INDUSTRIAL ASSESSMENT CENTERS
Student and Alumni Newsletter
February 2013
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Improving the Student Experience

The past year has brought numerous changes and some exciting additions to the IAC program. As expected, the program continues to produce top notch results and highly sought after alumni; however, we are always looking to improve. Most recently, we are undergoing a renewed focus on enhancing the student experience and are working toward implementing several new opportunities.

One of the new student opportunities has come in the form of an annual student research award program. The new research awards, of up to $25,000, encourage students to pursue IAC assessment-inspired research projects. Five research projects were awarded over the past year to students from the IACs at San Diego, Texas A&M, Alabama, Dayton, and Michigan. Congratulations to those centers! We look forward to hearing the results of those research projects.

Another step to expand the student experience comes through a collaboration program that partners IACs with local Society of Manufacturing Engineers chapters. Pilot programs are currently underway at several of our Universities and we are hoping to roll this collaborative effort out to more Universities over the next year. Feedback on the collaboration has been very positive thus far; we look forward to the new partnership.

Speaking of promoting collaboration, we have moved the timing of the annual IAC Lead Student Meeting from the spring to the fall. This has given students a perfect opportunity to connect at the beginning of the school year to network, "shop talk", and prepare for the coming school year. In addition, shifting the meeting timing has given us the opportunity to hold our meeting in conjunction with the World Energy Engineering Congress (WEEC). Students are now able to participate in the WEEC where they are exposed to the most up-to-date trends and technologies in the energy field. As a side benefit, it also gives many of our alumni, who already attend the WEEC, an opportunity to stop in at our meeting. Alumni are always welcome!

Some more opportunities that are currently in the works are a post-graduate program at some of our national labs, an intern program, and a student-led webinar series. It's too early to tell how these will all work out, but for current students – keep on the lookout for more news.

For many of our alumni who have been out of the program, you have likely missed our updated website; the IAC Forum student and alumni website has finally received a face-lift. The site has been redesigned for better functionality and easier use while maintaining popular items such as the jobs and resume boards. The website address has stayed the same (www.IACForum.org), so take a few minutes to surf the site and let us know what you think.

As always, I encourage you to keep in touch. We are always looking for student and alumni feedback on what is working with the program, what could be improved, and how your IAC experience has impacted you. Keep up the good work and enjoy this year's newsletter!

Thomas Wenning
IAC Student Activities Coordinator
Program Manager, Oak Ridge National Laboratory
wenningtj@ornl.gov

Newsletter Contents

Join Our IAC LinkedIn Group!

An IAC Student and Alumni group has been established on the LinkedIn to promote and develop a network of IAC students and alumni. As of February 2013, the group had 408 members. Please take advantage of this network to share ideas, identify and pursue new opportunities, and make an impact.

Routing Power Lines Is an Art, Not a Science

Will Randall, Georgia Tech IAC Alumni
will_randall@hotmail.com

The Canadian province of Alberta recently embarked on a multi-billion dollar electrical transmission infrastructure construction program to meet the demands of its fast growing population and industrial base. Deeming the lines 'Critical Transmission Infrastructure', provincial legislature chose to dispense with the usual process whereby the Alberta Utilities Commission both determined the need for a power line and the route, and left the AUC to determine only the power line route. The AUC is a quasi-judicial regulator that is insulated from political considerations.

As a lawyer practicing energy regulatory law, I was fortunate to represent landowners before the commission with respect to the route of a double circuit 500 kV direct current high voltage transmission line (HVTL) around Edmonton, the province's capital city which is 430 miles north of the U.S. border. The towers would reach heights of 73 m, and would be 300 m to 360 m apart.

AltaLink, a private electricity transmission company, consulted with landowners, municipalities, and aboriginal peoples to narrow the route options to two from which the AUC would choose one, choose one with modifications, or choose none at ll. The 'Preferred Route' traversed 66 km on the east side of the city primarily through a Transportation and Utility Corridor that abutted dense neighborhoods whereas the 'Alternate Route' traversed 88 km of farmland on the west side of the city away from densely populated areas.

My colleagues and I represented landowners along the Alternate Route who did not want an HVTL built near their farms and land. We worked with the landowners to determine why the HVTL should run through a populated area. Our arguments principally centered the effects of an HVTL on agricultural operations, viewscapes, and environmentally sensitive areas. We chose not to focus on electro-magnetic fields because because Health Canada deemed the expected radiation levels safe. The purpose of the arguments was to convince the AUC to choose the Preferred Route or no route at all.

HVTLs impact agricultural operations in that modern grain farmers use combines that are often so tall they cannot safely pass under the lines between towers. This reduces the useable area of farmland, and results in higher costs to AltaLink to acquire or lease the land. Cattle ranchers often complained the stray voltage of the HVTL impacts both electric fences in bull pens and watering troughs. These issues demonstrated to the AUC the HVTL would have a material impact on farming businesses.

The second issue was that of viewscape. Experts presented studies that HVTLs have a greater impact on rural property values than on urban property values, since rural buyers place a greater emphasis on bucolic vistas as opposed to those who buy within city limits. This demonstrated to the AUC that landowners on the Alternate Route faced a greater diminution in property values than those on the Preferred Route.

The third area we emphasized was that the HVTL would pass through more environmentally sensitive areas on the Alternate Route than on the Preferred Route. These river crossings and wetlands contain numerous species at risk, and some of the few natural area within a short distance of the Edmonton city limits. The Preferred Route traversed fewer such areas, since it was 22 km shorter than the Alternate Route.

Finally, the Preferred Route went through an area already designated for HVTL and highways that was politically unpopular since thousands bought houses close to what they believed was a greenbelt rather than a utility corridor. The provincial government already owned the land, so the costs AltaLink to lease land would be much lower. On the other land, urban voters were unhappy at the thought of 70 m towers dotting their backyards.

In early November 2011, the AUC issued a several hundred page decision choosing the Preferred Route in large part because of the higher cost of building the longer Alternate Route, the greater impacts on agri-business, and that the province already owned some of the land on the Preferred Route. The province plans to build at least three more HVTLs that will reach 500 km in length, so the lessons of this project will be of great use to the AUC, landowners, and their lawyers.

Zero Blade Technology

David Manthey, Boise State IAC
davidmanthey@u.boisestate.edu

Large industrial wind turbines and wind farms have the ability to produce Megawatts worth of electricity (assuming the wind permits it); however, there are complications with the production and installations of these large wind turbines. Rotors will kill various species of birds as well as bats and the vibration will disturb wildlife and farming operations up to a mile away from the source. In attempts to harness an optimal amount of wind energy, blade propelled turbines have environmental issues as well as the possible financial repercussions. In order to ensure renewable energy is clean a new method of harnessing wind energy must be considered.

Saphon Energy[1] has determined a new method of harnessing wind energy called the Zero Blade. This new method does not require any spinning blades or any large gearboxes that are prone to create large vibration issues. Instead of spinning the Zero Blade harness wind energy in a back and forth motion (similar to a sail). The kinetic energy is then transferred into mechanical energy using pistons. The hydraulic pressure from the pistons can either be instantly converted into pressure through a hydraulic motor and generator or be stored in a hydraulic accumulator. This new technology reduces the risk of impacting the natural environment and has potential to exceed the Betz Limit. Unfortunately the Zero Blade has yet to be mass-produced but it is intriguing enough to follow the progress and to hopefully implement in recommendations for the IAC in years to come.

New DOE Steam Tool

Mike B. Muller, IAC Database Administrator
Rutgers University
mbmuller@caes.rutgers.edu

http://www4.eere.energy.gov/manufacturing/tech_deployment/amo_steam_tool/

The Department of Energy has released a new web-based steam system software tool that maintains that same steam system modeling capacities of the Steam System Assessment Tool (SSAT) while adding individual calculators for equipment and steam properties. The modeler has also been enhanced with a number of new features including additional projects/system adjustments and complete details of all properties.

The design goal of the new tool was to fill gaps in the features and functions of the existing tools. These included issues with system compatibility, installation requirements, unit sets, and transparency of calculations. Making the steam tool web-based resolved many of these issues. Improvements to features and functions handled the rest.

The new tool was developed fresh from the ground up. Instead of a lookup table, it uses the IAPWS Industrial Formulations (IAPWS-IF97) to calculate steam properties. Everything has been written in PHP and JavaScript. Standard calculations are used for all components and are detailed in the individual equipment calculators.

Steam Property Calculators

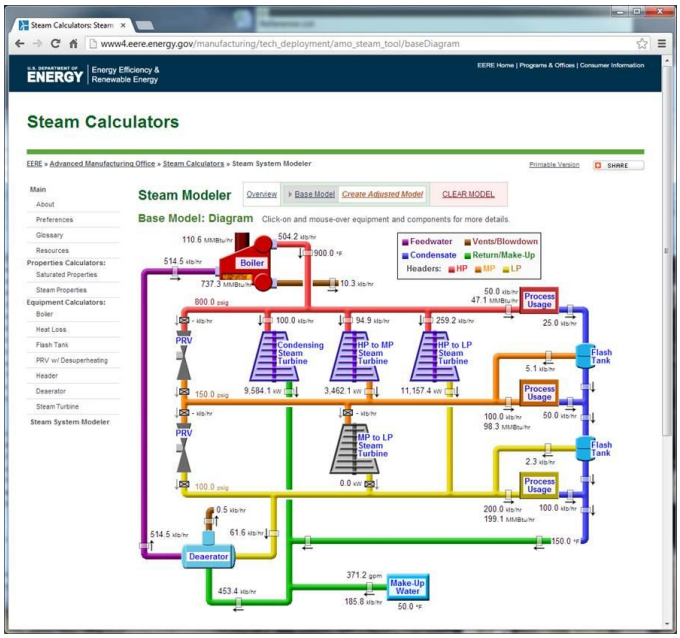
This steam tool includes steam property calculators that can provide the user with either saturated properties based temperature/pressure or steam point properties based on pressure and any other property value. As these properties are calculated using the IAPWS formulations, they can calculate properties all the way into the super-critical range. For both property calculators, the last 20 properties can be downloaded at any time into a spreadsheet to make it easier for the user to save these values and, if needed, do their own calculations.

Equipment Calculators

There are currently 7 individual equipment calculators available that allow the user to model a single piece of equipment. Any simplifications and assumptions used for these models are clearly stated at the bottom of each calculator. After an equipment model has been generated, a diagram with steam properties and a complete calculation details are provided to allow the user to understand and verify the results.

Steam System Model

Similar to SSAT, the steam system model allows for the generation of a 1, 2, or 3 header steam system model with the associated PRVs, steam turbines, flash tanks, heat losses, and condensate return conditions. In addition, users now have the option to change both the number of headers and units types at any time without reloading the model. Several new projects have been added that allow for the adjustments of unit costs, deaerator operating conditions and generation efficiency



The diagram associated with the steam model provides details on every point of the system. Moving the mouse over a steam point provides details on temperature, pressure, flow rate, specific enthalpy, and specific entropy. Clicking on a piece of equipment provides a table of all related steam properties and operating conditions. Most equipment even allows the user to copy the operating

[1] "The Zero Blade Technology." *Saphonenergy.com*. N.p., 2012. Web.

conditions to an individual calculator for further evaluation.

The is also a steam balance table that provides details of the mass and energy balances of all components and a sankey chart that provides a visualization of energy flows.

The tool only saves data during a browser session. Close the browser and the session is cleared. As needed users can download the steam system model they created and reload it at a later time.

