Energy on-line Management through Internet and a specialized Ontological Information System

Web based Energy Management

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E.M.I.R. System

Energy Knowledge Management

- Ontology based data management
- AMR based on Wireless Networks and ADSL-based VPNs
- Integrated Knowledge Management
- Cross correlations & time-variant Energy Management
- Decision Support System and variable Pricing Methodology
- Energy Data warehouse for energy transactions
- Web based Energy Search Machine for dedicated Customer profiles
- On-line Energy Stock Market
- Autonomous web-based broker for energy-based transactions

E.M.I.R. System

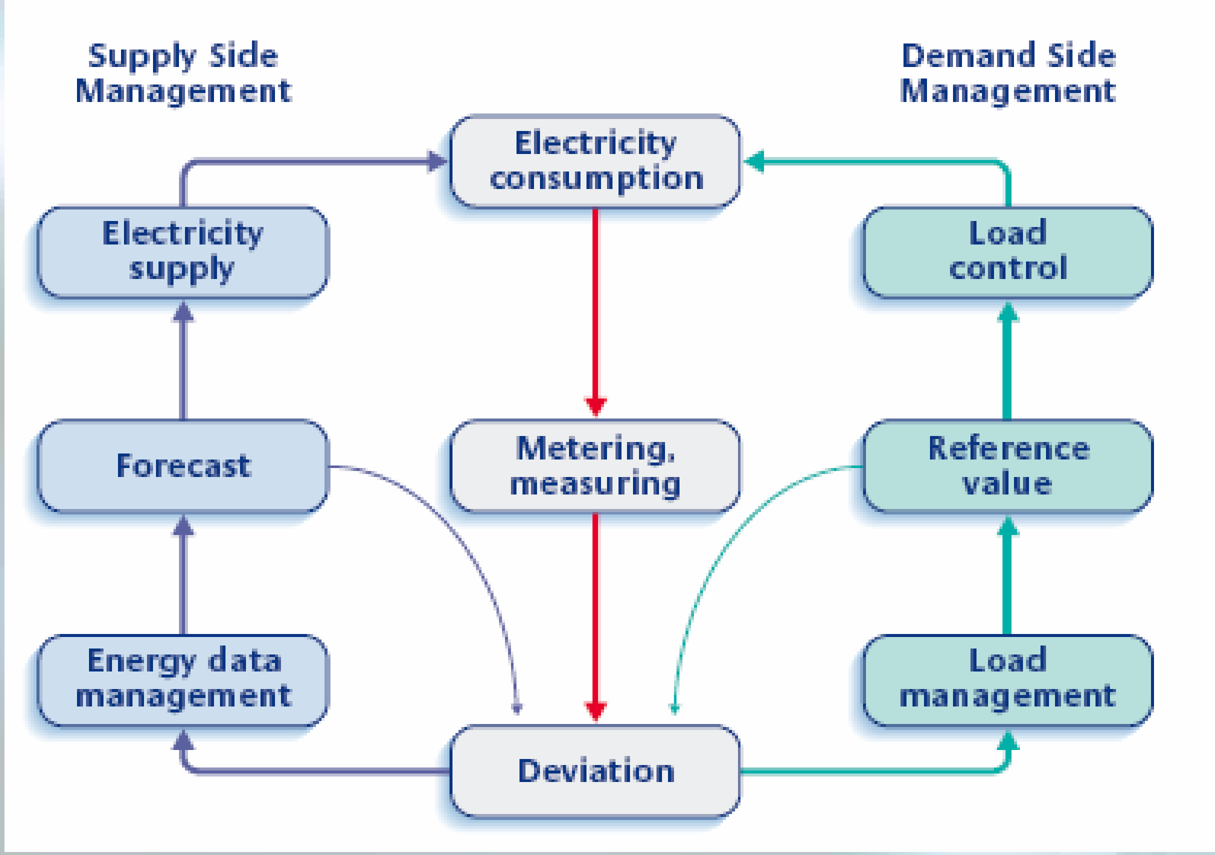
Bi-directional Energy Management

- Web-based System for Energy Suppliers to analyze and store energy information from various consumers
- Web based System for Energy Consumers to analyze their loads
- Bi-directional Energy Information System based on a simple Portal
- Bi-directional Energy Decision Support System
- Autonomous web-based Energy profiling of ad-hoc Customers
- System for on-line Peak Control during Summer days
- Control System of Energy Customers and variable Pricing

