

# Climate VISION Progress Report 2007

February 2008

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# Acronyms

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AASHTO .....	American Association of State Highway and Transportation Organizations	IPCC .....	Intergovernmental Panel on Climate Change
ACC .....	American Chemistry Council	IPIECA .....	International Petroleum Industry Environmental Conservation Association
AF&PA .....	American Forest & Paper Association	ITP .....	Industrial Technologies Program
AHSS .....	advanced high-strength steels	kWh .....	kilowatthour
AISI.....	American Iron & Steel Institute	LEED.....	Leadership in Energy and Environmental Design
Alliance .....	Alliance of Automobile Manufacturers	MMTCO <sub>2</sub> -eq.....	million metric tons carbon dioxide equivalent
APP .....	Asia-Pacific Partnership on Clean Development and Climate	MRF .....	material recovery facility
API .....	American Petroleum Institute	MW.....	megawatt
ASTM .....	American Society for Testing and Materials	NCASI.....	National Council for Air and Stream Improvement
CCPI.....	Clean Coal Power Initiative	NEI .....	Nuclear Energy Institute
CHP.....	Combined Heat and Power	NLA.....	National Lime Association
CO <sub>2</sub> .....	carbon dioxide	NMA.....	National Mining Association
CVP.....	Curbside Value Partnership	NRECA .....	National Rural Electric Cooperative Association
DOE .....	Department of Energy	PCA .....	Portland Cement Association
DSM.....	demand-side management	PFC.....	perfluorocarbon
EEI .....	Edison Electric Institute	RDD&D .....	research, development, demonstration, and deployment
EPA.....	Environmental Protection Agency	SF <sub>6</sub> .....	sulfur hexafluoride
EPAct 2005 .....	Energy Policy Act of 2005	SFI .....	Sustainable Forest Initiative®
EPRI.....	Electric Power Research Institute	SIA .....	Semiconductor Industry Association
GDP.....	Gross Domestic Product	SPL .....	Spent Potliner
GHG.....	greenhouse gas	TVA.....	Tennessee Valley Authority
HFC.....	hydrofluorocarbon	USDA .....	Department of Agriculture
ICFPA .....	International Council of Forest and Paper Associations	VAIP.....	Voluntary Aluminum Industry Partnership
IMA.....	International Magnesium Association	WBCSD.....	World Business Council for Sustainable Development
IMA-NA.....	Industrial Minerals Association—North America	WRI .....	World Resources Institute
		WSC .....	World Semiconductor Council

# CLIMATE VISION PROGRESS REPORT JANUARY 2008: SUMMARY

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Climate change is a complex, long-term challenge that will require a sustained effort over many generations. Under President Bush, the U.S. has developed and implemented policies that balance the desire to achieve near-term results and maintain a strong economy. This approach recognizes that economic growth makes possible greater financial investment in new, clean energy technologies. Further, the United States is laying a strong scientific and technological foundation to reduce uncertainties, clarify risks and benefits, and develop realistic mitigation options to meet the ultimate goal of the United Nations Framework Convention on Climate Change—stabilizing greenhouse gas concentrations at a level that avoids dangerous human interference with the climate system.

Major elements of the Administration's approach include: implementing near-term policies and measures to slow the growth in greenhouse gas (GHG) emissions; advancing climate change science; accelerating technology development and commercialization; and promoting international collaboration. From fiscal years 2001 through 2007, the Federal Government has invested about \$37 billion in science, technology, international assistance, and incentive programs that support climate change objectives, considerably more than any other nation.

In 2002, President Bush set an ambitious but achievable goal to reduce the Nation's GHG intensity—the ratio of greenhouse gas emissions to economic output—by 18 percent between 2002 and 2012. At the time the goal was set, the projected “business-as-usual” improvement over the period was about 14 percent. The President's goal, then, represents about a 29 percent improvement in the rate of improvement projected over the period. Compared to the business-as-usual baseline projection, the Administration estimated that achieving this commitment would avoid an additional 367

million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>-eq) emissions in 2012 and would result in cumulative savings of more than 1,833 MMTCO<sub>2</sub>-eq emissions over the decade.

Climate VISION is one in a large portfolio of Federal programs—including voluntary programs, deployment partnerships, incentives, and mandates—that help to achieve this end. In setting the 18 percent intensity goal, the President issued a challenge to the private sector to do its part. The President's call resonated with business, and in February 2003 the Federal Government and industry organizations representing thousands of companies from energy-intensive industrial sectors—accounting for about 40 to 45 percent of U.S. GHG emissions (see Table 2-1)—joined in a voluntary partnership known as Climate VISION (Voluntary Innovative Sector Initiatives: Opportunities Now). This response exemplifies to a great extent a change in corporate culture that recognizes the importance of GHG emissions and their consequences in business decisions.

Climate VISION partners have as members some of the largest companies in America, and they represent a broad range of energy-intensive industry sectors—oil and gas, electricity generation, coal and mineral production and mining, manufacturing (automobiles, cement, iron and steel, magnesium, aluminum, chemicals, and semiconductors), and forestry products. Association partners include:

- Alliance of Automobile Manufacturers
- Aluminum Association
- American Chemistry Council
- American Forest & Paper Association
- American Iron & Steel Institute
- American Petroleum Institute
- The Business Roundtable
- Industrial Minerals Association—North America
- International Magnesium Association

- National Lime Association
- National Mining Association
- Portland Cement Association
- Power Partners<sup>SM</sup> (Edison Electric Institute; Nuclear Energy Institute; American Public Power Association; Electric Power Supply Association; Tennessee Valley Authority; National Rural Electric Cooperative Association; and Large Public Power Council)
- Semiconductor Industry Association

Four Federal agencies also participate in the program: the Department of Energy (lead), Department of Agriculture, Department of Transportation, and Environmental Protection Agency. In marking the launch of this new voluntary program, President Bush stated: “I commend these initiatives which will help these businesses and industries continue to improve their energy efficiency and overall productivity, while contributing toward achieving our goal to reduce the greenhouse gas intensity of the American economy.”

The primary goal of the Climate VISION partnership is to identify and pursue cost-effective options to improve the energy or GHG intensity of industry operations by accelerating the transition to technologies, practices, and processes that are cleaner, more efficient, and capable of capturing or sequestering GHGs. Thirteen of the 14 Climate VISION partners have issued a letter of intent that set out goals—both quantitative and qualitative—for improving the energy efficiency or GHG intensity of its sector that will contribute to meeting the 18 percent intensity goal (Table 2-2).

The Climate VISION partners have undertaken a range of activities in support of these goals, which are described in the work plans partners have prepared detailing strategies for meeting their goals. Each work plan is organized around four themes: emission measurement and reporting protocols; identifying and implementing near-term cost-effective GHG reduction opportunities; cross-sector projects for reducing GHG

emissions; and technology research and development (R&D) and commercialization.

Since the program launch in 2003, the Climate VISION partners report that they are making progress, and many are ahead of schedule. Details are provided in section 3 of the report, but highlights for each sector include the following:

- Alliance of Automobile Manufacturers: From 2002 to 2005, Alliance members reduced absolute carbon dioxide (CO<sub>2</sub>) emissions by about 13 percent and reduced the emissions intensity, measured as CO<sub>2</sub> per number of vehicles produced, of their U. S. facilities by nearly 3 percent in 2005.
- Aluminum Association: Direct process emissions per ton of production, including combined perfluorocarbon (PFC) and CO<sub>2</sub> releases, decreased 56 percent from 1990 to 2005.
- American Chemistry Council: Between 1990 and 2006, the U.S. chemical industry’s GHG intensity improved by 34 percent. Total GHG emissions have fallen seven percent since 1990, even while industry output has risen 41 percent.
- American Forest & Paper Association: From 2000 to 2004, AF&PA member companies collectively reduced their direct greenhouse gas emissions from 61.2 to 51.4 MMTCO<sub>2</sub>-eq, or about 16 percent. This translates to a 12 percent reduction in intensity of direct emissions, from 0.514 to 0.453 tons of CO<sub>2</sub> equivalent per ton of production.
- American Iron & Steel Institute: Energy intensity per ton of steel shipped improved by approximately 15 percent from 2002 to 2006. Since 1990, energy intensity is down about 29 percent.
- American Petroleum Institute: Petroleum refiners are on track to achieve their goal

of a 10 percent improvement in energy efficiency over 2002 to 2012, with energy savings in 2006 equivalent to taking more than 528,000 cars off the road.

- The Business Roundtable: Seventy percent of Roundtable member companies are enrolled in Climate RESOLVE, the Roundtable's initiative to help companies develop and improve GHG management programs.
- Industrial Minerals Association—North America: Companies participating in the GHG program report that they have reduced their energy-related CO<sub>2</sub> emissions by an average of just over 15 percent from 2000 through 2005.
- International Magnesium Association: Under the Environmental Protection Agency's (EPA) SF<sub>6</sub> Emission Reduction Partnership for the Magnesium Industry, magnesium industry partners reduced direct emissions of the strongest GHG, sulfur hexafluoride (SF<sub>6</sub>), by 0.8 MMTCO<sub>2</sub>-eq in 2005. The goal is to completely eliminate the Partnership's SF<sub>6</sub> emissions by the year 2010.
- National Lime Association: Between 2002 and 2006, the energy-related CO<sub>2</sub> intensity of lime products produced by National Lime Association (NLA) member companies has been reduced by an aggregate of about 3 percent.
- National Mining Association: Methane emissions from coal mines have declined about 6 percent from 2000 to 2005.
- Portland Cement Association: Preliminary data indicates that U.S. cement manufacturers are making substantial progress towards achieving, and perhaps exceeding, their goal of a 10 percent reduction in CO<sub>2</sub> emissions per ton of cementitious product produced or sold from 1990 to 2020.

- Power Partners<sup>SM</sup>: The electric power industry is currently on track to meet its target of reducing GHG emissions intensity by the equivalent of 3 to 5 percent from the 2000-2002 base-year average over a 10-year period, as the 2005 GHG emissions intensity of Power Partners<sup>SM</sup> was 2.5 percent lower than the base-year average.
- Semiconductor Industry Association: In 2005, EPA's semiconductor industry partners reduced direct emissions of high global-warming-potential fluorinated compound gases such as PFCs, hydrofluorocarbons (HFCs), sulfur hexafluoride (SF<sub>6</sub>), and nitrogen trifluoride (NF<sub>3</sub>) by 7.7 MMTCO<sub>2</sub>-eq.

The success reported by the individual sectors is also evident in GHG intensity data for the U.S. economy and the overall industrial and power sectors (the "Industry & Power Group").<sup>1</sup> For the economy as a whole, GHG emissions have been growing more slowly than indicated in the baseline forecast, while the economy has been growing more rapidly. As a result, the GHG intensity improvement from 2002 through 2006 was substantially better than the baseline forecasts (9.5 percent vs. 3.8 percent), suggesting that the U.S. is on a path that will achieve, if not exceed, the goal of an 18 percent improvement by the year 2012.<sup>2</sup> Because of the faster rate of improvement in GHG intensity, GHG emissions for 2006 were about 450 MMTCO<sub>2</sub>-eq lower than the GDP-adjusted levels in the [baseline forecast](#).<sup>3</sup>

<sup>1</sup> For details of this analysis, see section 4 of this report or see: [http://www.climatevision.gov/pdfs/CV\\_TrackingReport\\_2002-2006.pdf](http://www.climatevision.gov/pdfs/CV_TrackingReport_2002-2006.pdf).

<sup>2</sup> It should be emphasized that the GHG intensity goals refer to an 18 percent economy-wide improvement in GHG intensity through the year 2012. This analysis does not imply that the 10-year, 18 percent intensity improvement goal has year-to-year numerical targets, nor does it imply that specific sectors of the economy are expected to achieve a specific portion of the total burden. Rather, these data provide indications of the progress being made.

<sup>3</sup> See: <http://www.whitehouse.gov/news/releases/2002/02/addendum.pdf>.

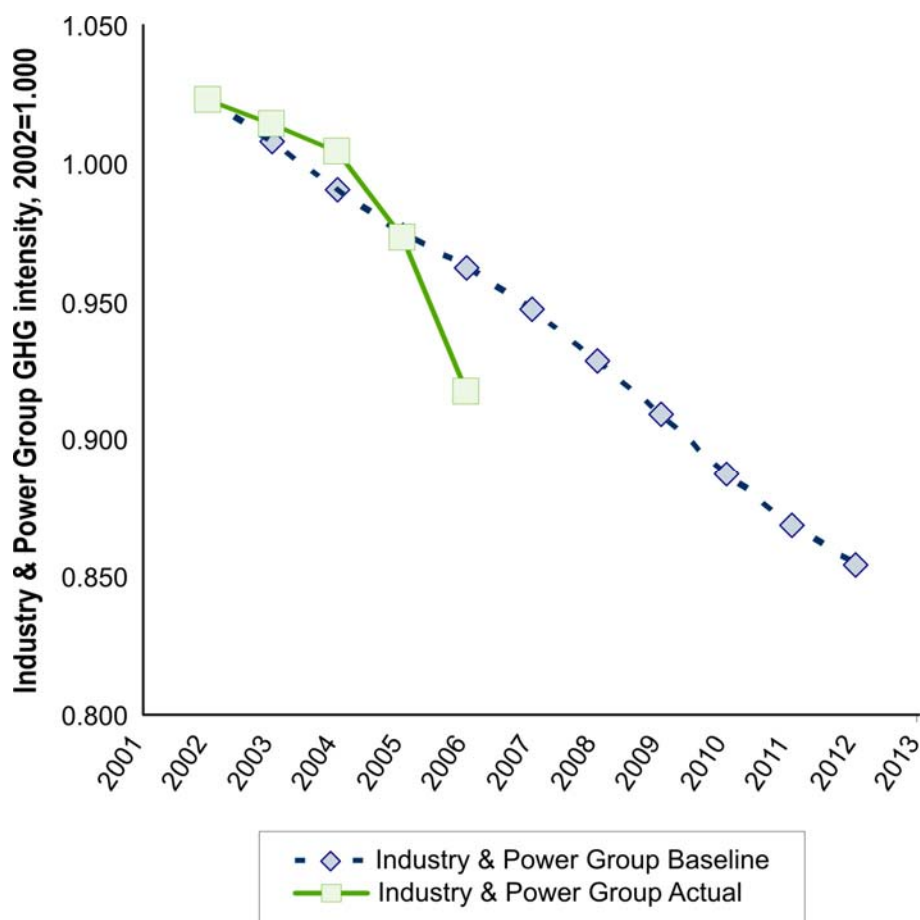
At 15 percent, the Industry & Power Group's 2002 to 2012 baseline intensity improvement forecast is about a percentage point higher than that projected for the economy as a whole. For the Industry & Power Group, GHG intensity improved 9.4 percent from 2002 to 2006, substantially better than the 5.4 percent improvement in the Group's baseline forecast. A substantial intensity improvement of about 2.8 percent in 2005 followed by another 5.2 percent in 2006 more than made up for weaker-than-forecasted improvements in 2003 and 2004.

For both the economy as a whole and the Industry & Power Group, these GHG intensity improvements are substantially greater than projected. As a result, the emission intensity trends for both metrics are solidly ahead of their respective baselines (Figure S-1).

Moreover, recent data from the Energy Information Administration indicate a 1.5 percent decline in U.S. greenhouse gas emissions<sup>5</sup> and a 1.4 decline in the Industry and Power Group emissions in 2006.

These data suggest that since 2003, Climate VISION partners have made considerable progress through voluntary action. The long-term success of the program will depend on many factors, some of which are beyond the control of

**Figure S-1**  
**Industry & Power GHG Intensity Actual vs. Baseline (2002-2012)<sup>4</sup>**



the partners. There are, however, reasons for optimism about future improvements in GHG intensity, both for the U.S. economy overall and for the Industry & Power Group. The activities, investments, and new technologies described in this report will continue to improve GHG intensity for years to come. Fuel market developments and economic incentives, such as those provided under the Energy Policy Act of 2005, are encouraging increased activity across the economy, and raising the importance of energy efficiency and low-carbon energy sources throughout the U.S.

<sup>4</sup> See Appendix Table A-2 for the underlying data.

<sup>5</sup> EIA, *Emissions of Greenhouse Gases in the United States 2006*, November 2007. See: <http://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057306.pdf>.

# 1. INTRODUCTION

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Climate change is a complex, long-term challenge that will require a sustained effort over many generations. As a party to the United Nations Framework Convention on Climate Change, the United States shares with many countries its ultimate objective: stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. In February 2002, President Bush reaffirmed the Administration's commitment to this long-term goal of the Framework Convention.

An effective approach to climate change cannot be developed in isolation from other pressing needs. Rather, it needs to be addressed as part of an integrated agenda that promotes economic growth, provides energy security, reduces pollution, and also mitigates GHG emissions. Meeting these complementary objectives will require a sustained, long-term commitment by all nations over many generations.

The Administration approach balances the desire to achieve near-term results, protect the economy, and capitalize on scientific and technological innovation. Major elements of this approach include (1) implementing near-term policies and measures to slow the growth in GHG emissions; (2) advancing climate change science; (3) accelerating technology development and commercialization; and (4) promoting international collaboration.

For fiscal years 2001 through 2007, the Federal Government devoted about \$37 billion to science, technology, international assistance, and incentive programs that support climate change objectives.

## Near-Term Policies and Measures

In 2002, President Bush set an ambitious but achievable national goal to reduce the GHG intensity—that is, emissions per unit of economic output—of the U.S. economy by [18 percent](#) by

2012. Based on projections of energy-related carbon dioxide (CO<sub>2</sub>) emissions by the Energy Information Administration (EIA) in its *Annual Energy Outlook 2002* (for CO<sub>2</sub>) and of other GHG emissions by the Environmental Protection Agency, the projected “business-as-usual” improvement in U.S. GHG intensity over this period was about [14 percent](#).<sup>6</sup> The President's objective, therefore, represents about a 29 percent improvement in the rate of improvement over the 10 years. Compared to the business-as-usual projection, the Administration estimated that achieving this commitment could avoid an additional 367 million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>-eq) emissions in 2012 and could result in cumulative savings of more than 1,833 MMTCO<sub>2</sub>-eq emissions over the decade.

This goal was set with the confidence that smarter policies would stimulate renewed investment in innovation and productivity. The Administration continues to implement many programs to help achieve this goal, including partnerships, consumer information campaigns, incentives, and mandatory regulations. These programs are directed at developing and deploying cleaner and more efficient energy technologies, encouraging energy conservation, and providing incentives for sequestration. Climate VISION is one of these programs.

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<sup>6</sup> See: <http://www.whitehouse.gov/news/releases/2002/02/addendum.pdf>.



## 2. CLIMATE VISION

[Climate VISION](#) is one of many programs and measures—some voluntary, some mandatory, and some incentive-based—that contribute to the President’s climate change strategy. In setting his 18 percent intensity goal, the President issued a challenge to the private sector to do its part. The President’s call resonated with business, and in February 2003, the Federal Government and 13 industry organizations representing thousands of companies from 12 energy-intensive economic sectors in energy, manufacturing, transportation, and forestry joined in a voluntary partnership known as Climate VISION (Voluntary Innovative Sector Initiatives: Opportunities Now).

On the occasion of the partnership’s launch, President Bush released a statement saying, “A year ago, I challenged American businesses to develop new, voluntary initiatives to reduce GHG emissions. I am pleased to announce today that 12 major industrial sectors and the membership of the Business Roundtable have responded with ambitious goals to reduce their GHG emissions in the coming decade.” (The full statement by the President appears in Box 2-1) Since the launch of

### Box 2-1

#### STATEMENT BY PRESIDENT BUSH

February 12, 2003

The United States is taking prudent steps to address the long-term challenge of global climate change. We are reducing projected greenhouse gas emissions in the near term, while devoting greater resources to improving climate change science and developing advanced energy technologies. America has already made great progress in this effort. Between 1990 and 2001, industrial sector emissions were held constant, while our economy grew by almost 40 percent. Sustaining and accelerating this progress will help us meet our goal of reducing the greenhouse gas intensity of the American economy by 18 percent by 2012.

A year ago, I challenged American businesses to develop new, voluntary initiatives to reduce greenhouse gas emissions. I am pleased to announce today that 12 major industrial sectors, and the membership of the Business Roundtable, have responded with ambitious commitments to reduce their greenhouse gas emissions in the coming decade.

America’s electric utilities; petroleum refiners and natural gas producers; chemical, automotive, magnesium, iron and steel manufacturers; forest and paper producers; railroads; the mining, cement, aluminum and semiconductor industries; and many of America’s leading corporations have committed to actions that will prevent millions of tons of greenhouse gas emissions in the coming decade. I commend these initiatives which will help these businesses and industries continue to improve their energy efficiency and overall productivity, while contributing toward achieving our goal to reduce the greenhouse gas intensity of the American economy.

As I said last year, every sector of the economy will need to contribute to our efforts to achieve our ambitious national goal. These initiatives are a first step in what we expect to be an ongoing engagement with these and other sectors of our economy in the years ahead.

Underpinning our approach to climate change is an understanding that meeting this long-term challenge requires policies that recognize that sustained economic growth is an essential part of the solution. Policies that undermine the health of our economy would only hamper America’s ability to develop and deploy new energy technologies and invest in energy efficiency and productivity improvements. The United States is the world’s leader in technological development, industrial productivity, and environmental quality. These strengths make possible the initiatives that have been announced today to reduce or capture and store greenhouse gas emissions.

the program, the number of participating sectors has risen to 14<sup>7</sup>.

<sup>7</sup> The railroad industry and DOE have agreed to move the railroads’ voluntary efforts to EPA’s [SmartWay Transport Partnership](#), which has as its focus surface transportation.

Participating industry sectors now include electric power producers; petroleum refiners; automobile, iron and steel, aluminum, chemical, and magnesium manufacturers; forest products producers; railroads; and the cement, mining, industrial minerals, lime, and semiconductor industries. Climate VISION partners include these organizations:

- Alliance of Automobile Manufacturers
- Aluminum Association
- American Chemistry Council
- American Forest & Paper Association
- American Iron & Steel Institute
- American Petroleum Institute
- The Business Roundtable
- Industrial Minerals Association – North America
- International Magnesium Association
- National Lime Association
- National Mining Association
- Portland Cement Association
- Power Partners<sup>SM</sup> (Edison Electric Institute; Nuclear Energy Institute; American Public Power Association; Electric Power Supply Association; Tennessee Valley Authority; National Rural Electric Cooperative Association; and Large Public Power Council)
- Semiconductor Industry Association

In addition, four Federal agencies also participate: the Department of Energy (DOE) (lead), Department of Agriculture (USDA), Department of Transportation, and Environmental Protection Agency (EPA). These agencies work in partnership with industry to accelerate the transition to technologies, practices, and processes that are cleaner, more efficient, and capable of capturing or sequestering GHGs.

## Sources of Industrial GHG Emissions

In 2003, the industrial sectors participating in Climate VISION accounted for roughly 40 to 45 percent of U.S. GHG emissions (Table 2-1).<sup>8</sup> By

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<sup>8</sup> These include only those emissions for which the Climate VISION partners have set numeric goals. It does not include emissions for Business Roundtable members.

far the largest source of industrial GHG emissions is from the combustion of fossil fuels to provide heat, power, work, and other needs.

As fossil fuels are combusted, the carbon stored in them is emitted almost entirely as CO<sub>2</sub>. The amount of carbon in fuels per unit of energy content varies significantly by fuel type. For example, coal contains the highest amount of carbon per unit of energy, while petroleum and natural gas have about 25 percent and 45 percent less carbon than coal, respectively.

According to [EIA](#), energy-related CO<sub>2</sub> emissions from the electric power generation sector account for about one third of total U.S. GHG emissions. Currently, about three quarters of generating capacity is fossil fuel-fired, and while coal-fired plants account for about one third of that capacity, they dispatch about half of the electricity generated for sale.<sup>9</sup> CO<sub>2</sub> emissions from the remaining Climate VISION sectors are responsible for roughly 11 percent of total U.S. GHG emissions.

GHG emissions also are produced as a by-product of many industrial processes. These can range from releases of CO<sub>2</sub> from the chemical transformation of raw materials to releases of gases used in industrial processes, such as hydrofluorocarbons (HFC), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>).

Next to fossil fuel combustion, cement production is the single largest human-caused source of CO<sub>2</sub> emissions. During the cement production process, calcium carbonate is heated in a cement kiln to form lime (i.e., calcium oxide) and CO<sub>2</sub>. The lime is then combined with silica-containing materials to produce clinker (an intermediate product), which releases the CO<sub>2</sub> produced earlier. The clinker is then allowed to cool, mixed with a small amount of gypsum, and used to make portland cement.

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<sup>9</sup> See: <http://www.eia.doe.gov/cneaf/electricity/epa/epates.html>.

