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

Overview of Advanced Manufacturing Office

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Advanced Manufacturing Office

manufacturing.energy.gov

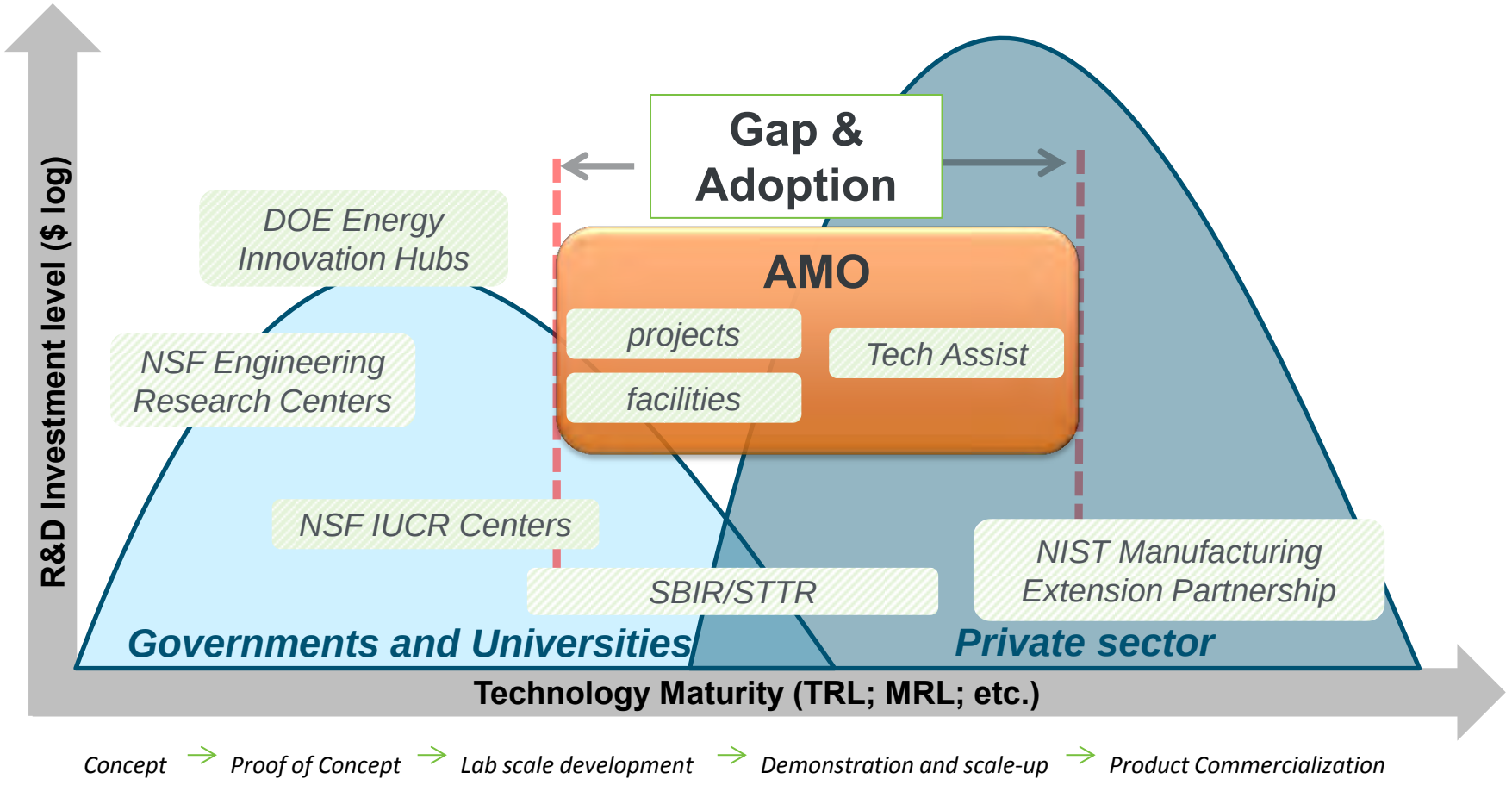
Advanced Manufacturing Office (AMO): Focus

AMO's Focus is to Increase U.S. Manufacturing Competitiveness through:

- Industrial Efficiency for Energy Intensive Industries
  - *examples: Aluminum, Chemicals, Metal Casting, Steel*
- Manufacturing Innovations for Advanced Technologies
  - *examples: carbon fiber composites, advanced structural metals, wide bandgap semiconductors/ power electronics*
- Broadly Applicable Industrial Efficiency Technologies:
  - *examples: industrial motors, combined heat and power (CHP), efficient separations*
- Technical Assistance to American Manufacturers:
  - *examples: Better Plants, Superior Energy Performance, Industrial Assessment Centers, CHP TAPs*

AMO R&D: Bridging the Gap

AMO Investments leverage strong Federal support of basic research by partnering with the private sector to accelerate commercialization

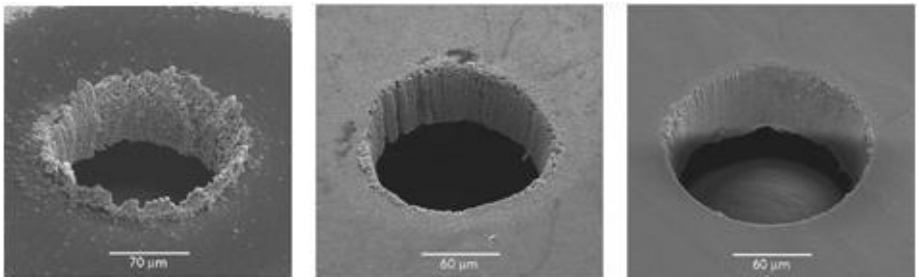


Partnership Driven

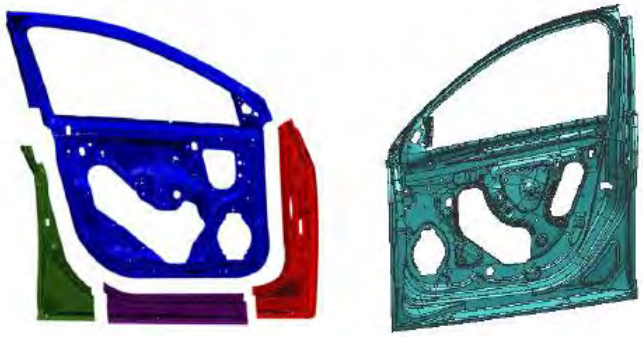
Three primary partnership-based vehicles to engage with industry, academia, national laboratories, and local and federal governments:

1. **Research and Development Projects - to support innovative manufacturing processes and next-generation materials**
2. Shared R&D Facilities
3. Technical Assistance

R&D Projects – Manufacturing Processes

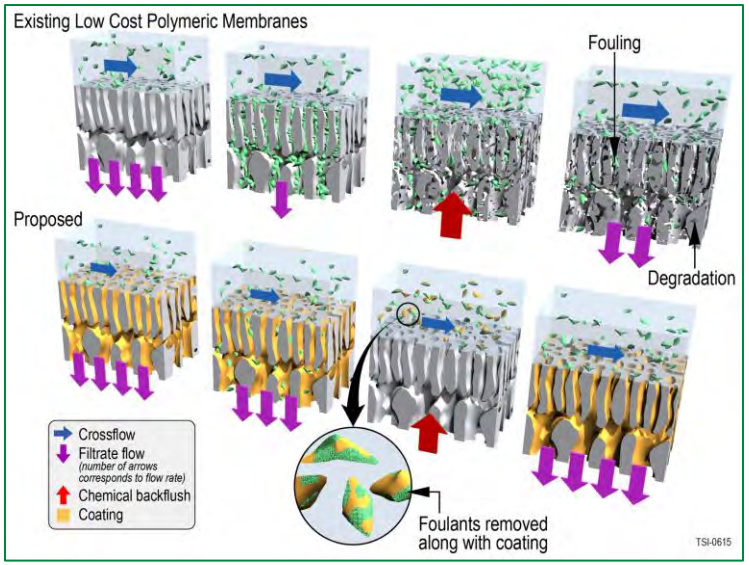


Ultrafast, femtosecond pulse lasers (right) will eliminate machining defects in fuel injectors.
Image courtesy of Raydiance.



