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Biofuels and waste to energy activities

Brief Outlook

*Strictly Private
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Draft*

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Agenda

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Outlook of our venture in Biofuels

Govt. of India commitment to green energy is demonstrated through supportive policies

National Biofuels Policy, 2018

01

GoI has set an indicative target of 20% blending by 2030 and proposed setting up of 12 2G bio refineries

02

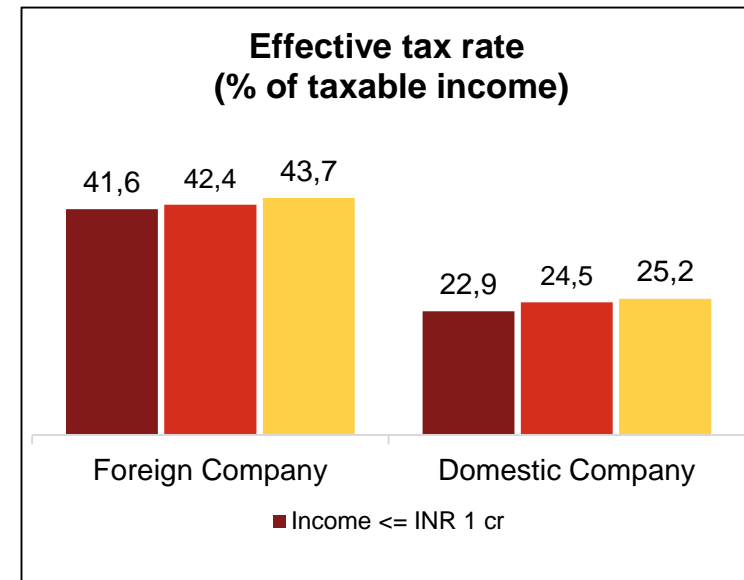
Assured Off-take price of C-heavy, B-heavy molasses and 100% sugarcane juice at INR 43.75/L, INR 54.27/L and INR 59.48/L respectively

03

Agreement for assured off-take of ethanol derived using 2G technology by public sector OMCs for a period of 15 years

GoI mandates the fuel retailers to have at least 5% outlets in rural areas and sell at least one of the alternative fuels (CNG, LNG, etc)

