TillaWatts

A Strategy for Tillamook's Future

TillaWatts

"TillaWatts" is a strategy
of combining
"Net-Zero-Energy" retrofits
of EXISTING homes

with "Accessory Dwelling Unit" ordinances,
to dramatically lower
per-capita energy needs and usage
in the county.

AVOIDING ENERGY NEED
IS BY FAR OUR LEAST EXPENSIVE ENERGY SOURCE

Off-Shore Wind, for example,
even if successful -
is projected to cost SIX TIMES
our current efficiency costs

CANNON BEACH

This is from Ecola - 2 miles, or 10,000' away.

The biggest
energy-efficiency gains
in the United States
lie in renovating or retrofitting
our existing
building stock.

(And existing homes make up virtually all
of TPUD's energy load.)

Efficiency improvements in EXISTING homes gives us:

* "Negawatts" for the electric utility (ie. us) at a fraction of the cost of ANY new generation - cutting fossil fuel use, global warming, and foreign debt.

* "Storm-proof" homes for residents, who can stay warm in power outages or whatever economic collapse occurs.

* Expanded ability of existing infrastructure to serve more residents.

* Local-employment-intensive investments, 80-year returns.

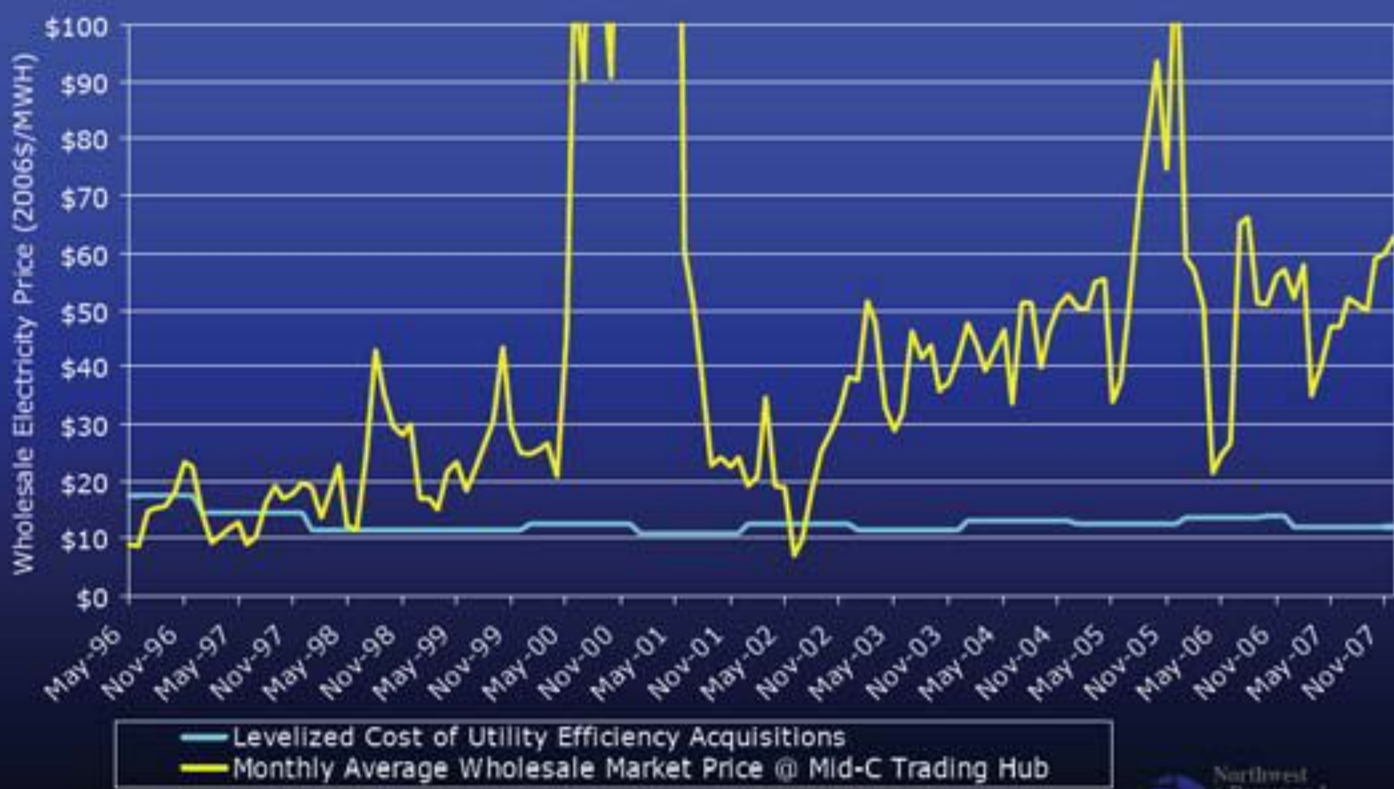
* Capacity for electric vehicles.

Net-Zero-Energy upgrades of existing homes
can cut their energy use by 80%.

ADU ordinances allow those homes to
accommodate two families instead of one,
cutting per-family energy use in half again!

Together, they can improve our efficiency of
energy use by 90%!

Utility Acquired Energy Efficiency Has Been A ***BARGAIN!***



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Northwest Power and Conservation Council

Energy Efficiency is Still the Cheapest Option

Assumptions :

Efficiency Cost = Average Cost of All Conservation Targeted in 5th Power Plan

Transmission cost & losses to point of LSE wholesale delivery

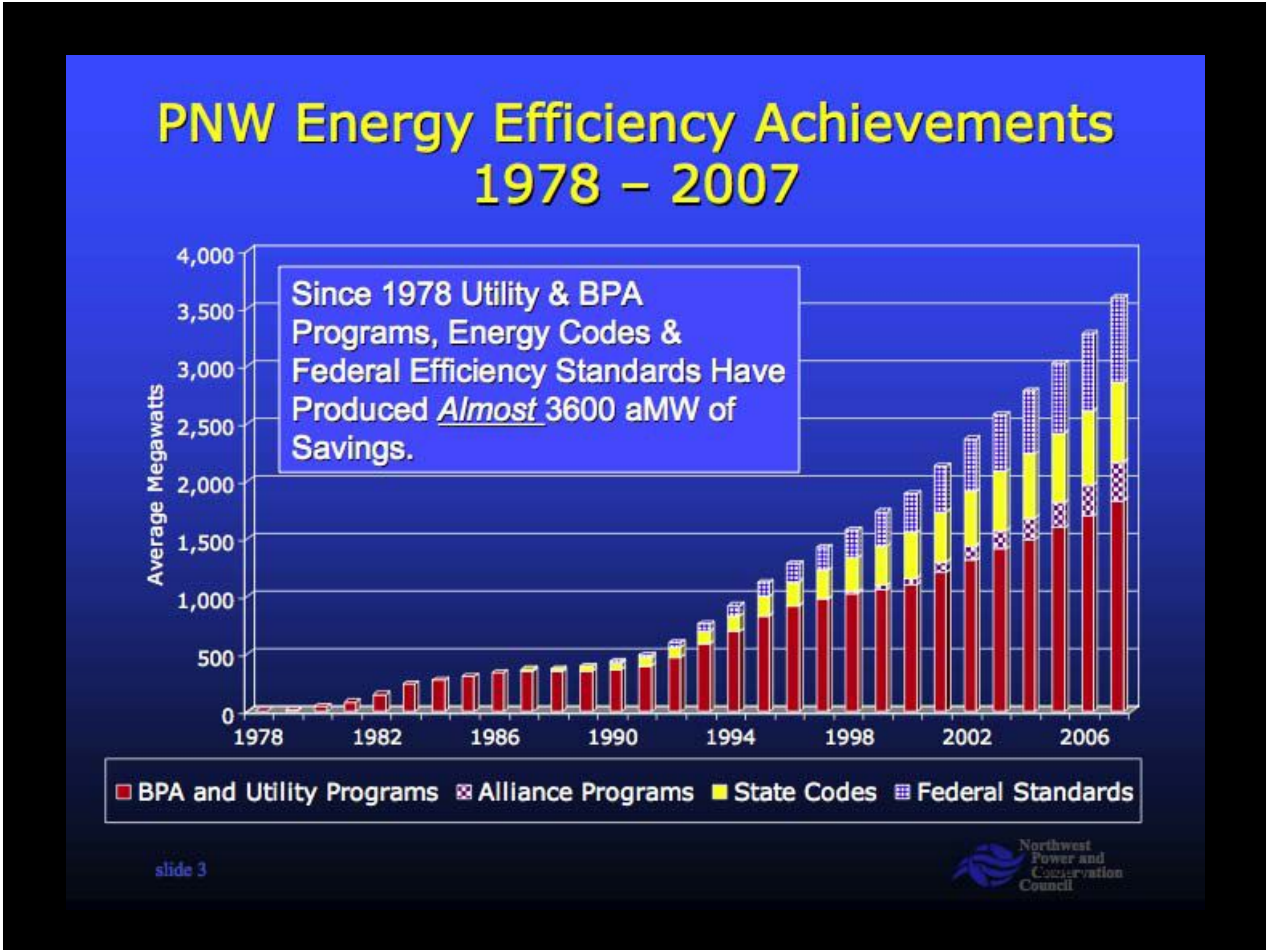
No federal investment or production tax credits

Baseload operation (CC - 85%CF, Nuclear 87.5% CF, SCPC 85%, Wind 32% CF)

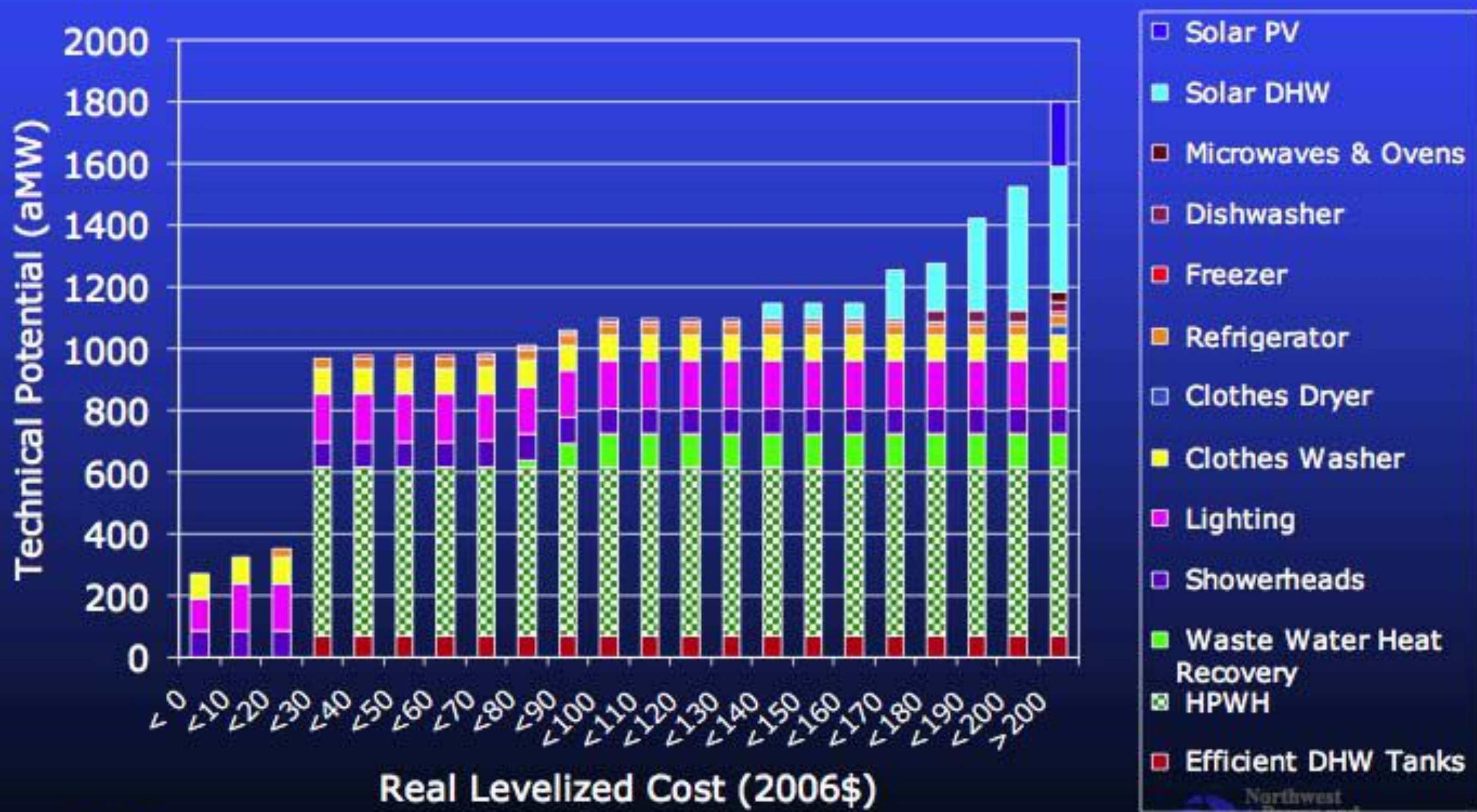
Medium NG and coal price forecast (Proposed 6th Plan)

