Location Case Studies

Honour Ranch

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

City of Salmon Arm

SITE PLAN: IMPLEMENTATION CASE STUDY

SITE PLAN: URBAN CASE STUDY
Location Case Studies

Honour Ranch

City of Salmon Arm

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

SITE PLAN: IMPLEMENTATION CASE STUDY

SITE PLAN: URBAN CASE STUDY

Vernon
Ashcroft
Kamloops
Merritt
Lillooet
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
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
Design Strategy

- Disaster Resilient
- Scalable
- Comfortable & Healthy
- Energy Efficient
- Community Engagement
Current State of Market

Typical Single-family Home

<table>
<thead>
<tr>
<th>Embodied Carbon</th>
<th>50 lbs CO2e/sqft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Cost</td>
<td>$235/sqft</td>
</tr>
<tr>
<td>Construction Time</td>
<td>8 months</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>30.8 MBTU/yr</td>
</tr>
<tr>
<td>Energy Production</td>
<td>0</td>
</tr>
<tr>
<td>Water Consumption</td>
<td>54,969 gal/yr</td>
</tr>
</tbody>
</table>

EcoHaven

<table>
<thead>
<tr>
<th>Embodied Carbon</th>
<th>44 lbs CO2e/sqft</th>
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<tbody>
<tr>
<td>Construction Cost</td>
<td>$232/sqft</td>
</tr>
<tr>
<td>Construction Time</td>
<td>4 months</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>17.4 MBTU/yr</td>
</tr>
<tr>
<td>Energy Production</td>
<td>27.4 MBTU/yr</td>
</tr>
<tr>
<td>Water Consumption</td>
<td>36,312 gal/yr</td>
</tr>
</tbody>
</table>
Demographics

Senior couples
31.1% of population

Couples with children
20.5% of families

62.3% Of dwellings in are single-detached houses

2.3 people Average size of families in Salmon Arm

50% Of seniors live in inaccessible housing

26.8% Of dwellings are 2-bedrooms
Affordability

Senior Couple
- Budget: $657,000
- Purchase Price: $301,285
- Budget as Percentage: 45%

Couple with children
- Budget: $423,344
- Purchase Price: $301,285
- Budget as Percentage: 64%
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

Metal Roofing, Windows & Sliding Doors
Vancouver Island, BC

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

Lumber & Helical Piles
Kamloops, BC

MgO Board
Irricana, AB

ROCKWOOL
Grand Forks, BC

HempWool
Jerome, ID

Metal Louvers
Edmonton, AB

DensGlass
Tacoma, WA

Exterior Doors
Winnipeg, MB
Site & Climate Analysis

Monthly Mean Relative Humidity
- Salmon Arm
- Honour Ranch

Mean High & Low Temperature

°F
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
BC FireSmart Landscaping Zones

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

Site Built Schedule

- Design Eng.
- Permits & Approvals
- Site Development & Foundation
- Building Construction
- Site Restoration

Modular Schedule

- Design Eng.
- Permits & Approvals
- Site Development & Foundation
- Install & Site Restoration
- Module Fabrication

Time Savings

8 months
4 months

PREFABRICATED MODULES
Construction Costs

Total Cost: $301,285

- Wall Assembly: 24.5%
- HVAC: 10.5%
- Interior Finishes: 10%
- Framing: 9.6%
- Exterior Deck: 8.3%
- Plumbing: 7.9%
- Fenestration: 6.2%
- Power Distribution: 4.9%
- PV Array: 4.5%
- Lighting: 0.4%
- Foundation: 3.6%
Structural Engineering

- Vaulted Parallel Cord Truss System
- Galvanized Steel Deck Framing
- Thermal Break Deck Connection
- Prefabricated Open Web Joist Floor
- Helical Pile Foundation

