Global Dynamics of the Pulp and Paper Industry
2017

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Four Main Points

1. Global Dynamics drive local decisions
   • *Decisions made by P&B companies in one part of the world impact decisions in all other parts of the world*

2. Global paper and board consumption increasing ...1% per Year
   • *Continues to grow globally, but declining in most of the Western World*
   • *Tissue and containerboard relatively strong, printing papers very weak*

3. Recycled Fiber availability will become more critical and costly
   • *Abundant wood – not an issue, but …*
   • *… Long fiber products from virgin fiber not increasing*
   • *Recovered paper supply and quality will be under significant stress*

4. The “Bioeconomy” will make little impact on Pulp and Paper Industry
   • *The “Nano” developments that are promising represent high price but …*
   • *Low volume products*
1. Global Dynamics

- Future growth depends on future GDP growth
- National Wealth drives National P&B Consumption
- Virgin Pulp produced where the trees are
- P&B Produced where the jobs are
- Recovered waste paper use far exceeds virgin fibers
- Global Production = Global Consumption
- Virgin Pulp produced where the trees are
- Must see growth in virgin fiber production

Global Dynamics:

- Wealth drives Paper and Board Consumption
- Black text: Future growth depends on future GDP growth
- Black text: National Wealth drives National P&B Consumption
- Black text: Virgin Pulp produced where the trees are
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- Black text: Global Production = Global Consumption
- Black text: Virgin Pulp produced where the trees are
- Black text: Must see growth in virgin fiber production
Global Dynamics drive Local Decisions

Global Production = Global Consumption

P&B Produced where the jobs are

Virgin Pulp produced where the trees are
2015 Global Production / Consumption
27% of Production is Exported

North America and Asia account for >50% of Production and Consumption

Source: RISI 2017
## Wood Pulp Balance

<table>
<thead>
<tr>
<th>Region</th>
<th>P&amp;B</th>
<th>Wood Pulp</th>
<th>Bleached Softwood</th>
<th>Bleached Hardwood</th>
<th>Recovered Paper</th>
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<tr>
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<td>-491</td>
<td>-145</td>
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<tr>
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Wood pulp is manufactured where the trees are.
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Canada (NBSK) and USA (SBSK) account for long fiber production.
# Hardwood Pulp Balance

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Brazil, Chile, Argentina and Uruguay (BEK) account for most of world short fiber. Brazil has abundant land for 25 more mills.
## Recovered Paper Balance

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The imbalance in Recovered Paper will cause major problems to be discussed later.
Wealth drives consumption

Future growth depends on future GDP growth

Wealth drives Paper and Board Consumption

National Wealth drives National P&B Consumption
Consumption

• Paper and Board Consumption are driven by wealth
  – Manufacturing activity drives containerboard
  – Business activity drives printing papers
  – Consumer activity drives containerboard and others other

• Local consumption is driven by local wealth
  – Global consumption can be predicted by Global GDP growth
  – National consumption is not so predictable

• Paper and Board are recovered at increasing rates
  – Paper is recovered locally and shipped globally
Global P&B Consumption related to Wealth

• Gross Domestic Product the best indicator

• Better correlation with packaging than paper
P&B Consumption v GDP per Capita

P&B consumption predictable for Developing nations

Not so much for Developed: Decline related to Printing Papers and Newsprint
Extremes in Global Product Demand Forecast

- Packaging more than 50% of P&B consumed, growing ~2% per year
- Tissue growth ~3.5% per year
- Both products highly dependent on the growth of wealth
- Printing Papers decline leveled off at -2.5% per year, but faster in Developed economies

Source: RISI 2017
Selected Countries GDP vs P&B Consumption

National Consumption Depends on Structure of the economy and wealth Distribution
China View

- A “Forecast” is an educated guess
- My guess in 2014 and my guess in 2017 are both based on RISI numbers for 2 years earlier (that’s the best you can get from RISI)
- All economists were more bullish in 2014 about the World and the Chinese economy in 2017 than today
• Continued overall growth of paper and board consumption, leveling off to still good numbers
• Packaging board continues to grow ~4% per year
• No growth in paper
• Tissue continues to grow, but volumes are small
• Paper and board consumption continues to decline, perhaps at slower rate
• Packaging board continues to grow ~2% per year
• Continued shrinkage in paper consumption
• Tissue continues to grow, but volumes are small
Rest of the World View

• Slow growth of paper and board consumption
• Packaging board continues to grow ~2% per year, about same as USA
• Continued shrinkage in paper consumption
• Tissue continues to grow, but volumes are small
3. Fiber Availability

Recovered waste paper use far exceeds virgin fibers

Must see growth in virgin fiber production
2015 Global Production / Consumption of Recovered Paper
24% of Production is Exported

North America accounts for >20% of Global Export of Recovered Paper
Why do we care what happens in China?

