

INTRODUCTION TO BUILDING AUTOMATION SYSTEMS



National Science Foundation
Advanced Technological Education Center



Building **E**fficiency for a **S**ustainable **T**omorrow
BEST Center

MODERN BUILDINGS ARE COMPLEX

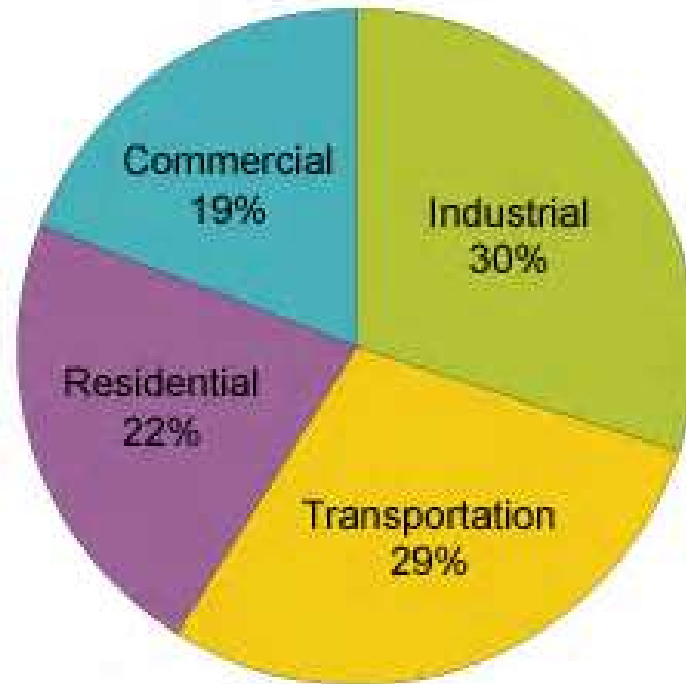
Systems Commonly Found in Buildings

- HVAC Systems
- Lighting Systems
- Security Systems
- Access Control Systems
- Fire Alarm / Life Safety Systems
- Energy Monitoring Systems
- Renewable Energy Systems



