DEMAND FOR BIOMASS PELLETS AND CHIPS: JAPAN AND SOUTH KOREA

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BIOMASS PELLET AND CHIP MARKETS: JAPAN AND SOUTH KOREA

Japan and South Korea are the two largest consumers of wood pellets and wood chips in Asian markets.

Japan's consumption of wood pellets is increasing significantly, higher by 46% in 2017 at 506,000 metric tons. Under the country's Feed-In Tariff (FIT) program aimed at increasing renewable energy production, this only promises to continue. In the last six months, announcement of new biomass facilities that will use wood pellets have averaged one per month:

- Biopower Kanda Goudou Gaisha's (a subsidiary of Kansai Electric Power) 75-MW biomass power plant in Kanda Machi
- An Obayashi's 50-MW biomass power plant in Kamisu-shi
- Renova's 75-MW biomass power plant in Kanda Machi, one of five planned 75-MW projects
- eRex's 300-MW biomass power plant in Oita, which will be one of the largest in the world
- Osaka Gas's 75-MW biomass power plant in Sodeguara
- Equis Bioenergy's 50-MW biomass power plant in Takaoka-shi

And these facilities are just the tip of the iceberg. The Japanese government has approved nearly 3.4 GW of biomass-fired capacity since the Fukushima Daiichi nuclear disaster. While it is unlikely that all this capacity will be built, once the additional demand enters the market, Japan's reliance on pellet producers from around the globe will increase. By 2030, Japanese demand for biomass will fall between 15 and 20 million tons per year (MTPY).

South Korea has been consuming between 1.5 to 2.5 million metric tons of wood pellets annually for the last four years, an increase precipitated by the country's adoption of a renewable portfolio standard (RPS). Thus far, most utilities meet their binding renewable obligations by co-firing coal and wood pellets, most of which are sourced from Vietnam. In 2017, Korea's consumption of wood pellets increased 42%, and the growth trend is likely to continue. New projects range from co-firing to full conversions and are scheduled to be commissioned in 2020 and 2021:

- Korea South East Power's (Koen) conversion of a second 125 MW coal-fired plant in Yeongdong
- Korea Midland Power (Komipo) 75 MW project in Gunsan
- Joint project by construction company Hanyang and state-controlled nuclear power producer KNHP, a 75 MW in Gwangyang
- SMG Energy’s S1 biomass plant, a 100MW project in Gunsan
- CGN’s 109MW dedicated plant in Daesan
- GS EPS's second 105MW dedicated biomass plant, Dangjin 2

By 2021, the Korean market for pellets is expected to total 6 MTPY.

While renewable energy policies in both countries are revised every two or three years, modifying the level of support to advantage different technologies based on current events, growth in South Korean and Japanese demand for biomass in the form of wood pellets or chips will continue.

As biopower markets in Asia mature, the increased competition for wood pellets and chips will provide opportunities for suppliers of these materials around the globe. Because biomass pellets can be made with low-cost wood raw materials and the cost of shipping is low, the number of potential suppliers is significant. Biopower producers in Japan and South Korea will require a secure and consistent supply of both pellets and chips, sometimes from multiple suppliers in multiple geographies. As a result, they will require strong procurement strategies, supply chain risk assessments, cost analyses, supplier diligence processes and contract negotiation strategies.

POLICY DEVELOPMENTS

Japan

Current

According to Organisation for Economic Co-operation and Development (OECD)[i], Japan has the second largest electricity market and the third largest economy in the world. Prior to the Fukushima Daiichi event, Japan's power was primarily generated from fossil fuels and nuclear reactors. Soon after the disaster, Japan increased its use of, and dependence on, fossil fuel imports for thermal generation, leading to an increase in electricity prices and in Japan's greenhouse gas emissions. In July 2012, the Japanese government established a renewable electricity goal, pledging that between 25%-35% of its electricity will be generated from renewable sources by 2030. To make this possible, Japan also introduced a generous feed-in tariff system to promote the introduction of renewable energy.

