

TerraGreen



VOLUME 15 | ISSUE 4 | July 2022

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Green Hydrogen

Is It a Solution for Net Zero Emission
Need of Our Planet?

TERRA YOUTH

GREEN Quiz

IN CONVERSATION

Frank Kuijpers

General Manager, Corporate Sustainability, SABIC

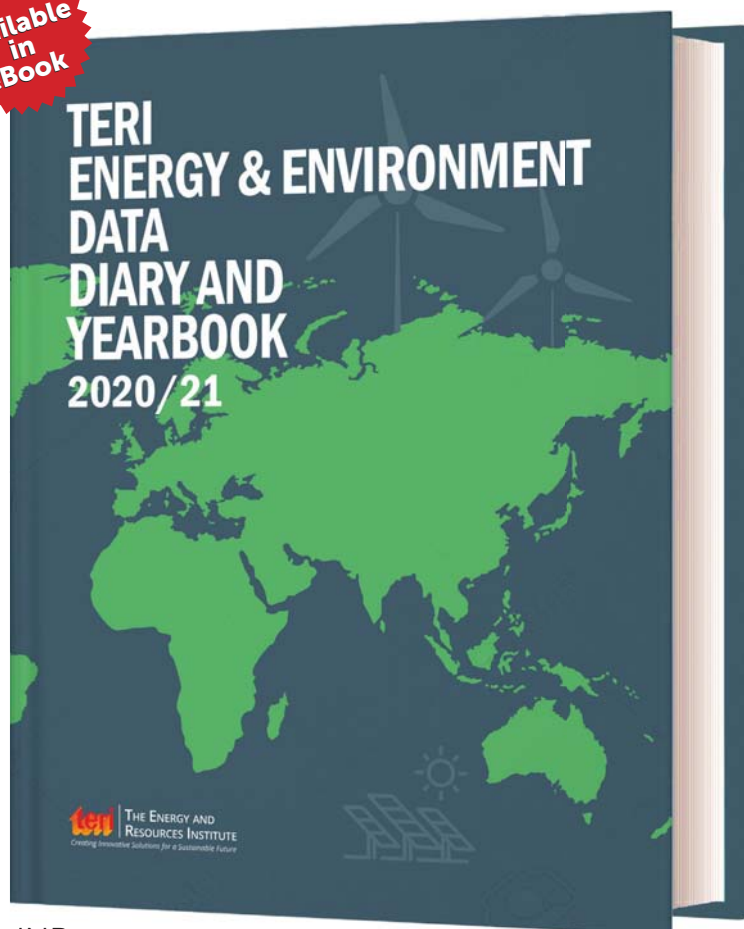
SPECIAL HIGHLIGHTS

Wetlands: Key to Tackling Climate
Change and Biodiversity Loss
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EDITORIAL



“This month’s cover story highlights how the production of clean/green hydrogen gas is being seen as the answer to climate change mitigation in the decades to come.”

After the launch of the National Hydrogen Mission in August 2021, the Government of India announced Green Hydrogen Policy in February 2022. The Policy for meeting the decarbonization goals towards net-zero emissions by 2050 is in line with the UN climate targets of capping the earth’s temperature to 1.5°C as pledged by India and other countries at COP26 summit in Glasgow in November 2021. The Policy comes with a host of benefits for industry leaders keen to install green hydrogen plants and develop its value chain. Quite like how the Indian government’s policies worked in favour of renewable energy sector to develop over the last decade, the following decades are expected to see green hydrogen becoming the key driver to the nation’s economy and to the rest of the world.

This month’s cover story highlights how the production of clean/green hydrogen gas is being seen as the answer to climate change mitigation in the decades to come. Because of its vital role in oil & gas industry, refineries, fertilizers, and a host of other applications as an energy carrier, the world can be made less dependent on fossil fuels. Green hydrogen is produced with clean renewable energy using a process called electrolysis of water and there is no carbon emission during H₂ production. Green hydrogen production is a process of splitting water into hydrogen and oxygen molecules by electrolysis using electricity generated by renewable energy sources such as solar and wind power.

The Green Hydrogen policy aligned towards making India *atmanirbhar* (self-dependent) emphasizes upon green ammonia production with several enablers for development of the industry. Though some deviations are expected from state to state, the key enabler is easy access to grid connectivity in 15 days, which was a major hurdle in the past. Land availability and fast banking approvals in 30 days, the Interstate transmission charges (ISTC) waiver for 25 years for projects commissioned before June 30, 2025 are some of other policy highlights that will help build integrated hydrogen/ammonia production units near the renewables units. The developers will get land allotment in renewable energy parks in the proposed manufacturing zones and bunkers for storage near ports for use by maritime industry or exports. The oil refineries using green hydrogen/ammonia along with natural gas will benefit by way of using the existing pipelines and other infrastructure.

With the onset of Ukraine war, and oil & gas availability becoming tough, need for hydrogen in this scenario appears more immediate than it was in the past few years or decades. Green hydrogen is thus poised to be one of the world’s most tradable commodity in the coming decades.

A handwritten signature in black ink that reads "Vibha Dhawan".

Vibha Dhawan
Director-General, TERI



I liked reading the online issue of the June 2022 issue of *TerraGreen*. Congratulations for the anniversary issue of the magazine. The author of the cover story very rightly highlights how India maintains a cordial balance between its rich traditional heritage and modernity without negatively impacting the environment. But, she also feels that technological advances alone or smart governance alone may not be able to solve the fundamental problem that environmental governance must address. While environmental governance is becoming more comprehensive, it is clear that the path and pace of development are constantly redefining the problems it faces.

Manish Kumar
Kanpur, Uttar Pradesh

The fictional article 'Sunshine' published in the online issue of the June 2022 issue of *TerraGreen* is an excellent read. It is a fictional story with factual information of a girl who devoted her life to the cause of promoting

sustainability, renewable energy use, and safeguarding biodiversity. I also got lot of information on Assam floods from the article published in this issue. As the devastating flood embraces vast areas of Assam (in northeast India) and Bangladesh, the mighty Brahmaputra comes to the focus again as the lone male river after originating in Tibet that flows through both the countries before culminating in the Bay of Bengal. Incessant rains for many days in the third week of June 2022 had inflated all the tributaries of Brahmaputra and it ended up inundating over one million hectares of land affecting millions of people in both the South Asian developing countries.

Aliya Ahmed
Indore, Madhya Pradesh

The Green Quiz published in the June 2022 issue is very informative indeed. In fact, my students have also been participating in the GREEN Olympiad by TERI. This column would help them immensely in preparing for the same. Thanks for this wonderful initiative. I also enjoyed reading other articles published in this issue of *TerraGreen*.

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Published by Dr Ajay Mathur on behalf of The Energy and Resources Institute, Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003. Editor-in-chief Dr Ajay Mathur

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<http://www.terragreen.teriin.org>

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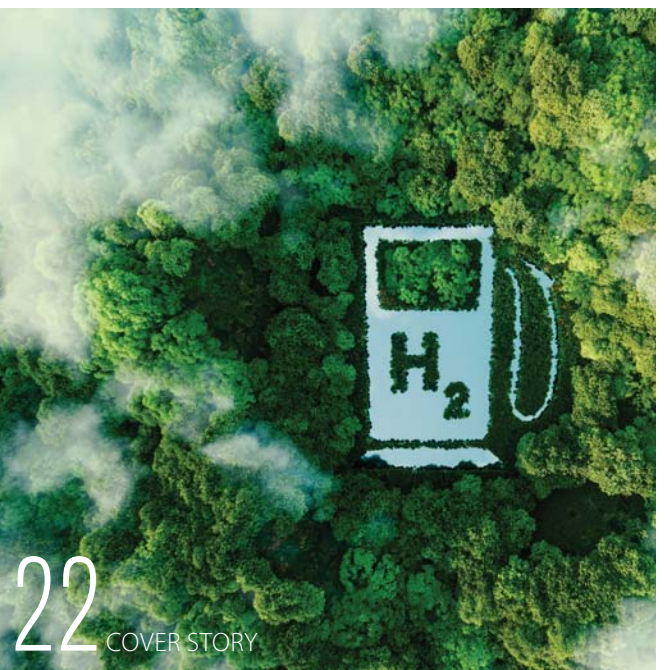
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Delhi's Air, Surface Temperatures Above Baseline Average

Air and surface temperatures in Delhi between March and May this year were significantly higher than the 1981–2010 baseline, and the heat index was well above a more recent 2010–19 threshold, found a study by the Centre for Science and Environment (CSE). The study, "Urban Heat Stress in major cities of India: Delhi" found that the Capital's average air temperature from March to May 2022 (considered the pre-monsoon period) this year was 30.03°C, higher than the 30-year baseline (1981–2010) of 28.25°C, while the average land surface temperature was 1.95°C than its baseline. At the same time, Delhi's heat index (also known as the 'real feel' of the weather) was 30.53°C, higher than the baseline figure of 28.89°C.

Source: <https://www.hindustantimes.com/>

July Rainfall in Rajasthan Highest in Nearly Seven Decades

Rajasthan received 270 mm of rainfall in July 2022, the highest precipitation for the month in nearly seven decades, according to official data. According to the data provided by the meteorological centre in Jaipur, the state recorded a rainfall of 270 mm in July—67 per cent more than the average of 161.4 mm for the month and the highest in nearly seven decades. In 1956, the state had recorded 308.7 mm of rainfall in the month of July. In July 2021, Rajasthan received 130.8 mm of rain. The July rainfall in the state stood at 288 mm in 1908; 281.6 mm in 1943; 270 mm in 2022; 262.3 mm in 2015; and 252.3 mm in 2017.

Source: <https://indianexpress.com/>



Eighty Per Cent Waterbodies in Kerala Contaminated

Coliform bacteria have been detected in almost all waterbodies in Kerala, further establishing the fact that faecal matter continues to pollute canals, ponds and rivers in the state. Coliforms have been found in 80 per cent of around 70,000 water samples collected from canals, ponds and rivers in all local bodies in the state under Thelineerozhukum Navakeralam initiative of Suchitwa Mission. The study shows sewage waste continues to be discharged into waterbodies without any scientific treatment. "Untreated sewage waste reaches canals and rivers through drains. Many houses and institutions directly discharge sewage waste into drains. The septic waste collected from households is also discharged into waterbodies. All these contribute to faecal contamination of waterbodies," a Suchitwa Mission official said.

Source: <https://timesofindia.indiatimes.com/>





World's Largest Floating Solar Power Plant to be Built in Madhya Pradesh

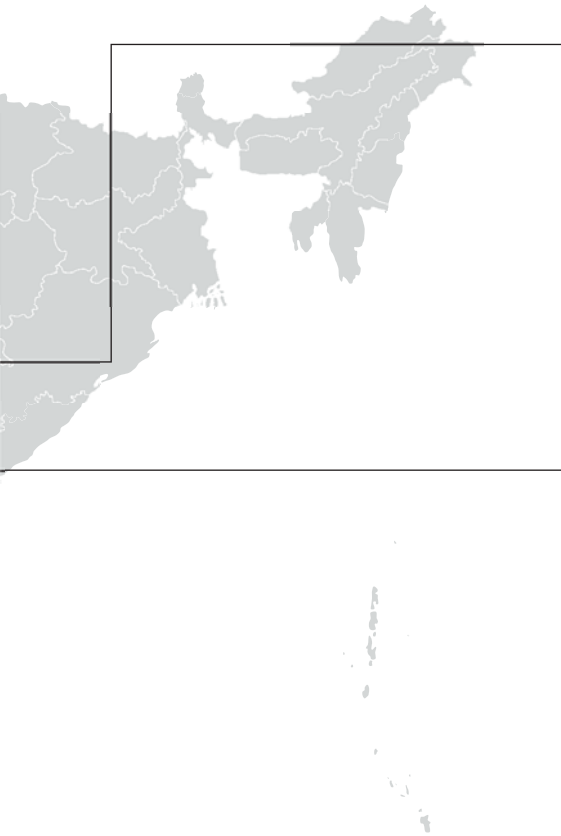
With an aim to increase the power generation capacity of the central state of Madhya Pradesh and address the electricity problems in the region, a floating solar power plant is going to be built in Khandwa which will generate 600 Megawatt power by 2022–23. Said to be the world's largest floating solar plant, the project is estimated to be worth over INR 3000 crore. "Omkareshwar Dam is built on the Narmada river. This is our hydel project and in this, we produce energy from water, but it is spread over about 100 square kilometres, there is a very large water body where the water level remains normal," Renewable Energy Department Principal Secretary, Sanjay Dubey said.

Source: <https://www.business-standard.com/>

1387 Tonnes of E-Waste Piles Up in 5000 Schools Across Karnataka

With technology becoming an integral part of education, e-waste is emerging as a mounting problem for several schools. According to the department of public instruction, there are around 1387 tonnes of e-waste lying in 5000 schools across Karnataka. The department of state education research and training has decided to call tenders for disposing of this waste. The highest bidder will get the waste which are mostly desktops, projectors, and lead acid batteries. Since the department introduced computer education in 2000–01, many of its schools were equipped with computers, thin clients, UPS systems with lead acid batteries, projectors, printers/multi-function devices, modems, etc., for technology-assisted learning.