**Table 2-1**  
**Climate VISION Sectors Direct Greenhouse Gas Emissions as Portion of**  
**Total U.S. Greenhouse Gas Emissions: 2002\***  
(MMTCO<sub>2</sub>-eq)

CLIMATE VISION SECTOR	2002 TOTAL SECTOR DIRECT GHG EMISSIONS*	TOTAL SECTOR DIRECT EMISSIONS AS PERCENT OF U.S. GROSS EMISSIONS	APPROXIMATE PERCENT OF SECTOR REPRESENTED IN CLIMATE VISION GOAL	ADJUSTED 2002 SECTOR GHG EMISSIONS	CLIMATE VISION SECTOR AS PERCENT OF U.S. EMISSIONS
Electric Power Generation	2,256 <sup>1</sup>	32.7	100	2,256	32.7
Chemicals	262 <sup>1</sup>	3.8	85	223	3.2
Petroleum Refining	172 <sup>1</sup>	2.5	60	103	1.5
Iron & Steel	96 <sup>1</sup>	1.4	75	72	1.0
Mining	72 <sup>1</sup>	1.0	100	72	1.0
Cement	70 <sup>1,2</sup>	1.0	95	66	1.0
Pulp & Paper	66 <sup>1</sup>	1.0	80	53	0.8
Auto Manufacturing	16 <sup>1</sup>	0.2	80	13	0.2
Lime	11 <sup>2</sup>	0.2	95	10	0.2
Industrial Minerals	9 <sup>4</sup>	0.1	80	7	0.1
Aluminum	5 <sup>2</sup>	0.1	98	5	0.1
Semiconductor	4 <sup>2</sup>	0.1	80	4	0.1
Magnesium	3 <sup>2</sup>	0.0	90	2	0.0
<b>Climate VISION Total</b>	3,042			2,885	
<b>U.S. Total</b>	6,891 <sup>3</sup>	44		6,891	42

\* Numbers may not add due to individual rounding. Includes only those emissions related to the primary goals of the Climate VISION partners. Sector GHG emissions include: energy-related CO<sub>2</sub> emissions for the electric power generation, chemicals, petroleum refining, iron & steel, mining, cement, pulp & paper, auto manufacturing, lime and industrial minerals sectors; and process-related emissions of CO<sub>2</sub> and other GHGs from the cement, aluminum, semiconductor, and magnesium sectors.

Sources: <sup>1</sup>EIA *Annual Energy Outlook 2005 Yearly and Supplemental Tables*; <sup>2</sup>EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2003*; <sup>3</sup>EIA *Emissions of Greenhouse Gases in the United States 2003*; <sup>4</sup>Climate VISION letters of intent.

Primary aluminum production results in process-related emissions of two GHGs—CO<sub>2</sub> and PFCs. The reduction of the alumina (aluminum oxide) to aluminum occurs through electrolysis in a molten bath of natural or synthetic cryolite. The reduction cells contain a carbon lining that serves as the cathode. Carbon is also contained in the anode, which can be a carbon mass of paste, coke briquettes, or prebaked carbon blocks from petroleum coke. During reduction, as the anode is consumed carbon is oxidized and released to the atmosphere as CO<sub>2</sub>. In addition, PFCs are emitted

as intermittent by-products of the smelting process during the production of primary aluminum.

The semiconductor industry uses combinations of HFCs, PFCs, SF<sub>6</sub>, and other gases for plasma etching and to clean chemical vapor deposition tools. PFC emission reduction methods, such as process optimization and advanced abatement technologies, can reduce these emissions, and their implementation has led to recent reductions in PFC emissions from semiconductor

manufacturing. Sulfur hexafluoride is also used as a protective cover gas for the casting of molten magnesium.

## Sector Goals

Before joining the partnership, each Climate VISION partner issued a letter of intent setting an energy or GHG emissions intensity reduction goal that could contribute to meeting the President's 18 percent emissions intensity objective.<sup>10</sup> These goals are summarized in Table 2-2. The letters of intent discussing these goals are available on the [Climate VISION website](#).

The Climate VISION partners have undertaken a range of activities in support of these goals, which are described in the work plans each partner has prepared detailing its strategy for meeting its goals. Each work plan is organized around four themes: emission measurement and reporting protocols; identifying and implementing near-term cost-effective GHG reduction opportunities; cross-sector projects for reducing GHG emissions, where applicable; and technology R&D and commercialization.

## Relation of Climate VISION to Other Programs

To help them achieve their goals, Climate VISION partners and their members take advantage of a broad range of other Federal, state, and local

<sup>10</sup> These sector goals were developed independently by each sector, do not necessarily use the same types of data, assumptions, or calculations, and may not be directly comparable with the goals of other Partners.

**Table 2-2**  
**Quantitative Goals of Climate VISION Partners**

PARTNER	QUANTITATIVE GOAL
Alliance of Automobile Manufacturers	10 percent reduction in GHG emissions intensity from U.S. manufacturing facilities (CO <sub>2</sub> per number of vehicles produced) between 2002 and 2012.
Aluminum Association	53 percent carbon equivalent reduction in perfluorocarbons and CO <sub>2</sub> emissions from carbon anode per ton of aluminum from 1990 to 2010
American Chemistry Council	18 percent reduction in GHG emissions per pound of production from 1990 to 2012
American Forest & Paper Association	12 percent reduction in GHG intensity from 2000 to 2012
American Iron & Steel Institute	10 percent improvement in energy intensity from 2002 to 2012
American Petroleum Institute	10 percent improvement in energy efficiency of refinery operations from 2002 to 2012
The Business Roundtable	100 percent participation by Roundtable members in voluntary actions to reduce, avoid, offset, or sequester GHGs
Industrial Minerals Association	4.2 percent reduction in GHG emissions from fuel combustion per ton of product between 2000 and 2012 for member companies in the soda ash and borates industries
International Magnesium Association	Elimination of sulfur hexafluoride emissions from magnesium production and casting by the end of 2010
National Lime Association	Eight percent reduction in GHG emissions from fuel combustion per ton of product between 2002 and 2012
National Mining Association	10 percent improvement in energy efficiency of mining operations from 2002-2012
Portland Cement Association	10 percent reduction in CO <sub>2</sub> emissions per ton of cementitious product produced or sold from 1990 to 2020
Power Partners <sup>SM</sup>	Equivalent of three percent to five percent reduction in GHG emissions per unit of electricity produced from a 2000 to 2002 base period to 2010 to 2012
Semiconductor Industry Association	10 percent reduction in absolute perfluorocompound emissions from 1995 to 2010

programs that help them increase energy efficiency, improve industrial processes, and reduce GHG emissions intensity. Climate VISION provides a framework for tracking and presenting industry's GHG emission reduction efforts. Examples of Federal programs and

initiatives that help enable industry to make progress include the following.

[Climate Leaders](#) was launched in early 2002 by EPA to encourage individual companies to develop long-term, comprehensive climate change strategies. Under this program, partners set corporate-wide GHG reduction goals and inventory their emissions to measure progress. The partnership now includes almost 139 partners, about 67 of which have already set aggressive GHG emission reduction goals. The U.S. annual GHG emissions of these partners account for more than 8 percent of the U.S. total.

The [Industrial Technologies Program](#) (ITP) provides national leadership in industrial energy efficiency through collaborative R&D and its Save Energy Now initiative, which industry uses to cut energy consumption. ITP works in partnership with energy-intensive industries such as chemicals, forest products, and steel; value-adding industries such as food processing, automotive, and fabricated metals; high growth industries such as computers and electronics; and new energy supply industries such as ethanol production to improve the energy intensity of operations, reduce greenhouse gas emissions, and enhance long-term competitiveness by helping accelerate research and development of technologies that increase energy and resource efficiency. Over 170 ITP-sponsored technologies have entered commercial markets, two dozen have received R&D 100 awards over the past seven years and over 156 patents have been awarded since 1994. Participating industries include aluminum, chemicals, forest products, mining, and steel.

ITP also helps plants save energy by promoting the use of proven energy management methods, energy efficient software tools, and the adoption of state-of-the-art energy saving technologies industry wide. Over 16,000 plants have been impacted by ITP's Technology Delivery efforts. A centerpiece of ITP's program is the Save Energy Now initiative. In 2006, ITP completed 200 Save Energy Now assessments at U.S. industrial plants.

The [ENERGY STAR for Industry](#) program also works with manufacturing industries to enable them to enhance their corporate energy management systems. EPA works with specific industries to identify barriers to energy efficiency, define strategies for minimizing these barriers, and design management tools that will assist the industries with improvements. These efforts include the development of plant energy-performance indicators that enable the industries to assess the efficiency of particular manufacturing plants, building upon the successful energy performance and benchmarking work of the ENERGY STAR program in the commercial sector. Since 2002, the program has worked with hundreds of industrial companies across energy-intensive and non-intensive sectors, including the automobile manufacturing, cement, and petroleum sectors. ENERGY STAR has provided strategies and guidance to help these businesses voluntarily improve the energy efficiency of their operations and at the same time contribute to the President's overall GHG intensity improvement goal.

[Natural Gas STAR](#) is an EPA-led partnership program that works with companies that produce, process, transmit, and distribute natural gas to identify and promote the implementation of cost-effective technologies and practices to reduce methane emissions. Since its launch in 1993, Natural Gas STAR has been successful in reducing methane emissions and bringing more energy to markets. As of 2007, Natural Gas STAR partner companies represented 62 percent of the U.S. natural gas industry.

In the transportation sector, EPA's [SmartWay Transport Partnership](#) is a voluntary program aimed at reducing emissions from the freight sector through the implementation of innovative technologies and advanced management practices. To date, about 430 companies and organizations have joined the partnership and have committed to reduce the CO<sub>2</sub> emissions associated with their freight operations. Additionally, there are now more than 50 diesel truck and locomotive engine-idling reduction projects across the United States.

The objective of the Environmental Stewardship initiative at EPA is to reduce or eliminate emissions of HFCs, PFCs, and SF<sub>6</sub> in three industrial applications: semiconductor production, electric power distribution, and magnesium production. Since 2002, the SF<sub>6</sub> emission reduction partnership for magnesium set a goal to eliminate emissions of SF<sub>6</sub> by the end of 2010.

The Voluntary Aluminum Industry Partnership has continued to reduce PFCs where cost-effective technologies and practices are technically feasible. Since 2002, the partnership expanded its reduction goal to reduce direct carbon emissions from anode consumption as well as PFCs.

The [National Action Plan for Energy Efficiency](#) (Action Plan), which is being facilitated by DOE and EPA, presents policy recommendations for creating a sustainable, aggressive national commitment to energy efficiency through gas and electric utilities, utility regulators, and partner organizations. Leading organizations across the country, including Climate VISION partners and their member companies, are taking specific actions to make the Action Plan a reality. As of March 2007, more than 90 organizations have announced public statements and commitments to advance energy efficiency across 47 states.

EPA's [Combined Heat and Power \(CHP\) Partnership](#), launched in 2001, provides technical assistance to organizations across multiple sectors that invest in CHP projects and assists state governments in designing policies that encourage investment in environmentally beneficial CHP. As a result, the program now includes almost 200 partners, among which are member companies of Climate VISION partners, who have installed more than 3,500 megawatts (MW) of operational CHP.

In addition to setting goals to reduce the emissions intensity of their operations, the Nation's automobile manufacturers and petroleum and chemical companies are working with DOE through the [FreedomCAR](#) program, a

public-private partnership to develop hydrogen as a primary fuel for cars and trucks. Its focus is on research needed to develop hydrogen from domestic renewable sources and technologies that use hydrogen, such as fuel cells. The program works jointly with DOE's hydrogen, fuel cell, and infrastructure R&D efforts and the efforts to develop improved technology for hybrid electric vehicles. These advanced technologies could result in dramatic reductions of criteria pollutants and GHG emissions from the transportation sector.

Member companies of Climate VISION partners are encouraged to report to the [Voluntary Reporting of Greenhouse Gases Program](#). Authorized under Section 1605(b) of the Energy Policy Act of 1992, this voluntary program provides a means for utilities, industries, and other entities to establish a public record of their emissions and the results of voluntary measures to reduce, avoid, or sequester GHG emissions. Currently, about 230 U.S. companies and other organizations file reports. The information collected through the program is made available through a public use database that supports educational exchanges, informs public policy development, and encourages public recognition of initiatives to reduce GHGs. New reporting guidelines are in place that are intended to strengthen the program by encouraging comprehensive, entity-wide reporting of emissions and emission reductions, including sequestration, and by increasing the measurement accuracy, reliability, and verifiability of reports.

Internationally, many Climate VISION partners are active in various activities, the most significant example being the [Asia-Pacific Partnership on Clean Development and Climate \(APP\)](#). At APP's ministerial launch, the partners created eight task forces. Many of the sector associations participating in Climate VISION play leading roles in these task forces, including the Aluminum Association, American Iron and Steel Institute, American Petroleum Institute, Edison Electric Institute, National Mining Association, and Portland Cement Association.

PowerPartners<sup>SM</sup> is active in multilateral longer-term R&D efforts, including the Generation IV International Forum, the Global Nuclear Energy Partnership, and the ITER fusion project, discussed earlier. Climate VISION members companies, such as those from the National Mining Association and the American Petroleum Institute, also participate in the Methane to Markets partnership.

These and other programs provide many opportunities for active collaboration to improve energy efficiency and reduce the GHG emissions intensity of the power generation and industrial sectors and also to develop new technologies that can have an impact in these and other sectors beyond 2012.

### 3. CLIMATE VISION PARTNER ACTIVITIES AND PROGRESS

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This section describes activities undertaken by the Climate VISION partners to achieve their goals. The information and data presented in this section were provided to DOE by the Partners and are available on the [Climate VISION website](#).<sup>11</sup> More information on some of the activities and programs described below can be found by visiting the links provided.

DOE reviewed and analyzed the data provided by the partners for quality and to ensure their general consistency with trends in EIA, EPA, and other public sources of data, where available. However, the information was generated by each sector individually and may not use the same data sources, assumptions, or calculations. As a result, the estimated GHG reductions and other benefits reported in this section should not be aggregated and do not directly correlate with the industry-wide calculations presented in section 4.

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<sup>11</sup> See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).



## AUTOMOBILE MANUFACTURING SECTOR: ALLIANCE OF AUTOMOBILE MANUFACTURERS<sup>12</sup>

### Highlights:

- In 2005, Alliance of Automobile Manufacturers (Alliance) members reduced absolute CO<sub>2</sub> emissions by 13.4 percent from 2002 levels. GHG emissions intensity (CO<sub>2</sub> per number of vehicles produced) also decreased by 2.8 percent in 2005 from 2002. These reductions contribute to the President's GHG intensity reduction goal by improving energy efficiency within the industry.
- Alliance members engage in a number of public-private partnerships that focus on cost-effective energy efficiency and energy management projects. They have been the recipients of a variety of recent national and local awards. Member companies are also working individually at their facilities to reduce emissions, benefit the environment, and improve their energy and fuel-use footprint.

### Industry Sector and Participants:

The Alliance is a trade association of nine car and light truck manufacturers, including BMW Group, Chrysler LLC, Ford Motor Company, General Motors, Mazda,<sup>13</sup> Mitsubishi Motors, Porsche,<sup>14</sup> Toyota, and Volkswagen.<sup>15</sup> Combined, these companies account for more than 80 percent of U.S. vehicle sales.

<sup>12</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See:

[http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

<sup>13</sup> Reporting covered by Ford Motor Company.

<sup>14</sup> Does not own or operate U.S. manufacturing facilities.

<sup>15</sup> Does not own or operate U.S. manufacturing facilities.

### Primary Climate VISION Goal:

Alliance member companies committed to a goal to achieve at least a 10 percent intensity reduction in GHG emissions from their U.S. automotive manufacturing facilities, based on U.S. vehicle production (CO<sub>2</sub>/vehicles produced), by 2012 from the base year 2002.

The primary mechanisms that individual companies are implementing include energy management programs that encompass energy efficiency improvements to automobile and light-duty truck manufacturing; buildings and process equipment (e.g., increasing efficiencies for lighting, heating, and cooling); conserving energy, electricity, and fuel demand; making process improvements; and recycling materials and packaging. Progress may be affected by external factors such as weather, fuel availability, and significant production fluctuation.

### Additional Climate VISION Goals:

- Alliance members agreed to make their progress public by annually reporting their energy use and GHG emissions and reductions to DOE's Voluntary Section 1605(b) GHG Registry.
- The Alliance and its members are working in collaboration with DOE, EPA, and other partners to implement activities which contribute to the President's goal of reducing the GHG intensity of the United States economy by 18 percent by the end of 2012.

### Related Industry Programs:

- ENERGY STAR "Industries in Focus" Program:

- ⇒ Alliance members participate in the Auto Sector activities under the [ENERGY STAR Industries in Focus Program](#), sponsored by EPA.
- ⇒ By the end of 2006, twelve U.S. automobile assembly plants had received the new [ENERGY STAR Plant Label Awards](#) in recognition of their superior energy performance. ENERGY STAR is the national symbol of energy efficiency and environmental protection. The ENERGY STAR Plant Label identifies the top quartile of plants in the industry in energy efficiency performance. Each of these plants is awarded the honor of displaying the ENERGY STAR in the form of a banner at the plant. Only eight facilities from all other manufacturing industries were recognized in 2006 calendar year.
- ⇒ Automobile manufacturers coordinated with EPA and Lawrence Berkeley National Laboratory to develop the ENERGY STAR Guide, *Energy Efficiency Improvement and Cost Saving Opportunities for the Vehicle Assembly Industry*, which has become a program model.
- ⇒ Automobile manufacturers also collaborated with EPA and Duke University to develop the Energy Performance Indicator tool to help facilities benchmark their energy usage, along with specific ENERGY STAR tools to help them with GHG reduction planning, conservation activities, efficiency improvements, changes in operating practices, and employee awareness programs.
- ⇒ Alliance members have been consistent recipients of the ENERGY STAR Partner of the Year Awards for strong corporate energy management (see web link below for recipients).

- DOE Office of Energy Efficiency and Renewable Energy:
  - ⇒ Alliance members participate in Industrial Technologies Program energy efficiency and technology training events on various energy applications (pumping, steam, process heating, etc.) and co-sponsored energy efficiency applications (i.e., Rebuild America Program). Members also take advantage of site auditing and technical expertise provided by DOE.
- Various members also participate in the EPA Climate Leaders Program, Suppliers Partnership for the Environment, and Landfill Methane Outreach Program.
- Forest preservation and reforestation activities are also ongoing, such as General Motors' \$10 million Brazilian Atlantic Rainforest Project in partnership with The Nature Conservancy.

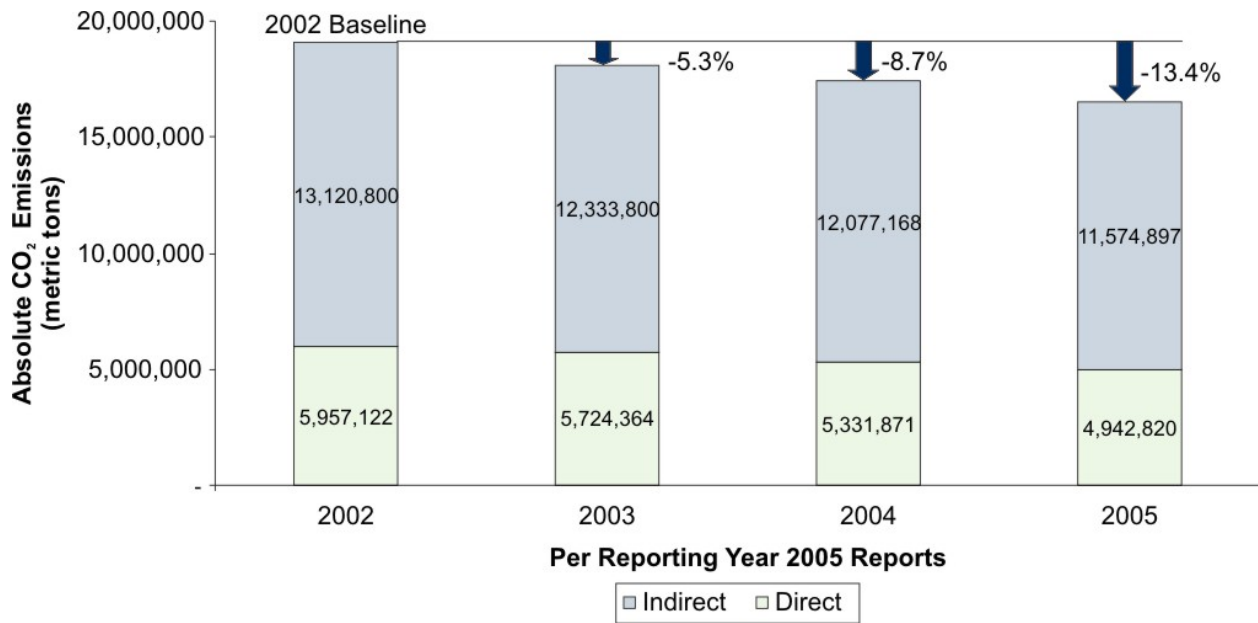
### **Metrics Identified:**

The Alliance target is expressed as a 10 percent intensity reduction in GHG emissions from their U.S. automotive manufacturing facilities, based on U.S. vehicle production (CO<sub>2</sub> per vehicle produced). The industry reports data through EIA's Voluntary Reporting of Greenhouse Gases program.

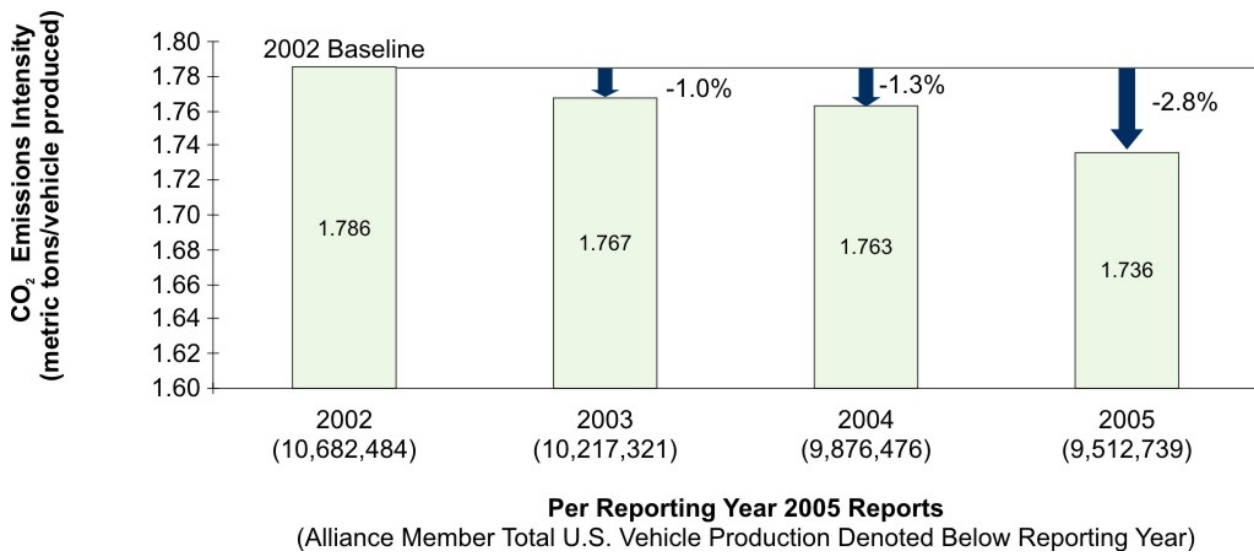
### **Measured Results to Date:**

Figures 3-1 and 3-2 below show that for Alliance member U. S. facilities, both absolute emissions and emissions per vehicle produced (emissions intensity) dropped in each year through 2005, compared with the baseline year of 2002, as reflected in member company reports to the DOE Section 1605(b) Voluntary GHG registry, as of December 2006. Reductions resulted from each company's mix of energy, fuel use, electricity use efficiency improvements, and operational and production changes.

**Figure 3-1**  
**DOE 1605(b) Reporting Summary for Members of the Alliance of Automobile Manufacturers**  
**Reporting Year 2002- 2005 Facility CO<sub>2</sub> Emissions**



**Figure 3-2**  
**DOE 1605(b) Reporting Summary for Members of the Alliance of Automobile Manufacturers**  
**RY 2002- RY 2005 Facility CO<sub>2</sub> Emissions**



## Industry Projects and Activities—Success Stories:

Each member is focusing on those projects that are the most efficient and economical to implement, based on company-specific considerations. The following is a subset of those projects:

- BMW initiated a project to use methane gas to power four on-site turbines and “cogenerate” electricity and hot water for the manufacturing plant in South Carolina. Annually, this project reduces CO<sub>2</sub> emissions equivalent to removing nearly 100,000 automobiles from the highways and recovers sufficient energy to heat the equivalent of 15,000 homes. BMW recently expanded landfill gas use to its painting facility.
- CHRYSLER LLC surveyed the energy consumption at its Kenosha Engine Plant for equipment and lighting operations during non-production hours. An annual savings of 40 kilowatthours (kWh) per engine produced has been achieved. This program prevents nearly 13,000 metric tons of CO<sub>2</sub> emissions annually. Chrysler LLC’s Sterling Heights assembly plant implemented a steam trap maintenance and repair program to promote efficient operation of end-use heat transfer equipment, which prevents approximately 49,000 metric tons of CO<sub>2</sub> emissions annually.
- FORD MOTOR COMPANY, in partnership with Detroit Edison, developed an award-winning “paint-fumes-to-fuel” cell system that uses paint booth gases to generate electricity. The system captures paint booth fumes, a plant’s largest source of emissions, and then uses them to produce electricity, reducing demand on public utility sources and CO<sub>2</sub> emissions. The Wayne assembly plant uses landfill gas to heat and cool the facility, reducing the consumption of natural gas. The Ford Rouge Visitor Center houses a photovoltaic array, a solar thermal collector, and an automated building management system. The adjacent Dearborn truck plant holds the world’s largest living roof that reduces solar thermal load while ground cover converts CO<sub>2</sub> into oxygen.
- GENERAL MOTORS CORPORATION received a gold certification from the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) program for its new Lansing Delta Township assembly plant. To date, the facility is the only automotive manufacturing plant in the world—as well as the largest facility and the most complex manufacturing site—to receive any level of LEED certification. Over the first 10 years of operations, the facility is expected to save over 30 million kWh of electricity.
- In 2006, General Motors’ U.S. operations recycled approximately 1.6 million tons, equivalent to about 4.2 MMTCO<sub>2</sub>, through prevention and recycling of paper, metals, plastics, organics, and other materials. Since June 2006, two 1 MW photovoltaic projects were installed on the roofs of two GM parts warehouses in California, with the ability to generate as much as 3 million kWh of electricity a year, which is expected to reduce overall electricity costs per facility by 10 percent a year. To date, 14 GM plants have reduced demand by over 30 MW—enough electricity to power a typical U.S. assembly plant. Additional plants are in process for similar improvements worldwide.
- MITSUBISHI MOTORS’ manufacturing facility in Normal, Illinois, achieved a 5 percent reduction in electrical demand during peak usage summer months in 2006 compared with 2005, reflecting Mitsubishi’s efforts to improve energy efficiency.

