



Mountain Laurel Home Race-to-Zero Design Competition

Lena Burkett, Chase Ambler, and Brad Painting

Jeff Tiller, Faculty Advisor

Department of Sustainable Technology and the Built Environment

APPALACHIAN STATE UNIVERSITY

19 April 2015

The App State Team

Jake Smith
Chris Schoonover
A.J. Smith
Josh Brooks
Chase Ambler
Brad Painting
Harrison Sytz
Chelsea Davis
Kaitlyn Morgan

Pedro Franco
Josh Smith
Jeff Tiller
Brenton Faircloth
David Leonard
Marshall Dressler
Lena Burkett
Kenny High
Chase Edge
Alex Taylor

THE MOUNTAIN LAUREL HOME



APPALACHIAN STATE UNIVERSITY



Dan Ryan Builders



3



- ▶ Number 39 on Building Magazine's "Builder Top 100" list
- ▶ In the Top 25 Private Homebuilders in the nation
- ▶ Operates in six states: Maryland, Pennsylvania, Virginia, West Virginia, North Carolina and South Carolina



- ▶ Awarded Builder of Integrity Award from Quality Builders Warranty Corporation (QBW) every year since 2008
- ▶ In 2013, 1,010 homes closed and over \$227 million in revenue





U.S. manufacturer of windows, doors, exterior finishes, roofing, and more.



4



Fewer Resources – Ply Gem takes a comprehensive approach to sustainable operations, limiting its use of nonrenewable resources, minimizing scrap, and reintroducing waste materials into manufacturing.



Energy Efficiency – Many Ply Gem products increase energy efficiency across the nation; quite a few also qualify for the ENERGY STAR label.



Life Cycle Benefits – Ply Gem's products are designed to be maintenance-free, thus increasing their durability, as well as reducing the use of chemicals for repair and cleaning.



Our Site: DRB Arrowhead Community; Mebane, North Carolina



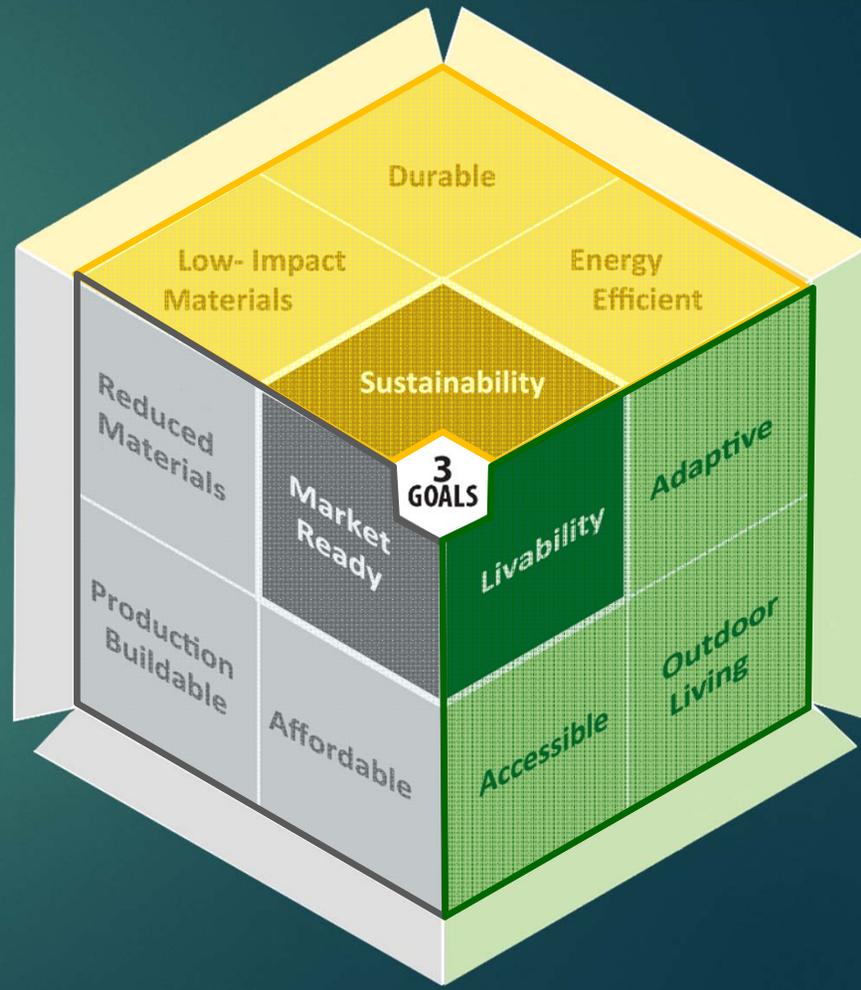
- ▶ Community Greenspace and Swimming Pool
- ▶ Within Walking Distance:
 - ▶ Daycare Center
 - ▶ Fitness Center
 - ▶ 2 Medical Offices + 2 Pharmacies
 - ▶ Restaurants and Supermarket
 - ▶ Many Retail Locations
 - ▶ Major Employment Centers





Design Goals & Strategies

- M L Complements Neighborhood Style
- M L Appealing Interior/Exterior Appearance
- M L Appropriately Sized Rooms
- M S L Functional, Flexible Efficient Layout
- M S L Long Term Durability
- S Materials with Low Embodied Energy
- M S Innovative Building Systems with Conventional Materials
- M S L Healthy Indoor Air Quality
- M S L Ventilation with Heat and Moisture Recovery
- M Attractive Return on Investment
- M S L High Efficiency Envelope
- M S L High Efficiency Mechanical Systems, Lighting, and Appliances



Integrated Design Process



7



House Design – Exterior View



Market Ready:

- ▶ Blends with neighborhood style
- ▶ 2 car garage (potential side location)

Livable:

- ▶ Large porch adds living space and connection to neighbors
- ▶ Strategically placed windows to provide natural light and views in daytime rooms

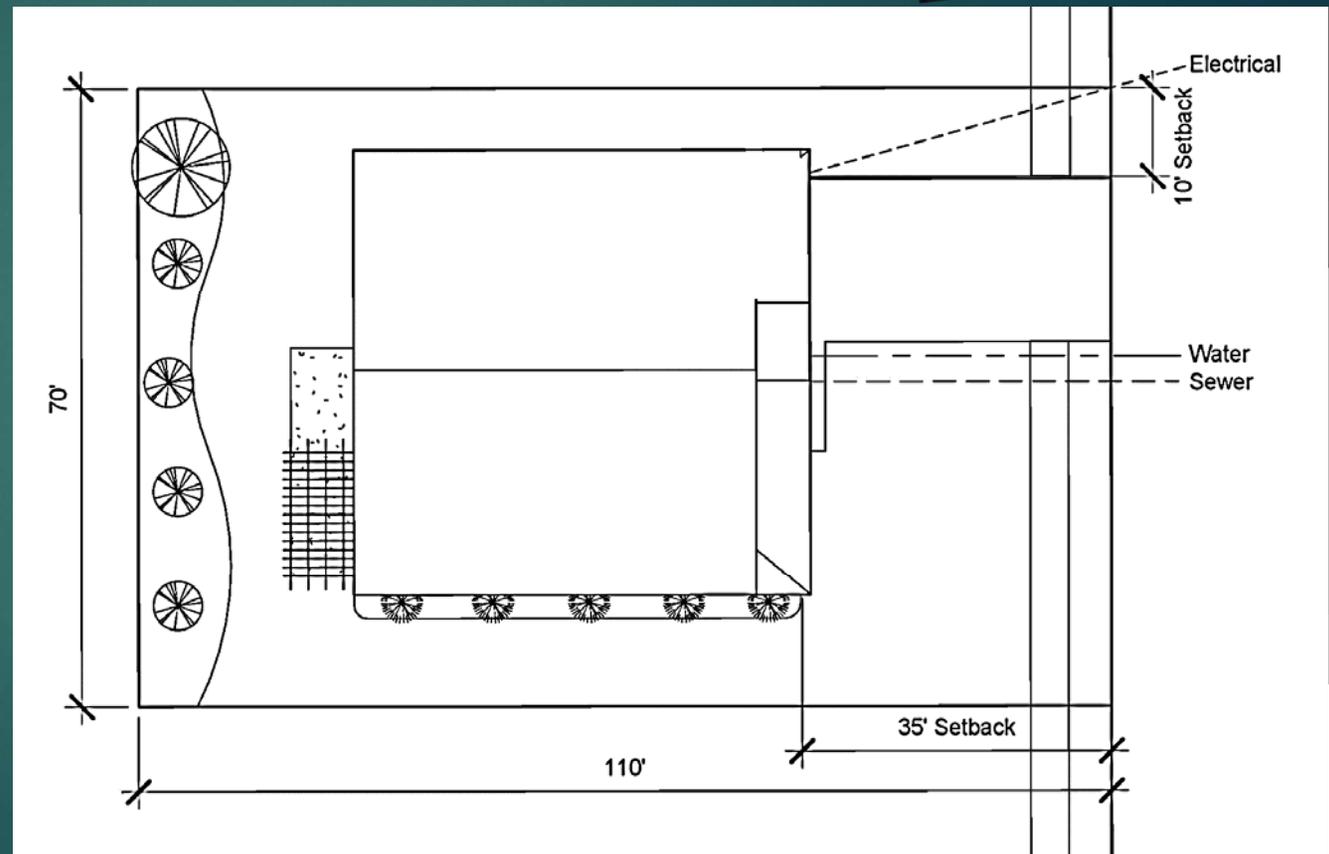
Sustainable:

- ▶ Simplified geometry reduces material waste
- ▶ Durable, low-impact finishes



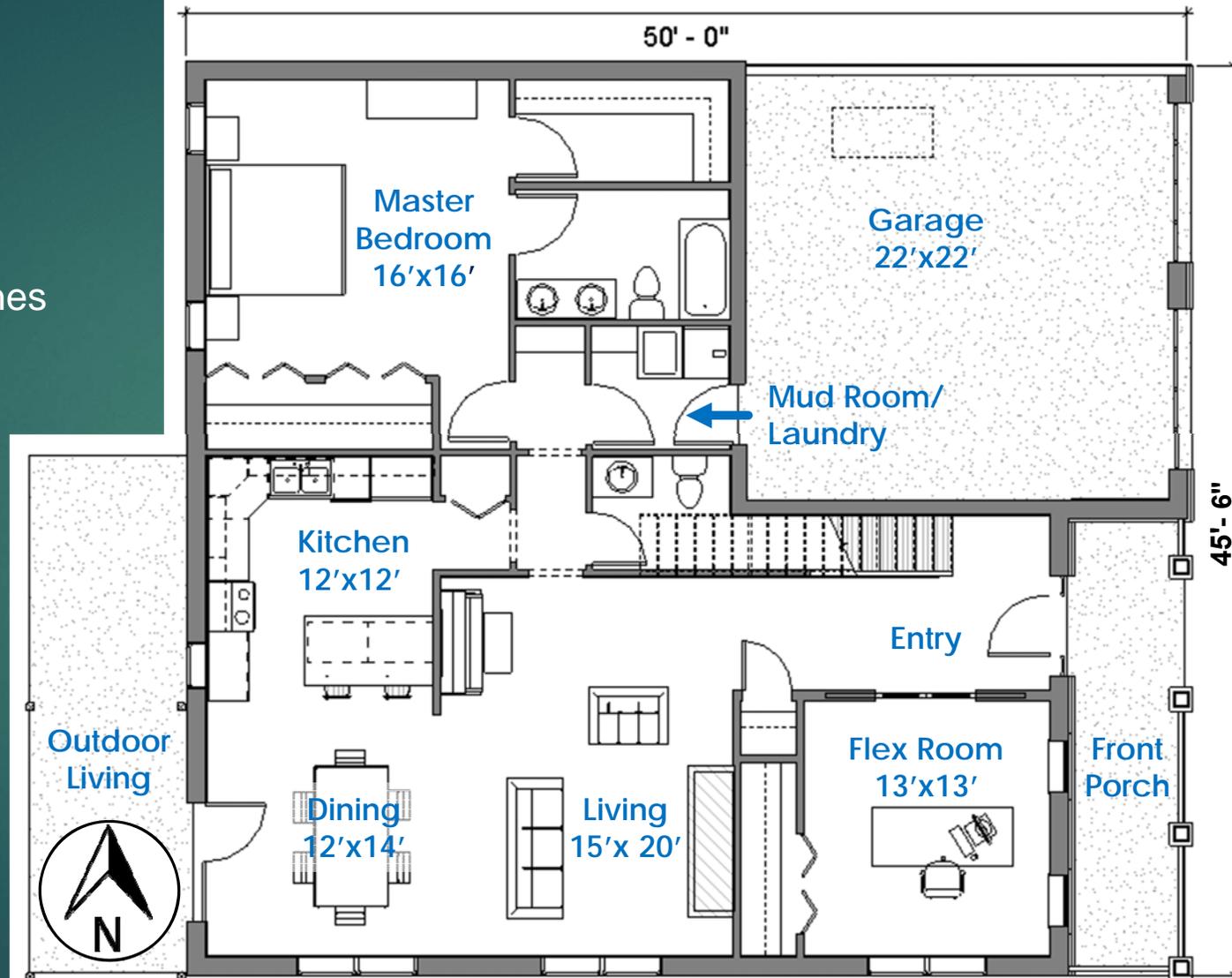
Site plan

- ▶ Permeable drive with open honeycomb design
- ▶ Drought tolerant native plants, including mountain laurels
- ▶ Backyard planting area redirects runoff
- ▶ Ample south-facing roof space for PV
- ▶ WaterSense certified rainwater catchment and irrigation system



