



IEA Energy Efficiency In Emerging Economies Training Week

Industry Stream: Leveraging the circular economy to support energy efficiency policy and programs

Ritu Bharadwaj, Chief of Program, IIP, New Delhi, 10-13 December 2018

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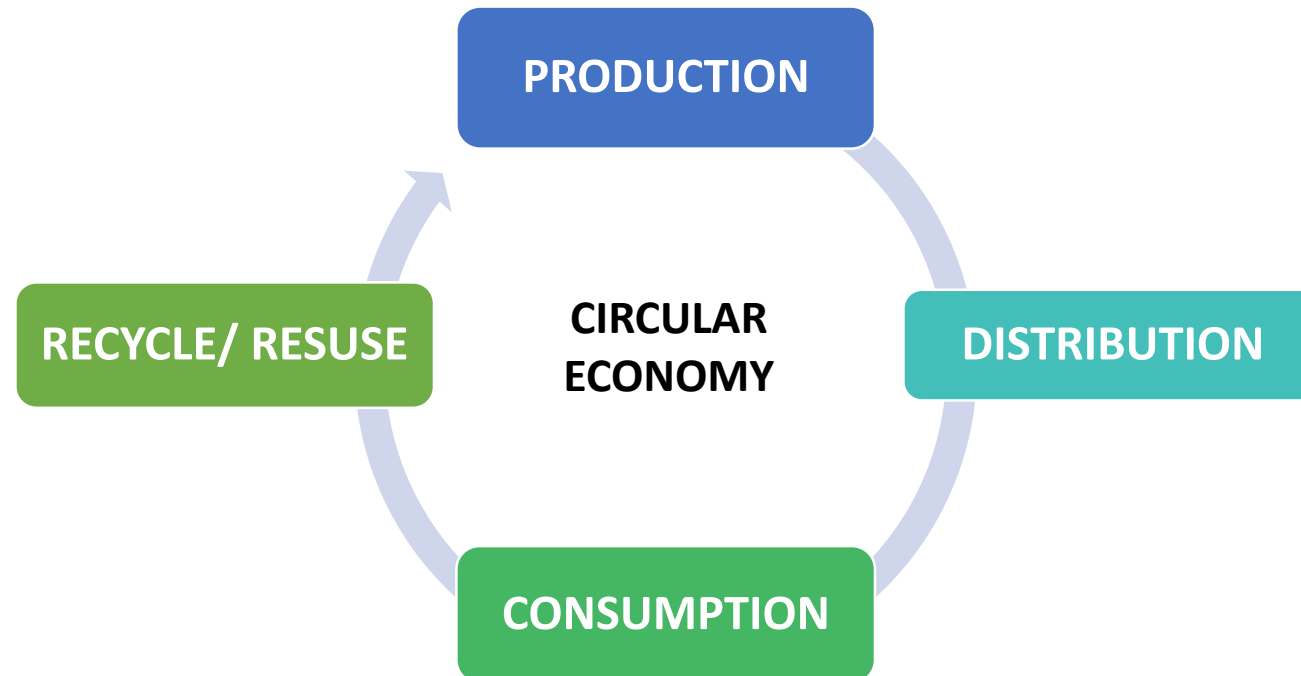
Circular Economy: A 'Win-Win' Model for Resource Conservation



