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Module 5
Industrial Energy Efficiency as a Method to Comply with Air Rules

Electric Energy Training
for Air Regulatory & Planning Staff
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Module Five: 4:15-5:00 PM

- Industrial Energy Efficiency as a Method to Comply with Air Rules

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Objectives of Industrial Energy Efficiency Module

- Increase familiarity with the types of industrial energy efficiency
- Energy, economic, environmental benefits
- Ways in which EPA could incorporate industrial EE to improve air quality, and reduce toxic and greenhouse emissions
- Other opportunities to increase industrial EE

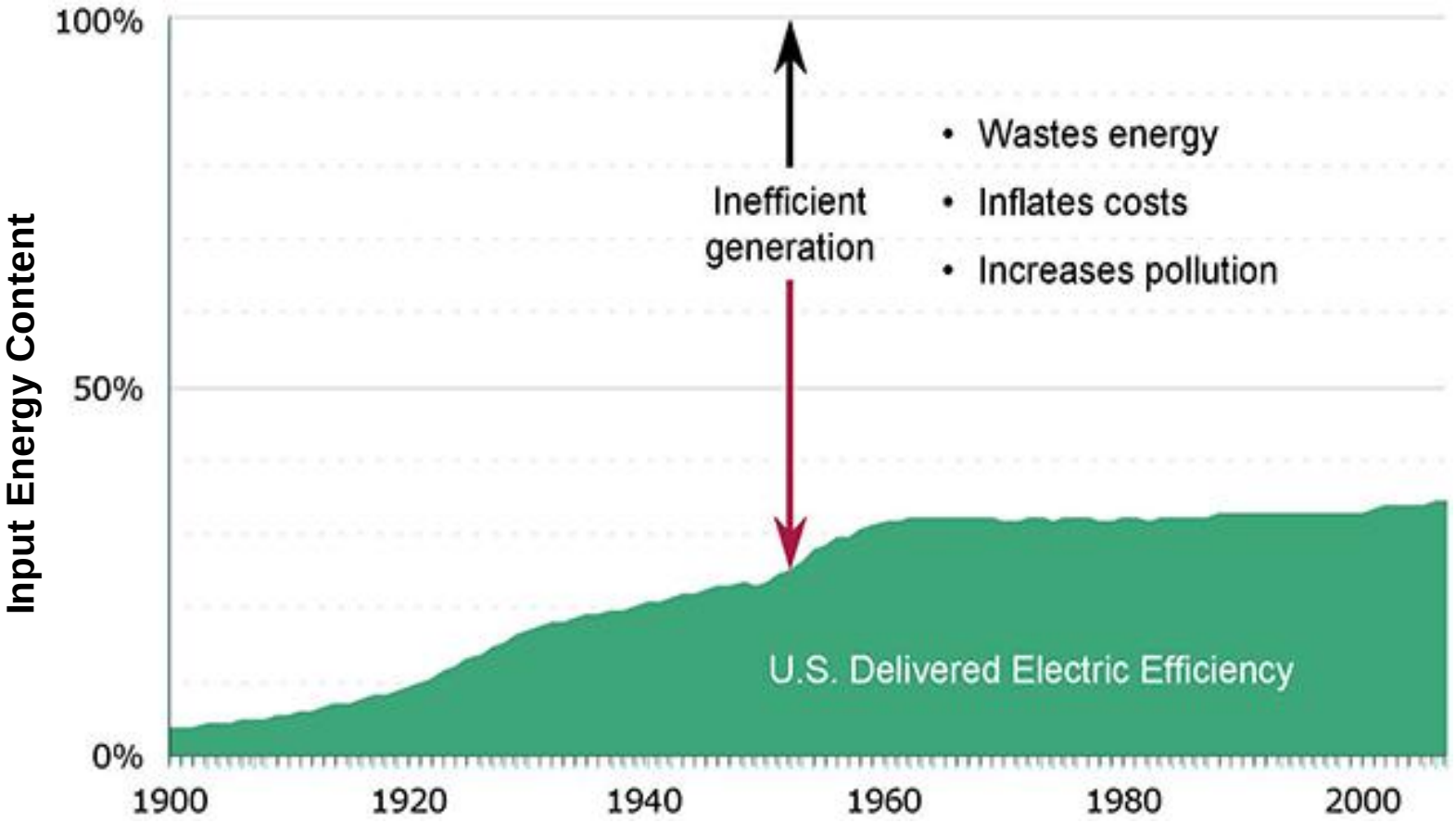
Industrial EE Examples

- On-site combined heat and power production (CHP)
- Improved processes
- Plant design and layout

