

Innovate, Design, Sustain.

University of British Columbia Okanagan | Thompson Rivers University
Solar Decathlon 2024 Design Challenge | Division Presentation





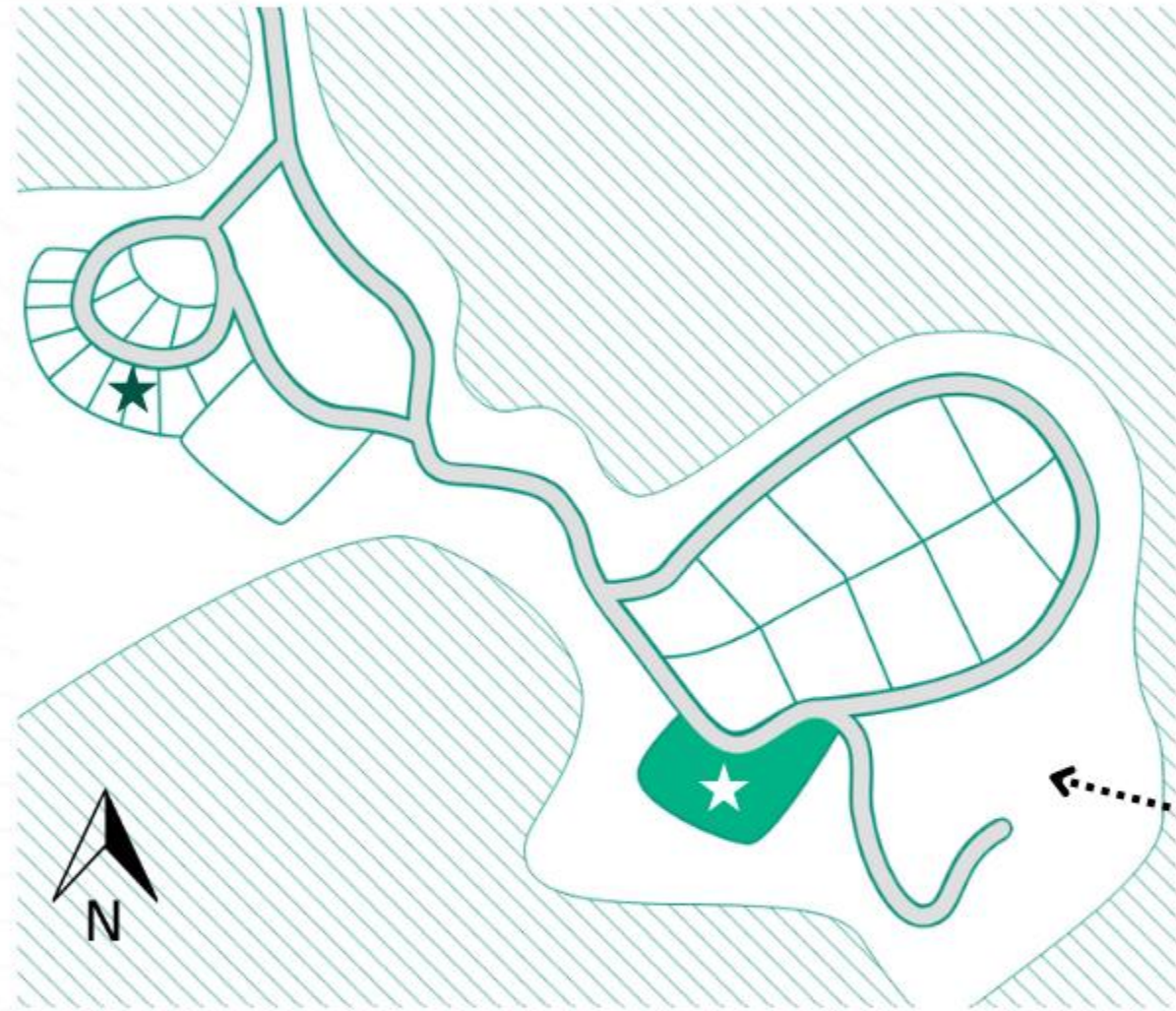


Innovate, Design, Sustain: EcoHaven

Building Better and Faster

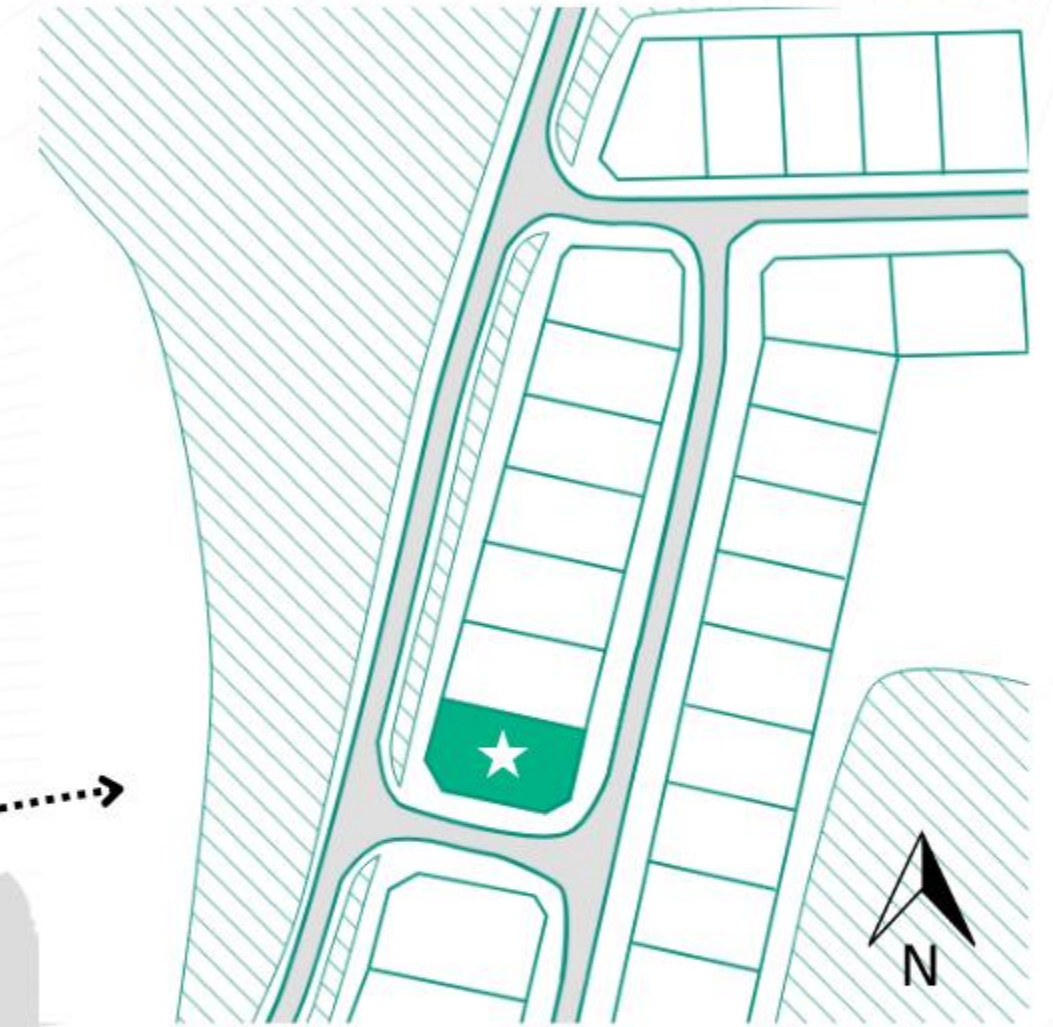
Location Case Studies

Honour Ranch

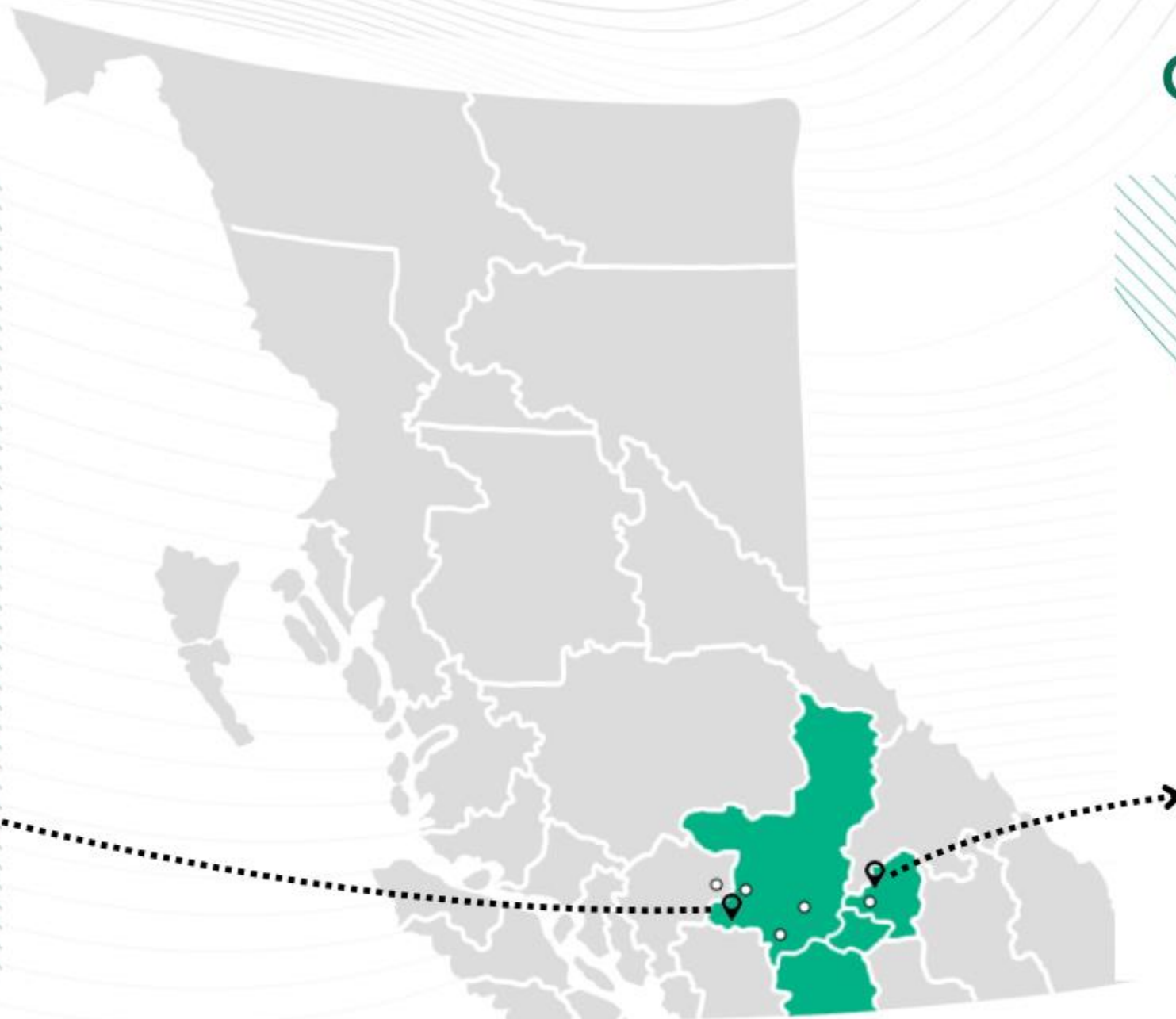


SITE PLAN: IMPLEMENTATION CASE STUDY

City of Salmon Arm



SITE PLAN: URBAN CASE STUDY

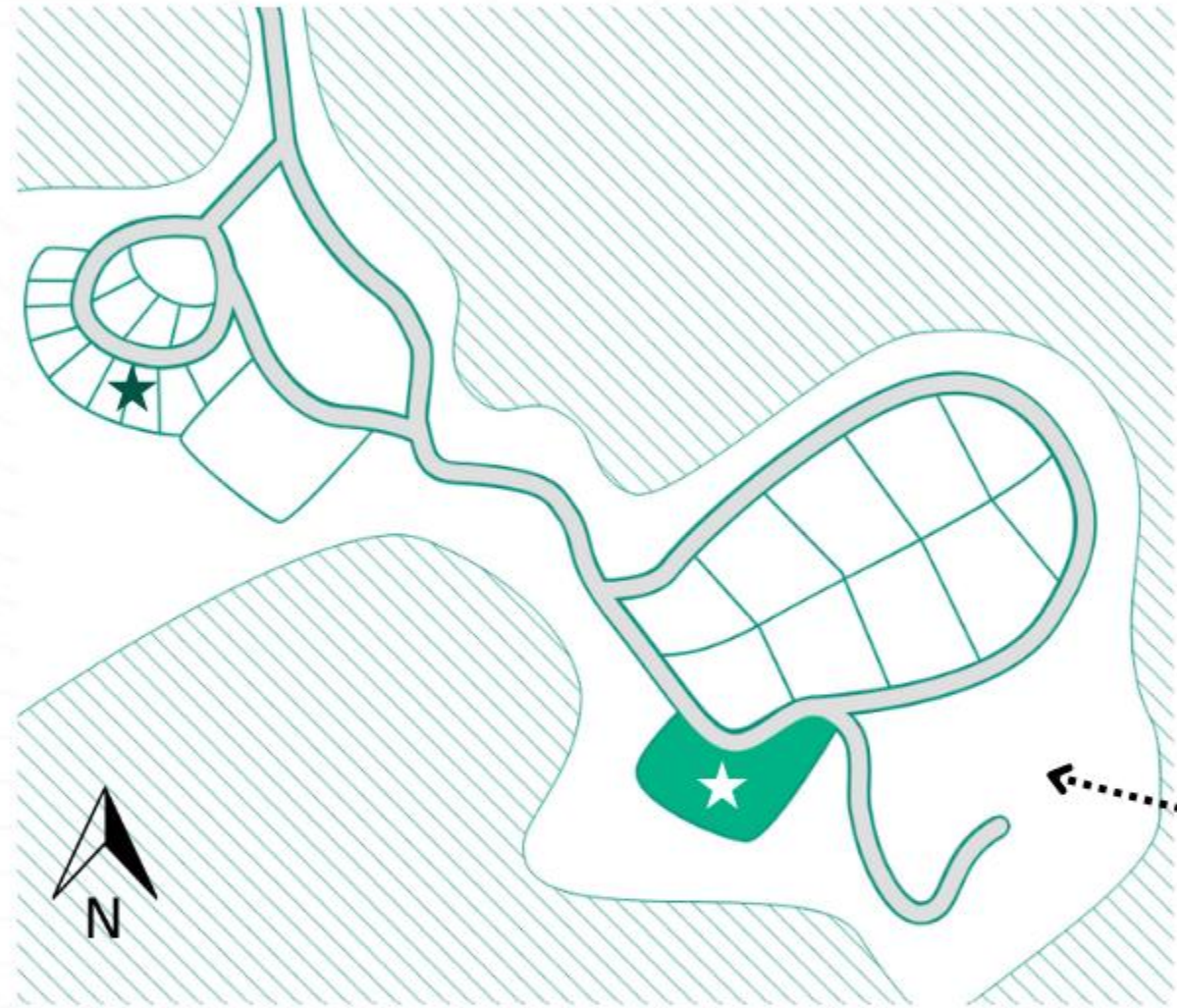


Legend

- Vegetation
- Road
- Future Development
- Existing Bldgs
- Proposed Lot

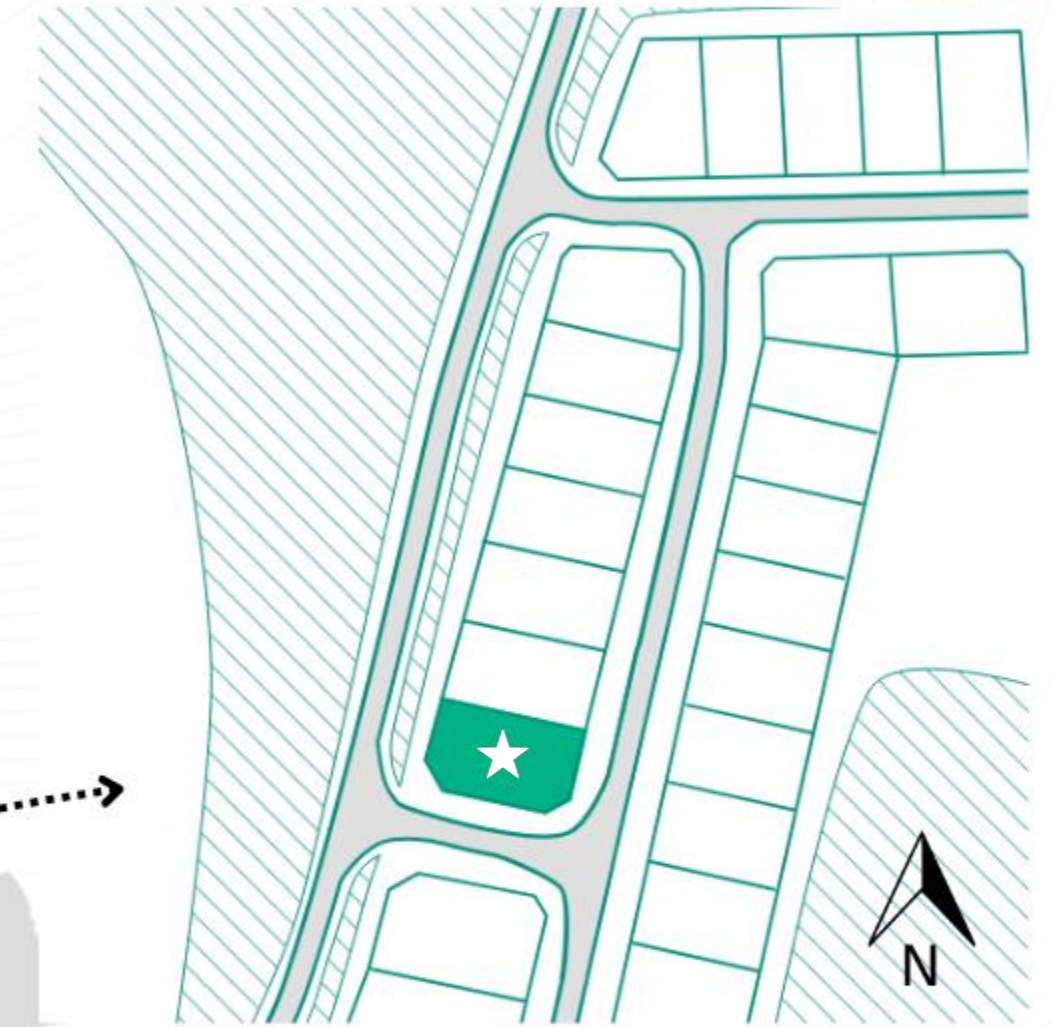
Location Case Studies

Honour Ranch



SITE PLAN: IMPLEMENTATION
CASE STUDY

City of Salmon Arm



SITE PLAN: URBAN CASE
STUDY



- Legend
- Vegetation
 - Road
 - Future Development
 - Existing Bldgs
 - Proposed Lot

Local Context



Thompson Okanagan can't house its growing population



No easy fix to housing affordability shortfall in Okanagan
Okanagan growth fueling housing shortage



Urgent need for more and different types of housing in North Okanagan

Thompson-Okanagan, BC

Local Context

Aug. 18, 2023 - 12:35 pm PDT

UBC Okanagan is under evacuation order. Please leave campus immediately.

2023 is now officially the most expensive, most destructive wildfire season on record in B.C.

