Building Low Energy Use Homes in South Central AK

Where Are We?

- What are the challenges we face building NZE
- What do we have going for us towards Building better preforming buildings
- What Market Conditions are in Our Favor?

Objectives

- Integrated Design Ideas for Low Energy Use Buildings
- 6 Star and some benchmarks
- A 6Star Retro Fit
- Towards NZE in South Central and some benchmarks
- Tap into Knowledge in the Room
- Energy Use, Heating, and Renewables for Low Energy Homes Locally

Only 15Min away from Alaska

Design Challenges

- Costs
- Solar Availability
- Standard Building Practice
- DHW and User Electricity
- Expected creature comforts
- Local Code

Why Build Towards NZE

- Comfort
- Health
- Quiet
- Energy Bills
- Affordable
- Carbon Emissions
- The New “Normal”

Resources

National	Local
Standards Organizations	AHFC, ACAT, CCHRC
Government	Well Trained Energy Sector from Builders to Energy Raters to Designers
Trade Groups	Example Cases
Forums	Wide Public Marketing, Discussion and Education
Universities	Locally Made Materials
Building Science Non-Profits	

Standards


PH


2.0™
LIVING
BUILDING
CHALLENGE™


energy
ENERGY STAR

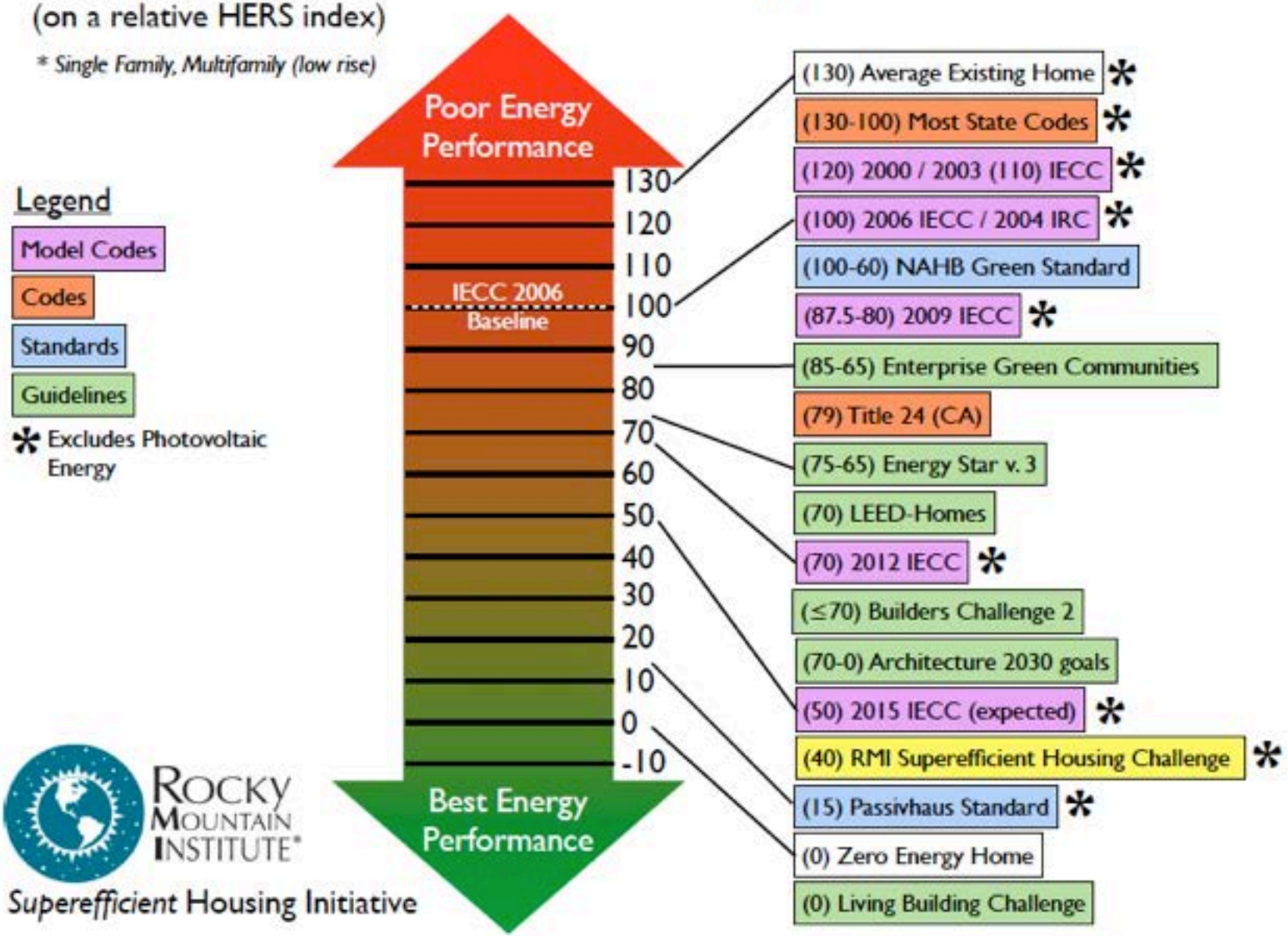

NETZERO
ENERGY BUILDING
CERTIFICATION℠


LEED™
FOR HOMES

Comparison of Residential* Energy Codes & Standards

(on a relative HERS index)

