Energy Management and Optimization

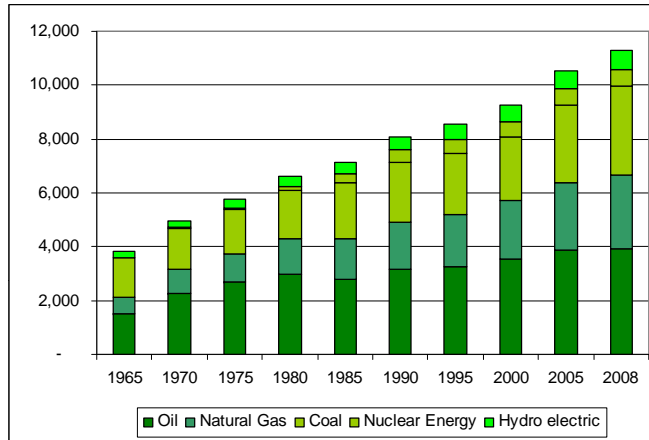Keith Masters, ABB

Presentation Topics

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

Importance of Energy Management

12,000

10,000

8,000

6,000

4,000

2,000

-

1965 1970 1975 1980 1985 1990 1995 2000 2005 2008

■ Oil ■ Natural Gas ■ Coal ■ Nuclear Energy ■ Hydro electric

World energy consumption (Metric Tonne) by fuel type

Source: BP - Statistical Review of World Energy 2009

- 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]
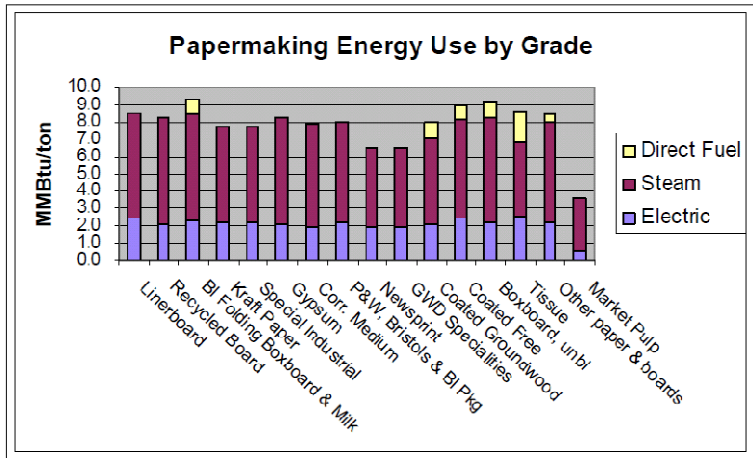
(1) Based on geographical area

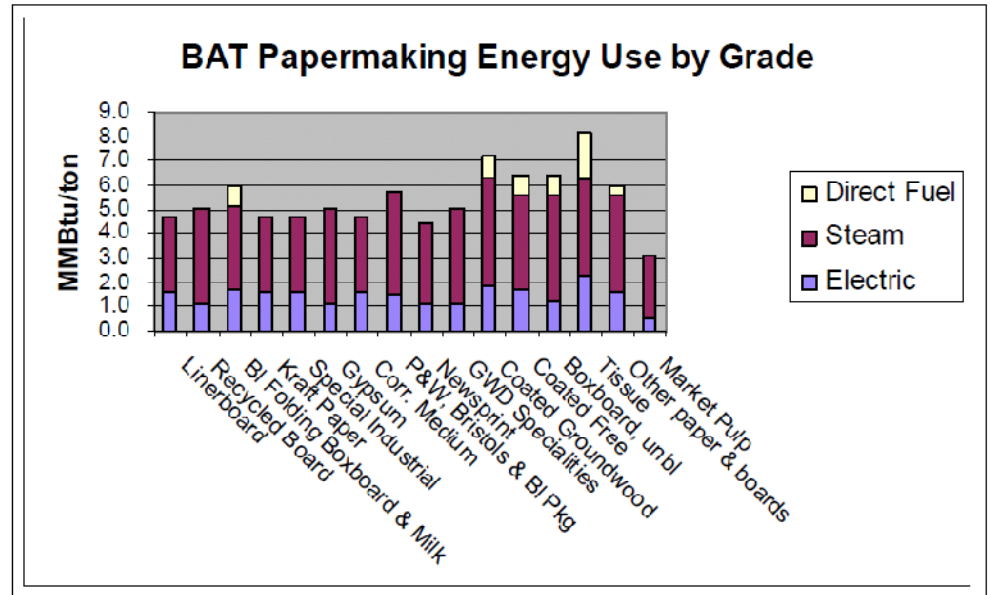(2) Source: ARC Best Practices for Energy Management report, Jan. 2009

