Net Zero Emerging Leaders
Internship

Maryam Esmailian

Ph.D. Student in Architecture

MSc in Sustainable Architecture

Maryame@uoregon.edu

Studio.e Architecture

An architecture firm in the Pacific Northwest committed to making beautiful, smart, sustainable buildings designed for living.

Studio.e's 2030 Commitment Goals

Integrate energy modeling into our project workflow

Track Baseline EUI via zero.tool & Predicted EUI via energy modeling

Work towards meeting the 2030 targets on 100% of our projects

AIA 2030 DDx Reporting

19 Reporting 100% of eligible projects from 2022

Project Type

Residential-single family detached

Construction Type

New construction and major renovation

Energy Code

Baseline Code

Residential Energy Consumption Survey (RECS) 2001

Energy Use Intensity (EUI)

An indicator of the energy efficiency of a building's design and/or operations

US NATIONAL AVERAGE pEUI

Sources: 2003 Commercial Building Energy Consumption Survey (CBECS) & 2001 Residential Energy Consumption Survey (RECS). Averages calculated as the arithmetic mean of reported EUI across all survey buildings of the given type.

Use Types	Baseline EUI (kBtu/sf/yr)	Source	Target EUI (kBtu/sf/yr)				
			60% (2010-2014)	70% (2015-2019)	80% (2020-2024)	90% (2025-2029)	100% (2030+)
Residential - Mobile Homes	73.4	2001 RECS Average	44.0	22.0	14.7	7.3	0.0
Residential - Multi-Family, 2 to 4 units	58.2	2001 RECS Average	34.9	17.5	11.6	5.8	0.0
Residential - Multi-Family, 5 or more units	49.5	2001 RECS Average	29.7	14.9	9.9	5.0	0.0
Residential - Single-Family Attached	43.7	2001 RECS Average	26.2	13.1	8.7	4.4	0.0
Residential - Single-Family Detached	43.8	2001 RECS Average	26.3	13.1	8.8	4.4	0.0
Residential - Mid-Rise/High-Rise	78.8	ES	47.3	23.6	15.8	7.9	0.0