Revised Effective Tax Rates

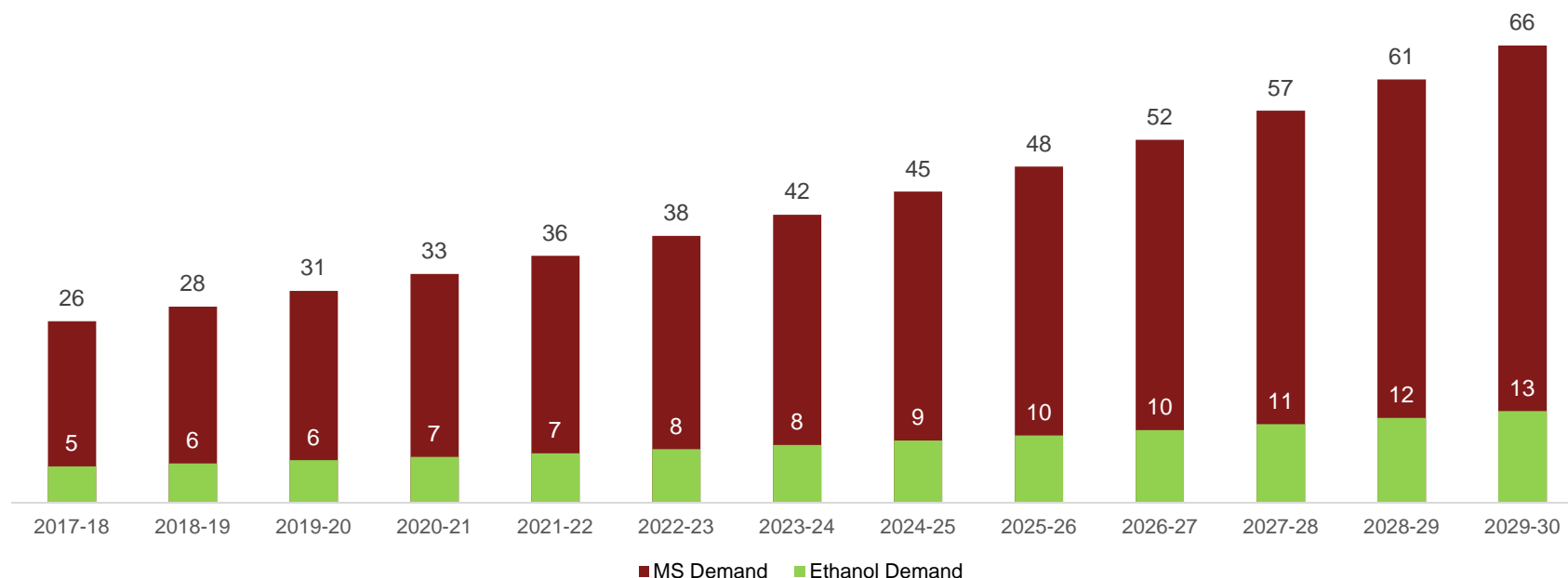


Lower taxes on domestic companies encourage JV with foreign companies

India's rapid improvement in "Ease of Doing Business" ranking to occupy 63rd rank in 2019 may be an important factor in attracting foreign investors

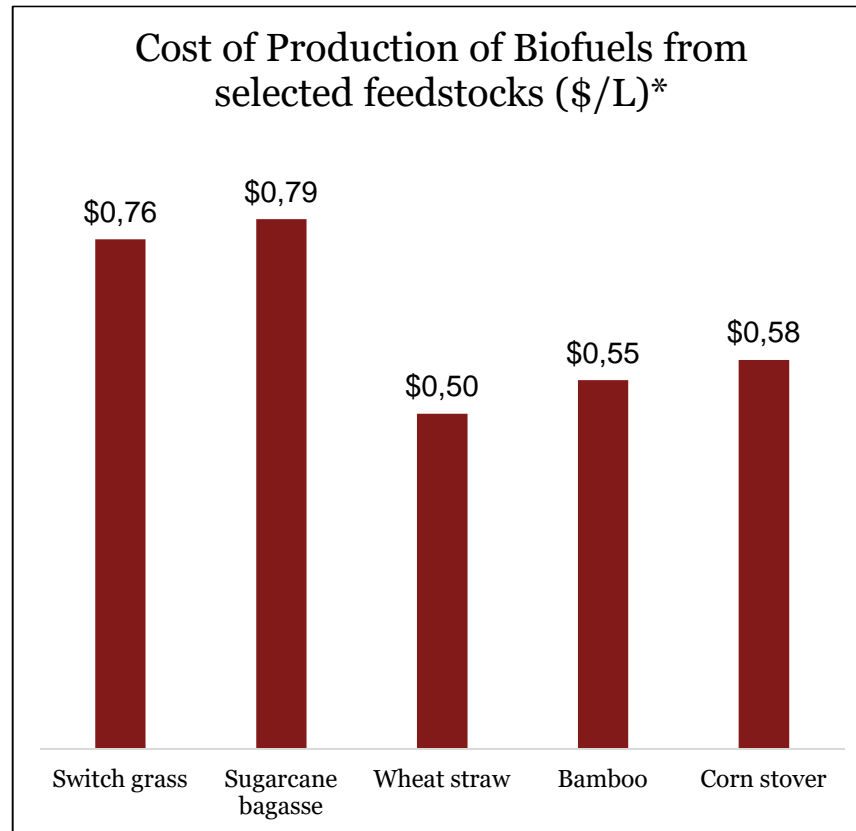
GoI's 20% ethanol blending mandate by 2030 is poised to have huge implications on the bio-fuel demand

Ethanol Demand Outlook for India (20% blending with Gasoline in MMTPA)



- *Last decade witnessed about 10% YOY growth in gasoline consumption*
- *Considering a pessimistic growth rate in gasoline demand of about 6%, ethanol demand would reach around 10 MMT*
- *To meet 20% blending target many more bio-refineries needs to develop*

