

# HOW CAN WE REDUCE BLACK CARBON EMISSIONS FROM INTERNATIONAL SHIPPING?



Black Carbon (BC) is a harmful air pollutant and accounts for **7-21%** of shipping's climate warming impact

To address the impact of ship BC emissions on the Arctic, the **International Maritime Organization (IMO)** has started a 3-step work plan:



BC is "a distinct type of material containing carbon or its compounds, formed only in flames during combustion of carbon-based fuels". It has a unique combination of four physical properties:

- 1 It strongly absorbs visible light
- 2 It is refractory; that is, it retains its basic form at very high temperatures
- 3 It is insoluble in water and in organic solvents
- 4 It exists as an aggregate of small carbon spherules

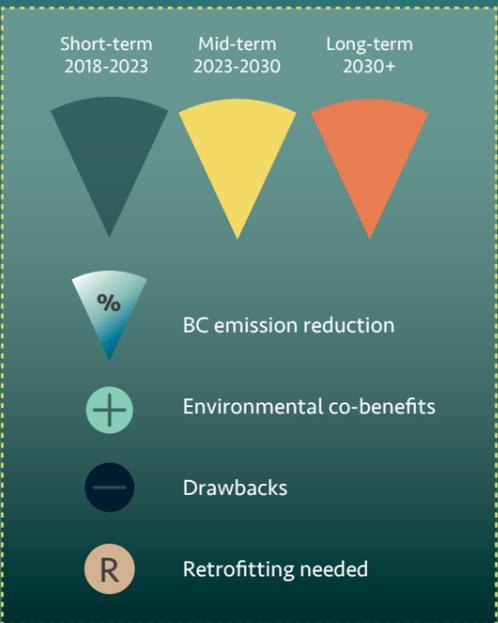
Following several years of research, a workshop hosted by the International Council on Clean Transportation (ICCT) in 2017 recommended three measurement methods, identified as reliable, robust and easy to use:

- 1 Filter Smoke Number (FSN)
- 2 Photo Acoustic Spectroscopy (PAS)
- 3 Laser Induced Incandescence (LII)

