

## Dr. Bhaskaran Gopalakrishnan Extends the Reach of the West Virginia University Industrial Assessment Center

*As Director of the West Virginia University (WVU) Industrial Assessment Center (IAC), Dr. Bhaskaran Gopalakrishnan (“Gopala”) has a clear goal—broadening the reach and impact of the program.*



Discussing energy audit results — Dr. Bhaskaran Gopalakrishnan (left) and Dr. Ed Crowe (right, Engineering Scientist at West Virginia University) discuss some of the findings of an energy audit of a small business in Fairmont

WVU, Photo by Brian Persinger

### Background

Gopala is a highly skilled leader with a Bachelor’s Degree in Production Engineering from the University of Madras in India; a Master’s Degree in Operations Research from the Southern Methodist University in Dallas, Texas; and a Ph.D. in Industrial Engineering and Operations Research from Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, Virginia. He is also a Certified Energy Manager; a Registered Professional Engineer in West Virginia; and a U.S. Department of Energy (DOE) Qualified Specialist in the areas of compressed air, process heating, fans, and steam systems. While noteworthy, these academic accomplishments only begin to depict the depth of Gopala’s experience and skill as a professor. Nevertheless, these attributes have enabled him to lead a highly successful IAC that has an impact far beyond its founding mission.

### Career Highlights

In August 1988, Gopala joined WVU as a professor in the Department of Industrial and Management Systems Engineering (IMSE), where he benefited from the mentorship of department chair Dr. Ralph Plummer. In 1992, Dr. Plummer and Gopala successfully initiated a center with the purpose of teaching students about energy diagnostics and analysis. This would later become known as the Industrial Assessment Center. In 2005, Gopala assumed the directorship of the school’s IAC, which he has since managed with the help of assistant director Dr. Wafik Iskander.

Gopala utilizes his impressive background in energy efficiency and management when teaching his IAC students. As a DOE Qualified Specialist, he has extensive experience performing Energy Savings Assessments (ESAs). ESAs are conducted at large manufacturing facilities with significant operations—often global in scope—that experience high energy consumption. Gopala began participating in these assessments in 2007 and, since then, has conducted more than 40 ESAs. Based on that experience, Gopala recognized an opportunity to combine traditional ESA strategies with the strongest elements of IAC assessments, including the incorporation of an end of project report. In 2008, he initiated the development of such a hybrid approach, which takes two days and is most appropriate for large facilities. Thus far, his team has conducted hybrid ESA-IAC assessments at two large plants—a copper melting facility and a steel galvanizing sheet facility. During the assessments, his students had the chance to follow ESA protocols and then draft an IAC report. It was a unique experience for the students to conduct an assessment at such a large facility, which demonstrated the importance of adjusting a process based on the client’s needs.

In addition to his expertise with ESAs, Gopala has also exhibited proficiency with the Superior Energy Performance (SEP) initiative and the new International Organization



Courtesy of WVU

Gopala and a student conduct an energy assessment on a glass-melting furnace

### Environmental Impact of the West Virginia University IAC

- Total energy saved: 5.4 trillion British thermal units (Btu) per year by 431 manufacturing facilities (implemented 2.38 TBtu/yr)
- Implemented projects worth \$11.6 million to achieve savings of \$18.2 million
- Total potential carbon dioxide emissions saved: 711,410 tons per year (314,016 implemented)
- Industry's payback on investments: on average, less than 2 years

for Standardization (ISO) energy management standard—ISO 50001. SEP is a certification process that supports manufacturing facilities in establishing and maintaining continuous energy management practices. Gopala is assisting facilities with implementing ISO 50001 and the SEP certification process, utilizing financial support from DOE and the American Recovery and Reinvestment Act of 2009, as well as the companies' own resources that have been committed to energy management. In addition, Gopala has informed several companies about the new ISO 50001 and SEP protocol, and his team of students has given three trainings on the ISO 50001 standard and SEP.

### IAC Success

WVU's IAC works with students at both the graduate and undergraduate levels. Since 1992, the IAC has delivered energy assessment and energy management training to more than 50 master's and doctorate students and approximately 20 undergraduate students. Under the terms of the recently awarded continuation of WVU's IAC grant, an increasing number of undergraduates will be trained through the program.

As director, Gopala is responsible for generating awareness and interest about the program among the university's student body, which can be challenging. One way Gopala plans to achieve this task is to get approval from the school to incorporate energy topics into other course curriculum at WVU and to have current IAC students give presentations to classmates in other courses. Peeking students' interest in a non-IAC setting helps ensure that the program attracts those individuals with true enthusiasm for the work and a desire to learn more about energy management.

Throughout the two years students spend in the program, Gopala encourages them to take control of the learning process by supporting self-driven inquiry and self-discovery. He has found that not telling them what to do at each stage of the process results in greater knowledge retention, confidence building, and pride in their work. Indeed, Gopala often finds that he learns something new from his students, just as they learn from him. The IAC program at WVU produces highly qualified graduates, the majority of whom—approximately 70%–80%—go on to careers in the manufacturing sector,

working in areas like energy efficiency and quality control. Many of the other graduates have gone on to careers in software development or academia.

Gopala has been able to differentiate his IAC from others by establishing it as a core of a regional hub. He has developed partnerships with other organizations in the region and secured a variety of grants that expand the IAC's typical mid-size industrial sector client base to include small commercial businesses, such as florists and bakers, as well as large industrial manufacturers.

Gopala also was awarded a *Save Energy Now* grant from DOE as part of the State and Regional Project Awards in 2010, which enables his IAC to support very large manufacturers. The financial resources provided under the grant enabled Gopala and his team to provide more assessments to a different subset of manufacturers in the region than he would have been able to work with otherwise. This opportunity exposed IAC students to large manufacturers and allowed them to study the unique challenges and the resources available at large organizations. In addition, the WVU IAC also has performed energy profiling





Conferring with plant staff during an assessment

for steel companies through DOE and Oak Ridge National Laboratory (ORNL) grants. As a result of this vast experience and broad range of clients, companies in the region make an immediate association between energy efficiency and the WVU IAC. Gopala established this as one of his key goals, believing that an IAC by itself is good, but a “wider reach” is even better.

Much of the WVU IAC’s success results from the strong curriculum and supplementary tools that Gopala and his students have helped to develop. One tool that has proven to be extremely useful is the student-developed Galvanizing Energy Profiler and Decision Support System (GEPDSS). This system utilizes data from energy-intensive equipment on galvanizing lines—such as burners on furnaces, motors, and boilers—and subsequently estimates the energy use of each piece of equipment using static simulation with respect to varying production rates of the coated steel. GEPDSS also estimates energy and emissions intensity. The software produces a schematic that allows a student or client to see how energy efficiency measure on equipment in the manufacturing line can affect the facility’s overall energy intensity.

### Expanding the Scope of the IAC Program

WVU’s most recent IAC grant, awarded by DOE in late 2011, extends the contract to continue IAC operations for another five years. This cyclical application and funding procedure enables DOE to ensure that the IACs remain effective and responsive to shifts in Advanced Manufacturing Office (AMO) program direction. Under the new funding, the WVU IAC will initiate a shift in its curriculum to emphasize various topics, including sustainability, corporate culture, and the business decision making process. Core subjects, such as conducting energy assessments

and learning about the emerging SEP and ISO 50001 standards, will also be included. Under previous grants, most IAC programs across the United States were focusing primarily on conducting energy assessments at small- and mid-sized facilities. Going forward, AMO is encouraging IACs to incorporate new elements into their curriculum that will better prepare graduates for real-world situations. Gopala intends to blend these topics into his own lectures, as well as provide students with the opportunity to learn directly from WVU’s manufacturing partners.

The WVU IAC is not only renowned locally—it also has a strong reputation internationally due to Gopala’s outreach efforts. In 2007, he traveled to China with the IAC lead student for two weeks on behalf of WVU’s Industries of the Future program to lead an energy assessment at two Chinese companies: Shanxi Jinneng Group New Oriental Aluminum Co. Ltd and Shanxi Hengtong Energy & Resources Co. Ltd. This experience provided Gopala with insight about how manufacturing and energy efficiency works in other countries. He was particularly pleased to be working in China because of the energy savings and emissions reduction potential that exists in the country. The trip yielded positive results, as both companies strongly considered implementing many of Gopala’s recommendations. However,

**“[The WVU] IAC has given me lot of exposure to different manufacturing processes and their intricacies and improved my understanding of how “bookish” engineering principles are actually applied in a production environment. This is an understanding that no laboratory can ever impart on students. Moreover, as an engineer [the] IAC taught me the importance of estimating quickly without getting caught up in unnecessary details. It builds the overall feel for how much something should be worth (order of magnitude) in industry. This is something that comes with lot of hands-on experience in industry, but [the] IAC prepares students for it in an academic setting. It generates more interest in students to seek to do new things in a manufacturing setting. Most importantly, I got several chances to interact with senior management of plants and different vendors, and it has enriched my understanding of how business works. I would say [that the] IAC has completely equipped me to take on challenges that face an energy engineer when I graduate.**”

*Subodh Chaudhari  
West Virginia University IAC Student*



Energy assessment at Davis Lynch glass factory in Star City, West Virginia

the true impact came during subsequent trips in 2010 and 2011, when Gopala learned the depth of Chinese interest in understanding the IAC protocol and the essence of industrial energy efficiency principles. During his most recent trip, Gopala conducted a two-day workshop (funded by an ORNL and the Lawrence Berkeley National Laboratory grant), that drew attendance by close to 40 Chinese energy professionals. Gopala collected data from plants in Suzhou and Guangzhou and then demonstrated the proper techniques for using that data to estimate a facility's energy efficiency potential and make recommendations on ways to reduce energy use—one of the most rewarding experiences of his career.

The trips to China proved invaluable for Gopala's students as well. On each trip, he took his lead graduate student with him. Together, they learned how to navigate the differences in language, cultural norms, and production processes to deliver energy efficiency resources. The knowledge gained was also spread to other IAC students upon returning to

the United States. Gopala has stressed to his students the importance of understanding how to work within the global economy, as some graduates will work for companies that have operations worldwide and, therefore, must be able to communicate effectively with colleagues from around the globe. Gopala wants to help his students realize that one approach cannot fit every company—there is a need to be flexible in developing energy efficiency measures.

### Conclusion

Gopala's success as director of the WVU IAC reflects his array of energy-related skills and processes, the global vantage point he brings, and the strong relationships he has forged with other energy efficiency organizations and stakeholders. He has exposed his students to a variety of professional experiences that they may not have otherwise enjoyed, and he has prepared them to be the energy managers of the future—both domestically and abroad.

## *A Strong Energy Portfolio for a Strong America*

Energy efficiency and renewable energy will mean a stronger economy, cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) invests in a diverse portfolio of energy technologies. The Advanced Manufacturing Office (AMO) within EERE is the lead government program working to increase the energy efficiency of the U.S. industrial sector.

### **ABOUT THE IAC PROGRAM:**

One program area within AMO, the Industrial Assessment Center (IAC) program, serves as a training ground for the next generation of energy-savvy engineers by providing eligible small- and medium-sized manufacturers with no-cost energy assessments.

### **ADDITIONAL INFORMATION:**

EERE website:

[www.eere.energy.gov](http://www.eere.energy.gov)

AMO website:

[www.eere.energy.gov/industry/](http://www.eere.energy.gov/industry/)

West Virginia University IAC website:

[www.cemr.wvu.edu/~wwwiac/team.html](http://www.cemr.wvu.edu/~wwwiac/team.html)

IAC student forum website:

[www.iacforum.org](http://www.iacforum.org)

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