Bingaman/Specter safety valve CO2 cost

Northwest Power and Conservation Council


PNW Energy Efficiency Achievements
1978 – 2007
Since 1978 Utility & BPA Programs, Energy Codes & Federal Efficiency Standards Have Produced *Almost* 3600 aMW of Savings.
Average Megawatts
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1978
1982
1986
1990
1994
1998
2002
2006
BPA and Utility Programs
Alliance Programs
State Codes
Federal Standards
slide 3
Northwest Power and Conservation Council

Preliminary Draft 6th Plan Residential Water Heating, Lighting and Appliance Supply Curve



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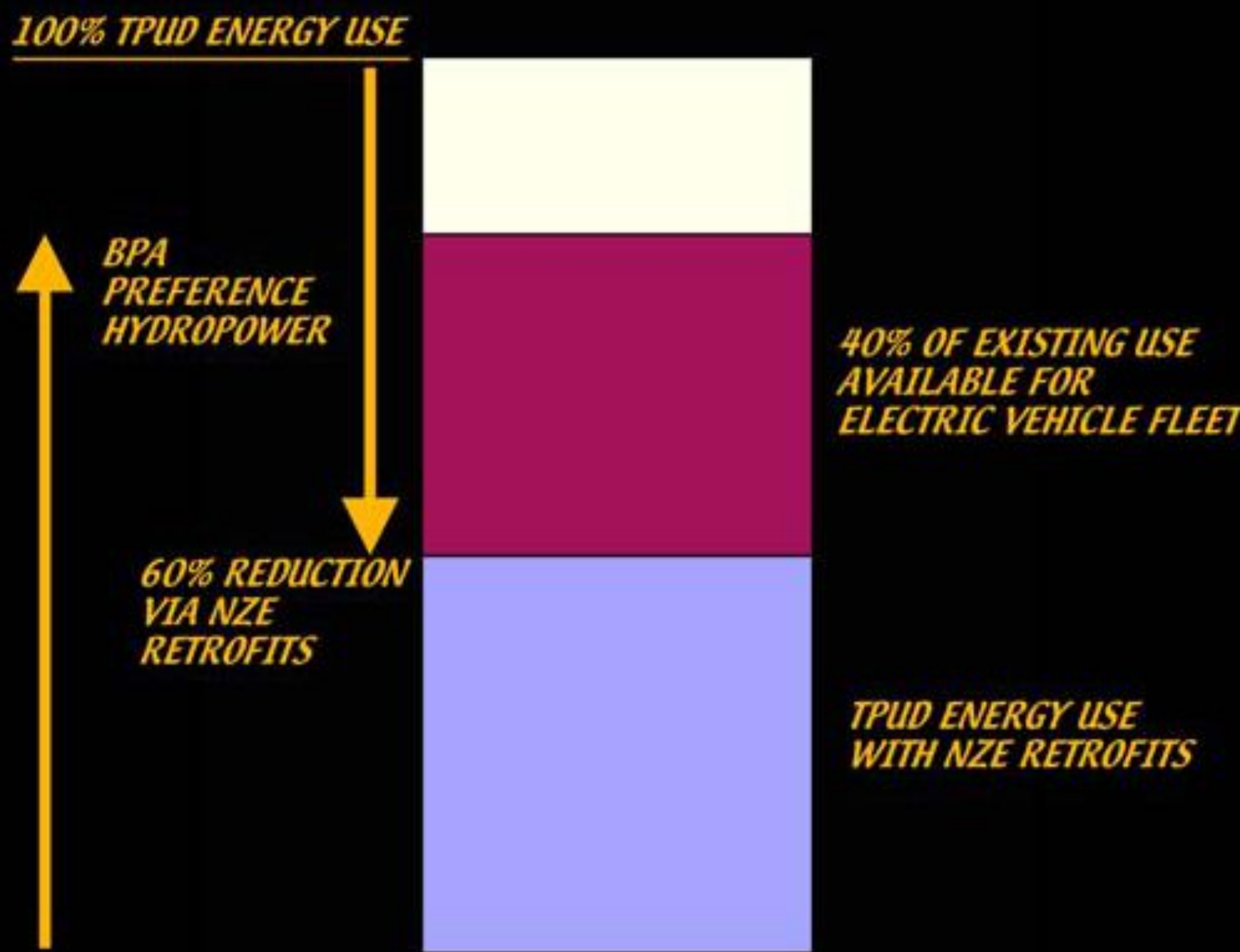
Northwest Power and Conservation Council

NET ZERO ENERGY RETROFITS
CAN REDUCE TPUD ENERGY USE
ENOUGH TO OPERATE AN ELECTRIC VEHICLE FLEET



Going outside of BPA power,

TPUD needs to follow
"Least Cost Power Acquisition"

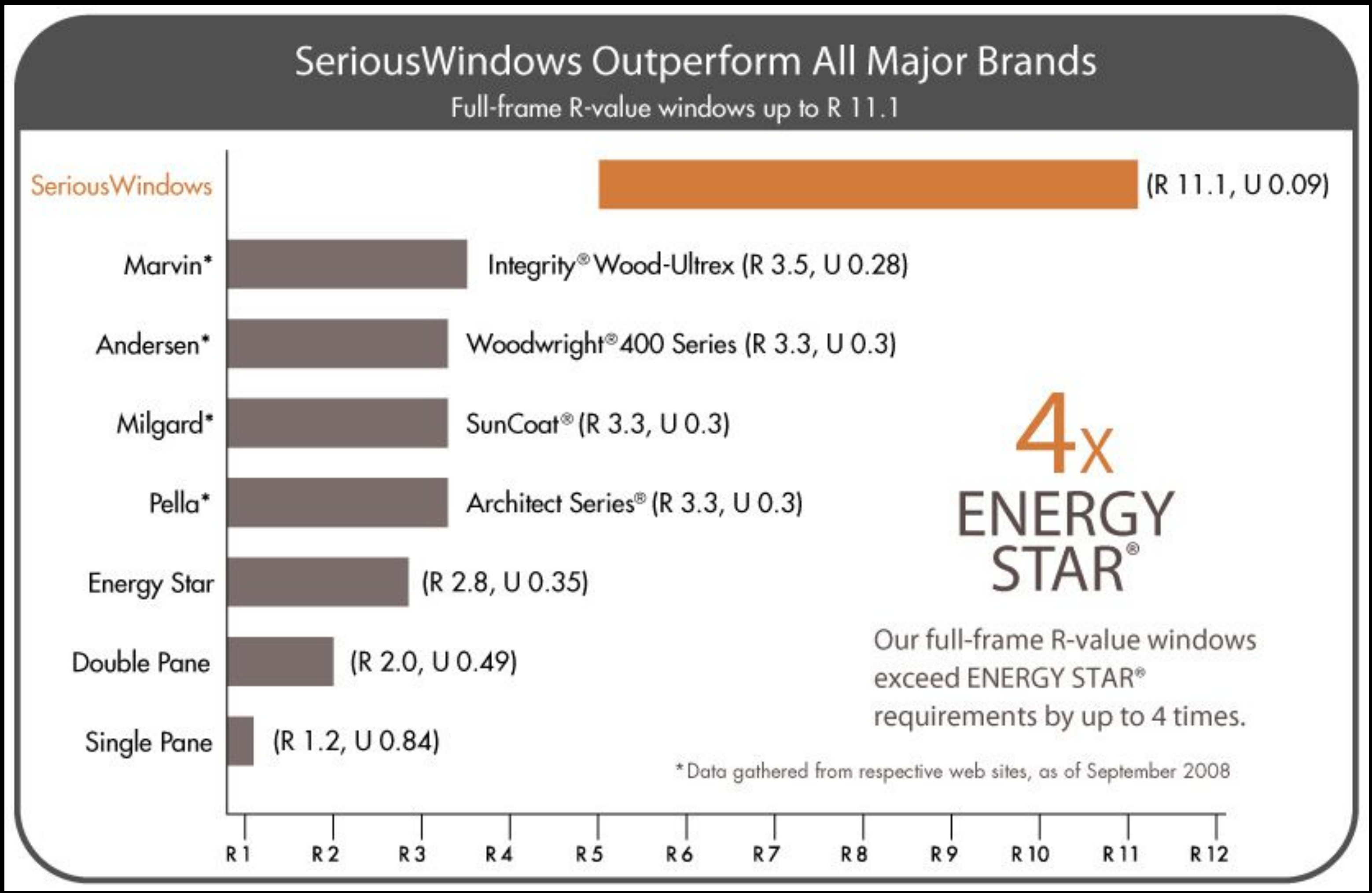
This includes efficiency, but is not restricted to average cost of existing energy as under current BPA regs.

Weatherizing, or building, to lower standards is an expensive missed opportunity.

Comparison of **Passivhaus** (PH), **2008 Oregon Energy Code** (OEC), **NW Energy Star** (NWES), **Oregon High Performance Home** (OHPH).

Element	PH	2008 OEC	NWES	OHPH
Ceiling	R-38	R-38	R-38/49	R-49
Walls	R-38	R-21	R-21	R-24?
Floor	R-38	R-15/30	R-15/38	R-15/38
Window area	No limit	No limit	≤21% fl area	≤16% fl area
Window U	0.14	0.35	0.32	0.32 avg.
Furnace eff.	No furnace	90% AFUE	90% AFUE	92% AFUE
Ducts	Inside	sealant/no test	mastic/testing	Inside
Airsealing	≤.6 ACH/50	no test	7 ACH/50	5 ACH/50
Ventilation	HRV or ERV	bath fan/window	whole house + spot	

Major savings are available beyond today's "standard practice" based on past energy costs.



German experience shows energy retrofit programs can work.

DENA – Energy Efficient Homes
(Germany – Existing Homes)

- Since 2004
- 140 homes
- ***Source energy*** heat & DHW
  Pre - 106,512 Btu/ft^2
  Post - 13,948 Btu/ft^2 (modeled)

Expanding program … 1300 applicants

Built on experience & products stimulated by the Passive House Institute

U.S. average residential source energy use for space & DHW is 36,590 Btu/ft2 (DOE 2007, Table 1.2.3)

So do numerous American and Canadian studies:

THE POTENTIAL IMPACT OF ZERO ENERGY HOMES

Prepared for:

National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401

Prepared by:

NAHB Research Center, Inc.
400 Prince George's Boulevard
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NREL Subcontract Number:
ACQ-3-33638-01
NAHBRC Report No. EG5049_020606_01

February 2006

Approaching Net Zero Energy in Existing Housing

Canadian Mortgage and Housing Corporation

Executive Summary
17 Dec 2007

The term Net Zero Energy Housing (NZEH) rose out of the US Department of Energy's Zero Energy Homes research initiative, started in 2000. In 2006, Canada Housing and Mortgage Corporation's (CMHC) EQuilibrium Housing Pilot Demonstration Initiative set the challenge for Canadian homebuilders and developers (CMHC-EQ, 2007). "Net zero energy housing', as defined by CMHC, describes a home that produces as much energy as it consumes annually. This is done through a variety of means, including:

- reducing energy loads through a climate-responsive, high-performance building envelope and use of energy efficient appliances and lights throughout the house
- increased use of passive solar cooling and heating techniques
- high-efficiency mechanical systems that match the lower energy requirements of the home
- space and water heating assisted by commercially available solar thermal systems and heat pumps
- electrical use offset by grid-connected commercially available photovoltaic (PV) systems

Determining cost-effective ways to retrofit houses to meet net zero energy targets is a key element to both energy security and climate change mitigation (CMHC, 2006). To date, most NZEH initiatives have been focused on new construction. This study looks at ways to approach net zero energy in the over 12 million existing houses in Canada. The age and style of a house as well as variations in regional and historical construction practices and materials choices all require consideration. Approaching net zero energy is more of a challenge in colder regions, yet these are the regions where homeowners can benefit most.

The goal of the study was to determine ways to approach net zero energy in housing in the Canadian context. Several house types were modeled in HOT2000 for typical energy usage in six cities (Vancouver, Calgary, Toronto, Montreal, Halifax and Whitehorse), and then a series of upgrades was applied to each house type in each city. When all reductions and changes to the base house had been made, a specialized EnerGuide for Houses rating (developed for CMHC's EQuilibrium Housing Initiative) was calculated. This rating (designated as EGH*) takes into account the total net energy consumption, and includes baseload reductions and renewable energy generation.

