WOLFE & CO

Low Carbon Liquid Fuels

Green Ports Webinar

21 May 2026

Low Carbon Liquid Fuels

Regulations, Aspirations, Technology and Economics

1. Background and Context

Context - International Regulations

There is EU and IMO commitment to decarbonisation of shipping

EU and Fuel EU Maritime

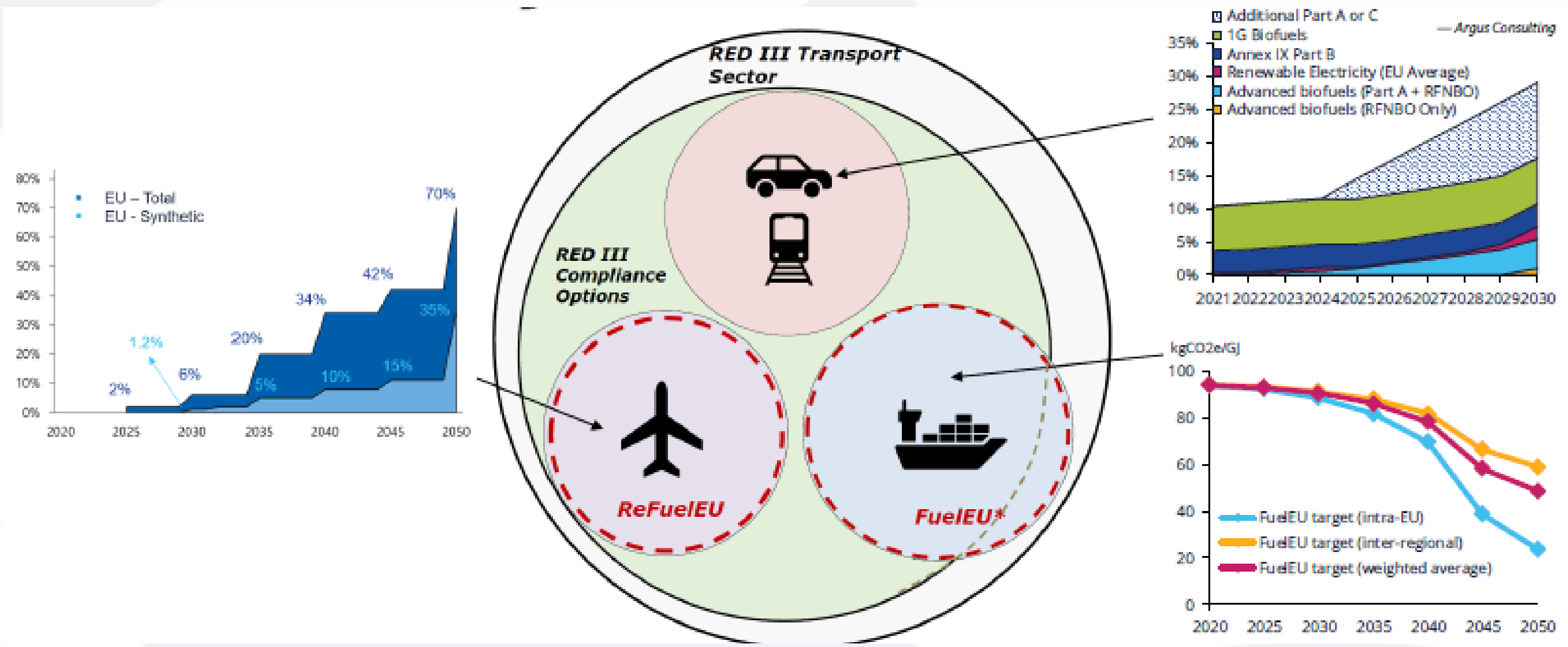
Organisation	European Commission (European Union)
Instrument	FuelEU Maritime Regulation 2023 (EU Fit for 55) Legislated July 2023, implemented from early 2024
Applicability	Ships weighing >5,000 tonnes (gross) Partial counting of voyages in and out of EU
GHG Emissions	Mandatory reductions in fuel emissions to 2050 Calculated on lifecycle energy-eq basis (well-to-wake)