* *Single Family, Multifamily (low rise)*



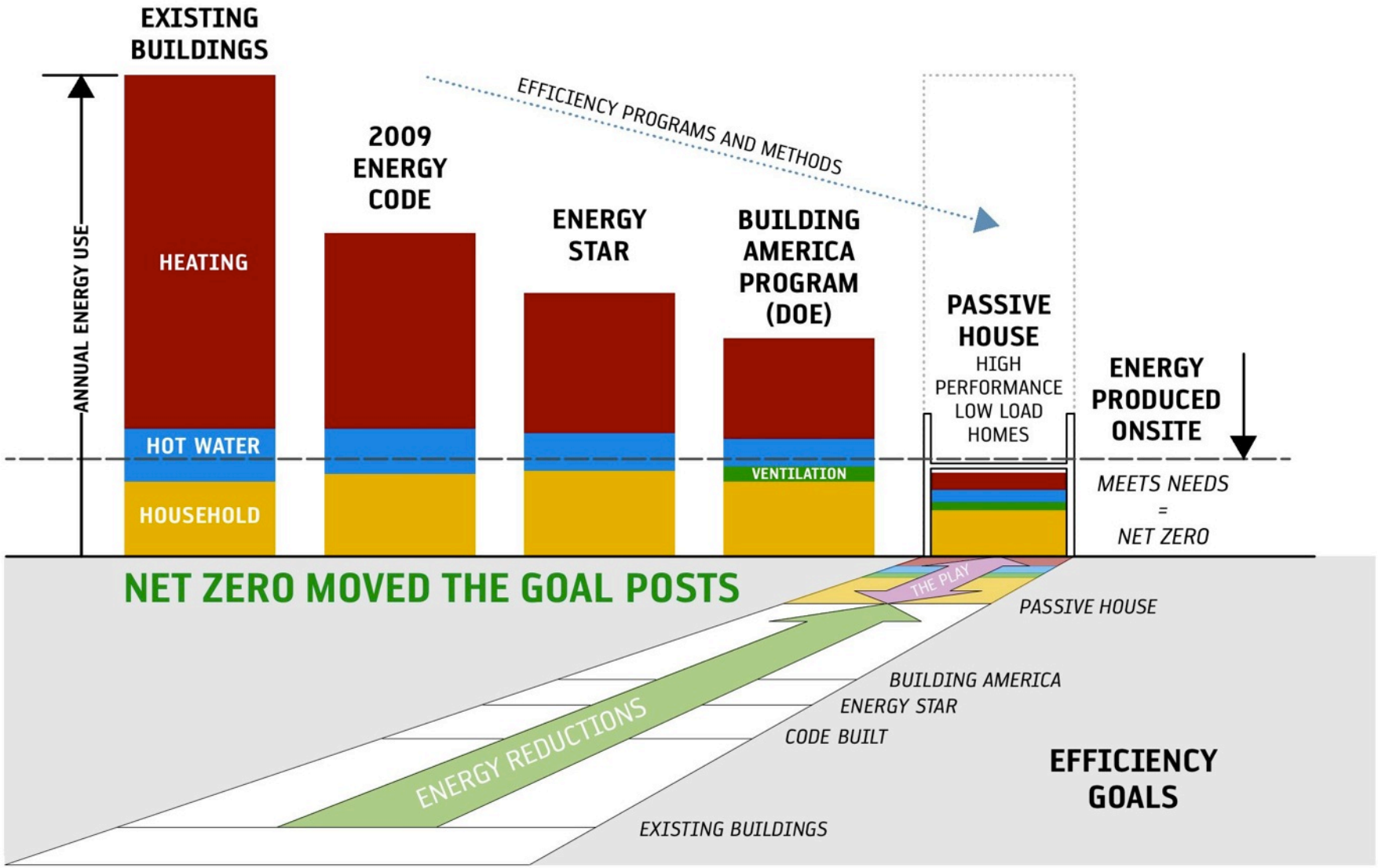
Legend

- Model Codes
- Codes
- Standards
- Guidelines

* Excludes Photovoltaic Energy

ROCKY MOUNTAIN INSTITUTE®

Superefficient Housing Initiative

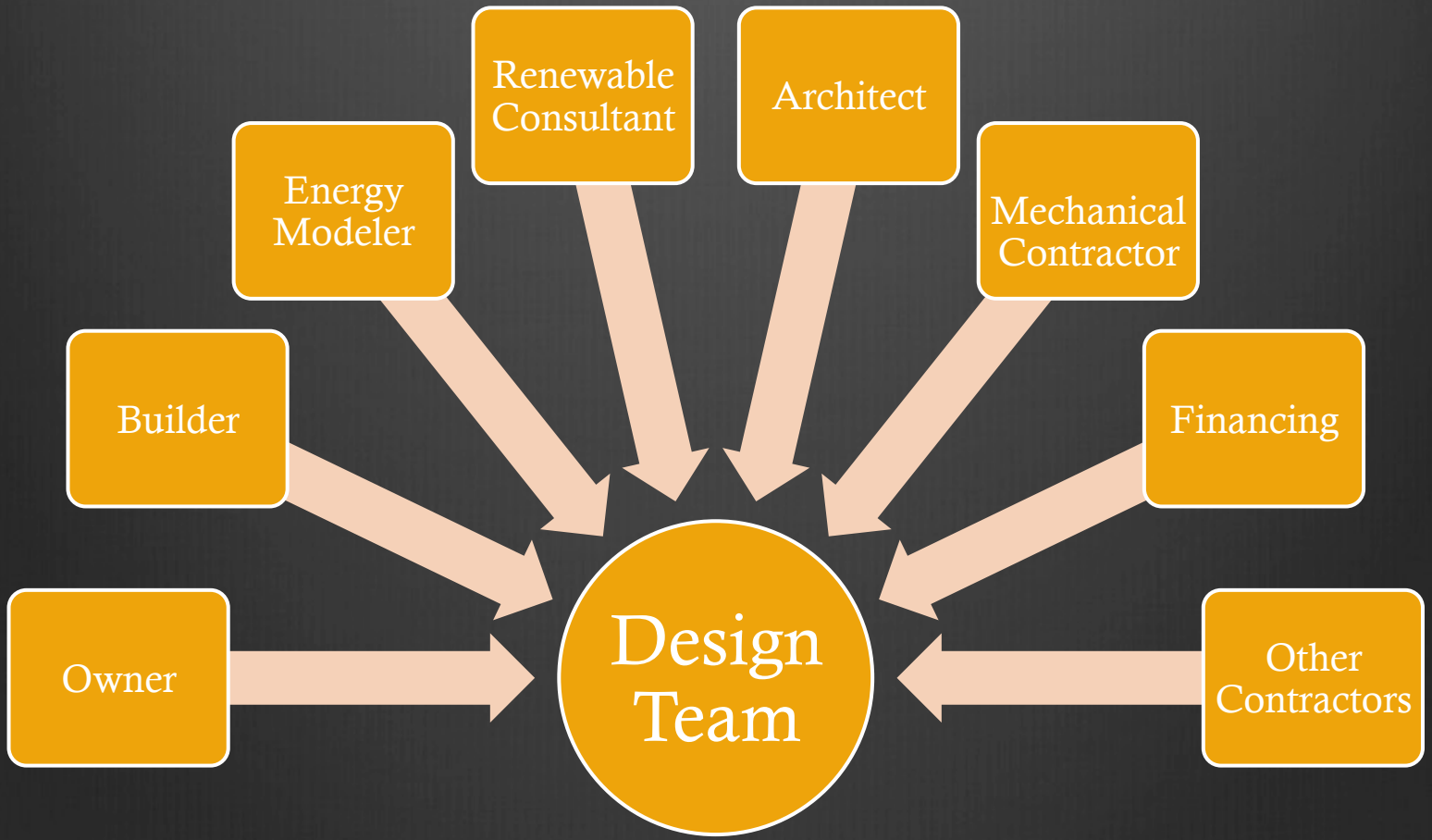

EXISTING BUILDINGS
ANNUAL ENERGY USE
HEATING
HOT WATER
HOUSEHOLD
EFFICIENCY PROGRAMS AND METHODS
2009 ENERGY CODE
ENERGY STAR
BUILDING AMERICA PROGRAM (DOE)
VENTILATION
PASSIVE HOUSE
HIGH PERFORMANCE LOW LOAD HOMES
ENERGY PRODUCED ONSITE
MEETS NEEDS
=
NET ZERO
NET ZERO MOVED THE GOAL POSTS
THE PLAY
PASSIVE HOUSE
BUILDING AMERICA
ENERGY STAR
CODE BUILT
ENERGY REDUCTIONS
EFFICIENCY GOALS
EXISTING BUILDINGS

Set A Specific Energy Goal for Building

Standards over-lap in many ways and should be used as a tool.

I can make everyone's house NZE with enough solar PV even in AK

Early Integration



Design Path for NZE

- Optimize Orientation
- Super-insulate, Air Seal +HRV/ERV
- Optimize Window Performance and SF
- Utilize Passive Space Conditioning Strategies
- Utilize High Efficiency Active Strategies
- Then… Zero Out with Onsite Renewables

A set of Ingredients Does Not Guarantee Meeting Your Goal

Test/model your design before you build

Retro-fits, 6Star, and Towards NZE in AK

Six Star Homes

Benchmarks of 6Star*

- R30 Foundation
- R30 Walls
- Windows U.15 and ~<15% of wall area
- R60 roof with energy heel
- Air tightness <2.5-3 ACH@50Pa
- Heating efficiency ^95%, condensing and modulating
- DHW efficiency ^90%
- HRV or ERV of at least 70% effectiveness
- No Naturally Aspirating Heating Appliances! (Garage Unit Heaters)

Foundation Options

ICF with or with out FG batts

Slab or on Crawlspace

Exterior Insulation whenever possible

All Exposed Faces of the Slab or Stem Wall Insulated

Perimeter of Slab or Foundation Wall Insulated

Thermal Break from Driveways, Walks, and Patios

Wall Assemblies Considerations

- Thermal Bridge Free Building
- Continuous Air Barrier, Reduce Penetrations
- Insulated Window Frame and Headers
- Transition Details Like Rim Joists, Foundation, and Roof
- Environmental Considerations for Materials

REMOTE Wall

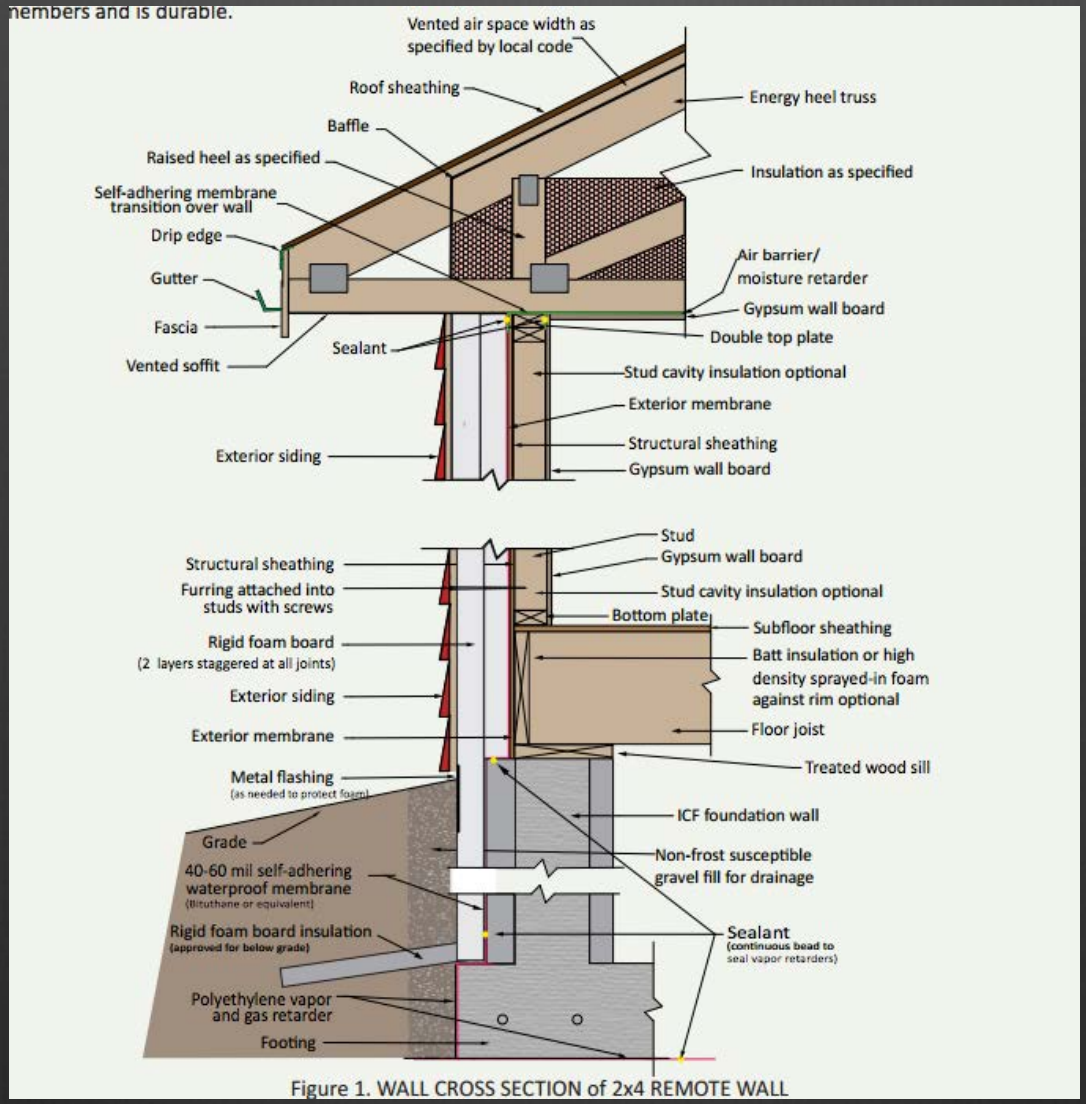
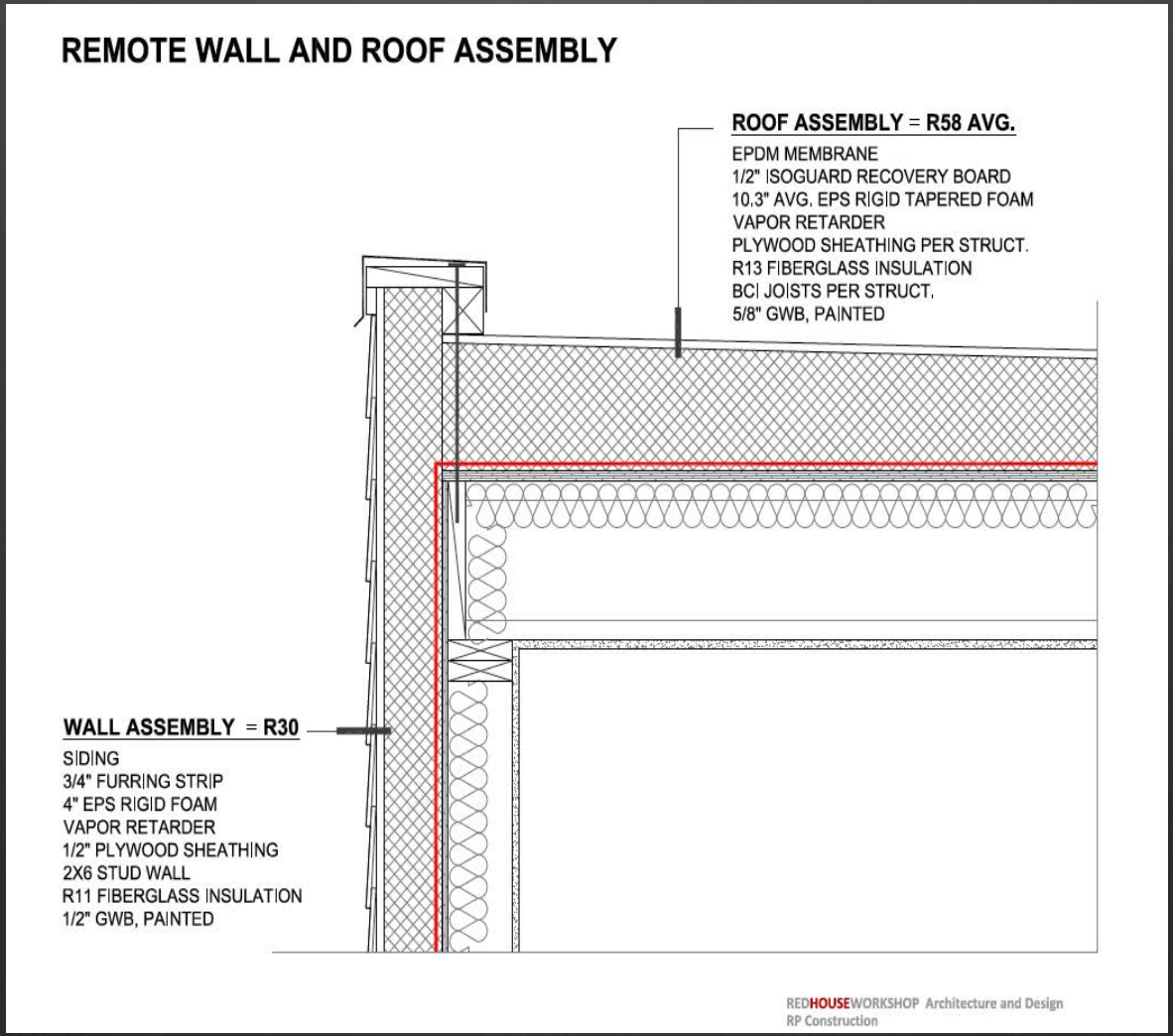