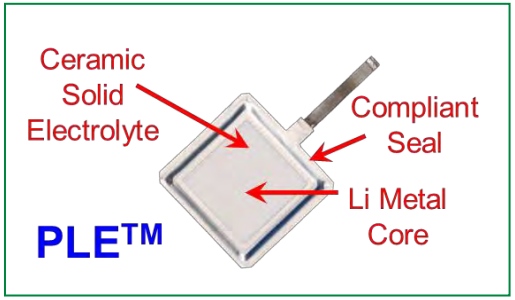
Energy-efficient large thin-walled magnesium die casting, for 60% lighter car doors.

Graphic image provided by General Motors.

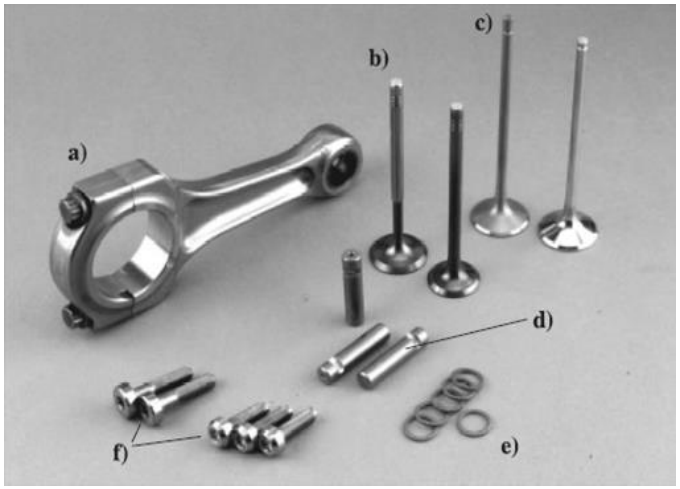


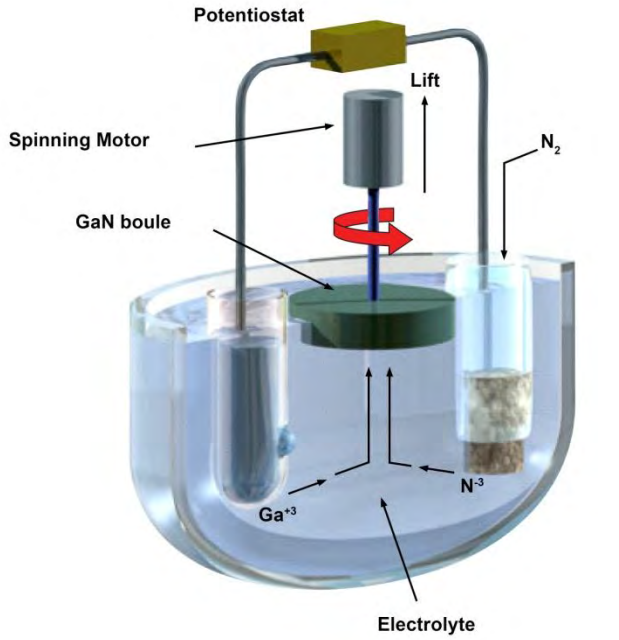
Protective coating materials for high-performance membranes, for pulp and paper industry.
Image courtesy of Teledyne

A water-stable protected lithium electrode.
Courtesy of PolyPlus



R&D Projects – Materials





1) Low-cost production process for titanium alloy components.

Photo courtesy Titanium and Titanium Alloys , Leyens & Peters

2) Pre-market-scale Carbon Fiber Technology Facility.

Photo courtesy of Oak Ridge National Laboratory

3) Electrochemical solution growth of GaN substrates (conceptual diagram).

Image courtesy of Sandia National Laboratory

Partnership Driven

Three primary partnership-based vehicles to engage with industry, academia, national laboratories, and local and federal governments:

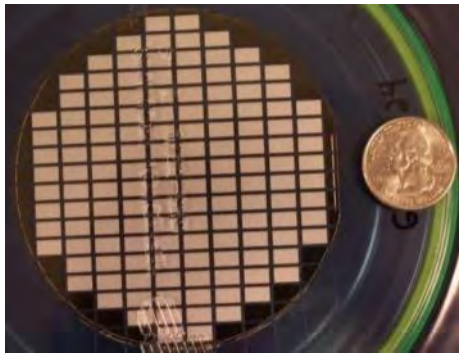
1. Research and Development Projects

2. **Shared R&D Facilities - affordable access to physical and virtual tools, and expertise, to foster innovation and adoption of promising technologies**