Source: <https://timesofindia.indiatimes.com/>



NTPC's 100 MW Floating Solar Project Becomes Fully Operational in Telangana

NTPC has recently said its 100 MW floating solar photovoltaic project in Telangana has become fully operational. "Consequent upon successful commissioning, last part capacity of 20 MW out of 100 MW Ramagundam floating solar PV project at Ramagundam, Telangana is declared on commercial operation with effect from 00:00 hours of 01.07.2022," it said in a BSE filing. With this, the standalone installed and commercial capacity of NTPC has become 54,769.20 MW, while group installed and commercial capacity is 69,134.20 MW.

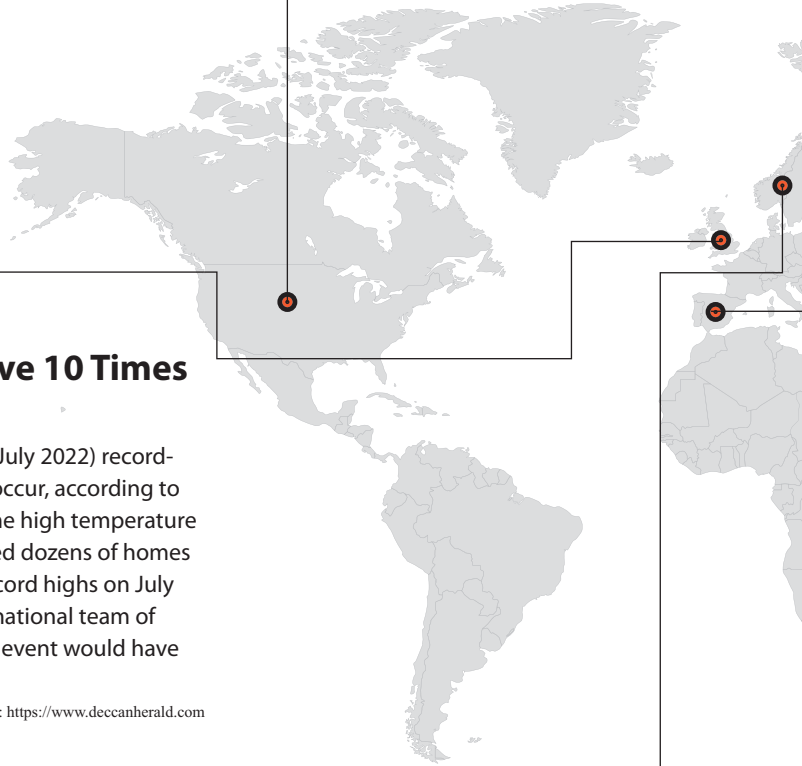
Source: <https://www.business-standard.com/>



Green Tea Extract Promotes Gut Health, Lowers Blood Sugar

New research in people with a cluster of heart disease risk factors has shown that consuming green tea extract for four weeks can reduce blood sugar levels and improve gut health by lowering inflammation and decreasing 'leaky gut.' Researchers said this is the first study assessing whether the health risks linked to the condition known as metabolic syndrome, which affects about one-third of Americans, may be diminished by green tea's anti-inflammatory benefits in the gut. "There is much evidence that greater consumption of green tea is associated with good levels of cholesterol, glucose and triglycerides, but no studies have linked its benefits at the gut to those health factors," said Richard Bruno, senior study author and professor of human nutrition at The Ohio State University.

Source: <https://www.sciencedaily.com/>



Climate Change Made Britain Heatwave 10 Times More Likely

Climate change caused by human activity made this month's (July 2022) record-shattering heatwave in Britain at least 10 times more likely to occur, according to research released recently. Eastern England recorded an all-time high temperature of 40.3°C (104.5°F) and the hot spell sparked fires that destroyed dozens of homes in London. Overall, at least 34 locations in Britain registered record highs on July 20, when the heatwave peaked over Western Europe. An international team of researchers modelled how likely such an extreme hot weather event would have been before the industrial era began in the mid-19th century.

Source: <https://www.deccanherald.com>

Forever Chemicals in Rainwater Exceed Safe Levels

New research shows that rainwater in most locations on the Earth contains levels of chemicals that 'greatly exceed' safety levels. These synthetic substances called poly- and perfluoroalkyl substances (PFAS) are used in non-stick pans, fire-fighting foam and water-repellent clothes. Dubbed 'forever chemicals', they persist for years in the environment. Such is their prevalence now that scientists say there is no safe space on Earth to avoid them. The researchers from Stockholm University say it is "vitally important" that the use of these substances is rapidly restricted. Scientists fear PFAS may pose health risks including cancer, though research has so far been inconclusive. They have been growing increasingly concerned about the proliferation of PFAS in recent years.

Source: <https://www.bbc.com/news>





Neglected Forests at the Mercy of Wildfires in Spain, Portugal

With climate change making devastating wildfires more likely, experts warn Spain and Portugal need to better manage their forests to stop vast swathes of land from being torched every year. Close to 200,000 hectares (495,000 acres) of forest in Spain have been lost to fire so far this year, more than in any other nation in Europe, according to the European Union's satellite monitoring service EFFIS. Portugal has lost just over 48,000 hectares to flames, the third highest amount in Europe that is only surpassed by Romania. The spread of wildfires depends on the weather, the type of vegetation and the topography of the land, said Monica Parrilla, a forest campaign manager with Greenpeace Spain.

Source: <https://www.deccanherald.com/>



First Global Map of Cargo Ship Pollution Reveals Effects of Fuel Regulations

A new study used satellite data from 2003–2020 to determine the effect of fuel regulations on pollution from cargo ships. The research team's data revealed significant changes in sulphur pollution after regulations went into effect in 2015 and 2020. Their extensive data set can also help scientists determine the extent of the cooling effect of particulate matter when it interacts with clouds. The role of clouds continues to be one of the biggest uncertainties in climate models.

Source: <https://www.sciencedaily.com/>

Global Forest Area Per Capita has Decreased by Over 60 Per Cent

Over the past 60 years, the global forest area has declined by 81.7 million hectares, a loss that contributed to more than 60 per cent decline in global forest area per capita. This loss threatens the future of biodiversity and impacts the lives of 1.6 billion people worldwide, according to a new study published in the journal *Environmental Research Letters*. The research team used global land use dataset to examine how global forests have changed over space and time. Consequently, the decline in global forests over the 60-year period has resulted in a decrease of the global forest area per capita by over 60 per cent.

Source: <https://www.sciencedaily.com/>



Shopping Reinvented

Zero-Waste Stores

The concept of zero-waste stores with packaging materials alternative to plastics has emerged as an innovative mechanism to overcome the problems associated with single-use plastic (SUP) waste. These stores aim to minimize plastics and non-biodegradable packaging material, which may otherwise find its way into the environment impacting both human and environmental health, says **Sukrit Joshi**.

Shanmughan, realizing that he had finished with rice at home, got up from his seat, picked up his grocery bag and left for the local kirana store. While leaving the room he saw the plastic packaging of the leftovers from the party last night... The plastic heap from last night's party was overwhelming. He proceeded with a deep sigh of despair.

The above imagery, perhaps, all of us identify to some extent. The Ghazipur landfill, which has now gained a height of 65 metres, frequently catching fire, is dangerous to human and environmental health. It has resulted in the air quality dipping from 'moderate' to 'very poor.' One of the major contributions to these landfills are plastics. It is estimated that the country generates 3.5 million tonnes of plastic waste annually, with per-capita waste generation almost doubling in the last five years.¹ Out of the total plastics manufactured in India, 43 per cent is used for packaging purpose.² To tackle the menace of plastic packaging in the country, consumer behaviour needs

to be shaped to incorporate a zero-waste approach to shopping that could discourage single-use plastics (SUPs).

The concept of zero-waste stores with packaging materials alternative to plastics has emerged as an innovative mechanism to overcome the problems associated with SUP waste. These stores aim to minimize plastics and non-biodegradable packaging material, which may otherwise find its way into the environment impacting both human and environmental health. The necessity of reducing plastic consumption in the supply chain, especially SUPs, has already prompted the global community to adopt these stores in Europe and the USA. This is evident from a large number of physical and online stores across the continents, who have amassed a loyal clientele committed to practising a more sustainable, eco-friendly lifestyle. The increasing demand for both sustainable products and a plastic free packaging culture is revolutionizing retail business in the region. Ironically, these stores are not a new concept in India, wherein traditional-local grocery stores commonly referred to as 'kirana' stores in North India, the vegetable street hawkers and the local 'bazaars', were practitioners of this lifestyle. Plastic packaging was



◀ ZERO WASTE SHOP ▶

absent in the production and distribution chain forcing shoppers to carry their own cloth bags to the shop. Discarded clothing, linen and other fabrics were recycled into convenient carry bags, which was the norm. This norm was however, replaced with low cost, durable, and long-lasting plastic alternatives. The flooding of e-retailers, dependent on the plastic packaging, further aggravated the situation, thereby transforming the production and consumption lifestyle from a zero-waste into a plastic waste generating one. However, a silver lining in the historical development of packaging is the gradual increase in

¹ India generates 3.5 million tonnes plastic waste annually: Environment Minister - The Economic Times

² Fact Sheet on plastic waste in India World Environment Day - The Energy and Resources Institute (TERI)

conscious shoppers who have been able to create a demand for such stores in the country. These stores have replaced plastics with sustainable alternate packaging materials made of paper and cloth-based packaging bags and jute bags. They promote reusable containers, like reusable glass jars, metal canisters, and coconut bowls, for storing grains in place of plastic laminated packaging materials. Using paper-based labels and tapes instead of laminated packaging materials contributes to zero-waste in entirety. Encouraging customers to bring their own reusable packaging to the store by incentivizing them has helped in generating awareness as well as marketing their business successfully.

In an ideal scenario, these stores have a potential to create a zero-waste shopping ecosystem. It aligns with the government's target to ban SUP products, especially plastic-based wrapping and packing films while encouraging eco-friendly, locally sourced, organic and sustainable products. However, in practice they suffer from many operational, financial, and market-related hurdles. They range from accessing appropriate finance to logistics, supply chain management issues and developing skilled human capital at each stage of the supply chain. These challenges have stemmed from supply side wherein managing supply chain logistics is a major challenge for zero-waste stores especially when most of these are small retailers, to the demand side, wherein there exists a lack of awareness among the average consumer, who prioritizes pricing, convenience and ease of access to products instead of adverse effects of SUP waste.

The impacts of these challenges on promotion of zero-waste stores are three-folds. Firstly, owners and promoters of such stores, who are also social entrepreneurs, struggle to develop these stores at the start-up stage. As operational and logistical costs mount at the beginning, the stores find it difficult to narrow the demand and supply



gap. Secondly, these stores struggle to diversify and upscale. As a result, they struggle to create profits, and end up depleting their savings becoming vulnerable to abrupt events such as COVID-19 leading to closure of their businesses. Thirdly, a successful store may not be able to replicate its business operations in a new environment as demand side issues and a lack of technological support, may multiply costs and affect its business, resulting in hyper-localized operations within the city. Needless to say, the government must encourage social entrepreneurship by way of assisting replication and scaling up of these stores throughout the country. Having said that, targeting resource efficiency and a zero-waste supply chain from procurement to managing waste generated at the end-of-life requires a considerable amount of deliberation and action from each and every stakeholder in the supply chain. This involves improving market access to sustainable packaging materials, facilitating human skill development to ensure zero-waste generation at each stage of the value chain, providing access to both financial and infrastructure-

related support to diversify store operations and, access to technological products to digitize its operations as well as compete with e-commerce retailers. The Indian pollution regulator, Central Pollution Control Board's (CPCB), recent announcement to ban identified SUPs by June 30, 2022 as part of India's commitment to phase out SUPs is a step in the right direction to encourage consumer to adopt a zero-waste lifestyle consisting of a zero-waste shopping experience.³ There is an enormous potential for zero-waste stores catering to a market as big as ours, to create a demand for responsible consumption and production, and paving the way for achieving UN SDG-12, by substantially reducing plastic waste generation by 2030. ■

Sukrit Joshi is a Consultant at The Energy and Resources Institute (TERI), working in the area of Waste Management and Smart Agriculture.

³ PHASING OUT SINGLE USE PLASTICS- What not to be used? As per amendment PWM Rules notified by the MoEFCC on August 2021

How Pandas Survive Solely on Bamboo

Evolutionary History

An ancient fossil reveals the earliest panda to survive solely on bamboo and the evolutionary history of panda's false thumbs.

When is a thumb not a thumb? When it is an elongated wrist bone of the giant panda used to grasp bamboo. Through its long evolutionary history, the panda's hand has never developed a truly opposable thumb and instead evolved a thumb-

like digit from a wrist bone, the radial sesamoid. This unique adaptation helps these bears subsist entirely on bamboo despite being bears (members of the order carnivora, or meat-eaters). In a new paper published in *Scientific Reports*, the Natural History Museum of Los

Angeles County's Curator of Vertebrate Paleontology Xiaoming Wang and colleagues report on the discovery of the earliest bamboo-eating ancestral panda to have this 'thumb.' Surprisingly, it is longer than its modern descendants.

While the celebrated false thumb



in living giant pandas (*Ailuropoda melanoleuca*) has been known for more than 100 years, how this wrist bone evolved was not understood due to a near-total absence of fossil records. Uncovered at the Shuitangba site in the City of Zhaotong, Yunnan Province in south China and dating back 6–7 million years ago, a fossil false thumb from an ancestral giant panda, *Ailurarctos*, gives scientists a first look at the early use of this extra (sixth) digit and the earliest evidence of a bamboo diet in ancestral pandas—helping us in better understanding the evolution of this unique structure.

