
Near-Term Solutions for Mitigation of Industrial Sector Carbon Dioxide Emissions in California

California Manufacturers and Technology Association

March 13, 2007

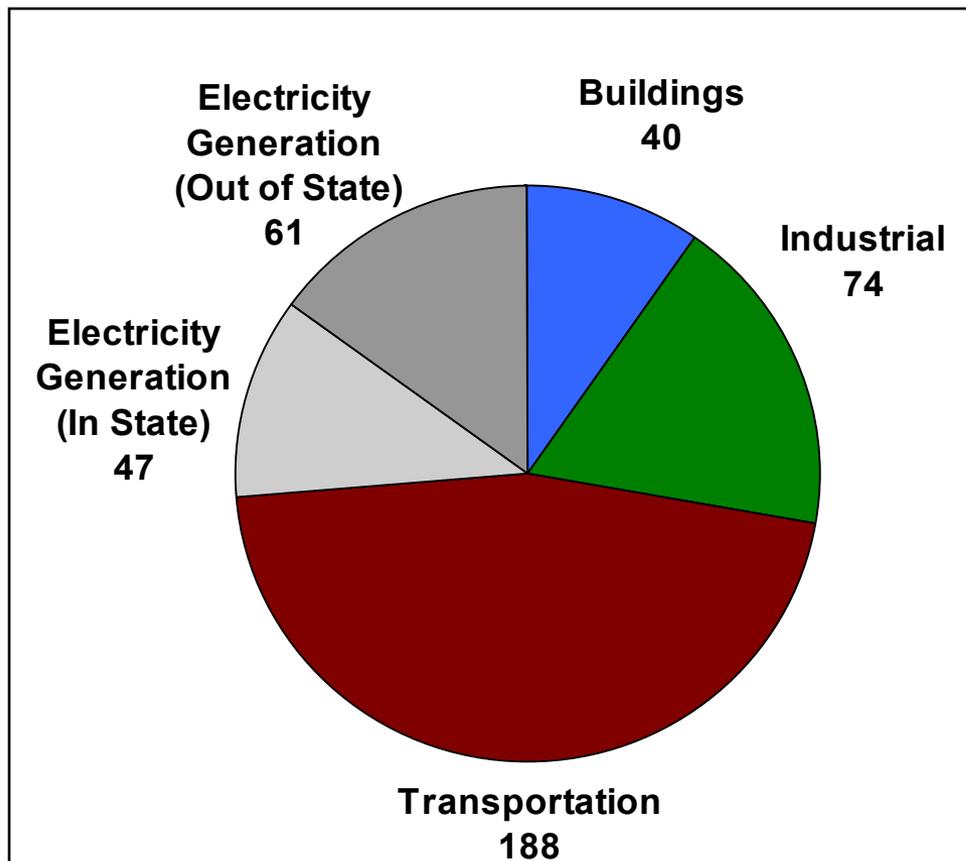
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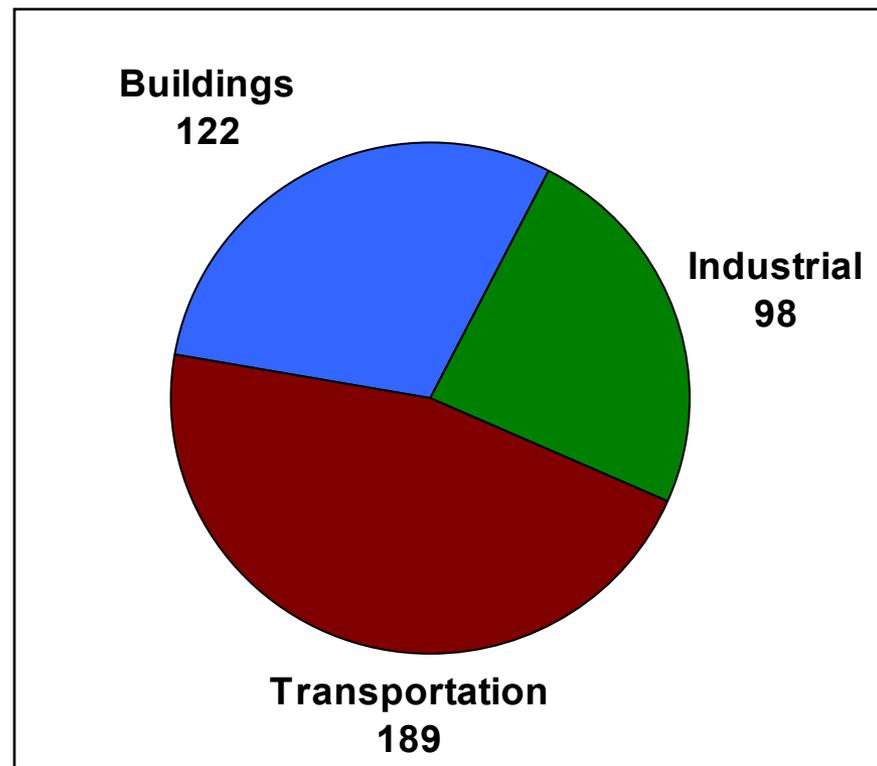
- U.S. Department of Energy research laboratory
- Managed by the University of California
- ~ 4000 employees
- 11 Nobel Laureates
- Environmental Energy Technologies Division conducts research and development leading to better energy technologies that reduce adverse energy-related environmental impacts
- Energy Analysis Department focuses on analysis of energy use and GHG emissions trends, mitigation options, and policies from an end-use perspective



