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CIRCULAR ECONOMY - THE WAY FORWARD TO SUSTAINABLE DEVELOPMENT

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***Abstract**: Concept of recirculation of resources has been discussed in the Stockholm Conference. Based on that concept, recently the policy makers, researchers, major global companies and implementers are attracted and increased their attention towards transition from the existing linear economy model to a circular one. After years of growing income inequality, concerns about technology-driven displacement of jobs, and rising societal discord globally, the combined health and economic shocks of 2020 have put economies into freefall, disrupted labour markets and fully revealed the inadequacies of our social contracts. A new circular economy model is needed to build truly sustainable businesses –that is recognized by the business leaders gathering at the World Economic Forum. Without urgent action, global waste will increase by 70% on current levels by 2050, according to the World Bank's "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050" report. The global annual waste generation is expected to jump to 3.4 billion tons over the next 30 years, up from 2.01 billion tons in 2016. In 2016, the world generated 242 million tons of plastic waste or 12% of all solid waste. Out of over 300 million tons of plastics produced every year, nearly 8 million tons are dumped into the oceans as plastic waste globally, and this will be doubled by 2025 at current rates of consumption and production, if no action is taken up to curb it. The 3R and circular economy are the way of rethinking our approach to waste. The portion of the write-up is excerpts from the book, CircularEconomy: Global Perspective, S. K. Ghosh, 2020, Springer Nature, gives a glimpse of the circular economy and its need.*

***Keywords**: Circular Economy, Consumption rate, Materials Extraction, Plastics waste, Solid Waste, 3R*

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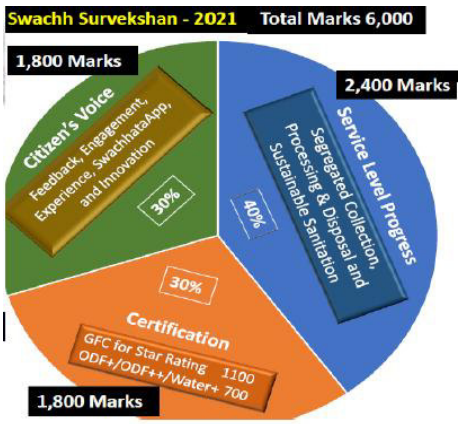


Status of waste management in a few countires

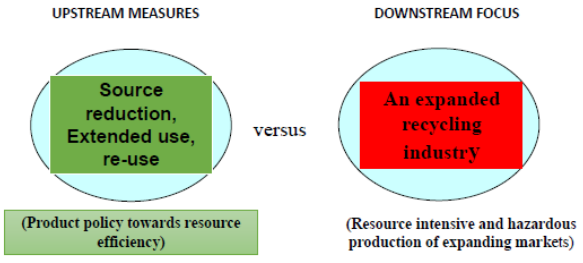
Country	MSW mil ton/Yr	kg/day Per capita	Collection efficiency	% recycled	% Composted	% Energy Recovery	% other treatment	% Landfill
Bangladesh	8.64	0.43	Urban:70% Rural: 35%	15%in Dhaka	3 %	NA	NA	82%
Bhutan	44,800	0.53	Urban:70% Rural: 25%	10 % in Urban	1 %	NA	NA	97%
Brazil	79.9	0.972	90.8 %	31.9%	10%	0.1%	4%	59%
Egypt	30	0.8	60 %	11.5%	NA	NA	NA	88%
India	**62**	**0.5**	**Urban:95% Rural:55%**	**28 %**	**12 %**	**3 %**	**5 %**	***57%***
Italy	29,5	1.5	100%	26%	18%	19%	11%	26%
Lebanon	2.55	1.0	90%	8%	15%	-	10%	70%
Portugal	4.52	1.26	100%	10%	25%	20%		34%
Nigeria	32.59	0.49	30%	??	??	???	??	??
S. Africa	59	0.7	74%	11%		unknown	2	90%
S. Korea	17.86	0.95	97.5%	36%	23%	25.3%	0%	15.7%; 3% by'20
Sri Lanka	2.74	0.4 –1.0	Western Province:59%;Others:8%	15%	5%			80%
USA 19/11/2020	254	2.0	100%	25.3%	9.7%	11.7%	-	53.8%

11th ICEEE Conference: CE-Way forward to Sustainable Development_Prof. Sadhan K. Ghosh_CSEAS_Hungary_19.11.2020

LOST OPPORTUNITY

The study, published in Science Advances, found that of the 8.3 billion tons of total plastic ever produced: Only 9 percent has been recycled. 90 % of the material recycled was only reused once. About 12 % was incinerated; 79 % ended up in landfills. 30 % is currently still in use. Packaging only remains in use max. for about a year. Plastics in construction and machinery remain in use for the longest period of time. If current production trends hold, total production will be 12 billion tons by 2050. The US lags far behind Europe, India and China in recycling. 2014 recovery rates: Europe (30 %), India (22%), China (25 %), and the US (9 %).

A prevalent policy dilemma - what should be the priority for government authorities?



Many government policies and programs tend to focus on conventional waste management solutions such as sanitary land filling or incineration – mainly downstream disposal, which is expensive, while failing to pursue upstream measures to reduce the actual waste load.

