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REHAU Montana Ecosmart Home Drives Industry Research

Geothermal Cost Effective Choice in Columbia River Gorge

geoOutlook STAFF 2012

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DIRECTORS' FORUM

NOTES FROM IGSHPA

By Jim Bose

Executive Director: IGSHPA

GSHP: The Gold Standard of the Residential Market

Residential markets have the advantage of the Federal and State tax incentives which have the effect of getting homeowners' attention when confronted with the higher first cost. It is difficult to measure the effect of tax credits on increasing sales, jobs, etc. since there isn't a mechanism in place to gather the data. My experience is that builders are more comfortable with the technology because their bottom line is not effected since the realized first cost is somewhat negated.

Marketing should include what most homeowners fail to factor into the cost of a conventional system. For the all-electric home, there is no second utility bill that carries a minimum charge even without any usage. Over the life of the house, this would pay for the incremental cost of the ground heat exchanger. Second, maintenance is much reduced and the decrease in efficiency of an outdoor unit, even when handled by a professional, is significant as reported by the California Energy Commission.

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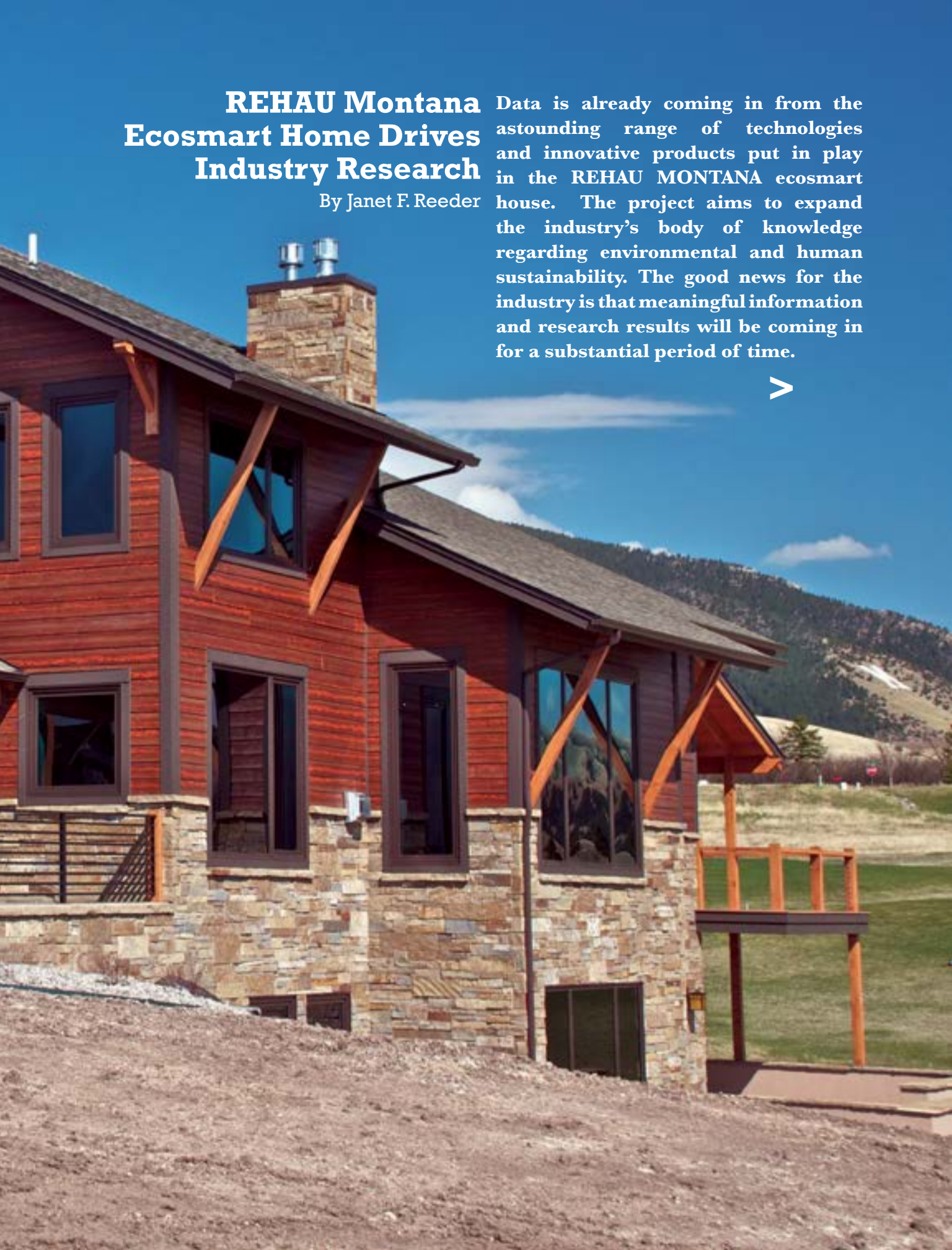
More information, including videos, about the REHAU MONTANA ecosmart house can be found at www.montanaecosmart.com.

(Photo by George Sporn)

REHAU Montana Ecosmart Home Drives Industry Research

By Janet F. Reeder

Data is already coming in from the astounding range of technologies and innovative products put in play in the REHAU MONTANA ecosmart house. The project aims to expand the industry's body of knowledge regarding environmental and human sustainability. The good news for the industry is that meaningful information and research results will be coming in for a substantial period of time.