First Floor

- ▶ Ground floor master suite for accessibility
- ▶ Compact and functional layout
- ▶ Designed for flow of daily routines
- ▶ Open living, dining, and kitchen, yet distinct spaces
- ▶ Public and private spaces
- ▶ Centralized wet rooms
- ▶ Flex rooms for many uses:
 - ▶ Office
 - ▶ Guest Bedroom
 - ▶ Media Room
 - ▶ Formal Dining
 - ▶ Playroom





▶ Living Room View



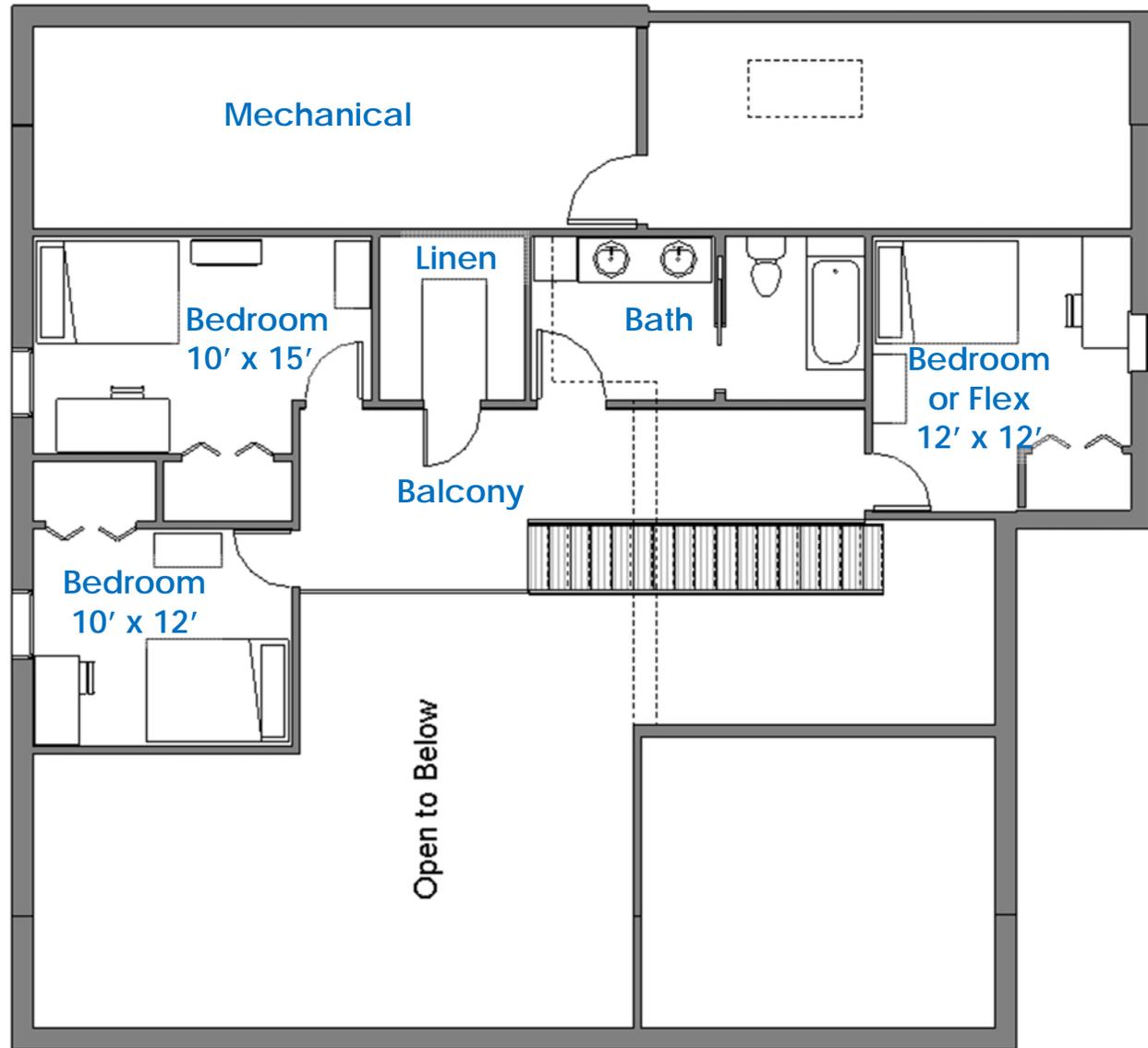
► Dining Room View



▶ Rear Terrace View

Second Floor

- ▶ Balcony open to living spaces and entry below
- ▶ Appropriately sized bedrooms
- ▶ Split bathroom to serve three bedrooms
- ▶ Ample storage
- ▶ Mechanicals in conditioned space

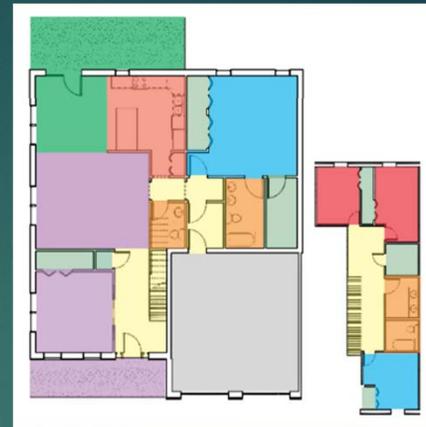
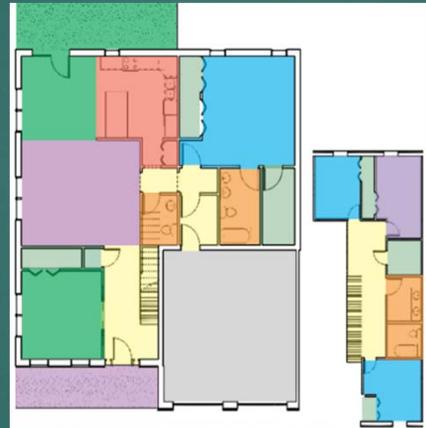




▶ Balcony View

Aging in Place

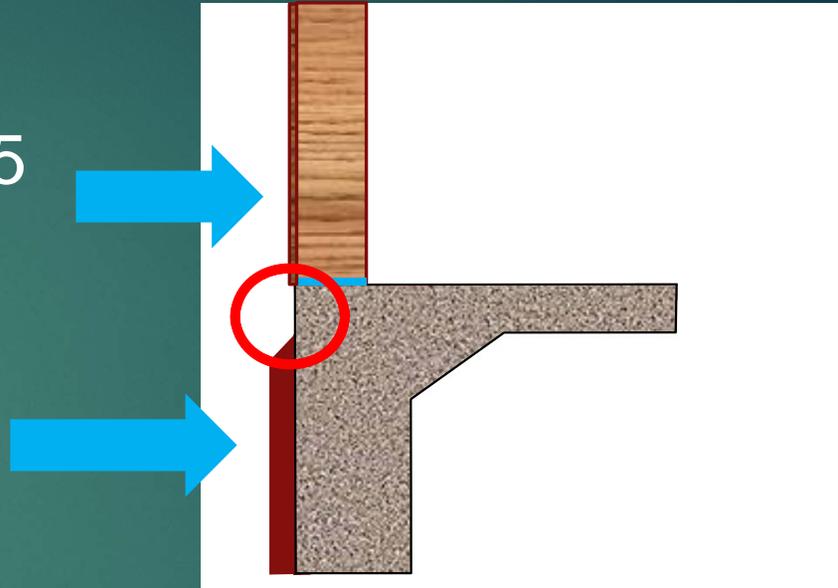
- ▶ Young professionals
- ▶ Parents with young children
- ▶ Parents with teenagers
- ▶ Caring for In-laws
- ▶ Empty nesters
- ▶ Middle age adventurers
- ▶ Active retirees
- ▶ Grandparents
- ▶ Less mobile seniors



Current Dan Ryan Slab/ Wall Construction

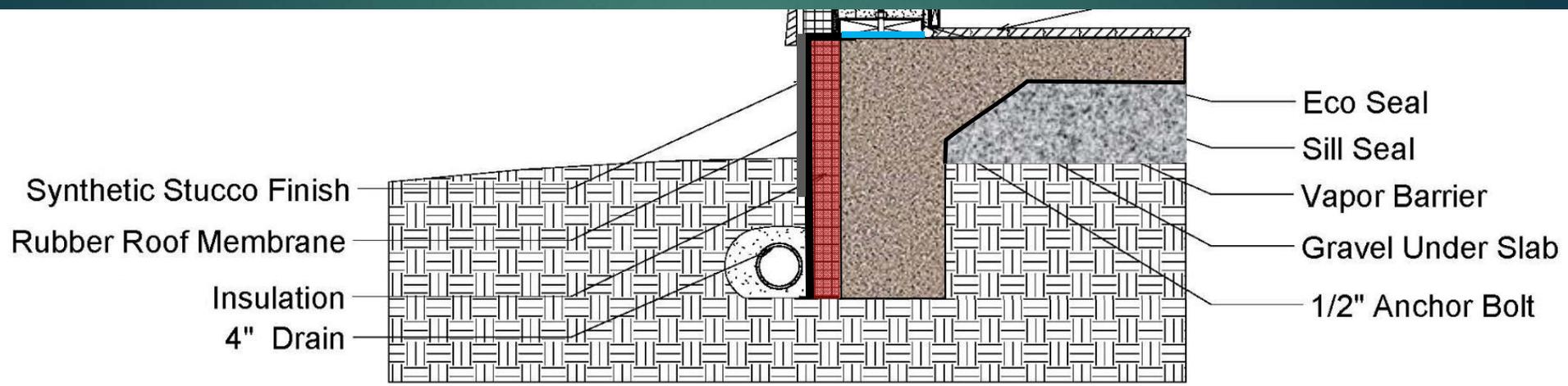
2x4 framed wall, 16" o.c. w/ R-15 fiberglass, 1/2" OSB sheathing

Slab-on-grade, R-10 perimeter with 2" termite inspection gap at the top





From the Ground Up: Floor System Insulation and Air Sealing



Wall System Selection Process



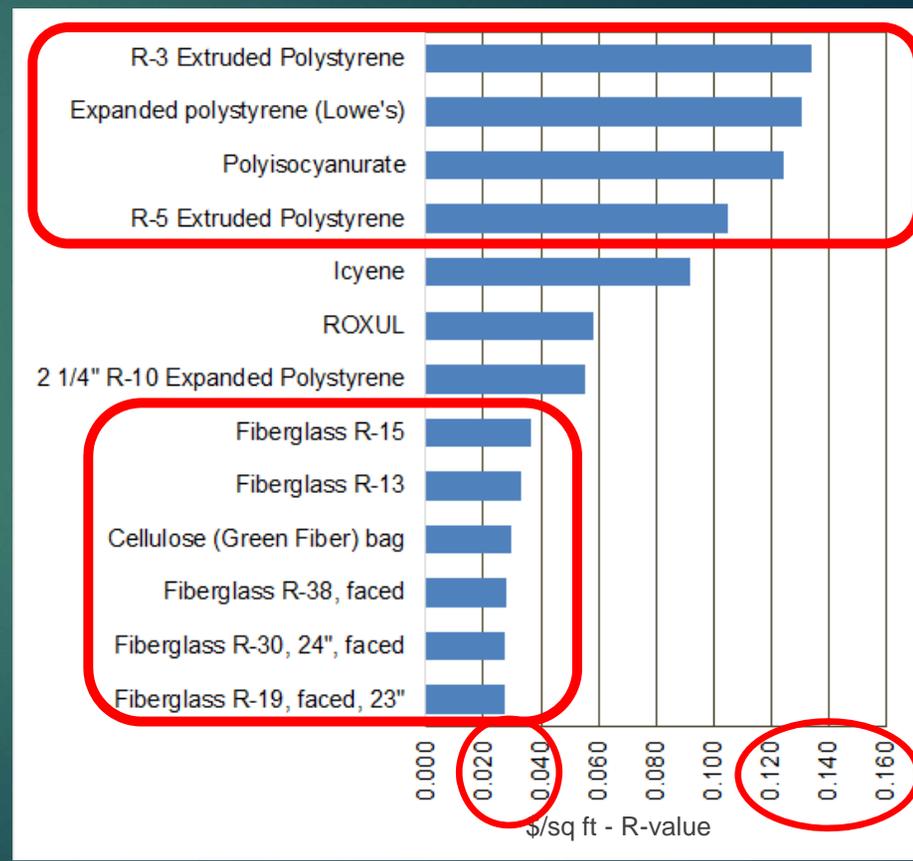
- ▶ Developed scoring system
- ▶ Conducted student survey
- ▶ Final selection

