

# Mythbusting: Industrial Energy Efficiency

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

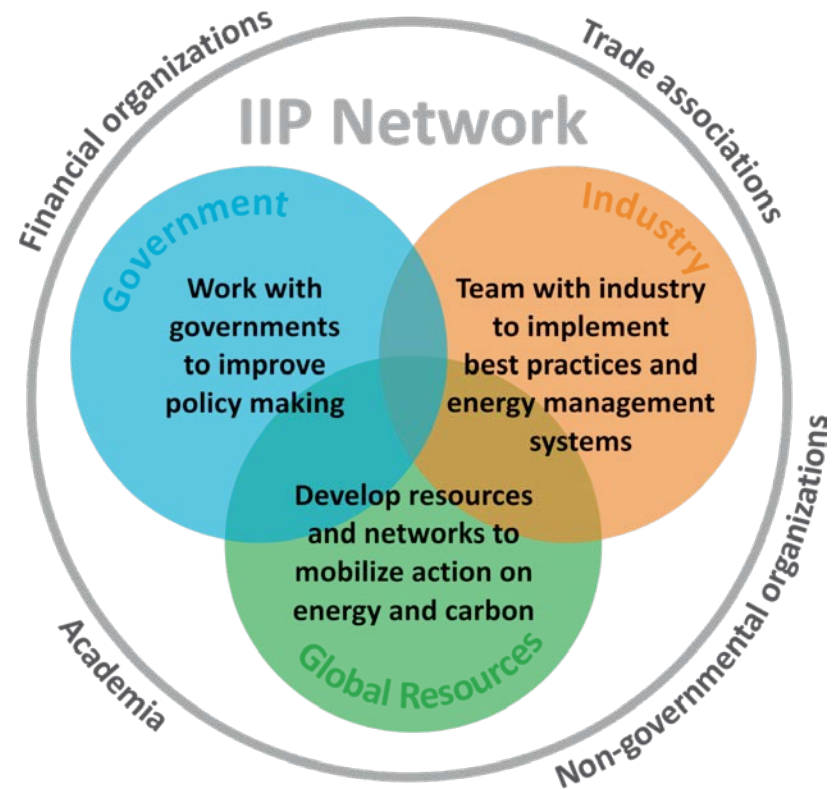


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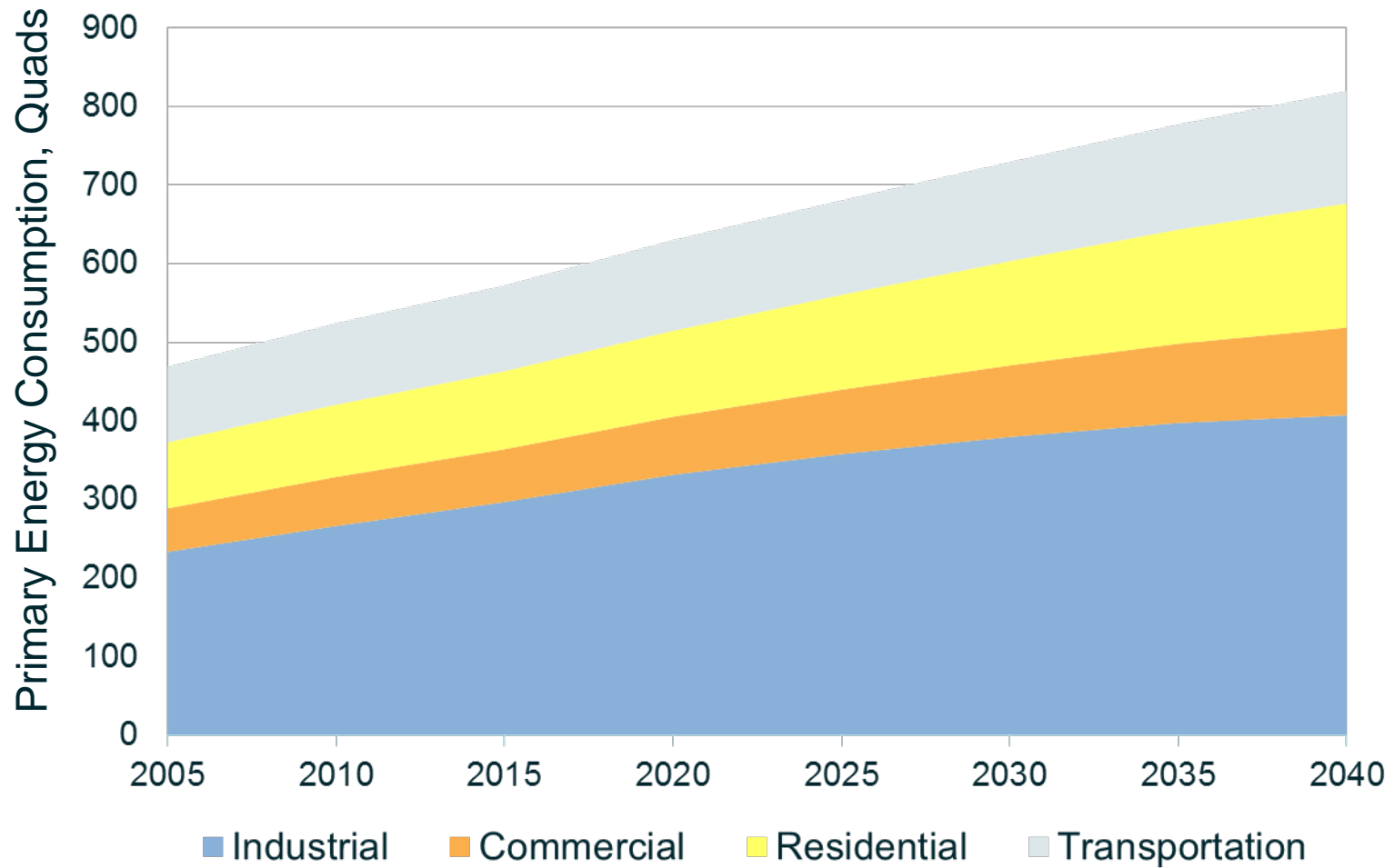
# About the Institute for Industrial Productivity

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\*)



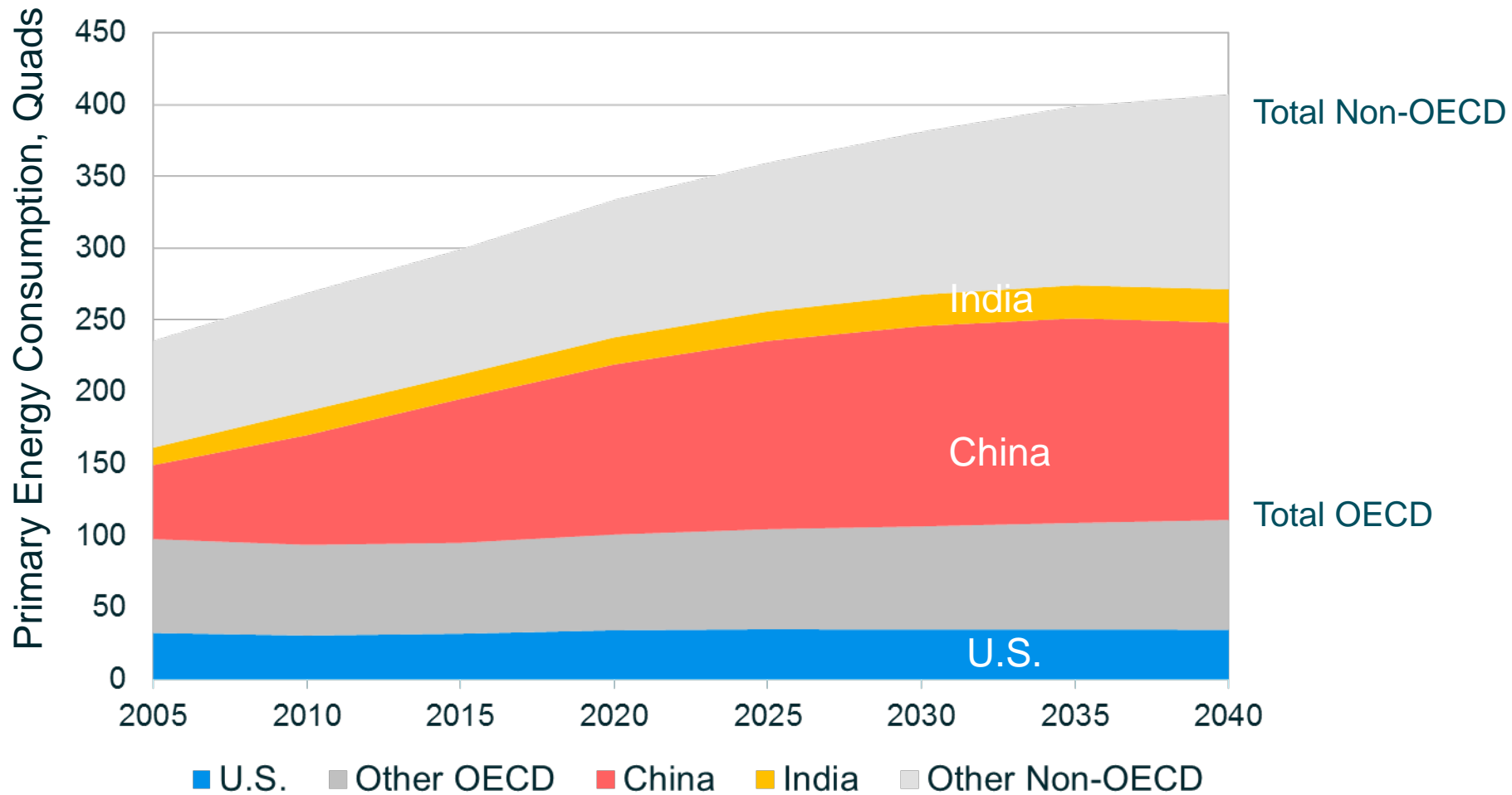
Source: DOE EIA International Energy Outlook 2013

