

Green-IT for Energy Issues

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KCC, KOREA

Geneva Meeting
1-3 September 2008

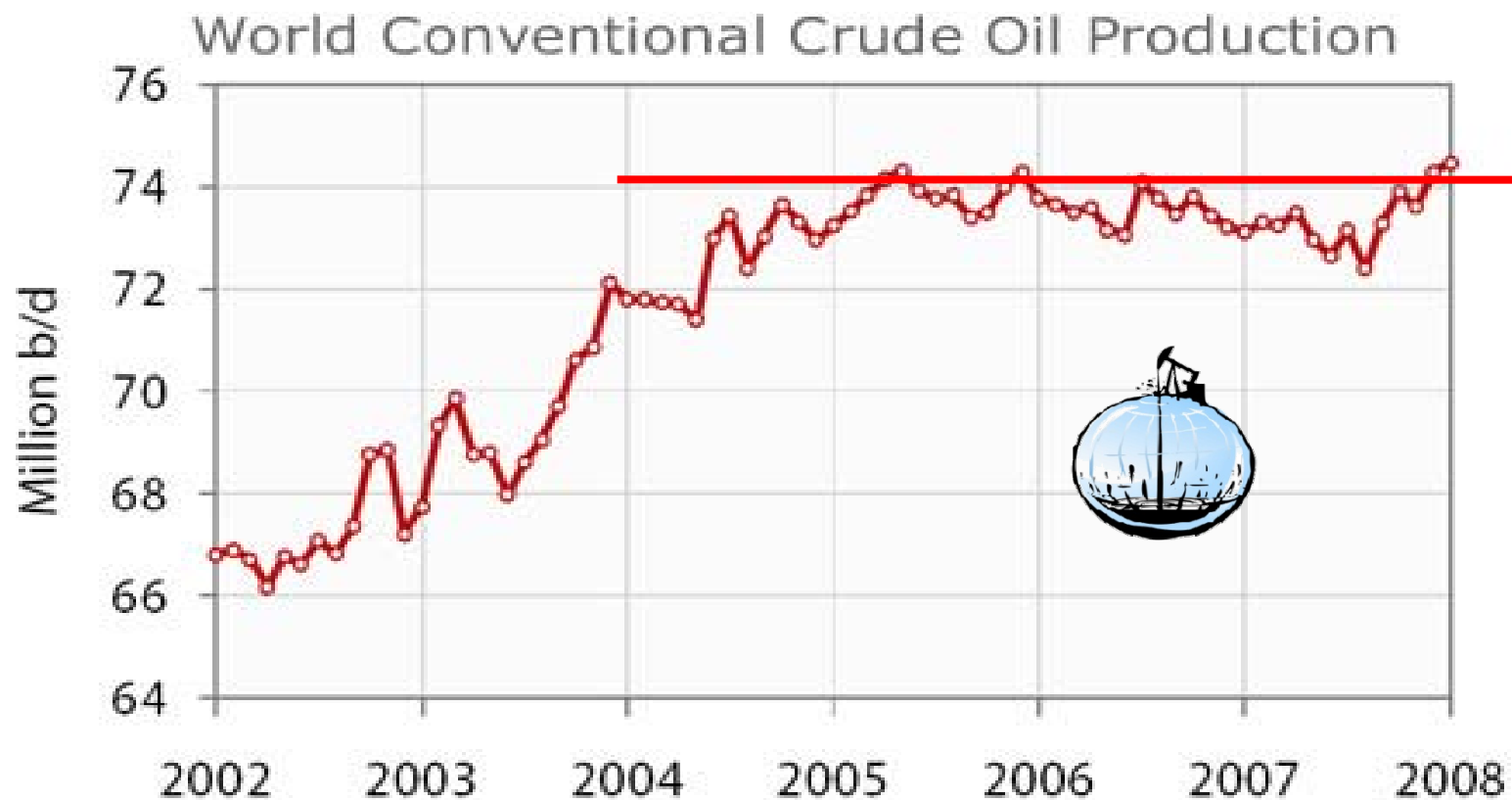




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 - Solar cell – very large semiconductor device
- **Energy Efficiency Enhancement - Green IT**
 - Green IDC
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 - Intelligent Micro-Grid
 - Energy Harvest