The master bedroom on the second floor has a majestic view of the mountains surrounding Bozeman, Montana.

(Photo by George Sporn)

Following construction completion in 2012, the sustainable building systems project has moved into the research and demonstration phase in Bozeman, Montana. After a two-year planning and construction phase, the REHAU MONTANA ecosmart house is now the focus of intensive monitoring to gain information about the high performance systems and strategies incorporated in the home.

The REHAU MONTANA ecosmart house is a major research project sponsored by REHAU, an international manufacturer of polymer-based innovation and systems, and led by the Creative Research Lab (CRLab) at Montana State University (MSU).

Dr. Kitty Saylor, REHAU North America CEO, says the project will demonstrate the occupant comfort and optimized energy efficiency that can be obtained by using "thoughtful building practices." Saylor, an alumna of MSU, says the project has been one of the most exciting things she has done while at the helm of REHAU.

One of the main objectives of the research project is to determine ways to integrate building systems for the best optimization of life-cycle costs, comfort and energy usage. The CRLab will compare international building standards to the ecosmart home model to discover how best to meet the residential building certification standards of ENERGY STAR™, LEED™, NAHB and IBEC.

"From the very beginning REHAU has considered this literally a dream project," Saylor says, "because it gives REHAU, as well as the other sponsors, the opportunity to get products and systems into the home in a very holistic and integrated way. But, perhaps even more importantly, it gives us the opportunity to collect data over a two-plus-year period of time."

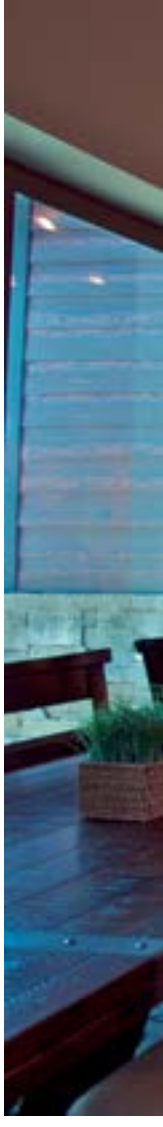
One of REHAU North America's three divisions focuses on construction including hydronic radiant heating, snow and ice melting, geothermal piping, ground-air heat exchange and high-performance window and door systems. Many of those products and technologies have been incorporated into the ecosmart home.

Saylor quickly brought in REHAU Construction LLC Director of Construction Solutions, Bill Johansen, because of his knowledge of sustainable construction and energy efficient mechanical systems. Johansen's background added a manufacturing orientation and thinking process to the team mix to "push it to the next level." Johansen did the initial sketch for the mechanical systems, a plan that included redundant systems and admittedly, some European influence. His ideas included bringing examples of commercially used applications that he knew might be verifiable for residential application. Johansen says the industry doesn't have enough applied scientists and engineers to use the innovative technologies and products that are becoming available.

Energy 1, based in Bozeman, handled the overall mechanical and renewable energy systems design. Mike Foran, senior project manager at Energy 1, says working with the project team was exciting from the beginning. The collaboration on the project made the project work, he says.

Adam Hawks, an MSU graduate and mechanical designer for Energy 1, says evaluating the home in both pre- and post- occupancy will give researchers the ability to access technologies and their function in the home under variables that include the area's climate.

An interesting aspect of the project is the number of MSU graduates involved. Following the research phase, homeowner Bill Hoy, an MSU architecture graduate who helped create MSU's CRLab, and has since come on board with REHAU, will move his family into the 3,800-square-foot



PEXa radiant heating pipe installed over ICF forms is routed through support sleeves to one of two first floor manifold locations.

(Photo courtesy of REHAU)

>

A special Pleotint SRT film and REHAU window and curtain wall profiles minimize energy lost through the home's large expanses of glass.

(Photo by George Sporn)

Top: An envious array of systems and technologies with corresponding pumps, controls and gauges deck out the mammoth mechanical room at the REHAU ecosmart home. Informative placards, as seen in these photos, explain each area.

(Photo by George Sporn)

home he designed. In a series of meetings over the course of several years, Hoy brought the idea of the home to Terry Beaubois, director of the CRLab, and then to Saylor, looking for corporate sponsorship.

The residential modeling and construction project took off with REHAU corporate sponsorship and collaborative efforts of MSU's CRLab, along with an impressive list of building industry representatives who brought with them the latest

top-of-the-line sustainable building products and innovative systems and an unusual collaborative attitude.

The 'take away' of the project, according to Hoy, will be sustainability and efficiency research to support an economic model that can be taken forward into northwestern Montana and similar climates. Hoy also believes the research will help to determine the right combination of products and practices with economics that work for other housing situations. He

Bottom: Manifolds for distribution are viewable above the entrance cabinet where RAUGEO™ geothermal loops are tied into the system in the photo on the left page. On the right, piping is shown for the supply and return lines for the radiant heating and cooling systems.

(Photo by George Sporn)

Carl Sampson and Tyler Sampson of Bridger Drilling install one of three RAUGEO™ Helix Probes in a 20-foot-deep well. An alternative to deep well drilling used throughout Europe, they will be extensively tested at the site.

(Photo courtesy of REHAU)

would ideally like to see data that could be extrapolated and scaled down for affordable housing.

