Ramanujan labs

Air Water Earth Energy

Who we are

- Climate tech and sustainability company
  - Striving to support 7 UN SDGs
- Working on Air pollution abatement and Carbon Mitigation
- First canvas is Converting hybrid-rice straw to biofuel pellets (sustainable fuel)
  - Pellets = coal replacement in power plants
  - Curb stubble burning
  - Waste to Value
  - Energy Security
  - Rural Rejuvenation
- Biochar
- Direct Carbon Sequestration

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Prasun Bansal

Entrepreneur (4x)
Rocket Scientist
Farmer
Options Trader
Angel Investor (16 cos)

Prasun is founder-director at Yamuna Mission which has cleaned up 2 crore liters a day of Masani Nala (drain) in Mathura, planted above 2 lakh trees, cleaned up 8 km of Yamuna banks and rejuvenated more than 20 lakes. Their work PDF can be accessed here.

B-Tech (IIT Delhi), MS (Stanford Aerospace), MBA (IIM-A)
Trades Options and futures using satellite maps and weather data
Entrepreneur in Solar, Agroforestry, Fashion
Knows Project Financing and Business Development
Can speak Farmer, Investments, Corporate and Science
Amateur Astronomer

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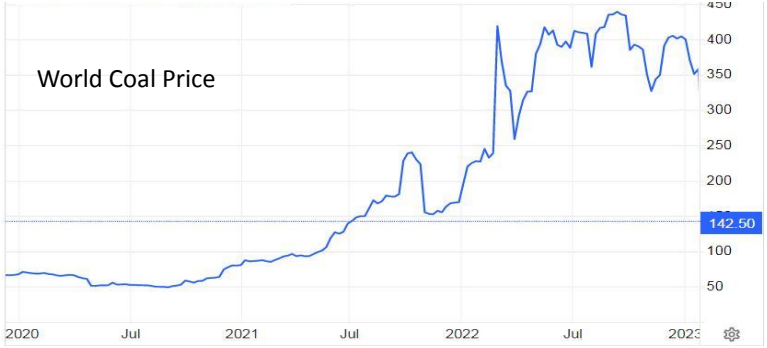
India Searches for Energy Independence

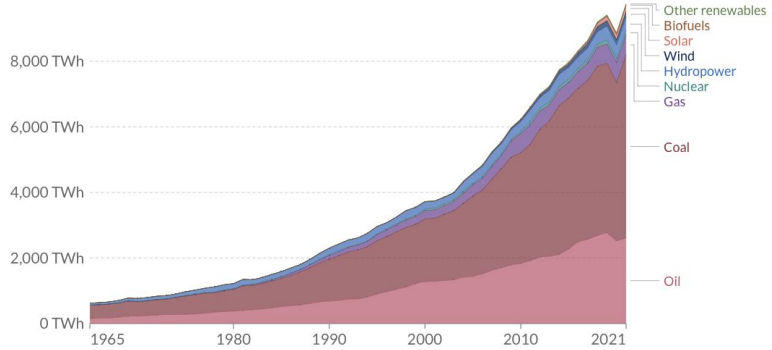
01 Make In India
Atmanirbhar Bharat

02 Imported coal is too expensive
G-16 coal goes 7X in 2 years

03 73% of Electricity is from coal

04 Coal dependence will continue





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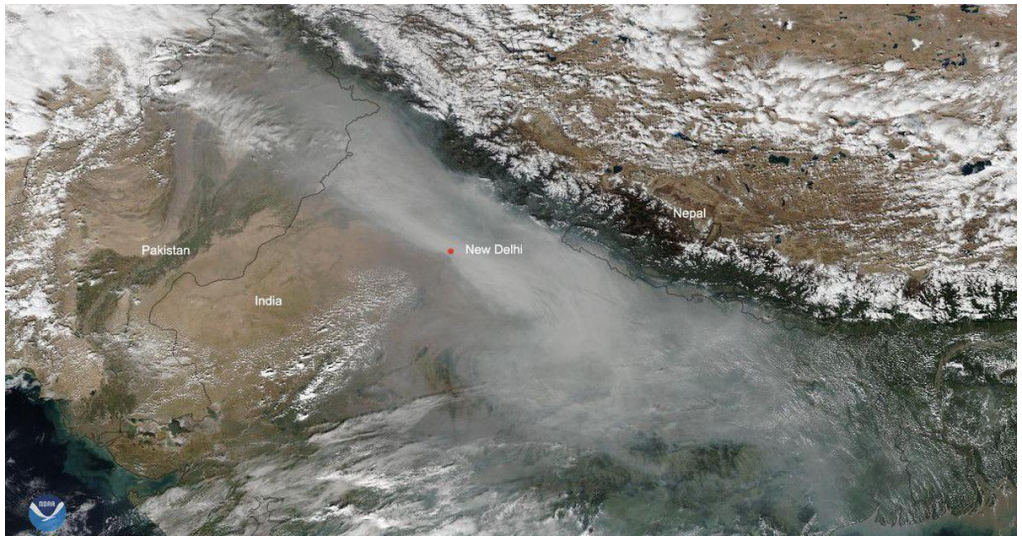
Air pollution in North India