3. Technical Assistance

AMO-Supported R&D Facilities

1. Critical Materials Institute: a DOE Energy Innovation Hub at Ames National Lab
2. Oak Ridge National Lab - Manufacturing Demonstration Facility
3. Next Generation Power Electronics Innovation Institute led by North Carolina State University
4. America Makes, an interagency National Additive Manufacturing Innovation Institute
5. Funding Opportunity Announcement: Advanced Composites Manufacturing Innovation Institute



Wide bandgap semiconductors are smaller, lighter, faster, and more reliable power electronic components for more efficient conversion, distribution, and use of electric power.

Oak Ridge National Lab Manufacturing Demonstration Facility

Supercomputing Capabilities

Spallation Neutron Source

Additive Manufacturing

Arcam electron beam processing AM equipment

POM laser processing AM equipment

Program goal is to accelerate the manufacturing capability of a multitude of AM technologies utilizing various materials from metals to polymers to composites.

Carbon Fiber

Exit end of Microwave Assisted Plasma (MAP) process, jointly developed by ORNL and Dow

Program goal is to reduce the cost of carbon fiber composites by improved manufacturing techniques such as MAP, which if scaled successfully could reduce carbonization cost by about half compared to conventional methodology.

Partnership Driven

Three primary partnership-based vehicles to engage with industry, academia, national laboratories, and local and federal governments:

1. Research and Development Projects
2. Shared R&D Facilities
3. **Technical Assistance – driving a corporate culture of continuous improvement and wide scale adoption of technologies, such as combined heat and power, to reduce energy use in the industrial sector**

Better Plants Program

- Voluntary pledge to reduce energy intensity by 25% over ten years over all facilities
- Over 120 Program Partners, over 1,750 plants, ~8% of the total U.S. manufacturing energy footprint
- Partners implement cost-effective energy efficiency improvements that:
  - Save money
  - Create jobs
  - Promote energy security
  - Strengthen U.S. manufacturing competitiveness

Better Plants
U.S. DEPARTMENT OF ENERGY

- **Through the Better Plants Program, companies receive national recognition and technical support from DOE**

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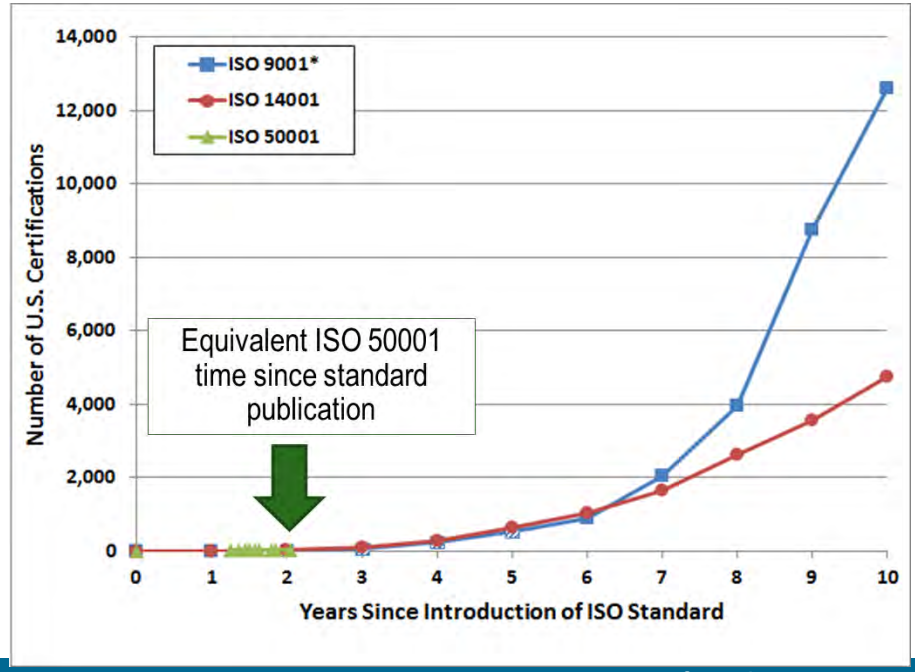
Superior Energy Performance (SEP)

