Bureau of Energy Efficiency

सत्यमेव जयते
Government of India
Ministry of Power

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DEUTSCHE ZUSAMMENARBEIT

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ANGAN

Augmenting Nature by Green Affordable New-habitat

A Courtyard for Revolutionary Change in Building Energy Efficiency

An International Conference on Building Energy Efficiency

9th-11th September, 2019 | Hotel The LaLiT, New Delhi

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THIS PRESENTATION WAS SHARED BY

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FOR THE SESSION:

"Circular Economy"

DURING ANGAN 2019

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Creating Innovative Solutions for a Sustainable Future

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Circular Economy in Construction

Is there a Business Case? - Experiences of Development Alternatives

Augmenting Nature by Green Affordable New-habitat
ANGAN-2019
Organised by BEE-GIZ

Dr.K.Vijaya Lakshmi
Development Alternatives
New Delhi, India

Hotel Lalit
09-09-2019

Development Alternatives …….

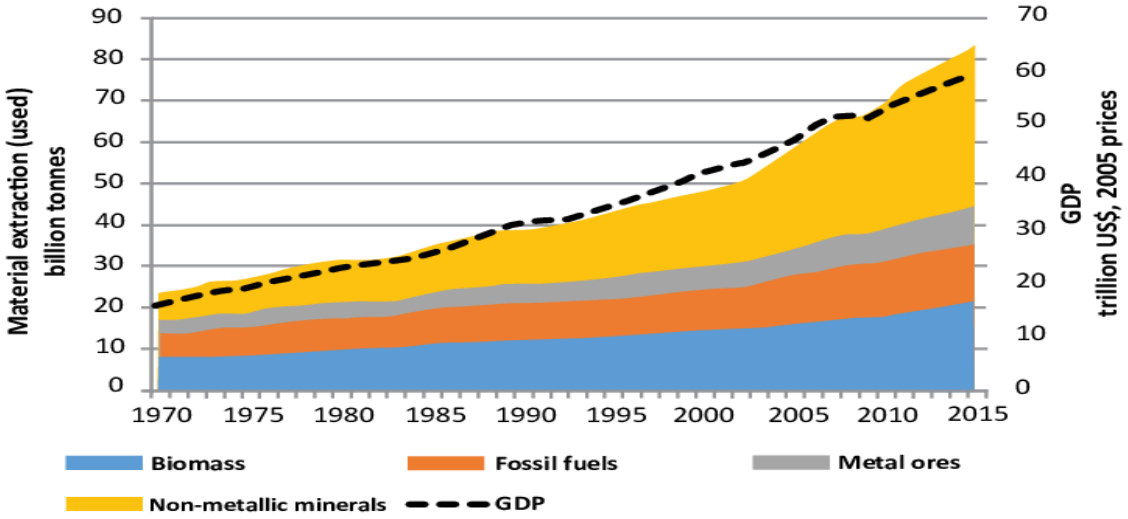
- A new kind of not-for-profit corporation that combines social objectives with business like methods and revenue streams
- Designs and fosters new relationship between technology-nature and people to attain the goal of Sustainable Development.
- Established in 1983

……. A hot bed for circular economy **experimentations** and **business models**

Global material extraction

20th Century – The Great Acceleration

- **Annual Extraction:**
  - **Ores and minerals: 27.0 X**
  - **Fossil fuels: 12.0 X**
  - **Biomass: 4.0 X**
  - **Construction materials extracted: 34.0 X !**
- **Total material extraction: 8.0 X**
- **GHG emissions: 13.0 X**
- **Growth of population: 3.7 X**



Source: Material extraction data from UNEP (forthcoming in 2016b), GDP data from UNSD (2015).

…and the need to decouple

Development Alternatives

Development Alternatives …….

What does circular economy mean to us ?

