The California Department of Public Health’s Building P served as one of several pilot projects for California’s Tier 1 and Tier 2 Energy Efficiency and Sustainable Building Measures Checklists, which were specifically developed to bring sustainable building practices into state projects. Building P successfully demonstrated in 2005 that sustainable design benefited taxpayers, building users and the environment by earning an ENERGY STAR rating of 91. As a result, the project helped drive California toward requiring LEED certification for all new state buildings.

Building P continues to improve its performance, increasing its ENERGY STAR rating to 94 in 2008, and by 2010, its rating increased to 98. Operational changes identified during commissioning and a program that places computers into sleep mode account for the majority of the continued energy savings, while participation in a demand response program reduces demand charges.

The energy savings reduced utility bills and resulted in a $150,000 rebate for the owner through Pacific Gas and Electric’s (PG&E) Savings by Design incentive program using the whole building approach.

**Orientation, Daylighting**

The California Department of Public Health’s (CDPH) Richmond Campus is a flat 29-acre property. Building P includes office space and a library, providing a home for many parts of CDPH that were previously housed in locations throughout the Berkeley/Oakland area. The building needed to meet the needs of multiple user groups within an economical construction budget and respond to communications and security concerns.

Optimal site orientation and plentiful daylighting provide a foundation for maximizing energy savings. The building is long and narrow, with short sides to the east and west. These concrete walls have only a few deep-set windows.

In the morning and evening, when the sun is low in the sky in the east or west, the interior is protected from sun glare. The design also reduces late afternoon heat and decreases loads on air-conditioning systems.

The long façades are north- and south-facing, and consist of floor-to-ceiling glass, which on the north side suffuse the building’s interior with natural light without glare or heat gain. The south glass admits natural light as well. However, the full-height windows set back into deep concrete overhangs prevent the direct midday rays from striking the glass during the summer.

The south elevation is further protected from solar heat gain by aluminum sunshades called brise soleil that run the length of the building in patterns calculated to block the sun’s direct rays. However, during the winter, the low sun penetrates the glass with natural light without glare or heat gain. The south glass admits natural light as well. However, the full-height windows set back into deep concrete overhangs prevent the direct midday rays from striking the glass during the summer.

The south elevation is further protected from solar heat gain by aluminum sunshades called brise soleil that run the length of the building in patterns calculated to block the sun’s direct rays. However, during the winter, the low sun penetrates the glass with natural light without glare or heat gain. The south glass admits natural light as well. However, the full-height windows set back into deep concrete overhangs prevent the direct midday rays from striking the glass during the summer.

The south elevation is further protected from solar heat gain by aluminum sunshades called brise soleil that run the length of the building in patterns calculated to block the sun’s direct rays. However, during the winter, the low sun penetrates the glass with natural light without glare or heat gain. The south glass admits natural light as well. However, the full-height windows set back into deep concrete overhangs prevent the direct midday rays from striking the glass during the summer.

As they shield, the brise soleil shades also reflect light up and toward the ceilings, bringing daylight deeper into the building, reducing the need for artificial lights and energy. Occupant-controlled shades on the south elevation also minimize glare.

**Building at a Glance**

**Name:** California Department of Public Health, Richmond Campus, Building P

**Location:** Richmond, Calif. (18 miles NE of San Francisco)

**Owner:** State of California, Department of Public Health

**Principal Use:** Office, 63%

**Conference:** 4%

**Library:** 3%

**Storage/ Mechanical/ Electrical/ Hallways/ Etc.:** 24%

**Outdoor Terrace/ Assembly:** 1%

**Light Court and Lobby:** 7%

**Employees/Occupants:** 665

**Occupancy:** 95%

**Gross Square Footage:** 205,153

**Conditioned Space:** 202,500

**Distinctions/Awards:**

- BusinessWeek/Architectural Record Merit Award, 2006
- The Chicago Athenaeum, American Architecture Award, 2006

**Total Cost:** $33,605,000

**Cost Per Square Foot:** $168

**Substantial Completion/Occupancy:** May 2004/August 2005
The need for artificial light. This design provides employees with access to natural light. Fifty-one percent of all regularly occupied space has direct line of sight to vision glazing, while 96% of the regularly occupied space has a daylight factor of at least 2%. Controls on the north and south interior perimeter lights turn off artificial lighting when natural light levels are sufficient. Task lighting at all workstations allows general lighting levels to be lower throughout. Occupancy sensors in private offices and conference rooms shut off lights when rooms are unoccupied.