PIMA TAPPI

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Benchmarks and Best Practices

Papermaking Energy Use by Grade

Best Available Technology (BAT)

BAT Papermaking Energy Use by Grade

Table 4.2
U.S. P&P Energy Distribution

	Electric		Steam		Direct Fuel	
	TBtu	**%**	**TBtu**	**%**	**TBtu**	**%**
Pulp Manufacture	158.6	40.3	449.3	41.5	100.2	76.2
Paper Manufacture	206.9	52.6	537.8	49.7	31.3	23.8
Utilities, excluding Powerhouse	27.8	7.1	94.3	8.7	0.0	0
Total Manufacturing	**393.3** (24.5%)	100.0	**1,081.4** (67.3%)	100.0	**131.4** (8.2%)	100.0
Grand Total	**1,606.1** (100.0%)					

Source:

Pulp and Paper Industry Energy Bandwidth Study

Prepared by

Jacobs
Greenville, South Carolina, USA
and
Institute of Paper Science and Technology (IPST) at
Georgia Institute of Technology
Atlanta, Georgia
August 2006

Energy Management Objectives

Reduce — Price you pay $ / MWh

$$\frac{\text{Average Unit Price}}{\text{Energy consumption}}$$

Price Optimization

Decrease — Energy Consumption MWh / Ton

$$\frac{\text{Total Energy Consumed}}{\text{Production output}}$$

Usage Optimization

Increase — Energy Cost Effectiveness (eE) Tons / e$

$$\frac{\text{Production Units}}{\text{Unit Energy Cost \$}}$$

Minimize energy costs

eE 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 & . . .