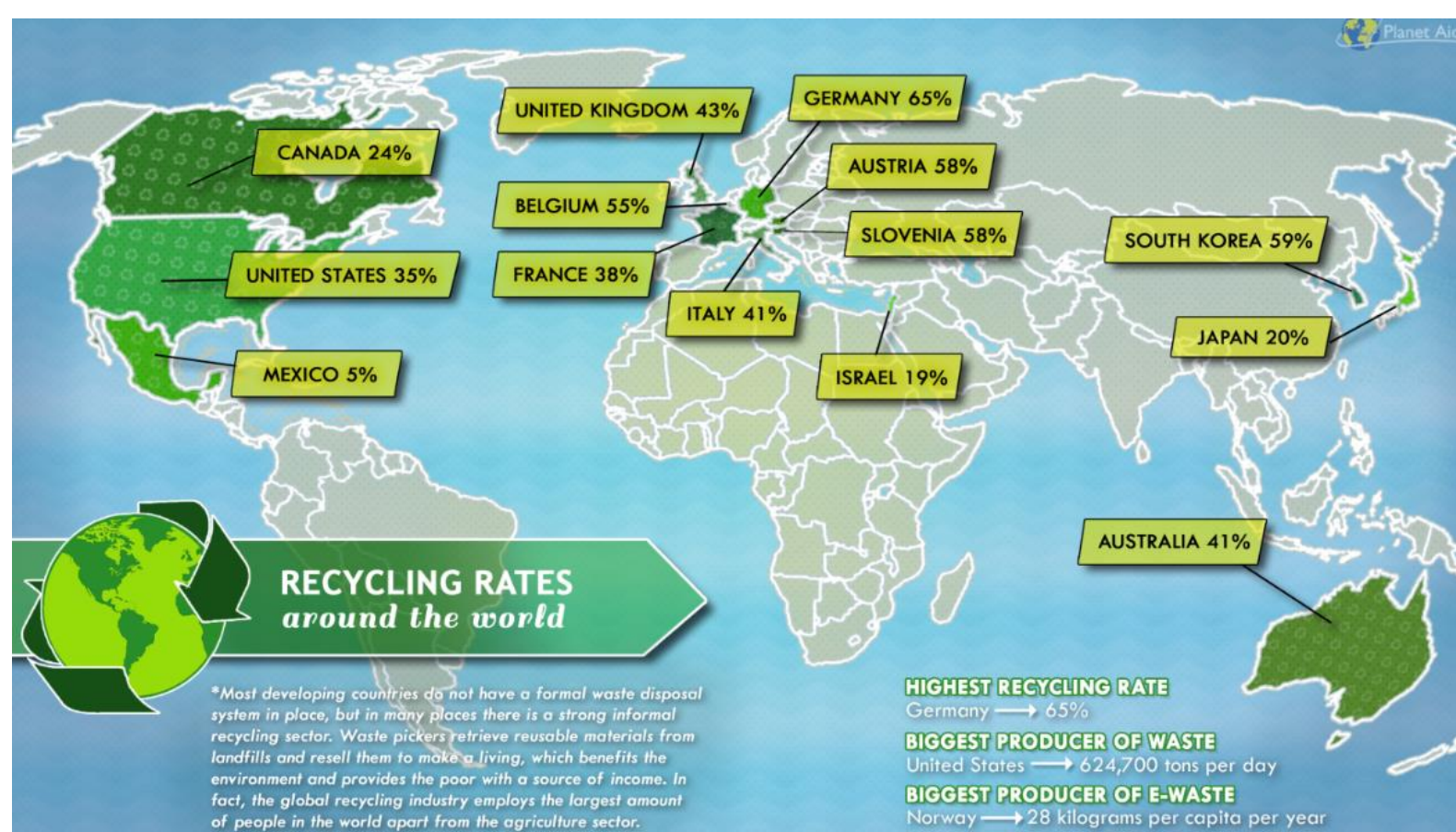
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What is the Concept



Where does India Stand



- About 68 MT MSW, 150 MT biomass waste, 8.5 MT hazardous waste, 5.6 MT plastic wastes are generated per year - majority goes to landfill sites
- Waste generation expected to increase further (per capita rate of approx. 1-1.33% per annum)
- Projected MSW of 165 MT by 2031, will require 66,000 ha landfill area

Barriers to Promoting Circular Economy

- Technological limitations
- Evaluated from a traditional ROI perspective
- Lack of Regulatory drivers
- Lack of Circular economy value chains
- Deep rooted cartel controlling Waste Management

Successful Circular Economy Models

providing solutions for dealing with the existing barriers of implementation

Brick Sector Intervention

What ails the brick industry- *the technology*

- Characterized by traditional firing technologies; low mechanization rate; dominance of small-scale brick kilns; dominance of single raw material (clay) and product (solid clay brick)
- The most commonly used technology is Bull Trench Kiln (BTK) & Fixed Chimney Kiln (FCK) that are extremely resource inefficient and highly polluting
- Industry is gradually switching over to Zig-Zag Kiln, Vertical Shaft Brick Kiln (VSBK), Hoffman's kilns that are marginally better, but are still highly polluting with far reaching social, health and environmental issues



