

Green Initiatives

Lesson 15

KEY CONCEPTS

■ SDGs relating to pollution ■ Pollution Abatement ■ Circular Economy ■ Green Bonds ■ Green Energy Corridor ■ Production Linked Incentive (PLI) Scheme ■ International Solar Alliance ■ Digital Water Management ■ Wastewater Processing ■ Advanced Filtration ■ Decentralized Infrastructure ■ Desalination ■ Domestic Waste ■ Industrial Wastes ■ Agricultural Wastes ■ Commercial Wastes ■ Autoclaving ■ Incineration ■ E-Waste Management

Learning Objectives

To understand:

- Background on climate change
- Discussions on climate change in COP 26 and COP 27
- Scenario of increasing pollution and its perils
- Renewable energy scenario
- Water management scenario
- Waste management techniques
- Practical scenarios of waste management
- Other pertinent concepts

Lesson Outline

- Pollution abatement and testing
- Reduction in Carbon / CHG Emissions
- Resource efficiency
- Renewable Energy Intensity
- Water Management
- Waste Management
- Lesson Round-Up
- Glossary
- Test Yourself
- List of Further Readings
- Other References

INTRODUCTION

Climate change is a global phenomenon and all the countries and various global forums are paying utmost attention to it, as rising GHG (Green House Gas) emissions are hazardous for both people as well as planet. The global temperature has already soared 1.1°C above the pre-industrial level, with glaciers melting and the sea level rising. Impacts of climate change also includes flooding and drought, displacing millions of people, sinking them into poverty and hunger, denying them access to basic services, such as health and education, expanding inequalities, stifling economic growth and even causing conflict.

Taking urgent action to combat climate change and its devastating impacts is therefore an imperative to save lives and livelihood, and key to making the 2030 Agenda for Sustainable Development and its 17 Goals, i.e., the blueprint for a better future a reality.

The following developments contributing to a gloomy ecosystem triggers the need for espousing green initiatives –

- (i) The global annual mean temperature is projected to rise beyond 1.5°C above pre-industrial levels in at least one of the next five years.
- (ii) Global carbon dioxide (CO₂) emissions declined by 5.2 per cent in 2020 due to lowered energy demand caused by COVID-19-induced social and economic disruptions. But with the phasing out of COVID-related restrictions, energy-related CO₂ emissions for 2021 rose by 6 per cent, reaching their highest level ever.
- (iii) Climate finance provided and mobilized by developed countries totalled \$79.6 billion in 2019, up from \$78.3 billion in 2018. It is estimated that \$1.6 trillion to \$3.8 trillion will be needed each year through 2050 for the world to transition to a low-carbon future and avoid warming exceeding 1.5°.
- (iv) About one third of global land areas will suffer at least moderate drought by 2100.
- (v) The sea level could rise 30 to 60 centimetres by 2100, even if greenhouse gas emissions are sharply reduced and global warming is limited to well below 2°C.
- (vi) About 70 to 90 per cent of warm-water coral reefs will disappear even if the 1.5°C threshold is reached; they would die off completely at the 2°C level.
- (vii) 3 billion to 3.6 billion people live in contexts that are highly vulnerable to climate change.
- (viii) By 2030, an estimated 700 million people will be at risk of displacement by drought alone.

Now coming to Indian scenario on climate change, there seems to be a light at the end of the tunnel by observing the rank it has secured in Climate Change Performance Index (CCPI). India has been ranked amongst top 5 countries in the world, and the best among the G20 countries, based on its Climate Change performance. India jumps 2 spots higher, and is now ranked 8th as per Climate Change Performance Index (CCPI, 2023) published by German Watch, New Climate Institute and Climate Action Network International based in Germany. The latest report of CCPI, released at COP 27 in November 2022, shows Denmark, Sweden, Chile and Morocco as the only four small countries that were ranked above India as 4th, 5th, 6th and 7th respectively.

India earned a high rating in the GHG Emissions and Energy Use categories, while a medium for Climate Policy and Renewable Energy. The aggressive policies of India towards rapid deployment of renewables and robust framework for energy efficiency programs have shown considerable impact. As per the CCPI report, India is on track to meet its 2030 emissions targets (compatible with a well-below-2°C scenario).

But despite an optimistic scenario, India has to go a long way in tackling the growing menace of GHG Emissions and pollution, as manifested from the following vital facts:

- (a) India has sizeable and growing energy needs, and with this, comes the prospect of spiralling greenhouse gas emissions (GHGs).
- (b) The country has made huge strides in improving energy access, but needs to continue to develop the energy network and diversify its fuel mix.
- (c) The country's path to decarbonization could be a net-positive one if it turns to low- and no-emissions technologies.
- (d) Any successful models it develops can be replicated in other economies, producing a beneficial effect for billions of people.

As per a study, it is expected that sometime in 2023, India will cross China in population and will become the country with largest population. A country with mammoth population and is witnessing industrialisation at an astounding pace, will have a huge demand for energy and with this there is a high probability of green house gas emissions. One of the biggest challenge for India is that on the one hand it is grappling with the issue of trying to quickly develop equitable economic growth to meet the changing needs and lifestyle hopes of its 1.4 billion people and on the other hand accomplishing national and international climate targets. However, it encouraging to see that India has been at the forefront of driving global action on climate change.

The need for having a congenial environment drives from the fact that more than 1.2 billion employment relies on a stable environment. In this regard, green initiatives act as a fulcrum in ensuring safe environment and conservation of natural resources. According to International Labour Organisation (ILO) Green Initiative throws light on the following three areas –

- (i) Advance research and understanding of the challenges and opportunities for the world of work arising from a green transition.
- (ii) Forge policy responses from the world of work in all sectors to ensure decent work and social justice for all.
- (iii) Build strategic partnerships at national, regional and international levels.

With the surge in pollution, i.e., air, water, soil etc., the world has witnessed climate change. Even though enforcement of the environmental laws has assisted in abating the environment related issues to some extent but they have also engendered a rise in the economic costs of products and services. These developments has encouraged policy makers to explore the relationship between environmental laws, industry competitiveness, and the organisations social responsibilities. In this regard, experts have concentrated on various factors exerting an impact on critical facets of environmental efficiencies like, public policies, energy policies and technological innovations. However, in view of substantial variations existing within the organisations that can affect the environment and its related factors, the researchers have commenced with the task of exploring the role of organisational structures in improving environmental efficiency.

With the onset of industrial revolution, numerous nations have embraced the process of industrialisation but they have paid the environmental cost as well. With the enhancement in industrialisation, people became more conversant with environmental-related matters. Similarly, along with rising environmental concerns, the organisations started to lay emphasis on improving the environmental efficiency. Therefore, it resulted into mounting pressure on the business enterprises or companies from all corners of the society, especially, civil society, environmentalists, to fulfil their obligations pertaining to environmental safety and protection. In this way, corporate social responsibility gained steam and become a norm for companies to conduct business activities.

Talking about 'Green Investment', an element of 'Green Initiative', there are two school of thoughts, first the traditional school of thought states that green or environmental investment is purely a cost and the modern

school of thought opines that environmental investment can bring future prosperity. In recent times, green investment has become an integral component of the firm's environmental strategy.

In view of the significance of the green investment by companies in protecting the environment, various factors have been considered as enabler of green investment, including green fees, eco-innovation, environmental technologies, waste discharge fees, pollution penalties, and so on.

With the passage of time, a significant relationship that has gained prominence is between corporate governance and green innovation. Modern day firms have become more focused about investing in green research and development activities that would lead them towards the trajectory of eco-innovations. However, it is to be noted that going green is relatively a newer concept that demands a shift in the firm's research and development culture, the introduction of new production techniques, investment in green technologies, and encouragement to novel ideas.

POLLUTION ABATEMENT AND TESTING

Pollution abatement refers to technology applied or measure taken to reduce pollution and/or its impacts on the environment. The most commonly used technologies are scrubbers, noise mufflers, filters, incinerators, waste-water treatment facilities and composting of wastes.

In other words, Pollution abatement refers to any measure taken to reduce, control or eliminate pollution from a given environment. Abatement measures can be technological, like catalytic converters on vehicles to reduce air pollution, or they may be regulatory, like laws limiting the amount of solid waste a sewage management facility can release into a waterway. Abatement measures may also be behavioural, like turning down a home thermostat a degree or two in winter to reduce electricity consumption and greenhouse gas emissions.

The need to espouse pollution abatement may be linked to the United Nations Environment Assembly of 2017, wherein to fight the pervasive impact of pollution on society, the environment ministers of the globe gathered to express their political commitment to work towards a pollution free planet. Governments also embraced resolutions targeting specific facets of pollution- air quality, water pollution, soil pollution, marine litter and microplastics, chemicals and wastes.

An implementation plan as devised, cutting across all these resolutions, with the aim to promote accelerated action, enhance capacities to address pollution and achieve the Sustainable Development Goals. The Environment Assembly welcomed the Plan and recognized it as the key vehicle for prompt implementation. It encouraged all Member States and relevant stakeholders to contribute to its effective implementation.

The Sustainable Development Goals (SDGs) pertaining to pollution is provided in table 1 below-

Table 1
SDGs relating to Pollution

Goal Number	Goal Title	Goal Description
1	No Poverty	Cleaner environments improve worker health and productivity and increase the number of days worked.
2	Zero Hunger	Better soil quality and uncontaminated land will reap higher quality harvests and help protect humanity's food sources.
3	Good Health and Well-Being	Action on pollution substantially reduces the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

Goal Number	Goal Title	Goal Description
4	Quality Education	A clean environment enables high-quality education, and education enables acquisition of the knowledge and skills needed to promote sustainable development and lifestyles.
5	Gender Equality	Pollution reduction can promote gender equality, for example through reduced burden of fetching clean water, cleaner indoor air quality and better health.
6	Clean Water and Sanitation	Addressing the contamination of water sources will help provide clean water and sanitation for all.
7	Affordable and Clean Energy	The development and dissemination of affordable, clean and efficient sources of energy and transport are key to cleaning the air.
8	Decent Work and Economic Growth	Improved worker health and well-being and toxin-free workspaces lead to increased productivity and economic growth.
9	Industry, Innovation and Infrastructure	Pollution avoidance through the adoption of green technologies and ecosystem-based solutions fosters innovation and sustainability in the industry and infrastructure sectors.
10	Reduced Inequalities	Pollution governance and actions can ensure that no group or community bears a disproportionate share of the harmful effects of pollution.
11	Sustainable Cities and Communities	Sustainable transport, waste management, buildings and industry lead to cleaner air in cities.
12	Responsible Consumption and Production	Proper management and disposal of chemicals and waste, and reduced food losses contribute to sustainable consumption and production practices.
13	Climate Action	Clean energy and low-carbon policies reduce air pollution and mitigate the impact of climate change
14	Life Below Water	Plastic and chemical pollution is causing great harm to all marine life and threatens life below water.
15	Life on Land	Thriving ecosystems require clean land and water sources. Tackling pollution is essential to protecting life on land.
16	Peace, Justice and Strong Institutions	Good Pollution-related governance reduces environmental burdens and injustices and can enhance the availability of 'saved' resources for the undeserved.
17	Partnerships for the Goals	Global partnerships to address pollution can have positive impacts on health, jobs, worker productivity the environment and well-being.

Source: *Beat Pollution, UN Environment Programme*

Industrialization, use of pesticides and nitrogen-based fertilizers, crop residues in agriculture, urbanization, forest fires, desert dust, and inadequate waste management have intensified environmental health risks and pollution, especially in low-and-middle-income-countries. At the same time, the global economy relies on deeply intertwined supply chains, sustained by more than 100 billion tons of raw materials entering the system each year. Intensive material consumption depletes natural resources and causes negative environmental impacts at every stage of the product life-cycle including production, use phase, and end-of-life. In light of the soaring wastes, the global waste is expected to increase to 3.4 billion tons by 2050.

Now before moving to pollution abatement initiatives at both global and Indian levels, it is essential to comprehend the concept of pollution testing.

Pollution Abatement – Global and Indian Initiatives

Indian Initiatives

Over the past several years, central and state government/agencies have launched several policies and programmes to combat the growing pollution levels across land, air and water. For example, in August 2019, the National Green Tribunal released an order to retrofit all operational DG sets with devices to reduce particulate matter (PM) emissions by at least 70%. Similarly, in January 2019, the central government launched the 'National Clean Air Programme' to reduce air pollution levels in 102 cities over the next five years.

Increasing levels of pollution and government policies/programmes to control the same have created business opportunities for established companies and start-ups. Numerous companies have ventured into this space with significant success, wherein a few companies expanded their existing product portfolios to meet the rising demand for air/water purifiers, while others established their businesses based solely on the demand for pollution reducing/recycling products and services. The sector of pollution control and waste recycling is highly under penetrated in the country has offers huge growth potential.

Another significant development that is a harbinger of India's determination towards pollution abatement is launching of long-term carbon development strategy at the COP-27 (UNFCCC COP 27). A Global call for Mission LiFE (Lifestyle for Environment) was given by Prime Minister of India, while delivering India's National Statement, at CoP26, held at Glasgow in October-November, 2021. Subsequently, Mission LiFE was launched at Ekta Nagar by Prime Minister of India, on 20 October 2022, in the presence of United Nations Secretary General, Mr Antonio Guterres. India participated in COP 27, with focus on mainstreaming the theme of LiFE - Lifestyle for Environment.

The Indian Pavilion at COP 27 highlighted the theme of LiFE in various ways – models, audio visual displays, activities and 49 side events with participation of various central government ministries, state governments, UN and multilateral organizations, public sector undertakings, think tanks, private sector, international organizations and civil society organizations. India invited all countries to join the LiFE movement which is a pro-people and pro-planet effort, seeking to shift the world from mindless and wasteful consumption to mindful and deliberate utilization of natural resources.

In continuation to the aforesaid noteworthy initiative, other vital measures taken by the government to provide a fillip towards pollution abatement are as under:

- (i) **Fostering Circular Economy:** Waste to Wealth: Honourable Prime Minister, in his address to the nation on the occasion of 75th Independence Day on 15.08.2021, highlighted India's action on 'Mission Circular Economy'. NITI Aayog constituted 11 Committees for development of circular economy (CE) action plans for different categories of wastes.

Circular Economy Action Plans for 10 waste categories (Lithium-ion batteries; E-waste; Toxic and hazardous industrial waste; Scrap metal (ferrous and non-ferrous); Tyre and Rubber; End of Life

Vehicles; Gypsum, Used Oil, Solar Panels and Municipal Solid Waste have been finalized, and are under implementation. Respective Nodal Ministries are coordinating on progress of implementation of these action plans. Ministry of Environment, Forest and Climate Change is the Nodal Ministry for Circular Economy Action Plan for Tyre and Rubber and stakeholder ministry in other CE Action Plans.

Regulations on market based Extended Producer Responsibility (EPR) principle have been notified for four categories of wastes i.e. plastic packaging waste, battery waste, e-waste and waste tyre.

“Extended Producer Responsibility (EPR) for Waste Tyre, 2022” on 21.07.2022.

“Guidelines on EPR for Plastic Packaging on 16.02.2022.

“Battery Waste Management Rules, 2022” on 22.08.2022.

“E-Waste (Management) Rules, 2022” on 02.11.2022.

In EPR for Plastic Packaging, targets for minimum recycling, minimum use of recycled content and use of rigid plastic packaging in identified sizes have been mandated. In rules incorporating EPR principle that have been notified/amended this year, different targets of minimum recycling, minimum recovery percentage and minimum use of recycled content have been given lead times to start with. The optimum level will be reached over a period of time. This has been done to provide time to the industry as well as recyclers for the development of systems and recycling infrastructure. Regulations to bring in EPR for end-of-life vehicles is under development.

The Waste-to-Wealth Mission/ Mission Circular Economy is bound to create new business models as well as new employment opportunities. This will also result in integration of informal sector. Participation of industry is of critical importance to make the Waste-to-Wealth Mission a success. This will result in moving away from mindless consumption to mindful utilisation and will help achieve the vision of Mission LiFE - Lifestyle for Environment given by Honourable Prime Minister.