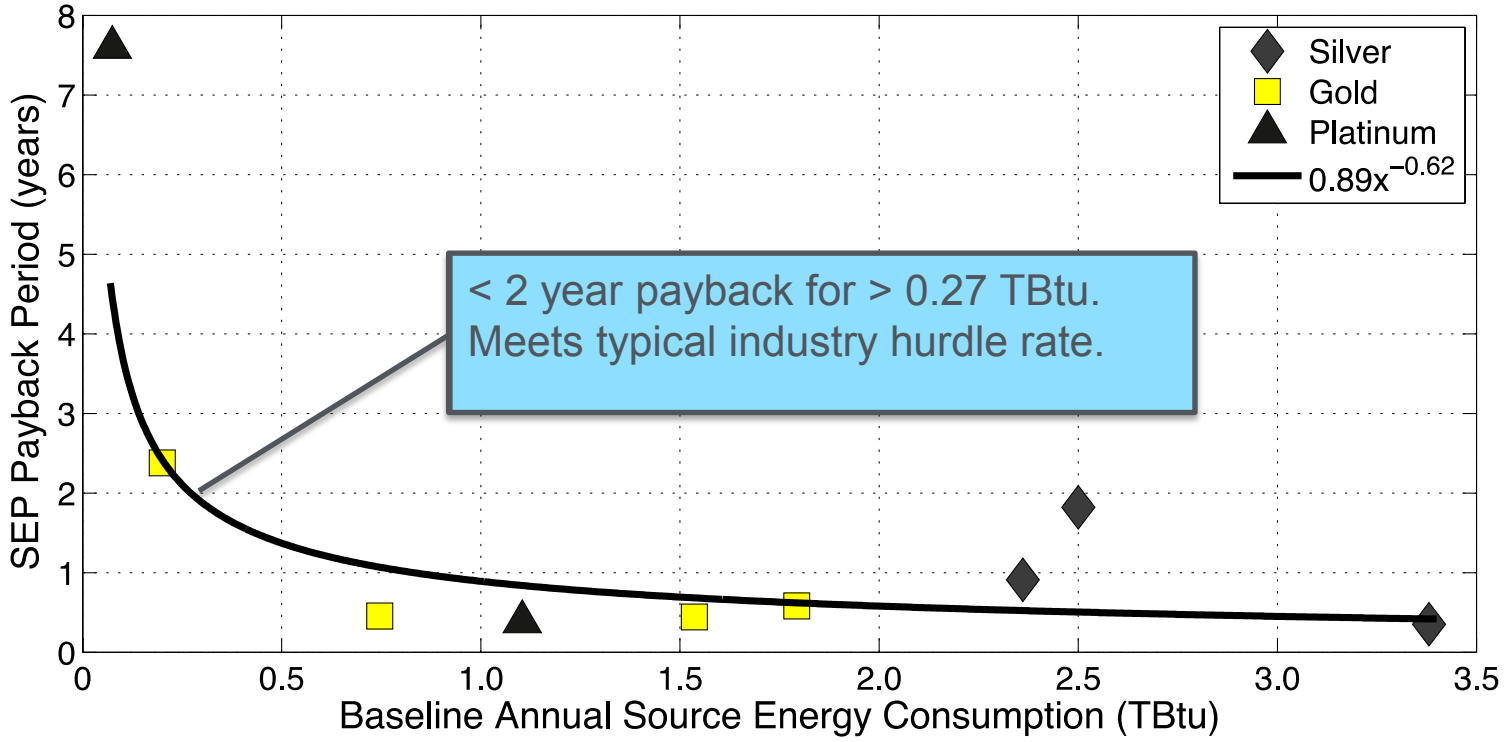
- Builds off of ISO 50001, an energy management standard
- ANSI/ANAB-accredited certification program
- Verifies energy performance improvement for overall facility (systems based)
- Findings: 15 SEP certified plants have improved their energy performance between 6 and 25% over a three year period.



