NYC's Living Lesson

BY KYRA EPSTEIN

For the 700 residents of the Solaire, New York high-rise living is providing a green culture that has set new standards with New York building agencies. It also shows the importance of recommissioning to fine-tune efficiency—information that already has been incorporated into two new, similar buildings near the Solaire.

Refining Guidelines

The Battery Park City Authority created *Residential Environmental Guidelines* in 2000 for requirements for water conservation, energy efficiency and other green measures for future residential buildings.

The Albanese Organization and the rest of the Solaire project team were the first to use the guidelines. The building also received one of the first New York State Green Building Tax Credit allocations, which allow building owners and developers to earn tax credits associated with the design and construction of green buildings.

The Solaire's design, construction, financing and operations helped refine Battery Park City Authority's guidelines. It also provided input for New York City's building code revisions.

For example, New York City implemented a rebate program for water conservation after the Solaire team demonstrated that the building has been using 43% less water than a typical building of its size. Based on demonstrated results, the New York City Water Board instituted a rate reduction program for buildings that install water treatment systems similar to the Solaire's.

Energy Performance

The 357,000 ft^2 Solaire also was designed to meet USGBC LEED® Gold requirements using strategies such as a black water/wastewater treatment plant; photovoltaics; efficient heating, ventilation and cooling systems; efficient windows and walls; efficient lighting and controls; and U.S. Environmental Protection Agency (EPA) ENERGY STAR® appliances in all units.

Sustainability encompasses more than energy efficiency. The Solaire team walked a fine line, balancing energy efficiency with other aspects of sustainability.

For example, making the windows at the Solaire smaller and inoperable would have reduced energy use, but also would have negatively impacted residents' living space. Additonally, reducing the amount of fresh air changes and leaving the water treatment/reclamation systems out of the design would have lowered overall energy consumption, but at

BUILDING AT A GLANCE

Building Name The Solaire

Location 20 River Terrace in Battery Park, New York City

Size 357,000 ft^2

Started June 2002

Completed August 2003

Use Multiunit residential tower

Distinctions LEED-NC Gold; AIA Committee on the Environment (COTE) Top Ten Green Project for 2004; Environmental Design & Construction Magazine Excellence in Design Award in 2004; Green Roofs for Healthy Cities Award in 2004

BUILDING TEAM

Owners Albanese Organization, Inc. and Northwestern Mutual Life

Architect Cesar Pelli & Associates

Architect of Record Schuman, Lichtenstein, Claman, Efron Architects

MEP Engineer Cosentini Associates

Landowner/Governing Authority
Battery Park City Authority

Structural Engineer
The Cantor Seinuk Group, Inc.

Energy Consultant
Steven Winter Associates
Viridian Energy & Environmental, LLC (Current Energy Consultant)

Environmental Building Consultant
Green October

Lighting Designer Ann Kale Associates

Photovoltaic Designer altPower

Landscape Architect Balmori Associates

Interior Designer Stedila Design, Inc.

Water Reuse Consultant
Alliance Environmental

Recommissioning Agent WM Group

Commissioning Agent
Horizon Engineering

Construction Manager
Turner Construction Company

Solaire Resident Electrical Use

	Standard 90.1* Predicted kWh	2005–2007 Average Actual kWh
January	159,712	118,331
February	149,336	116,989
March	167,516	110,128
April	152,494	102,863
May	132,852	104,974
June	130,349	107,979
July	137,221	109,934
August	138,283	101,832
September	129,274	112,438
October	152,637	114,529
November	166,048	122,583
December	151,399	123,970
Total	**1,764,120**	**1,346,551**

23.7% Less than Predicted

* ANSI/ASHRAE/IESNA Standard 90.1-1999, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