E.M.I.R. System

Bi-directional Energy Control

- Closed loop of Supplier vs Consumer



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Basic Energy Modeling

- **Load Elasticity** Demand to be completely inelastic (i.e. independent of market clearing price
- **Load Seasonality** Seasonality is a major driver for electricity demand observing seasonality over the daily, weekly, and yearly cycles
- **Load Mean reversion** Temporary spikes in electricity demand, often induced by extreme weather conditions. However, these spikes are not sustainable and demand reverts back to normal levels within a few days, hours
- **Stochastic growth** Growth in electricity demand is driven in part by trends in the overall economy.

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Basic Energy Equations

The typical load vector LD, comprised of various daily load vectors $\boldsymbol{\mu}_m$ can be described

$$L_D = \mu_m^L + \sum_{i=1}^{j} w_d^{Li} v_m^{Li}$$

where $\boldsymbol{\mu}_m$ and $\mathbf{v}_m$ are deterministic parameters and $\mathbf{w}_d$ is a daily stochastic process.

A monthly [24x1] vector $\mathbf{v}_{Lm}$ is used to describe load behaviour, reducing the load equation to

$$L_D = \mu_m^L + w_d^L v_m^L$$

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Energy Web-based Optimization

The basic Energy Objective function used (Energy Equilibrium Function)

$$\sum_{j=1}^{n}\left(Q_j - L_\Delta - L_E\right) * SMP + \sum_{i=1}^{m}\left(Q_i^a - L_i^a\right) * SMP = 0$$

$$\left[Q_i \propto \sum_{i=1}^{k} W_n^k\right] \propto e_r$$

Where Matrix **W** represents closed contracts between Suppliers and Consumers and **e** is a multidimensional stochastic vector

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Energy Customer Clustering

- Daily load curve indices has been proposed
- Coefficient ***a***= *Pmin/Pmax*
- Fill-up coefficient ***p*** = *Pav/Pmax*
- Modulation coefficient at peak hours **MCph** = Pav.,ph/Pav

Pmin is the minimum power demand of the representative day,

Pmax is the maximum power demand,

Pav is the av. power demand, based on the ratio of the electricity consumption

Pav.ph is the average power demand during daily peak hours.

