FutureMetrics™ LLC
8 Airport Road
Bethel, ME 04217, USA

Will India become an Importer of Industrial Wood Pellets?

By William Strauss, PhD

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This brief white paper is motivated by a policy announcement in India on October 8 that mandates that 5% to 10% biomass pellets must be blended with coal by October 2022 in most of its coal fueled power stations[1].

According to the Indian Ministry of Power document referenced in footnote #1, India produces 230 million tonnes per year of surplus agricultural waste. Most of that is burned in the fields causing serious air pollution over northern India every year. The stated motive for the policy is to soak up the ag waste and limit open burning.

This short analysis will quantify the demand for biomass pellets based on the Indian coal fueled power generation fleet. It will also offer an opinion on the potential for India to import wood pellets.

India's Coal Fueled Power Fleet

India has a total of 267,482 megawatts (MW's) of current and soon to be commissioned coal fueled generating capacity[2].

India's Coal Fueled Power Generation

	Count	MW	Avg. Age	Mean MW
cancelled	759	577,861		761
construction	50	34,405		688
operating	855	233,077	28.6	273
permitted	22	11,705		532
pre-permit	14	7,633		545
retired	145	13,691	41.5	94
shelved	35	30,306		866

source: Global Coal Plant Tracker, July 2021; Analysis by FutureMetrics

The chart below shows the distribution of all of the operating power units in India. The majority are relatively small.

[1] See HERE for policy announced on October 8, 2021. Some stations will be required to have higher co-firing rations in coming years.
[2] A interactive map of all of the operating and under construction stations is HERE. The satellite view allows the user can zoom in and get basic information about each of the 905 plants.

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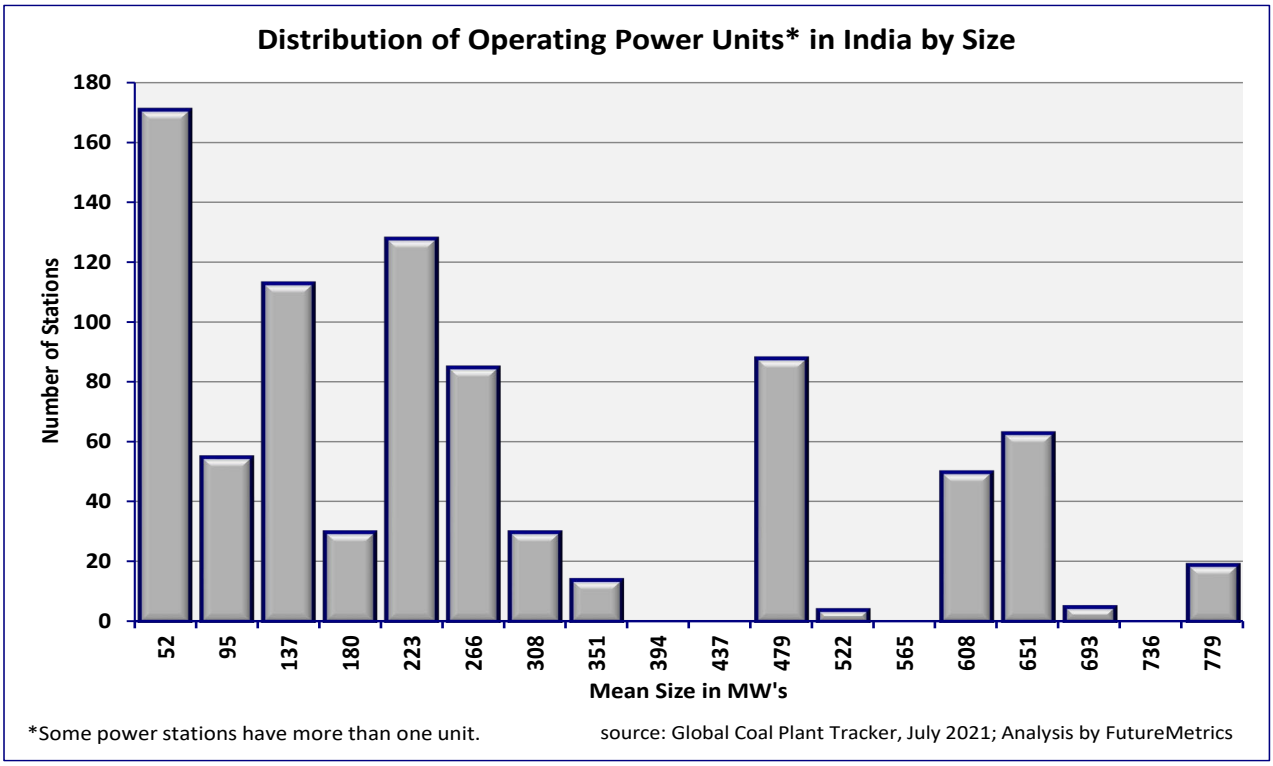

