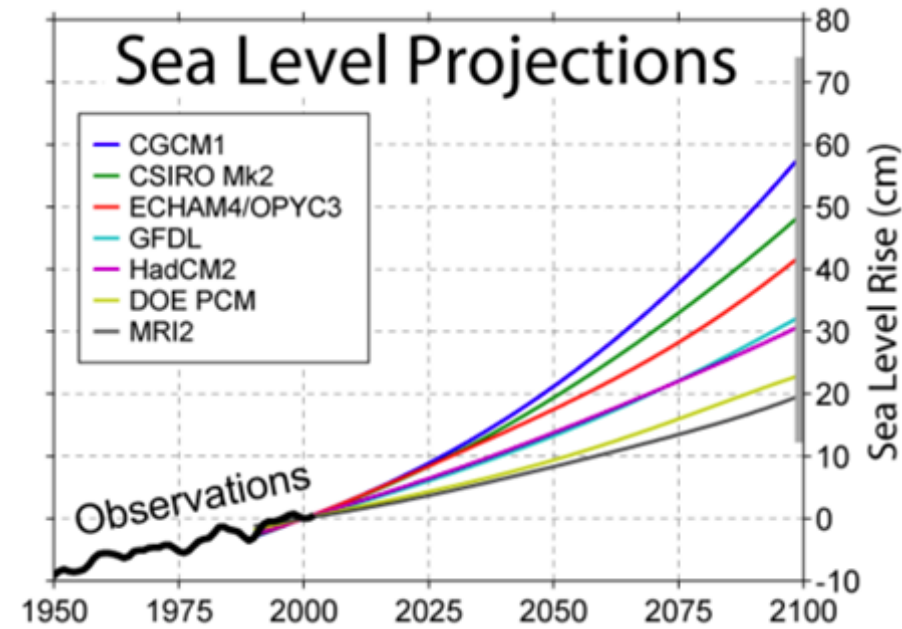
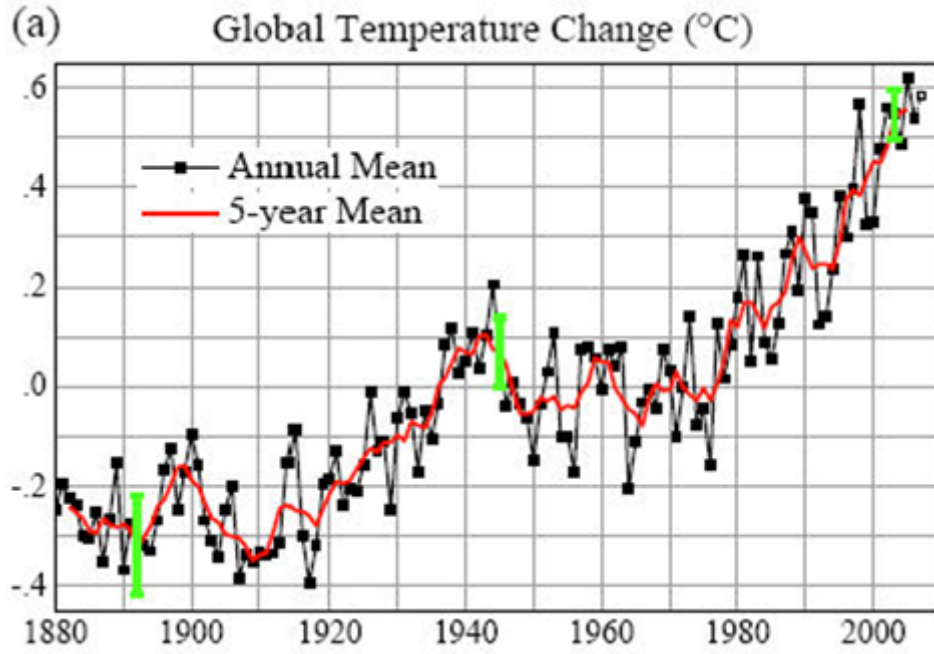


# Smart Building Smart Grid

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# Global Warming and Consequences



# Global Warming and Consequences



Many parts of the world become [Venice, Italy](#), willingly or not.

# Causes of Global Warming



Yes, but missing a major piece of the answer.

