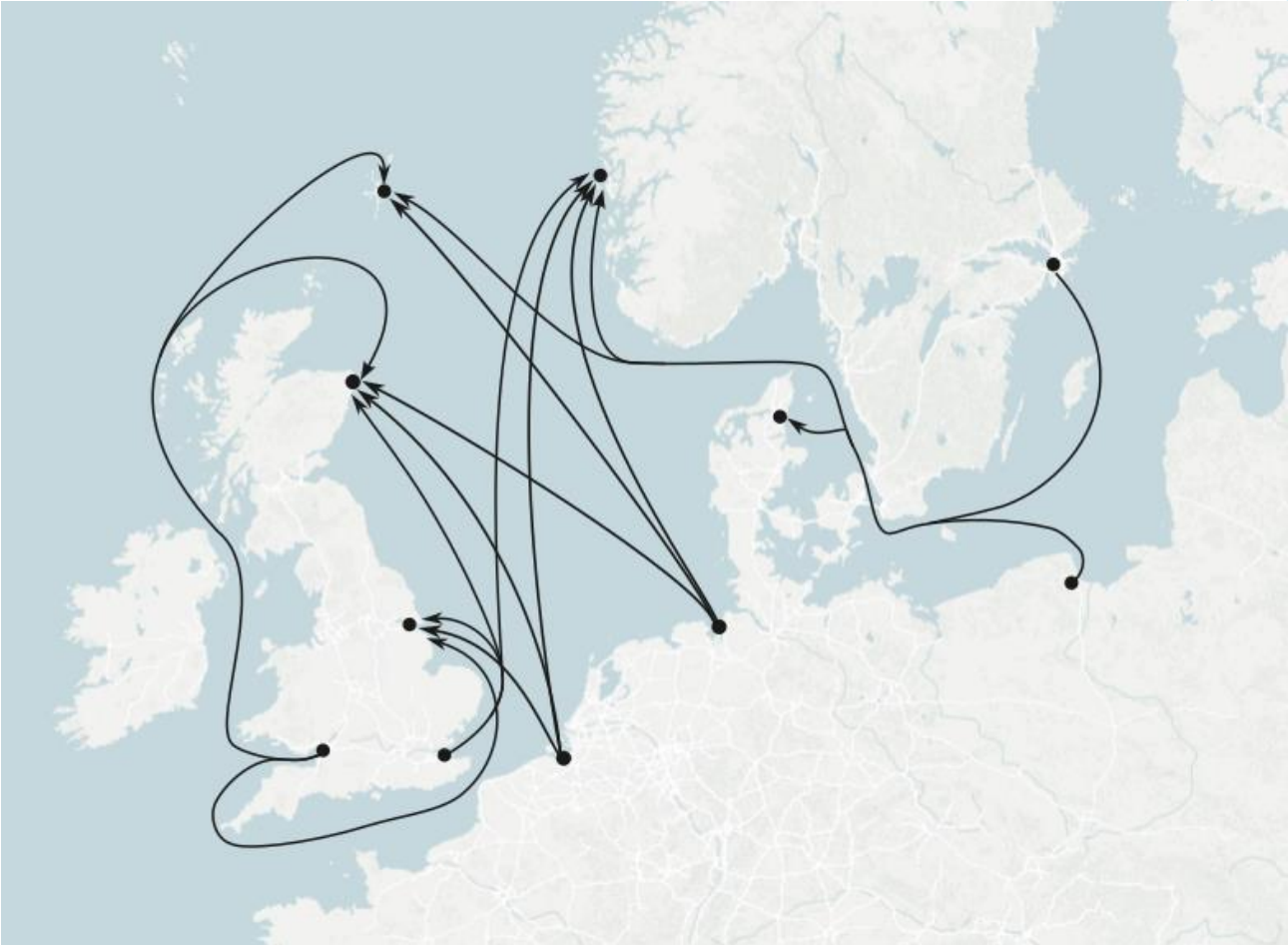
CLARKSONS/CCSA REPORT ON UPDATED COSTS FOR CO2 SHIP TRANSPORT



June 2024

Disclaimer

"The material and the information (including, without limitation, any future rates) contained in this presentation and in any documentation attached to it (together, the "Information") are provided by H. Clarkson & Company Limited and/or one of its 'connected persons' (together "Clarksons") for general information purposes only. It does not constitute an offer, recommendation or solicitation to any person to enter into any transaction nor does it constitute any predication of likely future movement in rates or prices. The Information is drawn from Clarksons' databases and other publicly available sources. This Information is confidential and is solely for the use of those to whom it is provided by Clarksons (the "Recipients"). In this disclaimer 'connected persons' means, in relation to Clarksons, its ultimate holding company, subsidiaries and subsidiary undertakings of its ultimate holding company and the respective shareholders, directors, officers, employees and agents of each of them. Clarksons advises that: (i) any Information extracted from Clarksons' databases is derived from estimates and/or subjective judgments; (ii) any Information extracted from the databases of other maritime data collection agencies may differ from the Information extracted from Clarksons' databases; (iii) whilst Clarksons has taken reasonable care in the compilation of the Information and believes it to be accurate and correct, data compilation is subject to limited audit and validation procedures, may accordingly contain errors, and we cannot guarantee its accuracy; (iv) the provision of the Information does not obviate the Recipient or any other person of the need to make appropriate further enquiries; (v) the provision of the Information is not an endorsement of any commercial policies and/or any conclusions by Clarksons and its 'connected persons', and is not intended to recommend any decision by the recipient or any other person; (vi) shipping/offshore is a variable and cyclical business and any forecasting concerning it may not be accurate. The Information is provided on an "as is" and "as available" basis. Clarksons and its 'connected persons' make no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability, suitability or availability with respect to the Information. Opinions and/ or projections may change without notice. Any reliance placed on such Information is therefore strictly at Recipients' own risk. Neither the whole nor any part of the Information may be used or relied upon by, any other person or used for any purpose without the prior written consent of Clarksons or one of its connected persons. Especially, the information is not to be used in any document for the purposes of raising finance whether by way of debt or equity. All intellectual property rights are fully reserved by Clarksons, its 'connected persons' and/or its licensors. Clarksons and/or its connected persons do not purport to provide you with investment, legal or tax advice. To the extent permitted by law, Clarksons and its 'connected persons' shall not be liable to the Recipients or any of other person or any third party for any loss, liability, damage, cost or expense including without limitation, direct, indirect, consequential loss or damage, any loss of profit, loss of use, loss of or interruption in business, loss of goodwill, loss