Biomass Cofiring Experience and Impact

V A Surendra AGM(OS)

Punjab farm fires send smog signal to Delhi; hope in panchayat action

The Punjab Remote Sensing Centre at Punjab Agricultural University, Ludhiana, which tracks s
images of stubble-burning, has recorded the most farm fires in four years this season.

Written by Anju Agnihotri Chaba | Jalandhar |
Updated: October 19, 2020 10:24:04 am

Stubble burning: Why it continues to smother north India

30 November 2020

Delhi: Crores allocated, but winter smog from stubble burning likely this year too

September 16, 2020 Asha Ramachandran

Delhi air pollution set to spike again as stubble burning begins and economy reopens

Experts say Covid-19 lockdown has reduced pollutants before stubble burning, so AQI is likely to be lower than last year. But a sharp spike is still expected.

MOHANA BASU 29 September, 2020 8:00 am IST

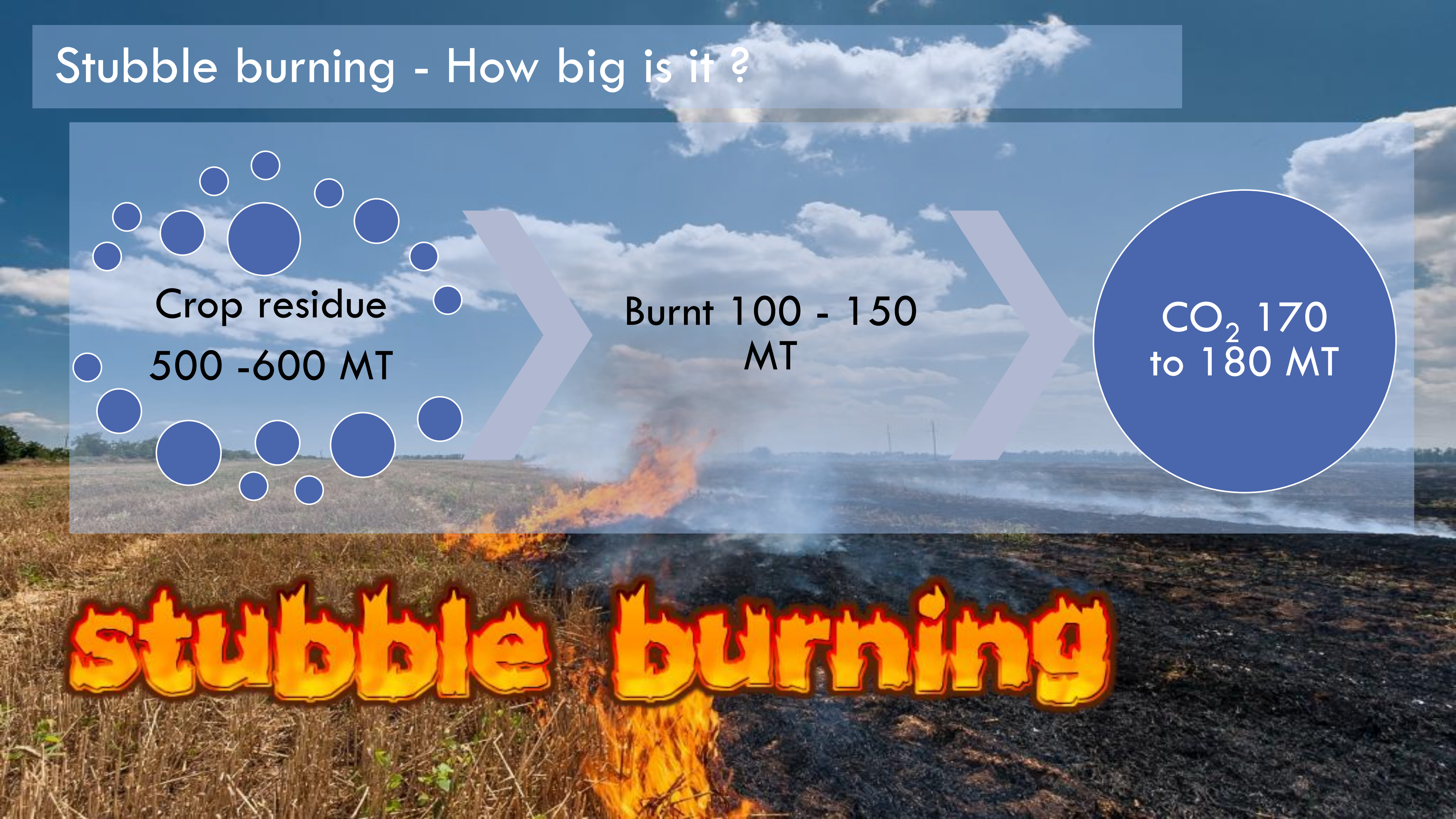
A Delhi Metro train running through the smog in November 2019 | File photo: Suraj Singh Bisht | ThePrint

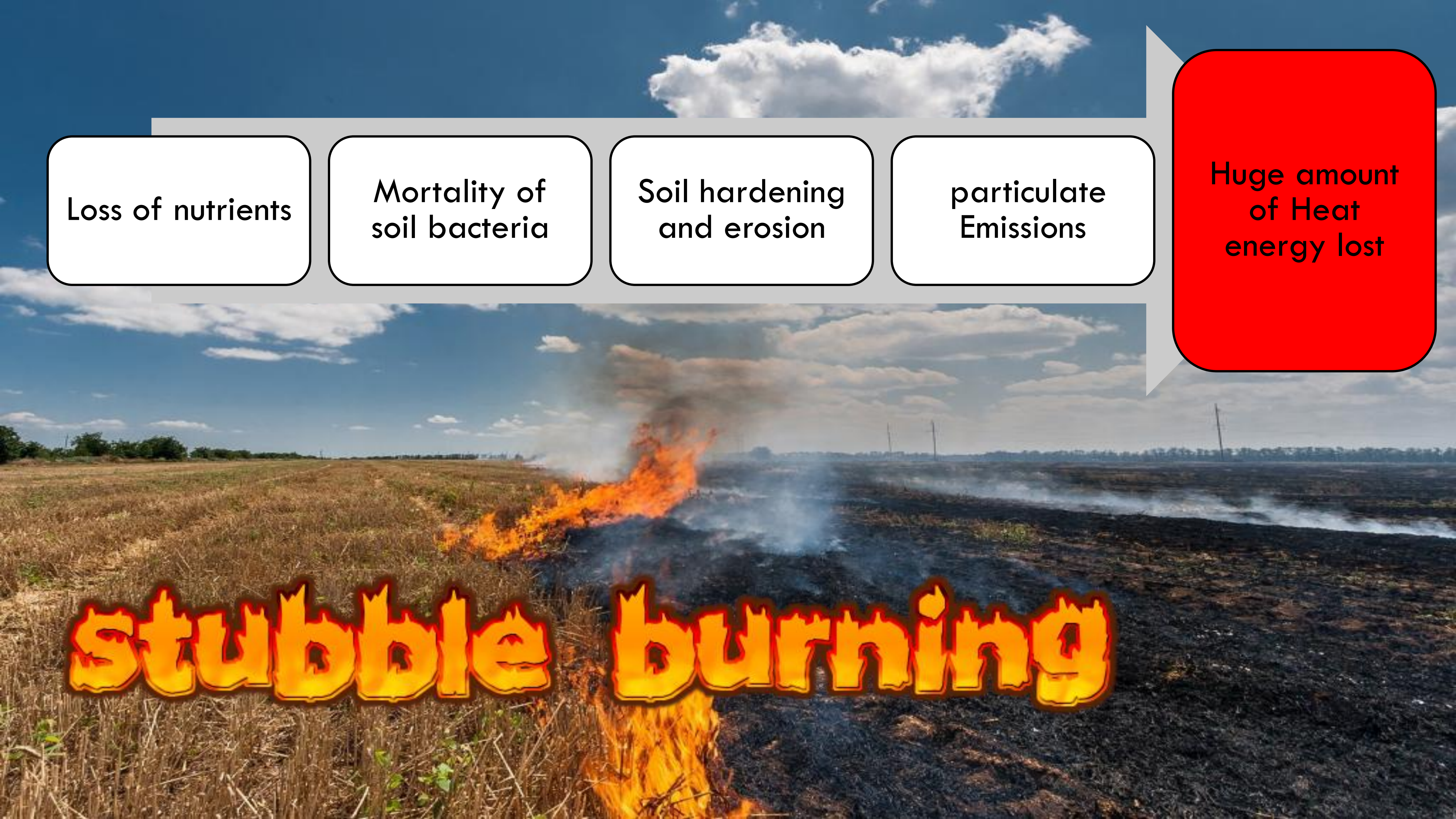
Text Size: A- A+

New Delhi: The approaching winter signals the annual return of the dreaded pollution and smog in Delhi — largely attributed to Punjab and Haryana farmers burning paddy stubble in their fields. But this time around, the resumption of economic activity after the Covid-induced

Beatiful farming
to
stubble burning

Stubble burning is a harmful practice that needs to be phased out. Transitioning to sustainable alternatives is crucial for protecting the environment, improving human health, and ensuring a sustainable future.