\* Includes fuel for electricity generation and T&D losses



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# The U.S., China, and India Represent about 50% of Total Industrial Energy Use



Source: DOE EIA International Energy Outlook 2013



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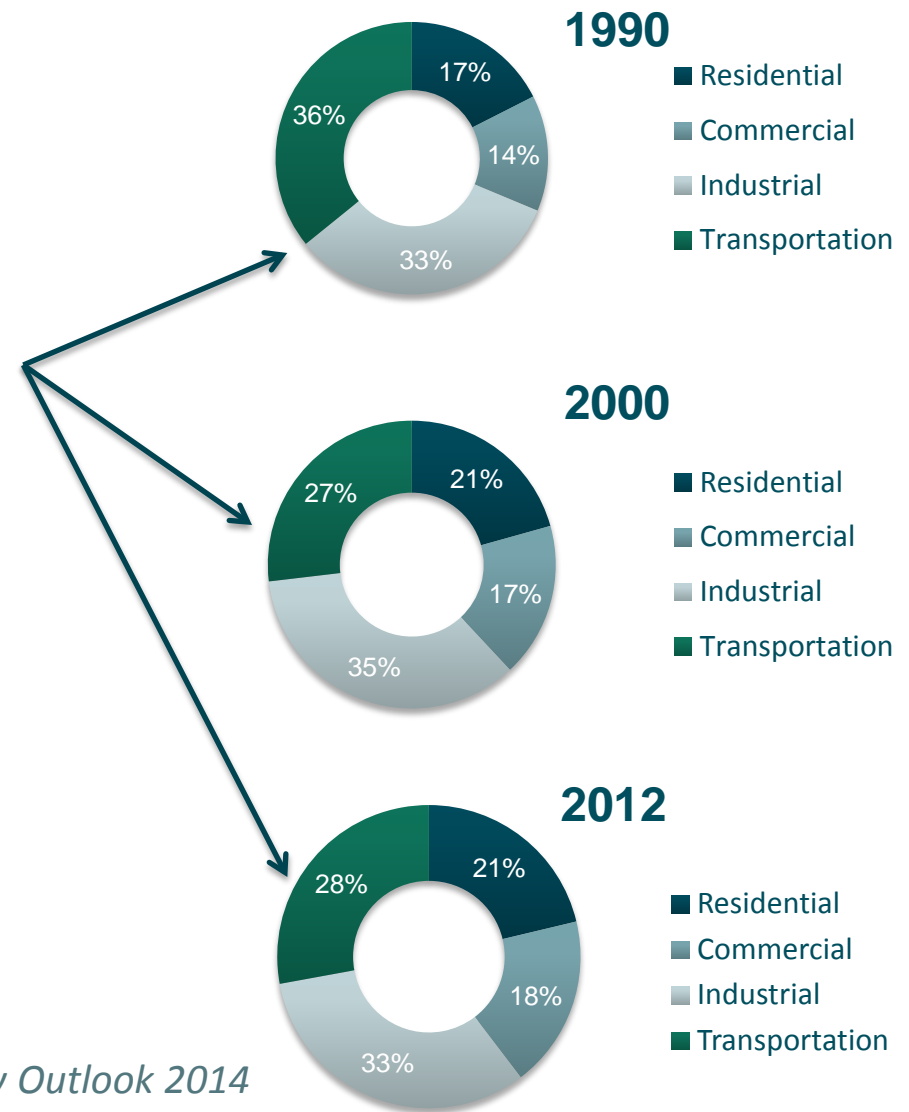
Myth 1:  
U.S. Industry is in decline, so why focus on  
industrial energy efficiency?



# Industry is still the Largest Energy User in the U.S.....

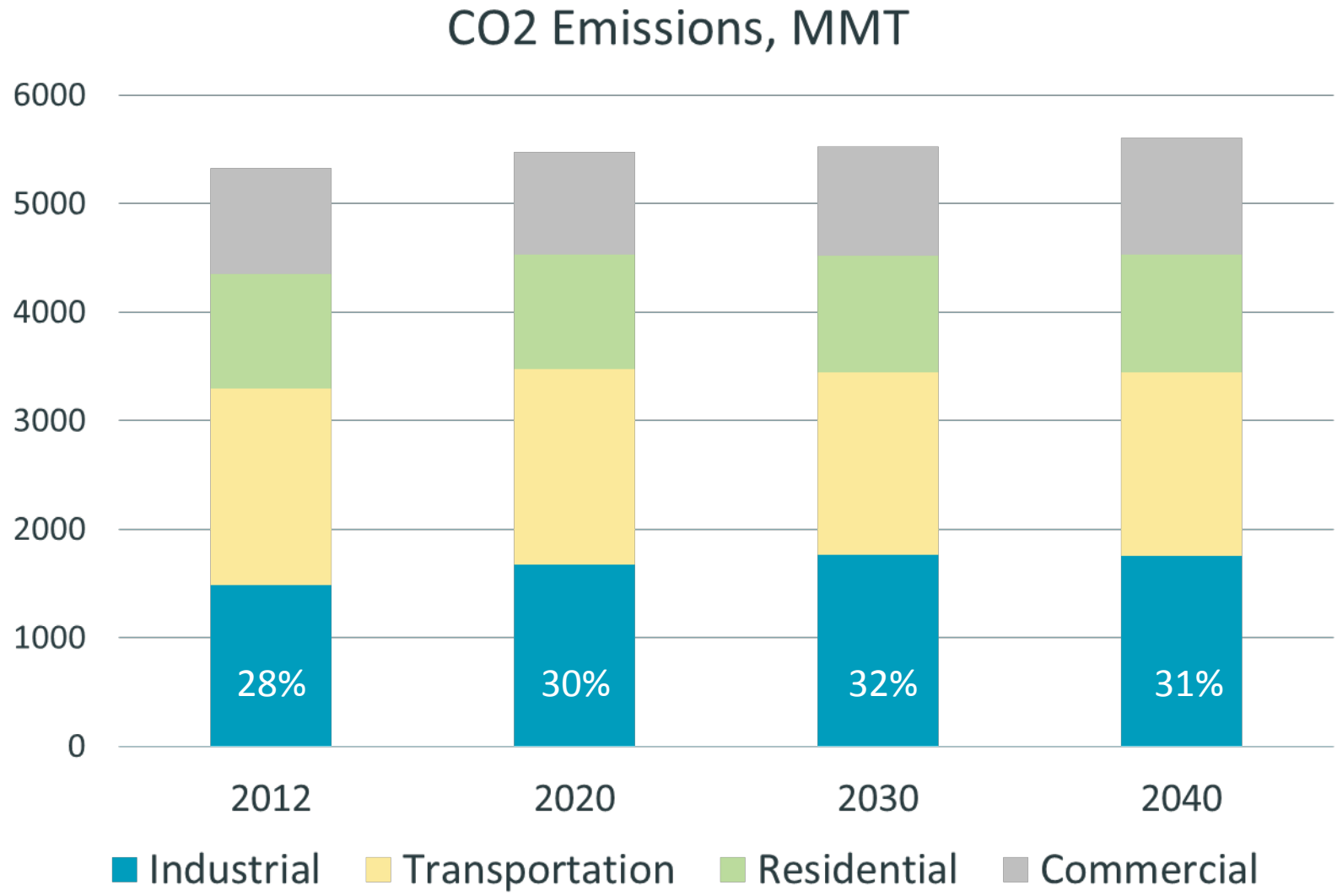
## The industrial sector:

- 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)**



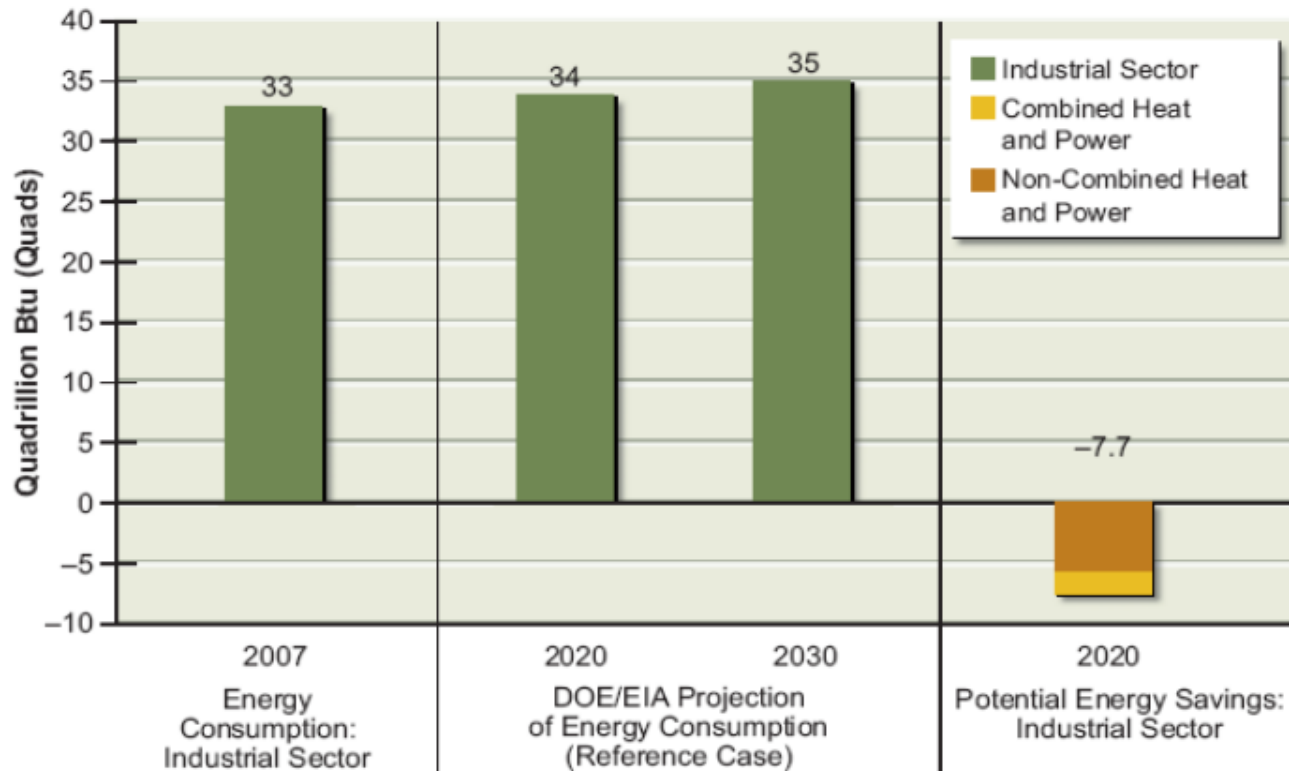
Source: Energy Information Administration Annual Energy Outlook 2014

# ....and will be the Largest Source of CO<sub>2</sub> Emissions in 2040



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

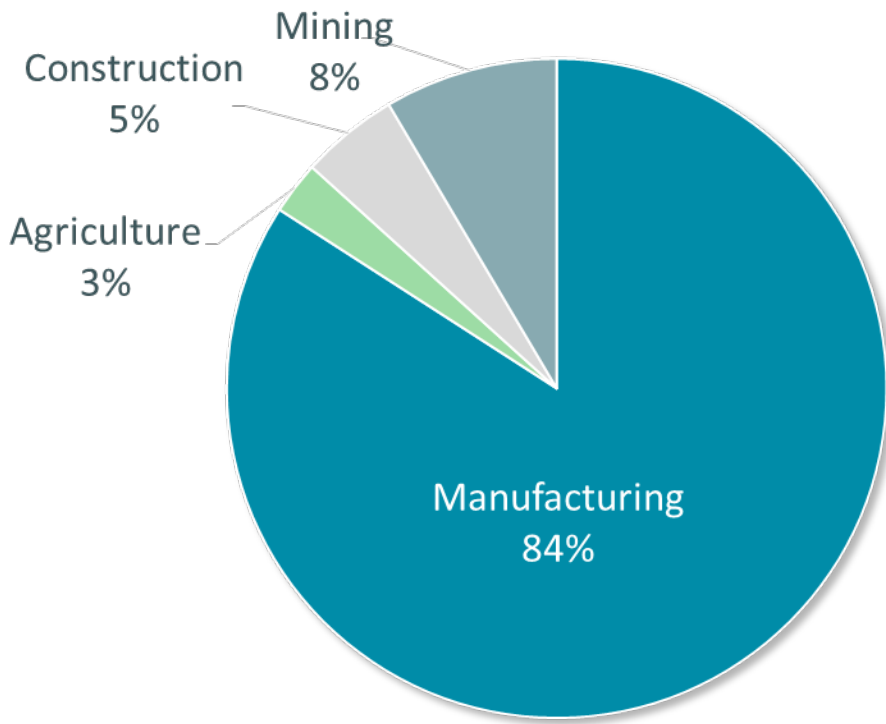


- States increasingly looking at IEE to meet EERS targets
- Federal and state initiatives moving to promote IEE
- Increasing focus on EnMS as path to greater and continuing IEE improvements
- Lower natural gas prices may reduce IEE economic drivers

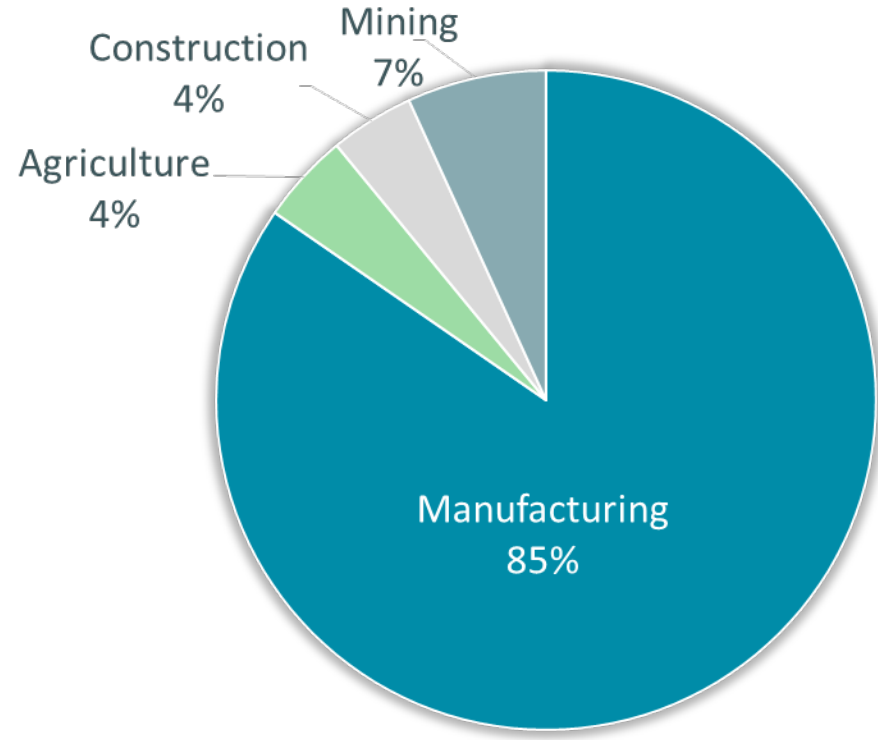
Source: National Research Council 2010.



