

Session 6: Circular Economy, Future Global Environment, and Scientific and Technological Response - Microplastics -

2023 Jeju Plus International Environmental Forum
ICC Jeju
7-8 September 2023

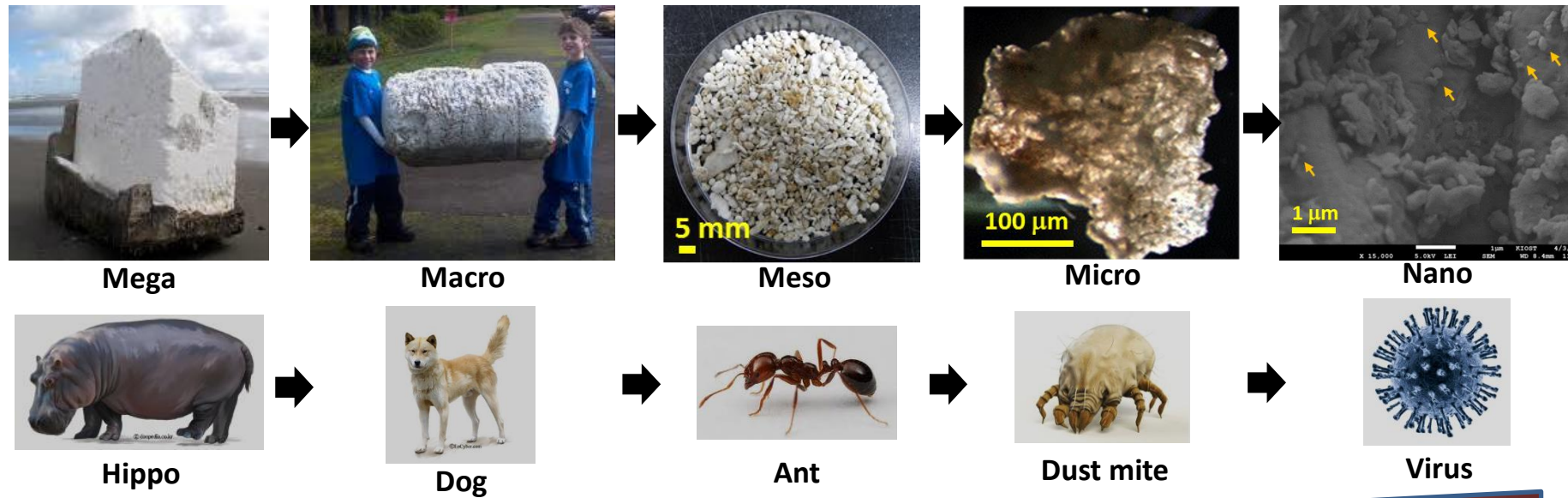
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Microplastics detected in various environmental matrices

Creek water	PE, 211µm	Polyisoprene, 393µm	Polybutadiene, 187µm	Polystyrene butadiene, 161µm	Rubber, 271µm	Polyacrylate, 65µm
WWTP	PP, 395µm	PDMS, 133µm	Polyacrylate, 185µm	PE, 225µm	PA, 582µm	PVC, 120µm
Air	PP, 433µm	PEVA, 1203µm	PVC, 283µm	PE, 127µm	PVA, 85µm	PP, >1mm
Seawater	ABS, 109µm	Polyepoxides, 106µm	Polystyrene copolymer, 130µm	Rubber, 113µm	Polyester, 210µm	PVC, 277µm
Sediment	Polyacrylate, 175µm	PP, 286µm	PP, 126µm	PS, 258µm	PE, 353µm	Polyepoxides, 127µm
Biota	Polyester, 948µm	PP, 102µm	PU, 155µm	Polystyrene butadiene, 155µm	Polyacrylonitrile butadiene, 155µm	Polyacrylate, 209µm