AIA 2030
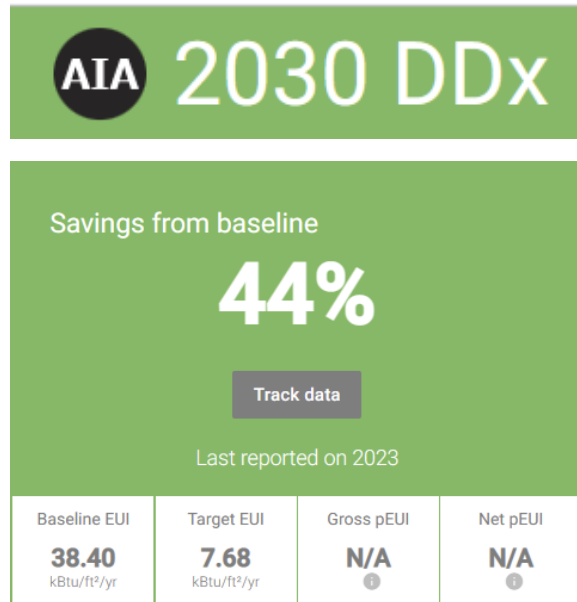
19 Projects

16 projects without energy modeling

3 projects with energy modeling

Energy Modeling Tools

BPS Software	Application Type	3D Modeling Tool	Calculation Engine	Quick Early Stage Parametric Analysis	Daylighting	Glare	Conceptual Energy Analysis	Detailed HVAC	Thermal Comfort	Natural Ventilation CFD
Sefaira	Web-based & Plug-in	SketchUp Revit	EnergyPlus Radiance	✔	✔	-	✔	-	-	-
Insight 360	Plug-in	Revit	DOE-2.2	✔	✔	-	✔	-	-	-
COVE tool	Web-based & Plug-in	SketchUp Rhino Revit	EN ISO 13790 CEN 15603 RayTrace	✔	✔	-	✔	-	-	-
Ladybug Tools	Plug-in & Web-base	Grasshopper Rhino Revit	EnergyPlus Radiance	✔	✔	✔	✔	-	✔	✔
ClimateStudio (DIVA)	Plug-in	Rhino	Radiance EnergyPlus	-	✔	✔	✔	-	-	-
EnergyPlus	Stand-alone	None	EnergyPlus	-	-	-	✔	✔	✔	-
OpenStudio	Plug-in Stand-alone	SketchUp	EnergyPlus Radiance	-	✔	-	✔	✔	-	-
DesignBuilder	Stand-alone	Built-in Revit (gbXML)	EnergyPlus Radiance	-	✔	-	✔	✔	✔	✔
IES VE	Stand-alone	Built-in Revit (gbXML)	Apache Radiance	-	✔	✔	✔	✔	✔	✔

Energy Modeled Projects

Terabithia House
New single-family 2-story house
Conditioned floor area: 1775 sf
Energy code-compliant construction