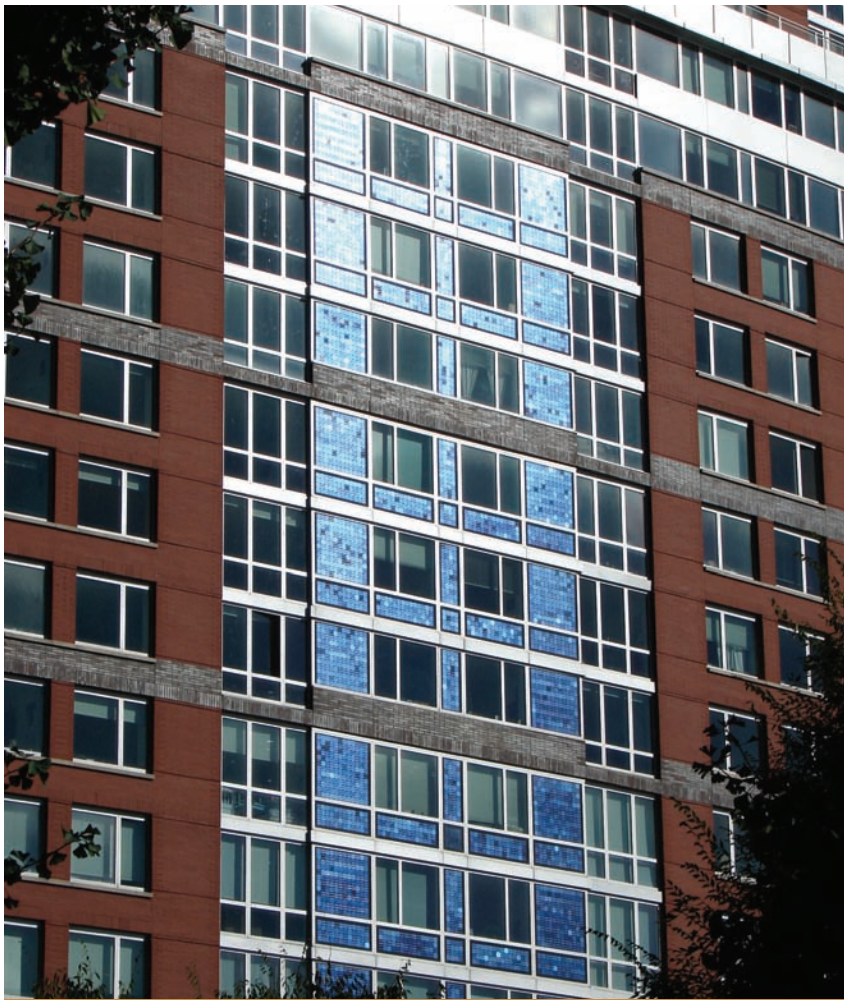
Note: Data does not represent whole building electrical consumption.

Solaire Energy Performance

	Total Gas MMBtu
2004*	42,179
2005	41,941
2006	41,267
2007	37,157
Predicted	35,736

In 2007, gas use was 3–4% higher than predicted, compared to 8% higher in 2004.

*Full occupancy reached in 2004.



The Solaire features 3,400 ft^2 of custom-laminated and standard photovoltaic modules.

the expense of air quality and water conservation goals.

The design team sought to use energy effectively, while providing healthier indoor air quality, enhanced daylighting, and drastically lower potable water consumption. These goals have been supplemented with resident education on the benefits and daily components of sustainability, and behavior reinforcing communications and operations protocols.

As a result, informed tenants use less energy in their residences. Energy consumption by residents, as measured by actual submeter readings, is 24% less than New York State code as predicted in the model for a building of similar size and residential square feet.

Building energy use, after almost four years of operation and annual recommissioning, also has decreased. Natural gas consumption has been reduced steadily each year by an average of 10%

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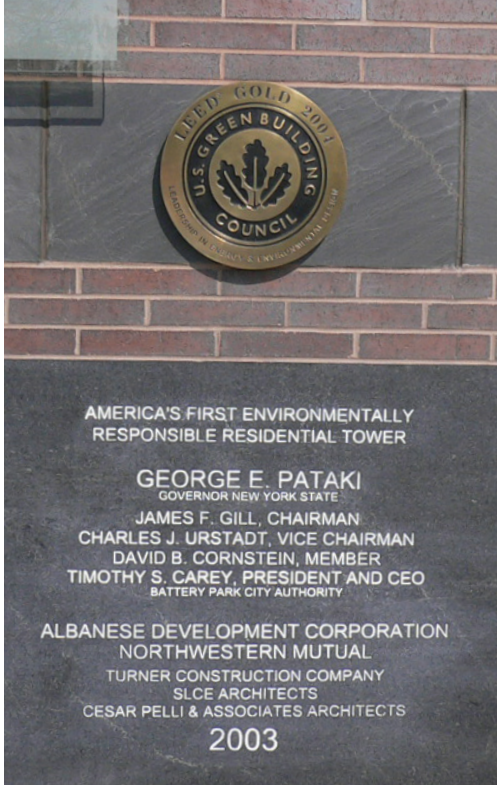


in each of the last two years. Consumption is almost 20% lower in the first four months of 2008 compared to the same period in the previous year.

