SECTION 06: CANDIDATE'S STATEMENT

INTRODUCTION

I chose **teaching as my area of excellence** because of its opportunities to foster deeper understandings of sustainable energy in engineering technologists and other global citizens of the future. I left industry to pursue a career in academia because I wanted to play a larger role in solving energy challenges. This passion serves as the cornerstone of my work as I integrate the goals and activities of my teaching, research, and service to improve the lives of real people locally, nationally, and globally.

I have published six peer-reviewed journal articles, 10 peer-reviewed conference proceedings, 48 peer-reviewed industrial reports, and six posters in the field of energy education and sustainable energy. Two education journal articles focus on improving college-level energy sustainability education and extend constructivist and experiential learning theory by explaining concrete ways to implement the concepts. One education journal article discusses the impact of informal energy education in fourth grade; standing alone this article adds to the limited body of knowledge in informal education, but along with the follow on article (to be submitted in October) on fifth grade students it suggests a cognitive development level between these grades which implies that energy education efforts will have more impact above fourth grade. Three energy journal articles show how waste streams can be viewed as resources and converted into energy. The first two energy articles are significant because they discuss the concept of looking at industrial process waste streams as resource streams and give examples with mathematical and economic justification. The third energy article is very significant because it reveals a new technology to reduce compressed air consumption, usually the third largest utility in an industrial facility, by as much as 50%. Additionally, I have written/edited 48 confidential energy reports, all with student co-authors, to Indiana manufacturing companies concerning ways to improve their economic development by improving energy efficiency, which have been peer-reviewed by faculty at Rutgers University and published (anonymous data) within the IAC Database at the US Department of Energy(R1). The impact of my efforts, with only 31 reporting, is that Indiana businesses have saved over $805,000 and are reducing greenhouse gas emissions by over 28,867,765 pounds per year. Finally, my commitment to providing experiential learning and research opportunities, and the impact of these efforts is demonstrated by student co-authorship on three of the journal articles, five of the conference proceedings, all 48 energy reports, and all six posters. The posters include all undergraduate students as collaborators.

Furthering my teaching and the educational opportunities of our undergraduate students, I adopted the university Research, International, Service, and Experiential (RISE) initiative to focus on funding to mentor students and provide learning opportunities in each area. My work provides a natural fit for the RISE initiative because of my training in constructivist learning theory. Through the support of several grants, as PI or co-PI, totaling over $1,520,000, I applied these theories to give students opportunities in experiential, research, and service learning through the development of six courses for the undergraduate Sustainable Technology Certificate in Engineering Technology and the development of four new courses for the graduate Energy Management Certificate in Mechanical Engineering, mentoring MURI students, and advising Engineers Without Borders students. I am currently developing one new study abroad course to address international RISE experiences for students in engineering and technology, which will develop engineering solutions for issues like desalinization in France. These achievements have been recognized in part by the 2013 Frank E. Burley Distinguished Professor Award and the 2014 Outstanding Teacher Award.

My achievements demonstrate my personal commitment to the foundational values of IUPUI; specifically in the areas of civic engagement, collaboration, diversity, the economic development of Indiana, interdisciplinary work, international work, service and RISE. My promotion to tenured Associate Professor is justified by my synthesis of teaching, research, and service initiatives that promote sustainable-energy education initiatives that inspire students and that generate successful funding proposals to provide mentoring opportunities. Additionally, sustainable energy has guided my path to improve the economic outcomes of Indiana businesses and has positively impacted the lives of people in the developing world. It continues building momentum and is a proven tool to achieve my future goals.

TEACHING

Course Development

My teaching has also served my passion for providing opportunities for students to expand their knowledge of sustainable energy as I coordinated the development of six new courses with professors in four different programs for the undergraduate Sustainable Technology Certificate in Engineering Technology, of which I regularly teach two courses (TECH-301, TECH-303) (T13). I also helped develop four new courses for the graduate Energy Management Certificate in Mechanical Engineering, of which I regularly teach ME-50103 (T15). These certificates have helped us retain at least five students to the graduate program.

