Title 24 and End Use Loads – Passive Approaches vs. Renewables for Achieving ZNE

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Presentation Outline

- How various buildings types use energy and scope of codes and standards
- Limits of prescriptive standards – we can only get so far with simple measures
- Contextual opportunities – we can make additional progress with proper siting, massing, orientation, daylighting, natural ventilation, and advanced HVAC systems
- On-site renewable potential – for many building types, adding renewables will achieve zero net-energy
- Special credits – some buildings will only be able to achieve “ZNE equivalent”
  - Renewable energy credits (RECs)
  - Off-site or remote generation
  - Grouping of meters (campuses, school districts, etc.)
  - Transportation (location efficiency)
  - Embodied energy
- Measuring Progress – we need for a better metric, like zEPI
Offices (CEUS)

Not currently regulated

- Heat
- Cool
- Vent.
- Int Ltg
- WH
- Ext Ltg
- Office Eqp
- Misc
- Air Comp
- Motors
- Proc.
Retail (CEUS)

Not currently regulated

- Int Ltg
- Vent.
- WH
- Cool
- Heat
- Proc.
- Motors
- Air Comp
- Misc
- Office Eqp
- Ext Ltg
- Cook
- Refrig.
Schools (CEUS)

Not currently regulated

- Int Ltg
- WH
- Vent.
- Cook
- Refrig.
- Ext Ltg
- Office Eqp
- Misc
- Air Comp
- Motors
- Proc.
- Cool
- Heat
Restaurants (CEUS)

Not currently regulated
Food Stores (CEUS)

Not currently regulated
Average Source Energy Consumption by Building Type

Source Energy Use (kBtu/ft²-y)

- Restaurant
- Food Stores
- Retail
- Office
- Schools
- Warehouses
- CA08
- CA05
- CA01

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Limits of Prescriptive Standards

- The requirements become quite complex as we attempt to achieve greater savings
- It is difficult to implement “contextual opportunities” like daylighting
- Building standards can’t easily address transient energy uses
Current Code Development Process – Bottom-up Approach

- Proponents come to the table with their favorite technology
- Each measure is evaluated and the following questions are asked:
  - Is it within the scope of the standard?
  - Is it cost effective?
  - Is it mature and offered by multiple suppliers?
- When the answer to these and other questions is yes, then the “measure” passes the tests and becomes a part of the standard. The “measures” that fail are discarded or postponed until the next code update cycle.
- After everything is sorted out, we take inventory of what passed the test and this becomes the next standard.
- Only then do we evaluate things to see what savings we have achieved.
- Performance standards are defined by the prescriptive standards.
Early Attempts at Top-Down Targets

- The Architecture 2030 challenge
- DOE/ASHRAE goal of 30% reduction compared to Standard 90.1-2004
- The California CPUC and CEC have said that new residential buildings will be zero net-energy by 2020.
- The same California policy makers have said that new commercial buildings are to be zero net-energy by 2030.
- California also has the goal that half of existing commercial buildings will be zero net-energy by 2030.
The Paucity of Prescriptive Standards

- Almost all building permits still use a prescriptive approach to compliance.

- Good buildings, including energy efficiency buildings are contextual.

- Prescriptive standards are good at addressing simple things like wall insulation or water heater efficiency, but they can’t take advantage of the contextual opportunities presented by the microclimate, the site or the program.

- The aggressive goals for energy efficiency that have been set by California and DOE cannot be achieved through prescriptive standards.
“Passive” Design Strategies
Renewables
Spacing is required to prevent self-shading
Potential PV area varies with building size and configuration

DOE Reference Buildings
Potential PV area varies with building size and configuration

DOE Reference Buildings (continued)
For many buildings the roof is already being used for HVAC
PVs must be integrated with skylights
Energy Intensive Buildings
Buildings with limited solar access
Preliminary CPUC Definition of Zero Net-Energy

The **societal value** of energy consumed by the **building** over the course of a typical year is less than or equal to the societal value of the **renewable energy** generated **on-site**.

- Time dependent valued (TDV Energy)
- The property receiving development entitlements and building code permits
- PV, solar thermal generated electricity, micro-hydro, and wind
Revised Zero-Net Energy Goals

- All new residential construction in California will be zero net energy or equivalent to zero net energy by 2020;

- All new commercial construction in California will be zero net energy or equivalent to zero net energy by 2030;

- 50 percent of existing buildings will be equivalent to zero net energy buildings by 2030 through achievement of deep levels of energy efficiency and clean distributed generation.

Added Text
Possible Credits toward “Equivalent”

- Purchase of renewable energy credits (RECs)
- Averaging of multiple buildings, for instance all schools in a school district or all building in a campus setting
- Off-site renewables such as a wind farm or solar system under the same ownership
- Reduced transportation energy (locational efficiency)
- Reductions in embodied energy

Such credits would be approved on a case-by-case basis by the CEC, CPUC or others
What is zEPI?

- A unitless ratio...

\[
zEPI = \frac{\text{Rated Building Energy Performance}}{\text{Comparator Energy Performance}} \times 100
\]

- The denominator is intended to represent the energy performance of an average existing building, as represented by CBECS 2003.

- The numerator and denominator should be determined with the same:
  - Climate
  - Building size
  - Operating Conditions
  - Other “neutral variables”
Energy Use
Prescriptive
Performance
Renewables
Special Credits
zEPI

Energy Dogs

Net Producers

Average Energy Consumption (adjusted for building type, climate, schedules, etc.)

CBECs 2003

ASHRAE 90.1-1999
Title 24 2001
ASHRAE 90.1-2004
Title 24 2005 ASHRAE 90.1-2007
Title 24 2008 ASHRAE 90.1-2010 Goal

zEPI Concept

Net Zero Energy

Zero Energy Performance Index (Zepi)
Using the Scale as a Framework for Code Development

Year

1990 2000 2010 2020 2030

HERS Style Scale

2008

All Buildings

New Nonresidential

New Residential

Goal

Goal
A parallel concept, the Consumer Price Index

Consumer Price Index, 1913-
1982-1984 = 100
2005 is estimated

- cumulative
- annual
A parallel concept, the Case-Shiller Home Price Index
Benefits of a zEPI Style Scale

- Stable over time
- Reduces the confusion associated with moving baselines
- Is technically consistent with the EPA ENERGY STAR scale
- Related to real-life energy consumption
- It works as we set goals that get us closer to net zero energy
- Works for both asset ratings and operational ratings
- Works for both new and existing buildings
Loading Order

1. Implement simple prescriptive measures such as insulation, quality fenestration, efficient equipment, and efficient lighting

2. Develop contextual design opportunities
   a. Building mass, siting and orientation
   b. HVAC system design
   c. Daylighting
   d. Natural ventilation
   e. Reduce conditioned area to a minimum

3. Integrate on-site renewables

4. Explore off-site credits to achieve “or equivalent” if unable to achieve zero net-energy (ZNE)
The End