- TOYOTA MOTOR ENGINEERING AND MANUFACTURING NORTH AMERICA continues to implement its energy-efficient lighting project to change metal halide fixtures to high bay fluorescent fixtures. It also plans to expand its pilot projects on heat recovery beyond its paint shops to other operations and plants and to use waste heat from incinerators to create steam for various applications. Last year, such projects prevented approximately 12,000 metric tons of CO<sub>2</sub> emissions.

### **Program Reports and Other Links:**

To learn more about auto industry efforts to address greenhouse gases, please visit the following websites:

- [Alliance of Automobile Manufacturers](#)
- [BMW Group](#)
- [Chrysler LLC](#)

- [Ford Motor Company](#)
- [General Motors](#)
- [Mazda](#)
- [Mitsubishi Motors](#)
- [Porsche](#)
- [Toyota](#)
- [Volkswagen](#)
- [ENERGY STAR Guide: \*Energy Efficiency Improvement and Cost Saving Opportunities for the Vehicle Assembly Industry: An ENERGY STAR® Guide for Energy and Plant Managers\*](#)
- [ENERGY STAR Plant Awards](#)
- [ENERGY STAR Partner of the Year Awards](#)
- [ENERGY STAR Industries in Focus](#)
- [Climate VISION Private Sector Initiatives: Automobile Manufacturing](#)

## ALUMINUM SECTOR: ALUMINUM ASSOCIATION<sup>16</sup>

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### Highlights:

- The Aluminum Association participation in the Voluntary Aluminum Industry Partnership (VAIP) program led to reductions in PFC emissions by over 45 percent in 2000 compared to the industry's 1990 baseline. Reductions achieved in 2005 have resulted in a 56 percent reduction in direct process emissions per ton of production, including combined PFC and CO<sub>2</sub> releases.

### Industry Sector and Participants:

The Aluminum Association and its members participating in the VAIP represent 98 percent of primary aluminum production in the United States.

### Primary Climate VISION Goal:

The Aluminum Association has committed under the Climate VISION program to a direct carbon intensity reduction of emissions of PFCs and of emissions of CO<sub>2</sub> from the consumption of the carbon anode from the primary aluminum reduction process. The primary aluminum industry emits PFCs and CO<sub>2</sub> directly from the production process and indirectly emits CO<sub>2</sub> from its energy consumption.

The Climate VISION target is a 53 percent total carbon equivalent reduction from these sources by 2010 from 1990 levels. The industry has been working to reduce GHG emissions for over a decade, and this new commitment equates to an additional direct carbon-intensity reduction of 25 percent since 2000.

### Additional Climate VISION Goals:

- As a large industrial energy consumer, the primary producers also agree to continue their efforts to reduce indirect CO<sub>2</sub> emissions through continued energy-efficiency improvements. This commitment builds on the efforts of the VAIP, a partnership program that EPA has had with the industry since 1995.
- The Aluminum Association also pledges to support climate protection through efforts to increase aluminum recycling and the development of lightweight vehicles.

### Related Industry Programs:

The Aluminum Association participates in the Aluminum Task Force of the Asia-Pacific Partnership on Clean Development and Climate. Asia-Pacific Partnership accounts for 37 percent of the world's aluminum production. The aluminum industry is one of the fastest-growing sectors, with rapid growth in developing countries. The industry can make further improvements in environmental performance, while reducing costs, through best practice use of existing equipment to manage perfluorocarbon emissions, increased uptake of the best available and affordable technology, continued development and deployment of new technologies, and increased levels of recycling. The Aluminum Association is working through the Partnership to reduce PFC emissions and address energy efficiency and other CO<sub>2</sub> process emissions by promoting best practice performance, increasing technical support, and identifying impediments to the deployment of best available and affordable technology.

### Metrics Identified:

The Aluminum Association is measuring progress for Climate VISION, based on data collected

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<sup>16</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

from its members. Metrics are based on metric tons of carbon equivalent per tonne of aluminum produced.

**Measured Results to Date:**

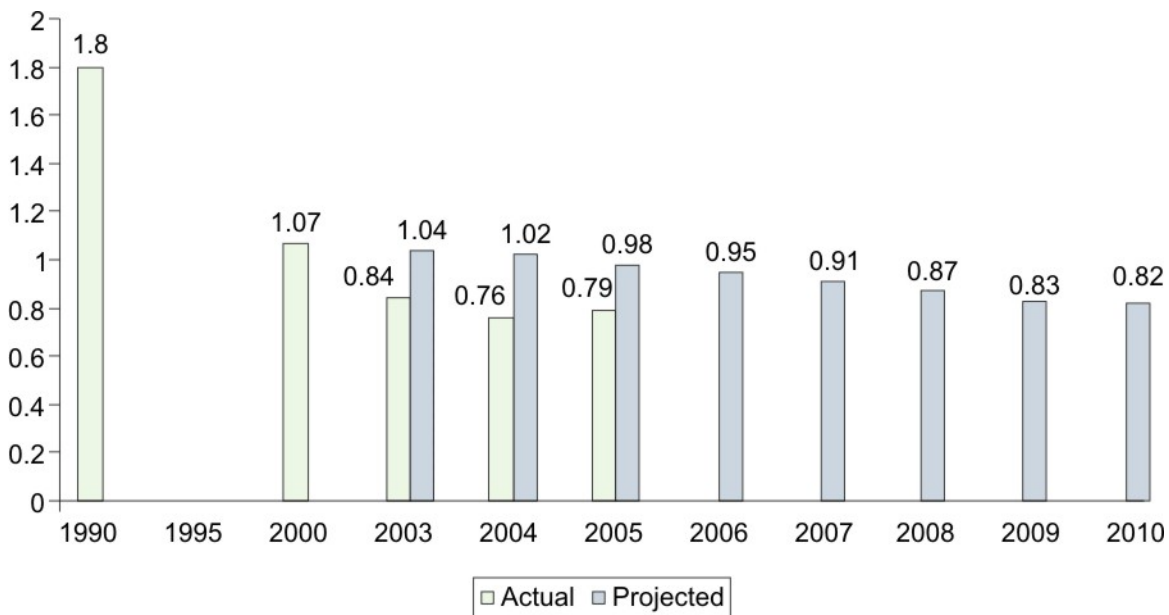
The Aluminum Association and the Federal Government have documented progress in the Climate Vision program. The results are measured by metrics developed by the industry, in partnership with the government, and reported. The industry has already achieved the goal set for 2010. The 56 percent reduction from 1990 to 2000 in direct process emissions per ton of production, including combined reductions in PFCs and CO<sub>2</sub>, exceeds the 53 percent commitment for 2010 (Figure 3-3). Further progress is expected in the industry, however complications from high power costs and potential curtailments make predictions for further reductions difficult to predict. Progress will also be tracked under the umbrella of the [Voluntary Aluminum Industrial Partnership](#) web site. Please check on this website and the [Energy Information Agency](#) website for updates.

For absolute reductions, in 2005 the Partnership reduced direct CO<sub>2</sub>-equivalent emissions by 8.2 MMTCO<sub>2</sub>-eq compared to business-as-usual emissions (14.7 MMTCO<sub>2</sub>-eq).

**Industry Projects and Activities—Success Stories:**

- **CURBSIDE VALUE PROGRAM:** The Climate VISION agreement includes efforts to address mechanisms to improve recycling of aluminum cans. To achieve can recycling progress, a pilot program is underway called the Curbside Value Partnership (CVP). The CVP is a national partnership funded by the Aluminum Association and the Can Manufacturers Institute, offered to cities, waste haulers, and material recovery facilities (MRF), designed to increase the economic value and payback of local curbside recycling streams.

**Figure 3-3**  
**Direct Process Emission 2010 Goals:**  
**53 percent below Year 1990, 25 percent below Year 2000**  
**Metric Tons Carbon Equivalent per Tonne Aluminum (TCE/tonne)**



Source: EPA Climate Change Division

The goals of the program include:

- ⇒ Increasing the aluminum can recycling rate;
- ⇒ Creating a cost-effective model for cities to implement self-sustaining recycling programs; and
- ⇒ Promoting self-sustaining recycling efforts by emphasizing value for the community and by providing advantageous business models to provide collection incentives.

For 2006, the CVP program is working to achieve a 50 percent participation rate by the top 100 MRFs in the United States. As of mid-2004, 25 MRFs were actively participating in the CVP efforts and reporting mechanisms, and approximately 25 percent more MRFs had signed up to the CVP program. More information on the CVP is available at its website [www.recyclecurbside.org](http://www.recyclecurbside.org).

- **SPENT POTLINER (SPL) WASTE UTILIZATION PROGRAM:** SPL is a waste by-product from primary aluminum production, composed of disposed solid carbonaceous material when aluminum production cells are relined. A two-phase testing program was completed in late 2005 and demonstrates the feasibility and substantial energy, emissions, and kiln production benefits of SPL processing. The benefits from SPL use in cement kilns include complete kiln destruction of all SPL waste constituents of concern (eliminating landfill disposal); reduction of cement kiln nitrogen oxide emissions; improved clinker quality from SPL mineralization benefits and fluoride utilization (also reducing the need for fluorspar in cement kiln operations); and reduced feedstock needs of alumina and silica for cement production. SPL used in a cement kiln would replace the equivalent of at least 1/3 ton of coal and result in a greater output of cement production.

- **ENERGY EFFICIENCY, TRANSPORTATION SECTOR—LIGHTWEIGHT VEHICLES, RECYCLING:** Together with the North American automotive industry, the Aluminum Association has conducted a comprehensive Life Cycle Assessment of aluminum use in the automobile and light truck transportation segment. The peer-reviewed study demonstrated that one pound of aluminum used in automobiles and light trucks saves, over the lifetime of the vehicle, an average of at least 20 pounds of CO<sub>2</sub> equivalent emissions. Aluminum use in the automobile and light truck market of the U.S. has grown from an average of 183 pounds per vehicle in 1991 to 295 pounds in 2004. Current projections forecast that this trend will continue with aluminum use expected at levels over 315 pounds per vehicle on average in 2010. At those projected aluminum use levels, at least 820 pounds of CO<sub>2</sub> equivalent emissions will be saved per vehicle over its operating lifetime for 2010 models compared to 2002 models.

#### **Program Reports and Other Links:**

- [Voluntary Aluminum Industrial Partnership](#)
- [Climate VISION Private Sector Initiatives: Aluminum](#)



## CHEMICALS SECTOR: AMERICAN CHEMISTRY COUNCIL<sup>17</sup>

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### Highlights:

- Between 1990 and 2006, the U.S. chemical industry's GHG intensity improved by 34 percent. Total GHG emissions have fallen 7 percent (21 MMTCO<sub>2</sub>-eq) since 1990, even as industry output has risen 41 percent.
- Recognizing the importance of industry transparency, in 2003 the American Chemistry Council (ACC) established a GHG intensity and energy-efficiency reporting mechanism under its [Responsible Care®](#) program to obtain more specificity on GHG intensity reductions by ACC members. In 2005, ACC began publicly reporting aggregated member results on improving energy efficiency and GHG intensity. The results show that between 2003 and 2005, ACC member companies have reduced their greenhouse gas intensity, per pound of production, by five percent and improved their energy efficiency by 1.5 percent.

### Industry Sector and Participants:

ACC represents the leading companies engaged in the business of chemistry. ACC members apply the science of chemistry to make innovative products and services that make people's lives better, healthier, and safer. ACC is committed to improved environmental, health, and safety performance through Responsible Care®, common-sense advocacy designed to address major public policy issues, and health and environmental research and product testing.

The ACC represents 85 percent of the basic industrial chemical industry production in the

U.S. The business of chemistry is a \$635 billion enterprise and a key element of the nation's economy. It is the nation's largest exporting sector, accounting for 10 cents out of every dollar in U.S. exports. Chemistry companies are among the largest investors in research and development.

### Primary Climate VISION Goal:

ACC members have committed to lowering their collective GHG intensity 18 percent by 2012, using 1990 as the base reporting year.

### Additional Climate VISION Goals:

ACC members will continue to manufacture products and pursue innovative ways to help other industries and sectors achieve the President's goal.

### Related Industry Programs:

The Responsible Care® Energy Efficiency Awards program is among ACC's many ongoing efforts to improve energy efficiency. These projects have the added benefit of reducing GHG emissions. Since 2003, the 112 award winners have reduced GHG emissions by over five million tons.

The chemicals industry also is a partner with DOE's ITP, participating in energy assessments and in technology R&D.

### Metrics Identified:

The Economics Group of the ACC each year compiles government data on production, processes, and fuel use, and uses these data to compute overall industry GHG emissions intensity. GHG intensity for the business of chemistry is the ratio of net GHG emissions to pounds of production. As this information extends back to 1990, ACC uses this as the basis for measuring its progress toward its Climate

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<sup>17</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

VISION goal of an 18 percent intensity improvement over the 1990 to 2012 period.

As an additional step to obtain more specificity on GHG reductions and energy consumption by ACC members, new reporting procedures were established through the Responsible Care® program. From 2003 through 2012, ACC will collect data directly from members to measure progress and will report this progress publicly. ACC began publicly reporting their aggregated progress in 2005.

### Measured Results to Date:

ACC collects and maintains times series data on energy consumption and through analysis calculates GHG emissions for the chemical industry. Energy consumption data and CO<sub>2</sub> emissions data are available back to 1974 and data on emissions of other GHGs are available back to 1990 (Table 3-1).

There are two primary means of measuring emissions: One is to combine both direct emissions from fuel use and processes and indirect (or embedded) emissions from purchased electricity. This presents somewhat of a life cycle approach. The other means is to exclude the indirect emissions from purchased electricity, as these emissions are generated by another sector of the economy. Because it more accurately reflects the progress that the U.S. chemical industry has made in reducing its GHG emissions, ACC's Climate VISION goal is measured using total direct and indirect GHG emissions. Nonetheless, ACC reports data for both direct and indirect emissions.

Between 1990 and 2006, the U.S. chemical industry's total GHG emissions have been reduced 21 MMTCO<sub>2</sub>-eq. Including indirect (or embedded) CO<sub>2</sub> emissions from purchased electricity, the chemical industry's emissions were reduced by seven percent. At the same time

**Table 3-1  
Business of Chemistry Greenhouse Gas Emissions (MMTCO<sub>2</sub>-eq)**

	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Fuel & Power CO <sub>2</sub>	229.6	247.0	257.3	257.6	255.6	261.5	244.1	244.0	248.2	245.1	241.2	237.0
Process CO <sub>2</sub>	2.7	3.3	3.5	3.4	3.4	3.5	3.4	3.5	3.5	3.9	3.6	3.6
<b>Total Carbon</b>	<b>232.3</b>	<b>250.3</b>	<b>260.8</b>	<b>261.0</b>	<b>259.0</b>	<b>265.0</b>	<b>247.5</b>	<b>247.5</b>	<b>251.7</b>	<b>249.0</b>	<b>244.8</b>	<b>240.6</b>
Nitrous Oxide	33.0	37.1	31.5	26.9	25.6	25.6	20.8	23.1	22.9	21.7	21.7	21.9
Methane	1.3	1.6	1.8	1.8	1.8	1.7	1.5	1.5	1.5	1.6	1.5	1.6
Others	35.0	27.0	30.0	40.1	30.4	29.8	19.8	19.8	12.3	15.6	16.5	16.5
<b>Total GHG Emissions</b>	<b>301.6</b>	<b>316.0</b>	<b>324.1</b>	<b>329.8</b>	<b>316.8</b>	<b>322.1</b>	<b>289.6</b>	<b>291.9</b>	<b>288.4</b>	<b>287.9</b>	<b>284.5</b>	<b>280.6</b>
<b>PERFORMANCE INDICES (1990=100)</b>												
Chemical Industry Output	100.0	106.8	115.3	117.4	119.7	121.5	119.3	127.9	129.7	135.2	138.1	140.9
<b>INCLUDING INDIRECT CO<sub>2</sub></b>												
GHG Emissions	100.0	104.8	107.5	109.4	105.0	106.8	96.0	96.8	95.6	95.5	94.3	93.0
GHG Emissions Intensity	100.0	98.1	93.2	93.2	87.8	87.9	80.5	75.7	73.7	70.6	68.3	66.0
<b>EXCLUDING INDIRECT CO<sub>2</sub></b>												
GHG Emissions	100.0	105.7	106.3	110.2	102.6	103.3	91.6	94.2	89.1	89.8	89.2	87.5
GHG Emissions Intensity	100.0	98.9	92.2	93.9	85.7	85.0	76.8	73.7	68.7	66.4	64.6	62.1

Sources: EIA, EPA, American Chemistry Council (Note: The data on fuel and power CO<sub>2</sub> reflect revised data on embedded CO<sub>2</sub> in purchased electricity)

chemical industry production rose 41 percent. As a result, GHG intensity improved 34 percent.

Direct GHG emissions are emissions from sources that are owned or controlled by the company (such as on-site combustion and process emissions). Excluding indirect (or embedded) CO<sub>2</sub> emissions from purchased electricity, the chemical industry's GHG emissions fell 12.5 percent in absolute terms between 1990 and 2006. As a result, direct GHG intensity improved 38 percent.

Additional detailed information on recent years is available through the member surveys developed and conducted under the Responsible Care<sup>®</sup> program. Between 2003 and 2005, ACC member companies reduced their GHG intensity by over five percent (Figure 3-4). In absolute terms, Responsible Care<sup>®</sup> companies reduced their emissions of greenhouse gases by 3.9 MMTCO<sub>2</sub>-eq over the same time period.

Also, between 2003 and 2005, ACC member companies improved their energy efficiency by 1.5 percent, equivalent to about 141 billion Btu (Figure 3-5).

### Industry Actions Taken:

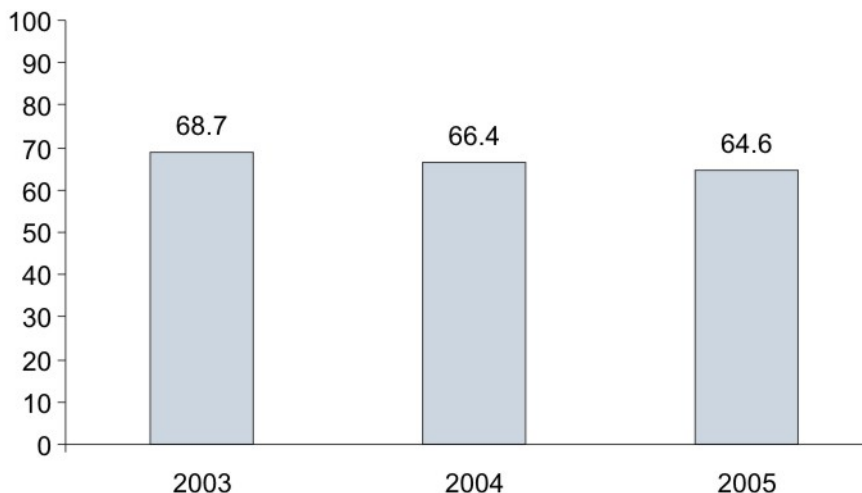
One method in which the industry is advancing energy efficiency is through the use of cogeneration—the simultaneous generation of electricity and steam from a facility that is located at or near the manufacturing site. Since cogeneration facilities use fuel to produce both electricity and steam, they are much more efficient than the older, stand-alone electric

utilities and conventional steam boilers. Today, nearly a third of all cogeneration used in manufacturing is conducted by the business of chemistry.

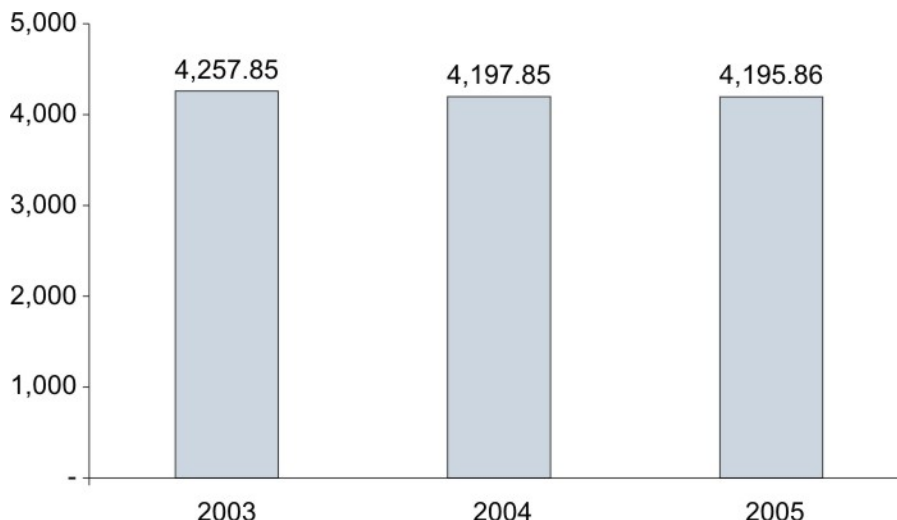
### Industry Projects and Activities—Success Stories:

For the past several years, ACC has honored member companies for energy-efficiency improvements in five categories: Environmental

**Figure 3-4**  
**ACC Member Companies Greenhouse Gas Emissions Intensity**  
(Pounds CO<sub>2</sub> Equivalents Per Pound of Production)



**Figure 3-5**  
**ACC Member Companies Energy Intensity**  
(Btu Per Pound of Production)



Impact, Energy Efficiency Program, Non-Manufacturing Improvement, Public Outreach, and Significant Improvement in Manufacturing.

For example, in 2005, 11 ACC member companies were honored for implementing energy-efficiency improvements that together saved enough energy to power a metropolitan area the size of South Bend, Indiana, and reduced CO<sub>2</sub> emissions equivalent to 475,000 cars. ACC presented a total of 26 awards to these companies for their company-wide or plant-specific progress. For 2005, the total annual energy savings represented by the awards is 22.7 trillion Btu, while annual CO<sub>2</sub> emissions reductions were approximately 2,852,000 tons. The savings from the combined projects represent 0.7 percent of total chemistry energy consumption for fuel and power in 2005.

## Program Reports and Other Links:

To learn more about chemical industry efforts to address GHG, please visit these websites:

- [Responsible Care® Program](#)
- [American Chemistry Council](#)
- [Climate VISION Private Sector Initiatives: Chemicals Manufacturing](#)

## FOREST PRODUCTS SECTOR: AMERICAN FOREST & PAPER ASSOCIATION<sup>18</sup>

### Highlights:

- American Forest & Paper Association (AF&PA) members are meeting their Climate VISION commitment to reduce GHG emission intensity by conserving energy, using renewable biomass energy, developing new biomass-based sources of energy, and using recycled materials.
- From 2000 to 2004 AF&PA member companies collectively reduced their direct GHG emissions 16 percent, from 61.2 to 51.4 MMTCO<sub>2</sub>-eq. This translates to a 12 percent reduction in intensity of direct emissions, from 0.514 to 0.453 tons of CO<sub>2</sub> equivalent per ton of production.
- Indirect emissions associated with the generation of purchased electricity decreased from 26.8 to 26.2 MMTCO<sub>2</sub>-eq from 2000 to 2004, which translates to a 2.8 percent increase in intensity of indirect emissions due to a smaller decrease in tons of production relative to indirect emissions.
- In addition, in 2004, AF&PA member companies' use of recycled paper to make new paper products has resulted in avoided emissions of 23.3 MMTCO<sub>2</sub>-eq due to the avoidance of methane emissions from landfills, where the paper would otherwise decay.

- Carbon sequestered in trees becomes stored in wood and paper products for the duration of the products' useful life. In 2004, carbon stored in products produced by AF&PA member companies increased by 25.7 MMTCO<sub>2</sub>-eq.

### Industry Sector and Participants:

AF&PA's commitment is made on behalf of almost 100 members, who manufacture approximately 75 percent of the paper and more than half of the wood and forest products produced in the United States. Trees and wood and paper products are natural, renewable, and recyclable resources that help remove GHGs from the atmosphere and store them. The world's forests—and the wood and paper products that come from them—can be managed to help meet the challenges of global climate change and the needs of the global economy.

The Forest Products Industry's carbon footprint is diverse. Its components include direct and indirect emissions of CO<sub>2</sub> from manufacturing operations, the ability to sequester carbon in forests and products, and the ability to reduce methane emissions from landfills through the use of recycled paper.

### Primary Climate VISION Goal:

Members of AF&PA are committed to collectively reducing their emissions intensity through improving energy efficiency; enhancing sequestration in forests and products; developing and implementing improved technologies; inventorying emissions; and increasing fiber recovery for recycling. AF&PA members estimate that these programs will reduce their GHG intensity by 12 percent by 2012 relative to 2000.

<sup>18</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

## Additional Climate VISION Goals:

AF&PA members also are pursuing a new paper recovery goal of 55 percent by 2012. Achieving this recovery rate will lead to corresponding reductions in GHG emissions by reducing methane emissions from landfills.

In 2006, the U.S. recovery rate for paper and paperboard reached 53.4 percent, and AF&PA is asking households and businesses across the country to help meet the new goal. AF&PA has created partnerships with organizations, including EPA, Keep America Beautiful, and CarrAmerica to raise visibility for the goal and continue increasing recovery of high-quality fiber. Nearly 80 percent of U.S. papermakers use some recovered fiber in manufacturing new paper products, and substantial investments have been made in new machines for recycling.