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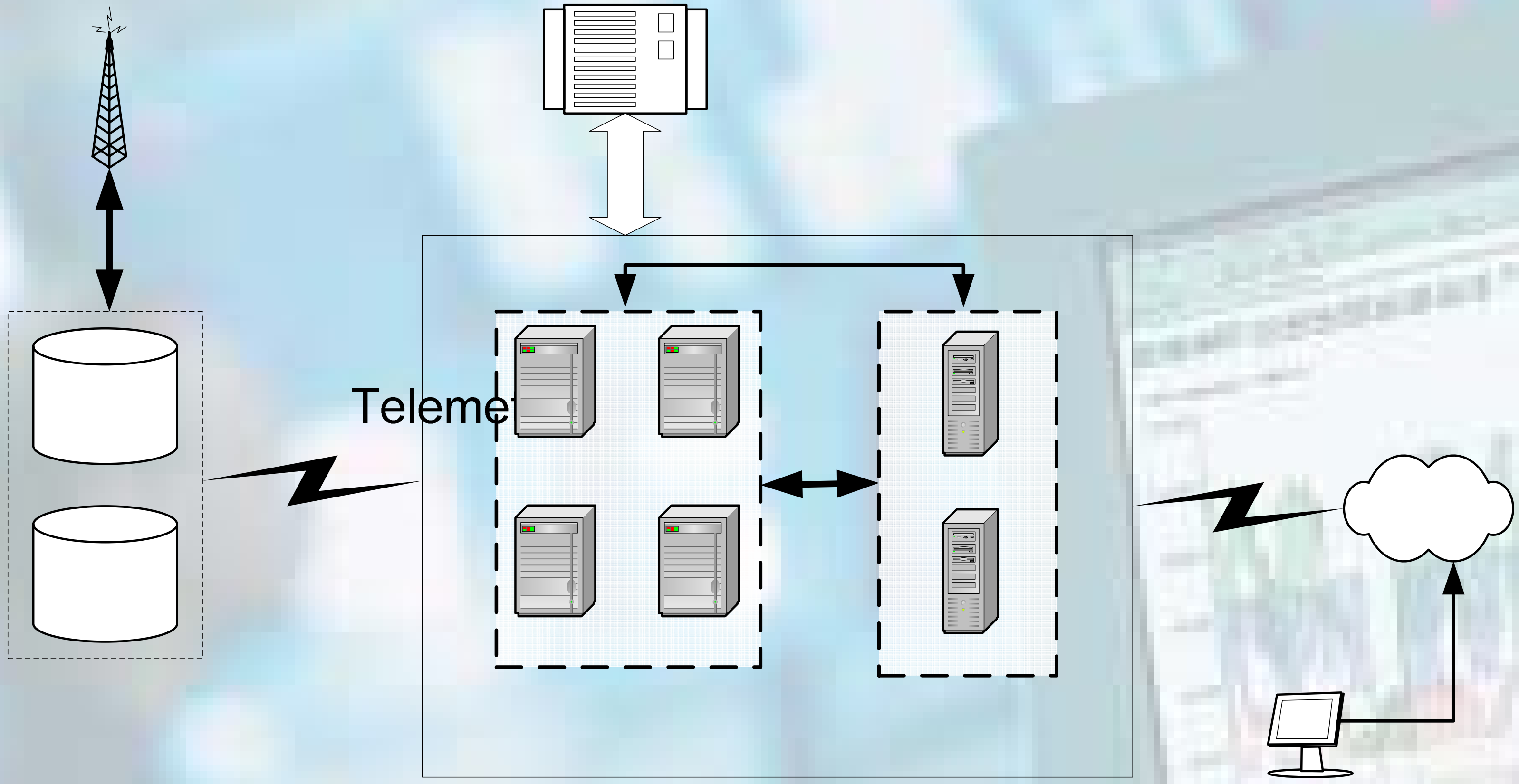
Cluster Grid