The FIT system requires power companies to buy electricity generated from renewable energy sources at set rates provided by the Minister of Economy, Trade and Industry (METI) for a period of 10 to 20 years. Operators of electric utilities can recover costs incurred by the purchase of renewable electricity by invoicing consumers a surcharge in addition to the amount usually charged for the supply of electricity. The following table highlights the METI FIT annual rates and specified periods.

FIT Purchase Rates per Year (10/3/2018 Yen to USD Exchange Rate)			
Category	**FY 2017 Rate**	**FY 2018 Rate**	**FY 2019 Rate**
Solar Power	¥21-30 ($0.18-0.26) per kWh	¥25-28 ($0.22-0.25) per kWh	¥24-26 ($0.21-0.23) per kWh
Wind Power	¥18-55 ($0.16-0.48) per kWh	¥17-36 ($0.15-0.32) per kWh	¥16-36 ($0.14-0.32) per kWh
Hydro Power	¥12-34 ($0.11-0.30) per kWh	¥12-34 ($0.11-0.30) per kWh	¥12-34 ($0.11-0.30) per kWh
Geothermal Power	¥12-40 ($0.11-0.35) per kWh	¥12-40 ($0.11-0.35) per kWh	¥12-40 ($0.11-0.35) per kWh
Biomass Derived Power			
Wood Materials	¥13-40 ($0.11-0.35) per kWh	¥13-40 ($0.11-0.35) per kWh	¥13-40 ($0.11-0.35) per kWh
Waste Materials	¥17 ($0.16) per kWh	¥17 ($0.16) per kWh	¥17 ($0.16) per kWh
Biogas from methane fermentation	¥39 ($0.38) per kWh	¥39 ($0.38) per kWh	¥39 ($0.38) per kWh

FIT rates for some types of renewable energy have decreased for 2017-2019 compared to the previous three years (sun, wind, hydro and geothermal). FIT rates for biomass have remained unchanged, which has helped boost the number of operational and announced biomass power plants.

Future

Japan's most recent energy plan backs off the 25-35% renewable energy goal to a degree. It calls for an energy mix that breaks down as follows:

- Nuclear plants will be restarted and account for 20%-22% by 2030.
- Renewable energy will account for 22%-24% by 2030, with solar energy accounting for 7%.
- Fossil fuels will account for 56% by 2030: coal (26%), oil (3%), and natural gas (27%).

While Japan's Strategic Energy Plan, which was approved by the Cabinet on July 3, 2018, sets a goal of making renewables a key power source, the achievement of that goal will be dependent on whether the government manages to reduce the financial burden of the FIT passthrough on Japanese ratepayers,

which is expected to be more than 50 trillion yen over the next two decades, according to The Institute of Energy Economics in Japan.

One of the methods the government is using to control costs is to replace the FIT scheme for some technologies with an auction system. In 2017, a solar PV auction of more than 2MW was the first to move from FIT to auction, and in 2018, there will be two solar PV auctions for 250 MW each. In December of 2018, both woody biomass of more than 10MW and liquid fuel biomass will switch from FIT to auction. The first auctions will be for 180 MW and 20 MW, respectively.

Despite the rising costs, the FIT program has been an effective one. Both solar and biomass have enough capacity either in operation or FIT-certified but not yet in operation to exceed their 2030 targets.

Two other oddities about Japan's energy plan should be noted, according to an article in *Science* by Dennis Normile[ii]:

1. Outside of China and India, Japan's reliance on coal is the largest planned coal expansion on record. Japan's previous 2030 goal for coal was 10%. To this end, eight new coal stations have opened in the last two years, and 36 more are planned over the next ten. This will make the country's goal for cutting greenhouse gas emissions by 26% below 2013 levels almost impossible.
2. The reduction in FIT rates for solar has had a catastrophic effect on that sector, with investments in solar assets down 32% from last year.

Both developments could advantage biomass-based power.

South Korea

Current

In January 2012, the Renewable Portfolio Standard (RPS) replaced the previous feed-in tariff system to accelerate South Korea's goal to create a competitive market environment for renewable energy. The RPS program requires 13 of the largest power companies (those with installed power capacity larger than 500 MW) to steadily increase their renewable energy mix in total power generation from 2012 - 2024.

