TRANSOCEÁNICA, Santiago

The Transoceánica building in Santiago, Chile is a 150,000 sq ft (14,000 sq m), LEED Gold-certified commercial office building.[31] The building is long, narrow, and elliptical in shape, maximizing daylight and views. Situated on 183,000 sq ft (about 4 acres/17,000 sq m) of green space, the building includes office space on three levels, two levels of underground parking with a green roof over it, an auditorium, an amphitheater, a cafeteria, and a café. Outside, a park and lagoon surrounding the building act as an artificial wetland with water from a deep well that supports the cooling system for the office.

Rather than employ a typical glass façade and installing traditional air-conditioning, the building was wrapped in a wood screen lattice on its north, east, and west (sun-facing) sides to deflect solar radiation, while allowing natural light into the office space. As a result, Transoceánica only uses one-fourth the energy of a comparable Chilean office.

A project of Empresas Transoceánica, the project design addressed three unique conditions. First, at the owner's request, the building is incorporated into a master plan, which defined the land use and specified the use of curved shapes for each floor, allowing for future site-development possibilities. Second, the building's energy concept emphasized climatic adaptation and required architectural designers to achieve the required sustainability goals. Third, the building site, located near a sports arena, has strict regulations on constructability, land use, and maximum height, forcing the project to be built on a larger-than-normal lot.

The resulting design contains a full-height atrium that opens into two wings. An independent wing along the north houses an auditorium and cafeteria, connected by an exterior canopy that integrates these spaces with the building and the land. The building's narrow shape optimizes solar orientation, favors natural light, provides views to the outdoors from all locations, and provides a careful façade treatment to avoid unwanted heat gain and loss.

The systems incorporate passive design elements such as location, orientation, solar control systems, natural light, renewable materials, and native vegetation from central Chile.

The building is heated and cooled using German-manufactured polypropylene tubing, installed beneath the floor slabs within a plaster layer throughout all office spaces, improving thermal comfort with radiant effects. The heat transfer fluid operates between 61°F (16°C) minimum and 95°F (35°C) maximum. Air renewal takes place using "displacement ventilation," by which fresh outside air is introduced at low speed through the raised floor and rises by convection wherever there are heat-emitting surfaces. It is then retrieved and directed toward the air handler, which precools or preheats the entering air, using a heat recovery system. In addition to the building's internal control unit, the German engineering office responsible for the energy concept monitors the project remotely via the Internet.

A renewable energy source, geothermal energy is incorporated by extracting water from a 248-ft (75-m) well at a constant 54°F (12°C) temperature, which is used to cool air and the fluid in the tubing using heat exchangers, leaving chillers only for circumstances with higher demand and internal heat generation.

7.8 *Below*: The Transoceánica building in Santiago is the first building in Chile to achieve a LEED Gold certification. Photo: Guy Wenborne.

7.9 *Right*: Transoceánica uses 75 percent less energy than a typical office building in Chile. Photo: Guy Wenborne.

TABLE 7.4

Annual electricity and water use

	Annual use	Intensity
Electricity	749,602 kWh	53.7 kWh/sq m
Potable water	4,614 cu m	330 l/sq m

TABLE 7.5

Estimated energy end-use requirements

	%
Lighting	19
Equipment and offices	27
Heating and cooling	32
Other (elevators, pumps)	22

At a glance

Name: Transoceánica
Location: Santiago, Chile
Size: 183,000 sq ft (17,000 sq m) site; 150,700 sq ft (14,000 sq m) gross floor area building (22,600 sq ft/ 2,100 sq m footprint); 143,160 sq ft (13,300 sq m) landscaping and lagoon area; 17,200 sq ft (1,600 sq m) terrace space
Completion: 2010
Cost: Construction: US$1,079/sq m; Site: US$420/sq m
Distinction: LEED-NC Gold
Program: Commercial office building

Project team

Owner and Project Manager: Empresas Transoceánica
Architect: +arquitectos (Brahm, Bonomi, Leturia, Bártolome)
Energy Concept: Bohne Ingenieure
Structural Engineer: Gatica & Jiménez
Construction: Sigro SA

to study how to persuade occupants to become more engaged in reducing building energy use.