Criteria	Mode of Measurement	Weight from Survey
Cost/sq ft-R-value	Cost of wall system / R-value per sq ft	22.01
Exterior drainage	Exterior vented rain screen	13.69
% recycled products	Cost of recycled product/ Total cost	10.76
Condensation potential	Sum of differences between dew point temp and exterior sheathing temp in Dec, Jan and Feb	13.32
Annual energy savings	Estimated annual energy savings from energy model	24.46
Financial analysis	Annual rate of return	15.77

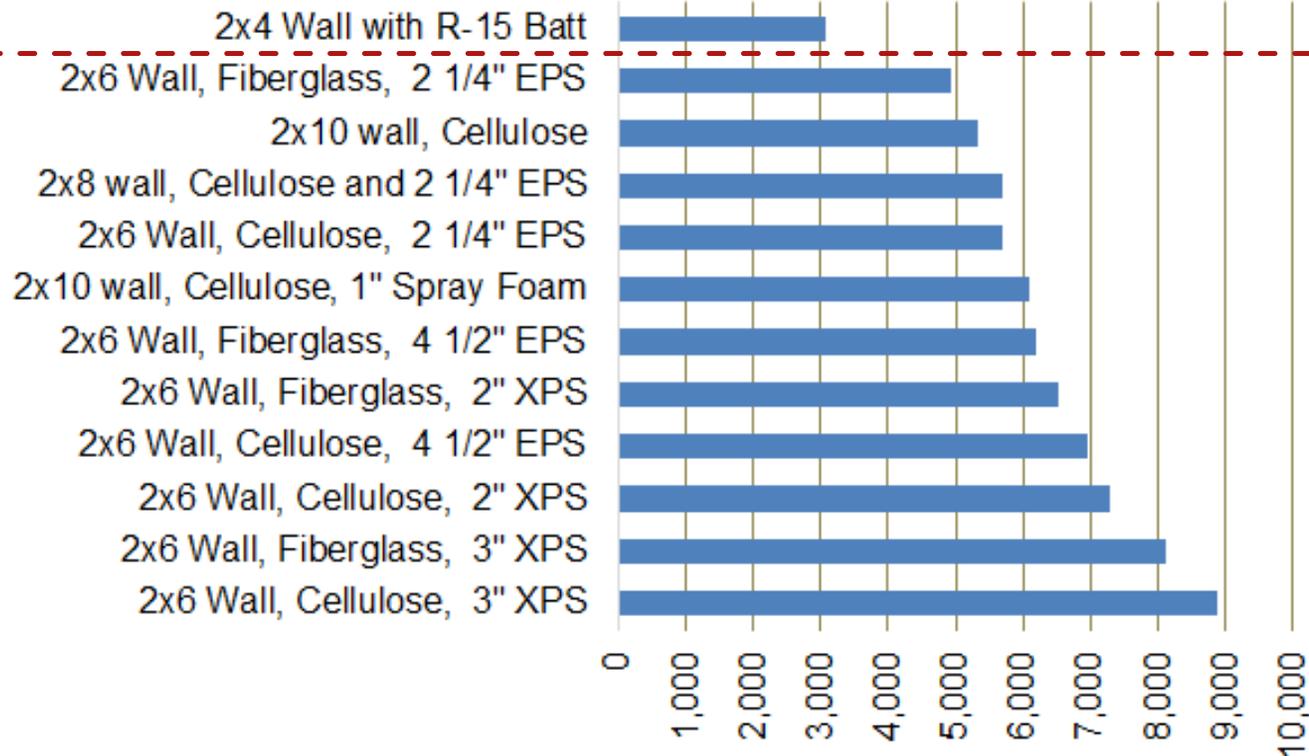


App State Team's Decision Making Process: Example for Wall System

- ▶ Considered the following wall systems:
 - ▶ 2x4 wall with R-15, OSB sheathing (base case)
 - ▶ 2x6 wall with R-21 fiberglass or cellulose and the following sheathing options:
 - ▶ 2" extruded polystyrene (R-10)
 - ▶ 3" extruded polystyrene (R-20)
 - ▶ 2 1/4" expanded polystyrene (R-10)
 - ▶ 4 1/2" expanded polystyrene (R-20)
 - ▶ 2" polyisocyanurate (R-13)
- ▶ Noted the high cost of exterior foam board insulation

