Energy Management and Optimization

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Presentation Topics

- Importance of Energy Management
- Objectives of Energy Management
- System Functions
- Case History Examples
- Wrap-up and Questions
Importance of Energy Management

- Focus in sustainable manufacturing
- Energy is a major production cost item in many process industries (1)
  - Pulp & paper approximately 10% of production cost
  - Energy savings up from 10% to 25% can be reached by taking various actions (2)

World energy consumption (Metric Tonne) by fuel type
Source: BP - Statistical Review of World Energy 2009

(1) Based on geographical area
Benchmarks and Best Practices

Best Available Technology (BAT)

Table 4.2
U.S. P&P Energy Distribution

<table>
<thead>
<tr>
<th></th>
<th>Electric</th>
<th>Steam</th>
<th>Direct Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TBTu</td>
<td>%</td>
<td>TBTu</td>
</tr>
<tr>
<td>Pulp Manufacture</td>
<td>158.6</td>
<td>40.3</td>
<td>449.3</td>
</tr>
<tr>
<td>Paper Manufacture</td>
<td>200.9</td>
<td>52.0</td>
<td>537.8</td>
</tr>
<tr>
<td>Utilities, excluding</td>
<td>27.8</td>
<td>7.1</td>
<td>94.3</td>
</tr>
<tr>
<td>Powerhouse</td>
<td></td>
<td></td>
<td>8.7</td>
</tr>
<tr>
<td>Total Manufacturing</td>
<td>383.3</td>
<td>100.0</td>
<td>1,081.4</td>
</tr>
<tr>
<td></td>
<td>131.4</td>
<td>8.2%</td>
<td>100.0</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1,666.1</td>
<td>(100.0%)</td>
<td></td>
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Source: Pulp and Paper Industry Energy Bandwidth Study

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Energy Management Objectives

**Reduce**
- Price you pay
  - $ / MWh
- Average Unit Price
  - Energy consumption

**Decrease**
- Energy Consumption
  - MWh / Ton
- Total Energy Consumed
  - Production output

**Increase**
- Energy Cost Effectiveness
  - (eE) Tons / e$
- Production Units
  - Unit Energy Cost $

**Minimize energy costs**

\[ eE \text{ is a KPI = Tons per energy dollar} \]
Energy Price Optimization

• Focus
  - Manage variable energy prices and optional supply resources
  - Energy demand planning and optimization
  - Energy supply planning and optimization

• Benefits
  - Purchase/produce required energy at the lowest cost
  - Optimize the use of alternative energy sources and energy supply contracts

• Performance Indicators
  - Average price of consumed energy
  - Average price of sold energy
  - Total net cost of energy / produced unit
  - Accuracy of consumption plans
Energy Usage Optimization

• Focus
  - Improve energy efficiency and reduce consumption
  - Reduce carbon footprint
  - Equipment that consumes a lot of energy

• Benefits
  - Maintain the most energy efficient operating mode in varying process conditions
  - Reduce energy consumption while maintaining or improving the production rate

• Performance Indicators
  - Actual energy consumption / expected target consumption
  - Energy consumption / produced unit
  - Energy efficiency / Energy Intensity Index and carbon footprint
System Functions

A **software package** that helps you:

- Purchase energy at the lowest available cost by . . .
- Predicting and planning energy consumption & . . .
- Optimizing energy consumption and supply & . . .
- Monitoring and reporting energy usage and efficiency

2 to 5% cost savings are achievable using energy procurement, dispatching and planning capabilities available with **Energy Management**
Planning and Scheduling

Benefits:
Lower price on consumed electricity, due to
- Providing load schedules to power suppliers
- Employing cost optimal power resources
- Scheduling consumption to off-peak times
What?
Predict load schedule based on production plan

Load plans are calculated for
- Process areas
- Total mill
- Corporation
- Different utilities (power, steam, gas, …)

Presentation of load plans
- Process area electric & thermal
- Mill electric & thermal
- Corporate electric (& thermal)
How?
Select power resources to match load schedule at minimum cost

- **Power resources**
  - Own generation
  - Purchase agreements
  - Electricity from spot market

- **Solution methods**
  - Economic Flow Network
  - MIP Optimization

- **Alternative**: Load scheduling to utilize inexpensive off-peak power
How?
Optimizing Electricity Procurement and Consumption

- Optimize procurement and generation based on consumption plans
- Optimize consumption to use off-peak hours if intermediate storage capacity is available
- Minimize startup and operating costs
- Compare different scenarios, and adjust the plan manually
- Provides decision support for users or automatically sends set points to Advanced Process Control or DCS
- 2 to 5% additional cost savings are possible with optimization
How?
Energy Efficiency Monitoring

- user configurable visual tools for monitoring, targeting and analyzing
- At a glance view of relevant KPI’s
- Clear indication of savings potential and lost opportunity
- Drill down to details
- Savings of 10%-15% savings can be achieved simply by making energy usage and savings potential visible in real-time
Example: Benefits of Accurate Planning & Monitoring

Case 1
Power [MW]

Surplus power to the grid operator: 30$/MWh

Case 2
Power [MW]

Deficit power from the grid operator: 50$/MWh

Ideal Situation
Power [MW]

Surplus power to the grid operator: 30$/MWh

Annual savings
~$800,000
= 2.5% of total electricity costs

Day-ahead
100 MW
40$/MWh

Average price:
41$/MWh

Average price:
40.95$/MWh

Average price:
40.01$/MWh

Measured consumption: 95 MW

Measured consumption: 99 MW

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Customer Case 1
Pulp & Paper Corporate Energy Management

• Energy Management System
  - Corporate Central Control Room
  - 10 Mills
• Functions
  - Energy load planning
  - Energy optimization
  - Energy monitoring, reporting and invoicing
• Total electricity bill 700 M$
• Own energy production 80 %
• Total annual savings
  - Savings in electricity price 14 M$
  - Savings in electricity consumption 35 M$
  - CO2 reduction 175,000 tons
Customer Case 2
Building Energy Monitoring and Reporting

- Multi site building energy monitoring and reporting system using Energy Management System
  - Load planning, energy monitoring and reporting
  - Energy benchmarking
- Total electricity bill 10 M$
- Own energy production 0 %
- Total annual savings
  - Savings in electricity price 0 k$
  - Savings in electricity consumption 400 k$
  - CO2 reduction 2,000 tons
Questions?