

Industry Insight

Shipping Industry's response to ECA 2015

February, 2015

www.mecintelligence.com

INDIA
112, Udyog Vihar Phase 4
122015 Gurgaon
Haryana, India

T: +91124 480 2700

DENMARK
Nordre Fasanvej 113, 2
2000 Frederiksberg
Copenhagen, Denmark

T: +45 3543 3277

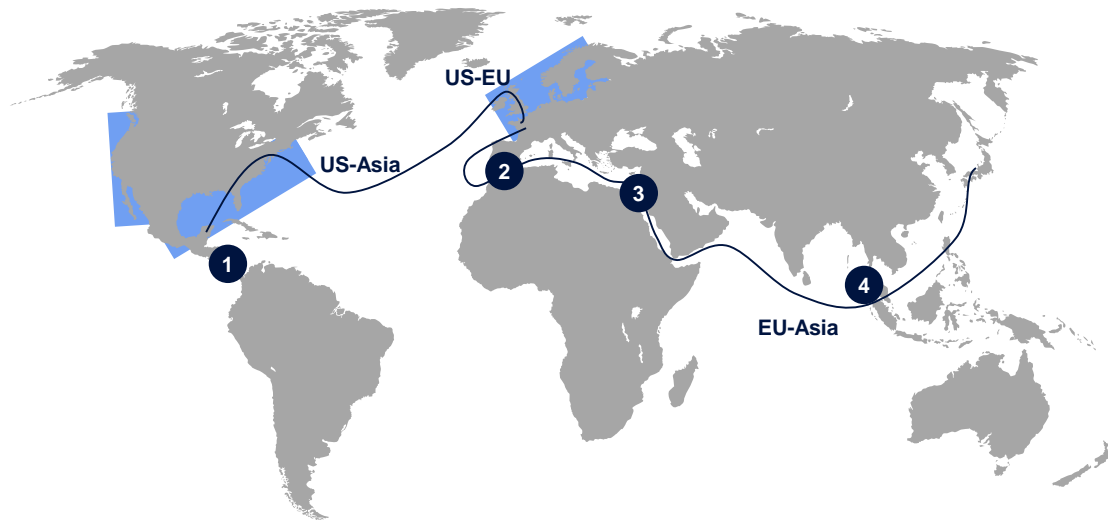
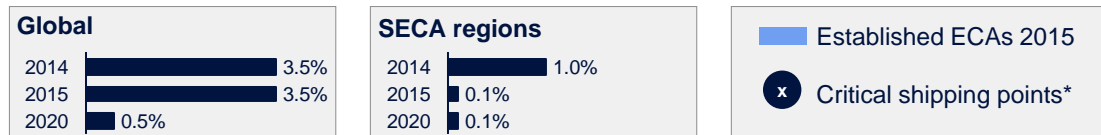
mec+

Executive Summary

	Observations	Conclusions
ECA and its implications	<ul style="list-style-type: none">▪ Stricter sulphur regulations are due enforcement by 2020, and they will affect three major trade routes US-Europe, US-Asia & Europe-Asia▪ SECA regulations can be met by 13 fuel options either by substitution or with emission control equipment with HFO, the dominant marine fuel option today▪ Out of available alternate fuels, 7 fuels remain relevant in 2015 while for global ECA due in 2020/25 only 4 fuels shall be eligible	<ul style="list-style-type: none">▪ Based on cost, availability & fuel price, MGO, HFO+ Scrubber and LNG are the most promising fuel solutions▪ MGO is one of the best compliance options, however supply sufficiency towards 2020 is a concern▪ Scrubber technology is promising, technical viability across categories would impact mass adoption▪ LNG could be optimal long term compliance fuel based on fuel price contracting strategy on select routes
Market response	<ul style="list-style-type: none">▪ 160 number of vessels have ordered scrubbers as compliance measure until 31st Jan 2015▪ Scrubber orders have increased at ~19% during Oct'14-Jan'15 as compared to 125% for period Mar'14-Sep'14▪ LNG propelled fleet count would be 130 by 2018 including 52 vessels in operation with reach limited to coastal/inland shipping▪ LNG order book has registered 10% growth as compared to Sep'14, container category added 10 out of 18 orders for period Oct'14- Jan'15	<ul style="list-style-type: none">▪ Passenger and ro-ro categories have decisively moved towards scrubbers as compliance▪ LNG has been adopted primarily by passenger category▪ Global oil prices drop has affected scrubbers and LNG order book negatively▪ MGO has been immediate compliance option