STRUCTURAL COMPONENTS AND MODULES
BC CODE 4.1
**Envelope Assemblies**

**EXTERIOR WALL CROSS SECTION**

- **BC CODE 9.11 & 9.25**
- **3M Air and Vapor Barrier**
- **Hempwool Cavity Insulation**
- **Magnesium Oxide Wallboard**
- **DensGlass**
- **Furring**
- **ROCKWOOLComfort Board 80**
- **HardiePanel Vertical Siding**

**NORTH FACADE**

- **Envelope Assemblies**
- **Performance**
- **Metric**
- **BC Code**
- **IECC R402.1.2.**
- **DOE ZERH**
- **Canadian Energy Star**
- **EcoHaven**

<table>
<thead>
<tr>
<th>Performance Metric</th>
<th>BC Code</th>
<th>IECC R402.1.2.</th>
<th>DOE ZERH</th>
<th>Canadian Energy Star</th>
<th>EcoHaven</th>
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</thead>
<tbody>
<tr>
<td>Exterior Wall</td>
<td>R 21.0</td>
<td>R 22.2</td>
<td>R 22.2</td>
<td>R 17.5</td>
<td>R 37.0</td>
</tr>
<tr>
<td>Low-slope Roof</td>
<td>R 30.0</td>
<td>R 41.7</td>
<td>R 41.7</td>
<td>R 26.5</td>
<td>R 43.5</td>
</tr>
<tr>
<td>Crawlspace</td>
<td>R 26.5</td>
<td>R 18.2</td>
<td>R 18.2</td>
<td>R 26.5</td>
<td>R 54.2</td>
</tr>
</tbody>
</table>
**Envelope Assemblies**

- **QuietWalk Plus**
- **MgO Subfloor**
- **Low-VOC Flooring**
- **SOF Seal Gasket**
- **DensGlass**
- **ROCKWOOL Comfort Board 80**
- **PanelShield SA**
- **Open Web Joist**

**Performance Metric**

<table>
<thead>
<tr>
<th></th>
<th>BC Code</th>
<th>IECC R402.1.2.</th>
<th>DOE ZERH</th>
<th>Canadian Energy Star</th>
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<td>Low-slope Roof</td>
<td>R 30.0</td>
<td>R 41.7</td>
<td>R 41.7</td>
<td>R 26.5</td>
<td>R 43.5</td>
</tr>
<tr>
<td>Crawlspace</td>
<td>R 26.5</td>
<td>R 18.2</td>
<td>R 18.2</td>
<td>R 26.5</td>
<td>R 54.2</td>
</tr>
</tbody>
</table>
Fenestration
## Moisture & Durability

![Southwest Corner Image]

### Wall Assembly

<table>
<thead>
<tr>
<th>Thermal resistance distribution</th>
<th>Diffusion resistance distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Outer</td>
</tr>
<tr>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>3/4&quot; Magnesium Oxide Wallboard</td>
<td>100%</td>
</tr>
<tr>
<td>5/8&quot; Densglass Fireguard</td>
<td></td>
</tr>
<tr>
<td>5&quot; ROCKWOOL Comfort Board 80</td>
<td></td>
</tr>
<tr>
<td>HardiePanel</td>
<td></td>
</tr>
<tr>
<td>3.5&quot; HempWool</td>
<td>Inner</td>
</tr>
<tr>
<td>3/4&quot; Magnesium Oxide Wallboard</td>
<td></td>
</tr>
</tbody>
</table>