Beaubois expects the project to be a valuable source of data for anyone in the construction industry, particularly those who are intending to meet building energy and other certification standards. He says the project is an ongoing, real-world learning and teaching tool for students in programs at MSU. The School of Architecture, the College of Engineering, the School of Film and Photography and the College of Business will involve MSU students in the project, Beaubois says.

Mechanical engineering technology (MET) program students placed more than 350 sensors throughout the house and in the geothermal borefield loops during construction. MET students also developed computer modeling to show effectiveness of innovative heating and cooling air exchanges. They will now look at the effectiveness of different building materials and technologies.

Under the guidance of Kevin Amende, assistant professor of mechanical engineering technology, they began gathering data before the home was even finished.

During the summer, excess solar energy will be stored in a 10-feet deep heat sink under the front patio slab. The heat sink, comprised of four zones of 1-inch PEX looped in 400-foot runs over sheet foil insulation, was designed by Patrick McMullen of PJ's Plumbing and Heating.

(Photo courtesy of REHAU)

A distribution trench shows some of the piping for three Helix wells and four RAUGEO™ wells that support the geothermal systems being tested.

(Photo courtesy of REHAU)

Amende, a licensed professional engineer, the son of an HVAC tradesman and a professor who teaches MSU's HVAC thermal process and manufacturing courses, sees the project from both an educator and an installer's perspective. He is excited for the opportunity this gives his students, who primarily began working with load calculations, then progressed with the project.

AAON, whose equipment operates the geothermal heating and cooling systems of the ecosmart house, brings yet another MSU graduate to the project, with AAON President and CEO, Norman Asbjornson. Asbjornson studied mechanical engineering at MSU, and has long been a generous supporter of the university through scholarships, endowments and internships.

"AAON has worked with MSU for more than a decade to help develop a program and create the facilities needed to train engineers for the HVAC industry," says Richard Davis, lab manager with AAON. About the ecosmart project, Davis says, "I think this kind of project and collaboration is innovative and a great place to head for universities and industry." Training engineers in HVAC is something AAON has been doing for years through internships and collaborations with several universities. "AAON likes challenges and we like trying new things in the industry," Davis said.

An AAON water-to-water geothermal heat pump uses the closed loop fluid from the geothermal system to produce design temperatures for radiant heating and cooling, Davis says. "This is a unit that we designed specifically for this house and research project, a hybrid," Davis said. It incorporates two innovative digital scroll compressors. Davis says the AAON 14-ton hybrid system is a non-typical design created so that full modulating heating and cooling load requirements could be managed with a single unit for increased testing possibilities. "We broke it into two systems with 7-ton circuits for better part-load modulation," Davis said. "I look forward to seeing how it works with all the other technologies that are incorporated into this house."

The first of four geothermal boreholes was drilled to 300 feet.

(Photo courtesy of REHAU)

Davis says that AAON has the capability to apply many geothermal options into their equipment.

The ground loop heat exchange system is the primary source for the radiant heating and cooling systems in the home. The pipe used for the geothermal vertical borehole field is RAUGEO™ PEXa pipe with double U-bends in each borehole for optimal energy extraction. Ground loops connect to the heat pump via a balancing manifold.

A REHAU ECOAIR™ ground-air heat exchange system is the primary fresh air supply. Outdoor air is drawn in through a 6-foot stainless steel air inlet tower equipped with HEPA filtration. The house has intake ports for two identical ECOAIR™ systems with separate valves and fans in order to demonstrate in the research phase how ECOAIR™ is best installed for optimum efficiency. One system is located within the footprint of the house and the other is outside that area buried 7-feet below ground.

Air travels underground through 8-inch REHAU ECOAIR™ solid-walled PVC pipes with a silver particle-enabled antimicrobial inner surface. Air is ducted to individual zones through standard ducts with automatic dampers. Individual zones are fitted with air handlers to allow room air recirculation.

Other featured systems or products in the home's building envelope include Insulating Concrete Forms (ICF), Structural Insulated Panels (SIPS), REHAU uPVC Window and Door Designs and Sunlight-Responsive Thermochromic (SRT) Glazing.

HVAC and mechanical technologies and products include REHAU Intelligent Climate Control Technology, REHAU PEX Plumbing, a specially designed thermal storage heat sink, radiant cooling panels, Solar Thermal, a REHAU Helix geothermal probe prototype, REHAU FIREPEX™ residential fire sprinkler system, and snow and ice melting systems.

Pat McMullen, Belgrade, Montana based PJ's Plumbing & Heating owner, found working on the project to be a real

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once-in-a-lifetime experience. Working on the first REHAU radiant cooling panel installed in North America, the heat sink in front of the home McMullen designed, and the REHAU Helix probes, provided a continual learning experience for McMullen and his crew. General contractor for the home was Tollefson Builders of Bozeman.

Because the home is designed for aging in place as well as inter-generational living, it also incorporates specialized telemedicine communications technology that allows for transfer of information through interactive audiovisual media for the purpose of consulting, and some remote medical procedures or examinations. From the house, family members will be able to connect to Deaconess Hospital in Bozeman, or any Internet accessible health, exercise, nutrition and diet resources on the Internet.

