

# TOWARDS A STRONG AND RELIABLE SHIP EMISSIONS MONITORING SYSTEM

What are the practical options to monitor ship emissions?

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*“To measure is to know. If you cannot measure it, you cannot improve it.”*

Lord Kelvin, 19<sup>th</sup> Century Scientist

## KEY FINDINGS

- Fuel monitoring is already a common practice in the shipping industry. But there are currently neither harmonised guidelines nor legal requirements that clearly define the method and the rules to follow to monitor on-board fuel consumption. The upcoming EU monitoring, reporting and verification (MRV) regulation will be a step towards a robust and consistent system of monitoring and open the door to mitigation strategies.
- Indeed, the EU announced that its MRV system would be a first step towards a more comprehensive system to reduce shipping GHG emissions. Only an accurate, enforceable and transparent MRV system will provide a solid foundation for regulation.
- After reviewing different available options to measure ship emissions, this analysis concludes that the upcoming European MRV system should rely on continuous on-board monitoring of either fuel consumption or CO<sub>2</sub> emissions.
- Direct emissions monitoring also has the potential to extend the scope of the system to cover other air emissions, such as SO<sub>x</sub> and NO<sub>x</sub>. In this case, the system could serve as a single framework to measure all shipping emissions to air and, when applicable, for enforcing relevant regulations.
- Discussions on efficiency measurement and emissions monitoring are important, but are secondary to the ultimate objective of reducing emissions and improving in-sector efficiency.

## Summary

The EU has been on record for several years that it would take regional action to reduce greenhouse gas (GHG) emissions from ships, if no global agreement had been reached at the International Maritime Organisation (IMO) by the end of 2011. After a series of public consultations meetings in 2011 the Commission indicated it was considering a number of options to cut shipping emissions, such as a fuel or carbon levy, a compensation fund or inclusion of the maritime sector in the ETS. However, on 1 October 2012, European Commissioners Hedegaard and Kallas announced that the Commission would first propose monitoring, reporting and verification (MRV) of emissions as a starting point towards a more comprehensive system to reduce emissions. This announcement was a great disappointment to the environmental community as it de facto postpones action to effectively address the issue of shipping emissions. However it can serve as an opportunity to establish a harmonised approach towards ship emissions measurement.



Although a significant number of ship-owners are already voluntarily monitoring the efficiency of their fleet, there is currently no legal requirement in Europe for ship-owners to keep track of their vessels' direct fuel consumption and communicate this data to port state authorities.

The precise requirements to be contained in the EU MRV scheme are not yet known. The legislative proposal is not expected before the first quarter of 2013. This paper highlights some important aspects to be taken into account when developing a reliable emissions monitoring system and it investigates different options.

## WHAT DOES AN IDEAL MONITORING SCHEME LOOK LIKE?

**Accuracy:** The data collected should reflect as closely as possible the real emissions of the ship. Procedures for data collection and verification should follow clear and transparent guidelines in order to guarantee the highest level of data consistency. Last but not least, data should be certified and linked to the relevant instruments / documents used by port or flag state authorities to verify compliance and measure progress.

**Enforceability:** Enforcement is a crucial aspect to be taken into account when adopting the regulation. This point is all the more important if the MRV has to serve as a first step towards a regulation on CO<sub>2</sub> reduction. Practical and robust enforcement can only be guaranteed if emissions data is easy to collect, survey and verify. Moreover, in order to minimise a ship's delay in port and to ensure a minimal administrative burden (both for private operators and port state control), the procedure for data verification should be simple and rapid.

**Transparency:** The principle of transparency may sometimes conflict with the preservation of confidentiality, especially of "sensitive" information. However, together with data accessibility, transparency is a fundamental element to be respected in the establishment of the EU MRV system, especially if it has to serve as a cornerstone for a CO<sub>2</sub> mitigation strategy. Transparency would lead to better decisions and could possibly improve energy efficiency in sector; e.g. by making the information on fuel consumption transparent, the charterers could take more informed decisions on what ship / company to charter. Public access to emissions data by ship is also important and should be guaranteed as a right: as is already the case for emissions from fixed installations covered by the ETS.

