Maritime decarbonisation – Sustainable Biofuel Strategies

13th SMI Forum

6 Nov 2023

Green COP Pte Ltd

A Logical First Step to Create a Greener Earth

About me

Green COP Pte Ltd

A logical first step to create a greener earth

Established in Singapore in July 2021, it was founded by Dr. Hanson Lee from the National University of Singapore. Based on the patented Green COP second-generation non-food biomass utilization technology, the company focuses on the research and production of converting biological waste into biofuels, using unique enzymes and green processes to manufacture bio-based alcohols, ketones, etc., and its products are widely used in aviation, shipping, automobile and other transportation fields and other material fields. The company is committed to solving the dual pressures of global "carbon emission reduction & carbon neutrality" and "food crisis" and promoting the harmonious coexistence between man and nature.

Non-food biotechnology

Biomass Liquid Fuel

Carbon Neutral

Dr. Hanson Lee

Co-founder & CEO

National University of Singapore
Inventor of Green COP technology

- Singapore Smart Port Challenge 1st runner-up
- Member of the Coastal Sustainability Alliance (CSA)
- Xiamen Govt. Talents Programme

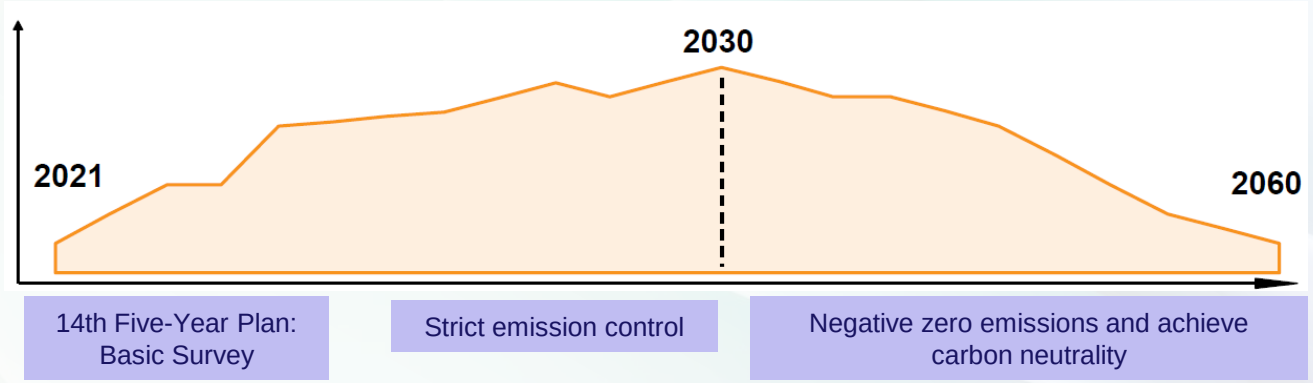
Global CO_2 emissions from the transport sector ≈ 7.98 Gt CO_2

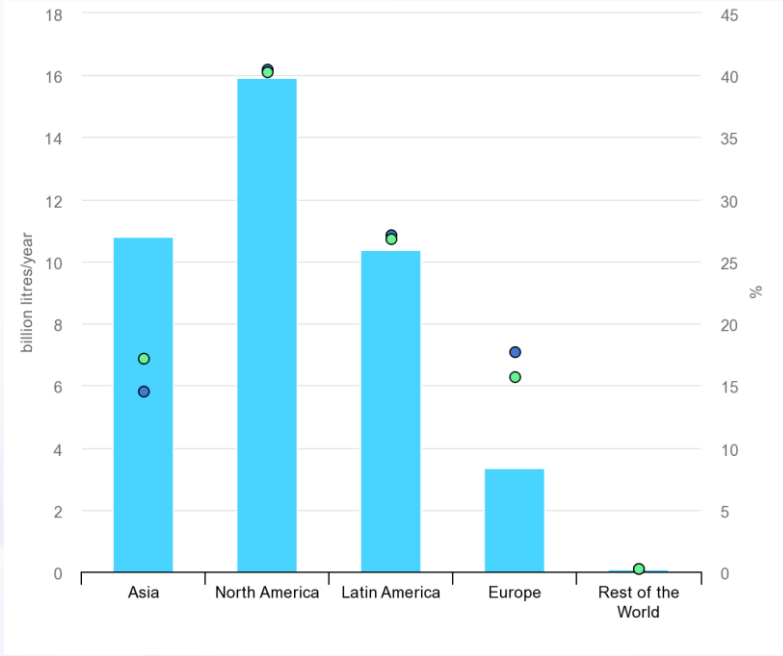
In 2022

More than 20% of global CO_2 emissions

Carbon neutrality and the food crisis have prompted countries to legislate and promote the development of non-food bioenergy

- **66 countries have formulated laws and regulations on biofuels, including 27 EU countries, 14 countries in the Americas, 12 countries in the Asia-Pacific region, 11 countries in Africa, and 2 non-EU European countries.**