McKenzie River Haven
New single-family 1-story house
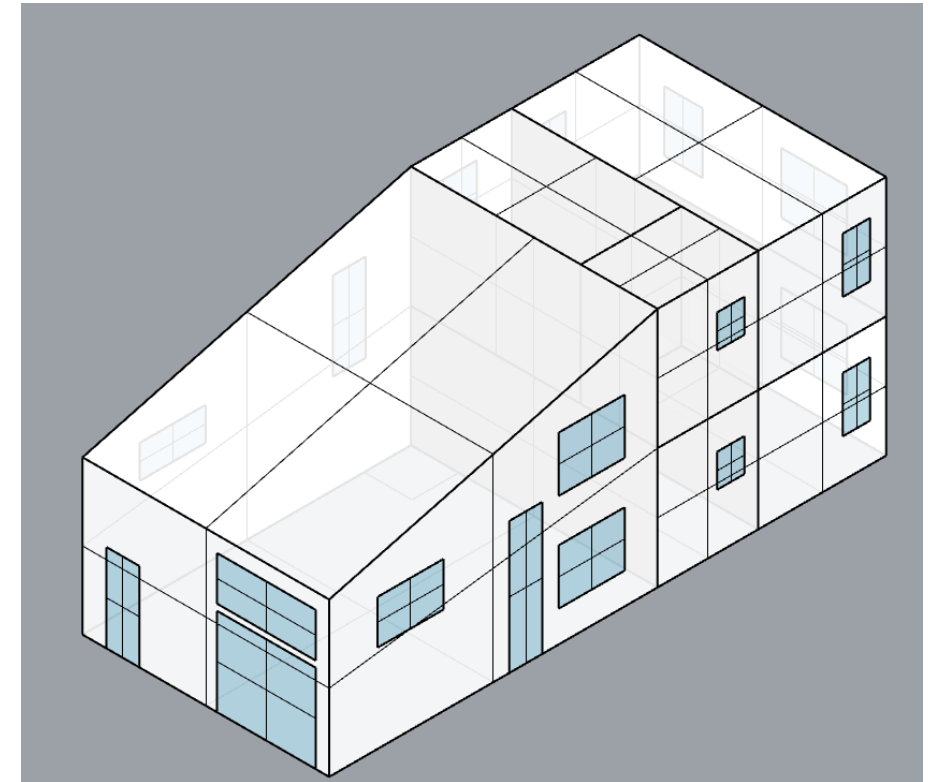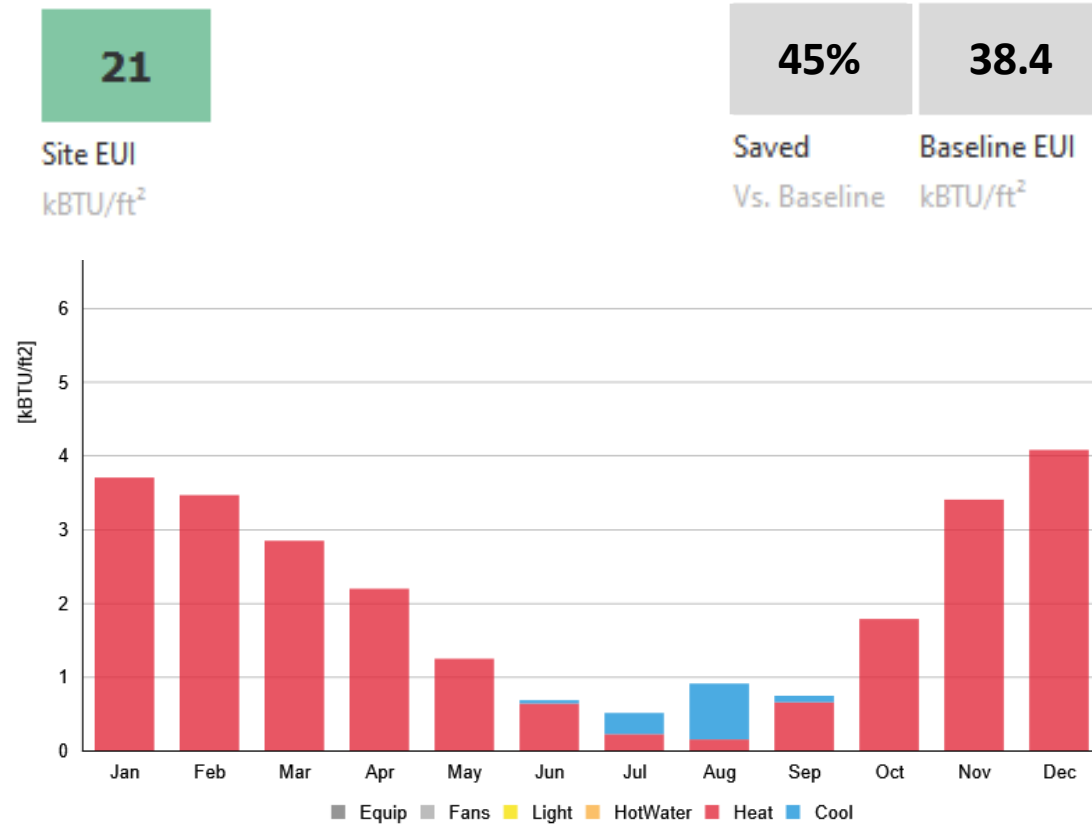Conditioned floor area: 1200 sf
Passive House-inspired construction

Wallace Creek Passive House
New single-family 2-story house
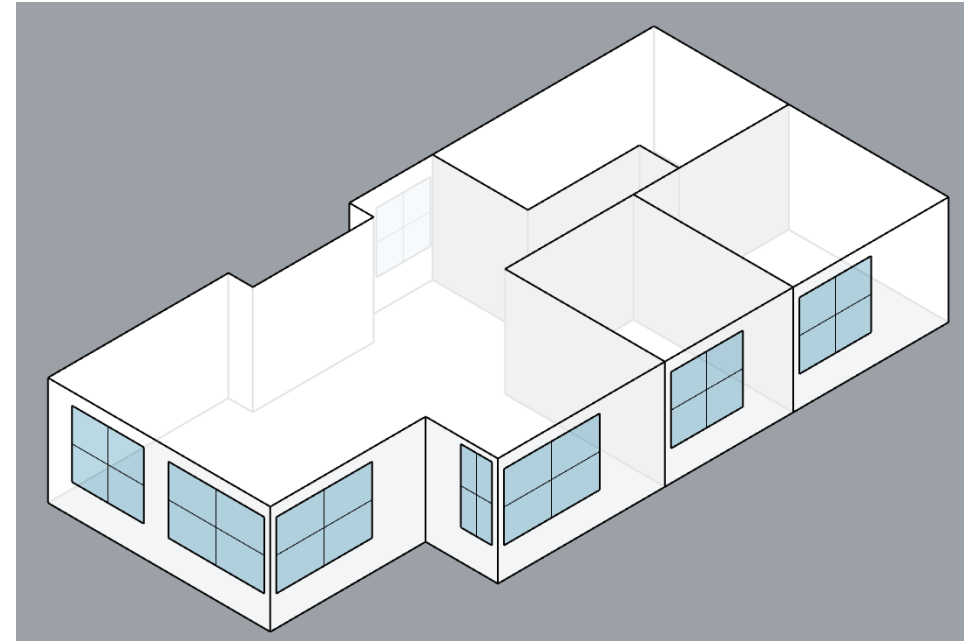Conditioned floor area: 2762 sf
Passive House construction