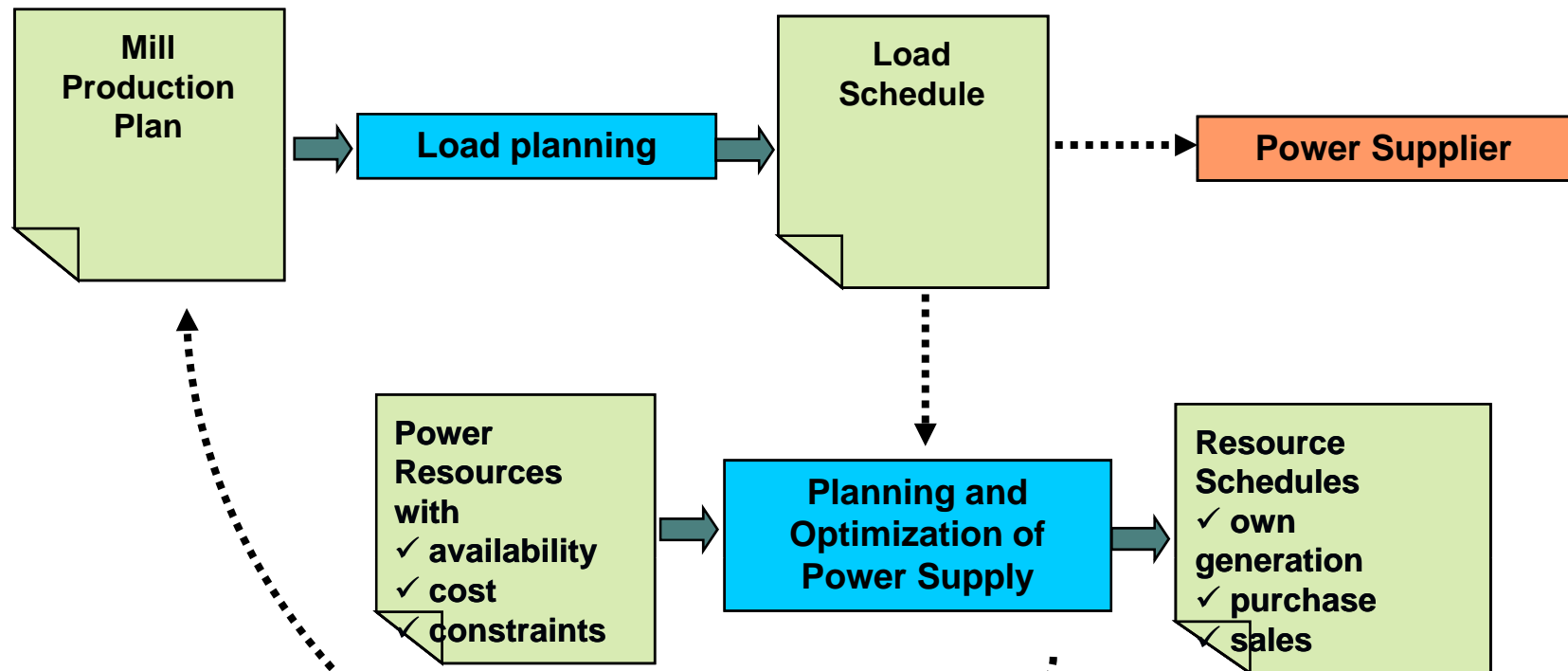- Monitoring and reporting energy usage and efficiency
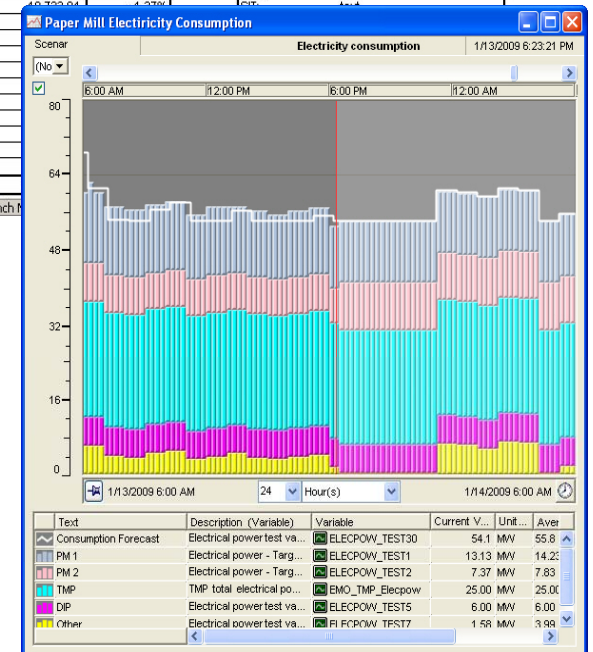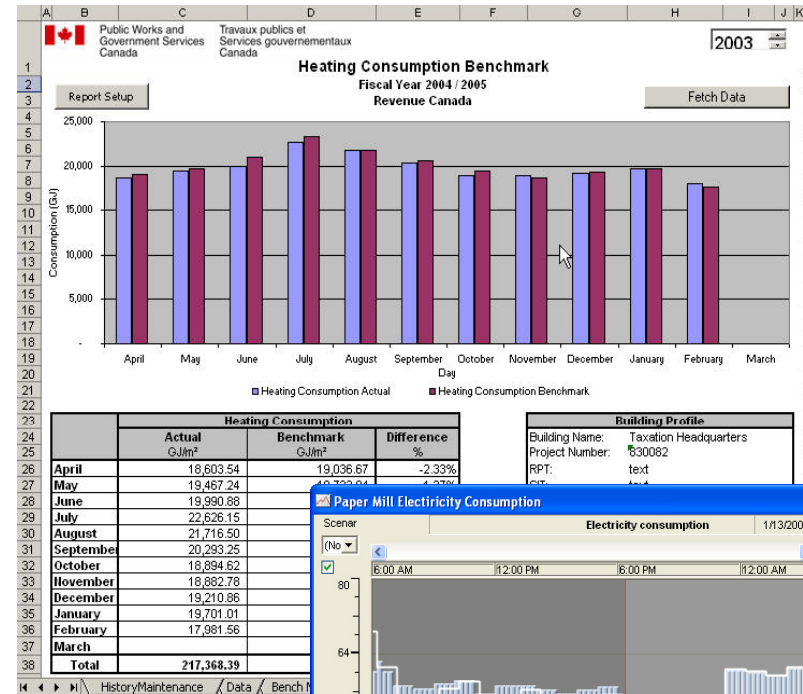
2 to 5% cost savings are achievable using energy procurement, dispatching and planning capabilities available with