I made significant changes to content, procedures, or requirements in ECET-231, ECET-371, ECET-490, and ECET-491. ECET-491 is the senior capstone project course for my department, which received praise from our Industrial Advisory Board (IAB) in 2014 for the improvement in student project and oral presentation quality over the past three years. This recognition is a direct result of the changes I made to the course (T10). An additional result of the changes I implemented include improved student outcomes and reporting in ABET areas 4, 5, 7, 8, and 11, which align with the university's Principles of Undergraduate Learning, and were important factors in the department's successful ABET Engineering Technology Accreditation Commission (ETAC) in 2013-14 (T11).

My excellence in teaching is partially demonstrated by my selection as the 2013 Frank E. Burley Distinguished Professor Award and the 2014 Outstanding Teacher Award. The awards are a result of my effort to keep current on learning theories by attending over thirty professional development events which increased and consistently improved my student evaluation scores, currently around 3.6/4 (T3), and lead to very positive peer-reviews from colleagues (T1). I continue to achieve excellence in this area through examining formative and summative assessment data and implementing adjustments in courses, generally adding explicit connections between classroom content and industry relevance. My most profound experience was attending the National Effective Teaching Institute (NETI), which taught me to take a long view of continuous improvement and to introduce changes slowly so that students can adapt. Through that workshop, I gained experience in the best ways to implement contemporary teaching best practices. For example, I used technology (Piazza.com and theCN.com) to facilitate an online learning platform that allowed students to collaborate on questions outside of class (social constructivist pedagogy), as well as using Adobe Connect for a more traditional question and answer session outside of class. My creation of 10 new courses (half way on an eleventh), improving four existing courses, which contributed to departmental recognition and accreditation; my work as a research mentor and collaborator with over 20 undergraduates and 20 graduate students; prove my ability to achieve excellence in teaching.

International Education

In accord with Friere's dialog about how knowledge emerges, my passion is centered around guiding students to help people in the developing world, particularly Ecuador and Haiti (Pedagogy of the Oppressed, 1970) (S3). I am particularly proud of the work done by my students in Ecuador, designing a school/community center for the blind in Santo Domingo, Ecuador. In addition, students designed a solar powered computer lab in Port au Prince, Haiti and a solar powered deep well pump system and village electrification plan for Carrefour Sanon, Haiti. Trips with students to countries with unique challenges offer learning experiences that cannot be duplicated in the classroom. Activities like these and others proved to students that I am committed to their learning and aspirations beyond the classroom. Given this trust; I advocated on their behalf, via a dozen recommendation letters to graduate schools and employers, and all were admitted to graduate school or are gainfully employed per their individual goals.

Engagement

In my goal to impact students in their daily lives and create a solid foundation for their future success, I have served on two department, three school, and five campus committees. I reviewed over 40 conference papers, moderated seven sessions for the American Society for Engineering Education (ASEE), and reviewed 20 grant proposals for the Environmental Protection Agency (EPA). Building on these

experiences, I also won a national ASEE election to be the 2015 program vice chair for the Conference for Industry and Education Collaboration. I recently won a national ASEE election to be the Treasurer of the Engineering Technology Division. This engagement provides a broader network of advisors to inform my pedagogy, ideas for research mentoring and experiential learning, and model civic duty.

Learning Styles and Experiential Learning

As an effective engineering technology educator, my goal is to teach students practical and contemporary skills so that they are ready to enter the workforce. My ultimate goal is to promote a level of theoretical understanding to generate curiosity about how and why things work, to think critically, and to solve problems. As an experienced engineer, I see the necessity of being able to problem solve and share these skills with my students. To foster these skills and understandings, I utilize a mixture of instructional methods (auditory, visual, tactile, etc.) to address the learning styles of individual students (e.g., Brent, 2009, von Glasersfeld, 1998, Kolb, 1984). I strive to make the instructional assignments model the real-world to be authentic. Therefore, I have partnered with service groups like Engineers Without Borders, Architects for Humanity, Haitian Association of Indiana, and Rotary International to use real-world problems and projects and to align course content with the profession, including design deadlines, progress reports, presentations, and on-call technical support. For example, while conducting a needs assessment in Haiti, my colleagues and I met Dr. Emmanual, a Dean at Quisqueya University. He asked us to design a new computer lab to replace the one destroyed by an earthquake. My IUPUI colleague, Dr. Cowan, and I brought the project request back to IUPUI. Dr. Cowan's architectural technology class designed a new computer lab out of recycled intermodal shipping containers, with my guidance on the location and orientation needed to optimize solar accessibility. Then my TECH-301 students designed the photovoltaic system necessary to power the lab and computers. The project enlightened students about the multidisciplinary process that occurs in industry, gave the electrical engineering technology students the opportunity to interact with architectural technology students, and allowed students to learn how location and orientation affect photovoltaic design. Through the complex project, learners saw the connection between course work and service to developing countries. I formed these organizational partnerships to identify real-world problems and projects because the process of solving and implementing them fosters a sense of purpose and community for students.

As an educator, I actively work to inspire, orient, and facilitate a desire in students to learn. I facilitate the learning environment in a way that reflects and expands the interests, backgrounds, and learning styles of students and to challenge students, so that learning occurs (e.g., von Glasersfeld, 1998, Piaget, 1970). In order to accomplish this, I am open and available to my students, I listen and am willing to change, and I am fair and impartial, so that I will understand what students need to create the best possible learning environment. I typically facilitate this by asking students to give me feedback on the course in the middle of the semester. For example, in ECET-371, I received comments from several students about student project teams, which indicated they were concerned about being assigned to the same team for two projects. Some students reported frustrations with unbalanced workloads. They felt that the mechanisms to share work evenly were not sufficient. With this feedback in mind, I thought about how things were done in industry and spoke to both students and faculty about team assessment mechanisms. The following semester, I modified the syllabus to allow students to vote members off a team if a person had documented poor participation, utilizing weekly summaries, peer evaluations, peer meetings, and meetings with the instructor. Following this strategy, I vigilantly observed the summaries and encouraged discussion of team roles and expectations, and noted that team imbalance issues were nearly eliminated.

My industry experience and college degrees have enabled me to be a content expert and provided many real-world examples that are excellent for teaching; but I always strive to improve. Therefore, I have attended several workshops (National Effective Teaching Institute (NETI) and Instructor Institute on Solar Thermal Instruction) and conferences (American Society for Engineering Education 2010-15, Indiana Campus Compact 2011) to improve my course structure, content, and effectiveness in both live and online class environments. I have also attended numerous workshops, seminars, webinars, and sessions on campus presented by CTL (Center for Teaching and Learning), CRL (Center for Research and Learning), and CSL (Center for Service and Learning). NETI was the most insightful because I learned that implementing many

changes in a short timeframe with too little experience could be ineffective, even though all the changes may be instructional best practices. That concept prompted me to take a longer view, to try to change the students' culture by explaining why student-centered, constructivist methods can help them learn (e.g., Brent, 2009). I have an adaptive teaching style and implement only a few changes in each course and build on best practices each semester, so students have a chance to adapt and maximize the benefits of the educational improvement.

Grants

My largest teaching grant, to date, was funded by the US Department of Energy (DOE) for $1.32M (co-PI 25%) to establish an Indiana Industrial Assessment Center (IAC). The center's mission is to teach students to assess energy usage, waste stream, and productivity issues in small- and mid-sized manufacturing companies, and recommend economical alternatives, as well as to develop a graduate-level Energy Management Certificate in Mechanical Engineering. Prior to that, I was awarded a $30,000 (PI 35%) internal Curriculum Enhancement Grant to develop an undergraduate Sustainable Technology Certificate in Engineering Technology that has gone on to impact IUPUI's STARS sustainability rating (T19). I am also committed to the ideals of the multidisciplinary undergraduate research initiative (MURI) and have received eight grants for over $112,600 (six as PI 35-80%, two as co-PI 20-30%) to mentor undergraduate students on various research topics. Finally, and perhaps the most valuable outcome of the funding, was the opportunity to mentor so many students outside of my courses, many of whom are outside of my discipline. I mentored 23 undergraduate students on MURI research projects, two international (France, Germany) undergraduate students who came to the US for energy internship projects, eight graduate and 25 undergraduate IAC students on energy efficiency projects, and one McNair Scholar on a sustainable architectural design project. In the case of the IAC, the funds established and furnished a collaborative space, in the same office suite, which allows me to train and mentor learners every day.

Other milestones of the grant include: 1) all 10 students that graduated from the IAC received a DOE Energy Auditing Certificate; 2) over 45 companies in Indiana have been audited and received a report detailing how they currently use energy and how they can reduce energy and operating costs. In the first 23 assessments, we have an average implementation rate of over 50% (15% above national average), with an average savings per audit reaching $82,346, with a simple payback under 11 months; 3) a company that was impressed with the training and professionalism of my students requested that I help them set up an internship program (in progress) which will provide more real-world experiences and competitive job placement advantages to many IUPUI students in the future (R1). This validates my impact on students and shows how constructivist principles can be used to provide authentic RISE experiences for students that are respected by industry and impact Indiana's economic development.

Second DOE Grant

My latest grant, from the US Department of Energy (PI, 100% effort, $51,984), was instrumental in the recruitment and retention of an excellent student graduating with an MS Electrical Engineering degree. I will mentor his research into Ultrasonic Gas Leak Detection. The grant was very competitive but the selection committee was "impressed with my approach" to developing a gas leak energy/cost calculator that would work for non-traditional industrial gasses (F2). They also asked that I take a broader look and consider this seed funding in this effort, therefore I plan to add a marketing student to help determine industry impact, which will provide opportunities to mentor non-discipline students and diversify the team.

Peer Evaluations

My goal to excel as an educator led me to seek advice from higher ranked, experienced peers. In 2010 I received feedback from Dr. Barb Christe, (FACET member) with comments such as: "He connected the outline with the previous week's lecture, encouraging students to recall older lecture concepts. Students were fully engaged in the presentation." Dr. Christe also said, "The instructor's knowledge of the subject matter is excellent. He was able to smoothly answer off-topic, detailed questions and return the class to task." She also stated that, "Overall, Dr. Goodman's classroom activities and presentation style are quite good. He offers a comfortable learning environment that fosters analytical and critical thinking." I have not rested on early peer-review observations and have continued to learn and practice in order to bring my

teaching skills toward the upper end of excellence. In 2012, Professor Brian Kinsey stated, "My impressions of his classroom management and presentation skills are most favorable. He also commented, "I was very satisfied with David's teaching strategy and his commitment to the students and his desire to draw the best effort from the students." In 2013 I asked Professor Ken Rennels to evaluate an online, graduate course, TECH-581 Energy Assessment. He stated, "Delivery of technical content is difficult via online courses. The format and delivery method for this course dealt with these issues very well. I found Professor Goodman's delivery method, enthusiasm, knowledge, response to questions outstanding." Finally, because I teach a hybrid online graduate course in Mechanical Engineering, ME- 50103 Industrial Energy Assessment: Tools and Applications, I asked Dr. Sohel Anwar for feedback. He stated, "Although the format of this course was a bit different than traditional mechanical engineering courses, students seemed to be fully engaged during the class. They asked relevant questions and interacted with fellow students at times. Dr. Goodman not only answered their questions, but also provoked more questions that were aimed at better understanding of the subject matter." They also provided feedback on many ways to improve (detailed in the teaching section); I have reflected on them and implemented changes to move towards the upper-end of excellence (T1).

To continuously improve my teaching effectiveness, I reflect on standardized school-wide student evaluation comments and ask students for mid-course feedback. The comments offer ideas and actionable ways to improve. Following student observations, I made several changes. The most significant revisions focused on course organization. I explicitly communicate the direct relationship between course expectations and assignments with expectations in the workplace following graduation. An anonymous student summed it up best "He was overall the most understanding teacher that I have ever had. He would help and encourage me when I needed help and would always want the best for everyone." The outcome has been student evaluations that have consistently improved, from the first course taught in rank 2.6/4 in 2009 to my last course in rank 3.67/4 in 2014. Each time I have taught a course more than once without a major revision my score has been well above the departmental average (T3). I improved the outcome while teaching 11 different courses in rank, developing seven new courses, five of which are online/hybrid, and several honors, directed project, and independent study courses (T12).

RESEARCH/SCHOLARSHIP

My most recent research grant was funded by the US Department of Energy (DOE) for $51,984 (PI 100%) to research and develop using ultrasonic sensors to quantify uncommon gas leaks and develop a calculator. The project will employ three students to develop a calculator that will be shared with energy efficiency experts via the DOE website. I also leveraged external industry contacts to bring in 2 grants for $19.3k (PI 100%). The first study allowed me to mentor 4 students (1 graduate, 3 undergraduate) in the design and construction of a test apparatus to study pH sensor performance and life expectancy in various types of fluid environments and at several environmental conditions. The students collected data, analyzed results, and assisted in the confidential report of our findings. The research is aligned with my industry experience and my previous work on solar thermal collector performance. In addition, it is associated with my recently awarded MURI proposal on Aquaponics which will conduct performance testing of different system designs and develop a standard for urban aquaponics equipment and optimized systems.

The second grant allowed me to mentor 4 students (1 graduate, 3 undergraduate) in the design and construction of a test apparatus to evaluate the potential efficiency gain from a new type of controller for diaphragm pumps. It has been accepted for presentation at the 2015 World Energy Engineering Congress in October, and has been submitted to the very prestigious International Journal of Modern Engineering.

Prior to these projects, I collaborated with a components manufacturing facility to develop an energy efficient compressed air system. The control system was evaluated with respect to operation, energy savings, installation costs, and return on investment. The results were published in the proceedings of the 2013 Society of Automotive Engineers World Congress and included three student authors (R4).

My first research project at IUPUI explored the amount of energy that can be collected through the use and

combining of photovoltaic (PV) and solar thermal (ST) systems in the Midwest. The data revealed that the thermal system was undersized (standard practice) during the harshest time of year and that the PV system is properly sized for the worst month, therefore diverting PV energy caused a 29% increase in thermal energy collected. Two graduate students conducted the research for their directed projects. The results were published in the proceedings of the American Solar Energy Society 2011 Annual Conference. I am in the process of building an off-campus living lab to verify the model and publish the results; the PV system is installed, webpage is live, and the solar thermal is planned for spring 2016.

SERVICE

I received 4 external grants and 1 internal grant for $19k (3 as PI 100%, 2 as co-PI 50%; $4k later rescinded due to patent issues) as service awards for non-research related projects. Two external grants where from UTC: Carrier Corporation to improve equipment in IUPUI's thermodynamic and energy efficiency labs. I used the awards to improve department lab equipment and give students access to modern portable instruments. One of the industry projects involved 3 students in a study to catalog every electrical device in a manufacturing facility. Since not every device could be measured while in production, I developed a three-tiered method to determine energy usage and to quantify the percentage of manufacturing versus non-manufacturing loads to determine how much energy usage could be tax-deferred.

On a school/campus level, I have been honored to serve on the School of Engineering and Technology Faculty Senate for the past four years. I actively participated with the Engineers Without Borders (EWB) chapter as advisor and project mentor from 2010-2013. From 2011-2013, I co-advised the Energy Club, a student organization, which brought industry experts to campus to discuss current energy topics. In 2012, I worked extensively with the Transatlantic Climate Bridge. This effort connected the German Embassy with various universities in the United States to discuss energy usage issues. In addition, I served on a department Search and Screen Committee, which attracted two top-level faculty members to the mechanical engineering technology program. From 2010-2013, I was co-chair for the Energy and Built Environment Committee, which is a subcommittee of the Sustainability Committee. This committee serves to bring sustainable principles and processes to buildings on campus to reduce energy usage and utilize greener materials at IUPUI. While under my leadership, the committee proposed three policy changes to advance those goals (S4). Finally, I was recruited to be a member of the Product Lifecycle Management (PLM) Core Working Group and I am actively helping develop plans to form a new PLM Center called the 'Initiative for Product Lifecycle Innovation (IPLI)' to leverage a $538M grant from Siemens and bring faculty from across the university together to conduct research and advance economic development (S4).

On a state and regional level, I am a founding member of and developed educational content for the Midwest Solar Training Network (MSTN). This organization is focused on quickly and effectively educating a workforce, primarily at the community college level, for the clean energy job sector (T9). I was invited to be on the Board of Governors for the Indiana Chapter of the Association for Energy Engineering, which is the fastest growing chapter in the US.

On the national level, I reviewed grant proposals for two separate grants (P3 and SBIR) for the EPA (S2). For each, I reviewed approximately 10 proposals and acted as Rapporteur for 3 proposals. I also reviewed approximately 30 abstracts and final conference proceedings for ASEE in both the Engineering Technology Division and the Architectural Engineering Division. Additionally, I have moderated at least one session for each ASEE Annual conference since 2011. In an ASEE 2014 national election, I was elected to be the 2015 Program Vice Chair and the 2016 Program Chair for the Conference for Industry and Education Collaboration (CIEC). In an ASEE 2015 national election, I was elected to be the Treasure of the Engineering Technology Division.

On an international level, in addition to the completed projects in Ecuador and Haiti, I am currently working on two new projects in Haiti (solar powered well pump and village electrification). I am also collaborating on a grant request to the World Bank to fund both projects. When that occurs, students and I return to Haiti to implement the well project (funded independently by Rotary International) and collect

more data for the electrification plans (S3).

SUMMARY AND FUTURE DIRECTIONS

I will build on the sustainable technology certificate and work to attract an ever larger body of students. I will collaborate and leverage the certificate to create a sustainable degree program, because IUPUI needs it to be relevant to future students and posterity.

I have already applied for $75k (PI 17%, 1 of 6 multidisciplinary collaborators) of internal funding to support students in developing more efficient HVAC monitoring, control, and implementation systems at a local facility and $800k (co-PI 10%, 1 of 7 multidisciplinary collaborators) of National Science Foundation (NSF) funding for an expansion of the same project. I am also in very positive discussions with the Indiana Municipal Power Association about applying for future DOE solar sunshot or market pathway grants, which will fund approximately six students per year to do directed project or thesis work on one of four existing 1MW PV power plants in Indiana.

In the future, I will continue to maintain the benefits to my students of having an integrated teaching, research, service model of teaching. I will do this by: 1) targeting outcome metrics and reapplying every five years for the IAC grant, 2) work to expand my informal energy education research to include high school students, and 3) work to involve more students in the design and installation of electrification projects in Haiti and international desalinization projects in France or Malta (new study abroad course).

I am collaborating with colleagues within the school and Earth-Solar Technologies Corporation to set up a two-week Photovoltaic Manufacturing Training Course next summer; I will develop material to train groups of entrepreneurs from Africa in: 1) solar fundamentals, 2) solar electricity, 3) process and methods of manufacturing panels from cells, etc. which will allow them to successfully run local/regional PV manufacturing and sales businesses (other school colleagues are designing the business courses). Earth-Solar Technologies has shown their confidence in my expertise by donating a PV array for the living lab.

My future publication plans are based around documenting the results of existing funded projects and winning the new funded projects mentioned above. Specifically, the MURI Aquaponics project is a collaboration with the department of biology and was developed as a platform for ongoing research in urban aquaponics. It will provide research projects for two to six students per year and will produce annual conference proceedings. The combined system solar research is currently funding two graduate students and will produce data starting in the fall of 2016 and will result in a journal article. Upon winning the internal and NSF grant proposals, the HVAC research will produce multiple publications annually; the preliminary work has already been submitted to a journal (in process).

In summary, my promotion to tenured Associate professor is justified because I synthesized teaching, research, and service in a way that provides consistent funding and allows me to expose more students to real-world issues that improve students' employment prospects, improves the economic strength of local industries, help people in the developing world, and improve the name recognition of IUPUI in those countries and relevant journals and conferences. My ongoing research plans will impact key areas of IUPUI's mission and have a track record of funding. Additionally my national reputation is grounded in professional recognition of my research and service, via invited and elected positions and awards, and inclusion of scholarly articles in respected national and international journals and conferences. Finally, I exceeded all departmental guidelines (in effect until April 2014) for scholarly publications, significantly exceeded guidelines on funding, and proven to be an enthusiastic and effective teacher.