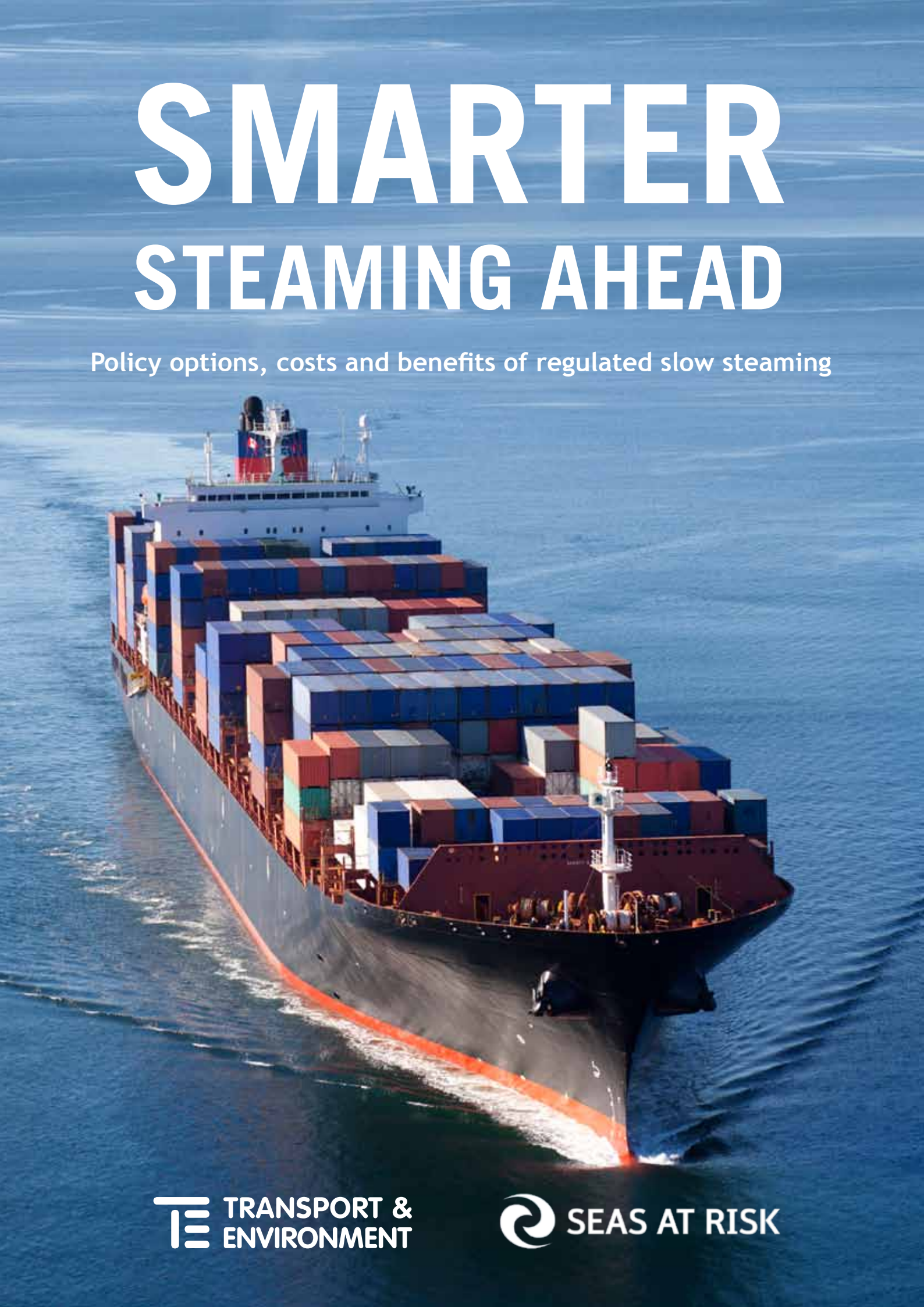
SMARTER
STEAMING AHEAD

Policy options, costs and benefits of regulated slow steaming



TRANSPORT & ENVIRONMENT

SEAS AT RISK

Smarter Steaming Ahead
Policy options, costs and benefits of regulated slow steaming

