Japan’s Use of Biomass for Power

Presented by William Strauss, PhD, MBA
President, FutureMetrics
September 24, 2019
Key Members of the FutureMetrics Team

**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. A leader in the industry for two decades.

**John Swaan, Pellet Plant Operations**
John is a leading expert on pellet plant operations. He is the founder of Pacific BioEnergy and producer of the first bulk shipment of wood pellets from North America to Europe (1998). Recipient of the 2014 International Founders Award.

**Annette Bossler, Market Intelligence Expert**
Annette provides detailed market intelligence on renewable energy policies around the world with a strong focus on Japan. Annette speaks, reads, and writes fluent Japanese. She was the 2013 recipient of the President’s Award from the Maine International Trade Center.

**Laurenz Schmidt, Technology Specialist**
Laurenz is a globally respected expert in thermodynamics and mass and energy flow dynamics in the renewable energy sector. He reviews and analyzes all advanced pellet technologies.

**Yoshinobu Kusano, Japan Policy Advisor**
Yoshi is one of the most highly respected participants in the Japanese biomass sector. He was a key member of Sumitomo’s pellet trading operations. He provides valued insights into Japanese policy developments.
FutureMetrics Forthcoming Comprehensive Report on Japan’s Biomass Power Markets

Annette Bossler is performing detailed primary research for FutureMetrics’ report on Japan’s biomass power sector.

Annette is examining Japanese language documents and databases from primary sources in Japan that are not available in English, and verifying the data with multiple sources.

Her work has discovered numerous differences between the data that she is collecting and the data presented by some of the mainstream providers of trade data and information on Japan’s use of biomass fuels.

A comprehensive report on the Japanese biomass markets, including forecasts, will be published by FutureMetrics in October 2019.
The reason that this industry exists...
If the trend in the chart below is followed, we will release most of the geologic carbon **sequestered over hundreds of millions of years** over a span of about 250 years.

Curve is from a simulation by FutureMetrics
Atmospheric CO$_2$ Concentration - 800,000 year history

5/15/2019, 415.70

298.60

\[\text{Time Scale is not linear} \Rightarrow \text{older history is highly compressed}\]

Source: EPA's Climate Change Indicators in the United States: www.epa.gov/climate-indicators, September, 2019, analysis by FutureMetrics
Global Land and Sea Temperature Anomalies

Anomalies compared to average of 20th century

R² = 0.9006

source: Temperature anomalies from NOAA, September, 2019; analysis by FutureMetrics
After 2020, under current policy, growth in Europe and UK is almost over.

Japan and South Korea are the major new growth markets.
S. Korea

What happens in S. Korea impacts Japan
As REC prices drop, S. Korean utilities reduce co-firing ratios.

The dramatic drop in REC prices has ripple effects into the Japanese pellet markets.

source: KPX South Korea as of September 7, 2019; Analysis by
Vietnam Pellet Exports to South Korea - Monthly Metric Tonnes

source: International trade data, Sept. 2019; Analysis by FutureMetrics
Wood Pellet Spot Price - FOB Vietnam

27 Jun 2018, $146.14

11 Sep 2019, $72.91

source: Argus, September 2019; Analysis by FutureMetrics
Scatterplot of S. Korean REC Prices vs Vietnam FOB Spot

Correlation = .947

source: Argus and S. Korea KPX Sept. 2019; Analysis by FutureMetrics
Excess supply in Vietnam is creating pressure on Canadian exports to Japan.
Estimated CIF Prices For Pellets from Canada and Vietnam to Japan
(US$ per metric tonne)

- Canada
- Vietnam
- 3-month mkt share weighted moving average
- Trend

source: International trade data; September 2019; Analysis by FutureMetrics
Japan
Japanese Government’s Target Energy Mix in 2030

**Primary energy supply**
- **Renewable energy**: 11% (FY 2017), 13-14% (FY 2030)
- **Nuclear power**: 1% (FY 2017), 11-10% (FY 2030)
- **Natural gas**: 23% (FY 2017), 18% (FY 2030)
- **LPG**: 3% (FY 2017), 3% (FY 2030)
- **Coal**: 25% (FY 2017), 25% (FY 2030)
- **Oil**: 36% (FY 2017), 30% (FY 2030)

**Composition of Power Sources**
- **Renewable energy**: 16% (FY 2017), 22-24% (FY 2030)
- **Nuclear power**: 3% (FY 2017), 10-9% (FY 2030)
- **Natural gas**: 40% (FY 2017), 22-20% (FY 2030)
- **Coal**: 33% (FY 2017), 26% (FY 2030)
- **Oil**: 9% (FY 2017), 3% (FY 2030)
- **Hydroelectric**: 8.8-9.2% (FY 2017), 7.9% (FY 2030)
- **Wind**: 1.7% (FY 2017), 5.9% (FY 2030)
- **Solar**: 7.0% (FY 2017), 5.2% (FY 2030)
- **Biomass**: 3.7-4.6% (FY 2017), 1.2% (FY 2030)
- **Geothermal**: 1.0-1.1% (FY 2017), 0.2% (FY 2030)

*Source: Strategic Energy Plan, Government of Japan, July 2018*
If nuclear does not reach 20%-22% and coal and NG reach 2030 targets, how will the grid stay energized?
As Japan is transitioning, its coal powered fleet will be challenged.

