



Road to ZNE

Mapping Pathways to ZNE Buildings in California

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CPUC Big Bold EE Strategies

Big Bold Energy Efficiency Strategies

Commercial New Construction

- All new commercial construction in California will be zero net energy by 2030.

Residential New Construction

- All new residential construction in California will be zero net energy by 2020.

Residential / Small Commercial HVAC

- Heating, Ventilation, and Air Conditioning (HVAC) industry will be reshaped



Low-Income Energy Efficiency

- All eligible homes energy-efficient by 2020



Overview

- Collaborative Research
 - Co-funded by four investor owned utilities (IOUs)
 - Planning coordinated with Energy Division
 - Unique Research
 - Program deliverables for PG&E's ZNE Pilot Program
 - Funded from IOU EM&V budget; led by IOU EM&V staff
 - Example of IOU contributions to pursuit of ZNE goals
 - Timely Research
 - Residential Roadmap to ZNE (CPUC/CEC)
 - 2016 Title 24 update (CEC)
 - C&S Planning and Coordination Subprogram (IOUs)
 - Emerging Technologies Program roadmaps (IOUs)
 - Overall study schedule
 - Start – Jan 2012
 - Draft Report – Nov 2012
 - Final Report – Dec 2012
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Research Teams

- Road to ZNE: Mapping Pathways to ZNE Buildings in CA
 - Study Team Lead: Abhijeet Pande, Heschong Mahone Group
 - Team Members: E3, CTG Energetics, Portland State University, New Buildings Institute
 - Assessment of the Technical Potential for Achieving ZNE Buildings in CA
 - Study Team Lead: Dan Suyeyasu, Arup
 - Team Members: Davis Energy Group, Sun Light & Power, Engineering 350, Sustainable Design & Behavior, New Buildings Institute
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Road to ZNE Study Goal

- Identify:
 - Pathways to achieving ZNE for new construction residential and commercial buildings
 - and deep energy retrofits in existing residential and commercial buildings
 - Establish:
 - A framework to understand existing body of ZNE work
 - Prioritize:
 - Relevant issues and potential pathways to ZNE including:
 - Emerging Technologies
 - Codes and standards
 - Programs
 - Workforce education
 - Outreach
 - Ratings....
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Efforts to Date

- Literature Review
 - Reviewed 225+ sources to date
 - Topics include:
 - ZNE Definition
 - EUI Targets
 - Fuel Mix Metrics
 - Grid Challenges
 - Certifications and Ratings
 - User Interaction and Feedback
 - Building or Project Design and Construction
 - Building Operations and Maintenance
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Efforts to Date

- **Market Actor Interviews**
 - List of market actors, their roles, and their likely incentives and barriers to achieving ZNE designs.
 - >30 formal interviews, plus informal discussions
 - **Data Analysis**
 - RASS: >20,000 anonymous samples
 - LEED: >400 LEED buildings
 - NBI ZNE Data on ~100 buildings
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Class Half Empty --- or is it --- Half Full