- (ii) **National Clean Air Programme (NCAP):** The Ministry of Environment, Forest and Climate Change (MoEF&CC) has been implementing since 10th January, 2019, a National Clean Air Programme (NCAP) as a national-level strategy outlining the actions for reducing the levels of air pollution at city and regional scales in India. Rs. 7100 crore have been released to 131 cities till date under NCAP & XVFC for implementing actions stipulated under city action plan. Fixed city wise year wise targets for improvement in air quality for FY 2021-22 to 2025-26 for this MoUs have been signed with NCAP cities between CPCB, SPCB and ULB and 42 MPCs between the MoEF&CC, State government and Urban local bodies under XVFC.

The national level plan: a comprehensive action plan has been prepared from 7 line ministries under NCAP which includes the action plans of different Ministries/ Departments of Government of India. This includes convergence of schemes/ programmes of different Ministries/ Departments.

State Action Plans are under process and received from 10 States/ UTs so far. City Action Plans are prepared by cities for implementation of activities which assists in air quality improvement. 88 Institute of Reputes (IoRs) are assigned to 131 NACs for capacity building and for effective implementation of City action plans.

MoEF&CC conducted regional workshops for sensitization, knowledge sharing and capacity building of the stakeholders in the State (3 regional workshops have been conducted so far and a National Conference on VAYU in Odisha).

MoEF&CC has also launched “PRANA” a portal for monitoring implementation of NCAP on the occasion of International day of clean air for blue skies on 7th September 2021 and in 2022 released brochures/ booklets on Guidelines for Capacity Building & Public Outreach.

Guidelines for release of funds under NCAP, Operational Guidelines for release of grants under Fifteenth Finance Commission along with that released booklets on best practices undertaken by various cities in sectors for abatement of emissions from waste and biomass dumping and burning, for abatement of vehicular emissions, Road dust and construction & demolition waste management, capacity building & monitoring network etc.

The Swachh Vayu Survekshan guidelines for Ranking of cities under NCAP has been issued to cities- 9 cities are awarded with a cash prize of 5 crores under 3 categories on 3rd December 2022 during VAYU conference in Bhubaneswar, Odisha.

An overall improvement in ambient air quality has been observed in 95 cities during 2021-22 as compared to 2017. 18 cities were found to be within the prescribed National Ambient Air Quality Standard (PM10 less than 60^µg/m³) in 2019-20 which has increased to 20 in year 2021-22.

- (iii) **Establishment of Asia's largest Ramsar Sites network:** On the eve of 76th Independence Day (15th August 2022), India added ten wetlands to the List of Wetlands of International Importance (also called Ramsar Sites) within the framework of the Ramsar Convention, taking the total number of Ramsar Sites in India to incredible 75, the highest in Asia, in the 75th year of its independence.

India ratified the Ramsar Convention in 1982. Keoladeo National Park (in Rajasthan) and Chilika (in Odisha) were the first two sites to be placed on the Ramsar List by the Government of India. Till 1990, only four more sites were added to the list, and another 20 over the following two decades. Since 2014, Ramsar Site designation has received a significant policy push from the MoEFCC, and 49 wetlands have been added to the list. The network of Indian Ramsar Sites currently covers 1.33 million ha, which is approximately 8% of the known wetland extent of the country.

Ramsar Sites form an international network of wetlands which are important for conserving global biological diversity and sustaining human lives through the maintenance of their ecosystem components, processes and services. The international significance of these sites is indicated by their fulfilling at least one of the nine criteria set by the Convention. With 2,455 sites spanning 255.8 million ha, the Ramsar sites represent the world's largest protected area network.

The Ramsar sites in India are highly diverse. The contribution that Ramsar sites make to biological diversity can hardly be over emphasised. A recent compilation of faunal diversity of 42 Indian Ramsar Sites by the Zoological Survey of India enlists 6200 species. For several of the faunal groups, these wetlands represent a significant share of the known diversity (for example, over one-third of recorded mammalian species, one-fifth of reptiles, and about two-thirds of known bird species). While the smallest Ramsar Site is just 19.75 ha in the area (Vembannur), the largest, the Sunderbans, spans 0.42 million ha.

Ramsar Sites are one of the three pillars of the Ramsar Convention, the other two being working towards the wise use of wetlands and cooperating internationally on transboundary wetlands, shared wetlands and shared species. The Ramsar Convention's pillar of wetlands wise use is very well aligned with L.I.F.E., international mass movement launched by Prime Minister Narendra Modi towards "mindful and deliberate utilization, instead of mindless and destructive consumption" to protect and preserve the environment.

Since 1986, the MoEFCC has been implementing a national scheme (presently known as the National Plan for Conservation of Aquatic Ecosystems) to assist state governments in preparing and implementing integrated management plans for Ramsar sites and other priority wetlands. Ramsar sites receive legal protection under Wetlands (Conservation and Management) Rules, 2017. Each Ramsar site needs to have a management plan which outlines the pathway to wise use. A diagnostic approach for developing such management plans has been prescribed by the Ministry. In June 2022, the Ministry also formulated the 'Sahbhagita Guidelines' outlining an "all of society" approach and governance framework for wetlands conservation in the country.

- (iv) **Ban on identified Single Use Plastics from 1 July 2022 and Plastic Waste Management:** India has taken resolute steps to reflect its commitment to eliminate single use plastics that are not biodegradable and have an adverse impact on environment. The strategy adopted by the Government to tackle unmanaged and littered plastic waste has two pillars – ban on single use plastic items which have high littering potential and low utility, and implementation of extended producer responsibility on plastic packaging.

The country has taken a defining step to eliminate single use plastics. A ban has been imposed on identified single use plastic items from 1st July 2022. The ban was notified on 12th August 2021.

Ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, polystyrene (Thermocol) for decoration; Plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping or packing films around sweet boxes, invitation cards, and cigarette packets, plastic or PVC banners less than 100 microns, stirrers. Thickness of Plastic carry bags increased to 75 microns (30.9.2021) and to 120 microns (31.12.2022).

The introduction and use of alternatives to banned single use plastic items have led to creation of new employment opportunities, promote innovation and development of new business models. The manufacturing of alternatives with eco-friendly material in the MSME sector will further support development of Atmanirbhar Bharat.

India had piloted a resolution in 2019 for addressing pollution caused by single use plastics which was adopted by the 4th meeting of United Nations Environment Assembly in 2019.

To develop alternatives to single use plastics “India Plastic Challenge – Hackathon 2021” was organized by the Ministry of Environment, Forest and Climate Change, for start-ups and students of colleges and Universities. Two startups in the area of alternatives to single use plastics were awarded. A completely biodegradable alternative to thermocol from paddy straw waste (Parali) has been developed. This innovation will use Parali and also replace thermocol. Packaging material from seaweed has been developed as innovative alternative to single-use plastics.

National Expo on Eco-Alternatives to single use plastic and start up conference 2022 held on 26th and 27th September 2022 in Chennai. More than 150 manufacturers of eco-alternatives from across the country are participating in the Expo. The eco-alternatives included material made from sea-weed, bagasse, rice and wheat bran, rice stubble, plant and agricultural residue, banana and areca leaves, jute and cloth.

Prakriti - Messenger of the Earth was launched as a mascot of sustainability and protection of environment spread awareness amongst general public. A public movement is being built on elimination of single use plastics by NSS, NCC and more than 100,000 eco-clubs in schools and colleges. Puneet Sagar and Swachh Sagar Surakshit Sagar Campaign have showcased the importance of collective action in maintaining clean beaches and coasts.

The Guidelines for Extended Producer Responsibility on plastic packaging are unique and have led to the establishment of world’s biggest framework for EPR implementation on plastic packaging. The implementation of EPR on plastic packaging will lead to reduction in littered and unmanaged plastic waste in the country, promote circular economy of plastic packaging waste promote development of new alternatives to plastics and development of new business models move towards sustainable plastic packaging. The EPR framework is implemented through a centralized online portal ensuring ease of doing business.

The Guidelines for EPR in plastic packaging promote an environmentally conscious lifestyle that focuses on ‘mindful consumption’ through the reuse of rigid plastic packaging and sustainable plastic

packaging instead of 'mindless and destructive consumption' of single-use plastics. The Guidelines for EPR in plastic packaging give a push for reducing plastic footprint in packaging through the use of recycled plastic content in manufacturing of plastic packaging material.

(v) **Budgetary Approach:** The Union Budget 2023-24 has espoused a futuristic approach towards environment. The approaches are as under:

- (a) Mangrove Initiative for Shoreline Habitats & Tangible Incomes', MISHTI, to be taken up for mangrove plantation along the coastline and on salt pan lands, through convergence between MGNREGS, CAMPA Fund and other sources.
- (b) Green Credit Programme to be notified under the Environment (Protection) Act to incentivize and mobilize additional resources for environmentally sustainable and responsive actions.
- (c) Amrit Dharohar scheme to be implemented over the next three years to encourage optimal use of wetlands, enhance bio-diversity, carbon stock, eco-tourism opportunities and income generation for local communities.
- (d) Looking at the previous union budget 2022-23, the Ministry of Environment, Forests and Climate Change has been allocated Rs. 3,030 crore, which is a 20% increase over the revised estimates in 2021-22.

(vi) **Green Bonds:** The Government of India has given approval for the sovereign green bonds framework which in turn has provided impetus to India's commitment towards its Nationally Determined Contribution (NDCs) targets, adopted under the Paris Agreement, and help in attracting global and domestic investments in eligible green projects. The proceeds generated from issuance of such bonds will be deployed in Public Sector projects which help in reducing carbon intensity of the economy.

The Framework comes close on the footsteps of India's commitments under "Panchamrit", as explained by the Honourable Prime Minister at COP 26 Glasgow in November 2021. The approval for green bonds is a metaphor of the fulfilment of the government's announcement in the Union Budget 2022-23 that sovereign green bonds will be issued for mobilising resources for green projects.

REDUCTION IN CARBON / GHG EMISSIONS

Discussing about reduction in carbon / GHG emissions, it is imperative to comprehend the concept of climate change and its related developments, as carbon and GHG emissions are major contributors towards climate change. Climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere.

Studies indicate that the amount of greenhouse gases including carbon dioxide, methane, and nitrous oxide in the atmosphere have increased rapidly over the last few centuries as a result of human activities. The increased concentration of greenhouse gases in the atmosphere has led to a rise in global temperatures leading to other changes in global climate, such as erratic rains, floods, and cyclones.

According to the Intergovernmental Panel on Climate Change (IPCC), the average global temperature is estimated to have increased by 0.85°Celsius (°C) between 1880 and 2012. At the end of the 21st century, the increase in global temperature is likely to exceed 1.5°C as compared to pre-industrial levels (1850 to 1900). However, in August 2021, the IPCC estimated that a 1.5°C increase may happen much earlier, by 2040.

This could lead to a reduction of the snow cover, increase in heat waves, extreme precipitation, intensification of tropical cyclones and increase in sea levels. Over the years, several international efforts have been made for global co-operation to address issues of climate change. In 1992, the United Nations Framework Convention on Climate Change (UNFCCC), an international framework for cooperation was established to stabilise greenhouse gas concentrations in the atmosphere.

The European Union (EU) has dedicated a modernisation fund to support 10 lower-income EU Member States in their transition to climate neutrality. Further, EU has also proposed that at least 25% of its expenditure will contribute to climate action during 2021-27. The United States of America (USA) has called for the preparation of a Climate Finance Plan, to focus on international climate finance. USA intends to double its annual public climate finance to developing countries by 2024.

After India's announcement of additional targets at COP26, experts have estimated that India will require over Rs. 700 lakh crore to meet its goal of net zero emissions by 2070. Of this, investment of over Rs. 600 lakh crore will be required to shift to renewable energy sources. This financing called for significant actions across all the ministries.

To combat the menace of growing carbon emission substantial investment is needed in India for implementing measures relating to climate change. The Economic Survey (2020-21) observed that India is relying on domestic resources to implement adaptation and mitigation action for climate change. It noted that the financing considerations will remain critical as the country had increased its targets substantially. Preliminary estimates provided by the NDC indicate that India's climate change actions till 2030 will require financial resource of USD 2.5 trillion (at 2014-15 prices). It recommended a clearer assessment of the financial requirement for implementing the NDC for appropriate allocation of resources. Further, the possible sources for meeting these requirements should also be devised.

The silver lining is that currently 100% Foreign Direct Investment is allowed in renewable energy sector. India attracts \$13 bn FDI in non-conventional energy sector. As per the estimates India could attract close to \$10 bn in renewable energy investment in 2023. India ranks 3rd in renewable energy country attractive index in 2021 and 3rd largest energy consuming country in the world. India stands 4th globally in Renewable Energy Installed Capacity (including Large Hydro), 4th in Wind Power capacity & 4th in Solar Power capacity (as per REN21 Renewables 2022 Global Status Report, <https://www.ren21.net/gsr-2022/>).

India has already set an ambitious target of accomplishing a capacity of 175 GW of renewable energy by 2022, which expands to 500 GW by 2030. It is to be noted that this is the world's biggest expansion plan in renewable energy.

India's installed renewable energy capacity has increased 396% in the last 8.5 years and stands at more than 159.95 Giga Watts (including large Hydro), which is about 40% of the country's total capacity (as on 31st March 2022). The installed solar energy capacity has increased by 19.3 times in the last 8 years, and stands at 56.6 GW as of 1st June 2022. The installed Renewable energy capacity (including large hydro) has increased from 76.37 GW in March 2014 to 159.95 GW in May 2022, i.e. an increase of around 109.4%. The installed power capacity in the country is around 408.72 GW as of 30th November 2022.

India achieves 166GW of renewable energy capacity till October 2022. India has achieved its NDC target with total non-fossil based installed energy capacity of 159.95 GW which is 41.4% of the total installed electricity capacity. The installed capacity of renewable energy is provided in table 2 below-

Table 2
Installed Capacity of Renewables

<i>Sl. No.</i>	<i>Source of Renewable Energy</i>	<i>Installed Capacity</i>
1	Wind Power	41.2 GW
2	Solar Power	59.34 GW
3	Biomass/Co-generation	10.2 GW

<i>Sl. No.</i>	<i>Source of Renewable Energy</i>	<i>Installed Capacity</i>
4	Small Hydro Power	4.88 GW
5	Waste To Energy	0.47 GW
6	Large Hydro	46.85 GW

India has set a target to reduce the carbon intensity of the nation's economy by less than 45% by the end of the decade, achieve 50% cumulative electric power installed by 2030, and achieve net-zero carbon emissions by 2070. Low-carbon technologies could create a market worth up to \$80 bn in India by 2030.

India has been ranked amongst top 5 countries in the world, and the best among the G20 countries, based on its Climate Change performance. India jumps 2 spots higher, and is now ranked 8th as per Climate Change Performance Index (CCPI, 2023).

India's target is to produce 5 MT of green hydrogen by 2030. Green Hydrogen target is set at India's electrolyzer manufacturing capacity is projected to reach 8 GW per year by 2025. The cumulative value of the green hydrogen market in India could reach \$8 bn by 2030 and India will require at least 50 gigawatt (GW) of electrolyzers or more to ramp up hydrogen production.

As the concept of net-zero emissions is becoming a top priority across the globe. Numerous countries are introducing schemes and campaigns to encourage the adoption of climate-smart actions. India is the 4th largest emitter of carbon dioxide, and is fortunately geared to tackle this issue by bringing forth multiple projects. In this regard, the Indian corporate sector is contributing substantially to reduce carbon emission. Sixty-four businesses based in India are already preparing strategies to achieve the goal of net-zero emission. These companies have made commitments to support the government's climate protection schemes. Some popular names include Mahindra & Mahindra, Wipro, HDFC banks etc.

Several Indian companies have partnered with the Confederation of Indian Industry (CII) to set targets to cause no net biodiversity loss. They have committed to addressing air pollution and working towards a circular economy, while also removing the commodity-driven deforestation in the sector of supply chains. There has been an increase in transparency regarding the environmental footprints of businesses. Companies that support green operations are advancing with greater finance and valuation.

