

Seminar 30 – Are We There Yet? A Review of the 2010-2018 Research Strategic Plan

2010-2018 ASHRAE Research
Strategic Plan

Learning Objectives

- Describe briefly the development process and goals of the ASHRAE 2010-2018 Research Strategic Plan.
- Explain what current ASHRAE research projects are underway or in development that support the RSP plan.
- Identify goals from the RSP that are currently not being addressed by any projects.
- Present potential research topic areas to encourage a more complete response to the goals of the RSP.

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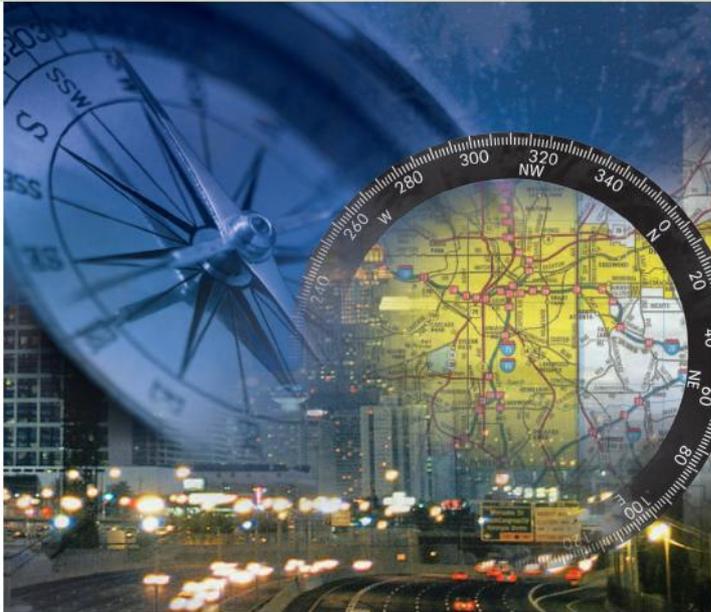
Outline

- History and Process
- Plan

History: 2005-2010 Plan

ASHRAE Research Strategic Plan 2005-2010

Navigation for a Sustainable Future



- Process
 - Invited expert workshops
 - ASHRAE forums
- 30 goals
- Aspirational
- TC reaction



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Process: 2010-2015

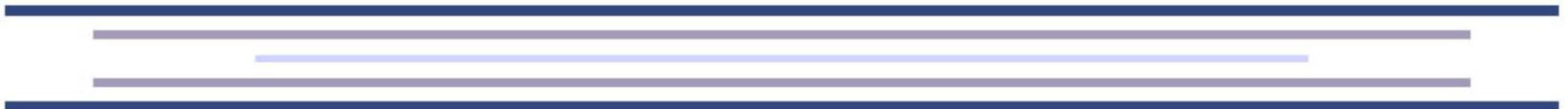
- Research Advisory Panel (RAP) not a “standing” panel
- Appointed by the Research Administration Committee
- Started July 2007
- Finished July 2010

Process: 2010-2015

- Evaluation of previous RSP
- Broad solicitation of input from TCs and ASHRAE Leadership
 - Survey
 - Discussions
- Identification of 11:
 - goal topics
 - goal champions
 - Ad hoc goal development subcommittees

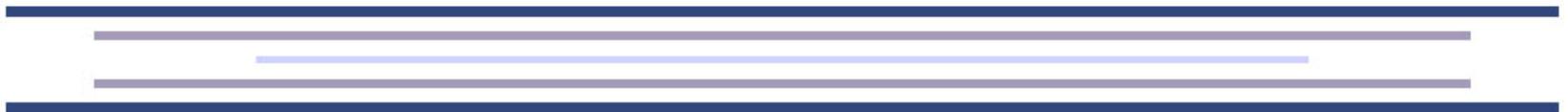
Review of Previous Plan

- We could identify research projects that address goals.
- We couldn't identify goals likely to be met by 2010.
- Lengthy list meant, at best, only a small fraction of goals could really be addressed.
- Lengthy list also suggests that anything not on the list is not suitable for ASHRAE research.
- Many goals so broad or far-reaching that they can only represent aspirations.
- Resulting Question: Should the RSP be a long list of worthwhile aspirations or do we need another format?



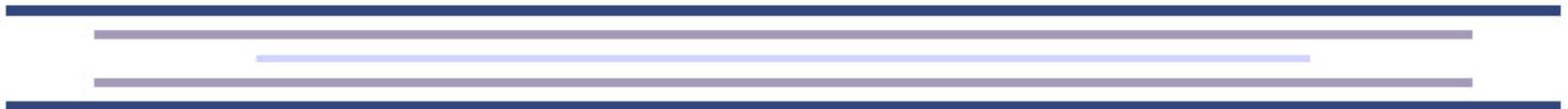
Desirable Characteristics

- Leads to some strategic research.
- Also recognizes that tactical research is important also.
- Recognizes that ASHRAE research is initiated and managed by TCs.
- Provides guidance and motivation for TCs.
- Provides prioritization for RAC.
- Enables strategic, broader-scope, larger \$ multi-TC research projects.

