8. Available Resources

8.1 The Industrial Assessment Center

In an effort to reduce the energy consumption of U.S. industry, the Department of Energy funded the Industrial Technologies program. This program seeks to educate those who work in industry in the following areas: tools development and training, plant assessments, showcase demonstrations, emerging technologies, Allied Partnerships, and technical information development.

The Industrial Assessment Center (IAC) was created for the Industrial Technologies program. There are 26 centers across the United States, offering free energy audits to mid-size manufacturing facilities; an engineering professor and student engineering team conduct the audits. The goals of each center are to increase energy savings in industry and offer graduate and undergraduate engineering students hands-on experience in manufacturing facilities.

Recommendations from energy audits offered by these centers have averaged savings around $55,000 for each audited manufacturing facility. A recommendation is written when the audit team discovers a process, machine, or area that could yield significant energy savings. The amount of savings per recommendation can very from hundreds of dollars to millions of dollars.

For the purposes of this project, a search on Industrial Assessment Center databases was conducted on the chemical industry in Iowa and also the United States. This search used SIC codes to separate chemical industry audits from other audits. While the recommendations offered by these energy audits do not include small or large manufacturing facilities, they do provide insight and options for facilities that aren't able to afford energy-consulting services.

Common recommendations in the U.S. chemical industry were found along with average savings, implementation costs, and the percentage of recommendations that were actually implemented. Table 8.1 shows some of the more common recommendations; these represent general areas of energy savings that were recommended by Industrial Assessment Centers nationally.

Table 8.1

Recommendation	Ave. Savings	Ave. Cost	% Implemented*	# Rec.
STEAM				
Improve Combustion Air to Fuel Ratio	$11,592	$1,652	72%	125
Recover Energy From Boiler Blowdown	$4,194	$3,843	63%	8
Implement/Improve Condensate Return	$304,892	$49,808	54%	28
Install/Replace Boiler	$112,480	$85,751	22%	9
Reduce Steam Pressure	$5,269	$5,134	25%	12
Repair Steam Leaks	$319,154	$7,741	80%	40
Install/Replace Steam Traps	$53,606	$5,112	75%	36
Implement a Cogeneration System	$547,317	$1,330,231	22%	18
Install Fire Tube Turbulators	$4,196	$2,910	56%	9
COMPRESSED AIR				
Repair Compressed Air Leaks	$4,284	$708	77%	124
Bring Outside Air into Compressor Intakes	$1,179	$678	46%	136
Reduce Operating Pressure Of Compressor	$5,999	$1,194	45%	78
Install/Replace Air Compressor	$7,190	$14,162	46%	11
PROCESS HEATING				
Install Heat Exchanger/Economizer on Process	$11,840	$11,903	28%	29
Recover Waste Heat from Equipment	$6,827	$12,319	38%	79
Use Flue Gases for Preheating Combustion	$23,567	$21,455	33%	45
Insulate Equipment and Piping	$4,059	$2,782	51%	188
EQUIPMENT				
Install a Variable Frequency Drive on Machine	$16,899	$23,814	21%	48
Install/Replace/Modify HVAC Equipment	$39,367	$53,783	43%	47
Install Premium Efficiency Motors	$4,596	$12,579	64%	201
Install Cogged V-belts on Equipment	$4,738	$2,873	56%	119
Install Setback Timers and Thermostats	$3,317	$1,770	45%	78
LIGHTING				
Install High Efficiency Lighting	$3,542	$5,724	60%	376
Reduce Illumination/Delamp Areas	$3,070	$909	58%	86
Install Occupancy Sensors	$1,856	$1,330	23%	88
Implement Photosensors/Daylighting Strategies	$9,365	$11,110	29%	28

*Percent Implemented represents what companies have currently reported, and this statistic doesn't take into account recommendations that may be implemented at a later date.
NOTE: These numbers represent approximations obtained from the October 2004 IAC National Database. To view the database, visit the internet address provided below.

