Port Risk Management

Building Resilience in a Changing Operational Environment

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Webinar CIP

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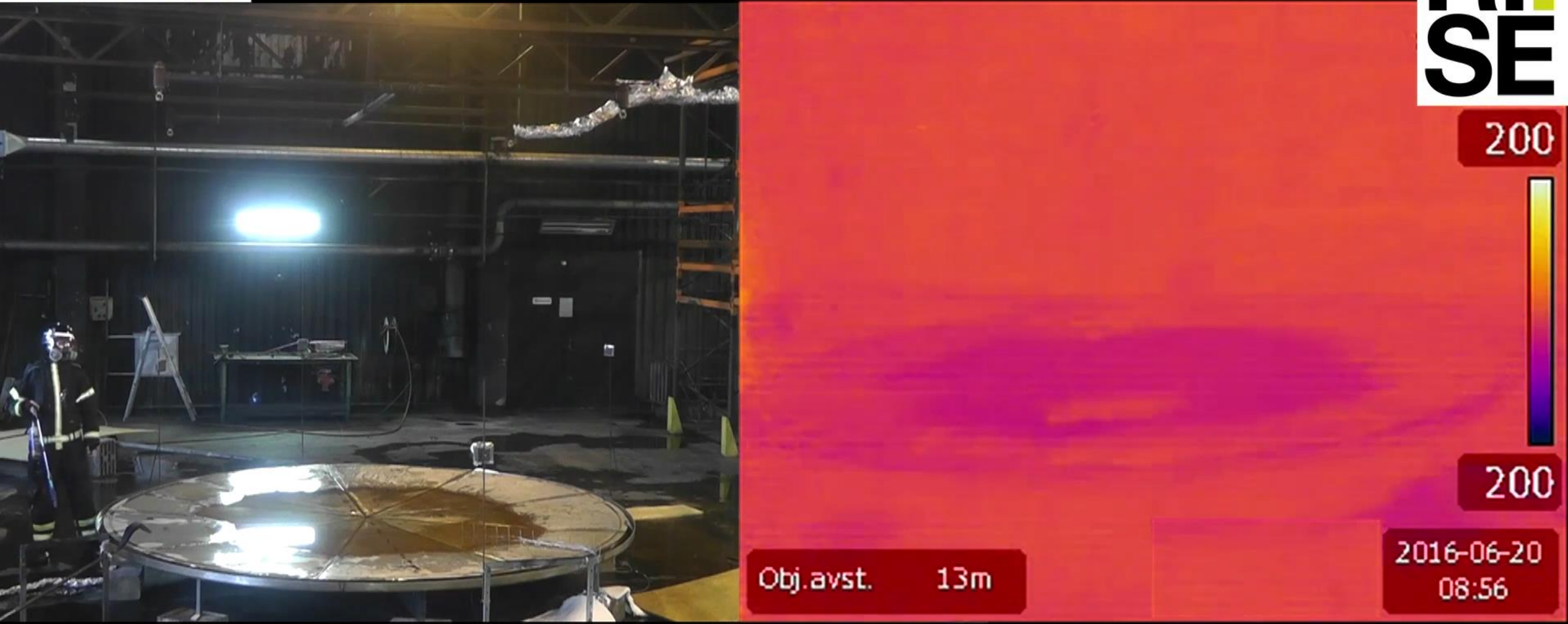
Comisión Interamericana de Puertos

Have you ever seen a methanol fire?

proFLASH
Protection against fire in low flashpoint fuel

RI.SE



Source: Evegren, F. (2017). proFLASH: Methanol fire detection and extinguishment : SP Rapport 2017:22. Retrieved from https://urn.kb.se/resolve?urn=urn:nbn:se:ri:diva-29442. Video available at https://www.youtube.com/watch?v=18eGaGHx_RU

Alternative Fuels

Some examples

LNG	LPG	Methyl/Ethyl Alcohols
Hydrogen	Ammonia	Biofuels

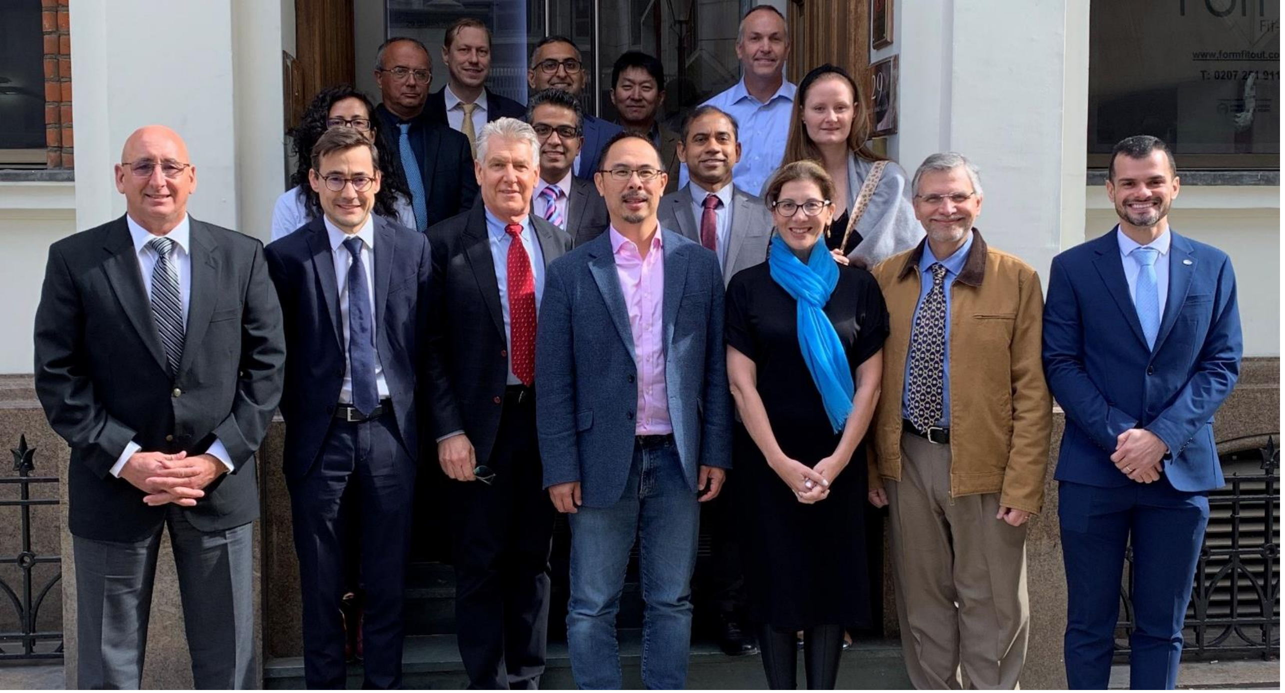
Alternative Fuels

Physicochemical characteristics

Baseline for comparison: HFO

	LNG	LPG	Methyl/Ethyl Alcohols	Hydrogen	Ammonia
Flashpoint	↓	↓	↓	↓	↓
Volatility	↑	↑	↑	↑	↑
Toxicity	↓	↓	↑ ↓	↓	↑
Density	↓	↓	↓	↓	↓
Viscosity	↓	↓	↓	↓	↓
Energy Density (Mass)	↑	↑	↓	↑	↓
Energy Density (Volume)	↓	↓	↓	↓	↓

Source: https://greenvoyage2050.imo.org/alternative-fuels/





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Working Groups

Maritime decarbonization

Port resilience

Definition in this presentation

The capacity to anticipate changing risk scenarios, prevent or contain disruption, maintain essential operations, recover safely, and adapt from experience.

Changing risk scenarios
In port operations

1. The evolving role of marine terminals in the **energy transition**.
2. Changing **weather**.

What is the role of marine terminals in the energy transition?