of data arising out of, or in connection with, the use of and the reliance on the Information whether in contract, tort, negligence, bailment, breach of statutory duty or otherwise, directly or indirectly from the Recipient's use of the Information, even if foreseeable. These exclusions shall override any terms or conditions otherwise applicable but do not apply to (i) death or personal injury caused by the negligence of Clarksons and its 'connected persons' or (ii) the liability of Clarksons and its 'connected persons' for fraud or fraudulent misrepresentation. This disclaimer shall be governed by and construed in accordance with the laws of England and subject to the jurisdiction of the English Courts."

TABLE OF CONTENTS

Introduction 4
Vessel design and future proofing 5
Asset Prices 5
Vessel Financing and Operating Costs 6
Freight Estimate Methodology 7
Voyage Routes 11
Freight Estimate Results 15
Cost Versus Market 17
General Market Dynamics 17
Due Diligence and Process 18
Contact Details 18
Appendix 1 – Freight Sensitivities 19
Appendix 2 – Glossary of Shipping Terms 20

Introduction

The carriage of CO2 by ship has been ongoing for 25 years on a relatively small-scale, transporting high purity or "food-grade" CO2 on liquified CO2 carriers (LCO2s) of approximately 1,800 CBM, around Northwest Europe and the Mediterranean. The trade developed primarily to service the food and drinks industry and has amounted to less than half a million tons per annum. The more recent drive to capture and store significant quantities of industrial waste CO2, to combat the effect of greenhouse gases, has brought the transportation of CO2 by ship into sharp focus on a global scale.

This has attracted attention from shipbuilders, ship designers, ship owners, financiers and potential charterers looking to become involved in the emerging CCS industry. Whilst the drive to carry industrial waste CO2 might be new, the types of ships which will carry the CO2 are effectively variants of "semi-refrigerated" liquified gas carriers which have been in service since the 1950s.

The primary purpose of this report is to provide guidance on the likely cost of transportation of liquefied CO2 by ship, given current price conditions. The report focuses on selected trade routes within Northwest Europe, representative of projects which are well publicised. Three containment modes have been used, Elevated Pressure, Medium Pressure and Low Pressure. Only Medium Pressure has a proven track record, having been used for the food grade CO2 business mentioned above. Elevated Pressure and Low-Pressure designs have received Classification Society approval but have not yet entered service.

Four Medium Pressure vessels, and four Low Pressure vessels have been ordered, intended to carry waste grade CO2. To date, there is no clear evidence to suggest that one containment mode is more effective than another and this study does not attempt to show favour in that respect. Those decisions are dependent on the most effective option for the overall value chain, from capture to sink.

No study can replicate the results which might be obtained in an established market, where the infrastructure is in place, cost factors are known, firm shipping requirements can be placed into the market within clearly defined parameters, allowing market forces to reach natural conclusions. The results of this study must be seen as theoretical, but realistic, with an emphasis on cost and not on "market".