Stricter sulphur regulations are due enforcement by 2020, and they will affect three major trade routes US-Europe, US-Asia & Europe-Asia

An overview of Emission Control Areas (ECA) and regulation timelines for sulphur content in marine fuels (in percentage)



- North Europe, Baltic sea & USA are 0.1% SECA zone with effect from 2015
- Rest of world shall have 0.5% Sulphur limits with effect from 2020, however timelines are not yet final. Decision will be made in 2018
- Tokyo bay, Panama, Canada, Mediterranean are also being considered for SECA
- All the services on 3 major trade routes will be most affected viz, US-Asia, US-Europe, & Europe- Asia
- Vessel owners have to go for alternate fuels in SECA regions, as currently used bunker fuel (HFO) has higher sulphur emissions

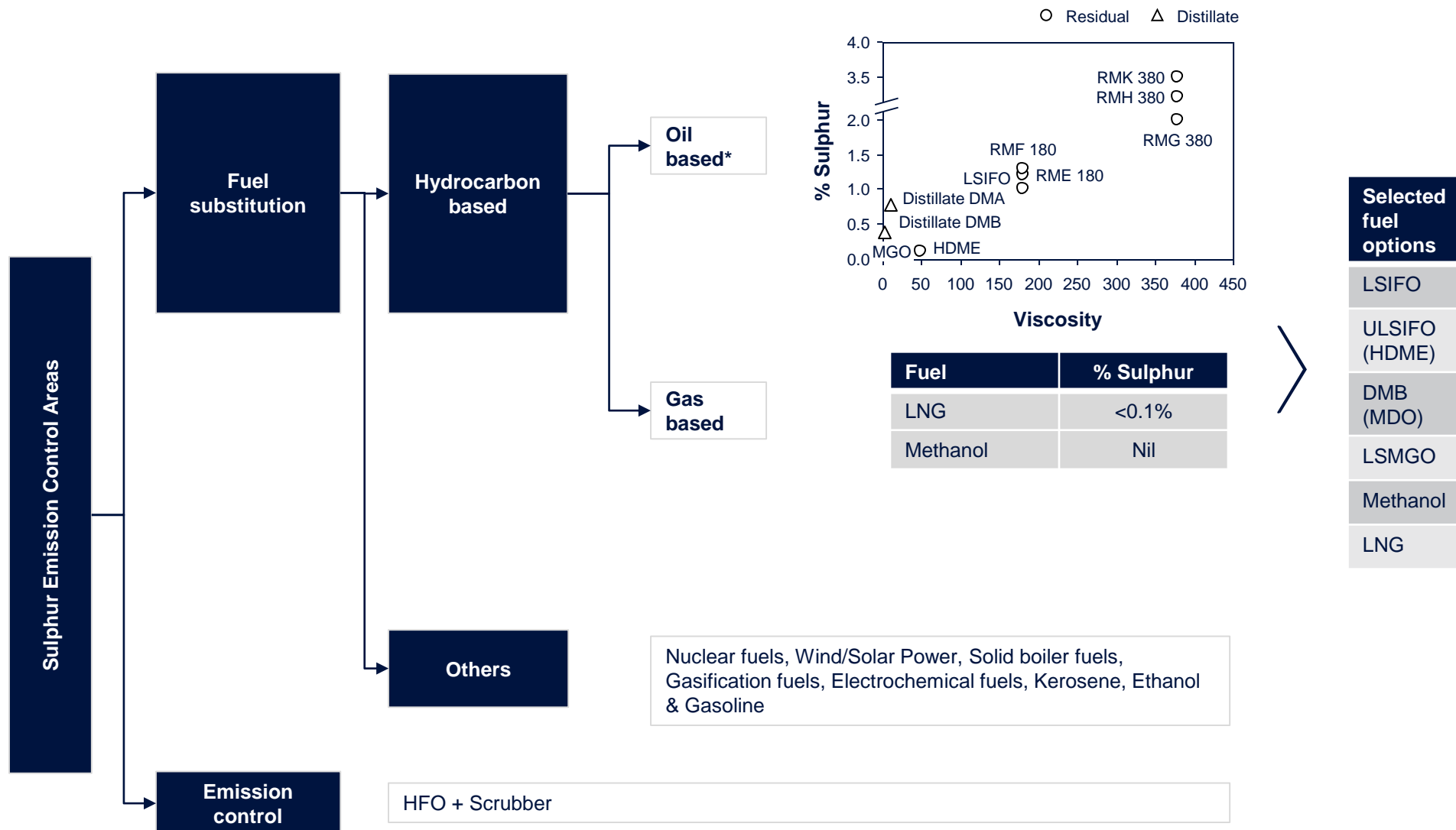
- 1 Panama Canal
 2 Strait of Gibraltar
 3 Suez Canal
 4 Strait of Malacca