Marine terminals in the energy transition

Primary roles

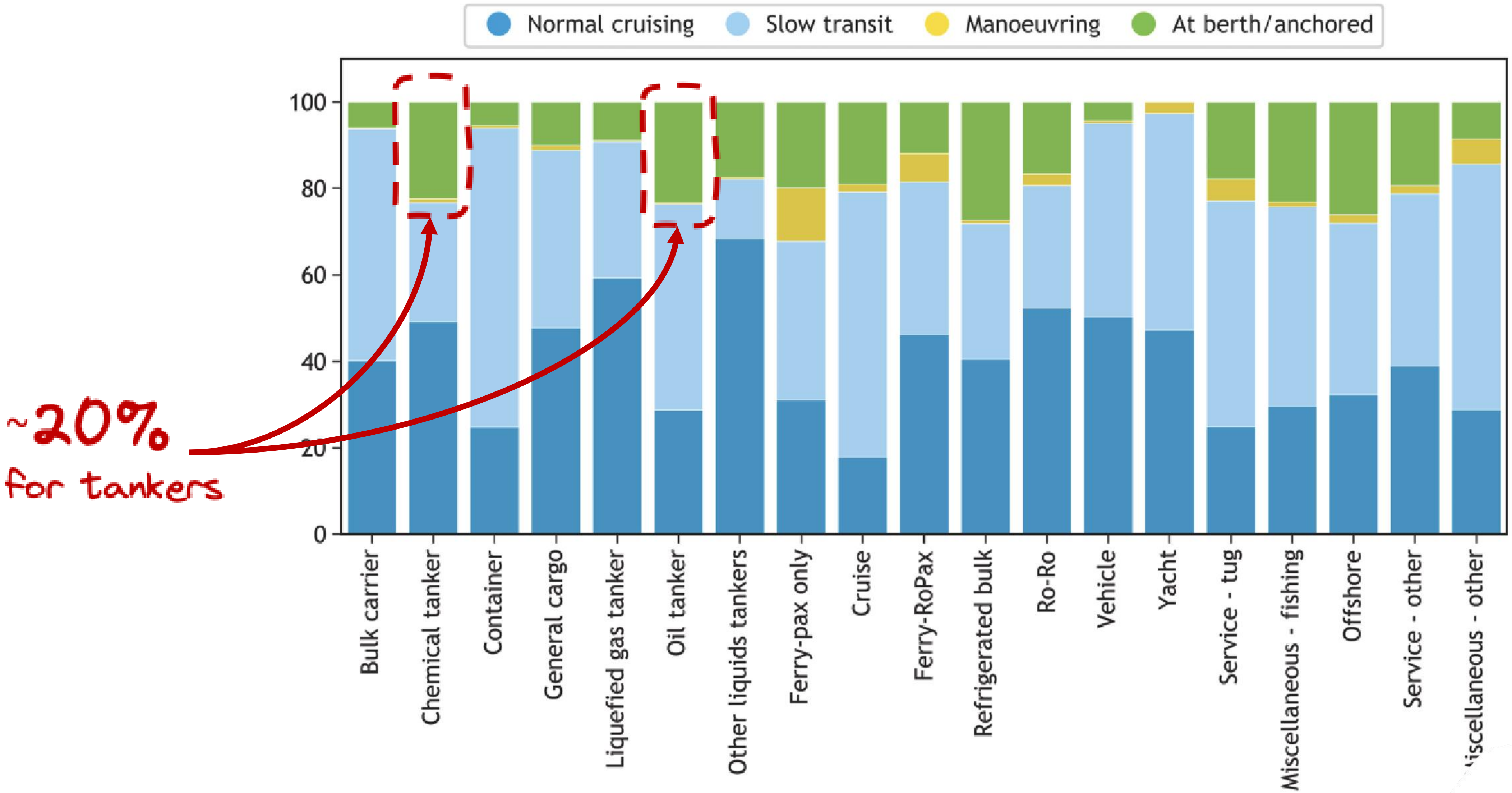
1. Enable ships to **reduce** their **emissions**.

2. Enable the **flow** of **low-carbon fuels as cargo**.

Terminals need to fulfill both roles while reducing their own emissions.

GHG emissions at marine terminals

Fourth IMO GHG Study 2020



Source: Fourth IMO GHG Study 2020. Available at:
https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Fourth%20IMO%20GHG%20Study%202020%20-%20Full%20report%20and%20annexes.pdf

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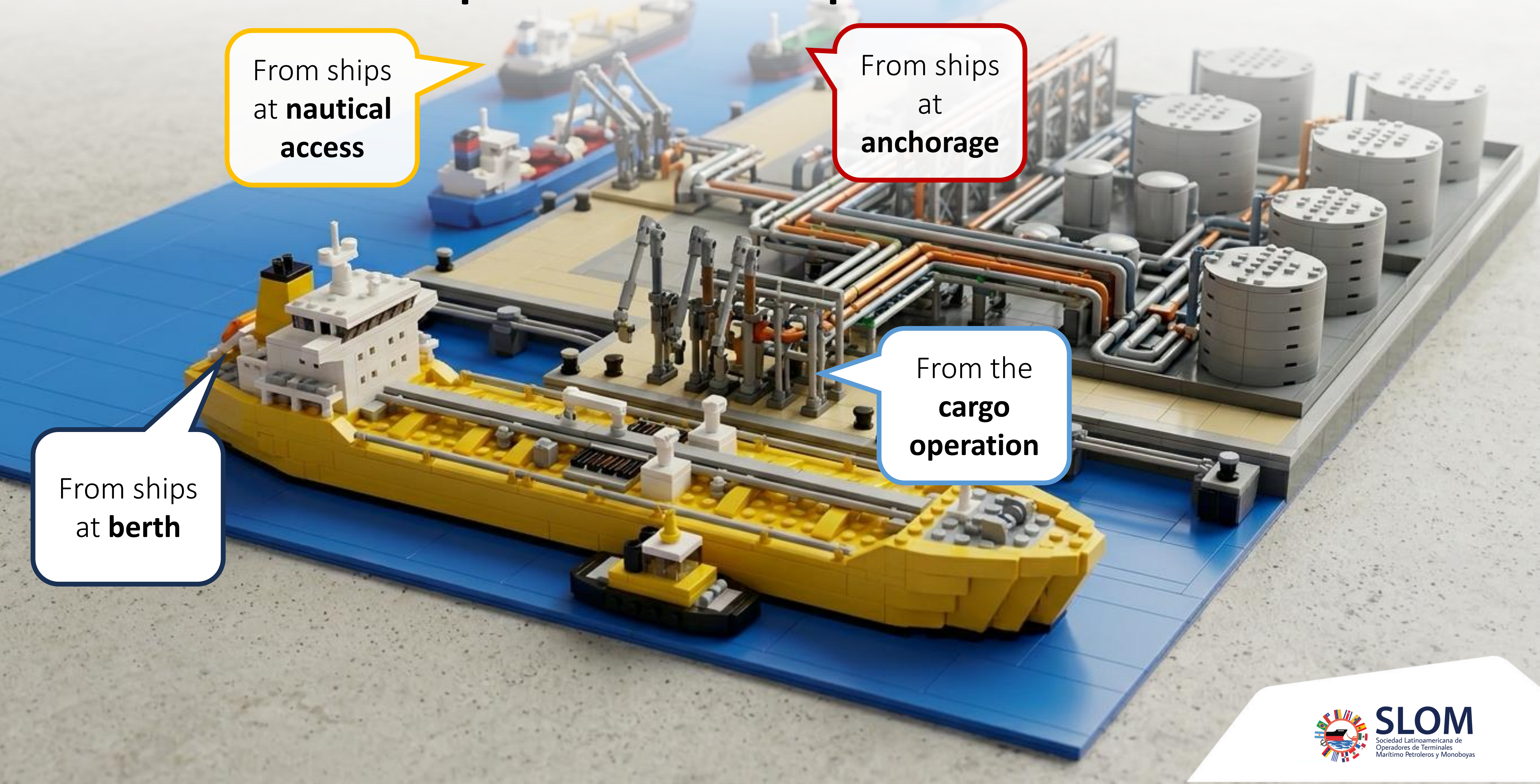
Emissions from ships in a terminal operation



