

A 'postcard from the future,' this zero-energy park building creates as much energy as it uses

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Plastic pipes snake down 460 feet into the earth, drawing up enough warmth to heat a 7,700-square-foot building—even on the coldest days

of winter.

Rooftop [solar panels](#) can produce twice as much electricity as the [building](#) needs.

And don't crack those triple-layered windows: Palm-sized sensors track the amount of carbon dioxide being exhaled into the room and send in fresh air whenever it's needed.

Truth is often as strange as science fiction at the Carroll Center, a classroom and recreation space operated by the Park District of Oak Park, a suburb of Chicago. It's the second building in Illinois to receive zero energy verification from the New Buildings Institute. Zero energy buildings produce at least as much energy as they use, and their numbers, while small, are growing rapidly, due in large part to concerns about climate change.

There are 150 zero energy buildings in the United States, up from 33 in 2011, according to the institute's database, which tracks only nonresidential buildings. They include buildings that house offices for state agencies, airports, libraries and nature centers, among others. An additional 585 buildings have registered an intent to apply for zero energy verification.

Zero energy buildings show how much can already be done to conserve energy and protect the planet, according to institute CEO Ralph DiNola. NBI is a nonprofit that works to improve [energy efficiency](#) and lower carbon emissions.

"What we like to say is, that which exists is possible," DiNola said.

Zero energy buildings, also known as net zero buildings, are part of a broader category of very high-efficiency, low carbon-emissions

buildings that will have to be the norm by 2050 if we are to stave off the worst effects of climate change, experts say.

"A net zero building is absolutely where we have to go," said Vivian Loftness, a professor and co-director of the Center for Building Performance & Diagnostics at Carnegie Mellon University.

While a big topic among architects and engineers, net zero building is not on the radar for many states or municipalities, she said. In Illinois, the state energy plan includes only a brief reference to zero energy buildings as one of many options for planners to consider.

Loftness said that buildings—both residential and commercial—consume 70% of the electricity generated by [power plants](#), and that deeply efficient new construction and retrofits of older buildings (with all-electric, high-efficiency appliances and equipment) are essential to reaching climate change goals.

"I think we're going to see a lot of acceleration" in the zero energy building trend, she said.

DiNola said the Carroll Center, which joined the Adlai E. Stevenson High School East Building Addition in Lincolnshire as the second zero energy building verified by the institute in Illinois, is "like a postcard from the future." A third building, the Northbrook Park District's Techny Prairie Activity Center, was added to the zero energy-verified list in recent days.

Low-lying and boxy, with a horizontal bank of windows raised high above the ground and sheltered by a solar awning, the Carroll Center is built for efficiency, with a flat solar roof and few energy-sapping windows.

To the right of the main entrance, a retrofit of the original 1928 Park District building retains its brick exterior and wood interior beams, but the bay windows have been reinforced—with an extra layer of glass and a rigid film—to retain heat and cooling.

The first thing you notice upon entering on a cold day is that the building is reliably warm, without drafts or cold patches. That's due to the heavy insulation and airtight construction, which meets rigorous Passive House Institute US standards, according to Chris Lindgren, superintendent of parks and planning for the Park District of Oak Park.

Passive Houses use features such as superinsulation, airtight sealing, advanced ventilation and high-performance windows to greatly reduce the energy needed for heating and cooling.

"We thought it would be a great teaching tool and a really unique challenge to take something this old—at least the original part—and meet these rigorous standards" that Passive House puts forth, Lindgren said.

Lindgren said the Park District board had already had a good experience with high-efficiency geothermal heating, which lowered [energy use](#) at the district's Austin Gardens Environmental Education Center, when planning for the Carroll Center addition began in 2018.

Zero-energy seemed like the right next step, he said, and it helped that a big grant was available to help defray the cost.

The total zero energy project—Carroll Center's addition and the retrofit of the original one-classroom building—cost \$2.1 million, with \$577,800 coming from an Illinois Clean Energy Community Foundation grant.

During a test period from October 2020 through October 2021, the new

building produced 26,864 kilowatt-hours of energy, more than twice the 11,654 kilowatt-hours it used, according to Lindgren. The building received its zero energy verification Feb. 1.

The all-electric building gets its electricity from rooftop solar panels, but its heat and cooling are powered by geothermal pipes, which are dug deep into the ground, to take advantage of relatively mild year-round temperatures of about 50 to 60 degrees Fahrenheit. The building, which does not have batteries to store energy, produces excess power during the day, when the sun is out, and pulls electricity from the grid at other times. Excess energy from the panels is used by the adjacent park.

Standing beside a series of bright red and blue valves in the basement of the building, Lindgren pointed out a dozen pipes rising up from the ground.

Water treated with antifreeze circulates through the pipes, transferring relatively mild below-ground temperatures to a [geothermal heat pump](#) in the basement. The pump is powered with solar energy from the roof.

"It's very, very efficient heating and cooling," Lindgren said.

A small number of private homes use geothermal heating and cooling, but Lindgren's big tip for most homeowners relates to the unassuming gray water heaters standing off to the side.

"I try to tell people, if your hot water heater goes out, you should really think about (an electric) heat pump hot water heater. They are amazing," Lindgren said.

"You don't realize how much [energy](#) you waste on just your hot water. They're just super, super-efficient—four times as efficient as the one in your basement right now."

DiNola said that those concerned about climate change or high gas prices have an array of home electrification options. Among them are electric induction stoves, which have been gaining popularity in recent years, with some cooks saying they actually prefer them to gas.

DiNola is particularly interested in a new 120-volt "plug and play" electric heat pump water heater, which his organization is field-testing in California. The 120-volt model can just be plugged in, with no rewiring required.

"I think that's going to be the disruptive technology in water heaters," DiNola said.

People often assume that superinsulated Passive Houses like the Carroll Center must be stuffy, but fans say that's a misconception. Continuous fresh-air ventilation systems provide filtered air from outside, with minimum heat loss.

During a recent visit, the air was fresh and odor-free, even in the basement, where the staircase was narrow and the ceilings were low, due to the installation of insulation under the floor during the renovation.

High ceilings, long expanses of windowless wall, and light pouring down from the skylights above gave the two classrooms in the new addition a distinctive, almost futuristic feel, as if they had been dug into the surface of a hot and windy planet.

But, other than that, the scene at the Carroll Center on a recent weekday morning was classic preschool, with brightly colored magic markers, tiny tables and chairs, and a little boy offering play money for a ride on a classmate's broomstick horse.

His offer accepted, the boy hopped on behind his classmate, and

together they galloped triumphantly around the room.

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