UNEP Shipping

Electrification of shipping
T&E:

26 Countries

61 Members

5 National experts
Founding member of CSC
Founding member of **Clean Arctic Alliance**
Climate change is affecting the world’s oceans modifying their temperature, nutrient supply, water chemistry, wind systems, and ocean currents, dramatically impacting marine biodiversity. The situation is no different in the Mesoamerican Reef, the second largest reef in the world.

Climate change is exacerbating anthropogenic (e.g., water pollution, land run off, overfishing) and natural (e.g., storms, coral disease) threatening the heart of Caribbean culture and economies.

VULNERABILITY TO SEA LEVEL RISE

Numerous model predictions foresee a sea level rise of 1 additional meter by 2100, which would displace millions of people and would cause billion-dollar losses in infrastructure.

CORAL BLEACHING

Healthy coral: Healthy coral with zooxanthellae in coral tissue.

Coral bleaching: Coral expelled zooxanthellae from tissue caused by thermal stress.

Dead corals are not able to recover its zooxanthellae starve to death.
The shipping industry emits over 1 BILLION TONNES OF CO2 per year.
Air pollution from shipping

★ 400,000 premature deaths / year
★ Tiny airborne particles (PM) cause premature death through lung & heart disease.
★ 6.4 Million childhood asthma cases

Black Carbon emissions from Ships

**Problem**
- 7-21% Ship Climate impact

**Solution**
- Switch to distillate fuels
- Transition to renewable fuels
- Avoid Arctic routes

**Policy at IMO**
- Decision on distillate fuel switch at Marine Environment Protection Committee next week!
The current proposal at IMO to tackle climate change is not aligned with the Paris Agreement Goals. We need to reduce emissions by 7% annually to meet the 1.5°C goal.

Source: https://theicct.org/blog/staff/imo-carbon-intensity-target-may2021
# Shipping Climate Regulation

<table>
<thead>
<tr>
<th></th>
<th>IMO</th>
<th>EU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-term target</strong></td>
<td>-50% by 2050/2008</td>
<td>Climate Law/2030 target</td>
</tr>
<tr>
<td><strong>Data collection</strong></td>
<td>Data Collection System (DSC)</td>
<td>MRV</td>
</tr>
<tr>
<td><strong>Design CO₂ standard</strong></td>
<td>Energy Efficiency Design Index (EEDI)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Operational efficiency/ CO₂ standard</strong></td>
<td>Carbon intensity indicator (CII)</td>
<td>-</td>
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<tr>
<td><strong>MBM</strong></td>
<td>Fuel levy</td>
<td>ETS</td>
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<tr>
<td><strong>Fuel/Energy standard</strong></td>
<td>-</td>
<td>FuelEU Maritime</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>-</td>
<td>AFID</td>
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"Fair share" decarbonisation of EU shipping

EU shipping needs to slash 90Mt CO$_2$/year in the next decade.

Note: "Fair share" trajectory envisages a -55% 2030 target (vs 1990) & -100% by 2050, compatible with the EU’s overall climate goals. "Fair share" assumes that shipping’s share in the overall EU emissions/ decarbonisation remains constant.
Up to 1/3 of maritime GHG can be removed by efficiency alone. But need e-fuels for the rest.
At its peak renewable electricity need, shipping would require to install each year 1.5x the total wind capacity installed in 2019 in Europe.
What are the realistic & sustainable technologies?

- Battery-electric
- Hydrogen fuel-cells
- Green ammonia
- Wind propulsion
<table>
<thead>
<tr>
<th></th>
<th>Direct electrification</th>
<th>Hydrogen</th>
<th>Power-to-liquid (diesel)</th>
<th>Power-to-liquid (petrol)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>2020      2050</td>
<td>2020     2050</td>
<td>2020  2050</td>
<td>2020  2050</td>
</tr>
<tr>
<td>Electrolysis</td>
<td>100%       renewable    electricity</td>
<td>100%    renewable electricity</td>
<td>100%  renewable electricity</td>
<td>100%  renewable electricity</td>
</tr>
<tr>
<td>( \text{CO}_2 )</td>
<td>air-capture    and FT-synthesis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation,</td>
<td>storage and</td>
<td>distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>efficiency</td>
<td>94%</td>
<td>89%</td>
<td>72%</td>
<td>72%</td>
</tr>
<tr>
<td>Fuel production</td>
<td>94%</td>
<td>68%</td>
<td>55%</td>
<td>55%</td>
</tr>
<tr>
<td>efficiency</td>
<td>(charged)</td>
<td></td>
<td>(charged)</td>
<td>(charged)</td>
</tr>
<tr>
<td>Charging equipment</td>
<td>95%</td>
<td></td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>Battery</td>
<td>charge efficiency</td>
<td></td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>( \text{H}_2 )</td>
<td>to electricity</td>
<td>conversion</td>
<td>54%</td>
<td></td>
</tr>
<tr>
<td>conversion</td>
<td>95%</td>
<td></td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>Engine/motor</td>
<td>efficiency</td>
<td>95%</td>
<td>95%</td>
<td>36%</td>
</tr>
<tr>
<td>overall efficiency</td>
<td>77% 81%</td>
<td>33% 42%</td>
<td>20% 22%</td>
<td>16% 18%</td>
</tr>
</tbody>
</table>

