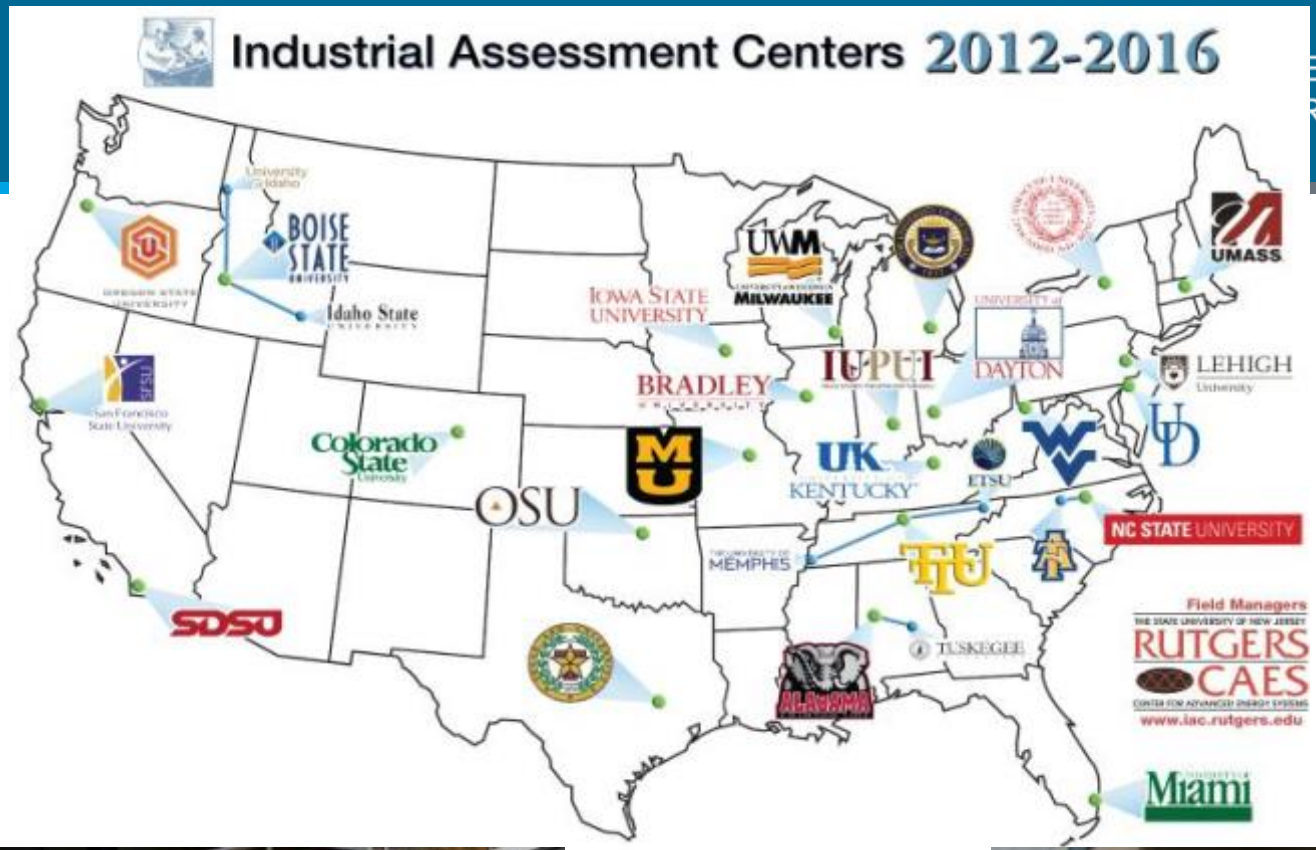
IAC Student Collaboration Webinar

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Thomas Wenning, PE
Oak Ridge National Laboratory

IAC Student Webinar Series
September 2015


Industrial Assessment Centers 2012-2016
University of Idaho
BOISE STATE UNIVERSITY
Idaho State University
Oregon State University
San Francisco State University
Colorado State University
OSU
SDSU
IOWA STATE UNIVERSITY
UWM
MILWAUKEE
BRADLEY
IUPUI
UNIVERSITY of DAYTON
UMASS
LEHIGH University
UD
UK KENTUCKY
ETSU
NC STATE UNIVERSITY
MEMPHIS
FIU
TUSKEGEE
ALABAMA
Field Managers
THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS
CAES
CENTER FOR ADVANCED ENERGY SYSTEMS
www.iac.rutgers.edu
Miami

IAC Student-Led Webinars Intro

- Alternative to student meeting
- Monthly student-led webinars
- Proposed Structure:
  - 40 min student presentation
  - 20 minutes of Q&A/open dialogue
- Allow students to connect

Webinar Series Purpose

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Mechanism for IAC-to-IAC student collaboration
- Possible topics:
  - Relevant items for day-to-day IAC operations (client recruitment, report writing, etc.)
  - New technologies and innovations
- Rotate speakers and topics each month
- Each center will lead or contribute a presentation to a future webinar

Feedback

We want your feedback (date, time, topics, etc)!

….and Volunteers!

Feedback

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Webinar Survey

1. Did you find this webinar helpful (1 being least helpful and 5 being most helpful) ?

   1 ○ 2 ○ 3 ○ 4 ○ 5 ○

2. What topic or topics would you like to see addressed in future IAC student-led webinars?

3. Would you be interested in leading a future webinar?

   ○ Yes

   ○ No

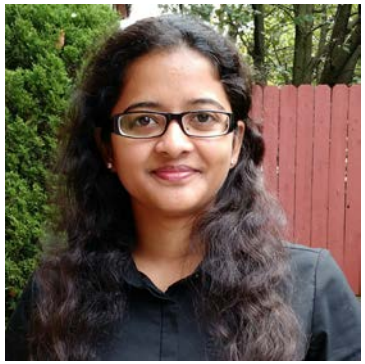
4. If interested in leading a future webinar, please list your name and contact email.

On to the Speaker…

- **Topic**: Energy Management using ISO 50001 and Superior Energy Performance
- **Who**: Amir H. Abolhassani & Chandana Chada, West Virginia University IAC

amirabolhassani@gmail.com

chchada@mix.wvu.edu

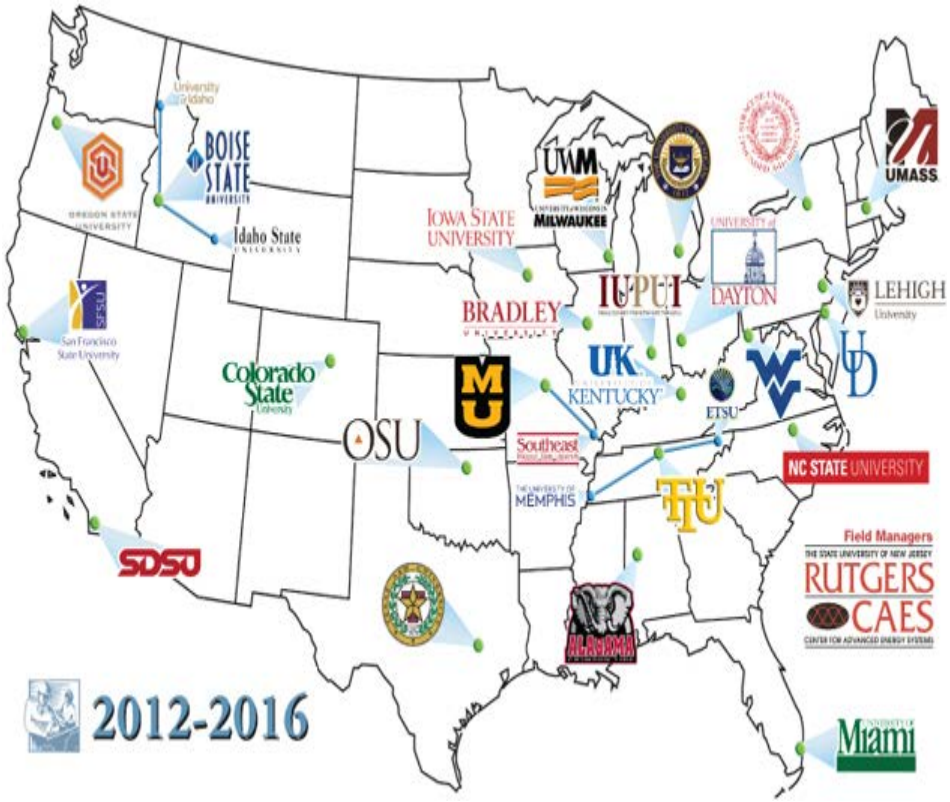


Energy Management using ISO 50001 and SEP

Amir Abolhassani, EIT
Chandana Chada, EIT

September 23rd 2015

Industrial Assessment Centers (IAC)



WestVirginiaUniversity

IAC

WVU – IAC Team

WestVirginiaUniversity

IAC

WVU - IAC

- Beginning 25th year in IAC program
- Conducted over 500 energy assessments for manufacturing facilities
- Focus on energy systems
- Student centered research
- Development of other research projects

WestVirginiaUniversity

IAC

Environmental Impact of IAC – WVU

- Total energy saved: 9.93 Trillion Btu per year by 515 manufacturing facilities (implemented 4.07 TBTU/yr – 495 manufacturing facilities)
- Implemented projects worth of $22.69 million USD to achieve savings of $60.01 million USD
- Total CO_2 emissions saved: 748,069 tons per year (317,506.74 implemented)
- Payback on investment: average less than 2 years

West Virginia University

IAC

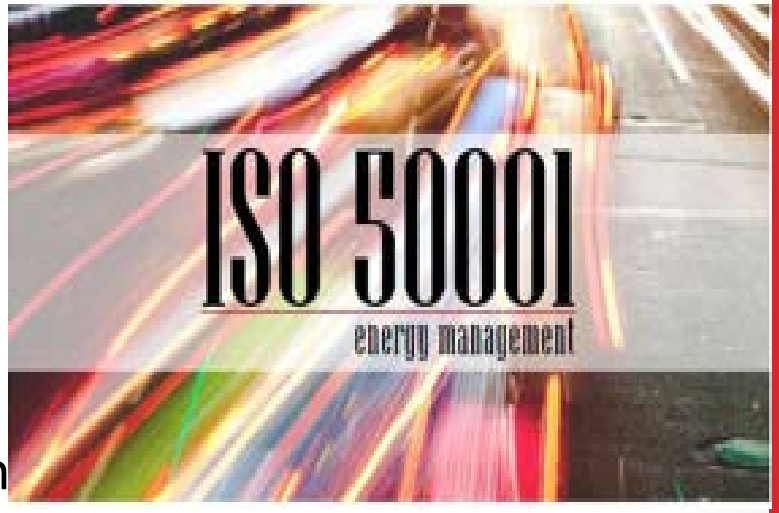
	Recommended Savings		Implemented Savings	
	Energy (MMBTU)	Cost ($)	Energy (MMBTU)	Cost ($)
Electricity	1,643,181	20,949,170	759,843	9,838,125
Natural Gas	3,909,365	28,453,750	1,304,820	8,726,355
Total	**5,552,546**	**49,402,920**	**2,064,663**	**18,564,480**

CO_2 Savings	Recommended Savings (Tons)	Implemented Savings (Tons)
Electricity	527,189.79	243,784.41
Natural Gas	220,879.12	73,722.33
Total	**748,068.91**	**317,506.74**

WestVirginiaUniversity

IAC

What will we cover in this webinar?

