INDUSTRIAL ASSESSMENT CENTERS

Student and Alumni Newsletter

January 2008

Visit us at www.IACforum.org and iac.rutgers.edu

IAC Alumni ARE "The People We Have Been Waiting For"

Those of you who keep up with the IAC Forum website (www.IACForum.org) have seen the article from Thomas Friedman of the NYTimes titled "The People We Have Been Waiting For." After an initial dose of criticism of U.S. energy policy, he writes about student-driven activities at MIT that create awareness and expertise in energy efficiency and renewable energy. As I read the article, I found myself yelling at my monitor—this is work that our IAC schools have been doing for the U.S. Department of Energy for 30 years! In addition to creating campus advocacy groups, our students are working side by side with some of the best energy experts this country has to offer and gaining experience that is second to none. So despite the lack of recognition from the NYTimes, we are making a difference!

This year's newsletter includes some exciting stories about the work of our students and alumni in deploying energy efficiency and renewable energy solutions. From our busy colleagues at ERS to our new City of Cleveland Energy Manager and our West Coast solar advocate—IAC'ers are translating their skills and experience into action to solve U.S. and global energy challenges. We also have two feature technical articles from our alumni that address transportation assessments and best practices in industrial refrigeration. Finally, because of the high demand for IAC graduates in 2007, we have added a section on corporate recruiters.

As we move into another year, I encourage you to keep in touch and send me updates of your successes and whereabouts. The benefits of networking through the IAC are tremendous. In the meantime, I think I'm going to send a copy of our newsletter to Mr. Friedman…

Michaela Martin, PE, CEM
IAC Student Activities
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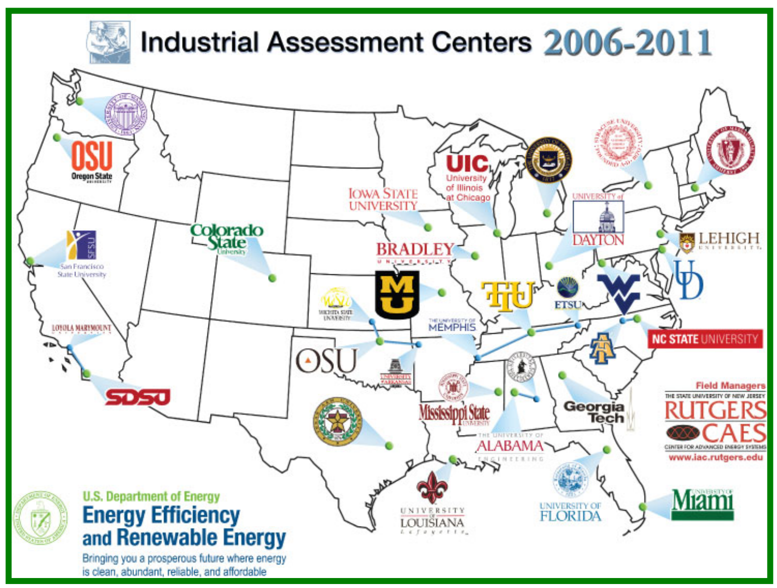

Current schools in the Industrial Assessment Center Program.

IACs Playing a Major Role in U.S. DOE Save Energy Now Assessments

Sandy Glatt, U.S. DOE
Tony Wright, ORNL

Uncertain energy prices and growing climate concerns have inspired U.S. industry to place a new emphasis on energy efficiency. In 2005, the DOE Industrial Technology Program (ITP) introduced the *Save Energy Now* (SEN) initiative to help industrial companies identify opportunities to reduce energy costs and energy use in their plants. Technical staff from the Industrial Assessment Centers (IACs) have played an important role in the overall success of the Save Energy Now assessments.

In calendar year 2006, 200 3-day steam and process heating SEN assessments were completed. In 2007, 250 steam, process heating, pump, compressed air, and fan system assessments will be completed, and an additional 250 SEN assessments are planned for calendar year 2008.

Save Energy Now assessments differ from traditional energy assessments because of their emphasis on training during the process of identifying plant energy-savings improvements. These assessments use ITP software tools, and the DOE energy experts who perform the assessments train plant staff in the appropriate use of these tools. Plant personnel get hands-on experience and, as a result, are more likely to embrace and promote the implementation of the results identified in the assessments. Seventeen of the energy experts who perform SEN assessments are IAC directors or associate directors and two energy experts are IAC alumni.

The potential savings identified from the SEN assessments have been impressive. For the 200 assessments performed in 2006, $500 million/year of potential energy cost savings, 53 trillion Btu of potential natural gas savings, and 4 million metric tons of potential CO_2 emission reductions were projected. For the first 103 assessments performed in 2007 where final reports have been received, the results have been equally impressive—$129 million/year in potential energy cost savings and 14.7 trillion Btu/year of potential natural gas savings.

Actual implementation of results from the SEN assessments has also been impressive. IAC staff from the University of Illinois at Chicago conduct follow-up evaluations with plant personnel at intervals of 6, 12, and 24 months after individual assessments are completed. For the first 128 plants that reported 12-month results from the assessments completed in 2006, $81 million/year in energy savings has been fully implemented, another $70 million/year is in progress, and an additional $180 million/year is planned, under review, or awaiting funding.

In addition to the SEN assessments being done on a national level, DOE is now engaging state energy offices to identify local resources that can conduct assessments at the state level. This effort was recently launched through a funding opportunity to states. Nineteen states were selected, and each partnership differs in terms of how and who conducts the assessments. In several instances, IACs are doing the state-level assessments. Often these assessments focus on smaller facilities or systems or at the plant level, which differs from the five system-specific national SEN assessments. DOE recognizes that the greatest opportunity for these partnerships to succeed is to develop local expertise and long-term local relationships.

Overall, the SEN assessments have been a clear success for U.S. industry—and the IACs have played a major role in achieving this success.

IAC Graduates Find a Home at ERS

Jon Maxwell, Alumni, Oregon State University IAC (jmaxwell@ers-inc.com)

Energy prices are rising thanks to global increases in demand for finite resources and additional costs associated with producing energy more cleanly. These rising prices make energy efficiency investments attractive, and now more than ever businesses are seeking consultants to help them discover energy savings opportunities in their facilities.

Energy and Resource Solutions, Inc. (ERS) is a leading engineering firm based in the Boston area, with offices in Maine, New York, Texas, and California. With a prime objective of assisting utilities, government, and large commercial and industrial end users in solving complex energy problems, the company attracts energy efficiency engineers from all over the globe and has become a workplace home of sorts to eight IAC graduates.

ERS founder, Gary Epstein, an IAC UMass alumnus himself, knows first hand the value of an IAC experience both as an engineer and as an employer seeking talented, experienced, energy–savvy staff. He described his own experience as follows: "My graduate education in the IAC at the University of Massachusetts was critically important to my development as an energy engineer, and I've maintained relationships from that period for over 20 years. The IAC program has also been instrumental in the success of ERS. Over the past years, we have hired many IAC graduates who have been invaluable in managing and conducting engineering analyses for high-profile clients in all regions of the U.S. and in locations as far away as China."

Jon Maxwell, ERS's Director of Engineering and a Oregon State IAC alumnus, confirms that IACs are ERS's first "go to" source for new graduates: "We've been thrilled with the technical training, industriousness, and commitment to quality that IAC alumni bring with them. The IAC professors do a great job of teaching fundamentals to students."

All of ERS's IAC-trained staff agree that the program prepared them well for a career in energy efficiency evaluation. According to Kevin Carpenter, "Serving as an IAC lead student at Dayton was the single most important experience in preparing for my professional career. The engineering, management, and client-interaction skills offered by the IAC program gave me cutting-edge expertise with which to enter the professional world." Satyen Moray also believes the IAC to be a perfect training ground for engineers desiring to enter the energy efficiency consulting field: "The 2 years I spent at my IAC taught me to interact with customers, understand systems, develop new tools, and write and present clear reports. The IAC also gave me the necessary motivation to hit the ground running at ERS from day one."

ERS is a fun, flexible, diverse organization focused on producing high-quality technical evaluations. "I'm not aware of another firm on the East Coast that does more industrial energy studies," says Jon Maxwell, "and our firm tends to be more field and instrumentation oriented than some." Satyen and others enjoy traveling to a variety of facilities, developing tools, managing their projects, and spending after-work hours honing their skills on the company foosball table.

ERS is growing rapidly and now employs 25 people across the country. Visit us at www.ers-inc.com.

Left to right: Gavin Gui (Arizona State), Satyen Moray, Yogesh Patil, Gary Epstein, Kevin Carpenter, Chris Schmidt (Dayton), and Kathryn LeBlanc (Utah). Jon Maxwell not pictured.

From IAC Student to City Energy Manager

Bill Eger, Alumni, University of Dayton IAC
(**egeriicw@gmail.com**)

As a graduate student working at the University of Dayton IAC, my days were fairly predictable—wake up, take a shower, dress, possibly eat breakfast, travel, call clients, crunch numbers, think, write, class, write… repeat. Now, as the Energy Manager for the city of Cleveland, predictability is far from commonplace.

As a member of the Office of Sustainability, and the city's first energy manager, I have been handed a blank slate to help foster and shape responsible, effective, and efficient energy operations. The Office of Sustainability, established in 2005, provides multidisciplinary and holistic leadership to save the city of Cleveland money and reduce its ecological footprint, use sustainability principles as a tool for economic development, and introduce sustainability principles into city government through education. As a technical advisory, "think tank," design, project management, and policy development group, we focus on improving city operations and community outreach through the following program areas: Energy Efficiency & Advanced Energy, Green Building, Quality of Life & Health, and Recycling & Waste Reduction.

While a typical day cannot be defined, the following projects consume the majority of my time:

- Instituting a comprehensive energy management program and plan
- Baselining, benchmarking, and performing building energy and waste assessments on over 200 city-operated facilities
- Developing a comprehensive demand management, scheduling, and control plan to provide value-added water delivery for the nation's eighth largest water treatment and distribution system
- Providing energy efficiency advisement for water treatment and distribution system capital improvement projects
- Instituting an energy management training program for water treatment plant managers and operators
- Developing an energy conservation and energy efficiency training course for city employees
- Developing a city-wide sustainability campaign with focus on recycling, energy efficiency and conservation, storm-water management, and green building
- Energy analysis and modeling, design, and advisement on HVAC and lighting systems to support Leadership in Energy and Environmental Design (LEED®) certification of city buildings
- Aiding the metering, design, development, and cost analysis of a city-operated onshore wind turbine farm and, peripherally, a county initiative for the world's first off-shore freshwater turbine farm
- Selecting and designing city-operated solar thermal systems for fire station and recreational center use
- Establishing and conducting a bio-diesel pilot project for the city's public utilities trucking fleet
- Providing research and analysis for the institution of a city-wide Renewable Portfolio Standard (RPS) and Advanced Energy Portfolio Standard (AEPS)
- Establishing the city's municipal power company's power purchasing carbon portfolio

These initiatives span the extent of the energy engineering profession. The IAC program has provided me with a firm foundation to successfully approach and accept these challenges and has allowed me to apply the experience and knowledge I gained from IAC to address the city of Cleveland's energy concerns.