## Related Industry Programs:

The industry is involved in a wide variety of programs to develop renewable energy and promote understanding of forest sequestration. Two key research programs include the following:

- **BIOREFINING/GASIFICATION:** Development of biorefining technology is an economic and technical priority under the Agenda 2020 Technology Alliance—an industry-led partnership that includes AF&PA member companies, academic partners, DOE, and USDA. Biorefining uses advanced technologies to grow and convert forest materials to bio-energy and bio-products while manufacturing traditional products. The residual pulping liquors from the papermaking process are uniquely suited for gasification, and the resulting synthetic gas can be used for electric power, converted to fuels, or used to make high-value chemicals.
- **FOREST RESEARCH:** The industry is working with the U.S. Forest Service, universities, and others on a wide range of

forest sequestration research projects. In 2002, industry members and associations established the Forest Carbon Consortium to promote research on the potential of managed forests to store carbon and produce renewable energy. For example, the industry collaborated with the U.S. Forest Service on development of a web-based tool for estimating forest carbon stocks using Forest Service national inventory data. The completed tool allows a user to define a region and estimate forest sequestration for that region.

## Metrics Identified:

Working with the National Council for Air and Stream Improvement (NCASI), AF&PA members developed a protocol to monitor progress in each area described in the Climate VISION commitment. The protocol defines three metrics that characterize the industry's performance in terms of emissions and reductions to emissions from sequestration and recycling activities. Indirect emissions associated with the generation of purchased electricity and forest sequestration are also monitored but not formally included in calculating progress against the Climate VISION Commitment.

- **DIRECT EMISSIONS METRIC:** This metric measures direct emissions of CO<sub>2</sub> from stationary combustion of fossil fuel. An earlier examination of emission sources determined that CO<sub>2</sub> emissions from stationary combustion of fossil fuels represent at least 90 percent of direct emissions from the U.S. forest products industry. In addition, it is these emissions that can be estimated with greatest accuracy. AF&PA collects data on fossil fuel consumption at member companies and these data are used, along with emission factors from the World Resources Institute (WRI)/World Business Council for Sustainable Development (WBCSD) GHG Protocol tools.

- **PRODUCT CARBON SEQUESTRATION METRIC:** The industry calculates the annual carbon sequestration in forest products in use by employing a method called “the 100-year method.” This method, developed and first used by Georgia Pacific Corporation and since endorsed by the International Council of Forest and Paper Associations (ICFPA), calculates the amount of carbon in the current year’s production that is in products expected to be in use for at least 100 years. It has been adopted as one of the accepted methods under the 1605b program for Voluntary Reporting of Greenhouse Gases Program.
- **AVOIDED METHANE EMISSIONS METRIC:** EPA has examined the GHG and carbon implications of using various methods to manage the major components of the municipal solid waste stream, including the effects of paper recycling on methane releases from municipal solid waste landfills. EPA’s analysis has been used to develop emission factors representing the amounts of methane avoided per ton of paper recycled. The emission factors are then multiplied by the changes in the quantities of paper recycled by AF&PA members in any given year, compared to a 2000 base year. The quantities of paper being recycled are determined based on data collected by AF&PA.

#### **Other Measures Monitored:**

- **INDIRECT EMISSIONS:** Indirect emissions are associated with the generation of purchased electricity: Although indirect emissions are not included in the AF&PA VISION commitment, the industry is tracking changes in these emissions. This is being done both to determine whether improvements in direct emissions intensity are a result of increased power purchases and to determine if the industry’s purchases of power are changing dramatically. Indirect emissions

are calculated from net purchases, using the most recent average U.S. emission factor for purchased electricity. The data on electricity consumption and sales come from the AF&PA biennial fuel and energy survey. The data are used to derive estimates of indirect emissions using methods analogous to those used for direct emissions.

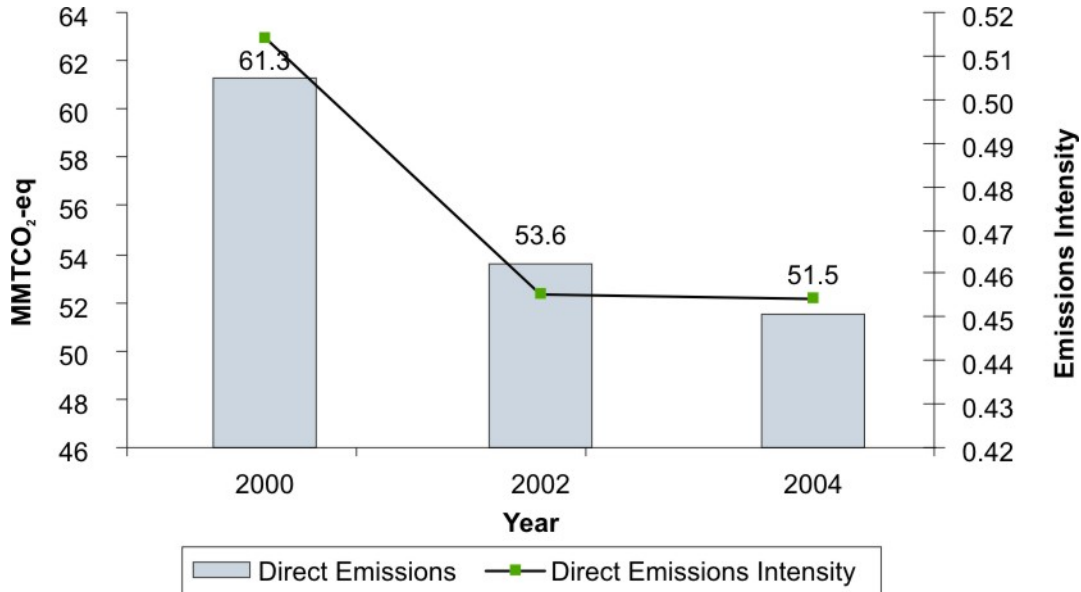
- **FOREST CARBON SEQUESTRATION:** Forests play a crucial role in the global carbon cycle. Well-managed forests, improvements in their productivity, and the creation of new forests provide a powerful mechanism for removing CO<sub>2</sub> from the atmosphere. The forest industry owns a relatively small percentage of the world’s forests, and AF&PA members’ contribution to forest sequestration is not quantified in this report. However, the industry plays a major role in promoting and supporting sustainable forest management on all forestlands through its commitment to the Sustainable Forest Initiative® (SFI) Program. The SFI Program—the most-recognized forest management standard and certification system in the U.S. and Canada—sets standards for maintaining long-term forest resources. Adherence to the SFI standard is a condition of membership for all AF&PA members.

#### **Measured Results to Date:**

From 2000 to 2004 AF&PA member companies collectively reduced their direct GHG emissions 16 percent, from 61.2 to 51.4 MMTCO<sub>2</sub>-eq. This translates to a 12 percent reduction in intensity of direct emissions, from 0.514 to 0.453 tons of CO<sub>2</sub> equivalent per ton of production (Figure 3-6).

Indirect emissions associated with the generation of purchased electricity decreased from 26.8 to 26.2 MMTCO<sub>2</sub>-eq from 2000 to 2004 which translates to a 2.8 percent increase in intensity of indirect emissions due to smaller decrease in tons of production relative to indirect emissions.

**Figure 3-6**  
**Direct Emissions (MMTCO<sub>2</sub>-eq)**



Detailed methodology and calculations for direct and indirect emissions, product sequestration, and recycling metrics can be found at the Climate VISION web site [here](#).

**ENERGY AND BIOMASS USE:** Current energy data show that AF&PA members are focused on conservation and made great strides in reducing their reliance on fossil fuels between 2000 and 2004. The data in Table 3-2 indicate that per ton of production pulp and paper mills:

- Reduced fossil fuel use by 11 percent;
- Increased renewable energy use by over three percent; and
- Reduced overall energy use (from both fossil fuel and renewable energy sources) by almost three percent.

**Table 3-2**  
**Energy per Ton of Paper Produced 2000 – 2004 (Million Btu)**

	2000	2002	2004
Fossil Fuel	10.44	9.76	9.31
Biomass & Hydroelectric	13.78	14.74	14.22
Total Energy Per Ton	24.22	24.50	23.53

Additionally, according to the latest DOE figures, in 2002 89 percent of electricity generated at paper mills was cogenerated (produced from steam generated on-site).<sup>19</sup>

The forest products industry leads all other industries in the use of biomass energy. The 2004 data indicate that 77 percent of the fuel used at wood product facilities and 60 percent of the fuel used at pulp and integrated pulp and paper mills are biomass fuels. Biomass fuels are derived from wood, chips, bark, sawdust, and pulping liquors recovered from harvesting and manufacturing processes.

DOE data show (Figure 3-7) that wood products facilities and pulp and paper mills produced 89 percent of the biomass-based fuel generated by all industrial sectors in 2003.<sup>20</sup>

<sup>19</sup> [Energy Information Administration 2002 report on Energy Use in Manufacturing, Table 11.3.](#)

<sup>20</sup> [Energy Information Administration, Industrial Biomass Energy Consumption by Primary Purpose of Business, Table H 1.](#)



Energy-rich biomass results from tree growth that removes CO<sub>2</sub> from the atmosphere and transforms it into carbon. DOE's 1605b program for Voluntary Reporting of Greenhouse Gases, the Intergovernmental Panel of Climate Change (IPCC), EPA, and other internationally recognized climate policy groups have concluded that GHG emissions totals should not include emissions of CO<sub>2</sub> associated with the combustion of sustainably managed biomass. As a result, biomass is often referred to as carbon neutral. Operationally "although these fuels do emit CO<sub>2</sub>, in the long run the CO<sub>2</sub> emitted from biomass consumption does not increase atmospheric CO<sub>2</sub> concentrations if the biogenic carbon emitted is offset by the growth of new biomass."<sup>21</sup> It is assumed that the carbon released during the consumption of biomass is recycled as U.S. forests and crops regenerate, causing no net addition of CO<sub>2</sub> to the atmosphere.<sup>22</sup>

### Industry Actions Taken:

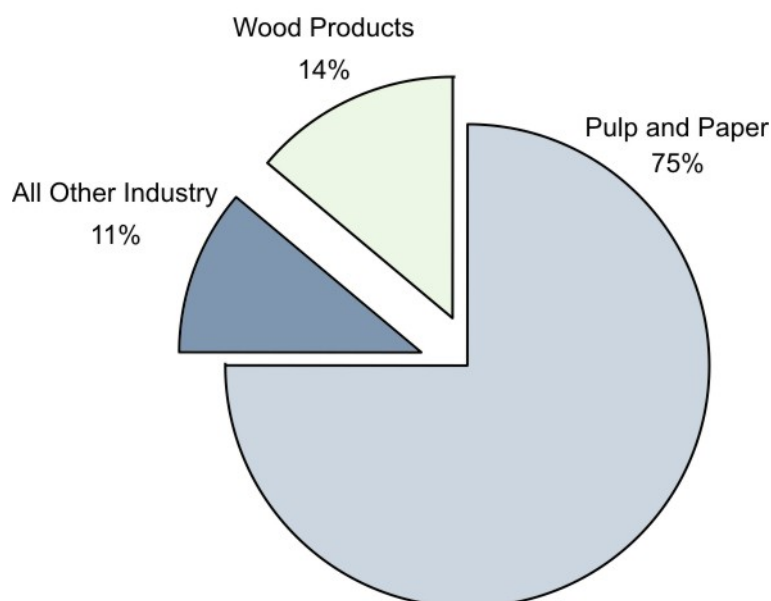
Early in the commitment period, AF&PA and its international counterparts retained NCASI to develop tools for calculating emissions and determining the amount of carbon stored in forest products.

- **EMISSION CALCULATION TOOLS:** Working with international forest and paper associations, AF&PA and NCASI developed tools for estimating greenhouse gas emissions from pulp and paper mills and wood products facilities. These calculation tools recognize the industry's unique attributes—such as the carbon neutrality of biomass fuel emissions—and allow the industry to collect credible data that is comparable worldwide. The methodologies are based on the

<sup>21</sup> [U.S. GHG Inventory to UNFCCC \(1990-2004\) page 3-11, Box 3-2 \(2006 submission\)](#)

<sup>22</sup> [U.S. GHG Inventory to UNFCCC \(1990-2004\) Energy 3-0 \(2006 submission\)](#)

**Figure 3-7**  
**Wood Derived Renewable Fuel Use**



Source: Energy Information Administration, Industrial Biomass Energy Consumption by Primary Purpose of Business, Table H 1.

Greenhouse Gas Protocol created by WRI and WBCSD. They received international peer review and were subsequently adopted by WRI/WBCSD for use with their protocol.

The pulp and paper mill calculation tools have a user interface to make the tools compatible with DOE's 1605(b) voluntary greenhouse gas registry. NCASI will update the user interface in 2007 to reflect recent updates to the registry.

- **PRODUCT SEQUESTRATION TOOL:** In addition to managing forests that store or sequester carbon, the forest products industry produces products that continue to store carbon. The harvesting and manufacturing of forest products essentially transfers carbon from the forests to the products. The carbon contained in these products continues to be sequestered from the atmosphere throughout the product life. In the case of building materials, this can be decades or longer.

As described earlier, the forest products industry has developed a calculation tool that companies can use to determine the amount of carbon stored in wood and paper products in use. The calculation method, also called “the 100 year method,” was developed by Georgia Pacific Corporation and since endorsed by the ICFPA. The method allows companies to use annual production to estimate their contribution to long-term product sequestration and has been adopted as an accepted method under DOE’s guidelines for its voluntary GHG registry.

### **Industry Projects and Activities—Success Stories:**

AF&PA member companies are taking individual steps to reduce GHG emissions:

- Members are calculating emissions and developing protocols for company-wide assessments. Data indicate that AF&PA members, representing over 60 percent of U.S. pulp and paper mill capacity, used the industry’s emissions calculation tools to calculate GHG emissions in 2004.
- Members are making individual company commitments to reduce emissions through a variety of programs such as EPA’s Climate Leaders, the Chicago Climate Exchange, and Business Roundtable’s Climate RESOLVE.
- They are also conducting research and making results available. One company recently conducted a study of GHGs in Douglas fir plantations in the Pacific Northwest and found that carbon sequestration is almost an order of magnitude greater than total emissions from forestry operations.

Member companies are also pooling their resources and taking collective action to promote development of renewable energy:

- Top forest products companies have committed to support a commercial-scale biorefinery demonstration project in southeast Arkansas. This integrated facility, which will use both forest-based and agricultural feed stocks, is supported by state and regional governments, the local agriculture industry, and not-for-profit rural and sustainable development organizations.
- Several companies have contributed to the advancement of biorefining by hosting biomass gasification demonstration projects at their facilities.

All of these actions—individual and collective—will lead to future progress in addressing GHG emissions.

### **Program Reports and Other Links:**

To learn more about forest products industry efforts to address GHGs, please visit these websites:

- [American Forest & Paper Association](#)
- [Climate VISION Private Sector Initiatives: Forest Products](#)
- Recycling guides for schools, offices, and communities and a recycling video are available at the [Paper Industry Association Council](#) website.
- Tools for calculating pulp and paper mill and wood products facility emissions and the amount of carbon stored in wood and paper products are available at the [National Council for Air and Stream Improvement](#) website.
- Information on the Agenda 2020 program is available at the [Agenda 2020 Technology Alliance](#) website.

## IRON AND STEEL SECTOR: AMERICAN IRON & STEEL INSTITUTE<sup>23</sup>

### Highlights:

- The American steel industry estimates that it has reduced its energy intensity per ton of steel shipped by approximately 15 percent from 2002 to 2006.
- Since 1990, energy intensity is down about 29 percent.
- Compilation and reporting of industry energy intensity on an annual basis
- Fostering energy and climate-related communication among steel industry stakeholders
- Coordinating and encouraging collaborative research and development projects with significant potential for GHG abatement

### Industry Sector and Participants:

The American Iron and Steel Institute (AISI) represents approximately 75 percent of the steelmaking capacity in the United States. Its 31 member companies include both integrated steelmakers, who produce steel from iron ore and recycled steel, and electric furnace producers, who produce steel primarily from recycled steel but using some virgin iron. AISI also works cooperatively with the Steel Manufacturers Association and the Specialty Steel Industry of North America, and the three organizations together represent nearly 100 percent of the total carbon and stainless steel production in the U.S.

### Primary Climate VISION Goal:

AISI has committed to a Climate VISION goal of achieving by 2012 a 10 percent reduction in sector-wide average energy intensity, using a 2002 baseline.

### Additional Climate VISION Goals:

Additional AISI commitments included the following:

- Development of an industry-wide energy reporting protocol

### Related Industry Programs:

As part of AISI's commitment to research and development into GHG reductions, and in conjunction with a global effort orchestrated by the International Iron & Steel Institute and referred to as the CO<sub>2</sub> Breakthrough Program, AISI is managing a collaborative R&D effort that to date has included four projects. Two projects involve new ironmaking processes which emit little or no CO<sub>2</sub> and two involve carbon sequestration. DOE is cost-sharing in all four projects. The two new ironmaking projects have been demonstrated to be technically feasible at laboratory scale and are being advanced to pilot-scale work. This is long-range R&D that has potential for significant change in the fundamental manner by which steel is made.

In addition, AISI is an active participant in the steel task force of the Asia-Pacific Partnership, which involves a six nation effort to work toward technology-based solutions for energy and CO<sub>2</sub> reductions through the identification of best energy and environmental practices and commercially available and emerging equipment that can improve the environment. Such equipment is listed in a document entitled the *State of the Art Clean Technology Handbook*, or "SOACT Handbook," which will be published at the end of 2007.

Finally, AISI is working with the International Energy Agency and the OECD to identify iron and steelmaking energy use in various countries

<sup>23</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

and to identify best practices that can be adopted by steel companies on a global basis.

**Metrics Identified:**

As part of its Climate VISION commitment, AISI developed a standard steel industry sector-wide energy protocol and promoted the use of that protocol for both AISI and non-AISI steel industry companies. The data collected allow for reporting of energy consumption in terms of million Btu per ton of steel shipped. AISI is also advocating use of the protocol by the International Iron & Steel Institute, the Asia-Pacific Partnership’s steel task force, and the International Energy Agency.

**Measured Results to Date:**

Based on data collected for 2003, 2004, and 2005, the American steel industry has demonstrated increasing energy efficiency, AISI estimates an overall reduction of its energy intensity per ton of steel shipped by nearly 15 percent between 2002 and 2006 (Table 3-3). Since 1990, energy intensity has been reduced by about 29 percent, and AISI also estimates that CO<sub>2</sub> emissions were reduced by 16 percent from 1990 to 2005.

**Industry Actions Taken:**

The following are industry actions taken to date:

- Development of an industry-wide energy reporting protocol

- Annual reporting of industry energy consumption
- Organization of energy workshops
- Initiation of collaborative R&D on new ironmaking processes.
- Participation in the Asia-Pacific Partnership on Clean Development and Climate
- Interaction with the International Energy Agency and the Organization for Economic Cooperation and Development to define steelmaking energy-saving opportunities
- Continued emphasis on steel applications with environmental benefits

**Industry Projects and Activities—Success Stories:**

A cross-sector breakthrough project developed by the steel industry, in cooperation with DOE’s Industrial Technologies Program, is advanced high-strength steels, or AHSS. Ten research projects investing \$6.3 million (Federal and steel industry funding) have focused on AHSS, which supports the design of automobiles that are lightweight (thus greatly reducing fuel consumption and consequently emissions) but also retain all the safety and affordability of basic carbon steel. AHSS are rapidly being adopted by automakers. Table 3-4 illustrates projected benefits calculated using a market penetration of only seven percent of AHSS-type vehicles, a low

**Tables 3-3  
Reductions in Energy Intensity (Btu) per Ton of Steel Shipped**

ITEM	2002	2003	2004	2005	2006
Tons Shipped	100,000,000	106,000,000	111,400,000	105,000,000	109,500,000
Million Btu Per Ton Shipped	13.6	12.6	12.2	12.0	11.6

**Table 3-4  
Projected Benefits from a Seven Percent Market Penetration of AHSS-Type Vehicles**

ITEM	SAVINGS PER YEAR	SAVINGS PER YEAR/ PER FEDERAL \$ SPENT	\$ SAVINGS PER YEAR AT \$60/BARREL
Barrels of Oil	4,071,429	0.84 barrel	\$244.4 million
CO <sub>2</sub> Emissions Reduction (tons)	2,100,000	0.50	N.A.

hurdle given the rapid adoption already evidenced in the new Ford 500 and Chrysler Pacifica.

AISI member companies are collaborating with DOE on a research program entitled the CO<sub>2</sub> Breakthrough Program. Its objective is to develop new steelmaking technologies that emit little or no CO<sub>2</sub>. There are four projects in the program, described briefly below:

- The Massachusetts Institute of Technology is developing Molten Oxide Electrolysis, technology in which a metal oxide feedstock is converted to liquid metal and oxygen gas. During the process, no CO or CO<sub>2</sub> is produced. According to Donald Sadoway, principal investigator at MIT, “Molten Oxide Electrolysis in conjunction with carbon-free electricity will usher in the era of sustainable metallurgy.” This research could break major new ground in terms of CO<sub>2</sub> emissions reductions and results thus far are encouraging enough that a proposal for a pilot scale plant is now under review. View the [project fact sheet](#) from AISI online.
- The University of Utah is developing a new “flash smelting” ironmaking process using hydrogen and fine iron oxide concentrates. This new process will not only use a clean fuel but also make use of very fine iron oxides, which are plentiful in the U.S. It has the potential to eliminate coke ovens, blast furnaces and thus their CO<sub>2</sub> emissions. It has also proceeded successfully to the point where researchers are proposing a pilot plant to further test the process at larger scale. Please see the [project fact sheet](#). The steel industry is also funding two geologic sequestration projects, as well.
- At the University of Missouri-Rolla, a process under development will directly remove CO<sub>2</sub> from steelmaking furnace (basic oxygen furnace and electric arc furnace) exhaust gases and react with

them so as to create carbonates suitable for polymer, agricultural, and construction applications, thus capturing and storing the CO<sub>2</sub>. View the project [fact sheet](#).

- At Columbia University, chemical pathways for mineral sequestration are being researched that could result in a process which would be a combination ironmaking plant and carbon disposal unit. View the [fact sheet](#) online. The two sequestration projects are early in development, but should they show similar promise as has been seen at MIT and University of Utah, the project research will continue.
- AISI and McMaster University have developed the Paired Straight Hearth Furnace. This technology doubles the capacity of existing hearth reduction processes and can be used to process iron from plant wastes and iron ore. This technology can stand alone to produce low-cost direct reduced iron or be coupled with AISI’s direct smelting technology making it more productive and thus more economically attractive. Plans for a demonstration project are now being formulated.

### Program Reports and Other Links:

To learn more about iron and steel industry efforts to address GHGs, please visit these websites:

- AISI’s [Manufacturing & Technology programs](#) relating to [climate change and energy](#)
- [Climate VISION Private Sector Initiatives: Iron and Steel](#)

### Highlights:

- America's oil and natural gas companies are addressing climate change issues as the world's demand for energy increases—driven in large part by economic and social development necessity to raise living standards of growing populations around the world. Working with the Climate VISION program in 2003, the American Petroleum Institute (API) established its Climate Challenge Program, building on the oil and gas industry's earlier work addressing climate change. API members are investing hundreds of millions of dollars to advance the cutting-edge technologies and energy sources that will help address climate change in both the near term and long term. Working with government, academic research groups, and others, member companies are undertaking diverse actions to address GHG emissions, including the following:
  - ⇒ Increasing energy efficiency as well as developing and promoting alternative energy use to reduce GHG emissions
  - ⇒ Reducing natural gas flaring and expanding supplies of low-carbon natural gas
  - ⇒ Establishing rigorous, industry-wide tools and procedures for estimating and tracking emissions
  - ⇒ Developing new energy technologies as well as carbon capture and storage technology that could reduce or sequester emissions
- API member refiners set a goal to improve energy efficiency by 10 percent between 2002 and 2012, and are making progress to meet it through such technologies as using heat from their operations to produce additional energy, which reduces energy use and resulting emissions. In 2006, for example, improvements in energy efficiency at API member refineries—compared to the technology used in 2002—produced energy savings equivalent to taking more than 528,000 cars off the road, or savings equivalent to the electricity used by more than 950,000 homes.
- Individually, API companies are undertaking a diverse set of actions to mitigate GHG emissions, including energy efficiency, advanced technology, reducing methane emissions, and developing methods to store CO<sub>2</sub> underground safely for thousands of years.
- Accurate estimation of GHG emissions is indispensable in order to responsibly address climate change; API has developed comprehensive tools for estimating emissions throughout the oil and gas industry. [These tools are available free](#) to any oil and gas company on the API website.

### Industry Sector and Participants:

API represents nearly 400 member companies involved in all aspects of the oil and gas industry as well as other energy technologies. Examples of actions taken by companies under the Climate Challenge Program are drawn from the voluntary actions of API members. [Additional information](#) can be obtained on-line.

<sup>24</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

### Primary Climate VISION Goal:

As part of API's Climate Challenge Programs, refiners have set a goal of improving their energy efficiency by 10 percent between 2002 and 2012.

### Additional Climate VISION Goals:

In response to the mission of Climate VISION, API and its members implemented the Climate Challenge Program with three major efforts structured to reflect the broad diversity of API members. Major components of the Climate Challenge Program commitments and subsequent actions are addressed below.

### Related Industry Programs:

API and its members are addressing climate through a variety of avenues, including working with the National Petrochemical and Refining Association to track improvements in the Nation's overall refinery energy efficiency; working with EPA's Natural Gas STAR and Natural Gas STAR International programs to reduce methane emissions from natural gas operations; partnering with the World Bank's Global Gas Flaring Reduction program to overcome barriers to reducing associated natural gas flaring.

