



Builders Making It Happen

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Builders Association of Minnesota

Energy Codes 2008 Conference

BAM 101

- Builders Association of Minnesota
 - Represents home building & remodeling industry in Minnesota
 - 14 local associations
 - NAHB
- 4,500 members/2,000 builder & remodelers
- Legislation, regulation, legal
- Very involved in development of new MN residential energy code

Minnesota Housing 101

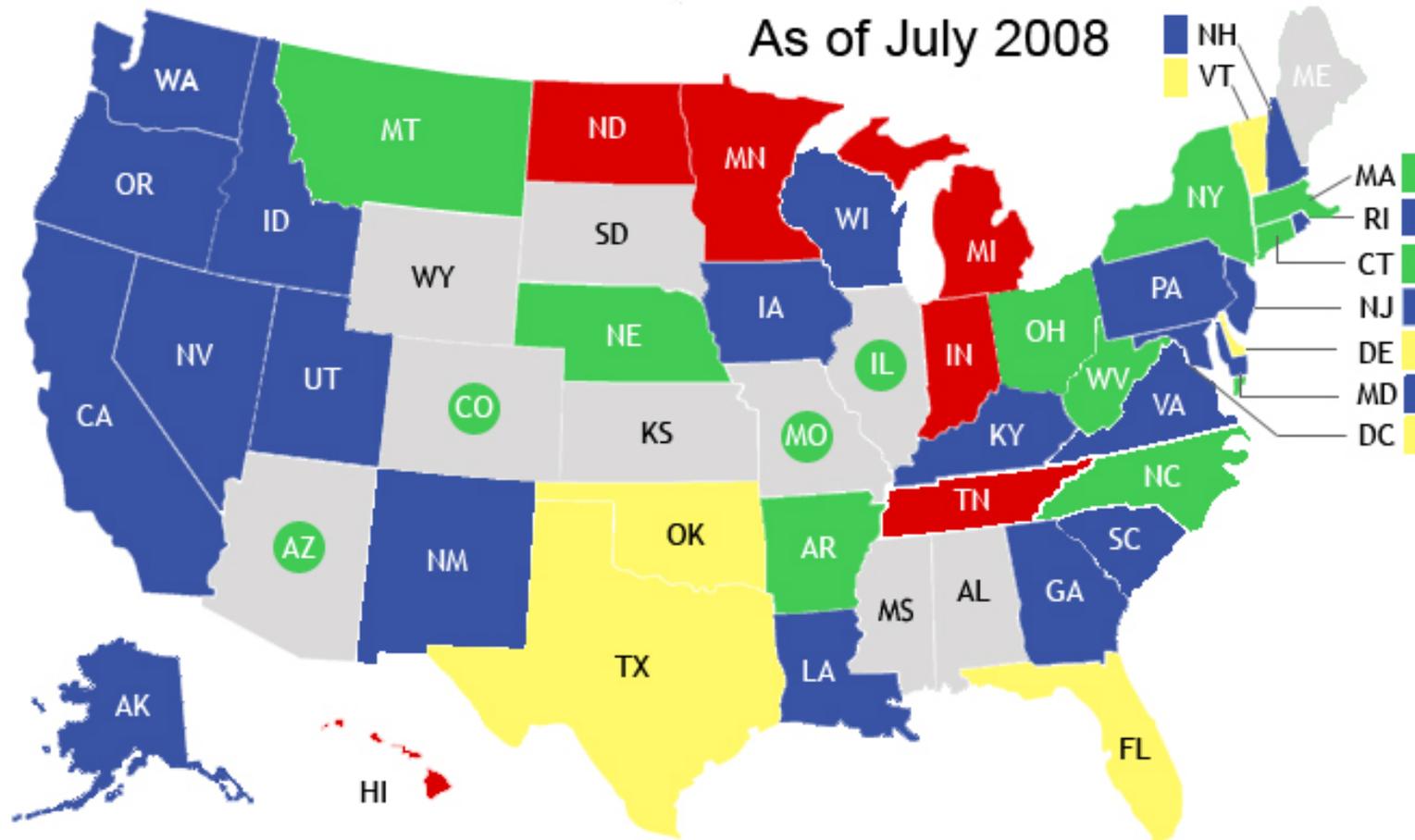
- Highest home ownership rate
- Licensed residential contractors have 7 hours of continuing education credits a year
- 15,000 – 40,000 new residential units a year
- What do St. Paul and St. Petersburg Russia have in common?

MN Energy Code 101

- Based on 1995 MEC
- Minnesota amendments
- Are we the strictest energy code in the nation?
- Or one of the worst?
 - BCAP based on DOE state reported R-Values

Residential State Energy Code Status

As of July 2008



- Adopted code meets or exceeds 2006 IECC or equivalent
- Meets 2003 IECC or equivalent
- Meets 1998-2001 IECC or equivalent (meets EPCA)
- Precedes 1998 IECC or equivalent (does not meet EPCA)
- No statewide code
- New code soon to be effective
- Significant adoptions in jurisdictions

Source:
Building Codes Assistance Project
www.bcap-energy.org

What Yardstick Should We Use?

- Measuring Energy Use/Efficiency
 - R-Values & U-Factor counts
 - IECC code requirements or ??% of ?? IECC code requirements
 - Equipment efficiencies
 - HERS ratings
 - Estimated/measured Btus
 - Results of field testing
 - What else?

What Yardstick Does BAM Use?

