District Energy

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INTERNATIONAL DISTRICT ENERGY ASSOCIATION

THIRD QUARTER 2011

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Responding to Water Scarcity

U.S. Biomass System Trends

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District Energy

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ON THE COVER: On May 17, Houston-based Thermal Energy Corp. (TECO) and Burns & McDonnell celebrated completion of TECO's $377 million district energy system expansion on the Texas Medical Center campus. Shown in front of one of the company's new 8,000-ton chillers are, from left to right, Stephen K. Swinson, chief executive officer and president of TECO; Paul G. Bell Jr., chairman of TECO's board of directors; Dr. Richard E. Wainerdi, president and chief executive officer, Texas Medical Center; and Greg Graves, chairman and chief executive officer of Burns & McDonnell. Courtesy Burns & McDonnell. Photo Paul Howell.

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

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IDEA was founded in 1909. Its purpose is to foster the success of its members as leaders in providing reliable, economical, efficient and environmentally sound district energy services. The association's membership consists of representatives from utilities, municipalities, universities, hospitals, military bases, airports, industrial parks and other physical plant systems engaged in supplying thermal energy in the form of steam, hot water and/or chilled water for heating, cooling and process uses. It also represents engineers; architects; financial, legal, and management consultants; and manufacturers who supply services and equipment for community energy systems.

Chair's Message

I hope that all of you who joined us in Toronto for the 102nd Annual Conference and Trade Show enjoyed your stay north of the border and, more importantly, came away with useful information, some new leads and new friends. We thank Dennis Fotinos and his staff at Enwave for being great hosts for the first-ever joint conference with the Canadian District Energy Association (CDEA). Our sincere appreciation for an excellent program goes to Laxmi Rao of IDEA, our technical co-chairs Richard Damecour of FVB Energy and Johnathan Coleman of JA Coleman LLC and all the speakers and panelists who willingly volunteered to share their experiences. I also want to recognize my predecessor, David Toombs, for his work as chairman during the past year. Well-attended and technically superior conferences were held in Indianapolis – where Dave was both host and incoming chair – and in Miami. We look forward to continuing to draw upon Dave's extensive experience in the district energy industry in his role as Past Chair.

The IDEA annual conference was unique in that two strong organizations partnered to ensure that we got the most out of the venue. New relationships were formed and, by now, have hopefully borne fruit. This concept of working together is in line with my theme for the upcoming year: District Energy Exchange (DEX).

Like so many people, for better or worse, we take our jobs personally. In that respect, membership in the IDEA is, in a way, similar to a club membership. Whether we are exchanging information by presenting at an IDEA conference or picking up the phone and calling a fellow member, we are usually sharing thoughts that are near and dear to us. That includes both our success stories and our occasional confessions.

When a major incident occurs in our industry, we usually don't have to do much for the word to get out, as the media will see to that. Fortunately, these incidents are infrequent, because maximizing safety is a core part of our business. Unfortunately, there are many near-misses that have the same or even greater potential for injury or property damage. These occurrences will often "fly under the radar." Think of the educational opportunities lost when we make a mental note of what happened and promise ourselves to not let it happen again. Taking the time to go through a root cause analysis, lessons-learned process and action plan to prevent a recurrence will undoubtedly pay dividends. Transparency will also go a long way with our customers, the local engineers who make energy decisions and our municipal leaders. Going one step farther and sharing what we learn with our peers will pay additional dividends in the district energy community.

Up to now, we have focused mainly on the sharing of experiences. Could we take this one more step and share our most valuable resource – our people? Regardless of our planning efforts and best intentions, there may well be a time when we find ourselves in an untenable position. How often have we seen a fleet of bucket trucks heading down I-95 to help an electric company after some natural disaster? Would a similar mutual aid arrangement benefit district energy companies? We recently heard from members interested in exploring the viability of a mutual aid agreement, wherein IDEA member systems will agree to share resources or expertise to support another member system in need, whether it is from a hurricane, an ice storm, or even worse, a terrorist event. As an industry association with over 102 years of shared common interests, we think it makes sense to explore how we can better support each other, should the need arise. Although we may operate systems of various vintages, we may all benefit from such an arrangement.

Many of us are proud of the job we have done to extend the life of mature systems so they continue to operate safely and reliably. However, we are falling short if we neglect to include system efficiency with our other major areas of emphasis. The number of systems yet to adopt combined heat and power (CHP) is an indicator that there is still much work to be done to better position district energy for the twenty-first century.

As chairman, I will work with President Rob Thornton, our board and members who share a common interest in these various initiatives. Together, we will continue to work together toward our common goals.

Vincent Badali

Chair, 2011-12
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& Engineering
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President's Message

At our recent 102nd Annual IDEA Conference in Toronto, we heard of a number of encouraging trends for the district energy industry. The theme of the conference, "District Energy/CHP 2011: Essential Infrastructure for Energy-Efficient Communities," was on full display in the opening plenary session as global industry leaders described roadmapping strategies, insightful policies and robust investments in district energy infrastructure aimed at more fully integrating combined heat and power and harvesting useful heat to make thermal energy an integral platform in a more sustainable urban future. It has long been my belief that any city that wants to reasonably claim the mantle of sustainability must have vibrant, effective district energy infrastructure to fully realize a low-carbon future. The economic and environmental health of our urban centers cannot rely solely on wires and natural gas piping to support growing population densities. It is folly to continue to throw away two-thirds of the fuel consumed in making electricity when that thermal energy resource can be effectively used in district heating networks.

Across Europe, concerns about reliance on natural gas supplies from Russia have served as a catalyst for the development of new district energy networks in order to take better advantage of local sources of energy. In addition, many countries have realized the double bonus of job creation with an economic multiplier effect where energy dollars recirculate in the local economy rather than flow out of the country. The history of Denmark's success with district energy starts with the first oil embargo in 1970 that exposed foreign oil dependency as the Achilles Heel of their economy.

> In the German energy model, the growth of CHP and district energy are inextricably linked.

Mayors and city planners are awakening to the trend that smart, sustainable development must include district energy networks. In the United Kingdom, and especially across greater London, new systems are proliferating as a primary means to reduce carbon emissions and stabilize energy supply. After World War II, many district heating systems that had supplied social housing networks fell into disrepair, leading to an image problem for district heating as part of the municipal welfare state. In the last decade, thanks to strong leadership from Mayor Boris Johnson and the advent of the Olympics, London has embarked on a plan to recover and use surplus heat from power-generating stations and to build multiple district energy schemes that utilize geothermal, waste heat and other forms of trigeneration. When a strategy like district energy also delivers substantial carbon reductions, it becomes a compelling public-private investment vehicle that appeals to all political stripes.

In Germany, CHP currently produces around 11 percent of the total electricity, which is analogous to the 9 percent share in the United States. The German government recently announced an objective to increase the relative share of CHP electricity to 25 percent by 2020. Today, the total length of the district heating grid in Germany is approximately 100,000 km and over 84 percent of district heating is generated in highly efficient CHP plants. When evaluating energy usage in larger cities, the Germans found that district heating leaves the cityscape untouched and is essentially "invisible" as infrastructure. In the German energy model, the growth of CHP and district energy are inextricably linked. As penetration of CHP electricity grows, the thermal sink of district energy infrastructure will expand to more fully utilize greater volumes of available heat, which, in turn, displaces combustion of other fuels that would have been burned in individual boilers. Germany has recognized that district energy infrastructure is, in fact, essential to their strategy of higher electric generation efficiency and reducing carbon emissions through combined heat and power.

The single most important finding at the conference was that heat dominates all other forms of end-use energy, as reported by Jayen Veerapen of the International Energy Agency (IEA). In its May 2011 report, "Cogeneration and Renewables," IEA research indicates that heat dominates all other energy uses, accounting for 47 percent of total end-use energy in non-OECD countries and 37 percent in OECD countries. These percentages make sense when you consider that richer countries tend to consume more energy for transportation and electrification of home and industry.

Moreover, heat is largely produced from fossil fuels such as coal, petroleum and natural gas. In OECD countries (Europe, Asia-Pacific, North America, etc.), natural gas accounts for 50.5 percent of heat production, while around the world, about 27 percent of heat is produced with natural gas. For economic and environmental reasons, heat production needs to be as efficient as possible, yet it is barely a blip on the policy radar screen. The IEA analysis of the dominance of heat deserves greater visibility and consideration in policy-making. In the U.S., energy policy has almost exclusively focused on electricity and has been remarkably silent in consideration of thermal energy, except for the 2010 Thermal and Renewable Energy Efficiency Act (TREEA). In bringing recognition to the dominance of end-use of heat, we need to leverage the work of the IEA to influence policy makers in integrating heat as a key element to increasing energy efficiency and, in turn, reducing energy dependence and cutting emissions.

"Cogeneration and Renewables" recognizes the gap in the energy discussion by focusing on heat and applying a more holistic approach to the synergies between the low-carbon options of cogeneration and renewables. Efforts to constrain greenhouse gas emissions and concerns over security of fossil fuel supplies have recently led to increased policy support for renewable energy. Shares of renewable energy (RE) supply have risen and the trend is likely to continue as countries transition to low-carbon economies. However, as the IEA report points out, transitions take time, especially on the scale needed to decarbonize our energy system. Even though the share of renewables will rise in the coming decades, fossil and other alternative fuels will still play a major role. For that reason, it is important to use these fuels as efficiently as possible. Cogeneration serves a dual purpose, since it is a proven energy-efficient technology and can accelerate the integration of renewable energy technologies.

In many instances cogeneration and renewables complement each other. Several renewable technologies can be operated in cogeneration mode, making both power and heat, including biomass, geothermal and concentrating solar power (CSP). Cogeneration, often fossil fuel-based, can assist in balancing electricity production from more intermittent and variable renewable sources. By increasing production efficiency, cogeneration represents a low-carbon balancing solution. While electricity supply is a crucial aspect of the energy debate and will continue to remain as such, decision makers must recognize that heat supply is a sizable part of the energy system and if the system is to be decarbonized, changing the heat supply will also need to be considered.

> The important point is that district energy and renewables are more complementary than competitive.

In markets where intermittent wind power has grown to a significant share of electricity capacity, the need to provide balancing reserves is growing, and in order to preserve the environmental gains, it is critical that balancing capacity be as energy-efficient as possible. Further, to provide better grid stability, locating renewables and distributed generation throughout the grid allows for greater penetration of both cleaner and greener sources of power. Rather than build large remote power stations away from load centers, CHP with district energy has the advantage of supplying dense power, heating and cooling loads of cities, campuses, research and healthcare with excellent capital and operating efficiencies. The important point is that district energy and renewables are more complementary than competitive. We must dispel the notion that energy is a zero sum game of either energy efficiency or renewable energy. Grid operators and supply competitors should embrace the complementary advantages of highly efficient CHP as a means to load-balance with clean intermittent sources like wind or solar.

The City of Toronto offers a compelling case for the value of district energy infrastructure as a means to strengthen grid resiliency and drive economic growth. The economy of Toronto experienced estimated losses of $4.2 billion during the four days of the 2003 North American Blackout. New York City, on the other hand, with substantial local CHP facilities and 102 miles of district energy infrastructure, was able to respond and recover much more rapidly. Learning from that lesson, since 2004, Toronto has cut 151 MW in peak power demand through the Better Buildings Partnership and Enwave's Deep Lake Water Cooling System, enough capacity to support approximately 25 major new office buildings. When city leaders compare the 50:1 ratio of tax revenue from a surface parking lot at $90,000 per year to a 40-story office building at $4,500,000 per year, clean local energy capacity is critical to economic growth.

As the larger trends of urban population migration converge with a desire for lower carbon solutions, planners and policy makers alike will invariably discover that district energy infrastructure is a key component of a more sustainable economic model.

Robert P. Thornton
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Feature Story

Managing Water Scarcity:

Why water conservation matters to business

Steve Spiwak, Industry Development Manager, Nalco Company

In recent years, the issue of water scarcity has often hit the headlines. Some states have gone to court over water rights and access even as others have agonized over scarce supplies. Water scarcity and drought have far-reaching impacts on regional and global economies and ecosystems. More than 20 percent of the world's population lacks access to safe drinking water, and more than 40 percent lives in water-stressed areas.

The bottom line is that our water stewardship practices have significant consequences for people, industry and the environment. As nations develop, industry accounts for an increasing percentage of total water use, often creating conflicts between industrial water needs and water required for agriculture and human consumption. This leads to industry efforts to conserve and reduce water use.

District energy providers understand that the days of unlimited, inexpensive water are almost over. While it remains inexpensive in comparison to other components of the heating and cooling processes, it is often the most visible reflection of the impact on the local environment. Much attention has been focused on this central issue and exploring different methods of assessing and tracking water use in district energy systems. While assessing water footprint and flows is a good first step, it is critical to further identify and understand the solutions and their economic, social and environmental impacts.

Business Implications

So why conserve? It's simple: Conservation can have a positive impact on your bottom line, but perhaps more importantly, it can position your system to function successfully in the future as water becomes both scarcer and more expensive. Adapting your system so that it can deliver reliable service in the face of water cost increases and usage restrictions will enhance your reputation as a trusted energy provider. Fortunately, there are steps toward water conservation you can take right now to protect this valuable resource for the future. A few of them are discussed in this article.

While conserving water may seem easy to talk about, there are hidden roadblocks and many unforeseen issues in implementation. Consider, for example, the water-energy nexus – the close connection and synergy that water has with energy, as it takes water to make energy and energy to make water accessible and usable. There are significant costs and ultimately savings associated with this water-energy relationship that need to be considered in a water conservation program. The key is to understand that water-energy relationship as you choose new methods and technologies to address your total water footprint reduction goals. For example, you may try to condition the water through mechanical means, but the energy to run that equipment can outweigh the benefits of the water saved.

State and federal legislation also plays a key role in industry's water conservation efforts. An increasing number of state and federal mandates require industry to achieve a water-reduction goal of 10 percent to 20 percent. One example of this, which has put severe pressure on industry, is California's Water Conservation Act of 2009 (Senate Bill SBx7-7). It requires a statewide 20 percent reduction in per capita urban water consumption by 2020. Water suppliers that fail to meet their water use targets will be considered in violation of the law and face administrative or judicial proceedings after Jan. 1, 2021. The expectation is that there will be significant financial repercussions for those water purveyors failing to meet these new state and/or federal requirements. In the end, district energy providers and other water users in those areas will feel the pain because the fees will get passed on to the end users and ultimately raise the cost of water.

Finally, you must look at your marketing or brand positioning within your local area. How will your water footprint or conservation efforts impact your brand? Will the steps you take to reduce water use help or harm your position within the community, among your peers or with local government? The answers to these questions can affect contract negotiations and perceptions of your system as well as limit your ability to maintain credibility with local government. Opinions matter, and good faith efforts to do the right thing are marketable to district energy end users.

Opinions matter, and good faith efforts to do the right thing are marketable to district energy end users.

Actionable Strategies

In developing a plan for reducing overall water consumption, one can take a hierarchical approach similar to the 'reduce-reuse-recycle' concept that is often applied to other waste reduction efforts. With this method, we tackle the easiest and least expensive solutions first, and then proceed to more elaborate solutions to attain further savings. The easiest way to reduce waste – of any resource – is to use less of it in the first place. For district energy providers, this means running our plants at maximum efficiency using the least amount of water possible, given our existing equipment. After that has been done, we might look for ways to reuse some of the water that is already going through the system, using it 'as is' for a second or third process, thereby getting more 'work' out of the same amount of water before it is ultimately discharged. The third step – recycling – would involve treating used process water in order for it to be acceptable for a second or third process.

As providers of heating and cooling, we automatically focus on our biggest water users – chillers and boilers. Ideally, however, our efforts should start with the water as it enters the plant. Understand the quality of the water entering your facility as well as where each gallon goes. Document and map all water inlet, usage and discharge streams. This will provide the foundation for conducting water-balance studies and ensure that your plant's total water footprint is accounted for.

There are many water conservation solutions available to district energy providers. The key to choosing the best option is understanding the impact of any given strategy on your level of energy use (increased/decreased), overall metered water use, legislation/potential funding from state or local entities, and finally your brand (i.e., your marketing materials, ability to help your customers earn LEED® [Leadership in Energy and Environmental Design] certification or the ENERGY STAR label, etc.). These are the basics behind defining your sustainable solution to water conservation.

Following is a short list of some of the more common water conservation approaches used within the district energy industry. This list continues to grow as new technology makes it easier to reuse and manage your water supply while supporting your water conservation goals.

1. Use of alternative water sources:
   - Rainwater – geographic-specific, requires good maintenance of the stored water
   - Grey water – requires access but can be a cheap resource
   - Recycled wastewater – requires access, sometimes referred to as "purple pipe water"
2. Increased return of condensate to boiler plant
3. Continuous tower cycle management, with automated fluctuation of cycles based on water characteristics achieving optimum water reuse 24/7
4. Reverse osmosis reject water for cooling tower makeup

In the last two years, we have also seen a new interest in softening the water in cooling towers as a conservation tactic. While softening is a proven technology, this application has come into question. What has been discovered is that many facilities are pushing ultra-high cycles through the use of soft water, assuming that they can save millions of gallons of water. The appeal and significance on their company's image is so strong, but we are seeing these decisions do not always consider all the environmental and economic impacts of the total system.

This is a perfect application to study to understand how a water conservation strategy can be applied in two different ways (ultra-high cycles vs. moderate cycles). Following is a high-level review of this nontraditional ultra-high-cycle approach explaining the impact it could have on your facility (brand, energy costs and asset preservation).

Case Study: Softening Cooling Tower Water

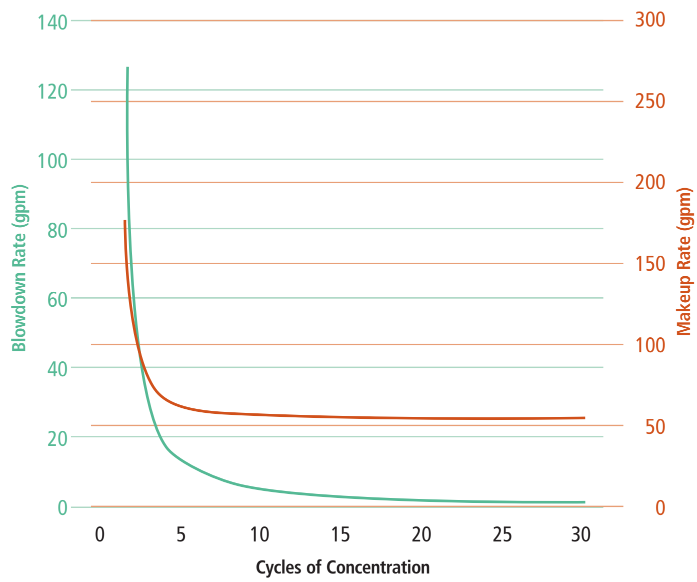
Many of these high-cycle applications have been touted as 'zero blowdown' applications to drive interest and acceptance as a tower cycle management practice, i.e., towers exceeding 100 cycles. (This is compared to the more moderate-cycle management practice using the same soft water, with towers at 15-20 cycles.) But let's consider the example of a 100,000-gal system with a 50 gpm evaporation rate and 250 ppm total dissolved solids (TDS) in the makeup water. If the chiller plant manager wants to use softening as a method to reduce freshwater usage, he must balance the energy breakpoint, the need to prevent chiller and pipe corrosion and the potential impact on the company's image as a sustainable operation.

In these ultra-high cycle applications there have been additional claims of zero blowdown because they will shut the blowdown valves and allow the tower to cycle up. While this has been seen recently as a sexier approach due to the opportunity it provides for marketing significant water savings, in most cases, it is not truly a zero blowdown application. From the standpoint of the overall plant water balance, there can be no such thing as zero blowdown in a cooling system that requires water to backwash its filter and to regenerate its softener, as both of these water streams are sent to drain.

So, what about the benefits of higher cycles? Figure 1 displays the water savings breakpoint as cycles are increased. In almost every case, the cycle curve flattens at around 15-20 cycles. This means that the water savings benefit decreases significantly (less water saved) as you drive higher cycles. But as the cycles continue to be raised, the tower stress increases. Tower stress includes higher levels of TDS and much higher concentrations of ions, leading to more challenging water quality issues such as increased corrosion, reduction of heat transfer, etc.

The question becomes, Why increase the challenges or risk of managing that water when the payoff – reduced water use – is so low? Once again we ask, Why do systems taking this approach still try to achieve extremely high-cycle tower management? Simply because it is very marketable to the end users, and companies have a strong desire to market their water reduction efforts. This sounds good on the surface, but when you take a closer look, you find that it is not as sustainable as originally assumed. There are other concerns and areas to understand before you push the cycle limits of your tower and chiller systems. Following are some of those concerns that a facility should investigate prior to instituting an ultra-high-cycle tower strategy.

Figure 1. Effects of Cycles on Makeup and Blowdown Requirements at 50 gpm Evaporation Rate.



Blowdown gpm	Cycles
50	2
25	3
10	6
5	11
2.5	21
1.25	41

Source: Nalco Company.

Energy Cost

While softening allows you to increase cycles, you increase the TDS. This tower water, which is like a brine solution, can start having an energy impact once the TDS level exceeds 10,000 ppm. When the TDS gets as high as 50,000 ppm in the tower water (200 cycles for our example system), the viscosity and density are significantly increased and the heat capacity significantly decreased compared to a pure water system. At this point, there are three main engineering ramifications to consider:

- Chiller condenser heat transfer coefficient drops by approximately 12 percent, representing a 2 percent increase in kilowatts per ton.
- Tower performance decreases by 5.5 percent (around 1-2 degrees F entering condenser water temperature), representing a 2 percent increase in kilowatts per ton.
- Pumping energy increases approximately 10 percent, representing a 2 percent increase in kilowatts per ton.

In this example of ultra-high cycles, the program increases kilowatts per ton by around 6 percent. Perfectly illustrating the water-energy nexus, freshwater use goes down, but energy costs go up. However, softening a tower while maintaining cycles closer to that breakpoint of 15-20 cycles (approximately 5,000 ppm TDS with 250 ppm TDS makeup water) can still reduce water usage significantly, allow for manageable control of the system and keep energy costs lower.

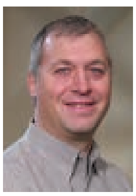
Reliability/Asset Preservation

The reliability or preservation of system assets can also be impacted by this softening technique. The narrow band of maintaining proper water quality is strongly impacted by the alkalinity and anion concentrations in the freshwater makeup source. A key area of concern is the level of chlorides and sulfates as it relates to alkalinity. These water characteristics can directly reduce asset life and increase corrosion rates significantly and quickly. In light of this, great care should be taken when choosing to soften tower water.

Sustainability Perception

This softening strategy could also adversely affect your brand or reputation. If you want a more sustainable campus or facility, softening may not be the appropriate choice. When you choose softening to achieve higher cycles, you increase the amount of salt required. How much salt do you need to run a softening system like this? It could be as much as 35,000 lb of salt annually. While water softening may enable you to slightly reduce your use of water treatment chemicals, you will have added thousands of pounds of chemical in the form of salt. This may not be considered a very 'sustainable' decision after all.

While softening is a proven water conservation approach, using it to generate very high cycles can have a far-reaching impact on a facility's energy, water and environmental initiatives. With so many issues to consider – including understanding a facility's water footprint and how new techniques and technologies are used – this course of action can be difficult. However, taking the time to properly consider the overall impact of water conservation strategies on not only water use but also energy use, asset preservation and reliability will help district energy system operators customize their strategies and ensure their facilities' goals are achieved. In the years ahead, with fresh, usable water in short supply, that is certain to become critically important.



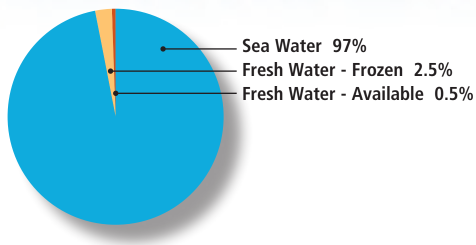
Steve Spiwak is currently an industry development manager for Nalco Company, where he is responsible for managing the district energy and higher education industries. Previously employed by Commonwealth Edison as a staff chemist, he has written articles and presented at numerous IDEA and APPA meetings throughout the years. Spiwak can be reached at sspiwak@Nalco.com.

Water Facts Drive Sense of Urgency

The facts illuminate the need to conserve water: Nearly 1 billion people (one in six globally) live without regular access to freshwater. While this sounds surprising, consider that most of the earth's water is salt water. A mere 3 percent is freshwater, and 2 percent of that comes from ice and snow. The remaining 1 percent is surface water from lakes, rivers, etc., which is available for consumption or use. (See figure 2.)

Let's break this down even further. Nearly 70 percent of the available global freshwater is used for agriculture. In addition, industry accounts for the use of another 20 percent to 22 percent of that freshwater pie. The rest is consumed by nature and humans. The bottom line is this: Water is scarce, still affordable and above all, although we don't like to admit it, wasted.

Figure 2. Global Water Sources.



Source: World Business Council for Sustainable Development.

Cover Story

A TEXAS-SIZED DISTRICT ENERGY SYSTEM:

THE ENERGY BEHIND WHAT'S NEXT AT THE TEXAS MEDICAL CENTER

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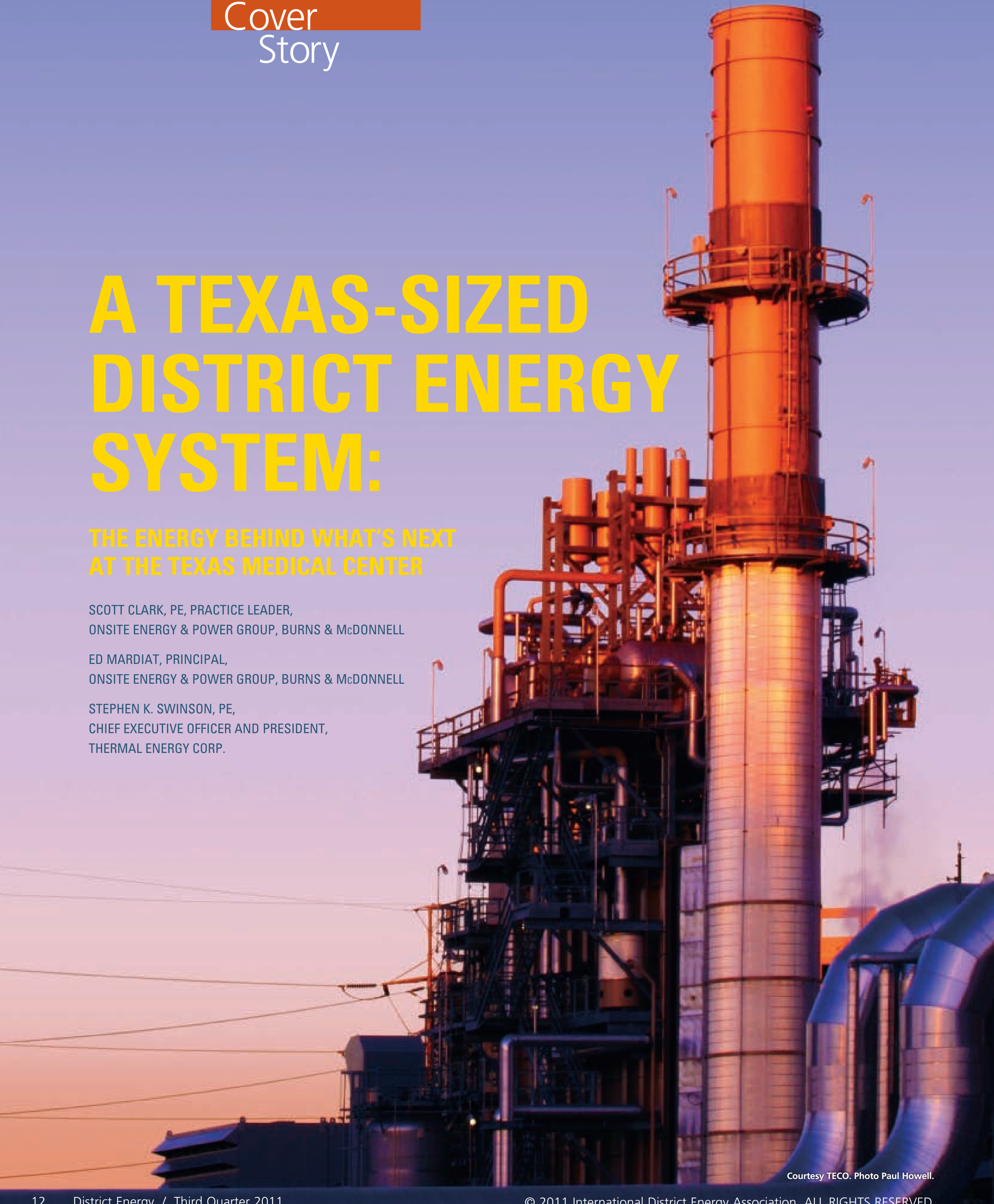


Courtesy TECO. Photo Paul Howell.