The research phase of the project will extend through 2014, during which time the REHAU MONTANA ecosmart house will be a valuable real-life teaching tool. REHAU plans to hold training and educational events at the site. A living laboratory, the house and the extensive range of systems it utilizes will be tested and evaluated to gauge how they work in tandem or in contrast to each other. The information will provide the research team a wide range of scenarios to optimize the systems that interact and overlap throughout the home.

Research will also allow economic comparison with traditional systems for initial costs, operating costs, life-cycle costs and payback period or return on investment (ROI). The impact of sustainable products on the resale value and marketability will be evaluated, as well as other issues such as insurance and financing.

Plans also include working with MSU extension offices in offering courses and training, and hosting webinars for trade associations, academic communities and local building officials. The house will also be used for education, tours and technology meetings. Research results will provide valuable information about sustainable construction for the academic world, building industry professionals, developers, homebuilders and homeowners.

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Geothermal Cost Effective Choice In Columbia River Gorge

By John Geyer and BreAnna Morris

One of the homes in John Geyer's study utilizes a 4-ton geothermal system.
(Photo courtesy of John Geyer)

When Certified GeoExchange Designer John Geyer of Vancouver, Washington, sought comparisons of geothermal systems versus other more conventional systems, his query turned up short. Geyer's business, John Geyer & Associates, Inc., receives calls every month from potential customers seeking actual operating costs of geothermal heating systems as well as percentage savings and comparisons to other systems.

Experienced geothermal system installer John Farlow who has worked with Geyer and has seen many types of configurations, says geothermal is more prevalent than ever before.

"Generally, homeowners and builders are a lot more knowledgeable and aware of geothermal than they were 20 years ago," Farlow said. "It's become more popular."

Despite the growing interest and knowledge in geothermal, many people still believe geothermal heating and cooling is not cost effective, regardless of the geographical area. This view persists even though there are 15,000 to 20,000 operating geothermal units in the U.S. Pacific Northwest service areas and perhaps half as many more in California.

Seeing the need for more research on geothermal costs, Geyer compared operating costs for four homes of similar size in one neighborhood in Stevenson, Washington. With cooperation from customers and neighbors, multi-year operating cost data was compiled for two geothermal systems, one propane system and one air-source heat pump system on the same street. All residences were similar in age, size, construction quality and occupancy.

Both of the geothermal heat pumps studied provide space heating and cooling and domestic water heating without auxiliary backup. The propane home uses propane for space and water heating, and electricity for air

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#2 Fuel Oil
80% Efficient., $2.10 / Gal $18.89

Electric Heat Pump
150% Efficient, $0.08 kWh $15.62

Geothermal Heat Pump
350% Efficient, $0.08 kWh $ 7.81

(Courtesy of John Geyer & Associates, Inc.)

conditioning. The air-source heat pump heats and cools while domestic water is warmed by an electric water heater. Both propane and electric costs were evaluated in the propane home.

Geyer analyzed the gross utility bills of each home to isolate HVAC energy costs spanning four and seven years for the geothermal homes, five years for the propane home with electric air conditioning and six years for the air-source heat pump home. Annual HVAC cost for each home is expressed as the average of all years.

Geyer considers the impact of having only one or two residents per home when determining water heating costs. The cost is minor compared to the energy used for space conditioning, so water- heating expense is not isolated or excluded during Geyer's heating cost analysis.

Each of the four homes in the case study overlooks a panoramic view of the Bonneville Dam and features expansive windows on the south side. Some ventilation aspects include range hoods, indoor spa tubs, fireplace flues, vaulted ceilings, whole house fans and vacuum systems.

Local climate conditions provide warm days with modest cooling during summer afternoons. Relative humidity is not an issue, so all four residential HVAC systems are sized for heating needs. Hot and dry or freezing winds from the Columbia River Gorge cause seasonal weather extremes in the Portland, Ore. area and equalize pressure and temperatures between dry, continental air east of the mountains and wet, marine conditions on the west side.

Both geothermal homes are new construction intended for retirement. Geyer and Farlow worked together on one of the geothermal homes in 2006. Geyer designed the heat pump and ground loops, and Farlow worked as the inside installer. They worked together during the weeklong installation, and the homeowners helped with most of the physical labor.

Homeowner and retired engineer Tom Lannen is handy around the house and had been curious about geothermal technology for years. He researched and read about it in building magazines, wondering about the cost benefits and economic impacts. Geyer encouraged the Lannens to pursue geothermal when they built their new home in 2006.

The Lannen home is 5,100 square feet with 3,586 square feet of conditioned space. The two-car garage and carpentry shop are not heated. First floor walls are insulating concrete form blocks and their construction quality is superior. Geyer helped the Lannens choose 5,800 feet of 0.75 inch HDPE piping to form a slinky mat loop system for the 6-ton Hydron Module heat pump and de-super heater that serves the home. The loop system has two layers of slinky-style pipe coils at five feet and nine feet below grade in a 30 by 70 foot pit.

At the time, Geyer and the Lannens were not aware of any tax breaks or rebates for choosing geothermal. "The Lannens made the determination to use geothermal on pure economics rather than incentives," Geyer said. "Numerous energy efficiency choices of the house focused on results, as there were no artificial incentives driving decisions. For example, they used concrete insulated forms at the basement level, and they used cost effective windows."

After the house was completed, the Lannens learned of a few federal tax breaks for geothermal systems and were able to break even on their investment in less than five years.

