Clarksons-CCSA Freight Study

CO2 Shipping

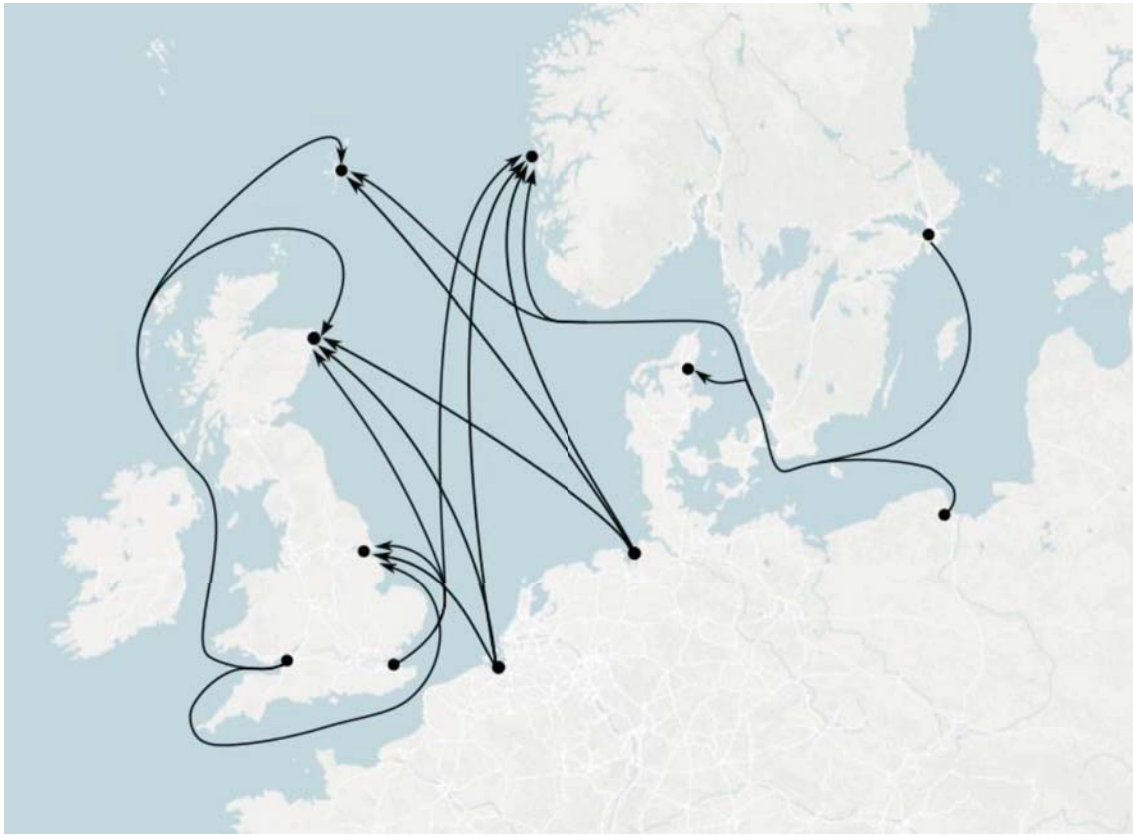
CCSA Webinar

19/09/2024

Introduction
Background to the Report
Sizes and Types of Vessel
Asset Prices
Operating Costs
Voyage Time
Fuel Costs
Cargo Intakes
Specimen Routes
Freight Estimates
Sensitivities
Cost Versus Market
General Market Dynamics

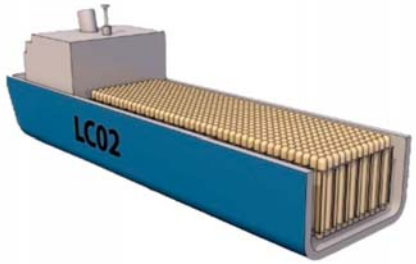
CLARKSONS/CCSA REPORT ON UPDATED COSTS FOR CO2 SHIP TRANSPORT

- Builds on earlier CCSA report ‘Achieving a European Market for CO2 Transport by Ship.
- Requested by CCSA to feed into DESNEZ ‘Call for Evidence’
- Released as joint Clarksons/CCSA Report.
- Review and approval by CCSA Non-Pipeline Transportation working group.
- Remedy to existing ‘literature’ based on ten-year-old data.
- Need for an update to feed into decision making processes.

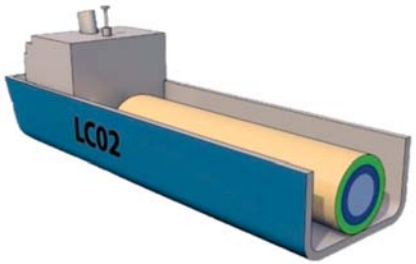


Selection of Sizes and Types of LCO2 Carrier for the Freight Study

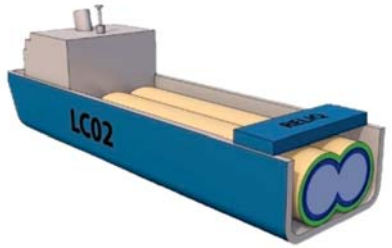
	7,500 cbm	12,000 cbm	18,000 cbm	20,000 cbm	22,000 cbm
Elevated Pressure	✓	✓	✓	✓	✓
Medium Pressure	✓	✓	✓	✓	-
Low Pressure	-	-	-	-	✓



