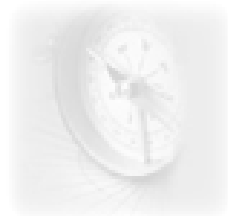


Industrial Wood Pellets in Japan Market Drivers and Potential Demand

Introduction to the Session by William Strauss



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The FutureMetrics Team for Power Plant Co-firing and Full-firing



FutureMetrics
RESEARCH, ANALYTICS, EXPERT ADVICE

- Leading global consultant in the wood pellet sector
 - Provides information, analysis, operations guidance and strategic advice to many of the world's leading companies in the wood pellet sector
-



draxbiomass
A Drax Group company

- Major manufacturer of wood pellets produced from sustainably managed working forests for use as a renewable, low-carbon fuel
 - Subsidiary of Drax Group, the world leader in industrial-scale biomass technology, logistics and operations
-

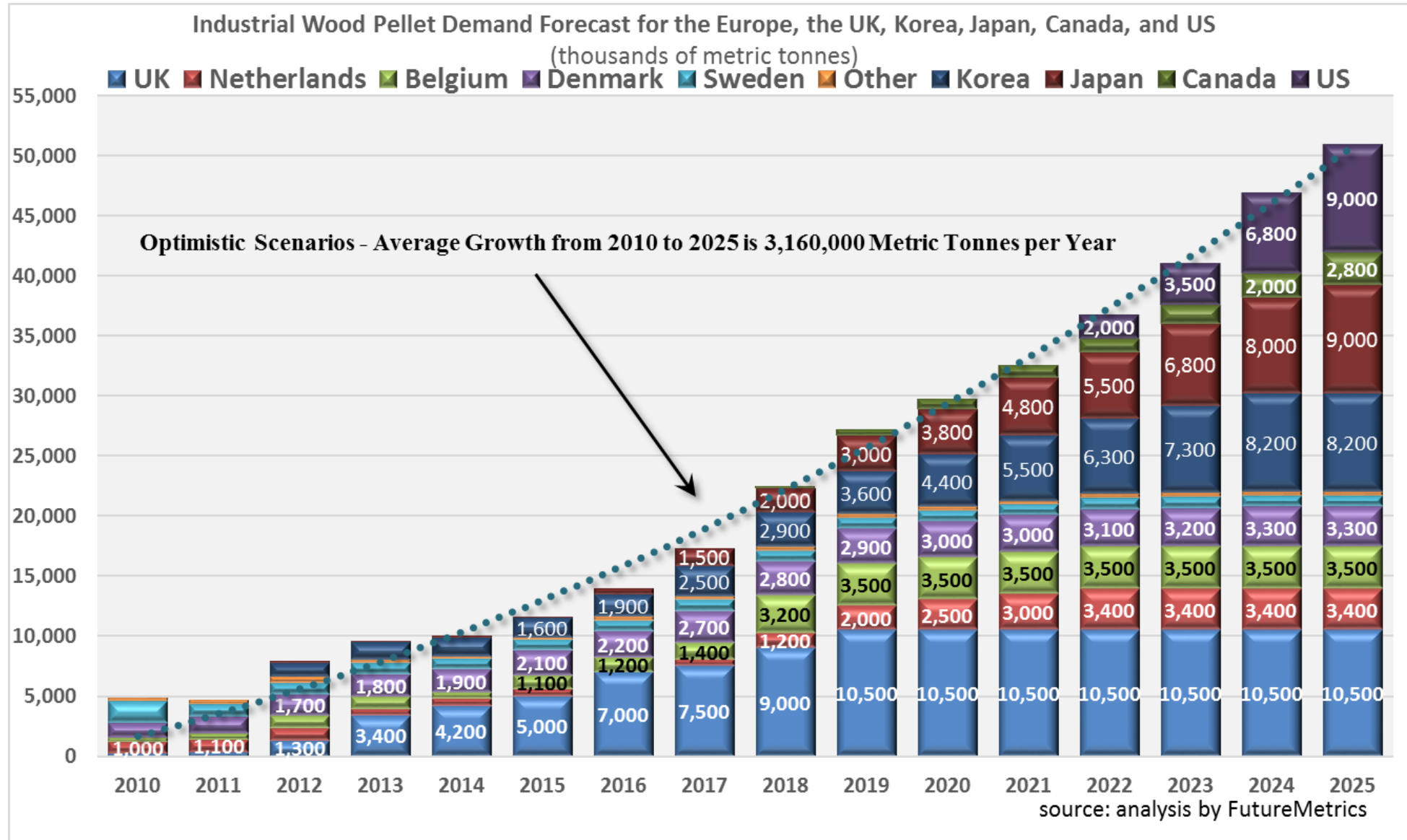
RAMBOLL

- Global leader in providing engineering services to power stations
 - Significant experience and in-house expertise in power plant modifications from coal to co-firing or full conversion to wood pellet fuel
-



