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CONTENTS

DEPARTMENTS

4  Geo Outlook Staff
6  Director’s Forum
8  Industry Leaders
46  Earth Insights

FEATURES

Cover Story:
Toyota Dealer Favors Environmental Benefits of Geo
By Janet F. Reeder

10  Montana Geo Hybrid Home Suits Family
By Janet F. Reeder

20  Old Number 1 - Replaced After 36 Years of Service
By Janet F. Reeder

36  Cornell Researching GSHP Use for Verizon
By Paige Worley

Toyota Dealer Favors Environmental Benefits of Geo

Montana Geo Hybrid Home Suits Family
Geo Outlook is published quarterly by Oklahoma State University and the International Ground Source Heat Pump Association (IGSHPA), 1201 S Innovation Way, Suite 400, Stillwater OK 74074. Send questions, story ideas, photos and comments to igshpa@okstate.edu, Geo Outlook, c/o IGSHPA, or call 800-626-4747. Visit our Web site at www.igshpa.okstate.edu.

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From “The Splash” to “The Grind”

The work of re-shaping IGSHPA, through the implementation of IGSHPA 2.0, has reached the stage I call “the grind.” We started with a retreat meeting with our industry leaders. That led to an organization design that had the components of new by-laws, a new Board of Directors, new working committees, and a new industry sector based Advisory Council. All this came with appropriate fanfare in a relatively short period of time. We have made a “splash.” Now comes “the grind.” The grind involves daily, sometimes hourly decisions and work to make the strategic plans an effective working reality. It involves active listening through both one-on-one conversations and targeted surveys. It involves small steps mostly forward but sometimes sideways and sometimes even backwards. IGSHPA is committed to getting this right. We ask for your involvement, your feedback and your patience as we work through “the grind.” Many of you, both members and ex-members participated in our recent survey. I am pleased with both the volume of responses we received and the detail of the content received. We are analyzing the results and modifying our strategic planning process now to prioritize what we have learned from you. Thank you so much for your participation.

Articles ranging from the continued evolution of GSHP technology to improving performance while reducing first costs are in this issue of Geo Outlook. Double u-bend configurations and hybrid system installs are effectively meeting commercial needs both for people as well as conditioning for equipment needs. The innovation continues with the Montana Geo Hybrid home article that showcases coupling a GSHP system with solar panels and the use of thermal storage. Finally, Old Number 1 is replaced after 36 years of service. A true testament to the reliability of this remarkable technology.
The IGSHPA Technical Conference and Expo will feature a wide variety of geothermal community representatives, including manufacturers, contractors, distributors, drillers and other industry resources. Throughout the conference you will continually be making valuable connections for your geothermal business with other professionals. Conference events and presentations allow you to take a look at the industry on national and global levels.

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- Accredited Installers Workshop - Oct. 5-8 $1075
- Accredited Drillers Workshop - Oct. 5-7 $975
- Building Load Analysis and Pumping (BLA) Workshop - Oct. 5-6 $975
- Certified GeoExchange Designer (CGD) Plus Course - Oct. 5-8 $2100

*All training workshops include conference registration and a complete set of workshop materials.*
John P. (Jack) DiEnna, Jr., the Executive Director & Founder of the Geothermal National & International Initiative (GEO-NII) is a business development and marketing professional with over forty years combined experience in the electric utility industry and the renewable energy industry.

DiEnna is a nationally recognized authority on renewable technology and specifically geothermal heat pumps. His experience includes marketing, creative financing, and the successful promotion of positive economic and environmental impact from the use of geothermal heat pump systems and other renewable technologies. His expertise is internationally acknowledged as a valued resource by government officials, both national and international, trade allies, and all major market segment associations in the promotion of geothermal heat pump technology.

For over 25 years, DiEnna has been the Marketing Chairman for the International Ground Source Heat Pump Association (IGSHIPA. He was the driving force in the creation and development of the Certified GeoExchange Designer (CGD) certification, a training program for design professionals in GHP technology.

In 2013, he was asked to become a member of the American/Canadian Bi-National GHP Standards Committee. He is also a founding member of the New York Geo Association. He is currently working with Bosch Thermotechnology to move the GHP industry to a higher market share.

The “Road to 30 Percent,” program was designed by DiEnna to increase the GHP industry to a 30 percent share of the HVAC market. He is involved in approximately 30 percent of all commercial geothermal heat pump projects in North America. He also consults to numerous companies and trade associations. His vision is to eliminate the “first cost” barrier, of GHP technology, through participation by utilities and other third party owners of the ground loop heat exchanger.

His mission is to prove that renewable energy technologies, such as geothermal heat pumps can provide our nation with a “Triple E” solution of, Energy Independence, Environmental Security and Economic Prosperity, now and for generations to come.

DiEnna has participated in developing Renewable Portfolio Standards in more than 10 States. He is also the originator and developer of the R.I.D.E. program, which is an acronym for Register, Inspect, Document and Evaluate. This program will capture the metrics of a geothermal heat pump system, giving information on where the system is installed, who installed it, what was promised and if it met expectations. This information is critical when the thermal value of a GHP system is recognized in a State’s Renewable Portfolio Standard (RPS).

In January of 2010, DiEnna, working under a contract to the Department of Energy, through Oak Ridge National Laboratory, developed a trade mission to India in support of the GHP Industry. While there he established an Indian Chapter of the International Ground Source Heat Pump Association. He returned to India in 2011 to deliver geothermal heat pump training to 20 industry professionals. He has continued to work with DOE and ORNL on the development of a sustainable infrastructure, through training to support the advancement of GHP technology in India. DiEnna conducted Certified GeoExchange Designer (CGD) training for design professionals in India in September 2012 as the next step in infrastructure development.