August in Houston can be hot, and in 2010, it was the hottest on record. On Aug. 23, demand on the Texas electrical grid hit an all-time high of nearly 66,000 MW. But at the 201-acre main campus of the Texas Medical Center, the leaders of Thermal Energy Corp. (TECO) weren't sweating over how soaring electricity prices or the threat of blackouts might affect their district energy system, which serves 75 percent of campus building space. Even as the temperature outside soared, TECO didn't need to pull a single watt of electricity from the grid.

Instead, the not-for-profit corporation relied on its newly commissioned, 48 MW combined heat and power system to generate the power needed to supply chilled water and steam to The University of Texas MD Anderson Cancer Center, Texas Children's Hospital and 16 other institutions at the Texas Medical Center. TECO not only reduced the load on the state's electric grid that day, it demonstrated one of the major reasons why it added on-site electricity generation to its Central Plant in the first place: to ensure that the world's largest medical center's thermal energy needs could be met, no matter what.

Courtesy Burns & McDonnell.

Houston-based Jackson & Ryan Architects incorporated architectural features into TECO's Master Plan Implementation Project that reflect the surrounding Texas Medical Center.

The CHP system is a major part of TECO's $377 million district energy system expansion, Master Plan Implementation Project – Phase One, which also included adding 32,000 tons of new chiller capacity, an 8.8 million-gal stratified thermal energy storage (TES) tank, distribution piping and an expanded operations facility featuring a state-of-the-art control room. The project was completed in May 2011, transforming TECO's energy center into a model for energy efficiency, operating flexibility, environmental sensitivity and system reliability – and the largest district cooling system in the U.S.

Developing a Master Plan for Growth

In 2006, the institutions at the Texas Medical Center were projecting major growth, and TECO could foresee a related increase in demand for chilled water for air conditioning and dehumidification and steam for air conditioning, space heating, sterilization, kitchen and laundry processes, and domestic hot water use. TECO responded by working with Jacobs/Carter Burgess to complete a master plan to keep pace with that growth. The plan provided solutions to expand the system, improve efficiency, reduce emissions and strengthen TECO's overall system reliability and emergency operating capacity, especially during natural disasters and other crises. Burns & McDonnell validated TECO's master plan, developed an implementation plan and later provided engineering, procurement and construction services for the project. The firm recommended a phased approach to the project to closely match campus growth projections.

One of the company's most significant design challenges was the site's space constraints. Land on the Texas Medical Center campus is a precious commodity, and while TECO would eventually need to double its capacity, it did not have the luxury of doubling the size of its 4.5-acre Central Plant site where the new equipment was to be located.

Master Plan Implementation Project – Phase One

In January 2008, Burns & McDonnell started the first of what are expected to be multiple phases of construction (which will be determined as the Texas Medical Center develops its plans for building out the campus). In preparation for construction, upgrades were made to TECO's 138-kV substation. This was followed by completion of the TES tank and Operations Support Facility in October 2009, the CHP system in August 2010, the distribution system expansion in September 2010 and the new East Chiller Building in May 2011.

TES Tank

TECO chose to install the 8.8 million-gal TES tank as a cost-effective way to increase peak chilled-water capacity. TES allows chilled water to be produced and stored when it is the most cost-effective (generally at night) and then used when chilled-water production rates are highest. TES

Courtesy Burns & McDonnell.

Inside TECO's Operations Support Facility, the state-of-the-art control room allows the district energy plant operator to better manage the integrated utility systems serving the world's largest medical center.

also helps reduce peaks on the grid during the hottest times of the day. In addition, TES enhances reliability, since it can be brought into service quickly and uses approximately 10 percent of the equivalent emergency power it would take to operate a chiller.

Chilled water leaves the tank at 42 degrees F and enters the distribution system through a 60-inch pipe. After it has been used in the buildings for cooling, the water travels back through the distribution system, returning to the tank at approximately 58 F. At night, electric centrifugal chillers cool the returned water back to 42 F for the next day's use.

For these reasons, the new TES tank was one of the first projects TECO completed. To facilitate cost-effective use of the available land, the tank was designed at 150-ft high, which makes it the tallest TES tank in the world.

Operations Support Facility

TECO's growth resulted in a need to provide environmentally controlled space to warehouse sensitive parts and materials, space for training operators and maintenance personnel, and secure areas for plant operations. To address these needs, TECO added 29,000 sq ft of new building space to its existing Operations Support Facility. The addition includes a new state-of-the-art control room that features 24 flat-screen monitors where staff can track system performance and site security and oversee daily operations. The space is hardened to ensure structural and operational integrity are maintained during severe weather conditions.

CHP System

Wanting to generate thermal energy as efficiently as possible, TECO added CHP to help squeeze maximum energy from every British thermal unit of fuel consumed. The technology has provided the additional benefit of improved reliability and significantly reduces emissions to the environment.

In a traditional central power delivery system, only about one-third of every Btu of fuel consumed is converted into electrical energy; the remaining two-thirds go up a stack and are wasted. TECO's 48 MW CHP plant, by comparison, operates at approximately 80 percent efficiency – more than 50 percent improvement over a central utility plant fed from the grid – and with a combined heat rate between 5,500 and 6,700 Btu/kWh.

TECO uses the electricity generated within its own Central Plant. The high efficiency is possible because the plant also recovers the waste heat from electricity generation and uses it to make steam and chilled water. TECO's CHP system consists of a GE LM-6000 combustion turbine and a heat recovery steam generator. It is designed to produce 125,000 lb/hr of steam – the minimum steam load for the summer months. During winter, using the natural gas-fired duct burners more than doubles

Due to campus growth, Burns & McDonnell built a permanent bridge over Brays Bayou to extend utilities to institutions that are expanding on Texas Medical Center's mid and south campuses.

Courtesy Thermal Energy Corp. Photo Paul Howell.

The heat recovery steam generator is a key component of TECO's on-site CHP system, which recovers waste heat via conductive heat transfer to produce steam.

the steam output to as much as 330,000 lb/hr of steam, increasing overall CHP efficiency by as much as 15 percent. The CHP system also uses chilled-water supply or return water for combustion turbine inlet cooling to maximize power production during the hot, humid Houston summers.

Because of these projected energy efficiencies, TECO received a $10 million federal grant – one of only nine American Recovery and Reinvestment Act grants from the U.S. Department of Energy for CHP and district energy technology.

Distribution System Expansion

TECO has historically served only the Texas Medical Center's main campus. (The Texas Medical Center's primary site in Houston consists of three contiguous campuses – main, mid and south.) More than 7.5 trench miles of piping supply district energy to 44 buildings. With the expansion, TECO built an additional chilled-water loop to serve new load on the west side of the main campus. It also constructed a new bridge to carry 60-inch piping over Brays Bayou, linking the main campus to the mid and south campuses, where the majority of future growth is projected to occur.

East Chiller Plant

Dedicated May 17, 2011, TECO's new East Chiller Building was constructed to house 10 8,000-ton chillers. (See "Industry News" for details about the dedication ceremony.) As part of Phase One, the first four 8,000-ton chillers and their associated equipment were installed to add 32,000 tons of chilled-water generating capacity. These four chillers and the new TES tank bring TECO's total cooling capacity to 120,000 tons, making it the largest district cooling system in the U.S.

> TECO's total cooling capacity of 120,000 tons makes it the largest district cooling system in the U.S.

At full buildout, the East Chiller Building will house six additional 8,000-ton chillers totaling 48,000 tons, bringing TECO's total cooling capacity to 168,000 tons – enough to cool two Texas Medical Centers at today's size or more than 42,000 average-sized households.

Timing Is Everything

When construction on the $377 million expansion kicked off, the world was in a far different economic place than it was when construction ended over three years later. In 2007, the economy was at its peak and inflation was on the rise, raising two major concerns for the project team. First, would they be able to find the skilled labor necessary to meet their high quality standards? Second, would labor scarcity drive up construction costs?

Both questions were answered in dramatic fashion months later when the stock market crashed, and almost overnight the prices of everything from raw materials to labor dropped significantly. TECO had worked with Burns & McDonnell to establish a guaranteed maximum price on the project. Using an open contracting approach, more than 85 percent of the project was competitively bid. As a result, TECO realized more than $30 million in equipment and subcontractor savings compared to original construction cost estimates.

As the economy slowed, however, so did growth at the medical center. As a result, TECO completed the first phase of implementation with more capacity than current Texas Medical Center campus load projections require. But it also built that capacity at a substantially lower cost than if the project had been postponed.

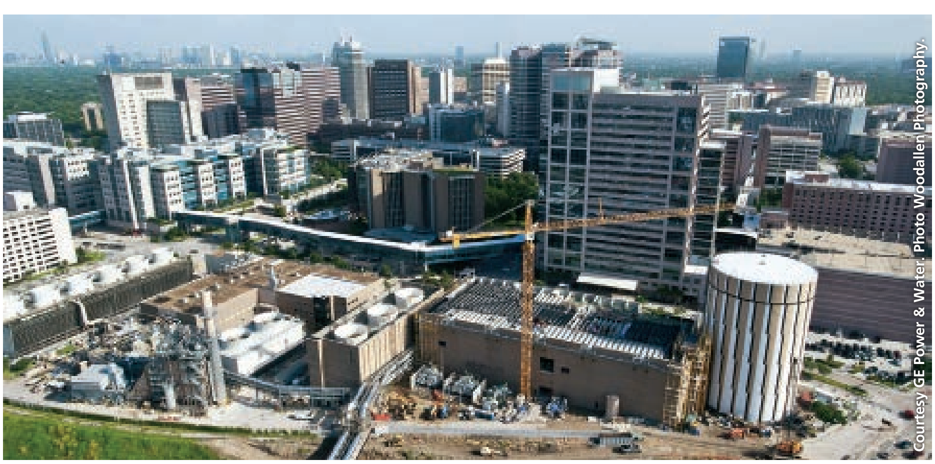
Mission Accomplished

While first-phase projects have been operational only for a few months, early assessments indicate the new facilities are operating according to plan and are achieving the objectives outlined in TECO's master plan:

1. **Improving efficiencies.** The two-for-one payback on each Btu of fuel input is primarily responsible for the 80 percent energy efficiency CHP delivers. However, it is not the only source of energy efficiency at TECO's energy center. The chilled-water storage made possible by TECO's new TES tank improves plant operating efficiency by giving TECO the flexibility to chill water when electricity rates are lowest. TECO can also start and stop its gas turbine as needed as the cost of natural gas and electricity change. TECO's phased expansion is also contributing to long-term savings. The new East Chiller Building, for example, uses a plug-and-play design that makes it relatively simple to add individual new chillers as demand increases. Similarly, TECO elected to plan for two smaller CHP plants – one now and one in the future, rather than a single large plant – which also contributes to operational flexibility.
2. **Reducing the electric distribution system load.** The power generated by the CHP plant doesn't power institutions at the Texas Medical Center; it is used solely within TECO's plant to power equipment and provide steam and chilled water to medical center customers. TECO's customers use electricity from the grid and operate their own independent emergency generators. Since they have no on-site chillers, their need for emergency generator capacity is cut in half.
3. **Lowering environmental emissions.** Because CHP improved overall system efficiency, TECO anticipates cutting carbon dioxide emissions by more than 302,000 tons in the system's first year of operation – equivalent to taking 52,000 cars off the road or planting 72,000 acres of new trees. The CHP plant will also reduce carbon emissions by 83,000 metric tons a year compared to TECO's previous operations. The TES tank further lowers TECO's carbon footprint by using the power from the CHP system to run the electrical centrifugal chillers to charge the tank and by using power from the grid during the off-peak periods.
4. **Saving money**. In its 2010 fiscal year, TECO reduced customer rates by 2 percent; in 2011, it dropped them an additional 1.4 percent. These rate declines are due largely to efficiencies gained through these and other projects. The master plan implementation is projected to save TECO and its customers more than $200 million over the next 15 years.

The master plan implementation is projected to save TECO and its customers more than $200 million over the next 15 years.

5. **Improving system security and reliability.** With critical patient care at stake and more than $1 billion in medical research performed on campus annually, TECO's service reliability must be second to none. Even when disaster strikes – as it did when Hurricanes Katrina and Rita hit in 2005 and Hurricane Ike made its presence felt in 2008 – failure is not an option. TECO's added capacity and ability to generate its own power, coupled with its detailed emergency preparedness plans, further improve the company's reliability.



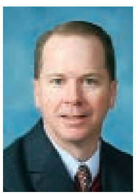
TECO's Central Plant site was under construction from 2008 until early May 2011. Nine months of construction remained when this aerial image with the Texas Medical Center campus in the background was captured. The expanded district energy facility's design allows TECO's capacity to reach 100 MW of on-site power generation, 168,000 tons of chilled water, 152,000 ton-hr of chilled-water storage and 940,000 lb/hr of steam.

Still to Come

With the first phase of its master plan implementation complete, TECO is preparing to take a fresh look at the big picture. In the coming months, the project team will re-evaluate the plan in light of the medical center's latest growth projections and begin planning TECO's next steps.

Likely on the agenda will be issues such as electricity generation. The day could come, for example, when TECO could provide emergency power to some or all of its customers. TECO also has the opportunity to export more of the power it generates to the grid, something it is already doing when market conditions and other variables warrant.

For the moment, TECO and its partners are taking time to consider the enormity of what they've accomplished and the excellent working relationships they've developed in the process. Given the project's size and scope, the current economy, the tight construction site and the need to keep existing operations going throughout construction, the TECO Master Plan Implementation Project is a prime example of what happens when things go right during project planning, design and construction. It is also proof that district energy systems aren't just bigger in Texas. They can also be better.



Scott Clark, PE, leads the Burns & McDonnell OnSite Energy & Power Group. In his 24 years of experience, Clark has planned and designed energy projects for higher education, health care and aviation clients. A Certified Energy Manager, he is a current board member of IDEA and received the 2007 Energy Manager of the Year Award from the Association of Energy Engineers – Region IV. He holds a bachelor of science degree in mechanical engineering from Texas Tech University and has completed coursework toward a master of business administration degree at Texas Christian University. He may be reached at spclark@burnsmcd.com.

Ed Mardiat, principal and CHP development director in the Burns & McDonnell OnSite Energy & Power Group, has 37 years of design, project management, marketing and project development experience. He worked with the U.S. Department of Energy to coordinate installation of the first packaged CHP demonstration project, owned and operated by Austin Energy. He served on the Design-Build Institute of America (DBIA) board, as vice president of the Mid-America DBIA and as director-at-large for the U.S. Clean Heat and Power Association. Mardiat is a member of the U.S. Environmental Protection Agency CHP Partnership and IDEA. His email address is emardiat@burnsmcd.com.

Stephen K. Swinson, PE, is chief executive officer and president of Thermal Energy Corp. in Houston. Swinson has 28 years of experience in the district energy industry, including positions at Trigen Energy Corp. and Auburn University. He chaired IDEA's board of directors from 1996 to 1998 and is now a board member. A licensed professional engineer, Swinson is a graduate of Auburn University with a bachelor of science degree in mechanical engineering. He also has a master of business administration degree from Northwestern University's Kellogg Graduate School of Management. He can be contacted at sswinson@teco.tmc.edu.

About the Texas Medical Center

Founded in 1945, the Texas Medical Center is the world's largest medical center. Recognized by *U.S. News & World Report*'s Annual Survey of America's Best Hospitals in all 19 categories of adult care and all 10 pediatric care specialties, its member institutions are known throughout the world for high-quality medical care and excellence in teaching and research. Here are some vital statistics for the year 2010:

Number of member institutions	49 including: • 21 academic institutions • 14 hospitals • 3 medical schools • 6 nursing schools
Size	162 buildings with space devoted to patient care, research and education space – equivalent to the 12th-largest business district in the U.S.
Patient beds	6,800
Physicians, scientists and researchers with advanced life sciences degrees	20,000
Employees	93,500
Annual patient visits	6 million, including 18,000 from international patients
Babies delivered	28,000
Students	71,500

Source: Texas Medical Center.

System Snapshot: Thermal Energy Corp., Houston, Texas

TECO is a not-for-profit corporation created to provide reliable thermal services to institutions in Houston's Texas Medical Center. Governed by a board composed of nine of the medical center's institutions served, TECO today operates two plants – the Central Plant and a satellite, the South Main Plant – that supply chilled-water and steam service to 18 institutions representing more than 75 percent of building space on the main campus.

	Chilled-Water System	**Steam/CHP System**
Startup Year	1969	Steam system, 1969; CHP, 2010
Number of Customers	18 medical institutions	18 medical institutions
Number of Buildings Served	44	36
Total Space Served	18.9 million sq ft	14.9 million sq ft
Total Capacity (at Central and South Main plants)	120,000 tons including 8.8 million-gal thermal energy storage tank (with ability to expand to 168,000 tons)	816,000 lb/hr steam (with heat recovery steam generator and duct firing); 48 MW electricity
Number of Boilers/Chillers	27 chillers total: 14 at Central Plant, 13 at South Main Plant	8 boilers total: 6 at Central Plant, 2 at South Main Plant
Annual Energy Sales	267,750,000 ton-hr	1,006,797 Mlb
Fuel Types	Electricity and natural gas	Natural gas and diesel
Distribution Network Length	7.5 miles	7.5 miles
Piping Diameter Range	6 to 60 inches	2 to 16 inches
System Pressure	65 psi	250 psi
System Temperatures	40 F supply/53 F return	450 F supply/150 F return
System Water Volume	12.4 million gal (including TES)	NA

Source: Thermal Energy Corp.

Feature Story

Biomass District Energy Update:
Current trends and issues in the U.S.

Bob Smith, PE, Vice President, RMF Engineering Inc.

Across the United States, the number of biomass-based district energy plants is growing, incorporating a variety of renewable fuels, technologies and business strategies. The motivations behind this increase include offsetting greenhouse gas emissions by utilizing carbon-neutral fuels, promoting renewable energy and reducing dependency on fossil fuels. With crude oil frequently topping $100 a barrel, the momentum to go green is compelling. But biomass systems are not without risks or significant financial investment that can make or break them. A look at recent trends and issues in biomass district energy can provide an overview of this segment of the industry and how various systems have found success.

Small-Scale Modular Boilers in Institutions

Among the district energy plants utilizing biomass are those at several higher education and health care institutions, which have capitalized on the availability of cost-effective modular biomass boilers. Several manufacturers of biomass combustion equipment have successfully packaged systems that can be offered at a competitive price and installed with minimal field fabrication and customized assembly. The pre-engineered, shop-manufactured equipment in the 10,000- to 50,000-lb/hr steam production range enables plants to incorporate a renewable energy source in their portfolio with limited capital investment.

Several higher education and health care institutions have capitalized on the availability of cost-effective modular biomass boilers.

Small-scale biomass boilers are now in use, for example, at Middlebury College, Bennington College and Green Mountain College in Vermont; Colby College, Maine; Colgate University, New York; Longwood University, Virginia; Northwest Missouri State University; Central Michigan University; and Cooley Dickinson Hospital in Massachusetts. Throughout the country, biomass-fired combined heat and power projects have also been funded at U.S. Department of Veterans Affairs (VA) medical centers. These systems have broken ground in Ohio, New York and Maine. More biomass CHP plants are proposed at Wyoming, Michigan, Tennessee and California VA medical facilities.

Middlebury College

One of the institutions tapping small-scale biomass boilers, Middlebury College used to consume approximately 2 million gal per year of residual (No. 6) fuel oil. Natural gas was not within geographic reach in the Northeast. A "carbon reduction resolution" initiated by Middlebury's student body was approved by the college's trustees. The college invested $12 million in a campus heating plant in 2008, complete with a glass front to increase visibility and showcase its mission. The project included a receiving facility for wood chip trucks, wood chip conveyors, a close-coupled gasifier with four-pass firetube boiler, and emission controls including cyclone separators and a baghouse.

"We considered every imaginable option," says Michael Moser, Middlebury's assistant director of facilities services. "The final solution was to retain our oil-fired infrastructure for backup and utilize biomass at the main plant for day-to-day steam production."

Michael Moser, assistant director of facilities services at Middlebury College, demonstrates the close-coupled gasifier boiler installed in the new campus heating plant.

This plant operates year-round with a steady load, consuming 75 tons of green wood chips daily. The boiler produces 22,000 lb/hr of 250 psig steam. "We cogenerate using as many as three backpressure steam turbine generators, which exhaust at 20 psig to heat the campus," Moser explains. "When we are not heating, the steam is used for generating up to 2,000 tons of absorption cooling."

The biomass system is very cost-effective: Twenty thousand tons of regional wood chips (primarily 'whole-tree') displace one-half of the previous oil consumption. Hardwood chips delivered for $40-$50/ton beat the oil alternative ($2.75/gal) by a ratio of more than 4-to-1. Although the chips are purchased through a broker, the college now wants to learn more about what state, town and wood lot the fuel is coming from and what is being done to restore it.

Bennington College

Bennington College built its biomass plant in 2007. "We used to burn about 370,000 gallons of No. 4 oil per year to heat 22 campus buildings. This year, that number will be less than 10,000 gallons," says boiler operator Todd Siclari.

Bennington invested $4 million in the new facility, which houses a 400 HP wood chip-fueled underfed stoker boiler and earned an architectural design award in 2009. The plant receives 30-ton trailer loads of whole-tree green wood chips, which fall onto a 'walking floor' and vibrating belt conveyors, and then pass through a magnet and shredder to ensure a clean, uniform grade of fuel. "The key is getting a good, reliable wood chip supplier," says Siclari. "No long sticks, dirt or contaminants: We find what works best is mostly hardwoods within a certain range of moisture content (less than 50 percent)."

Bennington College's emissions are controlled by a multiclone collector that removes particulate matter from the stack gases. The material-handling, combustion boiler and ash-removal systems were provided by AFS Energy.

Lessons Learned

Among the lessons Middlebury and Bennington have learned from their experience are the following:

- Fly ash byproduct has been a valuable resource to the agricultural community as fertilizer.
- Allow plenty of time to shake down the system and gain confidence. Moser reports: "It took us about a year of trial and error to get there."
- Secure a good, reliable, consistent fuel source. Wood fuel moisture levels and composition (percentage of hardwood, softwood, etc.) have very noticeable effects on combustion characteristics.
- Install a central vacuum system, as dust is an everyday challenge.
- Schedule outages every eight weeks for ash cleanouts and inspections.

Fewer Large-Scale Applications

Besides the small-scale biomass boilers, larger-scale systems have also been implemented, though they are fewer in number by an estimated 3-to-1, generally require customization and are many times more expensive. Two of the most visible biomass pioneers have been District Energy St. Paul, with the nation's largest wood-fired CHP plant (310,000 lb/hr) serving a district energy system, and the University of Iowa, which burns oat hulls to fuel its district

Bennington College's Todd Siclari inspects the delivery of whole-tree chips.

energy system and has displaced more than 150,000 tons of coal consumption to date. Both systems have operated successfully since 2003.

A more recent example is Seattle Steam Co.'s $25 million urban wood waste-fired boiler project at its Western Avenue Plant, completed in 2009. (See the cover story on this project in First Quarter 2011 *District Energy*). The company's new 85,000-lb/hr bubbling fluidized-bed boiler accommodates a wide variety of wood materials including storm damage, pallets and construction debris. Because of its size and location, Seattle Steam added a semidry absorption scrubber system to remove acid gases and urea injection to remove nitrogen oxide emissions.

Similar-scale gasification plants using various wood fuels such as hogged fuel, chips, etc., have also recently been developed by Nexterra Systems Corp. for the University of South Carolina and Oak Ridge National Laboratory (plants at both locations have 60,000-lb/hr capacity). Gasification plants of this size in a greenfield environment can require significant investments ($15 million to $25 million) but report some of the lowest-achievable emission levels and are able to accommodate a variety of fuels and moisture compositions.

Larger stoker-type wood-fired boilers have long been in common use in the pulp and paper industry to produce process steam and electricity. Established manufacturer Indeck Power Equipment Co., for example, has been providing units as large as 600,000 lb/hr for nearly 40 years.

One of the most ambitious and largest district energy system biomass projects is currently under way at the University of Missouri (MU, or 'Mizzou') in Columbia, Mo. This $76 million investment includes the removal of an older coal-fired boiler and installation of a 150,000-lb/hr, 950-psig, 850 degrees F, utility-grade bubbling fluidized-bed boiler; fuel-storage silos; and fuel-handling conveyors. Expected to be operational in mid-2012, the new boiler is estimated to burn more than 100,000 tons per year of regionally supplied biomass.

MU Power Plant Superintendent Gregg Coffin reports that "the bubbling fluidized-bed boiler system will offer flexibility to use a wide variety of sustainably sourced biomass feedstocks such as milling residues, clean wood waste, urban development clearing, logging residues, managed forestry thinning, corn stover, crop residues, waste papers and biomass crops that have been grown specifically for this purpose." Emission controls for the boiler are extensive, including a fabric-filter baghouse, selective catalytic reduction ammonia injection system, dust collection, and continuous emissions monitoring and continuous opacity monitoring systems.

Pellets: Still an Immature Market

There are an estimated 1 million residences or businesses in the United States currently heated with wood pellets, which are now produced at approximately 200 pellet mills throughout the country. The wood biomass used in pellet production comes largely from previously discarded forestry resources like tree tops, branches and stumps. Chips, bark and sawdust are also commonly processed into pellets.

Typically, wood waste is processed in a hammer mill, significantly reducing particle size. Moisture is then added or removed, and the wood particles are

The largest wood pellet mills in the U.S., like Green Circle Bio Energy Inc., export all of their product to European nations.

pressed through a die, resulting in a dry, consistent fuel product held together by a natural casing formed by lignin melting in the wood as it goes through the die press.

Pelletizing achieves many beneficial results such as densification, uniformity, transportability, storability and ease of cofiring in a combustion process. In this form, wood can be trucked, railed, augured or pneumatically conveyed. Pellets also contain twice the energy content of green wood (8,400 Btu/lb for premium-grade pellets).

A large pellet mill can produce 30,000 to 80,000 tons of pellets per year. Transportation and delivery of the pellets – once distributed only in 40-lb bags for household use – has expanded to a commercial level. Trailers and trucks with up to 25 tons of capacity commonly deliver using pneumatic conveying to a customer's storage silo.

One of the largest wood pellet producers in the world is Florida-based Green Circle Bio Energy Inc. It produces up to 560,000 tons of wood pellets annually using a variety of yellow pine species grown within a 50-mile radius. Plant Manager Greg Martin says that the market for wood pellets in U.S. utility plants has not yet arrived. The company ships all its pellets to Europe for use in district energy and electric utility plants, where they may be cofired with coal or burned exclusively. Martin says, "The difference is that in those countries there are financial incentives supporting biofuel use. The future of wood pellet use in the U.S. is dependent on legislation going forward."

> The cost differences between wood chips and pellets have largely confined pellet use to small standalone heating plants.

