



## Retrofitted BEEC Receives China's First LEED Gold for Existing Building

The Beijing Energy Conservation & Environment Protection Center (BEEC), an office building in downtown Beijing, is the first retrofitted existing building in China to receive the internationally recognized Leadership in Energy and Environmental Design (LEED) Gold certification.<sup>1</sup> Intended to be a model highlighting energy efficiency in office building retrofits, BEEC has achieved energy savings of 75 percent and water savings of 60 percent compared with regular office buildings of its size in China. Following the retrofit, the building's energy efficiency was more than 30 percent greater than the ASHRAE 90.1 Standard.<sup>2</sup>

There are more than 1.7 billion square feet of existing public buildings in Beijing. If these buildings could be retrofitted to achieve the same energy performance as this demonstration project, **Beijing could reduce carbon dioxide emission by 22 million tons each year from remodeling buildings alone.**

While the Chinese government develops a National Green Building Action Plan, Beijing has already launched a government and public building energy retrofit program.

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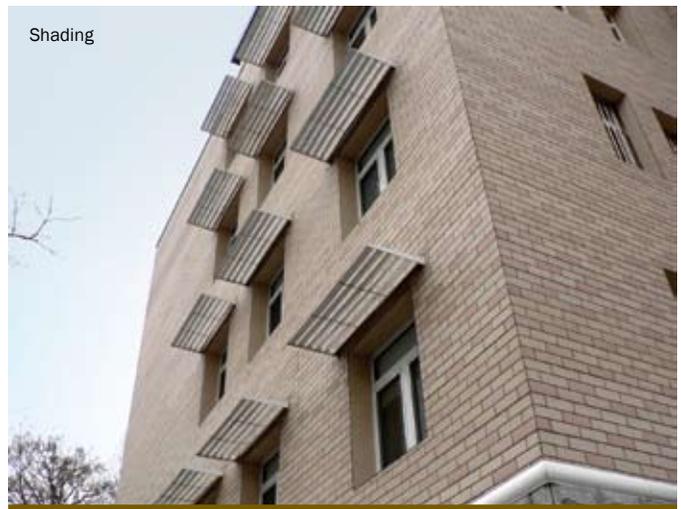
<sup>1</sup> Leadership in Energy and Environmental Design (LEED) is an independent green building rating system that provides third-party verification of high-performance, sustainable buildings.

<sup>2</sup> The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) is an international technical society for all individuals and organizations interested in heating, ventilation, air-conditioning, and refrigeration (HVAC&R). It publishes a well recognized series of standards and guidelines relating to HVAC systems and issues, which are often referenced in building codes

Built in 1986, the six-story office building showcases how an energy inefficient building can be successfully converted at low cost by integrating existing energy efficient technologies. The building owner, Beijing Energy Conservation & Environment Protection Center (BEEC), is affiliated with the Beijing municipal government, which has a mandate to manage and promote energy conservation in industry and building sectors. Financed by the city government, BEEC is an existing building energy retrofit pilot project led by the Beijing Development and Reform Commission. The main goal of the project is to introduce suitable technologies and approaches that can be replicated in existing public building energy retrofit programs throughout Beijing.

Supported by the Natural Resources Defense Council (NRDC), the retrofit of the 47,000 square feet building started in 2007 and was completed in 2008. In January of 2011, it received LEED-NC gold certification as the first LEED project of existing energy retrofit buildings in China.

In order to obtain the greenest results with the lowest environmental impact, NRDC experts worked with the project team for over a year to develop green remodeling strategies and selected available technologies and materials that are practical and suitable for the local building market. NRDC also helped to supervise construction and provided advice on energy use evaluation, building performance verification, and the actual LEED application. Technologies and best practices in this project can be widely adopted by other public building energy retrofit programs.



Shading

#### Among its accomplishments, the project:

- Retained its existing structure, therefore saving large amount of materials and reducing construction waste.
- Improved the building's envelope.
- Upgraded the heating, ventilation, air conditioning, and lighting systems.
- Replaced water fixtures with more efficient ones.
- Built a storm water re-use system, and installed solar PV and water heating systems.
- Adopted cool roof technology, first of its kind in China that could offset more than 30 tons of carbon dioxide emissions.

## To achieve its high performance, BEEC implemented the following green practices:

### Upgraded Energy Efficiency

Since 2009, the building has become 25 percent more energy efficient than required by China's energy code for new buildings, yet its construction costs were only 50% of building a new one with same performance. Energy efficiency measures adopted by the BEEC project include:



Rooftop collector for daylighting conduction device

Ceiling-mounted daylight conducting device delivers light into the lobby and core areas

- Upgrading the building envelope
- Replacing windows with more energy efficient double-paned ones
- Using highly efficient light fixtures with occupancy and daylighting sensor control systems, which saves 3,000 kwh of lighting power per year when the building is operating.
- Installing a daylighting conduction system on the roof, which conducts daylight into the lobby and core areas to save lighting energy use.
- Reusing energy from air exhaust for building heating or cooling at the heat recycle rate of 75%
- Upgrading the building's overall heating, ventilation, and air conditioning systems

— Installing a cool roof, a structure with a highly reflective composite coating on the surface, that covers more than 75 percent of the roof area. It reflects 80 percent of the solar heat gain in the summer. The cool roof reduces the temperature directly under the roof by 30 °C, lowering the building's indoor air cooling load in the summer. The cool roof also helps the building offset over 30 tons of carbon dioxide into the atmosphere every year.<sup>3</sup>



## Improved Building Insulation

The project dramatically improved building insulation by adding another technologically complex insulation system on the building exterior to cover the old building envelope, resulting in a significantly reduced heating and cooling load. BEEC also installed multiple doors and high efficiency windows with double-paned glass to help improve insulation.

