Efficiency First

THE PATH TO NET ZERO

Amy Schmidt
The Dow Chemical Company
October 2012
What is a Net Zero Energy Home?

- A home that produces as much energy as it consumes on an annual basis.
A study by the Electric Reliability Council of Texas (ERCOT) suggests that consumer demand may outstrip resources available as early as 2014.

Report on the Capacity, Demand, and Reserves in the ERCOT Region, May 2012
“... improvements in energy efficiency more than pay for themselves. We estimate that dramatically increasing energy efficiency would require annual investments of $170 billion over the next 13 years. But these investments would generate a return of well over $900 billion annually by 2020 through lower energy costs. Energy efficiency is the low-hanging fruit of the clean-energy revolution.”
MOVING TOWARD NET ZERO

• “Fort Bliss’s plans . . . to achieve net zero in three categories — energy, water and waste. And it must do this by 2018” Texas Tribune, 4/26/12

• 2008 California Long Term Energy Efficiency Strategic Plan: all new residential construction in California be ZNE by 2020, and that all new commercial construction be ZNE by 2030.
CHARACTERISTICS OF NET ZERO HOMES

- System approach:
  + Efficient footprint
  + Optimized orientation
  + Well insulated envelope and efficient windows
  + Air tight and ventilated right
  + Right sized HVAC
  + High efficacy lighting and day lighting
  + Efficient water heating
  + Renewable energy

High Performance

+ Renewables
CHARACTERISTICS OF NET ZERO HOMES

Efficient footprint

"a house that favors quality of design over quantity of space satisfies people far more than...those characteristics in reverse."

Susan Susanka, architect & author “The Not So Big House”

“Thirty-one billion cooled square feet have been added in the South in the last two decades alone, which is more than the cooled square footage of homes built in that region in the previous five decades combined. “

Source: U.S. Energy Information Administration

Source: National Association of Home Builders
CHARACTERISTICS OF NET ZERO HOMES

- Optimized orientation

Properly positioning your house on the site saves energy and makes the home more comfortable year-round.

Tips for Texas:

North – the cool side of the home. Locate the majority of windows on this side.

South – The sun is high on this side of the home. Use a 2 ft. overhang for effective shading throughout the day.

East – The morning sun is low in the sky. Avoid placing windows on this side of the home.

West – the afternoon sun is low in the sky. Minimize window and wall area on this side of the home or buffer with trees, carports, porches, etc.
CHARACTERISTICS OF NET ZERO HOMES

- Well insulated envelope and efficient windows

In warm/hot climates lower your SHGC. 2012 IECC for CZ 1-3 = 0.25

In warm/hot climates unvented attics with insulation at the deck are a great strategy for reducing energy consumption particularly when the HVAC is in the attic.
+ Air tight and ventilated right

You can’t guess . . . TEST!

Net Zero Homes typically test between 0.5 and 1.0 ACH50.

+ dehumidification in hot humid climates
CHARACTERISTICS OF NET ZERO HOMES

+ Right sized HVAC

Ducts:
- Location
- Design
- Sealed

“Studies have shown that occupants are more agreeable to a higher summer temperature set-point when the relative humidity is lower in the home. So to remove moisture, we need the air-conditioner running.”

Source: CARB, 9/2/2009

Don’t spend more than you need to on your HVAC. Bid requests should require Manual J calculations.
CHARACTERISTICS OF NET ZERO HOMES

+ High efficacy lighting and day lighting

<table>
<thead>
<tr>
<th>Energy Efficiency &amp; Energy Costs</th>
<th>Light Emitting Diodes (LEDs)</th>
<th>Incandescent Light Bulbs</th>
<th>Compact Fluorescents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life Span (average)</td>
<td>50,000 hours</td>
<td>1,200 hours</td>
<td>8,000 hours</td>
</tr>
<tr>
<td>Watts of electricity used</td>
<td>6 - 8 watts</td>
<td>60 watts</td>
<td>13-15 watts</td>
</tr>
<tr>
<td>(equivalent to 60 watt bulb)</td>
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<tr>
<td>LEDs use less power (watts) per unit of light generated (lumens). LEDs help reduce greenhouse gas emissions from power plants and lower electricity bills.</td>
<td></td>
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</tr>
<tr>
<td>Kilo-watts of Electricity used</td>
<td>329 KWh/yr.</td>
<td>3285 KWh/yr.</td>
<td>767 KWh/yr.</td>
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<tr>
<td>(60 Incandescent Bulbs per year equivalent)</td>
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<tr>
<td>Annual Operating Cost</td>
<td>$32.85/year</td>
<td>$328.59/year</td>
<td>$76.65/year</td>
</tr>
<tr>
<td>(60 Incandescent Bulbs per year equivalent)</td>
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</tbody>
</table>

Day lighting:
- Solar tubes
- Light shelves
- Reflective/light colored indoor surfaces
- Open floor plan
- Orientation
Efficient water heating

There are many system choices: solar thermal, on demand, storage, heat pump . . .

