



Efficiency First

THE PATH TO NET ZERO

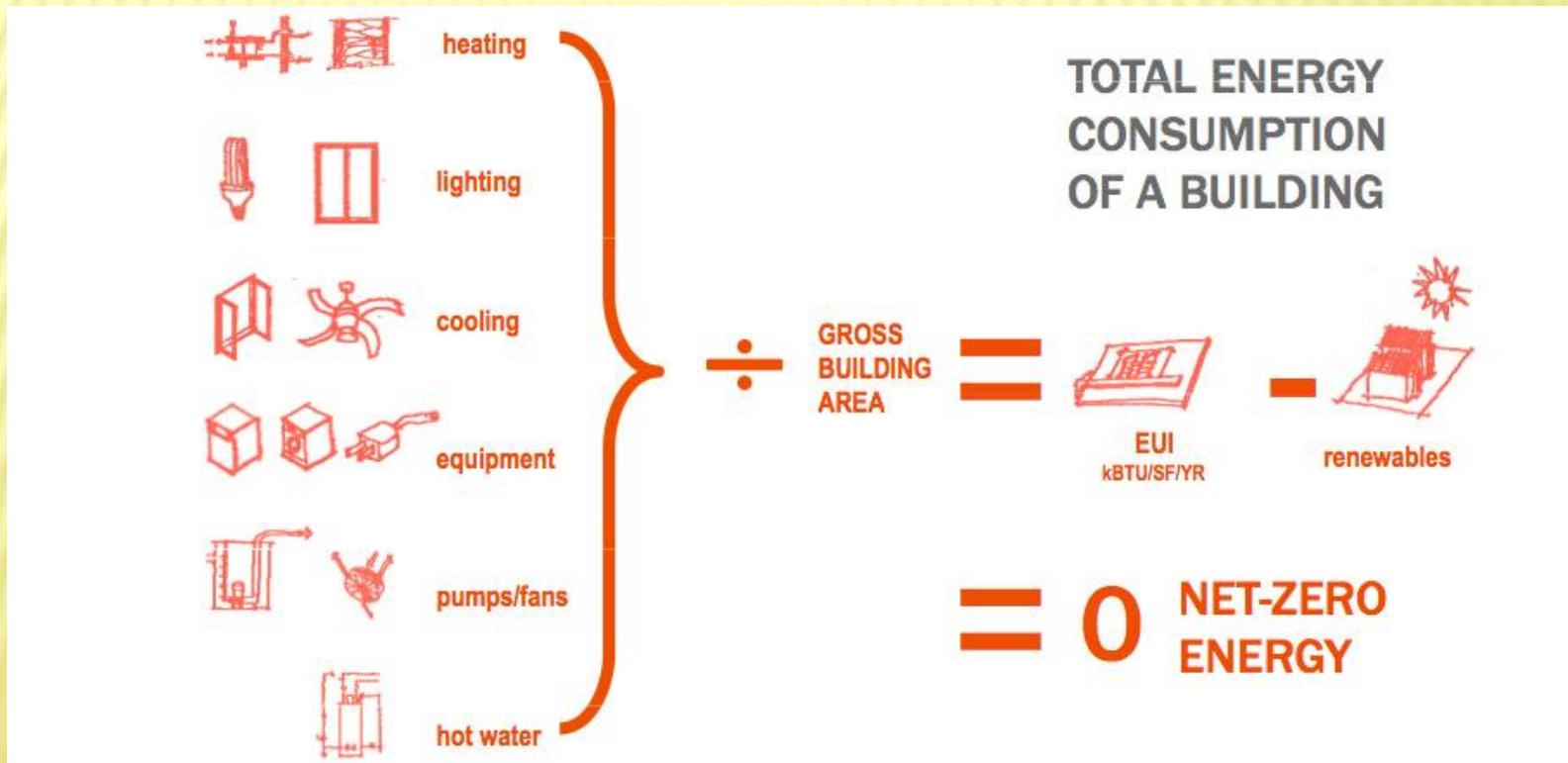
Amy Schmidt
The Dow Chemical Company
October 2012

OCTOBER 2012

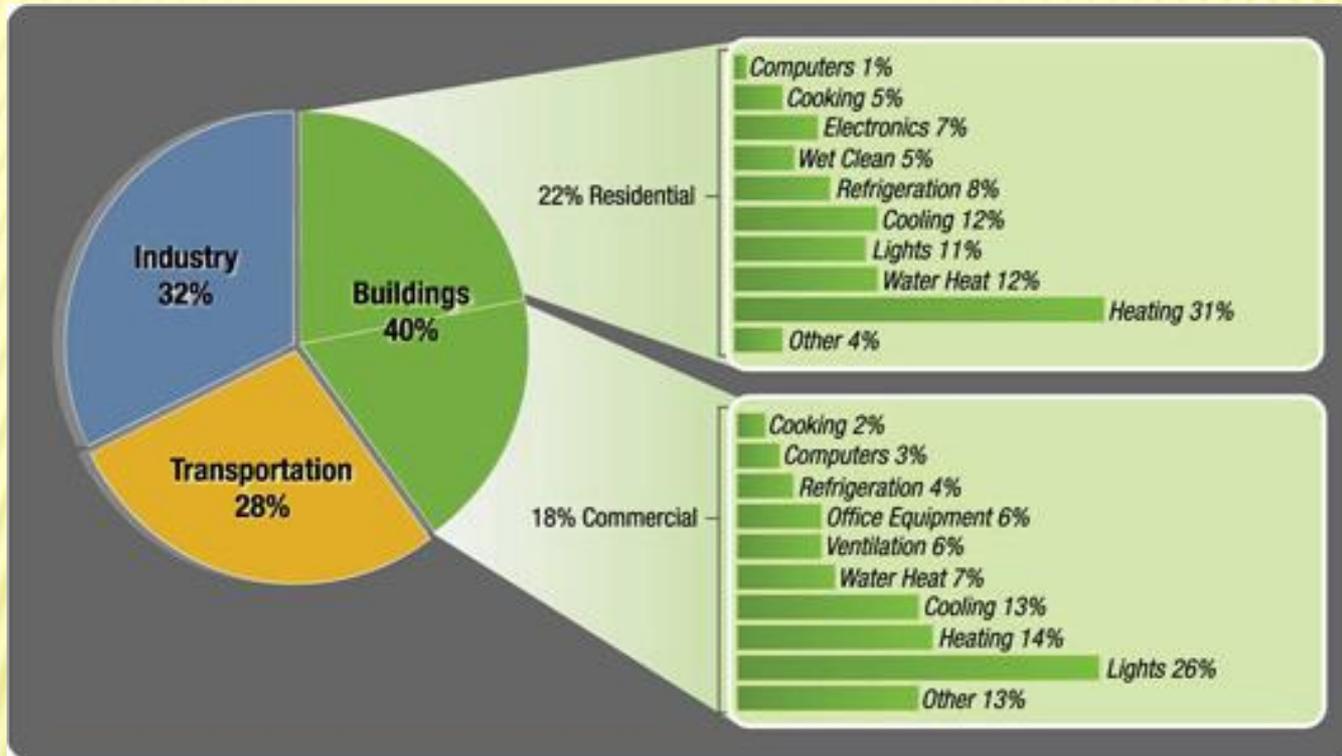


WHAT IS A NET ZERO ENERGY HOME?

