Sustainable & Equitable Affordable Housing Design
The most sustainable thing we can do to support affordable housing communities is to make smart investments in the building envelope and build high quality durable buildings that will last.
We help solve the planet’s energy and water challenges.

339 STAFF  4 OFFICES  53 YEARS

OREGON  Portland + Eugene
CALIFORNIA  San Francisco
WASHINGTON  Seattle

Mechanical  Electrical  Plumbing  Analysis and Modeling  Technology  Commissioning  Architectural Lighting
Sustainable & Equitable Affordable Housing

Thermal Comfort
Wellness INDOOR AIR QUALITY + ACCESS TO OUTDOORS AND NATURE
High Quality Materials
Beauty

Robust LONG LIFE
Resilient
Low Maintenance
Affordable

COST
EXPERIENCE
OPERATIONS
STEP ONE: DEMAND REDUCTION
Climate Responsive Design

SAN FRANCISCO

SAN JOSE

DRY BULB TEMPERATURE

Outdoor Temperature (°F)

80% Acceptability Range - Within Comfort Range - Outside Comfort Range
Benefits of Passive House Strategies

Approach
- Peak Demand Reduction
- Annual Energy Reduction

Benefits
- Analyze Opportunities to Improve Envelope
- Invest in Longest Life Components
- Minimize HVAC Systems

Key Strategies:
- Reflective Insulated Roof
- High performing and operable windows
- Energy Recovery Ventilation
- Balanced Ventilation
- Total envelope is tightly sealed + super insulated
- Thermal Mass
Adaptive Thermal Comfort
Enhanced Passive House Design

- Improved Thermal Comfort
- Enhanced Filtration and Improved IAQ
- Reduced Ambient Noise

Key Features:
- Reflective Insulated Roof
- MERV-15 Carbon Filter
- Energy Recovery Ventilation with cooling + filtration
- Cooling Coil
- Balanced Ventilation
- Total envelope is tightly sealed + super insulated
- Thermal Mass
- High performing and operable windows
STEP TWO: ELECTRIFY
Step 1: Demand Reduction

Path to Carbon Neutrality
Step 1: Demand Reduction

Step 2: Electrify Buildings

Step 3: Decarbonize the Grid

Path to Carbon Neutrality

Carbon Emissions

- Gas
- Electricity

Fully Carbon Neutral
ALL-ELECTRIC BUILDING SYSTEMS
Traditional Gas Fueled

- Gas Boiler
- Gas-Fired Water Heater
- Gas Oven

Electric

- Domestic Hot Water
- Cooking
Traditional Gas Fueled

- Gas Boiler
- Gas-Fired Water Heater
- Gas Oven

Electric

- Air-Source Heat Pump
- Variable Refrigerant Flow
- Air-Source Heat Pump
- Water-Source Heat Pump DHWH
- Electric Heat
- Induction Cooking

Space Heating

Domestic Hot Water

Cooking
Sharing the Exchange

Heat Recovery Application | SIMULTANEOUS HEATING + COOLING

COEFFICIENT OF PERFORMANCE
≈ 7

Heat Recovery Application

DHW WSHP

Gas

High-Pressure Gas

60°F

75°F

120°F

55°F

Liquid

High-Pressure Liquid
Annual Solar Exposure

North Facing Facade

East Facing Facade

South Facing Facade

West Facing Facade
Horizontal Overhangs on South Facing Façade

Overhangs on South Facade

Without any Shading
Mechanical Systems Options

Energy Performance Results

Site Energy Use Breakdown
WITHOUT SOLAR PV

EUI (kBtu/sf/year)

- LEED Baseline: 49.3 EUI
- Option 1 VTAC: 33.7 EUI (31.7% Savings)
- Option 2 WSHP: 30.3 EUI (38.5% Savings)
- Option 3 WSHP + Geo: 27.8 EUI (43.7% Savings)
<table>
<thead>
<tr>
<th>Option</th>
<th>Ventilation System</th>
<th>Space Conditioning System</th>
<th>% Energy Savings AGAINST LEED BASELINE</th>
<th>Thermal/Acoustic Comfort EUI kBtu/SF/yr</th>
<th>System First Cost</th>
<th>Simple Payback YEARS</th>
<th>System Net Present Cost</th>
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<tbody>
<tr>
<td>1</td>
<td>Localized Apartment Outside Air Fan</td>
<td>VTAC</td>
<td>31.7%</td>
<td>$11.8M</td>
<td>-</td>
<td>$59.3M* $81.7M**</td>
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<tr>
<td>2</td>
<td>Localized Apartment Outside Air Fan</td>
<td>WSHP</td>
<td>38.5%</td>
<td>$12.0M</td>
<td>8.9</td>
<td>$53.2M* $73.2M**</td>
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<td>3</td>
<td>Localized Apartment Outside Air Fan</td>
<td>WSHP + Geo-Exchange</td>
<td>43.7%</td>
<td>$12.9M</td>
<td>12.8</td>
<td>$51.2M* $70.8M**</td>
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**NOTES**

* Dollar amount excludes the impact on tenant utility bills
** Dollar amount includes the impact on tenant utility bills
Sizing Geothermal Systems

Annual Hourly Load Profile

Cooling Load

Cooling Distribution

0.0%
0.1%
0.3%
0.9%
2.4%
4.8%
9.0%
16.0%
26.5%
40.0%
A geo-exchange system sized at 30% of peak cooling demand will meet 82.5% of all annual cooling loads.
EMBODIED CARBON
Lifecycle Carbon Offset

Life Cycle of a Building

EMBODIED ENERGY + CARBON EMISSIONS

- Extract Raw Materials
- Transport
- Manufacture Building Materials
- Transfer to Site
- Build
- Operate
- End of Life
Lifecycle Carbon Offset

Life Cycle of a Building

- Embodied
- Balance
- Renewables
- Operational
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