SEP Payback (actual data)

$$\frac{\text{Costs}}{\text{Benefits}} = \frac{\text{EnMS and SEP Implementation Costs}}{\text{Operational Energy Savings (attributable to SEP in SEP reporting period)}}$$

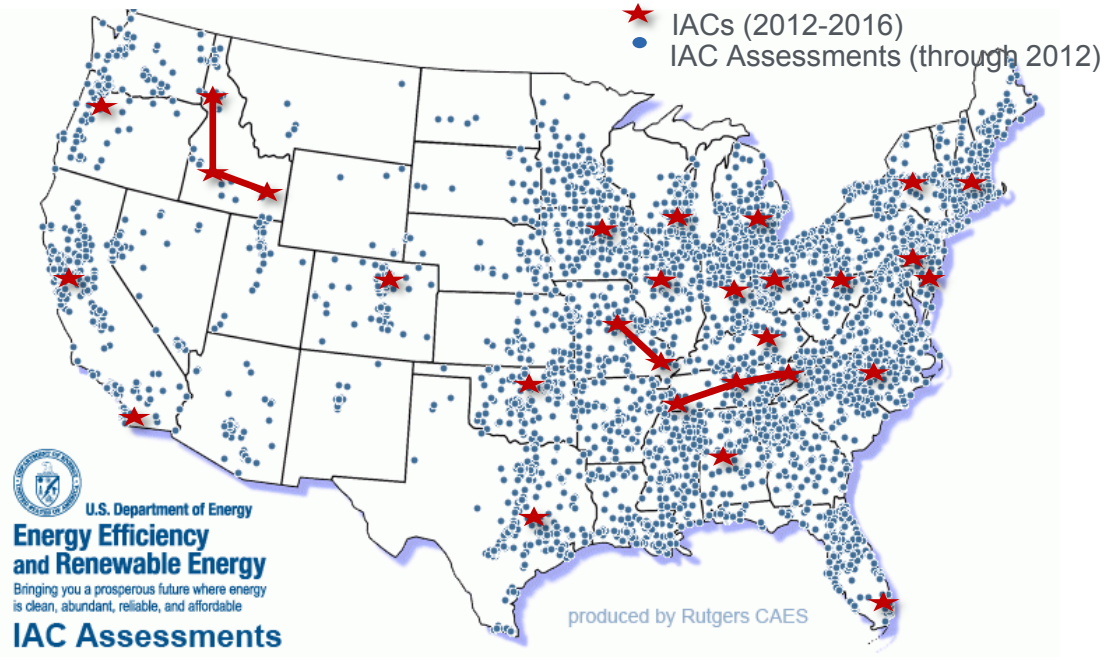
- Capital energy performance improvement action costs and savings not included.



- SEP certification payback related to baseline energy consumption.
- < 2 year payback for facility with > 0.27 TBtu baseline annual source energy consumption.

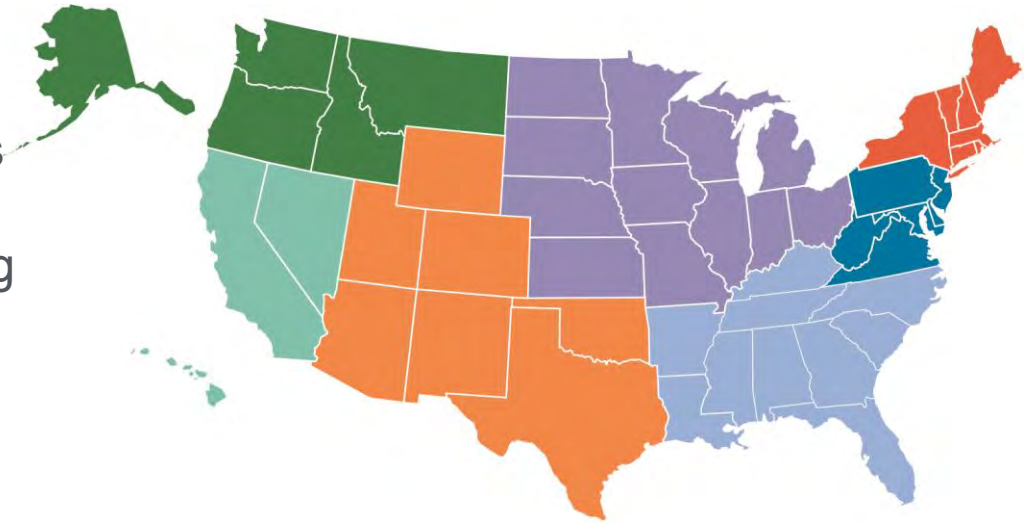
Industrial Assessment Centers (IACs)