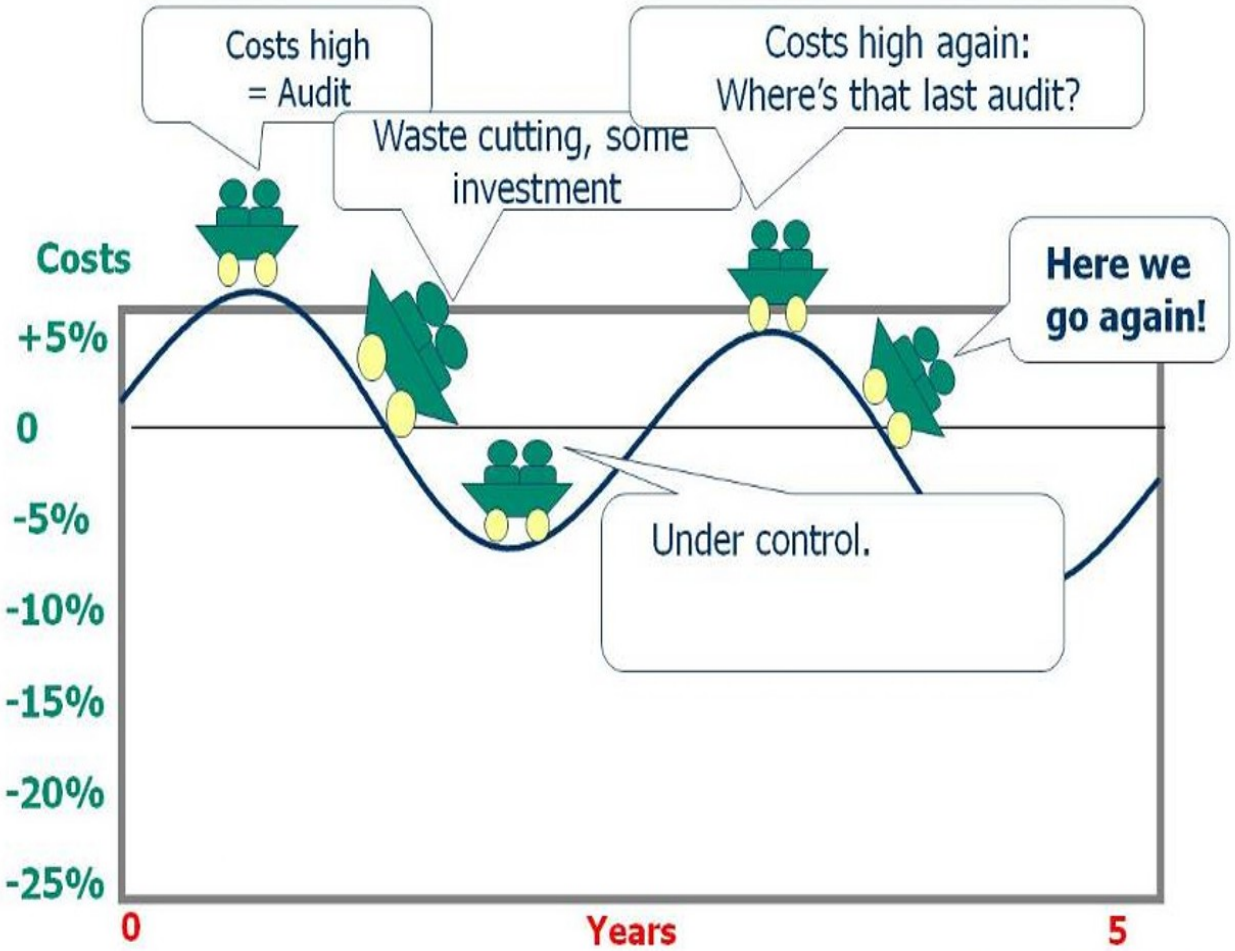


- What is Energy Management
- Overview of the ISO 50001 Stan
- The Plan – Do – Check – Act cycle for continuous improvement
- Elements of the energy management standard
- Introduction to Superior Energy Performance
- Documented performance of participating companies

West Virginia University

IAC

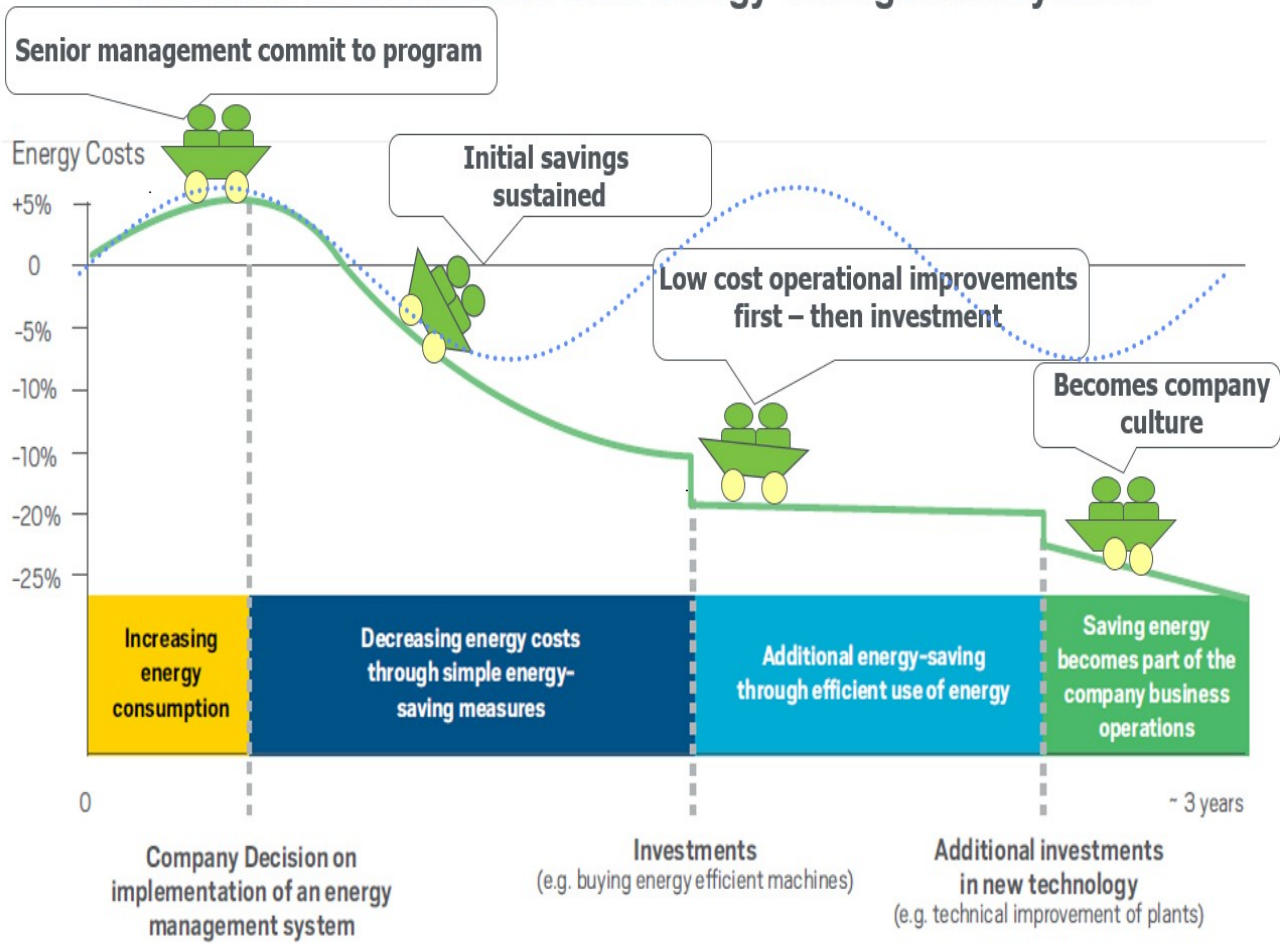
Ad hoc Approach to Energy Management



Source: UNIDO 2010

Structured Approach to Energy Management

Continuous cost reduction from energy management systems



SOURCE: Kahlenborn et al. (2012), based on Lackner & Holanek (2007).

