Q&A ON SHIPPING EMISSIONS / *ANAVE / OCTOBER 2019*

POLLUTING GASES

GREENHOUSE GASES

1 Are they the same?

Not at all. Although they are frequently confused, polluting gases are not the same as greenhouse gases and their impact and effects are very different too, therefore it is very important to distinguish between them.

2 What are the main polluting gases?

Main polluting gases are sulphur oxides **(SO_X)** and nitrogen oxides **(NO_X)** as well as particulate matter **(PM)** and polycyclic aromatic hydrocarbons **(PAH)**.

2 What are the main greenhouse gases?

Main greenhouse gases are, overall, carbon dioxide **(CO_2)**, also methane **(CH_4)**, volatile organic compounds **(COV)**, etc.

3 What are their effects on the environment (a) and on public health (b)?

Their effects are only harmful in short distances. The emissions produced at high seas do not have significant effects.

a) ON THE ENVIRONMENT

Acid rains. They have more impact in zones with acidic soils (e.g. granitic, like in northern Europe), than in those with basic nature (calcareous, south of Europe). For this reason, the north of Europe was designated by the IMO as a *«Sulphur Emission Control Area» (SECA)* and not the south of Europe.

b) ON PUBLIC HEALTH

They are harmful to human health, specially to persons those who suffer asthma or other breathing diseases.

No harmful effects from SO_X or NO_X emissions have been reported on ships' crews (see point 7)

No effects in short distances.

a) ON THE ENVIRONMENT

Wherever they are emitted (even at the centre of the oceans) **their effects take place at the atmosphere's high layers** and consist in increasing the greenhouse effect which subsequently, produces global warming. It's important to eliminate these emissions anywhere in the world.

b) ON PUBLIC HEALTH

They do not have severe effects even if they are emitted at city centres.

4 How are these emissions regulated today in maritime transport by the International Maritime Organization? (Annex VI - MARPOL Convention)

SO_X emissions: are regulated through **a cap in the sulphur content of marine fuels.** There is a general limit of 3.5% (still today) and a stricter one (0.1%) when sailing at SECAs. Furthermore, since 2010, through European Directive the same limitation (0.1%) at SECAs **applies in all European ports.**

NOWHERE IN THE WORLD ARE THERE STRICTER LIMITS THAN IN EUROPE.

NO_X emissions are regulated through three Tiers. Tier III applies only to new ships and in areas designated as *«Nitrogen Emissions Control Areas»* (NECAS).

Since January 2013 all new ships must comply with the Energy Efficiency Design Index (EEDI) that becomes more demanding through time.

EEDI = CO_2 emissions / transport work.

All ships must carry on board a Ship Energy Efficiency Management Plan containing all measures applied to reduce fuel consumption and, hence, reduce GHG emissions.

Thanks to the EEDI and SEEMP procedures, CO_2 emissions per tonne·mile were reduced more than 30%, from 2008 to 2018.

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5 What are the next targets for reduction of these emissions?

Following Annex VI of the MARPOL Convention, on **1 January 2020,** the sulphur maximum cap in marine fuels **will drop from 3.5% to 0.5% in the whole world outsides SECAs** (in other words, it will be reduced by 86%). (See figure below).

In order to facilitate its enforcement, as of 1 March 2020 it will be forbidden to carry non-compliant fuel on board unless the ship is equipped with SOx scrubbers. It is estimated that this new regulation will cost the shipping industry around **$60,000 million every year.**

In April 2018, the IMO adopted some very ambitious targets for the reduction of GHG in respect to 2008: **40% per tonne·mile transported in 2030 and 50% in absolute terms by 2050.**

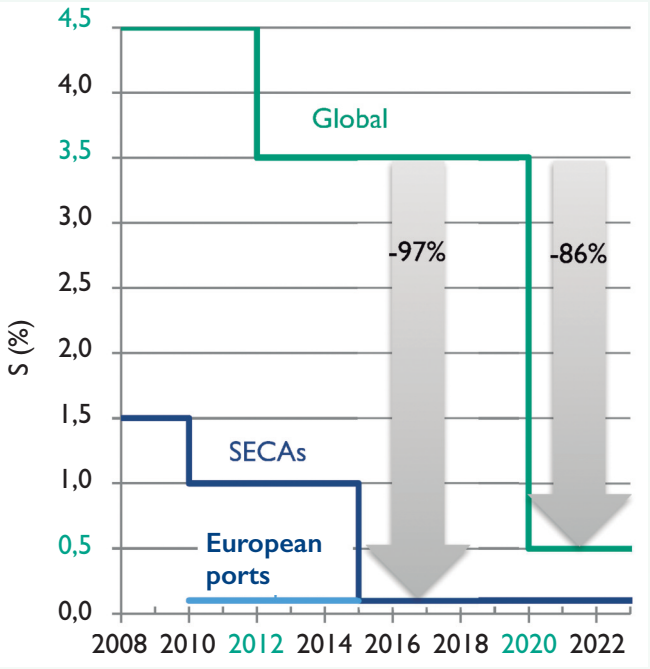
These objectives will be applied to all the world fleet including newbuildings and existing ships.

The IMO has already started the debate about the measures to be applied in order to reach those reduction targets. **It is likely that the first measures could be agreed during Spring 2020.**

6 What do the emissions from maritime transport mean in the whole of global emissions?

Shipping is the only transport mode authorized to use fuels with some sulphur content. Also, the biggest ships have a very high propulsive power.

Nevertheless, as said above, these emissions take place at safe distances from population and they are going to be drastically reduced as of 1 January as the next figure shows.