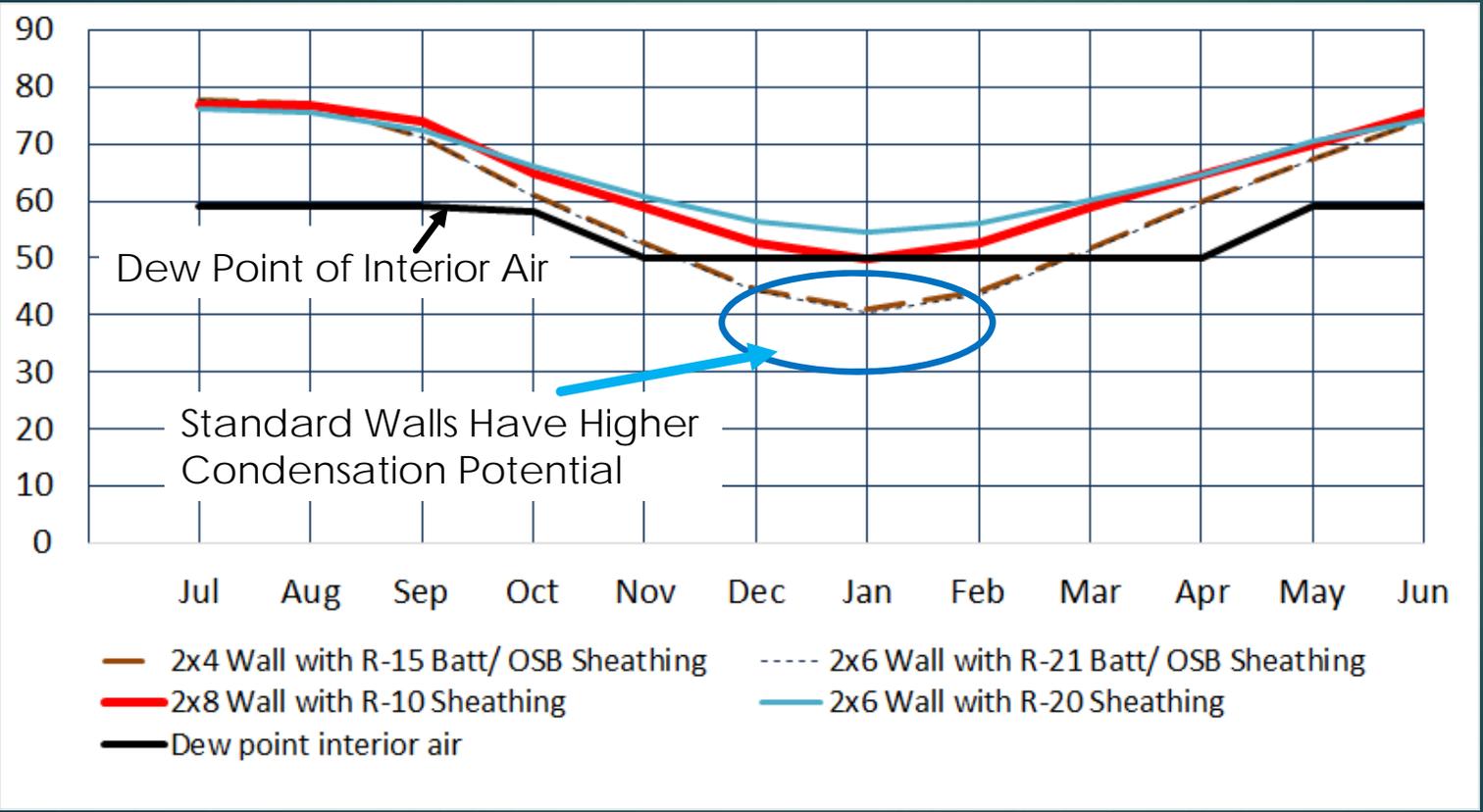


Wall System Selection Process: Cost of the Wall Options





Wall System Selection Process: Consideration of Condensation Potential



Wall System Selection Process: Final Rubric

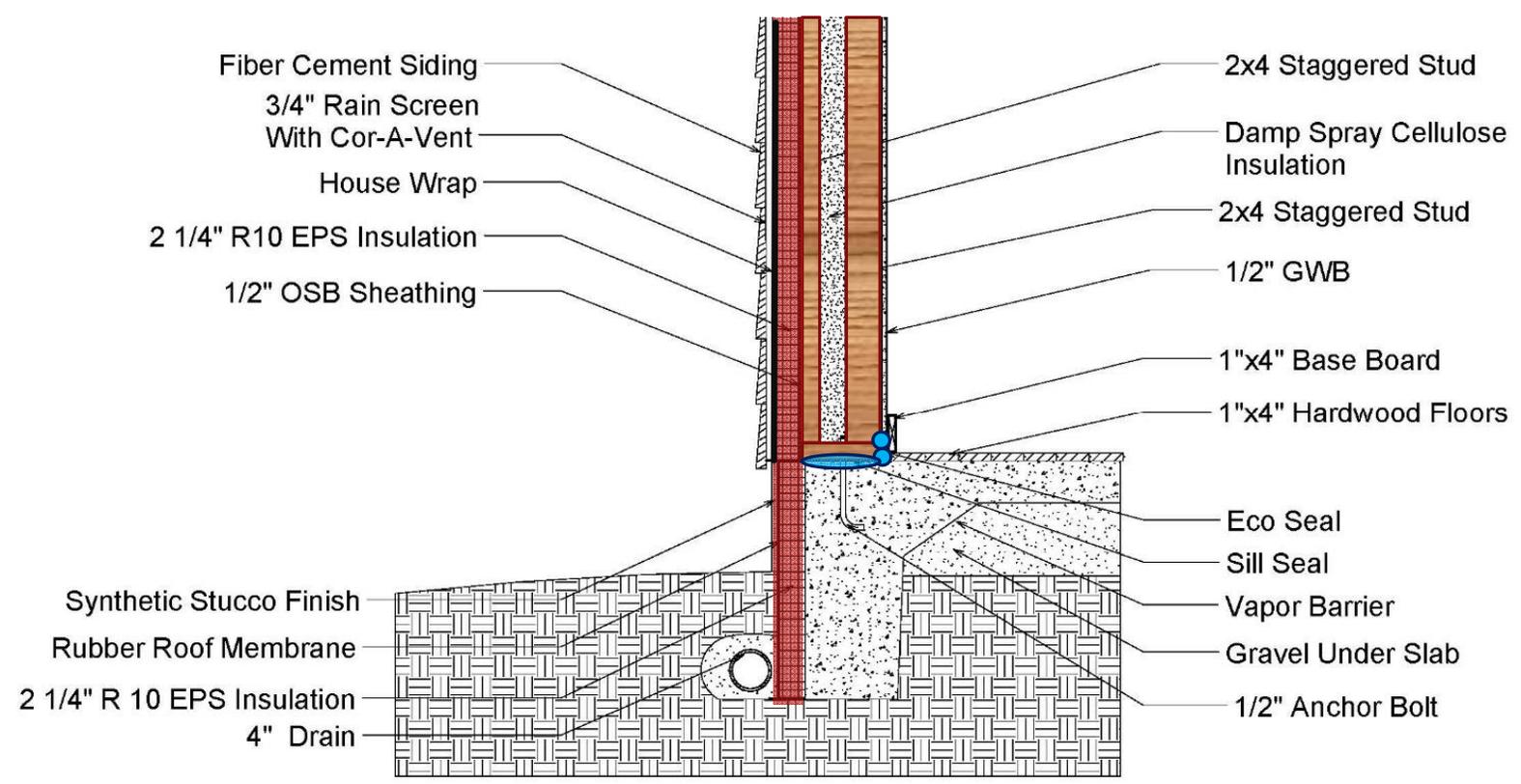


Scoring Rubric for Wall Construction

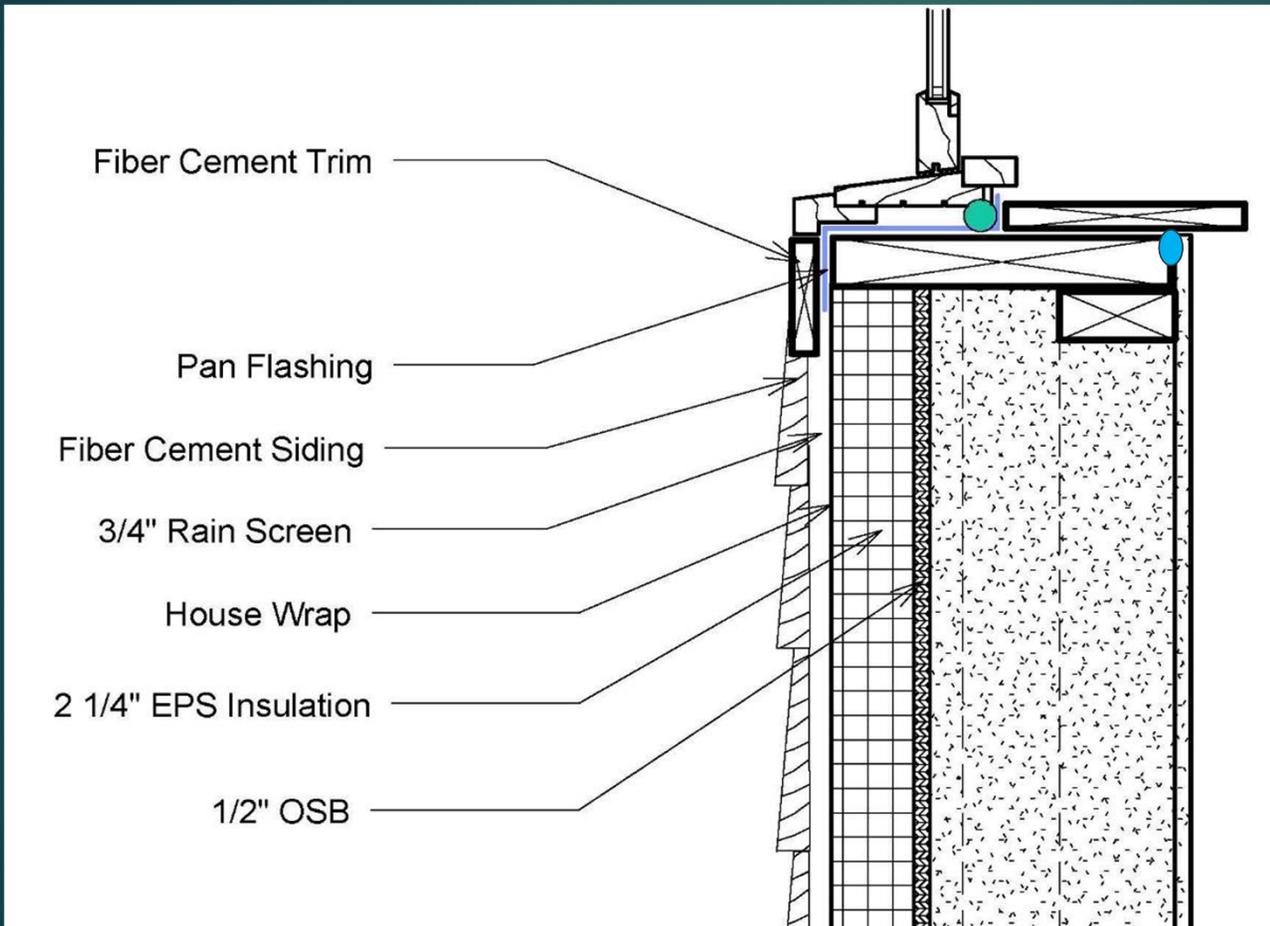
	Cost/sq ft- R-value	Drainage?	Recycled products	Condensation Potential?	Annual Energy Savings	Annual Rate of Return	Score
Weight	22.01	13.69	10.76	13.32	24.46	15.77	
2x4 Wall with R-15 Batt	1.00	1	0.0	1.1	1.00	1.00	0.9
2x6 Wall, Cellulose, 2" XPS	2.17	5	1.6	5.0	4.32	1.00	3.2
2x6 Wall, Cellulose, 3" XPS	1.91	5	1.3	4.4	4.65	1.00	3.1
2x6 Wall, Cellulose, 2 1/4" EPS	3.81	5	2.1	3.7	4.32	2.60	3.7
2x6 Wall, Cellulose, 4 1/2" EPS	4.38	5	1.7	5.0	5.00	1.35	3.9
2x6 Wall, Fiberglass, 2" XPS	3.03	5	0.0	3.7	4.32	1.00	3.1
2x6 Wall, Fiberglass, 3" XPS	2.64	5	0.0	4.4	4.65	1.00	3.1
2x6 Wall, Fiberglass, 2 1/4" EPS	4.65	5	0.0	3.7	4.32	5.00	4.0
2x6 Wall, Fiberglass, 4 1/2" EPS	5.00	5	0.0	5.0	5.00	2.73	4.1
2x10 wall with Cellulose	4.64	5	3.5	1.0	4.55	4.07	4.0
2x10 wall, Cellulose, 1" Spray Foam	4.25	5	2.7	2.4	4.65	2.97	2.7
2x8 wall, Cellulose, 2 1/4" EPS	4.85	5	2.6	3.2	4.79	3.46	4.2



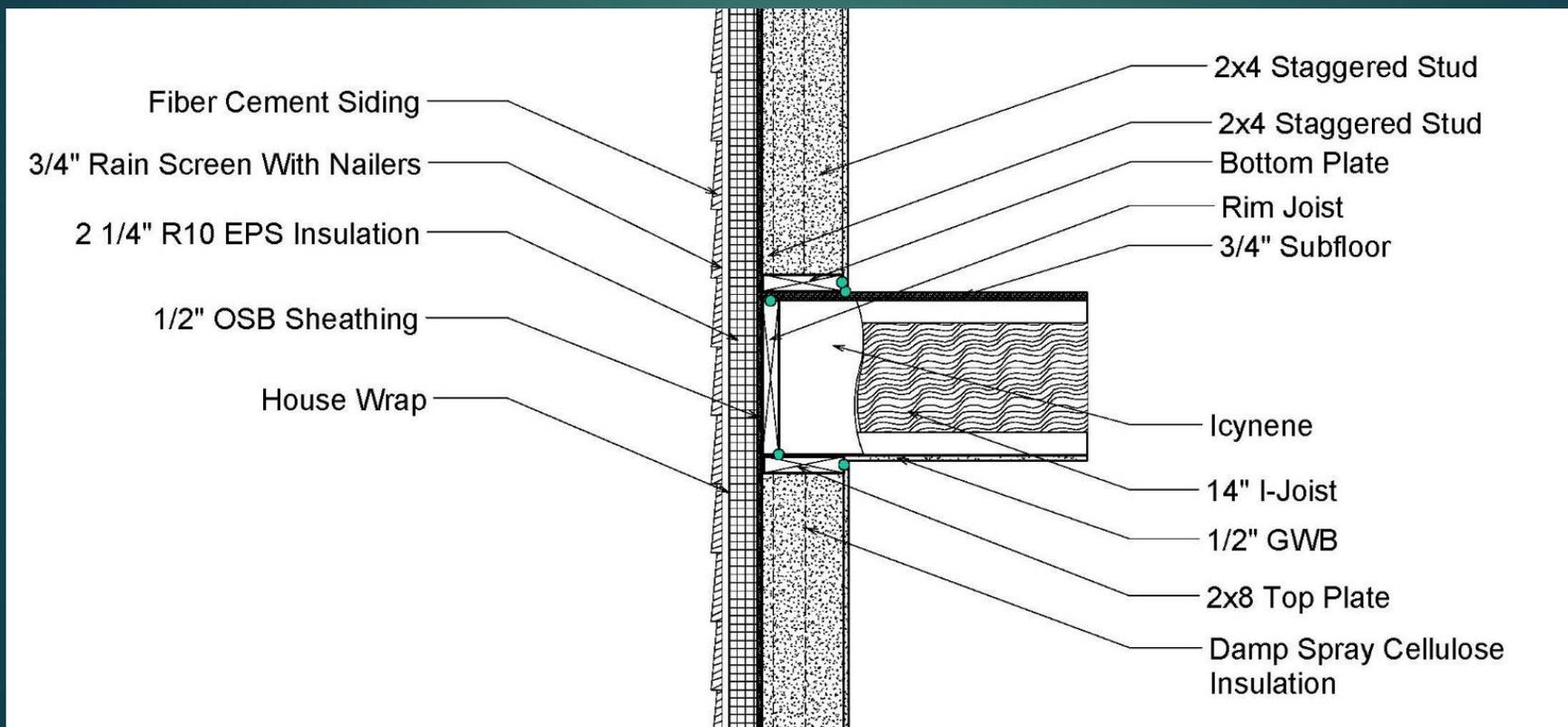
From the Ground Up: Wall System



Window flashing and air sealing



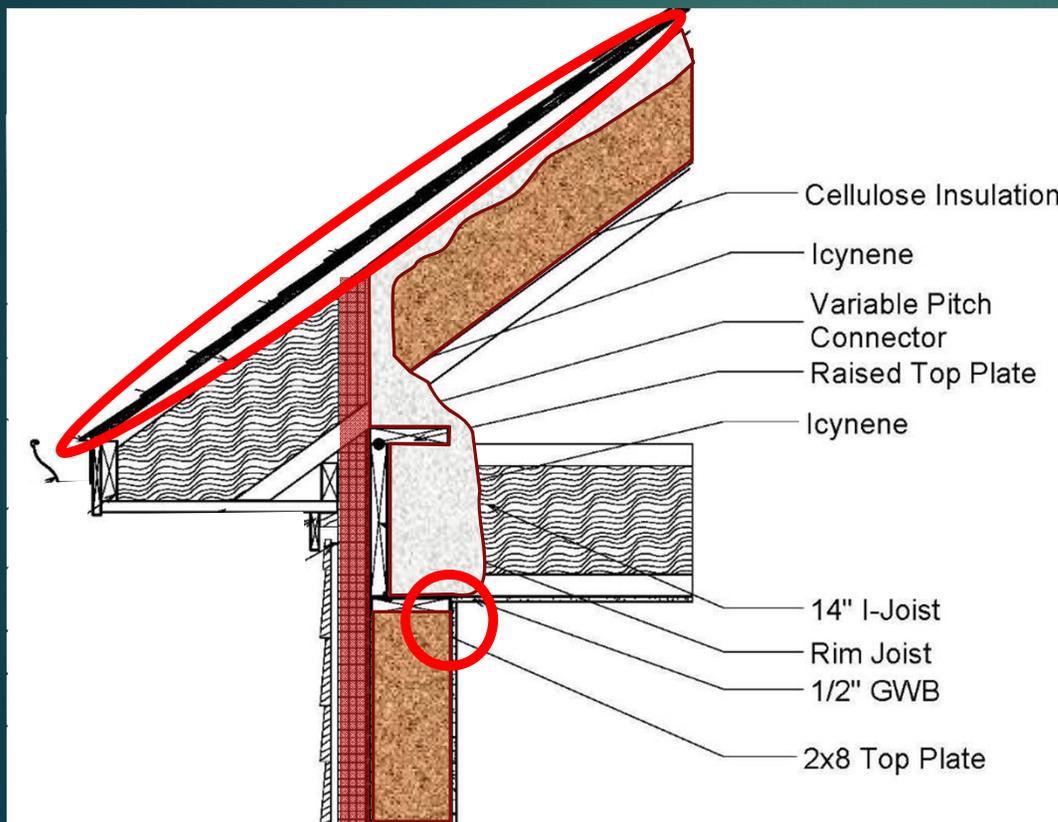
From the Ground Up: Band Joist Structure, Insulation, and Air Sealing



From the Ground Up: Roof-to-Wall Structure, Insulation and Air Sealing



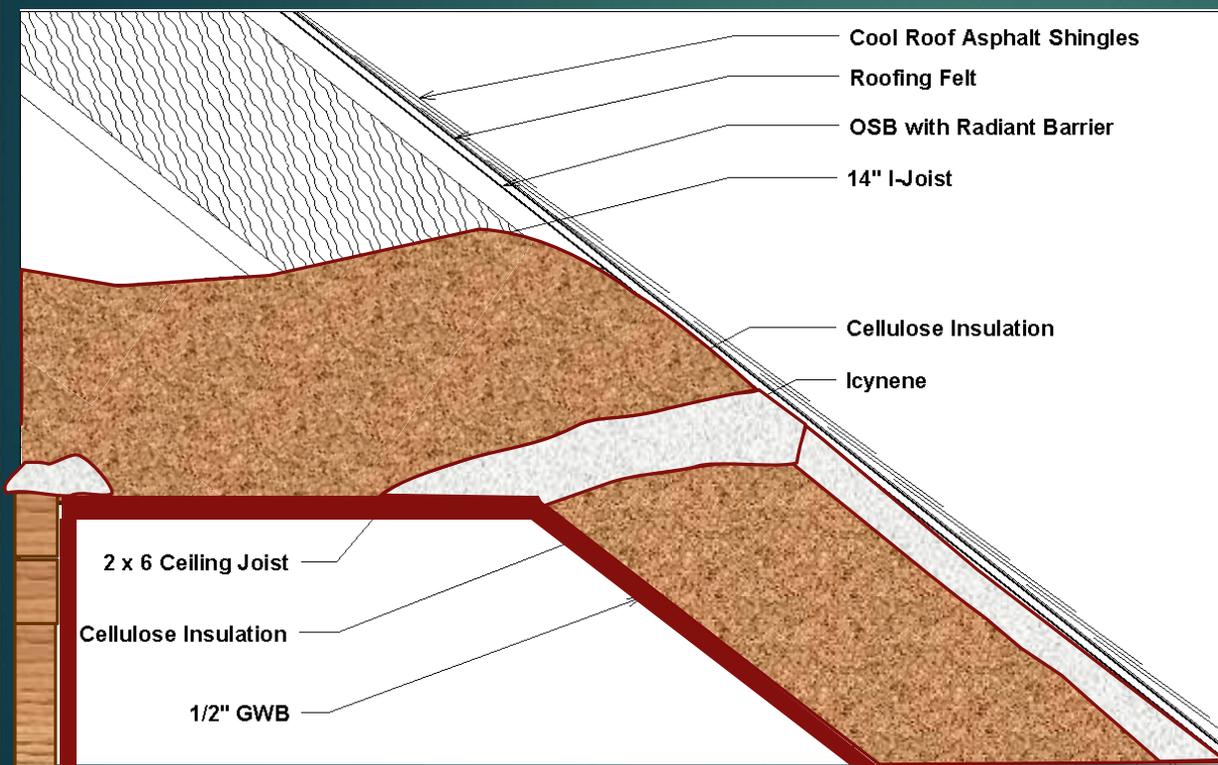
27



- ▶ Key Efficiency/ Durability Features
 - ▶ Ice and Water Shield
 - ▶ Airtight Drywall
 - ▶ Continuous Foam Sheathing
 - ▶ Entire Wall/ Ceiling/ Roof Connection Spray Foamed
 - ▶ Blown Cellulose Insulation