System Balance

The Solaire's heating and cooling system was designed to be energy efficient, provide high indoor air quality, and conserve water.

Heating, cooling and ventilation air is supplied to apartments and public corridors mechanically from HVAC units that humidify and dehumidify as necessary. This air also provides makeup air for kitchen and bathroom exhaust. Two direct-fired gas absorption chillers provide hot and chilled water to each unit.

All of the apartments include programmable thermostats that efficiently control four-pipe fan coil units providing heating and cooling all year. The fan coil units in the apartments also have MERV-12 air filters, which enhance the indoor environmental quality.

High-efficiency, variable-speed pumps, fans, and motors circulate ventilation air and water throughout the building, and the high-efficiency absorption chillers run on natural

The rooftop garden incorporates a storm water retention system.

SOLAIRE WATER USE FOR 2007

	Gallons Per Day	Gallons Per Capita Per Day	Gallons Per Day Per Ft^2	Percent of Total	
NYC Potable Supply	33,063	47	0.09	63%	Of All Water Use
Reuse Water Supply	19,555	28	0.05	37%	Of All Water Use
Total Water Use	**52,618**	**75**	**0.15**	**100%**	
Cooling Tower Potable	4,363	6	0.01	13%	Of NYC Supply
Cooling Tower Reuse	4,323	6	0.01	22%	Of Reuse Supply
Total Cooling Supply	**8,686**	**12**	**0.02**	**17%**	Of Total Water Use
Other Uses					
Humidification Supply	583	1		1%	Of Total Water Use
Irrigation	219	0.3		0%	Of Total Water Use

gas instead of electricity. The cooling tower uses a combination of process water from the wastewater treatment plant as well as city water as its makeup water.

Solar Cells

The Solaire's photovoltaic panels create a striking visual effect from the street, serving as reinforcement of sustainable principals. The west-facing façade features 1,300 ft^2 of photovoltaics with 76 custom panels. The total façade rating is 11 kW. The canopy above the main entrance is made of 151 ft^2 of building-integrated photovoltaic panels sandwiched between two panels of glass, generating electricity and also providing shade and shelter from rain. The total canopy rating is 662 W. At the top of the building are the bulkhead solar systems: 286 standard 75 W photovoltaic modules covering almost 2,000 ft^2 of building façade mounted to the bulkhead west and south walls, which use an ornamental aluminum mounting system. The total rating of the bulkhead is 21 kW.

Unlike many solar photovoltaic systems, this building-integrated photovoltaic project required a configuration of modules on the façade and canopy with custom sizes and

The Solaire's water treatment plant uses a process of digestion, membrane filtration and ultraviolet disinfection.

shapes. As manufactured, the panels become the structure of the façade, replacing the use of brick or glass.

Also, the solar cells that make up the panels on the Solaire were manufactured from recycled silicon, helping the building team reach its goal of using 50% recycled-content building materials, and the panels were manufactured less than 150 miles from the building site.

To meet a requirement of the Battery Park City Authority, the solar electric systems are sized to meet 5% of the base building's nonresidential electric load (common areas such as hallway lights and the mechanical systems). Since 2004, the photovoltaic system has been meeting or exceeding its production estimates. During 2005 and 2006, the façade system of 11 kW produced about 6,000 kWh of electricity per year. Ongoing performance data, including live data from the façade system, is available on the Solaire's Web site (www.thesolaire.com) and on the altPOWER Web site (www.altpower.com).

The various photovoltaic systems were commissioned in January 2003, approved by the local utility in March 2003, and have been operating since mid-February 2004.

Resource Efficiency

The Solaire's design specified source control of indoor air pollutants. Only building materials with low emission levels of VOCs were used. Prior to occupancy, 10% of the units were tested for air quality in accordance with EPA protocols, and IAQ testing has continued each year since opening.