Investors today show interest in comprehending the tracks of past emissions and future carbon footprint estimates of companies. This change has been encouraging many businesses to build eco-friendly strategies. However, several businesses find it hard to perform eco-friendly investments, hindering them from achieving their goals.

RESOURCE EFFICIENCY

Resource efficiency means using the Earth's limited resources in a sustainable manner while minimising impacts on the environment. It allows us to create more with less and to deliver greater value with less input.

Resource efficiency stands for the relationship between natural raw materials or technical-economic materials and the benefits gained from their use, whether in production or consumption. The aim is to maximize the benefits of products or services while minimizing consumption and waste. The less energy and material required to produce a product the better.

Continued worldwide population growth is resulting in a global increase in demand for products and associated resources. Currently, our society consumes more resources than the earth can provide and renew. Improved efficiency can counteract the soaring consumption of raw materials.

At this juncture, it will be interesting to know the ways to improve resource efficiency in business organisations-

- (i) **Application of waste hierarchy:** The Waste Hierarchy ranks waste management options according to what is best for the environment, with prevention being the most desirable option and disposal being the least. To put this in place, one should identify what type of waste the business creates, if any of this waste can be re-purposed, if recycling more waste materials is possible, and if any organic waste (e.g. food/garden waste) can be used to create renewable energy or composted.
- (ii) **Waste assessment:** Assessing waste will not only help the organisation to apply waste hierarchy, but also to identify problem areas and develop a plan of action. The management might discover that a particular process is causing more waste than realised, or that a different material can be used in place of a less efficient one.
- (iii) **Controlling of waste:** By enhancing accuracy, improving communication, and providing the appropriate tools and training, the management can assist its team in reducing wastages, thereby saving cost and also contribute substantially towards preserving the environment.
- (iv) **Implementation of Environmental Management System:** Environmental management systems, such as ISO 14001, are becoming increasingly popular for businesses looking to reduce their environmental impact. These management systems can help an organisation to improve its environmental performance, reduce environmental liability, and decrease costs.
- (v) **Reduce Energy Consumption:** By reducing the consumption of energy, an organisation can save both energy as well as costs. Some of the ways to reduce energy consumption include turning off lights and equipment when not in use, use cold water rather than hot water where possible, and utilising power saving functions in usage of various machines and other electrical gadgets.
- (vi) **Increase Energy Efficiency:** Not only the business organisation can take steps to reduce energy consumption in the workplace, but can also make changes in order to improve energy efficiency. For example, the business enterprise could change its lights to LEDs which use up to 90% less energy than traditional incandescent bulbs.
- (vii) **Communication with staff:** It is essential that management communicate the organisation's goals clearly to its human capital for enhancing efficiency and reduce waste in the workplace. Further, clarity in communication assist in creating an awareness among the team members as to what is expected from them by the management.

Participative management style needs to be embraced wherein the human capital employed at various levels of the hierarchy are consulted in order to obtain their views / suggestions on improving efficiency in production and reducing wastages.

- (viii) **Using Re-use and Refill Approach:** According to the United Nations Environment Programme, only about 9 percent of the 9.9 billion tons of plastic generated globally since the 1950s has been recycled. And almost half of the plastic waste poisoning marine life, contaminating food, and clogging waterways and sewers comes from consumer packaging. As citizens and governments wake up to this plastic pollution problem, they're turning to business to solve it. In response, companies are trying to craft new approaches to plastic, whether reducing over packaging or rolling out biodegradable materials made of seaweed and corn-starch. But one solution – the reuse and refill business model – stands out for its potential to shift consumer behaviours while unlocking new revenue streams and cost savings for companies.

In leading companies, the concept of sustainability has been around a long time. Procter & Gamble, for example, has been making its Tide bottles with 25 percent recycled plastic for more than two decades. SodaStream, PepsiCo's sparkling water-making home appliance, which provides consumers with a

fun, healthy, and eco-friendly experience. With reusable bottles and compressed CO₂ in returnable cylinders, consumers can make their own flavored sparkling water at home. As a bonus, they can help a brand that aims to eliminate 67 billion plastic beverage bottles by 2025.

Some reuse models, already woven into the culture and lifestyle of developing countries, are making their way into mature markets. In bustling Mumbai, the 130-year-old dabbawalla lunch system serves as many as 200,000 meals per day to the city's workers in metal lunchboxes and then collects the empty containers for reuse.

- (ix) **Reduce Wasteful Office Practices:** Going by the waste hierarchy, the best-case scenario is to prevent waste, even if it is recyclable. With this in view, the management may review the office practices to find ways to limit waste. Printing is one of the biggest culprits for unnecessary waste in the office – to combat this the management may discourage printing of long documents and prefer e-version of the documents as far as possible.
- (x) **Understand the Legislation:** It is essential that to comprehend the regulatory framework that governs the waste generated by the organisation. In this regard, the business organisations may adopt the following:
 - (a) Keep waste to a minimum.
 - (b) Sort and store waste correctly.
 - (c) Complete waste transfer notes.
 - (d) Ensuring registration of waste carrier.
 - (e) Ensuring that waste carrier disposes off the waste legally.

RENEWABLE ENERGY INTENSITY

Energy intensity is the amount of energy required to produce one unit of gross domestic product (GDP). Going by this definition, it may be opined that the intensity of renewable energy is increasing both at global and at national levels. The ensuing paragraphs highlights the growing intensity of renewable energy.

By 2024, almost 33 percent of the world's electricity is forecast to come from renewables, with solar photovoltaic (PV) accounting for almost 60 percent (or at least 697 gigawatts) of expected growth, according to Renewables 2019, a report from the International Energy Agency published in November 2019. Onshore wind (309 GW), hydropower (121 GW), offshore wind (43 GW) and bioenergy follow (41 GW).

Drastically lower production costs, growing concern around climate change, evolving global energy policies and increased pressure from investors on companies to adopt environmental social governance (ESG) policies are pushing renewables into the mainstream.

To comprehend the renewable energy intensity scenario at global level, the following economies have been referred as sample-

- (i) **Canada:** Riding the momentum of the Pan-Canadian Framework, by 2023, 85% of Canada's electricity will be produced by non-emitting sources—giving most Canadians the ability to power their lives with the clean energy of their choice. The Framework aims to support a transition to a clean electricity future by increasing the amount of electricity generated by renewable and non-emitting sources, connecting clean power with places that need it, modernizing electricity systems, and reducing northern and remote communities' reliance on diesel. Its goal is to have 90% of the country's electricity coming from non-emitting sources by 2030.

- (ii) **USA:** Natural gas will become the biggest source of electricity on the US grid, allowing renewables (solar, wind, hydropower, geothermal and biomass) to rise along with it, regularly outproducing coal in U.S. electric power generation by 2023.
- (iii) **South Africa:** With sporadic power outages the norm and the country's power crisis growing on the heels of a struggles at Eskom, the country's main electricity supplier, the Department of Energy will accelerate its alternative energy program. The department will do it by encouraging private investment into solar plants for consumption by Eskom. As a result, coal will be responsible for 60% of the national power sector's electricity generation, down from more than 85% currently.
- (iv) **Portugal:** Portugal's 15-year biomass energy installations scheme, boosted by a recent €320 million received from the European Commission, will serve as the new blueprint for how Europe produces biomass energy as a way to reduce dependence on coal and mitigate natural disaster risk.
- (v) **Malaysia:** On the heels of the country's expanding manufacturing capacity for renewables and declining production costs, Malaysia will begin maximising its strategic location for solar generation ahead of schedule: The country will increase its energy generation from renewable sources from 2% in 2018 to 25% by 2023.

India's Renewable Energy Scenario

With a population of 1.3 billion, India has a massive demand for energy to fuel its rapidly growing economy. From a power deficit nation at the time of Independence, the efforts to make India energy-independent have continued for over seven decades. Today, we are a power surplus nation with a total installed electricity capacity of over four lakh MW.

Keeping in mind the sustainable development goals, India's power generation mix is rapidly shifting towards a more significant share of renewable energy. Today, India is the world's third largest producer of renewable energy, with 40% of its installed electricity capacity coming from non-fossil fuel sources.

As a developing nation at the time of Independence, India relied heavily on coal to meet its energy demands. However, India has always been committed to looking for more alternative energy sources for sustainable development. The beginning was made with hydropower, with major hydroelectric power projects appearing on the scene of India's energy arena. Over the years, many policy and regulatory initiatives have promoted hydropower development and facilitated investments. Today, we are 5th in the world regarding usable hydropower potential.

Bhabha Atomic Research Centre (BARC) was founded in the 1950s to secure the country's long-term energy independence. Today, we are the only developing nation with indigenously developed, demonstrated and deployed nuclear reactors for electricity generation. This was made possible through several decades of extensive scientific research and technology development.

Work on wind energy started in India during the 1960s when the National Aeronautical Laboratory (NAL) developed windmills, primarily for supplying irrigation water. Today, we have the 4th largest wind power capacity in the world, blessed with a constant movement of wind, especially in the Southern, Western and North Western regions.

Solar energy-based applications have benefited millions of Indians by meeting their cooking, lighting and other energy needs in an environment-friendly manner. Having achieved large-scale success in solar energy solutions, India has spearheaded the International Solar Alliance (ISA) which is an action-oriented, member-driven, collaborative platform for increased deployment of solar energy technologies. The membership of the ISA is open to all member-states of the United Nations, and 107 countries are signatories to the ISA Framework Agreement at present. The Alliance aims to efficiently utilise solar energy to reduce fossil fuel dependence, thereby creating a greener planet.

Biomass has also been an essential source of energy for India. It is renewable, widely available, carbon-neutral and has the potential to provide significant employment in rural areas. Rapidly evolving technology has enabled thermal power plants to have more economical and energy-efficient operations. India has co-fired biomass in thermal plants across the country to reduce its CO2 footprint in thermal power generation. biomass power/co-generation programme since mid-nineties. Over 800 biomass power and bagasse/non-bagasse cogeneration projects have been installed in the country for feeding power to the grid.

Even though it supports the second largest population in the world, India's sustained efforts have ensured that its per capita CO2 emissions are much lower than the global average. The US emits 14.7 tonnes per capita, China emits 7.6 tonnes per capita, while India's CO2 emissions amount to 1.8 tonnes per capita.

India has always shown its willingness in leadership to fight climate change. The country's vision is to achieve Net Zero Emissions by 2070, in addition to attaining the short-term targets which include:

- Increasing renewables capacity to 500 GW by 2030.
- Meeting 50% of energy requirements from renewables.
- Reducing cumulative emissions by one billion tonnes by 2030.
- Reducing emissions intensity of India's gross domestic product (GDP) by 45% by 2030.

Proclivity of corporates towards renewable energy

Tech majors such as Amazon, Meta and Google have been the largest investors in clean energy, including wind and solar power. According to a report by an industry group, named the American Clean Power Association, Amazon, Facebook's parent company Meta and Google which is a subsidiary of Alphabet have been listed as the top three corporate buyers of wind and solar energy.

In India too, corporate houses are showing inclination towards usage of renewable energy in their business processes. According to a report published by WWF (World Wide Fund for Nature) revealed that 69% of the top 100 companies in NSE by market capitalisation procure renewable energy in some form and 22 percent have clean energy procurement targets.

The Central Electricity Authority or CEA predicts 66% share of India's total electricity production by 2030 will be consumed by commercial or industrial customers, compared to 50% in 2018. So, RE adoption by India Inc. is key to the country's success in its climate commitments, energy security and reduction of carbon footprint.

WATER MANAGEMENT

Access to safe water, sanitation and hygiene is the most basic human need for health and well-being. Billions of people will lack access to these basic services in 2030 unless progress quadruples. Demand for water is rising owing to rapid population growth, urbanization and increasing water needs from agriculture, industry, and energy sectors.

Decades of misuse, poor management, over extraction of groundwater and contamination of freshwater supplies have exacerbated water stress. In addition, countries are facing growing challenges linked to degraded water-related ecosystems, water scarcity caused by climate change, underinvestment in water and sanitation and insufficient cooperation on trans boundary waters.

Water management is the activity of planning, developing, distributing and managing the optimum use of water resources. Water is a basic necessity. No living creature can live without water. There's a scarcity of water. To avoid this scarcity, water is saved and managed efficiently.

The private sector is increasingly reporting water as a material risk. Water risks like scarcity, floods and droughts

can cause operational and supplier disruptions, higher operational costs, brand damage and heightened regulatory uncertainty. These risks pose threats not only to businesses themselves, but the people who rely on them for employment and services.

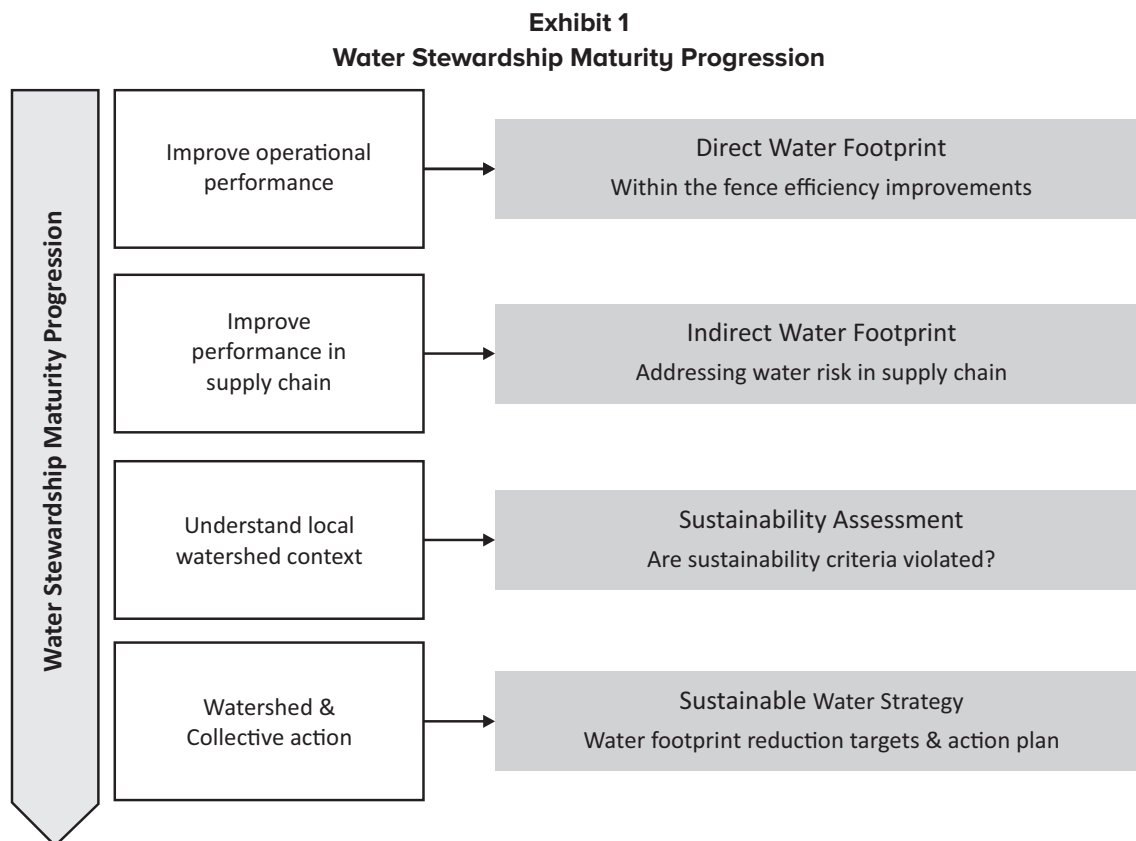
In a water-stressed world, there's a powerful business case for companies to manage this essential resource sustainably, engage in water stewardship and drive collective action. As a shared resource, water provides diminished benefits to all if each user acts only in their own self-interest. Addressing today's acute water problems – including droughts, dwindling groundwater and failing infrastructure – will require coordinated, collective responses.

Companies across sectors, non-profits, disclosure initiatives, industry associations and investor groups recognize this challenge and have responded with a range of water stewardship frameworks. Water stewardship is defined as using water in a way that is socially equitable, environmentally sustainable and economically beneficial. This is achieved through a stakeholder inclusive process that involves site and catchment based actions.

