Manufacturing Process & Business Challenges

Green Flyash Products

Centre for Science & Environment

December 2017

Fly Ash Products (FAP)

- **FAP Overview**
  - Types
  - Ingredients
  - Manufacturing Process
  - Technical Specifications
- User Benefits
- Initiatives & Recommendations
- Business Challenges
- Solutions & Way Forward

Types of FAP

Bricks (Standard and Modular)

Blocks (Solid and Hollow)

Tiles (Roofing and Floor)

Pavers (Moderate and Heavy Load)

Kerb Stones

Other Precast FAP Shapes

Wheel Stopper

Drain Cover

Fence

Beams and Columns

Gully Cover

… and many more up to the level of customization

FAP Ingredients

Blocks, Pavers, Kerb Stones and Thick Precast Shapes

- Fly Ash + Coarse Aggregate + Bottom Ash / Sand / Stone Dust + Lime / Cement + Gypsum + Curing

Bricks, Hollow Blocks, Tiles and Thin Precast Shapes

- Fly Ash + Bottom Ash / Sand / Stone Dust + Lime / Cement + Gypsum + Curing

Ultra Light-weight Products (AAC and CLC)

- Fly Ash + Bottom Ash / Sand / Stone Dust + Lime / Cement + Gypsum + Aluminium Oxide + **Steaming**

Manufacturing Process

- Chemistry behind FAP is the Pozzolanic reaction between Fly Ash and binder materials such as Lime /Cement

- Coarse Aggregate, Bottom Ash, Sand and Stone Dust act as filler material to reduce net surface area

- Gypsum is used for initial hardness and hydration of Lime / Cement

- FAP are made using following technologies:
  - Vibrating Bed: Used for FAP having Coarse Aggregate
  - Hydraulic Press: Used for FAP having fine particles such as Bottom Ash, Sand and Stone Dust
  - Vibro-hydraulic Press: Uses a combination of pressure and vibration based on the ingredients, to achieve maximum compaction
  - Steamed Baking and Autoclaving for Ultra Light-weight Concrete

