

Providing alternative marine fuels: Supply-chain sustainability considerations, required infrastructure, and how IMO can help

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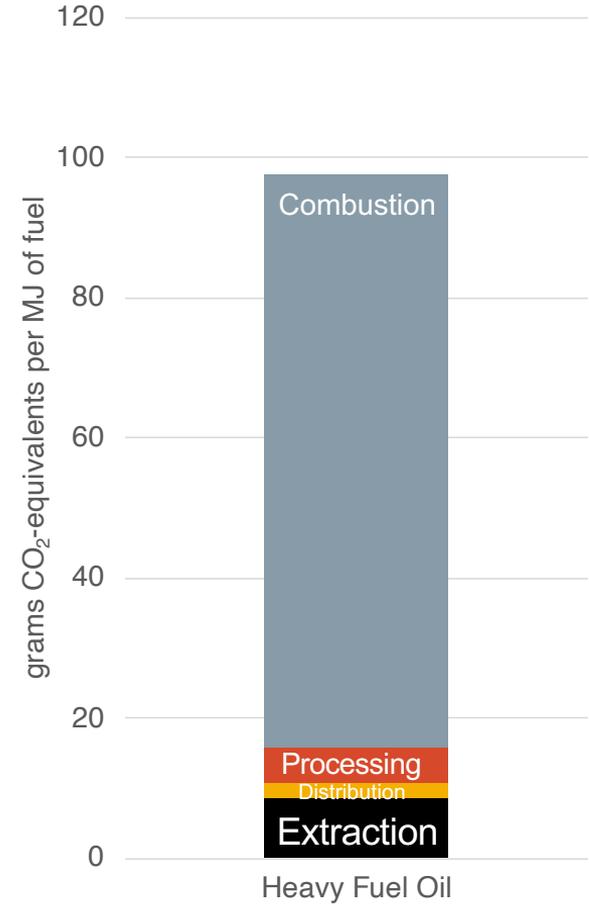
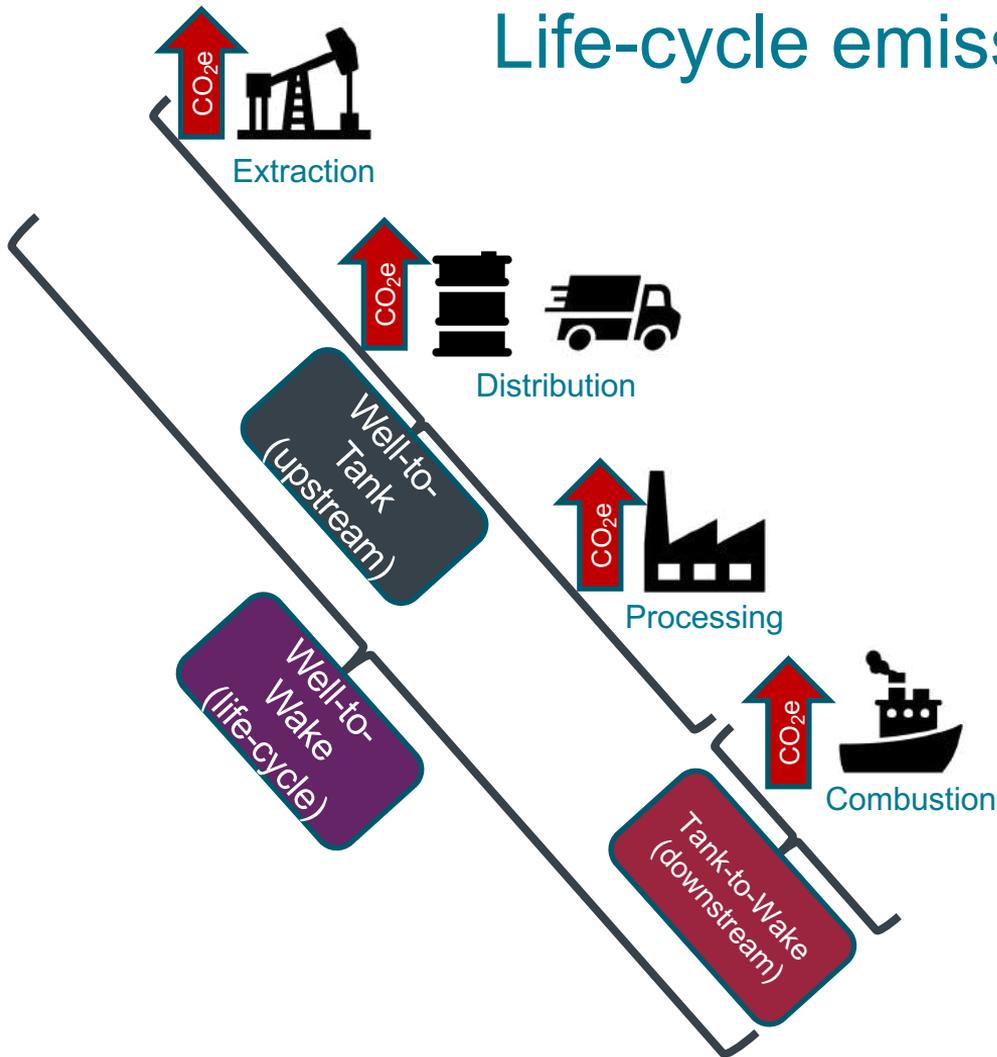
International Maritime Organization Symposium on
alternative low-carbon and zero-carbon fuels for shipping

