GHG Emissions from LNG Exports – FortisBC Tilbury1a to China

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Tilbury LNG

E-Drive and one of the Lowest Carbon in the World

Tilbury liquefies 13 million GJ of natural gas into 0.25 MTPA of LNG and uses about 200 GWh/year of electricity.

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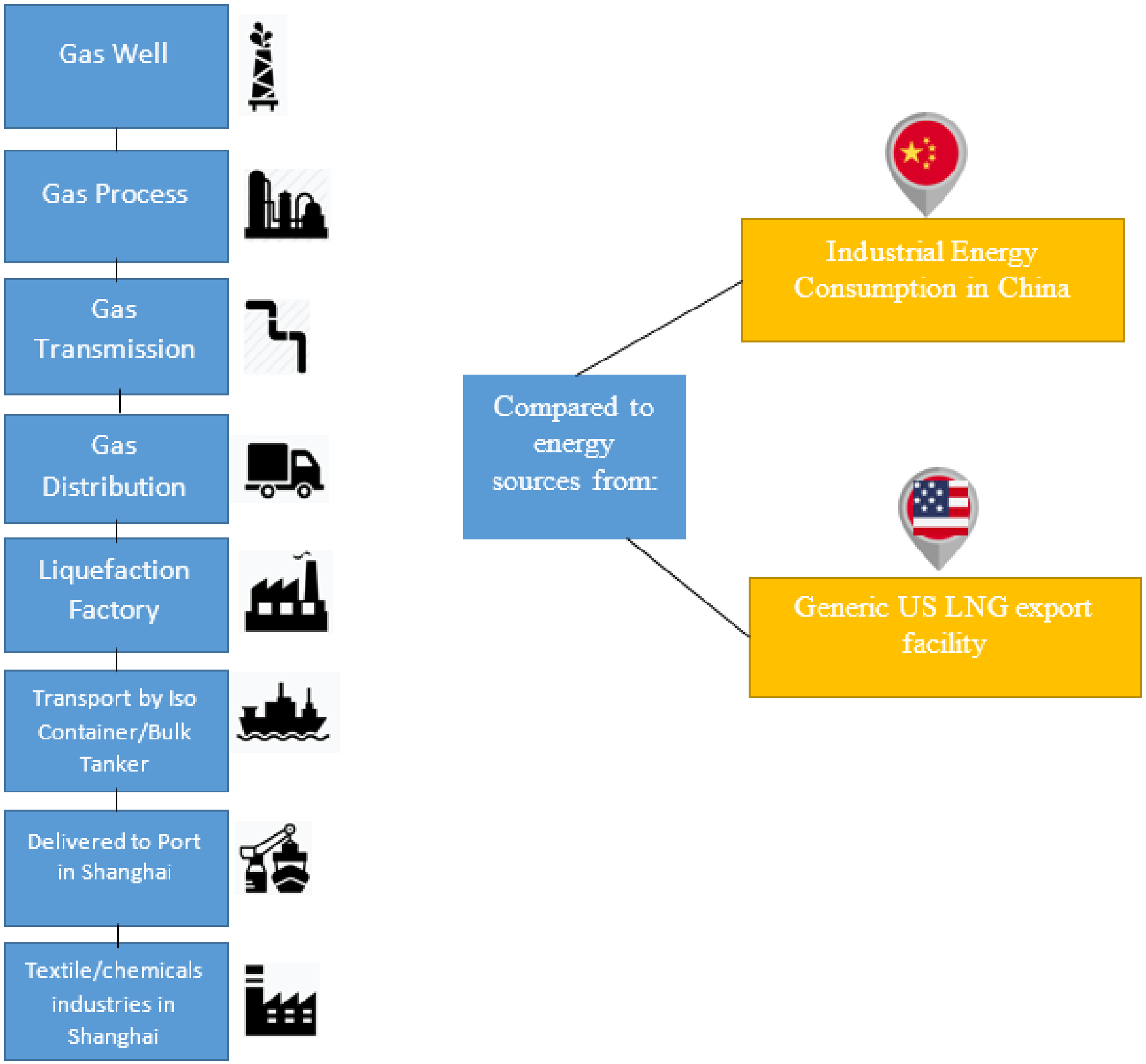
Background and Process

- John Hopkins University and University of Calgary published a paper showing the GHG reduction potential of BC LNG to the power sector in China in 2018
- Province of BC conducting benchmarking on LNG carbon intensity globally and Tilbury 1a is positioned as cleanest in the world
- FBC contracted study author for a specific look at Tilbury 1a
- FBC provided in-depth knowledge of LNG export activities, gas system and BC’s gas market
- Contractor used a number of public sources to develop a lifecycle GHG assessment across gas supply chain to China

Project Scope



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Main data sources

Applicable Sources used:

- BC Pembina Shale Scenario Tool
- Data from BC Ministry of Environment and the National Energy Board
- BC Oil and Gas Commission Reserves and Production Report 2016
- FortisBC Tilbury1a Data
- Peer reviewed journal articles
- Model of US LNG emissions owned by the contractor

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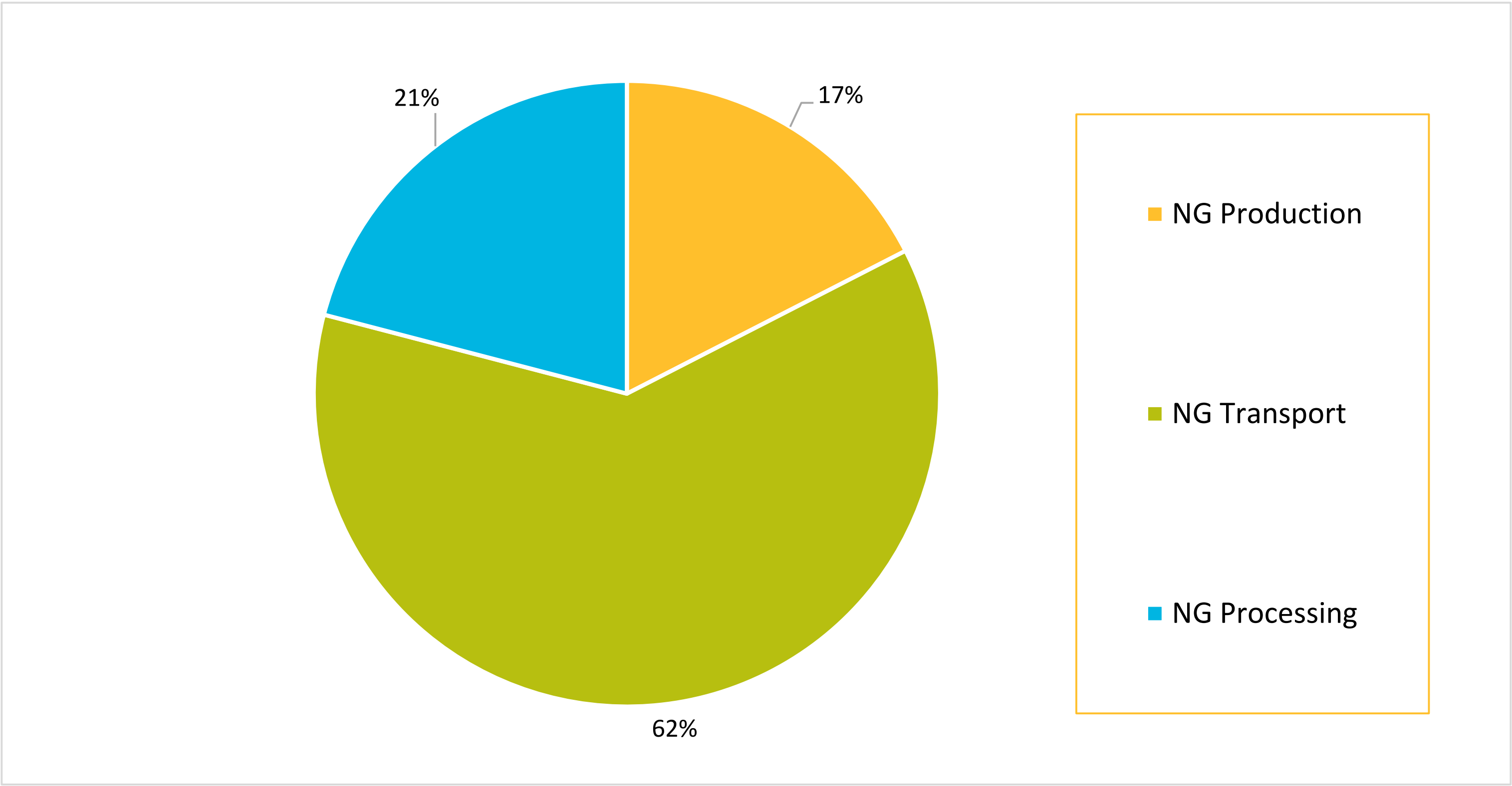
Key Assumptions Gas supply

- Gas supply mix proportional to current supply from Montney, Horn River, Liard, Jean Marie, Deep Basin and Conventional
- Lack of data applies emissions factors of Montney to other shale sources
- Gas delivered via T-South, no additional distribution emissions
- 45% methane reduction in upstream and transport in-line with provincial regulations
- Also performed another scenario of 75% methane reduction in upstream and transport