While large-scale pellet-fired plants are not yet in use in any U.S. district energy systems, institutions such as colleges and secondary schools have installed pellet heating systems for smaller properties. Dartmouth College, for example, installed a 2 million-Btu/hr pellet-fired system for its 125-unit Sachem Village housing complex. But the cost differences between wood chips and pellets have largely confined pellet use to small standalone heating plants. Generally, when combustion equipment capacities get above 3 million or 4 million Btu/hr, the cost differences largely favor chips or bulk wood residues. Commonly reported delivery costs for wood chips range from \$30 to \$55/ton (\$3 million to \$5 million/Btu), while pellets are rarely delivered for less than \$200/ton (\$12 million/Btu).

Expanding Fuel Opportunities

While the most common renewable fuel source used in district energy plants is wood waste, an industry is emerging to cultivate fast-growing grasses for this purpose. The trend is taking root in states such as Virginia, Pennsylvania, New York, Georgia and Kansas, where grasses are grown on farmland or underutilized/abandoned properties. These grasses include native warm-season varieties such as switchgrass and other perennials like Miscanthus and reed canary grass. Perennial grasses can be grown on marginal soils, reach high yields and sequester large amounts of carbon in their root systems and surrounding soils. Perennial grasses are being cofired with coal in electrical power plants and engineered as a feedstock for cellulosic ethanol.

Crops specifically grown for use as biomass fuel, such as giant Miscanthus, can yield as much as 10 tons per acre at maturity. These can be a valuable energy source for biomass firing and create new revenue streams for farmers and land

Perennial energy crops like Miscanthus are proving to be effective at carbon capture and high energy yield.

owners. Grasses can be harvested with conventional farming equipment and grow in closer proximity to plant sites than forests.

The interest in grasses as fuel has created new business enterprises. For example, Ohio-based FDC Enterprises Inc. is responsible for planting and maintaining nearly 150,000 acres of perennial grasses, and its subsidiary First Source Biofuel LLC is now harvesting grasses for use as biofuel feedstock.

Storage can be inefficient, however; and the difficulty of integrating grasses into district energy plants is mainly associated with the low-density material-handling and fuel-feeding systems. Grasses are bulky and nonuniform – generally incompatible with stokers and conventional conveying methods. Perennial grasses can be pressed into briquettes and cubed for densification. In many cases, the nonspecific grasses can be densified to produce pellets with a comparable heating value of approximately 90 percent of that of wood. Commercialized grass combustion has still not been realized, however.

Boiler MACT Regulations

With the momentum building for biomass boilers, a new challenge is presented by the U.S. Environmental Protection Agency's new emissions regulations for boilers and process heaters at major sources, i.e., the Boiler Maximum Achievable Control Technology (MACT) rule. The new regulations, signed Feb. 21, 2011, affect 13,800 new and existing boilers across the country, of which an estimated 420 are currently biomass-fired. Any boiler that burns at least 10 percent biomass on an annual heat-input basis is defined as a biomass unit. For new and existing large boilers (greater than or equal to 10 million Btu/hr), there are specific numeric emissions limits for particulate matter, hydrogen chloride, carbon monoxide, mercury, and dioxins and furans. The new regulations will require biomass boilers to add devices to meet the stringent standards in three years.

The emissions regulations for particulate matter are very restrictive. Fabric-filter baghouses and electrostatic precipitators are the most likely addition to cyclones or other mechanical collectors to capture particulate matter. Some sources may require extra measures for acid gases and oxidation catalysts for carbon monoxide. "These devices can add 25 percent to 30 percent to the equipment cost alone," says Richard Bellefleur, general manager of Wellons FEI Corp., manufacturer of packaged biomass boilers. "The emissions levels can be met, but at a cost."

At present, the newest MACT rules have again been temporarily suspended but are likely to return again after a public review period.

What Can Go Wrong?

Though increasing, biomass-fired district energy still faces many challenges. The most common obstacles tend to be a lack of local, reliable, cost-effective fuel supply as well as unanticipated high operating costs. Since fuel price can be the most significant operating cost, it has to be reliable and predictable. Successful plants rely on abundant fuel sources within 50 or 75 miles. Trucking, the most common method of fuel deliveries, is often limited to 25- to 35-ton loads.

Cost and distances are critical. One of the most notable examples of this was the closure of the Northern Nevada Correctional Center biomass plant, constructed in 2007 for $7.7 million. The expectation was that downed trees and other wood debris from the nearby Lake Tahoe Basin would be readily available, but wood proved to be more difficult and costly to obtain. Also, additional air-pollution controls were needed to comply with local requirements. The plant began losing $500,000 per year and was forced to close. Other biomass plants have been forced to seek fuel sources 100 miles or more away, resulting in high transportation costs that have jeopardized their viability.

Using biomass to generate thermal energy is generally more cost-effective than using it to produce electricity alone. In California, 61 biomass electric power plants were reportedly constructed between 1980 and 1992. The economic justification was based on the anticipation that the cost of conventional fossil fuel-produced power would increase significantly. When the power purchase contracts ended in the late 1990s, they were rewritten so low that less than one-half of these biomass plants are in operation today.

Still, large new biomass electric production plants are being developed. Novi Energy has started construction of a 50 MW generating plant in South Boston, Va., which will use 'slash wood' from the timber industry; and Dominion Virginia Power also announced that it is planning to convert three coal-fired power stations totaling 150 MW as early as 2013.

Added Bonus: LEED Credit

District energy providers that are incorporating biomass recognize the marketing value of being able to help customer buildings achieve LEED® (Leadership in Energy and Environmental Design) certification. Whether a new or existing facility, buildings seeking LEED certification can earn a tremendous number of points toward that goal if they are connected to a district energy system utilizing biomass that qualifies under LEED guidelines. Tim Griffin's "LEED + District Energy" column in this issue provides a detailed explanation of the LEED advantages of biomass. LEED points can be achieved under both Energy & Atmosphere Credit 1 and Credit 2.

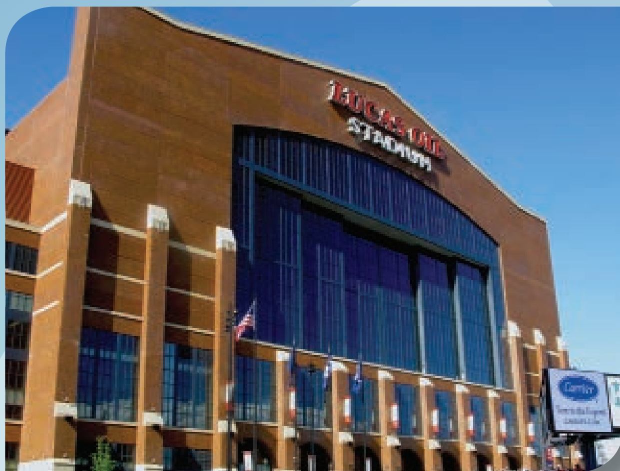
Additional Resources

The number of operating biomass district energy systems continues to grow, on college and university campuses, at health care facilities and in downtown business districts. Federal agencies, including the Department of Veterans Affairs, have already initiated or plan to initiate in the near term more than 15 biomass-based district energy systems in 10 states. This means the network of seasoned users, manufacturers and consultants is increasing, along with their expertise and eagerness to share advice and lessons learned.

To learn more about who is already successfully using biomass fuels, visit the following online resources:

- Biomass Energy Resource Center – www.biomasscenter.org/database.html
- Wood2Energy – www.wood2energy.org/Database%20Connection.htm

Bob Smith, PE, is vice president of RMF Engineering Inc. A former chair of IDEA, he is actively involved with the modernization of district energy systems throughout the U.S. He can be reached at rdsmith@rmf.com.



Lucas Oil Stadium

JW Marriott Hotel

Super Event – Super City – Super Energy Source

As a member of the International District Energy Association (IDEA), Citizens Thermal is proud to be a major energy source for businesses in Indianapolis. If you fly into our great city for that super event in February 2012, you will pass through the spectacular Colonel H. Weir Cook Terminal at Indianapolis International Airport. Citizens is proud to provide on-site management services at the airport's Central Energy Plant, which supplies high-pressure hot water and chilled water services to the terminal.

Citizens Energy Group is also proud to be a super energy source for other super clients in Indianapolis, including Lucas Oil Stadium, hotels, a major university, hospitals and a prominent pharmaceutical company. For more information, call Jeff Willman, Director of Sales for Citizens Energy Group at 317-927-4790, or visit CitizensEnergyGroup.com.

Conrad Hilton Hotel

Indianapolis Midfield Terminal

Feature Story

The Case for Filtration:

Maintaining system performance and extended equipment life

Allyn Troisi, Application Engineer, Heat Transfer Division Worldwide,
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With the increasing complexity and higher efficiency requirements of modern district energy systems, the use of filtration equipment is becoming more critical than ever. Given the demand for these systems to operate reliably 24 hours a day, seven days a week, they can ill afford any downtime – or worse, complete failure – that could be caused by fouling from the buildup of unwanted contaminants. Filtration can help systems large and small avoid such problems by reducing the levels of particulates in their water supply. As the acceptable levels of fouling continue to be pushed lower, filtration has become a key solution to this issue – and a source of savings. As such, it has also become a top priority in the design of district energy and HVAC systems worldwide.

Identifying the best filtration solution for an application requires understanding the main causes of particle (or solids) contamination and those elements of the operating environment that can reduce system efficiency. As the experience of Indianapolis-based Citizens Thermal shows, installing effective filtration equipment can play a key role in optimizing system performance and reliability.

Why Filtration?

Particle contamination can be an issue in both hot and chilled-water district energy systems. Solids buildup can be found in both closed- and open-loop systems but is most prevalent in open-loop systems where cooling towers continuously expose condenser water to the atmosphere. Most particles are introduced into the system through airborne entry, makeup water, corrosion byproducts and the precipitation of dissolved minerals (both naturally occurring evaporative precipitation as well as chemically induced). Generally 40 microns or larger, these particulates include dirt, scale, corrosion, iron oxides, calcium carbonate (a byproduct of water treatment) and other suspended solids.

Filtration of a district energy system's water supply can prevent the buildup of unwanted contaminants, such as in these dirty chiller tubes.

The buildup of unwanted contaminants not only threatens both health and safety, but it can also lead to fouling of heat transfer equipment, wasted energy, increased water usage, increased maintenance and/or shutdowns for cleaning, increased chemical costs and increased wear on many other system components.

All these issues affect overall system efficiency and sustainability, as well as the owner's financial bottom line. Therefore, in almost all cases, some filtration is better than no filtration. Effective filtration can increase savings across the board, in energy and water usage, maintenance and water treatment, for example.

A multitude of filtration techniques and equipment are available today that can provide system users with effective solutions in a wide price range. These solutions should be designed and selected based on each application's unique requirements; and although budget concerns are legitimate, the true lifecycle costing and return on investment of the entire filtration system should be considered.

The buildup of unwanted contaminants can lead to issues affecting overall system efficiency, sustainability – and the owner's financial bottom line.

Main Filtration Strategies

In today's sustainability-conscious environment, filtration methodology and equipment can offer a wide range of options that can be applied. All, however, fall into one of three main categories: full-flow, sidestream and basin cleaning techniques.

Full-flow filtration is used in applications requiring that 100 percent of incoming water be filtered to remove as many solids as possible. A great example of this would be a system that uses lake or river water to cool heat exchangers, where the water could contain large amounts of sand or silt capable of clogging the exchanger. It is important to note when considering this strategy that introducing full-flow filtration into the system will result in a pressure loss, which must be compared to the pump head and system losses to ensure there are no potential problems created downstream. This strategy is normally employed in new design-build applications where all the losses on the system can be calculated and the correct pump selections made.

Sidestream filtration, used to filter a percentage of the total water volume, is commonly applied to systems that don't have filtration and don't want to make major changes to the rest of the system. Sidestream systems are normally sized based on a percentage (5 percent to 25 percent) of either the main system pump flow rate or system volume; or they can be selected based on system turnover once per hour. Normally, sidestream systems are installed on the discharge side of the main system pumps or tied directly to a cooling tower basin or sump. Sidestream packages such as a separator with a small booster pump generally have low horsepower requirements and are 'quick and dirty' to install, making them attractive costwise. Properly locating and installing such packages is critical to achieving the highest level of solids removal possible.

Perhaps the most effective strategy overall, basic cleaning filtration most commonly incorporates a separator with a high head pump and sweeper piping designed with nozzles in a cooling tower basin or sump. The sweeper piping nozzles push the solids toward the filtration package pump suction, generally located away from the main cooling tower outlet connection. The separator removes the solids, and the clean water is fed back into the sweeper piping. The benefits of this method include removal of solids as they enter the cooling tower; reduced tower maintenance, specifically manual cleaning; reduced growth of bacteria, including Legionella; and the maintenance of an effective water treatment program.

Proper sweeper piping design is critical to filtration system effectiveness. The filtration package should be selected based on 1 gpm per square foot of basin area and at least 20 psi of pressure at the inlet point to the main sweeper piping header.

Basin cleaning is still considered a type of sidestream filtration in that it does not provide full protection for the system. Generally more expensive than full-flow or sidestream, it also provides more benefits over time.

Evaluating the Options

All three filtration strategies can be configured using separators, barrier filters such as sand media filters, bag/cartridge filters or a host of specialized equipment depending on the desired filtration solution. All three strategies can be applied to open-loop systems, which employ equipment that in some way is open to the atmosphere (e.g., cooling tower feeding a chiller or plate-and-frame heat exchanger). Closed-loop systems that are sealed from outside contamination and that may use other liquids for cooling (such as glycol) generally employ either the full-flow or sidestream strategies to remove solids such as pipe scale. Some applications may yield maximum benefits by using multiple filtration strategies together to remove particles of many sizes.

When evaluating filtration strategies, operators should also look at their systems' geographical location. Areas that may see increased solids loading include, for example, those with farm land, heavy industry and seasonal conditions (such as cottonwood seed) or proximity to major highways. Other regional considerations are the availability of water and whether there are any restrictions on its use or disposal, e.g., the blowdown of chemically treated water from a cooling tower to a municipal drainage system. Where water is an issue, it is very important to look at how the different filtration equipment uses or conserves water under operating conditions.

It is also important to remember that filtration does not replace good water treatment. Filtration and water treatment generally are applied in tandem to create a better-quality and stable operating environment. The removal of solids from the system through filtration allows water treatment to focus on the biological issues. An example of this would be employing the basin cleaning strategy to keep the cooling tower basin free of solids that would typically settle on the basin floor and create a bed for increased bacterial growth, resulting in under-deposit corrosion and contamination – and making it much more difficult for water treatment to be effective.

Filtration does not replace good water treatment. They are generally applied in tandem to create a better-quality and stable operating environment.

The performance, operating characteristics and costs of these various filtration solutions must be evaluated to determine the best design required for an individual application and its subsequent required performance.

Citizens Thermal Installations

District energy facilities worldwide have seen the benefits of filtration. One such company is Citizens Thermal, which provides steam to more than 250 buildings and chilled water to more than 80 buildings in downtown Indianapolis, Ind. Filtration plays an important role in keeping the company's chilled-water supply clean and its chillers operating efficiently.

Joe Ray, Citizens Thermal operations supervisor, comments, "We operate and maintain 75,000 tons of cooling equipment. Reliability and efficiency are key factors that allow us to meet our customer expectations. Using separators on both our closed- and open-loop systems assists us in maintaining the water quality necessary to achieve maximum system efficiency."

Since 1992, Citizens Thermal has installed various types of LAKOS filtration equipment at its downtown Indianapolis plants – including the West Street Chiller Plant, the Indianapolis Campus Energy Ice Plant and Illinois Street Chilled-Water Plant – as well as at other facilities elsewhere in the city. In total, the company supplies in excess of 130 million ton-hr of cooling from these facilities per year.

The filtration packages provided to Citizens Thermal through the years have consisted of standalone separators and purge equipment as well as large sidestream booster packages that include the separator, pump, purge equipment and controls all mounted on a single fabricated skid. Some of these systems are designed and operating in applications rated for 250 psi.

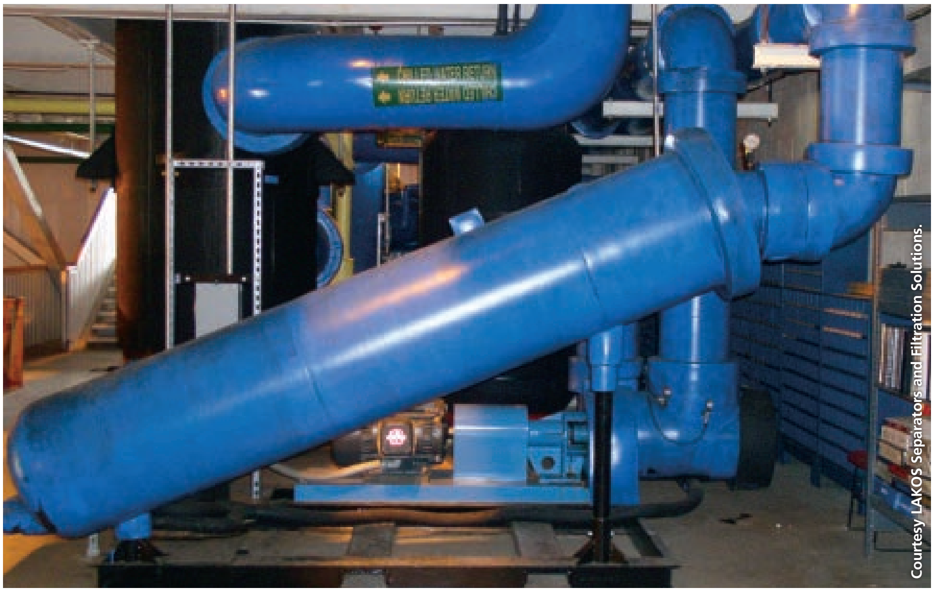
At Citizens Thermal's West Street Plant, as much as 36,000 tons of cooling is generated each day. Water for the system is drawn from reservoirs fed by lakes, streams and other natural water sources. As a result, airborne contaminates such as silt, dirt and other organic materials are constantly being added to the system. A separator rated for 2,000 gpm and a closed recovery system (CRS) to retain the solids collected were installed on this application in 1992. This sidestream package is still in service today. The combination of the separator and CRS allows the continuous purging of solids into 1-micron bags that are changed weekly with almost no water loss to the system. The separator and CRS coupled with good water treatment help protect a bank of eight steam turbine-driven chillers, three electric chillers, and system pumps. The separator has been extremely effective in removing particulates at the West Street Plant that over time would create fouling and decrease output and efficiency.

Another sidestream strategy that has been installed into several Citizens Thermal projects utilizes a sidestream booster package consisting of a separator, pump, pump starter panel and CRS all mounted on a common skid. This system pulls a percentage of flow off of the main system supply pipe, filters it and then returns it back into the same pipe downstream. The solids collected are purged into the CRS bag housing. When the bags are full, the operator simply isolates the bag housing using valves and empties the solids that have been removed by the separator, without any loss of water to the system.

In addition to using separators at its existing facilities, Citizens Thermal also plans to install a filtration package at the new central boiler and chiller plant that the company will build, own and operate adjacent to the new Wishard Hospital complex in Indianapolis. The hospital is due to

Courtesy LAKOS Separators and Filtration Solutions.

At Citizens Thermal's West Street Plant, the LAKOS RTS-1209B separator and CRS-836 closed recovery vessel have been providing filtration since 1992.



Courtesy LAKOS Separators and Filtration Solutions.

This LAKOS TBX-3100-SRV sidestream separator booster package, rated for 2,000 gpm, is one of several in use at various facilities.

open in 2014. The filtration solution for this system is designed for 250 psi with an ASME-stamped separator installed in a traditional sidestream application.

Citizens Thermal illustrates how filtration can be used to help maintain peak system efficiency in today's modern district energy systems. The design of filtration solutions for any individual application must also include the ability to deliver savings in as many areas as possible, including energy and water usage, maintenance, water treatment and equipment life in general. Filtration strategies should always be considered for all open- and closed-loop system applications, regardless of size. Filtration is no longer an option that can be value-engineered out of a plant design; it has become a key component in helping district energy systems achieve maximum efficiency and performance today and into the future.

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Meet the New Chair:

IDEA congratulates Vincent Badali

Editor's Note: *Vincent Badali was elected IDEA chair at the annual meeting held at the 102nd Annual Conference and Trade Show in June 2011. His 33-year career in the district energy industry has included management positions with Trigen Energy, Johnson Controls and Consolidated Edison, where his most recent position was section manager of the Steam Operations' Business Development Group. In May, he assumed a new position as director, business development & engineering at Veolia Energy North America. Badali graduated from New York Polytechnic Institute with bachelors and master of science degrees in civil engineering.*

Q Tell us a bit about your new role with Veolia.

Vincent Badali Veolia Energy's district energy network serves about 275 customers in Philadelphia's central business district and University City from three steam production facilities and one chilled water facility. I will be working with the business development and distribution engineering teams to continue expanding our customer base in the downtown area.

Q Veolia is one of the largest providers of energy and environmental services in the world. Can you briefly describe the scope of the company's operations?

VB: Veolia Environnement (VE) develops and markets solutions designed to contribute to sustainable development. VE is divided into four divisions: Water, Environmental Services, Energy and Transportation. Veolia's goals include utilizing water and energy resources rationally, recovering everything that can be recycled from collected waste, cutting greenhouse gas emissions, and developing attractive, energy-efficient and space-saving mass transit systems.

Veolia Energy is a major owner, operator and developer of CHP plants, with about 5,000 MW around the world, and 260 MW in the U.S. We view CHP as an important solution for optimizing energy efficiency and reducing the carbon footprints of the cities in which we operate. Our district energy networks, several of which currently include CHP, serve commercial, residential, healthcare, hotel, educational, industrial and government customers in 14 cities. Steam, hot water and chilled water production and distribution are provided by almost 700 employees.

Q Mergers and acquisitions have become more common in recent years. What does this trend mean for the future of the district energy industry?

VB: Over the past 25 years, we have seen many of the investor-owned downtown utilities focus on their electric and natural gas services. This trend has presented opportunities for district energy companies to expand into multiple areas. I see this as a good sign for district energy. Interested companies can concentrate on district energy as their core business.

Q In your most recent role at Con Edison, you were responsible for its steam business development. What are the particular challenges of attracting new customers in such a mature urban market?

VB: I believe the economic downturn brought many of the same challenges to most energy providers. The Con Edison steam business is faced with several additional challenges, as well as opportunities. As part of PlaNYC, the city is moving toward eliminating No. 4 and No. 6 fuel oil, presenting opportunities for both Con Edison gas and steam businesses. At the same time, the company provides three commodities – natural gas, electricity and steam – and is working toward a more strategic customer service approach.

In years past, steam-cooling incentives from New York State helped improve the steam system load factor, as our summer load was significant. These incentives were eventually eliminated, as the state shifted its focus from peak reduction to energy efficiency. Con Edison Steam Operations has been working toward reducing costs by maximizing steam production at its most efficient plants. Also, the Steam Peak Reduction Collaborative identified various measures to optimize the steam system and Con Edison is working to put in place pilot programs to assess their value to customers.

Q The district energy industry is undergoing a major generational shift as our most experienced operators and engineers near retirement. How can we encourage talented young people to pursue a career in the district energy field?

VB: I believe there are people of all ages who are not at all familiar with district energy. We need to establish more of an IDEA presence at the various student chapters of engineering societies and invite students to our conferences and workshops. In 2009, IDEA took an important step by creating the John Gray Scholarship, which supports talented individuals pursuing a career in the district energy field.

Q What is your greatest source of professional accomplishment?

VB: After a catastrophic event at Gramercy Park, we embarked on a ten-year enhancement program at Con Edison. This process involved the rewriting of procedures, the selection of optimal equipment, and the design review of 100 miles of piping to determine the required enhancements. The lessons learned through this process, and the new procedures that were implemented, gave me a sense of accomplishment and helped position Con Edison for enhanced safety and reliability in the future.

Q What piece of advice would you like to share with people who are new to the district energy and combined heat and power industries?

VB: My best advice is for newcomers to recognize that all district networks should include CHP because it is a great solution for optimizing energy efficiency. I would also advise people to get to know their peers, regardless of whether they are as new as you or industry veterans. You may be surprised at how easily they will share information. You will hear this message consistently from IDEA members.

Q What do you think is the most valuable aspect of IDEA membership?

VB: IDEA conferences and seminars provide a wealth of valuable content for people in all sectors of our industry. While you may occasionally return home from an IDEA conference with all the answers to your problems, you will always take home contact information for several new colleagues. I haven't stopped adding to my list and I've been at this for more than 30 years.

Q What's the most valuable piece of advice you've ever received from a fellow IDEA member?

VB: Take enough time to digest information to avoid making important decisions prematurely. A member once told me that one Friday many years ago he felt the need to fire an employee. Over the course of the weekend, he took some time to do a more thorough investigation. That employee was reinstated the following Monday, and ultimately progressed beyond all reasonable expectations. I think we can all learn from this lesson.

Q When you're not on the job, how do you like to spend your time?

VB: In 2007, when the last of our children was off to college and my youth hockey volunteer days came to an end, I found myself with some extra time. I accepted a job in New York City that increased my commute from 10 to 25 hours per week. Needless to say, now that I've returned to work in Philly, I will have some time to look for some new – or resurrect some old – hobbies. I hope to dust off the golf clubs that have taken the last four years off.

Vin Badali welcomed participants to IDEA's 24th Annual Campus Energy Conference, held in Miami in February 2011.

District Energy/CHP 2011

IDEA teams with the Canadian District Energy Association to jointly advance the common interests of the district energy industry

This Joint Annual Conference brought together the 102nd Annual Conference & Trade Show of the International District Energy Association and the 16th Annual Conference of the Canadian District Energy Association, June 26 through 29 in Toronto, Ontario, Canada at the Westin Harbour Castle Hotel and Convention Centre. The conference showcased highly efficient clean district energy technologies deployed on an urban scale. Our conference host and general chair, Dennis Fotinos of Enwave Energy Corp., owner-operator of one of the largest district heating and cooling systems in North America, provided gracious hospitality and outstanding support throughout the conference. In addition, our counterparts at the Canadian District Energy Association – including President Mary Ellen Richardson and Chair Bruce Ander – made all feel at home.

Pre-conference Workshops

Two Sunday workshops set the stage for professional give-and-take. The first, "Update on LEED® Guidelines for District Thermal Energy," was moderated by Tim Griffin of RMF Engineering and focused specifically on the revised LEED Guidelines for Buildings Served by District Thermal Energy and also explored variances between Canadian and U.S. Green Building Council programs.

The second workshop consisted of a Business Development Forum and Utility Roundtable featuring discussion of the IDEA Life Cycle Value Analysis, moderated by Steve Tredinnick, Syska Hennessy, and Jack Kattner, Kattner Associates. Discussion revolved around a standardized approach to comparing the overall owning and operating costs of a building served by district heating and cooling versus stand-alone in-building equipment on a life-cycle basis, which will be presented for inclusion in the ASHRAE Handbook. (For a related story, see "Inside Insights" on page 66 of this issue). Utility leaders and managers also discussed industry issues related to developing, owning and operating a downtown district energy system in a competitive urban energy market.

Sunday's activities were capped by IDEA's Annual Welcome Dinner Cruise, which took place place in ideal weather conditions aboard the beautiful *Captain Flinders.*

Global Venue Raises the Bar

This conference provided a global venue for industry thought leaders to come together to share emerging trends and compare policy advances from across Europe, Asia and North America. From technology solutions and community energy planning techniques to financing strategies and operational best practices, the conference offered a technical program covering a wide range of topics organized by Conference Technical Co-chairs Richard Damecour of FVB Energy and Johnathan Coleman of JA Coleman LLC, along with Laxmi Rao of IDEA.

What has set IDEA's annual conferences apart since 1909 is the collegial peer exchange and open access to friendly, expert colleagues who are moving the industry forward, solving technical challenges and willingly sharing their experiences. This year fit that description perfectly while setting new standards of robust content and attendance. Over 800 delegates from 13 countries represented a diverse spectrum of system owners and operators, manufacturers and suppliers, consultants, attorneys, government officials and students.

