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8 Airport Road  
Bethel, ME 04217, USA

# **A Short Update on the Japanese Industrial Wood Pellet Markets: Policies, and how they will drive current and future demand**

August 15, 2017

William Strauss, PhD

**FutureMetrics' Seth Walker is developing a comprehensive analysis of the Japanese industrial wood pellet sector. The report will contain detailed policy analysis, market intelligence that is not available from any other source, and scenarios for future demand.**

**That report will be available for purchase from FutureMetrics in the coming weeks.**

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**This brief white paper is a high-level overview of the Japanese industrial wood pellet sector. The paper has a short overview of global past demand and forecast demand for industrial wood pellets and then focuses on Japan. The paper reviews the policies in Japan that are driving the current and expected future growth in demand for industrial wood pellets.**

### **Overview of Global Pellet Markets**

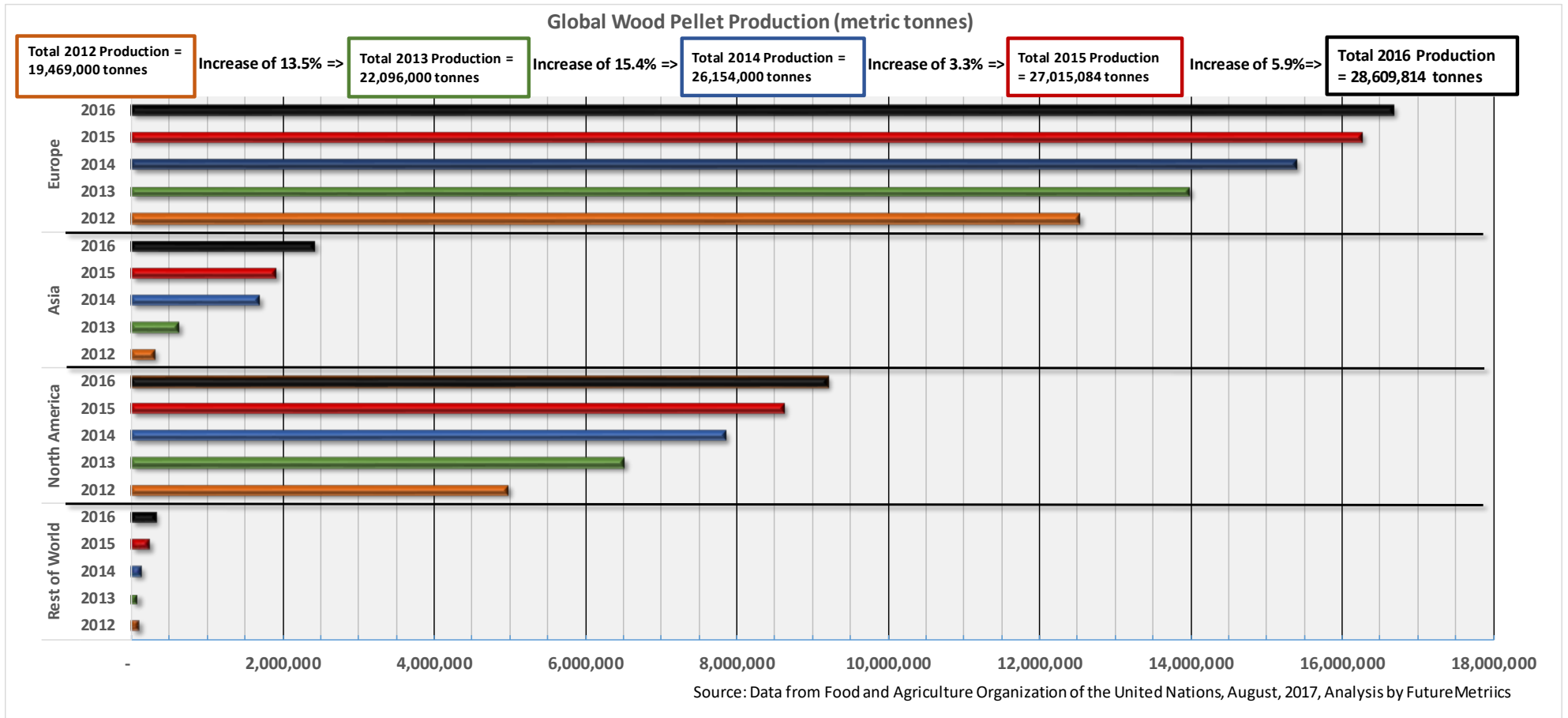
The wood pellet markets are comprised of two primary sectors: industrial wood pellets that are used as a substitute for coal in power plants, and premium/heating pellets used in pellet stoves and pellet boilers or furnaces for heating. The chart on the next page includes both sectors.