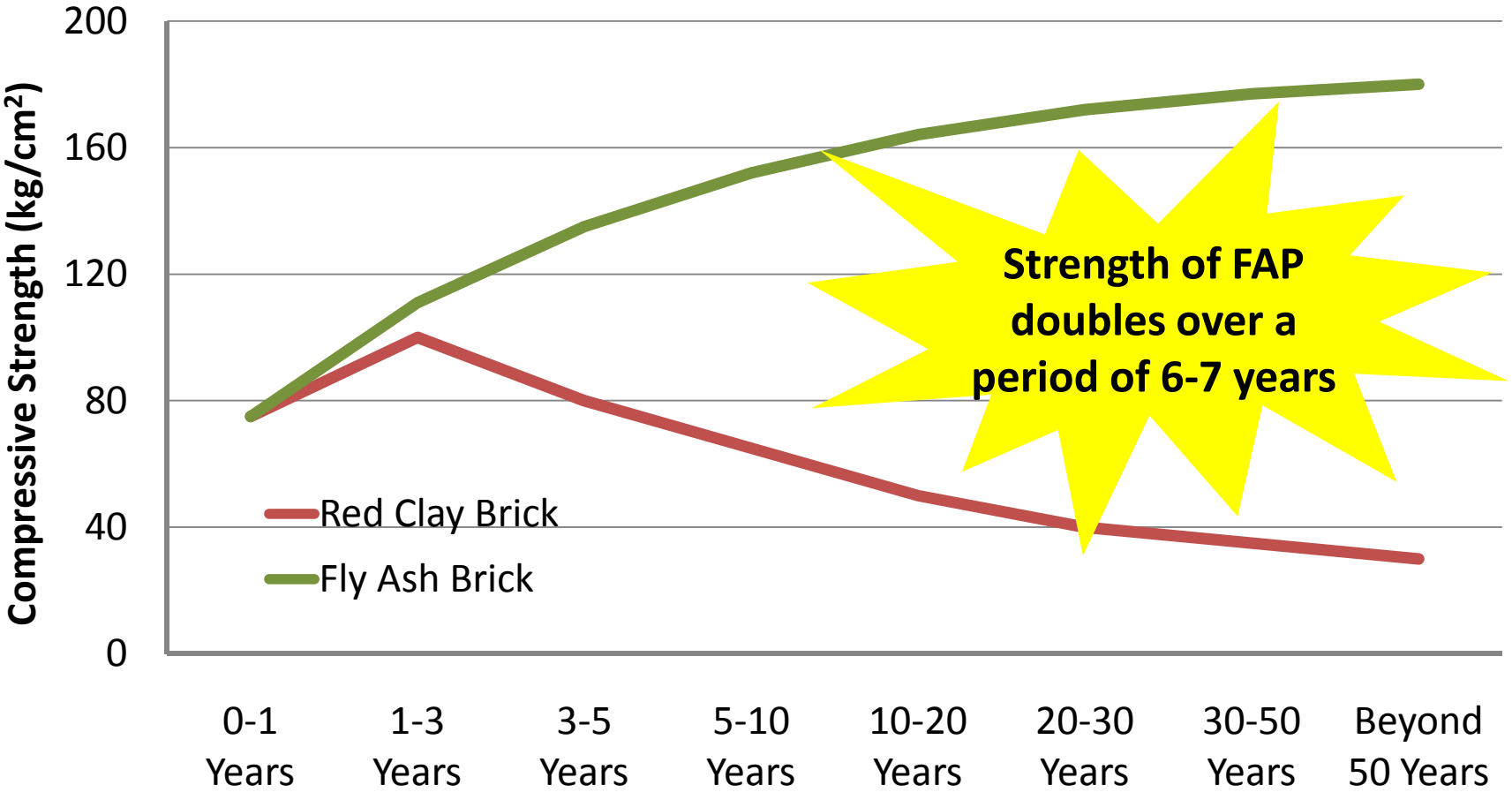
Technical Specifications

Type	Dimensions (mm)	No. per m^3	Weight (kg)	Strength
Standard Bricks	230X110X70 230X110X75 230X110X80	565 528 495	2.5-2.8	• Non-load bearing Bricks (wall between 2 beams): 50-70 kgf/cm^2 (M5-M7) • Load bearing Bricks (wall without beams), Boundary wall and Parapet: 70-100 kgf/cm^2 (M7-M10)
Modular Bricks	190X90X90	650	2.1-2.4	
Indian Blocks	290X140X190	130	11-14	• Load bearing Blocks: 100-150 kgf/cm^2 (M10-M15) • Heavy Duty Blocks and Precast Shapes: 150-250 kgf/cm^2 (M15-M25)
EU Blocks	390X190X190	71	20-26	
Tiles	25mm	Measured in m^2, e.g. 22 Milano design pavers in a m^2	Varies based on length and breadth (1800-2000 kg/m^3)	• Tiles, Pavers & Kerb Stones: 300-350 kgf/cm^2 (M30-M35)
Pavers	Medium duty: 60mm Heavy duty: 80mm			
Kerb Stones	290X125X300 & 75mm round curve	Measured in running meters		
Precast shapes	Customised	As per customisation		• Precast Columns & Beams: 250-300 kgf/cm^2 (M25-M30) • Special Precast Forms: >350 kgf/cm^2 (Above M35)

Fly Ash Products (FAP)

- FAP Overview
- **User Benefits**
  - Quality, Strength and Sustainability
  - Cost Effectiveness
- Initiatives & Recommendations
- Business Challenges
- Solutions & Way Forward

Quality, Strength and Sustainability



While Burnt Clay Red bricks deteriorate over time, Fly Ash bricks gain strength, making them a more sustainable building solution

Cost Effectiveness

Burnt Clay Red Bricks

Fly Ash Bricks

- Red bricks shrink unevenly in the brick kilns depending on the heat exposure
- 23% mortar required in red bricks due to irregular shape
- Cannot sustain wall putty without plaster
- 8-10% breakage due to labor handling & 3-4 qualities at brick kilns
- DPC required for water exposure

- 10% less Fly Ash bricks required due to standard size achieved using machines
- 15% less mortar needed due to smooth orthogonal shape
- No plaster required, and wall putty can be directly applied
- 2-3% breakage due to mechanized production process
- No DPC required

Fly Ash Products (FAP)

