Feasibility Study of Future Energy Options for Great Lakes Shipping

Presented by: Bryan Comer, PhD, Marine Program Director
Conducted by: ICCT, ABS, GSGP
Funded by: U.S. DOT Maritime Administration (MARAD)

February 16, 2024

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

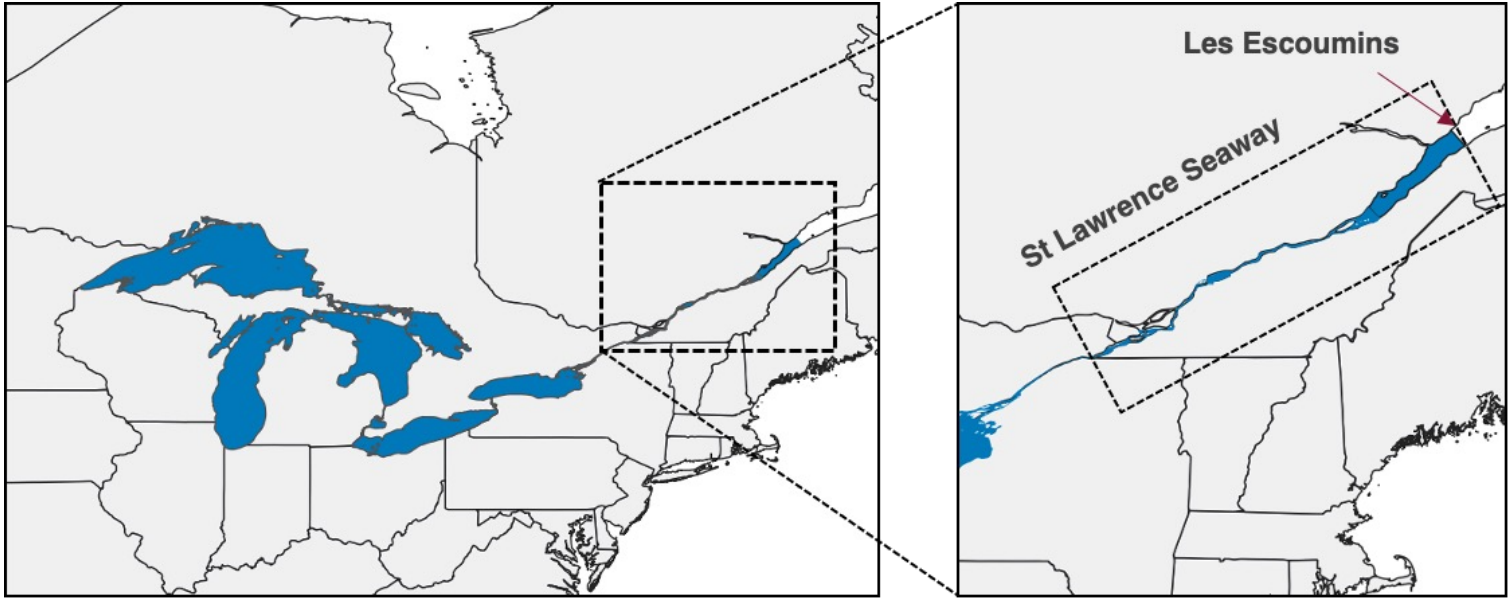
Agenda

1. Background
2. Baseline – What fuels are ships currently using? How much are they emitting? What are the major ports?
3. How can GL-SLS shipping decarbonize?
4. What are the regulatory considerations?
5. What are the conclusions and policy recommendations?