Global wood pellet markets have had significant growth in the past decade. Data from the Food and Agriculture Organization (FAO) of the United Nations shows growth rates over the most recent five years of data of about 9.3% annually: from about 19.5 million metric tonnes in 2012 to about 28.6 million metric tonnes in 2016. Europe remains the world's largest producer of wood pellets.



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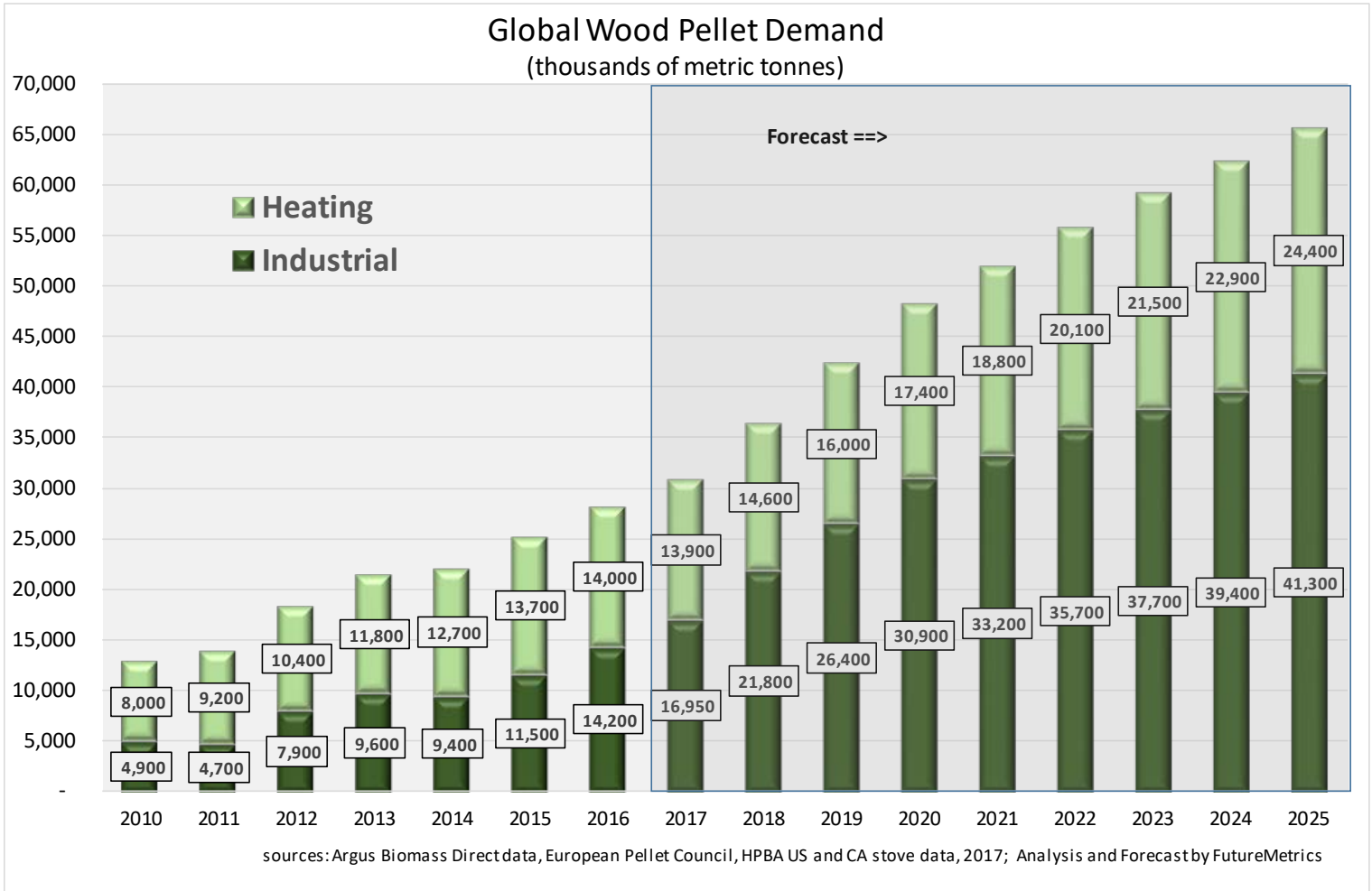




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The chart below shows historic aggregated demand in the heating and industrial sectors as well as the forecast demand. Growth in both sectors is expected to be significant but expected future growth is dominated by the industrial sector.



