1021 Prince St Renovation

OFFICE BUILDING DIVISION (OB)

Virginia Polytechnic Institute + State University
PRESENTATION OVERVIEW

- **SITE CONTEXT + CONSTRAINTS**
- **DESIGN GOALS**
- **DECATHLON CONTESTS**
  - Architecture
  - Integrated Performance
  - Engineering
  - Energy Performance
  - Embodied Environmental Impact
  - Durability + Resilience
  - Market Analysis
  - Occupant Experience
  - Comfort + Environmental Quality
- **CONCLUSION**
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BUILD UPON + OPTIMIZE THE BUILDING ENVELOPE FOR EFFICIENCY

EXTEND MATERIAL LIFECYCLES + MINIMIZE MATERIAL WASTE

SUSTAINABLE DEVELOPMENT IN A SENSITIVE CONTEXT

PRIORITIZE PASSIVE + NATURAL SYSTEMS

PLACE HUMAN HEALTH + WELL-BEING AT THE CENTER OF DESIGN

COMMUNITY ENGAGEMENT
DECATHLON
CONTESTS
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SOLAR DECATHLON DESIGN CHALLENGE 2021
VIRGINIA TECH

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### Site and Source Energy

<table>
<thead>
<tr>
<th></th>
<th>Total Energy [kBTU]</th>
<th>Energy Per Total Building Area [kBTU/ft²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Site Energy</td>
<td>676,114</td>
<td>20.63</td>
</tr>
<tr>
<td>Total Source Energy</td>
<td>2,141,253</td>
<td>65.34</td>
</tr>
</tbody>
</table>

### Annual Overview

<table>
<thead>
<tr>
<th>End Use</th>
<th>Consumption [kBTU]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>265,460</td>
</tr>
<tr>
<td>Cooling</td>
<td>246,003</td>
</tr>
<tr>
<td>Interior Lighting</td>
<td>90,929</td>
</tr>
<tr>
<td>Interior Equipment</td>
<td>73,722</td>
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</tbody>
</table>
SITE CONTEXT & CONSTRAINTS

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SOLAR DECATHLON DESIGN CHALLENGE 2021

VIRGINIA TECH

1021 Building Roof PVs
1001 Building Solar Shingles
Shadowvoltaics

<table>
<thead>
<tr>
<th>Month</th>
<th>Energy Generation [kWh]</th>
<th>Energy Generation [kWh]</th>
<th>Energy Generation [kWh]</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>10,738</td>
<td>4,663</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>12,329</td>
<td>5,438</td>
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</tr>
<tr>
<td>March</td>
<td>14,233</td>
<td>6,388</td>
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</tr>
<tr>
<td>April</td>
<td>15,420</td>
<td>7,022</td>
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</tr>
<tr>
<td>May</td>
<td>16,545</td>
<td>7,649</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>16,183</td>
<td>7,513</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>16,531</td>
<td>7,602</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>15,658</td>
<td>7,134</td>
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</tr>
<tr>
<td>September</td>
<td>14,883</td>
<td>6,713</td>
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<tr>
<td>October</td>
<td>13,136</td>
<td>5,804</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>11,230</td>
<td>4,909</td>
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</tr>
<tr>
<td>December</td>
<td>9,617</td>
<td>4,149</td>
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</tr>
</tbody>
</table>

Annual 166,503 74,984 16,468

Site and Source Energy

Total Energy [kBTU] Energy Per Total Building Area [kBTU/ft²]
Total Site Energy 676,114 20.63
Total Source Energy 2,141,253 65.34

Solar Energy Generation

Surface Annual generation [kWh] Annual Generation [kBTU]
1021 Prince St. Roof 166503 567775.23
1021 Prince St. Solar Shades 16468 56155.88
1001 Prince St. Roof 74984 255695.44

Total 257955 879626.55

EUI [kBTU/ft²] 26.84
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Global warming kg CO2e - Resource types
This is a drilldown chart. Click on the chart to view details
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SOLAR DECATHLON DESIGN CHALLENGE 2021
VIRGINIA TECH

OPERATION & PERFORMANCE

Nominal Energy (10-hour charge/20-hour discharge) 25.9 kWh
Nominal Voltage 48 V
Cycle Life 3,000 cycles (to 70% retained capacity)
Ambient Operating Temperature -5°C to 40°C
Voltage Range 40.0 to 59.5 V
Peak Power 11.7 kW
Continuous Current 240 A
Onboard Sensing Voltage, current, temperature
Usable Depth of Discharge 100%

WARRANTY

Limited Warranty 8 years: 5 years full + 3 years prorated

PHYSICAL CHARACTERISTICS

Height 1,159 mm (45.6”)
Width 1,321 mm (52.0”)
Depth 1,016 mm (40.0”)
Weight 1,504 kg (3,315 lbs)

CERTIFICATIONS

Sustainability Cradle to Cradle Certified™ Bronze product (component: Aquion Energy batteries only)
UL Recognition In process
CE CE marked
Shipping Testing ISTA testing in process
IP Rating IP2X

Performance characteristics based on testing conducted by Aquion Energy. Performance may vary depending on use, conditions, and application. For the most up-to-date specification, visit http://aquionenergy.com.
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### CONCLUSION

**New Construction**  
$1,143,080

**Renovated Construction**  
$1,890,000

**Demolition**  
$108,000

**Systems**  
(ERV, Radiant Flooring, Ground Source Heat Pump, Solar)  
$581,323

**Typical Cost in Alexandria, VA for 32,700 sq. ft Office Building**  
$5,000,000

**Total Savings:** $1,277,597

Calculated by RSMeans
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BIOPHILIC PATTERNS:
1. Visual Connections to Nature
2. Non-visual Connections to Nature
3. Non-rhythmic Sensory Stimuli
4. Thermal Air + Flow
5. Dynamic + Diffuse Light
6. Connection with Natural Systems
7. Biomorphic Forms + Patterns
8. Material Connection with Nature
9. Complexity + Order
10. Prospect
11. Refuge
12. Risk + Peril
CONCLUSION
THANK YOU

U.S. Department of Energy
Solar Decathlon Organizers
Solar Decathlon Jurors
Peter Vanderpoel
Susan Piedmont-Palladino
Teminioluwa Thomas
Project Advisors + Reviewers