- Measuring Energy Use/Efficiency
 - ✓ R-Values & U-Factor counts
 - ✓ 50% over 2004 Supplement to the 2003 IECC
 - ✓ Equipment efficiencies
 - ✓ HERS ratings
 - ✓ Estimated Btus
 - ✓ Results of field testing
 - ✓ Mechanical ventilation rates
 - What else?



IRS

Home Energy Tax Credit

- BAM's yardstick for Minnesota's residential energy code



IRS

Home Energy Tax Credit

- IRS Tax **CREDIT** not a rebate
- Given directly to **home builder** not homeowner
- **\$2,000 per qualifying home**
 - Sold in 2006, 2007, or 2008

IRS

Home Energy Tax Credit

- Qualifying homes have to be **50% more energy efficient** in heating & cooling than 2003 IECC (2004 supplement)
- 2003 IECC – 2004 Supplement is equivalent to ?? 2006 IECC ??

IRS Home Energy Tax Credit Requirements

- STEP 1: Plan review
 - ✓ Blueprints
 - ✓ Detailed checklists
 - ✓ R-values, u-values, materials, methods
 - ✓ HVAC equipment



IRS Home Energy Tax Credit Requirements

- STEP 2: On-site verification (at closing or after)
 - ✓ Envelope leakage
 - ✓ Duct leakage to exterior
 - ✓ Attic insulation r-value/depth
 - ✓ Ventilation rates
 - ✓ HVAC equipment efficiencies



What Isn't Checked

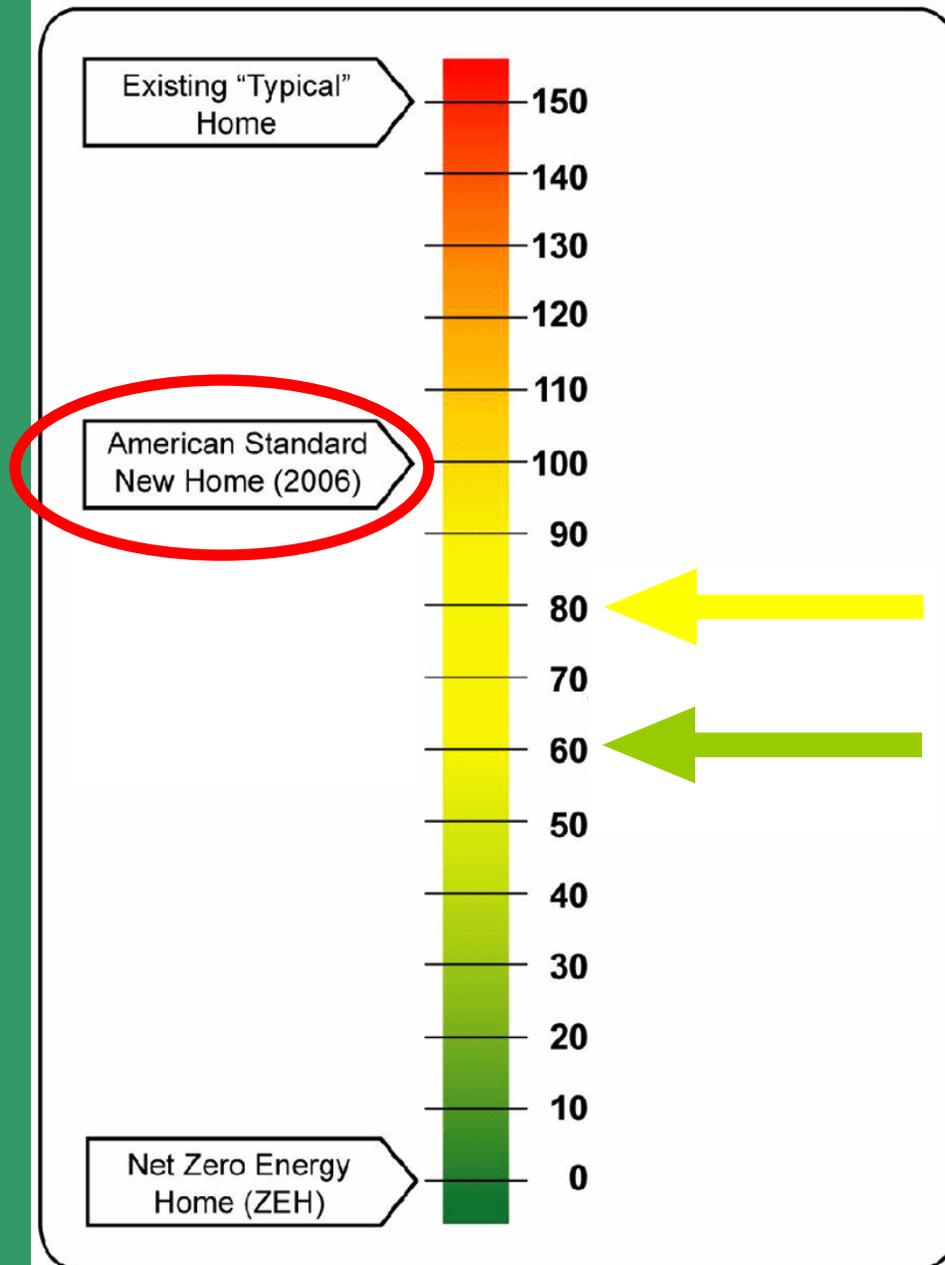
- No framing inspection
- No insulation inspection
- No inspection during construction
- Wall/floor/foundation insulation – worst default used



Which houses qualify?

