

Final Technical Report

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Executive Summary

The Industrial Assessment Center program at North Carolina State University has conducted one hundred industrial assessments of small and medium sized manufacturers in North Carolina, South Carolina, and Virginia. Reports were submitted to each facility that included a brief description of the plant, historical energy use, and a technical analysis of potential energy efficiency savings, waste reduction, and productivity savings. Seven hundred thirty eight conservation measures were recommended with total annual cost savings in excess of \$18 million.

The NCSU IAC has worked with other government and private entities to deliver energy efficiency and conservation services. We have worked closely with the NCSU Industrial Extension Service, the Manufacturer's Extension Partnership (MEP), and the North Carolina

State Energy Office to provide follow-up technical help and financial assistance in implementing conservation recommendations. In addition to these organizations, the NCSU IAC has also worked with the NC Department of Pollution Prevention and Environmental Assistance, the NC Solar Center, Advanced Energy Corporation, Duke Power, Progress Energy, Dominion Power, and the City of Danville, Virginia.

Eighteen undergraduate and twenty graduate students were exposed to a variety of manufacturing processes, trained on plant safety, and taught the use of various types of data collection equipment. The students performed technical analyses of each recommendation, computed the potential savings from engineering relations and collected data, estimated the cost from vendor information, and communicated the findings in a compact, well written report to the client. The students have also been exposed to a variety of business personnel, including corporate presidents, engineering managers, plant managers, plant engineers, facility maintenance staff, and production workers – each with a unique perspective on the challenges faced in a modern manufacturing facility.

The program has exposed hundreds more students to the importance of energy efficiency / conservation through the incorporation of IAC experiences into the undergraduate curriculum. Both the Director and the Assistant Director teach junior and senior level classes in the thermal sciences curriculum of Mechanical Engineering. These classes have enrollments exceeding 100 students per year, or half of the graduating class. IAC experiences provide real-world examples and topics for discussion to further out student's engineering education.

Task Summary

Task 1: Conduct Industrial Assessments, to include a variety of plant types and sizes and well as coverage of the geographic area defined in the Annual Workplan Industrial

Assessments: *Provide a summary of the assessments performed over the life of the award. Include overall number of assessments, types of businesses assessed, number of ARs, and any other related info.*

The NCSU IAC has performed one hundred assessments during the project period, and over three hundred and fifty assessments since it was established in 1992. Small to medium size manufacturing plants with less than 500 employees, gross sales of less than \$75 million, and annual energy costs of less than \$2 million were considered. These facilities manufacture a large variety of products, including food, textile goods, furniture, fabricated metal products, industrial chemicals, paper products, pharmaceuticals, and other consumer goods. Reports to the clients include 738 recommendations, mostly in the area of energy conservation. Recommended cost savings exceed \$18.25 million per year. The breakdown of manufacturer by four digit SIC code is provided in the table below.

Table of NCSU IAC SIC Codes FY2003 – 2006

SIC Code Range	Category	Number of Plants Surveyed
2000-2199	Food / Tobacco	6
2200 - 2399	Textiles	17
2400 - 2799	Wood / Paper products	24
2800 - 2999	Chemicals	9
3000 - 3199	Rubber and Plastics	13
3200 – 3299	Glass and Stone	7
3300 - 3399	Primary Metal	5
3400 - 3499	Fabricated Metal	7
3500 - 3599	Machinery	4
3600 - 3699	Electronics, Transportation, and Other	8
2000 - 3999	Total	100

Task 2: Promote and increase the adoption of assessment recommendations and employ innovative methods to assist in accomplishing these goals. *Provide a summary of the efforts used to promote the adoption of ARs, including any available overall adoption statistics.*

The NCSU IAC works with several organizations that promote energy efficiency in North Carolina and the Southeast. We highly encourage clients to work with the Industrial Extension Service and the Manufacturer's Extension Partnership (MEP) to implement measures. Both organizations provide additional expertise in a specific area (i.e., compressed air, lighting, boilers, etc.) and can provide the follow-up that companies need to get the project into a capital budget. The IES also provides energy training workshops to educate plant management and maintenance personnel on proper equipment operation and energy conservation / efficiency opportunities, reinforcing the information they learn from the assessment and the report.

We also work with other organizations periodically that have specific expertise or equipment to increase implementation. For example, the NC Department of Pollution Prevention has a staff of waste minimization specialists that will visit and work with companies for free. The Advanced Energy Corporation, a non-profit organization funded by the utilities, has equipment that can be used to test the effectiveness of various electrotechnologies, such as radio frequency ovens.

IAC staff has also been working with the State Energy Office to adopt energy conservation measures in state buildings, particularly on university campuses across the state. The program (called the Utility Savings Initiative, or USI) provides monies for on-site assessments of state buildings, and for implementation of specific measures, including monitoring before and after implementation to determine actual savings. This experience makes the IAC reports more realistic and gives credence to measures that we have actually implemented.

Task 3: Promote the IAC Program and enhance recruitment efforts for new clients and expanded geographic coverage. *Describe efforts to promote the IAC program and expand the reach of the center.*

Our work with the State Energy Office of North Carolina and the NCSU Industrial Extension Service has resulted in many assessments. The Industrial Extension Service (IES) has a history of service to North Carolina manufacturers. Information about the IAC is included in every workshop. We work closely with personnel at both organizations, which are well aware of our mission and encourage manufacturers to work with the IAC. The IAC is often used as a general survey to determine the specific needs for work at a facility. Using the IAC report as guidance, IES can then create a personalized plan for implementation. Our work with IES enhances both programs because we have access to the extensive IES database of contacts and the IES can provide targeted follow-ups to address particular energy conservation improvements.