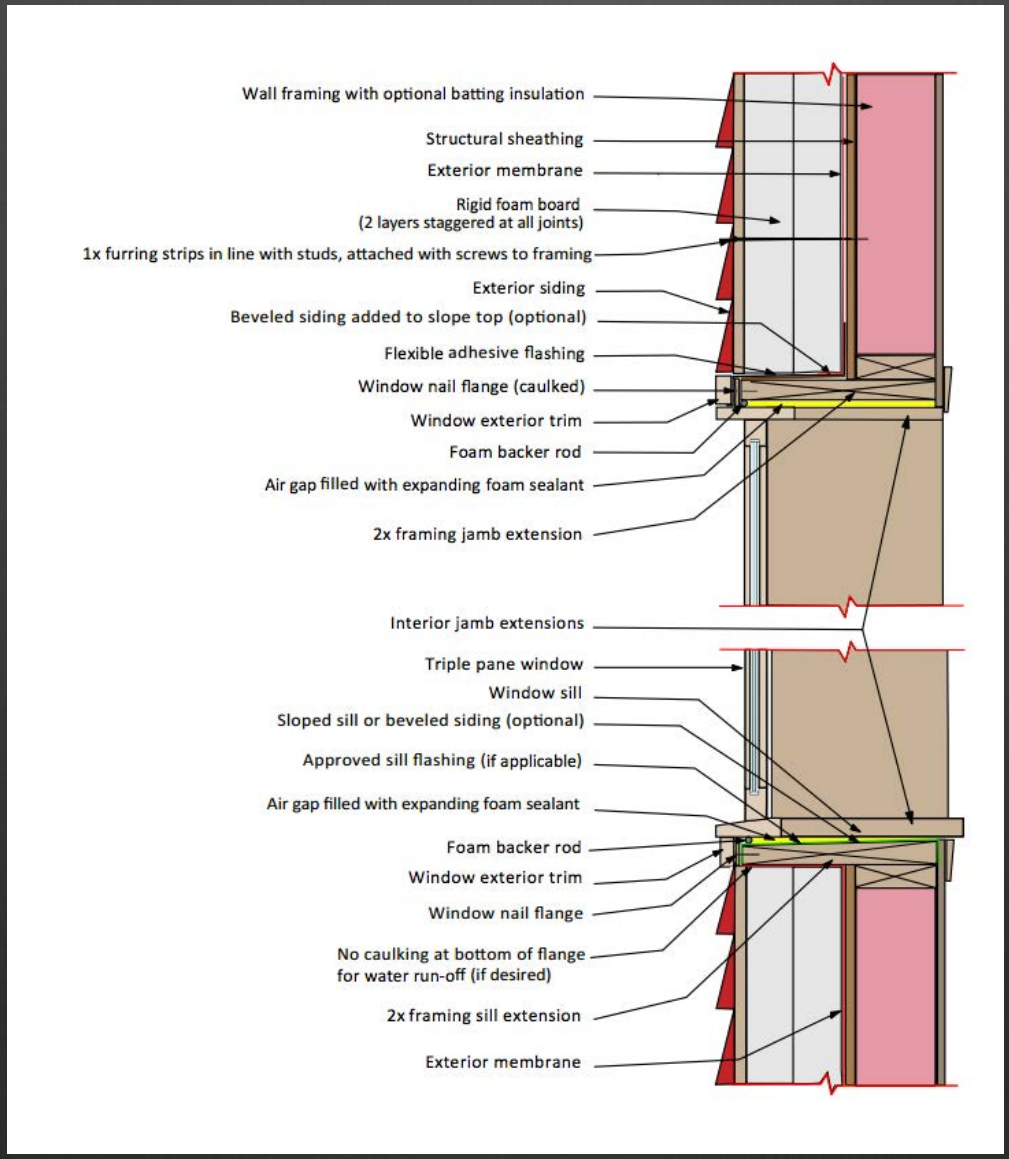
Figure 1. WALL CROSS SECTION of 2x4 REMOTE WALL

CCHRC Remote Wall Manual

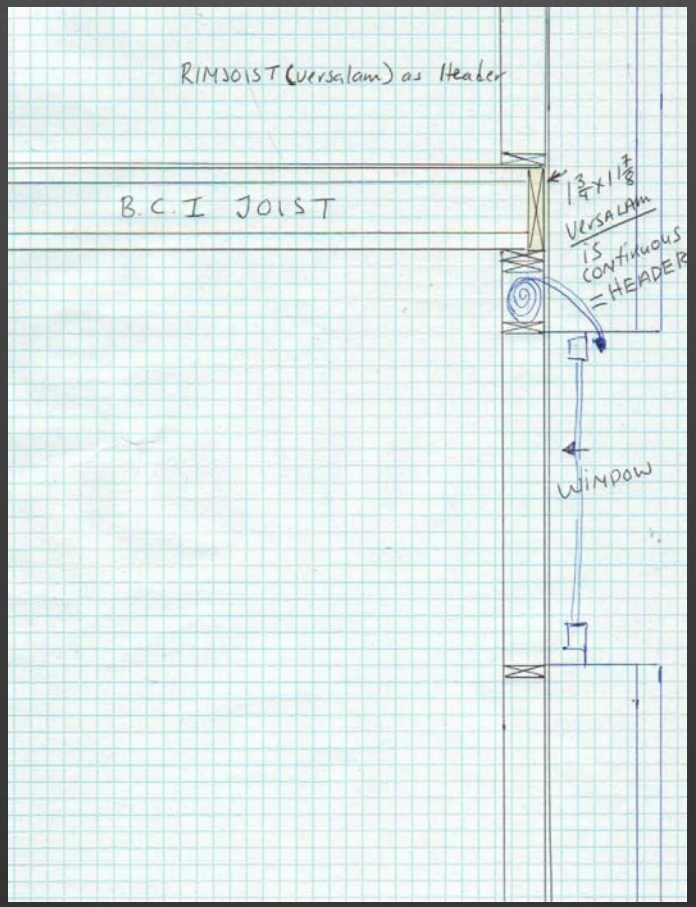
Continuous Insulation



Remote Window Detail



Optional Framing



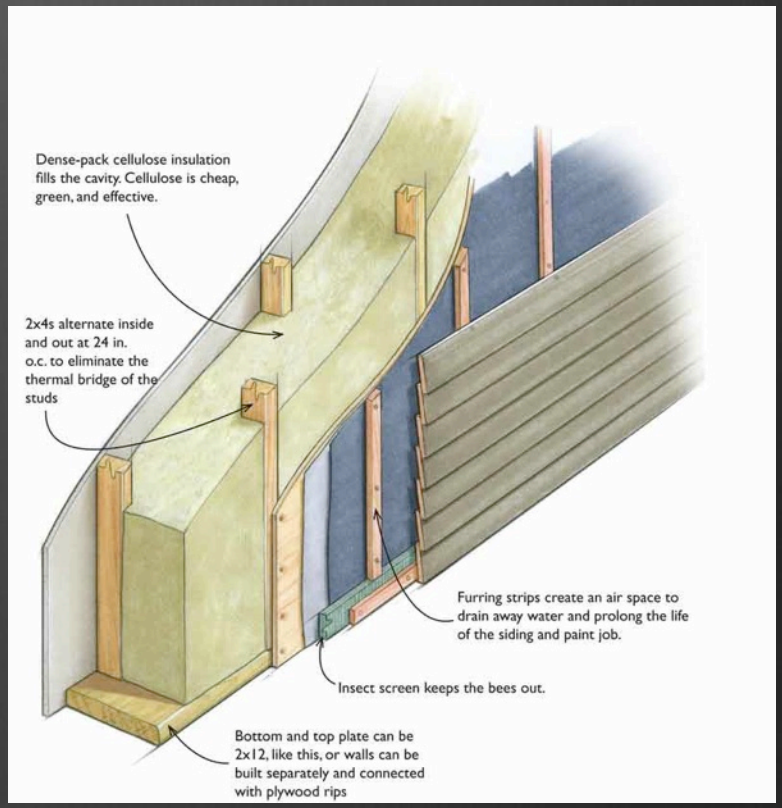
Double Stud Wall

Standard Easy Framing

R30 Wall is 2-2x4 walls with 2” gap if using dense pack Cellulose

Easy Details and Plenty of Nailing

Watch Air tightness at transitions



Other Wall Systems and Roofs

What are you guys(gals) Using?

How Are you picking up Cost Efficiencies in Higher Insulative Assemblies?

What Barriers Are you Hitting?

Williams St. Retro-Fit

Air Tight Layer

Buck Windows, add Foam

Reduce North Window Area

Create Rain Screen

Insulate Foundation and Slab

83.3 % reduction in heat load

AkWarm Heating Energy Flows Report

Client: Saskia Esslinger
Home at: 3842 Williams St.
Anchorage, AK 99508

Energy Flows below are in Btu/hour

Month	Hours	Gross Loss	Gross Internal	Useable Internal	Gross Solar	Useable Solar	Natural Infil cfm
Jan	744	38,402	7,350	7,350	803	794	162
Feb	678	34,803	7,175	7,175	1,923	1,916	159
Mar	744	30,431	6,937	6,937	3,761	3,673	151
Apr	720	21,935	6,699	6,699	4,171	3,942	138
May	744	14,446	6,524	6,524	3,879	3,399	131
Jun	720	9,121	6,460	6,052	4,119	2,517	118
Jul	744	6,660	6,524	5,282	3,844	1,375	102
Aug	744	7,804	6,699	5,809	3,263	1,766	102
Sep	720	12,870	6,937	6,892	2,645	2,359	114
Oct	744	22,398	7,175	7,175	1,863	1,854	136
Nov	720	31,795	7,350	7,350	1,069	1,060	151
Dec	744	37,731	7,413	7,413	491	485	160

Annual Energy Flows

Gross Loss: 195.6 MMBtu

Gross Internal: 60.8 MMBtu

118.3 MMBtu

Net Heat Load: 118.3 MMBtu

Design Heat Load

57,336 Btu/Hr

Main Home:	57,336	Btu/hour
Garage:	0	Btu/hour
Total:	57,336	Btu/hour

The above value is the required amount of heat to be supplied by the furnace/boiler. If the space heating system also heats domestic hot water, you need to add an allowance for this, typically 1,500 Btu/hour per person. If you need to determine the required Input Rating of the heating system, you must increase the output figure above to account for the inefficiency of the furnace/boiler and add a sizing safety margin.

