Army and Department of Energy Partner to Save Energy at Army Industrial Facilities

Four years ago, the Department of Defense (DoD) and Department of Energy (DoE) signed a memorandum of understanding (MoU) to work together to enhance national energy security and demonstrate the Federal Government's leadership in transitioning America towards low carbon economy. Under the framework of the MoU, the U.S. Army has successfully collaborated with the DoE's Advance Manufacturing Office to improve the overall energy efficiency of the Army's industrial base.

This coordination leverages the highly specialized capabilities of the DoE national laboratories to conduct industrial assessments for the purpose of identifying energy conservation measures on Army installations, including those operated by the Army Materiel Command (AMC).

The DoE's Advanced Manufacturing Office funds a program for Industrial Assessment Centers (IACs) to visit manufacturing plants, conduct energy assessments and develop site-specific recommendations at no cost. The IACs are comprised of teams of engineering professors and students from 24 universities across the country.

Project Overview

The IACs recently completed energy assessments at three installations operated by the AMC: Joint Systems Manufacturing Center - Lima, Scranton Army Ammunition Plant and Iowa Army Ammunition Plant.

In return, the Army provided funding for the DoE's Oak Ridge National Laboratory industrial energy team to take the energy conservation measures identified by the IACs and apply best practices and lessons learned to other AMC industrial sites, including Corpus Christi Army Depot, Lake City Army Ammunition Plant, Holston Army Ammunition Plant and Radford Army Ammunition Plant.

At the AMC industrial sites alone, over $8 million in annual energy cost reductions were identified, or the equivalent to the amount of energy consumed by approximately 14,000 U.S. homes each year, according to the Environmental Protection Agency (EPA)'s greenhouse gas equivalencies calculator. Timeframes for realizing returns on investment were typically four years or less. Summarized findings from the AMC sites are shown in *Table 1 below.*

Table 1 – Energy Conservation Measures (ECMs) Found During Energy Assessments

Site	Annual Energy Reduction (MMBtus)	ECMs as % of Savings from FY13	Total Cost to Implement All ECMs ($)	Annual Energy Cost Reduction ($)	Payback Period (Years)	Savings to Investment Ratio (SIR)*
Joint Systems Manufacturing Center - Lima	259,000	51%	$1,517,000	$2,349,000	.64	1.55
Scranton Army Ammunition Plant	242,000	44%	$1,037,000	$1,173,000	.88	1.13
Holston Army Ammunition Plant	174,000	13%	$3,514,000	$2,120,000	1.65	.60
Corpus Christi Army Depot	25,000	9.3%	$1,040,000	$824,000	1.26	.79
Lake City Army Ammunition Plant	40,100	3.8%	$1,035,000	$971,000	1.07	.94
Iowa Army Ammunition Plant	20,200	3.4%	$78,000	$115,000	.68	1.47
Radford Army Ammunition Plant	74,500	2.9%	$3,589,000	$1,019,000	3.52	.28
Total	**834,800**	**N/A**	**$11,810,000**	**$8,571,000**	**N/A**	**N/A**

***The SIR is based upon one year of savings. If more years of savings were included in the SIR calculation, the SIR would be higher. Two years of savings is the longest time period the site's usage pattern would remain consistent. The total cost to perform the energy evaluations at the sites was approximately $750,000, which was not included in the implementation cost estimate.**

Challenges and Opportunities

Each industrial site presented unique challenges and opportunities, based upon its utility configuration and mission. The IACs and Oak Ridge National Laboratory approached each site with their expertise to find an optimal solution. However, a few energy conservation themes emerged at nearly all sites:

1. Thermal distribution systems could be improved including replacing damaged insulation and/or improving steam trap maintenance.

2. Utility systems (steam, water and compressed air) could experience significant energy savings with the addition of control systems that allow them to be optimized to match fluctuating needs at the sites.

3. Energy savings could be gained for very low cost by simply changing basic operating practices on the production lines.

Implementation costs for energy conservation measures range from a simple process change with no capital investment to more capital intensive (greater than or equal to $100,000) to install. All identified energy conservation methods result in economically viable energy savings for the Army.

Installation Findings

Corpus Christi Army Depot

Located on Naval Air Station Corpus Christi on the Gulf Coast of Texas, Corpus Christi Army Depot is the military's primary site for rebuilding rotary wing aircraft.

A team of industrial energy experts from visited the site in March 2014, and identified 78 opportunities to save energy. The conservation measures range from simple changes in behavior to replacing or reconfiguring major items of equipment. In total, there is potential to save more than $824,000 per year in energy costs or 25,000 million metric British thermal units (MMBtus) per year.

A no cost energy conservation measures would be to lower the compressed air system pressure in a single building. The outlet pressure of the air compressors in the building is currently 115 pounds per square inch gauge (psig). However, the pneumatic equipment being served by this system is designed to be operated at a lower pressure. By lowering the system pressure to 100-107 psig and adjusting the existing control system, the compressor system will consume less energy while providing the needed compressed air to the building's functions. This no cost measure would result in 278 MMBtus of annual energy reduction and save the Corpus Christi Army Depot $8,700 per year.

Holston Army Ammunition Plant

Hoston Army Ammunition Plant is located in northeast Tennessee on the Holston River, and is the primary maker of high explosive compounds for a variety of military applications.

Holston Army Ammunition Plant was visited in April 2014, and energy engineers identified seven energy conservation measures that have potential to reduce annual gas, coal and electric costs by more than $2 million. This would be a 13 percent reduction on the site's current annual energy costs.

The single largest energy conservation measure identified would be to reconfigure the existing steam plant, optimizing it based on current needs. This measure alone could save approximately $1,340,000 per year in energy costs upon implementation.