- Our parents and children are losing 7.5 years of life expectancy
- 1.67 million deaths (20% of all Indian deaths) linked to air pollution
- Economic loss to India is 1.5% of GDP per year



Delhi suffers more than other cities due to

- Stubble Burning
- Geography
- Dust
- Festival cracker burning

This is an opportunity in the field of pollution abatement

Much like Israel's water woes paved the way for water sector innovations

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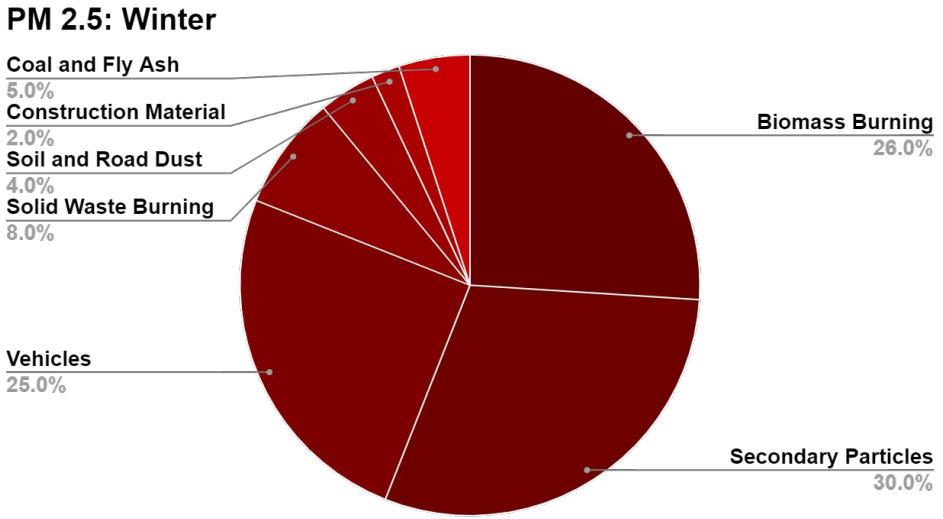
Causes of air pollution in North India

Air Pollution

- Vehicular Emissions
- Industrial Emissions
- Power Plants
- Stubble Burning
- Residential sources, hotels and restaurants
- Festival crackers
- Landfills and Crematoriums