In general, the modeled upgrades emphasized energy efficiency first, then add-on renewable energy systems. This meant improving the building envelope then upgrading and updating HVAC equipment, appliances and lighting. PV and solar thermal can be installed when economically feasible, or, in cases of houses where the building envelope, HVAC and/or secondary energy use cannot be improved.

As could be expected, there were differences between climatic regions that influenced the challenge of approaching net zero energy in existing houses. The region where retrofits were most likely to come close to net zero energy mainly through building envelope improvements was Vancouver.

The design heat loss indicates how much heat the house will require to maintain a comfortable inside temperature in the most severe winter conditions for a given location. In most cases, where envelope characteristics did not restrict the level of insulation improvements, the design heat loss was reduced by more than half, in some cases by up to three-quarters of the base case house.

The heating load is the amount of energy (in GJ) that the house consumes annually. In general, there were significant reductions in heating loads in all house types, and in all cities, for an average reduction of 81%. The overall range of reductions was from 56% to 96%. House type and age; typical construction patterns; and climatic differences between cities caused the variations in reductions.

The house type that would most easily be retrofitted to net zero energy was the bungalow, where the simple form of the building allows for better results from air sealing and insulation. In addition, the long axis of the house results in a larger, unobstructed or shaded roof face than other house types. This gives the potential for the largest possible roof-mounted PV array and solar domestic hot water system, even if the 4/12 roof typically is not at optimum slope for these technologies in most Canadian regions.

It was shown in the report that retrofits in the $30,000 and $50,000 range was cost effective when refinancing a mortgage. In many cases, the monthly energy savings outweigh the incremental increase in a mortgage payment. This figure is over double the 'average' major renovation figure of $12,000 reported in a CMHC study (CMHC, 2006). However, it has been the project team's experience that homeowners are willing to pay more for what they want, witness the number of $20,000 to $100,000 kitchen renovations.

The Cost of Net Zero Energy Housing Retrofit

A keynote presentation to the Affordable Comfort Institute's Summit on Carbon Neutrality in Summer 2007 estimated that existing housing in the US could see significant reductions in energy Four levels of retrofits were identified, moving from a 'general' energy efficient retrofit to a near zero or net zero energy retrofit as follows:

- Low hanging fruit: costs about US$1500/home, saves 1,000 kWh and 100 therms 4 annually
- Extensive retrofit: costs US$10,000/home, saves 4,000 kWh and 400 therms annually
- Deep retrofit: costs US$50,000/home, saves 7,000 kWh and 600 therms annually
- Deep retrofit + 3kW PV: costs US$75,000/home, saves 7,000 kWh and 600 therms annually and produces an additional 4,300 kWh/yr

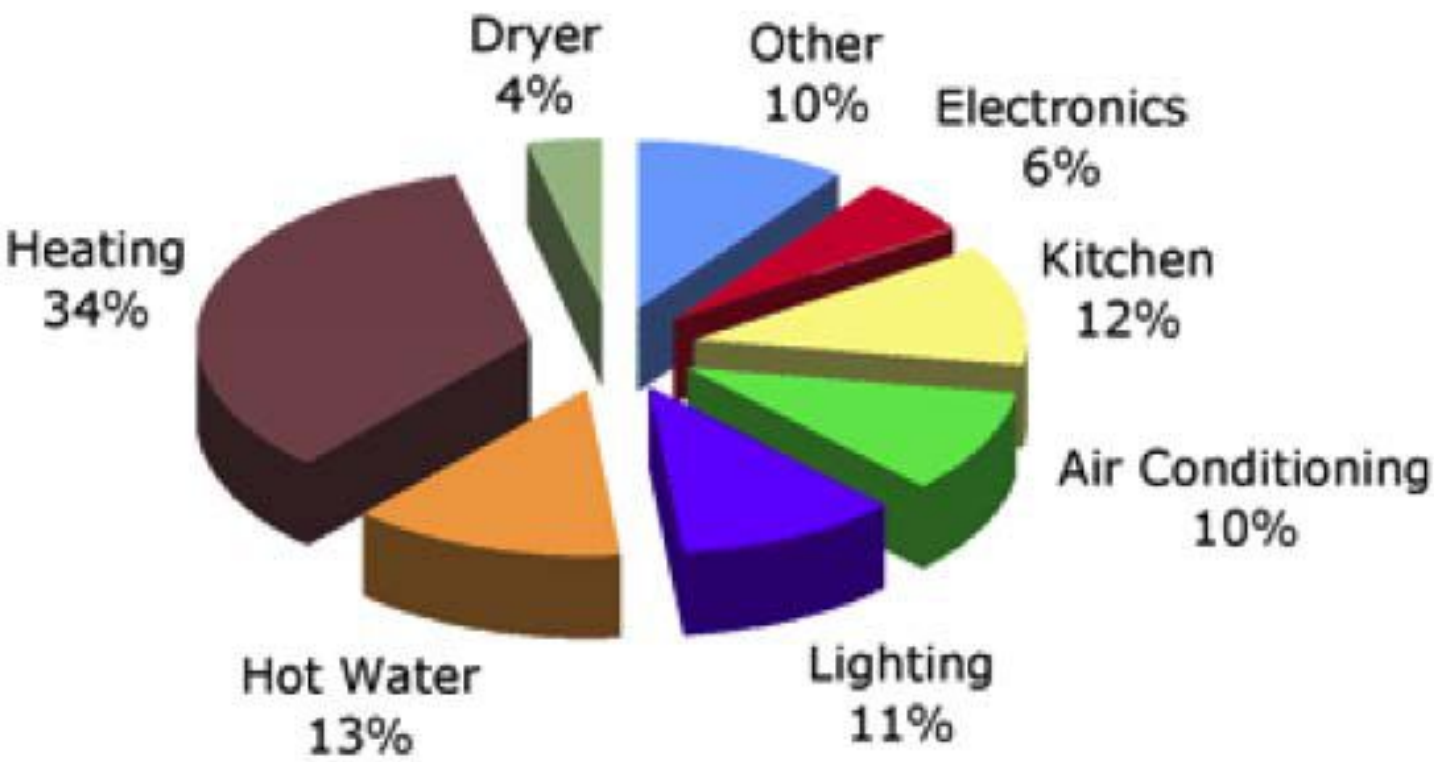
According the US-based presenter, the low-level audit listed above would pay for itself in 7 years in most cases. The deep retrofit with PV (near-zero or net zero, depending on occupant lifestyle) would pay for itself in less than 35 years at current costs with a 20% reduction in annual CO2 emissions for the US. (Parker, 2007).

Table 1. Many Paths To Thermal Comfort[10]

	Community Solutions	Behavioral Choices	Technical Fix – higher cost	Technical Fix – lower cost	On-Site Renewables
Range - % Reduction [11]	**20% – 70%**	**10% – 90%**	**30% – 85%**	**5% – 80%**	**10% – 70%**
Thermal comfort accounts for 25% to 80% of the residential energy use / household Options to reduce the energy use per person needed to achieve affordable, sustainable thermal comfort	Comfort centers Cogen or micro-cogen Community thermal storage Community-based renewable energy supply Use of waste heat from industrial processes GHG reduction campaigns Feedback, benchmarking, aggregation Competitions / Challenges within and between communities Technical, financial, & regulatory support	24/7 set point adjustment or setback Apply comfort zone Change use of space; new thermal boundaries Adaptive comfort (clothing, surface temp, air movement) Increase occupancy Reduce internal gains (behavioral – cooling loads) Decrease occupancy: (short-term or long-term) relocate or demolish	Climate specific superinsulation: (walls, ceiling, floor, foundation R 25 – R 80) Efficient windows (climate specific SHG, + U 0.1 to 0.3) Super air tightening (to 0.2 CFM/ft^2 floor space) High efficiency mechanical ventilation Ultra high efficiency HVAC system Automatic movable window insulation Highly insulated doors	Fill cavities with insulation Air sealing (to 1 CFM50/ft^2) Do-it-yourself superinsulation Seal / insulate attic ducts; better yet eliminate ducts Point heat or cooling source High performance storm windows Manually controlled movable window insulation Reduce internal gains technical fix (cooling loads) Control systems to optimize comfort, IAQ, & humidity control	Increase solar gain through windows Sunspace or solar buffer to reduce heat loss Active solar thermal Solar PV Wood heat (EPA approved) Trees, vegetation, or other shading to reduce cooling loads

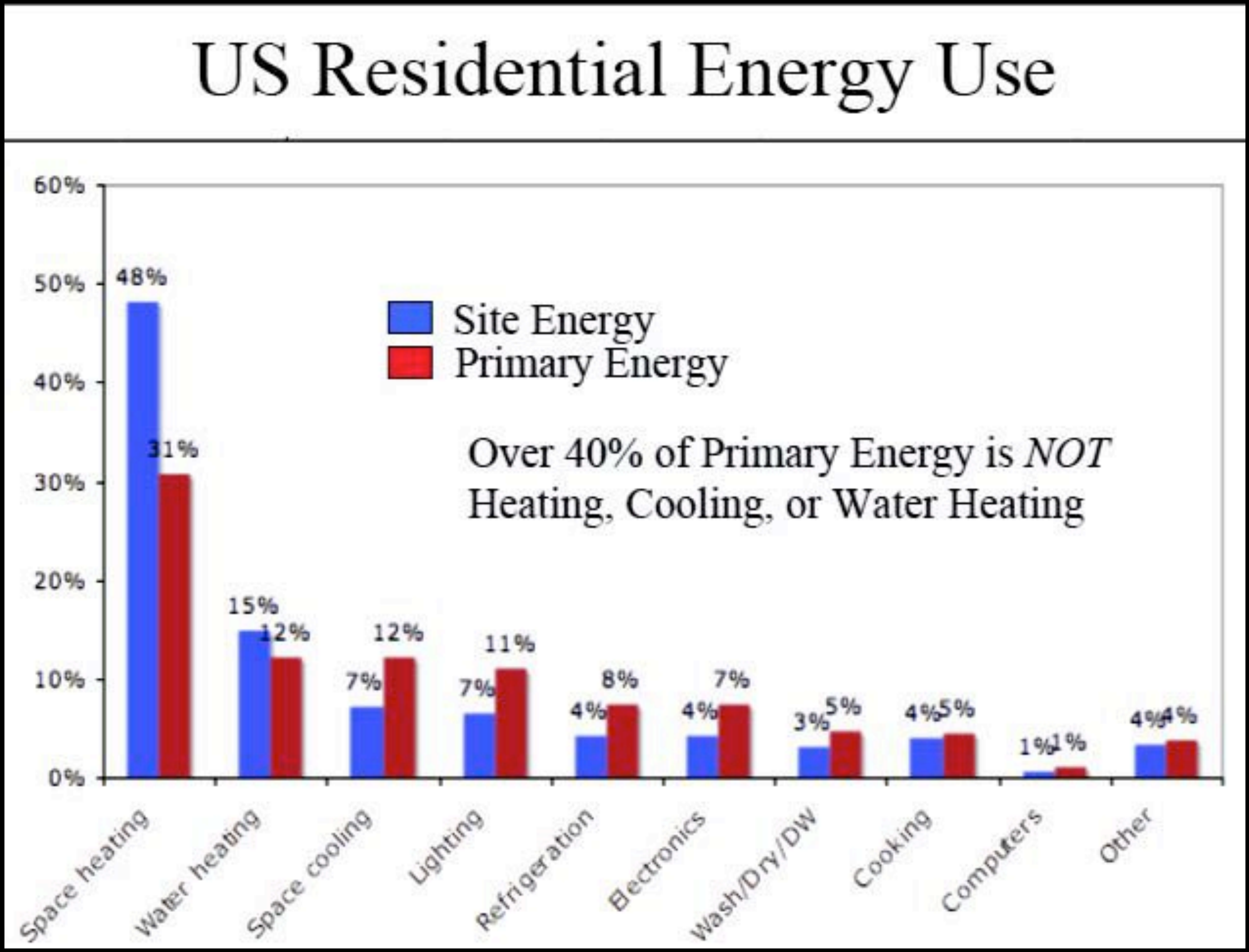
US Residential Energy Use (Source)