What to expect

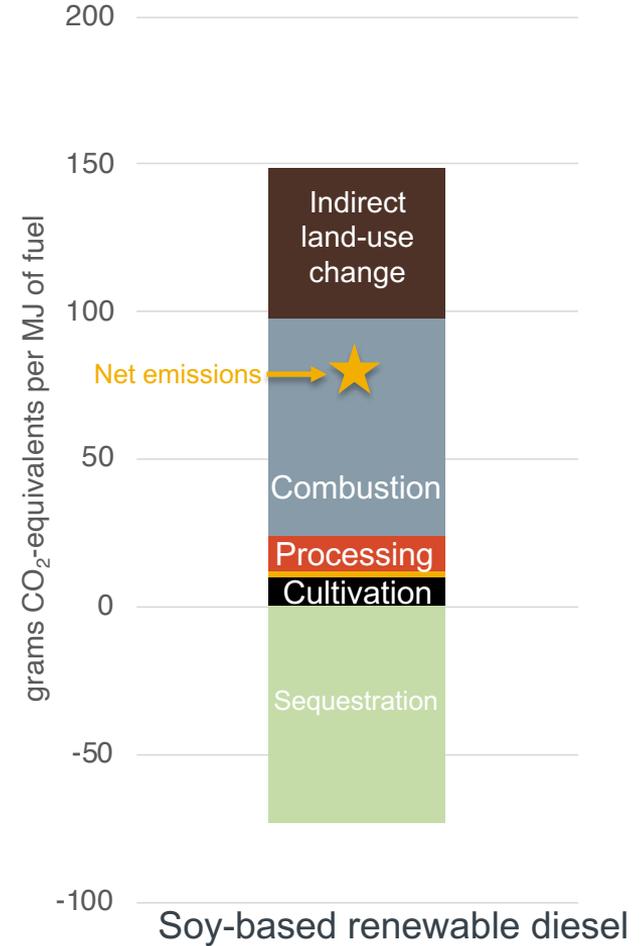
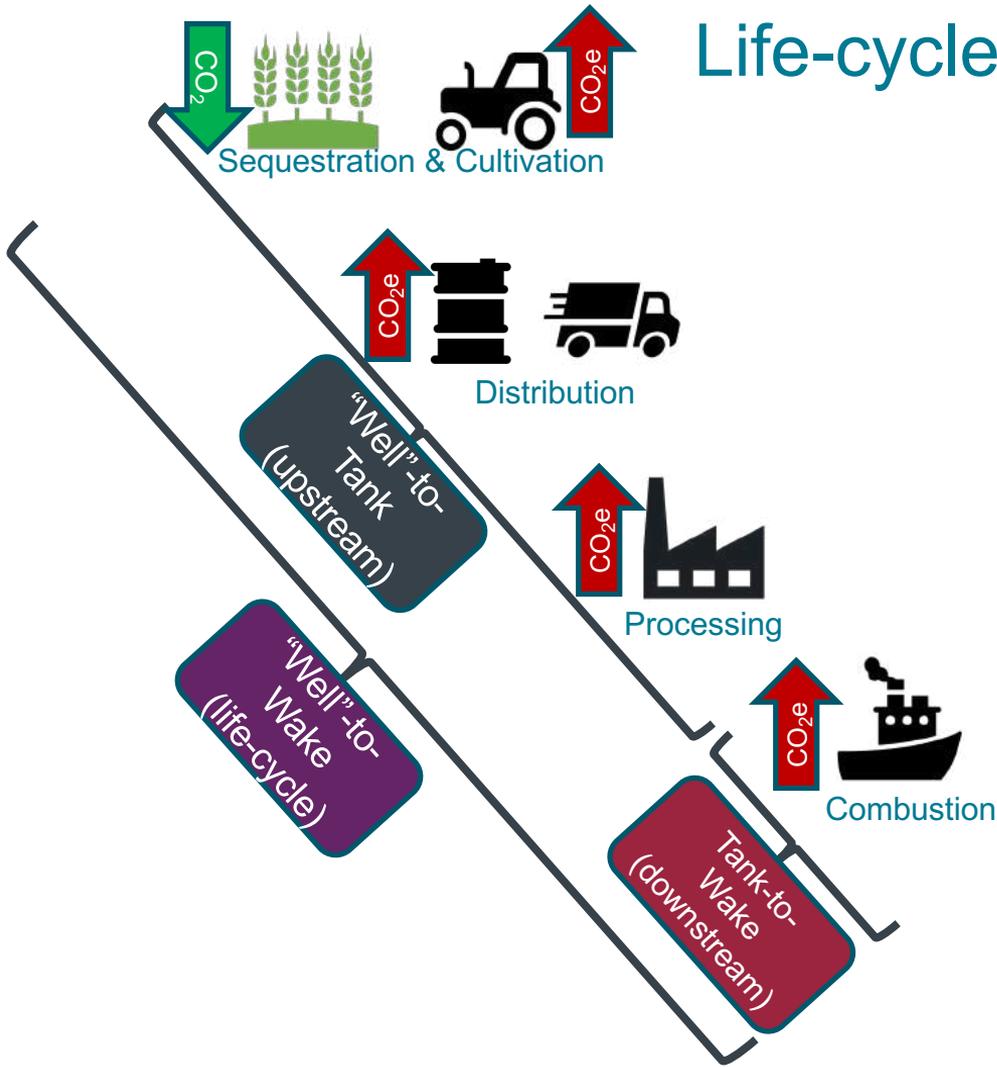
Today, I'll do the following:

- Explain the basics of life-cycle analysis
- Outline three principles for evaluating the “sustainability” of alternative marine fuels
- Give an example of where green hydrogen infrastructure investments could support zero-life-cycle emission container shipping
- Conclude with a summary of what IMO can do to ensure policies promote sustainable alternative marine fuels

Life-cycle emissions: fossil fuel example



Life-cycle emissions: biofuel example



Three Principles for Evaluating the “Sustainability” of Alternative Marine Fuels

Principle 1: Consider CO₂e not CO₂

Principle 2: Consider GWP20 not just GWP100

Principle 3: Consider well-to-wake not tank-to-wake

Principles for Evaluating the “Sustainability” of Alternative Marine Fuels

| Principle 1: CO₂e not CO₂ | | |
|--|--|--|
| <p>Why?</p> <p>Some fuels are “zero-carbon” but not zero-GHG</p> <p>Why is that important to IMO?</p> <p>IMO’s initial GHG strategy aims to reduce GHGs by at least 50% from 2008 levels by 2050 and to phase them out completely</p> <p>Some potential zero-carbon marine fuels still emit GHGs</p> <p>Example: burning ammonia (NH₃) does not emit CO₂ but does emit nitrous oxide (N₂O), a potent and long-lived GHG</p> <p>IMO regulations currently only regulate CO₂</p> <p>EEDI phase 4+ and the EEXI/CII could instead regulate CO₂e if the aim is to reduce GHGs</p> | | |