The vessel characteristics used for Elevated Pressure are based upon information provided by KNCC, the promoters of this design for CO2 carriage. Clarksons has obtained all other relevant information from a variety of sources, as part of its normal, day-to-day business of arranging construction and chartering of ships for its clients.

In an emerging industry with many elements not yet known or established, several assumptions have been used. Where possible, sensitivities have been included so that readers can make their own adjustments (See Appendix 1). All prices quoted in this study are in US$, as the recognised currency for international shipping.

Vessel design and future proofing

Ship design and the use of lower carbon fuel types are constantly evolving considerations. The starting point is for vessels to burn conventional fuels, with or without exhaust scrubbers which reduce NOx and SOx emissions but there are many other developments, too many to list here.

Gases like LPG and LNG are already used in many vessels that are designed to burn conventional fuel as well as gases (dual fuel). Other lower carbon fuels, such as methanol and ammonia, respectively are likely to play important parts in fuel development.

Until these fuels become fully established alternatives, with proven engines and bunkering infrastructures, many vessels are being built "ready" to use these newer fuels. This effectively means that they could be retrofitted more easily, at relatively low cost, to use these fuels in future, once safety, regulatory and logistical conditions allow.

Relatively recent systems, effectively additions to exhaust scrubbers, have been developed to capture part of the CO2 exhaust emissions, which are then stored on board in a variety of tanks or batteries, for discharge at some point during the voyage. There are pros and cons associated with these on-board carbon-capture systems, but it would seem likely that they may find a role at some point, particularly for LCO2s engaged in CCS. Most systems of this kind involve compromises between the energy required to operate them, meaning increased fuel/emissions versus the CO2 captured and the practicalities of on board storage and eventual disposal. Most prudent shipowners will make provisions to future-proof vessels at time of ordering.

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
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

Prices are based on most recent indications from credible shipyards and in some cases have been interpolated where actual data has not been made available. It should be noted that shipbuilding prices have been inflationary for several years, in some cases rising by as much as 10-15% in the space of a few months. That does not mean they will continue with the same trajectory, although

current market indicators suggest that prices are likely to remain firm and rising for the next couple of years. To reiterate, these are base case, indicative prices, not negotiated prices.

Vessel Financing and Operating Costs

The type and cost of financing ships is crucial in establishing daily hire rates, comprised of CAPEX and OPEX. This is particularly relevant when building new ships in an evolving, and not yet established trade, using highly specialised vessels, which in many cases will have no other business prospects outside of the project they are built against.

In an established, liquid market, owners and financiers may have little difficulty taking a view on employment prospects beyond an initial charter period, or indeed without any pre-secured business. In the case of CO2, writing off the cost of the vessel will likely be over the firm charter period. An exception to this would be where vessels are built on a speculative basis, for instance taking advantage of advantageous pricing and timing. The four Low Pressure vessels mentioned in the introduction are examples of this. This study assumes the vessels are constructed to carry CO2 only and have no employment prospects in other gas trades.

To calculate daily hire rates, the asset prices listed in the preceding section have been used. The daily operating costs (OPEX) for each ship type are based on recent indications received from several existing gas ship operators and some prospective LCO2 operators. The OPEX cover the general running of the vessel including stores, crewing, maintenance, as well as insurances and a provision for scheduled drydocking. We have seen considerable variance in these figures and have used those which we feel are reasonably conservative. Operating costs are then escalated throughout the period of charter.

7,500 CBM, ELEVATED PRESSURE	$8750 / day
7,500 CBM, MEDIUM PRESSURE	$8750 / day
12,000 CBM, ELEVATED PRESSURE	$8750 / day
12,000 CBM, MEDIUM PRESSURE	$8750 / day
18,000 CBM, ELEVATED PRESSURE	$9500 / day
18,000 CBM, MEDIUM PRESSURE	$9500 / day
20,000 CBM, ELEVATED PRESSURE	$9500 / day
20,000 CBM, MEDIUM PRESURE	$9500 / day
22,000 CBM, ELEVATED PRESSURE	$9500 / day
22,000 CBM, LOW PRESSURE	$9500 / day

Note that these operating costs are based on International Flag and Crew.

The applied charter period used is 15 years, starting when the vessel is delivered to commence trading. This is considered a normal requirement by most potential CO2 charterers. We have noted a preference from some charterers for shorter periods like 10, even 5 years, usually because shipping is seen as an interim solution before pipelines are constructed.

We have assumed that the vessel is purchased using 80% leverage from the banking market which tends to be the cheapest in terms of margin but also the most sophisticated in terms of being able to analyse the various project cashflows and repayment risks. We have also assumed that the Equity would require a 10% overall return and both debt and equity would expect full repayment over the 15 year term.

