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Harnessing complementary curricular preparedness
via sustainable management in response to civil
and military pollution on the coastline, tributaries
and lagoons in Black Sea's North, West, South zone

MARINE POLLUTION PREVENTION THROUGH SUSTAINABLE RESOURCE USE AND CIRCULAR ECONOMY APPROACHES



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Presentation Objectives

This presentation aims to explore how we can **prevent marine pollution** at its source through **sustainable resource use** and **circular economy approaches**.



Understand the sources and pathways

Identify the main sources and pathways of marine pollution, including land-based and maritime activities.



Promote sustainable resource use

Highlight efficient and responsible use of resources in marine and coastal sectors to minimize environmental impact.



Apply circular economy approaches

Explore circular economy principles and solutions to prevent, reduce and valorize waste before it reaches the sea.



Present innovative solutions and good practices

Showcase technologies, strategies and successful examples from the Black Sea and Mediterranean regions.



Encourage cooperation and collective action

Emphasize the role of stakeholders, policy and education in building a cleaner, healthier and more resilient marine environment.



Prevent today, protect tomorrow – for a clean and sustainable Black Sea.

The Key Question

How can we reduce pollution before it reaches the sea?



Preventing pollution at the source is more **effective**, more **sustainable** and **less costly** than cleaning it up.

Our focus:



Prevent waste generation at its **source**



Use resources **efficiently** and responsibly



Apply **circular** economy approaches



Valorize waste and by-products as **resources**



Act **together** for a cleaner and healthier sea



Small actions today can prevent big problems tomorrow.

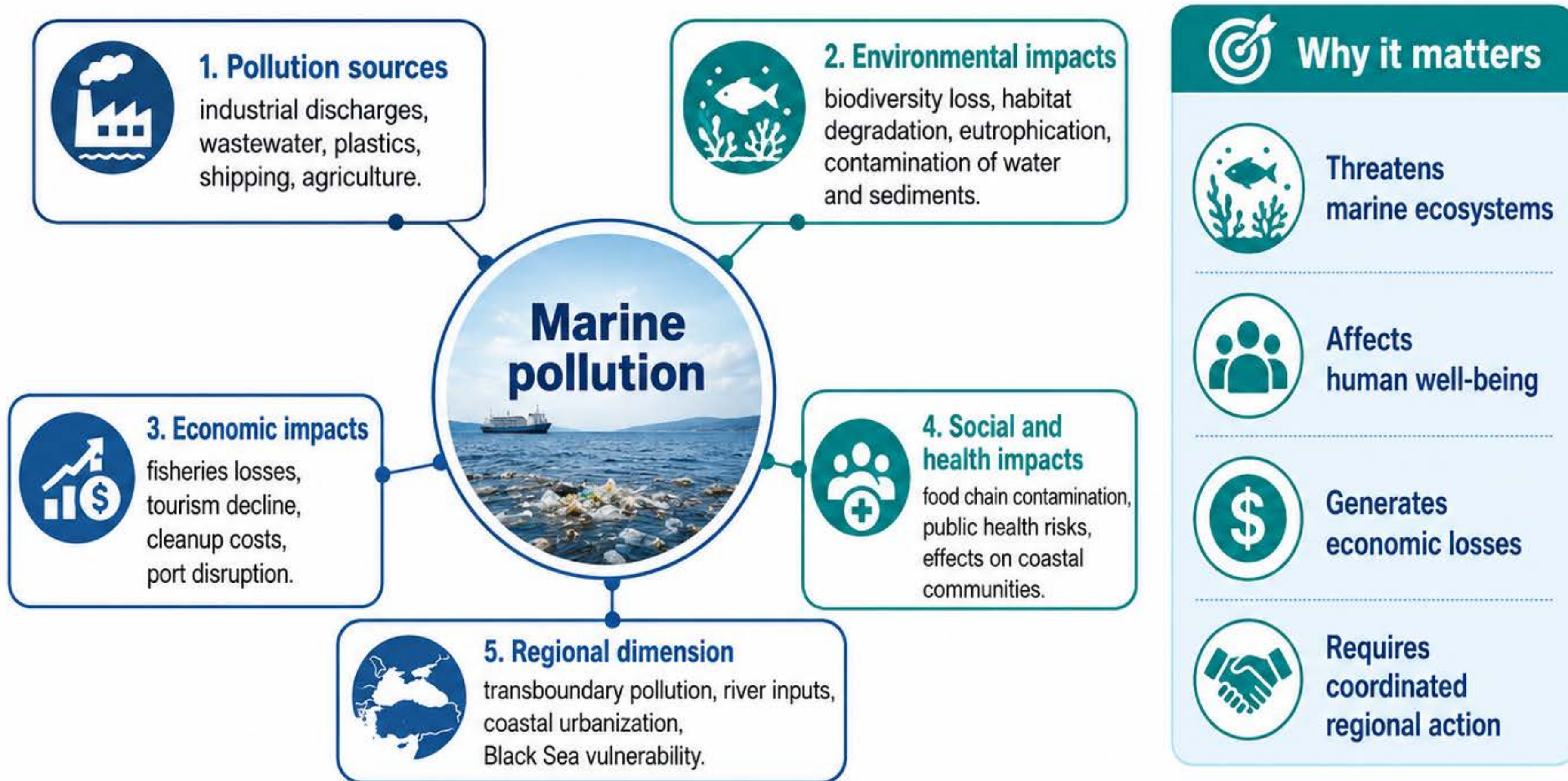


Prevention is the first and most powerful step towards a **healthy and resilient marine environment**.



Marine Pollution as a Global and Regional Challenge

Why marine pollution is an environmental, economic and social issue

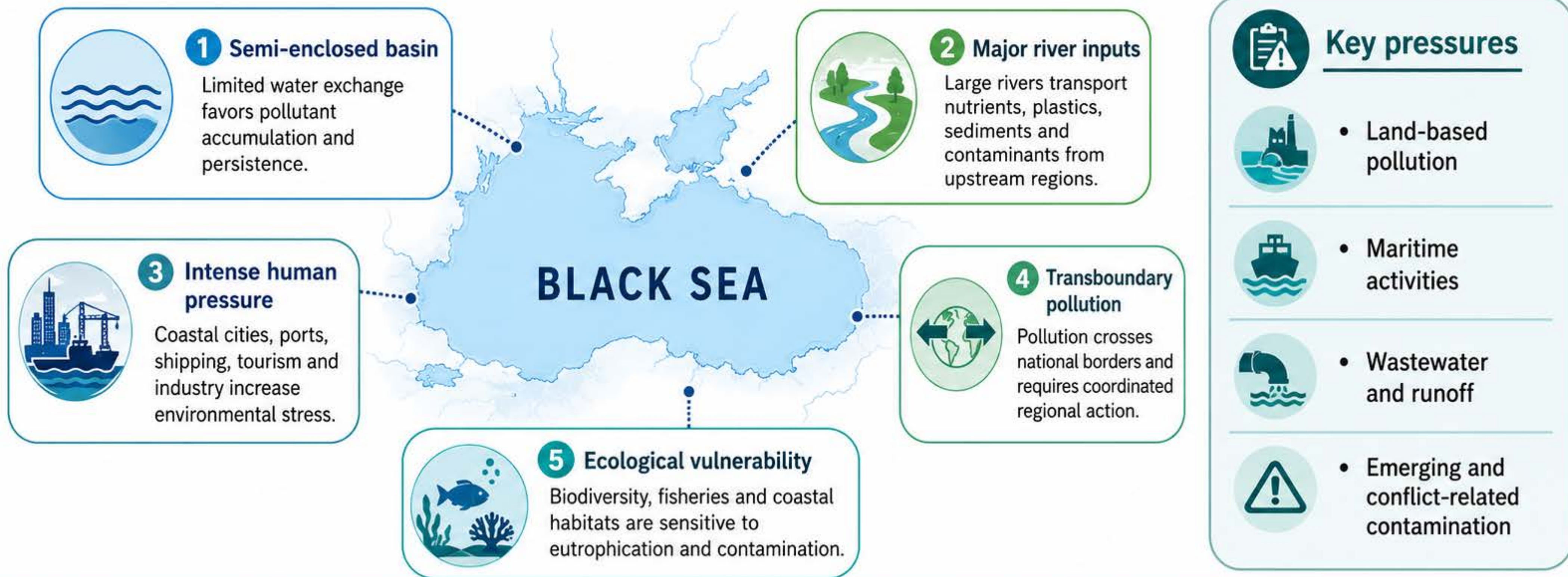


Marine pollution is not only an environmental issue — it is a regional sustainability challenge that requires prevention, cooperation and innovation.



The Black Sea Context

Why the Black Sea is especially vulnerable to marine pollution



The Black Sea is a high-risk marine system where prevention, cooperation and sustainable management are essential.



