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Marine Debris in Circular Blue Economy

2a. Blue Economy Industries and Plastic Pollution

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Content

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Summary

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Key Definitions

1. **Blue Economy :** Sustainable use of ocean resources for economic growth, improved livelihoods, and ocean ecosystem health.
2. Key sectors: Fisheries, aquaculture, tourism, shipping, offshore oil and gas, marine renewable energy, etc.
3. Circular economy is a **sustainable model** that contrasts with the linear "take-make-dispose" approach.
4. **Circular economy** helps address plastic pollution by promoting redesign, reduced use, innovation, and extended producer responsibility.

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Introduction

Objective:

- To incorporate the student with the understanding of the plastic pollution and blue economy

Learning Outcomes:

- **Examination of the role of various blue economy sectors, such as fishing, shipping, tourism, and offshore energy, in generating plastic waste.**
- **Analysis of the lifecycle of plastic products and their potential pathways into the marine environment.**
- Identification of key challenges and opportunities for reducing plastic pollution within blue economy industries.

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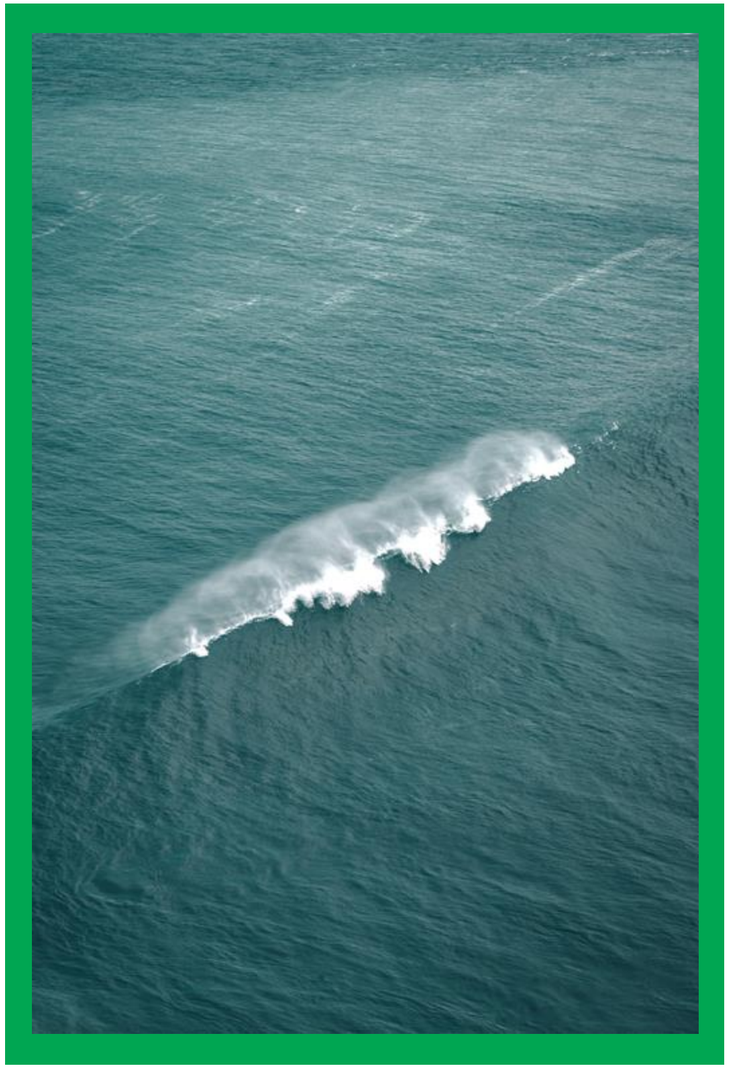
Learning Outcomes

At the end of the Topic, student should be able to:

1. identify key sectors within the blue economy contributing to plastic wastes
2. understand how plastic products enter the marine environment
3. Understand the lifecycle of plastic within blue economy industries
4. discuss the implications and relationship of plastic pollution in the blue economy sectors via case study



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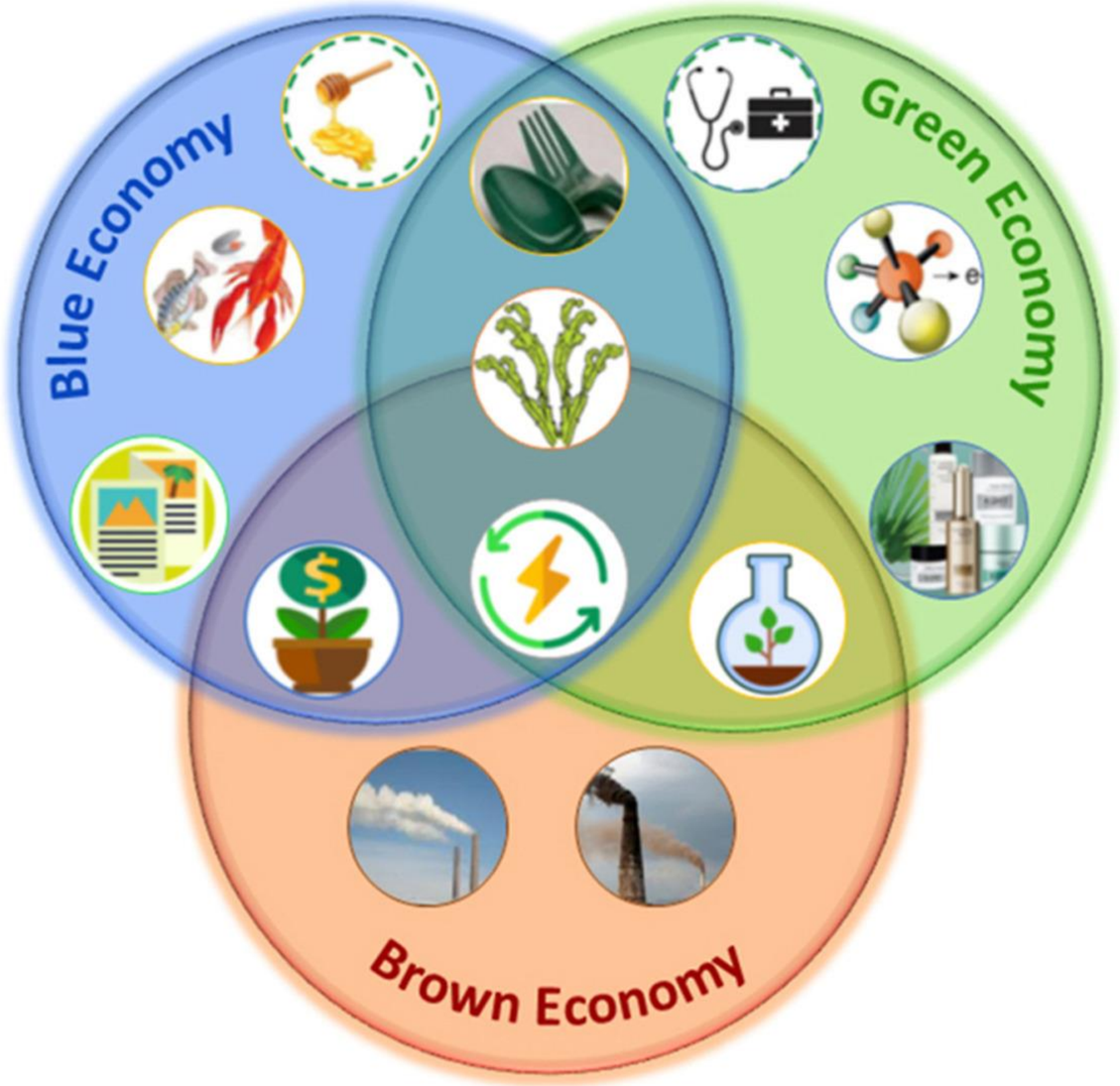
Introduction

