Benchmarking Industrial Plant Energy Efficiency

How EPA's ENERGY STAR® Program Helps Industry Improve Energy Efficiency

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ENERGY STAR Industrial Partnership
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Learn more at energystar.gov

ENERGY STAR

- Voluntary government partnership
  - ***Goal: reduce carbon dioxide emissions***
  - Introduced by EPA in 1992 to enable companies to improve in energy efficiency
- The national symbol of energy efficiency and environmental protection
  - Awareness exceeds 70% of U.S. households
  - A brand owned and managed solely by the government
- Focused on improving energy efficiency of:
  - Products
  - Homes
  - **Plants & buildings**
- For industrial businesses, EPA helps manufacturers improve strategic energy management.

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ENERGY STAR & Industry

- EPA's goals:
  - ***"Shift the curve" of energy performance for manufacturing industries***
  - Identify the transformative practices to achieve top energy performance
  - Help companies succeed in achieving top performance

Barriers to energy efficiency prevent progress

- *Lack of objective measurement methods*
- *Scarce information on how to improve*
- *Lack of corporate commitment*

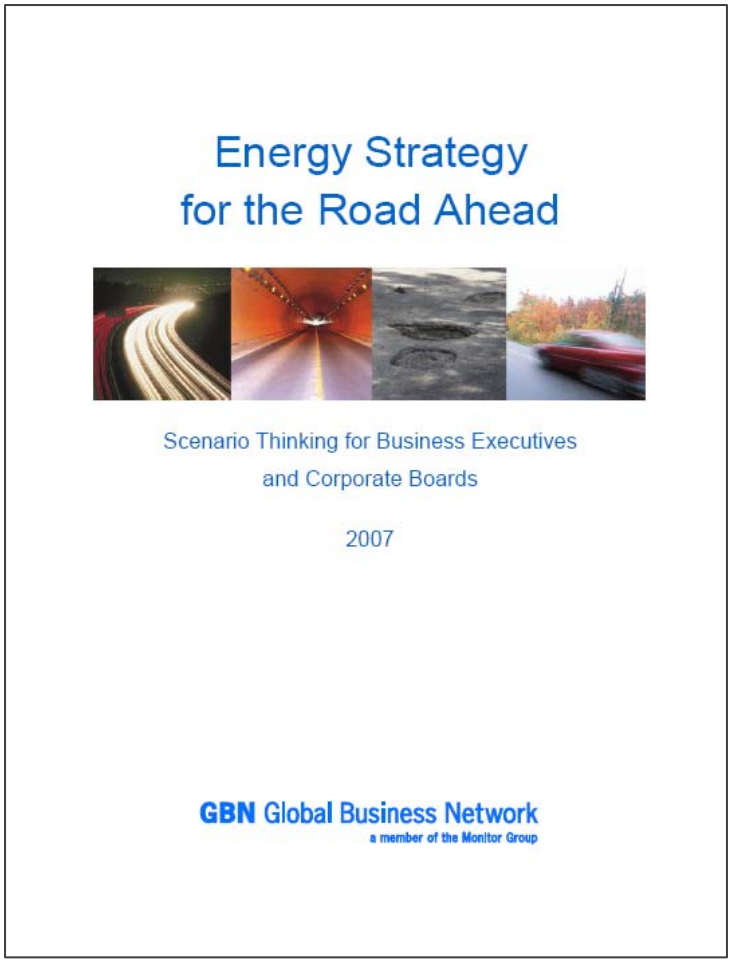
ENERGY STAR provides business a clear pathway to succeed

1. Evaluate risks, prepare energy strategy with senior management

2. Build company-wide energy program, using ENERGY STAR guidelines for energy management

3. Look to suppliers and customers

Step 1 - energy strategy



Energy Strategy for the Road Ahead

- helps companies prepare a strong energy strategy
- developed with 20 leading companies and their senior managers

•Report at:

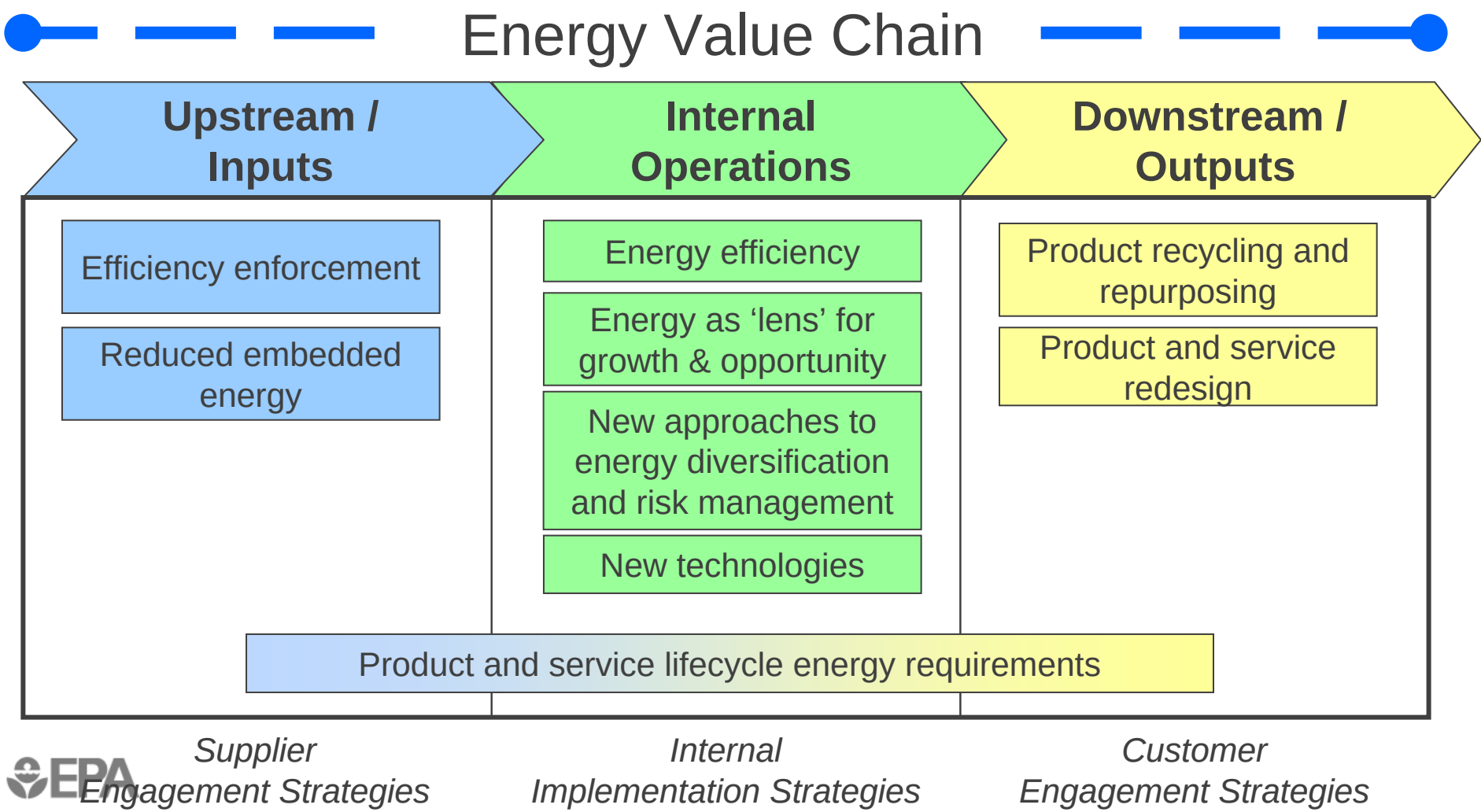
www.energystar.gov/energystrategy

Step 2 - guidance for managing energy

ENERGY STAR Guidelines for Energy Management

- help to put in place a strong energy management program
- **help to benchmark energy use & practices**
- consulted by thousands of organizations
- based on the successful practices of ENERGY STAR's partners
- www.energystar.gov/guidelines