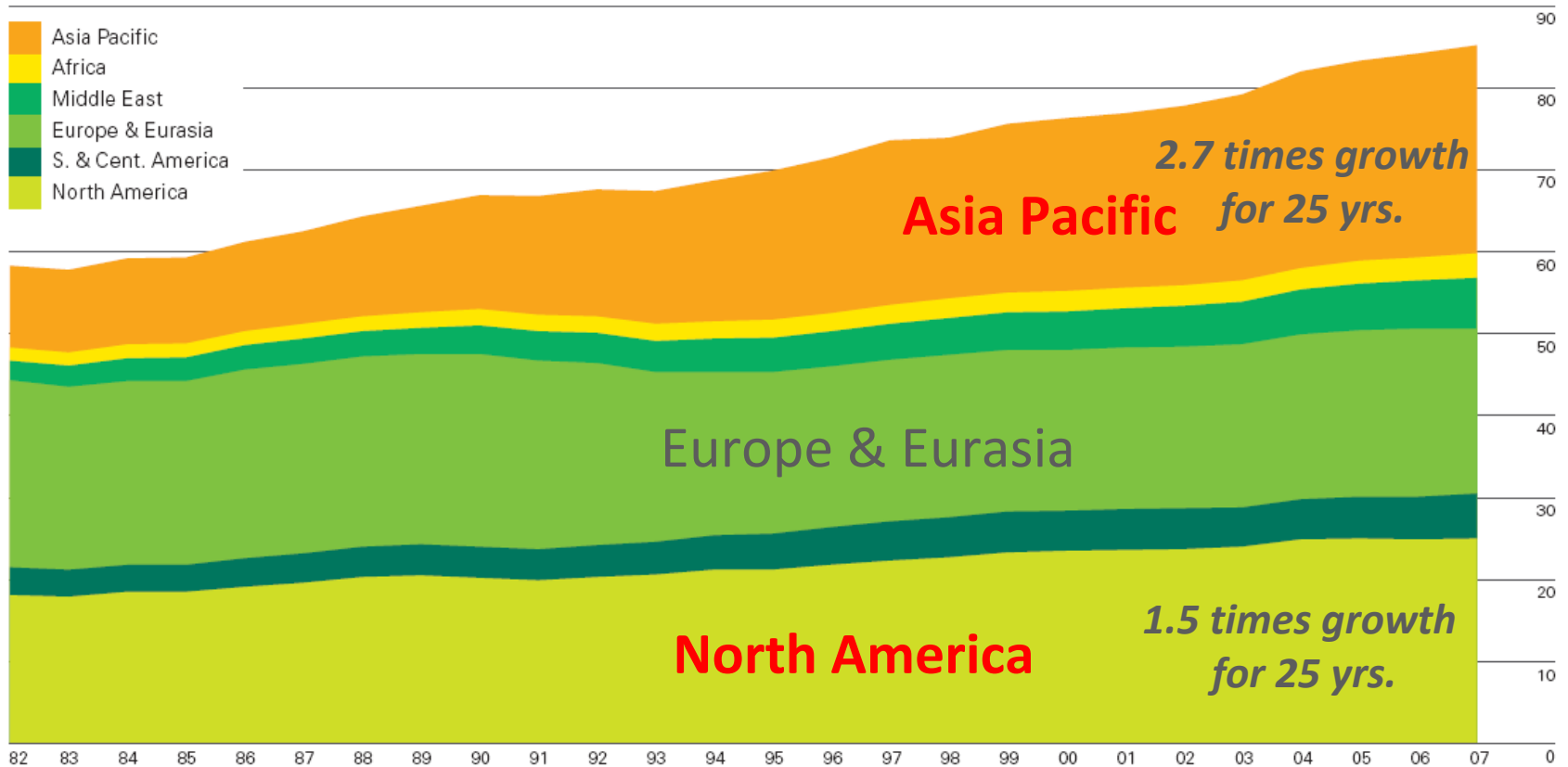
Saturated Oil Production



Source: Energy Information Administration

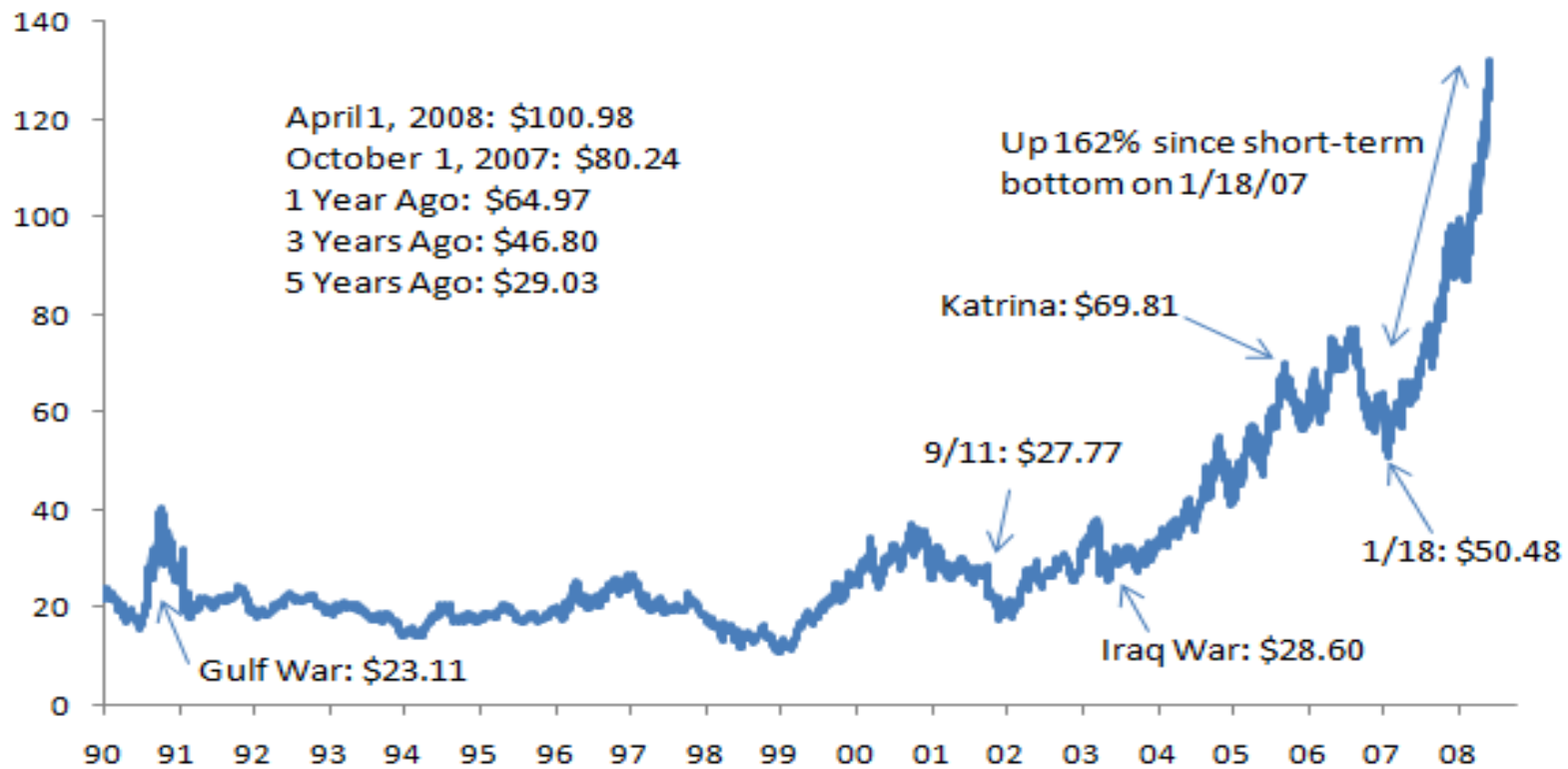
