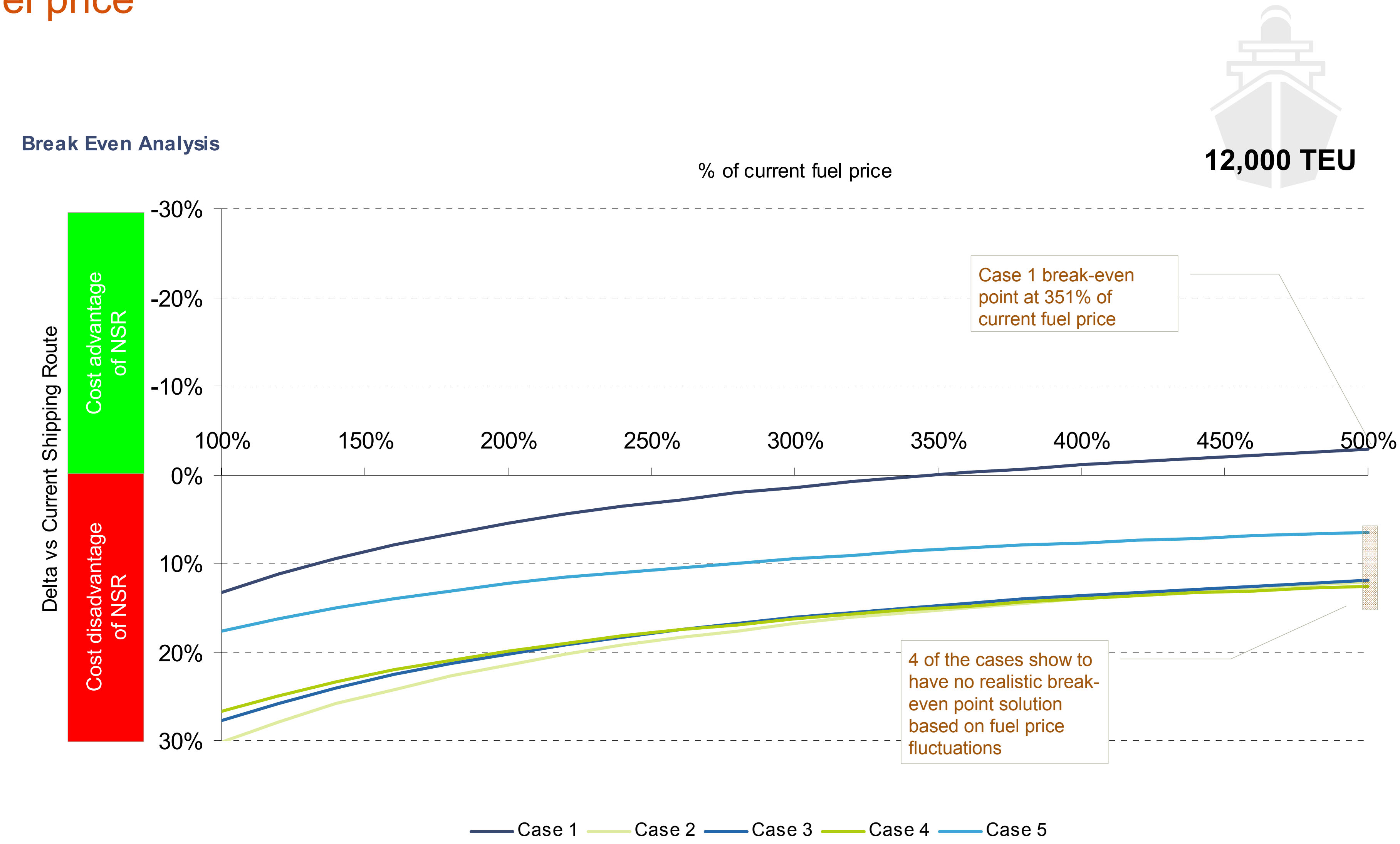
Break-even analysis
Fuel price



- For Case 1; a 251% increase in fuel price to break even would mean a HFO price of 702 USD/Ton, which is below the maximum (705 USD/Ton) of the past years.

