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POLICY BRIEF

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IMO Short-term Measures: A Review of the Carbon Intensity Indicator (CII)

The Carbon Intensity Indicator (CII) is one of the short-term measures introduced by the International Maritime Organization (IMO) to reduce greenhouse gas emissions from shipping. This policy brief reviews the measure and provides improvement recommendations, focusing on how emission standards at sea and at port should be dealt with.

Background

The maritime industry facilitates over 85% of global goods trade, in volume terms, while contributing 2.1%, on a well-to-wake basis, of global greenhouse gas (GHG) emissions[1]. The International Maritime Organization (IMO) has established a target to achieve net-zero emissions from international shipping by or around 2050[2]. The report focuses on one of the IMO's short-term measures, the Carbon Intensity Indicator (CII). As the adoption of IMO's Net-Zero Framework (NZF) is now uncertain, it is not within the scope of this report.

The CII aims to ensure continuous improvement of a ship's operational carbon intensity[3]. It came into effect on 1 January 2023 and applies to ships of 5,000 gross tonnage and above[3]. Other regulations, such as the Energy Efficiency Design Index (EEDI) and the Energy Efficiency Existing Ship Index (EEXI), consider vessel design and retrofitting but cannot incentivise operational improvements[4,5].

As is shown in Box (1), CII is calculated as the vessel's carbon dioxide (CO_2) emissions divided by its transport capacity times the distance travelled[6]: Based on its CII, a vessel is rated A, B, C, D or E (where A is the best). To comply with the IMO's CII, vessels need to be rated C or above. If they are rated with D for three consecutive years or E for one year, vessels need to submit a corrective action plan[3].

Box. 1. CII Formulae

$$CII = \frac{CO_2}{Transport\ capacity \times Distance} \quad (1)$$

The 2023 IMO GHG Strategy sets out the levels of ambition to reduce GHG emissions and includes candidate mid- and long-term further measures with possible timelines and their impacts. The UK Government also has decarbonisation targets for the sector and has set a zero fuel lifecycle GHG emissions target for 2050[7].

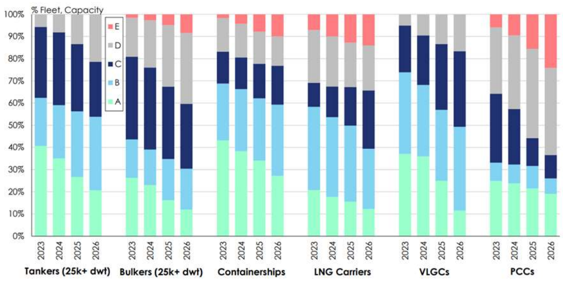
Key Highlights:

- CII is currently insufficient for capturing emissions accurately at sea and at port and incentivising emission reduction
- A range of revision options could be considered such as excluding port emissions, adjustments for time at port, or separate metrics for at sea and at port
- Other areas that could be considered include allowance for actual cargo, well-to-wake emissions, and pilot fuel

Recommended revision for CII is to use separate metrics for at sea and at port emissions.

Despite the internationally mandatory CII requirement, Figure 1 shows that CII ratings have been worsening in all shipping sectors since 2023. In other words, improvement of vessel energy efficiency and operations are not catching up with the stricter CII regulations over time[8]. The main reasons are that (i) there are not yet clear regulatory implications for non-complying vessels and (ii) the measure's design needs to be improved.

Figure 1. CII Ratings by Vessel Sector



Note: the statistics from 2025 onwards are predictions. Data source: [9]

The IMO is committed to regular review of the CII. Since the evidence points to the lack of effectiveness of the measure, we turn to some improvement options. Note though that no improvement is expected to yield significant emission reductions unless compliance is enforced.

Options to Improve the CII

One of the main areas of criticism about CII is the poor handling of port emissions. However, there are different definitions of port emissions (see Box (2)), and mixed views on whether to separate at sea (propulsion) and at port emissions. Four CII improvement options have been identified in the literature as follows:

1) Continue using the current CII that sums CO_2 emissions at sea and at port (as shown in Box 1)
2) Exclude port CO_2 emissions so that the CII reflects at sea emissions only
3) Add a correction factor such as converting the port waiting time to equivalent distance travelled
4) Have two separate metrics: one "at sea" and one "at port"

Box. 2. Definition of "at berth" emissions
The Fourth IMO GHG Study (2020)[10] uses an at berth definition for ships stationary less than or equal to 1 nautical mile (nm) of a port. For liquid tankers (chemical, liquified gas, oil and other liquids), this is within 5nm of a port.