Cities throughout the United States require the best and brightest to address today's energy and resource challenges. The IAC program has established an excellent training ground for those interested in serving their fellow citizens through municipal government. Through our unique skills and talents, IAC alumni can impact changes to create happier and healthier communities. For more information, visit http://www.cleveland-oh.gov/government/departments/pubutil/sustainability/.

Oregon State Student Goes Solar
OSU Media Release

During his senior year at OSU-IAC, mechanical engineering student Sam Walker (along with fellow engineering students Blake Giles and Rick Spindler) designed and built from scratch a solar trailer that can supply temporary power to outdoor concerts, generate electricity for remote rescue operations, or operate pumps at environmental cleanup sites.

Sam Walker atop the Solar Trailer.

The glass-walled trailer with a fold-out solar array on top also serves as a unique demonstration device that Walker will put to work.

Walker, accompanied by filmmaker Hovey Grosvenor, will go on a West Coast road trip. They will videotape their experiences and create a documentary about the trip. They plan to capture reactions from people as they demonstrate the trailer at wind farms, power plants, biofuel facilities, and other locations. The documentary film will be geared toward a nontechnical audience and expose viewers to a variety of power-generating technologies, Walker said.

"We'll also pull into small towns, fold out the trailer's solar array, put out dozens of plastic sunflowers, and talk to people about electricity and the different methods used to produce it," says Walker, who will pull the trailer with a biodiesel-fueled Isuzu box truck that will also serve as bedroom, kitchen, and film studio during the 2-week trip. "We're calling this trip the 'Demystification Tour' because we plan to dispel myths, displace fears, and encourage informed decision-making when it comes to different sources of power," Walker said.

While other mobile solar devices are available on the market, Walker says their solar trailer is well ahead of the pack. "Nothing comes close to ours in terms of solar-generating capacity and demonstrability," said Walker, who plans to visit festivals, rodeos, fairs, and other outdoor events during the trip.

After the trip, the trailer will be housed at OSU. When not powering campus events, it will be connected to a net meter, selling excess power to the local electric utility.

Spotlight on University of Illinois at Chicago
Rob Miller, UIC-IAC (*rob@uic.edu*)

Nebojsa Kisic, Joanna Zamiechowska, and Patrick O'Boyle.

The UIC-IAC has been conducting follow-up interviews of the Save Energy Now (SEN) Program for DOE. These follow-up interviews, conducted by undergraduate students, are helping document the measures implemented and savings realized by the SEN Program, as well as providing direct feedback from the plants to DOE. A total of four students have worked on the SEN Program, and two more will be trained to support the effort and eventually make contact with participating plants.

Over the last year, UIC-IAC students have been assisting in research to document and quantify the benefits of the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™. Energy-using systems at two buildings of similar design, one built using LEED principles and one using normal construction methods and equipment, are being monitored. As part of the effort, the students visit the two buildings monthly, downloading data and ensuring that the monitoring equipment is functioning correctly. Now in its 11th month, data collection is nearly complete and the students will shift to normalizing the data to account for weather and then analyze the resulting information to determine similarities and differences between the two buildings. It is expected that a draft report documenting the research and conclusions will be created in early 2008.

The UIC-IAC has been busy on a variety of other projects, including following:

- The UIC-IAC has written several new recommendations dealing with selling carbon credits, green energy purchasing, renewable energy credit (REC) purchasing, and incorporating energy into Lean manufacturing programs, specifically Five S and Six Sigma. Aside from the carbon credits, which generate direct revenue, the other recommendations are being justified in terms of adding/keeping clients, expected future mandates from parent corporations and/or client companies in terms of ISO, QSO, and demonstrated environmental responsibility, and the proven returns of investing in Lean manufacturing despite problems in quantifying the costs and savings of such programs. Initial responses from clients have been positive, and we look forward to the implementation surveys to let us know if they are being adopted.
- One of the lead students, Aaron Hart, became certified as a Qualified Steam Tool and Pumping System Assessment Tool (PSAT) Specialist, the second student at the UIC-IAC to do so. He has some suggestions for future test takers. "It's important to have basic knowledge of the system before taking the exam. For example, the effect head pressure has on flow rate and the effect steam flow rate has on deaerator flow rate." Before the test, "spend time preparing by becoming familiar with the tool. It is important to complete all the practice materials provided because they represent what you will be tested on. Also, try to model a sample system that you are familiar with using the tool." He also added that "it is important to keep in mind while taking the test that you are being tested on your ability to use the tool to analyze a system rather than your overall knowledge of the system." Most importantly, Aaron said that undergraduate and graduate IAC students with good system knowledge can take and pass these tests. "An

undergraduate or graduate student actually has an advantage going into these tests because they are currently in school and are used to learning every day. It is much harder for engineers who have been out of school to take and pass the test, as they haven't been in the classroom for some time." Aaron's most important advice is to "have your IAC Director pay for the test. You will be able to add a lot of value to your team—system recommendations will get better and return more savings."

- Three senior UIC-IAC students recently took the FE/EIT exam. The mechanical, industrial, and general engineering tests were taken. They offer this advice to future test takers:

Nebojsa Kisic, Montserrat Aguero, and Patrick O'Boyle.

  - When you register, you will be given a confirmation number. Save this number, especially if you are paying later, as it may be the only way your information can be accessed by the testing authority.
  - Pay for the exam early. Your registration does not guarantee you a seat—paying does. Don't wait until the week before the test to pay, as there may not be any seats available.
  - Don't rely on just the study guides offered by NCEES (the testing authority). Be sure to get a supplemental guide in order to identify all areas of study.
  - Download and become familiar with the formula book before the test. Knowing how the book is organized will save you valuable time.
  - Know your basic units, such as watt = joule/second. The formula book will not provide information such as this. Doing sample problems before the test will help you identify which units you need to know.
  - Be sure to read the exam instructions, especially as they pertain to calculators, prior to the test. The list of approved calculators changes, so someone's old calculator may no longer be an approved unit when you take the exam.
  - Study with your new calculator before the test—don't buy it the night before. Know how its functions work.
  - You will be wreckage after the test. Planning to study or do homework later that day is not a good idea.
  - Finally, UIC-IAC students are taking the exam the semester before the semester they are graduating. This allows them to have an awarded FE/EIT designation when they are interviewing, instead of having it pending, which brings more attention to their resumes. So far, seven students have taken the test in this manner and all seven have passed on their first try.

- The UIC-IAC has been assisting a local student engineering team in competing in the For Inspiration and Recognition of Science and Technology (*FIRST*) Lego League (FLL) 2007 Challenge. A portion of this year's contest, titled "Power Puzzle," challenges students to select a building in the community and evaluate the energy use, talk to experts, and propose solutions to reduce consumption or move toward alternative energy use, and share the suggested changes with the community. The team, N^3 (N-Cubed), composed of students aging in range from 10–14 years, conducted an assessment of a plastic injection molding plant in Union Grove, Wisconsin. N^3 identified lighting, compressed air, and heat recovery opportunities and is considering whether to recommend ground source heat pumps. The team will be competing in the regional qualifying event and expects to continue to the state championship tournament later this year. More information on the FLL can be found at http://www.firstlegoleague.org/.

Missouri IAC Students Attend First-Ever EE Global Forum in Washington, D.C., Hosted by the Alliance to Save Energy
Jason Fox, University of Missouri IAC
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Jason Fox and Chatchai Pinthuprapa at the EE Global Forum in Washington, D.C.

There seemed to be a general consensus among the participants of the 2007 EE Global Forum. This forum, which took place in Washington, D.C., during the second week of November, gathered over 800 individuals from 32 countries. The 3-day event included 36 executive dialogue sessions, four plenary sessions, and an exposition hall that featured companies engaged in every aspect of the energy efficiency industry.

Each booth was hosted by a team of intelligent and enthusiastic representatives; each discussion came to be a remarkable learning experience; and each host offered a new, unique perspective on the issues surrounding the energy industry. As we walked amongst the displays discussing various intriguing ideas, thoughts, and products with the representatives, it became clear that energy efficiency is the catalyst of the forthcoming energy revolution.

The consensus among the participants is that energy efficiency is the most logical and important method to achieving greenhouse gas (GHG) emission reduction targets that are crucial to maintaining climate conditions while also meeting the increased demands of global society. This general consensus was echoed by many speakers and exhibitors involved in both the symposium and exposition events.

Jim Rogers, the CEO of Duke Energy, ended the conference on Wednesday evening with an excellent speech. He focused on the importance of energy efficiency as "the fifth fuel" and its role in achieving the goals he feels are crucial to the future of our planet. We must substantially de-carbonize our energy supply in this century in order to meet the goals set forth by the United States Climate Action Partnership (USCAP), *a group of businesses and leading environmental organizations* that have come together to call on the federal government to quickly enact strong national legislation to require significant reductions in GHG emissions. The target created by the USCAP, of which Duke Energy is a member, calls for Congress to create a target emission reduction zone of 60 to 80% by 2050. Also, Jim spoke on the major initiative taken by Duke Energy in the development of their Save-A-Watt program, which will better allow utility customers to participate in energy savings programs. An innovative aspect of this program is that it allows all of Duke's customers to participate in several energy savings programs, one of which will allow Duke to control their customers HVAC equipment so that it can be reduced during periods of high demand.

Programs like this will send a strong message to customers on the value of energy efficiency and the savings it can create for them. Energy efficiency is currently the easiest and most cost-effective way in which we can reduce GHG emissions. Renewable technology will certainly be a prime component of our future energy portfolio, though currently the costs of renewables are still quite a bit higher than the costs associated with energy efficiency.

During a finance-focused executive dialogue session, a presenter compared the relative costs and benefits of energy efficiency against geothermal, solar, and wind energy. The costs to achieve a 1-kilowatt reduction through energy efficiency is currently around 6 cents compared to geothermal at roughly 10 cents, wind at 20 cents, and solar at 25–30 cents. With these statistics it is easy to see that capital spent on energy efficiency implementations will result in the greatest benefits. Investments in energy efficiency are considerably lacking in the current environment, and this simply has to change.

Energy efficiency needs to become the paramount goal for all users, from governments to corporations and individuals. The concern for energy efficiency is expanding rapidly, and each day climate change issues escalate and continue to gain attention globally. People are becoming aware of the effects current emission levels are having on the environment. There is an ever-growing population who supports decisive action now for reductions in emission levels that are in line with targets necessary to reach sustainable levels for the future.

As an IAC student engineer, I feel this growing consensus will bring a new challenge to our center.

