ZERO-CARBON SHIPPING
THE POTENTIAL FOR ZERO-CARBON BUNKER FUEL PRODUCTION IN DEVELOPING COUNTRIES

Shipping webinar || Public || Thu, 2 Apr 2020 || 9:30-10:30 am EST
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Welcome – original plan

Source: Dominik Englert, 2019
Welcome – current situation

Source: Hapag-Lloyd, 2012
Welcome – short-term challenge ahead

Source: Reuters, 2020
Welcome – mid-/long-term challenge ahead

Source: Jan Hoffmann, 2016
1 Intro – Planning for low-carbon development

2 Analytics – Assessing the potential of countries

3 Q&A – Asking nice or challenging questions
1 Intro – Planning for low-carbon development

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Why is shipping a development issue?

Source: UNCTAD, Review of Maritime Transport 2019
Why does shipping matter for developing countries?

Key enabler for developing economies

- 15 out of the 20 largest ports
- 1.2 million jobs
- 9 of the top 10 ship registries
- Shipbreaking
- Crucial lifeline for SIDS
- and more…
What scale of investment is needed?

Source: GtZ Coalition, The scale of investment needed to decarbonize international shipping, 2020
What scale of investment is needed?

Source: GtZ Coalition, The scale of investment needed to decarbonize international shipping, 2020
What does this mean for developing countries?

Source: GtZ Coalition, The scale of investment needed to decarbonize international shipping, 2020
A potential investment opportunity of $1+ trillion

Not only, but also in developing countries

Source: GtZ Coalition, The scale of investment needed to decarbonize international shipping, 2020
OUTLINE

1 Intro – Planning for low-carbon development

2 Analytics – Assessing the potential of countries

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Shipping’s decarbonization pathway

The IMO has committed to reducing GHG from international shipping by at least 50% by 2050 (2008 baseline)

Efficiency gains alone insufficient, zero-carbon fuels required
The ‘zero’-carbon bunker fuels options for shipping

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Production process</th>
<th>Zero-carbon fuels</th>
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<tr>
<td>Biomass</td>
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<td>Haber-Bosch process</td>
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<td>Hydrogenation for alcohols synthesis</td>
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2 Analytics – Assessing the potential of countries
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Haber-Bosch process
Hydrogenation for alcohols synthesis
Direct Air Capture
Top sample candidates for zero-carbon bunker fuels

Leveraging more than 20 recent studies, ammonia and hydrogen have been selected as best exemplary technologies for this assessment.

Environmental criteria:
- GHG emissions
- scalability of energy sources
- air pollutants emissions
- other unintended consequence

Economic criteria:
- development status and scalability of the key technologies
- economic competitiveness over time
- overall energy efficiency

Technical criteria:
- physical and technical characteristic
- storage volume requirement
- toxicity to humans and aquatic life
- flammability

- NG-methanol
- bio-methanol
- bio-ethanol
- e-ammonia
- NG-hydrogen
- e-hydrogen
- NG-ammonia
- E-LNG
- e-methanol
- bio-LNG
Arising research questions

1. Which factors might influence the viability for production of ammonia/hydrogen?

2. Based on these factors, where could large-scale production of ammonia/hydrogen be imagined?

3. Could there be economic opportunities for developing countries?
Assessing the potential of countries to supply future low-zero carbon bunker fuels

Assessment criteria:

1. Potential to leverage existing infrastructure
2. Geographic location
3. Shipping volumes
4. Potential surplus of energy required
5. Adequacy of regulatory framework
Assessing the potential of countries to supply future low-zero carbon bunker fuels

<table>
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<th>#</th>
<th>Description</th>
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<th>Relative impact</th>
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<tbody>
<tr>
<td>1</td>
<td>Potential to reuse existing infrastructure</td>
<td>1</td>
<td>5%</td>
</tr>
<tr>
<td>2</td>
<td>Geographic location</td>
<td>2.5</td>
<td>13%</td>
</tr>
<tr>
<td>3</td>
<td>Shipping volumes</td>
<td>4</td>
<td>20%</td>
</tr>
<tr>
<td>4</td>
<td>Energy Resources required</td>
<td>10</td>
<td>50%</td>
</tr>
<tr>
<td>5</td>
<td>Regulatory framework</td>
<td>2.5</td>
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Identifying potential for ammonia/hydrogen production for shipping

e-ammonia/
e-hydrogen

Note: The identified potentials do not account for the production cost competitiveness.
Identifying potential for ammonia/hydrogen production for shipping

ng-ammonia/
ng-hydrogen

Note: The identified potentials do **not account** for the production cost competitiveness.
Comparing hydrogen costs with identified potential

**Hydrogen costs** from hybrid solar PV and onshore wind systems in the long run

*Source: IEA, The Future of Hydrogen Seizing today’s opportunities, 2019*

**Heatmap** indicating the potential for countries to produce e-ammonia/hydrogen for shipping
Conducting three cases studies

- Is there a potential for these countries to be a **key node on future supply chains**?
- What would be the **potential future demand** at country’s ports?
- What are the **energy resources required** to meet that demand?
- What would be the **investment implications**?
Example: analysis of Malaysia

Photovoltaic Power Potential in Malaysia
Source: Global Solar Atlas, 2020

Potential area for carbon dioxide sequestration in sedimentary basins of Malaysia
Source: Radzuan and Hasbollah, 2016

Oil and Gas reserves in Malaysia
Source: Coordinating Committee for Geoscience Programmes in East and Southeast Asia, 2001
Way forward
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Questions & Answers

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