

## Case Study

# Deep Energy Savings in Existing Buildings



## Overview

### Site Details

- Owner: Glenborough LLC
- Location: Rosslyn, VA
- Building Type: Office
- Project Description: Deep Retrofit
- Size SF: 313,337
- Stories: 12
- Project Completion: 2010
- Year Built: 1987

### Recognitions:

- 4<sup>th</sup> Place in EPA National Building Competition – Led the Office Building Division
- Glenborough was honored as one of EPA's EnergyStar "Top Performers" in 2008 and 2009 with an overall portfolio rating of more than 75 – the current rating is 85.

## 1525 WILSON BOULEVARD

1525 Wilson Boulevard is a twelve-story building in Rosslyn, Virginia comprised primarily of office with ground level retail, storage and a three-level underground parking garage. Constructed in 1987, the property is situated on "The Hill," one of the strongest suburban office markets in the nation. The tenant mix consists of several high-profile tenants including government agencies and contractors, and large institutional firms.

This all-electric building's energy consumption was one of the highest in Glenborough's portfolio. Through a combination of energy efficiency strategies, including replacing HVAC and lighting systems and providing tenant education, energy use was reduced by 35% in just one year. This resulted in savings over \$250,000 on energy bills, and eliminated more than 1,200 metric tons of CO<sub>2</sub> emissions. 1525 Wilson Boulevard improved its EnergyStar score from 63 to 97 (out of 100), a 35% improvement placing it in the top 3% of office buildings in the nation based on energy use.

## Motivations

**Project goal:** Glenborough's primary objective was to take a mid-class building that was already 100% leased and elevate it to the top of the market by increasing efficiency, sustainability and comfort.

Glenborough follows a corporate retrofit strategy that examines each building according to five categories of sustainability – energy efficiency, water conservation, waste management, tenant education, and procurement and operational best practices – and attempts to maximize efficiency in each category.

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Major HVAC upgrades and replacement needs due to age and energy performance were a trigger for taking a deeper look at other opportunities.

*“The 1525 Wilson Boulevard building is an excellent example of how Glenborough’s methodical approach has maximized the benefits, efficiency, and functionality of energy management projects. This 313,337 square foot building has had a consistently high occupancy rate since 2004, and is currently 100% occupied”.* – CARLOS SANTAMARIA, GLENBOROUGH, LLC

**Rationale and economic criteria:** Glenborough began the transformation of 1525 Wilson by identifying a list of high-energy loads in the building and recommending select capital upgrades that would have the greatest impact on energy reduction.

*“We attacked high-energy-use loads such as compressors, and implemented energy management controls and proven technologies such as VAV boxes. It’s a great example of how an all-electric building can be approached – looking at the peak loads from 5am to 7pm.”* – CARLOS SANTAMARIA, GLENBOROUGH, LLC

**Barriers to energy efficiency measures:** Retrofitting a 100%-leased building was the greatest challenge to the project. Glenborough began by engaging tenants, conveying the benefits of the retrofit and establishing tenant feedback systems. Much of the retrofit work was completed during off hours, evenings and weekends.

*“With a 100% occupied buildings, we need to make sure all systems are running at top strength and are not interrupting tenant work.”*  
– CARLOS SANTAMARIA, GLENBOROUGH, LLC

## Technologies And Design Strategies

**HVAC:** Because 1525 Wilson is an all-electric building, Glenborough decided to address air distribution and HVAC compressors as the first priority, which was estimated to impact 50-60% of the building’s energy use. During the retrofit, existing VAV boxes were found in the ceiling that were not connected, maintained or documented, resulting in entire zones of the building disconnected. The company secured financing to perform a comprehensive upgrade to the whole-building VAV system, including the retrofit of 90% of compressors and sensors. The system framework is open source to allow expansion of additional capabilities to accommodate next-generation technology.

Indoor air quality was a major focus of the project and a key factor in tenant satisfaction. CO2 monitors were added to ensure adequate ventilation of occupied spaces and reduce ventilation rates when empty.

**Envelope:** Glenborough did a full exterior survey of all entrances and exits making sure gaskets were tight, as well as inspecting the exterior to assess

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### Efficiency Measures

- Compressor retrofits to variable frequency drives (VFD)
- CO<sup>2</sup> monitors
- Direct digitally controlled (DDC) energy management system
- Energy efficient lighting retrofit to T8s, CFLs and LEDs
- Implemented operational best practices

infiltration ex-filtration pathways. The review determined that the R-value of the existing, 20-year old glazing was sufficient and did not warrant window replacement. No work was done on wall assemblies. In the next phase of their program, Glenborough plans to conduct an infrared air sealing analysis to identify opportunities to reduce energy waste from uncontrolled infiltration.

**Lighting:** The lighting retrofit occurred throughout the building in various locations starting with all exit lamps as well as the replacement of high-wattage lamps with lower-wattage lamps and fixtures. It included replacing high-energy lighting such as high-pressure sodium in the garage, which runs 24/7, with new energy efficient LED lights. Glenborough installed compact fluorescent lamps throughout building and replaced inefficient office-area fixtures with T8 and T5 ballasts and lamps. The company negotiated with the janitorial crew to implement a daylight cleaning program so the building did not require interior lighting at night.