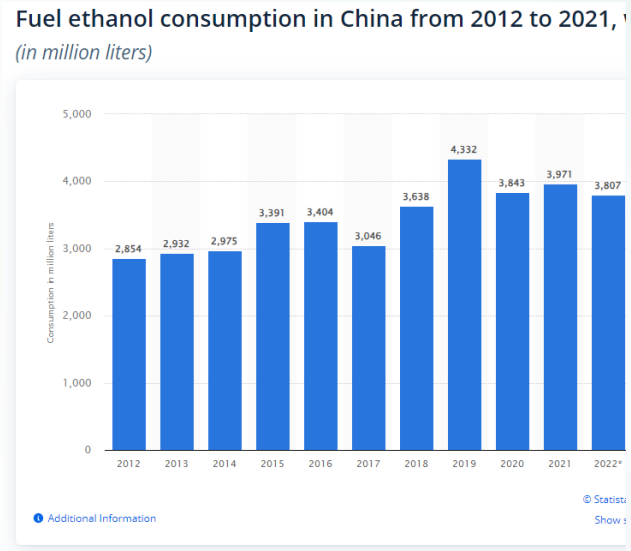
Country / region	Policy	Impact on biofuel demand
U.S.	Renewable Fuel Standard (RFS)	Surge in demand for total renewable fuels, advanced biofuels, biodiesel, cellulosic ethanol. Advanced biofuels require a 50% reduction in greenhouse gas emissions throughout the life cycle, and cellulose-based and agricultural waste-based biofuels require a 60% reduction in greenhouse gas emissions throughout the life cycle.
	Sustainable Aviation Challenge	By 2030, 11 billion liters of sustainable aviation kerosene will be used. Sustainable aviation kerosene will be subject to the Renewable Energy Standard (RFS).
EU	Renewable Energy Directive II (RED II)	By 2030, the use of renewable energy in transportation will reach 14%
	Carbon Border Adjustment Mechanism （CBAM）	By 2025, there will be an urgent demand for advanced bio-marine fuels
	ReFuelEU Aviation initiative (European Commission 2021d)	By 2025, 2% sustainable aviation kerosene
	FuelEU Maritime (European Commission, 2021e)	By 2025, 2% reduction in greenhouse gas emissions from the shipping industry
China	Carbon peaks in 2030 and becomes carbon neutral in 2060	
	Three-year action plan to accelerate the innovative development of non-food bio-based materials	
India		20% fuel ethanol blending in the next five years

Trillion-level market size, non-grain bioenergy market has broad prospects

Aviation

Biojet fuel (SAF) $200 billion

According to IATA's carbon neutrality target milestone, biojet fuel is expected to account for 2% of total fuel demand in 2025, and this proportion will further increase to 5%, 39%, and 65% in 2030, 2040, and 2050, corresponding to The demand for bio-jet fuel is expected to reach 620, 1800, 17800 and 350 million tons in 2025, 2030, 2040 and 2050