# Manufacturing Is the Primary Target for Energy and Emissions Savings



Energy Use (2012)

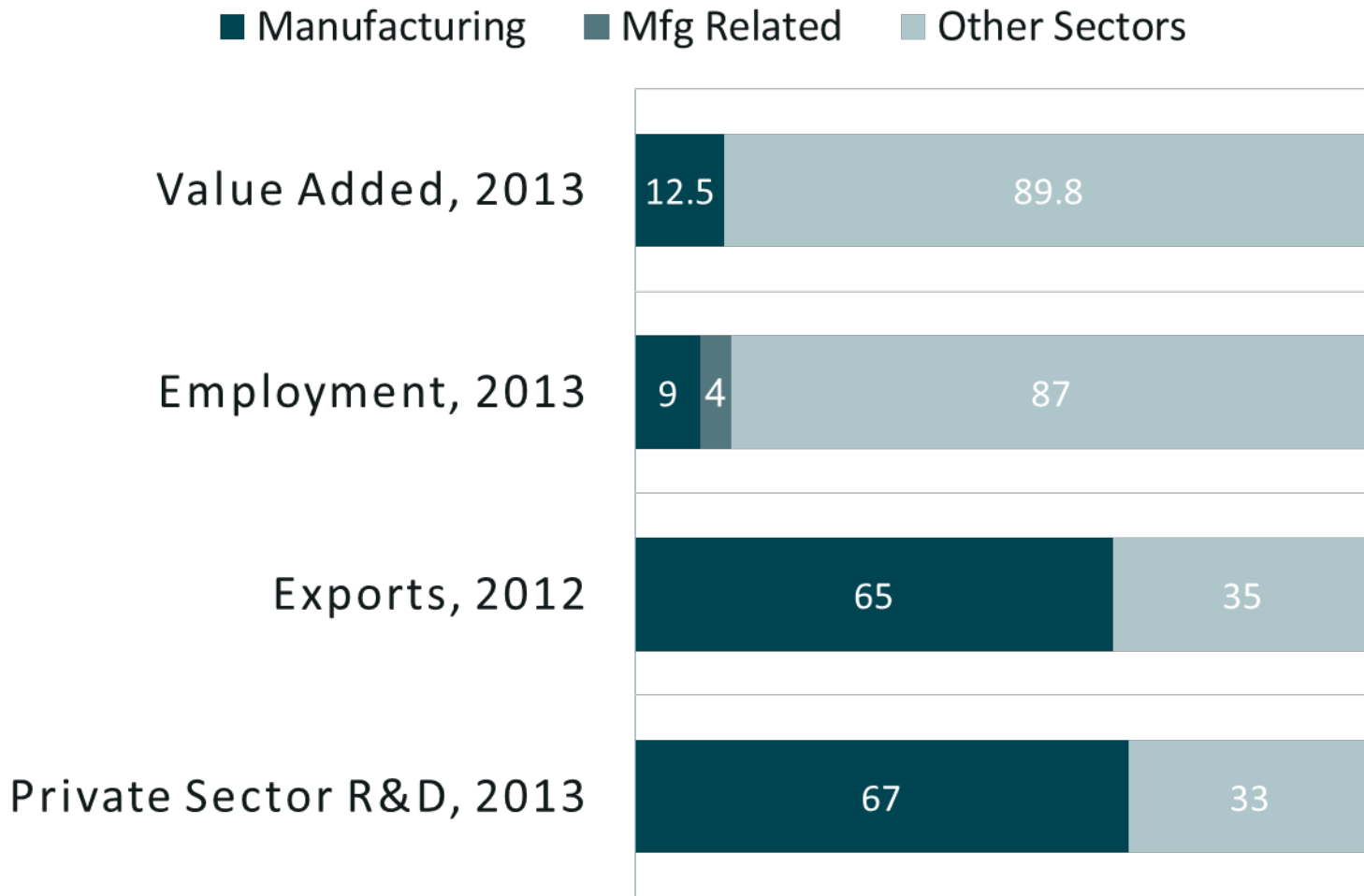


CO<sub>2</sub> Emissions (2012)

Source: Energy Information Administration Annual Energy Outlook 2014



# Manufacturing Contributes Disproportionately to the National Economy

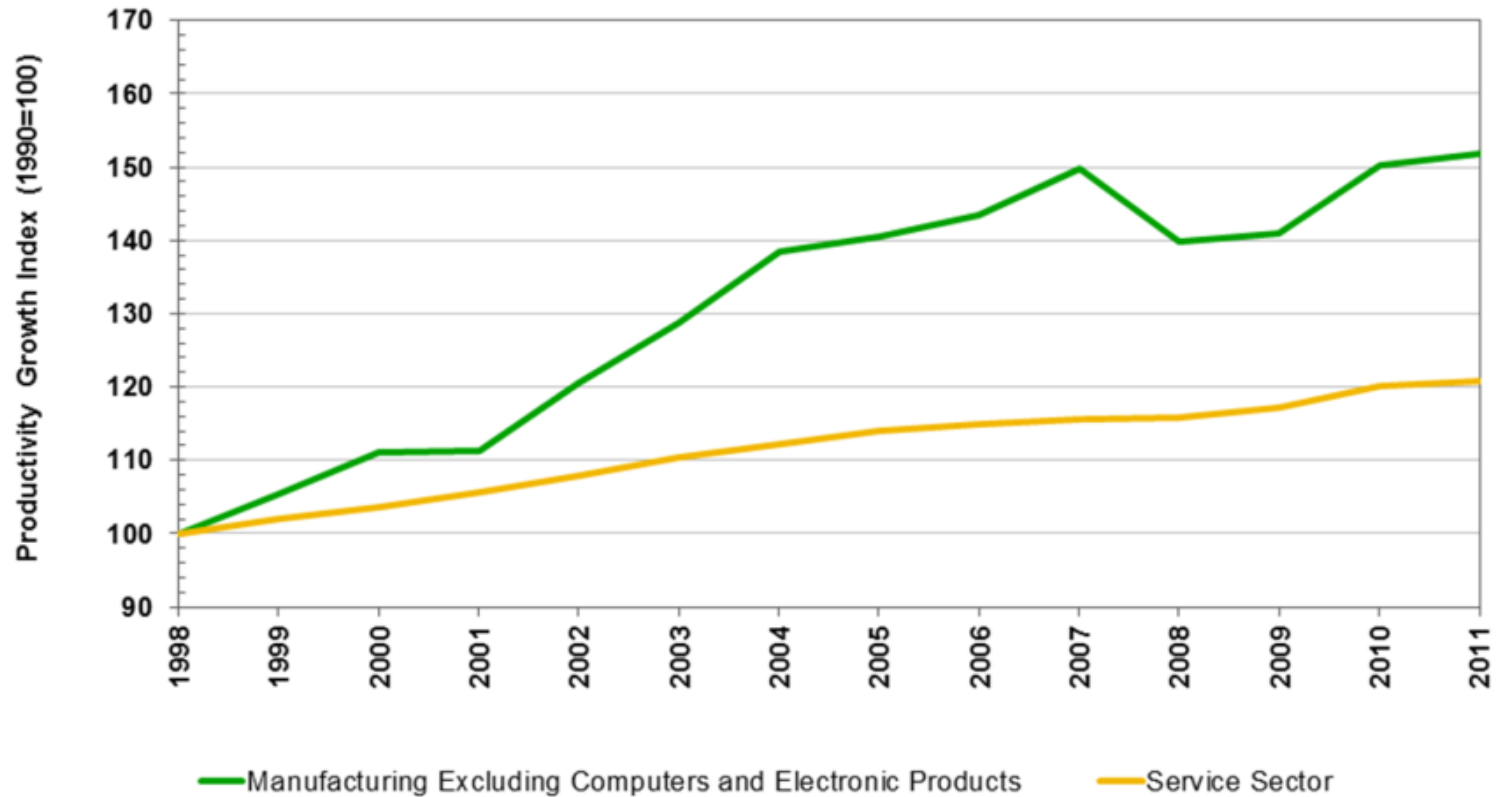


Value Added, Employment, Private Sector R&D from Bureau of Labor Statistics, Export data from Brookings and JP Morgan Chase

# Manufacturing Drives Productivity

## Manufacturing Drives Productivity Growth

(Updated January 2013)



Source(s): U.S. Bureau of Economic Analysis and MAPI



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# 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)



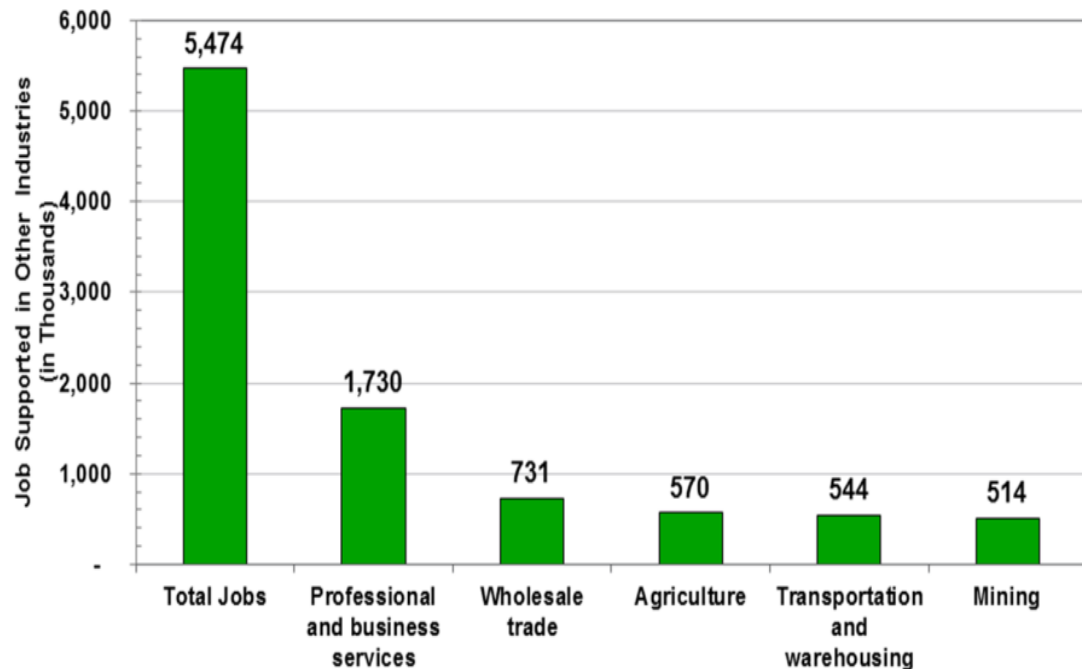
Source(s): U.S. Bureau of Economic Analysis, Annual Input-Output Tables