The benefits and limitations of Options 1, 2, 3, and 4, (also summarised in Table 1 below) are discussed in the sections that follow.

Option 1 – "No Change"

The benefit of Option 1 is no increase in administrative burden or additional legislation requirements. However, it is widely considered as insufficient for achieving decarbonisation goals. This is because it wrongly accounts for the "at port" emissions[11-14].

This option also incentivises gaming behaviour, such as artificial increases in distances, e.g. detours[15,16]. Such behaviour improves the CII rating despite resulting in higher CO_2 emissions.

CII unfairly penalises for factors beyond the control of relevant stakeholders (ship operators, shipowners, ports and cargo owners). For instance, if a vessel is delayed at port, the CII rating worsens despite lower emissions since the vessel is not sailing[9].

Ship operators can also be penalised for complying with standard clauses in charter contracts[23], or factors such as vessel size[19,24,25], vessel type[26], and weather[22,24]. The CII benefits routes with stable and optimal speeds, which are typically longer routes, or vessels with stable contracts. For certain charter contracts and vessel types, such as containerships, "just-in-time" arrival does not always happen due to meeting contractual obligations[27]. Larger ships have smaller speed adjustment ranges[28], and smaller ships require greater power reductions and higher costs to comply[4,24].

CII does not consider voyage routes[17-19]. Certain routes have worse CII ratings, such as shorter ones with more time manoeuvring or idling[19-21], as well as those within Emission Control Areas (ECAs) due to low sulphur requirements that increase fuel consumption and emissions intensity[17,22].

Option 2 – "Exclude Port"

The benefits of Option 2 are administrative and legislative simplicity, and compliance in the case of uncontrollable delays.

In principle, CII is meant to incentivise improvement of a ship's operational carbon intensity. Port emissions, in various ways, are outside the control of ship owners, e.g. reliance on the energy efficiency of the port's operation system and on what alternative low carbon energy systems are available. This, instead, could be incentivised by e.g. enhanced energy monitoring platforms, automated operation system, and provision of onshore power supply (OPS).

Evidence suggests that port regulations can effectively reduce GHG emissions and air pollution at ports. For instance, the ports of Las Palmas, St. Petersburg, and Hong Kong have reduced sulphur emissions up to 96%, and fine particulate matter (PM2.5) up to 80% with stricter measures[29].

However, 10 to 20% of total fuel consumption CO_2 emissions are attributed to the time spent in and close to port[21,10,30], and for cruise ships this is almost 50%[9]. Emissions in and around ports can have significant impacts on the health of nearby communities[31,32]. Excluding ports from the CII means not accounting for a large fraction of emissions and therefore impact on the health and wellbeing of surrounding areas.

The current CII includes port emissions, which can effectively encourage the collaboration between ports, ship operators, shipowners, and cargo owners to reduce emissions[33]. For instance, the arrangement of "just-in-time" arrivals can reduce port waiting time and emissions[27,34].

There is a further concern that excluding port emissions will discourage collaboration for the

Table 1. Comparison of Options 1-4

Aspect	**Option 1 "No Change"**	**Option 2 "Exclude Port"**	**Option 3 "Adjust Port"**	**Option 4 "Separate Metrics"**
Administration	No increase in burden	Simple administration	Complex due to correction factors	Complex especially short-sea shipping
Legislation	No additional legislation	No additional legislation	Requires adjustment to current CII	Requires new framework for dual metrics
Emissions Representativeness	Poor – misrepresents port emissions	Poor - excludes port emissions	Partial – allows for port waiting time	High – differentiates between at-sea and at-port emissions
Gaming Risk	High – detours and distance inflation	Low	Medium – depends on accuracy of correction factors	Low
Alignment with Targets	Weak – considered insufficient	Weak – excludes port emissions	Moderate – improves fairness	Strong – holistic approach aligned with IMO NZF
Feasibility & Complexity	No change to current practices	Simple to implement	Moderate – data requirement issues	Complex – requires new reporting and monitoring
Health & Wellbeing	Negative – ignores local air quality impacts	Negative – excludes port emissions affecting communities	Limited – overlooks non-waiting port emissions	Positive – accounts for port emissions and supports well-to-wake principle
Collaboration Incentive	Discourages collaboration	May reduce collaboration between ports and ships	Encourages collaboration for just-in-time arrivals	Strongly incentivises holistic collaboration
Other notable points	Penalises uncontrollable factors (weather, ECAs, vessel size) Risk of carbon leakage	Lack of support for net-zero port initiatives	Risk of carbon leakage to shore emissions	Flexible compliance options, supports ETS and net-zero ports

ship-port and owner-charterer interfaces[35]. Therefore, this could also disincentivise vessel R&D for at-port operations.