Views of the air-source heat pump home in both winter and spring show the weather extremes of the area.
(Photo courtesy of John Geyer)

"We were capable of doing more than we thought we could do," Lannen said. "These systems are straight forward and the savings were better than what we expected. They're very clean systems."

Results from Geyer's case study proved geothermal to be the most economic system, with energy cost savings upwards of 80 percent possible in some instances. A home's building envelope will also play a part in energy efficiencies. As the technology continues to develop, more homeowners are realizing the cost-saving benefits of investing in geothermal. Farlow has seen increased interest in the field in recent years.

"It's become a more and more competitive business and a lot less specialized than years past," Farlow said. "It's more affordable for the average homeowner than it used to be. HVAC contractors are in the game now. Fifteen years ago, a lot of the heating contractors told homeowners that geothermal was too expensive, wouldn't last, wouldn't work. Now those same contractors are installing geothermal."

The Lannen's ground loops and heat pump were installed July 2006, before their house construction began in August of the same year. The weather and other construction projects did not complicate the geothermal installation. Geyer and Farlow both said the installation process for geothermal is fairly simple.

"If done right, there aren't any challenges," Geyer said. "We did encounter a small buried spring which added moisture to the loop area after construction. That was a good thing. Water is your friend when you're a ground loop."

"The average geothermal installation like that doesn't have to be such a difficult and complicated task," Farlow said. "It can go in pretty fast. It doesn't have to be rocket science."

While each homeowner provided full or nearly complete records of utility payments, data gaps were filled by payment

All of the homes Geyer studied are in the same general area near Stevenson, Washington, and are similar in age, size, construction quality and occupancy.
(Photo courtesy of John Geyer)

histories from the district. Kilowatt and cost data were complete for each of the four homes studied, with exception of three missing entries that Geyer filled with the averages of same-month payments in other years. While actual costs were computed for the smaller air-source heat pump home, costs were inflated to represent a 3,000-square-foot structure for comparative purposes.

Geyer's results compare total cost for heating, showing the geothermal homes pay significantly less in a year for heating and cooling than the other systems studied.

Lannen is pleased with his geothermal system as well as with the results of the study.

"My first thought was 'how am I doing relative to the rest of the world,' and the results of the case study definitely made us feel like we made the right decision. Secondly, I thought it was a nice opportunity to share about this technology," Lannen said.

"Compared to all the electric systems we've had, the home feels more comfortable, and it's good for the environment," he said. "The system itself has been practically maintenance-free. We had it checked last year, but other than that,

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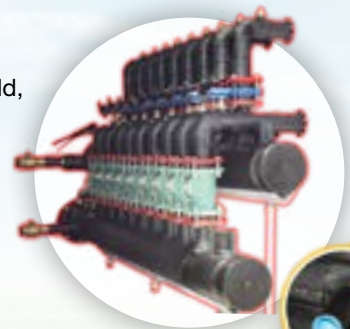

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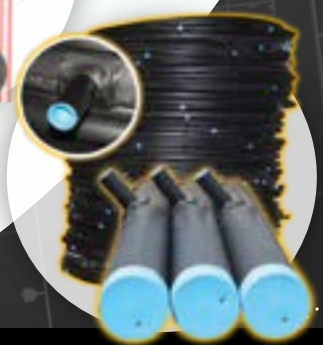

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The Lannen home uses a 6-ton geothermal system. The home shares a majestic view of the Columbia River Gorge and the expansive use of glass with several of the other homes Geyer studied.
(Photo courtesy of John Geyer)

The Lannen's helped with installation of the slinky heat exchange field for their home's geothermal system.
(Photo courtesy of John Geyer)

you almost forget about it. You don't have to worry about pilot lights or anything." Lannen said he has had to get used to the home not having a chimney.

"The lack of traction that geothermal has been able to get in the marketplace is astounding. It's an existing technology. It's nothing far out," Lannen says. "You have to have a heat source, so it's not that strange to get it from somewhere else."

The Lannen's personal account and the results of Geyer's four-home case study show the significant difference in cost and energy savings between geothermal and traditional HVAC systems. Contractors and installers can use the results to promote the technology by proving the cost benefits and energy savings of choosing geothermal.