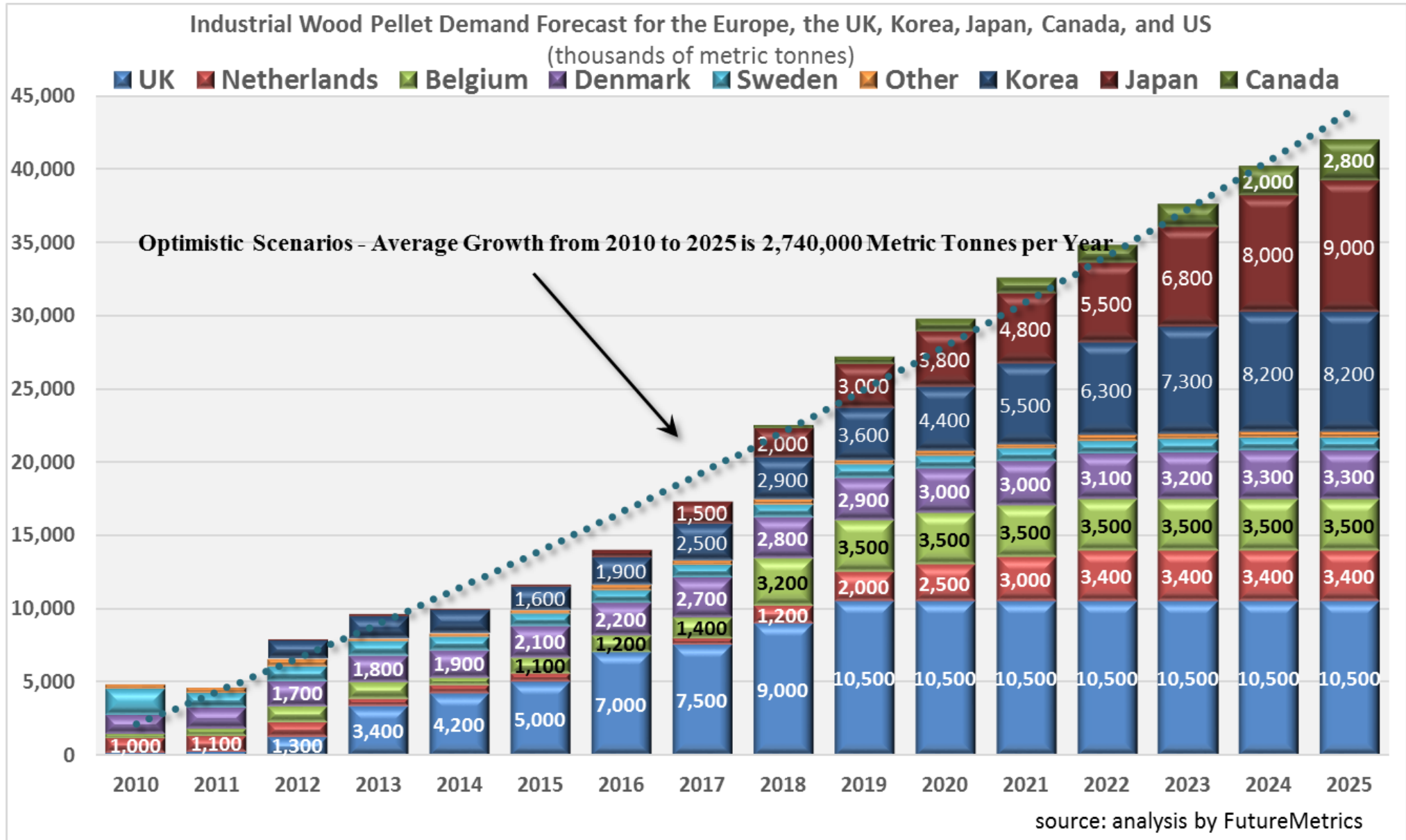
- Global leader in building and modifying power plants
- Significant experience in conversion projects, including EPC roles that include guarantees on both reliability and rating

FutureMetrics View of the Potential Global Industrial Pellet Sector



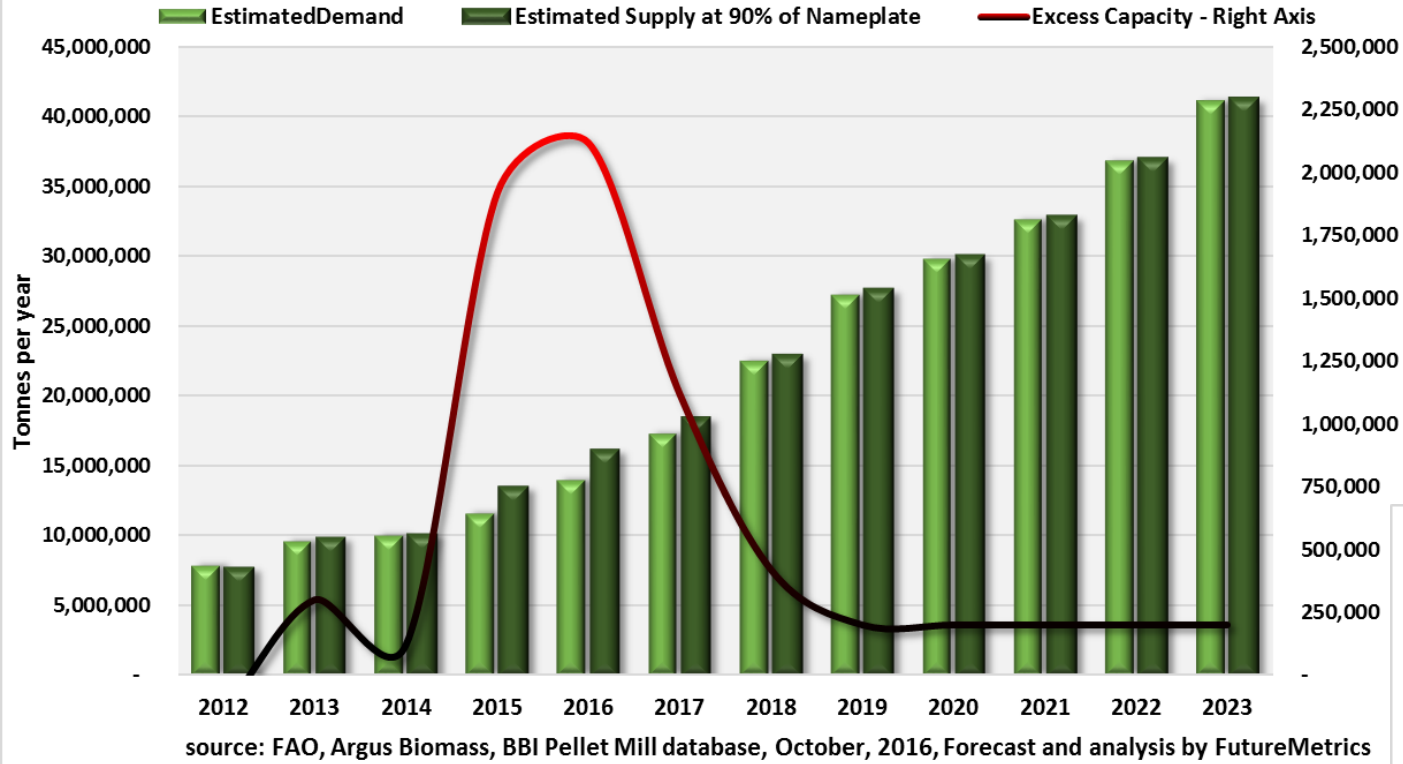
US depends on who wins the election!!