“Deep in the bamboo forest, giant pandas traded an omnivorous diet of meat and berries to quietly consuming bamboos, a plant plentiful in the subtropical forest but of low nutrient value,” says NHM Vertebrate Paleontology Curator Dr Xiaoming Wang. “Tightly holding bamboo stems in order to crush them into bite sizes is perhaps the most crucial adaptation to consuming a prodigious quantity of bamboo.”

How to Walk and Chew Bamboo at the Same Time

This discovery could also help solve an enduring panda mystery: why are their false thumbs so seemingly underdeveloped? As an ancestor to modern pandas, *Ailurarctos* might be expected to have even less well-developed false ‘thumbs,’ but the fossil Wang and his colleagues discovered revealed a longer false thumb with a straighter end than its modern descendants’ shorter, hooked digit. So why did pandas’ false thumbs stop growing to achieve a longer digit?

“Panda’s false thumb must walk and ‘chew,’” says Wang. “Such a dual function serves as the limit on how big this ‘thumb’ can become.” Wang and his colleagues think that modern panda’s shorter false thumbs are an evolutionary compromise between the need to manipulate



bamboo and the need to walk. The hooked tip of a modern panda’s second thumb lets them manipulate bamboo while letting them carry their impressive weight to the next bamboo meal. After all, the ‘thumb’ is doing double duty as the radial sesamoid—a bone in the animal’s wrist.

“Five to six million years should be enough time for the panda to develop longer false thumbs, but it seems that the evolutionary pressure of needing to travel and bear its weight kept the ‘thumb’ short-strong enough to be useful without being big enough to get in the way,” says Denise Su, associate professor at the School of Human Evolution and Social Change and research scientist at the Institute of Human Origins at

Arizona State University, and co-leader of the project that recovered the panda specimens.

“Evolving from a carnivorous ancestor and becoming a pure bamboo-feeder, pandas must overcome many obstacles,” Wang says. “An opposable ‘thumb’ from a wrist bone may be the most amazing development against these hurdles.” ■

The authors of this article are affiliated with the Natural History Museum of Los Angeles County, Los Angeles, CA, USA; Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; Arizona State University, Tempe, Arizona, USA; Pennsylvania State University, University Park, Pennsylvania, USA; Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming, Yunnan, China; Yunnan Institute of Cultural Relics and Archaeology, Kunming, Yunnan, China; Harvard University, Cambridge, Massachusetts, USA.



A person is silhouetted against a bright orange sunset sky, standing in a small boat on a vast wetland. The water is calm, reflecting the warm light. In the foreground, several thin, dark reeds or stalks rise from the water. The background shows a flat expanse of water extending to the horizon.

Wetlands

Key to Tackling Climate Change and Biodiversity Loss

At the end of June 2022, we saw the breakdown of the discussions of the Open-Ended Working Group for the Post-2020 Global Biodiversity Framework (GBF), which have been tasked with advancing preparation of the GBF. Very little consensus was reached on clear, meaningful targets for protecting and restoring global biodiversity. As we approach CBD COP15 in December, during which the GBF will be finalized for the next decade, we must see a concerted increase in ambition if we are to avert catastrophic harm to nature and exponential loss of biodiversity over the coming decades. And this ambition must inspire the global community to tackle the rapid decline in wetlands. Keep reading to know more...



A peat bog in Chandertal

In global discussions around nature, much is made of the land-sea binary, with targets focused around one or the other. That has led many of us to question: where are wetlands in this framework? As the interface between land and water, wetlands fit comfortably into neither category. At the same time, they are crucial ecosystems for life on this planet, supporting a staggering proportion of global biodiversity, and giving security to over one billion people. Wetlands are not just habitats, they are biomes. Despite this, the current iteration of the GBF fails to mention wetlands in the main text, and contains no explicit targets on their management or restoration.

This is a huge oversight. While covering only 6 per cent of the planet, a staggering 40 per cent of the world's plants and animals make their homes in wetlands, and every year 200 new species are discovered in freshwater wetlands. Over one million threatened species of plants and animals depend on wetlands for their survival. The intrinsic

value of wetlands for the communities that depend on them cannot be overstated. Wetlands are relied upon for storing, filtering and delivering water, protecting coasts, and capturing and storing significant levels of carbon. Despite this, wetlands are disappearing three times faster than forests, with over a third of global wetlands lost since

1970. It is apparent that without shining the spotlight on wetlands, the world cannot aspire to 'bend the biodiversity curve'. Yet, wetlands are being pushed to the margins, and the fatal mistake of grouping them with targets for the land and sea done under the Aichi Targets continues. We need to change this in the Post-2020 GBF.



A fisher at Kanwar Taal in Gandak-Kosi landscape, Bihar

Without clear and specific targets on protecting and restoring wetlands, not only will we lose the benefits we already receive from these ecosystems, we also risk plunging deeper into crisis. Given their effectiveness in sequestering and storing carbon, wetlands are a potentially deadly source of carbon should we allow them to be degraded and destroyed. Peatlands alone, for example, hold 30 per cent of all carbon stored on land—roughly twice the amount stored in the world’s forests despite comprising just 3 per cent of the global land surface—and intact mangrove swamps hold four times more carbon per hectare than rainforests. That’s before we consider the methane stored within Arctic wetlands, which is likely to be released more readily as the planet warms and permafrost melts. It is indisputable that without setting specific targets to protect wetlands, we will be fighting a losing battle when it comes to meeting global targets for climate mitigation.

Simultaneously, we are at a critical point for global biodiversity. Currently, one quarter of plant and animal species are threatened with extinction, and it is estimated that humans have caused the loss of 83 per cent of all wild animals



and half of all plants. These losses are devastating for countless reasons, not least because of the intrinsic value of nature. On a more practical level, there is a clear economic argument for halting and reversing nature loss, with the World Economic Forum revealing that over half of global GDP is threatened by biodiversity loss and the destruction of nature.

Meanwhile, coastal wetlands such as mangroves are among the most

biodiverse ecosystems on Earth.

According to the UN there are over 40 birds, 10 reptiles, 1 amphibian, and 6 mammal species that are only found in mangroves, and the ecosystems support more than 3000 species of fish. Coral reefs—perhaps less likely to be universally understood as a wetland—boast more species per unit area than any other marine ecosystem, and support an estimated 25 per cent of all marine life. This includes 4000 species of fish, 800



species of hard corals, and over 1 million species of other animals.

Which brings us back to COP15. As the make-or-break talks draw ever closer, Wetlands International is calling for specific global wetland targets for the next decade in order to ensure the protection and restoration of wetlands, and thus a liveable future for all. We are proposing five global, habitat-based targets, based on the best available science, that reflect the scale of change needed to improve ecological and social resilience:

1. The remaining undrained peatland carbon stores remain intact, and 10 million hectares of drained peatland are restored by 2030.
2. A net gain of 20 per cent in global mangrove cover by 2030.
3. Remaining free-flowing rivers and



- floodplains are preserved and river connectivity is enhanced, restoring floodplain ecosystem functionality and area by 2030.
4. A net gain of 10 per cent in the area of tidal flats by 2030.
 5. Fifty per cent of the estimated 7000 critically important sites identified along flyways come under favourable

management by 2030. The targets are ambitious, but they are achievable with collaboration and commitment from global actors. Existing projects across the world—including here in India—show the potential for sustainable and regenerative management of wetland ecosystems.



Working towards Vibrant Wetlands in Mahanadi Delta and Kosi–Gandak Floodplains

The Mahanadi delta and Kosi–Gandak floodplains are home to more than 21 million people. The delta is the ecological and socio-economic hub of the state of Odisha; supporting more than one-third of its population, 68 per cent of which are farmers. The region is also home to diverse wildlife, from birds to dolphins and turtles.

Each year, the Mahanadi delta and Kosi–Gandak floodplains are ravaged by floods. Previously, the wetlands served as a buffer for excess flood waters, as well as acting as water reservoirs during dry periods. Yet, hard infrastructure—built as a short-term solution for flooding—has disrupted natural linkages between wetlands and water. Altogether, alterations in natural water flows, environmental damage and the climate crisis have increased the frequency and intensity of weather-related disasters for local communities.

The delta is marked with persistent water logging, low agricultural productivity, loss of migratory fisheries, declining incomes, social conflicts, migration and health hazards due to

limited availability of safe drinking water and sanitation.

In response, Wetlands International is working to restore the wetland ecosystem and support the vulnerable communities in the delta to adapt to climate change and bounce back when floods occur. Through our advocacy, we have provided an ecosystem management framework—implemented at two sites—to reduce disaster risk, along with placing resilience at the core of management efforts. We have brought wetland conservation to the core of resilience building, by enabling rejuvenation and integrated management through an inclusive and stakeholder driven process. The ecological rejuvenation of Chilika is a testimony of collective efforts of government, civil society and research organizations to bring a dying wetland back to vibrancy, thus securing habitats of numerous species, including the endangered Irrawaddy Dolphin, and sustaining livelihoods of 200,000 fishers.

Conserving High Altitude Himalayan Wetlands

Nested in the Himalayas between the treeline and the permafrost, the high-

altitude wetlands play a significant role in providing water, food and climate security and cultural identity to the entire Indian Himalayan region, and beyond. These wetlands sustain biological diversity by providing crucial habitats to a range of species, including migratory birds, which depend on these ecosystems to complete their annual sojourn between the tropics and the temperate regions. Ensuring that these wetlands are well conserved is an imperative for sustainable development.

High altitude wetlands are highly sensitive and fragile ecosystems. Regional climate change is leading to rapid and fundamental changes in these ecosystems. Such changes are amplified by human activity such as agriculture, unregulated tourism and related pollution, and overgrazing.

Wetlands International is working with Himalayan states, United Nations Development Programme, the Ministry of Environment, Forest and Climate Change and local communities to create integrated management plans. These plans address the anthropogenic drivers of wetland degradation, such as tourism and grazing, and integrate climate risks.

We have a Once-in-a-lifetime Opportunity

The GBF is a vital window for the global community to set a nature positive path— with significant impacts on plans, programmes and investments at all levels. Putting wetlands within this framework would be an important policy signal from decision-makers that they recognize the criticality of wetlands in halting and reversing biodiversity loss and are prepared to act on it. We must therefore do everything in our power to make sure the importance of wetlands is recognized in Montreal later this year and beyond. Our future depends on it—and we at Wetlands International are watching with bated breath. ■

Op-ed by Ritesh Kumar, Wetlands International.





SABIC

Envisioning a True Circular Economy for Plastic

Frank Kuijpers is General Manager, Corporate Sustainability, SABIC. Here we are in conversation with him for *TerraGreen* magazine.

How is SABIC viewing its operations and products through a sustainable lens? What is SABIC's sustainability focus within the 2025 structure?

Sustainability is a core business driver for SABIC. We are a forerunner in efforts to transform low quality, mixed plastic waste otherwise destined for incineration or landfill into high quality and safe consumer packaging for food, beverage, personal, and home care products. We launched certified circular polymers to be used in packaging solutions for a

variety of consumer products that have now been introduced into the market for more than 2 years.

At SABIC, we are already contributing to the circular economy and climate change mitigation through a range of solutions developed by our teams, including plastic chemical recycling, renewable energy deployment and its operation of the world's largest CO₂ capture and purification plant in Jubail.

As part of our 2025 strategy, we envision a future where plastic continues





to be reused and remade—a true circular economy that keeps plastic out of the environment through our TRUCIRCLE™ initiative.

To this end, we have made several landmark decisions and invested our scientific and technological expertise over the past years to advance the circular economy and help close the loop on waste. We are the first petrochemical company in the world to scale-up high-quality processes for the chemical recycling of used mixed plastic back to the original polymer for commercial

application. This is one of the five pillars of our TRUCIRCLE™ portfolio of sustainable material solutions. We are working together with collaborators from across the value chain on this landmark initiative where we see used mixed plastic converted into a cracker feedstock to manufacture certified circular polymers that have similar properties to virgin polymers.

How is circular economy better than recycling? Please elaborate on how circular plastics are manufactured.

A circular economy is restorative and regenerative by design. This means materials constantly flow around a 'closed loop' system, rather than being used once and then discarded. An example of that is in the case of plastic where the value of plastics is kept within the economy, without leakage into the natural environment. The key goal of a circular economy with respect to plastics is to ensure that it never ends up in the environment, landfills, or in our oceans and instead is reused and remade into valuable new products and preferably also is not being incinerated.

In the face of our current challenges, recycling won't be enough to overcome the sheer amount of waste that is produced as recycling begins at the end of a product cycle, whereas circular economy goes right back to the beginning to prevent waste and pollution from being created in the first place, thereby making it a more sustainable practice, and preventing more waste from being created.

At SABIC, our certified circular polymers are produced through the feedstock recycling of low quality, used mixed plastic that could otherwise be destined for incineration or landfill. Renewable feedstock is any natural resource that can replenish itself in a limited time. It takes, difficult to recycle used plastic, back to the molecular level through a process called pyrolysis. This process breaks down used plastic by heating it at a very high temperature

in an oxygen-free environment, producing pyrolysis oil. The pyrolysis oil is then refined and upgraded for use as feedstock. This ultimately produces polymers that have identical properties to virgin-based polymers, allowing plastics to be recycled repeatedly with no loss of properties or characteristics. The finished circular products are then supplied to our customers for a variety of applications, including certified food standard packaging, personal and home care products, and healthcare—to name just a few.

