Defining Zero Energy Buildings

INTERAGENCY SUSTAINABILITY WORKING GROUP MEETING

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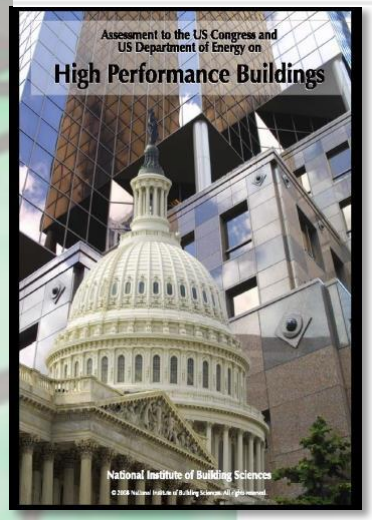
National Institute of BUILDING SCIENCES
An Authoritative Source of Innovative Solutions for the Built Environment

Agenda

1. Background and Goals
2. Zero Energy Building Definition and Framework

High Performance Building Council

a council of the National Institute of Building Sciences



National Institute of Building Sciences High Performance Building Council

Department of Energy

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BACKGROUND AND GOALS

Delivering Energy-Efficient Solutions

Emerging Technologies

- High-impact building technologies
- ~Five years to market-ready

Residential Building Integration

- Cost-effective technologies, tools, solutions
- Peak energy performance in new & existing homes

Commercial Building Integration

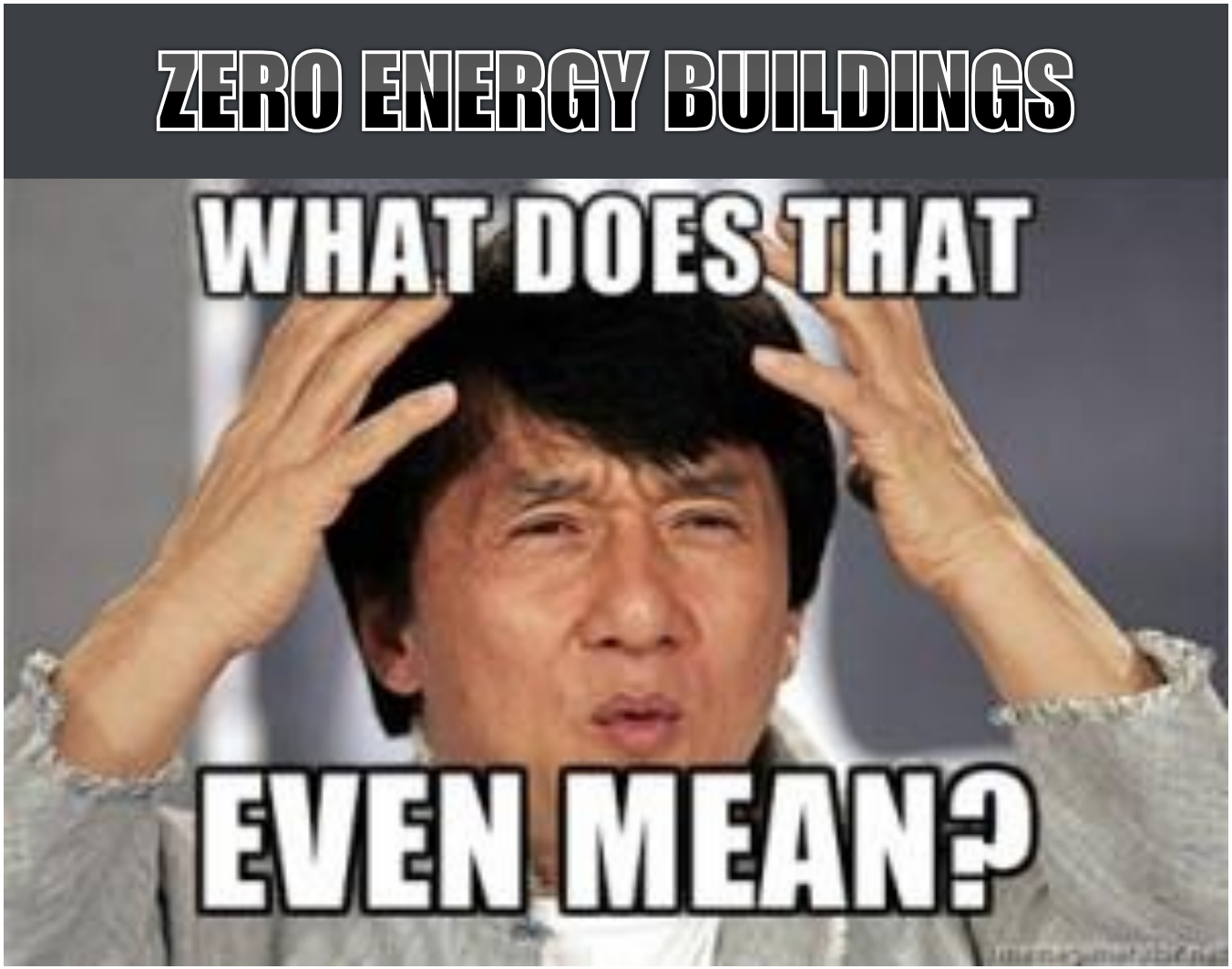
- Cost-effective technologies, tools, solutions
- Peak energy performance in new & existing commercial buildings