Elevated Pressure



Medium Pressure



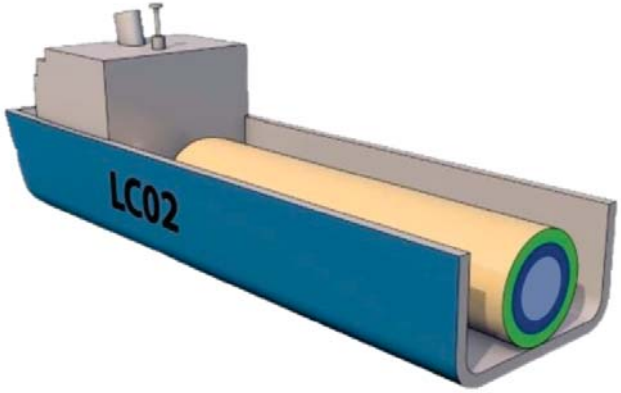
Low Pressure

Liquefied CO2 Carrier Designs

Elevated Pressure

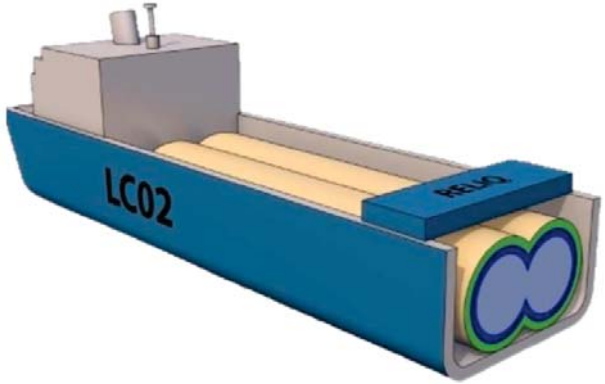
- **34 to 45 bar / 0 to 10 Deg C**
- Full class approval (GASA) but
- not yet in operation
- Vertical pipe formation
- Tank wall thickness reduced under IGC code (thinner than Type-C tanks)
- Ambient temperature, elevated pressure for liquefied CO2 as cargo

Medium Pressure



- **15 to 18 bar / -25 to -30 Deg C**
- Full class approval (already in operation)
- Type C cylindrical tank
- Increased shell thickness for greater pressure rating
- Medium pressure cargoes

Low Pressure



- **6 to 10 bar / -45 to -50 Deg C**
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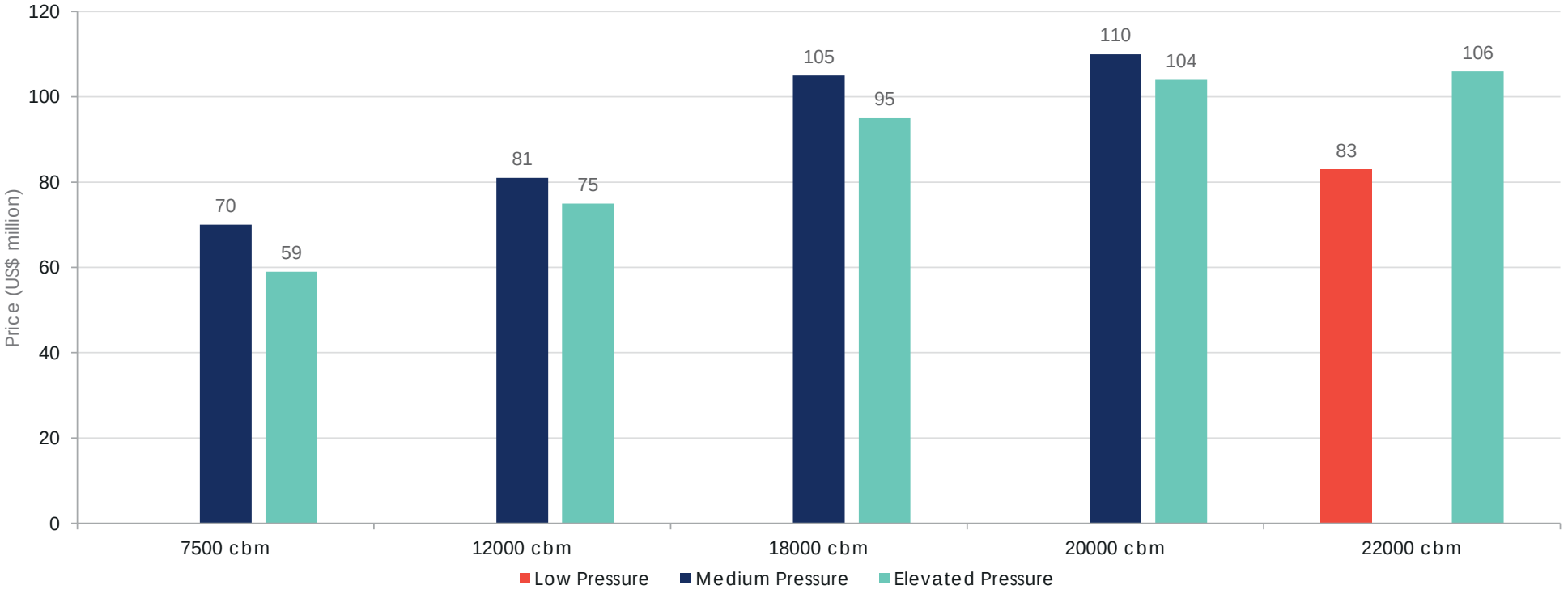
- Low pressure cargoes

CAPEX Continued

Vessel Design Pricing (US$ million)