Do you think efficient technology sharing between developed and developing nations will be helpful for the latter in building their economy sustainably?

Absolutely yes! For instance, at SABIC, one of our biggest goals is to give manufacturers around the world, access to more sustainable materials, which are Mechanically Recycled, Certified Circular, and Certified Renewable.

After pioneering circularity in Europe, we are now working globally with renewable feedstock and advanced recycling with our TRUCIRCLE™ programme, including in India. Our team in India at the state-of-the-art SABIC Technology Center (STC) in Bengaluru is conducting innovative research into new platforms for next-generation materials across industry sectors like Construction, Clean Energy, Electrics and Electronics, Medical Devices, and Transportation. We are also designing greener building materials to reduce carbon footprints and developing eco-friendly products in response to global needs to facilitate businesses to incorporate circularity in their operations.

What are some of the initiatives that SABIC has taken to address the problem of plastic waste in India? How SABIC is contributing to circular economy in India?

SABIC's vision for the future is that plastic should never end up in the landfill or in

our oceans and instead, is reused and recycled into new products. This vision requires a total transformation of the value chain. We have been working with our downstream and upstream partners to reinvent and pioneer our way towards a circular economy for the good of people and the planet.

Our TRUCIRCLE™ portfolio and services play a significant part in achieving our vision and closing the loop on used plastic. We believe that our cutting-edge innovation towards building a circular economy will be able to help in future-proofing India's growth journey.

What is SABIC's focus and strategy in India towards carbon neutrality?

It is our endeavour to make STC-B a carbon neutral entity. In this journey, the site has made significant progress since its establishment in 2013. While the site has reduced carbon footprint by more than 85% since its inception by adopting processes and technologies which are more carbon efficient and green, we have also made significant progress in building a culture and mindset of incorporating sustainability-based decisions in all our workings. We are continuing this journey and are aiming to become carbon neutral soon.

SABIC has made significant progress at its manufacturing facility at Baroda, India and have invested significantly in the last few years to make changes to lighting systems and installing more energy efficient production systems.



Indian Government's economic development strategy emphasizes on sustainable development. How do you see SABIC partner with India for sustainable economic development?

SABIC's sustainability vision and the Government's vision are aligned together. India is a signatory of the corporate UN sustainability goals 2030 and the government is already making positive progress towards those. SABIC also maintains its own global sustainability strategy, which is duly reported in a transparent manner through our sustainability report.

We believe the combination of our global technologies, expertise and activities in India will be able to support Indian Government's growth aspirations, helping in future-proofing the economy and industries.

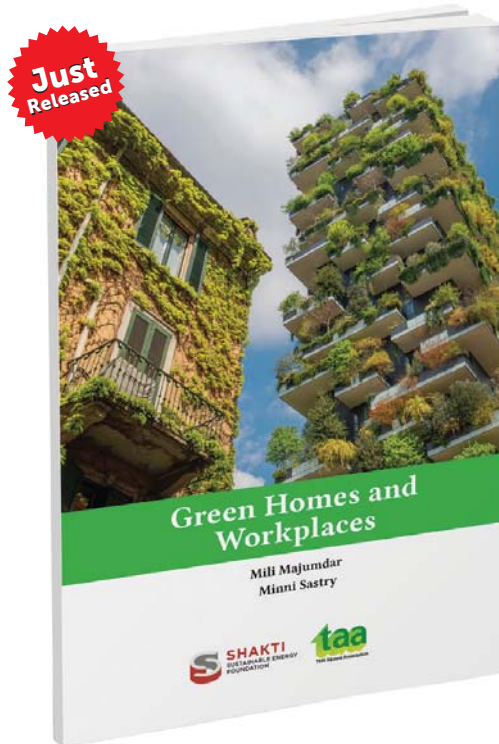
What are some of the solutions, technologies, innovations used by SABIC when it comes to addressing the problem of microplastics both present in the environment and ones that will

be used in future?

SABIC is a forerunner in efforts to transform low quality, mixed plastic waste otherwise destined for incineration or landfill into high quality and safe consumer packaging for food, beverage, personal, and home care products. At World Economic Forum, we also announced the launch of certified circular polymers to be used in packaging solutions for a variety of consumer products that have now been introduced into the market. SABIC is also the founding member of the Alliance to End Plastic Waste, a global collaboration that enshrines the responsibilities and actions agreed by major plastics producers to support the circular economy.

With regards to petrochemicals demand, our strategy anticipates overall market growth and market share growth, as well as movement up the value chain into higher technology materials. The chemical industry will continue to be cyclical, however global demand will continue to increase, but SABIC's diversity and cost advantage allows us to outperform through the cycle. ■

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Green Homes and Workplaces is simple and clear explanations of fundamentals and liberal use of illustrations. The authors aim to demystify the concepts and empower everyone to think and live green. For example, are you worried about polluted air indoors? Try a couple of houseplants. Living on the top floor? Try a reflective paint that can lower the inside temperature by at least a couple of degrees.

Although meant to be a guide to the concerned citizen, the book also has a more profound message: as green-buildings practitioners on the frontline of market transformation in India, the authors believe that our homes, buildings, and communities must move from not just doing less harm to becoming truly regenerative.

This book is useful for adults who are concerned about topical issues but lack the understanding to make sense of what they read or watch in the mass media

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Green Hydrogen

Is It a Solution for Net Zero Emission Need of Our Planet?

Green hydrogen is hydrogen generated from renewable sources of energy. In a far-sighted move, India has launched an ambitious Hydrogen Mission in August 2021 and further the Indian government announced the Green Hydrogen Policy in February 2022. In this article, **Lata Vishwanath** says that production of clean/green hydrogen gas is being seen as the answer to climate change mitigation in the decades to come. Because of its vital role in oil and gas industry, refineries, fertilizers, and a host of other applications as an energy carrier the world can be made less dependent on fossil fuels.



H Y D R



O G E N

H2



Following the launch of National Hydrogen mission in August 2021, the Indian government announced Green Hydrogen policy in February 2022. The policy for meeting the decarbonization goals towards net zero emissions by 2050 is in line with the UN climate targets of capping the earth's temperature to 1.5°C as pledged by India and other countries at COP26 summit in Glasgow in November 2021.

The policy comes with a host of benefits for industry leaders keen to install green hydrogen plants and develop its value chain. As the Indian government's policies worked in favour of renewable energy sector to develop over the last decade, the following decades are expected to see green hydrogen becoming the key driver to the nation's economy and to the rest of the world.

Hydrogen: An Overview

Hydrogen produced from water as a potential source of energy was envisioned by writer Jules Verne in 1874. Though scientists had been working towards making the fiction a reality, hydrogen didn't get much boost after oil gained popularity as a mainstay fuel in the 20th century. Some experiments proved disastrous, and hydrogen was looked at as a light and highly flammable

gas, with its storage at room temperatures a challenge.

In the island country of Iceland with abundant geothermal energy, much study and experiments were carried out by diligent scientists before proposing a Hydrogen economy for the country and the world. Though the industry didn't take off due to oil price going to rock bottom levels at the time, hydrogen had found its use as a key fuel in rocket and space industry and had been a part of other major industries across different sectors—in refineries as a basic component of oil and natural gas (hydrocarbons like methane or CH₄), a feedstock for the fertilizer industry as ammonia (NH₃), and in steel, and cement like industries.

The industry processes result in production of hydrogen, a potential resource for various uses. But the resulting carbon emissions alongside, in the form of carbon dioxide and carbon monoxide have been posing a serious threat to the environment resulting in global warming and the need for serious actions and policies as required by the UN charter.

Production of clean/green hydrogen gas is thus being seen as the answer to climate change mitigation in the decades to come. Because of its vital role in oil and gas industry, refineries, fertilizers, and a host of other applications as an energy carrier the world can be made less dependent on fossil fuels.

Colour Coding of Hydrogen

Hydrogen in its basic form is a colourless gas. However, due to its extensive use based on industry and processes, and fuel used for its production, and amount of CO₂ emission, it has been classified into different colours across the light spectrum.

One kilogram of hydrogen when produced with natural gas using a process known as steam methane reformation, releases 8–9 kg of carbon dioxide, a part of the process in ammonia production. It is grey hydrogen when the carbon emissions are released in atmosphere and blue hydrogen when produced with carbon capture and storage (CCS) facility mitigating the release of CO₂.

Black and brown hydrogen are produced by gasification of coal, bituminous and lignite respectively, a very polluting process, which produces approximately 50 kg of CO₂ and CO emissions with every 1 kg of hydrogen produced.

Hydrogen is turquoise when produced using pyrolysis—splits methane of natural gas at a very high temperature into hydrogen and solid carbon and does not result in air pollution. The solid carbon is a valuable commodity.

Hydrogen produced from electrolysis of water by electricity produced in nuclear plant is pink. It is purple when nuclear and thermal power are used for electrolysis, and red when nuclear thermal power is used for catalytic splitting of water at high temperatures.

Green hydrogen is produced with clean renewable energy using a process called electrolysis of water and



there is no carbon emission during H₂ production. When the electricity on grid is produced from both renewable and fossil fuels it is called yellow hydrogen.

Why the Buzz About Green Hydrogen?

Green hydrogen production is a process of splitting water into hydrogen and oxygen molecules by electrolysis using electricity generated by renewable energy sources like solar and wind power. Apart from need for energy and pure water to produce green hydrogen, a huge need is for electrolytes or catalysts. The electrolysis process in industry is presently of two types of technologies—alkaline and proton exchange membrane (PEM), each with different efficiency and cost. The third solid oxide electrolysis (SOE) technology is under demonstration stage and the fourth anion exchange membrane technology is under research stage. The green hydrogen so produced, presents an advantage of production possibility in small or large scale at any renewable energy plant location.



Favourable Policies for Atmanirbhar India

With favourable policies of the Ministry of New and Renewable Energy (MNRE) towards renewable energy sector, India like other countries has seen transition from fossil fuel-based energy to cheap and clean/renewable energy system with extensive deployment of solar and wind farms. Today, the renewable energy costs INR 2/kWh. According to an estimate by an Industry body for Hydrogen Alliance, India needs an investment of about USD 25 billion from public and private sectors, to create a domestic hydrogen supply chain with an installed electrolyzer capacity of 25 GW producing 5 million tonnes per annum of green hydrogen by 2030.

The Green Hydrogen policy aligned towards making India *atmanirbhar* (self-dependent) emphasizes upon green ammonia production with several enablers for development of the industry. Though some deviations are expected from state to state, the key enabler is easy access to grid connectivity in 15 days, which was a major hurdle in the past. Land availability and fast banking approvals in 30 days, the Interstate transmission charges (ISTC) waiver for 25 years for projects commissioned before June 30, 2025 are some of other policy highlights that will help build integrated hydrogen/ammonia production units near the renewables units.

The developers will get land allotment in renewable energy parks in the proposed manufacturing zones and for bunkers for storage near ports for use by

maritime industry or exports. The oil refineries using green hydrogen/ammonia along with natural gas will benefit by way of using the existing pipelines and other infrastructure.

Saving on Foreign Reserves

India had been importing 80 per cent of oil and 50 per cent of natural gas worth USD 160 billion annually, and ammonia worth nearly USD 1.4 billion to add to its domestic production of nearly 20–25 million tonnes of ammonia per annum. If the plan for hydrogen mission is met, India will be saving USD 30–40 billion annually, significantly bringing down the import exchange bill, in the first decade itself. With the installed green ammonia plants taking care of domestic needs, the surplus ammonia can be exported to other countries making it a net exporter of green ammonia.

Major Use Cases: Green Ammonia and Mobility

Ammonia fertilizer, which has played a major role in feeding our planet since the last century and has seen continuous rise in its production touching 170 million tonnes globally today, is forecast at 200 million tonnes needed by 2030. With its high energy density at 3 kW/litre, green ammonia's major use is not only in decarbonization process, but also has potential to be a key medium to store and transport chemical energy and thermal energy for future needs.

With green hydrogen application in mobility areas





such as fuel cell, forklifts and refuelling stations gaining traction, the major demand market share worldwide is forecast in transportation of heavy-duty vehicles and energy storage by 2030.

Global Markets and Demand Projections for 2030

In the world where half of its hydrogen production is grey from natural gas, 30 per cent brown and 18 per cent black from coal, and 4 per cent green and yellow, decarbonization goal is not only imperative for every country but an urgent need. Depending on available resources and infrastructure, renewable energy and demand centres created, every country has its own decarbonization process and policies towards net zero emission.

By an assessment by PwC, green hydrogen demand worldwide will grow steadily till 2030 to 100 million tonnes and reach 600 million tonnes by 2050, to meet net zero emission target. The market size is projected to reach USD 72 billion by 2030.

EU's target for production of hydrogen is set at 10 million tonnes by 2030 with need for import of another 10 million tonnes to meet the demand emerging in mobility areas. Germany and Japan, where wind is the predominant source of renewable energy and makes up for only 50 per cent of energy, are also emerging markets for green hydrogen in fuel cells for mobility. South Korea, France, and China are planning for a large share of green hydrogen in mobility areas of fuel cells

and refuelling stations. The proposed energy transition towards hydrogen in Iceland got a head start in 1999–2000 with introduction of few hydrogen-run buses and cars. The world's first hydrogen refuelling station was opened by Shell in Reykjavik in April 2003. The country has committed to net-zero by 2040.