The global sustainable water supply is estimated to be 4,200 km³ per year. In 2000, global water use stood at 3,950 km³. For 2030, global water demand is projected to be 6,900 km³, exceeding the sustainable supply by 40 per cent. The Organisation for Economic Co-operation and Development (OECD) forecasts that global water demand for manufacturing industries will increase by 400 per cent from 2000 to 2050.

Water stewardship is a collaborative and multi-stakeholder approach that aims to achieve social, environmental and economic benefits. By using Water Footprint Assessment, a company can ensure that all stakeholders are well informed and good river basin governance is developed.

Please refer exhibit 1 for water stewardship maturity progression.



Source: Water Footprint Network

With reference to Global Water Standard, in 2014, the Alliance for Water Stewardship (AWS) launched the world's first international standard to promote freshwater use in a way that is socially beneficial, environmentally responsible and economically sustainable. WWF, with multiple stakeholders, led the establishment of AWS and the creation of the standard with the vision of helping companies to become better stewards and demonstrate leadership in conserving the planet's limited fresh water.

Through the Alliance for Water Stewardship (AWS), WWF partners with global leaders in sustainable water management to promote the use of fresh water in a way that is socially, economically, and environmentally beneficial.

As one of the founding board members, WWF worked alongside the following organizations to establish the AWS as an independent non-profit organization dedicated to advancing water stewardship:

- The Nature Conservancy
- Water Stewardship Australia
- Pacific Institute
- CDP
- United Nations Environment Programme
- UN Global Compact's CEO Water Mandate
- European Water Partnership
- Water Environment Federation
- Water Witness International

As part of AWS's Secretariat, WWF led the development of the International Water Stewardship Standard 1.0, the first global framework to promote sustainable fresh water use, following ISEAL's Codes of Good Practice.

The Standard defines criteria for good water stewardship and was designed to align with other sustainability initiatives and support independent certification with varying levels of recognition. It was developed through a four-year, multi-stakeholder, global water roundtable process that included a diversity of business, public sector and civil society interests from around the world, as well as pilot projects held in seven countries.

Top Water Management Trends

At this juncture it will be of paramount academic interests to explore top water management trends that are as under:

1. **Digital Water Management:** Increasing global water demand and the need to maintain aging infrastructure necessitate the growth in digital water management. Technologies such as AI, IoT sensors, and advanced meters enable water quality and quantity control as well as remote asset management and responsible water use.

Also, geographical information systems (GIS), digital twins, and augmented and virtual reality (AR/VR) technologies visualize and model situational scenarios to identify anomalies and prevent potential damage. 5G, blockchain and cloud technologies ensure speed and data security for water management solutions. This way, digital technologies improve the decision-making and efficiency of water utilities.

2. **Wastewater Processing:** Large amounts of wastewater are discharged without prior adequate treatment. Lack of control over water wastage in industrial and residential activities causes pollution of freshwater reserves. Emerging innovations in wastewater processing are trying to effectively recover spent water in different industries.

Technologies such as advanced oxidation processes, adsorption/biosorption, and biological and anaerobic remedies demonstrate promising results. In combination with solar irradiation, they effectively absorb pollutants from wastewater and reduce the amount of produced sludge via microbial decomposition. This way, wastewater processing solutions mitigate contaminants to meet water demands.

3. **Advanced Filtration:** Due to the pressing water scarcity problem, startups are paying more attention to fresh and creative methods of water filtration. Nanotechnology advances are enabling the development of filtration membranes that remove hard-to-capture micro pollutants.

Since nanocomposite membranes have improved chemical properties, they provide higher flux, permeability, and selectivity than conventional solutions. Another important technology is biological filtration which uses bacteria to purify water while converting energy from oxidation into electricity. Together with natural and self-cleaning filters, new advancements contribute to energy-saving and cost-effective water filtration.

4. **Flood Prevention:** Global warming increases the likelihood of extreme droughts and floods. Recent advances involve not only improved device designs but also include solutions that facilitate monitoring, forecasting, and catastrophe modelling. Enhanced water gates, property protectors, dams, and flood blocks guarantee rapid response to the disaster.

Further, drone and satellite-based systems capture vital data through clouds and other obstacles. In combination with LiDAR mapping and weather radars start-ups measure wind directions to predict rainfalls. Apart from these, advanced catastrophe modelling provides potential financial consequences for a more holistic picture. Overall, these technologies rethink traditional flood measures to deliver better risk management.

5. **Water-saving Technology:** Facing growing challenges with freshwater availability, there is a growing global demand for water-saving technologies. This trend is impacted by water reuse, recycling, intelligent irrigation, and home conservation. To achieve circularity, startups design water-saving toilets, taps, and shower heads.

They control water flow, limit the quantity of water used, and redirect it for other purposes. Besides, new recycling technologies extract valuable resources and nutrients for practical repurposing. Efficient irrigation techniques are another important direction that advances precision farming by measuring and minimizing overwatering. This way, startups are using a range of approaches to save water in different settings.

6. **Decentralized Infrastructure:** The interest in decentralized water infrastructure is growing as a measure that improves the resilience of communities. Modular and mobile electrocoagulation treatment makes users independent of centralized systems that are unavailable in remote regions.

Further, personalized water systems include off-grid supply, facilitated by real-time digital technologies and tracking apps. Meanwhile, in-home water solutions offer alternative hydration methods by converting air into water. In this way, the distributed practice reduces rising costs and risks associated with old infrastructure, which ultimately improves general resilience.

7. **Innovative Materials:** Recent progress in material science provides new opportunities to overcome water supply challenges. Innovative materials such as modular adsorbents, electrode-based reactors, photo catalysts, and nanoparticles are key technologies that are advancing this trend. Their beneficial chemical and mechanical properties offer a smaller footprint while improving selectivity, efficiency, and reliability. By integrating materials with various properties, start-ups are developing multifunctional systems that achieve multiple functions in water management.

- 8. Desalination:** Water desalination is an industrial process that requires huge amounts of chemicals and energy to proceed. Therefore, start-ups are focused on developing innovative and eco-friendly solutions that reduce costs. New desalination approaches use renewable energy such as solar power to reduce carbon emissions.

Other methods employ biomimicry by which plants and fish extract seawater with minimal energy. Additionally, innovative aquaporin-based technology targets and blocks salt out of water. This way, novel seawater desalination shifts beyond traditionally expensive and fossil-based methods.

Cases of Water Management by Corporate Sector

- 1. Water conservation initiatives of DS Group:** The Dharampal Satyapal Group (DS Group) has been working in the water stressed areas of the country to ensure long term availability of water through geographic-specific conservation measures and judicious utilization of resources. The Group supports multiple water conservation and replenishing projects across Rajasthan, Madhya Pradesh, Uttar Pradesh, Himachal Pradesh, Uttarakhand and Gujarat, benefitting millions of people from the marginalized communities.

These projects involve construction of recharging and storage structures, renovation of existing defunct and underutilized water bodies, soil conservation measures, introduction of efficient irrigation practices and institutions building for long-term sustainability.

The work has significantly impacted the availability of water at surface and sub-surface level, which has led to increased irrigated area and improved crop productivity resulting in better economic conditions of the communities in the intervention areas.

- 2. Water conservation by JK Tyre and Industries Limited (Kankroli):** The various strategies adopted by the company for recycling and reusing water included working for zero discharge, developing hydrophobia for water in unwanted places, eliminating all open drains, optimising/loading cooling towers to their 100%, reducing evaporation losses, radiator/air cooling, eliminating flash losses in steam usage, eliminating wastage, treating sewage and rain water harvesting. As a result of these efforts, the specific and per capita water consumption reduced and overall availability of water improved significantly. This work won the CII-GBC National Award (Within the Fence Category) for Excellence in Water Management in 2008.
- 3. PepsiCo and Water Management:** PepsiCo a Food and Beverage Company, has substituted transplanting of paddy with direct seeding technology that reduces water consumption by 30 per cent. In 2014, PepsiCo India brought over 16,000 acres of land under direct seeding and saved more than 11.2 billion litres of water in Punjab, Haryana, Uttar Pradesh, Tamil Nadu and Karnataka. The company also provide assistance to the farmers in water scarce areas of Maharashtra, Gujarat, Karnataka and Haryana with drip irrigation methodology.
- 4. Water Conservation by Hindustan Unilever:** The country's largest consumer goods company Hindustan Unilever has been able to reduce its water use by regular metering, monitoring and controlling of utilities consumption at all its manufacturing sites.

Rainwater harvesting has been implemented in more than 50 per cent of HUL's own units. More than 75 per cent of HUL's manufacturing sites are zero-discharge. Some of the other initiatives have been better run-time strategies for lower use of cleaning water, identifying dry areas in the shop-floor, recovery and re-use of process condensate water and using recycled water instead of fresh water for operations.

5. **Water Management at ITC:** The company developed watershed development programme to cover 1 million acres of land by 2018. The company, which has been water positive for over 13 years, has brought soil and moisture conservation to half a million acres of land apart from monitoring water use at its plants.
6. **Water Management at SAIL:** With a view to minimise water consumption as well as to conserve water resource across the plants, actions have been/are being taken up to achieve the long-term goal of “Zero Liquid discharge” through treatment and recycling of effluent being discharged through the outfalls at the plant boundary. In this regard, waste water treatment and recycling facilities at the outlet B&C of BSP have been installed during the financial year 2021-22, as a result of which, around 8250 m³/hr. of effluent after treatment is re-circulated and reused at Bhilai Steel Plant (BSP).

Further, the following measures that may be in place in various industries, may be considered for efficient water management in business organisations, especially manufacturing sector based companies or organisations:

- (i) **Water Audit:** The first step in Water Conservation and Management Programme is comprehensive water Audit to arrive at a realistic water balance for the entire factory and colony. Water audits at regular intervals help the management to take stock of the situation and act before the problem escalates and threatens closure due to non-availability of water. The objectives of carrying out a water audit is not only to identify areas of excessive use (and its abuse) but also assess the quality of water being supplied for each application and compare it with the actual requirement and optimize the cost of treating water. This involves following exercise –
 - Measurement of water consumption at user points by calibrated instruments. Flow through closed pipes can be measured by an Ultrasonic flow measuring instrument and flow through open channels through V-Notch weirs.
 - The quality and quantity of effluents generated from each section should also be assessed. Conscious efforts shall be made to effect savings in cost of treating the effluent.
 - The next step is to establish bench marks for water consumption based on international practices for similar industries and identify areas of excess consumption.
 - An action plan should then be drawn for reducing the consumption of water in those areas. With good housekeeping discipline and perseverance it should be possible to achieve the results.
- (ii) **Conservation of Water for Cooling:** A major portion of industrial water is utilized for cooling applications in majority of industries and hence provides an opportunity to conserve the water by optimizing the operations of cooling towers and following the best practices as given below-
 - It is essential to check the cooling water treatment programme, which enables us to operate the tower at optimum cycles of concentration. The quantity of make-up water decreases significantly with increasing cycles of concentration. Water meters should be installed at cooling water make-up as well as blow down line.
 - Loss of water due to evaporation is around 2% of the water in circulation and hence in areas of water scarcity, the feasibility of using air cooled towers should be explored.
 - Side stream filtration should be adopted to keep cooling water free of suspended solids. Backwash water from side stream filter can be recovered by installing a plate type clarifier. The quantum of water recovered can be significant in large industries like fertilizer, steel etc.

- (iii) **Water Conservation in Pre-treatment Plant:** Almost all the plants utilizing surface water will have a clarifier and filter beds. Blow down from the clarifier must be treated through the sludge thickener and sludge dewatering unit (centrifuge / filter press).

The clear water from sludge thickener and the filtrate from sludge dewatering unit should be pumped back to the clarifier. This will not only help in water conservation but also reduces the cost incurred in sludge handling and disposal. The entire quantity of water used for backwashing the filters must be collected and returned to the clarifier.

- (iv) **Water Conservation in Softening Plants:** Softening plants offer scope both for water conservation as well as for a reduction in salt consumption by opting for salt recycling. Salt recycle is effectively used in almost all the power stations in Maharashtra as the entire quantity of water used for cooling is softened and the salt consumption is high. For salt recycling, it is necessary to install an additional brine measuring tank (BMT 2) identical to the existing one (BMT 1) and modify the frontal piping.

Part of the water used for slow rinsing and practically the entire quantity used for final rinsing can be recovered and reused partly for preparation of salt solution and partly for slow rinse. Salt recovery can be made by collecting the latter half of the effluent during salt injection in a separate brine measuring tank and using it to partially regenerate the resin during the next cycle.

- (v) **Water Conservation in Demineralization Plant:** Demineralization by the ion exchange process generates strong effluents which require dilution with fresh water or other streams low in dissolved solids prior to discharge. However water can be recovered from the effluents generated in a DM plant by installing a water recovery plant for reuse in the plant. Some plants use the strongly acidic effluents in cooling water for pH control in place of acid. There is considerable scope to conserve water in DM plant which can be achieved by following measures-

- Almost all the final rinse water during Mixed Bed regeneration can be recycled back to the filtered water tank. Part of the water used for final rinsing can be recycled back to the raw water tank as soon as its conductivity reaches the value equal to that of raw water.
- Good housekeeping can significantly contribute to conservation of water in a DM plant. Leaky valves and taps must be fixed immediately. Water flowing through pH and conductivity sensors must be routed to the raw water tank.
- Whenever rinse water volumes increase, the reasons for long rinse should be ascertained and action must be taken to fix the problem either by addition of some equipment or change over to non-fouling resins or both.
- Presence of non-reactive (colloidal) silica in boiler feed water high pressure boilers may result in increased blow-down. In case presence of excessive amount of colloidal silica is suspected it may be prudent to remove it from boiler feed water by installing an Ultra filtration unit after the Mixed Bed. In case the raw water is high on organics as well, the ultra-filtration unit may be located ahead of MB unit to take care of both issues.

- (vi) **Treatment of Condensate:** Conservation of condensate not only saves water but also the huge cost incurred in high purity water production and chemical conditioning. This can be achieved by arresting the leakages in the lines and installing suitable treatment units (condensate polishing units) for removal of undesirable components. Condensates with traces of hydrocarbons can be treated through the use of Oil Coalescers or specially designed Activated Carbon Filters.

- (vii) **Effluent Treatment:** Use of water in the industry produces an effluent which needs to be treated before it can be discharged into a public sewer or a receiving stream. Treatment of effluent is necessary to protect the receiving water bodies and ensure safe water availability to the downstream habitation. Moreover, the effluent after minimal treatment can be utilized for low end applications.

Efforts should be made to treat, recycle, and reuse the effluent in the premises so that the industry could approach towards zero liquid discharge concepts and uninterrupted water supply for production can be ensured. Often it is possible to recover a valuable byproduct for reuse in the process and remaining effluent is now more amenable for recovery of water economically.

For instance, in Tirupur, group of industries had installed a combined effluent treatment plant for treating their effluents with an option to recover the salt (Na_2SO_4) and water which is again recycled back to the process. This approach not only solved a potential problem of high TDS effluent disposal but also resulted in practically 'Zero-Discharge' with significant savings in the cost of treatment of effluent.

- (viii) **Water Conservation in Offices and Residential Colonies:** As far as possible, electronically operated proximity devices or at least press to open type of valves should be provided to reduce wastage. These types of installations result in water consumption of around 30%.

Supply of potable water to residential colony and other user points should be under gravity by installing water tanks on roof tops. Supply under gravity (through overhead storage tanks) will minimize wastage through splashing. Again restricting the supply to fix periods will also help in conserving water.

Almost all colonies housing the factory employees will have a dedicated sewage treatment plant. Water can be recovered by installing a tertiary treatment plant and can be used for low end applications like green belt development, gardening, flushing the toilets etc., thus conserving fresh water.

Needless to say this will involve separate storage and plumbing to ensure that there is no accidental contamination with potable water in other lines like washbasins and shower fountains. The recovered water can also be used as cooling tower make-up by installing membrane Bio reactor that will produce clear filtered water.

