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U.S. DEPARTMENT OF
ENERGY



Inspiring a Clean Energy Workforce

November 1st, 2022

11:00 am – 12:00 pm ET



John Smegal

U.S. Department of Energy

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

Better Buildings Webinar – Inspiring a Clean Energy Workforce

John Smegal

U.S. DOE, Advanced Manufacturing Office (AMO)

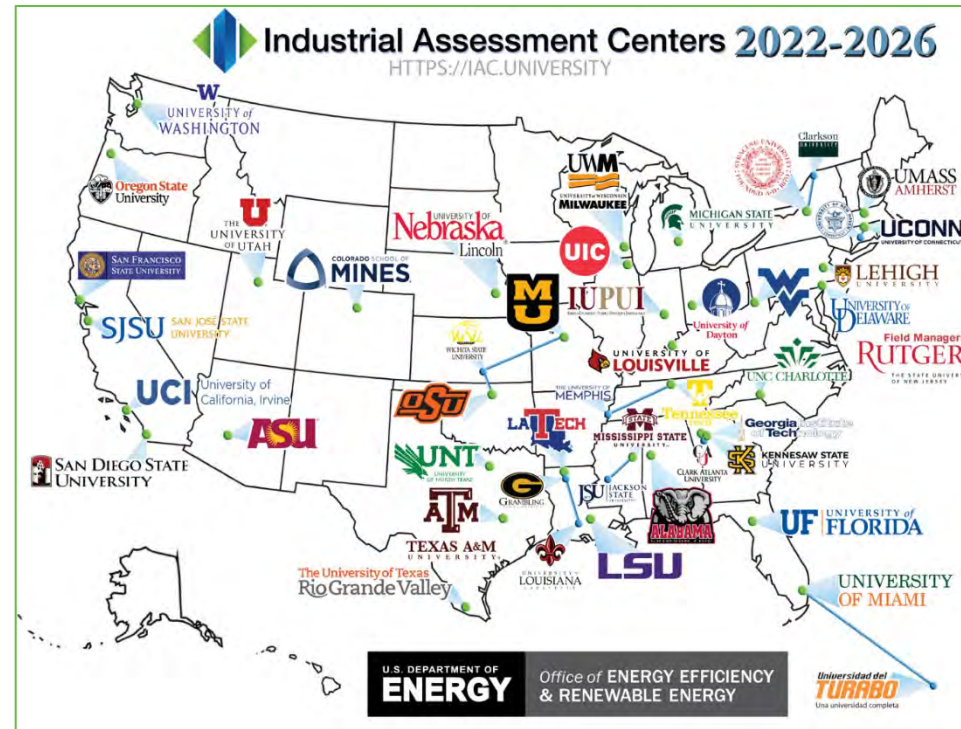
November 1, 2022

<https://iac.university/>



Background

- DOE provides financial assistance to engineering schools for students to conduct energy efficiency and productivity improvement assessments of small and medium-sized manufacturers
- IACs are currently located at 37 universities and nine satellite centers serving manufacturers in every state
- IAC program seeks to improve the competitiveness of small manufacturers while training the next generation of energy-savvy engineers



IAC Program Impacts – Workforce Development

- IAC students develop skills beneficial to a career in energy efficiency
 - IAC students have 72% more energy efficiency-related skills than other students in similar majors at their school who did not participate in the IAC program
- Students with more participation in the IAC program have more energy efficiency skills
 - Even students who do not participate in the IAC program for long still develop valuable skills
- IAC alumni possess more valuable energy efficiency skills
 - IAC alumni possess more skills than those in their comparison groups, and the energy efficiency skills are more valuable
 - IAC alumni also have a greater total skill value associated with their overall profile
- IAC alumni are more likely to work in energy efficiency jobs than their peers
 - The jobs listed on 46% of IAC alumni profiles were in an energy or “green” field, compared to only 18% of the jobs found on the profiles of their academic peers

IAC Program – Commercial Buildings Pilot

- Beginning with the most recently selected cadre of IACs in 2021, DOE launched a pilot program to expand the IAC assessments to include commercial buildings
- The nine IACs *initially* selected for this pilot are conducting assessments in partnership with community college and/or technical school program partners
- Preliminary results from the pilot have demonstrated strong demand for training to conduct commercial building energy assessments



IAC Program Expansion under BIL

- Designate Centers of Excellence to mentor IACs and provide additional assessment services
- Include trade schools, community colleges and union training programs in the IAC structure
- Establish an internship/apprenticeship program leveraged with private sector in which students are placed with manufacturers, utilities, ESCOs, and other stakeholders
- Promote R&D for alternative energy sources for energy intensive industries
- Increase coordination with stakeholders and federal partners
- Provide a clearinghouse for technical assistance resources
- Establish an implementation grant program

Thank you

John Smegal

Industrial Efficiency & Decarbonization Office

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(202) 288-7415



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Today's Presenters



Kody Powell
University of Utah



Kristen Cetin
Michigan State University



Pete Kiser
Henry Ford College



Ethan Languri
Tennessee Tech University



Kody Powell
University of Utah

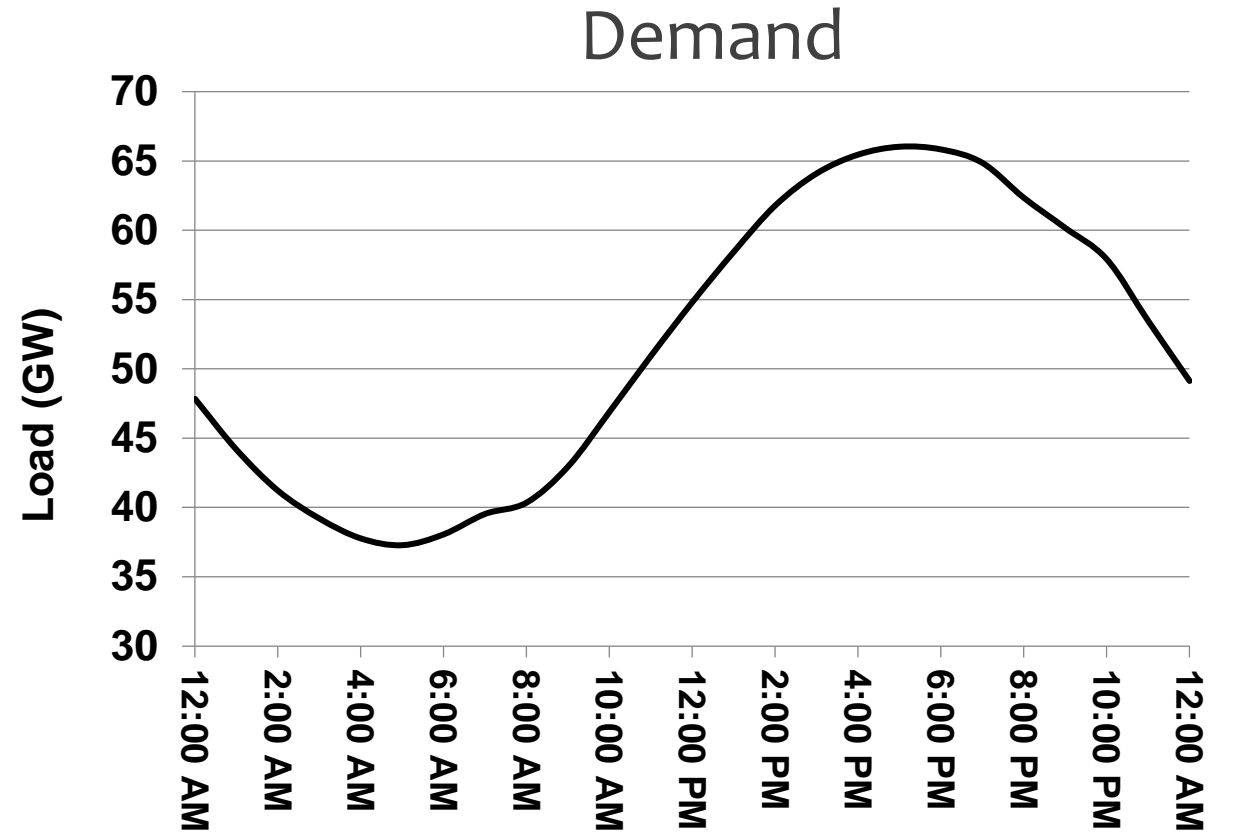
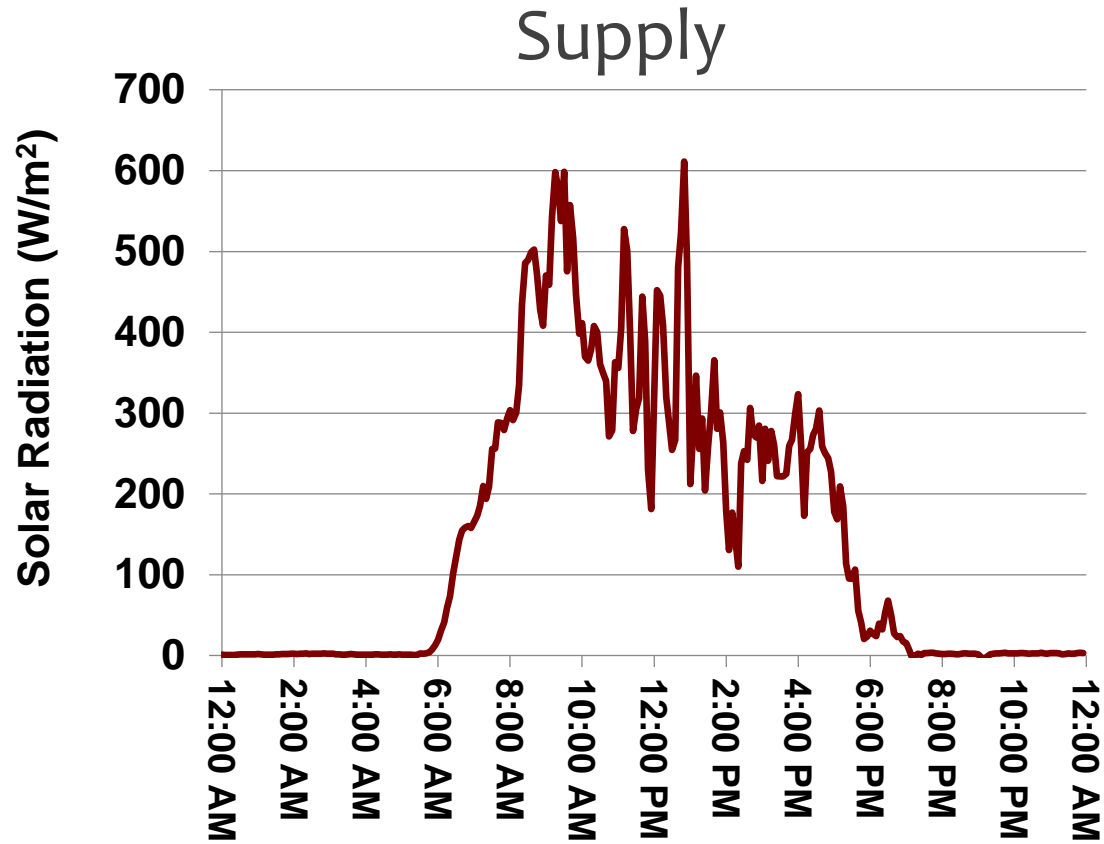