BUILDINGS CONSUME ENERGY

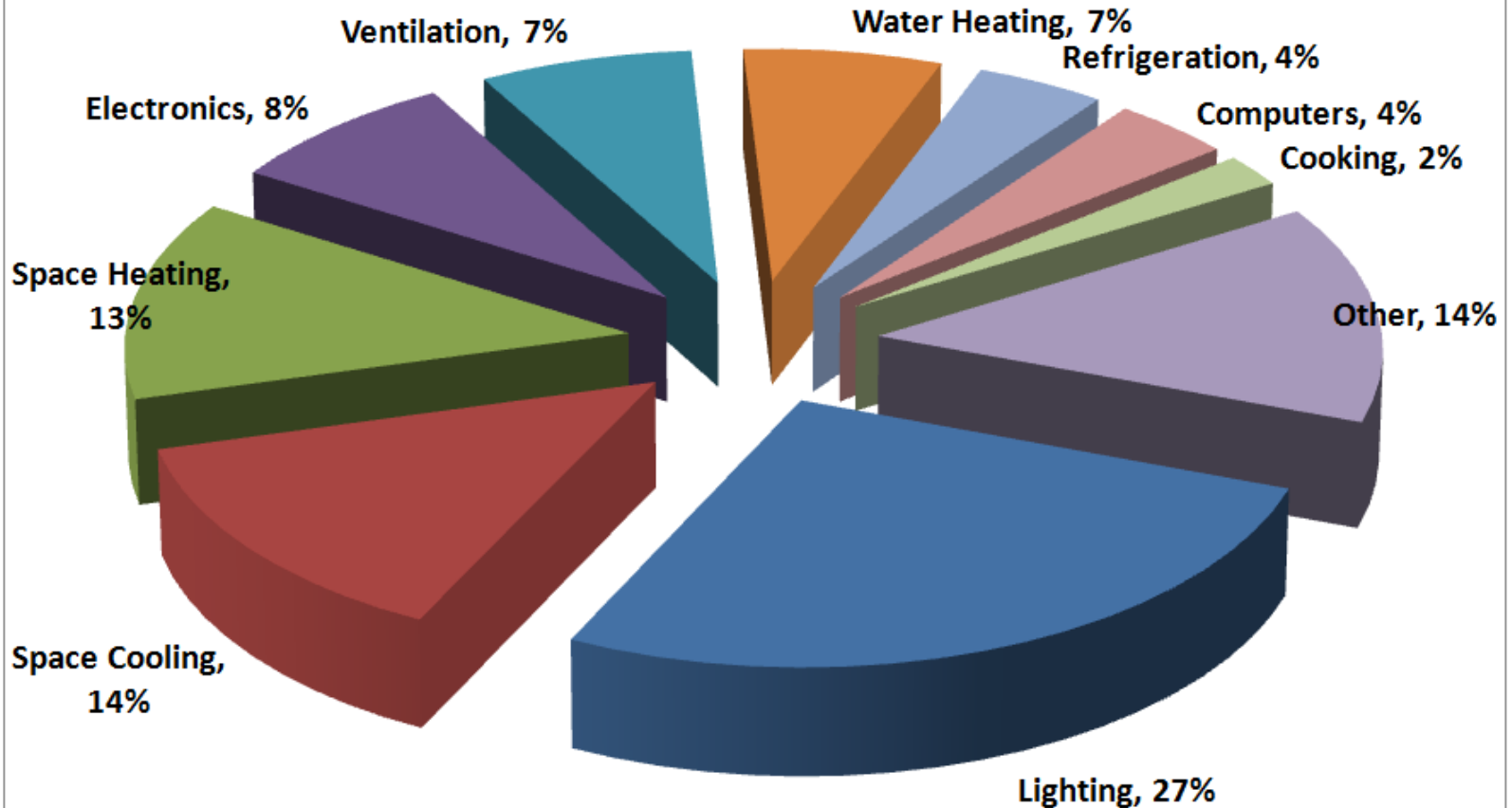
Share of Energy Consumed by Major Sectors of the Economy, 2009



Source: U.S. Energy Information Administration, *Annual Energy Review 2009*.

BUILDINGS CONSUME ENERGY

Commercial Facility Primary Energy Use Splits



Source: 2008 EIA Buildings Energy Data Book

HVAC-related systems consume highest %

BUILDING HVAC SYSTEMS

- Provide heating, cooling, ventilation, air filtration, and humidity control to building spaces
- Respond to varying ambient environmental conditions to maintain building occupant comfort
- Often have complex sequences of operation
- Typically highest energy consumer in building
- Modern building control systems had their roots in controlling HVAC systems

BUILDING CONTROL SYSTEMS

Pneumatics

- Pneumatics is the application of pressurized gases to create mechanical motion of some sort
- Prior to electrical and digital control, pneumatics were the primary means for controlling building HVAC systems
- Very reliable systems if routinely calibrated and if air supply maintained properly
- Difficult to maintain tight control
- Limited system access / Difficult to modify control sequences
- Many existing buildings still have at least some pneumatics

BUILDING CONTROL SYSTEMS

Pneumatic Control Panel



BUILDING CONTROL SYSTEMS

Electric Controls

- Electric controls utilize relays, time delays, clocks, thermostats, actuators, and various other basic electrical devices to maintain building space comfort
- Electric control systems gained popularity in the 1970s and 1980s and began replacing pneumatic control components in buildings
- Less component calibration required
- Tighter control possible
- Easier to modify control sequences

BUILDING CONTROL SYSTEMS

Electric Control Panel



BUILDING CONTROL SYSTEMS

Direct Digital Controls

- Direct Digital Controls is the application of microprocessor-based, networked distributed controllers to make control responses to changing systems parameters
- Less moving parts within the control system
- More accurate control
- Better access to system information / trending capabilities
- Easier to modify control sequences
- Ability to route alarm conditions to multiple locations
- Simple to make scheduling changes