DiEnna was the keynote speaker at ACRECONF 2013, for the Indian government, to discuss mandating the use of GHP technology in all government buildings. He has been the...
catalyst for IGSHPA chapters in India, Canada, Spain and South Korea.

He is also working for the Department of Energy as a peer reviewer for geothermal projects both nationally and internationally.

The Association of Energy Engineers awarded him the “Legend in Energy” distinction for his work with renewable technologies, specifically geothermal heat pump technology.

DiEnna has also worked with the U.S. Commerce Department to assist in negotiations for an environmental goods agreement within the World Trade Organization that would liberalize tariffs on climate change addressing products and services such as geothermal heat pumps.

In 2007, he was appointed to the Asian Pacific Partnership (APP) on the Renewable Energy and Building Efficiency task forces and is currently working with them to promote the increased use of renewable technology in China, India and Australia. He is also working with the Federal Ministry for the Environment of the German government on the increased use of renewable technology.

In 2006, the U.S. Secretary of Energy appointed DiEnna, to serve as a member of the Federal Energy Management Advisory Committee (FEMAC), representing renewable energy. FEMAC was formed to advise the Department of Energy’s Federal Energy Management Program (FEMP) on defining strategy for meeting their mandates and objectives. He was responsible for the implementation of numerous geothermal heat pump projects for the Department of Defense.

DiEnna worked with the New York City Council Environmental Protection Committee to compose legislation for the expansion of geothermal heat pump technology in the five-borough area signed into law by Mayor Bloomberg. He is currently working with the New York Public Service Commission (PSC) for the adoption of GHP technology as a renewable thermal asset technology in the New York RPS mandate.

Previously, as Director of the Geothermal Heat Pump Consortium, a group formed by the Clinton Administration and supported by the Bush Administration, DiEnna was responsible for the development and implementation of the Memorandum of Understanding with numerous Federal, State and Local government agencies. He also developed a state, as well as federal schools initiative program that promoted ground source energy technologies at the U.S. State Department of Education level.

DiEnna was responsible for the multi-year, million-dollar contract, with NYSERDA, to promote renewable energy technologies in New York State. He has spearheaded statewide projects in California, Oklahoma, Pennsylvania, Maryland, Illinois and New Jersey.

He previously was the business development director of Energy Performance Services (EPS), a wholly owned Energy Services Company and was instrumental in securing the partnership that delivered geothermal heat pump technology to both Fort Polk and Fort Erwin. This company was formed when Philadelphia Electric Company (PECO) purchased Energy Performance Services and combined it with HEATAC, a design build geothermal heat pump company.

He was also the manager of business development for HEATAC and part of the pioneering team that developed the third party ownership of the geothermal systems. DiEnna was instrumental in making HEATAC into the largest design build firm for geothermal systems in the U.S.
Doenges Toyota has a large open showroom space that is heated and cooled by a ground-source heat pump system installed by Geo Enterprises, Inc., of Catoosa, Oklahoma.

(Photo by Martha Ambler Photography)
Thousands of square foot of conditioned showroom space burden today’s automobile dealerships with a premium cost for air conditioning and heating. And that isn’t the total square footage kept comfortable. Add on another large out of sight area that houses service and office spaces also needed to operate a new car dealership successfully. One Oklahoma dealer recently changed that situation to his advantage.

For Brad Doenges, the owner of Doenges Family of Autos, taking care of automobile customers is deeply ingrained in his blood. A third generation new car dealer, Doenges learned well from both his father Bill Doenges, and his grandfather William Doenges. The current dealership sells Toyotas, Fords and Lincolns at 1901 S.W. Washington Boulevard in Bartlesville, Oklahoma.

William C. Doenges started the family involvement in Bartlesville when he bought the Ford dealership there in 1941. He had bought his first Ford dealership in Braman, Oklahoma, near the Kansas border, in 1931. Over the years he operated numerous dealerships in Oklahoma and Kansas. In 1948, he bought the Ford agency in Tulsa, which his sons Bill (Brad’s father) and Bob Doenges operated as Doenges Brothers Ford.

William Doenges acquired the Toyota franchise at the Bartlesville dealership in 1968. The seasoned car dealer also went on to receive a prestigious 50-year award from Ford Motor Company.

The service waiting area of the new Toyota dealership in Bartlesville, Oklahoma is comfortable and inviting.

(Photo by Martha Ambler Photography)
Today, Doenges Toyota is the oldest Toyota dealer in the state of Oklahoma. The Doenges tradition in all of the communities they have served has always involved strong commitment to their communities through leadership and financial support of organizations, sports teams and schools. In 2010, the Bartlesville Community Foundation honored the Doenges family with the Bartlesville Legacy Hall of Fame Award.

Brad Doenges’ Toyota dealership has also been voted Bartlesville’s Best Auto Dealer for five years running.

For Doenges, the decision to add energy saving and environmentally positive ground-source geothermal technology to plans for his new operation was an easy choice to make, even though it wasn’t part of the original blueprint.

When the original bid came back...
over budget, Ambler Architects of Bartlesville, asked geothermal expert Phil Schoen to step in and see if they could find a way to incorporate GSHP into a relook at the design.

Doenges Toyota faced those challenges and with Schoen’s input, changed their building plans to include GSHP. Their commercial building project was finished in April 2013.

“We’re heating and cooling a large, high-ceilinged open showroom. In terms of energy-savings geothermal just makes sense,” Doenges says.

The building site on the south edge of Bartlesville, a city known for past Phillips Petroleum headquarters and research facilities and the Price Tower, one of Frank Lloyd Wright’s final, and some say, most interesting projects. Situated within an hour of Tulsa, the city has had a number of ups and downs, but recently has begun growing again.

For Brad Doenges, the aesthetics of environmental friendliness matches his personal mindset of having as small of a carbon footprint as possible. It also makes good business sense, something the Doenges traditionally understand.