The Solaire also is equipped with HVAC units that filter the fresh

WATER CONSERVATION AND TREATMENT

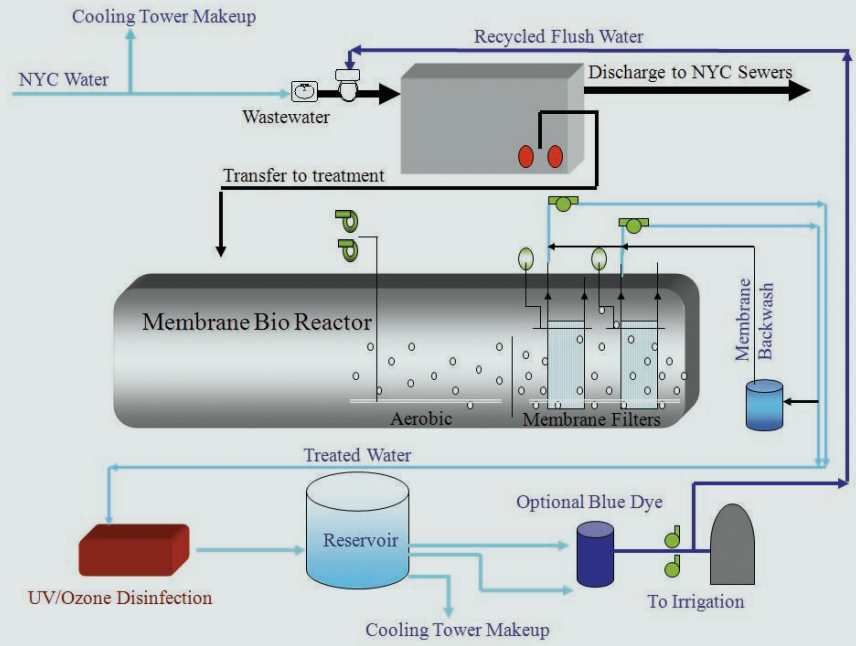
Solaire's wastewater treatment facility processes 30,000 gallons per day of black water from building occupants and reuses it in cooling towers and to flush toilets in both the Solaire and its sister building, the Verdesian.

Avoiding the energy and other costs of transporting water to treat it at the municipal plant, the Solaire's water treatment plant uses an efficient process of digestion, membrane filtration and ultraviolet disinfection. Water is treated to a nonpotable standard and is used for toilet flushing and cooling tower resupply. After water is extracted, sludge is sent back to the city through the sanitary system to aid in the municipal treatment process.

In addition, the rooftop garden design incorporates a storm water retention system that retains water, once soil is saturated, in a mat just below the soil's surface. Excess rainwater spills over into drains on the roof's surface. The rainwater is collected in a 10,000 gallon tank in the building's basement and saved for reuse by the high-efficiency drip irrigation system just below the top of the soil throughout the roof garden. The gardens also provide added thermal insulation for the building and help reduce the heat island effect in the city.

The building is also equipped with water-conserving devices such as low flow toilets and ENERGY STAR dish and clothes washers.

These water-saving features have allowed the Solaire to reduce indoor potable water use by 43%.



Distributed Water Reuse System

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LESSONS LEARNED

For a green high-rise residential building project, the team found and researched many areas where little precedent or benchmark data were available. The lessons learned from the Solaire project have informed the design and construction of two of Albanese Organization's other residential buildings nearby: the Verdesian, LEED-NC Platinum (occupied in 2006) and the Visionaire, anticipated LEED-NC Platinum (estimated completion in fall 2008).

In fact, lessons learned have translated directly into dollar savings: it cost an estimated 17% more to build the Solaire than a similar typical building, only 12% more to build the Verdesian, and an estimated 5% more to build the Visionaire. Higher rental income, higher tenant retention and occupancy, as well as lower operation and energy costs made the investment in green features profitable.

Energy Costs for New Systems

One outcome of the Solaire project was the understanding that some of the building's features had energy ramifications that were not predicted.

The black water treatment/reuse system added a considerable electric load (the need for fans and pumps not in any other building in New York City). The Solaire system was designed to treat water for both the Solaire and the Verdesian, but in future projects, a larger plant, serving multiple buildings, would reduce water demand and make the plant more cost effective.