* : Critical shipping points are globally strategic maritime passages, through which international vessels have to pass to traverse intercontinental routes

SECA : Sulphur emission control areas

3 | Source: IMO, MARPOL, MEC Intelligence Analysis

SECA regulations can be met by 13 fuel options either by substitution or with emission control equipment with HFO, the dominant marine fuel option today



Note: * Oil based fuels are selected on the basis of sulphur content <0.5% & low viscosity. Gas based fuels are selected on the basis of availability and technology maturity

Out of available alternate fuels, 7 fuels remain relevant in 2015 while for global ECA due in 2020/25 only 4 fuels shall be eligible

Fuel type	Compliance Option	Applicability in 2015*		Applicability in 2020*		Comments
		EU	Global	EU	Global	
Oil Based	Low Sulphur IFO LSIFO 180, LSIFO380	✗	✓	✗	✗	<ul style="list-style-type: none"> Sulphur emissions between 0.5-1% High availability and actively traded as a bunker fuel No technology addition required on vessel
	Ultra Low Sulphur IFO**	✓	✓	✓	✓	<ul style="list-style-type: none"> Sulphur emissions less than 0.1% High availability but not traded actively as a bunker fuel No technology addition required on vessel
	HFO/IFO 380	✗	✓	✗	✗	<ul style="list-style-type: none"> Sulphur emissions between 1.5%-4.5% High availability and actively traded as a bunker fuel Scrubber technology to be added to be SECA compliant
	DMB Marine Diesel Oil (MDO)	✗	✓	✗	✗	<ul style="list-style-type: none"> Sulphur emissions between 1%-2% High availability and actively traded as a bunker fuel No technology addition required on vessel
	Low Sulphur Marine Gas Oil (LSMGO)	✓	✓	✓	✓	<ul style="list-style-type: none"> Sulphur emissions less than 0.1% Actively traded as a bunker fuel Chiller and cooler technology addition required on vessel
Natural Gas based	Methanol	✓	✓	✓	✓	<ul style="list-style-type: none"> No Sulphur emissions Low availability and not traded actively as a bunker fuel Methanol handling specific (dual fuel engine, tanks) technology addition required on vessel
	Liquefied Natural Gas (LNG)	✓	✓	✓	✓	<ul style="list-style-type: none"> Sulphur emissions less than 0.03% High availability but not traded actively as a bunker fuel LNG handling specific (dual fuel engine, LNG tanks) technology addition required on vessel

* : Applicability means that fuel complies with the SECA norms (2015 : 0.1% in EU, 3.5% Globally & 2020 : 0.1% in EU & 0.5% globally)

** : Recently introduced (July 2014) by Exxon Mobil (named HDME)

Note : As marine fuels in particular should be available everywhere in the world; rare, experimental or exotic fuels not practical, economical or safe for ships are not included in this whitepaper. These include- Nuclear fuels, Wind/Solar Power, Solid boiler fuels, Gasification fuels, Electrochemical fuels, Kerosene, Ethanol & Gasoline

Based on cost, availability & fuel price, MGO, HFO+ Scrubber and LNG are the most promising fuel solutions