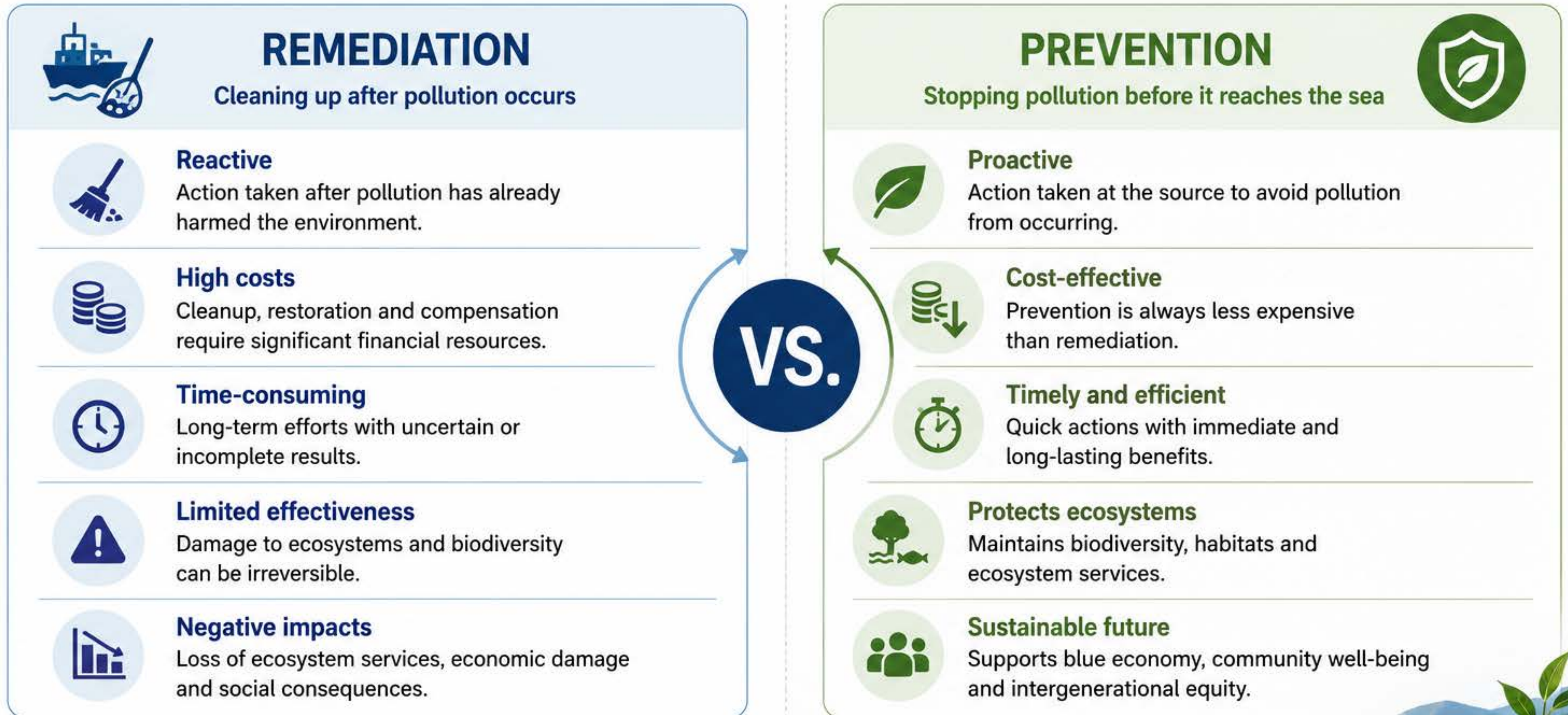
6. Main Pathways of Marine Pollution

*Pollutants reach the sea through multiple interconnected pathways.
Acting at every pathway is essential for effective prevention.*



7. Remediation vs. Prevention

Two approaches. Very different outcomes.



Prevention is the smarter choice: it protects our seas, our communities and our future.



8. Why Prevention Is More Efficient

Acting before pollution occurs saves money, protects ecosystems and supports a sustainable blue economy.



1. Lower costs

Preventing pollution costs significantly less than cleaning it up, restoring ecosystems or compensating damages.



2. Higher efficiency

Prevention stops pollution at the source, avoiding complex, long-term and uncertain remediation efforts.



3. Protects ecosystems

Healthy marine ecosystems provide essential services: biodiversity, fisheries, coastal protection, tourism and more.



4. Protects human health

Reducing exposure to pollutants improves public health and quality of life for coastal communities.



5. Supports the blue economy

Cleaner seas mean sustainable fisheries, aquaculture, tourism and maritime activities with long-term economic benefits.



6. Strengthens resilience

Preventing pollution increases the resilience of coastal communities and ecosystems to climate change and other pressures.



Key takeaway:

Prevention is not only the **right choice** for the environment, it is also the **most efficient**, **cost-effective** and **sustainable** choice for our future.



Prevention is an investment in our seas, our communities and our future.

9. Pollution Prevention Hierarchy

A step-by-step approach to minimize pollution and protect our seas.



Key message:



The higher we act in the hierarchy, the greater the **environmental and economic benefit**.

The goal is to keep resources in use and pollution out of our seas.

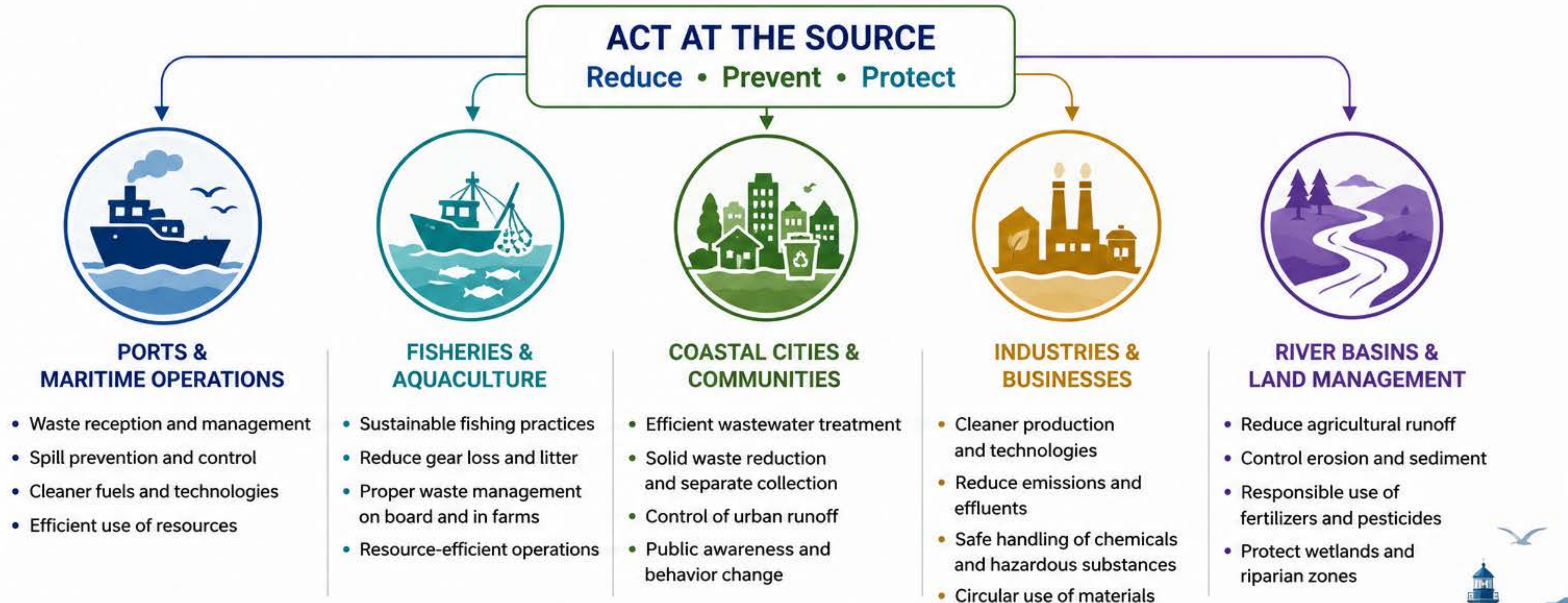
PREVENT TODAY – PROTECT TOMORROW.



10. Acting at the Source

Preventing marine pollution starts where it is generated.

Actions at the source stop pollutants before they reach the sea.



Every action upstream
makes a cleaner, healthier sea downstream.

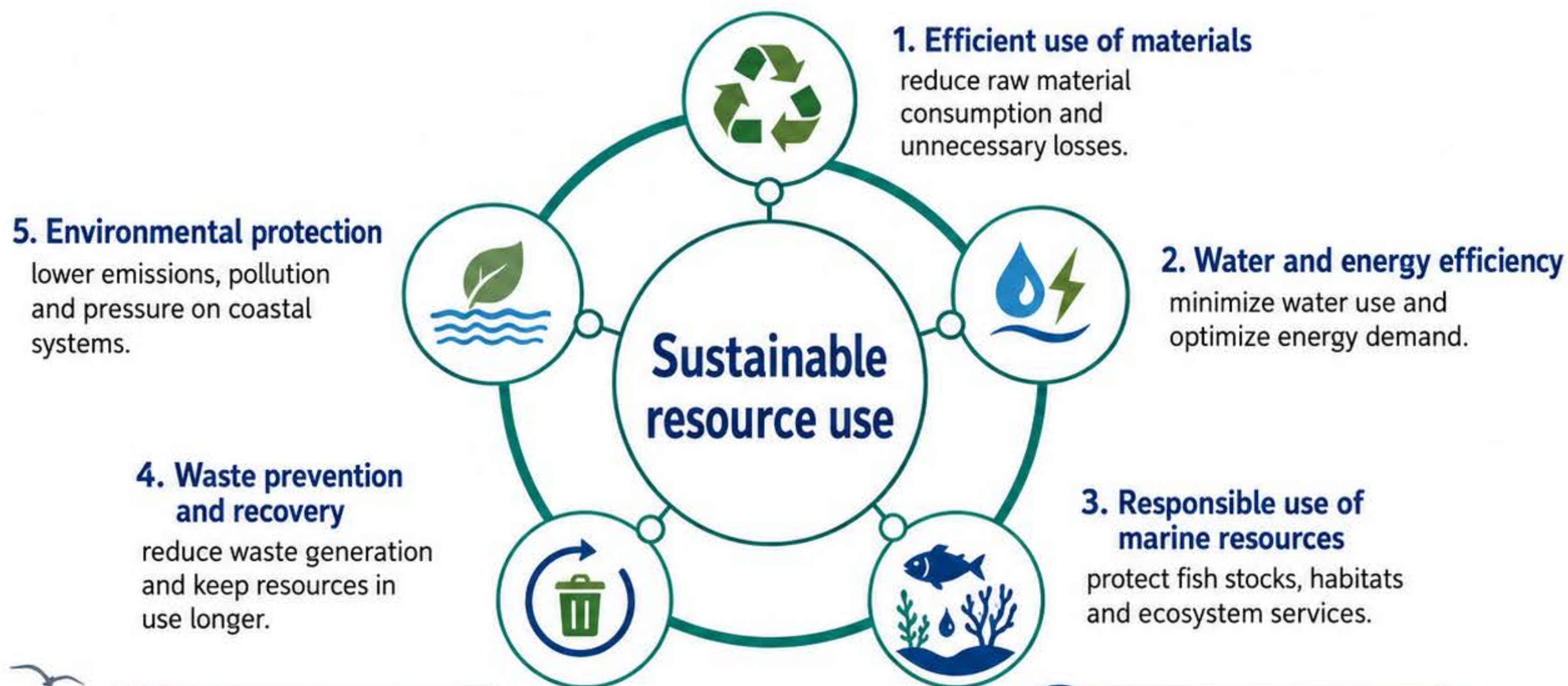


Small actions at the source today
create a big impact for the future.