Table 8.2 represents the recommendations found for the chemical industry in the state of Iowa, and only represents recommendations common with Table 8.1.

Table 8.2

Recommendation	Ave. Savings	Ave. Cost	% Implemented	# Rec.
Improve Combustion Air to Fuel Ratio	$12,578	$1,750	0%	2
Install/Replace Steam Traps	$688	$1,980	100%	1
Repair Compressed Air Leaks	$2,273	$212	67%	6
Bring Outside Air into Compressor Intakes	$825	$359	44%	9
Reduce Operating Pressure Of Compressor	$17,286	$36	33%	6
Install/Replace Air Compressor	$1,533	$9,824	100%	1
Install a Heat Exchanger/Economizer on Process	$310	$520	0%	1
Install a Variable Frequency Drive on Machine	$2,732	$16,938	0%	2
Install Premium Efficiency Motors	$1,485	$3,236	50%	4
Install/Replace/Modify HVAC Equipment	$4,028	$68,000	100%	1
Install Setback Timers and Thermostats	$3,963	$5,250	33%	3
Install High Efficiency Lighting	$1,689	$3,474	57%	14
Install Occupancy Sensors	$1,100	$1,009	0%	6

All of the common recommendations listed in the tables above were grouped into five main categories, which are steam, compressed air, process heating, equipment, and lighting.

Steam heating systems use boilers to produce steam, which is used in process equipment throughout a facility. There are many places throughout the steam distribution system where modifications or repairs can be made to help improve overall efficiency.

Improve Combustion Air to Fuel Ratio—Monitoring the oxygen levels of the leaving combustion gases can increase the efficiency of the steam system. (See: Section 4.4.1)

Recovery Energy From Boiler Blowdown—Solids (suspended or dissolved) are always present in water. When water in a steam system has a high concentration of solids, its efficiency is reduced and damage to components of the system becomes a concern. A process called "blowdown" removes the solids from the system. (See: Section 5.4.5)

Implement/Improve Condensate Return—Recovering water in a steam system can improve the efficiency of the system. The quality of newly condensed water in a steam system is very high and, as a result, less energy is required to change its state from water to steam. (Section: Steam)

Install/Replace Boiler —Occasionally old boilers have such low efficiencies that a surprising amount of energy can be saved by investing in a new, higher efficiency model. Improvements can also be made on current boilers to help improve the efficiency of the system. (Section: Steam)

Reduce Steam Pressure—Reducing the steam system pressure to an optimal/minimal setting can yield significant energy savings. When the system operates at a lower pressure, there are potential savings from labor and maintenance costs due to decreases in leakage and transportation resistance. (See Section 5.4.1)

Repair Steam Leaks—Steam leaks represent a large loss of energy as well as a hazard to equipment in the steam line, especially a boiler. To prevent large energy and repair costs, check for steam leaks on a regular basis. (See Section 5.5.1)

Install/Replace Steam Traps—Steam traps that are not functioning properly can waste energy, harm production, and damage equipment in the steam system. (See Section 5.5.3)

Install Fire Tube Turbulators—Installing turbulators in the "fire" tubes of fire-tube boilers can increase the efficiency of a steam system. These turbulators increase turbulence in the flow through the boiler, which increases overall heat transfer. Further information is provided in (Section: Steam).

Compressed air is sometimes referred to as the most expensive "utility" for manufacturing facilities. Air compressors consume great amounts of energy, thus these systems have great potential for energy savings.

Repair Compressed Air Leaks—Large amounts of energy are required to compress air, and any air that leaves the system through means other than the end applications wastes the energy used to compress that air. Further information is provided in (Section: Compressed air)

Bring outside Air into Compressor Intakes—Air at lower temperatures has a higher density and using air from outside is usually the lowest nearby air temperature to feed the compressor. Because the density is higher, more air mass will be compressed per volume. This recommendation is typically given for reciprocating compressors.