FutureMetrics View of the Potential Global Industrial Pellet Sector



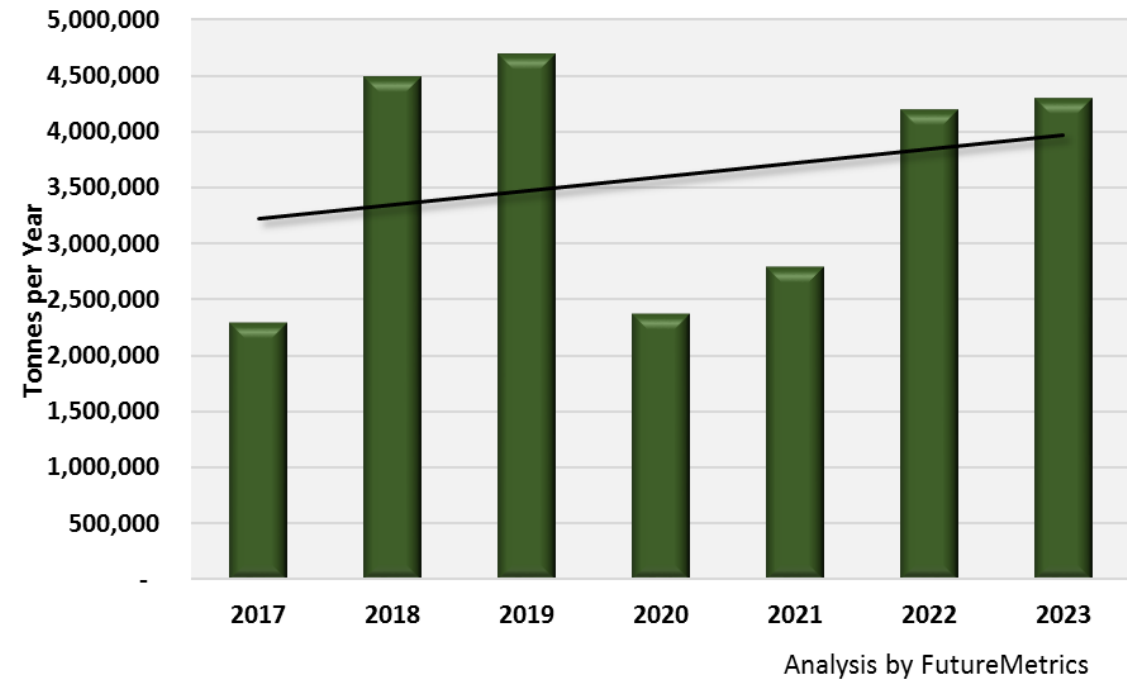
Without the US – Trump becomes president.

Estimating Supply/Demand and Excess Capacity



If growth is as expected in previous slide...

Estimated New Pellet Production Capacity Needed to Match Optimistic Scenario Demand Growth