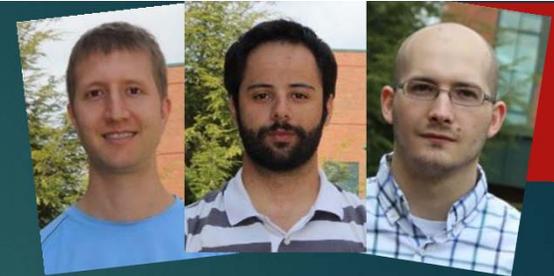


From the Ground Up: Ceiling Insulation and Air Sealing



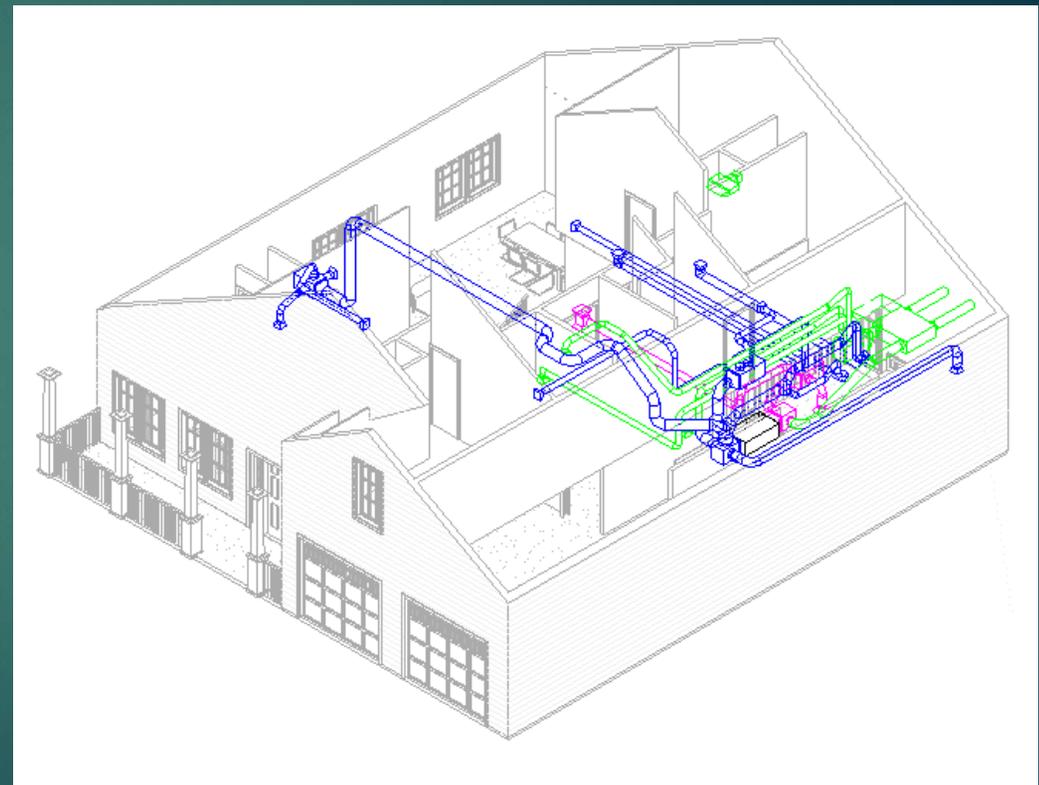
- ▶ Key Efficiency/ Durability Features
 - ▶ Spray Foam on Roof Deck
 - ▶ Cellulose Blown in Cathedral Ceiling
 - ▶ Drywall Sealed as Air Barrier
 - ▶ Spray Foam in Attic, including Cathedral Ceiling Bays
 - ▶ Blown Cellulose Insulation

HVAC System



29

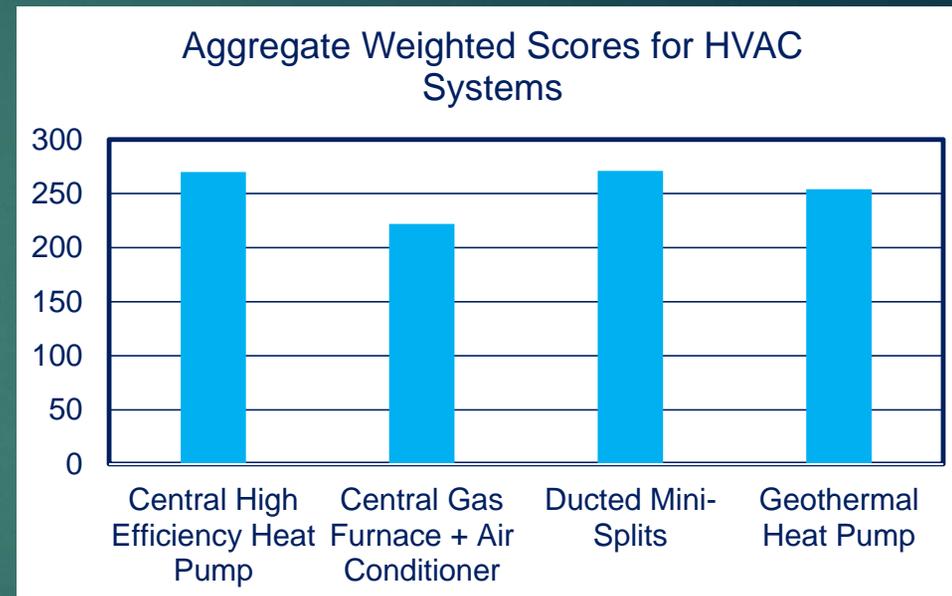
- ▶ HVAC Team sought maximum synergy between design goals:
 - ▶ Market Ready: *Affordable, Simple*
 - ▶ Livable: *Beneficial to IAQ, Humidity Control*
 - ▶ Sustainable: *Low Energy Consumption*
- ▶ Some of the systems we considered:
 - ▶ Central heat pump
 - ▶ Gas furnace/ air conditioner
 - ▶ Ducted mini-split(s)
 - ▶ Geothermal



Three Tier HVAC Selection Process



1. Race-to-Zero team ranked HVAC Criteria (results in order of priority):
 - ▶ Energy Efficiency – 9.1 / 10
 - ▶ Indoor Air Quality – 8.2 / 10
 - ▶ Thermal Comfort – 7.5/ 10
 - ▶ Affordability – 7.5/ 10
 - ▶ Low Maintenance – 6.7 / 10
 - ▶ Simplicity – 5.7 / 10
 - ▶ Electric vs Fuel– 3.5/ 10
2. Race-to-Zero Team applied the criteria to the different HVAC system options
3. Aggregate scores were calculated for each of the four systems

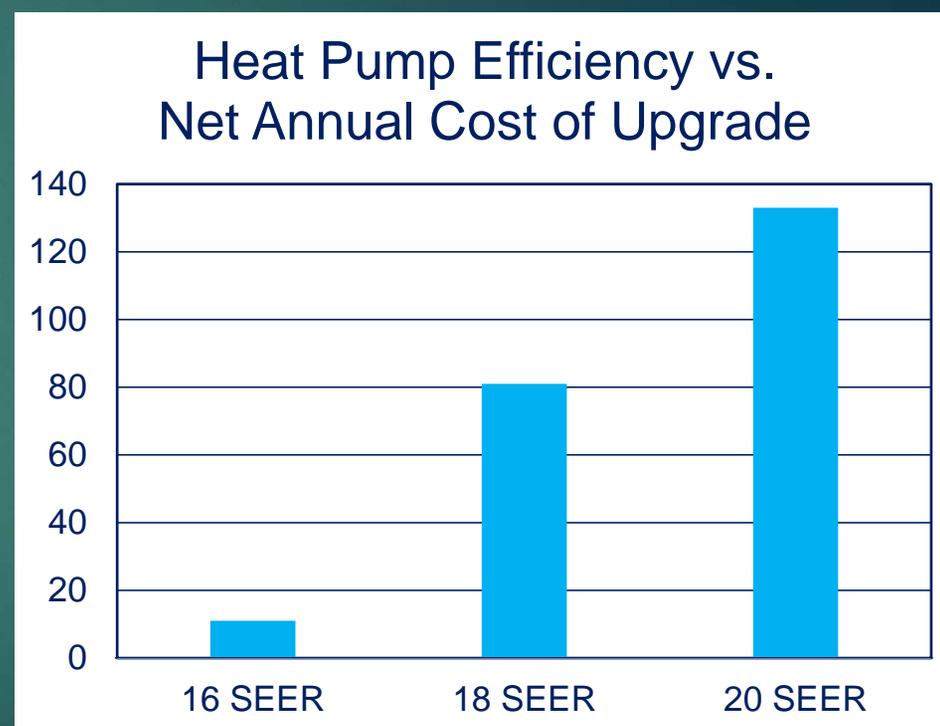


As shown, the Central Air Source Heat Pump and Ducted Mini-splits received the highest scores



HVAC Final System Design

- ▶ Based on cost estimates received from HVAC contractors, the central heat pump was selected as it was substantially less expensive than the ducted mini-split
- ▶ We decided on the SEER 16 unit – as energy prices increase, it will certainly become cost effective for the long run
- ▶ Designed using ACCA methodologies
 - ▶ Manual J for sizing
 - ▶ Manual D for duct design
 - ▶ Manual S for system selection
 - ▶ Manual H for heat pump design and selection

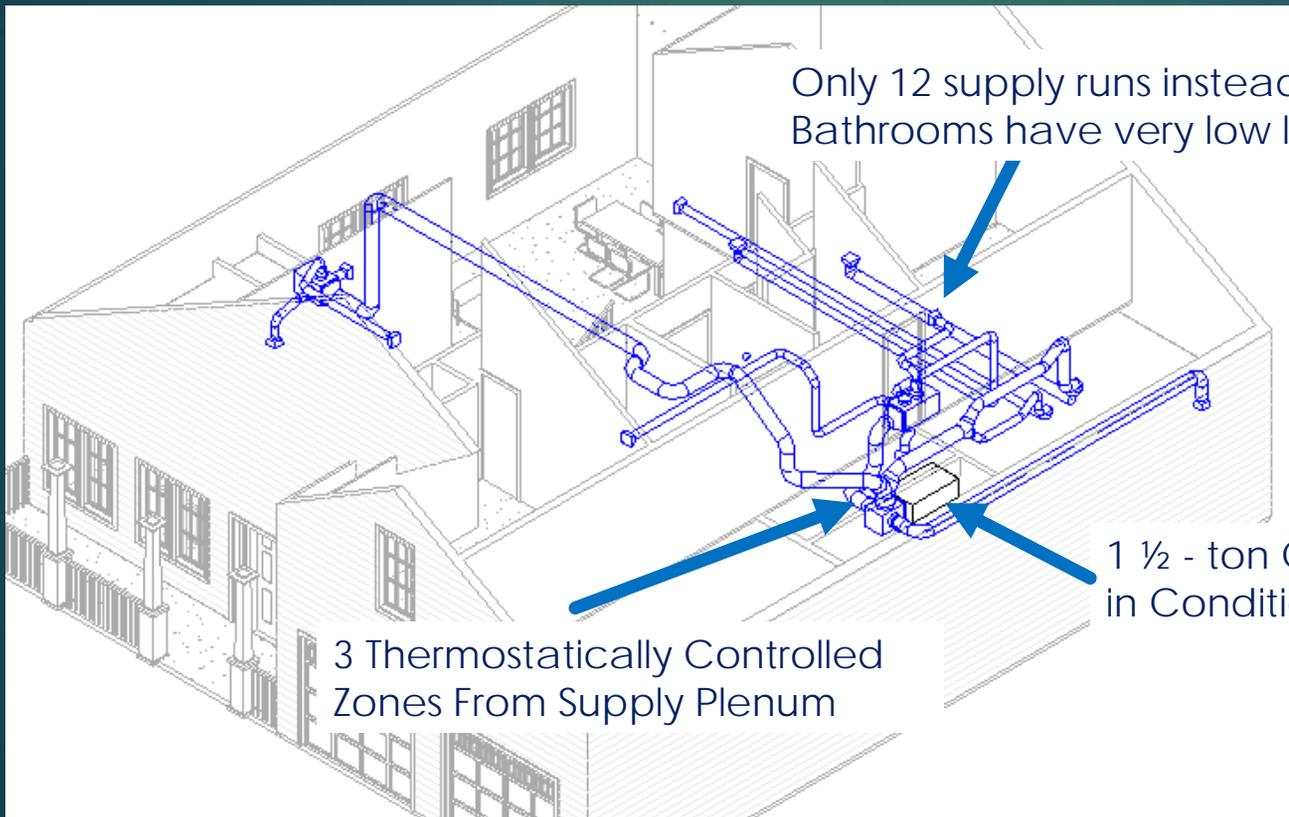


Manual J and D Results by Room



Rooms	Btuh Heating		Cooling Load (Btuh)			Design	Adjusted	Duct Size (inches)
	with HPWH	HPWH control	Sensible	Latent	Total	CFM	CFM	
Entry	1,550	1,550	758	153	911	36	39	5
Flex	1,686	1,686	1,126	218	1,344	53	57	5
Living + Bath	1,418	1,418	873	274	1,147	61	66	6
Kitchen	570	570	1,520	904	2,424	95	103	7
Dining	1,532	1,532	1,172	203	1,375	54	58	5
Master BR + Bath	3,617	1,764	1,370	433	1,803	71	76	6
Master BR Closet	1,959	685	270	33	303	14	15	4
Master Bath	shared	shared	shared	shared	shared	shared	shared	shared
Laundry	465	465	783	117	900	35	38	5
Bedrm 4 + Mech + Landing	1,357	1,357	1,382	303	1,685	60	64	6
Landing	shared	shared	shared	shared	shared	shared	shared	shared
Downstairs Bath	1,501	427	292	124	416	0	0	n/a
Bedrm 2 + Master Bath	1,689	392	629	254	883	45	48	5
Bedrm 3	346	346	605	250	855	34	36	5
Stair Bath	shared	shared	shared	shared	shared	shared	shared	shared
Mech	shared	shared	shared	shared	shared	shared	shared	shared
Total	17,690	12,190	10,779	3,266	14,046	558	600	14

HVAC Systems: Supply System

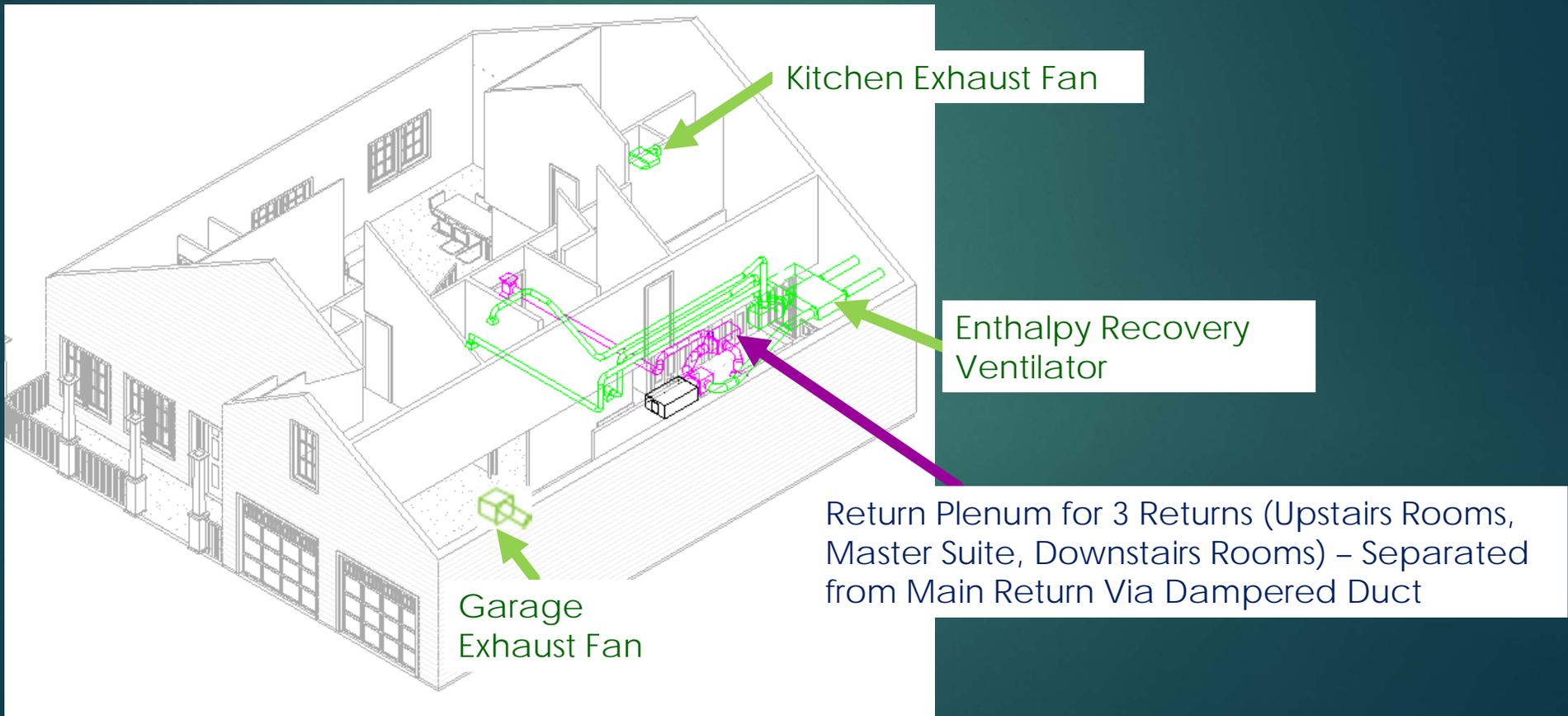


Only 12 supply runs instead of 19 to 20;
Bathrooms have very low loads and no supplies

1 ½ - ton Carrier Split System Heat Pump
in Conditioned Attic Knee Wall Area

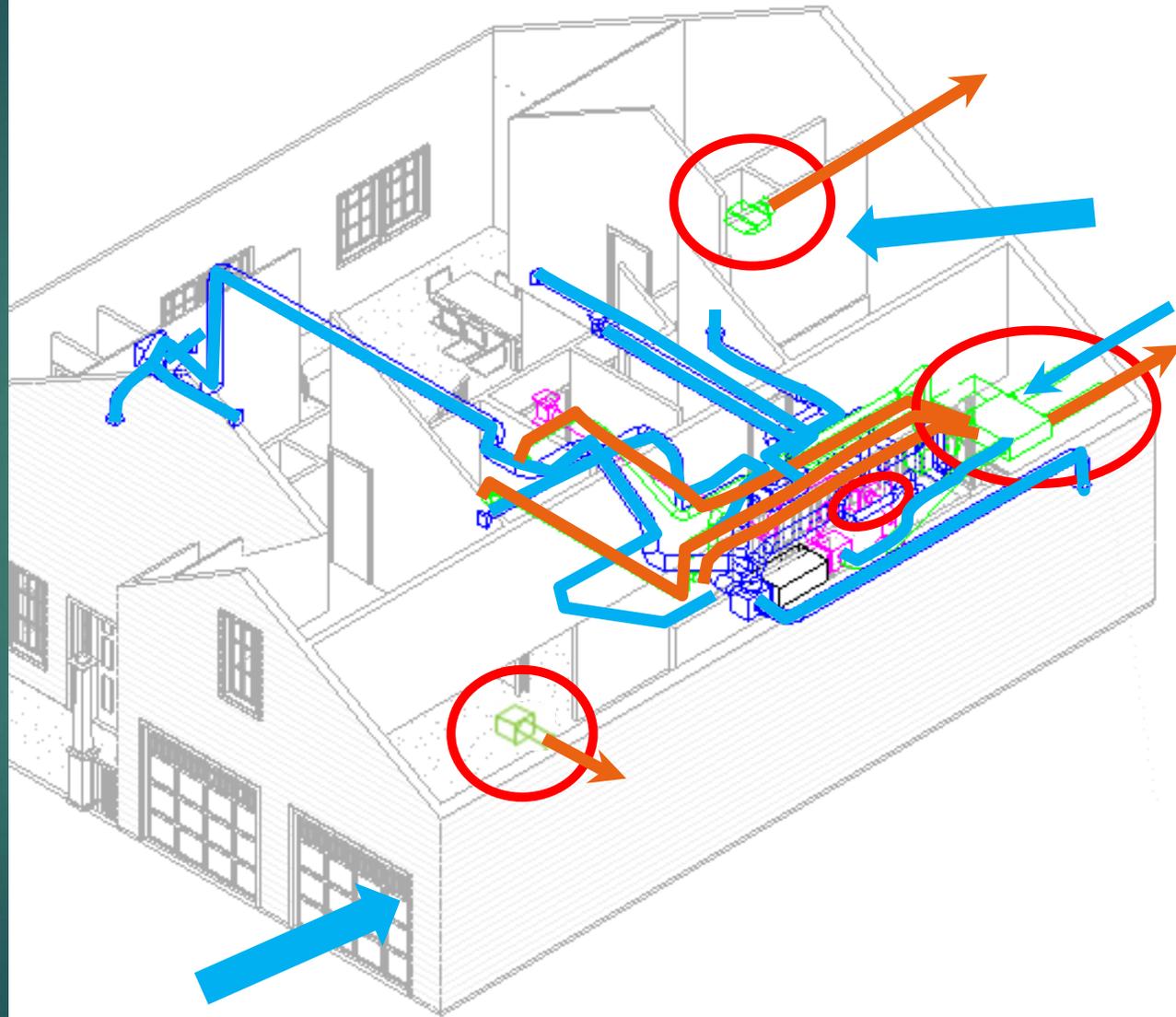
3 Thermostatically Controlled
Zones From Supply Plenum

HVAC Systems: Return and Ventilation



Ventilation & ERV Operation

- ▶ Exhaust air from 3 baths
- ▶ Make-up air from outside to return plenum
- ▶ Return ducts from house dampered from return plenum when HVAC is not operating
- ▶ Make-up air flows into home via supply ductwork
- ▶ Kitchen exhaust fan to exterior with dampered duct for make-up air
- ▶ Garage exhaust fan



Indoor Air Quality

- ▶ Low Emitting Materials
 - ▶ Cabinetry
 - ▶ Countertops
 - ▶ Flooring materials – some flooring is rapidly renewable, also
 - ▶ Paints and finishes
- ▶ Eliminated Carpeting for Reduced Contaminants over Time
- ▶ Covered Porch with Entry Pad “Welcome Mats” for Reduced Dirt and Dust from Outside
- ▶ Ventilated Garage Storage for Chemicals and Other Potentially Hazardous Materials



Energy Modeling

REM/Rate™



37

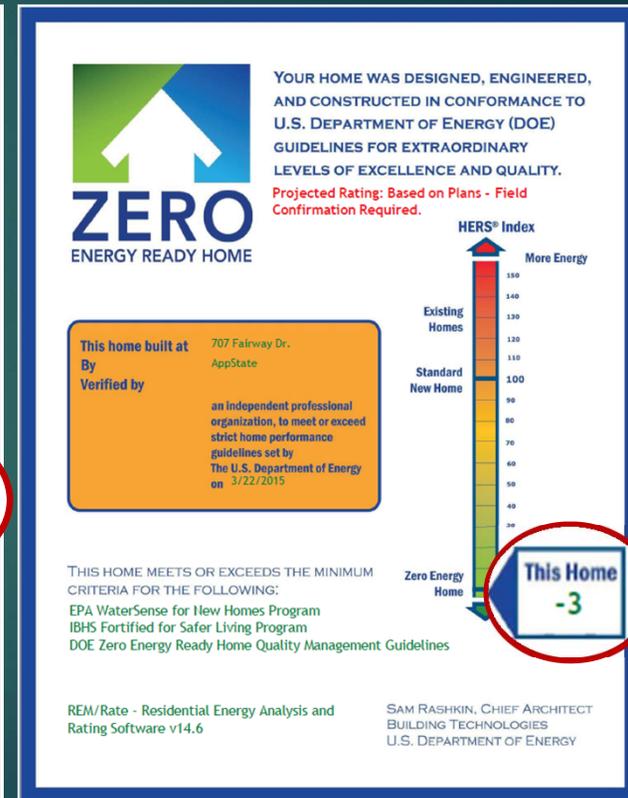
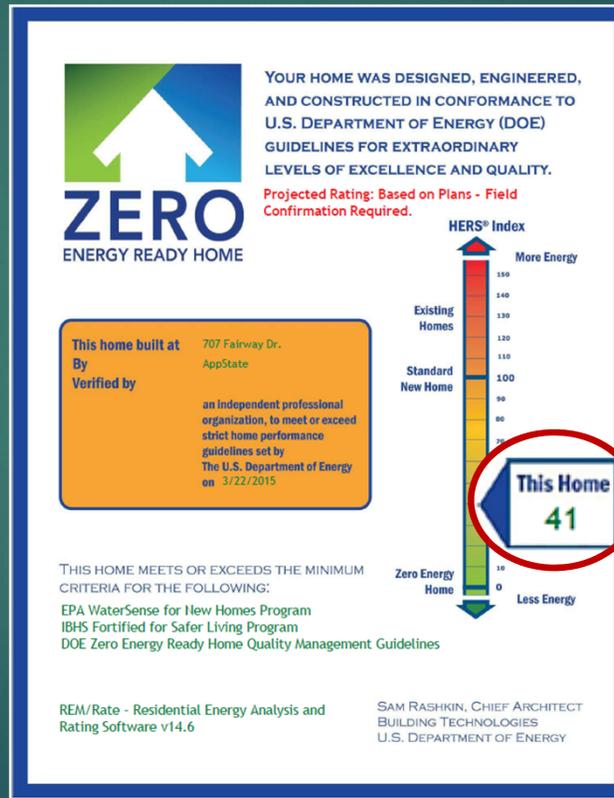
- ▶ Standard home in NC has HERS of 85 and annual energy cost of \$2,220
- ▶ 14 iterations analyzed to find the best way to meet our goals:
 - ▶ Insulation levels
 - ▶ Air infiltration levels
 - ▶ U-value and SHGC of windows
 - ▶ Ratio of window to wall area
 - ▶ SEER and HSPF of heat pump
 - ▶ % of high efficacy lighting
 - ▶ Efficiency Factor of Appliances
 - ▶ Efficiency Factor of Water Heater