2020	2025	2030	2035	2040	2045	2050
0%	2%	6%	15%	31%	62%	80%

Penalties	€670/t CO_2-eq penalty if targets not achieved Compounds for repeated non-compliance
RFNBO Fuels	200% energy multiplier available until 2033 Target 1% by energy by 2031 Mandatory 2% by energy from 2034 if below target
Pooling Mechanism	Voluntary pooling mechanism available

Context - International Regulations

EU RED III



Source: Argus Consulting

Context – International Regulations

There is EU and IMO commitment to decarbonisation of shipping

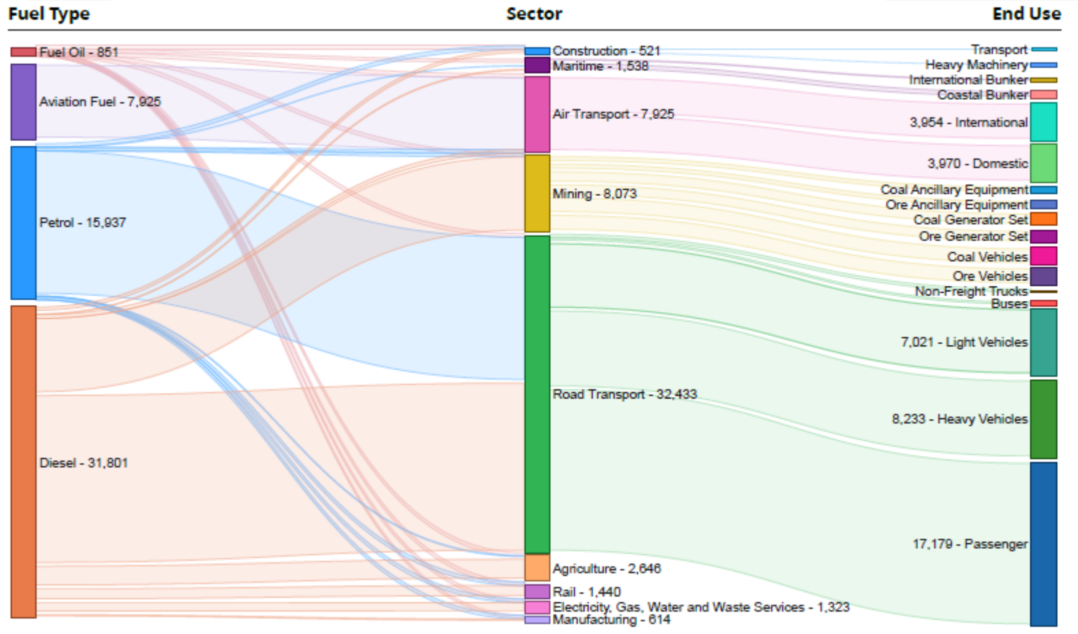
International Maritime Organisation

Organisation	International Maritime Organisation (UN)
Instrument	IMO GHG Strategy 2023 establishes pathway to adopting mandatory targets via the MARPOL convention
Applicability	IMO is the UN's shipping agency. Australian is a member of the IMO
GHG Emissions	Target reduction in fuel emissions to 2050, calculated on a total and lifecycle energy-equivalent basis (well-to-wake). Total emissions net-zero by 2050, and 40% reduction by 2030
Penalties	Mandatory reductions in fuel emissions pending Penalties for non-compliance pending Expected to be applied via the MARPOL convention
Near-Zero Fuels	Targeted 5% to 10% by energy by 2030 Equivalent to RFNBO in FuelEU Maritime Regulation
Pooling Mechanism	Voluntary pooling mechanism available