Energy Modeling

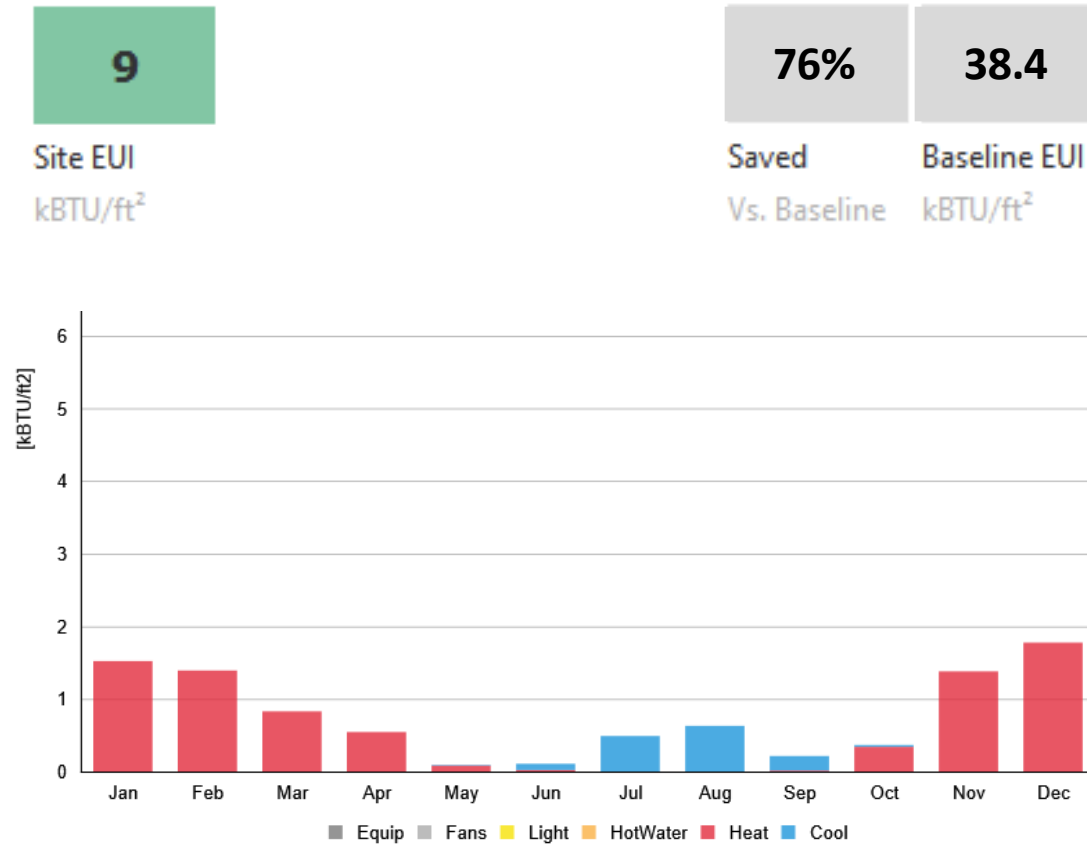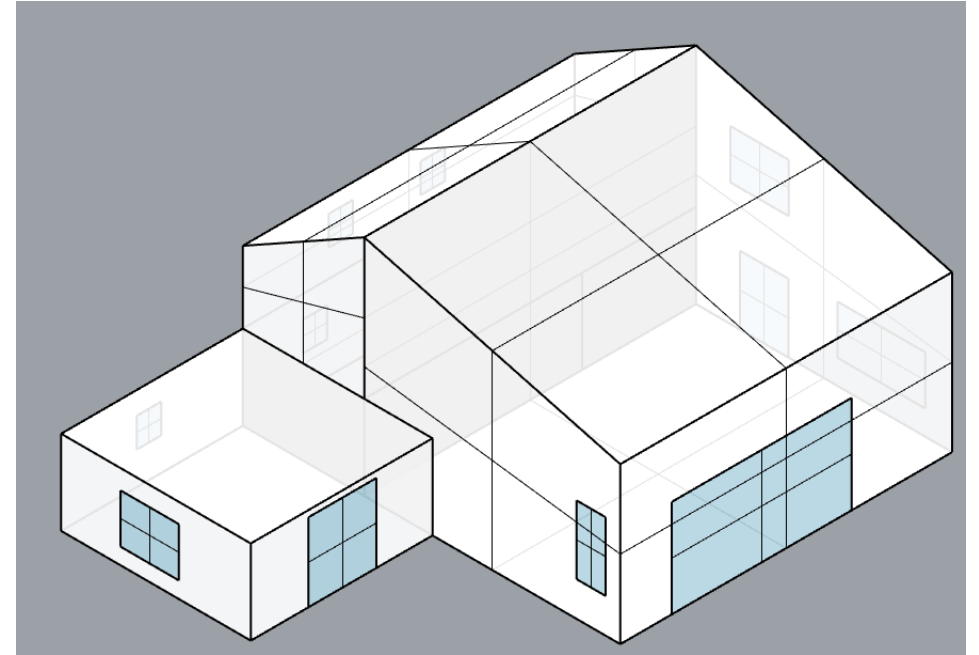