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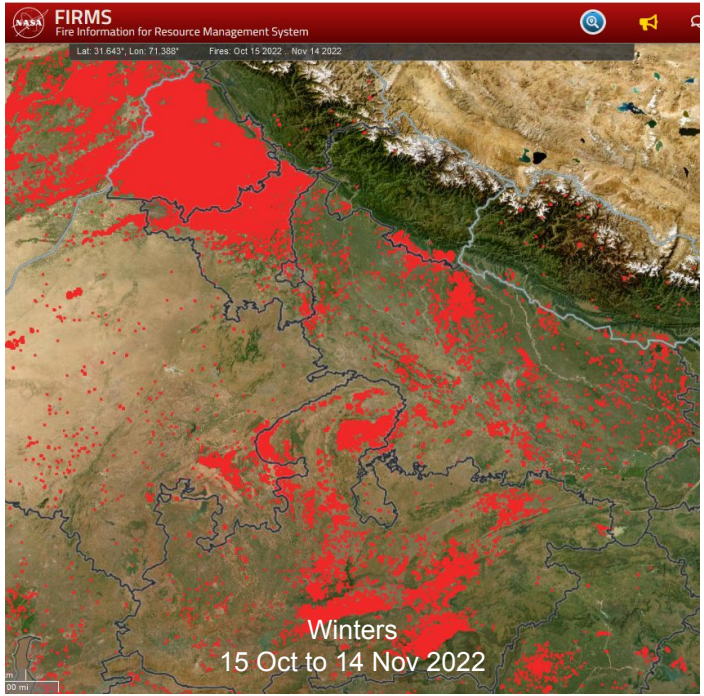
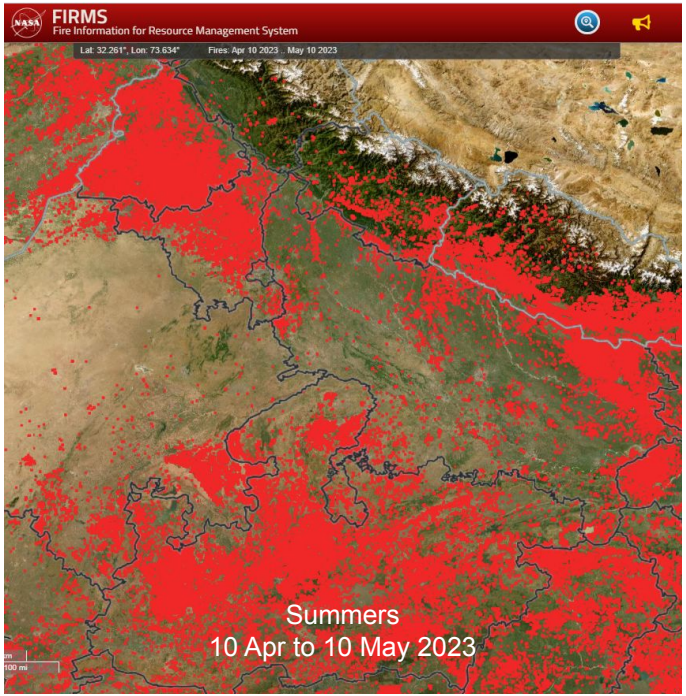
Scope and scale of stubble burning

- Winters: Rice Stubble (Parali) (Punjab & Haryana)
- Summers: Wheat Stubble (Bhoosa) (Punjab, Haryana & MP)





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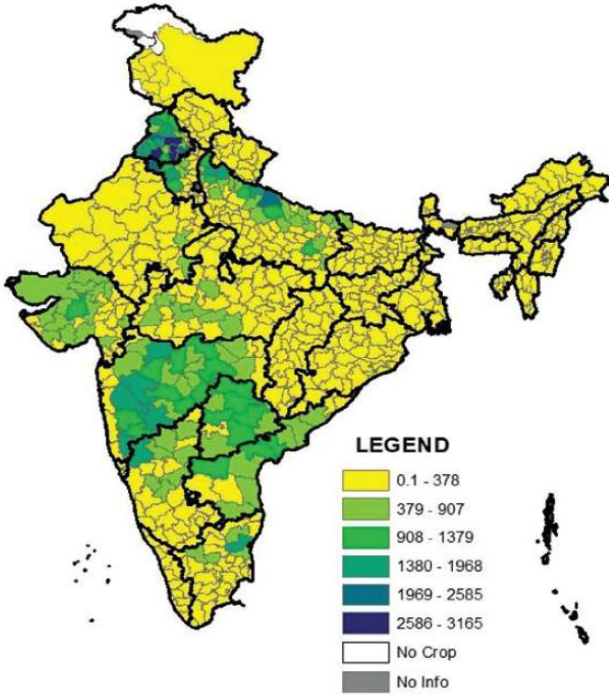
Surplus Biomass

Annual Total Surplus Biomass (Kilo Tons)



Biomass is available from multiple crops in all states
(Rice, mustard, cotton stalk, sugarcane, groundnut etc.)

Currently this Surplus Biomass is being Burned.

	Surplus Biomass (ICAR-IARI Data)
State	**Mn Tons / year**
Punjab	30.9
Haryana	10.1
UP	31.6
Rajasthan	5.4
MP	11.3
Total 5 States	**89.3**
All India	**178.7**