Increasing oil consumption

Consumption by region
Million barrels daily

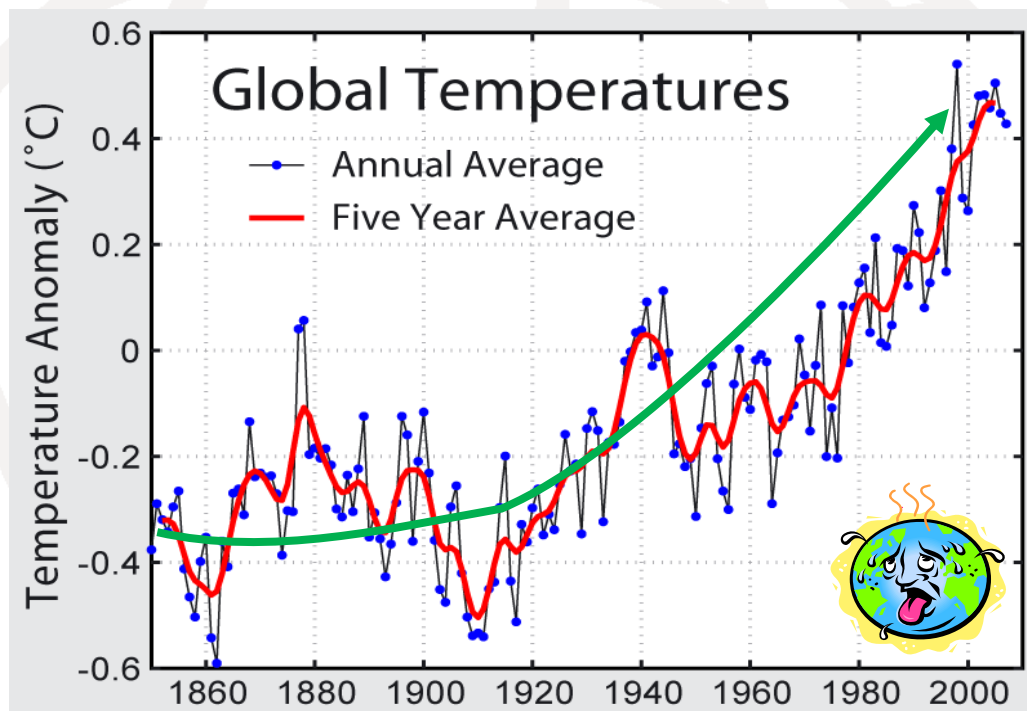


Economical & Environmental issues!

