Waste-2-Wealth

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**"Waste does not exist in nature.
Because ecosystems reuse everything
that grows in a never-ending cycle of efficiency and purpose".**

-Frans van Houten

In the world of consumerism, when the production and use of materials are encouraged, it is obvious that the Earth ends up in waste when the purpose of materials is no longer served. The waste may be of solid, liquid, or gaseous state. Again, in solid waste, municipal solid waste can be sourced from residential, commercial, institutional, and industrial (non-process waste) activities. The other types of solid wastes are obtained from construction and demolition sites, water and wastewater treatment facilities, industrial treatment processes, industrial waste, agricultural waste, and special wastes such as e-waste, biomedical waste, fecal waste, etc.

Waste Dump (Representation Image)

Waste Management Awareness Mascot (Inset)

Worldwide, a person generates 0.11-4.54 Kg of municipal solid waste per day. Hence, the global generation of municipal solid waste is approximately 2.01 billion tonnes in 2022 which is equivalent to the weight of 2,00,000 Eiffel Tower. The generation of municipal solid waste is steadily increasing at a minimum increment of 33% per annum and is expected to reach 3.4 billion tonnes by 2050. Here, the high-income nations produce around 34% of the world's waste, although having just 16% of the world's population. The East Asia and Pacific region accounts for 23% of global waste, whereas the Middle East and North African region produce the least 6%, however, these numbers are predicted to change in the fastest growing regions. Similarly, agricultural waste, industrial hazardous and non-hazardous waste, biomedical waste, and e-waste are holding their increasing trend in the waste production sector.

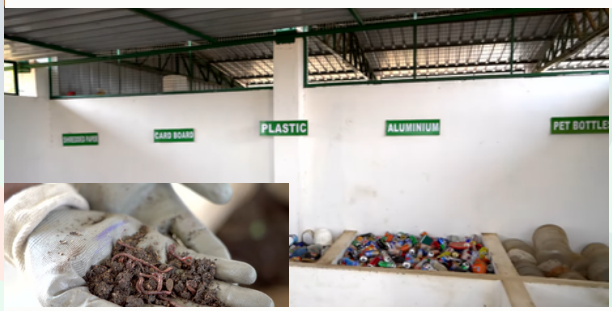
More than half of this waste is currently disposed of openly, and the rising pattern of waste generation will have significant impacts on the environment, human health, and economic growth, necessitating immediate action. The integrated waste management practices in India involve steps of source reduction and reuse, recycling, composting, waste to energy, and landfills.

For instance, **IIT Hyderabad has a two-bin door collection system to collect biodegradable and non-biodegradable waste. The biodegradable waste is sent to the composting unit inside the campus, and the resultant compost is used for horticulture activities. The plastics, glass, and paper wastes were segregated in the solid waste management site inside the campus Resource Recovery Park, and the leftover was sent for dumping.**

In Addition, IITH has a Biogas Digester for treating left-over food from the Mess (that generates 20 Cubic meters of Biogas daily, which is again used back by the IITH Mess) and a Zero-Liquid Discharge Plant.

IITH's Resource Recovery Park (RRP)

IITH's Biogas Digester



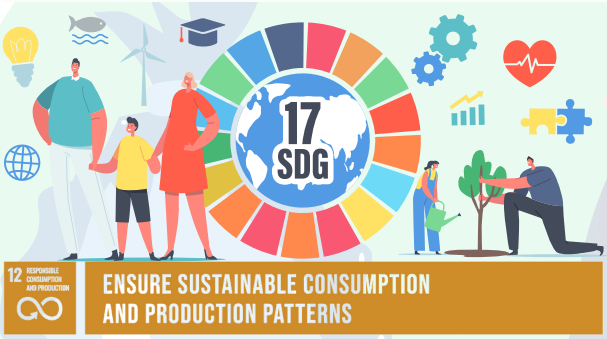
Waste Segaration at IITH's RRP and vermicompost facility (Inset)

