

## | CASE STUDY |

## Renewable energy and hydronic exploration inspired by challenge

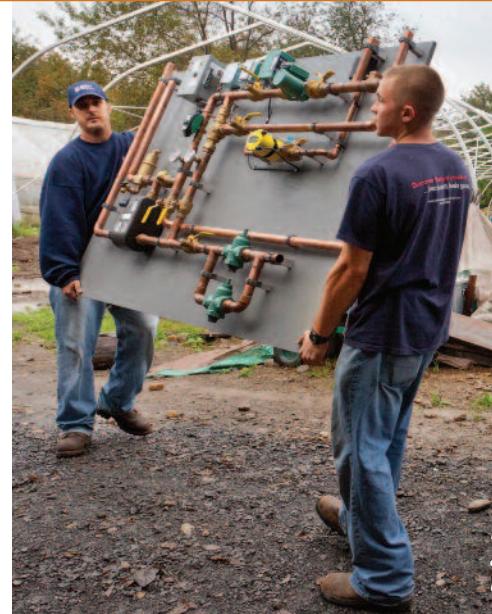
BY JOHN VASTYAN

**T**wo hours north of New York City, in the beautiful Hudson River valley, is a 365-acre farm community with organic gardens, fields, two large greenhouses, 10 homes and a barn with pigs and cows. There's also a dairy, bakery and pottery studio, all designed to serve young adults with developmental disabilities as residential or day students who are on the threshold of a transition into adulthood.

Triform Community is staffed by men and women who have chosen to live in a community that is dedicated to helping young people with special needs. Today, there are 95 residents who enjoy life within the structured learning environment.

Last year, Triform managers tapped John Abularrage, owner of Stone Ridge, N.Y.-based Advanced Radiant Design, Inc. (ARD), to install a sophisticated wood burning boiler and thermal storage system as the source for several interior spaces. Abularrage visited the community and soon devised a plan to install a small district heating plant that would move BTUs underground. The heart of the system is a 170 MBH Fröling wood gasification boiler coupled with a 1,500-gallon thermal storage system.

"Fuel costs were chewing through



Dave Bauer, lead installation technician, and Bob Witte, assistant mechanic, carry the prefabricated biomass control panel into the Triform mechanical room.

the community's reserves and, at the same time, preventing some of the desired facility improvements," Abularrage recalled.

Over the past few years, ARD crews have installed a dozen or more Fröling cordwood-burning and wood pellet-burning boiler systems. He was confident that, after studying the community's needs, the wood boiler/thermal storage solution, which is manufactured in Austria, would work ideally for them.

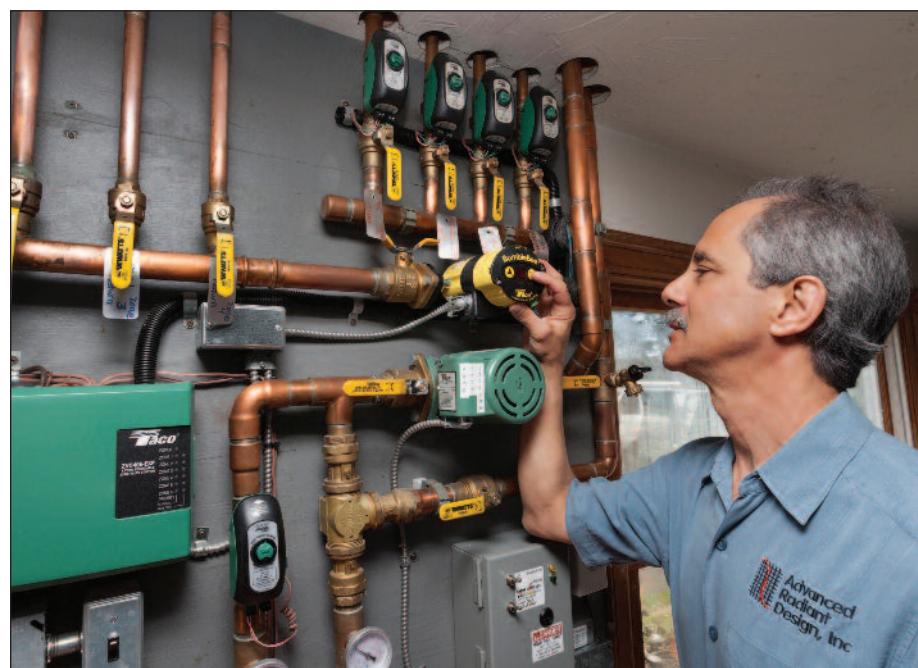
According to Abularrage, with so many complaints about smoke caused by the outdoor wood boilers that dot the countryside, many towns and states are cracking down on wood burning appliances. New