The humidification system, as well as the design goal of 100% fresh air ventilation, had a larger energy impact than expected. In fact, the team found that indoor air quality and energy efficiency became competing goals. In the subsequent designs of the Verdesian and Visionaire, steam generators are used for the humidification process. A heat recovery system (from exhaust systems) was also implemented for increased efficiency. In the Verdesian, the city allowed the project team to improve energy efficiency by lowering ventilation and exhaust air levels in accordance with ASHRAE standards in a pilot case that will help inform the city's building code revisions for green buildings.

The Importance of Commissioning

The Solaire had been commissioned before occupancy, helping to address issues with the design, function and operation of all the major systems. Since the building opened, the building has been recommissioned each year, helping to identify modifications that continue to improve efficiency in the building—an additional 8% energy efficiency between 2005 and 2007.

These improvements have ranged from maximizing the use of the available plate-and-frame heat exchangers that provide free cooling, calibrating faulty sensors and modifying equipment sequences of operation to reduce cost. For example, the primary chilled water pumps initially were designed and installed to operate at 100%. But through recommissioning efforts, they were modified to operate with a differential pressure sensor, using variable frequency drives that allowed the pumps to slow down to match chiller load—reducing peak load kW.

Education and Training

Consideration of local labor practices and construction methodology is critical to sustainable design implementation—perhaps just as important as design and technology. The Solaire project team put a strong emphasis on staff education and training. Building operators had and continue to have input in the design, construction and commissioning process. This has been a contributor to identifying issues and improving energy performance and building operations.

Resident education also is important. Staff members provide a tour for each person that moves into the Solaire, answering questions about green features and explaining the benefits and consequences that come with systems they may be unfamiliar with. Hundreds of additional tours given by the staff each year educate the community and provide feedback about the project to the green building industry.

Water Advancements

Water use can be reduced even more. At the Solaire, the cooling tower uses 50% reuse water, but the project team is looking at designs that can use 100% reuse water for cooling demand. Other significant advancements would include using nonpotable reuse water for laundry, estimated to be 15% of all indoor consumption.

air supply to a higher level than usual, removing 96% of the particles normally found in the outside air. Individual apartments have MERV-12 filters that are changed by management every three months. Other features aid in maintaining the highest quality indoor air. Entryways are outfitted with recessed floor mats to help trap dust and dirt particles.

Requirements for recycling and using recycled materials were specified in the design. In addition to low VOC emissions, during construction, more than 80% of the building's construction waste was recycled (60% was required by the Battery Park City Authority Guidelines at the time). As a result, the Battery Park City Authority increased its standards for construction waste recycling to 80% for future buildings in Battery Park.

Lighting

Fenestration design provides each unit with more natural light than a building built to New York state code. Daylighting designs feature 100% more natural light in bedrooms and 200% more in living rooms than required by code. Light

The 27-story, 293-unit residential tower borders New York City's financial district and the site of the former World Trade Center.

fixtures in each unit are ENERGY STAR rated, reducing electricity use by up to 75%. All permanently mounted lighting fixtures use efficient fluorescent lamps, and they are controlled with a master switch in each unit that turns them off and on with one movement. Lighting in corridors and other public spaces is controlled by timers and occupancy sensors, and lobby lighting is controlled with a photocell to reduce or increase electric light as natural light changes.

Envelope Features

Windows	
Shading Coefficient	0.43
Visible Transmittance	0.68
Solar Heat Gain Coefficient	0.35
U-Value (Fixed)	0.41
U-Value (Operable)	0.47
Exterior Walls R-Value	8.43
Roof R-Value	22.7

Airtight Insulation

An airtight, insulated, exterior brick-and-concrete block wall reduces heating and cooling requirements. The windows are double glazed with thermal breaks and insulated spacers to reduce heat loss in the winter. The glass has a low-e coating (shading coefficient of 0.43) to reduce heat gain in the summer. All points of contact between window and wall contain extra insulation in a system researched and designed specifically for the Solaire. Exterior walls contain more insulation than prescribed by local building code: an added separate layer of 2 in. thick insulation.●

ABOUT THE AUTHOR

Kyra Epstein is a technical writer who has worked with the National Renewable Energy Laboratory (NREL), Architectural Energy Corporation, and LOHAS (Lifestyles of Health and Sustainability). Contributors to the article include **Russell Albanese,** president of Albanese Organization, **Michael Gubbins,** vice president, director of residential management for Albanese Organization, and **Adam Hinge, P.E.,** managing director of Sustainable Energy Partnerships.