# Road to ZNE

## Mapping Pathways to ZNE Buildings in California

ZNE Stakeholder Meeting

Heschong Mahone Group, Inc.
Energy and Environmental Economics, Inc.
CTG Energetics
Portland State University
New Buildings Institute

**Nov 28, 2012**

# 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

# Overview

- 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 – Published Nov 20, 2012
  - Final Report – Dec 2012

# Draft Report
## Public Review Process

- Draft report posted on Energy Data Web (PDA) for public review
- Comments due December 6th, 2012
  - Use the comment feature on the PDA website
- Study team will consider all comments submitted by December 6th
  - Will not provide responses to comments
  - May not incorporate all comments in the report

# Study Goal

- Identify:
  - Pathways to achieving ZNE for new construction residential and commercial buildings
- Establish:
  - A framework to understand existing body of ZNE work
- Prioritize:
  - Relevant issues and potential pathways to ZNE

# Efforts to Date

- Study is meta-analysis of existing studies
  - Literature Review of over 225+ sources
- Complemented with interviews with stakeholders
- And data analysis of building energy use databases
  - RASS, LEED, NBI datasets

# ZNE Policy Context

- ZNE goals as outlined in the Strategic Plan and IEPR are not mandates
  - Currently there is no legal mandate to achieve the ZNE goals
- ZNE goals cannot be met unless
  - ZNE construction is proven cost-effective and technically feasible
  - Per cost-effectiveness rules at the CPUC and CEC
- It is not a foregone conclusion that ZNE goals will be met

# General ZNE Prognosis

- ZNE goals have captured the imagination of early adopters
  - Challenge is to go from the early adopters to rest of the market in time to meet ZNE goals
- Difficult to achieve ZNE goals with current trajectory
  - Voluntary efforts won't achieve goals in time
- Big issues to address include:
  - Cost effectiveness
  - Increasing penetration of plug loads
  - Consumer and workforce education and interaction
  - Marketing/outreach – low market awareness of ZNE

# What is ZNE

- There are multiple, competing definitions for ZNE
  - Each one works for the purposes of specific stakeholders
    - e.g. TDV based definition works best for CEC
    - e.g. site energy based definition has most traction in the market
- There may not be agreement on one definition of ZNE that works for all
  - And that is fine!
- We recommend the following taxonomy of definitions for consideration:

# Proposed ZNE Taxonomy

Mandate → Voluntary

## CEC: ZNE Code

- All new construction
- Based on TDV
  - Meets modified participant cost test
- Address electricity and gas usage
- Optimal energy efficiency
  - Address T24/T20 covered loads
- Renewables optional
  - OR Equivalency tests
- Asset metric

## CPUC: ZNE Capable/ Equivalent

- Projects with CPUC incentives
- Optimal energy efficiency
  - Address all end-uses
  - Address electricity and gas
  - Meets CPUC Cost-effectiveness Tests
- Renewables Optional
  - Or Equivalency Tests
- Asset metric

## Market: ZNE Site

- Voluntary
- Address all end-uses
  - Includes renewables
- Meets market desire for 'simplicity' of definition
- Choice of fuels covered
  - Electric-only
  - Electric and Gas
  - All-Electric
- May not meet cost-effectiveness tests
- Performance Metric

Regulated End Uses → All End-Uses

# ZNE messaging matters most

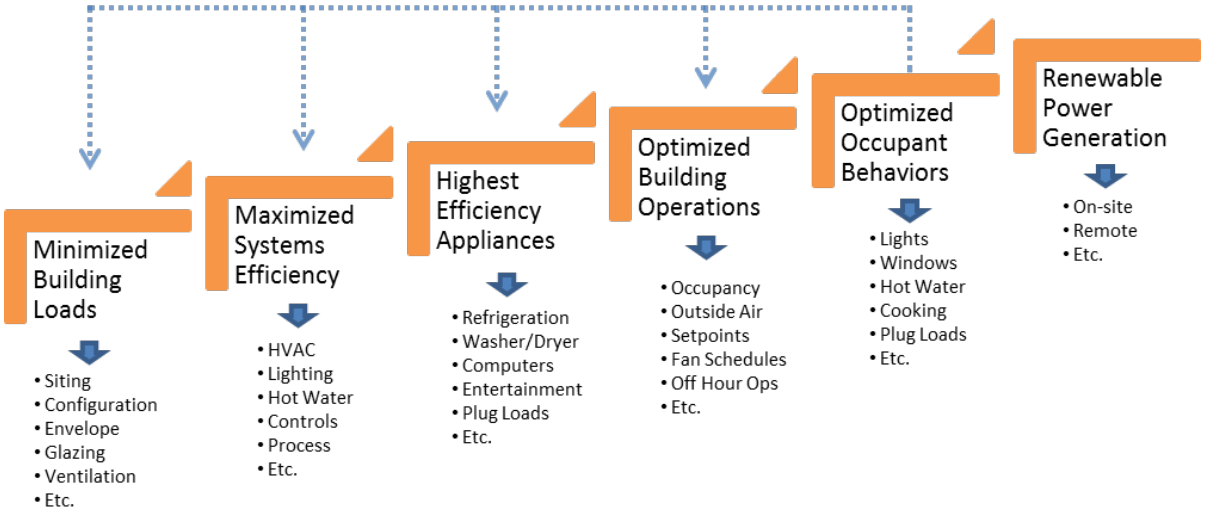
- Taxonomy caveats
  - ZNE code may be similar to ZNE equivalent or ZNE capable
    - Depending on the direction taken by Title 24 to address renewables
  - ZNE equivalent is also ZNE capable
    - But ZNE capable is not necessarily ZNE equivalent
- ZNE code, equivalent and capable are stepping stones to ZNE site
  - e.g. ZNE code does not preclude someone from achieving ZNE site
- Need to clearly delineate what ZNE means in a given context
  - Specify ZNE site or ZNE Code or ZNE Equivalent
    - Rather than calling everything ZNE