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)
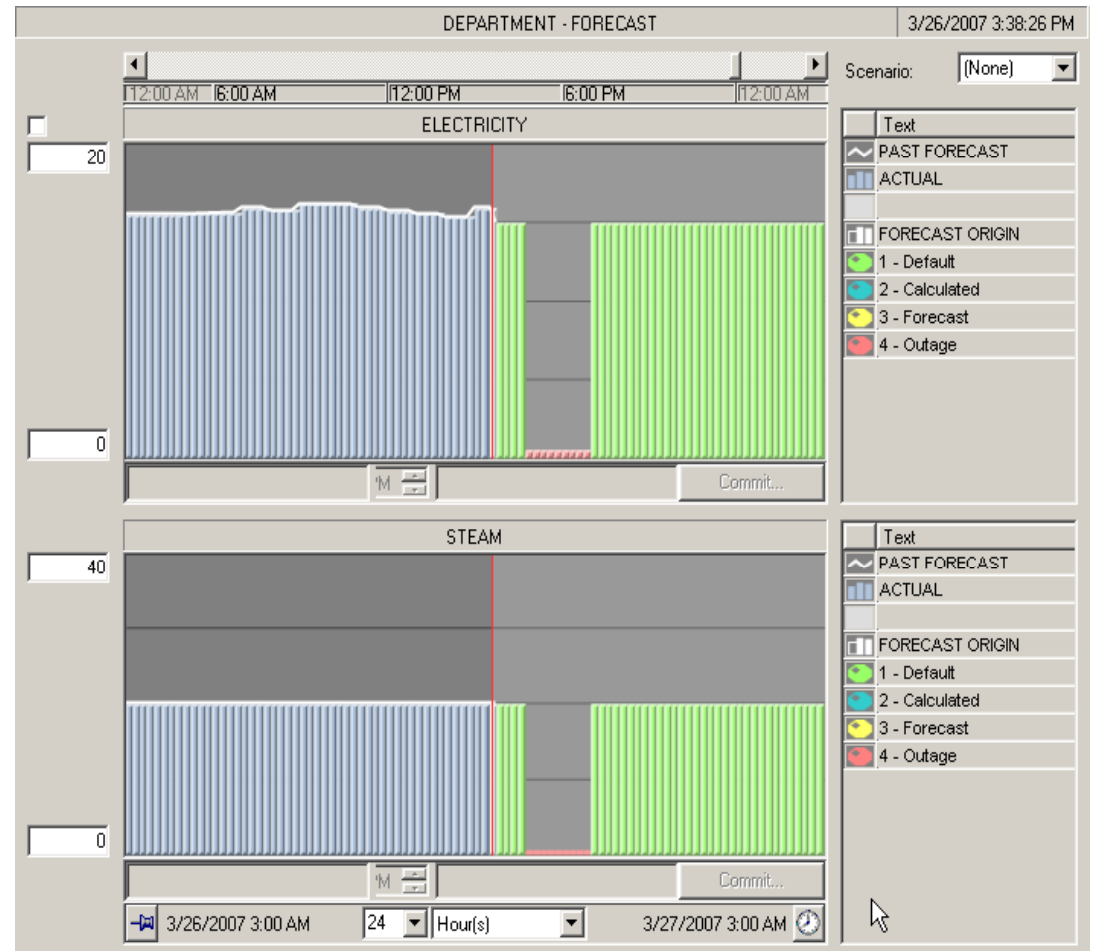
How?

