

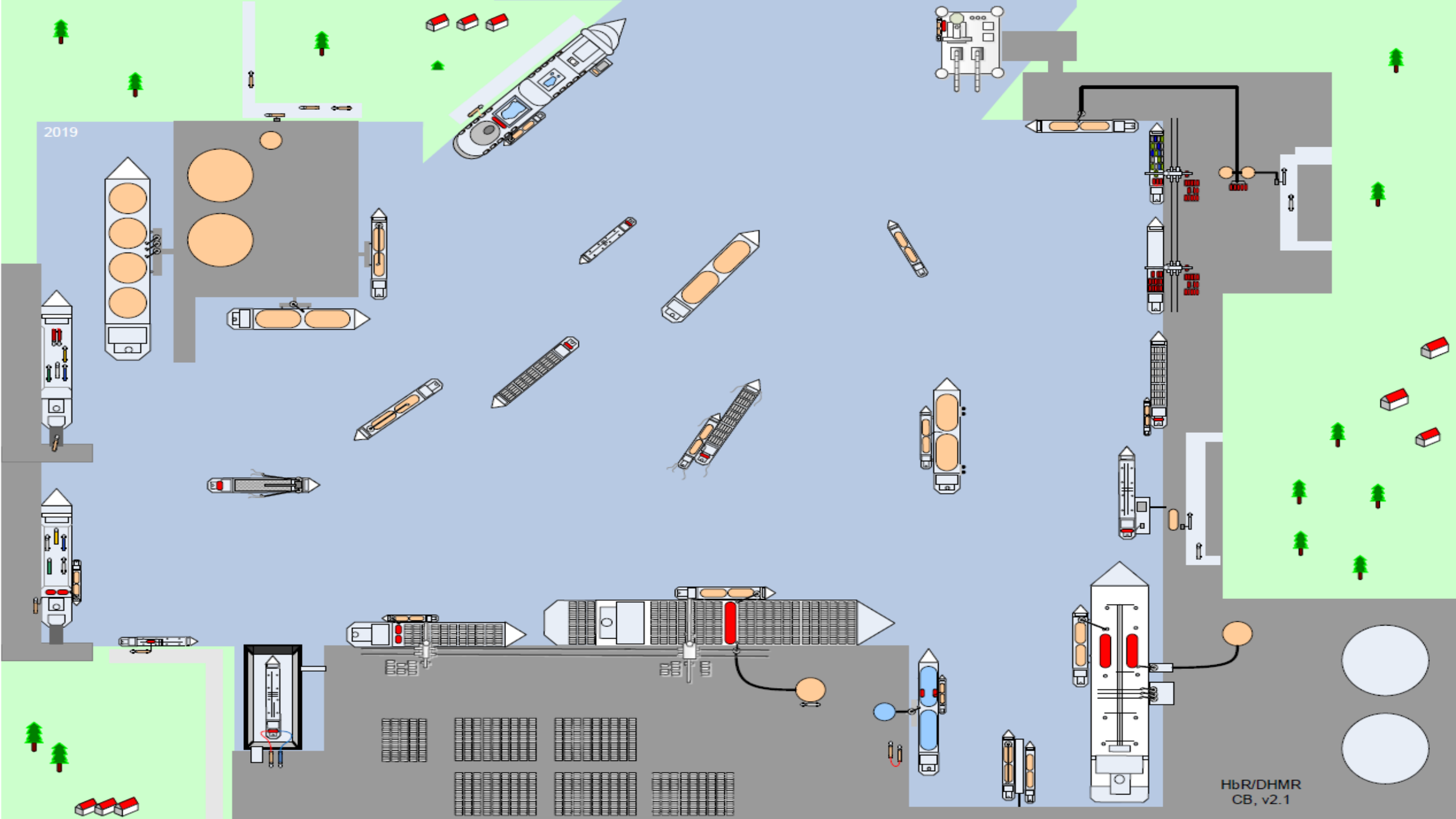
The background image shows a large industrial port at night. Two massive cranes with illuminated booms are the central focus, positioned over a large ship. The ship's deck is brightly lit with numerous yellow lights. In the distance, a line of wind turbines is visible against the dark sky. The water in the foreground reflects the lights from the port and the sky, which is a mix of deep blue and orange from the sunset or sunrise.