# ZNE Equivalency

- Why equivalency makes sense
  - Addresses practical limitations of renewables in each building
    - e.g. Urban environments or other sites with limited potential for renewables
  - Equivalency brings ZNE in line with broader goals
    - Smart growth and $CO_2$ emissions reductions
- Cost-effectiveness criteria point to need for equivalency
  - ZNE may not be cost-effective as a whole (including solar)
    - but portions of ZNE – energy efficiency – likely will be
- Potential credits for:
  - Offsite renewables installed on other buildings
  - Higher density developments
  - Reduced transportation
  - Reduced embodied energy

# Energy Efficiency as a Foundation for ZNE

- "All cost-effective energy efficiency"
  - Should be the foundation of any ZNE definition or metric

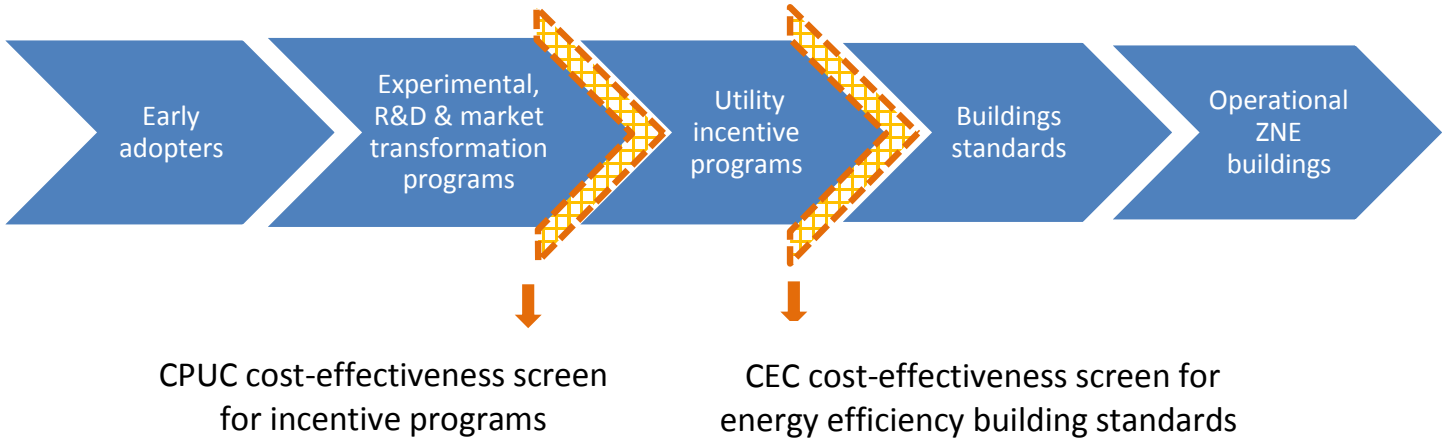



Steps to ZNE Buildings

# Energy Efficiency Targets for ZNE

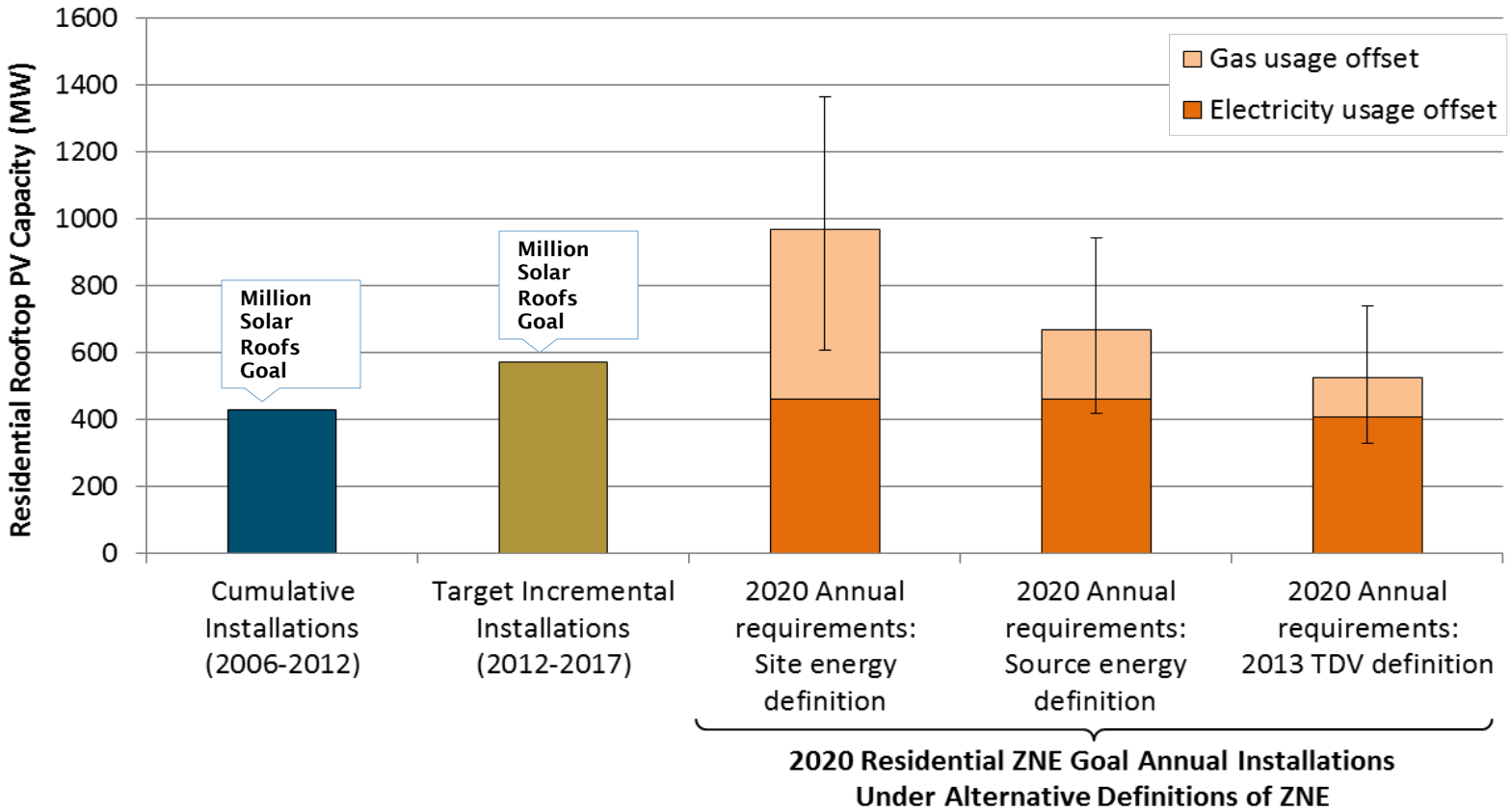
- ZNE metrics/definitions be based on an absolute energy use target
  - Rather than percent better than something else (e.g. x% better than code)
  - Expressed in terms of kBtu/sf/yr
    - Likely will vary by climate zone for many buildings
    - Results from the Technical Feasibility study should assist in developing these targets
- Different definitions should be pegged to this metric by developing relationship to this metric
  - e.g. HERS 0 = x kBtu/sf/yr in a given climate zone