Background

The Great Lakes-St. Lawrence Seaway (GL-SLS)

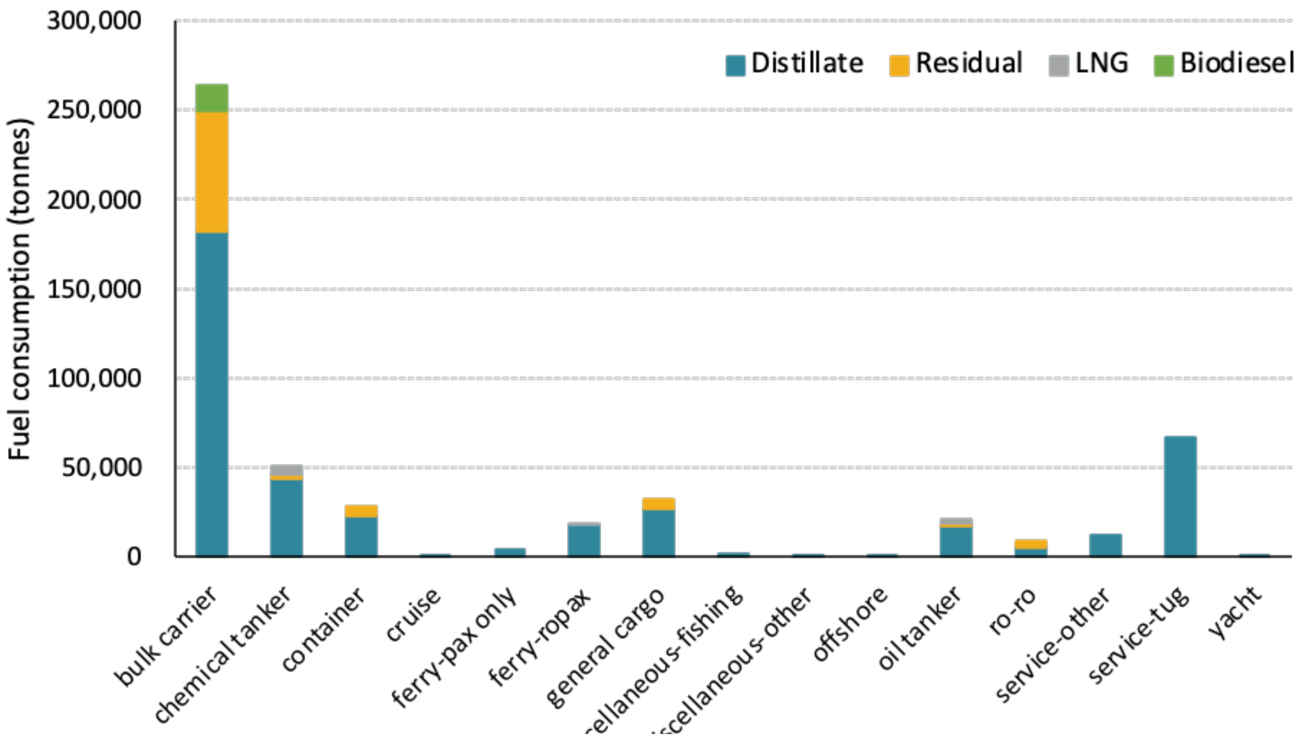
- 3,700 km (2,300 mi)
- 110+ ports
- 136 million tonnes (Mt) of cargo transported in 2022, valued at USD 26 billion.



THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Baseline – 2021 fuel consumption