Depending on the strength of the repayment cashflows, the jurisdictions of operations and project sponsors, it may be possible to achieve a higher degree of leverage from the leasing market, which whilst slightly more expensive than bank debt, would require less equity and could well provide a lower overall weighted cost of capital and corresponding daily hire saving of circa 10%.

Which financing structure and what source of capital is best suited will very likely vary project to project but in essence the biggest driver to achieving the lowest weighted cost of capital will be the underlying debt and equity assumptions and debt service certainty from the cashflows / project sponsors.

Freight Estimate Methodology

Freight estimates are a function of hire and voyage costs (port charges, bunker costs), over the period of a round voyage, resulting in revenue for that voyage. This is divided by the cargo quantity carried, giving a US$ per metric ton figure for the voyage, effectively the freight cost of carrying CO2 from A to B.

The components of the voyage are the following:

- **Daily hire**

As calculated, in US$ per day.

- **Distance**

In nautical miles, based on AtoBviaC, covering the laden and ballast voyage from load port, to discharge port and back to load port.

- **Vessel speed**

Measured in nautical miles per hour (knots). The study is based on 14 knots, laden and ballast.

- **Sea margin**

This is added as a percentage, to the laden and ballast distance, representing weather and sea conditions existing in the geographical area covered in the study. The study is based on 5% although some owners might prefer to use 7-8%.

- **Daily bunker consumption**

This is the fuel consumed by the vessel at sea and in port. The figures used have been obtained from shipowners and shipyards. Where no guidance has been provided, it has been based on best estimates, derived from other types of gas ships, adjusted to reflect the characteristics of LCO2 carriers. It has been assumed that ship operations in port will not be assisted with power supplied from shore during loading and discharging operations (cold ironing), because it is not yet established whether all vessels or terminals will be equipped to do so.

- **Propulsion**

The fuel chosen for the ships in this study is LNG, meaning the vessels are dual-fuel LNG. This is based on the growing expectation that LNG will be the fuel of choice, particularly in Northwest Europe. LNG fuelled vessels require conventional pilot fuel to ignite the LNG and that pilot fuel is factored into the figures used for the main and auxiliary engines, at sea and in port.

- **Fuel prices**

The prices chosen are those reported by reliable bunker reporting services, in Northwest European ports in June 2024.

LNG	$ 664.75 / metric ton
MGO	$ 740.00/ metric ton

Adjustments to freight results can be made using the sensitivities in Appendix 1.

- **Port time**

This is the time used for loading and discharging cargo. Additional time has been added for normal ship operations, plus the notice time usually given to the supplier and receiver of vessels to prepare port facilities for the arrival of a ship to load or discharge (notice of readiness time). In addition, time had been included to cover bunkering operations. As bunkering will not be required for every voyage, based on the short-haul nature of the envisaged trade, we have prorated a typical bunkering operation over several voyages.

For this study, these are the total port times used, per voyage.

7,500 CBM	39 HOURS
12,000 CBM	51 HOURS
18,000 CBM	57 HOURS
20,000 CBM	63 HOURS
22,000 CBM	63 HOURS

No allowance has been made for any potential restrictions which might apply in certain ports; for instance, daylight transit only, no nighttime berthing, or waiting for tides.

Adjustments to freight results can be made using the sensitivities in Appendix 1.

- **Port costs**

Port costs or tariffs are usually determined by vessel or cargo size, along with the type of cargo. Some ports in Northwest Europe are renowned as being very expensive, compared with others, and there is no clear logic for this, as it tends to be decided by the local authorities. Complicating matters further, CO2 is a new cargo for most ports, not falling into an existing category.

In many cases the actual loading and discharging facilities have not yet been constructed. Therefore, the port costs used for this study are assumed and standardised.

Port costs have a significant bearing on freight estimates, given the relatively short distances on most routes within the scope of this study. It should therefore not be assumed that freight rates for routes which are over longer distances will necessarily be much more expensive than those for shorter routes, even though they may appear to be from the results of this study. Particular attention should be paid to port costs as and when they are known, as these may throw up unexpected results.

7,500 CBM	$ 35,000 (per port)
12,000 CBM	$ 50,000 (per port)
18,000 CBM	$ 75,000 (per port)
20,000 CBM	$ 80,000 (per port)
22,000 CBM	$ 80,000 (per port)

No allowance has been made for special dues which may apply to some trading areas; for instance fairway dues for transiting parts of the Baltic Sea, at certain times of year.

Adjustments to freight results can be made using the sensitivities in Appendix 1.

- **Cargo intakes**

The cubic capacity of a vessel is not the same as cargo intake, because no gas vessel is able to load to 100% of its cubic capacity, nor may it be desirable to discharge the entire volume on board. Safety regulations dictate the maximum cargo which can be loaded. For most gases, this is 98%.