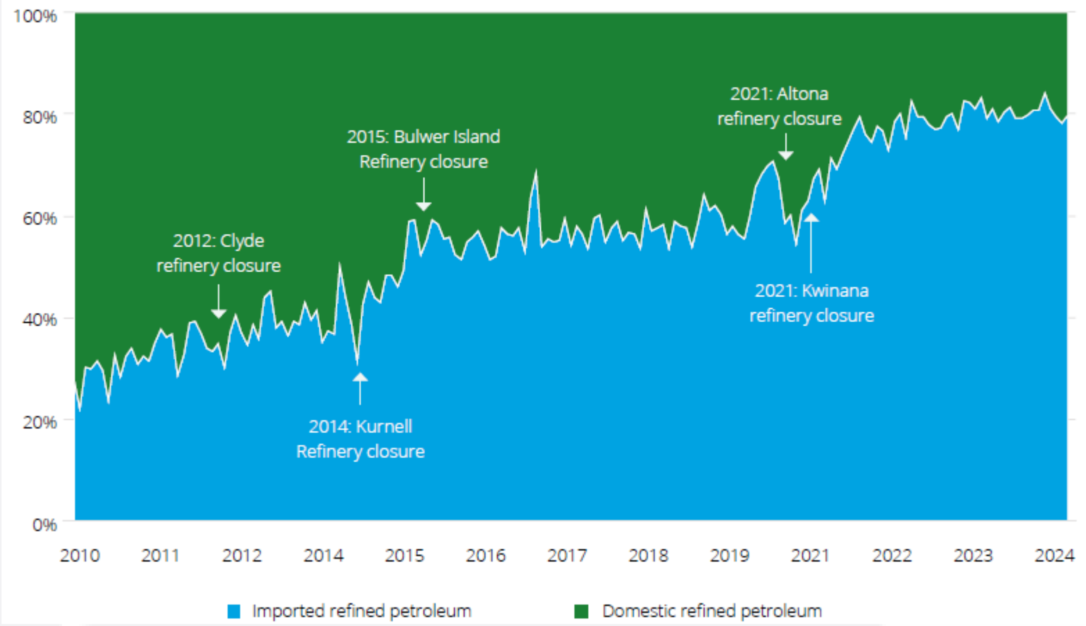
Context – Regulatory Factors

Australian Government Focus on Sovereign Risk

Liquid Fuel Use 2022-23



Import vs Domestic Production



Context – Regulatory Factors

Australian and State Governments

Policy Development

There are two primary policy areas from the Australian Government:

- Future Made in Australia Advancing Renewables Program.
- Clean Fuels Program

The second round of Hydrogen HeadStart has also just been announced, backing renewable fuel developments including methanol for shipping.

New South Wales and Queensland also have State-based policies to support development of LCLF projects.

Fuel Standards

- Australian fuel standards do not currently include more advanced bio- and renewable fuels.
- Fuel suppliers currently offering more advanced bio- and renewable fuels in the Australian market are adopting European fuel standards.
- There is ongoing engagement with fuel manufacturers and suppliers via Consultation committees that are updating current Australian Standards to include LCLFs, however the timing of publication of revised standards is unclear.

2. Decarbonisation Pathways

Decarbonisation Pathways

Current and Emerging Technology Options

Now

Options / technology that are available immediately.

Landside

- Biodiesel
- Renewable diesel
- Battery EVs

Marine Operations

- Renewable diesel
- Shore power
- LNG

New

Emerging options / technology that should be commercially available in the near future, notionally 5-10 years.

Landside

- Biodiesel
- Renewable diesel
- Battery EVs
- Hydrogen fuel cell (?)

Marine Operations

- Renewable diesel
- Methanol
- Bio-LNG

Next

Future options / technology that are at lab bench / demonstration status and may be available in 10 years +

Landside

- Hydrogen fuel cell
- Renewable diesel
- Biodiesel
- Battery EVs

Marine Operations

- Renewable diesel
- Methanol / methanol fuel cell
- Ammonia

Evolution of LCLFs

Production of LCLFs from various bio-feedstocks

Feedstocks and Pathways to LCLFs

Category	Bio-Fuels									E-fuels	
	First Generation Biofuels			Second Generation Biofuels			Biomass to Liquids			Power to Liquids	
Feedstock	Sugar cane	Corn	Molasses	Cooking Oil	Tallow	Plant Oil	Ag Residue	Forestry Residue	Biomass Waste	Carbon, Hydrogen	Nitrogen, Hydrogen
Primary Process	Fermentation			Trans-esterification	Hydrogenation		Gasification Methanation or FT Synthesis			Methanol Synthesis	Haber Bosch Synthesis
Primary Output	Bioethanol			FAME / UCOME	HEFA / SPK		Bio-methanol	FT Liquids		E-Methanol	E-Ammonia
Secondary Process	Blending w/gasoline	Alcohol to Jet		Blending w/diesel			Methanol to Jet	Hydrogenation		Methanol to jet	
Secondary Output	Biogasoline (E5, E10 etc)	AtJ-SPK (SAF)		Biodiesel (B10 etc)	Renewable Diesel (R100)		AtJ-SPK (SAF)	FT-SPK (SAF)		AtJ-SPK (SAF)	