RPS targets are reviewed and adjusted every three years and can be met by electricity generated from wind, solar, biomass, biogas, waste-to-energy, landfill gas, tidal, hydro and integrated gasification combined cycle. Power producers in the RPS system receive Renewable Energy Certificates (RECs) based on the technology used and, to meet their RPS targets, can either invest in renewable energy installations or purchase RECs on the market. Power companies are obligated to submit gathered RECs to the New and Renewable Energy Center (KNERC) on an annual basis.

Annual RPS Targets (% of Renewable Energy Power Generation)												
2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2.0%	2.5%	3.0%	3.2%	4.0%	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%	10.0%	10.0%

The government of South Korea has expressed concerns about power generators' heavy reliance on co-firing to fulfill their RPS obligation. Therefore, it has proposed a 30 percent limit on the proportion of the RPS quota that each utility could achieve through co-firing to encourage investment in a wider portfolio of renewable technologies.

Renewable Energy Certificates by Technology		
Description	**Technology**	**Multiplier**
Solar	Agriculture	0.7
	>30 kW	1
	<30 kW	1.2
	Building intergrated	1.5
Wind	Onshore	1
	Offshore < 5 km	1.5
	Offshore > 5 km	2
Bioenergy	Biogass	1
	Biomass	1
	Landfill gas	0.5
	Waste-to-energy	0.5
Tidal		2
Fuel-Cell		2
Hydro		1
Intergrated gasification combined cycle		0.25

Future

In its most recent energy plan, South Korea increased its commitment to electricity generated from renewable sources. By 2030, South Korea's energy mix is expected to look like this:

- Coal-fired power generation will drop from 45.3% in 2017 to 36.1%.
- Nuclear power generation will drop from 30.3% in 2017 to 23.9%.
- Natural gas power generation will increase from 16.9% in 2017 to 18.8%.
- Renewable power generation will increase from 6.2% in 2017 to 20%.

At the end of June 2018, the Korean government amended its RPS and REC policies to favor local biomass and disadvantage imported pellets and chips. Domestic unused woody biomass, primarily forest residues, will be eligible for 1.5-2.0 REC/MWh. REC support for imported fuel sources will be reduced from its original 1.5 REC/MWh, to 1.0REC/MWh for projects that complete construction plans in H12019, and 0.5 REC/MWh for those completed in H2 2019. In the short term, some projects have accelerated their development schedules to qualify for higher REC support. Of the 6 MTPY of biomass demand that is anticipated by 20221, one-third is expected to be met with domestic sources because of these changes.

