INTRODUCTION

With the price of fuel and electricity increasing at a rapid pace, many plants are taking a good look at energy efficiency of new, as well as old kilns. Maintaining the old ones and making judicious upgrades for energy efficiency can result in big pay back. This study deals with a plant trying to make technical decisions regarding the type of energy they should use for their new kilns.

FACTORS CONSIDERED

► Trade study for a proposed dry kiln
  natural gas supply, isolated coastal site
  kiln type and energy source options
  species and product mix considerations
► Volatile fuel prices and new technology
  method of wide applicability
  rigorous analysis key to viability

PRODUCT CHARACTERISTICS AND REQUIREMENTS

► Species/mix drying behavior
  critical of quality, limits throughput
► MC distribution and drying character
  average MC, species, dimensions, variability
  wet pockets, compression wood, collapse
  gains from sorting
► End use/market requirements and pricing
  lumber or added value; cost of logs versus yield
  degrade and final MC, costs of poor quality
► Present and future, likely scenarios
Energy Sources: Characteristics and Considerations

- Energy demand and supply, sources, other factors
  - drying usage and efficiency, peak and annual demand
  - natural gas, fuel oil, wood waste, electricity, waste heat
  - internal and external integration of energy sources/uses
- Long term availability and pricing
  - global and local factors, regulatory impacts
  - alternative uses, value of wood waste, landfill cost
  - scenarios and risks, probability and impact, mitigation
- Incidental costs and issues
  - incremental capital costs, maintenance and reliability
  - emissions and land use, regulations

Kiln Types and Capabilities

- Conventional
  - direct fired, air/air heat exchange, LP steam, thermal oil
  - fuel compatibility, machinery drive, exhaust heat recovery
  - effect on product quality, process capability
- Dehumidifying and vacuum drying
  - mechanical drive power and supplemental heat
  - value of higher quality product, low environmental impact
- Operational considerations
  - conditioning steam/water spray
  - emissions, reliability and maintenance
  - operator skills requirements

Initial and Operating Cost Analysis

- Capital cost baseline and differences
  - kiln construction, equipment, and energy supply
  - supplier quotes and historical data
- Fuel and electricity cost outlook for kiln lifetime
- Labor/staffing differences
  - operators, maintenance staff
- Other differences
  - repairs and parts, outsourced versus in-house

Summary

- Changeable market demand, volatile costs, and new technologies may obsolete traditional approaches to kiln drying.
- Identify and investigate available energy supply options vs. kiln heat and heat exchange options.
- Rigorous and systematic analysis challenges assumptions, defines optimal, robust solution.

Western Dry Kiln Association 56 May, 2005
### Analysis of Selected Technical Options

<table>
<thead>
<tr>
<th>Kiln/System Options</th>
<th>A: Baseline LPG Direct Fired</th>
<th>C: LP Steam + LPG</th>
<th>Cb: Thermal Oil + LPG</th>
<th>D: Dehumidification</th>
<th>C2: LP Steam + Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1: 90% 1&quot;-3&quot;:</strong> 350 mBfd capacity (826 ca. m²): nominally 3 side load package kilns</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1. Capital cost including site preparation (BCDN, 1996)</td>
<td>1,000,000</td>
<td>1,175,000</td>
<td>1,590,000</td>
<td>1,225,000</td>
<td>2,175,000</td>
</tr>
<tr>
<td>2. Fuel cost/year ($)</td>
<td>418,000</td>
<td>522,000</td>
<td>522,000</td>
<td>76,000</td>
<td>nil</td>
</tr>
<tr>
<td>3. Electricity Cost/year ($)</td>
<td>66,600</td>
<td>66,600</td>
<td>74,800</td>
<td>152,900</td>
<td>80,400</td>
</tr>
<tr>
<td>4. Added man-power/year, vs baseline ($)</td>
<td>N/A</td>
<td>400,000</td>
<td>100,000</td>
<td>100,000</td>
<td>600,000</td>
</tr>
<tr>
<td>5. Operating cost ($) increase from baseline</td>
<td>484,600</td>
<td>988,600</td>
<td>696,000</td>
<td>404,900</td>
<td>680,400</td>
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<tr>
<td><strong>Model 2: 60% 3&quot;-4&quot;:</strong> 585 mBfd capacity (1380 ca. m²): nominally 5 side load package kilns</td>
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<td></td>
</tr>
<tr>
<td>1. Capital cost including site preparation (BCDN, 1996)</td>
<td>1,650,000</td>
<td>1,725,000</td>
<td>2,250,000</td>
<td>1,725,000</td>
<td>2,275,000</td>
</tr>
<tr>
<td>2. Fuel cost/year ($)</td>
<td>502,000</td>
<td>625,000</td>
<td>625,000</td>
<td>74,700</td>
<td>nil</td>
</tr>
<tr>
<td>3. Electricity Cost/year ($)</td>
<td>113,300</td>
<td>113,300</td>
<td>123,700</td>
<td>244,800</td>
<td>127,200</td>
</tr>
<tr>
<td>4. Added man-power/year, vs. baseline ($)</td>
<td>N/A</td>
<td>400,000</td>
<td>100,000</td>
<td>100,000</td>
<td>600,000</td>
</tr>
<tr>
<td>5. Operating cost ($) increase from baseline</td>
<td>615,300</td>
<td>1,136,300</td>
<td>849,700</td>
<td>419,500</td>
<td>727,200</td>
</tr>
</tbody>
</table>

### Economic Evaluation

<table>
<thead>
<tr>
<th>Kiln/System Options: Wood</th>
<th>Heat Source</th>
<th>Heat Transfer</th>
<th>Operational Considerations</th>
<th>Commentary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline: Direct LPG Fired</td>
<td>Liquidified Petroleum Gas (LPG)</td>
<td>Direct Fired</td>
<td>Simplicity &amp; maintainability, low skill req's. Low temperature capability.</td>
<td>Selected as baseline for study due to low capital cost &amp; B.C. service experience. High temperature not required.</td>
</tr>
<tr>
<td>Low Pressure Steam; LPG Fired</td>
<td>Liquidified Petroleum Gas (LPG)</td>
<td>Low pressure boiler &amp; steam coils</td>
<td>Integral steam conditioning capability, good humidity control. Good product quality.</td>
<td>Proven high product quality option.</td>
</tr>
<tr>
<td>Thermal Oil: LPG Heat</td>
<td>Liquidified Petroleum Gas (LPG)</td>
<td>Thermal oil system</td>
<td>Lower maintenance than LP boiler. See Note 1. See Note 1.</td>
<td>Lower maintenance requirements than boiler.</td>
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<tr>
<td>Dehumidification with LPG pre-heat</td>
<td>Dehumidification system + LPG pre-heat</td>
<td>Dehumidification system + direct firing</td>
<td>Better humidity control &amp; product quality.</td>
<td>New technology, high product quality option.</td>
</tr>
<tr>
<td>LP Steam; Wood Waste</td>
<td>Shavings, sawdust, &amp;/or log fuel.</td>
<td>Low pressure boiler &amp; steam coils</td>
<td>Integral steam conditioning capability, good humidity control.</td>
<td>Proven solution for wood waste firing &amp; high product quality.</td>
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</tbody>
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