BUILDINGENERGY BOSTON

Beyond the Data:
The Humanity of Radical, Regenerative Retrofits

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Northeast Sustainable Energy Association (NESEA) | March 20, 2025

PURPOSE

WHY THIS PRESENTATION? WHY NOW?

HIT THE VIBE

RADICAL

1. growing {community} from the root
2. relating to the origin – fundamental
3. very different from the usual - extreme

HIT THE VIBE

REGENERATIVE

Moving beyond the 'usual' design approach and thinking *fundamentally* and holistically – RADICALLY, about the interdependence of the site ecology, built environment, food production, social equity, and economic resilience.

HIT THE VIBE

EMERGENCE

"small patterns that avoid useless predation, spread lessons, and proliferate change"

– adrienne maree brown

FRACTALS

"when we speak of systemic change we need to be fractal...we must create patterns that cycle upwards "

– adrienne maree brown

BE THE VIBE

DESIGN FOR HUMANITY

Diversity of race, gender, abilities, socio-economic factors, and house types

All the following projects have been fully designed and phased for the client to thoughtfully tackle their deep energy retrofits, and sometimes additions, over the course of 5-8 years.

BE THE VIBE

Chris V., mid-40's with family, Air Force pilot

Full deep energy retrofit of 1971 home.

"I want my home to be comfortable, resilient and more joyful for my family."

BE THE VIBE

Carol L., mid-60's, single retired firefighter

Already almost net zero with attic insulation/airseal + solar panels, wanting an air-tight envelope and then smaller H/AC plus ERV.

"In the end, I want my house to be more comfortable to live in."

BE THE VIBE

Luke + Elie, early-30's, fashion designer + IT guy + goats

Originally wanted to build a new net zero castle, but had to settle for retrofitting this old farmhouse to be net zero as a 10 year plan.

"the energy + envelope take priority over any architectural upgrades"

BE THE VIBE

Thatch + Dereke, early-30's, veteran + landscape architect studying to be a lawyer

Want to deep energy retrofit their first home to be comfortable, zero energy, and beautiful for their future family.

"ok, we've decided to do the exterior insulation"

BE THE VIBE

Molly L, mid-40s, research nurse + mother of two

Retrofit their historic house to be as energy efficient as possible.

"no, you can't talk me out of the triple-pane European windows."

BE THE VIBE

Eric + Evie F., almost 50 with two boys, psychologists

Want to deep energy retrofit their first home to be comfortable, zero energy, and beautiful for their future family.

"want their new forever home to be as energy efficient + comfortable as possible"

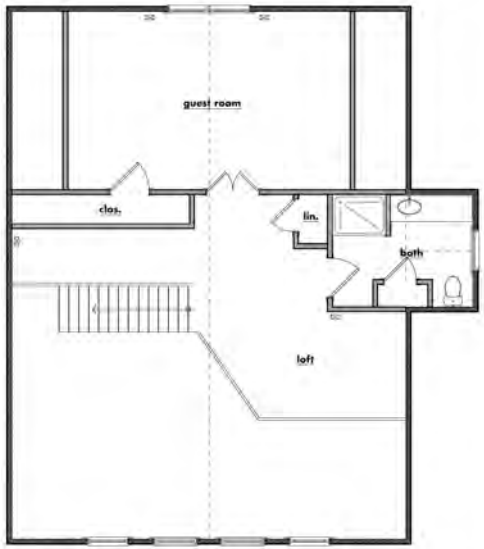
CASE STUDY

Jay M. + Wei G, 30s/40s, environmental justice advocate + human rights advocate

- net zero target, resiliency
- no-foam with all natural and salvage materials
- comfortable, warm house in the woods
- soften the lines and aesthetic of the house
- permaculture landscaping
- provide a retreat + education vehicle for others

CASE STUDY

before floor plans

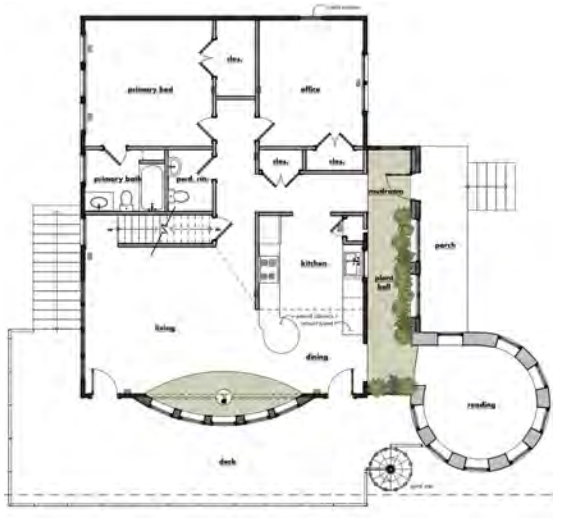


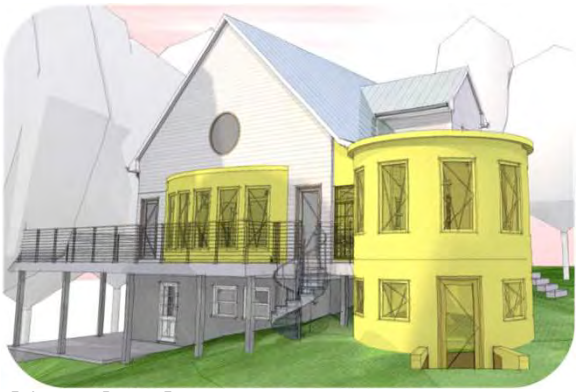
1 first floor plan: existing
scale:1/4" = 1'-0"

SCHEMATIC DESIGN ITERATIONS

Schematic Design A

Schematic Design B

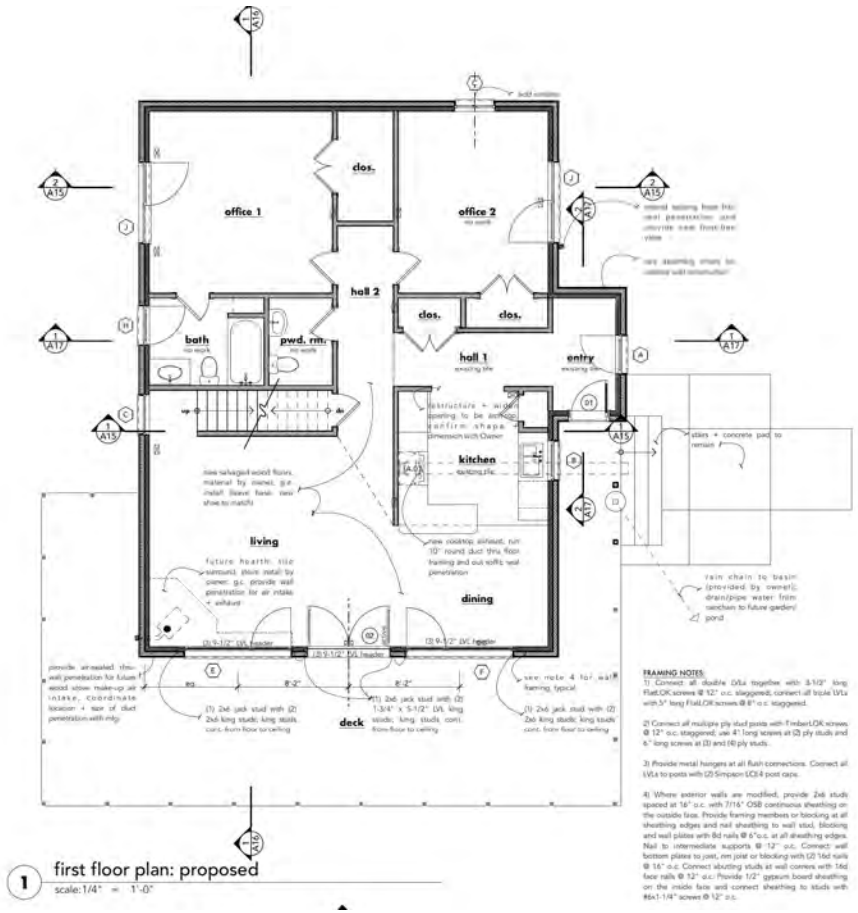




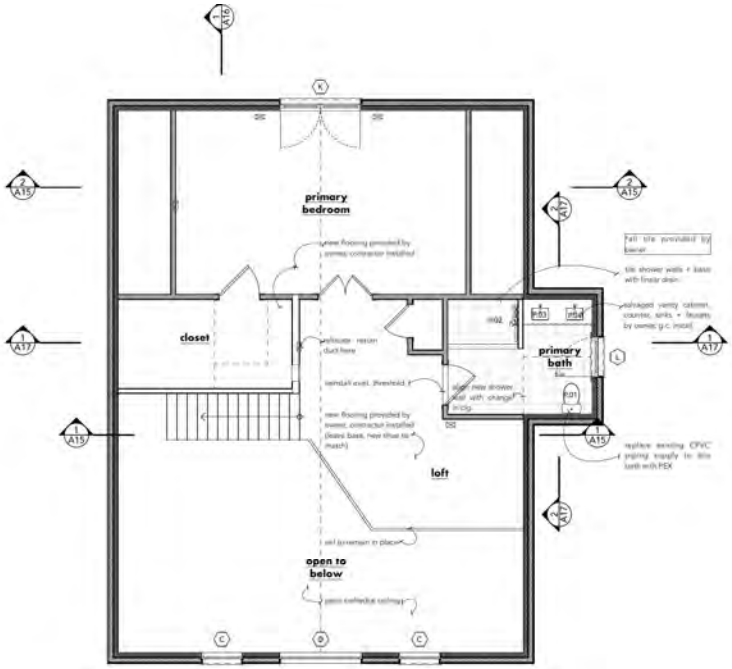
Schematic Design C

CASE STUDY

floor plan new



1 first floor plan: proposed
scale: 1/4" = 1'-0"



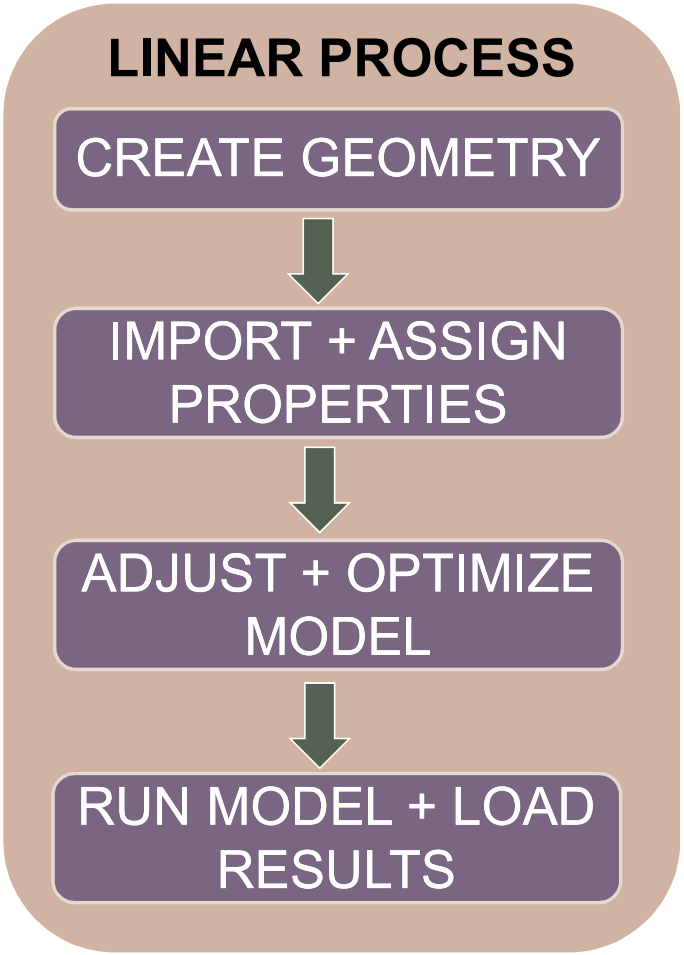
1 second floor plan: proposed
scale: 1/4" = 1'-0"

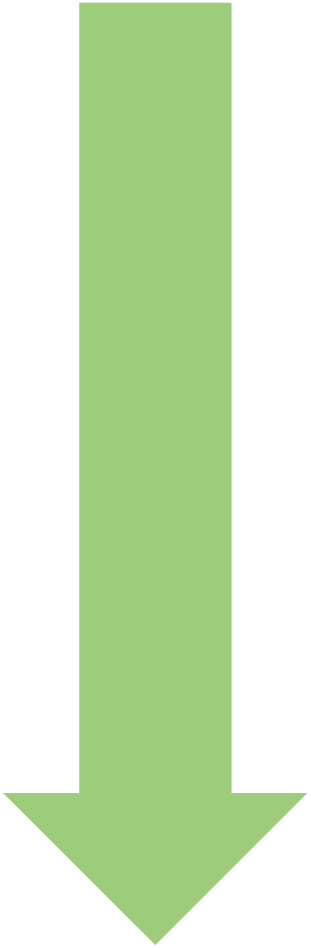
BEYOND THE DATA

MODELING AS A DIALOGUE

How energy modeling became a human-centered iterative process.

