State and Local Policies and Programs to Open the Market for Zero Net Energy Ready Buildings
About NASEO and State Energy Offices

- NASEO represents the 56 governor-designated energy offices from each state and territory.

- State Energy Offices develop programs and policies:
  - Energy efficiency in manufacturing and residential, commercial, and public buildings
  - Renewable energy
  - Oil, gas, electricity production and distribution
  - Energy emergency preparedness and resiliency

- NASEO has collaborated with States and NASEO Affiliate Members over the past several years on zero net energy (ZNE) policies, programs, and two national forums.
NASEO’s Affiliates

A robust and engaged network of +60 private-sector partners, including representatives from business, trade associations, nonprofit organizations, educational institutions, laboratories, and government.
ZNE Building Progress

Number of ZNE Projects from 2012 to 2014

- **2012**
  - ZNE Verified Buildings and Districts: 21
  - ZNE Emerging Buildings and Districts: 39
  - Ultra-low Energy Buildings: 39

- **2014**
  - ZNE Verified Buildings and Districts: 33
  - ZNE Emerging Buildings and Districts: 127
  - Ultra-low Energy Buildings: 53

(2012 report used label “ZNE-Capable”)

Courtesy of New Buildings Institute | newbuildings.org
ZNE by Building Type and Sector

ZNE Building by Type

Building Type
- Education–K-12
- Office
- Education–Higher
- Other
- Multifamily
- District
- Public Assembly
- Education–General
- Retail
- Library
- Laboratory
- Warehouse
- Public Order–Safety
- Airport
- Mixed Use
- Office-Other

ZNE Verified
ZNE Emerging

Courtesy of New Buildings Institute | newbuildings.org
Governors’ Executive Orders and Actions

- Executive Orders:
  - California Governor Brown Executive Order B-18-12:
    - All new state buildings and major renovations starting design in 2025 shall be ZNE; 50% of new state facilities beginning design after 2020 shall be ZNE
  - New Mexico: Governor Richardson Executive Order 2009-002 “Clean Energy State”

- Governor Action:
  - Former Governor Patrick of MA formed the MA Zero Net Energy Buildings Task Force
  - Final report contained 44 recommendations for advancing on path toward ZNE buildings

Links to more info on [CA](#) and [MA](#)
New Mexico Sustainable Buildings Tax Credit

- 2007 Senate Bill 463; administered by New Mexico Energy, Minerals and Natural Resources Department

  - Residential:
    - Build Green NM or LEED-H Silver
    - HERS Score of 60 or lower
    - 2,000 sq. ft. home $10,000 tax credit
    - $4 million annual cap (2014, 2015, 2016)
    - Over 4,000 credits to date (HERS average ~54/55)

  - Commercial:
    - LEED Silver, Platinum, or Gold
    - Modeled energy reduction of 60% vs. nat’l average (EPA Target Finder)
    - Enhanced commissioning (and exploring operational tracking)
    - $1 million annual cap (2014, 2015, 2016)
New Mexico Sustainable Buildings Tax Credit

Commercial 2013:
• 2 Macy’s
• 1 Church
• 3 Offices
• 1 hotel
• 9-10 multifamily

Link to program details and tiers

Hotel Clovis: 1930-era hotel turned apartments and commercial space (Clovis, NM) – had been abandoned
ZNE Homes - Colorado Energy Saving Mortgage Incentive

- **HB 13-1105** – June 2013
- Grew out of previous ENERGY STAR New Homes program and Architecture 2030 research
- Administered by Colorado Energy Office (CEO)
- Provides tiered mortgage incentives for both new & existing (e.g. refinance) homes
- Homebuyers select “energy package”
- Secondary goal of training mortgage lenders/brokers
- CEO providing building science/sales training

New Town Builders Zero Energy Home
Incentive structure ("energy package")

<table>
<thead>
<tr>
<th>New Homes HERS</th>
<th>Mortgage Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 – 40</td>
<td>$1,000</td>
</tr>
<tr>
<td>39 – 25</td>
<td>$2,500</td>
</tr>
<tr>
<td>24 – 11</td>
<td>$3,000</td>
</tr>
<tr>
<td>10 and below</td>
<td>$8,000</td>
</tr>
</tbody>
</table>

- Non-state match of mortgage balance required: .5% for existing homes; .6% for new homes
  - Can come from lender, builder, realtor, etc.
  - $300,000 new-home mortgage: state - $6,200; match - $1,800
- Approx. 300 mortgages ready to be reserved (~80% new construction)
Catalyzing the ZNE Schools Sector

