

Kamlesh Kumar / 14th May 2010

ABB India Ltd
CPM plus Energy Manager for Cement Industry.

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 for a better world™ **ABB**

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Overview of cpmPlus Energy Manager

- § Energy management means many things to many companies. But one thing is certain: It matters, especially in these trying economic times and with so much global emphasis being placed on conservation and environmental issues.
- § Energy management is must in terms of profitability and sustainability
- § Energy Monitoring of each equipment (whatever small it may be) in any industry is must.
- § We're all worried about energy prices. In the long term, they will rise. If you are a company, you use energy. How can you manage it?

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Overview of cpmPlus Energy Manager

- § We must start from the top down. You have to have some kind of strategy, and you set targets. Once you have a strategy and some targets to address this problem, you start processes, and you look at progress and results. This is a continuous process.
- § There are three formulae for energy measurement :
 - § 1) Cost of Consumed Energy
 - § i.e. energy consumption x average unit price
 - § 2) Specific energy consumption
 - § i.e. total energy consumed/production output
 - § 3) Energy and utility conversion efficiency
 - § i.e. (energy/utility output)/(energy/utility input)
- § The more output we get with the same amount of energy, the better the specific energy consumption.

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Overview of cpmPlus Energy Manager

- § There are three Areas for Energy Optimization :
 - § 1) Price Optimization
 - § We try to get energy consumption as low as possible
 - § 2) Usage Optimization
 - § We get energy usage as low as possible, while increasing the production output
 - § 3) Generation Optimization
 - § We increase energy/utility output, but reduce energy/utility input

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Overview of cpmPlus Energy Manager

- § Price Optimization :
 - § A company would co-ordinate energy demand and supply and execute energy-consumption predicting, planning and scheduling.
 - § This improves energy efficiency and reduces the carbon footprint. We try to get energy consumption as low as possible.
 - § By synchronizing energy generation, purchase and sales with energy demand, a company can purchase or produce its energy at the lowest market prices and optimize the use of alternative energy sources.

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Overview of cpmPlus Energy Manager

- § Usage Optimization :
 - § It focuses on process control principles, process parameter variation, human factors and equipment that consumes a lot of energy.
 - § By finding and implementing the most energy-efficient way to control and run the entire process and by using the most energy-efficient process technology, a company can reduce fuel consumption while improving production at the same time.
 - § Performance indicators for usage optimization include measuring
 - § the energy consumption/produced unit,
 - § the emissions/produced unit and
 - § the energy efficiency/energy intensity index.

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Overview of cpmPlus Energy Manager

- § Generation Optimization :
 - § It looks at distribution and use of utilities in the plant.
 - § Utilities can include steam, process heating, cooling, refrigeration, cooling water, compressed air and HVAC.
 - § Generation optimization can bring
 - § utility energy efficiency,
 - § energy conversion efficiency and
 - § a carbon footprint reduction.
- This can be measured by the cost of produced energy, emissions and losses in energy distribution.

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Overview of cpmPlus Energy Manager

- § For purposes of sustainability, a constant balance between production and consumption is necessary, and an energy savings program needs to be implemented.
- § An awareness of the energy balance and prediction of consumption and production require an energy management system and a savings program with top-management commitment, organization, visibility and tools.

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Overview of cpmPlus Energy Manager

There are three major steps in Energy Management

- 1) Monitoring and Reporting
- 2) Add Plant Wide Load Planning, optimizing and cost accounting to plan energy consumption against energy resources.
- 3) To put in a centralized planning and optimization system.

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Overview of cpmPlus Energy Manager

- § ABB offers a variety of tools for process automation, hardware, manufacturing operations, local electrical networks and external power grids.
- § ABB has energy monitoring and reporting to analyze how much energy is being used.
- § The cpmPlus Energy Manager is suited for energy optimization, including energy price reduction, energy consumption reduction, production efficiency, safety and sustainability.

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cpmPlus Energy Manager (EM) is ...



- § A software package that allows you to:

- § Monitor and report energy usage and efficiency

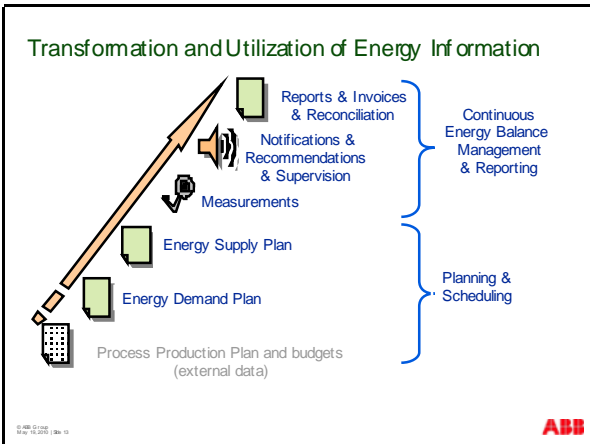
- §

Energy Manager
focuses on the business side of energy management.
1% to 5% cost savings possible with smart energy procurement and energy cost controls based on Energy Manager tools.