### Metrics Identified:

Metrics for tracking progress vary depending on the individual goal. Metrics include the following:

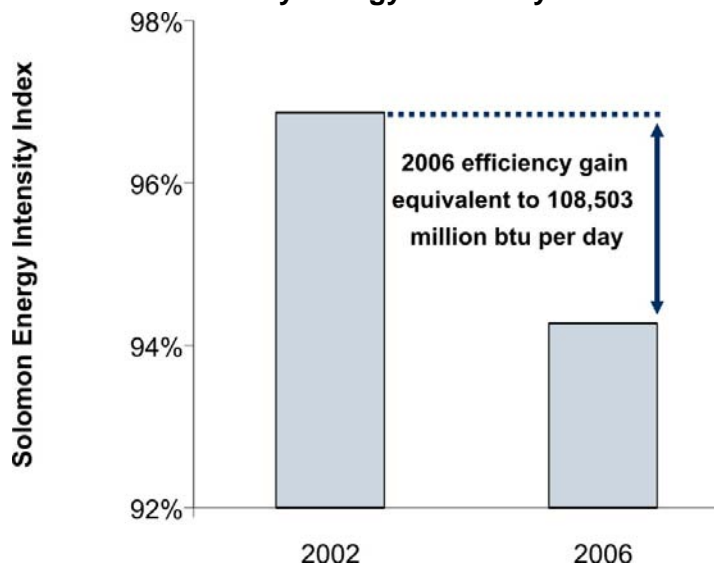
- The 10 percent refinery energy efficiency improvement goal for 2002-2012 is being tracked with the third-party Solomon Refinery Energy Intensity Index. The Solomon EII data are available every two years.
- Participation in EPA's Natural Gas STAR program is being tracked by the share of API member natural gas production from companies participating in the Gas STAR program.

- Future reporting under the recently initiated annual, industry-wide aggregate GHG emissions reporting program is expected to focus on metric tons of emissions and GHG-intensity of operations.

### Measured Results to Date:

- 10 percent refinery energy-efficiency improvement goal for 2002-2012: Based on the most recent data, API member refiners are making progress to meet this goal through such technologies as using heat from their operations to produce additional energy, which reduces energy use and resulting emissions (Figure 3-8). In 2006, for example, improvements in energy efficiency at API member refineries—compared to the technology used in 2002—produced energy savings equivalent to taking more than 528,000 cars off the road, or savings equivalent to the electricity used by more than 950,000 homes.

**Figure 3-8**  
**Refinery Energy Efficiency**



- Virtually 100 percent participation goal in EPA's Natural Gas STAR Program: According to EPA, API members have reduced methane emissions almost 180

billion cubic feet in their long-standing participation in the Natural Gas STAR program. Now, virtually all the natural gas produced by API members is from companies participating in Natural Gas STAR.

- Tools for consistent and comprehensive estimation of GHG emissions from oil and gas operations throughout the world:
  - ⇒ API with two other international oil and gas groups (the International Petroleum Industry Environmental Conservation Association (IPIECA) and the International Association of Oil & Gas Producers issued guidelines setting a framework for GHG emissions estimation for the global oil and gas industry.
  - ⇒ API's first-of-a-kind [Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry](#) details comprehensive and consistent GHG emission calculation methods for oil and gas industry operations. The robust methodology of the *Compendium* is recognized in DOE's "1605(b) Guidelines" for voluntary GHG emissions reporting.
  - ⇒ [API's website](#) makes the latest versions of these tools available free to the public and to oil and gas companies.
- Annual industry-wide aggregate GHG emissions reporting: API recently initiated the first U.S. oil and gas industry survey of CO<sub>2</sub> and methane emissions, with a goal of public reporting of aggregate data after the reliability and consistency of the data is established.

### Industry Actions Taken:

Through API, the oil and gas industry's primary trade association, companies are working together to create synergies in addressing climate change and speeding the flow of information within the

industry. In December 2006, API held its [fourth conference](#) on industry voluntary actions.

As mentioned above, API is also distributing a software tool, SANGEA™, which is one *Compendium*-compliant method companies can use to estimate their GHG emissions. API has related joint projects with IPIECA, focusing on GHG emissions estimation and reduction tools.

### Industry Projects and Activities—Success Stories:

The following examples illustrate some of the steps being taken individually by API members under the Climate Challenge Programs. The actions reflect the diversity of the industry and the wide range of strategies being undertaken to address GHG emissions.

#### Improving Energy Efficiency

- One company implemented a five-year \$350 million program to increase energy efficiency. In 2005, total primary energy consumption at this company was approximately two percent less than in 2004.
- An API member reduced CO<sub>2</sub> emissions by 9 MMTCO<sub>2</sub>-eq a year through more efficient production of steam and electric power, by investing in 85 cogeneration facilities at some 30 company locations worldwide.
- Through its energy-efficiency subsidiary (fourth largest in the U.S.), one company saved its customers 177 million kWh of electricity and 1.2 billion cubic feet of natural gas in 2005 alone.
- Numerous companies are participating in energy-efficiency-oriented voluntary partnerships, including EPA's SmartWay Transport, National Environmental Performance Track, and Combined Heat and Power Partnership programs.



## Natural Gas/ Flaring/Gasification

- API members are undertaking a wide range of actions under the domestic Natural Gas STAR program to reduce methane-related emissions. A single company achieved cumulative methane gas emission reductions in U.S. operations of 6.4 MMTCO<sub>2</sub>-eq.
- Members are utilizing new equipment and procedures to minimize or eliminate flaring at both upstream and downstream facilities.
- By investing in natural gas production and liquefied natural gas facilities, companies are facilitating greater use of lower-carbon natural gas.
- Taking a global perspective, members are implementing methane-related projects in world-wide operations, including increased use of natural gas to provide needed electricity in developing countries, reducing or eliminating natural gas flaring, and undertaking new pipeline projects to recover produced gas for beneficial use.

## Carbon Capture and Storage (CCS)

- Companies are injecting millions of tons of CO<sub>2</sub> into aging U.S. oil fields in enhanced oil recovery operations. This boosts U.S. oil production, reduces U.S. oil imports, and stores CO<sub>2</sub> that might otherwise have been vented into the atmosphere. CCS projects also are being undertaken abroad.
- A number of members are participating in CCS research and development efforts, including the \$50 million international CO<sub>2</sub> Capture Project, the Carbon Mitigation Program, DOE's Regional Sequestration Projects, and the International Energy Agency's CO<sub>2</sub>ReMove project.

## Advancing Energy Technologies

- Members are operating wind farms in the U.S. and Europe.
- Multiple companies are expanding U.S.-based solar energy production capacity to meet growing demand and to create jobs.
- One member—the world's largest producer of geothermal energy—is expanding its output.
- Another company is undertaking hydrogen production technology and basic fuel cell system R&D and building hydrogen-refueling stations in preparation for possible commercialization of fuel cell vehicles.
- Several members are working with auto and heavy-equipment makers to design high-efficiency, low-GHG emission fuel/engine systems.
- One company is partnering to develop and market advanced biofuels with properties that overcome the limitations of existing biofuels.
- One member is undertaking a \$1 billion investment to construct the first-of-its-kind plant to gasify petroleum coke, generate electricity, and capture and permanently store the CO<sub>2</sub> while boosting U.S. oil production.

## Research and Development/Partnering

- API members are partnering with major research institutions on a broad range of potential climate and energy technologies for the future, including these:
  - ⇒ The Carbon Mitigation Initiative at Princeton University, developing globally affordable CO<sub>2</sub> emission-reduction strategies;

- ⇒ Georgia Institute of Technology, U.C.-Davis, and the DOE's National Renewable Energy Laboratory research on cellulosic biofuels and hydrogen transportation fuels;
  - ⇒ A new \$500 million Energy Biosciences Institute at a major UK university, focusing on cleaner transport fuels;
  - ⇒ Stanford University's Global Climate and Energy Project, addressing more than 27 different energy/environment projects; and
  - ⇒ Imperial College of London's Urban Energy Systems project on city energy, people, and material flows.
- 
- A 10-year program at the Chinese Academy of Science and Tsinghua University, Beijing, on clean energy breakthrough technologies.

## Program Reports and Other Links:

To learn more about oil and gas industry efforts to address GHGs please visit these on-line resources:

- Updated information on [API and company actions on climate change](#)
- [Tools for estimating GHG emissions](#) for the oil and gas industry
- API's [Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry](#) (Feb. 2004)
- [Climate VISION Private Sector Initiatives: Oil & Gas](#)

## THE BUSINESS ROUNDTABLE<sup>25</sup>

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### Highlights:

- Through its Climate RESOLVE program, The Business Roundtable is encouraging voluntary actions to control GHGs by every company in every economic sector. Approximately 70 percent of Roundtable member companies are participating in the program. The Roundtable has held six workshops and over 50 telephone learning sessions to help companies develop and improve their GHG management programs. It has also launched a special initiative aimed at service sector companies. Information on Climate RESOLVE and GHG management can be found at [www.businessroundtable.org](http://www.businessroundtable.org).

### Industry Sector and Participants:

Business Roundtable is an association of chief executive officers of leading U.S. companies from every sector of the economy, with over \$4.5 trillion in annual revenues and more than 10 million employees. Member companies comprise nearly a third of the total value of the U.S. stock market and represent nearly a third of all corporate income taxes paid to the Federal Government.

### Primary Climate VISION Goal:

Business Roundtable launched Climate RESOLVE (**R**esponsible **E**nvironmental **S**teps; **O**pportunities to **L**ead by **V**oluntary **E**fforts) in 2003, because of a belief that every company in every sector of the economy should take voluntary action to control GHG emissions. While individual companies will take different steps to control GHG emissions, the combining of these actions will have real results.

- Approximately 70 percent of the Roundtable's 160 members have joined Climate RESOLVE to date. The ultimate goal is 100 percent participation.
- The Roundtable continues to actively recruit members—with a particular emphasis on increasing services sector participation.

### Additional Climate VISION Goals:

As an additional commitment to Climate VISION, the Roundtable, through Climate RESOLVE, is helping companies develop and improve—and in some cases, establish—GHG management programs. The Roundtable is committed to providing education and support to companies at all stages:

- Expert one-on-one consulting advice
- Annual workshops ([information available on-line](#))
- Telephone learning sessions ([information available on-line](#)).

DOE and EPA are providing valuable technical support, including presentations at Climate RESOLVE workshops, learning sessions, and in creation of a web toolkit for companies. A comprehensive library of Climate RESOLVE resources for Roundtable members is [available on-line](#).

### Related Industry Programs:

The Roundtable has launched an initiative aimed at helping service sector companies understand the need for those companies to address GHG emissions. The initiative includes a special step-by-step web tool, developed with the assistance of the EPA and DOE, to help companies establish and maintain energy-efficiency programs. As part of the initiative, the Roundtable also produced a guide for companies—[RESOLVE to Improve Energy Efficiency in Office Buildings](#)—with

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<sup>25</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

suggestions on everyday actions that can improve efficiency and address climate change.

### **Metrics Identified:**

Through Climate RESOLVE, the Roundtable encourages companies to report their progress to Federal programs such as the 1605 (b) program. The percentage of companies involved in Climate RESOLVE is another key metric.

In July, 2006 the Roundtable launched a Metrics Pilot Program. The goal is to demonstrate that collective company actions are achieving real and measurable results. The Program encourages companies to submit their GHG emissions to the Roundtable and allows tracking changes in the GHG intensity ratio of GHG emissions (CO<sub>2</sub> equivalent) to company revenues.

### **Measured Results to Date:**

Early in 2004, the Roundtable surveyed all Climate RESOLVE participants about GHG management efforts and issued a report on September 22, 2004. The report showed that 70 percent of Roundtable member companies were enrolled in Climate RESOLVE. These are among other key findings:

- 92 percent had reviewed their GHG emissions profile or were doing so in 2004.
- 89 percent had taken or were taking actions to reduce, avoid, offset, or sequester GHG emissions.
- 71 percent had established or were establishing written policies to track and meet GHG emissions goals.
- 72 percent had reported or were reporting GHG management activities to the public.
- 76 percent had participated or were participating in government-sponsored programs to reduce, avoid, offset, or sequester GHG emissions.

- 61 percent had invested or were investing this year in new technologies or products to improve energy efficiency, reduce GHG emissions, or lower GHG intensity in the environment.

### **Industry Actions Taken:**

Since the launch of Climate RESOLVE in early 2003, the Roundtable has done the following:

- Conducted six workshops for companies to provide practical hands-on guidance on how to reduce, avoid, offset, or sequester GHG emissions, with participation of more than 110 companies in 2006 and nearly 100 companies at 2004 and 2005 workshops. Many workshop presentations can be found on the Climate RESOLVE section of the [Business Roundtable website](#).
- Held more than 50 telephone learning sessions for companies, with experts on GHG management discussing issues such as successful energy management, improving quality of GHG data, and renewable energy
- Compiled 20 case studies of voluntary examples – from a variety of business sectors, that can serve as best practices for other companies
- Developed extensive resources for companies on the Climate RESOLVE section of [www.businessroundtable.org](http://www.businessroundtable.org), including a new member toolkit, workshop presentations, guides, and links to Federal resources
- Provided one-on-one consulting support for companies

### **Industry Projects and Activities—Success Stories:**

- [AIR PRODUCTS](#) is a global gases, chemicals, equipment, and services

provider with operations in more than 30 countries. In its effort to minimize its transportation footprint, Air Products sets "miles per gallon" targets to increase fleet efficiency and practices real-time monitoring to minimize trips and increase volume per delivery. Within its supply chain, it has partnered with customers to improve efficiency of combustion systems and has reduced electronics customers' perfluorinated compound emissions by as much as 85 percent. Other key efforts aimed at significantly improving the efficiency and economics of supply-chain projects include ion transport membrane syngas and oxygen technologies, which are being developed with U.S. DOE support. Air Products has also partnered with energy suppliers to optimize their generation efficiency by shutting down its production in times of peak demand and loading up on production at other times. Air Products also works with leading companies, governments, and universities to develop technologies that reduce the cost of capturing CO<sub>2</sub> from chemical production and power generation and safely sequester it.

- The [Noel Kempff Mercado Climate Action Project](#) is a partnership between the government of Bolivia, the Nature Conservancy, Fundación Amigos de la Naturaleza, [AMERICAN ELECTRIC POWER](#), [PACIFICORP](#), and [BP](#). The project involved the purchase and retirement of timber companies' logging rights on two million acres of biologically diverse tropical forests in Bolivia and the provision of resources for effective park patrols. The project has been incorporated into the Noel Kempff Mercado National Park, doubling the size of the protected zone. The project also promotes sustainable economic development in nearby communities to offset the unavailability of the protected land for logging and agriculture. The project conducts rigorous monitoring and

verification of carbon storage through an independent contractor.

- [DOW CHEMICAL](#) signed a contract to capture and use landfill methane at its Dalton, GA, polyurethane, latex, and polystyrene manufacturing plant. Landfill gas, a natural by-product of bacteria decomposing the organic materials contained in landfills, can be used to generate steam for general manufacturing purposes. Dow will take approximately 240 billion Btu per year of landfill gas from a county-owned landfill and use it in place of natural gas. This amount of energy is equivalent to the same amount of electricity used in approximately 2,100 average U.S. homes annually.
- [CHEVRON](#) supports a forestry project called "Lower Mississippi River Valley Reforestation Pilot Project" in Louisiana. Chevron planted 450,000 seedlings of 21 species of trees native to the area on 1,500 acres of land. Chevron cooperated with Environmental Synergy Inc., which carried out the tree plantings. The trees are located within the Tensas National Wildlife Refuge, which is managed by the U.S. Fish and Wildlife Service.
- [OFFICE DEPOT](#) is committed to continually seeking ways to reduce environmental impact and energy costs through sensible GHG mitigation strategies, which include four main components: energy efficiency, green design, renewable energy credits, and fuel-efficient transportation. Office Depot has retrofitted stores and warehouses, including one of the largest T-5 lighting retrofit programs in the U.S. and upgrades of older heating, ventilation, and air conditioning units throughout the chain. The company has incorporated energy-efficiency design components into new store and warehouse design, including piloting the use of cool-roof technologies and day lighting in new facility construction, as well as planning

to pilot SolarSave™ cool-roof membrane technology in older buildings. Office Depot purchased 76,000 megawatts of renewable energy in 2006, equivalent to over 12 percent of the company's North American electricity use for the year. As of mid-2006, Office Depot was the only office products company with membership in the EPA's SmartWay Transportation Partnership and has committed through this partnership to lowering the GHG emissions in its fleet, encouraging third-party carriers to join SmartWay and asking them to commit to their own GHG reductions.

## Program Reports and Other Links:

To learn more about chemical industry efforts to address GHGs, please visit these websites:

- [Every Sector, One RESOLVE: A Progress Report on Business Roundtable's Climate RESOLVE Program \(September 2004\)](#)
- [Business Roundtable learning sessions on GHG management](#)
- [Climate RESOLVE workshops and presentations](#)
- [Roundtable Guide for service companies: RESOLVE to Improve Energy Efficiency in Office Buildings](#)
- [Business Roundtable Step-by-Step Web Tool to GHG Management](#)
- [Climate VISION Private Sector Initiatives: The Business Roundtable](#)

## INDUSTRIAL MINERALS – INDUSTRIAL MINERALS ASSOCIATION— NORTH AMERICA<sup>26</sup>

### Highlights:

- Companies that participated in the GHG program of the Industrial Minerals Association—North America (IMA-NA) report that they have reduced their energy-related CO<sub>2</sub> emissions intensity by an average of 15.3 percent from 2000 through 2005.

### Industry Sector and Participants:

IMA-NA is a trade association created to advance the interests of North American companies that mine and/or process minerals used throughout the manufacturing and agricultural industries. Member companies produce ball clay, bentonite, borates, calcium carbonate, feldspar, industrial sand, mica, soda ash, talc, and wollastonite, as well as higher value-added products derived from these minerals. The companies included in IMA-NA's membership represent, in percentage of U.S. total production, some 80 percent of soda ash and 100 percent of borates.

### Primary Climate VISION Goal:

In response to the President's challenge, IMA-NA's soda ash and borates members<sup>27</sup> set a goal to reduce overall GHG emission intensity from fuel combustion per ton of product by 4.2 percent between 2000 and 2012. A variety of strategies are being employed to achieve this goal, including (but not limited to) improved energy efficiency through physical modifications to plant operations; use of alternative fuels; carbon sinks;

sequestration; and offsets. Because this is an aggregate goal, individual company intensity goals vary depending on their unique circumstances.

### Additional Climate VISION Goals:

Additional IMA-NA Climate VISION commitments include the following:

- IMA-NA member companies will investigate cost-effective methods of conserving energy and improving the energy efficiency of their processes and seek to improve on a continuous basis the efficiency of energy and power generation systems.
- Beginning in 2008, IMA-NA will initiate sessions on energy conservation and GHG reduction at IMA-NA workshops.
- IMA-NA will encourage member companies to conduct site-wide energy assessments and promote conservation across the entire IMA-NA membership.
- IMA-NA will seek cross-sector alliances and facilitate information sharing with industries with similar GHG reduction challenges.
- IMA-NA will seek partnerships with universities to develop innovative technologies in industrial minerals, including energy conservation and reduction of GHGs. IMA-NA has begun this process by contacting some 59 leading schools and universities to explore with them their possible membership in IMA-NA.

<sup>26</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See:

[http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

<sup>27</sup> FMC Corporation, General Chemical Industrial Products, Inc. (including its Amherstburg, Ontario plant), Searles Valley Minerals, Solvay Chemicals, and Rio Tinto Minerals.

### Metrics Identified:

IMA-NA published its GHG inventory protocol on May 19, 2004, marking a critical first step to assure that it generates complete, reliable, and valid data. The IMA-NA Greenhouse Gas Inventory Protocol was designed to assure that the GHG inventory developed by this industry sector conforms to the guidelines outlined in “The Greenhouse Gas Protocol,” published jointly by WBCSD and WRI.

### Measured Results to Date:

IMA-NA now has inventory results from 2000 through 2005 (Figure 3-9). IMA-NA estimates from these results show a reduction of GHG intensity over that period of 15.3 percent, compared with the IMA-NA target reduction of 4.2 percent for the period 2000 to 2012.

### Industry Actions Taken:

Soda ash and borates production in the United States is confined to a small number of facilities in Wyoming and California, yet fulfills virtually all of the nation’s needs for these products. As a

result, the facilities necessarily are operated on a large scale.

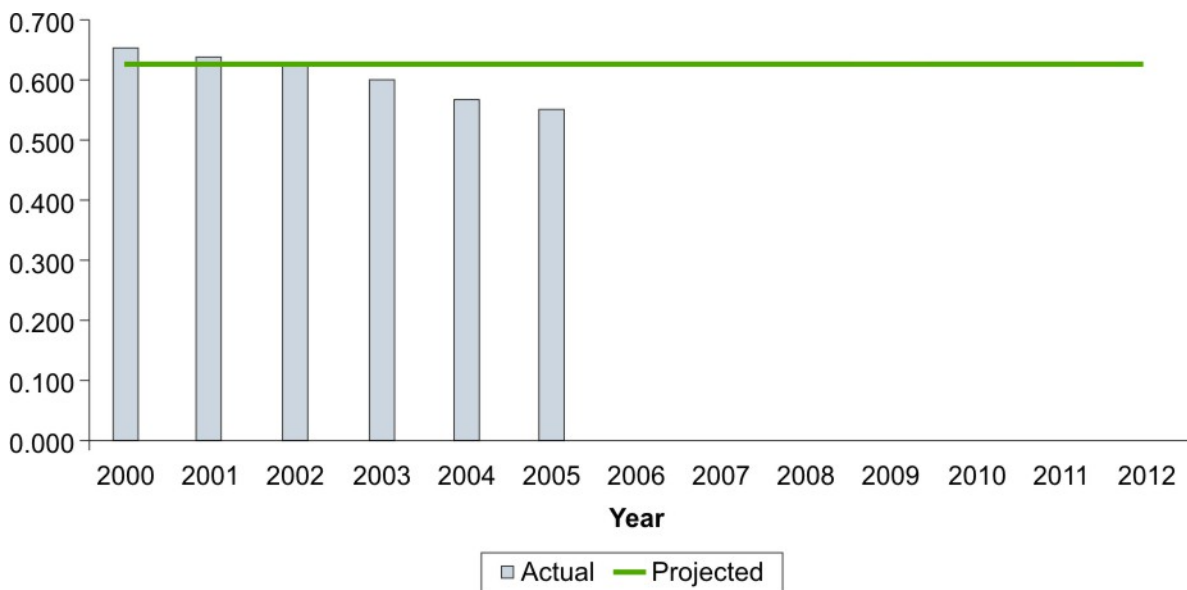
IMA-NA attributes the reduction in emission intensity indicated in Figure 3-9 above to capital investments by program participants in insulated buildings and equipment, increased efficiency of dryers and calciners, and implementation of numerous waste heat recovery projects. Additional improvements have included replacement of old electrical motors with new, more efficient ones, and replacement of incandescent lighting fixtures with fluorescent lamp technology.

### Program Reports and Other Links:

To learn more about industrial mineral industry efforts to address GHGs, please visit these websites:

- [IMA-NA Sustainable Development Web Page](#)
- [Climate VISION Private Sector Initiatives: Industrial Minerals](#)

**Figure 3-9**  
**IMA-NA Net Greenhouse Gas Intensity (T-GHGs/T-Prod)**





## MAGNESIUM SECTOR: INTERNATIONAL MAGNESIUM ASSOCIATION<sup>28</sup>

### Highlights:

- Under EPA's SF<sub>6</sub> Emission Reduction Partnership for the Magnesium Industry, magnesium industry partners reduced direct emissions of the strongest GHG, SF<sub>6</sub>, by 0.8 MMTCO<sub>2</sub>-eq in 2005.
- EPA, the International Magnesium Association (IMA), Japan Magnesium Association, and China Magnesium Association worked together to publish a technical brochure titled [Alternatives to SF<sub>6</sub> for Magnesium Melt Protection](#). The brochure is available in English, Japanese, and Chinese language versions.
- EPA and Lunt Manufacturing, a magnesium die-casting partner company, conducted industrial-scale trials with promising, climate-friendly magnesium melt-protection technologies. The study also characterized gaseous by-product formation and monitored for workplace exposure hazards. The preliminary results from the study were presented at EPA's Fourth International Conference on SF<sub>6</sub> and the Environment held November 28 – 30, 2006 in San Antonio, Texas. The proceedings from the conference, including a presentation of the study's preliminary results are available on the [EPA website](#).

### Industry Sector and Participants:

Climate VISION's magnesium sector participants include the members of EPA's SF<sub>6</sub> Emission Reduction Partnership for the Magnesium Industry and IMA. EPA's partnership currently includes 16 companies, representing

approximately 90 percent of U.S. magnesium casting and recycling operations and 100 percent of domestic primary magnesium production.

The IMA represents the global magnesium industry. Its membership spans 34 countries and comprises companies that are producers of primary and alloy magnesium, recyclers, users of magnesium in product manufacturing (die and sand casters, extruders, and sheet forming, etc.), and also academia, as well as suppliers to the industry.

### Primary Climate VISION Goal:

EPA's partners are joined by the IMA in their goal to completely eliminate SF<sub>6</sub> emissions by the year end 2010.

