

5. Waste Management

Objectives

The overall objectives of the waste management assessment are summarized below:

- (i) To assess the activities involved for the proposed and determine the type, nature and estimated volumes of waste to be generated.
- (ii) To identify any potential environmental impacts from the generation of waste at the site.
- (iii) To recommend appropriate waste handling and disposal measures / routings in accordance with the current legislative and administrative requirements; and
- (iv) To categorize waste material where practicable (inert material / waste fractions) for disposal considerations i.e., public filling areas / landfill.

Solid Waste Management

To reduce waste at institute, students and staff are educated on proper waste management practices through lectures, advertisement on notice boards, displaying slogan boards in the campus. Waste is collected daily from various sources and is separated into dry and wet waste.

Campus solid waste management program

The main objectives of SWM are the maintenance of clean and hygienic conditions and reduction in the quantity of solid waste (SW), which is disposed of in the sanitary landfill facility (SLF) of the area after recovery of material and energy from it. Student participation in waste management will play a very important role as they will also spread awareness programs along with their duty towards cleanliness.

Producing less wastes

- Students can utilize their belongings like paper, pencils, and pens to the maximum and produce less amounts of wastes.
- Keeping classrooms and households clean: The students can keep their classrooms and houses clean by not littering things here and there.

Here are the methods of solid waste disposal and management

- Solid Waste Open Burning.
- Sea dumping process.
- Solid wastes sanitary landfills.
- Incineration method.
- Composting process.
- Disposal by Ploughing into the fields.
- Disposal by hog feeding.
- Salvaging procedure.
- Benefits of waste management
- Reducing waste will not only protect the environment but will also save on costs or reduce expenses for disposal. In the same way, recycling and/or reusing the waste that is produced benefits the environment by lessening the need to extract resources and lowers the potential for contamination.

The 7 principles of waste management-



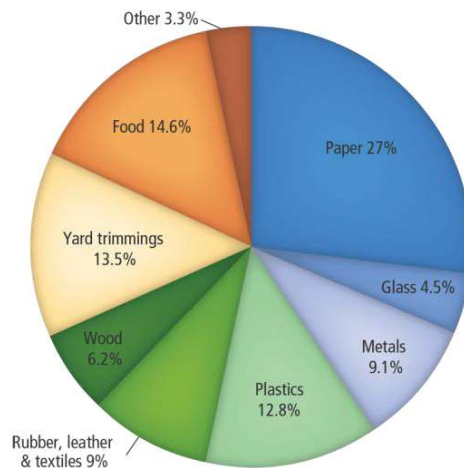
The 7 R's of Recycling

- Recycle.
- Refuse.
- Reduce.
- Reuse.
- Repair.
- Re-gift.
- Recover.

Municipal Solid Waste:

Top 3 items in municipal solid waste, In 2018, about 146.1 million tons of MSW were land filled. Food was the largest component at about 24 percent. Plastics accounted for over 18 percent, paper and paperboard made up about 12 percent, and rubber, leather and textiles comprised over 11 percent. Other materials accounted for less than 10 percent each.

Solid Waste Management may be defined as the discipline associated with the control of generation, collection, storage, transfer and transport, processing, and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other. The major sources of municipal solid waste



Municipal Solid Waste (MSW)—more commonly known as trash or garbage—consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This comes from our homes, schools, hospitals, and businesses.

Plastic Waste

India has banned manufacture, import, stocking, distribution, sale and use of identified single use plastic items, which have low utility and high littering potential, all across the country from July 1, 2022.

Recently, the Ministry of Environment, Forest, and Climate Change announced the Plastic Waste Management (Amendment) Rules, 2022, which notified the instructions on Extended Producer Responsibility (EPR) for plastic packaging.

Centralized Online Portal

- A. The government has also called for establishing a centralized online portal by Central Pollution Control Board (CPCB) for the registration as well as filing of annual returns by producers, importers and brand-owners, plastic waste processors of plastic packaging waste by 31st March 2022.
- B. It would act as the single point data repository with respect to orders and guidelines related to implementation of EPR for plastic packaging under Plastic Waste Management Rule, 2016.

Environmental Compensation

Environmental compensation will be levied based upon polluter pays principle, with respect to non-fulfilment of EPR targets by producers, importers, and brand owners, for the purpose of protecting and improving the quality of the environment and preventing, controlling, and abating environment pollution. The Polluter Pays Principle imposes liability on a person who pollutes the environment to compensate for the damage caused and return the environment to its original state regardless of the intent.