Good News – Bad News

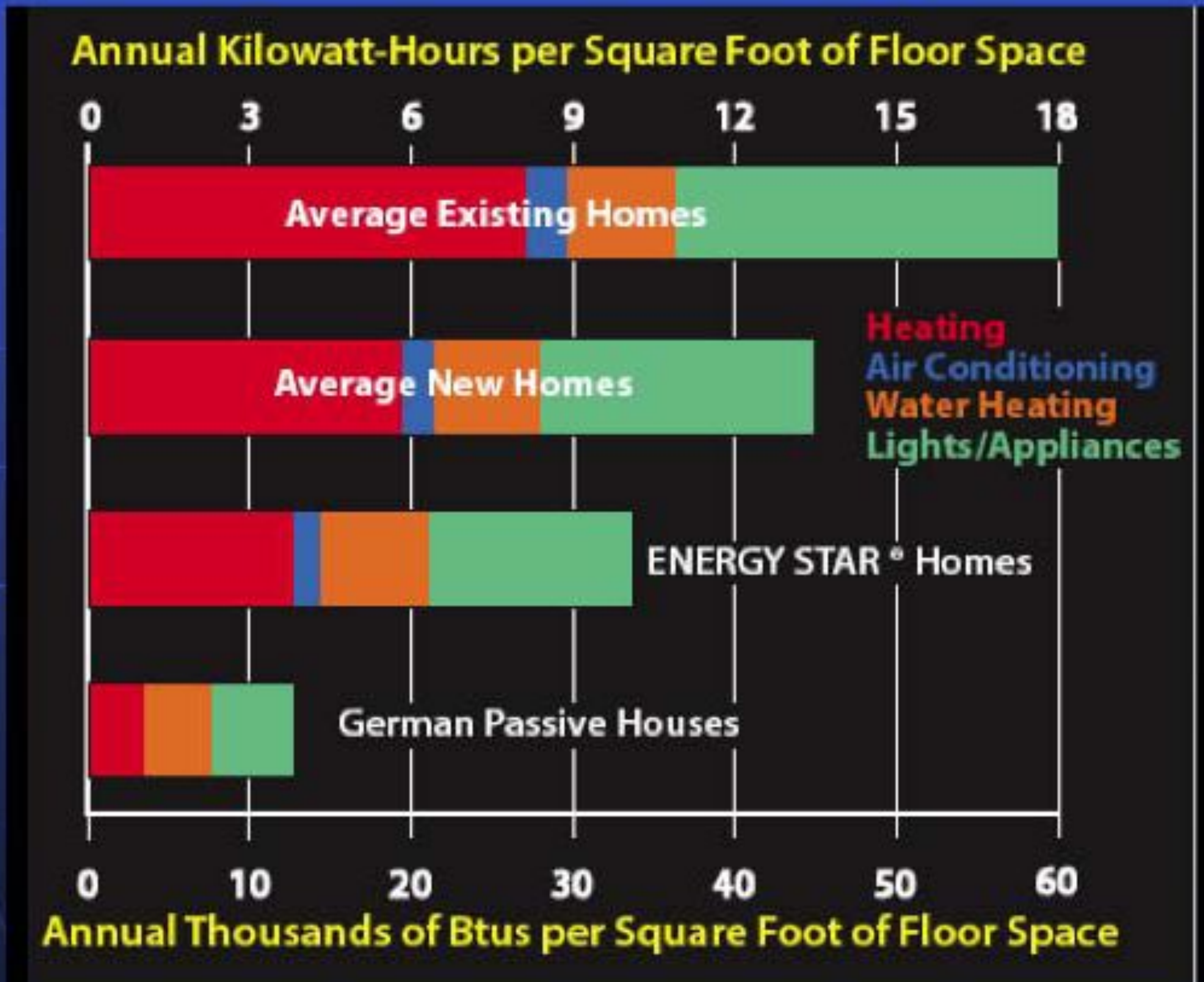


Source: Buildings Energy Data Book DOE 2006

SOURCE, or Primary, energy includes the fuels used to generate electricity used on site, etc.



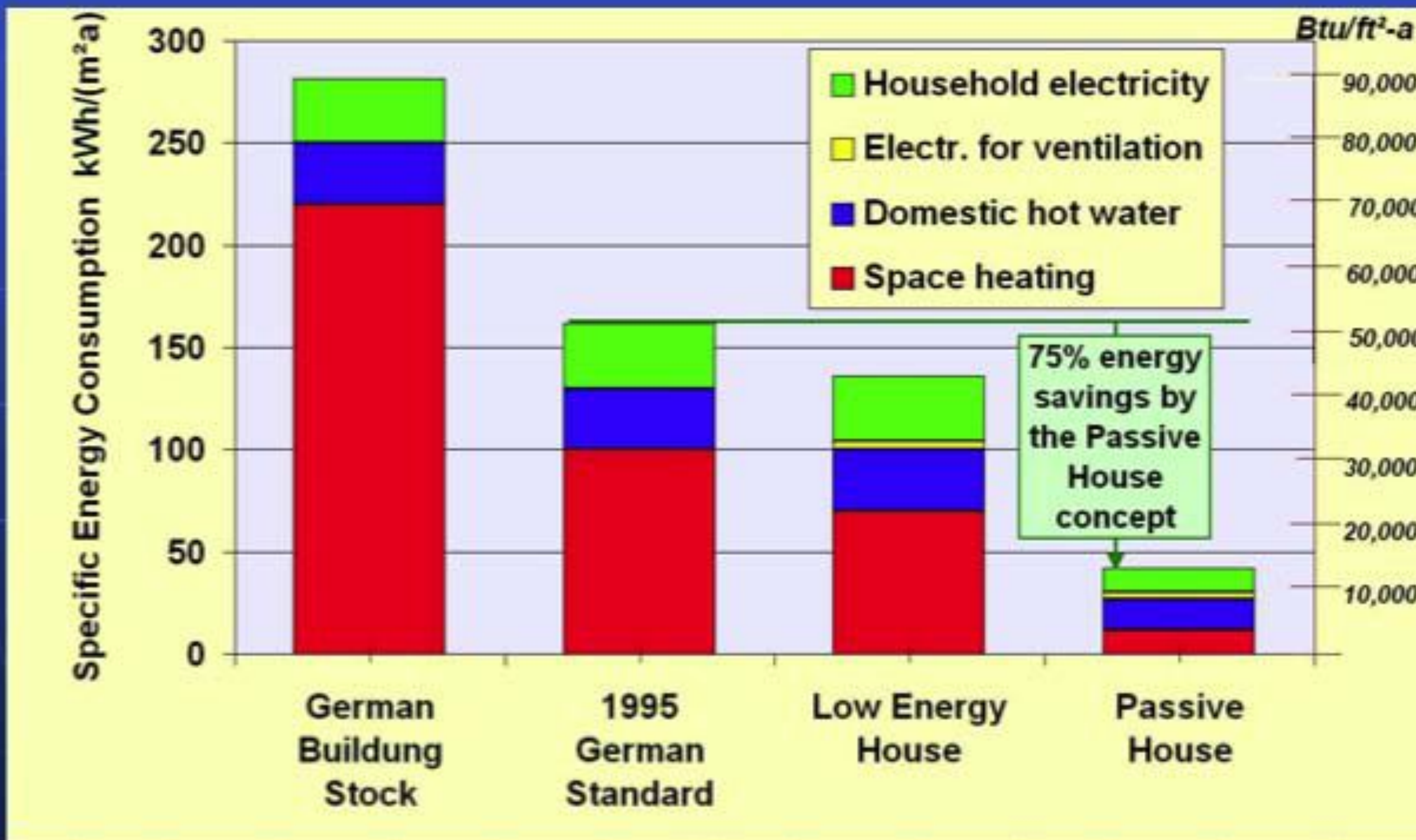
US Housing
Site Energy Use Compared



Saturn Resource Management Inc. - 2008

Passive House Potential (site energy)

Approximate Conversion – m^2 to ft^2 divide by 10



U.S. Residential *Primary* Energy Expenditures for End-Uses

Energy consumed is shown in quads and % of totals

End Use	Residential	
Space Heating	6.6	32%
Lighting	2.5	12%
Space Cooling	2.3	11%
Water Heating	2.7	13%
Refrigeration	1.7	8%
Electronics	1.1	5%
Cooking	1.0	5%
Wet Clean	1.0	5%
Ventilation		
Computers	0.2	1%
Other	0.9	4%
Adjusted to SEDS*	1.1	5%
Total	**21.1**	**100%**

* State Energy Data System

What's most important to focus on in reducing energy demand?

Table 4: Total Home Energy Use[1]

End Use	%	Heat%	Cool%
Space Heating/Cooling	43		
Roof		12	14
Walls		19	11
Foundation		15	
Infiltration		28	16
Windows (conduction)		26	1
Windows (solar gain			32
Internal Gains			27
Lighting	12		
Water Heating	13		
Refrigeration	8		
Electronics	5		
Cooking	5		
Wet Clean	5		
Computers	5		
Other	4		
Adjustment SEDS	5		

The BIG savings involve getting to the point where NO furnace is needed

PHANTOM LOADS
(what's ON when we think they're OFF)
- an issue, but decreasing

Appliance	Watts	kWhr per Year	Cost Per Year at $0.20 per kWhr
Cell Charger	1.2	11	$2
Laptop charger (unplugged)	1.5	13	$3
Printer	7.2	63	$13
Microwave	4.5	39	$8
Satellite Box	12.1	106	$21
TV (flatscreen)	15.0	131	$26
DVD Player	5.0	44	$9
Rice Cooker	3.0	26	$5
PS2 (video game console)	1.5	13	$3
Cordless Phone	5.2	46	$9
Desktop Computer	1.5	13	$3
Keyboard Piano	1.5	13	$3
CRT TV	8.2	72	$14
Really Old CRT Monitor	6.4	56	$11
Really Old Desktop	2.5	22	$4
Washing Machine	5.4	47	$9
Water Boiler	4.0	35	$7
Really Really Old VCR	6.0	53	$11
Radio Alarm Clock (digital)	3.9	34	$7
TOTAL	95.6	837	$167

Product Afterlife

What happens with the old inefficient equipment that is replaced?

Table 3. What happened to the old product? Percent.

	Refrigerator	Freezer
It was sold	16	16
Salvation Army, Flea market etc.	5	3
Given to family or friends	24	25
Placed in cabin, basement etc	21	11
Thrown, delivered at retailers' etc.	20	23
Other	15	23
Total	101/N=265	101/N=155

Even if numbers here are rather small, the tendency is overwhelming. A minimum of 66% of refrigerators that worked when the household bought a new one is disposed of in a way that prolongs its life. At least 17% of exchanged refrigerators and 8% of the freezers seem to be in use as cold appliances after the acquisition of the new product.

Some case studies of deep retrofits:

Bill Asdal's Cottage in Califon, NJ

- 74% energy reduction for heating and cooling, with modest envelope improvements – cellulose + foam-filled siding, dbl low-e Ar windows
- 2 ton GSHP, SDHW with instantaneous DHW back-up, 7.2 kW PV
- Base case upgrade estimated at $23K, yields $500/year energy savings
- Upgrade as built, w/o PV, cost $37K, yields $2,800/year energy savings
- More aggressive envelope strategies combined with minisplit HP and less PV may be a better overall investment

This 150+ year old NH house was enclosed with cellulose-filled Larsen trusses on the walls (9") and the roof (12"). New windows were installed, foam added to the basement interior, and a recycled greenhouse added. Heated by a point source Monitor heater or wood stove.

Gary Nelson's house in Minneapolis

• Exterior foam superinsulation
• Note the chimney...

New windows were added outside the existing windows, preserving the old windows to the interior

200 year+ old NH farmhouse with:
Phase 1 - 2" exterior polyiso foam insulation
Phase 2 - Oil boiler changed to wood-oil gasifier boiler
Phase 3 – New window sash modified to double low-e (Bi-Glass)

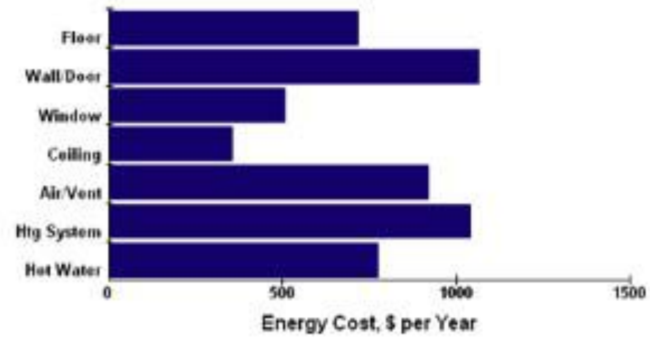
ALASKA

How a 30 year old house is retrofitted towards energy affordability - cost <$20/sq. ft.