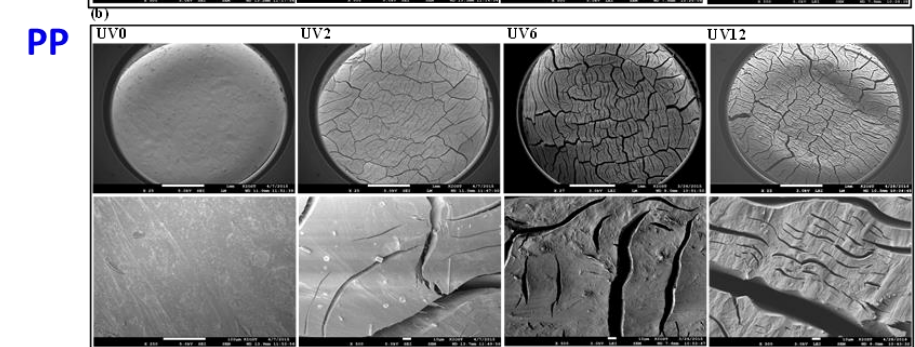
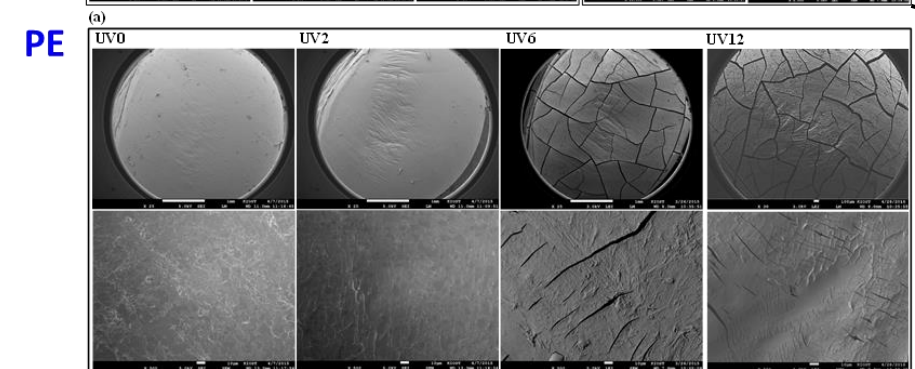
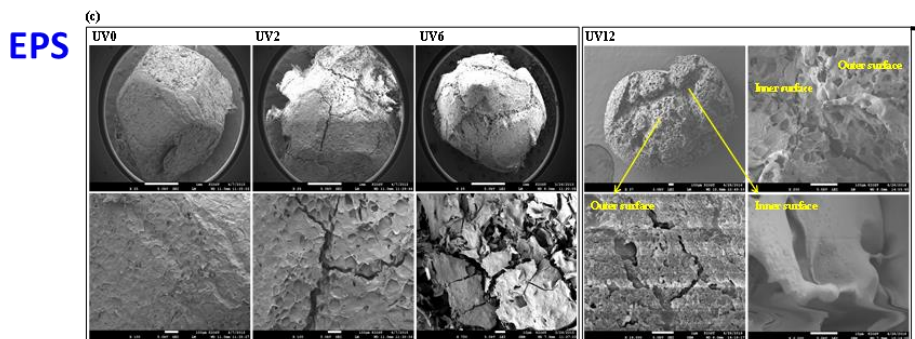
A paradigm shift in marine plastic pollution