Principles for Evaluating the “Sustainability” of Alternative Marine Fuels

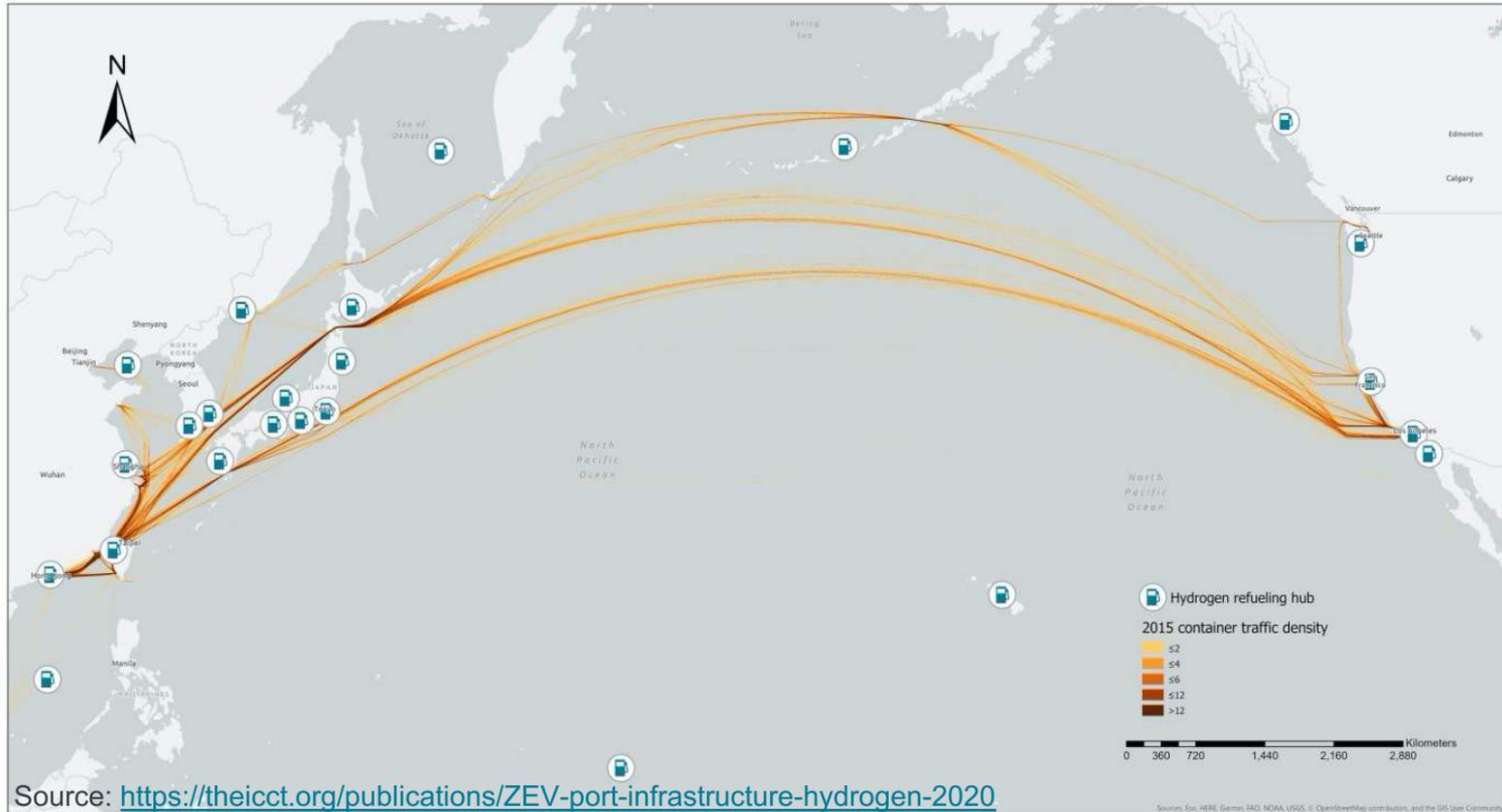
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Principles for Evaluating the “Sustainability” of Alternative Marine Fuels