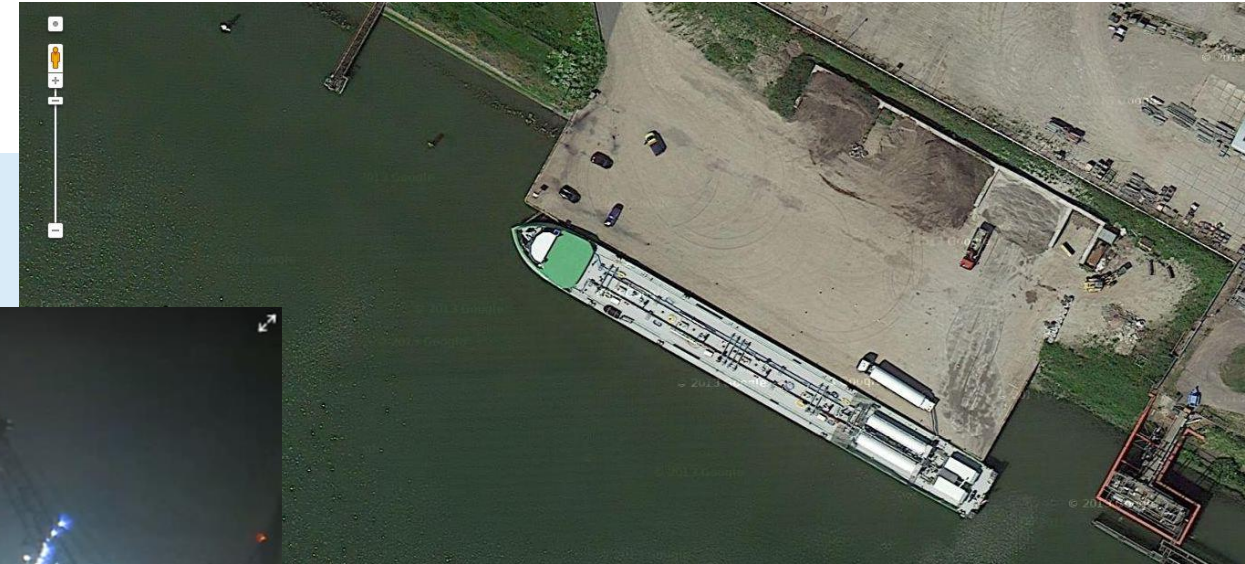
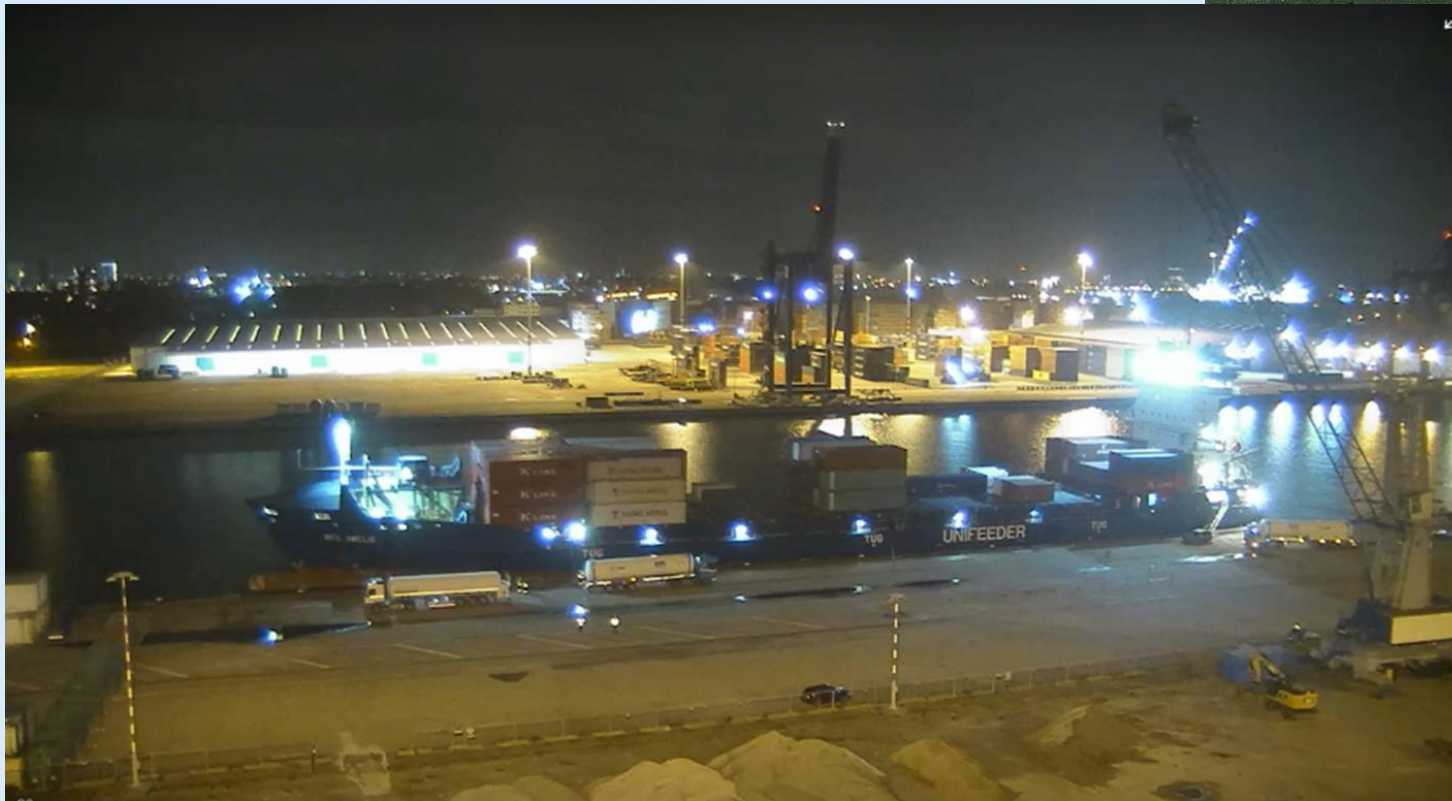
# BUNKERING ALTERNATIVE FUELS PORT OF ROTTERDAM