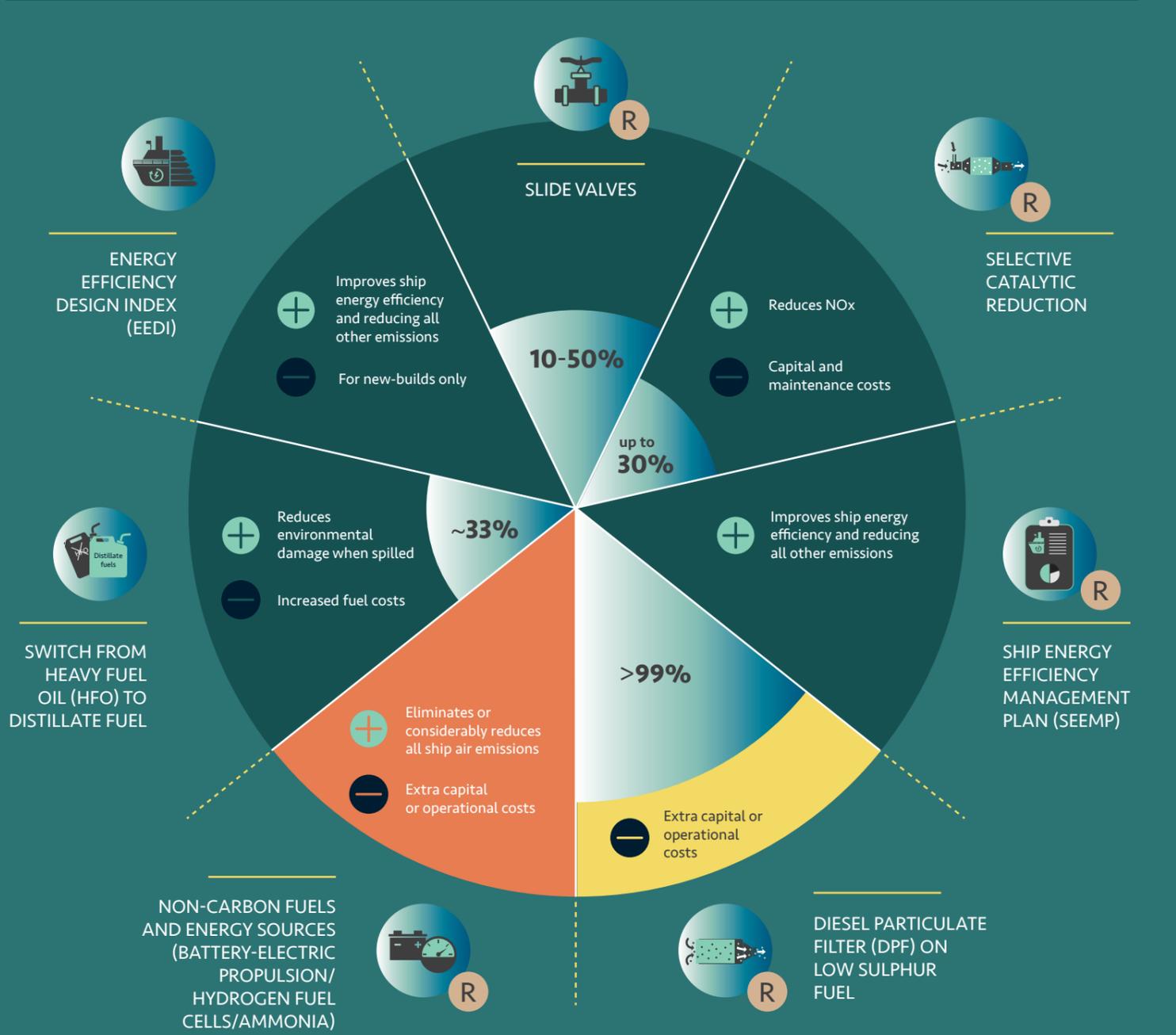
IMO needs to now start investigating and recommending the most appropriate **abatement measures** among those available and under development.

## ...SO WHAT ARE THE MOST EFFECTIVE ABATEMENT OPTIONS?

FUEL QUALITY	VESSEL DESIGN	ENGINE OPTIONS	VESSEL RETROFIT	EXHAUST TREATMENT	EXHAUST TREATMENT	DECARBONISATION
<b>SWITCH FROM HEAVY FUEL OIL (HFO) TO DISTILLATE FUEL</b>	<b>ENERGY EFFICIENCY DESIGN INDEX (EEDI)</b>	<b>SLIDE VALVES</b>	<b>SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)</b>	<b>SELECTIVE CATALYTIC REDUCTION (SCR)</b>	<b>DIESEL PARTICULATE FILTER (DPF) ON LOW SULPHUR FUEL</b>	<b>NON-CARBON FUELS AND ENERGY SOURCES</b>
BC emissions drop when switching from residual to distillate fuels.	Adopted in 2011, EEDI requires progressive improvements in efficiency of new ships, which result in reduction of air emissions.	Retrofitting old engines with slide valves can improve their efficiency. This has become a standard practice with new engines.	Adopted in 2011, SEEMP provides guidelines for improving ship efficiency via retrofit or operational measures.	Existing studies report BC reduction potential of SCR, but more research is needed.	DPFs drastically reduces BC emissions and is more efficient with low sulphur fuels.	In the long-term, ships must switch away from carbon-based fuels to reduce/eliminate both BC and GHG emissions.



## ZOOMING INTO THE TOP BLACK CARBON ABATEMENT OPTIONS



Sources: Lack, D. (2017); Comer, B., Olmer, N., Mao, X., Roy, B., and Rutherford, D. (2017).

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