TYPICAL MODELING WORKFLOW VS THIS PROJECT





CASE

TYPICAL MODELING WORKFLOW VS THIS PROJECT

LINEAR PROCESS

CREATE GEOMETRY

↓

IMPORT + ASSIGN PROPERTIES

↓

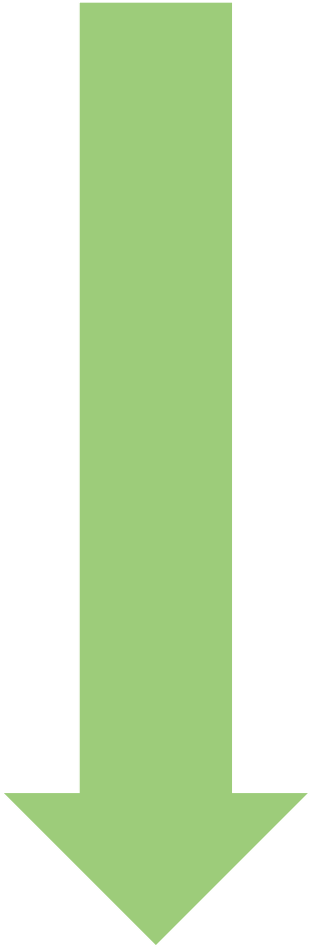
ADJUST + OPTIMIZE MODEL

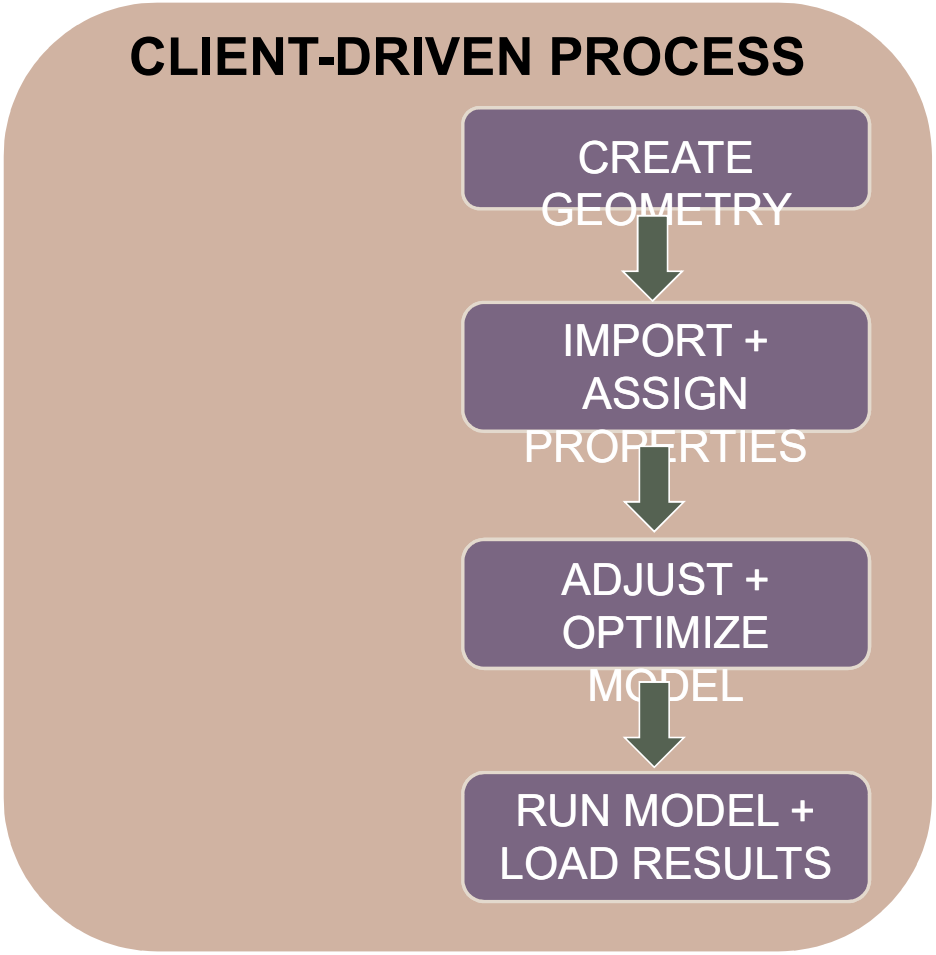
↓

RUN MODEL + LOAD RESULTS

CASE

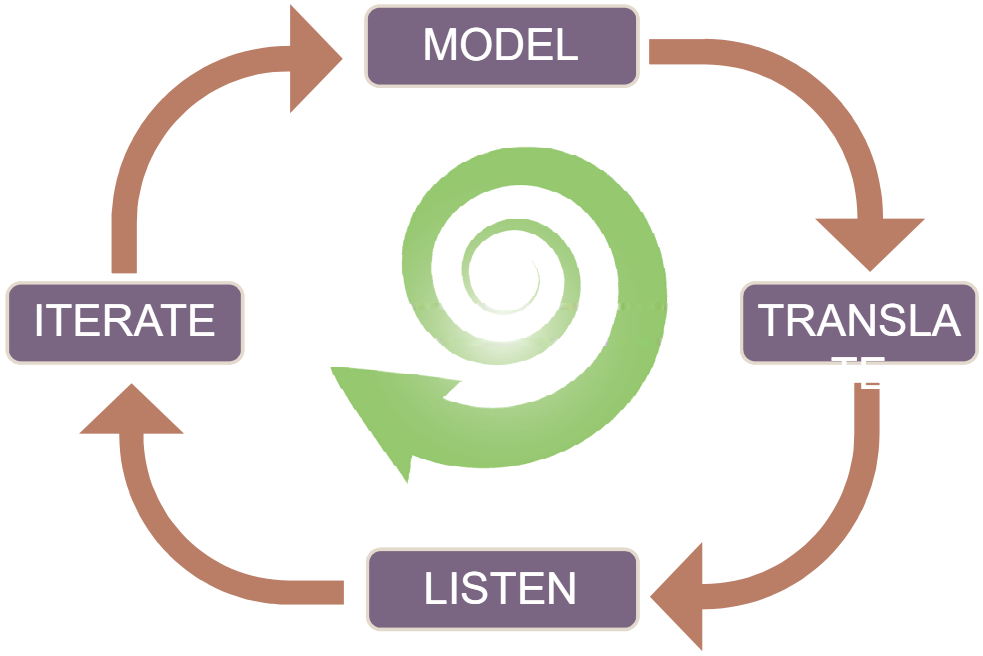
TYPICAL MODELING WORKFLOW VS **THIS PROJECT**