• China consumes more than 50% of the waste paper recovered in the world
  – *Pressures local pricing*

• China has several board machines producing over 1 MM t per year of product
  – *Those machines will always outbid local producers in the USA and elsewhere to assure their supply*

• Chinese companies now own 50% of the Canadian NBSK supply
  – *To ensure their machines have the premium fiber they need*
Production of Fiber

- Western World Wood Pulp Production declining
- Global RCP production exceeds virgin fiber by 40%
- Practical limit of ~70% recovery of domestic waste
- Practical limit on number of times fiber can be recycled

Source: RISI
China Packaging

- China production of P&B continues to grow at 2.5% per year
- China Production of Containerboard grows at 3% per year
- Chinese Containerboard 100% Recycled fiber

Source: RISI
• Not all Recovered Fiber goes to containerboard manufacture, but machine scales are enormous and will be satisfied as first priority
• Consume ~ 50% of all World exports of Recovered Paper, forecast to go to 55%
• How can P&B be recovered from Western Europe and North America when regional demand is declining?
The largest Chinese Mill produces 5 Million tonnes of 100% recycled liner per year

50% of all Mills produce 10% of total Production

7% of the Mills produce 50% of total Production

Source: FisherSolve database on mills producing more than 50 tonnes per day
Asia currently imports 35 Million Tonnes of waste

*Current collection rate of ~50%*

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Waste for Asia comes principally from North America and Western Europe.

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Source: RISI

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<table>
<thead>
<tr>
<th>Production</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20,036</td>
<td>8,124</td>
</tr>
<tr>
<td>35,110</td>
<td>(35,110)</td>
</tr>
</tbody>
</table>
Shortage grows to 37 Million Tonnes in 2020

*If recovery rate grows to 64%*

Waste availability from North America and Western Europe cannot grow because local consumption of P&B declines.
Demand / Supply Imbalance partly reflected in pricing trends

Source: RISI
Delivered to Beijing

Linerboard Cost Curve, FOB Mill

Linerboard Cost Curve, Delivered Beijing

Source: FisherSolve
20% Increase in OCC

Linerboard Cost Curve, Delivered Beijing

Total Cost and Cumulative Production

Source: FisherSolve
World will **not** run out of Wood fiber...

- Global Growth exceeds removals, even accounting for fuel wood harvest
- But only by small margin
- Planted forests versus natural forests are the key to future growth
  - Grow 5-10 times faster
  - But grown only for a profit

Source: FAO
2015 Global Production / Consumption of Bleached Softwood Pulp

61% of Production is Exported

North America accounts for 33% of World Exports
Global Production of Softwood Market Pulp not the same as Global availability

30 Million ST per Year Global Production

26 Million ST per Year Production in 3 Regions

Western Europe
North America
Latin America
1/3 of Softwood Pulp Sold as Fluff
½ Canadian Production owner by Asians

Western Europe
North America
Latin America

Canada

18 Million ST per Year Production of non-fluff pulp

7 Million ST per Year Production in Canada: 50% of Capacity ownership is Chinese or Japanese
Purchased Softwood Pulp in Balance

Today’s supply adequate but little capacity being built

Softwood well–balanced today globally with North American Surplus supplying Asia Deficit
Purchased Softwood Pulp Must Grow

Softwood Pulp will likely be in shortfall

Shortage in Asia not balanced by Excess produced elsewhere
Little growth in virgin liner capacity...
... And won’t be until a jump in Virgin Liner price is established

<table>
<thead>
<tr>
<th>Price Per FT</th>
<th>NPV (10%)</th>
<th>% IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>$700</td>
<td>($225,164,642)</td>
<td>6.9%</td>
</tr>
<tr>
<td>$750</td>
<td>($43,816,267)</td>
<td>9.4%</td>
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<tr>
<td>$800</td>
<td>$157,308,675</td>
<td>12.1%</td>
</tr>
<tr>
<td>$630</td>
<td>$100,941,612</td>
<td>12.7%</td>
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<tr>
<td>$675</td>
<td>$252,717,588</td>
<td>16.5%</td>
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<tr>
<td>$720</td>
<td>$404,493,563</td>
<td>19.9%</td>
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U.S. SBSK moving to Fluff Pulp
*Slightly lower return but faster growing market*