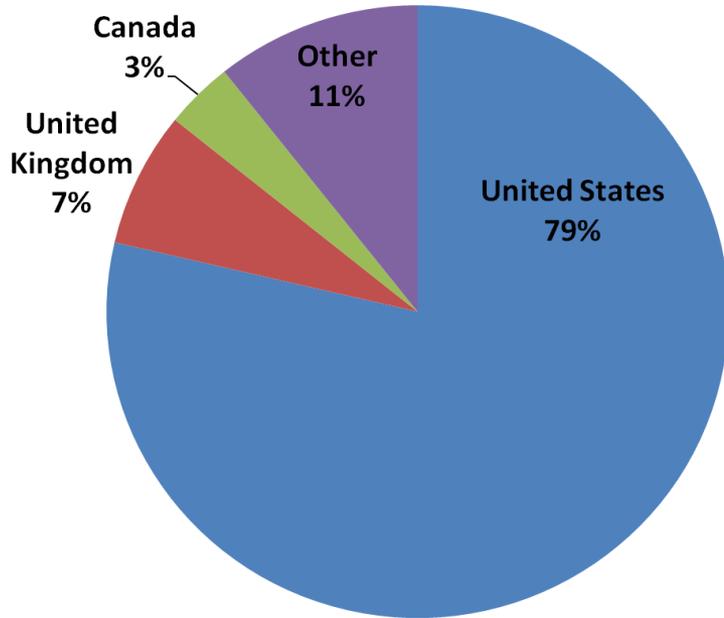


Member Survey: Respondents

- 388 respondents
- 187 TCs/TGs/TRG members, representing 100 of the 103 TCs/TGs/TRGs
- 80 SSPC, SGPC, SPC or GPC members
- 53 Chapter officers
- 85 BOD, Council, Society Committee

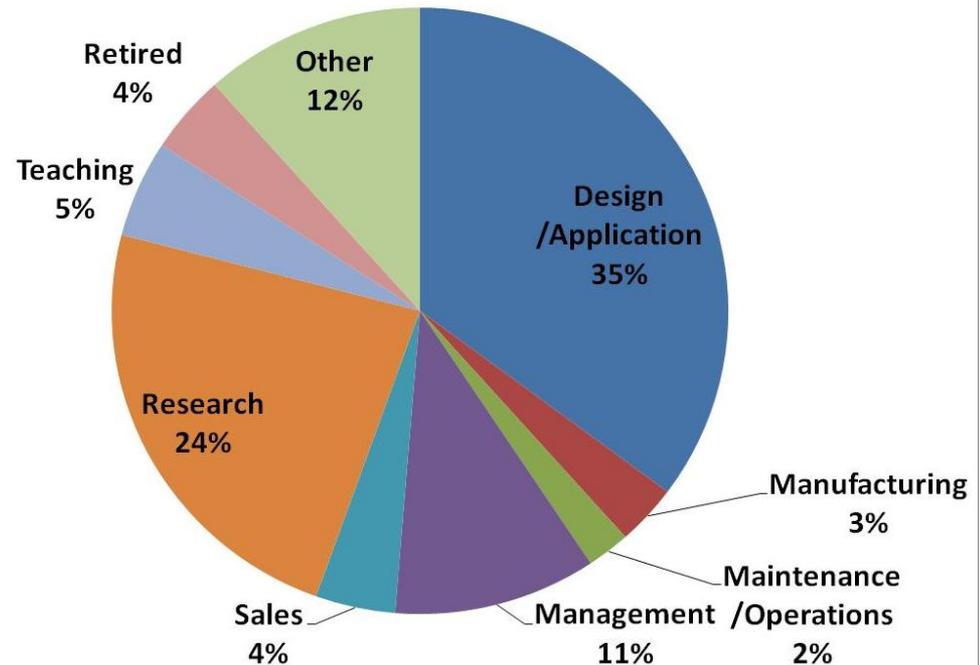


Member Survey: Respondents

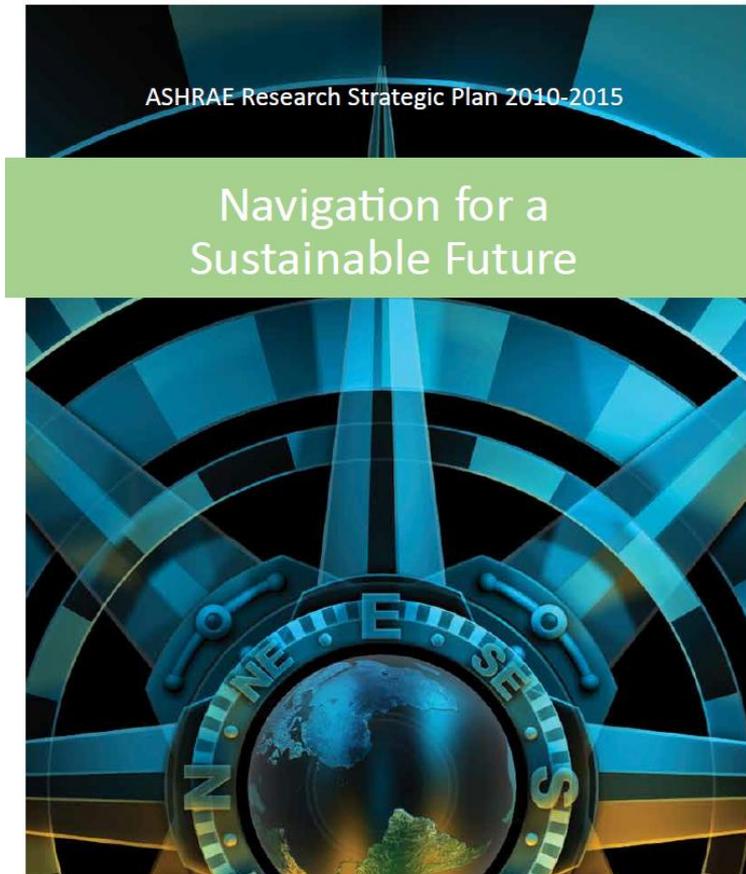


← By location

By Job Function →



2010-2015 RSP



- 11 Goals
- Every goal:
 - Goal statement
 - Technical Challenges
 - Needed research



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2010-2015 RSP Goals

1. Maximize actual operational energy performance
2. Progress toward cost-effective net-zero-energy (NZE) buildings.
3. To reduce significantly the energy consumption in existing homes.