Australia has a masterplan to be the major global player and supplier of green hydrogen by 2030. Canada released a Hydrogen strategy to achieve net zero emission by 2050. The United States today produces 10 MMT of hydrogen for its petroleum and ammonia industry but plans to join the clean energy race by 2030 with investments to the tune of USD 400 billion, with considerable part on zero emission cars and heavy-duty vehicles.

Middle East countries with abundant natural resources and established energy projects of solar and wind, and strategic location between Asia and Europe have a competitive advantage of production and export of green hydrogen. Some African countries also enjoy the same advantages of abundant energy and good location to produce blue hydrogen and green hydrogen though water demand is a critical issue in water scarce Africa. Germany has partnered with Namibia committing USD 45.7 million for green hydrogen strategy.

ASEAN countries too are gearing towards green hydrogen for their decarbonization goals and for transportation and energy storage sectors in near future.

Green Hydrogen for Energy Security

With the onset of Ukraine war, and oil and gas availability becoming tough, energy security is taking precedence over net zero emissions. Need for hydrogen in this scenario appears more immediate than in few years or decades. Green hydrogen is thus poised to be one of the world's most tradable commodity in the coming decades.

Investments and Financials

According to the World Energy Council's 2021 working paper, to meet the projected global market size of green hydrogen, there is a need for a multipronged approach towards the development of hydrogen ecosystem. As the cost of renewable energy and electrolyzers fall over the next decade with improved technologies and mass production, both linked to Operating Expenses (OPEX) and Capital Expenses (CAPEX) respectively, the production cost of hydrogen can be brought down to USD 2–6/kg in 2030 to USD 1.5–5/kg by 2050. With improvement of electrolyzer capacities from 50 MW in 2030 to 100 MW in 2050, the time in between is best suited to build infrastructure such as pipelines, import, export terminals to handle the increased production of hydrogen.

Increasingly the countries are looking to investing in hydrogen. According to financial analysts, the current political instabilities make it the best time to invest in hydrogen. Not surprisingly, share prices of green hydrogen companies increased between 2019 and 2021 with areas of investment mostly in carbon capture in oil and gas industry and in transportation areas like hydrogen fuel cells, refuelling stations, of which 50 per cent is directed towards improving efficiencies. It is encouraging that the vital area of electrolysis technology has received some investors' attention in recent years.



India's Position

With India's ambitious renewable energy drive continuing in the next decades, installation of hydrogen production units with large capacities of electrolyzers seems the way forward to handle grid system imbalances. It will also help meet the major demand for green hydrogen projected for oil refineries, maritime industry, transportation industry, buildings, battery storage, etc. Hydrogen used for energy storage upgrade system has use for regeneration of electricity in off-grid locations. The production and use of green ammonia is a great policy and political move, given that huge subsidies of billions of dollars are given for fertilizers, other than it being a big leap towards decarbonization goal. According to clean energy experts, today, in India, to kickstart the industry and to make green hydrogen a viable project, with falling renewable energy prices, there should be some mandate/obligations, such as minimum blending of hydrogen in oil refinery. By using the ISTS waiver, green hydrogen can be made into a central subject of the entire renewable energy ecosystem, meaning that renewable energy plant can be at one place in a state like Rajasthan and hydrogen plant can be in a demand place like refinery or a port.

From power purchase agreement (PPA) to hydrogen purchase agreement (HPA) in contracts, mandatory payment for the hydrogen produced will make it a viable bankable business. As new electrolyzer technologies will emerge with better efficiency and economies of scale, and round-the-clock (RTC) projects with battery storage, with maintaining of debt structure as per the financial instrument, hydrogen cost can be expected to fall to INR 150/kg in 2030 to INR 80/kg in 2050, from INR 400/kg today.

Pilot Projects

Indian energy giants like Reliance, Adani, NTPC, ACME have recently installed and commissioned pilot projects for integrated green hydrogen ammonia plant in some states such as Rajasthan, Gujarat, and Karnataka. As the production of green hydrogen/ammonia increases to the projected capacities in coming years, India will be well positioned to become a hub for export of green hydrogen to countries in EU and other demand centres of the world. ■

Lata Vishwanath is author of Autumn Showers, a creative non-fiction narrative published by TERI in 2017. An Electronics engineer and a Material scientist by training, she took to writing after working for many years in test and research labs in India and Singapore. Besides reading and writing, she is interested in gardening, travelling, cooking, music, and movies.

LET FOOD BE THY MEDICINE AND MEDICINE BE THY FOOD



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This book also describe the current scenario in terms of the expanding market, global trends that drive the industry at present, and the challenges it faces. The concluding section returns to the individual with some remarks on an individual-centric approach to nutraceuticals.

This book is useful for adults who are concerned about topical issues but lack the understanding to make sense of what they read or watch in the mass media

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Accelerating India's Low-cost Net-zero Transition

The Role of Smart Climate and Innovation Policy

Saswata Chaudhury and **Vidhu Kapur** have been working as part of the Economics of Energy Innovation and System Transition (EEIST) consortium, which is dedicated to developing tools to support government decision making around low-carbon innovation and to accelerate technological change towards a net-zero energy system. In this op-ed, Saswata and Vidhu detail how fostering synergies between actors and timely policy interventions helped to grow the LED industry in India and dramatically improve energy efficiency.

Energy efficiency is a key element in the low carbon transition in India. The mainstream adoption and use of energy-efficient appliances is necessary for effective demand management—

and that, in turn, can help India to meet its carbon reduction target. Growing populations, increasing urbanization and 100 per cent electrification are expected to increase residential lighting demand

significantly in the coming decades. As per a recent TERI estimate, the share of lighting demand from the total residential electricity demand in India is approximately 20–27 per cent, but, this





share varies across regions and income groups, and is as high as 60 per cent for poor households.

India has a mixed basket of lighting technologies, including incandescent bulbs (ICB), compact fluorescent lamps (CFL), fluorescent tube lights (FTL), and light-emitting diodes (LEDs). Among these technologies, LEDs are the most energy-efficient, consuming just 10 per cent of the energy required by an ICB, for a similar level of light output. In 2005, ICB and FTL together held around 95 per cent of the Indian market. However, due to various government initiatives, the market has undergone significant changes in the last decade or so, with LED holding a major market share. Survey findings by Agrawal revealed that by 2019, about 90 per cent of electrified households met their lighting demand using LED bulbs, of which 63 per cent used only LEDs. This article explores

the role of government and price management initiatives in the promotion of new technologies.

Accelerated Transition to LEDs in India

Owing to the projected growth of lighting demand, the Government of India rolled out two national-level initiatives in January 2015—the Unnat Jyoti by Affordable LED for All (UJALA) scheme and the Street Lighting National Programme (SNLP), with a twin objective of boosting the adoption of energy-efficient lighting alternatives at affordable prices and achieving India's commitments of emissions reduction. The design of the UJALA scheme was based on lessons drawn from previous government initiatives to promote technology intervention related to decarbonization pathways.

Key Enablers

The high initial investment cost of LEDs and easy availability of low-priced lighting alternatives (such as ICBs) were critical barriers to the adoption of LEDs, especially among poor households. The Bureau of Energy Efficiency (BEE) designed a new business model for the UJALA scheme called 'Pay-As-You-Save', reducing the upfront cost of LEDs, keeping them on par with ICBs. The balance amount can be paid through successive electricity bills. This was supported by technological advances in China that led to the scaling-up of low-cost, medium-grade LED bulbs, procured in bulk at historically low prices. As per a recent study by Dhupia, India's LED sales went from just 3 million in 2012 to 670 million in 2018 with prices dropping from INR 800 in 2010, to INR 400 in 2014, and to just INR 70 in 2019. The innovative

approach implemented by EESL for LED bulbs made UJALA the world's most extensive energy efficiency promotion programme.

As people became more aware of their benefits, the UJALA scheme led to the creation of a parallel market for LEDs. According to IBEF estimates, till May 25, 2022, over 36.79 crore LED bulbs had been distributed, resulting in an estimated energy savings of 47.78 billion kWh per year and avoiding a peak demand of 9567 MW. This also leads to an annual GHG emission reduction of 39 million tCO₂ and estimated annual monetary savings of INR 19,114 crore.

Under SNLP, EESL entered into an innovative arrangement with Indian municipalities (or Urban Local Bodies – ULBs). The contract offered minimum guaranteed energy savings on replacing conventional streetlights with LEDs and provided free maintenance services for the following seven years with no new investment required by the ULBs. ULBs were able to repay EESL with the savings accrued from reduced energy consumption and maintenance costs. This encouraged nearly half of all Indian ULBs to sign up for the scheme.

Encouraging Domestic Manufacturing of LEDs

UJALA's secondary objective was to promote and enhance the domestic manufacturing of LEDs. In 2015, the GOI announced a Preferential Market Allocation (PMA) policy, mandating government agencies to procure LEDs for the UJALA and SLNP schemes, whereby India imported LED components and assembled the final LED bulbs domestically. To further promote small-scale manufacturing, in 2017, duties on the import of final LED products were increased relative to duty on the import of LED components.

As a result, the import of LED components has rapidly increased in recent years, and the import of final products has reduced. In April 2021, the Department for the Promotion of Industry and Internal Trade (DPIIT) announced a Production Linked Incentive (PLI) scheme that would further incentivize the production of components of LEDs instead of just the assembled product.

Lessons for Future Transition

The Economics of Energy Innovation and System Transition (EEIST) consortium's analysis of the LED experience in India presents a strong case for fostering synergies between actors and timely policy interventions, unlocking incremental and cross-sectoral change. The Economics of Energy Innovation and System Transition (EEIST) consortium is engaging with policymakers and stakeholders in Brazil, China, India, the UK and the EU. The project aims to contribute to the economic development of emerging nations and support sustainable development globally by providing governments, new tools and analysis, by supplementing traditional cost-benefit analysis (CBA) with Risk Opportunity Analysis (ROA) in situations where transformational change may result—like transitioning to a low carbon economy.

The experience provides valuable lessons for how to create accessible markets and scale innovation, particularly for important sectors and technologies such as electric vehicles, batteries, and





green hydrogen, especially through stimulating domestic manufacturing and supply chain development.

The learning acquired from earlier schemes and the constant exchange of knowledge among stakeholders helped identify and address the barriers posed by LED adoption. This is clearly seen with BEE drawing its experience from various

previous schemes and how the standard and labelling (S&L) programme, was able to create synergies between stakeholders to quickly develop the minimal technical standards for LEDs.

Similarly, EESL engaged with the state regulator and distribution utilities to create the required distribution value chain, developed initially for promotion

of CFLs (under previous initiatives) and subsequently efficiently utilized for LEDs. Further, the EESL marketing strategies and campaigns advocating the energy and cost-saving benefits of LEDs and their availability at a lower price created awareness not only for the targeted consumers of UJALA but also for the larger target group. It added to the demand, thereby driving the local LED market. Subsequently, the initiative led to mandating the need for domestic value addition and enabled local manufacturing and supply capacity for the LED final product. The proportion of domestic value reached 20% by 2017, and with the PLI scheme announced recently, this share is expected to increase significantly in near future.

As India transitions towards electric mobility, the LED experience opens up the space to examine possibilities for similar holistic approaches to assess wider socio-economic implications for decision-making and greater use of new renewables and green technologies. ■

Saswata Chaudhury, Fellow & Area Convenor, CIAM, TERI, and Vidhu Kapur, Associate Fellow, CES, TERI. Authors acknowledge valuable inputs and feedback received from Ms Ulka Kelkar, Director, WRI India and consortium member EEIST project.



Pulp and Paper Industries

Moving Towards Water Sustainability

This study was conducted on secondary literature by **Bharg Modi and Sonia Grover** for the water conservation of pulp and paper industries. The article talks about the challenges and reflections from best practices that could be used as learning to improve water consumption of Pulp and Paper Industries in India.

Paper is one of the most essential items in our daily lives. Even after so many technological advances that the world has witnessed; paper has not lost its importance in the daily lives of people. From newspapers to paper bags, paper is a product that is around everyone in one form or another. The per

capita consumption of paper in India is at 15 kg, whilst the global average stands at 57 kg. Paper was first invented by a Chinese court official Cai Lun, during the Eastern Han period (25–220 CE). In the year 1812, the first paper mill was set up in Serampore (Bengal) but it didn't survive because of the low demand for

paper. After 58 years in 1870, another paper mill was established in Ballygunj near Kolkata and soon paper industry became the core industry in India.

Industry Overview in India

As per the Centre for Pulp and Paper Research Institute, there are in total of 900 paper mills in India out of which 526 are in operation. All mills combined have an installed production capacity of 29.11 million tonnes and 23.99 million tonnes are operational installed capacity. India consumes 22.83 million tonnes of paper and paper products per year. Different types of raw materials are used for the production of different products out of the pulp. Three types of raw materials that are used include—1) Wood-based, 2) Agro-residue-based, and 3) Recycled-fibres-based. Seventy per cent of the raw materials in India and China are agro-residue based and India and China combined are responsible for 80 per cent of the agro-residue-based pulp production in the world. Based on raw material used, it has been reported that 76 per cent of India's pulp and paper market uses recycled fibres, 18 per cent uses wood as their raw material and 6 per cent uses agro-residue for production.





Current Water Consumption Practices

Pulp and paper industry (PPI) is one of the most water-intensive industries. Fresh water is used for almost every process. The current global average specific water consumption¹ is ~30–50 m³/t for large-scale wood-based pulp and paper mills, which is better than India's average freshwater consumption in pulp and paper sector, which is ~60–70 m³/t of product. To reduce water consumption in the industry many interventions are done.