## Installed Solar Panels

The building installed solar photovoltaic (PV) panels with a 25 kw capacity, exceeding the building's lighting demand of 18 kw. The system can provide enough power to meet indoor lighting demand during peak hours. It is not designed, however, to operate independently, for it supplements the building's power system with automatic conversion between solar power and the grid. The majority of the time both the PV system and the grid function together to meet the building's electricity demands.

A relatively new kind of solar thermal technology is used to heat the building's water. Conventional power from the grid heats the water only in an emergency.

Overall, BEEC's solar energy system provides 10.7 percent of the building energy demand and enables the building to save 14,000 kwh of power.

## Water Conservation



BEEC replaced inefficient water fixtures with newer, more efficient ones, additionally installing waterless and water efficient urinals, which when combined, save 28 percent more water than required by China's baseline water savings code.

BEEC also installed pervious pavement, allowing storm water to flow into a rainwater capture and reuse system, where it is collected and recycled for plant irrigation and car washing. No storm water runoff drains into the urban drainage.



With local plant species grown for landscaping and collected rainwater used for irrigation, the building does not need potable water for irrigation. This allows it to save 3,600 gallons of water annually.

## Efficient & Sustainable Land Use

Located on a developed site, BEEC is adjacent to mass transportation, including two subway lines and five bus lines within walking distance. Dozens of free bicycle storage spaces are provided, encouraging building occupants to reduce their car use. More than 90 percent of the BEEC building occupants do not drive to working.

In the summer, people will be able to enjoy cooler temperatures at the building site. They will benefit from the combination of a roof solar system, cool roof, and permeable pavement that significantly reduce the building site's heat gain in summer, mitigating the urban island effect and improving the local micro-ecology environment. This also reduces the building's cooling load, minimizing air conditioning use.

## Sustainable Building Materials and Resources

More than 90 percent of the building materials and products used in this project were manufactured locally, dramatically decreasing the environment impact of transportation. About 15 percent of the content of the bricks and cement used in construction was recycled, as was fly ash content from power plants. All of BEEC's carpeting was made from recycled, low emission materials.

During the renovation process, the entire building structure was retained. Most of the construction waste was collected and recycled, diverting much of it away from the landfill.

## Improved Indoor Environmental Quality

The indoor environment quality of BEEC complies with ASHRAE standards for indoor air and thermal comfort level. It achieves this by using green building materials and carbon dioxide sensors, which control the air ventilation rate. When the carbon dioxide concentration is higher than designed in a given space, the air control system increases the intake of outdoor air.

## Leading Excellence

Because of the building's excellent green performance and application of best practices available in China's building market, the Beijing municipal government appointed BEEC as a model for the city's existing building energy retrofit programs. It became a green building education center for raising public awareness about green buildings. BEEC displays its energy performance on a large electronic LED screen attached to the building's outer wall. The same space is also used to advocate energy efficiency policies and environmental protection messages.

<sup>3</sup> July 28, 2008, Arthur Rosenfeld, Hashem Akbari. Global Cooling: Increasing World-wide Urban Albedos to Offset CO<sub>2</sub>, Climate Change 2008.

Using about ten major best practices, BEEC was converted from an inefficient, normal office building to an outstanding green one. After about two years of operation, the building's high performance in energy savings, water efficiency, and indoor and outdoor environmental quality was verified with a building monitoring system. In January 2011, it received its LEED gold certification as a major green renovation project.



LEED Gold Certificate

BEEC also installed a real time, online energy consumption monitoring center that tracks actual energy usage not only within its own building, but also records energy consumption of other government buildings and large industrial users within the Beijing municipality. It serves the administrative mandate of BEEC and helps it implement energy efficiency and energy use management. This monitoring center also functions as a data collection system, which uses "Energy Smart" technology that is 30 percent more efficient than a standard data collection system without similar "intelligent" technology, and contributes 20 percent energy saving in the building. The data obtained from this system will also be used to help enforce energy efficiency standards.

NRDC has worked closely with the project team since the beginning in 2006, supporting and advising each step of the project, from project planning and green strategies development to construction practices, building performance verification, building data documentation, and the LEED application. NRDC will continue to collaborate with Beijing Energy Conservation & Environment Protection Center (BEEC) to promote green buildings and enforce energy efficiency policies during China's 12th Five Years Plan period (2011-2015).

### Under the 11th Five-Year Plan (2006-2010)

China's central government had no mandatory requirement stipulating that existing public buildings undergo energy retrofits. Local governments, though, did develop their own requirements for energy retrofits for residential and public buildings, including heating system upgrades. Shanghai completed 40 million square meters of energy retrofits on existing residential and public buildings during that period. Under the 11th FYP, China completed a total of 560 million square meters of existing building energy retrofits nationwide.

### BEEC Retrofit on Cutting Edge of Broader Central Government Retrofit Program

The successful retrofit of BEEC is on the leading edge of a central government initiative mandating heating retrofits of existing residential buildings in China's northern provinces.

### Under the 12th Five Year Plan (2011-2015)

The Ministry of Finance and the Ministry of Housing and Urban-Rural Development (MoHURD) require cities in the northern provinces to do heating retrofits of at least 35 percent of existing residential buildings or have heat meters installed in them during the years 2011-2013. Local governments have also developed their own energy retrofit plans for existing buildings. Beijing has begun to implement its own existing building energy retrofit program on approximately 280 government and public buildings. Under the 12th FYP, Beijing plans to retrofit 30 million square meters of existing buildings, in addition to the 46.9 million square meters it completed by the end of 2010. Beijing's existing building energy retrofits must comply with the current 65 percent energy efficiency code stipulated in the 12th FYP. The city will develop and implement a slightly higher 75 percent residential energy efficiency code during the same 12th FYP.