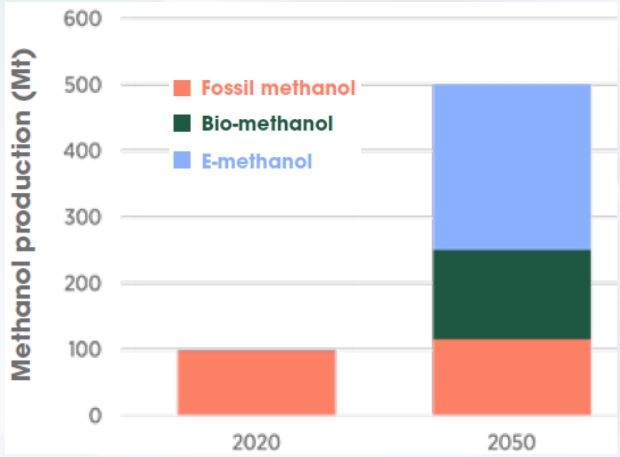


Maritime

Low-carbon butanol $4 billion

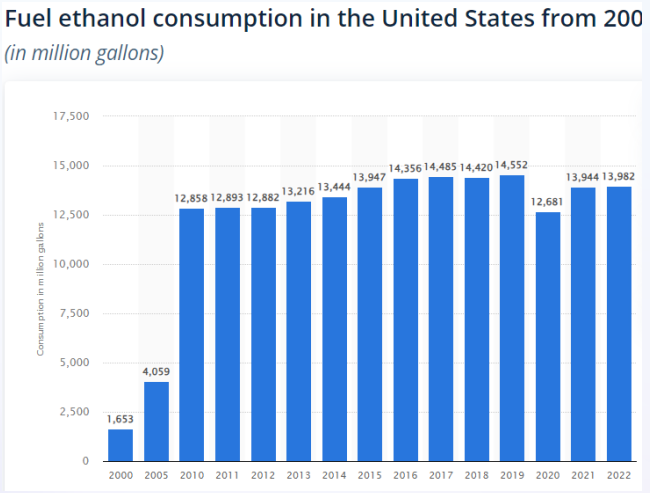
Low-carbon methanol $2 trillion

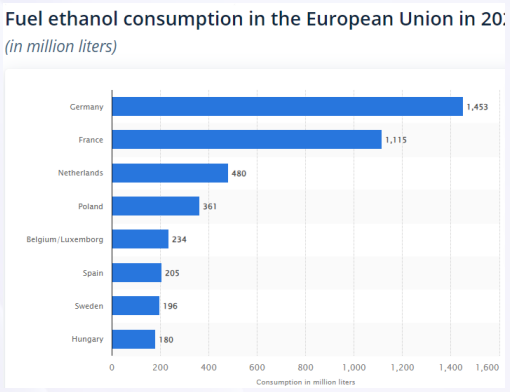
The International Maritime Organization (IMO) has set a target of reducing greenhouse gas emissions by 50% by 2050 compared with 2008 levels. IRENA reports that in the long term, the demand for renewable methanol in the European market is about 350 million tons of crude oil equivalent (equivalent to 700 million tons of methanol), and the global demand for renewable methanol is about 2 billion tons



Land Transport

Low-carbon ethanol $122.4 billion



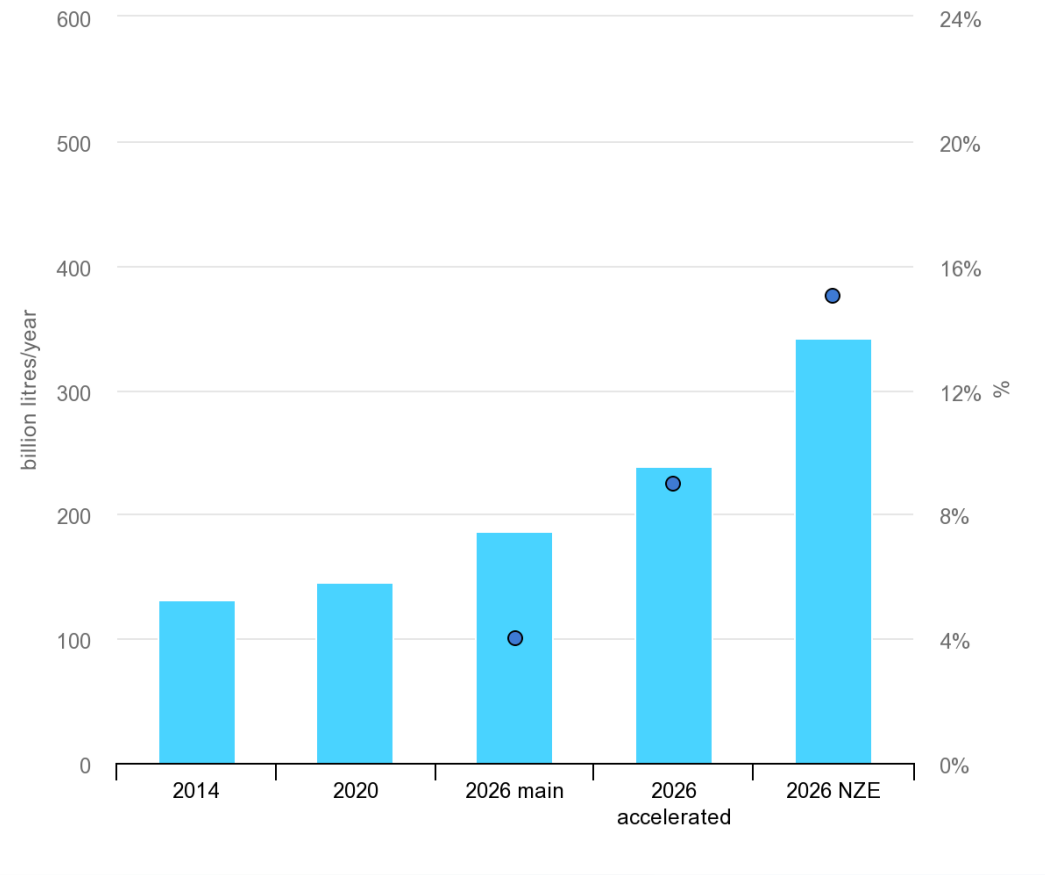


Note:

1. Bio-methanol is produced from biomass. Key potential sustainable biomass feedstocks include: forestry and agricultural waste and by-products, biogas from landfill, sewage, municipal solid waste (MSW) and black liquor from the pulp and paper industry.

