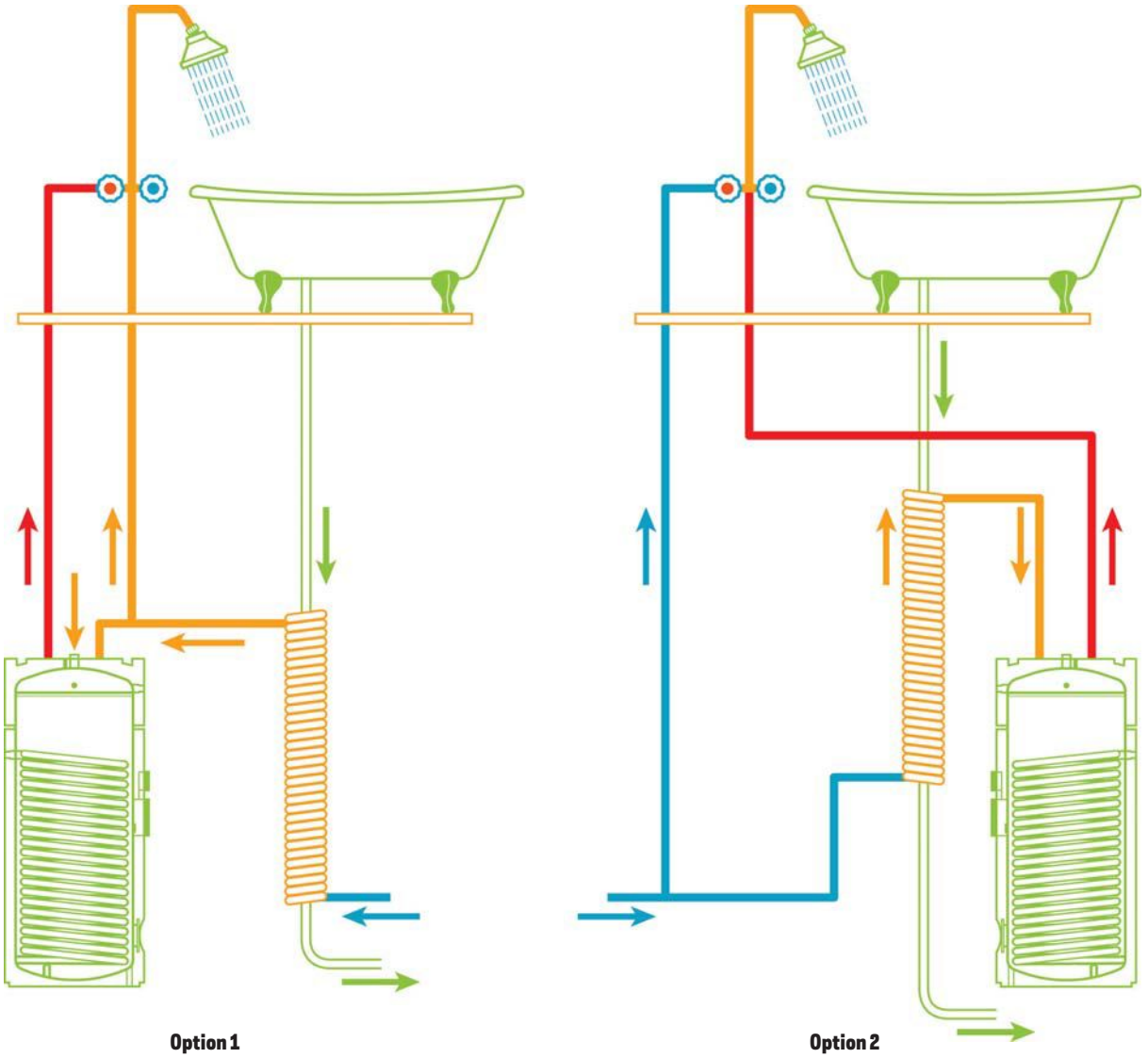

Option 1 Option 2

DOWN THE DRAIN

GRAVITY FILM HEAT EXCHANGERS RECOVER ENERGY THAT WOULD TYPICALLY BE WASHED AWAY.