Stubble burning - How big is it ?
Crop residue
500 -600 MT
Burnt 100 - 150
MT
CO_2 170
to 180 MT
stubble burning



Loss of nutrients
Mortality of soil bacteria
Soil hardening and erosion
particulate Emissions
Huge amount of Heat energy lost
stubble burning

Alternatives to Stubble Burning

Farmers have several sustainable options for managing stubble, reducing environmental impact, and improving soil health.

Biomass Utilization

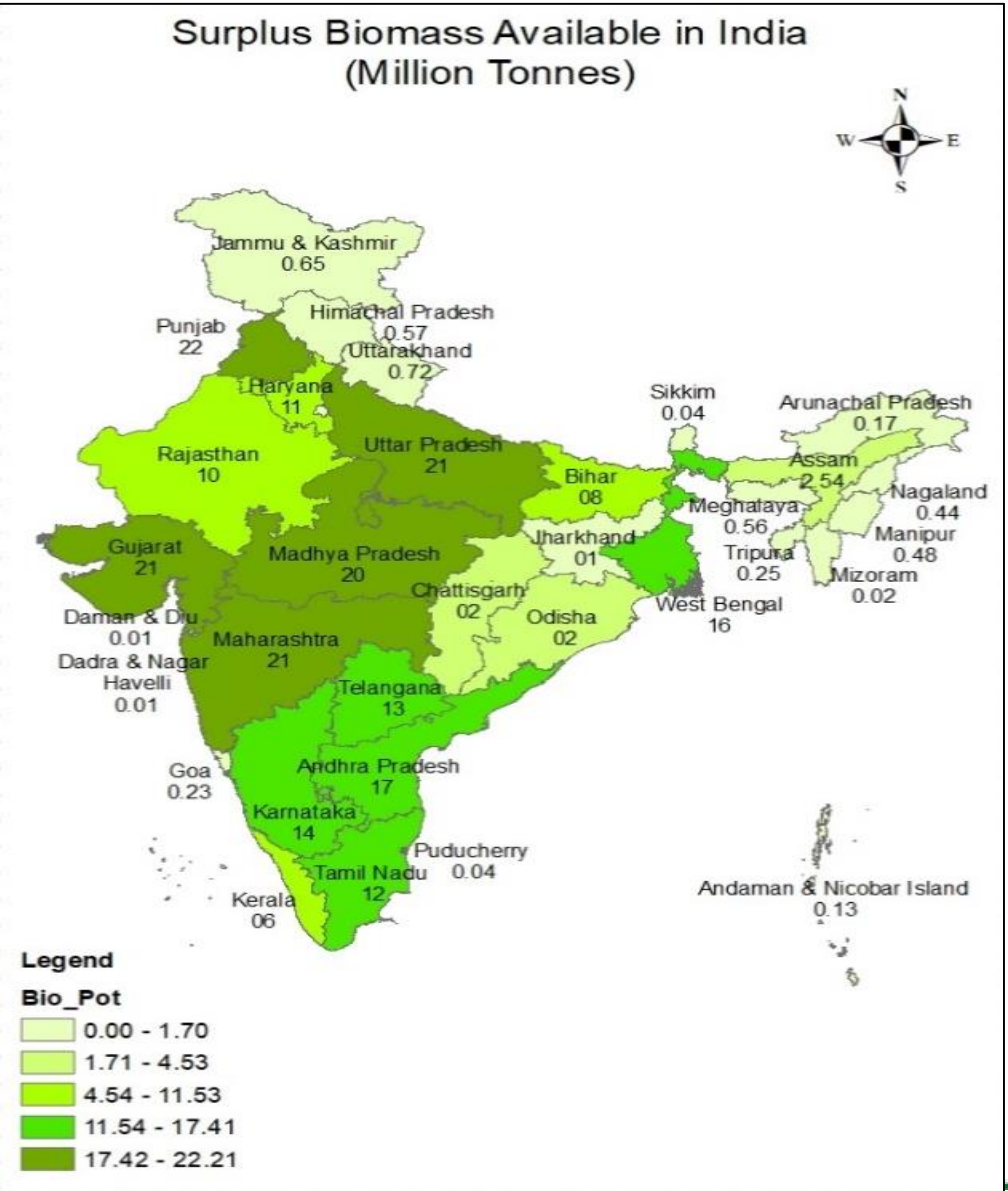
Stubble can be used as biomass for generating electricity or producing biofuel, creating a valuable resource from a waste product.

Farm fire as source of pollution

Uttar Pradesh, Punjab and Haryana—contributed around 60 per cent of the crop burning

When 1 ton of crop residue is burnt on the field, it releases approximately 1,400 kg of CO_2, 58 kg of CO, 11 kg of particulate matter (PM), 4.9 kg of NO_x and 1.2 kg of SO_2