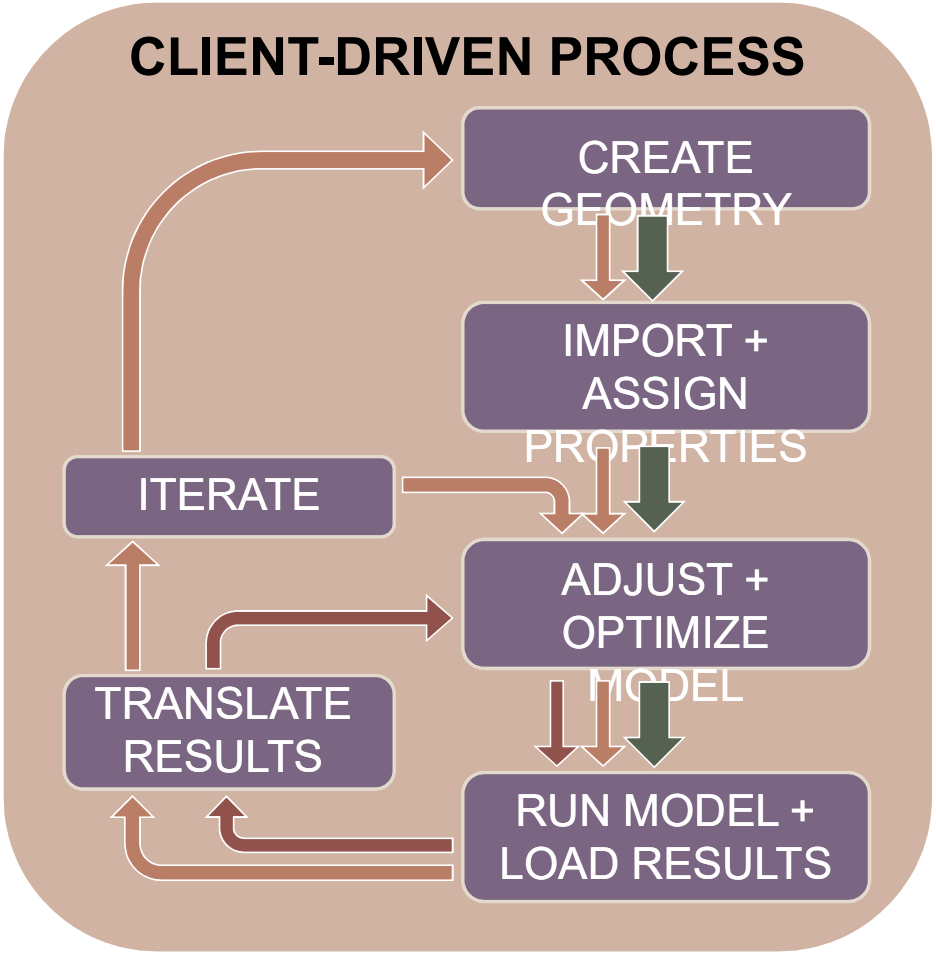




CASE

TYPICAL MODELING WORKFLOW VS **THIS PROJECT**

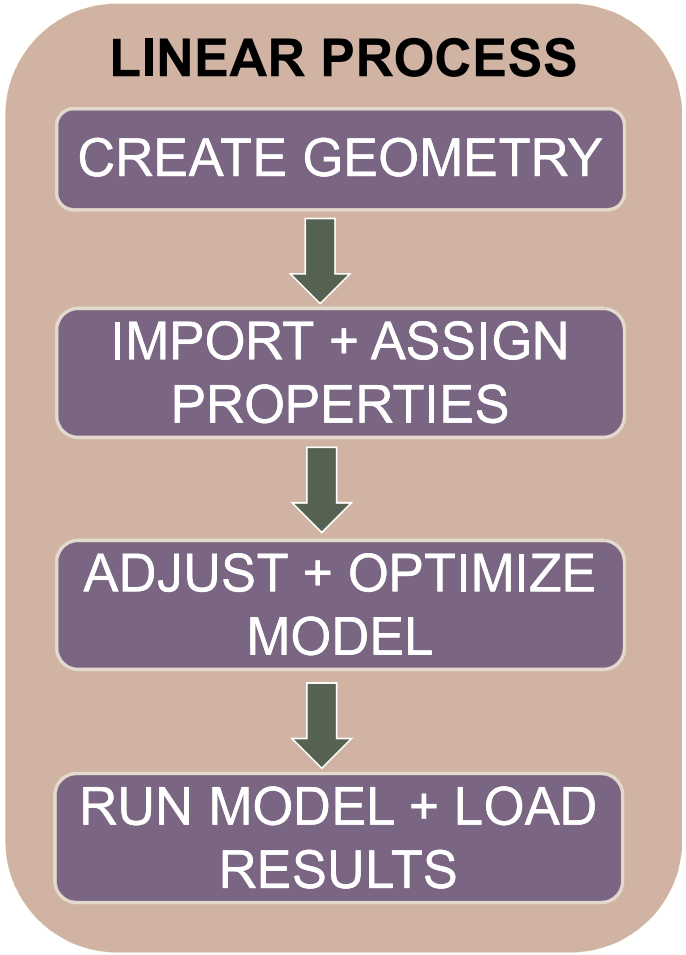


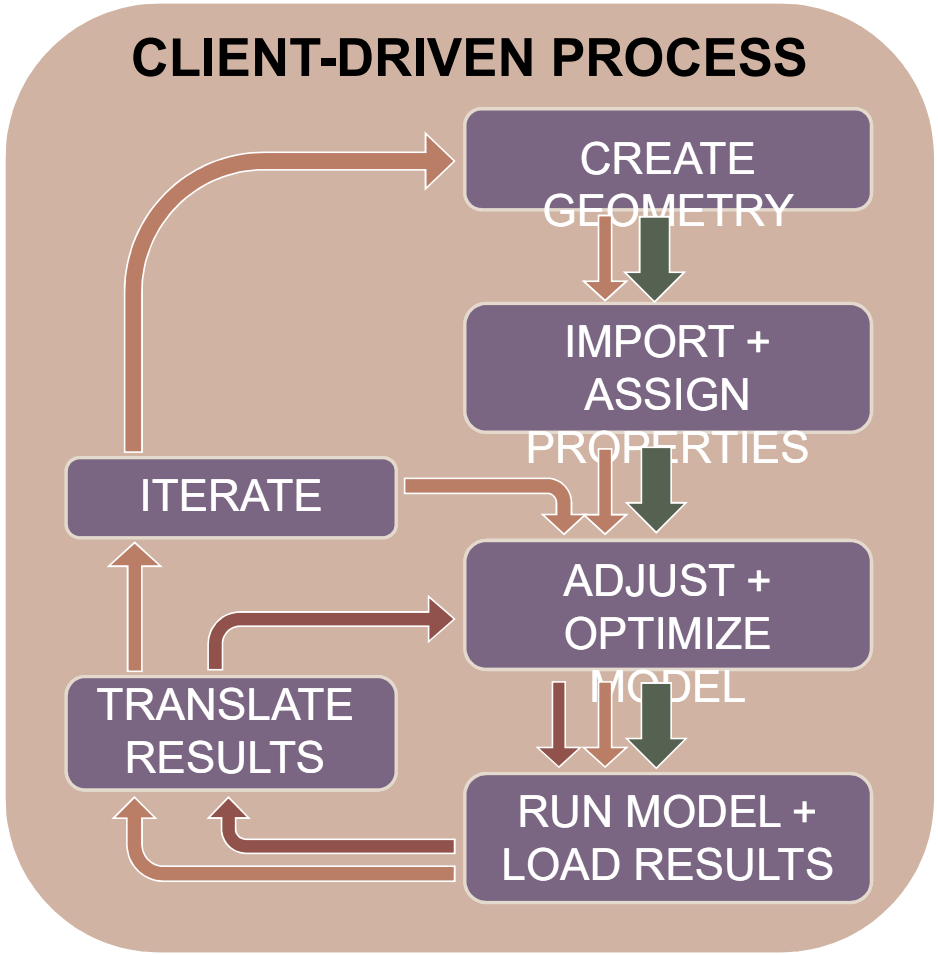


CASE

CASE STUDY

WHY DOES THIS MATTER?

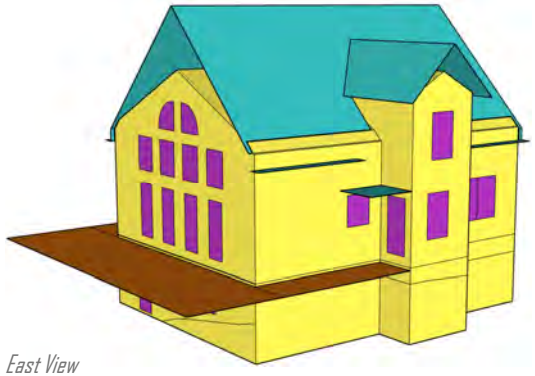




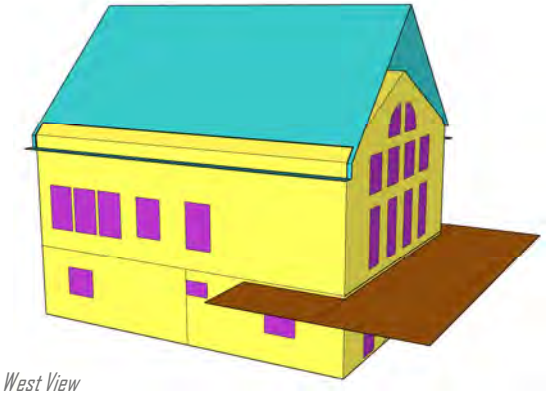
ENERGY MODELING: *Linear Process at FIRST*

Existing Conditions

CREATE GEOMETRY

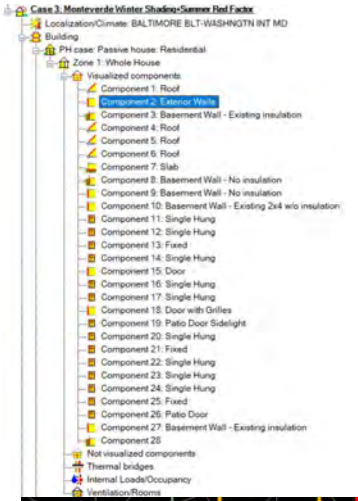


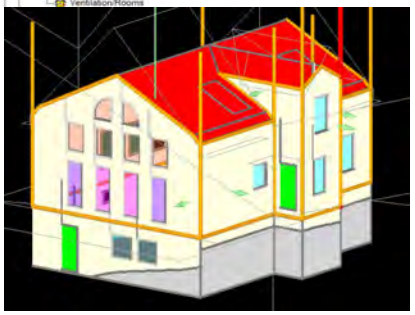
East View



West View

IMPORT + ASSIGN PROPERTIES + ADJUST





Slab ***(R-0.42)*:**
- 4" Concrete

Basement Walls (R-0.84):
- 8" Concrete

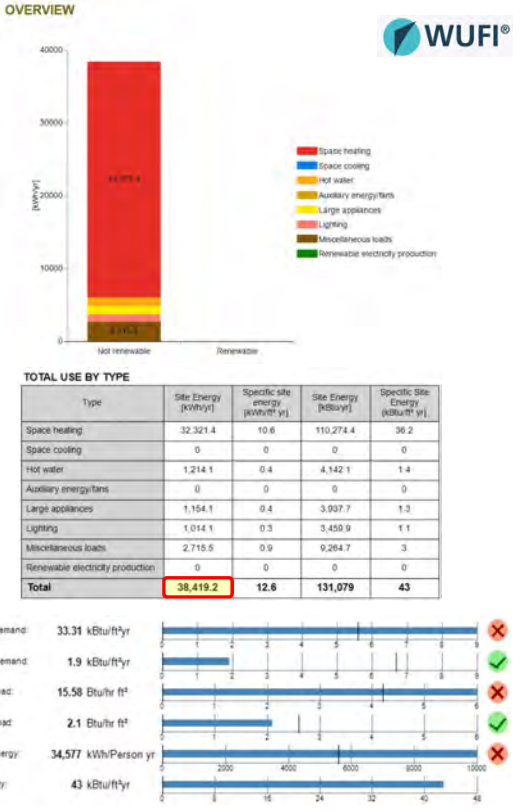
Above Grade Walls (R-11):
- Siding
- ½" OSB Sheathing
- 2x4 Wood Frame with Fiberglass
- 5/8" Gypsum Board

Attic (R-31):
- 6" Fiberglass
- ½" OSB Sheathing
- 2x4 Wood Frame with Fiberglass
- 5/8" Gypsum Board

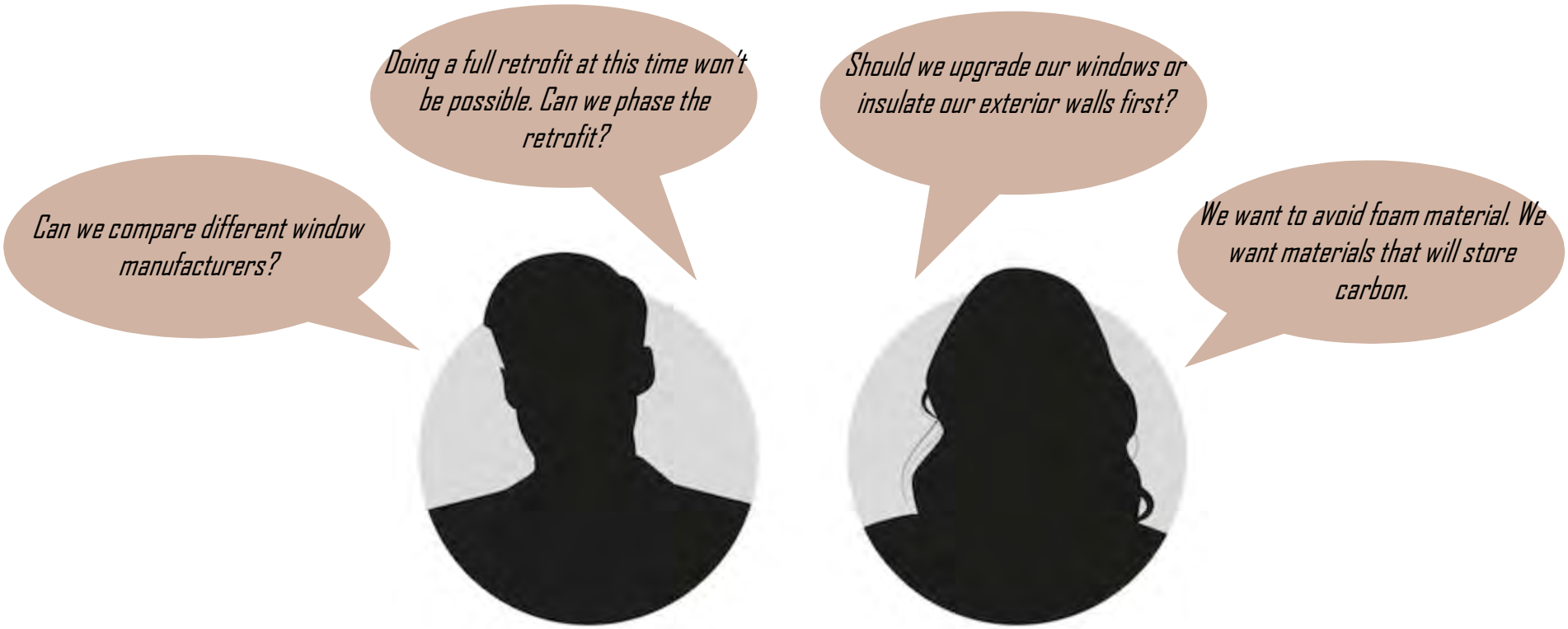
Windows (Uw-0.31):
- Andersen Windows

Airtightness:
- 0.31 cfm/sqft at 50 Pa

RUN + LOAD RESULTS



THE QUESTIONS THAT DROVE ITERATION



These weren't just technical questions. They were reflections of **personal values**, **financial constraints**, and a **desire for truly regenerative design.**