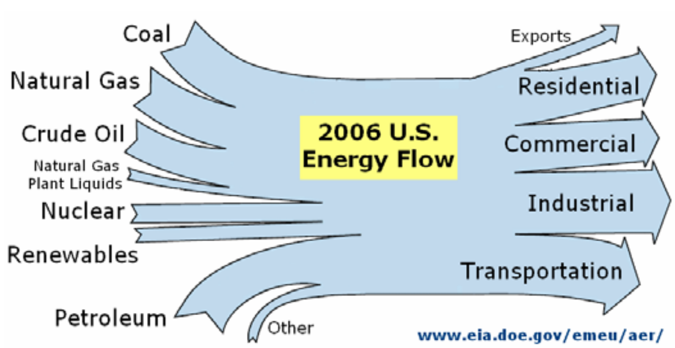
Our involvement and work in the energy efficiency field allows us to gain knowledge and experience not available to the vast majority of people. Ultimately, we as IACs must champion energy efficiency not only in our work with clients but also within our universities. As students we must continue to push forward the attitudes of energy efficiency within our peer groups, as they will go on to serve in all sectors of the economy and, with this attitude, they will consistently advance energy efficiency in their respected sectors. Here at the University of Missouri–Columbia (UM), members of the Industrial Assessment Center have worked to organize the Student Energy Conservation Society, an organization open to all MU students that is dedicated to improving campus energy efficiency and sustainability. Our other primary goal is to promote the idea that climate change is a direct result of human activity and demands decisive measures and actions to prevent drastic effects. Our organization's success will be evaluated on our ability to engage and involve the students of MU, for their devotion will be crucial to implementing our ideas and climate protection plan here in Columbia. This collaborative effort between the IAC and the Student Energy Conservation Society has proven successful during its brief existence. Our hope is to continue to expand on this initial success and hopefully to begin the process of transforming the MU campus into a beacon of energy efficiency and sustainability. The individuals we met and the ideas we refined while attending EE Global have greatly contributed to our fervent belief that our efforts will have a progressive impact for years to come.

Feature Article

Incorporating Transportation into the Industrial Assessment

Bryan Roy, Alumni, North Carolina State University IAC, bryan_roy@ncsu.edu

In the United States, the transportation sector accounts for 28.5% of the total energy consumed, equating to 28.4 quadrillion BTUs per year. Petroleum accounts for 97% of transportation energy use, two-thirds of which is imported into the United States to meet this demand.



Energy Information Administration: Annual Energy Review

With the cost of petroleum increasing, potential savings from an industry's transportation use can be significant. Assessing energy use in vehicles is essential in a complete industry audit, and there are many low and no-cost strategies that can be implemented to decrease transportation-related energy consumption. In addition to conservation and improved fleet efficiency, alternative fuels can contribute to fuel diversity and stability along with environmental benefits.

Conservation

An idling vehicle gets zero miles per gallon and can consume up to 1 gallon of fuel per hour. All stationary vehicles, whether they are being unloaded or having paperwork checked, or while a driver is finishing a conversation, should be turned off. Loading docks often have bad air quality from all the fuel that is wasted. Create a no-idling policy and have a comfortable waiting room for drivers so they don't need to keep their engines running. Petroleum and cost savings from an anti-idle policy get instant return. Investments in no-idling technology, such as auxiliary power units that can use electric energy or a smaller generator, are a valuable way to reduce idling time during overnight rest periods.

Reducing vehicle miles may be possible through better planning of routes, combining tasks, and car pooling. Delivery vehicles should be constantly refining their routes with driver experience and computer assistance to reduce miles and save time.

Even a single-mile reduction for each vehicle in a large fleet that operates every workday of the year can equate to significant savings. Using the same vehicle to perform multiple tasks and ensuring that carpooling is enforced for business meetings will also reduce mileage. With the advancements in communications technology, many meetings and seminars can be successfully conducted without using transportation, thus saving both time and money. Easily accessible public transit, ride-sharing programs, telecommuting, non-motorized paths, and bicycle storage may not directly translate to business savings but may be good incentives for employees. As transportation costs continue to increase, the availability of other commuting options may help attract or retain staff.

Efficiency

Simple strategies can improve the efficiency of vehicles with little or no investment, creating an instantaneous savings in fuel and cost. Under-inflated tires can lower gas mileage by 0.4% for every 1 psi drop in pressure of all four tires. Other maintenance, such as using the correct oil, tuning the engine, and replacing air filters can save fuel and extend the life of the vehicle. An extra 100 pounds in your vehicle could reduce your MPG by up to 2%, so make sure excess equipment is removed. Driving habits can also influence fuel economy, and companies should have policies in place to reduce aggressive driving and speeding, while encouraging the use of cruise control and overdrive gears.

Selecting the most efficient vehicle for the task is also very important, especially for larger trucks and vans. At 10,000 miles per year, a 3 mpg increase for a larger vehicle (from 14 to 17) will save 126 gallons per year, while a car (from 22 to 25) will only save 55 gallons. Having a policy in place for both vehicle purchases and use (i.e., choosing a company car instead of a van to go to a meeting) will save money.

Hybrid vehicles, in certain situations, have also been shown to produce a return on investment. These vehicles combine both an electric motor and combustion engine that have superior fuel economy in city driving. With the increasing cost of fuel, these hybrids can potentially save a company more than the increased incremental cost.

Alternative Fuels

Biofuels, such as ethanol and biodiesel, are naturally oxygenated fuels made from renewable resources. They are typically blended with petroleum fuels and labeled by the percentage of ethanol or biodiesel they contain. E10 is a high-octane fuel that can be used in any gasoline vehicle, while flex-fueled vehicles can use gasoline or any blend up to E85. Biodiesel can be used in any newer diesel engine without modification and is commonly sold as a B20 blend. With their higher oxygen content, biofuels burn more efficiently than petroleum fuels and can reduce emissions. With the potential production from a variety of locally grown biofuel feedstocks, ethanol and biodiesel add stability and security to fuel supplies.

Low-carbon fuels can also contribute to energy diversity and emission reductions, while reducing fuel costs. Most widely used for all vehicle types is compressed natural gas, while propane is often liquefied and used in large trucks. Vehicles can be sold as dedicated or bi-fueled, and conversions are also available. Eighty-five percent of natural gas and propane is produced domestically and may be already supplied to the site. Incentives are available for both vehicles and the fuel. Hydrogen is the cleanest burning fuel since it has no carbon atoms and can be combusted in an internal combustion engine or used with a fuel cell to power an electric vehicle. Currently, it is only available in demonstration vehicles and since hydrogen readily combines with other elements in nature (i.e., water), energy is required to create pure hydrogen.

Eliminating the combustion engine entirely, electric vehicles produce no emissions and are very practical for facility/campus operations. Because they are more efficient and use electricity instead of petroleum, these vehicles function at lower costs per mile. Current models operate at speeds up to 35 mph, use a standard 110 V outlet to recharge every 30 to 40 miles, require minimal maintenance, and come with many options.

Performing a Transportation Assessment

Company fleets with less than 10 vehicles may not have large potential for energy savings and could be served well with a basic outline of petroleum conservation tips. Larger fleets should be analyzed and reviewed for ways to save costs. To perform a transportation assessment, the following information should be collected:

- A list of vehicles containing the year, make, model, mileage, and what it is used for
- Fueling infrastructure details and future capability or if they fuel at commercial facilities
- Vehicle maintenance facilities and schedules
- Policy documents related to the purchasing or use of company vehicles

In addition to the on-road vehicles, there could be large amounts of energy use by forklifts, mowers, tractors, and other off-road mobile equipment. Similar conservation (non-idling or mowing less) and alternative fuel (propane or electric) strategies can be applied to these applications. While on-site, it would be useful to do the following:

- Observe idling behaviors (primarily at loading docks)
- Compare actual tire pressure to recommended value
- Determine if proper motor oil is being utilized
- Look for vehicles carrying excess weight
- Check vehicle air filters
- If conservation policies are in place, see if the drivers are familiar with them

Most significant potential energy-saving transportation recommendations should be obvious from these observations. More extensive evaluations to find more efficient driving routes, more efficient vehicles for the tasks, or alternative fuel options may only be necessary for businesses with large fleets or concerns about their transportation fuel costs.

Some useful resources to use when developing the transportation recommendations include the following:

Clean Cities www.eere.energy.gov/cleancities
US EPA www.fueleconomy.gov
US DOE www1.eere.energy.gov/vehiclesandfuels

About NC Solar Center's Clean Transportation

Alternative fuels and advanced transportation technologies are the focus of the Clean Transportation Program at NC State University's Solar Center. Collaborating with government, non-profit organizations, and businesses, the Clean Transportation team strives to improve air quality and energy security by diversifying fuel supplies and promoting economic development that utilizes local resources and cleaner technologies. Through a 3-year Clean Fuel and Advanced Technology project focused on reducing transportation related emissions, assistance and funding are provided to fleets in North Carolina counties that have air quality concerns.

Created in 1988, the North Carolina Solar Center serves as a clearinghouse for solar and other renewable energy programs, information, research, technical assistance, and training for the citizens of North Carolina and beyond. Through its programs and services, the Solar Center seeks to stabilize energy costs for consumers, stimulate local economies, reduce dependence on foreign fuels, and mitigate the environmental impacts associated with fossil fuels. By capitalizing on its close ties with the state government of North Carolina, North Carolina State University, the renewable energy industry, and various non-profit organizations, the Solar Center has developed into one of the premier renewable energy centers in the United States.

Bryan worked with the IAC at North Carolina State University while earning a master's degree in 2005. He is now the Clean Transportation Specialist at the NC Solar Center.

Feature Article

Introduction to Industrial Refrigeration Best Practices

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Abstract

Despite origins dating to the late 19th century, industrial refrigeration has been slow to adopt aggressive energy efficiency strategies reflective of today's energy climate. This is partially due to a traditional, slow-moving industry that prefers proven designs and components, particularly when associated with critical applications in the food processing and storage sectors. Combined with relatively low electrical energy rates through the 20th century, it was well into the 1990s before efficiency became a major design criteria.

Slowly, industrial refrigeration system designers, vendors, contractors, and end users have begun focusing on ways to implement energy efficiency into major equipment components, system design, and advanced features offered by computer control and variable frequency drive (VFD) technology. This paper is a brief introduction to the applications of industrial refrigeration, the primary components, and methods of implementing energy efficiency, both in new construction and as a retrofit.

Defining Industrial Refrigeration

Industrial refrigeration can be loosely defined as

- 100 tons of refrigeration or greater
- Ammonia (R-717) in vast majority, some R-22
- Centralized and built-up, as opposed to commercial packaged
- –60°F to +55°F loads, with normally at least one below 40°F
- Primary application: production and storage of food products

Note that centrifugal chilled water systems are not directly addressed within this category. However, much of the major efficiency concepts apply.

Typical Industries

Typical industries utilizing industrial refrigeration include

- Public refrigerated warehouses
- Food distribution centers
- Fruit controlled atmosphere
- Fruit and vegetable processors
- Breweries and wineries
- Dairy and ice cream processors
- Meat, poultry and fish processors

There are some additional applications of industrial refrigeration, such as in the petrochemical industry. These applications are not considered within this paper.

Why It's Challenging and Unique

There are a number of reasons why implementing energy efficiency in industrial refrigeration is challenging and unique:

1. In virtually all applications, an industrial refrigeration system is the "heart" of the facility. If the engine room goes down in a cold storage facility, the operators may have a day or two of thermal flywheel effect to carry the facility until the refrigeration system is returned to service. However, in a production facility, a struggling or failed refrigeration system can take down the entire process.
2. A systematic approach to efficiency is required. All components are extremely interactive, and it is rarely possible to modify one subsystem and not realize changes throughout other components.
3. The industrial refrigeration industry is quite "traditional," and at times can be resistant to change or innovation. For example, despite the full embrace of VFD technology with centrifugal chillers and screw air compressors, it wasn't until after the year 2000 that ammonia screw

compressor manufacturers began offering a thoughtfully designed VFD alternative.

