WORKING FOR

INDUSTRIAL ENERGY EFFICIENCY

From refineries and the petrochemical industry to the paper and pulp industry, energy is one of the most important cost factors in U.S. industry. By making strides in industrial energy efficiency, U.S. industry will become more globally competitive, by lowering current energy costs and protecting against future volatility, but will also create and retain good jobs for America and reduce its carbon footprint.

National and state policymakers—along with industrial and labor leaders—are increasingly concerned about the volatility of America's energy supply, and its implications for future economic growth, environmental health and national security. Though most public debate is over the right mix of energy sources, awareness is growing that the some of the greatest gains can be achieved by reducing the amount of energy required to make and do things. Workers and labor unions can benefit from and play a key role with other stakeholders in making energy savings—that is, increase the energy efficiency of their plants and workplaces.

THE INDUSTRIAL SECTOR

uses **one-third of America's energy** | **produces 28% of its of carbon emissions.**

Energy costs not only affect them as consumers, but also as workers. It is in the workers and their employers' interest to transform America's industrial sector to be more energy efficient and more competitive globally. By reducing energy costs, manufacturers add to their bottom lines, retain and or create jobs, reduce their carbon footprints, and become more globally competitive.

working FOR America
AFL-CIO INSTITUTE

Why does industrial energy efficiency matter to labor unions and workers?

Improving energy efficiency in industry can help manufacturers retain, restore and create jobs. Efficient businesses are more competitive and therefore more able to reduce costs without shedding jobs and many may expand their operations and hire more workers. Energy-intensive manufacturers that face strong foreign competitors will be less likely to cut back or offshore operations to remain in business— and many may be incentivized to return manufacturing capacity to the United States.

14% reduction

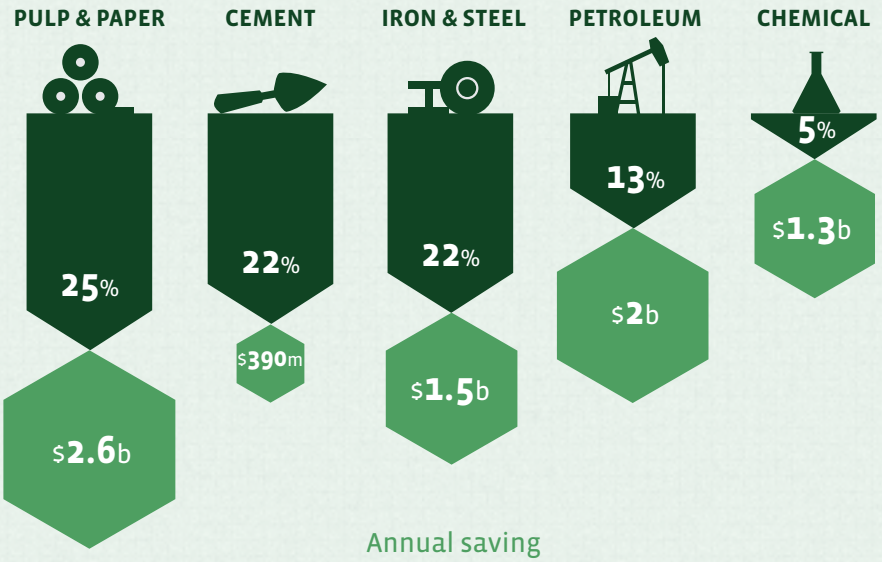
McKinsey estimates that the U.S. industrial sector can reduce their energy use by **18% by 2020** and save more than **$442 billion.**

600,000 new jobs in the United States

According to an **Oak Ridge National Laboratory** study, doubling the use of energy efficient technologies by 2020 could increase industry investments by **$140 billion** and add an **estimated 600,000 jobs in the United States.**

The potential gains from building, supplying and installing energy efficient technologies and processes in manufacturing are significant.

Reduction in energy use by 2020



Annual saving

23% of **BTUs projected demand saved** or **9.1 quadrillion BTUs**

The equivalent of taking the entire US fleet of passenger vehicles and light trucks off the roads.