Depletion of agriculture land threatening food security

- India produces 200 billion bricks per year, consuming 520 m tonnes of soil- equivalent to 30,000 ha agricultural land
- With the growing brick demand, these countries are fast moving towards severe food shortages in the foreseeable future



High Energy consumption and Emissions

- Bricks fired at 700 -1100 °C, requiring a large amount of fuel
- In India, Brick kilns consume 25m tonnes of coal per year -among the highest industrial coal consumers.
- CO₂ emission is 50m tonnes accounting for 4.5% GHG emissions in India
- Coal usage leads to SPM emissions- brick making accounts for approximately 60% of black carbon emissions from the industrial sector

Kiln Type	Coal per 100,000 bricks (t)	Particulates (mg/m ³)	CO2 emitted per 100,000 bricks (t)
FCK	20-22	1,000 +	50
Zigzag	16-20	500-1000+	40-45
Hoffmann (Natural gas)	16,000 m3	<100	30



Socio Economic issues

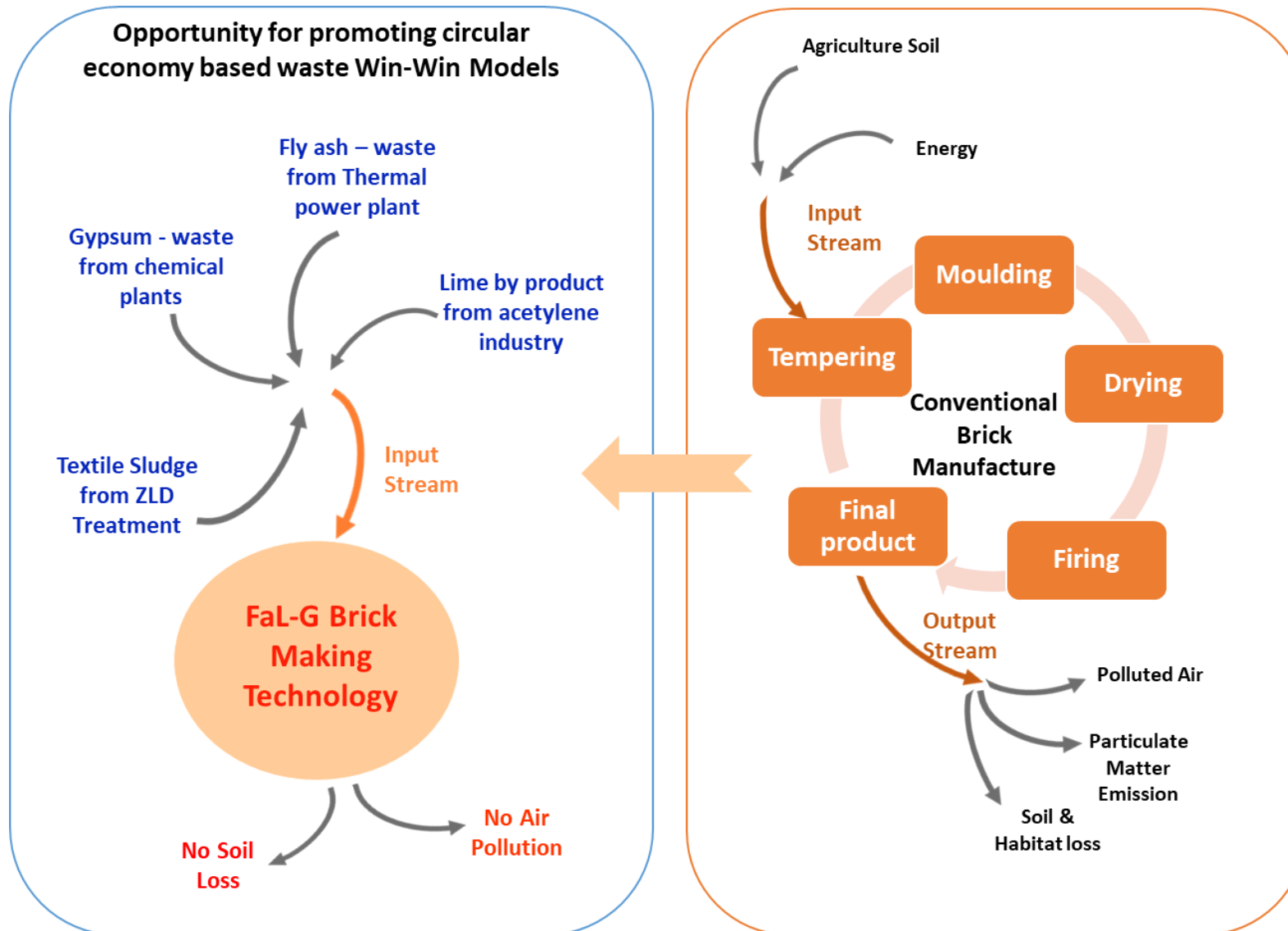
- Brick kilns provide seasonal employment and poor wages
- Children generally accompany parents instead of attending school as the brick kilns are located away from human settlements and the families are mostly migratory
- Families and children work and live in harsh conditions (exposure to extreme heat, GHG and SPM emissions) that lack of basic facilities