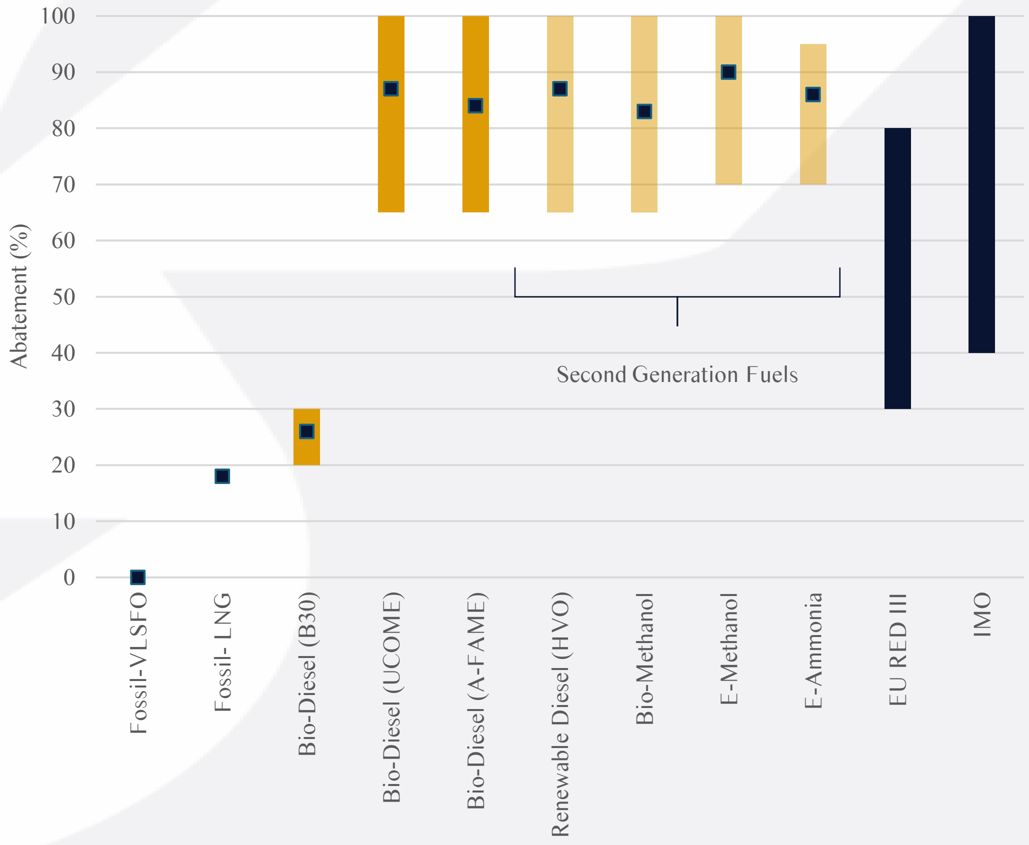
Blended Fuel
Drop-in Fuel

FAME	Fatty Acid Methyl Ester	SPK	Synthetic Paraffin Kerosene
UCOME	Used Cooking Oil Methyl Ester	FT	Fischer Tropsch
HEFA	Hydro-processed Esters and Fatty Acids	AtJ	Alcohol to Jet
HVO	Hydrotreated Vegetable Oil	SAF	Sustainable Aviation Fuel