- × A home that produces as much energy as it consumes on an annual basis.



OUR ENERGY PROBLEM



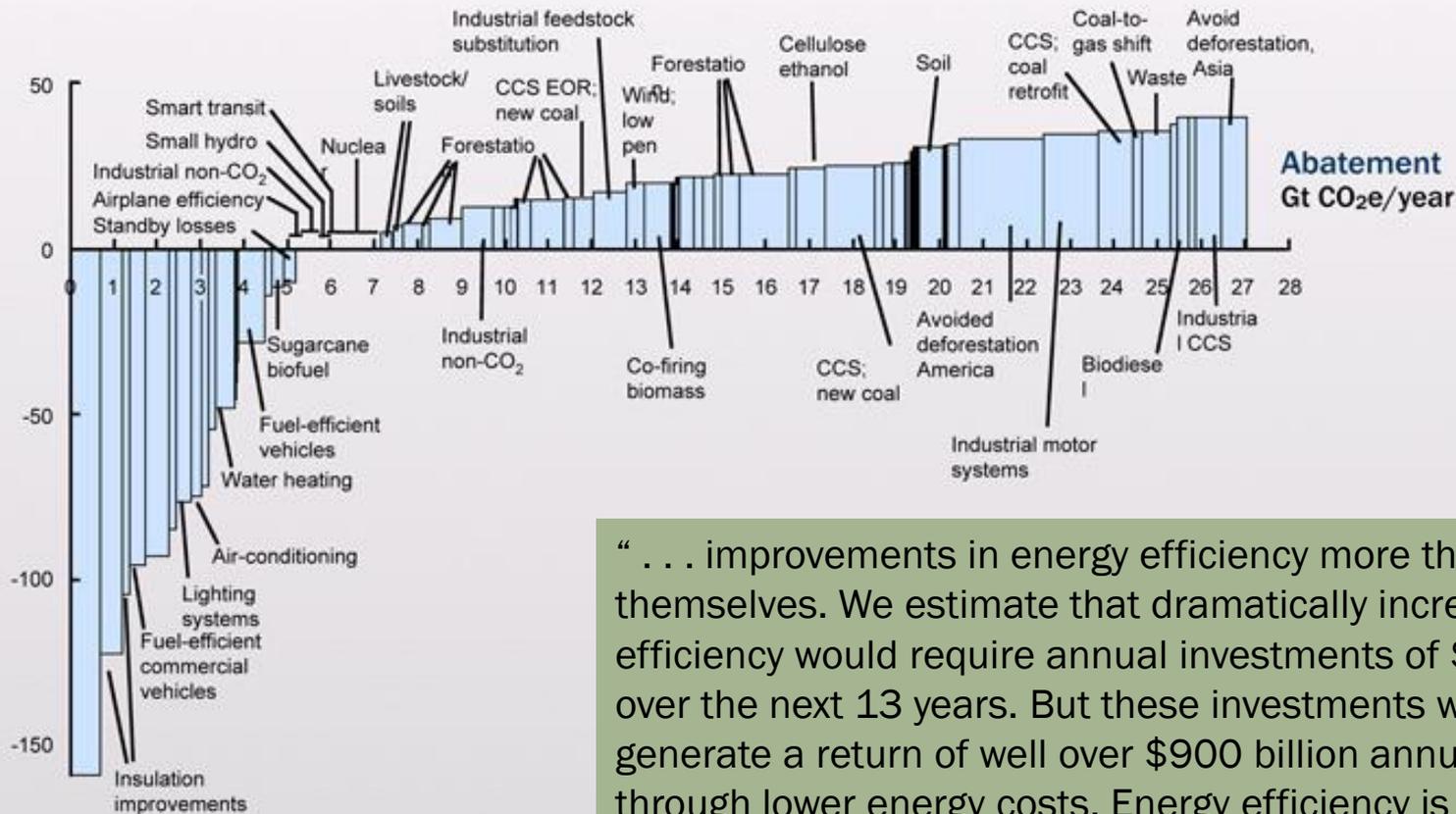
Source: U.S. Department of Energy Buildings Energy Data Book, Sept. 2008

A study by the Electric Reliability Council of Texas (ERCOT) suggests that consumer demand may outstrip resources available as early as 2014.

SOLVING THE ENERGY PROBLEM

THE COST CURVE PROVIDES A “MAP” OF ABATEMENT OPPORTUNITIES

Cost of abatement, 2030, €/tCO₂e*



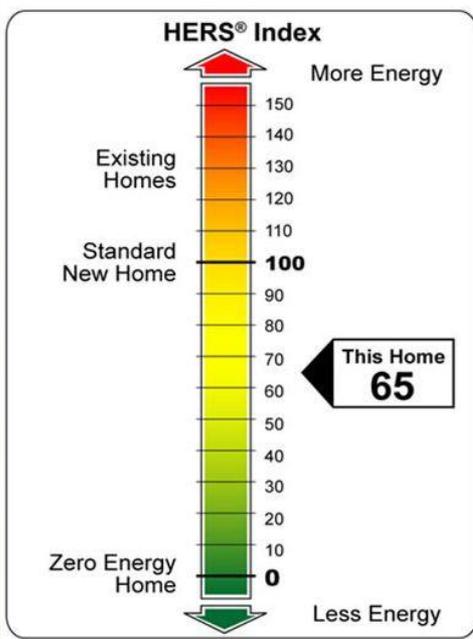
“ . . . improvements in energy efficiency more than pay for themselves. We estimate that dramatically increasing energy efficiency would require annual investments of \$170 billion over the next 13 years. But these investments would generate a return of well over \$900 billion annually by 2020 through lower energy costs. Energy efficiency is the low-hanging fruit of the clean-energy revolution.”

* Cubic feet of carbon equivalents.