PRELIMINARY LESSONS LEARNED

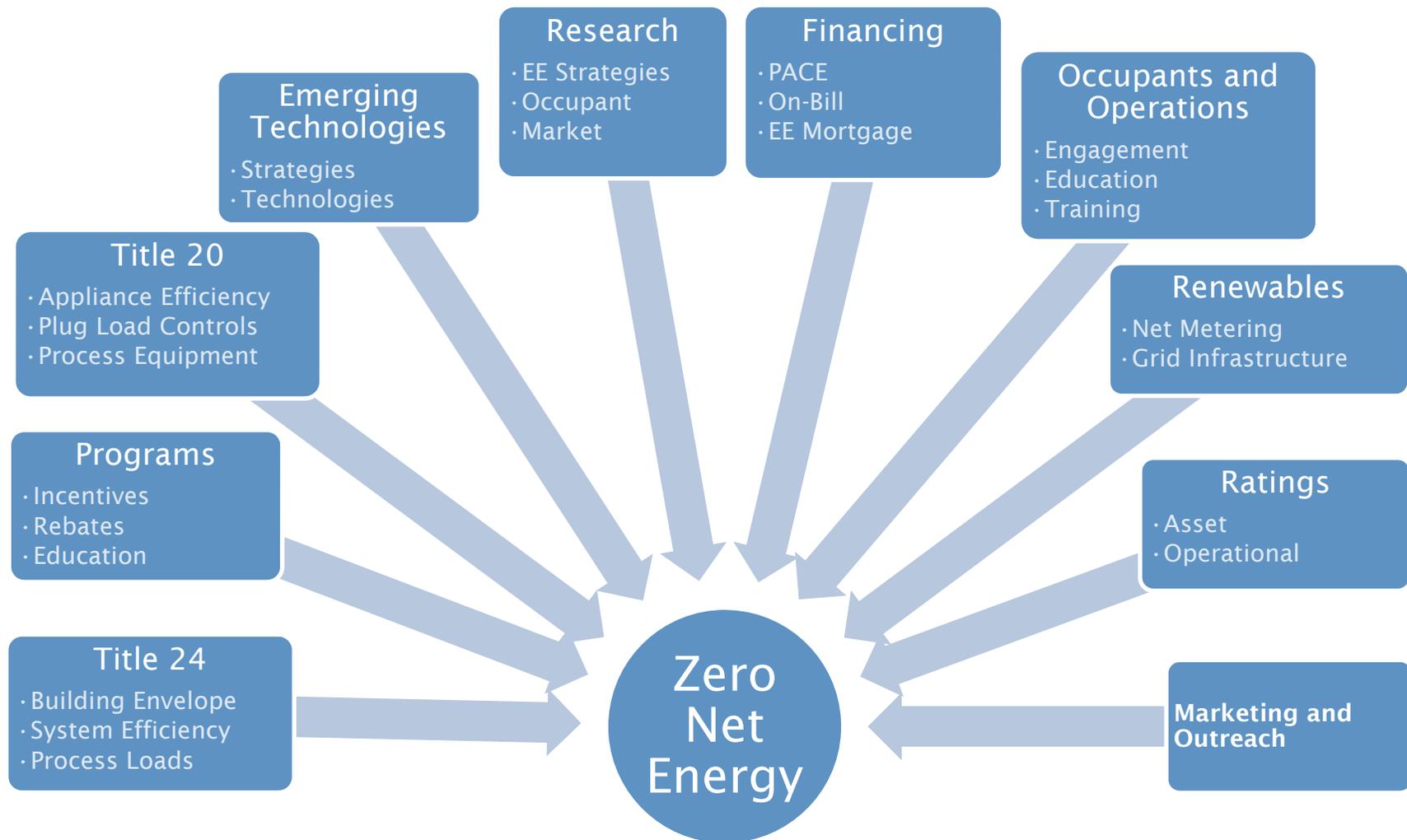
ZNE Basics

- What's in a name?
 - Everyone has a different opinion for what is ZNE
 - Site, source, TDV, embodied energy, community scale...
 - Growing recognition of 'ZNE Ready' and 'ZNE Equivalent'
- Barriers/Opportunities
 - Transitioning from early adopters to mainstream
 - Cost, trained workforce, public awareness, risk
 - Lack of data
 - Plugs loads, cost, behavior
 - Modeled energy use vs. measured/asset ratings
- Feasibility of the goals
 - General consensus that we are 'not on track' to achieve goals
 - New residential may be close
 - New commercial varies by building type
 - Retrofits are a BIG challenge

Key Takeaways

- No ‘silver bullet’ solution for achieving ZNE
 - Rather a combination of strategies needed
 - Essential challenge is how to go from the ‘boutique’ to the ‘mass market’
 - Current ZNE efforts are driven by early adopters
 - How to translate their success to others?
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Recommended Pathways to ZNE