<table>
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<tr>
<th></th>
<th>2020 Price</th>
<th>FT per Year</th>
<th>Capex</th>
<th>IRR – US MW</th>
<th>IRR – Far East</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBSK</td>
<td>$867</td>
<td>918,441</td>
<td>$1,666,684</td>
<td>11.8%</td>
<td>10.3%</td>
</tr>
<tr>
<td>Fluff</td>
<td>$927</td>
<td>957,381</td>
<td>$1,867,239</td>
<td>11.0%</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

![Market Pulp Graph](image)
Technology Impacts
Technology Impacts

• For Greenfield Mills
  – *In the 5-Year Horizon* – None, other than new mills are getting bigger
  – *In the 10-Year Horizon* – possibly
    • Black Liquor Gasification
    • Production of “Nano” materials with a small part of production

• For Existing Mills
  – *Conversion to Bioproducts by Repurposing Kraft Mill equipment*

• In general, minor impacts
4. Survival of Western Paper Mills requires radical solutions fueled by Innovation

Greenfield investment cost not supported by Market Price

Mill Economics don’t support higher Market Price

Innovation Required
Kraft Pulp Mill integrated with Bioenergy and Biomaterials
Kraft Pulp Mill integrated with Bioenergy and Biomaterials

Sawmill Chips → Chip Pile → Chipping → Debarking → Roundwood Receiving

Sawdust → Chip Screens → Wood Chips

Pre Treatment → Enzyme Hydrolysis → Ferment

Purify → Residue

Biomaterials

Succinic Acid

Lactic Acid

2,3-Diol

Chemicals Extraction
Kraft Pulp Mill integrated with Bioenergy and Biomaterials
Kraft Pulp Mill integrated with Bioenergy and Biomaterials

Chemicals Extraction

Extraction

Debarking

Chipping

Chip Pile

Chip Screens

Pre-Cook

Kraft Cook

Hemicellulose Extraction

Bioethanol, Foams/Gels

Sawmill Chips

Roundwood Receiving

Wood Chips

Sawmill Chips

Pulp Wood

Kraft Pulp Mill
Chemicals Extraction

Sawmill Chips

Chip Pile

Chipping

Debarking

Roundwood Receiving

Receiving

Sawmill Chips

Chip Screens

Wood Chips

Pre-Cook

Kraft Pulp

Chemical / Mechanical Treatment

KM – Cellulose Nano Crystalline Cellulose

Kraft Pulp Mill integrated with Bioenergy and Biomaterials
Kraft Pulp Mill integrated with Bioenergy and Biomaterials

$90 per BDt
Kraft Pulp Mill integrated with Bioenergy and Biomaterials

Lignin Recovery - Chemicals

Phenol Extender in Phenol-Formaldehyde Adhesives - $600 per BDt
### Example – Lignin Products

Recovered Lignin Valued as Fuel Pellets - $150 per Ton

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<th></th>
<th>Base</th>
<th>5% Lignin Removal</th>
<th>10% Lignin Removal</th>
<th>20% Lignin Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finished Tons per Year</td>
<td>1,069,461</td>
<td>1,099,836</td>
<td>1,130,786</td>
<td>1,199,318</td>
</tr>
<tr>
<td>Power Sales, $ per Year</td>
<td>$17,212,983</td>
<td>$15,060,444</td>
<td>$12,797,147</td>
<td>$7,873,528</td>
</tr>
<tr>
<td>Lignin Sales, $ per Year</td>
<td>$0</td>
<td>$5,331,677</td>
<td>$10,963,428</td>
<td>$23,255,757</td>
</tr>
<tr>
<td>Net Present Value, $</td>
<td>-$124,434,154</td>
<td>-$82,515,933</td>
<td>-$19,460,279</td>
<td>$150,388,200</td>
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<tr>
<td>IRR, %</td>
<td>8.94%</td>
<td>9.29%</td>
<td>9.84%</td>
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Selling lignin in pellets better than burning and selling power
Example – Lignin Products

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Selling lignin for chemical value can turn an unattractive pulp mill investment into one that can attract investor funding.
Summing Up

What does this mean for you?

• Tissue and Containerboard good growth and excellent returns
• Graphic papers (coated, uncoated, newsprint) will stabilize at about 50% of peak consumption
• Users of recovered papers be prepared for shortage and to pay more
• Users of bleached softwood pulp be prepared to pay more
• Freight will always provide a barrier to imports, but can be substantially lower cost difference than fiber
• No substitute for being low cost in the domestic market as protection against imports and potential
Final thing to keep in mind …

Latin America has had the best EBITDA Margin for the last 10 Years

USA has done the best job of investing while shareholders in Latin America are banks making slim margins