 Strong Driver

Marine fuel preference matrix for SECA compliance

Fuel Options		Marine Gasoil	HFO & Scrubber combination	LNG
Investment Parameters				
Cost	OPEX	MGO ~50% costlier than HFO	Cheaper HFO can be used with ~20% opex increase due to scrubber	O&M 10% higher than reference HFO vessels
	CAPEX	No significant spend ;less than \$1m	\$6-7 m per vessel	\$20-30 m more than a HFO vessel
Availability	Bunkering	Bunkering infrastructure available	Sufficient bunkering infrastructure and product availability	Insufficient bunkering infrastructure with high CAPEX*
	Product	Probable supply insufficiency for global limits in 2020/25		Sufficient product availability
Fuel Price		Ranges from \$12-14 per MMBtu**	Currently ranges \$8-\$9 per MMBtu	Hub based regional pricing Ranges \$7-\$17 per MMBtu
Revenue lost due to additional infra		Not significant	0.3% cargo volume lost	2-3% cargo volume loss



- MGO is one of the best compliance options, however supply sufficiency towards 2020 is a concern
- Scrubber technology is promising, technical viability across categories would impact mass adoption
- LNG could be optimal long term compliance fuel based on fuel price contracting strategy on select routes







* : LNG barge (3000 m³) costs ~\$35m; Small scale terminal (10,000 m³) costs ~\$110m

** : Calculated as 1 \$/ton HFO = 0.0267 \$/MMBtu, 1 \$/ton MGO = 0.0251 \$/MMBtu, 1 \$/ton LNG = 0.0218 \$/MMBtu

Executive Summary

	<u>Observations</u>	<u>Conclusions</u>
ECA and its implications	<ul style="list-style-type: none">▪ Stricter sulphur regulations are due enforcement by 2020, and they will affect three major trade routes US-Europe, US-Asia & Europe-Asia▪ SECA regulations can be met by 13 fuel options either by substitution or with emission control equipment with HFO, the dominant marine fuel option today▪ Out of available alternate fuels, 7 fuels remain relevant in 2015 while for global ECA due in 2020/25 only 4 fuels shall be eligible	<ul style="list-style-type: none">▪ Based on cost, availability & fuel price, MGO, HFO+ Scrubber and LNG are the most promising fuel solutions▪ MGO is one of the best compliance options, however supply sufficiency towards 2020 is a concern▪ Scrubber technology is promising, technical viability across categories would impact mass adoption▪ LNG could be optimal long term compliance fuel based on fuel price contracting strategy on select routes
Market response	<ul style="list-style-type: none">▪ 160 number of vessels have ordered scrubbers as compliance measure until 31st Jan 2015▪ Scrubber orders have increased at ~19% during Oct'14-Jan'15 as compared to 125% for period Mar'14-Sep'14▪ LNG propelled fleet count would be 130 by 2018 including 52 vessels in operation with reach limited to coastal/inland shipping▪ LNG order book has registered 10% growth as compared to Sep'14, container category added 10 out of 18 orders for period Oct'14- Jan'15	<ul style="list-style-type: none">▪ Passenger and ro-ro categories have decisively moved towards scrubbers as compliance▪ LNG has been adopted primarily by passenger category▪ Global oil prices drop has affected scrubbers and LNG order book negatively▪ MGO has been immediate compliance option

Compliance strategy of top players in 6 categories was studied based on time spent in ECA with combined fleet of ~5000 vessels

Category	Time in ECA	Size Range	Indicative Illustration
Feeder Container	Up to 100%	<ul style="list-style-type: none"> Up to 3000 TEU 	
Deep sea Container	Up to 30%	<ul style="list-style-type: none"> 3000-15000 TEU 	
Bulk Carrier	Up to 30%	<ul style="list-style-type: none"> All sizes included 	
Tanker*	Up to 30%	<ul style="list-style-type: none"> All sizes included 	
Passenger	Up to 30%	<ul style="list-style-type: none"> All sizes included 	
Ro-Ro Vessel	Up to 100%	<ul style="list-style-type: none"> 1000 cars and above 	

Note: * Tanker category includes crude oil tankers, product tankers and chemical carriers
 Source: DNV GL, News articles, MEC Analysis

Scrubbers have been ordered for 160 vessels, primarily passenger and ro-ro categories; order activity negatively impacted by global oil prices drop