Corrected Newbuilding Prices

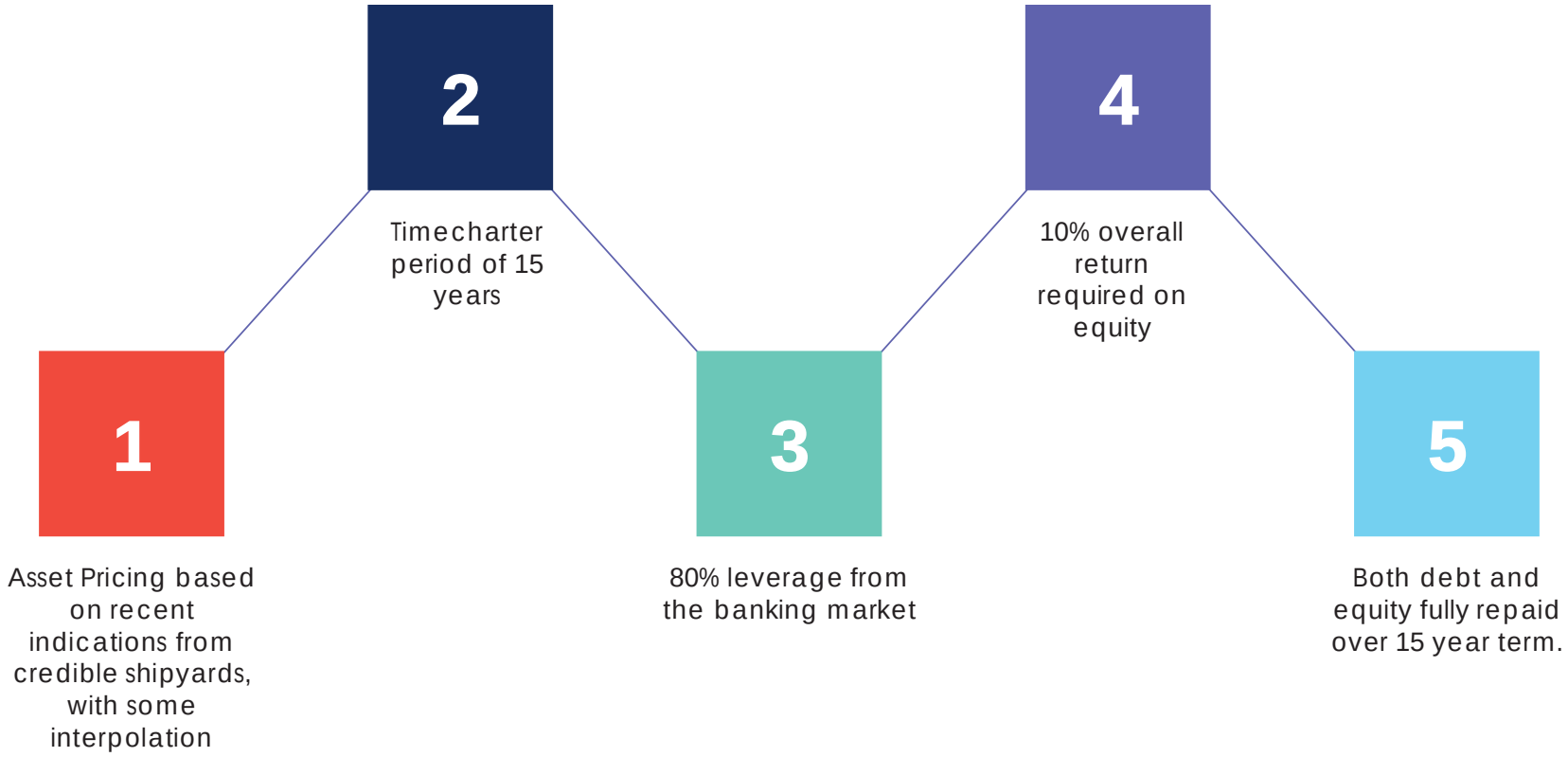
Asset Prices

The starting point for the calculation of freight costs is the price of ships (CAPEX) which are assessed as follows, based on contract signing in 3Q24 and delivery early 2028.

7,500 CBM, ELEVATED PRESSURE	$59 MILLION
7,500 CBM, MEDIUM PRESSURE	$70 MILLION
12,000 CBM, ELEVATED PRESSURE	$75 MILLION
12,000 CBM, MEDIUM PRESSURE	$81 MILLION
18,000 CBM, ELEVATED PRESSURE	$95 MILLION
18,000 CBM, MEDIUM PRESSURE	~~$116 MILLION~~ $105 MILLION
20,000 CBM, ELEVATED PRESSURE	$104 MILLION
20,000 CBM, MEDIUM PRESSURE	$110 MILLION
22,000 CBM, ELEVATED PRESSURE	$106 MILLION
22,000 CBM, LOW PRESSURE	$83 MILLION

CAPEX

Assumptions and Structure



Hire Cost (US$ per Day)

1) **Capital Expenditure**

2) **Operating Expenses**

   - Crewing
   - Stores
   - Maintenance
   - Insurances
   - Drydock Provision

3) CAPEX + OPEX = **Daily Hire Cost**

4) **Voyage Time** (Days)

5) Daily Hire Cost x Voyage Time = **Total Hire Cost**

Voyage Time

1) **Distance** Round trip in nautical miles.

2) **Speed** Nautical miles per hour (Knots).

Note: Study is based on 14 knots

3) Distance / Speed = **Time at Sea**

4) **Time in Port**
   - Notice of Readiness – 6 hours
   - Ship/shore meeting
   - Waiting for documents
   - Bunkering

3) Time at Sea + Time in Port = **Total Voyage Time**

Cost of Fuel

1) **Consumption at Sea** Metric tons per day

2) **Consumption in Port** Metric Tons per day

3) Consumption at Sea + Consumption in Port = **Total Consumption**

4) **Price of Fuel** US$ per metric ton

Note: Study is based on LNG

5) Total Consumption x Voyage Time x Price of Fuel = **Total Cost of Fuel**

Port Costs

1) Individual ports determines their tariffs.

2) No two are ever quite alike.

3) Different bases for charges – DWT? GRT?

4) Value of the cargo?

5) No CO2 port charges announced. Estimates based on conventional gas carriers.

6) European ports in general are expensive, especially UK and Scandinavia.

Total Voyage Costs

- ASSET PRICES (CAPEX)
- OPERATING COSTS (OPEX)
- DISTANCE
- SPEED
- PORT TIME

COST OF TIME

- FUEL CONSUMPTION
- TYPE OF FUEL
- FUEL PRICES

COST OF FUEL

- PORT COSTS

COST OF PORTS

Freight Calculation

Variables and assumptions

Daily Hire	*CAPEX; OPEX; voyage duration (at sea and in port).*
+	
Fuel Costs	*voyage distance; speed and consumption; consumption in port; price of fuel.*
+	
Port costs	*Will be determined on case-by-case basis.*
÷	
Cargo intake	*Loading limits; cargo heel; other loading parameters.*
=	
Freight rate (US$/mt)	

Cargo Intake

1) No Gas carrier loads to 100% of cubic capacity.

2) It may be necessary to leave a ‘heel’ of cargo after discharge.

3) For most gases the loading limit is set at 98%.

4) Designers of EP system advise 98% under the IGC Code.