Experiencing the Awesome of our New Ultrasonic Flowmeter

Alex Cimino-Hurt Oregon State University IAC
alex.cimino.hurt@gmail.com

As a recent addition to OSU's IAC, I have had much to learn about our current tools of measurement while at the same time I have also missed out on several wonderfully archaic methods. Fluid flow has been victim to this sort of SWAG (Scientific Wild A** Guessing) or otherwise highly imprecise measurement due to the challenging nature of fluids. They flow, spill, spray and move in other inconvenient ways. Duh, you might think, but then you go to measure the flow leaving a pump system and the head scratching begins. Among the highly sophisticated methods of flow measurement are the Bucket and Stopwatch, Pump Curve analysis, personnel experience, and if you are lucky, a preinstalled flow meter (hopefully recently calibrated). As you can imagine or may have experienced, all of these methods are somewhat lacking in both precision and accuracy. Take the bucket and stopwatch method. This requires a bucket, a stopwatch, a steady set of hands, a low fluid pressure, a conveniently located bleed off nozzle and a towel. The rest is pretty self-explanatory…oh and the fluid can't be toxic. Pump Curve analysis on the other hand assumes that A) you have a pump curve B) the pump's performance still closely matches said curve and C) some idea of the Total Dynamic Head of the pump system. Then of course, there is the opinion of the facility personnel. A mixed bag, you may get a manager who has an "idea" of what the system is design for or you may luck out and get the engineer who designed the system and has an appreciation for the systems performance. That being said, our center has moved to a new phase of flow analysis. That's right, an ultrasonic flowmeter. No towels, no guessing personnel, just a bare section of pipe is all that is needed to get a reasonably accurate reading.

A simple breakdown:

Advantages

- Compact device consisting of a primary handheld unit, transducers and cables, and attachment chains.
- Quick Set up and Break down (Less than 5 minutes)
- Versatile Application (Essentially any known fluid)
- Wide flow velocity range (0.03 to 75 ft/s)

Disadvantages

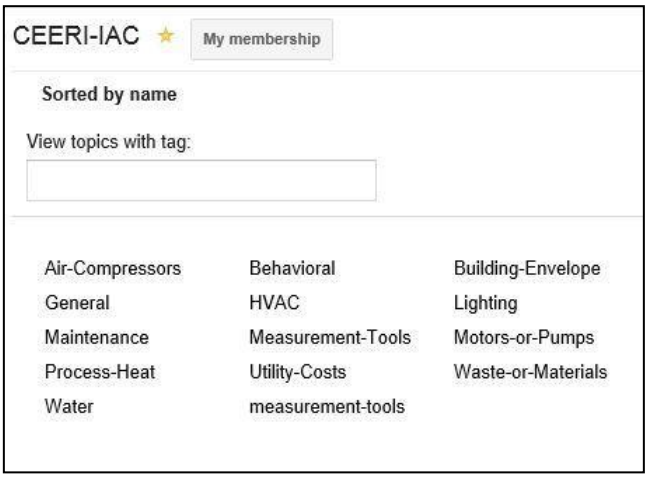
- Heavy equipment case (50 lbs. total equipment case weight)
- Can't handle a dirty flow (large particulate matter throws off accuracy of ultrasonic reading)

Training was quick and intuitive, given by the vendor, and we were even able to measure the flow coming out of our highly improvised test setup involving a sump pump in a garbage can pumping water through a PVC pipe loop. When we tested it against a physical plant's recently installed magmeter's performance we got the exact same measurement…in less than five minutes.

Technology Erases Distance between Idaho IAC Teams

Beau Husfloen, Boise State University IAC
husfbeau@gmail.com

In 2012, the Idaho Industrial Assessment Center began utilizing internet-based tools to facilitate communication between the teams at Boise State University, University of Idaho, and Idaho State University. With the three schools hundreds of miles apart, a more modern approach was necessary to assist inter-team collaboration. The tools being used are video conferencing via Google+ hangouts and a discussion board linked to the Boise State IAC Google site.



Screenshot of discussion board search page.

Video conferences have several advantages for teams that cannot meet in person on a regular basis. For centers with multiple locations, IAC members have the opportunity to "meet" one another and develop a familiarity that goes beyond strictly written communication. Also, the face-to-face exchange of ideas promotes more in-depth dialogue due to questions, brainstorming, and the like. Perhaps the most important advantage to video conferencing is simply the ability to have regular meetings at all. For our schools, without this tool we would only meet once or twice per year rather than getting to see each other and trade ideas monthly.

These conferences also allow for outside professionals to deliver presentations about IAC-related topics. Since Google+ allows up to 10 participants, the speaker can even be invited to speak from a separate location if necessary. The screen sharing feature makes presenting relatively simple.

The discussion board tool was created to simplify the exchange of ideas between IAC team members. It is set up as a forum with tags that can be added for individual technologies (process heat, compressed air, motors/pumps, etc.). The primary purpose is to post questions and receive feedback from the other IAC team members about a specific topic. Members can be notified by email about posts or simply visit the site to check discussions.

Any Idaho IAC member can access the discussion board topics, which means there will be a very broad knowledge base to draw from as topics continue to be added. This will allow any member of the three teams to research information previously added by other students and continue discussions as new ideas or technologies emerge.

Open access to previous IAC discussions has a twofold benefit. First, members currently researching a certain topic are able to learn from previous discussions. Second, the original contributors will also be able to follow the evolution of the topic. When compared to individual email communication, this system allows for a more dynamic exchange of ideas since all members are able to contribute to the dialogue, both at the time and in the future.

Even though these tools have not developed to their full potential, they have already become valuable in facilitating communication between the Idaho IAC centers. The three-school configuration is not the IAC norm, however, based on our intra-team usage of the tools it is very likely that a single school center could benefit from their implementation as well.

Industrial Assessments: Tips from the Field

Kristin Webster, Energy Engineer, WSU Extension Energy Program

Are you planning to conduct an energy audit at an industrial facility?

Whether you are just stepping into the field of industrial energy assessments or you have been conducting assessments for some time, you probably already realize what an arduous undertaking this task can be. Tackling energy efficiency in the industrial sector is the most complex of all sectors because no two industrial facilities are alike. Every process is unique, and each manufacturing site typically has specialty equipment that is unique to a particular industry type. Short of working as a plant engineer or maintenance manager for several years at a particular facility, it is unlikely you will become an expert in all the plant's processes prior to performing the energy assessment. If you are not an employee of the facility, you will not have much time for data gathering, general observations, or field tests during the assessment. However, the following general tips can help make your audit go more smoothly and yield more thorough results.

Let's assume…

- You are reasonably well-versed in industrial energy systems,
- You are familiar with best practices,
- You have read most of the energy tip sheets available from the U.S. Department of Energy's Advanced Manufacturing Office (formerly the Industrial Technologies Program),
- You are familiar with and may have even downloaded a software tool such as SSAT (Steam System Assessment Tool) or PSAT (Pumping System Assessment Tool) and received training to effectively use said tool,
- You have your steel-toed boots, hard hat, clipboard and a few instruments with which to gather data, and
- You are ready for the plant tour and the mission at hand.

What else do you need?

We consulted a few seasoned industrial energy systems experts that have over 80 years of combined field experience to get their advice for conducting field assessments. The following are some tricks of the trade you won't find in a training manual. Tuck these ideas in your back pocket and see how they will help you make the most of your limited time in the plant and with plant personnel.

Pre-Assessment Homework

Make sure you've done your homework before arriving on site:

- **Discuss the assessment process and goals with plant management** to ensure that the plant has the time, budget, commitment and appropriate staff to dedicate to the assessment and implementation of the measures that are identified. Find out if the facility is capital constrained, manpower constrained, or unwilling to risk production downtime to make changes.
- **Make sure an assessment is done only if the plant welcomes it and demonstrates a commitment to implementing improvements**. Plant staff should not adopt the philosophy that an energy assessment is "free"; that will undermine the value of the service you are providing. To get

During an industrial steam system assessment, an engineer noted that two identical boilers had flue gas sensors to detect the oxygen content of combustion exhaust. Flue gas oxygen content is monitored to verify that an optimum amount of air is being supplied to the boiler's burners. The sensors indicated that excessive oxygen was present in the flue gas streams from both boilers. The engineer pointed this out to operators who were not aware of the cost and energy penalties associated with improper combustion ratios. They made routine adjustments from that point on so that the oxygen readings would stay at more optimal levels. This quick, minor action was quantified as saving $90,000/year due to reduced natural gas use.

management's commitment to implement improvements, you are going to need to speak the same language as management.

- **Take time to understand how decisions are made and the key factors used for project selection at this company**. Deliver project recommendations in economic terms that management understands, such as return on investment, payback and internal rate of return.
- **Know what resources are available to you during every step of the assessment**, including knowledgeable plant staff and outside resources.
- **Obtain a copy of the plant's utility bills and compare the rate structure that is used with other possible rate structures the utility offers**. Savings from adopting a new rate schedule may actually dwarf the savings from implementing energy efficiency measures, and may free up extra funds with which to implement the measures you recommend.
- **Contact the utility and inquire about available incentives**. Some utilities offer a custom incentive program that can be applied to industrial energy efficiency projects. Find out from the utility what data is required, what forms need to be submitted, and the process for measuring and verifying results.

Kick-off Meeting

When you arrive on site, have a kick-off meeting with plant management, engineers, and operations/maintenance staff who will be assisting you.

- **Build a rapport with the folks you are going to be working with**. A box of donuts has been known to make many a plant operator smile during a morning meeting.
- **Clearly define roles and expectations so plant staff knows what assistance you will require throughout the assessment**.
  - Understand the boundaries and know when to ask for help when deploying instrumentation and collecting data.
  - Take photos to help you remember the location, size, orientation and condition of equipment and related piping. Ask permission beforehand as there may be certain areas where photography is not allowed if the process or equipment is proprietary. You may also want to take a digital voice recorder to help log your observations.
- **Ask if there are any abnormalities in the plant that day.** For instance, upon arriving at a facility to perform a steam system assessment, you may discover that the deaerator is temporarily out of service. That fact would need to be taken into account in the data evaluation of the boiler feedwater temperature.

During a plant tour, an engineer noticed an air compressor that seemed out of place. When he inquired about its purpose, he was told that compressed air from the modified air compressor was used to supply hot air to dry printing ink applied to plastic film. This was an inappropriate use of compressed air, which is a very expensive utility. All similar systems at the plant utilized direct gas-fired air handling units that supplied the drying air at approximately one-sixth the utility cost of operating the air compressor. Other inappropriate uses of compressed air are: tank mixing, blowing surface moisture from products, cleaning work areas, and cooling.

Plant Tour

Your tour of the plant should ideally be led by a knowledgeable engineer or operations personnel.

- **Ask the operator if there are recurring problems in the system you are evaluating**, such as water hammer in piping or noise from excessive vibration, even if it is not present at the time of the assessment. Asking these questions may provide insights about system inefficiencies.
- **Keep in mind that equipment is frequently oversized to accommodate surges, peak production times, or meet demand from anticipated expansions**. An oversized system can frequently be consolidated by taking one or more pieces of equipment out of service, which reduces the overall plant energy demand.
- **Watch for equipment that is out of place or used improperly**. Spotting these problems generally takes a trained eye and years of experience, but it is an important skill to start cultivating now.
- **Watch for steam and condensate leaks**. If you are conducting a steam system assessment, most of your time will be spent in the boiler room. However, take time to walk around the plant and observe the steam end uses. If you see excessive condensate leaks, there is likely an opportunity for heat recovery by improving the condensate return system. Ask facility personnel about their steam trap maintenance program. If it has been a while since
  the traps were inspected, chances are that many of them have failed and are wasting energy.
- **Look for opportunities for lighting retrofits, even if the focus of the assessment is not lighting**. Many industrial plants and manufacturing facilities still use 400 watt metal halide lighting. Upgrading to fluorescent lighting yields quick and significant energy savings, especially if utility rebates are available. Lighting retrofits can be packaged with other energy-saving measures to improve the economic payback of the combined measures. However, keep in mind that installation of new lighting fixtures may be pricey and inconvenient if light fixtures are in limited access areas. It also may be challenging to identify time periods to do the installations so you do not impact production areas that operate continuously.

Begin the Energy Assessment and Collect Data

Corroborate Data

- **Consider a two-person team approach if you are doing an equipment inventory**. One person can look for nameplate information and make general observations while the second person records the data.

- **Bring your own portable instruments**, such as a pressure gauge, temperature measurement and flow measurement devices that you know are accurate. Do not assume that the existing plant instruments have been recently calibrated.
- **Ask permission to verify plant readings**. Look for ways to corroborate the data you are collecting using available plant resources. These may include:
  - Tank level changes translated to volume change to obtain flowrate out of tank.
  - Gas meter billing readouts, especially if the gas flows only to the system under study (may need temperature/pressure/heat value corrections to convert to standard volume or energy units).
  - Water and other meter readouts for the process(es) being investigated.
  - Pump performance curves to estimate pump flow from line pressure and motor electrical demand measurements.
  - Facility-installed instrumentation for direct measurements, and possibly electronically archived data such as in a SCADA (Supervisory Control and Data Acquisition) system.
  - Handwritten log sheets for historical measurements.