- **TESTED** single family homes built to the Minnesota Energy Code
 - Sealed air barrier
 - Ducts inside conditioned space or those outside conditioned space are sealed
 - Minimum Minnesota energy code r-values/u-factors are met
- Zero % or very small amount of electric resistance heat

HERS Index



The Home Energy Rating System Index

Energy Star = 80

Avg. new SF home in MN = 61

Smaller = Better

EPI Testing Results

- Over 450 homes tested on-site by the Energy Payback Incentive program
- All of the houses are already built when they are tested
 - Unless they also are qualified for Energy Star
- Many are occupied
- Many more houses would have been tested but S-Corps can't claim credits

MN versus US

■ MN Code House

- 3,500 conditioned sq. ft. (includes basement)
- **92%+ AFUE** furnace
- Sealed ductwork outside conditioned spaces
- Field verified sealed air barrier

■ Comparable house

- 3,500 conditioned sq. ft. (includes basement)
- **78% AFUE** furnace
- Unsealed ductwork outside conditioned spaces
- Mostly sealed air barrier

What's Wrong with This Picture?

- MN Builder's House
- U.S. House



So Many Tax Credits So Little Time...

- Why are code built Minnesota builders houses qualifying for tax credits?
 - The Minnesota 90+% Solution
 - Sealed air barriers including HVAC ducts
 - Mechanical ventilation
 - Air-to-air exchangers or exhaust only fans
 - R-values where you need them the most
- DOE staff knew MN Builders would be “free riders”

MN versus U.S.

■ **Builder's House MN Energy Code**

- R-19 walls
- R-38 ceiling
- R-5 to R-10 basements
- Avg U-Factor 0.30-0.35
- Air sealing TIGHT

■ **Comparable house 2006 IECC**

- R-19 walls
- R-38 ceiling
- R-10 basements
- Avg U-Factor 0.35
- Air sealing average

MN versus U.S.

- Builder's House
92% AFUE
- Outside ducts are sealed



- Comparable house
78% AFUE
- Outside ducts = 12% loss of conditioned air



MN Residential Code Requirements

- This is what Minnesota Code requires for **EVERY** single-family/two-family home

Continuous Air Sealing



Sealed & Insulated Foundations



Air Sealed Rim Joists



3 Kinds of Air

- Air for furnaces and water heaters
- Air for kitchen vent hoods and other things that exhaust
- Air for people who live in the house

3 Kinds of Air

- **Combustion air** – gives water heaters and furnaces the air they need to operate
- **Make-up air** – gives kitchen vent hoods and other fans enough air to not cause backdrafting
- **Mechanical ventilation** – fresh air for occupants + moisture control

Who Loves MN Builders?

- Direct vent (sealed combustion) & fan assisted furnace & water heater mfrs
- Electric water heater mfrs
- Energy efficient window and door mfrs
- Direct vent (sealed combustion)/fan assisted fireplace mfrs
- Spray foam in a can mfrs

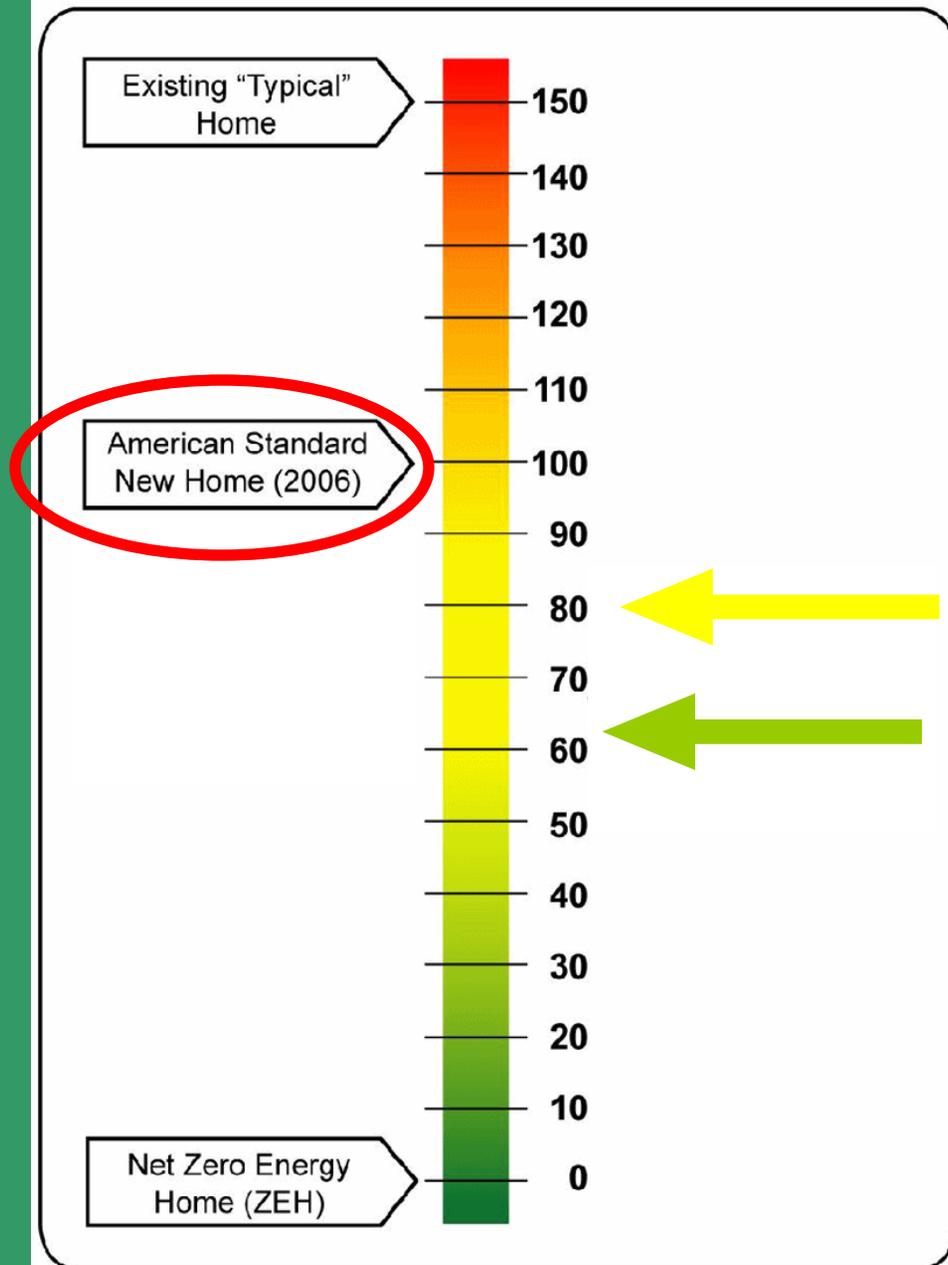
Who Loves MN Builders?

