Controls Section 2

- Controls Design Selection Process
  - *Who chooses what and why*
- User Experience
  - *Responses from operators and occupants on their experience with controls*
- Energy Findings
  - *Actual and estimated savings for the building and the systems due to controls*

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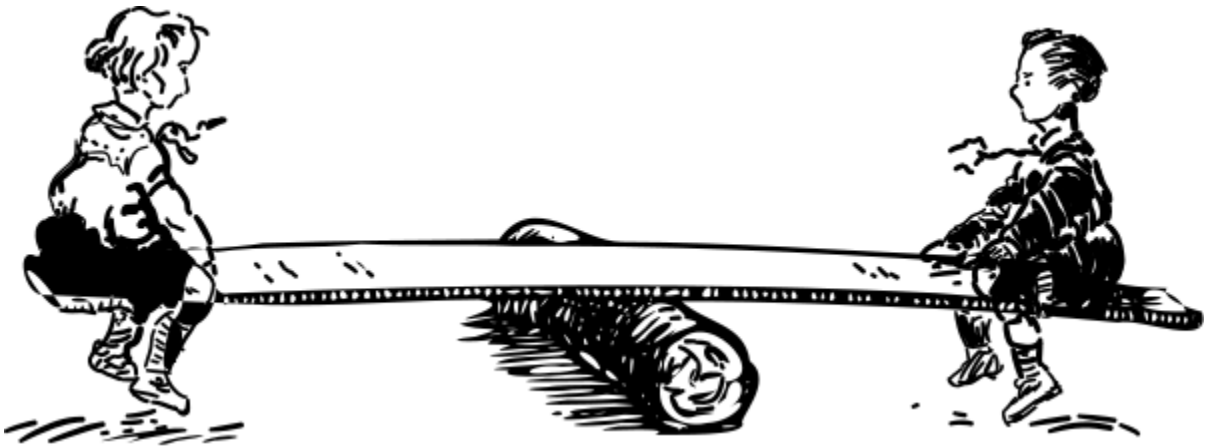
Controls Design Selection Process:

Designing a successful control system is a balancing act

- Rigid execution of design intent
- Thorough documentation and specifications
- Detailed sequence of operations
- Flexibility in implementation
- Flexibility in operation



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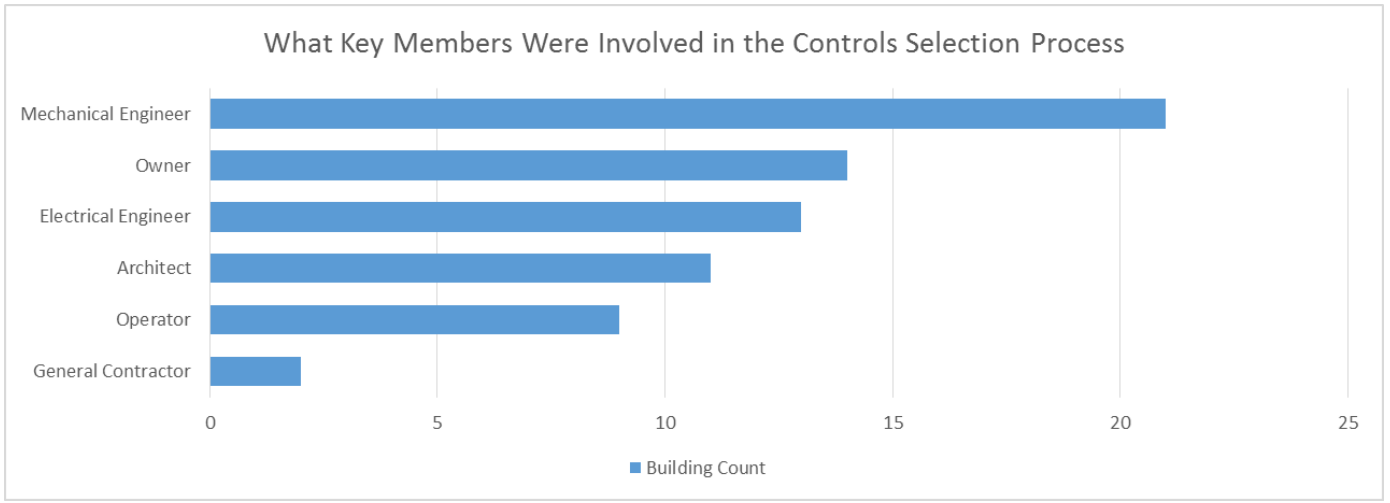
Controls Design Selection Process: *Who chooses*