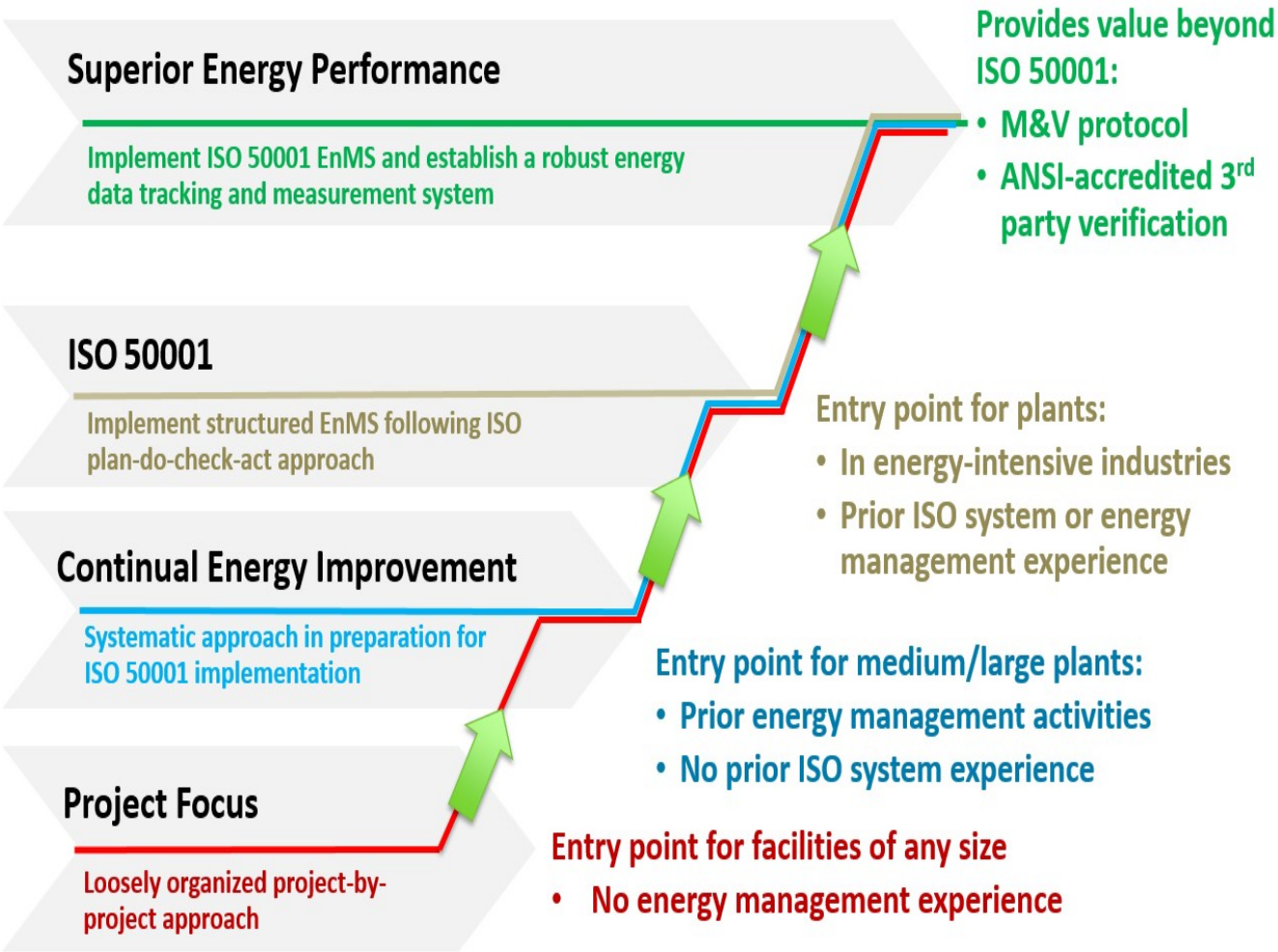
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

West Virginia University

IAC

- Can improve the energy efficiency sustainably in an industrial facility via operational changes.
- Requires an organizational change in culture
- Requires that top management be engaged in the management of energy on an ongoing basis

Strategic Energy Management Continuum



ISO 50001
ENERGY MANAGEMENT

What is ISO 50001?

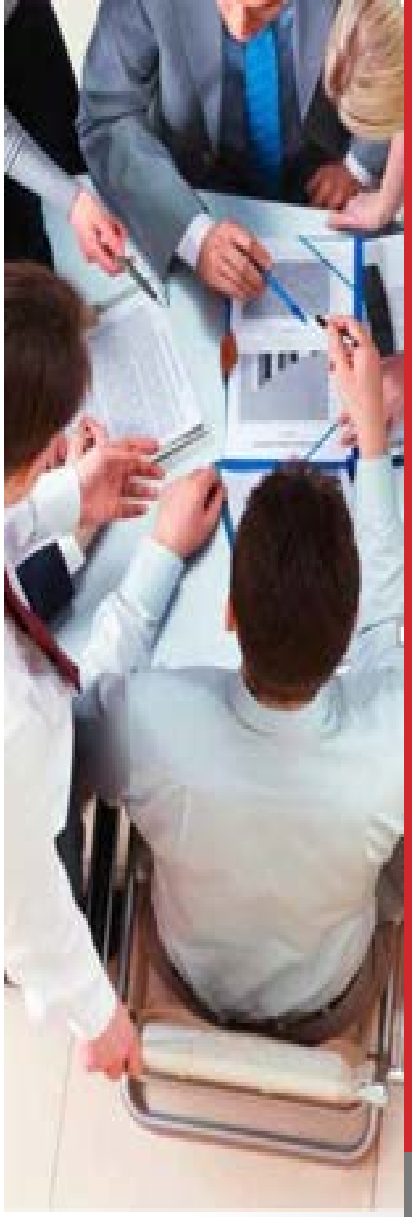
- A voluntary International Standard developed by ISO (International Organization for Standardization)
- Provides the requirements for an energy management system (EnMS)
- Provides benefits for organizations large and small, in both public and private sectors, in manufacturing and services.
- Establishes a framework for an organization to manage energy.

West Virginia University

IAC

What will it do?

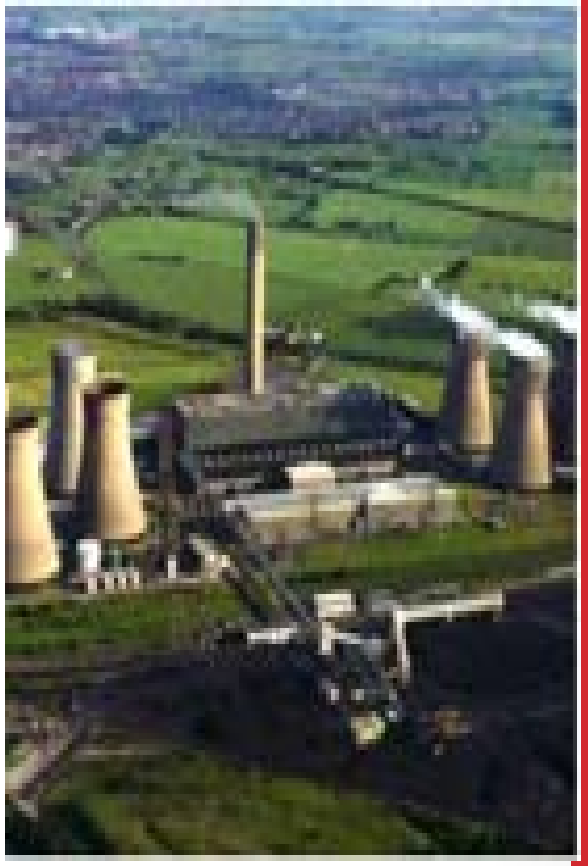
- Provides a proven methodology for integrating energy performance into management practices.
- Assist organizations in making better use of their existing energy-consuming assets
- Creates transparency and facilitates communications.
- Encourages best practices.
- Facilitates energy management improvements for greenhouse gas emission



West Virginia University

IAC

How does it work?



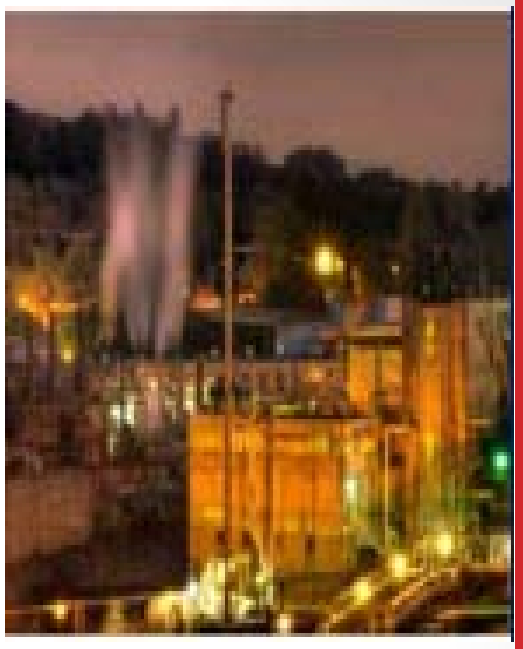
- ISO 50001 is based on the proven ISO management system model of continuous improvement
- Follows the Plan-Do-Check-Act process
- Requires an organization to implement, maintain, and improve an EnMS
- Enables systematic achievement of continual improvement in energy performance

How was it developed?

- Request to develop came from United Nations Industrial Development Organization (UNIDO)

- ISO had identified energy management as one of the top five fields for the development of International Standards.

- Experts from national standards bodies of 44 ISO member countries participated with another 14 countries observing.