Sustainable Resource Use: Concept and Relevance

Using resources efficiently without degrading marine ecosystems



Why it matters

- ✓ Reduces pressure on marine ecosystems
- ✓ Supports a circular economy
- ✓ Improves economic efficiency
- ✓ Strengthens long-term resilience



Key message

Sustainable resource use means doing more with less while protecting the sea for future generations.



Resource efficiency is a foundation for cleaner seas and sustainable coastal development.



12. Resource Use in Ports and Maritime Transport



Clean operations
Better efficiency
Healthier oceans

Efficient resource management in ports and shipping reduces costs, prevents pollution and protects our seas.

MAIN RESOURCES USED



ENERGY & FUEL

- Ship propulsion
- Port equipment
- Heating, cooling
- Lighting



WATER

- Ballast water
- Cleaning
- Cooling
- Domestic use



MATERIALS & SUPPLIES

- Lubricants
- Chemicals
- Packaging
- Provisions



SPACE & INFRASTRUCTURE

- Berths & terminals
- Storage areas
- Roads & rail
- Support facilities



ATMOSPHERE (EMISSIONS)

- CO₂, NO_x, SO_x
- Particulate matter
- Volatile compounds
- Odors

POTENTIAL POLLUTION FROM INEFFICIENT USE



Oil and fuel spills from storage, handling or leaks



Wastewater discharges (bilge, ballast, greywater)



Solid waste and plastic from ships and port facilities



Air emissions contributing to air pollution and climate change



Chemical contamination from hazardous substances



Ports and shipping are the lifelines of global trade. Managing resources responsibly is essential for a sustainable and sustainable Blue Economy.

KEY ACTIONS FOR SUSTAINABLE RESOURCE USE



IMPROVE ENERGY EFFICIENCY

Use efficient engines, shore power and smart operations.



SAVE WATER

Optimize use and prevent unnecessary consumption.



MANAGE WASTE RESPONSIBLY

Sort, recycle and reduce waste generation.



PREVENT SPILLS AND LEAKS

Maintain equipment, use safe procedures and quick response.



USE CLEANER FUELS AND TECHNOLOGIES

Reduce emissions through innovation and cleaner solutions.



ENGAGE & TRAIN PEOPLE

Raise awareness and build a culture of responsibility.



Efficient resources. Cleaner ports. Safer seas. Better future.



13. Resource Use in Fisheries and Aquaculture



Healthy seas, productive fisheries, responsible future.

Sustainable use of marine resources ensures healthy ecosystems, food security and long-term livelihoods.

KEY RESOURCES USED



FISH STOCKS

- Wild fish populations
- Spawning biomass
- Marine biodiversity



EQUIPMENT & GEAR

- Nets, lines, traps
- Hooks, ropes
- Electronic devices



FUEL & ENERGY

- Vessel fuel
- Electricity
- Cold storage



WATER

- Onboard use
- Processing activities
- Aquaculture systems



FEED & RAW MATERIALS

- Fishmeal & fish oil
- Plant-based feeds
- Other additives



MAIN CHALLENGES & POLLUTION RISKS



LOST OR ABANDONED FISHING GEAR

Ghost fishing, marine litter, habitat damage.



BYCATCH & HABITAT IMPACTS

Non-target species and sensitive habitats can be affected.



OIL & FUEL LEAKS

Spills and leaks pollute water and harm marine life.



EXCESS FEED & WASTE

Nutrient enrichment, water quality degradation.

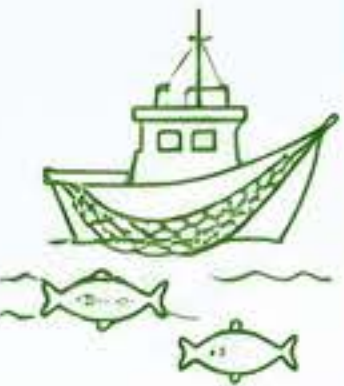


CHEMICALS & MEDICATIONS

Overuse can lead to residues and ecosystem disturbance.

GOOD PRACTICES FOR SUSTAINABLE RESOURCE USE

- ✓ Follow science-based catch limits and seasonal closures.
- ✓ Use selective and low-impact fishing gear.
- ✓ Prevent and retrieve lost gear (gear marking, reporting).
- ✓ Improve fuel efficiency and adopt cleaner technologies.
- ✓ Optimize feed use and reduce waste in aquaculture.
- ✓ Use responsible sourcing for feed and raw materials.
- ✓ Protect marine habitats and biodiversity.



WHAT WE ALL GAIN



Healthy fish populations for future generations



Resilient ecosystems with balanced biodiversity



Stronger coastal communities and livelihoods



Food security and high-quality seafood



Sustainable economies and Blue Growth

“ Our choices today in how we use marine resources shape the ocean we leave for tomorrow. ”



Use wisely. Protect habitats. Reduce waste.

A sustainable fisheries and aquaculture sector for a thriving ocean.



14. Resource Use in Coastal Tourism



Enjoy the coast
Respect the ocean
Support local communities

Sustainable tourism uses resources wisely, protects coastal ecosystems and benefits local communities.

MAIN RESOURCES USED



WATER

Freshwater for accommodation, cleaning, pools and landscaping



ENERGY

Electricity for facilities, heating, cooling and entertainment



MATERIALS & GOODS

Food, beverages, amenities, construction materials, beach equipment



WASTE MANAGEMENT

Solid waste, packaging, food waste, wastewater, hazardous household product



TRANSPORT

Tourist mobility, fuel use, emissions, infrastructure pressure



LAND & ECOSYSTEMS

Beaches, coastal ecosystems, habitats and scenic landscapes

KEY CHALLENGES & POLLUTION RISKS



PLASTIC WASTE

Single-use plastics and poor waste management lead to marine litter.



WASTEWATER & POLLUTION

Untreated or poorly treated wastewater affects water quality and marine life.



EMISSIONS

Energy use and transport contribute to greenhouse gas emissions.



HABITAT PRESSURE

Overdevelopment and foot traffic damage habitats and biodiversity.



NOISE & LIGHT POLLUTION

Disrupt wildlife behavior and affect sea turtles and sensitive species.



SEASONAL PRESSURE

Peak seasons create overload on resources, infrastructure and ecosystems.

BENEFITS OF SUSTAINABLE RESOURCE USE



PROTECTS ECOSYSTEMS

Healthy coasts support marine biodiversity.



REDUCES COSTS

Efficiency saves resources and operational costs.



SUPPORTS LOCAL COMMUNITIES

Jobs, local products and cultural heritage are strengthened.



IMPROVES COMPETITIVENESS

Sustainable destinations attract more visitors and investment.



BUILDS A POSITIVE IMAGE

Responsible tourism creates trust and long-term value.

GOOD PRACTICES FOR SUSTAINABLE TOURISM

- ✓ Use water and energy efficiently in hotels and facilities.
- ✓ Reduce single-use plastics and provide refill stations.
- ✓ Ensure proper wastewater treatment and monitoring.
- ✓ Promote local, seasonal and sustainable food.
- ✓ Support eco-friendly transport: walking, cycling, public transport.
- ✓ Protect dunes, habitats and wildlife.
- ✓ Engage guests through awareness and responsible tourism programs.



“Sustainable coastal tourism means great experiences today and a healthy ocean tomorrow.”

USE RESOURCES WISELY. REDUCE IMPACTS. INSPIRE CHANGE.

Sustainable tourism for thriving coasts and oceans.



15. Resource Use in Coastal Industries



Efficient industry,
cleaner coasts,
sustainable future.

Efficient use of resources and cleaner production in coastal industries reduce pollution, save costs and protect marine ecosystems.

MAIN RESOURCES USED IN COASTAL INDUSTRIES



WATER

- Process water
- Cooling water
- Cleaning water
- Auxiliary water



ENERGY

- Electricity
- Heat and steam
- Fuel
- Renewable energy



MATERIALS & RAW MATERIALS

- Chemicals
- Metals & minerals
- Packaging materials
- Additives



SUPPLIES & CONSUMABLES

- Lubricants
- Filters & membranes
- Cleaning agents
- Office & lab supplies



EMISSIONS & DISCHARGES

- Air emissions
- Wastewater
- Solid waste
- Noise & vibrations



MAIN POLLUTION RISKS FROM INEFFICIENT RESOURCE USE



WASTEWATER POLLUTION

Contains nutrients, chemicals, oils, metals and other contaminants.



AIR EMISSIONS

Greenhouse gases and pollutants affect air quality and climate.



SOLID WASTE

Industrial waste, sludge and hazardous waste pollute soil and sea.



CHEMICAL POLLUTION

Leaks and spills of hazardous substances harm ecosystems and human health.



NOISE & VIBRATIONS

Disturb marine life and affect coastal communities.



ECOSYSTEM IMPACTS

Loss of biodiversity, habitat degradation and eutrophication of coastal waters.

GOOD PRACTICES FOR SUSTAINABLE RESOURCE USE

- ✓ Implement cleaner production and resource efficiency measures.
- ✓ Optimize water use and promote water reuse and recycling.
- ✓ Improve energy efficiency and increase renewable energy use.
- ✓ Minimize waste generation and maximize valorization.
- ✓ Substitute hazardous chemicals with safer alternatives.
- ✓ Use eco-design for products and packaging.
- ✓ Monitor emissions and ensure compliance with best available techniques.
- ✓ Engage employees in sustainability and continuous improvement.