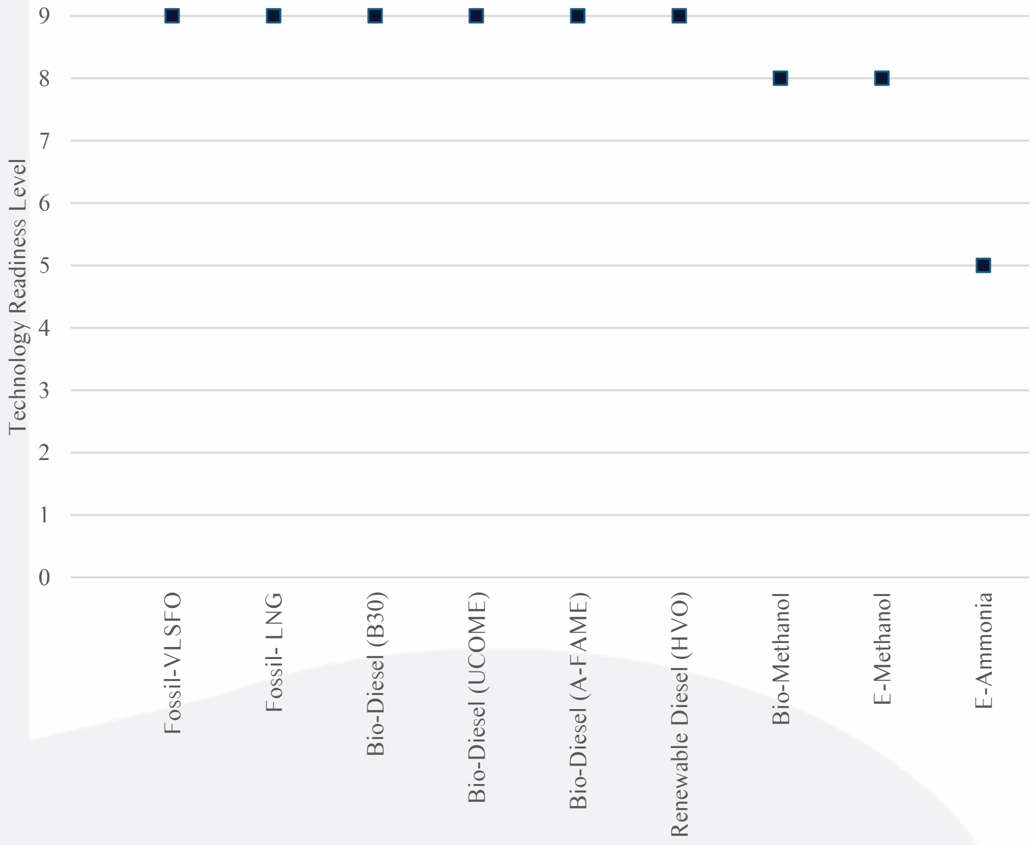
Decarbonisation Pathways

Carbon Reduction and Technology Maturity

Reduction in lifecycle emissions



Fuel Technology Maturity (TRL)