California 2004 CO2 Emissions (MtCO2)



Electricity Allocated to End-Use Sectors



Source: California Energy Commission, 2006. *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004*. Sacramento: CEC.

Note: cement process-related CO2 emissions include in industrial sector

California's Industrial Sector Energy-Related CO2 Emissions

MtCO2 (2000)

	Electricity	Natural Gas	Petroleum Products	Coal	Total
Oil Refineries	2.3	5.6	23.4	0.0	31.2
Oil and Gas Extraction	1.4	15.4	0.1	0.0	16.9
Non-specified (Industry)	0.2	0.8	5.2	1.5	7.7
Agriculture	2.3	1.0	4.1	0.0	7.4
Stone, Clay, Glass, Cement	1.2	1.7	0.8	2.9	6.6
Food Products	2.0	3.7	0.0	0.0	5.7
Chemicals and Allied Products	1.4	0.8	0.5	0.0	2.6
Metal Durables	1.8	0.8	0.0	0.0	2.6
Pulp and Paper	0.9	1.6	0.0	0.0	2.5
Electric and Electronic Equipment	2.0	0.3	0.0	0.0	2.3
Primary Metals	0.8	0.9	0.0	0.0	1.7
Transportation Equipment	0.9	0.5	0.0	0.0	1.4
Plastics and Rubber	0.9	0.3	0.0	0.0	1.2
Wood and Furniture	0.6	0.3	0.0	0.0	0.9
Textiles	0.3	0.6	0.0	0.0	0.9

Murtishaw, S., De La Rue du Can, S., Price, L., Masanet, E., and Simcich, M., 2006. *CALEB: California Energy Balance Database*, Berkeley, CA: LBNL.

Proposed Policies to Address California's GHG Emissions Reduction Goals

1. Target-setting Agreements

Also known as voluntary or negotiated agreements

Purpose is to establish targets for energy intensity reduction in industrial sectors . Agreements are typically between a government and industrial companies, based on sector-based negotiated agreements

2. Energy Management Standards

Purpose is to provide guidance for industrial facilities to integrate energy efficiency into their management practices. All existing and planned energy management standards are compatible with ISO 9000/14000

3. Industrial System Optimization

Purpose is to provide immediate opportunities (often 2 year payback or less) from projects to optimize industrial systems for energy efficiency. These systems are found in all industrial sectors.