Every bio-feedstock needs to be utilised in optimal manner to meet such a demand

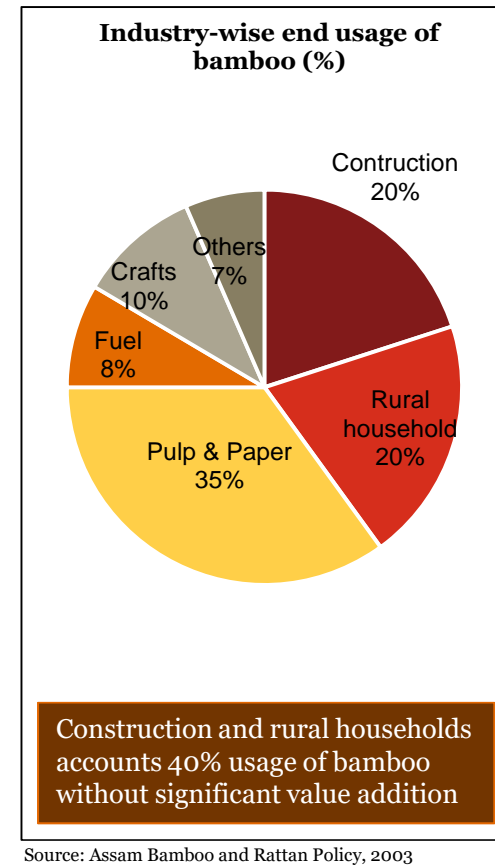
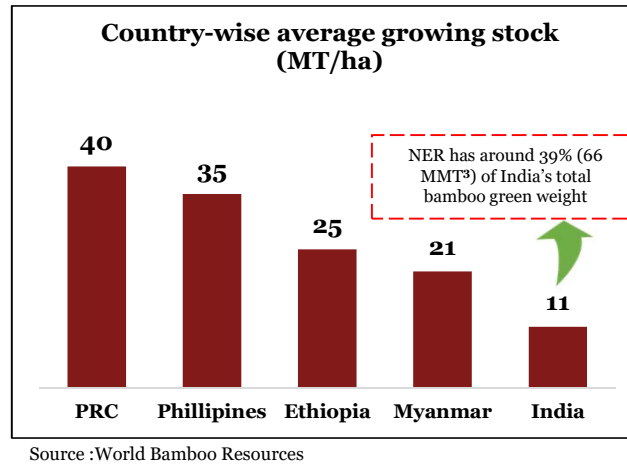
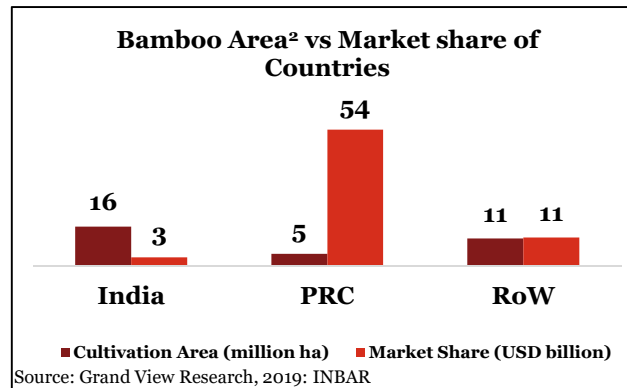
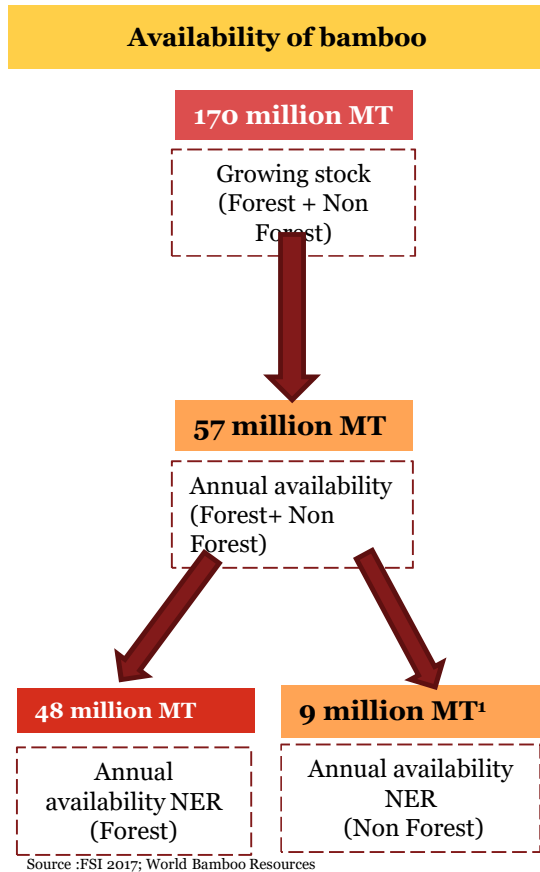


