ALLIANCE TO SAVE ENERGY

Using less. Doing more.

Emerging Technologies for Building System Efficiency*:*

Code Issues & Opportunities

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BCAP Annual Meeting
Thursday 12/1/16

Overview

- Building Systems Efficiency Initiative
- DC Power Distribution
- CHP and District Energy
- Buildings to Grid (B2G) & microgrids
- Codes as a policy tool for system efficiency

Why Systems Efficiency?

- Product-level efficiency: large remaining potential but diminishing returns (...?)
- Systems efficiency *vs* device-level: 2x to 10x gains
- Whole-building efficiency matters – but so do components and systems
- Non-energy benefits

SEI Year 1 Report

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Strategies for System Efficiency

- ***Break down silos -*** collaboration among industry stakeholders; between industry & policymakers
- ***Effective integration*** within and among systems
- ***Optimize technology –*** smart design and smart control
- ***Incorporate systems strategies throughout the building life cycle*** – from design through construction, commissioning, and O&M
- ***Think outside the building*** – campus or community scale systems; buildings-to-grid integration

SEI Roadmap (5/17) & Follow-ups

- Scope:
  - Building systems and interactions (modeling)
  - Building life-cycle
  - DC power distribution
  - Grid-edge and district energy
  - Implementation strategies
- Federal & state actions
  - Legislation (infrastructure, tax reform)
  - Utility regulation
  - Public sector leadership, demonstrations
  - Review DOE programs & structure
- Continuing outreach: Gov't., industry, practitioners...

DC Power Distribution

- DC benefits:
  - Reduced AC/DC conversion losses: ~7-14% savings
  - Power quality, safety, reliability
  - Resilience: Integrate with on-site PV + storage
  - Integrate power and control
  - Lower installation/remodeling costs
  - U.S. competitiveness
- 70% of residential end-uses are (could be) DC
- Near-term markets: Data centers, telecom, NZE

DC Power (cont.)

- Growing interest internationally
  - IEC/SEG4
  - Germany, EU ENIAC, China, India... (DC for rural microgrids)
- Industry & states provide U.S. leadership; not yet a DOE priority
  - EMerge Alliance; DC-Nexus
  - State initiatives in CA and CO
- Barriers to DC
  - Limited product availability ("chicken-and-egg")
  - Lack of supplier, installer, and consumer familiarity
  - Workforce training
  - "AC-centric" codes, standards, DOE test methods
- Pathways to introduce DC in existing buildings

DC Power – Recommendations

- RD&D on DC devices and systems
- Develop DC-oriented training and tools
- Update DOE energy test methods
- Review/revise electrical & building codes
- Federal inter-agency and inter-program coordination
  - Identify market barriers
  - Federal facility demo's (NZE, resilience)

CHP and District Energy

- CHP can contribute significantly to building resilience and grid reliability
- DES offers multi-fuel flexibility; heating/cooling savings of 30-50%
- CHP and DES often combined; more common outside U.S.
  - Now: DES for campus facilities, some older cities; CHP mostly industry
  - But DOE study found *more* CHP potential in commercial & MF buildings than in industry!
  - NYSERDA: "Packaged CHP" concept for buildings

CHP and DES (cont.)

- Early-stage DES feasibility studies (heat-mapping)
  - Reduce risk; attract private capital
- Extend CHP tax incentives; include DES connection
- DES-designated areas: development bonuses and "DES-ready" requirements
- Public infrastructure to consider CHP as default (hospitals, schools, wastewater treatment, etc.)
- DES and CHP in federal campuses, DoD bases (exempt from fossil-fuel phase-out?)
- State regulators:
  - CHP in resource portfolios
  - Utility investments in customer-site CHP

Buildings-to-Grid (B2G) and Microgrids

- B2G connectivity issues are complex and evolving
  - Closely related to "IoT" – involving non-energy services and benefits
  - Challenging rate design issues, especially for grid-integration of NZE buildings
  - How to assure B2G participation for smaller buildings and small-but-numerous loads?
  - Code issues: few constraints but little support – since energy codes focus on annual energy use not TOU
- Chicken-and-egg problem: Need connected devices + integrating framework (protocols, transactions)
- Need a coordinated national data collection effort to better understand:
  - technical *potential* for controllable loads
  - *customer willingness* to accept reduction or deferral of energy services

Hippocratic Oath for Codes and Emerging Technology

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Is Energy Efficiency Enough?

- Should the energy code also consider:
  - –Load controllability (thermal, electric)
  - –Grid-connectivity
  - –Technology-readiness requirements:
  - –Solar, DES, CHP, DC wiring, storage, etc.
- Should these be added to efficiency or alternatives (trade-offs)?
- Good role for Stretch Codes

Is Whole-building Performance Sufficient to Address System Efficiency?

What's Inside the Black Box??

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Other Code Issues and Opportunities

- Controls integration: pro's and con's
- Device-level energy reporting
  - Built-in M&V (?? – consumption vs. efficiency)
  - Feedback to improve test methods and cost-effectiveness estimates
  - More accurate prescriptive credits and performance predictions
  - Support "outcome-based" compliance
- How to control MELs: via receptacles (code), devices (stds/labels), or *users*?

THANK YOU!

SEI information at
https://www.ase.org/systemsefficiency

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