- There potentially are many jobs in industries that supply products and services used in making and installing energy efficiency improvements in industrial plants. Larger manufacturers can also spur gains in their regular upstream supply-chains by setting standards and requiring their suppliers to adopt energy efficiency measures.

- Correspondingly, when small and medium-sized suppliers improve their energy efficiency, they also lower their energy-related costs and carbon footprints—and therefore add to the competitiveness—of their larger customers.

- Energy efficiency gains not only lower production costs, they reduce manufacturers' reliance on external sources of electricity and other fuels, such as natural gas and fossil fuels whose supplies and prices can be volatile.

- New positions have been created and job skills have been upgraded in industries where companies engage employees in identifying and implementing energy efficiency improvements.

Industrial unions and manufacturing workers have a stake in supporting employer efforts to increase their energy efficiency and cut energy costs. Towards this end, it is helpful for workers to understand how energy is used, the potential for saving energy in their workplaces, the barriers and challenges for making gains, and how they can help their employers overcome these obstacles.

The AFL-CIO Working for America Institute and its Center for Green Jobs recently launched Working for Energy Efficiency Initiative works with affiliate unions and union members to increase awareness and advocacy on energy efficiency measures in the Industrial, Educational, and Construction sectors.

How is energy used in manufacturing?

Heat and power for production processes

Heat and power for production processes, including process heating (kilns, ovens, furnaces, strip heaters), process cooling and refrigeration, electro-chemical processes (reduction process), motor-driven systems (pumps, fans, compressed air, materials handling, and materials processing equipment), and other processes.

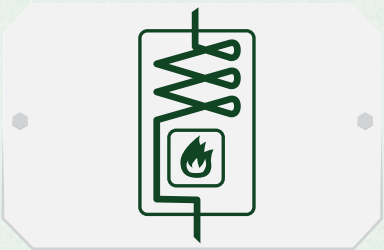
Raw materials

Raw materials (feedstock) in some industries, such as steel making and petrochemicals, used in the production of end products.

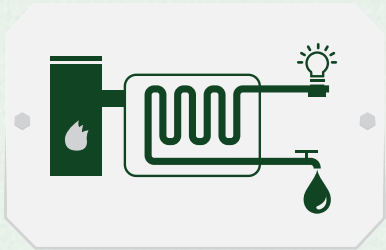
Non-process uses

Non-process uses, such as facility heating, ventilation, and air conditioning (HVAC) systems, lighting, other facility support (cooking, water heating, office equipment), onsite transportation, and other non-process applications.

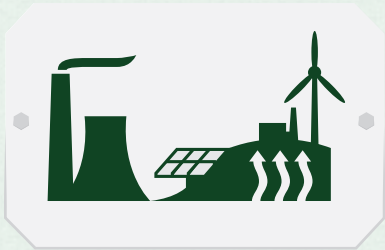
Energy use varies greatly across manufacturing industries, processes, and plants. Generally, most energy used by manufacturers is either purchased (and/or transferred from) offsite, i.e., outside industrial plant boundaries—including fuels (natural gas, coal, residual and distillate fuel oils, natural gas liquids (NGL) and liquefied petroleum gas (LPG)), electricity, and steam—or generated onsite. Onsite generation of steam or electricity within plant boundaries using purchased fuel or electricity includes:



Conventional boilers to produce steam.



Combined heat and power (CHP)/ cogeneration to produce steam and/or electricity.



Electricity generated onsite by generators burning fuels (natural gas, fuel oils, and coal) and/or by renewable sources including solar, wind, hydropower, and geothermal.

How can energy savings be made in manufacturing?

Energy is lost either mechanically or as waste heat in industrial processes. The amount of energy use and losses depend on the design, ages, and operating and maintenance practices of production equipment and the physical and chemical attributes of processes. Energy efficiency measures therefore must be tailored to the specific requirements of industries and plants.

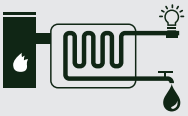
Sources of these losses include:

Inefficient equipment (motors, mechanical drive) and leaks in the use of all kinds of equipment (such as, air compressor systems and boilers).

