CABA

SMART GRID IMPACT
on Intelligent Buildings

Smart Grid Impact on Intelligent Buildings
IIBC Landmark Research: Executive Summaries Package

Continental Automated Buildings Association (CABA)

1.1 Detailed table of contents, background, objectives, methodology and executive summary – study PowerPoint presentation.

1.2 Detailed table of contents and executive summary – final written MS Word report.

1.1 Smart Grid Impact on Intelligent Buildings
IIBC Landmark Research: Executive Summary

The Continental Automated Buildings Association (CABA)

CABA and the following CABA Members funded this Research Project:

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The Continental Automated Buildings Association

- The Continental Automated Buildings Association (CABA) is an industry association dedicated to the advancement of intelligent homes and intelligent buildings technologies. CABA is an international association, with over 300 major private and public technology companies committed to research and development within the intelligent buildings and connected home sector. Association members are involved in the design, manufacture, installation and retailing of products for home and building automation. CABA is a leader in initiating and developing cross-industry collaborative research, under the CABA Research Program.
- In 2011, CABA conducted the Smart Grid Impact on Intelligent Buildings Market Landmark Research. The broad purpose of the study was to understand how the Smart Grid is going to impact on intelligent non-residential buildings in North America (USA and Canada) including Net Zero Energy Buildings (NZEB) and to size the business opportunities
- Organizations that participated in CABA's Smart Grid Impact on Intelligent Buildings Market study included:
  - Ruby Sponsor: Schneider Electric.
  - Emerald Sponsors: Cadillac Fairview Corporation, CoR Advisors, Diebold Incorporated, GE Energy Services, Honeywell International, Hydro Quebec, InfoComm International, Ingersoll Rand/Trane/Schlage, Johnson Controls, Legrand/Ortronics, Natural Resources Canada, Philips Research North America, Public Works & Government Services Canada, Robinson Solutions, Siemens Industries Inc., Southern California Edison, Tridium, Verizon Wireless, Viridity Energy
  - Diamond Sponsors: Belimo Air Controls Inc., CommScope Inc., Energent Incorporated, Grundfos Pumps Corp., LG Electronics, Priva Building Intelligence, Sempra Utilities, Shell International E&P Inc., US General Services Administration (GSA)

- CABA commissioned BSRIA (www.bsria.co.uk), an independent market research and consulting firm, to conduct the Smart Grid Impact on Intelligent Buildings Market Landmark Research research study.

Executive Summary: Table of Contents

Key Findings 1

- More building owners implementing holistic energy strategies including building optimisation and developing a closer relationship with their utility
- Senior individuals responsible for sustainability/energy driving change
- Growing number of end users negotiating deals for manual demand response - Automated demand response is lower penetration
- Driver #1: Cheaper energy price incentives, Driver #2: desire for energy efficiency
- Substantial differences between States; TX is leader, followed by CA, N.East
- Limited roll-out of smart meters in non-residential buildings is significant barrier
- More linking of disparate systems by middleware to have whole campus visibility and control
- Electricity represents 20% of operating costs of more than half of all respondents
- 2-3 years payback is general target on energy investments
- Owner-occupiers more inclined to invest and accept longer ROI

Key Findings 2

- Office Buildings, Retail and Education represent biggest opportunity by total floor space
- 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
- "BMS sales due to Smart Grid" share of total BMS market in 2012 could reach 14%
- Respondents see limited opportunity / slow uptake for NZEB today
- Best NZEB candidates are large footprint buildings

Strategic Market Implications

Finding	Strategic Market Implication	Companies for whom mainly relevant (based on their present profile)								
		Utilities	DR	BMS	BEMS	Energy Services	Systems Integrators	Engineering	IT/ Comms infrastructure	Consultants
Many end customers have recently appointed individuals with sustainability / energy efficiency responsibility - potentially confused by range and number of suppliers offering different solutions - Lack of awareness and education on how to make building more intelligent and automated	Suppliers need to target these decision makers/influencers with clearly differentiated value propositions	Med	High	High	High	High	Med	Med	Low	High
Commercial building developers/owners typically sell their property within a short time frame	Develop a range of solutions which offer a short payback period	Med	High	Med	High	High	Med	Med	Low	Med
Building owners are not well informed about the cost of energy efficiency and smart grid related investments	Suppliers should help them prepare a comprehensive business plan, including Capex and Opex forecasts and payback periods	Med	High	High	High	Med	Med	Med	Med	Med
Every building is different, or at least the owners/users perceive them to be	Need to develop more pilot and show-case projects demonstrating energy efficiency and DR - relate similarities to client's business case and building type	High	High	High	High	High	Med	Med	Med	Med
Not all building owners/users aware of DR benefits	Suppliers need to develop and implement clear and understandable marketing and sales campaigns to increase awareness for energy efficiency and DR packages	High	High	Med	High	High	Low	Low	Low	Med
Building owners/users looking for more holistic approach and "one-stop-shopping "	Suppliers need to develop more comprehensive solutions that bring hardware, software and services into the value proposition, possibly through partnership and acquisition	Med	Med	High	Med	High	Low	Low	High	Med

