Mythbusting: Industrial Energy Efficiency

Bruce Hedman, Institute for Industrial Productivity
State Energy Efficiency Policy Retreat
August 19, 2014
About the Institute for Industrial Productivity

The Institute for Industrial Productivity provides industry and governments with the best energy efficiency practices to reduce energy costs and prepare for a low carbon future.

• Sharing best practices, including policy experience, and providing access to a network of international experts.

• Developing original research, analysis and databases.

• Bridging the gap between government policy and industry implementation.
Industry Accounts for 50% of Total Global Energy Use
(Primary Energy Basis*)

* Includes fuel for electricity generation and T&D losses
The U.S., China, and India Represent about 50% of Total Industrial Energy Use

Source: DOE EIA International Energy Outlook 2013
Myth 1:
U.S. Industry is in decline, so why focus on industrial energy efficiency?
Industry is still the Largest Energy User in the U.S.

The industrial sector:

- Consumes more energy than any other sector and accounts for ≈1/3 of all end-use energy
- Remains the largest energy user even though industrial efficiency continues to improve
- Will consume 34.8 quads of primary energy in 2020 (36% of all end-use energy)
- Will consume 37.9 quads of primary energy in 2030 (38% of all end-use energy)

Source: Energy Information Administration Annual Energy Outlook 2014
….and will be the Largest Source of CO$_2$ Emissions in 2040

![CO2 Emissions Chart](chart.png)

Source: Energy Information Administration Annual Energy Outlook 2014
Industrial Energy Use can be Reduced by Over 20% in the near-term through Cost-effective Energy Efficiency Measures

- States increasingly looking at IEE to meet EERS targets
- Federal and state initiatives moving to promote IEE
- Increasing focus on EnMS as path to greater and continuing IEE improvements
- Lower natural gas prices may reduce IEE economic drivers

Manufacturing Is the Primary Target for Energy and Emissions Savings

Energy Use (2012)
- Manufacturing: 84%
- Construction: 5%
- Agriculture: 3%
- Mining: 8%

CO₂ Emissions (2012)
- Manufacturing: 85%
- Construction: 4%
- Agriculture: 4%
- Mining: 7%

Source: Energy Information Administration Annual Energy Outlook 2014
Manufacturing Contributes Disproportionately to the National Economy

Value Added, 2013:
- Manufacturing: 12.5%
- Mfg Related: 89.8%

Employment, 2013:
- Manufacturing: 9%
- Mfg Related: 4%
- Other Sectors: 87%

Exports, 2012:
- Manufacturing: 65%
- Other Sectors: 35%

Private Sector R&D, 2013:
- Manufacturing: 67%
- Other Sectors: 33%

Value Added, Employment, Private Sector R&D from Bureau of Labor Statistics, Export data from Brookings and JP Morgan Chase
Manufacturing Drives Productivity

Manufacturing Drives Productivity Growth
(Updated January 2013)

Source(s): U.S. Bureau of Economic Analysis and MAPI
Manufacturing Fuels Local Economic Growth

An additional $1.33 is added to the economy for every $1.00 spent in manufacturing.

Manufacturing’s Multiplier Effect Is Stronger Than Other Sectors’
(Updated April 2014)

- Manufacturing: $1.33
- Agriculture, forestry, fishing, and hunting: $1.11
- Transportation and warehousing: $1.00
- Construction: $0.86
- Arts, entertainment, recreation, etc.: $0.81
- Information: $0.80
- Education, health care, & social assistance: $0.72
- Retail trade: $0.66
- Other services, except government: $0.63
- Professional and business services: $0.61

Economic Activity Generated by $1 of Sector GDP, 2012

Source(s): U.S. Bureau of Economic Analysis, Annual Input-Output Tables
Manufacturing Supports Jobs

- Manufacturing supports one in six private jobs in the U.S.
- 12 million employed directly (2013)
- 5.5 million employed indirectly (2013)
- The average manufacturing worker earned $77,505 annually in 2012 (pay and benefits)

Source(s): Estimated (E) from the U.S. Bureau of Economic Analysis, Annual Input-Output Tables
Manufacturing Is Rebounding in the U.S.
Re-shoring of U.S. Manufacturing further raises the Stakes

Rising production of shale gas makes the prospect of U.S. manufacturing increasingly attractive:

*The Economist*¹:

“...lower American energy prices could result in 1 [million] more manufacturing jobs...”