2010-2015 RSP Goals

4. Impact of indoor environmental quality (IEQ) on work performance, health symptoms and perceived environmental quality in offices.
5. Support the development of ASHRAE energy standards and reduce effort required to demonstrate compliance.

2010-2015 RSP Goals

6. Building Information Modeling of energy efficient, high performing buildings.
7. Support development of tools, procedures and methods suitable for designing low-energy buildings.
8. Facilitate use and low global warming potential (GWP) refrigerants; reduce charge.

2010-2015 RSP Goals

9. Improved HVAC&R components.
10. Improved engineering and architectural education.
11. Understand influences of HVAC&R on airborne pathogen transmission in public spaces and develop effective control strategies.

Conclusions

- Broad consensus approach –
 - Advantages
 - Disadvantages
- Success?

Questions?

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Seminar 32 – Are we there yet? – A review of the 2010-2018 Research Strategic Plan (RSP)

Research Supporting 2010-2018
RSP and Goals not Addressed yet

2013 Annual Conference, Denver, Colorado

Learning Objectives

- 1. Describe briefly the development process and goals of the ASHRAE 2010-2018 Research Strategic Plan.
- 2. Explain what current ASHRAE research projects are underway or in development that support the RSP plan.
- 3. Identify goals from the RSP that are currently not being addressed by any projects.
- 4. Present potential research topic areas to encourage a more complete response to the goals of the RSP.

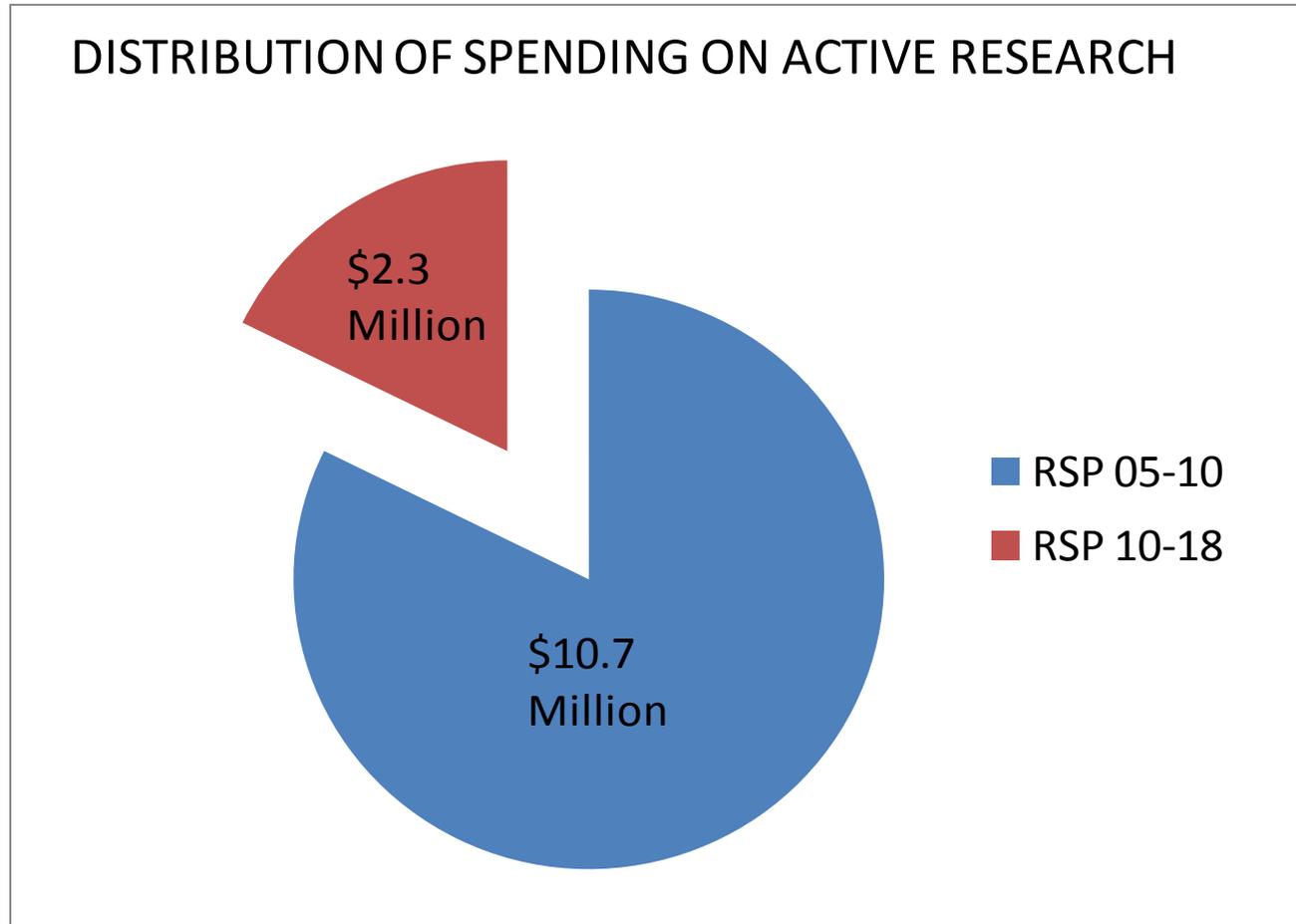
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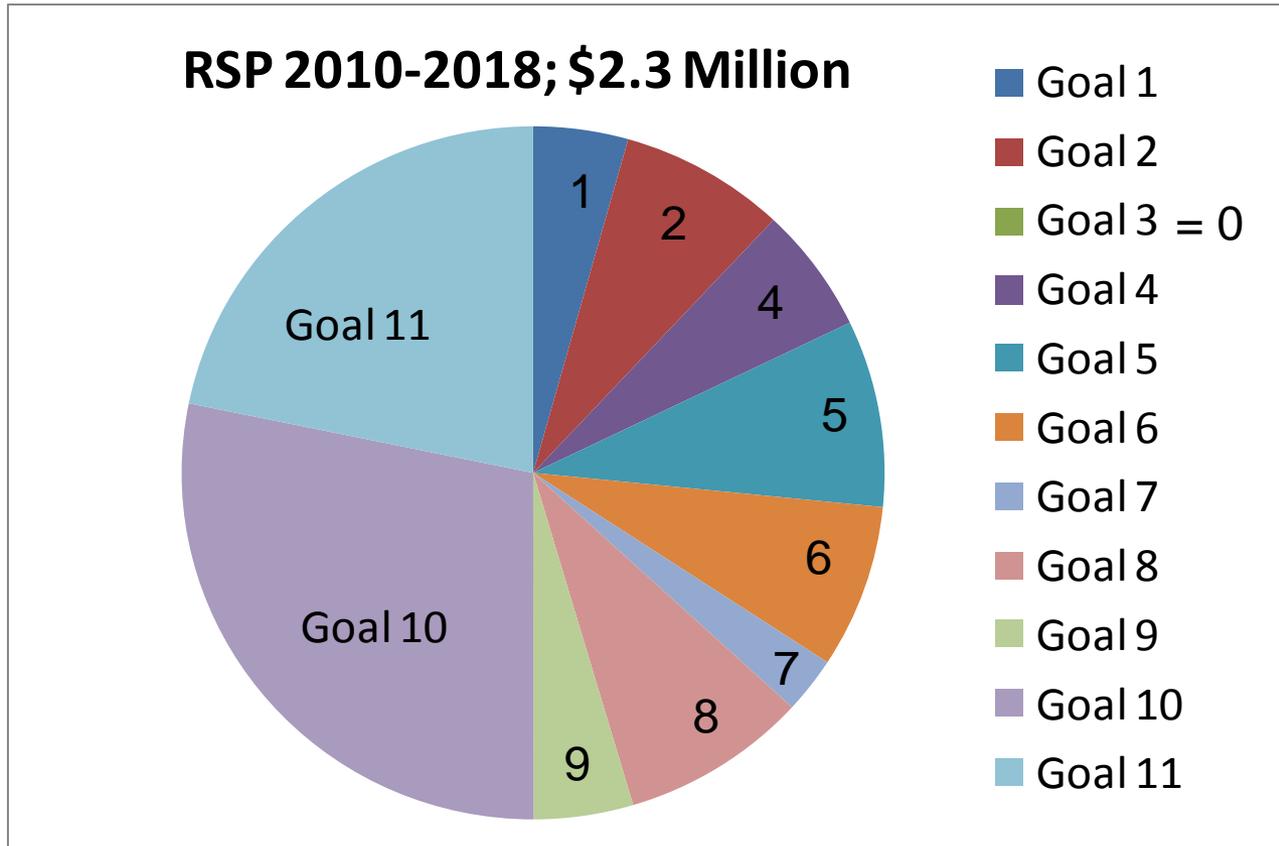
Outline/Agenda