PPI in India consumes approximately 2.3 per cent of 23 billion cubic metres, which is used in the industry sector. PPI

¹ Specific water consumption refers to the amount of water being used to prepare the final product (per t of paper) in that particular industry (here, it is Pulp & Paper industry).

are nowadays moving towards a green and clean approach to move towards a sustainable future. To conserve water, consumption has to be reduced so that there is less water in the loop.² The processes where fresh water is consumed are pulping and pulp dilution, hoses for clean-up, showers, boiler water make-up, chemicals make-up, cooling of press rolls, air compressors, etc. In India, waste-paper mills use 59 m³/t of water on average, according to a 2010 assessment by IL&FS EcoSmart. The average water use, as per the most recent FisherSolve data, is 39 m³/t. This is extremely high when compared to 16 m³/t for similar paper mills in the USA and 8 m³/t for similar mills in European Union (EU) countries.

² Water in the loop refers to the water, which is used in the processes throughout the plant/mill.

Scope of the 3R's for Industry

To reduce the use of fresh water, industries have started using white water.³ Many studies have shown that white water is more suitable in some cases for the processes, which consume fresh water. PPI uses various methods of water conservation like 3R's (reduce, reuse, recycle), zero liquid discharge, etc. Some of the major players in India such as ITC-Paperboards and Speciality Papers Division, Tamil Nadu Newsprint and Paper Limited, Emami Paper Mill, West Coast Paper Ltd, etc., use these technologies/interventions to reduce their freshwater consumption. Due to growing water stress in India, major industries in

³ The water which is recirculated from the paper machine to the initial point.



India and State Pollution Control Board and Central Pollution Control Board are working together to reduce freshwater usage by adopting innovative technologies and interventions. Market leaders like Tamil Nadu Newsprint and Paper Limited, Emami Paper Mills Limited, JK Paper, ITC Paperboards, and Special Paper Division, etc., have put the effort into reducing freshwater use and to treat and recycle water that is in the loop.

Best Industrial Practices in India

As per the Environmental Sustainability Report 2021 released by Tamil Nadu Newsprint and Paper Limited, it is one of the most environmentally friendly mills in India with water usage as low as 11.3 m³/t and 47 m³/t for paperboard and paper,

respectively.

Andhra Paper Limited is another major player in the pulp and paper sector which has done R&D in reducing and conserving water significantly for both boards and paper production.

ITC-PSPD, Bhadrachalam, Telangana introduced a bleached chemi-thermomechanical pulp (BCTMP) plant to reduce freshwater consumption. BCTMP plant has been specially designed to consume less water and discharge less effluent.

Emami Paper Mill Limited, Kolkata, West Bengal, has also done a few modifications in processes to reduce their water usage. In paper machines, reduction of nozzles diameter, installed disc filters to increase the fibre recovery and using super clear water LP showers, recycling of sealing water in all the

machines, and reuse of filter backwash for cooling tower make-up.

Naini Papers Limited, Kashipur, Uttarakhand has installed an efficient IBS shower system on paper machines that have drastically reduced their water consumption, from 2000 m³/day to 2200 m³/day. And they are using treated effluent water to cool down the pulp mill unbleached gland section.

All the stakeholders in this sector shoulder the responsibility for reducing the freshwater demand and recycle the water in the loop. In 2012–13, the Central Pollution Control Board implemented “Charter for water recycling and pollution prevention in Pulp and Paper Industries in Ganga River Basin” and after seeing the positive results in the Ganga river basin, in the year 2015 the charter was implemented for the whole country so that the industries optimally use water and are encouraged to undertake recycling and reuse of treated wastewater.

The Way Forward

The small and medium pulp and paper industries assume that reduction in the effluent volume is linked with expensive technologies. The mills that manufacture packaging or unbleached grades of paper are few industries where reduction of water usage is less cost intensive. However, the reduction in consumption could be through behavioural changes and usage of bare minimum technologies as stated in the charter. There is a need to build capacity of such industries around India. The water consumption monitoring of the industries should be done on quarterly basis and the data should be available through annual reports in public domain. This will also help the industries to enhance their sustainability reporting standards. ■

Bharg Modi, Student, M.Tech Water Resources Engineering and Management, TERI SAS and Dr Sonia Grover, Area Convener, WRP, TERI, New Delhi.



Terra Youth



Joining Hands
for a Greener
Tomorrow

All Eyes on Animal Welfare in Asia

India's Anti-cruelty Record

International non-governmental organization Sinergia Animal has released a cage-free report that tracks the efforts of several food companies to ban the use of cages for laying hens in their supply chain in Asia, including India. Of fifty companies surveyed, 70 per cent have already taken steps towards that ban globally.

In India, the policies of 36 companies were assessed. The report found that Danone, Dr. Oetker, Hain Celestial, and Marks & Spencer have already fully transitioned to cage-free systems. However, some big international brands such as McDonald's, Subway, Starbucks and Nissin haven't made any commitments in India yet.

When we think of a factory, usually what comes to mind is a production line of people working with materials

to produce goods we use in our daily lives, from shoes to automobiles. Now, instead of a steel moulding line, picture an infinite aisle of small cages locking crowded living individuals who want to be free but are cruelly forced into a life of pain and misery. In these cages, hens cannot open their wings completely, walk freely, clean themselves or peck the ground—behaviours that are extremely important for birds' well-being. This is what a battery cage system looks like and

how the egg industry (true to its name) mostly works.

There are 7.47 billion egg-laying hens worldwide, of which 60 per cent are estimated to spend their lives in battery cages. This percentage is usually even higher in countries of the Global South, even in economically powerful countries like India. However, there might be a light at the end of the egg production line.

Besides Bhutan, India is the only Asian country to have made significant





progress towards banning these controversial cages for hens. Although it has not yet been followed by all of the country's states, battery cages have been declared illegal by the Animal Welfare Board of India. Forced molting, a practice in which laying hens are starved for 7–14

days to induce molting to increase egg production, is another terrible practice used on laying hens that has been banned in the country.

Because of its traditional vegetarian food and its culture, India is famous around the world for being animal-

friendly. An example of how this translates to people's perceptions and values is a 2016 survey commissioned by World Animal Protection, which shows that 90 per cent of Indian respondents didn't agree with cruel treatment of animals in local dairies.

With initiatives to ban cages beyond the private sector, India has plenty of potential to lead the anti-animal cruelty movement in Asia and set an example for other countries. Besides demanding further policies from the authorities, companies must also do their part to end the use of battery cages. According to Sinergia Animal's report, many big international brands have already adopted cage-free policies in other countries. Given how big these brands are, it is clear that they do not lack the resources to respect Indian consumers and animals by doing the same in India.

If you want to learn more about the Cage-Free Tracker report and how you can help animals, visit cagefreetracker.com/asia. ■





GREEN Quiz



GREEN Olympiad Secretariat welcomes you to GREEN Quiz Section! Through this section, the Secretariat aims to reach out to student readers to avail an opportunity to prepare for GREEN Olympiad examination. We are continuing from the June 2022 issue. Happy quizzing again!

- A change in global or regional climate patterns, attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels is commonly known as:
 - Climate shift
 - Climate change
 - Greenhouse effect
 - None
- The term 'photovoltaic' comes from Greek language. 'Photo' in Greek means light. _____ is the unit of electromotive force and comes from name of Italian physicist, Alessandro Volta.
 - Voltaic
 - Edison
 - Franklin
 - Gilbert
- Biodiesel from palm oil and ethanol from sugarcane, corn and soya-bean fall in the category of:
 - Biogas
 - Biocure
 - Biofuels
 - Biogest
- An important energy efficiency measure is replacing all the incandescent light bulbs in your home with compact fluorescent lamps (CFL) or _____.
 - LED light bulbs
 - CFC
 - Photovoltaic cells
 - None of the above
- Light pollution is the excessive, misdirected or invasive use of artificial outdoor lighting. Mismanaged lighting alters the colour and contrast of the night-time sky, eclipses natural starlight, and disrupts circadian rhythms (the 24-hour processes of most organisms), which affects the environment, energy resources, wildlife, humans, and astronomy research. This is also known as:
 - Photopollution
 - Luminous pollution
 - Phytopollution
 - Both a and b
- _____decomposition takes place in nature, in areas where oxygen does not have access. This is usually marked by the presence of

- strong pungent odours due to the presence of sulphur containing compounds.
- a) Anaerobic
b) Aerobic
c) Alkaloid
d) None of the above
7. What of the following form of precipitation contains chemical waste and causes damage to plants and animals?
- a) Acid rain
b) Monsoon rain
c) Seasonal rain
d) Smog
8. _____ means a gas produced by the anaerobic digestion or fermentation of organic matter.
- a) Biogas
b) CNG
c) LPG
d) None of the above
9. _____ is the process of converting waste material into new product, which is of better quality and also of higher environmental value.
- a) Recycling
b) Upcycling
c) Conversion
d) Reuse
10. 'Black water' is a jargon used in environmental language, for:
- a) Effluent water containing faecal matter and urine
b) Effluent water that does not contain faecal matter and urine
c) Effluent water that is fit for usage
d) None of the above
11. The amount of water that is recommended by the United Nations for drinking, washing, cooking and maintaining proper hygiene is _____ litres per person per day.
- a) 55
b) 50
c) 45
d) 40
12. The groundwater gets recharged through a process called infiltration and is stored between layers of hard rock below the water table known as:
- a) Bedrock
b) Substratum
c) Aquifer
d) Wells
13. The moisture in the soil indicates the presence of water underground. If we dig deeper and deeper, we would reach a level where all the space between particles of soil and gaps between rocks are filled with water. What is the upper limit of this layer called?
- a) Water table
b) Well
c) Bedrock
d) Stratum

GREEN Olympiad is India's premier examination on environment for school students. The programme is organized since 1999 and aims to test the environment quotient of students and enhance their understanding about issues related to sustainable development. The programme is open for students of Std. 4 to 12 across the world. For more information and registration of 2022 edition, log on to www.teriin.org/olympiad or write to us at go@teri.res.in.

Aequs Foundation Launches “Hamara Gaon Project”

The CSR arm of Aequs rolls out early education support programme in twenty-five villages in Koppal District to create community ownership in children’s early-learning.

On July 13, 2022 Aequs Foundation launched the Hamara Gaon Project to impart education to children in the age group of 3–14 years in the Koppal District to create community ownership in early schooling. Taken up in partnership with Pratham Education Foundation, Hamara Gaon

will reach 5000 children over the next three years by supporting in-school and in-community components for early education. The programme will cover across twenty-five villages in the Koppal District, where India’s first toy manufacturing cluster, the Koppal Toy Cluster (KTC), is located.

The Hamara Gaon Project is implemented to support children in their early years (3–6 years) by training children with Anganwadi workers and volunteers on early-learning activities for children. The programme will also set up Mother’s Groups to increase the participation by them.





About Aequs Foundation

Set up in 2016, Aequs Foundation is the corporate social responsibility arm of Aequs with a mandate to positively impact communities in and around Aequs' manufacturing ecosystems. The Foundation aims at inspiring and educating underprivileged children in, Cognitive Development, STEAM Education (Science, Technology, Engineering, Arts and Mathematics) and Health Education through its various community and regional initiatives that help bring measurable and sustainable changes to the society and improve quality of life. It has particularly focused on imparting education through experiential learning and developmental activities apart from training teachers and contributing to improve school infrastructure. The Foundation runs the Anasuya Melligeri Science & Technology Centre at Hubballi to provide hands-on exposure to students in the STEM curriculum. In Belagavi, it runs Mobile Science Laboratories to benefit students at government schools apart from a host of other initiatives in the two cities. To date, the CSR initiatives of Aequs, have impacted nearly 13,000 students across more than 100 schools and villages in the Belagavi, Hubballi and Koppal regions of Karnataka.

About Aequs

Aequs is a diversified contract manufacturing company providing vertically integrated product solutions across the Aerospace and Consumer Goods industries. By leveraging its manufacturing ecosystems, Aequs reliably delivers supply chain efficiencies to its global customer base. Aequs currently employs over 5000 people and operates manufacturing facilities across India, France, and the United States. ■

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The primary objective of the programme is to build age-appropriate skills in children. The in-school component for children in grades 1–5 addresses learning loss and focuses on foundational literacy and numeracy skills. "In a rapidly transforming world, we believe education is the key. We at Aequs Foundation have introduced several programmes that aim to help students excel in academics and extra-curricular activities for all-round development. Research has shown, and the pandemic has proved the importance of the mother's role in building foundational skills in numeric and reading skills. This programme seeks to involve them more closely in this process along with teachers, and Anganwadi workers," said Ms Akkamahadevi Melligeri, Chairperson, Aequs Foundation.

Aequs Foundation and Pratham intend to create an environment that encourages both self-learning and group learning activity. Hence, Pratham team members conduct learning camps

(short bursts of intense activities) in school for children in grades 3–5 using Pratham's Teaching at the Right Level (TaRL) methodology. As part of the early schooling-interventions, several mother's groups in villages get trained in teaching their children. These groups meet weekly to share experiences and discuss activities they can take up with children. Pratham team members support the Lead Mothers and the groups by periodically visiting them.