Marketing Director Jason Briner is quick to point out how the showroom’s decor and artwork are a reflection of Brad Doenges’ interest in Oklahoma’s
something diverse natural landscape. Something Doenges is proud to help conserve.

“Geothermal is the best idea ever,” Briner says. Briner is heavily involved in Tulsa Sustainability, a group that promotes and educates the public about sustainable practices.

“Choosing geothermal was an obvious choice,” Doenges says. “The geothermal system benefits Doenges Toyota’s efforts to become LEED certified.”

Doenges Toyota, one of the largest auto dealers in the region, is also the oldest Toyota dealership in the state of Oklahoma. (Photo by Martha Ambler Photography)
Schoen’s Geo Enterprises Inc., of Catoosa, Oklahoma was happy to provide the impetus for the addition of geothermal to the dealerships building plans. The company, owned by Phil Schoen, former IGSHPA Advisory Council Chair, designed and installed the heat exchange groundwork for the GHP system.

Working with J. Grantham Drilling, Inc., out of Poteau, Oklahoma, Geo Enterprises designed a borefield and heat exchange system that would fit the commercial heating and cooling needs working with the space available on the building site.

Using the innovative double u-bend configuration, 30 boreholes at 300 foot were set for the loopfield. Geo Enterprise built the special loops using

One of 15 Florida Heat Pump 2-stage EES Series units is installed in the ceiling above the service department’s parts storage area. (Photo by Janet F. Reeder)

Phil Schoen visits with staff during a recent visit to the Doenges Toyota dealership to see if the GSHP system is meeting the dealership’s needs. (Photo by Janet F. Reeder)
their Sureclip product to tie the double u-bend loops together.

“This is the largest double u-bend project we have done so far,” Schoen says.

The size of the lot was restrictive for drilling a large number of boreholes. The innovative double u-bend was employed to provide the amount of heat-exchange field needed.

Schoen says that the drilling conditions in Bartlesville involved a lot of rock. The advantages to using the double u-bend, a strategy that has been popular for years in Europe particularly Germany, is in the reduction of borehole needed. He says that while it isn’t a guarantee, borehole can be reduced in many cases by as much as 25-30 percent.

“It depends on the soil conductivity,” Schoen says. “If you are working in conductive soil, it could go to a 40-percent reduction in boreholes.” Schoen has had success using the double u-bend to counter the expense of drilling in some residential cases.

Doenges Family of Autos Marketing Director Jason Brimer visits with Phil Schoen about the geothermal installation Schoen oversaw for the new dealership. Brimer says, “Geothermal is the best idea ever.”

(Photo by Janet F. Reeder)
“The harder it is to drill, the more expensive per foot,” he says. “Drilling prices are different in Texas than here in Oklahoma, for instance,” Schoen says. “So you have to take all of that into account. Generally, the more expensive the drilling per foot, the better the performance of the double u-bend and the cost. It drops the footage in half,” Schoen says.

“We are probably not getting the pure performance of doubling, and there are places where a double u-bend won’t give you savings.” A double u-bend will provide less benefit in conditions of lower conductivity.

Drillers are still hesitant to bid on double u-bend projects. He feels they have a misconception of the labor involved.

“They believe it is a lot more work than it is,” Schoen says.

“There is a little larger bore and the tremie line is a little more difficult,” he says. Experience quickly overcomes the differences, Schoen says.

“The East coast is doing some double u-bend installations,” Schoen said. Still overall, his estimate is that less than five percent geothermal work in the United States is double u-bend. On the other hand, according to Schoen, probably 50 percent of the geothermal work in Europe is double u-bend.

Air Comfort of Jenks, Oklahoma was mechanical contractor for the project. Cecil Crain with Air Comfort and David Roavane, Air Comfort project manager, oversaw the installation of the 61-ton system. Heat pumps installed included 15 Florida Heat Pump 2-stage EES Series units.

Scott Ambler with Ambler Architects, of Bartlesville was the architect for new Doenges Toyota dealership project. Ambler’s office is in the Price Tower, a building billed as Wright’s only skyscraper actually built.

Construction was handled through Gorman Construction as general contractor. Gorman is also out of Bartlesville, Oklahoma.
Montana Geo Hybrid Home Suits Family

By Janet F. Reeder
The perfect energy efficient retirement home for the Rex Hocking family is located in Ennis, Montana.

(Photo courtesy of Marie Schenck/Thermal Battery Systems, Inc.)
Rex Hocking studied for some time about using renewable energy in the retirement home he wanted to build in Montana.

Now retired from working in the electrical utility industry in Northern California, and living in that home with his wife, Hocking is pleased with the choices he made.

“When we started designing our home the architect asked us what we thought of alternative energy,” Hocking says. “And we told him we were all for it.”

The Hocking’s new home is in Ennis, Montana. Final design for the 4,500-square-foot home includes a variety of innovative renewable energy technologies. About 1,300 square foot of that space is a shop and garage area.

“A friend of mine was building a home over in Hamilton, Montana, that was ground based,” Hocking said. “That’s what got me thinking about geothermal.”

Hocking’s architect, Ben Elias, brought in James Schenck, of Energy Dynamics to discuss the geothermal possibilities for the new home. Elias, out of Bozeman, Montana, is LEED AP certified. Schenck is territory manager for the Montana and Wyoming area for Energy Dynamics. The company is a distributor of GeoComfort and Hydron Module geothermal systems.

After his retirement, Hocking began working again as a contractor with his former employer. He builds and rebuilds utility lines in Northern California in the winter.

The Hockings were pleased to share information about their new home and Rex Hocking mentioned having copies of Geo Outlook out for visitors during a summer home tour they are participating in.

(Photograph courtesy of Marie Schenck/Thermal Battery Systems, Inc.)
The great room window frames a picture perfect view of the mountains. (Photo courtesy of Marie Schenck/Thermal Battery Systems, Inc.)
“I work during the winter time, and so we are gone. We set the house at 60 degrees,” Hocking says. “And our bills are running about $135 a month.”