- Truss manufacturers
 - Energy heeled trusses required
- Air-to-air exchanger mfrs
 - More HRV and ERVs installed in MN than any other state
 - 2% of national population
- Exterior/integral foundation insulation mfrs
 - Move insulation to the exterior/integral

Energy Efficiency Paper Versus Reality

- **R-Value requirements do not magically produce savings**
- Heating system efficiencies matter!
- The air barrier quality is in the details
- No magic products – systems approach

HERS Index



The Home Energy Rating System Index

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Characteristics of EPI Houses

- 450 homes certified for the Tax Credit to date
- HERS ratings for 148 houses
 - Average HERS rating = 61

Characteristics of EPI Houses

- 22 houses had a HERS rating of 61
- Built by 12 different builders
- Tested by 7 different testers
- 5 different testing companies
- 8 homes Energy Star certified
 - Others already built when tested

Characteristics of the 61 HERS Houses

■ Conditioned square feet

■ Average = 3,307

■ Lowest to highest = 2,078 to 4,483

Characteristics of the 61 HERS Houses

- **Flat Ceiling** average R-Value = **40.8**
 - Range = R-30 to R-50
- 7 houses with **Vaulted Ceilings**
average R-Value = **42**
 - Range = R-35 to R-45

Characteristics of the 61 HERS Houses

■ **Foundation** wall insulation

average R-value = **8.8**

■ Range = R-5 to R-22

■ **Above Grade Walls**

average R-value = **17.6**

■ Range = R-15 to R- 21

Characteristics of the 61 HERS Houses

Heating Systems

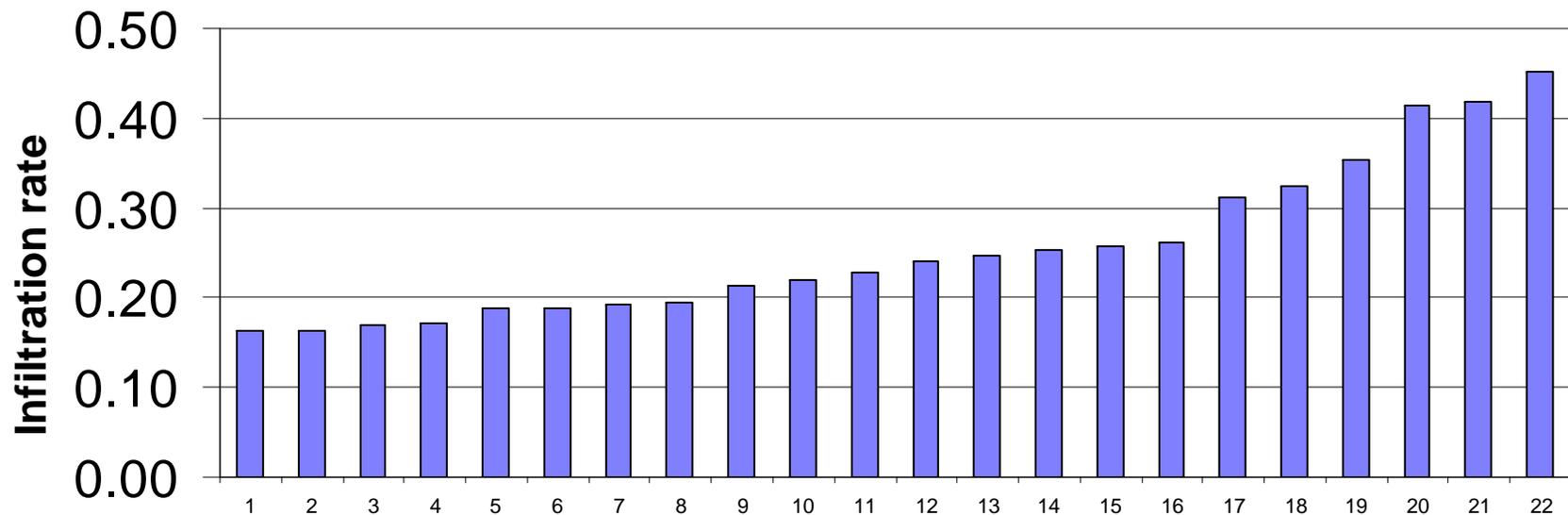
- Natural Gas Furnaces **average AFUE = 92.4**
- One dual fuel heat pump at 8.5 HSFP with back-up electric