- Goal 1 & 3 – Maximize Building Energy Performance
- Goal 2 & 7 – Advanced Design Guides & Tools
- Goal 4 – Understand the Impact of IEQ on Occupants
- Goal 5 – Improved Energy Standards
- Goal 6 – Facilitate the Use of BIM in Design
- Goal 8 – Promote use of Natural & low GWP refrigerants
- Goal 9 – Improved HVAC&R Components
- Goal 10 – Engineering & Architectural Education
- Goal 11 – HVAC&R & Airborne Pathogens

Current Funding Comparison between Plans



Current Funding Comparison between Goals



Goal 1 & 3 – Maximize Actual Building Energy Performance

Active Research:

- **1646-RP**, *“Measurements of Pipe Insulation Thermal Conductivity”*

Research in Development:

- **1615-WS**, *“Fault Detection and Diagnostic (FDD) Methods for Supermarkets”*
- **1639-RTAR**, *“Comparative Lab and Field Evaluation of Building Pressure Control Methods”*
- **1640-WS**, *“Hot Water Use in Office Buildings,”*
- **1649-RTAR**, *“IAQ and Energy Implications of High Efficiency Filters in Residential Buildings”*
- **1671-WS**, *“Real-Time Optimal Distributed Control of Building Energy Systems”*
- **1697-RTAR**, *“Reduce Simultaneous Heating and Cooling in Commercial Buildings”*

Goal 1 & 3 – Maximize Actual Building Energy Performance

Additional Project Topics for Consideration

- Energy savings and other benefits of pro-active maintenance
- Integrated space conditioning and water heating appliances & systems (electric and fossil paths).