An estimated 100 gallons per minute of clear water was being discharged to a paper plant's wastewater system. The source of the water was found to be once-through cooling water used to keep a solid fuel boiler's grates from overheating. Capturing this warm water and using it to supply a nearby boiler make-up water reverse osmosis treatment system saved energy and water costs of $30,000 per year.

Check for Valve Leaks

If working in a process that is presumably a closed system, check the process inlet and outlet and verify (don't assume) that control valves are operating as intended. For instance, valves and actuators can become faulty over time and begin leaking, thereby allowing "tramp air" into a system.

Verify Performance of Previous Efficiency Improvement Projects

If a system already has energy-saving components installed, verify that these components are operating properly and achieving the expected results.

Verify Performance of Control Systems Between Shifts

When you assess a system that has to be cleaned, such as a dairy's milk-chilling process, or a batch system with periods of downtime between operating shifts, remember to monitor the process during the off-periods to make sure no energy is wasted during these times.

Save Energy by Improving Product Reject Rates

Watch for scrapped or rejected product rates and determine the embodied energy wasted. One engineer found that a plastics manufacturer's multi-extrusion line facility had a rejection rate of approximately 35% of its product (including unavoidable "trim" scrap). If "first time quality" was improved to 100% and only unavoidable trim scrap remained, the facility could reduce its overall energy use by an estimated 30%.

Look for Opportunities for Waste Heat Recovery

When exploring options for waste heat recovery in a plant, the rule of thumb is that the heat sink should have good "coincidence" with the heat source. Coincidence means that the "need" for the heat exists when the surplus heat is available. Boiler flue gas is the classic example of waste heat in a facility. To find a use for this waste heat, first look for a heat sink within the boiler system, such as preheating boiler feedwater. In this case, hot feedwater is needed at the same time that surplus heat from the flue gas is available. Other heat sinks, such as preheating product elsewhere in the facility, may involve batch operations, where the need for the heat does not exist 100% of the time that the boiler is in operation.

Post Assessment Presentation

After the data collection and analysis are complete and you have found what you believe to be the best opportunities for energy savings, present these ideas to plant management. There is an art to doing this that will yield more effective results. You will most likely present energy efficiency measures along with corresponding annual savings and maybe even an expected payback period.

Raise Management's Awareness of the Cost of Inaction

Be sure to mention the "cost of doing nothing," as Christopher Russell states in his book, *The Industrial Energy Harvest* (2008). The cost of doing nothing goes up as the price per unit of energy goes up and as interest rates decrease, making the cost of energy improvements more affordable and increasing the annualized net savings of a project.

Highlight Non-Energy Benefits

Plant managers and operators are frequently lulled into complacency, allowing the same maintenance problems and energy waste to persist year after year. There is a chance that your energy savings assessment report will remain on a shelf unless the management is compelled to act.

- **Mention the non-energy benefits of implementing the measures you found**. This will include items such as ease of operation, equipment reliability, decreased downtime, employee comfort and safety, and improved environmental outputs.
- **Add a sense of urgency to your presentation to management**. Find out about timing deadlines for possible incentives, which should help encourage management to take action.
- **Educate plant management about the triple bottom line**. This is the sustainable business model that optimizes financial, environmental, and social performance all at once. Industry has a social responsibility to reduce waste and conserve energy in order to not overtax the existing power generation and

distribution infrastructure. Continuing to live with energy waste will cause accelerated investments in power generation capacity and higher energy prices for all users.

Learning From Experience

There are many guidebooks and resources that outline successful assessment procedures and principles. One useful resource is the new U.S. Department of Energy document *Guiding Principles for Successfully Implementing Industrial Energy Assessment Recommendations* (2011) that you can download at http://www1.eere.energy.gov/industry/pdfs/implementation_guidebook.pdf. This guide is intended for plant management and may help you with effective delivery of your assessment recommendations.

We hope that the ideas presented in this article, by industrial energy system experts, will help you to refine your energy assessment practices. As you conduct assessments and network with your colleagues, keep your ears open for additional tricks of the trade. The complex and unique nature of industrial energy systems ensures that you can have endless opportunities to expand your knowledge and skills.

High-Rise Renovations that Reduced Energy Bills by 50%

Matt Swanson, UIC IAC Alumni

In 2008, Elara Engineering conducted an objective energy audit and building pressurization study which included heating, cooling, ventilation and domestic water systems at 525 W Hawthorne Place. Located in downtown Chicago, 525 Hawthorne is a 31 story high-rise residential building that was constructed in 1969. The total residential portion of the building is approximately 275,000 ft2, with a total of 232 condominium units and there are approximately 8 typical units on 30 floors. The building's energy use intensity (EUI) was 122.9 kBtu/ft2/yr. The resulting 2008 audit identified eight opportunities for improvement in energy efficiency, comfort, maintenance and more importantly, reliability. Shortly after delivery of the report, Elara Engineering was enlisted to design a complete mechanical upgrade of the condominium building which included replacing the existing boilers, chiller, cooling tower and makeup air unit (MAU). Additional energy savings strategies included demand controlled ventilation (DCV), variable frequency drives (VFD), carbon dioxide control and a web-based building automation system.

525 W. Hawthorne Place, Chicago

Heating: Two new hot water boiler plants were installed to replace the existing steam boilers. The boilers were original to the building and were over 38 years old. The boilers had also undergone several repairs over the previous three years (totaling $78,000). A low-temperature condensing boiler plant is located in the penthouse and is used for space heating. An elevated-temperature, near-condensing boiler plant is located in the existing basement boiler room and serves domestic hot water, pool, garage and lobby level heating. Both new boiler plants were designed to offer increased redundancy.

Cooling: Elara's design included replacement of the existing steam absorption chiller with two new partially-redundant rotary screw chillers and an associated two-cell cooling tower with VFDs. The two new chillers were installed in the basement mechanical room in the place previously occupied by the absorption chiller. The absorption chiller and cooling tower were beyond their useful lives, they had recently undergone several repairs in the previous three years (totaling $41,000). In order for electrical chillers to be installed in place of the steam absorption chiller, new electrical service was provided.

Demand Controlled Ventilation (DCV): The building's existing ventilation system was comprised of a single MAU as well as a dedicated constant volume kitchen exhaust fan and toilet exhaust fan. The original design of the ventilation system only made up 50% of the exhausted air through the MAU. Consequently, the building was under severe negative pressure. Elara's design replaced the existing MAU with a higher capacity unit. The existing constant volume exhaust systems were converted to a DCV system using VFDs, and automated dampers. By exhausting air from the occupied kitchens and bathrooms only, the system optimizes performance of non-occupied periods to reduce the overall energy usage while minimizing infiltration and controlling building pressure. DCV was also implemented to control garage carbon monoxide (CO), which reduces exhaust fan energy and heating demand.

Building Automation System (BAS): A new web-based direct digital control (DDC) system was installed to monitor, control and meter the entire mechanical infrastructure over a fiber optic backbone. The DDC system is equipped with a web-based server and graphical front-end interface with BACnet communications. The new building automation system features real-time monitoring, global summer/winter changeover, hot water, chilled water and condensing water reset, building-wide alarming, remote login and independent control of garage heating, CO monitoring and remote user access.

Cost Effectiveness: Equipment selections that meet or

exceed ASHRAE 90.1 v2007, eliminating steam, division of hot water loads between elevated-temperature and low-temperature plants, variable ventilation and a new building automation all contributed to a highly efficient and sustainable whole building retrofit. In the first full year of operation, 525 W. Hawthorne observed over $240,000 in utility savings, 50% cost savings and 56% energy reduction, reducing the building's EUI to 54.5 kBtu/ft2/yr. The mechanical upgrade project was initially projected to increase electricity usage with the addition of electrical chillers; however, actual first year figures show an overall reduction in electricity usage, even with the addition of electrical chillers. Perhaps more valuable than utility cost savings are the avoided costs such as future equipment repair, increasing maintenance burdens and further damage to the existing mechanical infrastructure. Although these costs cannot be immediately measured, the savings are undeniable. As an example, during the implementation, both existing boilers required repairs to their fire-tubes. Fortunately, since the dependence on the boilers was being eliminated, the boilers were made to last without cost to the owner. The most cost effective aspect of this project, however, was its unique funding. The entire mechanical upgrade project was funded through a condominium board 10-year loan and is paid for entirely by the savings resulting from the implementation at no additional cost to condominium unit owners. Typical projects of this kind would require special assessments, or use of reserve funds.

The 525 W Hawthorne project received an Excellence in Engineering award from the Illinois chapter of the American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) in December 2010, was awarded First Place by Region VI of ASHRAE in spring 2011 and was awarded Second Place by the International Society of ASHRAE to be recognized at the winter meetings in January 2012.

Energy Retrofits for Army/Air Force

Phil Johnston, Alabama IAC Alumni
E4E Solutions
pjohnston@e4esolutions.com

As a graduate of the IAC program, I wanted to start a career in the energy field. The company I work for now, E4E Solutions, is a design/build energy engineering firm with experience in both commercial and industrial environments. I have primarily been involved with a project to retrofit facilities on Army and Air Force installations across the country.

We are currently working with The Exchange to implement the energy conservation measures that we have designed. These measures include lighting, motors, and anti-sweat controllers among other technologies. The lighting measures vary depending on the existing fixture. Most Exchange stores have 2' x 4' troffer fixtures with four T8 lamps on the main sales floor and other areas. We are retrofitting these fixtures with kits to convert the fixtures to two lamps instead of four, reducing the energy consumption by half. The reflector in the kit allows the lamp reduction because it distributes the light from the lamp more effectively. Some of the other lighting technologies we implement are LED cooler lighting, occupancy sensors, and exterior induction lighting.

Each facility has refrigeration systems for drinks, food, and other products. Cold air is supplied to these spaces to maintain temperature using evaporator fans located inside the space. Each fan is powered by a fractional horsepower motor, which historically are very inefficient (20-40%). We are replacing these motors with electrically commutated motors that have a much higher efficiency (60-80%). We are also installing 2 speed relays that work much like a variable speed drive in an industrial application. The 2 speed relay is connected to the thermostat for the cooler or freezer. When the temperature reaches the setpoint inside the space, the 2 speed relay slows down the fan motors saving energy in the process.

The reach-in doors of these refrigerated spaces have built-in heaters to prevent fog on the glass of the door. These heaters operate continuously, so they unnecessarily dissipate heat into the cooled space most of the time. We are installing controllers that turn off the heaters when they are not needed. The savings for these measures come from two sources: the reduction in power consumption of the heaters and the reduction of heat that is dissipated into the refrigerated space.

The program has been highly successful thus far. We have already noticed energy savings of up to 40% in the pilot store for the program. We estimate that savings for each building will be approximately 20-40% of total energy use in the building. We have already implemented these measures for stores in several states including Texas, Colorado, California, and Georgia.

About The Exchange

Formerly known as The Army & Air Force Exchange Service, The Exchange is a joint nonappropriated fund instrumentality of the Department of Defense and is directed by a Board of Directors which is responsible to the Secretaries of the Army and the Air Force through the Service Chiefs of Staff. The Exchange has the dual mission of providing authorized patrons with quality merchandise and services at competitively low prices and generating non-appropriated fund earnings as a supplemental source of funding for military morale, welfare and recreation programs. To find out more about the Exchange history and mission or to view recent press releases please visit our website at http://www.shopmyexchange.com.

About E4E Solutions

E4E Solutions, based in Atlanta, Georgia, specializes in the development, design, engineering and implementation of

innovative solutions to save energy, reduces operating costs, improve building performance, and help the environment. Our team is comprised of industry leaders, professional engineers, certified energy managers, and project managers that provide unmatched experience in energy technologies and their deployment to our commercial, industrial, institutional and government clients around the world. To find out more about E4E Solutions, visit www.E4ESolutions.com.