Up to 200 buildings estimated destroyed by Okanagan wildfires, fire chiefs say

B.C. extends fire state of emergency, says drought could continue into next year

Okanagan, BC



Design Strategy

Scalable



Community Engagement



Disaster Resilient



Energy Efficient



Comfortable & Healthy



Current State of Market



Typical Single-family Home

Embodied Carbon	50 lbs CO2e/sqft
Construction Cost	\$235/sqft
Construction Time	8 months
Energy Consumption	30.8 MBTU/yr
Energy Production	0
Water Consumption	54,969 gal/yr



EcoHaven

Embodied Carbon	44 lbs CO2e/sqft
Construction Cost	\$232/sqft
Construction Time	4 months
Energy Consumption	17.4 MBTU/yr
Energy Production	27.4 MBTU/yr
Water Consumption	36,312 gal/yr

Demographics

62.3%

Of dwellings in are single-detached houses

50%

Of seniors live in inaccessible housing

2.3 people

Average size of families in Salmon Arm

26.8%

Of dwellings are 2-bedrooms

Senior couples



31.1% of population

Couples with children



20.5% of families

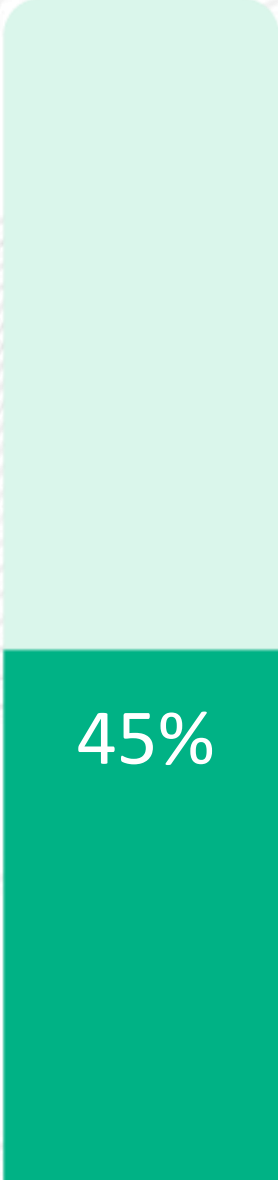
Affordability

Budget
\$657,000

Senior Couple



\$301,285
Purchase
Price

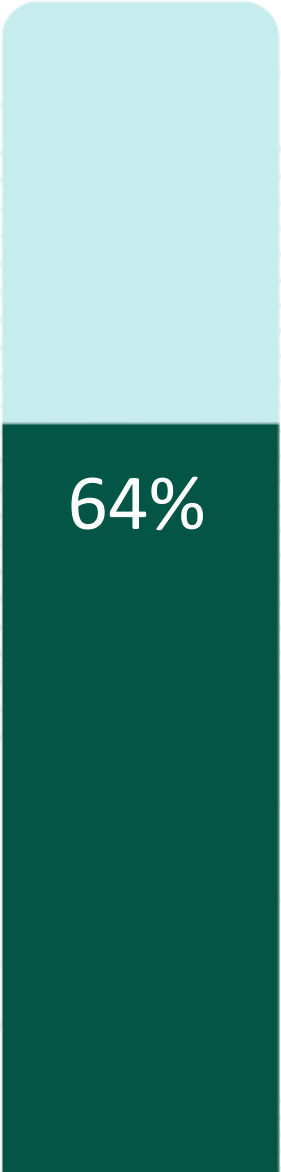


Budget
\$423,344

Couple with children



\$301,285
Purchase
Price



Precedence



PAST SOLAR DECATHLON PARTICIPANTS (2013)



PHOTOS BY D. PARKES

Scalable & Market Ready

Legend

- ★ Case Study Site
- < 250 miles
- 250 - 500 miles
- 500 - 800 miles

Lumber & Helical Piles
Kamloops, BC

Metal Roofing, Windows
& Sliding Doors
Vancouver Island, BC

Metal Louvers
Edmonton, AB

MgO Board
Irricana, AB

Structural Steel, Air/Vapour
Barrier, Railings
Greater Vancouver Area, BC

DensGlass
Tacoma, WA

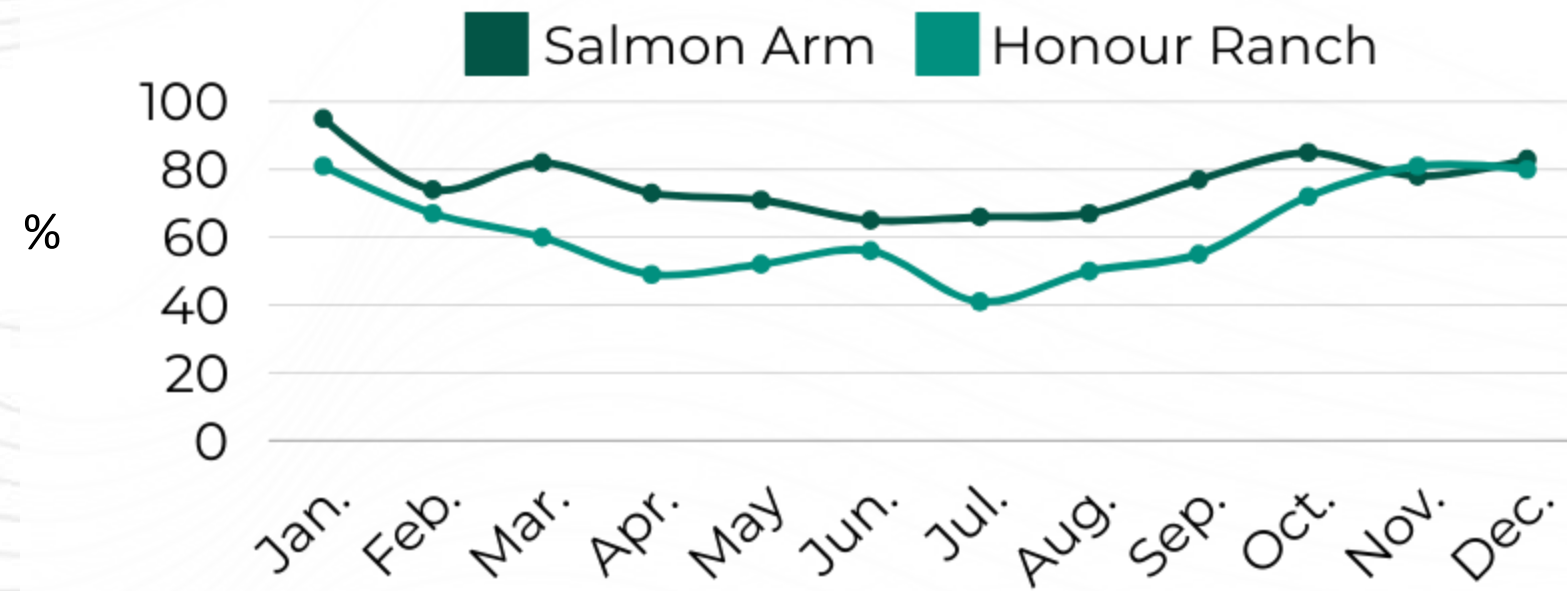
ROCKWOOL
Grand Forks, BC

Exterior Doors
Winnipeg, MB

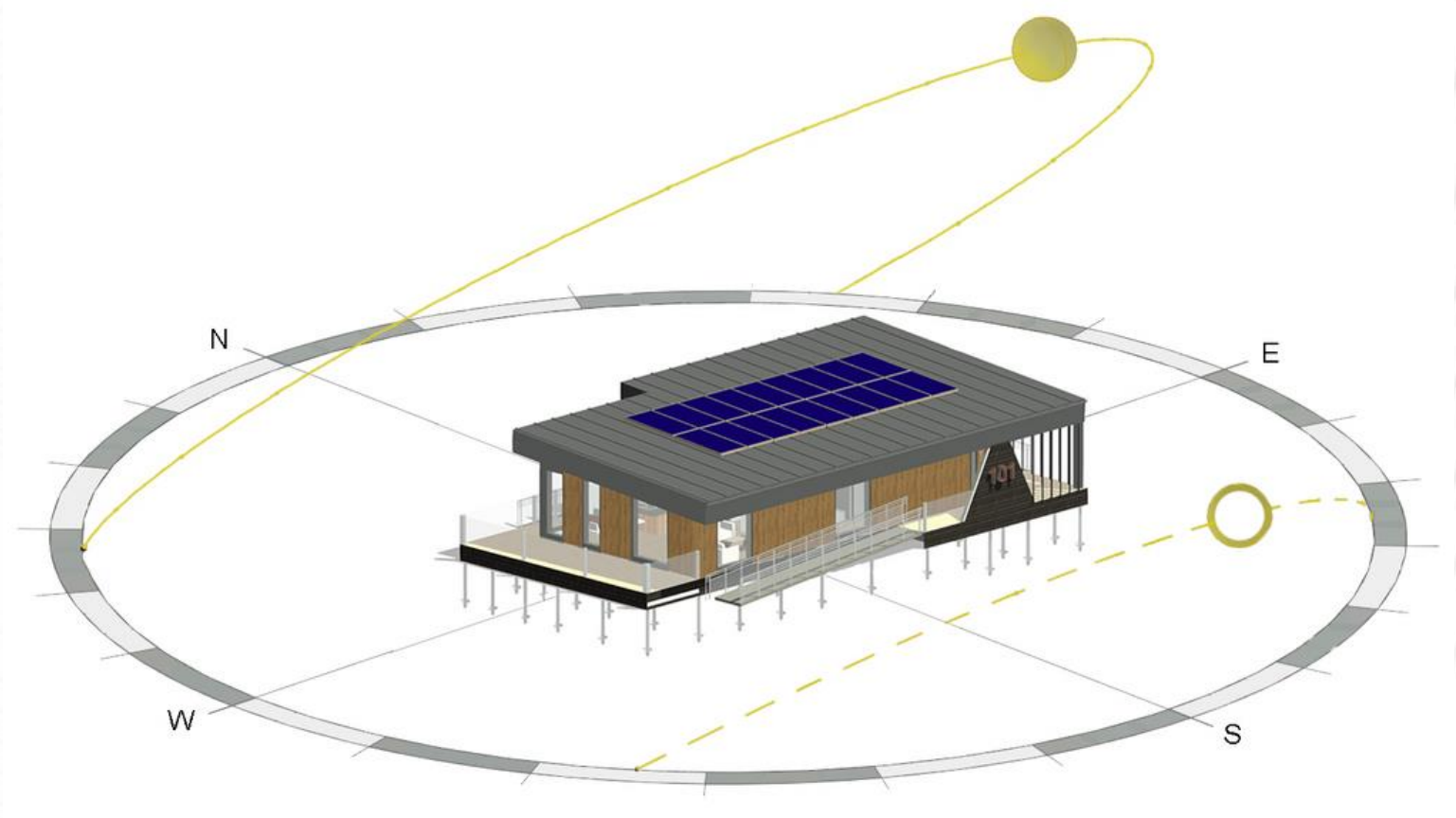
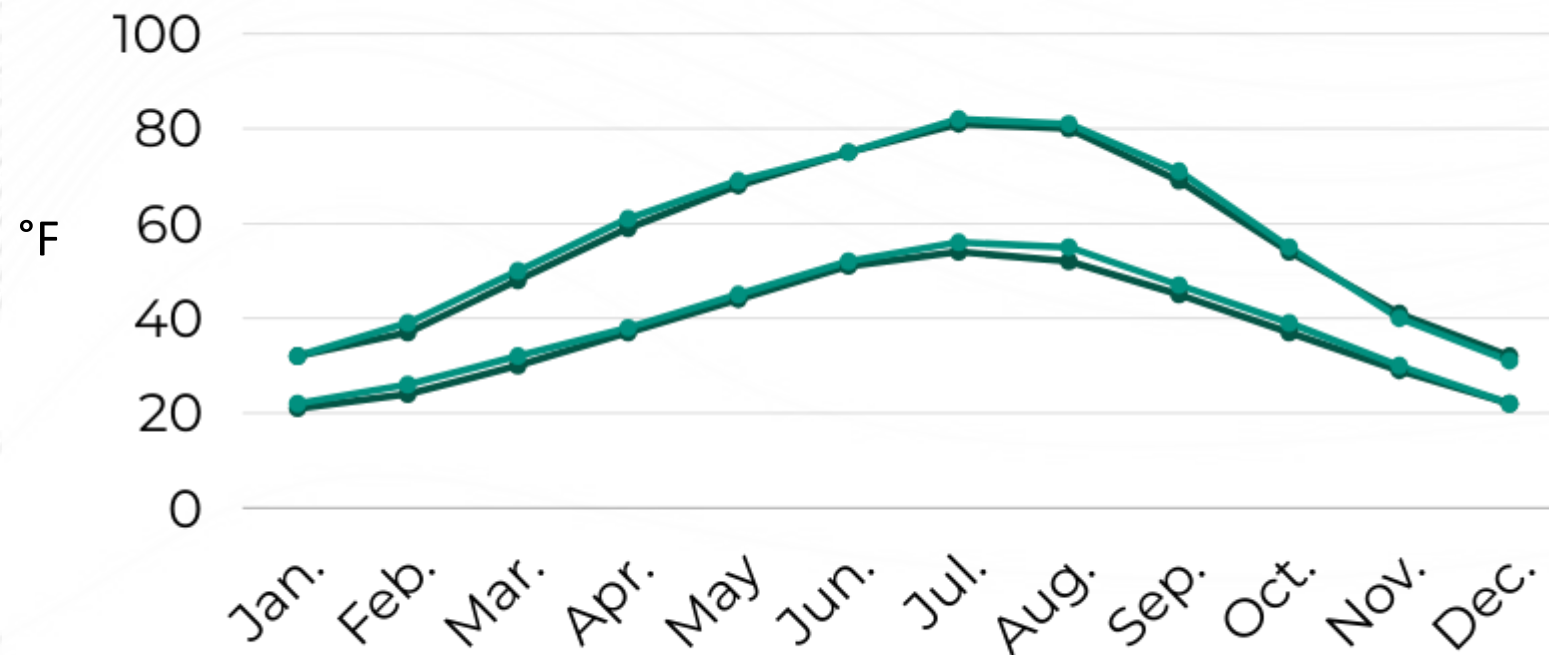
HempWool
Jerome, ID