<table>
<thead>
<tr>
<th>Status</th>
<th>Number of Plants</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>cancelled</td>
<td>15</td>
<td>8,318</td>
</tr>
<tr>
<td>construction</td>
<td>17</td>
<td>9,743</td>
</tr>
<tr>
<td>operating</td>
<td>135</td>
<td>44,483</td>
</tr>
<tr>
<td>permitted</td>
<td>4</td>
<td>2,600</td>
</tr>
<tr>
<td>pre-permit</td>
<td>4</td>
<td>1,812</td>
</tr>
<tr>
<td>retired</td>
<td>7</td>
<td>746</td>
</tr>
<tr>
<td>shelved</td>
<td>2</td>
<td>1,135</td>
</tr>
<tr>
<td><strong>total</strong></td>
<td><strong>184</strong></td>
<td><strong>68,837</strong></td>
</tr>
</tbody>
</table>

Source: Global Coal Tracker, September 8, 2019; Analysis by FutureMetrics

Wood pellets will be a large part of the solution. Several major power plant conversions are likely in the future.

And wood pellets already are part of the solution for IPP’s.
Evolution of the Feed-in-Tariff (FiT)

The FiT was revised downwards from 24 yen to 21 yen and now it is determined by public tender.

The FiT is fixed for 20 years (no adjustment for inflation). FiT money comes from the ratepayers, therefore it is designed to have a ceiling in order to avoid too much burden on the ratepayers.

Current approved FiT projects support substantial quantities of renewable power.

There are hundreds of small (avg. 21 MW, median 6.25 MW) biomass fueled independent power projects operating or in the pipeline*.

* source: [http://www.mori-energy.jp/hatsuden1.html](http://www.mori-energy.jp/hatsuden1.html); translated from Japanese by FutureMetrics
Includes both operating and in the pipeline

Distribution of Operating and Planned IPP Power Plants

MW’s
- Maximum: 200.00
- Mean: 21.00
- Values: 271

Larger plants not on graph

Source: http://www.mori-energy.jp/hatsuden1.html; translated from Japanese and verification and analysis by FutureMetrics
FiT approved projects under construction or in pipeline tend to be larger than those already operating. There are 70 projects starting in 2020 or later totaling 3,104 MW with an average size of 44.3 MW.

Source: [http://www.mori-energy.jp/hatsuden1.html](http://www.mori-energy.jp/hatsuden1.html); translated from Japanese and verification and analysis by FutureMetrics
The IPP power stations use fluid bed boilers and can use a wide variety of fuels.

**Biomass Imports into Japan (metric tonnes)**

- **Palm Kernel Shells**
- **Wood Pellets**

Source: Primary research by FutureMetrics, Sept 2019
Pellets are higher cost per tonne.

However, after adjusting for moisture content, the difference is significantly less.
Pellets are part of the fuel mix for Japanese IPPs because pellets are available at a cost that allows profitable generation under FiT.

AND

The suppliers of pellet fuel are “bankable”

[forthcoming sustainability requirements will challenge many PKS suppliers]
Example of one IPP’s Biomass Power Station Pipeline - RENOVA

- Construction of the Omaezaki Biomass Project is scheduled to begin in the fiscal year ending March 2020.
- Expecting to start construction on both the Ishinomaki and Sendai Biomass Projects after 2020.
- Undertaking efforts to shorten the construction periods.

<table>
<thead>
<tr>
<th>Year</th>
<th>Project</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>Kanda Biomass (75.0MW)</td>
<td>Planned start of construction Appx. 2019</td>
</tr>
<tr>
<td>2020</td>
<td>Tokushima – Tsuda Biomass (74.8MW)</td>
<td>Planned start of construction Appx. 2020</td>
</tr>
<tr>
<td>2021</td>
<td>Omaezaki Biomass (Appx. 75MW)</td>
<td>Planned COD Appx. 2023</td>
</tr>
<tr>
<td>2022</td>
<td>Ishinomaki Biomass (Appx. 75MW)</td>
<td>Planned COD Appx. 2023</td>
</tr>
<tr>
<td>2023</td>
<td>Sendai Biomass (Appx. 75MW)</td>
<td>Planned COD Appx. 2023</td>
</tr>
</tbody>
</table>

Notes:
1. Pipeline projects may be altered, delayed or cancelled. Projects for which work has commenced in accordance with the EPC contract are shown as ‘under construction’.
2. Excluding the period of preparation for construction after the financing contract. Development projects may be altered, delayed or cancelled due to development status, progress and comments reflecting environmental impact assessments.
3. Construction commencement presented in accordance with RENOVA’s expected schedule, and not construction commencement dates indicated in the preliminary environmental impact assessments materials.
Kanda Biomass Power Generation Project Scheduled for COD June 2021
Kanda-machi, Miyako District, Fukuoka Prefecture (As of August 2019)

- Construction is progressing as planned.