# Manufacturing Supports Jobs

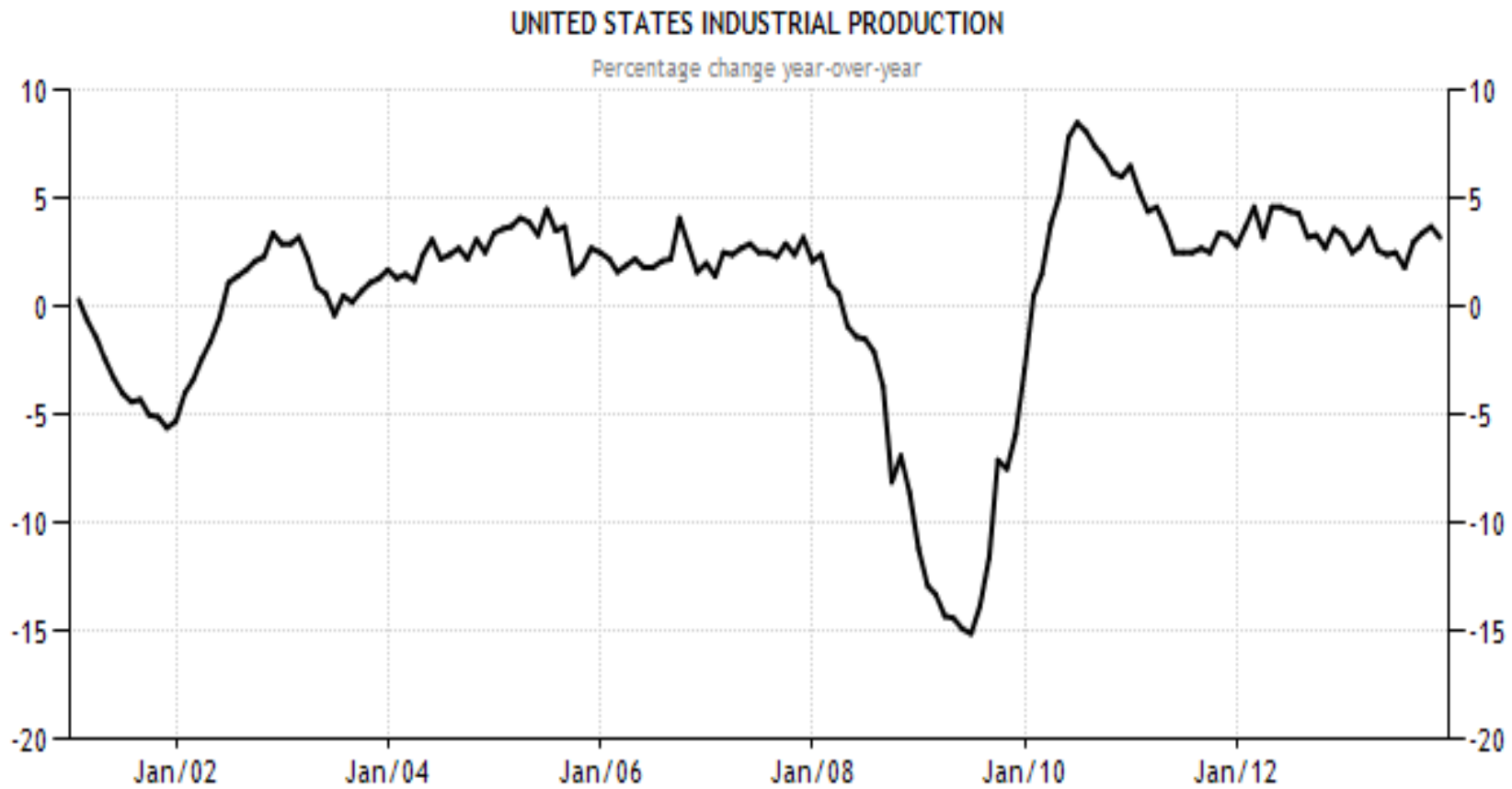
- Manufacturing supports one in six private jobs in the U.S.
- 12 million employed directly (2013)
- 5.5 million employed indirectly (2013)
- The average manufacturing worker earned \$77,505 annually in 2012 (pay and benefits)

**Manufacturing Supports Millions of U.S. Jobs in Other Sectors**  
(Updated April 2014)



Source(s): Estimated (E) from the U.S. Bureau of Economic Analysis, Annual Input-Output Tables

# Manufacturing Is Rebounding in the U.S.



SOURCE: WWW.TRADINGECONOMICS.COM | FEDERAL RESERVE

# 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*<sup>1</sup>:

*“...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)*

<sup>1</sup>Source: *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

### Project Economics

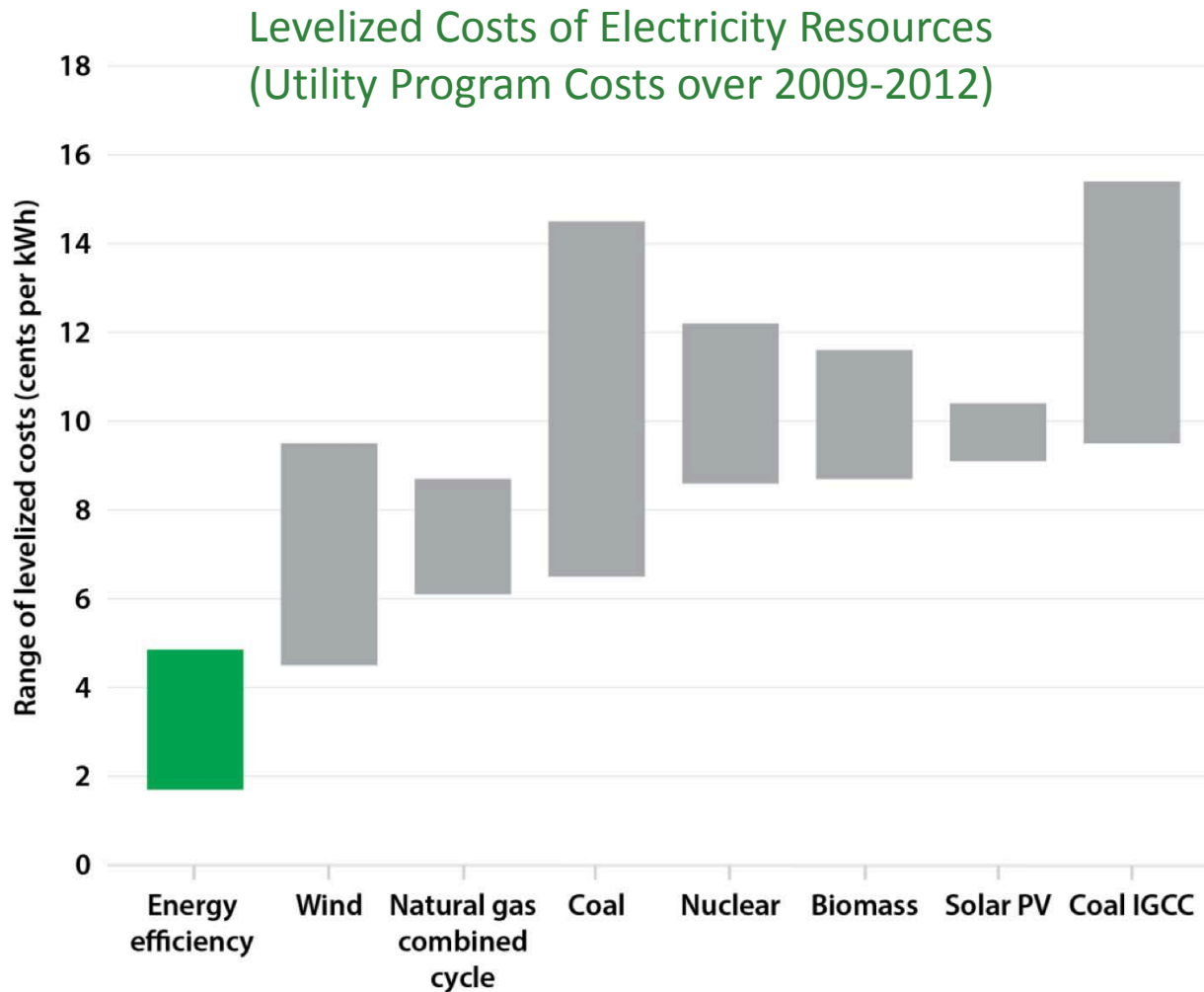
Total project costs	\$417,000
Annual energy savings	\$90,000
Annual non-energy savings	\$109,000
Total annual savings	\$199,000
Utility rebate	\$90,000
Simple payback, energy savings	4.63 years
Simple payback, total savings	1.64 years