BENEFITS OF SUSTAINABLE RESOURCE USE IN INDUSTRY



COST SAVINGS

Lower resource consumption reduces operational costs.



RISK REDUCTION

Compliance and prevention reduce fines, liabilities and reputational risks.



ENVIRONMENTAL PROTECTION

Cleaner operations protect marine ecosystems and biodiversity.



SOCIAL LICENCE TO OPERATE

Responsible industry builds trust with communities and stakeholders.



COMPETITIVENESS

Efficiency and innovation increase productivity and market value.



SUPPORTS BLUE ECONOMY

Sustainable industry contributes to a healthy and resilient Blue Economy.

“Efficient resource use today in coastal industries means cleaner seas, healthier communities and a stronger Blue Economy.”

USE RESOURCES WISELY. PREVENT POLLUTION. PROTECT THE OCEAN.

Sustainable industry for a cleaner coast and a better future.





16. Resource Efficiency Measures

Practical actions for reducing consumption and waste generation in marine and coastal sectors.



Do more with less.
Use resources wisely,
protect the ocean.



KEY PRINCIPLES OF RESOURCE EFFICIENCY



USE LESS

Reduce resource consumption without affecting performance.



USE BETTER

Choose efficient technologies and sustainable alternatives.



REUSE & REPAIR

Extend the life of products, equipment and materials.



OPTIMIZE OPERATIONS

Improve processes, planning and maintenance to avoid waste.



MEASURE & IMPROVE

Monitor performance, set targets and continuously improve.



ENGAGE PEOPLE

Awareness, training and responsibility at all levels.

PRACTICAL MEASURES ACROSS MARINE AND COASTAL SECTORS



PORTS & SHIPPING

- Shore power
- Energy-efficient equipment
- Optimized routing
- Digital solutions for efficiency



FISHERIES

- Selective gear
- Proper maintenance of equipment
- Reduced fuel use
- Minimize bycatch and discards



AQUACULTURE

- Efficient feed use
- Water recirculation systems
- Health management
- Waste valorization



COASTAL TOURISM

- Energy & water saving
- Low-impact facilities
- Reduce single-use plastics
- Local and seasonal sourcing



COASTAL INDUSTRIES

- Cleaner production
- Water recycling
- By-product valorization
- Eco-design



COMMUNITIES

- Separate collection
- Reduce food waste
- Reuse & repair
- Responsible consumption

EVERY ACTION COUNTS



Save water.
Every drop matters.



Save energy.
Use it efficiently.



Reduce waste.
Produce less, recycle more.



Choose sustainable products and services.



Protect nature.
It provides what we need.

BENEFITS OF RESOURCE EFFICIENCY

- ✓ Reduces costs and operational expenses.
- ✓ Decreases waste and pollution.
- ✓ Lowers greenhouse gas emissions.
- ✓ Extends the life of resources and infrastructure.
- ✓ Improves competitiveness and innovation.
- ✓ Protects marine ecosystems and biodiversity.
- ✓ Supports a sustainable and resilient Blue Economy.



STEPS FOR IMPLEMENTATION

- 1 Assess current resource use and identify hotspots.
- 2 Set realistic goals and prioritize actions.
- 3 Implement solutions and provide the right tools.
- 4 Monitor, measure and report results.
- 5 Review, learn and improve continuously.



*Small changes in how we use resources create a big impact for clean seas and a **better future.***

Use resources wisely today
for healthy seas and thriving communities tomorrow.

17. Linear Economy vs. Circular Economy

From take–make–dispose to resource loops

LINEAR ECONOMY

Extract



Produce



Use



Dispose



- High resource consumption
- More waste generation
- Pollution leakage to land and sea
- Loss of material value



Main consequences

- Marine litter and plastic leakage
- Higher emissions and costs
- Pressure on ecosystems

CIRCULAR ECONOMY



- Resource efficiency
- Waste prevention
- Lower pollution and emissions
- More resilient coastal economies



Benefits for marine protection

- Less waste reaches the sea
- Fewer raw materials are needed
- Supports sustainable Blue Economy

Examples in marine and coastal sectors



1. Ports:

reuse materials and improve waste sorting



2. Fisheries:

recover gear and reduce losses



3. Tourism:

reduce single-use plastics



4. Industry:

recycle by-products and redesign packaging



A circular economy prevents pollution at the source by keeping resources in use and waste out of the sea.





18. Circular Economy Principles

*Designing out waste and pollution,
keeping resources in use for as long as possible.*



A circular economy is restorative
and regenerative by design.
Better for people. Better for the planet.

WHAT IT MEANS



Decouple economic growth from the use of finite resources.



Prevent waste and pollution at the source.



Create value for businesses, communities and ecosystems.



Regenerate natural systems and biodiversity.



Build a resilient and low-carbon Blue Economy.



HOW IT WORKS



Extract

Use natural resources responsibly.



Make

Produce with efficiency and care.



Use

Use wisely and extend product life.



Return

Reuse, repair, recycle or recover value.



Regenerate

Restore natural systems and close the loop.

PRINCIPLES IN ACTION IN BLUE ECONOMY



Design ships and ports for efficiency and low emissions.



Use fisheries resources within ecological limits.



Reduce water use and prevent discharges.



Recycle and valorize waste and by-products.



Protect and restore marine ecosystems.

WHY IT MATTERS



SAVES RESOURCES
Less extraction, more efficient and circular use.



LOWERS COSTS
Less waste, more savings and competitiveness.



REDUCES EMISSIONS
Lower carbon footprint across the entire value chain.



PROTECTS OCEANS
Less pollution, healthier seas and marine life.



CREATES OPPORTUNITIES
Innovation, green jobs and sustainable growth.



BUILDS RESILIENCE
Stronger communities and a more resilient Blue Economy.

Think in cycles. Act in systems. Keep resources in use.
Together for a circular and sustainable future for our seas. 🌿



19. Circular Economy in Action for Marine Resources

Keeping materials in use, reducing waste, and regenerating marine ecosystems.



Close the loop.
Protect the ocean.
Secure our future.

THE CIRCULAR LOOP FOR MARINE RESOURCES



BENEFITS OF A CIRCULAR APPROACH TO MARINE RESOURCES



PROTECTS THE OCEAN

Reduces pollution, habitat destruction and overexploitation of marine resources.



SAVES RESOURCES & MONEY

Uses fewer raw materials and reduces waste management and disposal costs.



REDUCES CLIMATE IMPACT

Lowers greenhouse gas emissions across the value chain.



CREATES JOBS & INNOVATION

Drives green jobs, sustainable businesses and new solutions.



SUPPORTS FOOD SECURITY

Ensures long-term availability of healthy seafood.



STRENGTHENS RESILIENCE

Builds resilient communities and ecosystems in the face of change.

EXAMPLES IN PRACTICE



SUSTAINABLE FISHERIES

Selective fishing, quota management and protection of spawning areas.



AQUACULTURE

Integrated multi-trophic aquaculture, recirculating systems and low-impact feeds.



PLASTICS CIRCULARITY

Reduce, reuse, recycle and innovate to keep plastics out of the ocean.



PORTS & SHIPPING

Waste reception facilities, shore power, ballast water management.



INDUSTRY

Eco-design, material efficiency and industrial symbiosis.



COASTAL COMMUNITIES

Local solutions, responsible tourism and community engagement.

“A circular ocean economy is not just an option – it is our path to a thriving planet and prosperous future.”

Every resource has value. Every action counts.
Let's close the loop for a cleaner, healthier ocean.



20. Our Commitment to a Circular and Blue Future

Together, we can protect oceans, use resources wisely and build a sustainable, resilient Blue Economy.

OUR COMMITMENT

We commit to embedding circular economy principles in all decisions and actions related to marine resource use.



PROTECT

Protect and restore marine ecosystems and biodiversity.



USE WISELY

Use resources efficiently and responsibly.



REDUCE & REUSE

Reduce waste and pollution. Reuse materials and products.



INNOVATE

Innovate for sustainable solutions and a circular ocean economy.



COLLABORATE

Work together across sectors, communities and borders.

OUR PRIORITIES FOR A CIRCULAR AND SUSTAINABLE OCEAN ECONOMY



HEALTHY ECOSYSTEMS

Restore habitats and maintain the balance of marine ecosystems.



SUSTAINABLE FISHERIES

Harvest responsibly within ecological limits for future generations.



CIRCULAR SOLUTIONS

Design out waste and keep materials in use for as long as possible.



SUSTAINABLE SHIPPING & PORTS

Cut emissions, prevent pollution and use resources efficiently.



GREEN INDUSTRY & INNOVATION

Drive clean production, eco-design and green technologies.



STRONG COMMUNITIES & PARTNERSHIPS

Empower communities through jobs, education and collaboration.



Our ocean. Our responsibility.
Our actions. Our future.
Let's make it count.

HOW WE WILL ACHIEVE IT



INTEGRATE: Embed circular principles in policies, strategies and daily operations.



INVEST: Support research, innovation and sustainable infrastructure.



EDUCATE: Raise awareness and build skills for a Blue Economy future.



MEASURE: Track progress, share data and learn from success.



ACT TOGETHER: Engage all stakeholders and empower communities to take action.

*“The ocean connects us all.
A circular future protects it today
and secures it for tomorrow.”*

YOU CAN MAKE A DIFFERENCE



Save water and energy.



Reduce, reuse, recycle.



Avoid single-use plastics.



Choose sustainable seafood.



Speak up and spread awareness.



Support local and responsible initiatives.

A CIRCULAR AND BLUE FUTURE IS POSSIBLE.

Together, let's protect our ocean, our resources and our future.

CIRCULAR ECONOMY AS POLLUTION PREVENTION

Keeping materials in use and pollutants out of the sea



WHY IT MATTERS FOR OUR OCEAN

A circular economy reduces the extraction of natural resources, minimizes waste and emissions, and prevents pollutants from reaching our seas and beaches.