Site & Climate Analysis

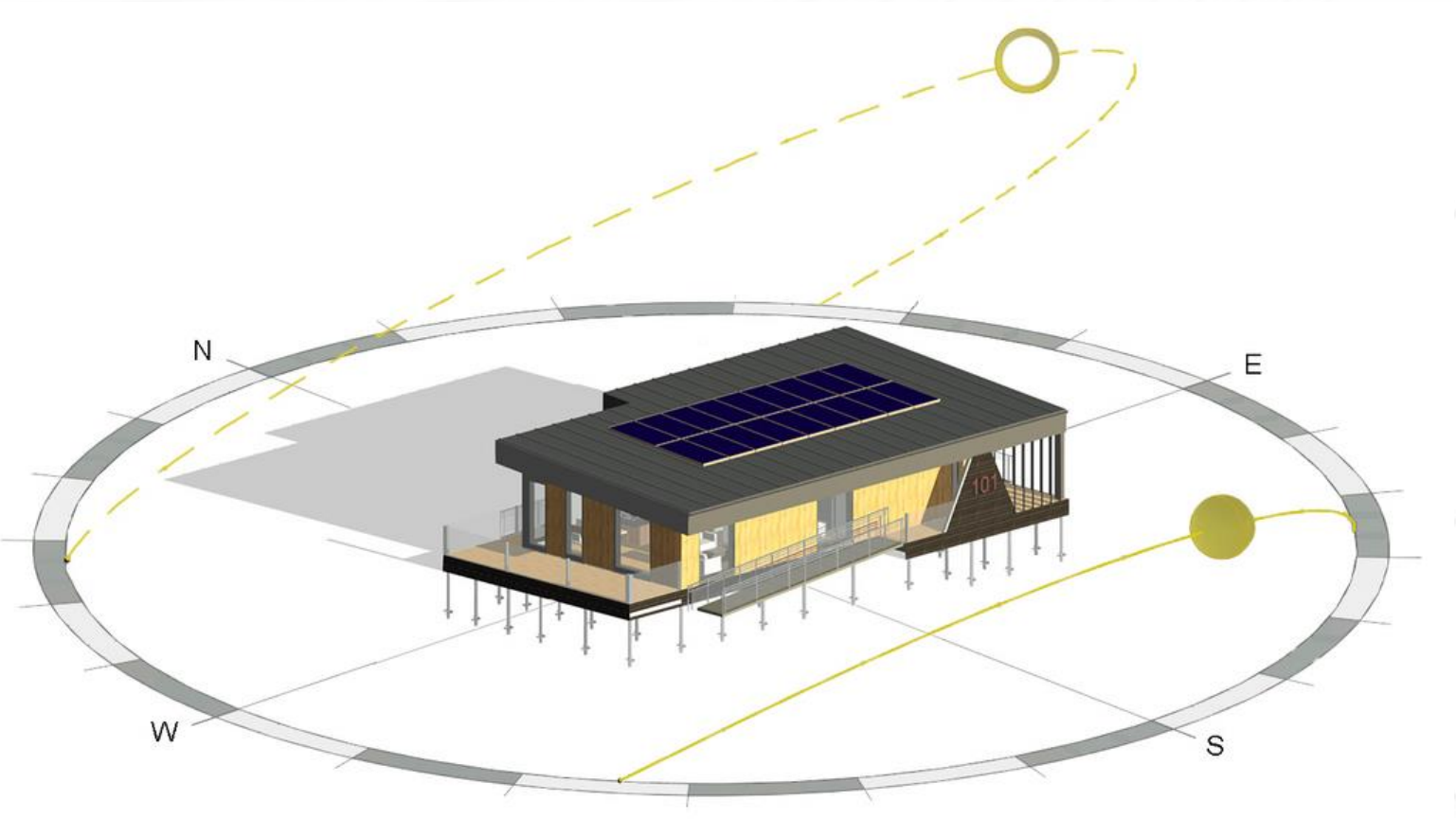
Monthly Mean Relative Humidity



Mean High & Low Temperature



SUMMER SOLSTICE SUNPATH



WINTER SOLSTICE SUNPATH

Architectural Design Concept



Accessibility



Easy-open Sliding Doors

Grab Bars & Easy-to-clean Fixtures



5' Wheelchair Turning Radius

Covered Entrance Ramp

ADA & SAFER HOMES COMPLIANT LAYOUT

Passive Design

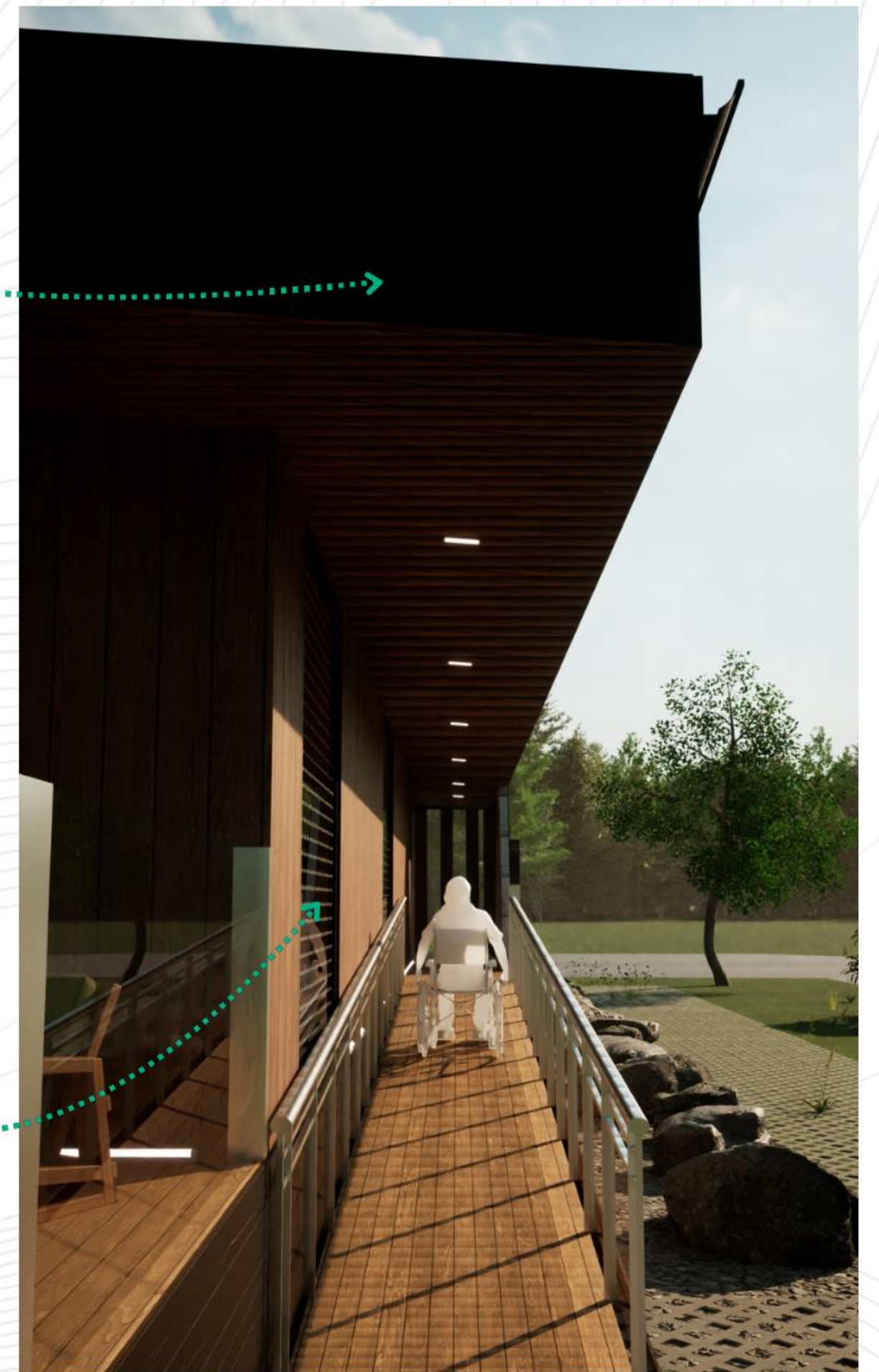


Extended Roof Overhangs

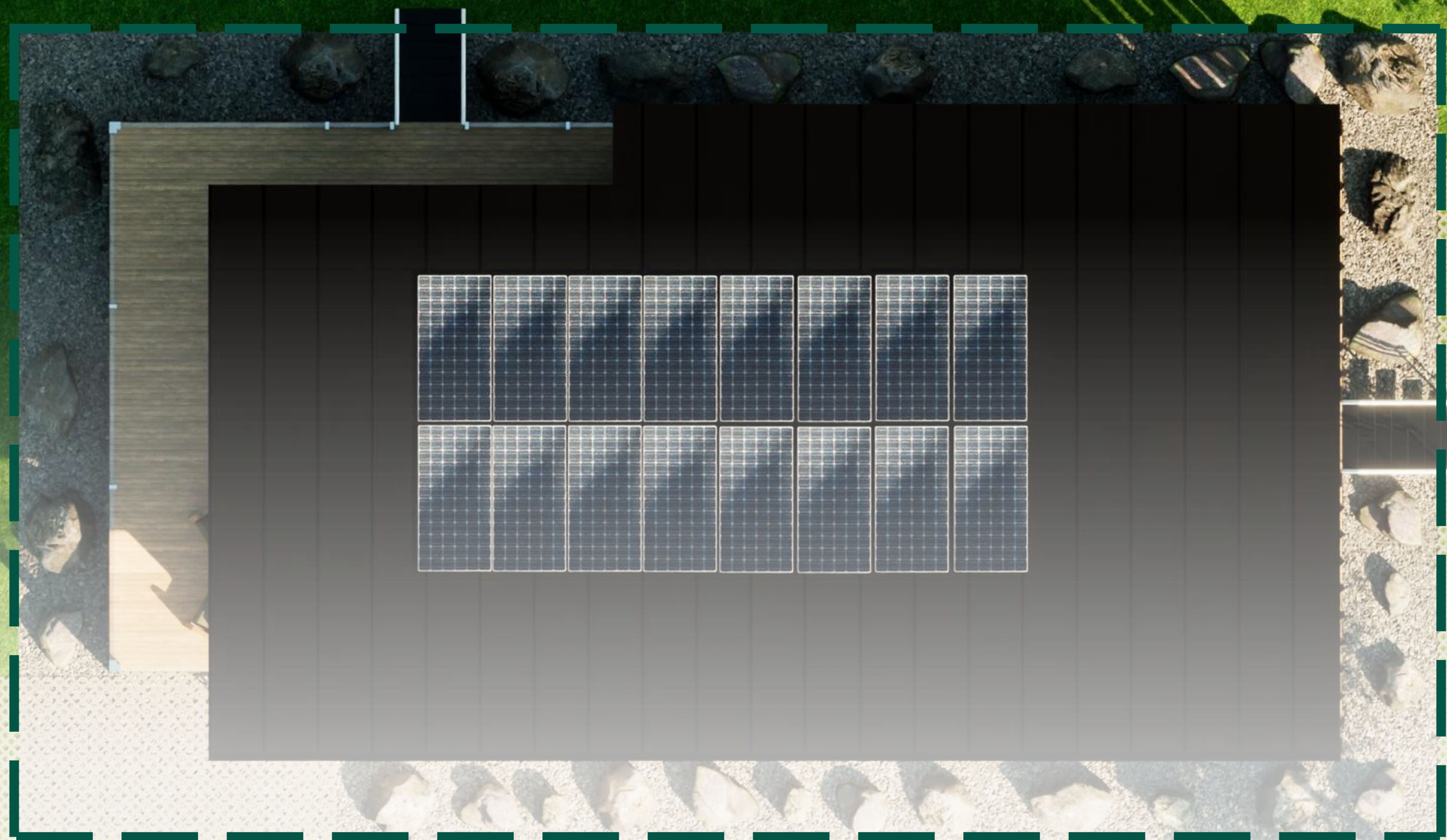
Shaded Outdoor Space

Metal Shading Louvers

Exterior Roller Shutters & Interior Blinds



Landscaping



BC FireSmart Landscaping Zones

- 0 - 5 ft Non-combustible Zone
- - - 5 - 33 ft Fire-resistant Zone



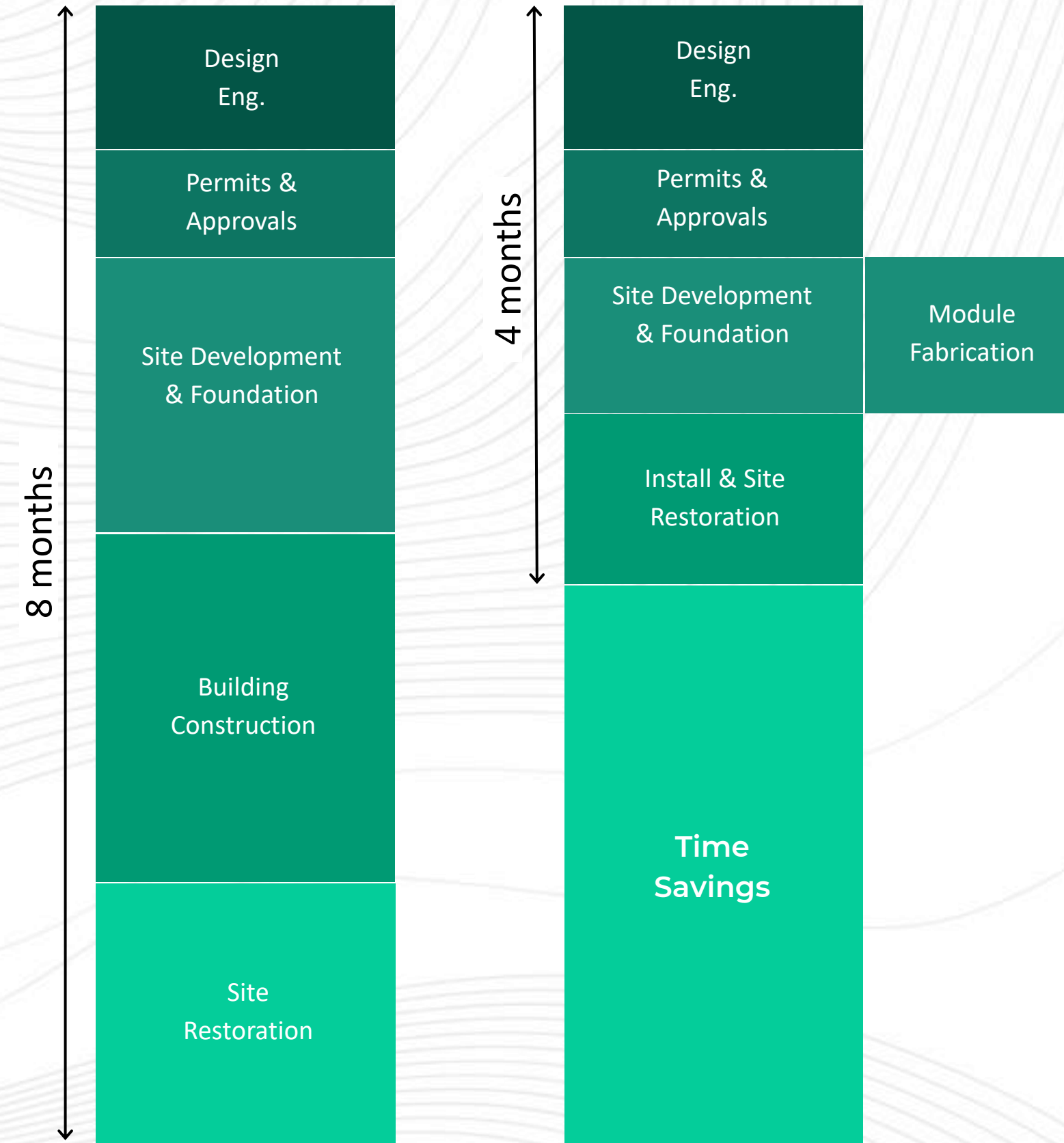
Modular Construction



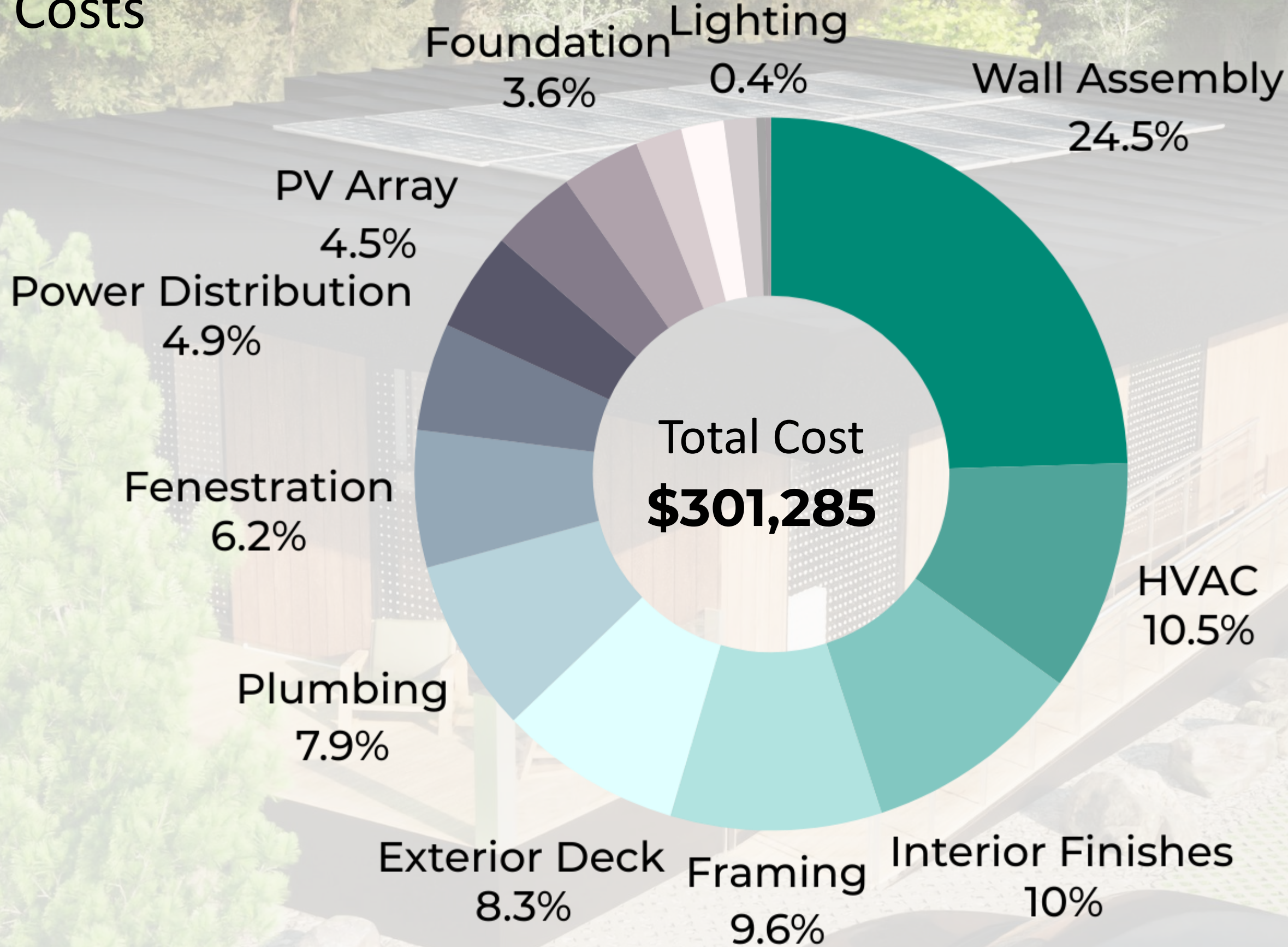
PREFABRICATED MODULES

Site Built Schedule

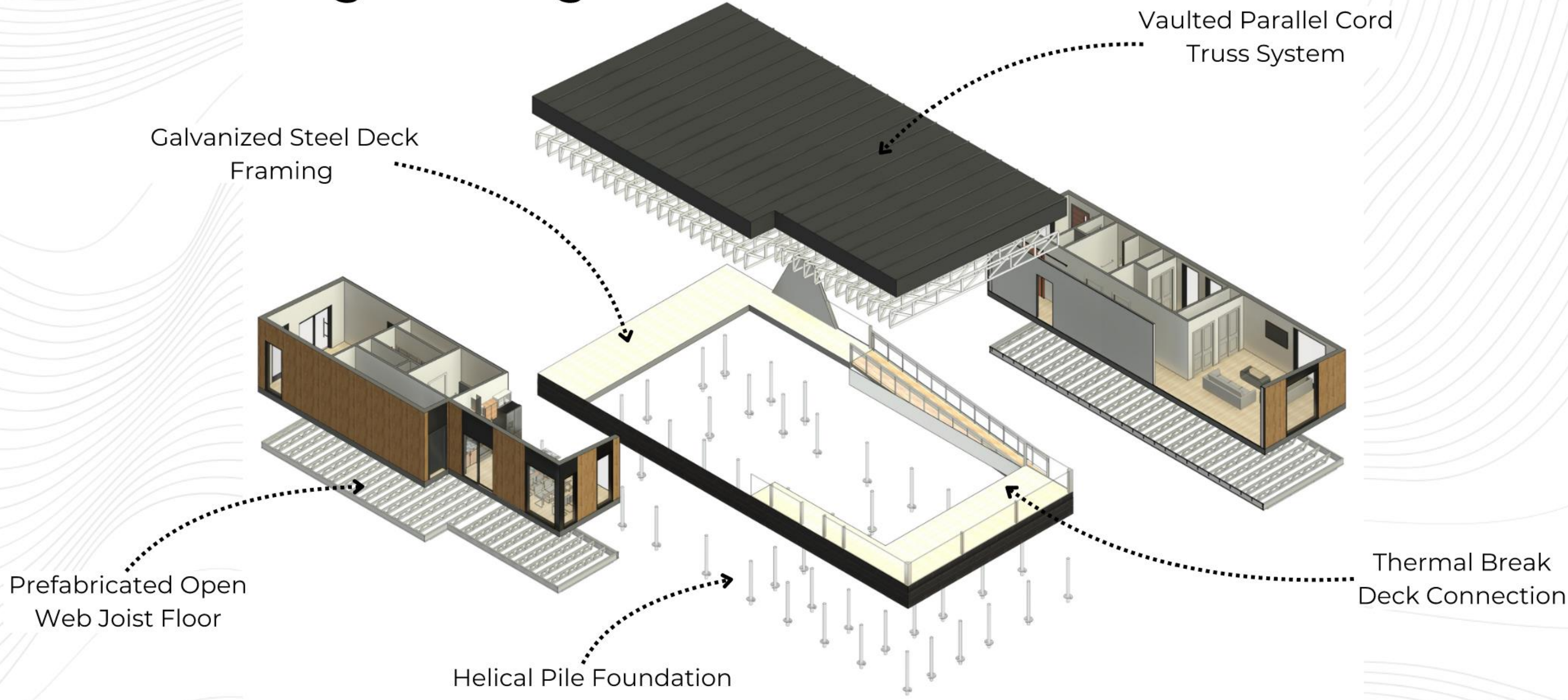
Modular Schedule



Construction Costs

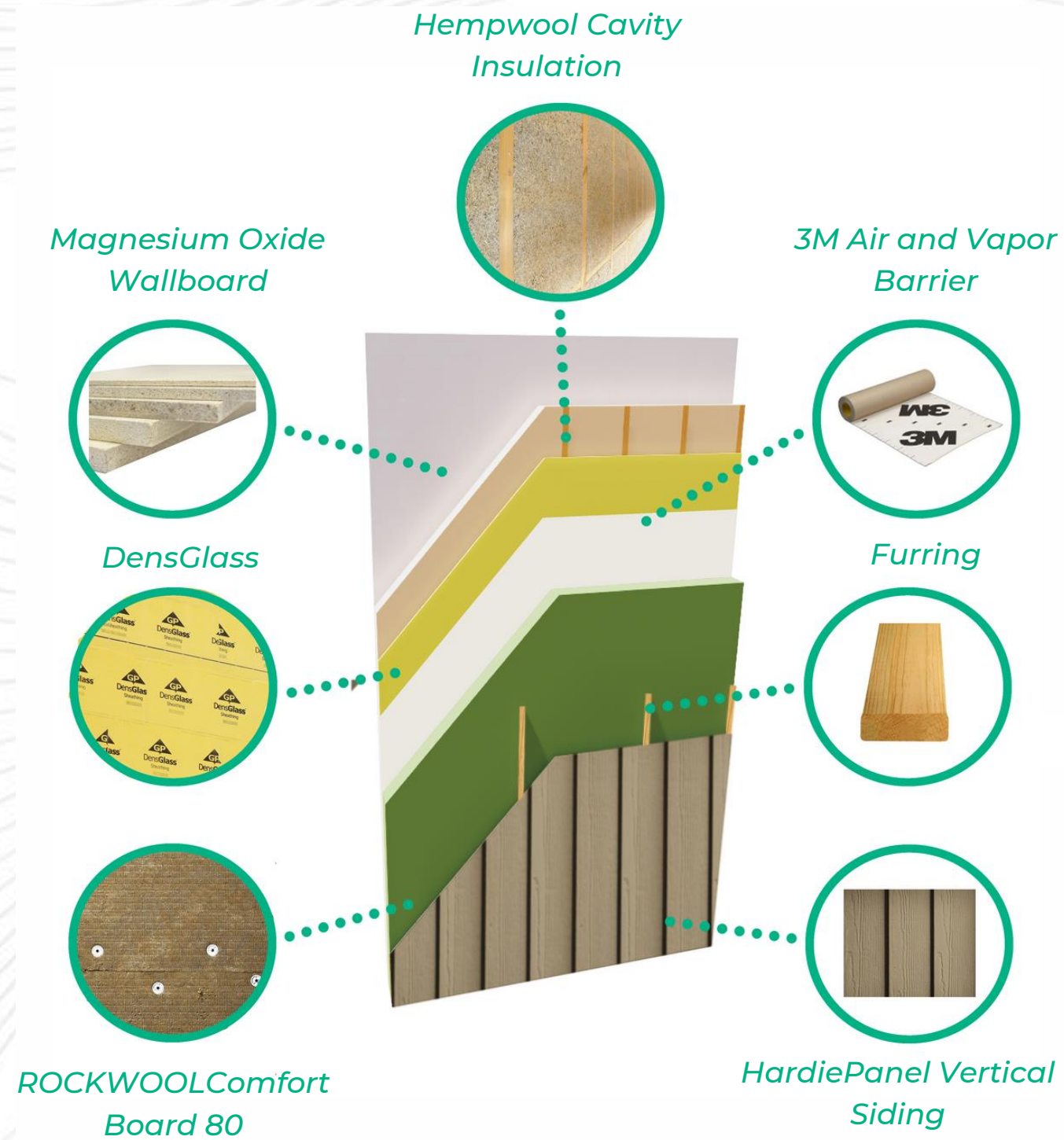


Structural Engineering



STRUCTURAL COMPONENTS AND MODULES
BC CODE 4.1

Envelope Assemblies



EXTERIOR WALL CROSS SECTION

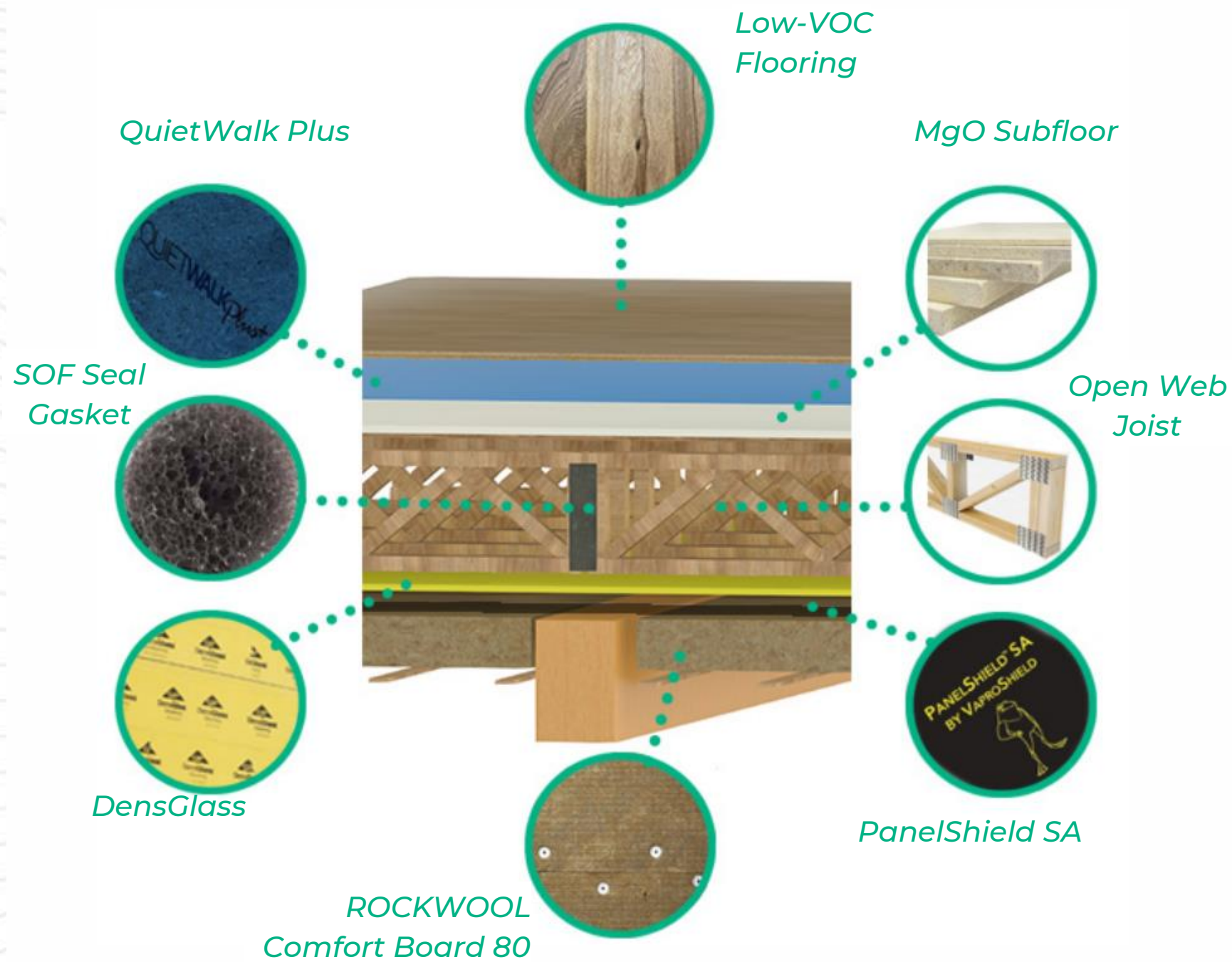
BC CODE 9.11 & 9.25



NORTH FACADE

Performance Metric	BC Code	IECC R402.1.2.	DOE ZERH	Canadian Energy Star	EcoHaven
Exterior Wall	R 21.0	R 22.2	R 22.2	R 17.5	R 37.0
Low-slope Roof	R 30.0	R 41.7	R 41.7	R 26.5	R 43.5
Crawlspace	R 26.5	R 18.2	R 18.2	R 26.5	R 54.2