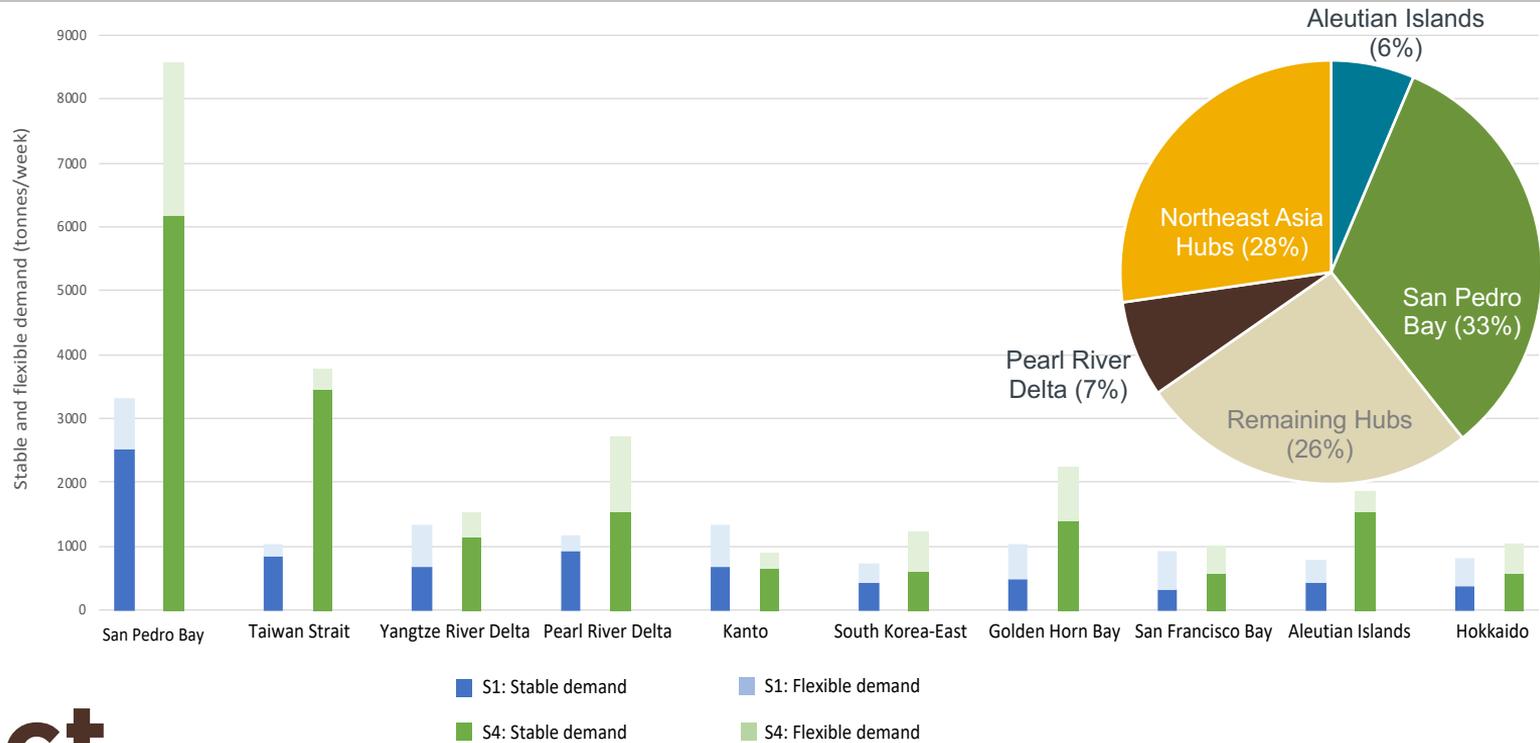
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Example of green hydrogen bunkering infrastructure to achieve zero-life-cycle emission transpacific container shipping

Where to put green hydrogen refueling stations?