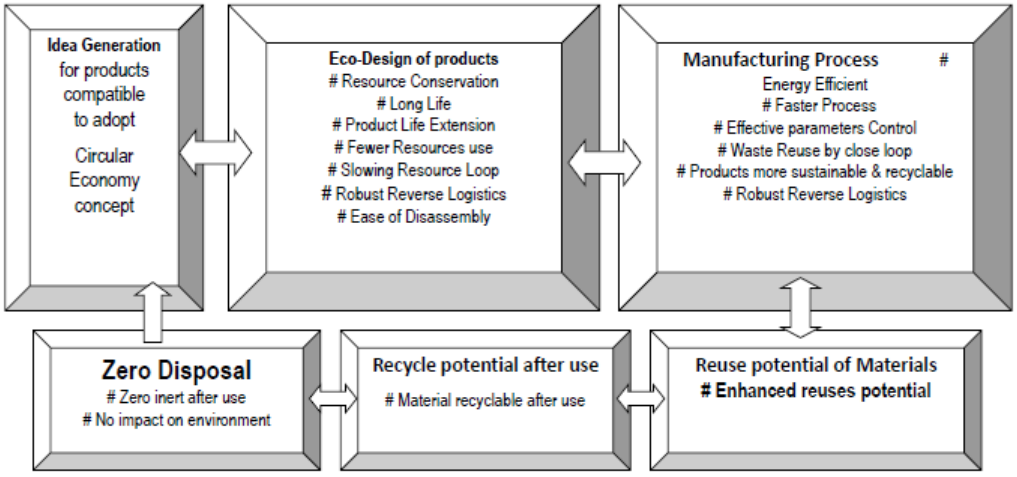
CE in post covid-19 Era

CE Definition: "CE is a systems-level approach to economic development and a paradigm shift from the traditional concept of linear economy model of extract-produce-consume-dispose-deplete (epcd2) to an elevated echelon of achieving zero waste by resource conservation through changed concept of design of production processes and materials selection for higher lifecycle, conservation of all kinds of resources, material and/or energy recovery all through the processes, and at the end of the life cycle for a specific use of the product will be still fit to be utilized as the input materials to a new production process in the value chain with a close loop materials cycles that improves resource efficiency, resource productivity, benefit businesses and the society, creates employment opportunities and provides environmental sustainability" (Source: Ghosh et al., 2020).

3R's Principles: Reduction, Reuse and Recycle

- Selection of lighter materials with extended life,
- Reduction in consumption of energy in the processes,
- Reduction in generation of wastes in the processes,
- Reduction in manual intervention,
- Reduction in the flow or steps in the manufacturing processes,
- Reduction in packaging,
- Reduction in cycle time,
- Reduction of resource consumption by reusing, and many more

Generic Business Framework for Design with intent for Circular Economy



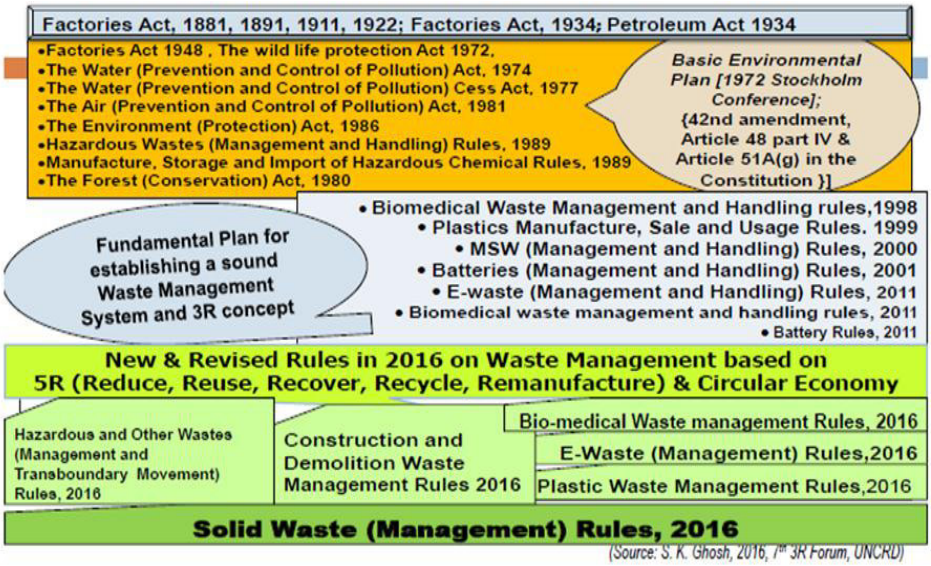
Swachh Bharat Mission & Swachh Survekshan in India Demostrating 3R & Circular Economy

How India is carrying out Circulation of Resources and Involving the Citizen

1. Swach Bharat Mission
2. Draft National Resource Efficiency Policy (Nrep)

Evolution of environmental legislation in India and its approach

Legal System for establishing "Sound Waste Management" in India

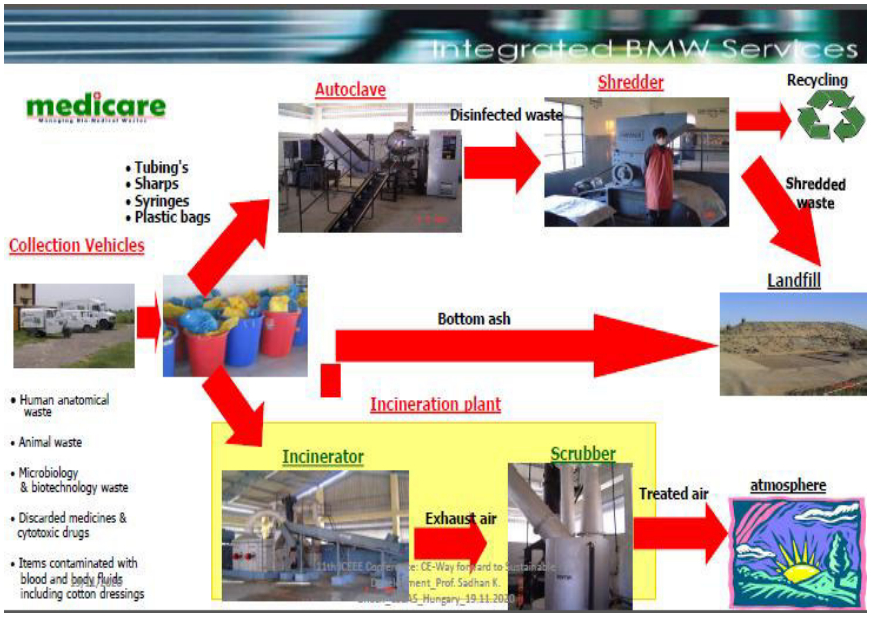


SW, Masks and gloves Disposal

ULBs: daily collection of segregated general SW from quarantine centers, home-care and hospitals in securely tied bags (without opening to ensure waste collector safety and to avoid pilferage).