- FAP Overview
- User Benefits
- **Initiatives & Recommendations**
  - Center Initiatives
  - Center Recommendations
  - State Recommendations
- Business Challenges
- Solutions & Way Forward

Center Initiatives

1	 Hon'ble Prime Minister Narendra Bhai Modi	PM praised and recommended Fly Ash bricks while inaugurating Baroda and Kochi Airports
2	NITI Aayog Government of India	NITI Aayog constituted Mission Fly Ash. Also, developing real-time Fly Ash utilization App, along with MoP, via GIS mapping of 400+ thermal plants and 20,000+ Fly Ash Product industries
3	Ministry of Power Government of India	MoP has proposed to use existing land of Fly Ash mounds and rail network to make Fly Ash cluster and PoS through out India; Planned INR 10 cr for promotions
4	Ministry of Road Transport & Highways Government of India	MoRT&H has promoted Fly Ash products in its all highways and express way projects
5	Ministry of Environment, Forest & Climate Change Government of India	MoEF&CC made Fly Ash Products mandatory in 300 km radius of thermal power plants, which covers all of India except Ladakh, and some part of North-east
6	National Green Tribunal	NGT has banned burnt clay red bricks in Agra and Mumbai, due to pollution – same expected for NCR and major metropolitan cities
7	Central Pollution Control Board	CPCB categorized Fly Ash Products in the "White Industry", and burnt clay earthen bricks in "Red Industry", along with MoEF&CC