- Maryland Energy Administration awarded $9 million as part of utility merger to design and build 3 ZNE public schools
  - 2 counties have been chosen: Howard County and Baltimore City
  - Funds will provide design assistance and pay for “incremental cost”

- Kentucky: Home of two verified ZNE schools and one ZNE Emerging school (Turkey Foot Middle School)

Locust Trace AgriScience High School Campus

Richardsville Elementary
Catalyzing the ZNE Schools Sector

- Bertschi School Living Science Building, Seattle, WA
  - 1,421 sq. ft
  - First building to achieve the Living Building Challenge v2.0

- Hood River Middle School Music & Science Building
  - 6,878 sq. ft
  - Hood River, OR

Bertschi School

Hood River Middle School

Courtesy of New Buildings Institute
ZNE in State and Local Office Buildings

- Alfred A. Arraj U.S. Courthouse, Denver, CO
  - 318,837 sq. ft
  - Meeting energy targets and security needs

- Iowa Utilities Board & Office of Consumer Advocate, Des Moines, IA
  - 44,638 sq. ft
  - Zero energy & cost effective, even with a limited budget
ZNE in the Multifamily Sector

La Valentina North Townhome Project, Sacramento, CA

- Public-Private Partnership
  - Sacramento Municipal Utility District (SMUD)
  - Domus Development, LC

Courtesy of New Buildings Institute
Strategies to Advance ZNE

- Develop Federal-State Collaborative ZNE Program
- Support State and Local ZNE Policies and Programs
- Develop and Coordinate Sector-Specific Task Forces
- Publish Case Studies and Best Practices
- Recognize ZNE and ZNE-Ready Accomplishments
- Ensure Communications & Market Motivations
- Create incentives for ZNE at the state or local level
Strategies to Advance ZNE (cont’d)

- Set voluntary ZNE goals for government buildings
- Identify and support target sector efforts (e.g., schools)
- Encourage district or community-scale planning and infrastructure for renewable and alternative-energy systems
- Improve appliance standards to reduce energy use outside the scope of building energy codes
- Address existing building stock by leveraging renewal cycles and adopting performance tracking requirements
- Encourage greater federal leadership and collaborative efforts with states, builders, and building product manufacturers
NASEO-NBI ZNE National Conferences

- NASEO and NBI collaborated to hold the nation’s first Getting to Zero national conference in September 2014
- NASEO, NBI, and RMI collaborated to hold the second Getting to Zero Forum in February 2015
- [http://gettingtozeroforum.org](http://gettingtozeroforum.org)
- ZNE Pathways Discussion at the NASEO Annual Meeting September 2015
The American Council for an Energy-Efficient Economy (ACEEE)

- ACEEE is a 501(c)(3) nonprofit that acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, & behaviors
- 50 staff; headquarters in Washington, D.C.
- Focus on end-use efficiency in industry, buildings, & transportation
- Other research in economic analysis; behavior; energy efficiency programs; national policy; utilities, state, & local policy
- Funding:
  - Foundation Grants (52%)
  - Contract Work & Gov’t. Grants (20%)
  - Conferences & Publications (20%)
  - Contributions & Other (8%)
### ZNE Terms and Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net zero site energy</strong></td>
<td>A building that produces as much energy as it uses in a year, when accounted for at the site</td>
</tr>
<tr>
<td><strong>Net zero source energy</strong></td>
<td>A building that produces as much energy as it uses in a year, as measured at the source (i.e., accounting for energy used to generate and deliver the energy to the site)</td>
</tr>
<tr>
<td>Net zero energy equivalent, or off-site zero energy</td>
<td>A building that produces as much energy as it uses in a year, with consideration of off-site renewable energy sources</td>
</tr>
<tr>
<td>Net zero energy emissions, or zero carbon</td>
<td>A building that produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources</td>
</tr>
<tr>
<td>Net zero energy ready, net zero capable, or <em>ultra low energy</em></td>
<td>A highly efficient building that could meet its energy needs with the addition of onsite renewables</td>
</tr>
</tbody>
</table>
State of ZNE Construction
commercial and multifamily

Number of ZNE Projects from 2012 to 2014

2015 Update:
- 39 verified
- 152 emerging
- ? ultra-low energy

2012:
- ZNE Verified Buildings and Districts: 21
- ZNE Emerging Buildings and Districts: 39
- Ultra-low Energy Buildings (2012 report used label “ZNE-Capable”): 39