**Daylighting:** Floor configurations allow the property to efficiently maximize views to the outside for tenants in most spaces.

**Controls:** Glenborough converted all compressors from pneumatic controls to Tridium Direct Digital Controls (DDC) on an open-source framework that will allow expanded capabilities to accommodate next-generation technology. Lighting use is reduced through the use of occupancy sensors and time controls.

**Commissioning:** All systems were commissioned by Glenborough's building engineers.

**Monitoring systems:** Currently all systems and some tenant spaces are monitored for performance. Glenborough is piloting an Energy Information System to look at various loads not previously monitored. In the near future, Glenborough will pursue metering all tenant spaces and pilot a program to reduce tenant plug loads.

*"Efficient implementation of the appropriate energy management strategies requires a dedicated team as well as expertise and precision. In areas where in-house expertise may be lacking, it is important to engage a systems integrator who has the capabilities to help execute the energy management plan through creative solutions extending equipment lifecycles."* – CARLOS SANTAMARIA

## Energy Performance

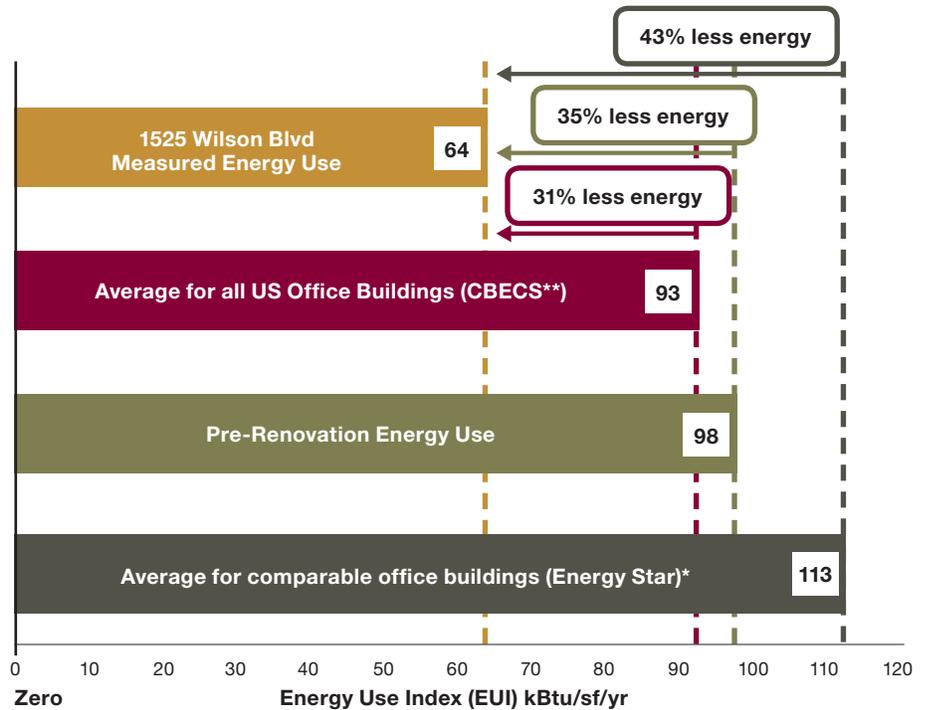
**Energy performance/savings:** 1525 Wilson's energy use intensity of 64 kBtu/sf/yr (EUI<sup>1</sup>) makes it 31% better than the national average for office buildings.<sup>2</sup> The

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1 An Energy Use Intensity (EUI) is the total energy (gas and electric) used in thousands (k) of British thermal units (Btu) divided by the square feet (sf) of the space – resulting in a commonly used metric of kBtu/sf.

2 CBECS – The Energy Information Agency's Commercial Buildings Energy Consumption Survey 2003.

### Energy Use per square foot Comparison



\* Comparable office average energy use from the Energy Star Portfolio Manager program based on like type, size, occupancy, hours, and climate - determined from statistical analysis of the CBECS dataset  
 \*\*Average energy use for all U.S. Office buildings through the Commercial Building Energy Consumption Survey (CBECS)

### Energy Performance

% Better than Baseline	<b>31%</b>
Baseline	<b>Average for U.S. Offices*</b>
Measured Energy Use (KBtu/SF/yr)	<b>64</b>
Energy Star Score	<b>97</b>

\*CBECS – U.S. DOE Energy Information Agency’s Commercial Building Energy Use Index 2003

U.S. average for all offices is a good basis for quickly comparing buildings of the same type. A more specific comparison can be made through the EnergyStar Portfolio Manager program, which determines the energy use of comparable buildings of like type, size, occupancy, hours of use and climate. In this example, the EnergyStar program calculation showed that buildings comparable to 1525 Wilson would use more energy than the average for U.S. office buildings. 1525 Wilson Blvd outperforms this reference set, using 43% less energy than the EnergyStar estimate.