Summary of research carried out for Seas At Risk and Transport & Environment by CE Delft, The ICCT and Mikis Tsimplis

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The full report can be downloaded at;
www.seas-at-risk.org
www.transenv.eu/slowsteaming-report

CONTEXT

International shipping accounts for around 3% of global CO_2 emissions. Shipping emissions will grow as world trade grows and, together with aviation, are estimated to comprise 4% to 5.7% of global CO_2 emissions in 2020 (UNEP) and some 10% to 32% in 2050 unless action is taken. The International Maritime Organisation (IMO) has been discussing what to do since it was tasked with reducing emissions from international shipping by the 1997 Kyoto Protocol. An IMO action plan on market-based measures is now in its 10th year.

A good number of policy options ranging from emissions trading, a global carbon levy, to efficiency trading and mandatory emission reductions by ship have been proposed, debated, studied and amended during this time and remain under consideration. The Energy Efficiency Design Index (EEDI) for new ships and Ship Energy Efficiency Management Plan (SEEMP) for existing ships were agreed in 2011.At the IMO's Marine Environment Protection Committee (MEPC 61) in September 2010, the IMO considered a proposal from the Clean Shipping Coalition (CSC) to apply speed restrictions to ships to reduce emissions, with CSC noting that average ship speeds have crept up over the past 20 years despite rising fuel costs and that fuel consumption and thus emissions are a cubic function of speed. However the IMO dismissed any further consideration of CSC's proposal for regulating ship speed after only a very brief exchange of views. This subsequent study seeks to investigate further and underpin the legal, environmental and economic feasibility of regulated slow steaming i.e. slow steaming at or beyond the level that companies initiate themselves.

INTRODUCTION

Slow steaming is not a new phenomenon and was widely adopted in response to the slump in demand and oversupply of ships that accompanied the start of the current economic crisis. The practice has been further extended since 2008 and has brought widespread benefits to shipping companies who have now embraced it as a useful operational measure to lower fuel costs.

Slow steaming has resulted in a significant reduction in emissions of GHGs and air pollution. However there is a widespread expectation in the industry that as the economy and markets pick up and excess capacity is brought back into service, speeds will increase again over time to meet the growing demand. If this occurs, we can expect a significant and sustained increase in ship emissions just at the time when long-term IMO initiatives to address shipping's carbon footprint are hopefully reaching a conclusion. Capping speeds at or around their current crisis levels – which estimates suggest could be 10-15% below their 2007 maximum – would prevent this from happening and avoid a market speed up largely negating the effect of any long-fought-for climate measure the IMO might adopt.

Speed restriction in the road and rail sectors is commonplace – mainly for safety but also for environmental reasons. Industry has however argued strongly that restricting speed in the shipping sector is not appropriate as it limits flexibility and will have negative safety, logistics and cost implications and result in a poor environmental outcome due to the need to build and operate additional ships.

This brochure provides a quick overview of the findings of a study into the policy options, costs and benefits of regulated slow steaming commissioned by T&E and Seas at Risk. The authors were CE Delft, Professor Mikis Tsimplis and The ICCT. The study effectively dismisses all the common concerns surrounding speed limitation as unfounded. Moreover it clearly demonstrates that regulated slow steaming not only reduces CO_2 and other emissions dramatically, it actually saves the sector money. Implemented carefully – e.g. by including certain provisions for ships that need to travel faster - such an intelligent approach to regulated slow steaming would provide industry with the flexibility they say they need. Such a provision could also be constructed in a way that raised revenues which could be used for climate change purposes.