Characteristics of the 61 HERS Houses

- **Infiltration rates average = 867** CFM₅₀
 - Lowest to Highest = 341 to 2030 CFM₅₀
- **Duct leakage to outside average = 48.8** CFM₂₅
 - Median = 38 CFM₂₅
 - Lowest to Highest = 0 to 205 CFM₂₅

Infiltration Rate Cfm50 by Sqft

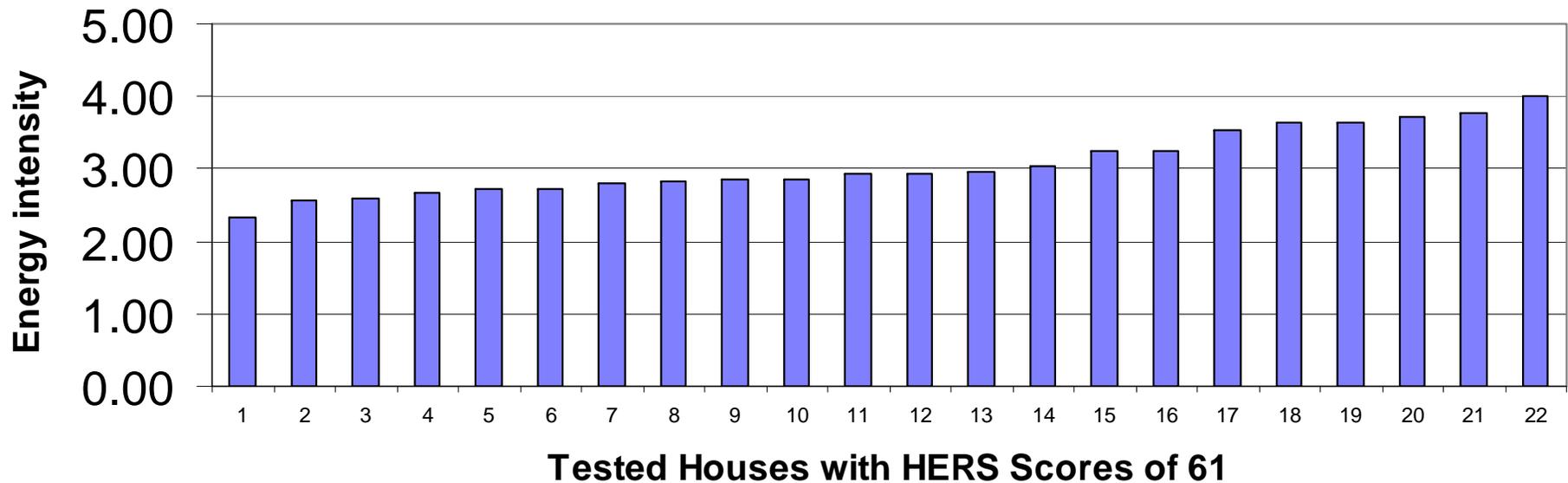
Average = 0.26
Range = 0.16 – 0.45



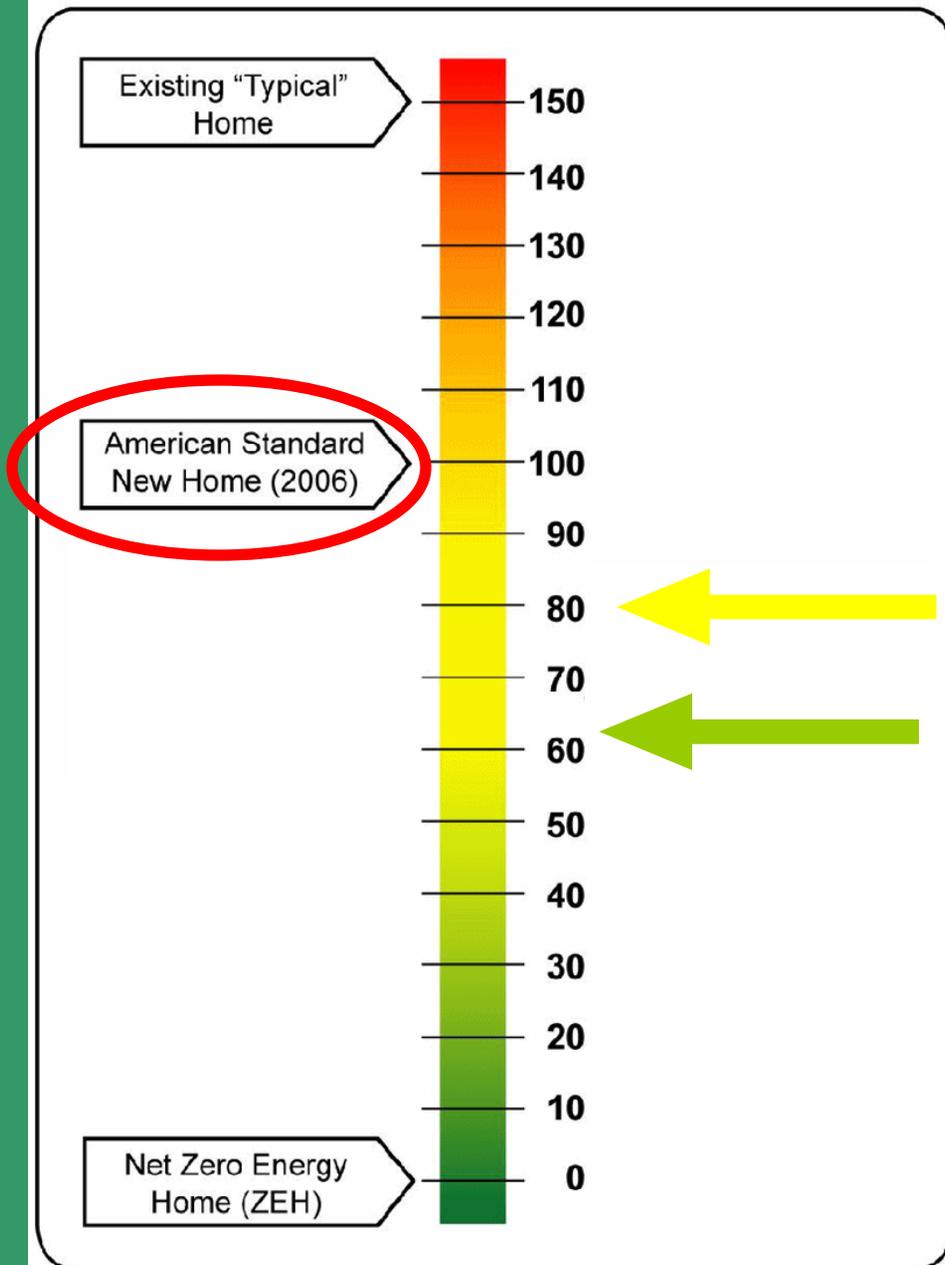
Energy Intensity - Heating Btus/sqft/HDD