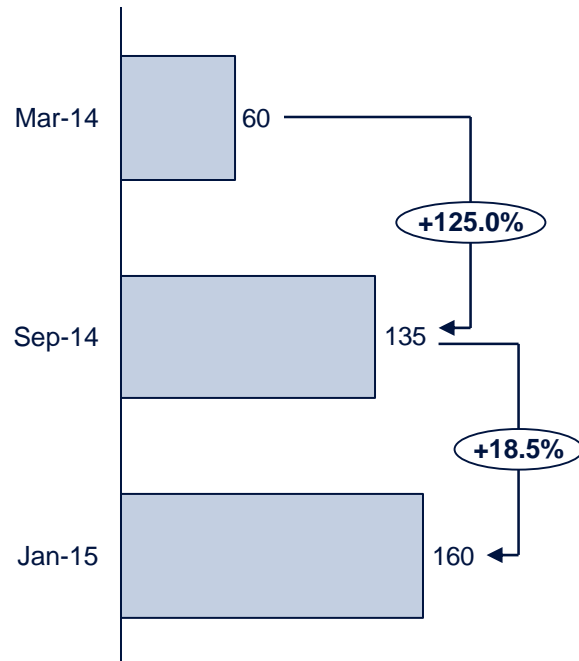
Scrubber order growth slowed down for period Oct'14-Jan'15 to ~19% as compared to 125% for period Apr'14-Sep'14

Ordered fleet
Number, Time

Drivers

Inhibitors

Key orders



- Technology maturity for passenger and ro-ro category
- Next competitive fuel MGO was ~50% costlier

- Technically not fit for all categories such as containers

- Carnival Corporation increasing order from 32 vessels to 70 vessels
- Finnlines 6 Ro-Ro vessels
- Solvang 6 Large gas carriers

- Concerns regarding supply shortage of MGO

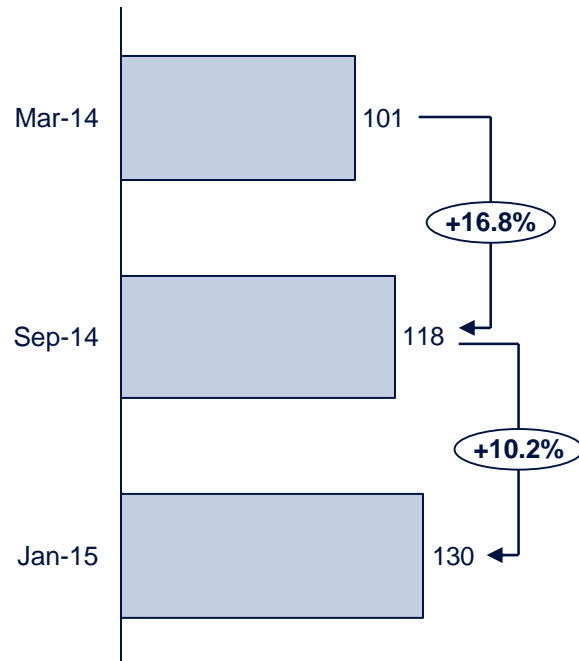
- Oil prices dropped by ~50% since Sep'14 making MGO attractive

- Royal Caribbean 13 number passenger vessels

LNG has been chosen by 130 vessels as compliance option, reach remains limited to coastal and inland shipping

LNG order book has not changed much during the period Sep'14- Jan'15; key contributor to the order book has been containerships with 10 new orders during the period

Ordered fleet Number, Time



Drivers

- Technology maturity for short sea vessels- passengers, tugs and PSV
- EU grants and infrastructure support programs such as TEN-T

- Container category showed confidence, order book increased from 8 to 18 during the period

Inhibitors

- Limited bunkering infrastructure availability
- 20-30% higher capex*
- Deep sea technology not proven

- Oil prices dropped by ~50% since Sep'14 making MGO attractive

Order activity

- Universal Marine ordered 6 number container vessels
- BC Ferries number Car/passenger ferries

- Ocean Yield ordered 6 gas carriers
- Universal Marine ordered 4 number container vessels
- Brittany Ferries cancelled order for 4 vessels