Select power resources to match load schedule at minimum cost

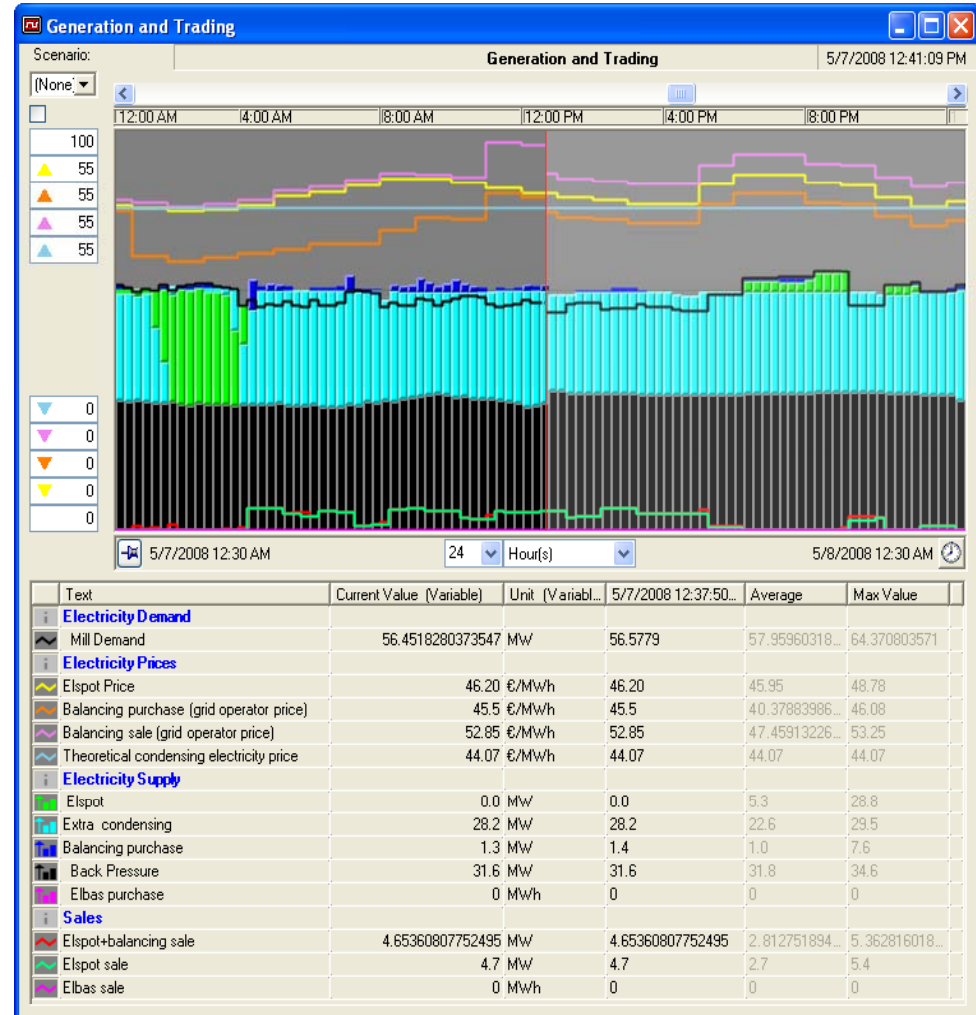- **Power resources**
  - Own generation
  - Purchase agreements
  - Electricity from spot market