SUPPLY

Japan

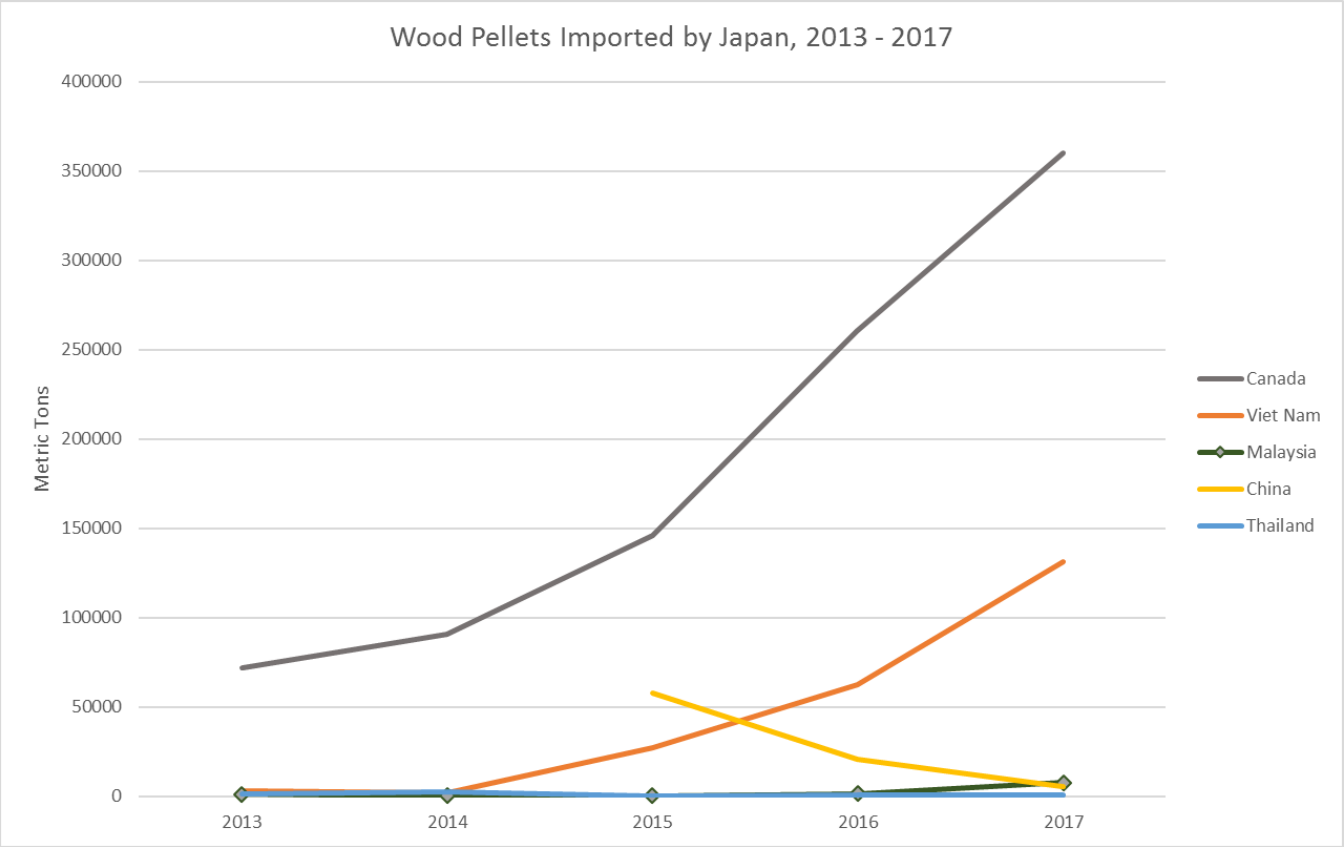
Wood Pellets

Japan's production and import of wood pellets has increased since the FIT system was expanded to include biomass and other renewables in 2012. In 2018, Japan is home to 145 operating pellet facilities that produce 125,000 metric tons annually; most facilities produce between 100 and 1,000 metric tons annually, which is a very small quantity compared to export wood pellet facilities in North America and Europe.

To make up the deficit, Japan imports most of its biomass. Canada has consistently been Japan's largest supplier of wood pellets, accounting for approximately 71% (or 360,068 metric tons) of the country's imports in 2017. Asian suppliers Malaysia and Vietnam both claimed larger market shares in 2017, with

roughly 300% increases for both. Both countries can compete on a cost-per-metric ton basis; however, Japanese buyers maintain strict criteria for pellet sustainability and quality.

Japan, Imports of Wood Pellets by Country of origin, 2012-2015							
Export Country	2017	2016	2015	2014	2016-2017 Change	% Change	Annual % Change
Canada	360,068	260,935	146,150	90,676	99,133	38.0%	58.4%
Viet Nam	131,115	62,441	27,440	1,979	68,674	*110.0%*	304.6%
Malaysia	7,604	1,418	162	128	6,186	436.2%	290.2%
China	5,592	20,733	57,870		(15,141)	-73.0%	NA
Thailand	951	451	194	2,682	500	110.9%	-29.2%
Norway	398				398	NA	NA
United States of America	316	306	237	563	10	3.3%	-17.5%
Indonesia	168	425	304	410	(257)	*-60.5%*	*-25.7%*
Estonia	52				52	*NA*	*NA*
New Zealand	45			280	45	NA	-45.6%
Latvia	23	46			23	*NA*	*-1.4%*
United Kingdom	21				21	NA	NA
Total	506,353	346,865	232,425	96,745	159,488	46.0%	73.6%



Total Wood-based Biomass Consumption

In total, Japan imported over 12.6 million metric tons of wood feedstocks in 2017, a 4% increase over 2016. Because the Japanese have higher quality standards and must therefore source more biomass

from Canadian producers, its overall average prices are significantly higher than those paid by South Korea.