Active Research Project Funding Committed so far to Goals 1 & 3

Goal 1: \$100,000

Goal 3: \$0

Goal 2 & 7 – Advanced Design Guides & Tools

Active Research:

- **1604-RP**, “*Demand Controlled Filtration for Cleanrooms*”

Research in Development:

- **1627-WS**, “*An Evaluation of the Actual Energy Performance of Small Office and K-12 School Buildings Designed in Accordance with 30% ASHRAE Advanced Energy Design Guides*”
- **1635-WS**, “*Simplified Procedure for Calculating Exhaust Intake Separation Distances*”
- **1666-RTAR**, “*Experimental Evaluation of the Thermal and Ventilation Performance of Stratified Air Distribution Systems Coupled with Passive Chilled Beams*”
- **1681-RTAR**, “*Low Energy Lighting Heat Gain Distribution in Buildings*”

Goal 2 & 7 – Advanced Design Guides & Tools

Additional Project Topics for Consideration

- Design methodologies for Solar-thermal cooling, heating and dehumidification technologies and their integration with other building systems
- Models and design procedures for natural and hybrid ventilation systems.
- Improve whole building simulation tools to simultaneously analyze energy consumption, thermal comfort, visual comfort, indoor air quality and other performance metrics.

Active Research Project Funding Committed so far to Goals 2 & 7

Goal 2: \$175,000

Goal 7: \$60,000

Goal 4 – Understand the Impact of IEQ on Occupants

Active Research:

- **1491-RP**, “*Literature and Product Review and Cost Benefit Analysis of Commercially Available Ozone Air Cleaning for HVAC Systems*”

Research in Development:

- **1450-TRP**, “*Transport of Contaminants from Garages Attached or Integral to Low-Rise Residential Buildings*”
- **1624-WS**, “*Effective Energy Efficient School Classroom Ventilation for Temperate Zones*”
- **1630-RTAR**, “*Update the Scientific Evidence for Specifying Lower Limit Relative Humidity Levels for Comfort, Health, and IEQ in Occupied Spaces*”
- **1631-TRP**, “*Countertop Commercial Appliance Emissions*”
- **1663-WS**, “*Residential IAQ Guide*”

Goal 4 – Understand the Impact of IEQ on Occupants

Additional Project Topics for Consideration

- Effects of OA ventilation rates
- Thermal comfort conditions
- Gas- & particle- phase air cleaning
- Indoor sound levels
- Effects on health and performance

Active Research Project Funding Committed so far to Goal 4: \$135,000

Goal 5 – Improved Energy Standards

Active Research:

- **1651-RP**, “*Development of Maximum Technically Achievable Energy Targets for Commercial Buildings (Ultra Low Energy Use Building Set)*”

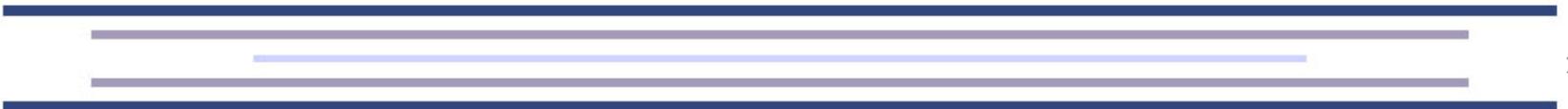
Research in Development:

None

Additional Project Topics for Consideration

- Develop prototype energy models of common building types and batch processing tools that allow quick energy savings estimates over multiple climate zones, occupancy types, etc.
- Develop updated first cost databases of envelope, lighting, and mechanical systems and equipment for use by SSPC 90.1 and 90.2 in life cycle cost analyses.

Active Research Project Funding Committed so far to Goal 4: \$200,000



Goal 6 – Facilitate the Use of BIM in Design

Active Research:

- **1468-RP**, “*Development of Reference Building Information Model (BIM) for Thermal Model Compliance Testing*”

Research in Development:

- **1609-TRP**, “*Defining the Capabilities, Needs and Current Limitations of Building Information Modeling (BIM) in Operations and Maintenance for HVAC&R*”

Additional Project Topics for Consideration

- Develop data exchange protocols for HVAC&R information that are consistent with the standards and protocols being adopted by architectural and structural engineers.
- Produce guidance on the deployment of BIM processes and tools, and on the information exchange requirements for HVAC&R related information, within a broader BIM environment.

Active Research Project Funding Committed so far to Goal 6: \$175,000

Goal 8 – Promote use of Natural & low GWP Refrigerants

Active Research:

- **1410-RP**, “*Effect of System Chemical Toward the Breakdown of Lubricants and Refrigerants*”
- **1507-RP**, “*Binary Refrigerant Flame Boundary Concentrations*”

Research in Development:

- **1641-TRP**, “*Effect of Unsaturated Fluorocarbon Contaminants on the Reliability and Performance of HVAC&R Equipment*”

Additional Project Topics for Consideration

- Assess “real” system performance of various natural and low GWP synthetic refrigerants, and identify design optimizations based on results.
- Research nano-technology and smart exchangers.
- Determine what types of applications can use flammable or toxic refrigerants safely and what system modifications could be made to improve safety.

Active Research Project Funding Committed so far to Goal 8: \$197,000

Goal 9 – Improved HVAC&R Components

Active Research:

- **1665-RP**, “*R-40 Stability with HVAC&R System Materials*”

Research in Development:

- **1629-TRP**, “*Testing and Modeling Energy Performance of Active Chilled Beam Systems*”
- **1642-WS**, “*Improved Compressor Performance Modeling Methodology for Use in System Simulation Programs*”
- **1645-TRP**, “*Development of New Accelerated Corrosion Tests for all Aluminum Micro-Channel and Tube and Fin Heat Exchangers*”
- **1653-RTAR**, “*Quantify the Degradation of Critical HVAC Components and Materials Exposed to UVC Levels Typically Used in HVAC Systems*”

Goal 9 – Improved HVAC&R Components

Additional Project Topics for Consideration

- Identify ways to push the heat exchanger efficiency envelope.
- Improve fan efficiency by identifying and eliminating adverse systems effects which directly impact their performance.