In addition, when a gas vessel discharges, it will have some cargo remaining as liquid and vapour. Some of this will remain because the vessel's pumps cannot discharge it during normal cargo operations, and some may be retained to ensure that vessel's tanks remain adequately conditioned to receive the next cargo. Cargo intake, is the amount which can be carried and discharged, taking these points into consideration.

KNCC have advised us that their design should be able to load to 98%, in accordance with the IGC Code, and we have adopted this accordingly. For Medium and Low Pressure systems, we are aware that the possibility to load to 98% is under debate, as safety concerns have arisen, specific to CO2 as a cargo. The argument suggests that 95% may become the recognised safety limit.

To maintain a conservative standpoint, we have used 95% for MP and LP vessels. Should the reader disagree with this assumption, it is easy to make a simple conversion, using the freight rates supplied, multiplied by the cargo intake below, and dividing this by the desired cargo intake they wish to use.

7,500 CBM, ELEVATED PRESSURE	6,900 MT
7,500 CBM, MEDIUM PRESSURE	7,550 MT
12,000 CBM, ELEVATED PRESSURE	11,000 MT
12,000 CBM, MEDIUM PRESSURE	12,000 MT
18,000 CBM, ELEVATED PRESSURE	16,575 MT
18,000 CBM, MEDIUM PRESSURE	18,150 MT
20,000 CBM, ELEVATED PRESSURE	18,400 MT
20,000 CBM, MEDIUM PRESURE	20,150 MT
22,000 CBM, ELEVATED PRESSURE	20,250 MT
22,000 CBM, LOW PRESSURE	23,775 MT

Please note that Low Pressure designs for smaller sizes are possible. However, for the purpose of this study we have accepted the general sense of a transition point from Medium to Low Pressure Designs at 22,000 CBM.

Voyage Routes

The routes selected for this study are listed below. These have been chosen to provide a reasonably broad comparison from likely loading locations to likely discharging locations. The study does not attempt to include nor exclude routes based on feasibility or preference. The focus has been to include Continent, UK and Baltic Sea as emission export areas and UK East Coast, Shetland Islands, Denmark and Norway as storage areas.

Routes UK to North Sea

Load port	Discharge port
AVONMOUTH	SULLOM VOE
AVONMOUTH	PETERHEAD
AVONMOUTH	IMMINGHAM
GRAIN	IMMINGHAM
GRAIN	ØYGARDEN
GRAIN	PETERHEAD

Routes Continent to North Sea

Load port	Discharge port
ANTWERP	IMMINGHAM
ANTWERP	ØYGARDEN
ANTWERP	PETERHEAD
WILHELMSHAVEN	ØYGARDEN
WILHELMSHAVEN	PETERHEAD
WILHELMSHAVEN	SULLOM VOE

Routes Baltic Sea to North Sea

Load port	Discharge port
GDANSK	AALBORG
GDANSK	ØYGARDEN
GDANSK	SULLOM VOE
STOCKHOLM	AALBORG
STOCKHOLM	ØYGARDEN
STOCKHOLM	SULLOM VOE

The routes are further shown on the following charts.

Routes UK to North Sea

Distances (nautical miles)

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 North Sea

Distances (nautical miles)

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

Distances (nautical miles)

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

Freight Estimate Results

The results of the freight rate estimates are summarised in the following tables, based on the respective vessel types and sizes. The report does not attempt to differentiate between one freight rate and another, as different projects and different trade routes will have unique constraints, which may define which type and size of vessel is best suited for that business. Other factors, such as choice of shipbuilder, location of shipyard, positioning time and costs, and delivery timing may also have a bearing.

No positioning costs are factored into this study, but this will be an important consideration. Vessels built in the Far East will have significant positioning costs and time, particularly if having to avoid dangerous areas, such as the Red Sea, instead routing via Cape of Good Hope. Vessels built closer to market, for instance in Turkey, Italy, Spain, UK or Continent would have considerably lower positioning costs. These will impact overall freight economics, although they will be spread over 15 years, in this instance.

The freight rates do not assume that the sizes of vessel are dimensionally suitable for the ports shown.

All rates are shown in US $/metric ton.