Committee to Recommend Measures

A committee constituted by the CPCB under the chairmanship of CPCB chairman will recommend measures to the environment ministry for effective implementation of EPR, including amendments to Extended Producer Responsibility (EPR) guidelines.

Construction & Demolition waste

The Bureau of Indian Standards has allowed the use of concrete made from recycled material and processed C&D waste. The Construction and Demolition Waste Rules and Regulations, 2016 have mandated reuse of recycled material. Even the Swachh Bharat Mission has recognized the need for C&D waste management.

Construction and demolition waste management

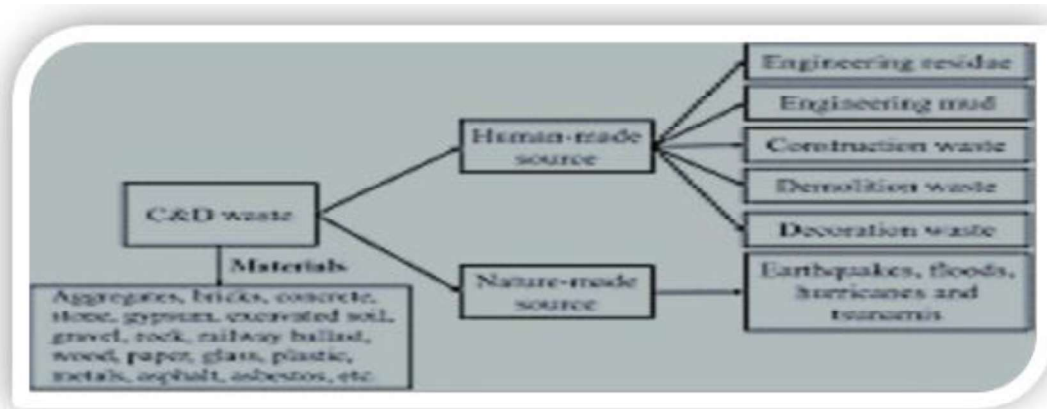
Construction and demolition waste is generated whenever any construction/demolition activity takes place, such as, building roads, bridges, flyover, subway, remodeling etc. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc.

C&D waste includes bricks, tiles, stone, soil, rubble, plaster, drywall or gypsum board, wood, plumbing fixtures, non-hazardous insulating material, plastics, wallpaper, glass, metal (e.g., steel, aluminum), asphalt, etc.

Recycling construction and demolition waste is profitable and environmentally friendly way to produce aggregates and reuse valuable materials that would otherwise be disposed. Processing the waste near the worksites also reduces the need for truck transportation resulting in lower logistics costs.

The impact of construction and demolition waste on the environment.

The environmental impacts caused by C&D waste mainly include land space consumption, landfill depletion, energy and non-energy resource consumption, resource depletion, air pollution, noise pollution, water pollution, etc. (Akanbi et al., 2018).



SOLID WASTE AUDIT

Solid waste is the unwanted or useless solid material generated from human activities in a residential, industrial, or commercial area. Solid waste management reduces or eliminates the adverse impact on the environment and human health. A number of processes are involved in efficiently managing waste for an organization. It is necessary to manage the solid waste properly to reduce the load on the waste management system. Solid waste generation and its management is a burning issue in current days. The rate of generation of solid waste is very high and yet we do not have adequate technology to manage the generated waste. Unscientific handling of solid waste can create threats to public health and environmental safety issues. Thus, it is necessary to manage solid waste properly to reduce the load on the waste management system. The purpose of this audit is to find out the quantity, volume, type, and current management practice of solid waste generation in the IPR campus. This report will help further solid waste management and to go for green campus development. Approximately **360 kg** per month solid waste is generated every month in IPR.

Generation of solid waste in IPR

IPR campus solid waste data is collected from all the building areas and the same is directly handed over to the Municipalities' Bin for further segregation and recycling purposes. There are different types of waste that are recorded such as paper waste, plastic waste, construction waste, glass waste, etc. However biodegradable waste is recycled through the vermicomposting process. The daily rate of waste generation has been increasing in recent time reaching up to an estimated amount of about 275 per month during peak academic sessions and the minimum amount generated during the lean period is about 450 Kg per month.