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

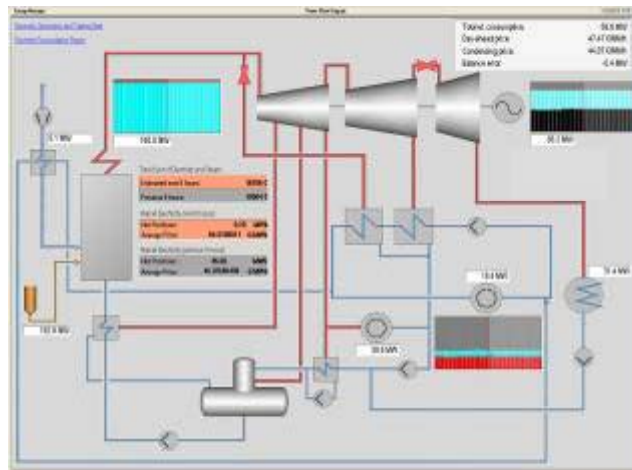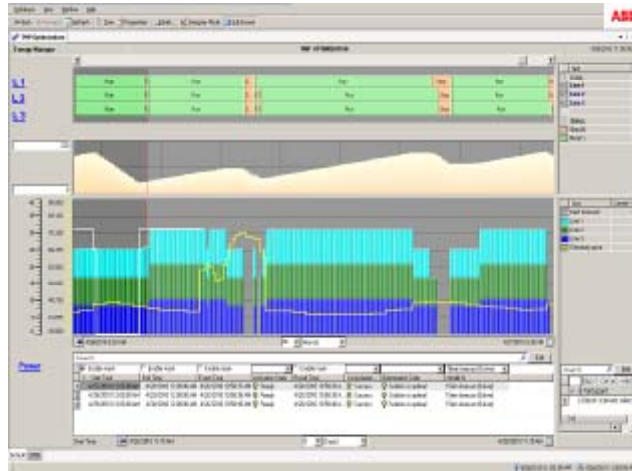- **Alternative: Load scheduling to utilize inexpensive off-peak power**