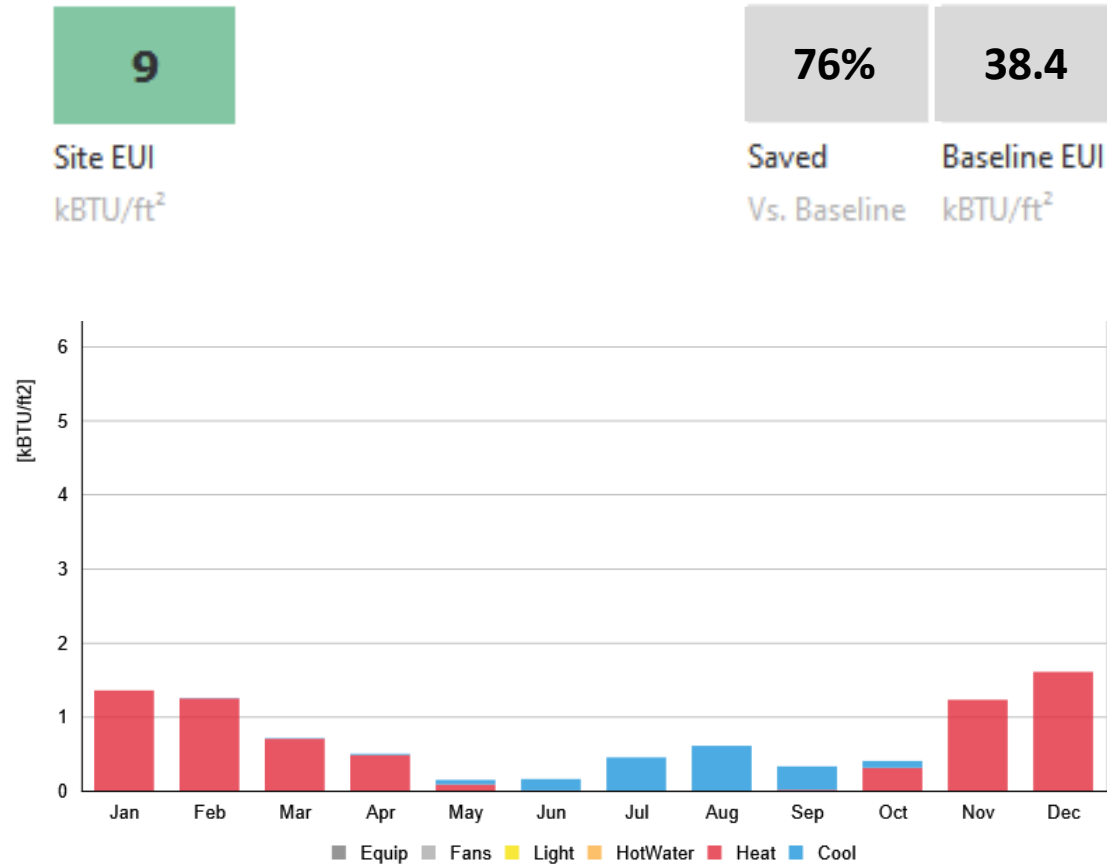Terabithia House