- (ix) **Rain Water Harvesting:** Rain water harvesting is yet another opportunity for the industries to ensure that the ground water gets recharged and the borewells do not run dry. The system is relatively inexpensive and the benefits are many. Water falling on the roof top is collected through channels, filtered and infiltration wells.

Water is a scarce resource and it needs to be treated with all the respect it deserves. Conservation, recovery and reuse must be practiced by all industries on a continuous basis to ensure availability of adequate quantity of fresh water for use. With the available technologies the fresh water consumption can be minimized and is not very much difficult.

WASTE MANAGEMENT

Waste management refers to the various schemes to manage and dispose of wastes. It can be by discarding, destroying, processing, recycling, reusing, or controlling wastes. The prime objective of waste management is to reduce the amount of unusable materials and to avert potential health and environmental hazards.

The process of managing unwanted waste items that have served their purpose but are no longer useful is referred to as Waste Management. It is to be noted that modern concept of waste management covers 7 R's- Rethink, Refuse, Reduce, Reuse, Recycle, Regulate and Research.

Wastes include dead and decaying plant and animal remains, metabolic by-products (faecal remains, excreta, etc.), discarded materials from homes, workplaces, businesses, restaurants, factories, hospitals, pesticides, herbicides sprayed on fields, and many more. This article will teach students about solid waste management, including the many trash management methods and their benefits. The various sources of wastes have been briefly discussed as under:

- (i) **Domestic Waste:** The waste materials produced from our households in our daily activities are called domestic waste. These include:

- Kitchen waste like vegetables, fruits, and other food waste.
 - Sewage-human excreta and waste from bathrooms and kitchens.
 - Garbage-newspapers, rags, hair, house dust.
 - Others-plastic bags, bottles, tins, etc.
- (ii) **Industrial Wastes:** All Industries generate waste materials. The wastes typically comprise of ashes, rubbish, building material wastes, toxic wastes, metal containers, plastic containers, paints, oils, and other complex synthetic materials.
- Mining operations leave tailings (rocks of little or no value) as waste.
 - Metallurgical industries release waste like slag and scrap metal.
 - Paper and pulp mills release effluents containing wood chips, bits of bark, cellulose fibres, and a number of chemicals.
 - Oil refineries and petrochemical units release a mixture of wastes containing hydrocarbons, organic acids, and sulphur compounds.
 - Food processing units such as dairy, breweries, and meatpacking units release organic wastes.
- (iii) **Agricultural Wastes:** Modern methods employed in agriculture and the use of a variety of chemicals have contributed to the production of large quantities of agricultural waste.
1. Agricultural wastes include crop residues like husk and straws, farm animal waste, and chemicals like pesticides, rodenticides, fungicides, herbicides, and fertilizers.
 2. These wastes can enter the water table as runoff from agricultural fields.
 3. Chemicals used in agriculture are toxic in nature.
- (iv) **Commercial Wastes:** Substantial waste is generated from commercial establishments such as restaurants, hotels, markets, offices, printing shops, auto repair shops, medical institutions, and hospitals.

There are mainly two kinds of wastes- Biodegradable waste and Non-biodegradable waste.

- (A) **Biodegradable waste-** Those wastes that can be decomposed by the action of micro-organisms is known as biodegradable waste. For instance, domestic sewage, newspapers, and vegetable matter are biodegradable and undergo rotting. Biodegradable wastes may be managed by embracing the following approaches:

1. **Segregation of wastes:** Garbage or waste may be in the form of fruit or vegetable peels, discarded objects, wrapping materials, wasted food as household garbage, or discarded chemicals and fertilizers washed into rivers, domestic sewage, etc. These wastes can be segregated into biodegradable and non-biodegradable.

Wastes that rot (undergo degradation) by the action of decomposers (tiny organisms found in the soil) are called biodegradable wastes. Dead plants and animals and their products (e.g., fruit and vegetable peels, paper, and leaves) decay very easily. These wastes mix with the soil and produce manure.

Depending on the type of wastes, two garbage bins—one for biodegradable wastes and other for non-biodegradable wastes should be used. This will help in easy sorting and recycling of wastes to make beneficial products.

Green bins are for biodegradable wastes like vegetables and fruit peels, spoilt food, tea leaves, egg shells, tissue paper, leaves, hair, etc. Blue bins are for recyclable wastes like glass bottles, plastic wastes, old batteries, chocolate wrappers, polythene bags, etc.

2. **Composting:** Since biodegradable or organic wastes like vegetable peels, waste food, leaves, dead flowers, and egg shells can be recycled, they are converted into manure by burying them in compost pits. Recycling of organic wastes like vegetable peels, waste food, leaves, etc., by burying them in compost pits is called composting.

Composting is a simple and easy process of recycling. The biodegradable wastes are degraded by the action of small organisms like bacteria and fungi. There is also a different kind of composting where a kind of earthworm called red worms (or red wigglers) act on wastes and degrade them. This type of composting with the help of a type of earthworm called red worms, is called vermicomposting. Red worms break down the organic matter into nutrient-rich manure which increases soil fertility.

3. **Landfills:** Large areas used for waste disposal are called landfills. Landfill is another method to manage huge amount, of biodegradable waste. In a landfill, garbage is buried in such a way that it does not damage the environment. Garbage buried inside landfills stay here for a long time as it decomposes very slowly. After a landfill is full, it can be converted into a park.

(B) Non-biodegradable waste- The wastes which cannot be decomposed easily are called non-biodegradable wastes. These wastes do not undergo rotting. For example, polythene bags, plastics, glass, aluminium cans, iron nails, and DDT. Plastic waste management is the need of the hour.

It is to be noted that leaving non-biodegradable waste untreated may prove to be menacing for the environment. Some of the issues may include uncontrolled landfills that may cause an unhygienic environment, leading to diseases among the people residing nearby. Plastics and other such waste can cause pipe blockages and groundwater contamination. Other waste like chemicals, biomedical and plastics can pollute water bodies as well. Thus, solid waste management is essential to overcome the challenges posed by non-biodegradable waste.

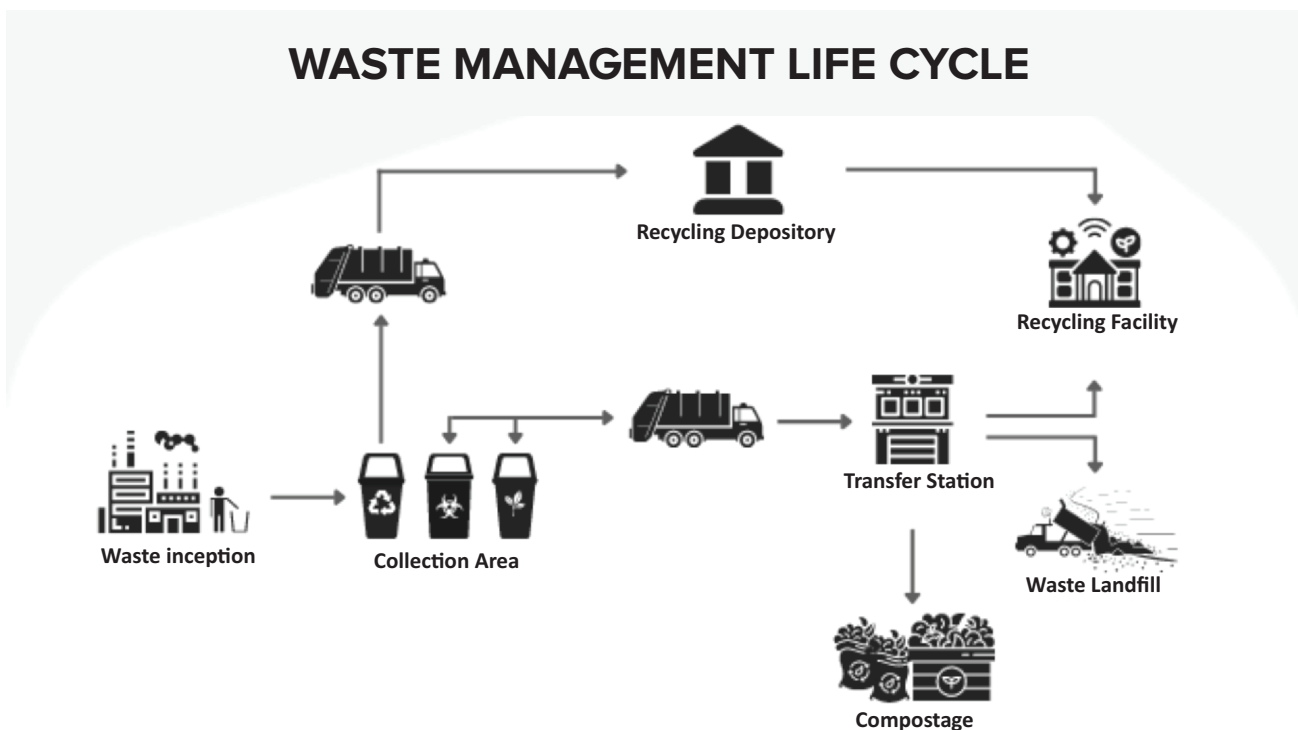
The following techniques may be espoused for management of non-biodegradable wastes.

1. **Recycling:** It is one of the best and popular methods employed for non-biodegradable waste management. The waste such as plastic, paper, glass, iron materials and cloth can be recycled and has economic value as well. It also helps in reducing the waste being sent to landfills, supports deforestation and saves energy.
2. **Incineration:** It is widely used to manage non-biodegradable waste, which is non-recyclable as well. It involves waste decomposition using temperatures above 5000 Degree Celsius and can help minimize the trash volume.
3. **Individual management:** Individual management of waste is the first step to efficacious non-biodegradable waste management. Separation of biodegradable and non-biodegradable waste in separate bins and following recycling practices whenever possible are some measures that can be taken at the individual level.

At this juncture, it is important to comprehend the waste management system. Waste management system is the strategy an organization uses to dispose, reduce, reuse, and prevent waste. Possible waste disposal methods are recycling, composting, incineration, landfills, bioremediation, waste to energy, and waste minimization. The waste management life cycle is provided in exhibit 2.

Exhibit 2

Waste Management Life Cycle



Source: Safety Culture

Forms of Waste Management

There are various types of waste management, however mainly the three forms of waste management are as under:

1. Solid Waste Management
2. Liquid Waste Management
3. Biomedical Waste Management
4. E-Waste Management

1. **Solid Waste Management:** At global level, waste generation rates are rising. In 2020, the world was estimated to generate 2.24 billion tonnes of solid waste, amounting to a footprint of 0.79 kilograms per person per day. With rapid population growth and urbanization, annual waste generation has been expected to increase by 73% from 2020 levels to 3.88 billion tonnes in 2050.

Compared to those in developed nations, residents in developing countries, especially the urban poor, are more severely impacted by unsustainably managed waste. In low-income countries, over 90% of waste is often disposed in unregulated dumps or openly burned. These practices create serious health, safety, and environmental consequences. Poorly managed waste serves as a breeding ground for disease vectors, contributes to global climate change through methane generation, and can even result into urban violence.

Managing waste properly is essential for building ecological and liveable cities, but it remains a

challenge for many developing countries and cities. Effective waste management is expensive, often comprising 20%–50% of municipal budgets. Operating this essential municipal service requires integrated systems that are efficient, sustainable, and socially supported.

Few cases of solid waste management are as under:

(a) Sustainable Waste Management in Bangalore- Case Study of Environmental Support Group

To address the peril of increasing waste in Bangalore and in light of the failure of civic authorities to resolve the mentioned issue, a civil society group named Environmental Support Group situated in Banashankari II Stage, Bangalore came forward and worked diligently with the Bruhat Bangalore Mahanagara Palike (BBMP), the city's body of government dealing with civic infrastructures, as well as other NGO's, since the early 1990's to bring about change in the state of waste management in Bangalore.

The mentioned efforts delivered positive outcomes. Through their campaign on waste segregation and better working wages for waste pickers, the group have brought a new conversation of waste management in the city. Further, Bangalore has witnessed a significant increase in awareness among the masses regarding waste management issues and the Environmental Support Group is still working relentlessly to create more meaningful, intentional strides in the arena of waste management.

Various approaches espoused by the Environment Support Group that is, educational reforms, public posters, commercials, trips to schools, and even Public Interest Litigation cases, assisted immensely in bringing out meaningful change in the domain of sustainable waste management.

(b) Solid Waste Management- Case of Tata Steel Limited

Tata Steel has been pioneering in value creation from waste and by-products in its quest to contribute to a sustainable ecosystem in the iron and steel industry. Tata Steel aims for a 'Zero Waste' goal using the 3R (Reduce, Reuse & Recycle) principles of circular economy. The company handled 15 MnTPA of by-products spanning across 25+ product categories comprising more than 250+ Stock Keeping Units (SKUs).

These value-added by-products serve as key raw materials for various industries like cement, chemical, construction, etc. In FY 2021-22, Tata Steel Jamshedpur and Tata Steel Kalinganagar achieved 100% solid waste utilisation and horizontal deployment of best practices in Tata Steel Meramandali helped to achieve 97% solid waste utilisation.

(c) Solid Waste Management- Case of Steel Authority of India Limited

Steel Authority of India Limited (SAIL) exhibits its commitment to reduce solid waste generation and maximise its utilisation to achieve 100% and has adopted the "4r's policy" (reduce, recover, recycle and reuse) across all its processes. With a view to enhance utilisation of Bof Slag, a R&D project proposal on "development of Steel Slag based cost effective eco-friendly fertilizers for sustainable agriculture and inclusive growth" has been taken up through ICAR-indian agricultural research institute, under the guidance of the Ministry of Steel. The project will ensure symbiotic growth of steel industry and agriculture.

as a green initiative and in compliance with the "Solid Waste Management (SWM) rules, 2016", Bhilai Steel Plant (BSP) has set up a Solid Liquid resource Management (SLRM) centre. The waste is handled in a scientific and hygienic way at the centre. The integrated facility has separate systems for segregation of wastes, converting green waste into manure and turning plastic waste into useful by-products and can handle 50 tonne of waste every day.

- 2. Liquid Waste Management:** Liquid waste can be defined as such Liquids as wastewater, fats, oils or grease (FOG), used oil, liquids, solids, gases, or sludges and perilous household liquids. These liquids that are hazardous or potentially harmful to human health or the environment. They can also be discarded by commercial products classified as “Liquid Industrial Waste” such as cleaning fluids or pesticides, or the by-products of manufacturing processes.

The forms of liquid wastes are as under:

- (a) Household Liquid Waste:** The source of this waste are households. Most of it comes from all the cooking and cleaning activities that takes place at homes. Household liquid wastes can be further classified into two categories- Sullage and Sewage. Sullage refers to the grey water. This waste comes from the kitchen and bathroom disposal system. This excludes waste water or excreta from the toilet.

Sewage typically contains sullage and blackwater – wastewater that has excrement.
- (b) Commercial Liquid Waste:** Most commercial centres have number of restaurants and eateries. Waste from commercial areas varies from household waste because of its magnitude and content like grease.
- (c) Industrial Waste:** This waste comes from industrial activities. Industrial waste can be dangerous or non-perilous. Industrial wastes is often released into nearby water bodies. It could be acidic, alkaline or lacquers. On a much larger scale, mega operations like fracking and oil supply can leave major liquid waste due to spillage and toxic runoff.
- (d) Stormwater:** This is weather related waste that is contaminated with pollutants. The are available at hard surfaces such as roads, footpaths, driveways and roofs. Stormwater is not treated like waste water before they reach water bodies like rivers, creeks and the ocean.

Few cases of liquid waste management are as under:

- (a) Environment Management at Indian Oil:** In the course of refinery operations, waste water, flue gases, fugitive emissions and solid wastes are generated. Refineries are also significant consumers of scarce resources like water and energy. Thus, pollution control and resource conservation activities are a priority area for environment management at Indian Oil. Effective treatment of wastewater and recycling, energy conservation and pollution abatement are examples of integrated activities that result in both pollution control and resource conservation.