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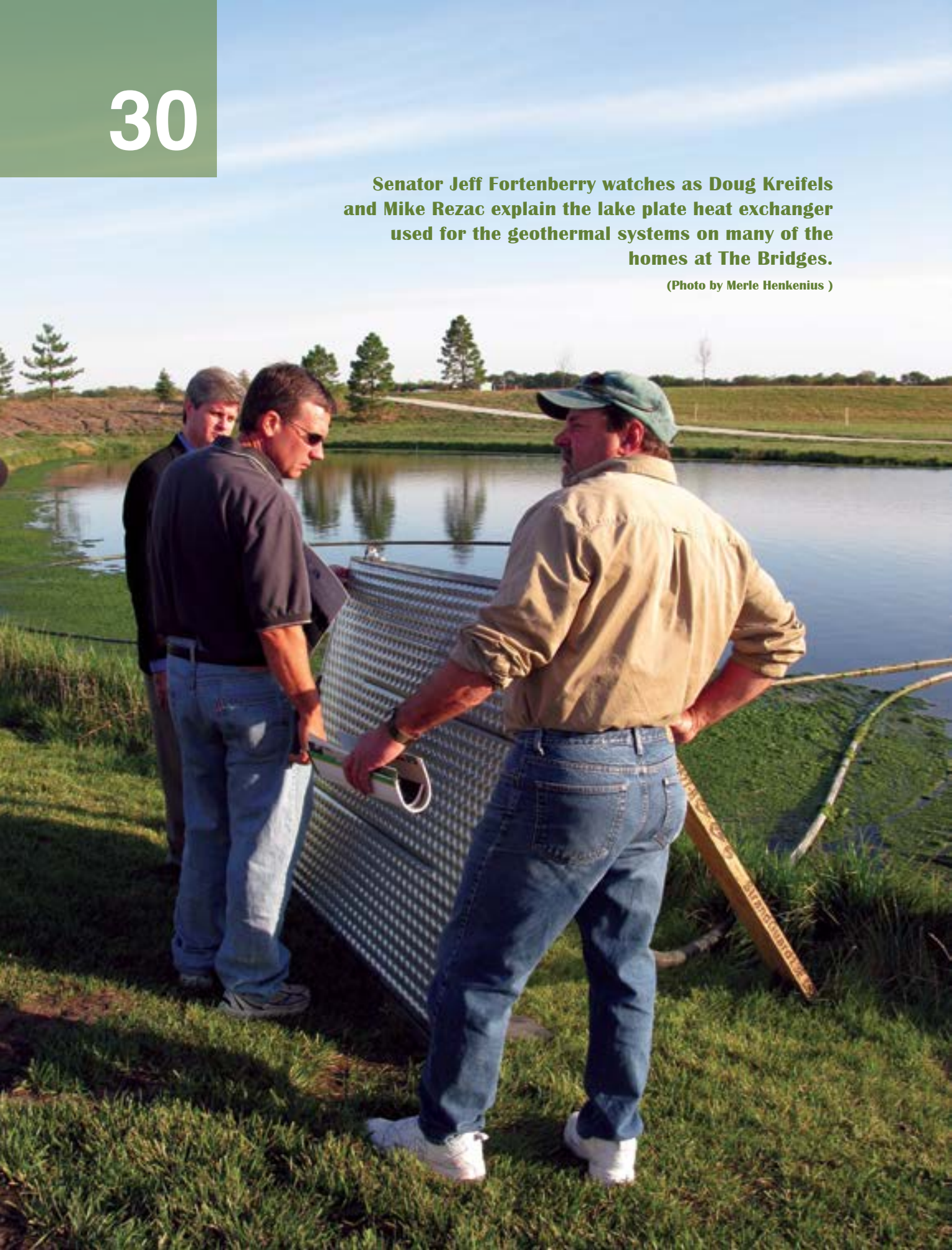

Senator Jeff Fortenberry watches as Doug Kreifels and Mike Rezac explain the lake plate heat exchanger used for the geothermal systems on many of the homes at The Bridges.

(Photo by Merle Henkenius)

The Bridges set to become Nebraska's first geothermal development

By Jennifer Cosentino

When completed, The Bridges in Lincoln, Nebraska, will be the state's first fully geothermal residential development. Even with the beautiful scenery and idyllic landscape of The Bridges, nothing about it reveals how different from other upscale housing developments it really is. But it is different.

Six large ponds look like they are just part of the rustic rural setting for The Bridges' countryside homes. While they add visually to the large lots and upscale homes, the ponds serve a much more important purpose than eye appeal for the development's homes.

Mike Rezac, the builder and owner of Lincoln's Rezac Construction Company and past chairman of the Nebraska Green Building Council, is passionate about The Bridges project.

As a progressive builder, Rezac was looking at this subdivision with a wealth of geothermal experience from other homes he has built. That experience and the opportunity he saw at hand, grew into what he hopes will become the wave of the future in home building. Rezac wanted to make a green subdivision with more geothermal, if not all geothermal homes. The Bridges project was born out of a combination of Rezac's experience with and passion for geothermal.

"The development is different from anything that is around here, specifically because of the ponds. Intertwined in each subdivision, the ponds create the home sites," Rezac says. "Instead of having another house in your backyard, you have a pond."

Doug Kreifels, president of Action Plumbing & Heating, also believes geothermal is a great choice for the development. Kreifels says that the decision to go with geothermal was made early in the project's design phase.

A number of the homes at The Bridges were designed by architect Michelle Penn of Authenticity, LLC.
(Photo by Dave Thiel)

"From our side, we looked at going all geothermal, especially since we have the lakes. We looked at utilizing them for doing the energy exchange. Fortunately, we were able to figure out a way to do it and develop the geothermal before the subdivision was down," said Kreifels.

"I partnered with Carrier, ClimateMaster and Action Heating, for help with the technical design and load capacity of our ponds and loop lines," Kreifels said. He feels that involvement was crucial to the success of the project.

"When we started developing The Bridges, we began with digging out allotted spaces for the ponds and before we filled them with water, we installed our loop lines into the ponds," said Kreifels.

"Each of the lots on a pond has a set of lines that go to the ponds. When we start construction, we take the lines from the ponds and pull them out of the pond. Then we hook them to a Slim Jim® lake plate, which is a stainless steel double plate heat exchanger that circulates a water-antifreeze solution. As the water circulates through the plate it exchanges the energy with water," said Kreifels.

