

+ GREEN SCHOOLS | COVER STORY | SPOOF

gobar times

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A DOWN TO EARTH SUPPLEMENT FOR THE YOUNG AND CURIOUS



THE MICRO MONSTER

*We're facing the danger of **micro-plastic**,
A big quiet ghost, too problematic.
Let's understand its erratic schematic,
And tame its spirit being a green pragmatic.*



INNOVATIVE SOLAR TECHNOLOGIES

Showcasing latest advancements in solar power equipment—flotovoltaics, agrivoltaics, solar vehicles, solar toys and daily products

Neeraj Kumar

What we decide to do today is bound to have an impact on our tomorrow. Therefore, it is up to us to determine the kind of world we want to develop for our future and leave behind for our next generation. We are already witnessing manifold consequences of rising global warming and climate change in the form of extreme weather events. Think about droughts, floods, forest fires, and many such catastrophes.

We all are aware that increasing carbon emissions are largely responsible for disturbing our climate. If we want to reduce these emissions then we will have to replace our fossil fuels with some renewable energy sources on a large scale. Solar power can play a big role in this transformation. According to scientists, our planet will have a steady and unlimited supply of sunlight for the next five billion years. Our atmosphere, barely within an hour, receives enough sunlight to provide for the electricity requirement of each and every person for an entire year!

Till now, we harnessed hardly a fraction of this power using rooftop and ground-mounted installations. However, in the last decade, these equipment have upgraded drastically. Their technologies are demonstrating incredible innovation and versatility so let us take a look at some of these significant developments now.



In India, the Rewa Ultra Mega Solar Limited is entrusted to build a **600 MW capacity** of floating solar project in the Omkareshwar reservoir in Madhya Pradesh. This plant will be India's largest flotovoltaic project and will also be among the **world's largest** floating solar establishments.

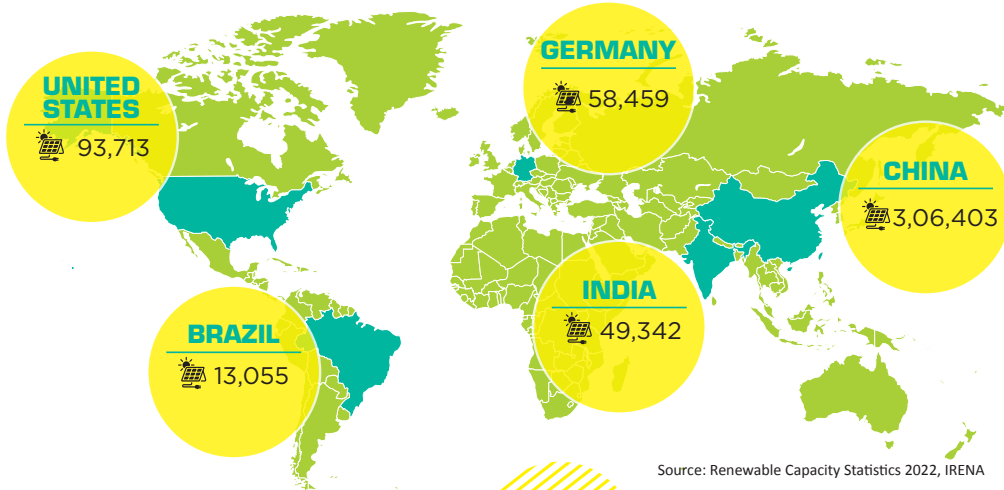
Building-Integrated Photovoltaics

Building-Integrated Photovoltaics (BIPV) is a technology which blends solar panels seamlessly with the architecture of our buildings. The panels are integrated into roofs, canopies, curtain walls, façades, and even skylight systems of different structures. BIPV systems act as both building materials and power generators, which help us save money both on construction and electricity costs. Unlike the conventional solar photovoltaic (PV) apparatuses, the BIPVs are very aesthetically appealing in terms of the design and appearance of a building.



Some countries with their total installed solar photovoltaics, 2021

 Installed solar photovoltaics in Mega Watts (MW)



Source: Renewable Capacity Statistics 2022, IRENA

Flotovoltaics

In the last few years, the prices of silicon panels have reduced a lot, and they have become much cheaper and efficient by day. According to experts, if PV panels are installed on water bodies, they can function much more effectively and provide a plethora of other benefits as well. Thus, floating photovoltaic systems or 'flotovoltaics' are designed to remain afloat over dam reservoirs and lakes. These projects not only reduce our dependency on fossil fuels but also overcome the major land acquisition challenge faced by land-based set-ups.