Agro biomass available in India

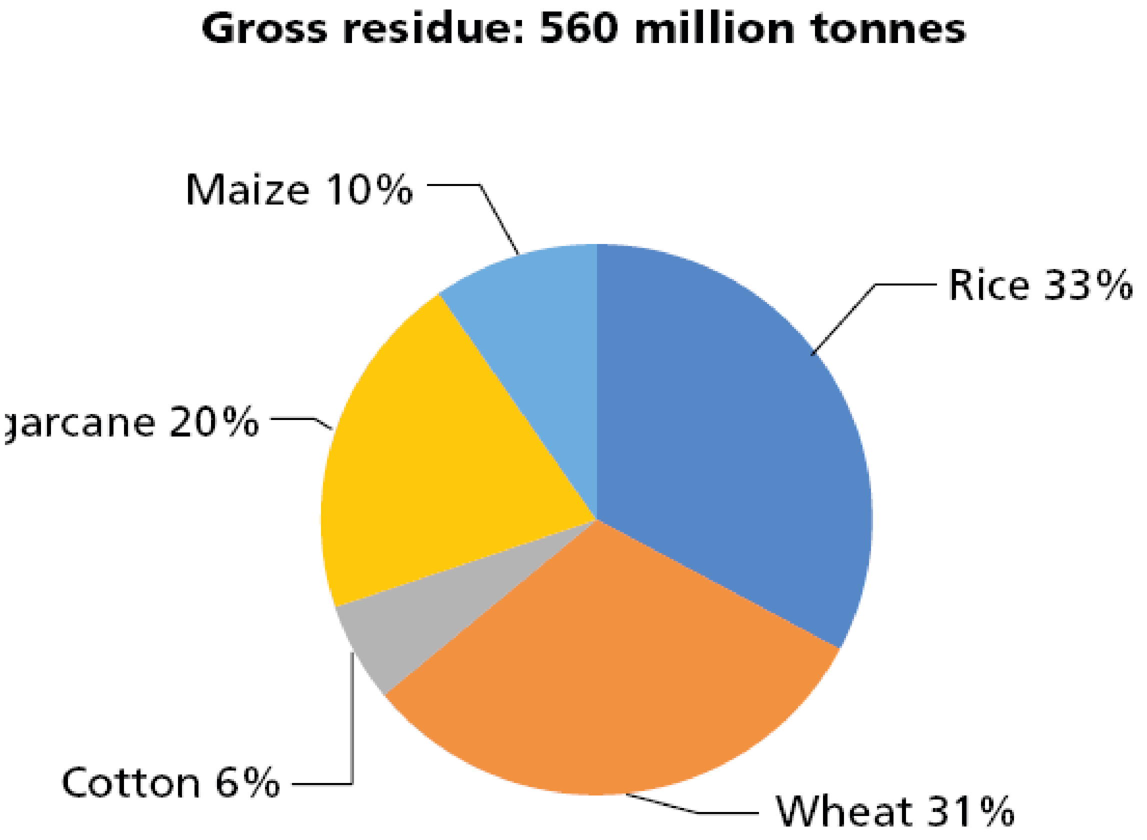


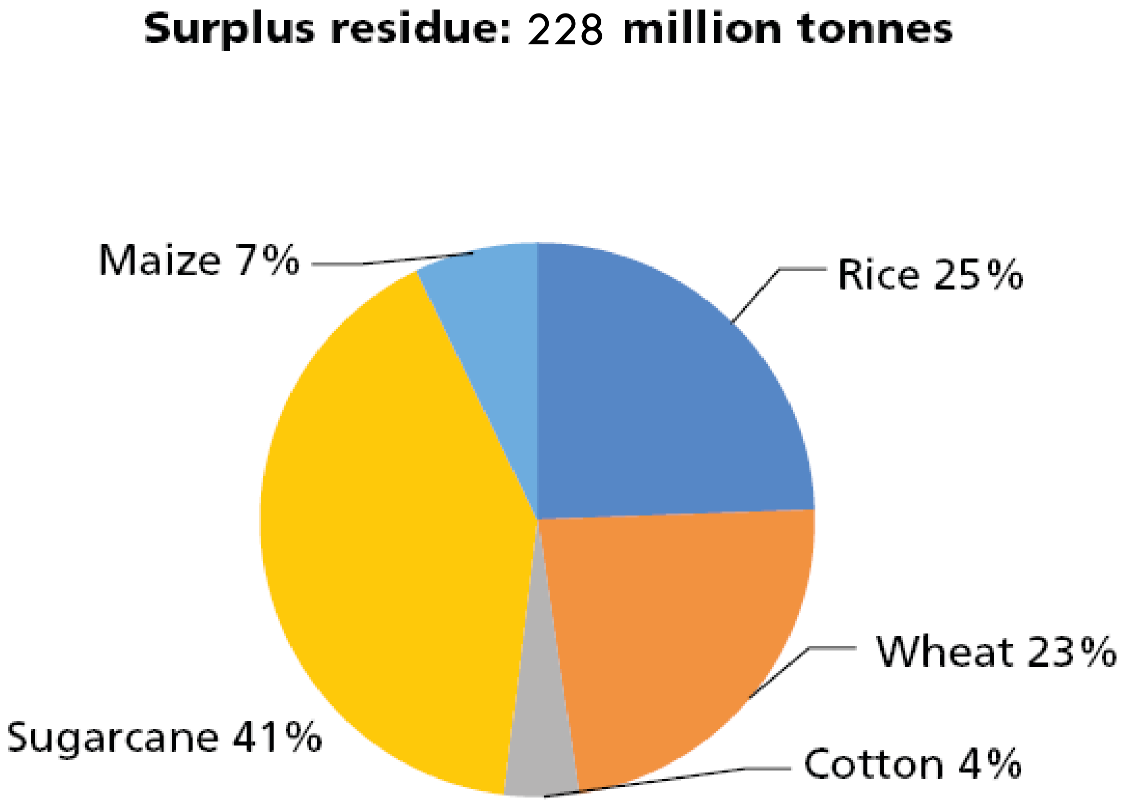
Rank	State	Surplus biomass (1000 MT)	State Land Area (km2)	Biomass Density MT/km2
1	Punjab	22251	50,362	441.82
2	Haryana	10907.5	44,212	246.71
3	West Bengal	16277.3	88,752	183.40
4	Kerala	6042.1	38,863	155.47
5	Telangana	13761.6	1,12,077	122.79
6	Gujarat	21740.3	1,96,024	110.91
7	Andhra Pradesh	17093	1,60,205	106.69
8	Tamil Nadu	12217.4	1,30,058	93.94
9	Uttar Pradesh	21600.7	2,40,928	89.66
10	Bihar	7983.9	94,163	84.79
11	Karnataka	14048.5	1,91,791	73.25
12	Maharashtra	21493.8	3,07,713	69.85
13	Madhya Pradesh	19928.3	3,08,252	64.65
14	Assam	2541	78,438	32.40
15	Rajasthan	10211	3,42,239	29.84
16	Chhattisgarh	2651.8	1,35,191	19.62
17	Jharkhand	1201.8	79,714	15.08
18	Odisha	2227.6	1,55,707	14.31

Major type of Agro biomass available in India

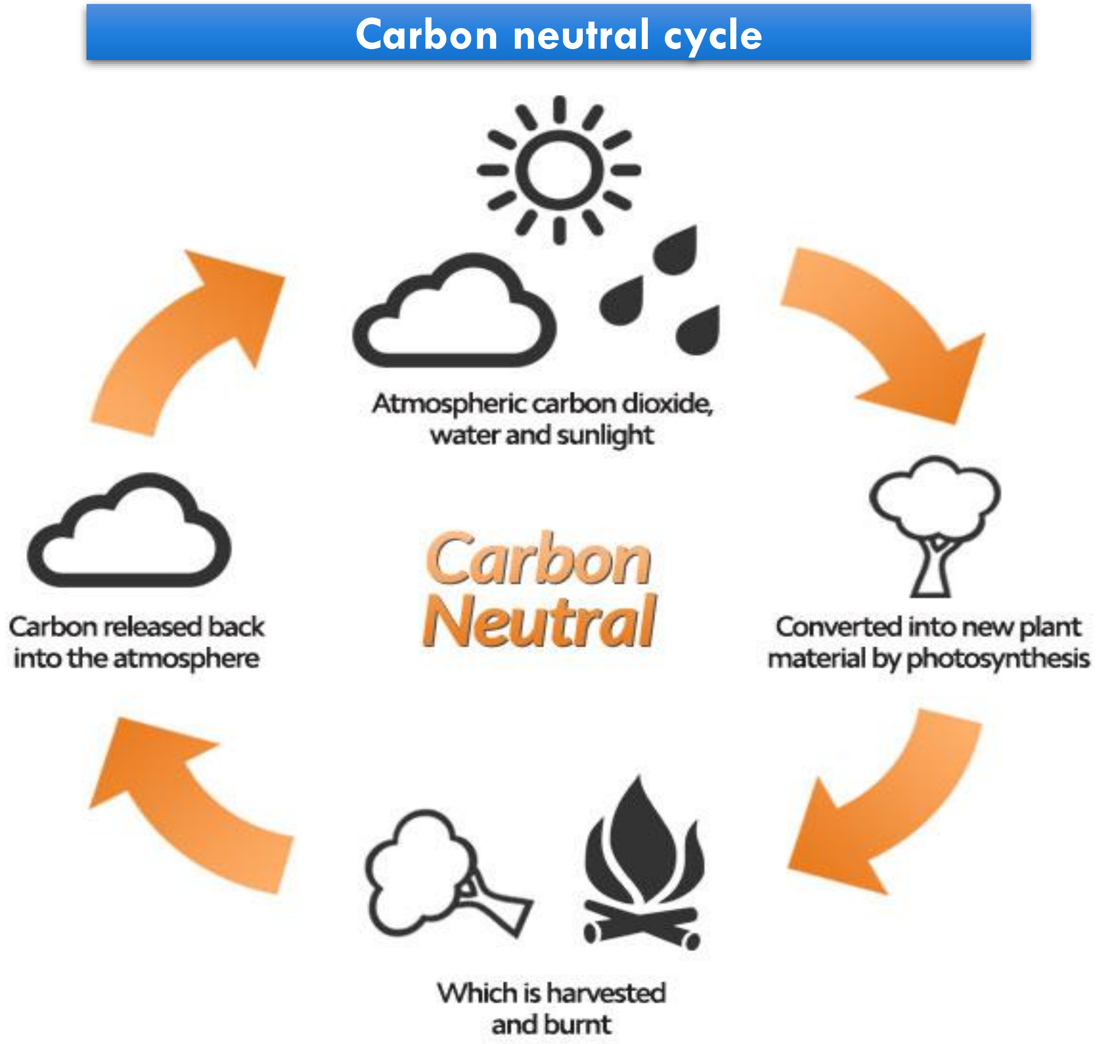
States	Major Surplus agricultural residue	Total 1000 MT
Punjab	**Rice-18921,** Wheat- 3092, Sugarcane- 91.55, Maize- 202, Musturd-40	22251.0
Gujarat	**Cotton- 10749**, Castor- 3740, Potato- 1776, Banana-1370, Wheat-980, Arhar-671, Bajara-460, Groundnut- 344, mustard-327, rice-111, tobacco-454, urad-55, moth-81	21740.3
Uttar Pradesh	**Wheat-12038,** sugarcane-2211, Potato-1475, Rice-1035, Musturd-875, Arhar-778, Bajra-465, Masoor-434, Gram-212, Urad-344, Peas-126, Jowar-95, Banana-123,	21600.7
Maharashtra	**Cotton-17040,** Jowar-981, Soyabean-836, Sugarcane-858, Wheat-609, Gram-349, Bajra-300, Groundnut-108, small millet-78, Urad-47, Sunflower-41, Sesamum-43	21493.8
Madhya Pradesh	**Wheat-6311,** Maize-2152, Cotton-2105, Rice-1940, Soyabean-1409, Arhar-909, Banana-996, Gram-746, Masoor-759, Musturd-584, Potato-559, Urad-315,Bajra-250	19928.3
Andhra Pradesh	**Oilseed- 5225,** Maize-2390, Cotton-2327, Rice-2571, Banana-1520, Sugarcane-394, Coconut-506, Urad-218, Dry Chillies-860, Arhar-195, Cashewnut-111, Urad-218	17093
West Bengal	**Potato-10240,** Rice-1225, Maize-756, Mustard-616, Wheat-270, Coconut-159, Sesamum-223, Masoor-101, groundnut-88, Urad-37	16277.3
Karnataka	**Arecanut-2752,** Coconut-1912, Cotton-1594, Arhar-1500, Maize-1876, Sugarcane-1524, Rice-750, Jowar-456, Dry Chilies-222, Groundnut-222, Ragi-140	14048.5
Telangana	**Cotton-8322,** Maize-2350, Rice-1368, Arhar-202, Dry Chilies-629, Oileseed-175, Groundnut-103, Castor-82, Banana-76,	13761.6
Tamil Nadu	**Coconut-2235,** Banana-2130, Maize-2124, Tapicoa-1507, Rice-228, Arhar-178	12217.4
Haryana	**Rice- 3002,** Cotton-2464, Oilseed-1573, Wheat-2002, Musturd-760, Bajara-383	10907.5
Rajasthan	**Wheat-4121,** Bajra-1709, Cotton-1521, Castor-377, Guar seed-502, Jowar-159, Moong-379, Oilseed-115, Rice-108, Potato-101, Coriandar-124	10211
Bihar	**Wheat-2019,** Potato-1686, Rice-1106, Maize-1860, Masoor-233, Sugarcane-570	7983.9
Kerala	**Coconut-3393,** Tapioca-1676, Arecanut-363, Banana-350, Rice-175, Cashew-60	6042.1
Chhattisgarh	**Rice-2189,** Maize-86, Kherari-74, Arahar-68, Wheat-53, Urad-19, Musturd-20	2651.8
Assam	**Rice-650,** Banana-583, Potato-380, Jute-240, Arecanut-231, Coconut-88	2541
Odisha	**Rice-2007,** Maize-66, Moong-64	2227.6
Other 16 states	**Misc.**	5533
Total		**228517**