Combined Heat and Power (CHP)

- Also called “co-generation”
- The average US power plant is ~33% efficient (unchanged since the 1950s). New BACT coal plants can achieve ~44% efficiency. CHP achieves minimum 67% efficiency and as high as 80-90%.
- Result: Same MW of electricity produced for 33-50% less fuel consumption (and emissions)
- Synching power to on-site load reduces transmission losses, which can be as high as 20% during HEDD
  - On these peak days, it can take 5 power plants to produce 4 power plants’ worth of electricity

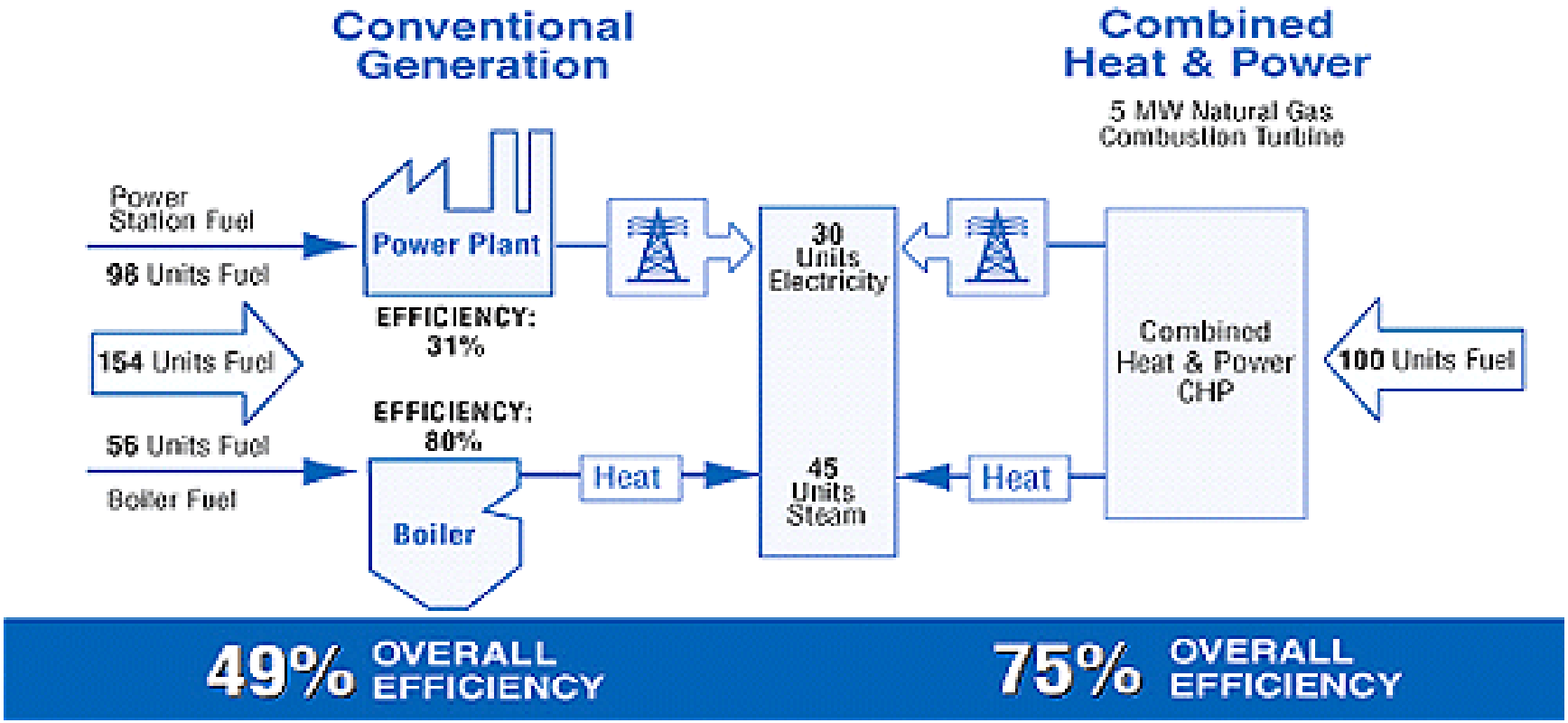
Average US Efficiency Has Changed Little Since Eisenhower was President