Japan, Imports of Wood Pellets and Wood Chips, 2016-2017								
	Pellets			Chips			Total Tons	Total Dollars
Year	Tons	Avg Price	Total Dollars	Tons	Avg Price	Total Dollars		
2016	346,855	$182	$62,992,000	11,900,600	$179	$2,124,540,000	12,247,455	$2,187,532,000
2017	506,353	$172	$87,271,000	12,169,839	$173	$2,106,544,000	12,676,192	$2,193,815,000
% Change	46%	-5%	39%	2%	-3%	-1%	4%	0%

In 2017, Japan primarily used non-coniferous wood chips as an energy source: 86% of its wood feedstocks were sourced from this category. And while its use of both coniferous and non-coniferous wood chips has remained relatively steady, its total expenditures on wood chips fell in 2017, a result of lower prices.

Japan, Import of Wood Chips, 2015-2017								
	Conifer Chips			Non-Conifer Chips			Total Tons	Total Dollars
Year	Tons	Avg Price	Total Dollars	Tons	Avg Price	Total Dollars		
2015	1,680,571	$200	$336,725,390	10,220,175	$184	$1,881,085,371	11,900,746	$2,217,810,760
2016	1,594,714	$193	$307,239,000	10,305,886	$176	$1,817,301,000	11,900,600	$2,124,540,000
2017	1,646,929	$177	$292,151,000	10,522,910	$172	$1,814,393,000	12,169,839	$2,106,544,000

Japan's use of wood pellets increased by 46% between 2016 and 2017, topping 0.5 million tons for the first time; because the average price per metric ton has decreased, however, it's total expenditures have remained relatively flat.

Japan values reliability of supply, and it is therefore willing to sign contracts with producers able to guarantee supply quality and stability. Their long-term strategy is to source high quality pellets and sign long-term contracts with reliable producers in North America. This is evidenced by the recent announcements about long-term off-take agreements with North American producers:

- A recent announcement from Canadian pellet producer Pinnacle Renewable Holdings Inc. that it signed a long-term, off-take agreement with Toyota Tsucho for the delivery of 170,000 metric tons per year to the Kanda Biomass Energy facility beginning in 2021.
- US pellet producer Enviva Partners LP noted in its second quarter financial results that it had 1.5 million metric tons (four times Japan's 2017 import volume) under contract with multiple Japanese power generators that will come online between 2018 and 2022.