AkWarmCalc ver. 2.3.1.0, Energy Library ver. 9/24/2013

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Month	Hours	Gross Loss	Gross Internal	Useable Internal	Gross Solar	Useable Solar	Natural Infil cfm
Jan	744	13,617	5,639	5,639	715	712	83
Feb	678	12,294	5,464	5,464	1,700	1,676	81
Mar	744	10,676	5,226	5,224	3,304	2,765	78
Apr	720	7,756	4,987	4,804	3,638	2,330	71
May	744	5,195	4,813	4,017	3,361	1,178	67
Jun	720	3,377	4,749	3,019	3,557	358	61
Jul	744	2,559	4,813	2,416	3,324	143	52
Aug	744	2,985	4,987	2,766	2,838	219	52
Sep	720	4,775	5,226	3,959	2,322	789	58
Oct	744	7,955	5,464	5,168	1,644	1,514	70
Nov	720	11,165	5,639	5,630	949	948	77
Dec	744	13,359	5,702	5,702	438	435	82

Annual Energy Flows

Gross Loss: 69.7 MMBtu

Gross Internal: 45.8 MMBtu
Useable Internal: 39.3 MMBtu

21.0 MMBtu

Net Heat Load: 21.0 MMBtu

Design Heat Load

21,062 Btu/Hr

Main Home:	21,062	Btu/hour
Garage:	0	Btu/hour
Total:	21,062	Btu/hour

The above value is the required amount of heat to be supplied by the furnace/boiler. If the space heating system also heats domestic hot water, you need to add an allowance for this, typically 1,500 Btu/hour per person. If you need to determine the required Input Rating of the heating system, you must increase the output figure above to account for the inefficiency of the furnace/boiler and add a sizing safety margin.

AkWarmCalc ver. 2.3.1.0, Energy Library ver. 9/24/2013

Roughly 17yr Payback at Current Energy Costs. NZE Ready?

Although a wonderful retro-fit, we would have done things a bit differently now.

- Air boundary in Attic and Roof Heel
- Window Detailing
- EPS insulation
- Bituthane air tight layer
- Window Area
- Door Quality and Placement
- Eves and Attic Ventilation
- Ventilation Terminations

What Went Right!

- Dramatic Energy Savings
- Noise Reduction
- Comfort
- Aesthetics
- Neighborhood Improvements
- Durability Increased
- Moisture Management
- Pollution Management
- Maintenance

Towards NZE Ready

Plan for Future Renewables

- Roof Lines
- Mechanical space for Solar Storage
- House Orientation
- Lower Heat Loads and User Loads
- Make Plumbing and Mechanical Lines short and sweet and accessible

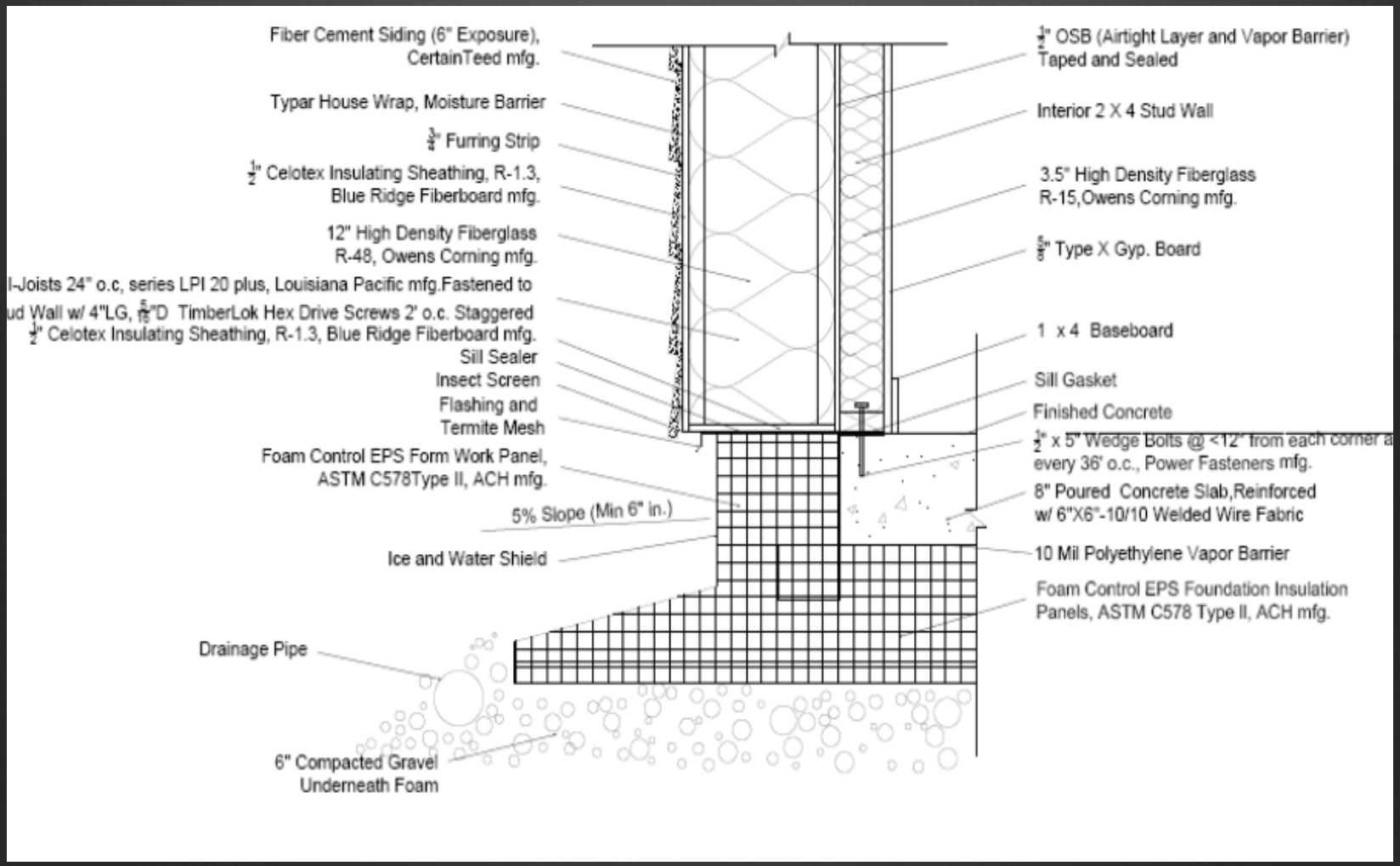
Benchmarks Towards NZE in South Central AK

R50-60 effective Foundation Insulation
R60 Wall Assembly
R80 Roof Assembly including Perimeter
<U.15 windows, <15% of wall area, good orientation, good instillation and over insulating frames
Passive Thermal Mass
Air Tightness <1.5ACH@50Pa
HRV/ERV effectiveness above 80%, High electrical efficiency
Small High Efficiency Heating Equipment

Foundations

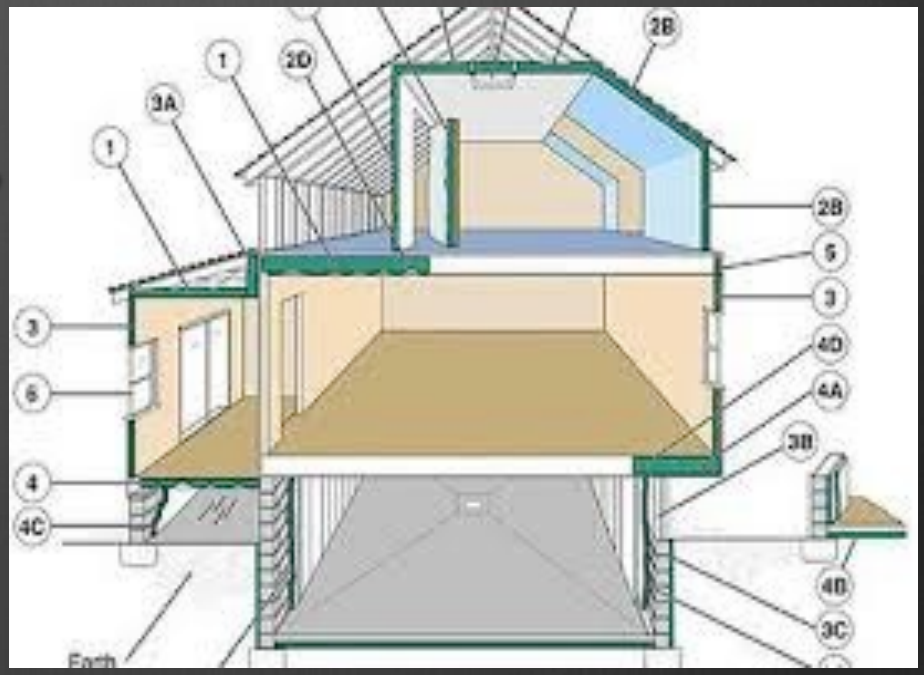
- Continuous insulative layer on all sides and into transition to Wall Section
- Look to Eliminate Crawlspaces
- Split Entries or Dug into Hill can Increase Over All Insulative Value
- Weakest Link in Standard Construction

Foundation Detail

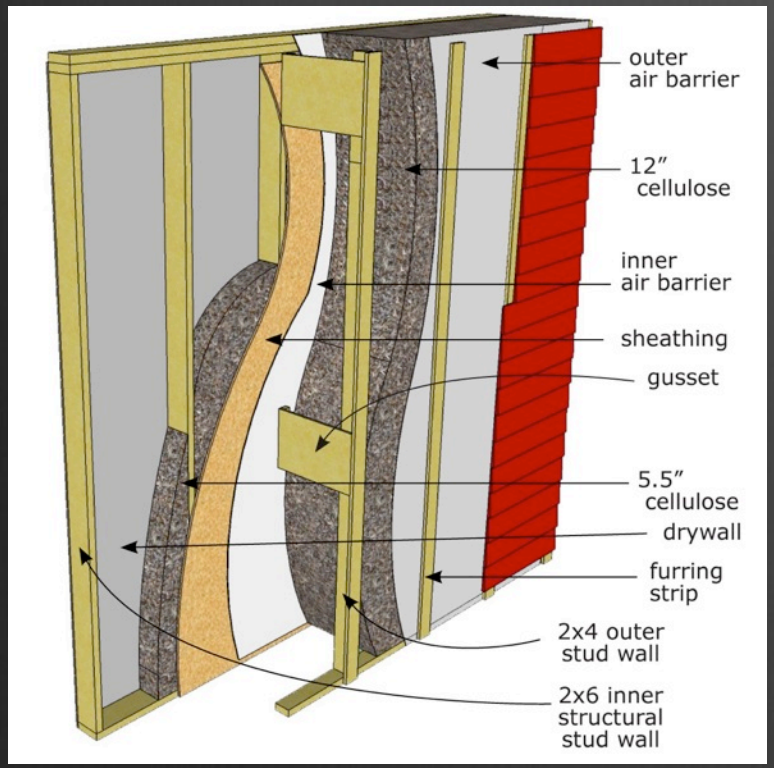


Wall Systems

- R60, Huh…
- Where is the Air Barrier?
- Covering Transitions
- Types
- Windows and Doors
- Rain Screens and Moisture