Improvement	Energy Use (Million Btu/yr)				Total Annual Energy Cost (\$)	HERS Rating
	Heating	Cooling	Water Heating	Lights & Appliances		
1	10.1	5.1	14.3	25.9	1519	74
2	7.9	4.9	14.3	25.9	1456	71
3	7.2	4.9	14.3	25.9	1439	70
4	6.5	4.8	14.3	25.9	1386	68
5	5	4.1	14.3	25.9	1360	64
6	4.9	4.1	14.3	25.9	1356	64
7	5.2	4.1	14.3	27	1382	60
8	5.4	3.8	14.3	27	1374	59
9	5.1	3.4	14.3	27	1371	57
10	4.9	3.1	14.3	27	1358	56
11	4.6	2.8	14.3	27	1341	55
12	4.8	2.7	14.3	25.6	1312	54
13	5	2.7	12.1	20.4	1118	47
14	5.1	2.8	3.9	20.4	969	41

Energy Modeling Results/ Our Home's Energy Choices



- ▶ Walls = R-37
- ▶ Ceiling = R-50
- ▶ Slab Perimeter = R-15
- ▶ Windows = U-0.27, SHGC- 0.17, 0.20
- ▶ HVAC: 16.0 SEER, 10 HSPF Air Source Heat Pump
- ▶ Heat Pump Water Heater
- ▶ Infiltration: 0.6 ACH @ 50
- ▶ HERS 41 (HERS -3 with PV)

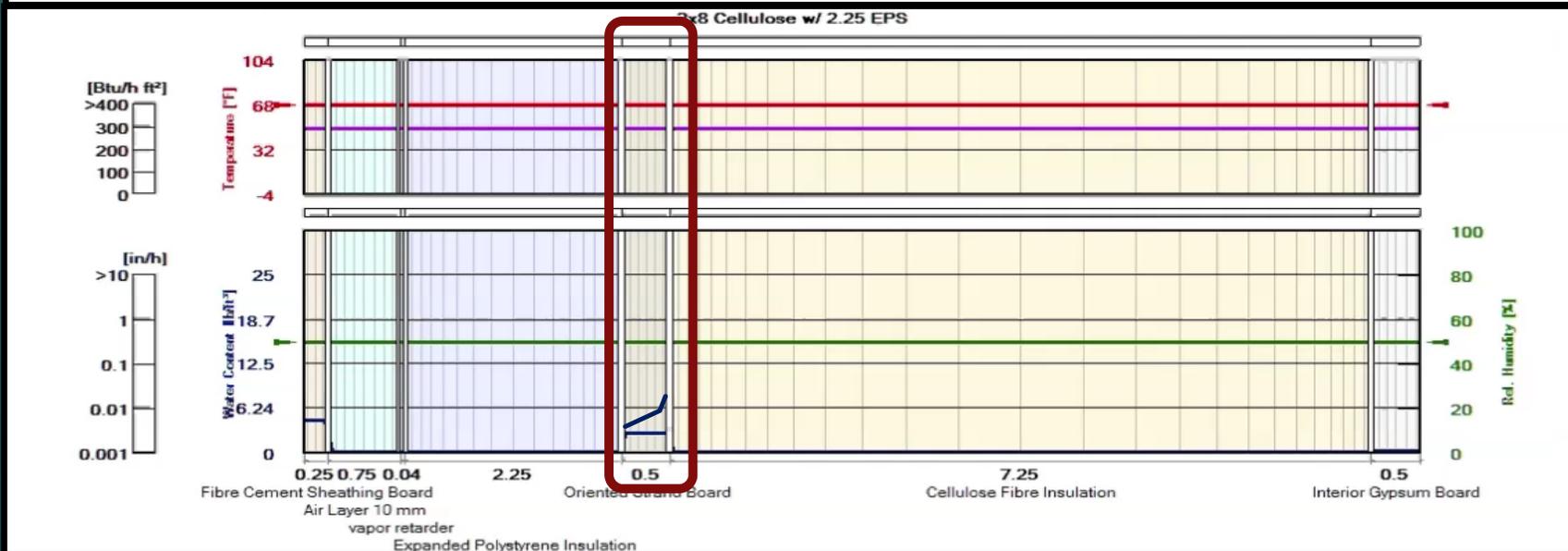


WUFI Models

Standard Wall



Mountain Laurel Home



Appliances



Energy Star	Appliance	Product	Capacity	Cost	kWh/yr
✓	Refrigerator	Frigidaire Side-By-Side Single Ice Maker	22.1-cu ft.	\$960	549
✓	Dishwasher	Whirlpool 55-Decibel Dishwasher	14 place setting	\$300	260
✓	Washer	Whirlpool Duet Hi-Eff Front Loader	4.2-cu ft.	\$720	145
✓	Dryer	Whirlpool Ventless Heat Pump Technology	7.3-cu ft.	\$1,600	531
N/A	Stove	GE Electric Range and Oven	5.3-cuft	\$404	487



Lighting and Daylighting

- ▶ Each room has daylight via fenestration
- ▶ High efficiency interior and exterior lighting
 - ▶ 76% LED
 - ▶ 16% Solar Powered LED
 - ▶ 8% Fluorescent
 - ▶ 0% Incandescent
- ▶ In most of the occupied rooms, lighting is integrated with ceiling fans
 - ▶ Provide central lighting in the room
 - ▶ Provide higher level of comfort during summer months
 - ▶ Extend period when no air conditioning is needed for comfort

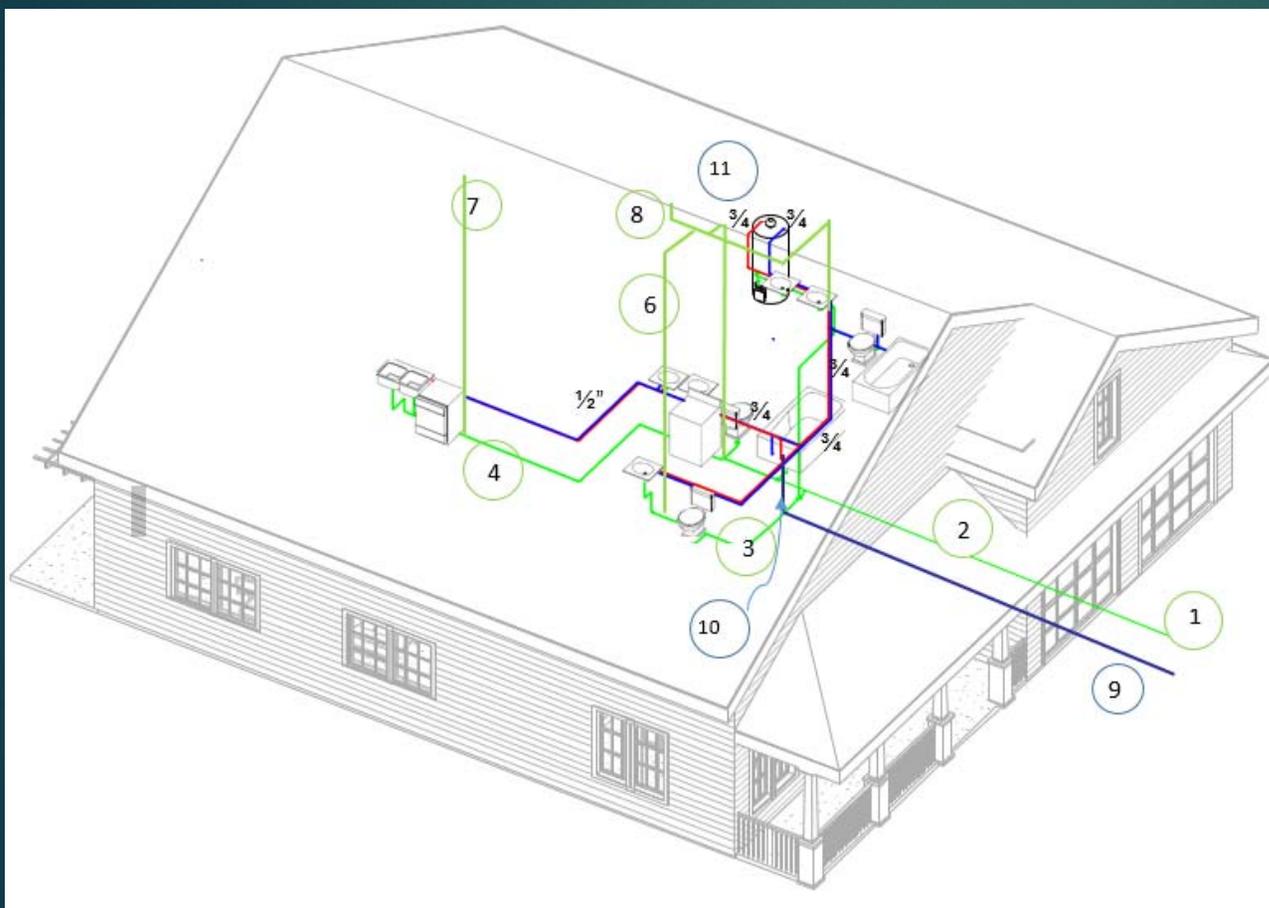


41



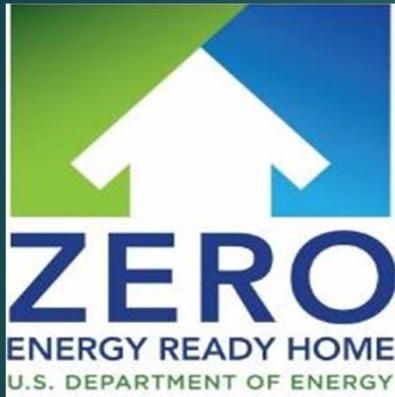


Domestic Water System



- ▶ Heat pump water heater with 2.75 Energy Factor
- ▶ Our home is WaterSense certified
 - ▶ Centralized wet areas for short runs
 - ▶ Limited wait times for hot water
 - ▶ 1.5 GPM faucets and showerheads
 - ▶ 1.0/1.6 GPM dual flush toilets
 - ▶ 3.5 Water factor clothes washer

Certifications



Construction Cost Estimate Mountain Laurel Home



44

- ▶ Developed lengthy database of itemized costs
- ▶ Conducted takeoff on materials and systems
- ▶ Compared cost of our home to a similarly sized home typical of Dan Ryan Homes
- ▶ Used cost data from Dan Ryan Homes, R.S. Means Cost Data, vendors and subcontractors to compare “apples to apples”

Sample Construction Cost Details



Craft/Process	Description	Quantity	Unit	Vendor	Price/unit	Cost	R2Z Cost		Price/unit	Base Cost
Pre Construction							\$ 9,150			\$ 9,150
	Permit Boards/Standards	1		DRH	\$ 150	\$ 150		\$150	\$ 150	
	Consulting Fees	1		DRH	\$ 9,000	\$ 9,000		\$9,000	\$ 9,000	
Engineering							\$ 550			\$ 550
	Stakeout	1		DRH	\$ 50	\$ 50		\$50	\$ 50	
	Foundation Survey	1		DRH	\$ 50	\$ 50		\$50	\$ 50	
	Misc. Engineering	1		DRH	\$ 100	\$ 100		\$100	\$ 100	
	Final Survey	1		DRH	\$ 100	\$ 100		\$100	\$ 100	
	Soil Survey	1		DRH	\$ 250	\$ 250		\$250	\$ 250	
Excavation							\$ 400			\$ 400
	Backfill	1		DRH	\$ 400	\$ 400		\$400	\$ 400	
Site Prep							\$ 985			\$ 985
	Silt Fence	1		DRH	\$ 985	\$ 985		\$985	\$ 985	
Utility Services							\$ 55			\$ 55
	Utility Services	1		DRH	\$ 550	\$ 550		\$550	\$ 550	
Dirt Movement							\$ 600			\$ 600
	Excavation	1		DRH	\$ 600	\$ 600		\$600	\$ 600	
Utility							\$ 550			\$ 550
	Materials/Permitting	1			\$ 550	\$ 550		\$550	\$ 550	
Grading							\$ 395			\$ 395
	Rough Grade	1		DRH	\$ 395	\$ 395		\$395	\$ 395	
Driveway							\$ 2,719			\$ 1,241
	Grass Paver	592.4	sq ft	NDSPRO.com*	\$ 2.49	\$ 1,477		\$ -	\$ -	
	Grading	65.8	sq yd	RS Means	\$ 1.38	\$ 91		\$1.38	\$ 91	
	Formwork	90.0	lin ft	RS Means	\$ 1.29	\$ 116		\$1.29	\$ 116	
	Concrete	8.8	sq yd	RS Means	\$ 103.00	\$ 904		\$103.00	\$ 904	
	Topsoil	592.4	lin cu yard	RS Means	\$ 0.22	\$ 130		\$0.22	\$ 130	
						\$ 2,719			\$ 1,241	
	* On-line retail price was									
Termite							\$ 125			\$ 125
	Termite Treatment	1		DRH	\$ 125	\$ 125		\$125.00	\$ 125	
Floor System							\$ 11,552			\$ 9,830
	Level 1	2104.62	sq ft	RS Means	\$ 3.79	\$ 7,971		\$ 2.80	\$ 5,903	
	Level 2	775.13	sq ft	RS Means	\$ 4.62	\$ 3,581		\$ 5.07	\$ 3,927	
	Total Floor					\$ 11,552			\$ 9,830	