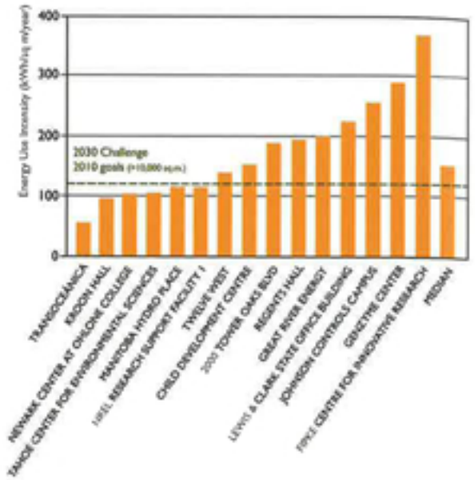
One can also look at the difference between the lower-rise Sydney (ten stories) building and the higher-rise (twenty-two-story) Beijing building, with elevators representing a more important load in the Beijing building, and pumps a much smaller load, whereas in Sydney the building employs direct cooling from Sydney Harbour, requiring considerable pumping energy.

ENERGY USE IN CASE-STUDY PROJECTS

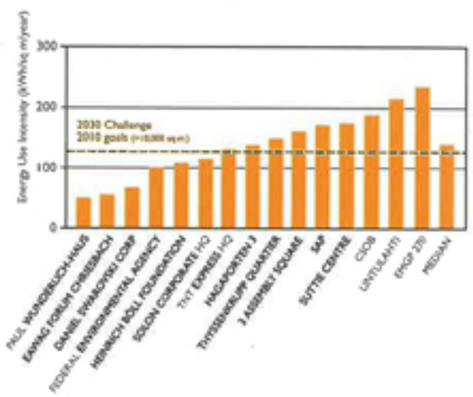
Figure 8.2 shows the measured site energy use intensity for case-study buildings, organized by region. Operating data is from the individual case studies in Chapter 7. There was simply neither data nor time to calculate the primary (source) energy use for each building, but this can be done by interested researchers. The reader can also readily see from Figure 8.2 that certain building types such as research laboratories and healthcare facilities have much higher energy use intensities than office or academic buildings.

What one can see in Table 8.3 and Figure 8.2, is that most projects' site energy use exceeded 100 kWh/sq m/year, although about 12 percent were able to reduce that number to 50 or 60, or even lower.[4] To reach a truly "stretch" goal of 100 kWh/sq m/year of primary (source) energy use would require most projects, with such technologies as ground-source heat pumps or free cooling from a nearby cold-water body, to reduce site energy use to nearly 50 kWh/sq m/year (EUI of 16 kBtu/sq ft/year), an achievable number in theory, but not yet widespread in practice. Of course, with on-site solar-power generation (or in the case of one building, a neighboring forest set aside for permanent conservation and carbon-fixing), it's possible to have a zero-carbon building with an EUI of 30–35 Btu/sq ft/year, as we saw for the NREL RSF I building in Colorado and the Zero Energy Building in Singapore.

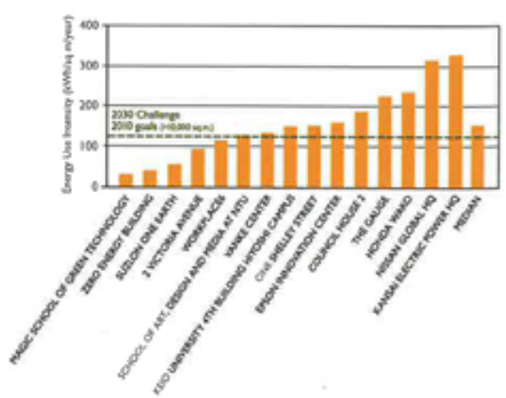
So, for designers, there are now clear targets: achieve at least the median energy use of similar LEED Platinum, BREEAM Excellent/Outstanding, 6-Star Green Star buildings in your region. Of course, many projects now aim at the low end of the energy-use range and have a clear goal to match the "best in class" results already obtained in that region.



8.2a Energy use intensity, Americas.



8.2b Energy use intensity, Europe.



8.2c Energy use intensity, Asia Pacific.