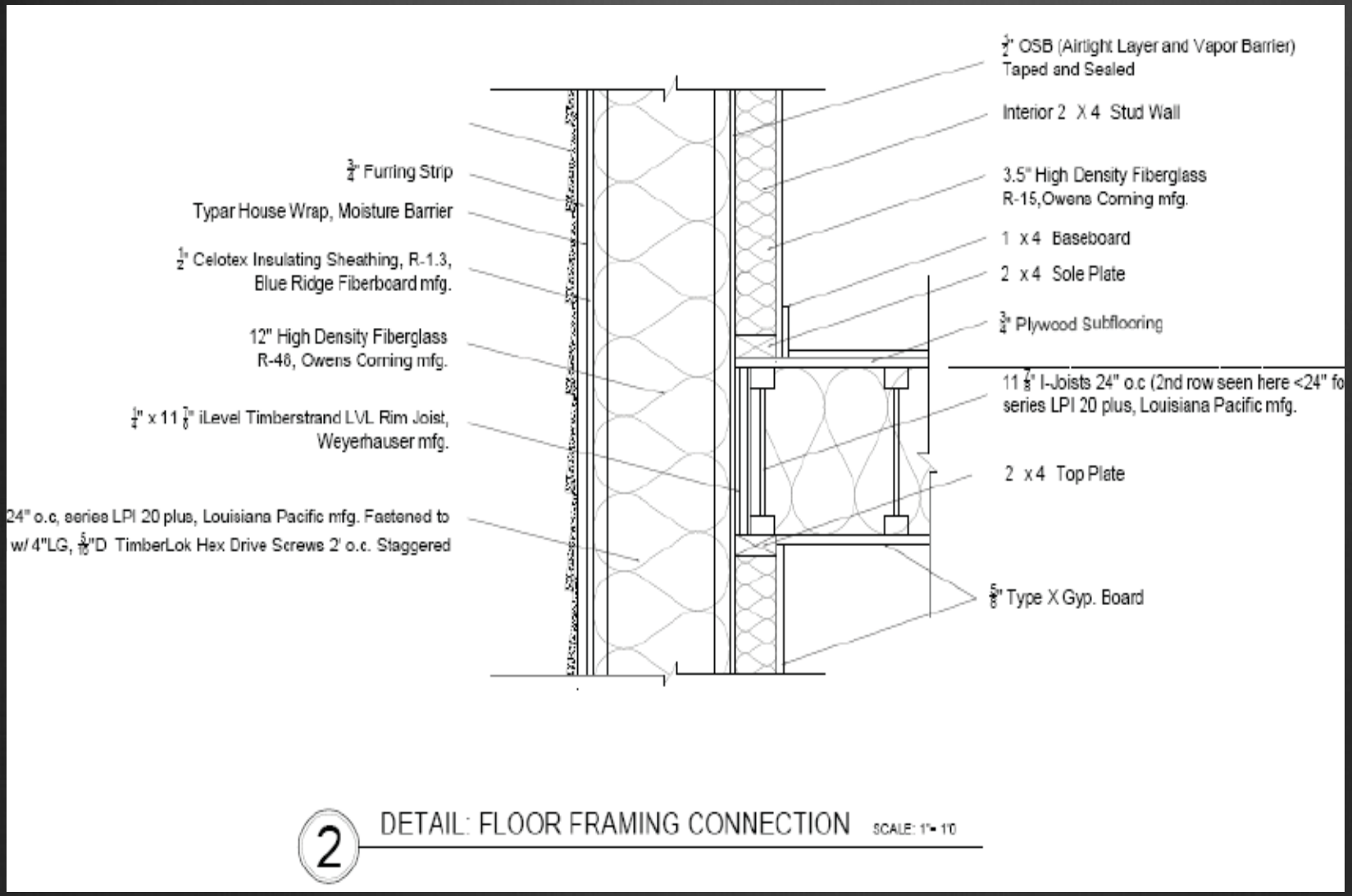


Arctic Wall



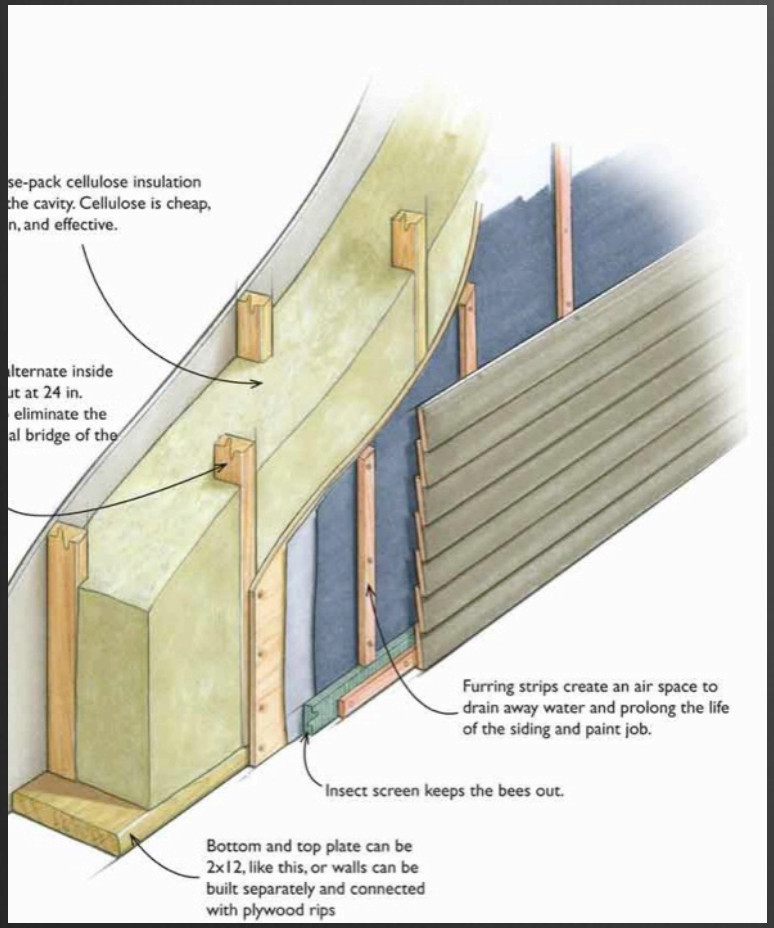
- Open Diffusion Exterior Insulation Technique
- Using Cellulose instead of Foam
- Can be customizable to thickness
- Durability due to air tightness and moisture transfer