### Metrics Identified:

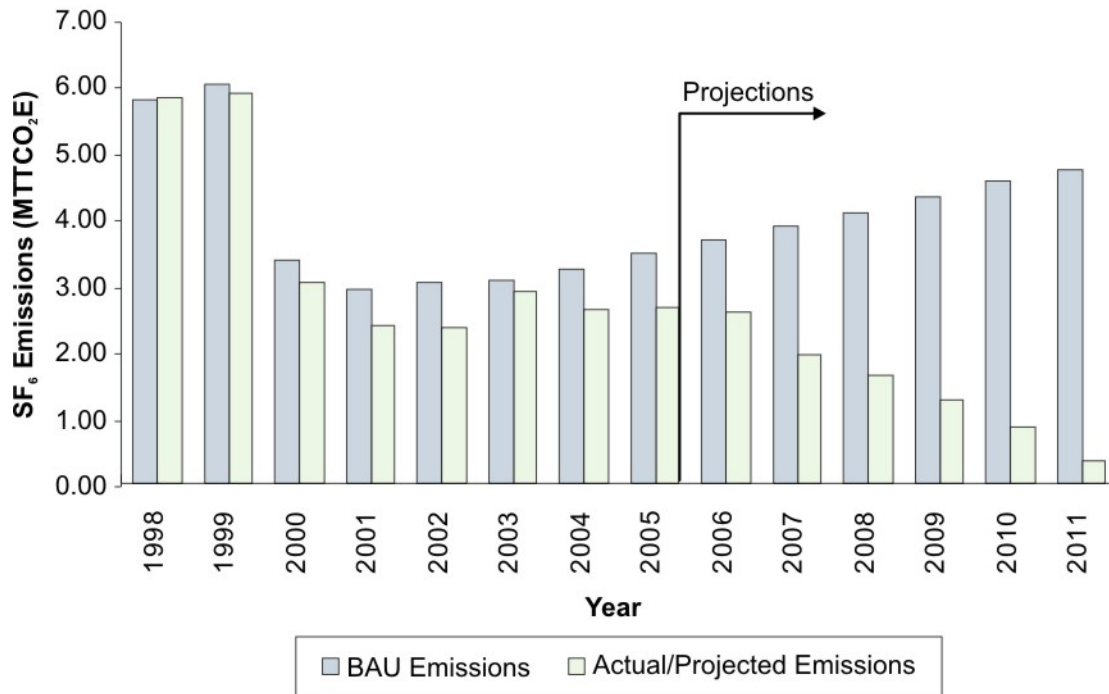
The magnesium industry participants (*i.e.*, EPA partners and IMA) are measuring their progress for Climate VISION by tracking and reporting the mass of SF<sub>6</sub> emissions consistent with IPCC guidance. In addition, EPA's partners track and report a normalized emissions metric based on the amount of magnesium produced or melted in given year—kg SF<sub>6</sub> used/metric ton of magnesium processed. The SF<sub>6</sub> intensity (usage rate) metric is valuable for individual companies to track their own year-to-year progress.

### Measured Results to Date:

IMA's goal is to eliminate completely SF<sub>6</sub> emissions by 2011. Magnesium industry partners have reduced direct emissions of this gas well below projected levels and reduced emissions by 0.8 MMTCO<sub>2</sub>-eq in 2005 (Figure 3-10).

<sup>28</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

**Figure 3-10**  
**EPA's U.S. Magnesium Industry Partner Achievements –**  
**Business-as-Usual v. Actual & Projected SF<sub>6</sub> Emissions (1998-2011)<sup>29</sup>**



Source: EPA, 2007

### Industry Actions Taken:

IMA and EPA have organized and led three Magnesium Melt Protection Users Group Workshops in conjunction with the IMA's Annual Magnesium World Conferences—Berlin in 2005, Beijing in 2006, and Vancouver in 2007. The purpose of these workshops is to advance climate protection via an open exchange of industry experiences and technical information related to new melt-protection technologies. The 2006 workshop featured more than 50 industry and government experts from around the world sharing strategies on eliminating SF<sub>6</sub> emissions.

IMA cosponsored EPA's Fourth International Conference on SF<sub>6</sub> and the Environment held November 28 to 30, 2006, in San Antonio, Texas. This meeting featured a two-day magnesium

industry track to discuss relevant international policy and technical approaches for eliminating SF<sub>6</sub> emissions. The conference proceedings are available on the [EPA website](#).

### Industry Projects and Activities—Success Stories:

- Chicago White Metal Casting conducted the first-of-its-kind cover gas leak detection study using an advanced laser imaging system tuned to identify SF<sub>6</sub> losses.
- Two of EPA's magnesium die-casting partners, Intermet and Lunt Manufacturing, have conducted industrial-scale trials and by-product characterization projects to support the achievement of Climate VISION's goal.

<sup>29</sup> Because the Partnership does not include the entire U.S. magnesium industry it is estimated that there will be a small amount of SF<sub>6</sub> usage continuing after the 2010 SF<sub>6</sub> phase-out target for the Partnership.

## Program Reports and Other Links:

To learn more about magnesium industry efforts to address GHGs, please visit these websites:

- [EPA's SF<sub>6</sub> Emission Reduction Partnership for the Magnesium Industry](#)
- [Climate VISION Private Sector Initiatives: Magnesium](#)
- [International Magnesium Association:](#)  
Founded in 1943, the mission of IMA is to promote the use of the metal magnesium in material selection and encourage innovative applications of the versatile metal.

## LIME SECTOR: NATIONAL LIME ASSOCIATION<sup>30</sup>

### Highlights:

- Between 2002 and 2006, the energy-related CO<sub>2</sub> intensity of lime products produced by National Lime Association (NLA) member companies has been reduced by an aggregate 3.4 percent.
- In 2004 and 2005, approximately 6 percent of the U.S. lime production capacity was decommissioned and replaced with new, energy-efficient equipment. On average, the energy-related CO<sub>2</sub> intensity of lime from the new equipment is 35 percent lower than from the retired equipment.
- Several companies have made great strides in increasing the recycling of lime by-products. Industry-wide, the quantity of lime by-products recycled has increased by more than 500,000 tons since the start of the program. By-product recycling as a percent of generation increased from 41 percent to 53 percent. As more by-products are reused or sold as product, the total amount of energy used per ton of usable product is reduced, and thus intensity is reduced.

### Industry Sector and Participants:

NLA is the trade association for manufacturers of high-calcium quicklime, dolomitic quicklime, and hydrated lime, collectively referred to as “lime.” The members of NLA manufacture approximately 95 percent of commercial lime produced in the United States. Nearly half of the companies are small businesses, and many have no operations other than lime production.

<sup>30</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

### Primary Climate VISION Goal:

In answer to the President’s call, the members of NLA have established a goal of reducing the intensity of CO<sub>2</sub> emissions from energy use in the lime industry. NLA members will pursue this goal by reducing (on an aggregate basis) CO<sub>2</sub> emissions from fuel combustion per ton of product by eight percent between 2002 and 2012. Strategies include (but are not limited to) physical modifications to kilns to improve energy efficiency, operational changes, increased reuse of by-products, use of alternative fuels, use of green power, carbon sinks and sequestration, transferable credits if available, and offsets.

### Additional Climate VISION Goals:

NLA will identify research projects that could lead to further improvements in energy efficiency and other means of reducing CO<sub>2</sub> intensity, such as waste heat recovery and by-product reuse, and will seek to cooperatively fund such projects with government agencies and other entities. NLA will also provide support and education for its members in their efforts to achieve its goals, through meetings, publications, and other methods.

### Metrics Identified:

NLA’s “CO<sub>2</sub> Emissions Calculation Protocol for the Lime Industry” is designed to allow the lime industry to achieve consistency, comparability, and transparency in accounting for CO<sub>2</sub> emissions and reductions and to ensure that technically supported emission factors and other standards are used. The protocol was last revised on February 2, 2005, and is available on the [Climate VISION website](#).

In developing the protocol, NLA used previous international protocols as a starting point, but added refinements to aid in more accurately estimating CO<sub>2</sub> emissions from lime plants. For example, NLA’s protocol includes CO<sub>2</sub> generated

from the production of by-products, encourages the use of measured values of oxide content in lime products rather than default values, and includes detailed instructions on how to properly calculate calcium oxide content in lime. DOE has adopted the principal elements of NLA's protocol in its final 1605(b) Technical Guidelines.

### Measured Results to Date:

Between 2002 and 2006, the energy-related CO<sub>2</sub> intensity of lime products produced by National Lime Association member companies has been reduced by an aggregate 3.4 percent. This shows significant progress in the last three years, (as intensity was essentially unchanged between 2002 and 2003), as reflected in the chart below:

### Industry Actions Taken:

In the fall of 2003, NLA developed a protocol for quantifying CO<sub>2</sub> emissions and emission reductions from lime manufacturing plants and began collecting data for 2002. Collection and analysis of both the 2002 and 2003 data were completed in 2004. In July of 2004, NLA submitted a report to DOE on aggregate industry trends in GHG intensity (emissions per unit of production). The second report was submitted in July of 2006.

The NLA Fall 2006 Operating Meeting & Professional Development Seminar focused on energy management and CO<sub>2</sub> intensity improvement. The Professional Development session on Energy Management was led by a management consultant and included strategies for energy-efficiency improvements, energy assessment, and cost control. The plenary session of the Operating Meeting included presentations and workshops on technological

approaches to increase energy efficiency, including recovery of waste heat, better measurements, and improved management of kiln operations to improve energy utilization. Strategies to increase the recycling of lime kiln dust were also addressed.

NLA's fall 2004 Operating Meeting & Professional Development Seminar addressed energy management and combustion optimization.

### Industry Projects and Activities—Success Stories:

The improvement in energy-related CO<sub>2</sub> intensity is the result of decisive actions taken by lime companies. Although many efforts contributed to the result, the largest reductions in intensity came as a result of (1) replacement of inefficient production capacity with more efficient capacity and (2) an increase in the recycling of lime by-products.

Several companies have improved by-product recycling or the energy efficiency of their kilns to such an extent that they have already met their share of the aggregate industry commitment for 2012.

For the next reporting period (2006-07), several projects are already underway that should further contribute to the lime industry meeting its Climate VISION goal. For example, permits for six new lime kilns have been issued in recent

**Table 3-5  
Energy-Related CO<sub>2</sub> Intensity of Lime Products Produced by  
NLA Member Companies**

YEAR	ENERGY-RELATED EMISSIONS OF CO <sub>2</sub> (MILLION TONS)	PRODUCT PRODUCED (MILLION TONS)	EMISSIONS INTENSITY FROM ENERGY USE (ENERGY-RELATED CO <sub>2</sub> TONS PER TON OF PRODUCT)
2002	12.9	19.1	0.68
2003	13.7	20.2	0.68
2004	14.6	21.5	0.68
2005	14.4	21.6	0.67
2006	14.7	22.5	0.65

years that have the collective capacity to produce annually more than 2.4 million tons of lime that was not reflected in the 2004-05 report. These new kilns are expected to be 25 percent more energy efficient than the current industry average.

Companies have also initiated studies of waste heat recovery projects, and one company has already made plans to include waste heat recovery in a kiln project to be completed in the next two years.

### **Program Reports and Other Links:**

To learn more about lime industry efforts to address GHGs, please visit these websites:

- [Climate VISION Private Sector Initiatives: Lime](#)

## MINING SECTOR: NATIONAL MINING ASSOCIATION<sup>31</sup>

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### Highlights:

- Data from EPA show that methane emissions from coal mines have declined 6.3 percent from 2000 to 2005.
- The mining industry will continue to participate in development and commercialization of advanced technologies that improve efficiency of mining operations and processing and use of coal and metals and minerals. Use of these technologies as well as development and use of advanced technologies that advance the capture, recovery and use of coal mine methane and improvement in carbon sequestration opportunities associated with reclamation of mined lands will result in continued reduction of GHG emissions associated with mining.

### Industry Sector and Participants:

The National Mining Association (NMA) represents the Nation's leading companies engaged in the production of America's coal, metals, industrial and agricultural minerals; companies that manufacture mining and mineral processing machinery, equipment and supplies and other organizations that support our nation's mining industry. NMA represents over 80 percent of an \$80 billion industry that provides the coal-based energy and basic metals and minerals.

### Primary Climate VISION Goal:

NMA members committed to increasing the energy efficiency of production (and where applicable) processing operations, with the goal of obtaining a 10 percent increase in energy efficiency in systems that can be optimized with

the processes and techniques supported by DOE and made available to the industry through a series of jointly sponsored government industry workshops. NMA members also committed to maintain and improve progress made in reduction of methane emissions from coal mines, wherever economically and technically possible.

### Additional Climate VISION Goals:

The industry participated in DOE's Mining Industry of the Future research program (discontinued in 2006) with an emphasis on projects that would increase efficiency and thus reduce carbon emissions intensity of operations. The industry has also committed to work with the Department of Interior (DOI) in an effort to increase the amount of carbon sequestered on reclaimed mine lands.

NMA members are working collectively and in partnership with DOE, other government agencies, and other industries in research programs intended to accelerate development and use of advanced technologies that will reduce GHG emissions intensity of both production and use of coal, metals, and minerals.

### Related Industry Programs:

The coal industry is working with related industries to identify and advance technologies that will allow the increase in coal use with a simultaneous reduction in carbon emissions and emissions intensity. Specific programs include the DOE's Clean Coal Power Initiative (CCPI) and the FutureGen Alliance.

NMA and its member companies have joined with DOI's Office of Surface Management and seven Appalachian states in the Appalachian Regional Initiative to reforest mined and abandoned mine lands resulting in greater level of carbon sequestration on these lands.

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<sup>31</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

## Metrics Identified:

Metrics to measure emissions intensity from mining operations would vary by type of product but the most common would be emissions of GHGs per unit of output, *e.g.* per ton of coal, pound of copper, or ounce of gold.

Unfortunately, with the exception of emissions of methane from coal mines, there are no public data available to measure emissions from mining operations in the United States. While an indication of the increase in efficiency of mining operations can be found in productivity increases (an overall improvement of seven percent since 2001) even rough estimations of energy used or emissions per unit of product output are not possible given the data available.

## Measured Results to Date:

As shown below, methane emissions from coal mines have declined from 55.9 MMTCO<sub>2</sub> eq in 2000 to 52.4 MMTCO<sub>2</sub> eq in 2005, a 6.3 percent decline, according to the EPA's Annual Inventory of U.S. Greenhouse Gas Emissions.

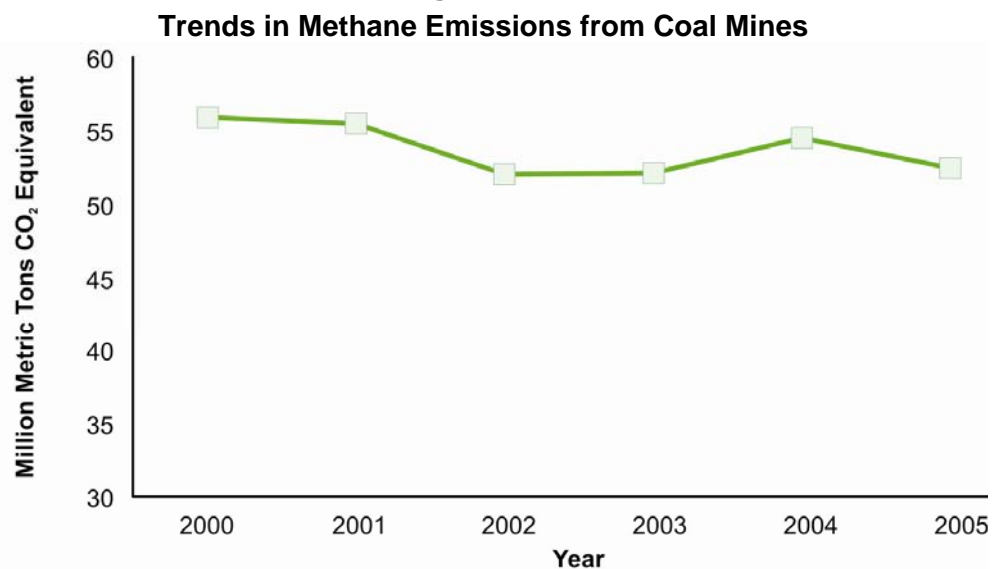
## Industry Actions Taken:

- **EFFICIENCY GAINS:** NMA sponsored energy efficiency workshops in conjunction with the Department of Energy, worked with DOE to identify areas where research is needed to improve the efficiency of operations and, until the program was eliminated, expanded participation in the DOE

Mining Industry of the Future research program. Results of this research have been made available to the industry through MINEXpo® and in other mining forums and seminars.

- **METHANE RECOVERY:** Several NMA members have been actively involved in research programs designed to enhance coal mine methane recovery and ventilation air methane capture. NMA members that are involved in methane recovery are active participants in all aspects of EPA's Coal Mine Methane outreach program as well as in the international Methane to Markets programs.
- **RECLAMATION AND SEQUESTRATION:** The industry formed a special industry task force with the Office of Surface Mining to work collectively to improve regulatory policies leading to more efficient reclamation with increased opportunities for carbon sequestration. Over 2,240,000 acres of abandoned mine lands have been reclaimed, a number that is increasing annually though participation in federal and state programs.

Figure 3-11



Source: Annual Inventory of U.S. Greenhouse Gas Emissions, EPA



NMA members are active participants or are supporting each of the seven DOE-sponsored Regional Carbon Sequestration Partnerships.

NMA members are participants in APP and specifically in the Coal Mine Task Force (CMTF). The CMTF has developed a work plan to facilitate both information exchange and technology transfer between the six APP members in the areas of coal mine health and safety, methane capture and reduction, coal beneficiation and reclamation. All the projects will lead to lower rates of GHG emissions associated with coal mining.

### **Industry Projects and Activities—Success Stories:**

Most individual NMA members have specific projects and activities that are designed to increase efficiencies in mining operations, thus reducing emissions and emissions intensity associated with mining and processing. Examples of these activities can be found on individual company web sites and/or are included in individual environmental reports or publications. The types of projects include: involvement in developing and construction of advanced clean coal electric generating facilities; developing and construction of advanced coal to liquids plants that include carbon capture and sequestration; expansion of capture and sequestration of carbon on reclaimed lands including expansion of tree planting programs; involvement in carbon capture and storage research projects; involvement in the Regional Carbon Sequestration partnerships; development and use of technologies to improve the efficiency of mining operations; involvement in research projects to demonstrate advanced coal mine methane capture technology.

Companies that have information on their web sites include but are not limited to: [Peabody Energy](#); [Consol Energy](#); [Arch Coal](#); [Foundation Coal](#); [RioTinto](#); [Newmont Mining](#); and [Freeport McMoran Copper and Gold](#).

### **Program Reports and Other Links:**

To learn more about mining industry efforts to address GHGs, please visit these websites:

- [National Mining Association](#)
- [Climate VISION Private Sector Initiatives: Mining](#)

## CEMENT SECTOR: PORTLAND CEMENT ASSOCIATION<sup>32</sup>

### Highlights:

- Data to date indicates that U.S. cement manufacturers are making substantial progress towards achieving their goal set in 2001. As this progress continues, the industry will consider whether to establish a more ambitious target.

### Industry Sector and Participants:

The Portland Cement Association (PCA) and its 28 member companies participating in Climate VISION represent 96 percent of cement production in the United States.

### Primary Climate VISION Goal:

In 2001, PCA members established the following voluntary goal:

- A 10 percent reduction in CO<sub>2</sub> emissions per ton of cementitious product produced or sold from a 1990 baseline by 2020.

The industry is now implementing a three-part program to achieve the goal and to foster additional reductions by users of the product, as described below. The reduction goal will be achieved by changes in the cement manufacturing process and in product formulation. In addition, applications of cement and concrete can result in energy savings that will further reduce overall global GHG emissions.

### Related Industry Programs:

PCA and/or its member companies have been and continue to be active in international and domestic efforts to measure and reduce GHGs, such as the following:

- EPA Climate Leaders program
- EPA ENERGY STAR program
- DOE 1605(b) Voluntary Reporting of Greenhouse Gases Program
- WRI/WBCSD GHG Protocol
- Pew Center on Global Climate Change
- World Wildlife Federation Climate Savers program
- WBCSD report on a sustainable cement industry.

### Metrics Identified:

- Cement Industry Emissions Protocol: The industry has developed a comprehensive and consistent means of measuring GHG emissions that result from the production of cement. The GHG Protocol—developed under the auspices WRI and WBCSD—includes a comprehensive measurement protocol for cement manufacturing emissions. PCA and some of its member companies were involved in the development of this protocol, and the Association endorses the protocol as a measurement and reporting tool. PCA is also assessing whether this protocol can be further enhanced with some minor adjustments or should be utilized for Climate VISION purposes as it stands.
- Cement Industry Emissions Profile: To the extent possible, the protocol would be back-applied to develop a profile of emissions from the U.S. cement industry for the 1990 baseline.

### Measured Results to Date:

Preliminary data indicates that U.S. cement manufacturers are substantial progress towards achieving their goal set in 2001—more than 14 years ahead of schedule. When this is confirmed, the industry will consider whether to establish a more ambitious target.

<sup>32</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

**Table 3-6  
Trends in Energy Consumption by Type of U.S. Cement Plant  
(Million Btu per Equivalent Tons<sup>\*</sup>)**

	1972	2000	2001	2002	2003	2004	2005	2006	%CHANGE 06/72	%CHANGE 06/05
<b>All Plants**</b>	7.436	4.982	4.930	4.858	4.762	4.755	7.699	4.649	-37.5	-1.1
<b>Wet Process</b>	7.978	6.250	6.442	6.676	6.647	6.807	6.387	6.464	-19.0	1.2
<b>Dry Process</b>	6.669	4.673	4.655	4.498	4.433	4.407	4.433	4.375	-34.4	-1.3
No Preheater		5.644	5.589	5.552	5.330	5.169	5.445	5.738		5.4
Preheater		4.579	4.463	4.414	4.318	4.354	4.425	4.411		-0.4
Precalciner		4.310	4.430	4.239	4.220	4.197	4.212	4.102		-2.6
Preheater/Precalciner***		4.393	4.439	4.279	4.248	4.239	4.269	4.158		-2.6

\* Metric tons used to measure energy efficiency are an equivalent ton measure composed of 92% clinker production plus 8% finished cement production.

\*\*Grinding only and white cement plants not included.

\*\*\*includes plants that are Preheater only.

### Industry Actions Taken:

The industry is working to reduce emissions through increased energy efficiency and decreased fuel use. PCA anticipates that approximately half of the projected reductions will come from these activities.

- **Efficiency technologies:** The industry continues to take advantage of new technologies such as conversion to modern preheater/precalciner kilns, highly energy-efficient fan systems, and other means of reducing energy use per unit of output.
- **Alternative fuels and raw materials:** It continues to utilize alternatives to conventional fuels and raw materials to reduce GHG and other pollutant emissions while attending to the goal of reducing the amount of energy required to produce a ton of cement.
- **Demand-side energy management:** The industry has reduced the amount of electricity used to produce a ton of cement through the application of improved energy management practices and more efficient technologies such as fans, motors, and other items utilized in making

cement. While member companies and PCA will track these emission reductions, they will not be counted toward the goal.

The industry continues to research long-term cement technology alternatives and contribute to research that could identify or develop emission-reductions technologies or options that are not currently envisioned.

In addition, the cement industry is looking at ways to change the “recipe” of cement that could lead to reduced emissions. These include the following:

- **Finalize changes to the Portland Cement Standard through the American Society for Testing and Materials (ASTM):** The U.S. cement industry supports changes to the standard recipe for portland cement developed by ASTM to allow intergrinding some uncalcined limestone into the finished product to reduce the proportion of clinker in the finished product. Acceptance of such a change would result in a significant reduction of CO<sub>2</sub> emissions per unit of cement.
- **Harmonize ASTM and American Association of State Highway and Transportation Organizations (AASHTO)**

cement standards: Some states use a portland cement standard developed by AASHTO, rather than the ASTM standard. After the ASTM standard is improved, the AASHTO standard should be changed to conform.

- Measure extent of clinker factor reduction in cementitious materials produced: Further reductions in clinker content might be achieved by utilization of non-clinker cementitious materials. PCA will annually quantify the impact of this practice as part of the effort to measure progress toward implementation of the 2020 CO<sub>2</sub>-reduction goal.

The cement industry also promotes the use of concrete as a climate change solution based upon the following considerations.

- Energy-Efficient Structures: commercial and residential structures built with concrete exterior walls to enhance their energy efficiency.
- Urban Heat Island Mitigation: light-colored concrete absorbs less and radiates more light energy than dark materials—whether on pavement, roofs, or other surfaces—thereby reducing radiated heat energy and thus ambient temperatures.
- Vehicle Fuel Efficiency: studies indicate that because of its rigidity, concrete pavement enhances fuel efficiency of vehicles when compared to flexible pavements.

These are areas that provide great promise for reductions, yet they are largely beyond the industry's control and therefore are not counted towards implementation of PCA's 2020 CO<sub>2</sub>-reduction goal.

## Industry Projects and Activities—Success Stories:

PCA participated in the development of *Roadmap 2030: The U.S. Concrete Industry Technology Roadmap* in December, 2002. This document defines enabling research opportunities for cement and concrete and proposes areas where governmental-industrial-academic partnerships can accelerate the pace of development.

The CO<sub>2</sub> reduction goal and other continuous improvement targets established by PCA members are key elements of the Cement Manufacturing Sustainability program and the broader PCA Sustainable Development program. Similar efforts have since been initiated around the world, resulting in the development of a global cement industry GHG emissions protocol, prepared under the auspices of the World Business Council on Sustainable Development.

Examples of specific activities undertaken by the cement industry and its member companies to reduce GHGs include:

- Aggressive energy efficiency and process improvement measures to reduce consumption of primary fuel and electricity
- Utilization of alternative fuels and raw materials to reduce dependence on virgin products and to minimize emissions
- Revision of product codes to reduce clinker factor of portland cement, dramatically reducing emission intensity
- Encouragement of green applications of concrete to improve energy efficiency of buildings and pavements

PCA members also participate in the ENERGY STAR Cement Manufacturing Focus activities under the ENERGY STAR “Industries in Focus” Program, sponsored by EPA.