When the Clean Shipping Coalition raised the issue of regulated slow steaming at the IMO in 2010, the idea was dismissed with very little discussion. Yet slow steaming has proven itself to be the only effective measure that has actually delivered significant in-sector emission reductions over past years. The industry may soon be on the verge of seeing average speeds increase again, potentially negating all those emissions reductions. The CE Delft study looks carefully at all the concerns about speed limitation. We believe it provides the necessary background to enable the IMO to revisit the issue. Time is of the essence.

It is not our intention to suggest that regulated slow steaming is the silver bullet to address shipping's climate impact. A range of efficiency and market-based initiatives is urgently needed. Our hope is to overcome the knee-jerk reactions which may have prevented this most simple and obvious of measures to reduce emissions from being given proper and detailed consideration.

Regulated slow steaming can produce emissions reductions by 2030 and 2050 which rival any other reduction option being considered at IMO or EU level. And it can do so with a sizeable economic gain. If we are serious about tackling shipping GHG emissions and making sure that the shipping industry contributes its fair share to tackling climate change, then the IMO – and industry - must look again at regulated slow steaming and give it full and proper consideration.

John Maggs, Seas At Risk
Bill Hemmings, Transport & Environment

Members of the Clean Shipping Coalition
www.cleanshipping.org

HIGHLIGHTS FROM THE STUDY

1. Slow steaming has significant multiple environmental benefits

A 10% reduction in fleet average speed results in a 19% reduction of CO_2 emissions even after accounting for the emissions of additional ships needed to deliver the same amount of transport work and the emissions associated with building the necessary additional ships. Emissions of SOx, NOx and probably black carbon will decrease in line with fuel use and CO_2 emissions. A ship speed reduction of 25% leads to a reduction of main engine fuel consumption of approximately 58% on a ship year basis. Fuel savings on a fleet level will be somewhat less as explained in the report. Lower ship speeds will also reduce whale strikes and other harmful wildlife interactions.

2. Slow steaming has significant economic benefits

Taking into account both the direct costs (fuel use, crew, capital costs of ships), indirect costs (additional inventory costs, adjustment of logistical chains) and the external costs (impacts of emissions on human health and ecosystems, climate impacts), the benefits of slow steaming outweigh the costs. This result is robust for a number of fuel price assumptions and discount rates. Implemented correctly, regulated slow steaming is cost free to the shipping industry as a whole and entails marginal incremental logistic and supply chain costs to consumers.

3. There are very few, if any, evident technical obstacles to slow steaming

Many shipping companies have experience with slow steaming in recent years. Even at very low engine loads, they have encountered only a few problems and these problems could be surmounted by small changes to operational procedures. Hence, it appears that there are very few technical constraints to slow steaming.

4. Regulated slow steaming is legally feasible

Compulsory slow steaming can be imposed by a State on the ships flying its flag; on all ships in territorial waters (but cannot be enforced while the ship is on transit or innocent passage); and in the Exclusive Economic Zone (EEZ) and the high seas as a condition of port entry of the imposing States.

5. Regulated slow steaming is feasible to implement

Regulated slow steaming is relatively easy to monitor and enforce, and may have a lower administrative burden than some of the recently proposed MBMs. Speed can be monitored, both by ships and by regulators, and reported to regulators with little additional effort. Enforcement can be based on existing port State control instruments.

6. Regulated slow steaming delivers emission cuts in-sector

Regulated slow steaming ensures that emissions in the shipping sector will be reduced from business-as-usual levels, regardless of the fuel price and demand for shipping.

7. Regulated slow steaming could avert a ship emissions spike as the global economy picks up

A cap on speed would reduce the possibility of an otherwise likely large and long-term spike in emissions if ships speed up in response to a recovery in demand. A cap set today around current average ship speeds will have little impact on industry.

REGULATORY EXAMPLES

Regulated slow steaming could apply at various levels. A global regime would potentially have the largest impact on emissions; a regional initiative, e.g. in the EU, would have a smaller impact. Regulated slow steaming in the Arctic could prevent an increase in black carbon (BC) emissions there as shipping activity increases when sea routes open; BC has a particularly strong climate effect when deposited on snow or ice.