Step 3 - help in managing energy across the value chain



ENERGY STAR designed to address the barriers

Barrier

- Lack of a bearing on efficiency

Solution

- Benchmarking is an objective measurement method

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Let's get on the same page

- Benchmarking
  - The process of comparing to something similar or the best

- ***Energy*** benchmarking
  - The process of comparing the energy performance of facilities, processes or equipment to something similar or the best

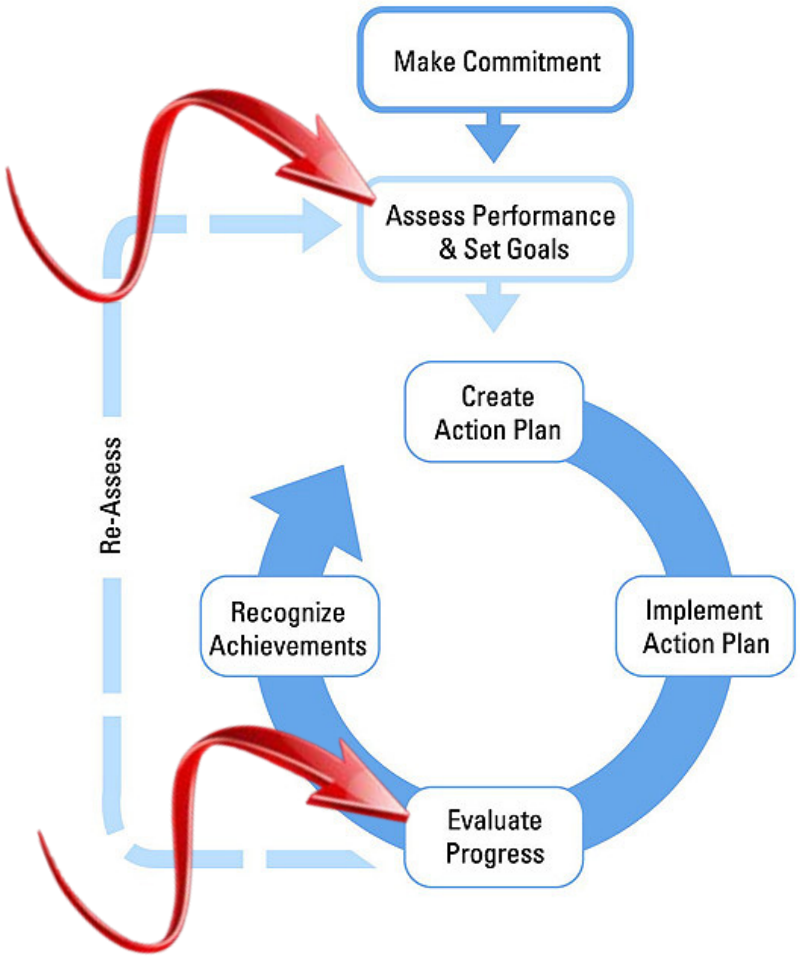
Types of benchmarking

- **Internal**
  - compares performance against internal baseline or benchmark
- **External**
  - compares performance against a metric “outside” of the organization
  - identifies “Best in Class” performance
- **Quantitative**
  - data-driven; compares actual numbers
- **Qualitative**
  - based on best practices; compares actions

Benchmarking's place in energy management

- Fundamental practice
- Energy reductions and project measurement are nice but only benchmarking proves improvements have had an effect
- Can be based on comparison of management practices or energy data
  - ***practice*** benchmarking gives an idea of where to improve by identifying best energy management practices
  - ***energy data*** benchmarking informs how well an entity might perform and improve and the position of that entity in terms of energy performance

ENERGY STAR Guidelines for Energy Management



Variety of benchmarking in energy management

Energy Management Objective	Scope		
	Scale	Focus	Time Frame
Assess equipment efficiency	Equipment or process	Internal – comparison against other owned equipment or process External – comparison to industry standard or cooperative study with other organizations	•Peak demand period •Three month sample •Weekly •Monthly •Annual •Continuous from baseline
Assess facility performance	Whole facility or sub-metered portion	Internal – comparison of single facility over time. Comparison of similar facilities within single organization External – comparison of facility against national performance rating	•Continuous from baseline •Monthly •Quarterly •Annual
Assess department or divisional energy use	Facilities or sub-metered portions of facilities	Internal – comparison against internal sub-divisions	•Continuous from baseline •Weekly •Monthly •Quarterly •Annual
Assess organizational performance	All facilities	Internal – comparison over time or towards goal. External – Comparison of portfolio average against a national performance rating	•Continuous from baseline •Monthly •Quarterly •Annual