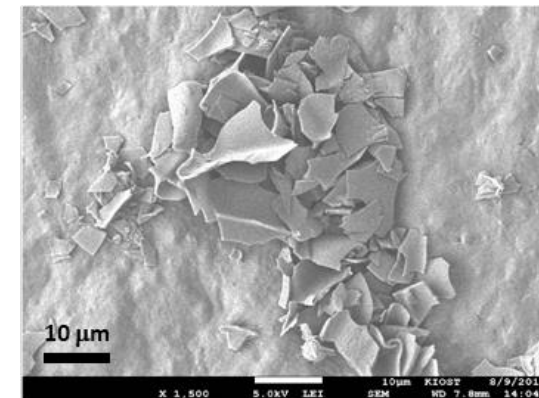
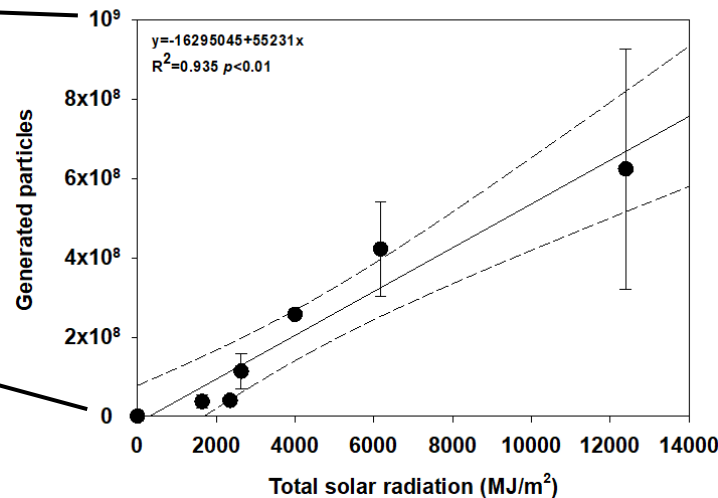
Increasing ...

- Numbers
- Bioavailability
- Target organisms
- Human exposure
- Toxicity
- Detection difficulty
- Cleanup difficulty

Generation of nano- and microplastics by photooxidation



Generated micro & nano particles



- 2.2×10^8 particles/cm² (0.13 μg/cm²) for nanoplastic
- 4.2×10^7 particles/cm² (670 μg/cm²) for microplastic



✓ Volume: 60 L
 ✓ ½ surface area: 7676 cm² x 1/2
 ✓ 3838 cm² x nano-/micro-production rate
 = 8.4×10^{11} nanoparticles/buoy·yr + 1.6×10^{11} microparticles/buoy·yr
 = **1 trillion nano-/microparticles/buoy·yr**

- **Marine environments**

- Coastal sediment and water
- Water column
- Deep sea floor
- Polar seas and ice core
- Organisms (from zooplankton to sea birds and marine mammals)

- **Terrestrial/Freshwater environments**

- River water and sediment
- Freshwater lake
- Soil
- Sewage and wastewater treatment plant
- Organisms (insect larvae, bivalve, and fish)