Industrial Energy Efficiency and GHG Emissions Reduction Programs



Target-setting programs

- Industrial sector target-setting programs are common
- Range from voluntary to mandatory
- Targets can be set for either industrial sub-sectors or industrial facilities
- Typically based on signed agreements committing upper management to reaching targets
- Some include energy or GHG taxes
- Some include emissions trading
- Supporting policies and programs are essential for assisting industry in reaching ambitious targets

Industrial Target-Setting Supporting Policies and Programs

- Informational campaigns
- Energy management standards
- Energy audits, system assessments, benchmarking
- Assistance in preparing inventories, identifying opportunities, developing energy management plans
- Financial assistance and incentives
- Government and public recognition
- Relief from additional regulations or exemptions from regulations
- Reduced or avoided energy/GHG taxes
- Penalties for non-compliance: stricter environmental permitting, penalty fees, energy or CO2 tax
- Emissions trading



Examples of Industrial Target-Setting Programs



- **Netherlands**
 - 20% energy efficiency improvement by 2000 (1989 baseline)
 - Long-Term Agreements: contracts between the Dutch Minister for Economic Affairs and associations representing 29 industrial sectors (1250 firms) representing 90% of industrial energy consumption
- **U.K.**
 - 20% CO2 emissions reduction by 2010 (1990 baseline)
 - Climate Change Agreements: Government signed agreements with either industrial sector associations or individual companies representing 44 sectors (about 5,000 companies and 10,000 facilities) responsible for 90% of energy-intensive industry
- **China**
 - 20% reduction of energy use per unit of GDP by 2010 (2005 baseline)
 - Top-1000 Energy-Consuming Enterprises: contracts between Provincial governments and 1000 enterprises representing 48% of industrial energy consumption and 30% of total energy consumption in China

Netherlands Long-Term Agreements on Energy Efficiency

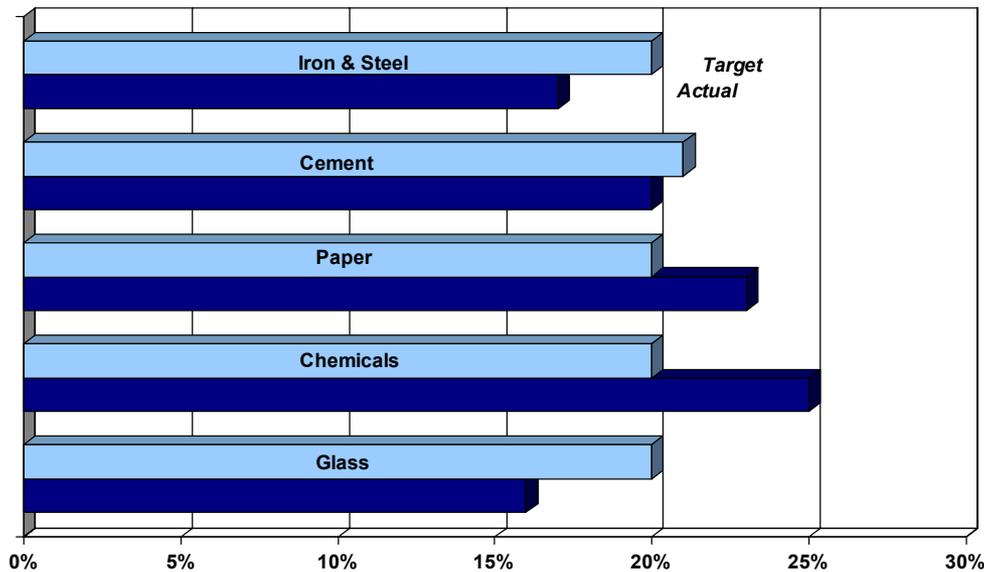
Goal: increase industrial energy efficiency by 20% between 1989 and 2000

- Novem approached industry sector, signed letter of intent
- Inventory of viable energy-efficiency improvement measures
- Target-setting agreement signed
- Energy Saving Plan developed
- Annual monitoring

Supporting Policies and Programs

- Subsidies
- Energy investment tax reduction
- Information dissemination and audit of facilities
- Simplified procedure for environmental permits
- Consistency in and protection from new energy regulation in industry

Netherlands Long-Term Agreements on Energy Efficiency



% improvement in energy efficiency, 1989-2000

Results:

- Overall energy efficiency savings of 22.3% realized
- 157 PJ or 9 MtCO₂/year saved
- 1/3 to 1/2 of the savings stimulated by the agreements (remainder was autonomous)
- Cost to government of program was \$10-20/tCO₂ saved, depending upon whether full costs of all subsidies are included
- Industry realizing ~\$650 M per year in reduced energy costs

UK Climate Change Agreements

Goal: Carbon savings of 9.2 MtCO₂ between 2000 and 2010

- Climate Change Levy: tax on energy (natural gas, coal, LPG, electricity)
- Companies that agree to and achieve GHG emissions reduction targets receive an 80% Climate Change Levy discount
- Company that does not enter into an agreement that does not reach its target, must pay 100% of the energy tax

Supporting Policies and Programs

- Carbon Trust: an independent body to promote carbon reductions in industry and commerce, advises industry through site visits, provides information and low costs loans for energy efficiency projects
- Enhanced Capital Allowance Scheme: Business can claim 100% tax allowances on their capital spending on energy saving equipment (specified in a government list) against their taxable profits for the year during which they make the investment
- Domestic Emissions Trading Scheme
- “Light Touch” on energy efficiency regulation

UK Climate Change Agreements



Results:

- 2001-2002: reductions of 16.4 MtCO₂
- 2003-2004: reductions of 14.4 MtCO₂
- Sectors did better than expected because industry underestimated what they could achieve via energy efficiency
- Industry is saving over \$832 M/year on the energy it has not bought as a result of meeting the CCA targets, in addition to the savings on the Climate Change Levy itself

U.S. ClimateVISION



- Overall goal of reducing GHG emissions per unit of gross domestic product by 18% by 2012 (2000 baseline) translated into specific goals for each industrial sector
 - Aluminium: 53% total carbon equivalent reduction from these sources by 2010 from 1990 levels
 - Cement: 10% reduction in carbon dioxide (CO₂) emissions per ton of cementitious product produced or sold from a 1990 baseline by 2020
 - Chemical manufacturing: overall GHG intensity reduction target of 18% by 2012 from 1990 levels
 - Forest products: reduce the forest products industry's GHG intensity by 12% by 2012 relative to 2000
 - Iron and steel: by 2012 achieve a 10% increase in sector-wide average energy efficiency per ton of steel produced using a 1998 baseline
 - Oil and gas: American Petroleum Institute-member refining companies are working to improve their energy efficiency by 10% by 2012

Company-Level Target-Setting

- Dow Chemical
 - 1994 to 2005 goal to reduce energy intensity (btu/lb product) by 20%
 - Achieved 22% (\$4B savings)
 - 2005 to 2015 goal to reduce energy intensity by 25%
- DuPont
 - Goal - 65% reduction in GHG emissions below 1990 levels by 2020
 - \$2B savings since 1990
- US EPA Climate Leaders (113 members, 67 w/goals)
 - American Electric Power met its 2006 goal by reducing total U.S. GHG emissions by 4% from 2001 to 2006 and has pledged to reduce total U.S. GHG emissions by 6% from 2001 to 2010
 - St. Lawrence Cement met its goal by reducing global GHG emissions by 16% per ton of cement-type product from 2000 to 2006 and has pledged to reduce global GHG emissions by 20% per ton of cement-type product from 2000 to 2012
 - United Technologies Corp met its goal of reducing global GHG emissions by 46% per dollar of revenue from 2001 to 2006 and pledged to reduce total global GHG emissions by 12% from 2006 to 2010

Energy Management Standards

Typical features include:

- a strategic plan that requires measurement, management, and documentation for continuous improvement for energy efficiency;
- a cross-divisional management team led by an energy coordinator who reports directly to management and is responsible for overseeing the implementation of the strategic plan;
- policies and procedures to address all aspects of energy purchase, use, and disposal;
- projects to demonstrate continuous improvement in energy efficiency;
- creation of an Energy Manual, a living document that evolves over time as additional energy saving projects and policies are undertaken and documented;
- identification of key performance indicators, unique to the company, that are tracked to measure progress; and
- periodic reporting of progress to management based on these measurements