Codes & Standards

- Building energy code language with adoption/compliance strategy
- National appliance & equipment standards

Project Background

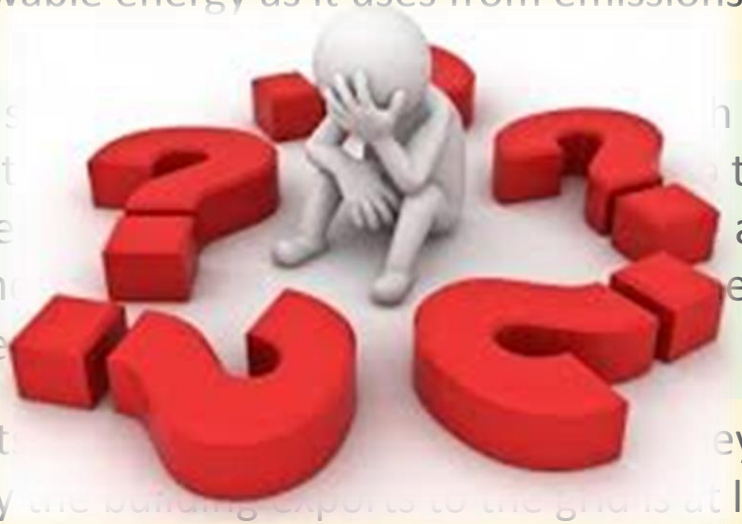
- Buildings identified as (Net) Zero Energy (Ready) are becoming more prevalent
- There is a growing number of local, regional, and other definitions
- This can lead to confusion and uncertainty in claims, which might hamper organic growth of ZEB's and rigor of voluntary and mandatory programs
- There is a federal role in initiating the development of a common, clear national definition


ZERO ENERGY BUILDINGS
WHAT DOES THAT
EVEN MEAN?

What are Zero Energy Buildings?

Net Zero Site Energy: A site ZEB produces at least as much energy as it uses in a year, when accounted for at the site.

Net Zero Energy Emissions: A net-zero emissions building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources.



Net Zero Source Energy: A s energy as it uses in a year, when accounted for at the primary energy used to generate and delive a building's total source energy, imported an e appropriate site-to-source conversion multiplie

Net Zero Energy Cost y the utility pays the building owner for the energy the building exports to the grid is at least equal to the amount the owner pays the utility for the energy services and energy used over the year.

The amount of energy provided by on-site renewable energy sources is equal to the amount of energy used by the building. A ZNE building may also consider embodied energy –the quantity of energy required to manufacture and supply to the point of use, the materials utilized for its building.

Existing Definitions

nbi new buildings institute

NREL

GSA

INTERNATIONAL LIVING FUTURE INSTITUTE

DEPARTMENT OF DEFENSE · UNITED STATES OF AMERICA

architecture 2030

..... And More

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Why a commonly accepted Zero Energy Definition?

For the building industry

- Focus on market transformation (and not technical problems)
- Consistency and market branding
- Increased industry confidence

For states

- Basis for incentive programs
- Recognition
- Provides clarity leading to consumer confidence
- Align programs
- Alleviate market confusion
- Consistency across state boundaries

Project Goal

Converge on an industry-accepted national DOE definition for ZE that will support program and policy goals and encourage commercial new construction and major renovation projects to design, construct, and operate buildings that achieve a high level of energy efficiency.