- **Atmospheric environments**

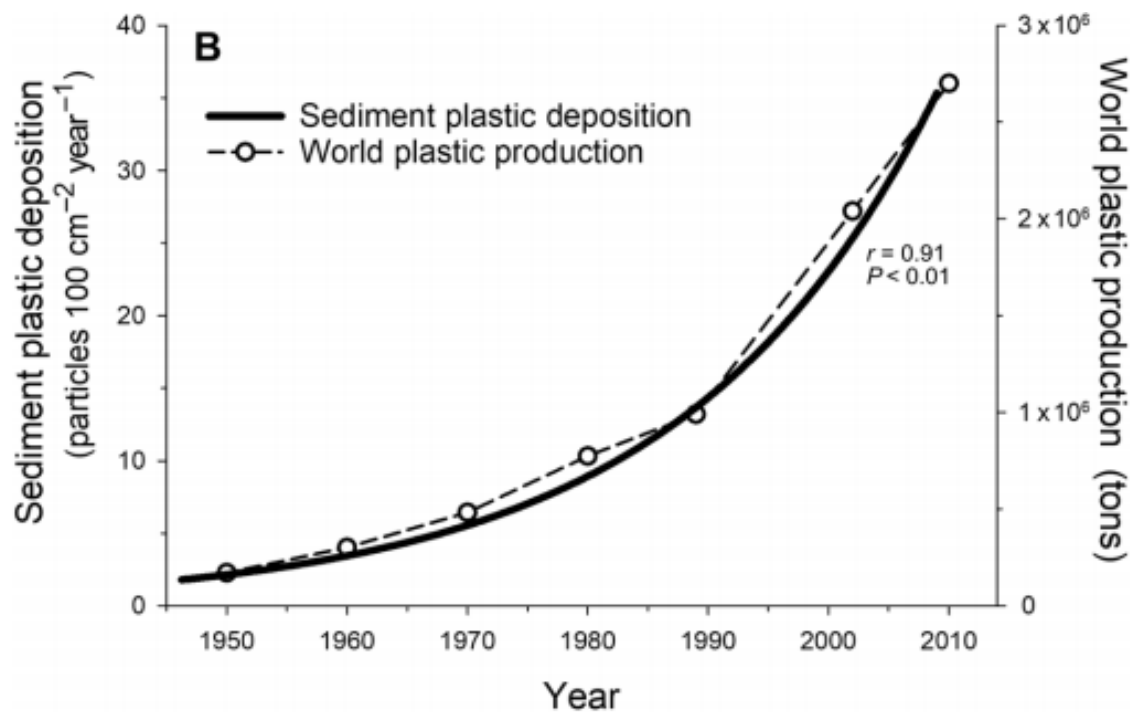
- Indoor and outdoor air

- **Drinking water and food**

- Tap and bottled water, beer, table salts, honey, vegetables, fruits and seafood stuffs, etc

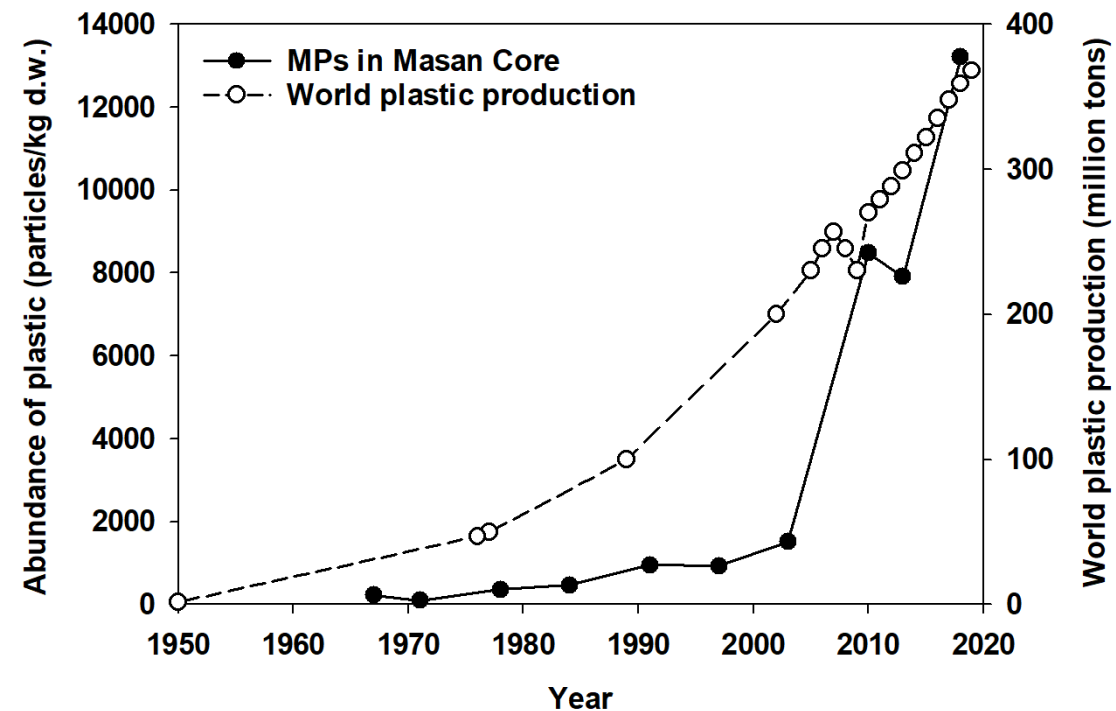
Historical trend of microplastic pollution