- Targets small and medium sized manufacturers (& institutional)
- 60% of IAC graduates go on to careers in the energy industry
- Process is assessment and 1 year follow up
  - 40% implementation rate of suggestions
- On average, an IAC client will save more than $46,000 in energy and process improvements



CHP Technical Assistance Partnerships

- **Market Opportunity Analysis:** Analyses of CHP market opportunities in industrial, federal, institutional, and commercial sectors
- **Education and Outreach:** Providing information on the energy and non-energy benefits and applications of CHP
- **Technical Assistance:** Providing technical assistance to end-users through the project development process from initial CHP screening to installation



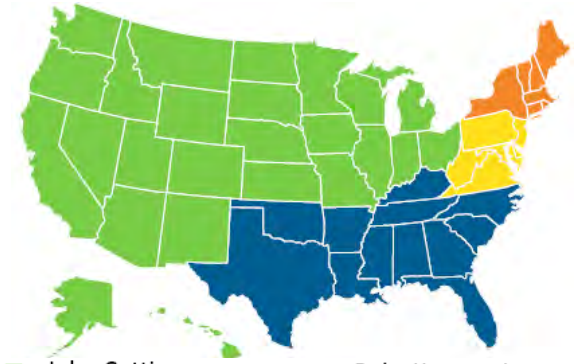
www1.eere.energy.gov/manufacturing/distributedenergy/chptaps.html//

Other DOE CHP & Boiler Resources

DOE Boiler MACT Technical Assistance

- DOE is providing site-specific technical and cost information on clean energy compliance strategies to those major source facilities affected by the Boiler MACT rule currently burning coal or oil.
  - These facilities may have opportunities to develop compliance strategies, such as CHP, that are cleaner, more energy efficient, and that can have a positive economic return for the plant over time

- DOE Boiler MACT Technical Assistance program was piloted in Ohio starting in Feb. 2012 and is being offered nationally



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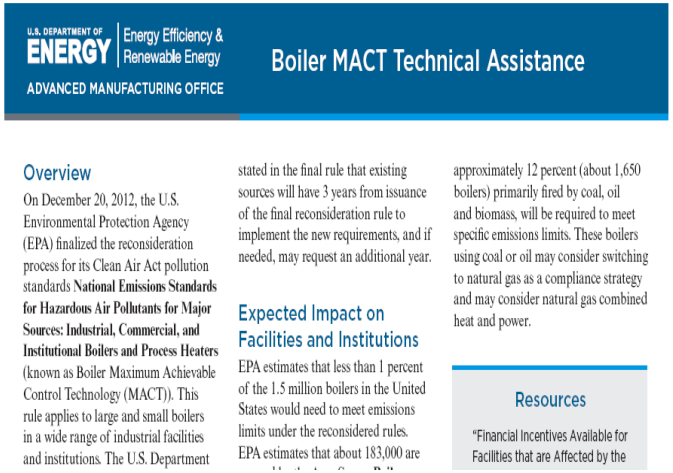

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ADVANCED MANUFACTURING OFFICE

Boiler MACT Technical Assistance

Overview

On December 20, 2012, the U.S. Environmental Protection Agency (EPA) finalized the reconsideration process for its Clean Air Act pollution standards **National Emissions Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters** (known as Boiler Maximum Achievable Control Technology (MACT)). This rule applies to large and small boilers in a wide range of industrial facilities and institutions. The U.S. Department stated in the final rule that existing sources will have 3 years from issuance of the final reconsideration rule to implement the new requirements, and if needed, may request an additional year.

Expected Impact on Facilities and Institutions

EPA estimates that less than 1 percent of the 1.5 million boilers in the United States would need to meet emissions limits under the reconsidered rules. EPA estimates that about 183,000 are approximately 12 percent (about 1,650 boilers) primarily fired by coal, oil and biomass, will be required to meet specific emissions limits. These boilers using coal or oil may consider switching to natural gas as a compliance strategy and may consider natural gas combined heat and power.