Profitable implementation of creative ideas

Where

- Nature benefits
- People benefits
- Economy benefits

Sectors and priorities

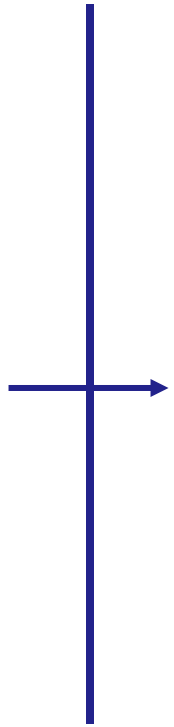
Potential to build economies with circular principles

Sectors	Potential Areas
Construction → housing	**Construction materials from secondary and bio-resources, mining wastes, space sharing**
Urbanization → urban services	Water recycling and harvesting and solid waste for soil nutrients, vehicle sharing & common work-spaces, energy generation
Agriculture → land & water	Soil nutrients, water, energy, growing materials for construction (bamboo), for replacing plastics and packaging
Textiles & Furnishing	Refurbishing, repairs, reuse markets, paper production, packaging

The Construction Sector in India

Resource Criticality

- **Sand**
  - Very high environmental impact. Already in short supply
- **Aggregates**
  - Very high environmental impact. Good quality an issue
- **Limestone**
  - Becoming scarce. To be in crisis in another 30-40 years
- **Soil**
  - Very high environmental impact



Sustainable Consumption and Production Practices

Opportunities

- 100% utilization of industrial and mine wastes
- Minimized use of natural mineral resources
- Carbon Sequestration through planned production of renewables

- Reduction in energy consumption
- Reduction in environmental and fugitive emissions

- Durable and high quality products

- Affordable product and technology
- Reduced cost of construction

- Easy return and pay back period

The Brick Sector

180 Million tonnes of fly ash generated every year

Bricks from Fly Ash

Potential impact:

- 30,000 enterprises
- 0.2 million skilled jobs
- 46 million tonnes of CO_2 savings per year

Economics of Fly Ash Bricks Production

The Business Case….

Investment

- Fixed capital — USD 44,000
- Working capital — USD 10,000

Scale of operations

- Annual production — 2.0 million bricks

Business performance

- Expenses — USD 117,100 per year
- Revenue — USD 142,000 per year
- Surplus — USD 24,900 per year

Pay back period — ~ 2 years

The Construction Sector

716 Million tonnes of C&D waste

Use of C&D Waste in Construction

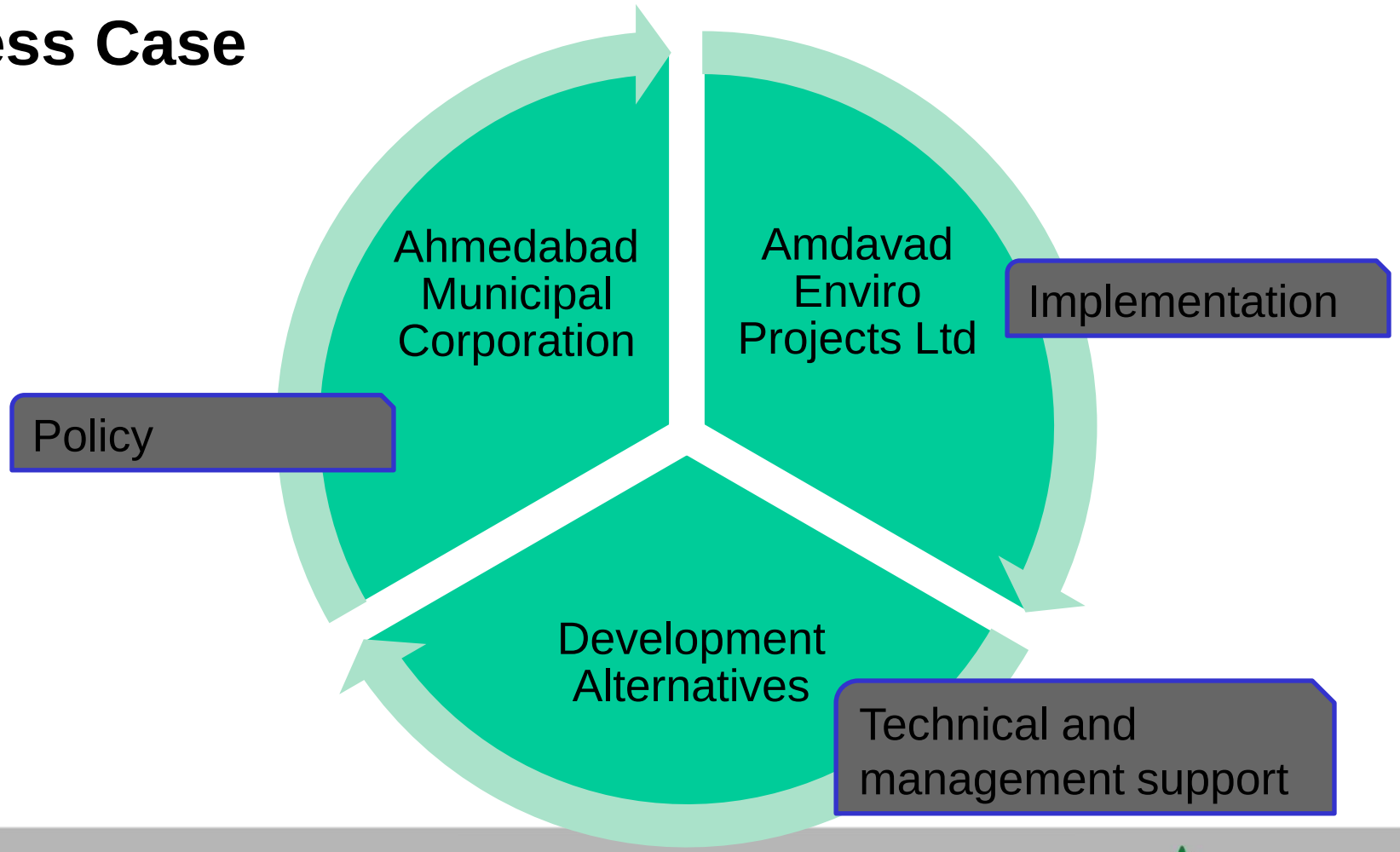
Potential impact:

- **3,600 enterprises**
- **0.1 million jobs**
- **1.5 million tonnes of CO_2 savings per year**

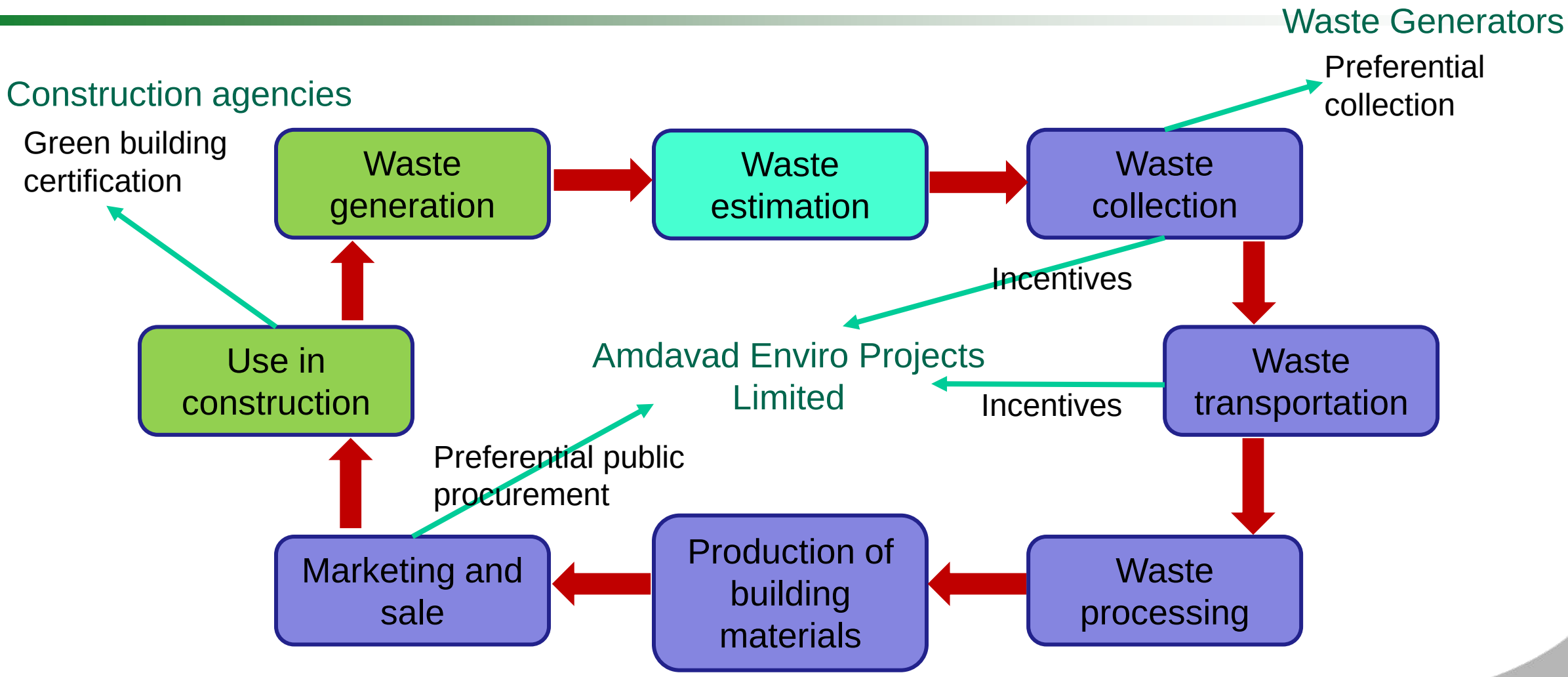
Development Alternatives

Use of C&D Waste in a PPP mode

Business Case



Use of C&D Waste in a PPP mode



Partnerships for Circularity – A Success Case of Ahmedabad Municipality

- Recycling of **30 T of waste / day** thereby reducing primary material usage by equivalent amount