Key Takeaways

- Need resolution on ZNE policy framework
 - Aspirational goals versus mandates
 - Definitions and targets
 - Need to institutionalize ZNE goals
 - Loading order matters
 - Efficiency first
 - Renewables after efficiency is addressed
 - Efficiency is not limited to technologies
 - Integrated design
 - Operation and ‘ease of operation’ matters
 - Integration of occupants is critical
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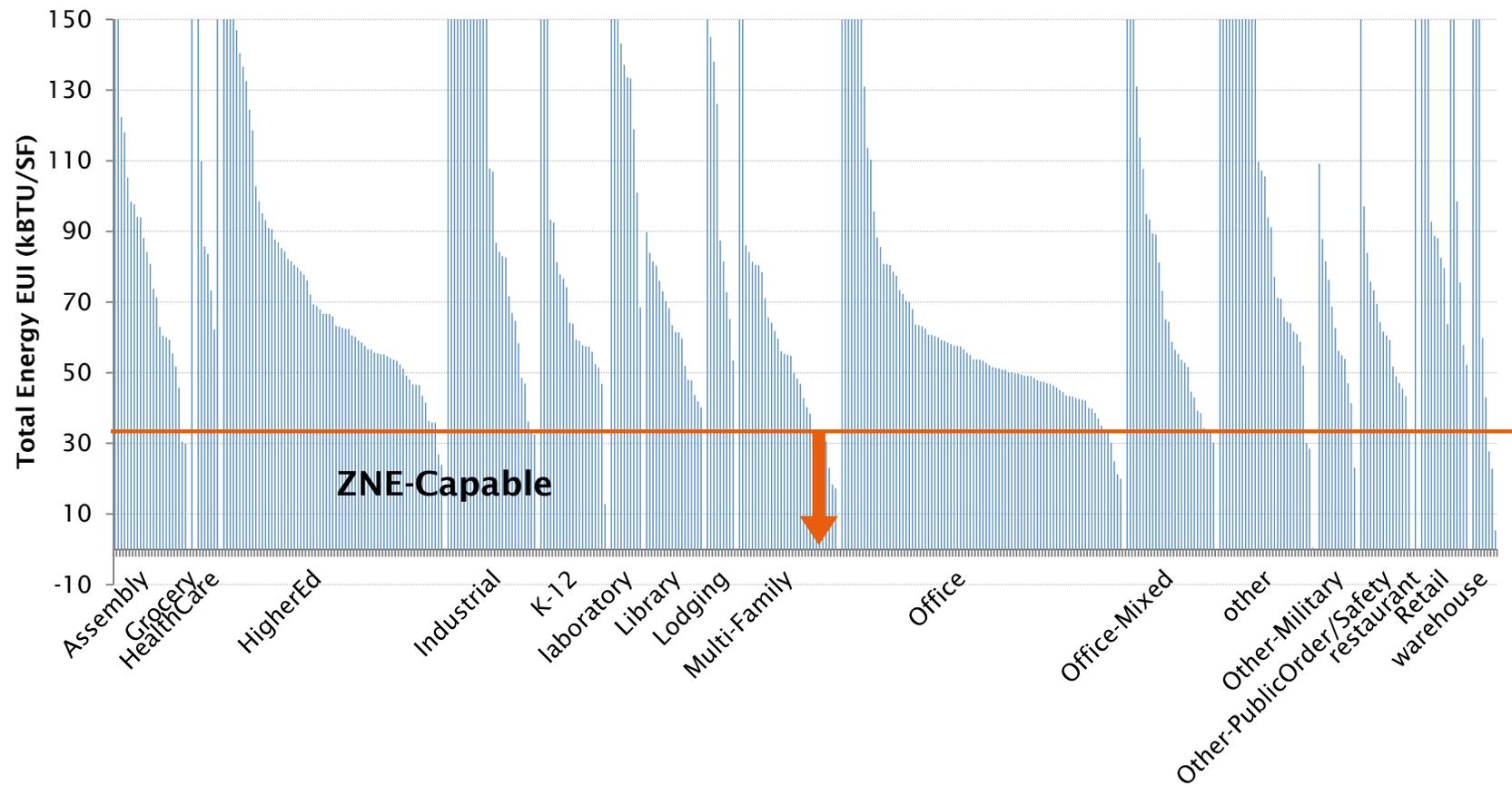
Key Takeaways