Environmental impacts

As a rule of thumb, engine power output is a third power function of speed. When a ship reduces its speed by 10% its engine power is reduced by 27%. Because it takes longer to sail a given distance at a lower speed the energy required for a voyage is reduced by 19% (a quadratic function).

Within most speed ranges, fuel consumption and consequently emissions of carbon dioxide and sulphur oxides are reduced in line with the energy consumption. Only at very low speeds may the amount of fuel needed to provide a unit of output energy increase somewhat, although this can be prevented by de-rating the engine. The emissions of nitrogen oxides are reduced in line with the fuel consumption unless the engine load becomes very low. Below a certain engine dependent load the absolute quantity of nitrogen oxide emissions is reduced but less than fuel consumption. Available scientific evidence suggests black carbon emissions will reduce in line with fuel consumption until the engine load becomes very low.

In sum, slow steaming reduces all shipping air emissions. The environmental impacts of slow steaming are independent of whether ships slow down voluntarily or are required to do so by law.

Legal issues

The legal feasibility of regulating ship speed depends on where and how the speed control is imposed.

Compulsory slow steaming can be imposed by a State on the ships flying its flag. For such ships the flag State has prescriptive and enforcement jurisdiction. Under a global agreement Port States would also have the right to impose speed controls on ships flying the flag of non-party States.

For a regional speed control the situation is more complex. Imposing slow steaming only on ships flying a flag within the region would risk distorting the market and, given the relative ease of changing flag, also risk eroding environmental impacts.

However, a coastal State can impose slow steaming on all ships as a condition for entry into its ports. Such a measure can be enforced on the basis of the presence of the ship in that port. Issues relating to the extraterritorial character of speed controls at the high seas or the EEZ are likely to arise, but in our view because they are imposed as conditions for entry to a port the fact that they dictate behaviour in areas outside the enforcement area of the coastal State is not a restriction in exercising enforcement rights because they are of no effect unless a ship voluntarily visits the port of the coastal State.

Implementation

The feasibility of implementation depends on whether speed can be accurately monitored, both by the ship and the regulator, and whether regulated speed can be set.

Satellite Automatic Identification Systems (S-)AIS, which most ships are required to have on board, allow both the ship and the regulator to monitor speed over ground. Moreover, independent verification of the average speed on a voyage is possible by inspecting logbook entries of when a ship leaves one port and enters another. There are no restrictions on the use of (S-)AIS data by regulatory parties.

A regulated speed that is dependent on ship size and type is preferable to a single speed for all ships, mainly because the latter would distort the competitive market between ship types. Ship-specific speeds could be monitored based on self-reporting of verifiable data.

Technical constraints

The report concludes that for existing ships there are very few technical constraints to slow steaming.

For new ships, we have not identified constraints to lowering the design speed. There are constraints to the power of ships, related to the ships ability to manoeuvre safely in adverse conditions, but ships can be equipped with redundant power, albeit at a cost. The decision becomes an economic consideration rather than a technical constraint. Ships designed for slower speeds may have a higher block coefficient, and as a result, the third power relation between speed and engine power cannot be taken for granted for new ships.

Industry responses

Many ships have slowed down in recent years. As a consequence, industry players like shipping companies, logistics service providers, ports and shippers all have recent experience with slow steaming.

Shipping companies face a constant need to manage their fleet size and available capacity while reducing their fuel costs where possible. Speed as a variable allows them to better manage these factors. The concept that slow steaming leads to a "greener" supply chain is a well understood (if unintended) benefit, but carriers will likely return to pre-2007 speeds when market conditions change and more capacity is required.

Regulated slow steaming would restrict the degree of freedom that the shipping companies have in responding to changing market circumstances, but would help guard against a spike in emissions as a result of improving market conditions.

Shippers have been affected by slow steaming as they have had to build up their inventory levels and adjust their supply chains. They recognise the benefits of being able to market the use of "green" shipping practices but do not feel that they have a consistent way to evaluate, communicate, and compare slow steaming with other tools to achieve similar goals.