Energy Management Standards

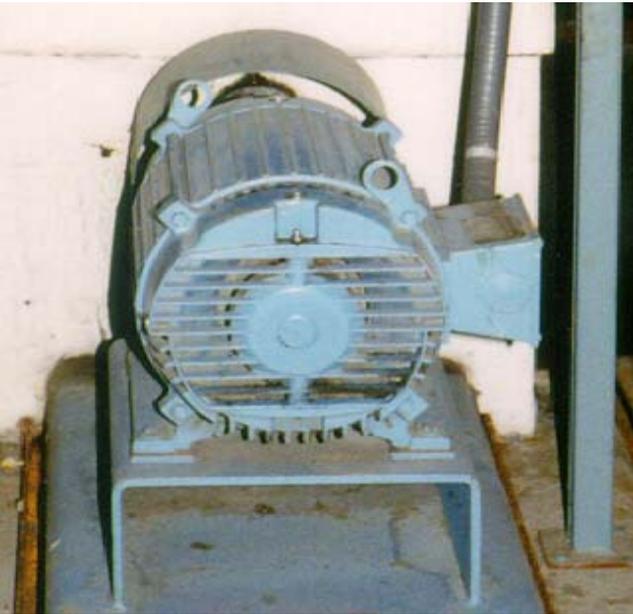
Current Status

- Several countries already have energy management standards (Denmark, Ireland, Sweden, US)
- Energy management standards under development in China, Spain, Brazil, Korea and the European Union
- ISO will be initiating work on an international energy management standard, with preparatory assistance from the United Nations Industrial Development Organization
- LBNL has a lead role in standards coordination & development in the US & China

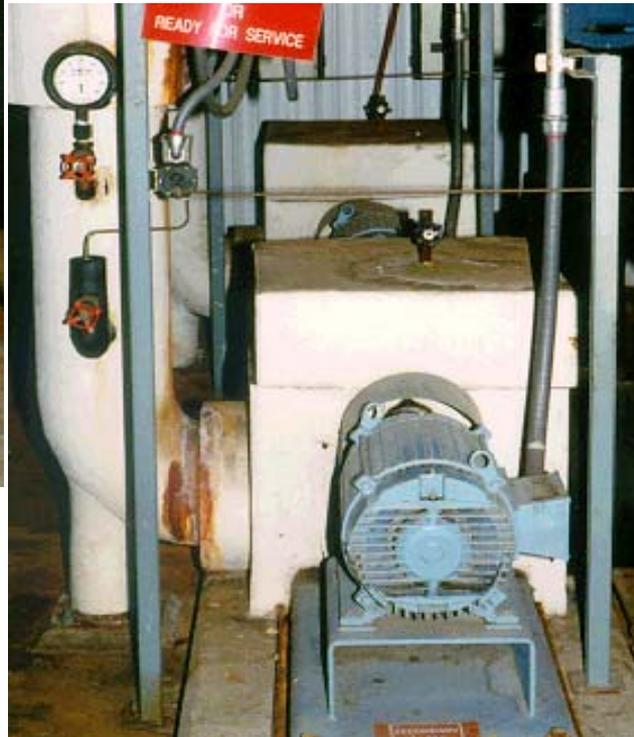
System Optimization

- Steam and motor-driven systems account for nearly 50% of final manufacturing energy use worldwide
- These systems typically offer at least a 10-30% improvement opportunity using readily available technology because they are engineered for reliability without regard to energy efficiency
- Both industrial markets and policy makers tend to focus on system components, which have a 2-5% improvement potential
- Barriers to improvement are institutional, not technical
- Systems engineered for energy efficiency are actually more reliable, have lower operating costs, and can result in higher productivity

Industrial Systems & Energy Efficiency



**15 kW motor
efficiency = 91%**



**Combined motor &
pump efficiency = 59%**

System efficiency = 13%



Adapted from Don Casada (Diagnostic Solutions)