Hocking says that originally the home was designed for rooftop solar panels and a geothermal heat pump system. To be able to include another innovative measure to that system was appealing, he says.

“I am all for it. It is the thing of the future,” Hocking said. “We have got to find ways to reduce emissions. And this is one of them.”

After he had the opportunity to discuss geothermal with Schenck, Hocking says he also became interested in a renewable technology that Schenck has been developing.

When options were proposed and considered, Hocking chose a conventional closed loop vertical geothermal system that would be coupled with solar panels and also include Schenck’s unconventional intermediate thermal storage and exchange element—a thermal battery.

“We were pretty excited to incorporate the concept,” Hocking said.

In his work, Hocking has a good look at the use of electric power and what it takes to get it from the utility to the user.

“Utilities have to reduce their use of fossil fuels,” Hocking says. “Each year the percentage goes up. This will cost a little more, but over time it pays itself off and is a good investment.”

Working with Wayne Baker of Baker Light Industries as the mechanical contractor, the hybrid system moved ahead.

During the construction of the home a first drilling attempt by Chet Graham of Graham Drilling for the domestic water well was unsuccessful. Schenck says they were quick to alert the general contractor, Wikkup Builders, that they could use that well for the Thermal Battery System and that no further drilling would be needed for the mechanical system.

The 340-foot deep abandoned well had a 1-inch HDPE loop installed and grouted. The top 100-foot is dry sand and the bottom 240-foot is dry granite.

Two Geo Pods—1,150-gallon poly cisterns with a single HyperLoop heat battery become 2-ton thermal battery pods piped in parallel on the same circuit as the heat pump. (Photo courtesy of Marie Schenck/Thermal Battery Systems, Inc.)
exchanger in each, are acting as the thermal batteries. Piped in parallel, both are on the same circuit as the heat pump. Schenck says this allows the batteries to provide the conductive stability to the 4-ton water-to-water GeoComfort heat pump when it operates. The batteries are insulated on the top only.

The solar system is comprised of four 4' x 10' Solar Skies flat plate collectors. They are roof mounted and utilize a drain back system.

The Hocking family was home in Montana for the holidays at the end of 2014. During that time they got to see just how comfortable their innovative hybrid geothermal system could keep their home.

“We were up here during December and January,” Hocking says. “It got to -15 degrees. I think Christmas morning it was 15 below.” The outdoor temperature didn’t dampen the warmth of the holiday. “It was so nice,” Hocking said. The home’s radiant floor heat kept the Hocking family very comfortable for their first holiday in their new home.

Schenck, who has been working with the concept of leveraging the higher capacity of phase change to store energy, says that he has been looking for ways to integrate solar thermal and geothermal on the source side of the heat pump.
He says that natural physics supports the theory and the concept of a latent capable thermal battery.

“It is legitimate to say these systems are complex,” Schenck says. He is continuing to refine the process and believes the challenges to the complexity can be dealt with through the use of “purposefully designed software.”

Schenck says that he is seeing more interest in multi-source systems and that many types of hybrid geothermal systems are already being designed. He feels that the thermal battery concept has merit and should be developed by the geothermal industry.

For the Hocking’s, the entire system is being controlled with an all-in-one system from EZESystems for extensive monitoring and data logging.

“The web connected system allows us to control and monitor every detail of system performance,” Schenck says. “It is currently logging every Btu and every Kwh that the system is using. From this extensive data, we are able to document the power that a latent capable thermal battery offers,” he said. To this point, the results are very positive.

Schenck has been involved in about a dozen thermal battery installations with his company Thermal Battery Systems. He says he understands that the practice is non-standard and that the complexity may put off some in the industry.

“It does get some flak,” he says. “But not anything we are really concerned about.

The KEY to the home’s innovative heating and cooling system sets out how each element works with the rest of the equipment. (Illustration courtesy of James Schenck/ Thermal Battery Systems, Inc.)

A variety of tanks including transfer, buffer, pre-heat and domestic hot water take much of the floor space in the mechanical area. (Photo courtesy of Marie Schenck/ Thermal Battery Systems, Inc.)
We are trying to develop the best way to take advantage of the concept and will continue to refine the process,” Schenck said.

“A lot of the criticism I have heard sounds legitimate, but it is usually because there are some assumptions that are not valid,” Schenck says. “All I am trying to do is to get the industry to be more dynamic in the application of geothermal,” he says.

“The software and the cloud back end management and optimization of the system is where we are focused,” Schenck says. He sees his company as a source energy management company, or essentially a cloud-based energy-resource company. The software is critical enough that Schenck says the concept can’t be done without it.

“It would be too complex if you were using traditional controls to do it. The industry front end is not built to deal with it,” he said. “Since we are doing something that we think is pretty unique, we want to develop it and define it so that it isn’t something the front end of the industry has to deal with,” Schenck says.

“Our system should be able to integrate with home energy and security systems and be compatible with other companies,” he said. “That is an example of our focus.”

Schenck says that while the industry does need to be wary of bad installations, they shouldn’t stifle innovation.

“Solar guys and geo guys should talk to each other,” he said.
The home Jim Partin built in Stillwater, Oklahoma, had the first residential ground-source heat pump installed in the U.S.

(Photo courtesy of Jim Partin)
Old Number 1 – Replaced After 36 Years of Service

By Janet F. Reeder
In March 1978, fine homebuilder Jim Partin was already building very efficient homes. But he was looking for ways to install even more efficient heating and cooling systems in four new custom-built rural homes in the Stillwater, Oklahoma area. He knew these homes would be all electric with little hope to ever have natural gas available.