2016 aggregate demand for industrial pellets used to replace coal in power generation is estimated to be about 14.2 million metric tonnes. That is the equivalent of a bulk carrier ship carrying 40,000 tonnes about every day.

**The majority of demand growth for industrial wood pellets after 2019 is expected to come from Japan and South Korea.**

The rest of this report will focus on the Japanese industrial wood pellet markets.



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### The Demand for Industrial Wood Pellets in the Japan

#### Why Japan and South Korea are different

Both the Japanese and S. Korean markets for industrial wood pellets are driven by policy. The policies are quite different. However, both policies result in creating a demand for industrial wood pellets as a coal replacement in power plants.

How the supply for those wood pellets is secured in each country is also quite different.

Japanese buyers, supported by a long-term feed-in-tariff (FIT), prefer long-term offtake contracts with set terms for prices. The basis for the policies in Japan, the decarbonization of the power sector, require that the suppliers show that the pellet supply chain meets sustainability criteria. Japanese buyers therefore prefer to engage with counterparties from countries with strong rule of law (for comfort with the durability, consistency, and security of the supply agreement), strong forest management practices, and stable macroeconomic conditions.

S. Korean buyers, incentivized by the need to comply with the S. Korean renewable portfolio standards (RPS) supported by renewable energy certificates (REC's), and to a lesser degree from carbon trading in the Korean Emissions Trading scheme (KETs), are currently seeking the lowest cost pathway to compliance. Some of the RPS compliance for generating a proportion of power from renewable sources has been from wind and solar generation. But some compliance has been via co-firing pellets. S. Korea has, to date, procured pellet fuel under a short-term tendering strategy which has producers competing several times per year to win supply bids to the individual utility buyers. S. Korean buyers prefer short-term supply contracts from low-cost producers<sup>1</sup>.

#### Japanese policy and how that drives demand for industrial wood pellets

Japan is guiding the power generation industry with four interlinked areas of policy: (1) carbon reduction, (2) the “best energy mix for 2030”, (3) required minimum efficiency for power generation, and (4) the FIT. The only policy instrument that provides a monetary incentive is the FIT.

**(1) Carbon Emissions Targets** - Japan has already implemented a target reduction of CO<sub>2</sub> emissions that will require all power companies to reduce CO<sub>2</sub> per kWh by 35% from 2013 levels by 2030. This is a reduction of from 0.57kg of CO<sub>2</sub>/kWh to 0.37kg of CO<sub>2</sub>/kWh. It is currently a voluntary target but a few major utilities are already co-firing wood pellets at modest 1% to 3% ratios.

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<sup>1</sup> FutureMetrics has a white paper on the S. Korean industrial wood pellet market and the risks associated with an incentive scheme that is based on REC's. The paper is free to download at [www.FutureMetrics.com](http://www.FutureMetrics.com).