- By the end of 2006, six U.S. cement plants were among the first recipients of the new ENERGY STAR Plant Labelplants in recognition of their superior energy performance. Receipt of the ENERGY STAR signifies that the energy efficiency of these plants was rated within the top twenty-five percent for their industry nationwide. As a result, each of these plants is awarded the honor of displaying the ENERGY STAR in the form of a banner at the plant.
- Cement manufacturers coordinated with EPA and Lawrence Berkeley National Laboratory to develop the [ENERGY STAR Guide: \*Energy Efficiency Improvement Opportunities for Cement Making\*](#), which has become a valuable resource for improving energy efficiency in cement plants.
- Cement manufacturers and PCA worked with EPA to develop the Energy Performance Indicator tool to help plants benchmark their energy usage, along with specific ENERGY STAR tools to help them with GHG reduction planning, conservation activities, efficiency improvements, changes in operating practices, and employee awareness programs.
- California Portland Cement Company is a recipient of the ENERGY STAR Partner of the Year Award for strong corporate energy management (see web link below for list of recipients).

## Program Reports and Other Links:

To learn more about cement industry efforts to address GHGs, please visit these websites:

- [Portland Cement Association](#)
- [PCA Report on Sustainable Manufacturing 2006](#)
- [World Business Council for Sustainable Development Sustainable Cement Initiative](#)
- [ENERGY STAR Guide: \*Energy Efficiency Improvement Opportunities for Cement Making\*](#)
- [ENERGY STAR Plant Awards](#)
- [ENERGY STAR Partner of the Year Awards](#)
- [ENERGY STAR Industries in Focus](#)
- [Climate VISION Private Sector Initiatives: Cement](#)

## POWER SECTOR: POWER PARTNERS<sup>SM</sup> 33

### Highlights:

- In January 2003, leaders from the nation's electric power sector formed Power Partners<sup>SM</sup> to coordinate new voluntary commitments to substantially reduce U.S. GHG emissions intensity. The seven electric power organizations comprised by Power Partners<sup>SM</sup> represent 100 percent of the U.S. power generators.
- Power Partners<sup>SM</sup> made a commitment to reduce GHG emissions intensity by the equivalent of 3 percent to 5 percent from the 2000-2002 base-year average over a 10-year period. The electric power industry is currently on track to meet its reduction targets; the 2005 GHG emissions intensity is already 2.54 percent lower than the base-year average, after only three years into the program.
- The first Power Partners<sup>SM</sup> Annual Report was published in January 2007. This 52-page report documents industry-wide and individual company achievements in voluntarily reducing GHG emissions intensity.
- Since 2002 the Power Partners<sup>SM</sup> have been pursuing a series of industry-wide initiatives to assist in achieving the carbon intensity goal: PowerTree Carbon Company, Coal Combustion Products Partnership, International Power Partnerships, and five Electric Power Research Institute (EPRI) technology initiatives – CoalFleet for Tomorrow, CO<sub>2</sub> Capture and Storage Test Centers, developing GHG offsets by reducing nitrous oxide emissions in agricultural crop production, promoting electric transportation and the jointly established DOE-EPRI Center for Nuclear Fuels and Materials Research.
- Electric power companies are undertaking hundreds of projects to reduce GHG emissions intensity. These projects include nuclear uprate programs, biologic sequestration, renewable energy programs, green power and green pricing programs, energy-efficiency and demand-side management (DSM) programs, SF<sub>6</sub> programs, clean coal technology, natural gas generation, and company-specific reduction commitments. Dozens of examples are described in the January 2007 Power Partners<sup>SM</sup> Annual Report.
- [The Power Partners<sup>SM</sup> Resource Guide](#) went online in 2005. The website is a web-based resource tool developed to help electric utilities and power generators undertake actions to reduce, avoid, or sequester GHG emissions. The Resource Guide helps thousands of users each month to find the latest, state-of-the-art information on a variety of topics through the use of project descriptions and annotated links to other websites.

### Industry Sector and Participants:

The seven organizations comprised by Power Partners<sup>SM</sup> represent 100 percent of the power generators in the U.S.

- The AMERICAN PUBLIC POWER ASSOCIATION (APPA) represents the interests of the nation's nearly 2,000 not-for-profit community-owned and state-owned electric utilities.
- The LARGE PUBLIC POWER COUNCIL (LPPC) is an organization of 24 of the largest publicly owned electric utilities.

<sup>33</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

Publicly owned electric utilities provide electric service to more than 40 million Americans.

- The EDISON ELECTRIC INSTITUTE (EEI) is the association of U.S. shareholder-owned electric companies, international affiliates, and industry associates worldwide. EEI's U.S. members serve 97 percent of the ultimate customers in the shareholder-owned segment of the industry, and 71 percent of all electric utility ultimate customers in the nation.
- The ELECTRIC POWER SUPPLY ASSOCIATION (EPSA) is the national trade association that represents competitive power suppliers, including generators and marketers. The competitive sector operates a diverse portfolio of technologies that represents 40 percent of the installed generating capacity in the United States.
- The NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION (NRECA) is the national service organization that represents the nation's 900-plus, consumer-owned electric cooperatives, which provide electric service to more than 39 million people in 47 states.
- The NUCLEAR ENERGY INSTITUTE (NEI) is the policy organization of the nuclear energy and technologies industry and participates in both national and global policy-making processes. NEI's objective is to ensure the formation of policies that promote the beneficial uses of nuclear energy and technologies in the United States and around the world.
- The TENNESSEE VALLEY AUTHORITY (TVA) is a Federal corporation and the nation's largest public power company. TVA was established by Congress in 1933, primarily to reduce the risk of flood damage, improve navigation of the Tennessee River, provide electric power,

and promote agricultural and industrial development in the region.

### **Primary Climate VISION Goal:**

Power Partners<sup>SM</sup> made a commitment to reduce the power sector's GHG intensity by the equivalent of 3-5 percent over a decade. Recognizing the effects of short-term fluctuations in weather, rainfall, and other operating conditions on generation mixes, this goal is expressed as a three-year average, using 2000-2002 as the base-year average, and 2010-2012 as the target-year average.

### **Additional Climate VISION Goals:**

USDA and Power Partners<sup>SM</sup> member NRECA, signed a memorandum of understanding to identify and advance technologies that will help achieve the U.S.'s 18 percent goal. In addition, Power Partners<sup>SM</sup> developed a work plan to implement the memorandum of understanding developed with DOE, and subsequently updated the work plan in September 2006.

### **Related Industry Programs:**

Climate VISION aims to work with industry groups/sectors to identify and implement near-term, cost-effective GHG reduction opportunities. Power Partners<sup>SM</sup> and DOE are working together across a broad range of voluntary efforts and programs. These include cross-sector and intergovernmental enabling initiatives such as advanced nuclear technologies, clean coal technologies, geologic sequestration and carbon capture and storage, energy efficiency, Utility Hybrid Truck Initiative, Initiative for New Homes, and various international efforts.

The Power Partners<sup>SM</sup> are taking actions to encourage and facilitate participation in Climate VISION by their trade association members and TVA. The important goals of this effort will be to improve the level and depth of participation, through workshops or other means, and to enhance performance and reporting. An example of this effort is the *National Action Plan for Energy*

*Efficiency*; a summary is available on the [EPA website](#).

Power Partners<sup>SM</sup> and DOE view the development and use of more advanced energy technologies as critical to the achievement of the U.S. GHG intensity reduction goal. Power Partners<sup>SM</sup> and DOE agreed to work collectively to develop a process (subject to available funds and applicable provisions of law) for (1) identifying high-priority areas for power sector research, development, demonstration, and deployment (RDD&D) associated with technologies that would contribute to the achievement of the national goal and ultimately would contribute to surpassing this goal and (2) recommending steps to carry out power sector RDD&D in the identified, high-priority areas.

The U.S. coal and utility industries are working with DOE to develop clean coal power plants through the FutureGen project, CCPI, and advanced research and development. Under FutureGen, the electric power industry and DOE plan to build and operate a 275 MW coal plant that produces both electricity and hydrogen with essentially zero emissions. Additionally, CPPI is a Federal cost-share program to conduct demonstrations of cutting-edge, commercial-scale, advanced clean coal technologies.

APP involves governments working with the private sector to expand investment and trade in cleaner energy technologies to address the challenges of reducing poverty and promoting economic development while reducing GHG emissions. The APP has established eight task forces covering (1) cleaner use of fossil energy; (2) renewable energy and distributed generation; (3) power generation and transmission; (4) steel; (5) aluminum; (6) cement; (7) coal mining; and (8) buildings and appliances.

Methane to Markets, a partnership established in November 2004, is a voluntary framework for cooperation to advance the recovery and use of methane as a valuable and clean energy source. One major goal of the partnership is to develop

and transfer methods and technologies for methane capture.

Power Partners<sup>SM</sup> are also actively participating in domestic and international partnerships to further the development of next-generation nuclear technologies, including:

- Nuclear Power 2010 (NP2010): A joint government-industry cost-sharing effort to identify new sites for nuclear reactors in the United States, to develop and bring to market new nuclear plant technologies, and to demonstrate untested regulatory processes.
- Global Nuclear Energy Partnership: Partners the United States with other advanced nuclear nations to develop a transparent fuel market and spent nuclear fuel recycling technology while reducing nuclear proliferation risks.
- Generation IV: An international initiative to develop six next-generation reactors designed to be safer, more reliable, more cost-effective, and more proliferation-resistant than today's current technologies.
- ITER: An international research and development project that aims to demonstrate the scientific and technical feasibility of fusion power.

### **Metrics Identified:**

The power sector's primary Climate VISION commitment is expressed in terms of the ratio of CO<sub>2</sub> emissions to electricity generated (kWh), as adjusted ("the equivalent of 3 percent to 5 percent").

Since the Federal Government's raw statistics for the industry do not take into account off-system actions and other non-generation activities by the power sector that offset and affect GHG emissions from generation, Power Partners<sup>SM</sup> surveyed its utilities, power generators, and members to obtain



this information. These off-system and non-generation actions included transmission and distribution actions; energy efficiency and DSM; carbon sequestration; coal combustion product utilization; SF<sub>6</sub> activities; and landfill methane recovery.

**Measured Results to Date:**

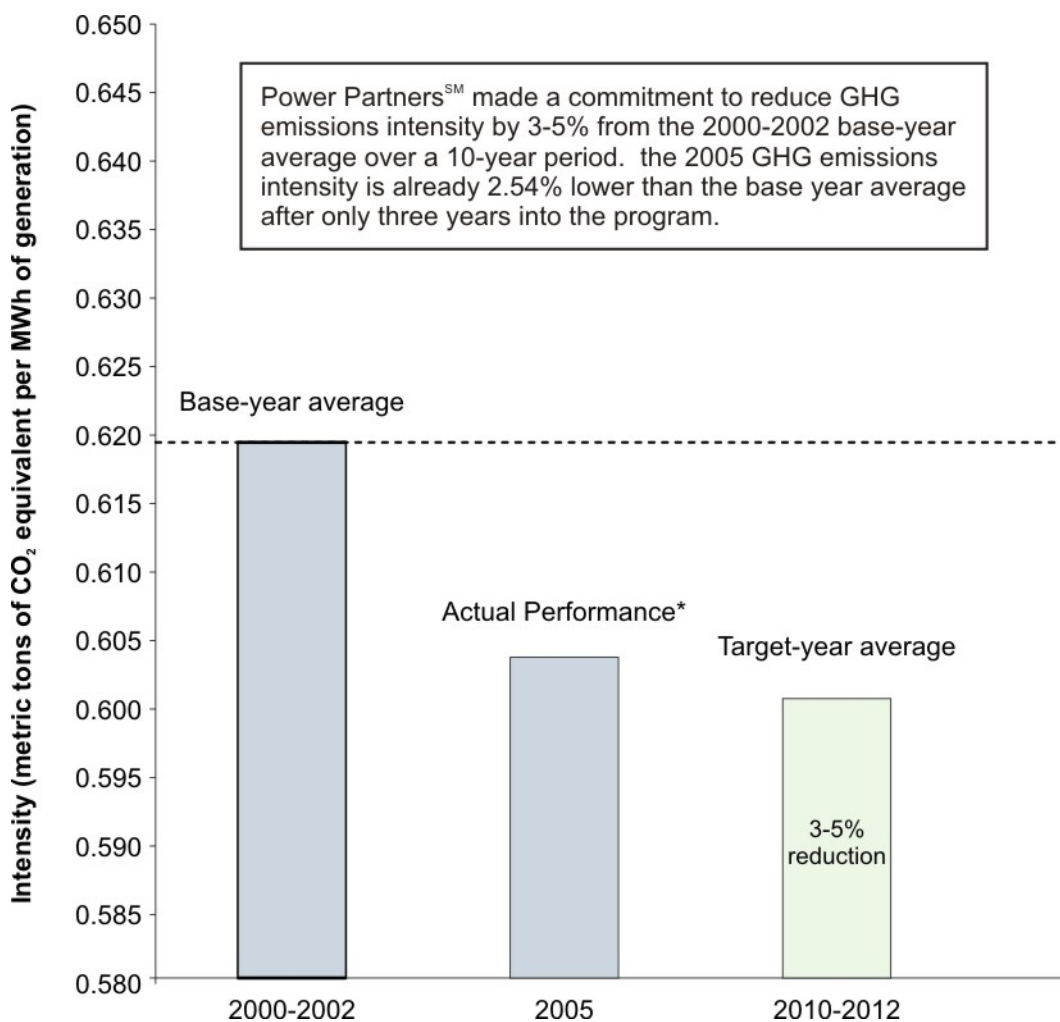
The results of the industry’s overall efforts through 2005 are shown below (Figure 3-12). The electric power industry is currently on track to meet its reduction targets. The 2005 GHG emissions intensity is already 2.54 percent lower than the base-year average, after only three years into the program.

**Industry Actions Taken:**

The Power Partners<sup>SM</sup> are developing and promoting power sector initiatives that will allow their member utilities, power generators, and TVA to pool resources and collaborate collectively on joint, industry-wide programs and activities to reduce GHG emissions intensity.

Since 2002 the Power Partners<sup>SM</sup> have been assessing and developing a series of industry-wide initiatives in support of the President’s goal and to help the power sector reduce its carbon intensity. The following activities are being pursued to assist in achieving the sector-wide carbon intensity goal: PowerTree Carbon

**Figure 3-12**  
**Trends in Power Partners<sup>SM</sup> GHG Emissions Intensity (Annual Average)**



Sources: U.S. Dept. of Energy, Energy Information Administration; 2006 Power Partners<sup>SM</sup> Survey.

Company, Coal Combustion Products Partnership, International Power Partnerships, and five EPRI technology initiatives: CoalFleet for Tomorrow; CO<sub>2</sub> Capture and Storage Test Centers; developing GHG offsets by reducing nitrous oxide emissions in agricultural crop production; promoting electric transportation; and the jointly established DOE-EPRI Center for Nuclear Fuels and Materials Research.

### **Industry Projects and Activities—Success Stories:**

Actions by utilities, power generators, and TVA are the cornerstone of success for the voluntary initiative by Power Partners<sup>SM</sup>. Power Partners<sup>SM</sup> are encouraging trade association members and TVA to undertake specific commitments, including achieving voluntary GHG intensity reduction goals, along with developing plans to implement such commitments.

Activities being pursued by companies include nuclear uprate programs, biologic sequestration, renewable energy programs, green power and green pricing programs, energy-efficiency and DSM programs, SF<sub>6</sub> programs, clean coal technology, natural gas generation, and company-specific reduction commitments. Dozens of examples are described in the January 2007 [\*Power Partners<sup>SM</sup> Annual Report\*](#).

These projects continue the electric power sector's long tradition of voluntary efforts to reduce GHG emissions. Since the 1994 beginning of DOE's Voluntary Reporting of Greenhouse Gases Program (§1605(b) program), electric utilities have been the dominant industry in reporting, accounting for over half of all voluntary reports since the program's start.

EI has analyzed the 2004 electric power company reports to EIA's 1605(b) program. On a project-by-project basis, the electric power sector reported nearly 1,500 individual projects that directly or indirectly reduced GHG emissions, both within the electric power sector as well as other sectors. On a tonnage basis, nuclear power-related projects, including increased generation

and capacity improvements (power uprates), accounted for about 142 MMTCO<sub>2</sub>-eq reductions, about 54 percent of the sector's total project-level reductions. Other major CO<sub>2</sub>-reducing activities reported by the electric power sector include DSM programs, transmission and distribution system upgrades, natural gas plant expansion projects, landfill gas recovery projects, and carbon sequestration activities.

### **Program Reports and Other Links:**

To learn more about lime industry efforts to address GHGs, please visit these websites:

- [Power Partners<sup>SM</sup> Annual Report \(January 2007\)](#)
- [Power Partners<sup>SM</sup> Website](#)
- [Climate VISION Private Sector Initiatives: Electric Power](#)
- [Power Partners<sup>SM</sup> Program Description](#)
- [Power Partners<sup>SM</sup> Work Plan](#)

## SEMICONDUCTOR MANUFACTURING SECTOR: SEMICONDUCTOR INDUSTRY ASSOCIATION<sup>34</sup>

### Highlights:

- In 2005 alone, EPA's U.S. semiconductor industry partners reduced direct emissions of high global-warming-potential fluorinated compound gases such as perfluorocarbons, hydrofluorocarbons, sulfur hexafluoride, and nitrogen trifluoride by 7.7 MMTCO<sub>2</sub>-eq. EPA's partners are on track to achieve and exceed its technically aggressive 2010 goal of reducing emissions 10 percent below their 1995 baseline.
- The Semiconductor Industry Association (SIA), electronics industry suppliers, and EPA led the IPCC's effort to revise the industry's GHG reporting guidelines in 2005 and 2006. The IPCC published the revised guidance in November, 2006.
- EPA and partner company, Qimonda, conducted a cooperative study of installed fluorinated compound emissions abatement equipment in 2006. EPA and Qimonda plan to conduct a follow-up study in 2007 to assess the consistency of abatement device performance over time. Other partners have conducted their own emission control technology assessments in the past; the Qimonda study is the first in which EPA was an active participant.
- In accordance with EPA's Partnership agreement, International SEMATECH and SIA published a milestone technical document titled, *Reduction of Perfluorocompound (PFC) Emissions: 2005 State-of-the-Technology Report*, in December 2005.

### Industry Sector and Participants:

One of EPA's earliest voluntary climate protection partnerships, the PFC Reduction/Climate Partnership for the Semiconductor Industry was launched in 1996. The partnership represents approximately 80 percent of the U.S. semiconductor industry. EPA's initiative with U.S. manufacturers catalyzed global semiconductor industry cooperation and a commitment, embodied by the World Semiconductor Council (WSC), to reduce PFC emissions worldwide.

China is world's fastest-growing semiconductor production center and therefore a potential new source of PFC emissions. In 2006, China's semiconductor industry agreed to join the WSC and support the industry's cooperative climate protection efforts.

The U.S. semiconductor industry has been undergoing changes. There are a number of participant companies no longer manufacturing or no longer manufacturing in the U.S. The principle reason for this is the high cost of manufacturing leading-edge products and keeping up with the technology changes from process generation to generation. Only the largest, most successful, companies can keep pace with the rising cost of manufacturing. Since much of the production now comes from foreign "foundries" using U.S. product designs, the global agreements which include these foundry-based companies become increasingly significant to the industry's climate-protection initiative.

### Primary Climate VISION Goal:

The U.S. semiconductor industry, represented by the members of EPA's PFC Reduction/Climate Partnership, has committed to reduce absolute PFC emissions by 10 percent below the 1995 baseline level by the year 2010.

<sup>34</sup> The information and data presented in this section were provided to DOE by the Partner and are available on the Climate VISION website. See: [http://www.climatevision.gov/pdfs/CV\\_Partner\\_Submissions\\_2007.pdf](http://www.climatevision.gov/pdfs/CV_Partner_Submissions_2007.pdf).

## Related Industry Programs:

Guided by the principles of pollution prevention, EPA's partners are striving to aggressively reduce emissions of PFCs. Six of EPA's semiconductor partners have expanded their climate protection efforts to address their firm's entire "basket" of GHG emissions by joining EPA's Climate Leaders program. The six semiconductor partners that have also joined Climate Leaders are AMD, Eastman Kodak, Fairchild Semiconductor, IBM, Intel, and ST Microelectronics.

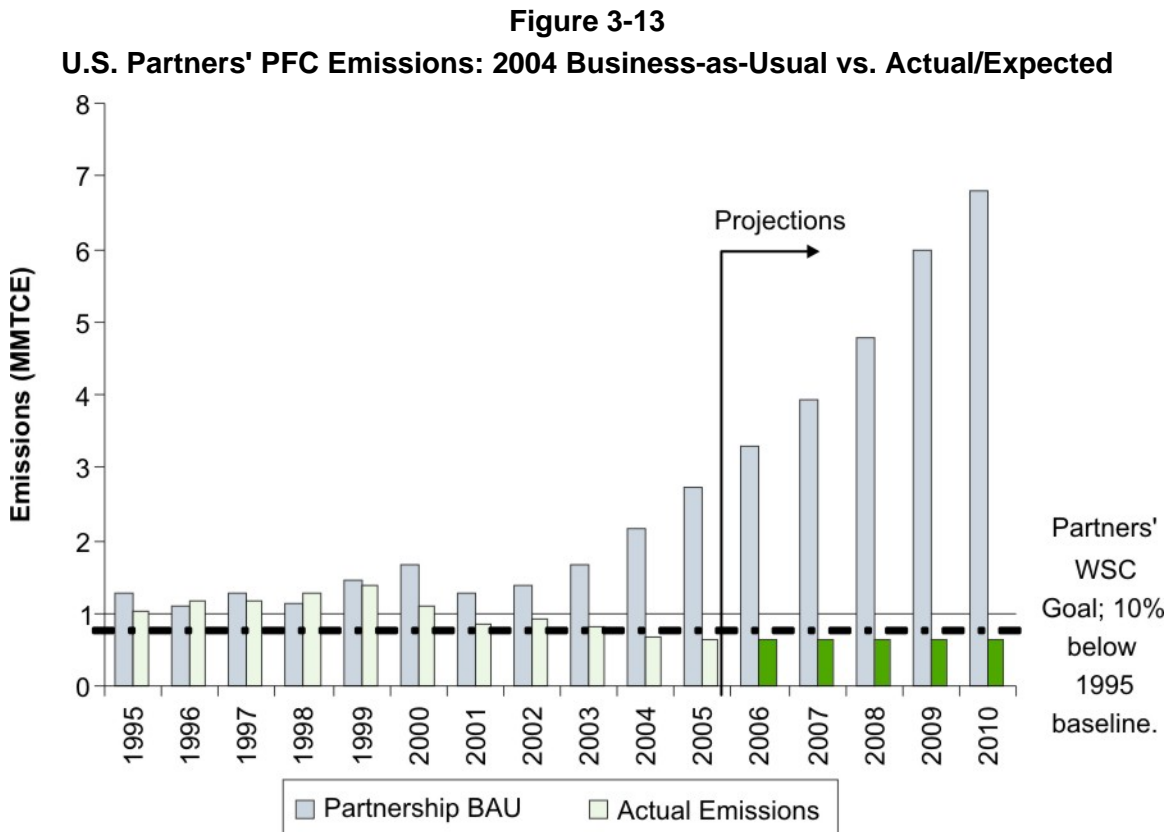
## Metrics Identified:

EPA's partners report their absolute PFC emissions data by specific process gas type annually, via a designated third party to protect confidential business information. EPA conducts an onsite review of the partners' reports and uses the data to generate their Inventory of U.S. Greenhouse Gas Emissions and Sinks. EPA's partners currently report emissions using 2001 IPCC Tier 2 methodologies.

The semiconductor industry uses and emits a variety of PFC materials during manufacturing. The emissions reporting metric used by the industry is mass of PFC gas. The exact mass of PFC gas is often converted to an equivalent mass of carbon by multiplying the amount by the 100-year global-warming potential value and 12/44, the atomic mass ratio of carbon to CO<sub>2</sub>. This conversion allows a company and the industry to express their PFC emissions in terms comparable with other GHG emission sources.

## Measured Results to Date:

In 2005, the U.S. semiconductor industry reduced direct emissions of high global-warming-potential fluorinated compound gases such as PFCs, HFCs, and SF<sub>6</sub>, and nitrogen trifluoride by 7.7 MMTCO<sub>2</sub>-eq. The industry is on track to achieve and exceed its 2010 goal of reducing emissions 10 percent below their 1995 baseline (Figure 3-13).



## Industry Actions Taken:

EPA and its industry partners have developed a draft revised FC emissions reporting format intended to improve and communicate the level of confidence and certainty associated with the partnership's data. The revised format is consistent with IPCC's 2006 guidance and may be adopted by the global industry pending approval by the WSC.

SIA together with its WSC counterparts organize the International Semiconductor Environmental Safety and Health conference each summer. EPA supports and attends this meeting, as it has become the semiconductor industry's premier venue for exchanging technical information on FC emissions reduction, in addition to addressing a broader range of the industry's environmental challenges.