Envelope Assemblies



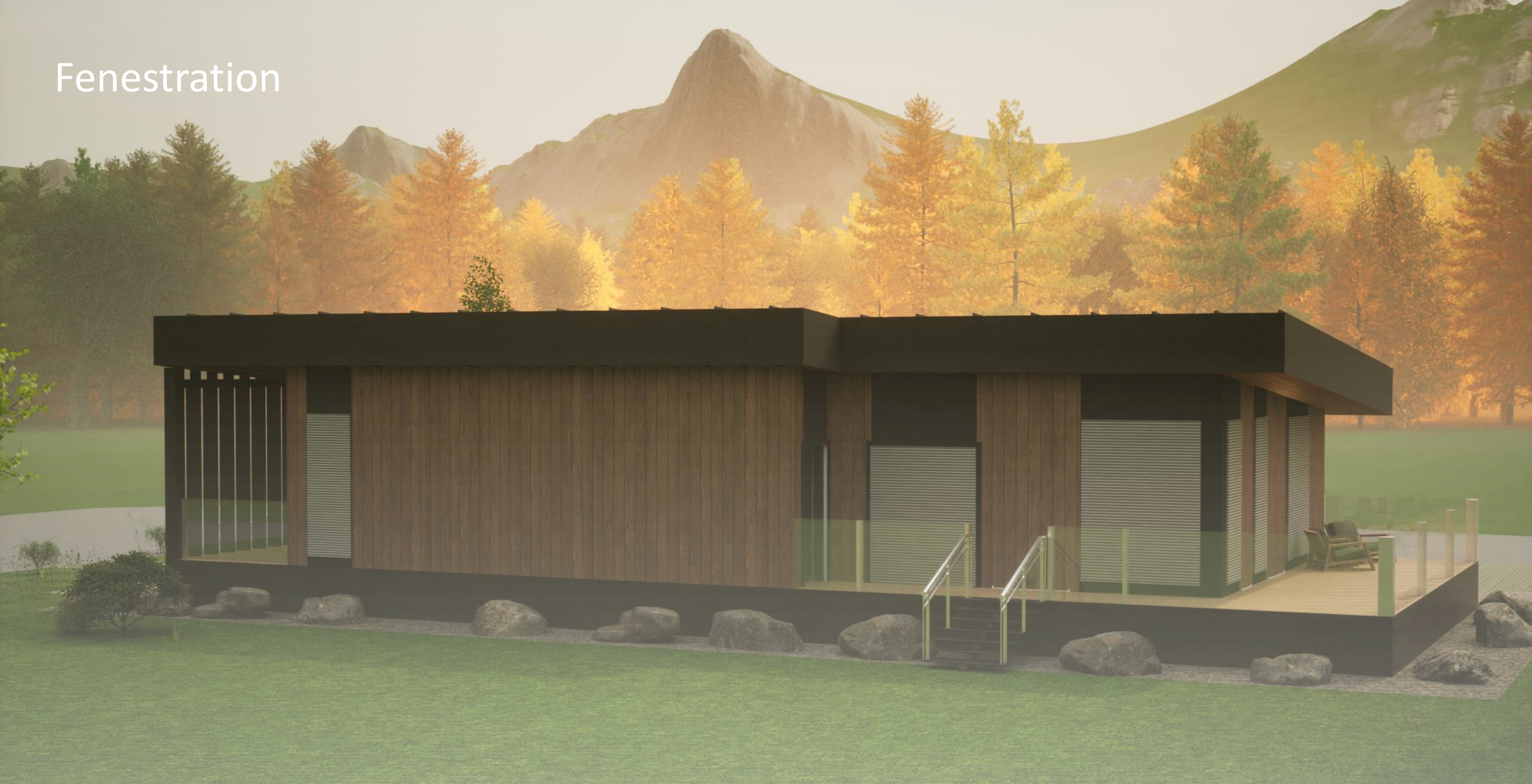
FLOOR ASSEMBLY & MARRIAGE LINE CROSS SECTION
BC CODE 9.11 & 9.25



NORTH FACADE

Performance Metric	BC Code	IECC R402.1.2.	DOE ZERH	Canadian Energy Star	EcoHaven
Exterior Wall	R 21.0	R 22.2	R 22.2	R 17.5	R 37.0
Low-slope Roof	R 30.0	R 41.7	R 41.7	R 26.5	R 43.5
Crawlspace	R 26.5	R 18.2	R 18.2	R 26.5	R 54.2

Fenestration

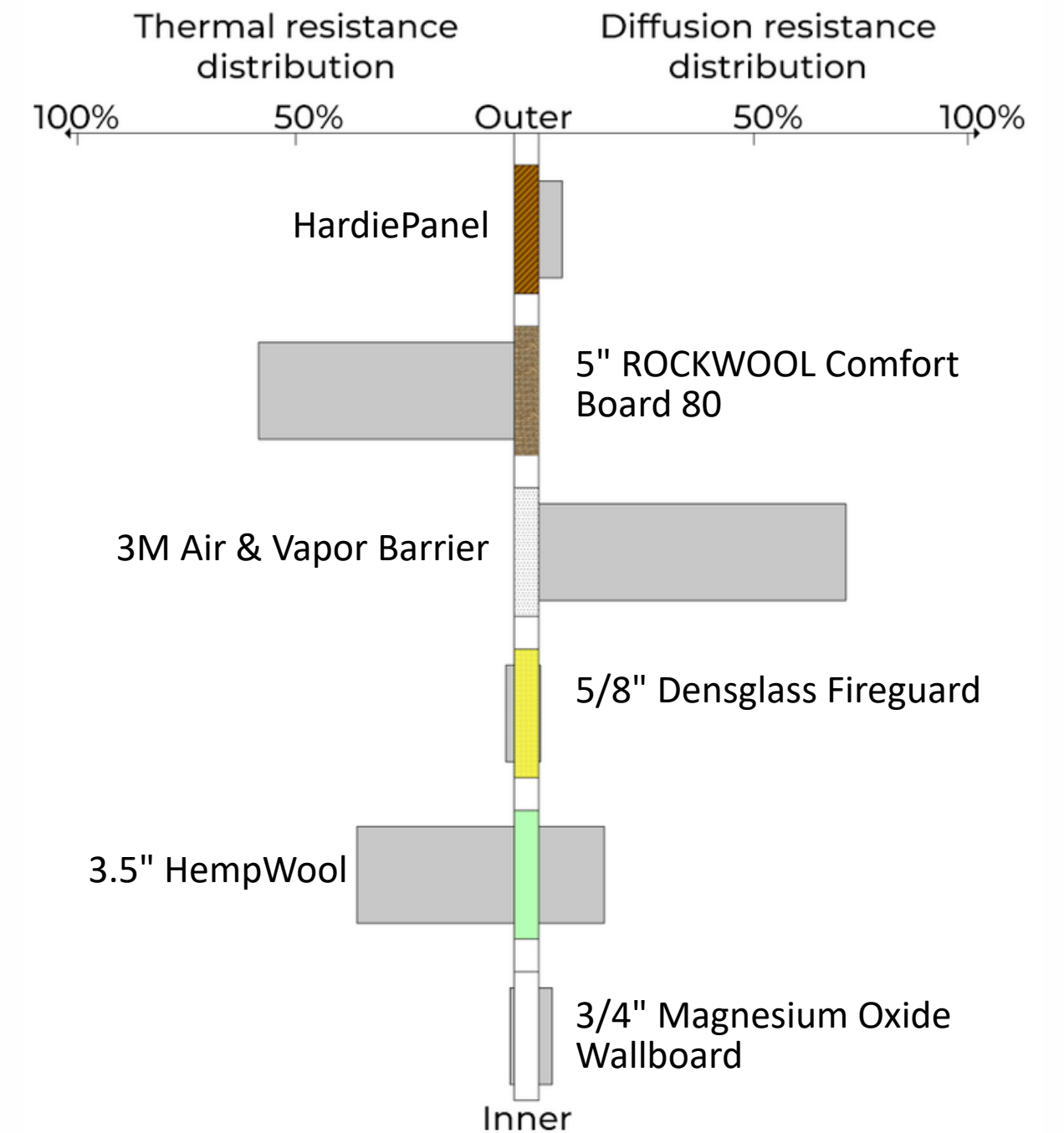


Moisture & Durability



SOUTHWEST CORNER

Wall Assembly



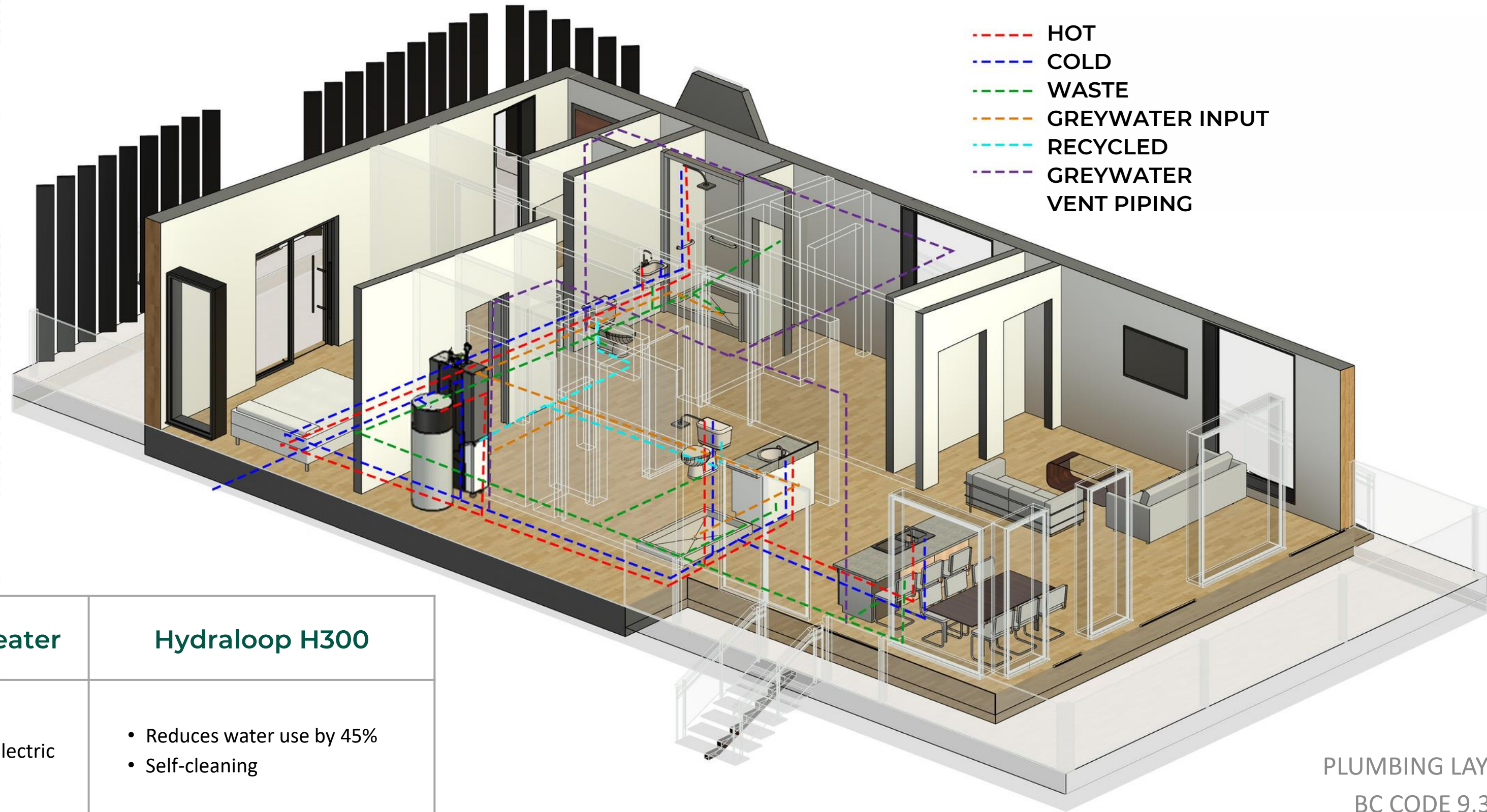
Acoustics

STC Rating of 45

STC Rating of 45

IIC of 71

Water Distribution



SANCO2 Water Heater

- Operates below -22°F
- 5x more efficient than electric heaters

Hydraloop H300

- Reduces water use by 45%
- Self-cleaning

Heating, Cooling & Ventilation



System	Product	Description
Air-source Heat Pump	Lennox EL22XPV	<ul style="list-style-type: none"> • SEER 22 • Min. Operating Temperature: -4F • HSPF 9.5
Energy Recovery Ventilator	Panasonic Intelli-Balance	<ul style="list-style-type: none"> • 50-100 CFM • MERV13 filter • Real-time monitoring
Air Purifier	Coway Airmega Mighty	<ul style="list-style-type: none"> • HEPA filter • Automatic shut-off
Portable Dehumidifier	LG PuriCare	<ul style="list-style-type: none"> • ENERGY STAR Rated • Reusable filter • Smart sensors

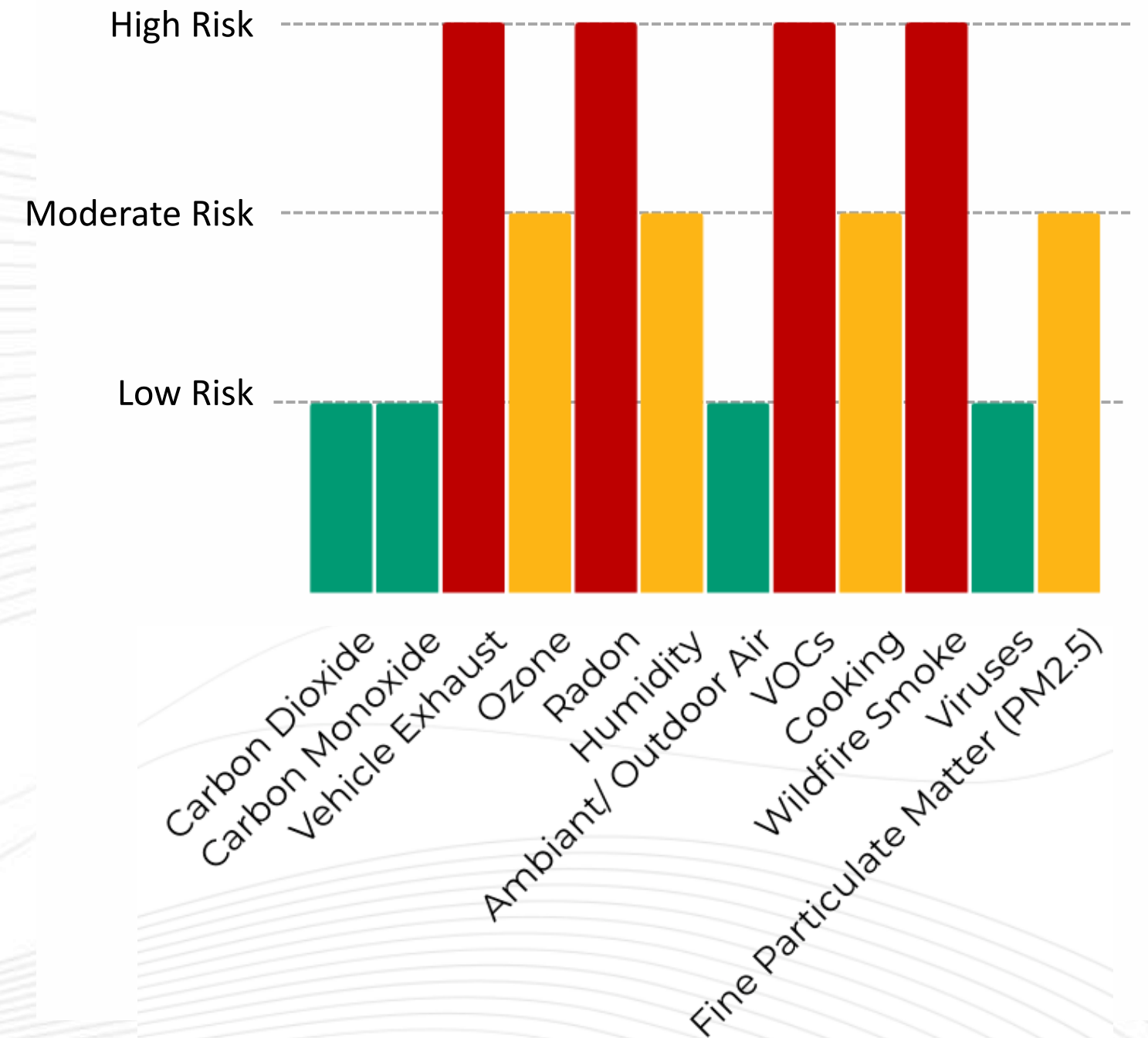
HVAC SYSTEM INTEGRATION
BC CODE 9.32 - 9.33

Indoor Air Quality



OPEN CONCEPT LIVING SPACE

IAQ Risk Assessment

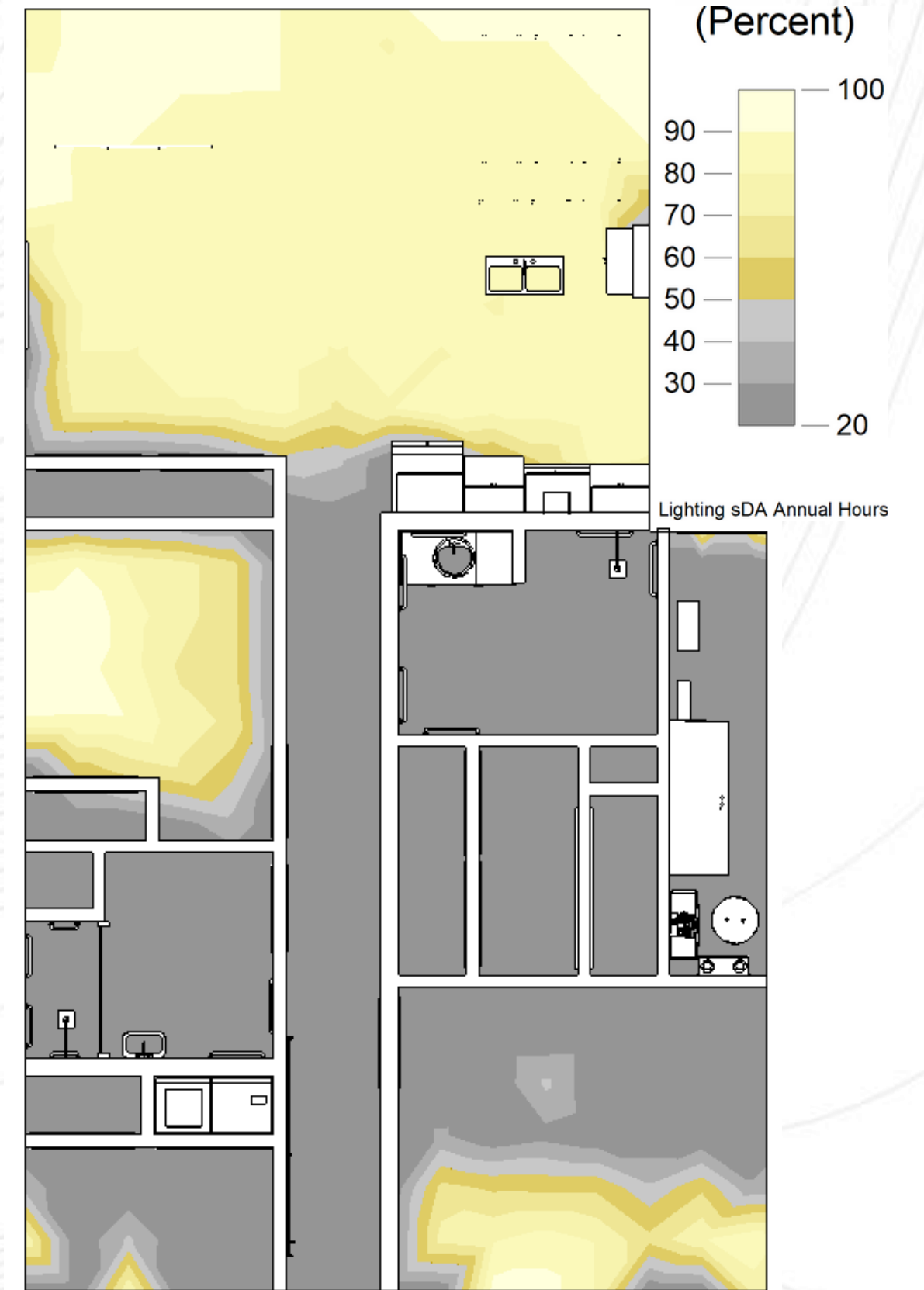


Building Controls

- Water Leak Sensor
- Smart Smoke and CO2 Detector
- Smart Programmable Thermostat
- Air Quality Sensor and Purifier
- Smart Doorbell and Doorlock
- EV Charger
- Smart Energy Star Appliances