In visiting with Carl Ledbetter, the local Carrier dealer, Partin was told a split system heat pump would be his only real option for heating and cooling the homes. In the Stillwater area, winter temperatures were often in the 20-degree Fahrenheit range.

Partin and Ledbetter both knew that the refrigerant cycle would perform poorly extracting heat from that range of cold outside air and heating it to the temperature needed. At that time, heat pump systems were routinely sized to cool and dehumidify. They needed supplemental heat, possibly with electric heat strips. The combination made a costly heating alternative.

Together the two came up with a new concept. They first looked at using a water-to-air heat pump using water from a well. That was rejected because there was little ground water available. And environmentally, they did not want to pump well water out and then dump it on the surface after running through the heat pump.

Partin chose a quiet rural location for the home he built for himself and his wife Annella in 1978. (Photo courtesy of Jim Partin)
From the concept of using well water, the two theorized that it could be possible to provide water to the heat pump with water circulating in a closed loop buried in the ground. If that worked, it would solve the water usage issue, since the loop would be filled only once.

“We would simply circulate water—extracting heat in winter and then absorbing heat in the summer,” Partin said.

To Partin that solved more than one problem. With all of the mechanical equipment indoors, there would be no noisy maintenance prone outdoor unit. The only thing outdoors would be the buried loop.

After examining the ground temperatures, the two realized that if the closed loop was correctly sized it would furnish water to a heat pump at a temperature well above the freezing point. Partin knew that would guarantee a much higher efficiency.

In deciding just what kind of loop would be best, three general types of closed loops were theorized using plastic tubing. An earth coil could be placed in a trench up to six-feet deep with the outbound pipe at the bottom and the return at about four feet. Or a set of drilled well bores could be placed with tubing running serially down and back up each hole. Another alternative would be to place a coil of tubing in a lake with outbound and inbound tubes in the same trench.

After serious study and consideration of each possibility, a decision was made to try several of the loop methods for the four homes. Two of the custom homes would be built with loops run serially in wells or in what today the industry calls boreholes. The other two would have trenched in loops.

Partin’s own residence was the first to be completed in 1978 with a 1,200 foot long closed loop buried under the lawn. Because of the pioneering effort Partin’s installation has been called Old Number 1.

Collectively all closed loop water source heat pump systems came to be called geothermal heat pump systems, or geosystems for short. GeoSystems, Inc., was formed later by Ledbetter and

The outdoor space Annella created can be enjoyed without the noise from an outside unit running, since all of the equipment for the GSHP system is indoors. (Photo courtesy of Jim Partin)
Partin in Stillwater to manufacture and sell system components.

Even then, Partin realized closed loop water source heat pumps had many advantages. They were much more efficient than air source units, especially in extreme hot and cold conditions. None of the mechanical equipment was outside where it would be subject to the weather. And the water-circulating pump that replaced the outdoor fan was also very efficient. It circulated water but did not have to lift it out of a ground water well.

A domestic hot water preheat unit was a part of Partin’s system. In summer, it heated water with rejected or waste heat. In winter, it heated water for a fraction of the cost of an electric water heater.

“There is a complete absence of outdoor noise,” Partin’s wife Annella is
quick to point out. She says that is also an important feature of the GHP system. She can often hear an air source unit at a neighbor’s home nearly a quarter mile away.

Partin’s unit was studied and researched to confirm what he had expected.

As the first split system closed loop ground source heat pump, it was instrumented with refrigerant pressure gauges and a run-time hour meter. Central Rural Electric Cooperative’s energy usage consultant Bill Blair, made three watt-hour meters available to Partin for monitoring compressor/pump, fan and electric heat, as well as the water heater usage.

Stillwater Water Corporation provided Partin a usage meter that monitored hot water usage. Inlet and outlet loop water temperatures were measured. Data collected years ago was used to confirm the feasibility of the system. Data from Partin’s Old Number 1 unit was shared freely with a large number of interested contractors and formed the basis for sizing closed loop pipe lengths.

One other notable advantage was that maintenance issues were minimized by all equipment being housed inside the home. Routine service, when needed, could be accomplished in any kind of weather.

The buried HDPE outdoor loops are expected to last indefinitely with no maintenance required. The trenched-in loop on the first GHP system has now been connected to its modern replacement system.

First started up in March 1978, and in operation for 36 years, Partin’s GHP system required replacement parts consisting of two compressor electric relays, one circulating pump and one hard start kit. This old system was fabricated with an external wall-mounted water-to-refrigerant coil and an external hot water preheater. It had many job-performed tubing welds and had a very tiny leak that required adding a bit of refrigerant every few years.

Partin says today’s modern systems are fabricated either as package units with all factory-performed welds, or as split systems with the only field welds on tubes running to and from the air handler. Leak possibility is therefore minimized. Prefabricated HDPE u-bends, pipe and other fittings are widely produced.

As far as economics, Partin knew then that his system would be more efficient than anything else available at the time.

“We understood that the closed loop ground-source heat pump would be more efficient than an air-source unit, delivering three or more units of heat for each electric unit consumed,” he said.

He expected a coefficient of performance of 3.0 or more. And he knew it would also be more efficient in cooling. He says modern units are projected to deliver even greater efficiency.

“Over the years we learned that the extra cost of a closed loop water source heat pump system could pay for the extra initial cost in about five operating years,” Partin said. “In other words you could justify one if you planed to pay the utilities for five years.”

When replaced at 36 years and 52,693 hours of run time, Partin believes that the system paid for about half the cost of his original home. Since the new system has been connected to an existing closed loop paid for years ago, he expects even greater savings relative to original investment in years ahead.