Text Heidi Moore
Illustration Jameson Simpson

If solar panels and green roofs represent the A-list celebrities of green building, perpetually gracing the pages of glossy brochures, then drain water heat recovery systems are the supporting cast. They show up and deliver the goods, but they don't receive the attention or accolades. Most people don't even know them by name.

"People like solar panels because they make a statement about how green they are," says Larry Weingarten, a Monterey, Calif.–based contractor with expertise in water heating. Drain water heat recovery "can do the same thing at far lower costs, yet it's not visible so people don't consider it."

When we take a hot shower, we're washing energy down the drain—literally. According to a 2012 article from the U.S. Department of Energy (DOE), between 80 and 90 percent of the energy used to heat water in a residence is then wasted in drain water. The DOE estimates that "the equivalent of 350 billion kilowatt-hours' worth of hot water is discarded annually through drains." But the good news is that "a large portion of this energy is, in fact, recoverable."

Drain water heat recovery systems—also known as drainline or gravity film heat exchangers—capture energy from graywater and use it to preheat supply water. Typically installed

Equal flow (option 1, above): Preheated cold water feeds both the water heater and the cold water supply line to the plumbing fixtures. Unequal flow (option 2): Preheated cold water feeds the water heater only.

Photos: Adrian Schulz

in the basement as part of the drainage stack, the systems lead to either a hot water tank or to an appliance that concurrently uses hot water and produces warm wastewater, such as a shower. Weingarten prefers to install the systems on appliances where hot water is fed directly to the appliance, such as a dishwasher, since this presents the best opportunity to increase efficiency. "It's a much simpler plumbing job with much shorter plumbing runs, so there's less opportunity to lose heat," he says. Bathtubs and washing machines, on the other hand, aren't effective applications for this type of technology given that they are filled once and then drained.

A typical drain water heat recovery system may comprise a 3-inch-diameter copper drainpipe wrapped by a coil of 1/2-inch-diameter copper water supply pipe. The system naturally heats the

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Designed by JSWD Architects, the Green Gulch Farm dormitory at the San Francisco Zen Center in Marin, Calif., captures graywater heat from the second-story showers through a drain water heat recovery unit.

incoming cold water using the principle of gravity film heat exchange (GFX). As wastewater flows down a drainpipe, it naturally lines or clings to the inside of the pipe in a thin film. Heat from this thin film of water conducts to the cold water traveling up through the supply copper pipe coiled around the drainpipe. This preheated supply water then travels to the shower, the dishwasher, or the hot water heater.

"Essentially, it's a counterflow heat exchanger—there's one fluid moving in one direction and another fluid moving in the other direction," Weingarten says. "A good [system] recaptures perhaps 60 percent of the waste heat."

The double-walled configuration of a GFX system prevents potable water from mixing with graywater, so the system complies with plumbing codes. Little, if any, upkeep or maintenance is necessary, Weingarten says, and the copper piping can last 30 years or longer. "There isn't a whole lot that can go wrong with them," he says. But how often they're employed is more "a matter of education. Unless consumers ask for it, there's not much motivation for contractors to look at this new thing."

Depending on the application, GFX systems can reduce water heating costs by 20 to 35 percent and overall energy costs by about 10 percent. Costing roughly between $500 and $1,000 per system, which includes installation costs, a GFX unit can take between two to 10 years to recoup the initial costs. But when one unit can serve multiple applications—and when used in multitenant buildings, military barracks, and other large-scale residential projects where demand for hot water is high—the return on investment may be realized even faster.