The long south-facing façade consists of floor-to-ceiling glass, which is set back into deep concrete overhangs, preventing the direct midday rays from striking the glass during the summer. In addition, exterior aluminum sunshades (brise soleil) also shown here block the sun’s direct rays. Below: North sides of the atrium. A large four-story open light court located in the center of the building provides employees with access to natural light for productivity, sustainability and quality of life. A large wood screen at the south and provides visual warmth. Other design solutions that increase natural light are narrow full-height windows (most are located within 30 ft). The four-story light court brings diffused light into the center of the building through clerestory windows, and a convex, curved ceiling bounces light in and down into the space, which reduces the need for artificial light. This story open light court located in the center of the building face north and south and provides visual warmth. Annual Energy Use Intensity (Site) 37.6 kBtu/ft² Natural Gas 11.7 kBtu/ft² Electricity 25.9 kBtu/ft² Annual Source Energy 99 kBtu/ft² Annual Energy Cost Index (ECI) $1.25/ft² Annual Load Factor 31% Estimated Savings vs 1998 California Title 24 Design Building 23.9% (Energy savings estimates and incentive estimates provided in the Savings By Design report submitted to PG&E in 2005.) ENERGY STAR Rating 98 Heating Degree Days 1,344 Cooling Degree Days 851 Annual Energy Cost Index (July 2010 to July 2011) 87,106 gallons Annual Water Use (July 2010 to July 2011) 25.9 kBtu/ft² U-value 0.029 Solar Heat Gain Coefficient (SHGC) 0.44 Visual Transmittance 69 Overall R-value R-19 Type 1 Type 2 Slab edge insulation R-value Not insulated—exposed concrete or spandrel glass Slab edge insulation R-value 5.3 Type 1: 1 1/2 in. thick reinforced concrete; Type 2: Floor to ceiling curtain wall; Type 3: Stud wall assembly: gypsum, stud, insulation, exterior sheathing, zinc or profiled metal panel Overall R-value 12 in. concrete: 1.8; stud wall assembly: 5.3 Glazing percentage 58% Visual Transmittance 69

Building Envelope

Walls

Type 1: 1 1/2 in. thick reinforced concrete; Type 2: Floor to ceiling curtain wall; Type 3: Stud wall assembly: gypsum, stud, insulation, exterior sheathing, zinc or profiled metal panel Overall R-value 12 in. concrete: 1.8; stud wall assembly: 5.3 Glazing percentage 58%

Basement/Foundation

Slab edge insulation R-value Not insulated—exposed concrete or spandrel glass

Windows

U-value 0.029 Solar Heat Gain Coefficient (SHGC) 0.44 Visual Transmittance 69

Location

Latitude 37° 55’ N Orientation The long façades of the building face north and south
off lighting in these spaces when unoccupied. All areas of the building are also equipped with time clocks to control lighting, and programmed systems and controls maximize safety and comfort while conserving energy.

Work areas are organized into open office “neighborhoods” located between mini cores of conference rooms and departmental management private offices; open plan work areas are located on the perimeter to provide ample light and views for everyone. The design maximizes the use of the exposed concrete structure as the primary interior finish, which saved both money and resources while reinforcing this key design element.

Lighting in these spaces when unoccupied. All areas of the building are also equipped with time clocks to control lighting, and programmed systems and controls maximize safety and comfort while conserving energy.

Work areas are organized into open office “neighborhoods” located between mini cores of conference rooms and departmental management private offices; open plan work areas are located on the perimeter to provide ample light and views for everyone. The design maximizes the use of the exposed concrete structure as the primary interior finish, which saved both money and resources while reinforcing this key design element.

### Annual Energy Use

<table>
<thead>
<tr>
<th>Year</th>
<th>Electricity (kWh)</th>
<th>Cost ($USD)</th>
<th>Gas (Therms)</th>
<th>Cost ($USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1,668,000</td>
<td>$236,672</td>
<td>48,850</td>
<td>$57,061</td>
</tr>
<tr>
<td>2006</td>
<td>1,894,800</td>
<td>$251,760</td>
<td>42,848</td>
<td>$51,872</td>
</tr>
<tr>
<td>2007</td>
<td>2,288,400</td>
<td>$282,305</td>
<td>45,362</td>
<td>$48,913</td>
</tr>
<tr>
<td>2008</td>
<td>2,051,200</td>
<td>$259,792</td>
<td>47,176</td>
<td>$55,138</td>
</tr>
<tr>
<td>2009</td>
<td>1,574,994</td>
<td>$246,888</td>
<td>24,632</td>
<td>$20,511</td>
</tr>
<tr>
<td>2010</td>
<td>1,632,763</td>
<td>$239,746</td>
<td>23,791</td>
<td>$25,572</td>
</tr>
<tr>
<td>2011</td>
<td>1,594,229</td>
<td>$241,166</td>
<td>24,307</td>
<td>$20,993</td>
</tr>
</tbody>
</table>

Note: 2005 gas data includes March through December 2011 electricity, and gas data includes January through November. Data extrapolated for 2005 and 2011 by adding the available data for each year, dividing by the number of months that the data represented and multiplying by 12. The reduction in gas use beginning in 2009 resulted from reprogramming the boiler operation schedules as part of the MBPCx.