Navistar Hosts Compressed Air System In-Plant Training at Its Springfield Truck Assembly Plant

Sachin Nimbalkar, Oak Ridge National Laboratory
nimbalkarsu@ornl.gov

On October 9, 2012, Navistar kicked off a four-day In-Plant Training (INPLT) event at its Springfield Truck Assembly Plant in Ohio.

Navistar's INPLT employed a unique approach that combined a 2-day crosscutting Industrial Assessment Center (IAC) assessment with a 3-day system-specific compressed air training. The INPLT closed with an energy management best practices workshop that included guidance on successfully implementing identified energy saving projects.

Approximately 30 individuals participated in the INPLT, including attendees from Navistar's Indiana facility and representatives from plants operated by the General Aluminum Manufacturing Company. Annual energy cost savings totaling $405,000 were identified through the training event. The implementation of these energy saving recommendations would decrease current energy costs by about 10%.

Some Highlights:

- Simultaneous delivery of the two-day IAC cross-cut and 3-day system specific compressed air assessments … combined approach tested first time.
- Approximately 30 individuals were trained during the 3 day assessment and over 30 individuals were trained during the final energy management workshop.
- Participation from Indiana Navistar plant and two General Aluminum plants.
- Direct cost share of $5k by the plant.

- The compressed air system was analyzed by Tom Taranto (DOE Energy Expert) and potential energy cost savings identified is equal to $62,000 per year.
- The HVAC, Process Heating, Fluid Flow (mainly Pumps) and other energy intensive systems were analyzed by Dr. Kelly Kissock's UD IAC team and potential energy cost savings identified is equal to $343,000 per year.
- Total estimated energy cost savings identified during the INPLT at the Springfield assembly plant = $405,000 per year.

Decision Support System for Industrial Energy *Management System (ISO 50001)*

Kartik Ramamoorthy, West Virginia University IAC
kartik0611@gmail.com

A group of interrelated or interacting elements of an organization used to establish energy policy and objectives, and to achieve the established objectives is called an energy management system. International Organization for Standardization (ISO) has determined energy management as a priority due to the enormous consumption of non-renewable energy sources and high potential to conserve energy and reduce greenhouse gas emissions.

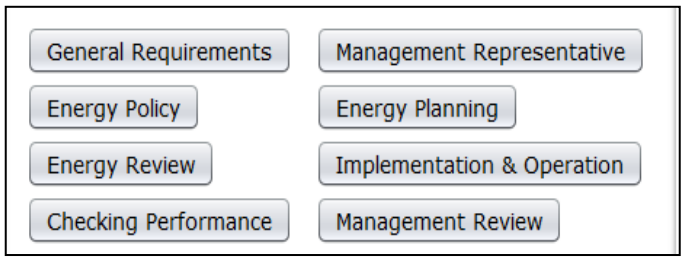
In general energy management procedures followed by facilities are not sequential or in an orderly manner. This makes continuous implementation of energy management strategies very difficult, as the preliminary job of every employee in the industry is to get the product produced in the most effective manner and with the specified requirements. The other tasks including energy management becomes an additional work on the employees. Also during rough times these tasks are completely omitted and the concentration is majorly focused onto the production output. Hence the energy management strategies previously followed start getting dissolved. To overcome the lack of availability of proper framework to implement an energy management system conforming to the ISO 50001, a decision support system software is being developed to help facilities implement and get certified by tracking progress towards the EnMS in accordance with the ISO 50001.

Energy management system implementation in accordance with ISO 50001 requires an organization to perform several tasks which includes establishing scope and boundary, energy policy, energy review, objectives, targets, action plans, energy baseline, energy performance indicators (EnPI), determining significant energy users, monitoring and measurements of

significant energy users and many other such requirements. The standard requires the organization to maintain specified documents and records. An organization would have to take several decisions in the entire process. The decision support system assists them in taking such decisions along with simplifying the requirements defined in the standard.

Development of the software

A Go/no go algorithm was initially built which decides on the next action to be performed by considering the decision's taken by the organization implementing ISO 50001 and the requirements in the standard. There exists an inter relationship between several parts of the standard. The software is built to recognize this relationship and hence once an organization makes changes to any individual section of the requirements, the software automatically asks the user if they would like to change any other related sections and it also records all the above decisions and stores them in a separate file. The figure above shows one of the sections of the decision support system.



Screenshot of a Section of the Decision Support System

The software also helps users identify and store required documents and records in a database. These records and documents are also controlled electronically (requirement in the standard). The major aim of the decision support system is to reduce the degree of difficulty in implementing an EnMS in accordance with the ISO 50001 and hence help plants reap the benefits of managing energy which include cost benefits and increased business (due to certification).

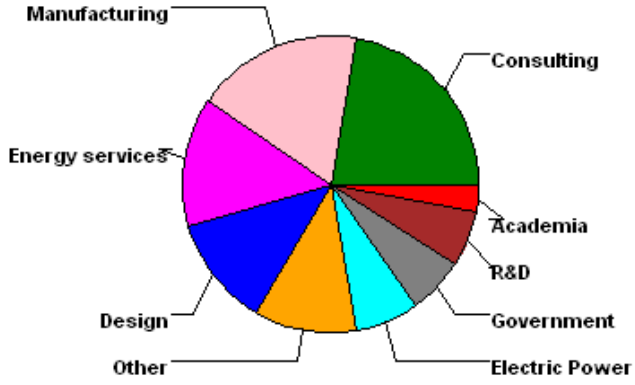
Work After The IAC

Daniel Cotton, Boise State IAC
daniel.cotten@gmail.com

Once you have graduated from college and hold not only a degree but also a certificate of completion from the Department of Energy for the IAC, what's next? The pie chart below shows different career paths that can now be explored that relate to the work in energy that you have just completed. In addition there are options to become a Certified Energy Manager or to pursue a LEED Professional Credential.

There are a lot of companies looking for the qualifications that the IAC provides such as experience in the energy efficiency industry and working with clients. At the IAC Forum (www.iacforum.org) a great resource can be found for job opportunities underneath the "Careers" tab. Here companies have posted the type of job, the responsibilities, and required qualifications of the individual. Also offered is a spot to add your resume, and a list of companies that have previously hired IAC students.

This resource at the IAC forum serves as not only a place to find companies to apply for, but examples of companies that seek applicants with the skills gained through the IAC and the job titles they use. This information can then be taken to a larger job posting website and used to filter searches and find ideal jobs for you.



http://www.iacforum.org/iac/metrics.jsp.

After graduating from college your education does not need to end. By getting certified in different areas you can make yourself stand out in the job market. One route is to become a Certified Energy Manager (Association of Energy Engineers). The path to this certification emphasizes the valuable qualities learned from the IAC and also helps you learn new ideas based around energy management. Obtaining this certification requires three years of experience in energy engineering or energy management beyond a four-year engineering degree; along with a test for you to demonstrate your knowledge of energy management.

If you are interested in green buildings and becoming an expert in the construction, maintenance, and operations of energy efficient buildings then a LEED Professional Credential is an answer (LEED). As the future moves towards energy efficiency LEED certified building are becoming more popular. When you are an expert in this field your worth in the job market place increases along with job stability and promotions. Two tests are available for the LEED Credentials. The LEED Green Associate exam tests your knowledge of green design, construction, and operations. The LEED AP with specialty exam tests your advanced knowledge of green buildings, and also tests you on a specialty that you have chosen.

This article only presented a few of the many options that are available. Your future after the IAC is full of opportunities but it is up to you as to what path is taken. The IAC also has a LinkedIn Group that now has over 400 members. By taking advantage of the Internet and the resources the IAC provides for you, your future as an energy savvy engineer is bright.

Companies Producing Their Own Power

Kenneth Boyland, Boise State IAC
kennethboylan@u.boisestate.edu

Rising energy costs are turning some large companies towards innovative renewable energy solutions. In a September 2012 survey of 100 companies with revenues over $1 billion, professional services company Ernst and Young interviewed C-Level executives about their energy usage and goals. 40% of these companies spend at least $50 million a year on energy, and 73% see their energy costs rising over the next five years.

When asked about their energy plan, the main goal of 92% of these companies was to reduce energy costs through more efficient machinery and practices. On the other hand, a significant portion of companies include renewable energy in their energy strategy. 48% of these companies purchase some amount of renewable energy. According to the EPA, Intel Corporation purchases the most green energy of any US corporation at an astonishing 2.8 billion kWh, which makes up 89% of their total electricity use. Kohl's Department Stores is second with 1.5 billion kWh, but this is 100% of their total electricity consumption. Other groups that the EPA acknowledges as 100% renewable energy purchasers include Whole Foods Market, Dannon, and the EPA themselves.

In addition to purchasing renewable energy, 41% of the companies in the Ernst and Young survey own some form of company generated renewable energy, and 51% expect company owned renewable energy to increase over the next five years. So just how do companies create their own energy?

At Apple's data center in Maiden, North Carolina, hi-tech solar arrays were installed at the end of 2012 over two separate 100 acre plots. Apple expects them to produce 84 million kWh annually, and has plans for a bio-gas-powered fuel cell installation which should produce another 40 million kWh per year. This adds up to about 60% of the electricity usage required to run the data center.

Apple's Solar Array in Maiden, NC

For Twin Rivers Technologies in Quincy, Massachusetts, producing their own energy was as easy as burning the byproduct from soybean and other natural oils. After spending about $75,000 on testing, the company decided to burn all of their byproduct in a 50-50 mixture with their fuel oil in 2007. Burning the natural oils, along with reclaiming excess steam energy to drive a turbine, provides a third of the plant's energy. This saves about $3 million a year, about 6% of the company's $50.5 million annual revenue.

At SC Johnsons largest plant in Waxdale, Wisconsin, two 415 feet tall wind turbines were installed in December 2012. They will produce about 8 billion kWh annually. The company already burns landfill gasses and uses cogeneration turbines to produce their own power at this location, and is hoping the wind turbines will bring their energy production to 100% of the demand at the site. "SC Johnson has been making green choices for our products and operations for decades. Our work toward reducing the company's dependence on fossil fuels at Waxdale is an important step," said Fisk Johnson, Chairman and CEO of SC Johnson. Renewable energy uses at other SC Johnson plants include additional wind turbines and burning waste palm shells in place of diesel fuel at their Medan, Indonesia plant.

The recent innovations in renewable energy are showing great promise. As companies continue to invest in renewable energy, the costs will continue to drop, and perhaps someday we can all have our own wind turbine or solar powered house.

West Virginia University IAC Gains New Experience through Data Center Assessment

Ryan Campione, WVU IAC
Rcampio1@mix.wvu.edu

The WVU IAC has recently conducted an energy assessment of a government data center facility for NASA, NOAA, and the Department of Defense. The assessment provided the team with a unique experience as they learned to adapt to the different type of energy demands and constraints that accompanied the data center environment.

The team first met with facility personnel to gather insight and collect basic information. This information was then used with the Data Center Profiler Software Tool Suite provided by the Advanced Manufacturing Office to help identify which of the facility's processes were primary candidates for reducing energy. Due to the data center's level of secure information, the assessment was not able to consider the center's computer equipment. The team then set out to tackle upgrading the facility's two largest significant energy uses: lighting and the computer cooling system to become more energy efficient.

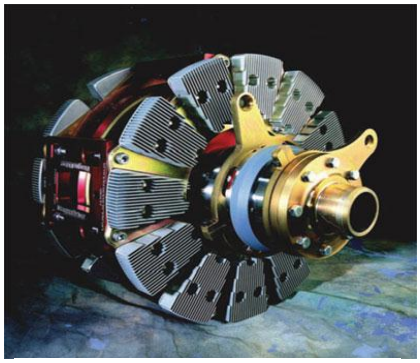
The facility's computer racks generated waste heat of around 120°F that had to continually be removed from the computers by a large chiller system to keep the computers operating at optimal performance. The team set out to research new methods to reduce the cooling system's overall energy consumption by offsetting the electricity consumed with the computers' waste heat. One method looked at replacing some of the facility's electric chillers with an absorption chiller that would run off of the waste heat extracted early on from the computer racks. Another method explored the possibility of adapting a heat exchanger to convert the waste heat into low grade heat for a domestic water tank. A final method considered piping the waste heat around the exterior shell of the building's offices for climate control during the winter months. Though each of these methods could have greatly reduced the facility's overall energy consumption, none of them proved to be desired due to the large implementation cost in replacing the already existing equipment.