*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



Source: ACEEE/Molina (2014). Energy supply data from Lazard (2013)

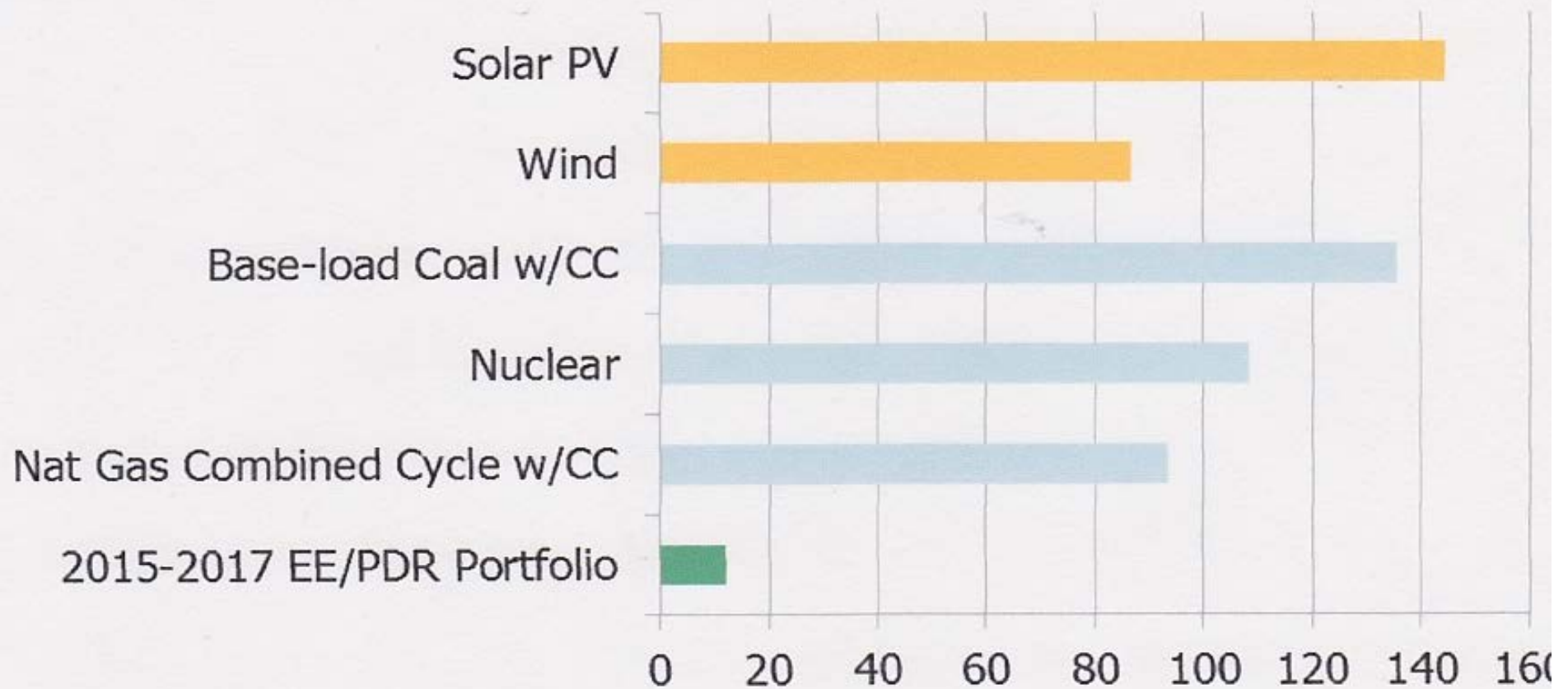
**Electric energy resources:**  
Cost of energy efficiency is cheaper than conventional supply side resources: EE program administrator costs average \$0.028 per kWh (Molina, 2014), compared to \$0.07-0.15 per kWh for supply resources (Nowak et al. 2013).

**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).

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

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

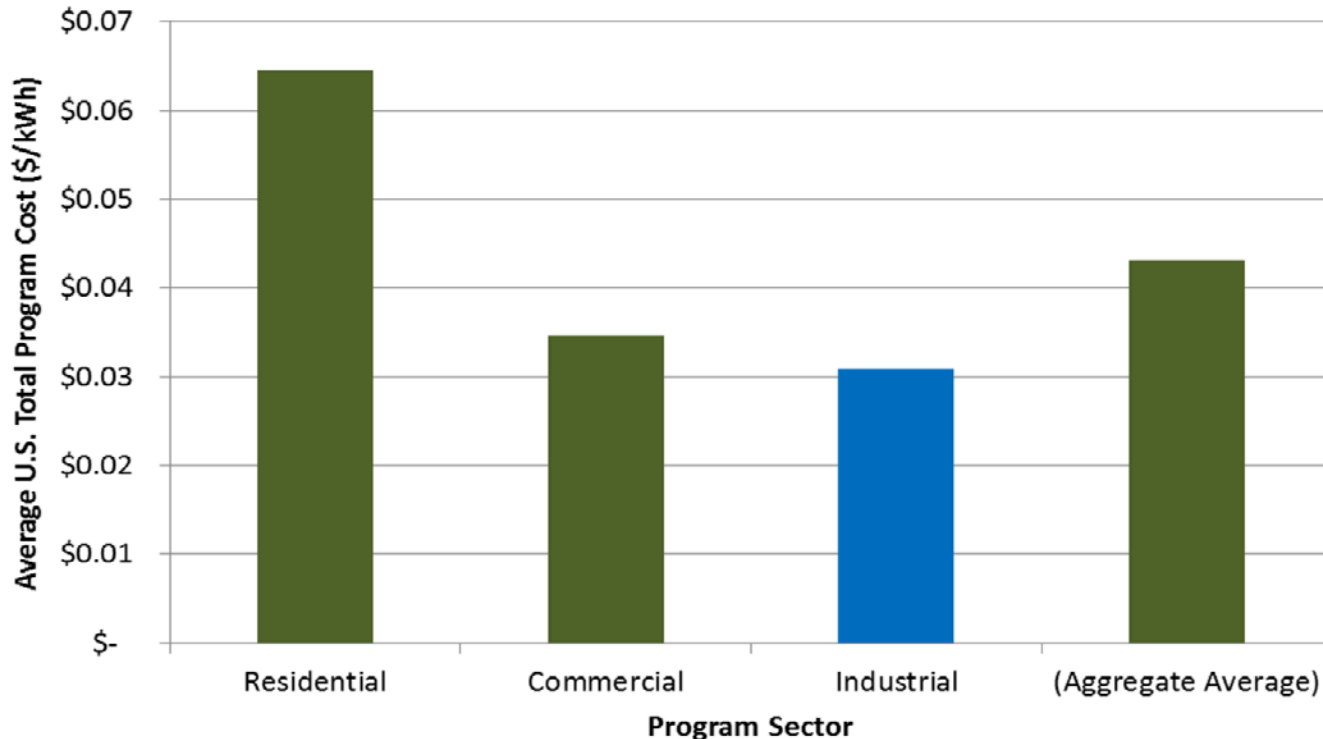
**\$/MWh**



Supply-side investments source: Energy Information Administration, Annual Energy Outlook 2013, January 2013, DOE/EIA-0383 (2012).