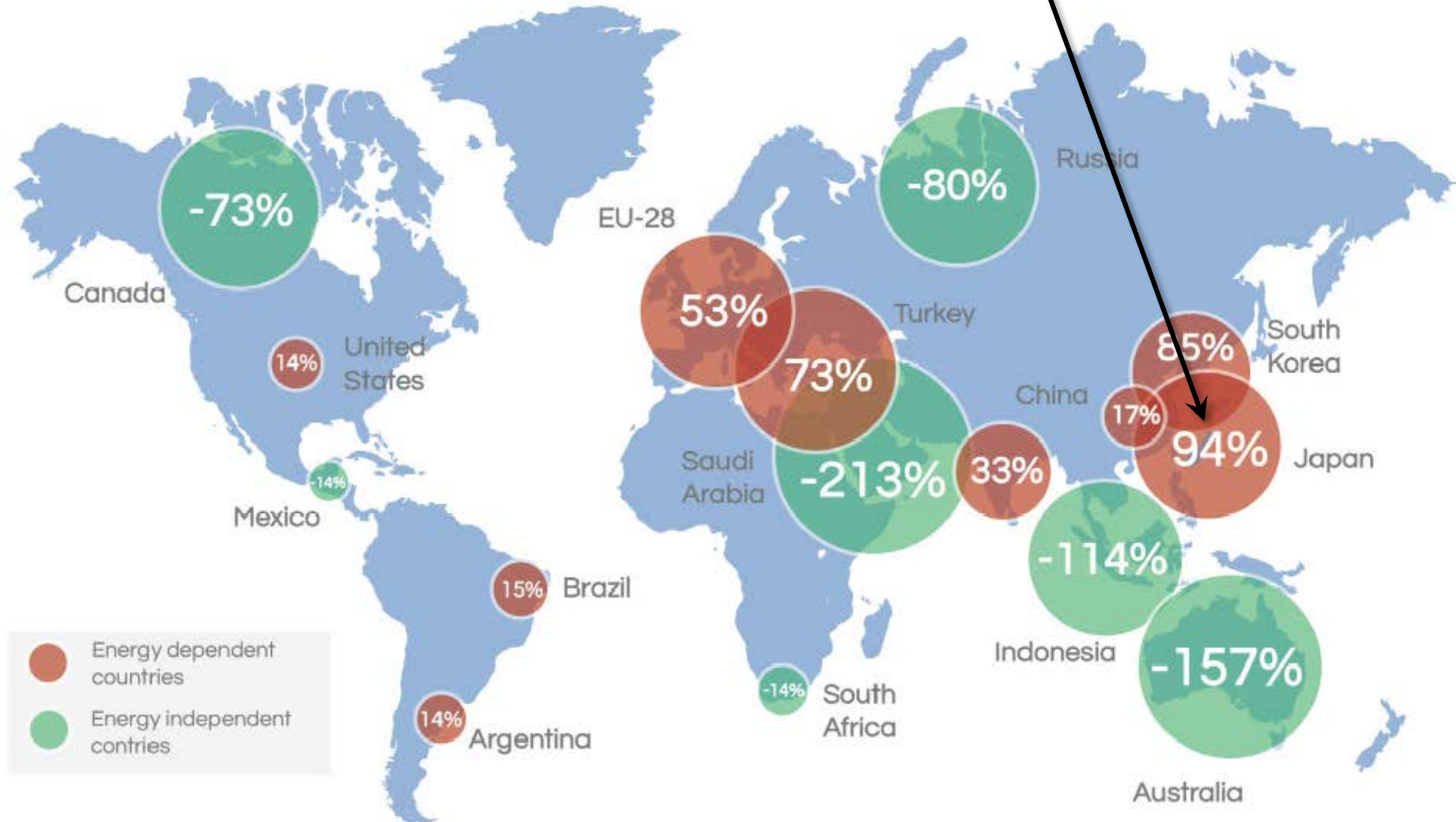


The Japanese Market for Industrial Wood Pellets

Japan is the most energy dependent country



World map of the energy dependency
(in 2013, %)



Source: Eurostat and the International Energy Agency

Map from AEBIOM Statistical Report, 2016

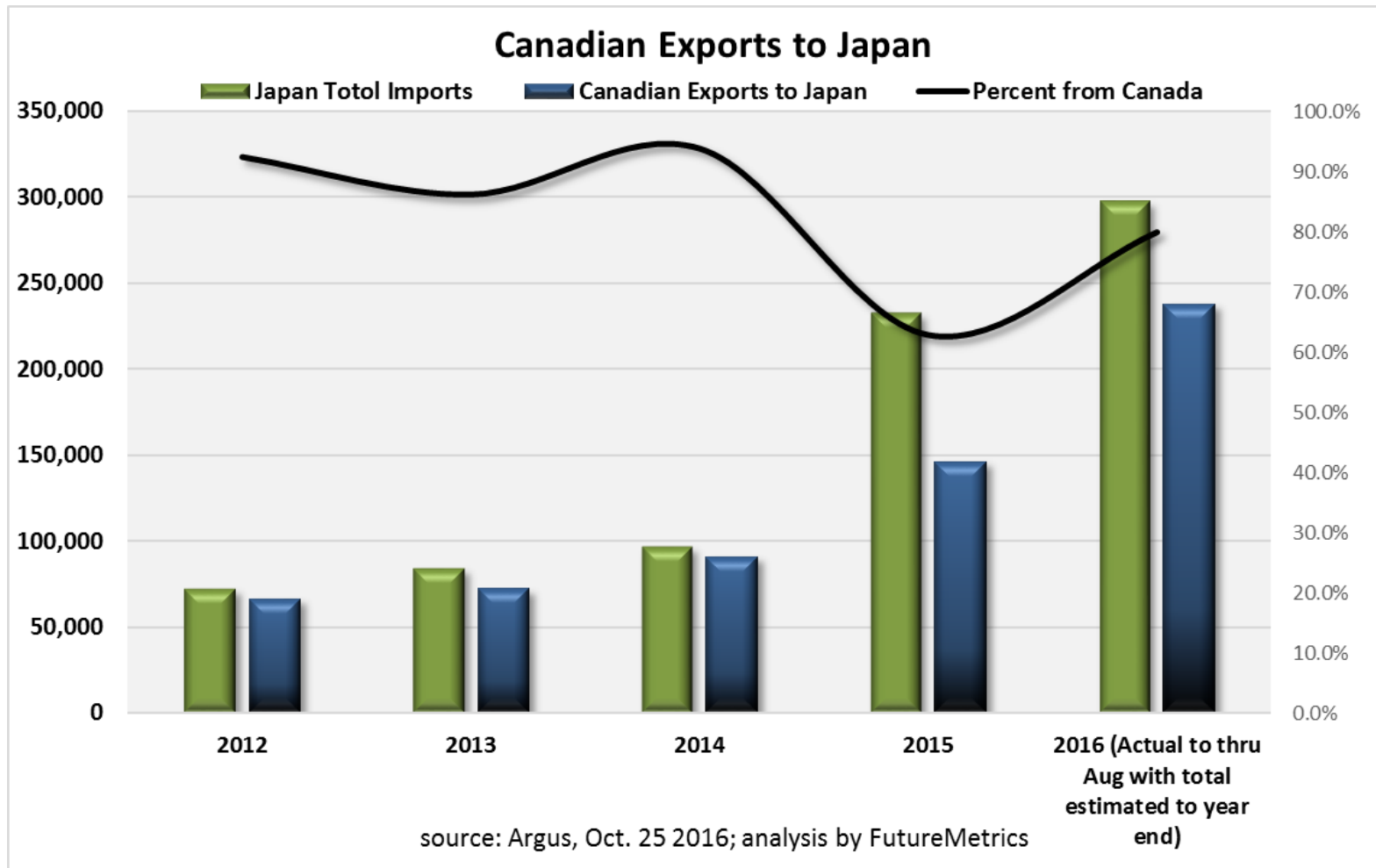
There are several policies in Japan that are driving current growth and will drive future growth.