The wastes generated in the campus include (i) kitchen wastes, (ii) wastes from construction sites, (iii) liquid waste (residential and eateries), (iv) sewage and sludge, (v) biomedical waste, (vi) laboratory chemical wastes, (vi) Plastic wastes, (vii) cans and bottles; (viii) damaged or spoiled laboratory glassware, (ix) Unused tools and machinery including battery, (xi) papers including packaging materials (xii) electronics waste (xiii) garden leaves and (xiv) sweeping litters, etc.

Proper segregation of waste can fetch more revenue to the institute.

Status of solid waste generation in IPR

The institute is committed to ensuring that all forms of wastes generated are handled based on the RRRR (Reduce, Reuse, Recycle, Recover) principles following appropriate source segregation

protocols including safe disposal of hazardous wastes. There are studies from time to time to estimate the amount and nature of wastes, particularly solid waste which indicates the increasing trend of the volume. A preliminary survey reveals the domination of biodegradable components (volume basis) over the non-biodegradable counterparts on the campus. The students' hostels share the highest amount of solid waste mostly dominated by food/kitchen wastes (substantial amount of papers, plastics, metals are also seen with waste also generated in hostels) followed by residential areas, eateries including shopping complex and offices including academic buildings, construction sites (occasionally), open areas including gardens and roads.

Liquid Waste Management:

Following the resounding success of Sujalam 1.0 and 2.0, the Department of Drinking Water and Sanitation (DDWS) on May 5, 2023 launched Sujalam 3.0 – a campaign to manage grey water across all levels towards the making of an ODF Plus nation. Under the campaign, States and UTs can achieve ODF plus Model status by saturating the villages with liquid waste management (LWM).

Grey water Management, an important component under Swachh Bharat Mission Grameen (SBM-G) Phase II prioritizes the management of grey water, preferably by simple techniques and near the source itself, using sustainable and economical technologies wherever feasible.

E-Waste

Importance of E-Waste management

It's critical to keep electronic waste out of landfills. The EPA has stated that e-waste is dangerous when improperly disposed of. Electronic devices are composed of toxic substances and heavy metals. Materials such as chromium, cadmium, mercury, and lead can leach into the soil contaminating the air and waterways. New Gazette Notification w.e.f. from 1st April 2023. A list of items have been mentioned in Schedule – I which have been considered as E – Waste in the policy.

Five Reasons Why E-Waste Recycling is Important

Everyone has one. That box, drawer or shopping bag in a closet filled with old cell phones, obsolete chargers, broken tablets, and defunct MP3 players. It's our personal pile of electronic waste. According to government agencies, these piles are getting bigger, forcing us to consider why e-waste recycling is important.

Recycling electronic waste (e-waste, sometimes called e-scrap has become an increasingly important environmental issue as the useful life of electronic devices becomes shorter and shorter and the list of electronic gadgets we use becomes longer and longer. E-waste recycling benefits are numerous and the need to address these items in the solid waste stream is becoming more urgent. There are many factors to consider when evaluating electronics recycling, but here are the most significant reasons why e-waste recycling is important.

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The EPA has stated that e-waste is dangerous when improperly disposed of. Electronic devices are composed of toxic substances and heavy metals. Materials such as chromium, cadmium, mercury, and lead can leach into the soil contaminating the air and waterways. EPA estimates there are about 60 million tons of e-waste per year globally. Recycling this material will save landfill space. For these reasons, there are numerous state laws that now ban e-waste in landfills.

Electronic products

These are valuable materials such as precious metals like gold, silver, and platinum along with copper, aluminium, plastic, and glass. Through the recycling process, these materials can be reclaimed. Most electronic devices are nearly 100 percent recyclable. It would be poor stewardship to landfill these materials.

Reclaiming valuable materials

Reclaiming valuable materials from the recycling process means there will be decreased demand for new raw materials. This will help conserve important natural resources. According to the EPA, one metric ton of circuit boards contains 800 times the amount of gold mined from one metric ton of ore.

Using recycled material

Using recycled material will also help reduce greenhouse gas emissions produced when manufacturing or processing new products known as “virgin material.” The more recycled material is available, the lower the demand for virgin material.

Discarded electronic devices

Discarded electronic devices can also be kept out of the landfill if they are refurbished, reused, and donated to a worthy cause. A quick Google search will provide a list of organizations in most areas that rebuild old electronics and provide them to those who otherwise would go without. “Reuse” is an important component of keeping material out of the waste stream.