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

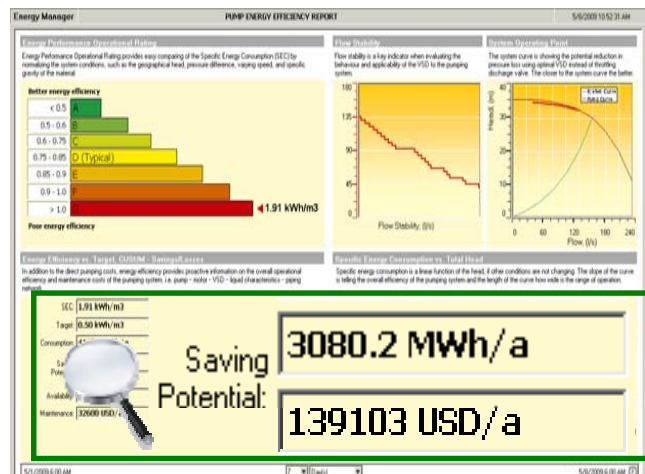- 2 to 5% additional cost savings are possible with optimization
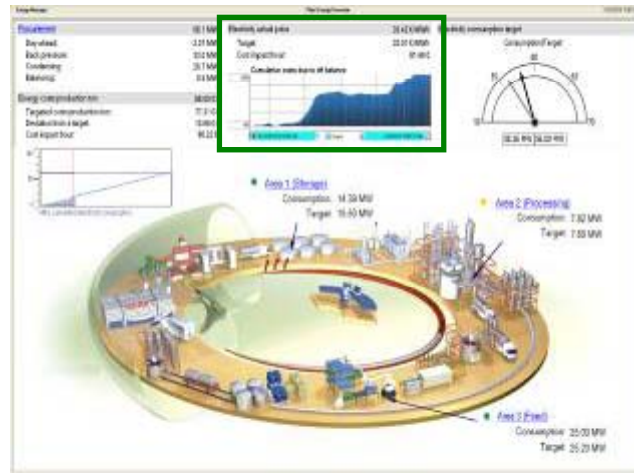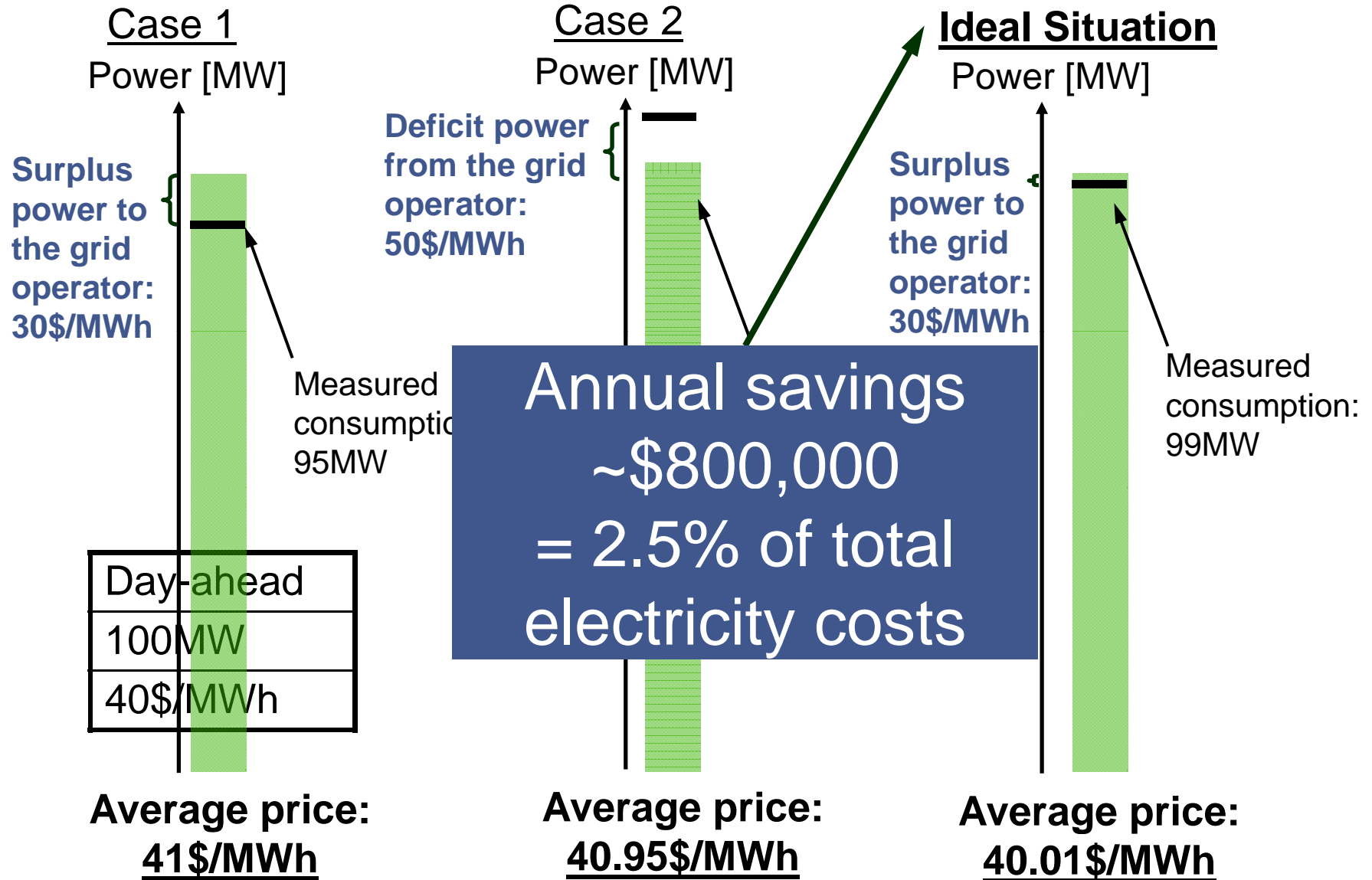
How?
Energy Efficiency Monitoring

- 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]

Case 2
Power [MW]

Ideal Situation
Power [MW]

Surplus power to the grid operator: 30$/MWh

Measured consumption 95MW

Day-ahead
100MW
40$/MWh

Average price: 41$/MWh

Deficit power from the grid operator: 50$/MWh

Average price: 40.95$/MWh

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

Surplus power to the grid operator: 30$/MWh

Measured consumption: 99MW

Average price: 40.01$/MWh

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$
  - CO_2 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$
    - CO_2 reduction   2,000 tons

Questions?