ITERATION PATHS – MODELING AS DECISION SUPPORT

CASE STUDY

CREATE GEOMETRY → IMPORT + ASSIGN → ADJUST → RUN + LOAD RESULTS → UNDERSTAND RESULTS + COMMUNICATE WITH CLIENT

QUESTION #1: *CAN WE COMPARE DIFFERENT WINDOW MANUFACTURERS?*

ANDERSEN WINDOWS & DOORS

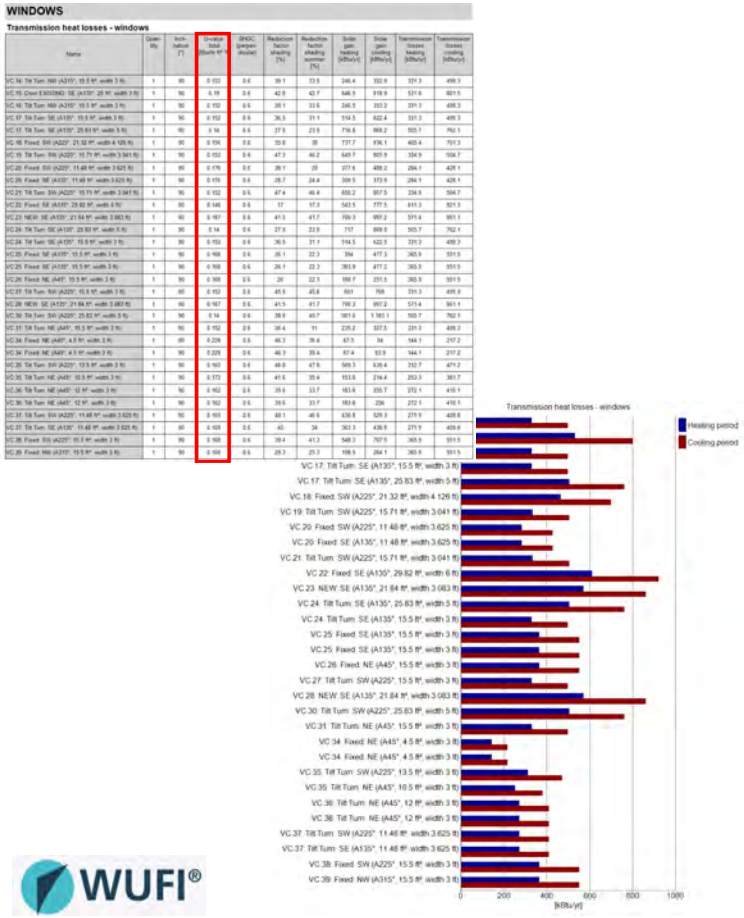
MARVIN

Loewen

IKON WINDOWS + DOORS

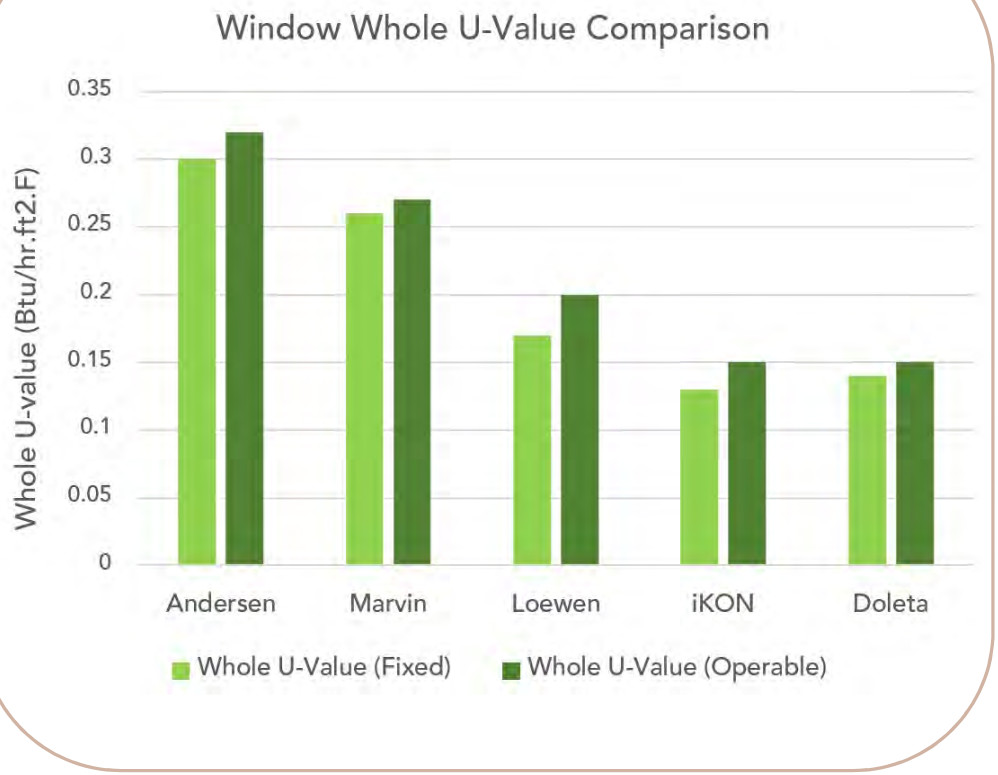
DOLETA

TRANSLATING THE DATA

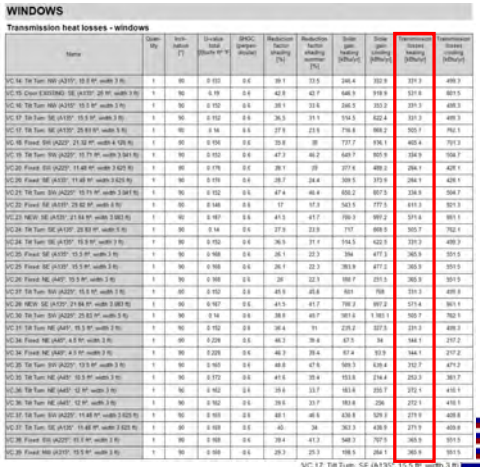


WUFI®

Pgs. 12-13 of PHIUS Verification Report for Doleta Model



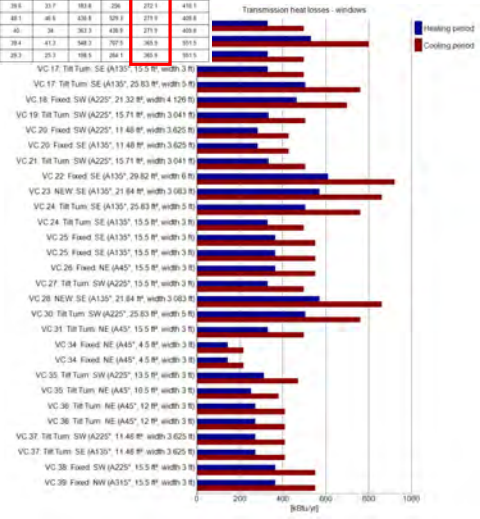
TRANSLATING THE DATA

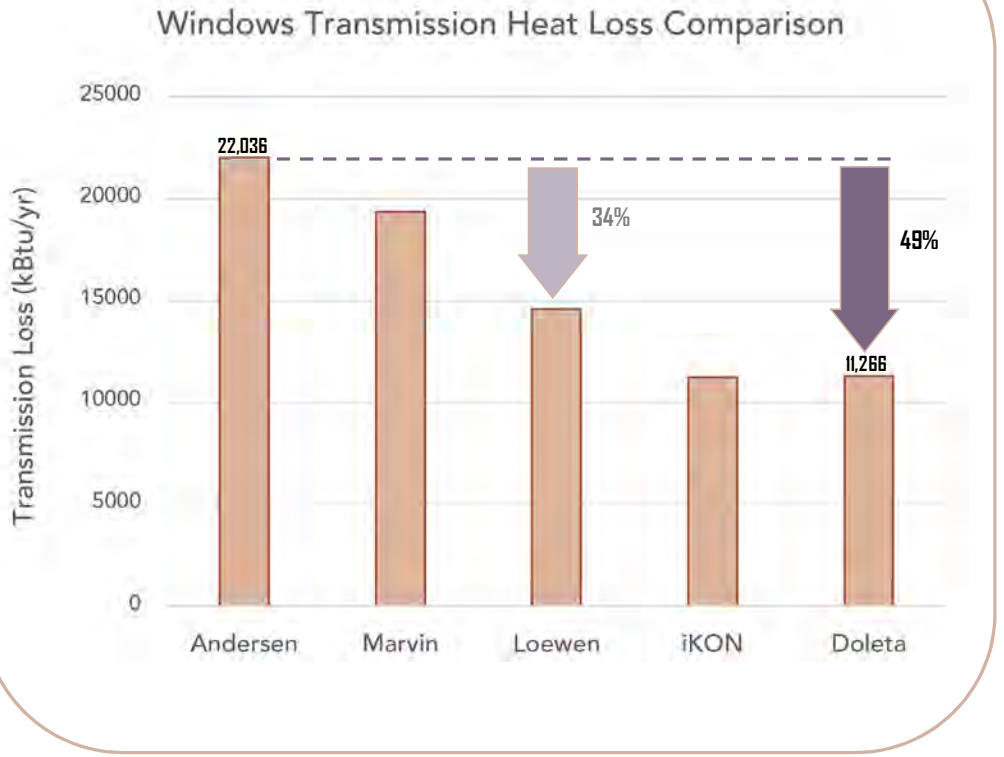


WINDOWS

Transmission heat losses - windows

Name	Quantity	Inclination [°]	U-value total [Btu/h·ft²·°F]	SHGC (perpendicular)	Reduction factor shading [%]	Reduction factor shading summer [%]	Solar gain heating [kBtu/yr]	Solar gain cooling [kBtu/yr]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC 14: Tilt Turn: NW (A315°, 15.5 ft², width 3 ft)	1	90	0.153	0.6	39.1	33.5	246.4	332.9	331.3	499.3
VC 15: Door EXISTING: SE (A135°, 20 ft², width 3 ft)	1	90	0.19	0.6	42.8	42.7	648.3	918.9	531.6	801.5
VC 16: Tilt Turn: NW (A315°, 15.5 ft², width 3 ft)	1	90	0.153	0.6	39.1	33.6	246.5	332.9	331.3	499.3
VC 17: Tilt Turn: SE (A135°, 15.5 ft², width 3 ft)	1	90	0.153	0.6	36.3	31.1	514.5	622.4	331.3	499.3
VC 17: Tilt Turn: SE (A135°, 25.83 ft², width 5 ft)	1	90	0.14	0.6	27.5	23.5	716.8	868.2	505.7	762.1
VC 18: Fixed: SW (A225°, 21.32 ft², width 4.126 ft)	1	90	0.154	0.6	33.8	30	737.7	936.1	465.4	701.3
VC 19: Tilt Turn: SW (A225°, 15.71 ft², width 3.041 ft)	1	90	0.153	0.6	47.3	46.2	649.7	905.9	334.9	504.7
VC 20: Fixed: SW (A225°, 11.48 ft², width 3.625 ft)	1	90	0.179	0.6	39.1	39	377.6	489.2	284.1	428.1
VC 20: Fixed: SE (A135°, 11.48 ft², width 3.625 ft)	1	90	0.179	0.6	28.7	24.4	309.5	373.9	284.1	428.1
VC 21: Tilt Turn: SW (A225°, 15.71 ft², width 3.041 ft)	1	90	0.153	0.6	47.4	46.4	650.2	907.5	336.9	504.7
VC 22: Fixed: SE (A135°, 29.82 ft², width 6 ft)	1	90	0.146	0.6	17	17.3	543.5	777.5	491.2	801.5
VC 23: NEW: SE (A135°, 21.64 ft², width 3.083 ft)	1	90	0.167	0.6	41.3	41.7	790.3	997.2	571.6	861.1
VC 24: Tilt Turn: SE (A135°, 25.83 ft², width 5 ft)	1	90	0.14	0.6	27.5	23.8	717	868.5	505.7	762.1
VC 24: Tilt Turn: SE (A135°, 15.5 ft², width 3 ft)	1	90	0.153	0.6	36.5	31.1	514.5	622.5	331.3	499.3
VC 25: Fixed: SE (A135°, 15.5 ft², width 3 ft)	1	90	0.168	0.6	26.1	22.3	394	477.3	365.5	551.5
VC 25: Fixed: SE (A135°, 15.5 ft², width 3 ft)	1	90	0.168	0.6	26.1	22.3	393.9	477.2	365.5	551.5