Carl Ledbetter and his AC Service Co. installed all the systems in Partin’s custom homes. Partin says that the new Carrier heat pump unit installed to replace the original ‘Old Number 1 unit,’ also a Carrier. (Photo courtesy of Jim Partin)
Partin’s system was metered and studied continuously. According to Phil Rawlings, it became the poster child for verification of every performance and benefit claim the GSHP industry makes today, including the use of a desuperheater. (Photo courtesy of Jim Partin)

Ledbetter died of natural causes in the Spring of 2014 without knowing that his GHP system had just been replaced with a modern split unit installed by Stillwater’s current Carrier dealer B & L Heating and Air Conditioning. Partin adds perspective to the story of his historical GHP by noting that Kyle Kelty, who operates B&L and did the retrofit of his system, was born in 1979, a year after Partin’s original system was installed.

Partin credits Ledbetter with a legacy of closed loop ground source heat pumps that now number in the tens of thousands. Partin says whole product lines have evolved to serve the industry.

The system affectionately and historically called Old Number 1—the first geothermal heat pump, was laid to rest in January 2014, at age 36 years.

Editor’s note: Jim Partin supplied the information and photos for this historical look at the first installed geothermal heat pump system, which was placed in his own home in 1978.
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It’s just another way quality and service continue to soar at Centennial Plastics!
Cornell Researching GSHP Use for Verizon

By Paige Worley
Verizon operates more than 45,000 cellular tower data centers in the United States. All are very similar to this one on the Cornell University campus, except for the innovative and experimental use of geothermal or ground-source energy to cool the structure and electronic equipment.

(Photo courtesy Jim Feeney/ Verizon)
When Verizon CEO Lowell C. McAdam spoke to the Cornell Energy Institute in 2009 on communications and energy, he discussed possibilities for reducing his company’s overall carbon footprint.

McAdam, also a Cornell alumnus, is energy conscious and has advocated for addressing the best solutions for maximizing efficiency of current cooling systems for the complex network equipment at cell towers across the nation. After the presentation, Cornell Energy Institute Director Dr. Jeff Tester, and graduate student Brandon LaBrozzi, began exploring the possibilities of ground-source heat pumps for cooling Verizon’s equipment at tower sites.

Verizon’s use of redundant HVAC systems at their sites has ensured reliable operation. If one unit fails, another unit still provides full cooling capacity. This cooling system is a workable solution for wireless companies that were trying to put towers up as quickly as possible to meet demand needs and to improve energy efficiency, Tester said.

“We talked to them about geothermal heat pumps, but there wasn’t a lot of data at all on how they would perform in different locations,” Tester says.

Tester and LaBrozzi conducted a preliminary feasibility study in 2010 on the nationwide potential of utilizing geothermal heat pumps instead of AC systems for cooling of cellular tower shelters. Using commercially-available heat pump modeling software, they found promising results, especially for hybrid systems including air economizers.

During that time, an old wireless structure on top of a rusting water tower on the Cornell campus needed to be replaced by Verizon. The opportunity allowed the research from LaBrozzi and Tester to be implemented in a model associated with the new structure.

Chemical Engineering graduate student Koenraad Beckers joined the team after LaBrozzi graduated in 2010. He assisted in creating the GSHP design model. The design involved four single U-bend heat exchangers at 385 feet deep each and two double U-bend heat exchangers at 285 feet deep. Each is supplied with a set of supply and return pipes controlled by a

Cornell engineering students Maciej Lukawski and Koenraad Beckers are working on the underground heat transfer modeling aspect of the project in a Cornell classroom.

(Photograph courtesy of Koenraad Beckers/Cornell University)
The cellular data centers generate a lot of heat and required the ground-source heat pump system design to be cooling dominant.

(Photo courtesy Jim Feeney/Verizon)
valve. Sensors collect a total of 30 field measurements for intensive monitoring of the system’s temperatures. The system was constructed during the spring and summer of 2013 and started full operation by 2014.

The geothermal loops were oversized to allow for the growth of future network gear. The loops also allow the collection of experimental data on the single U-bend and double U-bend exchangers and experimentation with different field management options.

Lono Mechanical installed three ClimateMaster TTV series heat pumps supplied from Piekunka Systems, Inc. Nothnagle Drilling, Inc., drilled 11 boreholes, eight at 265 feet and three at 385 feet.

The equipment shelter built by Verizon is 720 square feet, and is using heat pump units totaling nine tons. There is also a dry-cooler to assist with reservoir recharging and an air-economizer to cool the equipment with cold outside air, creating a hybrid GSHP system. The equipment is set to not exceed 78 degrees Fahrenheit. With equipment constantly running and producing heat, even cooling methods are necessary in the coldest winter months in Ithaca, New York.

“Verizon has both battery and generator backup, but the amazing thing really is the volume of heat that their network equipment generates,” Tester said.

The cooling-dominant GSHP system is unusual. Because of the nature of the project, they could try different options, said Chris Lesperance of Lono Mechanical and an IGSHPA Accredited Installer.

“Since this is a test site for the customer it had many added features that you normally would not install in a typical application such as a dry-cooler,” Lesperance said.

Verizon’s Engineer, Jim Feeney, says that over time, the constant cooling demand will make the ground temperature increase. “The dry-cooler will help to re-cool the ground during the winter months allowing the system to operate more efficiently,” added Feeney.

Along with the air economizer and heat rejection, each borehole has its own valve that controls the flow from the pump. “There is an almost infinite amount of control from where in the field the water is circulated. All pumps are variable speed, and as with the whole system, can be remotely monitored and controlled,” Lesperance said.

The team at Cornell will research this model for several years before making any definitive projections. “We are trying to be quantitative, and very objective about the data that comes out, and making sure that whatever we tell them really reflects the real performance of this type of cooling, and ultimately

Chris Lesperance of Lono Mechanical installed ClimateMaster TTV series units with 10 temperature sensors to allow for extensive data collection.

(Photo courtesy of Chris Lesperance/ Lono Mechanical)
the actual cost savings that might be realized,” said Tester.