# Cost-effectiveness of ZNE

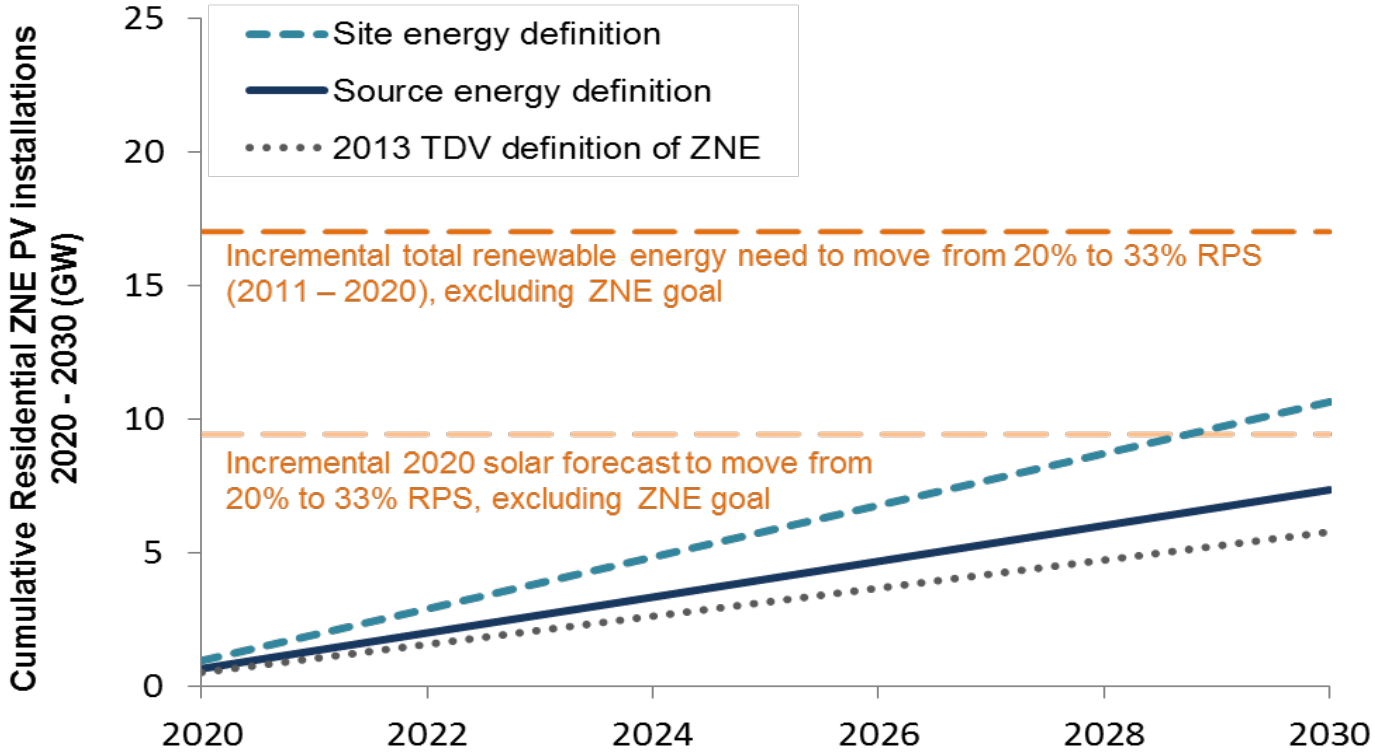



- ZNE equivalency useful to meet goals from cost-effectiveness perspective
- Even if ZNE is not cost-effective, we can get some way along the path with lower EUIs in buildings
- Cost-effectiveness of EE can be separate from that of DG

# Solar needed to meet ZNE Goals



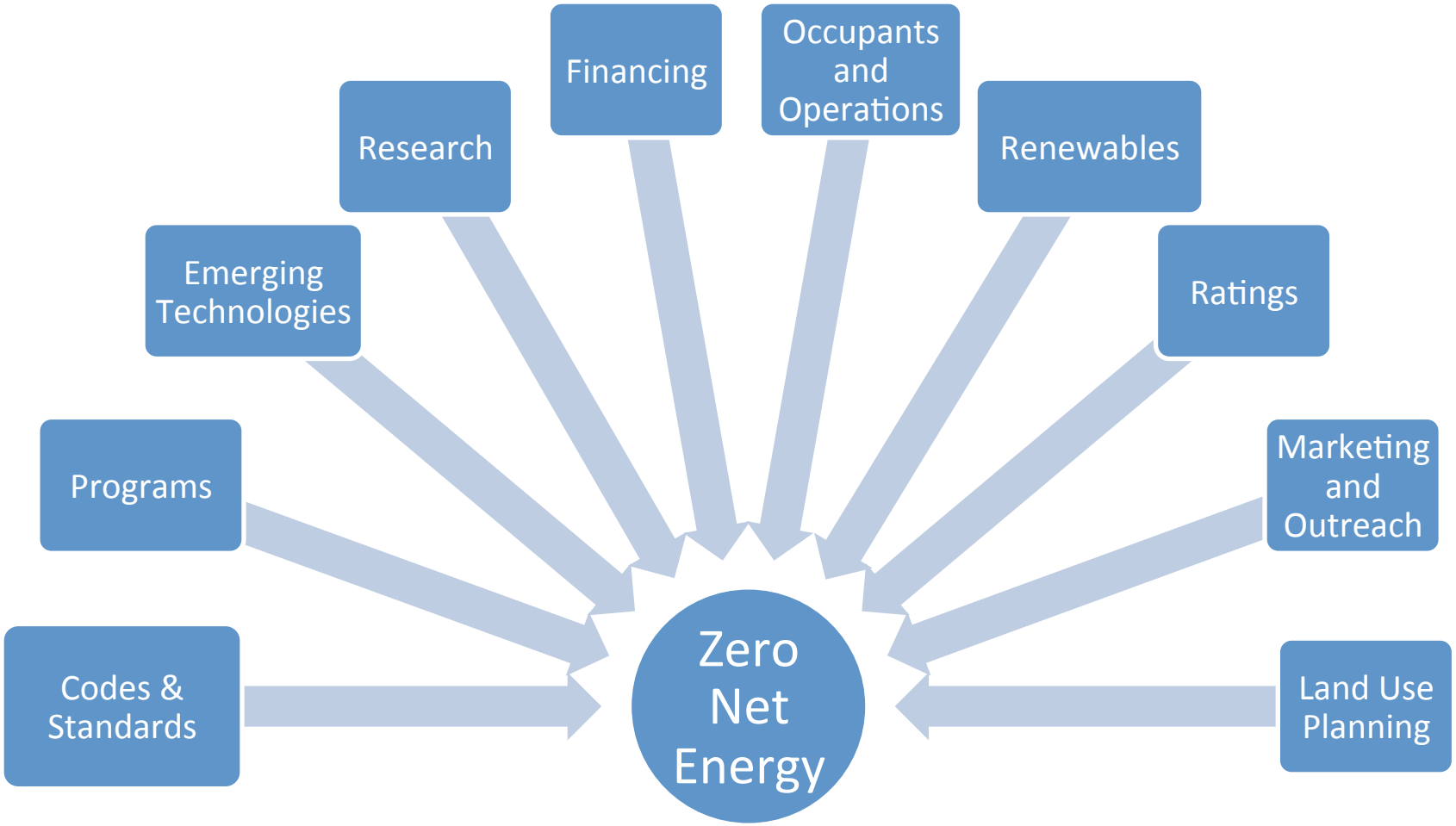
# Solar needed to meet ZNE Goals



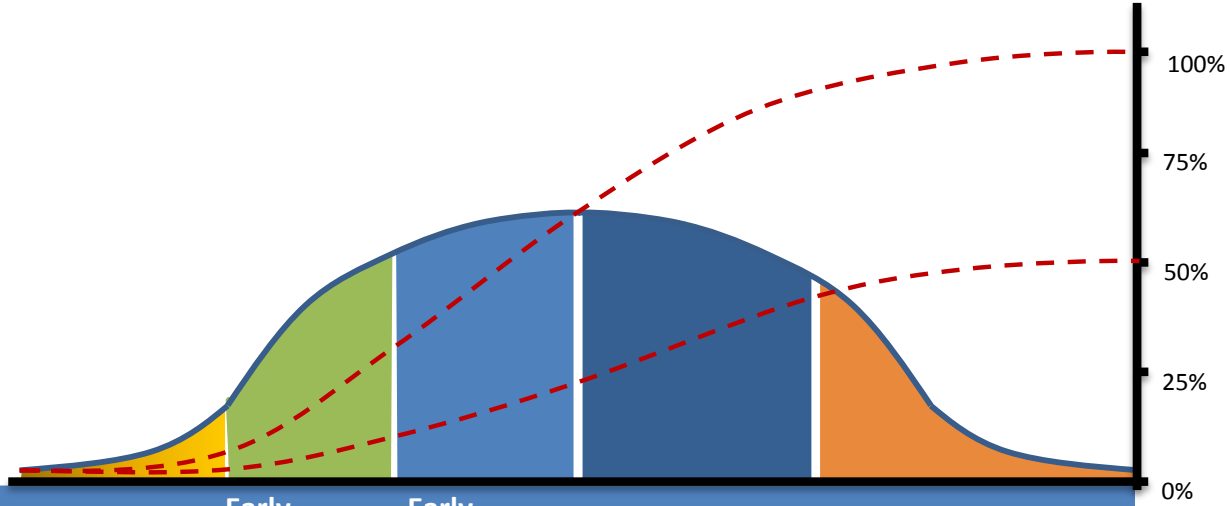
# Solar Cost-Effectiveness and Grid Impacts

- Rooftop solar may not be cost-effective by 2020
  - Levelized participant cost of PV: $0.25/kWh to $0.40/kWh
    - Capital cost of solar is expected to continue to drop
    - State & federal solar incentives likely reduced or not available
  - Changes expected to Net Energy Metering (NEM) rules
  - Changes possible to retail rate structures
- Larger-scale PV can be cheaper than small rooftop PV
  - Current policies do not support “community solar” options
- Unknown cost to upgrade grid to handle high DG
  - Voltage regulation, fault detection, anti-islanding
  - Two-way power flows on distribution system
  - Grid operational flexibility requirements

# Pathways to ZNE



# Pathways Alignment With Potential ZNE Adoption Curve




**Current Status**

| Pathways | Innovators | Early Adopters | Early Majority | Late Majority | Laggards |
|---|---|---|---|---|---|
| Codes and Standards | | | Y | **X** | **X** |
| Programs and Incentives | | **X** | **X** | X | |
| Emerging Technologies | x | **X** | Y | | |
| Research | | **X** | X | | |
| Financing | | Y | | | |
| Occupants and Operations | | | | X | X |
| Renewables | | **X** | | | |
| Building Ratings | | Y | Y | Y | Y |
| Marketing and Outreach | | **X** | | | |
| Land Use Planning | | | | | |

# Buildings are for people

- There is little empirical data on how people use energy in buildings
  - Especially buildings designed to be low energy
- Important to focus on how the designed efficiency may be implemented
  - Occupants are not the enemy
  - Rather need to design solutions that address occupant needs
- Occupants are a varied bunch
  - Stereotypical assumptions may not provide adequate insight

# Policy Recommendations

- Develop Equivalency Metrics
  - Equivalency critical to meeting needs of all stakeholders
  - However, there is lack of agreement on the specifics of equivalency
  - Stakeholders have proposed own metrics
    - e.g. VMT (vehicular miles traveled) equivalency for ZNE
  - CPUC should develop 'official' equivalencies
    - For incentive programs and outreach/marketing efforts
    - Thus ensuring ratepayer benefits
  - CEC should develop 'official' equivalencies
    - For Title 24 purposes

# Internalize ZNE Goals in Portfolio Planning

- Cost-effectiveness of ZNE measures
  - Will impact decisions about ZNE
  - at both policy level as well as individual building level
  - Need resolution on cost-effectiveness framework to be applied to ZNE at the policy level
- Integrated Demand Side Management
  - Integration of EE, DR and DG incentives and trainings needed if CPUC wants to move the market to ZNE
- Evaluate grid impacts of ZNE goals
  - When making policy decisions account for likely cost implications of ZNE goals on upgrading the electricity grid

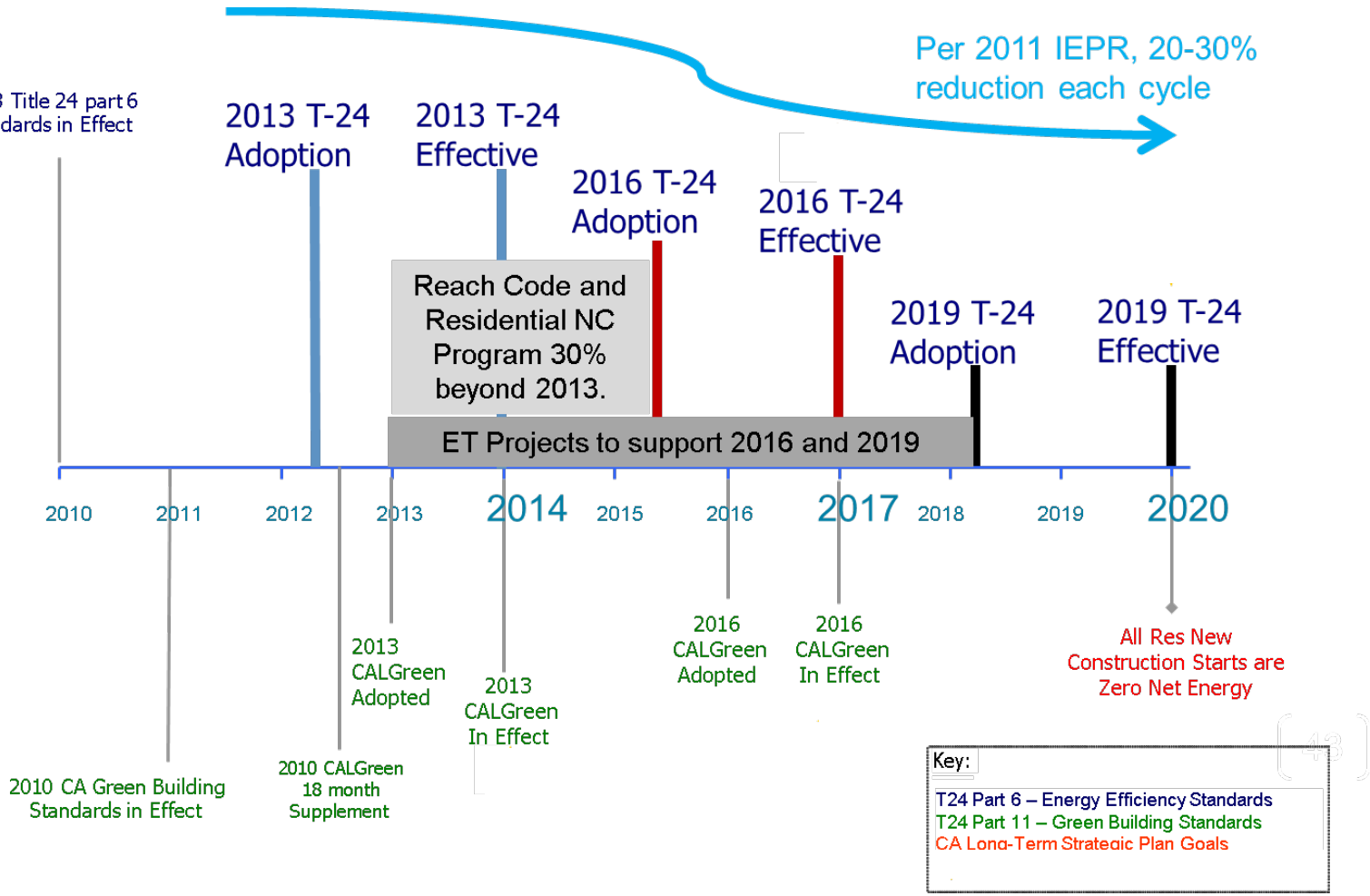
# Internalize ZNE Goals in Portfolio Planning