Onsite energy generation (in boilers and electricity generation) losses and energy distribution losses (in pipes, valves, steam traps, and electrical transmission lines).

Process energy losses in the form of waste heat, flared gases, and energy by-products.

Major kinds of industrial energy efficiency improvements include:



Waste heat recovery and combined heat and power (CHP) systems (also known as cogeneration). The former entails extracting useful energy from waste gas streams released by industrial processes, used to generate additional electric power or used in other heat processes and feeding it back into the process or diverting it for other uses in the facility. CHP is a form of energy recycling, which employs the heat byproduct of electric generation units to provide heat used in other processes in a plant.

Low-hanging" efficiency gains in common energy systems used across industries, such as steam generators, onsite power systems, fired heaters, heat exchangers, compressors, motors, pumps, and the like, and in most manufacturing facilities (HVAC, lighting). The largest potential for efficiency gains comes from replacing older motors with newer, more efficient equipment and improving systems operation and maintenance.

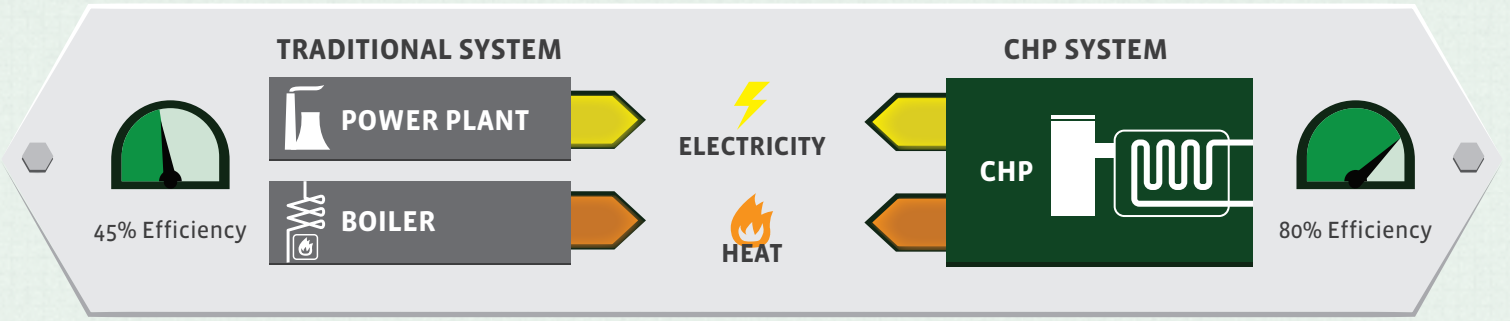
Industry-specific process efficiency measures, which can include retrofitting or replacement of existing process equipment, such as introducing lower-carbon steel making processes and improved separation efficiency in distillation process in petroleum refineries.

Recycling of waste material or recovered scrap plays an increasingly important role in reducing energy and carbon emissions in several energy-intensive manufacturing industries, such as steel, aluminum, paper, and glass manufacturing.

CHP and Waste Heat Recovery

Combined heat and power (CHP) has been used for over 100 years. CHP actually is a suite of technologies, which use a variety of fuels (e.g., natural gas, fuel oils, biomass, landfill gas) to provide electricity, mechanical power or thermal energy. CHP systems recover waste heat—normally wasted or vented in the air—to generate electricity, and recycles it for use in water heating, space heating, or industrial processes. CHP is used in a wide-range of settings, including industrial, large commercial and institutional facilities, among others. It is in every state, generating **85 gigawatts (GW)** of capacity annually, or nearly **9 percent of the nation's electricity.**

CHP has been attracting a great deal of recent attention because of its significant energy-savings potential—greater than most other energy efficiency technologies. Although typical fuel-burning electric generators are only 30-45 percent efficient, CHP systems can be 50 to 80 percent efficient. **Installations that consume large amounts of electricity and natural gas can double energy efficiency and cut energy costs by up to half.**



