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ICT applications enhancing energy efficiency

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Abstract: Computers, laptops and mobile devices – information technology (IT) accounts for 2% of human greenhouse gas emissions worldwide, as evidenced in a study by Global Action Plan, a UK-based environmental organization. This figure can be reduced if the green segment, or Green IT, continues to grow. Energy can also be saved through cloud computing, namely the principle of outsourcing the programs and functions of one's own computer to service providers over the internet. This also means sharing storage capacity with others. This paper highlights the impact of information technology applications towards enhancing energy efficiency of the systems.

Keywords: Efficiency of transmission and distribution networks, computer aided testing and performance analyses, intelligent meters with variables tariffs.

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1 Introduction: Soaring electricity demand throughout the fast developing Asian nations has given rise to a new emphasis on independent power and energy management. In the increasingly industrialized, automated, and high technology environments of the worlds booming economies energy scenario calls for reforms. The capital investments in power plants, substations, and transmission and distribution networks are enormous. If it is possible to utilize this system better, with lower losses, fewer disturbances, with higher loads and over a longer lifetime, this means a significant improvement of the total economy for the power system. I.T. in itself does not give any extra mega Watt hours, but it can provide the necessary information to improve both the efficiency and quality of the power process. Energy utilities see information technology as an important tool to enable them to improve the efficiency of transmission and distribution networks, as this technology may be used in all parts of process planning, operation and maintenance. The purpose is more efficient, reliable utilization of power system, with maximum life cycle economy. Powerful microprocessors have made the use of more intelligent devices possible throughout the power system. Intelligent meters with variables tariffs in houses, load control receivers to reduce peak loads, adaptive control and protection of substation, automation of processes, computer aided testing and performance analyses are some examples. Information technology can be seen as a tool to integrate all these functions and can reduce the operating cost by proper energy management and can increase the revenue.

Operations Information System (OIS) supports a copy of the real time data base and application program data files and runs programs such as:

- Power flow management
- Substation management
- Post Disturbance Analysis
- Historical Data Retention
- Generator Performance Records
- Energy Accounting

- Operations Reports
- Distribution Circuit Analysis
- Information Retrieval and Analysis
- Load Flow studies

2. Significance of IT in Power Sector: Poor load forecast particularly macroeconomics related long-term trends has brought the industry to having significant excess supply. Meanwhile, technological developments have brought small-scale distributed generation to the point of being competitive with the large power plants. This has opened the door to electricity competition several years ago. As many large power plants are likely to be replaced by smaller scale and/or sustainable resources, and as the retail at the small customer level becomes a law, the challenge is tremendous at all levels of business: supply, wire and consumption. The most important aspect of the newly evolved situation is that the interplay between economic, regulatory and engineering developments should be synchronized in order for the society to see the benefits of competition. The information technology (IT) play a major role in implementing more dynamic economic, regulatory and engineering solutions.

A. Generation: This business is characterized by a very active development of electricity markets daily, futures, Multilateral. Methods needed concern primarily estimation of projection of electricity prices, price differentiation being according to time horizons of interest and location of supply. The estimation of residual demand as seen by the group of electricity producers is a very difficult problem in economics. INDEX type experiments are needed to develop knowledge of the demand elasticity in response to various electricity pricing schemes. Without this knowledge, the electricity markets remain supplier's domains, in which gaming and market power determine what actually happens. Many researchers believe that electricity, because of its non-storability property, creates a challenge not typically studied in other competitive markets. On the other part of the spectrum, developing methods for supplying energy at a cogeneration level, combining gas-electricity management for newer power plants may get around this problem and offer new opportunities for efficiency and risk management.

B. Transmission: The overall result of supply / demand provision through active, open access electricity markets is that transmission owners / providers face a very uncertain demand for transmission. In the ultimate scenario, when majority of supply is distributed, small and local, the need for a strong transmission grid may diminish all together. Under competition, designing best transport to deliver inexpensive electricity from a far away plant is equivalent to using a more expensive local power. The IT tools could play tremendous role in the future power delivery business. One could envision a dynamic transmission provision in which the tradeoffs between risk management by transmission providers, and priority-based valuing of this service by the network users could be based on powerful IT methods.

C. Consumption: Consequently, much activity is likely and will, with the help of adequate IT tools, take place on the energy users' level. Genuine e-commerce for electricity needs response at this level. Sufficient information must be provided for the users to implement conservation, choice of power respond to the overall supply/demand conditions, electricity markets conditions, etc. IT tools supporting cooperation among the electricity users, for valuing economies of scope and scale are essential if the society is to see benefits of competition in electricity. This cannot be done without aggressive development of IT tools for the users.