Blue Economy

A systematic way of **utilizing ocean resources** by integration of **short- and long-term economic activities** based on principles of **social inclusion, environmental sustainability** and **innovations** on and around the sea.

→ Understanding the nexus between industry growth and marine plastic pollution!



(Choudhary et al.,, 2021)

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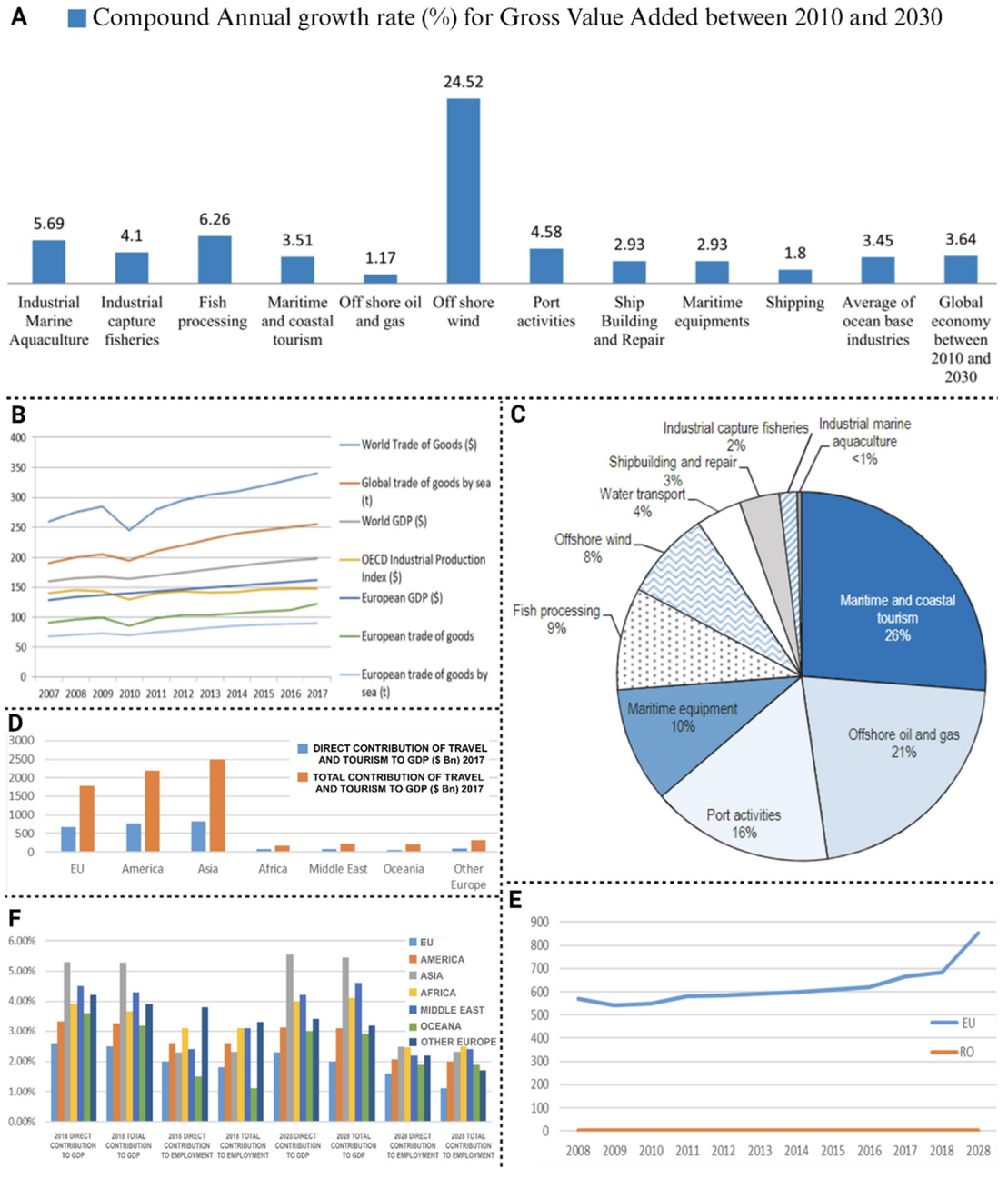
Introduction

The contribution of these sectors to a country's Gross Domestic Product (GDP): According to this frameworks, the emerging sectors of the Blue Economy include fisheries and aquaculture, coastal and marine tourism, maritime transport, offshore renewable energy, blue carbon, and marine biotechnology.