ENERGY STAR benchmarks

- External
- Define “best in class” for an industry or building type
- Industry sector-specific at 6 digit NAICS code (or more refined)
- Energy data at the whole facility level
- Source energy intensity
- Normalized for key variables

ENERGY STAR Industrial Focuses

Delivering energy management to specific industries through ENERGY STAR

ENERGY STAR's industrial sector-specific focuses

Collaborative process to develop:

- ✓ **Energy Performance Indicator (EPI) to benchmark/rate plant energy performance**
- ✓ **Energy Guide**

Facilitates:

- ✓ Sharing of best practices
- ✓ Networking
- ✓ Development of stronger company energy programs

Results in:

- ✓ **Sophisticated plant benchmarking tool**
- ✓ Recognition for energy-efficient plants with the ENERGY STAR
- ✓ Increased momentum for continued improvement
- ✓ Improved efficiency within an industry sector
- ✓ Prevention of carbon emissions

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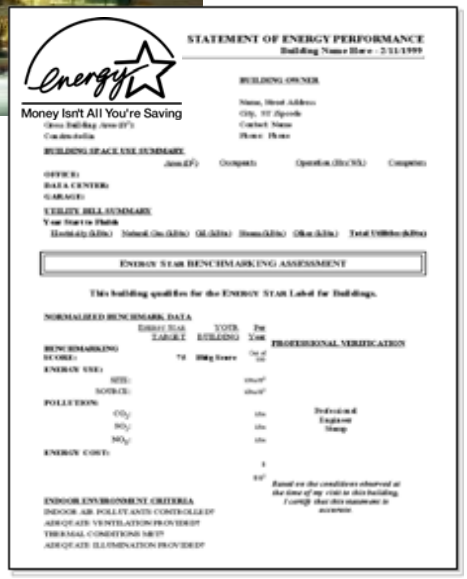
Benchmarking plant energy use: Facility energy performance ratings

Fuel Efficiency:

MPG



Energy Efficiency:

1 - 100

Benchmarking drives performance

Answers: *"If all plants in the industry use energy as this one, what percent of plants in the country would be better, and what percent would be worse?"*

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Standardized measurement: the plant EPI

- Plant energy performance indicators (EPI)
  - Enable a higher level of energy management
    - Compare how efficiently a plant uses energy relative to those of its industry
    - Enable goal setting
    - Empower management to require greater energy performance from plants
    - Score plants on a **percentile basis (0-100),** normalized to a plant's unique configuration
      - ENERGY STAR defines score of 75 or above to be energy-efficient; 50 is average
  - www.energystar.gov/epis
  - www.energystar.gov/industrybenchmarkingtools