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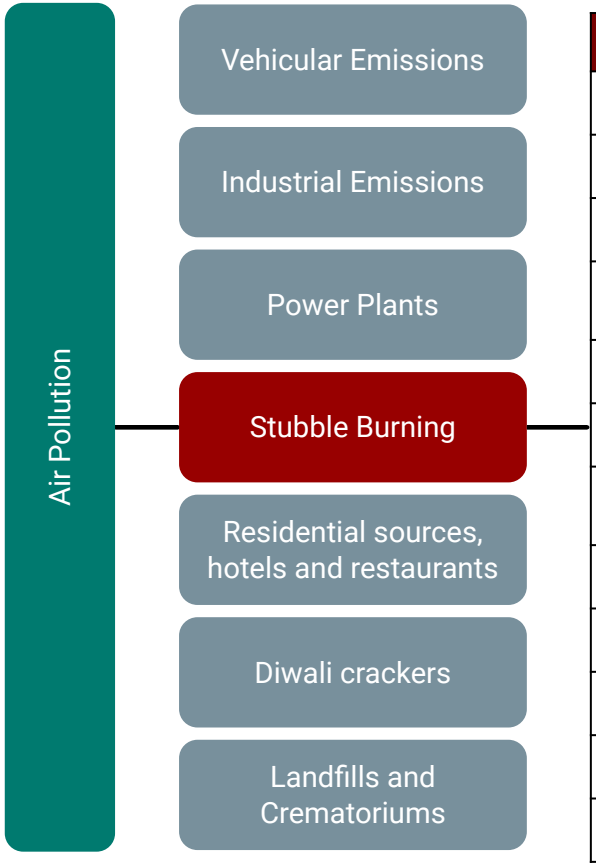
What can be done with Stubble



Product	Capital needs	Scalability	Complexity
Happy Seeder	$	Very High	Medium
Cow Fodder	$	High	Low
Compost	$	High	Low
Mulch, Mushroom and Animal Beds	$	Low	Medium
Biochar	$$	Medium	High
Pellets and Briquettes	**$$**	**High**	**Medium**
Papers/Cartons/Plates and Cutlery	$$	High	Medium
Biogas	$$$	High	Very High
Syngas	$$$	Medium	High
Particle Board	$$$	High	High
Direct Burning in IPPs	$$$$	Very High	High
Ethanol	$$$$	High	Very High

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Policies for Bio-fuels

Transformed Economic Realities

1. COP26: Biomass energy as a sustainable replacement for coal
2. 25% of India's coal is imported and expensive
3. Carbon neutrality and ESG compliance: Goal for companies and investors
4. Russia-Ukraine war: Localizes energy sourcing for countries and increases carbon credit pricing

Enabling National Mandates

1. 5%-7% biomass co-firing mandate in thermal power plants (Power Ministry)
2. CAQM mandates and monitors biomass burning in Delhi-NCR
3. Financial incentives to enable pellet plants (IT, MNRE, MSME and SBI)
4. Financial subsidy for pellet plant (MoEFCC)

Progressive State Policies

1. Punjab mandates 20% paddy straw co-firing for brick kilns
2. Punjab waives sGST for capital investment in Punjab
3. Haryana gives Rs 1000 per acre subsidy for collection and baling of hybrid-rice straw
4. Public and private power plants release long-term procurement tenders
5. CAQM imposes penalty on all farmers in 5 states upto Rs. 15,000

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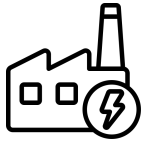
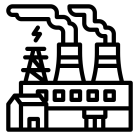
What Power Plants Need

Power Plants				
				
	Captive	Small scale	Large Scale	Carbon Credits

“Ensure that the cost of electricity generated does not increase” -
General Manager of Business development, Private power plant in Punjab

“I will happily pay the same rate of Rs/KCal, this helps me meet GoI, CAQM and GoP regulation”
DGM, Power plant in Punjab

“Ensure that it is easy to use, doesn’t generate too much waste and whatever waste is created can be utilized in some way”
Head of Ash Procurement, Private Power Plant in Punjab

“I want something similar to coal, do you have torrefied pellets?”
CEO of Thermal Power Plant in Haryana

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Biomass as a fuel source

- Different sources of biomass have different GCV, costs and availability
- Sources include Pine needles, Cashew nut shell, Coconut shell, SawDust, Groundnut Shell, Mustard Stalk, Soya stalk, Cotton stalks, Bamboo and Rice Straw
- The Gross Calorific Value (GCV) of bio-fuels compares favorably with that of domestic coal
- Biomass fuels are classified as sustainable fuel source and earn carbon credits
    - An additional source of income
    - Ensure that your plant meets its carbon requirements
    - Help transform to a green plant sooner

	Domestic Coal	**Rice Straw**	**Mustard Stalk**
GCV (kcal /kg)	3500-4000	3200	3600
Fixed Carbon %	30%	11%	14%
Volatile Material %	20%	72%	73%
Ash %	50%	18%	13%
Moisture %	10-15%	8-10%	8-10%
Sand %	2%	2%	2%
Size	10-30 mm	90 mm Logs 18 mm Pellets	90 mm Logs 18 mm Pellets
Area	Orissa, Jharkhand, Chhattisgarh etc.	Punjab, Haryana, Western Uttar Pradesh	Punjab, Rajasthan, Haryana, Western Uttar Pradesh
Usage	Boilers, furnaces, power plant and brick kilns		