VC 26: Fixed: NE (A45°, 15.5 ft², width 3 ft)	1	90	0.168	0.6	28	22.3	558.7	651.5	365.5	551.5
VC 27: Tilt Turn: SW (A225°, 15.5 ft², width 3 ft)	1	90	0.153	0.6	45.9	45.6	601	768	331.3	499.3
VC 28: NEW: SE (A135°, 21.64 ft², width 3.083 ft)	1	90	0.167	0.6	41.5	41.7	790.3	997.2	571.6	861.1
VC 30: Tilt Turn: SW (A225°, 25.83 ft², width 5 ft)	1	90	0.14	0.6	38.8	40.7	1 161.1	1 161.1	505.7	762.1
VC 31: Tilt Turn: NE (A45°, 15.5 ft², width 3 ft)	1	90	0.153	0.6	36.4	31	225.2	327.5	331.3	499.3
VC 34: Fixed: NE (A45°, 4.5 ft², width 3 ft)	1	90	0.229	0.6	46.3	39.4	67.5	94	144.1	217.2
VC 34: Fixed: NE (A45°, 4.5 ft², width 3 ft)	1	90	0.229	0.6	46.3	39.4	67.4	93.9	144.1	217.2
VC 35: Tilt Turn: SW (A225°, 13.5 ft², width 3 ft)	1	90	0.163	0.6	48.8	47.6	509.3	639.4	312.7	471.2
VC 35: Tilt Turn: NE (A45°, 10.5 ft², width 3 ft)	1	90	0.172	0.6	41.6	35.4	153.8	214.4	253.3	381.7
VC 36: Tilt Turn: NE (A45°, 12 ft², width 3 ft)	1	90	0.162	0.6	39.6	33.7	183.8	255.7	272.1	410.1
VC 36: Tilt Turn: NE (A45°, 12 ft², width 3 ft)	1	90	0.162	0.6	39.6	33.7	183.8	256	272.1	410.1
VC 37: Tilt Turn: SW (A225°, 11.48 ft², width 3.625 ft)	1	90	0.169	0.6	48.1	46.6	436.8	529.3	279.5	409.8
VC 37: Tilt Turn: SE (A135°, 11.48 ft², width 3.625 ft)	1	90	0.169	0.6	40	34	362.3	438.9	279.5	409.8
VC 38: Fixed: SW (A225°, 15.5 ft², width 3 ft)	1	90	0.168	0.6	39.4	41.3	548.3	707.5	365.5	551.5
VC 39: Fixed: NW (A315°, 15.5 ft², width 3 ft)	1	90	0.168	0.6	28.3	25.3	198.5	264.1	365.5	551.5





Pgs. 12-13 of PHIUS Vertification Report for Doleta Model

ITERATION PATHS – MODELING AS DECISION SUPPORT

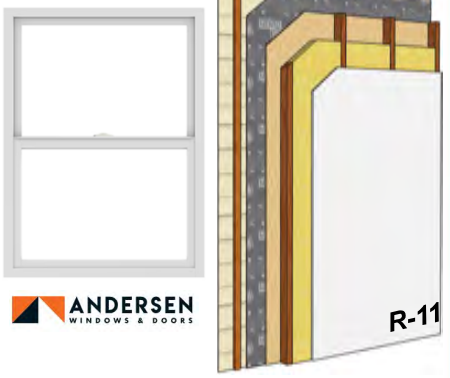
CASE STUDY

CREATE GEOMETRY → IMPORT + ASSIGN → ADJUST → RUN + LOAD RESULTS

UNDERSTAND RESULTS + COMMUNICATE WITH CLIENT

QUESTION #2: *INSULATE EXTERIOR WALLS* ***OR*** *UPGRADE WINDOWS FIRST?*

1



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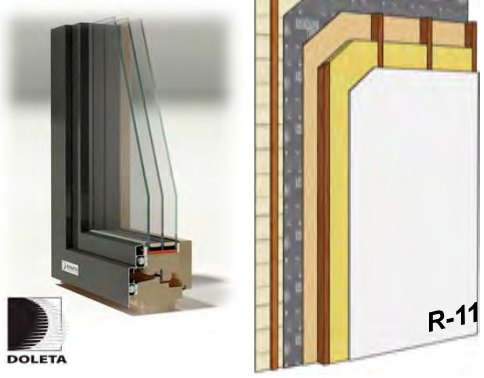

3

4

TRANSLATING THE DATA

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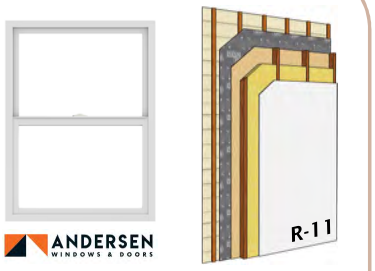
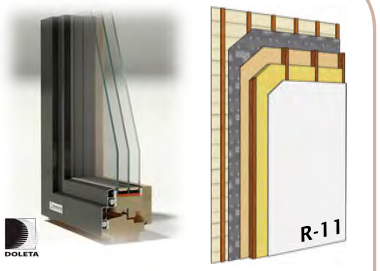


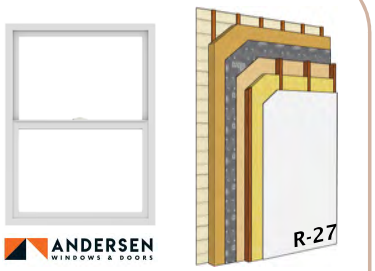
Existing Window + Existing Wall (R-11)

2



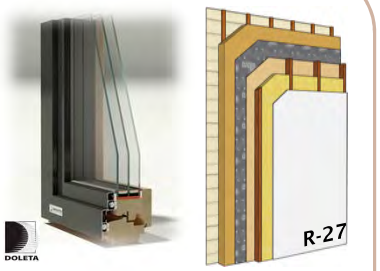
***Upgrade Window** + Existing Wall (R-11)*

3

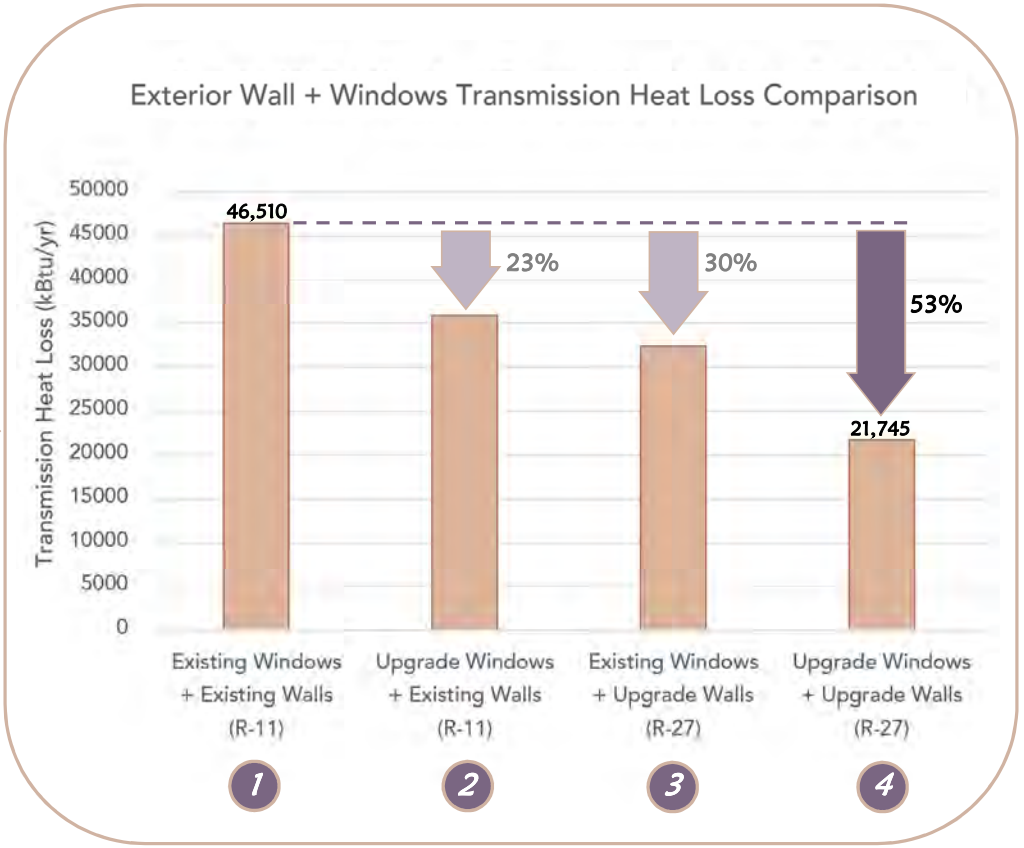


*Existing Window + **Upgrade Wall (R-27)***

4



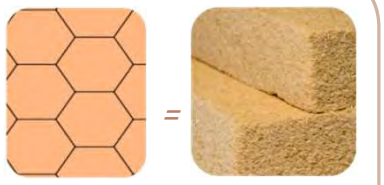
Upgrade Window + Upgrade Wall (R-27)