IPR is planning to segregate its E - Waste for further disposal to recyclers. For this they have already initiated the process. Also, in future they have agreed to file E-Waste return also.

Single use Plastic restriction in campus Area

From 1st July 2022, single use plastic is banned all over India. It is expected from the institute that posters and handbills to be pasted around the campus and those who find throwing of single use plastic in campus area to be fined. Student groups are encouraged to take active participation and watch and educate all that not to throw such plastic in the campus area. This can be achieved through awareness and participation only. It is recommended to put slogans for NO PLASTIC ZONE or such different types of slogans. A competition among the students shall be conducted to give different suggestions for Slogans. The best selected Slogans to be suitably rewarded or certificate to be issued to that student. Plastics are a good source of fuel also. The institute has assured to erect different placards at places with slogans for **NO SINGLE USE PLASTIC ZONE**.

Waste Bins and Controlled Waste Disposal

In United States, not abiding by the regulations and laws will lead to HEIs failing an inspection when the EPA, OSHA, or RCRA perform a routine examination of campus facilities. If an inspection fails, not only will it be costly, but these inspections are disruptive and can leave the HEIs with a negative reputation.

Any waste suitable for local garbage services, other than glass and paper is considered controlled waste. This waste includes your dirty paper, rubber, plastic, and wood and should be placed in waste bins. Waste bins should be available in all labs and collected daily through your regular cleaning services.

Each of the labs must have a container for specific wastes that are not allowed to go with normal waste bins. In one of these special containers, should have it labelled to hold all broken lab glassware, sharp objects such as glass or metals, fine powders (which should first be placed into a glass container), dirty sample tubes, and any other contaminated chemicals that are not needles or syringes.

The lab-controlled waste containers are required to be emptied on a regular basis and should never be allowed to overflow. It should never be allowed to place any glass, fine powder, or sharp metal into a standard lab waste bin. Before placing bottles into the waste container, remove their tops, and make sure there is no detectable smell of chemicals coming from the bottles. During our audit we found many dustbins in IPR campus.



Dustbins are placed at many places at IPR

Analysis:

1. The institute campus area is very neat & tidy at its overall look.
2. Municipal Solid waste is being collected on a daily basis & collected through AMC door to door.
3. On average 360 kg of solid waste is generated per month.
4. Waste bins at different locations were observed for collection of waste.
5. No littering was observed in the whole campus area.

Observation:

- The institute has already declared the campus as **Single Use Plastic Free Zone area**.
 - A proper record of scrap released from the purchase of Electronics gadgets be made. Also, a record of purchased electronic gadgets in replacement of old gadgets be maintained.
 - This year the institute has planned to summarize **all E – Waste** of the campus & send it to be authorized recycler/ refurbisher for its disposal.
 - Regarding **Construction & Demolition waste**, the authorities have informed that under the contract, it is the duty of contractor to dispose C&D waste.
 - It is recommended that the waste be collected under 3 heads (Dry waste, wet Waste & plastic waste) in accordance with the waste management policy of Government of India.
6. **Alternative Sources of Energy and Energy Conservation Measures (Biogas plant, green surroundings, solar panels, etc.) –**

Alternative Sources of Energy and Energy Conservation Measures

(Biogas plant, green surroundings, solar panels, etc.) –Solar Energy is generating **58116 kW** from September 2023 to March 2024. A total load of 100 kW solar energy is being generated by the institute through solar plants installed on the roof top.

Renewable Energy (Solar) Analysis

Month	Year	Solar generation
September	2023	7464
October	2023	5186
November	2023	8732
December	2023	8671
January	2024	8562
February	2024	9687
March	2024	9814
Total		58116

IPR has taken a big Leap by making 100 kW solar energy & thus saving conventional energy by 58116 kW being saved in last financial year with saving of Rs 2,49,898/- (approx.) (Two Lakh Forty-Nine Thousand Eight Hundred Ninety-Eight).

Exemplary Reduce Power Consumption in IPR

During the last 1-year IPR has achieved 100 kW of renewable Energy through solar power. This has reduced the electric consumption through the power grid by 100 kW thus having a net saving of Rs. 2.50 Lakhs approximately in the last financial year.



