Introduction to Research and Development on Building Management Systems, Diagnostics and Controls

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Presentation Overview

1. Introduction to Existing Technology
2. Overview of Current R&D
3. Barriers and Strategies to Address Gaps to Improve Existing and New Technologie

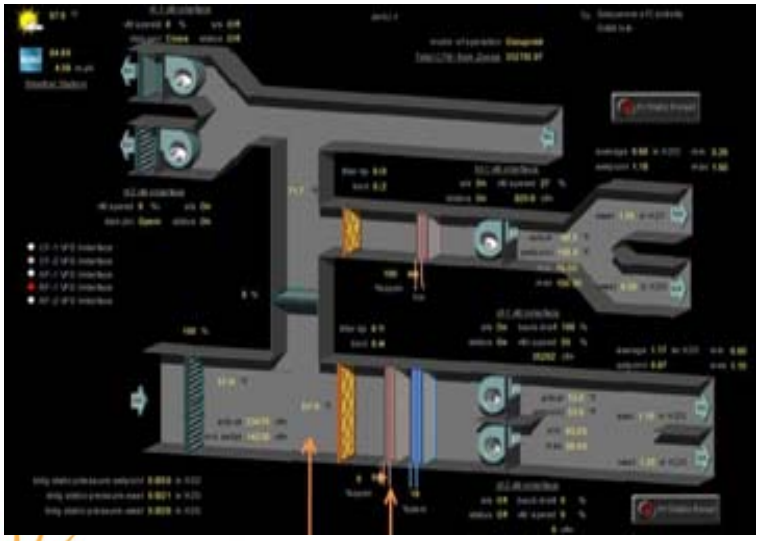
Key Themes for Future

- Improve measurement in building systems
- Develop and deploy integrated energy aware control systems
- Provide actionable information, recommendations
- Automated measurement & verification - performance & savings

1. Existing and Emerging Technology - Building Management Systems, Diagnostics and Controls

Building Management Systems and Controls

- Large systems provide temperature control, schedules, system set points. Integration with fire, life, safety systems. Minimal link to maintenance.
- Medium buildings, simpler systems, less trending capabilities
- New systems emerging for homes. Home Area Networks will link to meters. Communications in home require wireless mesh networks of power line carrier systems.