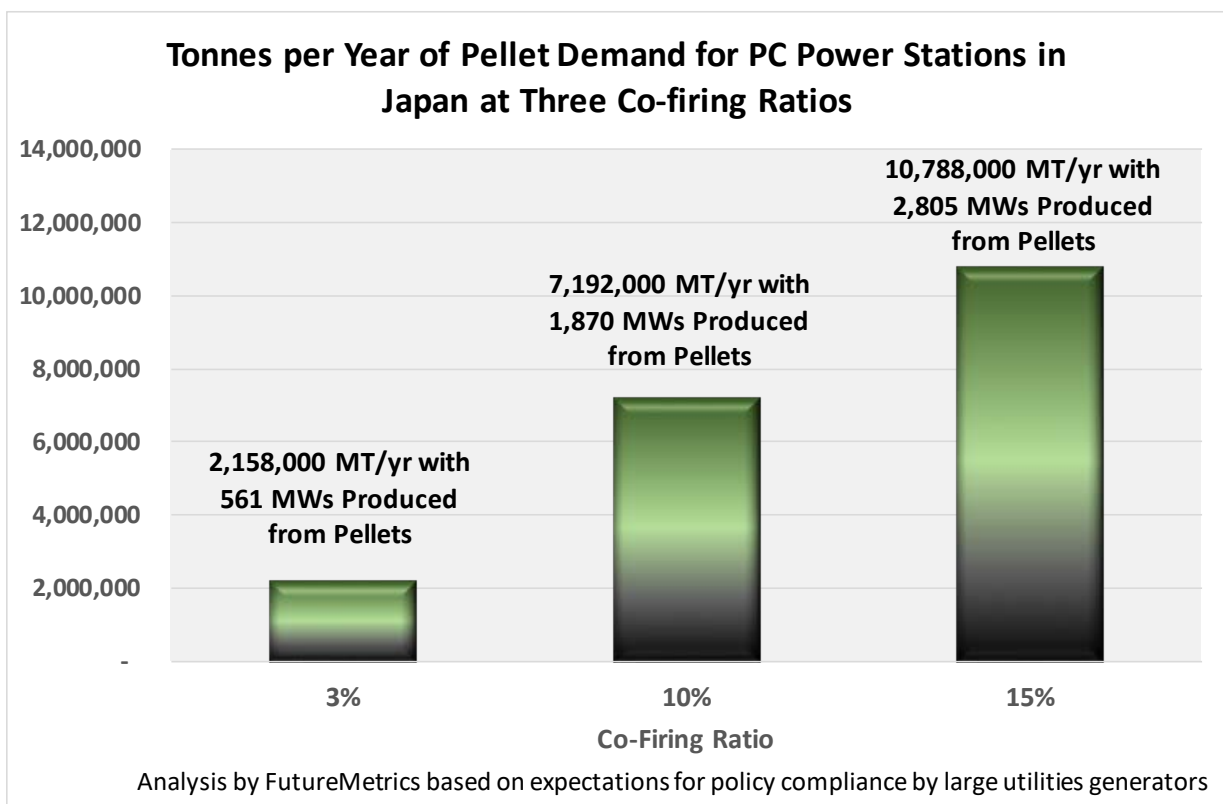


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There are a few pulverized coal (PC) power stations currently co-firing wood pellets in Japan and there are some that are having discussions for pellet fuel supply with major producers. Those stations that are either currently co-firing or in discussions about fuel supply add up to about 18,700 MWs. (See the section below about power stations meeting minimum efficiency requires for more on why large utility PC power stations will co-fire wood pellets.) The chart below shows the pellet demand at these stations under three co-firing ratios. At the higher co-firing ratios, the plants may need modifications and/or retrofits to pulverizers, burners, pneumatic fuel conveyance systems, and some other components.

It is unlikely that co-firing ratios for the large utility generators will exceed 15% as will be discussed more fully in the section below on the FIT.



The voluntary policy for carbon emissions mitigation may change to required reductions. Japan has committed to the international agreement for CO<sub>2</sub> reduction. That target is for a 27% reduction by 2030.

Some of that CO<sub>2</sub> reduction will be achieved with renewables and some with nuclear. The government's energy mix goals show how this might be achieved.

**(2) Best Energy Mix** - The Japanese government's analysis (from METI, the Ministry of Economy, Trade, and Industry) expects the nation to demand about 1,065 million MWh's in 2030. The government's



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strategic plan includes a breakdown of the desired energy mix in 2030. The nation will be expected to produce power based on the breakdown shown in the table below.

Based on 1,065 Million MWh's of Demand in 2030	Energy Mix	Millions of MWh's
Renewable	23%	244.95
Nuclear	21%	223.65
LNG	27%	287.55
Coal	26%	276.90
Oil	3%	31.95
<b>TOTALS</b>	<b>100%</b>	<b>1,065.00</b>

Within the renewables, biomass is 4.3% of the 245 million MWh's per year allocated to renewables. The breakout is below.

<i>Renewable Portion</i>	Energy Mix	Millions of MWh's	Capacity Factor	Nameplate MW's Needed
Geothermal	1.0%	10.65	90%	1,351
Biomass	4.3%	45.80	85%	6,150
Wind	1.7%	18.11	30%	6,889
Solar	7.0%	74.55	25%	34,041
Hydro	9.0%	95.85	90%	12,158
	23.0%	244.95		60,589

To meet that demand in 2030, Japan will have to have generations capacity of just over 6000 MW's from biomass. If 30% of that 6150 MW's (1,845 MW's) are generated from pellets, Japan will consume about 7.4 million metric tonnes per year of pellets.

That level is consistent with a 10% co-firing ratio shown in the chart on the previous page.