Significant Capacity for CHP in the US

- CHP provides about 7% of power in US today.
  - CHP potential is at least twice this quantity.
  - Potential to reduce total US GHG emissions by 20%, as well as criteria pollutant emissions
- CHP provides 50% of power in Denmark, 40% in Finland, and 12% in China
- CHP
  - When electricity and thermal energy are combined, is lower cost than conventional generation, and
  - can lower regional electricity costs and emissions by avoiding need to use less-efficient peaking generation
  - Can help maintain reliability without needing to build or upgrade transmission

CHP vs. Conventional Power & Heat



CHP Case Studies

- NC Solar Center, Raleigh:
  - 4.7 kW microturbine, 47,000 Btu/hr
  - 5.4 kW PV
  - Provides heating, hot water, cooling, dehumidification
  - Eligible for 35% investment tax credit
- UNC, Chapel Hill
  - 32 MW boiler (120 MW campus load)
  - Provides steam, chilled water, electricity to 175 campus buildings
  - Operating since 1939, upgraded in early 1990s
  - 70% thermal efficiency

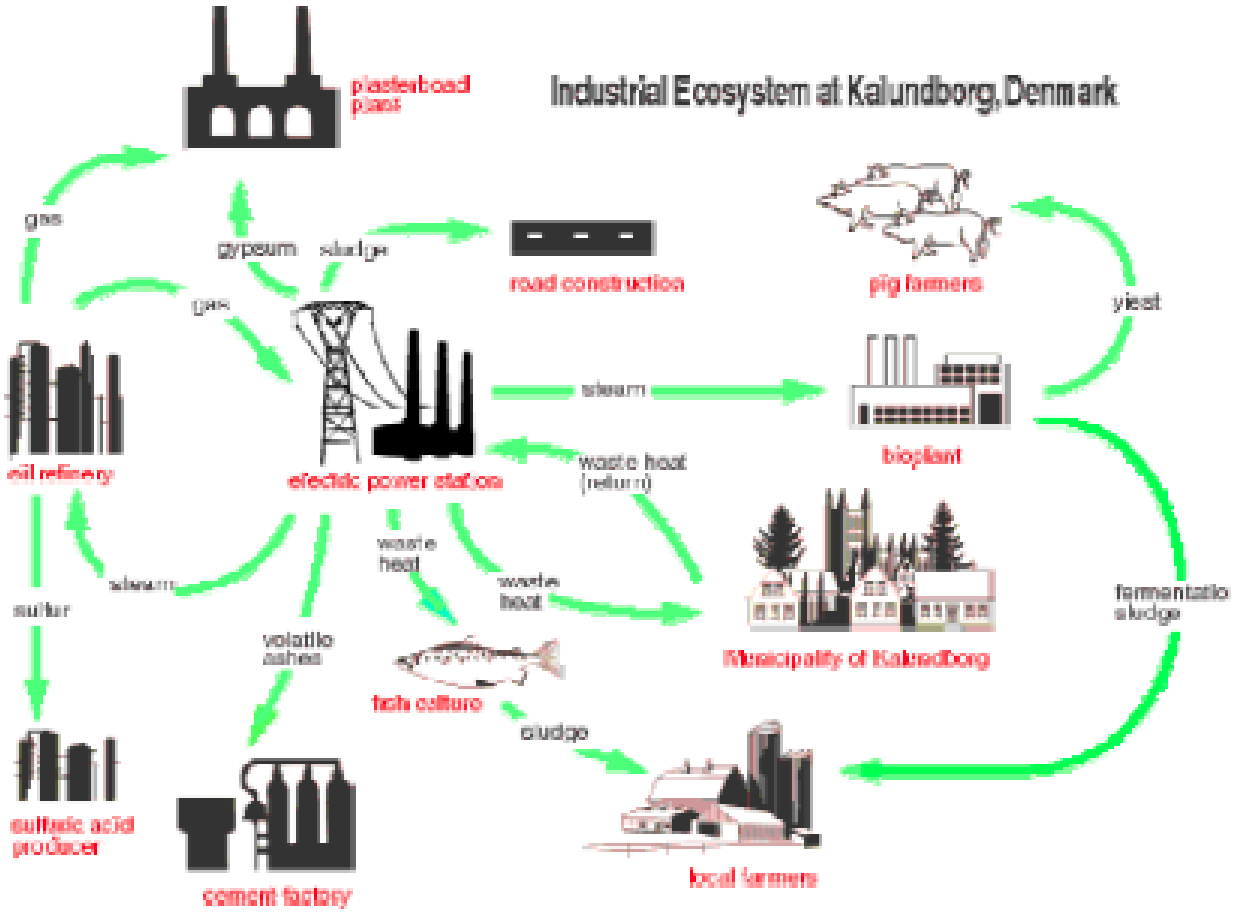
Improved Industrial Processes: Challenge the Engineers and Designers