Resources

"Financial Incentives Available for Facilities that are Affected by the

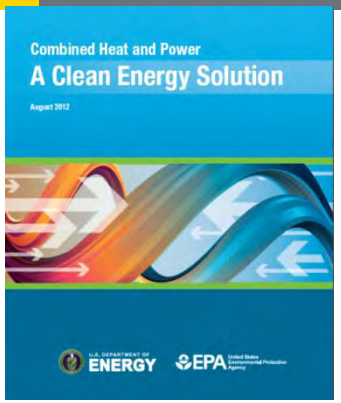
Results: National Technical Assistance

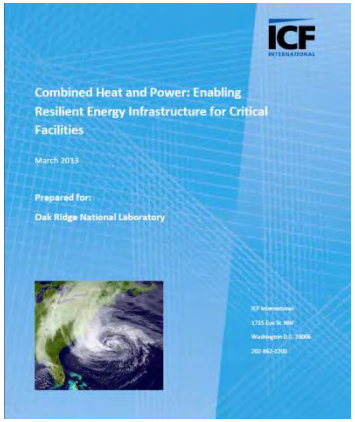
- Preliminary Findings Reported (as of September 10, 2013):
  - Over 482 companies contacted
  - 197 feel they are already in compliance
  - 67 no longer in business
  - Technical Assistance for 61 in various stages (discussions underway or analyses considering CHP)
  - All companies are now aware of how CHP can assist in a compliance strategy
  - DOE will continue to track results of results of technical assistance

Recent CHP Reports

CHP: A Clean Energy Solution, August, 2012

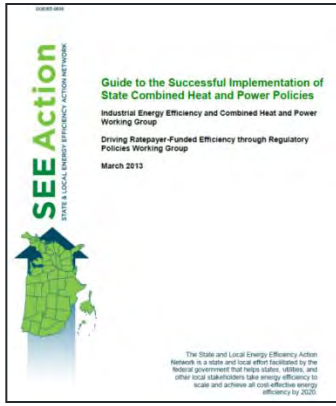
Provides a foundation for national discussions on effective ways to reach the 40 GW target, and includes an overview of the key issues currently impacting CHP deployment and the factors that need to be considered by stakeholders participating in the dialogue.





CHP: Enabling Resilient Energy Infrastructure for Critical Facilities, March 2013

This report summarizes how critical infrastructure facilities with CHP systems operated during Superstorm Sandy. Several examples from other storms and blackout events in other regions of the country are also included. The report provides information on the design and use of CHP for reliability purposes, as well as state and local policies designed to promote CHP in critical infrastructure applications.



Guide to the Successful Implementation of State CHP Policies, March 2013

Informs state utility regulators and other state policymakers with actionable information to assist them in implementing key state policies that impact CHP.

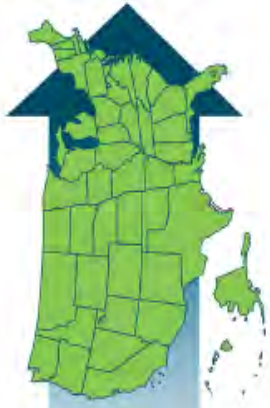
- Design of standby rates
- Interconnection standards for CHP with no electricity export
- Excess power sales
- Clean energy portfolio standards (CEPS)
- Emerging market opportunities—CHP in critical infrastructure and utility participation in CHP markets

The Guide provides state policy makers with actionable information regarding:

- Design of standby rates
- Interconnection standards for CHP with no electricity export
- Excess power sales
- Clean energy portfolio standards
- Emerging market opportunities: CHP in critical infrastructure and utility participation in CHP markets

In development: State workshops w/ PUCs on the Guide & how to refine policy implementation to achieve greater CHP.

SEE Action
STATE & LOCAL ENERGY EFFICIENCY ACTION NETWORK



Guide to the Successful Implementation of State Combined Heat and Power Policies

Industrial Energy Efficiency and Combined Heat and Power Working Group

Driving Ratepayer-Funded Efficiency through Regulatory Policies Working Group

March 2013

The State and Local Energy Efficiency Action Network is a state and local effort facilitated by the federal government that helps states, utilities, and other local stakeholders take energy efficiency to scale and achieve all cost-effective energy efficiency by 2020.

Learn more at www.seeaction.energy.gov