Multi-family Passive House Rehabilitation

The feasibility of improving affordability and health for low income individuals through extreme energy efficiency
Affordable Housing Crisis

ANNUAL INCOME & EXPENSES

INCOME

OPERATING EXPENSES

NEGATIVE CASH FLOW

POSITIVE CASH FLOW

TIME

OPERATING EXPENSES

20%
$1.37MM
Utilities

Reserves

Debt Services

Property Management

Resident Support Services

Maintenance

Other

Reserves

$1.37MM
Utilities

Reserves

Debt Services

Property Management

Resident Support Services

Maintenance

Other

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PH Efficiency Solution

TUNNELING THROUGH THE COST BARRIER

Source: Hawken & Lovins, Natural Capitalism

ANNUAL INCOME & EXPENSES

EFFICIENCY INVESTMENT

TIME

INCOME

REDUCED OPERATING EXPENSES

project team

Central City Concern
Walsh Construction
SERA Architects
Green Hammer

PAE Consulting Engineers

Source: Central City Concern
SERA
Walsh Construction
PAE Consulting Engineers
Green Hammer
Mark O. Hatfield Building

1930 (north & east elevation)

spalling concrete

today (north & east elevation)

today (south & east elevation)
Mark O. Hatfield Building

- 7 stories + basement
- 48,000 SF
- 106 single occupancy units
- completed in 1910;
- renovated in 1931, 1965, & 1994
- concrete frame construction

existing north elevation

proposed PH section

existing typical upper floor plan
Mark O. Hatfield Building
Mark O. Hatfield Building

Heat Recovery

Heat Pump

Exhaust Fan

400 CFM Grille, TYP
1 Toilet RM Per Floor

Electric Heater (TYP)

Existing Elevator Shaft

Window W/ Contact (TYP)

30 CFM Grille, TYP
18 Per Floor

Existing Toilet Exhaust Shaft
# Feasibility: Good, Better, & Best

<table>
<thead>
<tr>
<th>ASSEMBLY COMPONENT OPTIONS</th>
<th>Existing Building</th>
<th>Good Rehab</th>
<th>Better Rehab</th>
<th>Best Rehab Passive House</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall Insulation</td>
<td>none</td>
<td>none</td>
<td>2” EPS Exterior Insulation</td>
<td>6” EPS Exterior Insulation</td>
</tr>
<tr>
<td>Roof Insulation</td>
<td>Existing 4” Polyiso Board</td>
<td>Existing 4” Polyiso Board w/limited repair</td>
<td>Existing 4” Polyiso Board w/limited repair</td>
<td>Existing 4” Polyiso Board w/limited repair</td>
</tr>
<tr>
<td>Window Frame</td>
<td>Aluminum (not thermally broken)</td>
<td>Fiberglass (Cascadia 300 tilt/turn)</td>
<td>Fiberglass (Cascadia 300 tilt/turn)</td>
<td>Fiberglass/Vinyl (Rehau Geneo Euroline 4700)</td>
</tr>
<tr>
<td>Window Glazing</td>
<td>Single Pane</td>
<td>2-pane/Cardinal LoE 366 Argon</td>
<td>3-pane/Cardinal LoE 366/180 Argon</td>
<td>3-pane Rehau Geneo PHZ</td>
</tr>
<tr>
<td>Airtightness (ACH at 50 pa)</td>
<td>10</td>
<td>5.00</td>
<td>0.60</td>
<td>0.60</td>
</tr>
</tbody>
</table>

## HEATING & VENTILATION

| Space Heating System       | central boiler with unit steam radiators | existing central boiler to remain, new steam radiators, repaired distribution pipe | unit electric cove radiant heaters (1kW), central heat pump to temper supply air | unit electric cove radiant heaters (1kW), central heat pump to temper supply air |

| Ventilation                | operable windows, common room PTAC, common bathroom exhaust | operable windows, common room PTAC, common bathroom exhaust | operable windows, central HRV with unit supply and common bathroom exhaust | operable windows, central HRV with unit supply and common bathroom exhaust |

| Ventilation Heat Recovery  | none              | none       | yes, central 83% efficient model | yes, central 93% efficient model |
Performance