Basic Elements of an EnMS

PLAN
- Requirements and Policy
- Planning

DO
- Implementation and Operation

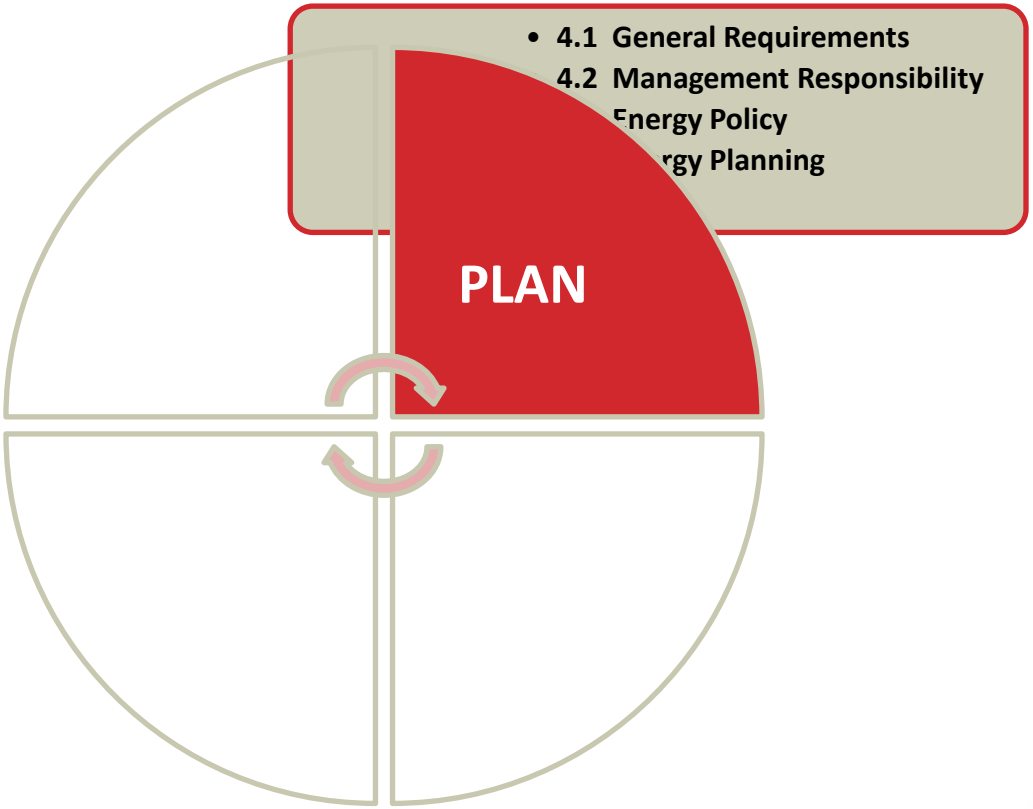
CHECK
- Performance Monitoring

ACT
- Management Review
- Continual Improvement

WestVirginiaUniversity

IAC

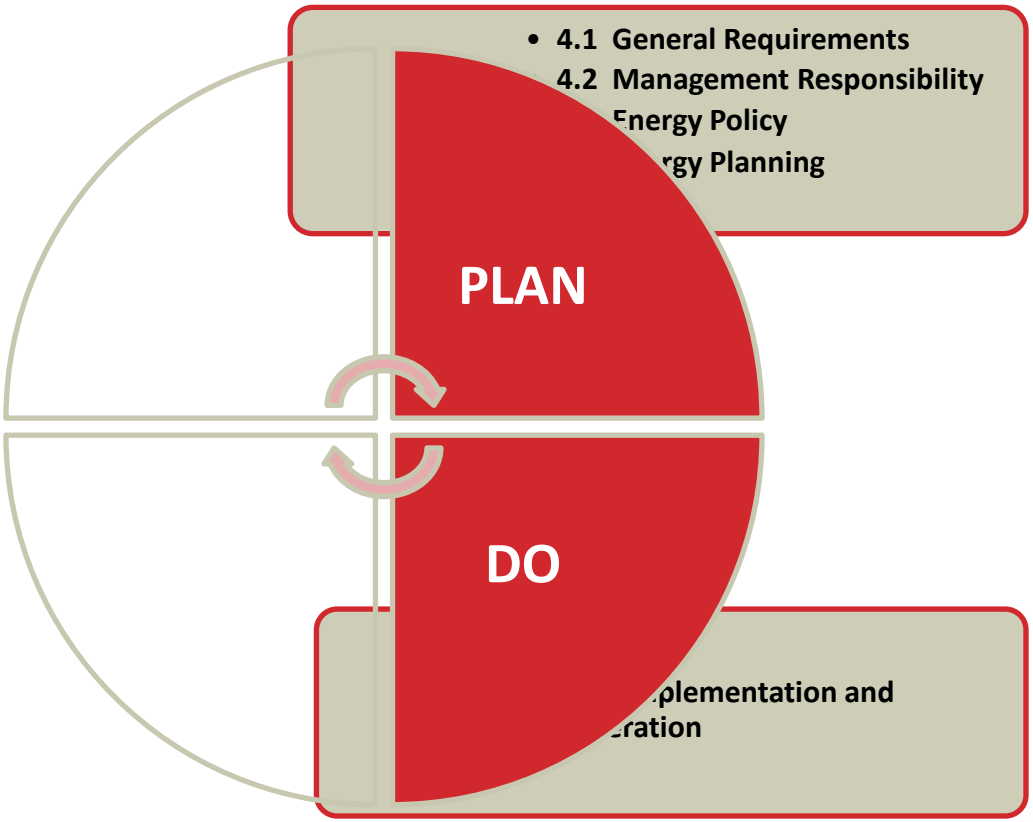
ISO 50001:2011
Energy Management System



WestVirginiaUniversity

IAC

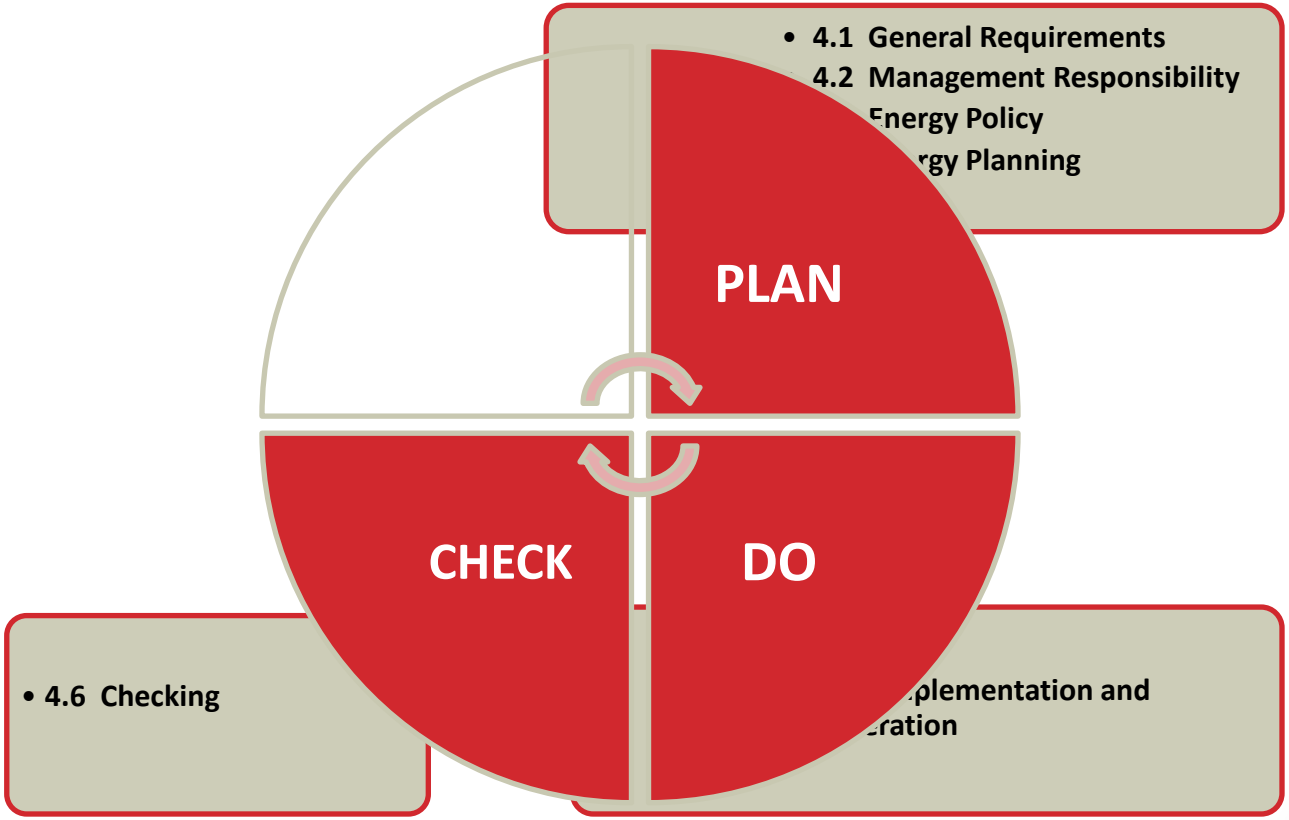
ISO 50001:2011
Energy Management System



WestVirginiaUniversity

IAC

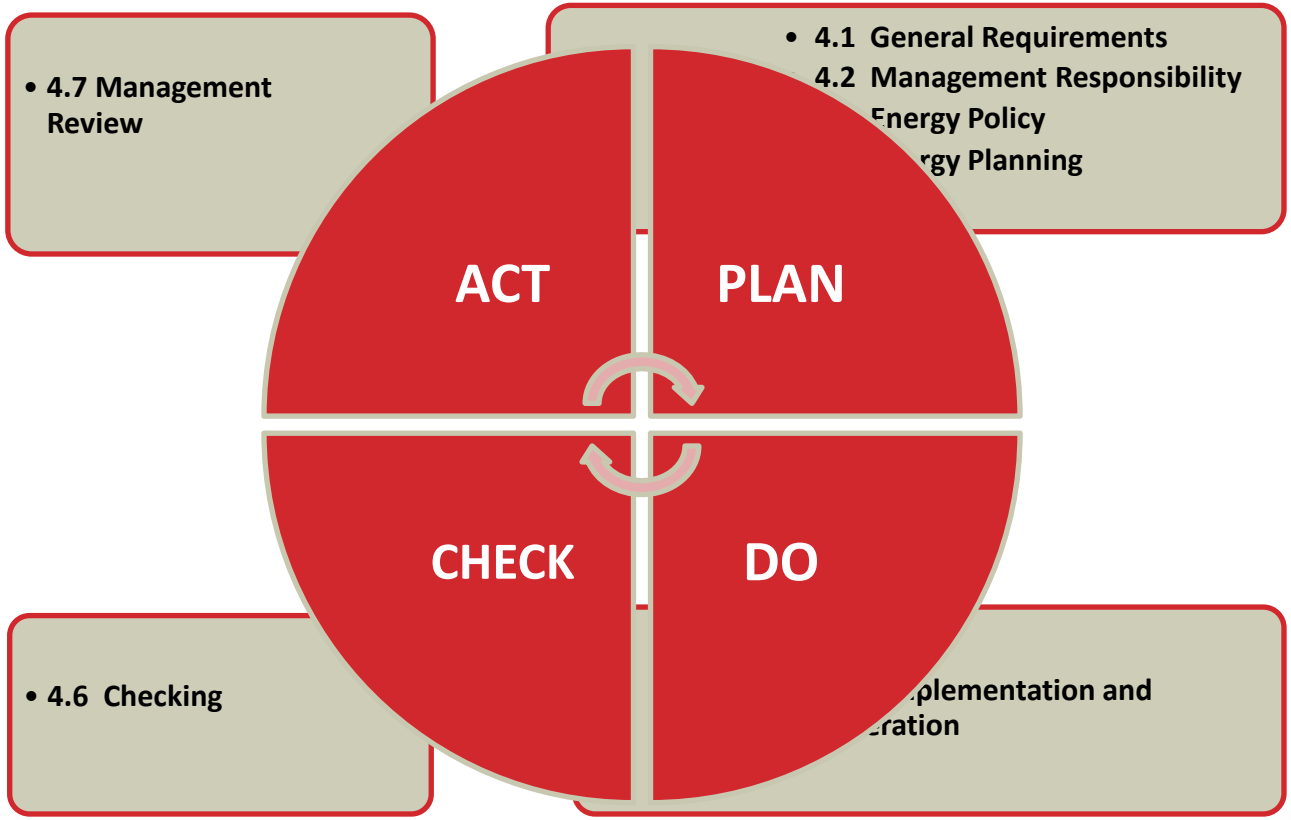
ISO 50001:2011
Energy Management System



WestVirginiaUniversity

IAC

ISO 50001:2011
Energy Management System



Start

4.2 Management Responsibility

4.2.1 Top Management

4.2.2 Management Representative

4.3 Energy Policy

4.4 Energy Planning

4.4.1 General

4.4.2 Legal/Other Requirements

4.4.3 Energy Review

4.4.4 Energy Baseline

4.4.5 Energy Performance Indicators

4.4.6 Energy Objectives, Targets & Action Plans

4.5 Implementation & Operation

4.5.1 General

4.5.2 Competence, Training & Awareness

4.5.3 Communication

4.5.4 Documentation

4.5.5 Operational Control

4.5.6 Design

4.5.7 Procurement of Energy Services, Products,

4.6 Checking

4.6.1 Monitoring, Measurement & Analysis

4.6.2 Evaluation of Compliance with Legal & Other Requirements

4.6.3 Internal Audit of the EnMS

4.6.4 Nonconformities, Correction, Corrective & Preventive Action

4.6.5 Control of Records

4.7 Management Review

Continual Improvement

WestVirginiaUniversity

IAC

Section 3:
Terms and definitions

- **Energy use** is the manner or kind of application of energy.
- **Energy consumption** is the quantity of energy applied.
- **Energy performance** is measurable results related to energy efficiency, use, and consumption.
- **Energy performance indicator(EnPI)** is a quantitative value or measure of energy performance.
- **Energy review** is the determination of energy performance leading to identification of improvement opportunities.

- **Scope** is the extent of activities, facilities and decisions which the organization addresses through an EnMS, which can include several boundaries.

- **Energy baseline** is a quantitative reference providing a basis for comparison of energy performance.

- **Energy Management System** is a system with set of interacting elements to establish an energy policy and energy objectives, and processes and procedures to achieve those objectives

- A **Significant Energy Use (SEU)** is an energy use accounting for substantial energy consumption and/or offering considerable potential for energy performance improvement.

Section 4:
Energy management system requireme

4.2 Management Responsibility

4.2.1 Top management

- Energy policy
- Appoint a management representative & energy team
- Provide resources
- Identify scope and boundaries
- Communicate importance
- Energy objectives & targets
- Energy performance indicators (EnPI)
- Energy performance in long-term planning
- Results are measured & reported
- Management review

4.2 Management Responsibility

4.2.2 Management representative

- EnMS is established, maintained, and continually improved
- Identify an energy team
- Report to top management on energy & EnMS performance
- Planning of energy management activities support the policy
- Define and communicate responsibilities and authorities
- Determine criteria and methods to ensure operation &

4.3 Energy Policy

- Appropriate to the nature and scale of the organization's energy use and consumption
- Continual improvement in energy performance
- Availability of information & resources to achieve objective & targets
- Comply with applicable legal & other requirements
- Provides a framework for setting and reviewing energy objectives & targets
- Supports the purchase of energy efficient products & services
- Documented and communicated at all levels
- Regularly reviewed and updated if necessary

4.4 Energy Planning

4.4.2 Legal requirements and other requirements

- Identify all applicable legal and other requirements related to energy use, consumption and efficiency.
- Determine how these requirements apply to its energy use
- Review at defined intervals

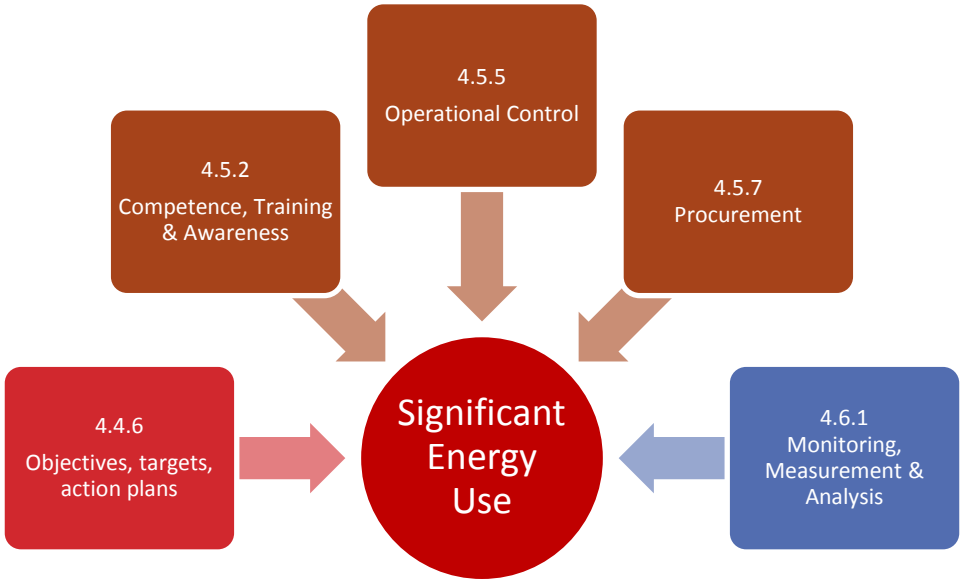
4.4 Energy Planning

4.4.3 Energy review

- Analyze energy use and consumption
- Identify areas of significant energy use
- Identify, prioritize and record opportunities for improving energy performance

Significant Energy Use (SEU)