***What is that?***





# Causes of Global Warming



***Buildings, Yes, Buildings***

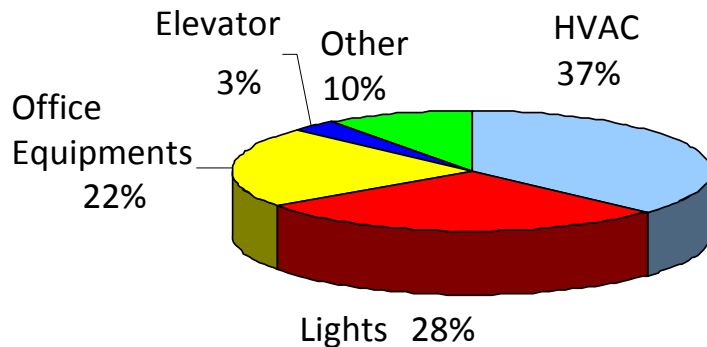
# Major Consumer: Buildings

- **Commercial and residential buildings** are the basis of our social and economic infrastructure.
- In the US, buildings are responsible for
  - ❑ 38% of carbon dioxide emissions
  - ❑ 71% of electricity consumption
  - ❑ 39% of energy use
  - ❑ 12% of water consumption
  - ❑ 40% of non-industrial waste
- We spend **90% of our time indoors**, and the indoor environment affects our health and productivity.

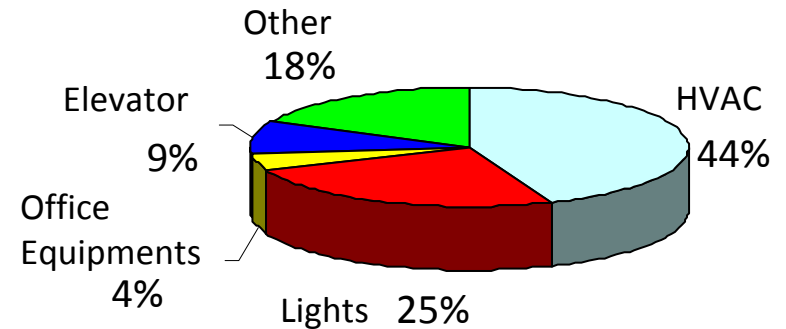
***Green, Secure, and Safe Buildings!!***

# Energy Consumption Distribution

## Office Building



## Hotel

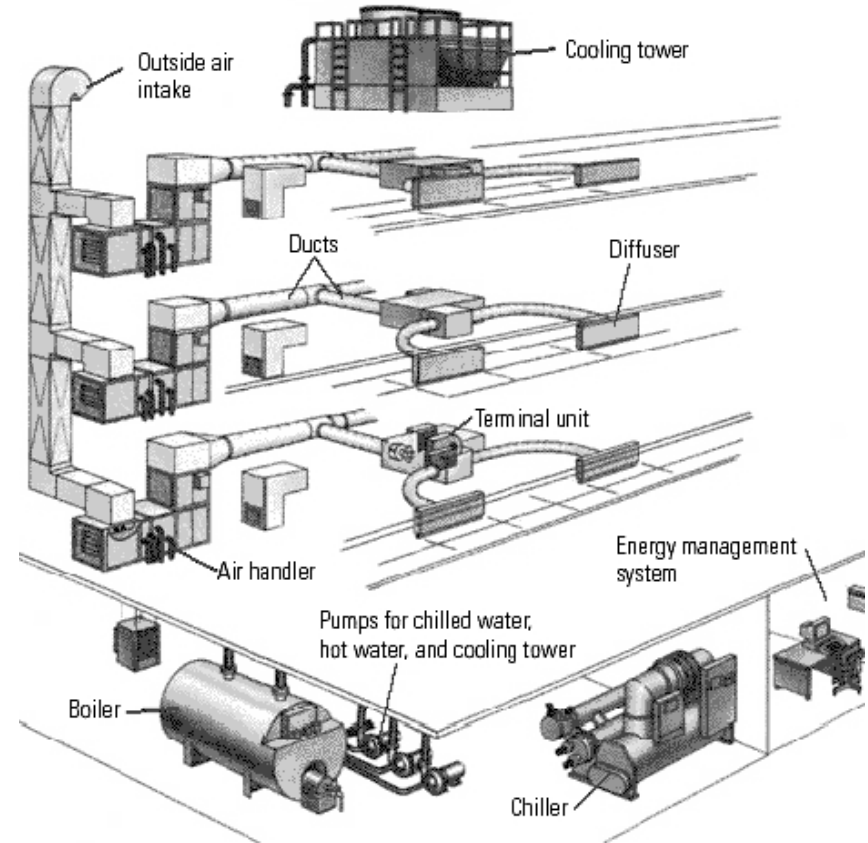
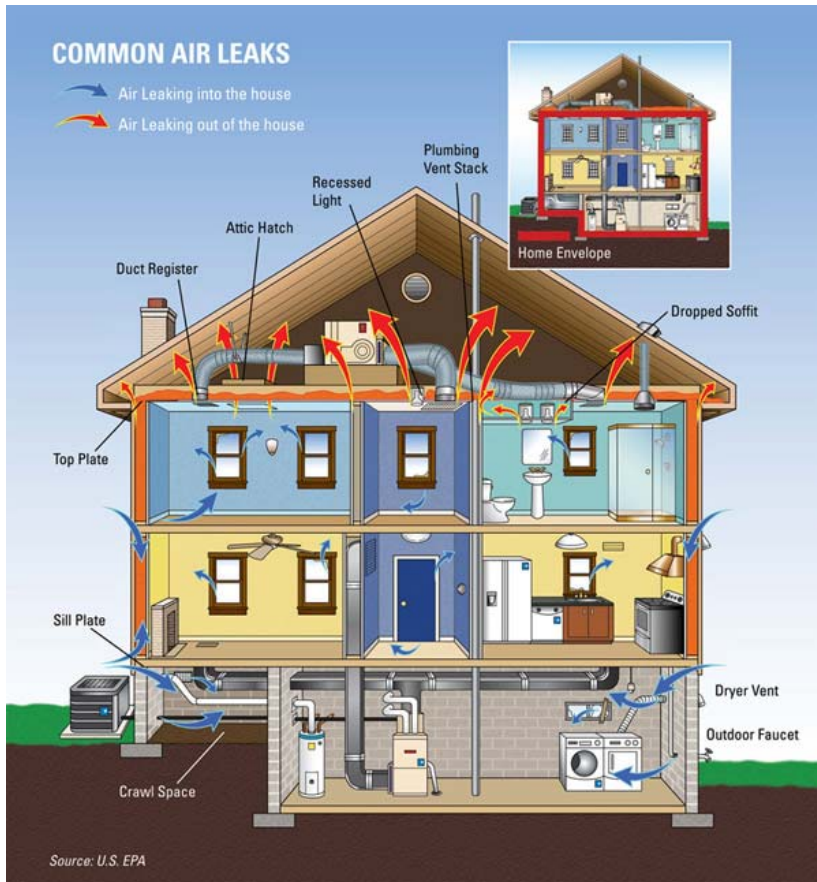


- Not difficult to save 20% ~ 30% energy through **fault detection/diagnosis and optimized operation/management**.
- Heavily dependent on **advanced modeling, analysis, optimization, simulation, sensing and communication**.
- **Autonomy and interdependence**.





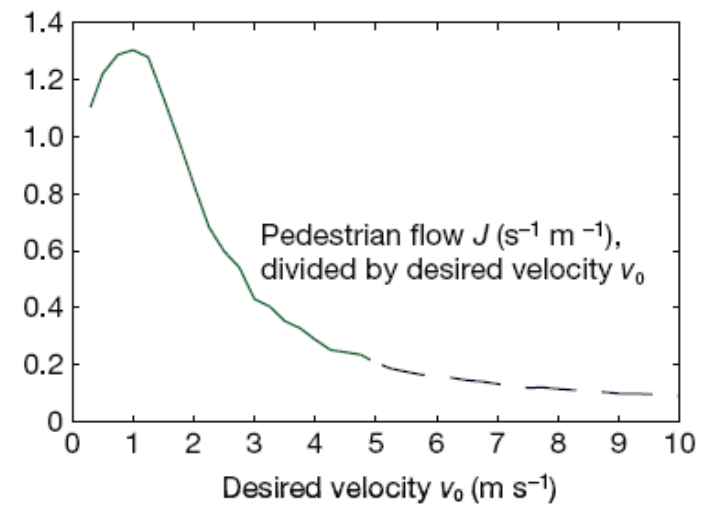
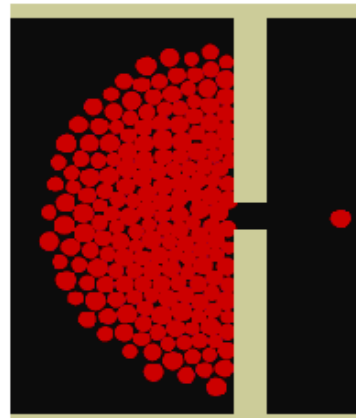
# Examples



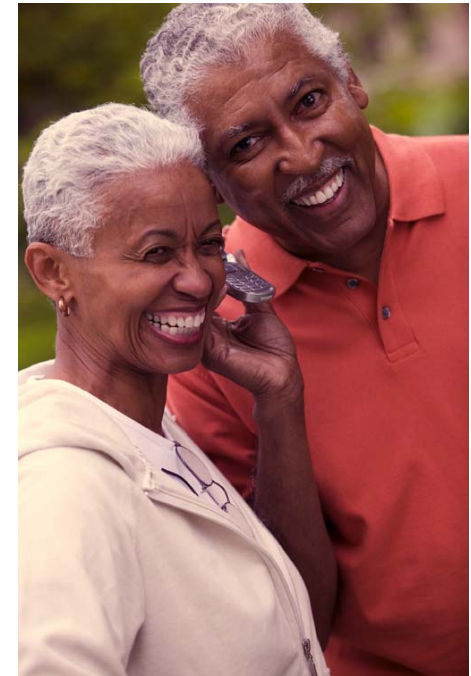
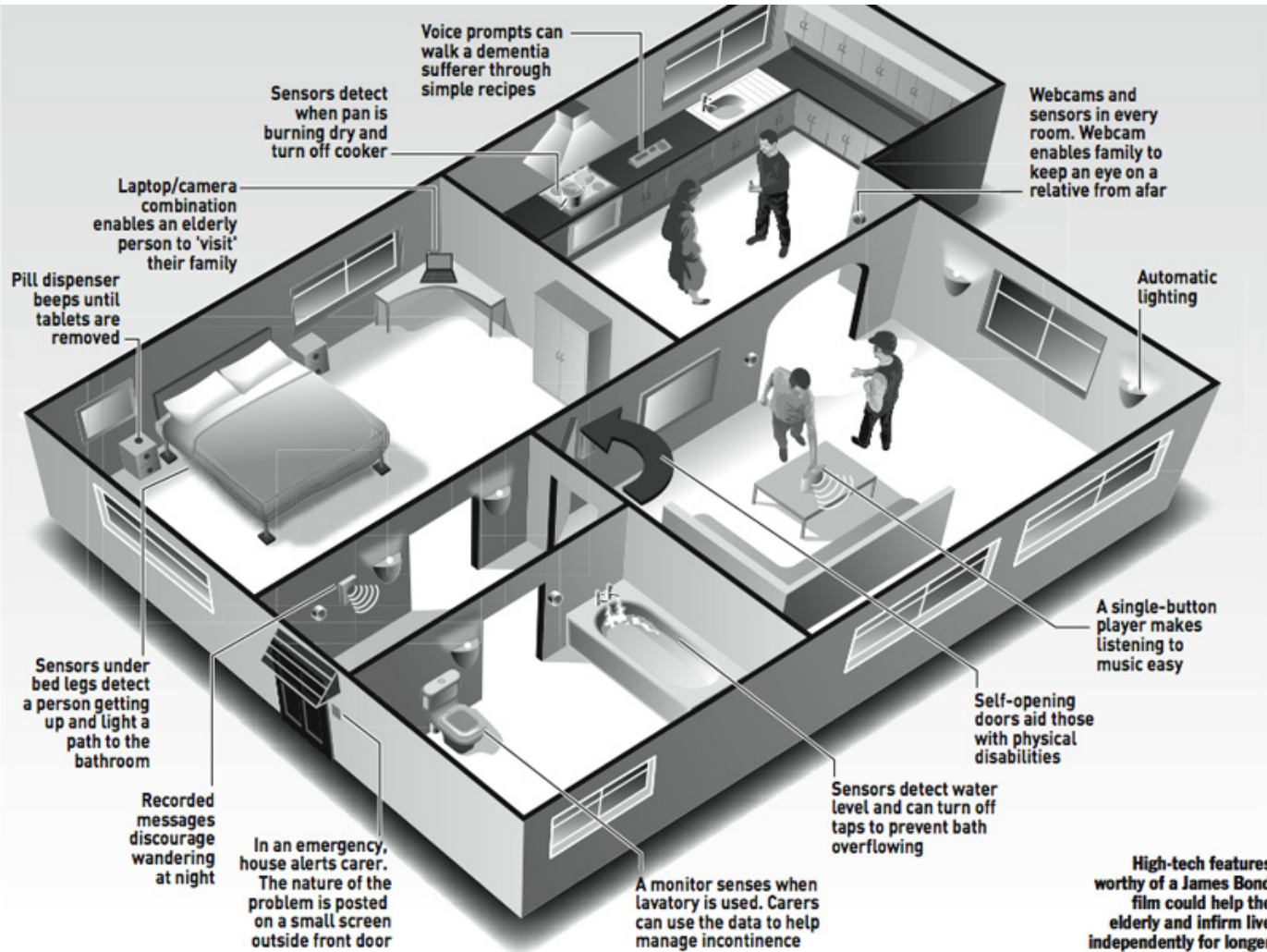
Fault detection and diagnosis; optimized operation of air conditioning with natural ventilation



# Crowd guidance in emergencies



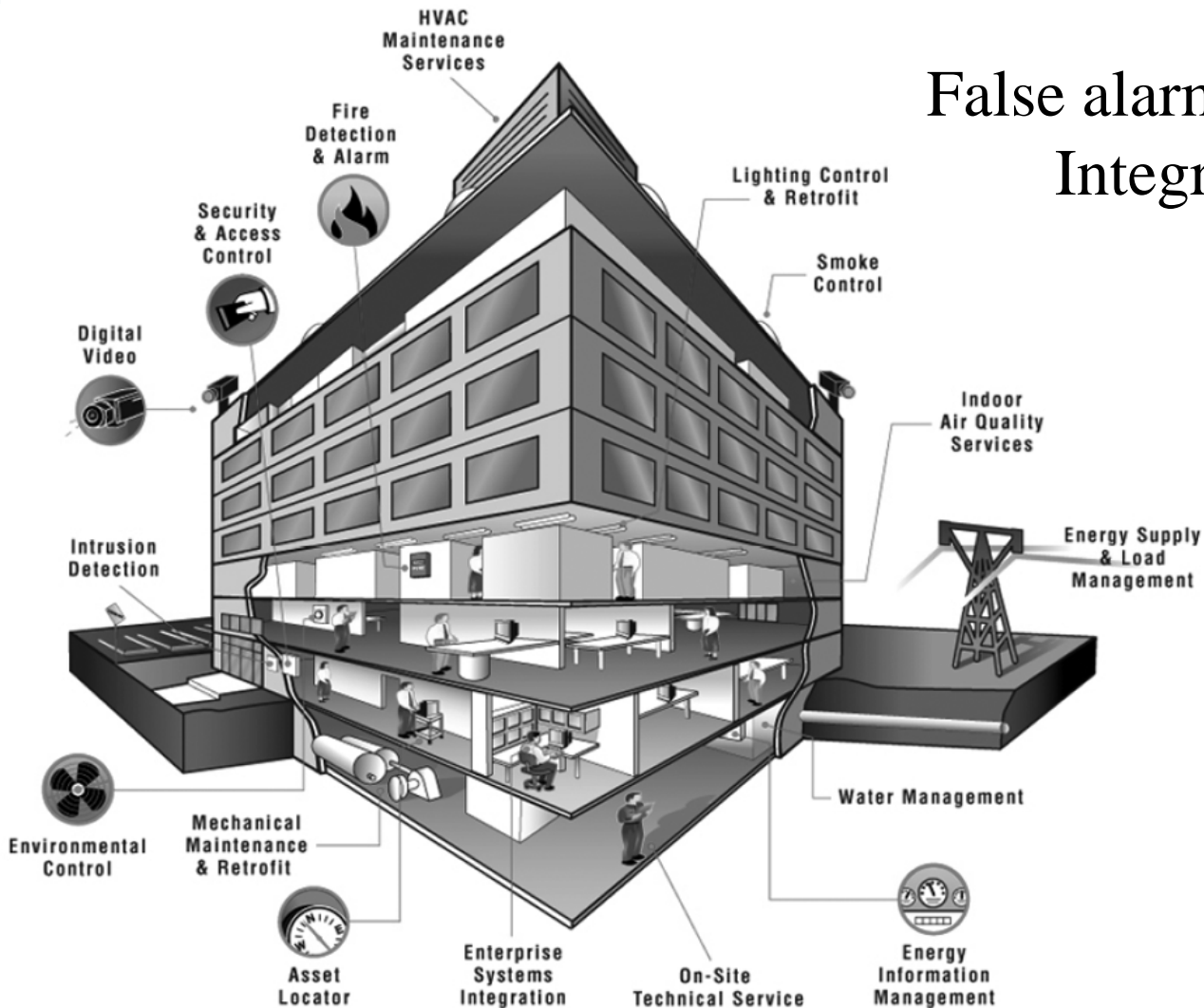
# Smart housing for the elderly





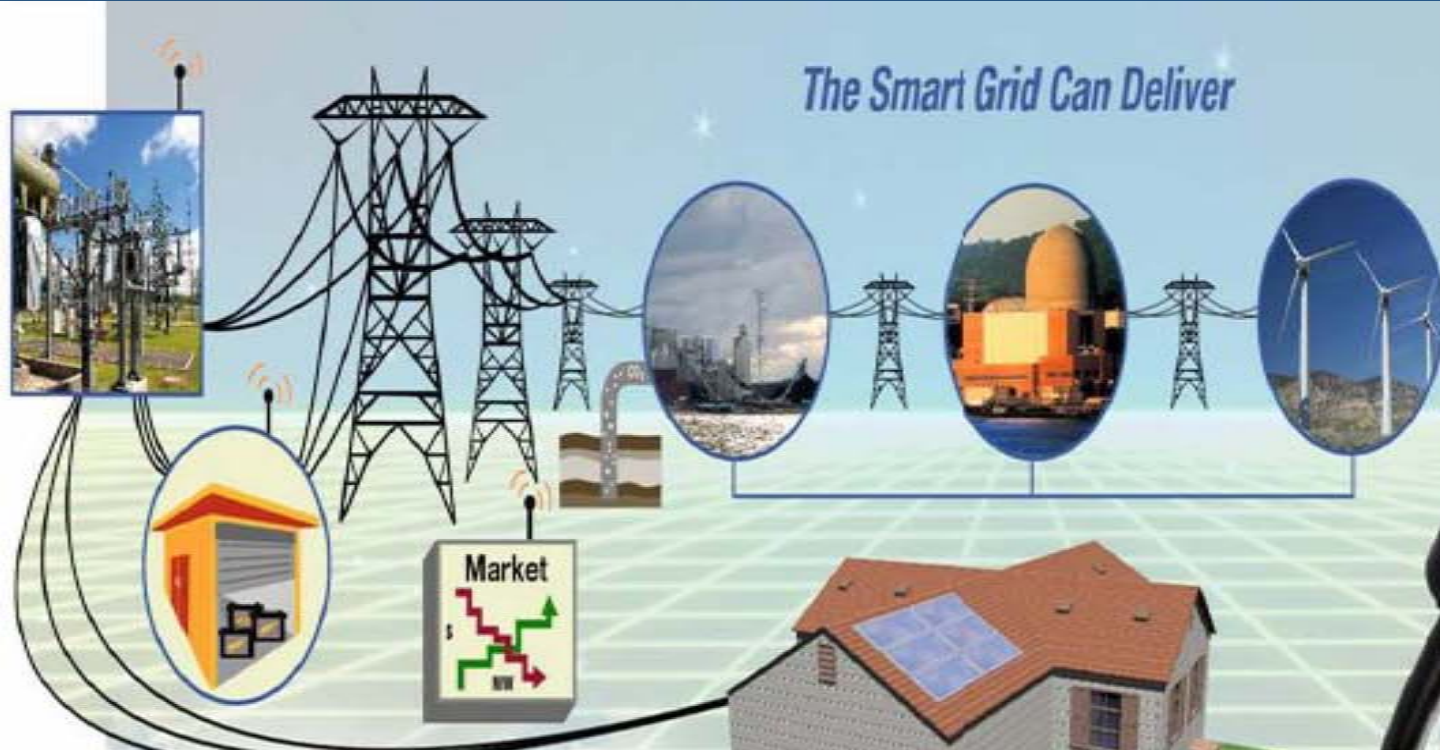
# Security

False alarms & sensor networks;  
Integrated building services  
with cloud computing





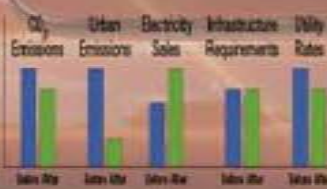
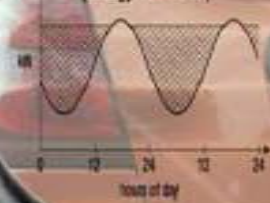
# The Smart Grid Can Deliver



## BENEFITS

- Enhanced energy security
- Reduced greenhouse gases
- Improved urban air quality
- Increased grid asset utilization

"Valley Filling"  
(Energy for PHEVs)

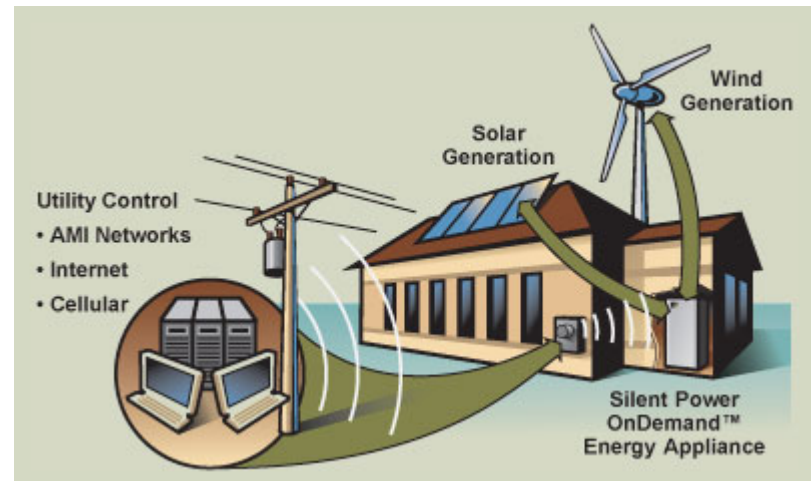


# Smart Building Smart Grid

- Buildings are at the receiving end of the smart grid
- Buildings can become an active and contributing partner
- Buildings can even be an integrated part of the smart grid
  - Respond to the need of the grid
    - Dispatchable and non-dispatchable demand responses



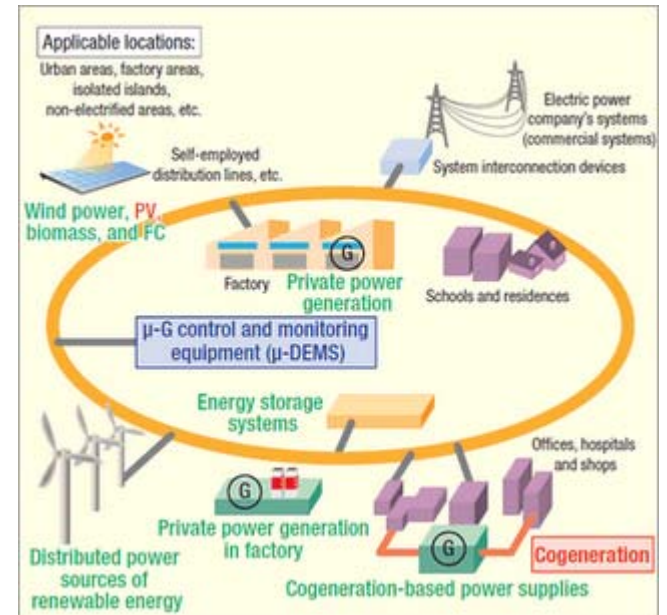
May 2011



ICRA 2011 W&T Luh



- Provide infrastructure for plug-in hybrid cars and distributed/renewable generation
- Reduce electricity usage through fault detection, diagnosis and optimized operation of HVAC and other systems
- Microgrid – A new mode of power system operation





# Actual utilization of coal fired electrical energy in China

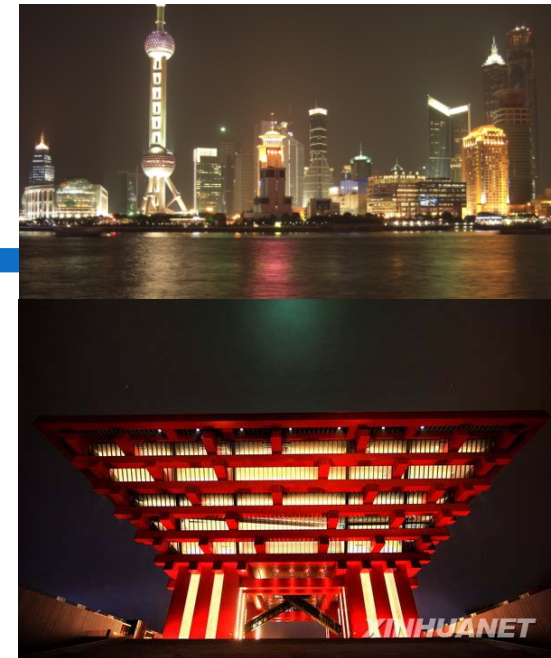


Coal mining loss



Thermal turbine loss

Magnifying effect  
of saving energy



Actual utilization



Coal shipping loss



Transmission & distribution loss

70%

20%

8%

1%

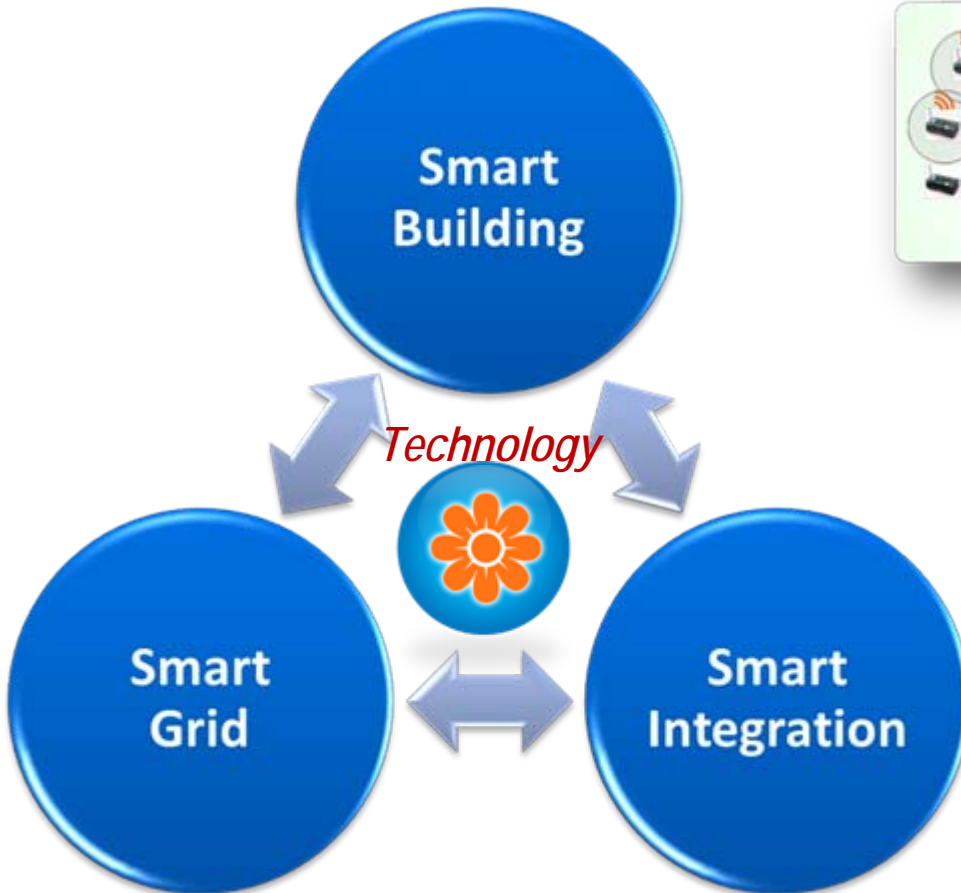
1%

Courtesy of  
Xiaohong  
Guan

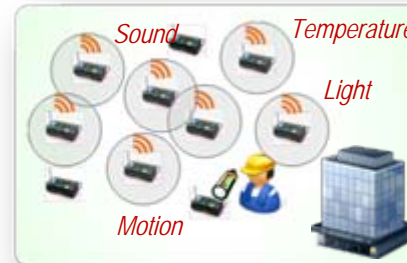
# UConn Retro-Commissioning Projects

- Retro-commissioning is a systematic investigation of buildings to identify methods to improve operations and reduce energy consumption
- UConn is in various phases of retro-commissioning of 34 “energy hogs” with funding provided by Connecticut Energy Efficiency Fund (CEEF) through CL&P
- Key aspects of retro-commissioning:
  - Change operation schedules, fine tune operations, and install sensors and control to reduce energy consumption
  - Focus on main air-handling units, hydronic pumping systems, kitchen hood controls and make-up air units

# Research Thrusts



## Sensing



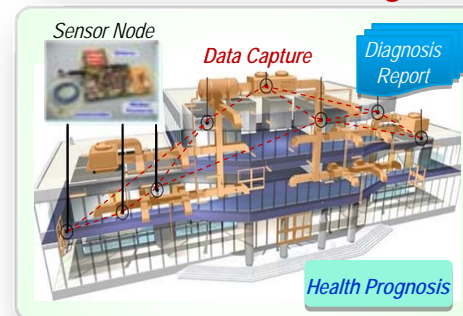
- Sensor networks
- Communication
- Device integration

## Energy Management



- Optimization
- Scheduling
- Cyber security

## Health Monitoring



- Node placement
- Diagnosis
- Prognosis



# Conclusions

- Smart Building can become an active and contributing partner
- Smart Building can become an integrated part of Smart Grid
  - ❑ Respond to the need of the grid
  - ❑ Provide infrastructure for plug-in hybrid cars and distributed/renewable generation
  - ❑ Reduce electricity usage through fault detection, diagnosis and optimized operation of HVAC and other systems
- *Smart Building, Smart Grid, and Smart Integration*, a rich, promising, and valuable research area – Sky is the limit.



Thank you!