- New construction programs should target ZNE goals
  - Expand incentives and trainings aimed at ZNE
  - Need resolution on incentive structures for ZNE
    - Should the model used for CSI/NSHP be applicable to ZNE?
- Emerging Technologies Programs
  - ZNE designs require innovative systems and integrated designs
  - Need for further technology and strategy developments through ET programs
- Education and Trainings
  - Need customer education on benefits of ZNE
  - Need workforce training on how to achieve ZNE designs in practice
    - Focus on quality construction and integrated approaches to construction

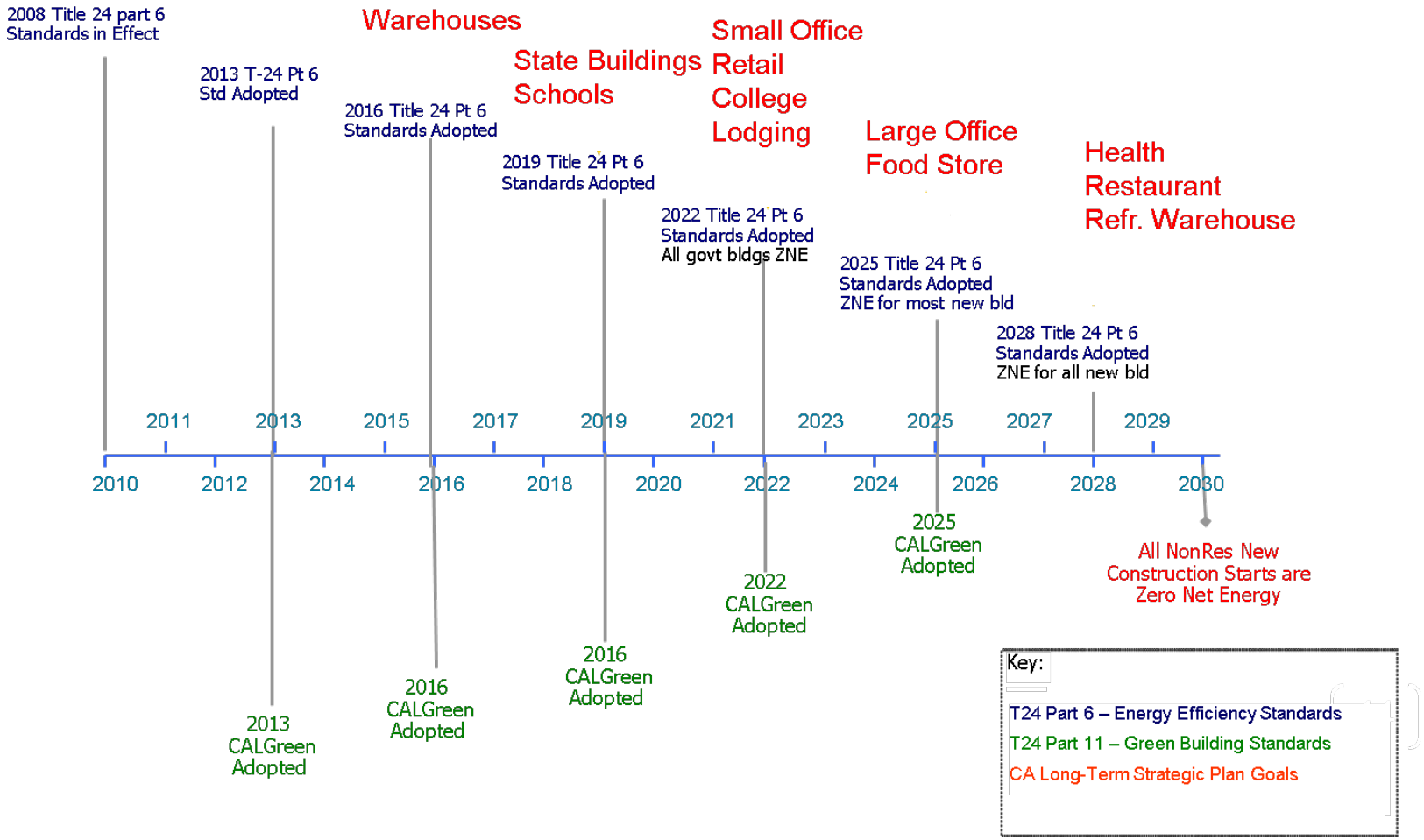
# Codes and Standards

- Make quality construction the foundational element of Title 24
  - e.g. QII, HVAC installation quality
- Develop EUI targets for ZNE Code
  - Develop correlations to kBtu/sf/yr EUI targets
- Performance-based approach to code compliance better suited to ZNE Code
- Update TDV metric to account for distributed generation
- Federal pre-emption of state standards is a barrier to improving codes
  - Innovative approaches such as those proposed for IECC, Oregon, Washington should be explored

# Residential 2020 Goals



# Nonresidential 2030 Goals



# Policy Next Steps

- CPUC and CEC sign a MOU around ZNE goals
  - Identify ways to streamline and codify common efforts towards goals
- Develop a codes and standards roadmap to achieving ZNE
  - CEC and CPUC set to begin this roadmap in 2013 for residential buildings
  - Encourage the agencies to expand the roadmap to include nonresidential buildings
    - And codify priority markets
- Align the new construction program portfolio to ZNE goals
  - New construction programs are currently active in promoting the general ZNE concept
    - Efforts need to be substantially enhanced in 2013-2014 onwards to reach a broader section of the market
  - A significant challenge is the cost-effectiveness of programs
- Align emerging technologies programs to ZNE goals
  - Identify a roadmap for the emerging technologies programs
    - Measures that need further laboratory and field testing