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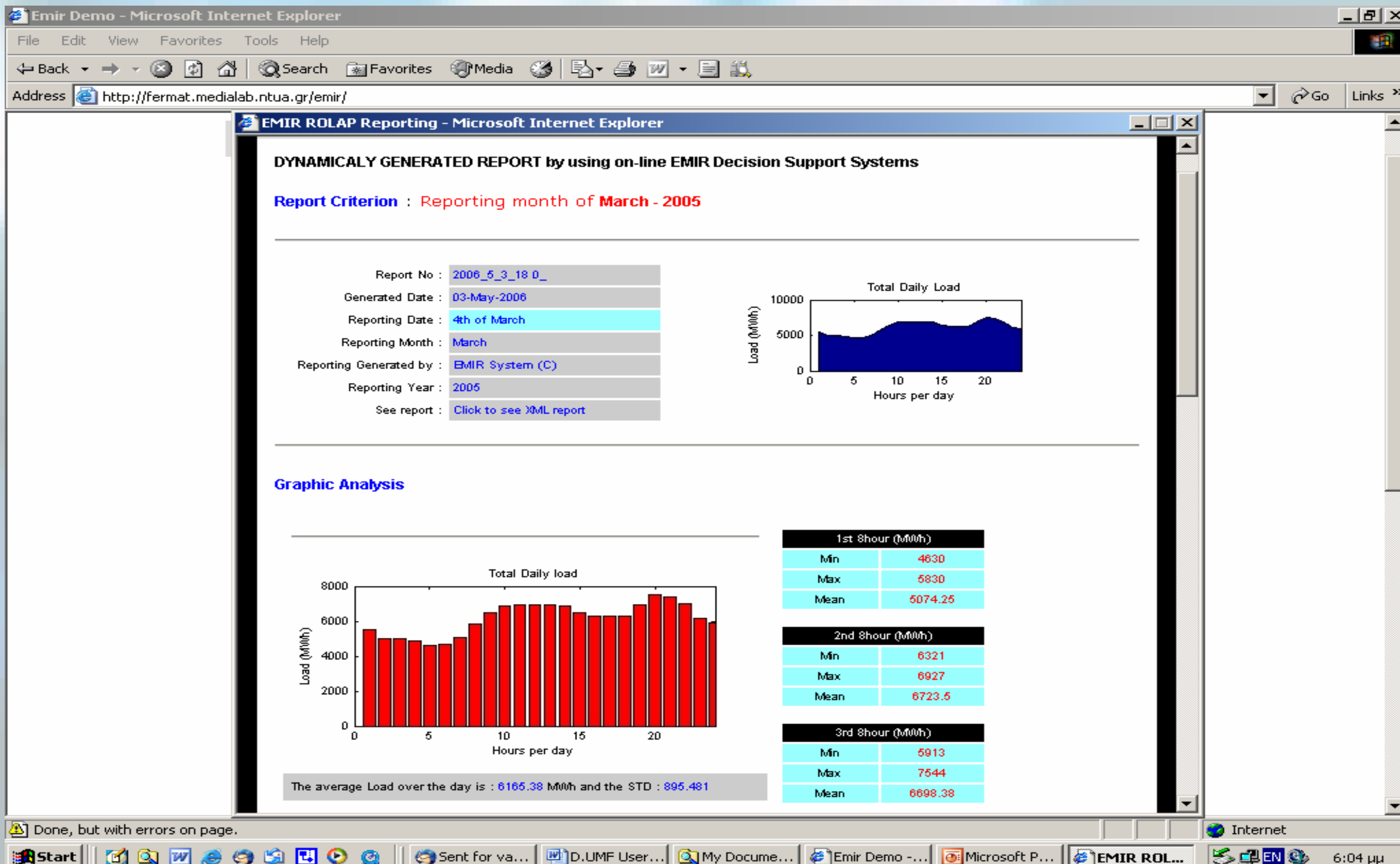
EMIR Case study