The first multiunit dwelling in California to achieve Passive House certification recently incorporated GFX. Designed by JSWD Architects of Berkeley, Calif., the eight-unit, two-story dormitory for the San Francisco Zen Center's Green Gulch Farm in Marin, Calif., meets Passive House's stringent sustainable building standards that specify near-net-zero energy consumption. The eight units are arranged into four pairs, each of which shares a bathroom and kitchenette. With laundry located at a separate central facility and little cooking occurring on site, the showers consume most of the energy that is used for heating water in the building.

At the Green Gulch Farm's dormitory, a drain water heat recovery unit extracts heat from the showers on the second floor. The first floor sits on a slab, so it wasn't possible to install a GFX unit underneath the first-floor showers. Though drain water heat recovery wasn't necessary to achieve Passive House certification, says Helen Degenhardt, AIA, the project architect, "it dealt with the overall goal of sustainability" and was straightforward to install.

As this project illustrates, the primary design challenge associated with drain water heat recovery is space. GFX systems need about 5 feet of vertical clearance to accommodate the wastewater drainpipe and surrounding coil—the closer the pipe can be to the application, the more

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efficiently it can capture the energy.

Currently, the GFX products on the market require vertical installation. However, EcoDrain—based in Montreal, Quebec, Canada—is developing a product that is oriented horizontally, which eases installation in tight areas, such as underneath dishwashers. The heat exchanger uses an agitator to double the rate of heat transfer as warm wastewater moves through a flat plate, heating up the cold water running in four separate parallel square channels beneath the plate.

When Robert Fortunato, president of ForStrategy Consulting, remodeled his 2,100-square-foot residence in Hermosa Beach, Calif., named the Green Idea House, he had his plumber install one of the earliest prototypes of the EcoDrain in the crawlspace below the first-floor shower. (The house is intended as a case study for an economical net-zero-energy and zero-carbon retrofit.)

The difference that the EcoDrain makes is significant in the winter, Fortunato says. "If you put your hand on the cold [water] pipe before it enters the heat exchanger, it's really cold. If you put your hand on the other side, you can feel the temperature difference."

Chris Hyder, co-founder of Smith-Hyder Construction, a high-end custom home builder based in Berkeley, Calif., recently installed his first GFX system in a 7,000-square-foot, LEED Platinum–certified home in Palo Alto, Calif. His team initially considered installing one system by RenewAbility Energy, in Kitchener, Ontario, Canada, to recover hot water for the showers. "Then we got a little more involved and put three in," Hyder says.

Currently, a maximum of three LEED points can be earned for residential drain water heat recovery systems under the efficient hot water equipment credit, which is Energy and Atmosphere credit 7.3 in LEED for Homes version 2008, and Energy and Atmosphere credit 12 in the forthcoming LEED for Homes v4. Projects with GFX units may also qualify for a LEED innovation point.

The three GFX units in the Palo Alto house capture heat from three wastewater sources—the master bath shower, the shower in a second bathroom, and a third bathroom shower and nearby laundry room—and return the preheated water to the showers.

The use of drain water heat recovery systems seems like a no-brainer, Hyder says. "It's pretty simple, which is great. It's easy to install. They're not horribly expensive. Why wouldn't you do it?"

"IT'S A MATTER OF EDUCATION. UNLESS CONSUMERS ASK FOR IT, THERE'S NOT MUCH MOTIVATION FOR CONTRACTORS TO LOOK AT THIS NEW THING."

— LARRY WEINGARTEN, CONTRACTOR AND WATER-HEATING EXPERT

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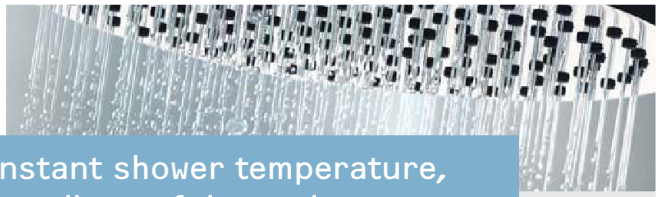

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