At this point in the research, the team has reported that preliminary results are showing the hybrid system of GSHP and the air-economizer is the most cost-effective option. However, estimates of energy and cost savings will not be calculated until the data-gathering phase is over.

Feeney is looking at the big picture for Verizon. “We are always looking to improve our energy efficiency, and we have to do this while maintaining our network reliability,” Feeney said.

As the work progresses, Beckers and Tester will monitor the system and report the results. Another graduate student on the team is surveying areas in the country to see how this equipment would work in different climatic zones, with different ground temperatures and different cooling loads.

“Clearly Key West, Florida, is going to be different than North Dakota. The ground temperatures are different, the loads are different for heating and cooling,” Tester said. “We will be able to say something definitively about the long term performance and adaptability of the equipment in a couple years.”
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GEOPROINC.COM
Bright ‘n Green Building Sustained by EarthLinked Technologies

In the establishment of a net-zero property, developers turned to EarthLinked Technologies, Inc. to meet space requirements and exceed expectations.

The Situation. There is a great strain on the environment and consumers’ wallets to produce enough energy to meet everyone’s needs. Attaining net-zero status is a great way to reduce the environmental impact of commercial and residential properties and save money.

Project Fact: Brooklyn’s first regenerative and sustainable stand-alone building

The Challenge. To create a net-zero energy condominium complex – a living, totally regenerative and sustainable building that is ready to be lived in and with no energy resources other than its own. Architect Robert M. Scarano, Jr. brought this experiment to Brooklyn where he invested in developing net-zero property Bright ‘n Green. Scarano had many barriers to overcome, including the lack of suitable environmental space within the city’s congested urban landscape.

Project Fact: The total amount of energy used by the building is roughly equal to the amount of renewable energy created on the site

The Solution. While traditional water-source renewable energy systems require excessive amounts of space, EarthLinked Renewable Energy Systems utilize a smarter and smaller design that allows for flexibility in its earth loop configurations. By partnering with EarthLinked Technologies, Inc., Scarano was able to overcome the limitations of available developmental space for the 15,000-square-foot Bright ‘n Green building.

Functionality & Features. To overcome the challenge of creating an eco-friendly building in the urban environment of Brooklyn, green technology had to be combined with modern industrial design. A key component to this combination of technology and design was including a geothermal energy source. The source needed to efficiently tap into the earth’s constant temperature beneath the surface to provide consistent energy all year long.

EarthLinked Renewable Energy Systems use small, highly conductive copper earth loops and environmentally friendly refrigerant, which require only a small yard space to begin the heating and cooling process. The EarthLinked heat pump intensifies the warm thermal energy from the earth and converts it into heat for your home. In the summer months, the process is reversed and heat from inside is stored back in the earth. EarthLinked’s patented technology controls this process more simply and efficiently than any other heating and cooling system available and also regulates the humidity levels within the building, reduces its carbon footprint and supplies free hot water.

The Results. The residents of Bright ‘n Green now enjoy the pleasures of contaminant-free air, clean recycled water and no energy bills. The building is a restorative ecosystem with the ability to generate its own energy, many thanks to the geothermal solution provided by EarthLinked Technologies. Bright ‘n Green also has the on-site capacity to provide all of the heating and cooling needs of the building, thus providing total energy independence.

Project Fact: New York City Green Property-certified

About EarthLinked Technologies, Inc. EarthLinked Technologies, Inc. is a research and technology company committed to simple, efficient and effective ways to make life easier for people and the planet. We are committed to developing innovative and state-of-the-art technology. In doing so, we have created better products with superior operations that will save you money, and ultimately provide you with a more comfortable home. EarthLinked Renewable Energy Systems are operating in a variety of applications and climates, saving energy and the environment on a global scale. Functional on any property, regardless of its size or age, EarthLinked Renewable Energy Systems continue to be the leading industry solution for environmentally conscious homeowners and developers.

Project Fact: Constructed with eco-friendly materials

“We are so proud to have been a part of the Bright ‘n Green project and that our technology fit so well into the concept of a passive, net-zero energy building. We look forward to sharing our technologies with other forward-thinking customers who want to create efficiencies and still be a friend to the planet,” said Jeff Miller, President EarthLinked Technologies.

The need for more products that save energy and benefit the environment continues to grow. Focusing on this need, EarthLinked Technologies remains committed to developing innovative and state-of-the-art technology that provide the best geothermal energy solutions for people and the planet.

Bright ‘n Green can be found in Brighton Beach, Brooklyn at 67 Brighton 1st Lane, Brooklyn, NY 11235.

Advertorial
Attending a 3-day training course in a classroom halfway across the country is costly. In addition to the cost of registering for the course, there’s the cost of flights, lodging, meals plus the cost of 3-4 days lost productivity and opportunity when you’re away from the office. While a concentrated 3-day classroom session has advantages, giving you the opportunity to interact directly with several other people who work in different facets of the industry, the cost is probably in the range of $5,000 to $6,000.

The high cost of attending a class is that it’s seldom scheduled in a place or at a time that’s convenient. Even if the class is being held in your own community, if you have a large project at a critical stage it may be impossible to attend and give the course the attention it requires. Two new ways of achieving your CGD Accreditation are now available that both lower the cost and make it more convenient to attend a CGD class.

Live, interactive online courses allows a great deal of flexibility for both the instructor and participants in the course. Instead of everyone travelling to a classroom for 3 days, the course material is easily split up into 10 sessions of about 90 to 120 minutes. The sessions can be held one evening a week, or whatever works for everyone. Because instructor travel costs and the cost of the venue is eliminated, the course can be delivered with as few as 4 participants. Classes are easily scheduled based on demand, and can easily be scheduled to accommodate the needs of time zones around the world.