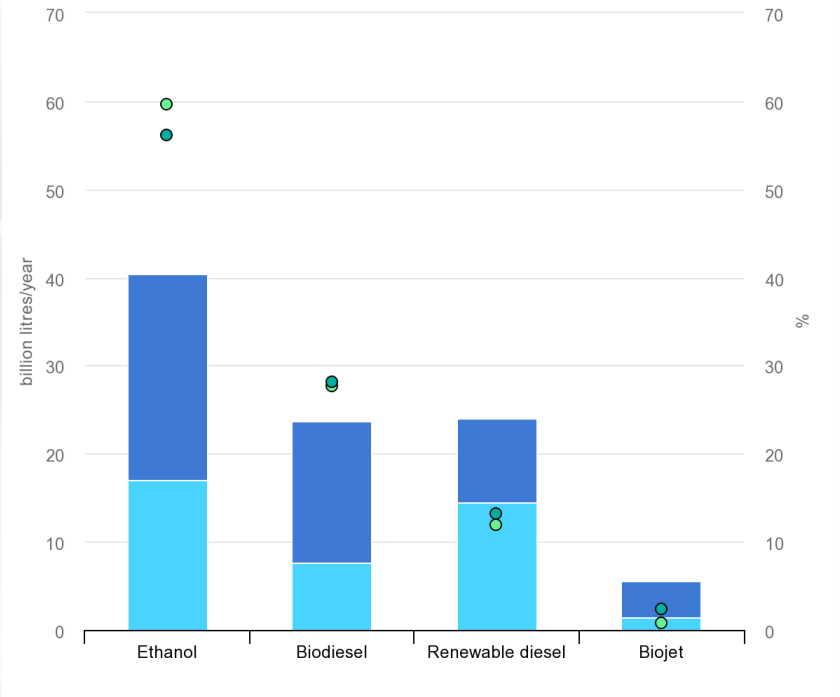
2. Green e-methanol is obtained by using CO2 captured from renewable sources (bioenergy with carbon capture and storage [BECCS] and direct air capture [DAC]) and green hydrogen, i.e. hydrogen produced with renewable electricity.

Biofuels production must increase doubled to meet market demand



Data source: IEA

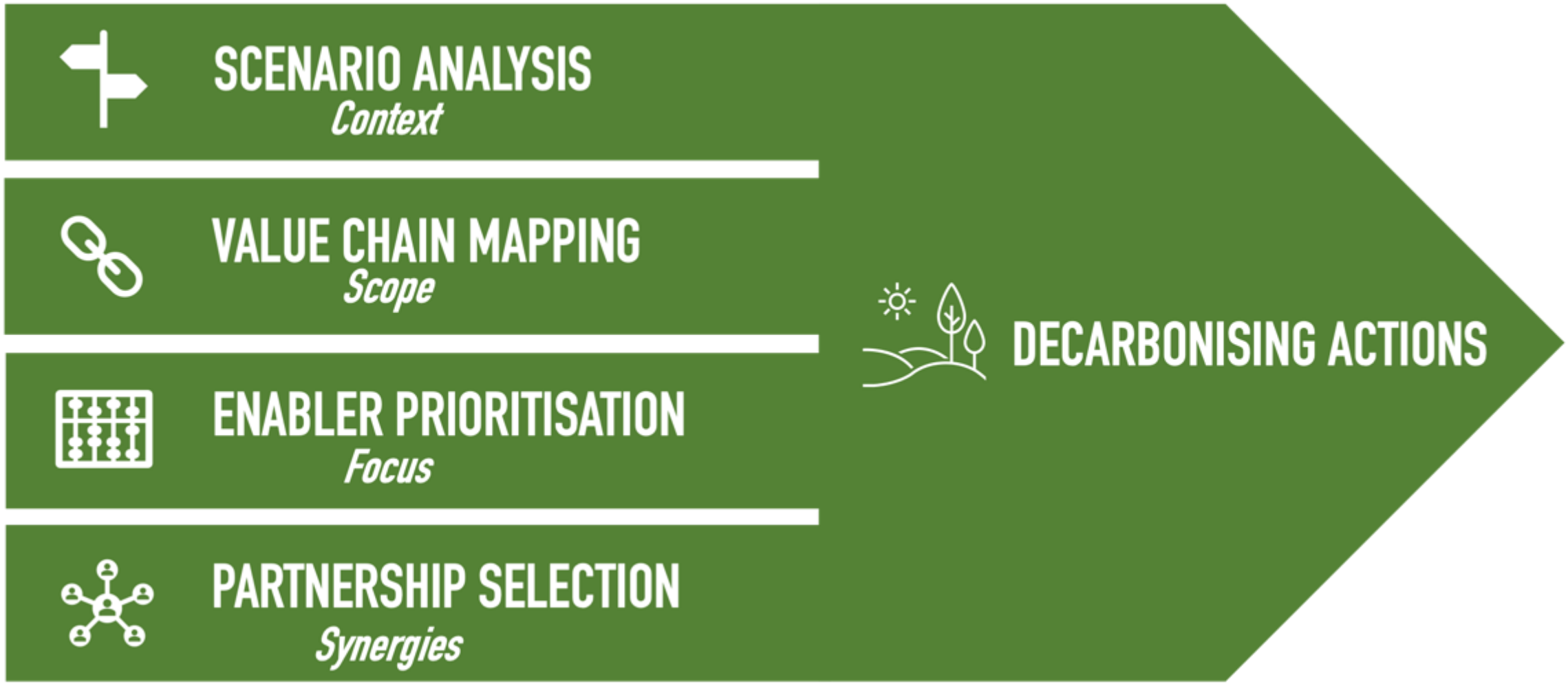
- Global biofuel demand to increase by 41 billion liters (28%) from 2021 to 2026
- To achieve the IEA net-zero emissions target, biofuel demand will double or grow by more than 40% on the above basis, with the main demand growth being liquid biofuels to meet the emission reduction requirements of land transport, aviation and maritime transport.