4. Energy analysis and proper modeling of industrial refrigeration systems are extremely challenging, particularly the subtleties of screw compressors (e.g., economizers, variable VI, etc.) and evaporative condensers (e.g., pump-only or dry operation, fan VFD control, complex staging algorithms, etc.).
5. The opportunities for energy efficiency are often vague or non-intuitive. Since these are indeed "systems," all potential ramifications associated with efficiency upgrades must be addressed for successful projects. In addition, designers and contractors are often focused on peak design loads under extreme ambient conditions, often forsaking the thousands of hours when the system operates at reduced capacity.
6. Refrigeration system operators dictate the energy use for the refrigeration system through setpoint and operational strategy decisions. Unfortunately, these same operators are under the competing responsibilities of production, maintenance, and efficiency. Of these three, efficiency is virtually always the lowest priority. This is further compounded by the fact that most operators are not privy to the monthly utility bill and have little capability for benchmarking key performance Indicators (KPIs) associated with the system.

Major Subsystems and Components

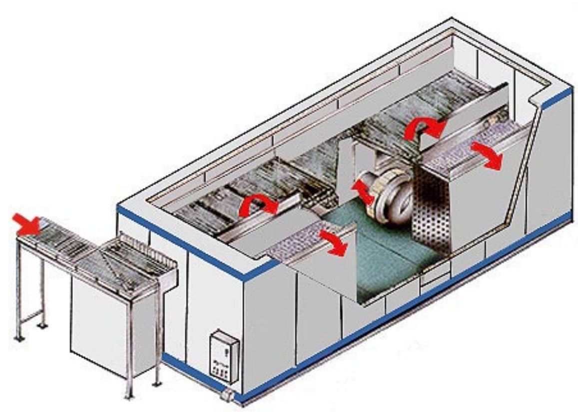
At most facilities in the United States, the compressors and condensers reside in the "Engine Room," while in Canada it is often referred to as the "Powerhouse." The term Engine Room will be used throughout this paper. The following sections provide an introduction to the typical components in an industrial refrigeration system. It is assumed that the reader has an existing knowledge of basic refrigeration cycles and components.

Standard Air-Coil Evaporators. The most common load in a system is an air-coil evaporator, as shown in the following figure.

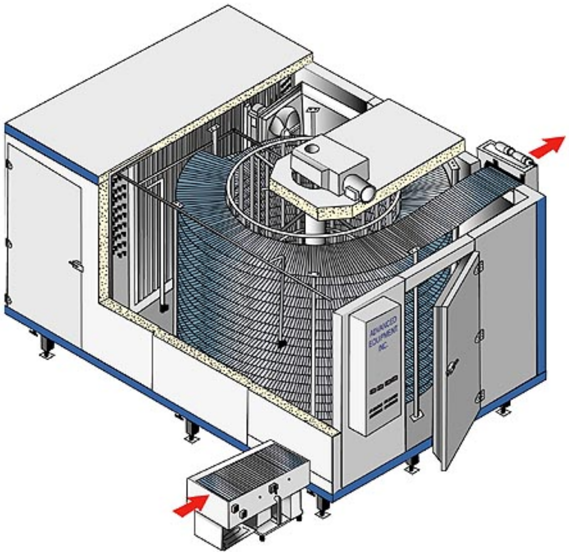
Sample evaporator coil.

Evaporator coils are typically hung from ceiling trusses in a warehouse, located in a penthouse atop the space, or are installed within a belt freezer, spiral freezer, or blast cell. The units can contain anywhere from 1 to 6 fans, ranging from fractional to as large as 25 hp or more in processing applications. The coils can be constructed of aluminum or steel and can utilize either stamped or cast fan blades. The majority of applications utilize axial fans, although some applications require the static pressure capabilities or noise benefits of centrifugal fans. The coils can be direct (thermal) expansion, flooded, or liquid recirculated design. Some examples of evaporator coils applications are shown in the following figures.

Typical warehouse application.



Sample belt freezer.



Sample spiral freezer.

Secondary Fluid Evaporators. Often, a facility may need to create chilled water or glycol, or cool a fluid product such as juice or milk. In these applications, it is common to use shell-and-tube, plate-and-frame, and falling-film heat exchangers.

Direct Contact Evaporator Loads. In some cases, a product may require cooling directly adjacent to the liquid refrigerant. Examples include freezing ice cream or making ice. Common systems include scraped-surface heat exchangers, flake and tube ice makers, and plate freezers, with examples shown below.

Scraped-surface heat exchanger.

Plate freezer.

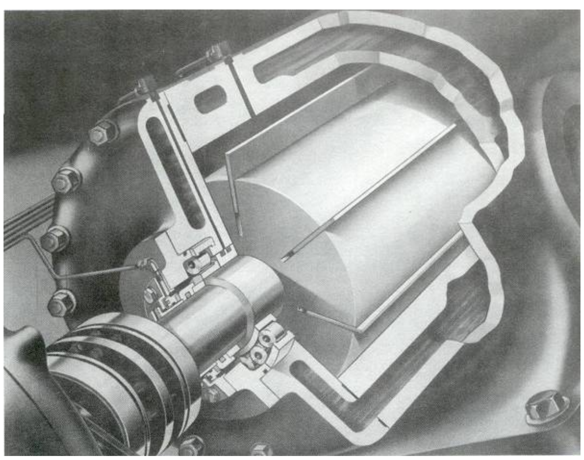
Compressors. Industrial refrigeration systems utilize reciprocating, rotary screw, or rotary vane compressors. The latter has all but disappeared from the new sales market, with screw compressors often being preferred due to capacity and maintenance issues.

Rotary screw compressors come in sizes up to 1500 hp and can be used as boosters, high stage, or single stage. Virtually all modern screw compressors are twin rotor design, although one prominent vendor offers a single screw design. Slide valve capacity control is predominant, although variable speed is becoming more widely adopted. The compressors are usually equipped with a micro-processor panel that can be operated stand alone or within a control system network. Cooling is typically accomplished with liquid injection or thermosiphon, although one vendor offers direct cooling of the oil with a layer of ammonia floating atop the oil in the separator. The compressors can come in fixed, manually adjusted, or automatic internal volume ratio.

Screw compressor package.

Reciprocating compressors were predominantly used until the 1980s. They are still in use today, despite the popularity of screw compressors. They come in sizes up to 300 hp, ranging from 2 to 16 cylinders. Despite increased maintenance requirements, they can often be serviced in-house and offer excellent part-load performance. They can be belt or direct driven and are typically water cooled. They can be controlled by simple pressure switches or by modern micro-processor panels. The compressors can be utilized as boosters or high stage but cannot be single staged to excessively low suction pressures due to pressure ratio limitations.

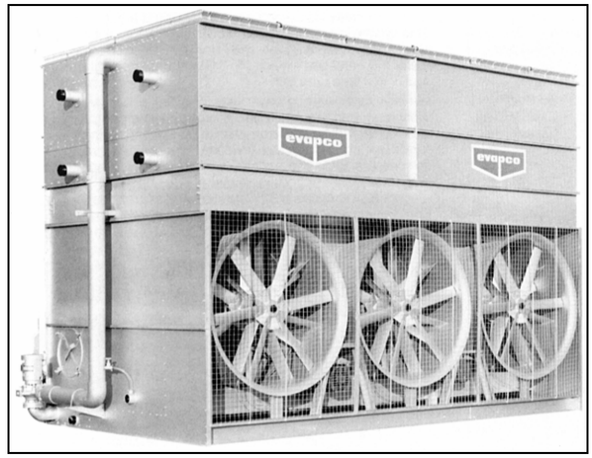
Reciprocating compressors.



Rotary screw compressor.

Rotary vane compressors were a common booster throughout the 20th century. However, their tendency to wear rapidly and susceptibility to liquid slugs and the popularity of screw compressors have all but eliminated them from the new sales market.

Evaporative Condensers. Evaporative condensers completely dominate in industrial refrigeration applications. The units can be equipped with either axial or centrifugal fans and utilize a built-in or remote water sump. Both induced and forced-draft designs are available. Capacity is typically managed by pump cycling or fan modulation of some form, including cycling, two-speed, pony motors, and VFD control.



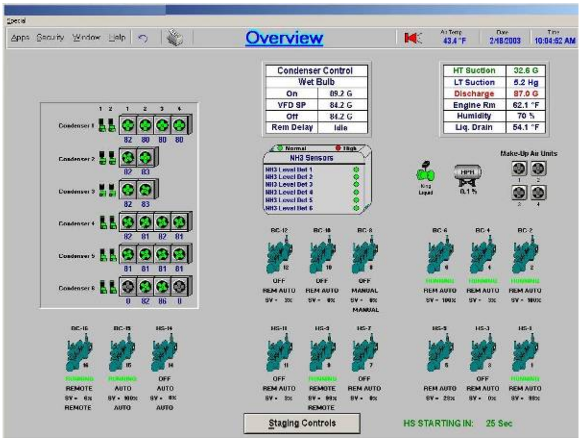
Evaporative condenser.

Controls. Refrigeration components and systems can be controlled manually, with electro-mechanical controls (e.g., pressure switches and thermostats), or with modern computer control systems.

Pressure switches.

Electromechanical controls can include pressure switches, thermostats, timers, relays, and other typical components to turn equipment on and off and to initiate capacity control (e.g., cylinder loading or fan cycling).

Increasingly common is the use of a full refrigeration computer control system to manage and monitor most or all of the components in a system. These control systems can be custom designed by a controls integrator, installed by a refrigeration-specific control firm, or even implemented with in-house controls staff. Most modern control systems utilize PC or PLC control and are based upon common industrial software such as Wonderware, Intellution, RS View, Siemens, and Think-N-Do. However, several prominent packages are based upon proprietary software and programming.



Sample control system screen.

Sample control system I/O panel.

Reducing Lift

Most refrigeration system operators and designers know that increasing suction pressure and reducing discharge pressure improves compressor efficiency. However, knowing these basic principles without addressing common barriers to these adjustments can leave a system operating inefficiently due to bottlenecks.

In general, raising suction pressure/temperature will increase compressor efficiency by approximately *2% per ºF increase* (compressor capacity increases) In the simplest scenario, the pressure is simply operated too low due to tradition, a troublesome minor load, or because product or space temperatures are maintained lower than necessary. Other opportunities include excessive suction piping pressure drop, poorly selected or operating evaporator coils, or inappropriate application of a low suction to a high-temperature load.

Similarly, reducing discharge (or "head" or "condensing") pressure/temperature will increase compressor efficiency by approximately *1.5% per ºF reduction* (compressor power decreases). Note that there are two completely separate issues when reducing discharge pressure: (1) the approach to wet bulb and (2) the minimum allowed pressure.

To reduce the approach to wet bulb, additional condenser capacity is typically required. *Efficient systems are often designed with condensers selected at 15ºF difference between condensing temperature and the peak ambient wet bulb.* This design consideration is valid in virtually all applications and climates, although certainly most prominently in southern climates and in area with warm weather for most of the year.

Key in most of the moderate and northern climates is the minimum allowable condensing pressure. *In a well-designed system, condensing pressure is allowed to float as low as 90 psig (58 ºF) for ammonia applications when ambient conditions allow.* In a moderate climate, such as Seattle, Washington, a system can run at this pressure approximately 3,000 hour/year.