CASE STUDY

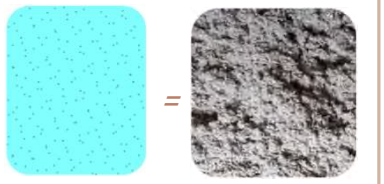
retrofit details

Key

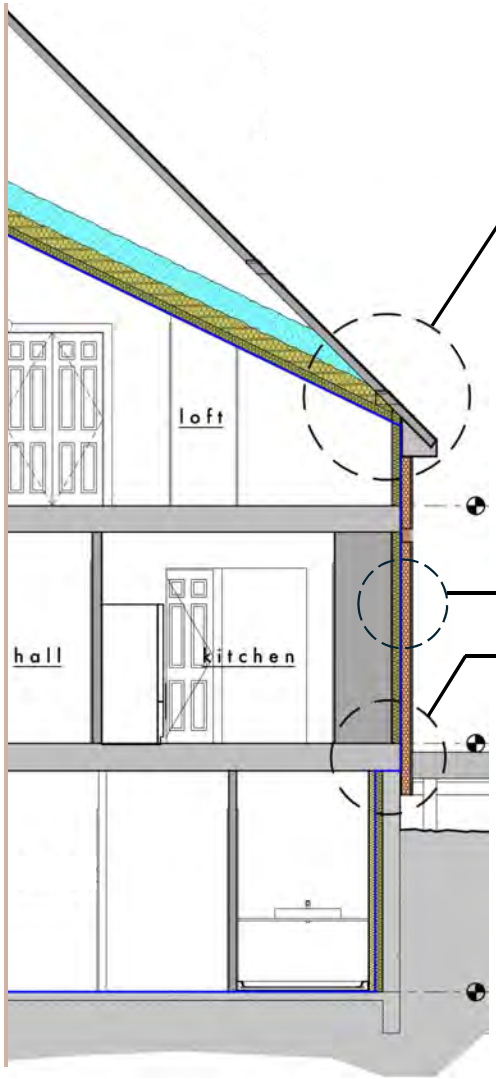


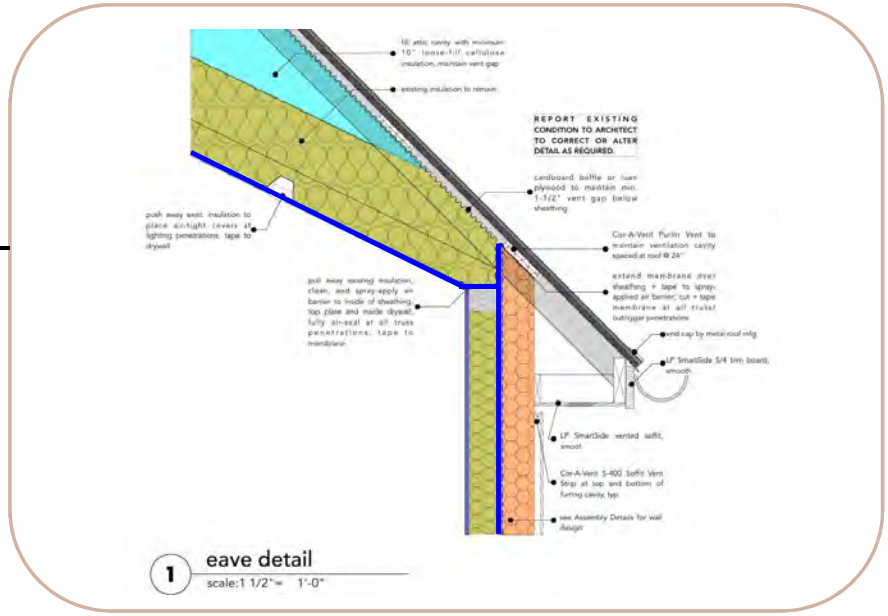
***NEW** 4" Wood fiber board insulation*

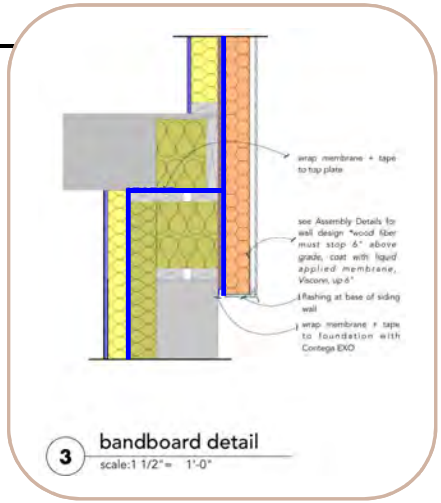
Existing fiberglass batt insulation

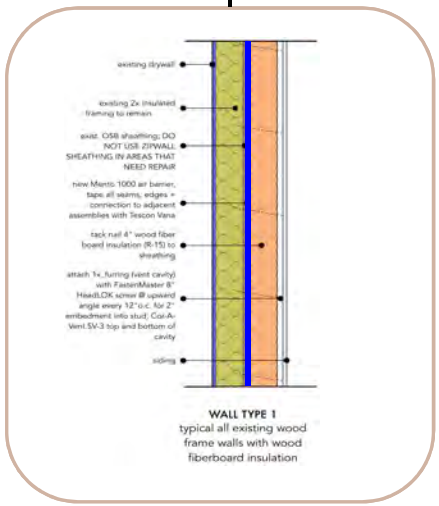


***NEW** 10" Blown in Cellulose*





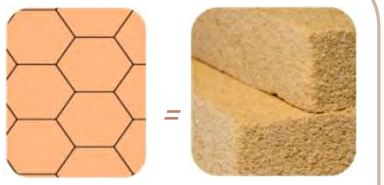




CASE STUDY

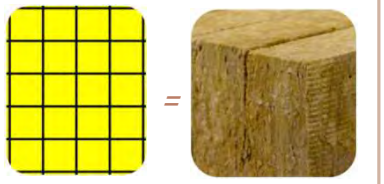
retrofit details

Key

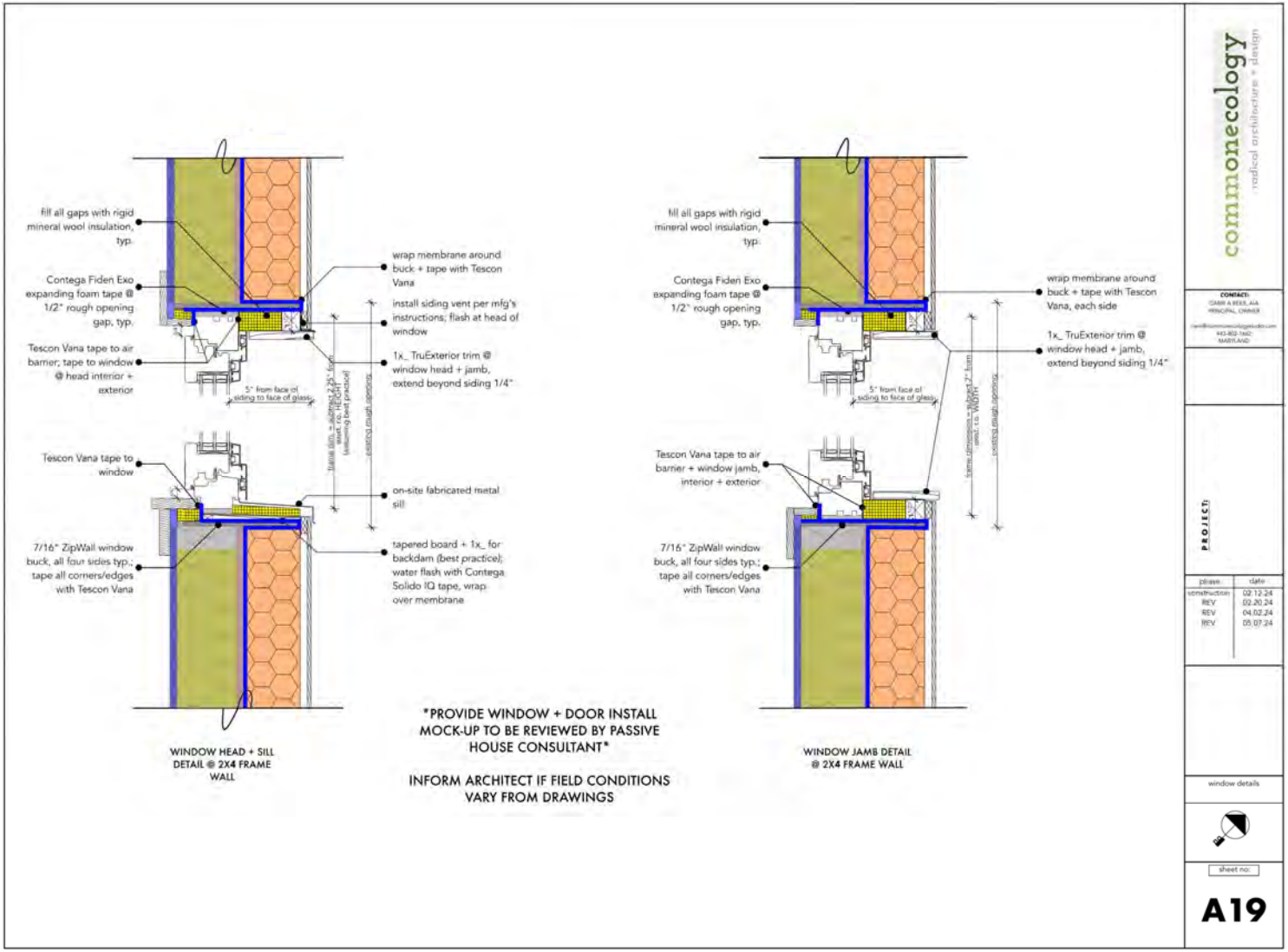


***NEW** 4" Wood fiber board insulation*

Existing fiberglass batt insulation

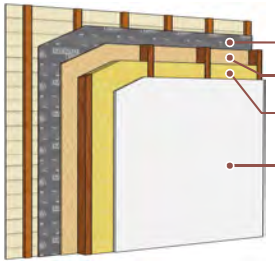


***NEW** Mineral wool insulation*

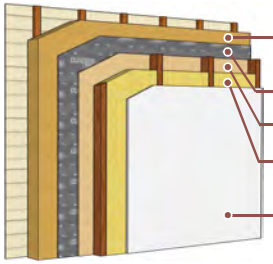


CASE STUDY: THE CARBON IMPACT

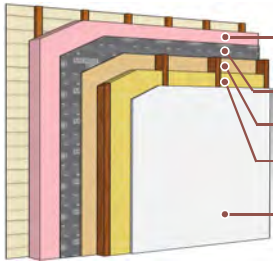
1 Existing Wall (R-11)

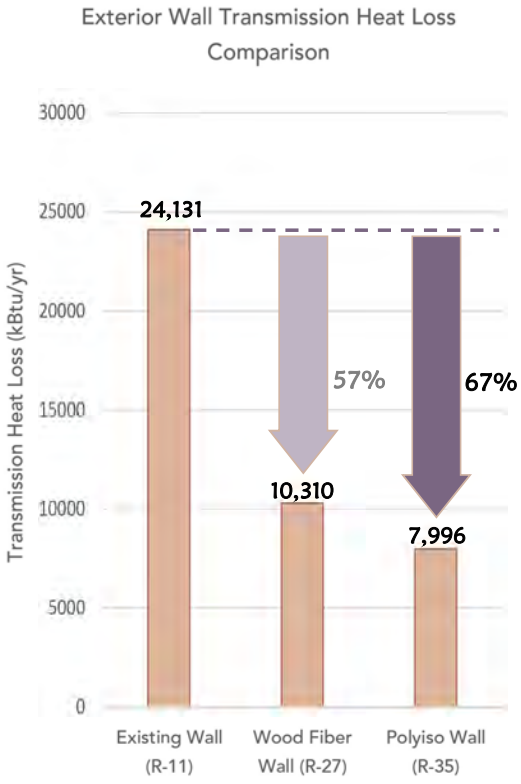


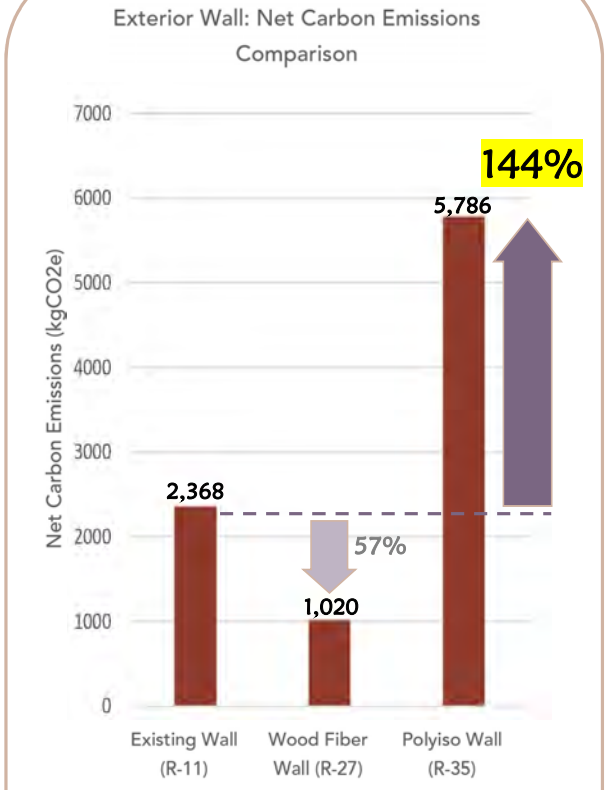
2 Wood Fiber Wall (R-27)