  - **Potential of 200 T /day**

- Savings in energy and GHG emissions through reduction of dumping and reuse of secondary materials

- **Jobs** created – around 20
  - **Potential of > 100**

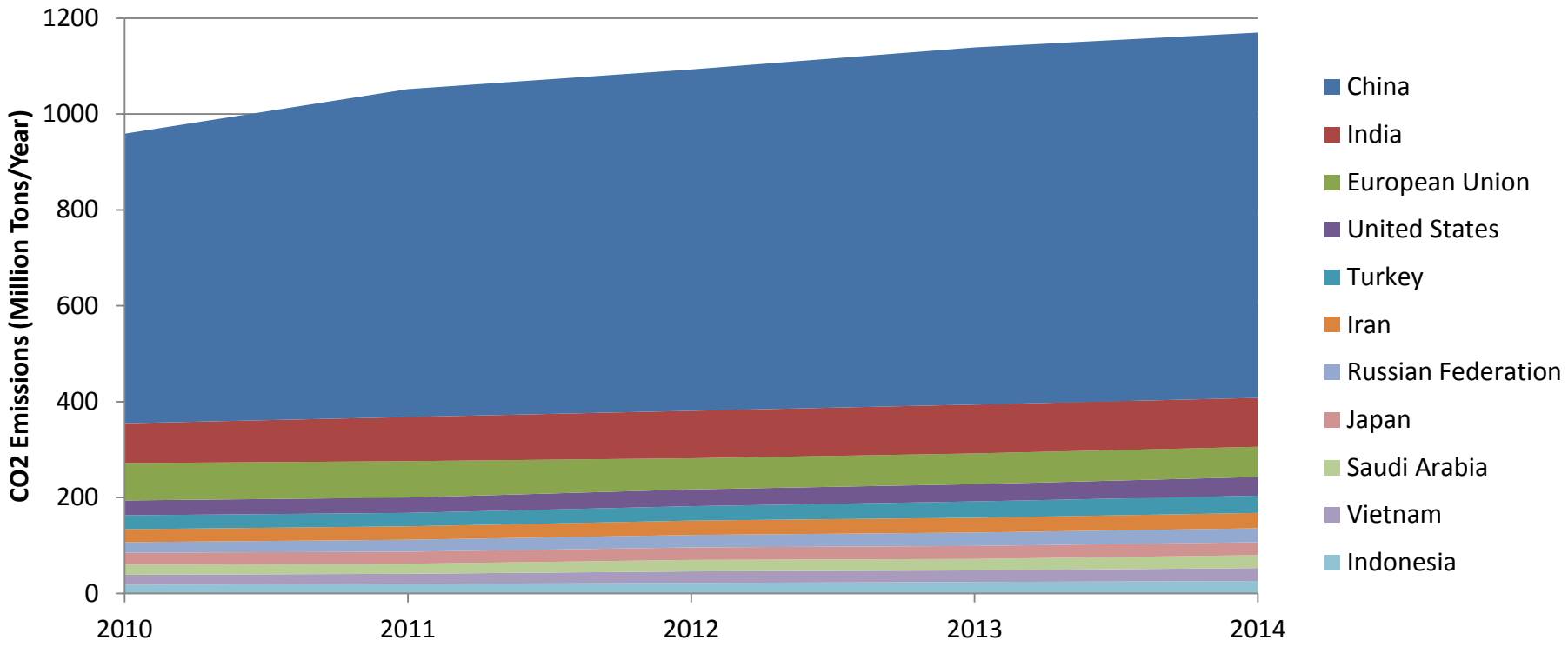
- New and **innovative products** developed leading to 100% utilization of C&D waste
- Approximately USD 40,000 being recycled in the economy with a **potential of USD 300,000**