'Circular Economy Opportunity' for cleaning the brick industry

- FaL-G Brick (Fly ash- Lime-Gypsum) technology provides the solution
- Provides ideal venue for circular economy: fly ash (unwanted residue from coal power plants) is mixed with two other industrial by products: Lime and Gypsum
- FaL-G produces bricks without firing, so it results in : Zero coal ; Zero top soil & Zero Emission
- Fly ash-lime reactions take a long time to offset. Adding gypsum at the threshold level aids setting avoiding the need for press and autoclave. Tropical climate further supports this reaction.
- As a result, the characteristic strength of fly ash-lime is maximised to as high as 3 to 5 fold, giving opportunity to achieve the same or higher strengths as conventional bricks and at comparable costs.
- FaL-G technology can also bind a number of materials as fillers or aggregate in the brick, thus providing options to gainfully utilize other wastes, besides fly ash

Circular Economy Opportunity



Advantages of FaL-G

- FaL- G provides effective alternate to burnt clay bricks
- Reduces plastering cost by 30% and consumption of cement mortar by 60%
- High compressive strength eliminates breakages/wastages during transport and handling
- Brings down operational energy in buildings as they have low thermal conductivity
- Suited for flood & earthquake prone area and range of infrastructure projects
- Manufacture a range of products - bricks, blocks, mortar, roofing and paving tiles and as concrete of comparable or higher strength
- FaL-G plants can be set up with investment of USD 5500



Contribution per Million FaL-G Bricks

- Conservation of top soil: 3500 ton
- Conservation of Coal: 200 ton
- Abatement of CO₂: 270 tonne
- Net profit ratio: 15 %
- Average Rate of Return: 38 %



Experience of fly ash brick technology in India

Pro-active policy measures and technology support led to :

- Over 18,000 FaL-G brick plants are now in operation throughout India
- Fly ash bricks account for about one sixth of India's annual brick production
- FaL-G plants use over 25m tons of fly ash, helping tackle its environmental menace
- Providing workers stable year-round livelihood nearer their homes and allowing their children to attend regular school, giving them reason not to migrate to cities
- FaL-G plants are getting carbon revenue -spent on welfare of workers' communities
- A sizeable number of women entrepreneurs are setting up FaL-G brick plants