Building Enclosure	**BEFORE** **CONDITIONED SQ. FT. = 1,720 (includes garage)** **CONDITIONED VOLUME = 14,756**
Air Leakage	**164 sq. in. of equivalent leakage area (LBL 4 Pa)**
Wall Insulation	**R-11**
Attic Insulation	**R-30**
Windows	**0.6 U-value**

Building Enclosure After Retrofit - Conditioned Volume Sq. Ft. 19,956	
Space Heating & Domestic Hot Water	**- No Change**
Unconditioned Attic	**Total Roof R-50**
Above Grade Walls	**R-11 Insulation in Existing 2 x 4 Walls**
Wall Sheathing	**6” R-30 XPS Sheathing Total Wall R-41**
Foundation Wall	**6” R-30 XPS on Perimeter Walls**
Crawlspace Floor	**2’ x 8’ x 3” R-15 XPS Footing Perimeter**
Windows	**0.2 U-value, SHGC 0.51**
Infiltration	**26.5 Sq. In. Equivalent Leakage Area (LBL)**
Ventilation	**Heat Recovery – 67% ASE @ 36 Watts**

1st the Structure



Annual Energy Consumption As-Is	
Space Heating	
Oil	918 Gallons
Hot Water	
Oil	775 Gallons
Appliances Lighting	7380 kWh

25 Btu's per sq. ft. floor area

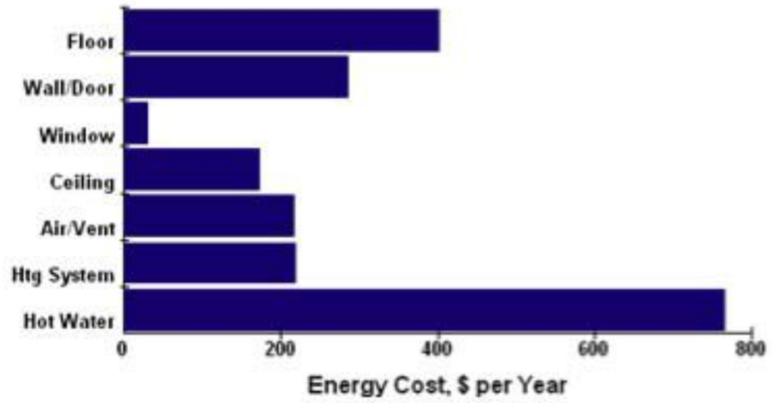
Estimated Annual Energy
$6314 per year

42,603 Btu's per hour –January

CO_2 Emissions – 23,912#

$3.67 per sq. ft. per year

75% reduction in heating and hot water energy use



Annual Energy Consumption – Post Retrofit

Space Heating
256 Gallons of Oil

Hot Water
159 Gallons of Oil

Appliances Lights
7898 kWh

10 Btu/Sq. Ft.

Estimated Annual Energy

$3,076 per year - $256. per mo

17,642 Btu's per hour -January

CO_2 Emissions – 9,260#

$1.78 per sq. ft. per year

Mike Rogers' 1920s house in Burlington, VT

Before

- 1,320 sf
- Heat: 198 MMBTU/year
- 6,000 kWh/year

After

- 2,060 sf
- Heat: 85 MMBTU/year
- 3,000 kWh/year

60% heating energy reduction, with modest envelope improvements – cellulose + 1.5" foam, dbl low-e Ar windows, ~1,000 CFM50, furnace

50% electricity reduction – lighting, Energy Star appliances

Today – more R, better windows, airtightness, point source heat, SDHW.

Peter Yost's house in Brattleboro, VT

Ecofutures 1247 Scrub Oak in Boulder, CO

- 1,000 sf + 1,000sf basement
- 2,700 sf incl. conditioned basement
- Basement 1" XPS + 2x4 w/batts, walls new 2x4 with open cell SPF, attic 8" open cell SPF + 12" cellulose, fiberglass windows quad glazed low-e, 750 CFM50
- Gas line disconnected, active solar thermal 180 evacuated tubes + 360 gallons water storage, back-up 9 kW modulating electric boiler, ERV
- 6.6 kW PV

New framing is held off the existing wall to produce a thermal break

1970s Ranch in northern MA

Before
- 2,430 sf
- Heat: 75 MMBTU/year
- DHW: 20 MMBTU/year
- Electric: 6,000 kWh/year
- Currently 1150 CFM50

After: projected
- 2,430 sf
- Heat: 24 MMBTU/year
- DHW: 6 MMBTU/year
- 3,600 kWh/year
- Budget is $50K

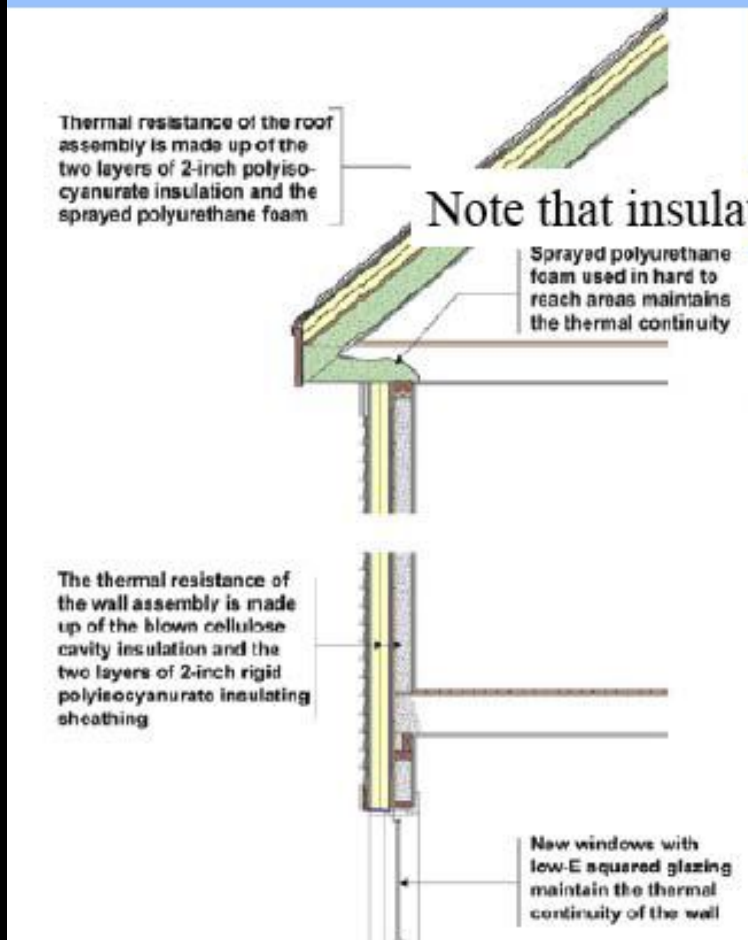
- Existing HVAC upgrade to gas boiler and fan coil - ~15% of existing electrical use

1970s Ranch in NH

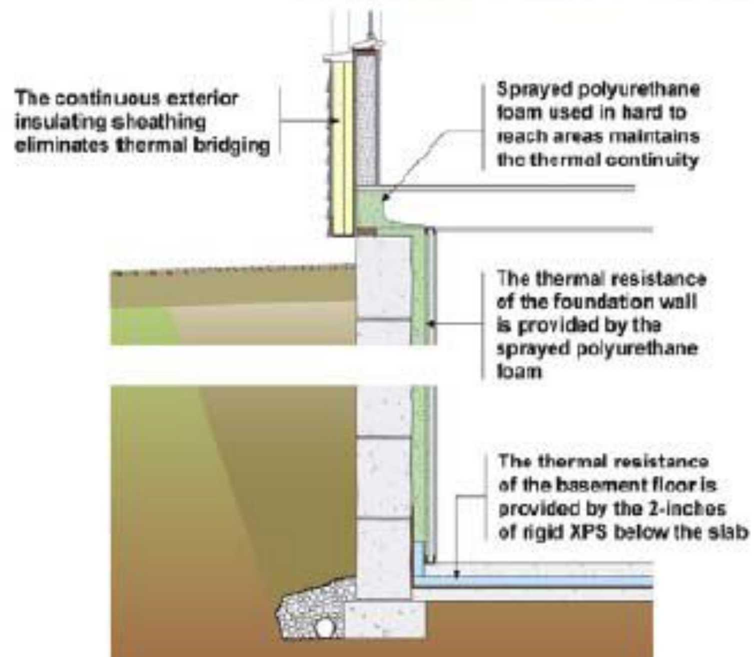
Before
- 4,000 CFM50

After
- 400 CFM50 (still dropping)
- Aiming for zero net energy

Betsy Pettit's Foursquare House in Concord, MA

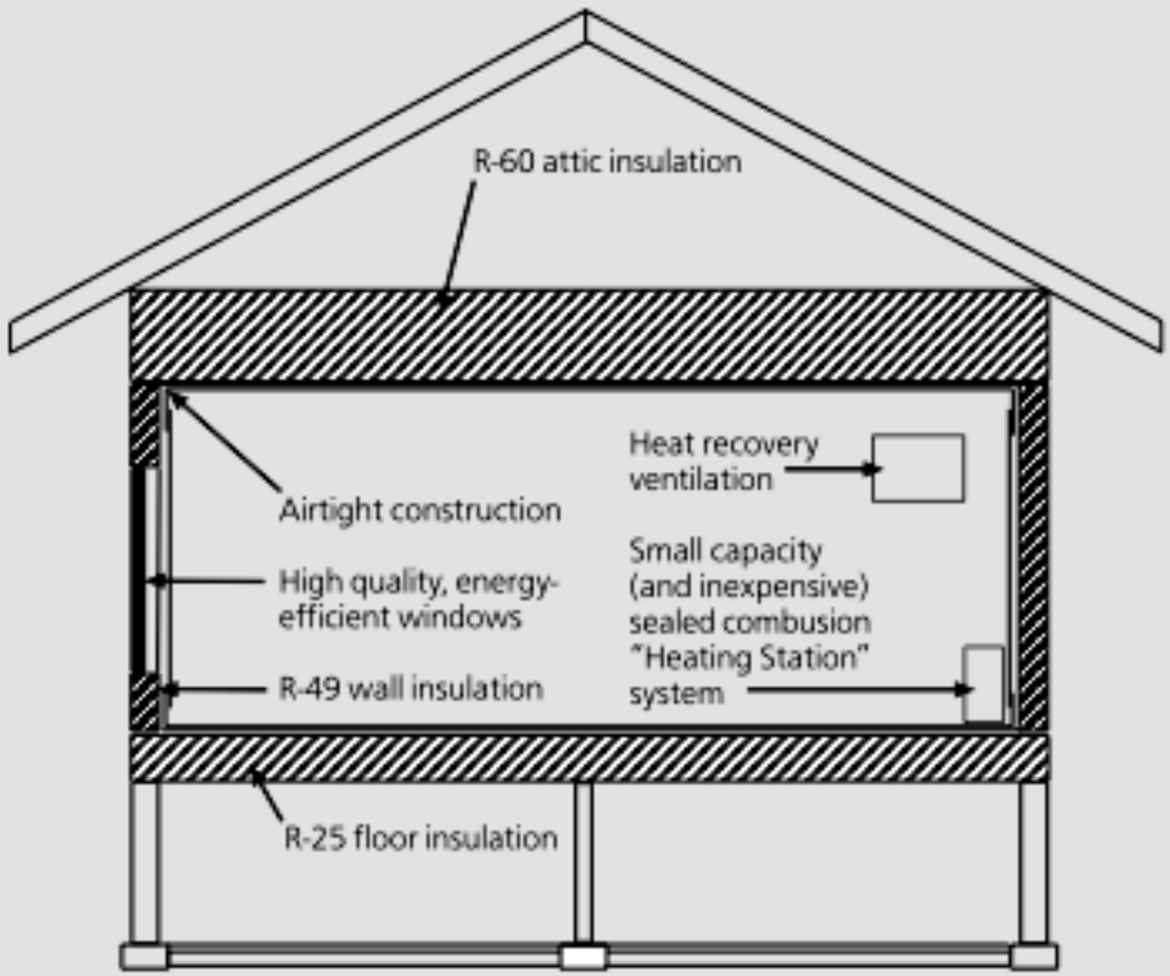


Note that insulation to the ground is taken seriously



In principle, retrofitting should adopt as much as possible the characteristics of high performance home construction.

Figure 7: High Performance Home Construction



Interior spray foam of an historic bearing wall brick building

Nehalem's REDWING HOUSE (2005):

R-19 to R-59 attic insulation, dual flush toilets, energy-star appliances, total light bulb conversion, high-efficiency fireplace inserts.

Concrete-cut windows, furred wall insulation, upgraded wall performance.