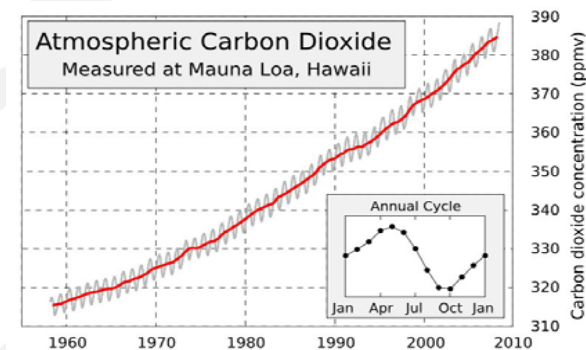
Oil: 1990-Present



Global Warming

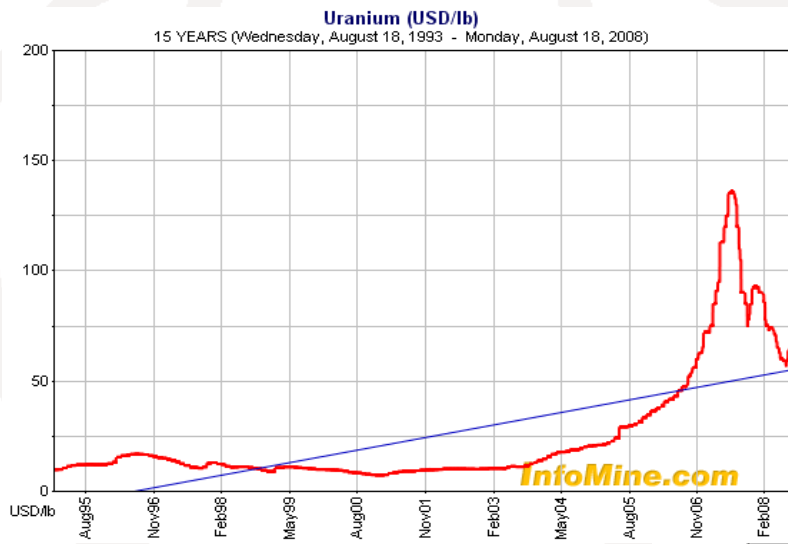


Industrialization @ 20th century

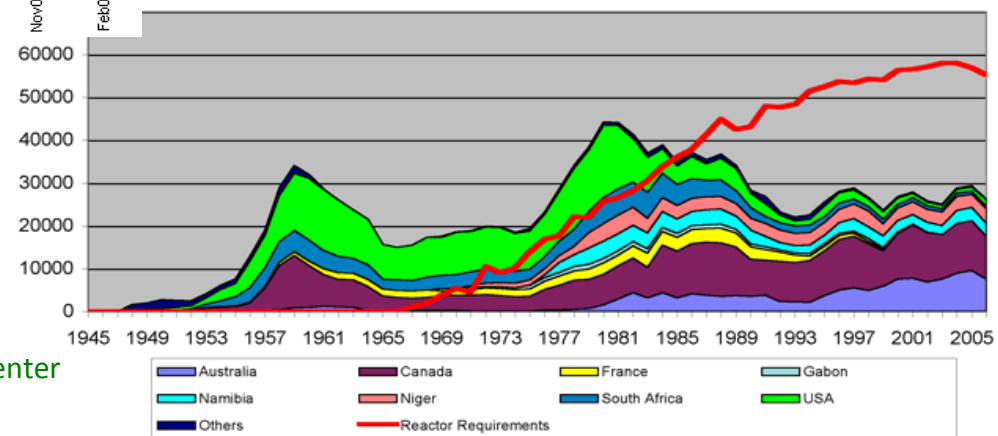


From : Wikipedia, atmospheric carbon dioxide concentrations as directly measured at Mauna Loa, Hawaii

Nuclear Energy – temporal solution



Western World U Production & Reactor Requirements



Source : Uranium Information Center
(<http://www.uic.com.au>)

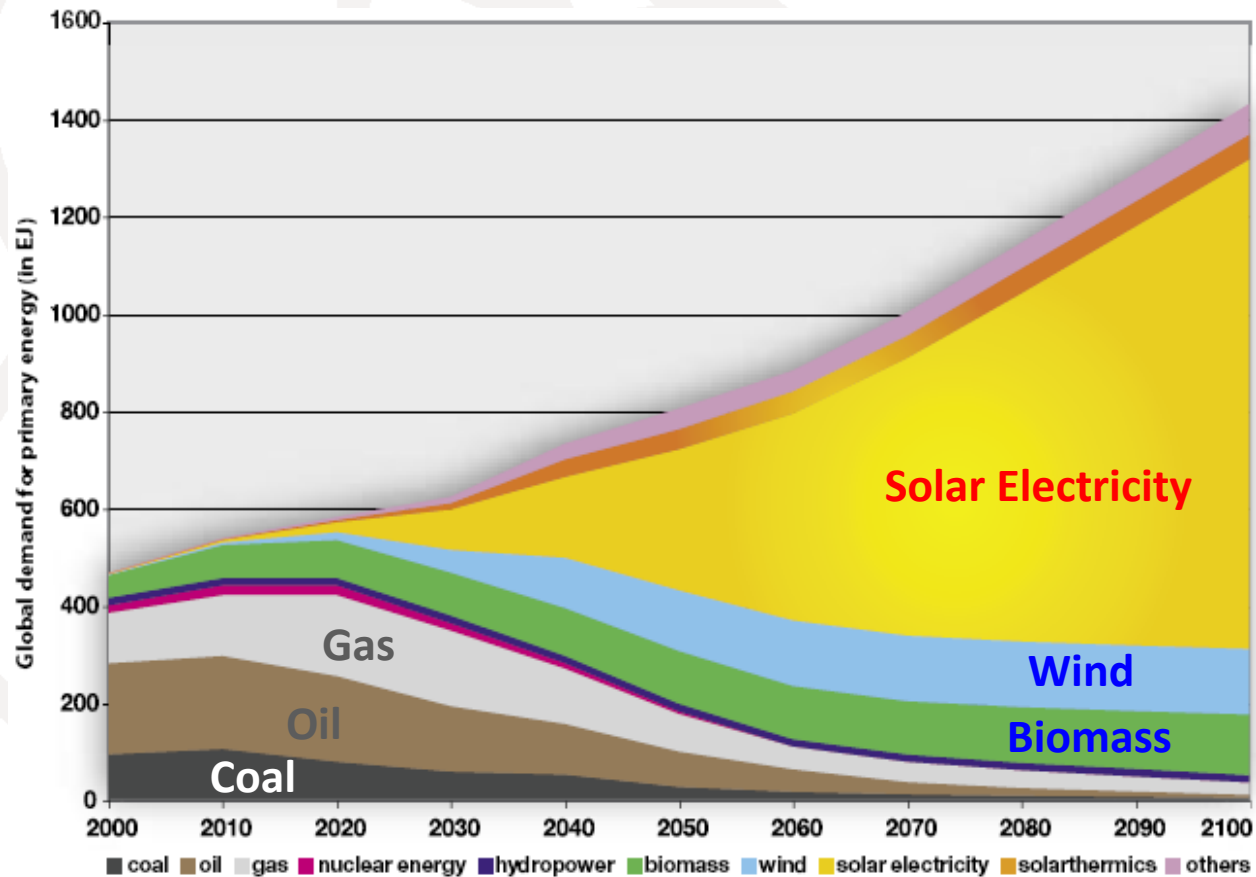


"IT" can provide the Green Energy

- Global Demand of Primary Energy
- Potential of Solar Energy
- Solar cell and Device

