John Russell purchased the 200 Market Building in downtown Portland, Ore., in 1988 and made a bet. He believed that improving the mixed-use office building’s efficiency and sustainability would save money, attract tenants, increase occupant satisfaction and help retain tenants.

Soon Russell started a $25 million renovation project to remove asbestos and reconstruct the building’s ground level. Over the years, building management has replaced the HVAC, lighting and life-safety systems; installed a 30 kW microturbine; and retrofitted restrooms with low-flow toilets and faucet aerators.

Two decades later, the return on investment includes steady utility bills despite rising utility market prices and a higher than average occupancy rate. The building is 97% occupied at a time when the average downtown Portland vacancy rate nears 10% and national vacancy rates are in the teens.

The owner pursued LEED certification because it offered independent verification of the facility’s green measures, and the framework identified new areas for improvement. In 2006, the 200 Market Building became the first multitenant building in the nation to earn certification under LEED for Existing Buildings Version 2.0 (LEED-EB). The building, which includes 16 office and education tenants and 11 retail tenants, was certified at the Gold level.

Now the owner is seeking Platinum certification under the current rating system, LEED for Existing Buildings: Operations & Maintenance. Because this system has more stringent requirements than the former version, the project team opted to pursue initial certification under the new program at the Platinum level rather than recertify.

Many prospective tenants in Portland won’t consider a building if it is not LEED certified. Portland is known as one of the most environment-friendly cities in the U.S. It has long emphasized proactive land-use planning and urban development. As a result, LEED-certified buildings can charge a premium because of the demand for sustainability.

Tenants benefit from the steady utility bills because escalation clauses in their leases allow the owner to pass on increasing utility costs. They also benefit from the building’s increased rate of outdoor air ventilation. The building’s Green Dividends

BY ELAINE AYE AND TED SPEAR, P.E.

Building management holds a bocci ball tournament (a lawn bowling game) on the green roof each September. The tournament, which began in 1990 and is only open to building tenants, takes place eight hours a day for a week. Two hundred two-person teams compete for first place.
saving approximately 792,000 kWh of electricity per year, 330 metric tons of carbon dioxide emissions are eliminated annually. By saving 28,180 therms of natural gas per year, 100 metric tons of carbon dioxide emissions are eliminated annually.

Energy consumption escalated each year from 2004 through 2006; however, since the building’s LEED certification in 2006 and implementation of energy-saving strategies, energy use declined in 2007 by 3%, in 2008 by 10.9% and in 2009 by 12.2%, reflecting increasing savings compared to the 2006 baseline. The building’s ENERGY STAR score has increased from 79 in 2006 to 96 in 2009.

The energy savings resulted from multiple improvements, including lighting upgrades and motion sensors in offices, and lighting efficiency measures in stairwells.

Locals know the 200 Market Building as the “Black Box” or “Black Beauty.” In 1990 upon dedication ceremony, a black horse participated in the completion of a two-year reconstruction project, a black horse participated in the dedication ceremony.

The facility team began upgrading lighting systems and motion sensors in 2005 during improvements to tenant space. About 20% of the tenant space has been renovated since that time.

To reduce energy use in the stairwells, motion sensors were installed on every other light, effectively turning off 50% of the stairwell lighting at most times. In the event of the ground level and reconstructing the exterior and interior of the building, 1988 Russell Development Company purchased building, $25 million renovation project to remove asbestos and reconstruct the exterior and interior of the building level.

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During renovations and tenant improvements, contractors follow a construction waste management program directed by the property management team with the goal of diverting at least 96% of waste from the landfill. Building staff has developed a sustainable purchasing program for furniture, copiers, electronic equipment, and other building products. This change has improved the building ventilation rate by 70%. Management also added outdoor air delivery monitoring devices that alert staff when the intake falls below ASHRAE Standard 62.1 outside air requirements. Demand-controlled ventilation, CO₂ monitoring, and a green cleaning products policy improve indoor environmental quality. To maintain sensor calibration and optimal efficiency, the facility team is using the same functional testing procedures from the building commissioning that took place during August and September 2009.

Sustainability

A $53,000 investment in 114 new low-flow toilets (1.6 gallons per flush), 37 half-gallon flush kits on urinals and 114 faucet aerators reduced water use by more than 1.6 million gallons a year. The owner received a 67% return on investment within a 1.5 year payback period. The building now operates at 32% water use reduction from low-flow lavatories, kitchen sinks and showheads, and ultra low-flush urinals.

Water Conservation

32% water use reduction from low-flow lavatories, kitchen sinks and showerheads, and ultra low-flush urinals

Sustainable purchasing program for furniture, copiers, electronic equipment

Recycling diverts 83% of building waste from landfill

32% of the building occupants use alternative modes of transportation

HVAC systems contain refrigerants with no CFCs

Lighting Total mercury content of purchased lamps must be 80 picogram/lumen/hour or less, motion sensors, dimmable ballasts

A local outside vendor performed a waste audit and determined that 200 Market’s recycling program diverts 83% of all waste from the landfill. Management continues to track performance.