Dylan Lamar - Portland OR Net Zero modeling - Feb. 2009

	Model A: Conventional	*Model B: Superinsulated "Good" Airtightness*	*Model C: Passive House*
Floor Area (gross)	1970 sf	1970 sf	1970 sf
Envelope Efficiency			
Wall R-value	R-19 (2x6 Frame)	R-49 (Double-Stud, 15")	(same as Model B)
Roof R-value	R-30 (8" Cellulose)	R-87 (24" Cellulose)	(same as Model B)
Window R-value	R-4.2 (U=0.24)	South: R-6.7 (U=0.15) Non-south: R-9.43 (U=0.11)	(same as Model B)
Window SHGC	0.35	South: 0.63 Non-south: 0.51	(same as Model B)
Airtightness, ACH @ 50 Pa	4	2.7	0.6
Mechanical Systems			
Ventilation System	No Mechanical Ventilation	Energy Recovery Ventilator	(same as Model B)
Heating System	All Electric	All Electric	(same as Model B)
DHW	All Electric	All Electric	(same as Model B)
Performance			
Space Heating EUI (kBTU/sf.yr)	31.8	9.1	4.8
Site EUI, kBTU/sf.yr (kWh/sf.yr)	38.8 (11.4)	15.8 (4.6)	11.7 (3.4)
PV System for Net Zero	14 kW	5.2 kW	3.8 kW
PV System Cost	$196,000	$72,800	$53,200

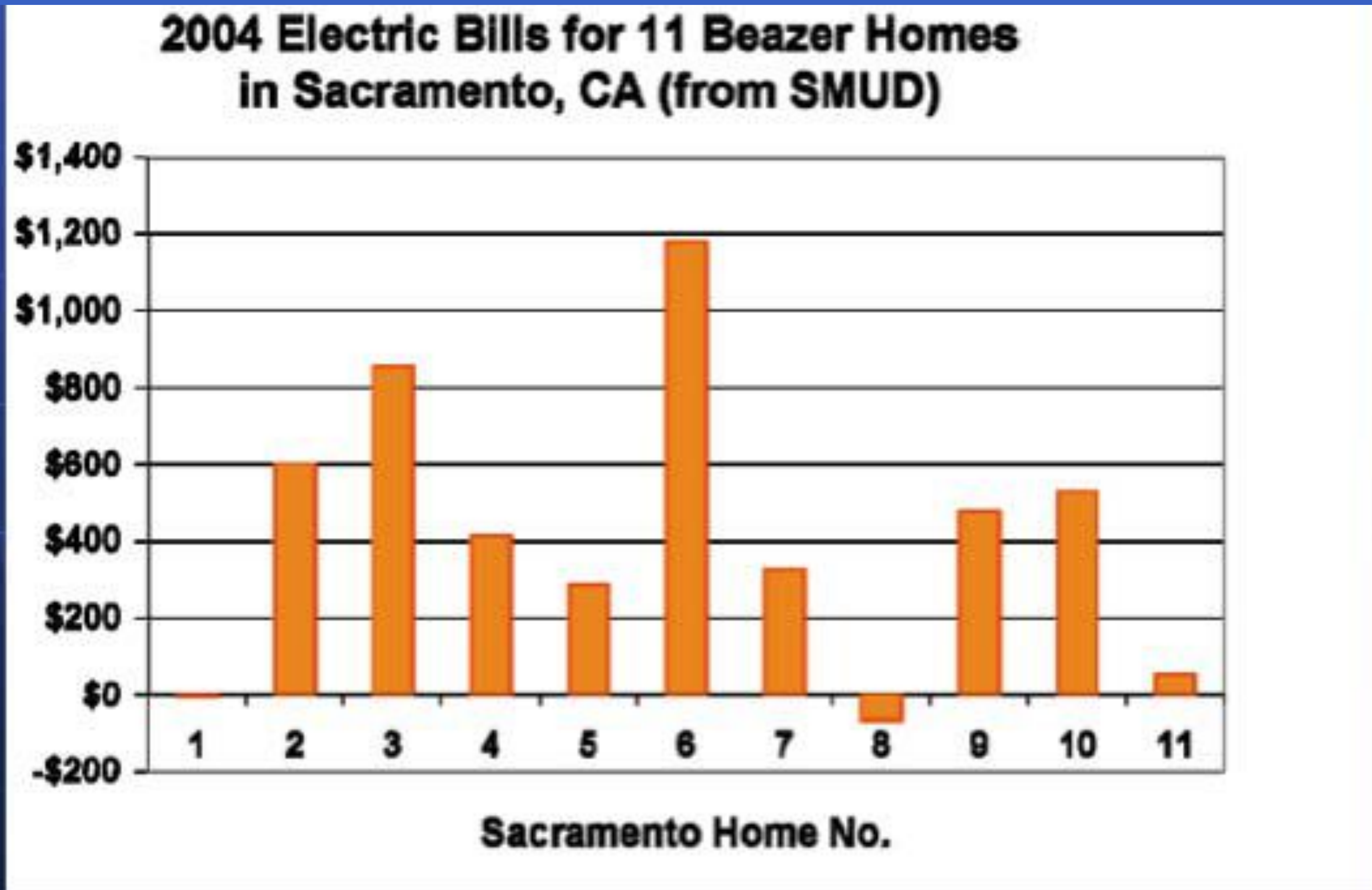
Rigorous airtight barrier results in ~$20,000 savings in PV system required to acheive net zero energy

ENVELOPE PRIORITIES:

- Attic and crawlspace first
- Windows second (depending on age)
- Wall super-insulating when easy to do.
- Require full-upgrade when house is sold.
- Hit the renovation market - costs are marginal when siding, windows, roofs are already being replaced.

Occupants Matter!

There is HUGE variation in measured energy use in IDENTICAL homes:



That means we need

Tiered Energy Rates.

A low-cost base rate can tie to BPA hydro rates,
and support "lifeline" inexpensive small use.

More expensive higher tiers can promote,
and fund
efficiency, efficiency investment,
and "lifeline" base rates.

PRIORITIES:

- Don't spend money on mechanicals.
- It's OK to phase, get easiest and highest return items first.
- Solar PVs can be planned for and added later.
- Reducing electrical loads is priority before doing PVs - and occupant choices predominate.
- Water heating options vary.

EASY IMMEDIATE ACTIONS:

Lighting upgrades can/should be done immediately
(But you don't get savings predicted, as with elec. water heaters)

Infiltration

Single-glazed windows, particularly, upgrade to new super-low-e

Upgrade attic insulation to R-50+/- ???, crawl spaces to R-38????

Eliminate ducted furnaces

Eliminate pilot lights in appliances

Replace all 12-15 year old furnaces, reefers, freezers, acs. and low-spin washers - others as they age (Lifespan of appliances averages 11 years)

Cook with pressure cookers or crockpots - can reduce cooking energy 50%

Clothes dryers use 10x energy of washers:
- High spin washers
- Outdoor lines
- Use lines in garages during rainy seasons

The Second Half of the Story:

ACCESSORY DWELLING UNIT ORDINANCES

"ADUs" are a mechanism
to create an additional dwelling from a portion
of an existing single-family residence,
without some of the costly requirements
of the Building Code.

Square feet/ person in our homes has doubled since 1960, and increased 33% just since 1990.

Figure 3: Changes in House Size and Density

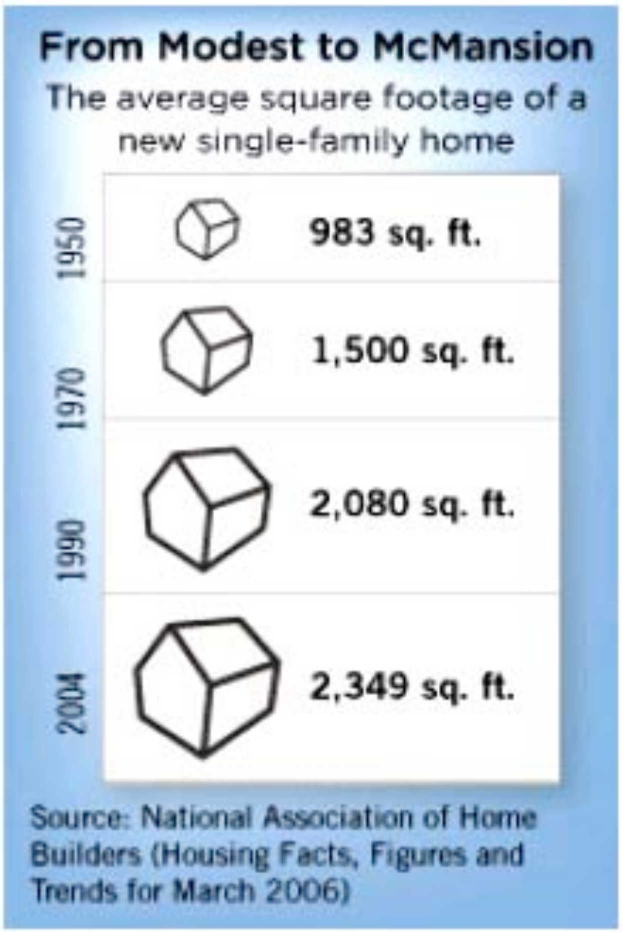
In 1990, per capita square footage was approximately 600. In 2005, per capita square footage for new construction increased to 800.

Not just bigger homes, but fewer residents per home.

Table 1: 2001 Residential Energy Consumption

Year	Per Square Foot (10^3 Btu)	Per Household (10^6 Btu)	Per Household Member (10^6 Btu)	Percent of Total Consumption
Prior to 1970	51.6	100.7	40.3	56%
1970-1979	45.5	79.0	31.6	15%
1980-1989	41.4	79.7	31.9	15%
1990-1999	38.5	91.3	31.2	13%
2000-2001	36.6	111.1	32.9	1%
Average	**46.7**	**92.2**	**36.0**	**100.0**

What's the REAL cost of an OVERSIZED home?



SMALL IS BEAUTIFUL HOME:

Space cost: 1200 sq.ft. x \$150 = \$180,000
Lot, @30% = \$54,000
Finance cost, with same payments as for 2400 sq.ft. house: 9 years = \$75,700
Energy for space: \$180,000
Subtotal: \$489,700
Income tax on earnings to pay @25% = \$122,425

Total cost: \$612,125

SUPERSIZED HOME:

Space cost: 2400 sq.ft. x \$150 = \$360,000
Lot, @30% = \$108,000
Finance cost: 30 years = 1.28 = \$599,040
Energy for space: \$360,000
Subtotal: \$1,427,040
Income tax on earnings to pay @25% = \$356,760

Total cost: \$1,783,800

A "Supersized House" costs almost
THREE times as much
as an adequately-sized home.

The difference, over 30 years,
is $1,171,675.

That's equivalent to over 50 years total after-tax income for a family earning $30,000/year.

How many years of vacation
on a tropical island
does that represent?

Why kill ourselves to over-consume?

We've ignored the REAL costs of oversized homes.

What is the REAL cost of an overstuffed chair to fill an oversized living room?

Chair purchase $600
Space cost: 20 sq.ft. x $150 = $3000
Finance cost: 30 years = 1.28 = $3840
Energy for space: $3000
Subtotal: $10,440
Income tax on earnings to pay @25% = $2610

Total cost: $13,050

What is the REAL cost of an island to fill an oversized kitchen?

Cabinetry purchase $1000
Space cost: 60 sq.ft. x $150 = $9000
Finance cost: 30 years = 1.28 = $11,520
Energy for space: $9,000
Subtotal: $30,520
Income tax on earnings to pay @25% = $7630

Total cost: $38,150

More than a year's wages for many people - just for an island to fill an oversized kitchen.

What is the REAL cost of a guest bedroom to fill an oversized house?

Furnishings: $1000
Space cost: 150 sq.ft. x $150 = $22,500
Finance cost: 30 years = 1.28 = $28,800
Energy for space: $22,500
Subtotal: $74,800
Income tax on earnings to pay @25% = $18,700

Total cost: $93,500

OR . . . about 1200 nights of motel rooms for guests, not counting the need for a ladder to climb into the oversized bed with oversized mattresses no more comfortable than before. How many years would you have to work to pay for this guest bedroom?