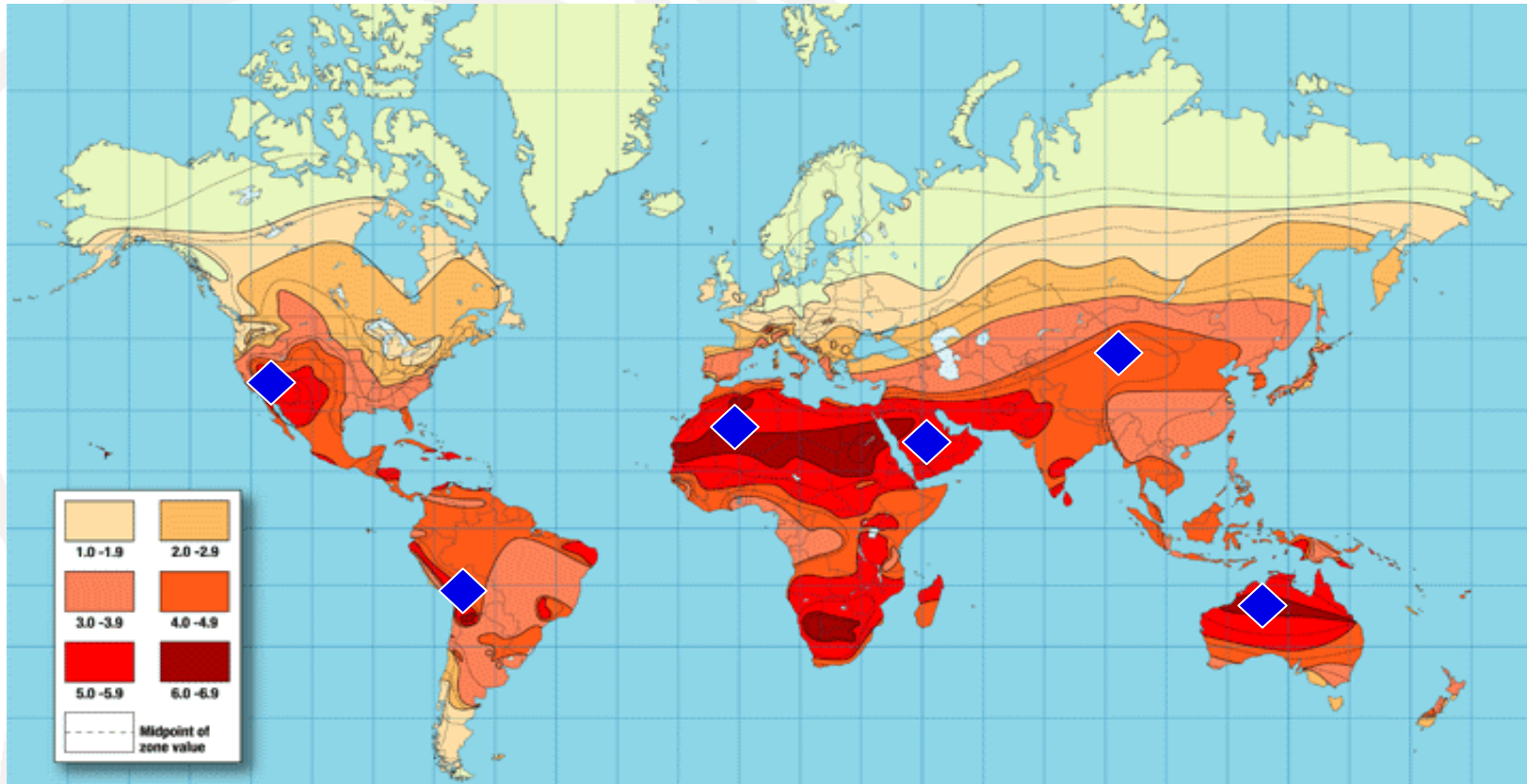


Global Demand of Primary Energy



Source : the European renewable energy council

Potential of Solar Energy



Source : http://www.oksolar.com/abctech/images/world_solar_radiation_large.gif

➤ (6 places) at 3 TW each = 18 TW

Solar Cell - Very Large Semiconductor Device

- Solar cell is specialized very large semiconductor device
- New market for the semiconductor and display industries
 - Portable power supply for the mobile IT device
 - Building –integrated Photovoltaics
 - distributed electric power generation
 - Industrial scale Solar power plant (Solar Farm)
- **Cost reduction is the key issues.**
- Korea is developing several types of solar cell and related technologies.





"IT" can save the Energy

- Green IDC, green computing
- Sensors and networks-AMI and SES
- Intelligent Micro-Grid
- Energy harvest





Green Internet Data Center

- **Reduce the energy consumption at IT service : low-power computing**
 - Enhance the energy efficiency
 - Low-power computing system
- **Service**
 - Green-service infra for low-power cloud computing
 - Green IDC platform based on the highly-integrated blade system and dynamic power management system
 - High-efficiency Power Supply Unit, Green OS, Green-PC, Green-mobile system
- **Key Technology**
 - Low-power server platform, green OS, Energy-aware virtual platform, Green-grid middleware, Autonomous system management, Dynamic Smart Cooling

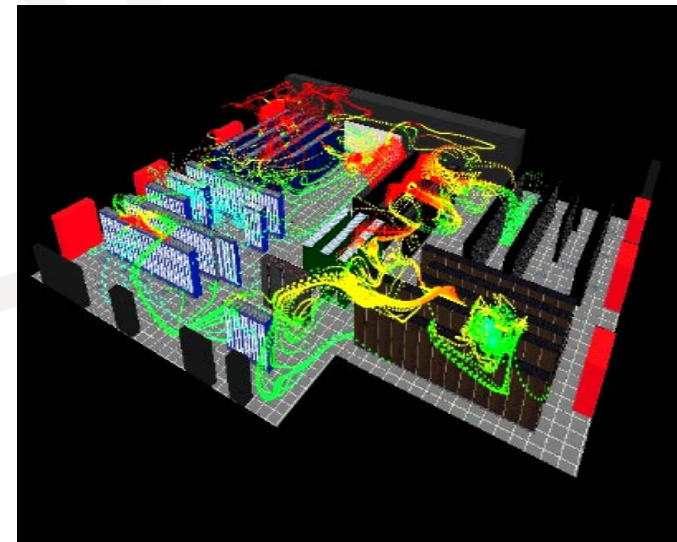
Energy Consumption at IDC

- **Computer Room Air-conditioning** 50%
- **Server/Storage** 26%
- **Conversion** 11%
- **Network** 10%
- **Lighting** 3%