Appendices

Order book-LNG

Company	Category	Number of vessels	Delivery schedule					Orders till Mar'14	Orders between Mar'14-Sep'14	Orders between Sep'14-Nov'14
			2014	2015	2016	2017	2018			
Universal Marine	Container ship	18	0	3	7	6	2	8	6	4
Harvey Gulf Int.	PSV	14	5	7	2	0	0	14	0	0
BC Ferries	Car/passenger ferry	13	6	0	6	1	0	8	3	2
Ocean Yield	Gas carrier	8	2	3	3	--	--	2	0	6
Terntank	Oil/chemical tanker	7	1	0	3	3	0	2	2	3
Norlines	Ro-Ro	7	4	0	3	0	0	6	1	0
Østensjø Rederi	Tug	7	2	2	0	3	0	1	3	3
Evergas	LEG carrier	6	0	3	3	0	0	3	3	0
UECC	Car carrier	2	0	0	2	0	0	2	0	0
Egil Ulvan Rederi	General cargo	2	2	--	--	--	--	2	0	0
--		--	--	--	--	--	--			

Order book-LNG (continued)

Company	Category	Number of vessels	Delivery schedule					Orders till Mar'14	Orders between Mar'14-Sep'14	Orders between Sep'14-Nov'14
			2014	2015	2016	2017	2018			
Rederi AB Gotland	RoPax	2	0	0	0	2	0	1	0	1
Finish Border Guard	Patrol vessel	1	1	0	0	0	0	1	0	0
Erik Thun	Bulk ship	1	0	1	0	0	0	1	0	0
Bergen Tankers	Product tanker	1	1	0	0	0	0	1	0	0
Finnish Transport A.	Icebreaker	1	0	0	1	0	0	1	0	0
Total deliveries		90*	24	19	30	15	2	53	18	19

Note: * Data updated on 4th Dec'14, includes vessels delivered and due delivery in 2014
 13 | Source: DNV GL, News articles, MEC Analysis

Order book-scrubbers

Company	Category	Number of vessels	Delivery schedule					Orders till Mar'14	Orders between Mar'14-Sep'14	Orders Sep'14 onwards
			2014	2015	2016	2017	2018			
Carnival	Passenger	70*	27	0	43	0	0	32	38	0
DFDS A/S	Ro-Ro	21	10	11	0	0	0	21	0	0
Unknown	Unknown	21	0	0	21	0	0	0	21	0
Royal Caribbean	Passenger	15**	0	6	7	--	--	2	0	13
Finnlines	Ro-Ro	6	0	6	0	0	0	0	6	0
Solvang ASA	Large gas carrier	6	0	0	6	0	0	0	6	0
Spliethoff	Con-Ro	5	5	0	0	--	--	5	0	0
Unknown	Unknown	4	0	2	2	0	0	0	0	4
Horizon Lines	Container	3	0	0	3	0	0	0	0	3
Dorian LPG	VLGC	2	0	0	2	0	0	0	2	0
---		--	--	--	--	--	--			


Note: * Carnival announced increasing investments from 32 vessels to 70% of its fleet into scrubbers

** 2 vessels already converted to scrubber system in 2012

Order book-scrubbers (continued)

Company	Category	Number of vessels	Delivery schedule					Orders till Mar'14	Orders between Mar'14-Sep'14	Orders Sep'14 onwards
			2014	2015	2016	2017	2018			
Hyundai Mipo	Tankers	2	0	0	2	0	0	0	0	2
Wilhelmsen Lines	Ro-Ro	2	0	0	2	0	0	0	2	0
Interlake Steamship Company	Bulk ship	2	0	2	0	0	0	0	0	2
Stena Ro-ro	Ro-Ro	1	0	1	0	0	0	0	0	1
Total deliveries		160	42	28	90	0	0	60	75	25

Companies used in the survey

Passenger		Container*		Ro-Ro	
Company	Fleet	Company	Fleet	Company	Fleet
	7		574		26
	101		428		11
	21		116		NA
	11		150		14
	12		154		33
	11		465		25
	41		11		57
	40		104		11
	18		28		22
	7		54		59






Note: * Same companies were studied separately for deep sea and short sea

Companies used in the survey

Tankers*

<u>Company</u>	<u>Fleet</u>
	43
	37
	153
	20
	44
	49
	55
	430
	17
	72

Bulk ships

<u>Company</u>	<u>Fleet</u>
	15
	45
	41
	28
	28
	NA
	NA
	128
	415
	NA