An energy use accounting for substantial energy consumption and/or offering considerable potential for energy performance improvement.



WestVirginiaUniversity

IAC

4.4 Energy Planning

4.4.4 Energy baseline

- Establish an energy baseline
- Changes in energy performance shall be measured against the baseline
- Adjustments shall be made
  - When EnPIs no longer reflect energy use and consumption
  - There have been major process or system changes
  - According to a predetermined method

4.4 Energy Planning

4.4.5 Energy performance indicators

- Identify EnPIs appropriate for monitoring and measuring energy performance
- Record and regularly review the methodology for determining and updating EnPIs
- Review and compare EnPIs to the energy baseline

Energy performance indicators are:

- Quantitative measure of energy performance
- An EnPI can be a simple ratio or a multi-variable model
- An example is energy consumption per unit of production
- EnPIs can be defined for individual processes or facility-wide

4.4 Energy Planning

4.4.6 Energy objectives, targets, and energy management action pla

- Establish, implement and maintain documented energy objectives and targets for energy performance improvement
- Objectives must be consistent with the energy policy and targets consistent with the objectives
- When establishing objectives the organization must consider
  - Legal and other requirements
  - Significant energy uses
  - Opportunities to improve energy performance
  - Financial objectives
  - Operational and business conditions
  - Technological options
  - Views of interested parties

4.4 Energy Planning

4.4.6 Energy objectives, targets, and energy management action p

- Establish, implement and maintain action plans for achieving the objectives and targets

- Action plans shall include
  - Designation of responsibility
  - Specific actions and time frame to achieve individual targets
  - The method used to verify energy performance improvement
  - The method of verifying the results

- Action plans shall be documented and updated at defined intervals

4.5 Implementation and Operation

4.5.1 General

- Use action plans and other outputs from the planning process

4.5 Implementation and operation

4.5.2 Competence, training and awareness

- Ensure that any person working for or on its behalf, related to SEUs, are competent to perform the work.
- Identify and provide training
- Ensure that anyone working for or on its behalf are aware of:
  - Importance of conformity with the energy policy and requirements
  - Their roles, responsibilities and authorities in achieving requirements
  - Benefits of improved energy performance
  - Impact of their activities with respect to energy use and consumption, the contribution to achieving objectives and targets, and potential consequences of not following procedures.

4.5 Implementation and operation

4.5.3 Communication

- Shall communicate internally with regard to its energy performance and EnMS
- Establish and implement a process by which any person working for, or on behalf of, the organization can comment or suggest improvements to the EnMS
- Shall decide whether to communicate externally and document the decision.

4.5 Implementation and operation

4.5.4 Documentation

4.5.4.1 Documentation requirements

- EnMS documentation:
  - Scope and boundaries of the EnMS
  - Energy policy
  - Energy objectives, targets, and action plans
  - Documents and required records
  - Documents determined by the organization to be necessary

4.5 Implementation and operation

4.5.4 Documentation

4.5.4.2 Control of documents

- Shall establish, implement and maintain procedures to:
  - Approve documents
  - Review and update documents
  - Ensure relevant versions are available at points of use
  - Documents are legible and identifiable
  - Ensure external documents relative to planning and operation of the EnMS are identified and controlled
  - Prevent the unintended use of obsolete documents

4.5 Implementation and operation

4.5.5 Operational control

- Identify and plan operation and maintenance activities related to SEUs by:
  - Establishing criteria for effective operation and maintenance of SEUs, where their absence could lead to a significant deviation from effective energy performance
  - Operating and maintaining facilities and equipment in accordance with established criteria
  - Communication to operating personnel.

4.5 Implementation and operation

4.5.6 Design

- Consider energy performance improvement opportunities in the design of facilities, equipment, systems & processes
- Results of the energy performance evaluation shall be incorporated into the design specifications
- Record results

4.5 Implementation and operation

4.5.7 Procurement of energy services, products, equipment and e

- If services, products or equipment can have an impact on SEUs, suppliers must be informed that procurement is partly evaluated based on energy performance
- Establish and implement criteria for assessing energy use, consumption and efficiency.
- Define and document energy purchasing specifications for effective energy use

4.6 Checking

4.6.1 Monitoring, measurement and analysis

- Shall monitor, measure and analyze key characteristics that determine energy performance which include:
  - SEUs and other outputs of the energy review
  - Variables related to SEUs
  - EnPIs
  - Effectiveness of action plans in achieving objectives and targets
  - Evaluation of actual versus expected energy consumption

4.6 Checking

4.6.1 Monitoring, measurement and analysis

- Record results from monitoring and measurement
- Define and periodically review measurement needs
- Ensure measuring equipment are accurate and repeatable
- Maintain calibration records
- Investigate and respond to significant deviations in energy performance
- Record results of these activities

4.6 Checking

4.6.2 Evaluation of compliance with legal and other requirements

- Evaluate compliance with legal and other requirements related to energy use and consumption at planned intervals
- Record results

4.6 Checking

4.6.3 Internal audit of the EnMS

- Conduct internal audits at planned intervals to ensure the EnMS;
  - Meets ISO 50001 requirements
  - Conforms with objectives and targets
  - Is effectively implemented and is improving energy performance
- Consider importance and performance of areas to be audited in developing an audit plan
- Ensure objectivity and impartiality of the audit process
- Record audit results and report to top management

4.6 Checking

4.6.4 Nonconformities, correction, corrective action and preventive

- Address actual and potential nonconformities including:
  - Review actual or potential nonconformities
  - Determine the causes
  - Evaluate the need for action
  - Determine and implement appropriate action
  - Maintain records of corrective and preventive actions
  - Review the effectiveness of actions taken
- Actions are to be appropriate to the magnitude of the problem
- Make necessary changes to the EnMS

4.6 Checking

4.6.5 Control of records

- Establish and maintain records to demonstrate conformance to the EnMS and ISO 50001
- Define and implement controls for record identification, retrieval and retention
- Records shall be legible, identifiable and traceable

4.7 Management review

4.7.1 General

- Conduct a review with top management at planned intervals to ensure the suitability, adequacy and effectiveness of the EnMS
- Maintain records of the management review

4.7 Management review

4.7.2 Input to management review

- Follow-up actions from previous reviews
- Review of energy policy
- Review of energy performance and EnPIs
- Evaluation of legal compliance and changes in legal and other requirements
- Extent to which energy objectives and targets have been met
- Audit results
- Status of corrective and preventive actions
- Projected energy performance
- Recommendations for improvement

4.7 Management review

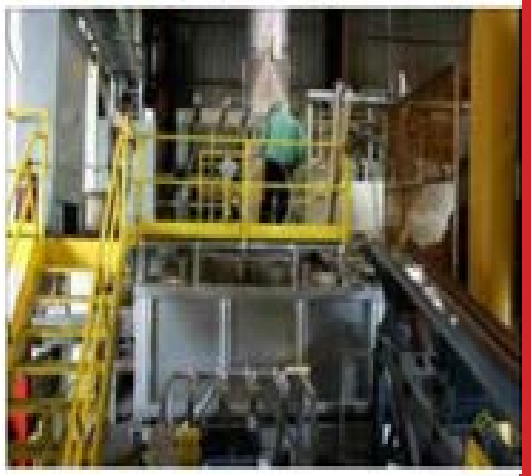
4.7.3 Output from management review

- Changes in energy performance
- Changes to the energy policy
- Changes to the EnPIs
- Changes to objectives and targets or continual improvement
- Changes to the allocation of resources

Superior Energy Performance

- ***Superior Energy Performance (SEP)*** is a market-based, ANSI/ANAB-accredited certification program that provides industrial and commercial facilities with a roadmap for achieving continual improvement in energy efficiency while maintaining competitiveness.

- SEP will provide a transparent, globally accepted system for validating energy performance improvement and management practices.



*ANSI- American National Standard Institute

ANAB- American National Accreditation Board

- Implementation of the ISO 50001 energy management standard, with additional requirements to achieve and document energy performance improvements.

- All industrial and commercial facilities pursuing certification must demonstrate an improvement in energy performance.

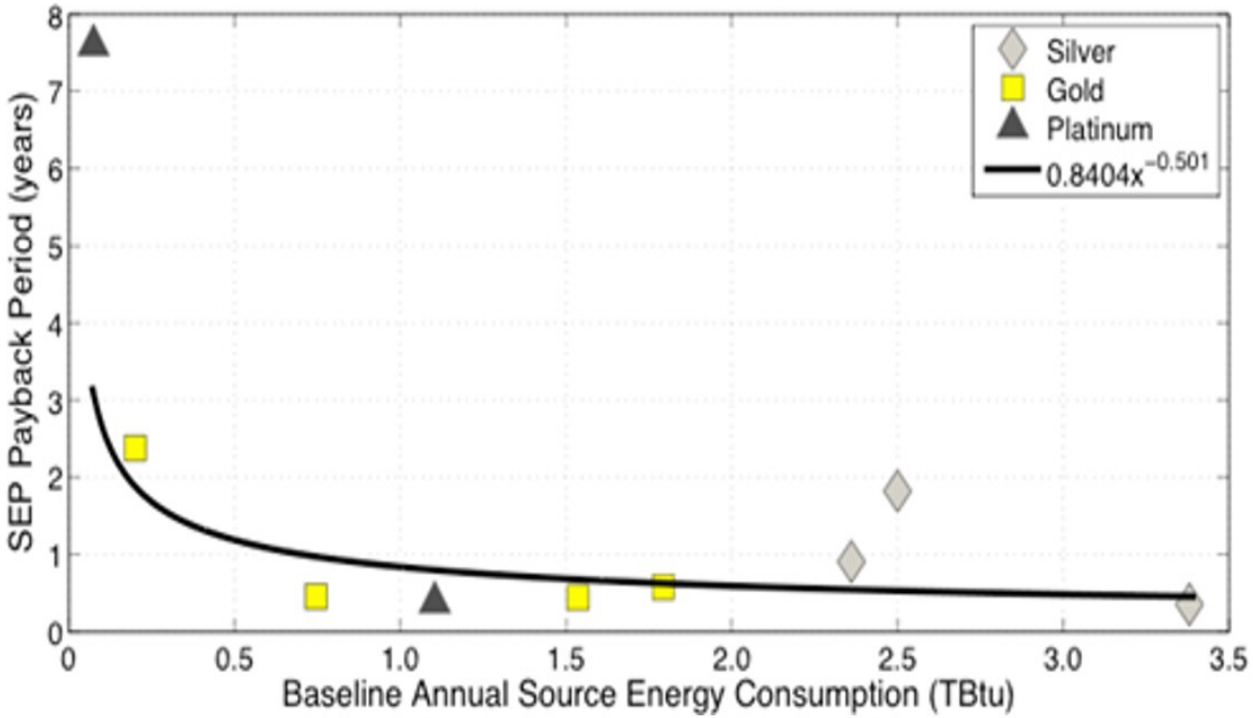
  Up to 25% in over 3 years and 40% in over 10 years

- Silver, gold and platinum level- based on improvement in energy performance

- **ANSI/MSE 50021-2012**
  Superior Energy Performance – Additional

Making the Business Case

- SEP marginal payback figures are calculated for each plant by dividing SEP costs (not including capital project costs) by associated SEP operational energy savings beyond business-as-usual operational energy savings prior to SEP



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

WestVirginiaUniversity

IAC

SEP PLATINUM CERTIFIED

COMPANY / LOCATION	ACHIEVEMENT*
Mack Trucks *Macungie, PA – Oct. 2013*	41.9% over 10 years
Schneider Electric *Saanichton, British Columbia, Canada – Nov. 2014*	30.6% over 3 years
Volvo Trucks, NA *Dublin, VA – Feb. 2015* (SEP Platinum certified in 2012 with 25.8% over 3 years)	28.4% over 10 years
Schneider Electric *Smyrna, TN – June 2015* (SEP Platinum certified in 2012 with 15.3% over 3 years)	23.1% over 3 years
3M Canada Company *Brockville, Ontario, Canada – Jun. 2015* (SEP Platinum certified in 2012 with 15.8% over 3 years)	21.4% over 7 years
Volvo Group Trucks *Hagerstown, MD – Nov. 2014*	20.9% over 3 years
Nissan NA *Smyrna, TN – May 2015* (SEP Silver certified in 2012 with 7.2% over 3 years)	17.7% over 3 years
Schneider Electric *Clovis, CA – Dec. 2014*	16.7% over 3 years
HARBEC Inc. *Ontario, NY – Nov. 2013*	16.5% over 3 years
Schneider Electric *Seneca, SC – Aug. 2013*	15.6% over 3 years

WestVirginiaUniversity

IAC

SEP GOLD CERTIFIED

COMPANY / LOCATION	ACHIEVEMENT*
Schneider Electric *Peru, IN – Oct. 2014*	24.9% over 10 years
Cummins *Whitakers, NC – Jan. 2014*	12.6% over 3 years
Coca-Cola Refreshments USA, Inc. *Dunedin, FL – Jan. 2015*	12.2% over 3 years
General Dynamics *Scranton, PA – Apr. 2013*	11.9% over 3 years
Schneider Electric *Tijuana, Mexico – Jul. 2015*	10.2% over 3 years
Schneider Electric *Hopkins, SC – Oct. 2014*	10.2% over 3 years
Cooper Tire *Texarkana, AR – Oct. 2012*	10.1% over 3 years

SEP SILVER CERTIFIED

COMPANY / LOCATION	ACHIEVEMENT*
Bridgestone *Wilson, NC – Oct. 2012*	16.8% over 10 years
Olam Spices *Gilroy, CA – Mar. 2013*	9.8% over 3 years
Schneider Electric *Cedar Rapids, IA – Jul. 2014*	8.8% over 3 years
MedImmune *Gaithersburg, MD – Sept. 2014*	8.5% over 3 years
Curtiss-Wright *Cheswick, PA – Mar. 2015*	7.6% over 3 years
Schneider Electric *Lexington, KY – Mar. 2014*	6.9% over 3 years
Schneider Electric *Lincoln, NE – Oct. 2013*	6.5% over 3 years
Schneider Electric *Rojo Gomez, Mexico – Nov. 2014*	5.9% over 3 years
Land O'Lakes, Inc. *Carlisle, PA – Mar. 2015*	5.7% over 3 years
3M Company *Cordova, IL – Oct. 2012*	5.6% over 3 years

Certified practitioner for Energy Management System

Dr. B. Gopala

Dr. Ed Crowe

Subodh Chaudhari

Kartik Ramamoorthy

CpEn
MS

ISO 50001 Certified

Chrysler, Detroit

American Axle, Detroit

Kartik
Ramamoorthy

ISO 50001 & SEP Platinum

Volvo Group Trucks, Hagerstown Harish Kanneganti

WestVirginiaUniversity

IAC

Additional Information

Superior Energy Performance

http://www.superiorenergyperformance.net/

ISO 50001 Energy Management Standard

http://www1.eere.energy.gov/energymanagement/

DOE eGuide for ISO 50001

https://ecenter.ee.doe.gov/EM/SPM/Pages/Home.aspx

Energy Management Webinar Series

http://www1.eere.energy.gov/manufacturing/resources/em_webinars.html

THANK YOU.

DO YOU HAVE ANY QUESTIONS ?

WestVirginiaUniversity

IAC

Q & A…

www.IACForum.org

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Student Registry and Exit Interviews

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

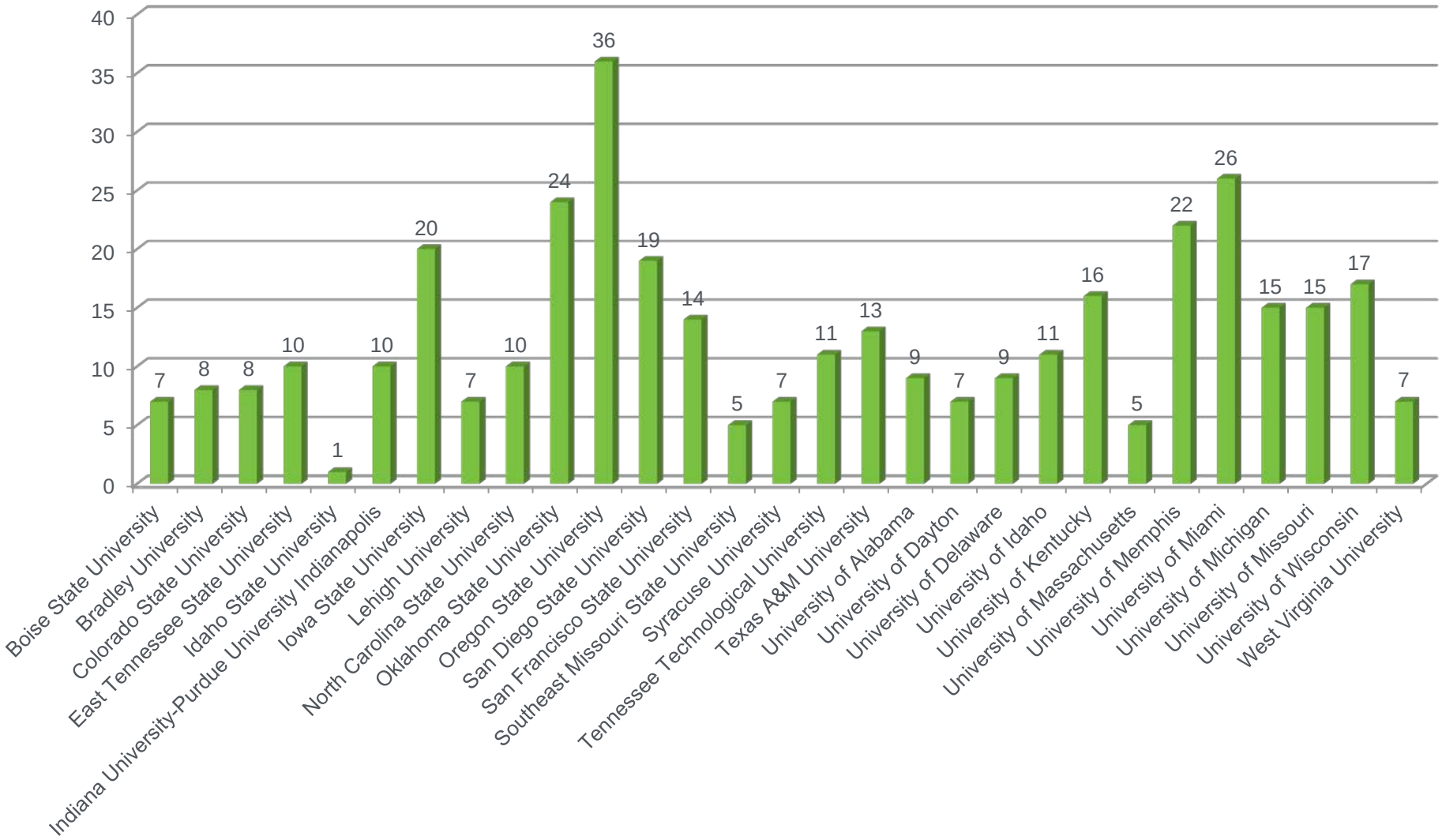
- **Lead Student Responsibilities**
  - Ensure all students complete registry entry
  - Ensure all students complete exit interview
  - Ensure that lead/active/inactive status is current
- Exit Interviews
  - Identify new lead students
  - Update contact information for alumni
  - Capture alumni career data

http://www.iacforum.org/

Student Registry and Exit Interviews

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

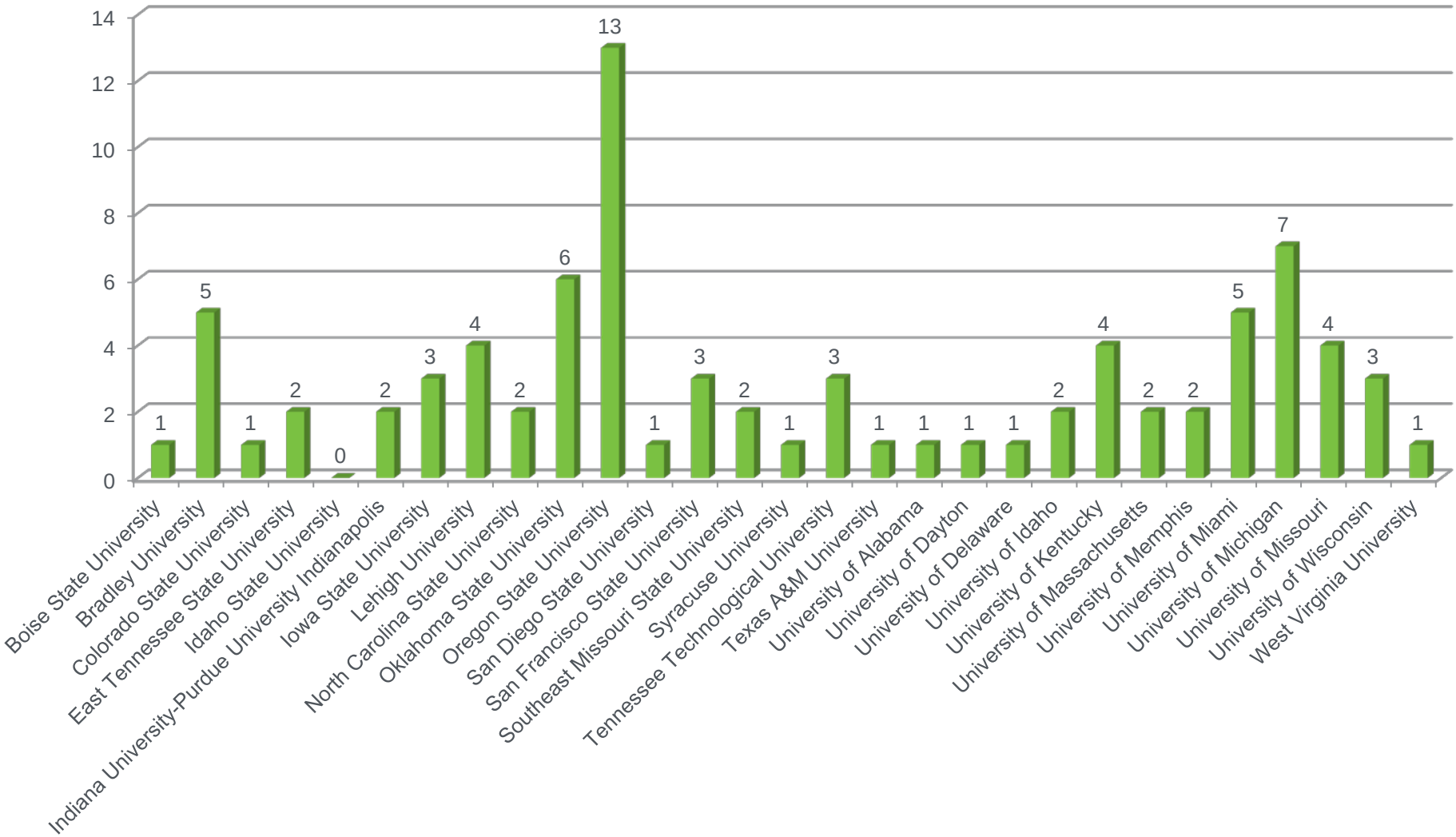
Number of Students Currently Listed as Active in the IAC Student Registry