On-line portal @ http://www.intelen.gr



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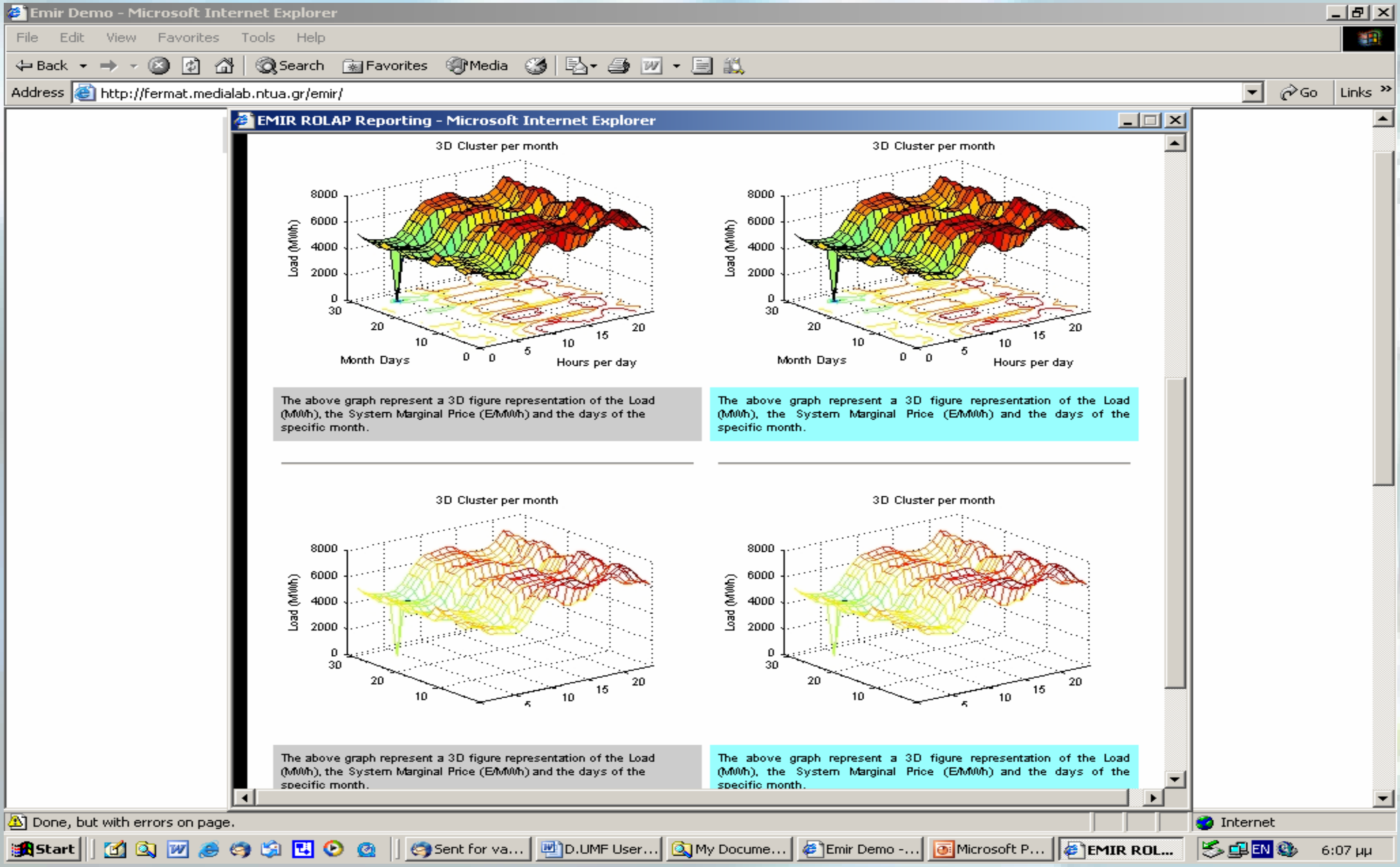