- Liquid disinfectant (1% sodium hypochlorite solution) may be sprayed over bags containing general wastes prior to collection or disposal. General SW may be disposed as per SWM Rules, 2016, in landfills, waste to energy plants, as is available infrastructure.
- Identify dedicated area on landfill and the bags should be spread and covered daily with layer of soil or stabilized waste after sprinkled with lime/bleaching powder. Access to landfills sites should be restricted;
- Masks and gloves used by persons other than COVID-19 patients should be kept in paper bag for a

minimum of 72 hours prior to disposal of the same as general SW after cutting the same to prevent reuse.



Water-energy-environment nexus

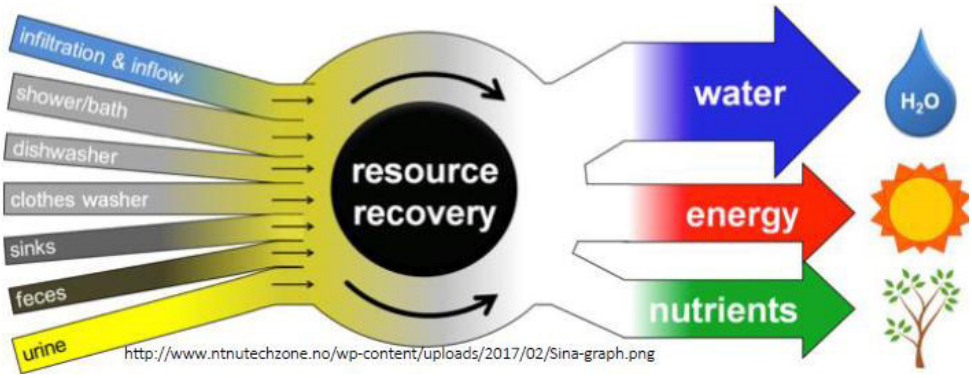
Energy & Resource recovery: A promising solution for wastewater treatment systems

- Achieving water, energy, and environment security pre-requisite for human welfare
- One third of countries (Northern Africa, Western, Central and Southern Asia) face medium to high levels of water stress (UN's SDGs report, 2019)
- Wastewater could contribute to address SDG

- Wastewater discharged to water bodies without any treatment (~ 90%)
- UN's Water Development Report, 2017; United Nations SDGs report, 2019 highlighted the importance of recovery of energy, nutrients and other recoverable by-products
- Paris Climate Agreement: energy recovery in wastewater treatment plants (WWTPs) has been given a renewed sense of urgency
- Implementation of principles of 3R & Circular Economy

Recovery from wastewater

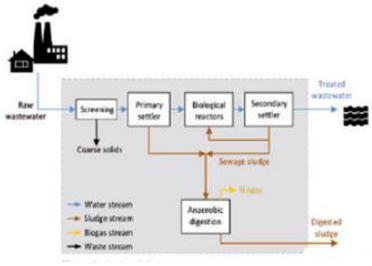
- Common recovery options: internal water reuse from treated effluent and sludge reuse for agricultural application



- Organic substances – source of chemical energy for useful energy (electricity and heat) via direct anaerobic treatment, anaerobic digestion of excess sludge and combined heat and power (CHP)
- Recovered Energy - offset energy need of plant (energy is consumed during sewage collection, transportation, effluent treatment, sludge treatment and disposal)

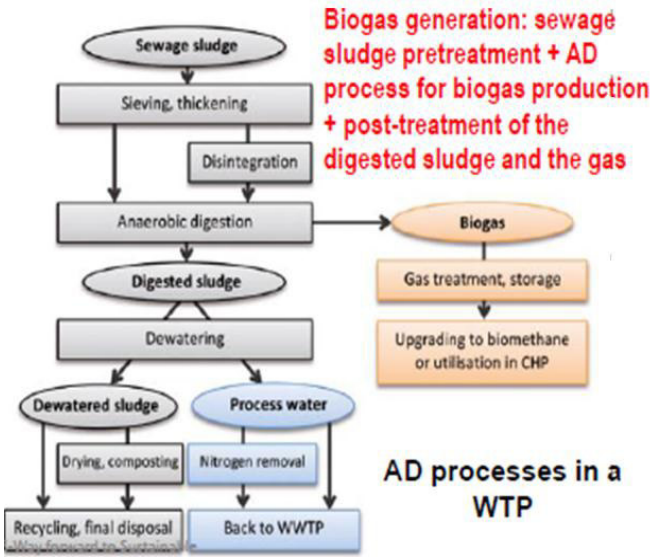
Anaerobic digestion: Energy recovery Processes

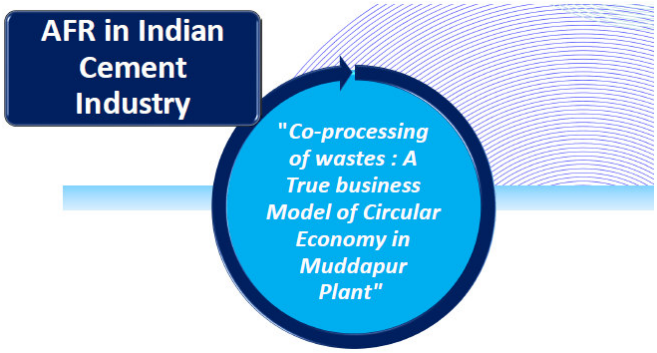
- AD - a widely used biological method - convert organic wastes into methane - leads to the stabilization & waste reduction
- Robust & efficient treatment of municipal wastewater & part of the process to treat biodegradable waste & sewage sludge