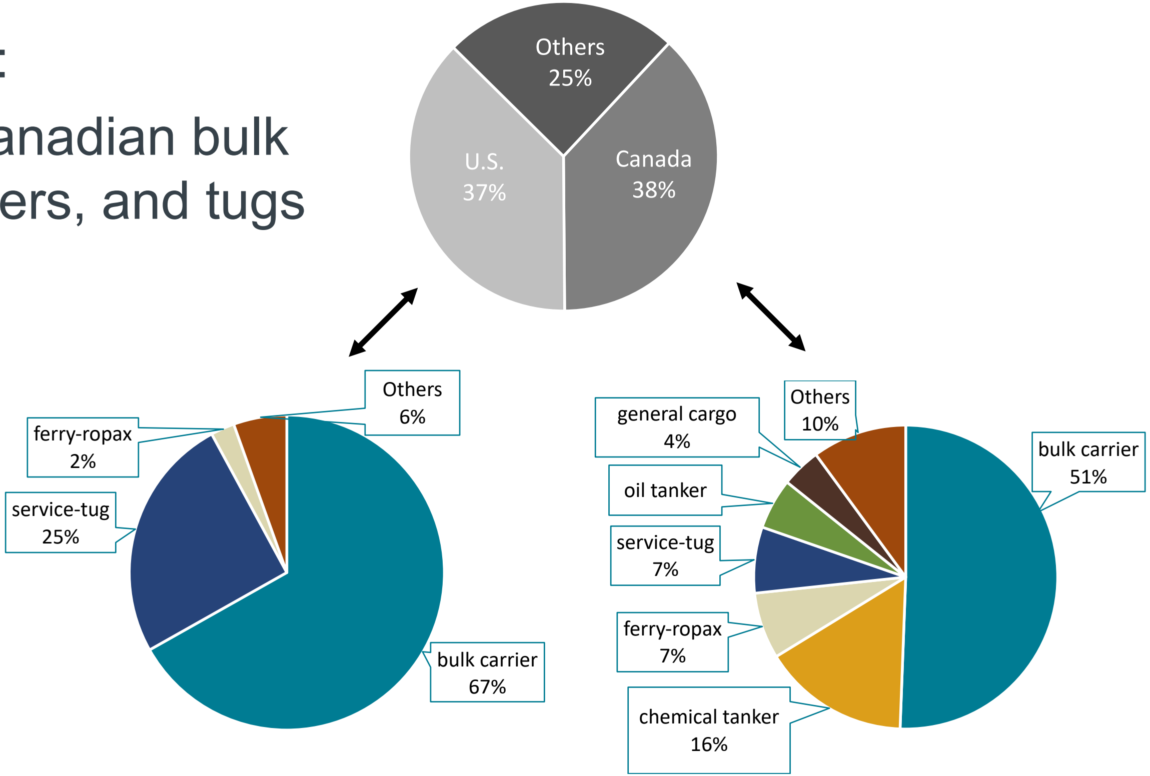
510,000 tonnes: ~80% distillate



Baseline – 2021 emissions

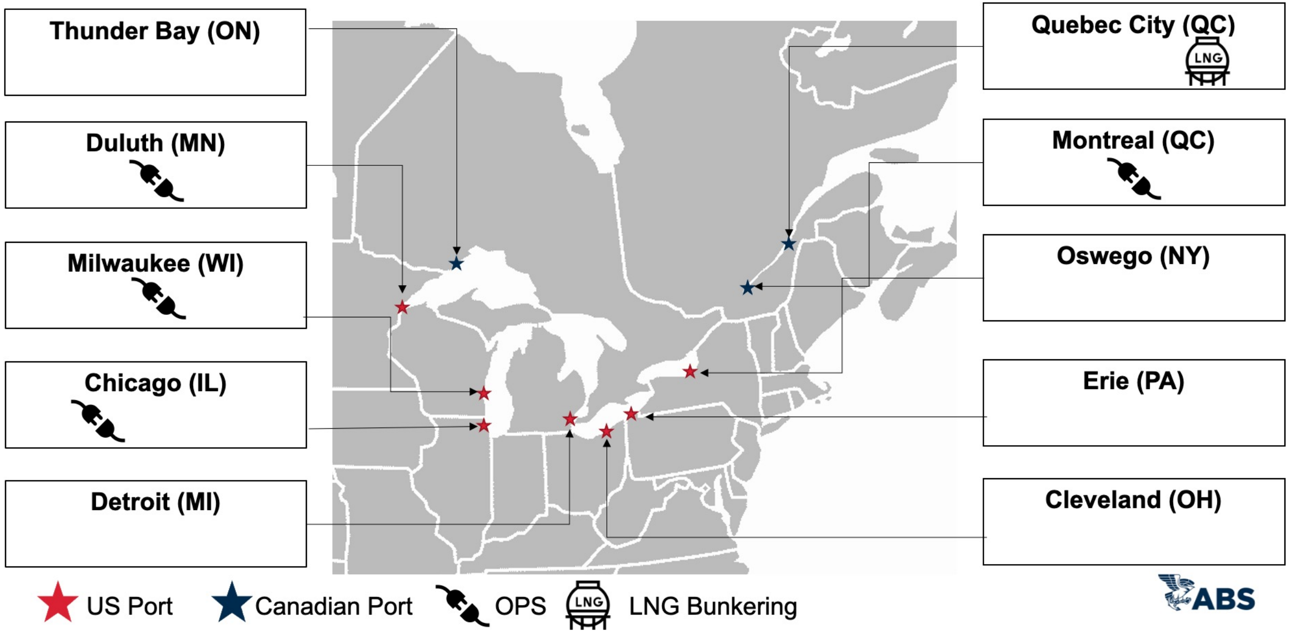
1.6 million tonnes CO_2:

Mainly from US and Canadian bulk carriers, chemical tankers, and tugs



THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Baseline – major ports and their infrastructure



ABS

THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

How can GL-SLS shipping decarbonize?

Fuel options to be used in engines, fuel cells (hydrogen), or batteries (electricity)

Fossil-based fuels
- Methanol
- Ammonia
- Hydrogen
- DME

Biofuels
- Methanol
- Diesel
- Methane
- DME

e-fuels
- Methanol
- Diesel
- Methane
- Ammonia
- Hydrogen

Electricity
- Batteries

Criteria to determine suitability of different fuel and power options for GL-SLS shipping

Life-cycle emissions

Total cost of ownership, including CAPEX and OPEX

Applicability to the types of voyages undertaken by GL-SLS ships

Technological maturity

Compatibility with existing ships/engines

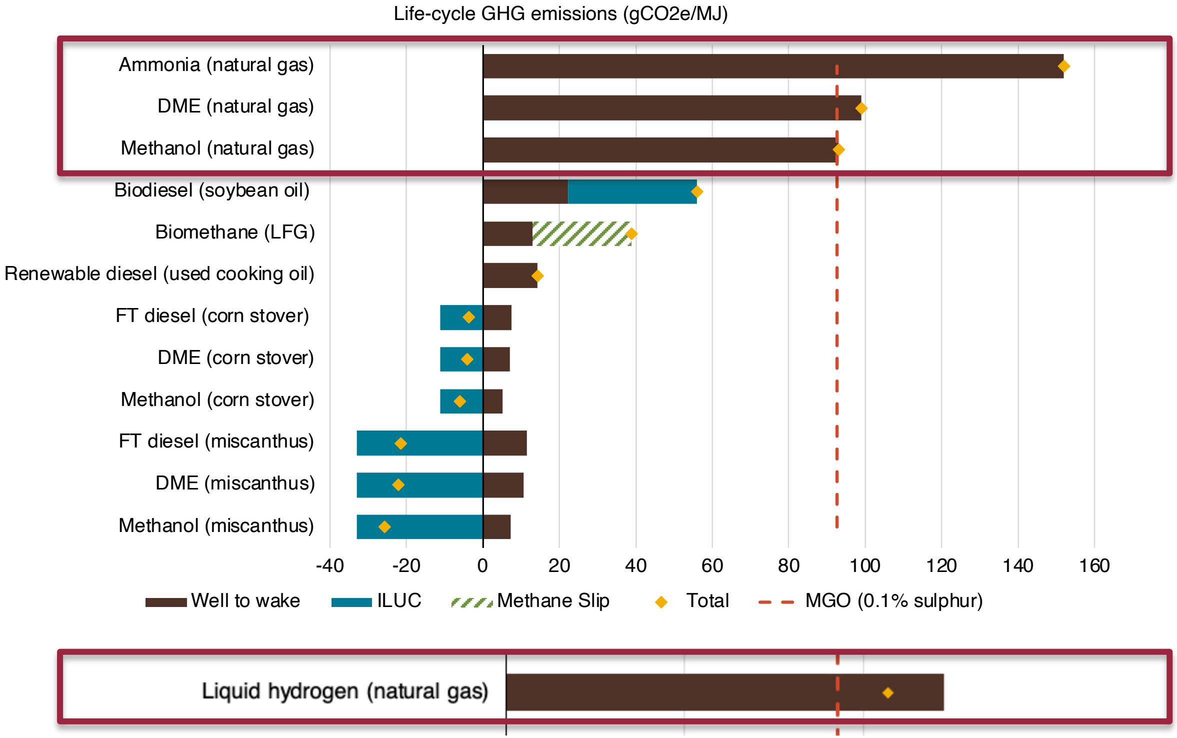
Feedstock availability

Risks, including safety and environmental hazards

Fossil-based fuels

Main problem:
high emissions

Main benefit:
inexpensive

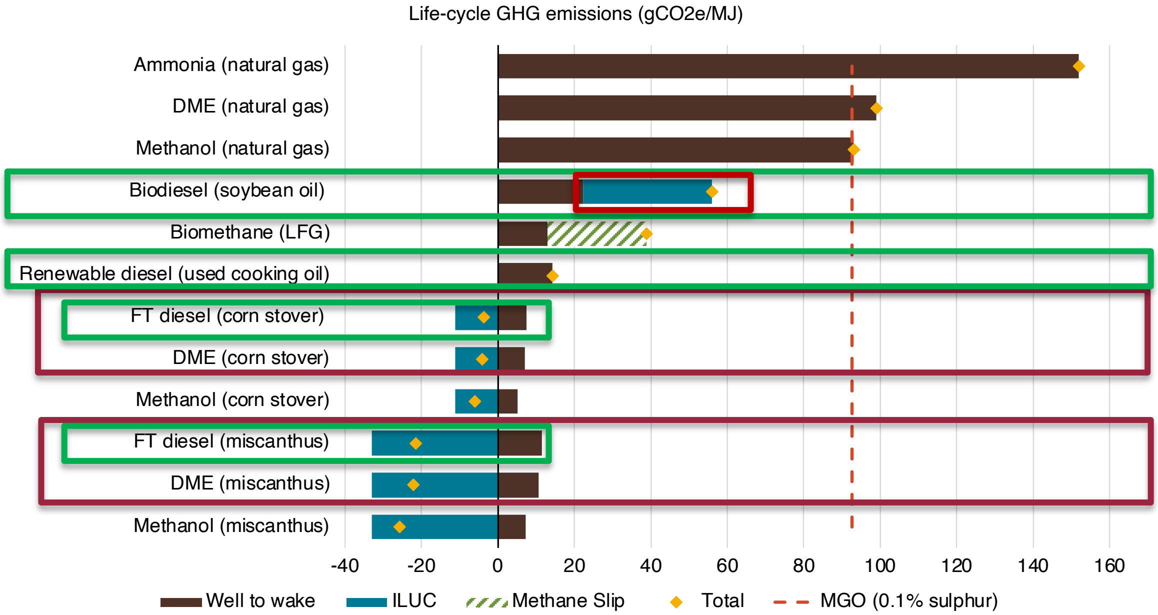


THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Biofuels

Main problems: **ILUC** (soy); **expensive** for advanced biofuels **(FT, DME)**

Main benefits: some are **drop-in fuels** for the existing GL-SLS fleet; can achieve low emissions