# Industrial Efficiency is the Most Cost-effective EE Option

## Cost of industrial EE resources vs. other customer classes



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](http://www.eia.gov/electricity/data/eia861)

- 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

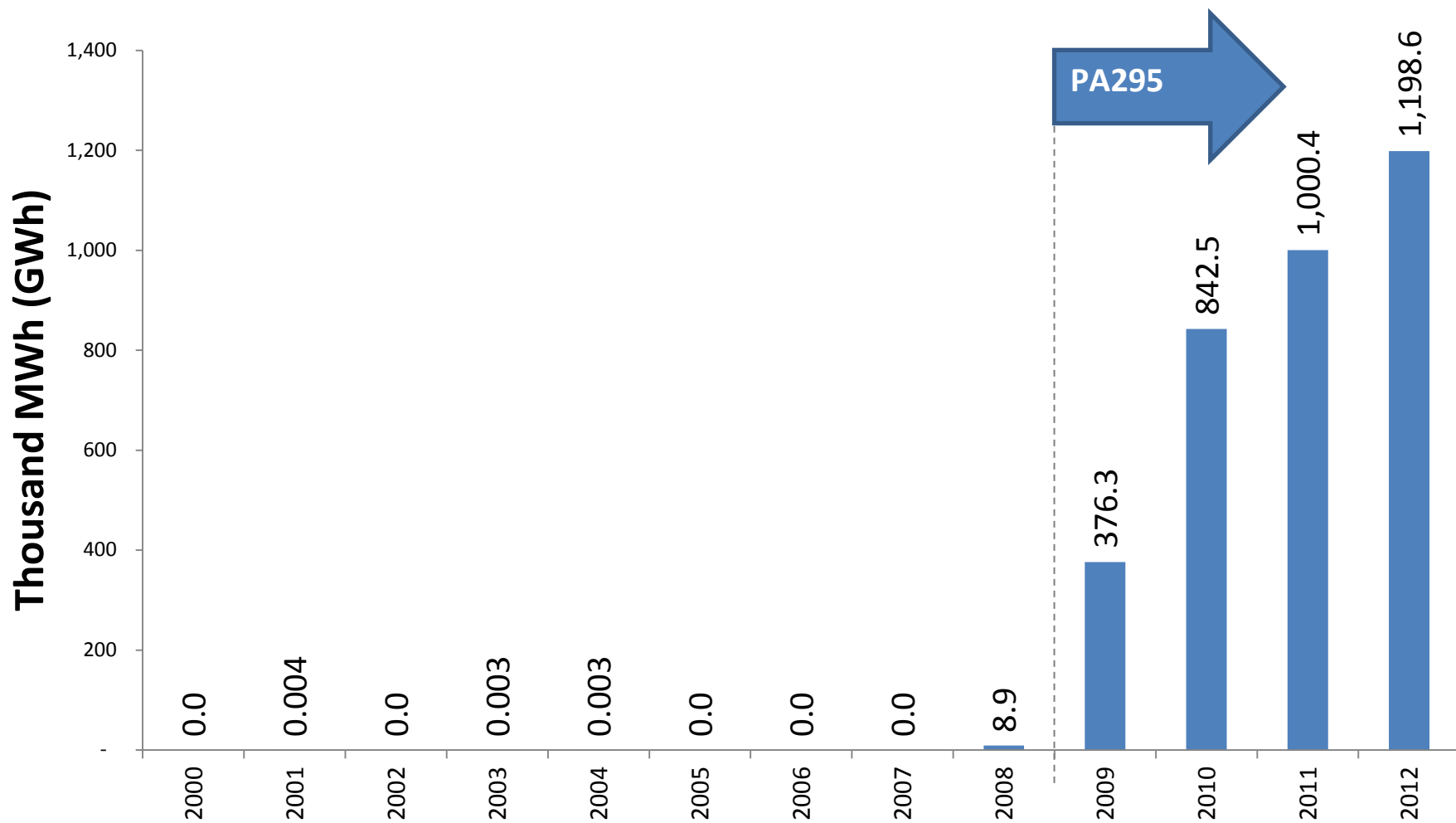
(LBNL/Billingsley et al. 2014)

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

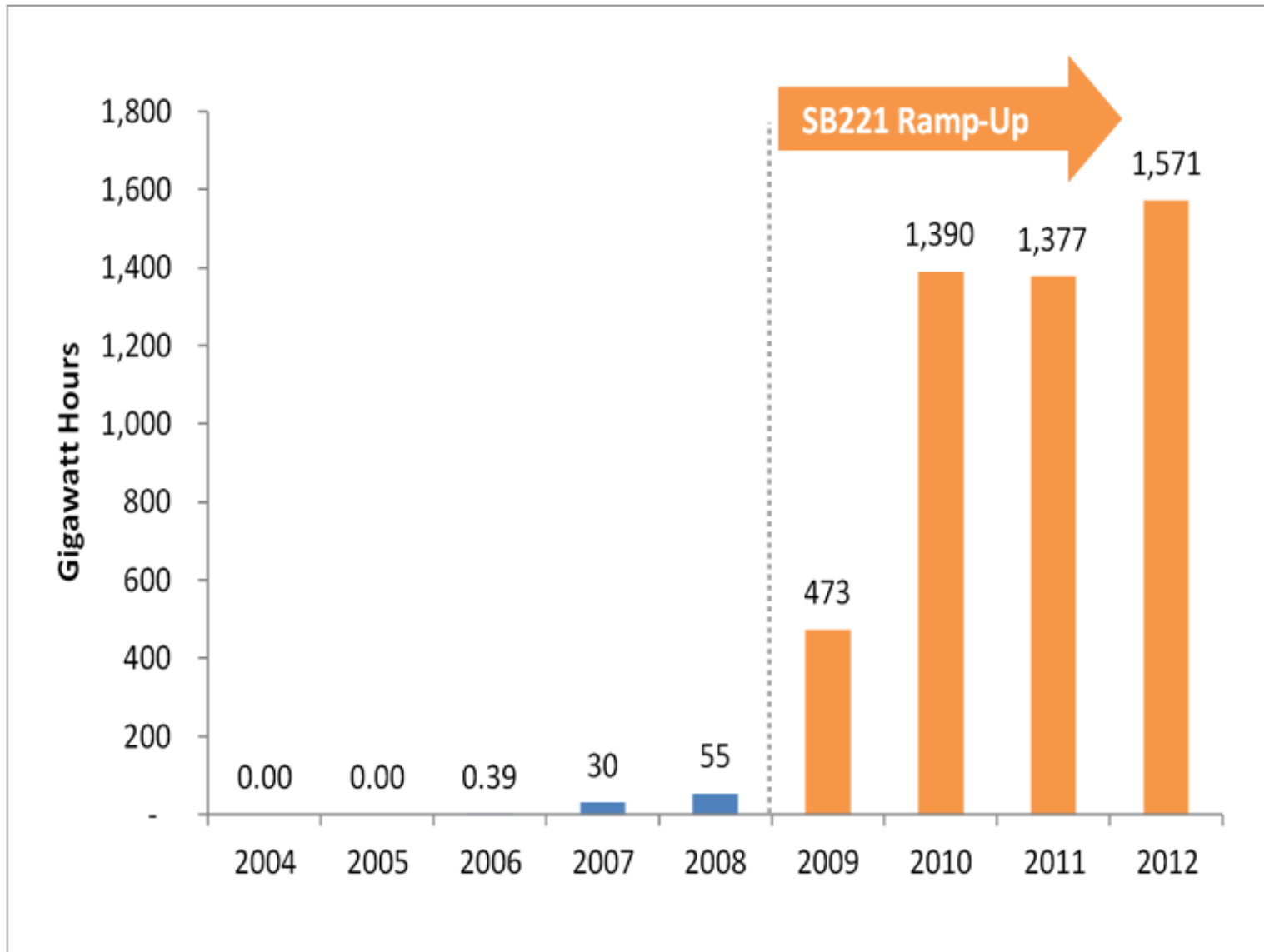
2009-2012: MPSC PA295 Annual Reports

[Graph by MEEA]



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# Ohio Electric Savings from Energy Efficiency



Sources:

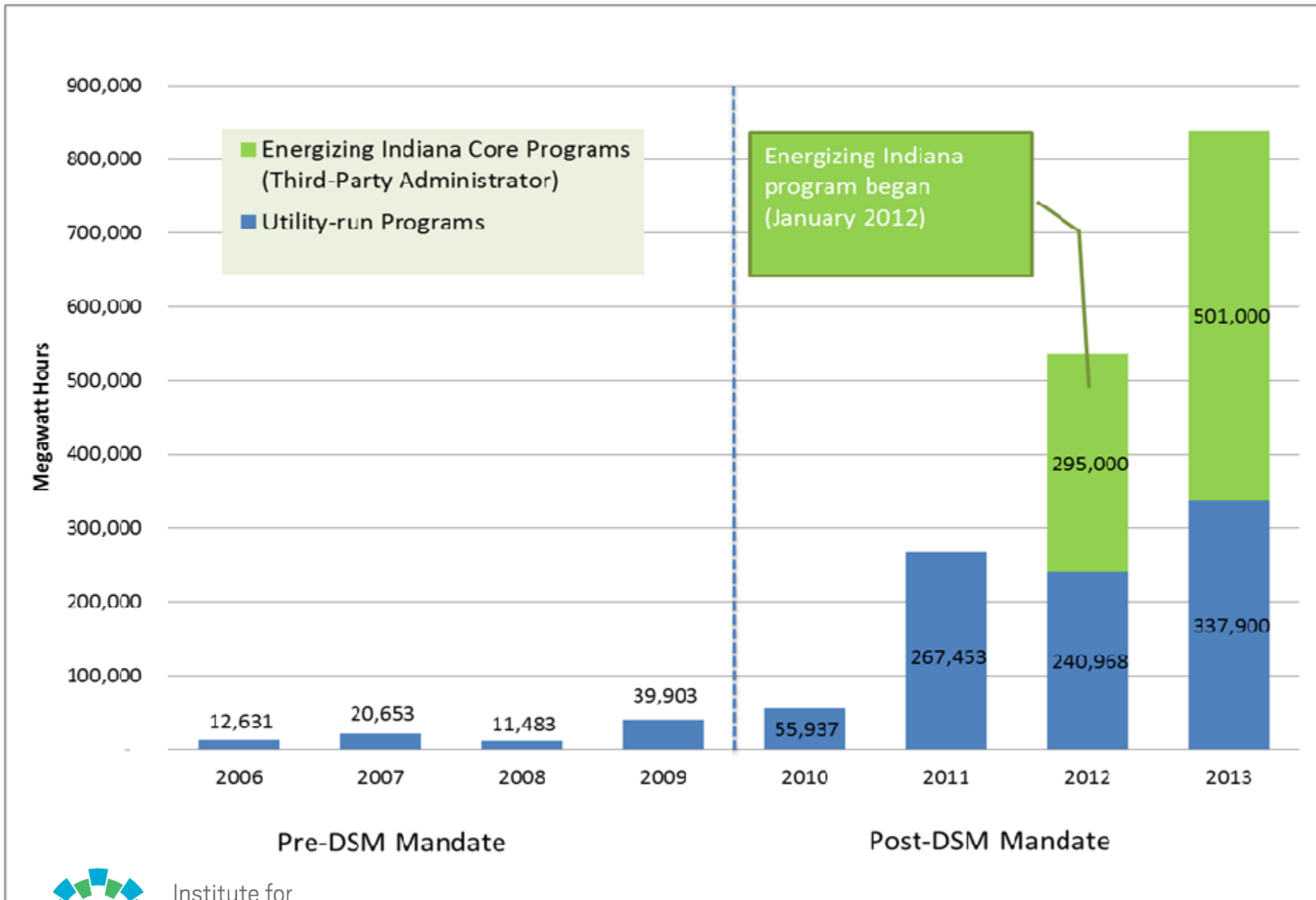
2004 - 2008: ACEEE Scorecard data

2009-2012: Utility findings under SB221



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# Indiana Electric Savings from Energy Efficiency

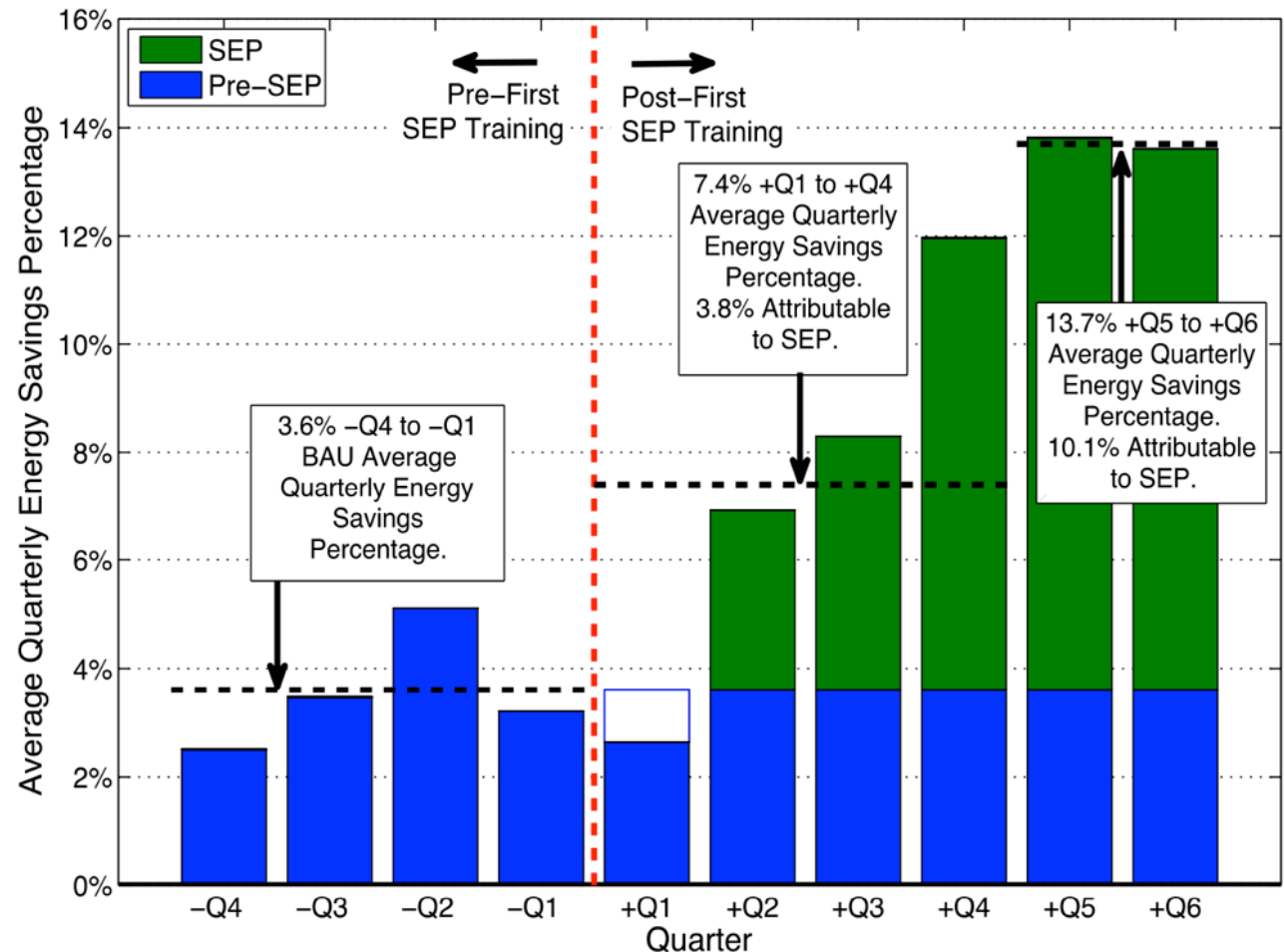


# DOE's Superior Energy Performance (SEP) Program

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

Pre-SEP ← → Post 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

## 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

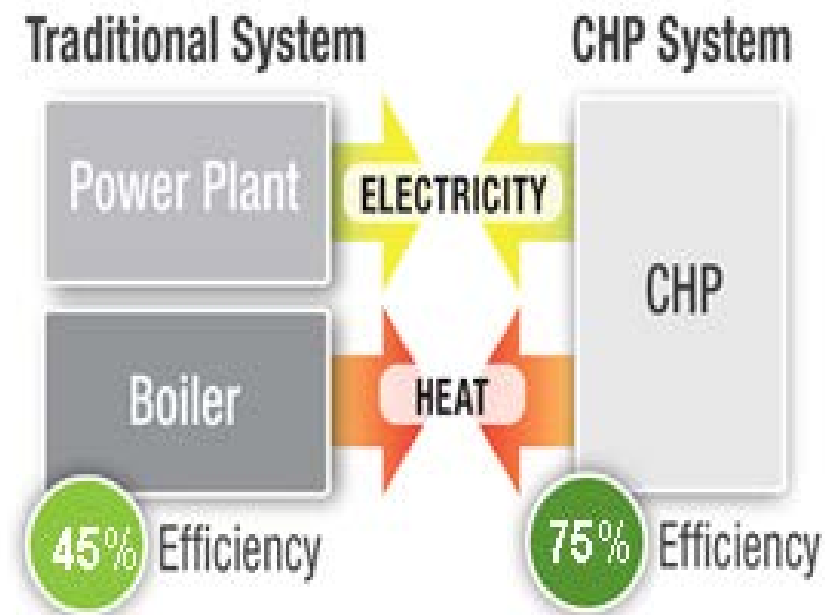
## Existing:

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

## In Process:

- Minnesota

## CHP Process Flow Diagram





# 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 ( $\geq$ 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%2011-18-10.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