emissions standards are pending at both the federal and state levels. That's why state-of-the-art gasification "biomass" boilers – also to include U.S.-made wood boilers like those produced by another firm, Brocton, N.Y.-based Econoburn – are now regarded as among the best heating systems from an environmental standpoint.

"A two-stage combustion process burns standard firewood very cleanly and at very high efficiencies," Abularrage explained.

The first stage is a traditional low-temperature wood fire and takes place in the upper firebox. This is also where wood is loaded into the boiler. The smoke and creosote vapor that would normally go up the chimney and into the atmosphere as visible smoke is, instead, burned as wood gas at 1,800°F to 2,000°F in a second, refractory-lined, combustion chamber. This high-temperature secondary combustion not only cleans up emissions dramatically, but also gives the boiler near condensing levels of efficiency.

Unique to Fröling boilers is a "Lambda" control system that, based on oxygen levels in the exhaust, continuously adjusts both primary and secondary air settings to achieve optimal combustion throughout the burn cycle. The boiler control automatically modulates the induction fan speed based on boiler and thermal storage temperatures. This makes their gasification boilers some of the cleanest burning, low NOx systems available.



John Abularrage checks the function of a Taco Bumble Bee circulator at another biofuel job just a few miles down the road from the Triform facility.

In Triform's mechanical space, ARD crews installed the boiler and its large, site-assembled thermal storage tank with copper coil heat exchanger. Between them went a large control panel, with hydronic components that were preassembled with factory precision back at ARD's home shop.

### At Triform

The Triform Community panel's six-zone, primary-secondary piping arrangement includes many specific wood boiler components – such as a Termovar loading unit to protect a boiler from thermal shock and condensation, a diverter valve that sends excess heat to the storage tank, and an "automag" valve to activate a dump zone in the event of a power outage.

"We chose Taco's ECM motor Bumble Bee Delta T circulator and Zone Sentry zone valves to help maximize the efficiency of the overall system," said Abularrage. "While we've built standard single- and dual-temp radiant control panels for decades, it's taken some time and careful thought to develop what we consider an optimal wood boiler control panel. And, if a job comes along that requires something different, then we go back to custom fabrication."

Abularrage added, "For this job, we were one of the first firms to install some of Taco's prototype BumbleBee pumps to prove-out their functionality. One of them is planted on the Triform panel. We were glad to have the opportunity, and from the day we commissioned the system in January of 2012, Triform's hydronic system – and the little Bumble Bee – have performed flawlessly."

The Bumble Bee is a wet-rotor circulator that utilizes the latest in ECM (electronically commuted motor) permanent magnet motor technology. It uses up to 85 percent less electricity than a standard circulator and its out-of-the box settings and 360° swivel flange makes it easy to install. The Delta-T circulator has the ability to determine the exact flow required to match ever-changing building heat loads, all the while reducing boiler short cycling, increasing total system efficiency, maximizing energy savings, and improving comfort.

"The Bee offers flow up to 15 gpm and head up to 15 feet," explained Abularrage.

Factory pre-set to run in Delta-T mode, it can also be programmed for variable speed set point operation to maintain a fixed supply temperature or dialed-in to one of four fixed speeds.