Notes: To be understood as approximate mean values taking into account different production methods. Hydrogen includes onboard fuel compression. Excluding mechanical losses.
Current limitations batteries for shipping

Rotterdam-Harwich ferry (~230 km distance)

Singapore-Rotterdam container ship (~15,000 km distance)

**T&E analysis:** modelled on per journey operational costs of the Selandia Seaways; based on 25 year ship lifetime, historical operations of 250 days per year and 2 journeys per day with a speed of 18 knots. CAPEX values are based on a 10% discount rate. Costs are shown in €/journey.
Why isn’t the uptake happening on its own?

Barriers

- Expensive H2
- Lack of fuel infrastructure
- Lack of demand
- Modal shift
- Safety risks
- Technical risks
- Finance system
- Trade concerns
- Climate change denialism
- Political salience
- Conservative industry
- Tech costs
- Fossil interests
- Low fuel density
How to incentivise electrification

Transparency and myth busting
★ Technical evidence and data
★ Environmental/climate benefits
★ Public pressure

Mandates & State aid
★ Exclusive licensing for ZEVs
★ Public service obligations
★ Subsidising ZEVs and shore-side infrastructure

Regulatory corrections
★ Electricity tax exemptions for OPS
★ Zero emissions at berth standard
★ Designate Emission Control Area (ECA)
★ Malus schemes: CO2/NOx charges
★ Port discounts for clean ships
Infrastructure for electrification / shore power

- Ship plugged into shore power
- Ship exchanging into containerised battery pack to use for propulsion
Amsterdam goes fully electric
Electric ferry - Ampere - Norway
Electric ferry - Ellen - Denmark
Hybrid electric Cruise ship - Hurtigruten - Arctic
Hybrid diesel electric sailing cruise ship
Battery Electric Inland Barge For Cargo
Ocean Bird hybrid sail cargo
SAILCARGO BLENDS OLD AND NEW IN SAILING FREIGHT VENTURE

IN A COSTA RICAN 'JUNGLE SHIPYARD', A SMALL TEAM IS BUILDING CEIBA, A COMBUSTION-FREE CARGO SAILING VESSEL THAT AIMS TO COMBINE TRADITIONAL SHIPBUILDING TECHNIQUES WITH AVANT-GARDE DESIGN. CHRIS LO FINDS OUT MORE FROM SAILCARGO MANAGING DIRECTOR DANIELLE DOGGETT
Find out more on transition to zero emission shipping in our latest report
Lucy Gilliam

Aviation & Shipping Campaigner

Transport & Environment
The advanced biofuels are too limited

Advanced biofuels won't be enough to decarbonise aviation by 2050

Focus on scalable technologies: electrofuels & hydrogen

NOT biofuels

Notes: T&E assumptions for aviation energy demand by 2050 are based on 2016 European Reference Scenario and take into account $150/CO2 carbon price and aircraft efficiency improvements. T&E assumes 7.5Mtce of the available stock of advanced biofuels would be used for aviation.

Notes: The chart is conservative as it compares 2050 supply with 2017 demand. This supply would only be feasible at a retail price of €6300/t (excluding taxes), which is more than 10 times higher than the current LNG prices. Energy demand for households is limited to natural gas demand only.

No subsidies to LNG ships: cure worse than the disease

Source: ICCT, 2020. Note: Medium speed, 4-stroke engines, which are the most wide-spread LNG engines among cruise vessels.
World Bank calls on regulators not to support LNG

“Over concerns about methane leakage, which could diminish or even offset any GHG benefits associated with LNG, and additional capital expenditures, the risk of stranded assets as well as a technology lock-in, the report concludes that LNG is unlikely to play a significant role in decarbonizing maritime transport.”

“The research further suggests that new public policy in support of LNG as a bunker fuel should be avoided, existing policy support should be reconsidered, and methane emissions should be regulated.”
7% e-fuels by 2030 would kickstart the decarbonisation of EU shipping.
Combined energy efficiency and e-fuels would save the industry up to 12bn€ to fully decarbonise by 2050.
Maritime industry supports green H2 and ammonia

Future of shipping fuel is green hydrogen and ammonia, industry groups tell EU

For immediate release - 4 March 2021, Brussels
Link to PR: https://transenv.eu/3uQzSvE

The EU should promote the use of green hydrogen and ammonia by ships as part of its upcoming maritime fuel law, major shipping industry players and environmentalists have told the European Commission. The FuelEU Maritime initiative will require ships carrying EU trade to progressively switch to sustainable alternative fuels.

