DPR Construction
Net Zero Energy Offices

Why It’s Important
If You Build It, They Will Come

DPR Construction Net Zero Projects

Getting to Zero Forum 2018

---

DPR National Net Zero Portfolio

DPR's LEED Silver Sacramento office was the first privately owned LEED certified building in California. Center left.

2010

DPR's San Diego office was the first commercial building to achieve both LEED NC Platinum and net zero energy status in San Diego.

2013

DPR's LEED NC Pollock's Projects office became the largest building in the world to achieve Net Zero Energy Building certification from the International Living Future Institute's Living Building Challenge.

2016

DPR's San Francisco office became the first certified net zero energy commercial building in San Francisco.

2016

DPR's LEED Platinum San Francisco office became the first certified net zero energy commercial building in San Francisco.
Legacy – Phoenix HQ

BEFORE

Building Envelope

Tenants Space

AFTER

DPR Construction Net Zero Projects

Getting to Zero Forum 2018
Legacy – Phoenix HQ

Solar Chimney
Solar Tubes
Shower Tower provides additional cooling
Green screen provides shading and bio mass
Covered parking incorporates photovoltaic panels

DPR Construction Net Zero Projects
Getting to Zero Forum 2018
Legacy – San Francisco HQ

BEFORE

AFTER
Bringing NZE to Washington DC

Context

Building Entry

Loading Dock

DPR Construction Net Zero Projects

Getting to Zero Forum 2018
Context

DPR Construction Net Zero Projects

Getting to Zero Forum 2018
Project Vision

- Create an **office of the future** that invigorates our people and encourages creative and efficient work practices.
- Do the right thing by incorporating **sustainable strategies** that contribute to the health and well-being of the environment and our people.
- Make data **driven-decisions** based on cost analysis, payback decisions and team member expertise.
- Build a **living laboratory** where we showcase technologies, products and systems, along with a robust educational program.
Environment and People

Project Basics

- Existing Building
  - 2 Story, 40,000 SF
  - Unoccupied for 7 Years

- DPR Lease Entire 2nd Floor
  - 10 Year Lease
  - 20,000 SF
  - Energy by Tenant
  - Roof Access

- ½ Mile from Wiehle Metro

- 200 Yards from W&OD Trail
The Supporting Evidence
Mechanical System Selection

<table>
<thead>
<tr>
<th>Energy Use (kWh)</th>
<th>DOAS VAV Existing Envelope</th>
<th>DOAS VAV Added Walls</th>
<th>DOAS VAV Added Roof</th>
<th>VRF Added Ins. and Roof</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>105,419</td>
<td>14%</td>
<td>102,830</td>
<td>98,364</td>
<td>74,636</td>
<td>12%</td>
</tr>
<tr>
<td>110,001</td>
<td>18%</td>
<td>105,936</td>
<td>103,064</td>
<td>82,944</td>
<td>13%</td>
</tr>
<tr>
<td>170,895</td>
<td>26%</td>
<td>170,895</td>
<td>214,191</td>
<td>24%</td>
<td>24%</td>
</tr>
<tr>
<td>237,177</td>
<td>35%</td>
<td>237,177</td>
<td>327,177</td>
<td>33%</td>
<td>37%</td>
</tr>
<tr>
<td>60,860</td>
<td>10%</td>
<td>60,860</td>
<td>60,022</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>8,153</td>
<td>1%</td>
<td>8,153</td>
<td>8,153</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>2,955</td>
<td>0%</td>
<td>2,955</td>
<td>2,955</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