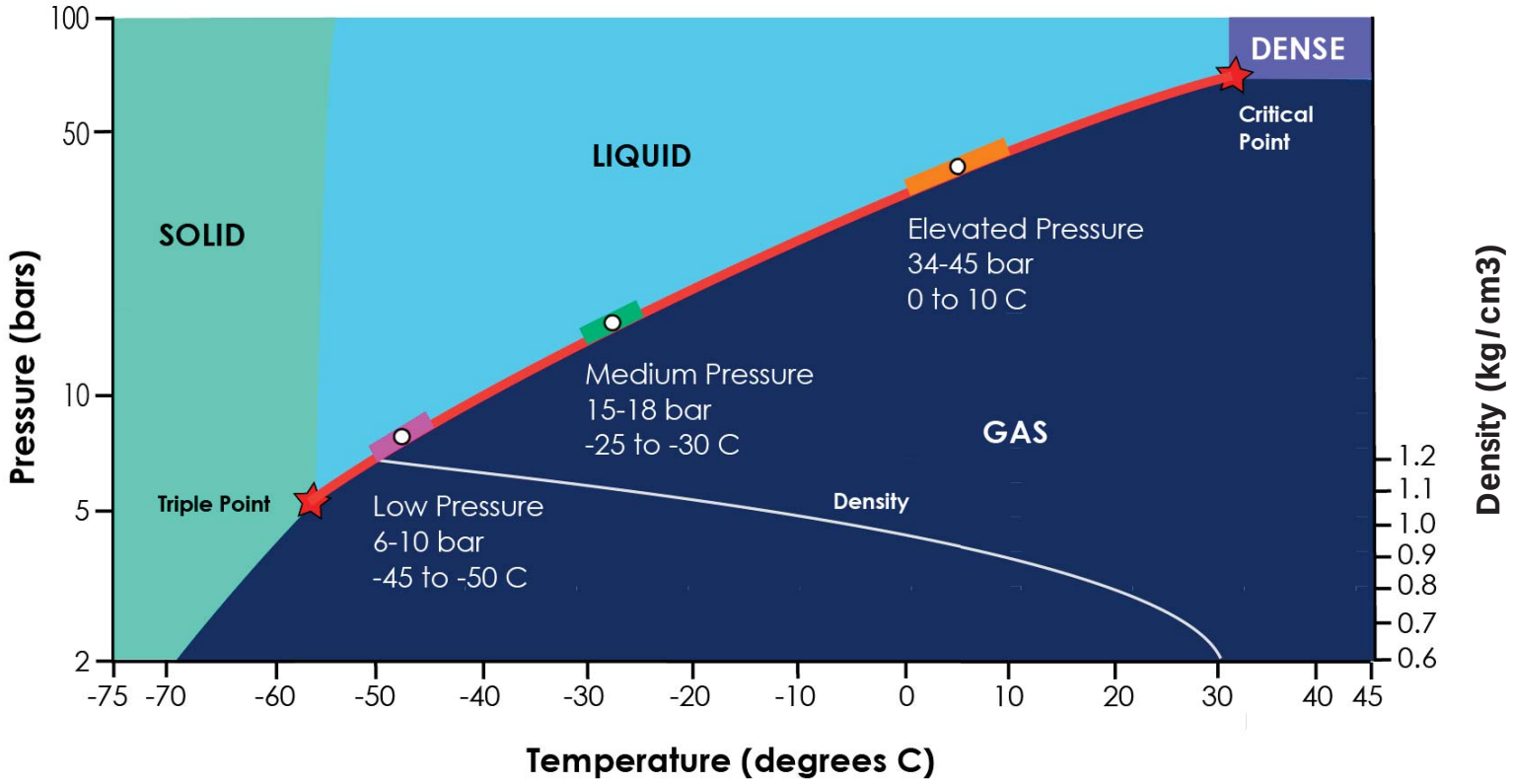
5) Capacity limit for MP and LP may be set at 95%.

6) Whatever the percentage, the intakes of different pressure regimes will vary.

Phase Diagram

Pressure, Temperature & Density Relationships of Liquefied CO_2

Three, generally recognised **conditions** of carriage:



Triple Point T = 56.6C / P = 5.18 bar

Critical Point T = 31 C / P = 73.83 bar

Liquefied CO2 Carrier Designs

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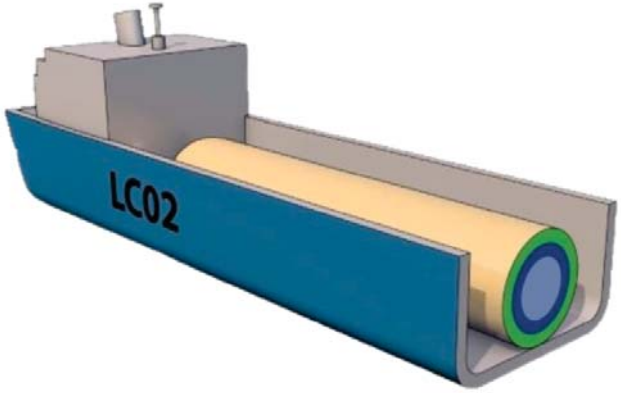

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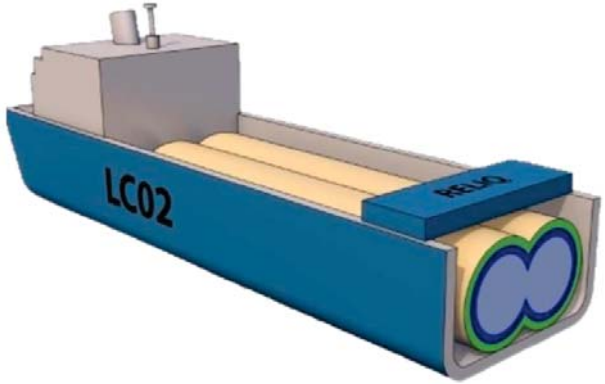