TABLE 8.3

Median energy use intensity, by region

Americas	193/156 kWh/sq m/year	19 examples; or 15 examples, excluding four very energy-intensive lab/research and hospital projects
Europe	135 kWh/sq m/year	15 examples
Asia Pacific	158 kWh/sq m/year	15 examples

TABLE 8.4

2030 Challenge target for 2010: 60 percent reduction from US national average[a]

Building type	Energy use intensity (1,000s of Btu/sq ft/year)	Energy use intensity (kWh/sq m/year)
Education	30	95
Healthcare: inpatient	91	287
Office, 10,000–100,000 sq ft	36	113
Office, > 100,000 sq ft	42	132

a AIA 2030 Commitment Reporting Tool, www.aia.org/about/initiatives/AIA 8079458, accessed February 4, 2012.

Beyond actual results, it's useful to look at what projects should achieve to meet the 2030 Challenge goals introduced in Chapter 1. Table 8.4 shows what these goals would be for 2010, representing a 60 percent reduction in energy use from US national averages in 2005. Recall that by 2015 new buildings should be performing 16 percent lower than these levels, to meet the 2030 Challenge goal of a 70 percent reduction (by 2015). One can see that the median energy use of the world's greenest buildings barely misses the 2010 large office target in Europe, exceeds it by about 20 percent in Asia Pacific, and misses the target by 18 percent in the Americas region, demonstrating that in some places the best buildings are on a path toward carbon-neutral energy use by 2030, but that in other places, designers, builders and operators still have a way to go.

WATER USE IN COMMERCIAL AND INSTITUTIONAL BUILDINGS

Water use in buildings in the commercial, industrial, and institutional (CII) sectors accounts for the majority of urban water use. We know that as the world's population continues to grow, water resources will come under increasing pressure and that high-performance green buildings should do much better in reducing potable water consumption.

Australian experience during the country's 1995–2009 drought showed how a developed country contended successfully with difficulties in preparing for present and future water supply.[5] With a metropolitan area of 4 million inhabitants, Sydney is home to Australia's first major response to continuing drought: major conservation programs, water reuse, public education, and a new desalination plant to provide new water for major cities. In Sydney, there is growing public acceptance for water conservation and reuse of treated municipal wastewater, a feature in several of the Australian buildings profiled in Chapter 7, along with two of the newer buildings profiled in Chapter 9. Because Sydney temperatures can reach more than 100°F (38°C) in summer, and many office buildings require cooling much of the year, almost 20 percent of water use derives from cooling towers, a level susceptible to reduction through improved technology, reusing rainwater, graywater, and blackwater, and more efficient operations. These facts suggest priorities for reducing water use in new high-performance buildings, by focusing first on a total water systems analysis and then by supplying as much of the demand as possible with non-potable water.[6]

HOW MUCH WATER SHOULD A BUILDING USE?

To find out how much water a commercial office building should use, we examined data from three countries: Australia, Germany, and the USA, as shown in Table 8.5. Australian data come from a study conducted in 2006 by the Australian Government; US data are representative from public and private offices; German data are from unpublished studies supplied by Transsolar, a German climate engineering firm.[7] While not definitive, the data represent both average use and "best practices." Increased water use can result from buildings in hot climates that require significantly more water for operating cooling towers. Interestingly, German data are quite a bit lower than either Australian or US data, reflecting perhaps a milder climate as well as more water-efficient building operations. From these data, building managers can get a better idea about establishing best practice goals, ranging from 5 to 10 gallons per year per sq ft (200 to 400 liters per sq m) for buildings without irrigation or cooling towers, up to 15 to 25 gallons per sq ft (600 to 1,000 liters per sq m) for buildings in hot climates with site irrigation and cooling towers. For benchmarking purposes, as with energy use, it's better to focus on absolute water use rather than just on relative improvement (e.g., saving 20 percent compared with a reference or "code" building).

WATER USE IN CASE-STUDY PROJECTS

Figure 8.3 shows the water use in the case-study buildings in each region. Interestingly, fewer projects measured (or reported to us) the water demand, but the actual use was very close to the numbers shown in Table 8.5. We believe that the same methods applied to zero-net-energy buildings can be applied to generate zero-net-water buildings; this goal is aspired to, for example, by the Bullitt Foundation office building in Seattle, Washington, profiled in Chapter 9.