Center Recommendations

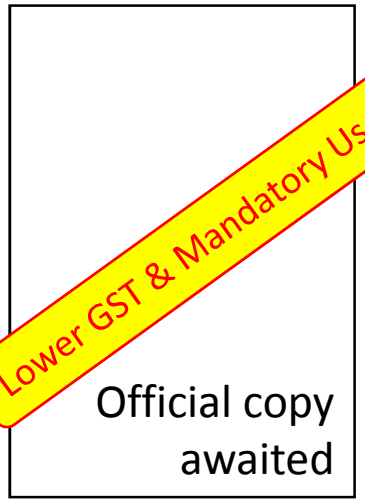
NITI Aayog

MoP

MoRT&H

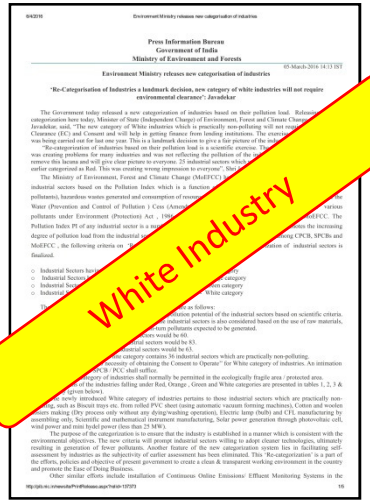
MoEF&CC

MoH&UPA

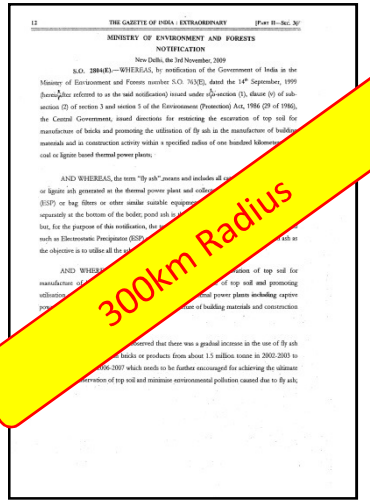


NGT

MoEF&CC / CPCB

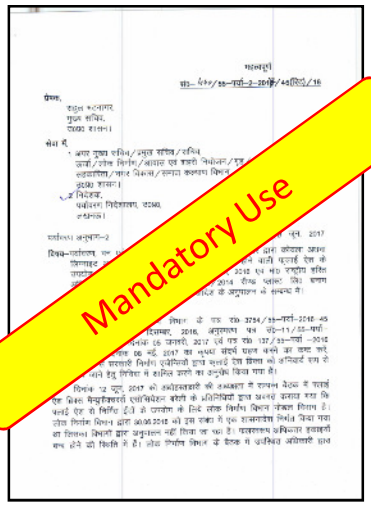


MoEF&CC

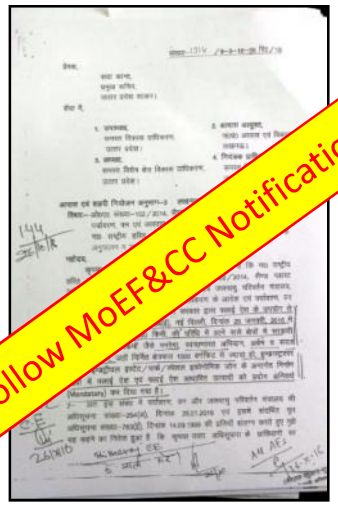


State Recommendations

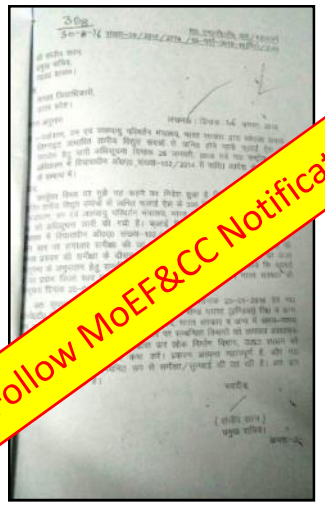
G.O. UP Govt.



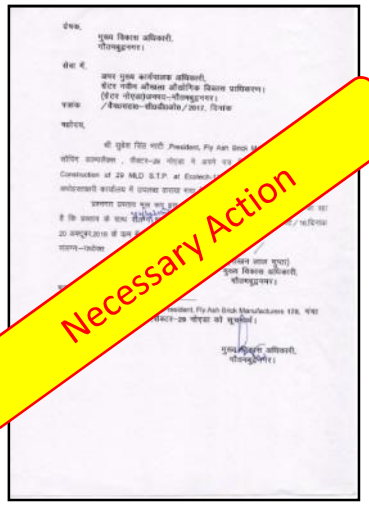
Chief Secretary, UP Govt.



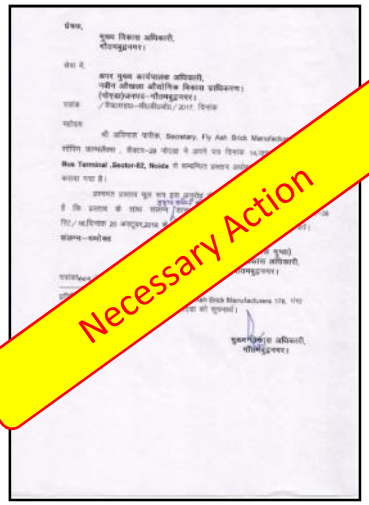
UPPCB



CDO Letter for Noida



CDO Letter for GNIDA



… and the necessary action is use of Fly Ash Products

Fly Ash Products (FAP)

