Location: Silver Spring, MD

Size: 120,000 SF (office/lab)  
75,000 SF (parking)  
10,000 SF (retail)  
5,000 SF (atrium)  

**Total: 210,000 sf**

Goals:  
- Net Zero Energy  
- All Renewables On Site  
- 70-75% Energy Reduction  
- Landmark Building
Form and function must inform one another.

Restrictive Urban Site

Urban vs. Rural Site

Energy Generation Becomes Limiting Factor

Adjust Program to Meet Net Zero Goal:

- Size
- Number of Occupants
- Activity
<table>
<thead>
<tr>
<th>METRIC</th>
<th>AVERAGE (90.1-2010)</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall Construction</td>
<td>R-13 + R-7.5 continuous U = 0.064</td>
<td>R-16.8 continuous U = 0.060</td>
</tr>
<tr>
<td>Glazing Conduction</td>
<td>U = 0.45 (Glazing + Frame)</td>
<td>U = 0.24 (Triple Paned)</td>
</tr>
<tr>
<td>Glazing Transmission</td>
<td>SHGC = 0.40</td>
<td>SHGC = 0.23 (Clear State)</td>
</tr>
<tr>
<td>Roof Construction</td>
<td>R-20 continuous</td>
<td>R-30 continuous</td>
</tr>
<tr>
<td>Lighting Density</td>
<td>0.90 W/SF</td>
<td>0.60 W/SF</td>
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<tr>
<td>Equipment Density</td>
<td>2 - 3 W/SF</td>
<td>0.75 – 1 W/SF</td>
</tr>
<tr>
<td>EUI (kbtu/sf-yr)</td>
<td>85</td>
<td>20 - 25</td>
</tr>
<tr>
<td>Solar Array (kW)</td>
<td></td>
<td>1,000 kW</td>
</tr>
</tbody>
</table>
### Passive
- Building Orientation
- External Shading
- Day Lighting
- Natural Ventilation
- Earth Labyrinth
- Evaporative Cooling

### Active
- Geo Exchange
- Energy Recovery
- Demand Control
- Electrochromic Glazing
- Building Automation
- Plug Load Mgmt
- Renewable Energy

---

Minimize Effects of Climate
Minimize Effects of Extreme Seasons
Envelope Upgrades
Energy Recovery
Modeled Entire Site in Ecotect
Incorporated Shading from Adjacent Buildings
Measured Total Radiation Available on Surfaces
Determined Optimal Solar PV Placement
SOLAR TRAY:
1206X360W
SUNPOWER X22 MODULES
434 KW DC ARRAY
578 MWH/YR

FACADE:
630X300W
SOLARWORLD MODULES
189 KW DC ARRAY
200 MWH/YR

GARAGE ROOF:
1088X360W
SUNPOWER X22 MODULES
392 KW DC ARRAY
389 MWH/YR

SOLAR WALL:
35X360W
SUNPOWER X22 MODULES
13 KW DC ARRAY
10 MWH/YR

TOTALS:
2,959 MODULES
1,028 KW
1,177 MWH
<table>
<thead>
<tr>
<th>Area</th>
<th>Energy kWh</th>
<th>Energy therms</th>
<th>Associated Area (SF)</th>
<th>EUI kbtu/sf/yr</th>
<th>CO2 Factor* lb/MWH or lb/MMBTU</th>
<th>lb CO2 Emission or (Offset)</th>
<th>Metric tons CO2</th>
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</thead>
<tbody>
<tr>
<td>Phase 3 Building Electric</td>
<td>(896,021)</td>
<td>-</td>
<td>(3,057,224)</td>
<td>121,711</td>
<td>758</td>
<td>679,184</td>
<td>308</td>
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<tr>
<td>Phase 3 Building Gas</td>
<td>-</td>
<td>(714)</td>
<td>(71,400)</td>
<td>121,711</td>
<td>0.6</td>
<td>117</td>
<td>4</td>
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<tr>
<td>Retail</td>
<td>(87,925)</td>
<td>-</td>
<td>(300,000)</td>
<td>10,000</td>
<td>30.0</td>
<td>758</td>
<td>66,647</td>
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<tr>
<td>Parking Garage</td>
<td>(17,150)</td>
<td>-</td>
<td>(58,516)</td>
<td>76,029</td>
<td>0.8</td>
<td>758</td>
<td>13,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>(1,001,096)</td>
<td>(714)</td>
<td>(3,487,139)</td>
<td>207,740</td>
<td><strong>16.8</strong></td>
<td>767,185</td>
<td>348</td>
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<tr>
<td>Solar Generation</td>
<td>1,177,000</td>
<td>4,015,924</td>
<td></td>
<td></td>
<td>758</td>
<td>(892,166)</td>
<td>(406)</td>
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<tr>
<td><strong>Net Energy/Emissions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(124,981)</td>
<td>(58)</td>
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<tr>
<td><strong>EPA EUI Calculation</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* CO2 factors for electric are from 2016 eGRID data for sub region RFCE and 2018 EIA data for natural gas.
LESSONS LEARNED

• Early Controls Involvement
• Geo-Exchange Drilling Contingency Plan
• Integration Effort – Early Engagement
• As-Built Circuitry vs. Sub Metering Approach
• Value of Mock-Ups
• Solar Tray Cantilever Challenges
• Expectations of Trade Contractors