A Projected growth of the marine industry Gross Value Added) from 2010 to 2030 (adapted with permission from (Upadhyay and Mishra, 2020);

B The progression of global and European trade of goods in relation to GDP and the OECD industrial Production Index. Adapted with permission from (OLTEANU and STINGA, 2019);

C Estimated value added of the ocean economy in 2030 on the assumption of the current business conditions. Adapted with permission from (The Ocean Economy in 2030, 2016); D Tourism and travel contribution to GDP in 2017 ($BN). Adapted with permission from (The Ocean Economy in 2030, 2016);

E Tourism and travel contributing directly to GDP ($BN). Adapted with permission from (The Ocean Economy in 2030, 2016); F The actual increase of tourism and travel's contribution to GDP and employment from 2018 to 2028. Adapted with permission from (The Ocean Economy in 2030, 2016).

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(Gupta et al.,., 2024; Microplastics: The imperative influencer in blueprint of blue economy. Journal of Environmental Management, 372: 173300. https://doi.org/10.1016/j.jenvman.2024.123300)

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Role of BE Sectors in Generating Plastic Waste

Role of
FISHERIES INDUSTRY
in generating plastic waste



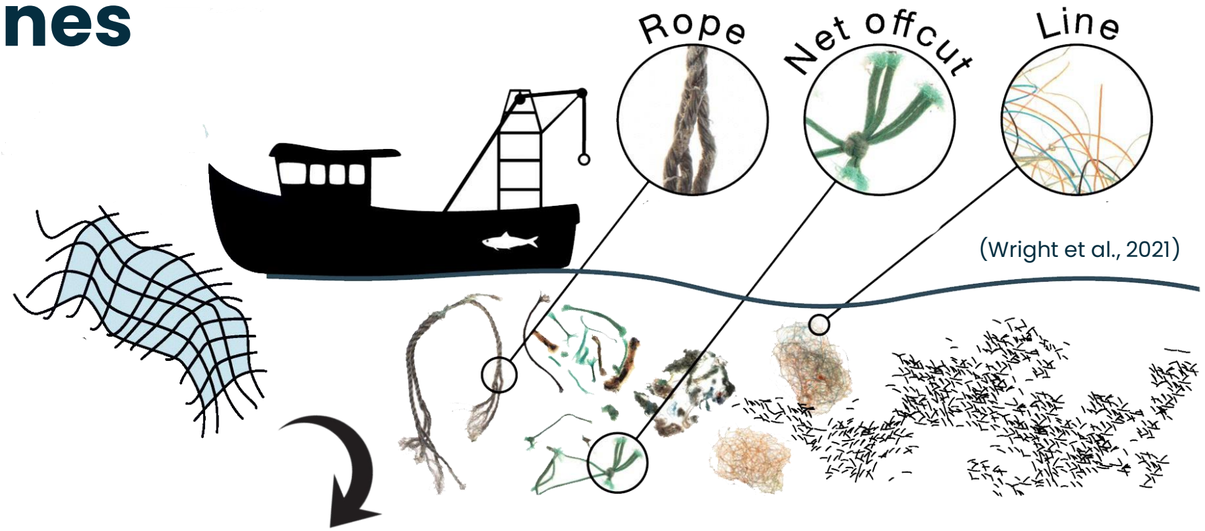
Discarded fishing nets, lines, buoys, packaging

At least

640,000 tonnes

enters our oceans every year and ghost gear makes up approximately **10% of the global marine plastic pollution**

(WWF, 2024)



(Wright et al., 2021)

ALDFG

- Abandoned, lost and otherwise discarded fishing gear

New report from WWF says abandoned fishing gear an **"immortal menace"** which must be central in the fight against plastic pollution

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Role of BE Sectors in Generating Plastic Waste

SHIPPING & PORTS INDUSTRY

ROPES
are a significant source of plastic waste from ships. The older the rope, more plastic generated

(Napper et al, 2022)

3.7% of plastic waste releases into the oceans from **MARINE COATINGS**

(Haley et al, 2025)

As shipping levels grow, shipping-generated GRABAGE grows too

3 000 people on board a cruise ship
= **706 000L of GREY WATER** daily.
A potential source of plastic waste.

(Ma et al, 2024)

Up to **10 000 containers lost at sea** annually, often containing harmful plastics and pollutants

(Turner et al, 2021)

(Modified from Seas at Risk, 2021)

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Role of BE Sectors in Generating Plastic Waste

(This photo by Unknown Author is licensed under CC BY-SA-NC)

(Khazanah Research Institute, 2019)

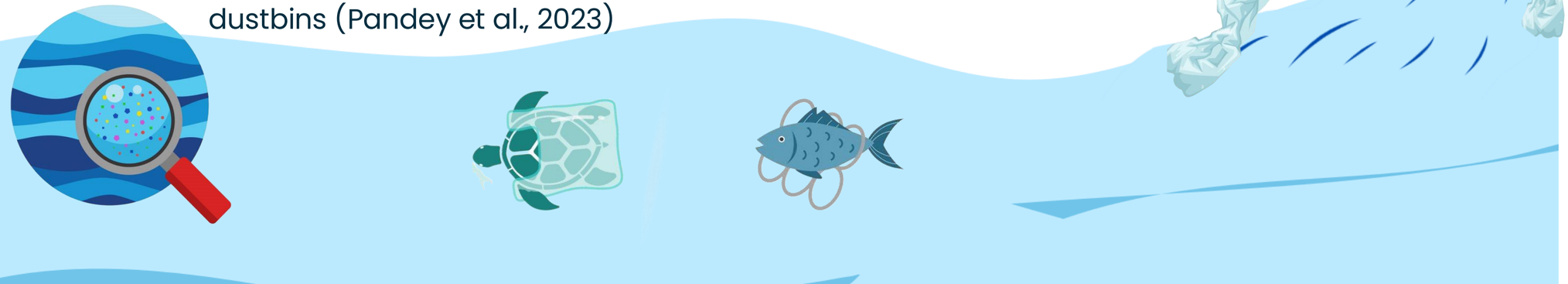
(World Wildlife Fund, 2019)