United Kingdom to North Sea		7,500 CBM		12,000 CBM		18,000 CBM		20,000 CBM		22,000 CBM	
Load Port	**Discharge Port**	**EP**	**MP**	**EP**	**MP**	**EP**	**MP**	**EP**	**MP**	**EP**	**LP**
AVONMOUTH	SULLOM VOE	48.93	48.22	39.80	37.47	34.05	32.56	33.38	31.65	31.05	23.81
AVONMOUTH	PETERHEAD	50.94	50.23	41.29	38.89	35.22	33.70	34.52	32.73	32.12	24.60
AVONMOUTH	IMMINGHAM	46.86	46.15	38.26	36.01	32.83	31.39	32.22	30.53	29.96	23.00
GRAIN	IMMINGHAM	28.77	28.05	24.77	23.21	22.25	21.12	22.01	20.75	20.38	15.87
GRAIN	ØYGARDEN	41.05	40.33	33.92	31.89	29.43	28.09	28.93	27.39	26.88	20.70
GRAIN	PETERHEAD	34.76	34.04	29.23	27.44	25.75	24.52	25.38	23.99	23.55	18.23

Continent to North Sea		7,500 CBM		12,000 CBM		18,000 CBM		20,000 CBM		22,000 CBM	
Load Port	**Discharge Port**	**EP**	**MP**	**EP**	**MP**	**EP**	**MP**	**EP**	**MP**	**EP**	**LP**
ANTWERP	IMMINGHAM	31.45	30.73	26.77	25.10	23.81	22.64	23.52	22.20	21.80	16.92
ANTWERP	ØYGARDEN	43.73	43.01	35.92	33.79	31.00	29.61	30.45	28.84	28.30	21.76
ANTWERP	PETERHEAD	37.44	36.72	31.23	29.34	27.32	26.04	26.90	25.44	24.97	19.28
WILHELMS-HAVEN	ØYGARDEN	36.00	35.28	30.16	28.32	26.47	25.22	26.08	24.66	24.20	18.71
WILHELMS-HAVEN	PETERHEAD	33.52	32.80	28.31	26.56	25.02	23.82	24.68	23.32	22.89	17.73
WILHELMS-HAVEN	SULLOM VOE	39.95	39.24	33.11	31.12	28.79	27.47	28.32	26.80	26.30	20.27

Baltic to North Sea		7,500 CBM		12,000 CBM		18,000 CBM		20,000 CBM		22,000 CBM	
Load Port	**Discharge Port**	**EP**	**MP**	**EP**	**MP**	**EP**	**MP**	**EP**	**MP**	**EP**	**LP**
GDANSK	AALBORG	33.93	33.22	28.62	26.86	25.27	24.05	24.92	23.54	23.11	17.90
GDANSK	ØYGARDEN	47.47	46.76	38.71	36.44	33.19	31.73	32.56	30.86	30.28	23.24
GDANSK	SULLOM VOE	51.91	51.20	42.02	39.58	35.79	34.25	35.06	33.26	32.63	24.98
STOCKHOLM	AALBORG	41.19	40.47	34.03	31.99	29.51	28.17	29.01	27.46	26.95	20.76
STOCKHOLM	ØYGARDEN	54.72	54.02	44.12	41.57	37.44	35.85	36.65	34.78	34.12	26.09
STOCKHOLM	SULLOM VOE	59.16	58.45	47.42	44.71	40.04	38.37	39.16	37.18	36.47	27.84

Cost Versus Market

The study focuses on the cost elements of building ships and how they translate into freight rates. It makes no attempt to replicate what would happen in "real" market conditions where shipyards and shipowners engage in competition against firm market enquiries.

Experience shows that the results of cost-based studies, usually undertaken at the evaluation or feasibility stage of projects, differ from the results of an actual market process. A market process may provide more favourable results, because shipyards and/or owners may be willing to compete to levels below perceived cost, for instance to be first movers, to gain market control in a particular sector or to bolster green credentials.

Sometimes the reverse occurs, where shipyards are not motivated to compete and ship owners have little incentive to invest in a sector which has little or no asset liquidity. Access to finance, how an owner or financier views residual value will also have a significant bearing on results.

There is no way to know in advance just how a market will react to an enquiry to build and charter vessels. This can be influenced by many factors, including the status of the charterer, timing, shipping cycles, the type and level of financing available, the number of yards and owners engaged in a process. Not all owners have the same level of access to favourable financing.

General Market Dynamics

At time of writing, shipbuilding is in a very active phase, with prices firm and rising. It would be optimistic to believe that prices might fall significantly in the next two to three years. Yards capable of building LCO2s, which may number less than 10 depending on the vessel size, are not overly motivated to take orders for such specialized vessels. The more established gas shipbuilders are also somewhat fatigued by the amount of enquiry they have received, versus the number of orders taken, when compared with every other shipping sector.

Shipyards have become reticent to provide even price indications without NDAs and background about the project and the principals involved. They also need to understand key project timelines like FIDs.

The lead-time for building ships is around 3 years from when an order is taken and the normal negotiation process to finalise contract terms and specifications can take 3-6 months before an order is confirmed. There are always exceptions when dealing with owners and yards who have good track records and have contracted numerous vessels beforehand.