Floor Detail



2 DETAIL: FLOOR FRAMING CONNECTION SCALE: 1" = 1'0

Double Stud and REMOTE



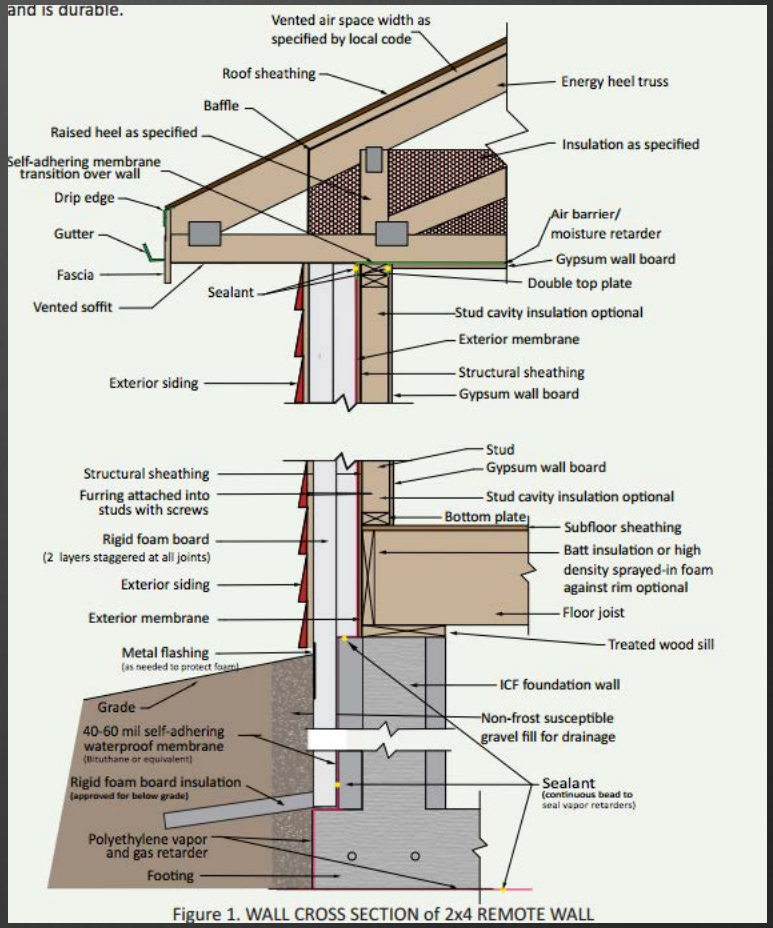


Figure 1. WALL CROSS SECTION of 2x4 REMOTE WALL

Double Stud

Detailing around Rim Joist

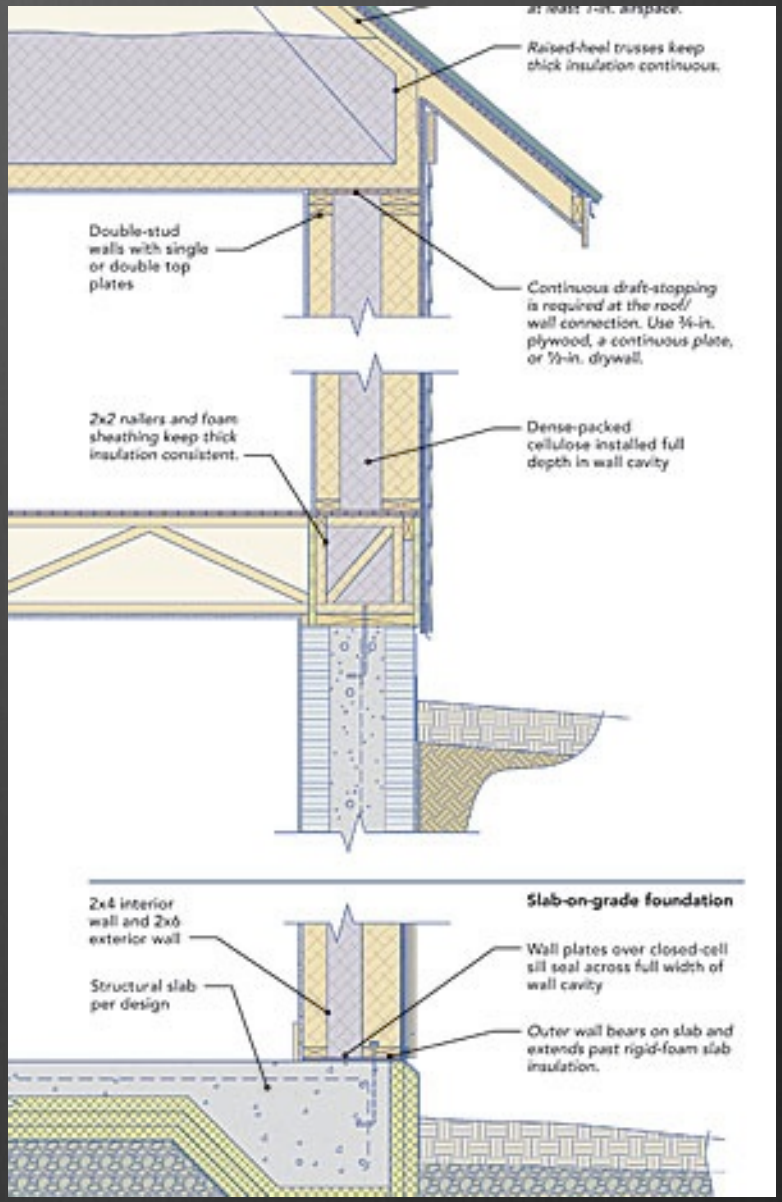
Air Barrier at Foundation

Air Barrier at Roof

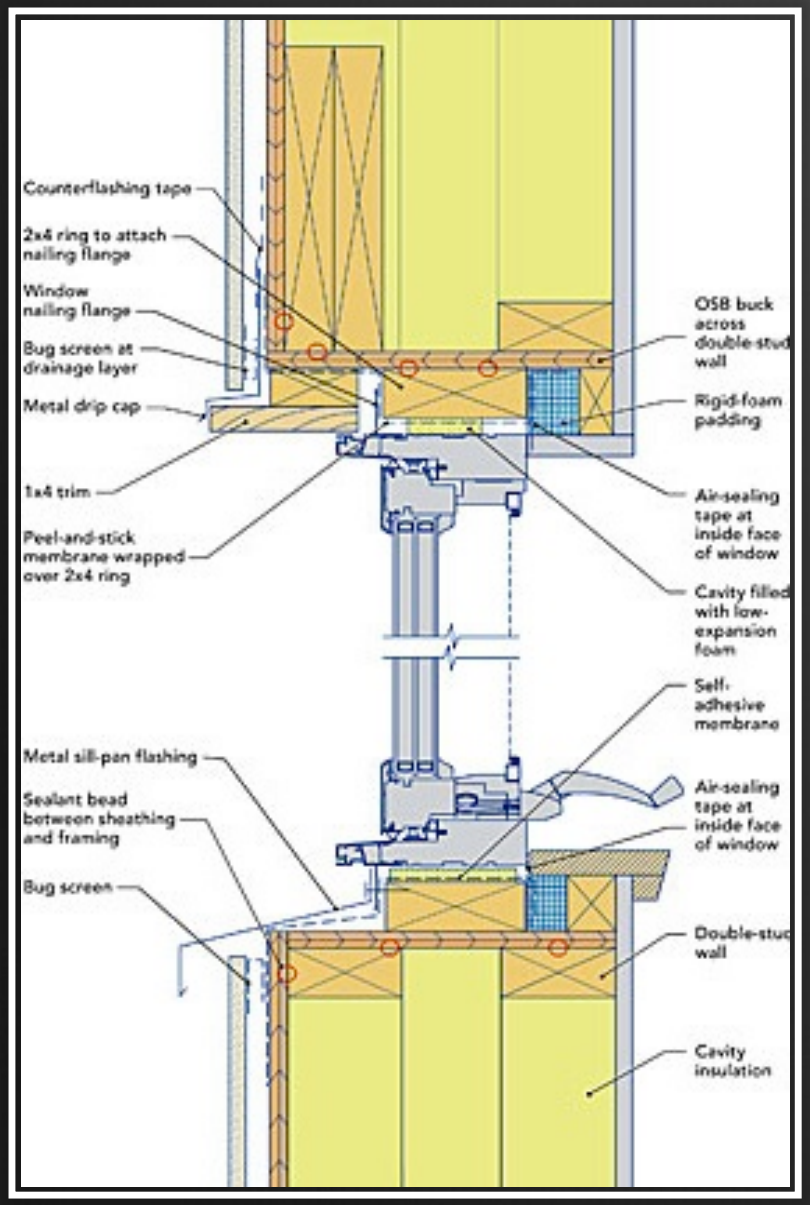
Wall insulation to Foundation Insulation connection

Possible Air barrier on outside of Inside Stud

Closest to standard framing



SIPS



Window Details

Window Placement in Thick Walls

U-Value

Frame Quality

Solar Heat Gain Coefficient

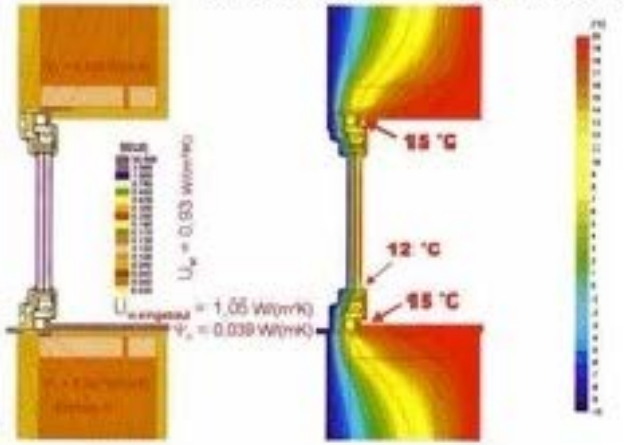
Thermally Breaking Window Framing

Over Insulating the Frame

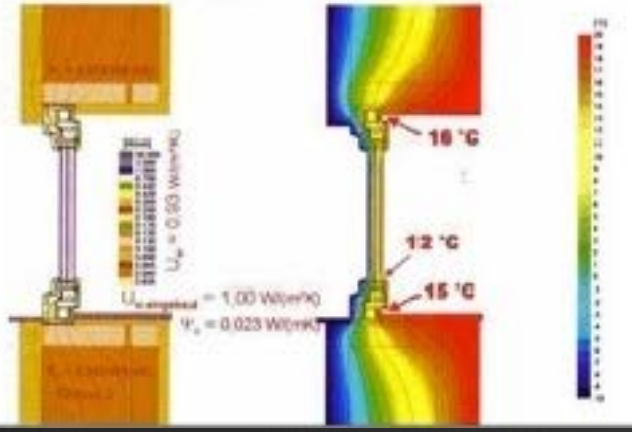
Orientation

Location, location, location…

POOR: **U_w(installed) = 1.05 W/m²K**
Psi-install = 0.039 W/m²K

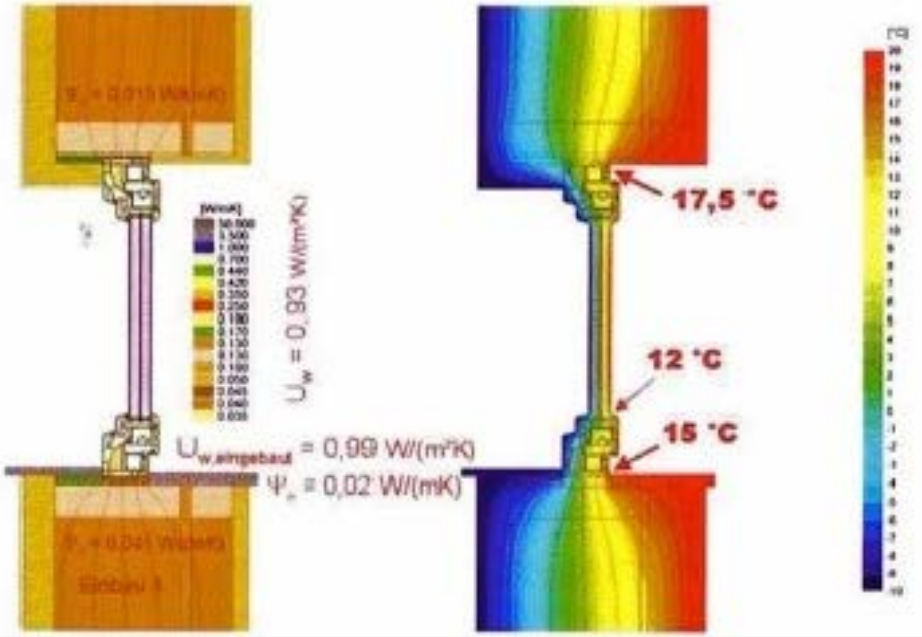


BETTER: **U_w(installed) = 1.00 W/m²K**
Psi-install = 0.023 W/m²K

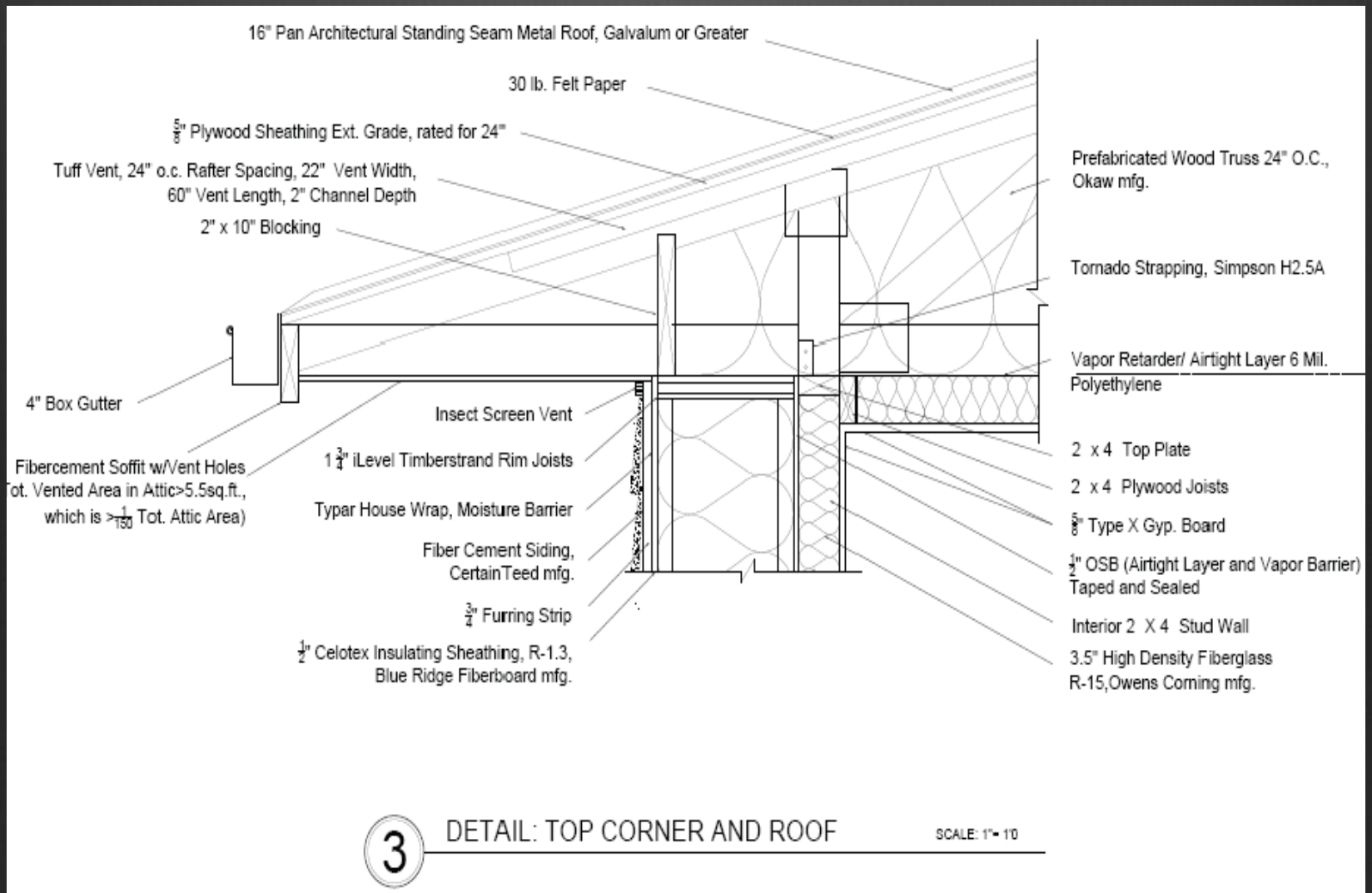


Placing the window in the best location within the wall cavity : Horizontal direction