Global regulated slow steaming

The main aim of global regulated slow steaming would be to reduce CO_2 emissions from shipping.

The development of a global regime for compulsory slow steaming provides the most difficult to achieve but least difficult to implement legal option. A general agreement on maximum (or average) speeds for each type of vessel approved by the IMO's navigation committee and the MEPC would give global consent to such measures. Building consensus within the IMO would be a necessary prerequisite.

The speed restriction should be expressed in average speed over the ground so that it can be monitored and verified, and be dependent on the ship type and possibly size in order to limit distortions of competition.

In a global system, enforcement would be both through flag State and port State control. The responsible entity can in that case be the ship owner. In case the owner is not the operator of a ship, he can contractually pass on the obligation to respect the speed restrictions to the operator.

Enforcement of global regulated slow steaming would be organised using flag State obligations and port State rights. Flag States that would be a party to a convention would take on the obligation to enforce the speed restriction on ships flying their flag. In addition, port States which are party to a convention would have the right to inspect any ship in their port for compliance. Compliance can either be demonstrated by a certificate from the flag State or a compliance report on board of the ship in case the ship is registered in a non-party State.

The time to introduction depends on whether a new convention is needed or whether regulated slow steaming can be introduced as a revision to an existing convention; the latter could see a new measure in place in as little as 5 years.

Arctic regulated slow steaming

The main aim of regulated slow steaming in the Arctic would be to reduce black carbon (BC) deposition on ice and snow in the Arctic.

Imposing speed restrictions in the Arctic can be done unilaterally by one or more States as a condition for entry into their ports; by including speed restrictions in the Arctic as part of the Polar Code; or by making such restrictions an Associated Protective Measure within the designation of an Arctic Particularly Sensitive Sea Area (PSSA).

The geographical scope of a speed restriction in the Arctic ensures that the aim of the regulated slow steaming regime is met, i.e. to reduce black carbon emissions from ships and/or deposition of these emissions in the Arctic. In case of the narrow aim, i.e. reduce emissions of black carbon from ships in the Arctic, the geographical scope would be confined to the Arctic. If the aim of the Arctic slow steaming regime is broader, i.e. to reduce deposition of black carbon from ships in the Arctic, the geographical scope needs to be larger than the Arctic itself.

The enforcement of an Arctic speed restriction could be organised by refusing entry to ports of contracting States to ships that cannot demonstrate compliance with the regulated slow steaming regime.

The designation of a PSSA typically takes a few years.

European regulated slow steaming

Speed restrictions on ships sailing to EU ports could be introduced in order to reduce the climate impact of ships sailing to EU ports.

As argued above, a speed restriction on voyages to EU ports would need to be adopted as a condition of entry into an EU port. A regulated slow steaming regime imposed on the high seas is not a violation of the exclusive rights of the flag State because they are not enforceable unless the ship voluntarily chooses to enter the port of the State imposing such controls. Thus speed restrictions on ships imposed as conditions for entry in the EU Member State ports are legally feasible. They are easier to justify when compliance is demanded for voyages to and from Member States. The port State has jurisdiction to enforce such measures. Thus it is a matter for the national legislator whether the enforcement jurisdiction of the port State should be exercised against foreign ships violating such regulations.

The geographical scope could either include all ships sailing to EU ports or ships sailing between EU ports.

In order for the speed restriction to be enforced, ships should report their average speed within the geographical scope to the regulator upon entering a port. If a ship can ascertain that it will continue to sail in Europe, the per voyage reporting requirement could be relaxed in order to reduce the administrative burden.