Supply Chain and Logistics

Sustainable Solutions = Expensive ?

4 steps to decarbonization



Maritime Transition Scenarios

Swells

- Uncertainty about key decarbonisation technologies, but pioneer private and public undertake strategic moves
- Starting point for less prosperous stakeholders to adopt greener approaches when obliged following a build up of pressures at extensive costs starting early/mid 2030s

Storms

- Sluggish global trade outlook and focus on domestic economies adding friction to accessing capital for new investment in new and greener technologies and practices
- Heterogenous landscape in regulation and a drift away from IMO legislation

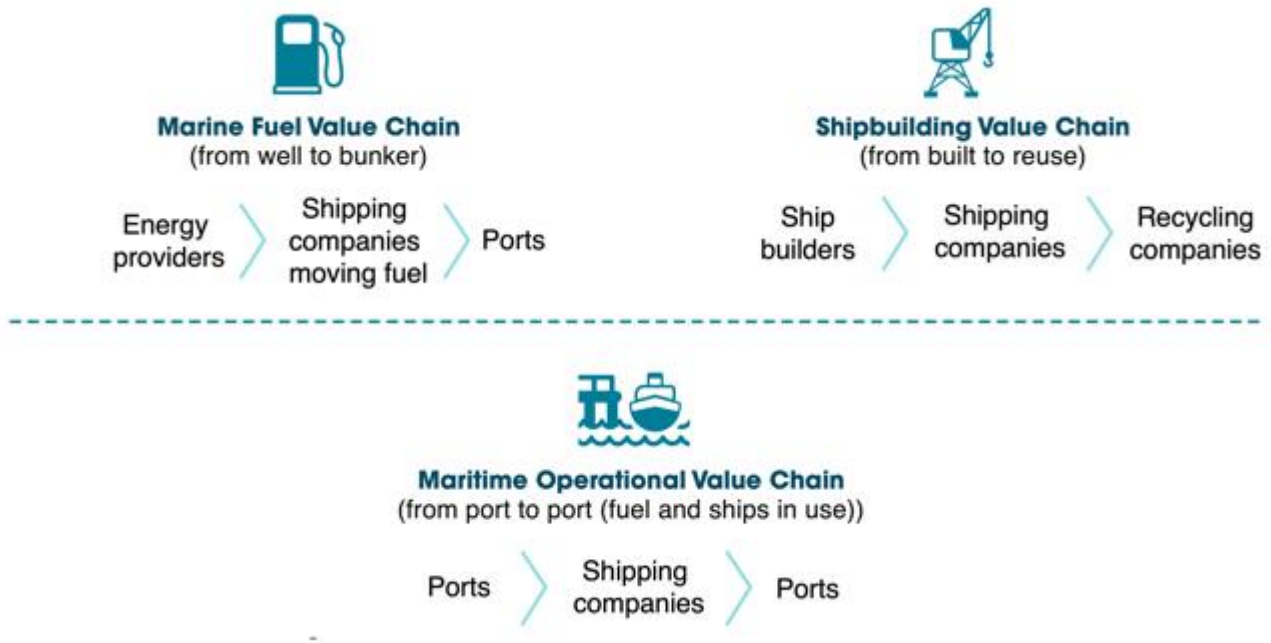
Clear Sky

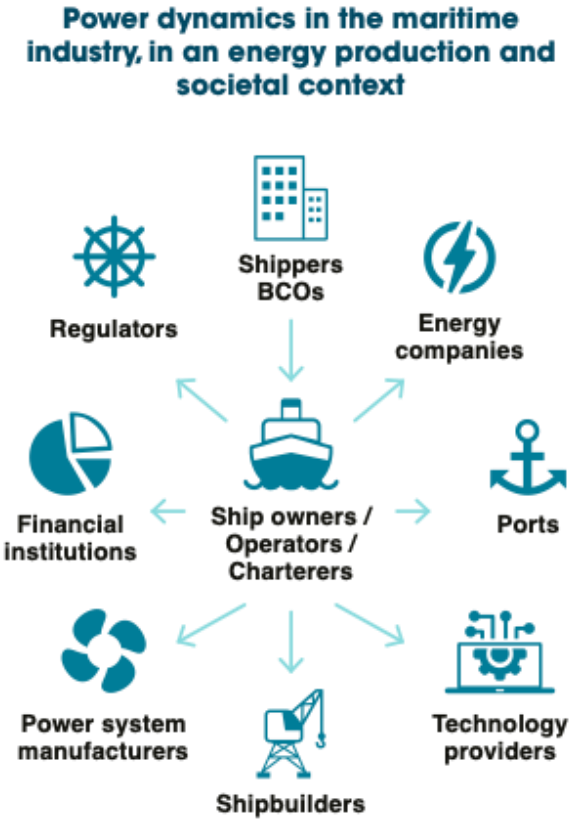
- Increasingly powerful maritime decarbonisation coalitions driving steady reductions in carbon emissions
- Developmets emerge across all areas of maritime industry, with proved alignment between land and sea connections.