- Mechanical Engineer (ME) takes the lead on the controls selection process getting input from the owner and other sub contractors on an as-needed basis
- ME is responsible for writing sequence of operation and controls specification and in some cases were involved in selection the controls vendor
  - Control subcontractors are a sub-trade of a sub-trade – making them a first-tier (separate) contractor would help elevate their input the design process
- When asked who *should* be involved in the controls selection process, the future building operator was frequently mentioned



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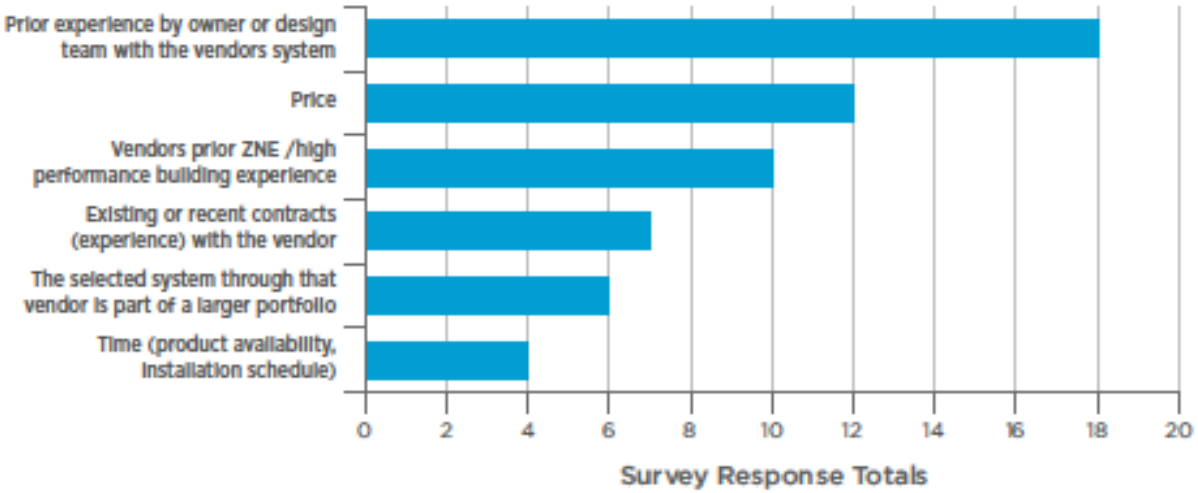
Controls Design Selection Process: *Selection Criteria*

- Prior Experience is the #1 selection criteria
  - Indicator of the importance of getting key players involved early in the design process
  - Demonstrates the important role controls play in achieving a ZNE goal