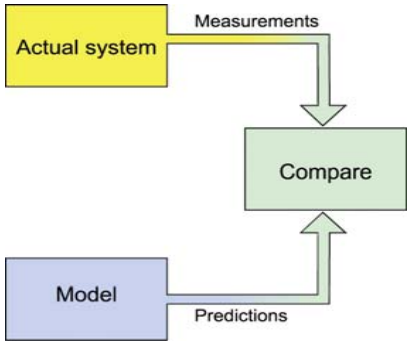


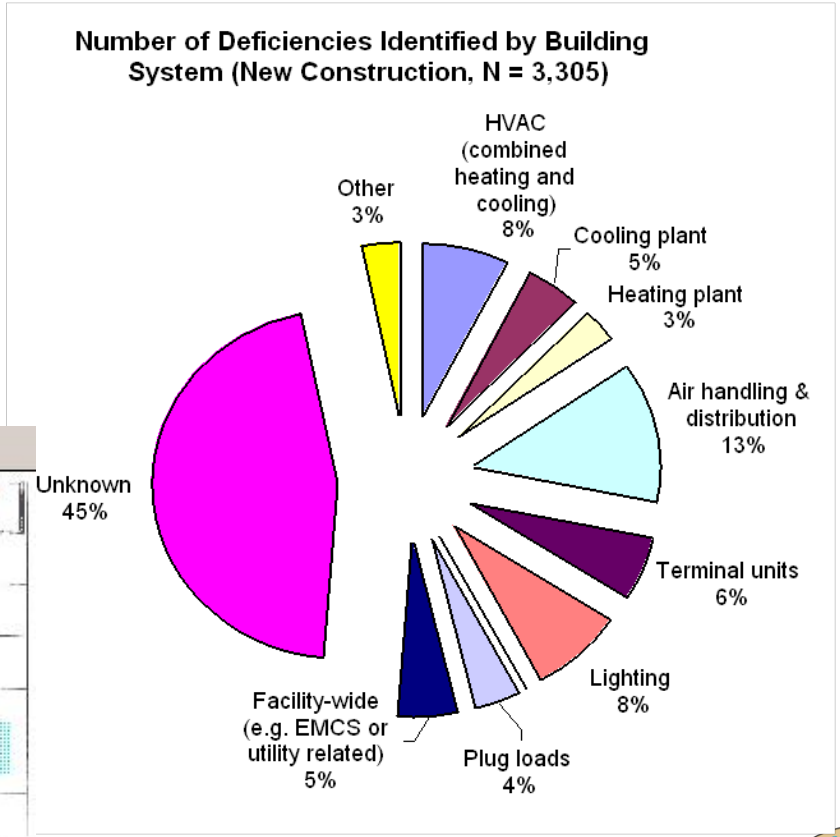
Source: UC Merced Classroom/Office

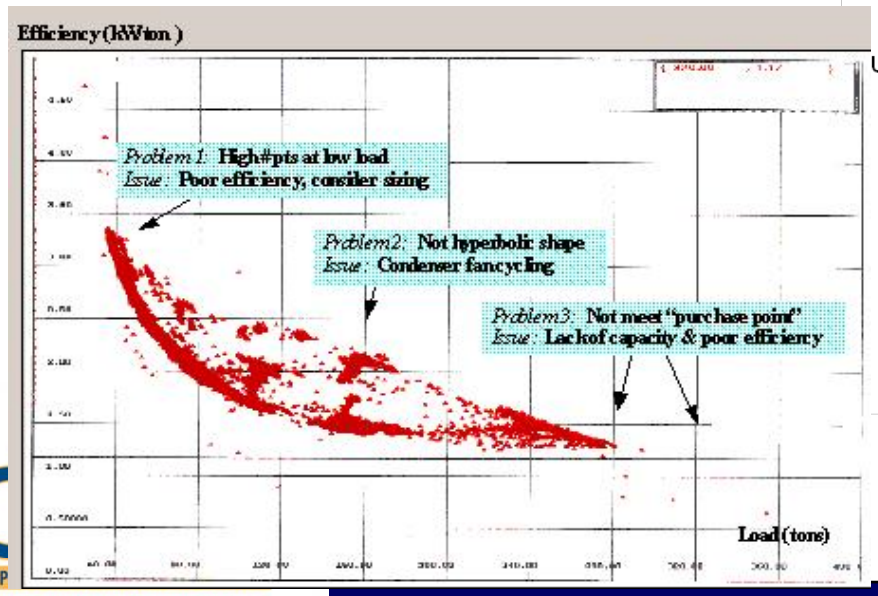
Source: Nest Labs, digital thermostat can be managed remotely to save energy. Many other vendors

1. Existing Technology - Building Management Systems, Diagnostics and Controls

Diagnostics and Commissioning – limited manual methods – no standardized procedures, emerging systems and 3rd party services