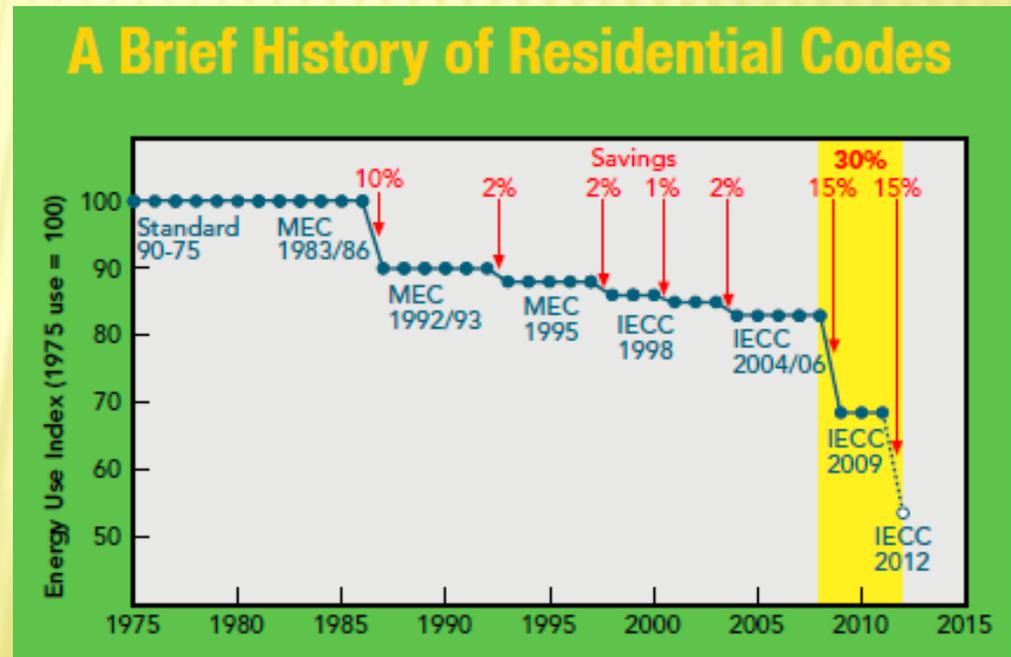
Source: McKinsey and Vattenfall analysis

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.



Source: EPA Energy Star



Source: The U.S. Department of Energy

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

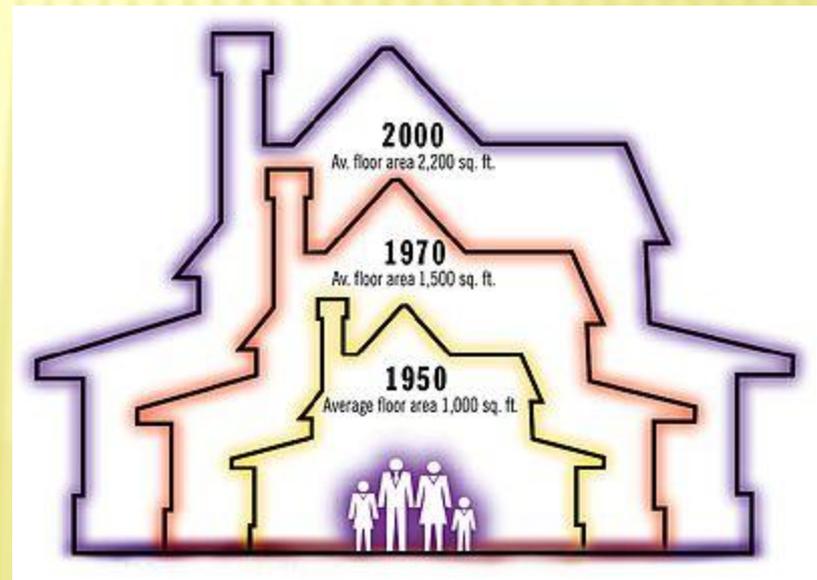
× Efficient footprint

"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

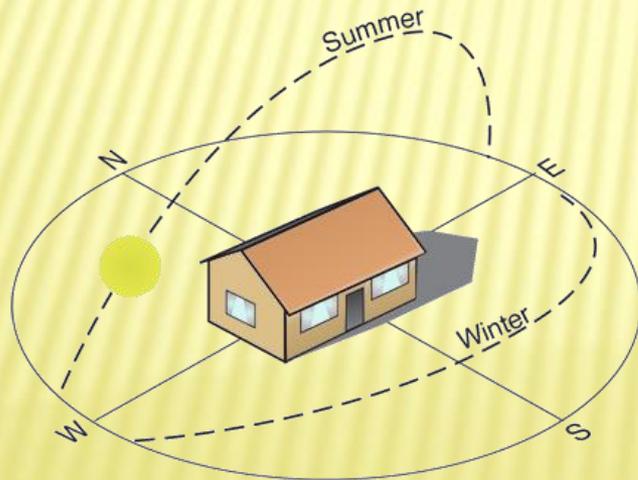


Source: National Association of Home Builders

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.

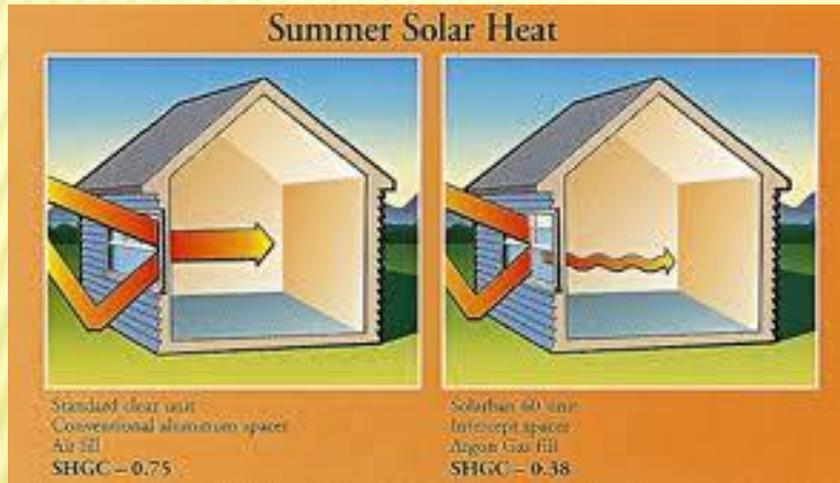
South – The sun is high on this side of the home. Use a 2 ft. overhang for effective shading throughout the day.

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 you SHGC.
2012 IECC for CZ 1-3 = 0.25

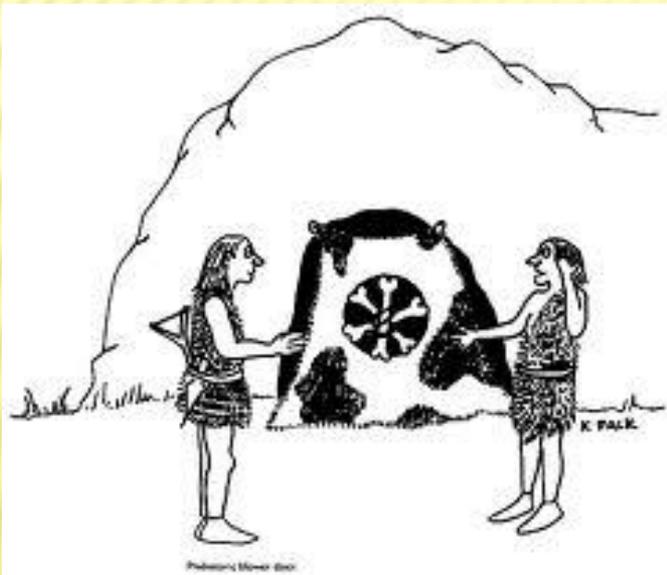


In warm/hot climates unvented attics with insulation at the deck are a great strategy for reducing energy consumption particularly when the HVAC is in the attic.

