

the Sustainability EducationAl programme for greeNER fuels and enerGY on ports



#### Module #3: Technologies and Techniques for energy transition – Part 1



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### Introduction



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#### Part1

- Global CO2 emissions of shipping
- IMO (International Maritime Organisation) Targets
- Actual ship and port technologies

Part2

- Comparison of Alternative Energy Carriers for Ships
- Forecast of Future Technologies
- The Role of Ports







# **Global CO2 impact of shipping industry**

FIGURE 6 Global emissions by sector





Source: Rhodium Group

https://rhg.com/research/global-greenhouse-gas-emissions-2022/



# CO2 Emissions by ship types



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#### IMO DCS share of CO2 emissions in 2019 (614m tonnes)

#### EU MRV CO2 share of CO2 emissions in 2019 (145.5m tonnes)



https://www.lloydslist.com/LL1136035/Shippings-big-three-account-for-almost-80-of-CO2-emissions



# International Maritime Organisation (IMO) - Targets



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#### Strengthened IMO strategy on GHG reductions



Total: Well-to-wake GHG emissions; Intensity: CO<sub>2</sub> emitted per transport work; Fuel: Uptake of zero or near-zero GHG technologies, fuels and/or energy sources

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https://ammoniaenergy.org/articles/theimo-charts-a-course-to-net-zero/



# Decarbonisation of Shipping

#### A wide variety of design, operational and economic solutions



https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx





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### Heavy Fuel Oil Production



https://www.oiltanking.com/en/news-info/glossary/the-petroleum-refining-process.html



## Marine Fuels



#### ISO 8217 Petroleum Products – Fuel (class F)

- MGO (Marine Gas Oil)
- MDO (Marine Diesel Oil)
- IFO (Intermediate Fuel Oil
- MFO (Medium Fuel Oil)
- HFO (Heavy Fuel Oil)

a distillate fuel oil (No. 2, Bunker A) a blend of MGO and HFO a blend of MGO and HFO, with less gasoil than MDO a blend of MGO and HFO, with less gasoil than IFO a residual fuel oil (No. 6, Bunker C)







# Sulfur limits in Marine Fuel Oil







https://www.sustainable-ships.org/rules-regulations/eca

Marine Fuel	max. Sulfur		
High Sulfur Fuel Oil (HSFO)	3,5%	Allowed with Scrubber	
Low Sulfur Fuel Oil (LSFO)	1,0%	Allowed with Scrubber	
Very Low Sulfur Fuel Oil (VLSFO)	0,5%	Except ECA	
Ultra Low Sulfur Fuel Oil (ULSFO)	0,1%	Worldwide	





Our World in Data

# SOx Emissions – Shipping Sector

- Until 2020 ~ 11% of global SOx emissions
- SOx Emission Reduction of ~60 % Sulphur dioxide emissions by sector, World
- After 2020 ~ 4% of global SOx emissions



Sulphur dioxide (SO<sub>2</sub>) is an air pollutant formed from the burning of fuels that contain sulphur, such as coal.  $SO_2$  is one of the main





#### Actual Marine Fuels & Prices



https://www.seaboardmarine.com/marine-fuel-weekly-averages/



# Scrubber



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https://www.dnv.com/expert-story/maritime-impact/Scrubbers-at-a-glance/



### **Slow Steaming**



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- Since 2008 container ships slowed down
- E.g. Slowing down of 12,5% 400 1eads to reduce 33 % 300 of fuel consumption 400 250



#### Fuel Consumption by Containership Size and Speed



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# **Bulbous Bow**

- Reduce water drag
- Up to 15% better fuel efficiency





- 1. Profile of bow with bulb
- 2. Profile of bow without bulb
- 3. Wave created by bulb
- 4. Wave created by conventional bow
- 5. Waterline and region of cancelled waves







# Wind Assisted Propulsion System WAPS

- 5-10% of fuel saving potential
- Depending on the routes and ships a good fuel saving possibility
- Different sail types





https://www.dnv.com/maritime/insights/topics/waps-wind-assisted-propulsion-systems/



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# Hybrid Engines



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- Higher propulsion efficiency with up to 15% fuel reduction
- Only electric driving in emssions zones possible



https://www.wartsila.com/marine/products/ship-electrification-solutions





## Electrification



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#### MV Ampere (2015) El. Ro-Ro Car Ferry

#### Yara Birkeland (2022) El. Container Ship 120TEU



https://corvusenergy.com/projects/mf-ampere/



https://www.yara.com/news-and-media/media-library/image-library/



## Shore Power



- Ships need electrical energy at ports for onboard systems
- In tradition done by auxilary diesel engine
- Emission reduction by external electrical Shore Power supply





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#### **Conclusions and take home message**

#### Learning objective 1

- Understanding of global CO2 emissions and the portion of the shipping sector
- Review of the legal and technological developments of the last decades in connection to the GHG emissions







#### **Conclusions and take home message**

#### Learning objective 2

- Identify technical solutions for reducing fuel consumption and the corresponding GHG emissions
- Illustrate of actual technologies for emission reduction





#### References



- <u>https://www.emsa.europa.eu/sustainable-shipping/alternative-</u> <u>fuels.html</u>
- DNV, Energy Transition Outlook 2024, MARITIME FORECAST TO 2050







#### Additional reading materials

- Masterclass Emission Control Area
  - https://www.sustainable-ships.org/rules-regulations/eca
- Our World in Data
  - https://ourworldindata.org/air-pollution#all-charts
- DNV, Energy Transition Outlook 2024, MARITIME FORECAST TO 2050
- EMSA, Alternative Sources of Power

https://www.emsa.europa.eu/sustainable-shipping/alternative-



fuels.html





#### THANK YOU FOR YOUR ATTENTION