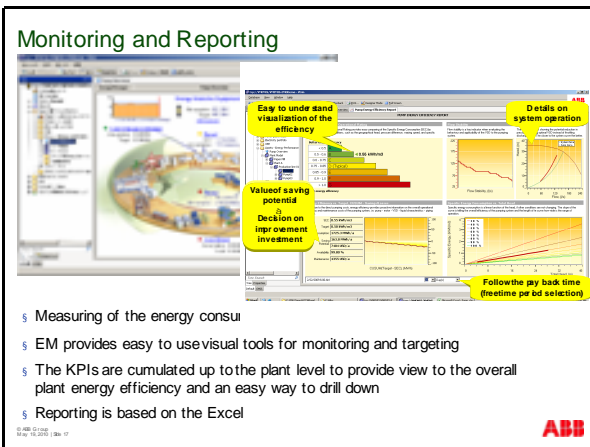
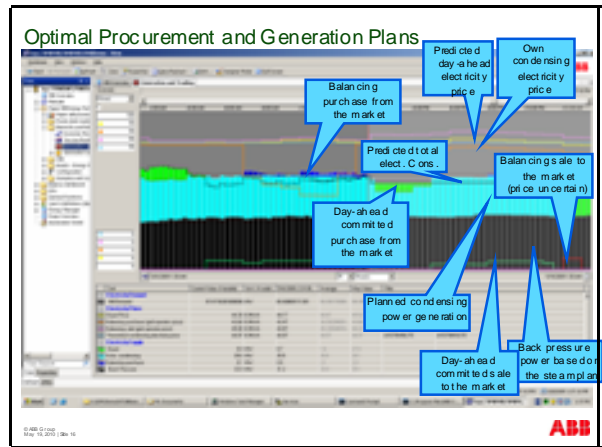
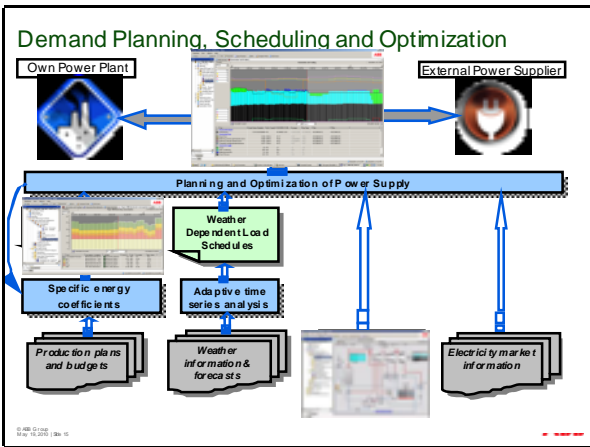
- § Optimize the use of alternative energy sources

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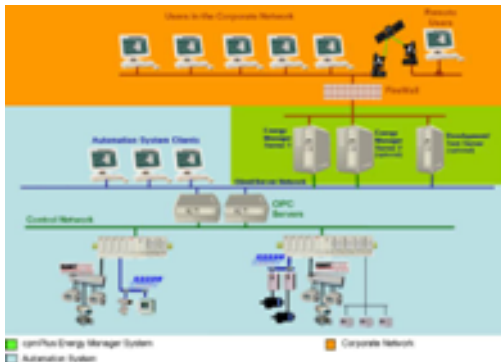


- ### Planning of Electricity Use and Generation is Essential
- § Motivation
 - § Scheduling and optimization of power generation capacity
 - § **Benefits for Power Companies:**
 - § More stable power grid
 - § Less spinning and fast reserves
 - § Regulating less expensive
 - § Less CO2 emissions
 - § Operating on optimal efficiency
 - § **Benefits for Consumers:**
 - § More stable power grid
 - § Unit price of electricity is lower
 - § Less penalties
 - § Improved energy efficiency (follow up)
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- ### Notices & Recommendations from the System
-
- § Comprehensive alarming capabilities with several alarm types and priorities
 - § Alarm/notices can be automatically sent via sms/e-mail, and/or can be spoken
 - § Alarming strategy for various purposes:
 - § Electricity price escalation
 - § Production deviation from targeted consumption
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cpmPlus Energy Manager: System Architecture



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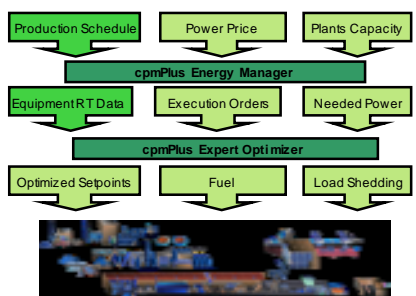
Typical Energy Management Applications