As the table below shows[3], most of the currently operating plants are subcritical[4] with relatively low efficiencies. Most of the 45 plants under construction are supercritical with better efficiencies than subcritical. Only two of the new power plants are rated as ultra-supercritical.

Operating				
	Count	Percent	Avg. Heatrate	Efficiency
subcritical	731	87.1%	10,694	31.9%
supercritical	96	11.4%	9,107	37.5%
ultra-super	2	0.2%	8,491	40.2%
cfb	10	1.2%	9,678	35.3%
Construction				
	Count	Percent		
subcritical	2	4.4%	10,007	34.1%
supercritical	41	91.1%	9,104	37.5%
ultra-super	2	4.4%	8,272	41.2%
cfb	0	0.0%		

source: Global Coal Plant Tracker, July 2021; Analysis by FutureMetrics

[3] More than 98% of the units use pulverized coal (PC) fuel systems. Only 1.2% use circulating fluidized bed (cfb) boilers. PC systems require that the fuel is converted into very fine particulate size for combustion. Pellet fuels satisfy this requirement and also optimize transportation costs per unit of delivered energy.
[4] See HERE for descriptions of utility coal power technologies.

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What Could be the Indian Demand for Pellet Fuel?

Based on the average of the efficiency data from all of the operating and under construction plants, and assuming a capacity factor of 60%, at a co-firing ratio of 5% Indian coal power stations will consume about 47.8 million metric tonnes per year of biomass pellets[5].

The energy density of the biomass pellets is a critical input in calculating tonnes per year of demand. As the table below shows, the assumption is that the biomass pellets contain about 16 gigajoules (GJ) per metrics tonne (equal to about 4.45 MWh/tonne). The feedstock, the ash content, and the final moisture content of the pellets will determine the actual energy density. Pellet fuel energy density will certainly vary. This analysis uses an assumed average.

Estimated Pellet Demand (tonnes/year) at a 5% Co-Firing Ratio at an Assumed 60% Capacity Factor

Operating	
subcritical	37,588,923
supercritical	4,203,951
ultra-super	81,655
cfb	465,336
Operating Total	**42,339,864**
Construction	
subcritical	264,850
supercritical	4,939,218
ultra-super	218,930
cfb	0
Construction Total	**5,422,998**
Total ==>	**47,762,862**

Input assumption on pellet energy density

4.45	MWh/tonne
16.02	GJ/tonne

source: Analysis by FutureMetrics

The conversion ratio of tonnes of raw ag waste to tonnes of pellets will depend primarily on the moisture content of the raw feedstock. It is also likely that some tramp materials such as dirt will be separated from the raw feedstock. Using a broad assumption that it will take 2 tonnes of raw feedstock to produce a tonne

[5] The actual quantity of pellet fuel demand may be lower since cfb boilers can use a wide variety of fuels and do not need to pulverize the fuel to be compatible with the boiler design. However, cfb boilers are only 1.2% of the fleet and they would use only about 465,000 tonnes per year out of the total of more than 47 million tonnes per year. The actual average capacity factor may be higher or lower as well.

of biomass pellet fuel[6], based on the table above, power stations will use about 41.5% of the annual 230 million tonnes of surplus agricultural waste.

It should be noted that in 2021 the total global demand for wood pellets for power generation will be about 23 million tonnes. India is essentially mandating that in one year from now they will use pellet fuel in quantities that are about double of what is currently produced for use in power boilers.