Strategic Market Implications

Finding	Strategic Market Implication	Companies for whom mainly relevant (based on their present profile)								
		Utilities	DR	BMS	BEMS	Energy Services	Systems Integrators	Engineering	IT/ Comms infrastructure	Consultants
Building owners/users unable/unwilling to invest due to lack of finance/short term economic uncertainty	Suppliers need to develop a range of up-front financing models including simple loans, performance contracting, other financing models	High	High	High	High	High	Low	Low	Med	Low
Users often complain that building controls are difficult to use	More intuitive operation and graphics needed on control and management systems - ideally by developing and adhering to a common standard	Low	Low	High	Med	Low	Med	Low	Med	Med
Building users are not aware of or engaged with the consumption profile of their buildings	Make energy efficiency and smart grid exciting! Get end users involved: e.g, use attractive and dynamic graphics to convey information, such as showing the customer his historical and current power utilisation	High	High	Med	High	High	Low	Low	Med	Med
Building systems are not understood and so they are poorly used, switched off or bypassed	Make clear training material accessible, develop networking peer groups to increase the understanding of how the building and the equipment can work optimally and to share ideas on best practice	Low	Low	High	Med	Low	Low	Low	Med	Med
Many end users outsource the operations of the buildings so have no way to relate to their building's performance	Develop better two way communications, retro commissioning, information portals that are easy to access and use	Low	Low	High	Med	Low	Low	Low	Med	Med
Energy prices vary across the country and not all regions are deregulated or yet progressively developing smart grids and rolling out smart meters/automated meter infrastructure to non-residential buildings	Target regions where smart infrastructure is most developed and incentives to invest are greatest	High	Med	High	High	High	Med	Med	High	Med

Barriers and Drivers

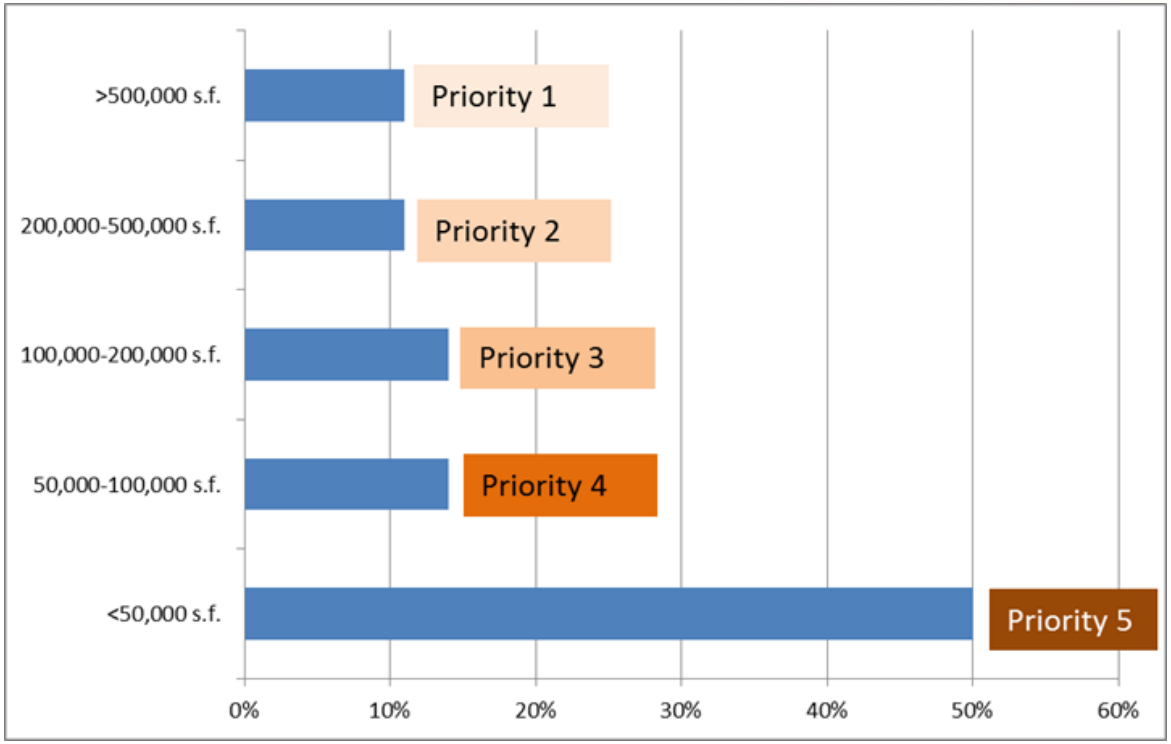
BARRIERS

- 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
- Deregualtion in states and utilities
- Increase in number of providers
- Variours options to avoid upfront cost