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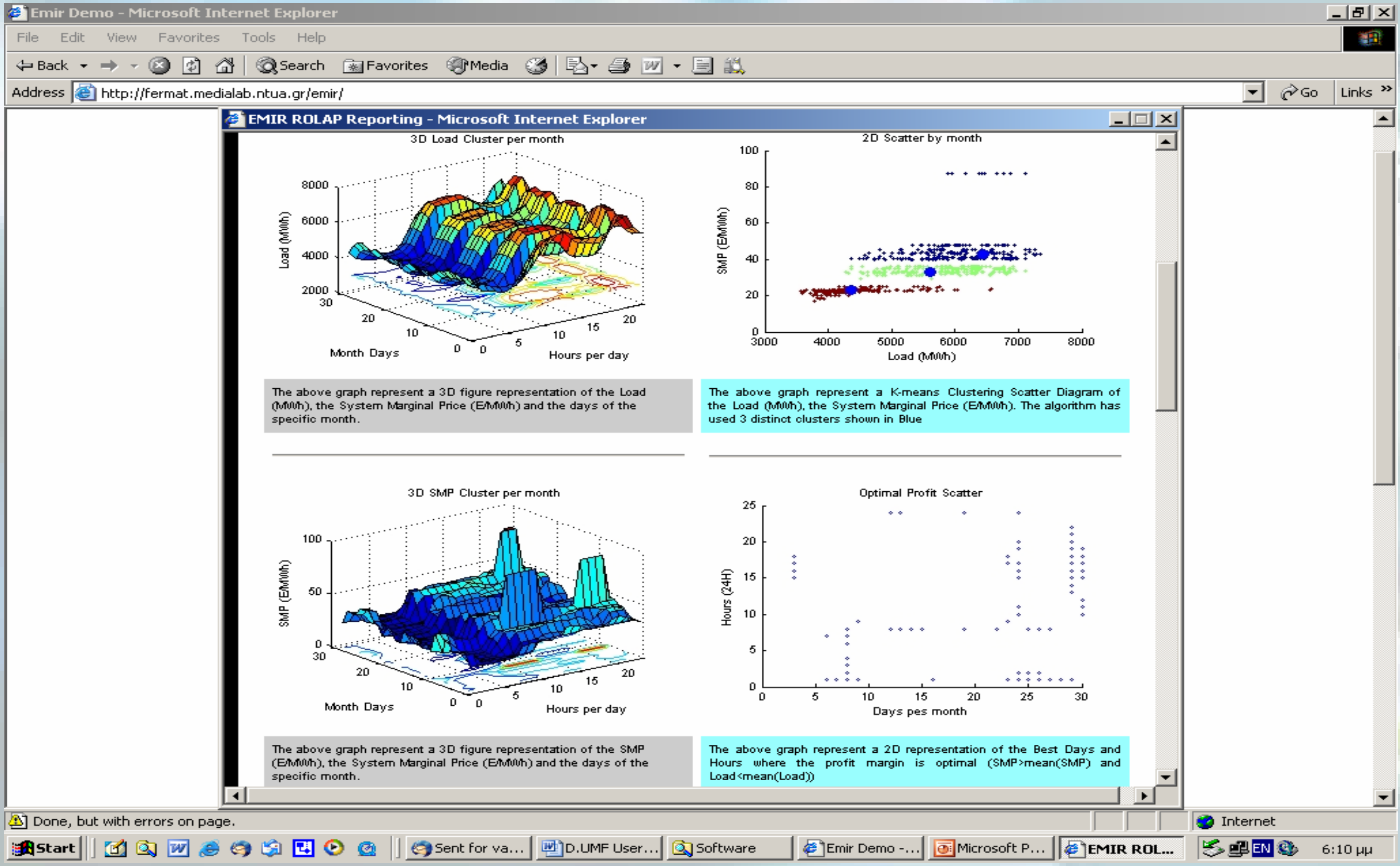

Conclusions

- Better on-line management of total energy usage
- Get details about the amount and timing of your energy use, so you can adjust accordingly and save money
- Advanced meter data can be stored and used to compare costs between competing utilities and to arrange for bulk-rate purchasing
- Identify and implement operational strategies to control load factor, peak load requirements and reduce energy waste
- Understand and improve consumption Clustering and Statistical patterns
- Measure and verify anticipated energy savings
- Secure a better variable **cross-correlated** pricing from the retail energy markets
- Highlight anomalies in electric consumption

Conclusions

- Identify and assess on a real time basis the fiscal impact of the energy consumption
- Advanced notification via email of a higher peak demand being set
- Energy suppliers can acquire faster data enabling proactive energy management They can immediately turn this data into valuable knowledge for them and their customers and offer improved services to their commercial and industrial clients
- Track in real time usage and load. Compare that to what has been scheduled and initiate any localized demand reduction during high market prices
- Manage peaks efficiently to avoid spot market energy purchases
- Reduce and limit the risk out of the energy business.
- Reduce the risks in a volatile energy market.

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