Reduce Operating Pressure of Compressor—Similar to reducing the operating pressure of a steam system, reducing the operating temperature of a compressed air system can reduce energy, labor, and maintenance costs. Further information is provided in (Section: Compressed air).

Install/Replace Compressor—Occasionally facilities will operate compressors that are inefficient. (Section: Compressed air)

Process heating is important in the chemical industry. Process heating is used to raise the temperature of materials during manufacturing. Because process heating is an energy-intensive process, there is large potential for energy savings.

Install Heat Exchanger/Economizer on Process—Wherever energy carried within process fluids is wasted, there is potential to add a heat exchanger or economizer to recover some of the wasted energy to serve other purposes. (See Section 5.6.2)

Recover Waste Heat from Equipment—Occasionally there are process applications where equipment generates a substantial amount of energy. If there is a nearby application where the energy may be utilized, such as supplemental heating during the winter, then there is a potential for energy savings. (See section 5.4.4)

Use Flue Gases for Preheating Combustion Air—If combustion flue gases are exiting the stack at a high enough temperature, the energy carried in the gas may be transferred to entering combustion air to reduce the energy consumed by the burner. (See Section 4.4.1)

Insulate Equipment and Piping—To prevent heat losses, ensure that all heating equipment and piping is properly insulated. (See Sections 5.5.2-5.5.3)

Pumps, motors, HVAC, and other equipment consume significant amounts of energy. Thus, any modifications or improvements to this equipment can yield significant energy savings.

Install a Variable Frequency Drive on Machine—Many machines in industry are run at full load even though they may require lower load conditions. Variable Frequency Drives (VFDs) modulate the speeds of motors operating equipment to match the optimum power output with the load required. (See Section: Equipment)

Install/Replace/Modify HVAC Equipment—Many manufacturing facilities are currently using HVAC equipment that is inefficient or operating at non-optimum levels. Software, product information, and consultant help can be used to optimize this equipment and realize energy savings. (See Section: Equipment)

Install Premium Efficiency Motors—Premium efficiency motors offer higher operating efficiencies than standard motors. Though purchasing a premium efficiency motor may involve a greater capital investment, the energy savings will more than pay for the price differential between the premium and standard motors. Utility companies may also offer rebates for premium efficiency motors. (See Section 7.5.1)

Install Cogged V-Belts on Equipment —Using cogged or "notched" v-belts can result in marginal energy savings. There's less slipping with cogged belts, although it should be noted that some applications run better with slipping.

Install Setback Timers and/or Thermostats—These units help control the conditioning of air in an area, using the optimal amount of conditioning.

Install High Efficiency Lighting —Replace standard lighting with higher efficiency bulbs or ballasts. Reduce the amount of unnecessary lighting present in the facility.

Reduce Illumination/De-lamp Areas—Some energy savings can be realized by eliminating excess lighting.

Install Occupancy Sensors—In low occupancy areas, installing sensors may prove to be a cost effective way to control lighting.

Implement Photosensors/Daylighting Strategies—Photosensors and daylighting strategies are implemented to utilize the free lighting from the sun.

For more information about the Industrial Assessment Center, visit http://iac.rutgers.edu/database/main.php on the Internet or contact the Industrial Assessment Center at Iowa State University at (515) 294-3080.

IAC Resources:

US DOE, Energy Efficiency and Renewable Energy
http://www.eere.energy.gov/industry/deployment.html
http://iac.rutgers.edu/database/main.php

8.2 Online Resources

There are many Internet-based assessment tools, programs, and sources of information available to chemical manufacturing facilities. Most of these resources are free and fairly easy to access, especially those provided by the Department of Energy. The DOE provides software tools, case studies, research and development projects/solicitations, and additional information for the chemical industry.