Under one plausible scenario, Japan could be demanding well in excess of 15 million tonnes per year of wood pellets by the mid-2020's.

Most of Japan's imports are currently from western Canada.

The Japanese utilities and/or the Japanese trading houses are interested in long-term contracts with well-established suppliers and strict accountability for sustainability and the legality of harvesting.

These requirements favor North American pellet producers.



Increasing demand from Japan will stimulate new industrial wood pellet production capacity in the US, Canada, and from other producer jurisdictions that can deliver pellets at competitive prices and source feedstock legally, sustainably, and with *security for long-term supply and durability of contracts.*

Policies that will support industrial wood pellets in Japan:

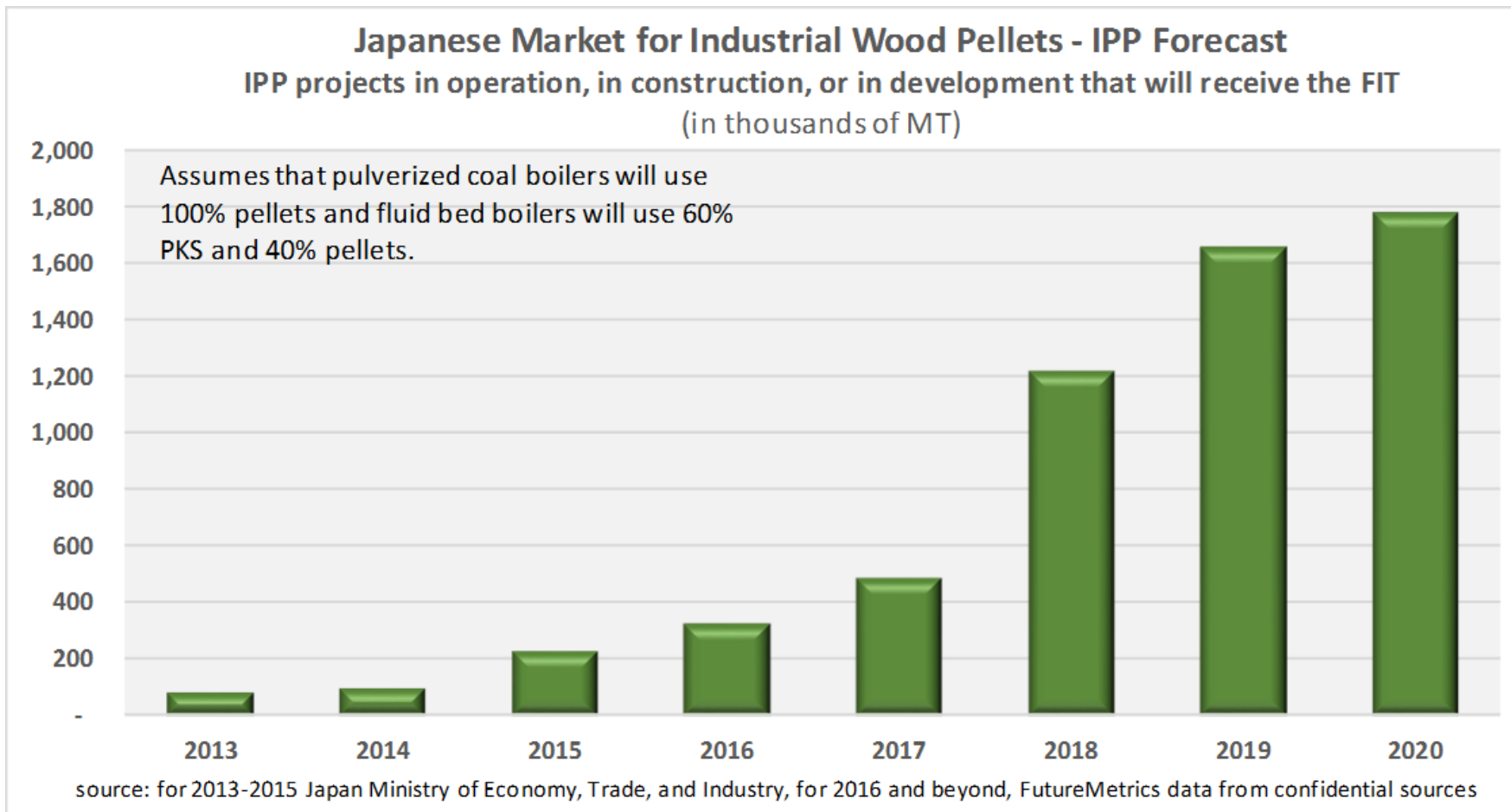
[1] Feed in Tariff (FIT)