Scaling up FaL-G

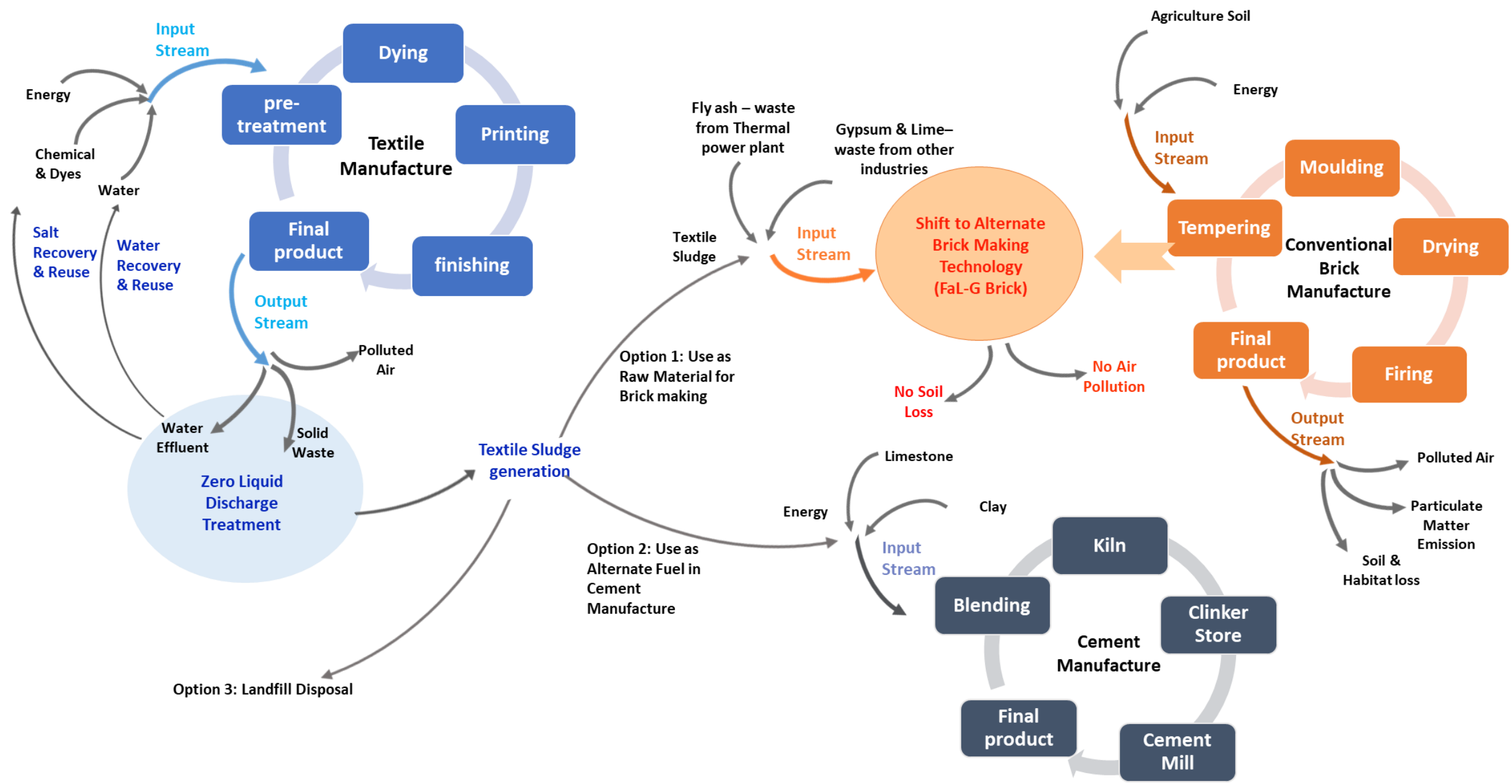
Barriers

- Support of Clay brick Industry missing-Clay brick production remains a popular family business in India, with no incentives to innovate or modernize.
- FaL-G manufacturers have to bear the cost of transporting fly ash to their production sites. In contrast, top soil for making clay bricks is easily available around the production sites.
- FaL-G is organized industry and therefore covered under taxation regime in comparison to clay brick industry which is largely unorganized

Drivers

- **Policy & Regulatory changes favouring Fly Ash products**
- **‘Supply side’ push-** technology assistance, capacity building and government policies that incentivizes adoption of such technologies
- **‘Demand side’ pull** -favourable public procurement policy that promotes sourcing of resource efficient brick by construction/ building companies and awareness campaign