Prioritization of Buildings by BMS Penetration



- Buildings greater than 500,000 sq.ft account for only 11% of building stock by share of total floor space, but 95% are estimated to have a BMS so should be first priority target for smart grid, energy management and demand response initiatives.
- Buildings 100,000-200,000 sq.ft also account for 11% of total floor space and an estimated 55% have a BMS so should be second priority
- Chart shows order of priority for each segment, based on estimated BMS penetration

Study Objectives and Scope

Objectives

- Assess the Smart Grid impact on intelligent non-residential buildings in North America (USA and Canada) including Net Zero Energy Buildings (NZEB)
- Size the business opportunities around the integration of smart grid into intelligent non-residential buildings

Scope

- The electricity supply and demand value chain to non residential customers in North America

Principal Stages of the Study Programme

Refine project objectives with sponsors

Agree Framework with sponsors: e.g.
- Market
- Technology
- Players
- Legislation
- Other...

Develop face to face & on-line questionnaires and establish interview targets

Conduct On-line, face to face and telephone interviews to collect hard data

Analysis – iteration - triangulation to make necessary checks

Report writing

Presentation and Webinar to sponsors

- Kick off webinar July 7th 2011
- Bi-monthly project meetings with sponsors
- On-line survey October 2011
- Field work and telephone interviews Sep.-Dec. 2011
- Report writing December 2011 - January 2012
- Face to face presentation in Chicago 23 Jan. 2012 & webinar 2 Feb. 2012

From Interviewee Groups to Deliverables

End User Segments
Office buildings: (public & commercial offices, corp. facilities)
Health: (hospitals, clinics)
Education (schools, universities)
Retail: (shopping centres, strip malls, supermarkets, department stores, large single shops)
Hospitality and leisure: (hotels, conference facilities, restaurants, sports stadiums)
Industry: (high tech, pharmaceutical, life science, manufacturing, assembly)
Transportation buildings: (airports, train stations)
Data centres

Suppliers
Building automation suppliers
Utilities
Utility systems developers and integrators
Demand response service and software suppliers
Infrastructure and metering suppliers
Others: (Government / consultants etc.)

Slide Set

Executive Summary

Main Report

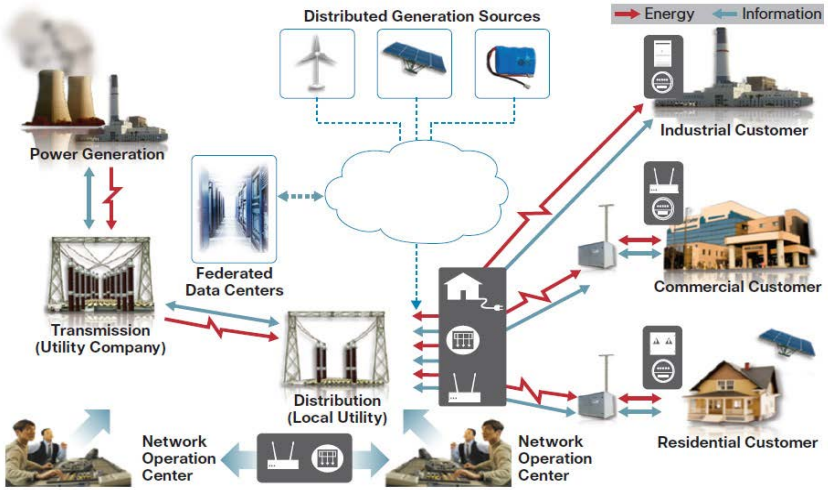
Distribution of Face-to-Face and Telephone Interviews

- Approx. 45 interviews conducted, 2/3 face-to-face, 1/3 telephone.
- BSRIA interviewed more than one respondent in some organisations
- Face-to-face interviews across North America -15 States /Provinces visited:
  - NY, FL, TX, IL, CA, WA, DC, NJ, IN, GA, MA, VA, PA, ON, QU.
- Interviewees with organisations representing large regional/national portfolios of buildings of varying sizes and energy demand
- High quality interviews, senior level respondents, principal building verticals & main supplier types covered
- Some interviews lasted several hours

  - Developers, owners, and managers: 40%
  - Building automation suppliers: 5%
  - Utilities: 13%
  - Utility systems developers and integrators; 2%
  - Demand response service and software suppliers: 9%
  - Infrastructure and metering suppliers: 16%
  - Others (U.S. GSA / Public Works Canada and independent consultants etc.): 15%