LESS WASTE

Keeping materials in use reduces the amount of waste that can end up in the ocean.



LOWER EMISSIONS

Circular solutions require less energy and reduce greenhouse gas emissions.



HEALTHIER OCEANS

Less pollution means cleaner water, healthier marine life and ecosystems.



STRONGER COMMUNITIES

New jobs, innovation and local solutions for a sustainable future.



RESILIENT PLANET

Using resources wisely today secures a better tomorrow for all.

**CIRCULAR TODAY,
CLEANER OCEANS TOMORROW.**

Every choice counts!



LESS WASTE



CLEANER OCEANS



HEALTHY LIFE



BETTER FUTURE

22. BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION

Infrastructure, costs, legislation, cooperation and behaviour



1. INFRASTRUCTURE

Insufficient collection, sorting, recycling and recovery facilities in coastal and maritime sectors.



2. COSTS AND INVESTMENT

High upfront costs, uncertain returns, limited financing for circular solutions.



3. LEGISLATION AND POLICY GAPS

Fragmented regulations, weak enforcement, lack of incentives and standards.



4. COOPERATION AND COORDINATION

Limited collaboration between ports, industries, municipalities, researchers and communities.



5. BEHAVIOUR AND AWARENESS

Resistance to change, low public awareness, limited training and circular habits.



WHY BARRIERS MATTER



Slows circular transition.



Increases waste leakage to the sea.



Limits innovation uptake.



Weakens marine sustainability goals.



Overcoming these barriers is essential for cleaner seas and more resilient coastal economies.





Plastic, packaging, oils, wastewater, food waste and fishing gear



WHY THESE WASTE STREAMS MATTER



Increase pollution pressure in ports and coastal waters.



Threaten marine life and habitats.



Create operational and disposal challenges.



Require prevention, collection and better management.



Understanding waste streams is the first step toward cleaner ports, safer seas and better circular solutions.



24. Waste Prevention in Ports

Reception facilities, sorting systems and cleaner port operations



MAIN PREVENTION ACTIONS



1. Ship waste reception facilities



2. Separate collection and sorting



3. Oily residues and bilge handling



4. Wastewater control



5. Staff training and port procedures



WHY PORTS MATTER



Ports are key gateways for waste management



Good systems prevent leakage to coastal waters



Cleaner operations reduce pollution risks



Circular practices improve resource recovery

PREVENTION WORKFLOW



Ship arrival



Waste declaration



Collection



Sorting



Treatment / recycling



Cleaner port



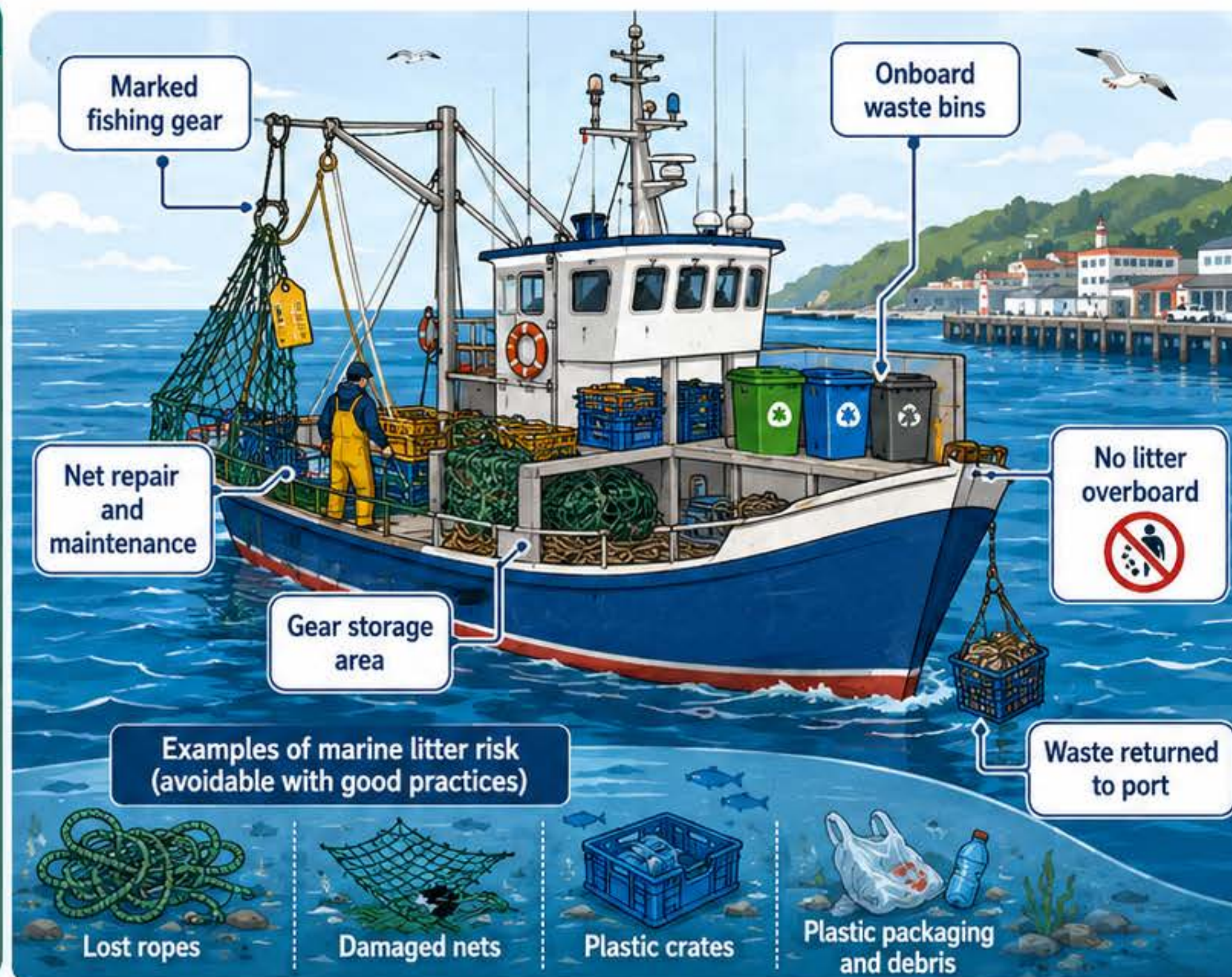
Efficient port waste management is a frontline defense against marine pollution.

25. Waste prevention in fisheries

Reducing lost fishing gear, onboard waste and marine litter

Main prevention actions

-  Gear marking and tracking
-  Retrieval of lost nets and ropes
-  Separate onboard waste collection
-  Landing waste in port facilities
-  Crew training and awareness



Why prevention matters

-  Reduces ghost fishing
-  Protects marine life and habitats
-  Keeps seafood operations cleaner
-  Supports sustainable fisheries

Prevention workflow



Preventing waste at sea is essential for healthier ecosystems and more sustainable fisheries.



26. Waste prevention in fish processing

Reducing losses and valorizing organic residues

MAIN PREVENTION ACTIONS



1. Yield optimization and process control



2. Separate collection of organic residues



3. Cold storage and spoilage prevention



4. Water-efficient cleaning and sanitation



5. Staff training and traceability



VALORIZATION WOTHWAYS



PREVENTION WORKFLOW



WHY PREVENTION MATTERS



Reduces raw material losses



Lowers disposal costs



Decreases pollution load



Supports circular economy in seafood industries



Preventing losses in fish processing creates cleaner production and more circular seafood value chains.

27. Waste Prevention in Coastal Communities

Separate collection, local campaigns and reduced single-use plastics



Key local actions



Separate waste collection



Community awareness campaigns



Reusable alternatives



Beach and street cleanup actions



Local rules and school education



Why it matters



Less litter reaches the sea



Cleaner beaches and public spaces



Higher community participation



Stronger local circular economy

How communities can act



Households and shops



Separate collection



Reuse and refill



Community campaigns



Less marine litter



Local action is a powerful first line of defense against marine pollution.



28. Reducing Plastic Leakage into the Sea

Prevention, collection, reuse and recycling strategies



MAIN LEAKAGE SOURCES



Household litter



Tourism and beach waste



Packaging waste



Fishing-related plastics



Stormwater/runoff



Poor waste collection

REUSE AND RECYCLING STRATEGIES



Reusable bottles and bags



Refill systems



Sorting and recycling



Community participation



Business responsibility

PLASTIC LEAKAGE PATHWAY



PREVENTION AND COLLECTION STRATEGIES



Source reduction



Deposit-return systems



Separate collection bins



Beach cleanups



Storm drain capture



Port/coastal collection points

EXPECTED BENEFITS



Less marine litter



Cleaner beaches



Lower wildlife entanglement



Higher material recovery



Stronger circular economy



1 Prevent at source

Reduce what we use and discard



2 Collect effectively

Ensure all waste is captured



3 Reuse and refill

Extend product life and avoid disposables



4 Recycle materials

Turn waste into valuable resources



5 Less plastic reaches the sea

A cleaner ocean for all



Every action on land counts. Together, we can stop plastic before it reaches the sea.



29. From Marine Waste to Resource

Changing the perspective from disposal to valorization



Valorization turns marine waste into economic and environmental opportunity.