The geothermal system functions differently for each season, appropriately reversing the movement of the heat for heating or cooling the home. During the summer, it rejects heat from the house and disperses it into the pond.

Many of the homes in The Bridges also utilize other renewables along with geothermal, such as solar, in an effort to be as energy efficient as possible. (Photos by Dave Thiel)

In the winter, it absorbs heat from the pond through the plate walls and the water-antifreeze solution. The heat transfers into the underground exchange system through the piping and to the mechanical area of the house. From there, the geothermal heat pump converts it to heat for the homes.

Rezac says loops and exchange plates are allotted to all the individual lots. Each one is sized appropriately for the size of the home that is being built or will be built at that site. The largest homes are set for around seven tons of heating and cooling and are about 7,000 square feet in size. The geothermal systems are using both forced air and radiant for space conditioning of the new homes, depending on the homeowners needs.

"In some applications, owners decided to use units that have the ability to do radiant along with forced air. We are specifically doing that in the basements for the homes that are choosing to use the radiant portion," Rezac says. "Occasionally, we will also put radiant under the tile if the homes have a lot of tile coverage," he added.

High-density polypropylene (HDPE) pipe is used for the heat exchange loop installations. The pipe size is an inch and a half for the main loops. The loop capacity is eight tons.

"Our pond system loops are closed loops that go into the pond so the distance into the pond is right around 100 to 150 feet. The exchange plate is a stainless steel plate that is 4 foot by 6 foot," said Rezac. "The lots that use a

Doug Kreifels and Steve Wilkey attach fusion fittings to the lake plate in preparation for installation.

1 - The lake plate is ready to be loaded onto a pontoon boat for placement.

2 - Doug Kreifels and Mike Rezac get the lake plate situated to transport into the lake.

3 - Kreifels and Rezac will sink the lake plate into the middle of the pond.

(Photos by Merle Henkenius)


1


2


3

The Heat Pump Advantage

Comparison of Equipment Operating Costs

(Homes in Lincoln, NE Area, Rezac Construction) **Estimated Annual Costs**

Traditional	3 Ton System Carrier 95% efficient 3 stage variable speed gas furnace with a Carrier 3 ton 2 stage 16.00 SEER air conditioner	Heating $620 Cooling $196 Total $816
GSHP	**3 Ton System Carrier 3 ton 2 stage variable speed Geothermal heat pump with desuperheater**	**Heating $252 Cooling $120 Total $372**
Traditional	3 Ton System Carrier 95% efficient 3 stage variable speed gas furnace with a Carrier 4 ton 2 stage 16.99 SEER air conditioner	Heating $827 Cooling $261 Total $1088
GSHP	**3 Ton System Carrier 4 ton 2 stage variable speed Geothermal heat pump with desuperheater**	**Heating $336 Cooling $160 Total $496**

vertical ground loop system normally have one loop per ton and our loops are running around 200 feet deep."

"The plates sit on the bottom of the pond in a vertical position surrounded by water, so essentially, they are standing on the bottom of the pond," said Kreifels. "Because of the unique lake system, boreholes are not used for the homes with ponds. Instead, lines extend from the houses to the ponds," he says.

"For the homes that are not on the ponds, we use a vertical bore and the pipe that's in the ground exchanges the energy with the ground, not the water. The vertical wells are about 190 feet deep and use one borehole per ton of air conditioning that is needed for the homes. If a three-ton air conditioner is needed for a home, then three boreholes will be needed for the home," says Kreifels.

The energy efficient construction of the homes is a big factor in the energy cost savings for all of the homes in the development. Coupled with the geothermal systems, homeowners are seeing fifty percent to sixty percent in energy cost savings when compared to a conventional system. In fact, the homes are tight enough that measures need to be taken to ensure proper air circulation for the comfort of the occupants and the efficiency of the systems and materials used.

The mechanical area for one of the homes shows the geothermal equipment and a typical setup. (Photo by Merle Henkenius)

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"We introduce an energy recovery ventilator to bring in fresh air, so we can couple that type of tight construction with our geothermal system," Rezac says. "Our homes are running about $250 to $300 per year for both heating and cooling costs."

Geothermal installation costs of The Bridges homes differ from home to home. According to Kreifels, one house may take a two-ton or a five-ton unit. "The lake plate costs and getting the piping in is similar to a vertical loop system, which typically runs around $2,000 per hole," Kreifels said. "A four-ton system loop with the vertical unit would run around $6,000. The cost would be similar for a lake installation by the time the lake plate and piping was figured in."

The Bridges housing development is distinctly different from any other development. It is an ongoing project with roughly ten houses completed at this time and two or three more in development.

It is apparent that going green is becoming more of a trend for homebuilders and is beneficial not only for the environment, but also for a homeowner's average utility savings. It is a great time to build an energy efficient home at The Bridges and become part of Nebraska's first geothermal development.