The installations including refinery units strive to ensure the following:

- Minimize adverse environmental impact from refinery activities, products and services by using processes, practices, materials that avoid, reduce or control pollution;
- Conserve scarce natural resources by continually optimizing their consumption.

Other significant initiative towards liquid waste management at Indian Oil includes, waste water management wherein the usage of water and quality of effluent discharged are carefully monitored. The refineries are equipped with a network of underground sewers for segregated collection of various wastewater streams, which are subjected to precise treatment in well-designed effluent treatment (ETP) facilities involving physical, chemical and biological processes.

State of art equipment have been provided in the ETPs like Tilted Plate Interceptor (TPI), Dissolved Air Floatation (DAF), Bio-tower, activated sludge basins, dual media filters for treating oily wastewater and hydrogen peroxide / wet air oxidation treatment for spent caustic streams etc. These treatment facilities are backed by sophisticated instrumentation and real time monitoring

systems for close and precise monitoring. In Marketing and Pipeline locations, effluent water is routed through oil water separator.

(b) **Liquid Waste Management at Bharat Petroleum:** The water control pollution measures of the company are as under:

- A state-of-art Effluent Treatment Plant for maximized recycle of wastewater
- Installation of oil containment boom for control of oil spills in surface water runoff are installed.
- Oil skimmers for control of oil spills in surface water runoff are installed.
- Real Time Emission Monitoring Systems installed for monitoring quality of treated water
- State-of-art well equipped laboratory capable of comprehensive environmental analysis

3. **Bio-medical Waste Management:** Bio-medical waste means “any solid and/or liquid waste including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps.

Biomedical waste poses hazard due to two principal reasons – the first is infectivity and other toxicity.

Bio Medical waste consists of

- Human anatomical waste like tissues, organs and body parts
- Animal wastes generated during research from veterinary hospitals
- Microbiology and biotechnology wastes
- Waste sharps like hypodermic needles, syringes, scalpels and broken glass
- Discarded medicines and cytotoxic drugs
- Soiled waste such as dressing, bandages, plaster casts, material contaminated with blood, tubes and catheters
- Liquid waste from any of the infected areas
- Incineration ash and other chemical wastes

The following approaches are generally used for disposal of bio-medical wastes –

- (i) **Autoclaving:** The process of autoclaving involves steam sterilization. Instead of incineration, which can be expensive, autoclaving simply introduces very hot steam for a determined amount of time. At the end of the process, micro-organisms are completely destroyed. This process is particularly effective because it costs much less than other methods, and doesn't present any personal health risks.
- (ii) **Incineration:** The major benefits of incineration are that it is quick, easy, and simple. It effectively removes the waste entirely, and safely removes any microorganisms. However, when burning hazardous materials, emissions can be particularly hazardous.
- (iii) **Chemicals:** When it comes to liquid waste, a common biomedical waste disposal method can be chemical disinfection. Chlorine is generally used for this process, and is added to the liquid waste in order to kill microorganisms and pathogens. Chemical disposal can also be used for solid wastes, but it is recommended that they be grinded first to ensure maximum decontamination. Liquid waste, once decontaminated, is then disposed into the sewer system.

- (iv) **Microwaving:** During this process, waste is shredded, mixed with water, and then internally heated to kill microorganisms and other harmful elements. One of the main benefits of this process is the shredding aspect; it lowers the volume of biomedical waste, and it is reportedly more energy efficient to use this method than to incinerate.

4. E-Waste Management: E-waste is electronic products that are unwanted, not working, and nearing or at the end of their “useful life.” Computers, televisions, VCRs, stereos, copiers, and fax machines are everyday electronic products.

Electronic waste (e-waste), is a generic term used to describe all types of old, end-of-life or discarded electrical and electronic equipment, such as household appliances; office information and communications equipment; entertainment and consumer electronic equipment; lighting equipment; electric and electronic tools; toys; and leisure, sports and recreational equipment that are powered by electricity. E-waste contains both valuable and hazardous materials that require special handling and recycling methods.

Due to the sheer expansion of the IT and communications industries, the use of electronic equipment has increased dramatically across India. According to a Market Research report, the Indian e-waste management market is rapidly expanding and is expected to grow at a CAGR of 14.25 percent in terms of revenue and 8.24 percent in terms of volume between 2021 and 2026. According to the report, rising government initiatives, raising awareness, and environmental concerns are driving the market’s growth.

In India, government has embraced numerous initiatives to formalise the e-waste recycling sector of the country. The E-Waste (Management) Rules, 2016 provide for compulsory authorisation of the dismantling and recycling units from the concerned State Pollution Control Boards (SPCBs)/ Pollution Control Committees (PCCs).

CPCB has issued guidelines/SOP for processing of e-waste. The CPCB and SPCBs have been monitoring the units and necessary steps have been taken to mainstream and modernise the recycling industry with the help of Ministry of Electronics and Information Technology.

Following steps have been taken by the government in the direction of finding out solution to the problems related to E-Waste:

- (i) The management of e-waste is being carried out under the frame work of E-Waste (Management) Rules, 2016 and amendments there off. The Rules, are effective from 1st October, 2016. The rules provide for followings:
 - Applicable to every manufacturer, producer, consumer, bulk consumer, collection centres, dealers, e-retailer, refurbisher, dismantler and recycler.
 - Under the EPR regime, producers have to obtain EPR Authorization from CPCB for implementing their EPR and details of their dismantlers/recyclers.
 - Notified EEE are twenty-one (21) and listed in Schedule-I of the above said Rules.
 - Under EPR regime, producers of notified EEE have been given annual E-Waste collection targets based on the generation from the previously sold EEE or based on sales of EEE as the case may be.
- (ii) Ministry has notified the E-Waste (Management) Rules, 2022 on 2nd November, 2022. These rules will replace E-waste (Management) Rules, 2016 and will be effective from 1st April, 2023. These rules will launch a new Extended Producer Responsibility (EPR) regime for e-waste recycling. The salient feature of new rules is as under:

- Applicable to every manufacturer, producer, refurbisher, dismantler and recycler.
- All the manufacturer, producer, refurbisher and recycler are required to register on portal developed by CPCB.
- No entity shall carry out any business without registration and also not deal with any unregistered entity.
- Authorization has now been replaced by Registration through online portal and only manufacturer, producer, refurbisher and recycler require Registration.
- Schedule I expanded and now 106 EEE has been include under EPR regime.
- Producers of notified EEE, have been given annual E-Waste Recycling targets based on the generation from the previously sold EEE or based on sales of EEE as the case may be. Target may be made stable for 2 years and starting from 60% for the year 2023-2024 and 2024-25; 70% for the year 2025-26 and 2026-27 and 80% for the year 2027-28 and 2028-29 and onwards.
- Management of solar PV modules /panels/ cells added in new rules.
- The quantity recycled will be computed on the basis of end products, so as to avoid any false claim.
- Provision for generation and transaction of EPR Certificate has been introduced.
- Provisions for environment compensation and verification & audit has been introduced.
- Provision for constitution of Steering Committee to oversee the overall implementation of these rules.

Under the E-Waste Management Rules, provision for reduction of hazardous substances in manufacturing of Electrical and Electronic Equipment (EEE) has been provided. It mandates that every producer of EEE and their components shall ensure that their products do not contain lead, mercury and other hazardous substances beyond the maximum prescribed concentration.

The E-Waste (Management) Rules also provide for recognition and registration, skill development, monitoring and ensuring safety and health, of workers involved in dismantling and recycling of e-waste.

At global level, the United Nation's Solving the E-waste Problem (StEP) Initiative, founded in 2007, is a global consortium of companies, research institutes, governmental agencies, international organisations and NGOs dedicated to advancing the management and development of environmentally, economically and ethically sound e-waste resource recovery, reuse and prevention. The StEP Initiative does not endorse any specific products and seeks instead to provide science-based but applied recommendations towards a sustainable solution to the e-waste issue.

Measures to reduce e-waste are as under –

- (i) **Reduce purchases and organise them accordingly:** The most common source of e-waste is the purchase of goods. In view of this, the organisations can organize their existing electronic devices and avert purchasing anything that cannot be reused or destroyed by the maker. Choosing recyclable or long-lasting electrical products is a long-term strategy for e-waste management. Even after wiping out electronic devices, personal information of human capital is still stored on them, which is another reason to keep them. Before recycling device, recycling facilities can clean it, thereby protecting the data from hackers.
- (ii) **Cloud Storage:** Business organisations may not buy a large server or storage system for

personal or commercial use. Cloud data solutions provide server that are ideal for archiving and synchronizing data across multiple devices.

- (iii) **Donate and Re-sold:** In case any electronic device is not required in a business organisation then the management may think of donating it to some individual or institution. Similarly, the business organisations may buy electronic gadgets on buy-back scheme, wherein the buyer will have the option to resell the electronic gadgets after expiry of its useful life and buy a new electronic gadget in lieu of it.

- 5. Plastic Waste Management:** Plastic was first invented in 1907, and given that it was cheaper and more convenient than other materials, it soon found use in varied ways in our daily lives. Plastic products have become an integral part in our daily life as a basic need. Today, plastic is present in almost everything, from our money to electronic appliances, and it is used across multiple sectors, including packaging, building, construction, transportation, industrial machinery and health among others.

However, the lack of sustainable plastic waste management (PWM) poses a serious threat to our environment and natural ecosystem globally. Plastic Waste, in particular, is a key contributor to the unsustainable surge in waste being generated, due to its wide-scale use across industries combined with the short life-span of its products, including single use plastics, packaging, consumer goods and clothing. Indeed, plastic consumption across the world has quadrupled over the last few decades, and global plastic waste is expected to nearly triple by 2060 (according to OECD).

Plastic waste has numerous implications on the environment and health. The plastic in food and water can cause severe health issues such as genetic disorders, and endocrine system damage. According to the United States Environmental Protection Agency, all the plastic waste ever generated is still present on Earth today, this makes sustainable management of plastic waste important.

Environmental issues on disposal of Plastic Waste:

Indiscriminate littering of unskilled recycling/reprocessing and nonbiodegradability of plastic waste raises the following environmental issues:

- During polymerization process fugitive emissions are released.
- During product manufacturing various types of gases are released.
- Indiscriminate dumping of plastic waste on land makes the land infertile due to its barrier properties.
- Burning of plastics generates toxic emissions such as Carbon Monoxide, Chlorine, Hydrochloric Acid, Dioxin, Furans, Amines, Nitrides, Styrene, Benzene, 1, 3- butadiene, CCl₄, and Acetaldehyde.
- Lead and Cadmium pigments, commonly used as additives are toxic and are known to leach out.
- Non-recyclable plastic wastes such as multilayer, metalised pouches and other thermoset plastic poses disposal problems.
- Littered plastics give unaesthetic look in the city, choke the drain and may cause flood during monsoon.
- Garbage mixed with plastics interferes in waste processing facilities and also cause problems in landfill operations.
- Recycling industries operating in non-conforming areas are posing threat to environment to unsound recycling practices.

The regulatory framework for combating plastic waste is as under:

Regulatory Framework for Combating Plastic Waste	
1	Recycled Plastic Manufacture and Usage Rules in 1999 <i>(Manufacturing and usage of Plastic carry bags. It is specified the minimum thickness of plastic bags)</i>
2	Plastic Waste (Management and Handling) Rules, 2011 <i>(Laid down certain conditions for manufacturing, stocking, sale and use of plastic carry bags and sachets)</i>
3	Plastic Waste Management Rules, 2016 <i>(Thrust on plastic waste minimization, source segregation, recycling, involving waste pickers, recyclers and waste processors in collection of plastic waste and adopt polluter pays principle for the sustainability)</i>
4	1st Amendment in March, 2018-Plastic Waste Management (Amendment) Rules, 2018 <i>(Every producer or brand-owner Registration with CPCB)</i>
5	2nd Amendment in August 2021- Plastic Waste Management (First Amendment) Rules, 2021 <i>(Ban on “Single-use plastic commodity”)</i>
6	3rd Amendment in September 2021-Plastic Waste Management (Second Amendment) Rules, 2021 <i>(Use of Recycled Plastics)</i>
7	4th Amendment in February 2022- Plastic Waste Management (Third Amendment) Rules, 2021 <i>(Guidelines on Extended Producer Responsibility for Plastic Packaging)</i>
8	5th Amendment in July 2022 (PWM Rules On EPR)
9	6th Amendment in April 2023-PWM Amendment Rules 2023
10	7th Amendment in October, 2023 -PWM Second Amendment 2023 <i>(Each plastic packaging shall contain the specified information, printed in English)</i>
11	8th Amendment in March 2024 -Plastic Waste Management (Amendment) Rules, 2024. <i>(Filing of Quarterly Report and Annual reports)</i>

Key initiatives by India on Plastic Waste Management

Plastic has multiple uses and the physical and chemical properties lead to commercial success. The Ministry had initially notified the Recycled Plastic Manufacture and Usage Rules in 1999, which was mainly on manufacturing and usage of Plastic carry bags. It is specified that the minimum thickness of plastic bags should be of 20 microns. However, the indiscriminate disposal of plastic has become

a major threat to the environment. In particular, the plastic carry bags are the biggest contributors of littered waste and every year, millions of plastic bags end up in to the environment vis-a-vis soil, water bodies, water courses, etc and it takes an average of one thousand years to decompose completely.

Therefore, to the address the issue of scientific plastic waste management, new regulations namely, the Plastic Waste (Management and Handling) Rules, 2011 were notified in 2011, which included plastic waste management. The Plastic Waste (Management and Handling) Rules, 2011 laid down certain conditions for manufacturing, stocking, sale and use of plastic carry bags and sachets, which were required to be monitored and implemented by the State Pollution Control Boards/ Municipal Authorities. It specified that the minimum thickness of plastic bags should be of 40 microns. This was to facilitate its collection and recycle. However, the implementation of these rules was not so effective.

To implement these rules more effectively and to give thrust on plastic waste minimization, source segregation, recycling, involving waste pickers, recyclers and waste processors in collection of plastic waste and adopt polluter pays principle for the sustainability of the waste management system, The Government has notified the Plastic Waste Management Rules, 2016, in suppression of the earlier Plastic Waste (Management and Handling) Rules, 2011 and as a part of the revamping of all Waste Management Rules to achieving the vision of our Prime Minister of Swacchh Bharat and cleanliness is the essence of health and tourism, The Plastic Waste Management Rules, 2016 aim to:

- Increase minimum thickness of plastic carry bags from 40 to 50 microns and stipulate minimum thickness of 50 micron for plastic sheets also to facilitate collection and recycle of plastic waste.
- Expand the jurisdiction of applicability from the municipal area to rural areas, because plastic has reached rural areas also;
- To bring in the responsibilities of producers and generators, both in plastic waste management system and to introduce collect back system of plastic waste by the producers/brand owners, as per extended producers' responsibility;
- To introduce collection of plastic waste management fee through pre-registration of the producers, importers of plastic carry bags/multilayered packaging and vendors selling the same for establishing the waste management system;
- To promote use of plastic waste for road construction as per Indian Road Congress guidelines or energy recovery, or waste to oil etc. for gainful utilization of waste and also address the waste disposal issue; to entrust more responsibility on waste generators, namely payment of user charge as prescribed by local authority, collection and handing over of waste by the institutional generator, event organizers.
- The Environmental Compensation shall be levied based upon polluter pays principle, on persons who are not complying with the provisions of these rules, as per guidelines notified by the Central Pollution Control Board.
- Every producer or importer or brand-owner shall for the purpose of one –time registration makes an application through the centralized online portal.
- Each plastic packaging shall contain the specified information, printed in English, namely, name and registration certificate number for producer or importer or brand owner generated through centralized online portal.
- Filing of Quarterly Report and Annual reports by every person engaged in recycling or processing of plastic waste, by every manufacturer and importer of plastic raw material, by every person engaged in the sale of plastic raw material.

Extended Producer Responsibility

The Extended Producer Responsibility (EPR) model is based on the polluter-pays principle, which aims to include producers of material goods in the management and treatment of waste and keep raw materials and goods in the economic cycle. The integration of EPR schemes in national legislation then sets clear objectives for circular economy: consumer waste prevention, eco-design of materials, optimization of waste collection with local authorities and development of new circular economic systems.