In addition, engagement kits are given to mothers as an engagement tool to support the mother-child duo. The kit comprises three components—individual pouch with materials for every child, a kit for every mother's group at the Mohalla level, and a village level kit. The kits contain various teaching-learning materials that help children acquire age-appropriate skills.

During the Inauguration of the programme on July 9 at Koppal, several Engagement Kits were distributed to the mothers.



Some Types of Stress Could Be Good for Brain Functioning

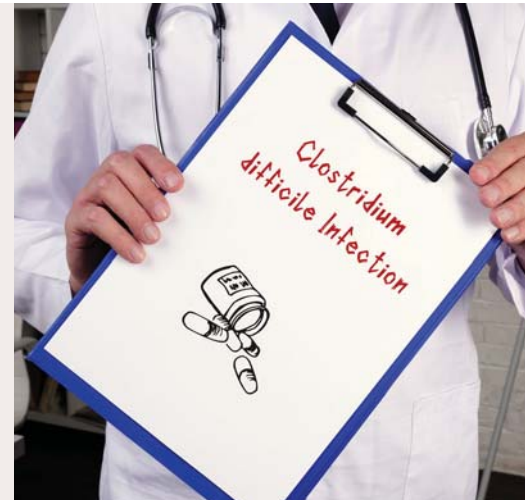
It may feel like an anvil hanging over your head, but that looming deadline stressing you out at work may actually be beneficial for your brain, according to new research from the Youth Development Institute at the University of Georgia. Published in *Psychiatry Research*, the study found that low to moderate levels of stress can help individuals develop resilience and reduce the risk of developing mental health disorders, like depression and antisocial behaviours. Low to moderate stress can also help individuals to cope with future stressful encounters. The stress that comes from studying for an exam, preparing for a big meeting at work or pulling longer hours to close the deal can all potentially lead to personal growth. Being rejected by a publisher, for example, may lead a writer to rethink their style.

Source: www.sciencedaily.com

Scientists Engineer Probiotic to Prevent Infection of Large Intestine

Scientists from the Yong Loo Lin School of Medicine, National University of Singapore (NUS Medicine) have created a probiotic to restore bile salt metabolism, found in the gastrointestinal tract, to counter the onset and effects of Clostridium Difficile Infection (CDI). CDI is the infection of the large intestine or colon that leads to infectious diarrhoea, caused by an infectious bacterium known as *Clostridium*. Most cases of CDI have been observed to occur in those who have been taking antibiotics or just finished their course of antibiotics. The administration of antibiotics in the treatment of CDI causes an imbalanced gut microbiome, known as dysbiosis, which can disrupt other microbiome processes such as bile salt metabolism. The dysregulation of bile salt metabolism can activate dormant Clostridioides difficile spores, leading to CDI, causing severe diarrhoea and colitis— inflammation of the large intestine, or a reinfection of CDI.

Source: www.sciencedaily.com



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ISBN: 9788195077687

POLLUTION SOLUTIONS FOR A CLEANER, GREENER EARTH

Urmi A Goswami

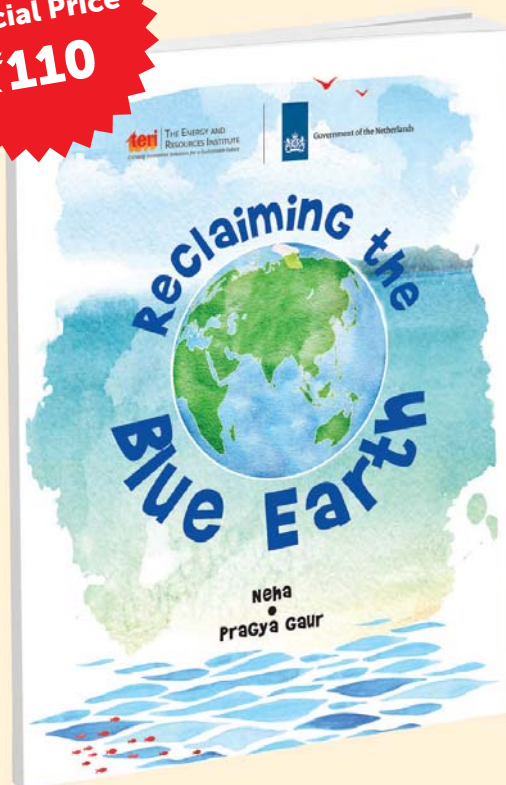
We are living in a fast changing world. Pollution of natural resources, such as air, water, and land is one of the biggest banes of our times. Under such precarious circumstances, it is needed that the young generation is not only made aware about the different kinds of pollution but also about the solutions. This is what this book *Pollution Solutions – For a Cleaner, Greener Earth* is all about.

Filled with eye-opening facts, informative illustrations, and multiple activities, this book is the perfect guide to help the young generation become environmental crusaders.

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Reclaiming the Blue Earth aims to generate awareness and develop consciousness about the use, reuse, and reclamation of water. The book also makes the readers realize their strength and role; change their thoughts, perspectives, and attitude towards the use and misuse of water. Contents are developed to sensitize people towards the use and reclamation of wastewater through critical thinking and problem-solving. The text has been supplemented with simple solutions for effectively dealing with potential problems related to water at homes and in the community at large. Let us take a step forward to save water for our future generations.

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Amagarh Leopard Safari

Another Feather in Rajasthan's Cap

Jaipur recently got a new wildlife hotspot in Amagarh Leopard Safari on World Biodiversity Day, May 22. So, now Rajasthan has got its third leopard safari after Jhalana and Jawai. This article by **Saurabh Somani** throws light on this new wildlife hotspot along with some aspects of this magnificent animal called leopard.

Jaipur has given all wildlife enthusiasts a big reason to smile and celebrate. The Amagarh Leopard Safari was inaugurated in Jaipur on May 22, 2022, which is going to be the second one in Jaipur after Jhalana Forest Reserve as the third one is in Jawai (Rajasthan). The combined count of leopards is above 60, though each one of them have their own distinctive features. Whereas Jhalana has the maximum count, which is also

Jaipur's first such organized leopard facility; on the contrary Jawai leopard citing is more in a natural cave style setting with equal amount of open and natural surroundings.

Amagarh is nestled among Aravalli mountain range sprawling over 1500 hectares housing over two dozen leopards providing a perfect breeding and hunting settlement for the growing population of leopards. This new leopard

reserve is expected to be monumental in landing Jaipur on world tourist map where apart from the usual attraction of markets, *bazaars*, museums, palaces, art, heritage, and culture, Jaipur will also be known as a wildlife destination for a rare special cat from the family of leopards. Not only leopards, but there are many other commonly spotted animals at Amagarh Leopard Reserve, which include hyenas, jackals, wild cats, foxes, civet cats,



nilgai, sambhar, and so on. There are also many forts and temples that one can explore during visit to Amagarh forest block. Popular spots include the Galta Temple, Amagarh Fort, Raghunath Fort, and Ambamata Temple.

Traditionally known as the Indochinese leopard, *Panthera pardus delacouri* is a leopard subspecies native to mainland Southeast Asia and Southern China. As per a survey between 2019 and 2021, more than 30 leopard cubs were born; though with proper settlement the cubs can actually survive the harsh changing climatic conditions along with constant fear of bigger wild animals and with human intrusion in their habitats.

Certain organizations across the globe have done tremendous work in preserving wildlife in natural settings. Many game reserves in Africa are perfect examples. It is evident as a result of constant dedicated work and effort of the state's forest department under Project Leopard launched in 2017. The said initiative is to provide proper habitat and hunting ground for leopards, illegal poaching is to be eradicated and the same is to be kept under non-bailable offence under stringent heinous crimes and atrocities towards protected animals. At the same time, human interference must be limited in protected wildlife areas, which needs to be minimized and to be restricted for selective workers and wildlife officials only.

Leopards are usually shy animals compared to other big cats. They are usually found in close proximity to humans as we have been listening to stories of human and leopard encounters where a sudden attack on cattle in open village homes is the first point of contact between the animal and human beings in the form of physical attack on human habitats.

Leopards have short legs, long bodies and a large skull compared to other large cats. It is similar in appearance to the jaguar and definitely smaller in size. The animal is packed with central dots all over. It can climb trees and can carry



prey heavier than its actual weight. Their vision is five times stronger than a fit human eye. At times, they can swim as well and during resting hours they can be found in hollow trees and caves. This is their comfort zone where unlike any other large cat they happily bring their hunt on these resting large branches and finish their meal with ease and comfort. Leopards move out during night when chances are high of catching their prey; however, they are mostly undercover and prefer to be alone. Leopard hunts alone after following and fixing its eye on its prey and after assessing the exact movement of its prey. During mating season, they usually leave a pungent smell along with urine droplets, which encourages the male leopard for mating exercise. The Asian leopard is believed to be the most difficult one to tame. They are a perfect mix of skills with patience and attacking methodology in comparison to other big cats as they are fierce and strong. They move like the wind without leaving much of their footprints, unlike lions or tigers. They are silent killers who usually do their job with perfection. They can run up to a speed of 58 km per hour. Their favourite prey is Indian deer.

Leopards mark their territories with scratches on trees and urine smell to

warn other leopards to stay away. A male or a female leopard will cross territory only for mating. Their camouflage trait is another reason, which makes them skilled attackers. Once they fix their eye on their prey, they stalk them carefully and quietly. Once it is in their range of 5–10 metres then the leopard will lower its body and pounce. It will take down its prey with a bite on the neck. If a male leopard wants to make another one aware of its presence then it is usually done with distinctive sound calls.

The Jaipur range forestry department now has a show to put on as the world is looking upon them with anticipation where with timely professional management and standard operating procedures they can do their job efficiently. Morning and evening safaris are scheduled and already in operation from May 23, 2022. Online booking for the Amagarh Leopard Safari has begun. There will be two shifts. This facility must be available to everybody without any kind of hindrance. State authorities and forest officials deserve applause and their support matters. ■

Saurabh Somani has been writing short stories and articles specializing in wildlife, forestry, climate change, art and cultural interpretation on Indian and Asiatic customs. He is an international trainer and mentor; learn more about him at yatri23.com.



Urine Markings in Cats and Their Meanings

“Cats do not hunt, eat or sleep in groups like dogs. They mark territories and avoid each other, whenever possible. They have no systems for deciding face-to-face disputes, so, to avoid them, they communicate indirectly by leaving messages—one of which is urine marking.”

A few years back, someone wrote to me from Mumbai saying they lived next to a person who kept cats in his flat. They complained about the smell. I sent a team to the gentleman's flat, thinking that he was that dreadful human subspecies—the hoarder. A person who piles on animals

because he is mentally unsound and starves them to death while being a nuisance to everyone around. But he wasn't. A sensible person who is regarded with great respect by everyone—including the woman who complained—he takes in animals that are hurt or ill. He nurses them back to health

and releases them, gets them adopted or keeps them if they are crippled. All the cats were sterilized, clean, and healthy. But there was a strong smell. The complainant was apologetic but she said she could not live with it.

Cat urine odour is a problem. Let's look at reasons and solutions. If you know anyone who has a problem, you could send this to them. Cats do not hunt, eat or sleep in groups like dogs. They mark territories and avoid each other, whenever possible. They have no systems for deciding face-to-face disputes, so, to avoid them, they communicate indirectly by leaving messages—one of which is urine marking. What area belongs to them and over what period of time, whether they want mates.

If their world is predictable, there are no conflicts, they are neutered and they don't need a mate, cats have little reason to mark and probably will not. But, if they want a mate, or are distressed about something, they'll deal with their distress by marking territory.





How Do You Make Out Urine Marking?

Urine marks are usually sprayed on vertical surfaces. The cat backs up to a vertical object like the side of a chair, a wall, or a stereo speaker, stands with his body erect and his tail straight up in the air, and sprays urine onto the surface. The urine smells pungent because it contains extra communication chemicals.

The more cats who live in a home, the more likely it is that at least one of them will urine mark. This behaviour can be triggered by any change: new people, getting another animal, remodelling the kitchen, changing work hours, having a baby, even a new coat. A cat is not challenged by another cat; he is stressed by his inability to deal with the intrusion. If a cat is prevented from avoiding the other cat, he will become increasingly stressed and mark often.

First, neuter all the cats. The best way to minimize conflict is to divide the food, water, litter boxes, in different places across the house, so no two of them are near each other. Conflict can often be reduced simply by providing more perching areas so that all cats can have a place away from the others. Creating space can be as easy as clearing window sills or shelves, or purchasing multiperch

cat trees. The second problem is how to make sure the cats use litter boxes to urinate/defaecate, rather than do it all over the house. Buy them from a pet shop. If the litter box is unclean then cats, being very fastidious, will not use it and then the whole house is used like a bathroom. Scoop the box daily. Dump out the litter, wash the box with soap and warm water (no ammonia-based cleaners), dry it and put fresh litter in. Try a litter deodorizer that can be either sprinkled or sprayed on the litter itself daily. Kitchen baking soda is non-toxic. Carbon litter box liners are helpful in bringing down such odours.

The rule is one litter box per cat, plus one. If you have one cat, you need two boxes. If you have four cats, you need five boxes. Keep the boxes in different locations in your home. Don't put a box in a small enclosed area, like a tiny bathroom, closet or under the stair cupboard, which will concentrate the smells and make the cat feel trapped. A larger, well-ventilated area is best in a quiet area, away from your cat's food, or anything that can startle your cat while he's using the box.