BUILDING CONTROL SYSTEMS

Direct Digital Control Panels



BUILDING CONTROL SYSTEMS

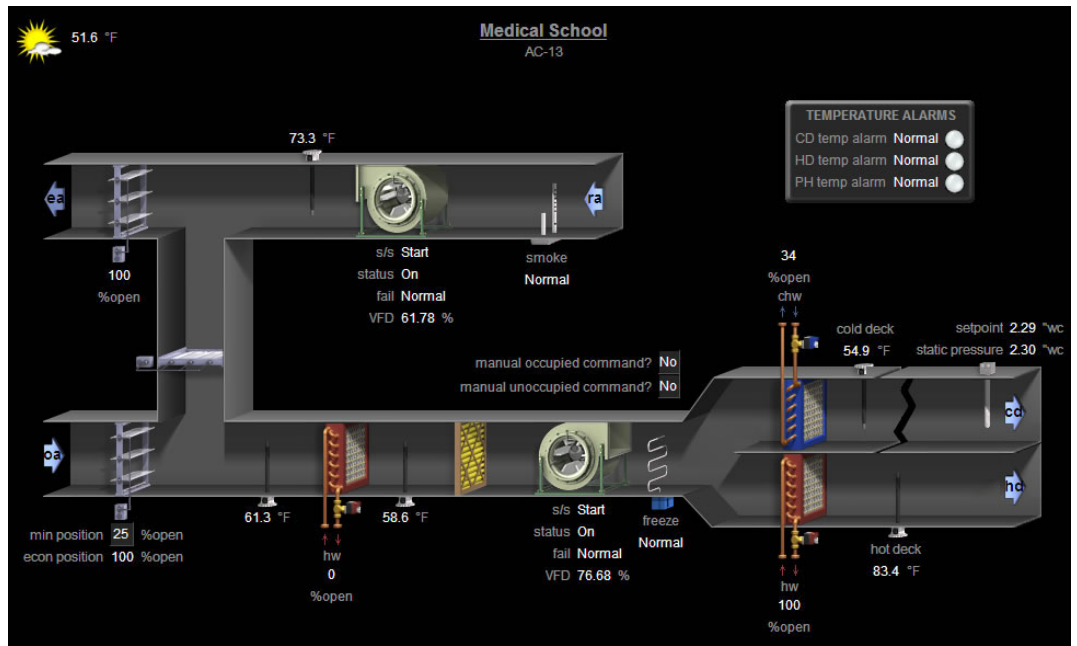
Direct Digital Controls

- The first digital control systems for commercial buildings were developed in the 1960s
- The Honeywell 16 Series was one of the first (pdf packet)
<http://www.building-automation-consultants.com/direct-digital-control-history.html>
- In the late 1980s, DDC systems began gaining wide acceptance in commercial buildings
- The 1990s saw the emergence of standard industry protocols for communication (BACnet / LonWorks)
- In the last 10 years, integration between various manufacturers has intensified (Tridium)

BUILDING CONTROL SYSTEMS

Modern Building Automation Systems

- HVAC / Lighting / Access / Energy Tracking Often Combined
- Integration with fire alarm, security, renewable energy systems
- Integration between equipment manufacturers
- Modern BAS systems serve as the central point of control and monitoring of the facilities' most important and complex systems