**(3) Minimum Generation Efficiency Requirements** - The Japanese regulators have set minimum generation efficiency requirements for all large coal power generation stations. The minimum requirement will be 41% and will have to be met by 2030. Currently only the ultra-supercritical pulverized coal plants meet this requirement.

The Japanese Ministry of Economy, Trade and Industry (METI) has allowed the formula for calculating efficiency to be modified to encourage the use of wood pellets as a substitute for coal to "change" the efficiency calculation. Typically, efficiency (or heat rate) is based on the energy output versus the energy



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input. For example, if 100 MWh’s of energy are put into the boiler and 35 MWh’s of electricity is generated, the efficiency is 35%<sup>2</sup>.

The modification to the calculation is to allow any MWh’s generated from wood pellets to be subtracted from the denominator. Thus the calculation for the example would now be:

$efficiency = \frac{power\ out\ (MWh's)}{total\ power\ in - power\ from\ pellets\ (all\ in\ MWh's)}$ . If the plant were production 35MWh’s and the total power is 100 MWh’s but the power from pellets is 15 MWh’s the “efficiency of the plant would be 35/(100-15) = 41%. In other words, PC power plants with efficiencies below 41% can co-fire wood pellets to achieve the minimum efficiency requirement.

The table below shows the estimated number of tonnes of wood pellet necessary to achieve the minimum efficiency requirement. The supercritical and subcritical plants that continue to operate will have to co-fire pellets if, for no other reason, to meet this requirement.

Type of Power Station	Share of Coal Generation	Output (GWh/year)	Actual Efficiency	Coal Consumption (Tonnes/year)	Target Efficiency	Co-firing needed get to Target (by weight)	Wood Pellets required (Tonnes/year)
Ultra Super-Critical	60.12%	134,600	41.5%	44,938,500	41.52%		-
Super-Critical	27.82%	62,300	39.9%	21,649,800	41.00%	2.71%	899,520
Sub-Critical	12.06%	27,000	37.7%	9,927,800	41.00%	8.05%	1,226,264
	100.00%	223,900	40.61%	76,516,100	41.00%		2,125,784

source: data from Japan Federation of Electric Power Companies, Analysis by FutureMetrics

Given 17 GJ/tonne pellets, these selected power plants will have to consume about 2.13 million tonnes of pellet fuel.

**(4) Feed-in-Tariff** – Of the four policy instruments in Japan, the FIT provides the direct financial support to the power generators that will compensate them for the higher cost of generation with pellet fuel.

The FIT scheme started in July 2012. Under the FIT, electric power transmission and distribution companies are obliged to purchase electricity generated from renewable energy sources on a fixed-period contract at a fixed price. The cost for purchasing the renewable power is paid by electricity users in the form of a nationwide equal surcharge on power bills.

<sup>2</sup> Heat rate is also measures the efficiency of the system. It is the value of the energy input to a system, typically in Btu/kWh, divided by the electricity generated, in kW. The BTU content of a kWh is 3,412 BTU. The convert from efficiency to heat rate, divide 3,412 by the efficiency. For the 35% example, the heat rate is 3412/.35=9,748.



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Since its 2012, purchase prices of the FIT have been reexamined every year by the Ministry of Economy, Trade and Industry (METI). The FIT price for solar PV has been lowered and some new categories have been created for wind, hydro and biomass.

The FIT for pellet fueled power generation will be lowered to ¥21/kWh in October 2017 from its current ¥24/kWh (from about \$0.22 to about 0.19 per kWh at 111 yen per dollar). The duration of the FIT is 20 years from the start of the project. However, the FIT is not adjusted for inflation. It is a fixed payment per MWh for 20 years<sup>3</sup>.

There is no upper limit restricting the size of a power plant benefiting from the FIT for new power plants. But there a de-facto limit due to permitting. If the power plant is less than about 110 MW's, then a full environmental assessment is not required. For a small plant the assessment takes 1 or 2 years. For proposed plants that are larger than about 110 MW's, the full assessment requires at least 5 years. Most of the current and planned FIT projects are smaller independent power producers (IPP's).

Due to the carbon policy, the "best energy mix" policy, and the required minimum efficiency requirement, some of the major power generators will be forced to co-fire pellets. The major power generators who need to co-fire pellets at their existing power stations will likely be allowed to benefit from the FIT<sup>4</sup> (for the MWh's generated by pellets) and co-fire at the rate of up to about 15-20 percent. However, as noted above, at a 10% co-firing ratio, it is possible to reach the "best energy mix" criteria.