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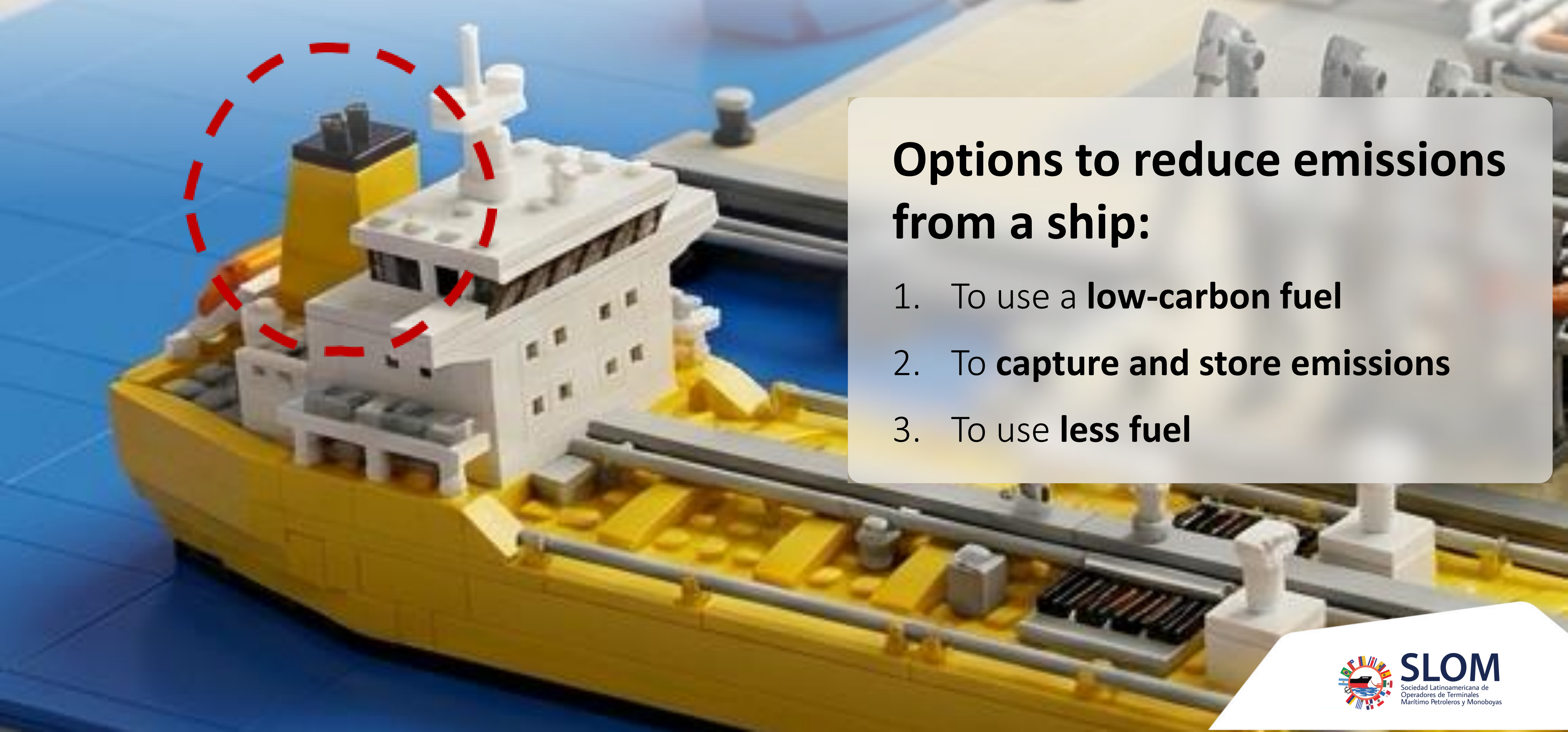
Reductions measures

GHG emissions from ships



Options to reduce emissions from a ship:

1. To use a **low-carbon fuel**
2. To **capture and store emissions**
3. To use **less fuel**

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Low-carbon fuels

At port

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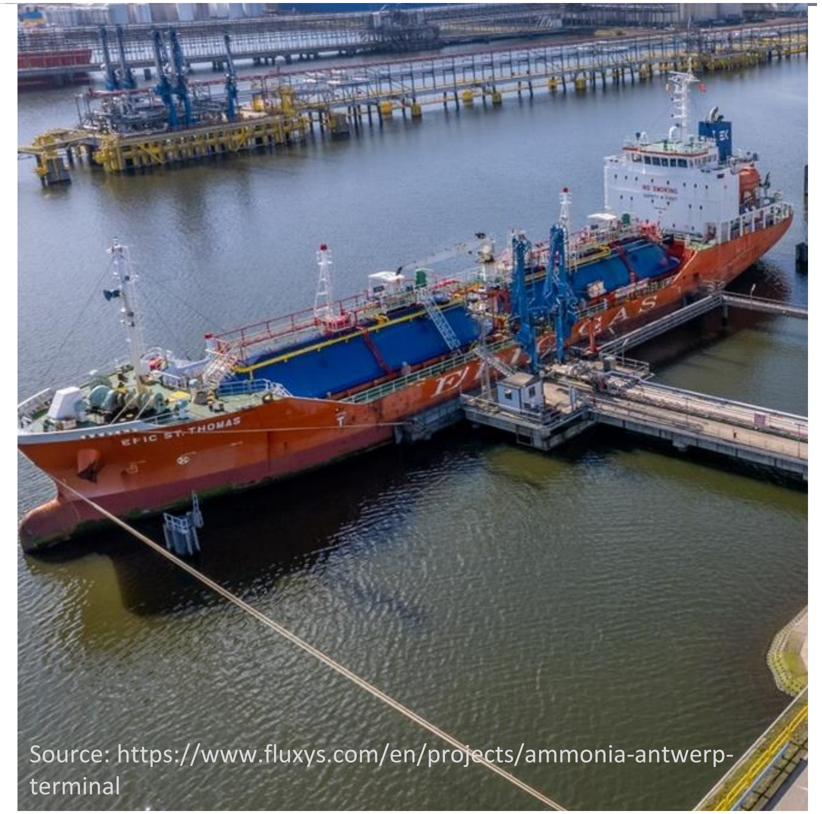
Alternative fuels in terminals

Cargo, bunkering, or ships using them

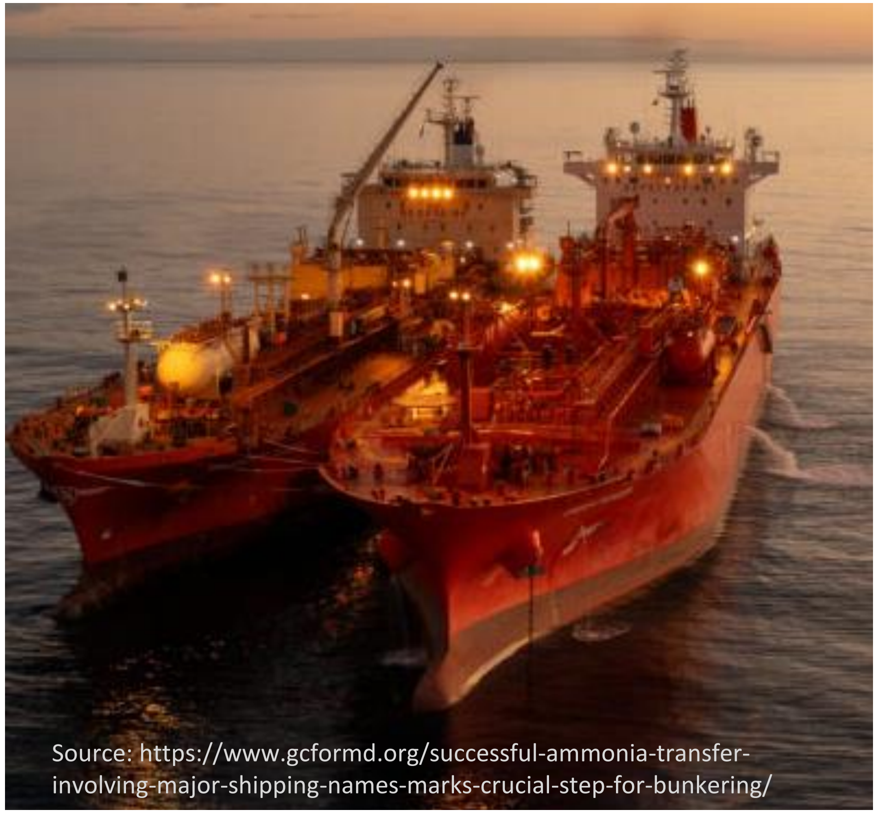
Terminals are enablers **of imports and exports of green fuels as cargo**.