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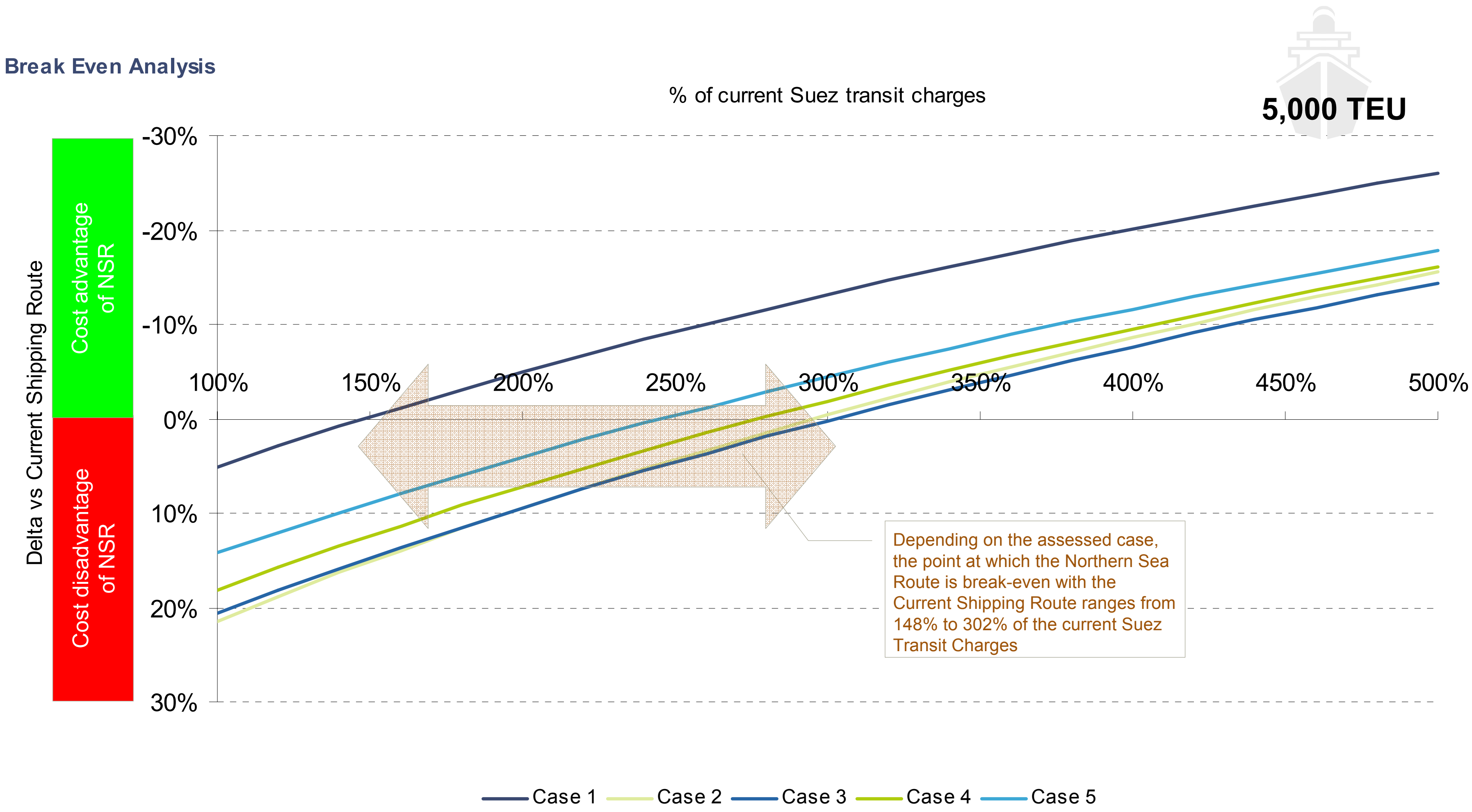
Break-even analysis
Suez transit charges



- Assuming that the Suez tariff continues to increase with 4.04% p.a., within 11 years the break-even point for Case 1 will be reached.
- To reach 202% increase of the tariff (which would cause all of the cases to have crossed the break-even point and the Northern Sea Route to become advantageous), a period of 29 years is needed with a 4.04% annual increase in Suez tariffs.