    - Technology needs that are not met such as smaller air conditioning systems with higher efficiency levels
    - Beyond technologies themselves, information needs to be collected on occupant interaction with systems and controls

# Policy Next Steps

- **Develop and encourage financing of ZNE buildings**
  - CPUC has initiated efforts to create policies encouraging private lending institutions to value and support energy efficiency efforts.
    - These policies should be aligned with ZNE goals
  - Efforts be undertaken to align building ratings and labels to the needs of financial institutions
    - To assist building appraisals
- **Research into existing ZNE Buildings**
  - Early adopters have taken the risks needed to design and construct buildings that meet ZNE goals
  - Field research on these buildings is required to answer a number of questions still outstanding including:
    - Technology field assessments
    - Occupant feedback and interaction
    - Plug and Miscellaneous loads

# Key Takeaways for Input

- Need for ZNE mandates?
  - ZNE if cost-effective as opposed to ZNE at all costs
- One definition to conquer all?
  - We don't think so – what do you think?
- We recommend that CEC and CPUC focus on achieving energy efficiency first
  - Reducing energy use through EUI-based targets as the pathway to ZNE
- Building demand for ZNE – what motivates the market?
  - Motivations different for early adopters versus rest of the market
  - Need for sustained outreach and training

# Thank You for your Time

- To download report:
  - www.energydataweb.com/cpuc
  - Search for "Road to Zero Net Energy"
  - Two documents posted
    - Main report and appendices
- To comment on Report:
  - Click the 'Comment' button to the right of the report title
  - Select "Add new comment" button
    - You can upload text or attach document
- Comments due by December 6th 2012
  - Study team will consider all comments
  - We will not respond to comments
  - Do not promise to incorporate all comments in the final report
- Study Lead:

Abhijeet Pande, 916-962-7001, pande@h-m-g.com