Bunkering of alternative fuels will likely take place in terminal areas.

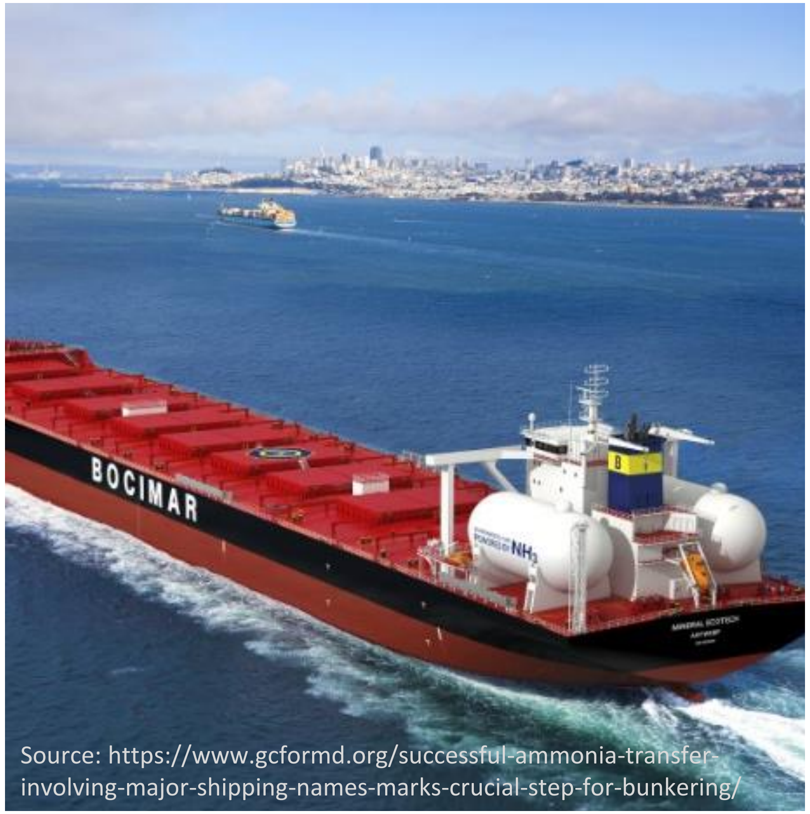
Non-chemical terminals may now operate with **ships using fuels that are hazardous chemicals**.



Source: https://www.fluxys.com/en/projects/ammonia-antwerp-terminal



Source: https://www.gcformd.org/successful-ammonia-transfer-involving-major-shipping-names-marks-crucial-step-for-bunkering/



Source: https://www.gcformd.org/successful-ammonia-transfer-involving-major-shipping-names-marks-crucial-step-for-bunkering/

Alternative fuels

Examples of risks

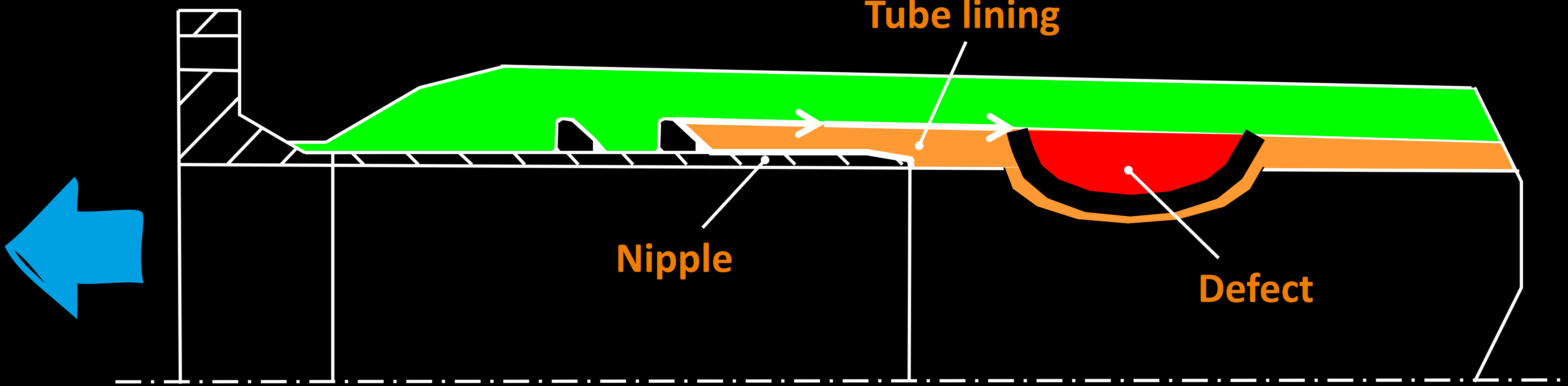
What is a lethal concentration of ammonia? 5000 ppm	
Lethal Concentration: 2500 - 4500 ppm in approximately 30 minutes	**Rapid Respiratory Arrest**: Above **5000 ppm**[1]

Calculating lethal volume of ammonia (gas) in an VLCC engine room: 200 m3		
Engine Room Dimensions: 40m (L) x 50m (W) x 20m (H) = 40,000 m^3	**Lethal Concentration**: 5000 ppm	**Required Gas Volume**: 40,000 m^3 x 5000 ppm / 1,000,000 = **200 m^3 of ammonia gas**

Daily ammonia consumption of a VLCC = 282,500 m3				
Typical HFO Consumption: 100 tons/day (full speed)	**Energy Density Comparison**: HFO (42 MJ/kg) vs. Ammonia (18.6 MJ/kg) = 2.26 ratio	**Required Ammonia**: 100 tons/day x 2.26 = 226 tons/day	**Liquid Ammonia Volume**: 226 tons / 0.680 tons/m^3 = 332 m^3	**Ammonia Gas Volume**: 332 m^3 (liquid) x 850 (expansion factor) = **282,500 m^3 of ammonia gas**

[1] Birken GA, Fabri PJ, Carey LC. Acute ammonia intoxication complicating multiple trauma. J Trauma. 1981 Sep;21(9):820-2.

Deterioration of cargo transfer hose due to exposure to high biodiesel (FAME) content



Source: Yokohama. Ref: SO 1209191

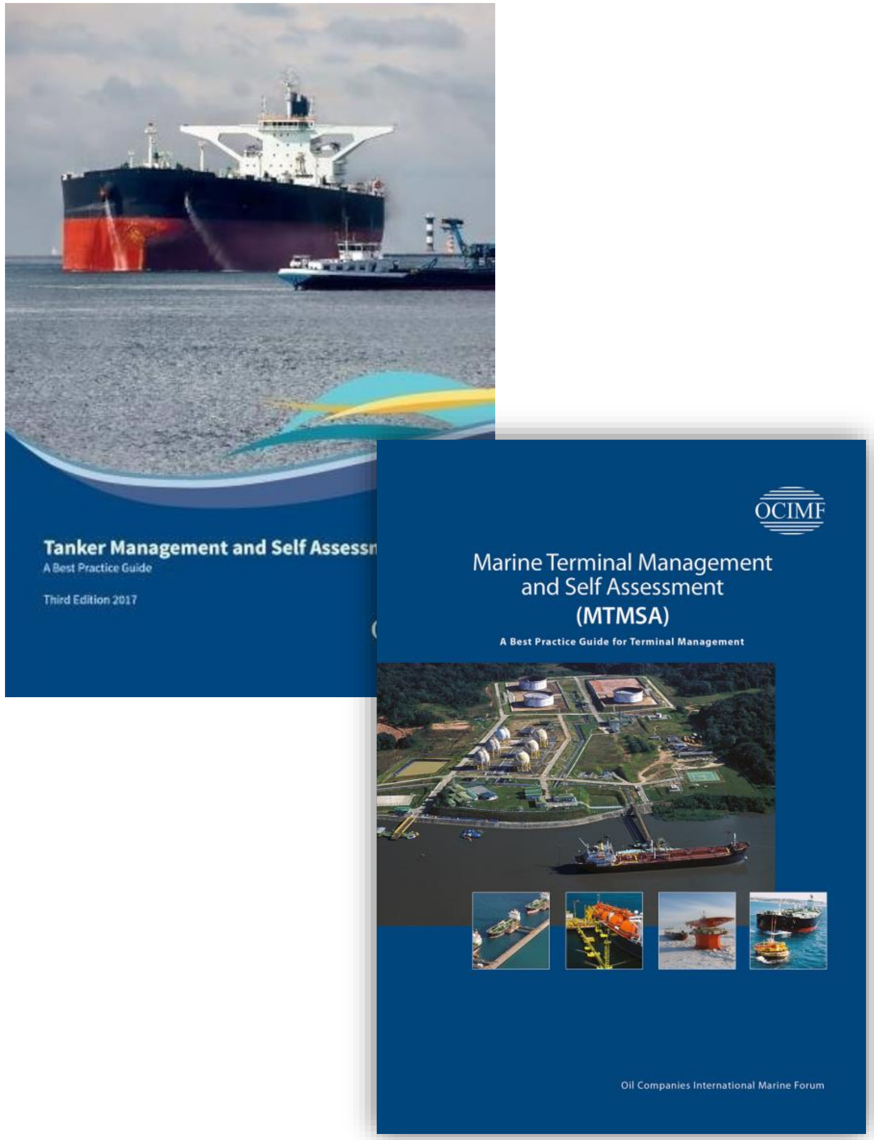
Alternative fuels in ships and terminals