Option 3 – "Adjust Port"

Option 3 is easier to implement than Option 4, as it only requires an adjustment. Option 3 encourages "just-in-time" arrivals. When the port waiting time is reasonably penalised, Option 3 could incentivise ship operators, shipowners, cargo owners, and ports to collaborate to reduce waiting time[27].

The aim of Option 3 is to adjust for unavoidable port delays such as port congestion, weather-related restrictions, and regulatory inspections[11,20,26]. Previous reports and studies suggest introducing a "port waiting time" as a correction factor[9,26] or converting port-stay carbon emissions into an equivalent sailing distance[11].

There are several limitations of Option 3 though. It poses administrative complexities since it is difficult to define "port waiting time". The CII already has several correction factors that confuse vessel operators[23]. Data unavailability is a main challenge to apply accurate correction factors[36,37]. Lack of accuracy could still incentivise gaming behaviours, such as detours.

Similar to Option 1, Option 3 narrowly defines port decarbonisation as reducing the vessel emissions at port, which could lead to carbon leakage to onshore emissions. Because Option 3 suggests correcting for waiting time, it can overlook port emissions from other non-waiting activities, such as cargo handling, dredging, manoeuvring support, tank cleaning, and bow thruster use[23].

Option 4 – "Separate Metrics"

The analysis above suggests that it is not appropriate for a single CII metric to simultaneously capture at sea and at port emissions.

Compared to Option 3, Option 4 provides a holistic coverage and incentivises port decarbonisation[12,21,22]. This option better aligns with the recent IMO proposal to consider well-to-wake emissions in the NZF.

Combined with other policies (e.g. extending emissions trading schemes (ETS) to maritime and potential net-zero ports legislation), Option 4 provides more options and wider scope for stakeholders to collaborate on decarbonisation[21,38-42]. For example, in terms of cold ironing (shore power), optimisation of port operations to minimise idle times, and reducing cargo-handling emissions.

By differentiating between at sea and at port emissions, Option 4 allows for more accurate monitoring of a ship's operational performance and the part(s) where corrective action may need to be taken. Flexibility is one of the essential reasons for relatively low costs and wide acceptance of the CII, as shipowners and ship operators can choose from a variety of operational and investment options for compliance with it[43,44]. When stakeholders are given options to comply in a holistic ecosystem, port decarbonisation can be faster and more economical[40].

A limitation of Option 4 is the added administrative burden. This is especially the case for short-sea shipping which is associated with numerous port calls.

Recommendation

The authors recommend implementing Option 4: Separate at-sea and at-port CII metrics.

How to Implement Option 4

There are 3 areas to support the implementation of Option 4: data collection and sharing; need to reflect different scenarios; and collaboration.

a) Data collection and sharing

There is insufficient live data to enable low-cost implementation of Option 4. Little data is publicly available for vessel emissions especially at small ports.

Automated data collection systems are required for effective and low-cost implementation of port decarbonisation[34,40,45]. To reduce administrative costs, it is important to enable real-time CII tracking for each vessel and collecting operational data at the end of each voyage as well as at port[16,46-49]. Currently, there are relatively advanced information systems in shipping, such as the automatic identification system (AIS) and IMO data collection system (DCS)[27,34]. In the future, and where appropriate, regulators may also use technologies such as blockchain to ensure security, data integrity and traceability[16].

Encouraging public disclosure of vessels' CII could enhance data transparency[20,35].

b) Need to reflect different scenarios

The CII standards for regulating port emissions should differentiate between vessel types, sizes, routes, weather, and operationality (for instance cargo/passenger handling)[11,19,23-25,28].

Various vessel types need to be treated differently for their port emission standards. For instance, cruise ships can be unfairly penalised for their hotel load when waiting at ports[9]. If a separate at port CII standard is to be implemented, correction factors would still be needed for uncontrollable operational conditions - such as weather, routes, fuel type, and biofouling.

c) Collaboration

It would be beneficial to build a global port network[47]. Ports could then collaborate with each other, sharing good practices in the green transition or/and coordinating green fuel distributions.

Ports could act as policy enablers working together with shipping lines and energy providers[40,41,47]. Ports can use real-time supervisory and data acquisition platforms to optimise energy flows[50].

Interaction with Regional Regulations

The uncertainty around the implementation of IMO's landmark NZF may incentivise the adoption of further or/and stricter different regional decarbonisation regulations. The interaction between the CII and regional measures can incentivise gaming behaviours and/or carbon leakage.