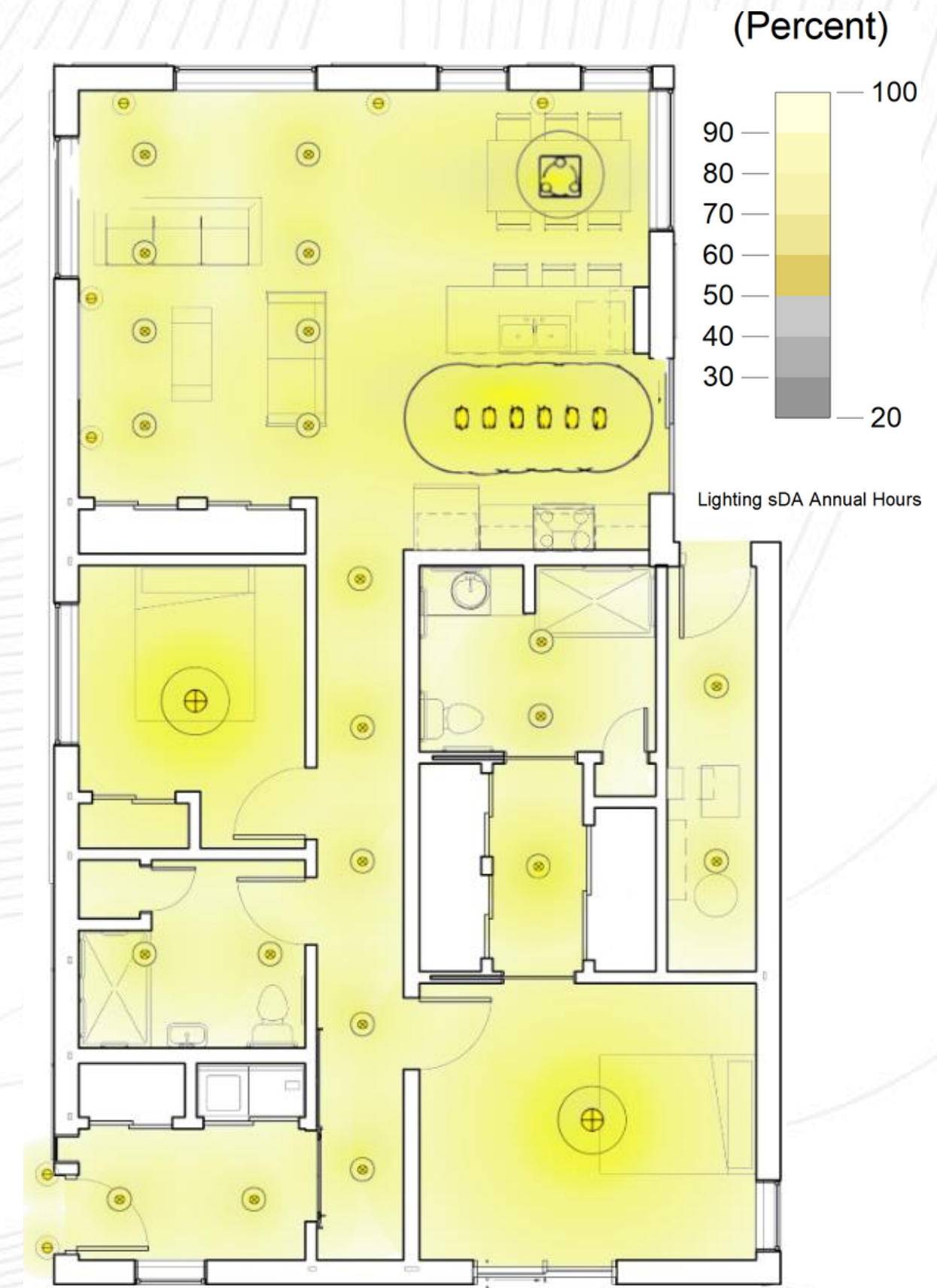


Daylighting & Lighting



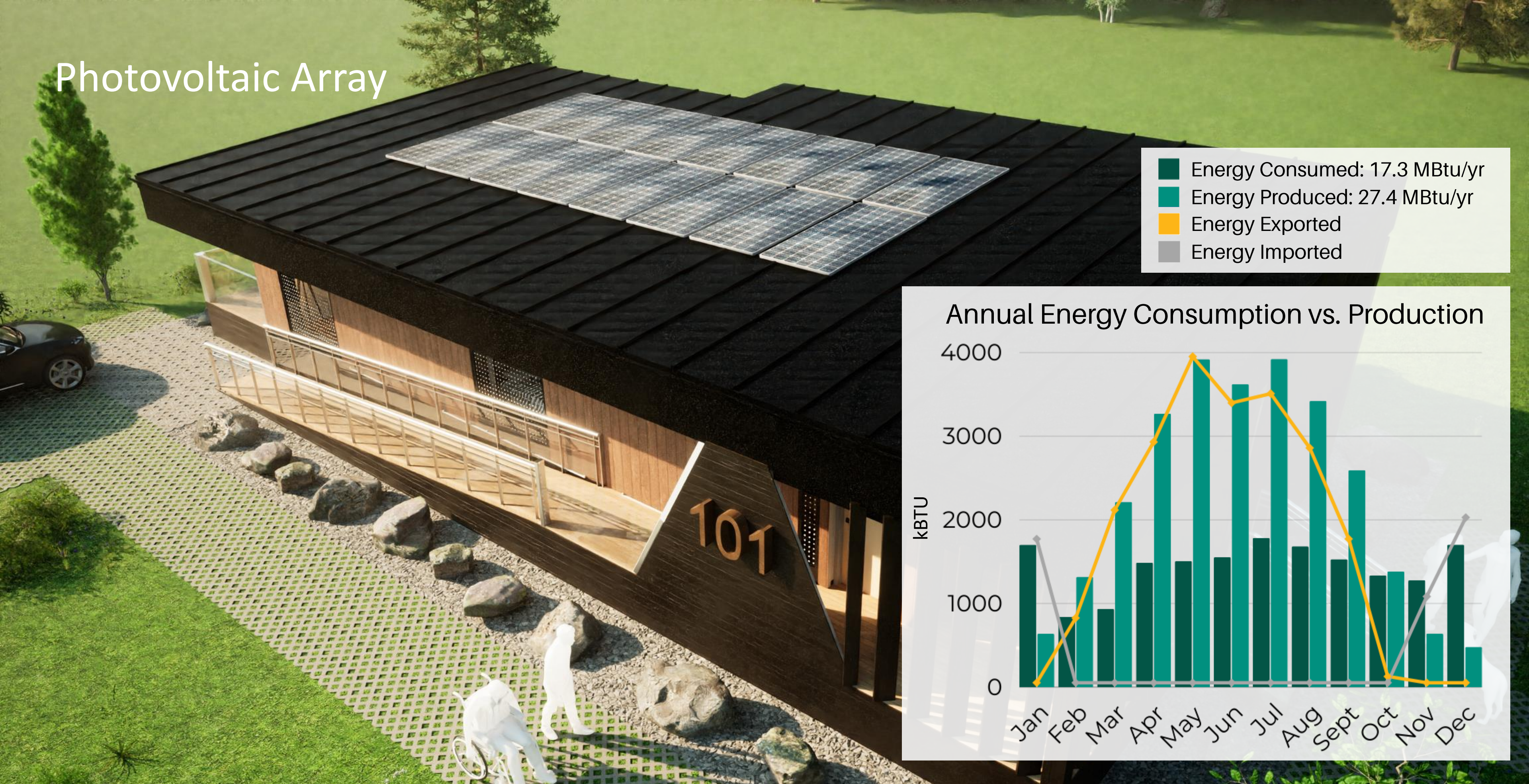
NATURAL LIGHTING

Daylighting & Lighting

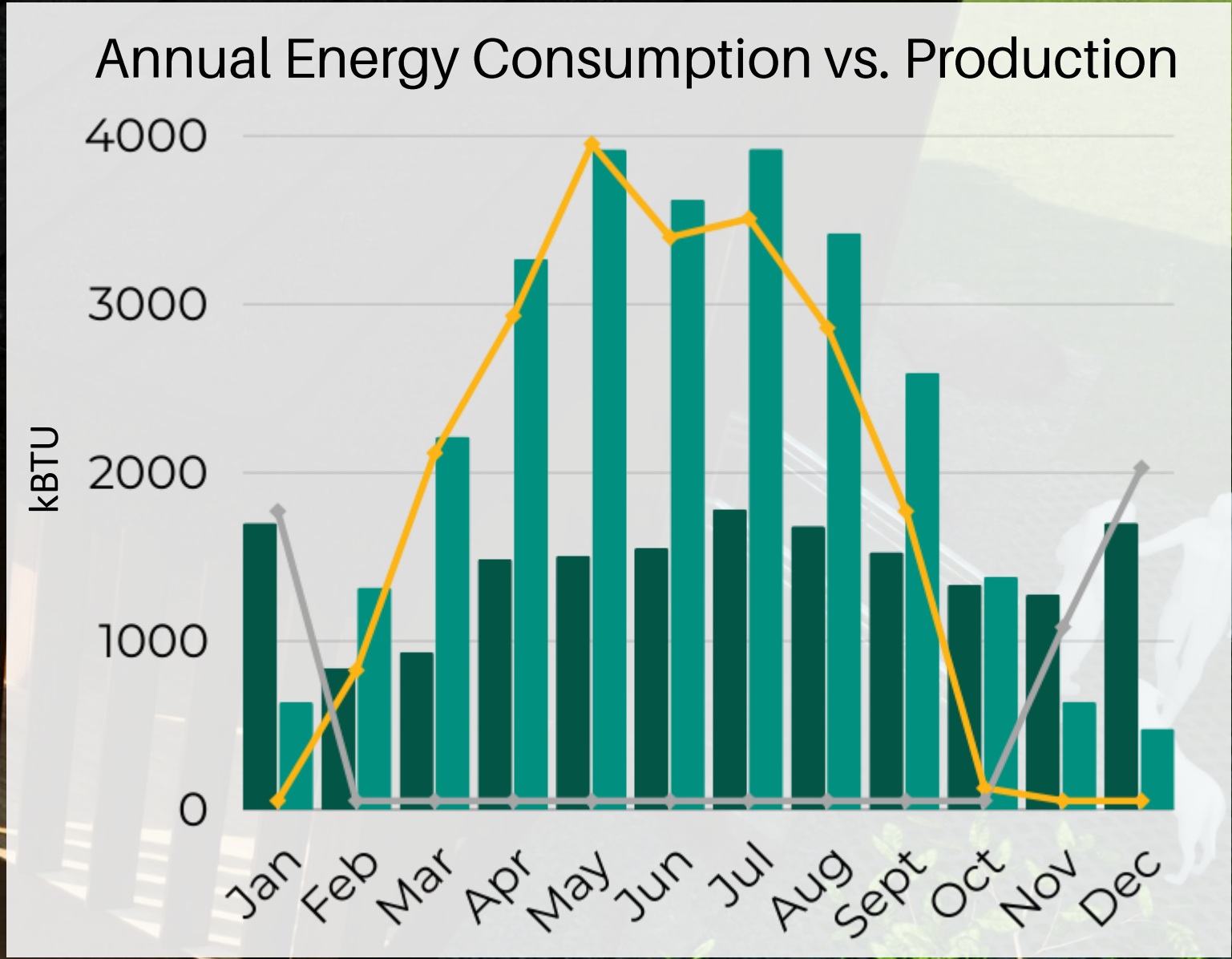


ARTIFICIAL LIGHTING

Photovoltaic Array

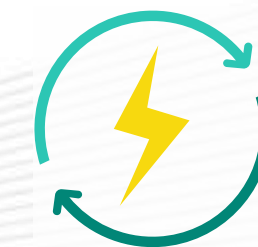
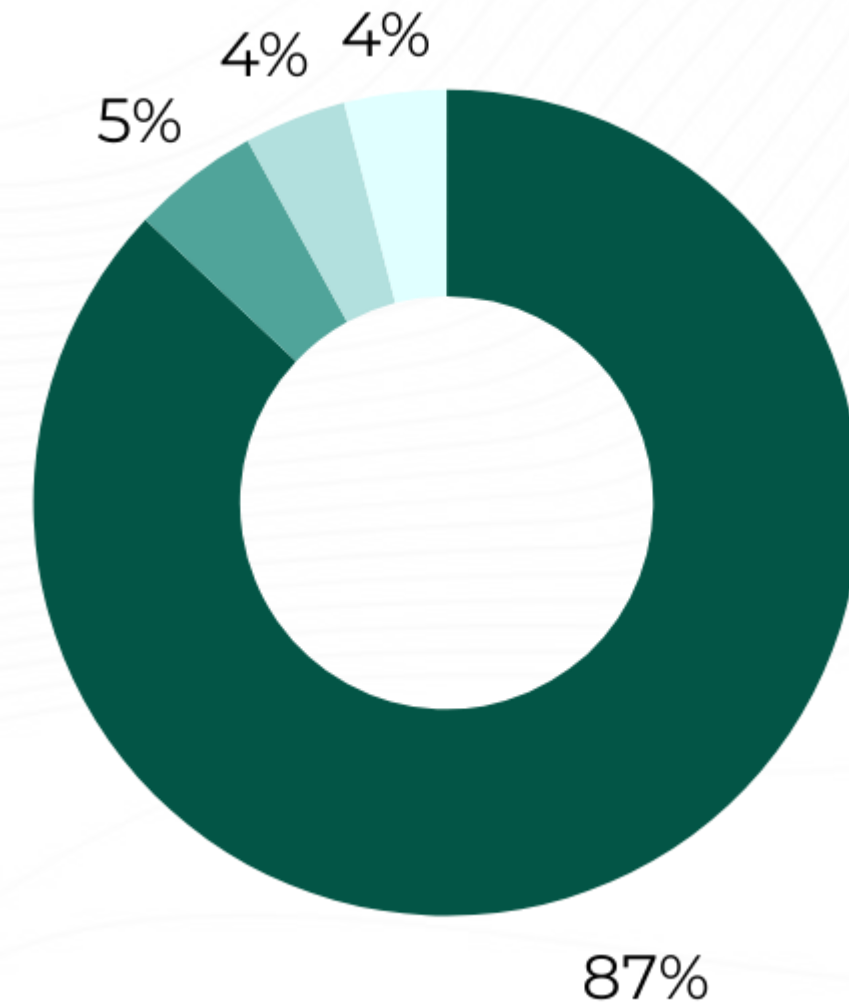
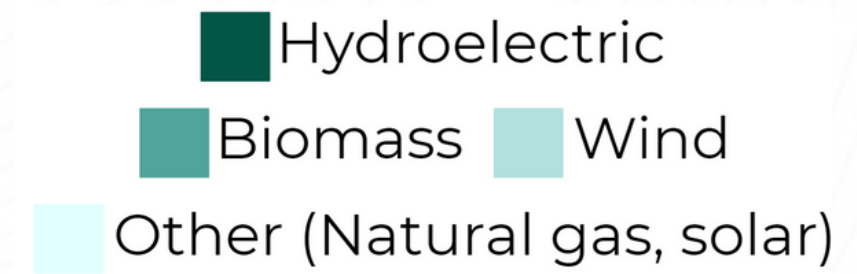


Energy Consumed: 17.3 MBtu/yr
Energy Produced: 27.4 MBtu/yr
Energy Exported
Energy Imported

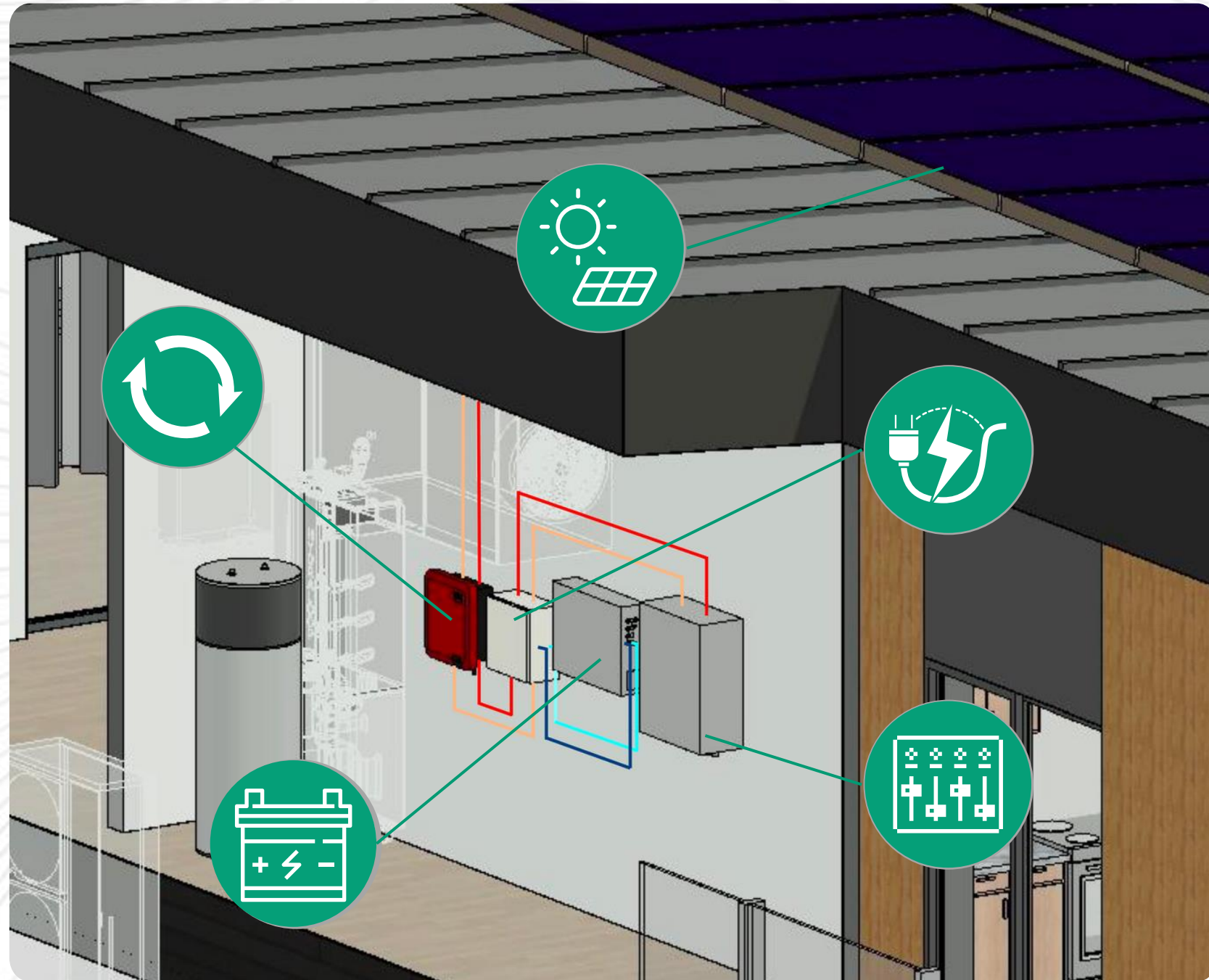


BC Grid & Reliability

BC Hydro Grid Distribution



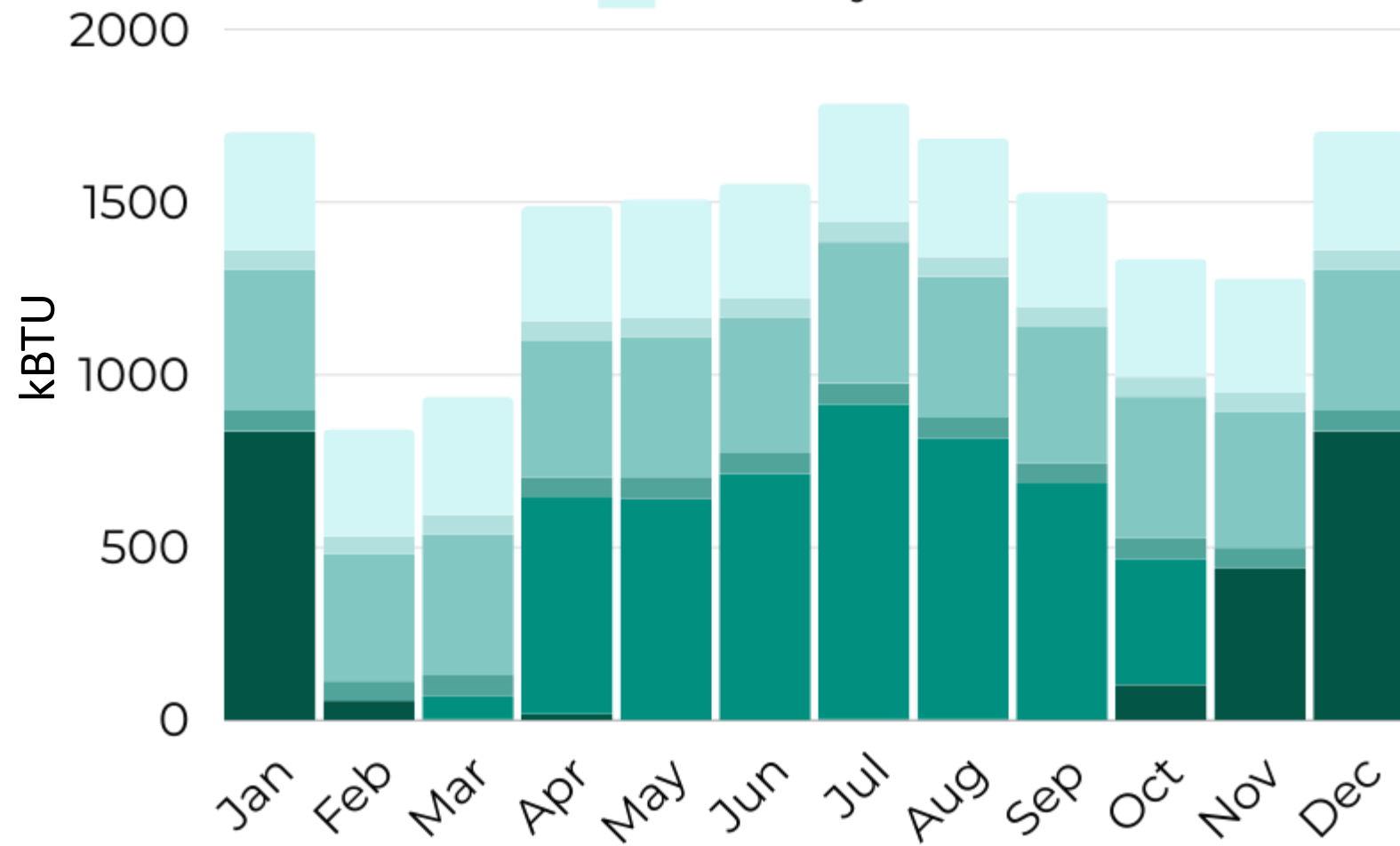
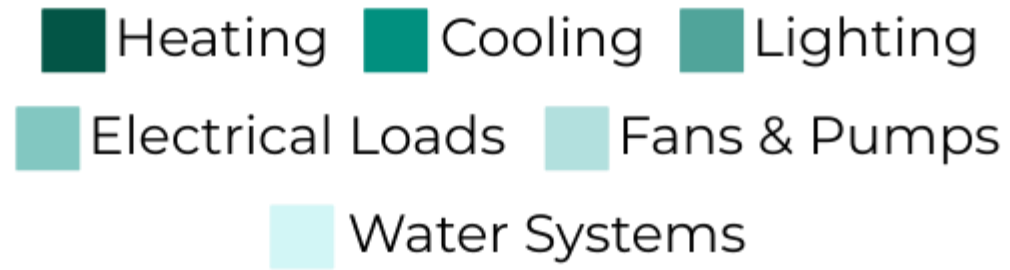
95% Renewable Sources & Energy Factor of 1.11