- Concept: Think about product design, manufacturing across entire supply chain
- Can a product's functionality be the same or better with fewer parts?
- Apply same standards to all suppliers, regardless of their size
- Locate industrial enterprises to encourage re-use of "waste" products among factories

Industrial Symbiosis

- Industrial ecology: Waste stream from one plant used as feedstock input at another
- "Design for the Environment" (DFE): EPA partnership with industrial sectors
  - Developed best practices guide, DFE product label
- EPA flexible permit program per Title V

Kalundborg, Denmark is Considered to Be Best Example of Industrial Ecology



Hierarchy of Environmental Technologies

Technology	Point of Application	Characteristics	Examples
Remediation Technologies	• symptoms • damaged resources or environments	• after the fact • costly • range from low tech to high tech	• soil remediation • toxic site clean-ups • water treatment
Abatement Technologies	• pollutant capture or treatment at end-of-pipe	• captures or treats pollutants before release • consumes capital, energy and resources • generates waste steam • fairly costly	• flue gas desulfurization • sewage treatment plants • catalytic mufflers
Pollution Prevention Technologies	• industrial process design • product design or composition	• changes product or process or reduce or prevent pollution • more cost effective that abatement • reduced waste steam	• chlorine-free paper • cyanide-free electroplating • lead-free gasoline • industrial process design
Sustainable Technologies	• alternate product or service	• multiple benefits: environmental, economic, social, resource efficiency	• efficient lighting • recycled paper • renewable energy • bio-cosmetics and drugs

