

Statistical analysis of the energy efficiency performance (EEDI) of new ships

built in 2013-2017

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Executive Summary

Statistical analysis of the IMO's EEDI database concluded that a substantial share of the new build fleet already complies and over-complies with current and future (2025) design efficiency requirements. Notably, 71% of containerships, 69% of general cargo ships, 26% of tankers and 13% of gas carriers already comply with the 2025 EEDI requirement (i.e. -30% reduction compared to reference line). For bulk carriers, however, this share is less than 1%.

Additionally, the study reveals that the top 10% of the best ships in each class category are doing far better than the average new ships in the fleet. Notably, the average performance of the best (top 10%) ships is around 58% for containerships, 57% for general cargo ships, 42% for gas carriers, 35% for oil tankers and 27% for bulk carriers relative to the reference line (Fig. 1). For this reason, the study recommends that the revision of existing EEDI targets and the setting of future design standards should be based on the performance of the 10% best ships in each segment.

Figure 1. The performance of the best 10% ships relative to current and future (2025) requirements

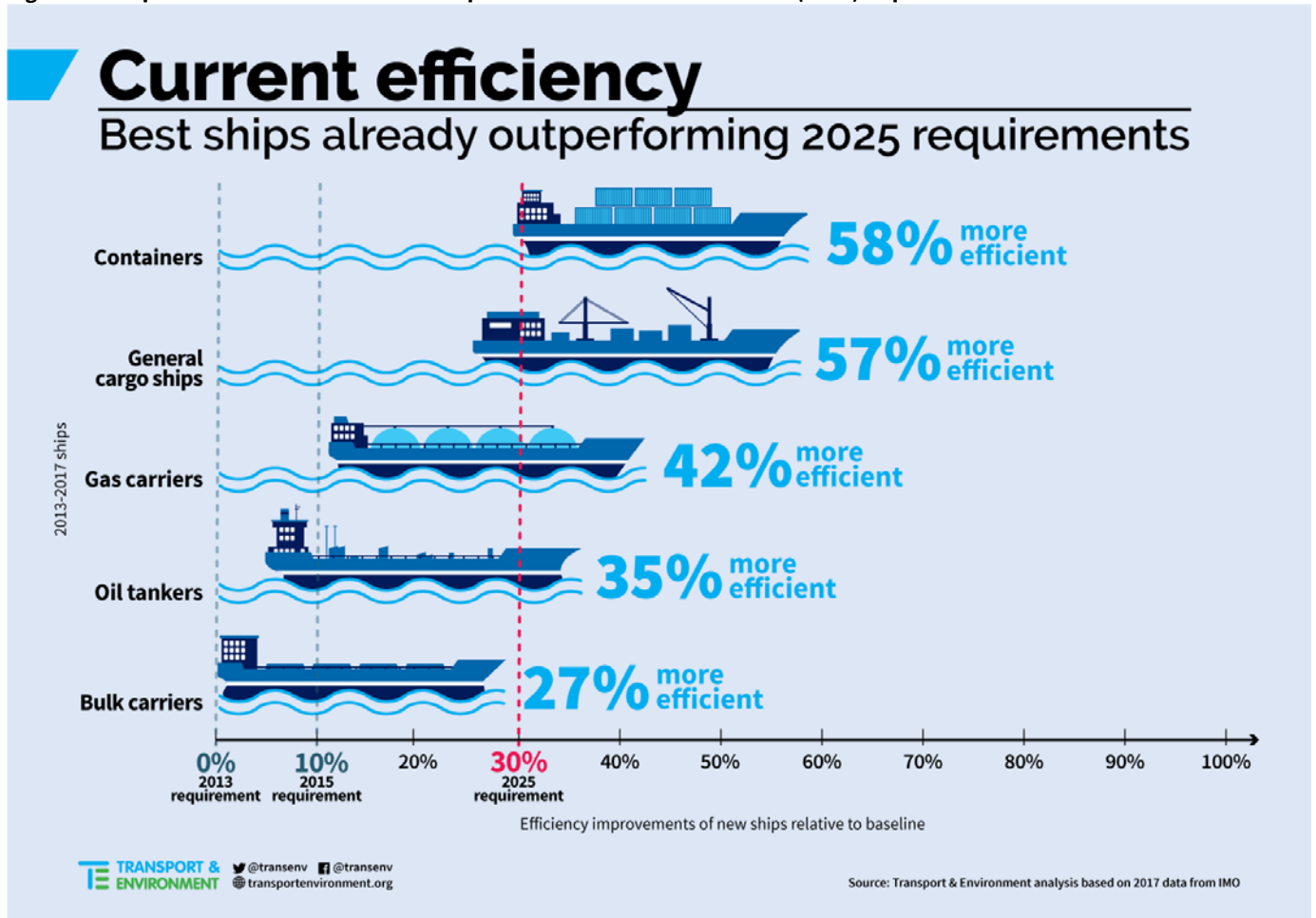


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1. Introduction

The International Maritime Organisation agreed in 2011 on a design standard, known as Energy Efficiency Design Index (EEDI), to apply to new ships built from 2013. The standard has a baseline - the average efficiency of ships built between 1999-2009 - and sets the maximum amount of CO₂ permitted per ship type and size in order to carry a unit of transport work (i.e. gCO₂/tonne-mile). To incentivise the future design efficiency of new ships, the IMO regulation sets 3 targets, known as phases, each progressively requiring less energy (and thus CO₂) to perform the same amount of transport work.

EEDI targets for new ships:

- Phase 0 - ships built between 2013-2015 are required to have a design efficiency at least equal to the baseline.
- Phase 1 - ships built between 2015-2020 are required to have a design efficiency, at least, 10% below the reference line.
- Phase 2 - ships built between 2021-2025 are required to have a design efficiency, at least, 20% below the reference line.