North East Pacific Ocean, USA



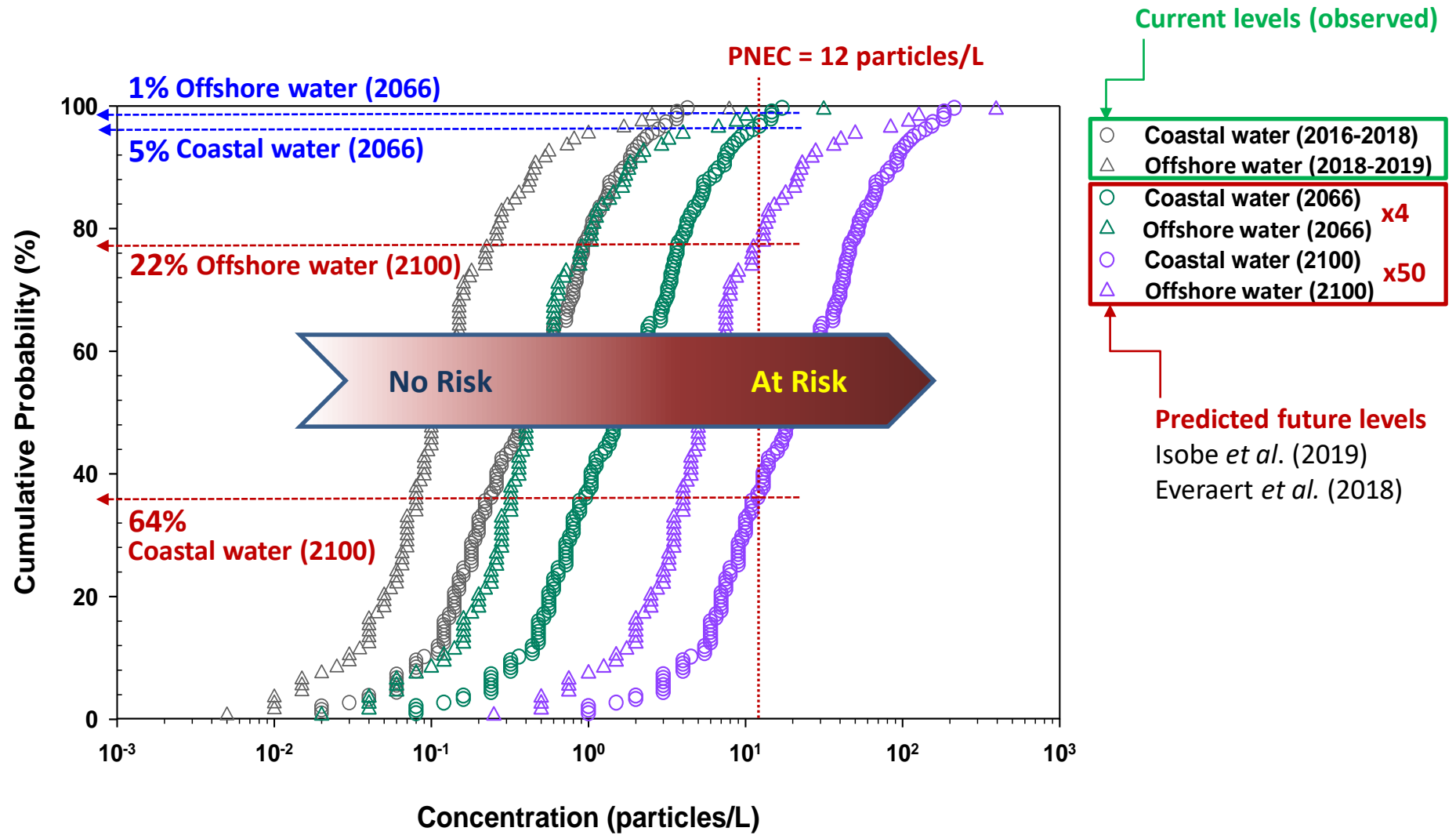
Brandon et al. (2019) *Sci. Adv.* eaax0587