We are aware of more than 30 ship owners who have expressed keen interest in becoming involved in the CCS chain, provided the business can be supported with a sufficiently long charter contract, with a strong counterpart. Many of these owners have already invested in their own LCO2 designs and have existing track records in gas trades, including LPG, LNG ammonia and petrochemical gases. For a firm, open market enquiry, we would expect additional shipowners, perhaps not previously involved in gas, being interested to compete.

Due Diligence and Process

CCS projects require significant funding and the costs involved will be important factors determining viability and success. In evaluating shipping alternatives and costs, project leads will benefit from engaging with the whole market to arrive at optimum solutions, not only in respect of cost, but also contract terms and counterpart. This is important in order to demonstrate due diligence of process, where multiple stakeholders are involved and projects rely on Government, and ultimately tax-payer funding.

Contact Details

This report has been prepared by Tommy Baggio, Seb Norton, and Elwin Taylor of Clarksons Gases on behalf of the CCSA.

CO2@clarksons.com

Appendix 1 – Freight Sensitivities

		AVONMOUTH -> SULLOM VOE	AVONMOUTH -> IMMINGHAM	AVONMOUTH -> PETERHEAD	GRAIN -> IMMINGHAM	GRAIN -> ØYGARDEN	GRAIN -> PETERHEAD	ANTWERP -> IMMINGHAM	ANTWERP -> ØYGARDEN	ANTWERP -> PETERHEAD	WILHELMSHAVEN -> ØYGARDEN	WILHELMSHAVEN -> PETERHEAD	WILHELMSHAVEN -> SULLOM VOE	GDANSK -> AALBORG	GDANSK -> ØYGARDEN	GDANSK -> SULLOM VOE	STOCKHOLM -> AALBORG	STOCKHOLM -> ØYGARDEN	STOCKHOLM -> SULLOM VOE
7500	**Base rate**	48.93	46.86	50.94	28.77	41.05	34.76	31.45	43.73	37.44	36.00	33.52	39.95	33.93	47.47	51.91	41.19	54.72	59.16
EP	± $10,000 Port Costs	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	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	4.85	4.85	4.85	4.85	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	0.98	0.77	0.72	0.63	0.85	0.64	1.11	1.27	0.90	1.36	1.52
	± $100/t MGO Price	0.06	0.05	0.06	0.02	0.04	0.03	0.03	0.05	0.04	0.04	0.03	0.04	0.03	0.06	0.06	0.04	0.07	0.08
7500	**Base rate**	48.22	46.15	50.23	28.05	40.33	34.04	30.73	43.01	36.72	35.28	32.80	39.24	33.22	46.76	51.20	40.47	54.02	58.45
MP	± $10,000 Port Costs	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	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	4.94	4.94	4.94	4.94	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	0.90	0.70	0.65	0.58	0.78	0.59	1.02	1.16	0.82	1.25	1.39
	± $100/t MGO Price	0.05	0.05	0.06	0.02	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.04	0.03	0.05	0.06	0.04	0.06	0.07
12000	**Base rate**	39.80	38.26	41.29	24.77	33.92	29.23	26.77	35.92	31.23	30.16	28.31	33.11	28.62	38.71	42.02	34.03	44.12	47.42
EP	± $10,000 Port Costs	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
	± 24 hours Port Time	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61
	± $100/t LNG Price	0.91	0.86	0.96	0.38	0.70	0.54	0.45	0.77	0.61	0.57	0.50	0.67	0.52	0.87	0.99	0.71	1.06	1.18
	± $100/t MGO Price	0.05	0.04	0.05	0.02	0.04	0.03	0.02	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.04	0.05	0.06
12000	**Base rate**	37.47	36.01	38.89	23.21	31.89	27.44	25.10	33.79	29.34	28.32	26.56	31.12	26.86	36.44	39.58	31.99	41.57	44.71
MP	± $10,000 Port Costs	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
	± 24 hours Port Time	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45
	± $100/t LNG Price	0.83	0.78	0.88	0.35	0.64	0.49	0.41	0.70	0.55	0.52	0.46	0.61	0.47	0.79	0.90	0.64	0.97	1.07
	± $100/t MGO Price	0.04	0.04	0.04	0.02	0.03	0.02	0.02	0.04	0.03	0.03	0.02	0.03	0.02	0.04	0.04	0.03	0.05	0.05
18000	**Base rate**	34.05	32.83	35.22	22.25	29.43	25.75	23.81	31.00	27.32	26.47	25.02	28.79	25.27	33.19	35.79	29.51	37.44	40.04
EP	± $10,000 Port Costs	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	± 24 hours Port Time	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91
	± $100/t LNG Price	0.67	0.63	0.71	0.29	0.52	0.40	0.34	0.57	0.46	0.43	0.38	0.50	0.39	0.65	0.73	0.53	0.78	0.87
	± $100/t MGO Price	0.03	0.03	0.04	0.01	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.02	0.03	0.04	0.03	0.04	0.04
18000	**Base rate**	32.56	31.39	33.70	21.12	28.09	24.52	22.64	29.61	26.04	25.22	23.82	27.47	24.05	31.73	34.25	28.17	35.85	38.37
MP	± $10,000 Port Costs	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	± 24 hours Port Time	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
	± $100/t LNG Price	0.62	0.58	0.65	0.27	0.48	0.37	0.31	0.52	0.42	0.39	0.35	0.46	0.35	0.59	0.67	0.48	0.72	0.79
	± $100/t MGO Price	0.03	0.03	0.03	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.04	0.04
20000	**Base rate**	33.38	32.22	34.52	22.01	28.93	25.38	23.52	30.45	26.90	26.08	24.68	28.32	24.92	32.56	35.06	29.01	36.65	39.16
EP	± $10,000 Port Costs	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
	± 24 hours Port Time	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76
	± $100/t LNG Price	0.69	0.65	0.73	0.30	0.54	0.42	0.35	0.59	0.47	0.44	0.39	0.52	0.40	0.67	0.75	0.54	0.81	0.89
	± $100/t MGO Price	0.03	0.03	0.04	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.02	0.03	0.04	0.03	0.04	0.04
20000	**Base rate**	31.65	30.53	32.73	20.75	27.39	23.99	22.20	28.84	25.44	24.66	23.32	26.80	23.54	30.86	33.26	27.46	34.78	37.18
MP	± $10,000 Port Costs	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	± 24 hours Port Time	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67
	± $100/t LNG Price	0.63	0.60	0.67	0.28	0.49	0.38	0.32	0.54	0.43	0.40	0.36	0.47	0.37	0.61	0.69	0.50	0.74	0.82
	± $100/t MGO Price	0.03	0.03	0.03	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.04	0.04
22000	**Base rate**	31.05	29.96	32.12	20.38	26.88	23.55	21.80	28.30	24.97	24.20	22.89	26.30	23.11	30.28	32.63	26.95	34.12	36.47
EP	± $10,000 Port Costs	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
	± 24 hours Port Time	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58
	± $100/t LNG Price	0.65	0.61	0.68	0.28	0.50	0.39	0.33	0.55	0.44	0.41	0.37	0.48	0.37	0.62	0.70	0.51	0.75	0.83
	± $100/t MGO Price	0.03	0.03	0.03	0.01	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.03	0.04	0.04
22000	**Base rate**	23.81	23.00	24.60	15.87	20.70	18.23	16.92	21.76	19.28	18.71	17.73	20.27	17.90	23.24	24.98	20.76	26.09	27.84
LP	± $10,000 Port Costs	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
	± 24 hours Port Time	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87
	± $100/t LNG Price	0.55	0.52	0.58	0.24	0.43	0.33	0.28	0.47	0.37	0.35	0.31	0.41	0.32	0.53	0.60	0.43	0.64	0.71
	± $100/t MGO Price	0.03	0.03	0.03	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.03	0.04