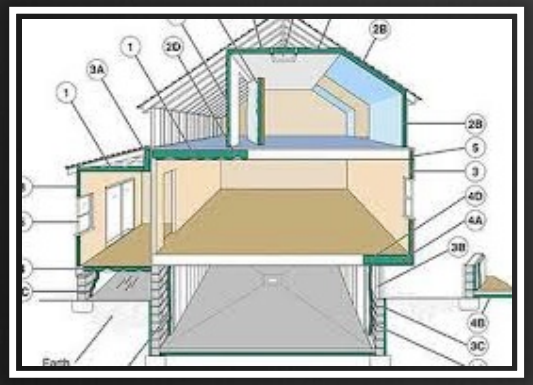
BEST: **U_w(installed) = 0.99 W/m²K**
Psi-install = 0.02 W/m²K



Roof Detail


16" Pan Architectural Standing Seam Metal Roof, Galvalum or Greater
30 lb. Felt Paper
5/8" Plywood Sheathing Ext. Grade, rated for 24"
Tuff Vent, 24" o.c. Rafter Spacing, 22" Vent Width, 60" Vent Length, 2" Channel Depth
2" x 10" Blocking
4" Box Gutter
Fibercement Soffit w/Vent Holes Tot. Vented Area in Attic>5.5sq.ft., which is >1/150 Tot. Attic Area)
Insect Screen Vent
1 3/4" iLevel Timberstrand Rim Joists
Typar House Wrap, Moisture Barrier
Fiber Cement Siding, CertainTeed mfg.
3/4" Furring Strip
1/2" Celotex Insulating Sheathing, R-1.3, Blue Ridge Fiberboard mfg.
Prefabricated Wood Truss 24" O.C., Okaw mfg.
Tornado Strapping, Simpson H2.5A
Vapor Retarder/ Airtight Layer 6 Mil. Polyethylene
2 x 4 Top Plate
2 x 4 Plywood Joists
5/8" Type X Gyp. Board
1/2" OSB (Airtight Layer and Vapor Barrier) Taped and Sealed
Interior 2 X 4 Stud Wall
3.5" High Density Fiberglass R-15,Owens Corning mfg.
3
DETAIL: TOP CORNER AND ROOF
SCALE: 1"= 1'0

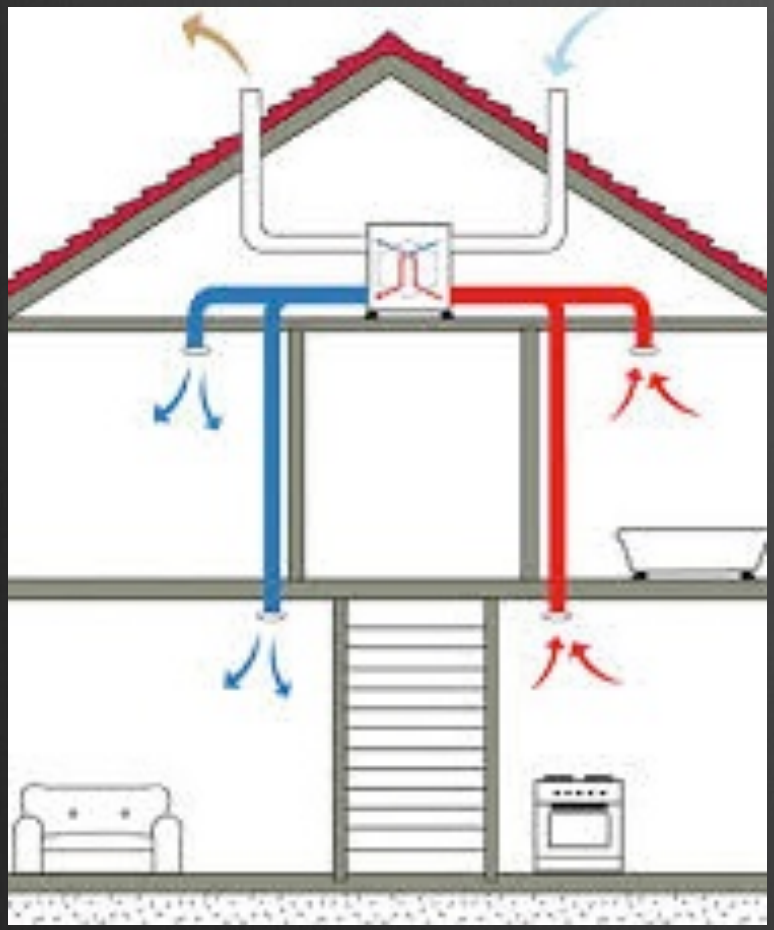



Air Seal for Continuous Air Barrier

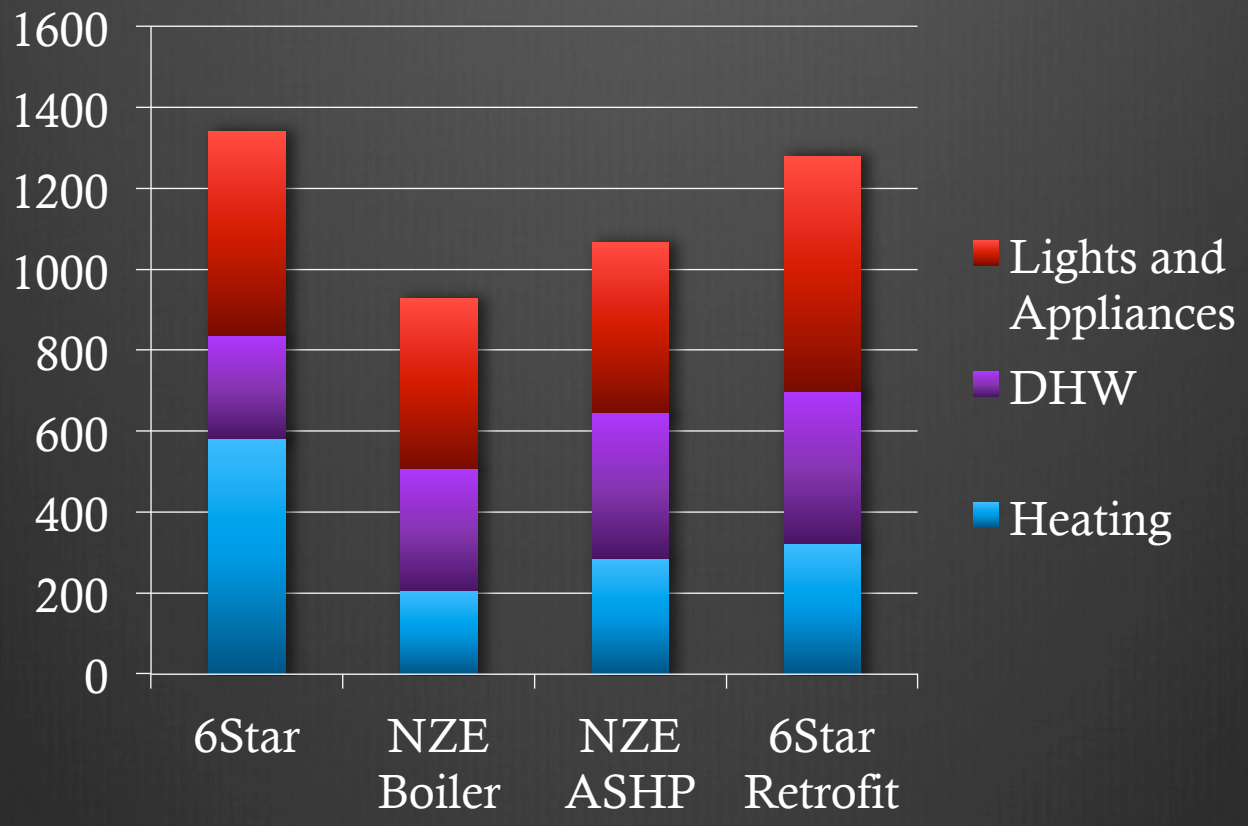
Look for simplicity in design, fewer penetrations, and coordination between the trades. Different wall, window, roof and foundation systems will have different air sealing tactics!!

And Ventilate Right

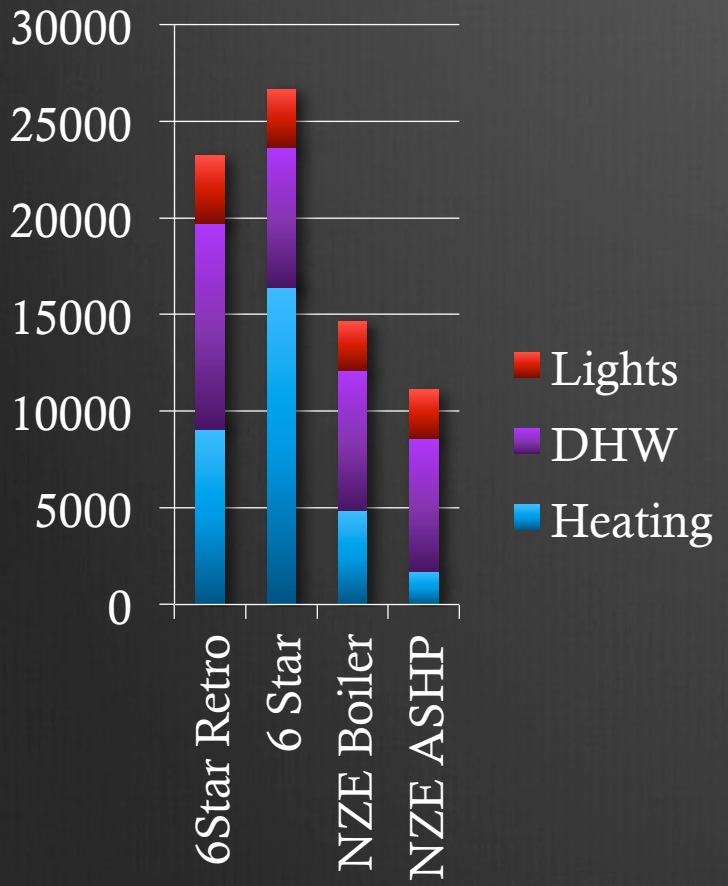


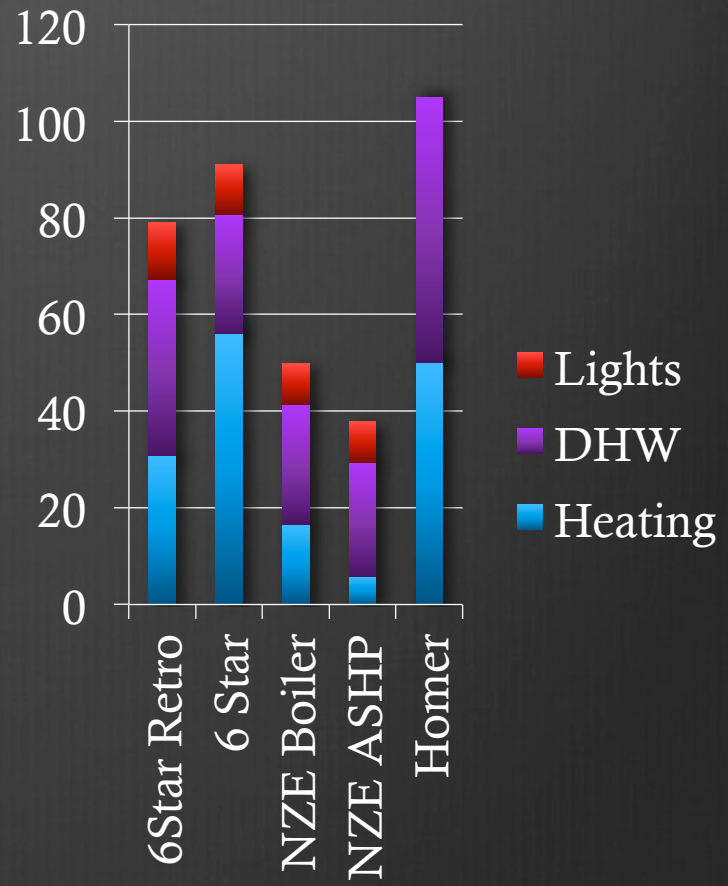
- High Efficiency Heat Recovery
- Consider ERV in Our Climate
- Short Well Insulated Inlet and Exhaust with Possible Flex Duct for Sound
- Shortest Most Direct Distribution
- Smart Controls with User Education
- Use Undercuts and Coanda Effect for Distribution Balancing
- Base Ventilation rate on Air Tightness and Occupant Use