Iowa Army Ammunition Plant

Iowa Army Ammunition Plant specializes in producing large caliber ammunition, including 105mm and 120mm tank rounds, as well as special-purpose large artillery rounds.

The IAC site visit found eight energy conservation measures, with potential annual reductions of $115,000 in energy costs and 2,070 tons of carbon dioxide (CO_2) emissions.

Six measures have implementation costs below $20,000 each. When

fully implemented, the low-cost energy conservation measures will avoid $86,000 in energy costs and 1,300 tons of CO_2 at the site annually.

The single largest energy conservation measure discovered at the Iowa facility was the opportunity to repair broken steam traps throughout the facility. For an estimated implementation cost of $6,400, there is potential to save $54,000 in utility costs.

Joint Systems Manufacturing Center – Lima

The Joint Systems Manufacturing Center in Lima, Ohio, has the mission of building, restoring and repairing armored vehicles. The IAC industrial energy assessment at Lima identified 14 energy conservation measures. If all energy conservation measures were implemented, annual energy cost savings would be greater than $2.35 million, which is a 44 percent drop from current annual energy expenses. These measures would also reduce the plant's annual CO_2 output by more than 36,500 tons, which is equivalent to the amount of CO_2 emissions released from 3.9 million gallons of gasoline consumed, according to the EPA's greenhouse gas equivalencies calculator.

Nine measures identified at Lima have implementation costs that do not exceed $20,000 per measure. When these low-cost and no-cost measures are added together, they have potential to save approximately $799,000 in annual energy costs and reduce the site's annual release of CO_2 by almost 13,000 tons.

The single largest energy conservation measure discovered at the Lima facility was the installation of a more energy efficient heating, ventilation, and air conditioning (HVAC) system that would turn off the heat recovery and makeup air units on evenings and weekends. For an estimated implementation cost of $100,000, there is the potential to save nearly $750,000 in annual utility costs. This measure is also estimated to reduce CO_2 emissions by 10,500 tons per year. *Table 2* provides energy and cost estimates for implementing this ECM.

Table 2 – Example of HVAC Control System at Joint Systems Manufacturing Center – Lima

Annual Energy Reduction (MMBtus)	Implementation Cost ($)	Annual Energy Cost Reduction ($)	Payback Period (Years)	Savings to Investment Ratio (SIR)
117,000	$100,000	$747,000	.13	7.47

Lake City Army Ammunition Plant

Lake City Army Ammunition Plant is the primary manufacturer of small arms ammunition used by all branches of the federal government. The site produces 5.56mm and 7.62mm North Atlantic Treaty Organization (NATO) ammunition, 0.50 Browning machine gun cartridges and 20mm ammunition.

The site was visited in April 2014, and the team investigated 28 energy conservation measures, concluding they have the potential to reduce the site's annual energy cost by $971,000. Upon full implementation, the annual energy savings is estimated to be 40,100 MMBtus per year.

An example of one large energy conservation measure at Lake City Army Ammunition Plant is to upgrade the air jets in a building used for cooling and drying rounds of ammunition. These jets, which are operating at 99 places within the cooling and drying process, are currently produced with open copper tubing that uses 100 percent compressed air to form the airflow across the rounds. Using commercially available engineered nozzles can produce the same

total airflow in the process with only 20 percent of the compressed air requirements. *Table 3* provides energy and cost estimates for implementing this measure.

Table 3 – Example of Airflow Upgrade at Lake City Army Ammunition Plant

Annual Energy Reduction (MMBtus)	Implementation Cost ($)	Annual Energy Cost Reduction ($)	Payback Period (years)	Savings to Investment Ratio (SIR)
3,400	$12,500	$75,000	.17	6.0

Radford Army Ammunition Plant

The Radford facility is the Army's primary factory for producing propellants, from gunpowder to solid-fuel rocket motors. Approximately 90 percent of the military's ordnance has its genesis at Radford.

Three major utility systems were identified for potential energy savings measures: compressed air, steam and water. A total of nine energy conservation measures were identified at the site. The team estimates that more than $1,019,000 in annual energy cost savings is available if these measures are implemented.

The six lowest cost energy conservation measures have implementation costs between $25,000 and $85,000 each. Total low implementation costs are estimated to be less than $300,000, resulting in combined annual energy cost savings of more than $410,000.

Scranton Army Ammunition Plant

The workers at Scranton Army Ammunition Plant in Pennsylvania are focused on producing large caliber projectiles for the Armed Forces. Items produced include artillery rounds between 105mm and 155mm, mortar rounds of the 120mm family, and ammunition for the 5-inch Navy gun.

The IAC team that visited Scranton identified 18 economically viable opportunities for energy savings, with total potential annual energy cost savings of $1,173,000.

Of these measures, 12 have an implementation cost less than $20,000 each. If fully implemented, these energy conservation measures have the potential to lower the plant's energy bill by almost $64,000 per year.

The single largest energy conservation measure discovered at the Scranton facility was replacing the metal halide fixtures throughout the facility with more energy efficient lighting fixtures. For an estimated implementation cost of $119,000, there is a potential to save $264,000 in annual utility costs and reduce energy consumption by 12,700 MMBtus per year.

Additional Opportunities for Collaboration

The successful partnership between the Army and DoE is a great example of the potential benefits of interagency agreements. The lessons learned and identification of best practices from the AMC site assessments will be applied across the Army's inventory of industrial and garrison bases, and the DoD-DoE MoU will continue to support future interagency projects that will benefit our troops and increase energy efficiencies on military bases worldwide.

For additional information on the DoE's Advanced Manufacturing Office efforts, visit http://energy.gov/eere/amo/technical-assistance-activities.