Project Guiding Principles

A commercial zero energy building (ZEB) definition should:

- Create a standardized basis for identification of ZEBs for use by industry.
- Be capable of being measured and verified, and should be rigorous and transparent.
- Influence the design and operation of buildings to substantially reduce building operational energy consumption.
- Be clear and easy to understand by the industry and policy makers.
- Be durable, needing only infrequent updates.

ZERO ENERGY BUILDING DEFINITIONS AND FRAMEWORK PROJECT

Definition Development Process Overview

1. Established project goals
2. Conducted literature review
3. Interviewed Subject Matter Experts
4. Compiled results and prepared draft definitions, framework, nomenclature and metrics
5. Convened Stakeholders to review results and discuss next steps needed
6. Revised draft definitions, circulated for SME and Stakeholder feedback
7. Public comment period
8. Develop and publish common ZEB definitions, guidelines, nomenclature and metrics that can be broadly accepted

Proposed Zero Energy Building (ZEB) Definition

- *An energy-efficient (**building**)* where the **actual annual source energy** consumption is balanced by **on-site** renewable energy**.*

* The term “building” could be replaced by – campus, portfolio, community.
** Physical site boundary = energy boundary (building, campus, portfolio, community).

Nomenclature

- Annual
- Building
- Building energy
- Campus
- Community
- Delivered energy
- Energy
- Exported energy
- On-site renewable energy
- Portfolio
- Renewable energy
- Site boundary
- Source energy

Measurement and Implementation Guidelines

1. Measurement boundaries for all definitions
2. Energy accounting and measurements
3. Source energy calculations

Energy Accounting and Measurement

- Energy Balance
- Measurement of Zero Energy Buildings – Source energy
  - True reflection of total energy use; Treats electricity and natural gas fairly.
  - Gives PV equal “credit” to grid electricity.
  - Better aligns with customers economic decisions to balance site energy usage with PV.
  - Can be calculated with national conversion factors.
  - National conversion factors recognize that the focus of ZEB definitions is on the building, not the energy supplier or resulting emissions.

Source Energy Calculations

Energy Type	ENERGY STAR Source-Site Ratio, r
Electricity	3.14
Natural Gas	1.05
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.20
Hot Water	1.20
Chilled Water	1.00
Wood	1.0
Coal/Coke	1.0

National Average Source-Site Energy Ratios

$$E_{source} = \sum_i \left(E_{del,i} r_{del,i}\right) - \sum_i \left(E_{exp,i} r_{exp,i}\right)$$

Where

$E_{del,i}$ is the delivered energy for energy type *i;*

$E_{exp,i}$ is the exported on-site renewable energy for energy type *i;*

$r_{del,i}$ is the source-site energy ratio for the delivered energy type *i;*

$r_{exp,i}$ is the source-site energy ratio for the exported energy type *i;*

The source-site energy ratios utilized are from EPA ENERGY STAR with the single exception of on-site renewable electricity, which is the same electrical value for delivered and exported energy. PV ratio = 3.14, same as Energy Star ratio for Electricity.

Using “Zero Energy Building”

- Only buildings that have demonstrated through actual annual measurements that the on-site renewable exported energy is greater than or equal to delivered energy.
- Buildings designed to be zero energy, but have not yet had a full year of operation are encouraged to identify their intent to be a *Zero Energy Building.*

Additional Considerations Under Review

1. Definition for a Zero Energy Building that uses Renewable Energy Credits (RECs)

   REC-ZEB: *an energy-efficient building where the **actual annual source energy** consumption is balanced by **on-site renewable energy production** to the maximum extent possible and then utilizes **Renewable Energy Credits (RECs)** from certified sources to make up the difference in renewable energy required to achieve a ZEB level.*

2. *Zero Energy Ready (ZER)* Building

   A highly energy efficient building that could conceivably become a ZEB in the future with the addition of renewable energy.

Status and Next Steps

1. Conducted research and developed draft material
2. Held stakeholder workshop
3. Revised definitions and nomenclature, developed implementation guidelines with SME/Stakeholder input
4. Conducted formal public comment period
5. Collect and analyze comments
6. Publish common definitions, nomenclature and guidelines

Resources

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