Average = 3.07

Range = 2.34 – 3.99



HERS Index



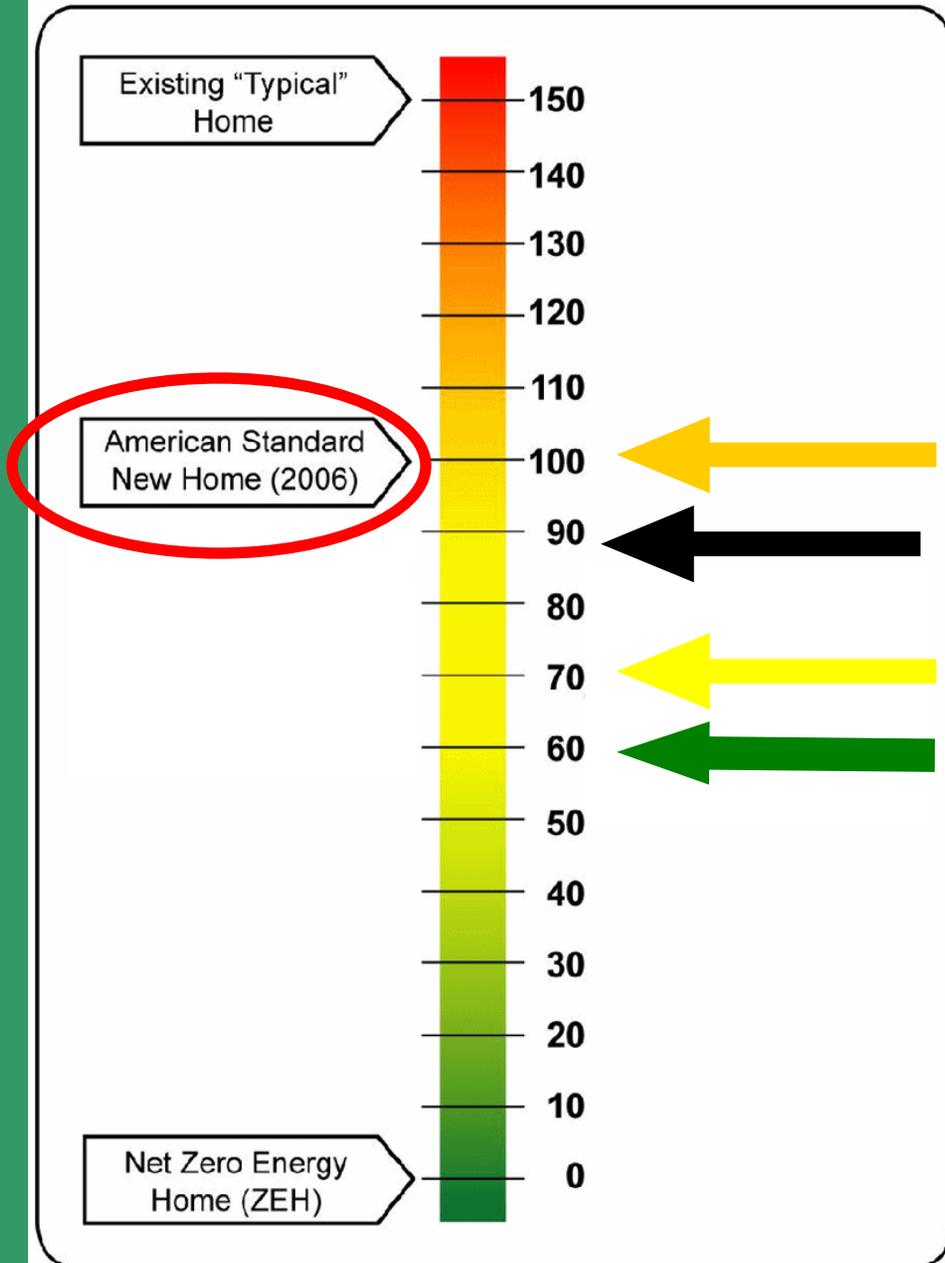
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HERS Index