Interdependent value chains

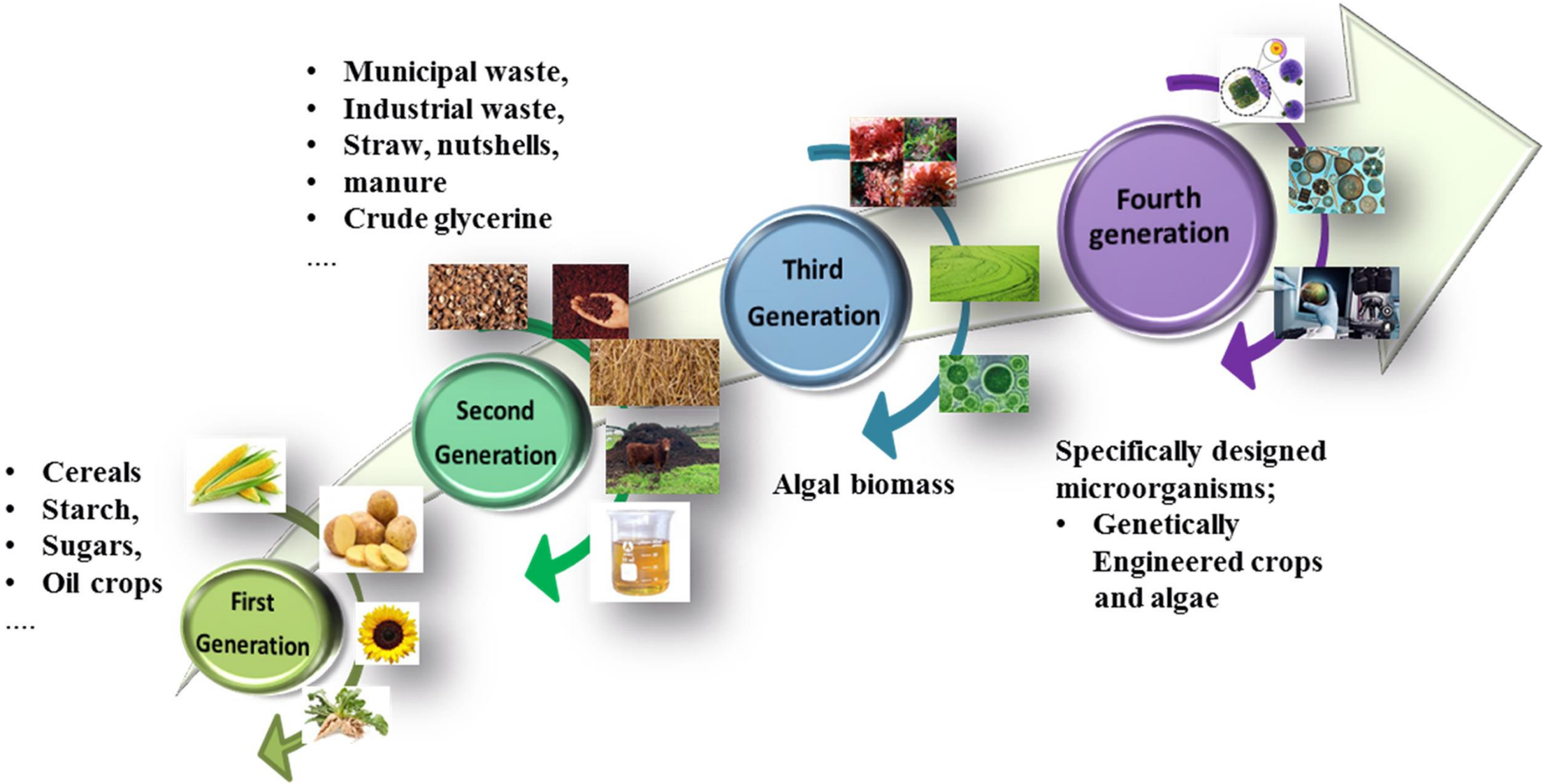
Enabler landscape and prioritization

Collaboration in decarbonization





Alternative Fuel : Biofuel



BIOFUELS

1st Generation

Food Crops:
Grains
Sugarcane

2nd Generation

Non-food Wastes:
Agricultural Residue
Forest Residue
Garden Waste
Used Cooking Oil