The event offered nearly 100 presentations, including a triple technical track, a rich poster session, two workshops and a world-class debate on energy and climate streamed over the Internet. Assembling all of this expertise in one location provided tremendous value with easy access to resources. We also held our largest trade show ever, with 120 booths and over 100 organizations represented. During the receptions, the trade show floor hummed with productive conversations.

Engaged communication was the hallmark of each activity, from the Opening Reception with exhibitors through the Workshops, International Panels, Technical Sessions, Keynote Luncheon, Debate, Awards Luncheon, Chairman's Banquet and Forum meetings. The event concluded on Wednesday with tours of district energy systems in the Greater Toronto Area, including Enwave, Markham District Energy, Corix Utilities at Regent Park Community Energy System, and Hamilton Community Energy. Throughout the event, attendees were engaged in IDEA-style peer-to-peer communications in the technical sessions, poster exhibit, trade show receptions, hallways, and the festive lunches and dinners.

Note to readers: Proceedings from workshops, technical sessions and poster sessions are posted on the IDEA Web site.

Global, National, Local Perspectives on District Energy

Monday's kickoff session, "Global Policy Drivers for District Energy," moderated by IDEA President Rob Thornton, provided an overview of policies driving district energy development across the EU. Presentations by Jayen Veerapen, International Energy Agency; Birger Lauersen, president, Euroheat & Power; Werner Lutsch, CEO, AGFW; and Simon Woodward, CEO, UKDEA all featured the critical importance of heat planning and energy efficiency in achieving near-term carbon reductions and energy security.

The next session, "North American Policy Drivers for District Energy/CHP," moderated by CDEA President Mary Ellen Richardson, focused on factors affecting district energy/CHP development in Canada and the U.S. Presentations by Geoff Munro, Natural Resources Canada (NRCan); Matt Clouse, U.S. Environmental Protection Agency; Colin Andersen, Ontario Power Authority; Mark Spurr, IDEA; and Paul Wieringa, British Columbia Ministry of Energy, Mines and Petroleum Resources called out effective clean energy strategies and policy drivers for CHP and district energy.

The third panel, moderated by Rob Thornton, "Local Drivers – District Energy: Essential Infrastructure for Energy-Efficient Communities" specifically focused on the integration and optimization of district energy as essential infrastructure for a sustainable energy economy in a major urban center. Panelists included Werner Lutsch, AGFW, Berlin; Jan Elleriis, CTR, Copenhagen; Fayad Khatib, Qatar Cool, Doha, Qatar; Simon Woodward, UKDEA, London; Dennis Fotinos, Enwave Energy Corp., Toronto; and Stan Gent, Seattle Steam, Seattle.

The importance of effective financing strategies on system development was addressed in a panel on "Financing District Energy Development: Challenges and Opportunities," moderated by Linda Bertoldi, Borden Ladner Gervais. Panelists included Tom Guglielmi, NRG Thermal LLC; Onno Kremers, Federation of Canadian Municipalities; Rob Mackay, PPP Canada; Steven Zucchet, OMERS; and Jason Salgo, Veolia Energy NA.

Conference General Chair Dennis Fotinos welcomes attendees at the opening plenary session.

A panel of distinguished experts from the U.S. and Canada address financing strategies for district energy systems.

Luncheon Keynote Address and Debate

The keynote, "Tackling Climate Change Smarter with Economic Rationality" was presented by Dr. Bjorn Lomborg, adjunct professor, Copenhagen Business School, director of Copenhagen Consensus Institute and author of "The Skeptical Environmentalist" and "Cool It." In his address, Lomborg acknowledged that climate change is real, largely man-made and a significant global problem that merits rational economic treatment of conditions and not just symptoms. A book-signing followed in the Exhibition Hall. The "main event" that followed was a debate on energy efficiency and mitigating climate change featuring Lomborg, Thomas R. Casten and Dr. Tom Rand.

Casten is chairman of Recycled Energy Development and founder of two publicly traded companies, Trigen Energy Corp. and Primary Energy Recycling Corp. A former chairman of IDEA, he is author of the book "Turning Off the Heat" and has been featured in the *New York Times*, *Forbes*, National Public Radio, *Nature*, *The Atlantic*, and *The New Republic*, among others.

Rand is cleantech advisor at MaRS Discovery District in downtown Toronto, founder and director of VCi Green Funds, sits on the board of directors of Morgan Solar and is author of "Kick the Fossil Fuel Habit: 10 Clean Energy Technologies to Save Our World." The debate, moderated by Rob Thornton, was structured around the premise that energy efficiency is the lowest hanging fruit, our electricity generation system is overly ripe for renewal, and thermal energy is the forgotten fruit in the policy mix. The debate was streamed live over the Internet; a video recording of the debate is posted on the IDEA website.

Opening Early

Before the Technical Sessions began on Tuesday morning, members of IDEA forums on Business Development, Distribution, District Cooling, Operations, Sustainability and Government Relations gathered to discuss issues of interest. For more on IDEA's forums, visit www.districtenergy.org/idea-forums-2 or contact Len Phillips, len.idea@districtenergy.org.

Annual Business Meeting

The 102nd IDEA Annual Business Meeting was called to order, with the following events noted during 2010:

- Added 138 new members
- Filed bi-partisan TREEA Legislation that was co-sponsored in Senate and House with over 200 organizations signing on as supporters
- Secured DOE contract to support RACs for District Energy/CHP/Waste Energy
- Advocated successfully on LEED District Energy Guidelines, EPA GHG Reporting and Boiler MACT
- Issued Clean Energy Standard White Paper
- Conference participation has grown dramatically, with IDEA selling every available booth space for past five years

The business meeting concluded with a keynote address by Tom Casten urging members to engage in the ongoing debate for energy efficiency.

Changing of the Guard

The following members were nominated and elected to serve three-year terms on the IDEA board of directors:

- Bruce Ander, Markham District Energy, Inc.
- Scott Clark, Burns & McDonnell
- Lynn Crawford, Jacobs Engineering
- Robert Manning, Harvard University
- Aurel Selezeanu, Duke University
- Jonathan Spreeman, Trane

In addition, Larry Plitch of Veolia Energy NA was elected to serve a one-year term, finishing out the term of Stewart Wood of Veolia, who has been transferred to its Australian office. The slate of officers was refreshed with the following appointments:

- Chair: Vincent Badali, Veolia Energy NA
- Vice Chair: Joseph Brillhart, Johnson Controls, Inc.
- Second Vice Chair: Patti Wilson, Affiliated Engineers
- Secretary/Treasurer: James Adams, Cornell University
- Immediate Past Chair: David Toombs, Citizens Thermal Energy

Triple-Track Technical Program

Track A consisted of four segments: "Future-Proofing District Energy Systems," "Renewable Energy and Sustainable Solutions," "Policy Drivers" and "Sustainable Strategies for Low-Carbon and Energy-Efficient Communities."

Track B consisted of "Heating Systems," "Combined Heat & Power/Energy Efficiency," "District Cooling" and "IEA Research: Evolving Technologies & Innovations."

Bjorn Lomborg, Tom Rand and Tom Casten engage in a spirited debate over energy efficiency and climate policies.

IDEA members gather at a book-signing event after Monday's keynote luncheon.

Track C included "Sustainable Infrastructure Options," "System Planning, Development and Optimization," "Operations, Compliance and Optimization" and "The Enwave Story: A Multi-Dimensional View."

Posters were presented by 18 authors. Conversations in the Poster area were frequent and animated!

Chairman's Awards – Recognizing Excellence, Honoring Contributions to the Industry

At the Tuesday evening Chairman's Banquet, David Toombs concluded his very successful term as IDEA chair with remarks encouraging members to remain involved in their industry association, to pay close attention to customer needs, and to collaborate and exchange ideas and best practices so that we all stay ahead of the rapidly changing energy industry. David graciously thanked his colleagues at Citizens Thermal and his wife Joan for many years of tremendous support before announcing his plan to retire early next year.

Chair Toombs was pleased to present Chairman's Awards for distinguished service to the district energy industry and IDEA to:

- Mark Vogler, Citizens Thermal; Greg Wells, Rice University; and Robert Manning, Harvard University for their contributions to the highly successful 2011 IDEA Campus Energy Conference and Workshop in Miami;
- Richard Damecour, FVB Energy and Johnathan Coleman, JA Coleman, Inc. for their support of the technical program of the 2011 IDEA Annual Conference in Toronto and with special recognition to Johnathan for two consecutive terms of service on the IDEA Board;
- Dennis Fotinos, Enwave Energy Corp., as Conference General Chair and Host of the 102nd Annual Conference; and
- departing board members Robert Maffei, Permapipe and Stewart Wood, Veolia Energy North America for their service.

Rob Thornton presented Chair's Awards to Fayad Al Khatib, CEO and Mohannad Khader, VP, Qatar Cool, in recognition of their tremendous support of IDEA's Fifth International District Cooling Conference in Doha, Qatar in November 2010.

Rob mentioned that the Unsung Hero Award was to be presented to Tim Griffin of RMF Engineering for his exceptional work with the U.S. Green Buildings Council on updating LEED and District Energy Guidelines, but Tim was called away and unable to attend the Banquet.

A special Chair's Award was presented to Anne Picillo of Custom Made Meetings for her tireless work and many contributions to the success and growth of IDEA conferences over the past three years.

Raymond DuBose, past chair of IDEA and chair of the System of the Year Committee, presented the coveted 2011 IDEA System of the Year Award to Enwave Energy Corp. Dennis Fotinos humbly accepted the award on behalf of the dedicated team at Enwave, making Toronto-based Enwave a two-time winner of the Award. DuBose mentioned that the exceptional quality of the submittal by Enwave for 2011 resulted in the committee's first-ever unanimous first ballot award to a candidate.

The Norm Taylor Award, IDEA's "Person of the Year" Award was presented to Thomas Guglielmi of NRG Thermal LLC for his dedicated service for the past eleven years as secretary/treasurer of IDEA. During that period, IDEA membership grew by 250% and annual revenue by 450% and as an industry volunteer, Tom never missed a single quarterly board of directors meeting. Tom will be succeeded by Jim Adams of Cornell as secretary/treasurer. IDEA thanks Tom and his employer NRG Thermal for more than a decade of exemplary service to the industry.

District Energy Space Awards

Announcing the results of IDEA's District Energy Space reporting has been an Annual Conference tradition since 1990. Data included the number of buildings and their area in square feet that have been committed or recommitted to district energy service in North America and beyond during calendar year 2010. District Energy system growth has been good, despite the challenging global economy. Our members reported that 121 customer buildings in North America totaling 23,333,939 sq ft of building space were committed or recommitted to district energy service during 2010, or were previously unreported. That compares with 95 buildings and 27,440,426 sq ft during 2009, bringing the running total for North America reported since 1990 to 518,461,287 sq ft.

There was also strong system growth reported from beyond North America. An additional 123,850,583 sq ft and 1,009 buildings were reported for 2010. That compares with 102 buildings and 41,113,744 sq ft during 2009. Details are described later in this report.

Joseph C. Hoose, president of Cool Systems Inc., presents a session on retrofitting hydronic steam heat systems.

Chairman David Toombs hands the gavel to IDEA's newly elected Chair, Vincent Badali of Veolia Energy North America, who thanked Dave for his service, recognized the prior award winners and promised a year of continued growth and progress.

Winners:

Congratulations to our award recipients, and thank you to all participants for your vital contributions.

Enwave Energy Corp. employees acknowledge receipt of the IDEA 2011 System of the Year Award.

Jeffrey Perry (Veolia Energy NA) receives multiple DE Space awards.

Ken Smith accepts an award on behalf of District Energy St. Paul.

Saumil Shukla (ConEd) receives multiple awards.

Fayal Al Khatib (Qatar Cool) receives awards.

Vic Koppang (Detroit Thermal) receives award.

Mohannad Khader (Qatar Cool) receives a Chairman's Award.

Tom Guglielmi acknowledges receipt of the Norm Taylor Award.

Greatest Number of Buildings/ North America

- Gold: Veolia Energy North America, Boston System (48 buildings)
- Silver: District Energy St. Paul (12 buildings)
- Bronze: Con Edison Steam Division (10 buildings)

Most Square Feet Added/North America

- Gold: Veolia Energy North America, Boston System (5,711,586 sq ft)
- Silver: Con Edison Steam Operations (4,157,298 sq ft)
- Bronze: Detroit Thermal (2,980,000 sq ft)

Greatest Number of Buildings/Beyond North America

- Gold: Emirates District Cooling (Emicool) (588)
- Silver: Palm District Cooling (367)
- Bronze: Qatar Cool (42)

Most Square Feet Added/Beyond North America

- Gold: Palm District Cooling (101,293,633 sq ft)
- Silver: Emirates District Cooling (Emicool) (9,202,964 sq ft)
- Bronze: Empower (6,864,628 sq ft)

John Gray Scholarship Award Program

Three brilliant young students whose academic work focused on district energy, CHP and waste heat recovery were recognized and received John Gray Scholarship awards. Brad Bradford of York University, Michelle Parks, a recent graduate of the University of Maryland and IDEA's newest staff member, and David Rulff of the University of Waterloo all received awards, demonstrating the bright promise for our industry's future.

Brad Bradford, Michelle Parks and David Rulff

Technical Tours

On Wednesday morning, four chartered coaches took attendees on technical tours to systems operated by Enwave Energy Corp., Regent Park (Corix), Markham District Energy and Hamilton Community Energy. IDEA thanks the system operators for leading these informative sessions in their plants.

Markham District Energy was one of four Toronto-area plants included in the technical tours.

IDEA thanks all panelists, presenters, moderators and participants for high quality technical discussion of industry topics. Proceedings are posted and available for download at www.districtenergy.org/proceedings-102nd-annual-conference/

IDEA Board Members 2011-12

Top row, left to right: Tim Merrill, Jim Adams, Scott Clark, Lynn Crawford, Steve Swinson, Ann McIver, David Musto; middle row: Jeff Zumwalt, Robert Manning, Larry Plitch, Ken Smith, Joel Greene (ex-officio), Bruce Ander, Jonathan Spreeman, Aurel Selezeanu; bottom row: Rob Thornton (ex officio), Dave Toombs, Vin Badali, Joe Brillhart, Patti Wilson. Not pictured: Tim Griffin, Kurt Liebendorfer, Chris Lyons.

Thank You to Our Sponsors

IDEA is grateful for the loyal support of our many sponsors of this conference. Thank you, Sustaining Sponsor: Enwave; Platinum Sponsor: Johnson Controls; Gold Sponsors: Benz Air Engineering, Borden Ladner Gervais, Citizens Thermal, Danish Board of District Heating and Solar Turbines; Silver Sponsors: Carrier, Chem-Aqua, Corix Utilities, EVAPCO, HH Angus, Jacobs, Siemens Energy, Inc. and Thermo Systems; and Bronze Sponsors: Affiliated Engineers, C&C Construction & Trades, and Stanley Consultants. We couldn't do it without you!

And Thanks Also to Our Exhibitors

From the very beginning of IDEA in 1909, our business partner exhibitors have played an integral role in the growth, innovation and reliability of our industry. The Exhibition Hall is a unique gathering of technical and business expertise under one roof and IDEA members greatly appreciate the opportunity to visit with the leading technology solutions in our industry. IDEA members report they are much more likely to purchase services and products from an IDEA member business partner due to confidence in continued involvement in the industry. We want to thank our 118 Exhibitors for making the 102nd Annual Trade Show a sell-out success and contributing to the vitality of the Technical Program!

Exhibitors | Toronto 2011

7-Technologies

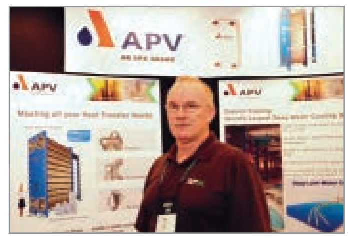
Adams Valves, Inc.

AIC Heat Exchangers

Alfa Laval Inc.

Alstrom Energy Group / ELGE® Shell & Coil

Ameresco Canada



APV, An SPX Brand

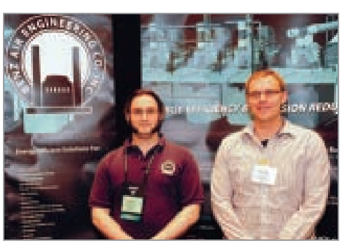
Aquatherm

Aspen Aerogels

Auburn Manufacturing, Inc.

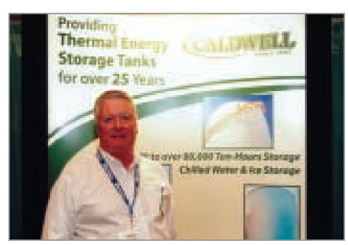
Baltimore Aircoil Company

The BD Company

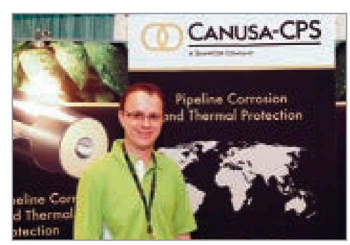


Benz Air Engineering Co., Inc.

Burns & McDonnell



Caldwell

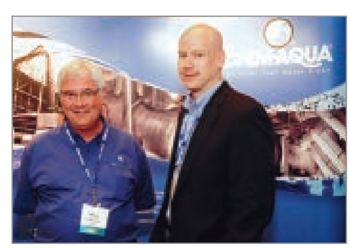


Canusa - CPS

Carrier Corporation

CB&I

CEM Engineering



Chem-Aqua, Inc.

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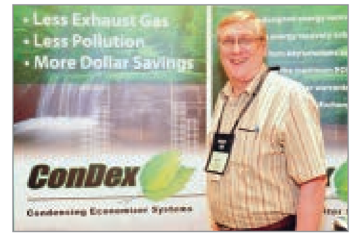
ChemTreat, Inc.

ChillCo, Inc.

Composite Cooling Solutions L.P.



ConDex Energy ---Combustion & Energy Systems Ltd.

Corix Utilities

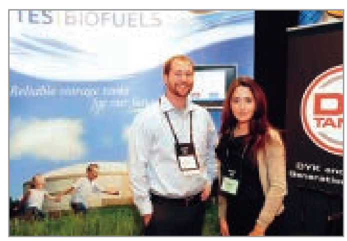
Croft Engineering Services

The Crom Corporation

Dalkia

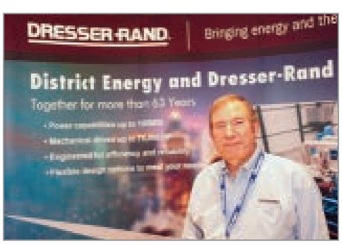
Danish Board of District Heating

DDACE / GE Jenbacher



DN Tanks

Doherty Engineering Inc.



Dresser-Rand

DriTherm International, Inc.

Elliott Group


Emerson Process Management

Enwave Energy Corporation

European Power Systems Ltd.

EVAPCO

Fellon-McCord

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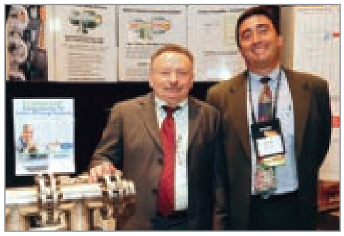
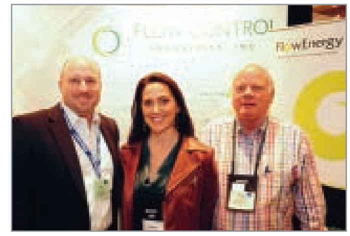
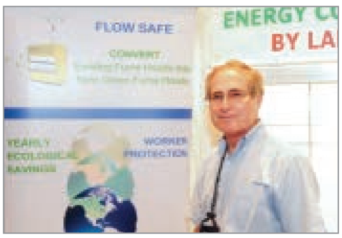
Fibrelite Composites Ltd


Fisonic / Cool Systems

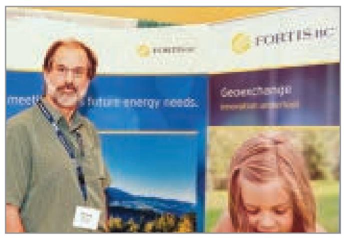

Flexim Americas Corporation



Flow Control Industries, Inc.



Flow Safe Inc.



Fortis BC

FVB Energy, Inc.

GE Measurement
& Control Solutions

GE Power & Water


Gilsulate International, Inc.

Glasscell Isofab

Golder Associates

Grundfos Canada Inc.

Gryphon International
Engineering Services Inc.

H.H. Angus & Associates Ltd.

Haldor Topsoe SCR Group

ICETEC Energy Services

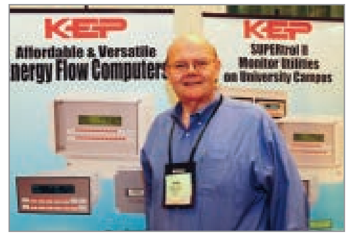
Indeck Power Equipment Co.

Industrial Resources, Inc.

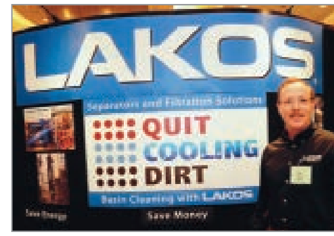
Insul-Tek

Johnson Controls, Inc.

Kawasaki Gas Turbines - Americas



Kessler Ellis Products

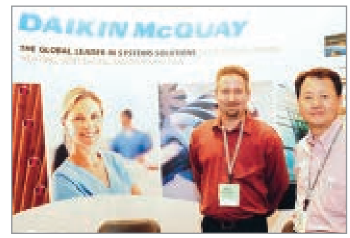


LAKOS Separators and Filtration Solutions

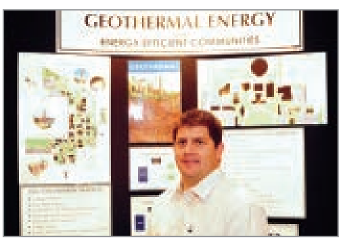

Landis + Gyr

Le Groupe Simoneau

McCrometer



McQuay International



MEP Associates, LLC

Miura North America, Inc.

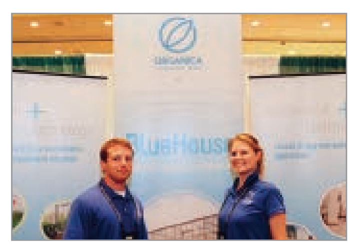
Nalco Company

Nationwide Boiler Inc.

Nexterra Systems Corp.

ONICON Incorporated

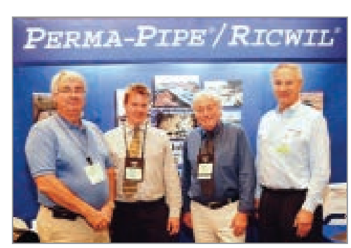

Optimum Energy


Organica Water

OSIsoft, LLC

PanGlobal Training Systems

Parsons Brinckerhoff



Perma-Pipe, Inc.

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Piping and Corrosion Specialties, Inc.

Pittsburgh Corning Corp.-Foamglas

Pure Line Treatment Systems

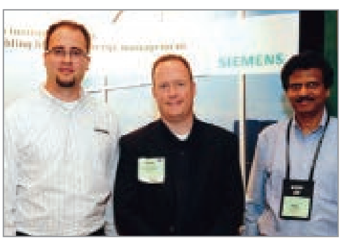
Regulvar Inc.

Rentech Boilers Systems, Inc.

Robert B. Somerville Co. Limited

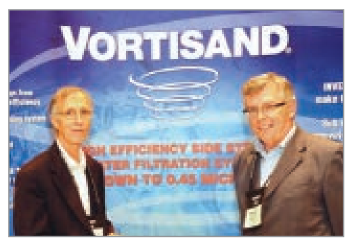
Rovanco Piping Systems

Sega Inc.



Siemens Industry Inc.

Solar Turbines Incorporated



Sonitec-Vortisand Inc.

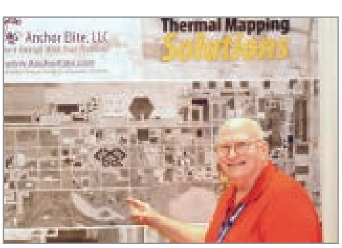
Soteica Ideas & Technology LLC

Spence Engineering Company, Inc.

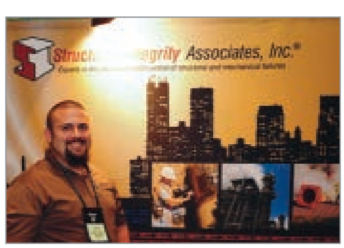
Spirax Sarco

Stantec

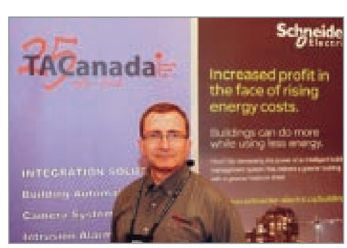
Statistics & Control, Inc.



Stockton Infrared Thermographic Services, Inc.



Structural Integrity Associates



TACanada (Thermo Automation Canada Ltd.)

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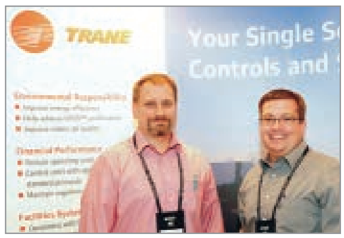


Trane

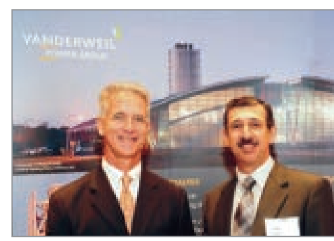
Tricon Piping Systems, Inc.

U.S. Water Services

Uponor, Inc.

Urecon Ltd.

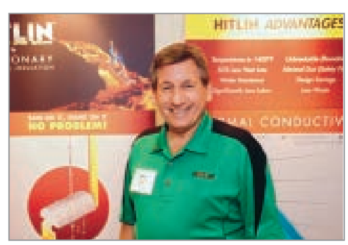
utiliVisor



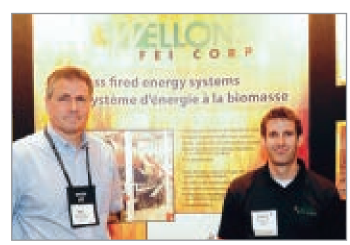
Vanderweil

Velan

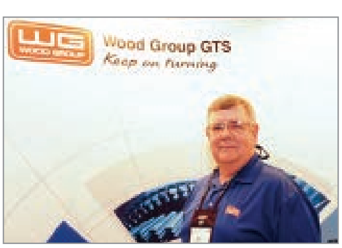
Veris, Inc.



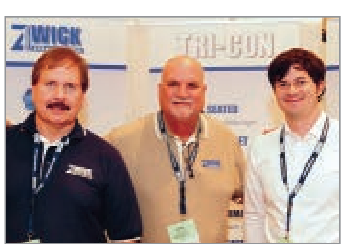
Visionary Industrial Insulation



Wellons FEI Corporation



Wood Group GTS



Zwick Valves N.A.

See you next year at District Energy/CHP 2012 in Chicago, June 30-July 3, 2012!

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NRG Uses Sun to Cool Phoenix Light Rail Riders

NRG Thermal LLC has built an innovative system that uses solar power and its downtown Phoenix, Ariz., district cooling system to provide cooling to the seating areas of the city's popular 3rd Street/Washington METRO light rail station. Ready in time for the Major League Baseball All-Star game held in Phoenix in July, the system will operate May through September annually, when summer temperatures often exceed 110 degrees F.

3rd Street/Washington light rail station

Phoenix Mayor Phil Gordon had experienced a similar system during a business trip to Dubai and brought the idea back home. "NRG took the ball and ran with it, investing its money and expertise to make this happen," he said. The project is the first use of solar energy on the Phoenix light rail system, and METRO Chief Executive Officer Steve Banta said he was hopeful it can lead to other solar opportunities along the line in the future.