Key Highlights:

- Since the pre-treatment process contributes to high price of production of ethanol from bamboo, other solvent could be tried to reduce the cost further
- Government support may also help in bringing the price down
- Bamboo and switch grass can be harvested throughout the year compared to other sources
- Other biomass could be integrated as a feedstock which will help in diversifying the dependency on a single source of feedstock

Source: Wang L. (2014), The Royal Society of Chemistry
 * Dilute acid treatment process is assumed in all the cases except sugarcane

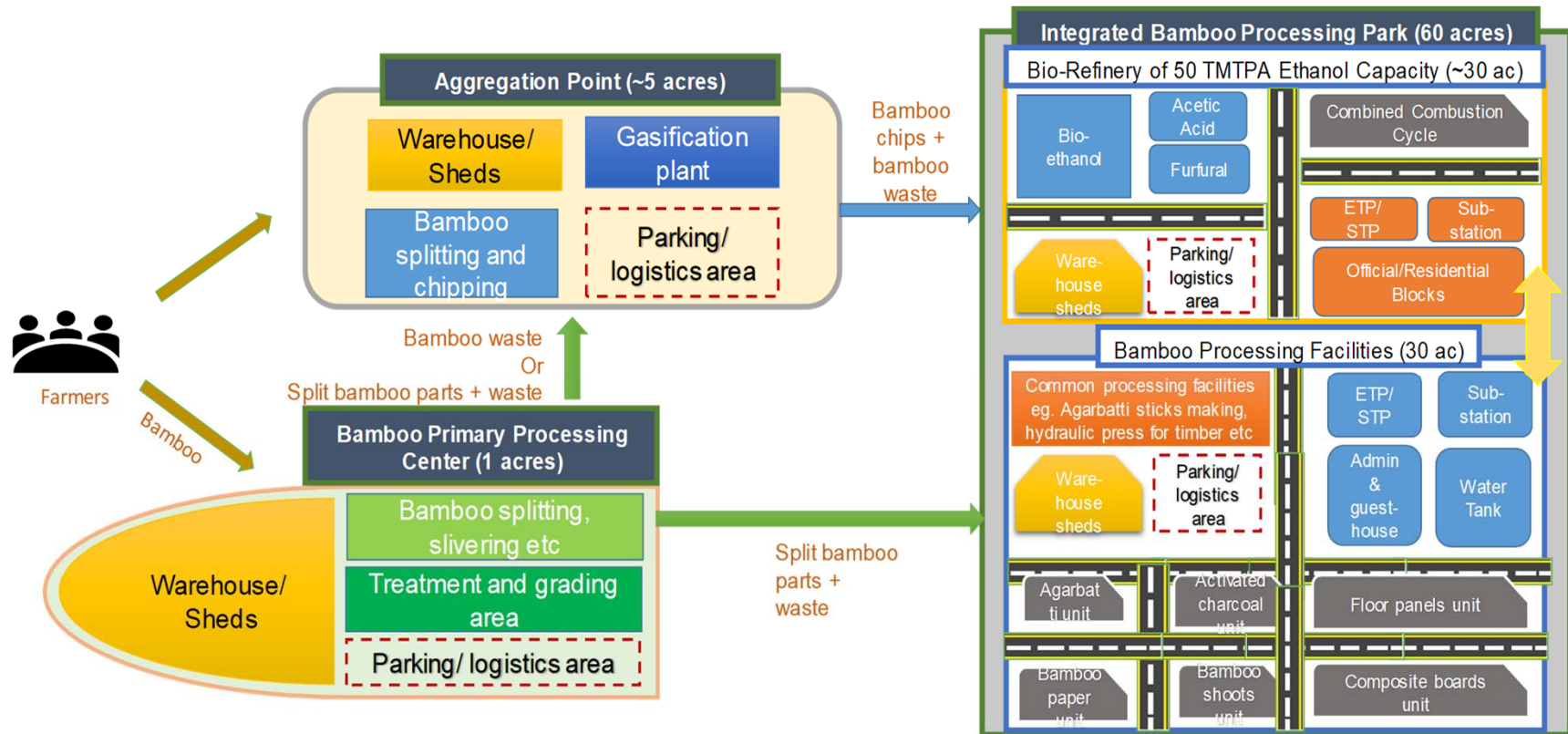
Despite holding about 50% share in global cultivation area, India accounts for only 5% share by market value