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

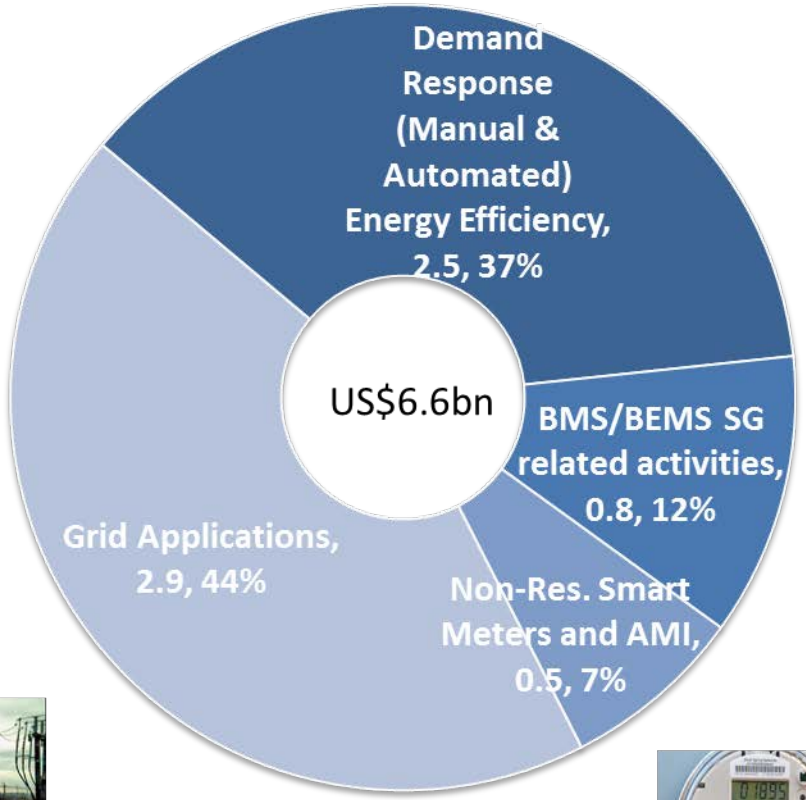


Source: NIST Framework and Roadmap for Smart Grid Interoperability Standards Release 1.0 (Draft), September 2009.

Six Chief Characteristics:

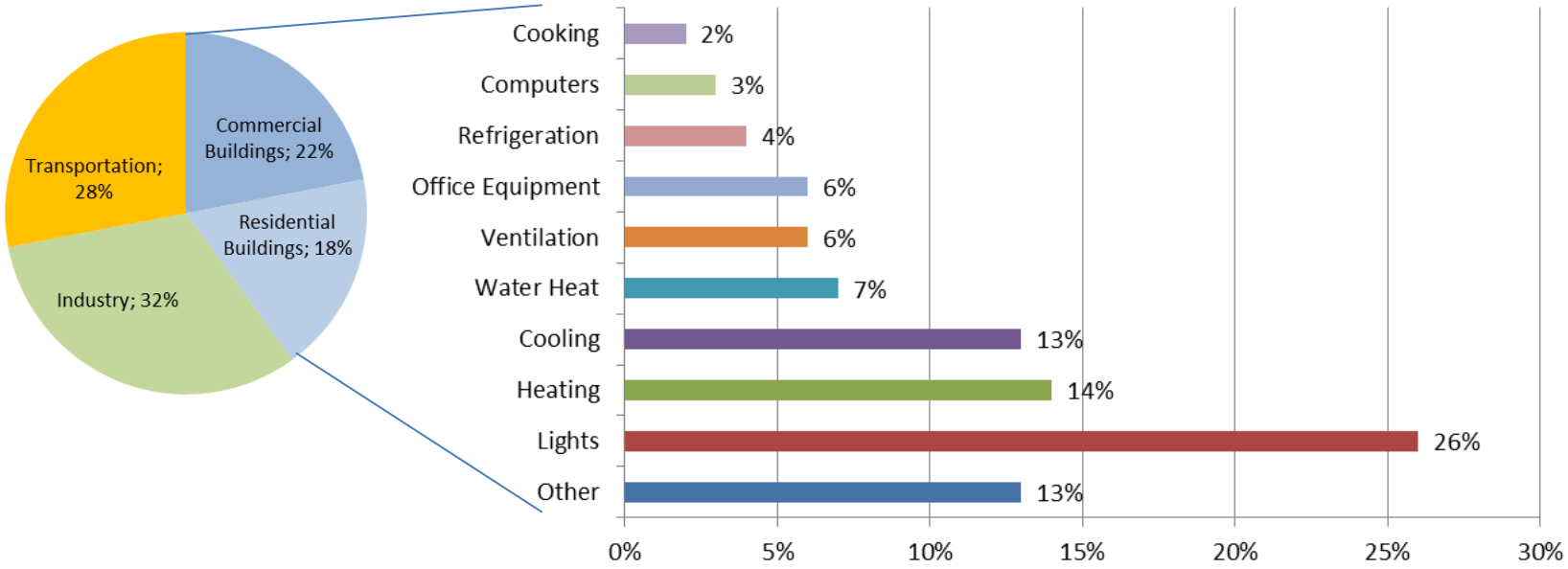
- **Enables informed participation by all parties**
- **Accommodates all generation and storage options**
- **Enables new products, services, and markets**
- **Provides the power quality for the range of needs**
- **Optimizes asset utilization and operating efficiently; and**
- **Operates resiliently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