The staff at the 200 Market Building collects and donates old electronic equipment from tenants, and recycles their batteries. The staff uses an e-mail newsletter to find new homes for all unwanted tenant furnuire, either in other tenant offices or employee homes. Tenants also recycle and compost kitchen debris. This change has improved the building ventilation rate by 70%. Management also added outdoor air delivery monitoring devices that alert staff when the intake falls below ASHRAE Standard 62.1 outside air requirements. Demand-controlled ventilation, CO₂ monitoring, and a green cleaning products policy improve indoor environmental quality. To maintain sensor calibration and optimal efficiency, the facility team is using the same functional testing procedures from the building commissioning that took place during August and September 2009.

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for office equipment, furniture and furnishings, and carpet.

To reduce light pollution, the property has only seven exterior lights: four at 36 W and three ranging between 4 W to 7 W each.

A secure bicycle storage area and showers are provided to encourage employees to use alternative forms of transportation and reduce carbon emissions. In addition, an anchor tenant, Regence, has a private gym with showers for employees. Tenant surveys show that at least 32% use alternative transportation (walk, bike, bus, light rail or carpool) to commute to work.

Building management developed a green building exterior management plan, which incorporates an integrated pest management policy and landscaping practices that reduce harmful chemicals from fertilizers, pesticides and equipment. A green roof over the parking structure reduces heat-island effect. Combined with a storm water management plan, the green roof reduces storm water runoff by more than 50%.

Sixty-four percent of workspaces have exterior views, which include a park next to the building and the Willamette River.

HVAC Upgrade

Projects to improve 200 Market Building’s sustainability and efficiency began long before it started the LEED certification process. All systems were upgraded in 1990 as part of a reconstruction effort. During the project, 17 water-cooled packaged variable air volume air handlers with waterside economizers were installed on floors 2 through 19. The air handlers are located in a central mechanical room on each floor, providing easy access for maintenance.

Supply air to each floor is provided through an overhead duct system that feeds parallel fan-powered terminal units with hot water reheat coils serving perimeter spaces, and variable volume terminal units serving the interior spaces. Two cooling towers provide cooling and condenser water to the packaged air handlers on each of the 17 floors and the heat pump loop that serves the lobby and retail level.

Two 50 hp VFD-driven circulation pumps (one for each cooling tower) are operated by the direct digital control (DDC) system and provide up to 1,300 gallons per minute of condenser water. One cooling tower is used only as a back-up in summer months when the temperature rises above 90°F and when maintenance is needed on the main cooling tower.

The main cooling tower operates with a plate and frame heat exchanger. This makes the condenser loop a closed loop, adding to savings in maintenance and operational costs. The second cooling tower that is original to the 1973 building uses an internal heat exchanger.

In winter during occupied hours, the condenser loop is operated similarly to a chilled water loop. After hours, the DDC programming uses the same loop to provide heat. This reduces the runtime of the cooling tower and the boiler systems.

All central systems are shut off between 6 p.m. and 7 a.m. Tenants who plan to be in the building after hours must make arrangements with the property management office for after-hours HVAC, but individuals working late can manually override the lighting in their specific area.

The building automation system monitors evening temperatures and responses if needed. Building engineers monitor night trends and day-by-day operation to maintain peak efficiency.

Each floor of office space now has a self-contained cooling and ventilating unit that replaced 25 to 30 water source heat pumps. The heat pumps’ location in the ceilings over occupied tenant spaces made it difficult to access them for maintenance.

The facility team replaced the original electric boilers in 1989 with two redundant natural gas hot water boilers to increase capacity, efficiency and reliability, and added variable-speed fan drives to all pumps and fans.

**MONTHLY ENERGY USE 2009**

<table>
<thead>
<tr>
<th>MONTHLY ENERGY USE 2009</th>
<th>Gas (therms)</th>
<th>Electricity (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>13,487</td>
<td>429,000</td>
</tr>
<tr>
<td>Feb</td>
<td>8,208</td>
<td>411,000</td>
</tr>
<tr>
<td>Mar</td>
<td>4,692</td>
<td>453,000</td>
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<tr>
<td>Apr</td>
<td>1,445</td>
<td>393,000</td>
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<tr>
<td>May</td>
<td>102</td>
<td>426,000</td>
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<tr>
<td>Jun</td>
<td>21</td>
<td>492,000</td>
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<td>Jul</td>
<td>0</td>
<td>516,000</td>
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<tr>
<td>Aug</td>
<td>28</td>
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<tr>
<td>Sep</td>
<td>1,187</td>
<td>504,000</td>
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<td>Oct</td>
<td>4,366</td>
<td>417,000</td>
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<tr>
<td>Nov</td>
<td>13,596</td>
<td>411,000</td>
</tr>
<tr>
<td>Dec</td>
<td>9,474</td>
<td>468,000</td>
</tr>
</tbody>
</table>
Programming overrides the pressure controls, allowing the pumps to run during occupancy times. The cost was approximately $11,000 with a five-year payback.