¹ Inclusive of Forest and Non-Forest bamboo area

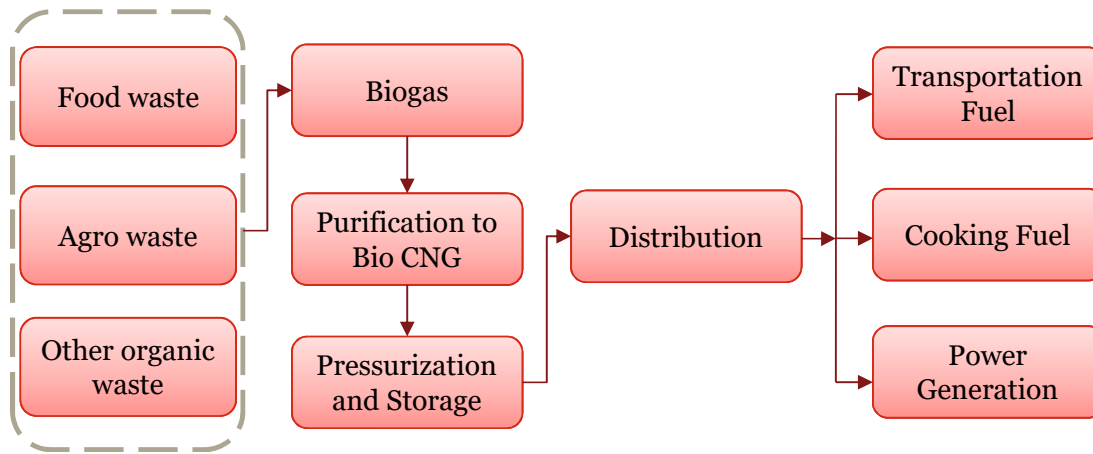
³ Since bamboo is harvested every 3 years hence the total bamboo available would be around 22 MMT(1/3rd of 66 MMT)

Schematic representation of Integrated bamboo park

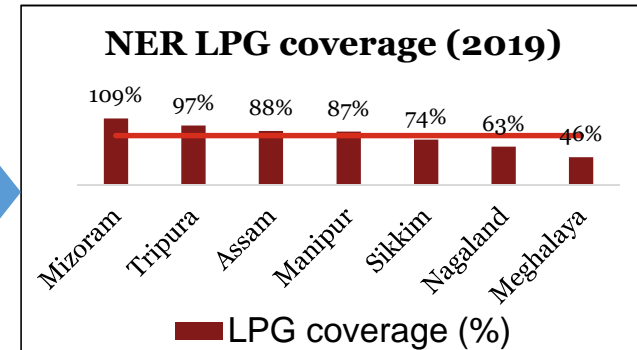


Bio-gas can supplement domestic natural gas supply and cater to government’s vision of providing clean fuel

An Indian technology has given a proof of concept of its technology. It has the potential to produce 5 MT of Bio CNG per day from about 30 MT per day of multiple biomass feedstock



Source: Indian Technology



Source: MOPNG Annual Report 2018

- The pilot plant required an initial investment of INR 21 Cr with a payback period of 3.5 years and annual biomass of 10 TMTPA