The team was able to provide energy recommendations for the facility's back-up power generators, small scale motors, and CRAC (computer room air conditioner) units. In total the assessment presented the team with a welcomed opportunity to explore new energy methods uncommon in the team's over twenty years of experience with energy assessments.

The Rise of a New Adjustable Speed Drive

Ramzi Sarama, Boise State University IAC
ramzisarama@u.boisestate.edu

Variable Frequency Drives (VFDs) have been notorious for their great energy saving opportunities when applied in industry. They take advantage of the affinity laws in pumps, fans and other industrial systems that work under variable loads. For example, the consumed power by a pump is proportional to the cube of the drive shaft rotational speed. Hence, reducing the speed by a small percentage using a VFD reduces the power by a greater one.


MagnaDrive Adjustable Speed Drive System

Industrial systems are designed to meet maximum load occurrences, leading to oversized systems for the remaining time. The excess capacity of the oversized systems are traditionally controlled by the use of valves and bypasses in pumps, vanes in fans, and other controls that don't offer tangible energy savings. On the other hand, the electronic VFD systems are able to precisely control the load by controlling the speed of motors through varying the frequency of the alternating current input. So, VFDs are great, but are they the only Adjustable Speed Drives (ASDs) in the market?

There is a growing new ASD system technology that many people in industry are unaware of: the Magnetic Coupling-Adjustable Speed Drive (MC-ASD) systems, also known as MagnaDrives. They control the load by controlling the speed of the drive shaft while keeping the motor at full speed. This is done through varying the air gap between rotating plates of powerful permanent magnets that control the torque between the motor and the drive shaft.

A test comparing the two drives was performed by the Pacific Northwest National Laboratory for the U.S. Department of Energy in June 2002. The test found that MagnaDrives were 2%-4% less efficient in the 80%-100% of full speed range comparable to VFDs. However, they were substantially less efficient than VFDs in lower speed ranges. Another research that was prepared by Quantec in May of 2002 for the Northwest Energy Efficiency Alliance indicated that, on average, VFDs have energy savings of 35% for fan applications and 42% for pump applications, while MagnaDrives have energy savings of 23% and 30% respectively.

Although less efficient, MagnaDrives have many advantages over VFDs. They are the only option of ASDs for large motors (>500 hp). Moreover, because of their mechanical nature, they can be used in non-electrical applications such as engine driven irrigation pumps. They are easier to install due to their simple designs. They cause less motor vibration and do not create harmonics. They can also be used with medium/high voltage applications and react better to poor power quality. They are cheaper for medium and large size motors (> 50 hp). Finally, they do not need to be housed in a separate controlled environment.

Oklahoma State IAC Continues Three-Decade Tradition of Promoting Energy Efficiency

Michael McCombs, Oklahoma State University IAC
mlmccom@ostatemail.okstate.edu

The recent completion of a survey and report for a 2.0 million-square-foot HVAC manufacturing plant marks the 842nd assessment for the IAC at Oklahoma State University, as it begins its thirty-fourth year of service to a diverse manufacturing base here in the South Plains. OSU serves Oklahoma, far north Texas, and in cooperation with engineering programs at the University of Arkansas and Wichita State University, Arkansas and Kansas.

OSU's assessments during this year spanned a wide spectrum of industrial processes and products (partial list): food service equipment, shopping carts, aircraft structural components, industrial and automotive drive belts, aircraft fuel cells, aircraft engine components, aircraft cabin fixtures, horse

trailers, waste dumpsters, truck leaf springs, processed meat, copper tubing, canned soft drinks, hardwood flooring, and plastic film.

In some cases, OSU staff encountered special problems with energy-saving equipment that clients had installed before requesting the IAC assessment. In one case, an aerospace engine component plant had installed hundreds of open F54T5HO light fixtures in an environment where cutting oil is used continuously. Within one year, the polycarbonate lampholders began to crack and fail, dropping lamps onto the production lines. OSU staff researched (and confirmed) the client's assertion that polycarbonate never should have been specified, and then worked with the manufacturer to provide a solution that all parties could approve: Rebuilding all fixtures with cutting-oil-resistant polybutylene terephthalate (PBT) lampholders. This is one of the aspects of the IAC program that is very valuable for students: They encounter equipment and operational problems that have not ever been included in the textbooks.

Cem Diniz is from central Turkey and has developed a keen interest in premium-efficiency chillers for both process & space cooling.

On the personnel side, there were several changes during the year. Amol Shenoy, Sai Kapayalam, and Kuldeep More all completed their master's degrees in industrial engineering & management, and landed career-track energy engineering positions in Oakland, CA; Oklahoma City, OK; and Vancouver, WA, respectively. At the same time, the center welcomed four new team members: Cem Diniz, Akshaya Satpute, and Kannan Ramasamy (all industrial engineering master's students), and Hugh Maguire (undergraduate mechanical engineering student).

Akshaya Satpute joined the program in 2012 and is now the lead student in our center. She worked in manufacturing engineering in India before coming to OSU, including a stint at Tata Motors.

Natalie Whalen continued her reliable, client-focused service in our center for a second year, and her engineering skills were further sharpened by her internship at a Pepsico regional marketing and production center in Tulsa, OK this past summer. Natalie expects to pursue a career in energy engineering after she graduates with her bachelor's degree in industrial engineering and management this spring.

The OSU School of Industrial Engineering & Management is dedicated to the goal of developing a new generation of energy engineers, so it has created courses that support the training goals of the national IAC program. For example, all OSU IAC representatives must first take and pass IEM 4953/5953 (Industrial Assessment and Improvement), which teaches the basics of assessing energy efficiency, quality control, and productivity in manufacturing facilities. This course was offered once again in the fall of 2012, and the ample enrollment indicates that student interest in industrial energy efficiency remains high.

Oklahoma State's IAC is not only committed to the training mission but also determined to capture the efficiencies of working with other fine engineering programs in the region to maximize the implementation of assessment recommendations. Thus, OSU's IAC staffers are gratified to note the success of their colleagues in the affiliate centers at Wichita State University and the University of Arkansas. Both centers are strategically positioned to serve the industries that have concentrated around the manufacturing hubs of Wichita and the Quad Cities of northwest Arkansas, respectively.

Optimization Projects at Texas A&M

Franco Morelli, IAC Lead Student

The Industrial Assessment Center (IAC) at Texas A&M University is working on several projects related towards energy optimization and conservation measures. The following projects outline current endeavors to streamline and optimize industrial energy usage.

Furnace Cooling and Time Reduction

ATI Firth Sterling, a tungsten-carbide nozzle manufacturer, experiences a bottleneck in production during their part sintering and cooling. To increase productivity, plant management is planning on purchasing a 6th, $1.5M furnace to meet demand. These ovens are on a 24 hour cycle, with 12 hours used for heat treatment, and 12 hours required for cooling the parts sufficiently for removal. Pressurized argon is used to partially cool the parts, and is currently vented to the atmosphere ($200k annual cost for argon). The proposed objective is to reduce the required cooling time by coordinating the use of multiple cooling mechanisms.

Part Tracking and Metrology

In addition, two more opportunities for significant energy savings and increased productivity have been identified. A major productivity challenge is managing each batch of parts as it is formed, treated, and processed. Currently this is all handled with paper forms that are transferred manually with each batch, resulting in scheduling problems, lost parts, and a general lack of ability to track orders through the production process. Problems in quality control also lead to significant waste. Required part measurements are taken and recorded manually, and are not considered reliable by plant

management. The proposed objective is to create an automated part tracking and quality control system to enhance productivity and reduce part waste.

Net Zero System Design and Control

The goal of the net zero home is to consume the same amount of energy as produced, resulting in net zero energy consumption throughout the year. Several system designs are being considered in both passive and active genres to achieve this goal. A thermal chimney, electro chromic glass, and variable speed geothermal HVAC systems all have the potential to mitigate and control heat transfer mechanisms; these all are being considered. A propriety thermostat like control system, developed by Altumaxis Technologies is being incorporated to optimize active systems, thus further increasing the likelihood of true net zero energy consumption.

Identifying Efficiency Degrading Faults in Packaged Air Conditioning Systems

The goal of this project is to design a low cost device that can non-invasively measure operating conditions in HVAC systems, diagnose faults, estimate potential energy savings, and provide instructions on how the system should be adjusted or repaired. Using primarily external thermocouples, the system analyzes several commons HVAC faults simultaneously. It is anticipated that the completed project will be used in actual IAC energy assessments, enhancing the center's ability to assess HVAC systems.

Image Recognition System for Automated Lighting Retrofit Assessment

In the initial phase of developing unmanned aerial and ground robot vehicles capable of conducting autonomous energy audits in commercial buildings, this project is developing an image recognition system capable of enumerating and classifying lighting in a building. Mounted on an unmanned aerial vehicle, the system uses a combination of a spectrometer, optical camera, and distance sensor to analyze the lighting and recommend economic lighting retrofits.

Institutionalization of Energy Efficiency Best Practices - The Case of a Global Manufacturing Organization Introduction

Bin Wu, Director University of Missouri Industrial Assessment Center

wubi@missouri.edu

Through a MoIAC alumna, Sandina Ponte, who is now leading the organization's effort in energy efficiency, this case involves an on-going collaborative effort between the Missouri Industrial Assessment Center of University of Missouri (MoIAC), and ABB. Inc., to institutionalize best practices of energy efficiency within the organization's global network of manufacturing companies (ABB is one of the largest manufacturers in power and automation that employs approximately 117,000 people in over 150 companies based in 100 countries).

Generally speaking, the messages are simple: a) It makes business sense for a manufacturing organization to become energy efficient; b) Numerous cases have shown that there are a lot of "low-hanging fruits" to be picked, requiring low level of investment and short payback period; c) To help reduce greenhouse emissions and be a responsible citizen, an industrial organization needs to become energy efficient.

There have been plenty of real life cases to support the claim that "energy efficiency is a source of energy". However, in reality companies are often faced with obstacles such as lack of in-house expertise or team, know-how, and lack of institutionalized operational procedures to set energy efficiency programs in the facilities. In the case of ABB: the organization's vertically integrated hierarchy did not allow local solutions to be shared by sister companies within the organization.

Consequently companies in different regions and country have been re-inventing the wheel time and time again, and best practices and experiences are not being shared., our collaboration has provided an means to come up with effective concepts, mechanisms and tools, to tackle the key tasks and issues related to the institutionalization of best practices of energy efficiency within its organizational and operational structures.

Institutionalization of Best Practice: A Computer-Aided Framework to Support Cycle of Continuous Improvement

Having realized that a key to improve the situation is to have energy efficiency best practices institutionalized within its organizational and operational structures, the structure and contents of a task-centered framework, previously developed by the MoIAC team, provided an ideal platform to help the organization achieve this. The organiziaton's leadership therefore decided to adapt this framework and implement it within its global network of manufacturing companies as part of its standard operational procedures, to fill in the energy efficiency gap.

The prototype of a comprehensive, computer-aided workbook has been developed to help with the institutionalization of best practices. This is required because the key to achieving energy efficiency is a continuous cycle of improvement, as shown. (Which is also the foundation of the newly established energy management standard ISO50001). Since industrial energy efficiency efforts involve a large number of documents and multitude of analysis and

decisions, an effective means is needed to support the tasks involved. We have adopted the concept of a task-centered approach to provide the basis for the development of this framework to incorporate all the procedures, processes, and tasks along the complete cycle.