Criteria for Selecting a Controls Vendor/Subcontractor



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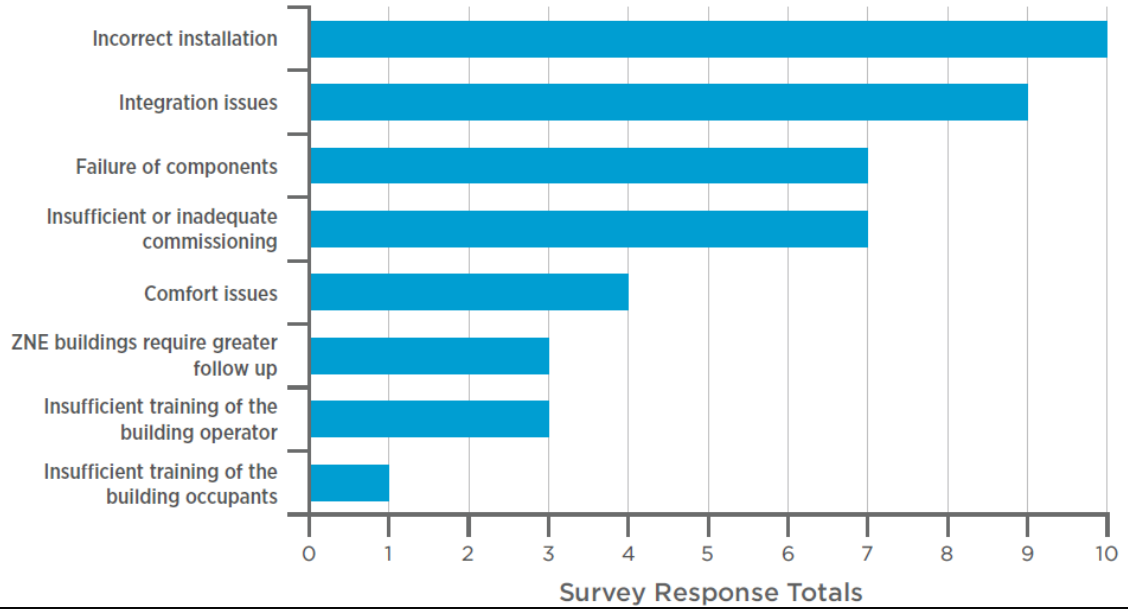
Controls Design Selection Process: *Follow Up*

Despite the focus on performance and the qualification of the design and construction teams associated with these projects…

The #1 reason for excessive follow-up:

Incorrect installation of controls systems in the field



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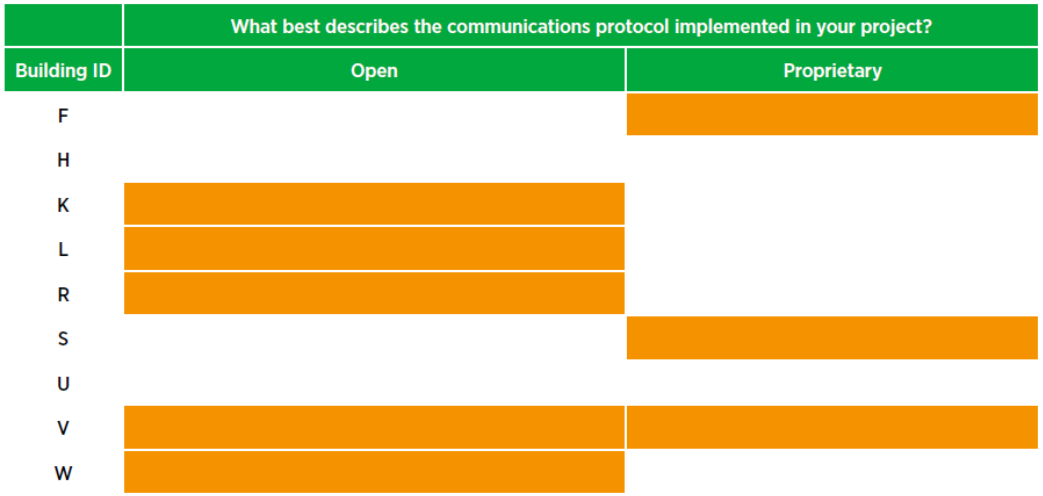
Control Design Selection Process:
Communication Protocols

- A majority of designers indicated that they did not feel like communication protocols limited their options during the design phase
  - There was no correlation between the designers who did feel limited by conflicting communication protocols and the type of communication protocol implemented
- "Integration Issues" were the second most common reason selected for excessive follow-up
- This applied to projects that used both open source and proprietary communication protocols