The list of potential barriers to reducing discharge pressure is quite long and includes the following:

- Hot gas defrost
- Heated zones
- Icing or other winter issues
- Water defrost and common sumps
- Oil separator performance
- Gas-powered valves or unloaders
- Liquid injection oil cooling
- Screw compressor oil carryover
- Underfloor heating performance
- Phillips Pumper drum operation
- Direct-expansion coil feed and performance
- Process or door hot gas needs
- Inadequate liquid pressure to serve loads
- Concerns about condenser fan and pump energy
- Misperceptions about screw compressor volume ratio and efficiency

- Tradition passed on verbally, or by criteria such as “target” marks on gauges

In some systems, several of these barriers may be an issue. However, each barrier has a solution, and only the most challenging system cannot be run as low as 90 psig.

Improving Part-Load Performance

Evaporators, compressors, and condensers are all required to operate at reduced capacity during some if not most operating hours. The simplest and lowest-cost forms of control are often the least efficient, and can be improved dramatically through improved computer control and primarily VFD technology.

Evaporator Coils. The worst form of evaporator coil capacity control is non-stop fan operation, with only the liquid solenoid or pressure regulator providing capacity modulation. Fan cycling is an improvement, but *the most efficient form of evaporator capacity control is with VFDs*. It is important that optimized control system algorithms are utilized to maximize the savings afforded by the fan affinity laws. In general, operating evaporator coils simultaneously at the same speed is preferred.

Sample evaporator fan VFD application.

Screw Compressors. Most screw compressors utilize slide valve capacity control, which requires from 30 to 50% of full-load power when completely unloaded. As with evaporators, *the most efficient form of screw compressor capacity control is with VFD technolog*y. Most compressors are slowed from 3600 to 1800 rpm as a first stage of control, with the slide valve providing the balance of trimming. One prominent manufacturer is providing VFD control down to 20% speed, and another is increasing maximum speed to 4500 rpm. In all cases, the local compressor microprocessor directly controls the VFD. It is important that the VFD-driven compressor be the dedicated trim machine, and that one VFD is installed per suction system. It is almost never advisable to install more than one VFD per suction.

Sample compressor VFD application.

Note that applying VFD technology to reciprocating compressors is typically ill-advised. Reciprocating compressors have nearly ideal part-load performance, and only a non-energy benefit should be considered in this application.

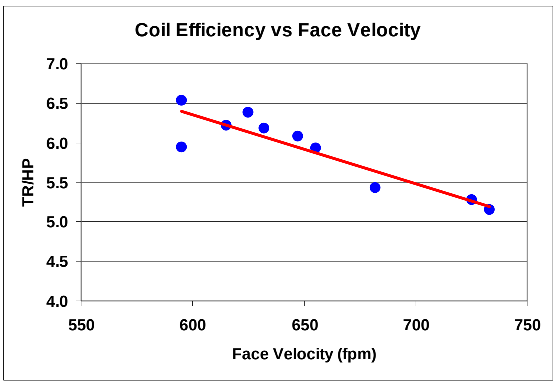
Condensers. The simplest form of condenser capacity control is simple fan cycling. Although some condensers have been equipped with two-speed motors in the past, *VFD technology is the most efficient form of condenser capacity control*. Of all subsystems, condensers require the greatest care with optimizing algorithms. Condensers are at peak efficiency when wet and at mid-range fan speeds. Any control algorithms should prioritize this mode of operation, avoiding dry or pump-only operation if at all possible. In addition, the most efficient condensers (e.g., axial, integral sumps) should be operated first.

Proper VFD Application. Note that these are challenging VFD applications for a variety of reasons, ranging from limitations of the driven equipment to the reflected wave phenomena and difficult environments. It is important that all potential design, control, and installation ramifications be well understood prior to implementing VFD control.

Equipment-Specific Upgrades

These are equipment features, characteristics, or options that can be ordered new, or in some cases retrofit.

Evaporator Coils. When ordering evaporator coils, query the vendor or contractor for coil selections that have low hp/TR ratings. This will typically be associated with *lower air velocity requirements* and fin/tube configurations that minimize air pressure drop across the coils.



Effect of face velocity on efficiency.

Screw Compressors. If at all possible, avoid liquid injection oil cooling. This form of cooling can impart a shaft power penalty ranging from 1 to 12%, often imposes a barrier to minimum condensing pressure, and ensures that booster compressor oil heat will be seen as a load by high-stage compressors.

Sample liquid injection cooling.

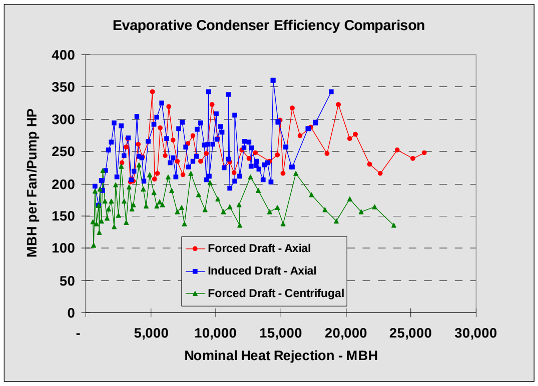
Thermosiphon oil cooling is more efficient, eliminating all of the mentioned inefficiencies for liquid injection. The method of cooling compressor oil by direct contact with a layer of liquid ammonia is relatively new to the market, and is only offered by one manufacturer. Other than eliminating a possible barrier to minimum condensing pressure, it is unclear if this form of cooling fully eliminates the injection penalty. In addition, any booster compressor application will still burden the high-stage compressors of a two-stage system with heat from the booster oil cooling.

An additional configuration option is automatic variable internal volume ratio (VI) adjustment. In some applications where suction and/or discharge pressure vary widely, a compressor with fixed or manually adjusted VI may experience over or under compression, reducing compressor efficiency. *In these applications, an auto VI feature will optimize compressor efficiency*.

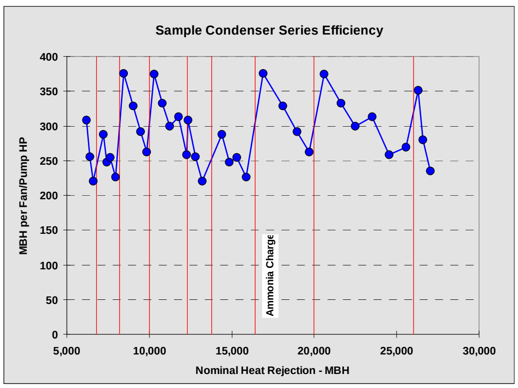
Sample thermosiphon application.

Condensers. Optimum evaporative condenser selection will prefer an axial fan unit over centrifugal. In addition, induced draft units tend to be slightly more efficient than forced draft units.

Every series of evaporative condensers has high- and low-efficiency units. Within a given tube bundle size (commensurate with a given ammonia charge), the first unit is typically the most efficient, performing heat rejection primarily with surface area rather than airflow. As capacity is increased with airflow, the efficiency of the unit degrades until the coil size jumps to the next size. Unfortunately, the lowest initial cost ($/MBH) is associated with the least-efficient unit. *An efficient selection would be one with the lowest MBH/HP in exchange for increased $/MBH.*



Comparison of condenser efficiencies.



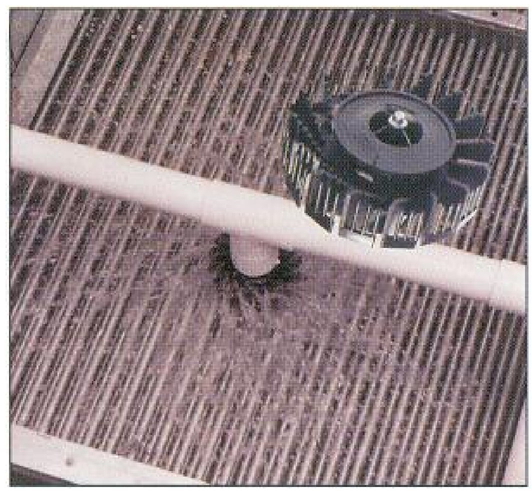
Sample condenser series efficiency.

Although frigid weather and other priorities (e.g., water treatment) make a remote water sump desirable, integral sump pumps minimize pumping heat and maximize efficiency.

Sample remote condenser pump.

Finally, condensers can be ordered (or retrofit) with new high-performance spray nozzles. In addition to superior water spray pattern, these nozzles resist troublesome plugging with the traditional 180º nozzles.

High-performance static nozzles.



High-performance rotating nozzle.

System Design Issues

There are many advanced system design issues. These include the following:

- Two-staging
- Multiple suctions
- Subcooling
- Pumper drums
- Hot gas defrost design
- Heat recovery
- Purging

Two Staging. *Two staging is the most efficient method of obtaining low suction pressures and temperatures*. Economized screw compressors can provide some of the efficiency benefit of a two-stage system. The trade-off with two staging is increased initial cost and additional system complexity.

Multiple Suction Systems. *If a facility has multiple temperature requirements, it is most efficient to divide loads into logical suction systems when loads differ by 10ºF or more.* This prevents serving a load with an inappropriately low suction. An example would be in a distribution center where a small ice cream room requires a lower suction than the main freezer, but a single suction adequate for the ice cream room is installed. In this case, these loads should be split into two suctions to improve efficiency.

Liquid Sub-Cooling. In a system with multiple suctions, additional thermodynamic efficiency can be obtained by using successive suctions to sub-cool liquid refrigerant served to lower suctions. This typically costs little to implement and only requires forethought during the design phase. Cascading sub-cooling can also be implemented as a retrofit if possible.

Phillips Pumper Drums. Some systems utilize hot compressor discharge gas to mechanically pump liquid refrigerant, in lieu of standard pumps. These systems are often known as Phillips Pumper Drums. These systems can be efficient if designed and maintained properly, allowing for low minimum condensing pressure and limiting the penalty associated with using hot gas for pumping. However, many existing systems seem to exhibit poor efficiency, due to original design, or drift from optimum configuration.

Hot Gas Defrost Optimization. Many systems utilize hot gas defrost. Under the simplest design and control configurations, hot gas defrost can be quite inefficient. Operators may feel they need high engine-room discharge pressure for adequate defrost, limiting minimum condensing pressure. When the defrost is nearing completion, hot gas can simply be "whistling" through the coil and returning to the suction line, false-loading the engine room. Inefficient designs will utilize simple time clocks to initiate, manage, and terminate defrost cycles, devoid of any external inputs indicating a need for, or completion of, a defrost cycle.

An efficient design will utilize low-pressure gas (e.g., 65 to 75 psig) in the coil during defrost, will utilize frost sensors or liquid run-time for initiation, and will terminate based upon a parameter such as return gas temperature. Liquid float drainers can be used to eliminate gas that might return to the suction line, and defrost return gas can be routed to a higher suction system (e.g., the intermediate of a two-stage system).

Sample evaporator frost sensor.

Heat Recovery. *Ammonia refrigeration systems can only provide low-grade heat recovery to water, in the range of 80 to 100ºF*. This can be achieved with a desuperheater on the compressor discharge line. A common application is pre-heating of boiler makeup or plant wash-down water. *In virtually no case should engine room discharge pressure be artificially elevated to increase heat recovery system performance*. If a large amount of high-quality heat recovery is required, consider dedicating one or more compressors to operate at elevated discharge pressure, acting as "heat pumps."