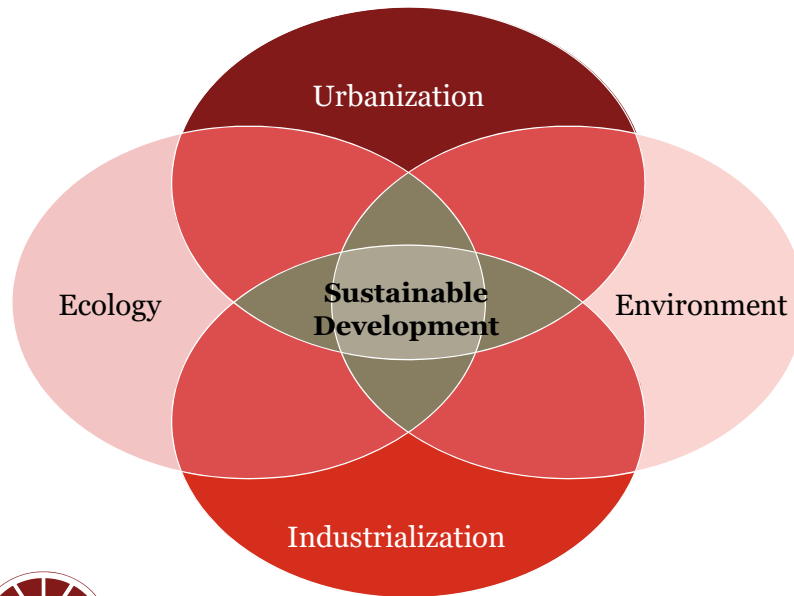
- Opportunities in Nagaland and Meghalaya
- IOCL’s EOI inviting entrepreneurs for CBG*

Assuming all the residuals to be aggregated at the aggregation points, even 10% of the total capacity at each aggregation point i.e., 1000 MT will suffice one 5 MT/day stand alone Bio-CNG plant; Additionally, residuals from the processing of the agarbatti can also be used as feedstock

*CBG- Compressed Bio-Gas

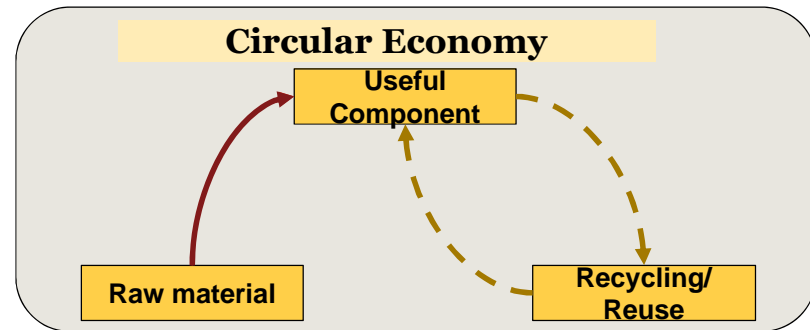
Integrating waste to energy activities

Global waste production is poised to become a major concern unless tackled by a "circular economy"



70%

Global waste production is predicted to rise by 70% by 2050

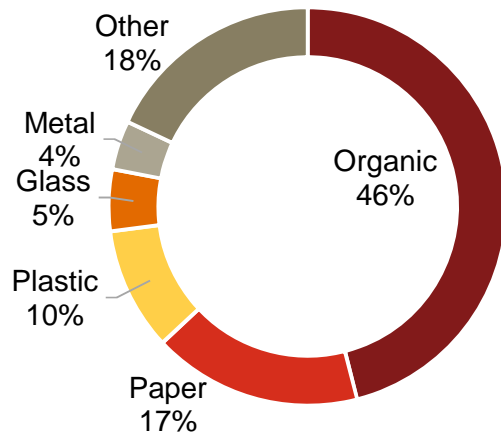


Waste management is a major concern globally	
North America and Members of Europe	China And India
Global population share: 16%	Global population share: 36%
Global waste production share: 34%	Global waste production share: 27%
Per capita income:	Per capita income:

- **The waste generation is heavily dependent on per capital income**
- **High income countries are now witnessing a declining trend in waste generation which indicates waste generation decoupling from economic growth**
- **Uncontrolled waste disposal is major concern and focus now is shifting on this**

Effective waste management is the key to convert the waste into useful feedstock for energy generation

Global solid waste composition



Source: What a waste: A Global review of solid waste management', World Bank Report, 2012