2014:
- ZNE Verified Buildings and Districts: 33
- ZNE Emerging Buildings and Districts: 127
- Ultra-low Energy Buildings (2012 report used label “ZNE-Capable”): 53

Courtesy of New Buildings Institute | newbuildings.org
Commercial building EUI: existing stock vs. recent codes and ULE/ZNE construction
ZNE can be cost-effective

Several studies on cost-effectiveness have found:

- Project costs fall within the same range as conventional construction projects for a diverse set of building types
- Incremental costs difficult to tease out because of design and technology tradeoffs
- Demonstration projects skew costs upwards relative to mainstream projects
- Commercial efficiency measures add 1-6% to project costs; efficiency + renewables add 5-10%; ROI ~9%
- Residential efficiency measures cost only 20-50% of the cost of PV to generate equivalent energy
Saving 50+% in Commercial Buildings

- Reduce lighting and “other” loads to downsize HVAC
- Install and commission enhanced controls including algorithms to spot problems
- Use air for ventilation, not for distribution of heating and cooling.
- Address specific challenges with cooling and miscellaneous end uses
  - Alternatives to “weatherized” roof-top units
- Match water heating service to demand for hot water
Moving the needle towards ZNE

- Early adopters see ZNE as inevitable
  - want to be ahead of the curve
  - willing to try new ideas
  - motivations are inherently different than rest of market

- Essential challenge is to move to the broader construction industry
  - industry is tradition bound and resistant to changes to standard practice

- Market transformation efforts can accelerate the change
  - ultimately, codes are needed to bring the entire industry along
Supportive policies and programs

- **Complementary policies**
  - Building labeling and disclosure
  - Stretch codes and green codes
  - Financing mechanisms
  - Public sector leadership

- **Coordination and advocacy activities**
  - Code development, adoption, implementation
  - Reform of cost-effectiveness methods
  - Appliance and equipment standards
**Program approaches**

- Promote integrated design for variety of building types
- Build capacity in design community, building trades, operations
- Collect data for code development and implementation
- Couple with demand response and peak reduction
- Encourage district-scale projects
- Leverage existing building programs (e.g., whole building performance/retrofits)
- Incorporate behavioral strategies
Thank You!

- Jennifer Thorne Amann, LC
- Buildings Program Director
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- Washington, D.C. 20045
- 202-507-4015
- jamann@aceee.org

- Web: aceee.org
- Twitter: ACEEEDC
- Facebook: American Council for an Energy-Efficient Economy
Zero Net Energy Buildings

High Performance Schools
The Kentucky Experience

Congressional Staffer Briefing
June 4, 2015

Greg Guess, Director
Division of Efficiency and Conservation
Kentucky Department for Energy Development and Independence
What is a High Performance School?

Photo Courtesy Sherman-Carter-Barnhart Architects
Characteristics

- Healthy and Productive Environment
- Cost Effective to Operate and Maintain
- Sustainability
- Reduced energy consumption saves districts money
- School Facility as 3-D Classroom
Integrated Design Process

Creating a school with these characteristics is not difficult, but does require an integrated, whole-building approach to the design process.

Engage all stakeholders in:

- Design
- Construction
- Operation
Building Blocks

Acoustic Comfort
Commissioning
Day lighting
Durability
Energy Analysis Tools
Energy-Efficient Building Shell
Environmentally Preferable Materials and Products
Environmentally Responsive Site Planning

High-Performance HVAC & Electric Lighting
Life Cycle Cost Analysis
Renewable Energy
Safety and Security
Superior Indoor Air Quality
Thermal Comfort
Visual Comfort
Water Efficiency

Source: Sustainable Buildings Industry Council
LEED

- LEED, Leadership in Energy and Environmental Design.

- Developed by U.S. Green Building Council to provide building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.

**New Construction and Major Renovations**

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation and Design Process
Partnering With ENERGY STAR®

- U.S. Environmental Protection Agency national energy performance rating system.

- Facilities among the top 25 percent of all comparable buildings.

- Measure a year’s worth of energy-use data.

- ENERGY STAR buildings must receive at least 75 out of 100 points in EPA’s rating system.
The Net Zero Concept – the Next Step

Questions:

- Could we create a building that consumes a minimal amount of energy?

- Could we then offset that by allowing it to produce clean energy?
Net Zero

Net Zero is defined by the Kentucky Department of Education as a facility that, although connected to the power grid, would produce as much energy as it would use annually.

This means, on average, generates enough energy to meet its annual energy demands.

These facilities are typically extremely efficient, to the point that the addition of renewable energy sources to meet the energy needs become cost effective.