What EPA's national level plant energy benchmarking accomplishes

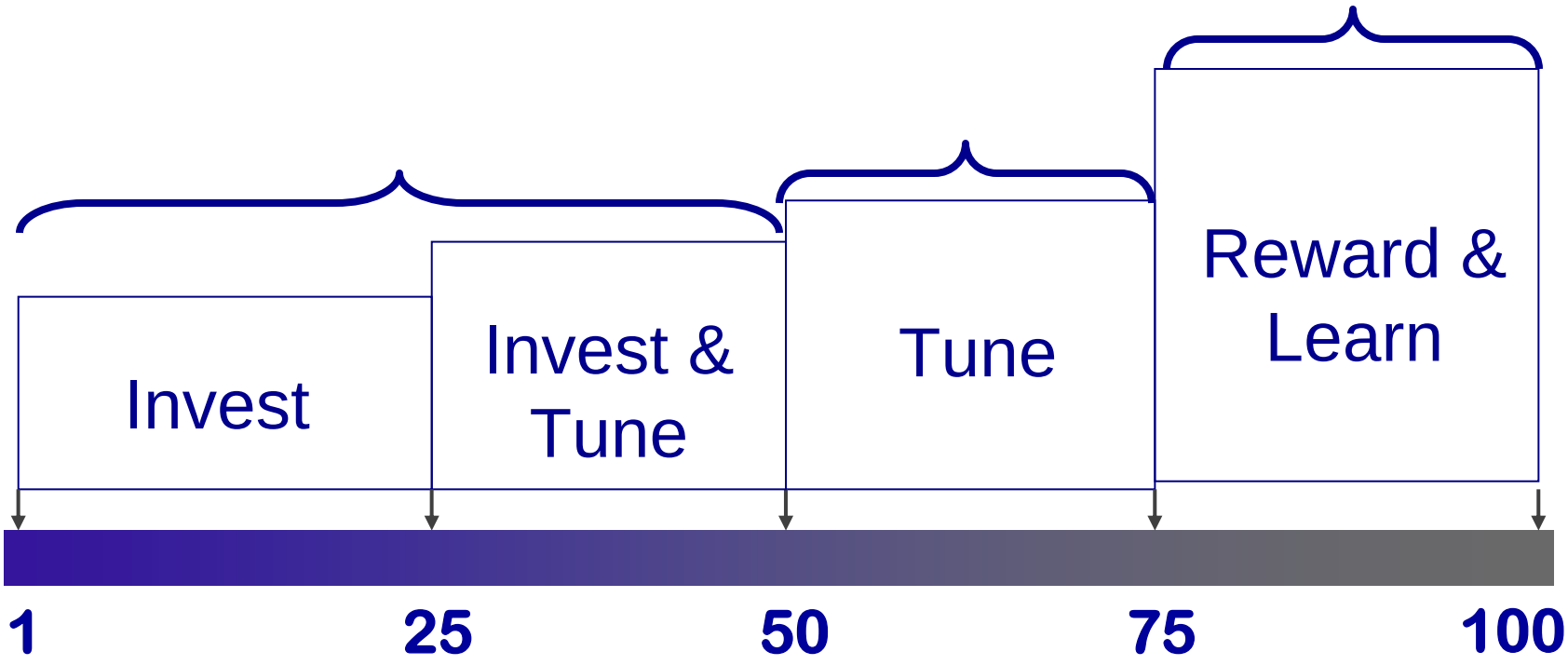
- Empowers industry to **shift the curve of energy performance**
  - For most companies, the ENERGY STAR EPI is the first time they are able to see how their plants' energy performance compares to that of their industry
- Enables companies in the benchmarked industry to **set competitive goals** for plant improvement
- Enables **EPA to gauge improvement** of an industry's energy performance over time

Enabling companies to make informed energy investment decisions

Best investment opportunities are in lower quartiles - greatest potential for improvement

RCx & O&M improvements yield savings and label candidates

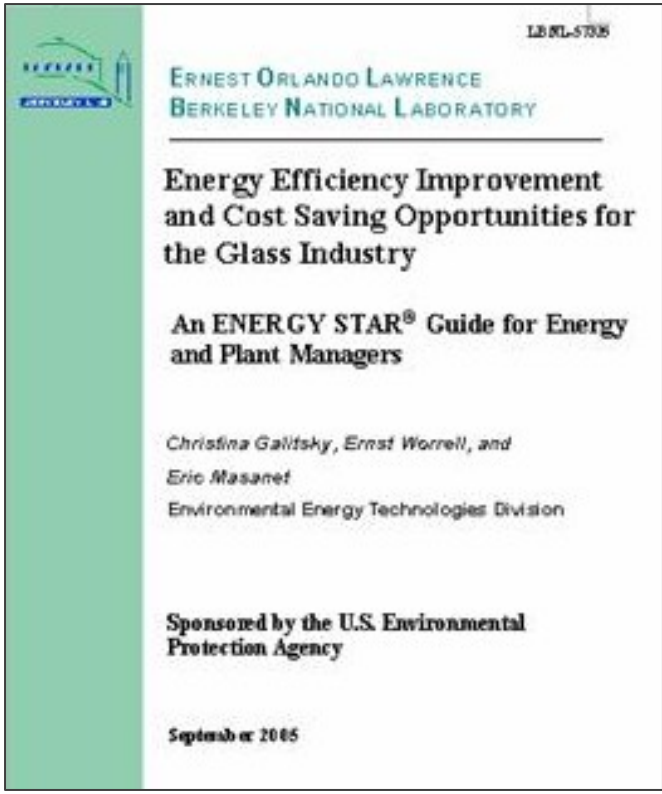
High scorers provide lessons learned and label candidates