The NCSU IAC also worked with utilities and municipalities. The State of Virginia has begun to deregulate its electric service and in 2004 (as a result) the City of Danville experienced a 40% rise in electrical rates in just one year. The NCSU IAC worked closely with the City of Danville's municipal electric department to assist local industry in identifying energy conservation opportunities and to lessen the impact of the large rate increase.

The NCSU IAC also works with Progress Energy, Duke Energy, Dominion Power, and several municipal electric utilities to provide energy conservation assessments to their customers. The utility can provide follow-up. These utilities cover the majority of the NCSU IAC's three state region.

Task 4: Provide educational opportunities, training, and other related activities for IAC students. *Summarize education, training and other any other activities for the students. Include overall number of students that participated during the course of the award.*

During the program period, 38 students have participated in the program. Eighteen of these students were involved as undergraduates and twenty students as graduate students. IAC students are provided significant educational opportunity with their participation in the program. Students are exposed to a variety of manufacturing processes and personnel. Analysis of potential measures includes use of knowledge of thermodynamics, heat transfer, and fluid mechanics. Communication of findings in a clear and concise manner is stressed.

In addition to the experiential learning that takes place as an IAC participant, our students are also encouraged to attend workshops (free of charge) presented by the Industrial Extension Service, as well as Best Practices workshops (steam, compressed air, pumping, process heat) provided by the Save Energy Now initiative. Dr. Terry, the NCSU IAC Assistant Director, is a qualified instructor for the DOE Steam End User class. He has taken IAC students to end-user classes, where practical.

IAC experiences are used in the junior and senior level undergraduate courses taught by the IAC staff. These experiences provide real-world examples to over one hundred students per year who take these courses. Dr. Herb Eckerlin teaches a senior level elective – Energy Conservation in Industry – that discusses specific industrial technology and energy conservation opportunities.

The course has an enrollment of between forty and seventy students per year. Dr. Terry teaches one of two sections of the senior level Thermal Systems Design class that is capstone course in thermal sciences. Here specific IAC experiences are shared through lectures, homework problems, and test problems. This comprises about half of the typical graduating class in the department.

In the summer of 2005, the NCSU IAC partnered with North Carolina A&T University, a historically black university, and performed several assessments with students from that institution. The assessments were co-lead by Drs. James Leach and Richard Johnson of NC State, and Dr. H. Singh of NC A&T. Students from both institutions interacted and co-authored the reports to the clients. A similar collaboration is scheduled for later in the spring of 2007 under the new IAC contract.

In the Spring of 2006, Dr. Herb Eckerlin developed a national webcast on “Measuring and Improving Boiler Efficiency” as part of the *Save Energy Now’s 2006 National Webcast Lecture Series*. This was shown nationwide and generated much interest in the IAC program.

Task 5: Coordinate and integrate Center activities with other Center and IAC Program activities, DOE’s Industrial Technologies programs and other EERE programs. *Summarize the integration activities with other centers, the ITP program, state programs, etc.*

IAC staff has and continue to work closely with the State Energy Office. The IAC is an important part of the effort to reduce energy usage statewide. Our contact information is included in literature distributed to manufacturers by mail and during training workshops. We have worked closely with the State Energy Office on the Utility Savings Initiative, discussed earlier, as well as on other projects.

In addition to the work with the State Energy Office and the NCSU Industrial Extension Service, the NCSU IAC continues to work with other DOE programs. Dr. Terry is a qualified instructor and energy saving expert for the Save Energy Now initiative. Dr. Terry has taught steam end-user classes in Alabama, North Carolina, Virginia, Delaware, Pennsylvania, and Massachusetts. He also performs three day steam assessments for the DOE, including work in North Carolina, Alabama, and Arkansas.

In 2006, the NCSU IAC was awarded a project to work with the state energy offices of Georgia, Mississippi, and North Carolina and the IAC’s at Georgia Tech and Mississippi State. This effort will include training workshops, three-day assessments, and client follow-up.

Task 6: Other tasks or special projects, as needed, and as determined by DOE to be advantageous to the program and in furtherance of IAC Program goals. *Briefly describe any other special projects or tasks performed for DOE under the award.*

Dr. Herb Eckerlin created and presented a webcast in 2006 on “Measuring and Improving Boiler Efficiency”. The webcast was part of the *Save Energy Now’s 2006 National Webcast Lecture Series*. The webcast was shown nationally and generated interest from the IAC community and from industry.

In the Fall of 2006, the NCSU IAC contact 189 Large Energy User facilities in the North Carolina, South Carolina, and Virginia region. The purpose of the effort was to establish a relationship between these facilities and the U.S. Department of Energy. Literature about the many programs and workshops available will be sent to these facilities.

Dr. Herb Eckerlin presented four “Improving Boiler Efficiency” workshops during the spring of 2006. These workshops were held in Hickory, Greensboro, Wilmington, and Raleigh, NC and were co-sponsored by the NCSU IAC, the NCSU Industrial Extension Service, and the North Carolina State Energy Office. The workshops were very well received, with an average attendance of 30 participants per workshop.