SOUTH KOREA

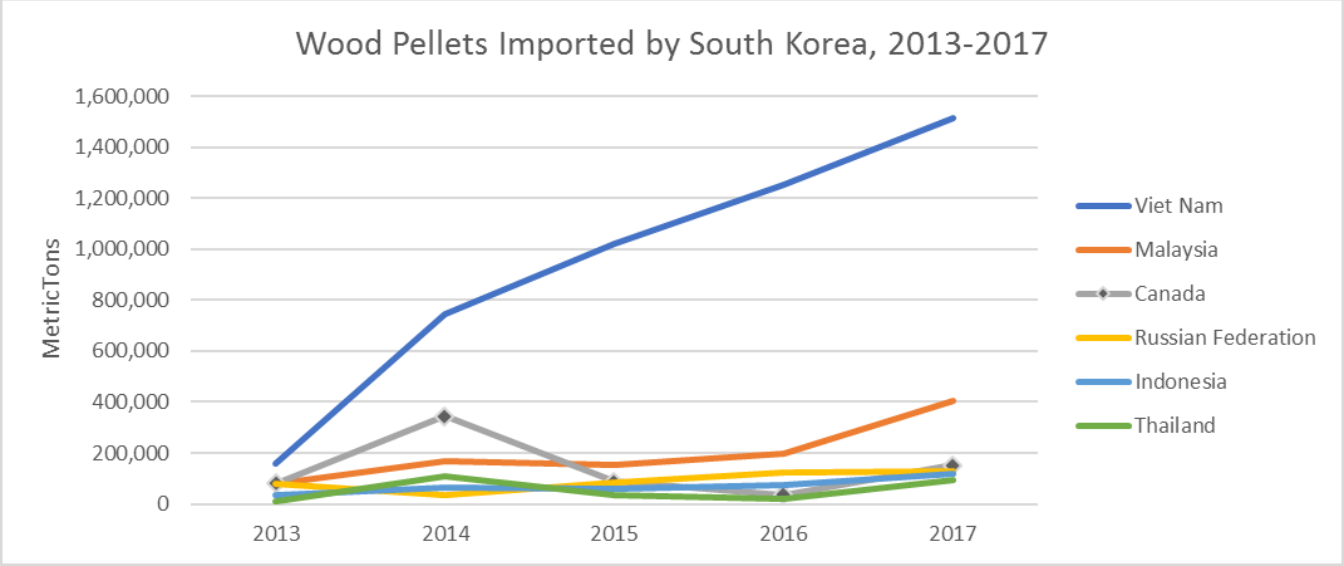
Wood Pellets

South Korea's production and import of wood pellets has increased significantly since 2012. By 2016, there were 24 wood pellet plants in the country, producing roughly 170,000 metric tons of pellets annually. In 2017, when the SY Energy facility in Chungcheongbuk-do province, with a capacity of 300,000 tons per year, began full operations, that number increased significantly.

Despite the increase in domestic production, South Korea must import most of the biomass they use to generate electricity. Vietnam has been South Korea's primary source for imported wood pellets over the last four years, with amounts steadily increasing on an annual basis since 2012. In 2017, Vietnam supplied 62 percent of South Korea's wood pellets, over 1.5 million metric tons, at the lowest USD$ per-metric-ton cost.

South Korea, Imports of Wood Pellets by Country of origin, 2014-2017							
Export Country	2017	2016	2015	2014	2016-2017 Change	% Change	Annual % Change
Viet Nam	1,515,803	1,255,401	1,022,809	742,794	260,402	20.7%	26.8%
Malaysia	405,431	199,102	153,959	168,336	206,329	*103.6%*	34.0%
Canada	151,673	35,263	87,743	344,261	116,410	330.1%	-23.9%
Russian Federation	127,913	125,841	84,070	34,756	2,072	*1.6%*	54.4%
Indonesia	119,562	75,854	59,977	62,729	43,708	57.6%	24.0%
Thailand	94,597	20,508	35,118	110,752	74,089	*361.3%*	-5.1%
United States of America	10,616	175	18,847	61,977	10,441	5966.3%	-44.5%
New Zealand	3,609	3,578	1,216	129	31	*0.9%*	203.6%
China	758	115	3,057	287,063	643	559.1%	-86.2%
Philippines	690				690	*NA*	NA
Japan	223	272	525	4,290	(49)	-18.0%	-62.7%
Germany	115	210	207	372	(95)	*-45.2%*	-32.4%
Netherlands	100	149	895	246	(49)	-32.9%	-25.9%
Poland	77	101	111	144	(24)	*-23.8%*	-18.8%
Total	2,431,167	1,716,641	1,470,684	1,849,641	714,526	41.6%	9.5%

Malaysia, Canada, the Russian Federation, Indonesia and Thailand are also selling pellets into South Korean markets.



Total Wood-based Biomass Consumption

In total, South Korean imports of wood-based biomass increased 21% to more than 3.3 million tons in 2017. Most of its demand for biomass, 73%, was sourced with wood pellets. The country's consumption of wood pellets increased by 42%, while its wood chip consumption fell by 13%.

South Korea, Imports of Wood Pellets and Wood Chips, 2016-2017								
Year	Pellets			Chips			Total Tons	Total Dollars
	Tons	Avg Price	Total Dollars	Tons	Avg Price	Total Dollars		
2016	1,716,641	$100	$172,249,000	1,021,126	$76	$77,888,000	2,737,767	$250,137,000
2017	2,431,165	$115	$280,433,000	889,043	$73	$64,499,000	3,320,208	$344,932,000
% Change	**42%**	**15%**	**63%**	**-13%**	**-5%**	**-17%**	**21%**	**38%**

Pellet prices increased in 2017, with an average price per metric ton of $115, higher by 15% than they were the previous year. And while its use of both coniferous and non-coniferous wood chips has remained relatively steady, its total expenditures on wood chips fell in 2017, a result of lower prices.