Crop Wise Residue Generation





Biomass pellets : A carbon neutral fuel



Activity	Fuel consumption	CO_2 emission per unit	Total CO_2 emission (kg)
Diesel consumption in collection and storage	3 liter/ton	2.86 kg/liter	8
Electricity consumption for pelletization	25-40 unit/ton	1.68 kg/unit	42-67.5
Diesel Consumption in transport of pellets up to 150-300 KM	5-10 liter/ ton	2.86 kg/liter	13.4-26.8
Total			**63-102**
Co2 emission reduction from per ton of Biomass Co-firing	**1 ton of pellet**	**1283 kg/ton**	**1283**
Net Co2 emission reduction per ton			**1181**

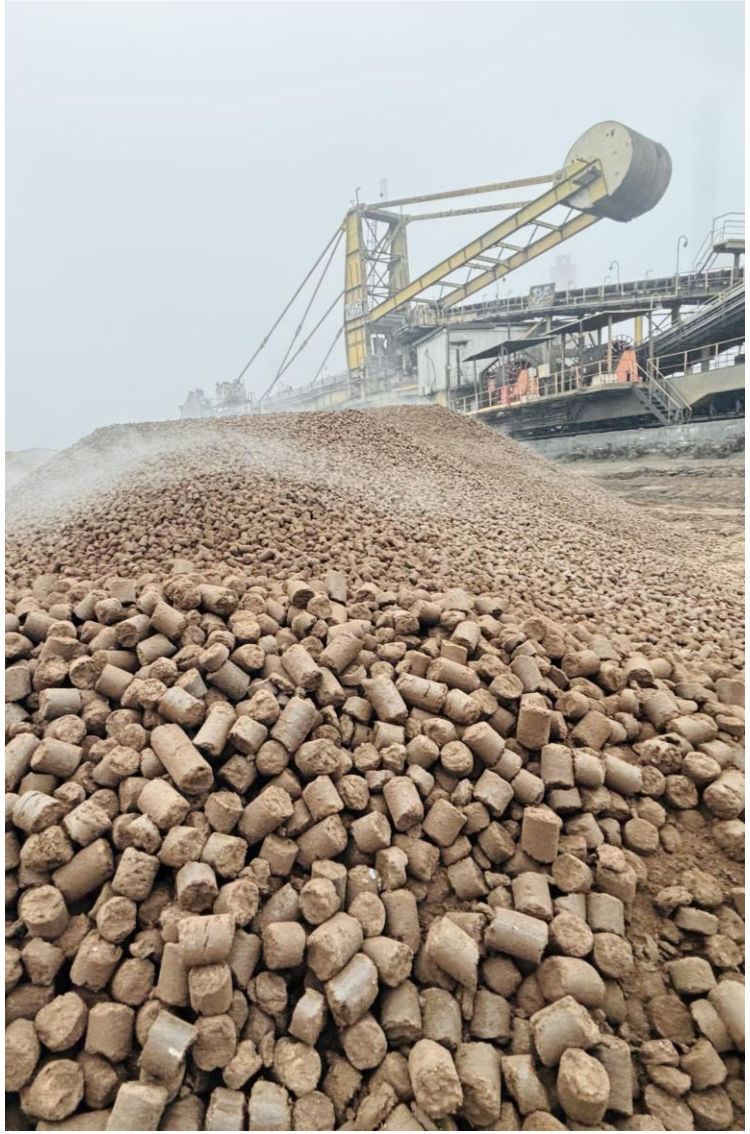
Potential and Current status

According to the Ministry of New and Renewable Energy, India's total biomass potential is estimated to be about 18,000 MW, with the potential for generating 146,500 million units of electricity per year.

Agricultural waste, such as rice husk, wheat straw, and sugarcane bagasse, is the largest source of biomass in India. It is estimated that about 754 million tons of agricultural biomass is generated in the country annually out of which surplus 228 million tons of surplus biomass is wasting, which have the energy potential of 28445 Mwe and can be used for energy production. Similarly, forest residues, such as tree branches and leaves, can also be used as biomass.

Total Biomass usage in the year 2023 has crossed 2.08 LMT (lakh metric tonnes). Cumulative biomass usage till the year 2023 has crossed 3 LMT. In the year 2023, orders for 31.50 LMT Biomass pellets have been placed. Tendering of ~ 38 LMT of Biomass pellets is under different stages.

NTPC being the front runner in biomass cofiring in thermal plants, NTPC Fired nearly 70% of total biomass fired in country.



Biomass Firing

- Commission for Air Quality Management in NCR and Adjoning Areas issued notification on 11th July 2023 for Biomass Co-Firing

Percentage of Crop residue pellets used	Rate of environment compensation for Rs/KWh	
	FY 2024-25	FY 2025-26
≥4% and <5%	0.00	0.01
≥3% and <4%	0.00	0.02
≥2% and <3%	0.01	0.03
≥1% and <2%	0.02	0.04
≥0% and <1%	0.03	0.05

Coal v/s Paddy Straw

Parameter	Coal	Paddy straw
Carbon content	34-35%	10-15%
Volatile content	20-21%	60-66%
Ash content	38%	15%
Moisture	6%	8%
GCV	3500 Kcal/Kg	3650 Kcal/kg
Alkali content (K, Na)	-	6-8%
Chlorine content	0.05-0.08%	0.8-1.5%
Density	833 kg/m3	700 Kg/m3
Ignition temperature	454 C	240 C
Grind ability index	70-80	Fibrous
Particle type	Brittle	
Ash Fusion Temp.	1150 C	850-900 C
Ash resistivity	moderate	High

Paddy Straw Analysis

Analysis on as received basis

S.No	Test Parameters	Observed Results	Test Method
1	**Proximate analysis**		
	Total moisture, % by mass	5.62	IS: 1350 (P-1) 1984
	Ash content, % by mass	18.90	IS: 1350 (P-1) 1984
	Volatile matter, % by mass	65.95	IS: 1350 (P-1) 1984
	Fixed Carbon, % by mass	9.53	IS: 1350 (P-1) 1984
2	Gross calorific value, k.cals/kg	3855	IS: 1350 (P-2) 1970
3	Net calorific value, k.cals/kg	3601	IS: 1350 (P-2) 1970
4	Bulk density, kg/m³	1018	By dimension
5	Ignition temperature, ºC	240	ASTM E1491
6	Chlorine, % by mass	0.61	ASTM D4208-13
7	**Ultimate analysis**		
	Carbon, %	42.08	IS: 1350 (P-4/sec 1) 1974
	Hydrogen, %	4.79	IS: 1350 (P-4/sec 1) 1974
	Nitrogen, %	0.65	IS: 1350 (P-4/sec 2) 1999
	Sulphur, %	0.02	IS: 1350 (P-3) 1969
	Ash, %	18.90	IS: 1350 (P-1) 1984
	Moisture, %	5.62	IS: 1350 (P-1) 1984
	Oxygen, %	27.94	By difference

Contd...