## GLOBAL ALLIANCE POWERFUELS



2019





In Rotterdam on this moment ten LNG bunker vessels are licensed:



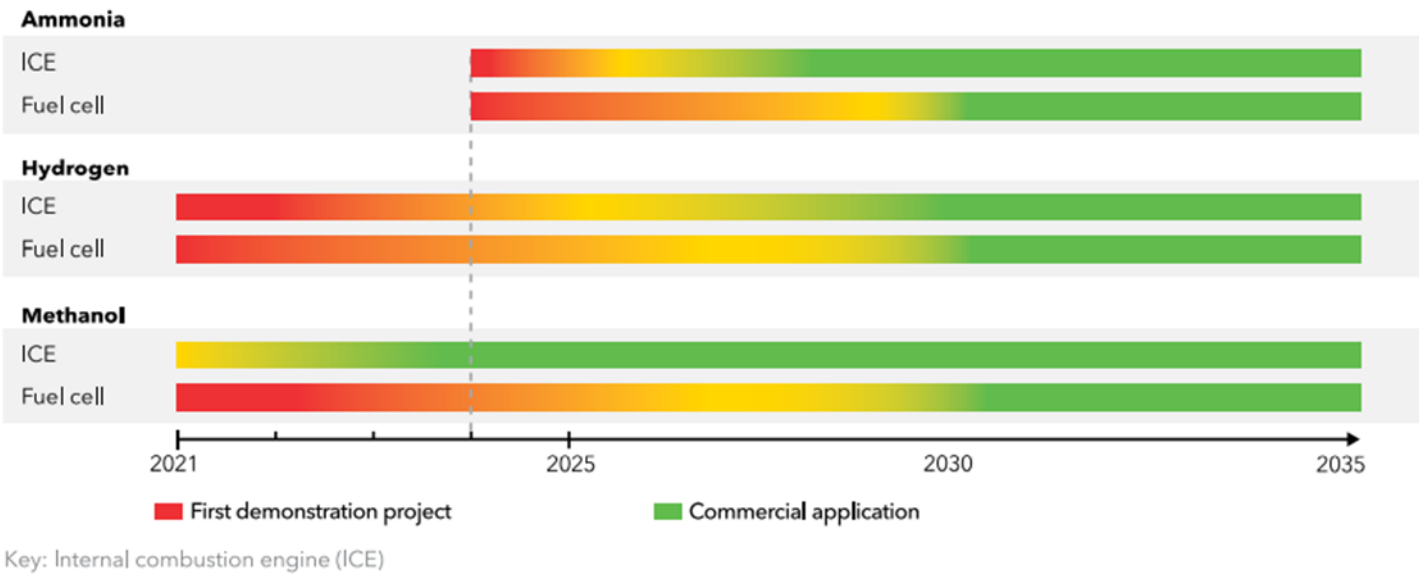
- Different LBV operators
- The capacity varies :  $18\text{m}^3$  -  $1800\text{ m}^3$  -  $18000\text{ m}^3$  LNG
- Different suppliers

# TIME LINE ALTERNATIVE FUELS SHIPPING

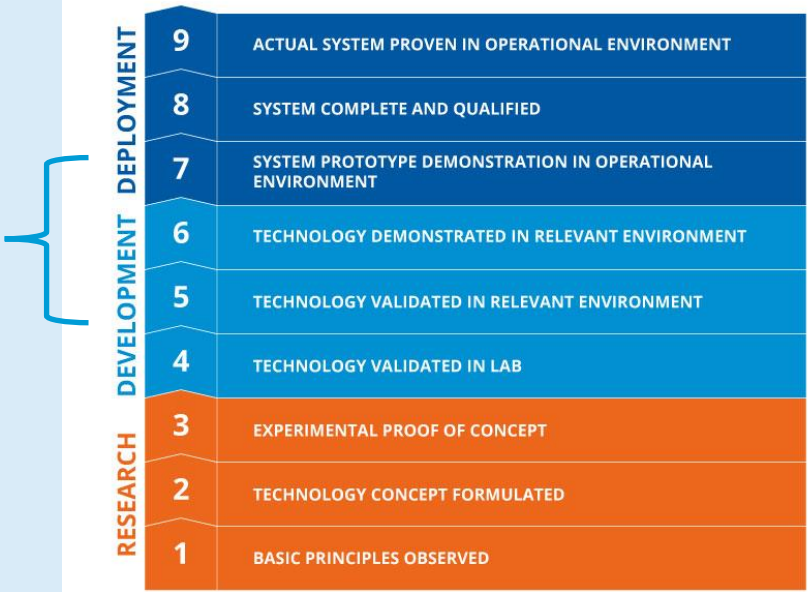


FIGURE 3.3

Timeline for expected availability of alternative fuel technologies - our best estimate for when these may be available for onboard use