At least 10 per cent of all cats develop elimination problems. Some stop using the box altogether. Some only use their

boxes for urination, or defaecation, but not for both. Still others eliminate both in and out of their boxes. If your cat isn't comfortable with her litter box, or can't easily access it, she won't use it.

Investigate possible medical issues like diabetes, kidney diseases, or urinary tract infections that might cause her to eliminate outside of her box. Other reasons include—the box is too small for her; it has a hood or liner that makes her uncomfortable; or the litter is too deep. Cats prefer one to two inches of litter. Cats who have grown accustomed to a certain litter, dislike the smell of another. Old cats, or cats with physical limitations, may have a difficult time using certain types of litter boxes, such as top-entry boxes, or with high sides.

The majority of cats prefer large boxes that they can enter easily. Plastic storage containers make excellent litter boxes. Most cats prefer clumping, unscented litter. Offer different types of litter in boxes placed side-by-side to allow your cat to show you her preference.

Some cats just like certain places, like carpets or bedding. Make these areas less appealing to stand on by putting rubber mats, plastic sheets, tin foil, or double-sided sticky tape. ■

To be continued...

Project Palaash

A Pioneering Initiative by Enactus Aryabhata

“Thousands have lived without love, not one without water.”

– W H Auden

For years, rivers and streams have borne the brunt of urbanization. Did you know that the seemingly harmless floral waste, if not managed properly can become one of the biggest environmental hazards! Have you ever wondered what happens to the beautiful flowers that adorn the body of our gods and goddesses? Not long after these are utilized for religious worship of our deities, these very flowers end up sulking in our water bodies.

These worn-out flowers contaminate the water quality and the residue of pesticides used on the flowers percolates into the waters, thereby hampering our precious marine life. Another compelling factor contributing to the hazard on the quality of water is the impurity caused by various dyeing and textile industries. “The synthetic dyeing and textile industry is the third-largest consumer of water in the world, expending nearly 2.4 trillion gallons of water a year, and effusing over

70 toxic chemicals into the hydrosphere.”

Enactus Aryabhata—a student-led team of young entrepreneurs, aiming to tackle a myriad of social issues plaguing the society by taking imperative steps to bridge the chasm between the rich and the poor with education and employment opportunities, ensuring judicious use of resources, significantly reducing wastage, promoting recycling and working towards building a community that is socially, economically,

8 million tonnes of floral waste in India are discarded every year amounting to one-third of the total solid waste





Enactus Aryabhata team

and environmentally sustained.

In 2019, Enactus Aryabhata set out on a mission, a mission to give new life to these flowers while providing an umbrella solution to the problems of water pollution, inadequate floral waste management, and fast fashion by launching Project Palaash. The team

utilizes the floral waste generated in religious places, flowers mandis, and weddings by converting it into vegan dyes and various other organic products including compost, candles, and colours.

Tapping into the environmentally-conscious consumer market, the team launched an exquisite apparel line

offering a range of elegant naturally dyed dupattas, t-shirts, kurtas and scarves, which are listed on their e-commerce website. The products are also listed on numerous e-commerce platforms including Going Zero and Eco Phase for better prospects and for promoting the common goal sustainability.



Waste collection



Composting



Organic dyeing

The project also offers natural dyeing services to various firms and fabric manufacturers taking the art of natural dyeing to a whole new level. These organic dyes create employment opportunities for survivors of human trafficking and underprivileged women thereby enabling them to achieve financial independence. These entrepreneurs undergo skill development training for dyeing techniques such as tie and dye, ombre, clamping and screen printing on fabrics.

In an effort to rekindle the dying handloom industry, the team collaborated with Loom Key and Banni Handicrafts, Gujarat and Madhya Pradesh based enterprises. Thus, the team empowered more than 350 artisans by procuring handloom cotton from these skillful workers and adding a spirit of Palaash by dyeing their textile.

The leftover floral waste is converted into compost—thereby ensuring a zero waste model. The compost made from floral waste was soil tested to find that

it has 30 per cent more nutrients than regular compost, and enhances plant growth by 20 per cent using enzymes derived from neem and jaggery acting as disinfectant. Each and every step, from procurement to packaging, follows eco-friendly methods.

Facilitating sales for their organic compost, Enactus Aryabhata reaches out to various nurseries, farmers, and housing societies. This composting model was recognized and adopted by Aryabhata College of Delhi University.

To utilize the full potential of this floral waste and capitalize on the seasonal surge in floral waste and customer demand, the project launched three seasonal campaigns. Starting the year with the most loved Indian festival Holi, the project has come up with the 'Abir Campaign' in which they make organic Holi colours. Followed by the campaign for Raksha Bandhan – Bandhan in which yarns are dyed naturally and woven into rakhis. And finally ending the year with Utsav – the campaign for Diwali in which

special hampers are curated with scented candles made using their very own ittar (made using flowers) and Rangoli colours made using floral waste.

Recently, the project has joined hands with the Delhi Government to establish Self-Help groups in Najafgarh and provide sustainable employment opportunities to them. Their efforts were also appreciated globally by The Very Group: the second-largest retail chain in the UK.

Palaash became a finalist in the Resilient Ecosystems Challenge in 2021 and won the Community Award after competing with 1800 teams from 128 countries. It has also emerged as one of the Top 20 Finalists in 2022 in the Youth Innovation Challenge conducted by MIT Solve amongst more than 800 teams from 148 countries.

Upholding the significance of ethical business practices, Project Palaash won the KPMG business ethics grant 2022 and received project scaling funding of INR 25,000. Palaash even won the Race for Better India, under SDG 5: Clean Water and Sanitation and received INR 25,000 as funding for the project. Through their relentless efforts, the project has been able to salvage 10 tonnes of floral waste, produce 600 kg+ of handloom cotton, avert more than 1300 litres of chemical pollution and 10 lakh microfibres, reduce 72,000 kg of carbon emissions, while creating an impact on more than 8000 lives. ■

For more information: <https://www.projectpalaash.com/>



Leverage the Power of Recycling for a Circular Economy

And Clean & Healthy Environment

Today, the world is producing twice as much plastic waste as two decades ago, with the bulk of it ending up in landfills, incinerated or leaking into the environment, and only 9 per cent successfully recycled, according to a new OECD report. On the contrary, a study by CSIR-NCL reveals that India recycles 90 per cent of its polyethylene terephthalate (PET) waste and outperforms Japan and the United States.

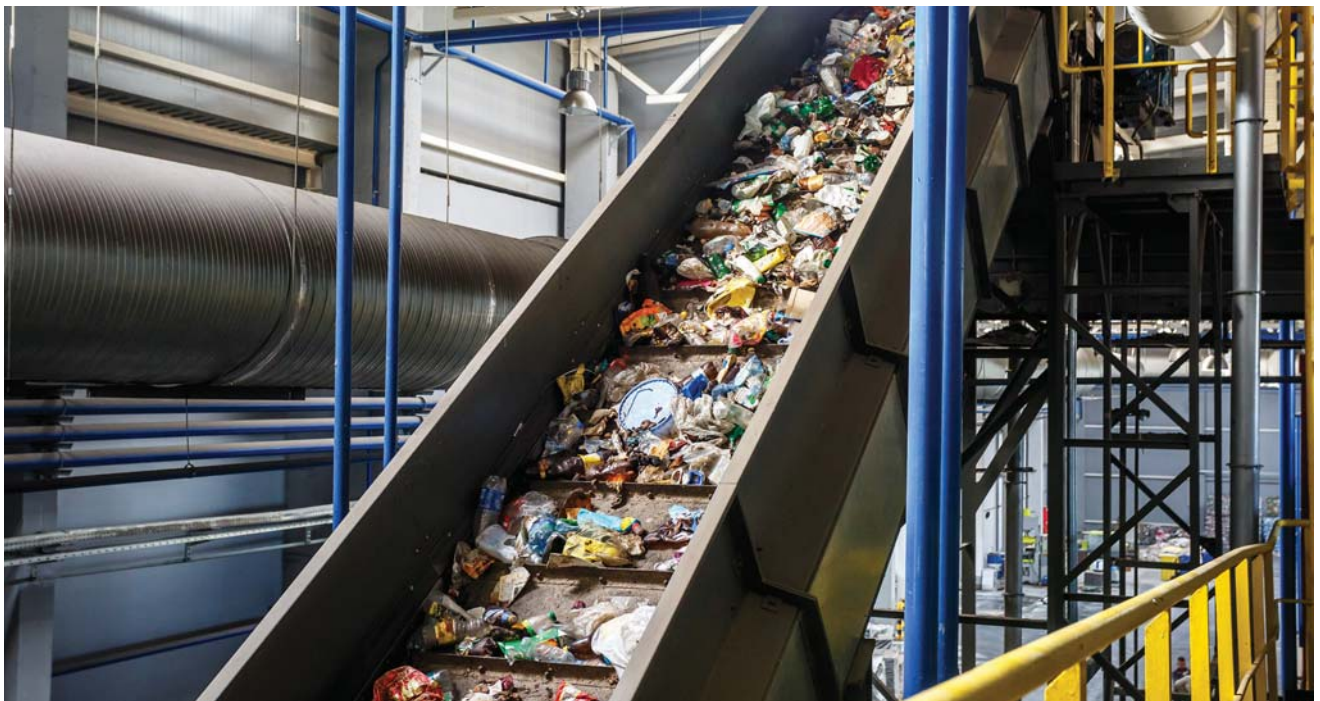
The report further validates that India is the second largest recycler of PET bottles globally. The comprehensive extended producer responsibility (EPR) guidelines notified by the Ministry of Environment, Forest and Climate Change (MoEFCC) is a welcome step towards streamlining the process of management of packaging waste. The EPR covers reuse, recycling, use of

recycled plastic content and end-of-life disposal by producers, importers, and brand-owners (PIBOs).

The new rules have numerous financial, environmental, and organizational benefits. The benefits of EPR include creation of a sustainable system focused on clean products and improved material management. It also reduces burden on municipalities and

simplifies issuance of recycler's certificate and ensures cheaper compliance costs.

EPR marks an important shift from a consumer-centric to a product-centric approach in addressing the life cycle of a product. Consequently, it also enables PIBOs to effectively manage their waste and promote the recycling culture in India. At the same time, it must be acknowledged that Indian PIBOs are



working in a concerted manner to boost collection and recycling initiatives while also working with plastic waste recyclers registered with the Central Pollution Control Board (CPCB). The commitment of PIBOs and other stakeholders will be key to a robust implementation of EPR in India. It is also important to bring together all PIBOs and Waste Management Agencies (WMAs), whether they are SME, MSME or corporate to register under PWM to ensure more transparency.

The theme announced by the United Nations Environment Programme (UNEP) for World Environment Day this year was “Only One Earth” and called for collective, transformative action at the global scale to protect and restore the planet. This is an opportune moment to acknowledge and celebrate the efforts of Indian Plastic industry as well as recognize initiatives of CPCB and the MoEFCC towards providing a blueprint to achieve a circular economy for India. No discussion on economy and environment can be complete without the inclusion of energy efficiency in all stages of production till the recycling stage. Especially for the FMCG industry, plastic packaging clearly has an obvious edge over glass primarily because glass production is a highly energy inefficient

process worldwide. It is important to consider effective mechanisms, which can monitor and reward Indian industry’s efforts towards recycling higher plastic waste year on year and set incentives for development of recycling infrastructure.

The high percentage of PET waste recycling in India evidently points at continuous capacity enhancement for recycling infrastructure. Unlike countries who choose to export plastic waste, India has developed an efficient infrastructure for recycling. Supported by a harmonious functioning of PIBOs, WMAs, informal sector and policy incentives, the Indian industry is leading globally in the area of PET bottle recycling and waste management. To show solidarity with industry which continues to expand aggregation and recycling capacities, the most judicious plan would be to prevent official prohibitions and promote ease of doing business.

Although India has achieved a high percentage of PET recycling, there is a potential for improvement through investments in infrastructure. Food Safety and Standards Authority of India (FSSAI) earlier this year approved the use of recycled plastics as food contact materials as per the draft Food Safety and Standards (Packaging) Regulations,



2022. Also, Food-grade rPET demand is slated to increase by 10 to 15-fold in India by 2030—almost solely driven by the packaging sustainability targets set by global F&B companies. Therefore, the industry should come together to identify recycling infrastructure as a priority, make necessary investments and set up requisite processes to accommodate food grade rPET generation.

Although brands are seeking to ramp up use of recycled materials, efforts are required to ensure a smooth supply chain where recycled commodities are connected with production. For recycling to be effective as a waste management solution, policymakers will need to focus on rigorous Information Education Communication (IEC) and Behaviour Change Communication (BCC) campaign for source segregation, capacity building of all the stakeholders, ensure source segregation of waste as well as segregated collection and transportation of PET waste.

With the implementation of EPR rules, there is an impetus to create products that require reduced virgin resources, use recycled materials, and have an effective collection mechanism and this underlines an effort towards “Living Sustainably in Harmony with Nature”. ■

Article contributed by Vagish Dixit,
President PACE.



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- Wash your hands with soap and water frequently for 20 seconds or use alcohol-based hand rub. Do not touch your eyes, nose, or mouth if your hands are not clean.
- Cover your nose and mouth with a disposable tissue or flexed elbow when you cough or sneeze.
- Practice social distancing and avoid close contact with people who are unwell.
- Avoid mass gathering and crowded places.
- Get yourself and family members vaccinated at the earliest.



Sneeze inside the corner of elbow



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