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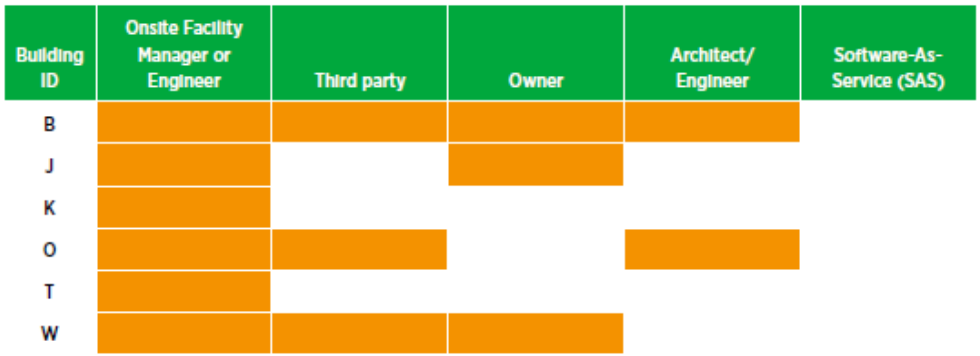
User Experience:
Operations Survey Summary

- All agree: bring Operator into design process <u>early</u>
  - Operator involved in all sequence development efforts
  - Operator involved in commissioning process
- Often, operators learn on the job (without formal training)
  - Heavy reliance on Operations and Maintenance (O&M) Manual and Commissioning process and report
- Building Operator & Controls Vendor – close relationship
  - Frequent communication in Year 1

- Maintaining Building Performance: Operator should write & use a *System Support Manual* or *Procedure Manual*

Building Monitoring Responsibility



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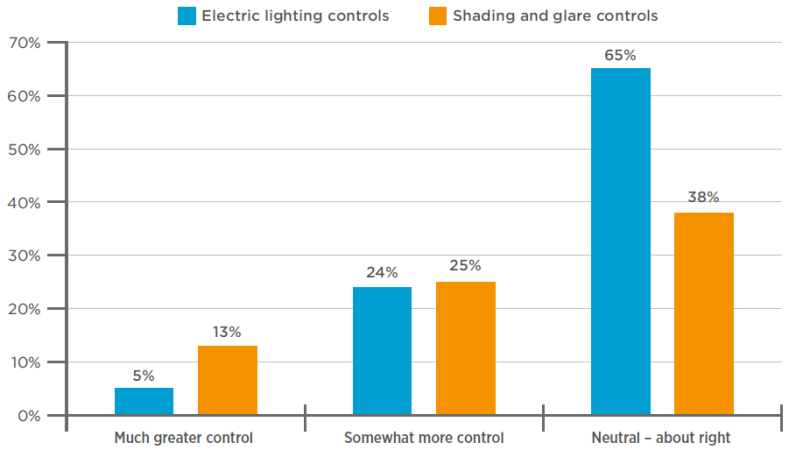
User Experience:
Occupant Survey Summary

- Occupants generally are satisfied with their ZNE building work spaces
- Design teams & operators must balance automation vs. occupant interaction
- 75% of occupants satisfied with daylighting – but often want more glare control

Occupant Interest in Interaction with Lighting and Shade Controls



- Broad satisfaction with natural ventilation, DOAS
- Heating systems are well regarded; desire for more control for cooling
- Plug load controls are not problematic or obtrusive for most occupants