## TECHNOLOGY READINESS LEVEL (TRL)



	CCC6	MSC102	CCC7	MSC105	CCC8	MSC106	CCC9	MSC107	CCC10
	SEP20	NOV20	SEP21	APR22	SEP22	NOV22	SEP23	2023	2024
LNG	Revision Exercise				Finalize Part A-1 amendments	Approve Part A-1 amendments			
Alcohols	Interim Guidelines finalized	Interim Guidelines Approved (MSC.1/Circ.1621)	Interim Guidelines under application				Start discussion of mandatory instruments	Draft mandatory req	
Fuel Cells	Drafting		Finalize Interim Guidelines	Approve Interim Guidelines	Interim Guidelines under application				Start discussion of mandatory instruments
LPG	Drafting						Finalize LPG Guidelines	Approve LPG Guidelines	
Low-flashpoint Oil Fuels	Discussion		Significant discussion around relevance of this work		How to address safety provisions for low-flashpoint oil fuels? DECISION				
Hydrogen			Initiate development of Interim Guidelines	Drafting					
Ammonia			Initiate development of Interim Guidelines	Drafting					

## IN TRL 5-7 IT'S IMPORTANT TO LOOK INTO.....

### Governance

- Knowledge gathering;
- Risks;
- Safety Management;
- Legislation and Por Bye Laws;
- Safety procedures;
- Safety reference;
- Consortia;
- Cooperation;
- Etc. ....

Energy source		Fossil (without CCS)					Bio	Renewable <sup>(3)</sup>		
Fuel		HFO + scrubber	Low sulphur fuels	LNG	Methanol	LPG	HVO [Advanced biodiesel]	Ammonia	Hydrogen	Fully-electric
<b>High priority parameters</b>										
• Energy density		●	●	●	●	●	●	●	●	●
• Technological maturity		●	●	●	●	●	●	●	●	●
• Local emissions		●	●	●	●	●	●	●	●	●
• GHG emissions		●	●	● <sup>(2)</sup>	●	●	●	●	●	●
• Energy cost		●	●	●	●	●	●	●	●	● <sup>(4)</sup>
• Capital cost	Converter	●	●	●	●	●	●	●	●	●
	Storage	●	●	●	●	●	●	●	●	●
• Bunkering availability		●	●	●	●	●	●	●	●	●
Commercial readiness <sup>(1)</sup>		●	●	●	●	●	●	●	●	● <sup>(5)</sup>
<b>Other key parameters</b>										
• Flammability		●	●	●	●	●	●	●	●	●
• Toxicity		●	●	●	●	●	●	●	●	●
• Regulations and guidelines		●	●	●	●	●	●	●	●	●
• Global production capacity and locations		●	●	●	●	●	●	●	●	●

(1) Taking into account maturity and availability of technology and fuel.

(2) GHG benefits for LNG, methanol and LPG will increase proportionally with the fraction of corresponding bio- or synthetic energy carrier used as a drop-in fuel.

(3) Results for ammonia, hydrogen and fully-electric shown only from renewable energy sources since this represents long term solutions with potential for decarbonizing shipping. Production from fossil energy sources without CCS (mainly the case today) will have a significant adverse effect on the results.

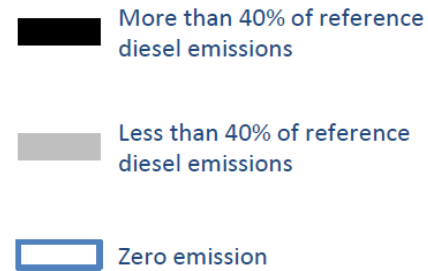
(4) Large regional variations.

(5) Needs to be evaluated case-by-case. Not applicable for deep-sea shipping.