Agrivoltaics

Agrivoltaics is a technology which combines solar power with agriculture. When the PVs are installed on farmlands, they offer shade to crops, which consequently lose less water due to transpiration. At the same time, they also generate solar power which the farmers can utilise for irrigating and ploughing their fields. In 2017, an agrivoltaic pilot project was initiated by the Central Arid Zone Research Institute in Jodhpur. Another was established in 2021 throughout all the agricultural lands of the Sitapur district in Uttar Pradesh.

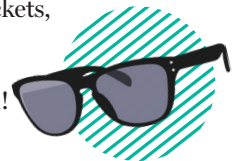
Solar Vehicles

From petrol and diesel based cars to CNG-based buses and electric automobiles, we now have vehicles running on solar. Though this sector is currently in its infancy, it can soon become an option for the future. Solar buses and solar cars are already being considered today.



Solar-Powered Products

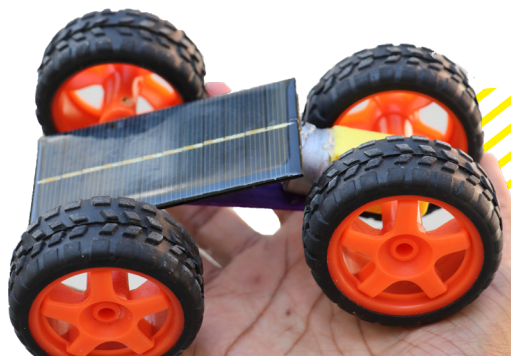
We are already familiar with solar lights and solar water heaters. Their efficiency and cost-effectiveness has made them very popular and hence we now have with us a wide range of daily-use solar products. These include: solar bags, solar jackets, solar chargers, solar emergency lights, solar sunglasses, and solar toy cars. Do check these out and you'd surely like many of them!



India and Solar Energy

In the COP26 in Glasgow, Prime Minister Narendra Modi declared that India would aim to reach the net zero target by 2070. It will do so by increasing its non-fossil energy capacity, i.e., capacity to generate energy from non-fossil fuel sources, to produce 500 GW by 2030. Since solar is the biggest contributor to India's non-fossil fuel sector, or the renewable energy sector, all the above innovations happening in this field will play a major role in fulfilling our national goals.

The author is a Deputy Programme Manager in the Environment Education Unit of the Centre for Science and Environment, New Delhi.



The Mega Problem of Micro Things



An explainer on the what, where, and how of micro-plastics and the pollution they cause.

Siddharth Ghanshyam Singh

What are Micro-Plastics?

Micro-plastics have not been defined in particular. They are just tiny particles that result from the disintegration of bigger plastic materials. However, most researchers say that any plastic smaller than 5 millimetres in size is a micro-plastic. Hence, these are really, really teeny-tiny!

Plastics are made up of polymers, which are derived from fossil fuels. A whole lot of chemicals are added to the polymers—close to 10,000—to ensure that a given plastic has the desired properties. Over 2,500 of these chemicals are known to be toxic, carcinogenic, or have endocrine disruptive properties (Psst: 'Endocrine' refers to the organs present in our body which secrete hormones into the blood; and hormones are substances that control our growth and development). So, therefore, plastics can have a direct and adverse impact our health.

What are the Sources of Micro-Plastics?

Primary sources of micro-plastics are the plastics we use in our daily lives. Right from the mundane plastic toothbrushes that we use first thing in the morning to the plastic water bottles we sip from every now and then, our exposure to micro-plastics is at a macro level! Most significantly, synthetic textiles, like nylon and polyester—think about your swimsuit and almost all the clothes you wear—include plastic fibres. Microbeads found in personal care products, like your body wash and facial scrubs, are also a source. Now, do you want to pause for a moment and check out all the plastic stuff around you? Oops!

A lot of micro-plastic is formed when a large piece of plastic is subjected to heat, temperature, and other physical factors. For example, disintegration of a plastic bottle due to

constant subjection to sunlight and faulty bottling operations generates a lot of micro-plastic. This gets collected in the water inside that bottle and was discovered to be an average of 325 particles per litre, as per a study of the State University of New York at Fredonia, USA. This quantity of micro-plastic is quite considerable when compared to tap water.