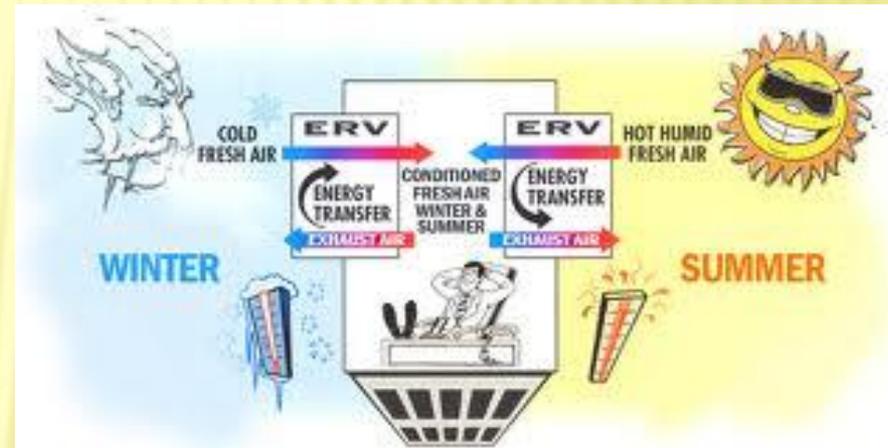
CHARACTERISTICS OF NET ZERO HOMES

+ 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

Energy Efficiency & Energy Costs	 Light Emitting Diodes (LEDs)	 Incandescent Light Bulbs	 Compact Fluorescents
Life Span (average)	50,000 hours	1,200 hours	8,000 hours
Watts of electricity used (equivalent to 60 watt bulb). LEDs use less power (watts) per unit of light generated (lumens). LEDs help reduce greenhouse gas emissions from power plants and lower electric bills.	6 - 8 watts	60 watts	13-15 watts
Kilo-watts of Electricity used (30 Incandescent Bulbs per year equivalent)	329 KWh/yr.	3285 KWh/yr.	767 KWh/yr.
Annual Operating Cost (30 Incandescent Bulbs per year equivalent)	\$32.85/year	\$328.59/year	\$76.65/year

Day lighting:

- Solar tubes
- Light shelves
- Reflective/light colored indoor surfaces
- Open floor plan
- Orientation

CHARACTERISTICS OF NET ZERO HOMES

+ Efficient water heating

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

City of Sunset Valley - Solar Water Heating Rebate Program

Last DSIRE Review: 06/08/2012

Program Overview:

State: Texas

Incentive Type: Local Rebate Program

Eligible Renewable/Other Technologies: Solar Water Heat

Applicable Sectors: Residential

Amount: 30% of installed cost

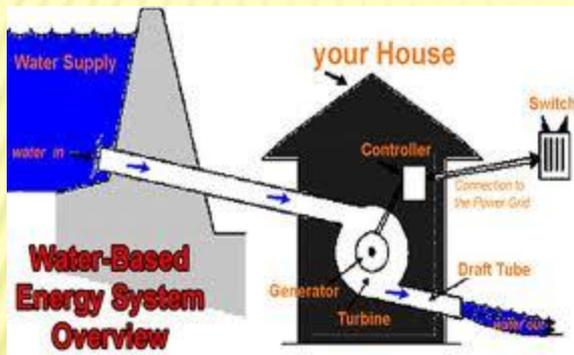
Maximum Incentive: \$2,000

Distribution:

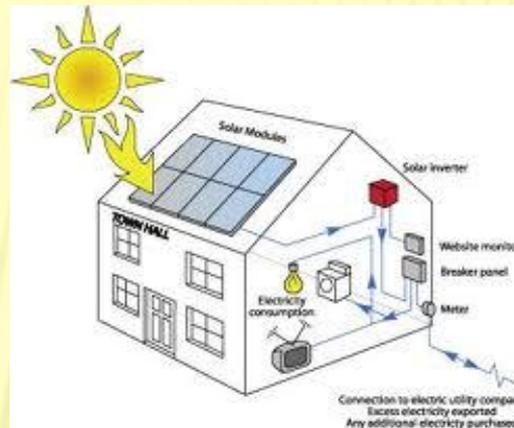
- Location of system
- Volume of run
 - pipe length
 - pipe diameter
- Pipe insulation
- Low flow fixtures
- Efficient dish and clothes washer

CHARACTERISTICS OF NET ZERO HOMES

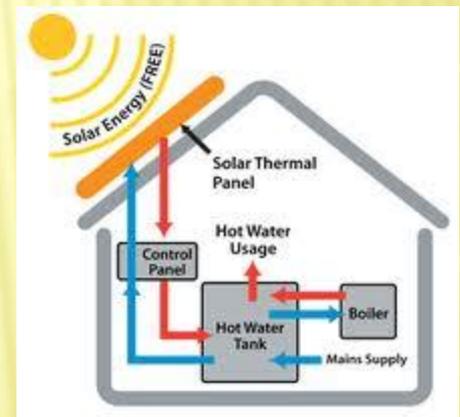
× Renewable energy



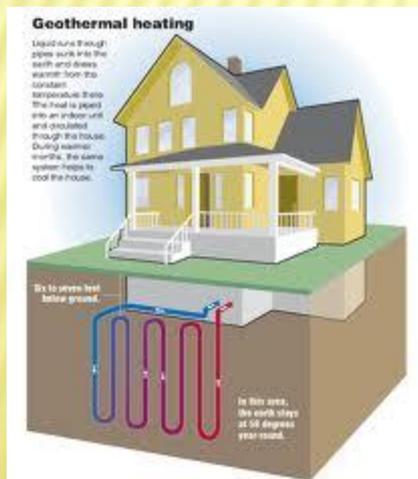
Hydro electric



Solar PV



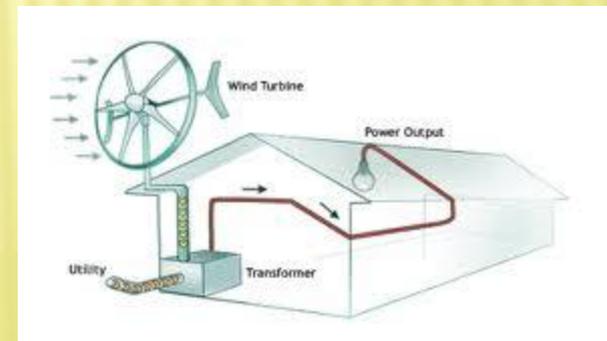
Solar thermal



Geothermal



Energy Storage



Wind power

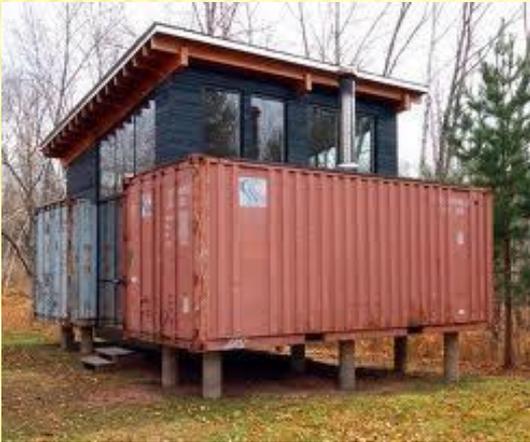
CHALLENGES OF NET ZERO

- × 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



VS.