Total Energy (kWh): 213,422

Data Driven Decisions

Project Cost Models

<table>
<thead>
<tr>
<th>Energy Cost $</th>
<th>Baseline</th>
<th>Existing System</th>
<th>DOAS VAV Existing</th>
<th>DOAS VAV Added Ins. Walls only</th>
<th>DOAS VAV Added Ins. Roof only</th>
<th>DOAS VAV Added Ins. Walls and Roof</th>
<th>VRF Added Ins. Walls and Roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>$ 4,949.34</td>
<td>$ 4,118.46</td>
<td>$ 2,530.42</td>
<td>$ 2,468.28</td>
<td>$ 2,366.36</td>
<td>$ 2,297.93</td>
<td>$ 1,779.57</td>
</tr>
<tr>
<td>Cooling</td>
<td>$ 1,970.49</td>
<td>$ 2,723.51</td>
<td>$ 3,144.47</td>
<td>$ 3,136.74</td>
<td>$ 3,093.77</td>
<td>$ 3,086.34</td>
<td>$ 1,969.10</td>
</tr>
<tr>
<td>Interior Lighting</td>
<td>$ 4,914.07</td>
<td>$ 4,094.95</td>
<td>$ 4,094.87</td>
<td>$ 4,094.87</td>
<td>$ 4,094.87</td>
<td>$ 4,095.04</td>
<td>$ 4,094.95</td>
</tr>
<tr>
<td>Interior Equipment</td>
<td>$ 5,693.53</td>
<td>$ 5,693.42</td>
<td>$ 5,693.07</td>
<td>$ 5,693.07</td>
<td>$ 5,693.07</td>
<td>$ 5,693.31</td>
<td>$ 5,693.42</td>
</tr>
<tr>
<td>Fans</td>
<td>$ 1,441.75</td>
<td>$ 1,131.41</td>
<td>$ 1,701.56</td>
<td>$ 1,696.28</td>
<td>$ 1,659.95</td>
<td>$ 1,654.36</td>
<td>$ 1,694.02</td>
</tr>
<tr>
<td>Pumps</td>
<td>$ -</td>
<td>$ 1,181.45</td>
<td>$ 244.67</td>
<td>$ 235.62</td>
<td>$ 237.71</td>
<td>$ 226.39</td>
<td>-</td>
</tr>
<tr>
<td>Heat Rejection</td>
<td>$ -</td>
<td>$ 611.32</td>
<td>$ 70.93</td>
<td>$ 67.28</td>
<td>$ 55.01</td>
<td>$ 51.02</td>
<td>-</td>
</tr>
<tr>
<td>Total End Uses</td>
<td>$ 18,969.19</td>
<td>$ 19,554.52</td>
<td>$ 17,480.00</td>
<td>$ 17,392.13</td>
<td>$ 17,200.74</td>
<td>$ 17,104.39</td>
<td>$ 15,251.07</td>
</tr>
</tbody>
</table>
### Data Driven Decisions / Sustainable Path

#### Comparison Matrix of Sustainable Pathways

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>Core and Shell</td>
<td>Tenant Improvements</td>
<td>Public Area</td>
</tr>
<tr>
<td>Cost</td>
<td>$1,205,466</td>
<td>$69.88</td>
<td>25,400</td>
</tr>
<tr>
<td>1,205,466</td>
<td>$69.88</td>
<td>25,400</td>
<td>Cost</td>
</tr>
<tr>
<td>$2,602,078</td>
<td>$179.02</td>
<td>30,982</td>
<td>$87.99</td>
</tr>
<tr>
<td>$3,000,441</td>
<td>$196.68</td>
<td>4,579,924</td>
<td>$166.12</td>
</tr>
<tr>
<td>882,756</td>
<td>$29.02</td>
<td>233,399</td>
<td>$6.95</td>
</tr>
<tr>
<td>TOTAL: CONSTRUCTION COST</td>
<td>$4,489,061</td>
<td>$239.13</td>
<td>4,865,623</td>
</tr>
<tr>
<td>951,523</td>
<td>$6.97</td>
<td>1,379,332</td>
<td>$31.98</td>
</tr>
<tr>
<td>TOTAL: CONSTRUCTION + RENEWABLES</td>
<td>$5,080,585</td>
<td>$277.60</td>
<td>5,247,955</td>
</tr>
<tr>
<td>75,345</td>
<td>50</td>
<td>75,316.07</td>
<td>50</td>
</tr>
</tbody>
</table>

### Determining Predicted EUI

![Pie chart showing energy consumption categories]

- **Annual Energy Use (kBtu/yr)**
- **End Use**
  - Heating: 42,200
  - Cooling: 80,331
  - Interior Lighting: 44,846
  - Plug Equipment: 557
  - Plug AV: 5,929
  - Plug Fitness: 15,711
  - Plug Refrigeration: 20,880
  - Plug-Office Equipment: 12,907
  - Plug Other Appliances: 7,409
  - Plug Workstations: 60,648
  - Plug Premises/Batteries/Computers: 57,570
  - Plug LAN Equipment: 86,137
  - Plug Other-Office Equipment: 5,948
  - Fans: 21,318
  - Pumps: 53,087
  - HVAC Reheat: 22,051
  - HVAC Recovery: 6,318
  - Water Systems: 24,378
- **Total:** 510,386
- **Net Energy Use (kWh/yr):** 143,302
- **Efficiency PV Modules (Wp):** 372
- **Efficiency PV kW Rating (kW):** 128
- **EUI (kBtu/ft²/yr):** 27.9
Building Dashboard

How do we get there?
Passive Strategies

Daylighting / Existing
Daylighting / Proposed

Active Strategies

- DOAS & VRF w/ Water-cooled condensers
- Air-cooled DOAS & Air-cooled VRF
- DOAS & Heat Recovery Chiller (Sails and FPTU)

Multiple Systems Evaluated

What Mattered to DPR?

- EUI
- Cost
- Temperature and Humidity Controls
- Flexibility
DOAS Mechanical System

Heat Pump Chiller
Active Strategies