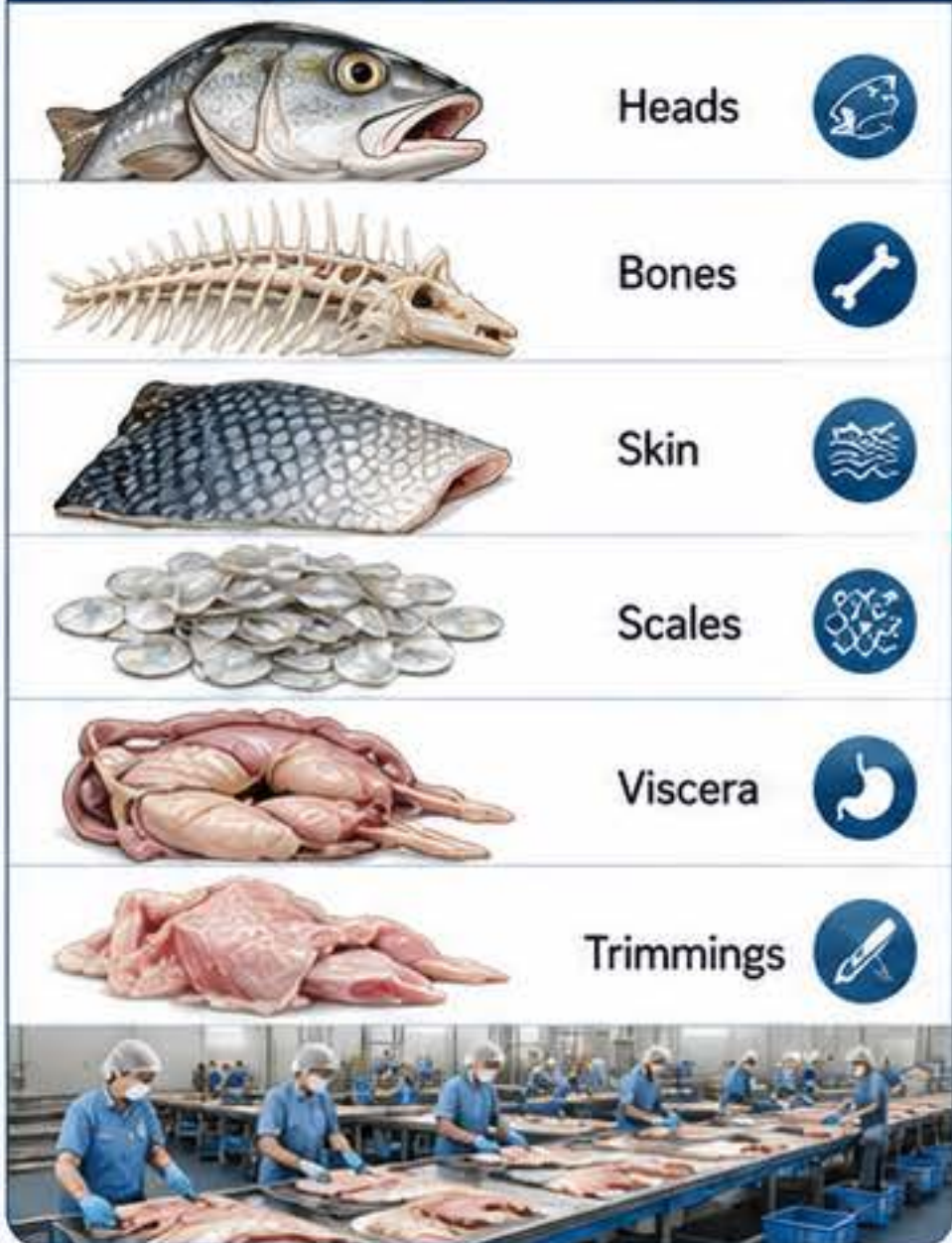


30. Fish Waste Valorization

Proteins, collagen, gelatin, oils, fertilizers and bioactive compounds



MAIN FISH WASTE FRACTIONS



VALORIZATION PATHWAY



HIGH-VALUE PRODUCTS



WHY IT MATTERS



Reduces waste and pollution



Creates added economic value



Lowers disposal and treatment costs



Supports circular economy



Builds a cleaner, more sustainable seafood industry

APPLICATIONS



Food (functional ingredients)



Nutraceuticals (supplements, health products)



Cosmetics (skin & hair care)



Agriculture (fertilizers, soil health)



Pharmaceuticals (bioactive ingredients)



Biomaterials (films, scaffolds, biopolymers)



Fish waste valorization transforms organic residues into high-value products and circular opportunities.

31. Shell Waste Valorization

Calcium carbonate, chitin, chitosan and adsorbent materials



MAIN SHELL WASTE SOURCES



Shrimp shells



Crab shells



Mussel shells



Oyster shells

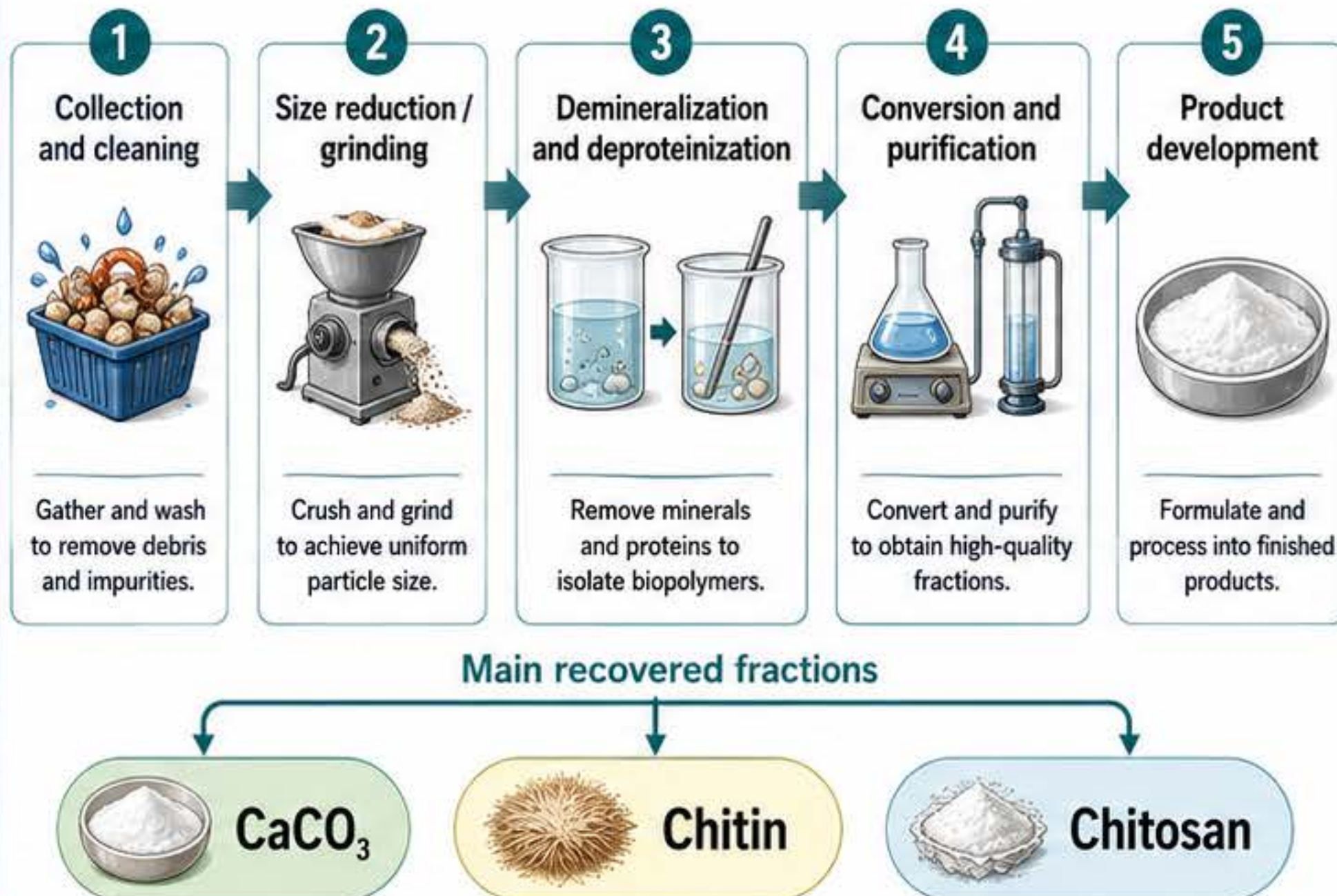


Clam shells



Seafood processing residues rich in minerals and biopolymers

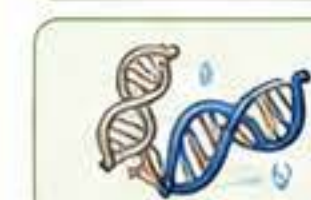
VALORIZATION PATHWAY



MAIN PRODUCTS



Calcium carbonate powders/fillers



Chitin and chitosan biopolymers



Adsorbent materials for water treatment



Functional materials / composites

Example applications



Wastewater treatment



Agriculture



Bioplastics and packaging



Biomedical/ cosmetic uses



Fillers/ coatings

WHY IT MATTERS



Reduces disposal to landfill or sea



Creates added value and jobs



Supports circular economy



Lowers environmental impact



Enables high-value marine biobased materials

Shell waste valorization transforms seafood residues into useful materials and circular opportunities.



32. Algae and Marine Biomass Valorization

Biopolymers, fertilizers, bioenergy and functional products



Main biomass sources



Macroalgae / seaweed



Microalgae



Seagrass and coastal biomass



Algal blooms / harvested biomass



Aquaculture-related biomass residues

Main recovered fractions / product groups



Polysaccharides / biopolymers



Proteins and pigments



Bioactive extracts



Lipids / biofuel precursors



Mineral-rich residues

Valorization pathway



1. Collection and harvesting



2. Cleaning and pretreatment



3. Extraction / processing



4. Fractionation / conversion



5. Product development



6. Market applications

Key products



Biopolymers / films



Fertilizers and biostimulants



Bioenergy / biogas / biofuels



Functional foods / nutraceuticals



Cosmetics / pharmaceuticals



Adsorbents / environmental materials

Why it matters



Reduces marine biomass waste



Creates added value and green jobs



Supports circular blue economy



Offers low-carbon product pathways



Helps develop sustainable bio-based materials



Algae and marine biomass valorization turns coastal biological resources into sustainable products and circular opportunities.

28.

Reducing plastic leakage into the sea

Prevention, collection, reuse and recycling strategies



PREVENTION
Reduce at source



COLLECTION
Keep waste out of nature



REUSE
Extend the life of products



RECYCLING
Turn waste into resources



29.

From marine waste to resource

Changing the perspective from disposal to valorization



From waste



To opportunity



To value



30.