The commercial building formerly ran two 480 V, three-phase 15 hp city water pumps 24/7, year-round to maintain water pressure on the upper stories. The facility team installed two pressurized water storage tanks on the roof in 2000 so the pumps can be turned off nights and weekends. Pressure sensors are used to cycle one pump when needed.

**WATER EFFICIENCY CHANGES**

<table>
<thead>
<tr>
<th>Fixtures</th>
<th>2005 Water Use</th>
<th>2010 Water Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Closets</td>
<td>4.6 gpf</td>
<td>1.6 gpf</td>
</tr>
<tr>
<td>Urinals</td>
<td>3.5 gpf</td>
<td>0.5 gpf</td>
</tr>
<tr>
<td>Faucets</td>
<td>2.5 gpm</td>
<td>0.5 gpm</td>
</tr>
<tr>
<td>Showerheads</td>
<td>2 gpm</td>
<td>1.5 gpm</td>
</tr>
</tbody>
</table>

gpf = gallons per flush, gpm = gallons per minute

Photos courtesy Green Building Services, Inc.

**LESSONS LEARNED**

Intensive project planning set the stage for minimal tenant disruption and fewer surprises. All stakeholders (owner, property manager, building engineer and contractors who perform maintenance, solid waste management and landscaping for the building) were involved as an integrated team and took ownership in the process.

New outside air fans provided an unforeseen benefit. The combined operation of the waterside economizers on the 17 floors and the new outside air fans keep the condensing loop cold enough that building engineers can operate the cooling tower much less frequently. During the first year after the changes, the team shut off the cooling tower for most of January. The engineers rewrote the system’s programming and adjusted the setpoints to take advantage of this benefit.

In cases where building engineers customize building control sequences to optimize operation and meet occupant needs, it is a good practice to document the new sequences. The documentation helps future building staff members ensure that the systems are operating according to the tailored plan.

Photos courtesy Green Building Services, Inc.

**GREEN Comes Standard.**

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[LEED is a registered trademark of the U.S. Green Building Council, of which Ductmate is a proud member.]
When the nation is asked to turn off the lights, the chief engineer investigated if they needed to be on all night. He added a time clock that now turns off the outside signs at 10 p.m. (when the last retailer closes) and turns them on at 7 a.m. The change saves 8,000 kWh and $500 in annual energy costs.

A nearly $6 million elevator upgrade in 2004 added new controls and replaced the direct current drives with alternating current drives that operate only when the elevators are in use, providing energy savings of up to 40% and allowing the elevators to move at twice the speed.

Defining Difference

The decisive factor in 200 Market’s energy savings has been the owner’s and chief engineer’s commitment to continual improvement. The staff looks for innovative ways to achieve sustainability goals, such as the prototype microturbine and switching to all LED lighting in elevators, lobby areas and the building management office.

In addition to the whole building water meter, building engineers monitor the submeters on the water tower and cooling fixtures daily so they can immediately detect leaks if usage is high. On hot days when cooling tower evaporation is high, the engineers turn off the cooling tower’s chemical feed system during the day since the extra chemical is not needed. This reduces the demand for and use of chemicals, and saves the owner money.

When the property manager asked if the retailers’ neon signs could be turned off for Earth Hour (one designated evening hour in April), the chief engineer investigated if they needed to be on all night. He added a time clock that now turns off the outside signs at 10 p.m. (when the last retailer closes) and turns them on at 7 a.m.

The change saves 8,000 kWh and $500 in annual energy costs.

Tenant Engagement

Tenant participation is critical to LEED EB: O&M certification. Managed by Cushman & Wakefield of Oregon, the building management has developed an ongoing program to educate tenants and inspire sustainable practices.

Tenants can borrow the building’s Flexcar during the day and preferred parking spaces are provided in the garage for carpoolers. A quarterly newsletter updates tenants on the facility’s ongoing green efforts and provides tips on strategies like composting, recycling and energy conservation measures.

Management also offers events such as Northwest Earth Institute classes, which identify sustainable actions individuals can take. Tenants engage in sustainable practices as a result of increased awareness and through a sense of social belonging and pride. The 200 Market Building fosters a sense of community among its diverse-occupant mix by hosting civic festivals, book fairs and a week-long tenant bocci tournament.

About the Authors

Elaine Aye, LEED AP O+M, is a principal at Green Building Services Inc. in Portland, Ore., a national sustainable development consulting firm. As a member of the USGBC training faculty, she frequently speaks at national building conferences and training programs.

Ted Spear, P. E., LEED AP O+M, is a senior consultant on Green Building Services’ Building Management Solutions Team.

Approved by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) through its peer review process as having been subject to a rigorous critical editorial review to ensure scientific accuracy and technical conformity with generally accepted principles of professional engineering, this V8 Air Cleaning System is used throughout the LEED renovation of ASHRAE headquarters.

Finally, high performance cloth shades help reduce heat gain by about 25% in the summer and help prevent heat loss in the winter.