Source : APC

61 TWh in US @ 2006

Source : EPA



Power Supplied in the Data Center

Green IDC

Green IDC

- Consolidate
- Virtualize
- Optimize
- Leverage

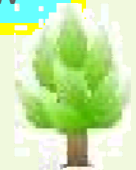


Energy-aware application	IDC Management
Energy-aware OS	IDC Cooling
PSU	Power distribution

Green PC



Energy-aware application
Energy-aware OS
LOW-POWER HW



Energy-aware application
Energy-aware OS
Low-Power HW

Green Mobile





Advanced Metering Infrastructure

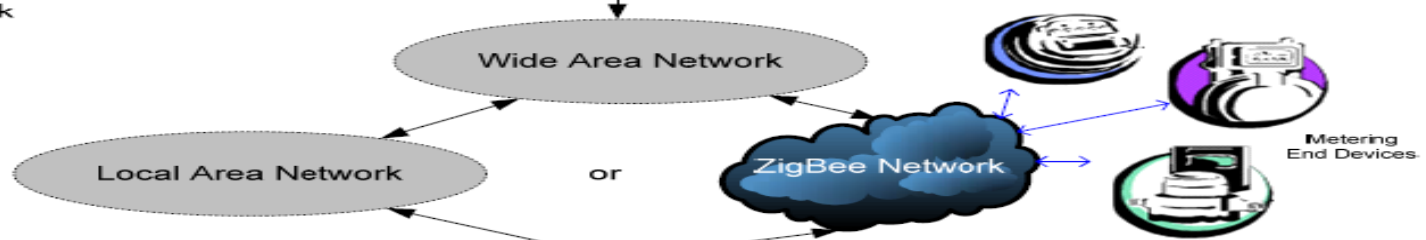
- **Advanced Metering Infrastructure(AMI)**
 - The two-way fixed network and associated systems for providing advanced metering data and energy management capability.
 - Provides the capabilities to improve data tracking above and beyond Automated Meter Reading (AMR) with the goal of influencing energy usage.
 - AMI can be incorporated into the sensor and communication infra of the intelligent micro-grid .

AMI ZigBee Network Components

Utility



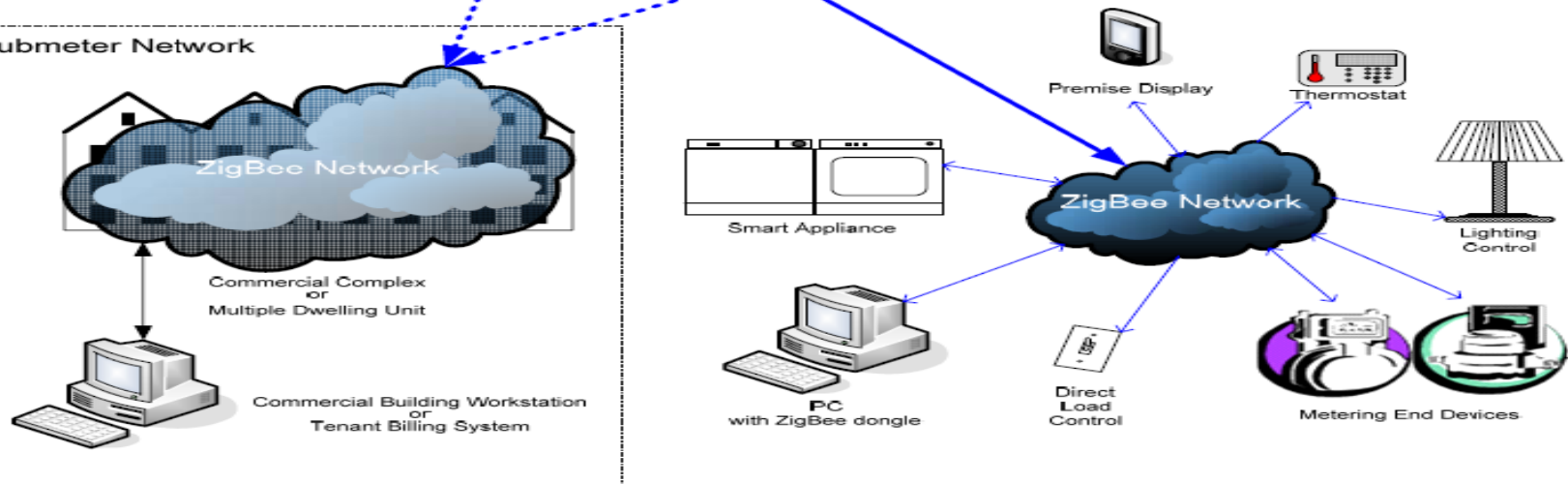
Fixed Network



Premise or Home Network



Submeter Network





Smart Energy System

■ Smart Energy System(SES)

- HAN (Home Area Network) based energy management.
- ZigBee based bidirectional communication and advanced metering.
- Real-time monitoring and notification of energy usage and payment.
- Network security to secure the metering data.
- Compatible to the OpenHAN.
- Easy network configuration and OAM.
- Direct Load Control :
 - The capability of a utility to control customer loads directly including turn-off and cycling capability