Source: Kentucky Department of Education
Net-Zero Ready

Net-Zero Ready Schools – defined as one that is designed with components and building strategies integrated into the design process to achieve state-of-the-art energy efficiency – operation at or below 25 kBtus/sf/yr, with hardware and engineering in place to readily accept renewable energy installations at a later date.

Kentucky Department of Education reports 14 Net-Zero ready school projects completed or initiated.

Source: Kentucky Department of Education
Turkey Foot Middle School
Kenton County School District

Year School Built 2010
School Building Size 133,000 sf
PV installation completed April 2012
Consuming 25 kBtu/sf/yr before solar
443 kW solar PV
Construction Cost - $200/sf with solar PV
Architects: PCA Architecture
Engineer: CMTA Consulting Engineers
Building Performance - 13 kBtu/sf
(May 2012-April 2013)
## Turkey Foot Savings Comparison

**New vs. Old**
Turkey Foot Middle School Comparison

**2011-2012 Savings of $56,395**

<table>
<thead>
<tr>
<th></th>
<th>Old TF School</th>
<th>New TF School</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Square Footage</strong></td>
<td>66,523</td>
<td>133,000</td>
<td>199.9% increase</td>
</tr>
<tr>
<td><strong>Annual Energy Cost</strong></td>
<td>$94,954</td>
<td>$38,558</td>
<td>59.4% decrease</td>
</tr>
<tr>
<td><strong>EUI (kBtu/sf)</strong></td>
<td>79.2</td>
<td>13.6</td>
<td>82.8% decrease</td>
</tr>
</tbody>
</table>

Photo courtesy Kenton County School District
Net-Zero Energy

Richardsville Elementary School is the first net-zero energy public school in the United States. Building is 72,285 sf and serves over 500 students. Uses 75% less energy than the average American school. Produces as much clean energy as it consumes by converting solar power to electricity with a 349 kW solar panel array.
Richardsville Elementary

Cost - $15.2 million (with solar)
$12.4 million (without solar)

Photos Courtesy Sherman-Carter-Barnhart Architects
Richardsville Elementary

✓ Registered as a LEED Gold School with the USGBC, making it as environmentally friendly as it is energy efficient.

✓ Constructed at a cost equal to a conventional school.

✓ Teaches students environmental stewardship by involving them in monitoring the building’s performance.
  • Student energy teams analyze the school’s plug-in devices and lighting.
  • Student monitored recycling program.
  • The weather station, part of the outdoor classroom, helps students monitor solar panel efficiency.
Strategies

- High Performance Building Envelope
- Active Day lighting
- Geothermal HVAC
- Monitoring Controls
- Dedicated Outside Air System with Energy Recovery and CO2 Sensors
- Alternative Renewable Energy Source
- Green Kitchen Strategies
- Operations and Maintenance Plan
- Wireless Computer Technology
Kentucky School Energy Managers

41 School Energy Managers serving 81 districts

Energy managers and districts expected to increase in FY 2015
Kentucky Accomplishments

- 70% increase in ENERGY STAR schools in less than 3 years.
- Places 4th nationally in percentage of schools ranked ENERGY STAR.
- 13% of Kentucky’s ENERGY STAR schools have scores above 95.
  Among these schools, eight have scored a near-perfect 99, and ten schools are among the most efficient schools in the nation with a score of 100.
- Two districts out of seven nationwide received the 2014 ENERGY STAR Partner of the Year Award for energy management.
- 11 districts recognized as ENERGY STAR Leaders for portfolio-wide energy efficiency improvements of 10%, 20% or 30% or more on organization-wide baseline.
- First Net-Zero Energy K-12 School in USA, located in Richardsville, KY.
Take-Aways

- You can do this!
- Challenge design team – efficiency does not have to cost more.
- Do design charrette – know what you want.
- Don’t be afraid to set ambitious goals.
- Do building commissioning.
- Market transformation is evolutionary.
KY Energy and Environment Cabinet

Greg.Guess@ky.gov

502 – 564-7192
Kentucky Accomplishments

- 70% increase in ENERGY STAR schools in less than 3 years.
- Places 5th nationally in percentage of schools ranked ENERGY STAR.
- 15% of Kentucky's ENERGY STAR schools have scores above 95. Among these schools, eight have scored a near-perfect 99, and ten schools are among the most efficient schools in the nation with a score of 100.
- Two districts out of four nationwide received the 2013 ENERGY STAR Partner of the Year Award for energy management.
- 12 districts recognized as ENERGY STAR Leaders for portfolio-wide energy efficiency improvements of 10%, 20% or 30% or more on organization-wide baseline.
- Six schools received US Green Ribbon Awards, 2012 and 2013 combined.
Zero Net Energy Communities