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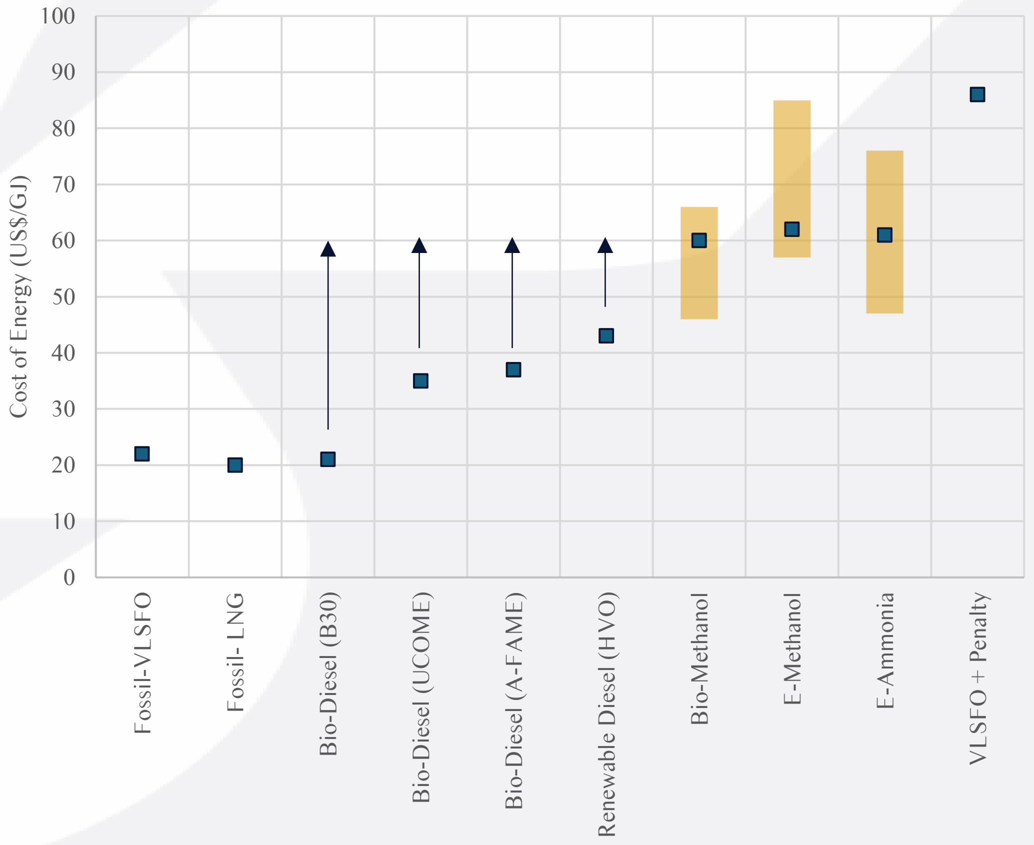
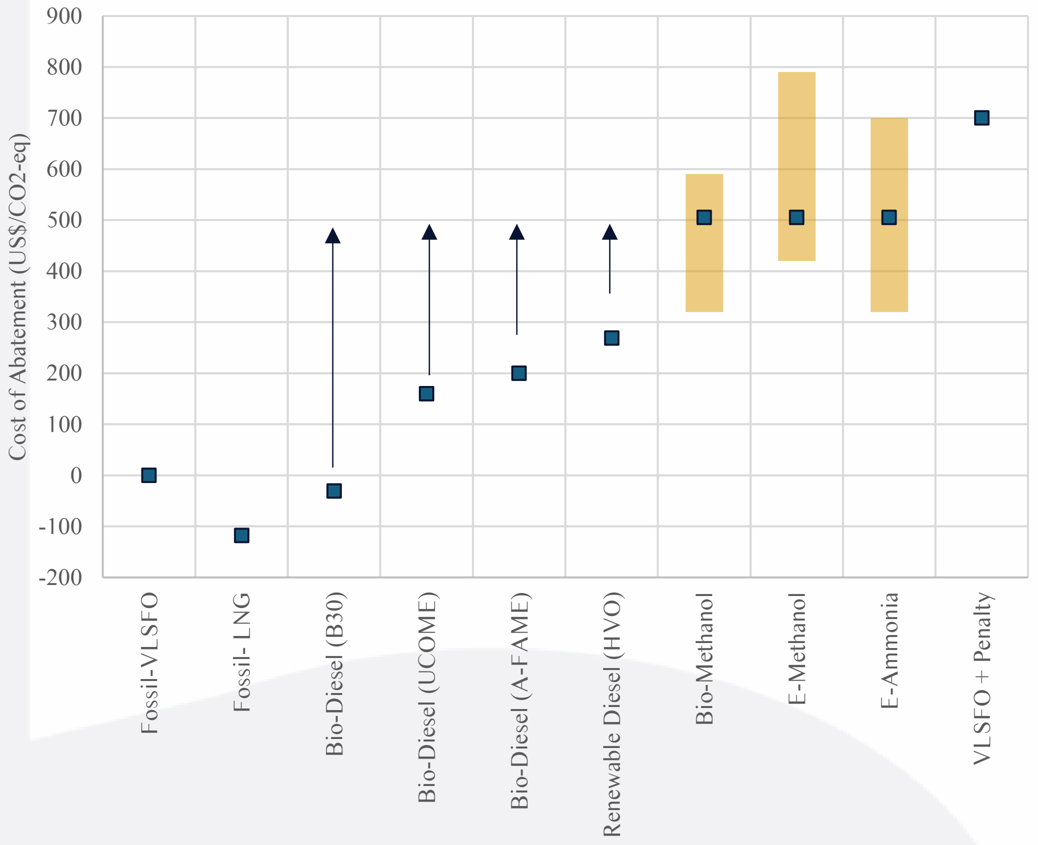
Decarbonisation Pathways