<table>
<thead>
<tr>
<th>Construction of the silo (July 2019)</th>
<th>Pouring concrete for water treatment equipment (July 2019)</th>
</tr>
</thead>
</table>

- Rendering of completed facility

<table>
<thead>
<tr>
<th>Capacity</th>
<th>75.0 MW&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIT price</td>
<td>¥24 / kWh (¥32/kWh for domestic wood biomass)</td>
</tr>
<tr>
<td>Net sales&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Appx. ¥13 billion/year</td>
</tr>
<tr>
<td>COD&lt;sup&gt;2&lt;/sup&gt;</td>
<td>June 2021 (expected)</td>
</tr>
</tbody>
</table>

COD = commercial operation date
Steady Progress in Large-Scale Biomass Project Development

Overview of the Tokushima-Tsuda Biomass Project (As of August 2019)

- Reached financial close on February 25, 2019.
- RENOVA was selected by the local consortium and led the development.
- Received a business development fee from the SPC and one of the project’s co-sponsors.

### Tokushima-Tsuda Biomass Project

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>74.8 MW</td>
</tr>
<tr>
<td>Major fuel</td>
<td>Wood pellets (co-fired with palm kernel shells (PKS) and domestic woodchips)</td>
</tr>
<tr>
<td>FIT Price</td>
<td>¥24/kWh (¥32/kWh for domestic wood biomass)</td>
</tr>
<tr>
<td>COD¹²</td>
<td>March 2023 (expected)</td>
</tr>
<tr>
<td>Net sales</td>
<td>Approx. ¥13 billion/year</td>
</tr>
<tr>
<td>Total Capex</td>
<td>Approx. ¥50 billion⁴</td>
</tr>
<tr>
<td>LTC</td>
<td>90%</td>
</tr>
<tr>
<td>Major stockholders</td>
<td>RENOVA (Economic Interest: 41.8%⁵) Osaka Gas</td>
</tr>
</tbody>
</table>

RENOVA’s second large-scale biomass project to reach financial close, leveraging knowledge and experience from past projects.
Business Structure of the Tokushima-Tsuda Biomass Project

- RENOVA leads the project as the lead sponsor.
- RENOVA holds the right to additionally acquire a 24.7% equity stake at COD\(^1\) from the project’s co-sponsors.

![Diagram of the Tokushima-Tsuda Biomass Project structure](image-url)
Not Just the IPPs

For the major utilities, carbon emissions limits and minimum efficiency requirements are foundations for the demand for wood pellets.

It is quite possible that a few of the large coal power stations will fully convert to wood pellets.

If that happens, each will demand millions of tonnes per year of pellets!
In 2018, the government launched the first tender for 180MW biomass generation for projects of 10MW or more capacity. The undisclosed ceiling price was JPY 20.60 /kWh. 7 bidders submitted proposals and 1 proposal got an award: Soma Kyodo Power for the 2,000MW Shinchi power plant co-fired by biomass and coal at JPY 19.60/kWh for 35MW of biomass capacity or 1.75pc of its 2GW power plant co-fired with coal\(^1\).

Bid fees were the same as for the solar tenders, i.e. JPY 127,000 general submission fee, primary deposit of JPY 500/kW and secondary deposit of JPY 5,000 /kW for the winning bid project.

However, Soma canceled its winning bid and is going to bid into the upcoming capacity market system which is likely to be more lucrative. The Japanese capacity market will formally launch in 2021.

The 2019/2020 biomass power tender that was announced will exclude co-firing projects. The currently ongoing tender for 2019/2020 which requires bids by December 6\(^{th}\), 2019 and seeks 120MW capacity, excludes any projects co-fired with biomass and coal, palm kernel shell, palm oil and palm trunk.

METI had discussed adding new biomass feedstocks for power generation under the FIT scheme, such as empty fruit bunches, plant shells such as coconut, cashew nut, walnut, almond, pistachio and sunflower seed, along with napier grass, sorghum, jatropha seeds and plant oils such as canola, soy, peanut, sunflower and palm acid.

However, no decision has been reached yet, due to the question re. how to ensure sustainability of these feedstocks. A newly launched working group along with the committee has taken over the discussions to establish how to confirm sustainability, aiming to finalize it by autumn 2019\(^2\).

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1 Press Release December 18\(^{th}\), 2018 of Japan Low Carbon Investment Promotion Organization (一般社団法人低炭素投資促進機構)

2 Argus News & Analysis May 27\(^{th}\), 2019