Save Energy Now initiative

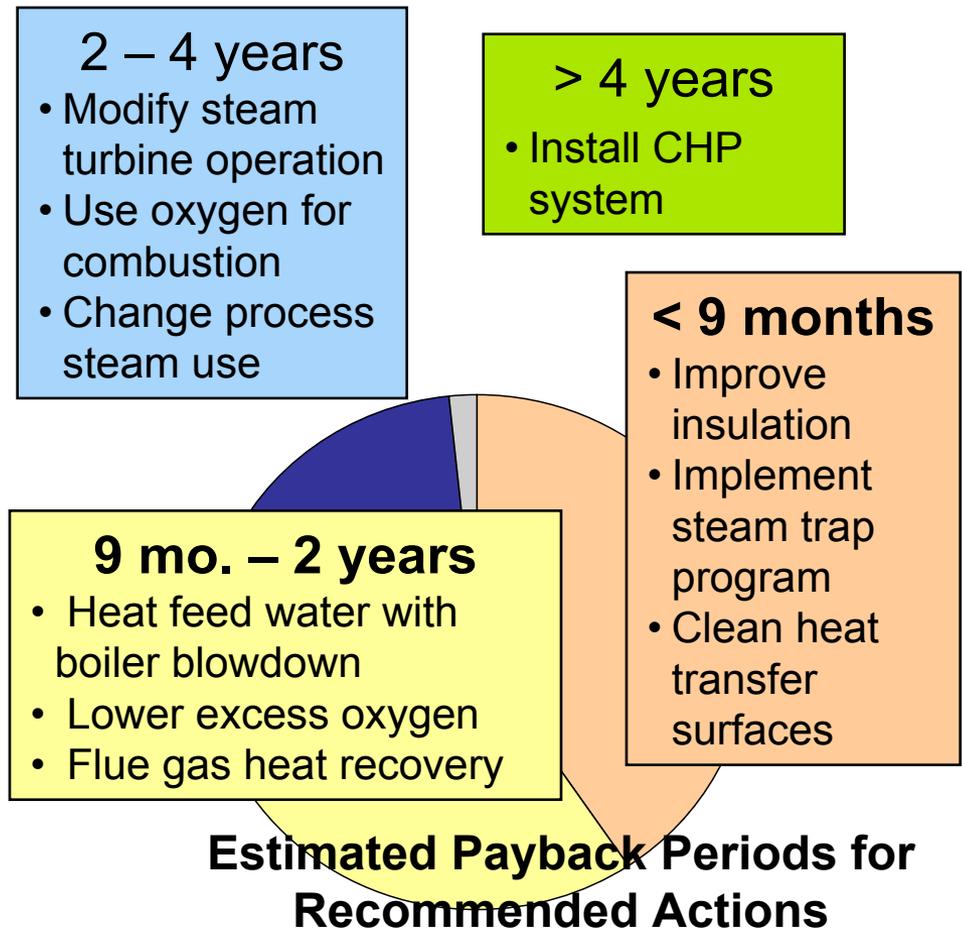
The U.S. Department of Energy (DOE):

- Created initiative in 2006 based on more than a decade of experience in industrial system energy efficiency
- Trains DOE energy experts to work with plant energy teams to identify opportunities for improving steam, process heating, pump, or compressed air systems through Energy Savings Assessments (ESAs)
- Together with energy experts, trains plant personnel to apply DOE software analysis tools to identify additional opportunities
- Recognizes plants with high energy savings resulting from implementation

<http://www.eere.energy.gov/industry/saveenergynow/>

USDOE's Save Energy Now: Energy Savings Assessment Status (March 15, 2007)

- 200 assessments completed
- Natural gas savings = 52 trillion Btu/yr
 - Equivalent to 725,000 U.S. homes
 - Carbon dioxide avoided = 3.3 million metric tons/year (7% of total US greenhouse gas emission growth, 2004 – 2005)
 - Cost savings opportunity = \$475 million per year
 - Savings implemented or planned = \$222 million (at 134 plants)