The workbook utilizes a front-end flowchart to specify the steps and tasks involved, and then logically integrate all the relevant entities such as training materials and instructions, data collecting tables, procedures of analysis and calculation, and worksheets to support task execution, project management and documentation. It is structured in a user-friendly and practical way, intended to support:

- Interactive learning and training, by providing learning materials and best practice guides and resources in a focused way.
- Application in actual energy improvement project.
- Working data/tool sheets that can be populated for data collection and task execution
- ALL of ISO50001 requirements in organization, personal, task planning, task execution, and documentation

Since it is based on a widely used computing environment, the workbook can be easily implemented and adopted by any manufacturing site within the organization's global network, regardless of location. It therefore should easily adopted by ABB and provides an consistent and organization-wide tool to supports its global energy efficiency efforts, help to institutionalize best practices at all levels following the complete cycle of system improvement, by:

- Establishing and standardizing organizational structures within the organization
- Identifying, capturing and disseminating industrial standard and company-specific best practices in energy efficiency
- Developing, standardizing, and implementing operational procedures
- Providing a knowledge-base for both training and application purposes for all sites
- Providing a project management tool for individual sites
- Providing task-centered information/ reference sources
- Providing a database of energy management for all sites
- Supporting data collection and documentation requirements

Current Status and Future Work

Up-to-date, the organization's global steering committee has used a top down approach to the framework's adaptation and implementation. Essentially the steering committee shall nominate the division environmental officers whom will roll out the initiative to the different factories worldwide. Once the improvements are proven for one division, the same model will then be copied, improved and implemented on other divisions of the corporation. Eventually the division level instructions (adopted task documents) regarding energy efficiency can then be elevated to become the global standard and operational procedures for the organization. It is also decided that the institutionalization of the framework shall follow the ISO 50001 standard. Generically, the framework is already complete and comprehensive, supporting the complete cycle of improvement, and in general in compliance with the standard. The next steps will involve the development and population of company-specific database and task-document to:

- In Policy: Populate its database to provide ABB-specific aims and goals.
- In Plan: Establish company-specific bench-marking guides (both external and internal) and operational procedures; in addition to the tools and resources of general best practices that are already provided, develop company- and process-specific best practice guides.
- In Implementation, Check, Review: Establish supplier/service database; modify the documentation templates to reflect company-specific requirements.

In reality, industrial companies need effective approaches and tools to help with a multitude of tasks that are essential to the success of energy efficiency initiatives. These include training and knowledge acquisition, organizational and operational procedures, project management, data collection and documentation management. This case presents a more system-oriented effort to help achieve the above. The company's estimate on the impact of the initiative, once it is more widely adopted and implemented within the organization, is signification.

University Briefs

University of Alabama- The University of Alabama was represented at the 2012 IAC Lead Student Meeting by Victor Alas and James McNorton.

Boise State- The Industrial Assessment Center in Idaho is celebrating our first year of operation. Over 20 students have been involved in the Idaho IAC program through our 3 regional centers at the University of Idaho in Moscow, Idaho State University in Pocatello, and Boise State University in Boise.

Students from throughout Idaho gathered in September for a joint 2-day training session. Front row, l to r: Beau Husfloen, David Manthey, Stephanie Johnson, Hannah Luthman. Back row, l to r: Kenneth Boylan, Andrew Engel, Daniel Cotton, Ramzi Sarama, Sagar Shrestha , Chris Anderson , Ryan Oliver.

The Idaho IAC team has a unique relationship where the 3 schools work closely together in a true partnership. IAC faculty and staff hold bi-weekly phone calls to discuss IAC status, upcoming visits, reports due, and training opportunities. In addition, students from the 3 schools share their learning through an online discussion board and monthly videoconferences.

While manufacturing plants thrive throughout Idaho, certain industries are concentrated in different areas. Lumber mills in Northern Idaho, potato processors in Eastern Idaho, and memory chip makers in Southwest Idaho each have unique challenges yet share some basic technologies. Maintaining close relationships among the schools has allowed our students to expand their knowledge base beyond the experience they may have had working independently.

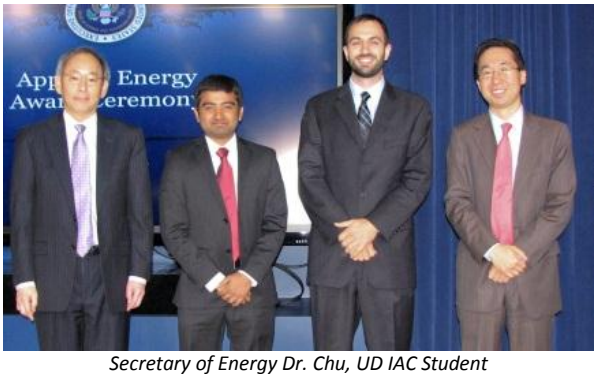
Bradley University- Bradley IAC graduate student Nishan Hundal was selected by the Illinois EPA for a summer internship at a Caterpillar Inc. facility in the Peoria, IL area. Brandon Larson, an MBA student with a B.S. in Industrial Engineering, represented Bradley University at the 2012 Lead Student Meeting in Atlanta, GA and gave a presentation on the convergence of engineering and business education at Bradley. Two students received IAC certificates in 2012 and eight new students have joined the IAC in the fall of 2012, giving us one of our largest teams in recent memory.

Colorado State University- JJ Moritz and John Whitmore traveled to Atlanta, Georgia to participate in the annual IAC Student Meeting.

University of Dayton

UD IAC Students Win Second Place on DOE "Apps for Energy" Challenge (and Yes They Went to the White House…)

In June 2012, UD IAC graduate students Mithun Nagabhairava and Dustin Pohlman won second place in the popular choice category for the US Department of Energy's "Apps for Energy Competition". Their smart phone app 'Innovative Solar Demand Response' links to Green Button Data to size a solar PV and a battery system to reduce electricity demand usage of a residential house. They received the award at a White House ceremony from Secretary of Energy Dr. Steven Chu and US Chief Technology Officer Todd Park.

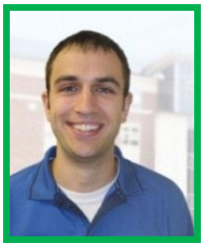


Secretary of Energy Dr. Chu, UD IAC Student Mithun Nagabhairava, UD IAC Student Dustin Pohlman, and US Chief Technology Officer Todd Park.

UD IAC Team Participates in DOE In-plant Training with Compressed Air Expert Tom Taranto

In October 2012, the University of Dayton Industrial Assessment Center members participated in the three day in-plant training in Navistar's truck assembly plant in Springfield, Ohio. This was the first time an IAC teamed with an US Dept. of Energy specialist to look for energy savings in both a specific system and across the plant. Compressed air expert Tom Taranto shared his knowledge and experience with Navistar plant personnel and UD-IAC students. Navistar, Taranto and UD-IAC team members all agreed that this joint assessment was extremely valuable.

UD-IAC Student Dustin Pohlman Receives Excellence in Applied Energy Engineering Research Award



In October 2012, Dustin Pohlman received the 2012 Excellence in Applied Energy Engineering Research Award from the US Department of Energy to conduct research on "Energy Efficient Humidity Control in Manufacturing". Dustin Pohlman and fellow IAC team mate Mohammed Qayyum have been collecting and analyzing data throughout the fall and will present their results in Summer 2013.

UD IAC Releases the "Energy Efficiency Guidebook"

The UD IAC released a public-domain, open-source, spreadsheet-based tool named the 'Energy Efficiency Guidebook' (EEG). The guidebook applies the Integrated Systems plus Principles Approach to industrial energy efficiency. It contains system best practices, spreadsheet calculations, energy analysis software and energy saving examples. UD-IAC students Tim Raffio and Jesse Monn won the Student Presentation Award at the 2012 IAC Lead Student Meeting in Atlanta, Georgia. The EEG is available free of charge at https://www.dropbox.com/s/amh60i6ooojciwn/EEG_Dist.zip

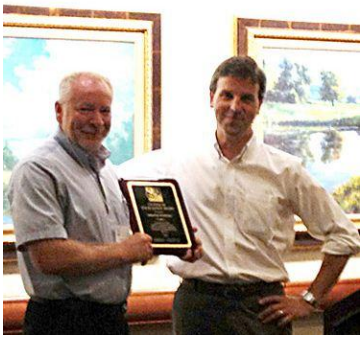
IAC Students Perform Energy Assessment in Suzhou, China

In December 2012, UD IAC students Hang Zhang and Jiawei Bu flew to Suzhou China to conduct an energy assessment for the large-scale Chinese optic cable manufacturer Tongding.

UD IAC Student Hang Zhang Describing Energy Efficiency Principles to Tongding Personnel in Suzhou China.

The assessment was organized by the University of Dayton China Institute, and built upon an energy efficiency seminar conducted this summer by Hang Zhang and UD-IAC personnel. The team utilized skills and experience gained in IAC assessments and applied the Integrated Systems plus Principles Approach. The UD-IAC is planning additional international assessments and is developing the capability of doing semi-remote and even remote assessments.

University of Delaware- The University of Delaware Center was very pleased to receive the Center of Excellence award this past year; it is the enthusiasm and dedication of the students in the program that resulted in this! Every assessment is met as a challenge and an opportunity to save energy.



Keith Goossen, director of the UD IAC (left) is congratulated by John Smegal, the workforce development lead for the U.S. Department of Eenrgy's Industrial Technologies Program.

After the 100th or so assessment, while still being a "newbie" to a certain extent, our center is able to reflect upon what works. One of our goals on every assessment is to leave the plant having saved the company money, having a recommendation, however small, essentially be implemented that day. Nothing is more rewarding than being able to experiment on-site and show plant personnel directly the savings of a measure. Examples of these measures abound.

At a plant with a large vacuum collection system, several of the trunk ducts had vane-diverter units that switched the vacuum between a pair of ports on 30 second intervals, but several ports did not have active machinery. The first question is, why not turn off the fan motors during the time it is sucking on the inactive port? To which the answer was, then it will not develop enough vacuum when it is switched to the active port. So, we showed the company that if you simply block the inactive port (with a handy piece of plywood), when the system is sucking on that port, since there is no air flow, the motor consumption drops by half. Thus we left the plant having shown the plant personnel that on their highest electrical consumer, they could save 25 % on trunk lines with inactive ports (50 % times 50 % of the time), and thus shave 1.6 % off their electric bill, that day.

We were at another plant recently having a large laboratory section with once-through HVAC, with supply via air handlers and exhaust via the laboratory ducts. We determined that 40 % of their electric bill was for the fan motors on this system. The system was air-balanced using in-line dampers. The company had a central control panel for the entire system, and VFDs on the fan motors controlled by pressure sensors in the manifolds. Examining the system from the panel, we saw that all of them were set < 70 %. We explained to plant personnel that the system should be set so that the dampers were as open as possible to save energy on the fan motor via the cube law. In real time, we lowered the pressure settings, and watched the dampers open up and the motors wind down. Adjusting pressure set points so that the most open damper was ~ 95 % (to still allow for control), fan motor consumption dropped 12 %. Thus we left the company saving them 0.12x0.4 = 4.8 % off their electric bill.

While it's not always possible to save the company a few percent on the day of the assessment, we find that if you can save even a few hundred dollars that day, showing them something (that they don't know about) that they can do easily and directly to save a few bucks, their estimation of your expertise goes up dramatically. Then, they're a lot more amenable to implementing the complex expensive recommendations you make.

IUPUI- Jason Campridge served as the representative for IUPUI at last year's student meeting.

Iowa State University- The Lead Student for the Iowa State IAC is Kyle McKenna. Kyle attended the 2012 IAC Lead Student Meeting last October.

Lehigh University - The Lehigh University Industrial Assessment Center has been extremely active in 2012, undertaking a broad range of assessments. These included foundry companies, valve manufacturers, a narrow fabric mill, a surgical and medical instrument manufacturer, a perishable prepared food manufacturer, and so on. Lehigh's IAC conducted 20 energy assessments last year with a total energy cost savings from our recommendations to the manufacturing companies of about $4 million. Meanwhile, we continue to make great progress in our student training program. The number of new IAC members increased to 21 in 2012, compared to only 10 new students in 2011. In May 2012, lead student Benjamin Rosenzweig graduated with a master's degree and chose to pursue a career as an offsite utility engineer in Washington, D.C.

During the summer of 2012, lead student Tim Huber began developing an energy efficiency practicum course around the IAC. This course was created with the intent of better integrating the IAC with the mechanical engineering department's curriculum. The course consists of formalized lectures on DOE's energy efficiency "Best Practices", covering all systems. In addition, individual and group student projects were developed. These projects focus on strengthening the quality of our assessments and/or broadening the services we provide to our clients. For instance, students are researching chiller best practices, as this area has been a point of weakness for our center. Another student is establishing a step-by-step guide to achieve ISO-50001 certification. During the fall semester, three graduate and five undergraduate students were enrolled in the course. One of the goals for this course is to significantly increase the number of students applying for IAC certificates.