The Home Energy Rating System Index

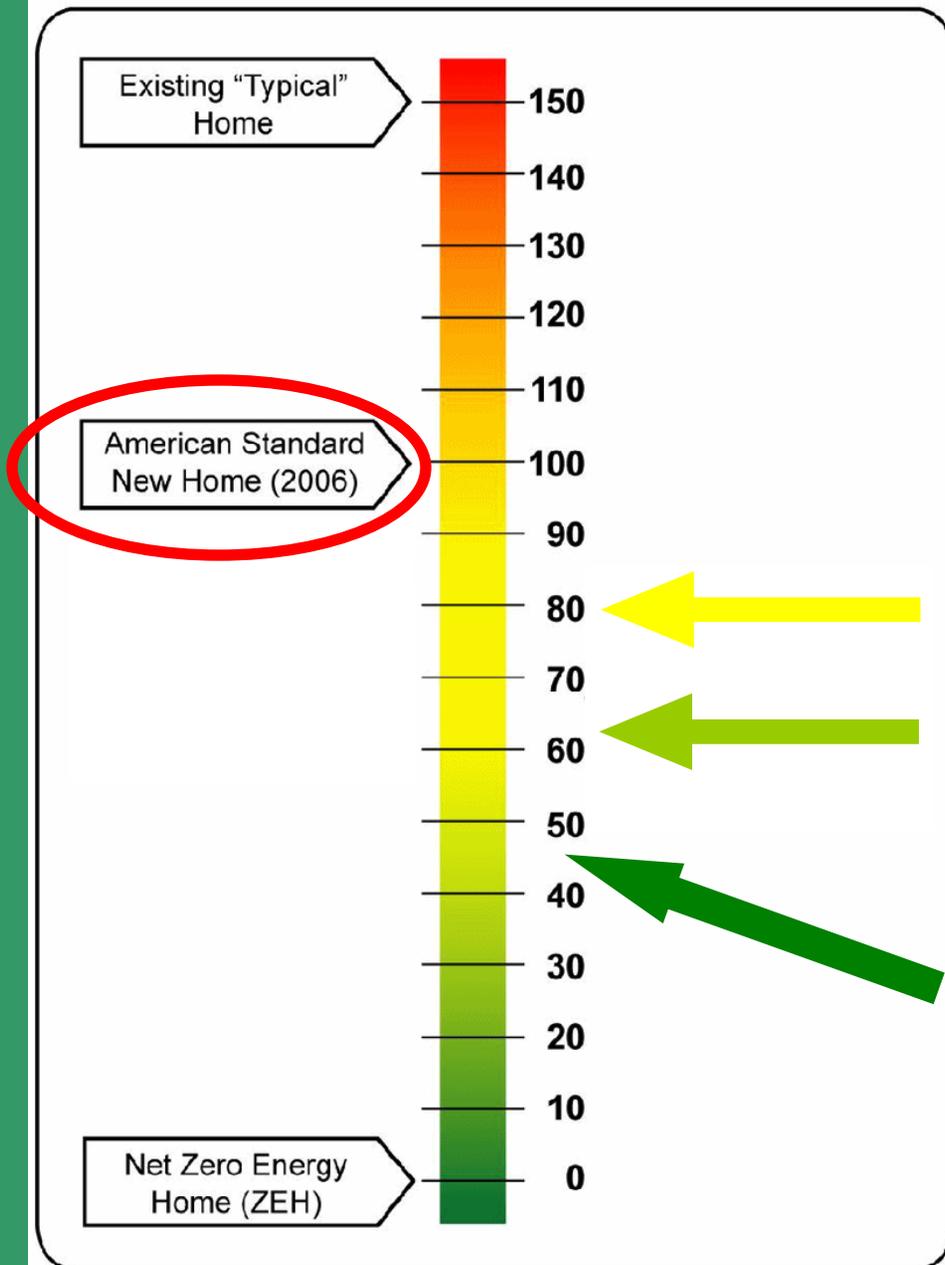
2006 IECC = 100

2009 IECC = ??

30% of 2006 IECC = 70

30% Solution = ??

HERS Index



The Home Energy Rating System Index

Smaller = Better

Energy Star = 80

Avg. new SF

home in MN = 61

"Best" home

in MN = 48

Home Energy Rating Certificate

H00590

St SE
Clear Lake, MN 56220



**5 Stars Plus
Verified Condition**

Uniform Energy Rating System

Energy Efficient									
1 Star	1 Star Plus	2 Stars	2 Stars Plus	3 Stars	3 Stars Plus	4 Stars	4 Stars Plus	5 Stars	5 Stars Plus
500-401	400-301	300-251	250-201	200-151	150-101	100-86	85-71	70-51	50-0

HERS Index: **48**

General Information

Conditioned Area: **6196 sq. ft.**
 Conditioned Volume: 54252 cubic ft.
 Bedrooms: 4
 HouseType: Single-family detached
 Foundation: Conditioned basement