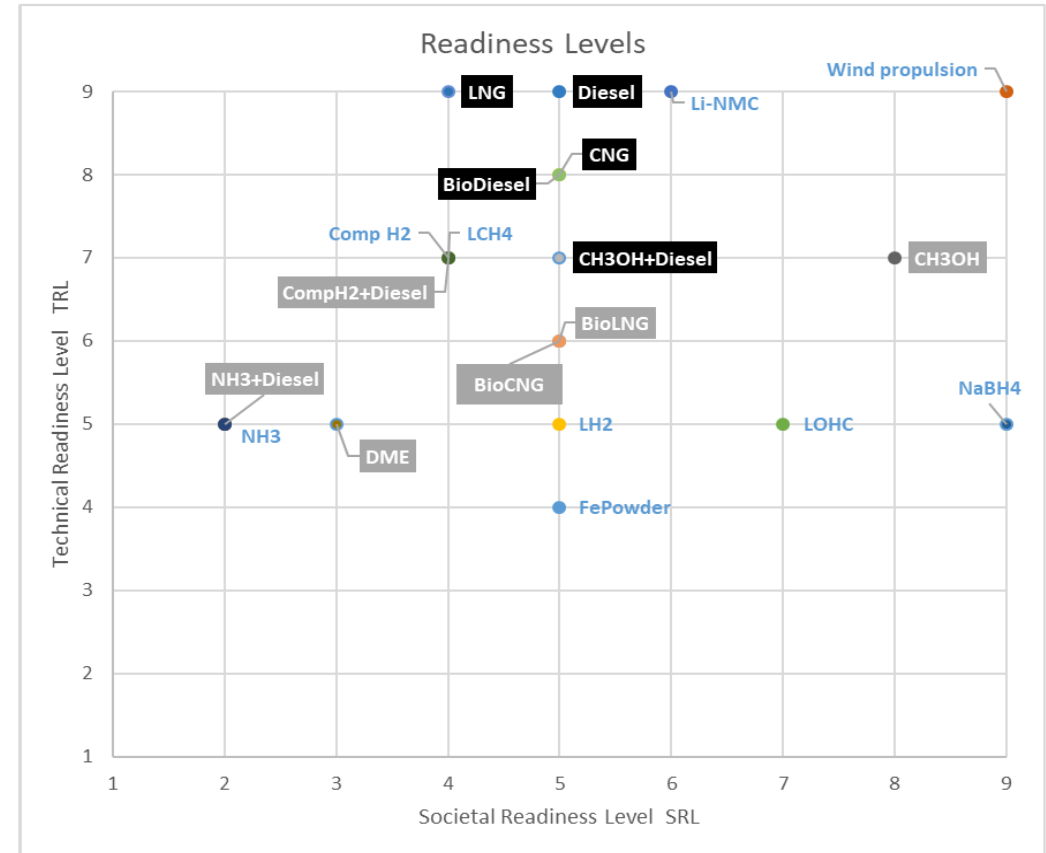
## AS A PORT WE TAKE CARE OF:

- Governance
- Infrastructure
- Safety
  - Safety framework
  - Spatial Planning
  - Perception
  - Port Bye Laws and procedures
  - Safety distances to public
  - Landlord tasks
  - Licensing
  - Impact on other port stakeholders
  - Incident response preparedness
  - Enforcement
  - ....
  - ....

## Readiness Levels



TECHNOLOGY READINESS LEVEL (TRL)	
RESEARCH	1 BASIC PRINCIPLES OBSERVED
	2 TECHNOLOGY CONCEPT FORMULATED
	3 EXPERIMENTAL PROOF OF CONCEPT
DEVELOPMENT	4 TECHNOLOGY VALIDATED IN LAB
	5 TECHNOLOGY VALIDATED IN RELEVANT ENVIRONMENT
	6 TECHNOLOGY DEMONSTRATED IN RELEVANT ENVIRONMENT
DEPLOYMENT	7 SYSTEM PROTOTYPE DEMONSTRATION IN OPERATIONAL ENVIRONMENT
	8 SYSTEM COMPLETE AND QUALIFIED
	9 ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT



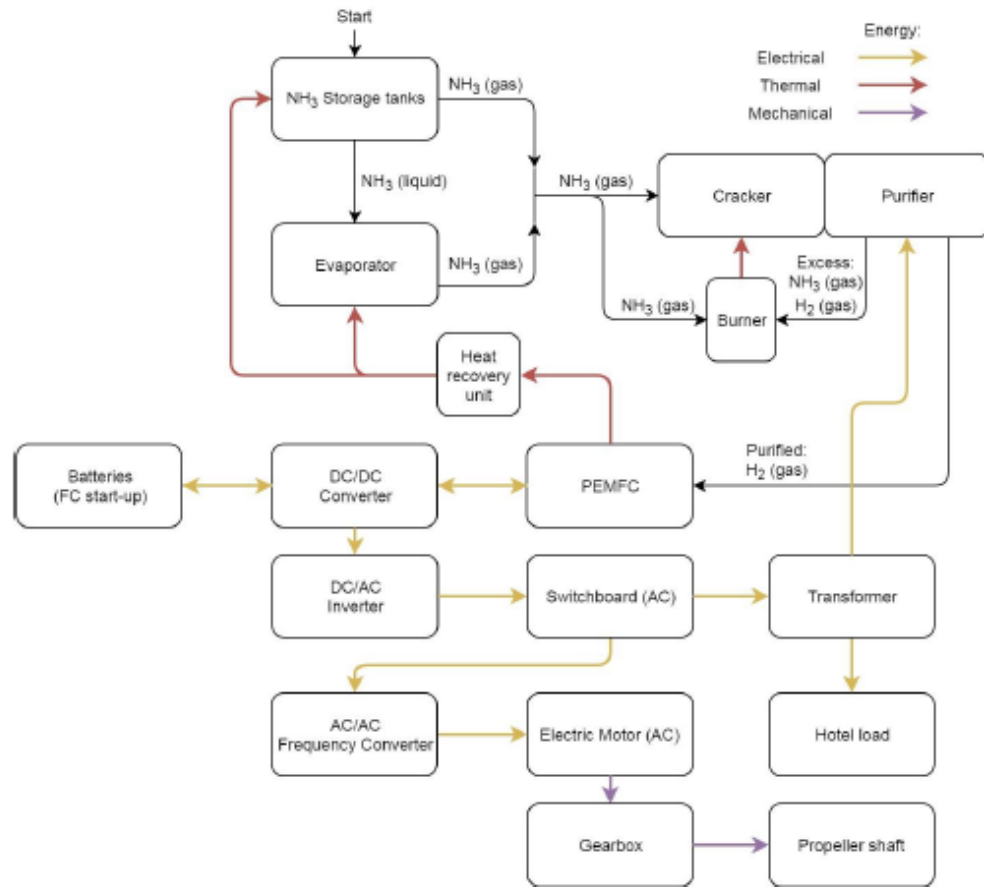


Figure 5-2: System design PEMFC option

The zero emission vessel:

Utopia for shipping and the environment;

A challenge for port safety management and incident response;



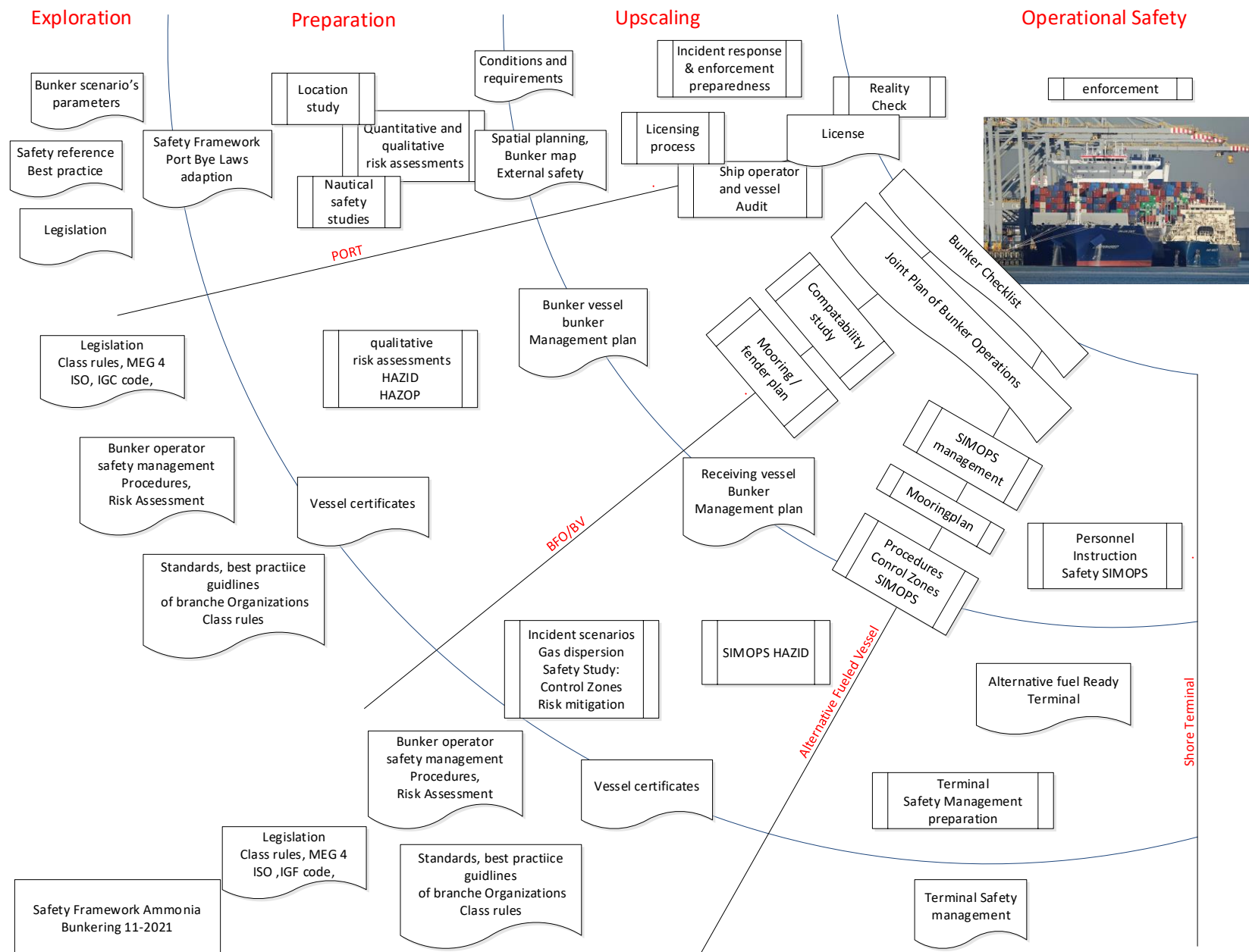
# The safety framework for Alternative Fuels:

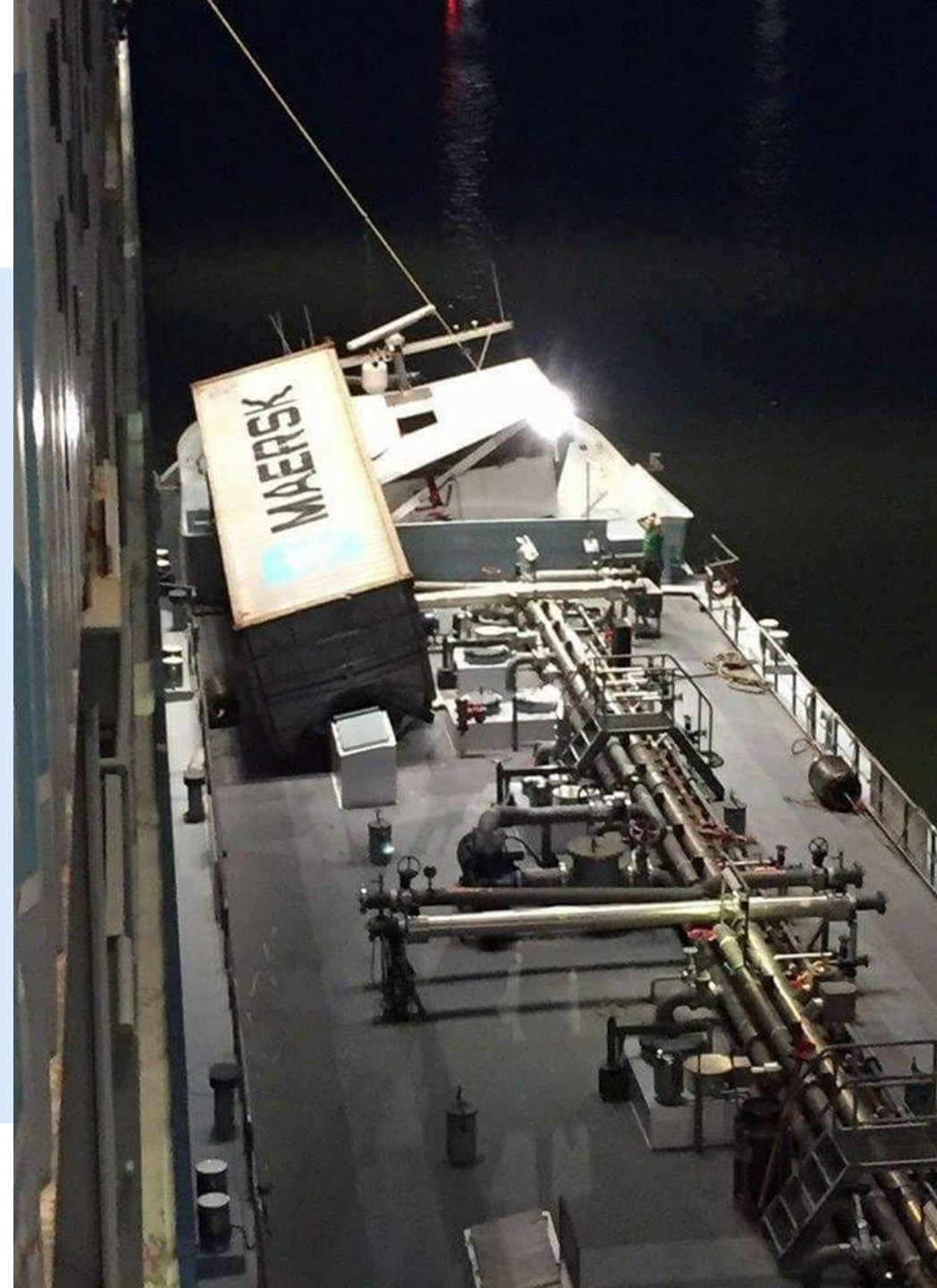
Four parties are involved:

- the port;
- the energy supplying vessel or BFO;
- the energy receiving vessel;
- the terminal or site operator.

Four phases:

- Exploration ;
- Preparation;
- Upscaling;
- Operation.