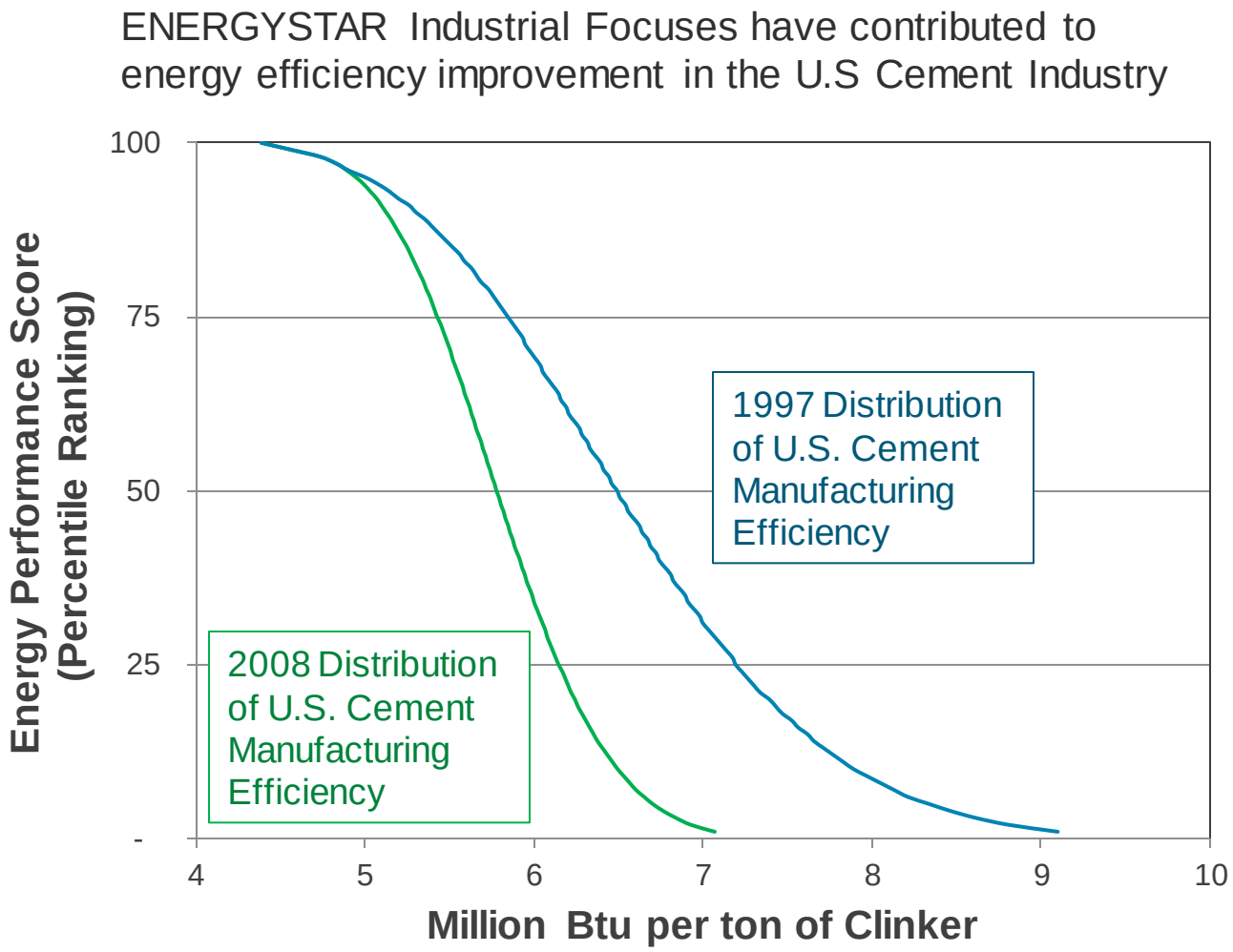
Industrial Process Design

- Reduce energy consumption requirements through plant design
- Larger pipes with straight runs, smaller pumps
  - Interface carpet plant in Shanghai reduced consumption 90% compared to conventional design; “short, fat pipes reduce friction”
- Whole building systems thinking enabled chip factory design to be built at 30% lower cost, saving $230 million, and built in Texas