Appendix 2 – Glossary of Shipping Terms

Bunker: The term for the fuel used by ships.

Bunkering: The process of supplying fuel to ships for their engines.

Cargo Intake: The amount of cargo that a ship can load, taking into consideration the cubic capacity and weight limitations.

CBM: Cubic Meter

Classification Society: An organisation that establishes and maintains technical standards for the construction and operation of ships and offshore structures.

Cubic Capacity: The total internal volume of a ship's cargo holds or tanks, usually measured in cubic meters (CBM). It determines the amount of cargo a ship can carry.

Freight Rates: The charge levied for the transportation of cargo per unit of measure (e.g., per ton, per cubic meter). These rates fluctuate based on market conditions, distance, and cargo type.

IGC Code: The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk. It sets standards for the safe transport of liquefied gases.

International Flag and Crew: Refers to the registration of a ship under a flag which permits the recruitment of officers and crew of all nationalities.

Laden and Ballast: Refers to the state of a ship being loaded with cargo (laden) or empty (ballast).

Long charter contract: A long-term agreement where a shipowner leases out their vessel to a charterer for an extended period.

NOx and SOx emissions: Refers to nitrogen oxides (NOx) and sulphur oxides (SOx), which are significant pollutants produced by ships' engines.

Price Indications: Preliminary estimates of costs, often provided to give an idea of potential expenses or rates before a formal quotation or contract is issued.

Scrubbers: Exhaust gas cleaning systems installed on ships to remove nitrogen oxides (NOx), sulphur oxides (SOx), and particulate matter from the ship's engine and boiler exhaust gases.