- Phase 3 - ships built after 2025 are required to have a design efficiency, at least, 30% below the reference line.

Smaller ships are either exempted or have less stringent requirements.

The IMO's EEDI regulation also includes a clause, requiring the periodic review of achieved efficiencies and, if appropriate, to revise the required targets. The first review began in 2015.

As part of this process, the IMO set up a number of correspondence groups (CG) to analyse the achieved efficiencies and make any needed recommendations to the IMO's Marine Environment Protection Committee (MEPC). Despite overwhelming evidence of over-compliance of Phase 0 and 1 ships (i.e. those built in 2013-2017) with Phase 2 targets several years in advance presented to the CG in 2016, the Group failed to recommend to the MEPC to tighten the Phase 2 targets on the argument that changing the 2020 requirement would give industry too little time to react. Instead, a proposal was tabled to bring forward the Phase 3 target (-30%) three years; from 2025 to 2022. In order to provide information to inform the decision-making process, the IMO secretariat released progressive updates of a database containing anonymised EEDI efficiency scores achieved by individual ships together with reported information on any new/innovative technologies utilised.

2. Methodology

Transport & Environment, a founding member of the Clean Shipping Coalition (CSC), carried out an in-house statistical analysis of ships contained in the IMO EEDI database, which included both those ships with a mandatory requirement to have an EEDI and those which compiled on a voluntary basis. In total 2452 EEDI scores were available for analysis covering five main ship categories responsible for around 65% global ship emissions (Fig. 2), namely bulk carriers, container ships, tankers, gas carriers and general cargo ships.

However, for consistency purposes, T&E's analysis was limited to only those ships having a mandatory EEDI requirement, i.e. 2058 ships in the 5 different class categories.

Table 2: Number of ships in the IMO database

Ship Type analysis 2011-2017 inclusive	Bulk Carriers	Container Ships	Tankers	Gas carriers	General	Total
Number of ships in mandatory phase	1087	258	540	141	32	2058
Number of ships in non-mandatory phase	111	102	151	19	11	394
Total number of ships in all phases	1198	360	691	160	43	2452