EPA is Recognizing EE in Recent EPA MACT Rules and Through EnergyStar Partnerships

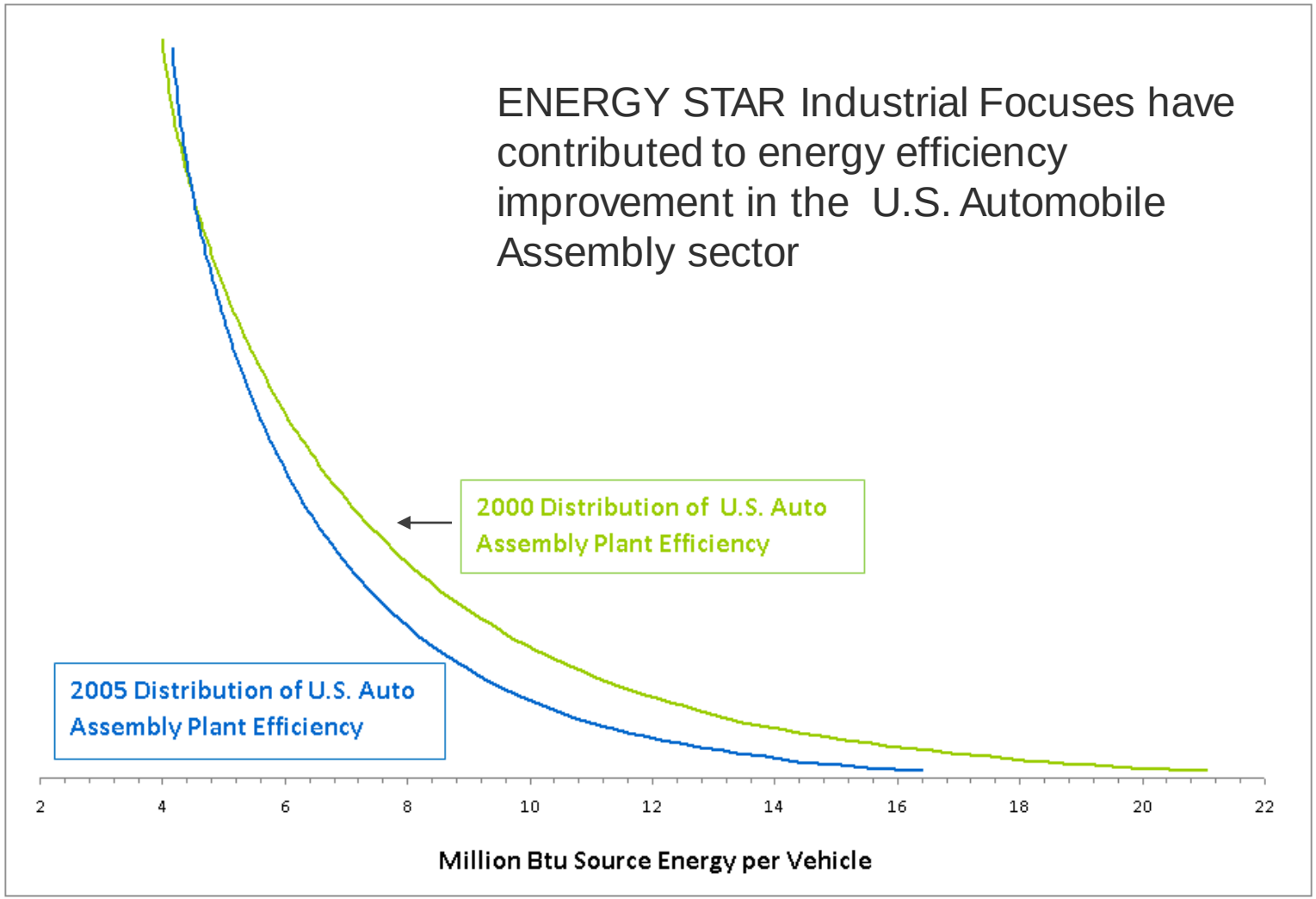
- Boiler MACT: Workplace standards, energy audits and output-based emission standard option
- Utility MATS: Sensitivity analysis reflects that compliance costs are reduced through EE
- EnergyStar program
  - Network with 800 corporations
  - Challenge for industry
  - Has improved energy performance in several sectors, including cement and automotive (next slides)