Coal v/s Paddy Straw Ash analysis

Coal Ash Analysis

3.0	**Ash Analysis**		
3.1	Silica (SiO2) (%)	32.74	34.94
3.2	Alumina(Al2O3) (%)	30.5	28.43
3.3	Iron Oxides(Fe2O3) (%)	18.2	15.2
3.4	Titania (TiO2)	1.56	1.76
3.5	Phosphoric Anhydride(P2O5) (%)	0.44	0.54
3.6	Lime (CaO) (%)	6.12	7.62
3.7	Magnesia (MgO) (%)	1.83	1.93
3.8	Sulphuric Anhydride (%)	6.95	7.65
3.9	Sodium Oxide (Na2O) (%)	0.3	0.4
3.10	Balance alkalies (by difference)	1.36	1.56
	Total	100	100
4.0	**Ash Fusion Temperature**		
	reducing temperature		
4.1	Initial deformation Temp (ºC)	1100	1250
4.2	Hemispherical Temp. (ºC)	1300	1350
4.3	Flow Temp. (ºC)	1400	1400

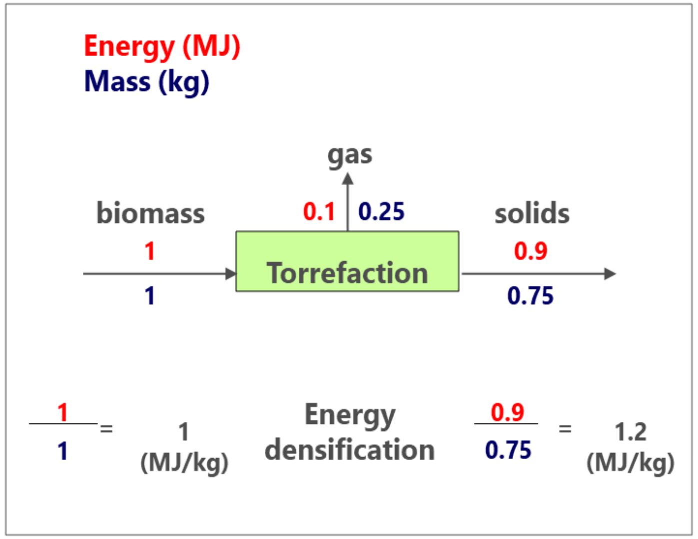
Biomass ash is characterised by a low melting temperature and a high tendency to slagging and fouling.

Paddy Straw Ash Analysis

S.No.	Test Parameters	Observed results	Test Method
1	**Chemical composition of ash**		IS: 1355-1984/XRF
	Silica (as SiO_2), % by mass	56.41	
	Alumina (as Al_2O_3), % by mass	1.94	
	Iron Oxide (as Fe_2O_3), % by mass	2.05	
	Calcium Oxide (as CaO), % by mass	5.68	
	Magnesium Oxide (as MgO), % by mass	5.28	
	Sodium Oxide (as Na_2O), % by mass	0.11	
	Potassium Oxide (as K_2O), % by mass	16.58	
	Sulphate (as SO_3), by mass	2.42	
	Chloride (as Cl), % by mass	6.73	
	Zinc Oxide (as ZnO), % by mass	0.07	
	Manganese Oxide (as MnO), % by mass	0.59	
	Phosphate (as P_2O_5), % by mass	2.04	
2	**Ash fusion profile (Oxidizing medium)** Initial deformation temperature Softening temperature Hemispherical temperature Fusion temperature	 1111 1164 1184 1208	ASTM D1857-16
3	**Ash fusion profile (Reducing medium)** Initial deformation temperature Softening temperature Hemispherical temperature Fusion temperature	 1074 1022 1051 1074	ASTM D1857-16

What is torrefaction?

Torrefaction of biomass ...



... makes coal-like fuel

- Higher caloric value
- Excellent grindability
- High bulk density
- Hydrophobic nature
- No biological activity

Biomass is heated to between 250 and 320°C in a low oxygen atmosphere which results in the thermal break-down of the hemi-cellulose

- During the torrefaction process, solid biomass is heated in the absence of or drastically reduced oxygen to a temperature of approx. 250-320°C, leading to a loss of moisture and partial loss of the volatile matter in the biomass.
- With the partial removal of the volatile matter (about 20%), the characteristics of the original biomass are drastically changed. The tenacious fiber structure of the original biomass material is largely destroyed through the breakdown of hemicellulose and to a lesser degree of cellulose molecules, so that the material becomes brittle and easy to grind.
- The material then changes from being hydrophilic to becoming hydrophobic.
- With the removal of the light volatile fraction that contains most of the oxygen in the biomass, the heating value of the remaining material gradually increases by 10%-20% torrefied biomass pellet and eventually by 50-60% in the case of complete devolatization resulting in charcoal.

Non-torrefied v/s Torrefied Biomass Pellet

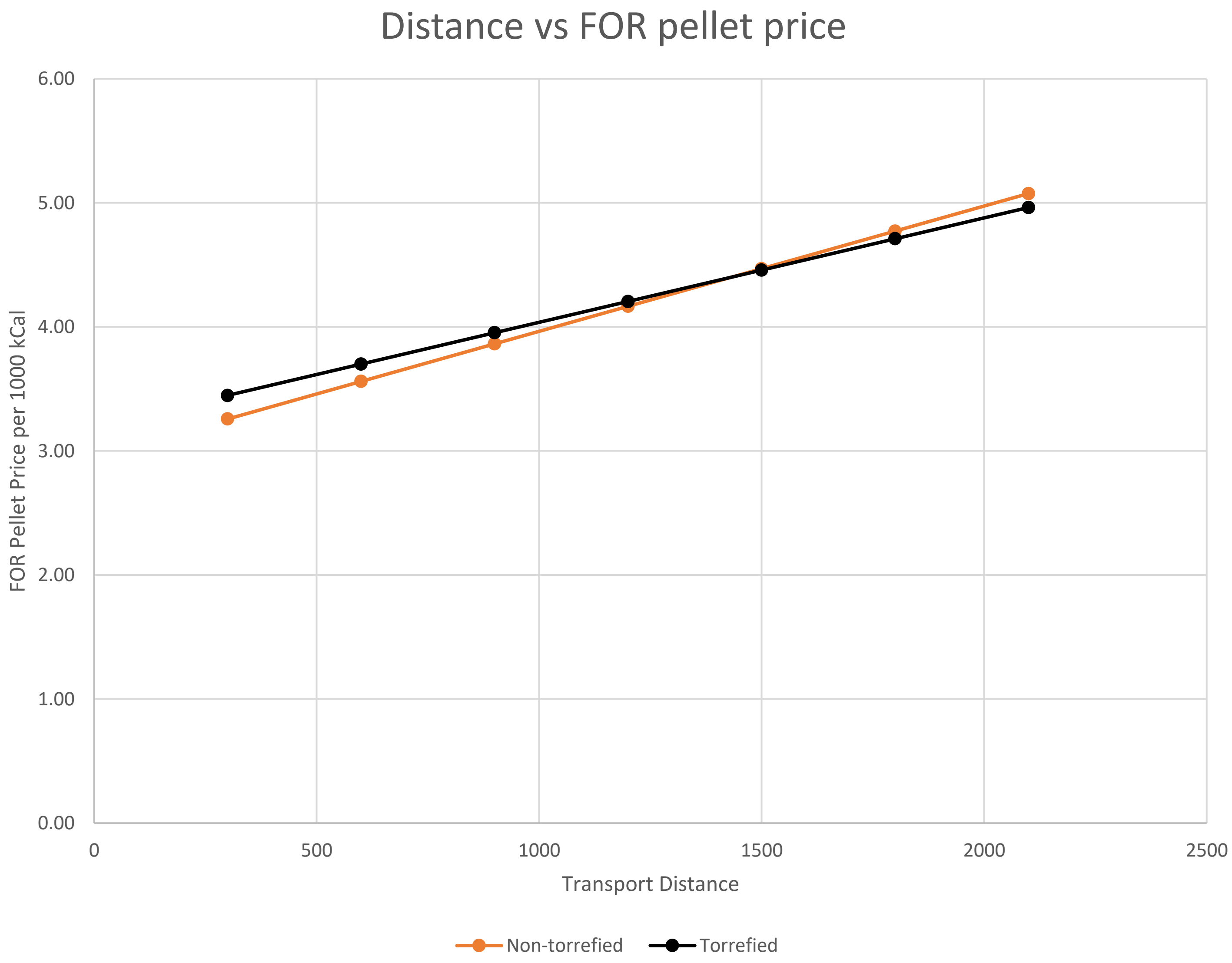
एनटीपीसी NTPC

Biomass Type	Non-Torrefied Pellet	Torrefied
Advantage	• **Lower Cost:** Technology to produce non-torrefied biomass pellet is cheaper and yield remains almost same as quantity of input raw material leading to lower cost. • **More energy efficient:** Less energy is consumed in manufacturing of non-torrefied pellet. • **Simpler manufacturing technology-** Manufacturing technology is simple. • **Wide Availability-** It is generally available widely.	• **Higher Energy Density**: More efficient for transport and storage and provides better combustion performance. • **Improved Grindability**: Comparable to coal, making it suitable for co-firing in existing coal power plants. • **Hydrophobic Nature**: Resist's moisture absorption, reducing the risk of degradation and spoilage during storage. • **Safe co-milling at higher ratio without any modification:** Lower volatile matter content leads to safe co-milling at higher blend ratio without any modification. Hence, no capex investment needed to achieve higher co-firing ratio.
Disadvantages	• **Lower Energy Density**: More transport cost per ton of biomass pellet. • **Poor Grindability**: Difficult to pulverize, limiting its use in existing coal-fired power plants up to 10 wt.%. • **Hydrophilic Nature**: Prone to degradation and microbial growth, leading to quality deterioration over time. • **Additional Capex Investment to achieve higher co-firing ratio:** To achieve higher co-firing ratio beyond 10 wt.%, additional capex is needed.	• **Higher Production Cost**: Requires additional processing steps, increasing the overall cost. • **Technology Requirement**: Needs specialized equipment for torrefaction, which can be a barrier for small-scale producers. • **Less energy efficient:** More energy is consumed in manufacturing of torrefied biomass pellet which make it less energy efficient.