At a co-firing ratio of 10% by selected major utility power plants, the demand for wood pellets is expected to exceed 7 million tonnes per year.

### **Japanese Policy Will Drive Significant Growth in Demand for Industrial Wood Pellets**

There are numerous projects planned and many currently either co-firing wood pellets or running dedicated systems using pellets<sup>5</sup> or low grade biomass or palm kernel shell (PKS). Most of the currently

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<sup>3</sup> If the Japanese utility is to avoid the risk of the fuel becoming too expensive given the fixed FIT, they will have to engage in offtake agreements that are based on a known starting \$/tonne with a fixed escalation rate. The cost of pellets cannot go too high over the term of the offtake agreement such that the cost of generation causes the power station to have their bottom line go negative. There are many inputs to determining the "levelized cost of energy" and the expected revenues from the sale of coal generated power and the portion generated from wood pellets that does receive the FIT. [FutureMetrics can provide detailed analytics on identifying and minimizing the risks in an offtake agreement for supplying pellets to Japan.](#)

<sup>4</sup> The details of how the major utilities can and will benefit from the FIT will be covered in the forthcoming FutureMetrics' report on the Japanese industrial pellet market.

<sup>5</sup> For example: August 4 (from Argus Media) — US wood pellet producer Enviva, and sponsor Enviva Holdings, has signed an initial agreement with a Japanese trading house for 650,000 t/yr of supply to a dedicated biomass-fired power plant in Japan. The dollar-denominated, 15-year contract is expected to commence in 2022, subject to documentation of the definitive agreement and contract particulars, and will fully cover the power plant's needs. The dedicated plant is the largest announced in Japan to-date, according to Enviva. Enviva is in discussions with other large Japanese trading houses, utilities and independent power producers that are looking to build more than a





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running dedicated systems are relatively small circulating fluidized bed (CFB) boilers that do not have pulverized fuel systems. CFB boilers can burn a wide range of biomass fuels, including wood pellets. However, most will likely use palm kernel shell (PKS). PKS is not pulverizable and cannot be used in PC boilers (see chart below on PKS demand in Japan).

There are many smaller IPP plants using or planning to use PKS or other non-pulverizable fuel in circulating fluidized bed or stoker boilers.

But there are also many larger PC power stations that will be co-firing wood pellets. The table below shows what annual pellet demand could be at 1%, 5%, and 15% co-firing ratios.

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combined 1.7GW of biomass-fired generation capacity. The negotiations are "well on track", chief executive John Keppler said. Those projects would create more than 7mn t/yr of wood pellet demand, although Enviva does not expect all the capacity to be constructed. Enviva has been eyeing the growing Japanese biomass market in recent years, but, as yet, only minimal US wood pellet exports have made it to Japan, which sources most of its imports from Canada's west coast. Japan imported 150,500t of wood pellets from Canada in the first half of this year, compared with just over 100t from US.



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Wood pellet demand at power stations that are or have announced that they will be co-firing wood pellets (excludes under 200 MWs)			
Capacity MW	Potential Demand at 1% co-firing	Potential Demand at 5% co-firing	Potential Demand at 15% co-firing
406	16,000	78,000	234,000
700	27,000	135,000	404,000
312	12,000	60,000	180,000
700	27,000	135,000	404,000
3,400	131,000	654,000	1,962,000
300	12,000	58,000	173,000
250	10,000	48,000	144,000
300	12,000	58,000	173,000
1,450	56,000	279,000	837,000
475	18,000	91,000	274,000
216	8,000	42,000	125,000
900	35,000	173,000	519,000
1,000	38,000	192,000	577,000
1,000	38,000	192,000	577,000
1,000	38,000	192,000	577,000
2,000	77,000	385,000	1,154,000
1,200	46,000	231,000	692,000
1,000	38,000	192,000	577,000
1,000	38,000	192,000	577,000
600	23,000	115,000	346,000
1000	38,000	192,000	577,000
1000	38,000	192,000	577,000
<b>20,209</b>	<b>776,000</b>	<b>3,886,000</b>	<b>11,660,000</b>