Student Registry and Exit Interviews

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

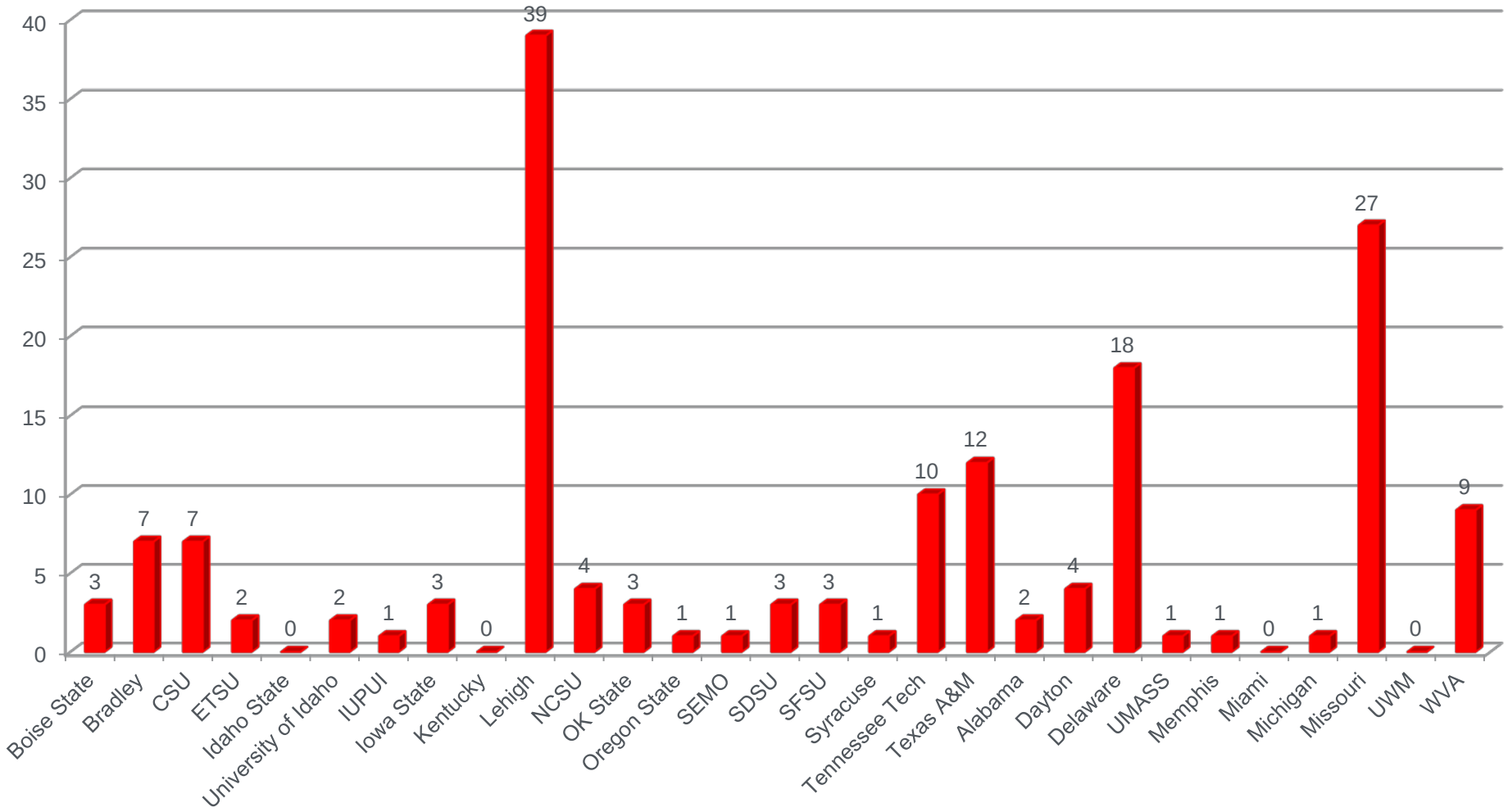
Number of Currently Active Students Listed as "Lead Student"



Student Registry and Exit Interviews

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Number of Students Completing Exit Interviews or Being Deactivated in FY 15



Student Certificates

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- On-line requests are processed through the certificates link on www.iacforum.org
- **Students and alumni must be in the IAC registry to receive certificates**
- Deadlines occur 3 times per year:
  - October 1, March 1, and July 1
- Certificate process
  - Student initiates request online,
  - Director/AD receives email notification with link
  - He/she completes the request online
  - Certificates arrive
- Certificates <u>are mailed to the Directors</u> within 30 days of deadline
- Applications for the October 2015 round of IAC Certificates are now being accepted

Certificate of Participation
presented to
Name
For the completion of requirements mandated by the
U.S. Department of Energy's
Industrial Assessment Center Program at
Texas A & M University

WEEC September 30-October 2

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- **We will Meet on Wednesday for IAC Discussions and a Presentation from IAC Alumni and Past AEE President, Dr. Eric Woodroof, Ph.D.**

IOWA STATE UNIVERSITY
Kaustubh Gosavi
Maria Blanek

UNIVERSITY OF Miami
Ahmed Abdulaal
Jaime Buitrago
Patricia Gomez

SYRACUSE UNIVERSITY
John Battistelli
Jillian Burgoyne
Mark Seibel

Amir Abolhassani

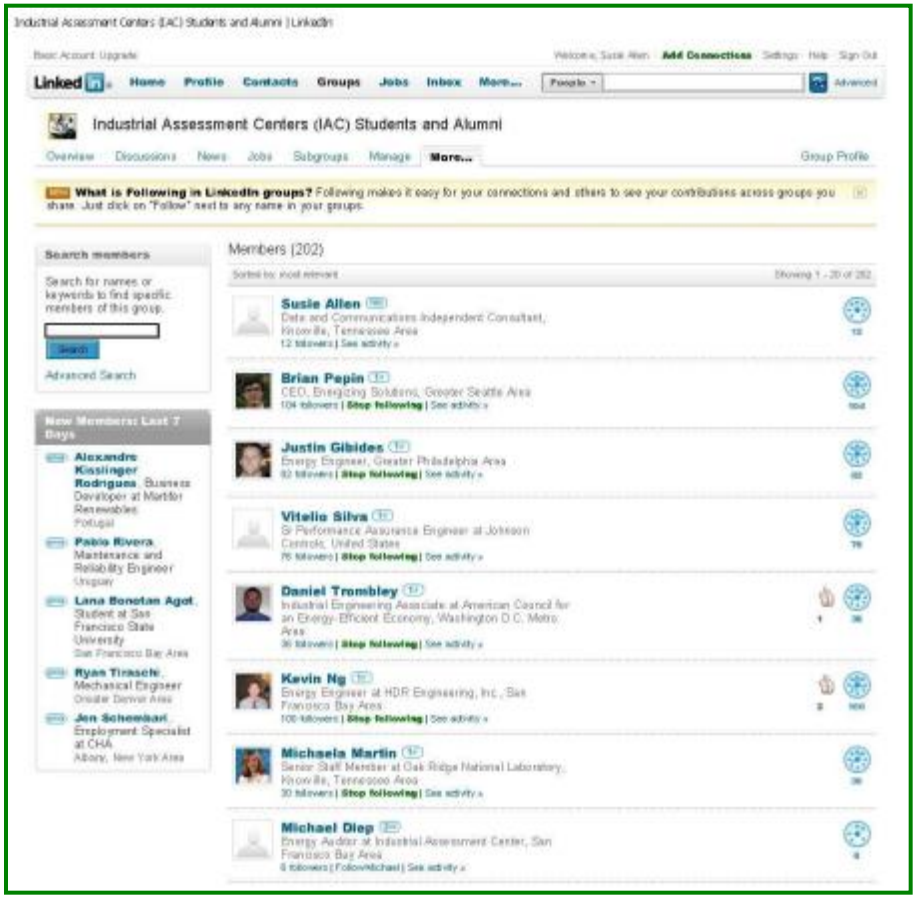
UWM UNIVERSITY of WISCONSIN MILWAUKEE
Tonghui Li
Junling Xie
Thomas Aminga Omwando

IUPUI
Abdul hadi Ayoub
John Flowers

LinkedIn IAC Group

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

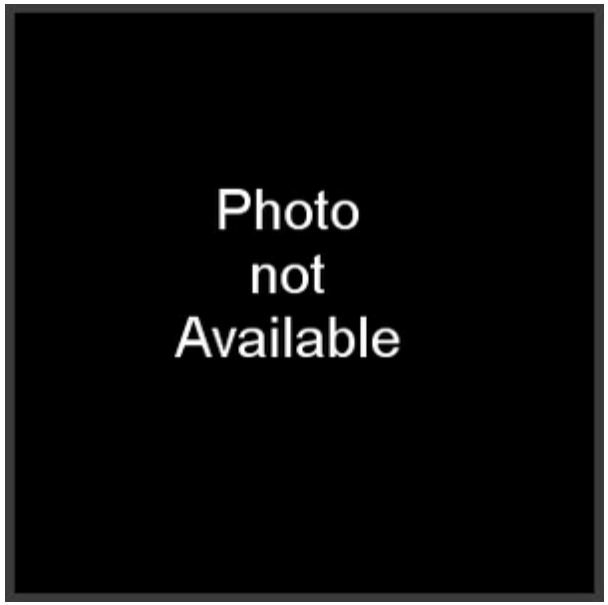
- Established in 2008
- Professional networking site for IAC students and alumni
- 560+ members
- News items, professional profiles, discussions
- **Please utilize for ongoing collaboration or technical questions**



https://www.linkedin.com/grp/home?gid=912947

NEW Facebook IAC Group

Request: Pictures, Video Clips, Articles & Stories



Please send to:
wenningtj@ornl.gov

Thank You!

Thomas Wenning, PE

IAC Student Activities Coordinator

Oak Ridge National Laboratory

865-946-1504, wenningtj@ornl.gov