Thus, the structuring of an EPR sector has several advantages; it allows the involvement of all actors, whether public authorities, industries or consumers, in a structured and sustainable framework dedicated to circularity and reduction of carbon emissions. At an international level, EPR deepens the social and environmental responsibility of companies, thanks to the traceability of the value chain and the better coordination of everyone's actions.

According to OECD, Extended Producer Responsibility (EPR) schemes are organizational mechanisms for the prevention and management of waste that concern certain types of products and are primarily based on the polluter-pays principle.

This principle emphasizes the idea of extended producer responsibility, according to which producers, i.e., the legal persons responsible for placing certain products on the market (namely producers, brand owners and importers), with government oversight, are made responsible for financing and organizing the prevention and management of waste from these products at the end of their life.

In that respect, it should be remembered that the EPR scheme is not a tax. Contributions from producers are thus directly used by the Producer Responsibility Organisation (PRO). Thus, this contribution didn't require additional budgetary resources from State, and is not "absorbed" into the overall public expenditure.

In order to meet the principles of EPR, producers usually organize themselves collectively to fulfil their obligations within the framework of PROs, whether non-profit or for profit. The mission of these PROs is to meet the challenges of reduction, reuse and recycling in the circular economy, thus playing a key role to the fight against climate change, the preservation of resources and biodiversity, and the reduction of carbon impact of product placed on the market.

To do this, the PROs meet several principles described in this note in order to fulfil their missions, in conjunction with all the stakeholders in the value chain from product to waste (including brand owners, retailers, recyclers, municipalities.).

They thus have several complementary missions:

- waste-prevention and awareness-raising among private consumers;
- limiting littering via collecting and subsequently recycling packaging waste;
- improving eco-design of the combination of product and packaging – in order to meet the climate-biodiversity challenges of life-cycle analyses and new consumer habits;
- collection and sorting in cooperation with the municipalities and waste management companies depending on the administrative, territorial and demographic structures;
- support for the development of new circular economy sectors focusing on reduction, reuse and recycling by R&D to enhance the material value chain from collection to recycling.

International bodies have been addressing the issue of combating plastic waste pollution (G7 in Charlevoix in 2018, G20 in Osaka in 2019). PROs from all over the world welcome the commitment of civil society, companies and governments to work together to define and build common responses to this global challenge.

International cooperation has reached an important milestone with the adoption on 2 March 2022 by the United Nations Environment Assembly of a resolution to end plastic pollution and to reach a legally binding international agreement by 2024. In the wake of these growing concerns, on 28 July 2022, the UN General Assembly adopted a resolution declaring that all people on the planet have the right to a healthy environment, a right that the circular economy can help make real, everywhere and for everyone.

The “Business Coalition for a global plastics Treaty”, coordinated by WWF and Ellen MacArthur Foundation, has created a first group of policy and scientific recommendations for future negotiations. This work will be made by bringing together NGOs, financial institutions and professional organizations from the plastics value chain.

In this context, the Extended Producer Responsibility (EPR) model has a key role to play. EPR systems are an essential instrument to finance the collection and environmentally sound treatment of waste, as well as to support the design and production of goods that consider and facilitate the efficient use of resources throughout their life cycle, including their repair, reuse, dismantling and recycling. PROs, in particular those in charge of household packaging, help to improve the management of the end-of-life of plastic products and packaging but also to encourage reduction at source as well as eco-design.

The first PROs already benefit from more than 30 years of experience in implementing EPR, and visibility on the actions taken and their impacts. This knowledge of the benefits of EPR encourages the deployment of this model on a global level, as it meets many needs. From the start, EPR systems were born out of the need to respond to the challenges of increasing quantities of waste, increasing costs to taxpayers, and the loss of resources that untreated waste represents. Today, their actions allow them to:

- Define, in conjunction with industry/producers national and local authorities, minimum targets for reuse, recycling or recovery when and where relevant;
- Introduce EPR fees at the time of placing on the market to cover the costs of end-of-life management of packaging;
- Modulate EPR fees with incentives and disincentives bonuses and/or penalties, in a way that reflects defined environmental criteria of the product - for example its recyclability - to promote to producers to design their products / packaging. It will facilitates the sorting for inhabitants and the treatment, re-use or recycling in the next steps so that the material stay in the economic cycle;
- Involve companies in the circular economy of their packed products: they are the ones who eco-design the packaging, finance a large part of its collection, sorting, recycling and reuse to turn it into new resources;
- Generate sustainable funding for the waste management service while boosting its efficiency;
- Gain economies of scale and efficiencies to help control costs to consumers;
- Include consumers in this transition to the circular economy by providing convenient separate collection opportunities, encouraging sorting, good consumption practices and supporting them in new uses;
- In relevant cases, educate consumers about the effects of littering. As such, EPR can encourage municipalities to develop more solutions on littering and waste collection;
- Whenever legally bound to, cooperate with recyclers in order to return the recycled materials to the companies that first placed them on the market in order to enable them to include recycled content;
- In view of the growing relevance of online sales, EPR can develop legal frameworks that force Marketplaces to equally contribute to the prevention and management of waste.

Extended Producer Responsibility (EPR) in India

If someone identified as Producer, Importer and Brand Owners (PIBO) and have PIBO operations in India that uses plastic packaging as part of its operation, irrespective of your turnover or scale of operations then PIBO fall under the obligation of Extended Producer Responsibilities (EPR) Under the current framework of EPR, PIBO are responsible to:

1. Register at EPR Portal of Government of India
2. Submit their Action plan
3. Fulfill obligations for: -
 - a. Recycling
 - b. Use of Recycled content
 - c. Reuse
 - d. End of life disposal
 - e. Optional engagement in collection and recovery of the plastics
 - f. Submit annual returns
 - g. Provide proof of certificates (Plastic credits)
 - h. PIBOs can engage with PRO's or other agencies separately to fulfill their targets but reporting and responsibility to fulfill the obligations is completely of PIBO.

Case Study on Plastic Waste Management in India

India generates 15 million tonnes of plastic waste every year but only one fourth of this is recycled due to lack of a functioning solid waste management system. This leads to burden on the landfills and poor socio- economic conditions of the waste pickers, mostly women.

United Nations Development Programme (UNDP) India, in partnership with Hindustan Coca-Cola Beverages Private Limited (HCCBPL), Hindustan Unilever Limited (HUL), HDFC Bank & Coca Cola India Foundation (CCIF) is building on existing systems to reduce the impact of plastic waste on environment in India. The partnership promotes collection, segregation and recycling of all kinds of plastics to move towards a circular economy.

This project aims to:

- Create a socio-technical model for taking plastic waste management from informal to formal economy.
- Establish Material Recovery Centres for sustained practices in waste management.
- Institutionalize Swachhta Kendras within governance framework structures and improved socio-economic conditions of waste pickers.
- Develop technology-supported knowledge management: Promote Cloud-based traceability, accountability and digital governance along waste value chain through our technical partner Mindtree through field implementing partners.

Achievements:

- The project is currently operational in 36 cities, with 22 Material Recovery Centres (Swachhta Kendras) established for sustainable waste management practices.
- The plastic collected and processed so far has already crossed 66,000 metric tonnes.

- Through these centres, the project has reached out to 5500 Safai Sathis, in an effort to institutionalize workers from the informal sector.
- UNDP was felicitated as a key partner by the Ministry of Housing & Urban Affairs at the Swachh Survekshan Awards 2020 under the Swachh Bharat Mission.
- With a strong approach towards providing social security to the Safai Sathis, Utthaan, a social protection programme was launched to help 9000 safai sathis on with regular workshops organised for them at Swachhta Kendras, where they are given assistance with opening bank accounts, enrolling for Aadhar cards, availing health check-up, and several other personal training sessions.

EXEMPLARS OF GREEN INITIATIVES IN INDIA

❖ Bharti Airtel Limited

- (1) The Company is committed to helping meet the goals of the Paris Accord and has identified 'Climate Change, Energy Efficiency and Emission Reduction' as a critical material issue. The Company has accordingly taken various public targets and initiatives to reduce its carbon foot prints.

Some of the green initiatives taken by the Company during FY 2020-21 includes:

- -284 MWh energy saved during the year
- 49% Reduction in network emission intensity for mobile
- 28% Reduction in CO₂ emission per square feet in its facilities
- 24% Reduction in CO₂ emission per rack in its data centers
- 82,917 MWh Renewable energy consumed.

❖ HDFC Limited

- To strengthen the Green & Sustainability culture with the firm, the Corporation has initiated a campaign on ESG for employees and their families called, 'Hope Begins at Home'. The objective is to encourage climate conscious decisions in daily lives and create more ESG Champions in the organization with the belief that small changes through collective efforts make a material difference.
- The Corporation has undertaken extensive learning and development initiatives to up skill employees on current and developing best practices on ESG & Sustainability. These include:
 - Creating bespoke training modules on ESG & Sustainability;
 - Training new recruits on ESG & Sustainability;
 - Systematic and consistent re-enforcement of ESG Best practices by inviting External ESG to Speak with ESG Champions;
 - ESG Champions work on Train the Trainer approach to further train their colleagues at the Corporation's PAN India Branches;
 - The Corporation's Library Team disseminates weekly media updates related to ESG & Sustainability;
 - ESG Appraiser training and development to assess Environment and Social impact while evaluating projects;

- Systematic engagement at the functional level to reinforce climate consciousness; and
- Involved a Big4 consulting firm to undertake an ESG Diagnostic exercise.

❖ **Tata Chemicals Limited**

- The Company's plant at Mambattu started with a renewable source of energy and is using 100% of biomass and has achieved zero liquid discharge.
- The Company's plant at Mithapur has achieved ZERO dependence on Groundwater
- The Company has set up a waste management plant at Mithapur and plastic waste collected is used as a fuel in their cement plant.
- The Company has fully (100%) utilized its Fly ash waste.
- The Company continues its biodiversity plantation covering almost 150 acres of land.
- The Company has its own Bio-diversity Policy.
- The Company monitors its progress through the Responsible Manufacturing Index and is committed to the Science Based Target Initiative and has recently got its targets Validated.

❖ **Tech Mahindra Limited**

- Reduction of 25,000+ MTCO₂e through RE and energy-efficient equipment.
- The Company has reduced its scope 1+2 emissions by 31% against FY 2019-20
- The Company has reduced energy intensity by 47.23% from FY 2019-20.
- The Company has reduced its Food wastage by 93%.
- The Company recycled 25% (804 tons) of food waste by converting it to manure through organic Waste Converters (OWCs) and Vermicomposting units. Also, Leaf Waste has been converted to manure.
- The Company has reduced paper consumption by more than 85% Since FY 2019-20.

❖ **Hindustan Unilever Limited**

- The Company has created a cumulative water conservation potential of about 1.3 trillion litres of water across India through improved supply and demand water management to ensure that people continue to have access to water even as the climate crisis looms.
- The Company in its manufacturing operations has reduced water consumption (in metric tons of production) by 54% against the 2008 baseline.
- Since 4 2018, the Company has facilitated safe disposal of more than 150,0000 tons of post-consumer use plastic waste with the help of collection and disposal partners across India.
- The Company has further announced that from 2021 onward it will be collecting and process more plastic packaging waste than the plastic in packaging used by it.
- The Company's laundry brand Surf Excel introduced Surf excel Matic Liquid using 100% biodegradable actives in formulation and with 50% recycled Plastic in Packaging.
- The Company has reduced Co₂ emission per ton of its production by 91% Compared to 2008 baseline.

- All factories, Offices, R&D facilities, data centers, warehouses and distribution centers of the company are powered by 100% renewable grid electricity.

❖ **AU Small Finance Bank Limited**

- The Bank has introduced digital visiting cards to reduce the wastage of paper while discontinuing and discouraging the printing of physical visiting cards since FY 2020-21
- The Bank launched Video Banking in Q3 FY21 With a vision of offering all its services virtually through video- enabled chat with branch executives, eliminating the need for branch visits.

❖ **Mindtree Limited**

- The Company has recycled 94.6% of the waste.
- The Company's 74.8% of energy requirement is met through renewable resources (PAN India).
- The Company's Pune location, a Zero- discharge location, upgraded STP to newer technology and utilized treated water for flushing and landscaping.
- The Company's Bengaluru East location is now a Zero-waste site, with recycling more of the rejected waste, and no burden on the landfill.
- The Company's Pune location reduced incineration by recycling used oil.
- The Company's Bengaluru locations have stopped external sourcing of water.
- The Company's all India locations are ISO 14001:2015 certified.

❖ **Rallis India Limited**

The Company has a Zero liquid discharge program to minimize the impact of factories on the environment and tracking the use of natural resources.

❖ **Syngene International Limited**

- The Company has sourced 82% of the energy consumed (63 million KWh) from green energy sources resulting in a reduction of -53280 MT of CO₂.
- The Company's site is maintained as 'Zero Liquid Discharge facility' and treated water is used for utilities and secondary purposes.
- The Company has achieved 21% (21290KL) reductions in its freshwater usage as compared to FY-20.
- The Company has eliminated use of all types of single use plastic, carrier bags, waste bottles inside the facility and introduced starch-based biodegradable bags.
- The Company has established a dedicated Central waste yard for effective segregation, storage and disposal of different types of waste begin generated from its operations.
- The Company Practices Green Chemistry concepts to replace Hazardous Chemicals to environmentally sound materials in its R&D operations.
- 100% closed loop collection of effluents generated from its operations ensures no effluent/ waste are discharged on soil.
- The Company has introduced Waterless urinals to reduce the generation of sewage.
- The Company has introduced 4 Electric vehicles for movement of materials inside the premises.

❖ Tata Elxsi Limited

- Rooftop Solar PV based electricity generation;
- Procurement of Electric Two-wheeler Vehicle;
- Use of Variable Frequency Drives (VFDs) in Air Handling units;
- Specialized agencies are hired to carry out the e-waste disposal, etc.

❖ EPL Limited

The Company has targeted to become 100% recyclable- ready by 2025. The Company has partnered for supplying 100% recyclable plating tubes for packing of FMCG Products.

❖ Happiest Minds Technologies Limited

CARBON (Clean, Assured and Responsible Building of Outcomes towards Neutrality) team has been formulated to ensure that the Company is in the path to be carbon neutral by 2023.

❖ DLF Cyber City Developers Limited

- The Company's buildings are Leadership in Energy and Environmental Design (LEED) Platinum Certified which is an ecology – Oriented building certification program run under the auspices of the U.S. Green Building Council (USGBC).
- Global Real Estate Sustainability Benchmark (GRESB), an international organization considered a Global standard for ESG benchmarking and reporting, has recognized DCCDL as Regional Sector Leader for its developments across the office space. DCCDL achieved the highest ranking of 5 star rating and has been Ranked # 2 in Asia in the Regional sector for its development across the unlisted office space by GRESB>.

❖ Mahindra Intertrade Limited

- Under the brand name 'CERO' which means 'Zero' in Spanish, the Company has set up state-of-the-art Vehicle scrapping centers at Greater Noida, Chennai and Pune.
- The Company has been set up with twin objectives of 'making the scrap steel imports'.
- CERO is India's first government authorized vehicle recycling facility.

❖ **Power System Operation Corporation Limited**

- 197 conventional lights replaced with LED Lights. This resulted in energy saving of approx. 25,272 Units. Reduction in CO₂ emissions was approx. 23,77KG CO₂.
- Solar rooftop photo Voltaic systems installed which is helping minimize fossil fuel burning by distribution utilities.

❖ **Tata Consulting Engineers Limited**

- The Company is working towards net Zero in Close collaboration with TERI/CII and Indian Green Building Congress.
- The Company has established Eco first services Limited, a 100% Subsidiary with core focus on sustainable practices.

EUROPEAN GREEN DEAL

As it is a widely accepted fact that climate change and environmental degradation are an existential to Europe and the globe, in view of this, to overcome these challenges, the European Commission embraced 'The European Green Deal', a roadmap for making the EU's economy sustainable by turning climate and environmental challenges into opportunities across all policy areas and making the transition just and inclusive for all.