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



Source: BSRIA

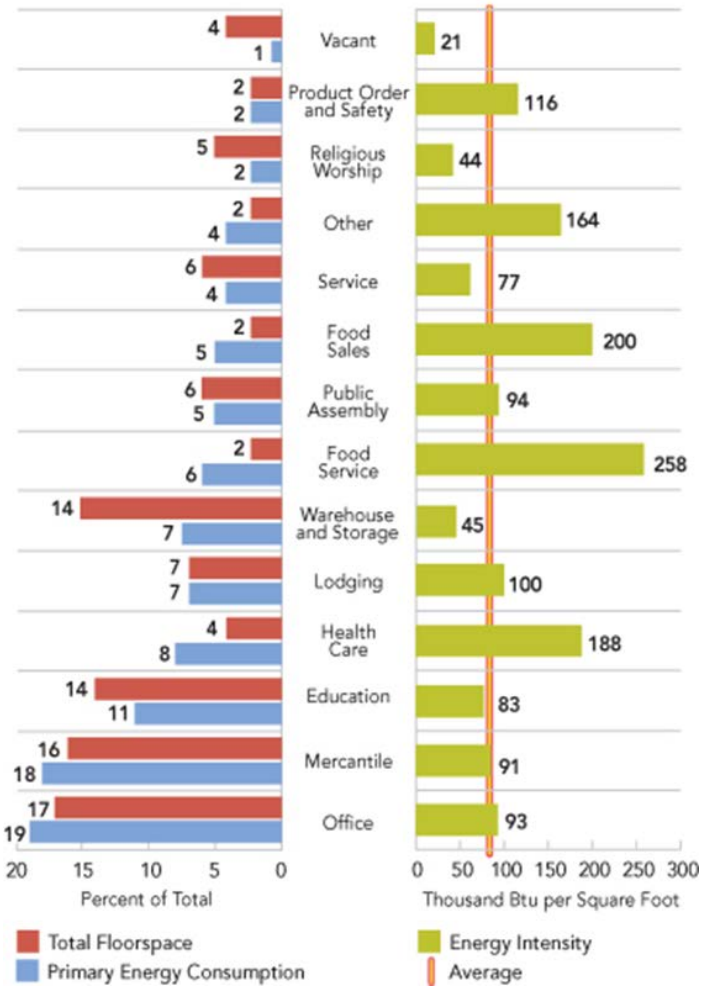
Energy Consumption by Sector (USA)



Source: DOE Buildings Energy Data Book 2007 (Tables 1.1.3, 1.2.3, 1.3.3)

Includes single- and multi-family residences and commercial buildings. Commercial buildings include offices, stores, restaurants, warehouses, other buildings used for commercial purposes, and government buildings

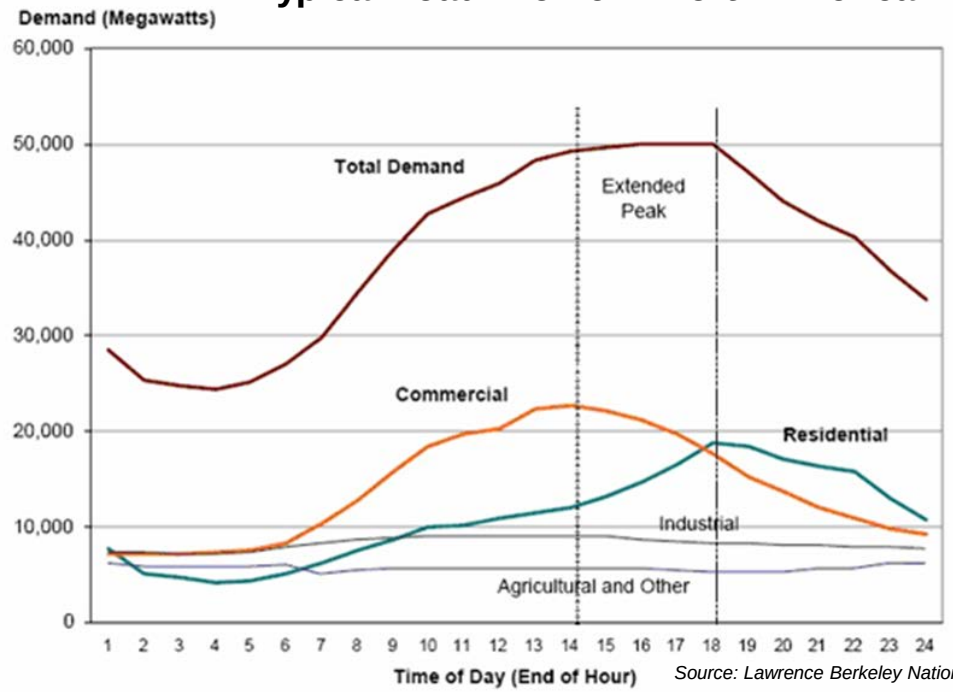
Comparison of Commercial Building Floorspace, Energy Consumption, and Energy Intensity, by Building Activity



Source: US DOE

Demand Response and Peak Load Management

Typical Load Profile in North America



Source: Lawrence Berkeley National Laboratory

Manage demand by shaving/ curtailing peaks to avoid building extra electric generation.