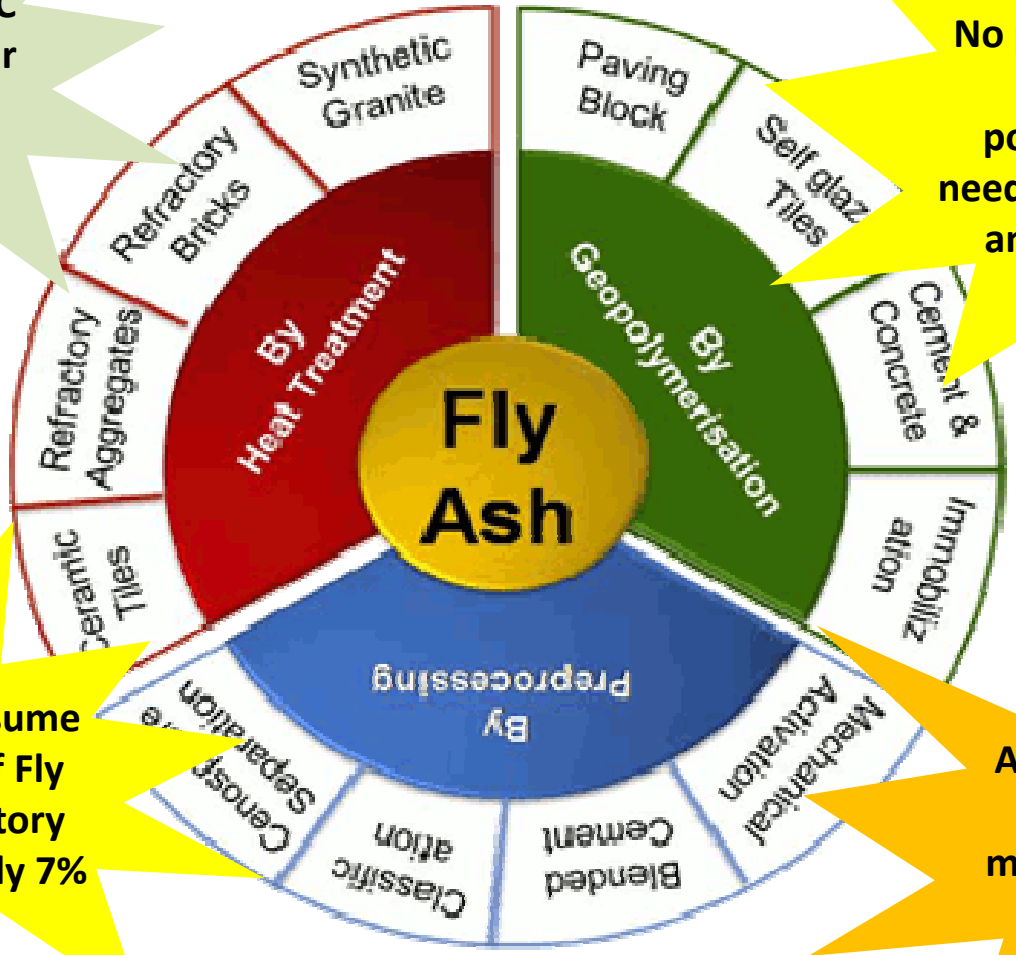
- FAP Overview
- User Benefits
- Socio-economic Benefits
- Initiatives & Recommendations
- **Business Challenges**
  - End-user Challenges
  - Administrative Perception Challenges
  - Administrative Violations
- Solutions & Way Forward

End-user Challenges: Testing at Site

Size	• Check the dimensions of the product to get the number of FAP required per m^3, with a tolerance of ±2% • $1m^3$ of brick work consists of 0.8 m^3 of bricks and 0.2 m^3 of mortar
Shape	• Orthogonal shape with smooth faces and sharp edges, with bonding frogs/ grooves
Colour	• Whether coloured or not coloured, tone shall be uniform through out the product
Marking	• Each brick shall be marked in a suitable manner with the manufacturer's identification mark or initials
Water Absorption	• Check the difference between the weight of a wet and a dry brick to get water absorption (should be 10-20%)
Strength	• CTM Test: Fill the frog with cement mortar (1:3) 24 hours before testing ○ Divide maximum load at failure with total area of the bed face to get the FAP strength • Drop Test: FAP should not break when dropped from a height of 4 ft on flat surface

Administrative Perception

Maharatna PSU NTPC used this logo in their User Meet dated 31 Aug 2017



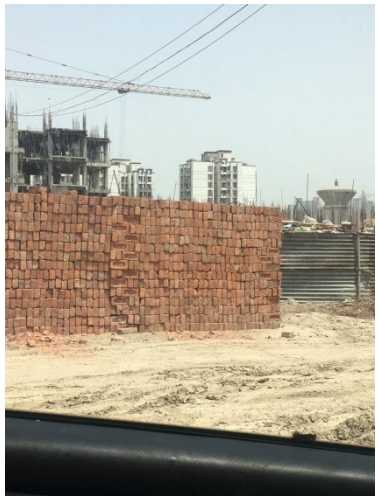
No paver block possible with Geo-polymerisation, as it needs abrasive resistance and fatigue strength

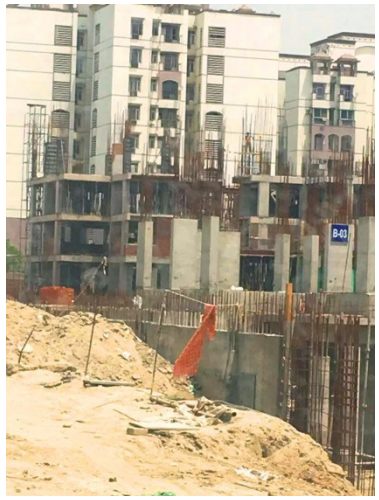
Fly Ash bricks consume more than 70% of Fly Ash, while Refractory bricks consume only 7%