Fish waste valorization

Proteins, collagen, gelatin, oils, fertilizers and bioactive compounds



PROTEINS



COLLAGEN
GELATIN



OILS



FERTILIZERS



BIOACTIVE
COMPOUNDS

31.

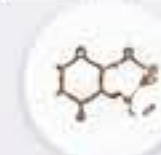
Shell waste valorization

Calcium carbonate, chitin, chitosan and adsorbent materials



CALCIUM CARBONATE

For industrial and environmental uses



CHITIN

From shell polysaccharides



CHITOSAN

Biopolymer with multiple applications



ADSORBENT MATERIALS

For water and pollutant removal

32.

Algae and marine biomass valorization

Biopolymers, fertilizers, bioenergy and functional products



BIOPOLYMERS
Sustainable materials



FERTILIZERS
Natural nutrients for soil



BIOENERGY
Renewable energy



FUNCTIONAL PRODUCTS
Cosmetics, nutraceuticals and more

33.

Organic waste and composting in coastal areas

Local recovery pathways for biodegradable residues



ORGANIC WASTE
Food scraps, plant residues, fish waste



SEPARATE COLLECTION
Keep it clean and separated



COMPOSTING
Natural process of transformation



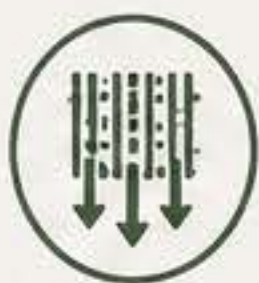
NUTRIENT-RICH COMPOST
For soils, gardens and green areas



34.

Waste-derived materials for pollution prevention

Filters, adsorbents, construction materials and eco-products



FILTERS

Natural and bio-based materials for air and water filtration



ADSORBENTS

Waste-derived adsorbents for removing pollutants



CONSTRUCTION MATERIALS

Sustainable aggregates and binders from waste resources



ECO-PRODUCTS

Innovative, durable and biodegradable solutions



WASTE
RESOURCES



CLEAN
TRANSFORMATION



LESS POLLUTION
GREATER VALUE



35.

Why land-based sources matter

Most marine pollutants start upstream

Pollutants generated on land are transported by rivers, runoff and air to the sea.

MAIN LAND-BASED SOURCES



URBAN AREAS

Sewage, litter, household chemicals, microplastics



AGRICULTURE

Fertilizers, pesticides, manure runoff



INDUSTRY

Chemical discharges, heavy metals, microfibers



INFRASTRUCTURE & ROADS

Oil residues, tire particles, road runoff



POOR WASTE MANAGEMENT

Litter, plastics, open dumping, leachate



PLASTICS & MICROPLASTICS



CHEMICALS & TOXIC SUBSTANCES



NUTRIENTS (N & P)



PATHOGENS & MICROORGANISMS

WHAT THIS LEADS TO →



Marine litter & entanglement



Harm to marine life & habitats



Water quality degradation



Impacts on fisheries, tourism & human health



Economic losses



Solving marine pollution starts on land.
Upstream action, cleaner oceans.

36.

Urban wastewater and marine pollution

Nutrients, microplastics, detergents and pharmaceuticals

Wastewater from homes, businesses and institutions carries a complex mix of pollutants to the sea.



KEY POLLUTANTS IN URBAN WASTEWATER



NUTRIENTS (N & P)

Cause eutrophication, algal blooms and oxygen depletion.



MICROPLASTICS

Tiny plastic particles pass through treatment plants and accumulate in marine life.



DETERGENTS

Surfactants and chemicals can be toxic to aquatic organisms and disrupt ecosystems.



PHARMACEUTICALS

Medicine residues can affect hormones, reproduction and antimicrobial resistance.

IMPACTS ON THE MARINE ENVIRONMENT



EUTROPHICATION

Algal blooms reduce water quality and biodiversity.



WILDLIFE HARM

Ingestion and exposure cause injury, disease and death.



HABITAT DEGRADATION

Pollutants degrade coral, seagrass and other habitats.



CHEMICAL RISKS

Toxic and persistent substances bioaccumulate in the food web.



HUMAN HEALTH

Contaminants can return to humans through seafood.



SOLUTIONS START IN CITIES

Improve infrastructure, upgrade treatment, reduce pollution at source. Cleaner wastewater means healthier oceans.



Upgrade infrastructure



Improve treatment



Reduce pollution at the source



Raise awareness and act together

37.

Agricultural runoff

Nitrogen, phosphorus, pesticides and sediment transport



Rain and irrigation water wash pollutants from fields and livestock operations into rivers, lakes and eventually the sea.

KEY POLLUTANTS IN AGRICULTURAL RUNOFF



NITROGEN

Excess nitrogen stimulates algal blooms and depletes oxygen.



PHOSPHORUS

Excess phosphorus promotes algal growth and harms aquatic life.



PESTICIDES

Toxic to aquatic organisms and can bioaccumulate in the food web.



SEDIMENT TRANSPORT

Increases turbidity, smothers habitats and carries attached pollutants.

THE PATHWAY: FROM FIELD TO SEA



RAIN OR IRRIGATION



RUNOFF FROM FIELDS



TRANSPORT VIA RIVERS AND STREAMS



POLLUTANTS REACH COASTAL WATERS



IMPACTS ON AQUATIC ECOSYSTEMS



EUTROPHICATION

Algal blooms reduce oxygen and degrade water quality.



HARM TO AQUATIC LIFE

Toxic chemicals and low oxygen harm fish and invertebrates.



HABITAT DEGRADATION

Sediments smother spawning grounds and aquatic vegetation.



WATER QUALITY RISKS

Contamination affects drinking water and human health.

SOLUTIONS FOR CLEANER WATERS



COVER CROPS & SOIL HEALTH

Keep soil in place and reduce runoff.



RIPARIAN BUFFERS

Vegetated buffer zones filter pollutants before they reach waterways.



NUTRIENT MANAGEMENT

Apply fertilizers at the right rate, time and place.



RESPONSIBLE PESTICIDE USE

Use integrated pest management and follow label instructions.



CONSERVATION PRACTICES

Reduce erosion with contour farming, no-till and proper drainage.



Healthy soils and smart farming protect our waters from field to sea.

38.

Industrial discharges

Heavy metals, organic compounds, hydrocarbons and process waters



Industrial activities release a wide range of pollutants into rivers, estuaries and coastal waters, threatening marine ecosystems and human health.

KEY POLLUTANTS IN INDUSTRIAL DISCHARGES



HEAVY METALS

Mercury, lead, cadmium, chromium and others accumulate in marine organisms and food chains.



ORGANIC COMPOUNDS

Phenols, solvents, dyes and other toxic organics can be persistent and harmful to marine life.



HYDROCARBONS

Oils, greases and PAHs contaminate sediments and cause toxic effects on ecosystems.



PROCESS WATERS

High pH, salinity, suspended solids and temperature changes disrupt aquatic life and habitats.



Untreated or poorly treated industrial wastewater pollutes our waters and persists in the environment.

IMPACTS ON THE MARINE ENVIRONMENT



TOXICITY TO MARINE LIFE

Causes stress, disease, reproduction failure and mortality.



HABITAT DEGRADATION

Pollutants damage coral reefs, seagrass and benthic habitats.



BIOACCUMULATION AND BIOMAGNIFICATION

Toxins build up in tissues and magnify up the food chain.



WATER QUALITY DECLINE

Pollution reduces oxygen, clarity and overall water quality.



HUMAN HEALTH RISKS

Exposure through seafood and recreational water use.

COMMON INDUSTRIAL SOURCES



CHEMICAL INDUSTRIES

Solvents, acids, alkalis, dyes.



PETROCHEMICAL & REFINERIES

Oils, hydrocarbons, process waters.



TEXTILE & DYEING INDUSTRIES

Dyes, salts, surfactants, and heavy metals.



METAL FINISHING & PLATING

Heavy metals, acids, and cyanides.



PULP & PAPER INDUSTRIES

Organic matter, chlorine compounds.

SOLUTIONS FOR CLEANER WATERS



IMPLEMENT CLEANER PRODUCTION

Reduce waste at the source.



TREAT WASTEWATER EFFECTIVELY

Use advanced treatment technologies.



MONITOR AND ENFORCE STANDARDS

Ensure compliance and transparency.



RECOVER AND REUSE RESOURCES

Promote circular economy.



COLLABORATE FOR HEALTHY OCEANS

Industry, regulators and communities together.



Responsible industry today for a cleaner ocean tomorrow.

River transport of pollutants

Rivers as pathways between inland pollution and marine ecosystems



Pollutants generated on land are carried by rivers through a connected network of streams and channels to estuaries and the sea.

THE JOURNEY TO THE SEA



1. ORIGIN

Pollutants are generated on land



2. MOBILIZATION

Rainfall and runoff wash pollutants into waterways



3. TRANSPORT

Rivers carry pollutants over long distances to downstream areas



4. ESTUARY

Pollutants mix and accumulate in estuaries, affected by tides



5. MARINE IMPACT

Pollutants reach the sea, impacting marine life, habitats and people



AGRICULTURAL RUNOFF

Nutrients, pesticides, sediments from fertilized fields and livestock areas



URBAN RUNOFF

Oil, heavy metals, litter, microplastics from roads and urban surfaces



INDUSTRIAL DISCHARGES

Chemicals, heavy metals, organic compounds, and process waters from industries



WASTEWATER EFFLUENT

Nutrients, pathogens, pharmaceuticals, detergents and microplastics



EROSION & SEDIMENT RUNOFF

Sediments and attached pollutants from land erosion and construction

RIVER TRANSPORT

Pollutants are dissolved, suspended or attached to particles and carried downstream.

POLLUTANTS COMMONLY TRANSPORTED BY RIVERS



NUTRIENTS (N & P)

Cause eutrophication and harmful algal blooms.



PESTICIDES & HERBICIDES

Toxic to aquatic life, bioaccumulate in food webs.