- Being promoted by major cities and towns

The Cement Sector

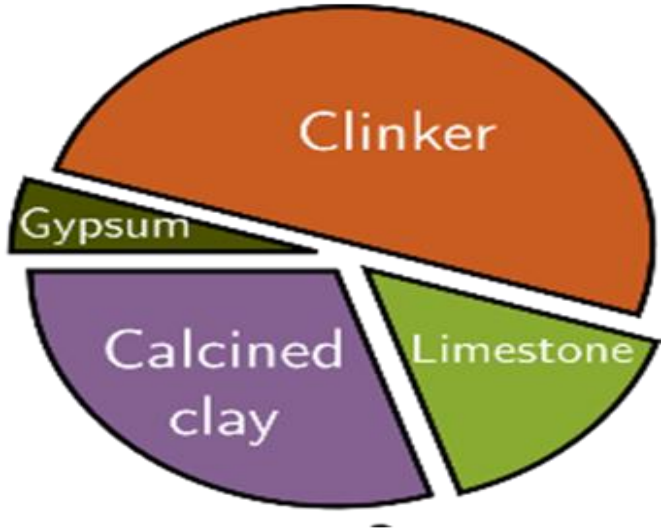
420 Million Tonne installed capacity; 2nd largest in the world

Global CO_2 Emissions From Clinker Production



Ref: Own Calculations

Limestone Calcined Clay Cement - LC^3



LC^3

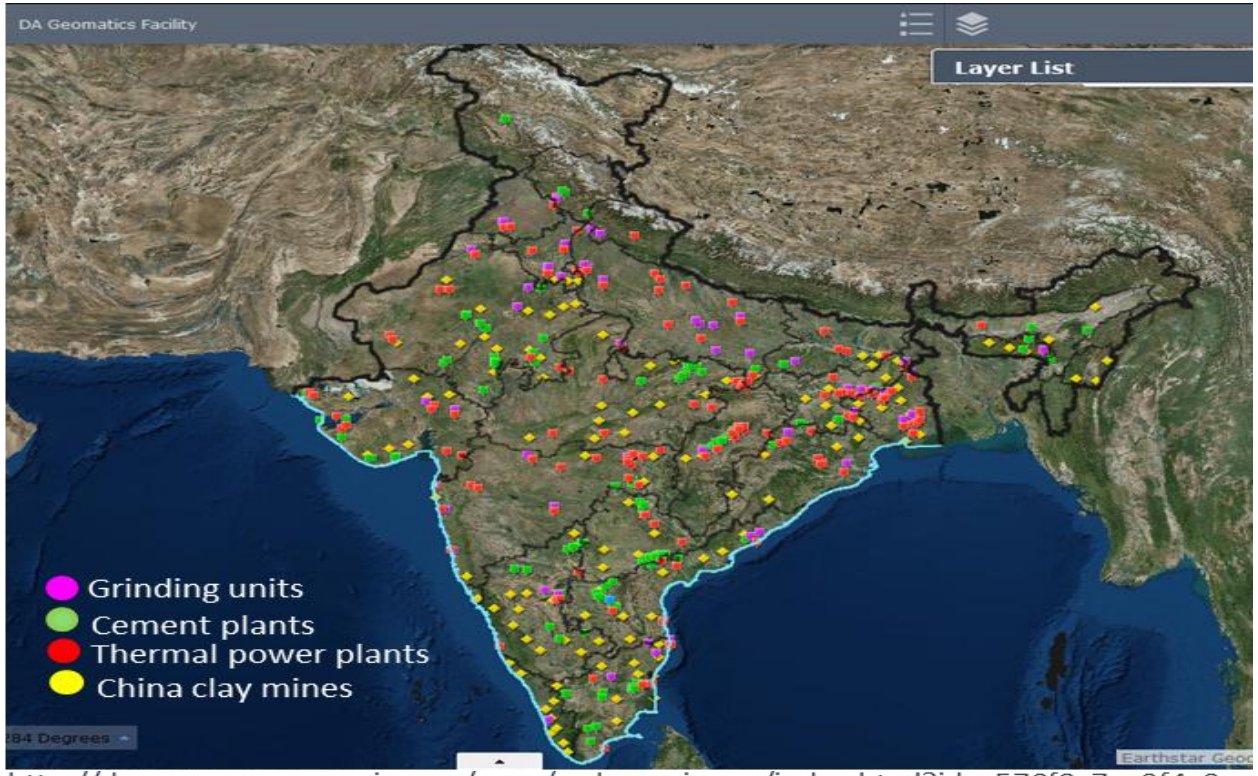
Potential impact:

- **35 million tonnes of CO_2** every year (at current production rate)

Suitable clay for LC^3 is a mine waste

Waste clay in Nadapa, Bhuj, Gujarat

China Clay Availability in India



http://dagroup.maps.arcgis.com/apps/webappviewer/index.html?id=c570f9a7ae0f4a0c9f61cac87fda8fac

GIS Data (from DA's analysis) shows:

- ✓ **Locations of**
  - ✓ cement plants
  - ✓ clay mines
  - ✓ thermal power plants
  - ✓ ports and railway stations
- ✓ **Nearest clay and fly ash sources**
- ✓ **Options for potential LC^3 plants locations**

Development Alternatives

LC^3 Applications

Demonstration Building made with LC^3 in DA premises in India

Building made with LC^3 AAC blocks - Swiss Embassy, India

Road made with LC^3 in New Delhi

Pre-Cast Slab made with LC^3 - Noida

Kerb Stones made with LC^3 - Jhansi

Blocks made with LC^3 - Ghaziabad

Foundry Slag Waste for Construction

1 Million tonne of foundry slag waste generated every year

Development Alternatives

New Resource Streams… *Industrial Wastes*

Bricks from Pond Ash

- **Use of coarse ash**
- **80-90% ash content**
- **High strength, Light weight**

New Resource Streams… *Industrial Wastes*

Marble sludge waste

- Used in ternary blended cement and white cement
- Equivalent to M43 grade 100% waste based bricks
- **Can be used in making waterless hand made paper**

New Resource Streams… *Municipal Wastes*

Building blocks made with plastics and rags

New Resource Streams… *Agriculture Wastes*

Tobacco industry waste

- High silica content and extremely fine particles
- Dust hazard and thus controlled disposal
- Usable calorific value
- Use as internal fuel in green brick making for producing burnt clay bricks
- Upto 5% by weight

- **40% reduction in overall energy consumption**
- **70% reduction in external fuel consumption**

- Improved burnt brick strength
- Extremely low emission

(Re) newed resource streams – *Bio-mass*

Pine Wood Shingles in roofs

(Re)newed resource streams – *Bio-mass*

Bamboo – Resin Wood

Challenges

- Bridging the Innovation to Market divide
- Minimal support from Government in promoting products
- Very slow and tedious process of developing standards
- Lack of any incentives in using alternate products and promoting enterprises
- Age old rules and cumbersome processes
- No action research on production and delivery / business models
- A mis-match between the understanding of “scale”

……Business process innovations

Development Alternatives – World HQ

Development Alternatives – World HQ

- Over **80%** material recovery
- **50%** reduction in material rucksack

- **30%** less steel & cement
- Industrial waste – Fly-ash based bricks and stone dust
- Construction debris – broken tiles and recycled earth
- **100%** harvested & recycled water
- **35%** reduction in energy consumption

- **Local** production models
- Small contractual and artisanal skill sets – job creation

Construction debris – broken tiles and recycled earth

Development Alternatives

THANK YOU

Development Alternatives