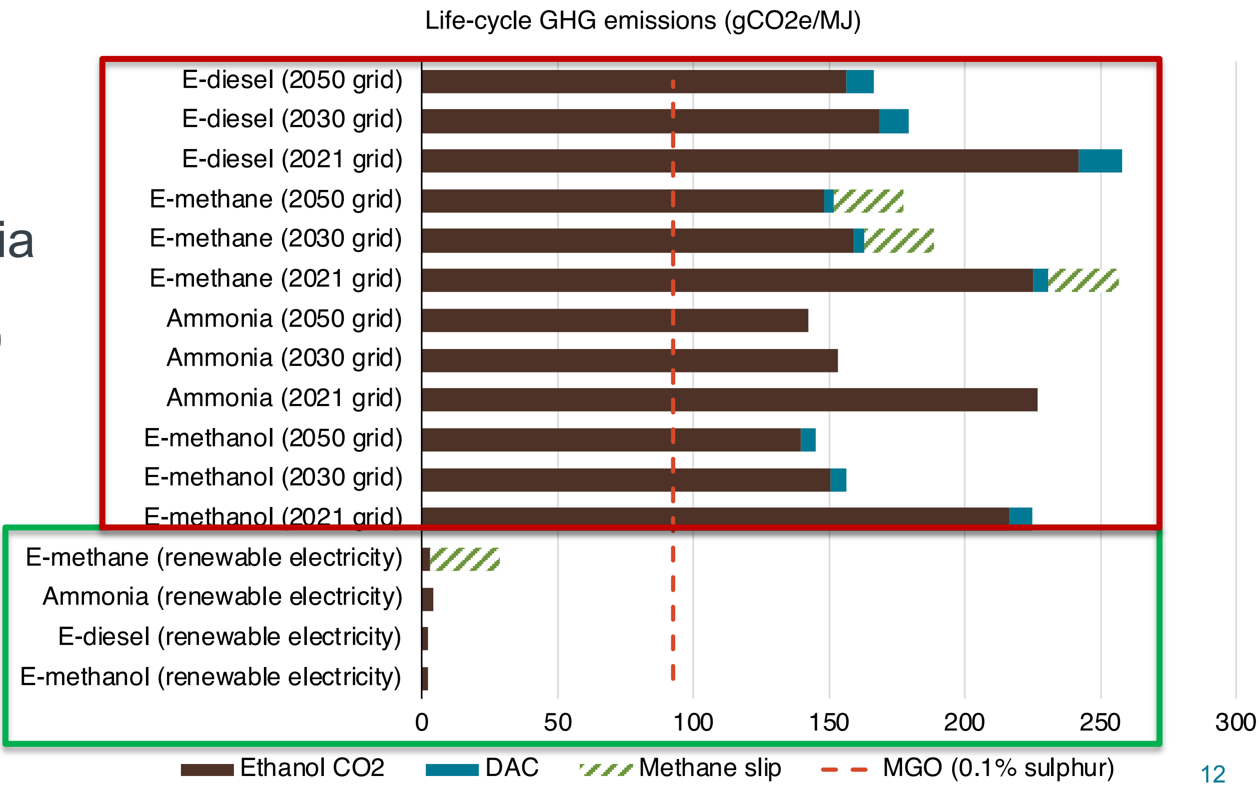


THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

e-fuels

Main problems: **high emissions** when using grid electricity; all are **expensive;** new risks for ammonia (toxicity) and hydrogen (explosion)