- **ZNE Market Status**
 - Current construction practice (as a whole) is ways away from ZNE practice
 - High-performance buildings on average still short of ZNE performance
 - Nonresidential ZNE projects mostly small, ‘unique’ and driven by early adopters
 - Though movement towards ZNE starting to happen in larger/typical buildings
 - Residential projects driven by ‘model’ or ‘marquee’ projects
 - Still limited traction on a market-wide basis
 - **‘Unregulated’ loads and ‘plug loads’**
 - Will play an increasingly important role in achieving ZNE performance
 - **Emerging Technologies is critical**
 - Most current ZNE buildings use ‘innovative’ systems
 - Need more research into how to integrate technologies into the broader market
 - Need more field placement studies, market assistance efforts
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EUI Analysis

California LEED Building EUI, by Building Type

**Modeled data*



Key Takeaways

- ZNE Costs
 - Incremental costs for ZNE buildings range from zero to 30-40% of ‘regular’ construction costs
 - First costs often cited as barriers to greater adoption of ZNE
 - Need approaches such as PACE, on-bill financing and other innovative financial mechanisms
 - ZNE has a strong ‘brand value’
 - ZNE needs a ‘sales proposition’
 - To align interests of the builder, owner, occupant and operator of buildings
 - Need better marketing of the brand to raise awareness
 - Path to Zero campaign may help
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Key Takeaways

- ZNE design may not equal ZNE performance when scaled up
 - Need better account of installation, performance and maintenance practices
 - Need integration of occupants into the design, operation, maintenance process
 - Emerging Technologies need to incorporate usability and feedback mechanisms
 - ZNE Actors
 - “It takes a village to raise a child” – African Proverb
 - ZNE will require a true ‘market transformation’ for all actors involved
 - Designers, developers, construction professionals, utilities, regulators....
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User Interaction and Feedback

- “Intelligent buildings” vs. “intelligent people” is a critical issue for design and policy
 - Assess and manage risks, now and future
 - Motivated occupants can help achieve ZNE goals
 - OR occupants could choose to not change behavior patterns affecting performance
 - Social learning is key in transitions
 - How can policy & industry facilitate learning for occupants, operators, designers, builders?
 - Let occupants know what to expect, how to use. Whose job?
 - But “education” ≠ obedience
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Key Takeaways

- Technical barriers are surmountable but need to be addressed
 - We need to improve existing technologies and applications
 - And we still need better systems that can achieve intended performance at lower energy use
 - Emerging Technologies programs will play a key role
 - Improving technologies is important
 - Improving integration of technologies is more important
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Key Takeaways

- Policy barriers need to be addressed
 - Need EE, DR, DG policies to be aligned
 - E.g. Net Energy Metering rules
 - Coordination between programs, C&S, ET, research
 - Cost-effectiveness of ZNE matters
 - CEC C&S uses a different criteria than CPUC programs
 - Cost-effectiveness of programs will be further stretched with each cycle
 - Cost-effectiveness of ZNE programs may become an issue for the portfolio as more buildings reach ZNE level of performance
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Coordinated Approach to ZNE

- ZNE goals are technologically achievable
 - Integrated approach among programs, research, codes and standards does provide a clear path to ZNE
 - Need tighter IDSM type coordinated approach
 - ZNE has ‘brand value’ for many
 - And it excites those who may not be excited by efficiency alone
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Contact Information

- For additional information, comments, questions
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The power of

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Thank You for Attending
Questions?