PV ARRAY & ELECTRICAL CONNECTIONS
CANADIAN ELECTRICAL CODE

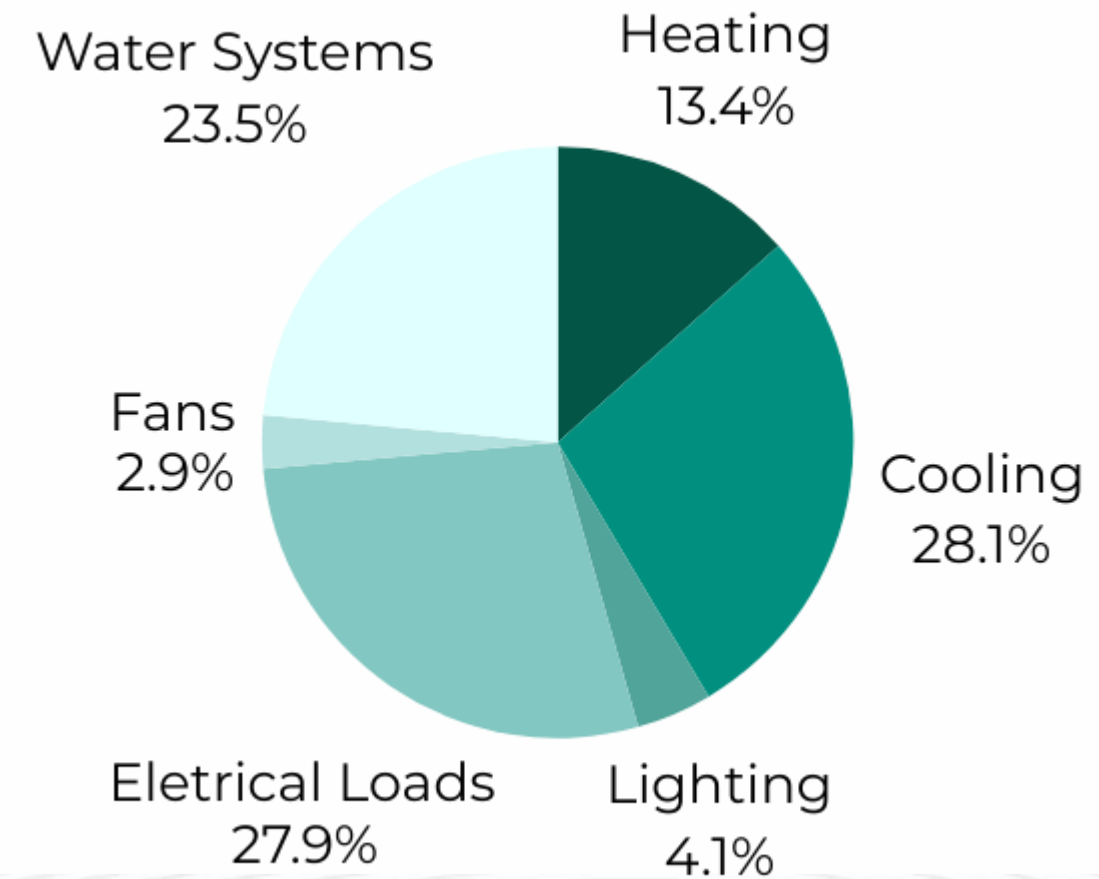
Efficiency

Annual Energy Consumption

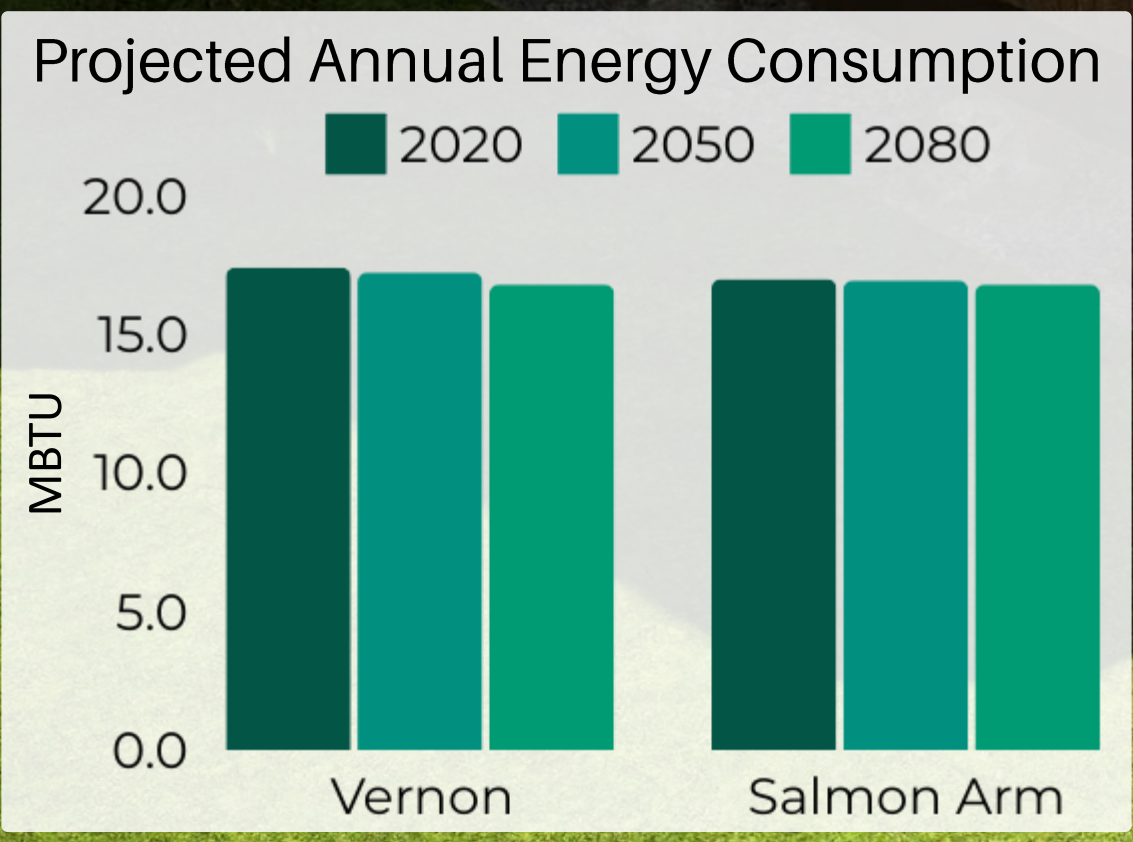


Performance Metric	BC Step 5	Salmon Arm	Honour Ranch
Thermal Energy Demand Intensity (kBTU/sqft yr)	7.3	5.9	5.6
Mechanical Energy Use Intensity (kBTU/sqft yr)	12.8	9.0	8.8
Water Use Intensity (gal/sqft yr)	-	16.91	16.91

Energy Consumption by End Use

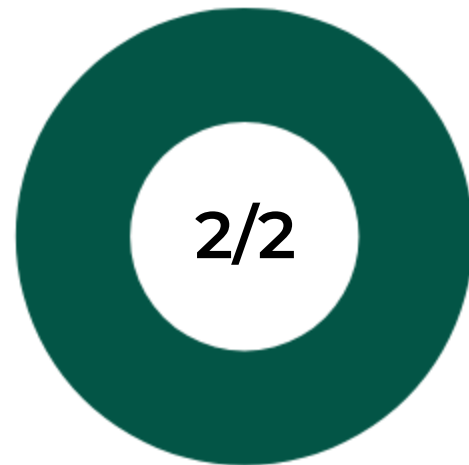


Climate Resilience & Scalability

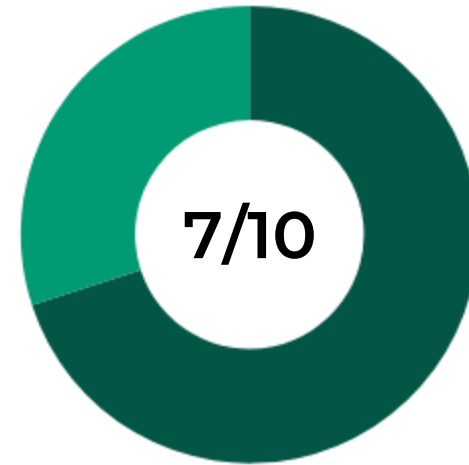


LEED Platinum

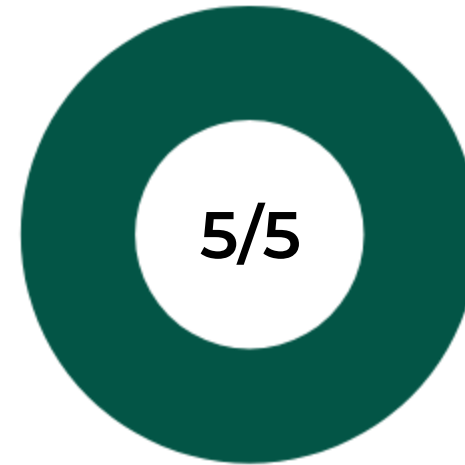
Integrated Process



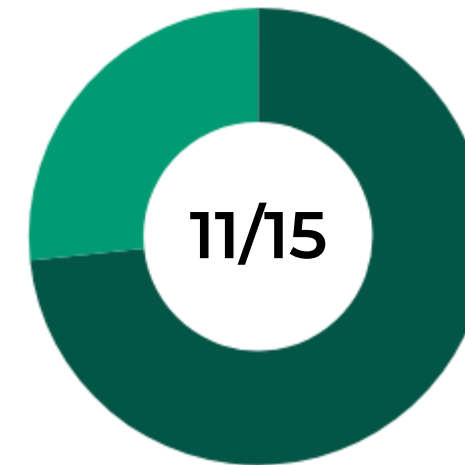
Location & Transport



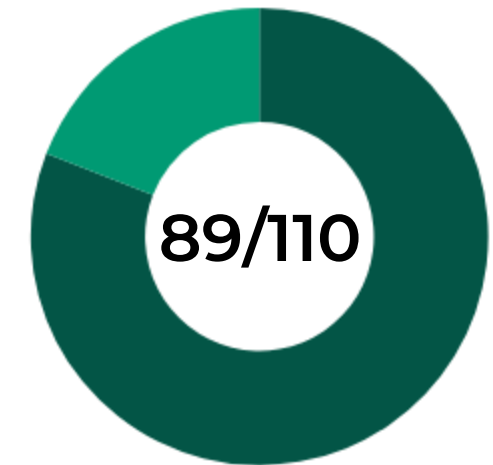
Sustainable Sites



Water Efficiency



Total Points



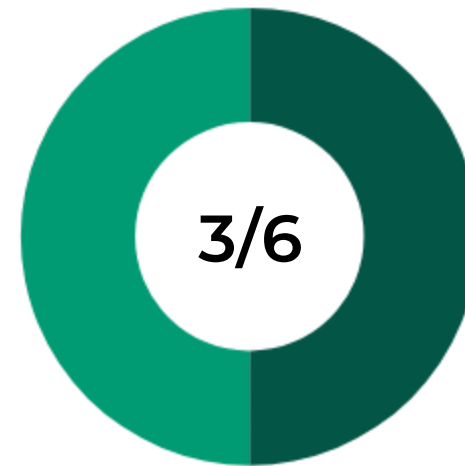
Material & Resources



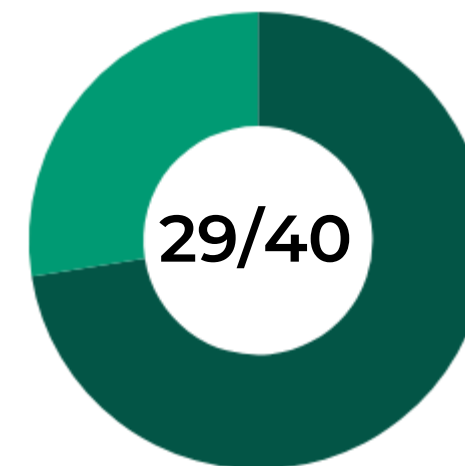
Indoor air quality



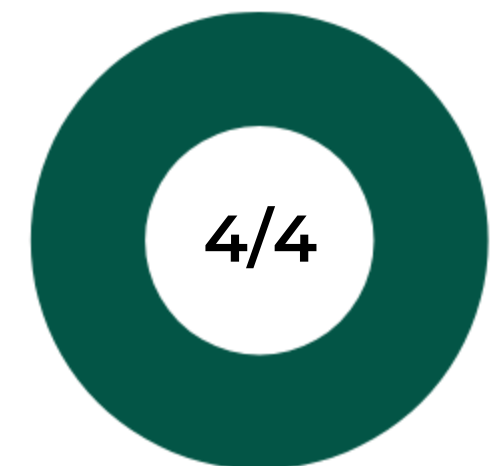
Innovation



Energy & Atmosphere

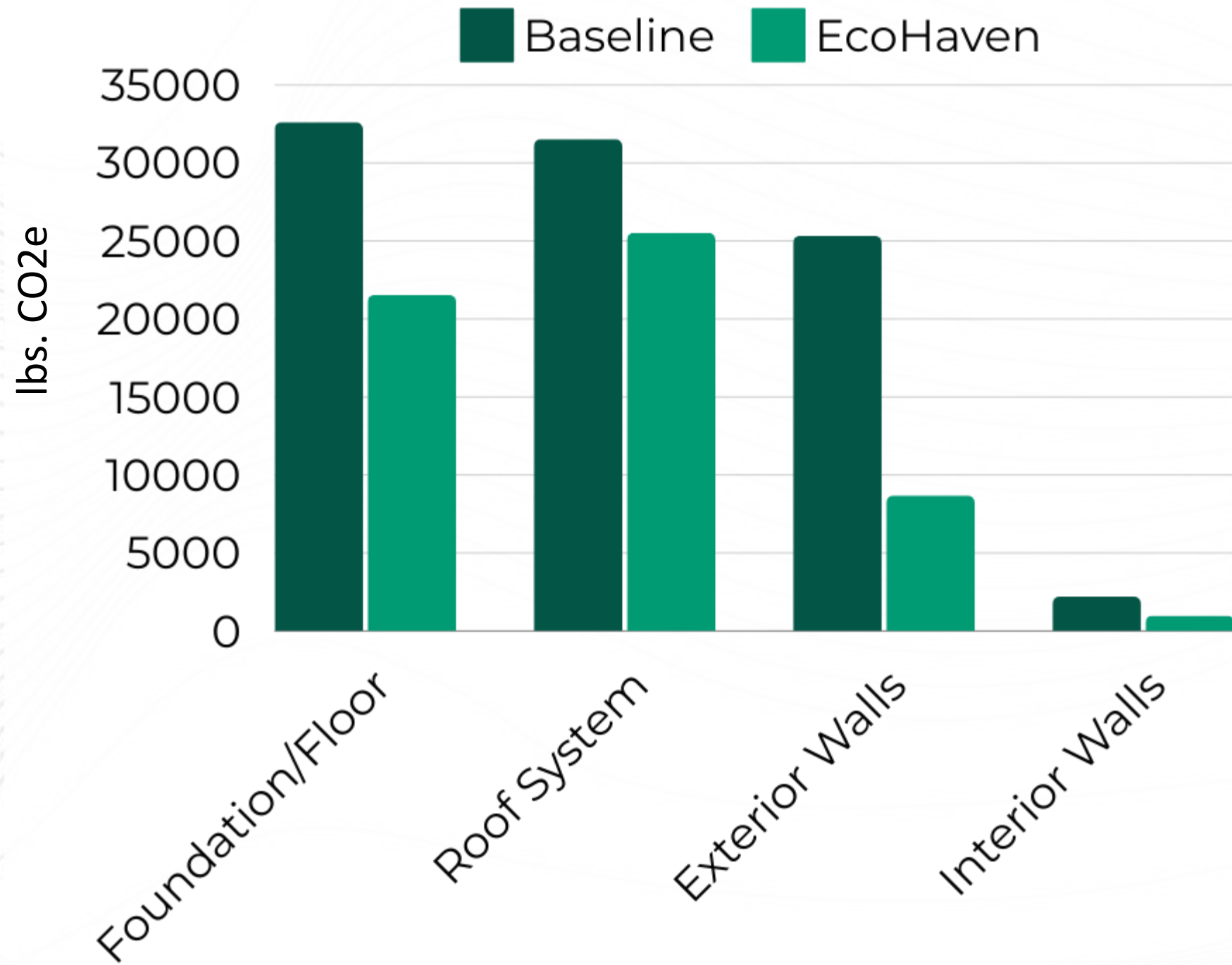


Regional Priority



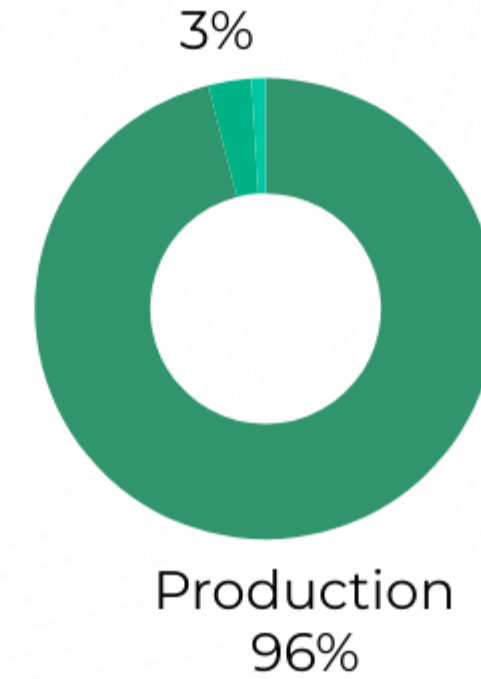
Life-Cycle

EcoHaven vs. Baseline Embodied Carbon



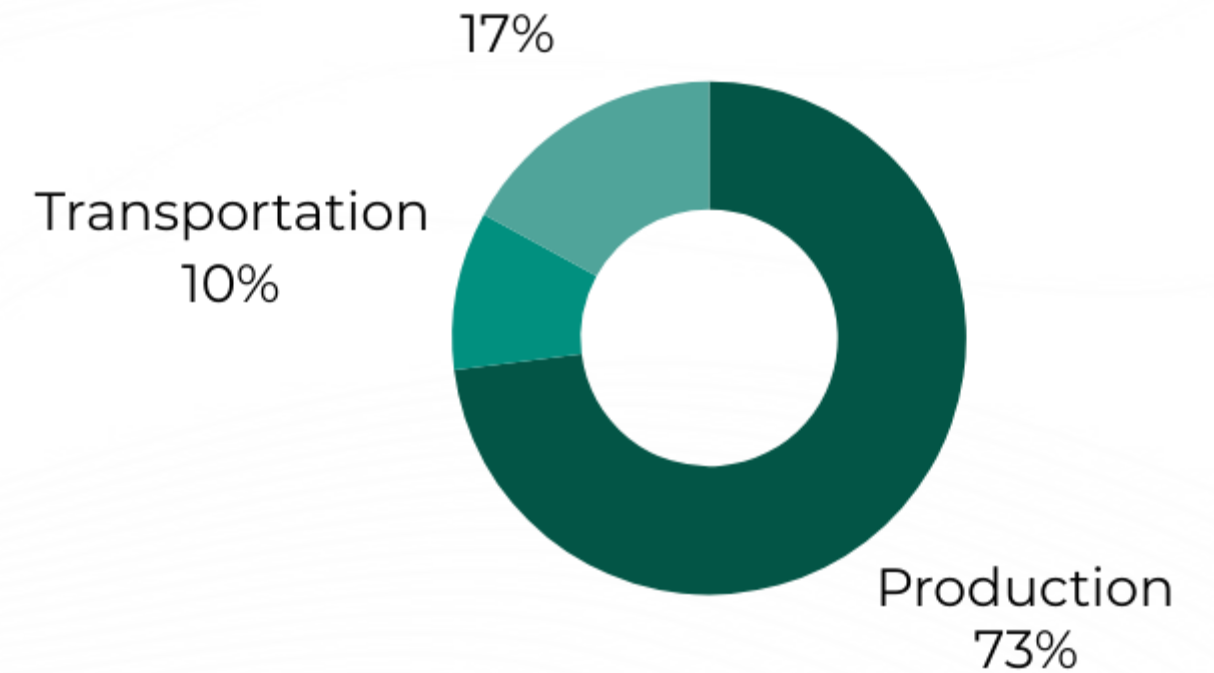
EcoHaven's Embodied Carbon by Life-Cycle Stage