Cost of Energy and Implied Cost of Carbon Abatement

Equivalent Cost of Energy



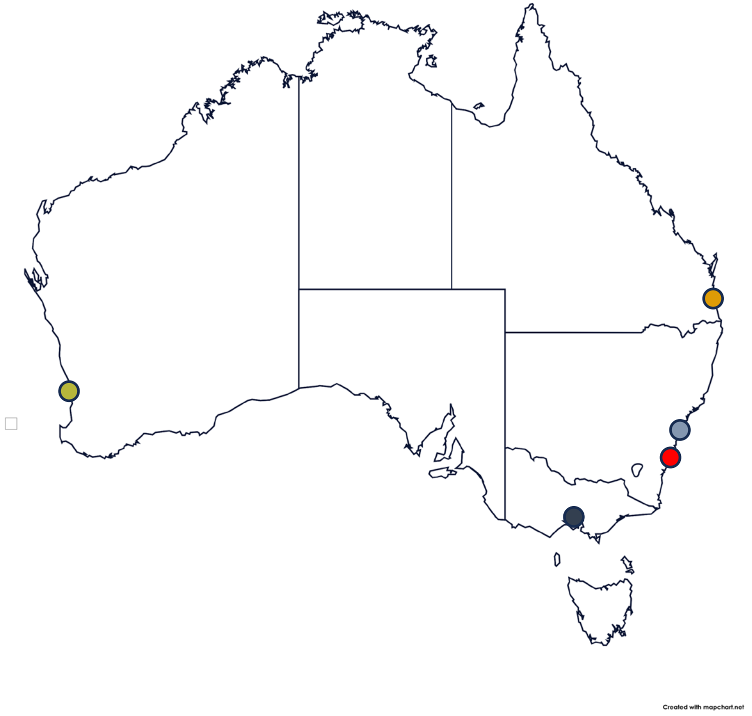
Equivalent Carbon Abatement Cost



3. Case Studies

Australian Ports

All major ports have decarbonisation objectives



PORT of BRISBANE	Port of Brisbane achieved carbon net zero in 2024 and is targeting absolute zero by 2030. Initiatives include renewable electricity power purchase agreements, significant on-site solarPV generation and a planned renewable diesel trial for its dredger
PORT of NEWCASTLE	Port of Newcastle has a target of net zero for Scope 1, 2 and selected Scope 3 emissions by 2040, and an interim target of 55% reduction in CO_2 emissions by 2030 from 2018 baseline. Key activities include: • Renewable electricity PPA • Transition of vehicle fleet to electric • LED upgrades to buildings and external lights Port of Newcastle operates a trailing suction dredger the 'David Allen'[1], and the 'Lydia' a bed levelling vessel that increases dredging efficiency
NSWPorts	NSW Ports indicates a target of net zero for Scope 1 and 2 emissions by 2025, supported by 100% renewable electricity supply via PPA.
Port of Melbourne	Port of Melbourne has a target of net zero for Scope 1 and 2 emissions by 2030, based on: • 100% renewable electricity • Transitioning of vehicles and marine survey vessel to electric or zero emission fuel. PoM has executed a Memorandum of Understanding for green methanol bunkering study and have joined the C40 Green Ports forum
Fremantle PORTS	Fremantle Ports is committed to reduction of its scope 1 and 2 emissions by 80 per cent below FY2019-20 levels by 2030, and net zero emissions by 2050. A trial using renewable diesel is planned, and Fremantle Ports has signed a renewable power agreement for its electricity supplies.

Ship lines

Maersk

Maersk is probably the most advanced international ship line in terms of future fuels.

It launched a methanol-fuelled vessel in 2023, has a further 12 ships to be operating by 2025, and an additional 13 vessels on order.

It supported a methanol bunkering simulation with the Port of Yokohama in September 2024, developed as part of the MoU between Maersk, Port of Yokohama and Mitsubishi Gas Chemical to develop methanol fuel supply infrastructure in the port.

Maersk is exploring ammonia as a future fuel but recognises the storage and operation of the fuel is challenging.