A detailed policy and right kind of marketing, is required for proper Fly Ash utilization

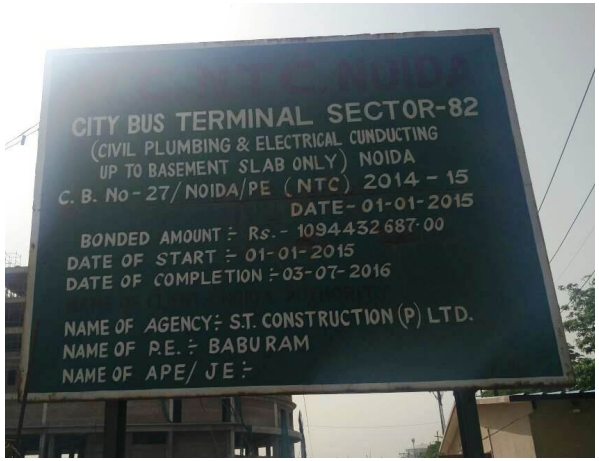
Administrative Violations …1 of 2

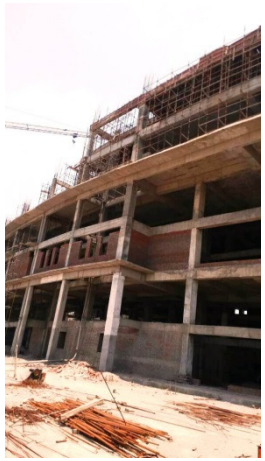
CGEWHO (Central Government Employees Welfare Housing Organization)





City Bus Terminal, Sector-82, Noida





Administrative Violations …2 of 2

Multi-purpose Indoor Stadium, Sector 21A, Noida

Sewage Treatment Plant, Greater Noida

Shilp Haat, Noida

Fly Ash Products (FAP)

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- Business Challenges
- **Solutions & Way Forward**
  - Proposed Solutions
  - Recent FAP Projects
  - GIS TPP Mapping

Barriers & Solutions Ahead

Barriers	Proposed Solutions
Least awareness in construction engineers, monitoring agencies and end-users about the qualities of FAP and how to test FAP at site	1. Promotion programs and workshops to educate 2. Updation of BIS standards 3. Updation of existing Center / State notifications
Mandate from Environmental Ministry regarding use of Fly Ash Products in 300km radius of thermal power plants, not obeyed	1. Make Fly Ash Products mandatory for all projects including PMAY. Make utilization certificate compulsory 2. Fix District Magistrate / Collector as a nodal agency to ensure mandatory use of Fly Ash products
No Railway Fly Ash cluster available to supply Fly Ash as a raw material to high demand areas	1. GIS mapping of thermal power plants and Fly Ash Product factories 2. Existing land of Fly Ash mounds and rail network to be used to make Fly Ash cluster and PoS