Share of GHG emissions from upstream sources



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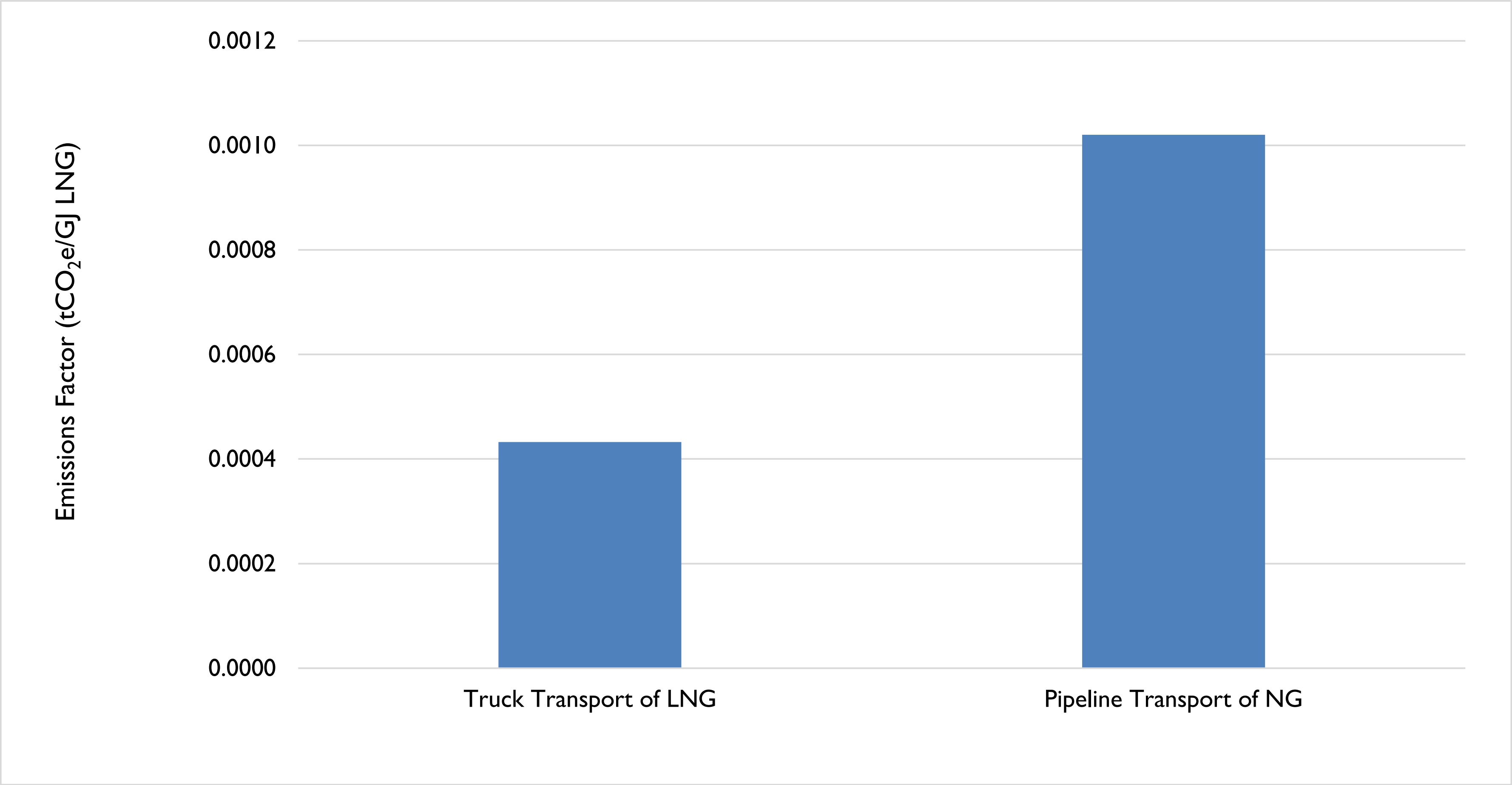
Downstream scenarios

LNG is shipped to two different end users in China in four different scenarios

	Inland truck	Inland pipeline
ISO Container	Option A	Option C
Bulk Tanker	Option B	Option D

China End-Use	Generic textile	Generic chemical

GHG Emission factors for different transport methods (FortisBC Tilbury1a – Shanghai, China)