Construction Estimate Summary: Mountain Laurel without PV System



Item	Mountain Laurel Home	Base Cost Home
General Requirements	\$9,700	\$9,700
Site Construction and Preparation	8,990	9,183
Floor Systems	11,552	9,830
Exterior and Interior Walls	23,429	18,528
Doors and Windows	9,139	8,706
Roof Systems	22,176	23,883
Mechanical and Electrical	28,143	25,312
Finishes and Cabinetry	33,247	29,688
Appliances	4,661	2,838
Testing and Certification	800	150
Specialities	5,744	5,744
Subtotal	\$157,582	\$143,561
Overhead and Profit (40.6%)	63,978	58,286
Total	\$221,560	\$201,847



Financial Analysis: Annual Mortgage Calculation

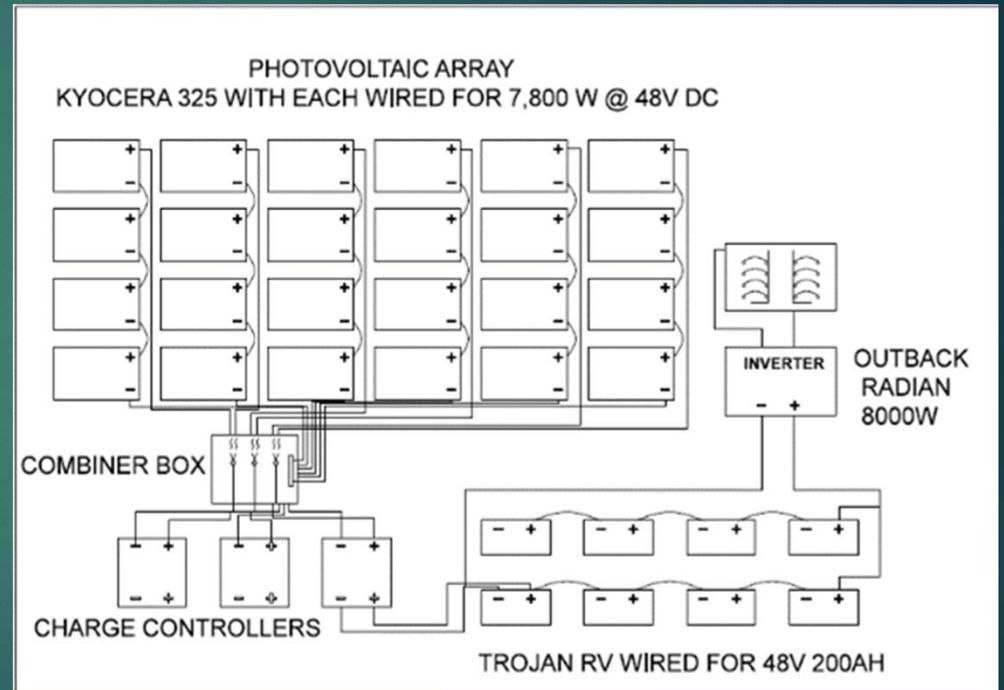
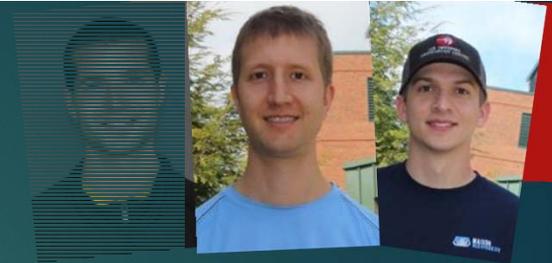
	Mountain Laurel Home	Base Cost Home
Sales Price for Home	\$ 221,560	\$ 201,847
Downpayment	44,312	40,369
Net Sales Price	177,248	161,478
Points at Loan Closing	2.5	2.5
Loan Principal	\$181,680	\$165,515
Annual Interest Rate	4.50%	4.50%
Term (years)	30	30
Annual Mortgage Payment	\$11,047	\$10,064

Financial Analysis: First Year Operating Cost and Annual Return on Investment



	Mountain Laurel Home	Base Cost Home	Annual Escalation
Annual Mortgage Payment	\$11,047	\$10,064	0.00%
Annual Insurance and Taxes	\$ 2,078	\$ 1,750	0.50%
First Year Energy	1,090	2,220	1.00%
First Year Water	685	959	1.00%
Average O&M Costs	500	500	0.50%
Total First Year Cost	\$15,400	\$15,492	
(except downpayment & incentives)			
Duke/ Progress Energy Incentive	\$ 4,000		
Return on Investment (% / year)	38.0%		
ROI Without Incentives	13.5%		

Renewable Energy System





Photovoltaic Module Performance

Photovoltaic Module Estimated Output (325 Peak Watts)

Month	Days/ Month	Avg. Insolation / Day (Kwh/m ²)	PV Output per Day (kWh / Module)	PV Output per Month (kWh / Module) *
Jan	31	3.42	1.11	27.9
Feb	28	4.05	1.32	29.9
Mar	31	4.68	1.52	38.2
Apr	30	5.13	1.67	40.5
May	31	5.13	1.67	41.9
Jun	30	5.13	1.67	40.5
Jul	31	5.04	1.64	41.1
Aug	31	4.95	1.61	40.4
Sept	30	4.68	1.52	37.0
Aug	31	4.41	1.43	36.0
Nov	30	3.69	1.20	29.1
Dec	31	3.24	1.05	26.4
Year				428.9

* Derated by 18% to account for inverter efficiency, other losses, and dust/ shading



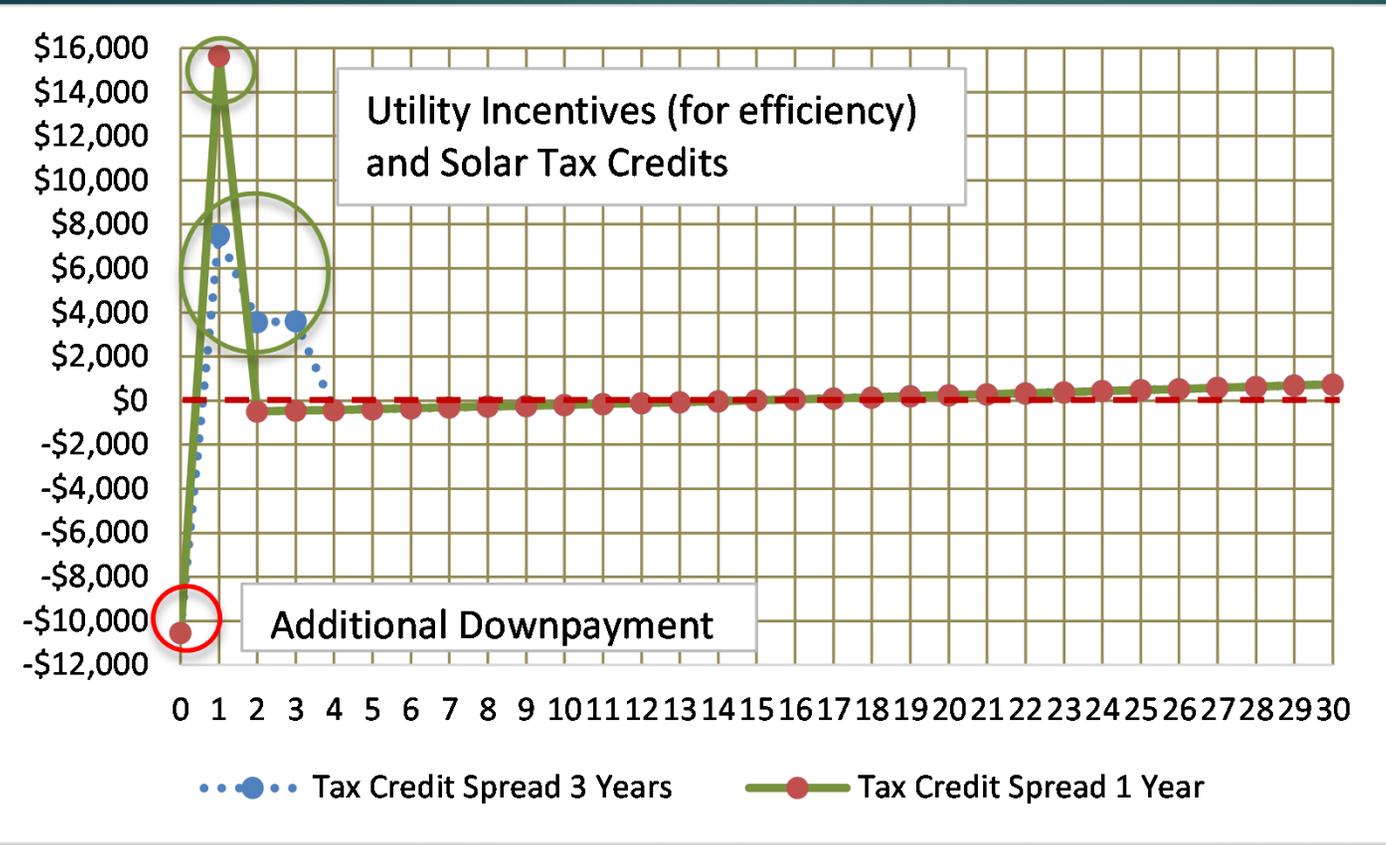
Photovoltaic System Costs, Incentives, Annual Revenues

- ▶ Price quote from Southern Energy Mgt: \$23,400
 - ▶ Federal Tax Credit: \$7,020
 - ▶ NC State Tax Credit (after federal taxes): \$5,148
- ▶ Revenues from Sales of Renewable Energy
 - ▶ Utility interconnection = \$0.0509/ kWh
 - ▶ NC Green Power = \$0.0385/ kWh
 - ▶ Total = \$0.0894/ kWh
 - ▶ Annual Revenue = \$932



Cash Flow and Rate of Return

Equiv. Annual Rate of Return = 17 to 39% per year tax free
(Rate of return depends on how many years tax credit is spread)



Cost Effective Packages



- ▶ Work with Dan Ryan Homes and other production builders on energy efficiency upgrades
- ▶ Packages matching Progress Energy (our local utility) incentives
 - ▶ “HERO Code” = \$1,000
 - ▶ HERS 66-70 = \$1,750
 - ▶ HERS 56-65 = \$2,500
 - ▶ HERS 55 or lower = \$4,000
- ▶ Photovoltaic renewable energy system package

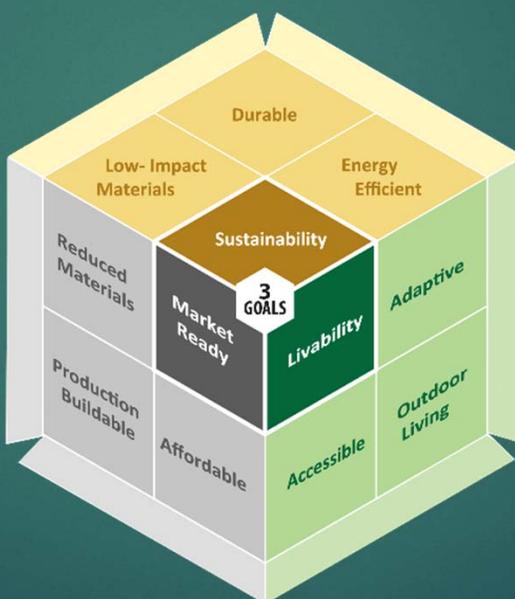


Summary: Did we meet our goals?

✓ Sustainability

- ✓ Met Zero Energy Ready goals
- ✓ Multiple certifications
- ✓ Durable assemblies with moisture management
- ✓ Continuous air, thermal, and moisture barriers
- ✓ Material efficiency
- ✓ Functional layout, small footprint
- ✓ High efficiency appliances and mechanicals

Integrated Design
is Crucial



✓ Market Ready

- ✓ Conventional building materials
- ✓ Integration with production built communities
- ✓ 17 to 39% annual rate of return

✓ Livability

- ✓ Flexible
- ✓ Open spaces and flow
- ✓ Connection to outdoors and neighbors
- ✓ Low maintenance materials and equipment
- ✓ Comfort

Mountain Laurel



55



- ▶ Durable
- ▶ Low Maintenance
- ▶ Adaptable
- ▶ Compact
- ▶ Resilient



Questions?