CHALLENGES OF NET ZERO

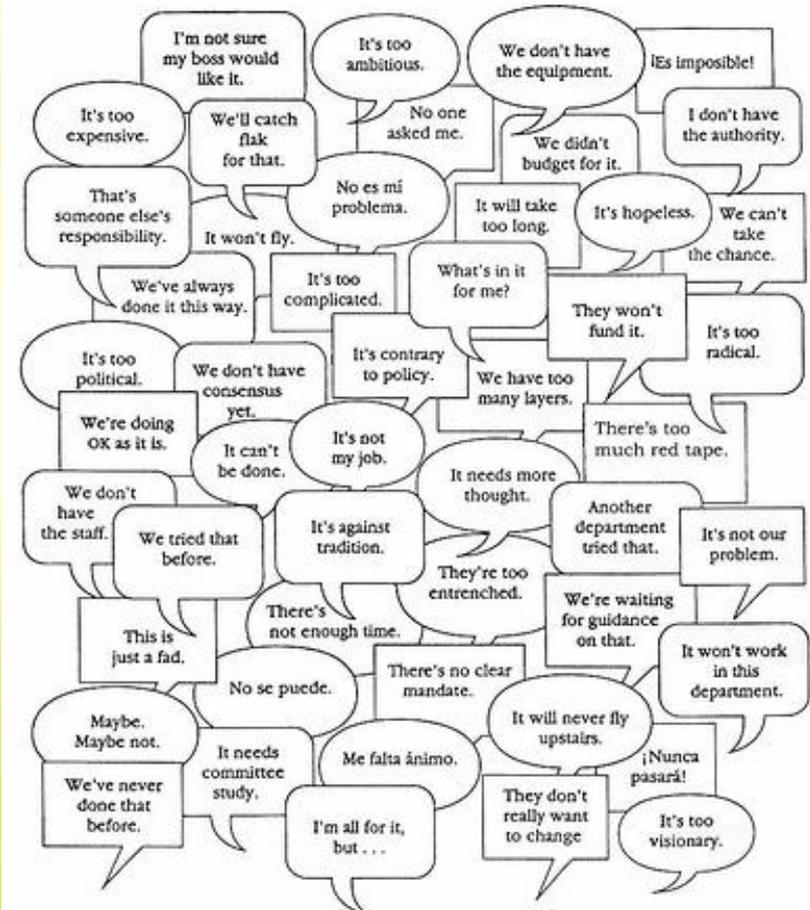
× Resistance to change

IF YOU CAN'T DO IT BETTER,
WHY DO IT?
HERBERT H. DOW

It's a team effort.
Communication is critical.



50 Reasons Not To Change



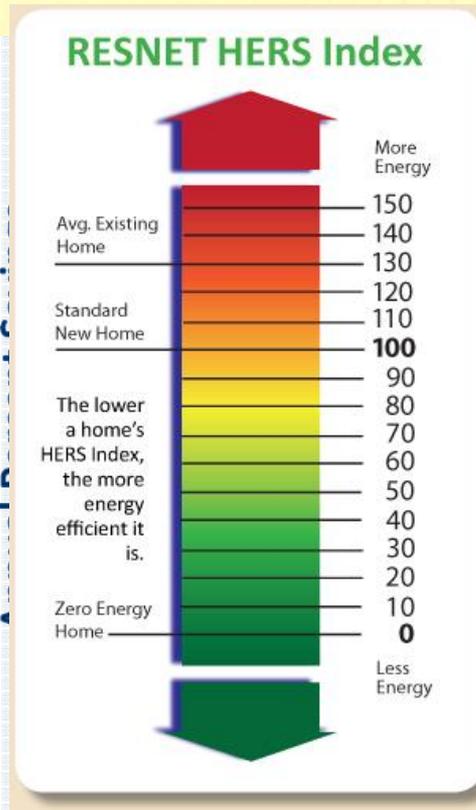
Source: Appetite for Change

CHALLENGES OF NET ZERO

× Lack of consumer awareness

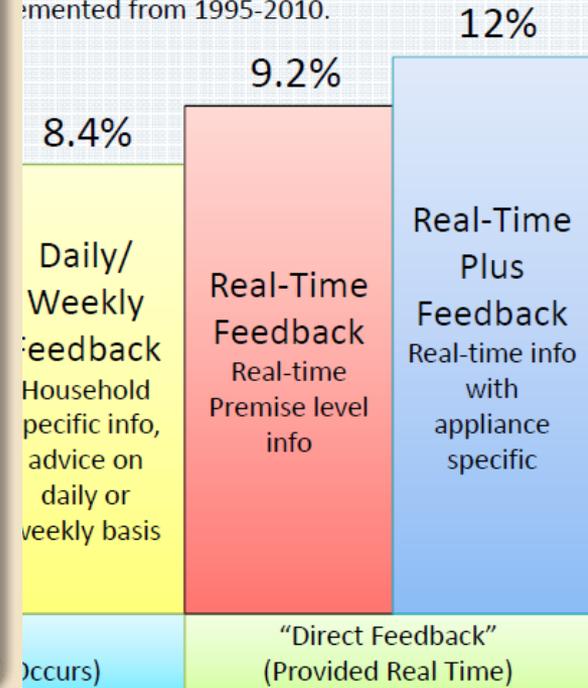


Source: GE



Energy Savings by Feedback Type*

*Implemented from 1995-2010.