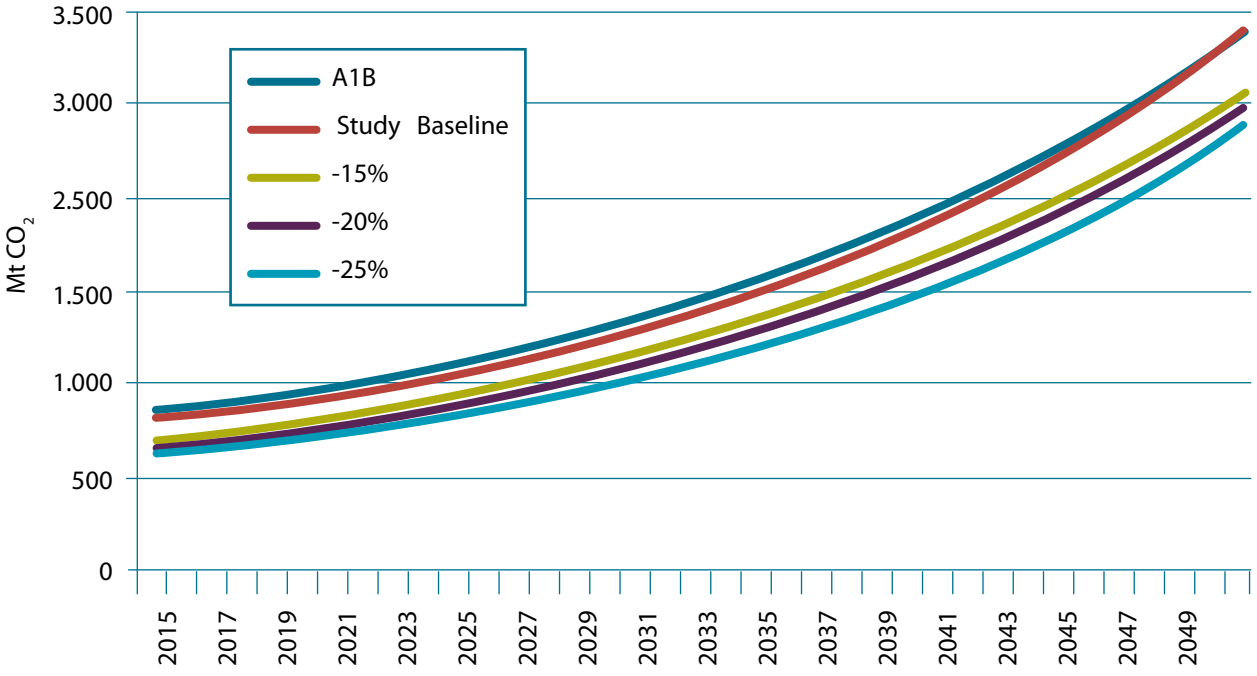
Enforcement of a regional speed restriction would ultimately take place by refusing ships that have sailed above the limit entry to EU ports.

A European Directive would take several years to be prepared and at least two years to be agreed upon by the Council and Parliament.

Emissions reductions of regulated slow steaming

Figure 11 CO_2 emissions as a result of global regulated slow steaming

Source: this report



The average relative fuel consumption reduction differs per scope of the regulated slow steaming regime, since the share of the different ship type/size categories differs respectively. The induced relative emission reduction in the period 2015-2050 corresponds to the relative fuel reduction as given in Table 21. As can be seen in Table 22 the relative emission reduction is, just as the fuel reduction, not constant over time. This is due to a change of the fleet composition over time.

Table 21 Relative fuel reduction on fleet basis in the period 2015-2050

	Global	All ships arriving in EU ports
-25%	25%	23%
-20%	18%	17%
-15%	13%	12%

Table 22 Changes in total CO_2 emissions (transport and shipbuilding) relative to the baseline resulting from regulated slow steaming

	Global			All ships arriving in EU ports		
	2020	2030	2050	2020	2030	2050
-25%	-25% (245 Mt)	-22% (300 Mt)	-17% (484 Mt)	-23% (42 Mt)	-20% (52 Mt)	-15% (85 Mt)
-20%	-20% (193 Mt)	-17% (233 Mt)	-13% (366 Mt)	-18% (33 Mt)	-15% (39 Mt)	-11% (62 Mt)
-15%	-15% (146 Mt)	-13% (176 Mt)	-10% (272Mt)	-13% (24 Mt)	-11% (29 Mt)	-8% (45 Mt)

