

## **ICT APPLICATIONS IN ENERGY MANAGEMENT**

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### **ABSTRACT**

The quest for energy and more energy has always been, and will continue to be, prominent in the global sustainable development agenda. Fears have been expressed about possibility of exhaustion of energy resources if the rapidly depleting natural and artificial resources are not replenished, or if the growing world population is not controlled. Energy scarcity and crisis are common causes of social, economic and political woes. Even renewable supplements and alternative energy sources so far discovered have not met the minimal energy demand of the world. Therefore, this paper considers potential applications of ICT in efficient energy management and saving; some of the associated threats or challenges of ICTs are also discussed.

ICT encompasses research and development in:

- Information technology (IT)
- Telecommunications
- Robotics
- Software engineering
- Networking
- Sensing

Scientists, engineers and technologists are increasingly deploying ICTs to tackle important challenges in diverse areas including:

- Energy
- Health
- Water
- Food

Governance, etc.

ICTs not only constitute an industry in their own right but they also pervade all sectors of the economy – as integrators & enablers.

They are essential for both

- System management
- Empowering end-users for innovations and creativity

There is increasing evidence that significant opportunities and threats are involved in widespread use of ICTs

Examples of both are the focus of this presentation.

## **Energy**

- Energy is closely related to economic development, poverty alleviation, and provision of vital services.
- Increasing energy demand is also closely related to global climate change.
- Major natural disasters in recent years – tsunamis, hurricanes, tornados, gully erosion, etc. – are closely linked to climate change.
- Present pattern of energy production and consumption appears to be unsustainable.
- Unsustainable trends undermine future economic growth and impact on the quality of life:
  - Increasing demand for natural resources, including energy.
  - Increasing CO2 emission resulting from production and use of energy.

## **Renewable Energy**

- The term refers to sources of energy that are generated by nature & sustainable in supply:
  - Solar
  - Wind
  - Geothermal
  - Biomass
  - Hydro, etc.

## **Sustainable development**

- DEVELOPMENT that
- “ meets the needs of the present  
without compromising the ability of  
future generations to meet their own  
needs” (Brundtland Commission, 1987)

## **CRITICAL INFRASTRUCTURE**

- A nation’s critical infrastructure comprises assets that are essential for the smooth running of society and the economy:

- Electricity generation, transmission & distribution
- Oil and gas facilities
- Telecommunications
- Transportations systems
- Water supply systems
- Agriculture
- Public health facilities
- Security services
- Financial services

The global economy runs on such infrastructure which in turn depends on availability of energy

### **Critical Energy Infrastructures (CEI)**

Critical energy infrastructures are vulnerable to:

- Natural hazards such as:
  - Hurricanes, Earthquakes, Tsunamis, Floods, etc
  - System failures due to:
    - Equipment breakdown
    - Human error
    - Intentional events (vandalism, terrorism, etc)

### **Opportunities offered by ICT**

- Optimization use of natural resources, including energy, throughout the whole life-cycle of products and processes
- Design of smarter and cleaner products and processes, optimizing energy consumption and reducing waste
- Reduction in vulnerability of CEI
- e-materialisation: the shift from products to services
- Intelligent transport systems' impact on increasing transport performance and promoting shift from the use of the private cars to public transport;
- Promotion of efficiency in electricity generation and distribution e.g. smart electricity grids;
- ICT-supported facilities for the management of energy savings e.g. intelligent lighting and environment conditioning system in smart buildings and neighbourhoods;
- Support systems for decentralized energy generation from renewable sources;

- With ICT we can monitor and detect emerging problems in energy infrastructure leading to possible failure
- ICT elements for this purpose may include
  - Sensors
  - Communication channels
  - Remote monitoring systems
- Real-time control and monitoring systems achieved using SCADA (supervisory control and data acquisition)
- Typical components of a SCADA system are depicted below:

- With ICT we can make energy infrastructure more robust
- We can remotely monitor energy infrastructure and perform preventive actions before failure – condition-based maintenance

### **Threats associated with ICT**

- ICT is itself vulnerable to attack – hence introducing new vulnerability to ICT-based systems.
- The digital divide:
  - Inadequate infrastructure
  - Inadequate ICT skills

## Challenges of ICTs

In addition to the fact that ICT-based products require considerable amounts of energy to realize (thus, generating a huge energy footprint which itself is a problem), there are numerous threats that use of ICTs tends to herald, and these range from stealing classified information and sensitive data to conducting warfare in cyberspace.

**Cyber Espionage:** This is the act or practice of obtaining secrets and sensitive classified information from individuals, competitors, rivals, groups, governments and enemies for military, political or economic advantage using illegal exploitation methods on internet, local area networks (LAN), software and computers.

- **Web Vandalism:** This involves attacks that deface web pages or cause denial-of-service.
- **Propaganda:** Political messages and anti-government campaigns can be spread through to anyone with access to the internet.
- **Vandalization of Critical Infrastructure:** Power and water supply networks, oil and gas pipelines, communications, commercial and transportation facilities are all vulnerable to cyber attack.
- **Compromised Counterfeit Hardware:** Hardware used in computers and networks that have malicious computer programmes hidden inside the software, firmware or the microprocessors.
- **Malicious Data Gathering:** This involves intercepting, and even modifying, secure information, making defined and intelligently directed illegal surveillance possible from any part of the world. For instance, business orders and communications can be intercepted or replaced; payments can also be diverted, thereby putting businesses at risk.

Also, during 'Operation Enduring Freedom' in Iraq, a smart weapons system used by US soldiers rebooted and unknown to the soldiers inserted their position as the missile target location into the system. Consequently, the missile vectored into their position instead of the selected target location.

## **Conclusion**

A consolidated approach should be evolved to upgrade existing critical energy infrastructure with ICT-enabled devices and components with a view to optimally managing energy production and consumption, while new infrastructure should be designed ground-up to incorporate ICT facilities.

Thank you for listening.