Plastic waste from

TOURISM

industry

- Coastal tourism generates large amounts of **single-use plastics** (bottles, cutlery, straws, food wrappers) (Dey et al., 2024)
- Improper waste management at tourist beaches and islands
- Over 300 g/day of plastic waste produced per shop at coastal tourist areas, primarily from tourists who often ignore provided dustbins (Pandey et al., 2023)



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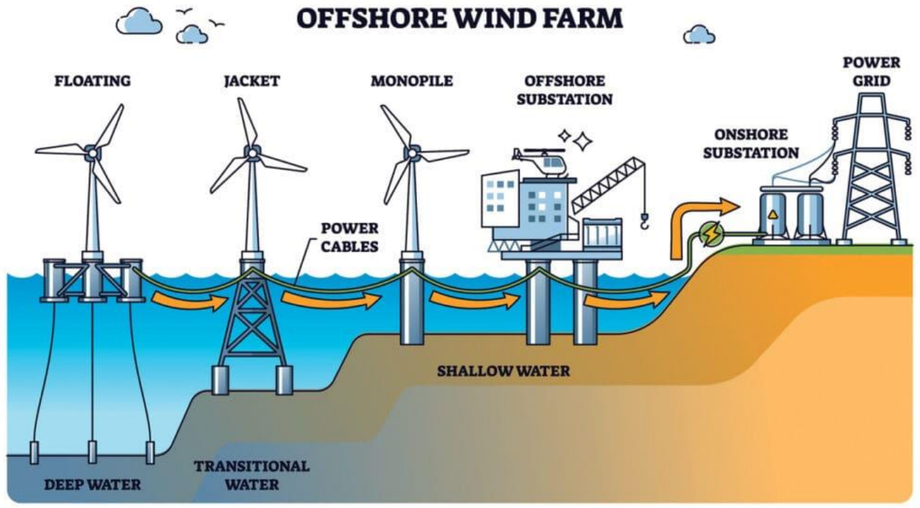
Role of BE Sectors in Generating Plastic Waste

OFFSHORE RENEWABLE ENERGY



- Plastics in pipelines, coatings, safety equipment, cable sheathing
- Waste from offshore rigs: plastic packaging, maintenance gear
- Wind and solar energy at sea still use **plastic composites** in turbines and solar panel structures
- Potential for long-term leaching or accidental losses during maintenance or accidents
- Estimated values between **0.08 kg to 1000 kg of MPs** per turbine per year (Parades et al., 2025)

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Lifecycle of Plastic Products & Potential Pathways

LIFE CYCLE OF A PLASTIC PRODUCT

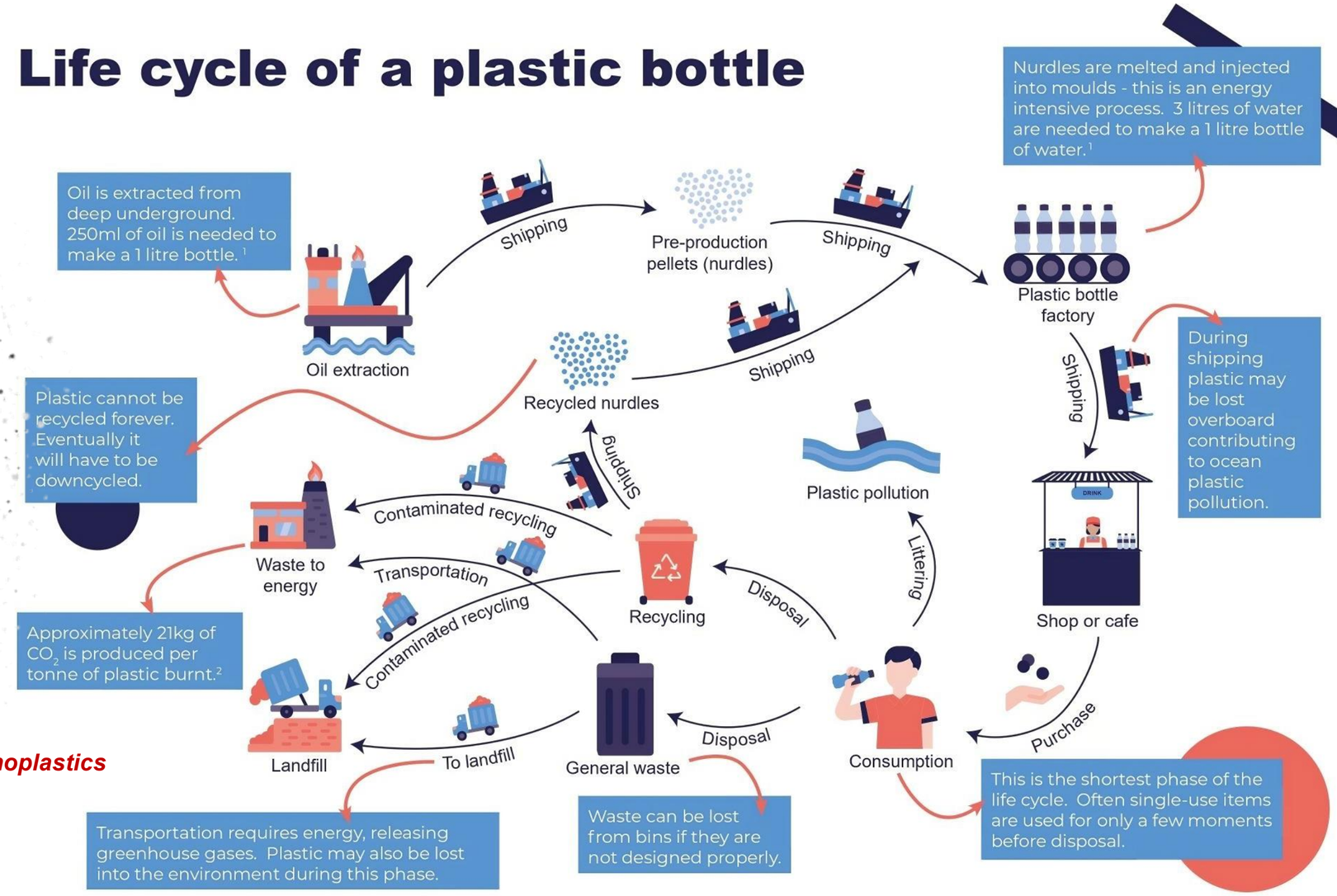
Stages:

Production →

Consumption →

Disposal →

Environmental Entry



macroplastics → microplastics → nanoplastics

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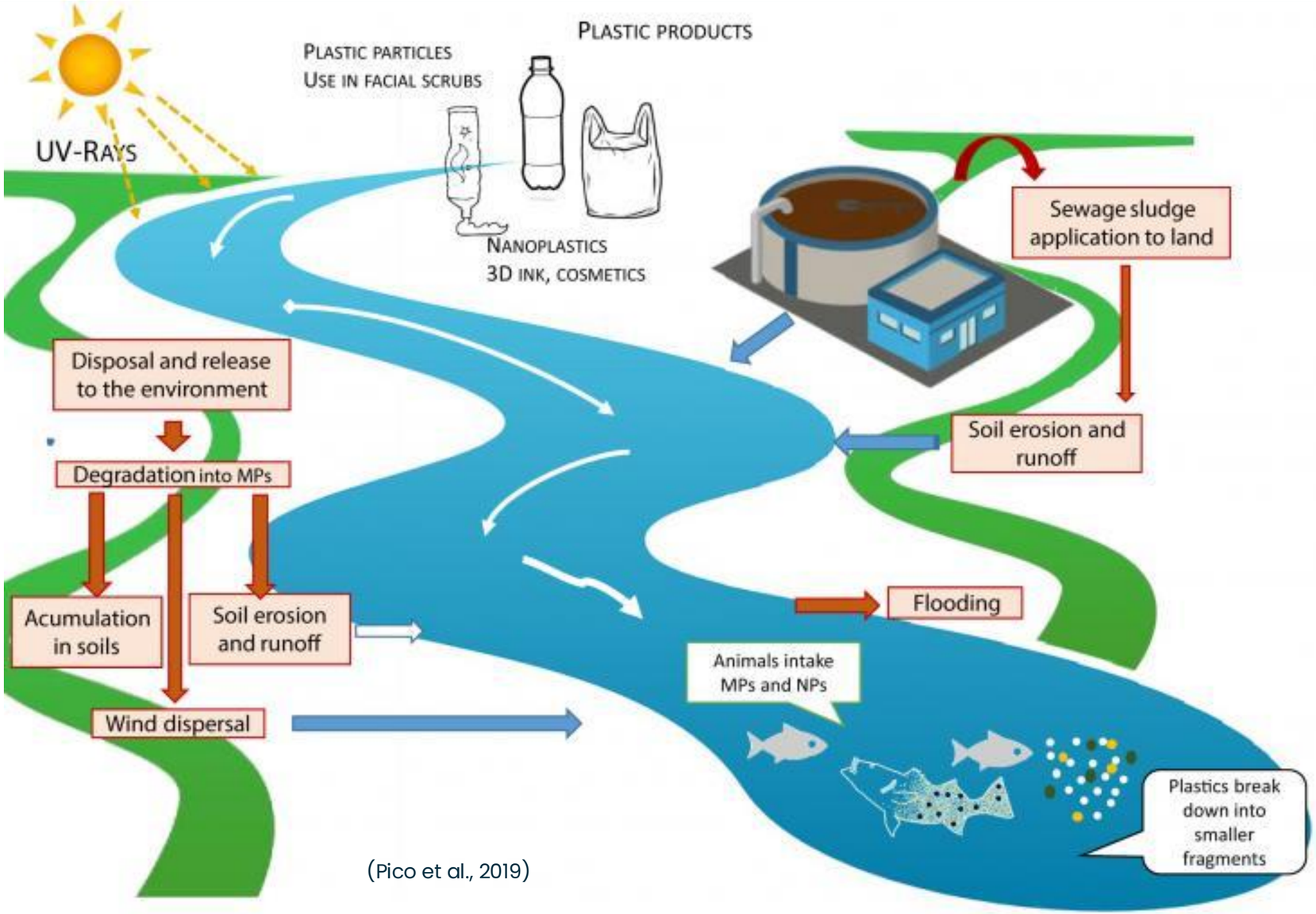
(Mannheim et al, 2021)

Lifecycle of Plastic Products & Potential Pathways

Primary pathways: Landfill/Land-based/ Riverine input, direct disposal, stormwater runoff, fishing gear loss.

Global statistics: 11 million metric tons of plastic enter oceans annually (UNEP, 2021), giving both ecological and socio-economic impacts



(Pico et al., 2019)