source: Argus Direct, analysis by FutureMetrics

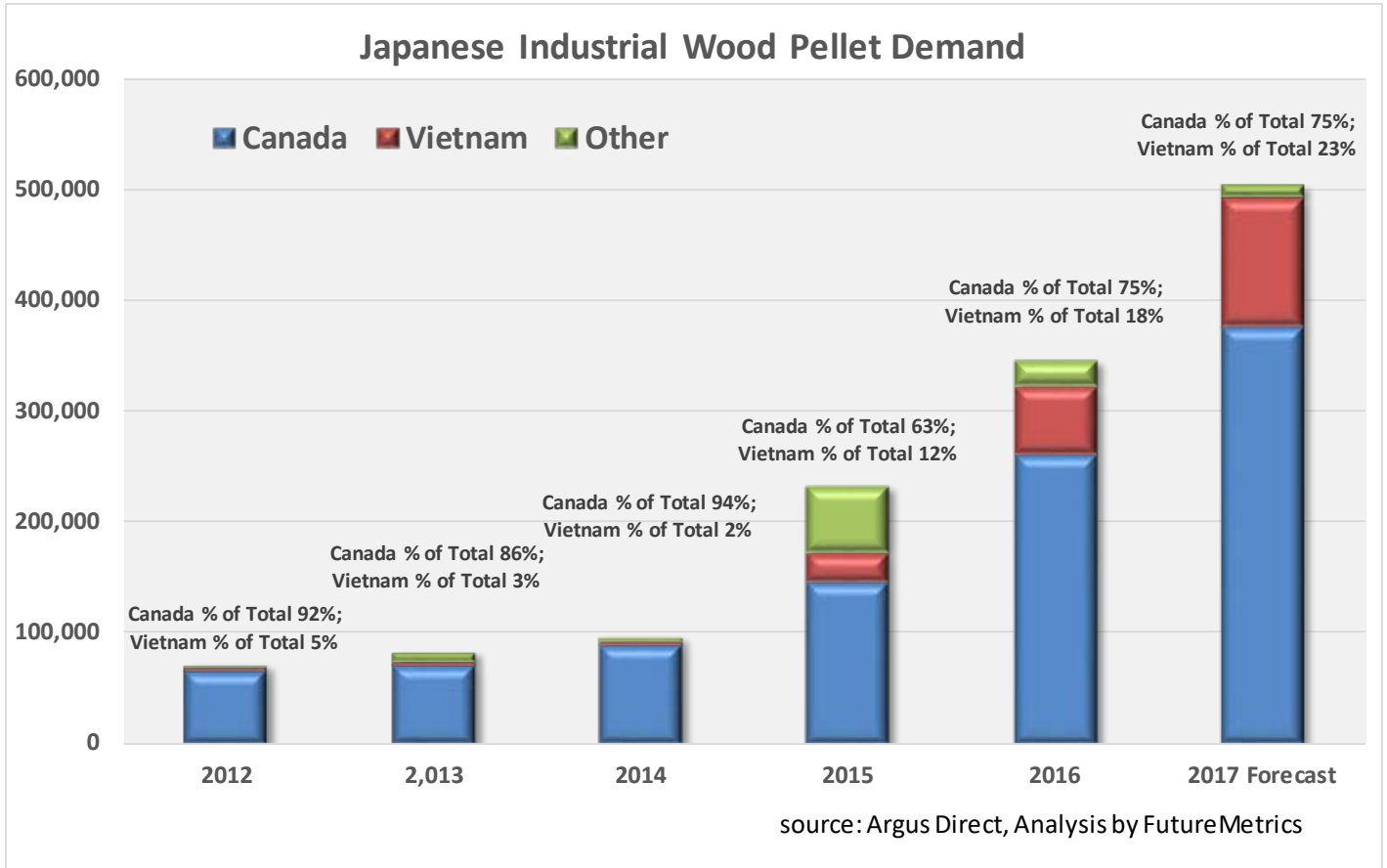
Actual demand though 2016 and forecast demand for 2017 is shown in the following chart. Canada continues to be the major supplier of wood pellets to Japan and is expected to be a major supplier into the 2020's<sup>6</sup>.

<sup>6</sup> The forthcoming FutureMetrics report on the Japanese markets will contain detailed and longer range forecasts for industrial wood pellet demand.