Regional legislations include (but are not limited to):

- The European Union FuelEU Maritime Regulations[51], which came into force in 2025. This includes GHG emission intensity reduction and mandatory use of alternative power sources in ports.
- EU ETS expansion to maritime[52] came into force in 2024 and requires relevant vessels to buy and surrender emission allowances for the GHG emissions produced when operating in the European Economic Area (EEA).
- UK ETS expansion to maritime[53], which will come into force in July 2026 and requires relevant vessels operating within the UK to monitor, report, and surrender GHG emission allowances.

There are several issues with multiple regional regulations, and these include:

1. Increased costs and administrative complexity[54]. For instance, the low sulphur regulation for ECAs increases fuel consumption and emission intensity, making it more expensive to comply with CII[13,17].
2. There are conflicting incentives. The CII incentivises optimising operational efficiency, which may not always align with minimising GHG emissions and, thus, ETS costs. For example, a ship might prefer

detouring through or operating in longer voyages to achieve a better CII rating but this may increase its total emissions and, thus, ETS costs[54].

3. Factors outside the control of ship operators affect compliance with CII and regional regulations in different ways. For instance, ships in EU ports often have shorter voyages, higher ballast ratios, and more port calls. While these factors lead to worse CII ratings, they are accounted for under the EU Monitoring, Reporting, and Verification (MRV) regulation.

Future Outlook

There is uncertainty surrounding the IMO's NZF, as to if, when, and in what form implementation will take place. In contrast, CII is already in place, and the industry and member states have widely accepted it due to its relative simplicity and practicality[43] and the fact that compliance does not require significant costs[13,55].

The CII is the only measure that directly targets operational emissions and is under ongoing review. Ensuring its enforcement in practice and revising its design to become fairer and more effective provides an immediate way to further incentivise decarbonisation while the sector awaits decisions around an international decarbonisation framework.

By design, CII becomes stricter annually to motivate improvements in vessels' energy efficiency. As improved energy efficiency reduces fuel use and, in turn, emissions, it can support compliance with a future international decarbonisation framework[56] at lower costs. Namely, if the vessel burns fossil fuel, the total price that will need to be paid for GHG emissions will be lower due to lower fuel needs. If the vessel then switches to greener fuels, the total additional price that will need to be paid for the more expensive fuel will be less due to higher efficiency levels.

However, compliance with the CII (as it currently stands) without simultaneous adoption of zero or near-zero emission fuels, technologies or energy sources (ZNZs) may be insufficient for compliance with an international decarbonisation framework in the longer run. On the other hand, adoption of ZNZs can ensure compliance with CII as the latter becomes progressively stricter. Note that around 36% of the dry bulk, tanker, and container fleet is estimated to be rated D or E in 2026[57], i.e. noncompliant (Figure 1). Note too that, as of December 2025, only 9% of the global fleet and c.50% of the orderbook (in gross tonnage terms) are alternative fuel capable[57].

The CII applies to a variety of vessel types to reduce emissions, including containerships, dry bulkers, gas carriers, general cargo carriers, tankers, vehicle carriers, and cruise ships[13,18,43,58]. CII can act as a good example of an international decarbonisation policy that motivates further global regulations.

It can also help to create a database to encourage international collaboration and data sharing between ship operators, ports, and cargo owners[33,34,59]. Such data availability and transparency will be essential for the successful implementation of an international decarbonisation framework.

Additional Recommendations

It is recommended that some additional revisions to the CII are considered, particularly in the longer run, irrespective of which of Options 1-4 is adopted. These are as follows:

- The current CII uses the vessel's nominal transport capacity and fails to consider the actual cargo carried[11,44]. In other words, the CII fails to motivate vessels to produce more transport work per unit of emissions. If a vessel sails frequently on ballast, it produces less transport work but has similar CII ratings[23]. Therefore, allowing for actual cargo data would provide a more accurate measure of the attained CII[23,56]. As such, instead of transport capacity weight in Box 1, "cargo mass + ballast mass" can be used in the denominator in the CII equation[16].

- The current CII fails to consider other important GHG emissions such as methane[57] and whole lifecycle (referred to as "well-to-wake") emissions. As such, the numerator of the formula should capture well-to-wake GHG emissions in terms of CO_2 equivalent[56,58]. This would ensure consistency with regional measures such as the EU and UK ETS and FuelEU Maritime.

- The CII formula could account for GHG emissions associated with the pilot fuel. Pilot fuel is a small amount of conventional fuel used for ignition in dual-fuel combustion engines where low carbon fuels with poor ignition characteristics, such as ammonia, are used[60].

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ENDNOTES

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