Yearly Energy Cost



kWh vs. Mbtu Total Energy Units Used



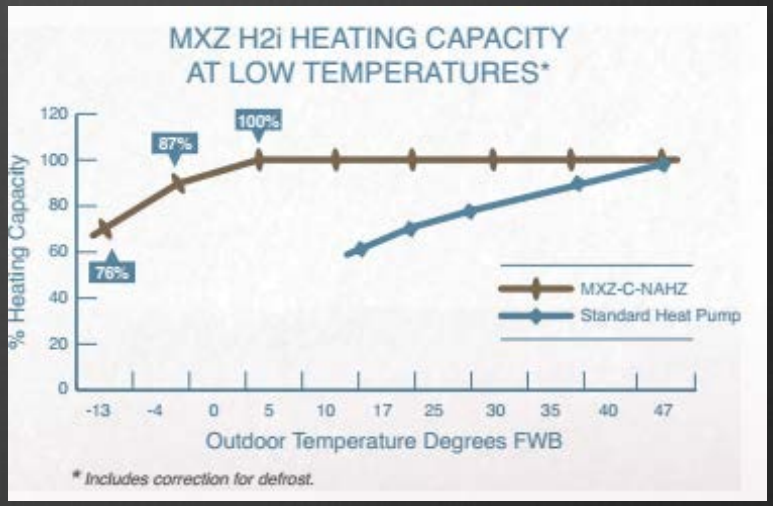


Heating Options

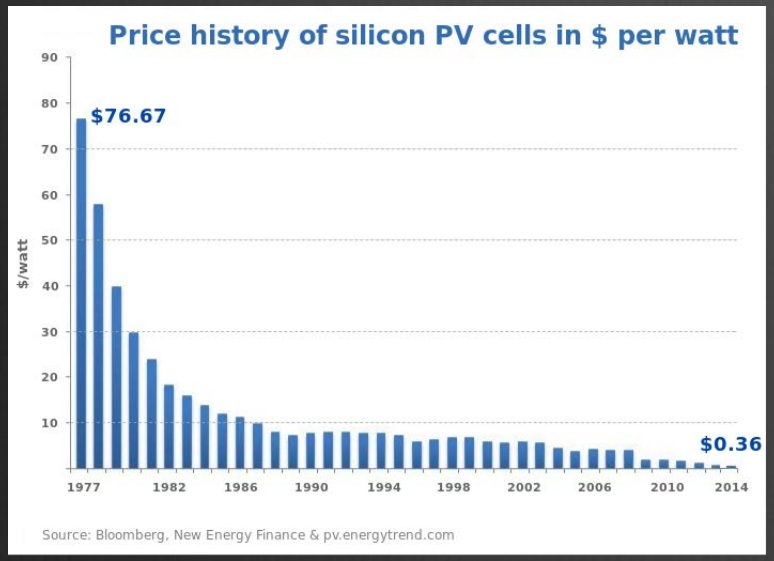
Natural Gas

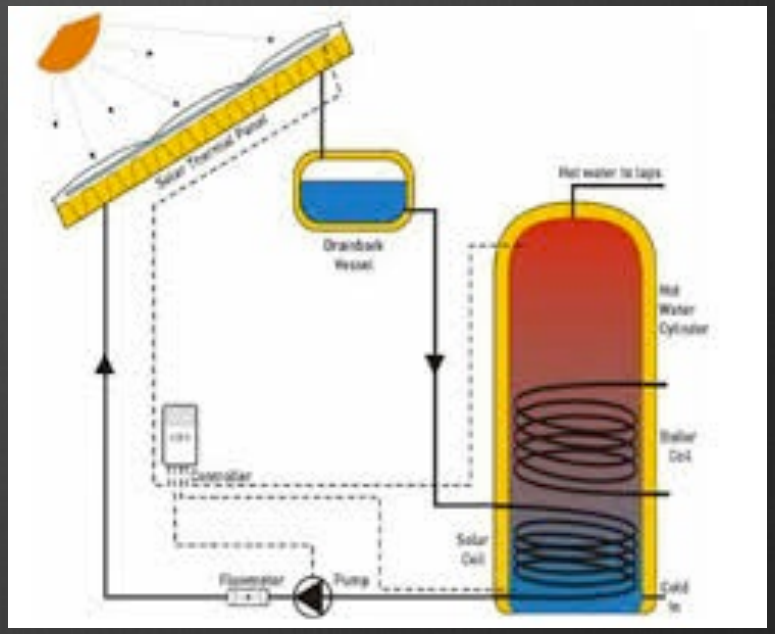
- Sealed Combustion
- Modulating Burners
- Low Water Content
- Condensing
- Low Temp Operation

Electric



How Do We Balance it Out?

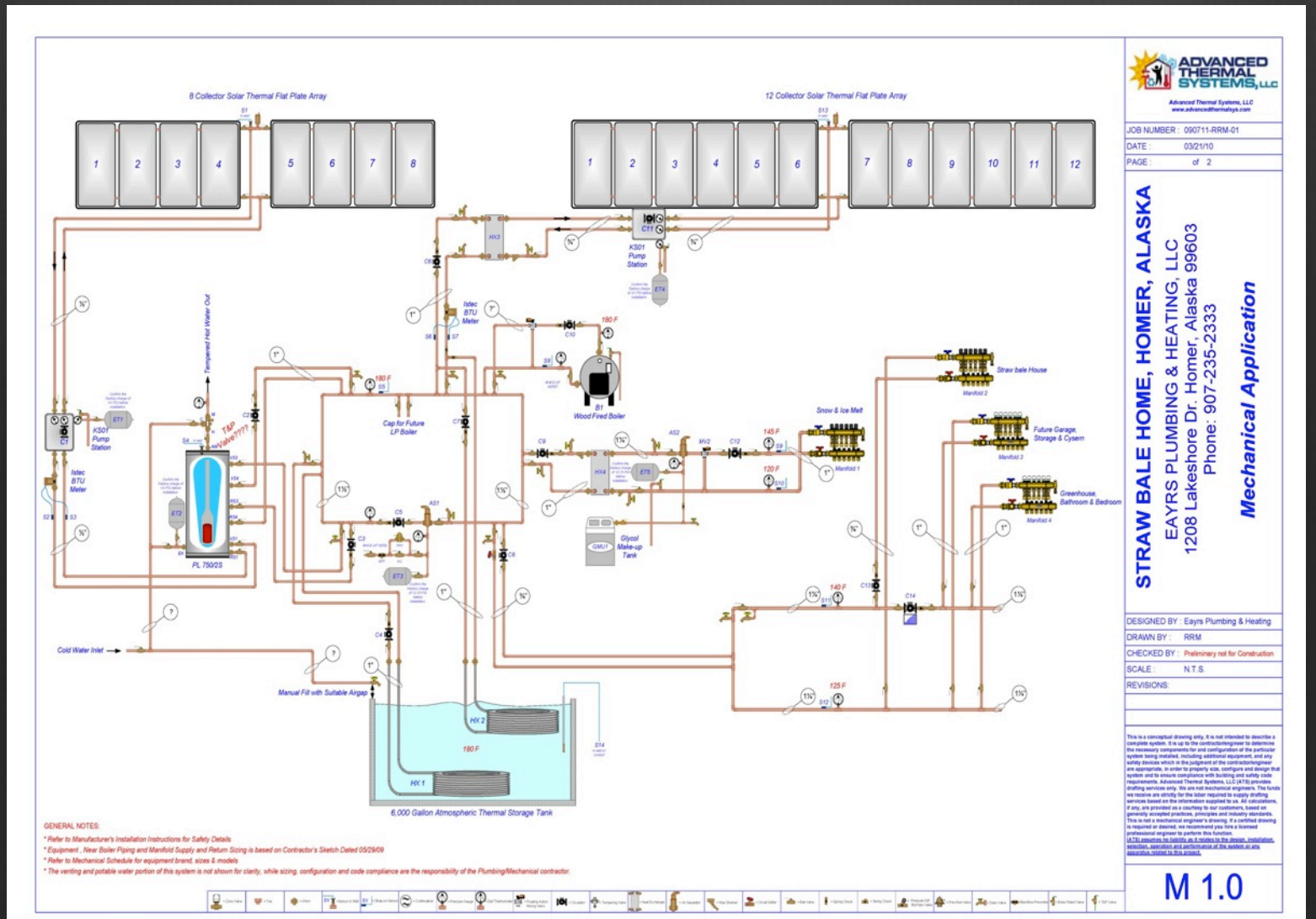




Renewables are Sexy

- Use as Marketing Tool
- Consider Off Setting just Heat Load or Electrical Load
- Keep it Simple at First
- They Are More and More Affordable

Wood Fired Thermal Storage



Controls

STATE OF ALASKA
-AHFC CREATED THE ENERGY EFFICIENCY APPRAISAL TOOL

-PROVIDING COMPARABLES BASED ON ENERGY AUDITS & PERFORMANCE
-$7,500 REBATE FOR 5 STAR PLUS & $10,000 6 STAR

FEDERAL
FOR 2014 TAX YEAR, THERE IS A 30% TAX CREDIT FOR RESIDENTIAL ENERGY EFFICIENT PROPERTY PLACED IN SERVICE:

-SOLAR ENERGY SYSTEMS, FUEL CELLS, SMALL WIND ENERGY SYSTEMS AND GEOTHERMAL HEAT PUMPS

New Appraisal Institute Book Aids Valuation of 'Green' Homes

CHICAGO (April 8, 2014) – Appraisers need to get up to speed on the latest energy efficient home features and should learn to determine how green a property is, according to a new book by the nation's largest professional association of real estate appraisers.

"The market for green, or high-performance, homes is clearly growing, and appraisers who want to appraise these homes competently need to stay up-to-date on the latest green terms, home features and organizations," Appraisal Institute President Ken P. Wilson, MAI, SRA, wrote in the book's foreword.

"Residential Green Valuation Tools" (ISBN: 978-1-935328-52-0) is a 191-page soft cover book. It is available for $60 ($50 for Appraisal Institute professionals). Call 888-756-4624 or order online. This book is used to educate appraisers how to value and fill on the new
"Residential Green and Energy Efficient Addendum"

Wrap-up.

We have the technology and expertise for low energy home building

People want efficient homes

Near Net Zero Construction can be Affordable and not too Far from Standard

We have many examples and an incredible knowledge base