Purging. *Automatic purgers should be installed on all systems, even those not operating in a vacuum*. Air can enter the system through seals or during servicing. This air accumulates at the top of the condensers, resulting in elevated compressor discharge pressure.

Reducing Refrigeration Load

Any efforts to reduce refrigeration load obviously provide energy savings in the engine room. Some typical methods are discussed as follows.

Increased Insulation. Insulation levels for the envelope can be increased during new construction. *However, in most cases the incremental economics of adding insulation are poor* in all but the most extreme climates and space temperatures.

Improved Door Selection. Fast-acting doors should be implemented in place of manual doors, strip curtains, or simple air curtains. This is true for both cooler and freezer applications. *For freezer applications, select doors that have minimal electric heating requirements*. If the door utilizes hot refrigerant discharge gas for heating, ensure that it will operate properly down to 90-psig discharge pressure. Some of the high-performance vestibule-style doors offer excellent safety benefits yet can be initially configured or improperly field adjusted, resulting in inefficient operation.

Multiple suctions on heat exchangers.

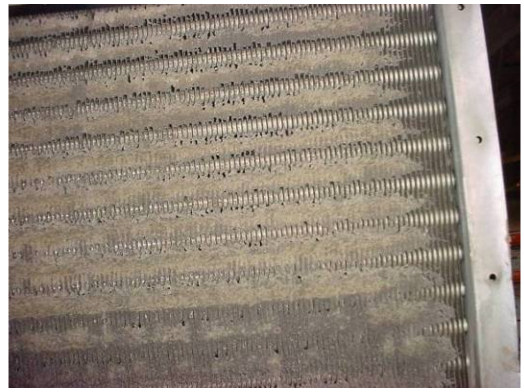
Process Improvements. *Utilize cooling tower water in lieu of chilled water when process temperatures allow*. Avoid the use of chilled water or glycol for inappropriate cooling applications, such as air compressors. Perform multiple stages of cooling with various refrigeration suctions, cascading the loads from the higher to lower suctions.

Proper O&M Practices

To achieve peak energy efficiency, a system must be well maintained.

Evaporator O&M

- Clean evaporator coils at least annually
- Repair or replace faulty valves and solenoids
- Calibrate temperature probes used by controls
- Adjust liquid overfeed rates in recirculated systems



Dirty evaporator coil.

Compressor O&M

- Calibrate slide valve potentiometers
- Calibrate pressure transducers used by the micro-processor
- Ensure that auto-VI features operate properly
- Correct any current-limiting/forced-unloading issues
- Maintain belt drives on reciprocating compressors

Screw slide potentiometer.

Condenser O&M

- Clean nozzles and strainers
- Clean tubes
- Clean drift eliminators
- Check and set water header pressure
- Service belt drives
- Prevent recirculation and saturation
- Treat condenser water
- Check and purge non-condensables
- Deal with poor environment, such as boiler or fryer stacks that discharge near condensers
- Ensure proper water treatment

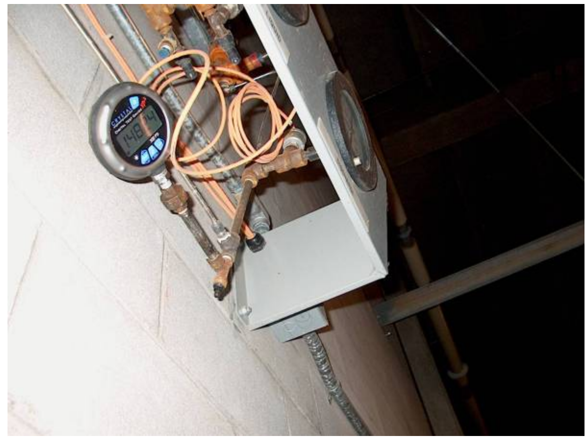
Plugged condenser nozzles.

Results of poor water treatment.

Control System O&M

- Repair failed communications (RS-485 is often frail, flakey, or failed)
- Repair failed compressor microprocessor panels
- Repair & calibrate probes, transducers, sensors, etc.

Faulty mechanical gauges.



Calibration of transducer and gauge.

Summary

Virtually all industrial refrigeration systems can benefit from O&M and commissioning efforts, typically improving efficiency by 5 to 15%. In addition, aggressive capital upgrades during new construction and as retrofits can add another 10 to 30% savings. There is little relationship between savings potential and age or complexity of the system.

Note: This paper was created with excerpts from the Industrial Refrigeration Best Practices Guide, *created by Cascade Energy Engineering, Inc. with funding from the Northwest Energy Efficiency Alliance. Copies of the full guide can be obtained from the Alliance.*

University Briefs

University of Alabama. As the Alabama IAC celebrates its first anniversary, we look back on a productive and educational year. The center has completed 11 regular assessments and 2 Manufacturing Extension Program (MEP) partnership assessments, with a third joint assessment to come. The MEP partnership has proven to be very rewarding for the AIAC team. Dimos Triantafillu spent the past summer as an intern at the Alabama Productivity Center (APC), which is one of 10 Alabama Technology Network (ATN) regional NIST/MEP Centers in Alabama. Dimos was able to act as a liaison between the AIAC and the APC, conveying valuable knowledge and strengthening the relationship between the two centers. Consequently, a student/faculty team from the AIAC partnered with the APC to conduct an energy audit of the Alabama State Docks in Mobile, Alabama. This particular project, existing under the sponsorship of the APC, displays the progress already made to establish connections with current organizations serving the state of Alabama. It is also evidence of the myriad opportunities for developing these growing relationships in the coming years.

In other news, AIAC graduate students Aaron Cossey and Dimos Triantafillu co-authored a paper entitled “Energy Efficiency Improvements for Aluminum Crucible Heating Systems,” which was based on an energy efficiency project for a large aluminum foundry. Also, Drs. Woodbury and Taylor attended the Alabama All-Hands Meeting in September 2007. In the spring of 2007, current graduate lead student Blair Clinton and former undergraduate student John Lindley attended the Fundamentals of Compressed Air Systems, an introductory course sponsored by the Compressed Air Challenge and hosted by The University of Alabama.

The AIAC now has a team of three mechanical engineering graduate students, five undergraduate students (two industrial and three mechanical), and three principal faculty members. The AIAC team is looking forward to the new year and the challenges it may bring.

Bradley. The Bradley University IAC conducted an Energy Efficiency Workshop on August 3, 2007. Representatives from over 60 manufacturing companies attended this day-long workshop. The director of the BU IAC Dr. D. Paul Mehta gave an introduction about IAC and the necessity of energy audits to industry. Drs. David Zietlow and Dean Kim also participated and gave presentations, and Mr. Martin Wiesehan gave a presentation on the use of Quick Pep. In addition, IAC team members presented different software tools, like AIR Master, PHAST, and PSAT, that can be used to identify and analyze energy saving opportunities in plants. The team members explained each tool briefly with practical examples, giving the attendees an idea of how and where to use them. The participants appreciated the workshop.

Bradley IAC Team Members.

Colorado State. Colorado State University (CSU) IAC has had a busy year of plant visits. The main areas of industry our center saw this year dealt with wood products, metal containers, and gypsum products. Continuing our commitment to smart energy practices, our center celebrated its 600th assessment this year as well. It has been some time since our center has been in Nebraska, but this year we were finally able to return for two assessments. We also returned to New Mexico to do several assessments and completed assessments all around our native Colorado industrial community.

A major boom in green energy initiatives and industry in our area of the United States has aided our center's focus on renewable energy. For example several recommendations aimed towards using solar energy in heating and power applications, while others focused on biomass power generation. Green energy is something the CSU IAC prides itself on and hopes to continue focusing on in the coming year. Our center also saw some fascinating industrial equipment, like several immense drying ovens used in gypsum drywall products. One of these behemoths consumed a hefty 7 million dollars worth of natural gas in a year and stood roughly two stories high and 800 feet long!

University of Dayton. The UDIAC has had a very productive year full of interesting audits and research. Typically, the center only schedules about 7 audits per semester. However, this season the center has had an unusually busy fall semester with 12, one-day assessments scheduled. These assessments have included mid-sized industries, large industries, and joint audits with our local Manufacturing Extension Programs (MEP).

Thanks to an all-star lineup of experienced lead students and talented new graduate students, the center has been able to complete its demanding schedule, while maintaining a high quality of work. Mechanical engineering graduate students Dan Trombley and Peter Kleinhenz have been sharing the lead student position. Dan is scheduled to graduate in December of 2007 and Peter in May of 2008. Both will graduate with over 40 completed audits and are hoping to pursue careers in energy consulting. Other experienced members of the team include Kazim Mirza and Charlie Schreier. Both Charlie and Kazim are not only involved in conducting industrial energy audits with the IAC but also put significant work into maintaining a building energy center, which specializes in building energy science rather than industrial. Newer members of the center include mechanical engineering graduate students Shuihua Hu, Steve Mulqueen and Tom Wenning. Steve, from Milwaukee, Wisconsin, and Shuihua, from Wuhan, China, both benefit the team with their useful experiences from working several years professionally in the energy field. Tom, who recently received his bachelor's degree from the University of Dayton, also brings strong engineering skills and leadership potential.

Along with conducting energy audits, the UDIAC continues conducting research and publishing works in prestigious conferences and journals. Oftentimes, this research is conducted in collaboration with UDIAC alumni working in the professional energy field all over the country. This past year the team was able to publish and present papers in several conferences covering topics such as, the carbon market impacts on energy efficiency, the optimization of skylighting design to minimize HVAC loads, analyzing statistical correlations of energy usage to weather and production and net zero energy houses. UDIAC alumni who teamed up with the center to conduct this research include John Seryak from Go Sustainable Energy, Bill Eger, the city of Cleveland energy manager, Kevin Carpenter from Energy Resource Solutions, Rizwan Syed from Graphet, Inc., and Ovelio Isambert from AAM. More information regarding the UDIAC team, research and audit data can be found at http://www.engr.udayton.edu/udiac/.

Delaware. The University of Delaware has had a great first year, with an average recommended savings in our first year of 15%. We've had the opportunity to do assessments at a variety of plants ranging from plastics to chemical gases, one where we even had to cross state lines during the assessment day! We've had positive interactions with local utilities (including a donation of a thermal camera) as well as the local MEP and business organizations. Our assistant director made a presentation at a local industrial fair, and our director gave a talk at the EPA Metro Philly Energy Efficiency Workshop, both resulting in new customers for our center.

Besides our work in energy efficiency, we have ongoing research into alternative energy, including a large effort into photovoltaics for portable electronics. Our director is teaching a course in energy sustainability this semester where, in addition to covering both fossil sources and alternate energy, principles of energy efficiency employed in our assessments are delved into, with the goal of the course to answer the question, "what does the energy makeup of our country look like in 2030?" This is an exciting time to work in the energy field, and our entire team recognizes the importance of our efforts in efficiency as well as alternate energy, as both are required to meet our nation's future needs.