Annual Heating EUI of Various Scenarios

- Existing
- Good: 38% reduction from Existing
- Better: 89% reduction from Existing
- Best: 96% reduction from Existing

kBTU/sf.yr
Performance & Savings

existing building

- Heating (GAS): 1,104,799 kWh/yr, $53,037 (76%)
- Heating (ELECTRIC): 14%
- Cooling: 5%
- Lighting & Appliances: 1%
- Hot Water (GAS): 1%
- Ventilation: 3%

good rehab

- Heating (GAS): 401,697 kWh/yr, $31,997 (81%)
- Heating (ELECTRIC): 9%
- Cooling: 8%
- Lighting & Appliances: 1%
- Hot Water (GAS): 1%
- Ventilation: 3%

better rehab

- Heating (GAS): 133,558 kWh/yr, $9,541 (45%)
- Heating (ELECTRIC): 28%
- Cooling: 23%
- Lighting & Appliances: 4%
- Hot Water (GAS): 3%
- Ventilation: 3%

best rehab (passive house)

- Heating (GAS): 97,492 kWh/yr, $6,512 (39%)
- Heating (ELECTRIC): 32%
- Cooling: 22%
- Lighting & Appliances: 4%
- Hot Water (GAS): 4%
- Ventilation: 3%
# Capital Cost

<table>
<thead>
<tr>
<th>Category</th>
<th>Good</th>
<th>Better</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 General Requirements</td>
<td>$373,507</td>
<td>$373,507</td>
<td>$373,507</td>
</tr>
<tr>
<td>2100 Site Work</td>
<td>$98,389</td>
<td>$103,389</td>
<td>$103,389</td>
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<tr>
<td>7000 Thermal &amp; Moisture Protection</td>
<td>$30,783</td>
<td>$45,998</td>
<td>$46,862</td>
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<tr>
<td>8000 Doors &amp; Windows</td>
<td>$325,027</td>
<td>$369,843</td>
<td>$397,563</td>
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<tr>
<td>9000 Finishes</td>
<td>$949,469</td>
<td>$1,337,865</td>
<td>$1,425,925</td>
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<tr>
<td>10000 Specialties</td>
<td>$0</td>
<td>$2,500</td>
<td>$2,500</td>
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<tr>
<td>12000 Furnishings</td>
<td>$29,777</td>
<td>$29,146</td>
<td>$26,463</td>
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<tr>
<td>15000 Mechanical</td>
<td>$296,059</td>
<td>$560,059</td>
<td>$703,259</td>
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<tr>
<td>16000 Electrical</td>
<td>$281,030</td>
<td>$441,743</td>
<td>$450,713</td>
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<tr>
<td>17000 Other</td>
<td>$201,524</td>
<td>$236,115</td>
<td>$253,363</td>
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<tr>
<td>0H&amp;P</td>
<td>$96,959</td>
<td>$131,256</td>
<td>$141,883</td>
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<tr>
<td>Insurance</td>
<td>$33,532</td>
<td>$45,393</td>
<td>$49,068</td>
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<td>Performance Bond (GC)</td>
<td>$18,822</td>
<td>$24,718</td>
<td>$26,545</td>
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<tr>
<td>Performance Bond (sub)</td>
<td>$10,342</td>
<td>$14,001</td>
<td>$15,134</td>
</tr>
</tbody>
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**TOTAL CONSTRUCTION**

- **$2,745,220**
- **$3,715,533**
- **$4,016,174**

**construction cost/SF**

- **$57**
- **$78**
- **$84**
Capital Cost

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<th>Existing</th>
<th>Good</th>
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<td>$0</td>
<td>$2,745,220</td>
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$0, $1 million, $1.5 million, $2 million, $2.5 million, $3 million, $3.5 million, $4 million
Feasibility pre-Conclusions

• There is a premium to go PH, however...
• With structural issues, ‘Good’ may not be enough to preserve the building
• PH Hatfield rehab costs are in line with other rehabs
• A building replacement would likely cost 2X that of a PH rehab
• Energy savings in a PH Hatfield may be 45k annually
• Structural savings in a PH Hatfield may be 275k every 15 years
• Capitalized energy & structural savings equal $800,000 (20yr, 5%)
• Feasibility study is a tool to respond to needs, make financial case and fundraise
• Feasibility study has helped owner commitment to a PH Hatfield
• With limited capital, A phased approach may be necessary