A key improvement for 2012 is that the Lehigh IAC tried to apply more high-tech and cutting-edge energy conservation tools in energy audits. We are trying to make more accurate measurements and data logging during the plant visit by employing better measurement devices. A regular training schedule was created to ensure all IAC members are properly trained using the equipment available to our center. IAC Member John Curry employed the use of Google SketchUp and Google Earth to re-create and geo-locate a facility for a solar energy system recommendation. The model was used to assess shading conditions round year for a proper estimate of available roof space.

Overall, 2012 has proved to be a successful year. The Lehigh IAC is pleased with the work it has accomplished and hopes to perform even better in the coming year. More students are interested in our cause and are eager to join the IAC office. With the growing concern about energy conservation, more companies are also seeking our advice. We look forward to a busy year full of exciting new challenges and companies to work with in an effort to increase their energy efficiency.

University of Kentucky- The University of Kentucky just completed its first full year of operation as an IAC, with assessments covering a variety of industries, ranging from metal alloys to poultry. At the 2012 Lead Student Meeting in Atlanta, three students (Jake Trimpe, Rahul Nehete, and Evan Schroader) represented the Kentucky IAC. They gave a presentation on the use of anaerobic digesters to generate energy from industrial waste, based on their exposure to such a system in one of their industry assessments.

University of Massachusetts- Alex Quintal attended the 2012 IAC Lead Student Meeting for the UMass IAC.

University of Miami- The University of Miami IAC (MIIAC) has had an exciting past year. The Center was honored by a visit from the President of the United States. Several graduate and undergraduate students demonstrated IAC methodology and technology directly to President Obama. MIIAC is extremely proud of the fact that the White House decided to visit MIIAC as a backdrop to the President's speech on energy policy at University of Miami. The Center also hosted Mr. Rick Counihan, the vice-president government affairs at EnerNOC, who gave a presentation about Demand Response in which he talked about the challenges of implementing demand response, the current state of the field, and the effectiveness of existing demand response programs. The MIIAC team now consists of eight Ph.D. students, three Master's students, and nine undergraduate students which is the largest the Center has ever been since its inception. Two Ph.D. students at MIIAC have been working on their dissertation research related to real-time energy monitoring with peak-demand prediction and advanced control strategies for HVAC systems in buildings. MIIAC completed several interesting assessments this past year including four companies in the Commonwealth of Puerto Rico in conjunction with Primex (MEP of Puerto Rico).

President Barack Obama during his visit to the University of Miami IAC on February, 23 2012.
From left to right: Ms. Mariah Szpunar (Undergraduate IAC Member), Dr. James Tien (Dean of College of Engineering), President Barack Obama, Dr. Shihab Asfour (Associate Dean of College of Engineering & MIIAC Director), Mr. Jason Grant (Graduate IAC Member), Mr. Hanzala Siddiq (Undergraduate IAC Member)

University of Michigan- In addition to helping conduct energy audits, students at the University of Michigan Industrial Assessment Center have been attending educational lectures. Recent lectures focused on the ISO 50001 Energy Management System set of guidelines and procedures. The lectures give an overview of the standards and highlight the steps that an organization may take in order to successfully implement energy saving strategies. During the lectures, students are challenged to think about how the University of Michigan IAC's strategy of (Plan, Do, Act and Check) could be integrated with the ISO 50001. Students use case studies to brainstorm how typical energy saving strategies might be adopted using the protocol outlined in the ISO 50001. Participating in such exercises helps students gain an understanding of the organizational challenges associated with introducing energy plans and implement saving measures.

The University of Michigan IAC team consists of Mechanical Engineering faculty Arvid Atraya and Claus Borgnakke, Research Investigator Pawel Olszewski, Ph.D student Xinyu Ming and undergraduate students Wei Jin Bong, Dan Borgnakke, Marco Campos, Robin Choi, Jeff Hwang, Nick Montes, Stephen Ratkowiak, Eric Pulick, Joshua Padeti, Sriram Yarlagadda and Yalim Yildirim.

University of Missouri- John Wibbenmeyer and Tyler Burns delivered a presentation on ISO Implementation at the 2012 IAC Lead Student Meeting.

North Carolina State University- 2012 was a year of change at the NCSU IAC. The year saw the end of the State Energy Internship Program that funded over 60 student interns to work in various energy related areas – both on-campus and at over a dozen off-campus private businesses. The program was a huge success and resulted in many of the students getting great job offers at graduation and the assessment of hundreds of facilities. Several of these students have become IAC graduate and undergraduate students as a result.

2012 also saw the graduation of five graduate students from the program. We would like to congratulate David Hunt, Andrew Murphy, C. Blake Chestnut, Kate Patterson, and Saurabh Ray on obtaining their IAC certificates and Masters degrees. Four of the five are currently employed in the energy field.

This fall, the NCSU IAC sent three students to the IAC Student Meeting in Atlanta, GA. The proximity of Atlanta to Raleigh made it easy and economical to send three students, who shared a car ride and hotel room. All three reported that the meeting and the World Engineering Energy Congress were a great experience. Dr. Stephen Terry, Assistant Director, won the Region II Energy Professional Development Award.

Oklahoma State University- There were five students from OK State who earned IAC certificates in 2012.

Oregon State University- Lead Student Alex Cimino-Hurt attended the IAC Lead Student Meeting in Georgia last fall.

San Diego State University- Jonathan Butbul, Michael Soda and Kevin Braderhorst were awarded certificates during the last year.

San Francisco State University- The SFSU IAC had three students achieve DOE certificates.

Syracuse University- The Syracuse University IAC has had another exceptional and productive year. We are entering our second year under the new Department of Energy grant and moving into our 13th fiscal year with a new head director, Suresh Santanam.

Our center has grown considerably in the last year with not only the addition of more students at SU but with a brand new satellite center at Clarkson University. Under the leadership of Kenneth Visser, a faculty member in the department of Mechanical and Aeronautical Engineering, the SU-IAC has hired three Clarkson engineering students, Daniel Barron (senior) our first civil engineering student and Michael DiLorenzo (senior) and Matthew Russell (junior), both mechanical engineering students. All three are pursuing a minor in Sustainable Energy Systems. They are currently undergoing our stringent training program and have already participated in a few energy assessments. Back in Syracuse, the SU-IAC has hired four more energy analysts: Joshua Huizinga (senior), Timothy Castelein (junior), Ryan Milcarek (junior) and Diana Siegel (junior), bringing the center total to 13 students.

In December, 2011, we graduated Nick Pasco who received his M.S. in Environmental and Resource Engineering, Renewable Energy and Ecological Engineering at SUNY College of Environmental Science and Forestry and is currently working for O'Brien and Gere, an engineering consulting firm, in their Syracuse, NY office. In May, 2012, energy analyst Abigail Hutchins graduated with her B.S. in mechanical engineering after completing 6 assessments with our center. She is currently working for Consolidated Edison in New York City. Finally, we graduated our lead student, Christopher Buttitta who after four years with the program, participated in 32 assessments. He now works for Clough Harbour & Associates (CHA), an engineering consulting firm, in their Albany, NY office.

In the coming year, four of the SU-IAC students will be embarking on a new project. The students were selected to compete in the New York State Pollution Prevention Institute's Research and Design Competition entitled *G2C: Go Green on Campus.* The project entitled *Rainwater Harvesting: Creating a More Sustainable Campus Drop by Drop* will involve designing a system capable of harvesting the rainwater from the field house on campus and using it to water the surrounding fields. The competition will take place in April.

The center is maintaining partnerships with the New York State Center of Excellence in Environmental Systems and Sustainable Energy, located in Syracuse, NY and with GDF Suez Energy Company. The SU-IAC has already seen the benefits of these partnerships as they have both contributed to supplying our center with new clients.

Tennessee Tech- James Leverette and David Clifford attended the 2012 IAC Lead Student Meeting.

Texas A&M University- This year has seen a wide variety of assessment and outreach activities at Texas A&M University. The center completed their normal complement of assessments, including our first assessments in Louisiana. Students participated in a series of training sessions provided by industry partners, covering steam systems, HVAC systems, lighting technologies, ESCO operations, low temperature waste heat recovery, and renewable energy technologies. The team also enjoyed an extensive tour of the new campus Combined Heat and Power (CHP) plant.

The center is also supporting several senior "capstone" design projects related to energy optimization and conservation. These projects are funded by grants from the US Dept. of Energy, the Dwight Look College of Engineering, and industrial partners.

Finally, the center sponsored a new outreach program entitled "E^3: Energy Experiences for Educators." Several high school teachers learned first-hand about renewable energy technologies, energy conservation, and efficient power plant operations.

University of Wisconsin at Milwaukee- After just one year of operation, the IAC at the University of Wisconsin-Milwaukee looks forward to another successful and beneficial year. The start-up of an IAC in South Eastern Wisconsin could not come at a more critical time for area manufactures. WE Energies, the utility service provider in the area, projects energy costs to increase by 4.2% in 2013. Now more than ever company personnel are looking to implement sustainable strategies in energy efficiency. All the assessments scheduled for the next three months have come from manufacturers contacting us as opposed to through targeted marketing techniques.

One IAC Certificate was awarded to former lead student Elizabeth Ehrke after her graduation with an M.S. in Mechanical Engineering. The departure of Ehrke has provided an opportunity for structural and management changes within the organization. Ellen Forde and Junling Xie have been selected as Co-Lead Students, each leading one team of project engineers on alternate assessments with one of five Co-Directors. Ten graduate and undergraduate students round out the two teams with a mix of backgrounds from mechanical, industrial, material, and electrical engineering.

Following a two day, intensive training to kick start the semester, UWM IACers are ready to begin another year of assessments. Training placed an emphasis on identifying energy saving opportunities within industrial systems, standardized measurement techniques for data collection and sound engineering principles of cost-benefit analysis. The 2013 IAC cohort is excited to continue learning and providing excellent services to area manufacturers.

West Virginia University- With manufacturing industries facing tougher markets, Industrial Assessment Center at West Virginia University (WVU-IAC) had busy time assisting them to save energy and become more competitive. WVU-IAC had wide variety of energy assessments, technical assistance activities, trainings and several notable accomplishments this year.

WVU-IAC conducted 20 regular assessments with focus on QuickPEP, MotorMaster+, 3E Plus, AirMaster, PHAST and other Best Practices Software tools. IAC also successfully conducted 8 training assessments in which the students were given the chance to lead the assessment team as well as in planning and execution of energy analysis and diagnostic activities. IAC team is working on many other energy projects that are funded by USDOE, WV IOF, West Virginia Division of Energy (WVDE) and USDA.

The IAC students Dayakar Devaru, Ramakrishna Maddula and Harish Kanneganti successfully passed the FE exam and obtained EIT certification. IAC Director Dr. Bhaskaran Gopalakrishnan, IAC Engineering Scientist Subodh Chaudhari, and IAC student Kartik Ramamoorthy became Certified Practitioners of Energy Management Systems (CPEnMS). The Director and IAC student, Kartik Ramamoorthy successfully completed the Pumping System Assessment Tool (PSAT) Qualified Specialist training and received certificates from DOE.

WVU-IAC Team at ISO 50001 case-study discussion in Morgantown From Left to Right: Dr. Ed Crowe (3rd Party Trainer), Dr. Gopalakrishnan, Subodh Chaudhari, Amir Abolhassani, Harish Kanneganti, Prateek Vaish, Dayakar Devaru (Presenter) and Ryan Campione (Left Bottom Corner)

IAC students Phani Kishor, Kartik Ramamoorthy and Liza Fulks graduated and took job in ICF international, American Axle and Hershey Corporation respectively. Kartik Ramamoorthy developed a structured approach for facilitating the Implementation of ISO 50001 Standard in manufacturing industry for his MS thesis. Unfortunately Phani Kishor fell from a museum attic of 40 feet high while doing energy assessment and got severely injured and is still in the ICU taking treatment. This incident teaches us a lesson not to climb heights without proper safety gear.

Classroom training in ISO 50001 and SEP was conducted for the IAC students from a third party Certified Practitioner in Energy Management Systems. This training created a pathway towards CPEnMS certification and an ISO 50001 auditor to the students. This activity took place for 1 hour each week for 15 weeks in the Spring and continued in an expanded format focusing on applications during Fall.