In a letter published today [1], shipping companies DFDS, CMB and Viking Cruises, commodities trader Traffigura, and green group Transport & Environment (T&E) say green hydrogen and ammonia are sustainable and can be produced in sufficient quantities to decarbonise the industry.

Biofuels, on the other hand, do not offer a sustainable alternative for shipping, the groups say, as crop-based biofuels emit more than the fossil fuels they replace and there will not be enough advanced biofuels. Instead, lawmakers must send a clear signal to potential investors to focus on renewable electricity-
What do the shipyards say?

**Dalian Shipbuilding Industry** (China) - world’s largest shipyard
- Ammonia - *The Closest Alternative to an Ideal Fuel*
- Even the largest vessels can be powered - 23 000 TEU
- Enough autonomy for a single trip from S. Korea to Poland
- Multiple refueling can be realised along the route - already existing ammonia discharge/loading ports

**Daewoo Shipbuilding & Marine Engineering** (S. Korea)
- Ready to commercialise 23 000 TEU container ship by 2025

**Hyundai Mipo & Samsung Heavy Industries** (S. Korea)
- Ready to commercialise 50000-125000 DWT tankers by 2024/2025
Major opportunities for Maritime Climate Fund

De-risking initial deployments via contracts for difference (CfD)

Reduce administrative burden
ETS obligation is **limited** to paying for GHG emissions, as opposed to emissions trading.

Compatible with future IMO MBMs
ETS fund mimics a **CO₂ levy**, similar to global fuel proposals by the industry.

Learn more: [https://www.transportenvironment.org/publications/how-decarbonise-shipping-industry](https://www.transportenvironment.org/publications/how-decarbonise-shipping-industry)
Insignificant impact of including ETS on consumer goods

<table>
<thead>
<tr>
<th>Product</th>
<th>Origin</th>
<th>Destination</th>
<th>Distance</th>
<th>Ship CO2 emitted per item</th>
<th>Additional costs with shipping in the ETS with €50/tonne CO2</th>
<th>Old Price in Belgium* without ETS</th>
<th>New price in Belgium* with ETS</th>
<th>Price increase due to ETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana (single)</td>
<td>Ecuador</td>
<td>Netherlands</td>
<td>10464 km</td>
<td>22 g</td>
<td>0.11000 € Cents</td>
<td>1.200</td>
<td>1.207 €/kg of banana</td>
<td>0.5500%</td>
</tr>
<tr>
<td>iPad (single)</td>
<td>China</td>
<td>Denmark</td>
<td>19327 km</td>
<td>55 g</td>
<td>0.27500 € Cents</td>
<td>550</td>
<td>550.003 €/iPad</td>
<td>0.0005%</td>
</tr>
<tr>
<td>Grain (1 kg)</td>
<td>Brazil</td>
<td>Holland</td>
<td>10416 km</td>
<td>21 g</td>
<td>0.10500 € Cents</td>
<td>0.16</td>
<td>0.161 €/kg of grain</td>
<td>0.6562%</td>
</tr>
<tr>
<td>Diesel (1 litre)</td>
<td>USA</td>
<td>Italy</td>
<td>8575 km</td>
<td>24 g</td>
<td>0.12000 € Cents</td>
<td>1.4</td>
<td>1.401 €/litre of diesel</td>
<td>0.0857%</td>
</tr>
</tbody>
</table>

Source: Estimates made by T&E based on product emissions data from Danish shipping: [www.navigatingresponsibly.dk](http://www.navigatingresponsibly.dk)
T&E priorities (in Europe)

- **Polluter pays principle + De-risking initial deployments via EU carbon markets**
  - CO2 in use requirements for ships sailing to the EU.

- **Predictable demand for investments in green marine fuel production**
  - MANDATORY installation of charging & hydrogen/ammonia stations in ports.

- **Refueling infrastructure mandates in ports**
Ship Types

- **Container ships**
  - #: 5,009
  - $\text{CO}_2$: 22%
  - ![Container ship image]

- **Roll-on/Roll-off (Ro-Ro)**
  - #: 7,524
  - $\text{CO}_2$: 9%
  - ![Roll-on/Roll-off ship image]

- **Bulk carriers**
  - #: 11,435
  - $\text{CO}_2$: 20%
  - ![Bulk carrier image]

- **General cargo ships**
  - #: 10,973
  - $\text{CO}_2$: 6%
  - ![General cargo ship image]

- **Tankers**
  - #: 12,802
  - $\text{CO}_2$: 24%
  - ![Tanker image]

- **Cruise ships**
  - #: 477
  - $\text{CO}_2$: 5%
  - ![Cruise ship image]