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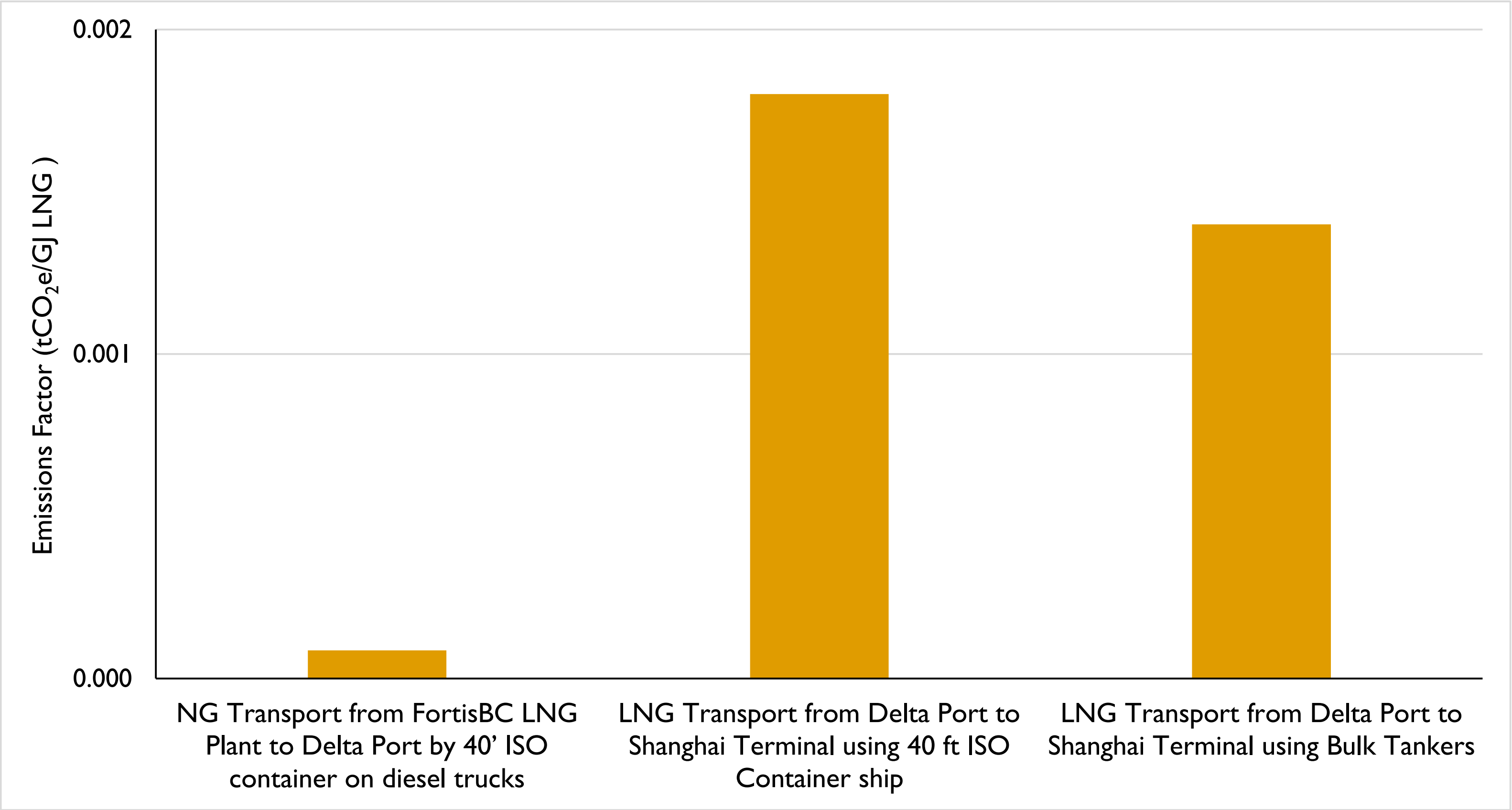
Findings – GHG Emission factors for different transport methods (FortisBC Tilbury 1a – Shanghai, China)