Florida. The University of Florida Industrial Assessment Center (UF-IAC) recently hosted two experts from the National Insulation Association for a web broadcast entitled "Insulation, the Forgotten Technology for Energy Conservation." UF-IAC students attended the live broadcast along with students from the Industrial Energy Management undergraduate course. Comments were very favorable since many students were not familiar with insulation beyond standard fiberglass batting.

The web broadcast will be available for viewing at the National Insulation Association website at www.insulation.org at no charge on or after November 12, 2007. A feature of the broadcast is the use of infrared cameras to easily spot and quantify potential savings.

Georgia Institute of Technology. This past year, the Georgia Tech IAC welcomed four new students to the program. Achin Chugh, a senior student who has invested 3 years with the IAC program, is graduating in December. His contributions to the program will be missed.

A topic that has been in the news a lot lately is the growing concern in Georgia about the available water supply. This water shortfall is a function of both large growth in Georgia and the ongoing shortage of rain. Significant reduction efforts have already been implemented, primarily in the form of water use restrictions and mandated cuts. This center has always considered water consumption efficiency as part of its industrial assessments. Because of the new challenges faced by Georgia, this topic will get increased attention in upcoming plant visits as this center tries to do its part.

The University of Illinois at Chicago. As the year closes, the UIC-IAC is pleased to announce that four of its students have received a total of nine scholarships, grants, and waivers. These awards, from national, state, and local organizations, amount to more than $17,000 and will allow the students to spend more time on their studies and IAC work, as well as reducing the amount of debt they have to carry to fund their education.

Left to right: Alora Moore, Andrey Gribovich, James Gilbert, and Jim Lyon.

The UIC-IAC is also pleased to announce that four new engineering students are joining the team. They are Andrey Gribovich (IE), James Gilbert (Ch. E), Jim Lyon (ME), and Alora Moore (ME). Currently the UIC-IAC has a total of 15 graduate and undergraduate students representing the mechanical, industrial, chemical, electrical, and civil engineering majors at UIC. Welcome aboard!

Iowa State University. Iowa State has recently had to say goodbye to some IACers. We sent undergrads, Nick Reick, Adam Wellman, Dan Jensen, and Grant Miller off to full-time jobs upon their graduation. Graduate student Mirka Deza went on for her PhD in another area. Alex Kisslinger Rodrigues also left the IAC at Iowa State. Alex took a job in Lisbon, Portugal, and we wish him and all our former staff the best of luck. The following students also received their certification: Justin Walker, Som Shrestha, Dan Jensen, Mark Johnson, and Randy Teed.

Lehigh. The Lehigh University IAC has been very active during the past year, undertaking 12 assessments, as well as 6 additional assessments for large energy users.

To provide further assistance to industrial sites in our area, a workshop, in conjunction with Spirax Saarco, was presented on June 29, 2007, at Spirax Saarco in Center Valley, Pennsylvania. This workshop focused on steam system savings opportunities. Additionally, the Lehigh IAC has cooperated extensively with the local MEP (Manufacturing Resource Center, Bethlehem, Pennsylvania), identifying several valuable clients for assessments, as well as conducting several joint IAC-MEP assessments.

During the months of May through July, our lead IAC student, Bhaskar Vempati, a Lehigh University Ph.D. candidate, served as an intern for the Manufacturers Resource Center in Bethlehem, Pennsylvania. During this period, Dr. Vempati assisted the MRC with marketing energy services for the MRC clients and identified potential customers. Successful energy assessments for 7 facilities (6 companies) were undertaken. The following goals were achieved during the internship: energy conservation awareness was created among MRC personnel and several MRC clients, best practices and assessment recommendation information was given to the MRC staff, shorter energy assessments were conducted at smaller plants, and referrals were made to the Lehigh University IAC.

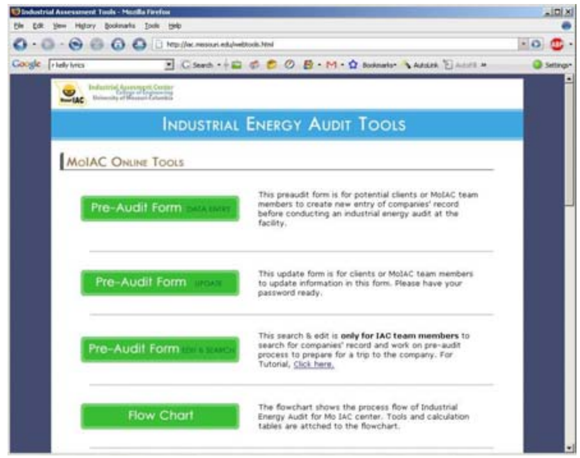
During the fall of 2007, the DOE Industrial Technologies Program (ITP) gave Energy Champion awards to two of the Lehigh IAC clients and Energy Saver awards to eight clients.

In addition, a case study for Pennex Aluminum, a company assessed in February of 2006, was submitted to the ITP for publication. A potential annual energy savings of $2 million was identified during this assessment.

University of Louisiana–Lafayette. The year's staff consisted of all new students except one. The new students are now well trained and prepared for future assessments. We took many long trips and conducted a few very interesting assessments. One of those trips was to a glassware production facility, as shown in the picture. The year ended with many assessments made over the summer, and we are now gearing up for the new year.

Left to right: Manager of a glassware manufacturer, Bimal Kaur, John Pechon, Dr. Jim Lee, Jeanese Carriere, Chad Olsen, and Aaron Artigue.

Molten glass poured into a mold at a glassware manufacturer.



MoIAC online web tools.

University of Massachusetts. Dylan Chase completed 8 assessments and received his student certificate in July 2007.

University of Michigan. Dr. Merte Herman replaced Dr. Margaret Wooldridge as the Assistant Director of our center in September 2007. On May 3, 2007, Dr. Arvind Atreya, Brad Zigler, and Won Chan Park of our center presented at the Reduce Energy Use Workshop in Detroit. Our center covered topics including Overview of IAC, PHAST training, Introduction of Quick PEP and CHP. Devin Rauss who worked with us as a undergraduate student, started his new career in August at Southern California Edison, in a position in their Refrigeration and Thermal Test Center. A graduated student, Sean Berhan, and an undergraduate student, Kyle Rademacher, joined our center in this past summer.

University of Missouri. The Missouri IAC has implemented a new centralized web site called Web Tools that contains all the tools necessary for our IAC members to perform detailed energy audits. The objectives of Web Tools are to save time, reduce number of necessary tasks, and increase productivity within the time frame of the entire industrial energy audit. With these aims, we hope that the Web Tools frame work can improve the quality of our organizational activities and can be an example for future development. Web Tools can be viewed at http://iac.missouri.edu/webtools.html.

Also, over the past several months, several of our students have been involved in a newly created cooperative program in which our center collaborates with the Missouri Enterprise Business Assistance Center in an effort to improve Missouri businesses. In the program, members of our center have provided energy audit services and issued AR reports, while the MEP provides services to enhance productivity and production. The involvement of these students allows further insight into the energy efficiency of various operating processes. With this insight, we are able to better assess problem areas in energy usage as well as in productivity and manufacturing.

University of Miami. One IAC graduate student, Mr. Ziad Roushdy, graduated in May 2007 with a master's degree in industrial engineering and has been hired in private industry. His thesis was entitled "Simulation for Solar Tracking Device on Mobile Object." Another two IAC graduate students, Ms. Deger Ozkaramanli and Ms. Sonila Cami, are approaching degree confirmation as they prepare to defend their thesis research requirements. Their theses are entitled "Kinetics, Kinematics and Muscle EMG of Different Designs of High Heeled Shoes," and "The Effects of BMI Index on Kinetics and Kinematics of Gait." One of these students has been hired in private industry, while the other intends on continuing her education.

In addition to our current local assessments, which included a boat, pharmaceutical plastics, and cement manufacturer, MI-IAC team members are focusing on our MEP relationship with Puerto Rico. To date, our center has conducted five assessments in collaboration with our MEP.

MI-IAC is also in the process of preparing a workshop for local industry and the academic community. This workshop will focus on DOE issues including software, Save Energy Now, and Quick PEP. Additionally, the workshop will discuss electrical data logging and energy management and conservation equipment. Pertinent issues regarding local manufacturing will also be addressed.

Mississippi State University. The Mississippi State IAC had two students earn certificates in 2007.

North Carolina State University. The staff at the NCSU IAC has completed another year of providing surveys to manufacturers in North Carolina, South Carolina, and Virginia. We've seen a variety of products being made ranging from bricks to fiber optic cable to cookies. We have sent three graduate students and several undergraduates into the workforce this year. Their IAC experience was very helpful in getting them good jobs in the energy field.

We had the pleasure this summer to host Mr. Luke Nickerman on an assessment. Luke is in charge of the IAC program at DOE in Washington, D.C. We toured a facility that makes refrigerated, ready-to-bake cookies, pastas, and sauces (and yes, the cookies were tasty). The assessment gave us an opportunity to show Luke what an IAC assessment was about.

The NCSU IAC will be receiving an award from the City of Danville, Virginia, in November to recognize our work there. Three years ago, Danville Utilities asked us to help their industrial customers, because electric rates were scheduled to increase by over 50% due to deregulation. To date, we have assisted nine companies in the Danville area, helping them save energy and jobs, and to remain competitive in the marketplace.

Oklahoma State University. Ms. Haiyan Zhao, a long-time employee of our IAC at Oklahoma State, is nearing completion of her doctoral dissertation. The subject matter is focused on the economic justification for energy conservation projects which involve both a manufacturing company and an energy service company (and possibly other parties) in performance contracting. Ms. Zhao has developed an analysis model which includes multi-party involvement in justifying energy conservation projects that require expertise beyond that found in the manufacturing company. Examples include energy generation from waste heat, solar applications, and so on. Her model is a multi-party model which seeks to find "win-win" solutions for all parties (or to expose shortcomings of projects where all parties cannot win). The thought is that such model applications will help in justifying projects that might otherwise be discarded as too complex and too risky or, on the other hand, expose projects that will not produce demanded economic performance.

Oregon State University. OSU's IAC has been tapped by the Tillamook County Creamery Association to track energy cost and use, identify waste, and suggest improvements to achieve steady gains in energy efficiency. This is already saving tens of thousands of dollars per year, an amount that will likely increase as we continue implementation of the IAC's recommendations. "In today's energy environment, this is important, and we are grateful to OSU Engineering for providing this service to Tillamook County Creamery Association and other Oregon businesses," stated Jack Mulder**,** Director of Engineering, Tillamook County Creamery Association.

San Diego State University. San Diego State University IAC celebrated the 400th client visit with a party in September. Many of the faculty and staff of the Mechanical Engineering Department came for the lunch and enjoyed Dr. Asfaw Beyene's stories of high security at a gold plating manufacturing plant and the novelty of the foreign currency printing press operation. The celebration increased campus awareness of the federal grant at the beginning of its 15th year.

Lead Student Akasha Kaur Khalsa celebrating the SDSU IAC 400th client visit.

San Francisco State University. In October 2007, San Francisco State University IAC performed its 350th audit at a rubber plant in California's central valley. The group was accompanied by Don Kasten from Rutgers, the State University of New Jersey, and Kristen McDaniel with the DOE Golden Office.