India's goal is ambitious for several reasons.

For starters, the ramp up envisioned over a one-year period will require immediate massive investments in the development of new pellet manufacturing capacity. The build out of that capacity will require that the construction is done over a period of time that is shorter than even the most aggressive wood pellet projects. And once built, those factories will require production ramp up to full production in very short time.

Logistics solutions will also be challenging. The average size operating power generating unit in India is about 275 MW's. At the typical energy density for pellet fuel, and at a 5% co-firing rate, that unit would use a bit more than 50,000 tonnes per year of pellet fuel (daily use of about 250 tonnes at an assumed 60% capacity factor for the generator). In other words, the Indian market for pellets will require extensive micro distribution networks to spread 40+ million tonnes per year of production to over 900 generating units. Coal is already moved to these units from mines and ports, but the dry storage requirements of pellet fuel will require different logistics solutions.

Beyond the challenges of building, bringing online over 40 million tonnes per year of new biomass pellet production capacity by October of 2022, and distributing that fuel to over 900 end users, there are inherent operational problems associated with using agricultural by-products. Pellet production from agricultural waste streams have unique challenges that wood pellets do not have.

Most of the ag by-products are produced during harvests. But harvests of agricultural crops are not continuous over the year. Managing the rapid influx of feedstock during and around harvest and inventorying it for continuous pellet production and use in power stations requires massive investment in feedstock storage buffers. The materials cannot be left in the fields. And even if come of the harvest by-products can be left on the ground, many would rapidly deteriorate, become contaminated with dirt, and become unsuitable as fuel.

There will have to be investment in large scale baling and storage of a significant proportion of the raw biomass pellet feedstocks. In addition to the capital costs, the costs of operating the baling and storage solutions need to be considered.

[6] This assumes that the raw feedstock has about a 48% moisture content (MC), that the final pellet fuel has a MC of 6%, and that raw biomass will be used for drying energy. To investigate details of feedstock demand as a function of moisture content, use the free FutureMetrics dashboard HERE.

Agricultural feedstocks also can have chemical and physical characteristics that can be problematic for utility power boilers such as high chlorine levels (corrosion of steel surfaces) and high silica levels (abrasion of boiler tubes and ducting). These issues may be minimized at low co-firing rates by dilution within a fuel mix that is mostly coal. But as co-firing rates increase as is mandated in the policy, those issues may become significant.

India's new policy is an important recognition of the technical efficacy of substituting pellet fuel for coal.

But it will take much longer than one year for the supply side to match the required demand.

What about Importing Wood Pellets?

The new policy in India will be in force for at least 25 years. It also mandates that the power generating utilities enter into at least 7-year offtake agreements with suppliers. The language in the policy document says that they will use "biomass pellets made, primarily, of agro residue…" (see link at footnote #1).

While the motivation for the policy is to create a market for the ag residues produced by Indian farmers that are currently open-air burned, the language of the policy does not explicitly rule out pellet fuel imports.

The policy document does not make clear what the consequences of non-compliance are. However, if it is assumed that compliance is mandatory, filling the gap between demand and supply over the next several years could stimulate offtake agreements from southeast Asian wood pellet producing countries.

In fact, wood pellet fuel imported from SE Asian producers may offer competitive costs per delivered GJ versus biomass pellets produced from ag residues after the costs of managing the intermittent flows of raw materials and other logistics challenges are better quantified.

The Indian utility solid fuel markets may already be considering wood pellet imports. At current coal prices (which may or may not persist), pellet fuel imported from low-cost SE Asian pellet producers may be the lower cost fuel for power generation.

The chart below shows the estimated cost per MWh generated from pellets and coal. Wood pellets, even after shipping costs, are estimated to have become cheaper per MWh generated than coal!

This condition is unlikely to persist, but it does illuminate the potential economic value of substituting pellet fuel for coal.