Many CHP technologies are available today. According to an Oak Ridge National Laboratory study, as much as 85 GW of new CHP capacity could be cost-effectively added over the next 10 years. In September, 2012, President Obama issued an Executive Order that sets a goal of 40 GW of new CHP capacity by 2020, nearly a 50% increase in capacity from the over 82 GW in operation today. **A doubling of CHP by 2020 would reduce annual U.S. energy consumption by 3 percent—avoiding the need to build more than 200 midsize power plants.** The U.S. Department of Energy's (DOE) Advanced Manufacturing Office (AMO) estimates that if CHP's share of total U.S. electricity generation capacity increases to 20 percent by 2030, the United States would see large reductions in both annual energy consumption and CO_2 emissions—the equivalent of taking **154 million cars off the road or saving 189 million acres of forests.**

1 Million new jobs in the United States

AMO claims that a 20% increase by 2030 in CHP's electricity generation share, the US could leverage **$234 billion of new private investments and create 1 million new jobs.**

Which industries benefit the most?

Energy can account for over 20% of a manufacturer's production costs, almost all companies and industries, large and small, can benefit from improving their energy efficiency and reducing energy use. Iron and steel mills, chemicals manufacturing (especially petrochemicals, alkalis and chlorine, and nitrogenous fertilizers), paper and paperboard mills, cement, petroleum refining, aluminum smelting, and food processing, among others, are the nation's largest industrial consumers of energy. Since they primarily rely on fossil fuels for heat, power and feedstock, they also are among the largest emitters of greenhouse gases. Even non-energy-intensive manufacturers can gain from reducing their energy use and carbon footprints—and many have made strides in this area. Assembly and fabrication industries such as transportation equipment, machinery, and fabricated metal products, among others, in particular, include internal operations that are heavy users of electricity and energy fuels, such as auto paint, parts stamping, metal forging and casting shops.

Successful Company Examples

There are many examples of U.S. manufacturers, often fueled by efforts of their workers, investing in energy efficiency projects that result in significant energy savings, reduced energy costs, job creation and retention, and strengthened local economies. A small sample of notable successes:

Flambeau River Papers

This century-old **paper mill** in **Park Falls, WI**, has increased production by 11.9%, retained 300 jobs and added an additional 55 jobs by improving its energy efficiency and shifting its fuel source to a wood-based biomass, and saved $105 million. With public and private sector assistance, and drawing on input from its workforce, the mill improved its efficiency through the purchase, installation and use of variable frequency drives, new pumps, lighting upgrades, and process improvements in the plant's steam systems, and heat recovery systems.

Dow Chemical

- Saved annually **$1.8 million**

By improving the efficiency of its steam system at its **Hahnville, LA petrochemical plant**, Dow Chemical has been saving $1.9 million annually. The $225,000 in improvements paid for itself in just 6 weeks.

ArcelorMittal

With a $31.6 million Recovery Act grant from the Department of Energy, the largest **steelmaking facility** in North America, ArcelorMittal's Indian Harbor plant in **East Chicago, IN**, has saved more than $100 million by installing CHP systems to capture waste heat.

Union: United Steelworkers (USW)

Proctor & Gamble

- Saved annually **$309,000**

By improving the compressed air system at its **paper products mill** in **Mehoopany, PA**, Proctor & Gamble started saving $309,000 annually. The initial investment paid for itself in 21 months.

Union: United Steelworkers (USW)

Madison Paper Industries

- Saved **$2 million**

This 240-employee **paper mill** in **Madison, ME** will save over $2 million in energy costs by white water heat recovery system, replacing No. 6 fuel oil to create steam, and installing more efficient grinding stones used to make pulp for making paper. The efficiency measures also helped retain several jobs at the mill and strengthen the area's economic stability.

Union: United Steelworkers (USW)

Lehigh Southwest Cement Company

- Saved annually **$199,000**

By improving the efficiency of their compressed air system at its **Tehachapi, CA cement plant**, the Lehigh Southwest Cement Company utilized incentives from Southern California Edison to save $199,000 ann.