8.2.1 Software Tools

A good source for software tools is the DOE website, www.doe.gov. This website branches off into sub-sites, many which provide the items discussed above. The following software tools are available from the DOE Industrial Technologies Program:

DOE-EERE, http://www.oit.doe.gov/bestpractices/software_tools.shtml

- AIRMaster+, a compressed air assessment package
- Fan System Assessment Tool, a fan optimization package for various fan system configurations
- MotorMaster+ 4.0, an energy efficient motor selection guide and management tool
- NOx and Energy Assessment Tool, a software package that helps assess NOx emissions and applications of energy efficiency improvements
- Process Heating and Assessment Survey Tool, a program which provides introductions to process heating methods as well as tools to help improve the thermal efficiency of heating equipment
- Pumping System Assessment Tool 2004, helps industrial users assess the efficiency of pumping system operations
- Steam System Tool Suite, collection of tools which help identify steam system improvements

DOE-EERE, http://www.eere.energy.gov/industry/chemicals/chemicals_ind_tools_cd.html

- Chemical Industry Tools CD, provides resources and tools such as new innovative energy efficient technologies, energy analysis software tools, hands-on tips, plant assessment information, financial assistance and more

DOE-EERE, https://sslserver.com/bcstools.net/CPAT/login.asp

- CPAT 2.2, user inputs provide a measure of the potential commercial deployment of new processes, technologies, and practices

8.2.2 Case Studies and R&D Projects

Case studies offer information about energy audits conducted on manufacturing facilities. This information includes descriptions of the processes modified, successes, and experiences from the audits. Along with information from previous studies, the DOE Energy Efficiency and Renewable Energy Program offers information on active studies. The DOE is currently looking for companies to participate in these studies. The following websites provide information pertaining to case studies as well as current and past research and development projects:

DOE-EERE, http://www.oit.doe.gov/bestpractices/case_studies_pwa.shtml

- These case studies describe the energy improvement projects, process improvement projects, and assessments at the plant level.

DOE-EERE, http://www.oit.doe.gov/bestpractices/emerg_tech/chem.shtml

- This website provides contact information on emerging technologies in the chemical industry.

DOE-EERE, http://www.eere.energy.gov/industry/chemicals/portfolio.html

- This website provides information on past and current research and development projects, DOE partnerships in Industry, and current events being held by the DOE.

STEAMING AHEAD, http://www.steamingahead.org/casestudies/index.php

- Search through a case study database to find case studies applied to different facility types.

COMPRESSED AIR CHALLENGE, http://www.compressedairchallenge.org/

- This website contains a case study index dedicated to the improvement of compressed air systems.

8.2.3 Organizations

Many alliances, partnerships, etc. provide resources on energy conservation, including:

- Alliance to Save Energy, http://www.ase.org/
- American Council for an Energy Efficient Economy, http://www.aceee.org/
- Association of Energy Engineers, http://www.aeecenter.org/
- Boiler Efficiency Institute, www.boilerinstitute.com
- Center for Analysis and Dissemination of Demonstrated Energy Technologies (CADDET) www.caddet.org
- Center for Industrial Research and Service http://www.ciras.iastate.edu
- Compressed Air Challenge, http://www.compressedairchallenge.org
- Council of Industrial Boiler Owners, http://www.cibo.org/
- Energy Information Bridge, http://www.osti.gov/bridge

- Energy Manager Training, http://www.energymanagertraining.com/new_index.php
- Energy Services, http://www.energyexperts.org/
- Energy Star, http://www.energystar.gov/
- Environmental Energy Technologies Division, Energy Analysis Department, http://eetd.lbl.gov/EA.html
- International Energy Agency, www.iea.org
- Iowa Energy Center, www.energy.iastate.edu
- Iowa State University Industrial Assessment Center (IAC), (515) 294-3080 www.me.iastate.edu/iac
- MidAmerican Energy http://www.midamericanenergy.com
- Cheresources, http://www.cheresources.com/pinchtech1.shtml
- Steaming Ahead, http://www.steamingahead.org/casestudies/index.php
- Simply Insulate, http://www.simplyinsulate.com/