Apart from external factors, industrial manufacturing of plastic products—including activities like recycling—may also give rise to micro-plastics.

Why Should We Be Concerned About Micro-Plastics?

● **It is in the food we eat.** Micro-plastics are a concern because of their widespread

presence in our ecosystem. When we throw any plastic garbage indiscriminately into rivers and oceans, it disintegrates over time and becomes micro-plastic. Then, fishes ingest it, confusing it to be a source of food. Birds feed upon these fishes, which in turn are hunted by animals up the food pyramid. Finally, we humans consume such animals and that's how plastic enters our bodies.

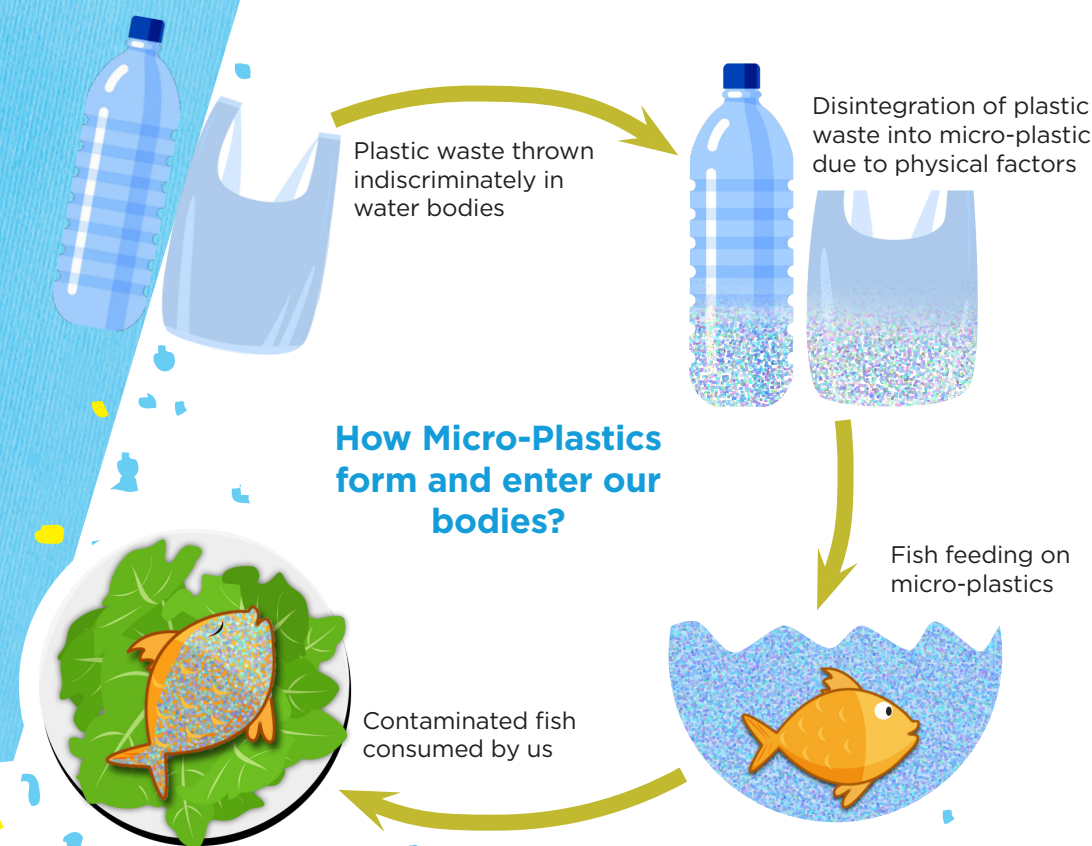
Several research have detected heavy metals, flame retardants, and phthalates—chemical salts containing phthalic acid—posing intense toxicological risks to us. These substances are present in the micro-plastics polluting many marine species, vegetables, fruits, common edible salt, and other regular foods we consume.

Micro-plastics are just tiny particles that result from the disintegration of bigger plastic materials. They are smaller than 5 millimetres in size.

● It is in the air we breathe.

Most of the face masks we wear to protect against the coronavirus are made from non-woven plastic. These masks expose us directly to micro-plastic inhalation. Similarly, all clothes mentioning 'poly-ester' have a considerable amount of plastic. Not just that, your very own acrylic paints and 'plastic' crayons are nothing but an obvious submission to plastic!

In fact, scientists are already



of the opinion that we may be inhaling much more micro-plastics than we are ingesting.

● It is in our bodies.