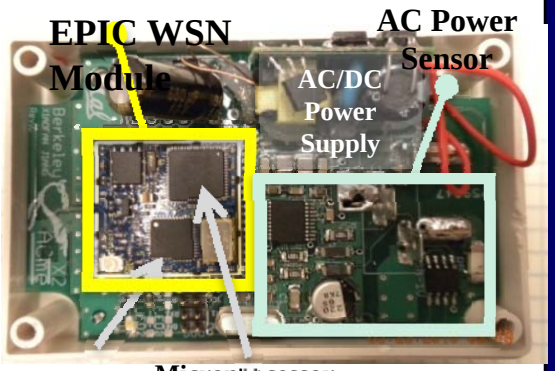


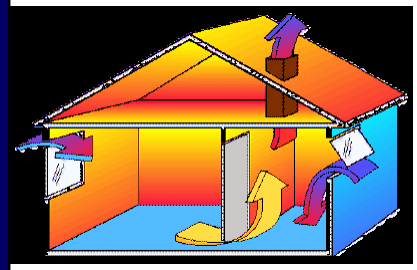


2. Overview of Existing R&D Topics

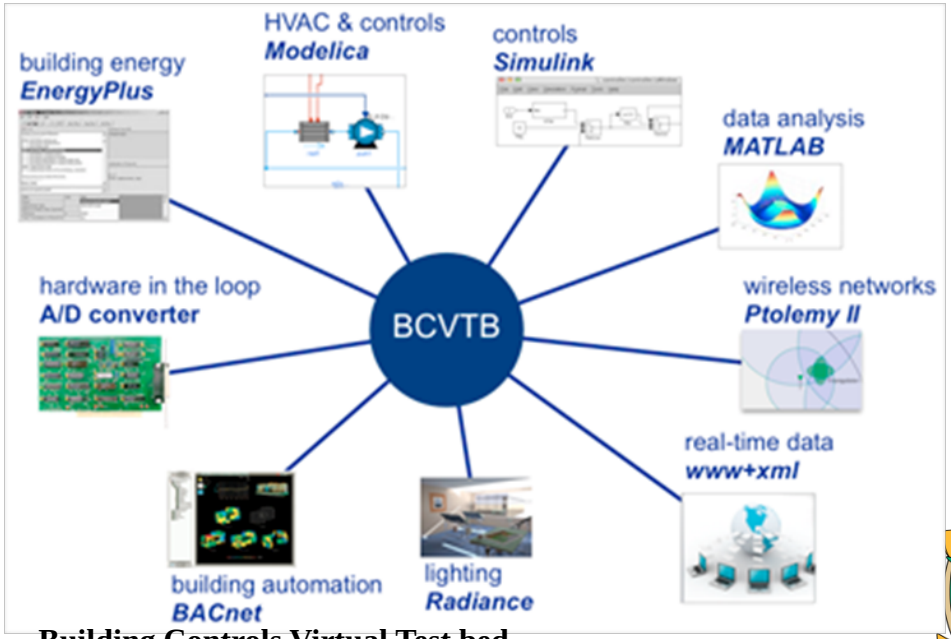
Building Management Systems and Controls

- Wireless sensors and control platforms
- User Interface design
- Model predictive control
- Building Information Models (BIM) and interoperability
- Demand response communications and control
- Sensors for building performance information
  - Energy, air quality, duct leakage, occupancy, flow measurement, etc.





Need to better measure airflow, pollutants, natural ventilation

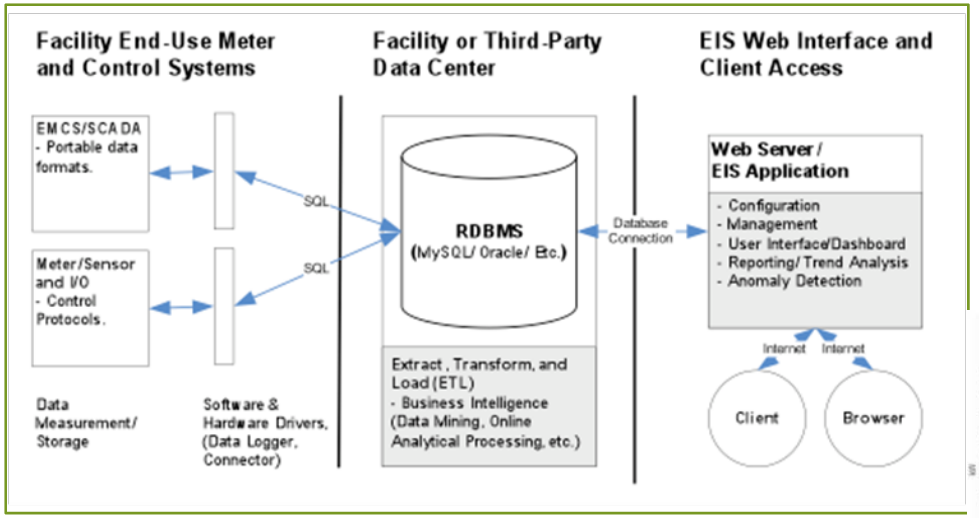


Building Controls Virtual Test bed

2. Overview of Existing R&D Topics

Diagnostics and Commissioning

- Energy Information Systems (EIS)
- Commissions tools, guides, cost effectiveness studies
- Model and Rule Based Fault Detection and Diagnostics
- Air flow, façade performance, HVAC diagnostics, lighting