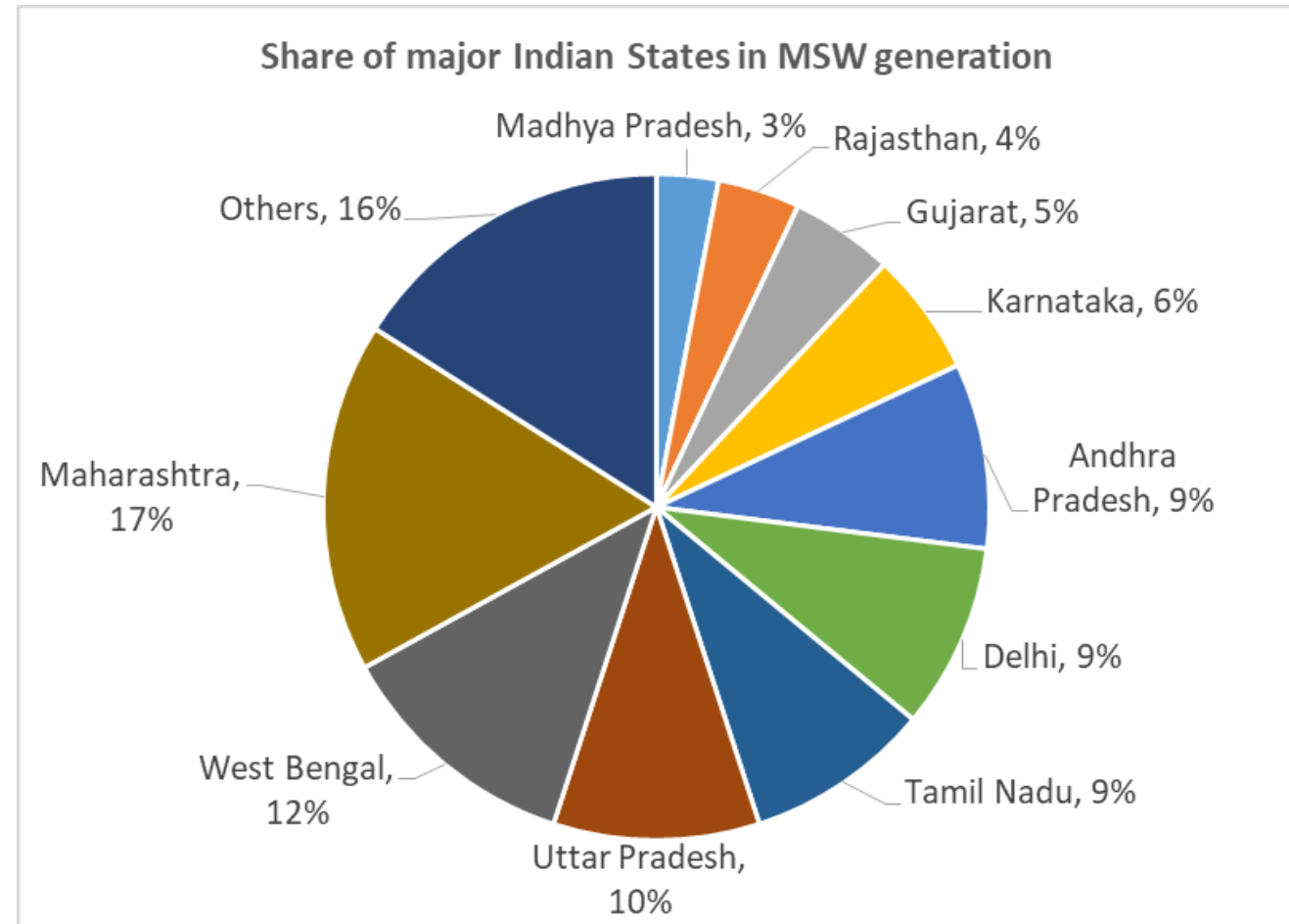
Other Circular Economy Opportunity in conjunction with brick industry