American Council for an Energy-Efficient Economy

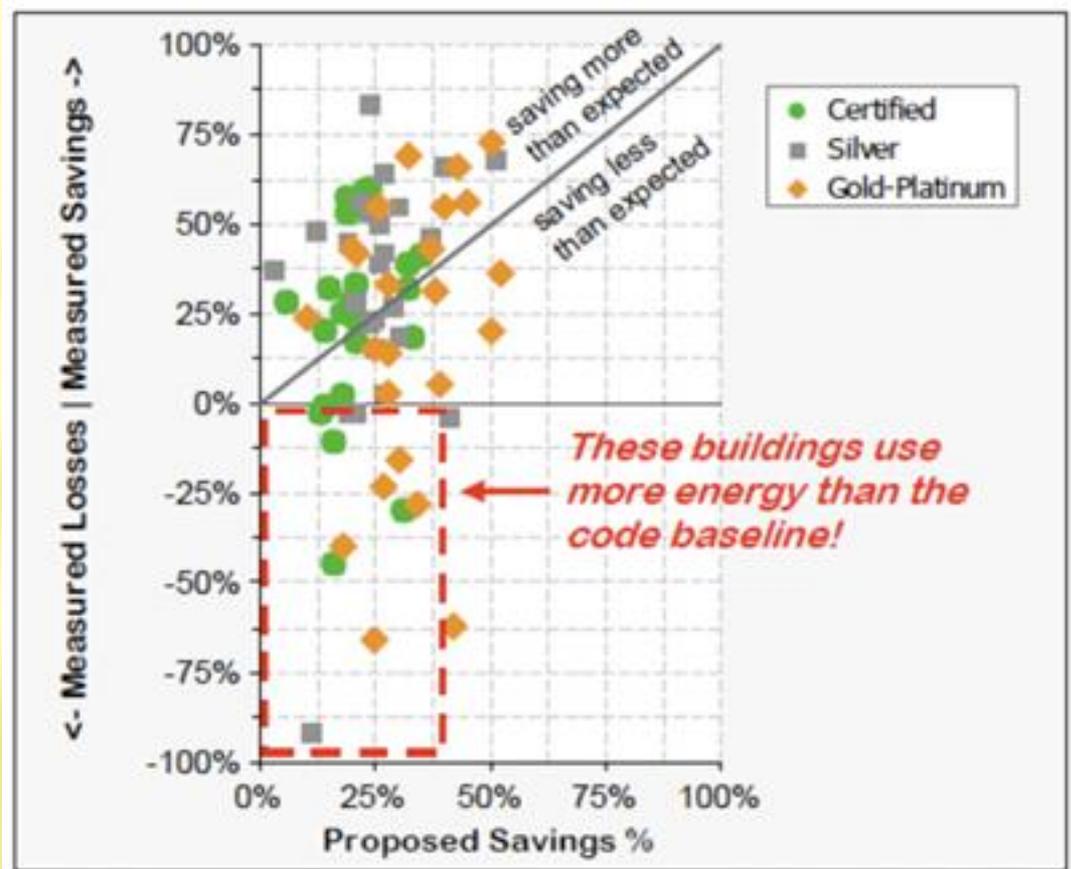
CHALLENGES OF NET ZERO

× Modeled vs. actual performance

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



Check your data!



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



Last year, we built Michigan's first Net Zero Energy Home, changing mindsets about energy efficiency. In 2011, we've done it again.



COBBLESTONE
Homes

Sustainable is Attainable — InVision Zero, 2011

CHALLENGES OF NET ZERO

× Home valuation (PITI)

Change the equation: PITIE = Principle + Interest + Taxes + Insurance + **Energy**

 <p>AI Reports® Form 820.03*</p>	Client File #:		Appraisal File #:	
	Residential Green and Energy Efficient Addendum			
	Client:			
	Subject Property:			
	City:		State:	Zip:
Additional resources to aid in the valuation of green properties and the completion of this form can be found at http://www.appraisalinstitute.org/education/green_energy_addendum.aspx				

“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).”