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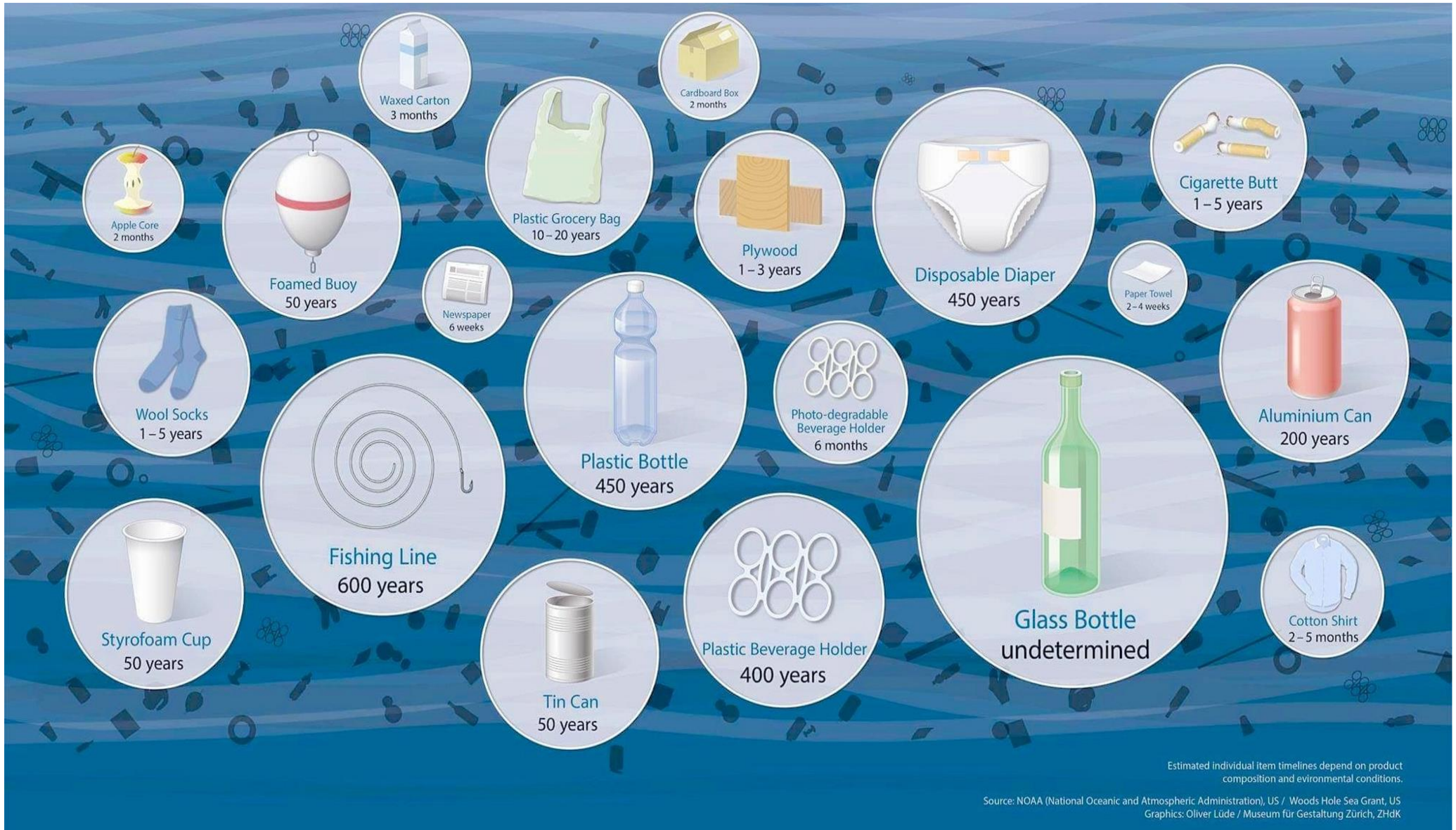
Lifecycle of Plastic Products & Potential Pathways

Persistent nature and degradation of plastic (megaplastics/marine debris/macroplastics) into microplastics & nanoplastics



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Integration of Blue Economy

Impacts of Plastic Pollution on Blue Economy:

1. Economic losses (fisheries, tourism)
2. Damage to marine habitats and biodiversity
3. Public health risks from contaminated seafood

Mitigation and Policy Responses :

1. International/Regional policymaking (MARPOL, GESAMP, UNEP) & campaigns.
2. Industry actions: Eco-tourism certifications, Green Labelling, Circular economy and Extended Producer Responsibility (EPR)
3. Innovation for mitigation (long term vs short term)

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Adaptation from: Borriello A. Preferences for microplastic marine pollution management strategies: An analysis of barriers and enablers for more sustainable choices Journal of Environmental Management 344 (2023) 118382: https://doi.org/10.1016/j.jenvman.2023.118382

Integration of Blue Economy

Global and regional commitments to protect ocean values

RESOLUTIONS ADOPTED AT UN ENVIRONMENT ASSEMBLY, PARTICULARLY:

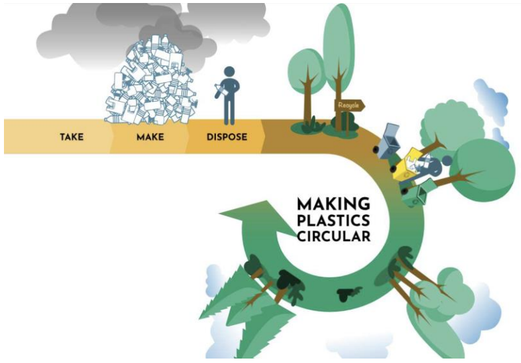
- UNEA 2/4: Implementing the Samoa Pathway
- UNEA 2/5: Delivering the 2030 Agenda
- UNEA 2/8: Sustainable Consumption and Production
- UNEA 2/10: Oceans and Seas
- UNEA 2/12: Sustainable Coral Reef Management
- UNEA 2/13: Natural Capital for sustainable development and poverty eradication
- UNEA 3/10: Addressing water pollution to protect and restore water-related ecosystems

DECISIONS ADOPTED AT CBD COP, PARTICULARLY:

- Decision 14/3: Mainstreaming of biodiversity in the energy and mining, infrastructure, manufacturing and processing sectors
- Decision 14/9: Marine and coastal biodiversity: ecologically or biologically significant marine areas
- Decision 14/10: Other matters related to marine and coastal biodiversity

REGIONAL SEAS STRATEGIC DIRECTION 2017-2020

- Support integrated oceans policies and management at regional levels, having ecosystem-based management as a core objective