Energy Modeling

9	76%	38.4
Site EUI kBTU/ft²	Saved Vs. Baseline	Baseline EUI kBTU/ft²

Equip Fans Light HotWater Heat Cool

McKenzie River Haven

Energy Modeling

9		76%	38.4
Site EUI		Saved	Baseline EUI
kBTU/ft²		Vs. Baseline	kBTU/ft²

Legend: ■ Equip ■ Fans ■ Light ■ HotWater ■ Heat ■ Cool

Wallace Creek Passive House

Annual PV Panels Production: 12 kBTU/ft2

Energy Modeling Inputs

HVAC System Efficiency (COP)

WWR
Window to Wall Ratio

Infiltration Rate
ORSC 2021
Code minimum = 4 ACH50

	Terabithia House	McKenzie River Haven	Wallace Creek Passive House	
HVAC COP	4.06	3.8	3.3	Heating
	1.08	3.66	3.81	Cooling
WWR	17%	24%	16%	
Infiltration Rate	2	0.9	0.46	

Energy Modeling Results

	EUI kBTU/ft2/yr	Reduction compared to baseline
Terabithia House Energy code-compliant construction	21	45%
McKenzie River Haven Passive House-inspired construction	9	76%
Wallace Creek Passive House Passive House Construction	9	76% 101+% **PV Production**
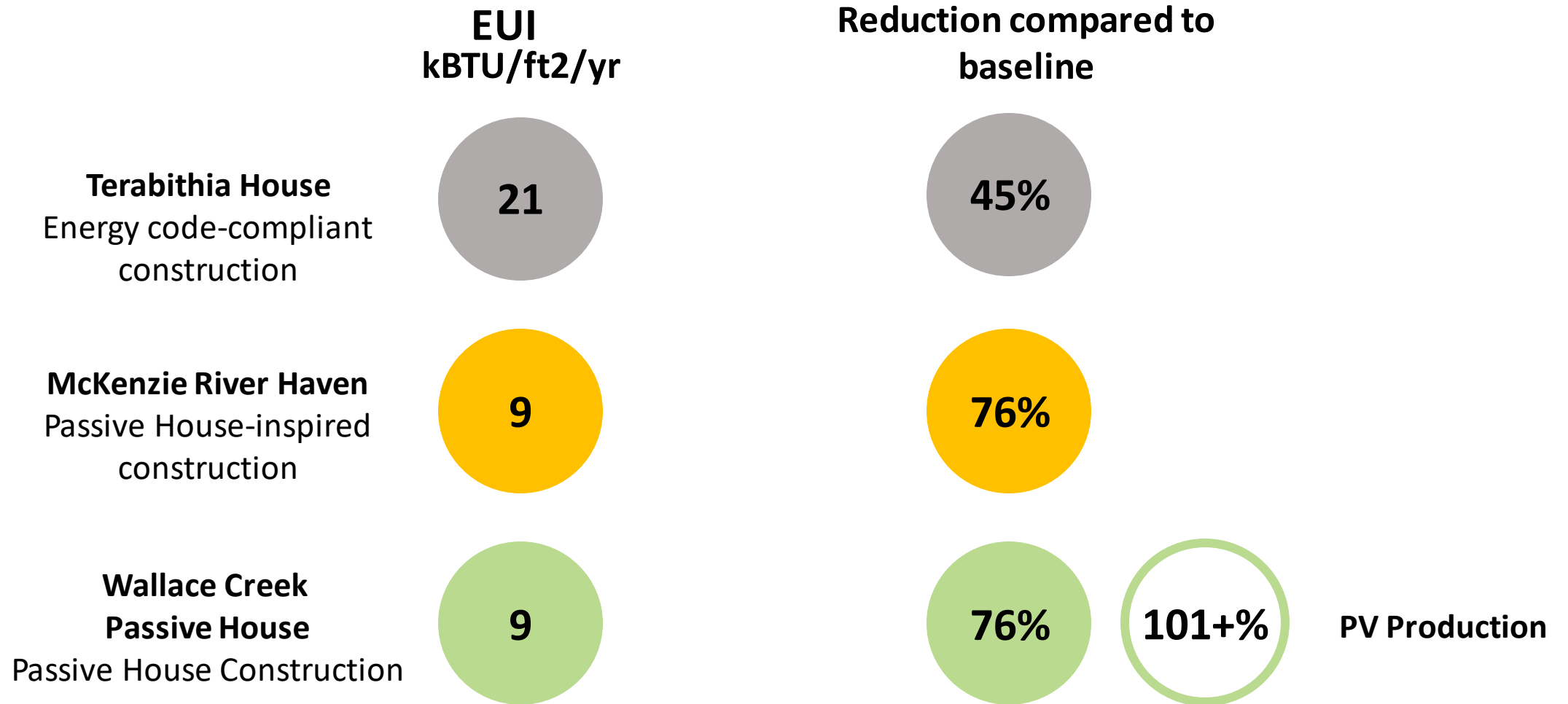
Project Performance
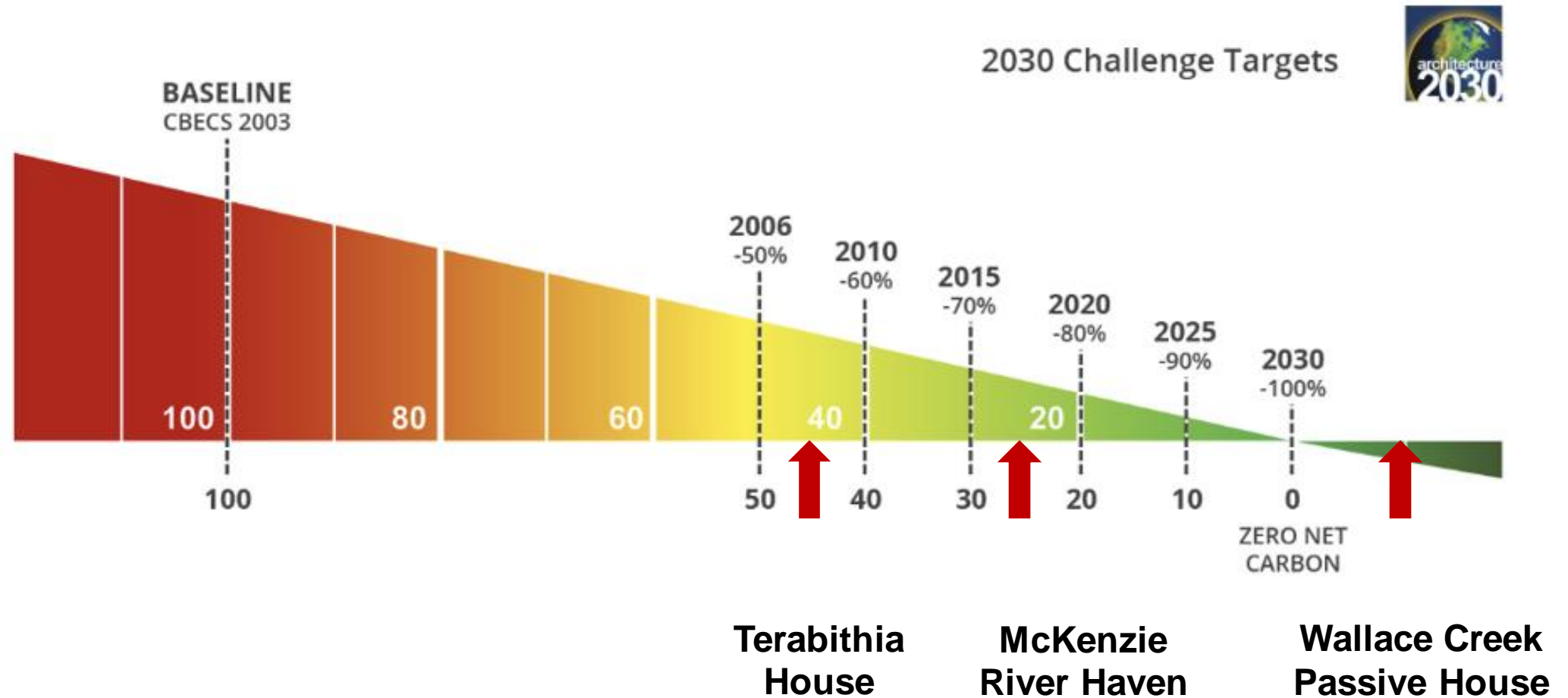
Validating Simulation Results