More help to improve: Energy Guides

Practices and technologies available now to improve energy efficiency in an industry

- **Identify existing & promising emerging technologies**
  - provide brief overview of technology or practice
    - review its limitations
    - quantify potential energy and cost savings
    - estimate payback periods
    - provide case study from application
    - highlight industry success stories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ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Energy Efficiency Improvement and Cost Saving Opportunities for the Glass Industry

An ENERGY STAR® Guide for Energy and Plant Managers

Christina Galitsky, Ernst Worrell, and Eric Masanet
Environmental Energy Technologies Division

Sponsored by the U.S. Environmental Protection Agency

September 2005

Example: Cement Industry Energy Guide

Over 40 efficiency measures for cement plants

No Capital Cost	**Short Payback**	**Capital Projects**
Preventative maintenance	Energy & Process Controls: - Kiln - Raw material - Finish Grinding	Efficient Grinding Mills
Seal Replacement (kiln)	High-efficiency Classifier	Roller Mill
Shell heat loss reduction	Improve Combustion System	Grate Cooler
Optimization of compressed air systems	Indirect Firing	Low-Pressure Drop Preheaters
Low-Carbon Fuels	Optimize Grate Cooler	Multi-Stage Preheaters
Intergrinding Limestone	High efficiency Motors	Precalciner
Reduced fineness cement	Adjustable Speed Drive	
Increased Alkali Content	Blended Cement	
	Slags in Clinkermaking	

Case study

- Example: U.S. cement plant
- Initial cement plant ENERGY STAR EPI score: **61**
- Upgraded in 2002, EPI verified energy reductions of 40%
  - Energy efficiency improved by 2.5 mmBtu/short ton of clinker
- Commercially available technologies employed (described in Energy Guide) :
  - Improved grinding mills
  - Roller mills
  - Improved preheaters
  - Indirect firing
- New ENERGY STAR EPI score: **98**
  - national energy efficiency scoring system demonstrated this plant is now one of the most efficient cement plants in the U.S.

Results – EPA experience with US auto assembly plants

- Based on ENERGY STAR benchmarking of auto assembly plants, EPA has seen fuel usage in the industry improve by 12 percent over a five year period.
- The level of inefficiency has also dropped by 1.0 mmBtu/vehicle.
- The range of performance has also narrowed.
  - This means that while the best auto assembly plants have improved, the others have more than "kept up" with this improvement.