At this moment, if we look at the description of "waste", it is defined as any substance that is in the wrong place and/or available at the wrong time and/or in the wrong person's hand who does not know its use. Hence, when any substance of such nature can be shifted to the right place and/or at the right time to the right person's hand who knows its application/value, then it will be considered a "resource". **This changing perspective of seeing waste as a resource shifted the research pathway from waste management to "Waste-2-Wealth".**

The Waste-2-Wealth mission in any nation aims for zero waste and zero dumpsites. At this point, the Waste-2-Wealth approach has two options, firstly, "waste to energy" and secondly "waste to useful materials". Based on the physical, chemical, and biological characteristics of the waste, the option will be selected, and the conversion techniques will be fixed. This approach makes the materials and resources in cyclic use, though their forms and states may change, aiming for the best use. This way of expanding the life cycle of resources for their use is the main concept in the "Circular Economy" model. The three basic principles of circular economy are the elimination of waste and pollution, the circulation of products and materials at their highest value, and the regeneration of nature. For an effective waste management system, the circular economy-based "Waste-2-Wealth" approach is a resilient solution that further develops business opportunities and mitigates the impact on the planet and people. Thus, the resultant circular economy from Waste-2-Wealth addresses the three pillars of "Sustainability" – Economy, Environment, and Society.

The Sustainability Development Goals (SDGs), which are formally articulated and adopted in the United Nations General Assembly (UNGA), have 17 goals containing 169 targets. Though all the goals relate to the theme of Waste-2-Wealth, the most important goal which must be achieved to have an effective Waste-2-Wealth mission is "SDG 12: Responsible Consumption and Production". By managing the most frontage of consumerism – consumption by creating awareness, the production can be controlled.

Representation Image



At IIT Hyderabad, the faculties of Civil, Chemical, Climate Change, Mechanical, Design, Electrical, and Materials Science, Metallurgical Engineering, and Chemistry are majorly working on the various aspects of Waste-2-Wealth aspects. Some of them are highlighted in this issue. Among these, the Environmental Engineering group in Civil Engineering focuses on Waste to Materials, Waste to Energy, Circular Economy involved, and Sustainability Assessment and Framework Creation. The research findings are published in top journals in Nature, ACS, RSC, Elsevier, etc. In addition, the group provides various academic courses on solid, liquid, and gaseous waste management and actively participates in various rural and industrial waste management projects. Besides, the IITH-CMET joint MTech E-Waste Resources Engineering and Management program specifically focuses on the academic and research activities on the extended life scenarios of resources in e-waste.

As a whole, to have an effective Waste-2-Wealth, the best practices consider the following points: Firstly, the consumer decides the production and the waste generation, hence, the people's roles in achieving Waste-2-Wealth, Circular Economy, and Sustainability are significant and needs study. In addition, during the Waste Wealth conversion, the technology that is used needs to be analyzed for its complete life cycle to understand the material use, energy consumption, and secondary waste generation. The secondary waste may be a solid matter, aqueous stream, or gaseous emissions however has the potential impacts that may end up in a negative feedback loop. Also, the business market for the Wealth that is generated from Waste must be well studied to convert it as a business model to be on the gaining side of the economy. Besides, the policies, rules, and laws of the intra and inter-nations should support the Waste-2-Wealth movements in terms of monetary benefits such as business loans and subsidies, research grants for researchers, startup funds, tax exemptions, etc., and administrative support from the local authorities, and across different states of the country.

Link to IITH's Waste Management Systems Video Abstract: https://youtu.be/Nlf81-xkhME

In summary:
(i) Careful techno-economic analysis followed by lifecycle-based impact analysis for the technology selection,
(ii) awareness among the people on eco-safe consumerism,
(iii) extensive and deep market survey, and
(iv) Legal and monetary support from the government is the base requirement of a successful implementation of Waste-2-Wealth, Circular Economy, and Sustainability Nexus.

Prof B S Murty, Director IITH with Dr N R Munirathnam, Former Director of CMET during IITH-CMET MoU signing ceremony in 2020 for MTech in EWREM

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