NRG will cover the entire cost of building, operating and maintaining this new solar-powered system, which means no additional costs to local residents and commuters. The project will also include an educational exhibit showcasing the technology and how it works.

NRG owns and operates NRG Energy Center Phoenix, which provides district cooling for 34 major buildings in downtown Phoenix. NRG also owns and operates distributed solar systems in Arizona at several schools, which help reduce the schools' utility bills and provide shade for on-campus parking lots. NRG is in the process of building 12 large solar pavilions at schools in four districts across the state as the first stage of the program. The company also provides large-scale solar solutions in Arizona, as it is developing a 25 MW solar photovoltaic (PV) project in Pima County and the 290 MW Aqua Caliente PV project in Yuma County.

Commerce Official Addresses USCHPA

Assistant Secretary of Commerce for Manufacturing and Services Nicole Y. Lamb-Hale spoke at the U.S. Clean Heat and Power Association (USCHPA) Spring Forum May 3, highlighting the important role that combined heat and power plays in the U.S. economy and the need for more efficient forms of energy generation.

"From heating homes more efficiently to running our factories with fewer emissions, combined heat and power makes sense both environmentally and economically," she said. Lamb-Hale reiterated the importance of international commerce to promote clean energy technologies, energy efficiency and combat climate change.

"The United States is not alone in its desire to promote renewables and energy efficiency. We must work with our many trading partners, removing barriers and encouraging the free and fair exchange of goods and services," she noted.

Lamb-Hale highlighted President Obama's National Export Initiative and the Renewable Energy and Energy Efficiency Export Initiative. The Department of Commerce advances these two programs to support U.S. exporters and renewable energy and energy efficiency companies. The Renewable Energy and Energy Efficiency Export Initiative will better tailor U.S. government financing products to the specific needs of the renewable energy and energy efficiency sector.

In his 2010 State of the Union speech, President Obama announced the National Export Initiative with a goal of doubling U.S. exports by 2015.

Domtar, We Energies Partner on Wisconsin Plant

Pulp and paper producer Domtar Corp. announced in June that its board of directors had authorized the signing by wholly owned subsidiary Domtar Paper Co. LLC of the revised project agreements with Wisconsin Electric Power Co. (We Energies) to participate in a project that will see We Energies construct a biomass-fueled power plant at Domtar's Rothschild, Wis., paper mill site.

Wood, waste wood and sawdust will be used to produce 50 MW of green electricity for the grid and to support Domtar's papermaking operations in Rothschild under a steam supply agreement. The project is expected to create approximately 400 construction jobs and 150 permanent jobs in the surrounding community, including jobs for independent wood suppliers and haulers. The project will result in a highly efficient use of biomass resources and the Domtar mill's infrastructure while allowing Domtar to retire less efficient boilers, virtually eliminating its use of fossil fuels at the mill. Construction is expected to take 30 months for a startup by the end of third quarter 2013.

The revised project agreements have been agreed to by the parties and reflect the order points contained in the Certificate of Authority issued May 12 by the Wisconsin Public Service Commission (PSC). Under the timeline set out by the PSC, We Energies must submit a compliance filing within a 45-day period from the date of the Certificate of Authority, indicating that the order points have been addressed.

Domtar Corp. is approximately 75 percent energy self-sufficient across its North American manufacturing footprint of 13 pulp and paper mills. The average Domtar pulp and paper facility draws approximately 87 percent of its thermal energy (energy required to make steam) from renewable fuels such as biomass and spent cooking liquor (separated in the sulfate pulp process).

Jingoli-DCO Energy Moves Up on Top Contractors List

For the ninth straight year, Jingoli-DCO Energy has made the Top 400 Contractors list published by *Engineering News-Record* (ENR). This year, the company received its highest ranking to date: 115th place. Published annually in May, the list ranks the 400 general contractors, both publicly and privately held, based on construction contracting-specific revenue. In addition, Jingoli-DCO Energy ranked highly in a number of ENR's additional market sector categories: 14th place in the Top 20 Power, 19th place in Top 20 Telecommunications and 85th place in Top 100 Contractors by New Contracts.

Sierra Debuts Next-Generation Ultrasonic Flow Meter

Sierra Instruments has introduced the next-generation Innova-Sonic® 210i, the company's updated universal transit-time flow meter for liquid flow measurement applications. The Innova-Sonic 210i features a high-powered ultrasonic pulse with improved digital signal processing, enabling the unit to use just one set of transducers over a wide range of pipe sizes. The 210i also includes a new user-friendly tactile pushbutton interface with a large digital display that significantly simplifies setup and data collection.

The unit comes with a fully field-configurable 4-20 mA current loop analog output, 2 GB SD memory card for data logging and a suite of programming menus that simplify data analysis. Complex totalization functions are standard, including parallel operation of positive, negative and net flow totalizers. The Innova-Sonic portable features an accuracy of +/-1.0 percent of reading, a wide operating temperature range (minus 40 degrees F to 176 F) and a bidirectional flow range of 0 to 40 f/s liquids. The flow meter can be used for a wide range of pipe sizes from 1.0-48 inches. For more information, see www.sierrainstruments.com/innovasonic210i.

Sierra Innova-Sonic® 210i

Pennsylvania School District to Get Biomass System

Pennsylvania's Sullivan County School District is installing a new biomass district energy system that will supply heating and hot water for its elementary school, high school and new administrative offices in Laporte. Ground was broken for the new biomass plant June 8. The project will replace 85 percent of the fuel oil used at the school complex and reduce the district's annual heating cost by $115,000.

The state-of-the-art plant will generate hot water from locally sourced woody biomass. Pennsylvania-based AFS Energy Systems is the biomass system manufacturer. The project is part of the state's Fuels for Schools and Beyond program, made possible by financial support from the Pennsylvania Energy Development Authority – Pennsylvania Department of Environmental Protection (with American Recovery and Reinvestment Act funding) and a number of other federal, regional and state agencies.

IEA: Heat Represents 47 Percent of Energy Consumption

The supply of heat is largely ignored in the energy and climate change debate, even though heat represents nearly half the world's final energy consumption, according to a new report by the International Energy Agency (IEA). The report, *Co-generation and Renewables: Solutions for a low-carbon energy future*, states that heat represents 47 percent of energy consumption, compared with 17 percent for electricity, 27 percent for transportation and 9 percent for nonenergy use (which covers fuels used as raw materials in different sectors, such as oil used to make plastics). Oil, coal and gas account for more than two-thirds of the fuels used in meeting this significant demand for heat.

The IEA report recognizes the role combined heat and power and district energy can play in resolving energy and climate change issues. The authors state that while electricity supply is a crucial aspect of the energy debate, decision makers increasingly realize that heat supply is a sizable part of the energy system; and if the system is to be decarbonized, changing the heat supply also needs to be considered. "Both cogeneration and renewables are technologies that are relevant to heat supply," they write.

The full report can be found at http://tinyurl.com/3k26ax8.

Opcon Subsidiaries Win Major Contracts

Two subsidiaries of Swedish energy and environmental technology company Opcon have recently signed major contracts. Opcon Bioenergy has finalized an agreement with Falbygden Energi AB for delivery of a new bioenergy-powered combined heat and power plant to Marjarp, Falköping, Sweden. Falbygden Energi is a subsidiary of Göteborg Energi, the leading energy company in western Sweden. To be completed in 2012, the CHP plant has capacities of 12 MW thermal and 2.4 MW electric. The contract is expected to be worth around 80 million Swedish crowns ($12.7 million), making it the largest order ever for Opcon Bioenergy.

Opcon subsidiary Saxlund International Ltd. has been awarded a major order for Land Energy Ltd., a leading U.K. wood pellet producer. The contract is for the design, installation and commissioning of a biomass-fired furnace with thermal oil heater for Land Energy's new wood pellet production and CHP facility near Girvan in Scotland. This is the first major order in the U.K. for a Saxlund bioenergy power plant designed to make wood fuel pellets for sale and electricity via an organic

Rankine cycle system. Land Energy's onsite biomass CHP plant rated at 12.5 MW thermal will supply process heat and electricity to the new wood pellet factory. This will supply enough wood pellets for the equivalent of up to 15,000 homes with sufficient energy for all their heating and hot water requirements.

Imtech to Supply U.K. Waste-to-Energy Plant

German group MVV Energie AG has awarded European technical services provider Imtech NV a 30 million euro ($43.06 million) contract to provide sustainable technology solutions for a waste-to-energy plant to be built in Plymouth, U.K. The plant, which will generate both heat and electricity, will be built on behalf of MVV O&M, a subsidiary of MVV Umwelt in Mannheim, which forms part of MVV Energie AG. Some 245,000 tonnes of domestic waste collected from 650,000 homes in and around Plymouth will be used to produce 23 MW of thermal capacity and up to 22.5 MW of electricity. A large portion of this energy will be used by the nearby Royal Navy base in Plymouth.

Imtech Deutschland (Germany) is supplying a steam-turbine generator with a special air-cooled condenser. The German Imtech division is also responsible for the overall provision of water and steam, the innovative heat extraction technique and the handling of water and condensate. Imtech UK has assisted with the tender procedures and the health and safety regulations. Imtech will start work on the plant in spring 2012; it is expected to be operational in 2014.

Termoindustriale to Distribute SkyFuel Parabolic Troughs

Parabolic trough maker SkyFuel has reached an agreement with Italian power engineering, procurement and construction firm Termoindustriale for distribution of its SkyTrough concentrating solar collector in Italy. The agreement covers systems up to around 50 MW thermal. SkyFuel will provide the solar collectors and technical advice, and Termoindustriale will provide turnkey energy systems to its customers. Termoindustriale will focus on smaller concentrated solar power systems using organic Rankine cycle or traditional Rankine cycle engines with steam turbines for electricity generation.

The construction of solar thermodynamic plants is supported in Italy through a feed-in premium for 25 years, administered by Gestore dei Servizi Energetici, SpA, a private company owned by the Italian Ministry of Economy and Finance.

IPCC: Renewable Energy Can Exceed Global Demand

Close to 80 percent of the world's energy supply could be met by renewables by midcentury, if backed by the right enabling public policies, a new report shows. The findings, from more than 120 researchers working with the Intergovernmental Panel on Climate Change (IPCC), also indicate that the rising penetration of renewable energies could lead to cumulative greenhouse gas savings equivalent to 220 to 560 gigatonnes of carbon dioxide between 2010 and 2050.

The upper end of the scenarios assessed, representing a cut of around a third in greenhouse gas emissions from business-as-usual projections, could assist in keeping concentrations of greenhouse gases at 450 ppm. This could contribute toward a goal of holding the increase in global temperature below 2 degrees C – an aim recognized in the U.N. Climate Convention's Cancun Agreements.

These findings are contained in the *Special Report on Renewable Energy Sources and Climate Change Mitigation* compiled for IPCC's Working Group III. The report considers the potential contribution from biomass, geothermal, hydro, ocean, solar and wind energy, as well as the policies needed to put them in place. For more information, visit www.ipcc.ch.

Nexterra Secures $17.5 Million to Accelerate Growth

Nexterra Systems Corp. has secured CA$2.5 million ($2.6 million) in equity financing from the Business Development Bank of Canada (BDC). Coupled with a recent investment of CA$15 million ($15.6 million) from Tandem Expansion Fund and ARC Financial, Nexterra has secured a total of CA$17.5 million ($18.2 million) in 2011 to further its biomass energy system business.

"We believe that the market for onsite biomass heat and power systems is poised to grow significantly in the next few years to meet the rising demand for greenhouse gas reductions, energy security and overall energy cost certainty," said Tony Van Bommel, partner, BDC Energy/Clean Technologies Venture Fund.

One of the Nexterra's upcoming projects is the installation of a biomass gasification system at the University of Montana (UM) in Missoula. The system, which will be installed at a total cost of $16 million, will provide heat to campus buildings. The Nexterra system will convert locally sourced wood residues into 34,000 lb/hr of steam, which will displace 70 percent of UM's natural gas consumption and deliver upwards of $1 million in annual energy savings. The project will be delivered in conjunction with McKinstry Essention Ltd., a Seattle-based energy services contracting company. Nexterra will supply the gasification system. McKinstry will install the system and provide the balance of plant.

Veolia Energy Recognized by LADWP

Veolia Energy North America was recognized by the Los Angeles Department of Water & Power (LADWP) for the efficiency gains associated with installation of a new Trane duplex chiller at Veolia Energy's Bunker Hill central plant. The new chiller complements two other existing Trane duplex chillers at the facility, all with 2,500-ton capacities. A LADWP representative awarded a rebate check to Veolia Energy executives during a June 3 ceremony and tour at the Bunker Hill plant.

Veolia Energy's district energy network supplies chilled water for cooling to 20 commercial office buildings in downtown Los Angeles and Century City, representing nearly 12 million sq ft of space. The company acquired the Los Angeles network in late 2007 and determined that the three rotating engine-driven chillers in place were not sufficiently energy efficient. After assessing its options and searching for new technology, Veolia Energy found the Trane HVAC equipment to be the best fit, and then identified that the company qualified for an efficiency rebate from the LADWP for making this investment. The upgrades to the duplex chillers began in June 2009 and were completed in December 2010.

CDEA Applauds B.C. Investment in Burnaby Mountain System

Bruce Ander, chair of the Canadian District Energy Association (CDEA) added his congratulations to Simon Fraser University (SFU) and SFU Community Trust – developers of UniverCity, a sustainable community being built on Burnaby Mountain in British Columbia – following the announcement that SFU, the Trust, Corix Utilities and the province of British Columbia will be partnering on development of a community district energy system. The primary feedstock for the project will be biomass in the form of recycled wood waste.

Ander noted that the province will provide CA$4.7 million ($4.88 million) of the CA$39 million ($40.5 million) capital cost through B.C.'s Public Sector Energy Conservation Agreement, with SFU agreeing to purchase energy from Corix at a rate set by the B.C. Utility Commission.

CDEA President Mary Ellen Richardson added that the system will enable SFU to reduce its greenhouse gas emissions by more than 80 percent, allowing the university to avoid penalties imposed on public bodies by the B.C. government of approximately CA$1 million ($1.04 million) a year. "Timing is everything," she said. "By making this investment now at a time when its aging natural gas boilers are reaching the end of their useful life, SFU and new developments at UniverCity are gaining a high-efficiency heating plant, which is consistent with the 'sustainable urbanism' principles espoused by award-winning UniverCity."

European Commission Proposes New Energy Efficiency Directive

On June 22, the European Commission proposed a new Energy Efficiency Directive calling for member states to use energy more efficiently at all stages of the energy chain – from the transformation of energy and its distribution to its final consumption. The goal is to help the European Union reach its target of cutting energy consumption by 20 percent by 2020. The EU is currently on track for energy savings of 9 percent with all the EU and national measures in place so far.

Key elements of the proposal include the following:

- Legally required energy-saving systems – Energy distributors or retail energy sales companies will be obliged to save 1.5 percent of their energy sales, by volume, annually through implementing energy efficiency measures such as improving their heating system efficiency, installing double-glazed windows or insulating roofs, among final energy customers. Alternatively, member states can propose other energy-savings mechanisms, e.g., funding programs or voluntary agreements that lead to the same results.
- Public-sector leadership – Public bodies will push for the market uptake of energy-efficient products and services through a legal obligation to purchase energy-efficient buildings, products and services. They will further have to progressively reduce the energy consumed on their own premises by carrying out every year the required renovation works covering at least 3 percent of their total floor area.
- Major energy savings for consumers – Easy, free-of-charge access to data on real-time and historical energy consumption through more accurate individual metering will now empower consumers to better manage their energy consumption. Billing should be based on actual consumption reflecting metering data.
- Industry incentives – Incentives for small and medium enterprises to undergo energy audits and disseminate best practices, while the large companies will have to make an audit of their energy consumption to help them identify the potential for reduced energy consumption.
- Efficiency in energy generation – Monitoring of efficiency levels of new energy generation capacities, establishment of national heat and cooling plans as a basis for sound planning of efficient heating and cooling infrastructures, including recovery of waste heat.
- Energy transmission and distribution – Achieving efficiency gains by ensuring that national energy regulators take energy efficiency criteria into account in their decisions, in particular when approving network tariffs.

ClearEdge Power Receives $2.8 Million to Deploy Fuel Cells

A grocery store, greenhouse, hotel and community college will be among a diverse group of West Coast organizations testing the next generation of fuel cells that produce both electric power and heat while saving energy, thanks to a $2.8 million combined industry and government award announced in June. The award was made by the U.S. Department of Energy's (DOE) Pacific Northwest National Laboratory (PNNL). The federal portion of funding for this award was provided by DOE's Office of Energy Efficiency and Renewable Energy – Fuel Cell Technologies Program.

ClearEdge Power of Hillsboro, Ore., will install its ClearEdge5 combined heat and power fuel cell system at 10 different businesses in California and Oregon, while PNNL will monitor the systems and measure the energy savings the systems are expected to provide.

The ClearEdge5 system is compact – a little larger than a typical home's refrigerator – and is fueled by natural gas from existing conventional pipelines. Inside the fuel cell system, natural gas is chemically broken down into a hydrogen-rich gas that reacts with oxygen in the air to form energy, producing electricity with heat as a byproduct. The electricity produced by the fuel cell is used to power the building.

The excess heat generated by the fuel cell is released into the facility's HVAC system to provide space heating to the building. Alternatively, the energy can be used for hot water or other needs for the facility. Excess electricity produced, but not consumed by the building, is then sold back to a local utility company. While the ClearEdge5 is not currently grid-independent, future systems are being designed to operate during a grid outage, giving companies a continuous power advantage.

Each ClearEdge5 unit will have a high-speed Internet data feed, allowing researchers at PNNL continuous access to analyze each installation's performance. PNNL will independently verify and analyze the engineering, economic and environmental performance and carbon footprint of these systems during the next five years. Then PNNL will provide its analysis in a report to DOE's Fuel Cell Technologies Program.

E.ON Project Stores Heat From Renewable Sources

E.ON has launched a pilot project in Hamburg, Germany, to feed heat from renewable energy sources into the public district heating grid. Homeowners who produce heat with the aid of solar thermal systems can feed it into the grid of E.ON Hanse Wärme. Customers feeding in heat continue to own it, meaning that they can feed in heat in the summer and then withdraw it again in colder months. This enables homeowners to dispense with the need for buying their own storage units for their solar thermal systems as well as the complex control devices required.

"The combination of point-of-use production and central storage will be an essential element of tomorrow's energy supply. With this project E.ON is showing that it is already possible not only to feed renewable power into the grid but also heat," said Dr. Dierk Paskert, member of the E.ON Energie board of management and chairman of the E.ON Hanse supervisory board.

Germany's Federal Ministry of the Environment is contributing to the funding of this project, which costs 7 million euros ($10.1 million). The existing heat storage system of a housing development in the Hamburg district of Bramfeld has a capacity of 4,000 cu m. For the purposes of this pilot project, it has been converted into a multifunction storage system and integrated into the E.ON district heating grid. E.ON is breaking new ground by feeding solar heat into a district heating grid on this scale.

When it was set up almost 15 years ago, the solar storage system was already the first of its kind in Germany. It has been given a stainless steel lining and 20-cm (7.9-inch) thick heat insulation. Integrating the storage facility into the district heating grid makes it possible to store not only solar heat from the estate but also heat produced in other distributed generation units. The multifunction storage system is connected to E.ON's district heating grid in the eastern part of Hamburg. E.ON uses this grid to supply up to 400,000 MWh of heat to its customers every year. This meets the heating requirements of about 50,000 single-family homes.

Jenbacher Engines Installed at French Greenhouse

Since the beginning of the year, two of GE's Jenbacher J624 two-stage turbocharged gas engines have enabled French grower Serres Vinet to generate all of the hot water and electricity required for its extensive tomato and lettuce greenhouse operations in Machecoul, in the Loire-Atlantique region. These are the first two-stage turbocharged gas engines in France, and they are the heart of two cogeneration plants powering Serres Vinet's existing greenhouse operations plus a recent 17-hectare (42-acre) expansion.

The units with GE's 'ecomagination'-approved combined heat and power solution complement a 13 MW wood biomass-fired boiler and a 20 MW gas boiler and give Serres Vinet the flexibility to switch among electrical energy, thermal energy and fuel sources as economics dictate. This allows the grower to generate revenue during the winter months by selling electricity into the public power grid.

Each Jenbacher J624 engine offers around 4.4 MW of electrical output at 44.4 percent efficiency and 4,014 kW of thermal output at 47 percent efficiency. Forclum, GE's customer on this project involved with engineering, procurement and construction, has purchased two additional units from GE for another French grower's greenhouse.

Industry News

Saudi Tabreed Projects Under Way

Saudi Tabreed District Cooling Co. is currently executing two district cooling projects in Saudi Arabia, which Managing Director Rasheed Al-Rasheed says are progressing on schedule. Development of a district cooling system to serve King Abdullah Financial District (KAFD) in Riyadh is under way. Total plant capacity will be 100,000 tons of refrigeration. The first phase of the plant (50,000 tons) and related distribution network is expected to be commissioned by mid-2012. Part of the initial phase (11,000 tons) will be commissioned by the end of 2011. Full capacity will be utilized within three or four years. Saudi Tabreed signed an agreement last year with Raydah Investment Co. in consortium with SNC Lavalin-Canada to design, build, operate and maintain the system.

Another Saudi Tabreed project, scheduled to commence service in mid-2012, is a district cooling system that will serve Saudi Aramco buildings in the Dhahran area. Tabreed signed an agreement last year with Saudi Aramco to design, construct, finance, own, operate and maintain the central cooling plant and distribution network, which has a design capacity of 32,000 tons of refrigeration. This system is one of the first district cooling projects in the Middle East and North Africa region that achieved financial closure under a limited recourse project financing arrangement in the midst of the global financial turmoil.

Rendering of the district cooling system planned to serve Saudi Aramco in Dhahran.

UGL Services to Operate Green Mountain College Plant

UGL Services, a division of UGL Ltd., has received a five-year contract with two one-year renewal options from Green Mountain College (GMC) in Poultney, Vt., to provide facilities services and grounds management, as well as to operate GMC's biomass combined heat and power plant. The plant will reduce GMC's oil consumption and carbon dioxide equivalent emissions by more than 80 percent while producing 400,000 kWh of electricity per year.

The plant has contributed to GMC becoming just the second college in the U.S. to achieve climate neutrality and the first to accomplish it through efficiency, adoption of clean energy and purchase of quantifiable local carbon offsets. GMC has been named the greenest college in the nation by Sierra magazine. In June, it received the Second Nature

Climate Leadership Award at the fifth annual Climate Leadership Summit of the American College & University Presidents' Climate Commitment in Washington, D.C.

"EcoHeat4EU" Project Completed

An executive summary is now available online for "EcoHeat4EU," a recently completed survey and analysis of legislative support for district energy in 14 European countries. The project was supported by the European Commission's Intelligent Energy Europe program and coordinated by Euroheat & Power. "EcoHeat4EU" aimed to present policy makers with tools to improve the legislative environment for district heating and cooling. It showed that increased use of district energy and combined heat and power in the 14 countries studied could deliver an impressive 6 percent reduction in total carbon dioxide emissions in the European Union by 2030. Assuming the 14 countries are a representative cross section, this equates to one-seventh of the EU's ambitious CO_2 reduction target being achieved by district energy technologies alone. To download the summary and learn more about the project, go to www.ecoheat4.eu.

EBRD Supports Biomass CHP in the Baltics

The European Bank for Reconstruction and Development (EBRD) is providing a loan to AS Graanul Invest, a leading Estonia-based wood pellet producer, which will boost the volume of green energy generated in the Baltic states and continues the bank's support for sustainable energy infrastructure investments in the region.

The 34.4 million euro ($49.36 million) senior corporate loan will finance the construction of two biomass-fueled combined heat and power plants in Estonia and Latvia, each with a capacity of 6.4 MW electric and 15 MW thermal. The financing will also fund associated energy efficiency investments in Graanul Invest's adjacent pellet plants, improving the operational efficiency of its pellet production.

This project is a continuation of last year's involvement by the EBRD in the Baltic power sector, when it supported major infrastructure investments aimed partly at replacing generation capacity lost after closure of the Ignalina Nuclear Power plant. This project will not only increase the power generation capacity in Estonia and Latvia, but also contribute to increasing the share of renewable energy in the energy mix of the two countries.

USDA Forest Service Awards Wood-to-Energy Grants

The U.S. Department of Agriculture Forest Service has awarded nearly $3 million in grants to 17 small businesses and community groups to develop wood-to-energy projects that require engineering services and will help expand regional economies and create new jobs. The various projects will use woody biomass removed from forests for wildfire prevention to produce green energy for heating and electricity. Examples of projects receiving the grants include the engineering design of a biomass power generation facility, a biomass boiler to produce steam at a sawmill or a hot water system for a hospital or school. The Forest Service Woody Biomass Utilization grant program has been in effect since 2005 and has awarded more than $33 million in grants to 140 projects. For a list of the grantees, go to http://tinyurl.com/3lkqfa2.

New UBC District Energy System Approved

A new CA$85 million ($88.3 million) University of British Columbia (UBC) district energy system will dramatically reduce campus greenhouse gas emissions and energy consumption while advancing clean energy research and development opportunities. Approved in June by UBC's board of governors, the five-year project will replace UBC's Vancouver campus's aging steam heating system with a hot water system that will heat more than 100 buildings used by more than 70,000 students, faculty and staff. Construction began July 4.

The new system will reduce Vancouver campus energy use by 24 percent and its greenhouse gas emissions by 22 percent. It is a key component of UBC's strategy to reduce institutional emissions from 2007 levels by 33 percent by 2015, 67 percent by 2020 and 100 percent by 2050. These are the most aggressive carbon reduction targets among the world's top 40 universities.

The project will include 14 km (8.7 miles) of insulated piping, 131 energy transfer stations across campus and a 52 MW natural gas-powered hot water plant to be built in 2013. The new system is expected to save UBC CA$4 million ($4.2 million) in operational and energy costs annually. The largest source of energy and financial savings will come from the system's ability to heat the campus while operating at a significantly lower average temperature of 80 degrees C (176 F) than the outgoing system, which operates at 190 C (374 F).

The new system's ability to operate at lower temperatures also provides increased compatibility with other technologies. As a result, it will integrate current and future UBC clean energy projects. This will enable improved collaborations between researchers, students, staff and corporate partners to explore and develop green technologies and best practices in such areas as geothermal energy, biomass gasification, ocean thermal energy, solar energy and waste heat recovery.

The project will occur in nine phases to minimize campus disruptions. Phase one will connect 15 buildings in the Lower Mall, which includes the Bioenergy Research and Development Project, a CA$27 million ($28.06 million) first-of-its-kind project that will generate energy for the campus from biomass such as wood chips and beetle-killed pine when it opens in 2012. Totem Park student housing residences, the University Services Building and the Frank Forward building will also be included in the first phase. The outgoing steam system will be decommissioned in 2017.

Collegiate Green Power Challenge Winners Announced

The U.S. Environmental Protection Agency's Green Power Partnership has announced the winners of its 2010-2011 College & University Green Power Challenge, which honors the collegiate athletic conferences with the highest

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combined green power purchases in the nation as well as the largest single purchasers within each participating conference. Several IDEA member campuses were among the institutions recognized.

This year's Collective Conference Champion was the Big Ten, topping the list with the largest total green power purchase among all conferences: 256,574,541 kWh. Of the five Big Ten schools contributing in this category, three were IDEA members: Pennsylvania State University (83,600,000 kWh); University of Wisconsin, Madison (38,900,400 kWh); and University of Iowa (8,348,746 kWh).

Five IDEA members were among the Individual Conference Champions: Pennsylvania State University, Big Ten; Carnegie Mellon University, University Athletic Association (86,840,000 kWh); University of Utah, Mountain West Conference (85,293,850 kWh); University of Maryland, Atlantic East Conference (66,000,000 kWh); and University of Colorado at Boulder, Big 12 Conference (11,319,617 kWh).