Transforming Industrial Energy and Inspiring a Clean Energy Workforce

DOE's Industrial Assessment Centers Program



A Major Issue Facing the Grid Today




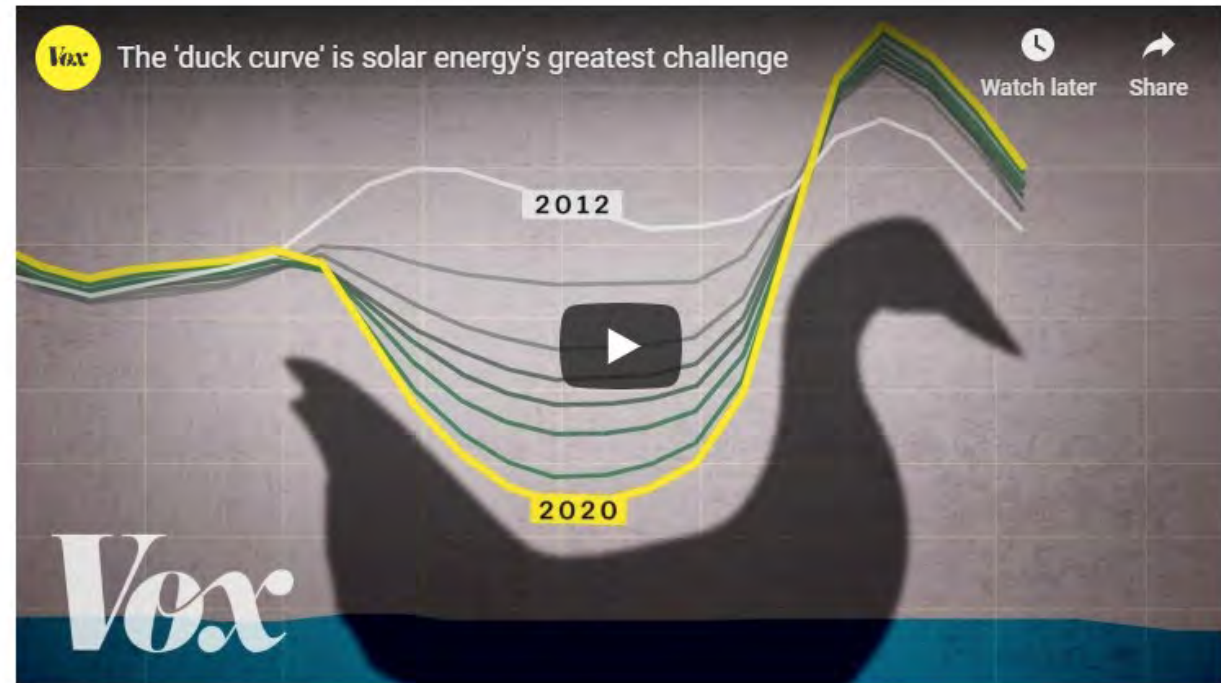
The Infamous Duck Curve

This “duck curve” is solar energy’s greatest challenge

Renewables require a change in the how we supply electricity.

By Carlos Waters | carlos.waters@vox.com | May 9, 2018, 4:40pm EDT

f   SHARE



Carlos Waters/Vox

Can we work smarter and not just harder?

“We can’t solve problems by using the same kind of thinking we used when we created them.”

-Albert Einstein



Enter the Industrial Assessment Centers Program



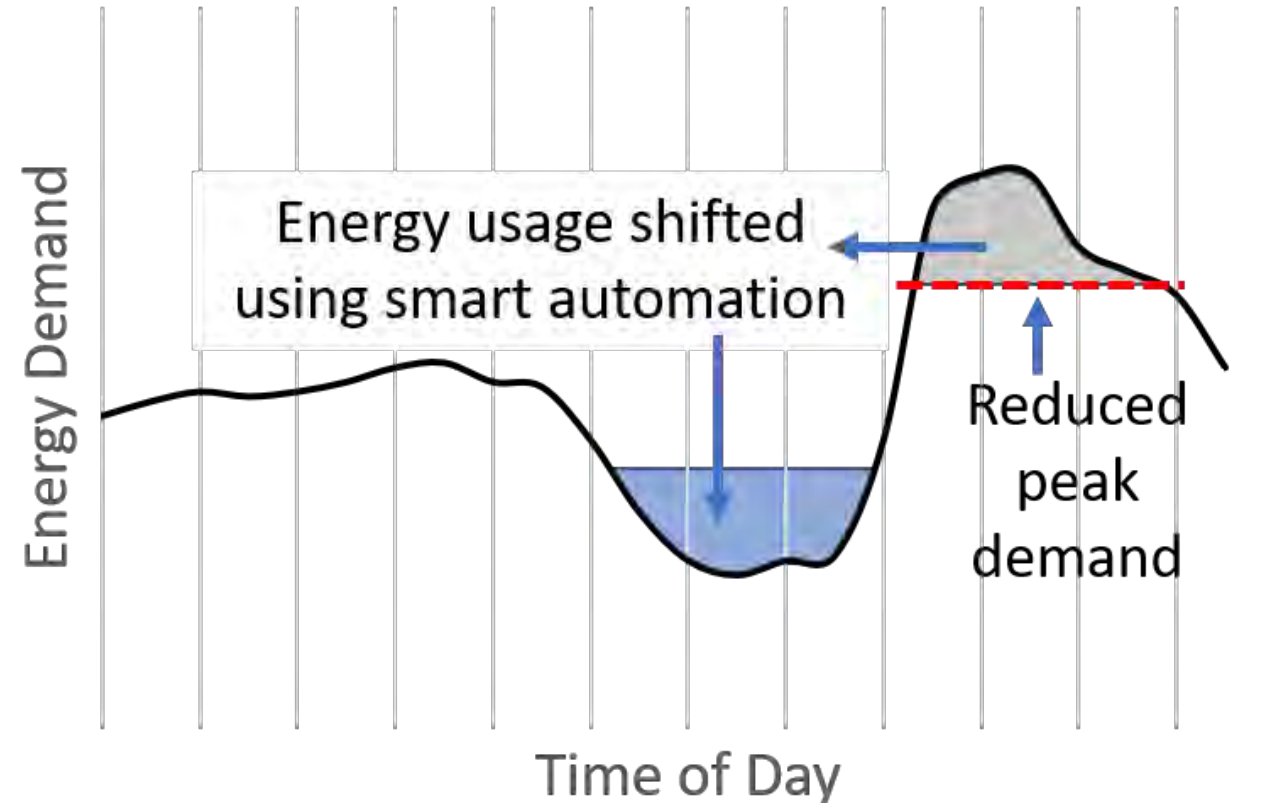
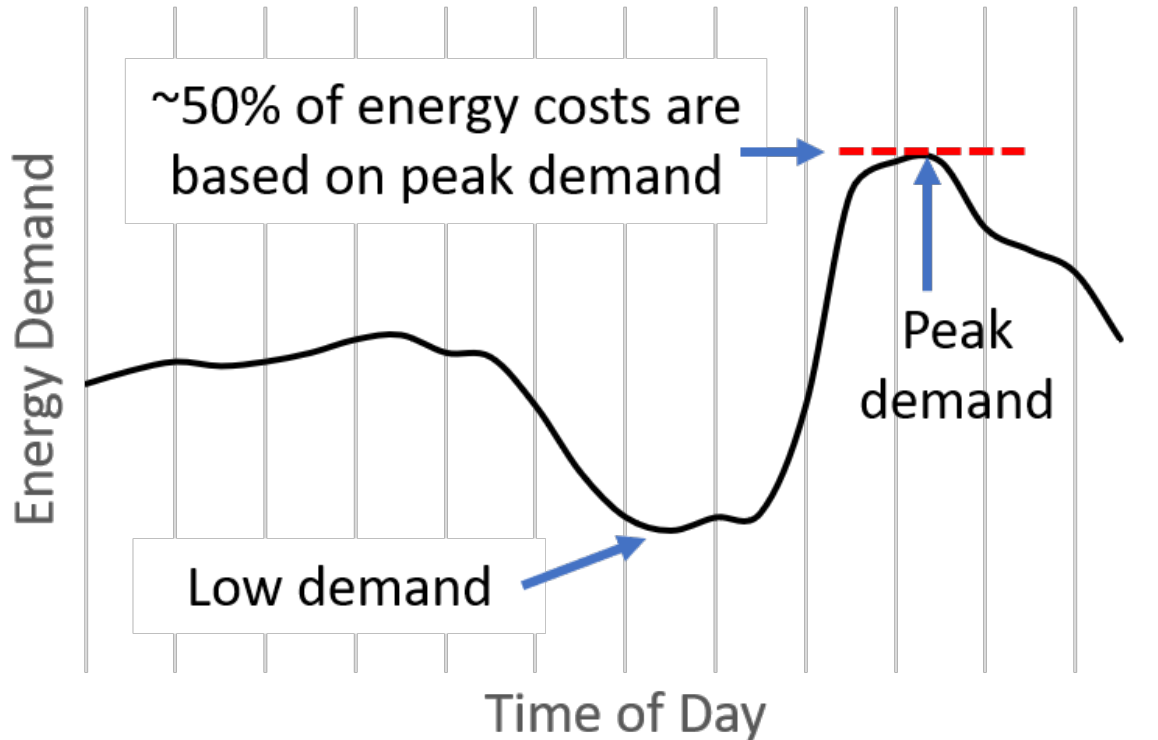
Industrial Assessment Centers 2022
WITH EXTENSION CENTERS
[HTTPS://IAC.UNIVERSITY](https://iac.university)

The map displays the following participating institutions:

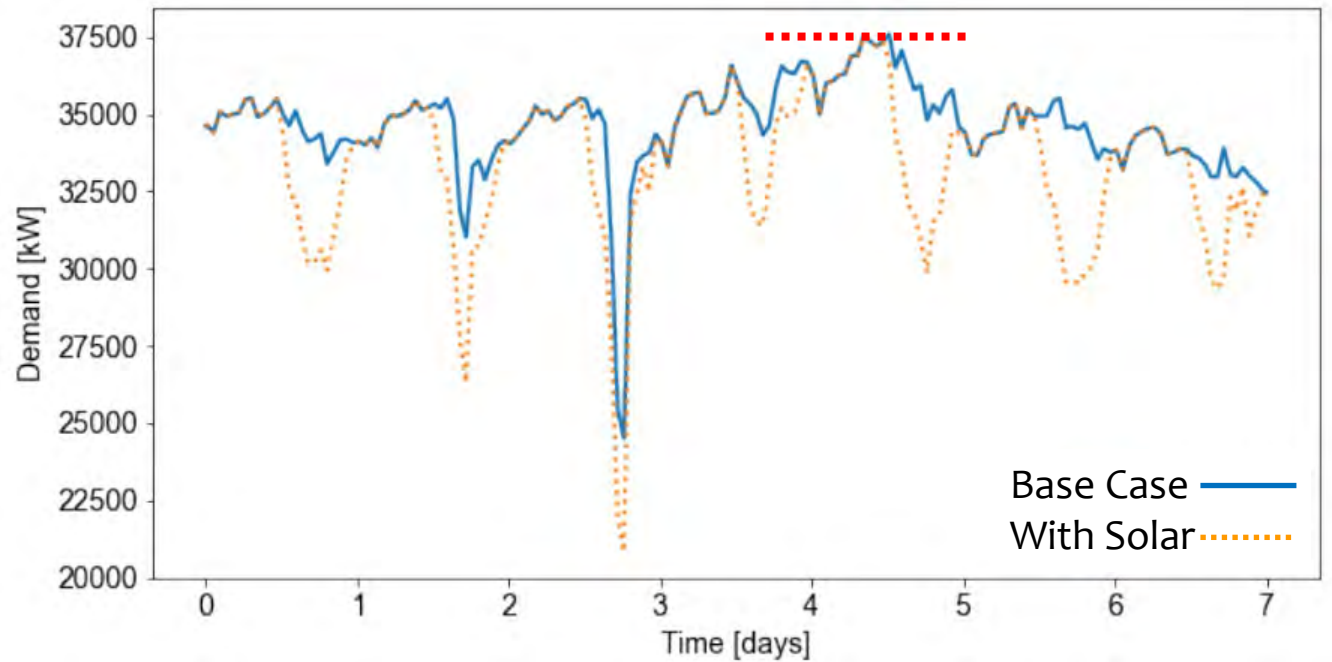
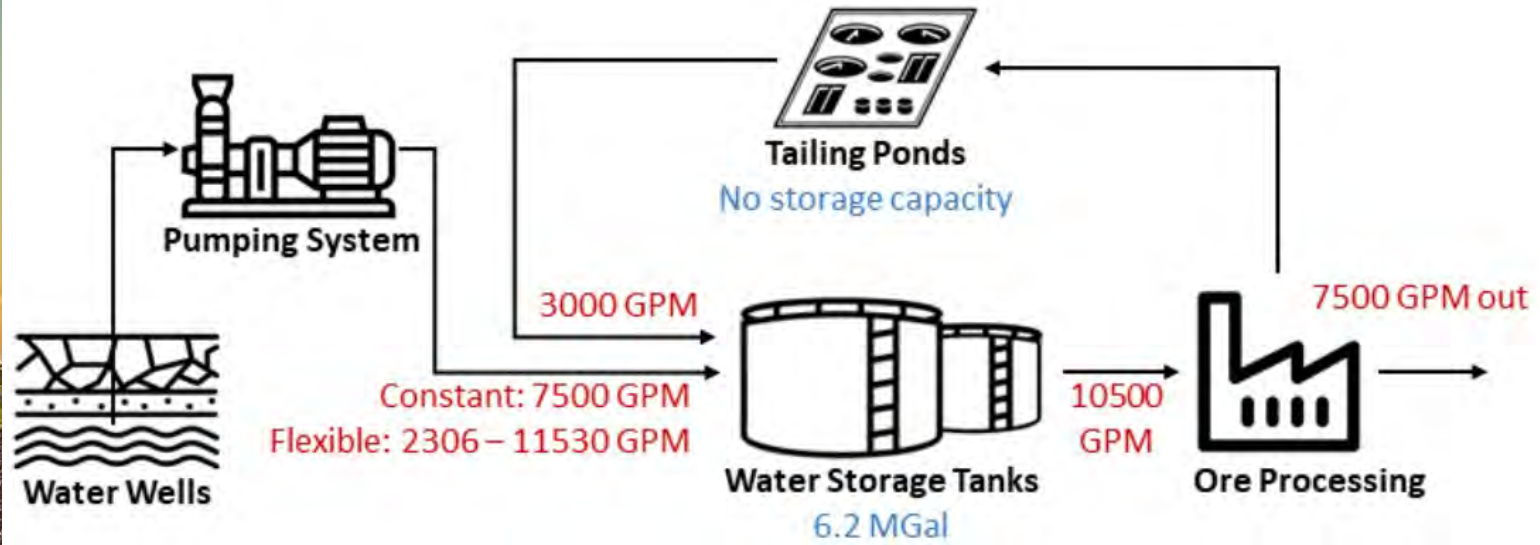
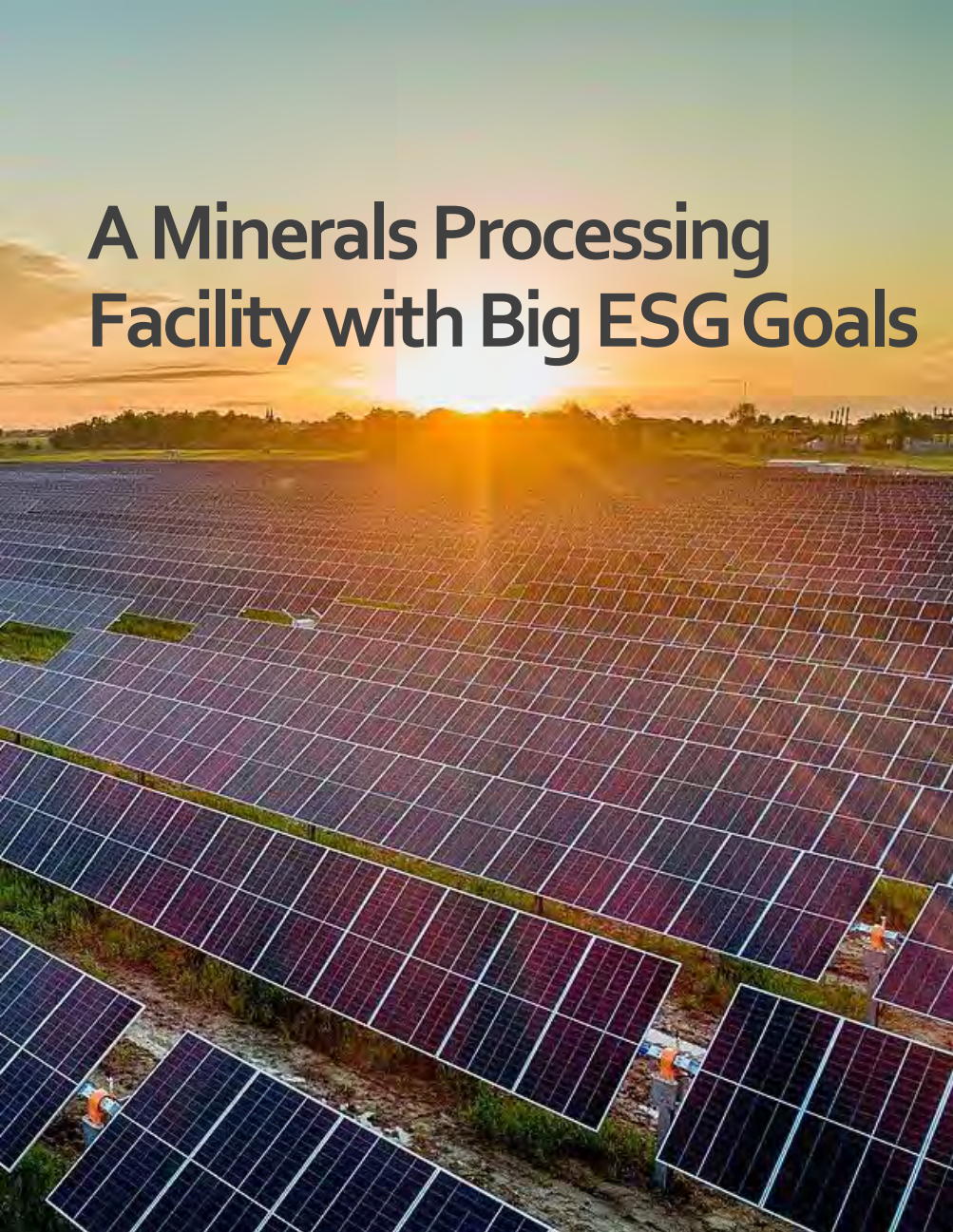
- UNIVERSITY OF WASHINGTON
- Oregon State University
- THE UNIVERSITY OF UTAH
- Nebraska Lincoln
- Colorado School of Mines
- Colorado State University
- ASU
- UCI University of California, Irvine
- UCM University of Central Missouri
- UWM University of Wisconsin Milwaukee
- UIC University of Illinois at Chicago
- IUPUI Indiana University Purdue University Indianapolis
- Michigan State University
- Clarkson University
- UMASS Amherst
- UCONN University of Connecticut
- Case Western Reserve University
- Lehigh University
- University of Delaware
- Field Managers Rutgers
- University of Dayton
- University of Louisville
- OSU Oklahoma State University
- LA Tech Louisiana Tech University
- MSU Mississippi State University
- Tennessee Tech Tennessee Technological University
- UNC Charlotte
- Kennesaw State University
- Clark Atlanta University
- UF University of Florida
- University of Miami
- LSU Louisiana State University
- Alabama Alabama State University
- University of Texas Rio Grande Valley
- University of Louisiana at Lafayette
- University of Louisiana at Monroe
- Universidad del Turabo

U.S. DEPARTMENT OF ENERGY Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

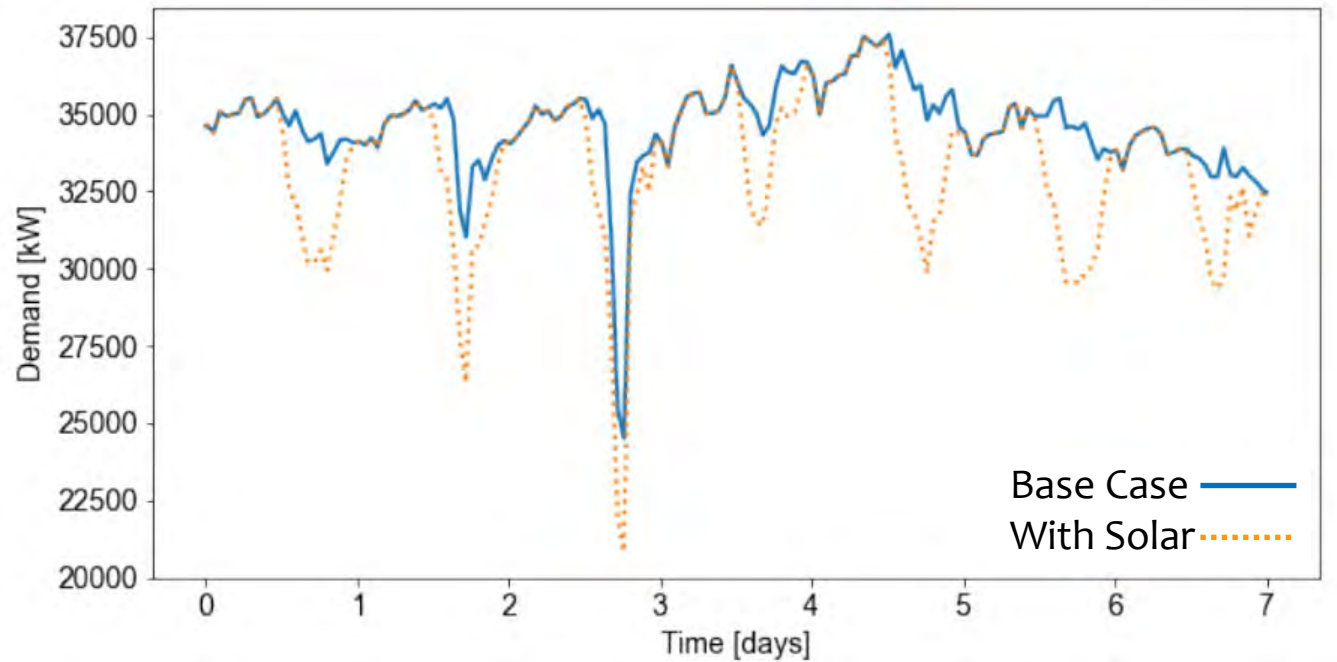
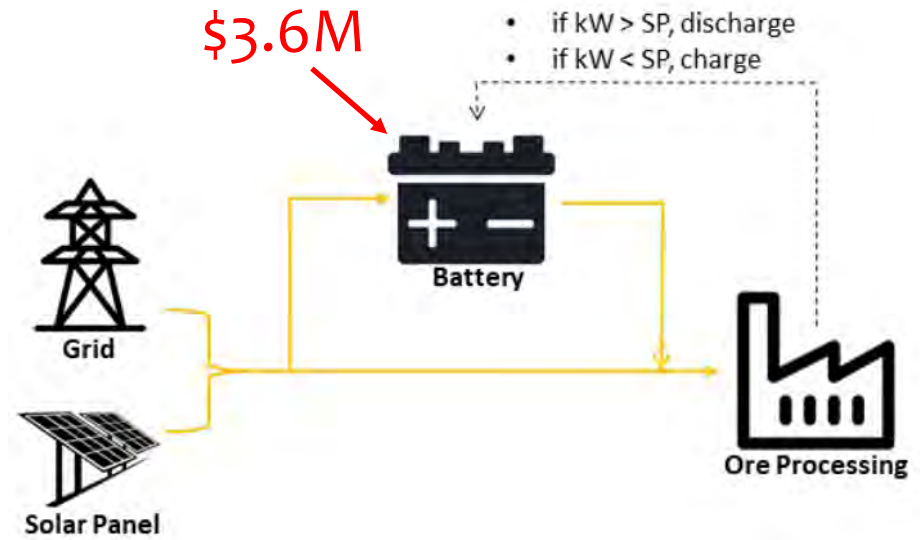
Grid-Responsive Smart Manufacturing



A Minerals Processing Facility with Big ESG Goals

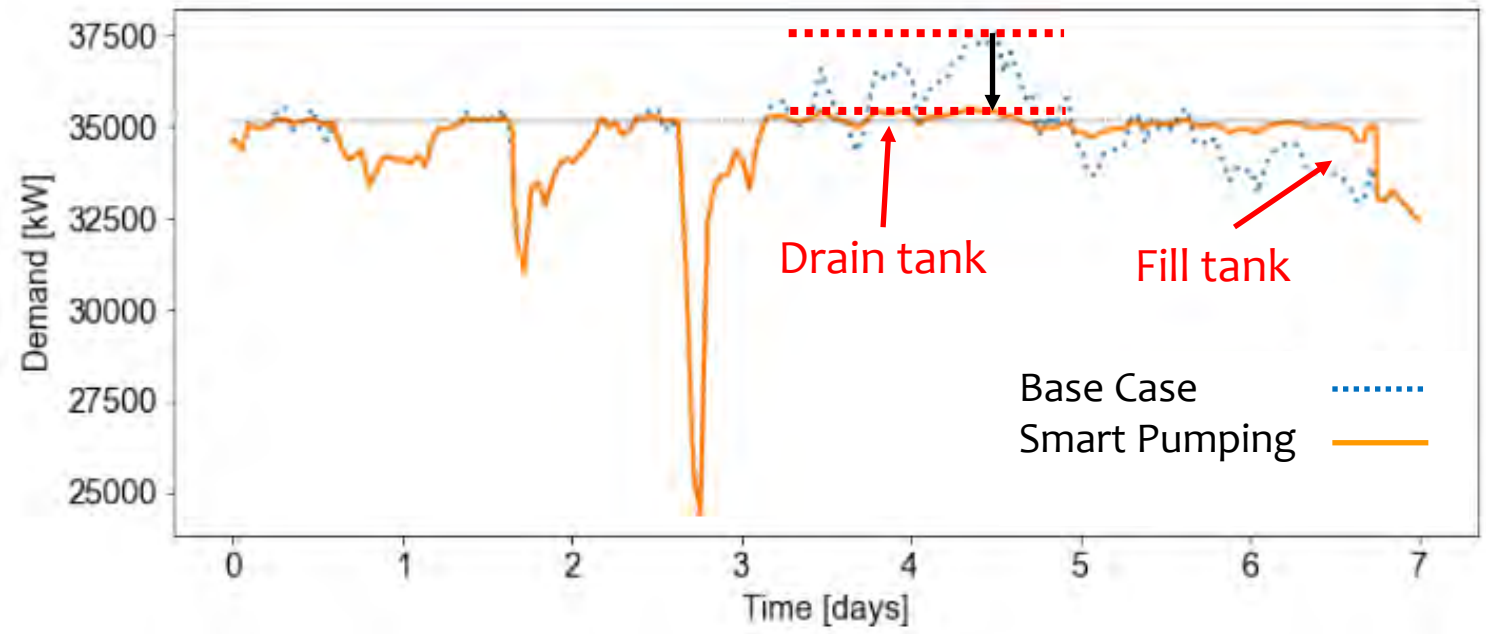
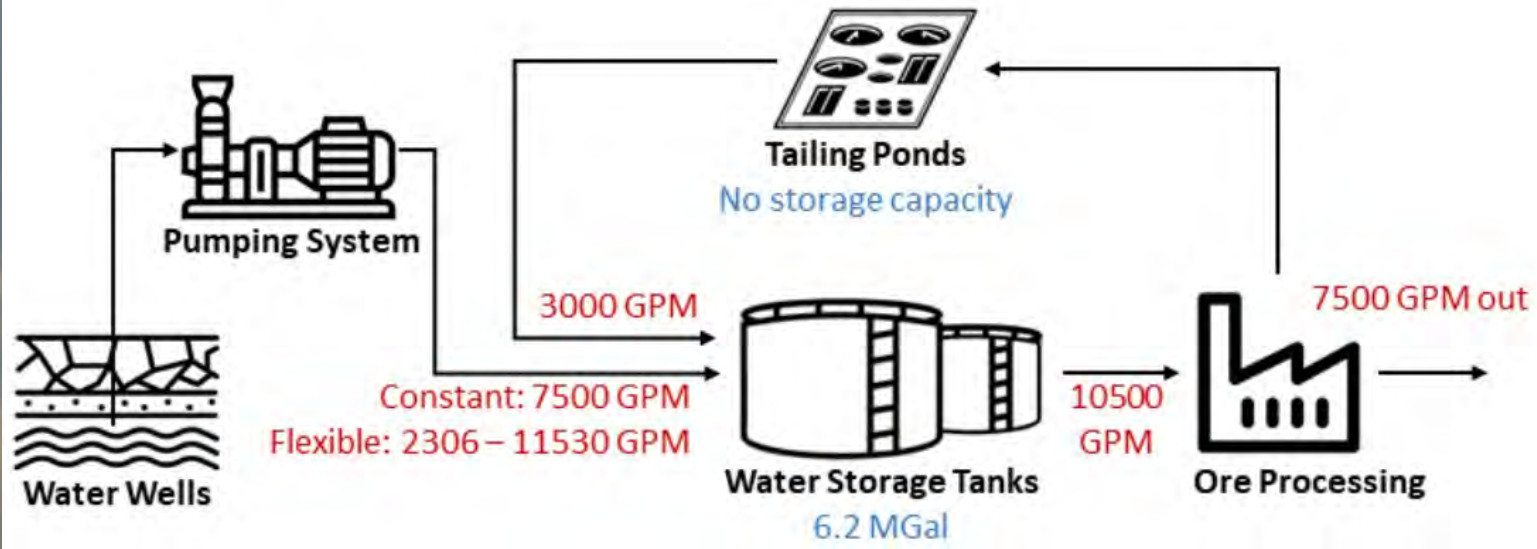


Battery Storage as the Obvious Solution





A Smarter Solution Using Existing Infrastructure



The Results of Working Smarter

Scenario	Avg. Monthly Peak Demand (kW)	Project Cost (\$)	Savings (\$/yr)	Time Required to Recoup Investment (yrs)
Business as usual	35,919	-	-	-
Solar	35,850	\$7.6M	\$269K	28.4
Battery	34,638	\$3.6M	\$318K	11.5
Solar + Battery	34,258	\$11.3M	\$664K	17.0
Smart Pumping	34,428	\$250K	\$372K	0.7
Solar + Smart Pumping	33,906	\$7.9M	\$755K	10.5



Results from “Grid-Responsive Smart Manufacturing: Can the Manufacturing Sector Help Incorporate Renewables?”
Chen et al., *IFAC PapersOnLine*, Volume 55, Issue 10, 2022

IAC Students Are Driving This Change

Improving the economics of battery storage for industrial customers: Are incentives enough to increase adoption?

Anne Dougherty, Blake Billings, Nestor Camacho, Kody Powell  

Integrating a Microturbine into a Discrete Manufacturing Process with Combined Heat and Power Using Smart Scheduling and Automation

Moriah Henning ¹, Derek Machalek ², Kody M. Powell Ph.D. ²  


Dynamic optimization with flexible heat integration of a solar parabolic trough collector plant with thermal energy storage used for industrial process heat

Jake Immonen, Kody M. Powell  

Techno-economic analysis of the impact of dynamic electricity prices on solar penetration in a smart grid environment with distributed energy storage

Moataz Sheha ^a, Kasra Mohammadi ^a, Kody Powell ^{a, b}  

Industrial battery operation and utilization in the presence of electrical load uncertainty using Bayesian decision theory

Blake W. Billings ^a, Philip J. Smith ^a, Sean T. Smith ^a, Kody M. Powell ^{a, b}  

Grid-Responsive Smart Manufacturing: Can the Manufacturing Sector Help Incorporate Renewables?

Yunzhi Chen ¹, Blake Billings ¹, Sammy Partridge ¹, Brittany Pruneau ¹, Kody M. Powell ^{1, 2}  

Automated electrical demand peak leveling in a manufacturing facility with short term energy storage for smart grid participation

Derek Machalek, Kody Powell  

Mine operations as a smart grid resource: Leveraging excess process storage capacity to better enable renewable energy sources

Derek Machalek, Aaron Young, Landen Blackburn, Pratt Rogers, Kody M. Powell  

The IAC Program Can Fundamentally Change How the Grid Works

- A distributed approach
 - Boots on the ground
- Energy assessments → transformational energy solutions
 - Learning the basics of energy efficiency
 - Creating and driving the solutions for the future
- **Tomorrow's energy workforce will work smarter and not just harder**





Kristen Cetin
Michigan State University



Pete Kiser
Henry Ford College

INSPIRING A CLEAN ENERGY WORKFORCE

Industrial Assessment Center

@ Michigan State University

In collaboration with Michigan Tech & Henry Ford College

November 1, 2022

Dr. Kristen Cetin

Director, MSU Industrial Assessment Center



Industrial Assessment Center @ MSU



Michigan
Technological
University

Center Established 2021

*Collaboration to
support all parts of
Michigan*

*Industrial (20/year) &
Commercial (10/year)
Building Assessments*



MICHIGAN STATE
UNIVERSITY

HENRY
FORD
COLLEGE
FUTUREDRIVEN

Industrial Assessment Center @ MSU

Leadership @ MSU  MICHIGAN STATE UNIVERSITY



Dr. Kristen Cetin
Civil and Environmental Engr.
IAC Director



Dr. Annick Anctil
Civil and Environmental Engr.
IAC Assistant Director



Dr. George Berghorn
Construction Management
IAC Assistant Director

@ Michigan Tech

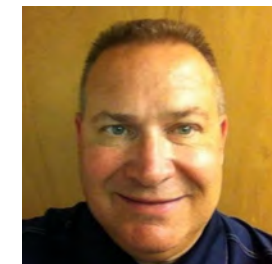


Dr. Rob Handler
Chemical Engr.

@ Henry Ford



Chad Richert
Architecture



Pete Kiser
Energy Technology
HVAC Systems

Industrial Assessment Center (IAC) @ MSU

Students & Project Teams



MSU Student Background

(most common)

- Civil Engineering
- Environmental Engineering
- Mechanical Engineering
- Biosystems Engineering
- Chemical Engineering
- *Sustainability & Energy Minors*

Degree Level

- Undergraduate (*Soph.-Senior*)
- BS/MS, Masters, PhD

Michigan Tech *(most common)*

Chemical Engineering



Henry Ford *(most common)*

Energy Technology (HVAC)
Architecture/Construction
Technology



Workforce Development: *Completed in 2022*

Students Trained

16 MSU students (*Mechanical, Civil, Environmental, Biosystems Engineering, Construction Management, Business Econ*)

2 Henry Ford students

2 Mich. Tech

Joint student positions with MSU
Infrastructure Planning and Facilities

Training Development

Spring 2022 - Pilot Training Course

Spring 2023 - New 3-Credit course for on
*Sustainability and Energy Assessments
of Commercial and Industrial Buildings*

Asynchronous Training Development



Workforce Development: *Completed in 2022*

Outreach to K-12

STEM Activities for summer camps

Presentations at high schools



Introducing K-12 students to sustainability and energy

Workforce Development: *Completed in 2022*

Training Research

Evaluating the use of Virtual Reality to improve training and better prepare students for assessment processes; improve Post-Assessment process



Assessing the use of virtual reality for training



Virtual environment for assessment training

Workforce Development Perspective

What's Unique about the Michigan IAC?



New Center: Established in 2021



Collaboration across 3 universities



Limited energy/manufacturing programs @ MSU (*energy minor, sustainability minor only*) but several faculty with this expertise



Lots of manufacturing in Michigan



Many manufacturers pushing suppliers regarding sustainability goals → **company interest in reducing emissions**



One of 9 initial centers as a part of **commercial building pilot** program at IACs



MICHIGAN STATE
UNIVERSITY



Michigan
Technological
University

HENRY
FORD
COLLEGE
FUTUREDRIVEN

Many things to do

Potential for growth and impact

Workforce Development:

Awareness of Energy, Sustainability, Manufacturing Careers

Challenges:

- **Lack of awareness** of energy- and manufacturing-related careers (especially in places where there are less established energy/sustainability/manufacturing programs)
- **Many other careers options** for engineering students for internships and jobs (at the moment)



Opportunities:

- Students are **interested in energy/sustainability**, and concerned about climate change (in general) → use this to generate awareness
- **Increasing awareness** through: Guest speakers, IAC alumni, recruiting early, working with student groups
- Recruiting **non-engineering students** (diverse majors)
- Student **participation during the semesters**



Workforce Development:

Student's Schedules and Availability

Challenges:

- Students do **not** have many options to do **engineering-related paid work experiences during semesters** (i.e. on campus jobs) but most want to (need to) work
- Engineering students' schedules are **busy**; many classes are **intense**
 - Meeting together with students (and faculty/staff) is challenging



Opportunities:

- **IAC** provides opportunity to work on campus in a **paid** position doing **meaningful technical (engineering) work** during the semester
- **Recruit students early** before they decide their class schedules
- Allow for **flexibility in working** (remote, in person), and facilitate this (e.g. hybrid meetings)



Workforce Development:

Soft Skills, Communication & Non-Technical Skills

Challenges: Students do not (typically) have strong experience with:

- Communication & Scheduling

- Using Outlook, Slack, Teams
- Using calendars for scheduling, setting up meeting invites
- **Communication** with external parties & hosting professional meetings



- Data Management

- File **organization** (collaborative)
- **Visualization** of results (graphing)
- Working with **large datasets**



Opportunities:

- Participation in IAC program (and other extra curriculars)
- **Shadowing** other students/faculty/staff
- Give **regular feedback**
- Setting **standards** for file management; **templates**



Workforce Development: *Starting a New IAC Program*

Challenges

- It is hard to **start from zero**
- Such a program is successful due to local/ state (and national) support → this takes time to establish
- **Awareness** for student recruitment is challenging (previously discussed)



Opportunities

- 37 **other IACs** to collaborate with and support
- **Mentor** center(s) to answer questions
- **Local & state collaboration**



Workforce Development:

Supporting Community College Student Participation

Challenges:

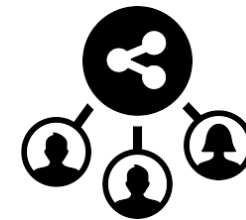
Community college & trade school students have **different life situations & priorities** than 4-year college students

- working full time, family commitments & responsibilities
- Taking classes at night for a degree or promotion
- Not necessarily looking for extra activities
- Communicating the value of participation



Opportunities:

- Many IAC **pilot programs** & partnerships
 - Determine what model works best
 - **Sharing** successes (and failures) with
 - other schools



- **Financial support** for assessment participation

Workforce Development:

What do students say?

“The biggest benefit of participation in the IAC program is that I feel I am doing something that will **directly contribute to the United States and the environment**, and that makes me happy. I can see that the reports we prepare are **valued** and taken into consideration by companies.”

- MSU IAC graduate student (Civil Engineering)

“Participation in the IAC has taught me invaluable **real-life experience** in the energy efficiency and clean energy field through its hands on approach to work. The opportunity to completely lead an energy assessment and the report writing afterwards is the perfect **leadership experience**. Training at the IAC has taught me loads about the confusing terminology and systems that are used within the industry frequently, allowing for a **competitive edge when entering the professional workforce**.”

- MSU IAC undergraduate student (Environmental Engineering)

“The IAC helped me by providing **training** on both energy assessments and report writing, which is something I do in my [current] job.”

- MSU IAC graduate student alumni (Civil Engineering)

Contact Us:

MSU IAC: iac@msu.edu

Kristen Cetin (Michigan State): cetinkri@msu.edu

Pete Kiser (Henry Ford College): pjkiser@hfcc.edu





Ethan Languri
Tennessee Tech University

Tennessee Tech Industrial Assessment Center Experience in Inspiring a Clean Energy Workforce

for
Better Plants – U.S. Department of Energy

Ethan Languri, PhD, PE

Director, Industrial Assessment Center (IAC)

Associate Professor, Mechanical Engineering Department

Tennessee Tech University

November 1, 2022



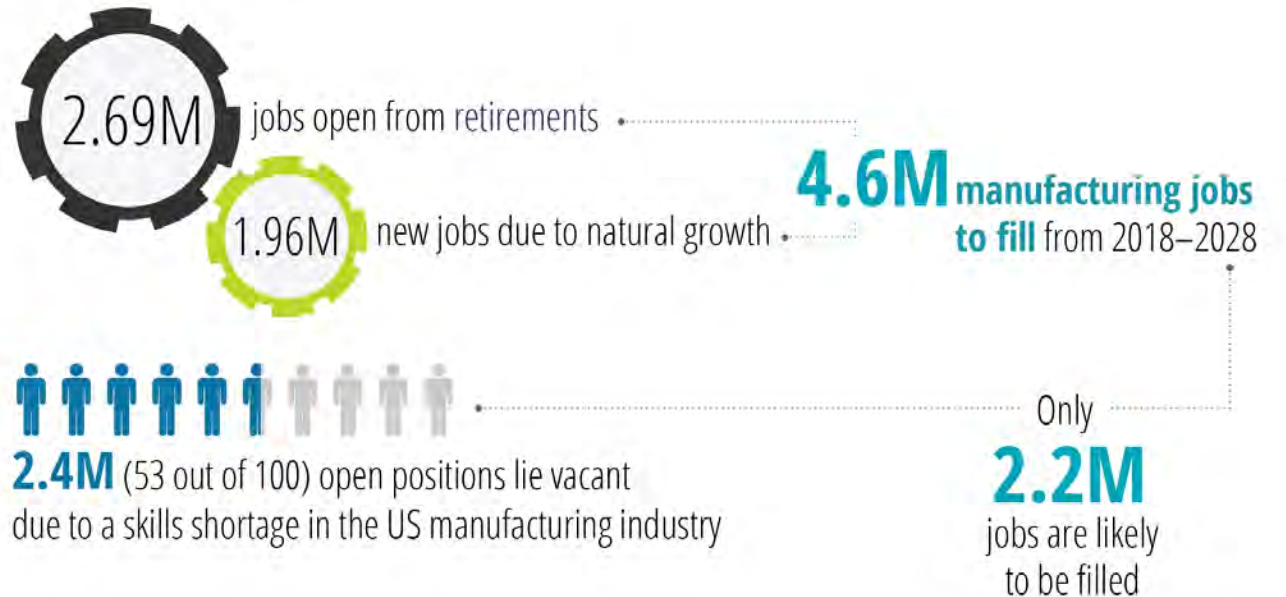
elanguri@tntech.edu , 931-372-6790



Why Workforce Development?

- 4.6 millions jobs to be filled by 2028 in manufacturing. [\[www.manufacturingusa.com\]](http://www.manufacturingusa.com)
- The mismatch between *current workers skills* and *those required*.

The skills gap may leave an estimated 2.4 million positions unfilled between 2018 and 2028



*Calculated on the basis of 52.7% of the skilled manufacturing positions that are unfilled (per the 2018 survey)

**Retirement age of 66

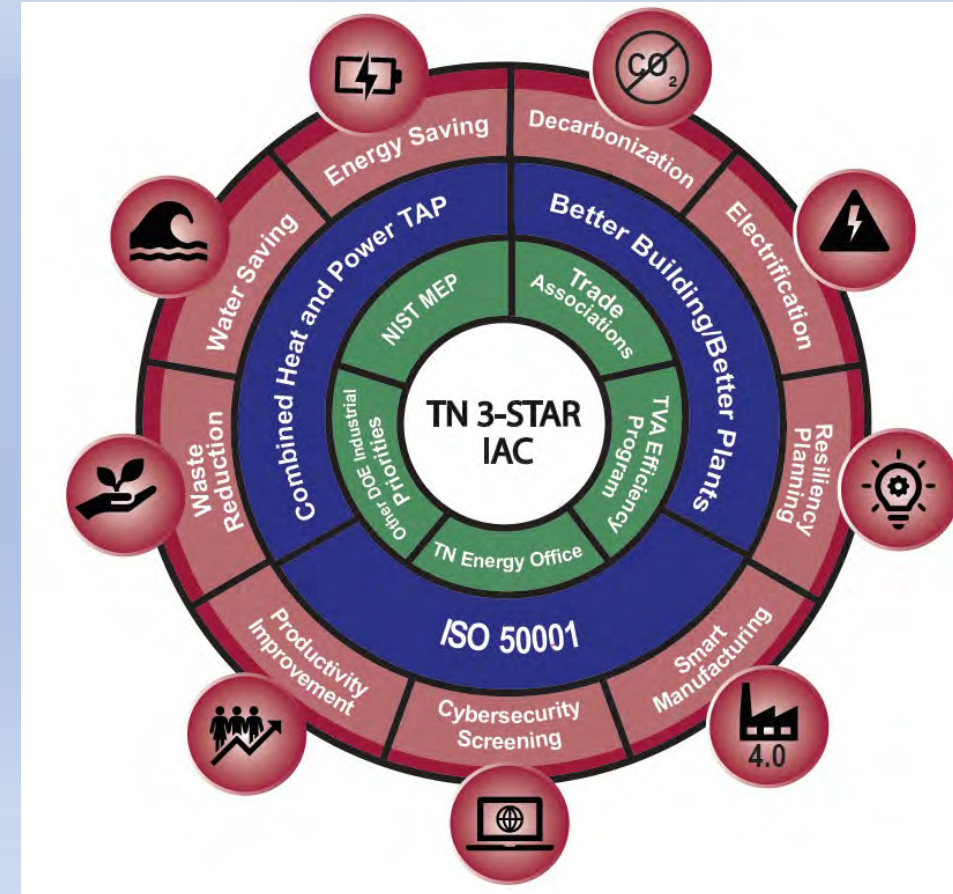
Source: BLS Data, OEM (Oxford Economics Model), Deloitte and Manufacturing Institute skills research initiative.

Deloitte Insights | deloitte.com/insights

Industrial Assessment Center - IAC

Goals of IACs:

1. Cost saving to manufacturers
2. *Workforce development* in advanced manufacturing



Challenges & Opportunities

- Onboarding new students
- Stay laser focused!
- Learning from research
- Keeping up with technology
- Other workforce training activities

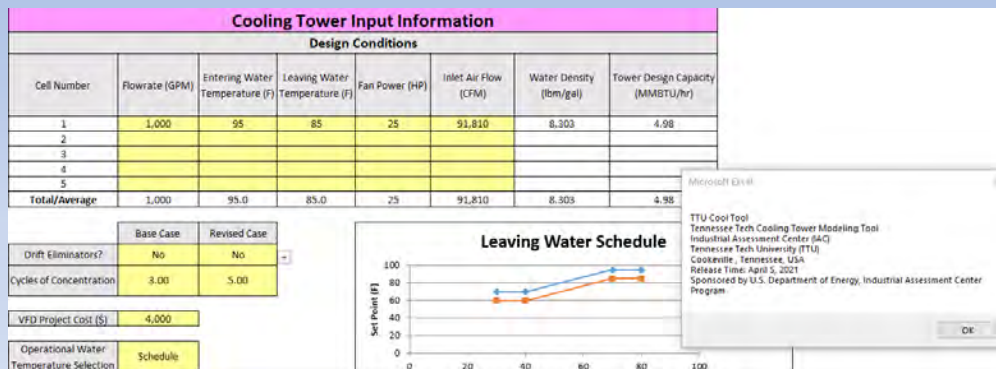
Onboarding New Students

- In-house training
- Hands-on training
- Support system
- Being fun, flexible and friendly



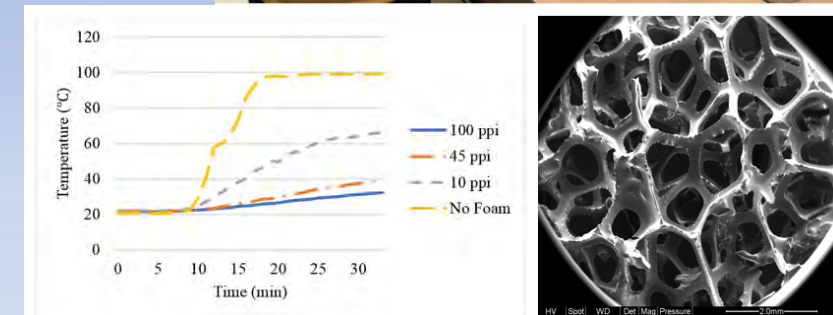
Stay Laser Focused!

- Keep experienced students involved!
- Specialized trainings for experienced students!
- Planning for their next steps



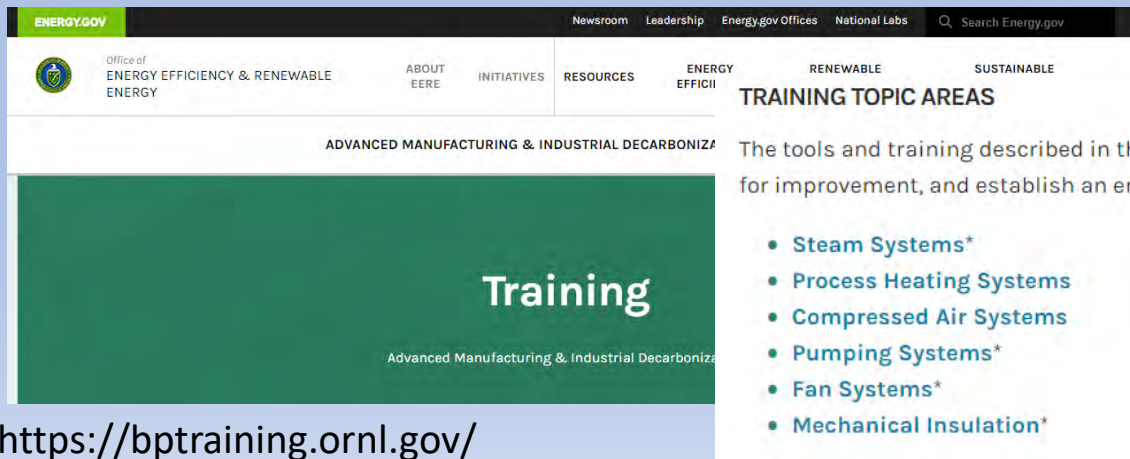
Learning from Doing Research

- Research opportunities for students!
- Publish!
- Win research awards.



Keeping up with Technology

- Keep learning.
- Certificates and trainings!

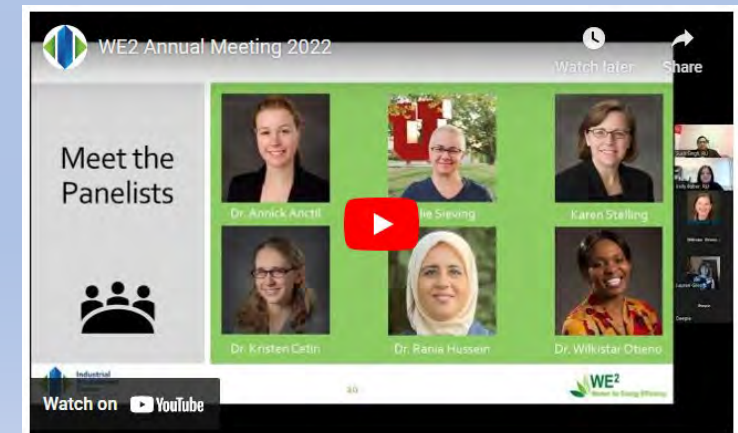
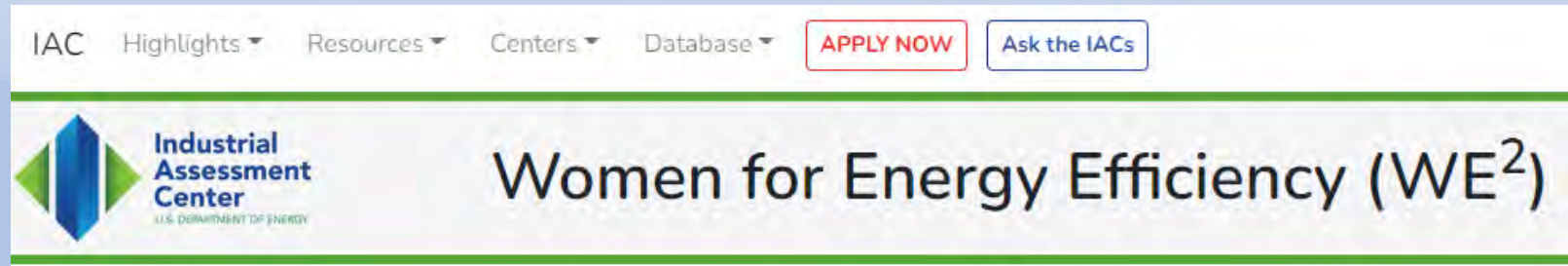


<https://bptraining.ornl.gov/>



Other Activities

- Mentorship
- Senior Design sponsorship!
 - TN IAC sponsors 3 Senior Design teams!
- Engaging the community!
 - Training TVA customers
 - Workshop on energy savings hosted by the Tennessee Office of Energy



Thank you!

Ethan Languri, PhD, PE

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IAC Website: <https://iac.university/center/TT>



Interested in Learning More?



Better Buildings[®] U.S. DEPARTMENT OF ENERGY

2022-2023 Better Buildings Webinar Series

Strategies for Achieving Zero Energy in Multifamily Buildings

Additional Resources

Learn more about the topics discussed on the webinar by visiting the resources below.

Better Buildings Resources

- [Multifamily Resources](#) for Reducing Carbon Emissions

Explore more resources on the [Better Buildings Solution Center](#)

Other Resources

- ASHRAE's [Advanced Energy Design Guides](#)
- ASHRAE's The Advanced Energy Design Guide – Achieving Zero Energy [series](#)
- SBP Protects [website](#)

Up Next in the 2022-2023 Better Buildings Webinar Series

Show Me the Money: Financing Decarbonization Projects
Tuesday, September 27th from 11am – 12pm ET

Learn about the financing mechanisms Better Buildings Financial Allies use with organizations interested in decarbonization projects, along with practical steps to identify and source capital from grants, third-party investors, bonds, and more.
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Q & A

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LEVERAGING THE CAPABILITIES OF THE MEASUR TOOL SUITE

Tue, November 15, 2022, | 11:00 AM - 12:00 PM ET

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DOE's MEASUR tool suite contains an impressive 50+ calculators to help users analyze their energy use for a wide range of industrial systems. If you have it in your facility, you can probably model it using MEASUR! Get a demonstration of this powerful, free, and open-source software package to find out how to use it with your own systems.

APRIL
11-13
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