![Wall Assembly Diagram]
Acoustics

STC Rating of 45

IIC of 71
## SANCO2 Water Heater

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

## Hydraloop H300

- Reduces water use by 45%
- Self-cleaning

---

**Water Distribution**

- HOT
- COLD
- WASTE
- GREYWATER INPUT
- RECYCLED
- GREYWATER VENT PIPING

---

**PLUMBING LAYOUT**

BC CODE 9.31
Heating, Cooling & Ventilation

<table>
<thead>
<tr>
<th>System</th>
<th>Product</th>
<th>Description</th>
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<tbody>
<tr>
<td>Air-source Heat Pump</td>
<td>Lennox EL22XPV</td>
<td>• SEER 22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Min. Operating Temperature: -4F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• HSPF 9.5</td>
</tr>
<tr>
<td>Energy Recovery Ventilator</td>
<td>Panasonic Intelli-Balance</td>
<td>• 50-100 CFM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• MERV13 filter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Real-time monitoring</td>
</tr>
<tr>
<td>Air Purifier</td>
<td>Coway Airmega Mighty</td>
<td>• HEPA filter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Automatic shut-off</td>
</tr>
<tr>
<td>Portable Dehumidifier</td>
<td>LG PuriCare</td>
<td>• ENERGY STAR Rated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reusable filter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Smart sensors</td>
</tr>
</tbody>
</table>
Indoor Air Quality

OPEN CONCEPT LIVING SPACE

IAQ Risk Assessment

- High Risk
- Moderate Risk
- Low Risk

- Carbon Dioxide
- Carbon Monoxide
- Vehicle Exhaust
- Ozone
- Radon
- Humidity
- Ambient/Outdoor Air
- VOCs
- Cooking
- Wildfire Smoke
- Viruses
- Fine Particulate Matter (PM2.5)
Daylighting & Lighting
Daylighting & Lighting

ARTIFICIAL LIGHTING
Photovoltaic Array

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

Annual Energy Consumption vs. Production

- Jan
- Feb
- Mar
- Apr
- May
- Jun
- Jul
- Aug
- Sept
- Oct
- Nov
- Dec
BC Grid & Reliability

PV ARRAY & ELECTRICAL CONNECTIONS
CANADIAN ELECTRICAL CODE

BC Hydro Grid Distribution

- Hydroelectric: 87%
- Biomass: 4%
- Wind: 4%
- Other (Natural gas, solar): 5%

95% Renewable Sources & Energy Factor of 1.11
Efficiency

Annual Energy Consumption

Performance Metric

<table>
<thead>
<tr>
<th></th>
<th>BC Step 5</th>
<th>Salmon Arm</th>
<th>Honour Ranch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy Demand Intensity (kBTU/sqft yr)</td>
<td>7.3</td>
<td>5.9</td>
<td>5.6</td>
</tr>
<tr>
<td>Mechanical Energy Use Intensity (kBTU/sqft yr)</td>
<td>12.8</td>
<td>9.0</td>
<td>8.8</td>
</tr>
<tr>
<td>Water Use Intensity (gal/sqft yr)</td>
<td>-</td>
<td>16.91</td>
<td>16.91</td>
</tr>
</tbody>
</table>

Energy Consumption by End Use

- Water Systems: 23.5%
- Heating: 13.4%
- Cooling: 28.1%
- Electrical Loads: 27.9%
- Lighting: 4.1%
- Fans: 2.9%
Climate Resilience & Scalability

Projected Annual Energy Consumption

<table>
<thead>
<tr>
<th>MBTU</th>
<th>2020</th>
<th>2050</th>
<th>2080</th>
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<tbody>
<tr>
<td></td>
<td>Vernon</td>
<td>Salmon Arm</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
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<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LEED Platinum

Integrated Process: 2/2
Location & Transport: 7/10
Sustainable Sites: 5/5
Water Efficiency: 11/15
Total Points: 89/110
Material & Resources: 12/12
Indoor air quality: 16/16
Innovation: 3/6
Energy & Atmosphere: 29/40
Regional Priority: 4/4
Life-Cycle

EcoHaven vs. Baseline Embodied Carbon

<table>
<thead>
<tr>
<th>Component</th>
<th>Baseline</th>
<th>EcoHaven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation/Floor</td>
<td>35,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Roof System</td>
<td>30,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Exterior Walls</td>
<td>20,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Interior Walls</td>
<td>10,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Total</td>
<td>95,000</td>
<td>42,000</td>
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</table>