Top: The primary public entry, located adjacent to visitor parking on the west side, provides an open, welcoming introduction to the building. Glazing is limited due to the need to minimize harsh western light and unwanted heat gain. The entry courtyard functions as an extension of the light court space within and provides an opportunity for outside staff gatherings and relaxation.

Above: To encourage employees to use mass transit, the California Department of Public Health (CDPH) provides a free bus shuttle between the Richmond Campus and the nearest Bay Area Rapid Transit (BART) station. CDPH also provides monthly bus and vanpool fare subsidies.
A VRF solution with lower total installed costs than traditional HVAC alternatives? **No problem.**

**Rightsizing Equipment**

The building’s HVAC systems were designed for output based on careful calculations using the actual conditions in the building, instead of maximum anticipated load. Sizing the equipment to meet actual conditions created a more energy-efficient design.

The air-conditioning system uses air-side economizers, taking advantage of Richmond’s mild weather by supplying outdoor air into the system instead of mechanically cooling the air to meet the occupants’ comfort needs.

Two pairs of large packaged air-handling units on the roof serve the east and west sides of the building. The HVAC systems are variable air volume (VAV) with hot water zone heating. While more-expensive on a first-cost basis, water-cooled chillers were selected because of their higher efficiency. All of the pumps, chillers, cooling towers and air-handling unit fans have variable speed drives (VSD). Concrete walls provide thermal mass, absorbing the sun’s heat during the day and releasing it at night when heat will not overload the building’s air-conditioning system. In addition, reflective roofing materials reduce solar heat absorption, decreasing the building’s cooling load.

**Ongoing Operations**

Improvements in Building P’s operations helped boost the building’s ENERGY STAR rating to 98. The facilities staff pursued PG&E’s energy efficiency rebates and participated in the utility’s Monitoring-Based Persistence Commissioning (MBPCx) program, a systematic process for optimizing an existing building system’s performance by identifying operational deficiencies and making adjustments. All energy-saving measures identified in Building P were achieved by operational changes (such as revising the air handler schedule), adjustments made during the commissioning process (such as resetting condenser water temperature set points), and other measures that reduced energy use.

**ENERGY USE JUNE 2010–MAY 2011**

<table>
<thead>
<tr>
<th>Month</th>
<th>Electricity (kWh)</th>
<th>Gas (therms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun 10</td>
<td>142,210</td>
<td>1,933</td>
</tr>
<tr>
<td>Jul 10</td>
<td>134,984</td>
<td>1,418</td>
</tr>
<tr>
<td>Aug 10</td>
<td>134,260</td>
<td>1,998</td>
</tr>
<tr>
<td>Sep 10</td>
<td>135,794</td>
<td>3,165</td>
</tr>
<tr>
<td>Oct 10</td>
<td>138,037</td>
<td>2,935</td>
</tr>
<tr>
<td>Nov 10</td>
<td>136,293</td>
<td>3,600</td>
</tr>
<tr>
<td>Dec 10</td>
<td>131,448</td>
<td>3,205</td>
</tr>
<tr>
<td>Jan 11</td>
<td>131,757</td>
<td>1,282</td>
</tr>
<tr>
<td>Feb 11</td>
<td>135,629</td>
<td>856</td>
</tr>
<tr>
<td>Mar 11</td>
<td>136,483</td>
<td>483</td>
</tr>
<tr>
<td>Apr 11</td>
<td>129,548</td>
<td>1,670</td>
</tr>
<tr>
<td>May 11</td>
<td>136,743</td>
<td>1,395</td>
</tr>
<tr>
<td>Total</td>
<td>1,568,186</td>
<td>23,949</td>
</tr>
</tbody>
</table>

**KEY SUSTAINABLE FEATURES**

- **Daylighting**
- **Occupancy sensors**
- **Individual Controls**
- **Task lighting**
- **Materials**
  - Certified, sustainable wood products; recycled content materials including carpet, latex paint, benches; precast pavers manufactured within 500 miles of site
- **Transportation**
  - Bus stop, CDPH provides free bus shuttle between the Richmond Campus and the nearest Bay Area Rapid Transit (BART) station, preferred parking for alternative fuel vehicles; bike shelter, showers