Terabithia House

ClimateStudio

Actual EUI:

19 kBTU/ft2/yr

Predicted EUI:

21 kBTU/ft2/yr

studio.e architecture

Validating Simulation Results

Wallace Creek Passive House

ClimateStudio

Actual EUI:

8.25 kBTU/ft2/yr

Predicted EUI:

9 kBTU/ft2/yr

Challenges

Energy modeling is necessary in order to accurately report to DDx and reflect for future reductions

Energy model must use simplified schematic model or a new shoebox model must be built from scratch

Extracting correct assemblies and HVAC equipment specs

studio.e architecture

Takeaways

Energy use is mostly impacted by air infiltration/exfiltration, window-to-wall ratio, material U-value, HVAC equipment efficiency (COP/SEER), temperature set points

The Passive House-inspired design and construction is close to the current 2030 targets

Designing and building to Passive House standard is close to the current 2030 targets

On-site renewable energy is critical to meet the current 2030 targets

References

https://climatestudiodocs.com/

https://www.solemma.com/climatestudio

https://codes.iccsafe.org/content/ORRSC2021P1/chapter-3-building-planning

https://www.eia.gov/consumption/residential/data/2001/index.php?view=consumption#undefined

https://transform.aia.org/confluence/pages/viewpage.action?pageId=81756799

Ghobad Ladan et al.: Building Performance Simulation Tools. AIA CA Statewide COTE Roundtable (2021)