- Organic waste and paper, comprises of 63% of global waste, these are biodegradable and can be used to generate energy
- Plastics, accounting for 10% of global solid waste, could be extracted and used to produce useful products

Effects of waste mismanagement



Organic waste end up being landfills

01



Health risks associated with landfills

02



Plugging of sewage pipe by plastics

03



Production of more virgin plastics

04

PwC Survey- The rise of the circular economy

Response from the Business Houses

Senior management of corporations indicated three major trends which together are the drivers of the circular economy

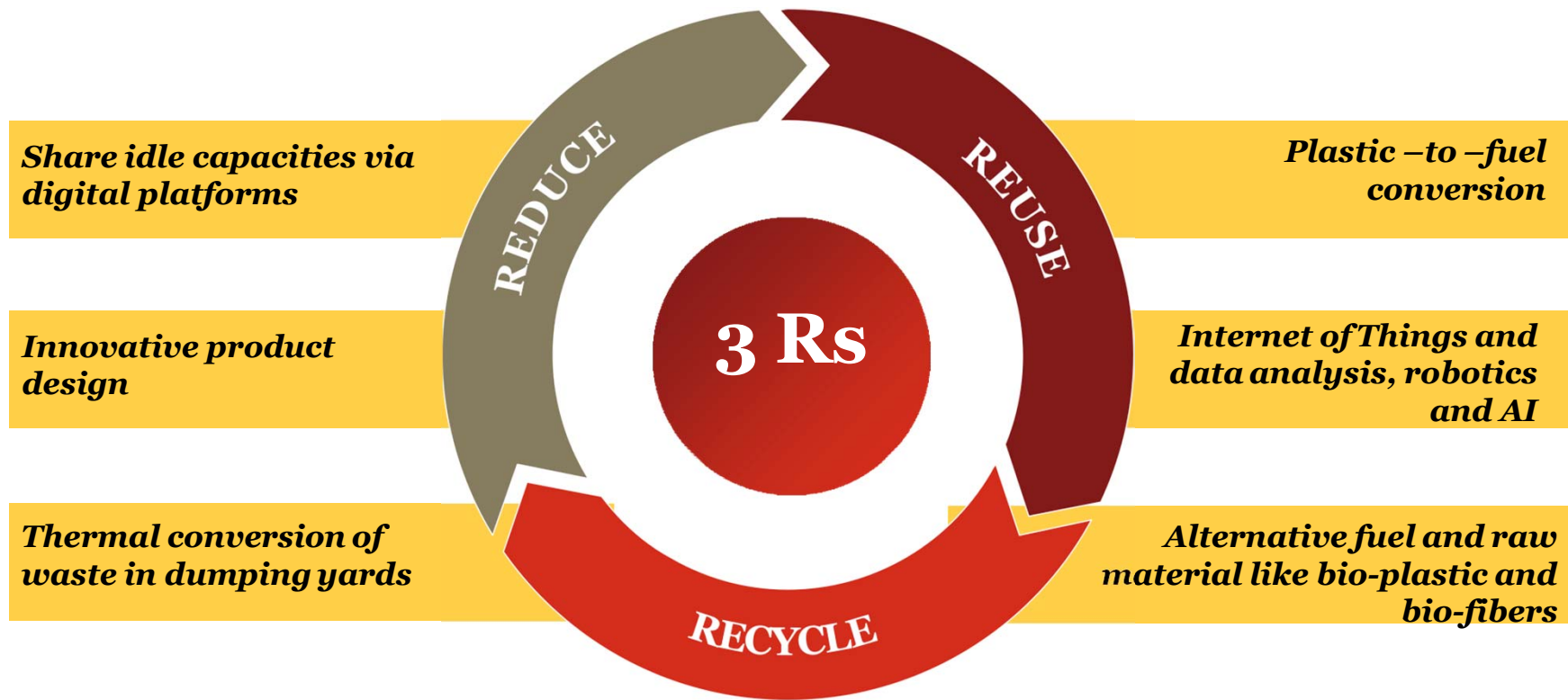
- 1. changing consumer needs**
- 2. resource limitations**
- 3. technological breakthroughs**