CHALLENGES OF NET ZERO

✘ Quality of construction

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



Source: Green Journey



Source: Knight



CHALLENGES OF NET ZERO

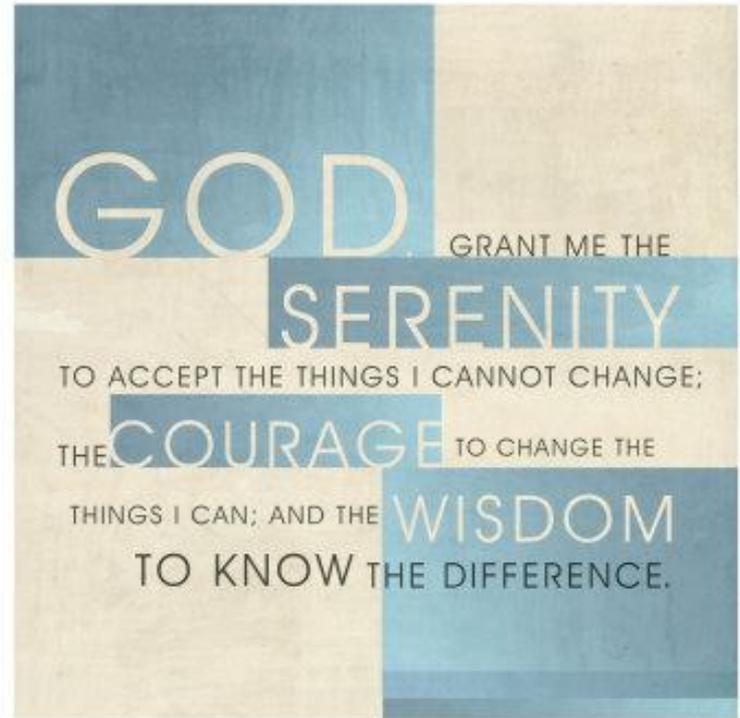
× Occupant behavior



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

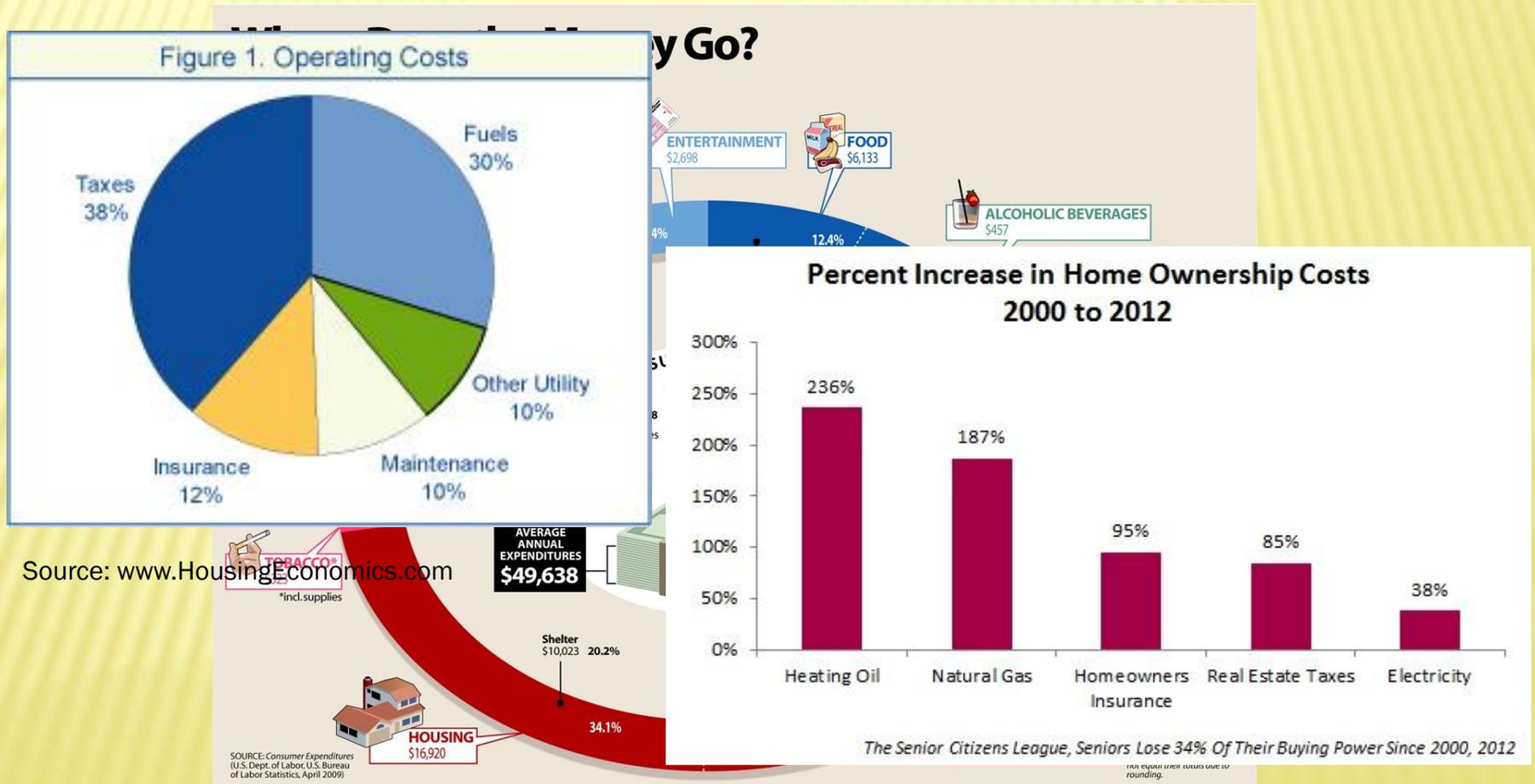
BENEFITS OF NET ZERO

- × 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



BENEFITS OF NET ZERO

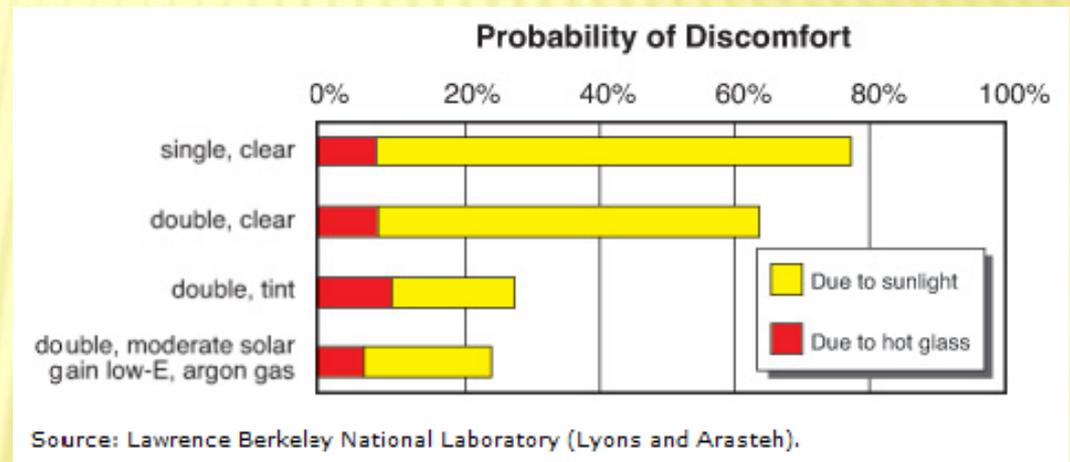
× Greater comfort

Right sized equipment results in smaller temperature swings.