Recent FAP Projects

Baroda Airport

Kochi Airport

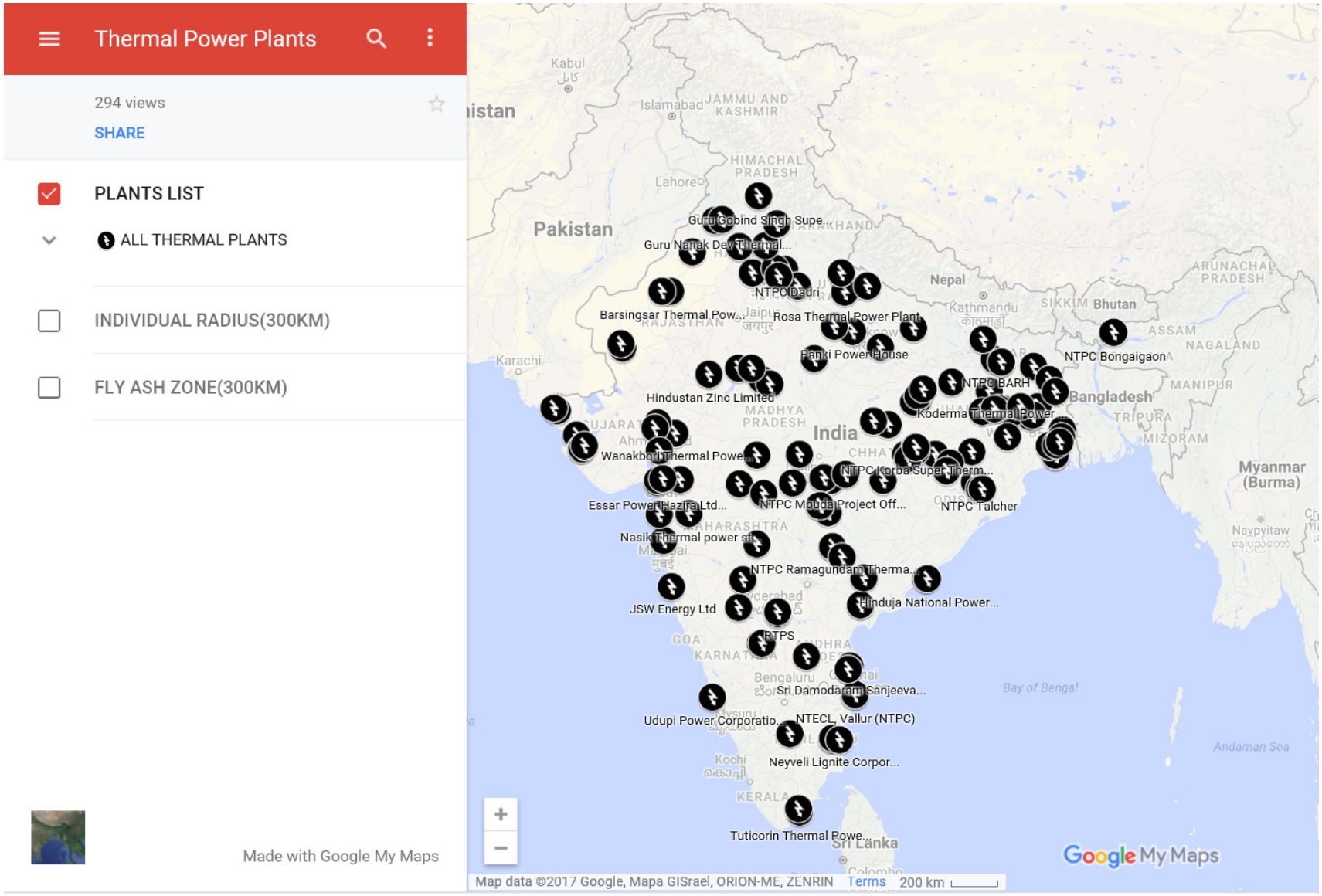
Metro Stations

GNIDA

Affordable Housing

… and many more

GIS TPP Mapping



Thank You

ये नफ़रत बुरी है न पालो इसे, दिलों में खलिश है निकालो इसे।
ना मेरा ना तेरा ना इसका ना उसका, ये सबका वतन है बचा लो इसे

Knowledge-based Activism

Though Yesterday was Red, But Tomorrow must be Green

Together We Can and Together We Will…

References

- IS 12894:2002 – Pulverized Fuel Ash-Lime Bricks – Specification
- IS 3115:1992 – Specification for lime based blocks
- IS 10049: 1981 (Reaffirmed 2009) – Code of Practice for Manufacture of Lime Based Blocks
- IS 2541:1991 – Code of practice for preparation and use of lime concrete
- IS 4098:1983 – Specification for lime-pozzolana mixture
- IS 5817:1992 – Code of practice for preparation and use of lime- pozzolana mixture concrete in buildings and roads
- IS 10359:1982 – Code of practice for manufacture and use of lime- pozzolana concrete blocks for paving
- IS 10360:1982 – Specification for lime-pozzolana concrete blocks for paving
- IS 10772:1983 – Specification for quick setting lime pozzolana
- IS 12654:1989 – Code of practice for use of low grade gypsum in building industry
- IS 12679:1989 – Specification for By-product gypsum for use in plaster, blocks and boards
- IS 2212:1991 – Code of practice for Brick Works
- IS 3495:1992 – Compressive Strength of Brick