Active Research Project Funding Committed so far to Goal 9: \$105,000

Goal 10 – Engineering and Architectural Education

Active Research:

- **1616-RP**, *Revise Load Calculation Application Manual*
- **1634-RP**, *“Guide for Sustainable Refrigerated Facilities and Refrigeration Systems”*
- **1674-RP**, *“Research to Support the Revision to Ground Source Heat Pumps: Design of Geothermal Systems for Commercial and Institutional Buildings (ASHRAE, 1997)”*

Research in Development:

- **1673-WS**, *“Revision of the ASHRAE HVAC Design Guide for Tall Commercial Buildings”*

Additional Project Topics for Consideration

- Develop curriculum resource materials on net-zero design

Active Research Project Funding Committed so far to Goal 10:

\$648,000

Goal 11 – HVAC&R & Airborne Pathogens

Active Research:

- **1603-RP**, “*Role of HVAC Systems in the Transmission of Infectious Agents in Buildings and Intermodal Transportation*”

Research in Development:

- **1669-RTAR**, “*Measurements of the Response of Cooling Coils to Ultraviolet Radiation for Improved Ultraviolet Germicidal Irradiation Modeling*”

Additional Project Topics for Consideration

- Engineering data is needed to specify minimum ventilation rates, humidity limits, air purification and other HVAC&R parameters to prevent airborne pathogen transmission in high risk building and transportation environments.

Active Research Project Funding Committed so far to Goal 11:

\$500,000

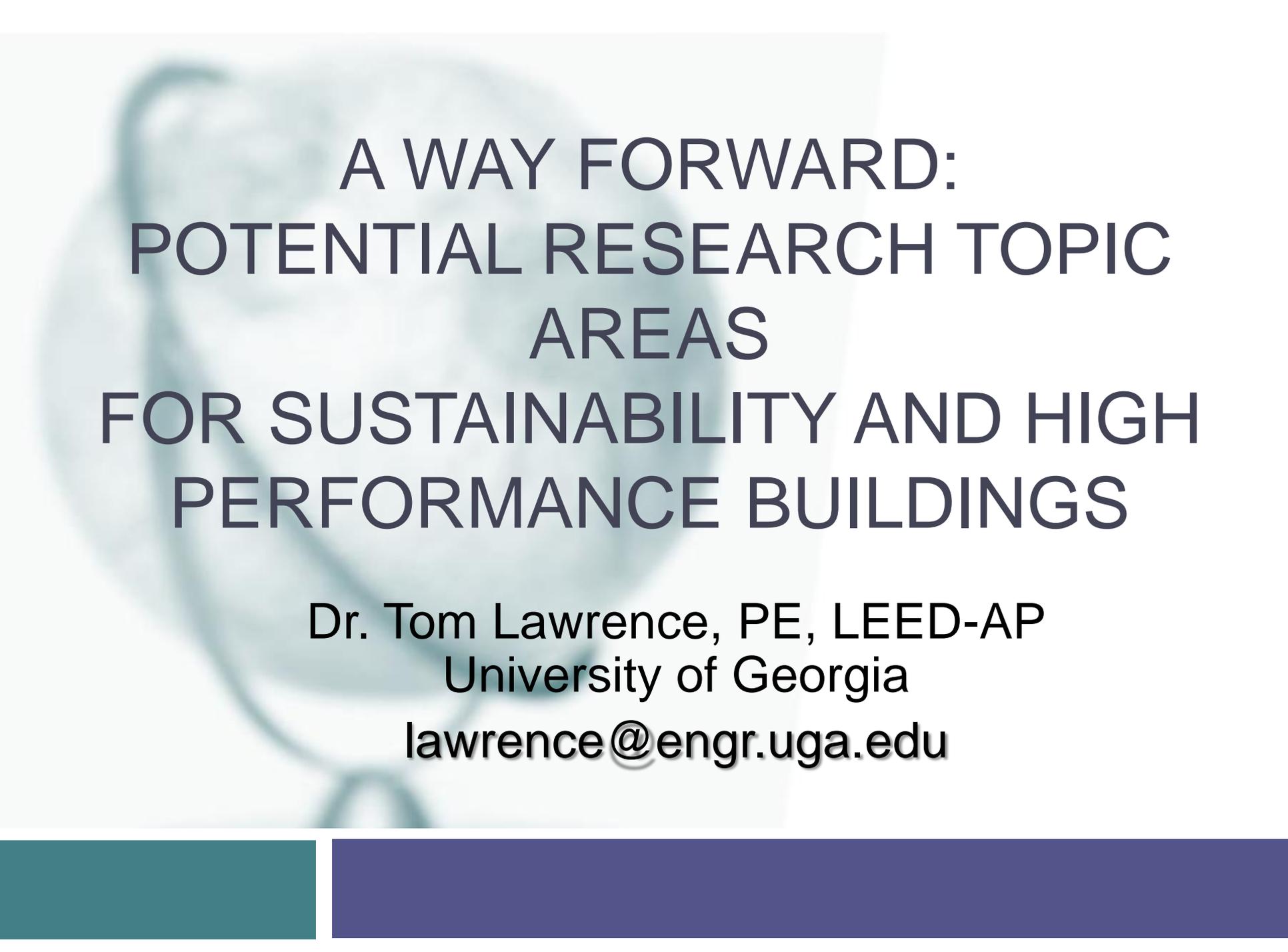
Bibliography

- Research Page - Strategic plan, Implementation Plan, RFPs posted for bid, bidders listserv, proposal instructions, projects underway, procedures & forms, completed research, RAC, and research awards & grants

www.ashrae.org/research

Questions?