GREENCOP

2nd Generation

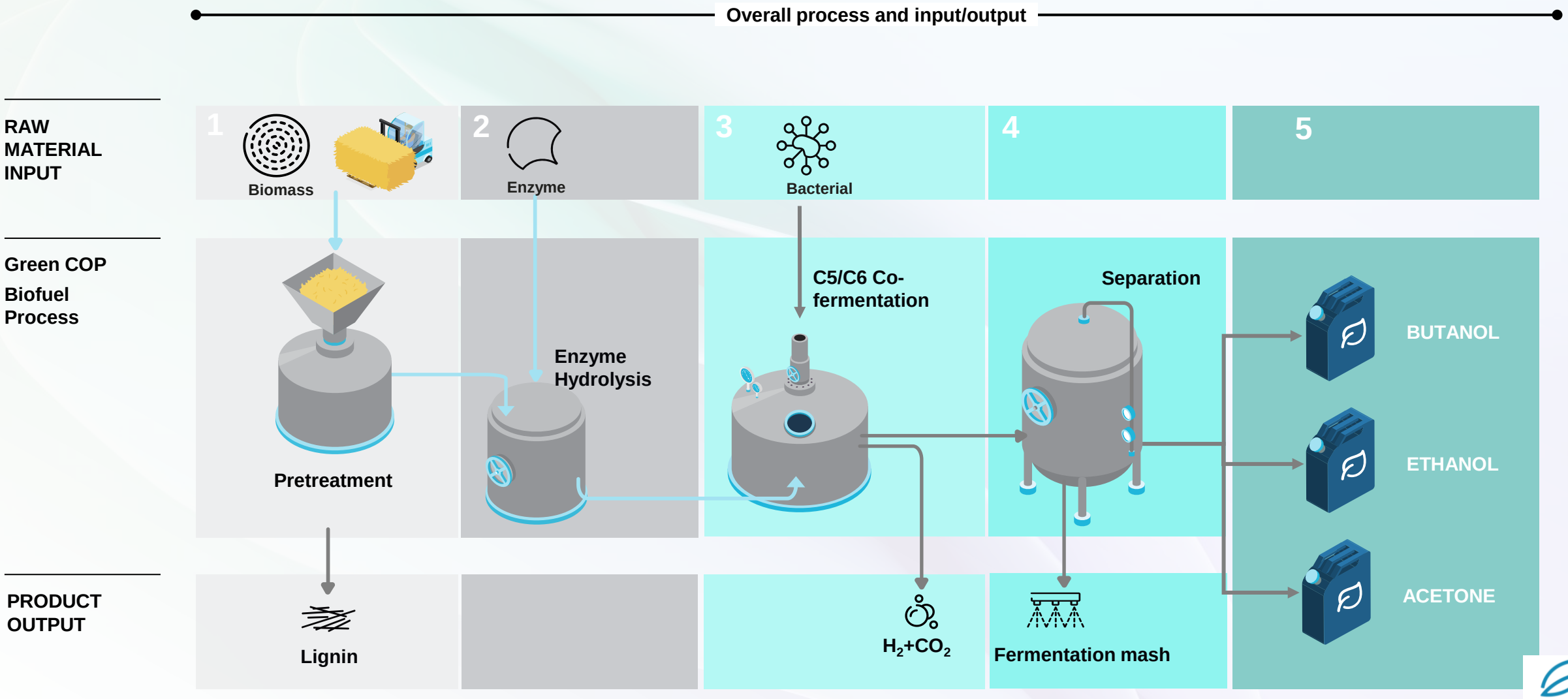
Non-food Wastes:
Agricultural Residue
Forest Residue
Garden Waste
Used Cooking Oil

Green COP PATENTED Pretreatment & Fermentation Technology

Plant-based Waste → **GEN2 Biofuels**

- Long shelf life (at least 24 months)
- Drop-in fuels (do not require special facilities for blending)
- Reduce NOx emission by 20-30%

Process, raw materials and products



Key targets and benefits of creating Singapore's

Coastal Sustainability Ecosystem

by Coastal Sustainability Alliance (CSA)