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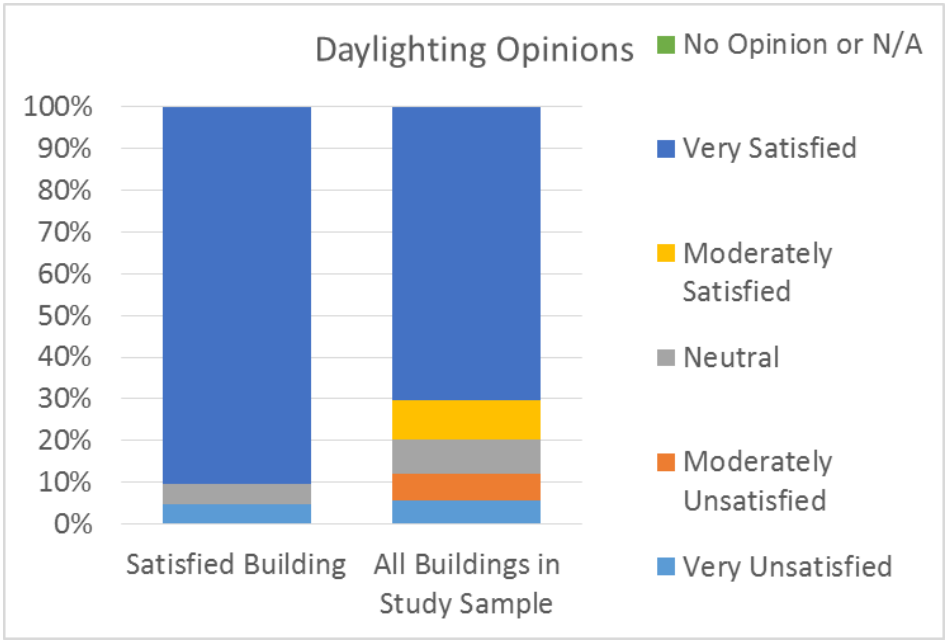
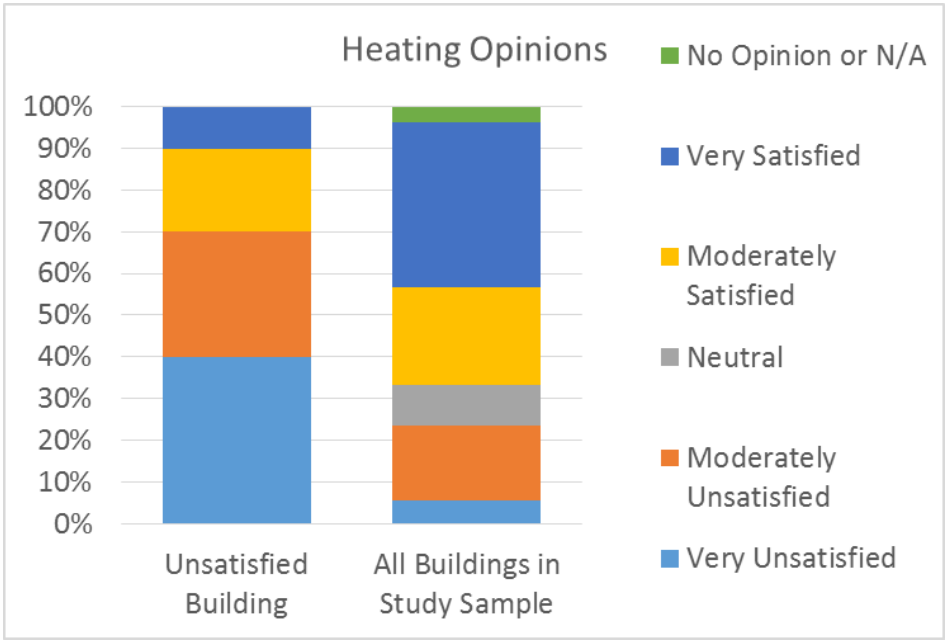
User Experience:
Occupant Survey Summary

- Occupant satisfaction with building control interaction varies widely, by system and across buildings
  - Typically Very to Moderately Satisfied: Electric Lighting, Daylighting, Ventilation, Plug Loads
  - Variable Satisfaction across Spectrum: Glare Control, Heating, Cooling, Indoor Noise Control