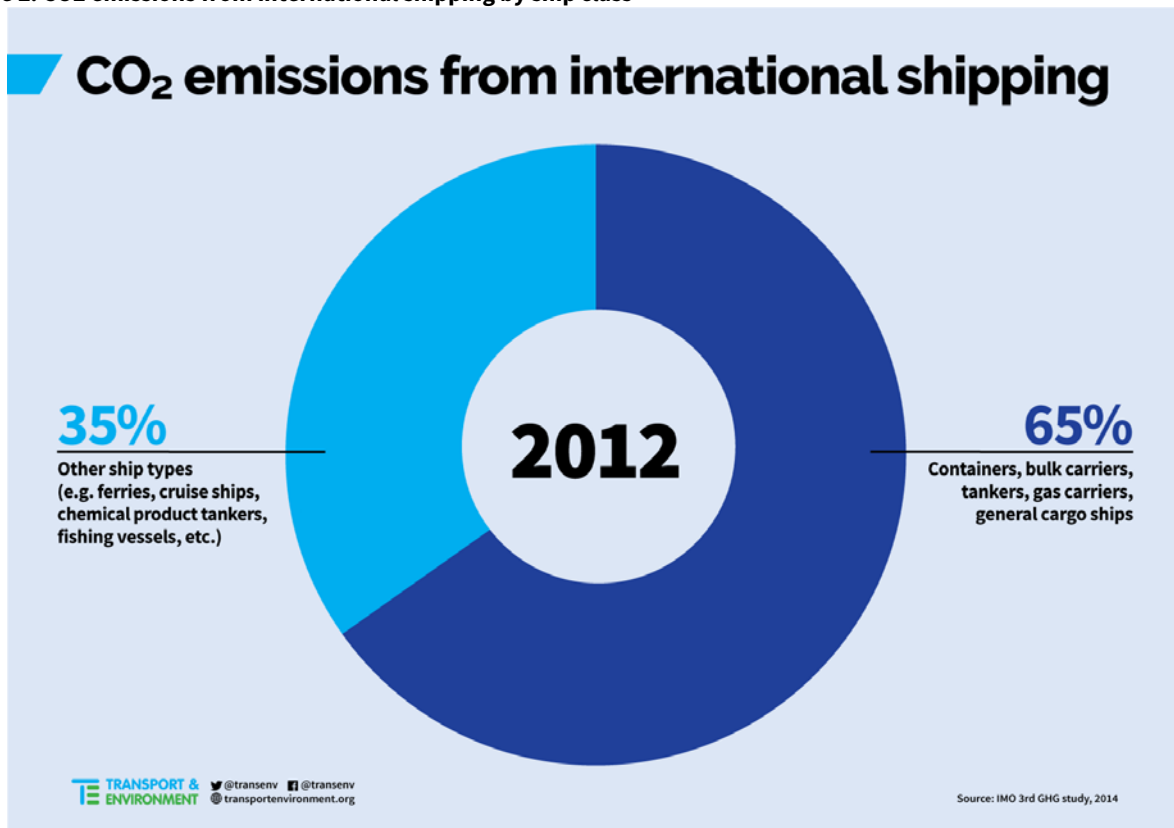
Source: T&E analysis based on IMO data

The following key indicators were used in order to analyse the EEDI performance of new ships:

- Average distance to reference line of the 10% best performing ships in each ship class category
- Median distance to reference line of each ship class category
- Share of ships in each class category already meeting Phase 3 requirements
- Share of ships in each class category using innovative technologies expressed in 4th and 5th terms of the EEDI formula
- Difference in energy efficiency performance of ships with and without 4th/5th term technologies in each ship class category

Of particular importance is the analysis of the EEDI values of the 10% best performing ships in each class category. Our methodology is based on the Japanese Top Runner program, which identifies existing achievements and future targets on the basis of both the efficiency of the best-in-class in the current market and an analysis of the impact of innovations (METI, 2015).