Dramatic Building Energy Savings Possible With Existing Technologies

A new report from the International Energy Agency (IEA) shows how existing energy-efficient heating and cooling technologies can dramatically reduce energy consumption and carbon dioxide emissions from residential, commercial and public buildings. The latest in the IEA's series of 'technology roadmaps,' *Energy-Efficient Buildings: Heating and Cooling Equipment* analyzes the status of such technologies as combined heat and power, thermal energy storage, solar thermal and heat pumps. It also outlines strategic goals, actions and milestones to reach higher levels of market penetration for these technologies around the world by 2050 – by which time, the report says, they could potentially reduce CO_2 emissions by up to 2 billion tons (around a quarter of today's emissions from buildings) and save 710 million tons of oil equivalent of energy. To read this report, visit http://tinyurl.com/3ar4ngu.

Corix Utilities a Prospective Partner in Yellowknife System

The Canadian city of Yellowknife, in the Northwest Territories, has selected Corix Utilities as its prospective business partner for the funding, development and operation of the Con Mine geothermal district heating system. Corix will take the lead role in the funding and creation of the Con Mine Community Energy System, while the city will participate in the governance, policy development and ownership of the resource.

After the results of a referendum vote in March limited the city's ability to fund the project through borrowing, Corix stepped forward and offered to finance the project. Under the new arrangement, Corix will now act as the primary financier for the project, and the city's contribution in the project will be limited to grants secured from other levels of government. The parties have signed a memorandum of understanding that outlines the process for developing the terms of a working business contract. It is estimated that this process will lead to the signing of a final business contract in fall 2011.

Corix specializes in providing products and utility solutions for sustainable infrastructure in the water, wastewater and energy sectors for clients across North America, including community and district energy systems for Simon Fraser University in Burnaby, B.C.; the University of Oklahoma; and Fairbanks Water and Sewer in Alaska. The company also has significant experience in the Northwest Territories, with five water treatment plants already in operation and five more currently under construction.

BTEC Webinar Explores Biomass CHP, District Heating

The Biomass Thermal Energy Council (BTEC) has produced a free webinar on "Large-Scale Biomass Thermal: District Energy and CHP." Recorded in May, the webinar covers how these technologies use biomass as a fuel, what government initiatives support these systems, how to right-size a biomass CHP system for a facility's needs, lessons learned from system installation and operation, and a look at how District Energy St. Paul "became the face of biomass district energy."

Webinar speakers include John Cuttica, director, Midwest CHP Regional Application Center, and director, Energy Resource Center, University of Illinois at Chicago; Michael Burns, senior vice president of operations and engineering, Ever-Green Energy; and Jonathan Wilkinson, senior vice president, business development, Nexterra Systems Corp. To listen and view presentation slides, go to www.biomassthermal.org/resource/webinars.asp.

Montpelier Voters Approve Bonding for District Heating

In a June 14 special election, voters in Montpelier, Vt., approved $2.75 million in bonded debt to finance an upgrade of the state's existing wood-fired district heating system that will allow it to serve more of the city. The existing plant already provides space heating and domestic hot water to the Capitol building and some state offices. The expanded system will also serve City Hall, the police and fire stations, and two schools. Private buildings along the distribution piping will also be able to connect to the service.

The entire project, which is expected to cost around $20 million, has already secured an $8 million U.S. Department of Energy grant, $7 million from the state of Vermont's capital budget, and $1 million and a $750,000 low-interest loan from the Vermont Clean Energy Development Fund. The $2.75 million in debt approved by voters includes $2 million in traditional bonding and the $750,000 loan.

Woodpecker Energy Boilers Selected for Olympic Venue

Woodpecker Energy has been selected to supply its wood pellet biomass boilers for use in heating the Olympic Sailing Village in the U.K., the first site that will be completed for the London 2012 Olympic Games. Located in Osprey Quay in Portland, Dorset, the venue will house up to 400 international athletes, sailors, coaches and officials. After the Games, the development of 78 contemporary two-, three- and four-bedroom homes will be sold, with some units made available to the local community as affordable housing.

The Olympic Sailing Village will be heated by a district heating system powered by three large-scale Woodpecker Thermon biomass boilers (two 150 kW and one 200 kW). The project will use indoor pellet silos that will constantly feed the boilers with wood pellets via built-in vacuum fuel-loading technology. The silos will be supplied with regular deliveries of wood pellets, enabling a seamless heating input.

Based in the U.K., Woodpecker Energy has installed more than 2,500 wood pellet biomass boilers mainly in the U.K., Ireland, Canada, U.S. and New Zealand.

Work Starts on New Low-Carbon U.K. Community

After 10 years of planning, ground was broken June 29 for Phase One of Cranbrook, a new low-carbon community in East Devon, U.K. This first development phase will include construction of 1,120 homes, a new school, community facilities, a railway station and a biomass combined heat and power system that will be able to supply electricity and heat for the first 2,900 homes in the community.

The system, which will burn locally sourced sustainable wood fuel, will be the first biomass CHP system in the country to serve a large-scale private residential development. It is expected to eliminate 10,000 tonnes of carbon dioxide emissions a year. In addition to serving Cranbrook residents, the system will supply space heating and hot water to businesses at the planned neighboring Skypark Business Park and generate electricity for the national grid.

The Cranbrook project has received funding support from the Homes and Communities Agency, including £16.6 million ($26.7 million) from the National Affordable Housing Programme and £3.6 million ($5.8 million) from the Low Carbon Infrastructure Fund.

Grontmij Leads Construction of Norwegian Biomass Plant

Sustainable design and management consultancy Grontmij has been selected by Eidsiva Bioenergy, a subsidiary of Eidsiva Energi AS, to assist the company in constructing what will be one of the largest biomass plants in Norway. The plant, to be built in Gjovik, will produce approximately 170 GWh of steam, electricity and district heating for local industry, businesses and a few hundred households. The facility is expected to be operational in early 2014 and to reduce the city's carbon dioxide emissions by 30 percent. Eidsiva Bioenergy's total investment in the project is around 50 million euros ($71.3 million).

Grontmij's Water & Energy division will handle the preconstruction planning and procurement for the plant and will ensure that it is built to have as little impact on the environment as possible. Grontmij previously participated in a pilot study that led to the decision to build the power plant. The contract with Eidsiva Bioenergy is valued at approximately 1.5 million euros ($2.1 million) for work through mid-2013.

RMF Engineering Moves to Raleigh, N.C.

RMF Engineering has relocated its Durham, N,C., office, to Raleigh, N.C., a move that supports the firm's continued growth. RMF signed a lease for class A office space in the Brier Creek Community, part of American Asset Corp.'s mixed-use development, which includes retail, commercial and residential projects strategically positioned in one of the Triangle's fastest growing submarkets.

Currently, there are 50 people in the new Raleigh office, comprising four teams: buildings, focusing on engineering systems; infrastructure, working with district energy systems; civil structural, concentrating on utility distribution systems; and building commissioning. The teams include four partners, as well as project managers, engineers, designers and support staff. The new office location will allow the employee base to expand by 30 percent in the near term. The RMF Raleigh office currently serves clients globally, working across multiple markets with a specialty in education and health care facilities.

University Business: Time is Right for On-Site Renewable Energy

An online article in the June 2011 edition of *University Business* concludes that it's an opportune time for colleges and universities to consider developing on-site renewable energy systems, including combined heat and power facilities, solar photovoltaic and wind power sources. "Colleges, Universities, and Renewable Energy: A Perfect Match" notes that higher education institutions spend nearly $10 billion on energy each year. Combined with the social conscience of students and faculties, that campus energy demand is motivating many institutions to decrease their carbon footprint and energy consumption by implementing renewable energy projects – which also have the potential to generate substantial cost savings.

The authors point out that with cogeneration colleges and universities can eliminate up to 20,000 tons of air pollutants each year for every 7.5 MW of CHP facility installed. The article explains direct and third-party ownership options for renewable energy systems and discusses the availability of government incentives and subsidies for developing such projects. To read the full article, go to http://tinyurl.com/3rvfstc.

TECO, Burns & McDonnell Complete System Expansion at Texas Medical Center

Thermal Energy Corp. (TECO) Board Chairman Paul G. Bell Jr. pulled the lever at May 17's ceremonial startup of TECO's new chillers, which were installed as part of its $377 million expansion project on the Texas Medical Center campus in Houston. The rest of the board members and guests looked on. TECO and Burns & McDonnell hosted the dedication ceremony, "The Energy Behind What's Next," in TECO's new East Chiller Building to celebrate completion of the system expansion, Master Plan Implementation Project – Phase One (see cover story).

Behind the scenes, TECO operators simultaneously started the chillers. As the chilled-water valve opened, guests could hear water rush through the pipes in the ceiling above. A video feed enabled guests to see the cooling towers start to spin atop the building as the chillers began operation.

During the luncheon, U.S. Rep. Al Green, Texas-9; Stephen K. Swinson, chief executive officer and president of TECO; Greg Graves, chairman and chief executive officer of Burns & McDonnell; Bell; and Dr. Richard E. Wainerdi, president and chief executive officer of the Texas Medical Center, spoke to the more than 200 in attendance. Guests toured TECO's expanded Central Plant site following the luncheon.

More event images and project information, including a construction video shown at the ceremony, are available at http://pitch.pe/146014.

Burlington Studies District Heating System Feasibility

As reported May 11 in *Seven Days*, a community group called the Burlington District Energy System (BURDES) has unveiled a new engineering study that has revived a decades-old plan to heat the city of Burlington, Vt., using excess heat from a local wood-fired power plant. The report demonstrated the technological feasibility of tapping waste heat from the Burlington Electric Department's McNeil Generating Station to heat water for distribution in the Old North End and downtown area via a new district heating system.

Opened in 1984, the McNeil plant was originally designed to produce both power and steam heat, and its boiler is large enough to meet both needs. In the past 20 years, at least three other studies have also proposed capturing and reusing waste heat from the plant.

The $140,000 engineering study, conducted for BURDES by St. Paul-based Ever-Green Energy, offers three alternatives for building out the district system and expanding it incrementally. It has not yet been established what entity would build and operate the system. To read the full article, go to http://tinyurl.com/6l3krcg.


Courtesy Burns & McDonnell. Photo Paul Howell.

TECO Board Chairman Paul G. Bell Jr.

People in the News


NRG Energy Center San Francisco has named **Dwain Botelho** (left) as director of sales and marketing and **Ted Vincent, PE**, (right) as plant manager. In his new role, Botelho will focus on developing new business opportunities for NRG San Francisco's steam and combined heat and power services. He has worked for more than 20 years in regional sales, sales management and other positions selling to Fortune 500 companies in the renewable energy, contract manufacturing, aerospace, medical, semiconductor and data storage fields. Prior to joining NRG San Francisco, he served as regional sales manager for an energy company that provided custom-engineered materials and services to photovoltaic manufacturers.

Vincent will be primarily responsible for overseeing the operation of NRG's downtown steam generation plants. He joins the company with a broad 30-year background in mechanical, civil and environmental engineering that includes the design of cogeneration systems and power generation facilities. He founded Vincent Engineering, a multidisciplinary engineering and environmental services firm, and Energy Solutions Group Inc., an energy conservation and management company. Vincent is a licensed professional mechanical and civil engineer and a licensed general building contractor who is active in California's green building code rollout.

Danfoss has announced that **Jorgen M. Clausen**, chairman of the board, has accepted an invitation from former President Bill Clinton to join the Clinton Global Initiative (CGI). Established in 2005, the CGI convenes global leaders to devise and implement innovative solutions to some of the world's most pressing challenges. The membership underscores Danfoss's commitment to sustainability, and it will provide the company the opportunity to forge new partnerships with government and business leaders to generate new ideas, learn about new and best practices, and take action to make a difference.

WM Group Engineers PC announced that **Nitin Pathakji** has joined the firm as manager, central utilities group. His responsibilities include overseeing WM Group's cogeneration engineering practice and spearheading its operator training program, designed to help the firm's district energy system clients further increase their energy efficiency. Pathakji is a mechanical engineer with 20 years of experience in the design, engineering and marketing of cogeneration and absorption technologies, thermal energy and HVAC systems. Most recently, he served as technical manager for Broad USA Inc., where he worked closely with engineers in developing new cogeneration, solar, waste heat recovery and absorption applications. Pathakji holds a bachelor of mechanical engineering degree from Walchand College of Engineering in Sangli, Maharashtra, India. WM Group is based in New York, N.Y.

Johnson Controls has named **Anwar Hassan** as vice president, Engineered Systems Group Saudi Arabia, and vice president of technology, Global Business Lines & Operations, based in Jeddah, Saudi Arabia. His new responsibilities include managing the engineered systems sales team in Saudi Arabia and growing that business as well as the associated service business. Hassan brings to his post more than 30 years of HVAC&R experience. He holds a master's degree in refrigeration and air conditioning and a doctorate in mechanical engineering from King's College, University of London, U.K.

Concurrent with the appointment of Hassan, Johnson Controls announced that **Ash Abdalla** was named vice president of the Building Efficiency division's newly created Chiller Solutions global business line, which combines the Small Tonnage Chillers and Large Tonnage Solutions lines. In his new position, Abdalla is responsible for the execution of growth strategies, product management and development, technology road mapping and customer satisfaction. He brings more than 20 years of experience to this position, including 12 years in leadership at Johnson Controls. He holds a master's degree in refrigeration and air conditioning from King's College, University of London, U.K.

Timothy A. Brown, PE, has been named vice president of operations for Thermal Energy Corp. (TECO), a not-for-profit company located in the Texas Medical Center in Houston, Texas. In his new role, Brown heads up TECO's plant operations, environmental health and safety, emergency response, information systems, procurement and energy management. He is also involved in long-term planning and serves as principal liaison to TECO customer facilities managers. Brown first joined TECO in 1998 as senior project manager, becoming engineering manager in 2002, a post he held until 2007 and then again from 2009 to 2011. He served in the U.S. Navy in 2008, where he was deputy section chief and operations officer for biometric operations in Iraq. Brown is a graduate of the Naval Nuclear Propulsion Program and has completed extensive additional professional technical training. He holds a bachelor of science degree in mechanical engineering from Texas Tech University.







LEED® + District Energy

Renewables:

A big win for district energy

Tim Griffin, PE, LEED AP, IDEA USGBC Liaison

Editor's Note: *"LEED® + District Energy" is a quarterly column providing information about the U.S. Green Building Council's LEED® rating system and how it applies to buildings served by district energy systems.*

Renewable energy has been around for centuries. Power from wind and water movement and solar thermal were used by ancient civilizations. Today, solar energy, wind and biomass all offer promises of reducing dependency on traditional nonrenewable energy sources such as coal, oil and natural gas. The need for renewable energy has never been greater, as the world simultaneously wrestles with climate change, increased demand for fossil fuels in developing countries and the concept of "peak oil," defined by Wikipedia as "the point in time when the maximum rate of global petroleum extraction is reached, after which the rate of production enters terminal decline."

The problem with traditional renewable energy sources, however, is that they are often cost-prohibitive and difficult to use and maintain. Wind and solar are not in constant supply; and biomass feedstocks often come from immature markets with unreliable supply streams and large price swings – neither of which is conducive to attracting normal sources of private capital investment. The point at which these energy choices can stand on their own economics has been 'just around the corner' for decades; but that proverbial corner has yet to be reached.

In concept at least, renewable energy certainly makes a lot of sense. If we can effectively harness the energy of the sun, wind or tidal wave movement, or harvest energy from waste streams, our current problems with energy security, supply, pollution and global warming could in theory all go away. As a result, the U.S. government and many state governments encourage the development of renewable energy markets in the form of tax incentives, grants, regulation, etc. However, governments are not the only entities trying to encourage the development of renewable energy markets. The U.S. Green Building Council (USGBC), a nongovernmental organization whose core mission is to drive sustainable building construction, uses its LEED® (Leadership in Energy and Environmental Design) green building certification system to help change the investment equation, in hopes of accelerating the maturity of renewable energy markets and technologies. It does so by awarding project buildings that use renewable energy a very significant number of points toward their LEED rating goals.

LEED and Renewables

The USGBC recognizes that encouraging the use of renewables helps achieve its goals. It also recognizes that in order to sufficiently encourage the use of renewables, significant incentives are required within the LEED rating system to overcome first cost, operating cost and/or long payback periods. As a result, the USGBC gives points for renewable energy in two separate credit categories within the LEED rating system. It is possible, in fact, for qualifying projects to earn many points within these categories.

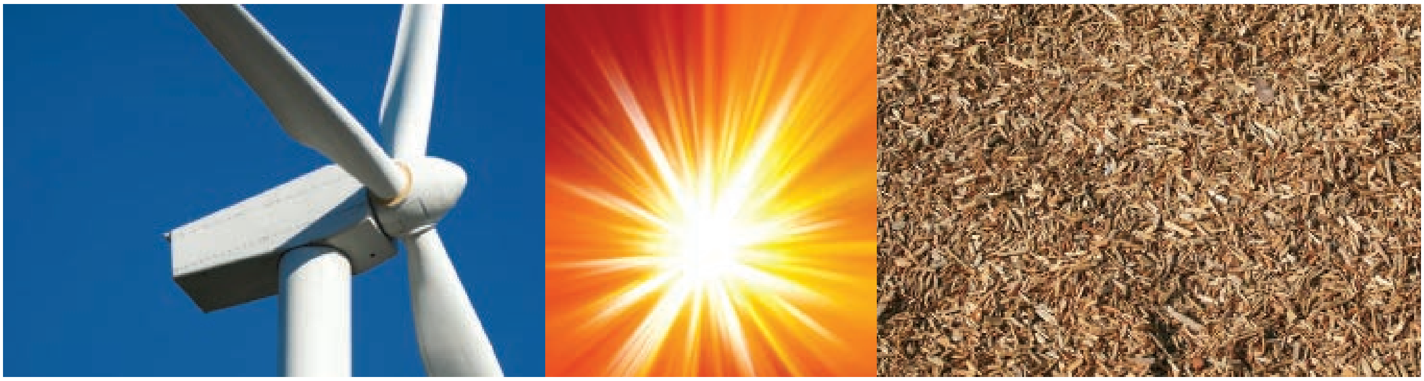
The first way to achieve LEED points with renewables is under Energy & Atmosphere Credit 1 by reducing the total annual energy cost of a project building. This credit awards up to 19 points to projects that can demonstrate a percentage of energy savings, as measured in terms of a building's total annual energy costs, compared to the minimum energy requirements for the same building as outlined in ASHRAE 90.1 – Appendix G. The LEED rating system, however, assumes that the input fuel costs of all renewables is zero. This is certainly true for solar and wind but rarely the case for waste products such as wood chips, oat hulls, poultry waste, etc. As a result, the assumed 'free' cost of renewables increases the amount of points that can be achieved under Credit 1.

Table 1. Renewable Energy Use Point Thresholds, LEED Energy & Atmosphere Credit 2.

Points Available	Percentage of Building's Total Energy Use From Renewables
1	1%
2	3%
3	5%
4	7%
5	9%
6	11%
7	13%

Source: USGBC LEED Reference Guide for Green Building Design and Construction, 2009 Edition.

Second, under Energy & Atmosphere Credit 2, projects can achieve up to seven points by utilizing renewable energy. To do so, however, they must consume what the USGBC considers to be renewable (more on that later), and the amount utilized must reach certain



thresholds as defined by the percentage of total annual building energy use. Those percentages along with their associated assigned points are shown in Table 1.

The relatively high thresholds required to achieve points for renewables make it very difficult for a project building to capture any points under Credit 2 with on-site renewables. For example, the amount of photovoltaics required to achieve just one point would cover most buildings. In addition, the operational and fuel-handling challenges of burning biomass within a single project building are substantial. On the other hand, the size and scale of district energy often provides good opportunities for burning renewables. (My colleague, Bob Smith, has described these opportunities as well as some of their challenges in the article in this magazine issue titled "Biomass District Energy Update: Current trends and issues in the U.S.")

District energy is often the best and sometimes the only option for obtaining credit for renewables in the LEED rating system.

Originally, however, the USGBC did not include provisions that would allow renewables consumed in district energy systems to be applied to customer buildings. This was changed in the first district energy guide published by the USGBC and has been improved in the second version of that guide, *Treatment of District or Campus Thermal Energy in LEED v.2 and LEED 2009 – Design & Construction*. As such, district energy is often the best and sometimes the only option for obtaining credit for renewables in the LEED rating system.

What Qualifies as Renewable

The USGBC is fairly clear about what is and what is not considered renewable. Photovoltaic systems, wind energy, solar thermal, geothermal heating and electric, low-impact hydroelectric power, and wave and tidal power systems are all considered renewable under LEED guidelines. In addition, biofuel systems utilizing untreated wood waste (including mill residues, agricultural crops or waste, animal waste and other organic waste) and landfill gas are also considered renewable. In contrast, however, solid municipal waste; forestry biomass waste other than mill residue; wood coated with paints, plastics or Formica; and treated wood are not considered renewable, and their use will therefore not result in points under Credit 2. Moreover, architectural features, passive solar systems, daylighting strategies and ground source heat pumps are not considered renewable energy systems.

Several interesting questions arise from this list. The first is, Why aren't ground source heat pumps considered renewable? I have never presented this information without someone immediately asking this. The more I have pondered this question and even debated it with members, the more I agree with the USGBC's assessment. Ground source heat pumps are an energy efficiency measure, and as such, points are rewarded for them under Credit 1 already. The 'fuel' for ground source heat pumps is still electricity, which is nonrenewable; you will just use less of it. I have even had a member argue that ground source heat pumps are renewable since the energy for heating a building using them comes from the ground and that heat in the ground ultimately comes from the sun rays impacting the earth. Using that same logic, however, you could argue that a traditional heat pump on a residence is renewable since it pulls heat from the atmosphere, which is also heated by the sun. With that line of thinking, you could argue that everything is renewable.

Another interesting question that often arises is, Why isn't solid municipal waste considered renewable? This one has perplexed me as well. I certainly see the benefits to the global environment of converting locally produced solid municipal waste into usable energy. Done properly, it can significantly reduce the amount of solid municipal waste sent to landfills. Produced locally, it also reduces the negative environmental impact of needing to be transported or procured from unfriendly parts of the globe.

My original thoughts have been that the USGBC may have concerns with the emissions from burning solid municipal waste. Also, the organization may feel that encouraging the combustion of solid municipal waste could lead to generation of greater amounts of it, which would be contrary to the USGBC's overall goals. However, I recently realized that the USGBC may not be discouraging solid municipal waste at all by not considering it renewable. Although its use cannot provide points under Credit 2, there exists an opportunity to more than make up for these lost points under Credit 1. If solid municipal waste were listed as renewable, then its cost would be assumed to be zero. Since it is not listed, modelers must use its actual cost in their energy models. The actual cost of solid municipal waste as a fuel is a negative number, since waste facilities are normally paid to accept it. As a result, using solid municipal waste can 'supercharge' the number of LEED points that can be achieved.

The final question is the most perplexing to me: Why is wood waste from mill residue classified as renewable? Wood waste that is not generated by a mill, on the other hand, is not. Therefore, it is necessary for systems such as Middlebury College (mentioned in Bob Smith's article) to know the source of their wood supply if they want to give renewable credit to buildings connected to their system.

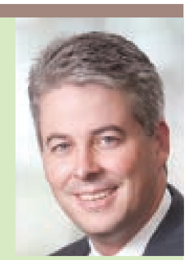
In some ways this makes sense. The USGBC does not want to encourage the clearcutting of forests to produce energy – a practice being debated in many states that have mandated power utilities to reach a minimum target for renewable energy use in their fuel portfolios. However, there is a place within the LEED rating system where this creates an unintended consequence. Some district energy systems, such as District Energy St. Paul's downtown system, use a mixture of wood that includes waste wood from mills, which qualifies as renewable, and waste wood from the forest referred to as slash piles, which does not qualify. This waste product, if not converted to energy, will be left to degrade on the forest floor, yet does not meet the USGBC's technical definition of renewable. Slash piles used to be included as renewable by the federal government before this was changed behind closed doors as a part of the Energy Independence and Security Act of 2007. It seems we've taken two steps forward and then one step back here.

Renewables Moving Forward

As district energy owners and operators, how should we think about renewables? Moving forward, the USGBC and federal and state governments want to continue to incentivize their use. While there are challenges associated with using renewables, many of these challenges are reduced when applied to district energy. This creates an opportunity for us. If you already utilize renewable energy sources in your district energy system, make sure your customers know how to apply the benefits in a LEED application. If you have a mixture of sources – some that qualify as renewable under LEED guidelines and some that do not – consider changing your fuel mix to increase the percentage of qualified renewables. If you are considering capital investment in your district energy system, take into account what adding renewables to your system will mean for your customers' pursuit of LEED certification.

District Energy St. Paul, for example, recently commissioned the largest solar thermal system in the Midwest and the only one in the U.S. that is tied to a district energy system. (See "Customer Closeup" in this magazine issue for a profile of this solar project.) This asset helps increase the percentage of renewable energy delivered to all of the company's customers and, as a result, creates another incentive for a LEED project building to connect to the system. In addition, District Energy St. Paul is studying its existing biomass fuel supply, consisting of waste wood, to determine if it can increase the percentage of its wood supply that qualifies as renewable energy under LEED guidelines.

The topic of LEED and renewables gives us a lot to think about; but who better to answer these questions than the engineers and operators among the systems represented in IDEA?



Tim Griffin, PE, LEED, AP, is IDEA's liaison with the U.S. Green Building Council and serves on IDEA's board of directors. He is a principal and branch manager with RMF Engineering Inc., a firm specializing in district energy system planning, design and commissioning. A registered engineer and a LEED Accredited Professional, Griffin has a bachelor of science degree in mechanical engineering from North Carolina State University and a master of business administration degree from Colorado State University. He may be reached at tgriffin@rmf.com.

Out for Review: LEED 2012

Would you like to provide input to the USGBC on the LEED rating system? Now is your chance! From July 1 through Aug. 15, 2011, the USGBC will hold the 2nd Public Comment Period for its next LEED update. To let your voice be heard, visit the USGBC Web site.

According to the USGBC, the 1st Public Comment Period, which took place Nov. 8-Jan. 19, generated more than 5,000 comments and recommendations from LEED stakeholders. Those are being reviewed by USGBC staff and LEED committees, whose responses are posted online. Further revisions will be made to rating system language based on comments, emerging themes and knowledge gained from participants in the USGBC's Pilot Credit Library, a test program for new and innovative LEED credit ideas.

After the 2nd Public Comment Period, additional public comment periods may be held as needed. At the end of this process, a final draft will go before USGBC's membership for a vote, currently projected for August 2012, with release of the next version slated for Nov. 7, 2012. For more details, visit www.usgbc.org.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Inside Insights

Benefits of Economic Analyses (part 2):

Real-world examples

Steve Tredinnick, PE, Vice President of Energy Services, Syska Hennessy Group

***Editor's Note:** "Inside Insights" is a column designed to address ongoing issues of interest to building owners, managers and operating engineers who use district energy services.*

Welcome back! In my last column, we discussed the virtues of lifecycle value analysis (LCVA) and how my father applied this technique to our family car purchases. We also covered that there are quantitative and qualitative parameters involved when making any large financial decision or purchase – especially connection to a district energy system. In this edition, we will expand on the large issues, provide some sample chilled-water plant costs and walk through a sample analysis of the costs of connecting to a district cooling system versus an on-site cooling system. If you attended the business development workshop presented by Jack Kattner and me at IDEA's 2011 annual meeting in Toronto, you will have a good idea what the rest of this column will entail. Marketing genius that he is, Jack introduced the "V" for value in "LCVA" in our presentation as a way to quantify the worth of nonquantifiable parameters that influence financial decisions that a lifecycle cost analysis (LCCA) would not address. Viva la "V"!