Mechanical System Features

Ground-source heat pump: Electric, Htg: 3.3 COP, Clg: 16.3 EER.
 Heating: Fuel-fired hydronic distribution, Propane, 80.0 AFUE.
 Water Heating: Conventional, Electric, 0.90 EF.
 Duct Leakage to Outside: Total: 60.00 CFM @ 25 Pascals.
 Ventilation System: Balanced ERV, 165 cfm, 150.0 watts.
 Programmable Thermostat: Heating: Yes Cooling: Yes

Building Shell Features

Ceiling Flat: R-44 Exposed Floor: NA
 Vaulted Ceiling: R-44 Window Type: 0.0-31, SHGC:0.30
 Above Grade Walls: R-18 Infiltration
 Foundation Walls: R-10.0 Rate: Htg: 1540 Clg: 1540 CFM50
 Slab: R-0.0 Edge, R-10.0 Under Method: Blower door test

Lights and Appliance Features

Percent Fluorescent Pin-Based: 0.00 Clothes Dryer Fuel: Natural gas
 Percent Fluorescent CFL: 25.00 Range/Oven Fuel: Natural gas
 Refrigerator (kWh/yr): 775.00 Ceiling Fan (cfm/Watt): 0.00
 Dishwasher Energy Factor: 0.46

The Home Energy Rating Standard Disclosure for this home is available from the rating provider.

REM/Rate - Residential Energy Analysis and Rating Software v12.2

This information does not constitute any warranty of energy cost or savings.

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Rating Number: H00590

Certified Energy Rater: Kirk Kolehma

Rating Date: 7/24/07

Rating Ordered For:

Estimated Annual Energy Cost

Use	MMBtu	Cost	Percent
Heating	61.0	\$951	32%
Cooling	4.8	\$113	4%
Hot Water	16.4	\$384	13%
Lights/Appliances	65.0	\$1372	46%
Photovoltaics	0.0	\$0	0%
Service Charges		\$192	6%
Total		\$3012	100%

This home meets or exceeds the minimum

criteria for all of the following:

2004 International Energy Conservation Code

Builder:

Lumber One-Cold Spring
 700 3rd St So, (PO Box 395)
 Cold Spring MN, 55320
 (320)-685-3631

Certified Energy Rater

Best House HERS 48

- Energy Intensity Factor for heating = **1.23**
- Infiltration or air leakage rate @cfm50/sqft = **0.25**
- R-10 foundation walls/R-19 walls/R-44 ceilings
- Geothermal heat pump = 3.03 COP
 - Propane back up at 80 AFUE

Why the 30% Solution Isn't One in MN

- Heating system efficiencies matter!
- Increases in R-values do not make up for inefficient furnaces & water heaters
- Sealed air barriers without mechanical ventilation is not green nor sustainable!
 - Been there, built that, had to replace in 5 years
- More insulation isn't always better

More R-Value Isn't Always the Answer

- Rim joist/band joist
- Adding insulation without air barrier and vapor retarder can = condensation





Why BAM Is Opposed to the 30% Solution

- It ignores the 90% Solution!
- Increase furnace and water heater standards to 90%+

Why BAM Is Opposed to the 30% Solution

- **Encourages inferior building practices**
- **Current MN code in basements**
 - R-10 interior/exterior or
 - R-5 exterior trade off using RESCheck
- **Proposed 30% Solution for basements in Minnesota**
 - R-19 interior
 - R-15 exterior

Why BAM Is Opposed to the 30% Solution

- R-15 exterior insulation for basements
IS NOT FEASIBLE
 - Not enough house to cantilever!
 - No exterior foundation insulation
 - No integral foundation insulation
- Exterior insulation allows basements to dry to the interior
- Benefit of thermal mass

Basement Insulation

Is trickier than it looks...



Basement Insulation

- Are they wet or dry?
- Vapor retarder under the slab?
- When is waterproofing required?
- When is drainage/drain tile required?
- Can the system dry? If not, is it an adequate barrier system?
- Unique environment/unique building techniques

Why BAM Is Opposed to the 30% Solution

- Ignores low federal furnace efficiencies
- Ignores complexities of basement construction
- Does not promote energy efficiency and long term durability
- Makes it harder for cities or states without a code to adopt the 2009 IECC



The REAL Energy Efficiency Solution

- Give builders an energy code they can't refute.
- Not one that prevents them from using best practices!



The REAL Energy Efficiency Solution

- Minnesota's been there and we build that every day.
- Why not a 90% solution for furnaces?
- Sealed air barriers
- Mechanical ventilation
- R-value/U-factor increases where they count

Learn from MN's Experience

- Don't add insulation without controlling moisture
- Integrate energy codes with building codes
- Ask builders how proposed codes would affect their practices...then **LISTEN** and adjust

Learn from MN's Experience

- Make innovations easy for building code officials to accept
- Ask don't assume, what's being done in the field
- Respect "real life on-site" results
- Don't install a "pretty tight" air barrier without mechanical ventilation

Learn from MN's Experience

- Don't assume code officials or builders speak energy ease
- Tell them what to build and why
- Use diagrams, pictures, hands on demonstrations whenever possible
- Remember that paper codes must be translated into real results and builders still have to make a profit

Learn from MN's Experience

- Prescriptive codes can equal high performance
- Make sure your energy code encourages efficiency and durability

What Do You Think?

- Is Minnesota's Residential Energy Code one of the most or least efficient in the nation?
- Minnesotan's in the room?
- Anyone else?