According to the most reliable studies, **maritime transport emissions account for less than 2.4% from all the anthropogenic GHG emissions.**

In comparison with **land transport**, on average, shipping emits **6 times less CO_2 per tonne·km. And 60 times less than air transport.**

For each tonne of cargo that passes from land transport to shipping, CO_2 emissions would be divided on average by 6. Therefore, **in the fight against global warming, maritime transport is not an enemy but an ally, part of the solution.**

Therefore, why so much emphasis on reducing maritime transport emissions? Because, altogether shipping produces as much CO_2 as Germany. That is why the industry is firmly committed to its reduction.

ENERGY EFFICIENCY OF MARITIME TRANSPORT IS OUTSTANDING:
A medium size tanker (Suezmax) has around 15,000 kW of power, which is equivalent to 150 cars or 50 trucks. However, while a truck can carry a maximum 35 t of payload, a Suezmax can transport 150,000 t, in other words, 4,300 times more cargo, with only 50 times more power. Nearly 90 times more efficient.

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7 Why is it not compulsory to eliminate these emissions completely?

Despite the negative effects indicated, the permanence of **SO_X in high layers of the atmosphere,** in the form of droplets (sulfated aerosols), positively influences the net balance of radiation from the earth's heat to the outside. **Its effect is opposite to GHG, as they contribute to reduce the greenhouse effect.**

Also, to eliminate sulphur from crude oil (through distillation or hydrocracking) a lot of energy is needed which **increases CO_2 emissions at refineries.**

Therefore, a complete removal of sulphur from marine fuels would be very negative for climate change.

What about the effects from SO_X and NO_X on crew members? Unlike cars in the cities, whose emissions are produced directly on the population, **ships have high funnels which do not allow their emissions to depose on the vessel and its crew members.**

During their stay at European ports, vessels must burn 0.1% sulphur marine fuel, considered as a safe limit by the IMO and the EU. Since 2011, nowhere in Spain the SO_2 *«limit values»* were exceeded, according to the 2018, Air Quality Report from the Spanish Ministry of Ecological Transition.

This is because it would not be viable yet. **There are still no technologies available to eliminate GHG emissions** from maritime transport. The same happens with air transport.

In the case of land transport, it is much more viable the **electrification**, because the vehicles' autonomy does not need to be that big. But this only assures full decarbonization if the **electricity comes from renewable sources.**

In maritime transport there are different ways to reduce GHG emissions:

Using LNG as fuel reduces them between a 7% to a 21%, depending on the engine type and methane slip (according to a recent report by the consultancy firm Thinkstep). Some shipping companies, like the Spanish Balearia, have invested in 9 vessels which use LNG as fuel.

The installation of wind power systems to help propulsion could save fuel and emissions between 4% and 7%.

Introducing energy saving measures, either to reduce the vessel's hydrodynamic resistance or to improve the engines performance.

The application of digitalization techniques in order to optimize vessel's speed, etc.

The use of alternative fuels which could be available in the future (see point 9).

Completely eliminating GHG in maritime transport implies a technological challenge that has no solution for the moment.

8 ¿Can a solution be connecting ships to the land's electricity grid during their stay at ports?

The connection of vessels to the land electricity grid eliminates their emissions during their stay at ports. It is a good solution for the polluting emissions **if the electricity is not generated in the same port** and comes from a renewable source. Otherwise it could produce NOx emissions and be counterproductive in respect of the purpose pursued.

In relation to GHG emissions, the electricity produced on land does not imply any advantage in respect to the energy produced on board unless they come from renewable sources.

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9 What are scrubbers and which are their effects?

Scrubbers are equipment that purify the exhaust gases from the engines, eliminating the SOx, PM and PAH. With the installation of scrubbers, vessels can still burn Heavy Fuel Oil (HFO) and hence GHG emissions are also reduced in the refineries

There are two types of scrubbers: **closed loop** (which keep the washing waters on board) and **open loop.** The IMO has regulated the sea discharge of scrubbers washing waters through Guidelines.

Some ports (Singapore, Hamburg, Antwerp…) have announced that they are going to prohibit the use of open loop scrubbers at their ports without having any scientific evidence to do so. For this reason, **the IMO has started to review those Guidelines.**

! Some recent studies indicate that, thanks to the elimination of Polycyclic Aromatic Hydrocarbons (PAH), it is better for air quality to use heavy fuel oil (HFO) and scrubbers than distillate fuels.

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9 How could GHG emissions be eliminated?

Among all possible technologies or fuels which can contribute to the full decarbonization of maritime transport, those considered today as the most feasible are:

Hydrogen: clean fuel and without GHG emissions. The disadvantage is its very low point of liquefaction (-253°C). Not available commercially on a short or medium-term basis.

Ammonia: it can be used directly in internal combustion engines or as a «hydrogen carrier». Not available commercially on a short-term basis.

Batteries and hybrid systems: already in use but they are only viable for very short distance traffic.

Biofuels: there are already fuels whose net emissions are zero and have been tested with positive results however the main problem being its massive production.

* Where do nitrogen, sulphur, carbon and oxygen of emissions come?

Both polluting and greenhouse effect gases are made from **nitrogen, sulphur, carbon and oxygen.** However, the origin of these elements is not the same. **Carbon and sulphur** are part of the composition of the fossil fuels that today move the world and hence vessels.

Nitrogen (78%) and **oxygen** (21%) are the main components of the air we breathe, they make vessels engines work (as well as cars, trains and planes) and during combustion they give out nitrogen oxides. However, reducing drastically those NO_x emissions, would reduce the engines' performance and increase CO_2 emissions.

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