“Companies such as Dow Chemical...and Vallourec [steel-tube producer]...have announced new investments in America to take advantage of low gas prices and to supply extraction equipment.”

The U.S. Government is tracking over $100 billion in planned manufacturing investments (fertilizer, chemicals, steel, assembly)

¹Source: The Economist, “Reshoring Manufacturing – Coming Home”
Myth 2: Energy Efficiency projects provide limited benefits to industrials
Energy is One of the Few Costs that can be Controlled

- **ALCOA**, at an initial cost of $5000 in consulting fees for purchasing a three-fan, variable inlet valve (VIV) controlled system, created a potential incremental annual revenue $375 000

- **DOW CHEMICAL** achieved a 22 % improvement between 1994 and 2005 and reaped $4 billion in savings

- **TOYOTA NORTH AMERICA** reduced energy use per unit by 23 % since 2002; company-wide energy savings efforts have saved $9.2 million since 1999

- **ST MARYS CEMENT** in Canada gained an 8 % absolute reduction in energy operating costs over five years, amounting to savings of $C1 million in total operating costs per year
Non-Energy Benefits of EE can be Even Greater

• Energy Efficiency does more than save energy
  – Environmental benefits
  – Productivity improvements
  – Reduced wastage
  – Water reduction/reuse
  – Reduced risk
  – Enhanced reliability

• Conventional approaches towards analyzing energy efficiency projects understate the impact of NEBs
  – Can impact both project and program economics
NEB Example – Lehigh Southwest Cement Plant

Compressed Air System Improvement Project
• Stabilized system pressure
• Reduced compressed air leaks
• Replaced low efficiency compressors with more efficient units
• Lowered system pressure

Results
• Saved 900,000 kWhs annually
• Eliminated rental compressors
• Reduced maintenance costs

<table>
<thead>
<tr>
<th>Project Economics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total project costs</td>
<td>$417,000</td>
</tr>
<tr>
<td>Annual energy savings</td>
<td>$90,000</td>
</tr>
<tr>
<td>Annual non-energy savings</td>
<td>$109,000</td>
</tr>
<tr>
<td>Total annual savings</td>
<td>$199,000</td>
</tr>
<tr>
<td>Utility rebate</td>
<td>$90,000</td>
</tr>
<tr>
<td>Simple payback, energy savings</td>
<td>4.63 years</td>
</tr>
<tr>
<td>Simple payback, total savings</td>
<td>1.64 years</td>
</tr>
</tbody>
</table>

Source: U.S. DOE Best Practices Case Study, October 2003
Myth 3: IEE programs are not cost-effective from a program administrator perspective
Energy Efficiency Represents a Low Cost Utility Resource

Electric energy resources: Cost of energy efficiency is cheaper than conventional supply side resources: EE program administrator costs average $0.028 per kWh (Molina, 2014), compared to $0.07-0.15 per kWh for supply resources (Nowak et al. 2013).

Natural gas resources: Natural gas EE resources cost program administrators on average $0.35/therm across 10 states (Molina 2014). This value is lower than the average citygate price of natural gas of $0.49/therm nationally in 2013 (EIA 2014).

**Levelized Costs of Electricity Resources (Utility Program Costs over 2009-2012)**

AEP Ohio’s Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan  (March 26, 2014)

Figure 1. EE/PDR vs. Supply-Side Investments

$/MWh

- Solar PV
- Wind
- Base-load Coal w/CC
- Nuclear
- Nat Gas Combined Cycle w/CC
- 2015-2017 EE/PDR Portfolio

Industry has the lowest cost of saved energy on a national level, although it is important to note that cost structures vary by program and sector at the state level.

Possible factors that may influence program costs: 1) program administrator experience, 2) Scale of program, 3) Labor costs, 4) State policy environment, 5) Retail rates.