Distribution:
- Location of system
- Volume of run
  - pipe length
  - pipe diameter
- Pipe insulation
- Low flow fixtures
- Efficient dish and clothes washer
CHARACTERISTICS OF NET ZERO HOMES

- Renewable energy

- Hydro electric
- Geothermal
- Energy Storage
- Solar PV
- Solar thermal
- Wind power
CHALLENGES OF NET ZERO

- Misconceptions
- Resistance to change
- Lack of consumer awareness
- Modeled vs. actual performance
- Lack of design guidance
- Home valuation (PITI)
- Quality of construction
- Occupant behavior
- Cost of renewable energy
CHALLENGES OF NET ZERO

- Misconceptions
CHALLENGES OF NET ZERO

- Resistance to change

It’s a team effort. Communication is critical.

Source: Appetite for Change
CHALLENGES OF NET ZERO

- Lack of consumer awareness

Source: GE
CHALLENGES OF NET ZERO

- Modeled vs. actual performance

“I predict that someday, energy use will be so important that we will measure it.” - Henry Gifford

Check your data! Source: www.energysavingscience.com
CHALLENGES OF NET ZERO

- Lack of design guidance

“Results from this lab will show if net-zero technologies are ready for a neighborhood near you”  P. Gallagher, NIST

Building America Solution Center launching Jan. 2013 www1.eere.energy.gov/buildings/

COBBLESTONE Homes

Sustainable is Attainable — InVision Zero, 2011
CHALLENGES OF NET ZERO

Home valuation (PITI)

Change the equation: \( \text{PITIE} = \text{Principle} + \text{Interest} + \text{Taxes} + \text{Insurance} + \text{Energy} \)

“PITI absolutely misrepresents the situation. For many homeowners, Energy is the top cost after PI (principal & interest) payments, frequently larger than property taxes and is almost uniformly larger than that last I (insurance).”

Source: Get Smart! NOW!
CHALLENGES OF NET ZERO

Quality of construction

• Educate contractors
• Provide a mock up of proper detailing
• Inspect
• Test

Source: Knight

Source: Green Journey

IF ALL ELSE FAILS
LOWER YOUR STANDARDS

Source: Knight
CHALLENGES OF NET ZERO

- Occupant behavior

Source: CEC, Oct. 2006

Source: Wattstopper

Source: Wattstopper

Source: CEC, Oct. 2006
CHALLENGES OF NET ZERO

Cost of renewable energy

+ Efficiency First!

Renewable energy systems are more expensive than efficiency. Make the home as efficient as you can and then add a smaller less expensive system to take it to NZE.

www.dsireusa.org
BENEFITS OF NET ZERO

- Lowered cost of home ownership
- Greater comfort
- Reduced need for new power generation
- Environmental stewardship
- Energy independence and security
- Marketing and press
BENEFITS OF NET ZERO

- Lowered cost of home ownership

Source: www.HousingEconomics.com
BENEFITS OF NET ZERO

Greater comfort

Right sized equipment results in smaller temperature swings.

ASHREA Standard 55, Thermal Environmental Conditions for Occupancy

- Temperature
- Thermal radiation
- Air speed

Windows

Insulation plus air sealing results in fewer comfort complaints, better noise control, less condensation, greater durability and reduced costs.
**BENEFITS OF NET ZERO**

- Reduced need for new power generation

The cheapest energy is the energy that will never be produced.

Source: ERCOT
BENEFITS OF NET ZERO

- Environmental stewardship

Figure 2-7. CO₂ Reductions From Energy Efficiency and Renewable Energy

BENEFITS OF NET ZERO

- Energy independence and security

U.S. Electrical Generation by Source

- Reduce price instability:
  - peak demand reduction
  - use domestic sources
  - keeping demand inelastic

Source: EIA
BENEFITS OF NET ZERO

Marketing and press

“Cobblestone Homes was honored to host Charles "Chuck" McConnell, the U.S. Department of Energy's assistant secretary for fossil energy, at our InVision Zero house today (June 28, 2012). "Then I get here, and these beautiful custom homes are on big lots, and they had everything you could want — plus great energy ratings," Guiney said of the homes, which, like all Cobblestone homes, were built to high performance standards, operating at energy levels far below the industry standard."
VISION ZERO & INVISION ZERO

2009
2011

www.invisionzerohome.com
INVISION ZERO

Location: subdivision in Midland, MI (climate zone 5)

Cost: under $250,000

Size: 1556 sq/ft ranch 3 bedrooms, 2 baths, tall crawlspace

Estimated Annual Energy Savings: $2,441

Space & Water Heating: geothermal
Renewable energy: BIPV shingles (6KW)

Plug load management: card switch

Under slab: R10

Ceiling: R60 (1.5” cc SPF + cellulose)

Foundation walls: R30 (R10 exterior, R20 interior)

Above-grade walls: R40 (R30 cavity - 2x6 w/cc SPF, R10ci 2” rigid foam)
Mark Wahl Talks About Cost of Ownership

Net Zero Energy Home