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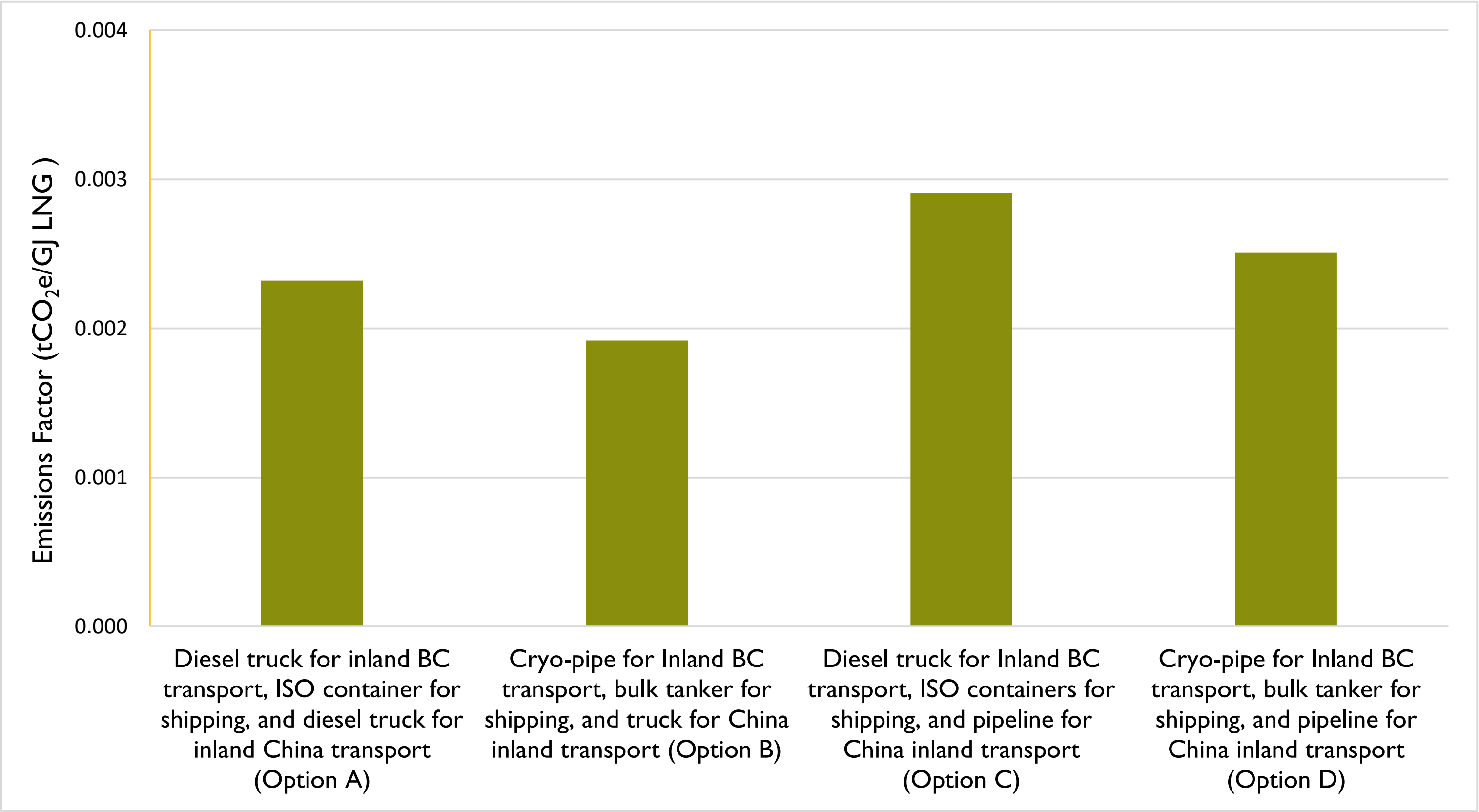
Findings – 4 Options of Transportation (FortisBC Tilbury 1a – Shanghai, China)

GHG Emission factors from total transportation



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Industrial energy use in China

Assumptions

- Lack of data makes it difficult to conduct detailed analysis
- Used two sources to estimate upstream and downstream emission factor in China industry
- Assumed one end use emission factor for gas in both industries
- Conservative estimate of total emissions in Chinese industry
- Net emissions changes could vary depending on data source applied

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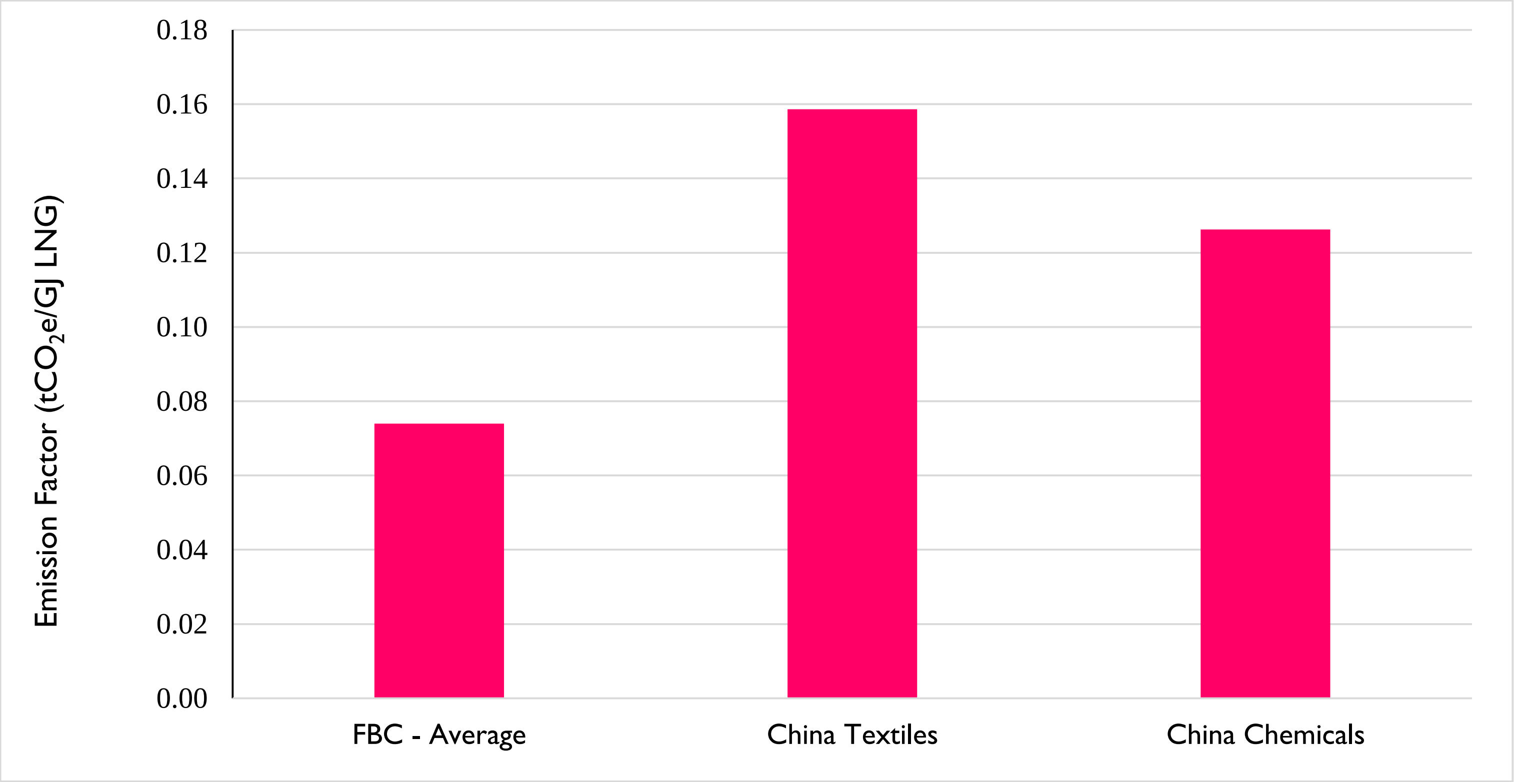
Findings – FortisBC Emissions vs Local Emissions in China