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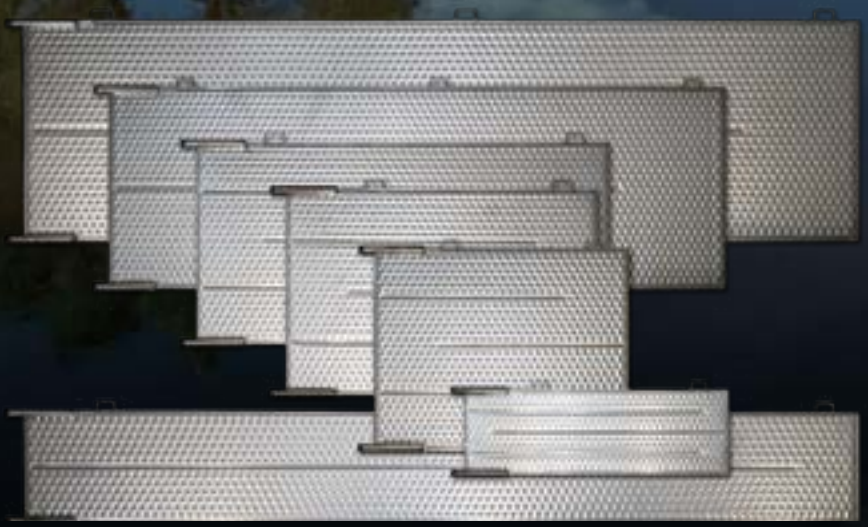

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EARTH INSIGHTS

If you have a question about geothermal installation, design or troubleshooting, send it to Phil Rawlings in care of *Geo Outlook,* Oklahoma State University, 1201 S. Innovation Way, Stillwater, OK 74074

Flushing/Purging Made Simple

I've used the approach shown in the attached piping schematic, developed by Carl Ledbetter many years ago, in mechanical room designs for years. It's simple, inexpensive, and enables flushing and purging in the mechanical room at start-up and during the system's life with limited components and/or equipment. The commercial class systems of today typically use pumps and stand-by pumps in shared duty. Their loop fields are typically designed with multiple flow paths – each with multiple loops. Building distribution piping to GSHP units is also accomplished with multiple flow paths. The only system requirements are opening flow control/flow setting means to allow flushing velocities, then returning the flow controls/flow setters to desired settings.

Using this schematic, mechanical room settings and operation are as follows:

During normal operation, valves D1 and D2 are closed, all others are open.

Closing one of the ground loop valves (A or B) or GSHP circuit valves (H, J, or K) will block flow through that flow path. Closing both the supply and return valves on a flow path will isolate it from the system.

Closing both valves in a pump circuit (C) will allow maintenance or removal of that pump with little system fluid loss. The system can continue operation using the other pump. Note that check valves are used to prevent short circuiting through the other pump.

Opening valve D1 and closing a valve on each one of the GSHP circuits (valves H, J, K) will allow one or both pumps to be used to flush and purge a GHEX flow path. Site specific evaluation of pump power supplies and pump flow/head capacity will determine if flow paths can be flushed and purged using a single pump or both system pumps. Use Flush/purge port assembly G2.

Opening valve D2 and closing a valve on each GHEX flow paths will allow the same activity for building interior piping flow path flushing/purging.

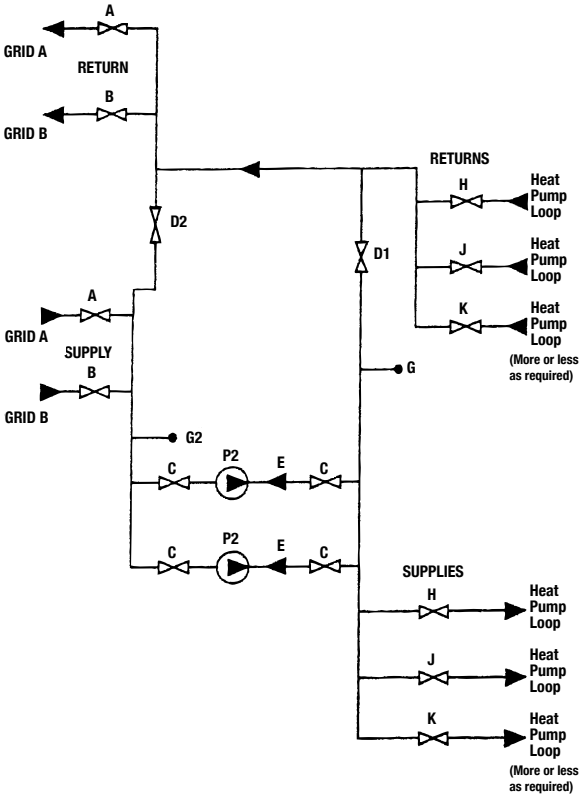
The flush/purge ports (G2) are located before the pump intake, removing any contaminates from the system before they can reach pump impellers. The G2 assembly is actually an in line tee with a matching size valve and connector on the branch, a full size blocking valve between the two tees, and then the second in line tee/valve/connector assembly.

G indicates air venting means at a system high point (air vent, air separator with vent, etc.)

Using this approach with a high volume portable container (barrel, horse trough, etc.) allows flushing and purging portions of the system using only hoses connected to the G2 ports and the reservoir IF the pumping capacity is adequate. While not capable of fully flushing/purging the entire system at start-up, this approach makes flushing/purging portions of the system at start-up or after it has been placed in service (for example, after repairing inadvertent damage to the piping system) much simpler and does not require utilizing specialized flushing/purging equipment.

Mr. Rawlings has more than 30 years experience in the geothermal industry. He is a Certified GeoExchange Designer (CGD) and an IGSHPA Accredited Installer and Trainer.

Large System Water Side Schematic



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