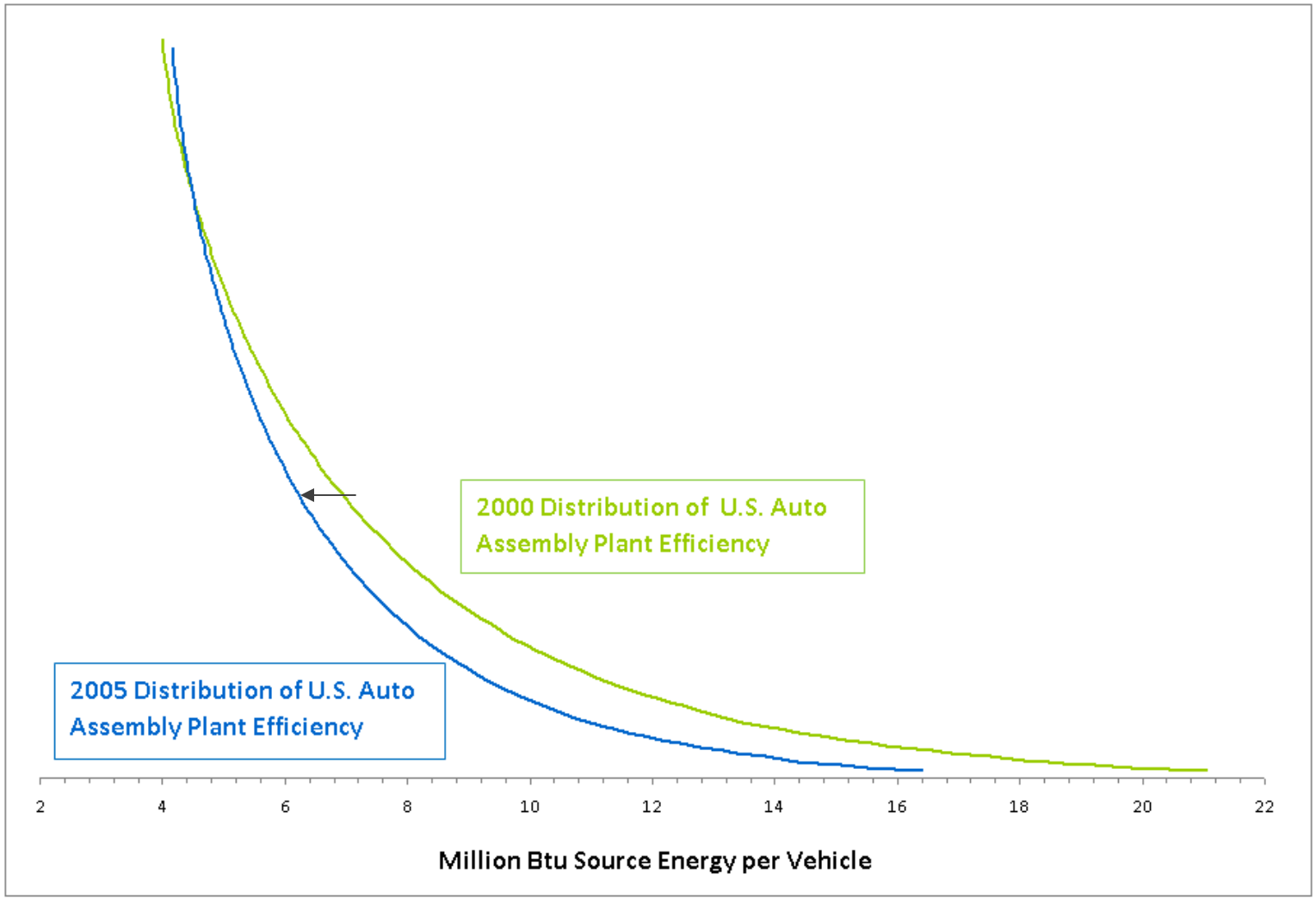
ENERGY STAR benchmarking resources

- **Plants** use ENERGY STAR's **Energy Performance Indicators** (EPIs)
- **Commercial Buildings** use ENERGY STAR's **Portfolio Manager**

Industrial EPIs
Motor Vehicle Assembly
Wet Corn Milling
Cement Manufacturing
Petroleum Refining (private system recognized)
Pharmaceuticals
Food Processing (variety)
Glass Manufacturing (variety)
Petrochemicals (draft)
Pulp and Paper (drafts)
Steel (draft)

Portfolio Manager
Office Buildings
Hospitals
K-12 Schools
Hotels
Supermarkets
Retail Stores
Warehouses
Bank Branches
Residence Halls
Waste Water Treatment
Court houses
Medical Office Buildings

ENERGY STAR Benchmarking: Auto Assembly 2000-2005



EPA, Duke University

Lessons

- It is possible to benchmark plants and help industry improve
- Benchmarking takes data (lots of it) and time
- Benchmarked entity should be homogeneous.