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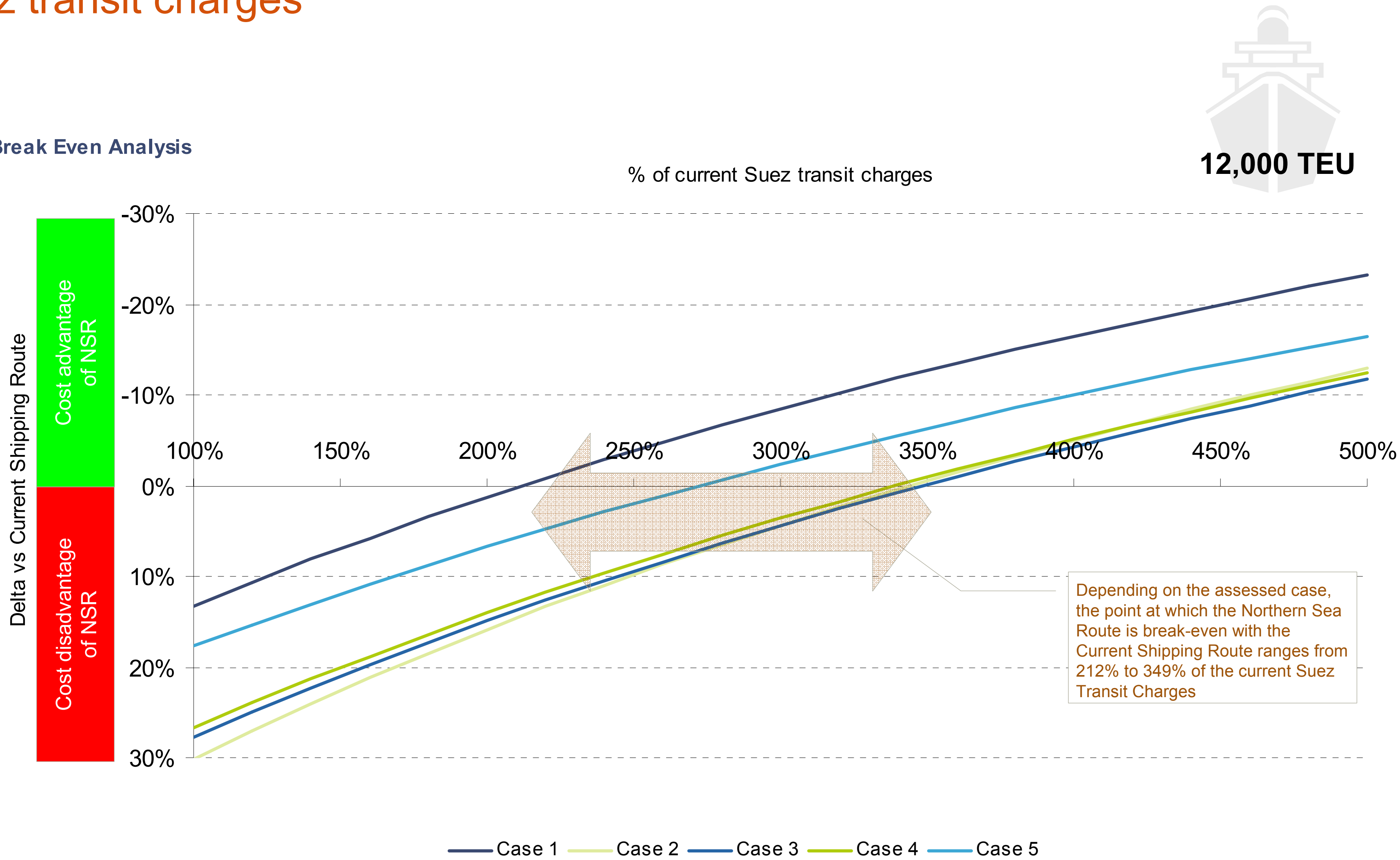
Break-even analysis
Suez transit charges



- Assuming that the Suez tariff continues to increase with 4.04% p.a., within 20 years the break-even point for Case 1 will be reached.
- To reach 249% increase of the tariff (which would cause all of the cases to have crossed the break-even point and the Northern Sea Route to become advantageous), a period of 33 years is needed with a 4.04% annual increase in Suez tariffs.

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