## REVIEW OF PRACTICAL OPTIONS TO MONITOR SHIP EMISSIONS

### GENERAL PRINCIPLES

Although the specific rules for the EU MRV have not been made public yet, it is our understanding that the system will be based on port-state control and would therefore require annual fuel consumption data for voyages to EU ports (and potentially originating from EU ports) during the reporting period. As explained earlier, the MRV system should establish a harmonised method to measure emissions on a ship-by-ship basis, for all types of ships and for the entire journey).

Different methods can be used to measure or estimate the CO<sub>2</sub> emissions of a ship. Three of the four (non exhaustive) options presented here are based on the measurement of fuel consumption, which has a direct relationship to CO<sub>2</sub>

emissions. So by establishing the carbon content of the fuel, the CO<sub>2</sub> emissions can be calculated by applying an emission factor to fuel consumption data. The last option discussed in this paper will rely on direct measurement of CO<sub>2</sub> emissions (i.e. gas measurement) in the ship funnel.

The options can be split into two categories: estimates based on activity data or written documentation and measurements made on board the ship. Estimate options could be defined as top-down and require a relatively high level of analytical work in order to provide emissions data. Measurement options could be defined as bottom-up with no or very little data treatment required.

## ESTIMATE OPTIONS

### Oil record book and bunker delivery notes

Current MARPOL regulations require ships to keep an oil record book, bunker delivery notes (BDN) and fuel samples on board and make them readily available for port state inspection. This material can, under certain circumstances, be used to determine fuel consumption and thus CO<sub>2</sub> emissions. This approach uses fuel sold as a proxy for fuel consumption data and then emissions are calculated. Such a method has already been used to establish various global emissions inventories (e.g. the so-called top-down approach in the second IMO greenhouse gas study). While the method seems easily applicable to measure the amount of fuel sold (and then supposedly consumed) over a certain period globally, it is likely to be difficult to use to determine emissions during specific voyages.

In addition, the accuracy of this method greatly depends on the quality and the exactitude of information contained on the BDN and on a number of assumptions that can significantly affect the results of the equations: all fuel sold is consumed, the exact carbon content of the different fuels (including blends) is known, the exact quantity of fuel in the tanks is known, etc. All this reduces the practicability and the transparency of this method. Moreover, there is important data treatment needed to produce emission figures and therefore the burden falling on public authorities / port state control to calculate and verify is potentially very high.

### Estimating emissions from AIS data

The Automatic Identification System (AIS) was introduced by the IMO to enhance navigational safety by providing better information on ship location and the navigational status of vessels (e.g. at anchor, under way sailing, etc.). However, the system does not only collect data on location; it also includes static information on the vessel such as the ship's IMO identification number, her name and dimensions as well as dynamic information on position at sea, course, speed over ground, etc. By correlating ship data (and thus information on the power installed on board, the type of engines, the type of fuel, etc.) with activity data, it is possible to estimate ship emissions. These estimates can be improved by calculating water resistance/friction, and information on currents and weather conditions etc.

The main advantage of this option is that AIS data now has worldwide coverage and is collected automatically for all ships for all journeys; the administrative burden for ship-owners is therefore reduced to a minimum. However, the verification and enforcement burden falling on public authorities / port state control is potentially very high. A lot of administration of data is required to estimate emissions with this option and the accuracy of the results will be highly dependent on the assumptions used (carbon content of the fuel, amount of power used, etc.) in the model.

If this method does not seem to be appropriate as a direct reporting scheme, it could nevertheless be potentially useful as a complementary enforcement tool, e.g. enabling fraud detection, assessing the overall impact of an efficiency measure, evaluating changes in behaviour (e.g. routing measures, slow steaming), etc.