Main benefit: **low emissions** using additional renewable electricity

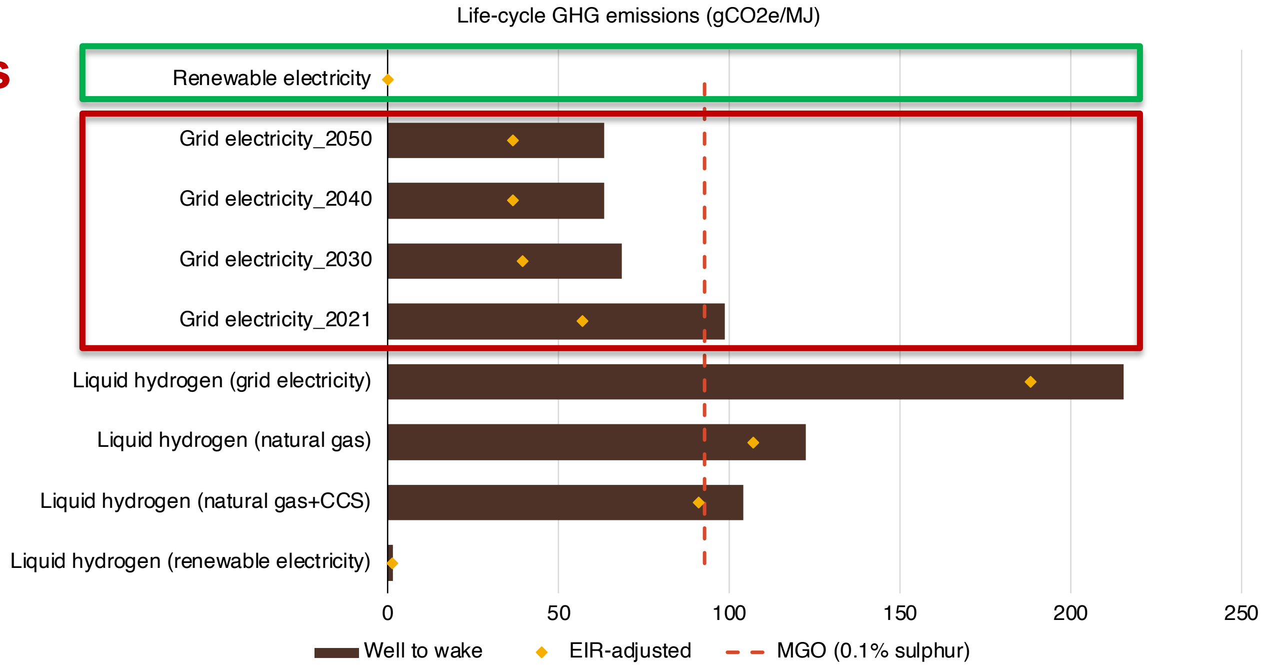


THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Electricity

Main problems: **TCO of using electricity is expensive;** mediocre emissions savings using grid electricity

Main benefits: **zero emissions** using additional renewable electricity; can be used to electrify tugs



icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

What are the regulatory considerations?

THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION

Regulations

Air pollution	GHGs	Safety
Easy Low/no sulfur, low PM, no major challenges for NOx and CO	More complicated Requires full life-cycle assessment	Challenging for new fuels Still being developed for hydrogen (explosion risk) and ammonia (acute toxicity)

What are the conclusions and policy recommendations?

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Conclusions

Fuels and power options

- Avoid fossil-based fuels.
- Use waste-derived biofuels.
- Use additional renewable electricity for e-fuels and electricity for batteries.
- Use fully-electric tugs/harbor craft and hybrid-electric setups for cargo ships.
- Use hydrogen made from additional renewable electricity in fuel cells to improve efficiency and virtually eliminate life-cycle emissions.

Regulations

- Compliance with air pollution regulations will be straightforward.
- Compliance with GHG regulations, which are still being developed, will be more complicated, requiring full life-cycle analyses.
- Safety regulations for using hydrogen and ammonia as marine fuels are still being developed.

Policy Recommendations

Policy recommendations

- Focus on driving down the cost of producing and using low life-cycle GHG e-fuels, or making fossil fuels more expensive (e.g., carbon pricing), or both.
- Consider adopting a low-carbon fuel standard (LCFS) or a blending mandate.
- Expand shore power for electric tugs/harbor craft and cargo auxiliary power.
- Plan for new fuel storage infrastructure for hydrogen, ammonia, and methanol.
- Promote repowering and replacement of GL-SLS vessels to make them zero-emission vessels.
- Establish a public database of total annual fuel consumption and in-port fuel consumption by each ship in the GL-SLS.

Questions?

bryan.comer@theicct.org

THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION