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Smart Grid Impact on Intelligent Buildings

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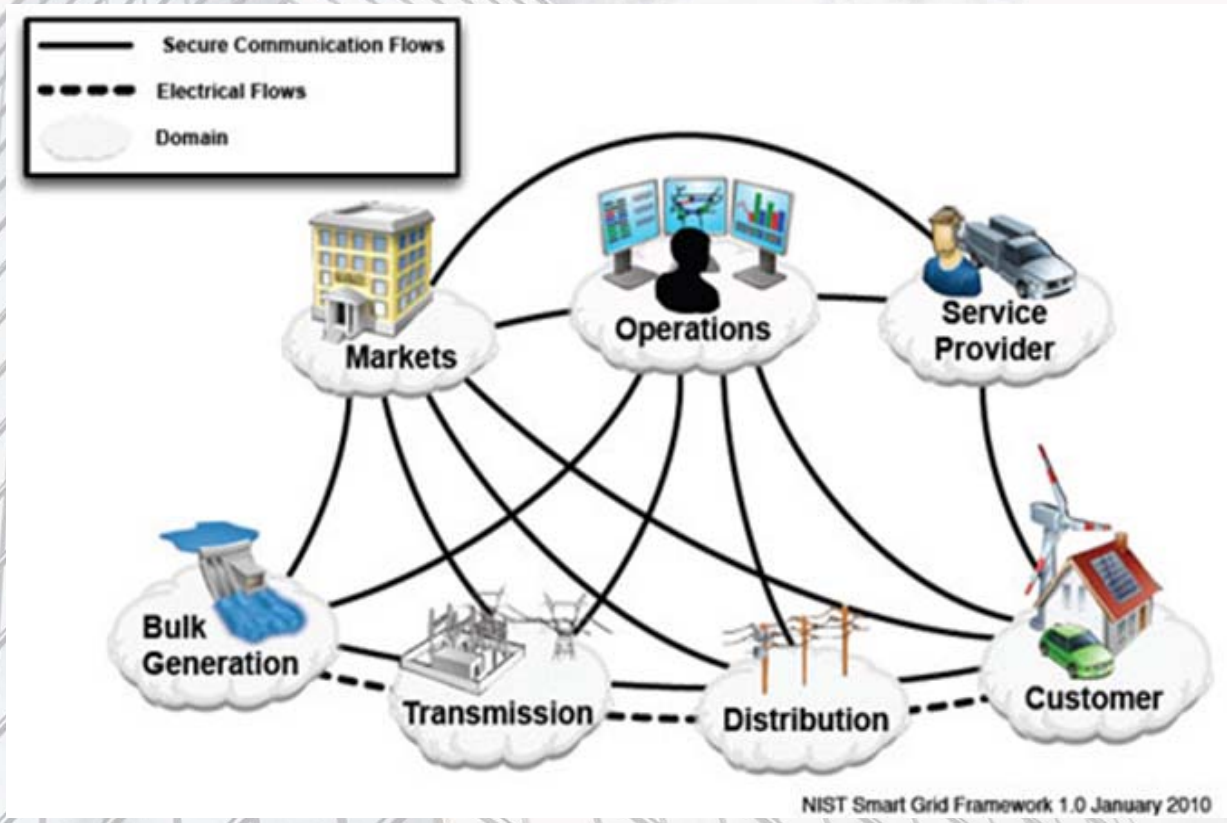
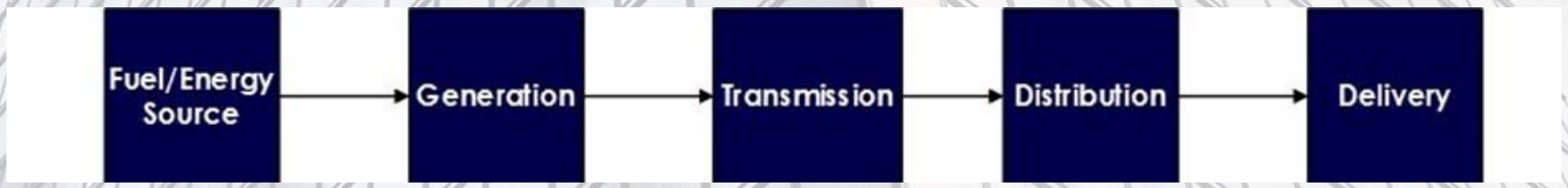
Making the Grid Smart

Smart grid features expand energy efficiency beyond the grid into buildings by coordinating low priority energy consuming devices to take advantage of the most desirable energy sources

Smart grids coordinate power production from lots of small power producers - otherwise problematic for power systems operators at local utilities





Smart Grid Impact on Intelligent Buildings Research Study

The Continental Automated Buildings Association (CABA)

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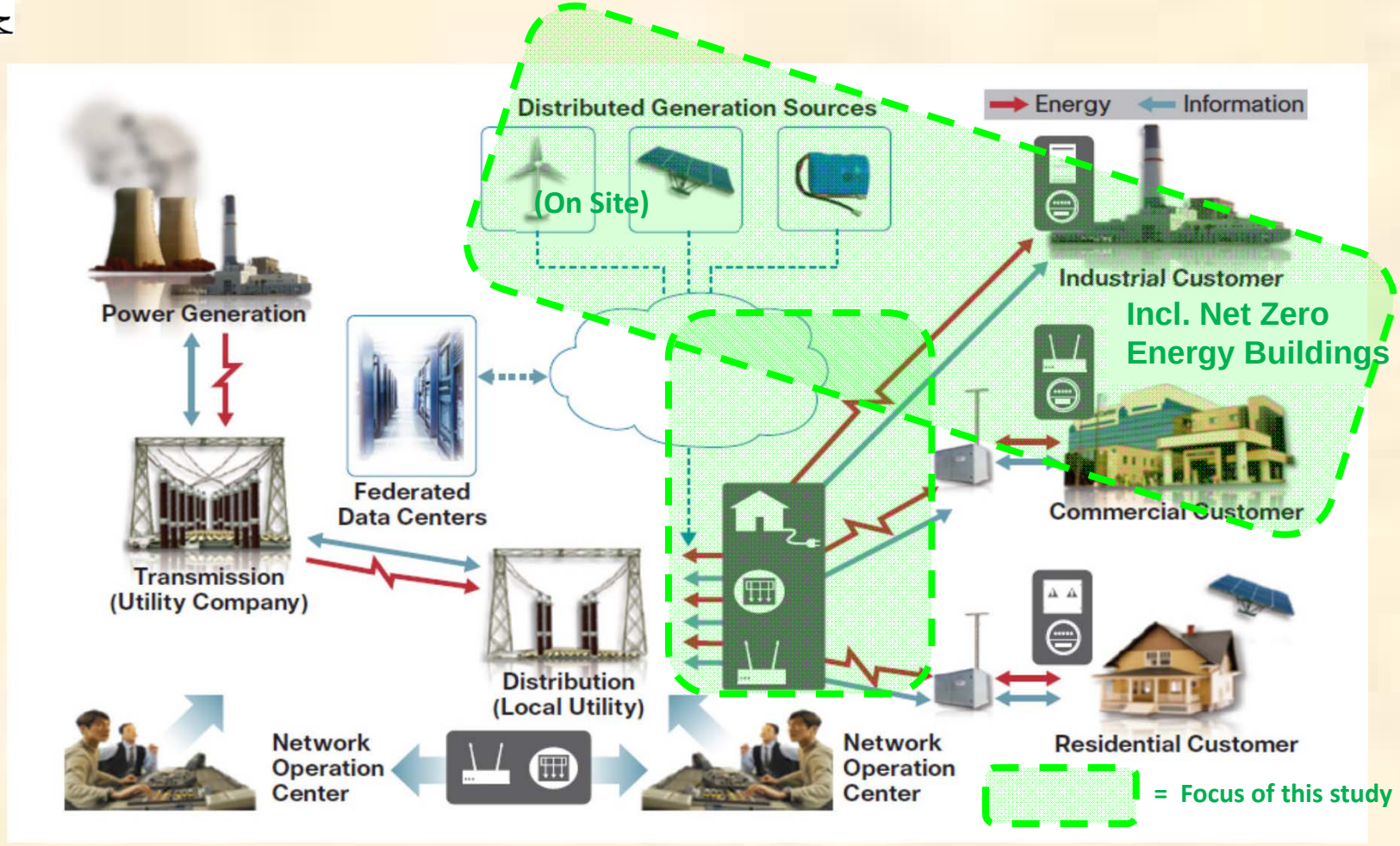
Focus of the Study

Smart Grid Commercial Buildings Business Opportunities



Source: CABA's Smart Grid Impact on Intelligent Buildings

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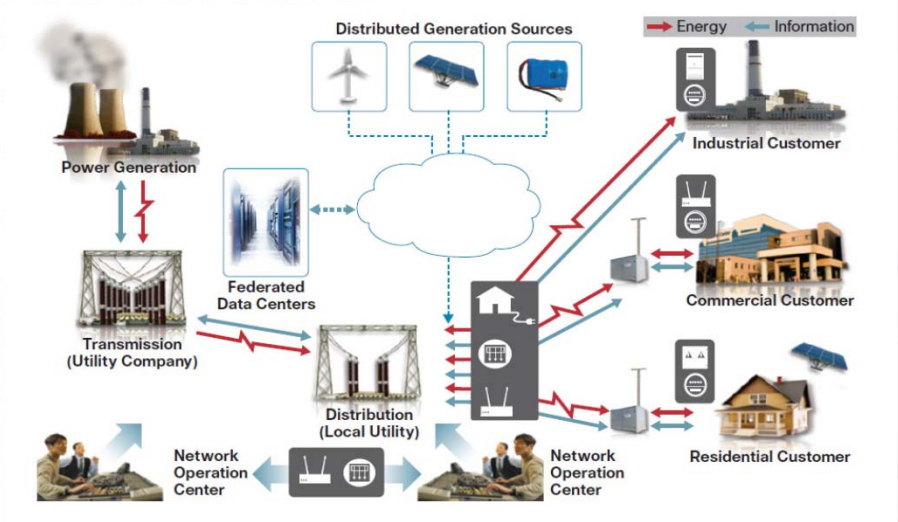
Smart Grid - Definition

An advanced power grid for the 21st century ... adding and integrating many varieties of digital computing and communication technologies and services with the power-delivery infrastructure. Bi-directional flows of energy and two-way communication and control capabilities will enable an array of new functionalities and applications that go well beyond "smart" meters for homes and business



Source: NIST Framework and Roadmap for Smart Grid Interoperability Standards Release 1.0 (Draft), September 2009.

Six Chief Characteristics:

- **Enables informed participation by all parties**
- **Accommodates all generation and storage options**
- **Enables new products, services, and markets**
- **Provides the power quality for the range of needs**
- **Optimizes asset utilization and operating efficiently; and**
- **Operates resiliently to disturbance, attacks, and natural disasters**

Source: CABA's Smart Grid Impact on Intelligent Buildings

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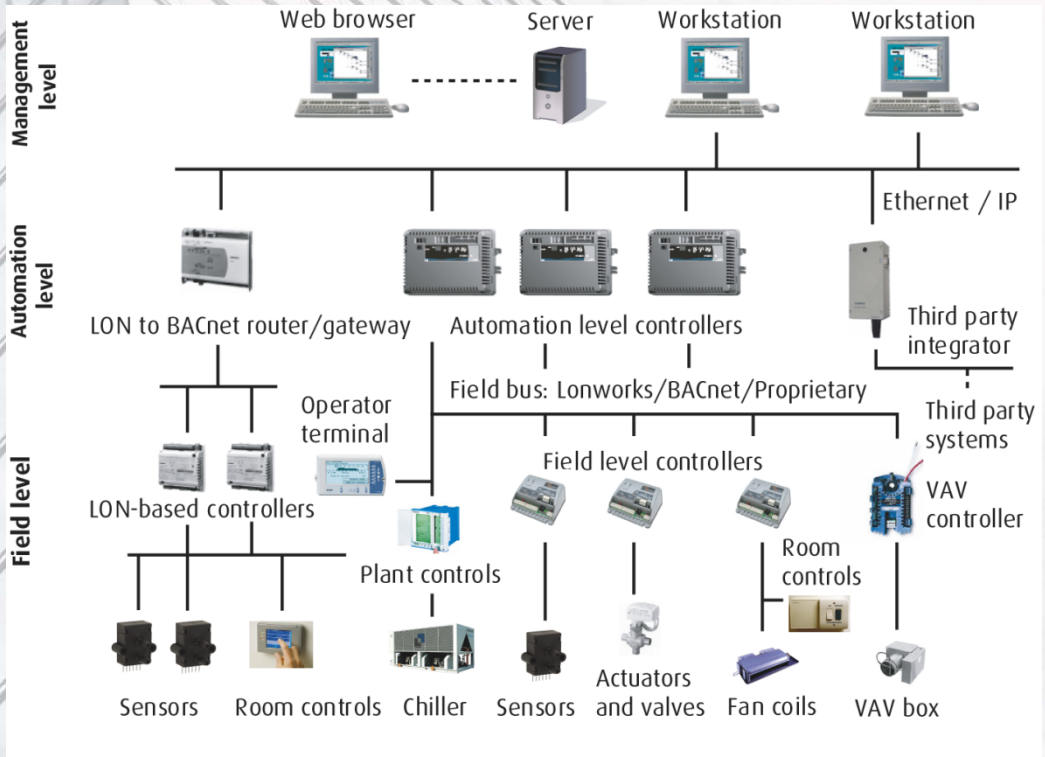
Building Management System (BMS)

A computer-based control system - controls and monitors building HVAC and electrical equipment - commonly also systems for lighting, power, security, fire detection and alarm

Comprises central computers, workstations, PCs, direct digital control (DDC) controllers, display panels, communication elements such as routers, switches, sensors for temperature, humidity, CO2, pressure etc. , meters/data loggers

Outputs typically connect to hydraulic control valve and actuator assemblies, air damper actuator assemblies and variable speed drives.

Software for monitoring, control and management usually configured hierarchically and use manufacturers' proprietary communications protocols or Internet protocols and open standards such as BACnet, LonWorks, Modbus, XML, SOAP, DeviceNet etc.



Source: BSRIA

Source: CABA's Smart Grid Impact on Intelligent Buildings

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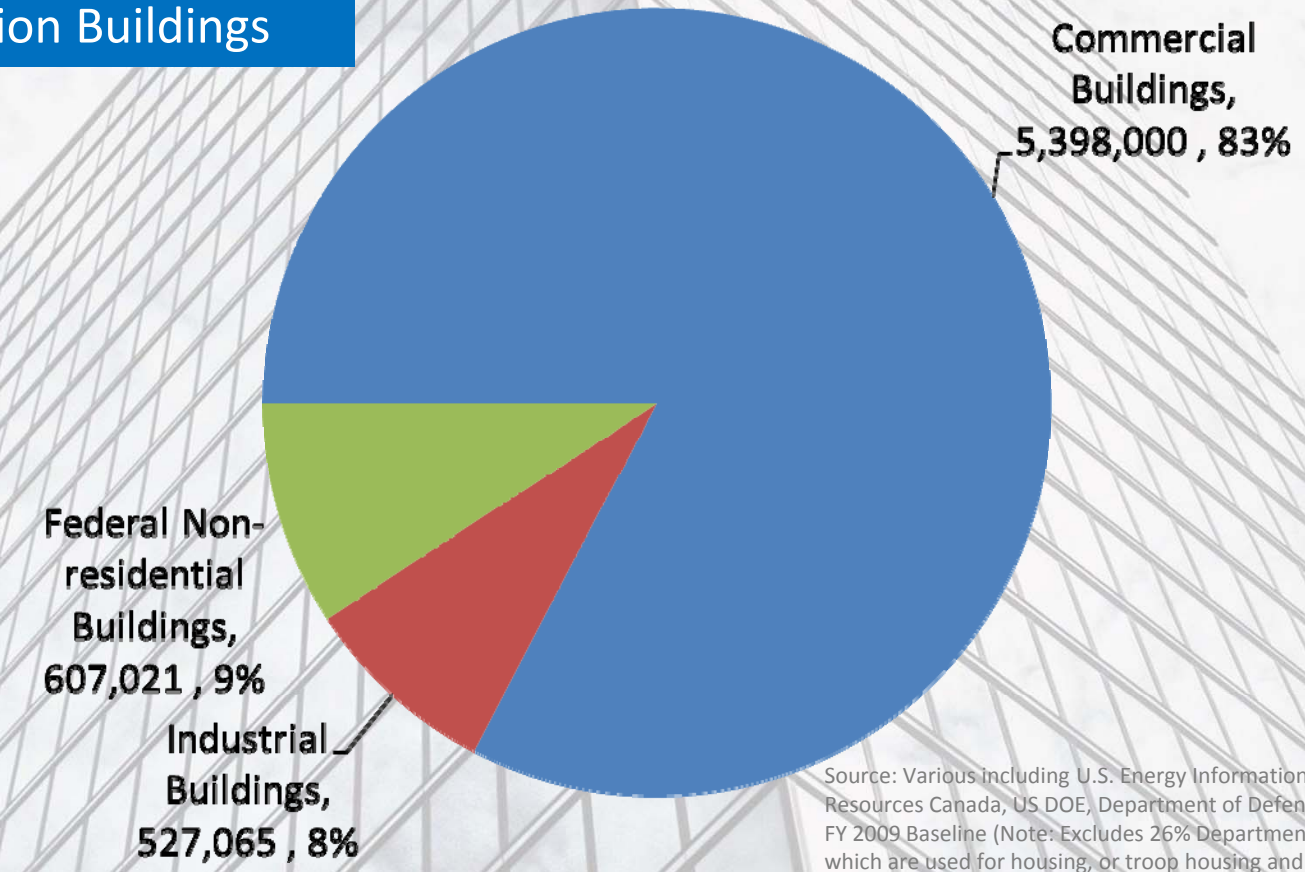
Non-Residential Building Stock - North America (USA & Canada)

6.5 Million Buildings



Source: Various including U.S. Energy Information Administration, National Resources Canada, US DOE, Department of Defense Base Structure Report FY 2009 Baseline (Note: Excludes 26% Department of Defense buildings which are used for housing, or troop housing and mess facilities), and BSRIA estimates.

Source: CABA's Smart Grid Impact on Intelligent Buildings

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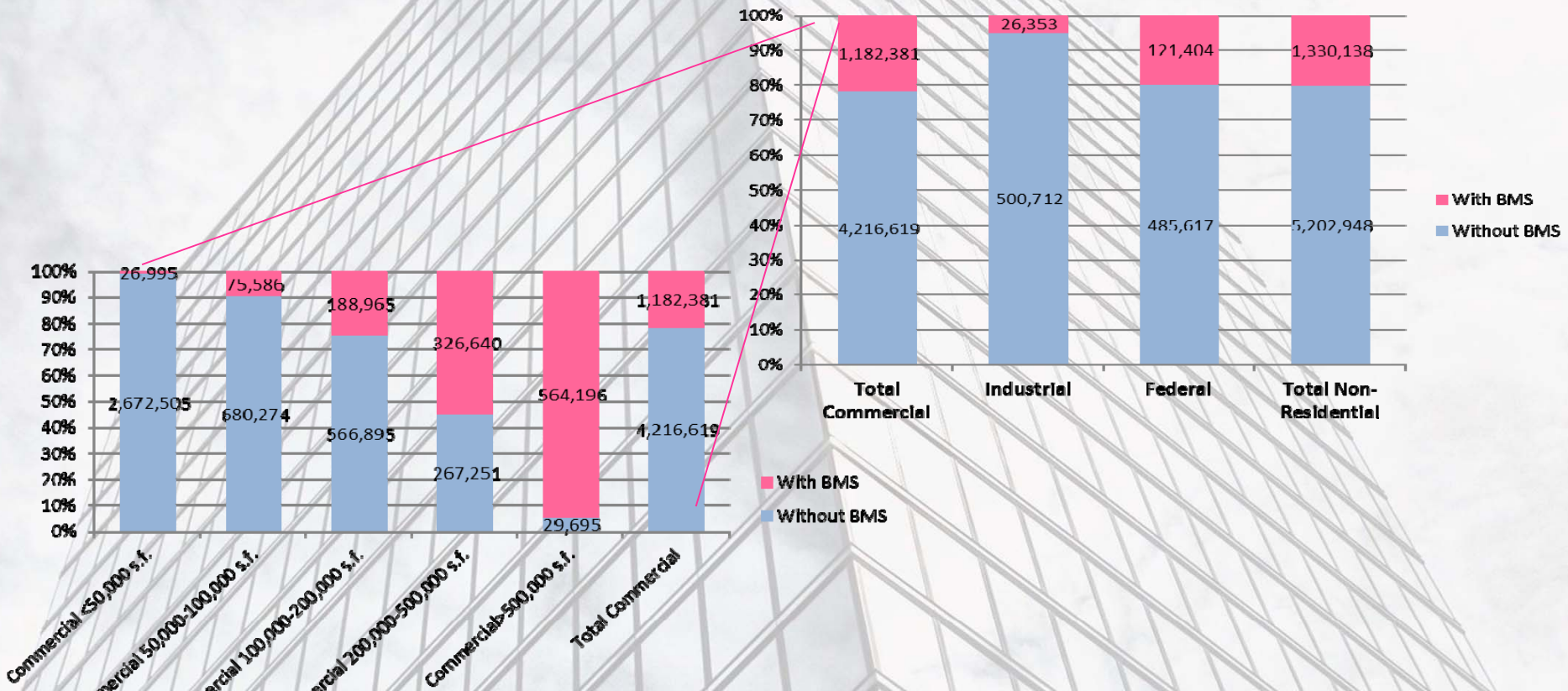
BMS Penetration by Number of Buildings – by Commercial Building Size Category



Source: CABA's Smart Grid Impact on Intelligent Buildings

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Number of Utilities in North America

3,100 Utilities in the USA (approx)

- About 100 Investor owned companies (produce 70% of the electricity)
- About 1000 Rural cooperatives
- About 2000 Municipal power companies

380 Utilities in Canada (approx)

- 16 major electric utilities:
  - 8 provincially owned
  - 7 investor-owned
  - 2 municipally owned
  - 2 are territorial Crown Corporations
- Additional 4 privately-owned in Ontario
- About 364 smaller utilities across Canada (87% located in Ontario)
- Most owned by municipalities. Do not own generating capacity; usually purchase power from the major utility in their province.
- Several small investor-owned with own generating capacity.

Source: CABA's Smart Grid Impact on Intelligent Buildings

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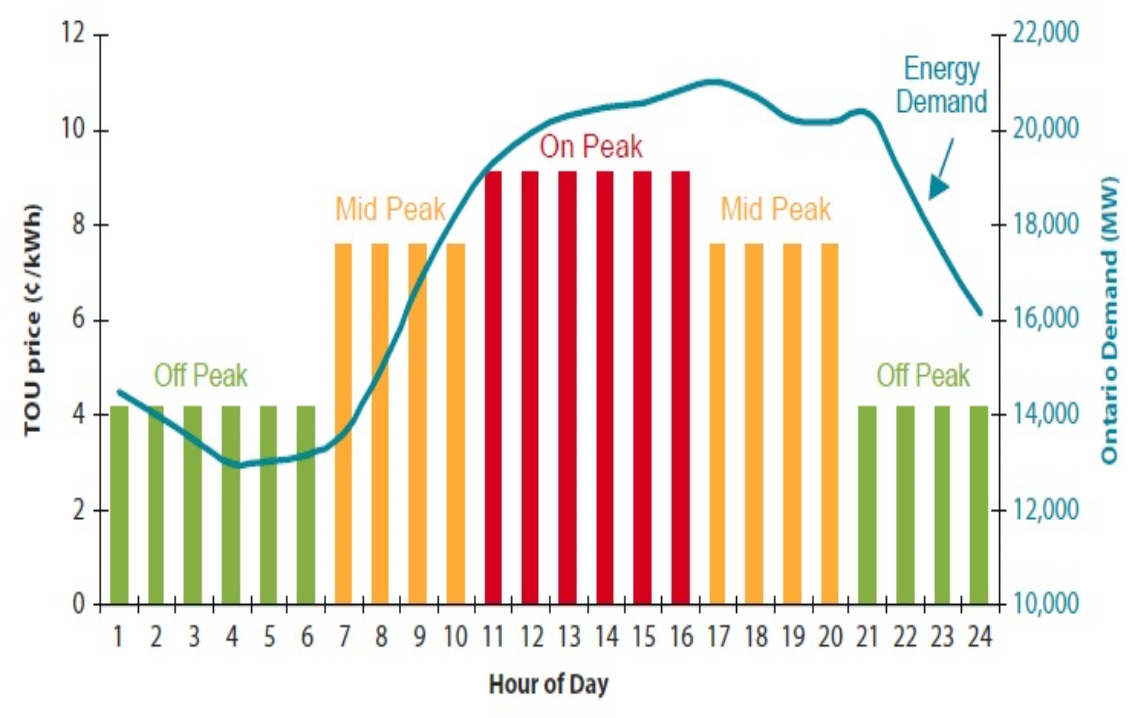
Why do we Need a Smart Grid?



- Shave the peaks
- Increase grid stability and reliability
- Improve efficiency – energy, consumption data management
- Save on energy costs
- Buy at optimal price
- Empower customers

Source: CABA's Smart Grid Impact on Intelligent Buildings

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Blackout Areas

USA

The top 10 blackout states include some of the states that house the most data centers:

Source: Eaton Blackout Report 2010

2010	
California	508
New York	176
Texas	145
Ohio	135
Washington	125
New Jersey	121
Pennsylvania	120
Florida	118
Michigan	116
Wisconsin	106

Canada

Provinces and territories ranked by number of reported outages:

Source: Eaton Annual Report 2010

2010	2009
Ontario – 64	Ontario – 80
British Columbia – 43	British Columbia – 23
Alberta – 22	Saskatchewan – 8
Saskatchewan – 20	Alberta – 6 (tie)
Nova Scotia – 12	Nova Scotia – 6 (tie)
Quebec – 11	Quebec – 6 (tie)
Manitoba – 9 (tie)	Manitoba – 4 (tie)
New Brunswick – 9 (tie)	New Brunswick – 4 (tie)
Newfoundland – 2	Prince Edward Island – 4 (tie)
Prince Edward Island – 1(tie)	Northwest Territories – 1
Northwest Territories – 1 (tie)	

Source: CABA's Smart Grid Impact on Intelligent Buildings

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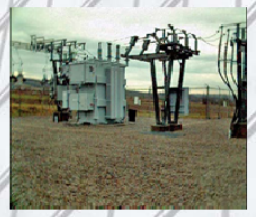
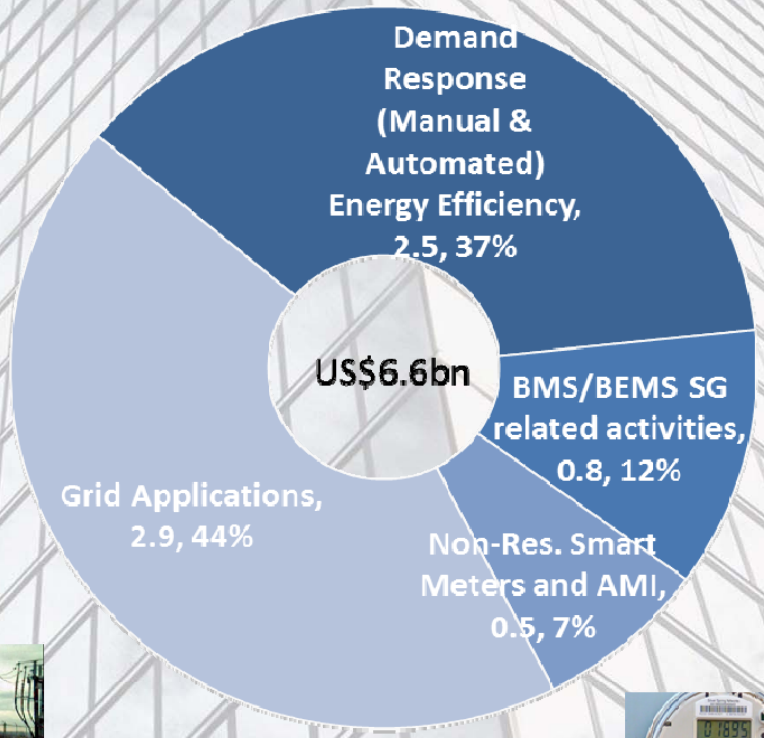
Main Components of the Smart Grid Market (US$ bn)





Source: BSRIA

Source: CABA's Smart Grid Impact on Intelligent Buildings

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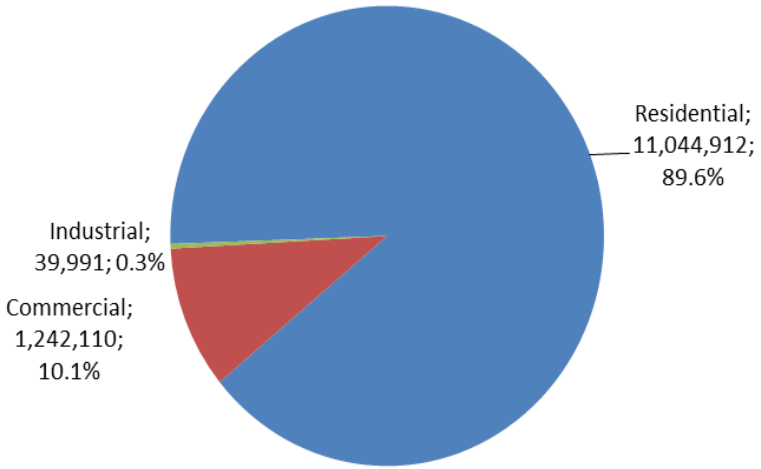
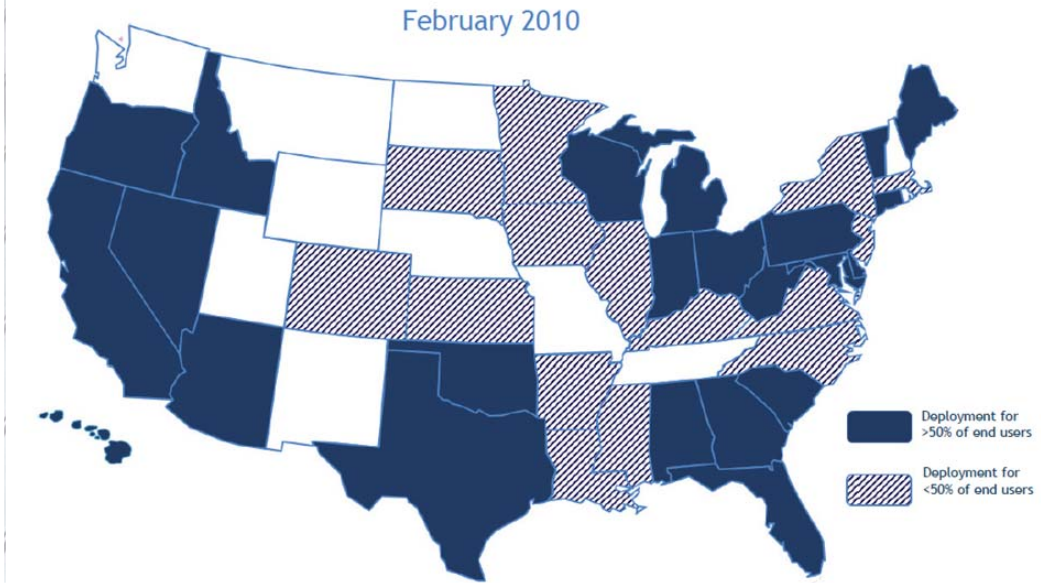
Smart Meter Installations





	Residential	Commercial	Industrial	Total
USA	6,564,949	738,294	23,770	7,327,013
Canada (Assumes segmentation proportions similar to USA)	4,479,963	503,816	16,221	5,000,000
Total North America	11,044,912	1,242,110	39,991	12,327,013
	89.6%	10.1%	0.3%	100.0%

Source: CABA's Smart Grid Impact on Intelligent Buildings

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Definition Demand Response 1 (DR1)

- Existed for the last 15 years
- The aim is to reduce/shave/curtail the demand peaks
- Most end-users respond manually but some also automated
- Most end-users typically reduce the load 5 – 10 days a year
- Most end-users will be told 24 hours in advance
- DR1 sites are not necessarily linked to energy efficiency
- Some end-users provide emergency DR e.g. shorter notice and shorter intervals, mostly automated

Source: CABA's Smart Grid Impact on Intelligent Buildings

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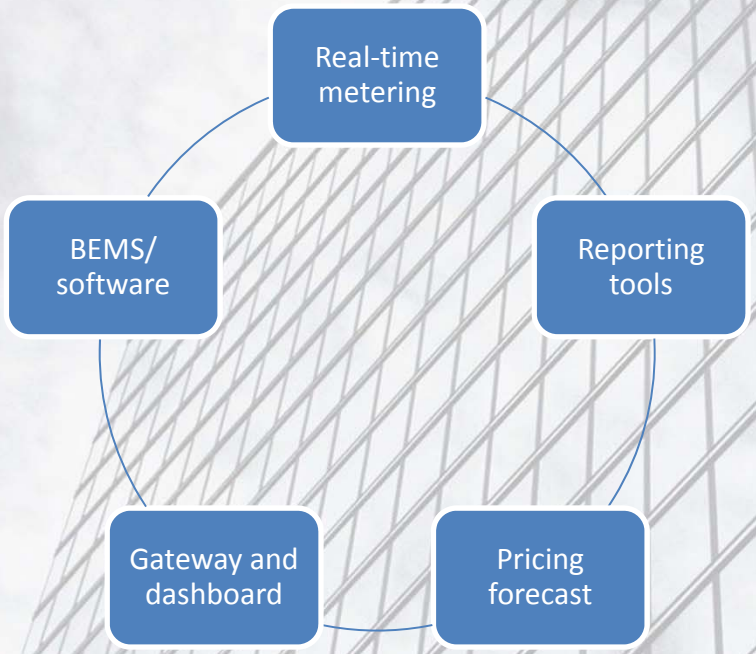
Definition Demand Response 2 (DR2)



- DR2 is more interactive
- Client energy profile
- The energy consumption will be monitored and system faults identified
- Usage data will be available every 5 – 30 minutes
- Many different software packages are available to be linked to the client's BMS
- DR2 is mostly automated
- There are different levels of DR2. More advanced DR2 would include buying and selling electricity

Source: CABA's Smart Grid Impact on Intelligent Buildings

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How will the Smart Grid impact buildings?

DR 1

On-site generation / energy efficiency

Saving electricity bill: 3 – 5%

Energy efficiency

- Smart metering
- Energy profile
- Energy date available

DR 2

Energy usage per equipment/zone and fault finding

Plan electricity consumption: reduce when high, use when low

Buy and sell electricity. Produce and store

Saving electricity bill: 15-20%

Source: CABA's Smart Grid Impact on Intelligent Buildings

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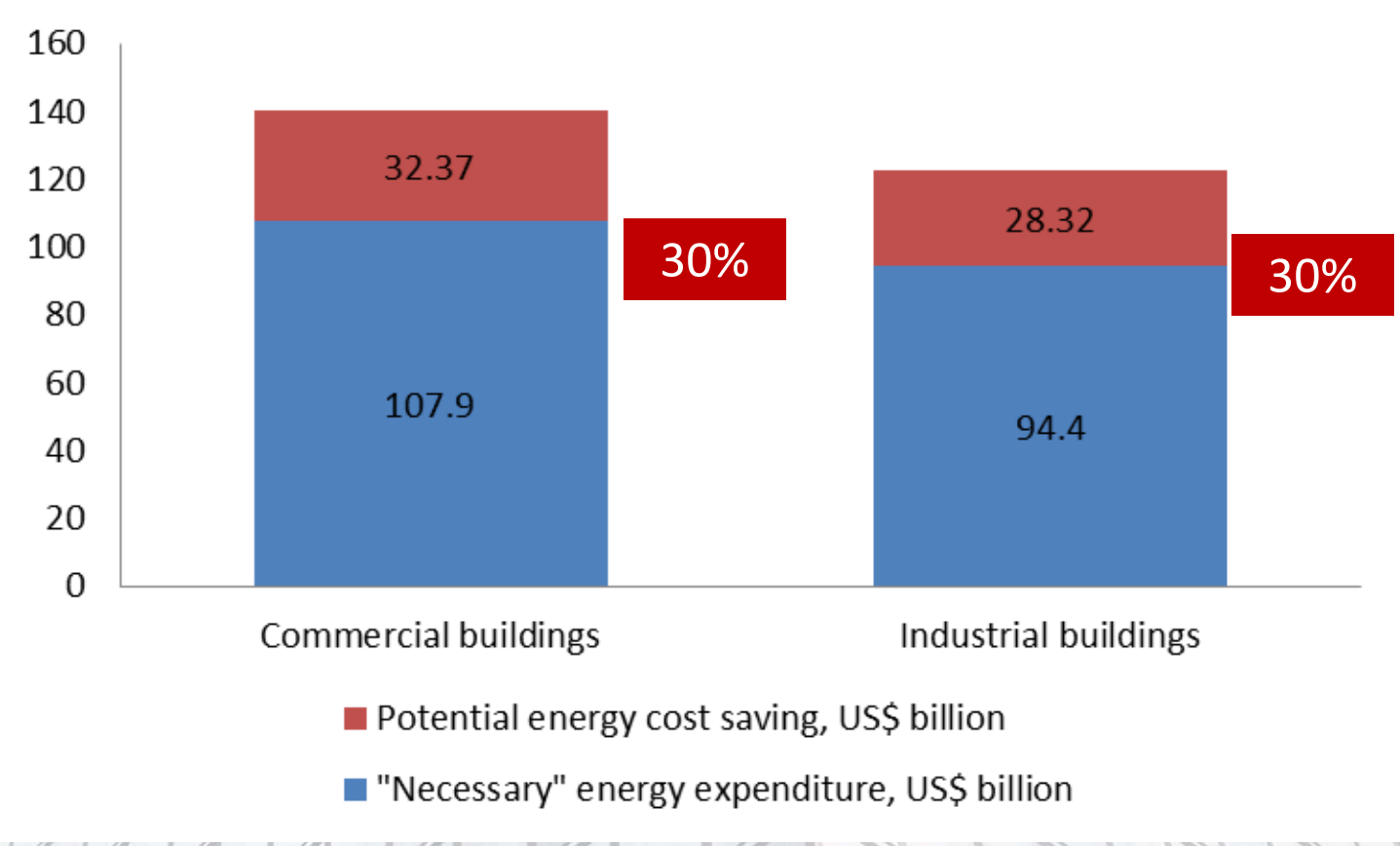
Potential Energy Savings in Non-Residential Buildings



Source: CABA's Smart Grid Impact on Intelligent Buildings

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Source: Energy Information Administration. "2003 CBECS Detailed Tables. Table C4A. Expenditures for Sum of Major Fuels for All Buildings, 2003." December 2006. 1 June 2007 and "2002 Energy Consumption by Manufacturers--Data Tables. Table 7.9 Expenditures for Purchased Energy Sources, 2002." 2002. 1 June 2007.
U.S. Environmental Protection Agency, ENERGY STAR program. "Useful Facts and Figures." 1 June 2007.

Barriers and drivers

Barriers

-No capital to invest in upgrades
-Lack of awareness
-Lack of knowledge / training
-Outdated technology
-Low penetration of advanced metering

Drivers

-Increasing awareness
-Electricity cost anticipated to continue to increase
-Political focus and increasing incentives
-Deregulation in states and utilities
-Increase in number of providers
-Various options to avoid upfront cost

Source: CABA's Smart Grid Impact on Intelligent Buildings

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Key Findings

- More building owners developing a closer relationship with their utility
- Senior individuals responsible for sustainability/energy are driving change
- Growing number of end-users negotiating deals for manual demand response
- Driver #1: Cheaper energy price incentives, Driver #2: desire for energy efficiency
- Limited roll-out of smart meters in non-residential buildings is a barrier
- More linking of disparate systems by middleware to have visibility and control
- Energy represents 20% of operating costs of more than half of all respondents
- 2-3 years pay back is general target on energy investments
- Owner-occupiers more inclined to invest and accept longer ROI
- Health, food sales and food service biggest opportunity by energy intensity
- Potential to save 30% of energy used in buildings
- Approx 20% of all non-residential buildings have a BMS today
- Office Buildings, Retail and Education represent biggest opportunity by total floor space
- "BMS sales due to Smart Grid" share of total BMS market in 2012 could reach 14%

Source: CABA's Smart Grid Impact on Intelligent Buildings

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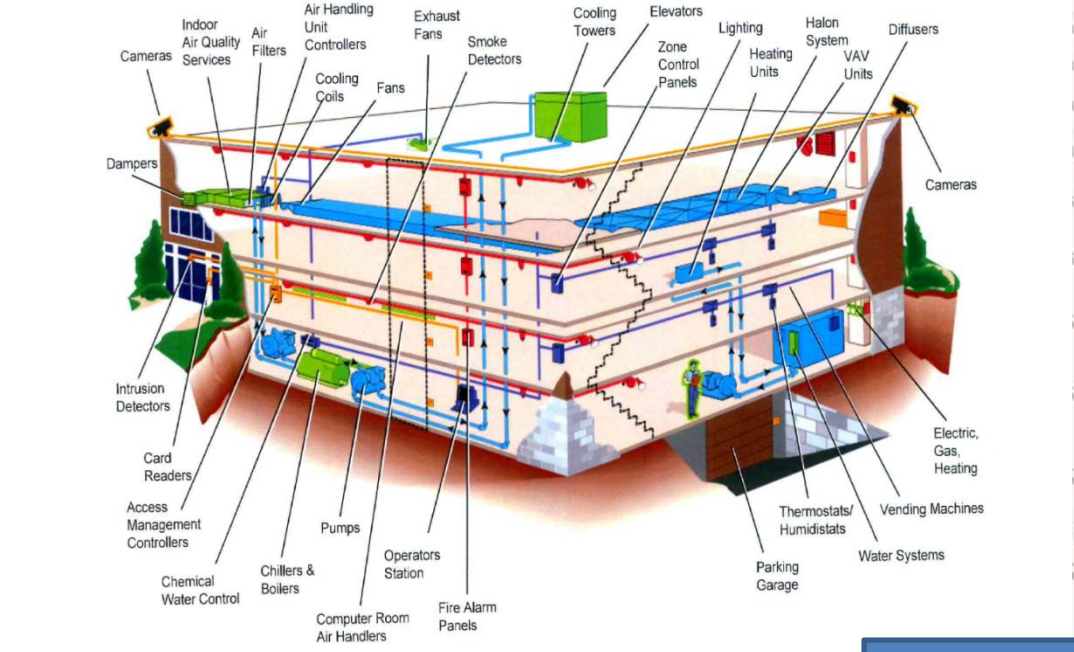
How will the Smart Grid impact buildings? - Intelligent / Converged building



Information collected and analysed:

- Energy consumption
- Overview of cost per energy supplier
- Building occupancy
- Building usage
- Overview of operational cost (by section, building)
- Bench mark data (property cost per sq. metre, energy cost per sq metre)

The information management system optimises the decision

- Building management & investment decisions
- Outsourcing strategies
- Space allocation
- Choice of suppliers
- Implementation of demand response strategies

Source: CABA's Smart Grid Impact on Intelligent Buildings

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“Life-Cycle Costing for Intelligent Buildings”

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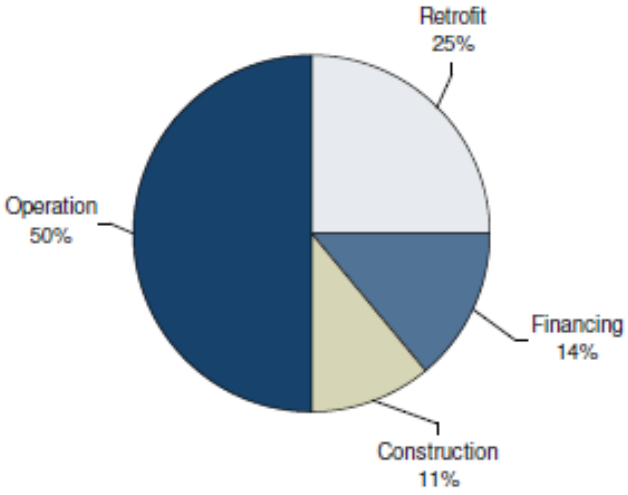
Life Cycle Cost

www.frost.com

Why will intelligent technologies cost less than traditional technologies?

Building's Life Cycle Cost Over 40 Years



Source: ASHRAE

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Source: CABA's Smart Grid Impact on Intelligent Buildings

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