Repair, Replacement & End-of-Life



Baseline Embodied Carbon by Life-Cycle Stage

Repair, Replacement & End-of-Life



Community Impact

Scalable



Community Informed



Disaster Resilient



Energy & Water Efficient



Comfortable & Healthy

Community Impact

Scalable



Community Informed



Disaster Resilient



Energy & Water Efficient



Comfortable & Healthy



Community Impact

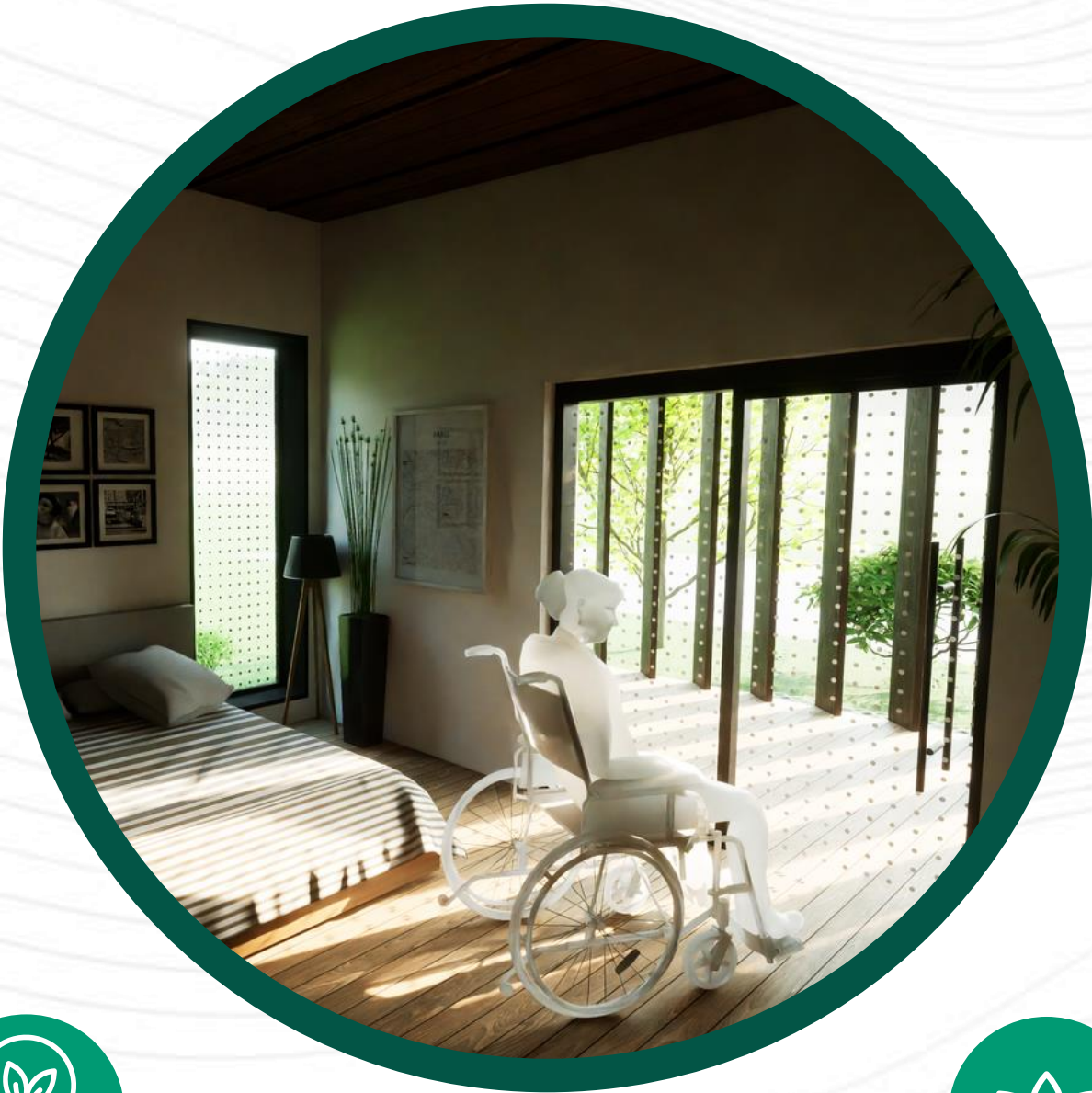
Scalable



Community Informed



Disaster Resilient



Energy & Water Efficient



Comfortable & Healthy

Community Impact

Scalable



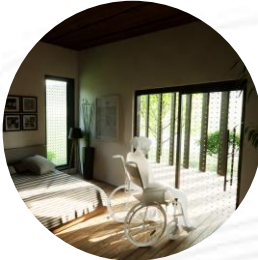
Community Informed



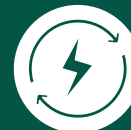
Disaster Resilient



Energy & Water Efficient



Comfortable & Healthy



Community Impact

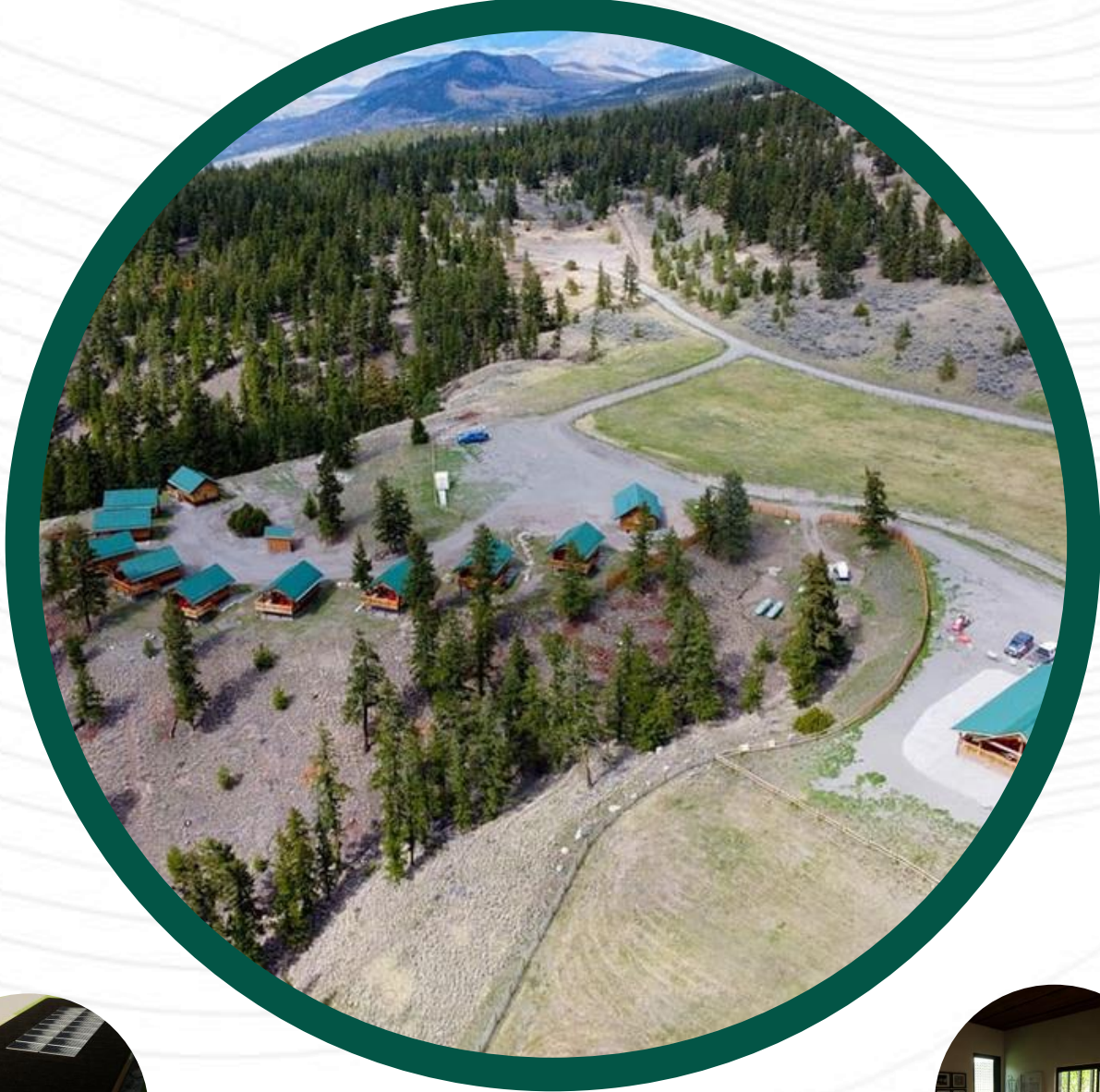
Scalable



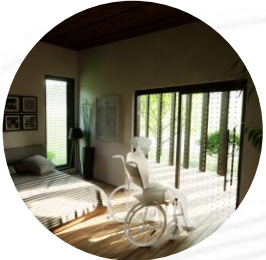
Community Informed



Disaster Resilient



Energy & Water Efficient



Comfortable & Healthy



Community Impact

Scalable



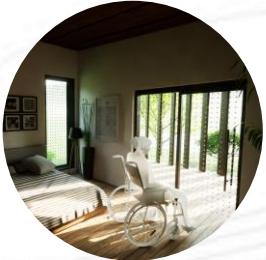
Community Informed



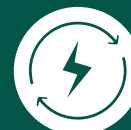
Disaster Resilient



Energy & Water Efficient



Comfortable & Healthy





Innovate, Design, Sustain: EcoHaven

Building Better and Faster

Appendix 1: Building Codes

Canadian Codes

- British Columbia Building Code 2024
 - Part 4 – Structural Design § British Columbia Building Code, BC Reg. 295/24, s.4., Structural Design.
 - Part 9 – Housing and Small Buildings § British Columbia Building Code, BC Reg. 295/24, s.9., Housing and Small Buildings.
 - British Columbia Building Code, BC Reg. 295/18, s.9.36.6., Energy Step Code.
- British Columbia Plumbing Code 2018

Canadian Standards

- Engineering Design in Wood, Canadian Standards Association O86, 2019.
- Design of Steel Structures, Canadian Standards Association S16, 2019.
- National guide for wildland-urban-interface fires, National Research Council of Canada, 2021.
- The Canadian Electrical Code Regulations, RRS c E-7.1 Reg. 4, 2018.
- ENERGY STAR for New Homes Standard, Version 17.1—Revision 2, 2020.
- City of Vancouver Embodied Carbon Guidelines, Version 1.0, 2023.
- National guidelines for whole-building life cycle assessment, National Research Council of Canada, 2022.

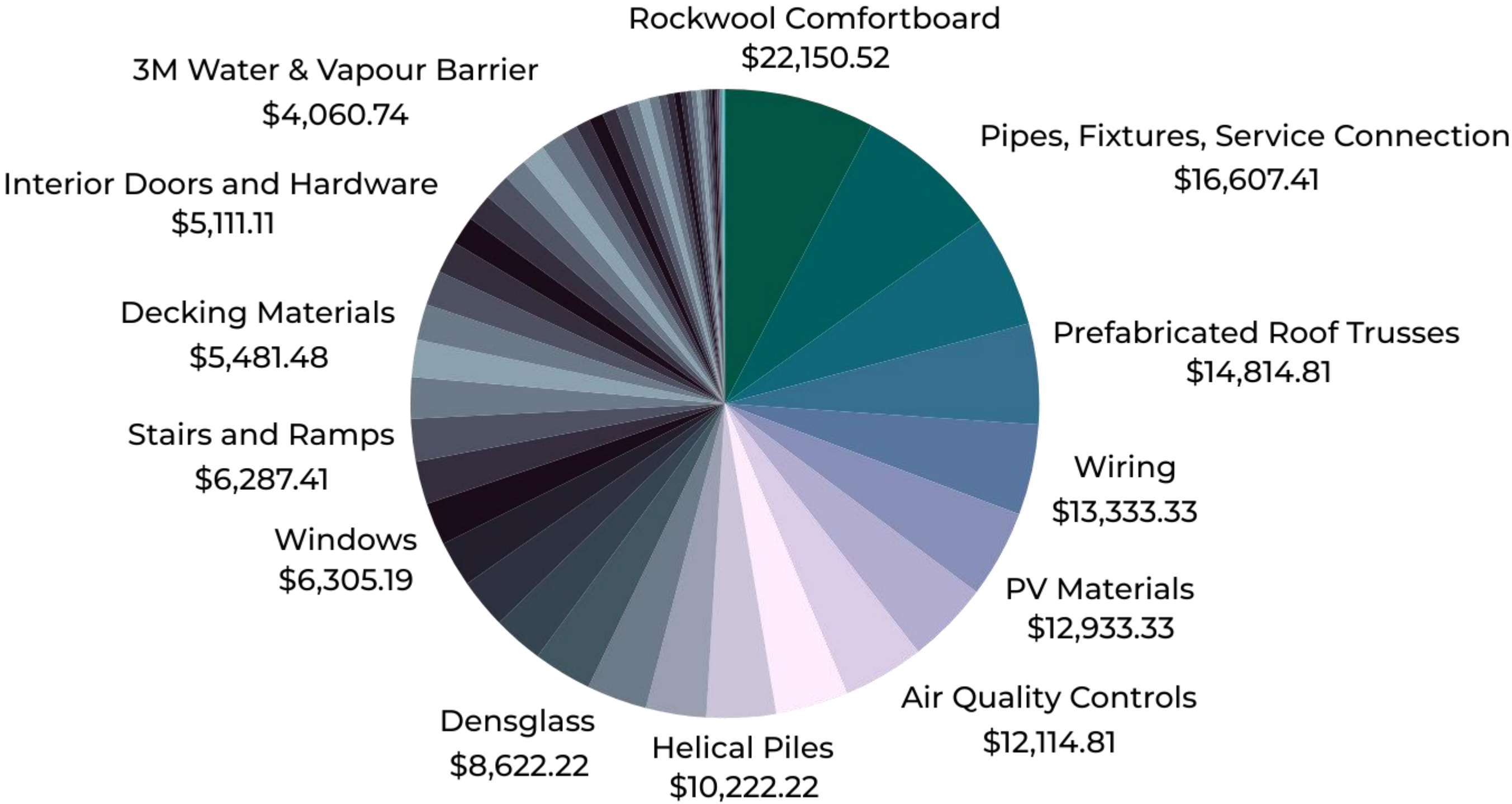
International Standards

- International Energy Conservation Code 2021
 - Building Envelope Requirements, International Energy Conservation Code Section R402, 2021.
 - Climate Zones, International Energy Conservation Code Section R301, 2021.
- Building Envelope Requirements, International Energy Conservation Code Section R402, 2021.
- Climate Zones, International Energy Conservation Code Section R301, 2021.
- International Green Construction Code 2021
- Ventilation for Acceptable Indoor Air Quality in Residential Buildings, ASHRAE Standard 62.2, 2022.
- Standard Method of Evaluating Zero Net Energy and Zero Net Carbon Building Performance, ASHRAE Standard 228, 2023.
- Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index, ANSI/RESNET/ICC Standard 301, 2022.
- Hygrothermal performance of building components and building elements — Internal surface temperature to avoid critical surface humidity and interstitial condensation — Calculation methods, International Organization for Standards 13788, Version 2.0, 2012.
- LEED v4.1 Residential Single Family Homes, U.S. Green Building Council, 2020.
- Designing and Specifying Daylighting for Buildings, American National Standard LP-3-20, Illuminating Engineering Society, 2020.

US Standards

- Americans With Disabilities Act of 1990, 42 U.S.C. § 12101 et seq. (2008).
- DOE Zero Energy Ready Home Program, Single Family Version 2, 2022.
- DOE Zero Energy Ready Home Program, Manufactured Housing Version 1, 2022.

Appendix 2: Cost Breakdown



Appendix 3: Mechanical Specifications



SANCO2 Heat Pump Water Heater

43-gallon tank

- 5x more efficient than electric heaters
- Delivery rating: 115 gallons in first hour
- Capacity to deliver 15,000 BTU/hour
- Allows use of off-peak power
- Minimum Operating Temperature: -22F
- CO2 used as refrigerant
- Up to 150°F delivered hot water temperature



Hydraloop H300 Greywater Recovery System

- Input: Greywater from shower, bath, and washing machine
- Output: Two valves for reusable water to the toilets and the washing machine
- Cleans 80 gallons per day
- Wi-Fi Enabled
- Save 25% to 45% on tap water with clean, clear, safe, and disinfected reuse water.
- Control and monitor performance with Smartphone app

Appendix 3: Mechanical Specifications



Lennox EL22XPV Air-to-Air Heat Pump

36,000 BTU
SEER: 22

Efficiency Rating (HSPF): 9.5
WiFi enabled (iOS & Android)

Minimum Operating Temperature: -4F
Self-cleaning, leakage detection
Diagnostics display
De-humidification
Comfortable sound levels - 65 decibels



Lennox CBA27UHE Air Handler

Multi-Speed

High-Efficiency Evaporator Coil
High Static Capability

Constant torque motor adjusts airspeed based on demand
Drain pan inhibits mold and mildew growth
R-410A refrigerant



Panasonic Intelli-Balance Energy Recovery Ventilator

Customizable Air Flow: 50 to 100 CFM
Real-time monitoring
Minimum Operating Temperature: -22F
Frost control: automatic timed recirculation
MERV13 Filters

Appendix 4: Building Controls & Air Quality



Conway Airmega Mighty Air Purifier

36,000 BTU

HEPA Filter

Constantly monitoring the air quality and automatically adjusts

Receive alerts when air filters need to be replaced or cleaned

Wi-Fi enabled with Mobile IoCare App

Ultra quiet with noise levels of 24 dB to 53 dB



Lennox IComfort S30

Energy Star Certified

Performance Reports

Adapts to occupant patterns

Temperature & Humidity Control

App to control and monitor from anywhere

Smart Away Mode: GPS monitoring automatically increases system efficiency when you're away

Maintenance reminders

Alerts indicate when there's a problem that needs immediate attention

First Alert Smoke Detector

Uses both ionization and photoelectric sensing technologies for best protection

Ionization alarms are more sensitive to fast flaming fires

Photoelectric alarms are generally more sensitive to smoldering fires

10 Year Battery Life

Wifi-Enabled

Voice alerts



LG PuriCare

Removes 50 pints/day

ENERGY STAR Certified

Set relative humidity between 30% - 80% in 5% increments

Reusable and washable air filter

Appendix 5: Appliances



Stovetop Oven
LG Smart Wi-Fi Enabled ProBake Convection Oven
Annual Energy Use (kWh/yr): 195
Compatible with Samsung SmartThings
Monitor cooking progress
Wi-Fi enabled & remote oven control
Energy Star Certified
ADA Compliant



Refrigerator
Samsung 25 cu. ft. 33" 3-Door French Door
Annual Energy Use (kWh/yr): 643
Compatible with Samsung SmartThings
Receive alerts when filters need to be changed
Alerts you when the door is left open, or if there is an unexpected change in temperature
Energy Star Certified
ADA Compliant



Hood Range
RIAS Smart Ducted Stainless Steel Under Cabinet Range Hood
Remote control and voice control via smart home hub
600 CFM
Low Noise (43 dBA)
ADA Compliant



Microwave
Samsung 1.8 cu.ft. Countertop Microwave with Sensor Cook
Compatible with Samsung SmartThings
ADA Compliant

Appendix 6: Appliances



Dishwasher

Samsung Smart Stormwash+ 7 Series 42 dBA
Dishwasher with Smart Dry
Annual Energy Use (kWh/yr): 239
Compatible with Samsung SmartThings
Intelligently senses and adjusts drying temperature
and releases the door to help achieve fast drying
results
Energy Star Certified
ADA Compliant



Washing Machine

Samsung Stackable Steam Cycle Smart Front-
Load Washer
Annual Energy Use (kWh/yr): 90
Compatible with Samsung SmartThings
Get end of cycle alerts, remotely start, and set
schedules
Energy Star Certified
ADA Compliant



Dryer

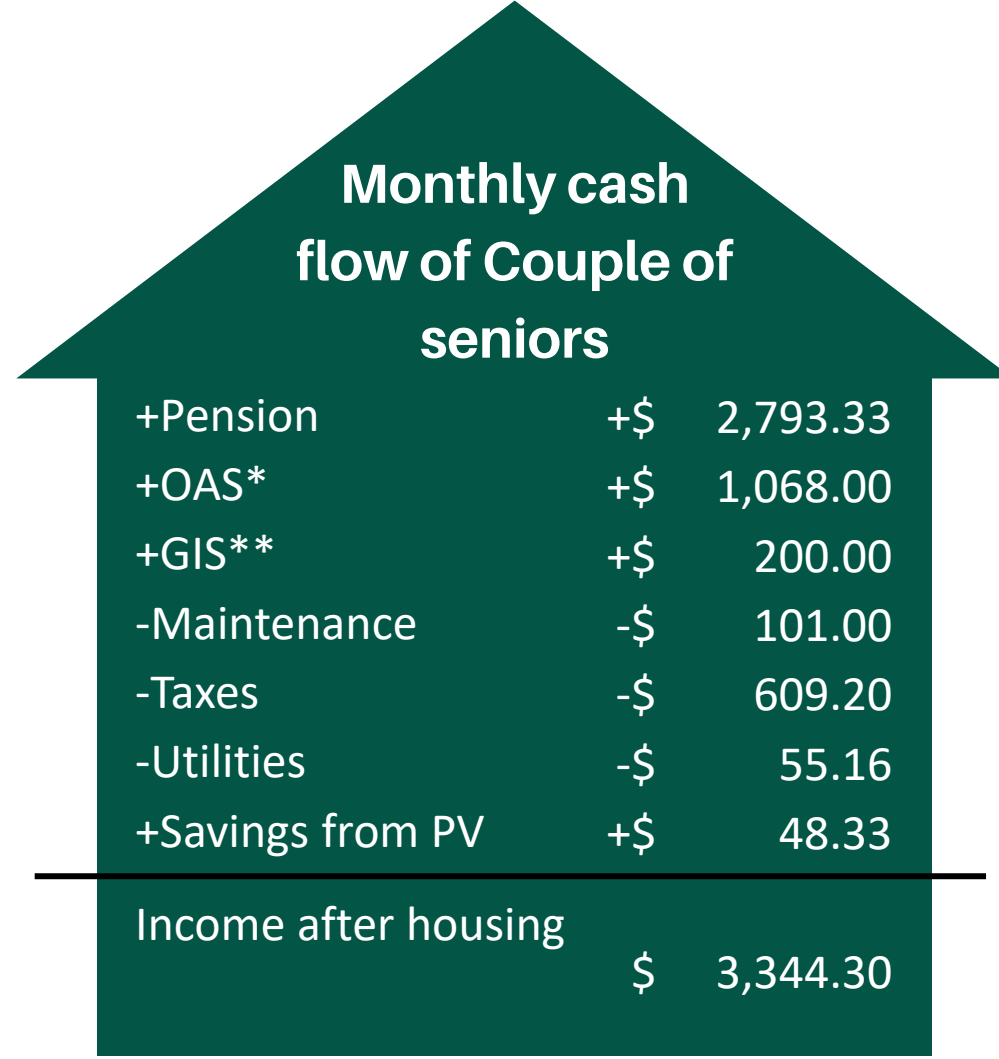
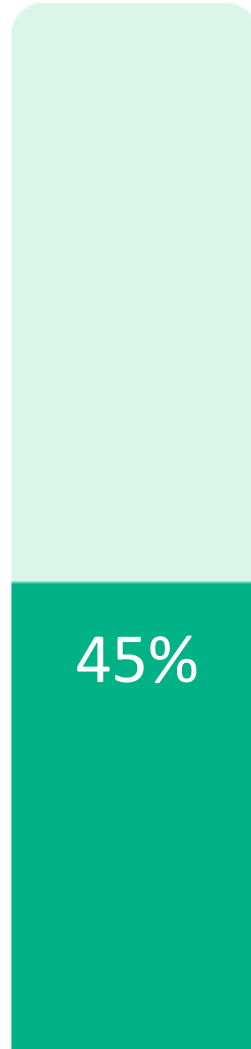
Samsung Stackable Ventless Smart Electric Dryer
Annual Energy Use (kWh/yr): 125
Compatible with Samsung SmartThings
Automatically optimizes the time and
temperature of your drying cycle
Energy Star Certified
ADA Compliant