FUTURE	• Strategic planning	Budget
	• Load planning	
	• Planning simulation tools	
	• Support for hedging	Long term energy plans
	• Operative planning	
	• Load planning	Production plans, weather forecast
	• Power trading (day-ahead auction)	Market price forecast
	• Balance management	On-line measurements
	• Load prediction	
	• Trading in energy balance market	Concluded balancing contracts
PAST	• Continuous power monitoring	
	• Energy reporting and cost accounting	Revenue metering
	• Balance settlement	Reconciliation and approval

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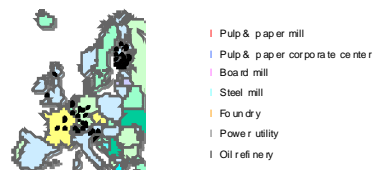
Automated Energy Management



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cpmPlus Energy Manager Reference Systems



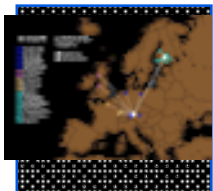
- § ABB has over 20 years' experience in helping industrial customers to be more competitive using Energy Management
- § 40+ Energy Manager systems delivered since 2000

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UPM Corporate wide Energy Management

Corporate-wide energy management network



- § 20 TWh/y total electric energy procurement
- § 17 Mill systems and two corporate centers
- § Energy procurement and production planning, real-time monitoring and reporting on mill and corporate level

- § Reductions in carbon dioxide and sulphur dioxide emissions
- § Investment payback time ~ months

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PVO-Pool, Finland

Energy management for PVO Power Utility

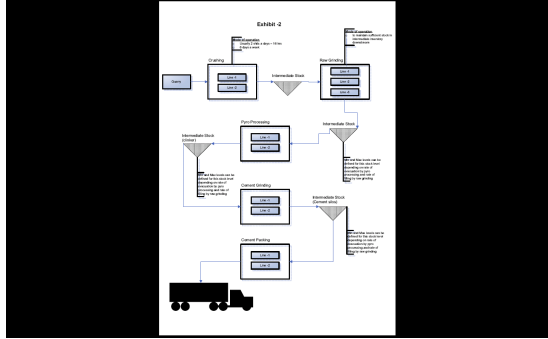


- § Operating a 3.4GW power portfolio including
 - § 21 thermal power plants
 - § 2 nuclear units
 - § 12 hydro stations
 - § 5 wind power stations
- § Approximately 25% of total electricity production in Finland

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Optimization: Schematic Process Flow of the Cement Manufacturing Process



Optimization: Configuration with Economic Flow Network

Annotations for the Economic Flow Network configuration:

- Define the structure of the optimization problem as a flow network
- Input prices and restrictions for a contract
- Electricity consumption is the total of all line consumptions
- Define time tariff structures for electricity prices
- Flow is enabled

Optimization: Cement Manufacturing and Energy

Cement_line_optimization - Wadi II

Equations/restrictions between decision variables

Energy optimization - Example

- Rule balance: Coal stock, Heat losses in boiler, Energy balance/Live steam, Boiler construction air pre-heating
- Energy balance: Extra condensing, Low pressure steam delivery, Cooling, Gross electricity production/Gross condensing electricity power, Boiler balance/Live steam
- Gross electricity production: Electricity balance/total electricity production, Net electricity production, Energy balance/Gross back pressure power
- Electricity balance: Net electricity production, Consumption in the process, Distribution losses, Grid, Purchase, Sale

Calculate the total of electricity (C using Line 1's production rate specific electricity coefficient, etc.)

Optimization: Example, Crushing Line 1 (1/2)

Annotations for Crushing Line 1 configuration:

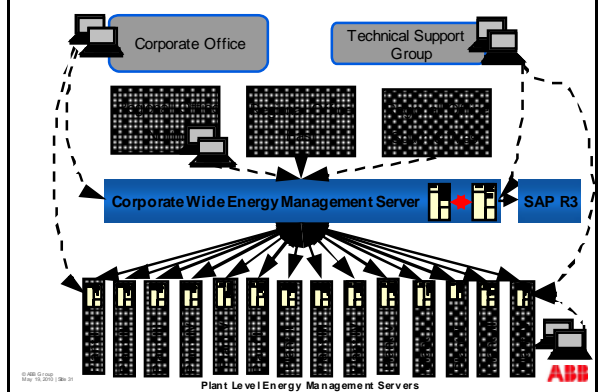
- Production limits and rules
- Definition of Crushing Line 1
- Crushing lines feed material to intermediate stock

Optimization: Example, Crushing Line 1 (2/2)

Annotations for Crushing Line 1 rules:

- Set of rules to optimize on/off state of the line

Energy Manager System Architecture



cpmPlus Energy Manager Summary

- § Predicts automatically companies power demand
- § Schedules and optimizes own generation and purchased power
- § Takes an advantage of varying prices
- § Allows monitoring your procurement and energy efficiencies
- § Modular product: Allows to start small and grow over time

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