**WIDE VARIETY OF DUCTED AND DUCTLESS PAN COOLE SAVE LABOR AND MATERIAL COSTS.**

**COMPACT CONDENSING UNITS SIGNIFICANTLY REDUCE STRUCTURAL COSTS.**

**NO 100% SECONDARY HEAT SOURCE FOR MOST CLIMATES; LOW AMBIENT CONDITION CAPABILITIES.**
temperature), and additional low-cost energy-saving retrofit measures (such as replacing return air damper actuators and relocating some thermostats getting direct sunlight). These measures provided estimated annual savings of 543,000 kWh and 9,250 therms, with a payback of 0.4 years. A computer program (called Verdiem®) that places computer CPUs into sleep mode when they are not being used also proved to be an effective energy reduction strategy. Each computer used an annual average of 580 kWh in 2009; implementing the sleep mode program in 2010 reduced the annual energy use per computer to 246 kWh, a reduction of 42%. With about half of the campus’s 1,200 personal computers located in Building P, the energy savings add up. Participation in PG&E’s Automated Demand Response Program (Auto DR) has reduced demand charges. During times of high electricity prices or system emergencies, PG&E sends a signal via the Internet to a communication box connected to the building’s energy management system, initiating a cooling offset of all the VAV temperatures by 4 degrees, raising building temperatures by the same amount.

**Indoor Air Quality**

Indoor air quality (IAQ) measurements of the building confirm that careful design of the HVAC systems, proper building material selection, implementation of green building cleaning practices, and regularly scheduled HVAC maintenance can result in excellent IAQ and energy efficiency. The HVAC systems are designed to supply the minimum amount of outdoor air to the building when not in the economizer mode. Alarms in the building’s energy management system alert maintenance engineers to conditions requiring IAQ attention.

**HACKS FOR HVAC**

The success in implementing sustainable measures in California government buildings. When the design of Building P started in 2002, few green buildings existed and few designers had expertise in this area. The state of California selected a few pilot buildings to determine the reaction of the design community. The Tier 1 and Tier 2 Energy Efficiency and Sustainable Building Measures Checklists had mandatory and optional measures, but did not require third-party verification. At approximately the same time Building P was being designed, another sustainable design/build state office building project (known as the Capitol Area East End Complex1) was also being designed and constructed. The success in implementing sustainable measures in Building P as well as in the other pilot state buildings, led to Executive Order S-20-042, which extended the outdoor air intake away from the cooling tower. CDPH later required a 5 ft vertical separation (known as the Capitol Area East End Complex). The result was that the outdoor air intake of one of the units was too close to the cooling tower. Although this installation met the mechanical code in effect at the time (5 ft vertical separation) CDPH and the designers agreed on constructing a shroud, which extended the outdoor air intake away from the cooling tower. CDPH subsequently pursued and succeeded in changing the Uniform Mechanical Code requirement on the separation distance between building outdoor intakes and cooling towers (Section 1313.0). A 5 ft vertical separation is no longer allowed.

**Energy Management Software.** Using the PC management software has reduced energy consumption. However, implementation of this software was challenging. The state’s bureaucratic process and rigid information technology (IT) infrastructure made it challenging to convince the IT management that computers would not crash when this software was installed. After nearly a year, facilities staff were successful in resolving all IT concerns and the software was launched campus-wide with no reported problems.

**Communicating with Occupants.** Building occupants are aware of the efforts to enhance energy efficiency and sustainability in their building. They participated in a questionnaire as part of the LEED-EB application, and they are directly affected by the computer sleep mode software. In addition, their comfort is affected when PG&E calls for a demand reduction event, which automatically raises building temperatures by 4 degrees. Quarterly newsletters from facilities management to all employees ensure ongoing communication of sustainable efforts to the employees.

**Indoor Air Quality**

Indoor air quality (IAQ) measurements of the building confirm that careful design of the HVAC systems, proper building material selection, implementation of green building cleaning practices, and regularly scheduled HVAC maintenance can result in excellent IAQ and energy efficiency. The HVAC systems are designed to supply the minimum amount of outdoor air to the building when not in the economizer mode. Alarms in the building’s energy management system alert maintenance engineers to conditions requiring IAQ attention.

**Energy Management Software.** Using the PC management software has reduced energy consumption. However, implementation of this software was challenging. The state’s bureaucratic process and rigid information technology (IT) infrastructure made it challenging to convince the IT management that computers would not crash when this software was installed. After nearly a year, facilities staff were successful in resolving all IT concerns and the software was launched campus-wide with no reported problems.