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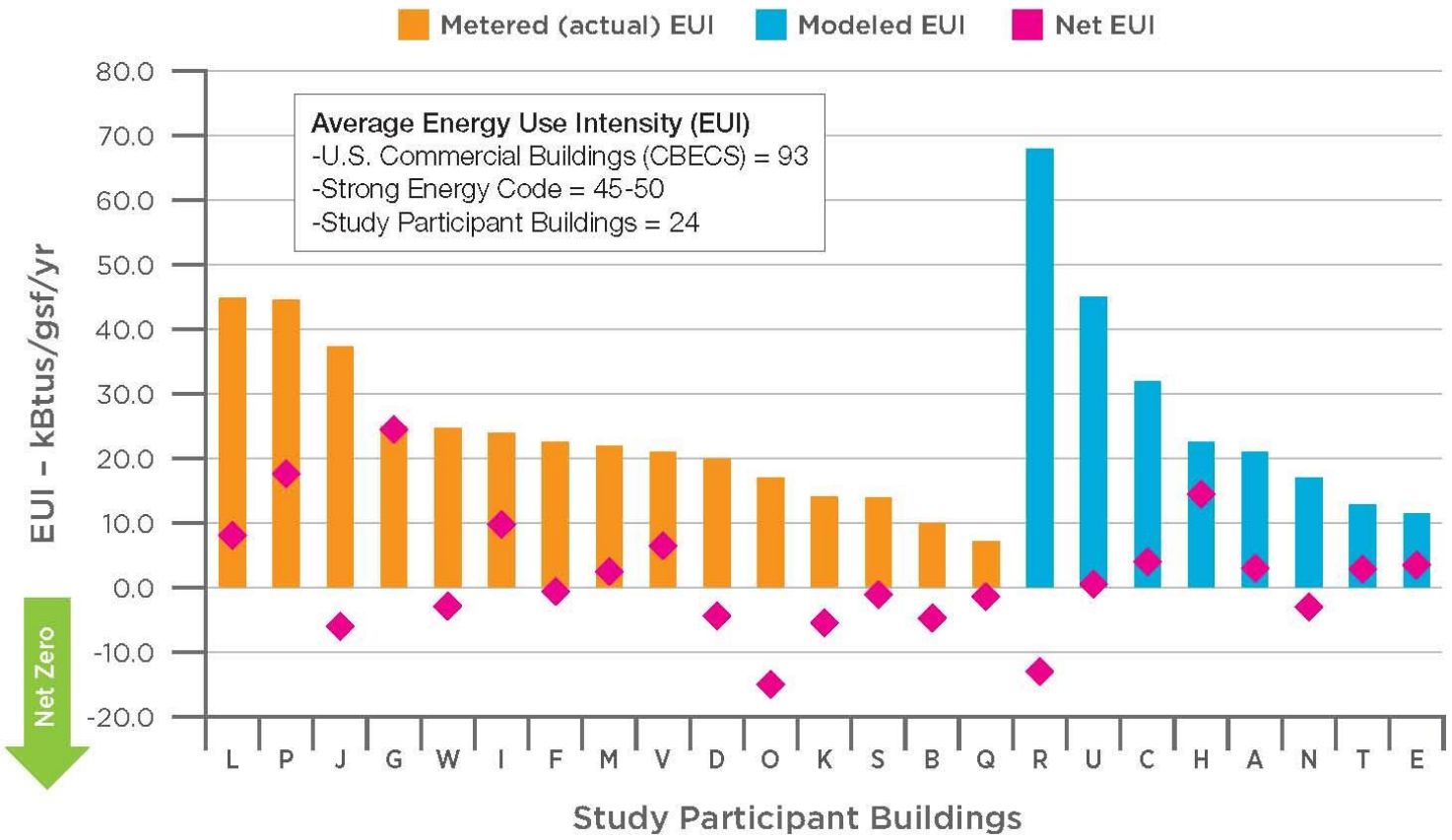
Energy Findings:
Participant Buildings