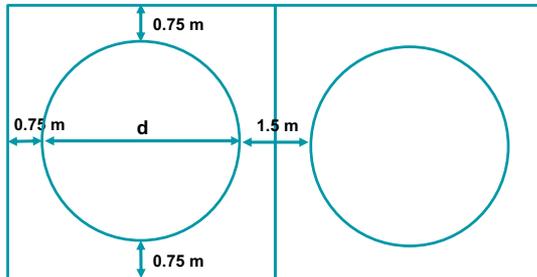
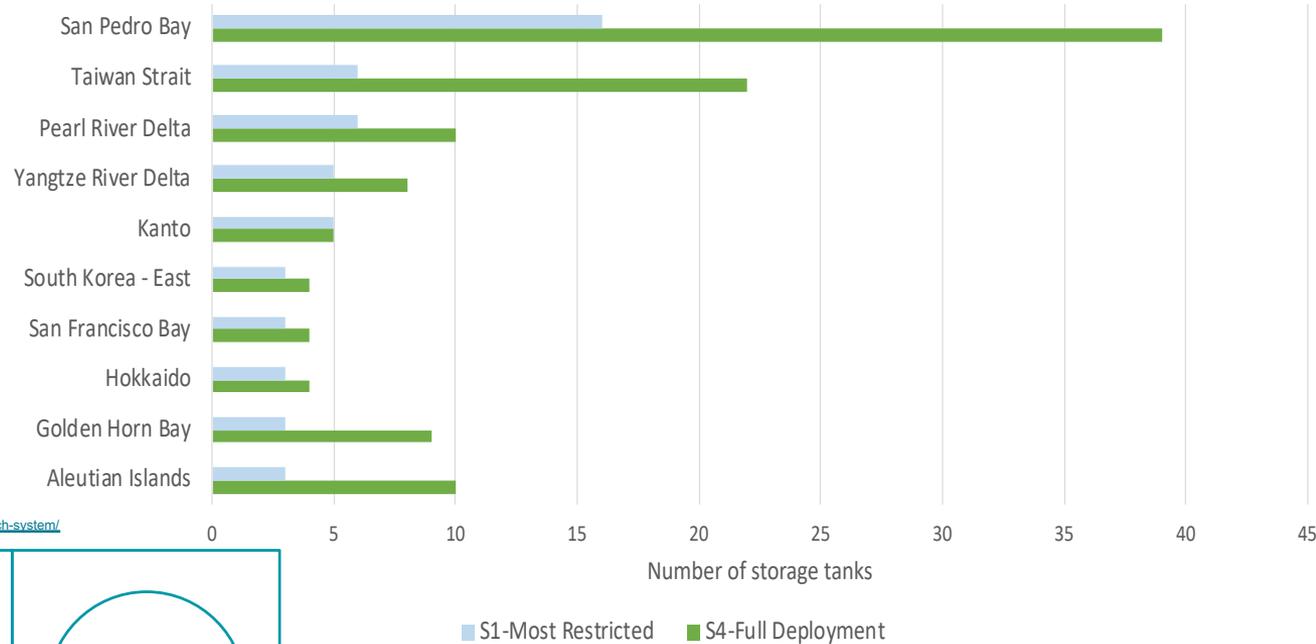
Expected demand of green hydrogen at ports