Appendix 7: Affordability

Couple of seniors

Budget*
\$657,000

\$301,285
Purchase
Price



*OAS: Old Age Security pension
**GIS: Guaranteed Income Supplement

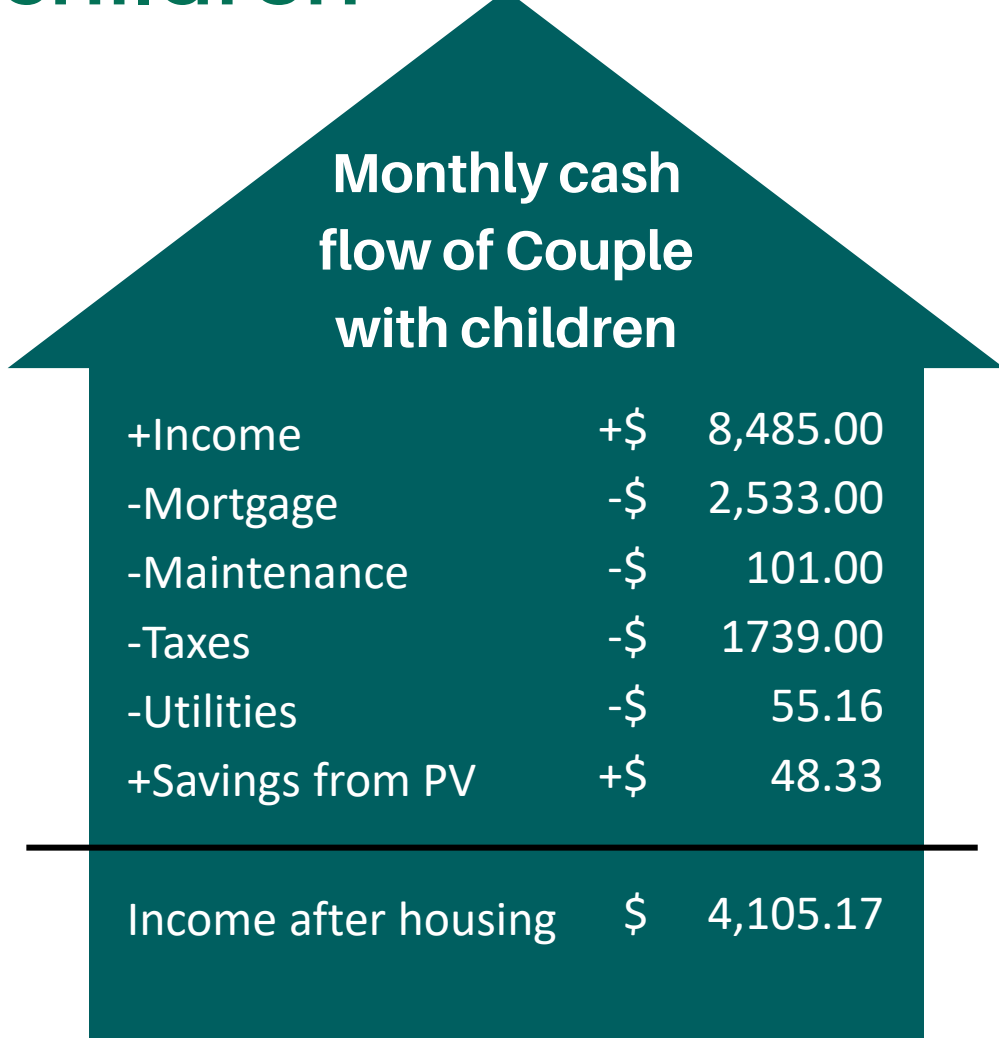
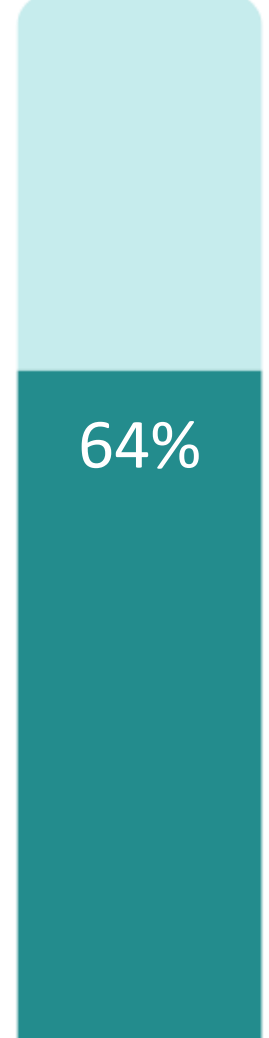
- **Age amount tax credit of \$6,213**
- **Pension income amount credit up to \$1,480.**

*Average current value of single family homes in Salmon Arm (2024)-downsizing scenario

Couple with children

\$423,344
Budget*

\$301,285
Final price of
EcoHaven



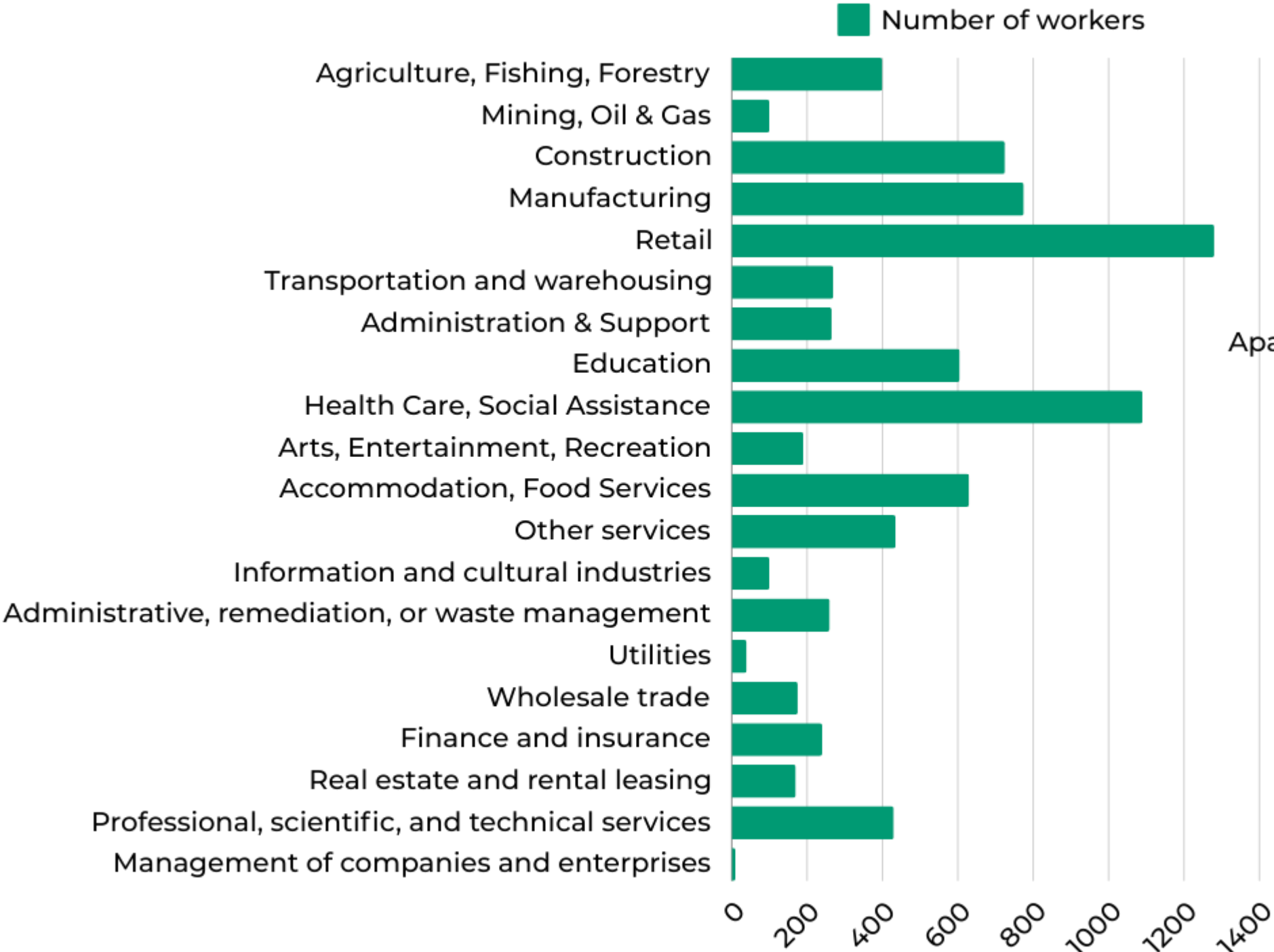
*Maximum affordable mortgage (10% down payment, 5.19% annual interest rate, 25-year term)

- **First-Time Home Buyers' Tax Credit of \$1,100**
- **First Home Savings Account (tax-free) up to \$29,630**

Appendix 8: Demographic data

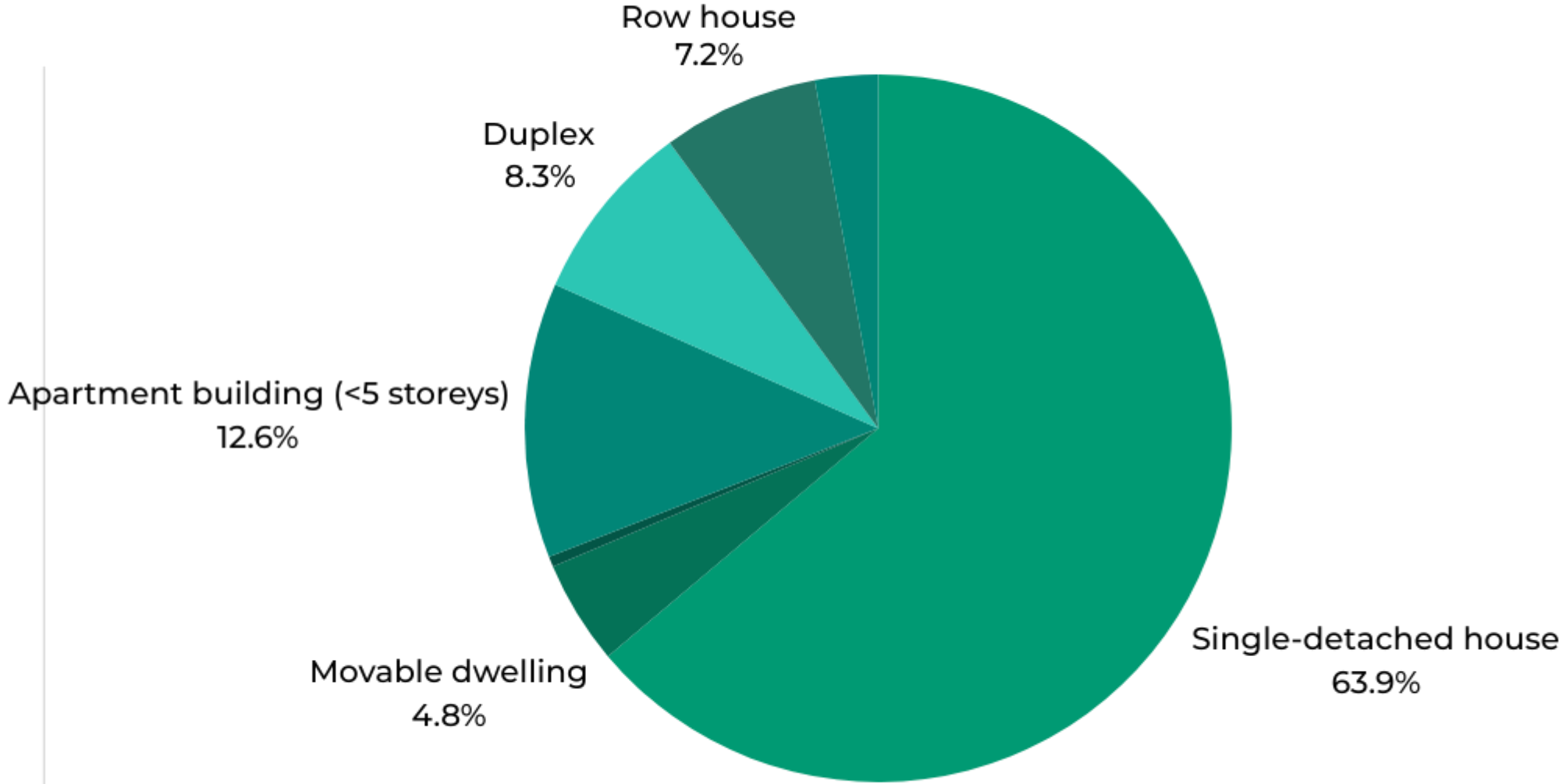
Number of workers employed in each industry, 2016

Source: Statistics Canada, Custom information for BC Ministry of Municipal Affairs and Housing



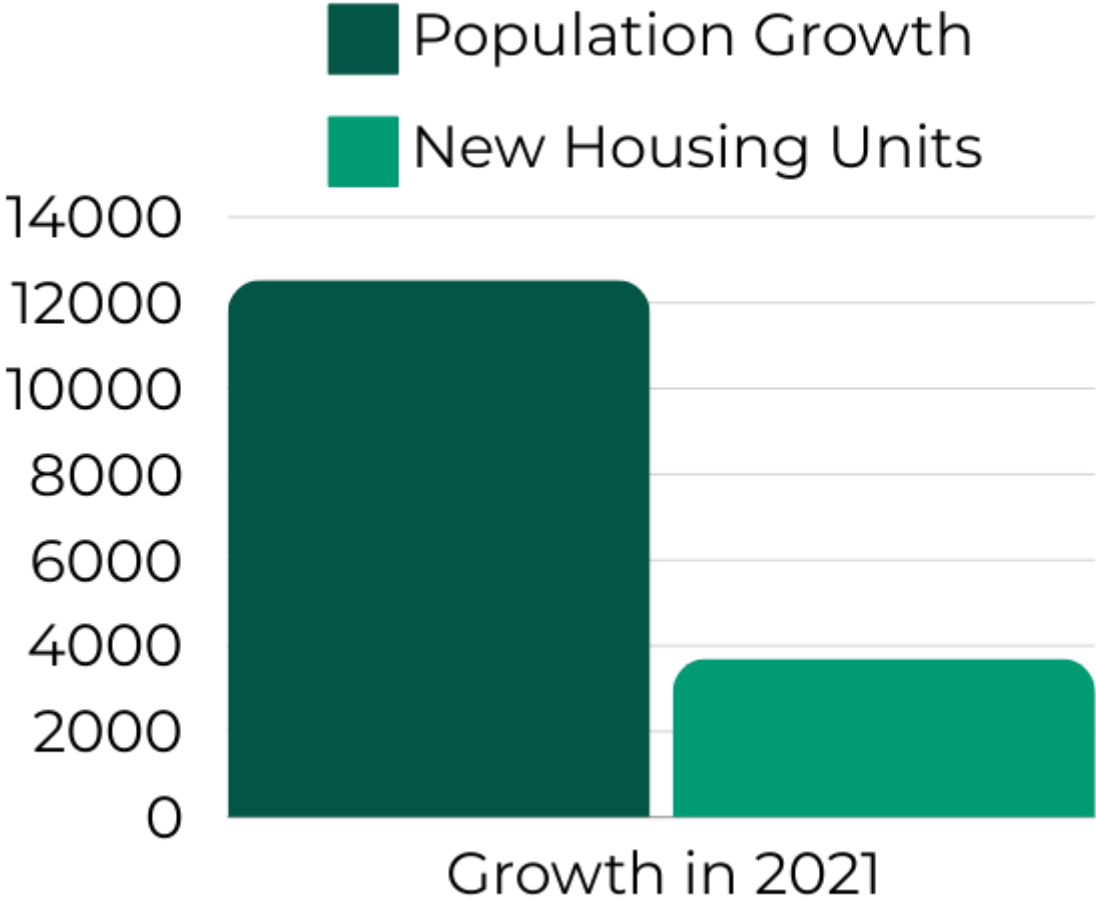
Salmon Arm Housing by Type, 2016

Source: Statistics Canada, Census 2016, Custom information for BC Ministry of Municipal Affairs and Housing

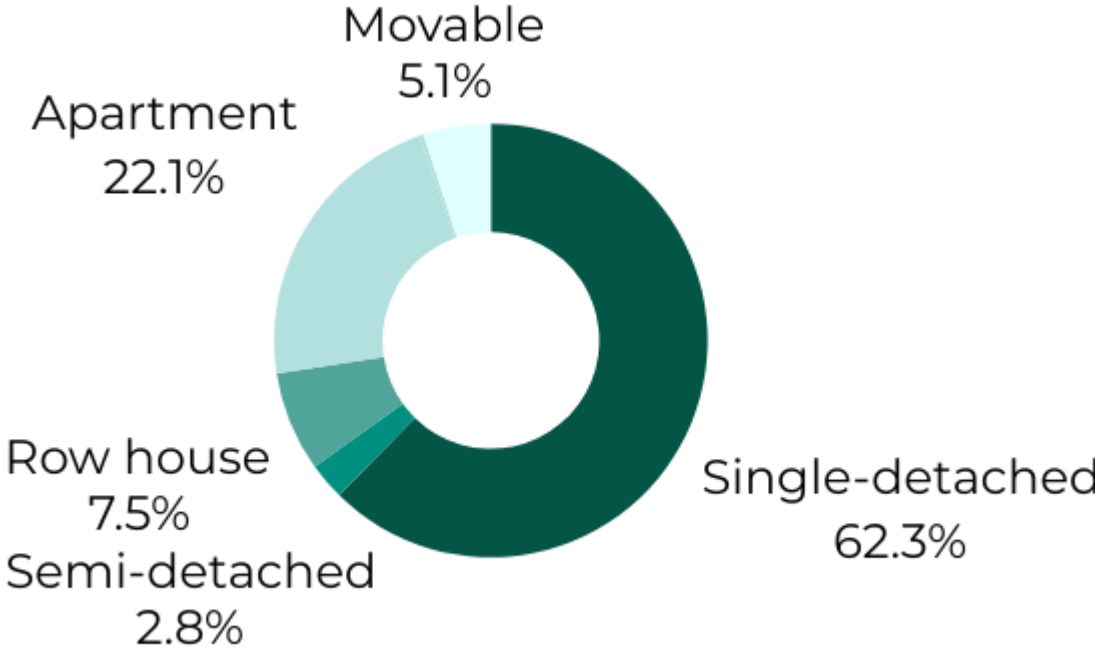


Appendix 9: Demographics & Target Market

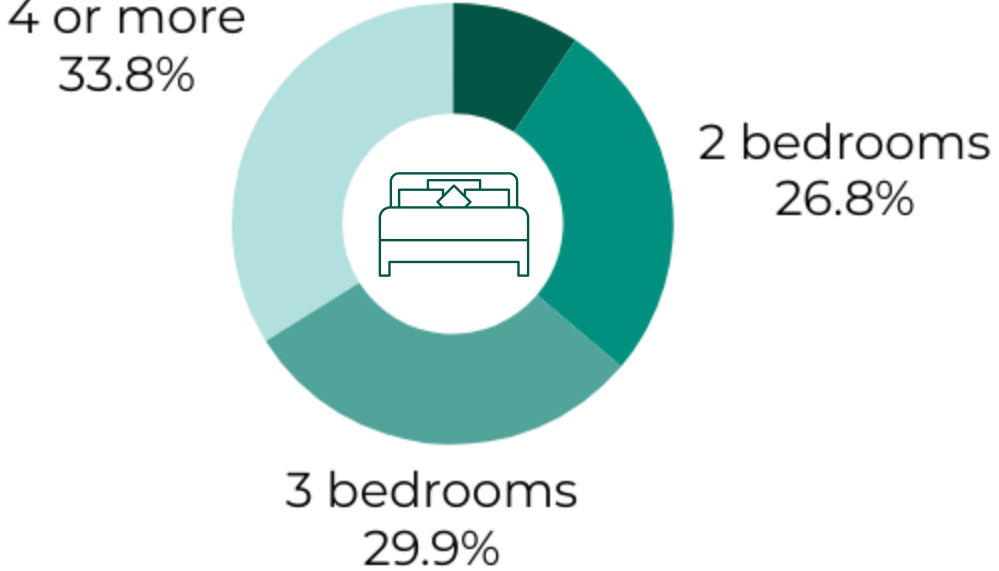
Population Growth vs. New Housing Unit Construction in 2021



Housing Types Salmon Arm



Bedrooms per Dwelling Unit Salmon Arm



Current State of Salmon Arm Housing Market



Salmon Arm Age Demographics