3 Foam Wall (R-35)



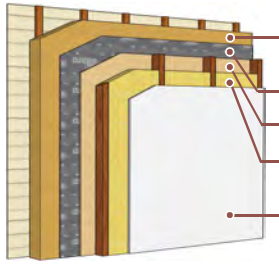




CASE STUDY

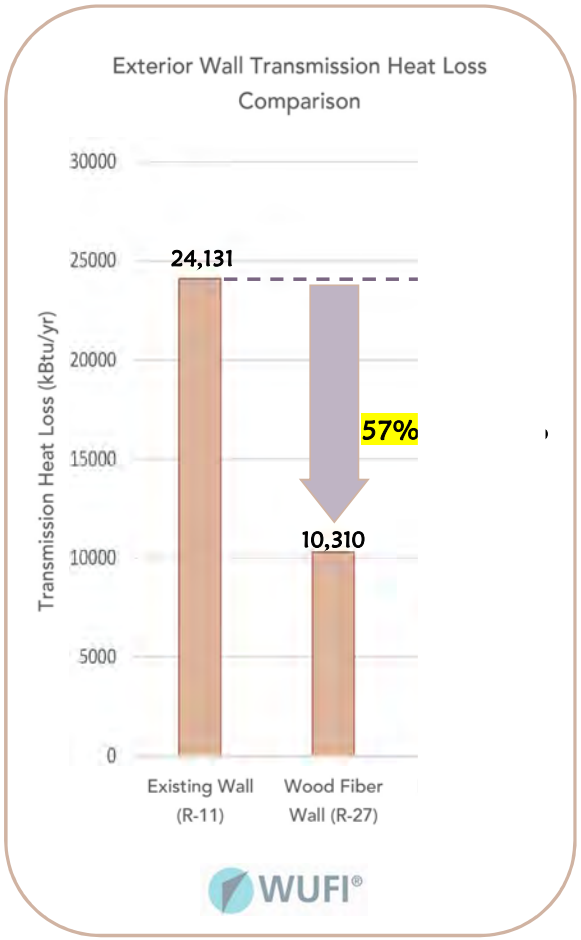
2

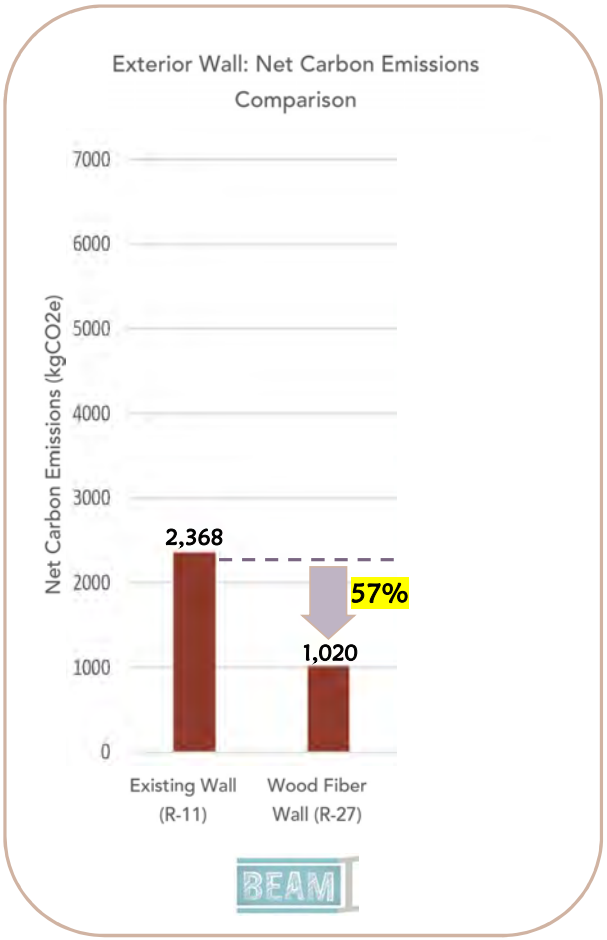
Wood Fiber Wall (R-27)

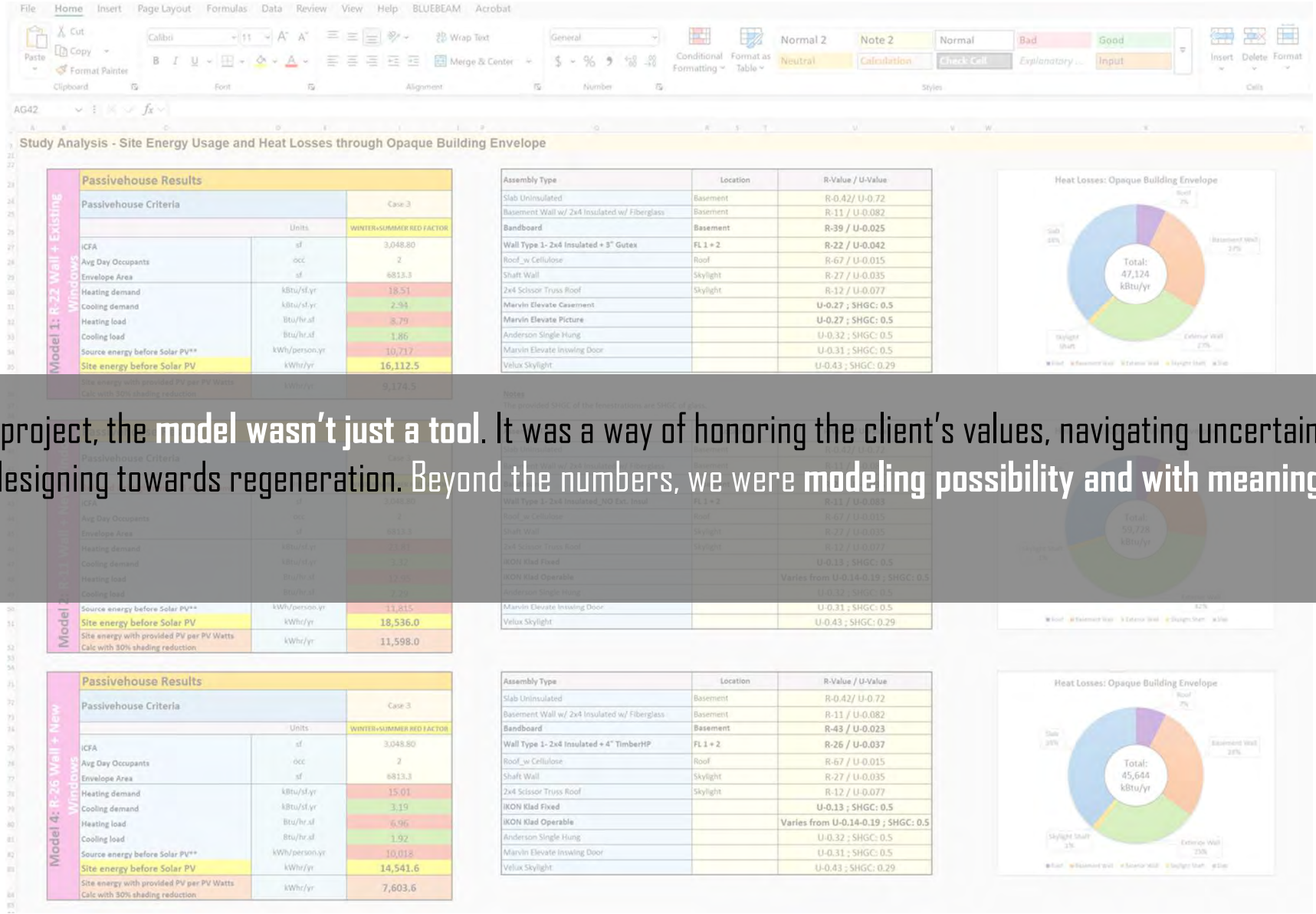


Why the homeowners went with this wall type:

- Were against using foam material.
- Wood fiber is biodegradable at end of life.
- Wanted to sequester carbon.
- Healthier choice for indoor air quality.
- Wood fiber allows the home to breathe and helps reduce moisture buildup in walls.







Study Analysis - Site Energy Usage and Heat Losses through Opaque Building Envelope

Model 1: R-22 Wall + Existing Windows

Passivehouse Results		
Passivehouse Criteria		Case 3
	Units	WINTER+SUMMER RED FACTOR
iCFA	sf	3,048.80
Avg Day Occupants	occ	2
Envelope Area	sf	6813.3
Heating demand	kBtu/sf.yr	18.51
Cooling demand	kBtu/sf.yr	2.94
Heating load	Btu/hr.sf	8.79
Cooling load	Btu/hr.sf	1.86
Source energy before Solar PV**	kWh/person.yr	10,717
Site energy before Solar PV	kWhr/yr	16,112.5
Site energy with provided PV per PV Watts Calc with 30% shading reduction	kWhr/yr	9,174.5

Assembly Type	Location	R-Value / U-Value
Slab Uninsulated	Basement	R-0.42/ U-0.72
Basement Wall w/ 2x4 Insulated w/ Fiberglass	Basement	R-11 / U-0.082
Bandboard	Basement	R-39 / U-0.025
Wall Type 1- 2x4 Insulated + 3" Gutex	FL 1 + 2	R-22 / U-0.042
Roof_w Cellulose	Roof	R-67 / U-0.015
Shaft Wall	Skylight	R-27 / U-0.035
2x4 Scissor Truss Roof	Skylight	R-12 / U-0.077
Marvin Elevate Casement		U-0.27 ; SHGC: 0.5
Marvin Elevate Picture		U-0.27 ; SHGC: 0.5
Anderson Single Hung		U-0.32 ; SHGC: 0.5
Marvin Elevate Inswing Door		U-0.31 ; SHGC: 0.5
Velux Skylight		U-0.43 ; SHGC: 0.29

Model 2: R-22 Wall + New Windows

Passivehouse Results		
Passivehouse Criteria		Case 3
	Units	WINTER+SUMMER RED FACTOR
iCFA	sf	3,048.80
Avg Day Occupants	occ	2
Envelope Area	sf	6813.3
Heating demand	kBtu/sf.yr	17.87
Cooling demand	kBtu/sf.yr	3.32
Heating load	Btu/hr.sf	12.05
Cooling load	Btu/hr.sf	2.29
Source energy before Solar PV**	kWh/person.yr	11,815
Site energy before Solar PV	kWhr/yr	18,536.0
Site energy with provided PV per PV Watts Calc with 30% shading reduction	kWhr/yr	11,598.0