The director, Dr. Bhaskaran Gopalakrishnan and assistant director, Dr. Wafik Iskander successfully conducted seminars/webinars on Fundamentals of Compressed air Systems and Process Heating Systems on Jan 31st and March 3rd, 2012. The IAC director Dr. Bhaskaran Gopalakrishnan got recognized as the instructor for 'Fundamentals of Compressed Air' workshop by Compressed Air Challenge after conducting this workshop on April 16th in Morgantown, WV. IAC students Harish Kanneganti and Ananthi Paul attended this training. WVU-IAC organized a webinar on Lighting Technologies on Nov 2nd, 2012.

Eight new students joined IAC and 6 students left this year.
A total of nine students (6 graduate students, 3 undergraduate students) are working at the IAC now.

Director along with other co-principal investigators worked on SEN project to facilitate post assessment analysis of energy efficiency measures. This analysis was deployed through a system which is called as Energy Efficiency Knowledge Center (EEKC). The EEKC was successfully demonstrated with respect to usage, security and analysis features during the SEN annual meeting held on February 15, 2012.

Lead Student Dayakar Devaru attended lead student meeting held in Atlanta and also attended World Energy Engineering Congress. The IAC engineering scientist, Subodh Chaudhari and past IAC student Senthil Sundaramoorthy attended Association of Iron and Steel Technology meeting in Calvert, AL and made a presentation on the topic of energy efficiency in hot dip galvanizing lines which is also adopted technology for WVU-IAC.

The activities at WVU-IAC the IAC are focused on workforce Development to create the next generation of energy engineers trained in energy efficiency, sustainability, business sense, & energy management.

Recruiter's Corner

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/RecruitersCorner.

ERS, Inc. is a progressive energy engineering consulting firm based in Haverhill, Massachusetts, with additional offices in New York, Maine, and Texas.
Contact Recruiting, 978-521-2550

Cascade Energy Engineering is a consulting firm specializing in industrial energy efficiency projects. Cascade has offices in Portland, OR; the Salt Lake City, UT area; and Walla Walla, Washington.
Contact Dan Brown, 503.287.8488

NORESCO is one of the nation's most experienced energy service companies, building self-funding energy-efficient infrastructure improvements and renewable energy installations for a wide range of educational, government, commercial, cor-rectional, public housing, and industrial customers.
Contact Anthony Sclafani or Tina Boydston, Recruiter, 508-614-1049

Nenni and Associates is a leading resource in retained and permanent placement recruiting and consulting in the HVAC, Energy Services and Renewable industry.
Contact David Kelley , 815-899-9421

The Cadmus Group is an environmental consulting firm headquartered in Watertown, Massachusetts.
Contact Lauren Mattison, 617-673-7107

Enovity, Inc. is a sustainability consulting firm that provides customized energy and operational solutions for high performance buildings.
Contact Pamela Boyes, 415-974-0390

CHA is an ENR Top-100 Engineering Firm and was recognized in 2008 among Zweig White's 100 Hottest Firms in North America.
Contact Jennifer Schembari/Ann Devost, (518) 453-4500

Geo-Marine, Inc. Geo-Marine, Inc. (GMI) has more than 30 years of experience in delivering innovative, cost effective engineering and environmental services to our clients.
Contact Steve Silva, 817-226-8385

Energy Solutions is one of the leading consulting firms in the field, specializing in energy efficiency program design, implementation, and marketing as well as solar feasibility studies and financing and water conservation programs.
Contact Kate Merrill, 510-482-4420 x223

Siemens Building Technologies As a leading provider of energy and environmental solutions, building controls, and fire safety and security systems solutions, we make buildings more comfortable, safe, secure, and less costly to operate.
Contact Kristin Junia, 847-215-1000

Elara Engineering ELARA Energy Services, Inc. is a 9 year old Mechanical, Electrical, Plumbing, Fire Protection and Information Technology (MEPFPIT) consulting engineering firm located in Hillside, Illinois.
Contact Caitlin Levitsky, (708) 236-0300

Ameresco, Inc. is an independent energy solutions company delivering long-term customer value through innovative systems, strategies, and technologies.
Contact Trish Puopolo, 508-661-2200

Nexant, Inc. is a provider of intelligent grid software and clean energy solutions—pioneering, developing, and advancing electric power grid and alternative energy technologies and services.

CLEAResult Consulting CLEAResult is an energy efficiency consulting firm with expertise in utility program design, development, implementation, and evaluation.
Contact James Hatheway, 512-259-2383

McKinstry Established in 1960, is full service design, build, operate and maintain (DBOM) firm.
Contact Heidi Cunningham, 206-762-3311

Redfish Technology, Inc. is a nationwide executive recruiter focused on Talent Scouting and Employment Opportunities in Clean, Green, Alternative Energy and High Tech.
Contact Rob Reeves, 208-788-8260

Honeywell Honeywell Building Solutions (HBS) is a strategic business unit in Automation and Control Solutions (ACS).
Contact Ryan Smith, 763.954.5969

Schneider Electric As a global specialist in energy management with operations in more than 100 countries, Schneider Electric offers integrated solutions across multiple market segments, including leadership positions in energy and infrastructure, industrial processes, building automation, and data centers/networks, as well as a broad presence in residential applications.
Contact Michelle Rouley , 847-925-3694

Ecos delivers proven results for clients looking to reduce their energy use, manage their carbon emissions and make their operations more environmentally sustainable.
Contact Kia Packard, 503-525-2700

CPC Recruiting is a professional recruiting partner to Super ESCO & Performance Contracting talent.
Contact Jacqui Staruck, (607) 397-8259.

Johnson Controls is a global diversified technology and industrial leader serving customers in over 150 countries. Our 130,000 employees create quality products, services and solutions to optimize energy and operational efficiencies of buildings; lead-acid automotive batteries and advanced batteries for hybrid and electric vehicles; and interior systems for automobiles.

Global Recruiters of Mount Airy is an executive search firm that focuses on bringing renewable energy and energy efficiency professionals together with great companies who can benefit from their expertise and allow them to continue growing professionally.
Contact Anthony DiGiovanni, 215-849-3070

EnerNOC EnerNOC is transforming the way the world uses energy. We help commercial, institutional and industrial organizations use energy more intelligently, pay less for it, and generate cash flow that benefits the bottom line.
Contact Derek Popek, 617.692.2538

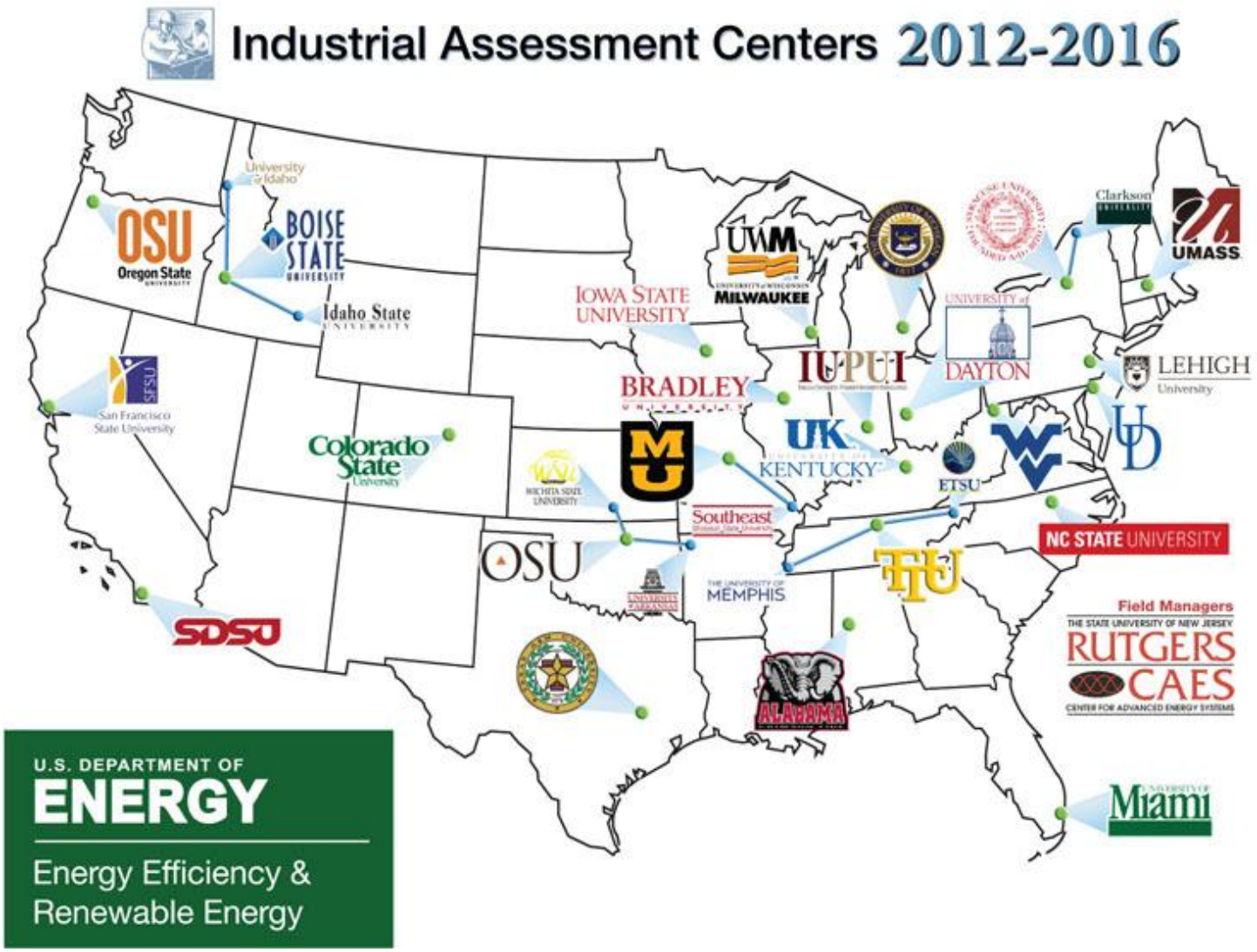
KEMA , an international company headquartered in Arnhem, The Netherlands, is a technical leader in the way power is supplied and electricity is used around the world.
Contact Recruiting, 781-273-5700

IAC Program Contact Information

Newsletter Editor and IAC Student Activities Coordinator: Thomas Wenning, wenningtj@ornl.gov
IAC Student Activities Assistant: Susie Allen, allensc@ornl.gov
U.S. Department of Energy Headquarters, Workforce Development Lead: John Smegal john.smegal@ee.doe.gov
U.S. Department of Energy Golden Field Office, IAC Project Officer: Bill Prymak bill.prymak@go.doe.gov
Rutgers IAC Field Management
Director: Dr. Mike Muller, muller@caes.rutgers.edu
Manager of Technical Operations: Don Kasten, Kasten@caes.rutgers.edu
IAC Database: Mike B. Muller, mbmuller@caes.rutgers.edu , database location: http://iac.rutgers.edu

Calendar of Events and Training

- **2013 IAC Lead Student Meeting**, September 25-27, 2013, Washington DC, Past proceedings at www.IACforum.org
- **DOE Industrial Technologies Program Qualified Specialists and End-User Training,** throughout 2013, http://www1.eere.energy.gov/manufacturing/tech_deployment/training_calendar.asp
- **SAE World Congress and Exhibition,** April 16-18, 2013, Detroit, MI, http://www.sae.org/congress/
- **Industrial Energy Technology Conference,** May 21-24, 2013, New Orleans, LA, http://ietc.tamu.edu/home
- **ASHRAE 2013 Annual Conference,** June 22-26, 2013, Denver, CO, https://ashrae.org/membership--conferences/conferences/2013-ashrae-annual-conference
- **ACEEE Summer Study on Energy Efficiency in Industry,** July 23 – 26, 2012, Niagra Falls, NY, http://www.aceee.org/conferences/2013/ssi
- **2013 World Energy Engineering Congress,** September 25-27, 2013, Washington DC, http://www.energycongress.com/
- **ASHRAE 2014 Winter Conference,** January 18-22, 2014, New York, NY, http://ashraem.confex.com/ashraem/w14/cfp.cgi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