Figure 2: CO2 emissions from international shipping by ship class



3. Key findings

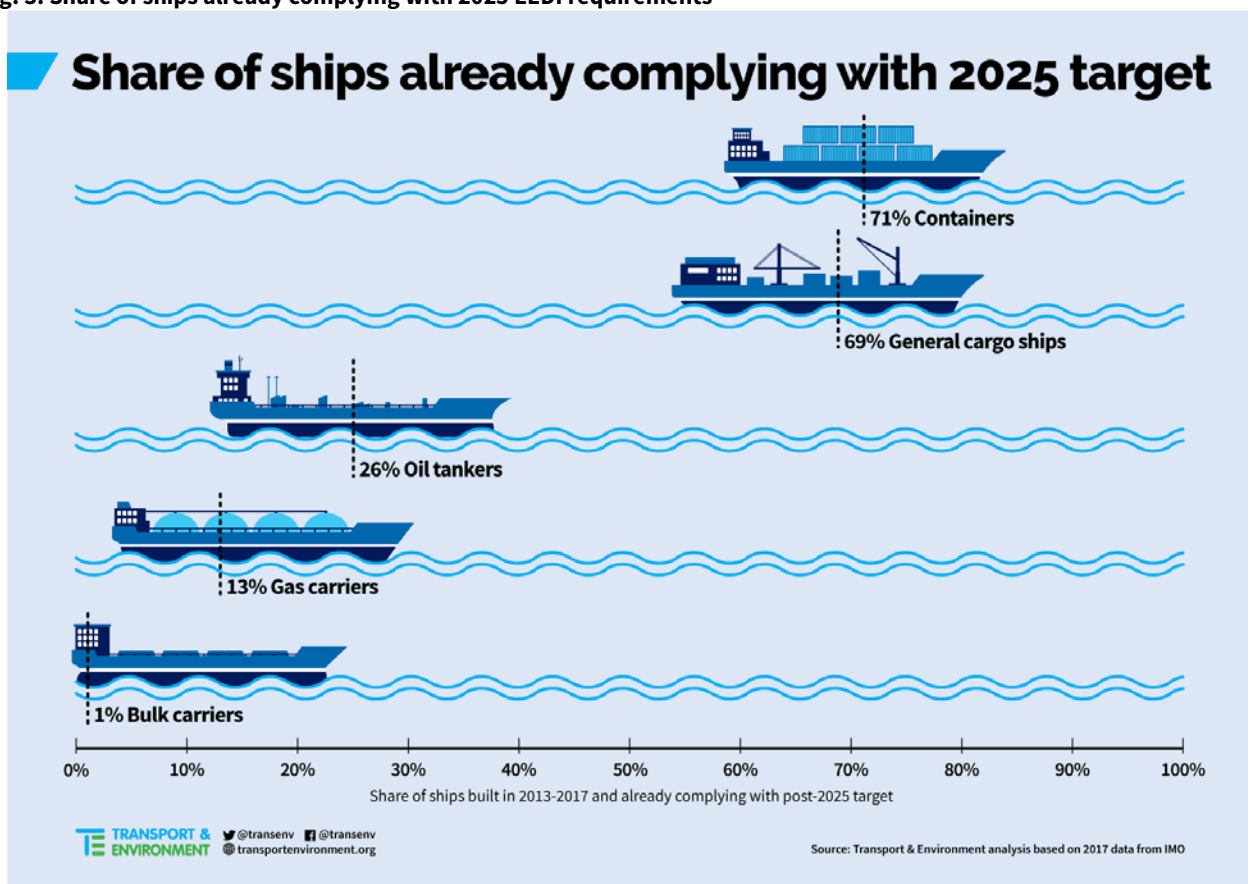
Key conclusions of the report in each ship category is presented in table 3 and figure 3.

Bulk carriers - A total of 1087 bulk carriers built between 2013 and 2017 and falling under the phase 0 and phase 1 of the EEDI were analysed. Key findings:

- The average performance of the 10% market leaders was 27% below (i.e. better than) the reference line.
- Median distance of all bulk carriers to the respective reference line was 20%.
- Less than 1% of bulk carriers built between 2013-2017 already met the phase III (-30%) (2025) target.

No ship in this category reported using innovative mechanical or electrical technologies to achieve current efficiencies. This suggests that there is scope for further improvements if available energy saving technologies are used.