Why torrefied Biomass Pellets ?

Torrefied biomass pellets production is costlier than that of non-torrefied biomass pellets due to high machinery cost and lesser yield. Despite this, it makes a good business case in following conditions-

- When raw material is abundantly available at low cost.
- When it is difficult to chip, pulverize, pelletize the raw material due to high silica content leading to high rate of wear and tear. Such raw material is MSW and paddy straw.
- When plants are located far away from the raw material availability zone leading to higher transport cost. In that case, it would be more economical to use torrefied biomass pellet at higher co-firing ratio in plants located in nearby regions.
- Loss due to heat rate and APC during co-firing is almost half than that of non-torrefied pellet if blend ratio is kept 20%.



Benefits of Biomass Co-firing

CEA's notification on co-firing 5–10 percent biomass can potentially replace 50–100 million tonnes of coal by 2030. It will be equivalent to a 90–180 million reduction in CO_2 emissions. Biomass co-firing has been accepted as the most economical method to reduce carbon footprints of coal power plants

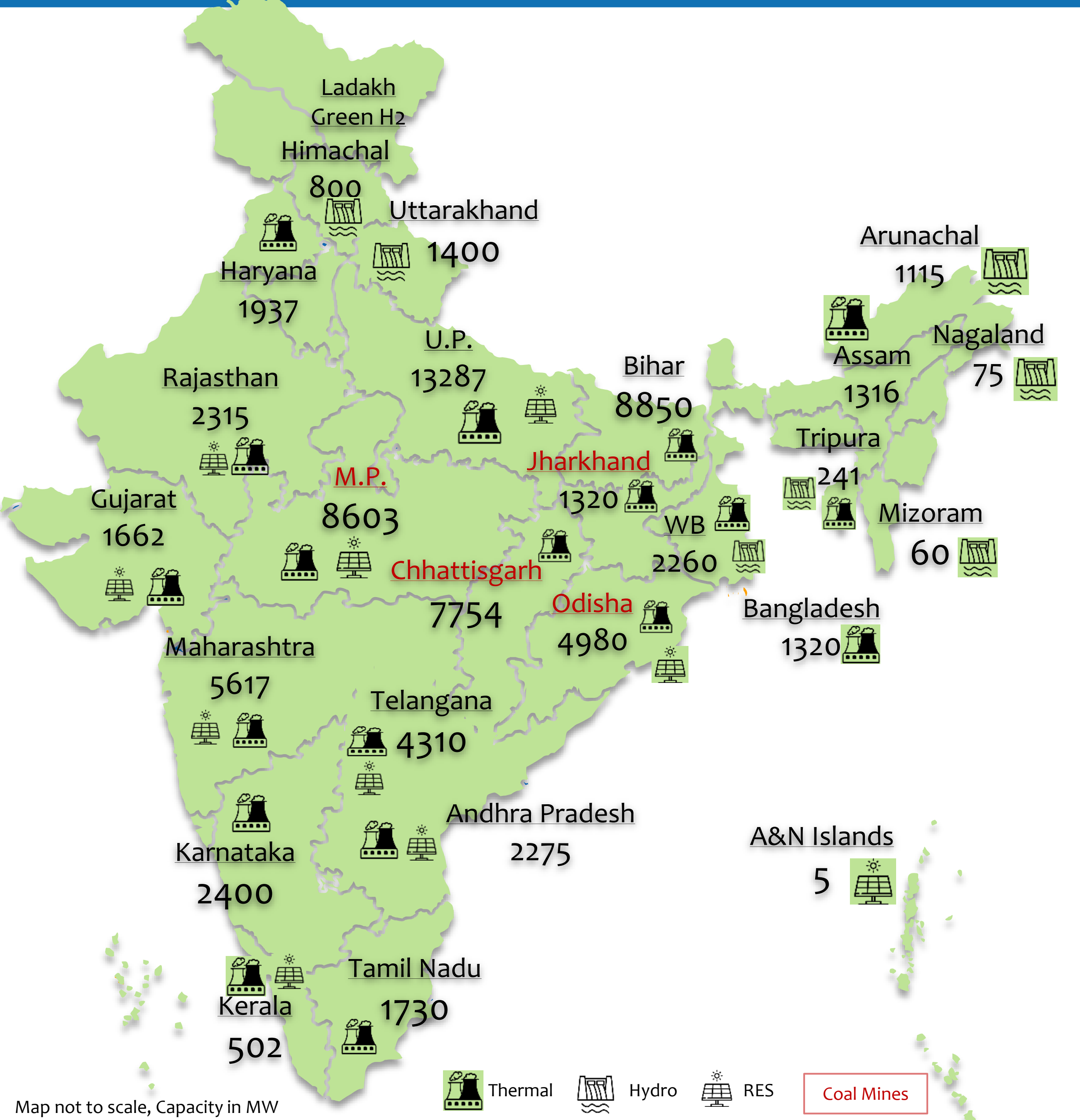
- Win-Win situation for farmers and environment.
- New source of income for farmers and employment generation
- Neutralizing carbon footprint by Biomass co-firing.
- Reduction in Sox and Nox Generation.

Impact of Biomass composition in co-firing

- Substantial proportion of volatile matter in the biomass fuel can be a positive factor in improvement of ignition of the dust-air cloud and flame stability
- Some volatile matter enhances the fire-explosion risk in the pre-processing system
- Biomass has less ash and sulfur than coal but higher moisture, Chlorine, alkali and alkaline earth metals
- High chlorine content may lead to Chlorine corrosion issues
- Sodium and potassium may react with SO_2 or SO_3 in the gas to form the alkali sulfates, K_2SO_4 and Na_2SO_4, which can condense and deposit
- The vaporization and subsequent chemical reactions are responsible for much of the fouling, corrosion, and silicate formation found in boilers.
- Addition of these alkalis tends to lower the fusion temperatures of the solids, making them more liquidus and able to stick to waterwall surfaces.

NTPC experience in Biomass Pellet Firing

Energizing India's Growth …………….with Pan India Presence

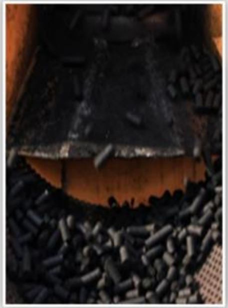


Map not to scale, Capacity in MW

Fuel Mix	Stations	Installed Capacity (MW)	% Share
Owned by NTPC			
Coal	27	53,850	70.7%
Gas/ Liquid Fuel	7	4,017	5.3%
Hydro	1	800	1.1%
Solar/ Wind/ Smal Hydro	17	501	0.7%
Sub-total	**52**	**59,168**	**77.7%**
Owned by JVs and Subsidiaries of NTPC			
Coal	9	8344	11.0%
Gas/ Liquid Fuel	4	2,494	3.3%
Hydro	8	2,925	3.8%
Solar/Wind/ Small Hydro	21	3203	4.2%
Sub-total	**42**	**16, 966**	**22.2%**
Total	**94**	**76,134**	

Data source : Installed Capacity | NTPC Limited

Key Initiatives



MSW to Charcoal

600 TPD Harit Koyla Plant at Varanasi

Bhopal (400 TPD), GB Nagar (900 TPD), Hubli-Dharwad (200 TPD)

Farm to Fuel: Biomass Pellets

~1.17 LMT biomass co-fired with coal

Orders placed for 4.5 MMT quantity

Setting up biomass pellet plants

Bamboo based Biorefinery

MoU with Chempolis to explore the feasibility of setting up a Bamboo based Bio-Refinery in Bongaigaon

Biomass Cofiring status in NTPC

- No of stations where biomass fired 14
- Quantity of biomass fired till now 464000
- in FY 24-25 alone > 200000 tons

Biomass Cofiring status in NTPC

FY	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Station	Received Qty (MT)	Received Qty (MT)	Received Qty (MT)	Received Qty (MT)	Received Qty (MT)	Received Qty (MT)	Received Qty (MT)
Dadri	3,903	9,733	6,382	574	36,596	1,04,492	1,61,680
Farakka			77				77
Gadarwara			343	1,936	6,804		9,083
Jhajjar			263	8,451	96,536	85,263	1,90,513
Kahalgaon			4	6			10
Khargone			4,197	4,403	20,586	7,590	36,777
Kudgi		904	1,009				1,913
Lara			374	138			512
Mouda		7,738	13,317	2,578	4,981	7,613	36,226
Simhadri		137	3,950	480			4,566
Sipat			206	3,646			3,852
Solapur		977	2,083				3,060
Tanda		177	2,138	1,490	197	2,791	6,793
Unchahar		4,723	4,609	154			9,486
Total	3,903	24,389	38,953	23,856	1,65,700	2,07,748	4,64,549