South Korea, Import of Wood Chips, 2015-2017								
Year	Conifer Chips			Non-Conifer Chips			Total Tons	Total Dollars
	Tons	Avg Price	Total Dollars	Tons	Avg Price	Total Dollars		
2015	22,406	$92	$2,058,000	942,566	$84	$79,032,000	964,973	$81,090,000
2016	14,238	$96	$1,362,000	1,006,888	$76	$76,526,000	1,021,126	$77,888,000
2017	13,715	$76	$1,048,000	875,328	$72	$63,451,000	889,043	$64,499,000

The South Korean market is relatively young, however, and South Korean power generation companies are still on a bit of a learning curve. South Korea has traditionally valued lower-cost supply, and they are willing to take chances on newer producers. Because of the variability in their supply, South Korean electricity generators established new tender invitations that distinguish between “wood pellets” and “woody biomass solid refuse fuel (SRF).” This change gives the generators the opportunity to source lower cost, non-woody biomass if they wish, while allowing them to account for the varying quality of the two categories when evaluating the price of the tender. Such an arrangement should create a more level playing field between potential wood pellet suppliers.

In 2017, Canada and the United States increased the number of tons of pellets they sold in South Korea significantly. This may signal more willingness on the part of South Korean energy companies to sign long-term agreements. A recent announcement from Canadian pellet producer Pinnacle Renewable Holdings Inc. that it signed a long-term, off-take agreement with CGN Daesan Power for the delivery of 315,000 metric tons per year beginning in 2021 supports this change in direction.

COMPETITION

Japan

An abundance of domestic biomass exists in Japan, though most of it cannot be sourced economically. As Japan adds more biomass to its energy portfolio to meet its 2030 goal, it will need to rely on imports.

Palm kernel shells (PKS) are the major competition to wood-based products in terms of imported biomass used for power generation in Japan. PKS is a fibrous material and can be easily handled in bulk directly from the product line to the end use. In 2017, Japan imported 1,137,464 metric tons of PKS from Indonesia

and Malaysia, which was nearly 50% higher than 2016 imports (761,410 metric tons) and nearly twice as much as wood pellet imports (506,000 metric tons).

South Korea

South Korea has access to wood residues from its domestic sawmilling industry that could be used for the manufacturing of pellets. However, this domestic supply will not be sufficient. The government estimates that by 2020, 75-80% of pellets consumed in the country will need to be imported.

PKS is also being consumed in the market. In 2017, South Korea imported 756,450 metric tons of PKS from Indonesia and Malaysia. This number has remained in the mid-700,000s since 2014. This indicates that additional demand for biomass is likely to be met with wood pellets.

CHALLENGES

As both Japan and South Korea both face challenges in their efforts to promote biomass power. This is especially the case if South Korea hopes to increase its consumption to 6 MTPY by 2021 and Japan hopes to increase its consumption to 15-20 MTPY by 2030.

Japan's biggest challenge comes in the form of its infrastructure. Currently, Japan's ports cannot accommodate the larger ships, the traditional and most cost-effective method of shipping pellets from North America to overseas markets.

For Korea, the major challenge is going to be finding additional low-cost sources of pellets. In 2017, they paid an average of $115 per metric ton for pellets to Japan's $172. While they do not have the same expectation of high quality pellets that Japan has, there is a limited amount of wood-based SRF available.

CONCLUSION

As biopower markets in Asia mature, the increased competition for wood pellets and chips will provide opportunities for suppliers of these materials around the globe. Because biomass pellets can be made with low-cost wood raw materials and the cost of shipping is low, the number of potential suppliers is significant. Biopower producers in Japan and South Korea will require a secure and consistent supply of both pellets and chips, sometimes from multiple suppliers in multiple geographies. As a result, they will require strong procurement strategies, supply chain risk assessments, cost analyses, supplier diligence processes and contract negotiation strategies.

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[i] https://data.oecd.org/energy/electricity-generation.htm, November 1, 2016.

[ii] Normile, Dennis. "Bucking global trends, Japan again embraces coal power." *Science,* May 2, 2018.

Note: all trade data comes from International Trade Center (ITC) Trade Map (http://www.trademap.org/Index.aspx)