Managing change

Ships and Terminals should consider the impact on the following elements when performing a **management of change** to operate handling green fuels:

- **Training** and management of **personnel**.
- **Operational procedures** and the ship/shore interface.
- New and existing **equipment**.
- **Inspection and maintenance** programs.
- **Emergency** preparedness.

The principles in **TMSA** and **MTMSA** can help operators update their management systems to operate with green fuels.



To capture emissions

At port

Capture and control at berth

California

Source: Business Wire

Technologies available

Emissions capture and control at berth

Incident

Emissions capture and control at berth

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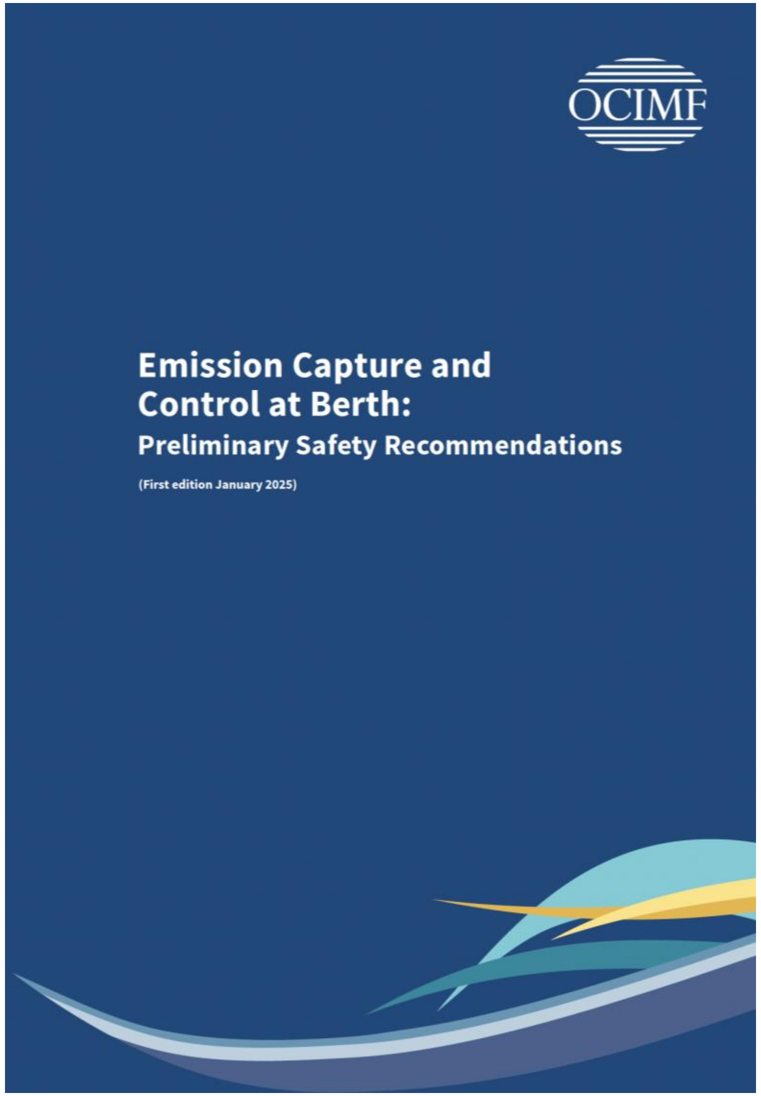
Risk mapping

Emissions capture and control at berth

Insufficient power supply from the electrical grid for the potential demand	Potential operation of non-hazardous zone compliant boom within hazardous zone	Lack of sufficient ECC collector to stack relative position keeping	Potential risk of collision/allision of the ECC barge with one the following during approach and departure	Potential electrical short circuit and static discharge upon contact of stack adaptor to stacks	Potential damage to underground pipelines or cables at port from spud or jack-up solution for ECC barge	The ECC barge causes the tanker to not safely meet the minimum regulatory requirement regarding evacuation time from the berth (30 minutes for California)	Potential interference of the technology with normal tanker operations (interference with tanker's discharges or mooring system)
Potential non-compliance with the terminal engineering and maintenance standards requirements while using capture and control technology	Inadequate spud design for the floating-facility-based capture and control technology	Lack of compatibility with existing tankers	Impact from floating-facility-based capture and control technology on the port/terminal manoeuvring area	Impact of crew competence on the system's reliability and safety of the operation	The effects of emission capture and control on emergency response	Insufficient pier strength for the equipment needed	Potential fire or explosion from the technology in the event of an oil spill/loss of cargo containment
Potential environmental impact assessment (increased emissions) from continuous operations of floating units using DP system	Loss of barge stability	Mooring system failure	High air draft of the capture and control system	Inadequate capacity of capturing emissions	Human exposure during connection / disconnection	Excessive back pressure	Improper material selection resulting in spark generation
Insufficient personnel	Limited visibility	Hazardous fluids on the barge	High quantity of unburnt fuel in the exhaust stream due to malfunction/standard operations of ship equipment	Loss of containment of exhaust gas in the capture system	Reverse flow of exhaust gas in the accommodation block	Cross-contamination of ship's systems	Inability to comply with regulation (liability)
Failure of control system on the barge	SIMOPs	Contact between emissions collection system (including the potentially heavy hood) and the stack	Damage to the emissions capture boom due to shipboard operations	Barge crew evacuation and egress	Loss of power on the barge	Failures of spud deployment and retrieval equipment	Man overboard due to slip, trip, fall
Lack of regulation standards related to construction	Personnel transfer from ECC barge to ship	H2S risk to barge personnel	Pressure surge from boiler resulting in ignition	Impact from detachable bonnet that would remain on board and attached to the funnel	Capture bonnet blocks the top of the stack	Barge crane failure lowering the capture bonnet on the top of the stack	

Safety guide

Emissions capture and control at berth



- Considerations for explosive atmosphere
- ECC collector, boom, and ductwork design and compatibility
- Safe positioning of the ECC collector to the tanker stacks or funnel
- Barge's manoeuvring and station-keeping, including emergency scenarios
- Tanker departure in case of an emergency
- Potential impacts to tanker machinery and ECC technology
- Risks associated with hazardous substances on ECC barge
- ECC Safety Management
- Competency and training of ECC personnel
- Manning requirements
- Human factors
- Process safety-critical equipment
- Redundancy and secondary means of operations of ECC equipment
- Barge design and construction verification
- Communication protocols