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Forms of Biomass

Biomass can be used in various forms

- Loose
  - Direct burning of Bales of Biomass
  - Used in Direct Biomass IPPs, Pottery units, Ethanol / Biogas plants

- Briquettes
  - 70 to 90mm dia
  - Shredded biomass is loosely held together
  - Used in small boilers, brick kilns etc
  - Mostly manually fed

- Pellets
  - 6 to 25 mm dia
  - Shredded and hammered biomass is compressed into pellets
  - Used in large boilers where automatic systems are installed
  - Works well as size is similar to coal

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Non-Torrefied Pellets / Briquettes

- Biomass is shredded and then compressed into pellets / briquettes
- These are burned directly in boilers and power plants as coal replacement
- Power plants have to use upto 10% Pellets
- NTPC Dadri has conducted tests for upto 30% safe firing of pellets

- Binders can be used to improve physical properties
- Process optimization can reduce energy costs
- R&D improvements can enable multi-crop usage

- GCV of pellets/briquettes depends on the biomass.
- Typically from 3200-4000 KCal/kg

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Torrefied Pellets

- Torrefaction is a mild form of pyrolysis (200-320 °C) which reduces volatile material, increases carbon and increases GCV
- Improved fuel quality and resistance to water absorption
- Increased energy density and grindability
- Ball and Tube mills can accept only Torrefied pellets due to fire hazard

- GCV of these Pellets is increased by 30-50% and is above 4000 Kcal/Kg

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Process

Collect

- Collection of raw biomass from farmer
- Bale and transport to storage
- Store it in open fields

- Stakeholders are farmers and aggregators at, village, block, tehsil and sub-district level

Parali after harvest

Baling

Transport

Storage

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Process

Collect → **Convert**

- Convert biomass to pellets
- Input is raw biomass
- Shred and compress the biomass into pellets of various sizes

- Stakeholders are factory/plant operators and rural entreprenuers

Storage

Pelletization

Pellets

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Process

Collect → **Convert** → **Market**

- Market and sell pellets / briquettes
- Handle Logistics
- Provide biomass at customer schedule
- Aid in certification of carbon credits

- Stakeholders are trading platforms, logistics companies and end customers

Pellets

Transport

Boiler

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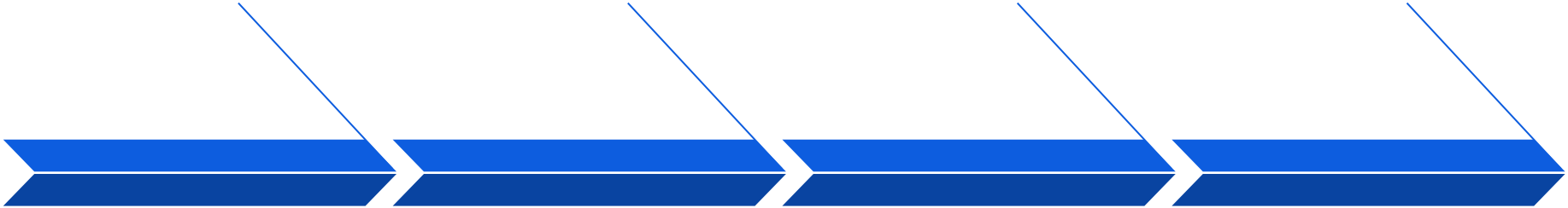
Biofuels to Energy, Sustainability and ESG Impact!



Biomass to Energy

Pellets and Briquettes as Energy for power plants

Carbon Credits

Biomass is a sustainable source of energy and can earn carbon credits

Circular Ash-handling

Better Ash-handling closes the loop on sustainability

ESG Reporting

Augment Rural incomes and make a real ESG impact

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Biofuels: Risk to Opportunity

Rice Stubble is **Biocoal**

Same Gross Calorific Value

Lower Ash content

Farms as **Decentralized Coal Mines**

25% of India's Coal is imported

Farms = Energy Mines

Bioenergy is **Green Fuel**

COP26: Biomass energy earns CO2 Credits

ESG Mandates for Corporates

India **Energy Mandates**

10% Co-Firing in Power Plants

Coal burning banned in Delhi-NCR

Waste to Value

Circular Ash Handling







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Thank you

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