ASHREA Standard 55,
Thermal Environmental
Conditions for Occupancy

- Temperature
- Thermal radiation
- Air speed

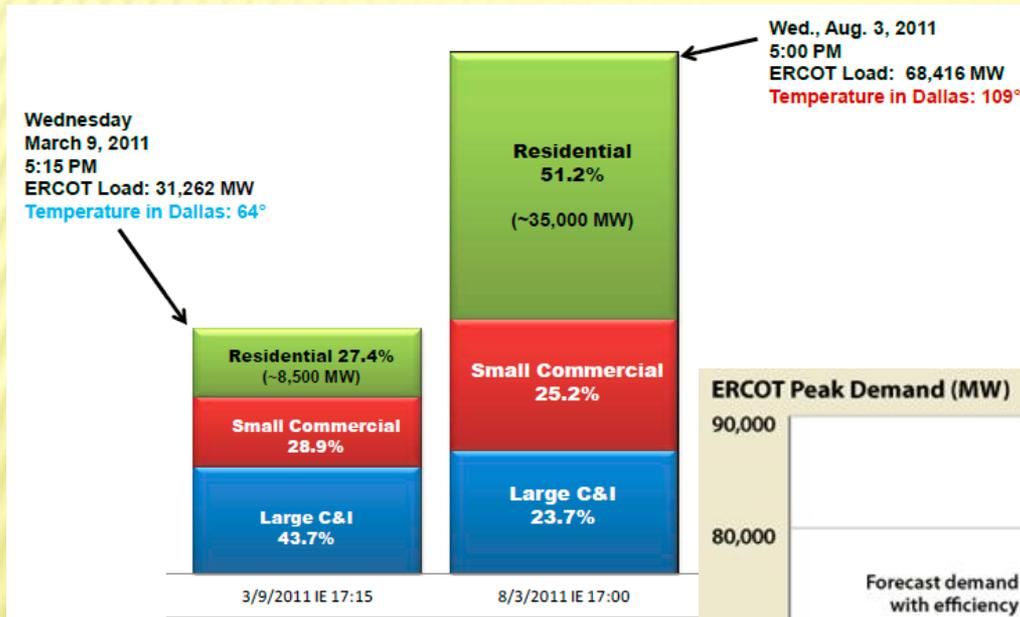
Windows



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

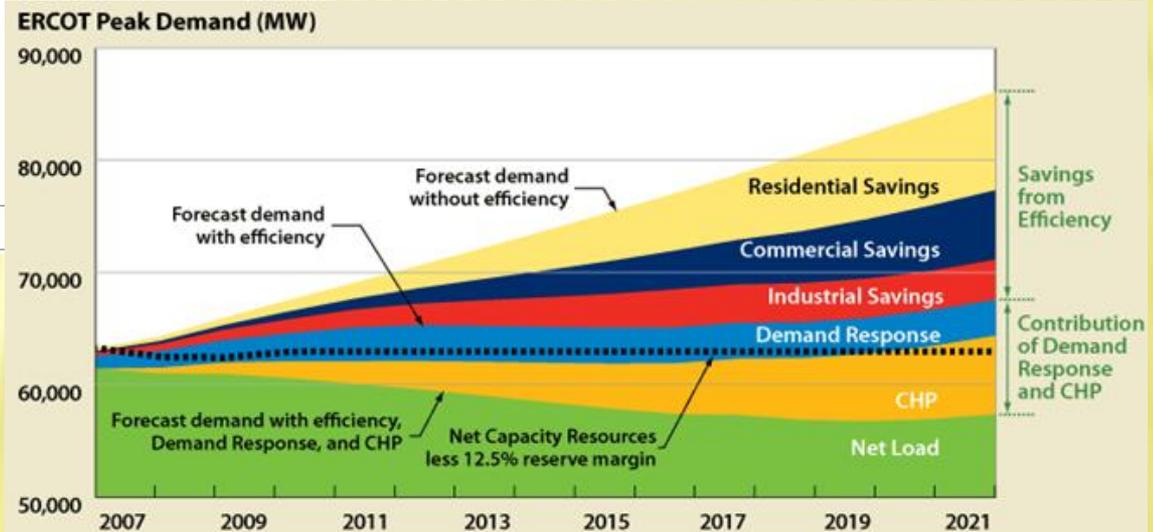
BENEFITS OF NET ZERO

✘ Reduced need for new power generation



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

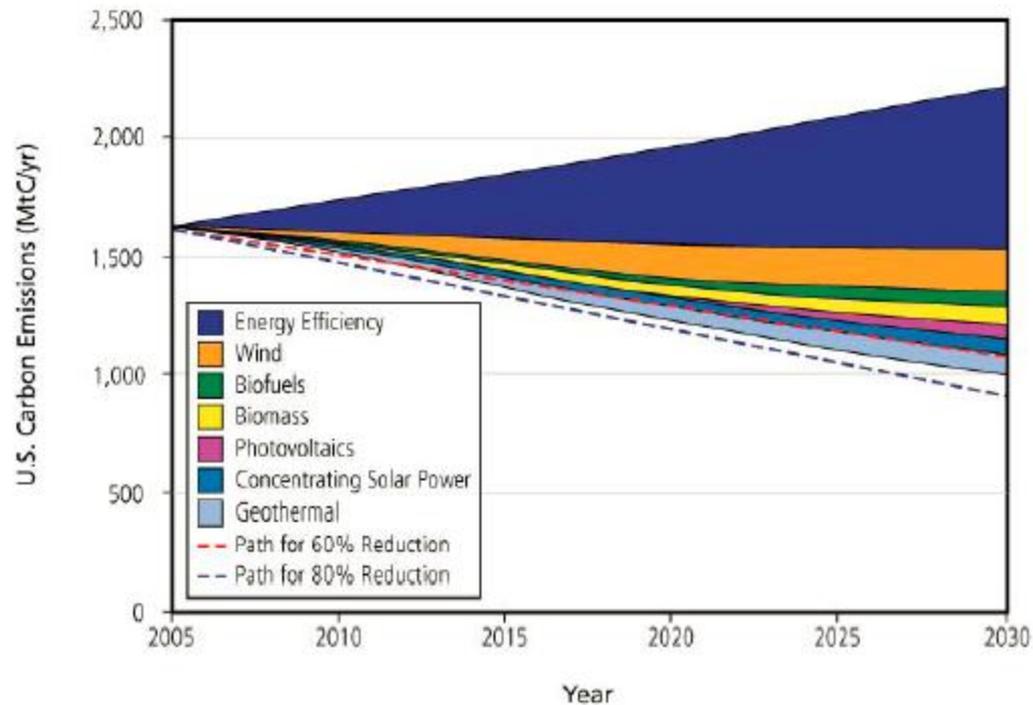
Source: ERCOT



BENEFITS OF NET ZERO

× Environmental stewardship

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

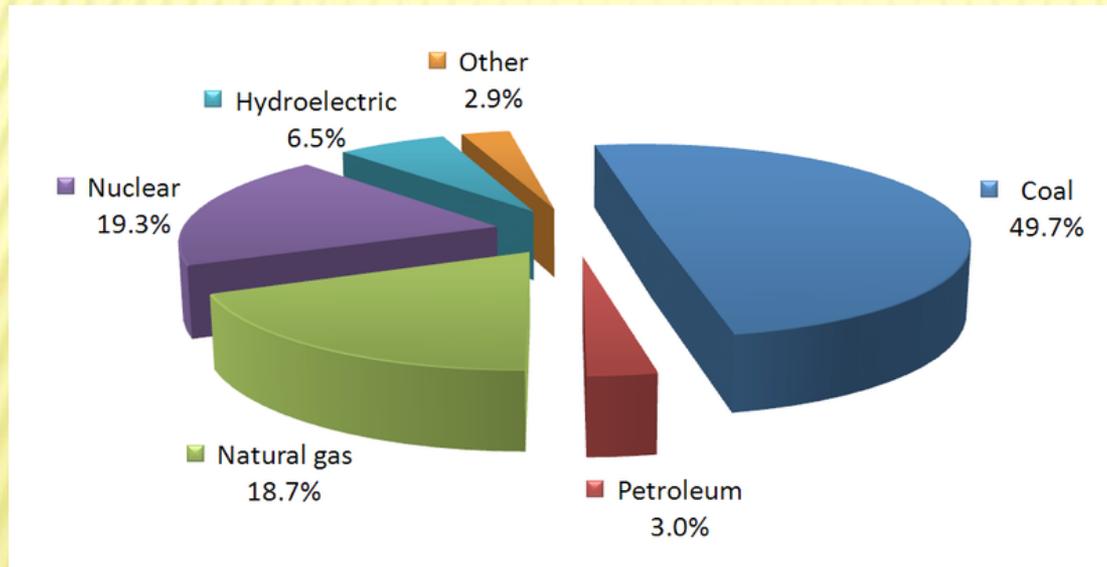


Source: Kutscher, 2007.

BENEFITS OF NET ZERO

× Energy independence and security

U.S. Electrical Generation by Source



Source: EIA



Reduce price instability:

- peak demand reduction
- use domestic sources
- keeping demand inelastic

BENEFITS OF NET ZERO

× Marketing and press



“Cobblestone Homes was honored to

complete the project here, and these beautiful custom homes are on big lots, and they have 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



COBBLESTONE
Homes

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



INVISION ZERO



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)



VISION & INVISION ZERO

[Mark Wahl Talks About Cost of Ownership](#)

[Net Zero Energy Home](#)