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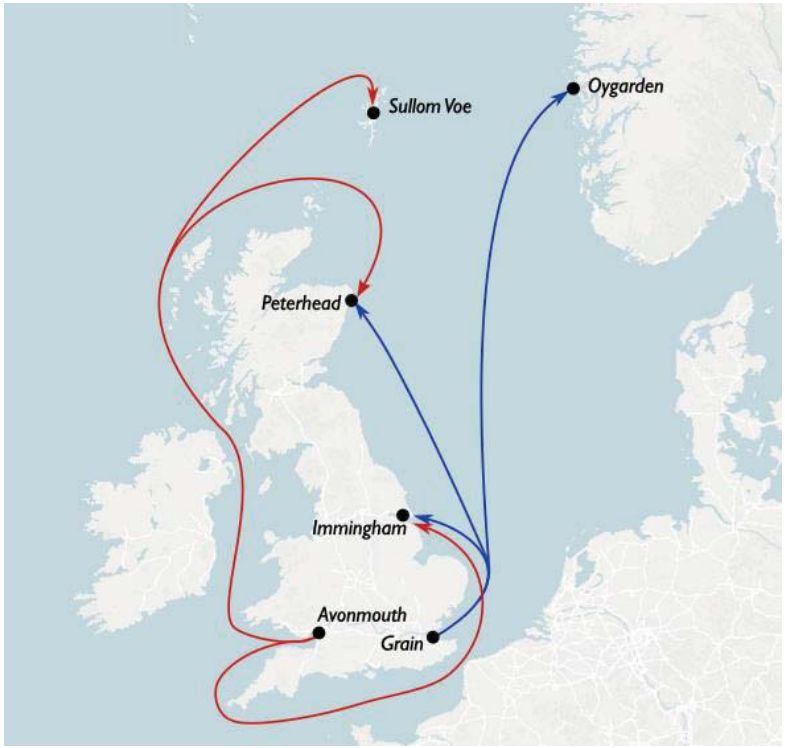
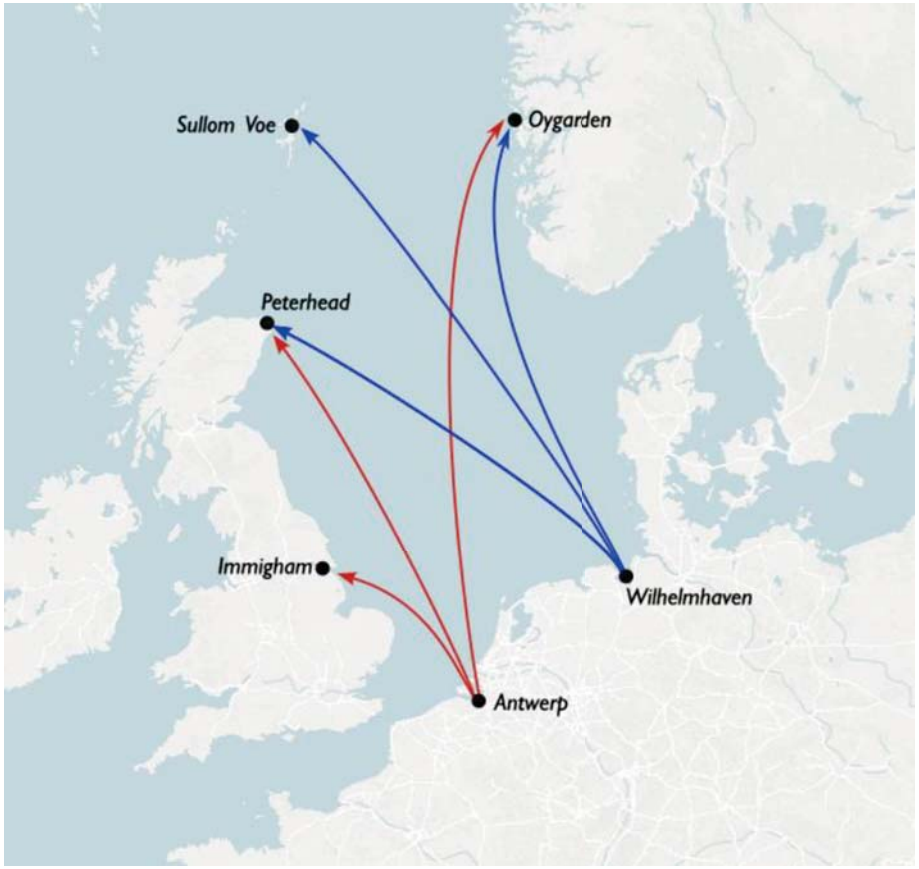
Routes UK to UK - North Sea

Load Port	Discharge Port	Laden	Ballast
AVONMOUTH	SULLOM VOE	840.25	845.31
AVONMOUTH	PETERHEAD	894.96	900.02
AVONMOUTH	IMMINGHAM	796.86	775.78
GRAIN	IMMINGHAM	296.42	289.82
GRAIN	ØYGARDEN	636.16	619.51
GRAIN	PETERHEAD	460.25	452.42



Routes Continent to UK - North Sea

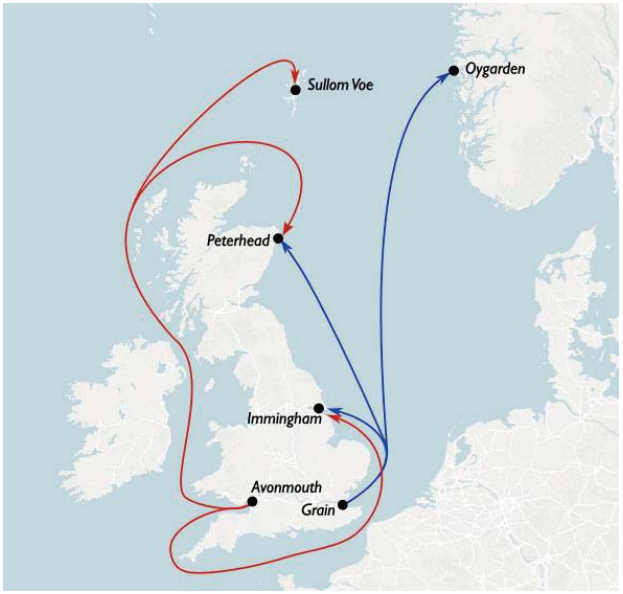
Load Port	Discharge Port	Laden	Ballast
ANTWERP	IMMINGHAM	360.98	371.31
ANTWERP	ØYGARDEN	700.72	701
ANTWERP	PETERHEAD	524.8	533.9
WILHELMSHAVEN	ØYGARDEN	488.07	492.05
WILHELMSHAVEN	PETERHEAD	422.36	422.48
WILHELMSHAVEN	SULLOM VOE	597.89	598.01

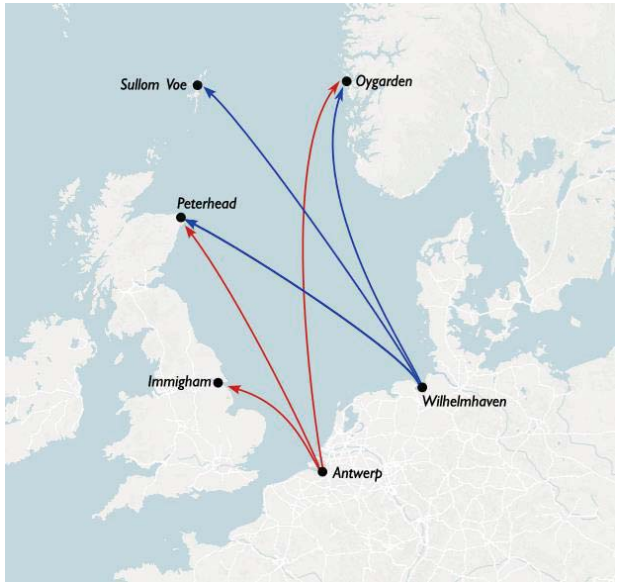


Routes Baltic Sea to North Sea - UK

Load Port	Discharge Port	Laden	Ballast
GDANSK	AALBORG	432.78	434.88
GDANSK	ØYGARDEN	798.11	807.86
GDANSK	SULLOM VOE	921.46	926.44
STOCKHOLM	AALBORG	628.7	634.51
STOCKHOLM	ØYGARDEN	994.03	1007.5
STOCKHOLM	SULLOM VOE	1117.4	1126.1