Green hydrogen storage considerations by port

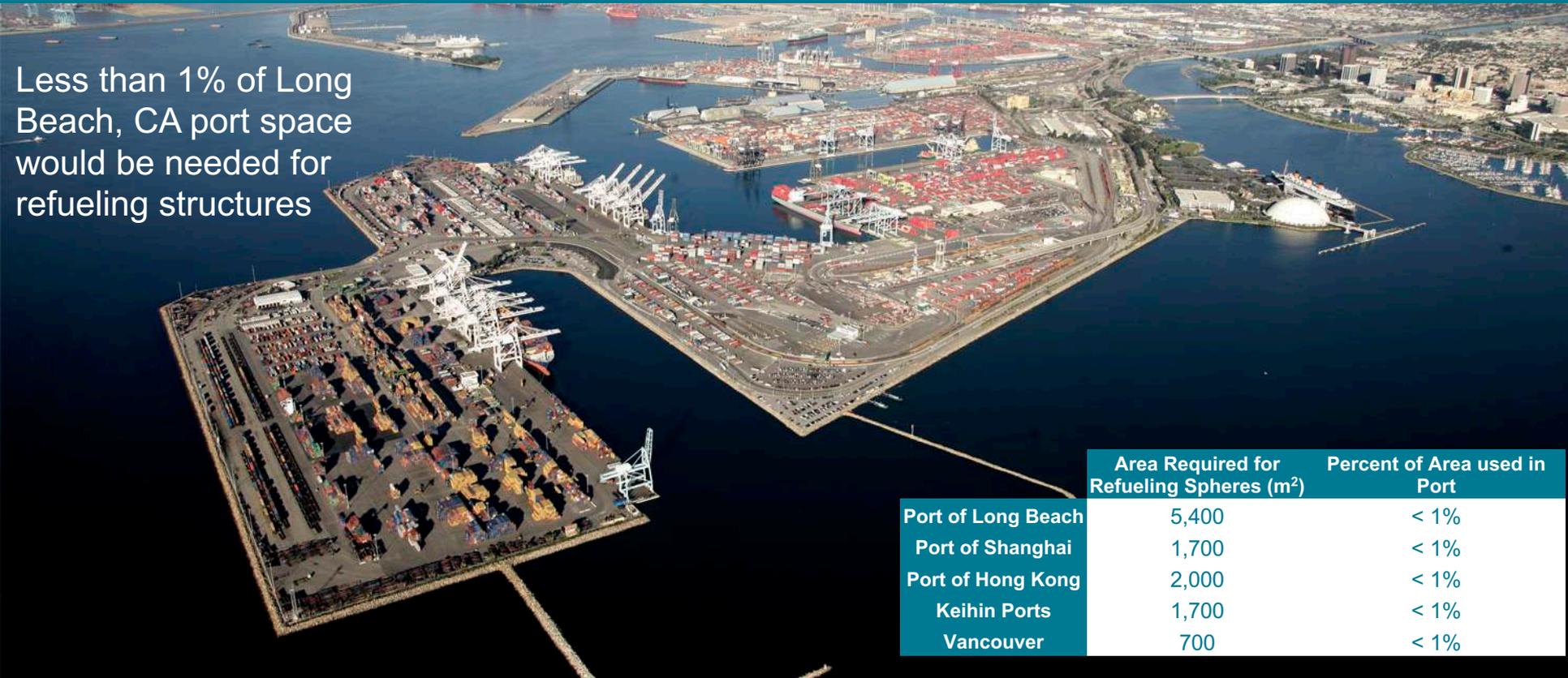


Picture source: <https://www.nasa.gov/feature/innovative-liquid-hydrogen-storage-to-support-space-launch-system/>



Land requirements for on-site storage tanks

Less than 1% of Long Beach, CA port space would be needed for refueling structures



| | Area Required for Refueling Spheres (m ²) | Percent of Area used in Port |
|--------------------|---|------------------------------|
| Port of Long Beach | 5,400 | < 1% |
| Port of Shanghai | 1,700 | < 1% |
| Port of Hong Kong | 2,000 | < 1% |
| Keihin Ports | 1,700 | < 1% |
| Vancouver | 700 | < 1% |

Source: <https://theicct.org/publications/ZEV-port-infrastructure-hydrogen-2020>

Picture Source: <https://lbpost.com/news/business/development/port-of-long-beach-to-host-community-forum-on-master-plan-update>

IMO could help ensure that policies promote sustainable alternative marine fuels by...

1. Replacing CO₂ with CO₂e in proposed and existing IMO regulations
2. Calculating CO₂e based on GWP20 for regulations meant to align with Paris Agreement temperature goals
3. Regulating well-to-wake CO₂e emissions in policies that promote the uptake of alternative marine fuels

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Questions or comments?
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ON CLEAN TRANSPORTATION