Makiko Yashiro, UN Environment Asia and the Pacific Office

Activities around a boat dock in Ly Son, Viet Nam
Image by Tuan Thanh Cao

ASEAN BLUE ECONOMY FRAMEWORK

https://asean.org/wp-content/uploads/2023/09/ASEAN-Blue-Economy-Framework.pdf

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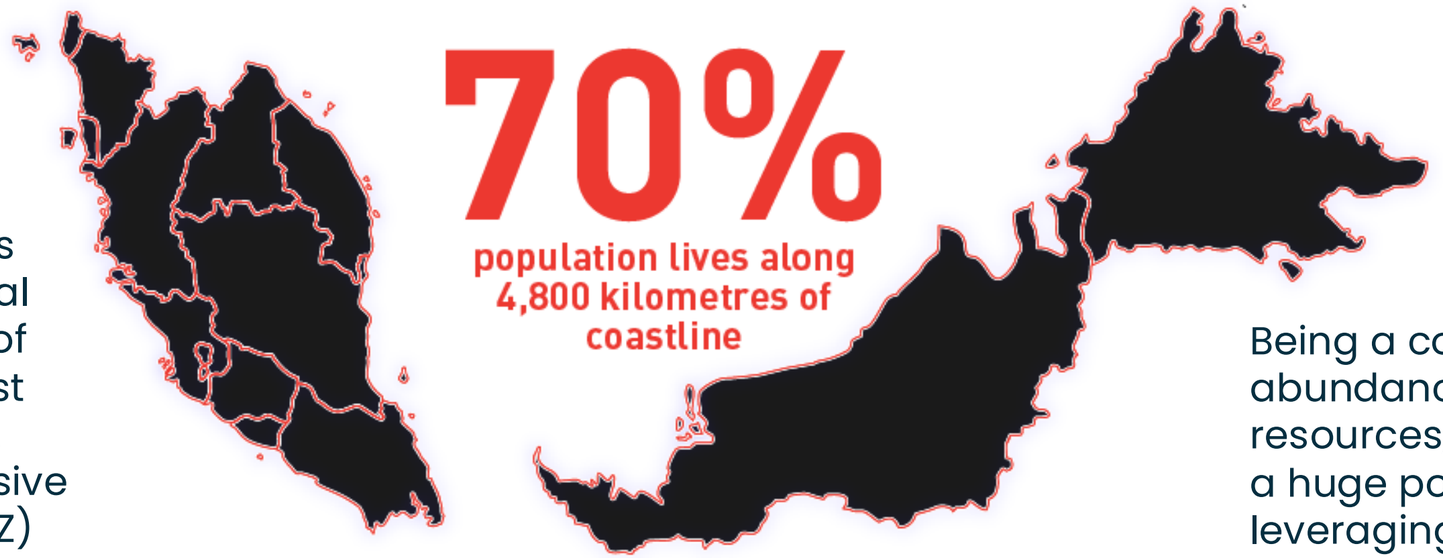
Integration of Blue Economy

In Malaysia perspective....

Malaysia possesses an extensive coastal and marine areas of **614 159 km2**, almost twice its landmass. The size of its Exclusive Economic Zone (EEZ) alone is 453 186 km2



(Akademi Sains, 2021)

Being a country with abundance natural resources, Malaysia has a huge potential in leveraging these advantages of the Blue Economy for its economic value and prospects

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Integration of Blue Economy

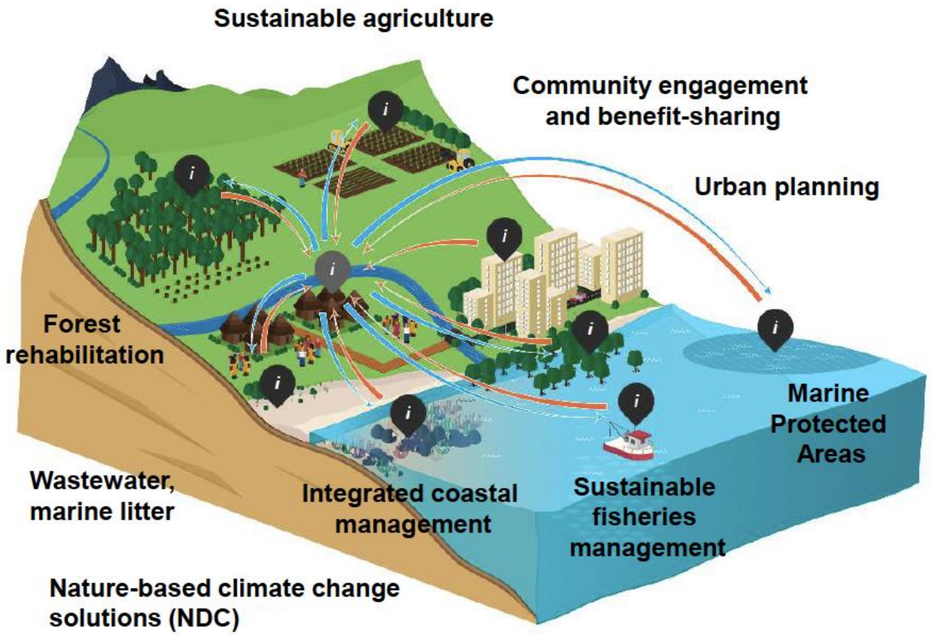
Integration of

Blue Economy

and SDGs

‘Sustainable Blue Economies’

Taking a holistic approach to policies and management to realize the full potential of sustainable ocean-based economies



Knowledge => policy actions account for full value of Natural Capital, vulnerability and risk

Circular economy and and resource efficiency => sustainability of blue sectors

Governance and management => optimal use of ocean space and ecosystem services

Strategic investment => blue financing principles and facility, and other innovative financing tools

Makiko Yashiro, UN Environment Asia and the Pacific Office

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Integration of Blue Economy

CASE STUDY:

INNOVATION RELATED TO BLUE ECONOMY

CATAMARAN –

Modern Vessel for Fishermen

Transforming Coastal Fisheries through Model Prototype Design and Development of an Innovative Fishing Vessel

UMT is building a modern catamaran to help increase fishermen's catch.

The project "Transforming Coastal Fisheries through Model Prototype Design and Development of an Innovative Fishing Vessel," led by Professor Dato' Dr. Nor Aieni Mokhtar, is being supported by the Ministry of Science, Technology, and Innovation (MOSTI) through the Strategic Research Fund grant totalling RM3.1 million.

https://www.umt.edu.my/umt-is-building-modern-catamarans-to-help-increase-fishermens-catch/

https://backend.orbit.dtu.dk/ws/portalfiles/portal/341184950/fmars-10-1310318.pdf

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Integration of Blue Economy

CASE STUDY:

INNOVATION RELATED TO BLUE ECONOMY

CEFORE

Centre for Offshore Renewable Energy (CEFORE)

PETRONAS

UMT

Innovative Renewable Energy Hub

CEFORE combines offshore wind, solar, and wave energy with advanced storage systems to deliver clean, reliable power, supporting Malaysia's energy transition goals.

Community Empowerment & Economic Growth

Led by Associate Professor Dr. Mohd. Hairil Mohd., the center provides free RE-powered cold storage and ice-making for fisherfolk, while fostering edu-tourism, infrastructure development, and local job creation.