To use less fuel

At port

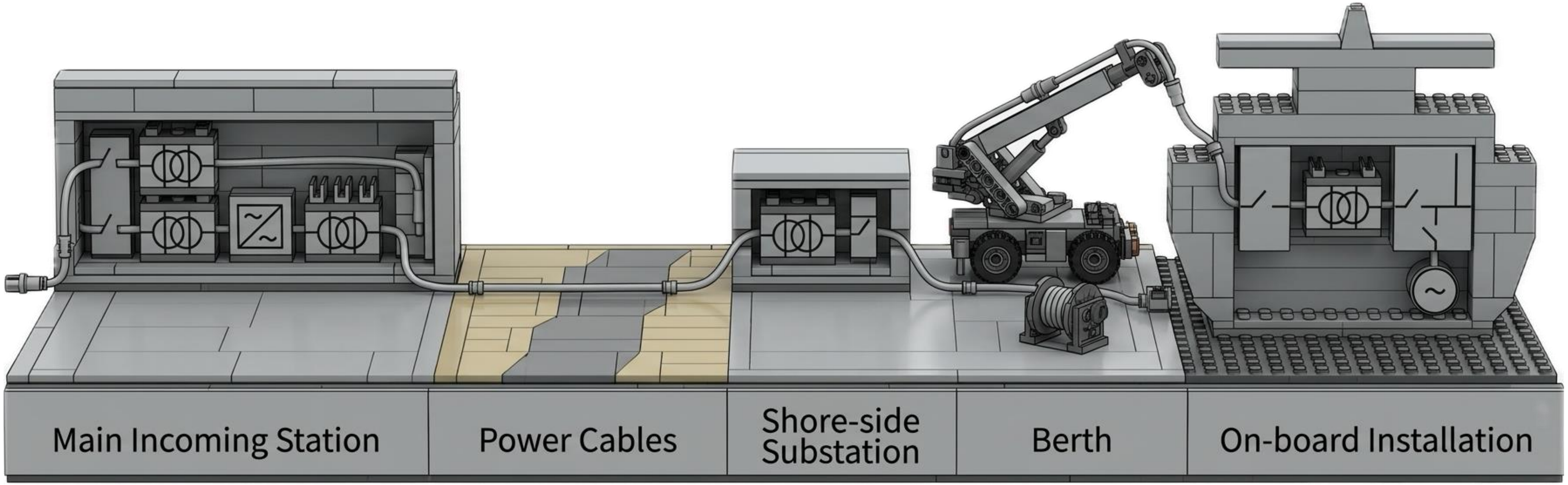
Onshore Power Supply

Using less fuel at port

An **OPS system connects a ship to the terminal's electrical grid** using high-voltage cables.

Once connected, the **ship can stop using its own generators** and switch to shore power instead.

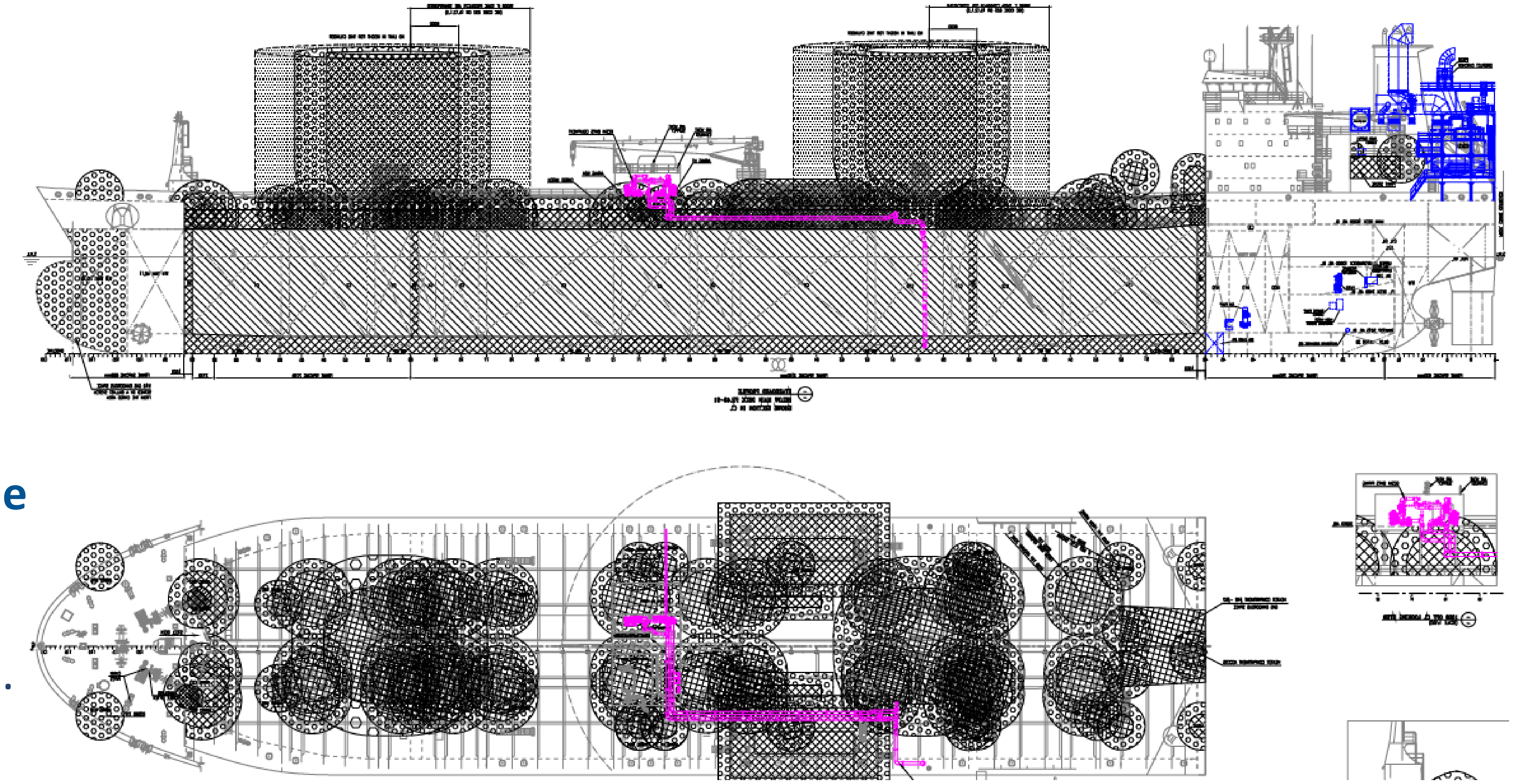
The system includes equipment for controlling **voltage and frequency, protection, grounding, cable handling, and safely connecting** the terminal to the ship.



Challenge for tankers

Hazardous areas

- The **cable properties must be** suitable for the hazardous area.
- Parts of the **Cable Management System** cross hazardous zones.

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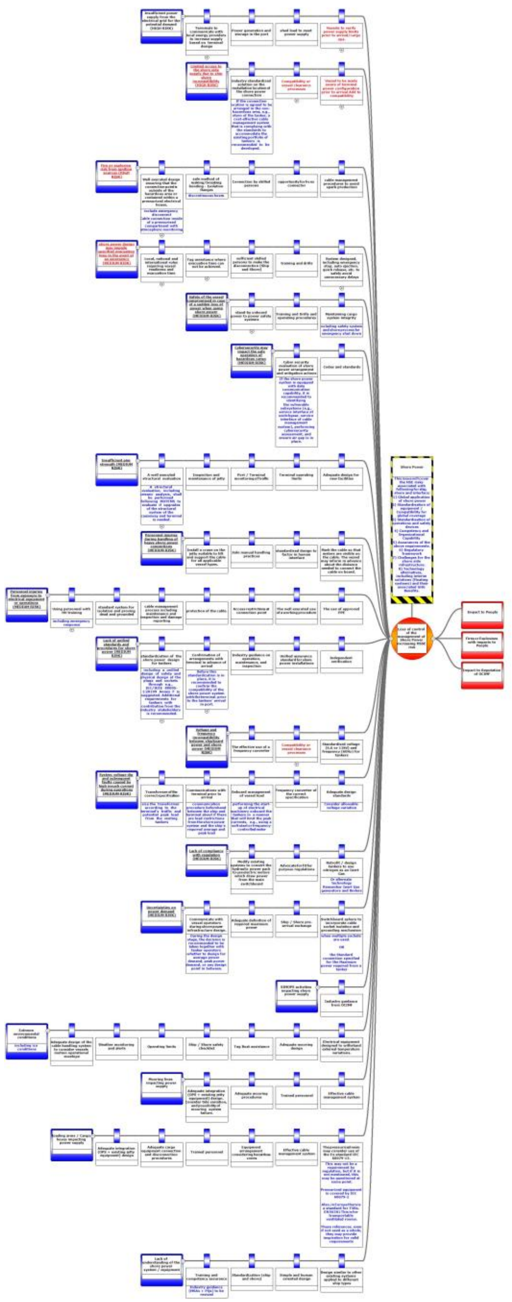
Risk mapping