Continuous exposure to micro-plastics leads to their bioaccumulation and biomagnification within our bodies. Bioaccumulation is simply the gradual accumulation of something inside our bodies. Biomagnification is the accumulation of something to a harmful level inside our bodies. Here, 'something' refers to the toxic elements present in micro-plastics, which are getting collected due to our high intake of contaminated food and water.

In 2019, the World Wildlife Fund for Nature found that we people were consuming about 5 grams of plastic every week, through inhalation and ingestion. This is like feeding upon a plastic credit card per

Bioaccumulation is simply the gradual accumulation of something inside our bodies and biomagnification is the accumulation of something to a harmful level.

week or consuming almost 260 grams of plastic per year.

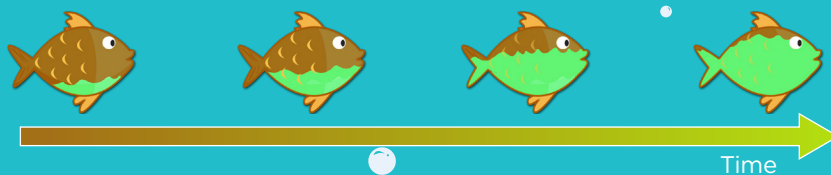
Poly-ethylene terephthalate (PET) and polyethylene are found to be the most common type of micro-plastics present in our blood stream, as per a study published in the *Environment International*, 2022. PET is the plastic that is used to manufacture mineral water bottles, and polyethylene is the plastic from which most of our carry bags and milk packets are made these days.

Though a considerable amount of such chemicals are eliminated by our excretory system, it is alarming to note the extent to which they have infested us. Micro-plastics have already reached the most innocent and vulnerable members of our society—the babies. Baby poop contained traces of micro-plastic in almost 10 times more concentration than adults, as per the body weight and plastic amounts in their faecal samples.

Apart from our stool and blood stream, micro-plastics have also been identified in our lung tissues. According to the *Science of the Total Environment*, 2022, scientists have found micro-plastics penetrating all parts of the lung with significantly higher levels in the lower lung. Studies have shown them damaging our cells, causing both allergic reactions