3. Ten Technology Trends for the Energy and Utilities Sector:

Gartner, Inc. (NYSE: IT) is the world's leading information technology research and advisory company headquartered in Stamford, Connecticut, USA. A new report from Gartner, Inc. identifies the top ten technology trends affecting the global energy and utility markets in 2013, as the industry faces significant challenges from ongoing environmental sensitivity, changing policymaker attitudes and consumer expectations. The top ten technology trends are -

Social Media and Web 2.0: Utility IT leaders have opportunities to use social media as a customer acquisition and retention medium for competitive energy retailers, as a consumer engagement channel to drive customer participation in energy efficiency programs and as the emerging area of crowd-sourcing distributed energy resources coordination.

Big Data: Smart grid development will increase data quantity by several orders of magnitude, driven by a host of edge devices, as well as new IT and OT applications such as advanced metering infrastructure (AMI), synchrophasors, and smart appliances, micro-grids, advanced distribution management, remote asset monitoring, event avoidance and self-healing networks.

Mobile and Location-Aware Technology: owering costs and improving the accuracy and effectiveness of the field force are the main drivers for utilities to deploy mobile and wireless technologies. Mobile and location-aware technology spans hardware (such as ruggedized laptops, PDAs and smart phones), communication products (such as navigation, routing and tracking technologies like GPS) and services (such as cellular digital packet data and general packet radio service, using high-speed terrestrial data networks, Wi-Fi and satellites).

Cloud Computing and SaaS: Although the utility industry trails other sectors in cloud adoption due to security and reliability concerns, solutions are beginning to emerge in areas such as smart meter, big data analytics, demand response coordination and GIS.

Sensor Technology: Sensors are applied extensively throughout the entire supply, transmission and distribution domains of utilities. Sensor fusion — the addition of onboard digital signals processing and associated software development capabilities — is accelerating potential applications. Widespread utility adoption is challenged by specific implementation requirements, such as ruggedization, electromagnetic shielding, temperature extremes, cyber security and remote access.

In-Memory Computing: Increasing use of in-memory computing (IMC) application infrastructure technologies as enablers inside multiple types of software and hardware products will result in rapid IMC adoption by mainstream, risk-averse IT organizations. The ability of IMC to support high-scale, high-throughput and low-latency use cases will make it possible for IT organizations to implement innovative scenarios, such as those addressing processing of the smart-grid-generated metering and real-time sensor data.

IT and OT Convergence: Virtually all new technology projects in utilities will require a combination of IT and OT investment and planning, such as AMI or advanced distribution management systems (ADMSs). More than any industry, the utility sector faces the challenge of the separation between IT and OT management, coupled with the importance of hybrid projects that link IT and OT systems.

Advanced Metering Infrastructure: AMI constitutes a cornerstone of the smart grid by potentially providing a communication backbone for low-latency data aimed at improving distribution asset utilization failure detection, and facilitating consumer inclusion in energy markets. Different market structures, regulatory drivers and benefit expectations create different ownership models for components of the AMI technology stack, which favor different technology solutions across the globe.

Communication Technology: The distributed nature of utility assets, combined with the need for more efficient asset management and labor use, makes mobility and supporting communication technologies high investment priority areas for utilities. The smart grid drive toward better observability of the distribution network requires machine-to-machine (M2M) monitoring systems that are similar in function to low bandwidth SCADA, but use different communication technologies and approaches (such as personal-area networks (PANs), HANs, FANs, substation, control center and enterprise LANs, and shared wide-area networks (WAN).

Predictive Analytics: Predictive analytics has become generally used to describe any approach to data mining with four attributes: an emphasis on prediction, rapid time to insight, an emphasis on the business relevance of the resulting insights and an increasing emphasis on ease of use, thus making the tools accessible to business users.

4 Conclusions: On one hand energy production will become more localized, however renewable are more effective across larger grids. Super grids, where multiple countries are connected via high-voltage DC lines (HVDC) in a mesh-like system are beginning to take shape. The way new technologies are able to forecast weather patterns will help us mitigate the variability of supply. It will help us to forecast offshore wind supply and the output of solar farms across countries. For a super grid, having the ability to predict how renewable will perform is critical. The development of cloud computing has a beneficial influence on energy consumption by sharing processors and other hardware, to avoid data centers being grossly underused as in the past. Technological progress also favors energy efficiency because each newer generation of devices is smaller and more energy efficient. New processor architectures are getting more efficient. An example is the use of GPUs (graphical processing units) instead of CPUs (computing processing units) for a number of scientific computing tasks, which are thus processed with better energy efficiency. IT should play critical role as a catalyst toward the effective generation, delivery and consumption of the evolving energy businesses. The benefits of competition cannot be achieved without extensive use of high technologies IT, systems approach to the problem. Furthermore, the incentives for using these technologies are hard to develop using strictly engineering approach to the problem, or strictly regulatory, or economic.

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