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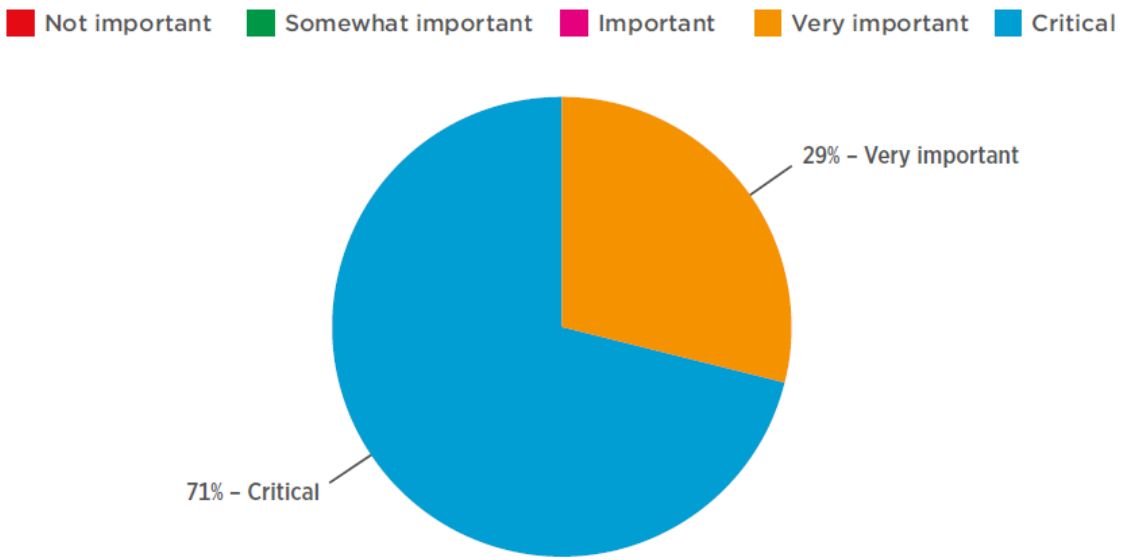
Energy Findings:
Setting Energy Targets

Energy Targets are Key

100% of design teams set an aggressive low-energy EUI target



100% of design teams considered setting early energy targets as key to the design process & outcomes

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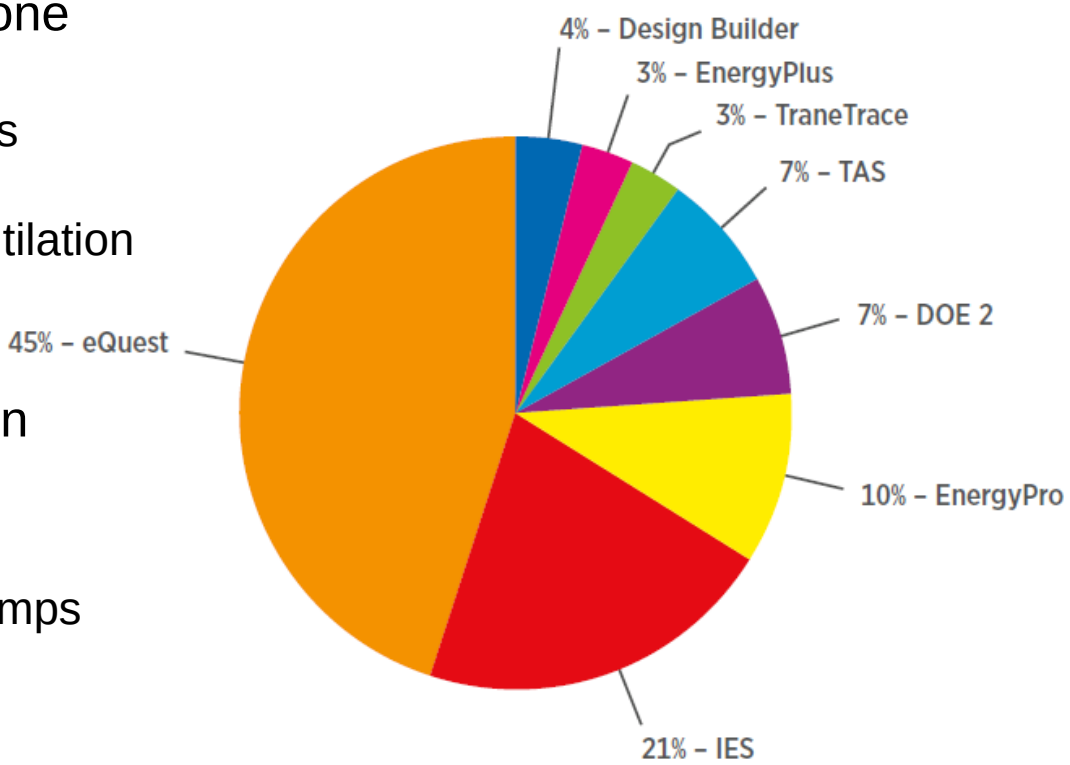
Energy Findings:
Whole Building Energy Aspects

