# “Heat pumps help reduce global warming”

These ultra-efficient systems could massively reduce our emissions from heating and cooling buildings.

By Ula Chrobak, Popular Science  03/03/2020

Many states have made ambitious goals to cut their greenhouse gas emissions in an attempt to meet the targets established by the Paris Climate Agreement. California wants to be carbon neutral by 2045, New York is aiming for a 100 percent cut from 1990 emissions by 2050, and Florida has committed to an 80 percent reduction over the same time frame.

But if we’re going to have any shot at meeting these goals and averting some of the worst consequences of climate change, we need look within—within our buildings, that is. Buildings are the source of 40 percent of U.S. greenhouse gas emissions, and more than a third of those emissions come from heating, cooling and ventilation. Heating our indoor spaces is responsible for a tenth of annual emissions. Most structures today use natural gas, oil, or propane to stay warm, creating millions of small sources of carbon pollution with a big cumulative punch.

Luckily, there’s another option already available: heat pumps. Some suck heat from the air, others from the ground, and they’re all more efficient and less polluting than your clunky gas furnace [especially with California’s very green electricity.]

There’s nothing new about the fundamental technology of heat pumps. Your fridge is a heat pump. It sucks out heat from inside and pushes it out—that’s why the compressor at the back of it feels hot. Even at cold temperatures, there is heat in the air, and the vapor compression cycle that fridges and air conditioners use essentially concentrates that heat and moves it away. It warms up one space to cool another.

Heat pumps are basically a highly efficient and reversible air conditioner. When it’s cold indoors, they can suck heat from an outside source—the air or the ground, in the case of geothermal units—and use it to warm up air or water for hot water pumps inside. When it’s too hot inside, they can move that heat outside.


A Daikin Air Source Heat Pump System

Air source heat pumps concentrate heat from outdoor air and use it to heat indoor spaces, and function similar to an air conditioner when it’s hot inside. Geothermal, or ground-source, heat pumps also have thermodynamics on their side for heating and cooling. From 30 to a couple hundred feet below the surface, the Earth maintains a fairly constant temperature year round. In the U.S., that temperature is between 45 and 75ºF depending on where you are, with many states falling right

in the middle of that range. These temperatures are close to those comfortable for humans, and the heat pump can take advantage of this for energy-efficient heating and cooling.

Heat transfer is inherently more energy efficient than generating heat, which is why heat pumps use much less energy than a conventional furnace. In fact, all heat pumps are technically over 100 percent efficient, meaning that it produces more energy as heat than it consumes for electricity. Meanwhile, even an especially efficient gas heater might only reach 90 percent. For that reason, according to the U.S. Department of Energy, heat pumps can cut energy bills by 65 percent compared to traditional HVAC systems.

Scaling up heat pumps holds a lot of promise for curbing climate-warming emissions. In a 2018 study prepared for the Natural Resources Defense Council, researchers estimated that switching to heat pumps for space and water heating could cut emissions from California households by about half. With the massive amount of energy used across the country to heat and cool homes, a nationwide shift would also foster large cuts to greenhouse gases.

The United States Mid-century Strategy for Deep Decarbonization, an official document from 2016 laying out how the country would meet the Paris Agreement (before the Trump Administration withdrew the U.S. from the agreement), specifically mentions heat pumps as part of strategies for reducing emissions from buildings. "Geothermal heat pumps use electricity to provide heating, cooling, and water heating to buildings at higher energy efficiency than conventional heating and cooling air conditioning systems," says Xiaobing Liu, a geothermal heat pump researcher at Oak Ridge National Laboratory. "Even though we still use electricity generated at power plants, heat pumps can still reduce the emissions related to electricity because of their efficiency." With government incentives and policies, and more investment and workforce training, heat pumps have the potential to help us meet our emissions goals. "We're seeing the beginning of a revolution. We've seen a tremendous shift," she says. "So I feel like the movement is gaining momentum."