Biogas production; bio-solid incineration

- Provides electricity; Reduce the organic & inorganic loads of wastewater



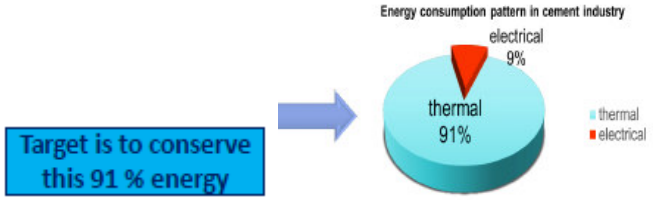


Energy consumption - Indian cement industry

Cement production in India is about 545 MioTPA

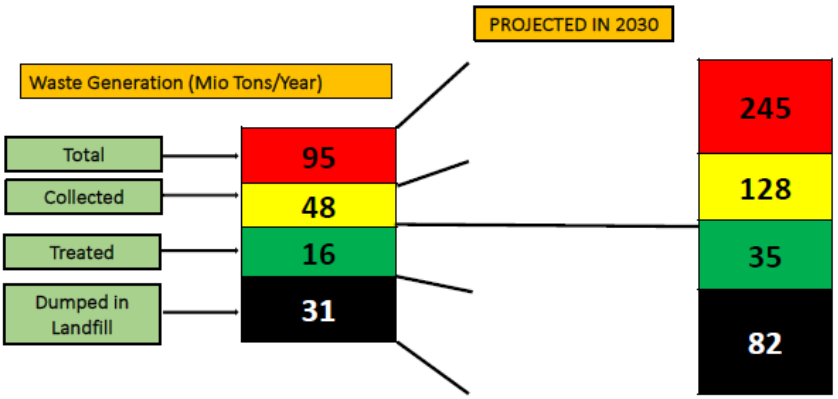
- India is 2nd largest cement producer after China
- Estimated coal required - 40 MioTPA

India has the potential to use the entire hazardous/Non-hazardous waste generated, if suitable for co-processing.



- Energy cost is 50-70% comprising of both thermal and electrical energy of total cost of production.
- The energy distribution is given as:
- The conservation of energy and use of cheaper renewable alternate fuel have assumed greater importance for improving productivity and reducing thermal energy consumption

Total Waste & potential in INDIA



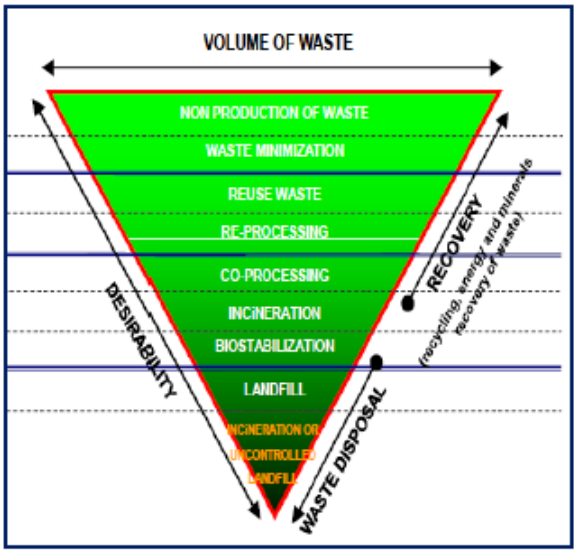
Waste Management hierarchy

1. Reduce
2. Reuse
   - ❖ *When prevention/reuse not feasible*

3. Recycle-Re-processing
   - ➢ Recycling of end of life cementitious product
   - ❖ *When Re-processing is not feasible*

4. Resources Co-processing in existing EII's
   - ➢ Process specific guidelines
   - ➢ Pre-processing is key
   - ❖ *When Co-processing is not applicable*

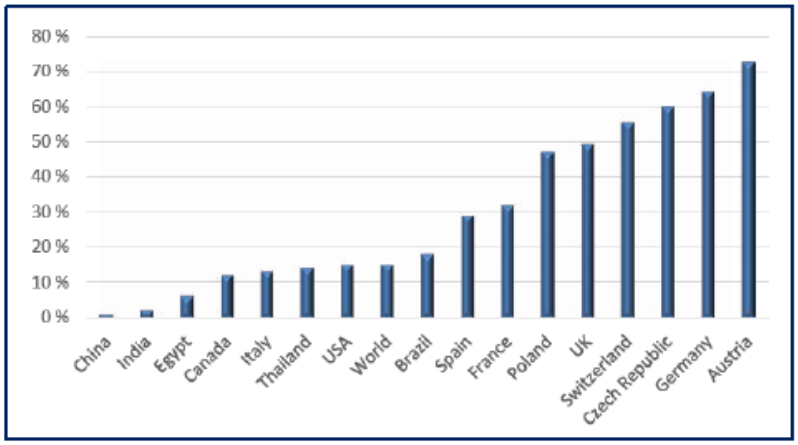
5. Waste disposal activities
   - ➢ For organic : Incineration
     - Waste to energy programs
     - Energy efficiency is key
   - ➢ For Minerals: Land filling



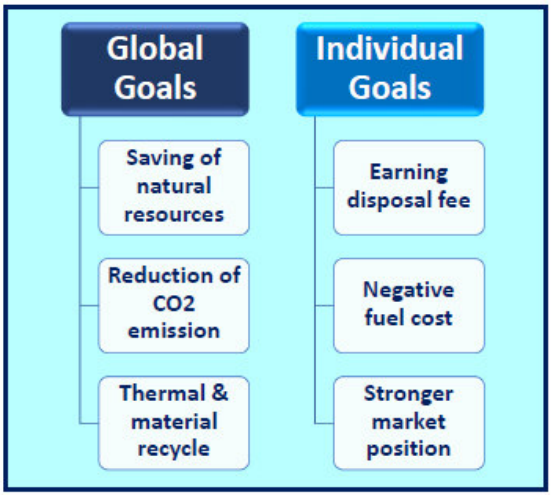
Alternative Fuel - Fact & Figures

Recent database analysis shows that the green house gases emission reduction potential through waste utilization in cement industry is extremely higher.