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A WAY FORWARD: POTENTIAL RESEARCH TOPIC AREAS FOR SUSTAINABILITY AND HIGH PERFORMANCE BUILDINGS

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Background and Purpose

- “Not enough research topics have been put forth in the area of sustainability and high performance buildings” - ASHRAE Research Administration Committee (RAC)
- In particular, targeted some TCs:
 - TC 2.8 – Buildings Environmental Impacts and Sustainability
 - TC 6.7 – Solar Energy Utilization
 - TC 6.9 – Thermal Storage
- Unsolicited research projects underutilized

***To set the stage, the next two slides are from:
"The Basics of High Performance Building Design" ALI Course***

What is a High-Performance Green Building, Anyway?

- Low energy consumption? (Net-Zero?!)
- Low water consumption?
- High return on investment for the owner?
- “Performance” of the occupants?
- The building’s impact on the surrounding locality (performance of its’ “neighbors”)?
- Smooth operations and maintenance?
- Does it make the cover of *High-Performing Buildings* magazine?

What is a High-Performance Green Building, Anyway?

- *'High-performance building' means a building that integrates and optimizes on a life cycle basis all major high performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.*

Energy Independence and Security Act, 2007

A Blank Slate ...? Topics Covered

From survey of my colleagues (and personal opinion):

- High Performance is not just a “Net-Zero Energy Building”
- Life is complicated: Complex interactions
- Performance versus promise
- Think outside the ASHRAE box

Disclaimer: The following presentation is representative of topics for consideration. It does not represent the full, complete set of potential research topic ideas.

High-Performance Not Just NZEB

- How to maintain “Environmental Health in Low Energy Buildings”? (theme of ASHRAE IAQ 2013)
 - The saga of ventilation requirements in ASHRAE Standards, LEED, etc.
 - Can a building be “sick” in and of itself?

High-Performance Not Just NZEB

- Water consumption, modeling
 - Similar to a building energy simulation model
 - For use to verify compliance with a future ASHRAE Standard 191 (Baseline and As-Designed case comparison)
- Compliance checking software for energy and Standard 189.1

Topics

From survey of my colleagues (and personal opinion):

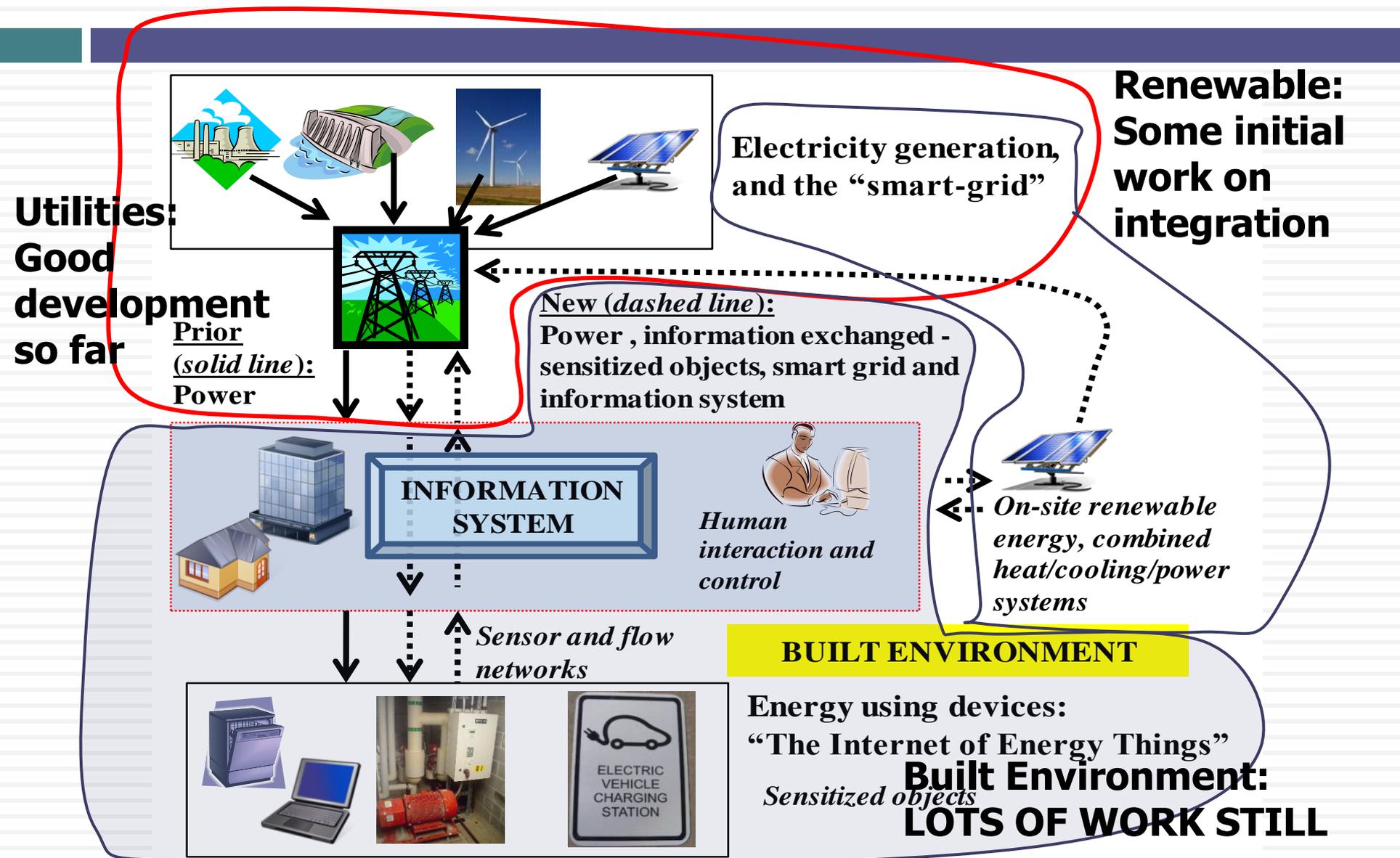
- High Performance is not just a “Net-Zero Energy Building”
- **Life is complicated: Complex interactions**
- Performance versus promise
- Think outside the ASHRAE box