Results: Industrial Focus



- Energy intensity improved 13 percent.
- The energy performance of the industry's least efficient plants changed most dramatically.
- Total source energy savings are 60.5 trillion Btu annually.
- Environmental savings are 1.5 million metric tons of energy-related carbon.

Results: Industrial Focus



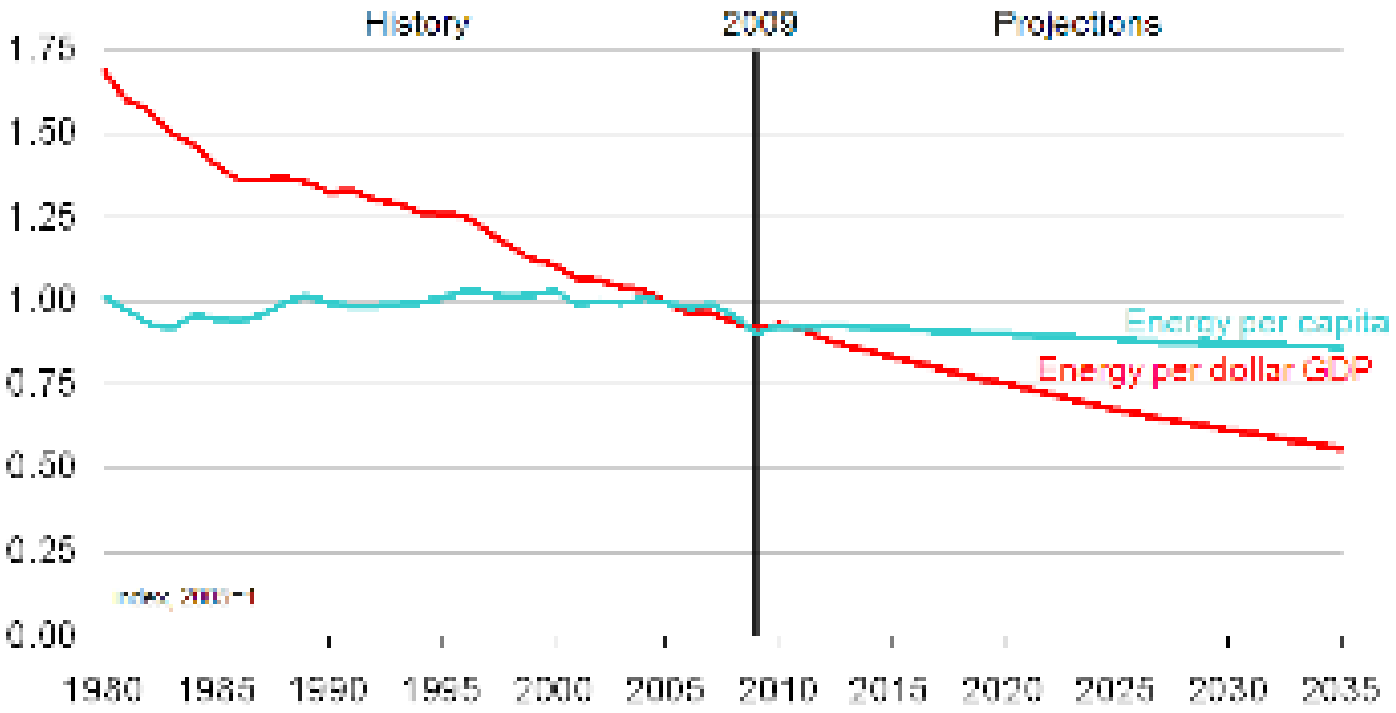
Source: EPA, Duke University

Benefits of Industrial EE

- Measures highly cost-effective, many have negative payback (i.e., cost savings)
- Improves economic competitiveness
- Energy savings improve profit margin
- Improved worker conditions
- May be eligible for lower insurance premiums due to reduced occupational exposure and risk
- Also all the other benefits associated with EE, as discussed in Module 2

EPA Analysis of EE in Rulemaking

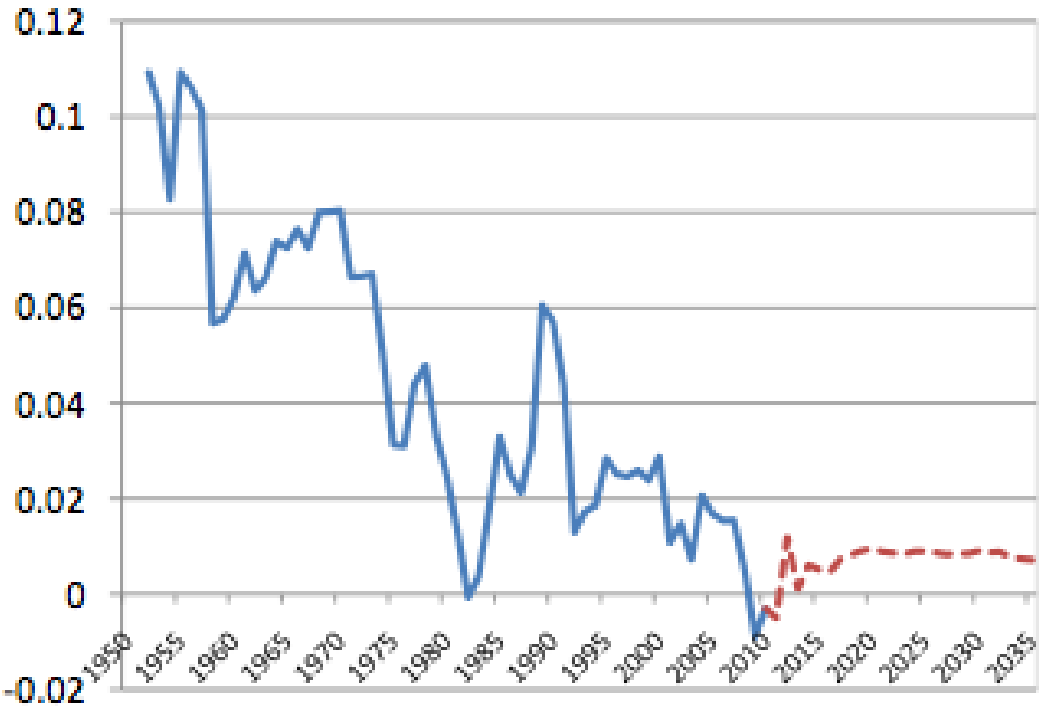
Figure 7-8. Energy Use per Capita and per 2005 Dollar of GDP



Source: EIA AEO 2011

EE Could Satisfy Much of Future US Load Growth

Figure 7-9. Electricity Growth Rate (3 Year Rolling Average) and Projections from the Annual Energy Outlook 2011



Source: EIA Annual Energy Review 2009 and Annual Energy Outlook 2011

EPA's RIA for the MATS Rule Reflects Reduced Compliance Costs Through EE

Table D-2. Electric System Generation & Energy Efficiency Costs (billions of 2007$)