BAS INDUSTRY & EMPLOYMENT



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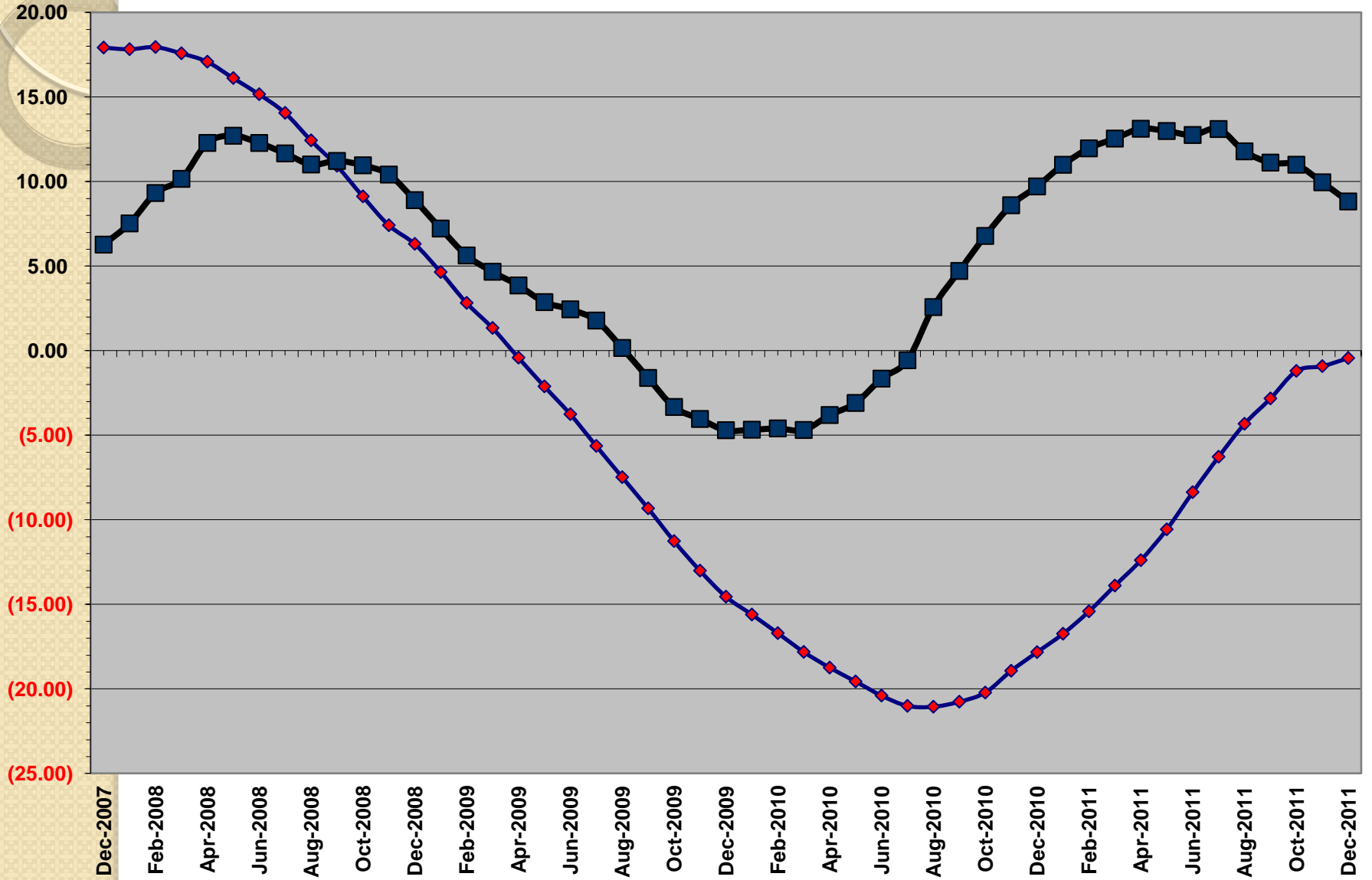


BAS INDUSTRY

-  - Leading supplier to BAS industry
<http://www.kele.com/home.aspx>
- Industry Outlook – Green Jobs? Yes!
- Internal Estimates
 - U.S. Market - \$5 Billion 2012
 - World Market - \$15 Billion 2012
- Recession Resistant
 - 2002 Recession – Plus 1 % vs. Construction Down 15%
 - 2008 Recession – Down 5% vs. Construction Down 23%
 - Forward – Double-Digit Annual Growth, Starting Now

Building Automation Market Growth Versus Non-Residential Construction Growth

◆ US Non-residential Construction
 ■ North American BAS Market



BAS INDUSTRY

Drivers

- **Energy Costs**
- **Environmental Awareness**
 - **LEED / Energy Star / Others**
- **Building Codes**
 - **International Energy Code**
 - **ASHRAE 90.1-2010 / ASHRAE 189.1-2011**

BAS INDUSTRY EMPLOYMENT

Employment

- Demand Matches Industry
- Specialized Construction
- No Labor Economies of Scale
- Too Few Trained People to Hire...