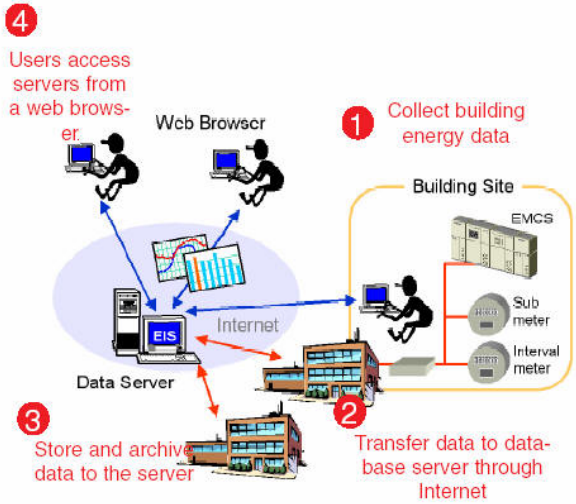
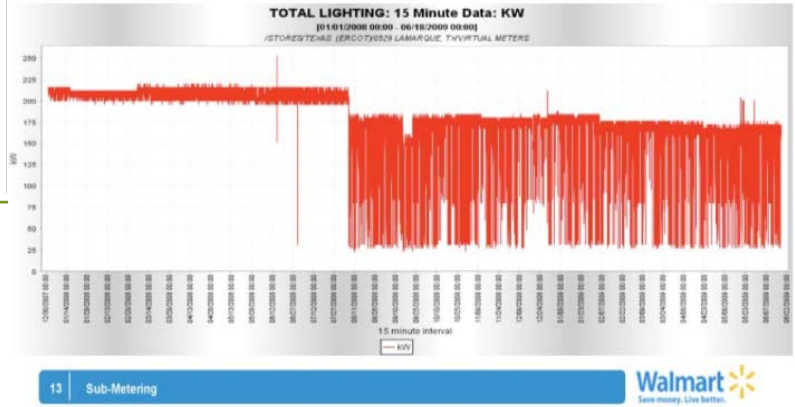
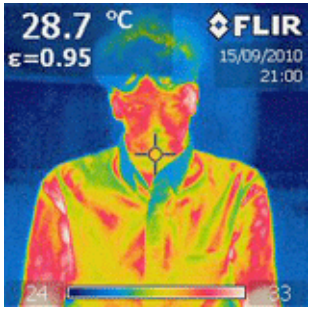


Figure 1. Typical Architecture of EIS



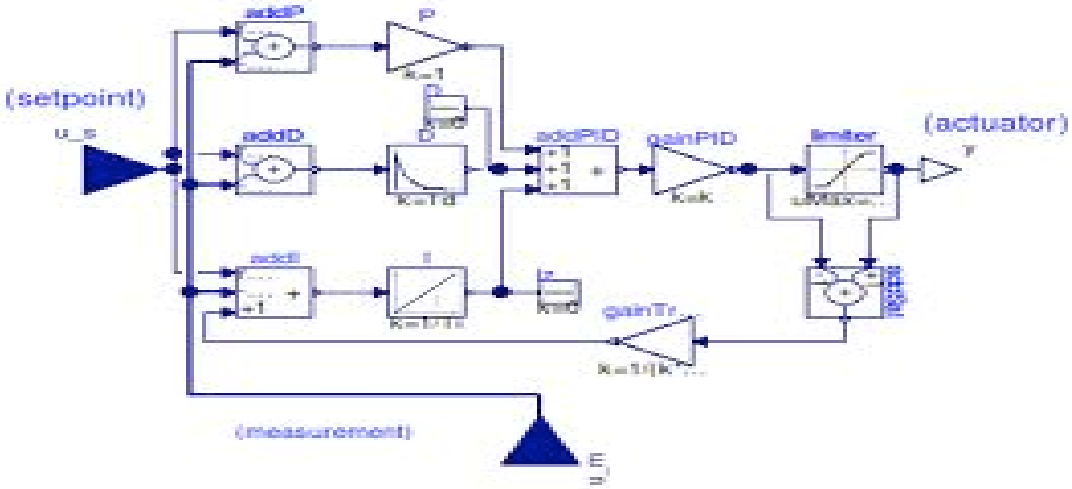
Example of savings from manual diagnostics

3. Barriers and Strategies to Address Gaps to Improve Existing and New Technologies



Need for New Technology

- Task/Ambient distributed control
- Personal environmental control systems
- Low cost, sensing and communications platforms (more measurement)
- High quality data acquisition systems, standard naming conventions
- Use of simulation models for energy-aware control strategies
- Plug and Play interoperability for data models and controls
- Standard rating for controls performance
- Automated commissioning



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"Research Powers the Future"

3. Barriers and Strategies to Address Gaps to Improve Existing and New Technologies

Data → Information → Action

Need to better document building operations

- Equipment performance monitoring to link design and operations
- Transform controls to energy aware performance analysis tools
- End-use data by building type, size, climate, etc.
- Continuous financial feedback

Example of published data on low-energy performance of UC Merced

2007-08 Campus 802,323 gsf *Measured	Benchmark Campus 35% Complex Buildings 2007-08	Campus As Operated* (% of Benchmark) 2007-08	Campus with Best Practice Plant (% of Benchmark) 2007-08
Annual kWh/gsf (including plant)	22.8	14.9 (66%)	14.0 (62%)
Annual kWh/gsf at Building			
Annual ton-hrs/gsf at Building			
Annual Therms/gsf	0.78	0.57 (73%)	0.54 (69%)
Annual Source kBtu/gsf (9,215 SourceBtu/kWh)	287	195 (68%)	183 (64%)
Annual Site kBtu/gsf	155	108 (69%)	101 (65%)