It is worth preceding any further discussion with a brief history explaining why LCVA is important enough to justify two columns in this magazine. Over a year ago, it came to my attention that my colleagues at ASHRAE had used an LCCA example in Chapter 38 of the 2011 *ASHRAE HVAC Applications Handbook*, which has become contentious. While this chapter is effective in educating readers how to conduct an LCCA, the last example compares the economics of an in-building chilled-water plant versus connecting to a district cooling system. This topic is quite controversial to us district energy folks, and why it was selected is not clear. The handbook example ultimately recommended the building chilled-water plant. (Bummer!) Unfortunately, some folks have interpreted this result to suggest that ASHRAE is against district energy. This is simply not true.

Discussions with the cognizant ASHRAE technical committee members (TC 7.8) revealed that this particular example had been in the handbook for at least eight years, and the original data source was unknown. The good news is ASHRAE did not have a hidden agenda to scuttle district energy. In my humble opinion, the ASHRAE analysis was oversimplified and did not quantify a great number of other parameters that have long-term economic consequences. An LCVA of these options should not be a quick and dirty back-of-the-napkin effort; rather, it requires a more complicated examination of many factors that should address and analyze all quantifiable costs and qualitative benefits over the life of the plant or duration of the contract.

> An LCVA should address all quantifiable costs and qualitative benefits over the life of the plant or duration of the contract.

While I routinely conduct net present value evaluations to assist in decision making to optimize central utility plant configurations, it is not my full-time job to analyze district energy proposals. However, in my experience analyzing several district cooling comparisons, the outcome is usually extremely close, and changing a single parameter can truly tip the scale either way.

I hope to help ASHRAE not come across as one-sided. As I'm involved in writing the district heating and cooling chapter (Chapter 11) of the 2012 *ASHRAE HVAC Systems and Equipment Handbook*, I decided to add another LCCA example reflecting our LCVA perspective comparing district cooling versus on-site cooling costs to this chapter that would avoid an 'our-dog's-better-than-your-dog' scenario and instead show a different perspective on the results (since our dog can hunt too).

Taking a New Approach

The new portion of Chapter 11 includes a review of additional parameters and costs that are important in any district energy service discussion. See table 1 for a summary of those parameters and sample costs.

Table 1. Parameters and Sample Costs for Use in District Cooling Lifecycle Cost Analyses.

Comparison Parameter	Discussion and Sample Costs
Overall Construction Costs of Chilled-Water Plant	Based on installed capacity of the plant. Larger plants benefit from economies of scale with reduced unit prices. • Typically $2,300 - $2,900 per ton for plants over 4,000 tons and $3,000 - $3,500 per ton for plants below 4,000 tons. Costs include the value of equipment (chillers, pumps, cooling towers, etc.) from vendors, contractor's overhead and profit, design fees, taxes and costs of screening rooftop equipment and structural supports, pipe chases, mechanical and electrical room space requirements, additional electric service, construction permits and fees. Higher costs also applicable to more stringent architectural standards of the facility or campus and material selection. Costs obtained from vendors, project experience and other sources such as *RSMeans Mechanical Cost Data*.
Equipment Repair and Replacement Costs	Can be found in *RSMeans Facilities Maintenance & Repair Cost Data*. This quantifies long-term rebuild costs (compressors, bearings, etc.) as well as replacement cost of major components (20-year life of cooling towers, etc.). For example: • 1,000-ton cooling tower – repair at $16,100 every 10 years and replace at $102,000 in 20 years • 300-ton open-drive centrifugal chiller – repair at $114,500 every 10 years and replace at $276,000 in 20 years • 350-ton absorption chiller – repair at $19,500 every 10 years and replace at $418,300 in 20 years • 1,000-ton open-drive centrifugal chiller – repair at $362,000 every 10 years and replace at $944,000 in 20 years
Financing Cost and Discount Factor	More than just the cost of obtaining money, but for private entities, also the hurdle rate of investments. • Typically around 5 percent to 6 percent for public entities and 15 percent to 25 percent for private entities looking for faster paybacks or better returns on investments.
Makeup Water and Blowdown to Sewer	Volume can be calculated using equations found in Marley's *Cooling Tower Fundamentals and Applications*; then apply local utility rates to quantities. • Typically in the $3-$4 per 1,000-gal range for both makeup and blowdown volumes.
Water Treatment Chemicals	Typically only for condenser water chemicals on a per-ton-hour basis for annual cooling load. • A rule-of-thumb number is $0.0025/ton-hr (check with local provider for costs and recommended methods based on city water quality).
Maintenance, Operations and Administration Labor (Quantity, Expertise and Training)	Accounting for the labor and staff that is directly accountable for maintaining and operating the chiller plant. For example: • One operator at $34/hour = $70,700/year salary, but must be burdened by benefits package of around 40 percent or total wages and benefits of $99,000/year.
Equipment Maintenance Costs	Different from the repair and replacement costs and comes from the local chiller service department including any outside or third-party service contracts. Some annual cost examples include • 450-ton and smaller electric centrifugal chiller = $6/ton, • 450-ton to 1,500-ton electric centrifugal chiller = $4.50/ton, • 1,500-ton and larger electric centrifugal chiller = $2.50/ton, and • 200-ton and larger air-cooled screw chiller = $10/ton.
Spare Parts and Supplies	Minimal costs but can be quantified by contacting local equipment service organization.
Electricity Rates	Obtainable from local utility for type of appropriate electrical rate structure (e.g., time of day rates, etc.).
Natural Gas Rates	Obtainable from local utility for type of appropriate rate structure (e.g., firm or interruptible gas supply, etc.).
Insurance Cost	Based on project construction cost and typically between 0.5 percent and 1 percent of costs.
Design Services (Architecture and Engineering)	Dependent on a number of variables such as size (cost) and complexity of project, location, overall scope, bidding climate (e.g., extremely active or economic downturn), number of design meetings, detailed analyses, number of construction observation visits, etc. • Typically in the range of 5 percent to 8 percent of construction costs with the higher percentage applied to smaller projects and the lower percentage applied to larger projects.
Energy or Resources Used	8,760-hour analysis is recommended using a program that will calculate the heating and cooling load for peak and annual basis. The specific plant configuration can be input into the software for equipment sizing and efficiency. The more detailed the input, the more detailed the output.
Escalation Rates	Could be different for each component (salaries, electricity, gas, water, sewer, etc.).

Source: Steve Tredinnick, Syska Hennessy Group.

Table 2 contains a summary of the new example to be included in the 2012 *ASHRAE HVAC Systems and Equipment Handbook* as well as in the future (mid-2012) *ASHRAE District Energy Design Guide*. It is based on a municipally owned court building in a warm climate where the city has the option of connecting to an existing district cooling system or building its own plant. The center column of table 2 has the input values for the example analysis; the far right column will be explained later.

The values in table 2 were put into a spreadsheet that calculated the 25-year net present value (NPV). The NPV calculation takes into account all future costs and converts them to present-day dollars for easy comparison of alternatives. Table 3 summarizes the results with only a $1.5 million difference between the two options. This analysis shows district cooling having the lowest NPV: While a 3 percent lifecycle cost difference is still relatively close, it is significant enough to suggest district cooling as the best option. The analysis results are graphically displayed in Figure 1 and Figure 2.

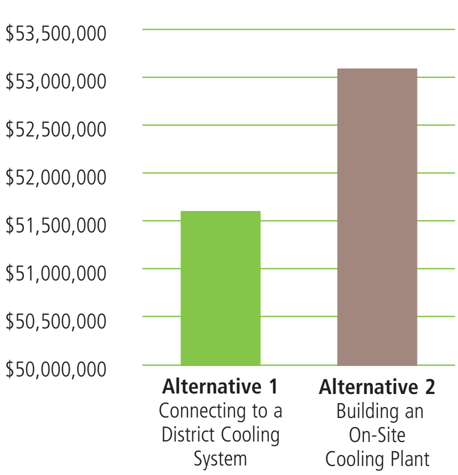
Figure 2 shows what a large influence the individual components of financing, energy usage, maintenance labor and makeup water costs have in this specific analysis. Any small change in

Table 2. Sample Lifecycle Cost Analysis: Input Values and Results.

Project and Input Parameters	LCCA Input Values	'Goal Seek' Analysis Values
Peak Cooling Load (tons)	2,400	2,400
Annual Cooling Load (ton-hr)	6,240,000	6,240,000
Configuration (installed tonnage)	3 x 900 tons = 2,700	2,700
Study Period (contract length in years)	25	25
Estimated Chiller Plant Cost	$8,981,000	$8,281,330
Percent of Project Financed	90%	72%
Discount Rate (municipal bonds)	5.5%	4.5%
Escalation Rate, City Water	10.0%	8.97%
Escalation Rate, All Else	3.5%	4.0%
Cost of Insurance (percent of construction)	0.75%	0.35%
Building Chiller Plant Maintenance and Operating Parameters		
Annual Chiller Plant Electric Usage (kWh)	4,389,950	4,389,950
Annual Makeup Water (gal)	16,181,000	16,181,000
Annual Blowdown to Sewer (gal)	3,773,000	3,773,000
Escrow for Chiller Plant Overhaul ($/ton/year)	$400	$53.30
Chiller Plant (Chiller and Tower) Maintenance ($/ton)	$6	NA
City Sewer Water ($/1,000 gal)	$4	$3.22
City Sewer Charges ($/1,000 gal)	$4	$3.22
Blended Electrical Rate ($/kWh)	$0.10	$0.091
Electrical Rate Reduction Due to District Cooling ($/kWh)	$0.0125	$0.0099
Number of Operating Staff Assigned to Plant	1.0	0.62
Operator Salary (including benefits)	$99,008	$61,565
Cost of Water Treatment (ton-hr)	$0.0025	NA
District Cooling Charges		
Capacity Charge ($/ton/year)	$285	$301.15
Consumption Charge ($/ton-hr)	$0.13	$0.136
Interconnection Charge (recovered over life of contract)	$289,500	$1,099,413

Source: Steve Tredinnick, Syska Hennessy Group.

Figure 1. 25-Year Lifecycle Cost Analysis (NPV) Comparative Results.



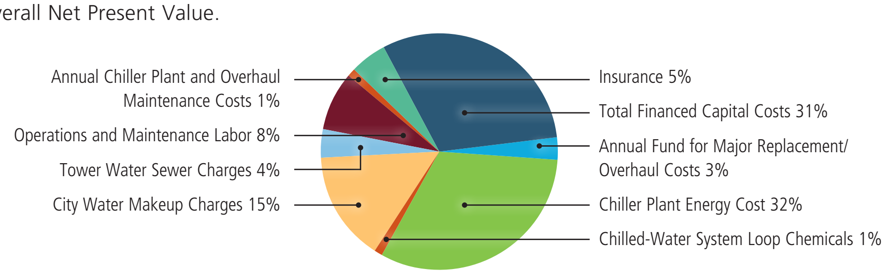
Source: Steve Tredinnick, Syska Hennessy Group.

Table 3. Results of Lifecycle Cost Analysis.

	Final LCCA Net Present Value
Alternative 1 – Connecting to a District Cooling System	$51,525,050
Alternative 2 – Building an On-Site Cooling Plant	$53,034,500

Source: Steve Tredinnick, Syska Hennessy Group.

Figure 2. Alternative 2, Building an On-Site Cooling Plant. Percent of Major Input Parameters of Overall Net Present Value.



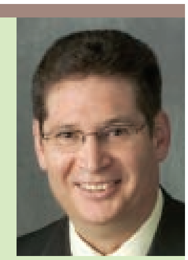
Source: Steve Tredinnick, Syska Hennessy Group.

any of these components will drastically affect the analysis outcome. This is highlighted in the righthand column of table 2, where each value has been calculated using the 'goal seek' macro within Excel that mathematically solves each parameter in order to make the difference between the two options zero. Take the operator's salary, for example: The base case has the salary at $99,000, and reducing it to $61,565 will make the two NPVs identical. As the French might say, "Zut alors!" Think of that – just $38,000 per year is the difference in a $51 million dollar investment.

When is the difference between the two options economically insignificant? Technically, when the NPVs are very close or equal. When this is the case, I would typically go to the first-cost parameter to assist in the decision. In our example, district cooling would save more than $8.5 million in first costs. Again, I would recommend the district cooling option since that initial money could be invested in other projects. Furthermore, if the building owner can be convinced to put a monetary value or worth to several of the following qualitative parameters, they may be used to tip the scales even further, even if the NPV of the district cooling option is higher:

- reuse of roof space for roof garden, patio or pool area
- increased premium rentable area from turning penthouse chiller room space into offices or residence
- savings for not having grade or roof-top equipment screens
- freed-up maintenance staff
- no visible plume from cooling towers or boiler stacks
- 'sleep-at-night' factor for allowing someone else to reliably meet the building's thermal requirements

In closing, whether you are looking at buying a new car or connecting to a district energy system, using an NPV analysis technique can effectively capture all of the parameters economically over the life of the study. As Jack Kattner will tell you, it is not just about the money. As an industry, we have to start quantifying the qualitative advantages of district energy to help level the playing field. Let us assign some worth to the "V"! We have covered a great deal of ground with this topic, and a great deal has been left unsaid or glossed over; so stay tuned. I think we may have more to say on this topic in the future, either in this column or at upcoming meetings. Viva la "V"!



Based in Madison, Wis., **Steve Tredinnick, PE**, is vice president of energy services for Syska Hennessy Group, which has more than 16 locations across the U.S. He has more than 28 years' experience related to building heating, ventilation and air-conditioning systems. The past 17 years of his work have been focused on district energy systems. Tredinnick is a graduate of Pennsylvania State University with a degree in architectural engineering. A past IDEA board member and a member of ASHRAE, he is currently immediate past chair and handbook chair of ASHRAE TC 6.2 District Energy and current chair of the Chilled Water Plant Subcommittee of ASHRAE TC 6.1 Steam and Hydronic Systems. He may be reached at stredinnick@syska.com.

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Members Speak Out

Time to Commit to Low Temperatures

David W. Wade, PE, President, RDA Engineering Inc.

Editor's Note: *"Members Speak Out" runs in each issue of* District Energy *magazine. Its purpose is for a member to briefly share his/her district energy experiences and opinions – and obtain feedback from fellow members. Please email comments to David Wade at dww@rdaeng.com.*

As long as I have been associated with IDEA, members have argued for and against steam, high-temperature water (above 350 degrees F), medium-temperature water (250-350 F) and low-temperature water (180-250 F) as distribution media for district heating. We can look back on our industry's history and assume that the first district heating systems were steam, because that was the common heating process for buildings in the late 1800s. Steam was an easy way to connect to buildings from a distribution system, and steam boilers were a well-understood technology that could be upsized for central power generation and steam supply to district systems.

History also documents that in the 1930s and 1940s many buildings began using hot water for heating as pump and electric motor technology advanced. Oil and natural gas fuel sources allowed boilers to become smaller and operate without attendants. Hot water systems became a safe and efficient technology for building heating. After World War II, high-temperature water systems were advanced as a breakthrough in district heating technology and were widely adapted at military bases and colleges as a replacement for central steam distribution systems. In practice, however, the advantages promised by high-temperature water systems were not realized, and they are rarely the system of choice for new applications today.

Medium- and low-temperature water distribution systems are selectively used today in the United States, particularly for college campuses or small groups of buildings. They are widely used throughout Europe for community district heating that serves millions of customers. In Canada, several new systems currently under design are being implemented as medium- and low-temperature hot water rather than steam or high-temperature water systems. You will find many proponents of medium- and low-temperature hot water systems among the IDEA membership, including this author.

Without advancing a discussion of the advantages of hot water over steam, I will concede that where steam is needed for industrial processes the advantages of steam for district systems are obvious. On the other hand, where space heating and domestic hot water heating are concerned, there is no need to expend the fuel necessary to create high-pressure steam in order to use heat exchangers to produce low-temperature hot water for building heating. The higher pressures and temperatures of steam and high-temperature water require more expensive equipment, materials suited for higher pressures and temperatures, greater insulation thicknesses, and greater fuel use to develop elevated pressures and temperatures. Lower-temperature hot water systems use less-expensive materials and result in lower system operating costs, even though pipe sizes and flow rates are larger for the same amount of energy transported.

Several trends in the energy industry could support a district heating industry using low-temperature distribution.

I bring this to your attention now because I see several trends in the energy industry that could support a district heating industry using low-temperature distribution networks. First, the desirability of natural gas as a fuel has taken on new life. Just a decade ago, we were thinking of natural gas as a scarce resource that would be phased out in a few years. Today the gas industry has demonstrated new exploration and drilling techniques that promise to make this resource abundant and a mainstay of the U.S. energy economy for decades to come. Natural gas is a unique fuel that can be used in many types of equipment, including small distributed generators, fuel cells, and boilers with the ability to condense flue gases to near-ambient conditions. Natural gas is also used in stationary turbines with combined heat and power. These types of natural gas-fired equipment generate large amounts of low-temperature heat that can be distributed through low-temperature piping networks. Maximum efficiency is gained by units exhausting waste heat at near-atmospheric conditions, which is ideally matched to low-temperature heating systems.

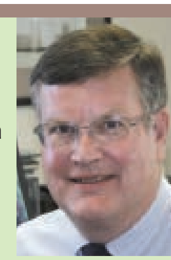
Secondly, renewed interest has been directed at heat pump systems serving multiple buildings. Heat pumps recover waste heat from low-temperature sources or utilize the ground as a seasonal heat sink or source. Distribution from heat pump systems to buildings is more efficient at lower temperatures. A significant number of development opportunities exist for heat pumps in low-temperature district systems.

Third, solar energy can play a role in low-temperature district systems. Solar input to a low-temperature network can contribute to system input and may be sufficient to provide summertime domestic hot water requirements without fossil fuel input.

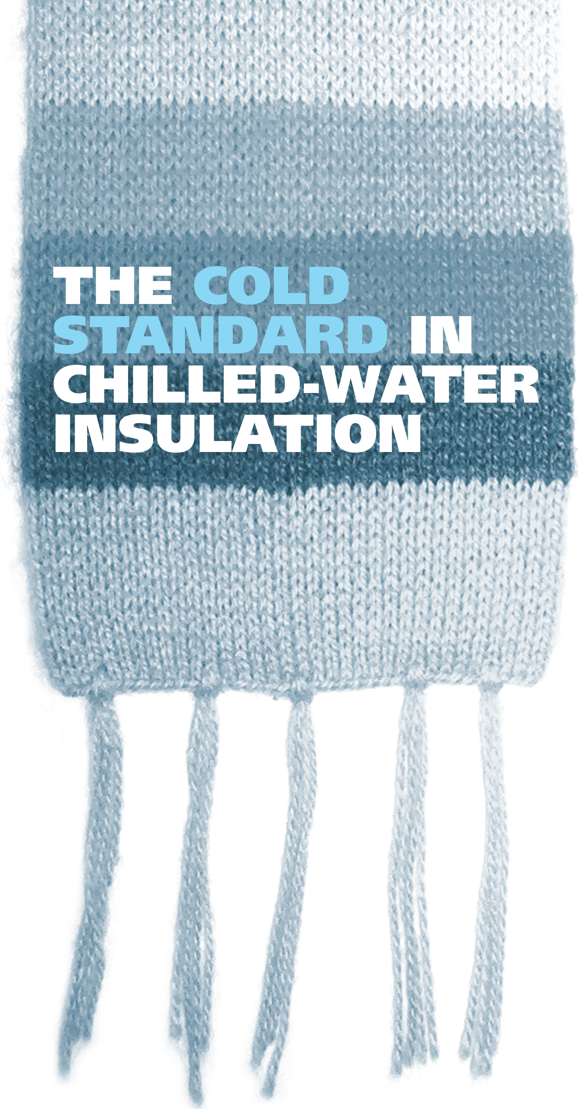
A fourth technology I find supportive of low-temperature systems is the organic Rankine cycle (ORC) generators just becoming available from U. S. and European manufacturers. This technology uses relatively low-temperature heat in a Rankine cycle to provide electric generation. Numerous European systems operate with an ORC unit taking moderate-temperature heat from a combustion process, producing electricity and then using a low-temperature hot water district heating system as a downstream heat sink. This cycle is similar to the familiar steam topping cycle but operates at much lower temperatures and pressures than a steam cycle.

Of course, other new technologies may become available to interface with low-temperature district heating. These four trends are occurring today and can provide new business opportunities for district heating developers, operators and equipment manufacturers.

Since most U.S. district heating systems are based on steam or high-temperature water, there is reluctance to consider low-temperature hot water. The typical response is that it is just too expensive to consider the change. Certainly the large investments in existing systems cannot be ignored, but neither should they be allowed to dictate future district energy investments. Imagine if the radio and television industry had doggedly stuck with vacuum tubes instead of moving to transistors. It's time our industry planned for a move to lower temperatures.



David W. Wade, PE, is president of RDA Engineering Inc. in Atlanta and has been an IDEA member for more than 25 years. He has served on IDEA's board and is a past chair of ASHRAE's national technical committees dealing with building steam and hot water systems and district heating and cooling. Wade may be reached at dww@rdaeng.com.



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District Energy a Key Piece of the Energy Policy Puzzle

Mark Spurr, IDEA Legislative Director

How does district energy fit into broader energy policies? This question is being asked in governments in North America, Europe and elsewhere, at levels ranging from national to state/provincial to local government. The debate involves a range of considerations, but one of the key questions relates to the greenhouse gas (GHG) emission reduction potential of district energy compared to alternative approaches to building heating. The International Energy Agency (IEA) will soon publish a report intended to help policy makers understand the potential contributions of district energy in a balanced and flexible energy policy, and this column focuses on the results of that report. (The report, authored by FVB Energy Inc. and BRE Sustainable Development Group, is titled *Fundamental Benefits of District Heating and Cooling to Society and a Model to Quantify and Evaluate the Benefits*, published by the International Energy Agency Implementing Agreement on District Heating and Cooling including integration of CHP, Report 8DHC-11-06, Annex IX.)

Relevant to Broad Policy Goals

District energy is directly relevant to major energy policy goals in the following areas:

- **Energy and economic security** By tapping thermal energy from local sources – existing in the community served – district energy helps reduce economic risk and retain more energy expenditures in the local economy, providing opportunities for economic multiplier benefits as that money is spent locally.
- **Reliability and power grid benefits** District energy not only provides reliable thermal infrastructure, it can also strengthen the power grid by
  - ~ reducing power demand in high-load areas by cutting power requirements to meet thermal demands;
  - ~ generating power in high-load areas with combined heat and power;
  - ~ shifting power demand to off-peak periods using thermal energy storage; and
  - ~ facilitating use of renewable power sources through load balancing and voltage support using thermal energy storage and CHP.
- **Environment** – By enabling the use of renewable and waste heat sources, district energy helps reduce consumption of fossil fuels (primary energy) and the related environmental impacts, particularly GHG emissions.

Quantification of district energy benefits depends on a broad range of case-specific circumstances, including fuel availability and price, power grid characteristics, climate, local resource base and economy, etc. Economic security and power grid benefits are quite case-specific. On the other hand, it is possible to model the GHG emission impacts of district energy systems compared to conventional heating and cooling technologies, even with a wide range of power grid characteristics and thermal load patterns.

Comparative Analysis Approach

The IEA report presents an analysis of primary energy consumption and GHG emissions of 30 different district energy system configurations compared with 11 building heating and cooling systems, in six cities representing different climates and related heating and cooling requirements. The six cities are Minneapolis, Toronto, Seoul, Copenhagen, London and Sacramento. Further, this analysis was undertaken for three different assumptions regarding the primary energy and GHG characteristics of the power grid. In addition, two different district energy system densities were modeled for some technology combinations.

The district energy systems were assumed to use the identified technology (e.g., natural gas engine CHP) to provide baseload capacity at 50 percent of the peak demand. Peaking was assumed to be provided by natural gas boilers for heating and electric centrifugal chillers for cooling. As a result, for example, the solar district heating scenario incorporates significant amounts of natural gas consumption for peaking and for backup for the intermittent solar resource.

The analysis examines societywide consumption and emissions, defined as follows:

- District energy GHG emissions are the sum of
  - ~ emissions from fuels consumed by the district energy system and

- ~ emissions related to power grid generation and delivery of electricity consumed by the district energy system
  - ~ minus offset power grid emissions for electricity supplied to the grid from district energy CHP, as applicable.
- Similarly, conventional building technology GHG emissions are the sum of
  - ~ emissions from fuels consumed by the building systems and
  - ~ emissions related to power grid generation and delivery of electricity consumed by the building systems.

This comparative analysis is intended to inform policy making, not to assess the feasibility of a particular district energy system. It cannot be overstated that there is a multitude of case-specific variables that must be analyzed to come to a responsible conclusion regarding a particular system.

Power Grid Assumptions Are Key

Some argue that electric-driven heating and cooling systems such as heat pumps will have a better carbon performance than district options. Such conclusions rest on the assumption that the power grid will become dramatically 'decarbonized' through significant increases in renewable power generation, nuclear power or carbon capture and sequestration.

In Figure 1, the GHG emission intensity of the power grids of a range of countries is summarized. These calculations use the 'power loss' methodology, in which the power output of CHP plants is adjusted for the amount of power generation that is reduced by extracting heat in a power plant. The calculated emissions include 7 percent losses for power transmission and distribution, reflecting the average in the European Union.

What is more important in policy development than current average emissions are the 'marginal' emissions, which are the characteristics of power generation that would be used (or turned off) if demand increases (or is reduced). There is no consistent definition, methodology or database of marginal emissions. In some locations, the marginal capacity is coal, at least in the short term. In the longer term, many people consider new combined-cycle gas turbine (CCGT) power plants the marginal capacity. Figure 1 shows the GHG emissions for a delivered megawatt hour of electricity from a new CCGT.

The countries with low emissions all have substantial use of nuclear energy and/or hydroelectricity or other renewable sources. For other countries, dramatic increases in renewable power generation face a range of challenges, including the following:

- Some countries lack available renewable options. Renewable resources, such as wind and solar, are highly site-specific. Most countries have little or no potential for hydroelectricity, and those that may have additional potential face environmental impact concerns.
- Siting of renewable energy facilities, particularly wind, is facing increasing resistance due to concerns about visual impact, noise and impact on birds.
- Frequently, renewable resources such as wind are located far away from where the power demands are highest, requiring construction of additional power transmission capacity, which is both expensive and faces local resistance along the transmission line route.

Nonrenewable power-only options are also problematic. Nuclear energy is extremely difficult to site and carries with it concerns about safety during operations and long-term storage of spent fuel. CCS is an unproven technology.

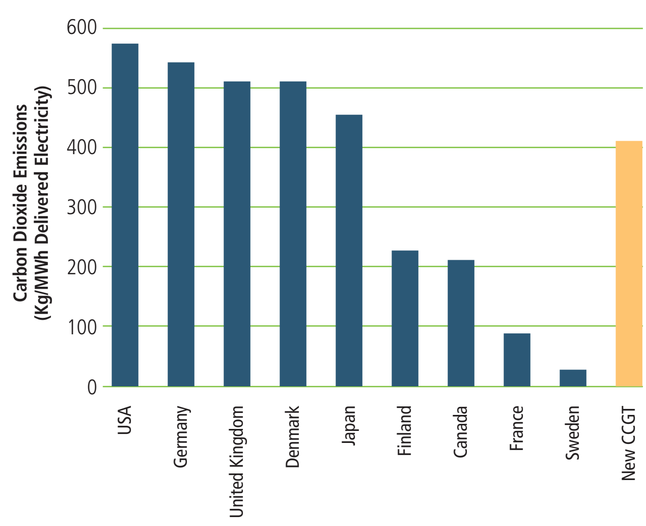
Theory vs. Reality

Policy analyses are based on assumptions regarding the energy efficiency performance of various technologies. Frequently, the assumptions for building heating and cooling systems are based on theoretical values or equipment ratings based on static laboratory conditions rather than 'real-world' data reflecting part-load operations, weather variations, operator inputs and system depreciation. Such real-world data are generally less available for building-scale systems, whereas district energy systems collect such data as a matter of course because they are in the energy business, and such data are vital indicators.