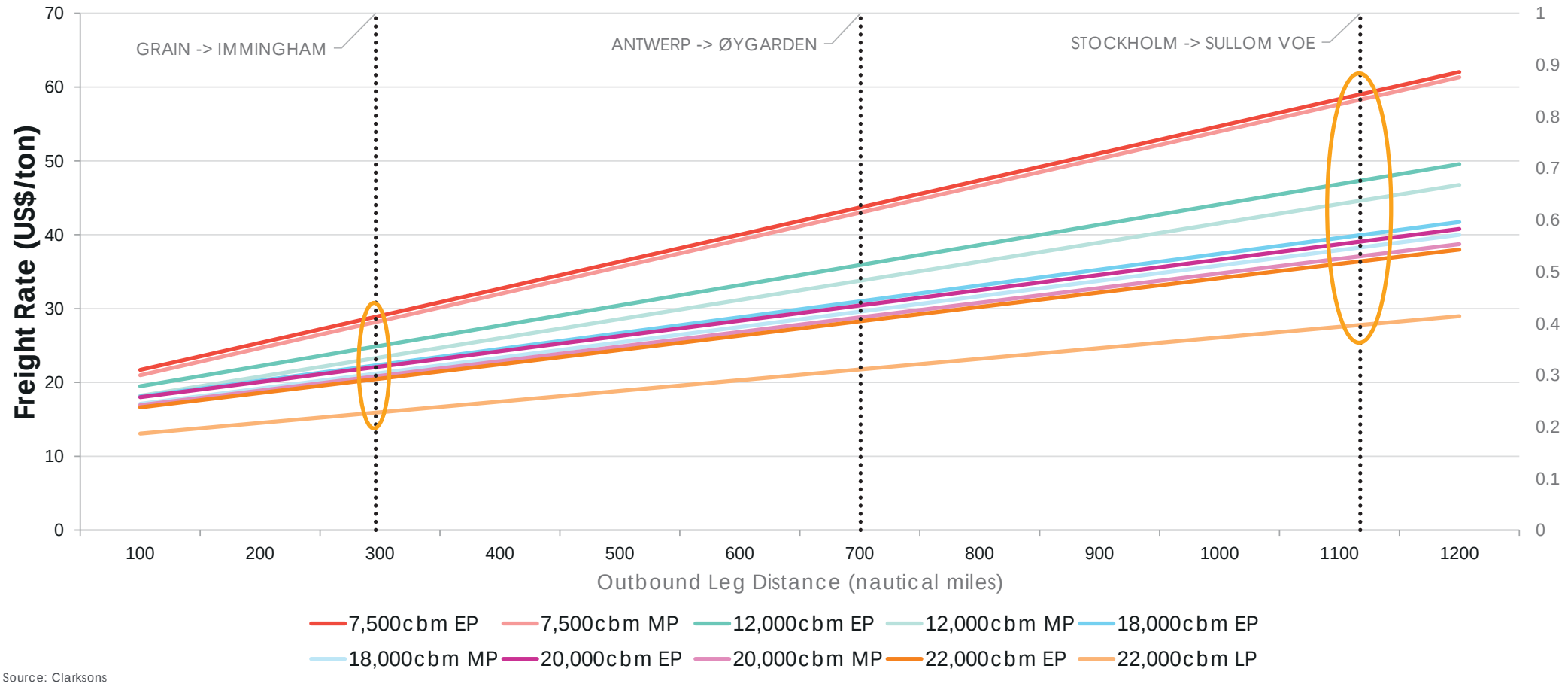
Specimen North Sea-Baltic CO2 Trade Routes