[2] Carbon Emissions Targets

[3] Best Energy Mix

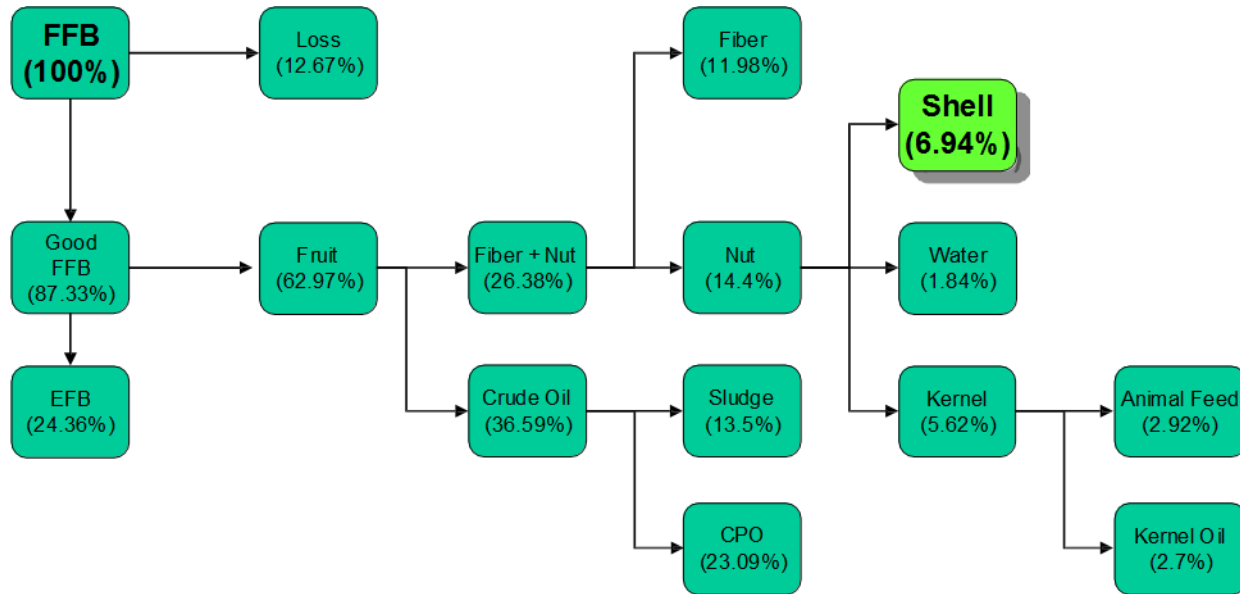
[1] The FIT is offered to independent power producers (IPPs) at rates that vary depending on the type of energy.

For wood pellets and other biomass such as palm kernel shells (PKS) the current FIT is 24 Yen per kWh. This converts to about \$0.233/kWh or \$233/MWh. The rate is set and guaranteed for 20 years.



If all circulating fluid bed projects use 100% PKS or other biomass fuels other than pellets, pellet demand by the IPPs is expected to be about 1.2 million tons per year by 2020.

Palm Kernel Shell (PKS) – Not suitable for large scale pulverized coal boilers but useful in smaller circulating fluid bed boilers.



[PKS] demand is expected to rise sharply as a result of increased Japanese demand. Japanese PKS imports rose to 306,000 tonnes in the first half of 2016, a 75% increase on imports during the first half of 2015, and are expected to increase further throughout the year.

Source: Argus Biomass Report, Sept 28, 2016

While the technology for producing PKS is well developed, unlike the industrial wood pellet supply chain, there are many risks in the PKS supply chain. Supply risk is summarized by the following:

- Highly manual operations and logistics
- Multiple locations have to be aggregated
- Weather / crop Issues
- Unreliable suppliers
- Constant infrastructure challenges
- Port congestion
- Producer countries domestic biomass demand increasing
- Local mills using PKS themselves

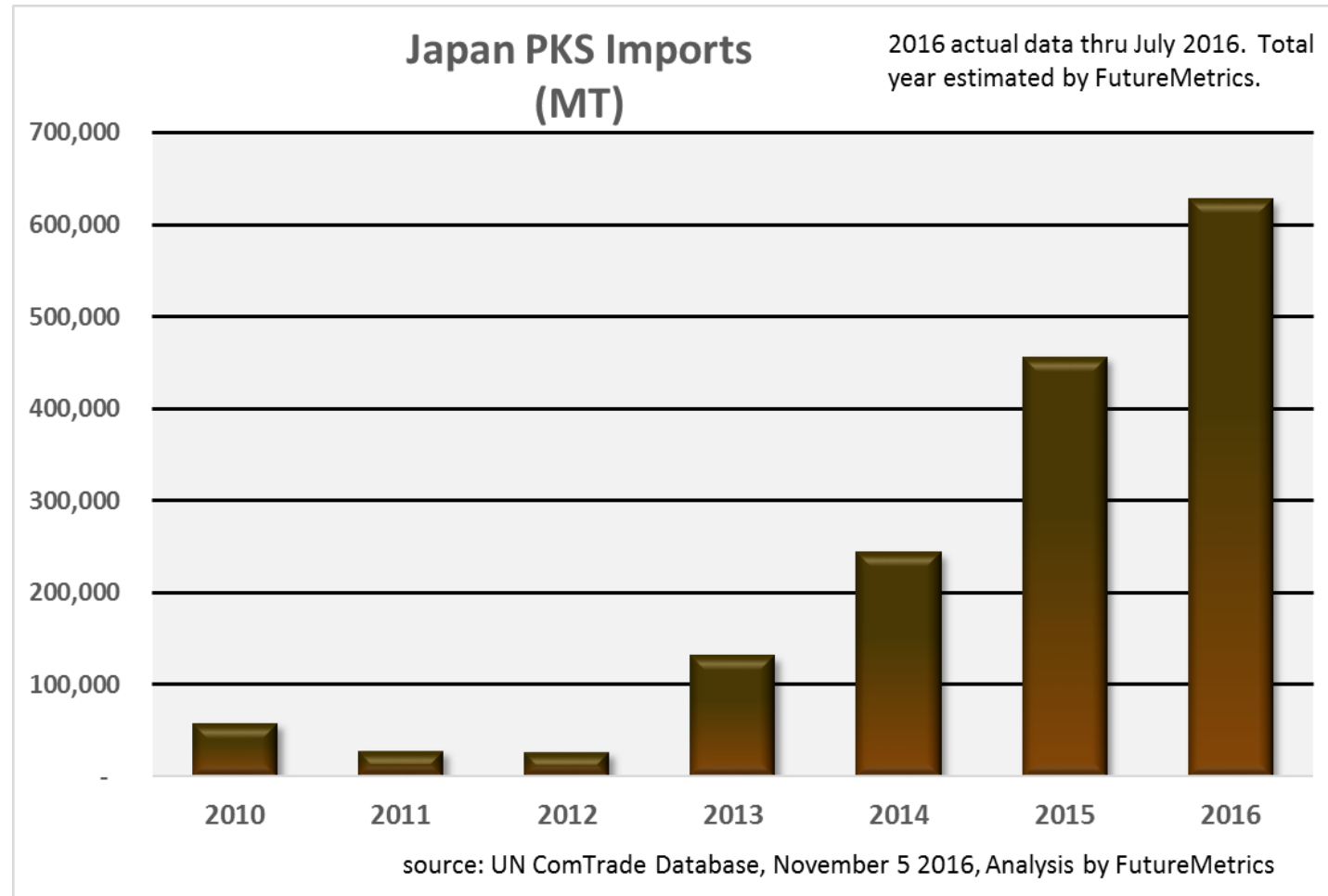
source: Asia Resource Partners; CPO = crude palm oil



Japan's PKS demand growth may trigger shortage

Singapore, 12 October (Argus) — Japan may need as much as 20mn-30mn t/yr of palm kernel shells (PKS) by 2030 to help meet its renewable energy standard, likely generating a shortfall given Malaysian and Indonesian production levels, Japan's External Trade Organisation (Jetro) said.

Japan's sole PKS suppliers, Indonesia and Malaysia, produce 7.5mn t/yr and 5.5mn t/yr of PKS respectively and also have large and growing domestic markets. This means "there will naturally be a shortage" of PKS as Japan nears its renewable energy target of 22-24pc for electricity generation by 2030. Some Japanese utility buyers have concerns about security of supply and sustainability when it comes to PKS, and see wood pellets as a more secure and sustainable alternative. But this has not deterred the strong forecasts for PKS demand. Japan's Biomass Fuel president Eisuke Nomura projected earlier this year that Japan's PKS imports could reach 2.9mn t/yr by 2020. (source: Argus Direct)



[2] Carbon Reduction Mandates

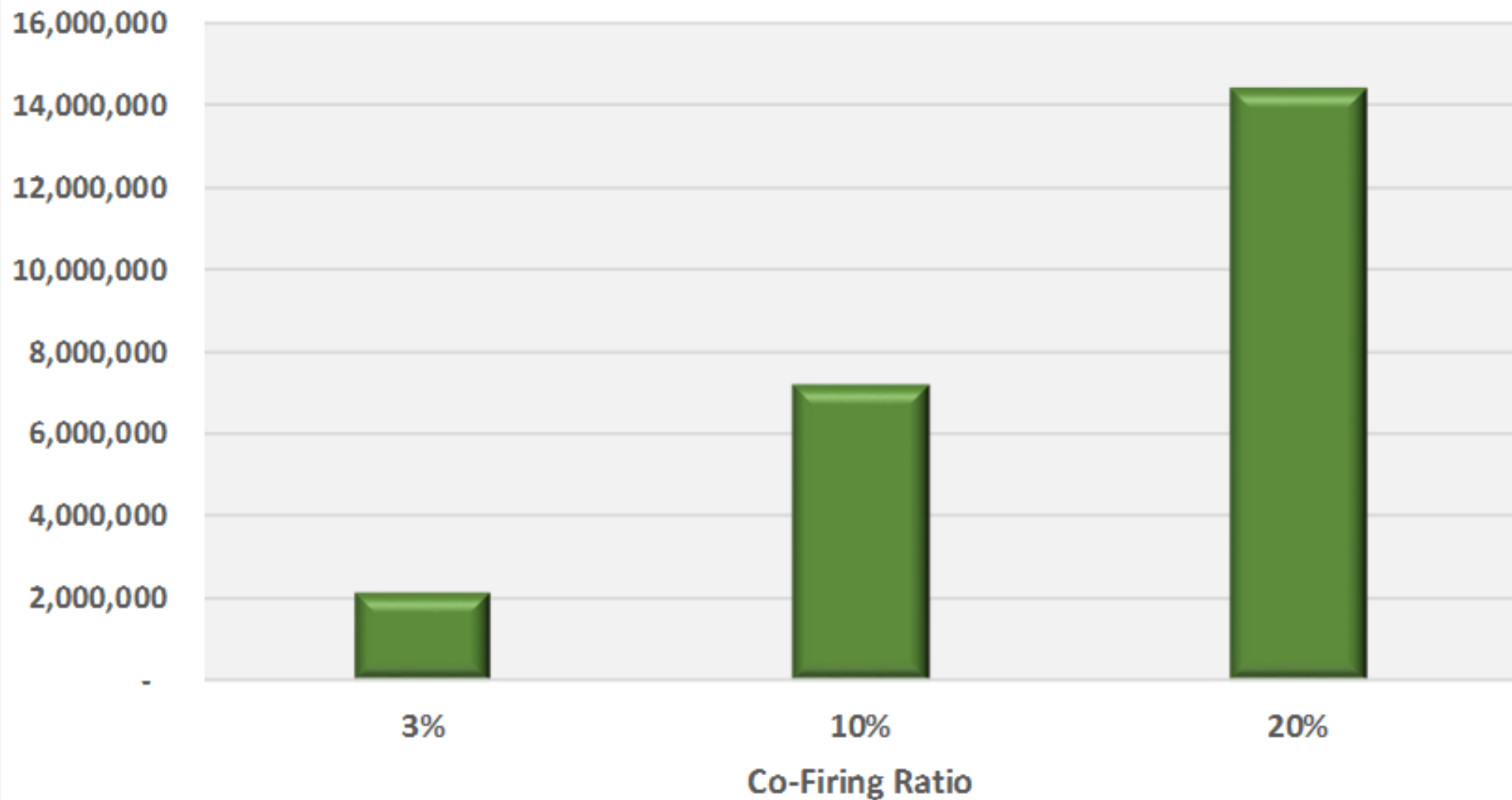
Japan has already implemented a target reduction of CO₂ emissions that will require all power companies to reduce CO₂ per kWh by 35% from 2013 levels by 2030.

It is currently a voluntary target but a few major utilities are already co-firing wood pellets at modest 3% ratios.

There are a few other pulverized coal (PC) power stations also co-firing and there are some that are having discussions for pellet fuel supply. Those stations either currently co-firing or in discussions about fuel supply add up to about 18,700 MWs.

The chart on the next slide shows pellet demand at these stations under three co-firing ratios.

Tonnes per Year of Pellet Demand for Selected PC Power Stations in Japan at Three Co-firing Ratios



Data from confidential sources; Analysis by FutureMetrics

Shinchi power station is a 2 x 1,000 MW supercritical coal plant in Japan.

Co-firing at ~3% wood pellets with no mods to the plant.
~130,000 tonnes per year.



Bill Strauss

Purpose built ship unloader for pellets.



[3] Best Energy Mix

The Japanese government's analysis expects the nation to demand about 1,065 billion kWh's in 2030. The government's strategic plan includes a breakdown of the desired/mandated energy mix in 2030.

Based on 1,065 Million MWh's of Demand in 2030	Energy Mix	Millions of MWh's		<i>Renewable Portion</i>	Energy Mix	Millions of MWh's	
Renewable	23%	244.95		Geothermal	1.0%	10.65	
Nuclear	21%	223.65		Biomass	4.3%	45.80	
LNG	27%	287.55		Wind	1.7%	18.11	
Coal	26%	276.90		Solar	7.0%	74.55	
Oil	3%	31.95		Hydro	9.0%	95.85	
TOTALS	100%	1,065.00				23.0%	244.95

Large existing power plants use pulverized coal fuel systems in which the coal is ground to a fine particle size and pneumatically conveyed to the burners. Only wood pellets can be easily ground and used in PC boilers. In the table below, the assumption is that 30% of the 6,150 MWs are produced from pellets being co-fired with coal in modified existing coal power stations.

Analysis of Potential Wood Pellet Demand Based on Government's Best Energy Mix Policy for 2030

Based on 1,065 Million MWh's of Demand in 2030	Energy Mix	Millions of MWh's		Renewable Portion	Energy Mix	Millions of MWh's	Capacity Factor	Nameplate MW's Needed	Tonnes of Wood Pellets per Year if 30% of Needed MW's are Produced from Pellets	
Renewable	23%	244.95		Geothermal	1.0%	10.65	90%	1,351	7,640,000	
Nuclear	21%	223.65		Biomass	4.3%	45.80	85%	6,150		
LNG	27%	287.55		Wind	1.7%	18.11	30%	6,889		
Coal	26%	276.90		Solar	7.0%	74.55	25%	34,041		
Oil	3%	31.95		Hydro	9.0%	95.85	90%	12,158		
TOTALS	100%	1,065.00				23.0%	244.95			60,589

2030 MWh demand and energy mix from Japan Ministry of Economy, Trade, and Industry

Analysis by FutureMetrics

There is a scenario in which the Japanese market's demand for biomass could be much larger.

Under the government's policy for the best energy best mix, any generation not produced by nuclear has to be made up by low carbon renewable generation.

Most experts in Japan think that it is unlikely that Japan will generate 23% of its power from nuclear stations in 2030.

If nuclear does not reach 23%, the best available renewable low carbon pathway that can supply baseload power is pellets being co-fired or full-fired in existing utility PC power stations.



Low Nuclear Scenario			Low nuclear made up by baseload biomass					
Based on 1,065 Million MWh's of Demand in 2030	Energy Mix	Millions of MWh's	<i>Renewable Portion</i>	Energy Mix	Millions of MWh's	Capacity factor	Nameplate MW's Needed	Tonnes of Wood Pellets per Year if 30% of Needed MW's are Produced from Pellets
Renewable	↑ 32%	340.80	Geothermal	1.0%	14.82	90%	1,879	
Nuclear	↓ 12%	127.80	Biomass	↑ 13.3%	197.07	85%	26,467	32,880,000
LNG	27%	287.55	Wind	1.7%	25.19	30%	9,585	
Coal	26%	276.90	Solar	7.0%	103.72	25%	47,362	
Oil	3%	31.95	Hydro	9.0%	133.36	90%	16,915	
TOTALS	100%	1,065.00		32.0%	474.16		102,208	

2030 MWh demand and energy mix from Japan
Ministry of Economy, Trade, and Industry

Analysis by FutureMetrics

Conclusion

The Japanese industrial wood pellet market has a high likelihood of developing significant demand over the next decade.

Japanese buyers value the ability of the producer to offer contract longevity and security of certified sustainable supply.



Thank you!

William Strauss
(and Fritz)

FutureMetrics