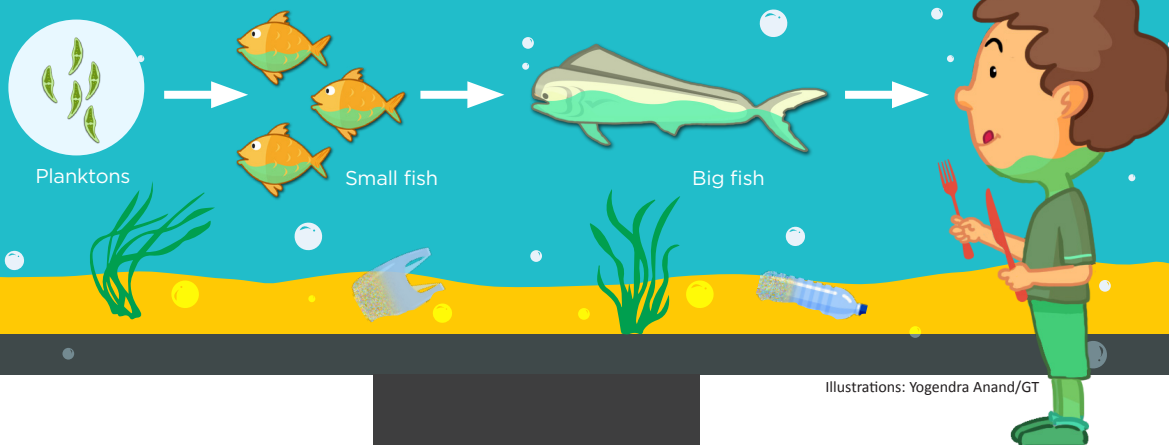
Bioaccumulation

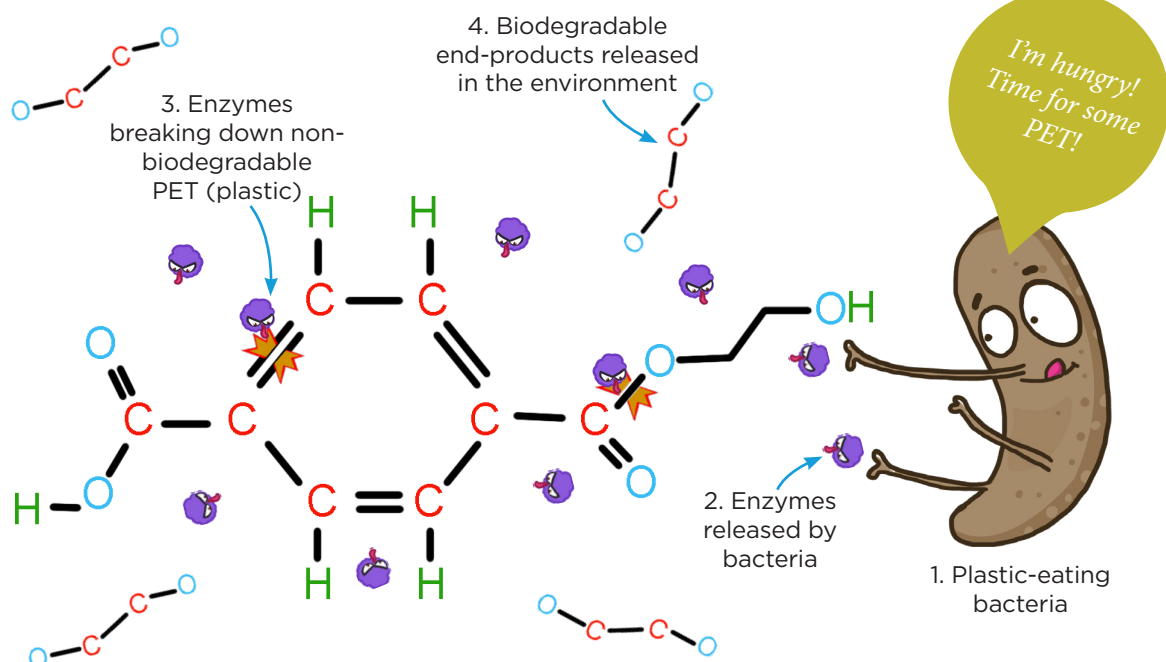
■ Contamination level



Biomagnification

■ Contamination level





Cover Story

and cell deaths. They can also trigger inflammatory or immune responses from our body.

Micro-plastics are now existing in all the biotic and abiotic environments—from across our food chain to the freshly fallen snow in Antarctica this year. Nonetheless, there prevails a knowledge gap on the extent of harm they can cause and how we can keep safe, which need to be filled in as we move ahead.

What is the Way Forward?

The United Nations Environment Programme (UNEP) engaged about a 100 countries in educational campaigns to raise awareness on plastic pollution. Other international cooperative programs were also launched to address marine wastes, particularly micro-plastics. In 2015, the United States passed the Microbead-Free Waters Act, which prohibits the manufacture and distribution

of rinse-off cosmetics products containing plastic microbeads. These products, like face wash, require the user to wash them with water after application. This causes their plastic microbeads to enter our drains and, eventually, spread in the aquatic system. Many countries have already banned such plastic microbeads. No wonder many products often carry the label, 'Microbead-free' these days.

Strategies for remedying micro-plastics include biodegradation using certain bacteria and fungi. A number of microorganisms can breakdown synthetic micro-plastic polymers—such as polystyrene, polyester polyurethane, and polyethylene—into organic stuff. Such microbes can be applied to sewage wastewater to decompose the polluting plastic impurities.

Apart from these scientific solutions, we need better legal policies to arrest this less-spoken pollutant. Unfortunately in

Unfortunately in India, micro-plastic pollution is rarely discussed, which is obvious from the fact that we don't even have any micro-plastic policy as yet!

India, micro-plastic pollution is rarely discussed, which is obvious from the fact that we don't even have any micro-plastic policy as yet! Even when these policy interventions are formulated, they will take time to be effective. Thus, till then, let us find plastic alternatives, study the harmful health impacts of plastics, and manage their waste meticulously. Importantly, identify and eliminate all their unwanted pieces from our lives.

The author is Programme Manager, Municipal Solid Waste department, Centre for Science and Environment, New Delhi.



Human-induced global warming has spurred the frequency of natural disasters in about the past 20 years. Floods, droughts, and severe storms are not new problems but climate change, or the climate emergency, has intensified them both in severity and frequency. Climate change affects all of us in direct and indirect ways. It impacts the spread of diseases, such as malaria and malnutrition, and can contribute to conflict and displacement. Thus, the climate crisis is also a health and humanitarian crisis.