Demand Response in Building Codes

- ASHRAE Standard 189.1 (Design of High-Performance Green Buildings)
 - Automatic systems capable of reducing peak demand by at least 10%
 - Standby generator does not count
- International Green Construction Code (IgCC)
 - Automated demand response infrastructure via building energy management system to incorporate preprogrammed demand response strategies

If selected by the jurisdiction,

The Grand Challenge



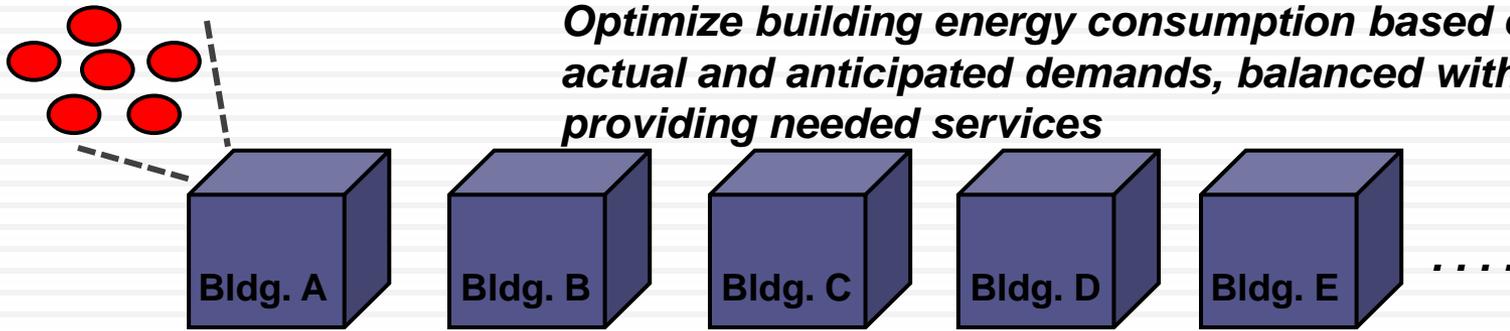
Building Electricity Demand Response and the Smart Grid

Individual pieces of equipment:

- 1. Fault detection and diagnostics*
- 2. Controlled by building systems*

Equipment Level

Optimize building energy consumption based on actual and anticipated demands, balanced with providing needed services



On-site renewable energy, combined heat/cooling/power systems

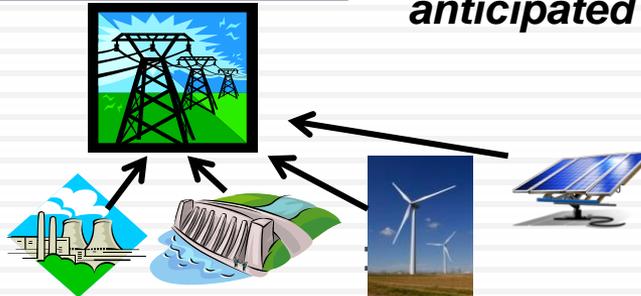
Central energy supplier system (electrical grid, chilled water, steam)

Building Level

Optimized operation of energy supply systems based on actual and anticipated demands

Campus or Utility Level

Electricity generation, and the “smart-grid”



Interaction of Buildings and District Energy Systems

- Thermal storage potential of chilled water district energy systems (for demand reduction)

The concept of “Fratricide”

- Definition:
“the act of a person killing his or her brother.”
or a “friendly fire” incident
- Chemical emissions from one class of building materials damaging other materials or systems in a building
 - Chinese drywall damage to appliances, wiring, plumbing
 - Formicary corrosion from adhesives in fabricated wood products (“ants nest” corrosion)
 - Wood preservatives? Spray foam?

Topics

From survey of my colleagues (and personal opinion):

- High Performance is not just a “Net-Zero Energy Building”
- Life is complicated: Complex interactions
- **Performance versus promise**
- Think outside the ASHRAE box

Performance versus promise

- In-depth post-occupancy surveys; lessons learned
- Engaging AIA and Architecture 2030 to set consistent EUI targets
- Follow-up from buildings designed to Standard 189.1
 - Which requirements / criteria worked; which didn't?

- 1651-RP, "*Development of Maximum Technically Achievable Energy Targets for Commercial Buildings (Ultra Low Energy Use Building Set)*", Sponsored by: MTG.ET, Energy Targets

A Blank Slate ...?

From survey of my colleagues (and personal opinion):

- High Performance is not just a “Net-Zero Energy Building”
- Life is complicated: Complex interactions
- Performance versus promise
- **Think outside the ASHRAE box**

ASHRAE's Mission

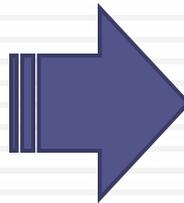


Shaping Tomorrow's
Built Environment Today

- From the ASHRAE Strategic Plan (2011)
Direction 1 ASHRAE will be a leader in advancing sustainable design, construction, and operations for new and existing built environments.

Think Outside the ASHRAE Box

- Topics outside of the traditional lines of research should be considered if we are to truly address high-performance buildings and sustainability



Thank you!

- Comments, questions, concerns, advice ...

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