Fig. 3: Share of ships already complying with 2025 EEDI requirements

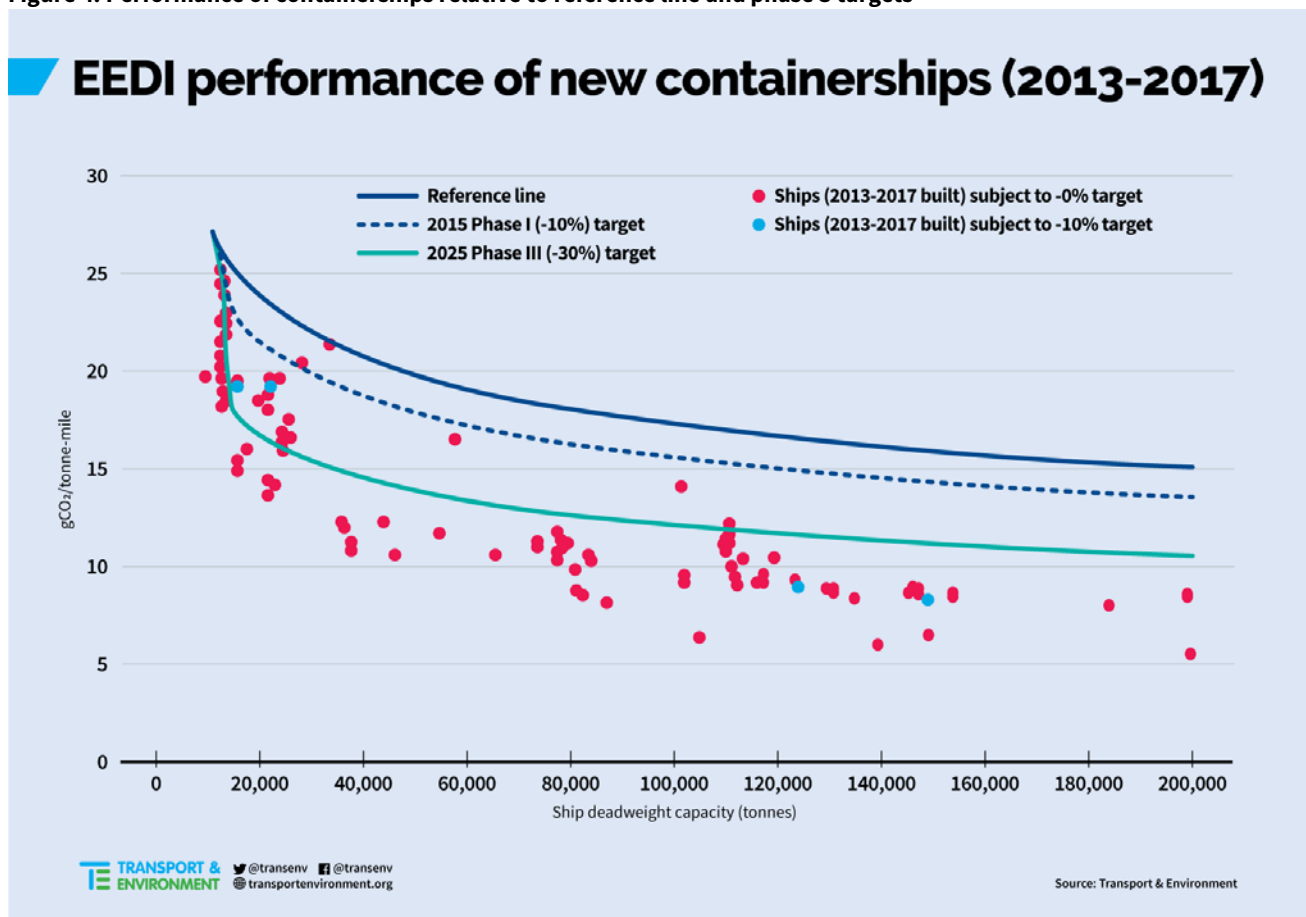


Container ships - A total of 258 container ships built between 2013 and 2017 and falling under phase 0 and phase 1 of the EEDI were analysed. Key findings:

- The average performance of the 10% market leaders was 58% below (i.e. better than) the reference line. The market leaders over-complied with the Phase III (-30%) target on average 10 years early and almost by a factor of 2 (Fig. 4).
- Median distance of all containerships to the respective reference line was 43%.
- More than 71% of containerships built between 2013-2017 already met the phase III (-30%) (2025) target.

- Only 9% of ships in this category reported the use of innovative mechanical or electrical technologies to achieve current efficiencies. This suggests that there is still considerable scope for further efficiency improvements if available technologies are more widely taken up by the rest of the container fleet.
- Furthermore, **Table 4** indicates that ships that reported using innovative technologies had on average a 14% lower (i.e. better) EEDI than those not using them. For the biggest ships (above 200,000 DWT) the improvements are over 30%.