EcoHaven’s Embodied Carbon by Life-Cycle Stage

- Production: 96%
- Repair, Replacement & End-of-Life: 3%
- Transportation: 10%
- Production: 73%
Community Impact

Community Informed

Disaster Resilient

Scalable

Energy & Water Efficient

Comfortable & Healthy
Community Impact

- Community Informed
- Scalable
- Disaster Resilient
- Energy & Water Efficient
- Comfortable & Healthy
Community Impact

- Community Informed
- Scalable
- Disaster Resilient
- Comfortable & Healthy
- Energy & Water Efficient
Community Impact

- Community Informed
- Energy & Water Efficient
- Disaster Resilient
- Comfortable & Healthy
- Scalable
Community Impact

Community Informed

Disaster Resilient

Scalable

Energy & Water Efficient

Comfortable & Healthy
Community Impact

- Community Informed
- Disaster Resilient
- Scalable
- 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 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
- Design of Steel Structures, Canadian Standards Association S16, 2019.

International Standards
- International Energy Conservation Code 2021
- International Green Construction Code 2021

US Standards
Appendix 2: Cost Breakdown

- **Rockwool Comfortboard**: $22,150.52
- **Pipes, Fixtures, Service Connection**: $16,607.41
- **Prefabricated Roof Trusses**: $14,814.81
- **Wiring**: $13,333.33
- **PV Materials**: $12,933.33
- **Air Quality Controls**: $12,114.81
- **HeliPiles**: $10,222.22
- **Densglass**: $8,622.22
- **Windows**: $6,305.19
- **Stairs and Ramps**: $6,287.41
- **Decking Materials**: $5,481.48
- **Interior Doors and Hardware**: $5,111.11
- **3M Water & Vapour Barrier**: $4,060.74
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: -22°F
- 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 smouldering 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

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

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

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**

<table>
<thead>
<tr>
<th>Monthly cash flow of Couple of seniors</th>
</tr>
</thead>
<tbody>
<tr>
<td>+Pension</td>
</tr>
<tr>
<td>+OAS*</td>
</tr>
<tr>
<td>+GIS**</td>
</tr>
<tr>
<td>-Maintenance</td>
</tr>
<tr>
<td>-Taxes</td>
</tr>
<tr>
<td>-Utilities</td>
</tr>
<tr>
<td>+Savings from PV</td>
</tr>
</tbody>
</table>

Income after housing $3,344.30

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

**Budget** $657,000

**Purchase Price** $301,285

45%

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

**Couple with children**

<table>
<thead>
<tr>
<th>Monthly cash flow of Couple with children</th>
</tr>
</thead>
<tbody>
<tr>
<td>+Income</td>
</tr>
<tr>
<td>-Mortgage</td>
</tr>
<tr>
<td>-Maintenance</td>
</tr>
<tr>
<td>-Taxes</td>
</tr>
<tr>
<td>-Utilities</td>
</tr>
<tr>
<td>+Savings from PV</td>
</tr>
</tbody>
</table>

Income after housing $4,105.17

**Budget** $423,344

**Final price of EcoHaven** $301,285

64%

*Maximum affordable mortgage (10% down payment, 5.19% annual interest rate, 25-year term)
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
- Population Growth
- New Housing Units

Current State of Salmon Arm Housing Market
- Unaffordable: 1440
- Unsuitable: 190
- Inadequate: 395

Housing Types Salmon Arm
- Apartment: 22.1%
- Row house: 7.5%
- Semi-detached: 2.8%
- Single-detached: 62.3%
- Movable: 5.1%

Bedrooms per Dwelling Unit
- 1 bedroom: 9.4%
- 2 bedrooms: 26.8%
- 3 bedrooms: 29.9%
- 4 or more: 33.8%

Salmon Arm Age Demographics
- 0-14: 14.5%
- 15-64: 55.1%
- 65+: 30.4%