Solar Panel Installed on the roof of various buildings of IPR

Energy Management should be seen as a continuous process. Strategies should be reviewed annually and revised as necessary.

Institute Corporate Approach

The starting point in energy management is to identify a strategic corporate approach to energy management. Clear accountability for energy usage needs to be established, appropriate financial and staffing resources must be allocated, and reporting procedures initiated. An energy management program requires commitment from the whole organization to be successful. A record of Energy consumption must be kept and monitored on regular basis, to optimize the Energy consumption.

Designate an energy manager

An Energy Manager must be identified, and time bound responsibility must be given to him/her in getting implemented the findings of the Energy Audit points, which the Plant Establishment has planned to implement.

Setup an energy monitoring and reporting system

Successful energy management requires the establishment of a system to collect/analyses and report energy costs and consumption pattern. This will enable an overview of energy use and its related costs, as well as facilitating the identification of savings that might 'otherwise not be detected. The system needs to record both historical and ongoing energy use, as well as cost information from billing data, and is capable of producing summary reports on a regular basis. This information will provide how trends can be analyzed and reviewed for corrective measures.

Implement a staff awareness and Training program

A key ingredient to the success of an energy management program is maintaining a high level of awareness among staff. This can be achieved in several ways, including formal training, newsletters, posters and publications. It is important to communicate program plans and case studies that demonstrate savings, and to report results at least at 12-month intervals. Staff may need training from specialists on energy saving practices and equipment.

7. **Promotion of Gender Equity Events:** There is no committee as such for promotion of gender equity events but the talks organized on women's day were by eminent women who excel in their field of work. The details of program organized by the committee in respect of women's day is attached. Kindly refer annexure 3.

8. Water Conservation Facilities:

Sustainable Water Practices and Watershed Management Practices

The institute has taken many initiatives in water conservation and management of water available on the campus.

Rainwater Harvesting Units

The underground water table is decreasing day by day & minute by minute. There is no attempt to replenish the groundwater table with rainwater during the monsoon & other rainy days. Rainwater harvesting is the simple collection or storing of water through scientific techniques from the areas where the rain falls. It involves the utilization of rainwater for domestic or agricultural purposes. The method of rainwater harvesting has been in practice since ancient times. It is far from the best possible way to conserve water and awaken society towards the importance of water. The method is simple and cost-effective too. It is especially beneficial in the areas which face the capacity of water. We can see that the People usually make complaints about the lack of water. During the monsoons, lots of water goes waste into the gutters. And this is when Rainwater Harvesting proves to be the most effective way to conserve water. We can collect the rainwater into the tanks and prevent it from flowing into drains and being wasted. It is practiced on a large scale in metropolitan cities. Rainwater harvesting comprises the storage of water and water recharging through the technical process.

- Non-teaching staff or peons in the concerned section should take responsibility for monitoring the overflow of water tanks.
- A Large amount of water is wasted during the practical process in science laboratories. Designs of small water recycling systems help to reuse water.
- Producing distilled water in the laboratories required a large amount of water to distillate. To reduce 1 liter of distilled water required more than 33 liters of water. To avoid more wastage, the institute should design a common distillation plant for the Science Department.
- Reduce chemical waste formation in the laboratory; adopt the principles of green chemistry to reduce chemical waste.
- Pipes, overhead tanks, and plumbing systems should be maintained properly to reduce leakages and wastages of water.
- As institute is already having a bore well recharge unit. It will certainly add value to meet the mission of water conservation. And help in increasing the ground water table.



RWH system at IPR, Gandhinagar

Observation:

IPR is already having three bore well recharge units to recharge the ground water. The necessity to further increase recharge well may depend on reports received by Ground water Authority & under the guidance/ consultation of Civil Engineering dept. of IPR.

- Green Campus Initiatives:** Green Campus Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of various establishments. It aims to analyze environmental practices within and outside of the concerned sites, which will have an impact on the eco-friendly ambience.

Green campus audit can be a useful tool for HEIs to determine how and where they are using the most energy or water or resources; the HEIs can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. It can create health consciousness and promote environmental awareness, values, and ethics. It provides staff and students with a better understanding of green impact on campus. If self-enquiry is a natural and necessary outgrowth of a quality education, it could also be stated that institutional self-enquiry is a natural and necessary outgrowth of a quality educational institution. Thus, it is imperative that the HEIs evaluate its own contributions toward a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent.