Biomass Power Options for Power Generation: Pellets, PKS, Chips...?

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FutureMetrics

Intelligent Analysis, Operations Expertise, and Strategic Leadership for the Pellet Sector

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- Project evaluation and risk analysis for investors
- Operations optimization for new and existing pellet plants
- Market research and strategic guidance across the pellet supply chain
Consultants to the World’s Leading Companies in the Wood Pellet Sector

Selection of Current and Recent Clients of our Team
The **FutureMetrics** Coal-to-Pellets Team

- 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

- Financing for new pellet manufacturing, new pellet transportation infrastructure, and power plant upgrades and modifications
- An investment and asset management subsidiary of Manulife Financial investing capital in timberland, agricultural land and renewable energy infrastructure (with a focus on biomass)

- 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

*FutureMetrics - Intelligent Analysis, Operations Expertise, and Strategic Leadership for the Pellet Sector*
Award Winning and Well-Respected FutureMetrics Team Members

Dr. William Strauss, President

- Named one of the most influential leaders in the biomass sector in 2016 and 2017 by *Argus Media*.
- Recipient of the 2012 International Excellence in Bioenergy Award.

John Swaan, VP

- Recipient of the 2014 International Founders Award.
Growth from 2020 onward is primarily expected to be in Japan and S. Korea.

Source: Historical data from Argus Direct, 2017 and beyond, forecast and analysis by FutureMetrics.
Japan is the most energy dependent country; S. Korea is a close second.
Both Japan and S. Korea are major importers of coal.

For renewable low carbon thermal energy generation, biomass imports will be needed.

Wood Pellets, Palm Kernel Shell (PKS), or Chips?
A Primary Consideration for Biomass Fuels:
The cost per unit of energy delivered to the power station!
(There are other considerations which are highlighted later in this presentation)

Optimizing the cost of the delivery of energy (gigajoules or GJ’s) drives the selection of fuel.

Wood chips are 40% to 55% water! So transport cost per GJ are high.
When used as fuel, the high moisture content dramatically lowers efficiency.
The power plant needs a very large area and to store the lower energy density fuel.

Dry energy-dense fuel is preferred: wood pellets or PKS.
Wood pellets are used in existing large power boilers that rely on pulverized coal. Wood pellets pulverize and can substitute for coal. If properly modified, there is no lost of output or reliability.
Palm Kernel Shell (PKS) – Are not suitable for large-scale pulverized coal boilers (they do not pulverize) but are used in smaller circulating fluidized bed (CFB) boilers.

While the technology for producing PKS is well developed, compared to the industrial wood pellet supply chain, there are more risks in the PKS supply chain. Long-term consistent offtake is challenging.

Supply risk is summarized by the following:

- Highly manual operations and logistics
- Multiple locations have to be aggregated
- Weather / crop Issues
- Uncertainty with consistency of suppliers
- Infrastructure challenges
- Port congestion
- Producer countries domestic biomass demand increasing

source: Chart, risk summary, and photos from Asia Resource Partners; CPO = crude palm oil
Many of the IPP projects in Japan built to benefit from the FIT are CFB systems.
Large existing utility power stations have to use a fuel that pulverizes into consistent fine particles. They also need a reliable and robust supply chain. That will drive demand for wood pellets.

New-build smaller circulating fluidized bed (CFB) power plants can use a wide variety of biomass fuels. That will drive demand for PKS and other biomass.
Major Drivers for Japan and S. Korea for Biomass Imports

**Japan** is guiding the power generation industry with three areas of policy:

1. carbon reduction goals,
2. “best energy mix for 2030” goal, and
3. the Feed-in-Tariff (FIT) with a locked in 20-year known rate for power (¥21/kWh or about $180/MWh at current FX).

The only policy instrument that currently provides a monetary incentive is the FIT.

**Explicit CO₂ goal and FIT only awarded if wood pellets are from certified sustainable sources.**

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**S. Korea** is guiding the power generation industry with a Renewable Portfolio Standard (RPS). The RPS program requires 13 largest power companies (with installed power capacity larger than 500 MW) to steadily increase their renewable energy mix in total power generation over the period from 2012-2024.

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The instrument that provides a monetary incentive are Renewable Energy Certificates (RECs) and fines for non-compliance.

**CO₂ not explicit. Sustainability criteria in flux...**
Japan

Carbon Emissions Targets - 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. This will drive increased compliance challenges in large power stations and therefore increase the demand for wood pellets.

A few major utilities are already co-firing wood pellets at modest 1% to 3% ratios in pulverized coal (PC) stations.

**Major gencos can now benefit from the FIT.**

**Only wood pellets can be co-fired in large PC power plants.**

About the same output and demand as the Drax power station in the UK.
For power companies to meet their RPS targets they can:

(1) invest in renewable energy installations themselves and generate RECs (one REC per MWh), or

(2) purchase RECs on the market to meet their obligation.

The power companies have to submit the total RECs either generated or purchased to the New and Renewable Energy Center (KNERC) on an annual basis.

If the power company fails to present required number of RECs, KNERC applies a financial fine. The penalty equals to 150% of the average market price of the REC for that year.

The non-compliance fine, based on 2016 average REC price, is equivalent to $225/MWh!
Some industry participants are now projecting total South Korean woody biomass demand of around 7mn-8mn t/yr by 2020, an upward revision from 5mn-6mn t previously. This growth is based on conversion projects and the addition of at least two large dedicated biomass power projects in South Korea in the coming years. Previously announced planned projects by state-controlled utilities Koen and Korea Midland Power (Komipo), as well as a joint project by construction company Hanyang and state-controlled nuclear power producer KNHP, could together create demand for 3.6mn t/yr of wood pellets when they start full operations by 2020, according to Argus calculations. (source: Argus Direct, April 17, 2017)
Japan Pellet Imports are Primarily from Canada

Japanese Industrial Pellet Imports

- **2012**: Canada % of Total = 92.3%
- **2013**: Canada % of Total = 93.7%
- **2014**: Canada % of Total = 86.1%
- **2015**: Canada % of Total = 62.9%
- **2016**: Canada % of Total = 75.2%
- **2017 (forecast)**: Canada % of Total = 75.5%

Source: Argus Direct, April 2017; 2017 forecast and analysis by FutureMetrics
South Korean Pellet Imports are Primarily from Vietnam

South Korea Industrial Pellet Imports

source: Argus Direct, April 2017; 2017 forecast and analysis by FutureMetrics
Japan FIT has resulted in many small independent power producers (IPPs) building small power stations using CFB boilers which can combust many forms of biomass. Thus PKS imports have surged.

S. Korean RPS has impacted the large gencos who have to use a pulverizable fuel in their large PC boilers. Thus PKS is not supported by the RPS.

Future growth in demand for biomass will be dominated by wood pellets.

The certification of sustainability will become critical.
Key characteristics that will determine pellet sourcing

✓ Cost of Wood / Cost to Produce Pellets
  • Health of other nearby forest products sectors: sawmilling (plus), pulp and paper (minus), furniture industry (plus).
  • Good infrastructure for harvest and extraction (logging, trucking, aggregation)
  • Growth rate (10 year rotation versus 50 year rotation)

✓ Sustainability
  • No depletion of the forest or the carbon stock held in the forest (Japan ✔, S. Korea?)
    • Growth rate is greater than or equal to the harvest rate
    • Other factors contributing the continuous health of forests and their habitants
  • Rule of law and lack of corruption to provide underpinning to the sustainability certification and the long-term security of offtake agreements (Japan engages in long-term offtake; S. Korea does not, and may not!)

✓ Logistics
  • Mill-to-port distance and quality of roads and rail
  • Size and “busyness” of the terminal
  • Shipping distance
What about so-called “black” pellets?

Two types:
- Torrefied
- Steam Exploded

**Advantages:**
- Higher energy density which lowers transport cost per GJ.
- Steam exploded pellets are water resistant.
- Drop in coal replacement (not true – next slide)

**Disadvantage:**
- To date, delivered cost per GJ has not provided an advantage over white pellets (including accounting for lower transport and the avoided dry storage costs)
The PC power station still has to be modified to **safely and efficiently** use black or white pellets.
FutureMetrics works with Ramboll on optimized power plant mods and conversions.
About 16,000,000 metric tonnes of white pellets will be consumed in power plants in 2017.

To date, for black pellets as replacement fuel in PC power stations:

0,000 tonnes/year of torrefied pellets and about 7,500 tonnes/year of steam exploded pellets from Norway in one super-peaking station in Canada that runs only a few days per year.

Reliable and cost effective thermal treatment processes have been elusive... We will hear more later in this session.
Conclusion

Demand for wood pellets in Japan and S. Korea will increase significantly and rapidly.

Carbon reduction targets in Japan and RPS in S. Korea means that...

Existing PC power stations will be using sustainably sourced, and reliably produced and delivered wood pellet fuel.
Thank you

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