Explanatory note:

1. The cubic relation between fuel use and speed per ship and the square relation for the fleet only applies to main engine fuel consumption.
2. In our model, auxiliary and boiler fuel consumption remain constant. As a result, the relation is less than square (a 10% reduction in speed results in a less than 19% reduction in fuel consumption).
3. The speed reduction in the first column of Table 21 is speed relative to 2007. For container ships, the speed reduction relative to the baseline is less. As a result, a 15% speed reduction relative to 2007 will not result in a 28% reduction in main engine fuel consumption (85%x85%=72%), but less.
4. As the number of containerships in the fleet increases over time, (3) above becomes more important, which partly explains Table 22.
5. The other explanation of Table 22 is that it accounts for the emissions associated with new ships, which are small over the lifetime of a ship but can be significant in years when a large number of ships are built.

Economic benefits of regulated slow steaming

Regulated slow steaming would have costs and benefits to society. The balance of costs and benefits depends, inter alia, on the stringency of the speed restriction, fuel prices, and the type of speed restriction.

A global regime which limits average ship speeds to 85% of their average speed in 2007 would have benefits that outweigh the costs by USD178-617 billion, depending on future fuel prices. Main costs are the purchase of additional ships and the main benefits are reduced net fuel expenditures.

Table18 Costs and benefits of global regulated slow steaming (4% discount factor)

Speed reduction	-25%			-20%			-15%		
Fuel price scenario	Low	Base	High	Low	Base	High	Low	Base	High
Costs for purchase extra ships	668	668	668	476	476	476	327	327	327
Fuel expenditure extra fleet	350	575	663	261	425	490	197	320	369
Other annual expend. extra fleet	431	431	431	310	310	310	214	214	214
Change of fuel expend. baseline fleet	-1262	-2069	-2387	-938	-1529	-1764	-697	-1133	-1307
Engine modification costs	26	26	26	25	25	25	24	24	24
Extra inventory costs	759	759	759	516	516	516	343	343	343
Change of external costs									
- Costs operational CO_2	-298	-298	-298	-229	-229	-229	-172	-172	-172
- Shipbuilding CO_2	19	19	19	12	12	12	7	7	7
- No_x	-608	-608	-608	-453	-453	-453	-335	-335	-335
- BC	-5	-5	-5	-4	-4	-4	-3	-3	-3
- So_x	-150	-150	-150	-114	-114	-114	-84	-84	-84
Net costs (Billions USD)	-70	-653	-883	-137	-564	-734	-178	-491	-617

A **European regime** in which all ships arriving in European ports would need to reduce their speed to 85% of their 2007 average would on balance either have a cost of USD1 billion or net benefits of up to USD 74 billion, again depending on fuel prices. In the base and high fuel price scenarios the benefits outweigh the costs, but not in a low fuel price scenario.

The results are sensitive to fuel price projections; higher fuel prices result in larger benefits, lower fuel prices in lower benefits. The results are also sensitive to the discount rate used, although in most cases, a change in discount rate does not change the sign of the net costs or benefits.

Author's observations

The report's authors refer to the perceived loss of market flexibility, the largely negative attitude of shipping companies and shippers, and the possibility that speed reduction may not be cost-effective for all ships on all routes or for all ship types. The report also says that speed reduction is likely to reduce the cost-effectiveness of other means of fuel efficiency improvements and may result in less innovation, and by prescribing a specific measure, regulated slow steaming would diverge from the goal-based approach to shipping environmental policy favoured in recent years. The authors note that regulated slow steaming, if implemented carefully, need not impose additional costs on the shipping sector as a whole. At the same time, it would not raise revenues for use in fighting climate change in developing countries. {Comment; this need not necessarily be the case should some sort of payment mechanism for flexibility be developed}.

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