Cement Sector Intervention

MSW disposal: a Challenge

- Total estimated generation of MSW is about 68 million tonnes from urban sources alone
- Open Land filling is still most common practice
- Local Municipal Corporation face severe challenges in adopting other gainful means of waste disposal due to scarcity of financial resources, inherent institutional weaknesses and choice of method/technology for waste disposal



MSW Co-processing in Cement Plants: an effective solution

- Making Refuse Derived Fuel (RDF) from MSW and using it as a fuel in cement offers sustainable long-term solution
- Provides win-win situation by way of reducing coal use in cement manufacture on one hand and finding a long-term sustainable solution to urban waste management on the other
- Despite many potential benefits, RDF usage is not getting scaled up. Current rate of co-processing ranges between 0.5-1%
- RDF can replace up to 15-20% of fuels used in cement plants

Potential benefits of co-processing

- Addressing local environment issues
- Addressing health and social issues
- Creating sustainable livelihood option
- GHG reduction potential
- Coal saving potential

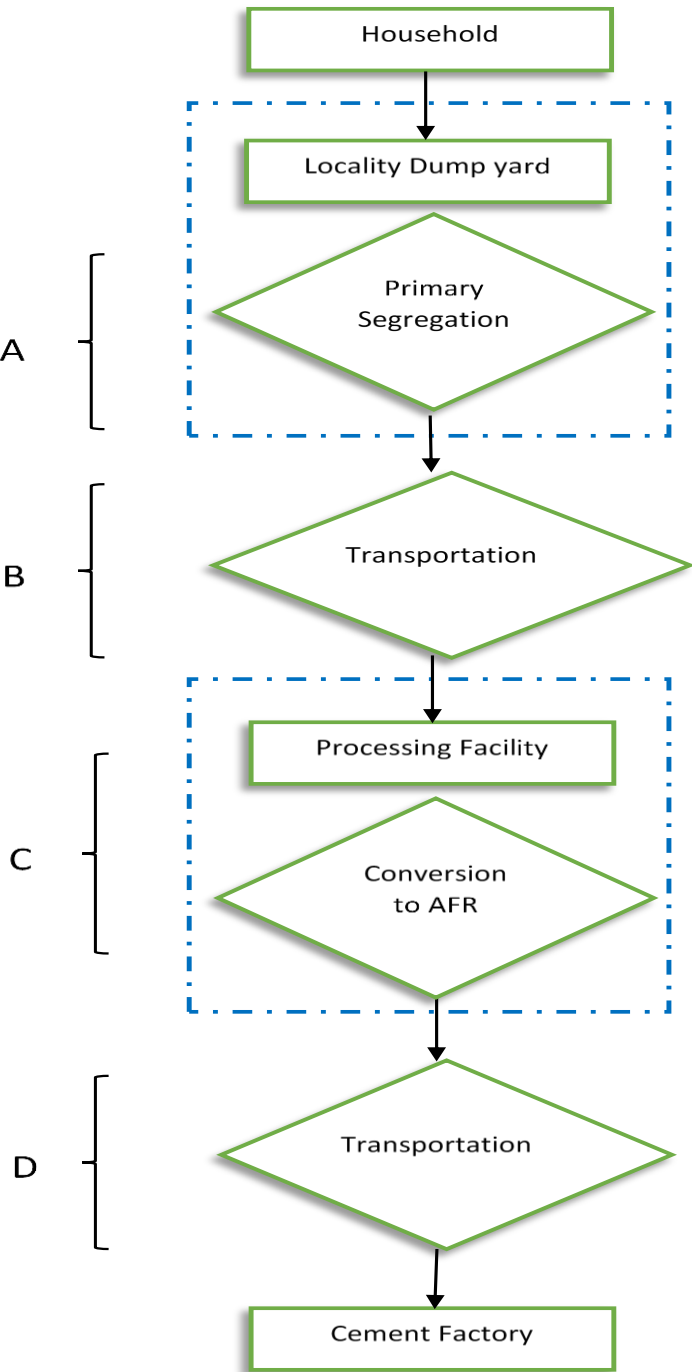
Models of MSW co-processing

Three different models co-processing MSW analysed to cover projects that are being managed by different types of stakeholders viz.