### Continuous fuel consumption monitoring

Monitoring fuel consumption can also be carried out on board and it has been widely used by ship owners and operators to assess operational and environmental performance of their fleet. On-board (continuous) fuel consumption monitoring can be done by using, for instance, fuel flow meters for the main and the auxiliary engines, by precise sounding of the tanks, etc. Different technologies have already been certified and are available for new builds and retrofits. Of course the accuracy of fuel measurements will be highly dependent on the type of equipment used, but modern systems have proven to be of high precision. Today's instruments can even cope with issues like fuel viscosity, density, blending, etc.

Compared to the previous options, this method measures (and does not only estimate) the amount of fuel consumed. The accuracy of the results produced is therefore considerably enhanced. In addition, these systems provide continuous feedback on the real fuel consumption figures to the ship operators. If a proper reporting system were to be established this data could easily be made available to public authorities. As the data collection is done automatically, the burden for the crew is minimized and because the data obtained is already in the form of fuel consumption figures, there will be no need for additional processing, which consequently reduces the burden for public authorities. The system is clear and its functioning is relatively simple.

## MEASUREMENT OPTIONS

### Direct emissions monitoring

A further approach would consist in directly measuring CO<sub>2</sub> emissions in the funnel, without using fuel consumption figures as a proxy. This option is fundamentally different from the previous ones as it relies on the measurement of gas (i.e. CO<sub>2</sub>) and not liquid (fuel). On board exhaust gas measurement is already available and is used by a number of shipping companies. These systems were first developed to measure emissions of conventional air pollutants such as SO<sub>x</sub> and NO<sub>x</sub>. Most systems available on the market now are also separately certified for CO<sub>2</sub> measurement (the SO<sub>x</sub> measurement was in fact already based on a SO<sub>x</sub>/CO<sub>2</sub> ratio).

Similar to on-board continuous fuel consumption monitoring, direct emissions monitoring seems to be an attractive option to provide robust and transparent data both for the operators and for automatic reporting to enforcement authorities. The main advantage of direct monitoring is the ability to combine CO<sub>2</sub> measurement with other air pollutants such as SO<sub>x</sub> and NO<sub>x</sub>. As a result this method could be used as a unique instrument for the measurement of all ships' emissions to air and to inform the regulator, as an enforcement tool and as a performance indicator etc.

# COMPARISON OF OPTIONS

	Accuracy	Enforceability	Transparency
AIS	Medium	Potentially low	Medium
Oil record /BDN	Potentially low	Low	Low
Fuel monitoring	High	High	High
Emissions monitoring	High	High	High

## RECOMMENDATIONS

Different options are available to measure air emissions from ships. After reviewing four approaches, this paper recommends to adopt procedures based on on-board, continuous monitoring of either fuel consumption or CO<sub>2</sub> emissions. These methods considerably reduce the management burden for ship-owners and crews and require minimal administrative burden for public authorities. Moreover, direct emissions monitoring will provide more reliable data and is more appropriate for the measurement of emissions ship-by-ship.

Direct emissions monitoring also has the advantage to become the single method for data collection of all ship emissions to air. Integrating climate and air pollution requirements into one regulation on emissions monitoring will have the advantage of creating a unique and clear framework for ship-owners and operators. Data collected through direct emissions monitoring could be used for different purposes by public authorities and policy makers; for example to report on the extent of the problem for NO<sub>x</sub> emissions, serve as a first step towards an efficiency regulation for CO<sub>2</sub>, or become an additional enforcement tool for regulations on SO<sub>x</sub> emissions. The Commission has stepped back from directly regulating CO<sub>2</sub> from European shipping. It should not miss the chance now to send an ambitious message for developing a comprehensive, strong, reliable and transparent monitoring system covering all shipping emissions to air.



### FOR MORE INFORMATION, PLEASE CONTACT:

**Antoine Kedzierski / T+ 32 (0)2 893 08 52**  
[antoine.kedzierski@transportenvironment.org](mailto:antoine.kedzierski@transportenvironment.org)

**Bill Hemmings / +32 (0)2 893 08 53**  
[bill.hemmings@transportenvironment.org](mailto:bill.hemmings@transportenvironment.org)