Assembly Type	Location	R-Value / U-Value
Slab Uninsulated	Basement	R-0.42/ U-0.72
Basement Wall w/ 2x4 Insulated w/ Fiberglass	Basement	R-11 / U-0.082
Bandboard	Basement	R-39 / U-0.025
Wall Type 1- 2x4 Insulated_NO Ext. Insul	FL 1 + 2	R-11 / U-0.083
Roof_w Cellulose	Roof	R-67 / U-0.015
Shaft Wall	Skylight	R-27 / U-0.035
2x4 Scissor Truss Roof	Skylight	R-12 / U-0.077
IKON Klad Fixed		U-0.13 ; SHGC: 0.5
IKON Klad Operable		Varies from U-0.14-0.19 ; SHGC: 0.5
Anderson Single Hung		U-0.32 ; SHGC: 0.5
Marvin Elevate Inswing Door		U-0.31 ; SHGC: 0.5
Velux Skylight		U-0.43 ; SHGC: 0.29

Model 4: R-26 Wall + New Windows

Passivehouse Results		
Passivehouse Criteria		Case 3
	Units	WINTER+SUMMER RED FACTOR
iCFA	sf	3,048.80
Avg Day Occupants	occ	2
Envelope Area	sf	6813.3
Heating demand	kBtu/sf.yr	15.01
Cooling demand	kBtu/sf.yr	3.19
Heating load	Btu/hr.sf	6.96
Cooling load	Btu/hr.sf	1.92
Source energy before Solar PV**	kWh/person.yr	10,018
Site energy before Solar PV	kWhr/yr	14,541.6
Site energy with provided PV per PV Watts Calc with 30% shading reduction	kWhr/yr	7,603.6

Assembly Type	Location	R-Value / U-Value
Slab Uninsulated	Basement	R-0.42/ U-0.72
Basement Wall w/ 2x4 Insulated w/ Fiberglass	Basement	R-11 / U-0.082
Bandboard	Basement	R-43 / U-0.023
Wall Type 1- 2x4 Insulated + 4" TimberHP	FL 1 + 2	R-26 / U-0.037
Roof_w Cellulose	Roof	R-67 / U-0.015
Shaft Wall	Skylight	R-27 / U-0.035
2x4 Scissor Truss Roof	Skylight	R-12 / U-0.077
IKON Klad Fixed		U-0.13 ; SHGC: 0.5
IKON Klad Operable		Varies from U-0.14-0.19 ; SHGC: 0.5
Anderson Single Hung		U-0.32 ; SHGC: 0.5
Marvin Elevate Inswing Door		U-0.31 ; SHGC: 0.5
Velux Skylight		U-0.43 ; SHGC: 0.29

In this project, the **model wasn't just a tool**. It was a way of honoring the client's values, navigating uncertainty, and designing towards regeneration. Beyond the numbers, we were **modeling possibility and with meaning.**


CONSTRUCTION!!

HVAC


First Class Mechanical
410-876-2434
AO Smith


MITSUBISHI ELECTRIC
22"

HVAC

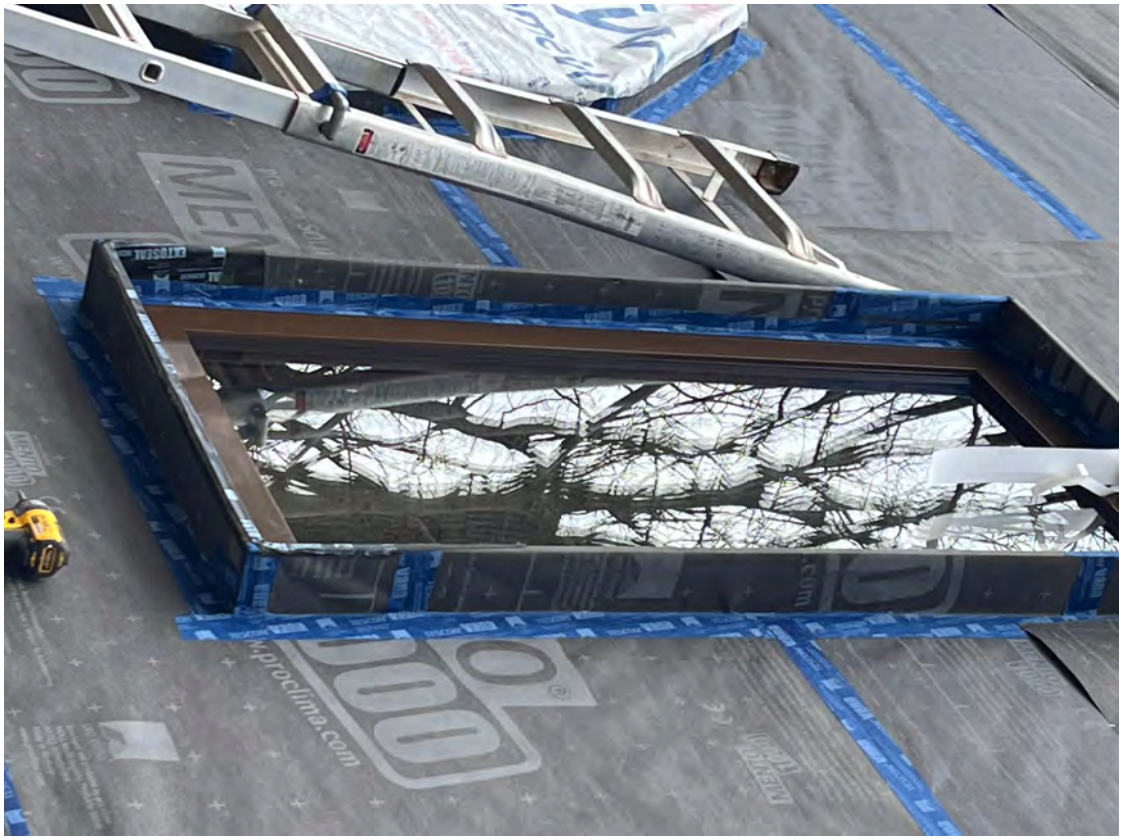
RESILIENCY

AIR-SEALING + INSULATION

AIR-SEALING + INSULATION

WINDOWS + DOORS

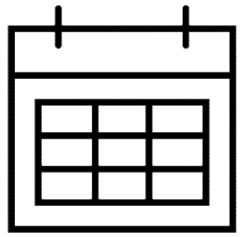
WINDOWS + DOORS



WINDOWS + DOORS

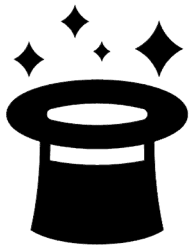
WHAT'S THE MAGIC?

1



schedule flexibility

2



experienced design team

3

motivated contractor

4

dedicated client

RADICAL RETROFIT GUIDE

Response to Make Retrofits Attainable to Everyone

RADICAL RETROFIT GUIDE

Customize Your Guide


name (required)

First Name

Last Name

email (required)

address (street, city, state) (required)

year built (required)

square footage (required)

above grade stories (required)

foundation (required)

Select an option


Tell us about your home.

Each **Radical Regenerative Retrofit Field Guide** is customized to your home, climate zone, and existing conditions. This form has been created to obtain the necessary information so that we can specify appropriate details and make recommendations for your home. Our Field Guide targets Net Zero, with details focused in building science and delivering healthy, high-performing homes without the use of foam or toxic products. Remember! There's more than just energy information - see what all is included.

If there are items on the form you don't know, you may find it helpful to conduct an energy audit first. An energy audit is highly recommended before starting any retrofit work! Check with your local utility for audit incentives.

- Upon submission of this form, we will contact you by email to request any additional info and photographs.
- After receipt of all the necessary documentation we will forward a payment link to begin processing.
- Once payment is received, we will begin customizing your **Radical Regenerative Retrofit Field Guide** with details and recommendations.
- You should receive your Field Guide in 2-3 weeks. For an optional $25 fee, we will mail you a professional printed, soft-cover, color copy of your Field Guide.

Table of Contents

RADICAL RETROFIT GUIDE

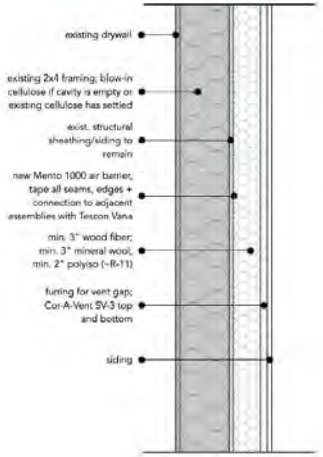
03 Envelope - Assemblies

Per the findings of your energy audit dated 06/24/24, we propose the following for your exterior envelope assemblies to create a more comfortable, high-performing home:

1) First Floor: It would be difficult to remove existing fiberglass insulation in the first floor walls without removing all interior finishes. It is generally not a good idea to spray cavities that have existing batt insulation because the batts crumple and leave air pockets. If these walls were insulated with old cellulose, this tends to settle and makes it easier to spray new cellulose into the cavities from the interior with minimum finish patching (drill and fill); more details on type of existing insulation is needed to determine the best course of action.
2) Second Floor: Same comment as above, however, when siding needs replacement, adding an exterior air-tight membrane (like Mento, not Tyvek) over existing sheathing and adding exterior wood fiber insulation prior to new siding would really boost the performance of the home. You can also "drill and fill" from the exterior if the existing insulation is old cellulose.
3) Basement: Insulate and airseal rim board. Line your basement walls and slab with a drainage mat or high quality vapor barrier. If your basement has a perimeter drain or central drain to a sump or exterior drainage outlet, tape the floor membrane to the wall membrane. If you don't have basement drainage, we suggest you invest in a perimeter drain to remove any water or vapor between the concrete and the barrier. Tape wall membrane to rim board airseal. Insulate floor and walls.
4) Attic: Insulate and airseal top plate. Because you're a/c unit is in the attic, install a baffle at the roof sheathing and add the thickest batt insulation possible, install Intello smart barrier below insulation and tape all seams; tape smart barrier to top plate air seal. An alternative that allows for more impactful performance is to build an insulated, air-sealed hut around your unit and fill the attic floor with minimum of 18" of loose fill cellulose; bury insulated ducts; baffles at eaves are required to hold insulation from sheathing.

03 Envelope - Assemblies

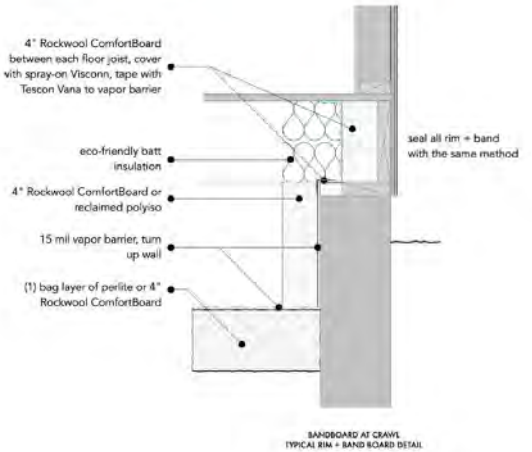
Wood Frame



WALL TYPE 1
typical all existing wood frame walls with exterior insulation

All details based on standard construction; if in-field conditions differ, please contact us

Crawl Space Wall



A Homeowner's Field Guide to Radical Regenerative Retrofits

TAKE-AWAYS

- Payback = Human Connections
- Payback = Regeneration of Communities
- Meet Folks Where They're At
- Call to Action

"shape tomorrow toward abundance"

– adrienne maree brown

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Passive to POSITIVE
PASSIVE HOUSE AND LOW IMPACT DESIGN