For example, the actual efficiency of building-scale heat pumps falls significantly short of the theoretical values often used in policy analyses. Although heat pumps are often promoted as having a heating coefficient of performance (COP) of 3.0-4.0, actual test results indicate significantly lower efficiencies. Figure 2 shows actual seasonal efficiency performance for 22 air source heat pumps from field measurements in the United Kingdom. The weighted average heating COP for the air source heat pumps was 1.94, far below the theoretical efficiencies of 3.0 and 3.1 for an ambient temperature of 7 degrees C (44.6 F). (The weighted average heating season ambient temperature in London is 7.1 C [44.78 F].)

Figure 3 shows similar actual seasonal efficiency data collected for ground source heat pumps in the United Kingdom. The weighted average heating COP for the ground source heat pumps was 2.34, or only 0.40 higher than the average for air source heat pumps.

Figure 1. Current Average Power Grid Carbon Dioxide Emissions in Selected Countries.



Source: Graus and Worrell, *Methods for calculating CO_2 intensity of power generation and consumption: A global perspective*, October 2010, www.elsevier.com.

Analysis Results

District energy offers a broad array of energy source options with lower GHG emissions than conventional building-scale heating and cooling systems. District energy has very strong GHG advantages when power grid emissions are based on the current grid in most locations. If power grid emissions are based on the characteristics of a CCGT, district energy's advantages decrease but remain significant.

Current Power Grids

Assuming that electricity GHG emissions are based on the current power grid in most locations, a broad range of district energy technologies reduce GHG compared with building-scale technologies. The exception is in Canada, where significant amounts of hydroelectricity and nuclear power provide a low current average carbon footprint for the power sector. However, as discussed above, current average emissions are of limited relevance to policy makers.

Power Grid Represented by Marginal CCGT

Figure 4 compares the average GHG emissions per megawatt hour of delivered thermal energy for a range of district energy and building-scale heating systems. To simplify the presentation, results for all six locations have been averaged, and only selected heating technologies are shown.

District energy options generally compare favorably with building-scale heating systems even if the power grid is assumed to have emissions equivalent to a CCGT. Although near-term district heating capacity may be natural gas boilers, the district system provides the infrastructure to later incorporate more carbon-lean technologies. The one building-scale technology with relatively lower emissions, the ground source heat pump, is sometimes difficult to site in the densely developed areas most conducive to district energy systems.

Renewable and waste heat district systems (biogas, biomass, municipal waste, industrial waste heat recovery, solar thermal) show dramatic reductions compared with building options, especially if renewable fuels are used for CHP. Solar district heating and to a lesser extent industrial waste heat recovery show higher emissions than might be expected because, as noted above, we assume natural gas boilers are used when these resources are not available.

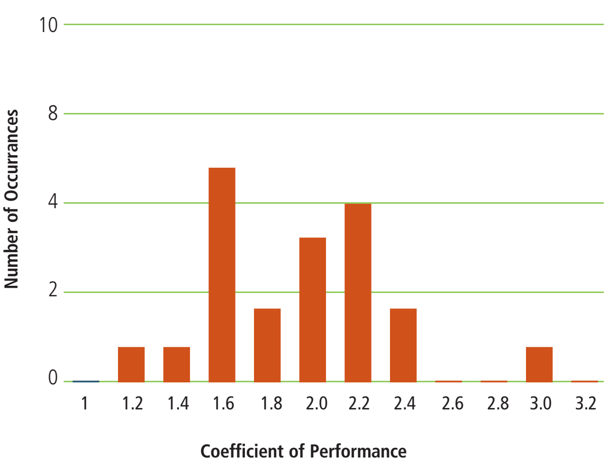
District energy options generally compare favorably with building-scale systems, with dramatic emissions reductions when renewable energy and waste heat are used.

Implications for Energy Policy

Relative to key energy policy goals, district energy provides multiple benefits relative to energy efficiency, GHG and air pollution emissions, energy security and power grid reliability:

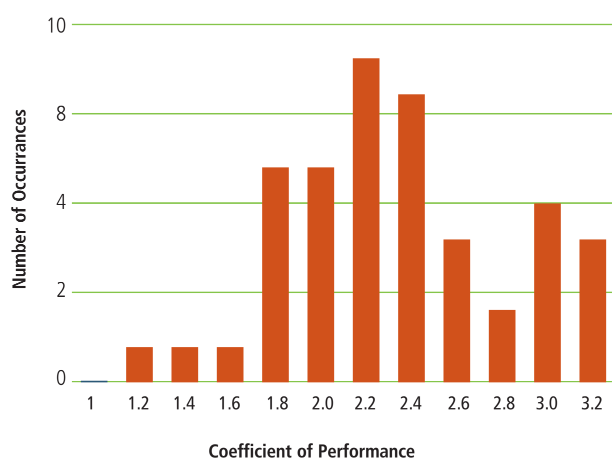
- **District energy provides flexibility for a wide range of low-carbon energy sources.** Sound energy policy recognizes uncertainty and the value of flexibility as technology evolves and energy prices change. We don't know if we can continue to access large amounts of natural gas securely and with reasonable economic and environmental costs. We don't know if we can drastically decarbonize the power grid at acceptable economic and environmental costs. The flexibility provided with district energy should be an important consideration in developing energy policies for a future with many uncertainties regarding technology development, fuel availability and prices, environmental impacts and political acceptability of increased nuclear power.

Figure 2. Actual Air Source Heat Pump Heating Efficiencies Based on Field Measurements in the United Kingdom.



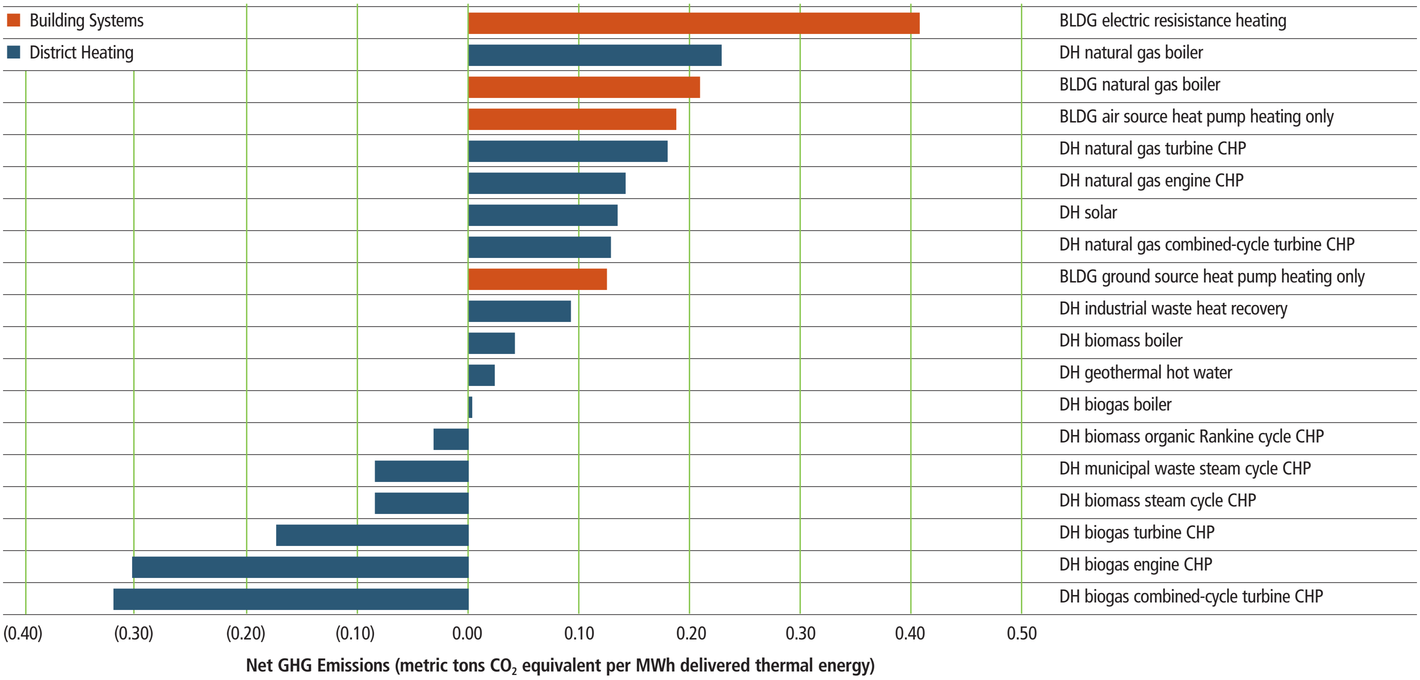
Source: ***Getting Warmer: a field trial of heat pumps*****, Energy Saving Trust, 2010.**

Figure 3. Actual Ground Source Heat Pump Heating Efficiencies Based on Field Measurements in the United Kingdom.



Source: ***Getting Warmer: a field trial of heat pumps*****, Energy Saving Trust, 2010.**
Analysis Results

Figure 4. Representative Greenhouse Gas Emissions of District Energy and Building-Scale Heating Technologies.



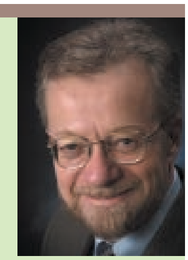
Source: FVB Energy Inc., summarizing results from analysis for *Fundamental Benefits of District Heating and Cooling to Society and a Model to Quantify and Evaluate the Benefits*, International Energy Agency Implementing Agreement on District Heating and Cooling including integration of CHP.

- **Thermal grids have a demonstrated ability to decarbonize.** It can be argued that we should not compare district energy with today's power grid, because there is an ambition to decarbonize the electricity grid through nuclear energy, wind farms, tide, wave power, etc. By the same token, we should not compare near-term district energy to a hoped-for future power grid. We should compare the future power grid to the future district energy system. It is intellectually inconsistent to assume decarbonization of the power grid but not the thermal grid. There are plenty of real-world examples of decarbonization of thermal grids, as described in my First Quarter 2011 column.
- **District energy strengthens and greens the power grid.** District energy provides multiple benefits to power grids relative to efficiency, emissions and economics. First, district cooling systems reduce peak power demand through the use of chilled water or ice thermal energy storage, which shift power demand from on-peak to off-peak periods. Second, district energy CHP facilities generate power in high power load areas and can be dispatched based on real-time peak power pricing signals. For example, Princeton University cut its peak power demand from 27 MW to 2 MW with a combination of CHP, absorption chillers and thermal energy storage. Hot water thermal storage can be used to maximize CHP heat recovery by smoothing out the supply of heat relative to demand. Third, district energy can facilitate increased renewable power generation by helping balance the power grid, as nondispatchable renewable generation sources (such as wind and solar) increase.

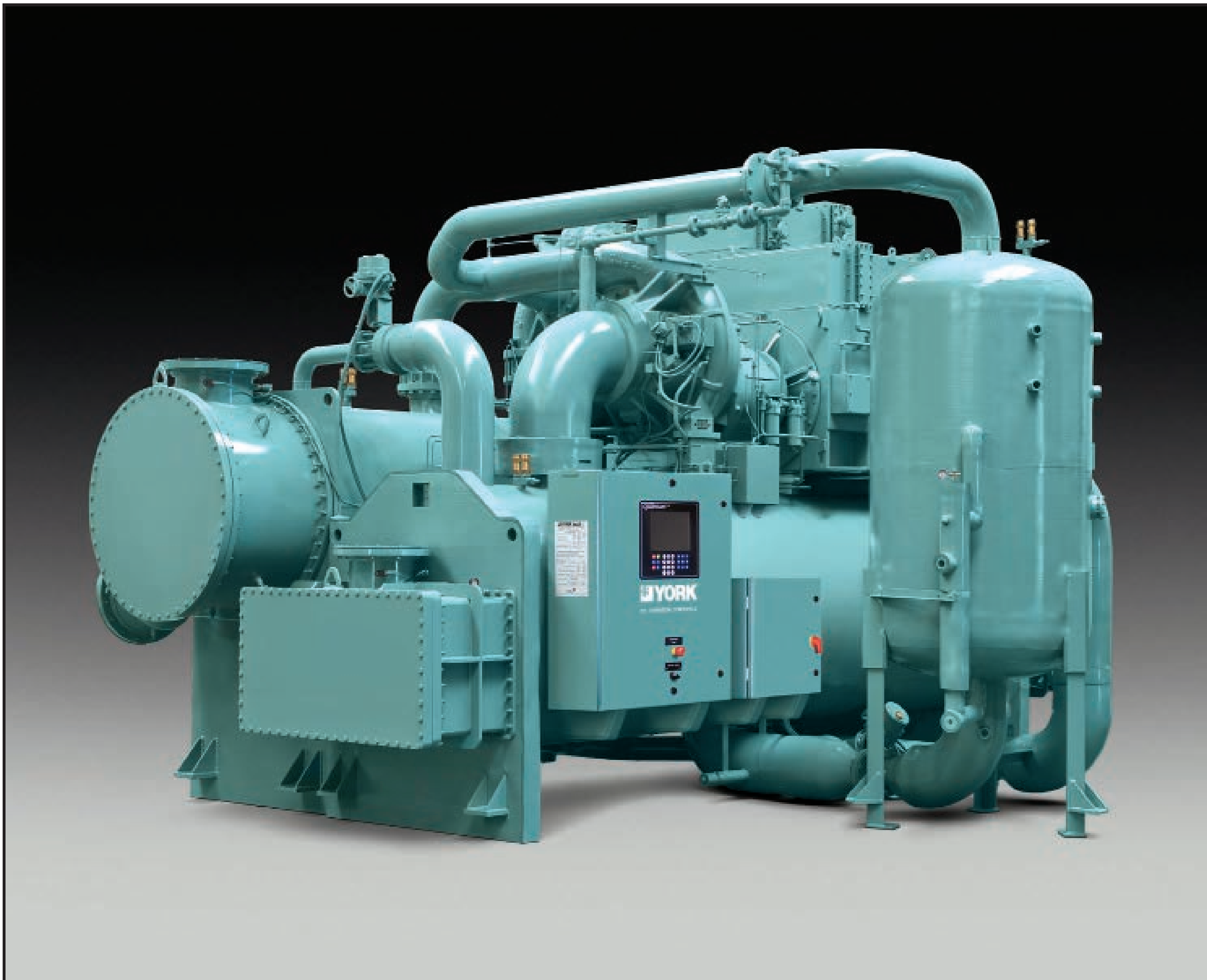
  Reductions in peak power demand or generation of CHP power in high-load areas have multiple benefits. Electricity transmission and distribution losses from remote power plants are reduced, constraints in delivery of power to high-load areas are relieved, reliability is increased and generation of power using inefficient and polluting peaking plants is reduced.

District energy provides multiple benefits to power grids relative to efficiency, emissions and economics.

- **District energy complements other strategies**. Relative to building heating, it should not be an 'either/or' choice – district energy or (fill in the blank). Diversity of energy technologies and energy sources helps reduce risks, and district energy can and should be a part of the mix, particularly for higher-density areas, where its economic and efficiency strengths are greatest, and where its benefits to the power grid are maximized.



Mark Spurr is legislative director of IDEA. He also is president of FVB Energy Inc., a U.S. consulting firm specializing in district energy and CHP business development, engineering and marketing, with offices in Minneapolis, Minn., and Seattle, Wash. FVB also has offices in Edmonton, Toronto and Vancouver, Canada; and in Stockholm, Västerås and other cities in Sweden. Spurr represents the United States on the executive committee of the International Energy Agency Implementing Agreement on District Heating and Cooling, including Implementation of CHP. He may be reached at mspurr@fvbenergy.com.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U.S. DOE Gulf Coast Clean Energy Application Center

Daniel Bullock, Director, U.S. Department of Energy Gulf Coast Clean Energy Regional Application Center

Combined heat and power has a long and successful history in the Gulf Coast region. With nearly 24,000 MW already operational, Texas and Louisiana are national leaders in CHP adoption. In Texas today, CHP supplies about 20 percent of the state's electricity – some 80 million MWh annually. With the large base of chemical plants, refineries and process industries along the Texas and Louisiana Gulf Coast, the states still have enormous potential in industrial applications, while growing interest for CHP in commercial and institutional markets represents a largely untapped emerging opportunity.

To help tap this potential, the U.S. Department of Energy created the Gulf Coast Clean Energy Regional Application Center (Gulf Coast RAC) in 2005. The Gulf Coast RAC supports the Industrial Technology Program's CHP efforts in Texas, Louisiana and Oklahoma. Our mission is to help DOE implement its vision for CHP by delivering services that will help increase the use of combined heat and power, industrial waste heat recovery and district energy technologies. Our services include:

- providing an outreach program to educate potential adopters and other stakeholders about the benefits of the CHP approach;
- providing support for potential adopters through technical assistance on specific projects early in the development cycle; and
- providing assistance to policy makers and industry stakeholders to help develop policy proposals supportive of greater CHP adoption in all market segments.

Since 2005, the Gulf Coast RAC has endeavored to build a community of enthusiastic supporters among the CHP industry, allied groups and adopters. This work led to the establishment of the Texas CHP Initiative in 2007, a vibrant industry association representing the CHP community in Texas and neighboring states. Our network of supporters continues to be a vital source of our success.

The Gulf Coast RAC has an extremely capable team including three full-time employees (located in The Woodlands, Texas – a suburb of Houston) and two part-time subcontractors (located in New Orleans, La.). Our skill sets include policy analysis and development, technical and economic analysis, and marketing and business development. In the last year, we've provided CHP feasibility studies for ten large industrial and commercial facilities, including one for the Texas Facilities Commission, which is considering CHP for the Texas Capitol Complex in Austin. Recently, we completed a case study for the Dallas Water Utilities CHP project and are currently working on case studies for recent CHP installations at Thermal Energy Corp., Texas A&M University and The Methodist Hospital in Houston.

Working closely with the Texas CHP Initiative and other stakeholders, the Gulf Coast RAC provided information and analysis on important policy issues. This work led to several legislative changes including the following:

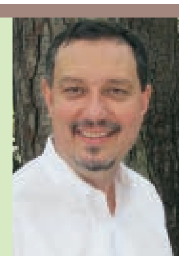
- HB 3693 (2007) – required the Public Utility Commission of Texas to create a report highlighting the state's CHP industry, resource potential and benefits
- HB 1831 (2009) – requires CHP feasibility studies to be completed by Texas governmental entities prior to construction or major renovation of critical government buildings
- HB 3268 (2011) – requires the Texas Commission on Environmental Quality to develop a nondiscriminatory permit by rule or standard permit for CHP projects by Sept. 1, 2012.

In addition to this legislation, we provided technical analysis and information that led to a change in the rules at the Public Utility Commission of Texas to allow CHP projects smaller than 10 MW to receive incentive payments through the state's energy efficiency program. In 2011, we are working to implement similar policies in Louisiana, both at the state level and within the city of New Orleans.

Our recent white paper examined the impacts that would result from increasing CHP from 20 percent to 35 percent of total electricity production in Texas. Our analysis showed that Texas could increase consumption of natural gas by some 3.3 trillion cu ft over the next 14 years, while significantly reducing carbon dioxide, nitrogen dioxide and sulfur dioxide emissions and water consumption. The Texas CHP Initiative is using the white paper as a platform to support its ongoing efforts to implement meaningful changes in the state's energy policy.

One of our most visible successes was last year's Texas CHP Policy Forum and Trade Show in Austin, Texas. Working in conjunction with the EPA CHP Partnership, we attracted more than 300 attendees and 25 exhibitors for a dedicated two-day CHP meeting. As a result of the strong interest and excellent feedback from attendees, we plan to establish the meeting as an annual CHP conference serving the southern U.S. To that end, we are now organizing the follow-on event, which will be held Oct. 18-19 at the Westin Galleria Houston Hotel. The highly anticipated event promises to be even better than last year's.

Other activities provided by the Gulf Coast RAC include a robust outreach effort via a regular email newsletter called "The Baseline," our highly acclaimed Web site at www.gulfcoastcleanenergy.org and free weekly webinars on a wide variety of technical and policy topics. Recent webinars have included technical discussions on waste heat recovery opportunities at cement plants and natural gas compressor stations, absorption chiller fundamentals, as well as policy updates on Texas and Louisiana. More information about our past and future webinars can be found at www.gulfcoastcleanenergy.org/webinars.



Daniel Bullock is the director of the U.S. DOE Gulf Clean Energy Regional Application Center. Dan has over 20 years of experience in high technology covering a wide variety of roles including fundamental research, technology development, operations, marketing and sales. Bullock has previously worked for IBM, Advanced Micro Devices and a number of technology start-up companies in the energy and microelectronics industries. Bullock graduated with distinction in solid state physics from Pennsylvania State University and holds advanced degrees from the University of Texas at Austin in both engineering and public administration. In 2009, Bullock was awarded the CHP Champion Award by the U.S. Clean Heat and Power Association.

Customer Closeup

Saint Paul RiverCentre and District Energy St. Paul:

Partners in solar and sustainability

Overlooking the Mississippi River in downtown Saint Paul, Minn., is one of the premier convention centers in the Midwest: Saint Paul RiverCentre. Since it opened in 1998, the 162,000-sq-ft facility has hosted a wide variety of meetings, trade exhibitions, festivals and other events, including the 2008 Republican National Convention and President George W. Bush's 2001 energy policy address. It is owned by the city of Saint Paul and managed, together with the adjacent Xcel Energy Center and Roy Wilkins Auditorium, by Saint Paul Arena Co. A customer of District Energy St. Paul from the start, Saint Paul RiverCentre is known as a model of sustainability practices that include its most recent green project: a groundbreaking solar thermal installation.

Saint Paul RiverCentre relies on hot water district heating and chilled-water district cooling from District Energy St. Paul. In March, District Energy partnered with the convention center to launch the Midwest's largest solar installation. The project consists of 144 solar thermal collectors on the Saint Paul RiverCentre roof, which peak at 4.09 MMBtu/hr of thermal energy, reducing carbon dioxide emissions by 900,000 lb each year. The solar energy produced is primarily used by the convention center for space heating and domestic hot water. Any excess energy is exported to District Energy's downtown hot water district heating network. The 624 MMBtu-hr system already receives the majority of its energy from a biomass-fueled combined heat and power plant.

The solar thermal project was made possible through the U.S. Department of Energy (DOE) Solar America Communities program in partnership with the city of Saint Paul, the city of Minneapolis and the Minnesota Division of Energy Services. The city of Saint Paul secured a $1 million DOE Market Transformation grant matching $1.1 million in funding from District Energy St. Paul.

Preliminary design began in December 2010, and District Energy selected Saint Paul's TKDA, along with the firm's partner Ramboll, to assist with design and engineering. Saint Paul RiverCentre met the technical requirements for installation, with additional panel structural considerations for wind, ice and snow loading specifications.

Solar panel selection was crucial to maximize the $2.1 million budget and 30,000 sq ft of roof space. ARCON Solar collectors from Denmark were chosen for their high performance. Most importantly, these panels have a starting efficiency of more than 0.70, minimal thermal losses and can reach temperatures up to 200 degrees F.

After panel selection and final design, local contractors spent a cold, snowy winter installing the steel frames, piping and collectors. The convention center's internal systems were upgraded for the solar heat source in conjunction with District Energy's supply of hot water to the building.

An installation of 144 solar panels atop Saint Paul RiverCentre generates 4.09 MMBtu/hr of thermal energy annually that is used at the convention center and by District Energy St. Paul.

After three months of operation, the system had outperformed expectations during available solar production hours. Positive performance data have led more than a dozen other cities and universities to inquire about developing similar projects that will rely on this system's experience to lead the way. In particular, there is great potential for solar installations integrated with steam-based district systems.

As the solar success moves forward, so does the convention center's broader sustainability initiatives, including its 'buy green' program (supporting the purchase of recycled, compostable and/or high-efficiency products) and a multifaceted waste reduction program that significantly increased recycling and introduced composting in public areas. Last year, Saint Paul RiverCentre launched a new "80-20 in 3" initiative to cut the facilities' carbon footprint by 80 percent and become 20 percent more efficient than average within three years. A major lighting replacement and upgrades to HVAC equipment, doors and window coverings are all planned.

District Energy St. Paul and Saint Paul RiverCentre are proud to collaborate on solar and sustainability, and are excited to see how the new solar thermal installation will further advance the possibilities for integrated energy systems.

For more information, visit www.solarsaintpaul.com or contact District Energy St. Paul Project Manager Nina Axelson or Project Engineer Ray Watts at outreach@districtenergy.com.

To view other Customer Closeup profiles, visit *District Energy* magazine online at www.districtenergy-digital.org/districtenergy/2011Q2 and search "Customer Closeup" in all issues.

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Calendar of Events

EPA CHP Partnership Meeting
October 5, 2011
L'Enfant Plaza Hotel, Washington, D.C.

USCHPA Annual Meeting
October 6-7, 2011
L'Enfant Plaza Hotel, Washington, D.C.
To register: www.uschpa.org.

2011 CHP Conference & Trade Show
Gulf Coast Regional Application Center
October 17-19, 2011
Westin Galleria Houston Hotel
To register: www.CHPCon2011.com

25th Annual Campus Energy Conference and Distribution Workshop
Feb. 6-9, 2012
Crystal Gateway Marriott
Arlington, Va.

District Energy/CHP 2012: 103rd Annual Conference & Trade Show
June 30-July 3, 2012
Hyatt Regency Chicago
Chicago, Ill.
Hosted by Thermal Chicago

District Energy/CHP 2013: 104th Annual Conference & Trade Show
June 23-26, 2013
Hyatt Regency Miami
Miami, Fla.

Questions? (508) 366-9339 or visit www.districtenergy.org/calendar.htm.

Dates to Remember

8.19.11 .... 4th quarter magazine advertising space deadline

9.9.11 .... 4th quarter magazine advertising material deadline

9.17.11 .... Abstracts due to be considered for 2012 Campus Energy Conference

11.18.11 .... 1st quarter magazine advertising space deadline

12.9.11 .... 1st quarter magazine advertising material deadline

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IDEA 2012 Innovations in Clean Energy

Call for Presentations

IDEA's 25th Annual Campus Energy Conference

February 6-9, 2012

Crystal Gateway Marriott
Arlington, VA

The International District Energy Association (IDEA) is pleased to open the call for presentations for educational sessions at the 25th Annual Campus Energy Conference.

Presentations should aim to reinforce the conference theme – "***Innovations in Clean Energy***"– which reflects current policy preference for innovative solutions in integrating and advancing clean, sustainable energy solutions for campuses, communities, cities and military bases.

Suggested presentation topics for submissions include:

- Master Planning – Reducing Carbon Emissions on a Growing Campus
- Combined Heat and Power/Cogeneration/Waste Heat Recovery
- Campus Cooling, Thermal Energy Storage and Turbine Inlet Cooling
- Renewable Energy Applications (Geothermal, Wind, Solar Electric &Thermal)
- Innovative Approaches to Climate Action Planning and Campus Carbon Reduction
- Clean Energy Solutions for Dormitories and Housing
- Partnering with Offices of Sustainability
- Serving LEED Buildings on Campus
- Biomass, BioFuels and Fuel Flexible Solutions
- Managing Loads, System Optimization & Efficiency
- Case Studies of Central Plants (campuses, military bases, municipal, state and federal government buildings)
- Mission Critical Cooling for Data Centers, Airports, Medical Centers
- Advanced Computerized Control, Monitoring and Energy Management Systems and Techniques
- Utilizing Sub-meter data to Enhance Energy Management
- Operations, Maintenance, Safety, Training and Development
- Creative Approaches to Financing Clean Energy Projects

Please submit a 75-word summary abstract outlining your presentation by Sept. 17, 2011, to Conference Technical Chair, David Adamian, GreenerU at **David.A@GreenerU.com** with copy to Laxmi Rao, IDEA at **laxmi.idea@districtenergy.org**.

For exhibitor and sponsorship information, please contact Tanya Kozel at tanya.idea@districtenergy.org or call 410-518-6676.