*Mike Cahill, job foreman and shop manager, and Bob Witte, assistant mechanic, make Watts Radiant R-Flex supply and return connections inside an R-Flex distribution vault.*

Integral flow checks (IFC) and two plug-in remote temperature sensors are included in the carton.

The high-temp hydronic system installed for Triform provides heat for a 288 square foot staff meeting room, a small greenhouse (720 square feet), the larger one (3,072 square feet) and the 2,500 square foot barn woodworking workshop areas. All, but the meeting room with 16 feet of baseboard, receive heat via fan coil units.

"The tank's water temperature will vary according to where the boiler is in its cycle, and what the heating loads are," explained Abularrage.

The delivery system is designed to work at temperatures between 140°F and 180°F.

"When there's a heat demand, the boiler's always sourced first, and if the boiler's in a cycle where adequate output isn't available, then heat is sourced from the tank," Abularrage added.

According to Abularrage, the boiler's gasification process involves a carefully-engineered firing process through two combustion chambers. The boiler is designed to run continuously, hot and clean, and at close to maximum output. When optimal output and operational efficiency are achieved, the heating load is served directly from the boiler.

If the boiler is producing a higher-than-load output, excess heat is sent to the storage tank, allowing the boiler to continue operation at peak efficiency.

"But if a call for heat exceeds the boiler's output, or if the boiler isn't firing, the system pulls heat directly from the storage tank," said Abularrage.

### Subterranean heat

To provide heat for the community, ARD crews installed the heat plant in an improved area that was once used as a tool shed. They dug trenches and buried about 400 lineal feet of preinsulated, 1-1/2-inch R-Flex supply-and-return tubing manufactured by Watts Radiant to circulate heated water/glycol mix to the large greenhouses, new woodshop and the meeting room.

"Products like R-Flex have made small, district heating plant installations viable for homes, schools, farms and businesses," said Abularrage. "The use of R-Flex at Triform was a huge advantage for us, making it possible to deliver heat in many directions with negligible loss of BTUs."

R-flex piping consists of long-lasting PEX carrier pipes surrounded by thick micro-cellular, cross-linked polyethylene foam insulation layers with a closed cellular structure, all contained in a double-wall outer casing for maximum protection. The flexibility and light weight of R-Flex make it far easier to install than rigid piping systems.

### An environmental win

"With firewood harvested from their own land, Triform is very pleased to be heating with a carbon-neutral, locally produced fuel, all while slashing their heating costs and allowing more money to be available to support their mission," Abularrage said.

Triform's newly-heated greenhouses not only produce food for community residents; they also offer a way for residents to acquire new skills.

"It's an amazing place," Abularrage continued. "It's gratifying to solve a

challenge for the community. We have grown very fond of the staff and residents."

Keith Bogdanovich, co-director of Triform, said that if they were heating the greenhouses with gas or oil there would be no advantage in growing lettuce, spinach, tomatoes and cucumbers for the residents.

"But today we harvest our own fuel, saving substantially that way, and now we also save by growing food," Bogdanovich said. "The greenhouses are producing year-round. Our only regret is not having done it sooner. Last winter was rather mild, but the winter before it was awful. If we'd have made the switch to wood heat a year earlier, our savings would have been that much greater."

### Early years

John Abularrage is a guy who never stops smiling. Maybe it's because he already knows everything there is to know about hydronic and renewable energy systems. Taco trainer John Barba once said, "John Abularrage is to the solar and radiant heat realm what Jacque Cousteau was to early, underwater exploration."

Spurred by the Gulf Oil Crisis of 1973 that shook foundations of the developed world, Abularrage turned

his attention to studying alternative energy. In 1975, he was a student at the State University of New York (SUNY), New Paltz. Four years later, he joined Bio-Energy Systems where, in the R&D lab, John developed algorithms for measuring radiant heat emission and heat transfer in slabs and developed and tested solar thermal panels.