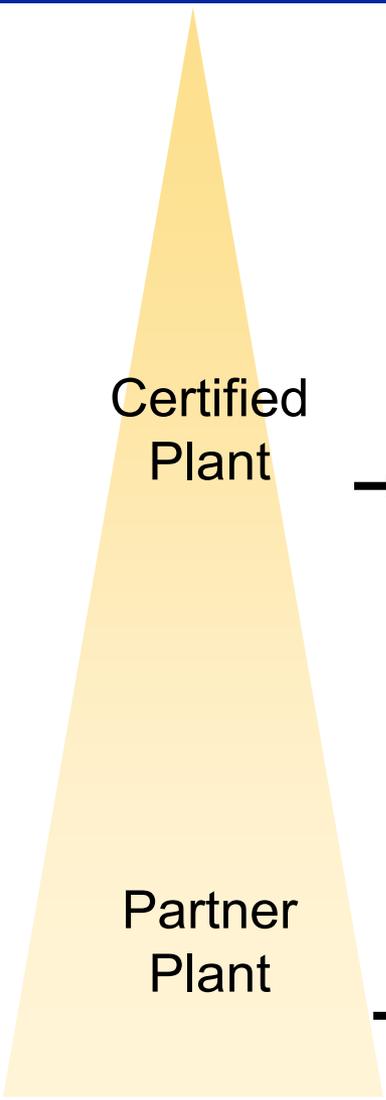
What is “Plant Energy Certification”?

- An Industry-Government partnership addressing the current need for a consistent, performance-based framework that fosters continuous progress in industrial energy efficiency.
- The proposed framework provides a mechanism to help individual companies:
 - Assign greater value to energy efficiency improvements
 - Get verification of the resulting energy savings
 - Receive public recognition for achievements

Who's involved?

- U.S. Industry (currently only end users)
- U.S. Department of Energy's Industrial Technologies Program
- U.S. Environmental Protection Agency's ENERGY STAR for Industry Program
- U.S. Department of Commerce, Manufacturing Extension Partnership (MEP) Program
- Texas Industries of the Future Partnership
- American National Standards Institute (ANSI)

Proposed Progression to Plant Certification



Certified
Plant



- Demonstrates compliance with ANSI energy management standard through accredited certifier
- For initial certification, identifies energy intensity performance improvement opportunities.
- Achieves validated initial energy intensity performance improvement (accommodate plants that are already using best practices)
- Reports plant energy savings and energy intensity improvement (%) annually to third-party certifier
- Re-certifies every 3 years by documenting energy savings (and perhaps renewable energy projects) and demonstrates a minimum level of continuous improvement in energy intensity within the re-certification period

Partner
Plant



- Fosters continual improvement in plant energy management
- Profiling plant energy use, conducting assessments, tracking energy savings for projects (can use DOE *Plant Profiler tool*, *energy savings protocols*, and/or *Qualified Specialists*)
- Documents and reports energy savings annually.

Conclusions

- **No “silver bullet”** – there are hundreds of emission reduction technologies and measures for industry
- **Implementation of mitigation measures is key issue** – industry excels at producing specific commodities, not at saving energy or reducing GHG emissions
- **Target-setting can provide motivation** - experience from other countries and companies shows that target-setting with explicit commitments can result in significant savings
- **Supporting policies and programs are essential** - comprehensive programs are needed to assist industries in reaching their goals

Resources

LBNL's industrial energy use website: <http://industrial-energy.lbl.gov>

Voluntary agreement information: <http://industrial-energy.lbl.gov/node/93>

Energy Management --UNIDO Experts Group Meeting

<http://www.unido.org/doc/64561>

UK Climate Change Agreements: <http://www.defra.gov.uk/environment/ccl/index.htm>

US DOE BestPractices: <http://www1.eere.energy.gov/industry/bestpractices/>

US DOE Save Energy Now: <http://www1.eere.energy.gov/industry/saveenergynow/>

US EPA Energy Star for Industry:

http://www.energystar.gov/index.cfm?c=industry.bus_industry

US EPA Climate Leaders: <http://www.epa.gov/stateply/>

US ClimateVISION: www.climatevision.gov

US Superior Energy Performance: <http://www.superiorenergyperformance.net/>

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