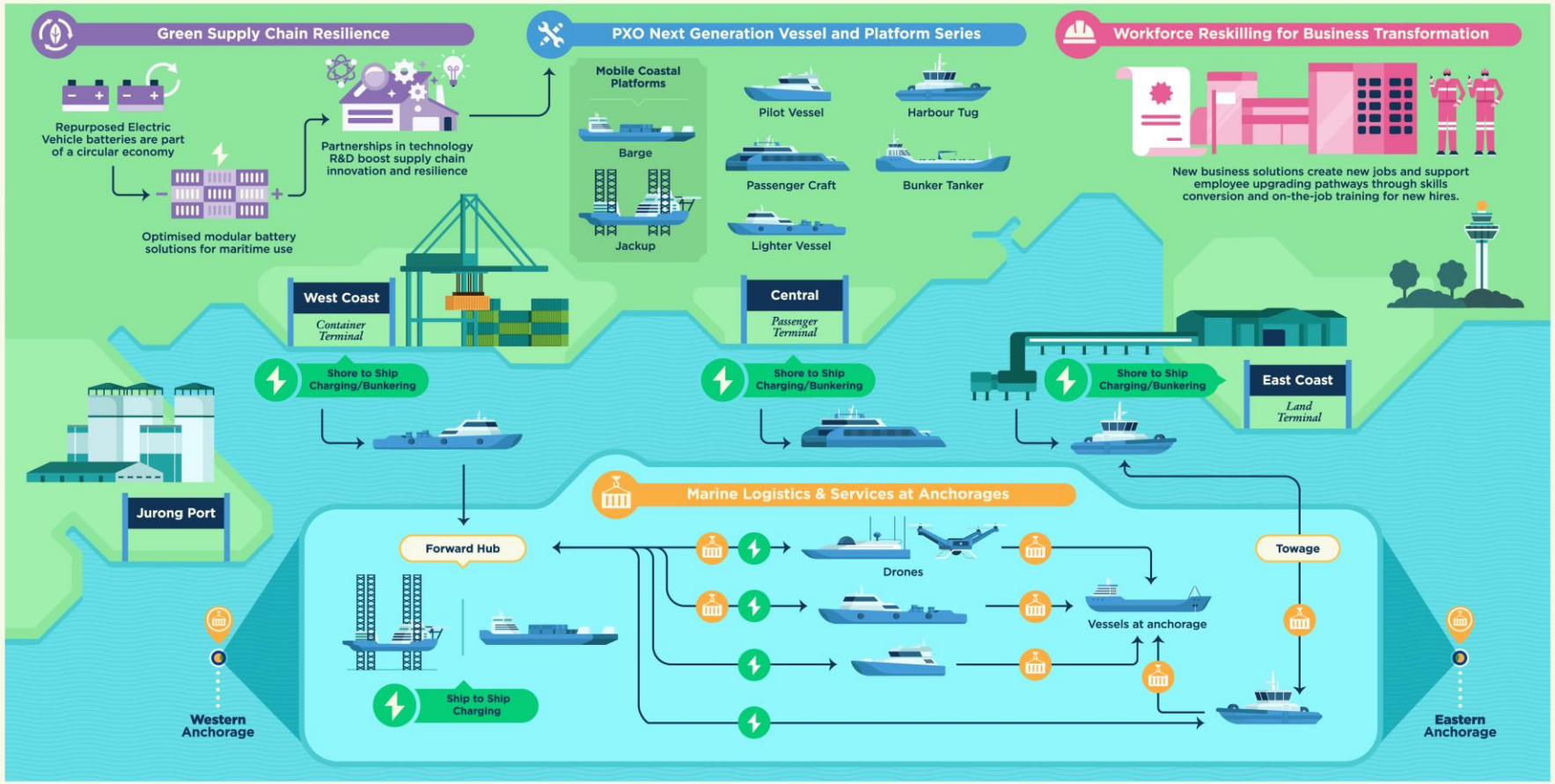
Green Supply Chain Resilience
Build comprehensive supply chain, charging infrastructure and capabilities with SMEs.

PXO Vessel and Platform Series
Design, build and deploy PXO vessels by 2025. Vessels to achieve up to 50% reduction in carbon emissions.

Electric Charging
Charge PXO vessels through a network of shore and mobile e-charging points.

Workforce Reskilling for Business Transformation
Reskill, redeploy employees in enhanced job roles to support new business growth areas.

Marine Logistics & Services
Reduce marine traffic by 20% through fleet optimisation, floating platforms in anchorage and drones for last-mile deliveries.



The **Coastal Sustainability Alliance** (CSA) aims to build a next-generation maritime ecosystem to decarbonise, electrify and transform Singapore's maritime industry towards a circular economy. The ecosystem comprises electric vessels, shore and marine charging platforms, battery repurposing, renewable energy sources, energy-efficient logistics and innovative engineering solutions for future growth opportunities.

CSA Members:

Collaboration

Driving the Adoption of Sustainable Solutions

GREENCOP

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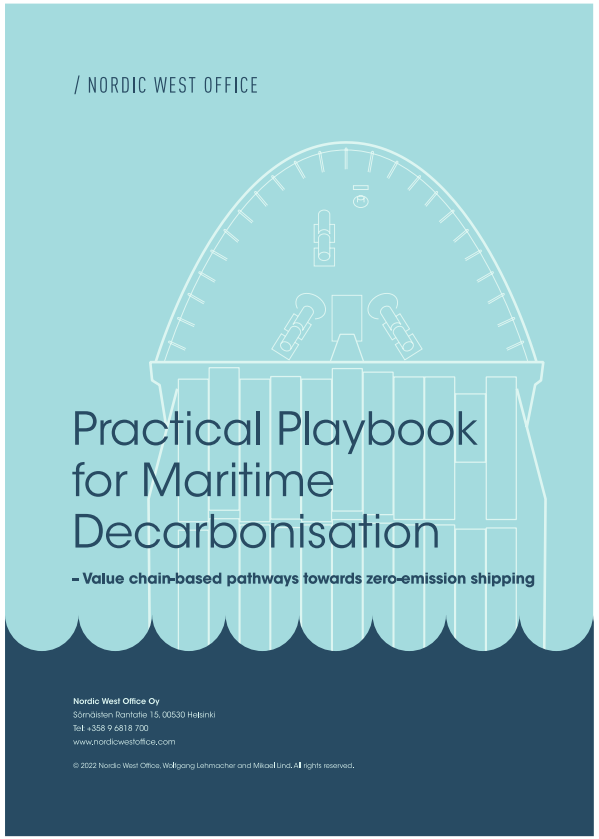
Reference



Four Steps Towards Maritime Decarbonizing Actions: Playbook Part 5

Courtesy Sandra Haraldson

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