For the Chemicals and Textiles industries in Shanghai, China, utilizing any of the four options (A, B, C or D) from FortisBC Tilbury 1a, results in lower emissions than using local energy sources in China.



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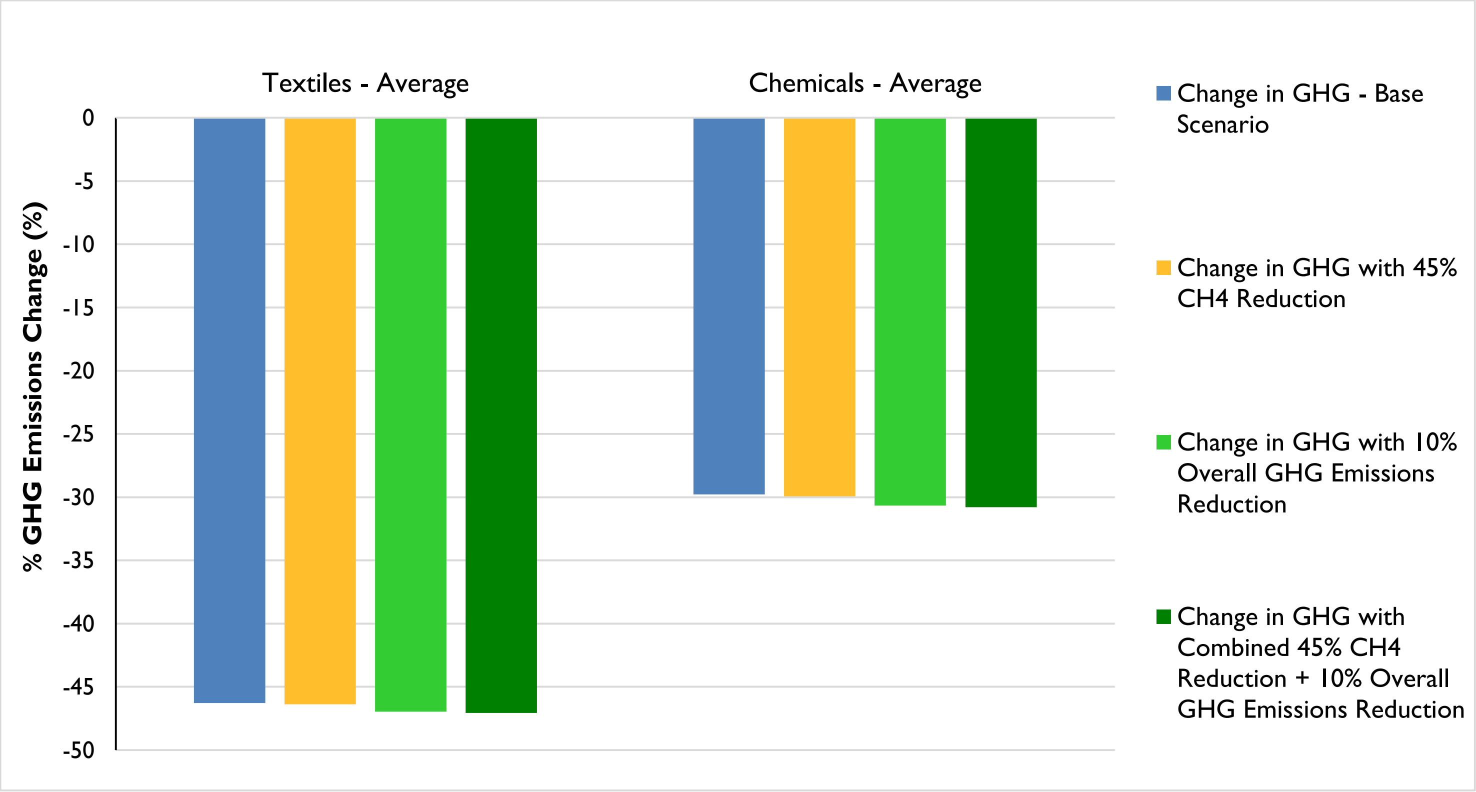
GHG Emissions Reductions Scenarios Comparison