CMA CGA

CMA CGM is focussed in the immediate term on the use of LNG, including where available on bio-LNG.

It ordered 12 methanol-fuelled vessels in 2023 and has commenced planning for methanol conversion of existing assets from 2024.

CSL

CSL is actively engaged with Bioenergy Australia and Maritime Industry Australia to develop a biofuel supply chain in Australia to build on its successful trial of second generation biofuel (B100) in Canada.

The trial was undertaken in a staged manner, adopting B100 in;

- An auxiliary vessel engine
- Main and auxiliary engines on two vessels
- 8 vessels in 2021

The trial has used B100 over nearly 30,000 running hours and 14,000 tonnes of biodiesel, with no modification to existing equipment.

CSL continues to operate 8 vessels on B100 in Canada and is implementing renewable fuels in Europe.

It has ordered methanol-ready dual fuel ships for the US but they are not currently operating on methanol.

Svitzer

- The largest global tug operator, with 450 vessels globally and 90 operating in Australia.
- It was spun-out from Maersk in April 2024
- Decarbonisation target of 50% reduction by 2030 and carbon neutral by 2040.
- Decarbonisation plans are focussed on 3 themes;
    - People is focussed on operational efficiency
    - Svitzer's trials in the UK (R100) and Netherlands (B100) have been successful
    - New tug designs and new propulsion systems.
- Svitzer has recently signed an MoU with the Port of Melbourne to deploy new electric tugs into the port.

Dredging Contractors

Van Oord

Van Oord has launched a methanol-fuelled offshore installation vessel, Boreas, that is anticipated to be operating in 2025.

The Boreas will be powered by 5 methanol engines produced by Wärtsilä. The engines passed factory acceptance tests in April 2023.

DEME

DEME has purchased a former Supramax bulk carrier 'Yellowstone' to support its offshore rock protection / armouring activities, with the vessel retrofitted in Singapore.

The vessel is the first in DEME's fleet to be operated on methanol, and it also includes a 1MWh battery to support hybrid electric operation.

DEME is also co-developing a green hydrogen to ammonia plant in Oman with the Port of Antwerp, although it is unclear the intended use for the ammonia produced.

Boskalis

Boskalis has recently completed a demonstration project where it retrofitted a pontoon excavator with hydrogen storage and fuel cell units, operating the excavator with zero carbon hydrogen.

It has also deployed battery packs onto some vessels to maximise the use of existing hybrid technologies.

Logistics Companies

Toll Group

Toll has for a number of years been trialling alternative fuels for its transport logistics operations, including LNG trucks.

In 2023 Toll has been trialling an electric yard tractor at a depot in Victoria. The tractor features a swap-out battery arrangement meaning that there is minimal downtime for battery swap.

It is understood that Toll is trialling electric forklifts at the Port of Brisbane but is facing challenges associated with ability to charge the equipment due to constraints with electrical network capacity.

DP World

DP World has implemented a program to adopt HVO (renewable diesel) at its operations at its Southampton container terminal in the UK. HVO is used in its straddle carriers, reefers and forklifts.

It has also trialled an electric tractor at its London Gateway operation, which is used to transport container trailers on a 3.5km trip from the quayside to a distribution centre. DP World is planning to replace all of its diesel tractor fleet with electric tractors in the near future, replacing 11 tractors.

Renewable Fuel Availability

Supply Side Factors

Renewable Diesel

- Renewable diesel is widely available and is currently imported by the major fuel importers via Isotainer
- Generally supplied from Singapore, or China
- Certified to EN 15940 and Australian Fuel Quality Standards
- Also emerging dedicated LCLF suppliers such as RD2Go, HAMR Energy, Abel Energy and HIF Global

Biodiesel

There are two predominate manufacturers of first generation biodiesel in Australia:

- Ecotech Biodiesel, Narangba, QLD
- Just Biodiesel, Victoria

Conclusions

Options are available but cost remains challenging

- The LCLF market is moving, driven by international regulations, particularly the EU
- Current US Administration is not supportive of climate policy generally, and this impacted the passage of the most recent IMO initiative
- Lack of policy drive in Australia makes the commercial challenge very difficult for most sectors
- Many local and international organisations remain committed to the decarbonisation with many trials and small scale initiatives underway

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