OPS for tankers

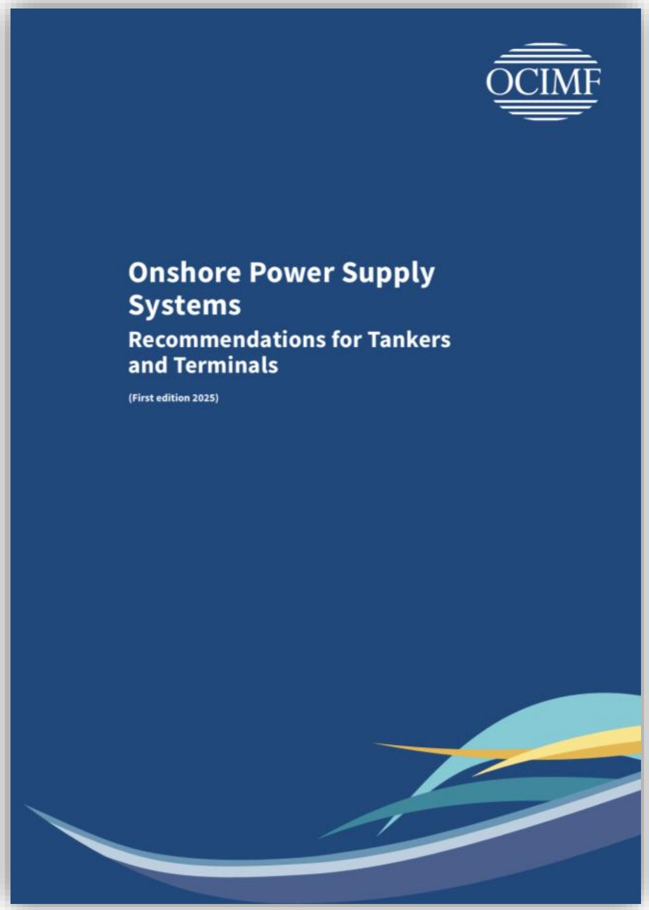
Threats being covered:

- Insufficient power supply from the electrical grid for the potential demand.
- Limited access to the shore side supply due ship shore incompatibility.
- Fire or explosion risk from ignition sources.
- Shore power design may impede specified evacuation time in the event of an emergency.
- Safety of the vessel compromised in case of a sudden loss of power when using shore power.
- Cybersecurity may impact the safe operation if hazardous cargo.
- Insufficient pier strength.
- Personnel injuries from exposure to electrical equipment or operations.
- Lack of unified standards and procedures for shore power.
- Voltage and frequency incompatibility between shipboard power and shore power.
- System voltage dip and subsequent faults caused by high inrush current during operations.
- Lack of compliance with regulation.
- Uncertainties on power demand.
- SIMOPS activities impacting shore power supply.
- Extreme environmental conditions.
- Loading arms / cargo hoses impacting power supply.
- Lack of understanding of the shore power system / equipment.



Safety guide

OPS for tankers



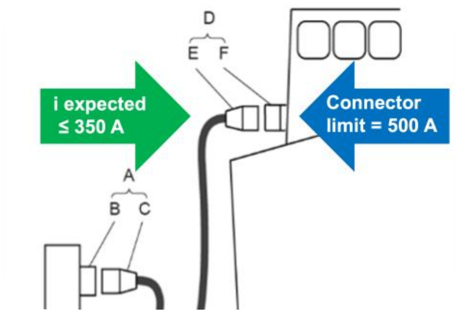
Available at:
https://www.ocimf.org/document-libary/onshore-power-supply-systems-1

Executive summary:

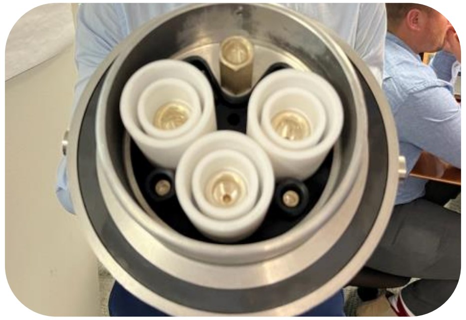
- The guide is divided into three parts: **tanker**, **terminal**, and **interface**.
  - Each part covers: **design**, **operation**, **inspection** & **maintenance**, **training**.
- The shore power connection should follow IEC/IEEE 80005 Series Standards, as amended.
- The provision of OPS at **6.6 kV, 60 Hz** as standard is recommended.
- The OPS system may have **1, 2, or 3 cables**, depending on the power demand of the typical design ship.
- A specific standardized plug and socket type is recommended.
- The relative installation location of the ship/shore connection is not prescribed but is left to the involved parties’ discretion based on case-specific evaluations.
- A risk assessment is critical, emphasizing safety related to hazardous areas.

Other elements covered

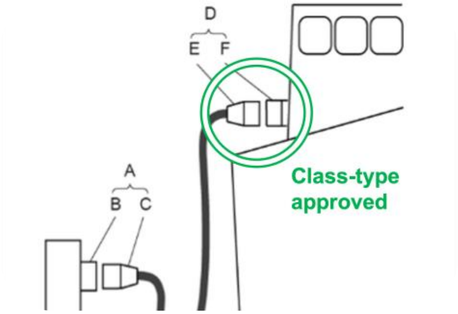
OPS for tankers



Nominal current per connection requirement.

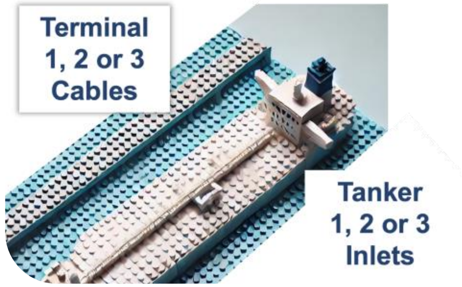


Connector design and nominal capacity.

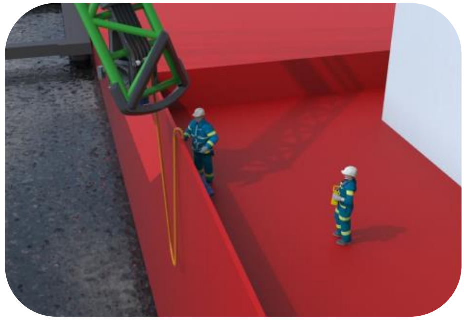


Cass-approval requirements.

Cable design.



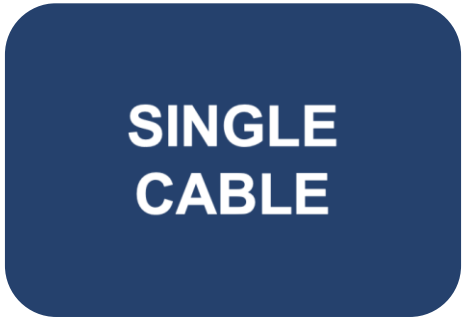
Scalable number of cables and ship's inlets.



Cable lifting and payout requirements.

Cable storage and parking requirement.