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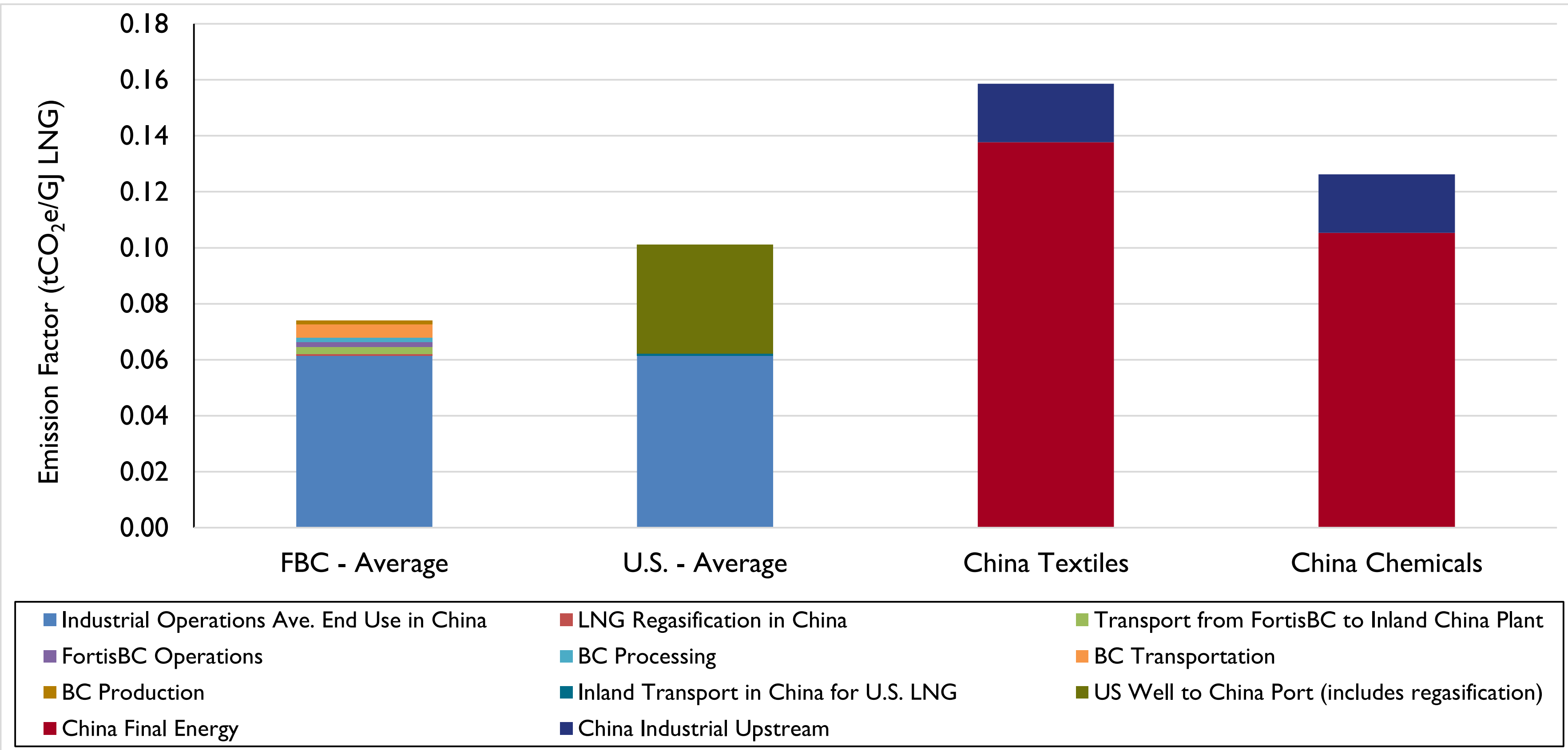
Comparison of emissions of Shanghai, China, FortisBC Tilbury1a and generic US Plant

LNG from FortisBC Tilbury1a significantly reduces emissions as compared to local sources in China and sources from U.S.