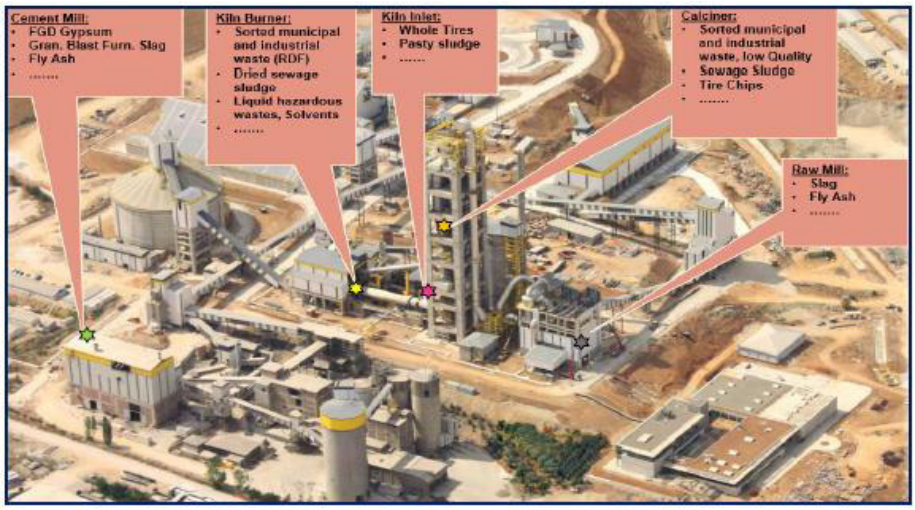
Average utilisation of alternative fuels in selected countries



Goals & Challenges



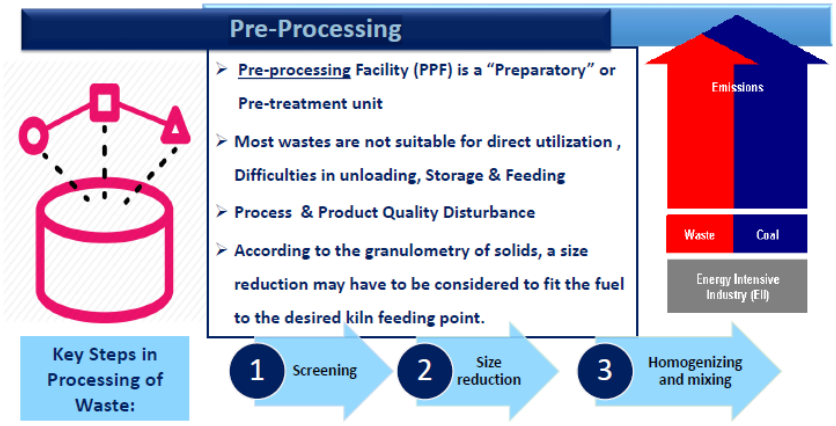
AFR-Feeding Points in Cement Plant



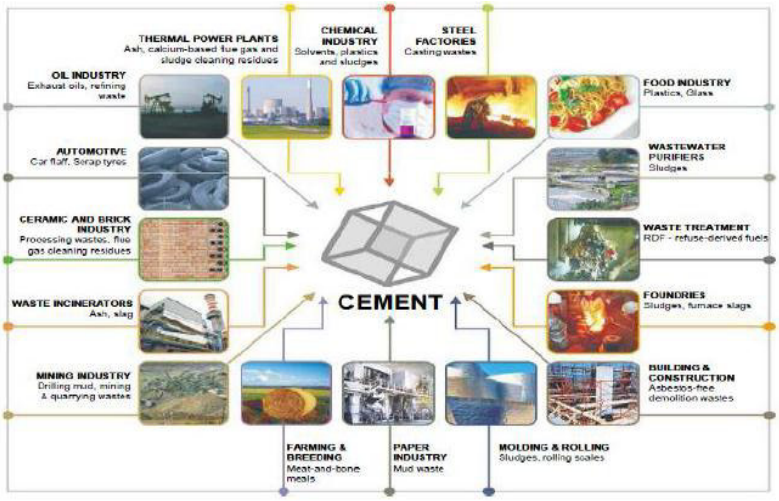
Types of Waste

Hazardous	Non Hazardous	Municipal/ Domestic	Commercial	Agro
• *All kind of Organic Residues, Wastes, Sludge* • *Paint Sludge* • *Distillation Residue* • *Spent Carbon* • *Process Waste* • *Spent Catalyst* • *ETP Sludge* • *Resin Material, etc.*	• *Municipal solid waste* • *Packaging materials* • *Scraps (Waste cloths/Fiber)* • *Packing Paper, Plastic* • *Waste from office, etc.* • *Insulation* • *Lining*	• *Plastic Bags* • *Bottles* • *Rubber* • *Vegetables* • *Food Waste, etc*	• *Paper* • *Wooden* • *Cloths* • *Resins* • *White Goods* • *Rubber Waste* • *Plastic from packing & other users (Non-recyclable), etc.*	• *Non Edible* • *Rice Husk* • *Corn Stover* • *Agro Residue, etc*