Compared to its pre-retrofit energy use of 98 from the summer of 2008, 1525 Wilson Blvd has a demonstrated reduction in energy use of 35% as a result of its upgrades. The building’s EnergyStar rating of 97 (out of 100) places it in the top 3% of office buildings nationally.

*“In looking at the many new energy efficiency technologies used in this building, I have observed a growing trend. Organizational awareness and commitment in managing and reducing energy is rapidly increasing among all stakeholders in the building industry. Energy management technologies and operational best practices will soon become a requirement for every business. The energy efficiency revolution will change the way the world uses energy.”*

– CARLOS SANTAMARIA

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## Project costs

Below are specific project costs of 200 Market that were disclosed.

- \$25,000,000 (1989) for boiler upgrade, variable-speed drives added to all pumps and fans and asbestos removal, the reconfiguring of the ground floor and upgrading of the life-safety systems.
- \$11,000 (2000) for pressurized water tank/pressure sensor replacement of water pumps.
- \$1,000,000 (2004) for elevator upgrade including conversion to alternating current drives and new controls.
- \$180,000 (2008) for garage lighting upgrade.

## Financial

**Energy Improvement Costs:** \$ 1,100,000 (\$3.50/sf). Additional costs for internal maintenance staff implementation of lighting improvements not available.

**Funding:** The assessment of sustainability categories at 1525 Wilson was done in 2009; due to the economic downturn, there was little access to market capital for this type of project. Glenborough had internal funds reserved for capital facilities and decided to invest in 1525 Wilson, the company's East Coast flagship building.

- Simple payback less than 2 years.
- Estimated annual energy savings 2,300,000 kWh of electricity.
- Estimated annual energy cost savings \$283,000 at a low rate of 7.5 cents per kWh.
- \$75,000+ in maintenance savings.

## Project Results

**Competitive positioning in market:** Glenborough uses key metrics and tools to select properties that are the best candidates for energy management programs. Glenborough found that easy access to historical energy data is the key to gaining visibility into how a building is operating and identifying possible opportunities for efficiency and savings. It is also important to understand the property's business considerations in terms of evaluating the value of energy upgrades. These include:

- Comprehensive view of revenue and expenses.
- Asset hold period, ownership entity, and market conditions.
- Tenant lease expirations and projected occupancy levels.
- Tenant leases with recoverable operational or capital expenditures.

As a result of the energy management project Glenborough enacted, energy consumption has been reduced by approximately 2,300,000 kWhs per year, translating into a 25% reduction in energy cost, for an annual savings of approximately \$283,478 at electrical rates well below national averages. In addition, the EnergyStar score over the last 16 months has improved from 63 to 97. The building has strong improvements in energy performance while increasing tenant satisfaction and maintaining 100% occupancy.

**Tenant Education:** Glenborough believes tenant education is essential to accomplishment of efficiency targets. They plan to pilot a tenant program to reduce plug loads which represent 7.5-15% of the Aventine building energy use. Their goal is to effectively monitor plug loads and usage, without interrupting business functions of tenants.

**User Satisfaction:** Tenants are pleased with higher efficiency HVAC systems that provide more reliable indoor air quality.

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**Innovation:** Glenborough has also embarked on a major elevator upgrade. The company is installing next-generation elevator software that uses algorithms to dispatch cars so that the system is not sending elevators randomly – an expected energy savings of 40-60% by reducing elevator trips.

Glenborough is acting as a pilot for the elevator service provider and will be one of the first projects metered via open-source data gathering with real-time monitoring of elevator efficiency. The service provider will get real data about how much the software will save and how it will optimize service – this partnership benefits both.

*“We do these things pro-actively because we are responsible owners and operators – this makes a big impact to our visibility, our transparency, the quality of our buildings, and our bottom line. So many people say, “You saved so much now you’re done”. But we always look further. We feel we can squeeze out another 5-10% of energy savings. – CARLOS SANTAMARIA*

## Acknowledgements and Sources

### Project Team:

- Owner: Glenborough, LLC [www.glenborough.com](http://www.glenborough.com)
- General Contractor: Alpha Mechanical
- Mechanical Engineer: Alpha Mechanical
- Property Manager: Catherine Winder
- Regional Vice President: Michael Williams

### Sources:

- Carlos Santamaria, LEED AP, Vice President- Engineering Services, Glenborough, LLC

**Photos:** Glenborough, LLC

### Research and Development:

- Preservation Green Lab (PGL): Ric Cochrane
- New Buildings Institute (NBI): Cathy Higgins, Liz Whitmore , Mark Lyles

### Funding:

- NBI and PGL's work is supported by a grant from the Doris Duke Charitable Foundation and the Kresge Foundation

### *New Buildings Institute*

New Buildings Institute (NBI) is a nonprofit organization working collaboratively with commercial building professionals and the energy industry to improve the energy performance of commercial buildings.

**For additional case studies highlighting high performance commercial buildings, visit NBI's Getting to 50 Database:**

[buildings.newbuildings.org/](http://buildings.newbuildings.org/)

**For more information about NBI's efforts to improve the energy performance of existing buildings, visit:**

[newbuildings.org/advanced-design/existing-buildings](http://newbuildings.org/advanced-design/existing-buildings)