In 1981, Abularrage left Bio-Energy to form the consulting group, Aeolian Institute of Research where he was busy with passive and active solar design analysis as well as radiant heating system design for architects and engineers.

Four years later, he opened Energy Efficient Systems, one of the first radiant heat installation firms on this side of the Atlantic. He also dove deeply into heat recovery and energy management systems. Gradually, business grew and Abularrage found the 72 acre property on Vly Atwood Road, just six miles West of Stone Ridge, complete with waterfall and a post n' beam barn.

For Abularrage, it was the perfect place to build a home and launch the business. Perched among towering conifers, the 150-year-old barn was eventually renovated, making a great nest for solar and hydronic fabrication.

### Overkill is underrated; it's all about the team

The barn in the woods has morphed into a comfortable base of operations for Advanced Radiant Design, the company that, in 1998, grew from Energy Efficient Systems. Now with seven full-time employees, ARD serves the greater Hudson Valley, focusing on radiant heat and all things hydronic that connect to it, sometimes incorporating solar thermal and geothermal.

"Overkill is underrated," is the motto here. Take a look inside the shop and you'll see why this small firm has made such a huge impact in the market.

"Everything we build is drawn," Abularrage explained. "We especially like to control and integrate multiple systems and sub-systems, bringing tight attention to all facets of the installation. We may be guilty of overkill, occasionally. But we also share comfort in knowing we've given each job our very best." ●

**John Vastyan** is president of Common Ground, based in Manheim, PA. He specializes in communications for the radiant heat, hydronics, plumbing and mechanical, HVAC and geothermal industries. He can be reached at [cground@ptd.net](mailto:cground@ptd.net).

## Prefabrication: Key to higher quality and profit

The staff of Advanced Radiant Design has worked diligently through the years to bring near-perfection to the craft of hydronic panel prefabrication, and art form that, says owner John Abularrage, requires close attention to detail and a highly organized approach.

### Advantages abound

According to Mike Cahill, shop manager, prefabrication can save 50 percent or more in labor costs over site fabrication.

"Constructing panels in the shop provides a controlled and comfortable work environment with all the necessary tools at our disposal and eliminates the repetitive set-up and breakdown on a daily basis usually required with field fabrication," Cahill said.

On long-distance jobs, prefabrication can reduce travel time and expense. It also permits unrestricted work hours, unlike the time constraints which may be present jobsites. And – pointed out Cahill – a preassembled panel's quality is higher than what can be achieved in the field.

"At times, we have had as many as a half dozen control panels prefabricated in our shop, waiting for the appropriate time for installation," Abularrage said. "This solves the problem created by the 'hurry up n' wait' jobs that would otherwise be impossible to complete in a timely manner."

A less evident benefit of prefabrication is training. "Mentoring an apprentice under shop conditions with real-world applications is priceless. It acts as a bridge between the classroom and the field," Abularrage added.

### Planning is key

The process of prefabrication always begins with accurate measurement of the space available for the prefabricated equipment.

Early on, ARD staff generates an accurate CAD drawing of the floor and wall space available for all system components. Only then, can the basic layout of the fittings and components begin; then assembly.

"At this stage, decisions about the alignment of valves and components are made. While this has little effect on system performance, it adds to the overall cohesiveness of the finished project without adding significant time to the fabrication. This visually important refinement communicates a high level of craftsmanship and professionalism. Don't dismiss the value of this as merely 'mechanical vanity,'" Abularrage warned.

According to Abularrage, while prefabrication may not be for every situation, it can be an important key to higher quality and profit for every contractor.

# IT'S TIME BOILERS DO AN OTHERS.

**SAVES TIME. SAVES MONEY.**



*Our WM97+ is loaded with the features contractors have been asking for and is extremely easy to install and operate, saving you time and money.*

*WM97+ has been designated as one of the Most Efficient ENERGY STAR® qualified products in 2013.*

Start your savings today by visiting [www.weil-mclain.com](http://www.weil-mclain.com)