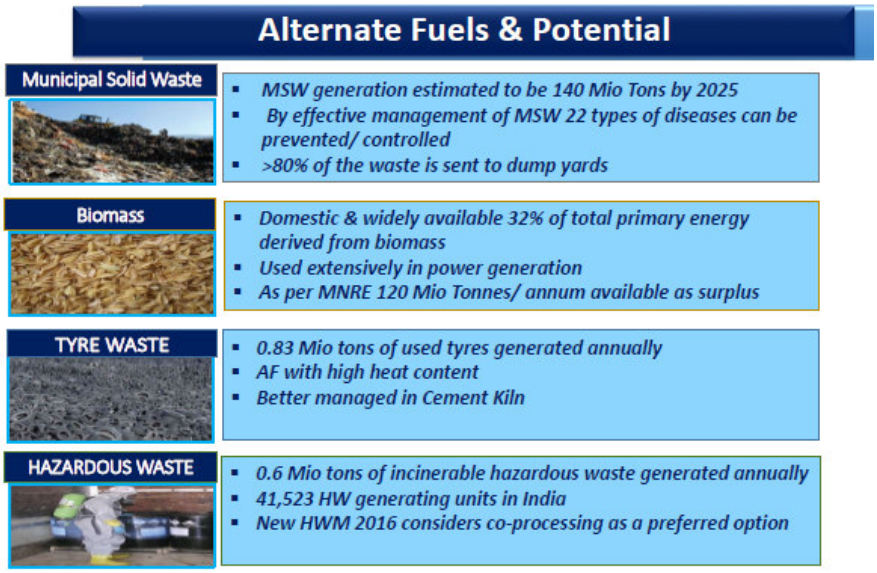
Pre-Processing



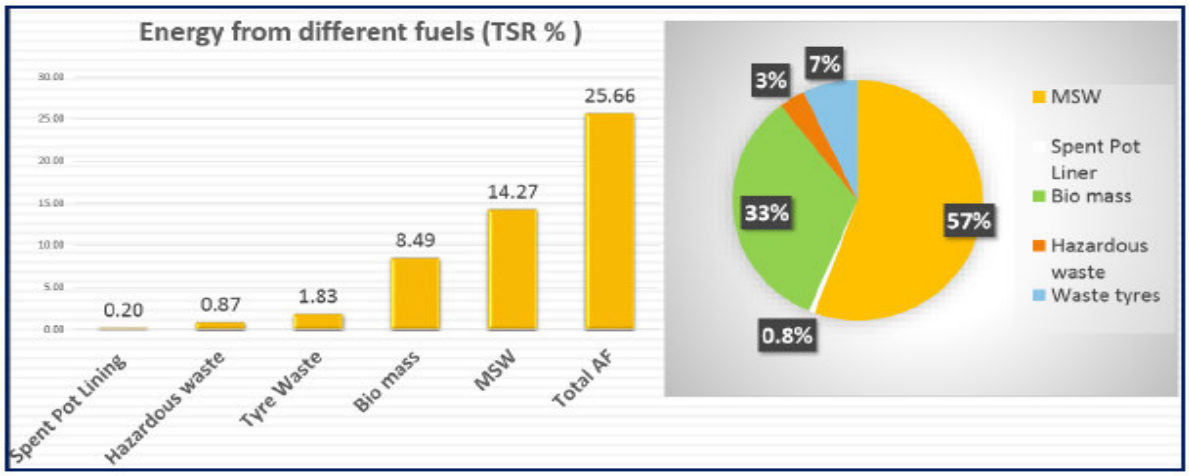
Sources of Alternate Raw material



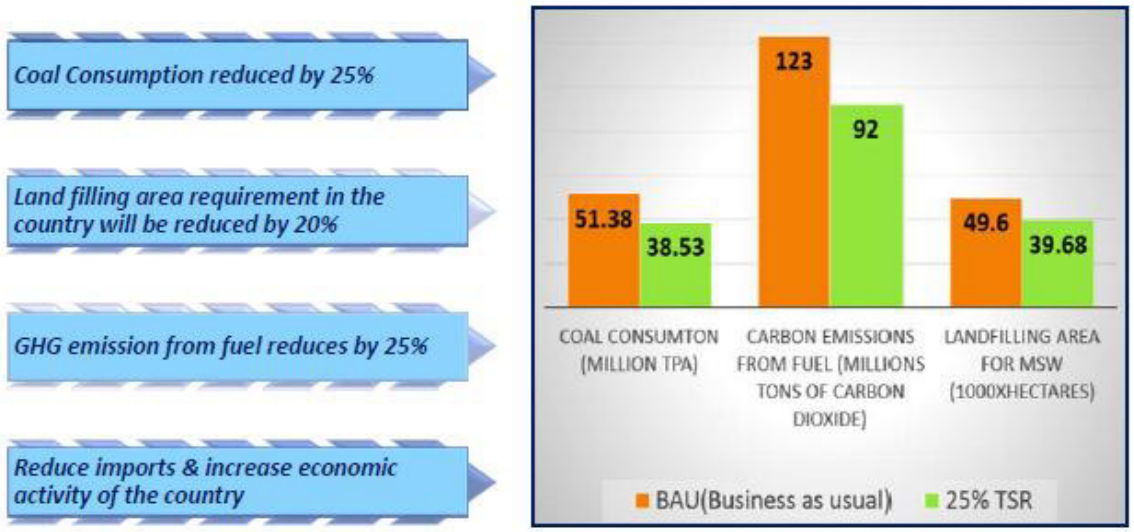
Alternate Fuels & Potential



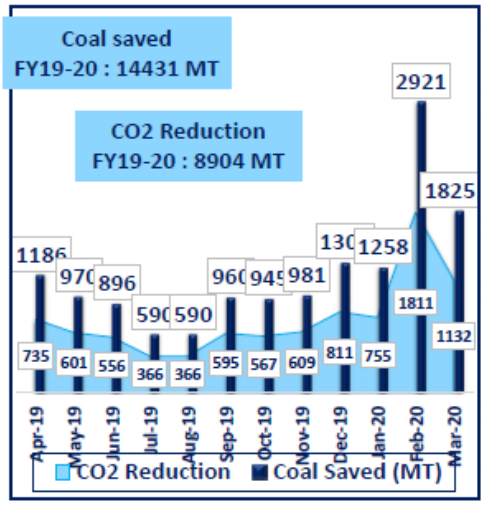
Energy From AFR Projected 25% TSR @ 2025