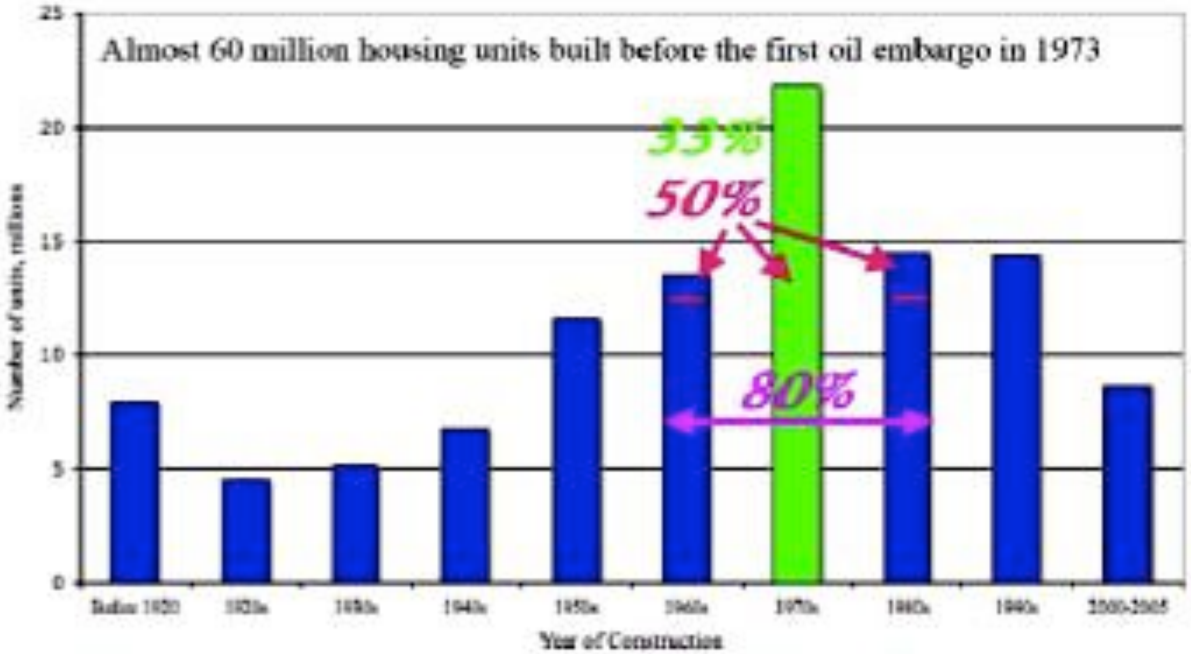
Savings with "Small Is Beautiful" homes are huge.

But cutting average house size in half is only a start.

THINK EVEN SMALLER!

IKEA presents demonstration living spaces in their stores to show that we can live comfortably – not in 1200 square feet but in 590, or 375, or even 235 square feet!

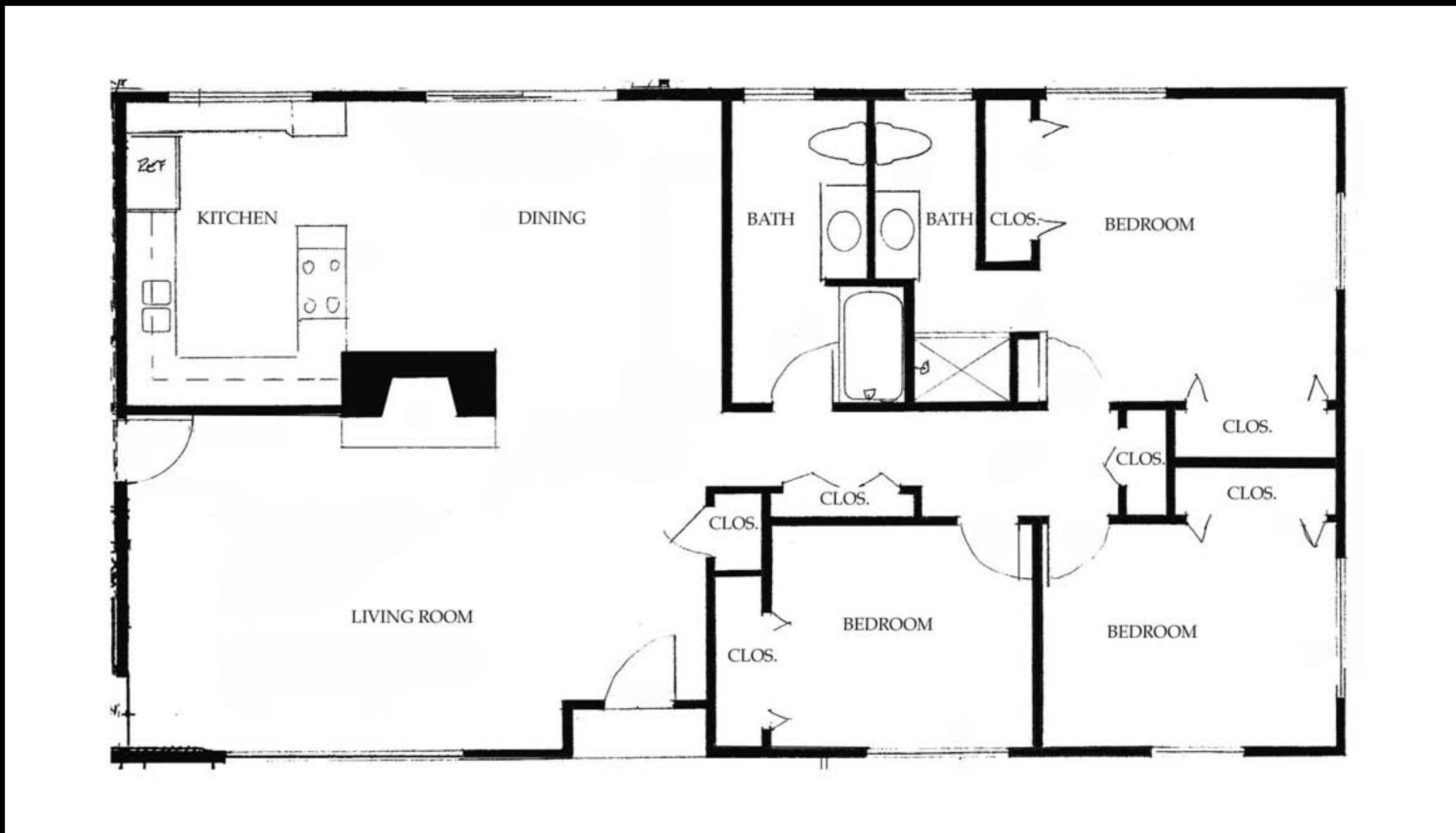
Creating smaller homes from our existing ones is easy!

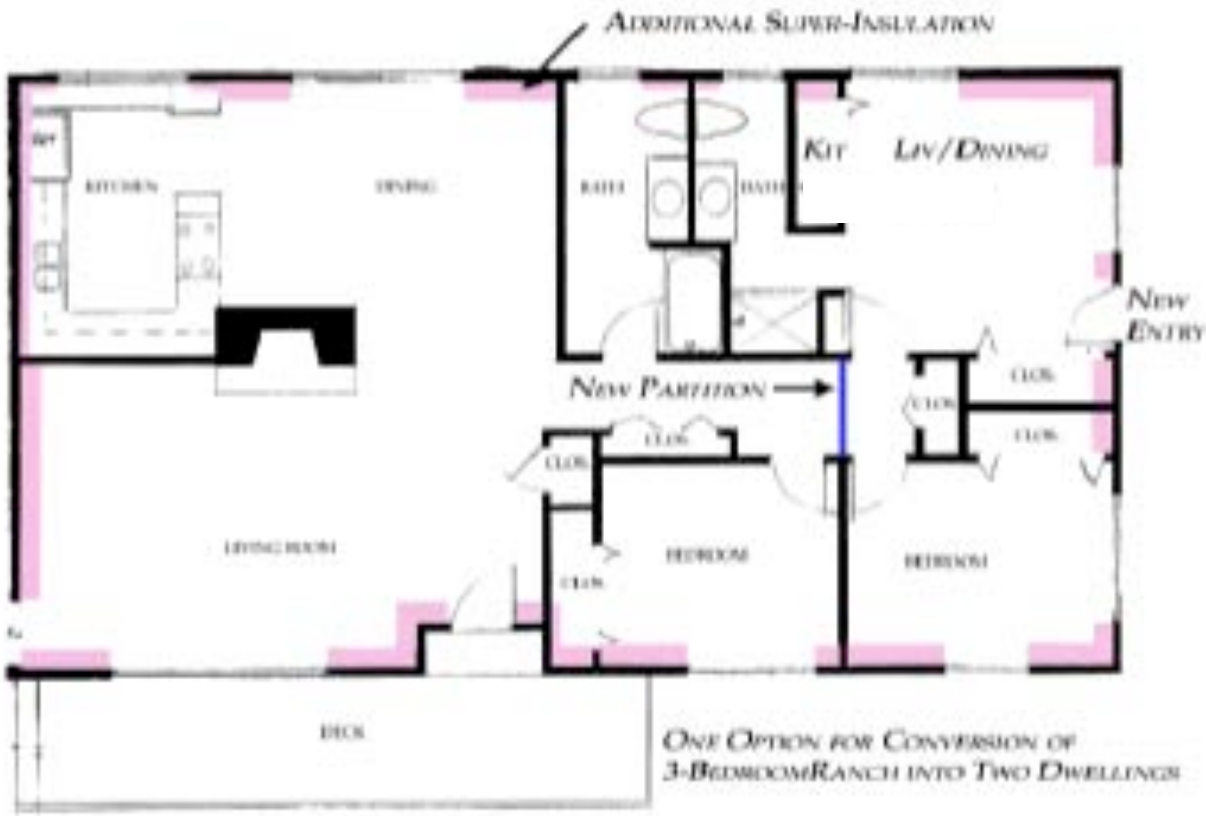


Probably a third of our housing stock is 3-bedroom ranch houses. They are easy to retrofit for net-zero-energy, and can easily be partitioned into a duplex.

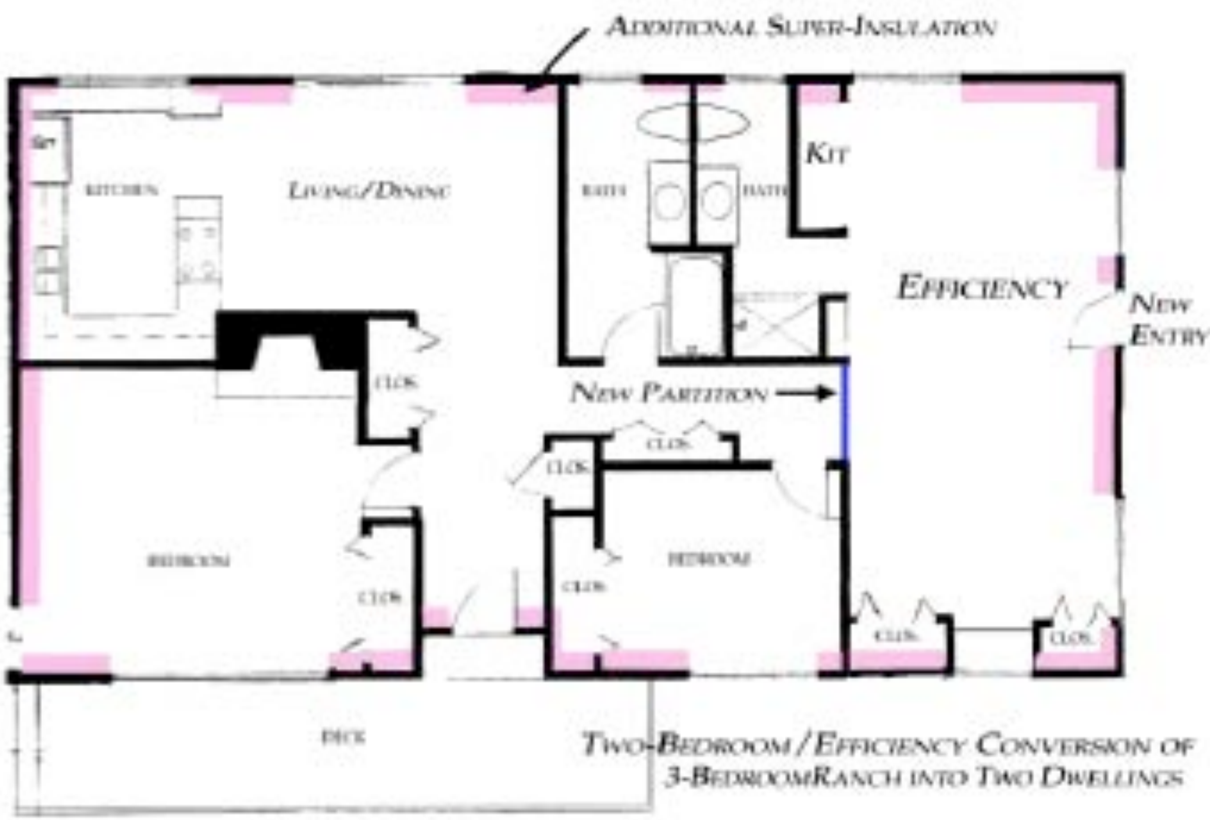
The 1970s 3-bedroom ranch house is our greatest source of potential "negawatts" <u>AND</u> affordable housing.