Energy Management Systems

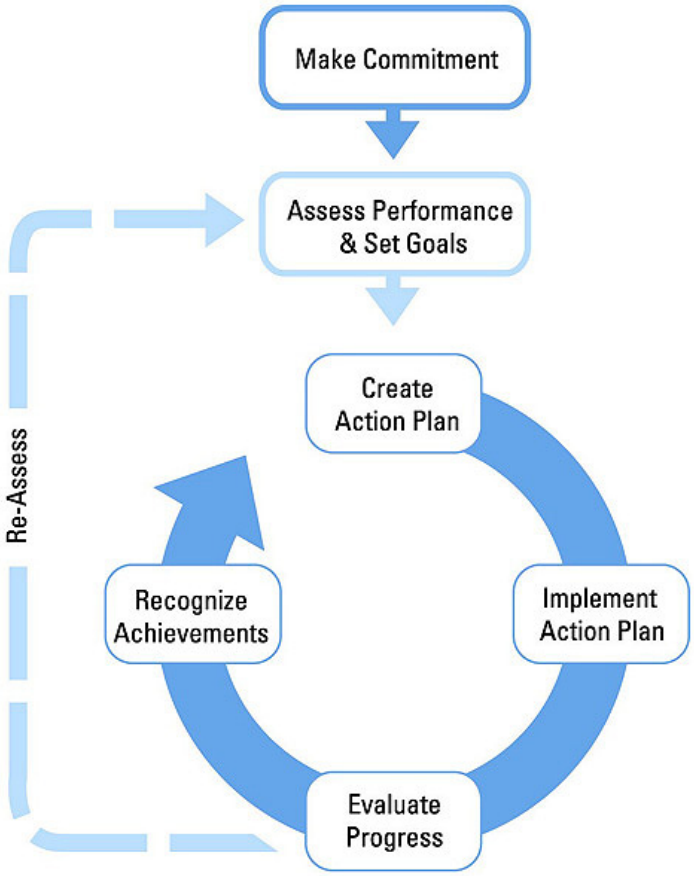
- Growing interest in the role of management systems to promote and ensure energy efficiency.
  - EPA's ENERGY STAR program has been promoting a systems approach since 2003.
- Energy Management Systems (EnMS) can help organizations achieve greater savings.
- EnMS can help organizations build capacity and focus on continuous improvement
- EnMS provide a means (not an end) towards increasing efficiency
- EnMS do not measure or guarantee energy savings or CO_2 reductions on their own.

Management Systems Approaches

Management systems promote continuous improvement through:

- Organizational practices
- Organizational policies
- Team development
- Planning & evaluation
- Tracking & Measurements
- Communication & employee engagement

ENERGY STAR Guidelines for Energy Management



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Standardization of Energy Management

Current efforts to create standards for energy management:

- ISO 50001 - Draft Energy Management Systems underdevelopment
- EN 16001 - European Energy Management Standards
- ANSI MSE 2001:2008 – Energy Management Standard
- DS 2403:2001 – Danish Energy Management Standard
- NSAI IS 393 – Irish Energy Management Standard
- KATS KSA 4000:2007 – Korean Energy Management Standards
- ASTM standards being developed for:
  - Compressed systems, motors, steam systems, etc.

Considerations

- Elements of an EnMS can be applied without achieving certification
  - E.g: ENERGY STAR Guidelines & Partners
- EnMS Standards (ISO, EN, etc) are designed to be flexible
  - Scope, boundaries, etc. are defined by the user
  - A single processes / production lines can be certified within a plant to meet the standard
  - Determination of applicability of standard is done by paid Auditor
- Certification is not based on efficiency or savings
  - ISO 50001, etc. do not establish performance standards
  - Achieving a target or maintaining a level of performance is required for certification or re-certification
- Certification is expensive
  - Internal personnel costs
  - Auditor and registry expenses
  - Few companies have pursued certification to date

Summary

- A *systems* approach to energy management is good to promote:
  - Organizational & facility-wide EnMS are the most effective
  - Shifts thinking from “projects” to “programs” to achieve greatest benefit
- There are multiple pathways for promoting & implementing an EnMS.
- The effectiveness of an EnMS is tied to its scope, goals, and the benchmarks are used.
- Energy performance (efficiency, reductions etc.) ultimately reflects the effectiveness of an EnMS and corporate energy program.

Contact

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All resources found at:
www.energystar.gov/industry