CHP Examples

Lorin Industries

3.2 MW natural gas CHP system

Since the 1990s, this **metal finisher and anodized aluminum manufacturer** in **Muskegon, MI** has used a 3.2 MW natural gas CHP system, which supplies up to 50% of the plant's electricity demands and up to 90% of its steam needs, saving the company $540,000 annually.

Broshco Fabricated Products

4.55 MW natural gas CHP system

In 2000, Broshco Fabricated Products, a **automobile seat frame manufacturer** in **Mansfield, OH**, installed a 4.55 MW CHP system that generates electricity and hot water to supplement building and process heat loads.

Seaman Paper

238 kW biomass CHP system

Seaman Paper, a **producer of tissue papers** in **Otter River, MA**, uses a biomass CHP system to displace internal electricity load. The system, comprised of a turbosteam generation set and biomass boiler, has yielded over $1.5 million in yearly savings and significantly reduced the following greenhouse gas emissions: NOx emissions by 30% and SO2 emissions by 95%.

Union: United Steelworkers (USW)

Mississippi Chemical Corporation

20 MW natural gas CHP system

In the early 1980s, the **chemical manufacturer**, in **Yazoo, MS** installed a 20 MW CHP plant that includes a gas turbine generator and waste recovery boiler. Workforce training and involvement played a valuable role in this energy efficiency initiative that saved the company over $5.6 million yearly.

Why don't more manufacturers invest in industrial energy efficiency?

Most manufacturers have an interest in cutting their energy use, if they can do it cost-effectively. Unfortunately, they face a number of obstacles in making the "business case" for making investments in industrial energy efficiency, and achieving the savings that are possible.

Lack of information

Internal barriers refer to factors in the operation of manufacturing plants that make it difficult for managers to identify, plan, design and justify investments in energy savings. These range from managers' **lack of information and awareness** about efficiency options and benefits and high financial "**hurdle rates**" and rapid payback requirements to justify energy-related, as opposed to production-related, investments, to **capital budget constraints**, **high transaction costs**, and a **lack of internal technical expertise** and an **adequately trained workforce**.

Availablity of capital

External technical and economic barriers include the **availability of capital**, which is the largest single concern of managers and the **availability of new technologies**, **processes and products** that can be help reduce energy use and carbon emissions.

In-house expertise

Small and mid-sized manufacturers, in particular, often lack sufficient in-house expertise, resources, and time to even assess the potential benefits of industrial energy efficiency, much less invest in and implement energy saving measures.

How can workers help manufacturers achieve energy savings?

Although managers and engineers traditionally have been responsible for overseeing energy efficiency efforts, frontline workers can play a key role in helping their companies achieve significant energy savings. There are new initiatives that provide workers with the skills and actively engage them in helping employers achieve industrial energy efficiency goals.

Working training, skill standards and employee involvement programs can greatly help employers carry out cost-effective energy efficiency programs in their plants. Additionally, workers can take initiative in identifying energy savings by conducting energy audits, encouraging their employers to conduct energy audits. And, finally by working with their employers to develop and implement energy management plans at their plants.

Workers leading the way to energy efficiency

Two innovative projects, both involving the leadership of **IUE-CWA**, a labor union with **45,000 members** at over **300 manufacturing plants** across the United States, includes one that provides training and skill standards certification in "green skills," including skills relating to assessing and implementing IEE opportunities, and a "Treasure Hunt" project, involving plant workers and their union in assessing IEE opportunities at several manufacturing plants.

Manufacturing Skill Standards Council Green Production Module (GPM)

The **IUE-CWA**, partnered with the **Manufacturing Skill Standards Council (MSSC)** and the AFL-CIO Working for America Institute to develop and deliver a **Green Manufacturing Skill Training Certification** training program to address the need for emerging job skill training in "green skills"—environmental compliance and energy-efficiency—for production workers, with a specific focus to enhance the green-related skills of the production workforce in all manufacturing industries, in order to help manufacturers improve their energy and environmental performance. Like the MSSC's other **four skill modules, the GPM is based on industry-defined nationally validated standards and includes curriculum, text, e-learning, instructor certification training, assessments, registration, and credentialing.** The credential will be an industry-recognized, nationally portable MSSC certificate.

Energy-Efficiency Treasure Hunts

IUE-CWA and the **Environmental Defense Fund (EDF)** partnered in a project to train and involve IUE-CWA members in identifying energy efficiency opportunities that improve the competitiveness of manufacturing facilities, save companies money, hedge against higher energy prices, and improve environmental performance. The **"Treasure Hunts"** utilize cross-functional teams comprised of site employees and external experts to assess a facility's energy and natural resource consumption. They then identify, quantify, and recommend projects to maximize efficiency and minimize waste. The team working with company managers conducted a pilot Treasure Hunt at the **Cobasys advanced battery manufacturing plant in Springboro, OH**. It searched the plant for energy-saving opportunities, including examining process equipment, lighting, compressed air, and HVAC systems. Over **$67,000 worth of savings** (18.5 percent of current energy costs) and 674 metric tons of carbon were cut. The IUE-CWA and EDF team are planning Treasure Hunts at five additional manufacturing plants. **As IUE-CWA president Jim Clark notes, *"Energy-efficiency Treasure Hunts will give IUE-CWA workers new skills to make their companies more productive and competitive. That's good for our members' job security and good for their company's bottom line."***

IEE Tools and Resources

Many if not most employers, much less their workforces, are probably not fully aware of the many types of assistance and programs available to them in the public sphere. The U.S. DOE's Advanced Manufacturing Office and the Environmental Protection Agency (e.g., ENERGY STAR) are the leading federal agencies that provide a very large assortment of resources and tools to help manufacturers cost-effectively implement IEE improvements. Most states also have a variety of programs aimed at assisting manufacturers and other businesses in adopting IEE measures. There are also NGOs, including business associations and environmental organizations, which also provide information and guidance in IEE.

Financial assistance

The availability of capital ranks highest on manufacturer's list of obstacles to investing in IEE. Both the federal government (DOE/AMO) and most states have programs that provide grants, loans, loan guarantees and tax incentives (tax credits) to eligible manufacturers for IEE projects (such as CHP).

Database of State Incentives for Renewables & Efficiency (DSIRE): http://www.dsireusa.org/

U.S. Department of Energy, Energy Efficiency & Renewable Energy/Advanced Manufacturing Office, State Incentives and Research Database:
http://www1.eere.energy.gov/manufacturing/states/state_activities/incentive_search.aspx

National Association of State Energy Officials (NASEO), State Energy Programs for Industry and Manufacturing Database:
http://www.naseo.org/resources/sepis/

Software tools for IEE assessments

The DOE in particular makes online resources available, including software tools to help manufacturers assess options for improving IEE in process heating, steam systems, motors, pumps and fans. Training introductory courses area also availability via webinars.

Energy Resource Center:
http://www1.eere.energy.gov/manufacturing/tech_deployment/ecenter.html

Technical assistance

DOE's Industrial Assessment Centers (IACs) and Clean Energy Applications Centers (CEACs), and the National Institutes of Standards and Technology's (NIST) Manufacturing Extension Partnership (MEP), provide various forms of technical assistance (e.g., energy audits, energy savings assessments and efficiency recommendations, access to expertise, energy management) for manufacturers involved in IEE initiatives. The MEP in particular provides assistance to small and mid-sized manufacturers. States also have technical assistance resources.

AMO, Industrial Assessment Centers (IACs):
http://www1.eere.energy.gov/manufacturing/tech_deployment/iacs.html

Clean Energy Application Centers (CHCs):
http://www1.eere.energy.gov/manufacturing/distributedenergy/ceacs.html

Manufacturing Extension Partnership:
http://www.nist.gov/mep/

Research and development (R&D) and technology innovation

The federal government, and some states, provide direct funding and/or tax incentives to encourage R&D and technology commercialization of innovative IEE technologies and processes.

DOE's Advanced Manufacturing Office:
http://www1.eere.energy.gov/manufacturing/rd/index.html

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U.S. Environmental Protection Agency ENERGY STAR for Industry
http://www.energystar.gov/industry.

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