Source: Aden (2013) based on EIA 2012 DSM, energy efficiency and load management programs data for more than 1,000 utilities.

www.eia.gov/electricity/data/eia861
Myth 4:
Industrials will do all cost-effective efficiency on their own
Michigan Electric Savings from Energy Efficiency

Sources:
2000-2007: Form EIA-861
2008: ACEEE Scorecard 2010
2009-2012: MPSC PA295 Annual Reports
[Graph by MEEA]
Ohio Electric Savings from Energy Efficiency

Sources:
2004 - 2008: ACEEE Scorecard data
2009-2012: Utility findings under SB221
Indiana Electric Savings from Energy Efficiency

- **Energizing Indiana Core Programs (Third-Party Administrator)**
- **Utility-run Programs**

<table>
<thead>
<tr>
<th>Year</th>
<th>Pre-DSM Mandate</th>
<th>Post-DSM Mandate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>12,631</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>20,653</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>11,483</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>39,903</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>55,937</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>267,433</td>
<td>240,968</td>
</tr>
<tr>
<td>2012</td>
<td>295,000</td>
<td>337,900</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td>501,000</td>
</tr>
</tbody>
</table>

Energizing Indiana program began (January 2012)
DOE’s Superior Energy Performance (SEP) Program

Nine industrial facilities certified to Superior Energy Performance have:

- Improved their energy performance by an average of 10% and over $500,000 per year over business-as-usual in the first 18 months of SEP implementation
- Saved an average $503,000/yr. from operational improvements alone (low/no cost investment) attributable to SEP

- US DOE Superior Energy Performance program
Myth 5: 
IEE programs are difficult to design and expensive to implement
There is a Wide Range of Successful IEE Program Models

<table>
<thead>
<tr>
<th>Category</th>
<th>Features</th>
</tr>
</thead>
</table>
| **Knowledge Sharing**     | • Low-cost or no-cost technical assistance  
                            • Workshops and other outreach  
                            • Peer exchange between industrial clusters or groups of companies  
                            • Success story dissemination |
| **Prescriptive Incentives**| • Explicit incentives or rebates for specific eligible energy efficient equipment and technologies |
| **Custom Incentives**     | • Specific EE projects tailored to individual customers  
                            • May be a mix of technologies  
                            • Incentives or rebates often based on entire energy savings |
| **Market Transformation** | • Streamlined path for introduction of new EE products to market  
                            • Address structural barriers to EE |
| **Energy Management**     | • Operational, organizational and behavioral changes through strategic energy management  
                            • Continuous energy improvement (e.g. embedded energy manager to provide leadership and continuity for implementing change) |
| **Self-Direct**           | • Customer fees directed into EE investments in their own facilities instead of an aggregated pool of funds  
                            • Eligibility for participation often based on threshold amount of energy use capacity  
                            • Verified energy savings |
Myth 6: CHP does not fit into energy efficiency programs
States with CHP as an Eligible EERS Measure

Existing:

• Massachusetts
• Maryland
• Connecticut
• Ohio (SB312)
• Illinois (DCEO pilot)

In Process:

• Minnesota
MASS SAVE Energy Efficiency Program for CHP: Incentive Structure

- Green Communities Act of 2008 recognizes CHP as an Energy Efficiency Measure eligible for incentives by utilities.

- Rebate Incentive Structure
  - Small systems (<150 kW): $750/kW
  - Larger systems (≥150 kW): up to $750/kW
  - Rebate limited to no more than 50% of installed cost.

- Benefit/Cost Ratio (BCR) Test considers operational and electric grid value of CHP project. Analysis is on a case-by-case basis, typically with hourly simulation.

- Only high efficiency CHP units likely to demonstrate threshold BCR > 1.
MASS SAVE Energy Efficiency Program for CHP: Recent Outcomes

• For projects awarded, Benefit/Cost ratios have ranged between 1 and 2.

• For 2011:
  – CHP represented 30% of Commercial/Industrial EE Target Savings
  – $/kWh savings have been the lowest of all MASS SAVE measures.

Link to Guide for the MASS SAVE CHP Incentive Program
http://www.masssave.com/business/building-or-equipment-upgrades/find-incentives/~/media/Files/Business/Applications%20and%20Rebate%20Forms/CHP%20Incentive%20Guidebook%20-%20dated%202011-18-10.ashx
Opportunities for Industrial Energy Efficiency in the U.S.

- Growing number of industrial companies are establishing sustainability goals
- Increasing number of utilities and EE program administrators are realizing IEE is critical to meet state energy efficiency targets
- ISO 50001 taking hold globally
- Benefits of EnMS/SEM are beginning to be quantified and recognized in the US
  - Energy Trust of Oregon
  - DOE’s Superior Energy Performance and SEM Accelerator
- 111(d) may provide important driver for IEE/CHP in some states