The European Green Deal aims to transform the EU into a modern, resource-efficient and competitive economy by ensuring:

- No net emissions of greenhouse gases by 2050.
- Economic growth decoupled from resource use.
- No person and no place left behind.

The chronology of the important developments relating to European Green Deal is provided in the table below-

Chronology of the Significant Developments Pertaining to European Green Deal

Dates	Developments
11 December 2019	Presentation of the European Green Deal
14 January 2020	Presentation of the European Green Deal Investment Plan and the Just Transition Mechanism
4 March 2020	Proposal for a European climate law to ensure a climate neutral European Union by 2050
10 March 2020	Adoption of the European Industrial Strategy, a plan for a future-ready economy
11 March 2020	Proposal of a Circular Economy Action Plan focusing on sustainable resource use
20 May 2020	Presentation of the EU Biodiversity Strategy for 2030 to protect the fragile natural resources on our planet. Presentation of the 'Farm to fork strategy' to make food systems more sustainable
8 July 2020	Adoption of the EU strategies for energy system integration and hydrogen to pave the way towards a fully decarbonised, more efficient and interconnected energy sector

Dates	Developments
17 September 2020	Presentation of the 2030 Climate Target Plan ¹
14 October 2020	Renovation wave ² Methane Strategy ³ Chemicals strategy for sustainability ⁴
19 November 2020	Offshore renewable energy ⁵
9 December 2020	European Climate Pact ⁶
10 December 2020	European Battery Alliance ⁷
18 January 2021	New European Bauhaus ⁸
24 February 2021	New EU strategy on adaptation to climate change ⁹
25 March 2021	Organic Action Plan ¹⁰
12 May 2021	Zero pollution Action Plan ¹¹
17 May 2021	Sustainable blue economy ¹²
14 July 2021	Delivering the European Green Deal
15 September 2021	New European Bauhaus: new actions and funding ¹³
17 November 2021	Proposals to stop deforestation, innovate sustainable waste management and make soils healthy ¹⁴
14 December 2021	New transport proposals target greater efficiency and more sustainable travel ¹⁵
15 December 2021	Commission proposals to remove, recycle and sustainably store carbon
15 December 2021	Proposal of a new EU framework to decarbonise gas markets, promote hydrogen and reduce methane emissions ¹⁶
8 March 2022	REPowerEU: Joint European action for more affordable, secure and sustainable energy ¹⁷

1. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1599

2. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1835

3. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1833

4. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1839

5. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2096

6. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2323

7. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2312

8. https://ec.europa.eu/commission/presscorner/detail/en/IP_21_111

9. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_663

10. https://agriculture.ec.europa.eu/farming/organic-farming/organic-action-plan_en

11. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_2345

12. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_2341

13. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_4626

14. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_5916

15. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6776

16. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6682

17. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511

<i>Dates</i>	<i>Developments</i>
23 March 2022	Options to mitigate high energy prices with common gas purchases and minimum gas storage obligations ¹⁸
30 March 2022	Proposals to make sustainable products the norm in the EU, boost circular business models and empower consumers for the green transition ¹⁹
5 April 2022	Proposals to phase down fluorinated greenhouse gases and ozone depleting substances
22 April 2022	The European Commission joins the European Climate Pact and pledges to make its operations climate neutral by 2030
18 May 2022	REPowerEU plan: affordable, secure and sustainable energy for Europe
22 June 2022	Nature protection package
20 July 2022	'Save gas for a safe winter' proposal ²⁰
15 September 2022	Proposal for an emergency market intervention to reduce energy bills for Europeans
26 October 2022	Commission proposes stronger rules for cleaner air and water
27 October 2022	The Council and the European Parliament reach a provisional political agreement on stricter CO2 emission performance standards for new cars and vans
10 November 2022	Proposal for new Euro 7 standards to reduce pollutant emissions from vehicles and improve air quality. Biodiversity: Stronger measures against wildlife trafficking.
15 November 2022	EU Algae Initiative
30 November 2022	Circular Economy: Packaging and Packaging Waste Regulation. Proposal for a first EU-wide voluntary framework to reliably certify high-quality carbon removals.
6 December 2022	EU agrees law to fight global deforestation and forest degradation driven by EU production and consumption
9 December 2022	New rules on applying the EU emissions trading system in the aviation sector
18 December 2022	EU agrees to strengthen and expand emissions trading, and creates a Social Climate Fund to help people in the transition
24 January 2023	Presentation of a 'A New Deal for Pollinators' to tackle the alarming decline in wild pollinating insects in Europe.
13 February 2023	The Commission sets out rules for renewable hydrogen

18. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1936

19. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2013

20. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4608

Dates	Developments
14 February 2023	The Commission proposes 2030 zero-emissions target for new city buses and 90% emissions reductions for new trucks by 2040
10 March 2023	The EU agrees stronger rules to boost energy efficiency

Source: European Commission

Along with the above mentioned table, it is pertinent to refer the following table also, as it elucidates the key steps initiated by European Commission as well as proposed towards 'Green Deal'.

Dates	Key Steps
December 2019	Commission presents European Green Deal, committing to climate neutrality by 2050
March 2020	Commission proposes European Climate Law to write 2050 climate neutrality target into binding legislation
September 2020	Commission proposes new EU target to reduce net emissions by at least 55% by 2030, and add it to the European Climate Law
December 2020	European leaders endorse Commission's proposed target to reduce net emissions by at least 55% by 2030
April 2021	Political agreement reached on European Climate Law by European Parliament and Member States
June 2021	European Climate Law enters into force
July 2021	Commission presents package of proposals to transform our economy, to reach our 2030 climate targets. European Parliament and Member States to negotiate and adopt package of legislation on reaching our 2030 climate targets
September 2021	New European Bauhaus: new actions and funding
October 2022	The Council and the European Parliament reach a provisional political agreement on stricter CO2 emission performance standards for new cars and vans
2030	EU to deliver a reduction of emissions of at least 55% compared to 1990 levels
2050	EU to become climate neutral

Key Steps towards Green Deal

Source: European Commission

The benefits of the European Green Deal

The European Green Deal will improve the well-being and health of citizens and future generations by providing:

- fresh air, clean water, healthy soil and biodiversity
- renovated, energy efficient buildings

- healthy and affordable food
- more public transport
- cleaner energy and cutting-edge clean technological innovation
- longer lasting products that can be repaired, recycled and re-used
- future-proof jobs and skills training for the transition
- globally competitive and resilient industry.

GRI (GLOBAL REPORTING INITIATIVE) STANDARDS

For more than 25 years GRI has developed and provided globally recognized standards for organizations to communicate and disclose information placing accountability for the impact on environment, economy and people. These standards are inter-connected in a structured manner in order to provide complete disclosures.

Any organization, irrespective of size can adopt these standards. These Standards also assist stakeholders and other information users understand what is expected from an organization to report on and use the information published by organizations in various ways.

The GRI Standards are a modular system comprising of:

- i) GRI Universal Standards.
- ii) GRI Sector Standards.
- iii) GRI Topic Standards.

These Standards consist of structured disclosures, which can include requirements or recommendations. Requirements specify the information a company should provide and comply with. Recommendations include a voluntary course of action that is encouraged but not made voluntary.

GRI Universal Standards: This Standard applies to all organizations and consists of the following:

- (a) **GRI 1: Foundation 2021** provides the conceptual understanding like the purpose of these Standards, critical concepts, and clarification for using the Standards. It comprises of principles such as accuracy, balance and verifiability.
- (b) **GRI 2: General Disclosures 2021** consists of disclosures like organizational structure, governance, policies, practices, strategy, stakeholder engagement etc. They provide insights into the organization's profile and scale and help in providing a context for understanding an organization's impacts.
- (c) **GRI 3: Material Topics 2021** provides the steps through which an organization can determine the topics that are of most relevance to it in terms of impact. It provides the use of sector standards in this process. It also provides disclosures pertaining to material topics, the method of assessing the materiality and the management of every material issue.

GRI Sector Standards: These Standard are sector-specific in nature and are created with the intention of increasing the quality, completeness and consistency of reporting by organizations. These Standards have been developed for 40 sectors and they are significant for organizations operating in that particular sector.

They indicate the disclosure requirements on sector-specific issues. If an applicable Sector Standard is available, an organization is obliged to use it when reporting with the GRI Standards.

GRI Topic Standards: These Standards provide disclosures for specific topics. This section include Standards for topics like waste, occupational health and safety, and tax. The organizations can select the Standards that are related to the material issues that have been identified and the associated impacts.

As the lesson has focused on green initiatives, so the following exhibit have covered the GRI Standards pertaining to Environmental dimension.

GRI Environmental Standards

SL. NO.	GRI STANDARDS NUMBER	GRI STANDARDS	DESCRIPTION
ENVIRONMENTAL (GRI 300)			
1.	GRI 301	Materials 2019	It addresses the topic of materials. The inputs used to manufacture and package an organization's products and services can be nonrenewable materials, such as minerals, metals, oil, gas, or coal; or renewable materials, such as wood or water. The disclosures in this Standard can provide information about an organization's impacts related to materials, and how it manages these impacts.
2.	GRI 302	Energy 2016	It addresses the topic of energy. An organization can consume energy in various forms, such as fuel, electricity, heating, cooling or steam. The disclosures in this Standard can provide information about an organization's impacts related to energy, and how it manages them.
3.	GRI 303	Water and Effluents 2018	It addresses the topic of water and effluents. Access to fresh water is essential for human life and wellbeing, and is recognized by the United Nations (UN) as a human right. The Sustainable Development Goals, adopted by the UN as part of the 2030 Agenda for Sustainable Development, include key targets related to sustainable water management under Goal 6: 'Ensure availability and sustainable management of water and sanitation for all'. The disclosures in this Standard are designed to help an organization better understand and communicate its significant water-related impacts, and how it manages them.
4.	GRI 304	Biodiversity 2016	It addresses the topic of biodiversity. Protecting biological diversity is important for ensuring the survival of plant and animal species, genetic diversity, and natural ecosystems.

SL NO.	GRI STANDARDS NUMBER	GRI STANDARDS	DESCRIPTION
			The disclosures in this Standard can provide information about an organization's impacts related to biodiversity, and how it manages them.
5.	GRI 305	Emissions 2016	It addresses emissions into air, which are the discharge of substances from a source into the atmosphere. Types of emissions include: greenhouse gas (GHG), ozone-depleting substances (ODS), and nitrogen oxides (NOX) and sulfur oxides (SOX), among other significant air emissions.
			The reporting requirements for GHG emissions in this Standard are based on the requirements of the 'GHG Protocol Corporate Accounting and Reporting Standard' ('GHG Protocol Corporate Standard') and the 'GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard' ('GHG Protocol Corporate Value Chain Standard').
6.	GRI 306	Effluents and Waste 2016	It addresses the topic of effluents and waste. This includes water discharges; the generation, treatment and disposal of waste; and spills of chemicals, oils, fuels, and other substances. The disclosures in this Standard can provide information about an organization's impacts related to effluents and waste, and how it manages these impacts.
7.	GRI 306	Waste 2020	It addresses the topic of waste. Waste can be generated in the organization's own activities, for example, during the production of its products and delivery of services. It can also be generated by entities upstream and downstream in the organization's value chain, for example, when suppliers process materials that are later used or procured by the organization, or when consumers use the services or discard the products that the organization sells to them. The disclosures in this Standard are designed to help an organization better understand and communicate its waste-related impacts, and how it manages these impacts. The disclosures require information on how the organization prevents waste generation and how it manages waste that cannot be prevented, in its own activities and upstream and downstream in its value chain.

SL. NO.	GRI STANDARDS NUMBER	GRI STANDARDS	DESCRIPTION
8.	GRI 308	Supplier Environmental Assessment 2016	It addresses the topic of supplier environmental assessment. An organization might be involved with impacts either through its own activities or as a result of its business relationships with other parties. Due diligence is expected of an organization in order to prevent and mitigate negative environmental impacts in the supply chain. These include impacts the organization either causes or contributes to, or that are directly linked to its activities, products, or services by its relationship with a supplier. The disclosures in this Standard can provide information about an organization's approach to preventing and mitigating negative environmental impacts in its supply chain.

LESSON ROUND-UP

- Pollution abatement refers to technology applied or measure taken to reduce pollution and/or its impacts on the environment.
- SDGs relating to pollution are- No Poverty, Zero Hunger, Good Health and Well-Being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, Industry, Innovation and Infrastructure, Reduced Inequalities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice and Strong Institutions and Partnerships for the Goals.
- Resource efficiency means using the Earth's limited resources in a sustainable manner while minimising impacts on the environment. It allows us to create more with less and to deliver greater value with less input.
- Energy intensity is the amount of energy required to produce one unit of gross domestic product (GDP). Going by this definition, it may be opined that the intensity of renewable energy is increasing both at global and at national levels.
- Water stewardship is a collaborative and multi-stakeholder approach that aims to achieve social, environmental and economic benefits. By using Water Footprint Assessment, a company can ensure that all stakeholders are well informed and good river basin governance is developed.
- Water desalination is an industrial process that requires huge amounts of chemicals and energy to proceed. Therefore, start-ups are focused on developing innovative and eco-friendly solutions that reduce costs.
- Waste management refers to the various schemes to manage and dispose of wastes. It can be by discarding, destroying, processing, recycling, reusing, or controlling wastes. The prime objective of waste management is to reduce the amount of unusable materials and to avert potential health and environmental hazards.

GLOSSARY

- **Biodegradable:** Something capable of decaying into its basic components.
- **Carbon emissions:** Pollution released into the atmosphere from carbon dioxide and carbon monoxide; often produced by motor vehicles.
- **Climate change:** Significant change in climate including temperature, precipitation, or wind that lasts for an extended period.
- **Climate positive:** Exceeding achieving carbon neutrality by removing additional carbon dioxide from the atmosphere; also referred to as carbon negative.
- **Eco-conscious:** The mentality to focus on reducing harm to the environment wherever possible.
- **Ecological footprint:** Measurement based on the amount of nature it takes to support something.
- **Global warming:** The average increase of temperature of the troposphere.
- **Grey water:** Domestic wastewater including wash water from the bathroom, kitchen, and laundry.
- **Greenhouse effect:** When excessive heat is trapped and built up in the troposphere by a blanket of gases.
- **Greenwashing:** Misrepresenting something as being “green” when it’s not environmentally sound.
- **Reforestation:** Planting of forests on lands that were depleted.
- **Wish-cycling:** An aspirational approach to recycling items without knowing if they’re recyclable but expecting them to be properly dealt with.
- **Sustainability:** Environmental practices that protect natural resources needed by future generations for a positive quality of life.
- **Commingle:** To blend together similar recyclable materials such as mixed brown, green, and clear glass – but separate from disposable materials in the waste stream.
- **Cradle to Cradle:** In cradle to cradle production all material inputs and outputs are seen either as technical or biological nutrients. Technical nutrients can be recycled or reused with no loss of quality and biological nutrients composted or consumed.
- **Brown Power:** Electricity generated from the combustion of fossil fuels, such as coal, oil, and natural gas, which generates significant amounts of greenhouse gases.

TEST YOURSELF

(These are meant for recapitulation only. Answer to these questions are not to be submitted for evaluation)

1. What is the purpose of green initiatives?
2. How do you promote green initiatives?
3. What are the barriers to successful green innovation?
4. What are the barriers to green infrastructure?
5. What are the 3 pillars of sustainability?
6. What is sustainable technology?
7. What is the goal of sustainable development?

LIST OF FURTHER READINGS

- Corporate Governance Values & Ethics Book for MBA by Dr Neeru Vasisht, Dr Namita Rajput, Taxmann
- Concepts of Environmental Management for Sustainable Development by M C Dash
- The Age of Sustainable Development by Jeffrey D Sachs and Ki-moon Ban
- Environmental Ecology, biodiversity And Climate Change: Towards Sustainable Development by H M Saxena
- Sustainable Development: Linking Economy, Society, Environment by Tracey Strange and Anne Bayley

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Green Initiatives