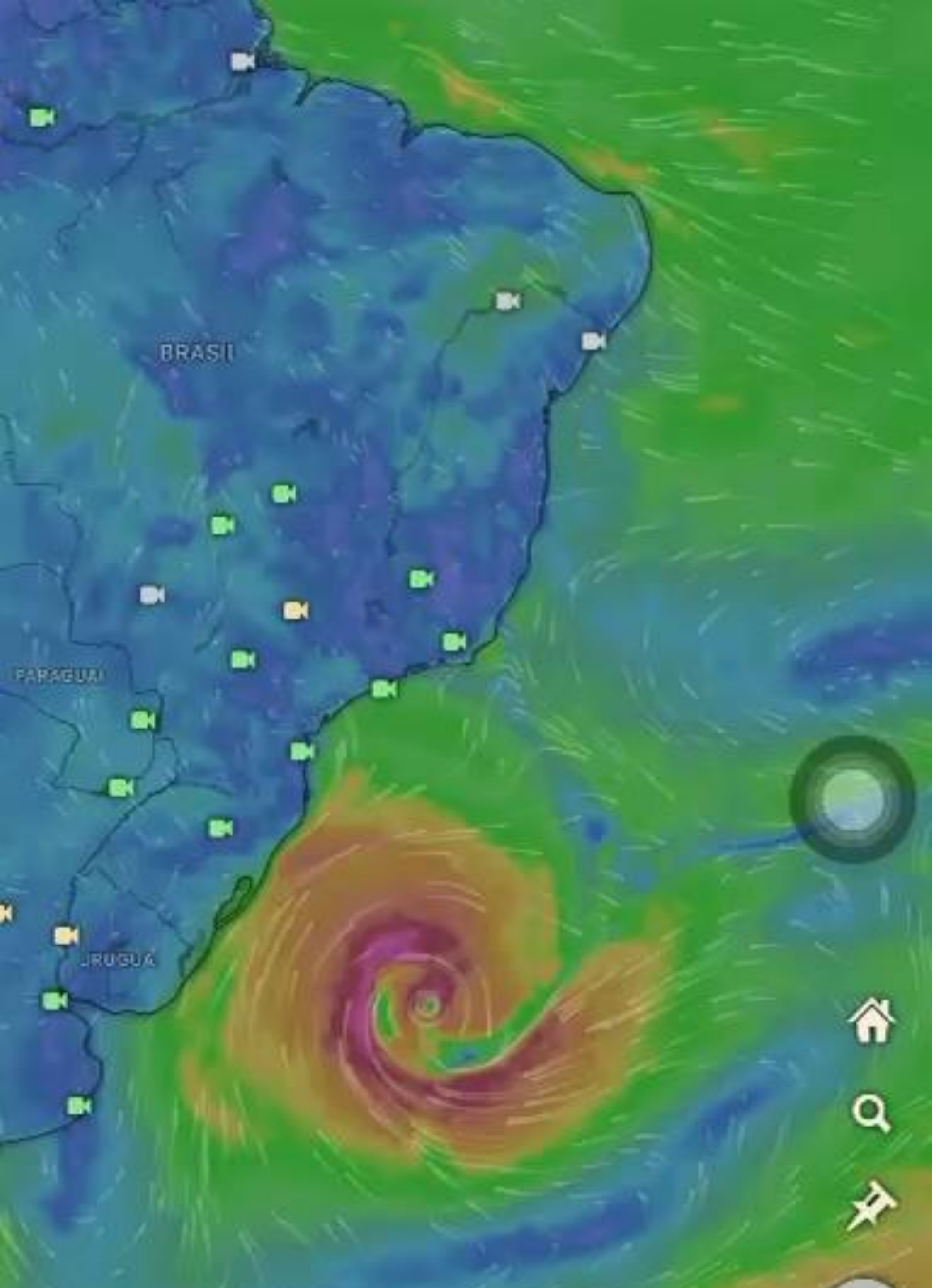
Cable tension and movement monitoring.



Bonding or control.

OPS shutdown and emergency decoupling

How is the changing weather affecting marine terminal operations?



We are observing extreme climate events much more frequently.

Climate change can make historical design assumptions less reliable.

Operators should review whether the wind, wave, current, rainfall, and compound-event criteria used to design jetties, offshore berths, and other marine infrastructure continue to reflect current and future operating conditions.

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New times bring new challenges and opportunities.

But one thing remains the same…

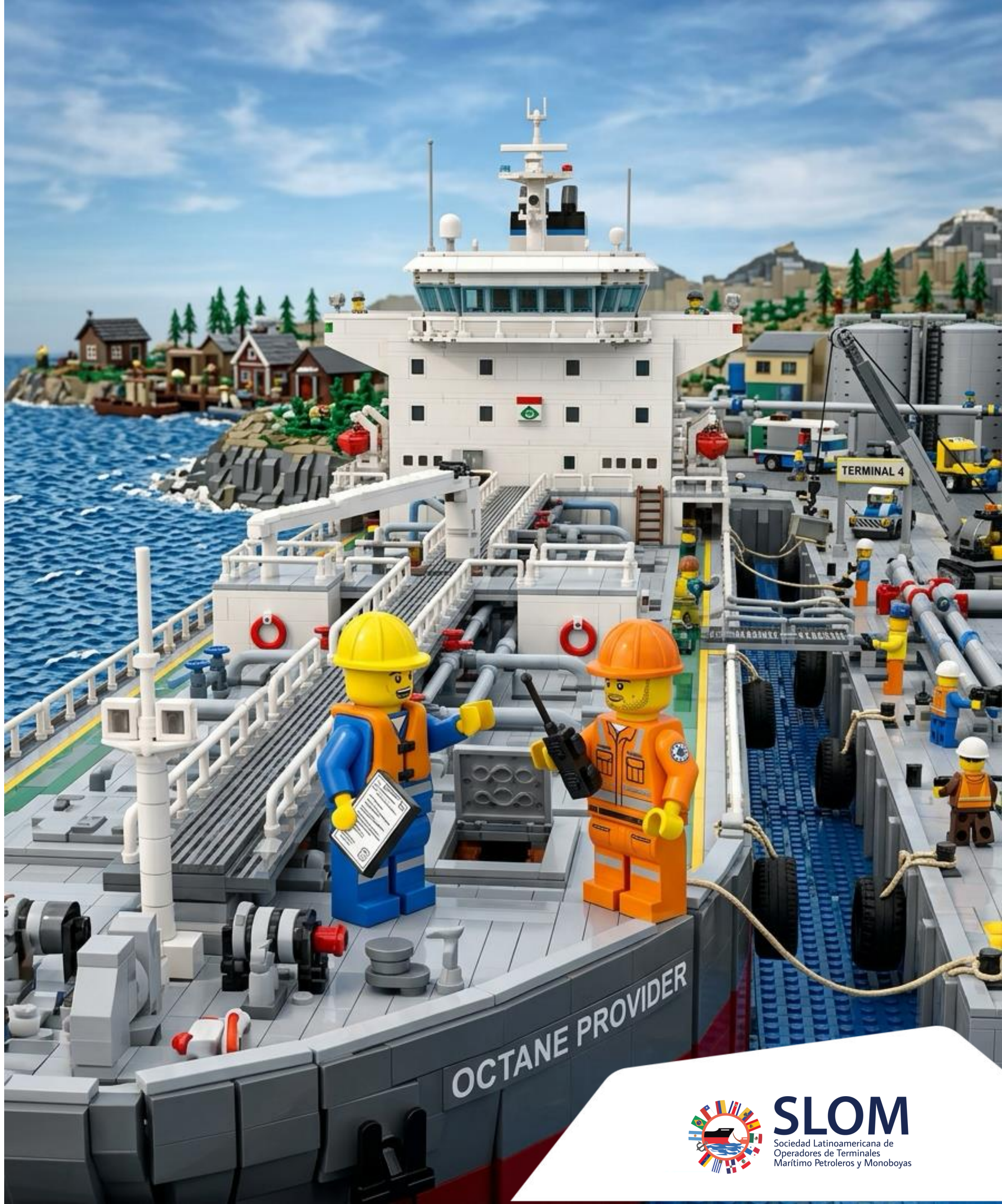
People are key!

The change is already here due to the evolving role of marine terminals in the energy transition and changing weather, and this shift is accelerating.

Ensuring **people are trained and competent** is crucial to safe, resilient operations.

Our teams will play a key role in preparing the **next generation of professionals** to manage the new risks.

We are a key piece in sharing knowledge and educating our workforce.



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Please let me know if you have any questions.

Thank you

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