Impact of Voyage Distance on freight rate for various ship sizes

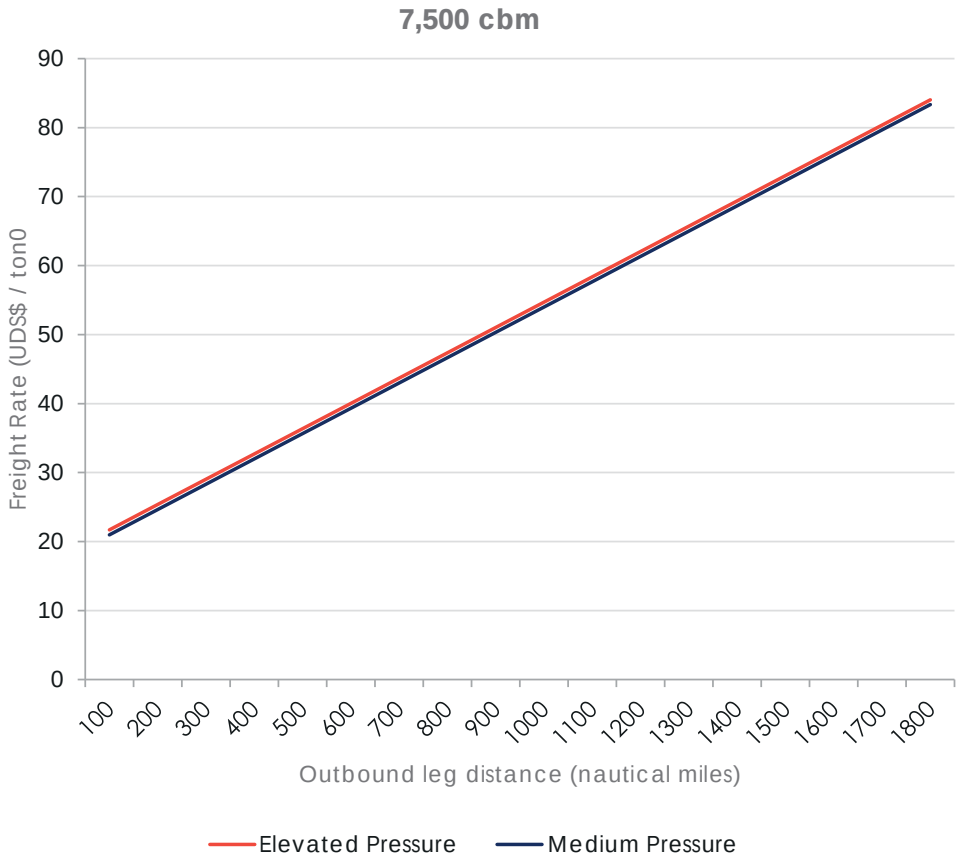
Port costs versus bunker costs

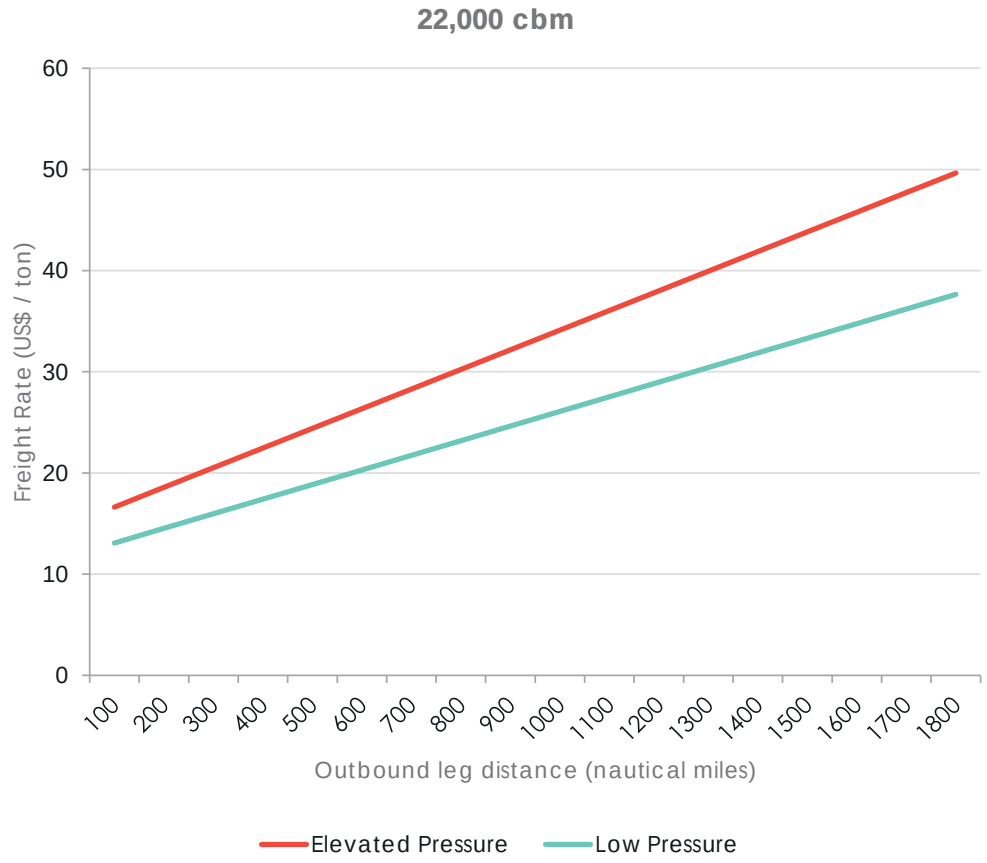


Source: Clarksons

Impact of CO2 Containment regime

7,500 cbm EP/MP & 22,000 cbm EP/LP





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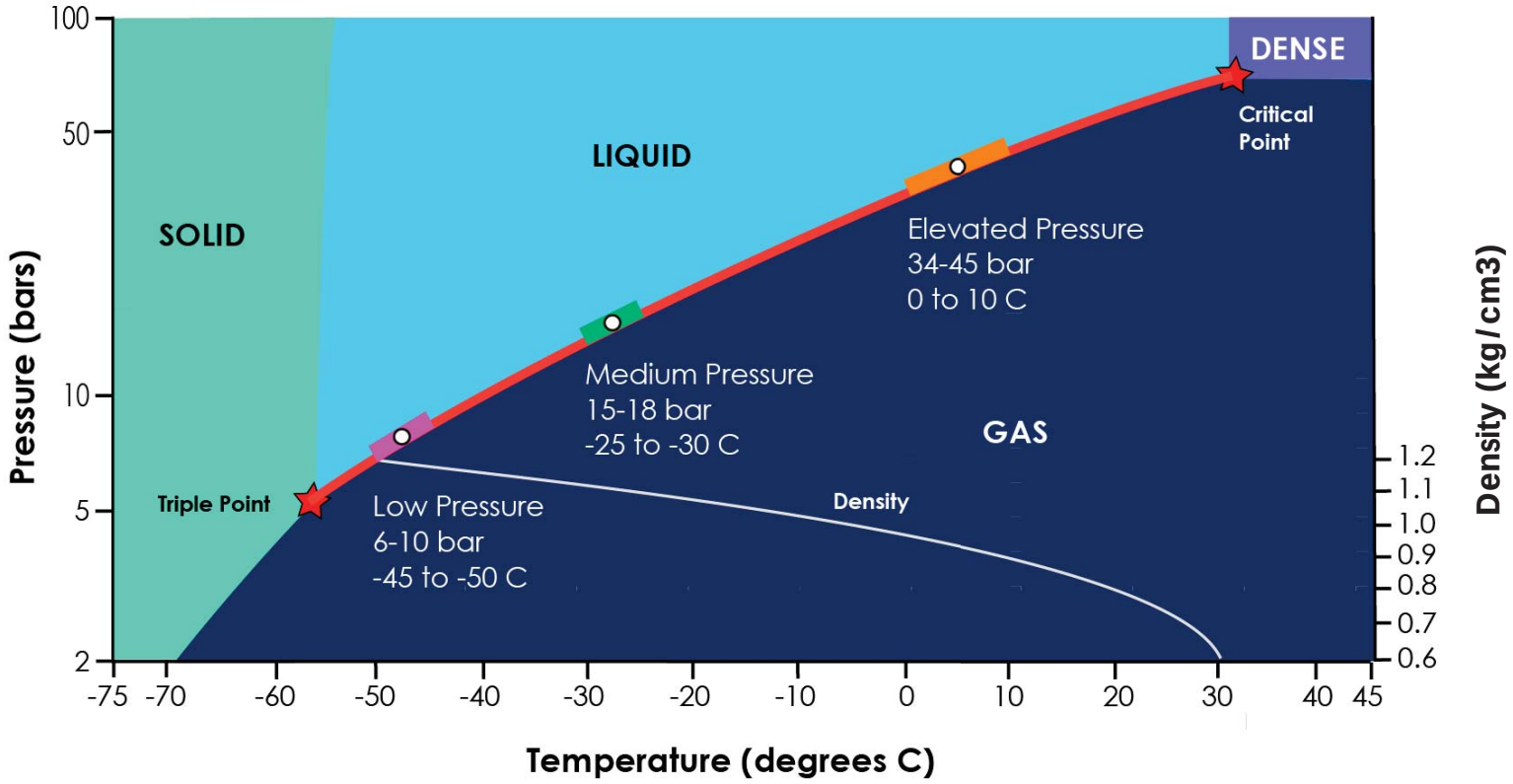

Triple Point T = 56.6C / P = 5.18 bar

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Freight Sensitivities

- Impacts in keeping with short sea voyages.
- Port Time stands out.
- Port costs are based on $10,000 variance.
- Comparatively less sensitivity to fuel costs.