MICROPLASTICS

Tiny particles persist, accumulate and harm organisms.



HEAVY METALS

Toxic and persistent, damage organs and ecosystems.



PHARMACEUTICALS

Affect hormones, reproduction and microbial balance.



DETERGENTS & SURFACTANTS

Harm aquatic life, contribute to foam and water quality loss.



SEDIMENTS

Increase turbidity, smother habitats, transport other pollutants.

IMPACTS ON MARINE ECOSYSTEMS



EUTROPHICATION

Algal blooms reduce oxygen and degrade water quality.



HABITAT DEGRADATION

Sediments and toxins damage seagrass, coral and wetlands.



TOXICITY TO MARINE LIFE

Poisons organisms and disrupts reproduction.



BIOACCUMULATION

Pollutants build up in food webs, affecting humans.



HUMAN HEALTH RISKS

Contaminated seafood and water pose risks to communities.

SOLUTIONS: STOP POLLUTION AT THE SOURCE



Sustainable agriculture

Use less fertilizer and pesticides.



Wastewater treatment

Improve and maintain treatment systems.



Industrial best practices

Treat discharges and reduce toxic releases.



Green infrastructure & urban solutions

Permeable surfaces, rain gardens, retention basins.



Protect rivers & riparian zones

Restore wetlands and vegetation buffers.



Monitoring & enforcement

Track pollutants and ensure compliance.



Community awareness

Everyone plays a role in cleaner rivers.



Healthy rivers, healthy oceans.

Protect upstream, protect the sea.

40.

Integrated watershed and coastal management

Connecting river basin management with marine protection

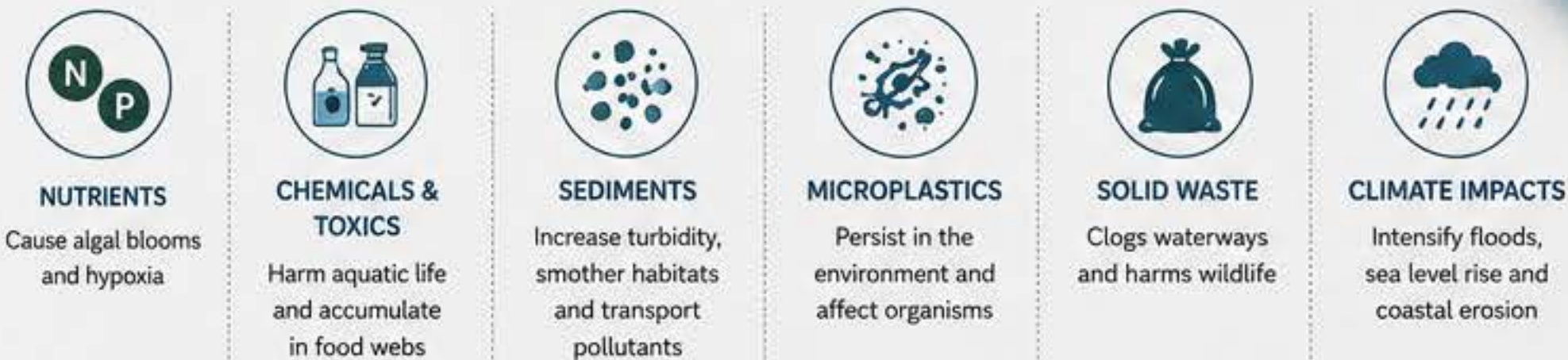


A healthy ocean starts in healthy watersheds. Coordinated actions from source to sea reduce pollution, restore ecosystems and build climate resilience.

SOURCE TO SEA CONTINUUM



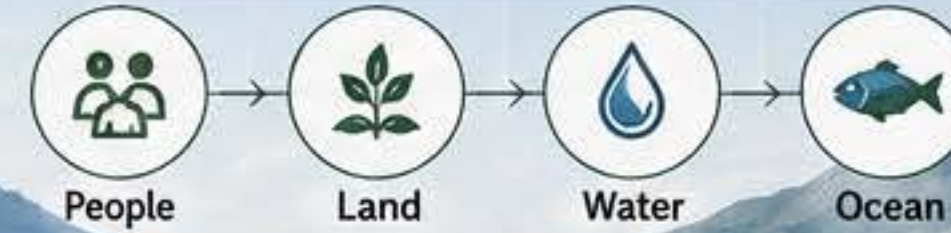
KEY POLLUTANT PATHWAYS



PRINCIPLES FOR SUCCESS



ONE WATERSHED – ONE HEALTH



UPPER WATERSHED

- Forest conservation
- Soil protection
- Sustainable agriculture
- Erosion control

MID-WATERSHED

- Wastewater management
- Green infrastructure
- Floodplain restoration
- Responsible industry

LOWER WATERSHED

- Urban stormwater control
- Solid waste management
- Habitat protection
- Community engagement

COASTAL ZONE

- Wetland & mangrove protection
- Sustainable fisheries
- Marine protected areas
- Pollution monitoring

BENEFITS OF INTEGRATED MANAGEMENT



Healthy watersheds.
Healthy coasts. Healthy ocean.

Manage together today
for a thriving tomorrow.



41.

Eco-design for marine pollution prevention

Designing products and systems with lower environmental impact



Eco-design integrates environmental thinking at every stage of a product's life cycle to prevent pollution at the source and protect marine ecosystems.

ECO-DESIGN PRINCIPLES



MATERIAL SELECTION

Prefer renewable, recycled, non-toxic and biodegradable materials.



REDUCE

Minimize material and energy use, weight and complexity.



SAFER CHEMISTRY

Avoid hazardous substances of concern.



DURABLE & REUSABLE

Design for long life, repair, upgrade and reuse.



RECYCLABLE & COMPOSTABLE

Enable high-quality recycling or safe biodegradation.



SYSTEMS THINKING

Consider the whole life cycle and cumulative impacts.

EXAMPLES OF ECO-DESIGN IN ACTION



RETHINK MATERIALS

Use recycled, renewable or ocean-bound plastic alternatives.



SMART PACKAGING

Reduce packaging and use recyclable, compostable or refillable options.



ENERGY & WATER EFFICIENCY

Design products that save energy and water during use.



CLEANER PROCESSES

Use low-impact dyes, adhesives and manufacturing methods.



DESIGN FOR REPAIR AND UPGRADES

Make it easy to maintain, repair and extend product life.

THINK LIFE CYCLE



BENEFITS FOR OCEANS AND SOCIETY



Less pollution, fewer plastics and harmful chemicals reaching the sea



Healthier marine ecosystems and biodiversity



Lower resource use and greenhouse gas emissions



Innovation, responsible business and a cleaner, safer future

HOW ECO-DESIGN PREVENTS MARINE POLLUTION



Fewer toxic inputs and emissions in production



Less waste and leakage to land and water



Reduced microplastics, chemicals and litter in rivers and coasts



Lower harm to marine life and food webs



Cleaner oceans for people and future generations



Design today.
Protect our **oceans**
for tomorrow.



42

Digital tools for prevention and monitoring

Sensors, GIS, AI, databases and remote sensing



Why digital tools matter

- Early detection of pollution events
- Better spatial understanding of risks
- Faster response and decision support
- Improved data sharing and transparency



Main digital tools



Sensors

real-time monitoring of water quality, temperature, salinity, turbidity, hydrocarbons



GIS

mapping pollution sources, hotspots and vulnerable coastal areas



AI and analytics

pattern recognition, forecasting and decision support



Databases and platforms

storing, sharing and integrating environmental data



Remote sensing

satellite, drone and aerial observation of spills, litter and algal blooms

Applications in marine pollution prevention



Tracking land-based pollution pathways



Monitoring ports and coastal activities



Detecting marine litter and oil spills



Supporting emergency preparedness



Identifying trends for long-term management



Benefits for the Black Sea region



Supports cross-border cooperation



Improves evidence-based policies



Enhances operational preparedness



Helps protect sensitive ecosystems



Strengthens sustainable coastal management



Digital monitoring turns data into action for cleaner seas and smarter prevention.

43. Good Practices from the Mediterranean Basin

Circular economy, fish waste valorization and plastic reduction



1. Circular economy actions

- Reuse
- Repair
- Recycling
- Port waste collection
- Local circular businesses



2. Fish waste valorization

Conversion of fish processing residues into:

- Collagen / Gelatin
- Fish oil
- Feed ingredients
- Fertilizers
- Bioactive products



3. Plastic reduction measures

- Reduced single-use plastics
- Separate collection
- Deposit-return systems
- Beach cleanup
- Fishing gear recovery



4. Stakeholder collaboration



Municipalities



Ports



Fisheries



Tourism



Researchers



NGOs



Citizens



5. Why these practices matter



Less marine litter

Lower disposal costs

Added value from waste

Cleaner coasts

Stronger blue economy

EXAMPLES OF TRANSFERABLE LESSONS



Source prevention
Avoid waste at the source



Separate collection
Collect materials separately and properly



Valorization of by-products
Turn residues into useful resources



Public awareness
Educate, engage and change behaviors



Coastal cooperation
Share knowledge and act together across borders

Mediterranean good practices show that prevention, circular use of resources and collaboration can reduce marine pollution.

44. Good Practices Relevant for the Black Sea Basin

Regional transfer, adaptation and stakeholder cooperation



Examples of actions for the Black Sea Basin



From transfer to implementation



Continuous improvement for a resilient Black Sea

45. Final Conclusions and Discussion

Prevention today, protection tomorrow



01

Prevention is more effective than remediation.



02

Circular economy reduces waste and resource loss.



03

Land-based sources must be addressed upstream.



04

Stakeholder cooperation is essential for impact.



05

Regional knowledge transfer strengthens Black Sea resilience.



Prevent



Reduce



Reuse



Recycle



Protect



DISCUSSION



Which prevention measures are most feasible in your region?



How can local stakeholders cooperate more effectively?



What practices can be transferred to the Black Sea Basin?



Cleaner seas start with smarter choices on land and along the coast.



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Thank You for Your Attention Q&A

Questions, comments and discussion are welcome.



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