- i. Municipal Corporation (Panjim Model);
- ii. an NGO (Sarthak Model);
- iii. Cement manufacturer (Jaypee Model),

to get a range of perspective, understand their implementation challenges and review their comparative advantages/ disadvantages. Each of these models involve different actors in its operations, handle different nature of waste and have varying degrees of mechanization in production process

Management Responsibility in Different Models



Process	Panjim (Municipal Corporation) Model	Sarthak (NGO) Model	Jaypee (Private Company) Model
A	Household- Source Segregation	Trained rag pickers	Not done
B	Municipal Corporation	Sarthak	Municipal Corporation
C	Municipal Corporation	Sarthak	Jaypee
D	State Government	State Pollution Control Board	Jaypee

Financial Performance of Different Models

Parameters	Panjim (Municipal Corporation) Model	Sarthak (NGO) Model	Jaypee (Private Company) Model
Cost/ tonne RDF (INR/ USD)	1100/ 18.33	5000 / 83.33	2500 / 41.67
Selling Price/ tonne RDF (INR/ USD)	Not estimated	5500 / 91.67	1750 / 29.17
Major Costs	Wages for municipal workers, Transportation of RDF	Wages for Sarthak Karmis ,Waste collection and segregation	Processing of waste using capital intensive machinery

Opportunity for Co-processing other wastes in cement sector

Apart from MSW, Cement industry offers opportunity for Co-processing other wastes like Hazardous Wastes, Plastic Wastes, Biomass, Used Tyres, but issues impeding its scale up are

- Policy & Regulatory barriers
- No policy incentive for encouraging co-processing of alternate fuels
- High cost and volume of transportation of wastes
- High investment cost for setting up pre-processing unit
- High moisture content
- Clear detailed information on different types of wastes is not available on public domain

Innovative Financing Models for scale up

CSR funds can be used in MSW supply chain right from supporting segregation to processing wastes to RDF and enhance the economic viability of the model by

- Creating awareness at the household on primary segregation of wastes and also among the cement companies on co-processing
- Employing marginalized sections of the society, like rag pickers to carry out the task of segregation and create employment opportunities for them either by directly recruiting them or by collaborating with NGOs like Sarthak
- Covering the costs of transportation of collected waste to the processing facility, which was seen to be one of the most significant costs incurred across all the three models
- Providing funds for the capital intensive activities like running, maintenance and upgrading of the processing facility. This would also include employment cost of personnel working at the plant.

Addressing Policy and Regulatory Barriers

- Addressing Policy and Regulatory barriers key to enhancing Cement Co-processing
- A **Forum of Regulators**, to identify and resolve the regulatory and policy issues for promoting Co-processing, with high level representation from State Pollution Control Boards (SPCBs)
- Forum met regularly to deliberate on the key policy and regulatory bottlenecks and came out with a series of Five White Papers/Policy Briefs.
- White Papers/ Policy Briefs were developed based on the inputs of the members of the SPCB, technical experts, industry representatives and learnings from international best practices
- Recommendations of the Forum were acknowledged by CPCB, which set up a '**National Task Force on Cement Co-processing**' to take the recommendations of the Forum forward. Since then, two of the five White Papers have been implemented

Benefits Achieved – Brick & Cement intervention

- The interventions resulted in substantial energy, material and water saving along with waste minimisation;
- Industry benefitted by way of improved resource productivity, product quality and higher profit;
- Workers and society benefitted through reduced social and health impacts such as improved workplace environment, safety at workplace, reduced respiratory diseases, stable employment; and
- Government benefitted on account of reduced environmental and climate change impacts.

Way Forward

- Assess the potential of the wastes to generate energy and other resources in urban and industrial sectors,
- Identify priority areas for intervention in urban and industrial sectors,
- Select appropriate technologies as well as institutional, financial and management models for identified priority areas,
- Set targets and time-frames for implementation in each sector, and
- Develop a Strategic Action Plan (Road Map) consisting of activities to achieve the targets and estimate the funding requirements

Thank You

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