Biomass co-firing Initiatives in NTPC

- In NTPC Direct Co-combustion philosophy is used for Co-firing
- NCTPS Dadri first started using biomass pellets as co firing along with coal.
- Monitoring of boiler performance during biomass cofiring
- Based on the experience in NCTPS dadri, we have further identified 14 stations for biomass co – firing
- Station identified for pellet firing – 14 nos
  - **Dadri**, Farakka, Gadarwara, Jhajjar, Kahalgaon, Khargone, Kudgi, Lara, Mouda, Simhadri, Sipat, Solapur, Tanda, Unchahar
  - All stations successfully completed
- Torrefied pellets firing with 20% blending in one station – Tanda stage I completed
- Non torrefied pellet firing in NCR zone is being done regularly as per receipt
- MSW cofirng at Tanda station upto 10% successfully done at Tanda
- Sludge pellets from Delhi jal board trial firing done at Dadri

Biomass Firing in NTPC Units

- OGN on “Operating Guidelines for Biomass Pellet co-firing in PF Boilers” revised on . 01 Dec.23
- Areas covered in OGN
  - Types and Properties of biomass pellets
  - Handling, storage and blending of pellets
  - Monitoring of chemistry parameters
  - Impact of biomass firing on combustion
  - Unit Operational issues while handling pellets
  - Actions to be taken in a milling system having fire during Biomass firing
  - Combustion issues in pellet firing
  - Impact of ash and usage in cement industry
  - Safety aspects of pellet firing
  - Infrastructural requirements of biomass pellet handling
  - Combustion and clinkering issues

Ongoing issues in Biomass co-firing in boilers

- Mill loading Reduction due to restriction in mill inlet temperature and outlet temperature to have a safe cofiring of biomass due to high VM and combustibility.
- Keeping Extra mill in service due to Mill loading restriction on account of low Mill outlet temp while running in biomass mode.
  - Lean Mixture issues
  - High APC due to additional mill
  - Increased flue gas temperature due to high tempering air
- Mills running in biomass mode has to be kept in manual mode to keep the feed rate steady, so there was no contribution of mills running in biomass mode in achieving ramps.
- Higher PA/SA ratio due to extra mill, flame stability issues.
- Even after blending in 3 mills, maximum cofiring achieved was 3% only with mill inlet restricted below 180 deg. C.
- Slow mill start-up and shutdown.

Balancing the situation

- Proper blending of Biomass
  - Blending infrastructure
  - Blending methodologies
  - Development of logic for blending

- Fuel side considerations
  - Shifting to torrefied pellets instead of non torrefied.(increased cost of generation)

- Taking Advanced measures to cater bottlenecks of biomass cofiring.
  - Hybrid Mill air control Logics
  - Enhancing emergency tools to cater exigencies.

- Process based control.
  - Enhancing mill inlet temperatures
  - Controlling mill outlet temperature

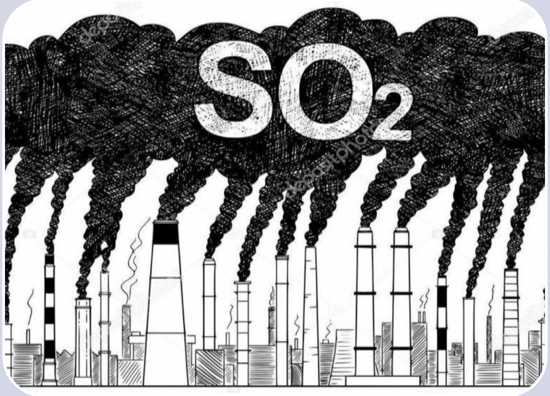
- Impact on FGD yet to be assessed

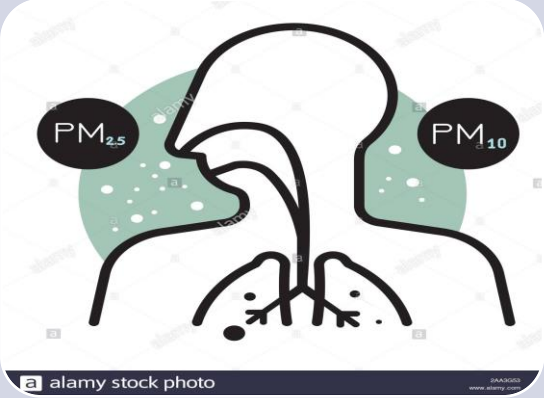
Strategy adopted for Biomass co-firing in NTPC

At the Organisation level,

- Task force is created for identifying the issues in firing of the biomass along with coal
- Biomass started firing biomass upto 5% and based on the experience gained, Operation Guidelines for Biomass Cofiring upto 5% prepared and issued for implementation across NTPC stations
- Steps involved
  - Handling, storage and blending of pellets:
  - **Combustion monitoring of biomass co firing**

Effect of co-firing on Environmental Emissions





CO_2 Emissions

- GCV almost comparable to GCV of coal
- Co firing will reduce emissions by almost that much

SOx

- Biomass generally has much lower contents of sulphur, together with higher concentrations of alkalis in its ash, so SO_2 emissions are generally considerably reduced when cofiring. But due to addition of binder(press mud), Sox levels have gone up . So while manufacturing press mud is to be changed as binder.

NOx

- lower flame temperature, reducing thermal Nox
- Can reduce NOx through lower N content (depends on biomass)
- higher volatiles release in the fuel rich zone of the flame

PM

- Chemical and physical properties of fly ash particulates biomass combustion are different
- Can give higher release of trace metals
- Reduces fly ash loading
- Can increase overall collection efficiency of ESPs due to larger particulates and ease of agglomeration
- But on higher co-firing ratio it may instead reduce collection efficiency, due to high resistivity of fly ash, and increase PM2.5 emissions

Steps taken for Biomass co-firing

- Conveyor Belt Scale Calibration done to ensure required blending ratio.
- New stations logic modification incorporated in conveyor systems
- Sufficient Quantity of Coal Kept in Track Hopper to ensure continuous Coal Feeding.
- Pre-Unloading of Biomass in Hopper before start of blending
- Before start of blending all Bunker Levels maintained at 15 Meters.

Supply chain issue of pellets

- Irregular supply of pellets due to poor pellet manufacturing capacity
- Poor stacking infrastructure of pellets
- As per Ministry of Power's (MoP) policy on biomass utilization, for every 1 GW capacity at 7 per cent co-firing, nearly 0.25–0.3 million tonnes of biomass pellets are required.