Leading the Way for Sustainable Development
Market: Consumer Sentiment

University of Michigan Consumer Sentiment (UMSENT)
Source: Thomson Reuters/University of Michigan

Market: Residential Construction

Total Private Construction Spending: Residential (PRICESCONS)
Source: U.S. Department of Commerce: Census Bureau

Market: Oil Price

Spot Oil Price: West Texas Intermediate (OILPRICE)
Source: Dow Jones & Company

Market: Natural Gas Price

Natural Gas Price: Henry Hub, LA (GASPRICE)
Source: Dow Jones & Company
Market Drivers

Economic
- Housing market shows signs of recovery
- Master Planned communities

Energy Efficiency
- Increased awareness
- DOE Performance Rulings.

Policy
- Investment Tax Credit
- Local state and utility rebates
- ZNE building codes
- Reduction in GHG Emissions

Energy & Utilities
- Manage Peak Load
- Aging infrastructure
- EPA 111D – Clean Power Plan
- Renewable Portfolio Standard

Demographics
- Baby Boomers – Fixed Income
- Millennials – educated consumer
- Federal Gov’t – largest building owner

Factors
- ‘Green’ Loan Programs
- 3rd party financing

Drivers
- Higher Efficiency product range
- Savings as a Solution

Market drivers and

Source: TTNA
Breaking Down the Hurdles for Adoption

The Thermal Service Provider
- Public Utility Model

System Sale

Thermal Energy Service Charge

Facility Charge
On-Bill Financing

Maintains Loop

Maintenance Contract

Home Owner

Utility

Loop Contractor

Geothermal Contractor

On-Bill Financing
Breaking Down the Hurdles for Adoption

The Thermal Service Provider

- Private Utility Model

Renewable Energy Credits

• Tax Credits
• Rebates
• REC Issuance

Sales of RECs to Market

Fixed Monthly Loop Access Fee

100% of the cost at commissioning

Geothermal Contractor

System Sale

Thermal Service Provider

Home Owner

Monthly Energy Savings

Renewable Energy Credits
# Geothermal Master Planned Communities

<table>
<thead>
<tr>
<th>Name</th>
<th>Serenbe, Georgia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New Urban village based on English hamlets</td>
</tr>
<tr>
<td></td>
<td>• High density clusters with green space and agriculture</td>
</tr>
<tr>
<td></td>
<td>• &gt; 400 residents, retail, food services, hospitality</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>Building Technology –</td>
</tr>
<tr>
<td></td>
<td>• Geothermal heating and cooling system</td>
</tr>
<tr>
<td></td>
<td>• Heat pump water heater</td>
</tr>
<tr>
<td></td>
<td>• Solar photovoltaic system</td>
</tr>
<tr>
<td></td>
<td>• Energy efficient home appliances</td>
</tr>
<tr>
<td></td>
<td>• Controls</td>
</tr>
<tr>
<td><strong>Success factors</strong></td>
<td>Private thermal service provider concept adopted by master developer</td>
</tr>
</tbody>
</table>
## Geothermal Master Planned Communities

<table>
<thead>
<tr>
<th>Name</th>
<th>Badger Mountain South, Richland, WA</th>
</tr>
</thead>
</table>
| **Overview** | • Master planned community.  
• 1,500 acres  
• 5,000 new homes planned  
• major retail center, four sites for neighborhood schools  
• over 400 acres of parks, trails and green spaces.  
• 20 yr build out |
| **Design** | **Building Technology** –  
• Geothermal HVAC  
• PV ready  
• EV Charging Stations  
• Smart Home Security |
| **Success factors** | • ORCA Energy Master Service Agreement  
• Geothermal loop utility removes initial cost barrier for home owners. |
# Geothermal Master Planned Communities

## Name

<table>
<thead>
<tr>
<th>Whisper Valley, Austin, Texas</th>
</tr>
</thead>
</table>

## Overview

- 2,063-acre, mixed-use planned community
- 7,500 single and multi-family homes
- 2 million square feet of retail and office space.
- 15 year Build Out

## Design

- Zero Net energy Ready construction
  - Geothermal community loop
  - PV ready
  - Energy efficient appliances

## Success factors

- EcoSmart Solution
  - develops and implements alternative energy structure programs in large-scale real estate projects.
  - Aggregation of technology, construction, communications and finance companies,
Thank you!