Response from the Consumers

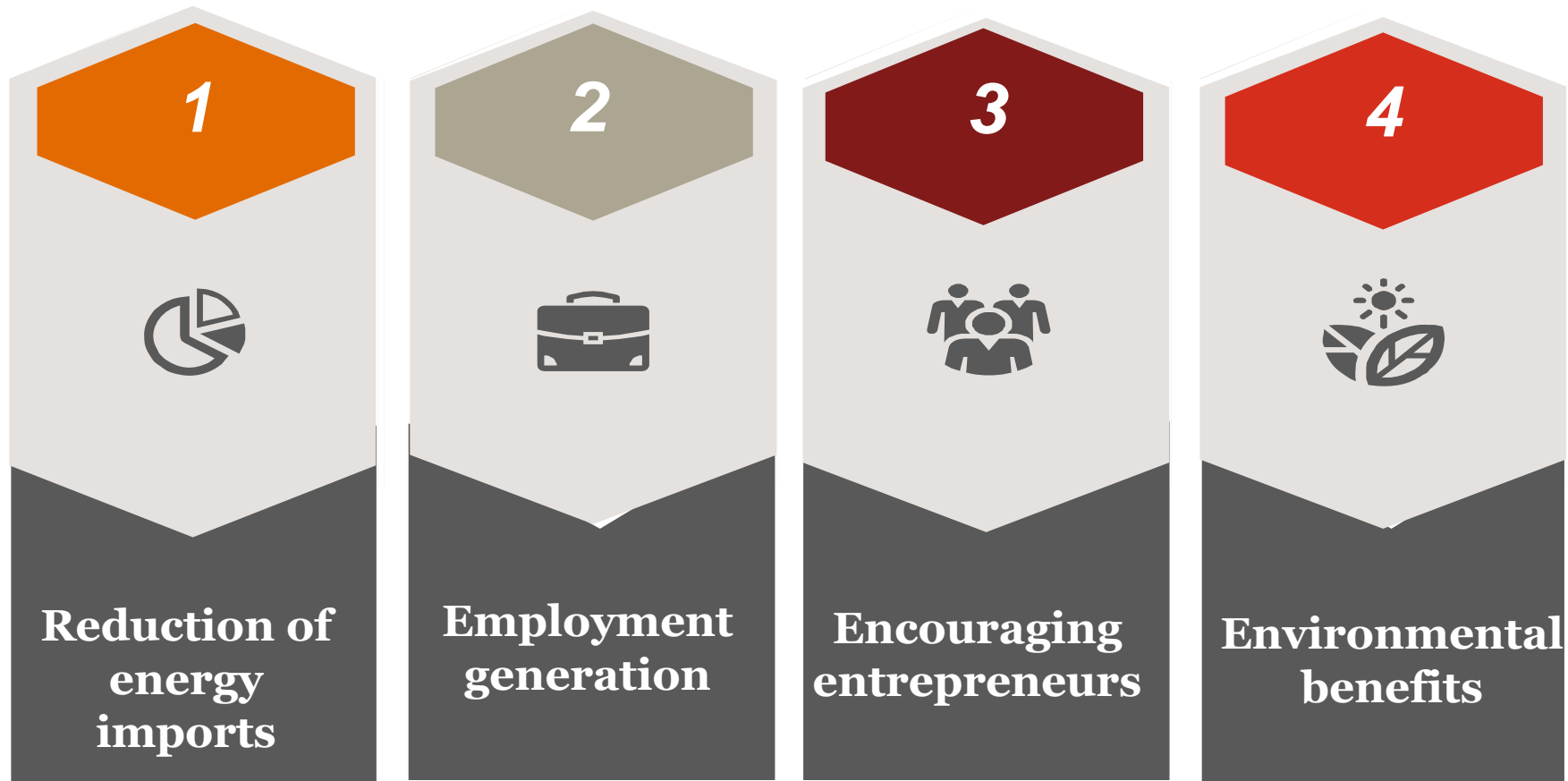


The study concluded that advance technologies will form the backbone of waste to energy

Advanced technologies in waste to energy activities



Multiple benefits can be reaped by investing in waste management and waste to energy technologies



We invest in relationships....

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