Larger engineering and mechanical contracting firms may find it more cost-effective to have the instructor come to their offices rather than have several engineers and designers fly to a class a few cities away. The instructor and firm can mutually agree on times to hold the class. The classes could, for example, be held from mid-afternoon into the evening, allowing participants at least part of the day to deal with project
needs. Or they could be scheduled over a weekend.

Scheduling the course specifically for a single firm would allow other people from the firm...drafting personnel or technologists, for example...who might otherwise not have the opportunity become an integral part of the “geo team”. Architects, mechanical contractors or drillers the firm works with regularly could also attend part of the course and understand their role in optimizing a project to work well with the earth.

The AEE website indicates approximately 10% of the active CGD’s are from outside of the U.S. The course has been translated into Metric units, including Metric pipe sizing, to make the course more relevant to designers outside of the U.S. Outside of the U.S. water to water heat pump systems are more common than distributed water to air heat pump systems. The section on distribution systems now has a greater emphasis on water to water systems, including radiant floor heating and cooling, chilled beams and thermally activated building systems.

Two online courses are scheduled to begin on June 1st and 2nd. One is scheduled for 7:00 – 9:00 pm GMT using Metric units for designers in the EU. The other is scheduled for 7:00 pm to 9:00 pm CST using Imperial units for designers in North America. If there is demand for other times, please contact IGSHPA.

For more information, visit:
http://www.geoptimize.ca/online-cgd-courses.html
In the previous GeoOutlook magazine I addressed issues with flushing and purging the ground heat exchanger. Now, there are two other issues that involve the water side components of a GSHP system that sometimes create questions - ground heat exchanger operating pressure and temperature and the desuperheater circuit temperature.

In the early days of the industry, pressure gauges and thermometers were typically installed on the GHEX and a thermometer was sometimes installed in the hot water tank return line in the desuperheater circuit. Homeowners were interested in this new, emerging technology they purchased and wanted to know everything about its operation and benefits - their new toy. Thankfully, while we have not progressed to my goal of being treated like a gas furnace (you know – behind the door, it works or you call a service tech), test ports have typically replaced the thermometer and pressure gauge on the GHEX and the desuperheater thermometer is no longer used - indicating the level of homeowner interest in attempting to analyze every aspect of operation has declined.

**DESUPERHEATER:**

Installation comment: DO NOT use the concentric fitting designed to supply from and return to the hot water tank drain valve location. It draws contaminants into the pump and piping and, over time, inhibits or interrupts proper desuperheater operation.

If you have installed a desuperheater and try to measure water temperatures, you will note fluctuation. As water circulates through the desuperheater water-to-refrigerant heat exchanger while the GSHP is operating in cooling, heat from the refrigerant is transferred into the water. If hot water is being used elsewhere in the residence, previously unheated make-up domestic water will be circulated through the desuperheater before flowing to the tank. If hot water is not being used, previously heated domestic water is circulated from the tank, through the desuperheater, and back to the tank. Water temperatures can vary widely based on domestic water supply temperature and hot water tank water temperature. The key point is when the GSHP is operating in cooling waste heat that would otherwise be rejected to the GHEX is being added to the hot water tank - basically for FREE! So, variations in the water temperature returning to the tank have no impact on performance or operation. As long as the GSHP continues to run, the desuperheater will continue to heat water until the desuperheater maximum water temperature safety shut-off switch is satisfied and shuts the desuperheater off.

**GHEX TEMPERATURE & PRESSURE:**

Ground heat exchangers will continuously change temperature and pressure throughout the annual cycle. As the GSHP operates throughout the annual cycle, it will either reject heat to or extract heat from the GHEX fluid, changing the fluid’s temperature as it passes through the water-to-refrigerant heat exchanger. In summer, as the fluid temperature increases, the increasing temperature causes the high density polyethylene pipe to expand, somewhat relieving GHEX system operating pressure. It should be noted that if the GHEX was not properly pressurized when placed into service (approximately 20 PSI minimum in summer, 30 PSI in winter), the pressure can fall to a point that does not meet the suction pressure requirements of the system circulating pump, causing the pump to cavitate and interrupting GHEX fluid circulation, which shuts the GSHP off. In winter, the opposite occurs and the pressure within the GHEX will increase. In both cases these fluctuations in system pressure, as long as not causing the pump to cavitate, have no impact on system operation or performance.

The temperature and pressure within a GHEX will fluctuate on a continuous basis any time the system is operating. As previously stated, sufficient pressure must be maintained within the GHEX to prevent pump cavitation during the summer. Also as mentioned previously, as the pipe expands when warmed in the summer, it somewhat relieves system pressure, so when pressurizing a system for start-up in summer conditions, pressurize to at least 20 PSI. The fact that temperatures can change in a very short period of time is normal operating procedure for a GSHP system, so changes in GHEX fluid temperature are not a cause for concern - unless - the fluid temperature falls below or exceeds design fluid temperature parameters. Likewise, GHEX operating pressure changes as described above are not problematic unless the pump cavitates or as a worst case scenario, operating pressure drops to zero. That is another matter entirely!

Mr. Rawlings has more than 35 years experience in the geothermal industry. He is the Director of Geothermal Services for Trison Construction, a Certified GeoExchange Designer (CGD) and an IGSHPA Accredited Installer and Trainer.
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Pictured are: (left to right) Jerry Buschur, Keith Buschur and Jeff Miller

Jerry and Keith Buschur of Buschur’s Refrigeration proudly receive the 2015 President’s Award from EarthLinked Technologies’ President, Jeff Miller.

To recognize the Buschur family for their commitment to selling the most simple, efficient and effective technology on the market, EarthLinked was honored to award them with the EarthLinked President’s Award. The award is presented annually to a member of EarthLinked’s Elite Dealer Network and is a prestigious distinction in the industry. It is well deserved by Buschur’s Refrigeration based on their continued commitment to consumers and our environment.

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