Anticipated Benefits By 25% TSR @ 2025



AFR Coal Savings & CO2 Reduction

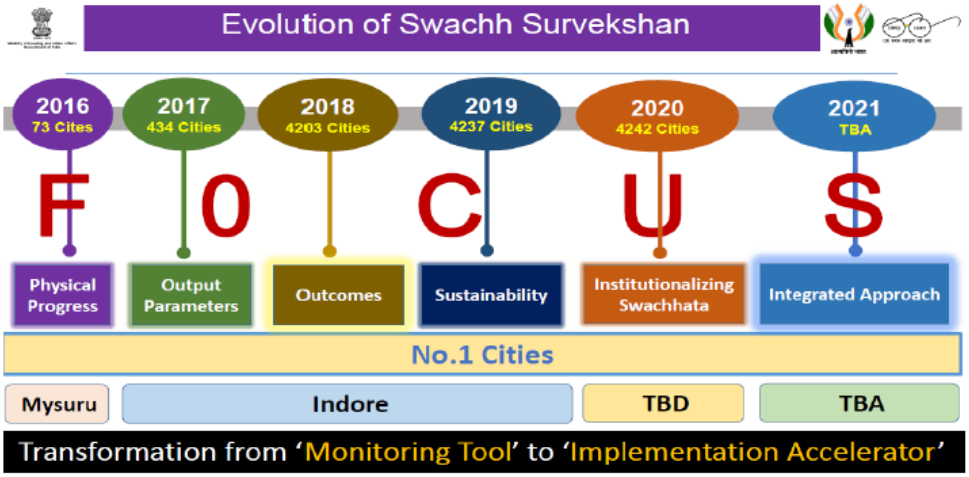


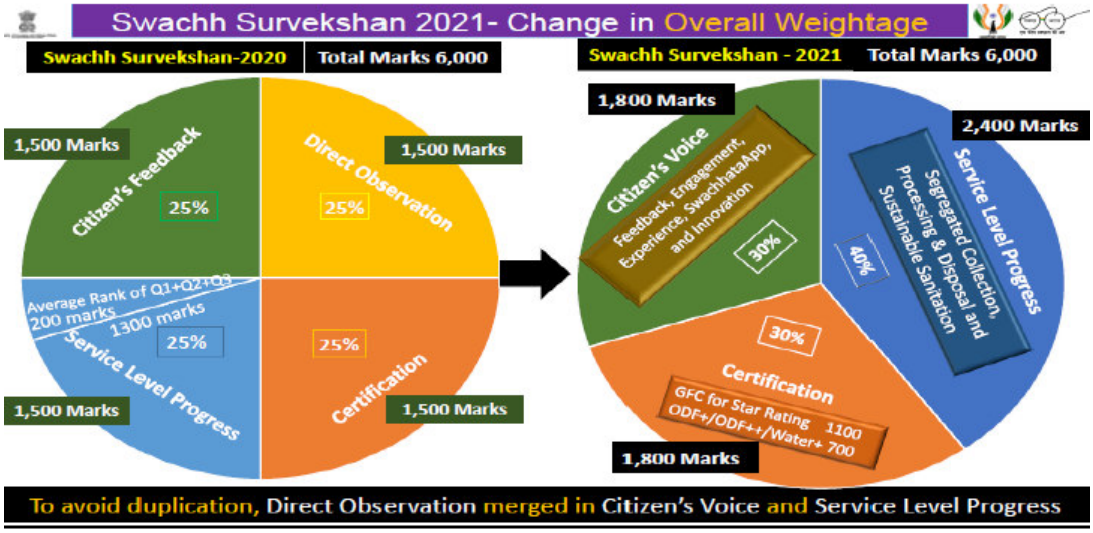
- Conventional fuel reduction by Volume (20-25 %) and TSR (10-15 %)
- PAT target to reduce 5% MTOE will be helpful by using AFR
- Reduction of global emission
- High temperature around 1400 Deg C & long Calciner residence time around 5-6 Seconds
- Double valorization: organic and minerals totally destroyed
- High efficiency and total recovery
- No adverse effect in cement product quality

Challenges of AFR

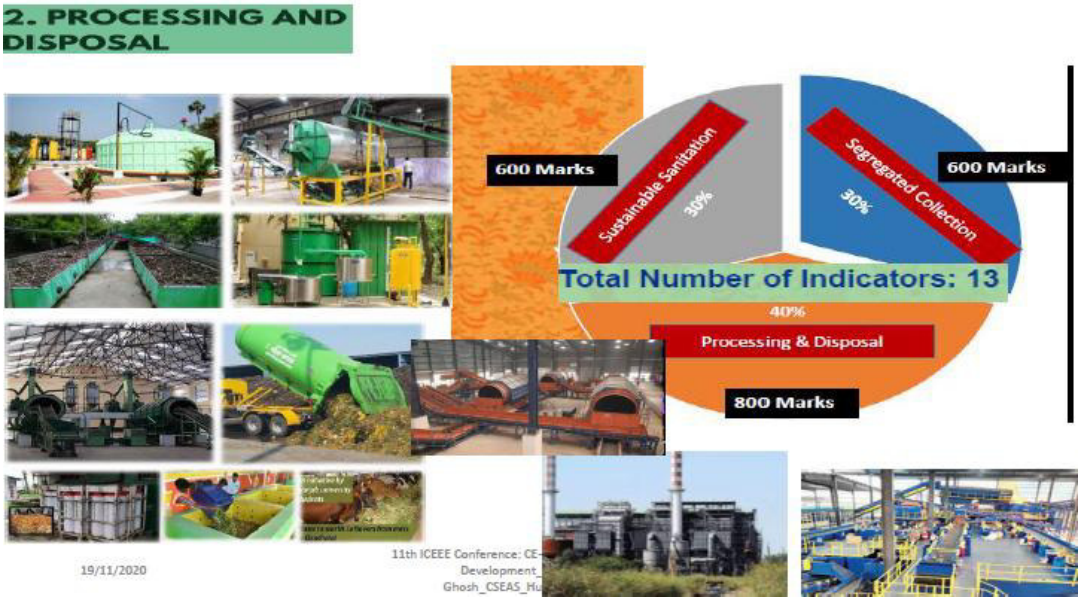
- Problem in burning and operational stability, reduction in thermal efficiency (If feed size is > 50 mm)
- Handling as well as additional heat is required for drying, reducing thermal efficiency (If Moisture content is > 15 %)
- Not suitable for direct feeding, required additional cost for conditioning, causes increase in specific power (Low Calorific value < 2500 Kcal/Kg)
- Effect of minor component on clinker quality (Proper selection of AFR/RDF)