- Baseline: High-Performance/LEED
- Energy modeling: More than one software package used
  - eQuest remains #1, but this is shifting
  - Radiant systems, natural ventilation modeled with IES/TAS
- Keys to ZNE: Building Siting
- Keys to ZNE: Envelope Design
- Keys to ZNE: HVAC Systems
  - Ground source heat pumps
  - Advanced air source heat pumps
  - Radiant heating & cooling distribution
  - Variable refrigerant volume



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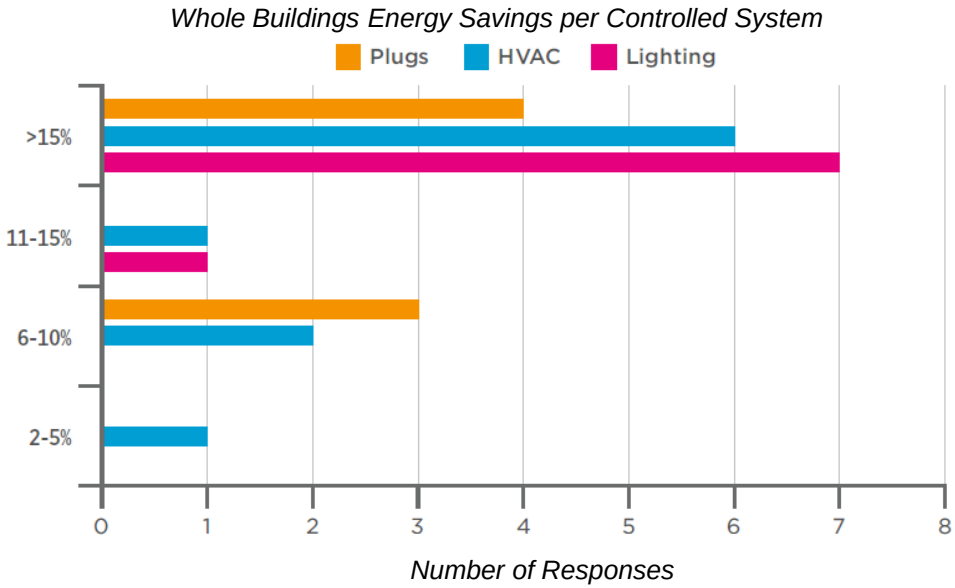
Energy Findings:
System Level Priorities

- Lighting Controls: Daylighting first, then other electric lighting controls.
- HVAC Controls: Passive first: natural ventilation & use of thermal massing. Then, optimize mechanical system control and monitoring.
- Glare Controls (Shading & Blinds): 33% got thermal savings => Reduced thermal loads & thus HVAC system needs.
- Plug Load Controls: up to 50% of usage in some ZNE buildings. Designers are still experimenting with different control approaches.

"Design For Off"



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End of Section 2