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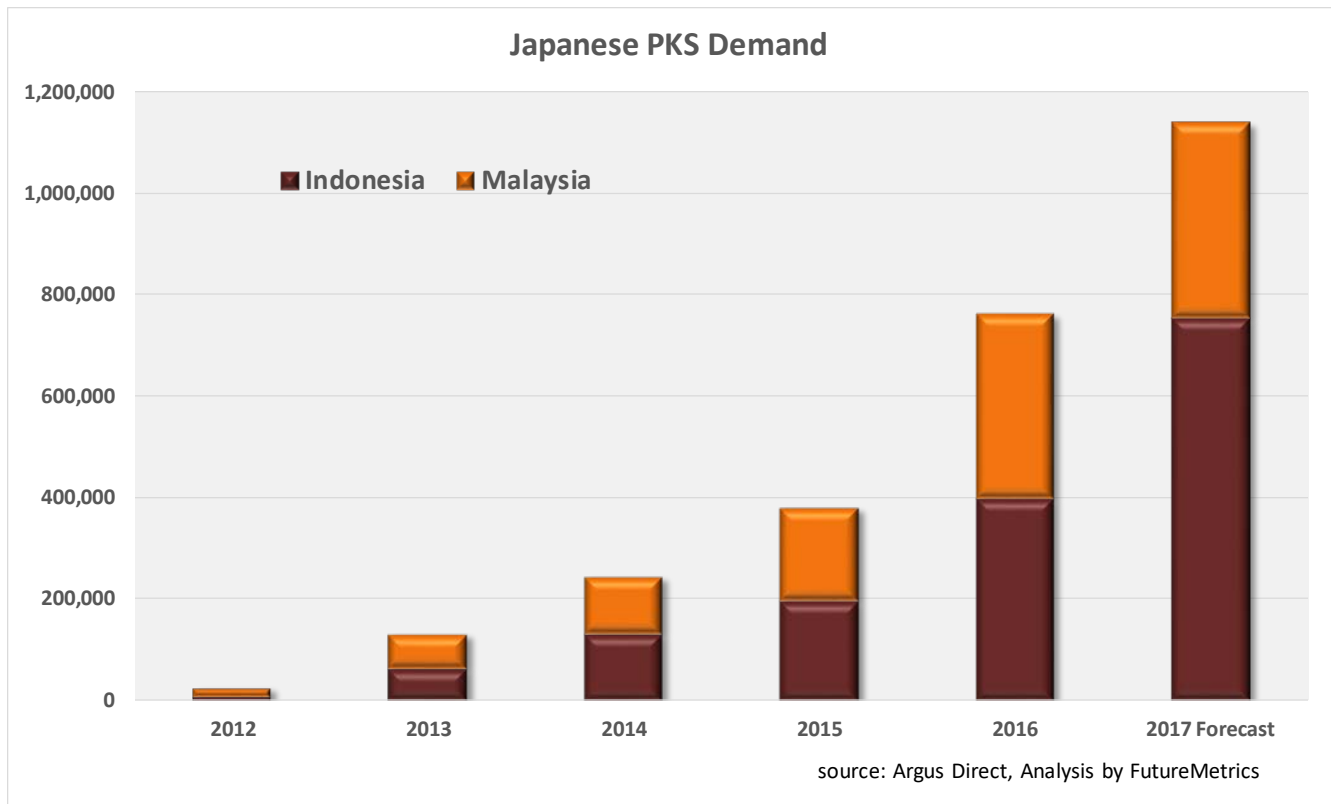


As noted above, a significant proportion of current biomass demand in Japan is satisfied by the import of palm kernel shell (PKS). PKS imports into Japan are shown in the next chart. All PKS imported into Japan comes from Indonesia or Malaysia.



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### Conclusion

The large power stations owned by the major Japanese utilities are being guided into decarbonization with the limits on CO<sub>2</sub> per MWh, with compliance to the “best energy mix”, and with improved efficiency that allows the wood pellet generated portion of the total power output to “improve” efficiency.

The twenty-year duration of the FIT, starting at very generous rates that are more than double the average spot rate in Japan<sup>7</sup>, will support long-term and stable demand for industrial wood pellets. However, given that the FIT is fixed for 20 years, those long-term agreements with Japanese buyers will likely require known starting prices and fixed price escalators.

Given a set starting price and a fixed annual increase in price, inflation risk will be borne by the producers. Understanding that risk and setting the terms of the agreement are critical to the financial durability of the deals. Nonetheless, there is an expected large and stable market in Japan bringing significant potential for healthy sustainable growth in industrial pellet production.

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<sup>7</sup> For real-time spot rates click on this link <http://www.jepx.org/english/>. In the summer months on very hot days the spot rate may exceed ¥25/kWh. The average over a year is under ¥10/kWh.