Glimpses of Liquid AFR System


Evolution of Swachh Survekshan
2016
73 Cites
2017
434 Cities
2018
4203 Cities
2019
4237 Cities
2020
4242 Cities
2021
TBA
F O C U S
Physical Progress
Output Parameters
Outcomes
Sustainability
Institutionalizing Swachhata
Integrated Approach
No.1 Cities
Mysuru
Indore
TBD
TBA
Transformation from 'Monitoring Tool' to 'Implementation Accelerator'

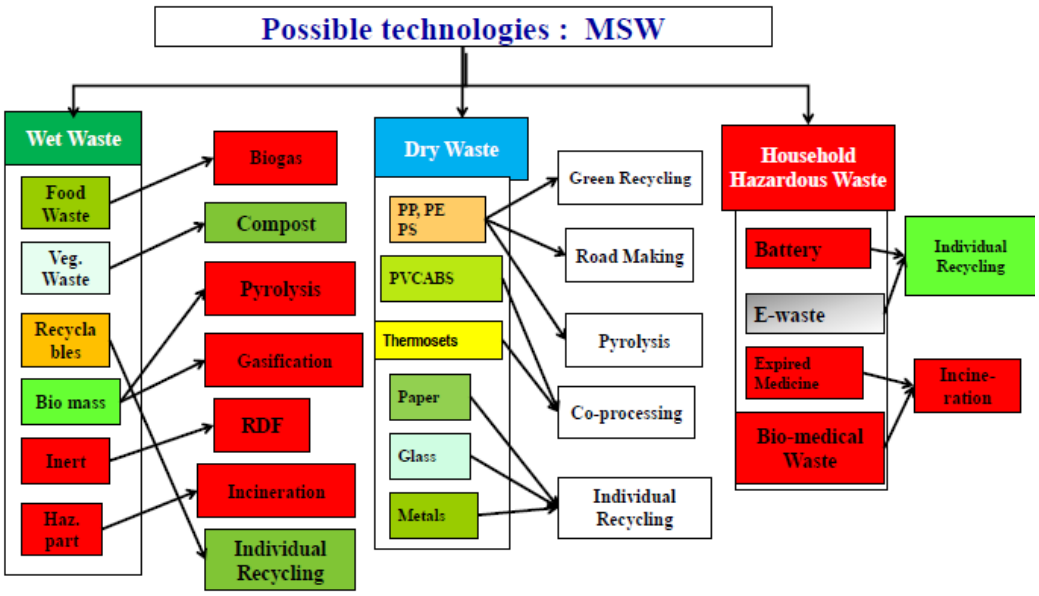

Swachh Survekshan 2021- Change in Overall Weightage
Swachh Survekshan-2020
Total Marks 6,000
1,500 Marks
Citizen's Feedback
25%
1,500 Marks
Direct Observation
25%
Average Rank of Q1+Q2+Q3
200 marks
1300 marks
25%
Service Level Progress
1,500 Marks
25%
Certification
1,500 Marks
Swachh Survekshan - 2021
Total Marks 6,000
1,800 Marks
Citizen's Voice
Feedback, Engagement, Experience, SwachhataApp, and Innovation
30%
2,400 Marks
40%
Service Level Progress
Segregated Collection, Processing & Disposal and Sustainable Sanitation
30%
Certification
GFC for Star Rating 1100
ODF+/ODF++/Water+ 700
1,800 Marks
To avoid duplication, Direct Observation merged in Citizen's Voice and Service Level Progress


SS-2021
New Performance Category
'Prerak DAUUR Samman'
Service Level Progress
1. SEGREGATED COLLECTION
2,000 Marks
for each Indicator
Total :
2000 Marks
Total Number of Indicators: 7
600 Marks
Sustainable Sanitation
30%
600 Marks
Segregated Collection
30%
40%
Processing & Disposal
800 Marks
Banned
Artefacts from Waste
19/11/2020


2. PROCESSING AND DISPOSAL
600 Marks
Sustainable Sanitation
30%
Segregated Collection
30%
600 Marks
Total Number of Indicators: 13
40%
Processing & Disposal
800 Marks
19/11/2020


Segregated as per value
REVENUE
EXPENSES
CDW Recycling
Landfill & Remediation
Processing
19/11/2020


SUSTAINABLE
3. SANITATION
600 Marks
Sustainable Sanitation
30%
Segregated Collection
30%
600 Marks
Total Number of Indicators: 5
40%
Processing & Disposal
800 Marks
FSTP/
STP
Sewerage/Septic Tank
19/11/2020



CONCLUSION

- Resource consumption must be reduced in all the countries
- Comply with the requirements of SDG 2030,
- Resource Efficiency need to be enhanced in all the countries by implementing 3Rs(Reduce, Reuse and Recycle) and Circular Economy