Masan Bay, South Korea



Eo et al. (2023) *Mar. Pollut. Bull.* 193: 115121

Ecological risk of marine microplastics in Korean waters



***PNEC: Predicted No Effect Concentration = 12 particles/L**

We currently eat
a credit card (5 g) per week



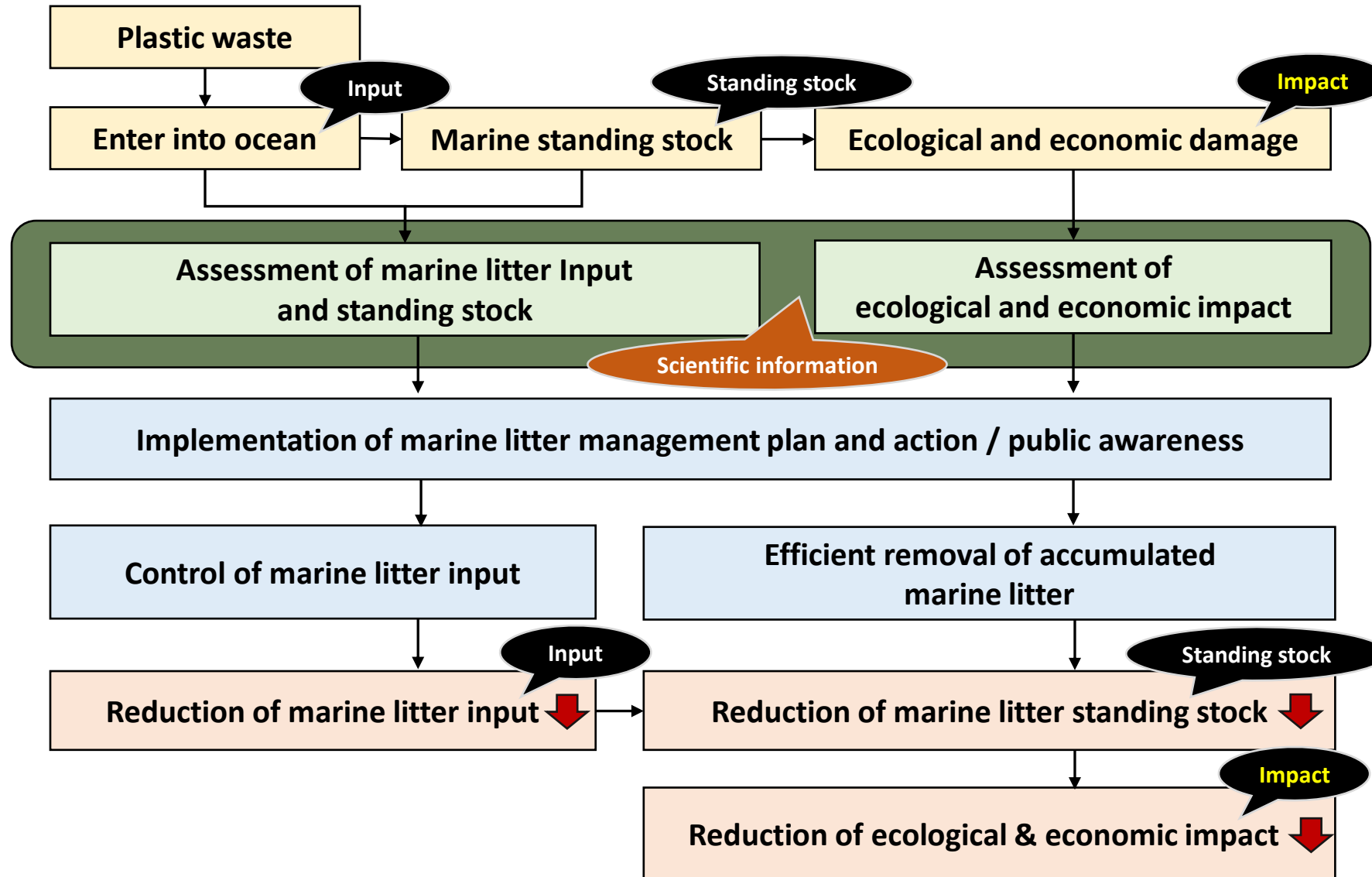
WWF (2019)