		AVONMOUTH -> S	AVONMOUTH -> IM	AVONMOUTH ->	GRAIN -> IMMI	GRAIN -> ØYG	GRAIN -> PETE	ANTWERP -> IMA
7500	**Base rate**	48.93	46.86	50.94	28.77	41.05	34.76	31.45
EP	± $10,000 Port Costs	1.45	1.45	1.45	1.45	1.45	1.45	1.45
	± 24 hours Port Time	4.85	4.85	4.85	4.85	4.85	4.85	4.85
	± $100/t LNG Price	1.16	1.09	1.23	0.47	0.89	0.67	0.56
	± $100/t MGO Price	0.06	0.05	0.06	0.02	0.04	0.03	0.03
7500	**Base rate**	48.22	46.15	50.23	28.05	40.33	34.04	30.73
MP	± $10,000 Port Costs	1.32	1.32	1.32	1.32	1.32	1.32	1.32
	± 24 hours Port Time	4.94	4.94	4.94	4.94	4.94	4.94	4.94
	± $100/t LNG Price	1.06	1.00	1.13	0.43	0.81	0.61	0.51
	± $100/t MGO Price	0.05	0.05	0.06	0.02	0.04	0.03	0.03

Cost vs Market & General Market Dynamics

- The results are derived from **COST**, not **Market**.

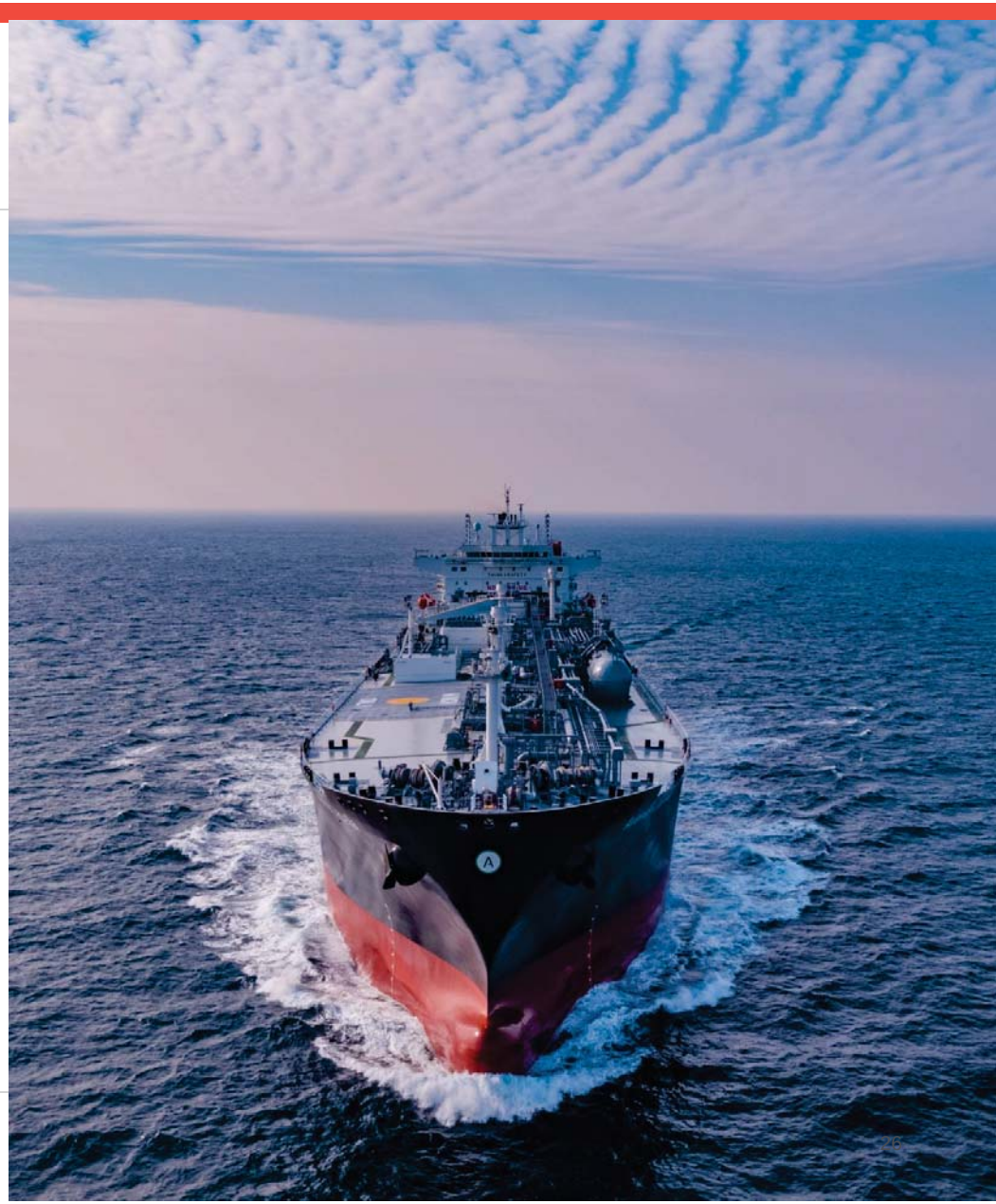
- An organized market process in which yards and owners compete can produce surprising results for price and contract terms.

  - Yard differentiation:
    - Overall shipbuilding demand.
    - Strategic sector-specific objectives.
    - Economy of scale (number of vessels per design).
    - Relationship with the customer.

  - Owner differentiation:
    - Access to financing and cost of capital.
    - View on residual asset values.

- Status of the Charterer.

- Market Dynamics.



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Thank You

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