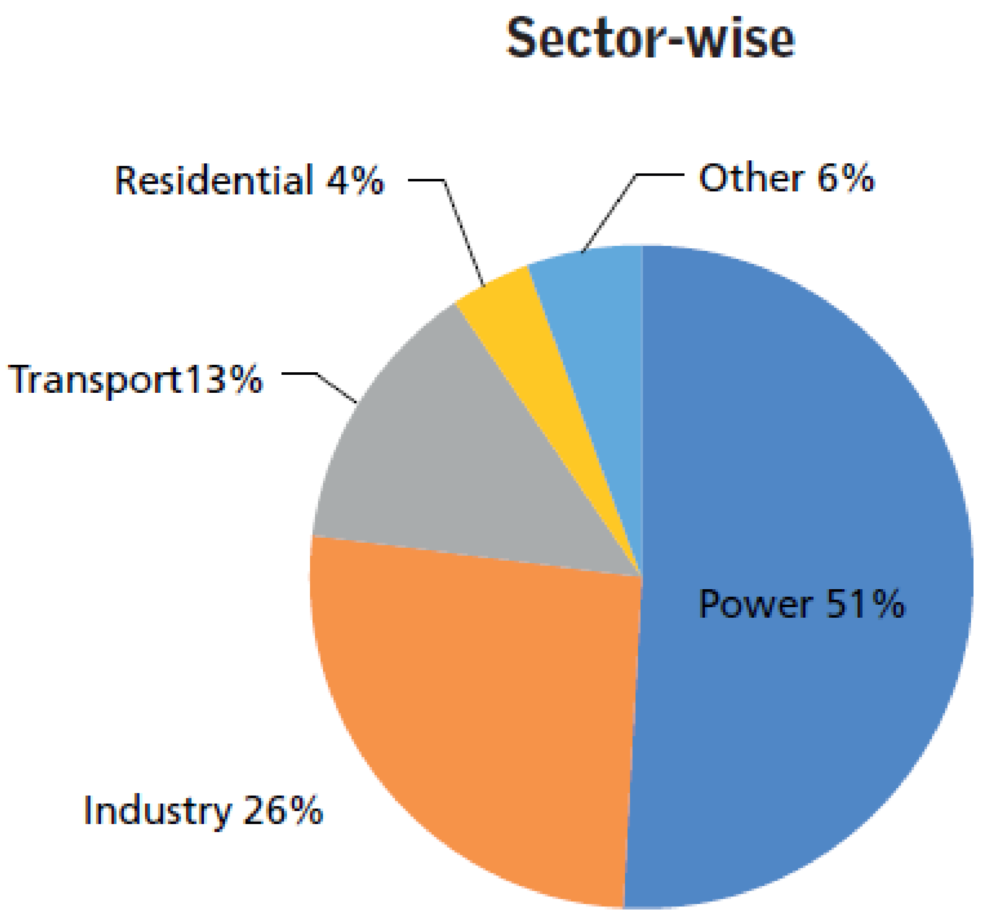
Challenge in Biomass Pellet Sector

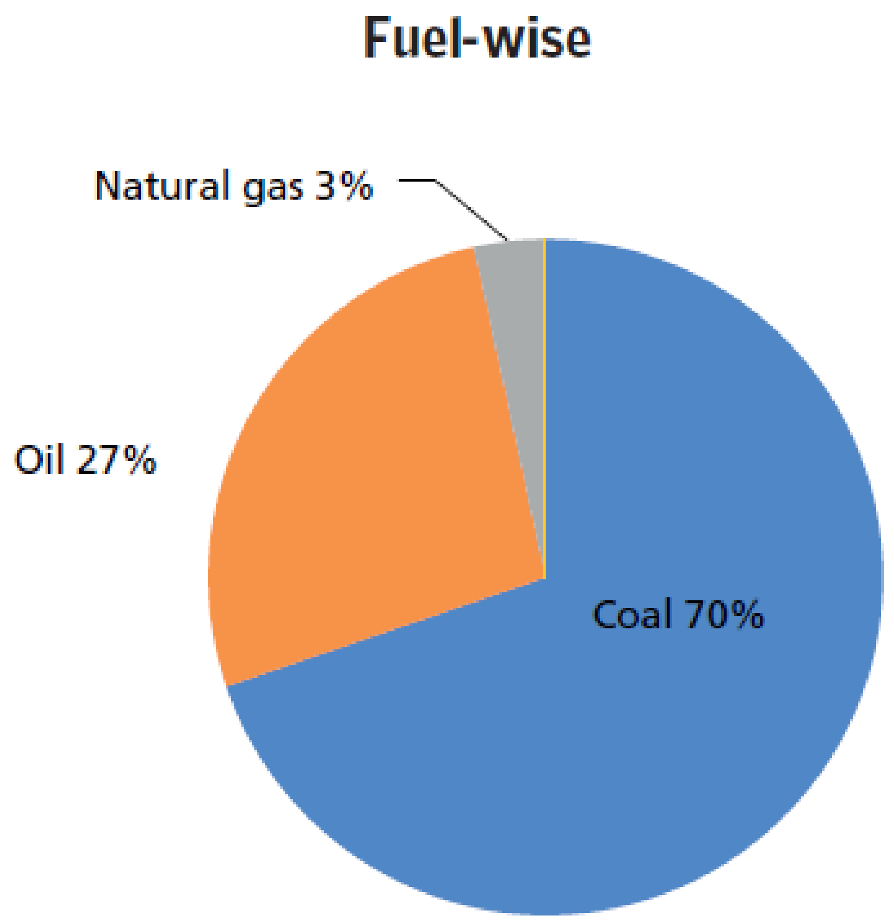
Co-firing Ratio	5%	Assumptions 0.7 specific coal		
SN	**Project**	**State**	**Capacity in MW**	**Requirement TPD**
1	NTPC Singrauli	Uttar Pradesh	2000.00	1428
2	NTPC Korba	Chhattisgarh	2600.00	1856
3	NTPC Ramagundam	Telangana	2600.00	1856
4	NTPC Farakka	West Bengal	2100.00	1499
5	NTPC Vindhyachal	Madhya Pradesh	4760.00	3399
6	NTPC Rihand	Uttar Pradesh	3000.00	2142
7	NTPC Kahalgaon	Bihar	2340.00	1671
8	NTPC Dadri	Uttar Pradesh	1820.00	1299
9	NTPC Talchar	Odisha	3010.00	2149
10	NTPC Unchahar	Uttar Pradesh	1550.00	1107
11	NTPC Simhadri	Andhra Pradesh	2000.00	1428
12	NTPC Tanda	Uttar Pradesh	1760.00	1257
13	NTPC Sipat	Chhattisgarh	2980.00	2128
14	NTPC Mauda	Maharashtra	2320.00	1656
15	NTPC Barh	Bihar	3300.00	2356
16	NTPC Kudgi	Karnataka	2400.00	1714
17	NTPC Bongaigaon	Assam	750.00	536
18	NTPC LARA	Chhattisgarh	1600.00	1142
19	NTPC Solapur	Maharashtra	1320.00	942
20	NTPC Gadarwara	Madhya Pradesh	3200.00	2285
21	NTPC North Karanpura	Jharkhand	1980.00	1414
22	NTPC Darlipali	Odisha	1600.00	1142
23	NTPC Khargone	Madhya Pradesh	1320.00	942
24	NTPC Telangana	Telangana	1600.00	1142
25	NTPC Barauni	Bihar	720.00	514

40000 Tons per Day of requirement

Thank You

CO2 emission contribution



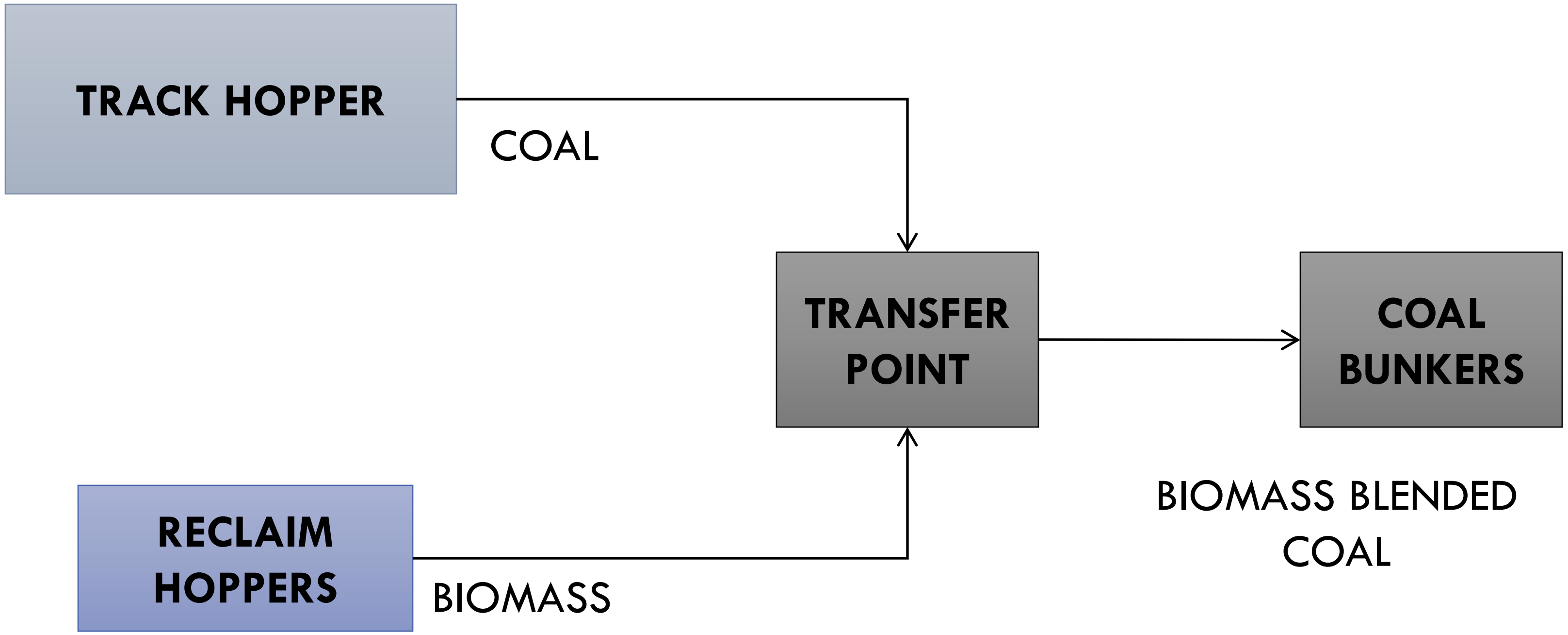


Source: IEA, 2020

Biomass pellets proximate analysis as fired in Kudgi

Type	Non Torrefied – Agro Residue
GCV	3947 Kcal/kg
Moisture	6.45 %
Ash	14.10 %
Fines -1 mm	79.20 %
Fines – 3 mm	100 %
VM	55-65%
Stock	30 Tons
Cost	9483 Rs /Ton

BLENDING


TRACK HOPPER
COAL
TRANSFER POINT
COAL BUNKERS
RECLAIM HOPPERS
BIOMASS
BIOMASS BLENDED COAL

Acknowledgements

Vinay Trivedi 2020, *Agro-residue for power: Win-win for farmers and the environment?,* Centre for Science and Environment, New Delhi