Figure 4: Performance of containerships relative to reference line and phase 3 targets



Tankers - A total of 540 tankers built between 2013 and 2017 and falling under the phase 0 and phase 1 of the EEDI were analysed. Key findings:

- The average performance of the 10% market leaders was 35% below (i.e. better than) the reference line, indicating considerable over-compliance with the Phase III (-30%) target on average 10 years early.
- Median distance of all tankers to the respective reference line was 27%.
- More than a quarter of tankers built between 2013-2017 already met the phase III (-30%) (2025) target.
- No ship in this category reported the use of innovative mechanical or electrical technologies. This suggests that there is scope for further improvements if available energy saving technologies are used.

Gas carriers - A total of 141 gas carrying ships built between 2013 and 2017 and falling under the phase 0 and phase 1 of the EEDI were analysed. Key findings:

- The average performance of the 10% market leaders was 42% below (i.e. better than) the reference line, indicating considerable over-compliance with the phase 3 (-30%) targets on average 10 years earlier.
- Median distance of all gas carriers to the respective reference line was 24%.
- Around 13% of gas carriers built between 2013-2017 already met the phase 3 (-30%) (2025) target.
- No ship in this category reported the use of innovative mechanical or electrical technologies to achieve current efficiencies. This suggests that there is scope for further improvements if available energy saving technologies are used.

General Cargo Ships - A total of 32 general cargo ships (representing the minimum sample size for statistical analysis) built between 2013 and 2017 and falling under the phase 0 and phase 1 of the EEDI were analysed. Key findings:

- The average performance of the 10% market leaders was 57% below (i.e. better than) the reference line, indicating considerable over-compliance with the phase 3 (-30%) target on average 10 years earlier.
- Median distance of all general cargo ships to the respective reference line was 50%.
- Around 69% of general cargo ships built between 2013-2017 already met the phase 3 (-30%) (2025) target.
- No ship in this category reported the use of innovative mechanical or electrical technologies to achieve current efficiencies. This suggests that there is scope for further improvements if available energy saving technologies are used.

Table 3: Performance of bulkers, containerships, tankers, gas carriers and general cargo ships

Ship Types analysis from 2013 to 2017, inclusive		Bulk Carriers	Container Ships	Tankers	Gas carriers	General cargo
Total number of ships in mandatory phase		1087	258	540	141	32
Distance to EEDI reference line	Mean	20%	40%	26%	25%	48%
	Median	20%	43%	27%	24%	50%
Share with EEDI 30% under reference line		<1%	71%	26%	13%	69%
Share of ships with innovative technology		0%	9%	0%	0%	0%
Average distance to EEDI reference line of top 10%		27%	58%	35%	42%	57%

Source: T&E analysis based on IMO data

Table 4: Statistical analysis of containerships by size categories

Size category (DWT)	10000–19999	20000–59999	60000–79999	80000–119999	120000–199999	200000–+
Total number of ships in mandatory phase ¹	39	58	21	79	50	10
Average DWT of ships in size bin	13718	29397	76500	105241	152730	200950
Mean EEDI	19.7	16.0	10.8	9.7	8.0	7.4
Mean EEDI distance to reference	31%	29%	41%	43%	49%	50%
Mean EEDI (with technology)	N/A	N/A	N/A	10.3	6.4	5.4
Mean EEDI (without technology)	19.7	16.0	10.8	9.6	8.2	7.9
Technology improvement	N/A	N/A	N/A	-8%	22%	32%

Source: T&E analysis based on IMO data

4. Conclusions and Policy recommendations

Analysis of the IMO EEDI database reveals that with the exception of bulk carriers a large share of ships in all class categories already comply with the 30% improvement required by the Phase 3 target on average a decade in advance. Less than 1% of bulk carriers comply with the Phase III targets. However, the performance of the top 10% market leaders among bulk carriers almost meets the phase 3 requirements. Given that no bulk carrier has reported the use innovative electrical and/or mechanical energy saving technologies, there is considerable scope for further improvement in this category of ships. This also applies to all major ship types, of which only 9% of containerships have reported the use of innovative technologies.

Therefore, in order to incentivise development and deployment of further energy saving technologies and innovative ship designs, the revision of existing and setting of future design standards should be based on the performance of the 10% best ships in the market.

¹ The IMO database included 1 container ship with DWT less than 10,000 tonnes, which is the minimum threshold for the data presented in Table 4.