Typical 3 bedroom ranch plan





Here two one-bedroom units are created with just a hall partition.



TWO-BEDROOM / EFFICIENCY CONVERSION OF 3-BEDROOMRANCH INTO TWO DWELLINGS

Here a non-bearing partition is removed to make an efficiency, and the old living room partitioned into a bedroom for a two-bedroom unit.

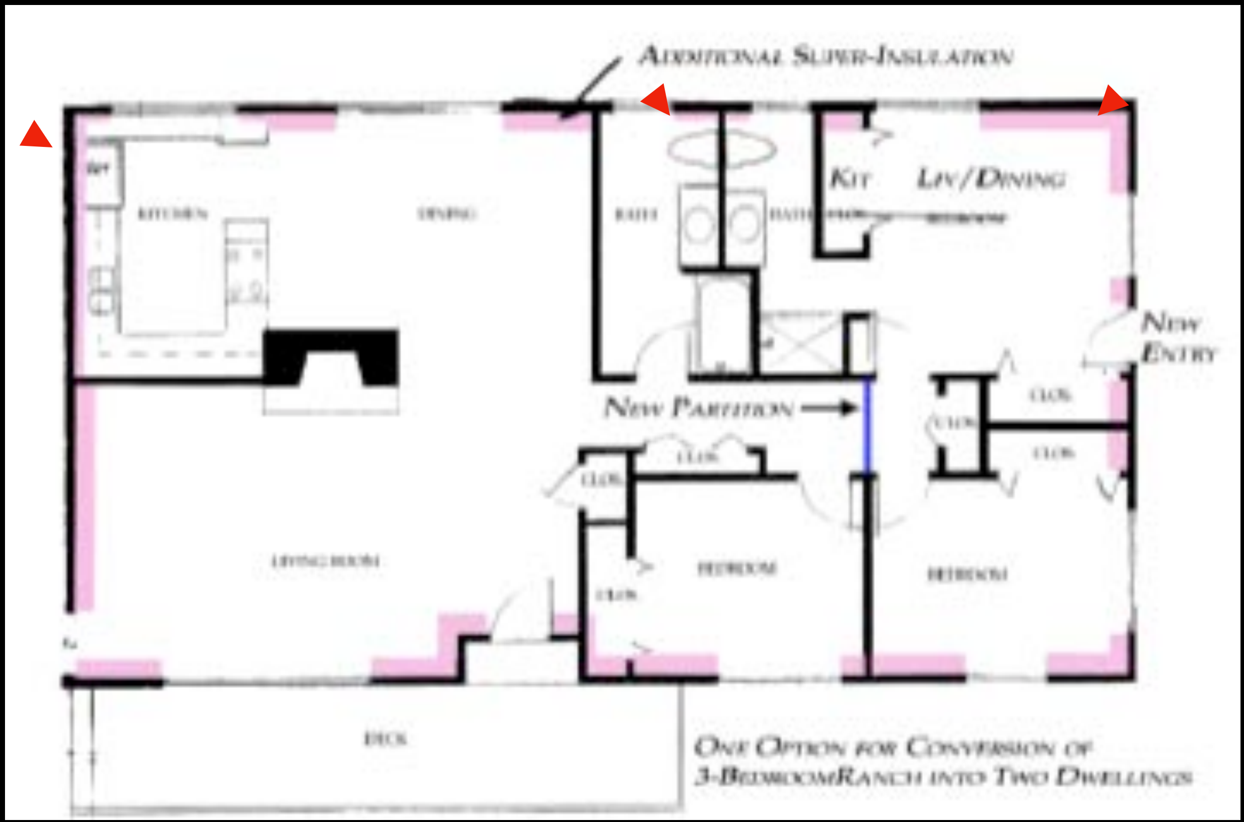
And *ALL* can approach Net-Zero-Energy!

Problem areas in Net-Zero upgrades:

Existing kitchen cabinet areas

Bathrooms

Extending electrical outlets to new wall surface



What is essential in ADU ordinances for affordable housing on the coast?

- Restricted to full-time residents (not motel units).
- Rents restricted to what is affordable by 80% AMI incomes.
- Registered, to ensure compliance with above.
- Efficiency upgrades if wanting to qualify for SDC waivers.

Details of ADU ordinances vary

to meet local preferences in areas such as:

- More building on a lot vs. splitting existing; building size and lot coverage limitations.
- Parking, and energy upgrade requirements
- Owner-occupancy requirements
- Number of occupants, handicapped access
- Design/appearance requirements
- ADU Occupant requirements, home occupations
- Attached vs. detached ADUs
- Lot size, density, # of ADUs per lot
- Utility service, registration of ADUs

COMMUNITY BENEFITS OF ADUs:

- Very affordable housing without government subsidies.
- Efficient use of existing housing and infrastructure.
- More density to support transit, neighborhood stores.
- Income for homeowners.
- Better maintenance and neighborhood stability.
- More housing opportunities within existing communities.
- Energy and resource efficiency.

HOMEOWNER BENEFITS OF ADUs:

- Care and support of elderly residents.
- Income allowing people to remain in neighborhood longer, meet rising costs.
- Increased security and companionship.
- Help first-time homeowners meet payments, qualify for mortgages.
- Easy "oversight" of rental property.
- Ability to make best use of existing home after children grow up.

And the last big question:

HOW DO WE PAY FOR IT?

TillaWatts: Possible Funding Sources

- *Federal Tax Credits*
- *State Tax Credits*
- *Unemployment*
- *TPUD 10% discount $$$*
- *TPUD rates*
- *TPUD tiered rate structure*
- *BPA Conservation $$$ pass-through & "bonus"*
- *Federal low-income weatherization $$$*
- *Homeowner reduction of energy bills*
- *Homeowner investment in home improvement*
- *SB201 "Energy Matchmaker" funds*

Learn from / Build on Initiatives

- Passive House Retrofit Kit (www.energieinstitut.at/retrofit
- Passive House USA (www.passivehouse.us)
- Passiv Haus Institut (www.passivhaus.de)
- German Energy Efficiency Retrofit Demo
- Passive House Retrofit Kit (www.energieinstitut.at/retrofit
- Riot for Austerity (www.riot4austerity.org)
- National Affordable Housing Network (www.nahn.com)
- 2030 Challenge (www.architecture2030.org)
- Building Science Corp. (www.BuildingSciencecorp.com)

Work with others to develop effective programs:

Thousand Home Challenge

Sponsors*[1], *Ring Leaders*, *& Collaborators

CSG, National Grid, NYSERDA, PG&E[1]

CCHRC, City of Boulder, Office of Environmental Affairs, CMHC, Community Solutions, Conservation Connection Consulting, CSG, Davis Energy Group, Inc., NAHN, National Grid, NEEP, NREL, PG&E, Sustainable Spaces

ACEEE, AO Smith, BKi, BSC, Columbia Gas of Ohio, Conservation Technologies, ConSol, Delta-T Inc., Earth Advantage, GreenHomes America , Heyoka Solutions LLC, HomeEnergy magazine, Johns Manville, KEMA Services Inc., LBNL, Metropolitan Energy Center, Minnesota Power, Oak Ridge National Labs, Passive House Institute US, PSD, SRMI, The Energy Conservatory, VEIC, WSU Energy Program

[1]Guidance Document Sponsor

Potential partners for effective regional programs:

- Local utilities such as TPUD
- NWEEA - program development
- Energy Trust - experience in retrofit programs.
- NW Power Council - guiding efficiency programs.
- State energy departments, building codes, and funding.
- National efficiency organizations such as Affordable Comfort, NAHN.

***Affordable Comfort, Inc.* is coordinating a national program for energy-efficiency retrofits of existing homes.**

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www.affordablecomfort.org

ACI White Paper
Home Energy magazine: Climate Solutions
Deep Energy Reductions Resources
Coming Soon - Guidance Document

Refinements needed as national program develops:

- Financing instruments
- Verified performance prediction tools
- A matrix of bio-climatic and housing type approaches
- Systems approach and phasing strategies
- Rapid deployment of demonstration homes and publicity
- Occupant behavior and feedback methods
- Product innovation – esp. windows, micro HVAC, feedback systems
- Communities of interest, communities of locale

For more information locally, contact:

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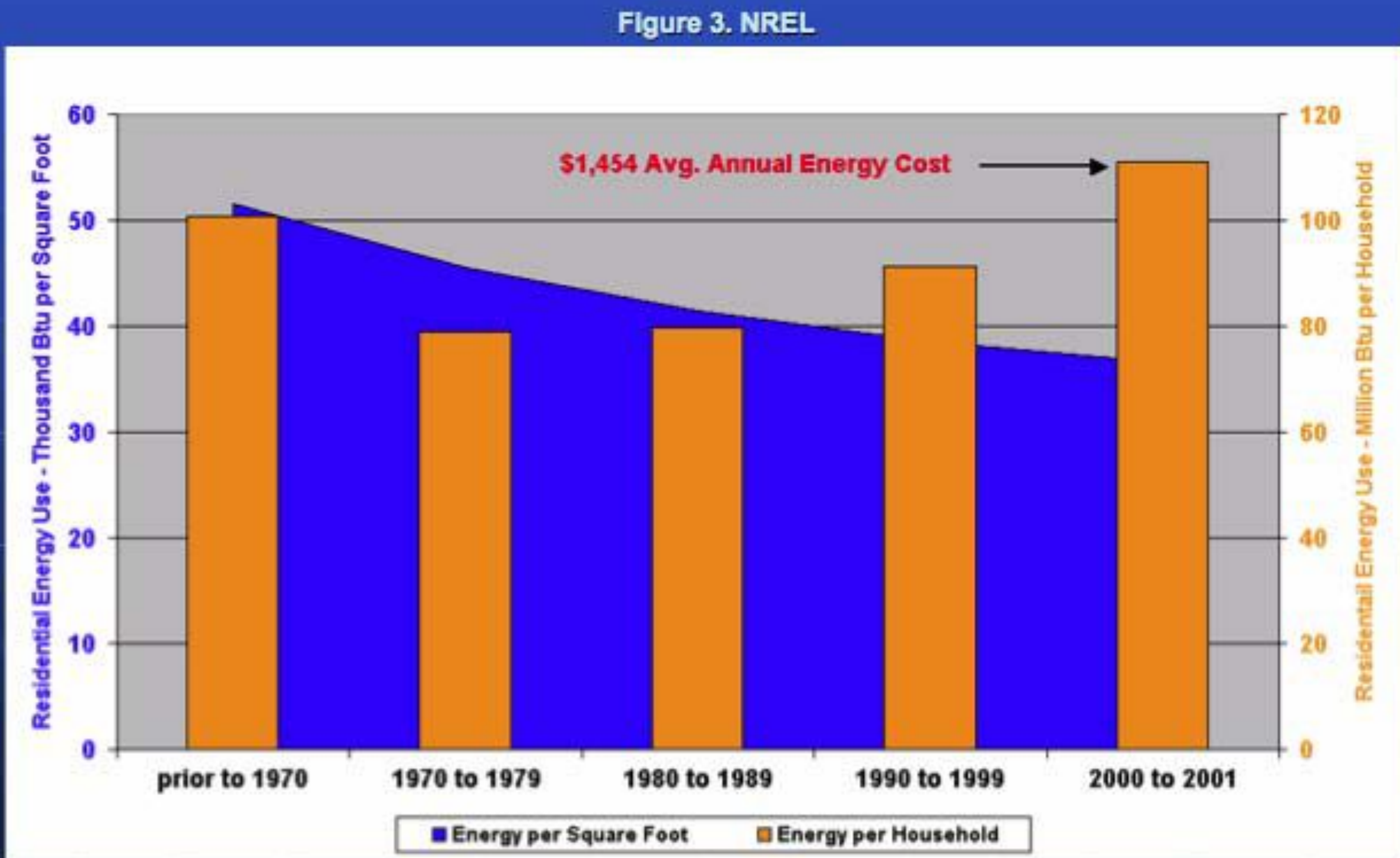
Residential Energy Use by Year of Construction (site energy)



NAHBRC Report No. EG5049_020606_01

Benefits of Deep Energy Retrofits

Adapted from: Moving Existing Homes Toward Carbon Neutrality
ACI July 2007 Summit White Paper

- Reduces GHG emissions
- Energy cost savings
- Increases long term affordability
- Increases passive survivability
- Maintains embodied energy and cultural value
- Improves durability, IAQ, comfort, health and safety
- Increases the impact of investment in renewables
- Builds local economies
- Creates good jobs that cannot be out-sourced
- Stimulates product development
- Builds energy independence for US/Canada

www.affordablecomfort.org/event/aci_summit_moving_existing_homes_toward_carbon_neutrality/resources/29