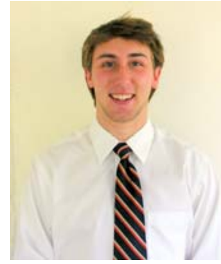
This was one of a number of audits initiated by the local utility company. The representative of the local utility keeps in close contact with and actively uses the services of the IAC group since they do not have the resources to perform similar audits. Although previously audited by the IAC group several years ago, this facility had expanded and changed ownership. The plant is old, and the previous owners were more focused on increasing production than energy improvements that did not have an immediate payback. The current management was initially skeptical of the benefit the IAC group could

Left to right: R. Mark Ritchie (ME), Antonio Aliberti (CE), Kristin McDaniel (DOE), Matt Suidan (ME), Dr. Ahmad Ganji (IAC-SFSU Director), Don Kasten (Manager of Technical Operations, Rutgers), and Cyrus Lam (ME).

provide but had invited us on the recommendation of the utility representative. By the end of the audit day, though, they were quite enthusiastic about the possibilities as 16 new energy conservation and waste minimization opportunities were identified during the visit.

Syracuse University. The Syracuse University IAC has enjoyed a good year. As we enter our eighth fiscal year, the center has acquired some updated equipment and a larger office in the L. C. Smith College of Engineering building. Since, our last news brief, we've had two new hires to the center, Brandon Peery and Nathan Kuslis, as well as a third hire, Eric Rall, to act as a permanent liaison with the Central New York Technology Development Organization (CNY TDO). The CNY TDO, one of 350 Manufacturing Extension Partnerships (MEPs), is a not-for-profit economic development organization which primarily focuses on providing business strategy to manufacturing companies. The CNY TDO and the Syracuse University IAC have entered into a Memorandum of Understanding. The relationship between the IAC and the TDO has been mutually beneficial. As usual, we also conduct the occasional pro-bono project. This year we will be helping a condominium association install energy efficiency measures throughout their property with emphasis on renewable technologies.

Brandon W. Peery



Eric Rall

Nathan W. Kuslis

Tennessee Tech. The Tennessee 3-Star IAC consists of East Tennessee State University, the University of Memphis, and Tennessee Tech University, and together we cover the entire state of Tennessee and southern Kentucky. Our first year has been fantastic—together we completed 13 plant assessments and hosted two workshops. The Energy Efficient Commercial and Industrial Lighting Workshop in Memphis was attended by representatives of 30 manufacturers. The Tennessee Manufacturing Extension Partnership at the University of Knoxville co-hosted the Energy Management Certificate Workshop, which had 20 participants. We are proud to have seven students participating in the center, including two lead students: Brian Traylor and Albert Wilson. Michelle Davis has also joined the center as the new Outreach Coordinator, following Hope Laycock's departure. Chad Bays, one of the original students, has graduated with a B.S. in mechanical engineering and is now employed as an engineer at Sturdy-Lite Corporation in Bristol, Tennessee. We have reached the point in our program at which implementation follow-ups are due and are looking forward to finding out about all the improvements our clients are enjoying as a result of their assessments.

Texas A&M. Andrew Hanegan completed 45 assessments during his tenure at the TAMU IAC and was one of four students to be awarded IAC certificates this past year.

University of Washington. The UW IAC has registered 11 students since joining the program last year.

West Virginia University. There have been several notable accomplishments this year for the IAC at WVU. The IAC conducted three joint assessments with WV-MEP. Active participation from WV-MEP was encouraged in assessments in order to facilitate the field training for MEP in QuickPEP, PHAST, AirMaster+, MotorMaster+, SSST, and other Best Practices software tools. Dr. Gopalakrishnan and Dr. Iskander, along with lead students, conducted two training workshops on data collection and measurement for MEP personnel. The training was well received by MEP staff.

The West Virginia University IAC received an award of appreciation from U.S. DOE for dedication to the Save Energy Now program.

Dr. Gopalakrishnan became a Qualified Specialist in Process Heating in addition to his QS certification in compressed air. He is an Energy Saving Expert conducting ESAs for DOE in these two areas.

The annual workshop on May 10, 2007, focused on saving natural gas and electricity costs in industry and was well received by the industry. Personnel from 17 different manufacturing facilities attended the workshop. The feedback score was 4.27 on the scale of 1 to 5 (with 1 being the worst and 5 being the best).

Three IAC Students, Nasr Alkadi, Yogesh Mardikar, and Deepak Gupta, defended their Ph.D. dissertations and will be completing their doctoral work by December 2007. All three students were heavily involved in energy research. IAC student Christopher Gump completed his M.S. degree and joined Siemens Building Technologies in Buffalo. Deepak Gupta accepted the position of Assistant Professor in South East Missouri State University. Yogesh Mardikar took a job with Sieben Engineering in the Chicago area.

Dr. Gopala and Subodh working on a compressed air system in New Oriental Aluminum facility in China.

Dr. Gopalakrishnan and lead student Subodh Chaudhari along with members of the Industries of the Future-West Virginia team traveled to Taiyuan, Shanxi in China for energy assessments. They toured three manufacturing plants in the surrounding area for 2 days and then conducted detailed IAC styled energy assessments for New Oriental Aluminum and Shanxi Hentong Energy Plants. The assessments were very well received by the Chinese government, and they showed a lot of interest in energy conservation projects. The reports have been completed and sent to China.

Recruiter's Corner

Because of their specialized and highly sought after training, knowledge, skills and abilities, IAC students and alumni are heavily recruited throughout the energy sector. Listed below are corporate profiles of several companies that routinely post positions on the IAC web site and actively recruit IAC students and alumni. For more information on these and other prospective employers and opportunities, see the career section of the IAC Student and Alumni web site at http://www.iacforum.org/iac/app?service=page/JobList.

CascadeEnergy ENGINEERING

Cascade Energy Engineering, Inc., is a consulting firm specializing in industrial energy efficiency projects.

- We are industry leaders in evaluating, implementing, and commissioning of these projects.
- We also work strategically with corporate clients to implement broad energy management plans focused on industrial energy efficiency. We help these clients set goals, define plans for improvement, and implement systems for tracking progress. We serve a broad array of industries including food processing and distribution, oil and gas, pulp and paper, and chemical industries.
- We also serve a wide range of electrical energy efficiency demand side programs wherein utilities or public agencies assist their industrial customers in implementing energy efficiency projects.

Cascade is focused on providing excellent technical work and customer services to its customer base. This emphasis, along with heightened awareness of energy and energy costs within industry, has allowed Cascade to grow steadily since its inception in 1993. We have a highly skilled and loyal engineering staff.

For additional details on Cascade, its services, and clients, visit the company web site at www.cascadeenergy.com.

Natek

Founded in 1990, Natek Corporation is a nationally recognized ENERGY staffing and recruiting firm specializing exclusively in the energy industries. We have well over 1000 energy professionals and help staff most of the Energy Services Company in today's market.

Mark Dillon

Mark Dillon is the President of Natek Corporation, where he manages the firm's recruiting practice. Mark has recently led all energy recruiting activities for one of the largest global energy service providers. Mark is also a member and speaker for the Association of Energy Engineers (AEE) and has hosted the career center with AEE at the World Energy Congress Show for many years.

We have nationwide energy opportunities on an ongoing basis.

Let Natek be your career coach within this ever-changing energy industry!

Please e-mail or call us at 518-583-0456 or mdillon@natek.com.

SAIC
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SAIC is a leading provider of scientific, engineering, systems integration, and technical services. With more than 44,000 employees in over 150 cities worldwide, SAIC engineers and scientists solve complex technical challenges requiring innovative solutions for mission-critical functions.

SAIC integrates energy solutions that enable customers to reduce costs, streamline operations, and operate more effectively. We are widely respected for our capabilities in energy analysis, modeling and simulation, and construction projects using energy efficient technologies.

Energy Procurement—Our custom solutions have helped customers increase their efficiency and add value to their operations.
Risk Management—SAIC's unique, fully integrated energy modeling capabilities enable us to analyze multiple interacting energy systems and determine financial impacts.

Low-Carbon Energy Solutions—To reduce carbon emissions, SAIC develops low carbon energy solutions, including conservation strategies and renewable carbon-free generation.

Advanced Metering Infrastructure (AMI)—SAIC's AMI solution works seamlessly with a utility's other automated systems, such as outage and distribution management systems and geographic and customer information systems.

Integrated Climate Change Services—SAIC custom tailors the climate strategy to fit the context of your business model. We deploy in-house experts in greenhouse gas (GHG) and related air emission inventories; sustainability strategy and reporting; GHG offsets; energy and economic modeling; energy efficiency; and low- and zero-carbon technologies such as solar and wind.

Conserving Energy at the State Level—SAIC promotes constructing energy efficient buildings as a key component of a sustainable energy policy. SAIC helps develop programs that promote "green" construction and achieve significant energy savings.

Leadership in Energy and Environmental Design (LEED®)—SAIC's LEED professionals assist with LEED processes and filing for certification credits; analyze, model, and investigate alternative green technologies and designs; and oversee the commissioning process.

Visit us at www.saic.com/career, choose "find your job" and enter the keyword energy.

DMJM HARRIS | AECOM

DMJM Harris and its Energy and Power Services practice is part of AECOM Technology. Headquartered in Los Angeles, AECOM is one of the nation's leading planning, engineering, and construction firms and was recently ranked as the #1 design firm in the Education Market by Engineering News-Record (ENR). With 18 operating companies focused on all aspects of architectural and engineering projects, we are able to provide an unparalleled depth and breadth of resources, local knowledge, and extensive experience with energy projects, all in the context of sustainable practices that meet community standards.

DMJM Harris Energy and Power Services has been a national leader in providing energy services for government and public agencies, colleges and universities, and utilities for the last 20 years. We help our clients plan for their energy future, update their equipment, and optimize operations while lowering expenses. We provide our clients with creative, objective, sustainable, and comprehensive energy solutions. We have implemented over $500 million of energy efficiency projects, including the installation of renewable energy technologies, resulting in close to $70 million in reduced annual energy costs for public agencies. San Diego State University IAC alumni Annika Moman and Ertun Reshat work on energy infrastructure projects for California state universities out of the company's Encinitas office. Our power group has a wealth of knowledge and experience with particular emphasis in designing, engineering and constructing transmission and distribution systems, renewable energy plants (wind, biomass, and waste to energy), distributed generation under 100 MW, and utility infrastructure. DMJM Harris clients benefit from this combination of both energy and power expertise as they navigate their way through the next chapter for the new century—the development of a low-carbon economy with sustainable solutions in both the facility and natural environment. For more information, visit our website at www.dmjmharris.com.

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Calendar of Events and Training

- **2008 IAC Lead Student Meeting**, February 7–8, 2008, Washington, D.C. Proceedings may be found at www.IACforum.org
- **ASHRAE Winter Meeting (Net-Zero Energy Design)**, January 19-23, 2008. New York, N.Y., http://www.ashrae.org/events/page/1334
- **Industrial Energy Technology Conference (IETC)**, May 6–9, 2008, New Orleans, http://esl.eslwin.tamu.edu/ietc/home.html
- **AEE World Energy Engineering Congress 2008**, October 8–10, 2008, Washington D.C., http://www.energycongress.com/
- **DOE Industrial Technologies Program Qualified Specialists and End-User Training,** throughout 2008, http://www1.eere.energy.gov/industry/bestpractices/professional_development.html