Using DR tools such as:

- Dynamic pricing and tariffs
- Contractually obligated and voluntary curtailment
- Direct load control and cycling
- Payment incentives

Electricity bill:

1. Energy consumption charge

2. Demand charge.

Reset monthly and based on the highest rate at which electricity is consumed during peak-utility-service hours.

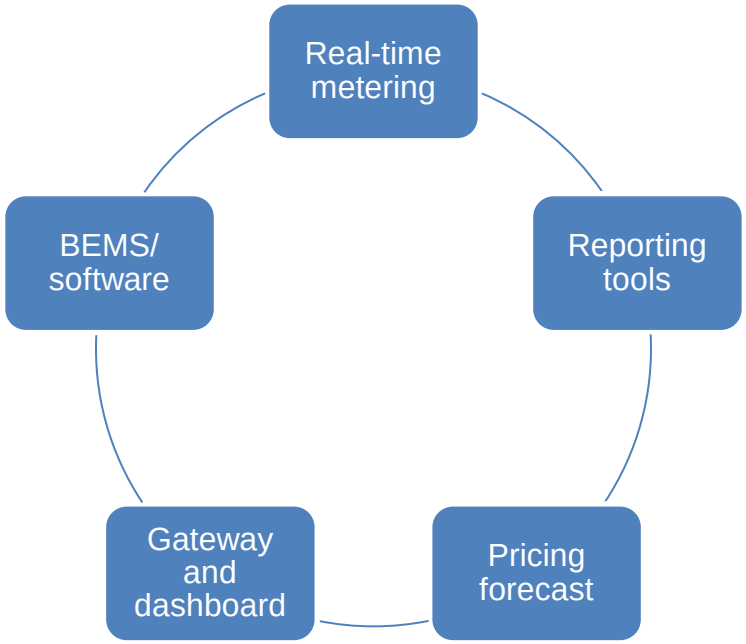
Peak load management:

"Economic reduction of electric energy demand during a utility's peak generation period."

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

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

Examples of DR1 and DR2 Approaches

DR1	DR2
- Customer agrees to cut the electricity load by xx% on a few agreed days - Typically only 5 – 10 days a year - Typically 24 hours warning - Mostly manual and often by using on-site generators	- The client pays a monthly fee - Upfront cost for metering if not DR1 - Energy software/BEMS - Energy profile and strategy - Data accessible by client and provider
- Customer profile/curtailment strategy - No payment by the clients - Meters for free - Manual or automatic (up to the clients) - Agree metering data (real-time, 5 min interval etc.) - Data accessible by client and provider	- Energy profile and strategy - Real-time or interval metering - Energy software/BEMS upgrade (free) - Free/ no capital cost (savings split between provider and client) - Data accessible by client and provider
Performance contracting: The provider/ESCO takes over the installation and maintenance on a 7 - 20 year contract. The investment and fee is paid by the energy savings. The client pays a monthly fee which includes part of the energy saving gained	

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

Energy usage per equipment/zone and fault finding

DR 2

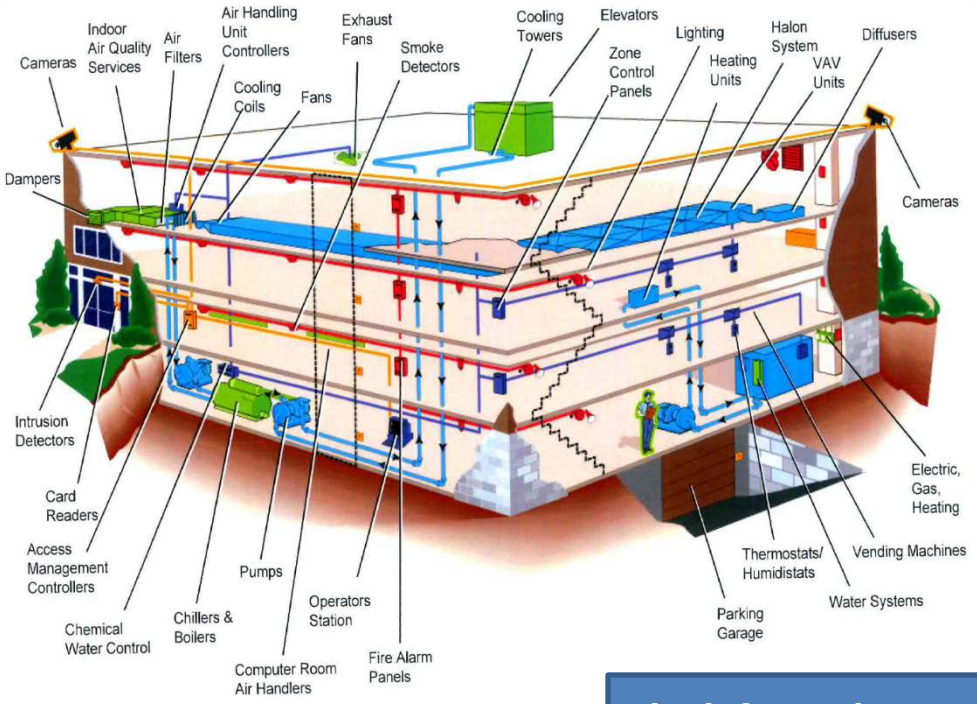
Plan electricity consumption: reduce when high, use when low