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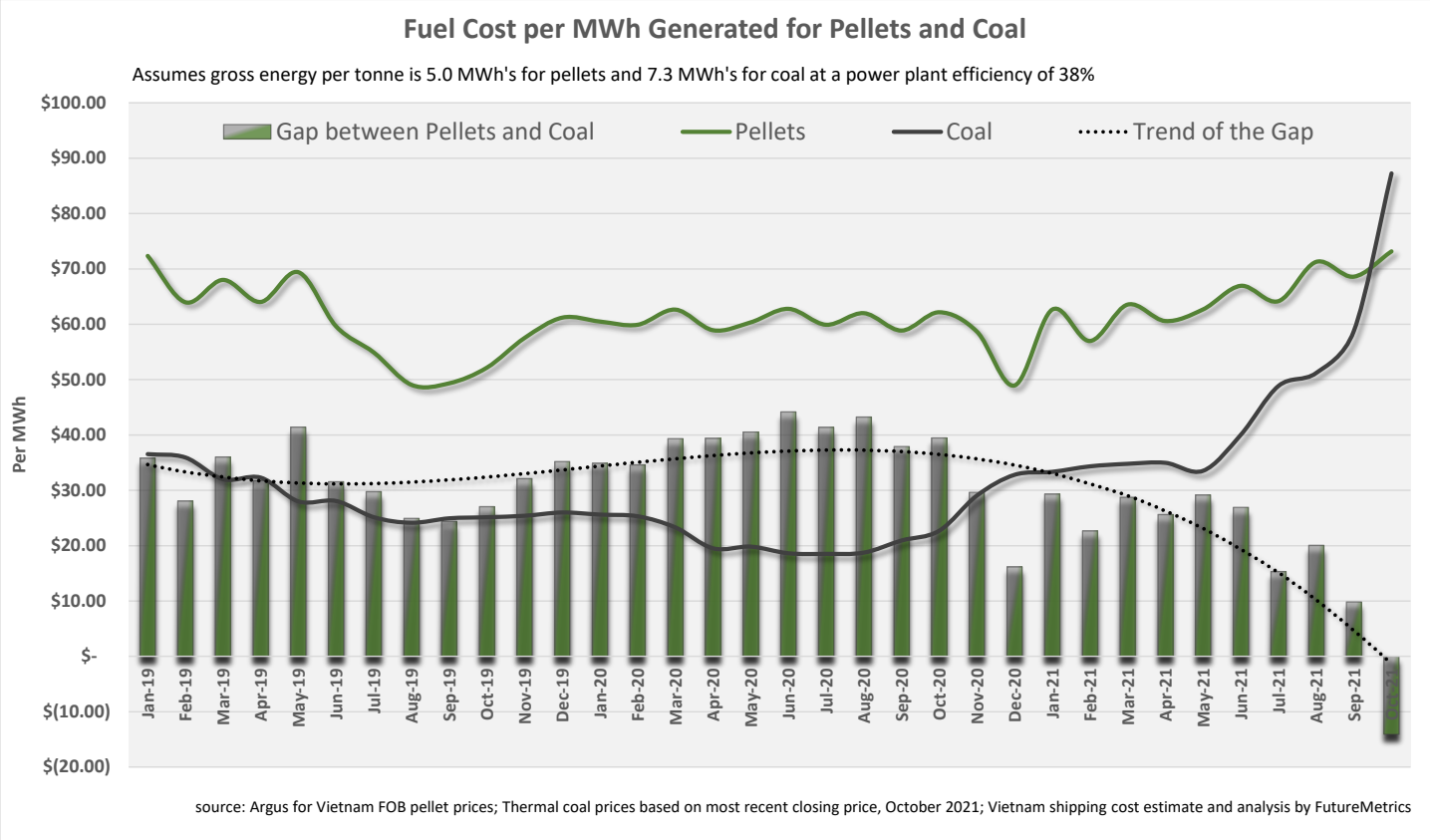

Conclusion

Because of the size of India's coal generation fleet, even at 5% co-firing rates and even if all the generators do not fully comply, the demand for biomass derived pellet fuel will be huge.

At the very least, the next few years will be very good for the producers of equipment for preparing, drying, and densifying biomass.

The next several years may also be see the emergence of a new major importer in wood pellets as Indian power generators seek reliable supplies of biomass pellets.

Even if only a small percentage of the pellet fuel is imported, the result is still a large number. For example, if 5% of the total expected Indian demand is imported wood pellets, that amounts to about 2.4 million tonnes per year.