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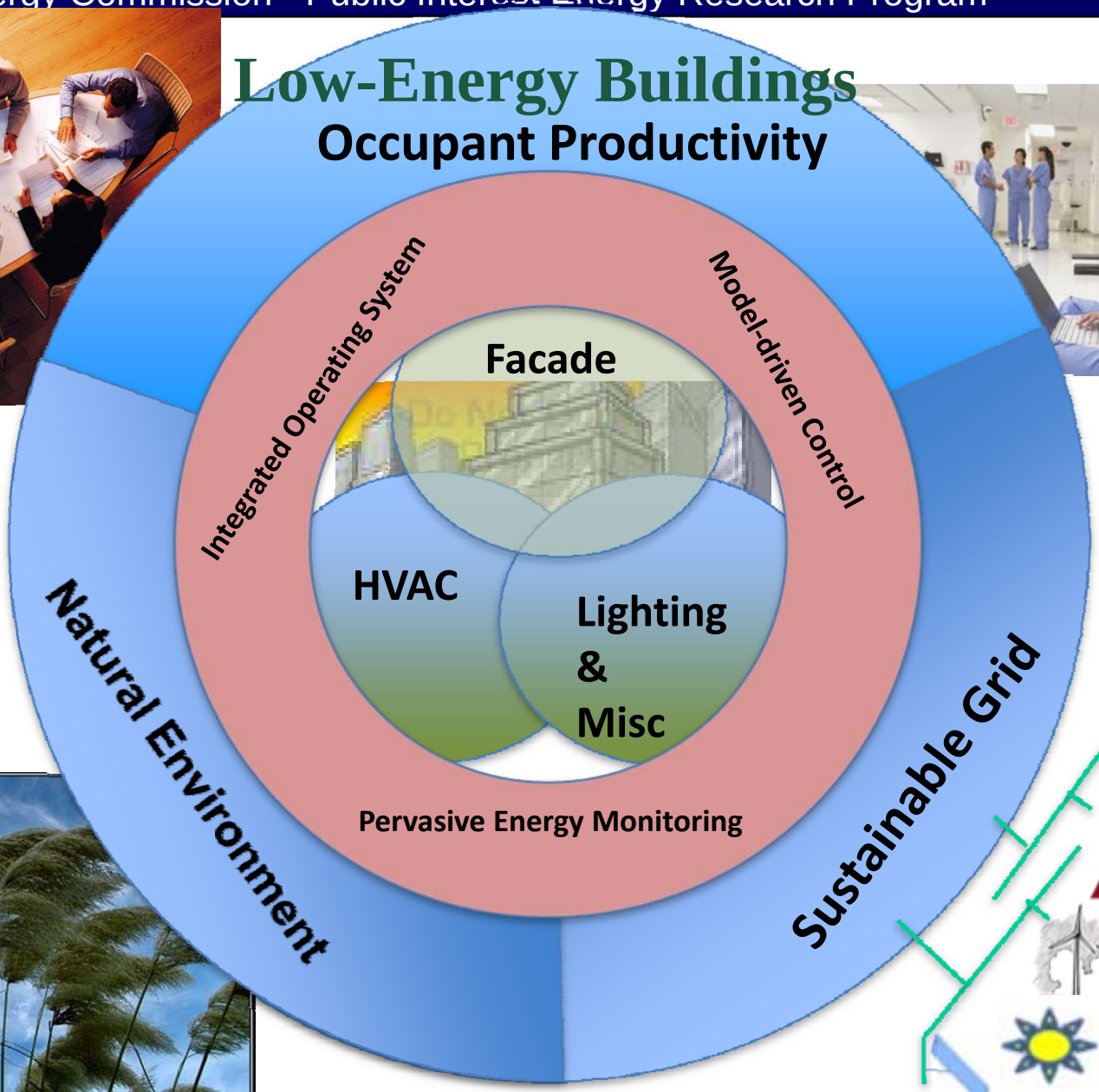
3. Barriers and Strategies to Address Gaps to Improve Existing and New Technologies

Partner with Industry, owners, manufacturers, to establish common targets, demonstrate progress toward goals, e.g:

- ASHRAE, IEEE, USGBC, DOE, Other States
- Performance Measurement Protocols and Standards
- Large firms that want to explore new markets
- Report measurement and verification results

Track Progress

- Need RDD&D program linking long, medium, short term and stock data to ensure actual progress toward NZEB
- Need database of new technologies, new and retrofit sites, costs and benefits

Low-Energy Buildings