	2015	2020	2030
Total Costs			
Base Case	$144.3	$155.2	$200.4
Base Case w/ Energy Efficiency (EE)	$142.3	$150.3	$189.8
Toxics Rule Case	$155.2	$165.3	$210.3
Toxics Rule Case w/ Energy Efficiency (EE)	$152.9	$159.3	$198.9
Incremental Costs			
Base to Base w/EE	-$2.0	-$4.9	-$10.6
Toxics Rule to Toxics Rule w/EE	-$2.3	-$6.0	-$11.4
Base to Toxics Rule	$10.9	$10.1	$10.0
Base with EE to Toxics Rule w/EE	$10.5	$9.0	$9.1
(Base to Toxics Rule) to (Base w/EE to Toxics Rule w/EE)	-$0.3	-$1.1	-$0.8

Source: Integrated Planning Model run by EPA, 2011, and EPA estimates of energy efficiency policy costs.

EPA's RIA for MATS Also Shows that EE Would Reduce Electricity Costs

Table D-3. Projected Contiguous U.S. Electricity Prices Including Energy Efficiency Costs (2007 cents/kWh)

	2015	2020	2030
Base Case	9.01	8.94	10.16
Base Case w/ Energy Efficiency (EE)	8.95	8.54	9.72
Toxics Rule Case	9.35	9.17	10.35
Toxics Rule Case w/ Energy Efficiency (EE)	9.31	8.80	9.93
Incremental Price Changes			
Base to Base w/EE	-0.07	-0.40	-0.44
Toxics Rule to Toxics Rule w/EE	-0.04	-0.38	-0.42
Base to Toxics Rule	0.33	0.23	0.19
Base with EE to Toxics Rule w/EE	0.36	0.26	0.21
(Base to Toxics Rule) to (Base w/EE to Toxics Rule w/EE)	0.03	0.02	0.02

Source: Integrated Planning Model run by EPA, 2011, EPA's Retail Electricity Price Model, and EPA estimates of energy efficiency policy costs.

MATS RIA Reflects that EE Would Reduce All Emissions

Table D-6. SO2 Emissions Impacts Including Energy Efficiency Cases (million tons)

	2015	2020	2030
Base Case	3.89	3.87	3.71
Base Case w/ Energy Efficiency (EE)	3.86	3.84	3.67
Toxics Rule Case	1.84	1.85	1.90
Toxics Rule Case w/ Energy Efficiency (EE)	1.80	1.78	1.85
Incremental Emissions Impacts			
Base to Base w/EE	-0.03	-0.03	-0.04
Toxics Rule to Toxics Rule w/EE	-0.04	-0.08	-0.05
Base to Toxics Rule	-2.05	-2.01	-1.81
Base with EE to Toxics Rule w/EE	-2.06	-2.06	-1.82
(Base to Toxics Rule) to (Base w/EE to Toxics Rule w/EE)	-0.01	-0.04	-0.01

Source: Integrated Planning Model run by EPA, 2011

How Could EPA Expand EE as Means to Comply with Air Quality Rules (1)

- Credit for avoided line losses for CHP and EE
  - Average line loss is 5%; during peak demand periods, it can be as high as 20%
- EE as consideration in BACT review for new/modified sources
  - Output-based performance standard (i.e., lbs pollutant per ton of production)

How Could EPA Could Expand EE as Means to Comply with Air Quality Rules (2)

- Flexible permits
  - Premise-wide
    - Precedent: EPA P4 program for Title V (late 1990s)
  - Use EnergyStar sector performance as benchmark (i.e., facility performance in top quartile for the sector)

Caveats on Industrial EE

- Lowest cost energy efficiency is not necessarily most valuable energy efficiency
- **Identifying** highest avoided cost times and places and end uses and **targeting** programs at them can maximize value, though at potentially higher cost per saved kWh

Opportunities (1)

- Shaheen-Portman Energy Savings and Competitive Act (2011) (passed Senate committee)
  - Goal of zero-net energy homes by 2030
  - Establish revolving loan program to finance efficiency upgrades
  - Pay-As-You-Save program for rural electric cooperative customers
  - Requires federal government to adopt more energy savings techniques

Opportunities (2)

- EU Pollution Prevention Directive (multi-media) applied to entire premise.
  - Possible US application as BACT?
- Multi-pollutant planning processes
  - EPA is working with NY, NC, St Louis, Detroit
  - Bay Area AQMD 2010 Clean Air Plan
- What other opportunities can you think of?

Question and Answer Period

- What could EPA do to remove barriers/increase penetration of EE/RE/DR/DG in industrial energy efficiency?
- Thank you!