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Key Findings

- The maximum GHG reduction potential of Tilbury 1a could be as high as 1 Mt GHG
- Depending on delivery and destination Tilbury1a could reduce anywhere from 30 to 46% of lifecycle GHGs in Chinese industry
- For every tonne of emissions occurring in BC to produce LNG, 2 tonnes of GHG are reduced in China's industry
- Upstream and liquefaction GHGs in BC are less than half that of a generic US facility
- Tilbury reduces GHGs by up to an additional 25% compared to a generic facility in the US Gulf Coast
- Additional GHG policies in upstream gas (methane, electrification) have a small additional impact
- Different delivery methods are more or less GHG intensive however they do not significantly affect the lifecycle GHG reduction potential

LNG Bunkering a Significant Opportunity for BC

20 transpacific vessels:

60 PJ – 1 MTPA – 80 MW - 660 GWh ~ 1.5 Mt lifecycle GHG reduction

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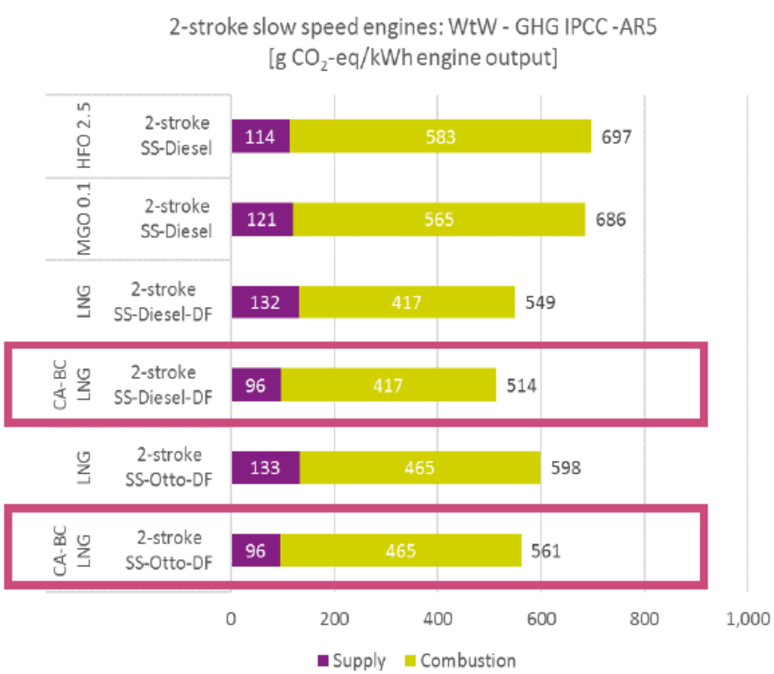
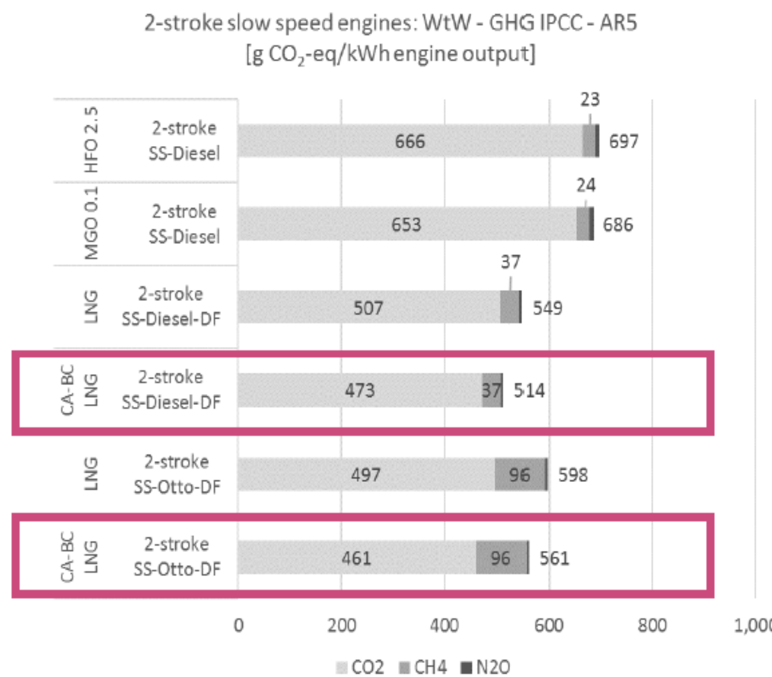
Well-to-Wake GHG Emissions

2-Stroke Slow Speed Engines (Tier III)





1. When using global LNG, GHG reduction is 14-21% compared with $HFO_{2.5}$
2. The use of BC LNG reduces the GHG emissions by 20-26% compared with $HFO_{2.5}$
3. Methane emissions of oil-based fuels ~3% of total WtW GHG; for LNG: 6-17%

Thank you

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