# PORT SAFETY MANAGEMENT

- Port Bye Laws
- **Spatial planning**
- Enforcement
- Incident response preparedness
- Bunker vessel operators and vessels are audited
- LNG fueled vessels regulations
- Simultaneous operations are regulated
- Terminals should be prepared



# LICENSING



## International Safety Tools

- Alternative Fuel bunker checklists
- Audit tool for Alternative Fuel Bunker Operator
- Alternative Fuel Ready Terminal
- Port assessment tool on Alternative fuel Readiness



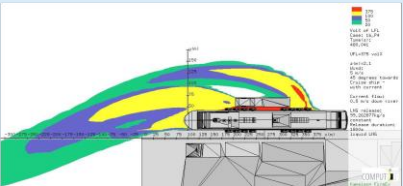
<https://sustainableworldports.org/clean-marine-fuels/about-our-cmf-working-group/>



# SIMOPS



Credible scenario



Gas dispersion study or BASIL  
→ Safety zone



Control zone

SECURITY	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Environment	Reputation	A	B	C	D	E
1	Minor	Minor	Minor	Minor					
2	Minor	Minor	Minor	Minor					
3	Minor	Minor	Minor	Minor					
4	Minor	Minor	Minor	Minor					
5	Minor	Minor	Minor	Minor					
6	Minor	Minor	Minor	Minor					
7	Minor	Minor	Minor	Minor					
8	Minor	Minor	Minor	Minor					
9	Minor	Minor	Minor	Minor					
10	Minor	Minor	Minor	Minor					
11	Minor	Minor	Minor	Minor					
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95	Minor	Minor	Minor	Minor					
96	Minor	Minor	Minor	Minor					
97	Minor	Minor	Minor	Minor					
98	Minor	Minor	Minor	Minor					
99	Minor	Minor	Minor	Minor					
100	Minor	Minor	Minor	Minor					

HAZID (vice versa)



Safety zone  
Control

# Prepared Terminal

gas as a marine fuel

Simultaneous Operations (SIMOPS) during LNG bunkering

safety

somf

gas as a marine fuel

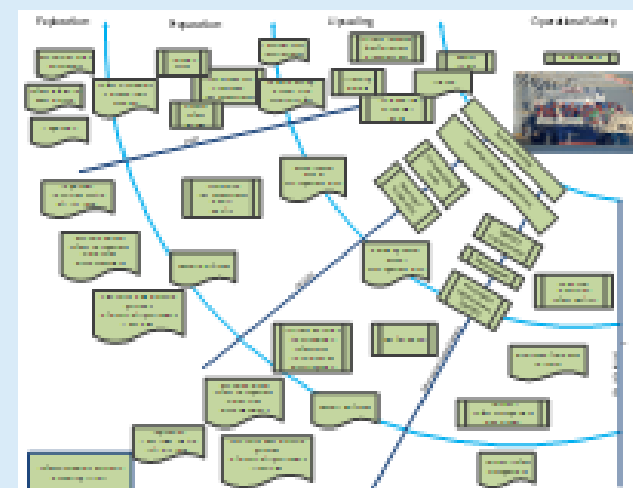
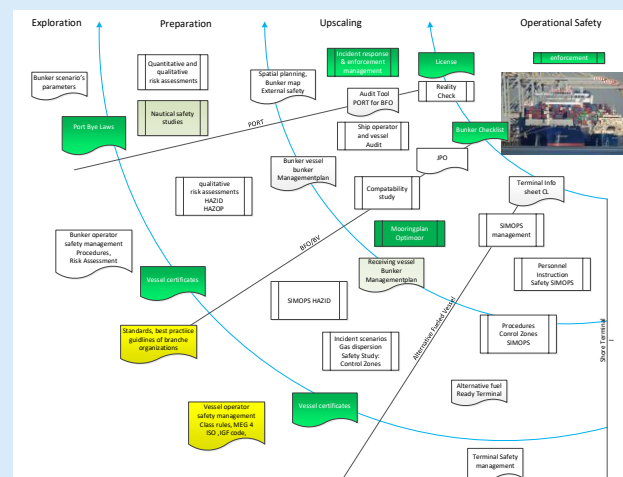
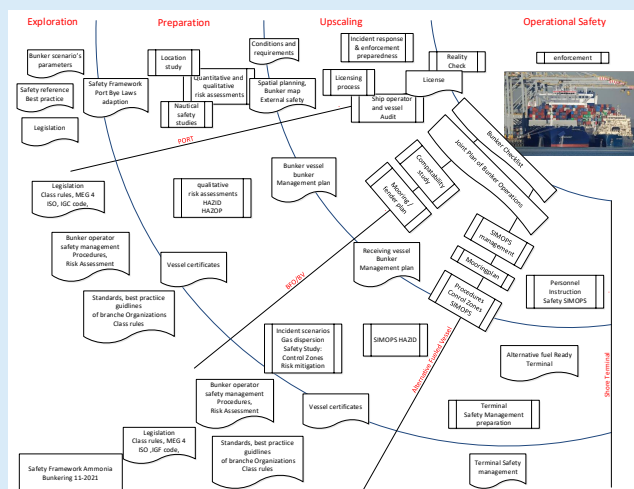
Recommendation of Controlled Zones during LNG Bunkering

safety

somf



## The Alternative fuel bunker challenge:



A large wind turbine stands prominently in the center-left of the frame, its three blades reaching towards the top of the image. The background is a bright, orange-hued sky, suggesting a sunset or sunrise. In the foreground and midground, the silhouettes of various port infrastructure are visible, including cranes, scaffolding, and large storage tanks. The overall scene conveys a message of sustainable energy and industrial operations.

Questions?

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