Strategic Collaboration for Sustainability

Backed by UMT, PETRONAS, and industry leaders, CEFORE aligns with national and corporate energy strategies, marking a milestone in Terengganu's renewable energy progress

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https://ptsg-1instepwb01.azurewebsites.net/instep-and-umt-forge-strategic-partnership-to-strengthen-energy-transition-capability-development-harnessing-cefore/

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Integration of Blue Economy

MFAST

CASE STUDY:

INNOVATION RELATED TO BLUE ECONOMY

Advance Ocean Forecasting, Revolutionizing Marine Operations

1st Ocean Forecast in Malaysia

OCEAN HYDRO SDN. BHD.

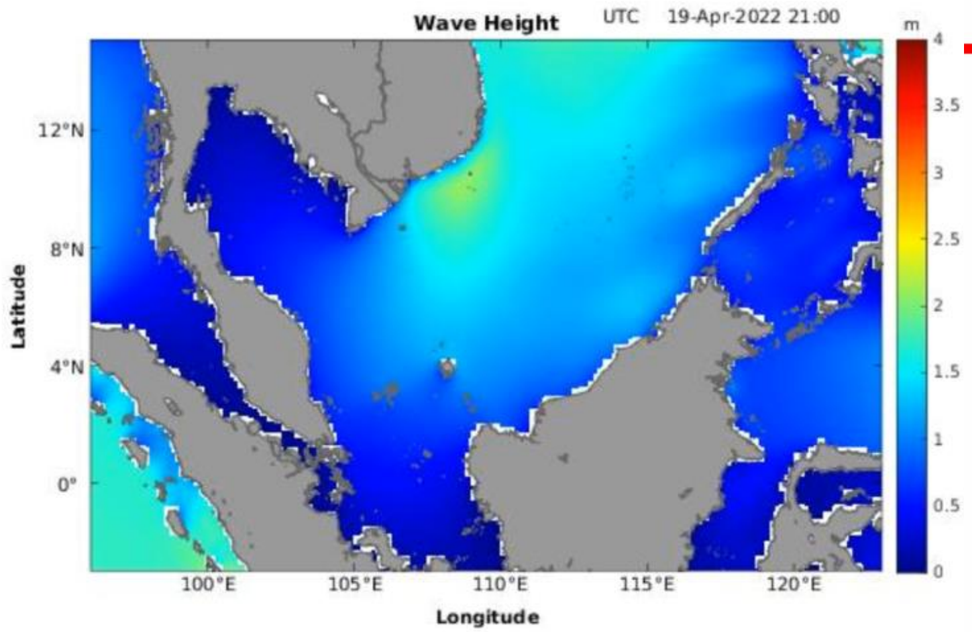
Innovated by Professor Ts. Dr. Mohd Fadzil Mohd Akhir and his team, MFAST is now operated by UMT's startup company, Ocean Hydro Sdn. Bhd.

Malaysia's first high-resolution ocean forecast system, delivers reliable 5-day predictions of currents, waves, and temperature to enhance maritime safety, operations, and research.

(https://oceanhydro.org.my)

UMT INOS INSTITUTE OF OCEANOGRAPHY AND ENVIRONMENT
Envision Marine Future

MFAST MALAYSIA MARINE FORECAST SYSTEM



Integrate with leading Malaysia API marine forecast

POWERED BY INOSURF INOS Supercomputing Facility

theSun TELLING IT AS IT IS

27 Disember 2021

UMT to develop sea forecasting system app

KUALA NERUS: Universiti Malaysia Terengganu (UMT) is developing a sea forecasting system application for the benefit of the public.

Vice-chancellor Prof Dr Mazlan Abd Ghaffar said the Malaysia Marine Forecast System (MFAST), which was developed three years ago, is the first national marine operations system to offer a five-day current, wave and ocean temperature data for use in all sectors including recreation, tourism, fisheries, rescue, shipping and the oil and gas industry.

He said the warning system is far more accurate than using satellites for weather predictions because the data gathered from the sea using buoys are more "in situ" or real-time.

"There are a lot of models of weather prediction systems in the world. But most models are made for global and large-scale use by developed countries such as the US, Bernama reported.

"Therefore, the accuracy for use in Malaysia is not as good as MFAST comparatively where real data come from our own area. This will improve the accuracy of the prediction system," he said when met by Bernama recently.

For the development of the application, which is expected to be completed next year, UMT is working with experts in the field of information technology to develop visualisation and simulation which are more interactive and user-friendly.

He said the main challenge was to transfer the data into an application form that could be easily read by the public thus enabling them to act swiftly during a disaster.

"The IT experts are fine-tuning the system to come out with visualisation that is easily accepted by all because we want the application to be more interactive and able to act fast."

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Conclusion

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- The Blue Economy encompasses ocean-based sectors such as fisheries, aquaculture, marine tourism, shipping, ports, offshore energy, marine biotechnology, coastal mining, and waste disposal management, etc.
- Unsustainable practices in these industries contribute to environmental degradation, especially marine litter and plastic pollution
- Plastic pollution (projected to increase significantly) is a shared responsibility across blue economy sectors.
- While the economic potential of ocean industries is vast, aligning development with circular economy principles and integrated ocean governance is essential (e.g.: embedding plastic pollution mitigation into national development policies)
- Understanding pathways and lifecycle is key to targeted interventions.

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Evaluation

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1. Which sector of the blue economy do you think contributes the most to plastic pollution and why?

2. How can lifecycle thinking be integrated into marine industry practices?

3. What are feasible policy tools for Southeast Asia? (*Please read the first topic to answer this question*).

4. Due to the high coastal population density and plastic usage in the region of Asia, how the informal waste management systems can influence the blue economi sectors within the region? (*Please read the first topic to answer this question*).

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Evaluation

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5. In the context of the Blue Economy, which sector is most directly associated with ghost gear contributing to marine plastic pollution?
A. Coastal tourism
B. Offshore renewable energy
C. Fisheries and aquaculture
D. Maritime transport

6. A coastal city experiences an increase in plastic waste during tourist season. As an environmental planner, which of the following measures would best align with circular economy principles to address this issue?
A. Installing more trash bins at tourist sites
B. Banning all tourism activities
C. Launching a campaign to clean up plastic waste after every tourist season
D. Promoting the use of reusable packaging and eco-certification for tourism operators

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Further Reading

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Answer: 5) C; 6) D

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THANK YOU

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