Our children and grand children might eat
50 credit cards per week or
2,500 cards per year in 2100



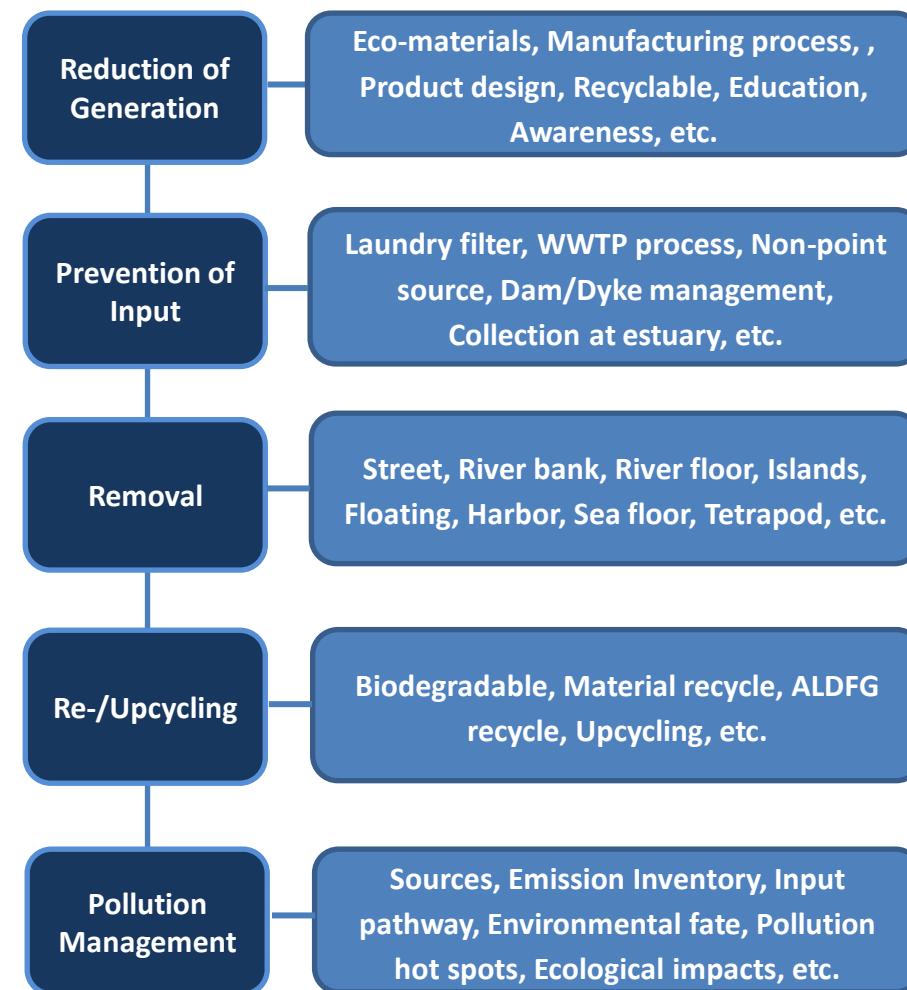
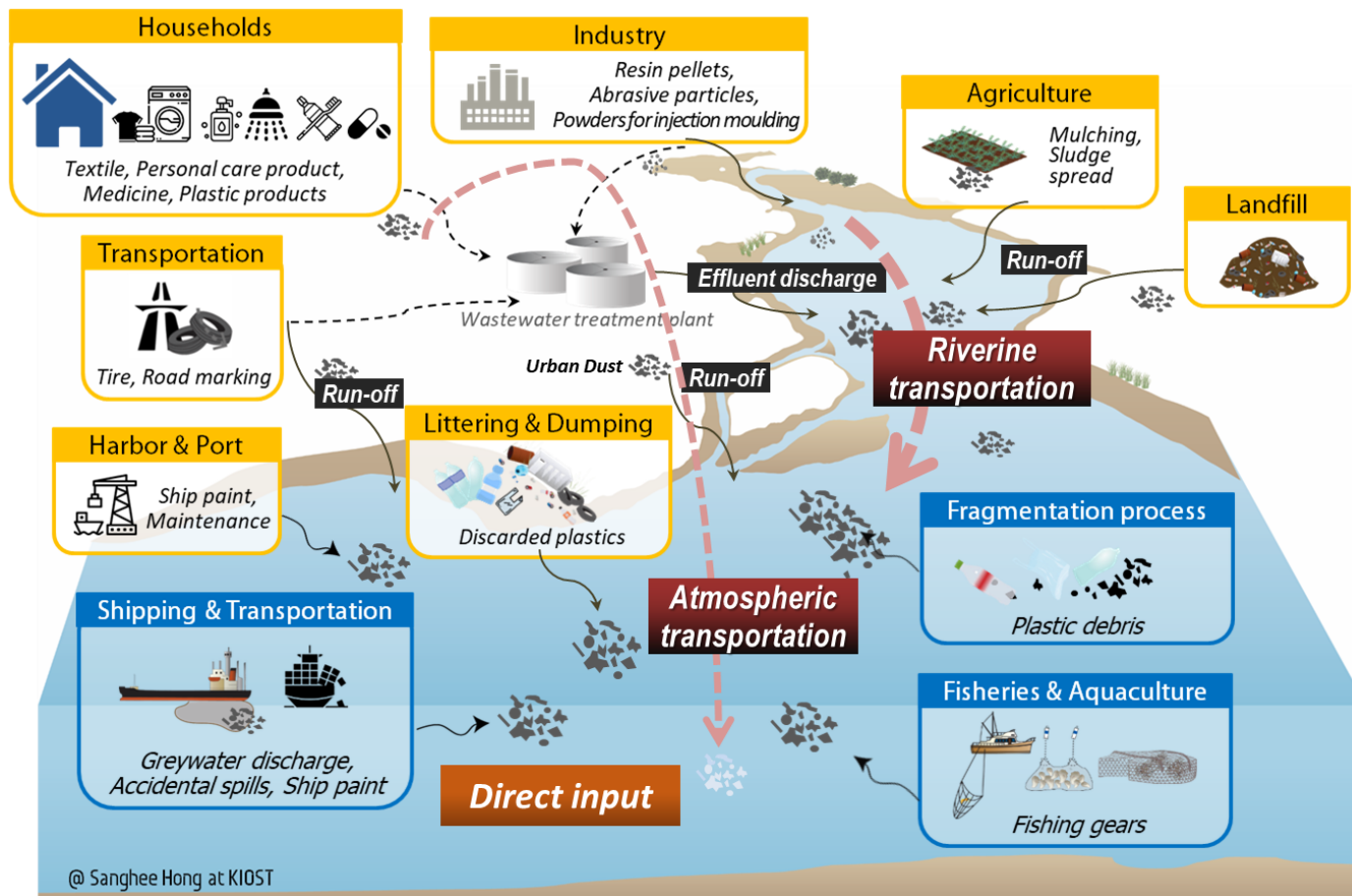
If we keep current increase rate of plastic production (use) and current plastic waste generation rate

Breaking the plastic wave



How does science contribute to break the plastic wave?

The UNEA Resolution (Mar 2022) for **End Plastic Pollution**: Towards a **legally binding instrument**, establishes an INC that will develop the specific content of the new plastic pollution treaty to address the **full lifecycle of plastics**.



Acknowledgement



Ministry of Oceans
and Fisheries