ZigBee Alliance
ZigBee Smart Energy



Metering Device Requirements

- **Electric Meter (mandatory)**
 - Main Power : 220VAC or 110VAC
 - Assistance Power : 3.3V or 5V Battery
- **Gas, Water, Hot Water and Heater Meter (Option)**
 - Main Power : 3.3V or 5V Battery
- **Battery Life Time : more than 10yrs**
- **Networking**
 - Method 1
 - Electric Meter : Router
 - Other Meter : End-Device
 - Method 2
 - All Meter : End-Device and independent Router/Gateway

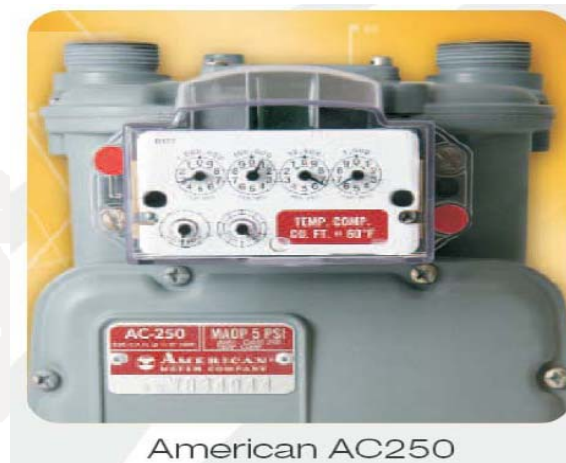
Metering Device Requirements(cont.)

- **Data Upload Period**
 - 1 Time/24H Periodic Upload : All Meter
 - On-demand Update : Electric Meter
 - Data mining Duration : more than 30 min
- **RF Range Extension Device**
- **40 Days Meter Value Store**
- **Public key infrastructure (PKI) based Security**



LS Industrial Systems

- Intelligent fully featured revenue-grade energy meters with integrated communication function
- Two-way communication via plug-in type communication modules using standard-based ZigBee and PLC
- Complies with IEC 62052, 62053 and 62056 standards



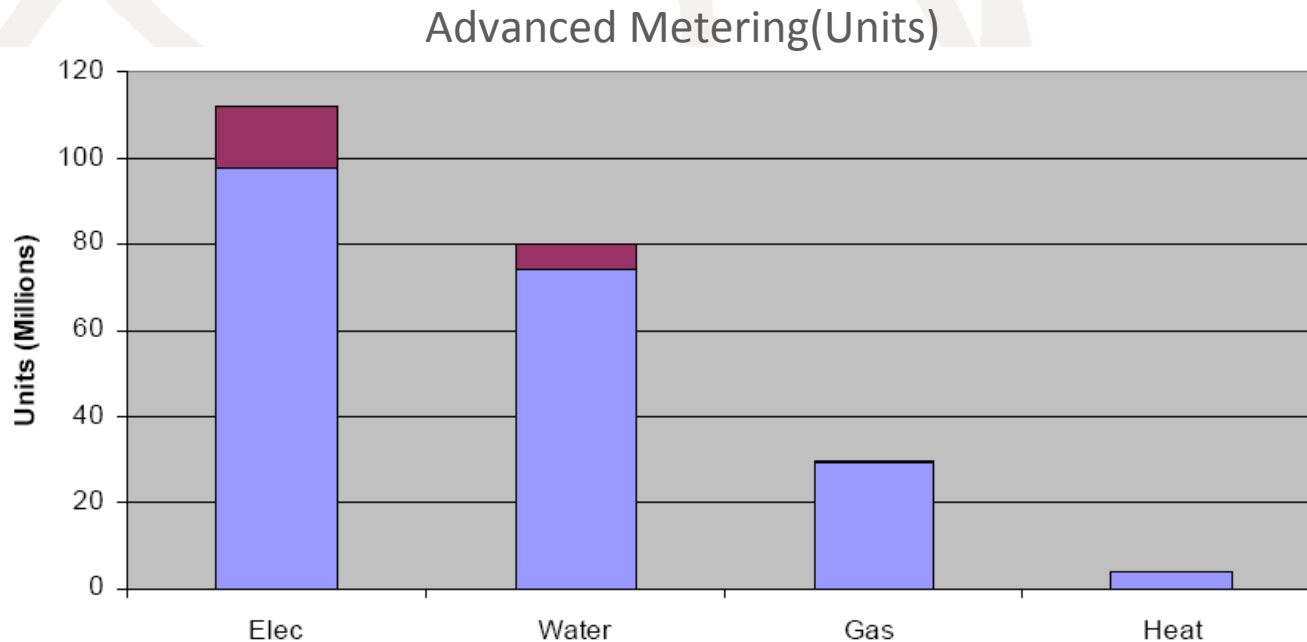
American AC250

Itron – OpenWay Gas Module

- 2 way communication with the OpenWay CENTRON meter
- Stores and updates the last 40 days of hourly and daily data
- Max. 20 year battery life
- Two 'A' cell lithium batteries
 - 1 transmission per day : 18 to 20 Yr
 - 2 transmission per day : 15 to 17 Yr
- Updated housing optimizes antenna performance and maximizes RF signal

AMI / AMR market

- **Advanced Metering market**
 - Electricity Metering ~75% of global total
 - Water Meters – Second most potential
 - Gas Metering – mostly retrofit AMR in US
 - Heat metering – Limited potential



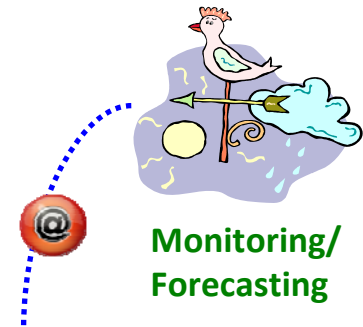
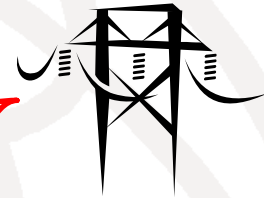
Intelligent Micro-Grid

- De-centralized power grid architecture : aggregation of electrical loads and generation
 - Can be a quick and inexpensive way to include renewable energy
 - Monitoring and control of the electric power consumption or generation from distributed renewable (solar/wind...) source
- Service:
 - BcN based Electric Power Grid management network
 - Real-time electric power metering and trading → Energy Prosumer
- Key Technology
 - Proactive Power Computing, Flexible Power Management based on real-time demand/price variation
 - Networking and management of power electronic appliances/distributed generators, Standard for compatibility and interconnection
 - SoC/Imbedded SW for intelligent PCS/inverter, Sensor technology
 - Back-up power storage : Plug-in Electric Hybrid Vehicle

Intelligent Micro-Grid

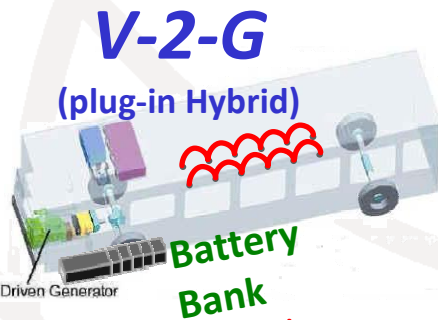


Power Transmission
/Management Network



Power Transmission
/Management Network

Distributed Power Generation
/Load Management Network



Engine Driven Generator

Battery
Bank

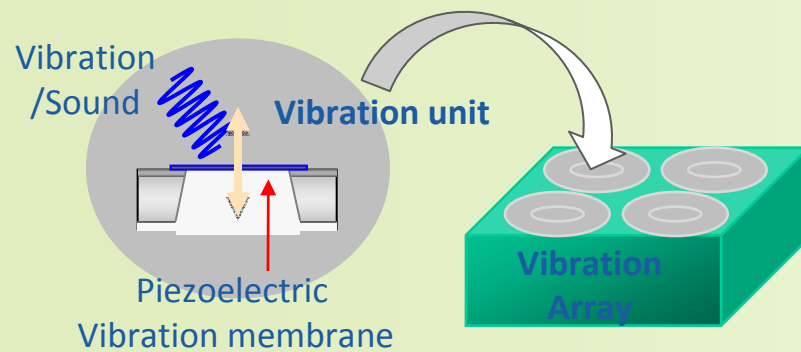
Power/Load Management



Energy Harvest

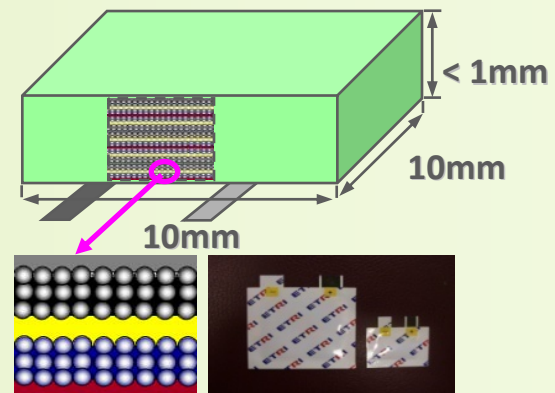
- **Micro Energy Harvest**
 - Convert the mechanical vibration/sound energy into the Electrical energy
 - Semi permanent and independent power source
- **Service**
 - Micro energy application
 - Ubiquitous micro sensor, medical sensor, RFID, USN sensor
- **Key Technology**
 - MEMS, nano piezoelectric material/structure, high energy density, micro battery, ultra-thin battery, wireless power transfer/charging

Micro Energy Harvest



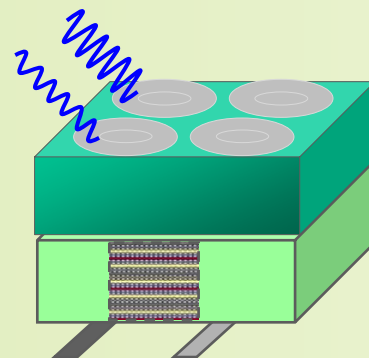
<Wireless charger>

+



<Ultra-small rechargeable battery>

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Wireless rechargeable
ultra-small battery



Conclusions

- **Power savings using Green-IT**
 - **Green IDC :**
Power consumption by IT service can be reduced.
 - **Advanced Metering :**
Sensor integrated realtime monitoring will help making good power consumption plan.
 - **Micro Energy Harvest :**
Energy-IT convergence will change the energy policy and create new market.

- **Photovoltaic Power Generation/Distribution by Intelligent Micro Grid for Green IT:**
 - **No pollution or CO₂ emission**
during the electric power generation by PV
 - **Cost reduction is the key issue in PV power generation**
 - **Grid parity will be achieved within 5 ~ 10 years**
depending on the insolation condition and land costs.



Thank You

Abbreviations

- IDC : Internet Data Center
- PV : Photovoltaic
- CIGS : Cu(Copper)-Indium-Gallium-Selenium
- LNG : Liquefied Natural Gas
- GaAs : Gallium Arsenide
- InP : Indium Phospide
- CIS : Cu(Copper)-Indium-Selenium
- CdTe : Cadmium Telluride
- DSSC : Dye Sensitized Solar Cell
- C-Si : Carbon Silicon

Abbreviations

- a-Si : Amorphous Silicon
- nc-Si : Nanocrystalline Silicon
- AMI : Advanced Metering Infrastructure
- SES : Smart Energy System
- BcN : Broadband communications Network
- SoC : System on Chip
- OAM : Operation, Administration and Maintenance
- PLC : Power Line Communication
- AMR : Automated Meter Reading
- PSU : Power Supply Unit
- MEME : Microelectromechanical Systems