Saving electricity bill: 15-20%

Buy and sell electricity. Produce and store

How will the Smart Grid Impact Buildings?

Intelligent / Converged Building



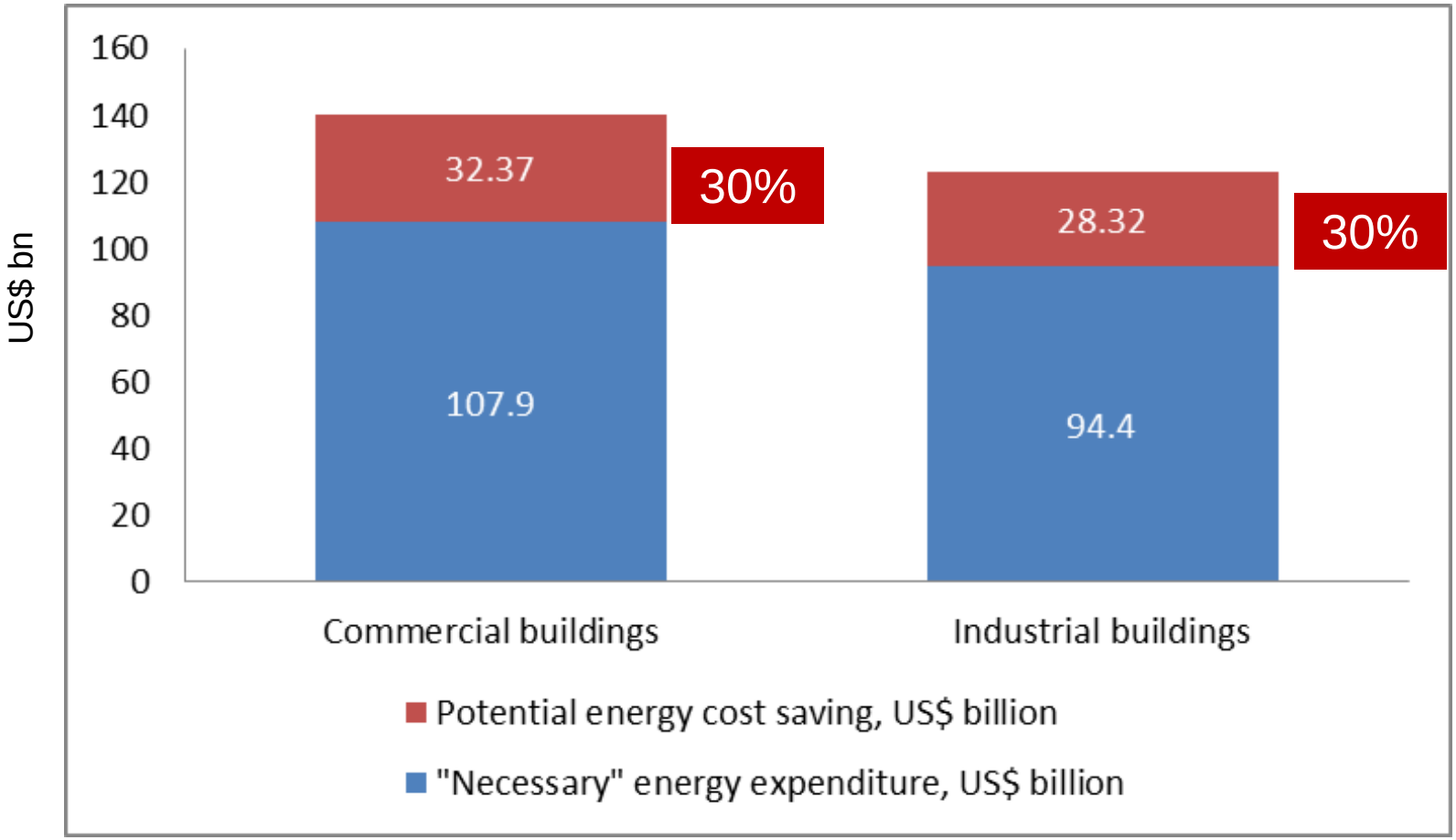
Information collected and analysed:

- 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

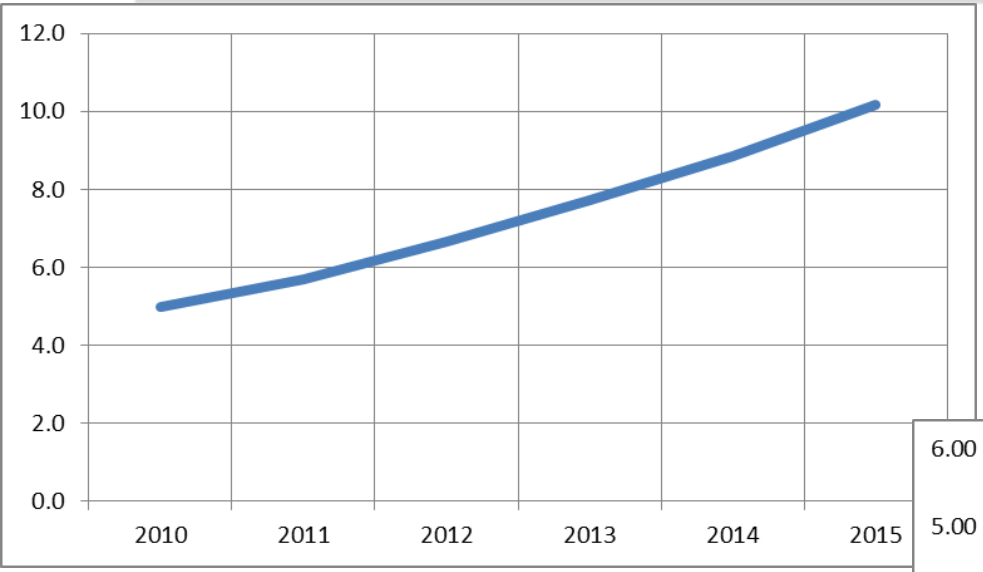
- Building management & investment decisions
- Outsourcing strategies
- Space allocation
- Choice of suppliers
- Implementation of demand response strategies

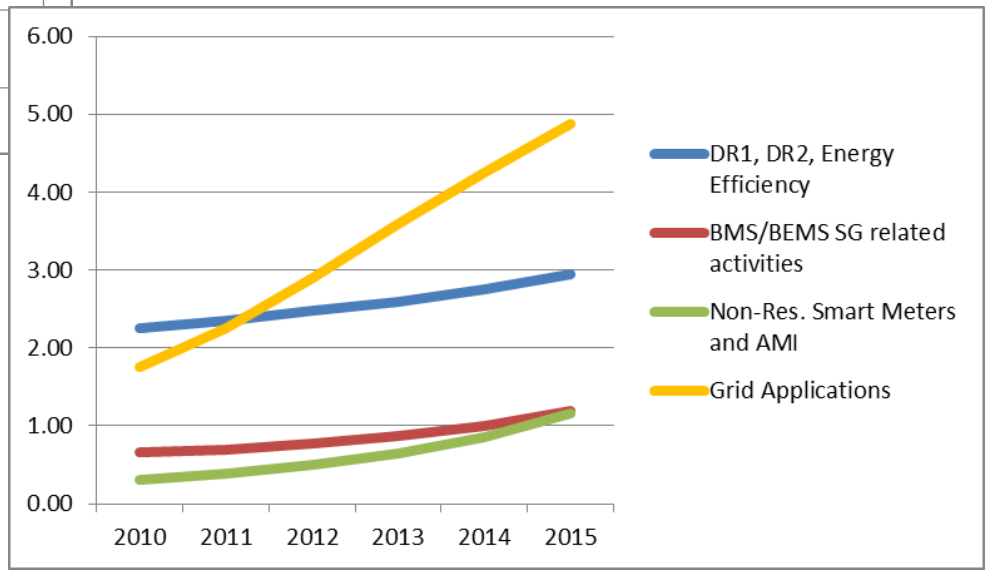
Potential Energy Savings in Non-Residential Buildings



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.

Growth of the Smart Grid Market in North America (US$bn)





Appendices: Table of Contents - Full PowerPoint Presentation

Appendices: CABA Contacts

John Hall
CABA Research Director
Suite 210
1173 Cyrville Road
Ottawa, ON
K1J 7S6

hall@CABA.org
613.686.1814 ext. 227

George Grimes
CABA Business Development Manager
Suite 210
1173 Cyrville Road
Ottawa, ON
K1J 7S6

grimes@CABA.org
613.686.1814 ext. 226

www.CABA.org

http://www.linkedin.com/groups?gid=2121884