**Communicating with Occupants.** Building occupants are aware of the efforts to enhance energy efficiency and sustainability in their building. They participated in a questionnaire as part of the LEED-EB application, and they are directly affected by the computer sleep mode software. In addition, their comfort is affected when PG&E calls for a demand reduction event, which automatically raises building temperatures by 4 degrees. Quarterly newsletters from facilities management to all employees ensure ongoing communication of sustainable efforts to the employees.

**Indoor Air Quality**

Indoor air quality (IAQ) measurements of the building confirm that careful design of the HVAC systems, proper building material selection, implementation of green building cleaning practices, and regularly scheduled HVAC maintenance can result in excellent IAQ and energy efficiency. The HVAC systems are designed to supply the minimum amount of outdoor air to the building when not in the economizer mode. Alarms in the building’s energy management system alert maintenance engineers to conditions requiring IAQ attention.

**Energy Management Software.** Using the PC management software has reduced energy consumption. However, implementation of this software was challenging. The state’s bureaucratic process and rigid information technology (IT) infrastructure made it challenging to convince the IT management that computers would not crash when this software was installed. After nearly a year, facilities staff were successful in resolving all IT concerns and the software was launched campus-wide with no reported problems.

**Communicating with Occupants.** Building occupants are aware of the efforts to enhance energy efficiency and sustainability in their building. They participated in a questionnaire as part of the LEED-EB application, and they are directly affected by the computer sleep mode software. In addition, their comfort is affected when PG&E calls for a demand reduction event, which automatically raises building temperatures by 4 degrees. Quarterly newsletters from facilities management to all employees ensure ongoing communication of sustainable efforts to the employees.

**Indoor Air Quality**

Indoor air quality (IAQ) measurements of the building confirm that careful design of the HVAC systems, proper building material selection, implementation of green building cleaning practices, and regularly scheduled HVAC maintenance can result in excellent IAQ and energy efficiency. The HVAC systems are designed to supply the minimum amount of outdoor air to the building when not in the economizer mode. Alarms in the building’s energy management system alert maintenance engineers to conditions requiring IAQ attention.
when the minimum airflows in any of the four AHUs are not being met. Filters with a rating of MERV 13 reduce the amount of particulates introduced via the AHUs.

Janitorial closets with exhaust-only ventilation ensure that no chemicals from cleaning products migrate to the occupied space. Entry mats minimize the introduction of particles tracked in by shoes.

Sustainable cleaning products, systems, and equipment also reduce generation of potentially harmful chemicals and particles. Using low-environmental-impact fertilizers and pest control products also minimize exposure of occupants to chemicals.

The pre-occupancy testing of air contaminants at six indoor locations with the HVAC systems set at their minimum outdoor air setting indicated that all indoor concentrations were below the Chronic Reference Exposure Limits as published by the Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency, and below 1% of the Permissible Exposure Levels as published by the U.S. Occupational Safety and Health Administration.

The measurements included individual volatile organic compounds (VOCs) (including formaldehyde and acetaldehyde), airborne particulate matter, carbon monoxide and carbon dioxide. The VOC measurements confirmed that the new building materials and furnishings were indeed low-emitting.

**Water Efficiency**

Water-efficient plumbing fixtures such as dual flush toilets and ultra low-flow lavatories resulted in a 40% calculated fixture water use reduction based on LEED-EB’s baseline. Per LEED-EB v.2.0 calculations, the fixtures use 4.44 gallons per square foot annually.

The landscaping consists of plants that generally require low amounts of irrigation and that can withstand severe wind and poor drainage, as well as the green clay soils of the site. In addition, minimizing lawn areas and using extensively decomposed granite (supplied from within 500 miles of the site), significantly reduce the amount of landscape area that requires irrigation and helps maximize pervious area.

Permeable surfaces prevent 27% of precipitation falling on the site from becoming runoff (calculations based on LEED-EB v2.0). Finally, deciduous trees shade the building and hard paved surfaces in the summer and allow sun penetration in the winter.

**Conclusion**

As Building P management looks to continue increasing the building’s efficiency and sustainability, it is considering purchasing renewable energy generated by solar photovoltaics. More specifically, the team is looking into adding roof-mounted and canopy covered parking PV that could combine solar power with charging stations for electric vehicles.

In conclusion, Building P has achieved exemplary energy performance despite a tight government construction budget. The energy performance is a result of the energy-efficient design and the building management team, which operates and maintains the building while pursuing additional energy efficiency measures.