## Program Reports and Other Links:

To learn more about semiconductor industry efforts to address GHGs, please visit these websites:

- [EPA's PFC Reduction/Climate Partnership for the Semiconductor Industry](#)
- [SIA's Environment, Safety & Health](#)
- [The World Semiconductor Council](#)
- [2006 IPCC Guidelines on National Greenhouse Gas Inventories](#) (see Chapter 6 for electronics industry emissions)
- [Climate VISION Private Sector Initiatives: Semiconductors](#)

## 4. MEASURING PROGRESS IN THE INDUSTRY & POWER GROUP

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This section provides an analysis of emission trends in the industrial and power sectors as a whole. In this section, calculations use data and projections from the analysis used to develop the President's 18 percent intensity reduction goal and data from the Federal Reserve and EIA. The calculations presented in this section cover many aggregate sectors of the economy, and cannot be linked directly to the estimated reductions reported by the individual Climate VISION partners and presented section 3. Hence, while the progress shown in section 3 is believed to contribute to the trends presented below, there is no reported direct connection between them. The information and data provided in this section are available at the [Climate VISION website](#).<sup>35</sup>

### Highlights:

- The U.S. overall has shown strong improvements in GHG intensity since the President's 18 percent goal was announced in 2002. GHG emissions have been growing more slowly than indicated in baseline forecasts. The resulting GHG intensity through 2006 was substantially better than the baseline forecasts and suggests that the U.S. is on a path to achieve the goal of an 18 percent improvement by the year 2012.
- For the overall U.S. economy, the cumulative improvement in GHG intensity from 2002 to 2006 was 9.5 percent, substantially better than the 3.8 percent improvement in the baseline forecast. This faster rate of improvement in GHG intensity results in 2006 GHG emissions that are 449.8 MMTCO<sub>2</sub>-eq lower than the GDP-adjusted levels in the baseline.
- For the combined industrial and power sectors (the "Industry & Power Group"), GHG intensity improved 9.4 percent from 2002 to 2006, substantially better than the 5.4 percent improvement in the Industry & Power Group baseline forecast. The substantial intensity improvement seen in 2005 (about 2.8 percent) and 2006 (about 5.2 percent) more than made up for weaker-than-forecast improvements in 2003 and 2004.
- For the combined Industry and Power Group, emissions of greenhouse gases fell 1.4 percent in 2006.
- The activities, investments, and R&D described in the previous sections are ongoing, and they will continue to improve GHG intensity for years to come.

### Measuring and Tracking Performance

The President's 18 percent emissions intensity goal can be measured as the carbon-equivalent GHG emissions in MMTCO<sub>2</sub>-eq for each \$1 million of Gross Domestic Product (GDP).

The 2002 analysis constructed an economy-wide business-as-usual baseline of forecasted U.S. GHG intensity from 2002 to 2012. That baseline forecasts an improvement in GHG intensity of about [14 percent](#)<sup>36</sup> by 2012. The President's goal of an 18 percent improvement would thus require additional improvements of nearly four percentage points economy-wide.

Using the original analysis to develop the 18 percent intensity goal, a business-as-usual forecast was developed for the industrial and

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<sup>35</sup> See: [http://www.climatevision.gov/pdfs/CV\\_TrackingReport\\_2002-2006.pdf](http://www.climatevision.gov/pdfs/CV_TrackingReport_2002-2006.pdf).

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<sup>36</sup> See: <http://www.whitehouse.gov/news/releases/2002/02/addendum.pdf>

power sectors. It is possible to use this baseline to help gauge the overall progress of the Industry and Power Group, which encompasses all of the sectors represented in Climate VISION. For this purpose, the Federal Reserve Board's Industrial Production (IP) Index was used both to define the parameters of the industrial sector and to develop a measure of industrial and power sector economic output.<sup>37</sup>

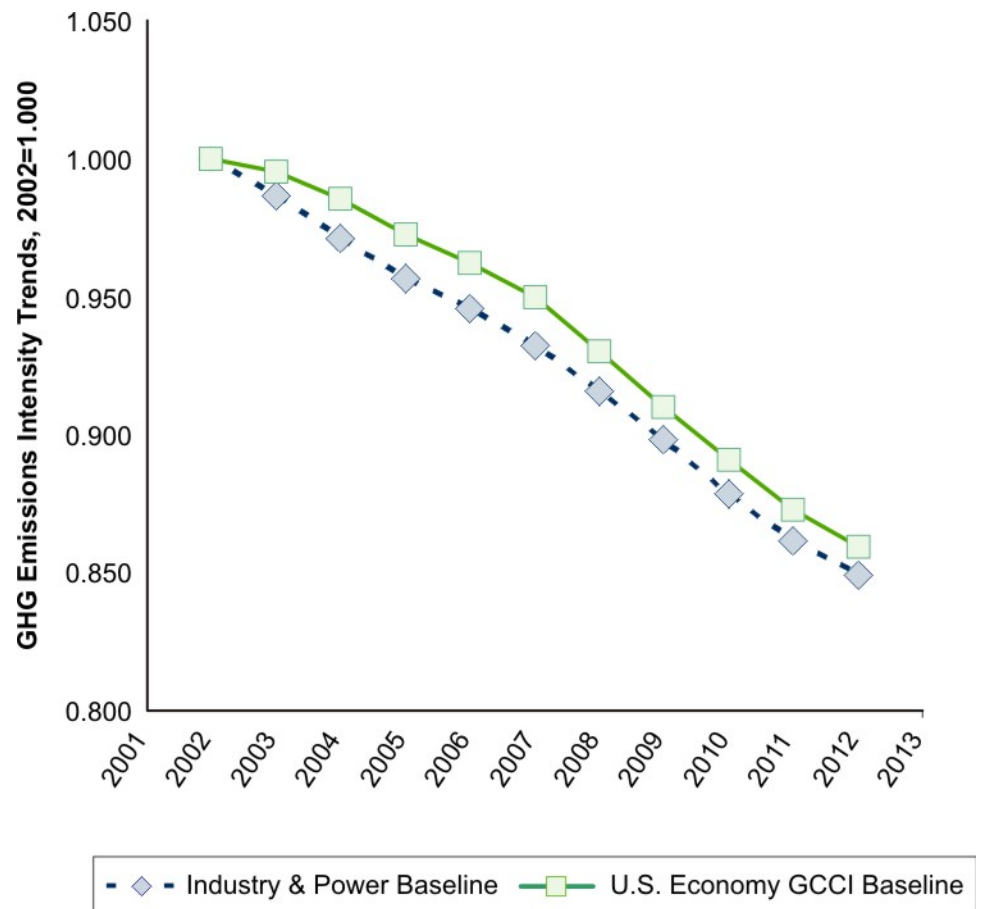
Estimates of GHG emissions were developed using EIA data for 2002 through 2006.<sup>38</sup> The data used to prepare Figures 4-1, 4-2, and 4-3 in this section of the report can be found in the Appendix. The business-as-usual baseline developed for the Industry & Power Group forecasts an improvement in GHG intensity of 15.1 percent by 2012—about a percentage point greater than that projected for the economy as a whole (Figure 4-1). In 2002, the

<sup>37</sup>For the set of industries represented within Climate VISION, the “U.S. industrial sector” definition used for the Federal Reserve Board’s Industrial Production Index can serve as a proxy for the collective program participants. The Federal Reserve’s monthly index of industrial production and the related capacity indexes and capacity utilization rates cover manufacturing, mining, and electric and gas utilities. Further, it does not include agriculture, construction, and some other activities that fall within the Energy Information Administration’s definition of “industrial sector” but are not represented in Climate VISION.

<sup>38</sup> All GHG emissions data used here are from EIA, *Emissions of Greenhouse Gases in the United States 2006*, November 2007. See: <http://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057306.pdf>.

<sup>39</sup> See Table A-1 for underlying data tables.

**Figure 4-1**  
**U.S. Economy-wide vs. "Industry & Power Group"**  
**GHG Intensity Baselines (2002-2012)<sup>39</sup>**



total GHG emissions from this Group amounted to about 57 percent of all U.S. GHG emissions.

For the Industry & Power Group, GHG emissions increased between 2002 and 2005, but fell 1.4 percent in 2006 such that in 2006 overall emissions were only 28.7 MMTCO<sub>2</sub>eq more than in 2002. Since 2002, the 0.2 percent average annual increase in Industry & Power Group GHG emissions is less than the 0.5 percent annual growth rate in overall U.S. GHG emissions. The post-2002 rates of GHG emissions growth in both the Industry & Power Group and in total U.S. GHG emissions are less than the 1990 to 2002 trends, which showed 0.7 and 1.0 percent average annual growth in Industry & Power Group and in total U.S. GHG emissions, respectively (Table A-2).

Over the same 2000 through 2006 period, GHG emissions intensity for the Industry & Power Group improved at an average annual rate of 2.4 percent, whereas for the U.S. economy it improved at an average annual rate of 2.5 percent per year. Total U.S. GHG emission also fell in real terms 2006, declining 1.5 percent.

Both for the U.S. economy and for the Industry & Power Group, the year-by-year values derived from the baseline forecasts serve as a benchmark against which to track actual year-by-year progress in GHG intensity. When actual data reported over time indicate a GHG intensity trending lower than the baseline, then the overall economy is making progress toward the 18 percent goal, and this incremental intensity improvement can be converted into MMTCO<sub>2</sub>-eq savings.<sup>40</sup>

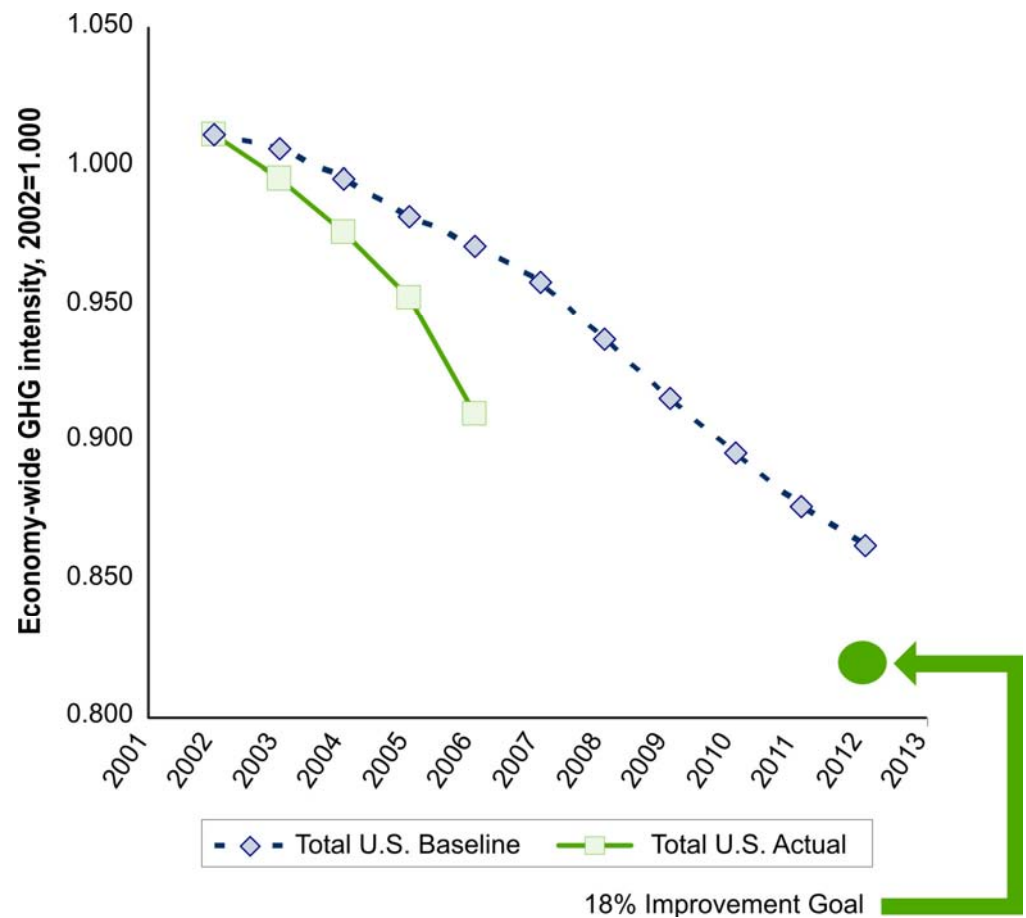
Improvements in GHG emissions intensity result from use of better technologies and processes and

<sup>40</sup> In reviewing results to date, it should be emphasized that the GHG intensity goals refer to an 18 percent economy-wide improvement in GHG intensity through the year 2012. This analysis does not imply that the 10-year 18 percent intensity improvement goal has year-to-year numerical targets, nor does it imply that specific sectors of the economy are expected to achieve a specific portion of the total burden. Further, fluctuations in economic growth, weather conditions, fuel prices, international circumstances, and other factors can be expected to lead to yearly changes in emissions that may not be representative of longer-term trends. Accordingly, the 2002 to 2005 results presented here should be interpreted only as indicators of progress to date.

<sup>41</sup> See Table A-2 for the underlying data tables.

Figure 4-2

U.S. GHG Emissions Intensity Actual vs. Baseline (2002-2012)<sup>41</sup>



through myriad investment and operating decisions that do not happen in isolation. Turbulent fuel prices, competitive international markets, variability in rainfall, and other conditions all affect energy production and use, GHG emissions, economic output, and the resulting GHG intensity. For the Industry & Power Group, conditions since 2002 have posed many challenges as well as opportunities. Indeed, the Climate VISION program was launched amid a very challenging environment for energy-intensive industries to improve their GHG emissions intensity. The economic recession in 2001, the terrorist attacks of September 11, and slow growth among our major trading partners dampened economic activity and business investment, the latter of which slowed sharply in



late 2000 and remained soft for more than two years.<sup>42</sup>

For the U.S. economy overall, there was a 9.5 percent cumulative improvement in GHG intensity from 2002 to 2006, substantially better than the 3.8 percent intensity improvement forecast in the baseline (Figure 4-2). This faster rate of improvement in GHG intensity results in 2006 GHG emissions that are about 450 MMTCO<sub>2</sub>-eq lower than the GDP-adjusted levels in the baseline forecast.

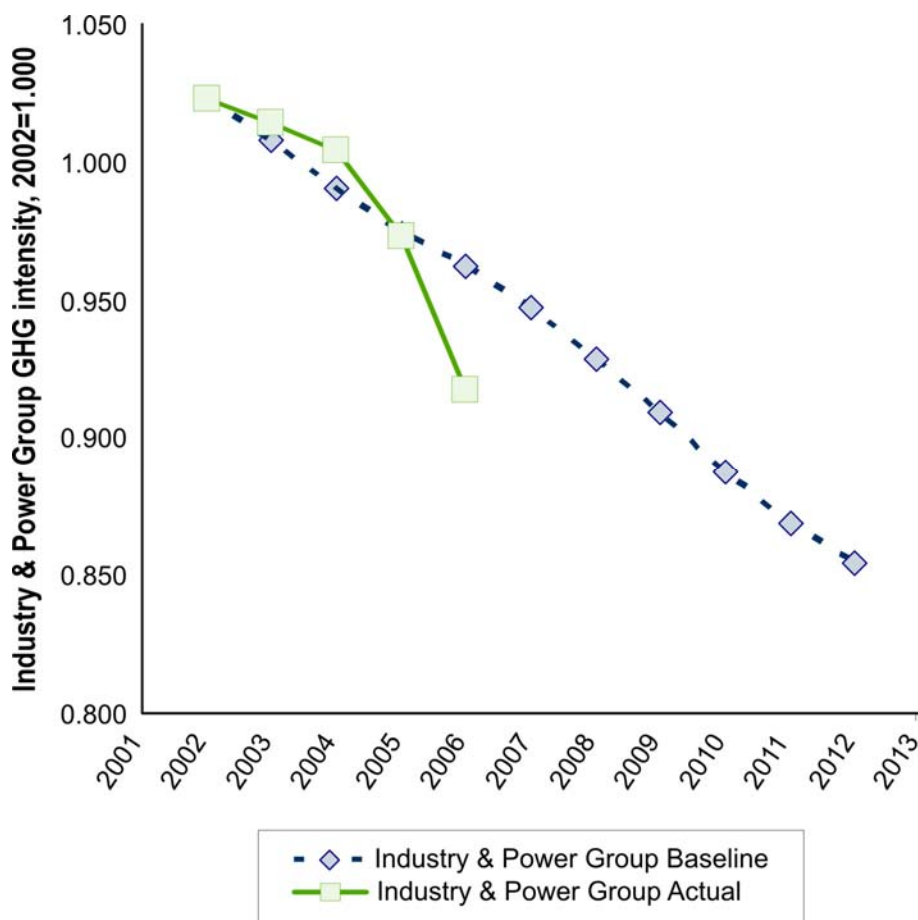
For the Industry & Power Group, GHG intensity improved 9.4 percent from 2002 through 2006, substantially better than the 5.4 percent baseline forecast (Figure 4-3). The intensity improvements of about 2.8 percent in 2005 and 5.2 percent in 2006 more than made up for weaker-than-forecasted improvements in 2003 and 2004.

The relatively slower rate of improvement in GHG intensity for the Industry & Power Group is the net effect of many factors, not least of which is that oil and gas prices since 2002 have been far higher than those originally anticipated in the baseline forecast. These high prices have affected different industries in different ways. For many, the higher fuel prices accelerated the adoption of energy-efficiency projects. The high fuel prices also affected the industry mix in overall economic

<sup>42</sup> U.S. Climate Action Report - 2006, Fourth National Communication of the United States of America Under the United Nations Framework Convention on Climate Change, Chapter 2 National Circumstances, July 2007. See: <http://www.state.gov/g/oes/rls/rpts/car/index.htm>.

<sup>43</sup> See Appendix Table A-2 for the underlying data tables.

**Figure 4-3**  
**Industry & Power GHG Intensity Actual vs. Baseline (2002-2012)<sup>43</sup>**



output, with the less energy-intensive industries having fewer adverse cost impacts. Economic activity for the Industry & Power Group, as measured by the IP Index, showed only modest improvements in 2003 and 2004, both in absolute historic terms and relative to the growth anticipated in the baseline forecasts. The smaller denominator in the GHG intensity calculation results in a higher GHG intensity, other things being equal.

In the electric power sector, the higher prices for natural gas and petroleum had the effect of shifting more of the generation to other capacity resources, particularly coal-fired unit capacity, which is a more GHG-intensive source. Additionally, the growth in hydroelectric generation that was forecasted in the baseline was not realized, leaving more of the load demand to be met by fossil-fired capacity.

## Prospects for the Future

The U.S. has shown strong improvements in GHG intensity overall since 2002. GHG emissions have grown much more slowly than indicated in baseline forecasts. Resulting GHG intensity through 2006 was much better than the baseline forecasts and suggests that the U.S. is on a path to achieve the goal of an 18 percent improvement by the year 2012.<sup>44</sup>

Although the trend has been more uneven for the Industry & Power Group, improvements—especially in 2005 and 2006—are also apparent. The volatility in fuel prices and the generally high prices of oil and natural gas have created many challenges for industry, particularly electric power generators and energy-intensive industries competing in the global marketplace. For electricity generators, the high natural gas and petroleum prices have shifted more generation to coal-fired capacity. Some industries have responded to higher fuel prices by adopting energy-efficient technologies and other conservation measures. The group has also seen changes in the industry mix, where some of the energy-intensive industries have experienced slower growth relative to the less energy-intensive industries.

Nevertheless, the activities, investments, and technologies described in the previous sections are expected to continue contributing to reducing GHG intensity for years to come.

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<sup>44</sup> The [United States Climate Action Report – 2006](#) projects that, with full implementation of the policies and measures, the United States economy is projected to achieve an 18.6 percent reduction in GHG intensity in 2012. *U.S. Climate Action Report - 2006*, Fourth National Communication of the United States of America Under the United Nations Framework Convention on Climate Change, Chapter 5 Projected Greenhouse Gas Emissions, July 2007. See: <http://www.state.gov/g/oes/rls/rpts/car/index.htm>

## APPENDIX: DATA TABLES

The data used to prepare Figures 4-1, 4-2, 4-3 are presented below. More detailed documentation is available at the [Climate VISION website](#).

### Baseline Forecasts for GHG Emissions, Economic Output, and Emissions Intensity, 2002-2012

Table A-1 summarizes the baseline GHG emissions, economic output, and emissions intensity (per \$ GDP or per unit IP index) embedded in the baseline analysis, for both the overall U.S. economy and for the Industry & Power Group. (The baseline GHG intensities are also depicted in the graph in Figure 3-1.) These baseline forecasts are all expressed as an index with the 2002 values equal to 1.000.

From Table A-1, the following trends are observed:

- **ECONOMIC OUTPUT:** Over 2002 to 2012, the baseline U.S. GDP is forecasted to grow 38.3 percent in real terms. The baseline

industrial output index shows slightly higher growth, increasing 39.1 percent over the same period.

- **GHG EMISSIONS:** For 2012, the economy-wide GHG baseline index is 1.188, which means that base case emissions are forecast to increase by about 18.8 percent over the 2002 to 2012 period. For the Industry & Power Group, the baseline index is slightly lower, showing an 18.1 percent increase.
- **GHG INTENSITY:** Economy-wide, the baseline GHG intensity in 2012 is only 85.9 percent of that in 2002, representing an improvement of about 14.1 percent. The corresponding baseline index for the Industry & Power Group shows a slightly greater improvement, declining 15.1 percent over the 2002 to 2012 time frame. This reflects the combined effects of slightly lower forecasted growth in industrial GHG emissions, together with slightly higher forecasted growth in

**Table A-1**  
**Baseline Forecasts for GHG Emissions, Economic Output, and Emissions intensity (2002-2012) (2002=1.000)**

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>ECONOMY-WIDE INDEXES</b>											
U.S. GHG Index	1.000	1.027	1.045	1.064	1.083	1.102	1.118	1.134	1.152	1.171	1.188
GDP Index	1.000	1.032	1.061	1.094	1.126	1.160	1.201	1.246	1.293	1.342	1.383
Intensity U.S. GHG per \$ GDP	1.000	0.995	0.985	0.973	0.962	0.950	0.930	0.910	0.891	0.873	0.859
<b>GHG Intensity Improvement from 2002</b>	<b>0.0%</b>	<b>0.5%</b>	<b>1.5%</b>	<b>2.7%</b>	<b>3.8%</b>	<b>5.0%</b>	<b>7.0%</b>	<b>9.0%</b>	<b>10.9%</b>	<b>12.7%</b>	<b>14.1%</b>
<b>INDUSTRY &amp; POWER GROUP INDEXES</b>											
Ind. & Power GHG Index	1.000	1.029	1.047	1.067	1.087	1.107	1.120	1.133	1.149	1.166	1.181
Ind. & Power Output index	1.000	1.043	1.078	1.115	1.150	1.188	1.223	1.261	1.307	1.353	1.391
Ind. & Power Intensity GHG/\$ Output	1.000	0.987	0.971	0.956	0.946	0.932	0.916	0.898	0.879	0.862	0.849
<b>GHG Intensity Improvement from 2002</b>	<b>0.0%</b>	<b>1.3%</b>	<b>2.9%</b>	<b>4.4%</b>	<b>5.4%</b>	<b>6.8%</b>	<b>8.4%</b>	<b>10.2%</b>	<b>12.1%</b>	<b>13.8%</b>	<b>15.1%</b>

Source: Twenty-First Strategies' memo titled *Industry & Power Group GHG Tracking for Voluntary GHG Programs, 2002-2006*, Attachment A. See: [http://www.climatevision.gov/pdfs/CV\\_TrackingReport\\_2002-2006.pdf](http://www.climatevision.gov/pdfs/CV_TrackingReport_2002-2006.pdf).

industrial output. The difference between the two baseline indices is most prominent in the early years of the series. For example, by 2006 the baseline intensity for the Industry & Power Group shows a 5.4 percent improvement relative to 2002 levels. In contrast, the baseline intensity for the overall U.S. economy shows only a 3.8 percent improvement over 2002 levels.

### **Summary of Actual GHG Emissions Relative to Baseline Forecasts, 2002-2006**

Table A-2 further develops the GHG calculations, comparing the actual year-by-year progress in GHG intensity to the benchmarks derived from the baseline forecasts.

For the 2002-2006 period, GHG emissions intensity for the U.S. economy improved 9.5 percent. This improvement is substantially better than the 3.8 percent improvement seen in the baseline forecast. This faster rate of improvement in GHG intensity results in 2005 GHG emissions that are 450 MMTCO<sub>2</sub>.eq lower than the GDP-adjusted levels in the baseline forecast.

For the Industry & Power Group, GHG emissions intensity improved 9.4 percent from 2002 to 2006. This improvement is substantially better than the 5.4 percent improvement seen in the Industry & Power Group portion of the baseline forecast. The substantial intensity improvement of about 2.8 percent in 2005, followed by another 5.2 percent in 2006, more than made up for weaker-than-forecasted improvements in 2003 and 2004.

**Table A-2**  
**Summary of Actual GHG Emissions Relative to Baseline Forecasts, 2002-2006**

<b>TOTAL U.S. ECONOMY</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006p</b>
<b>GHG Emissions</b>					
Index of Baseline Forecast Total U.S. GHGs (2002=1.000)	1.000	1.027	1.045	1.064	1.083
Actual Total U.S. GHG Emissions as Reported by EIA (MMTCO <sub>2</sub> -eq)	6,944.9	7,012.4	7,133.5	7,181.4	7,075.6
Index of Actual Total U.S. GHG Emissions (2002=1.000)	1.000	1.010	1.027	1.034	1.019
<b>Economic Activity</b>					
Index of Baseline U.S. Economic Forecast (2002 = 1.000)	1.000	1.032	1.061	1.094	1.126
Index of Actual Total U.S. Economic Activity (2002 = 1.000)	1.000	1.025	1.062	1.095	1.126
<b>GHG Intensity</b>					
Index of Baseline Total U.S. GHG Intensity Forecast (2002 = 1.000)	1.000	0.995	0.985	0.973	0.962
<i>GHG Intensity Improvement from 2002</i>	<i>0.00%</i>	<i>0.48%</i>	<i>1.47%</i>	<i>2.74%</i>	<i>3.80%</i>
Index of Actual Total U.S. GHG Intensity (2002 = 1.000)	1.000	0.985	0.967	0.944	0.904
<i>GHG Intensity Improvement from 2002</i>	<i>0.00%</i>	<i>1.50%</i>	<i>3.32%</i>	<i>5.57%</i>	<i>9.55%</i>
<b>GHG Reductions Due to Intensity Improvements</b>					
Relative to Total U.S. Baseline (MMTCO <sub>2</sub> -eq)	-	72.9	136.4	215.2	449.8
Relative to Total U.S. 2002 Level (MMTCO <sub>2</sub> -eq)	-	106.8	244.7	423.2	747.4
<b>INDUSTRY &amp; POWER GROUP</b>					
<b>GHG Emissions</b>					
Index of Baseline Forecast Ind.& Power GHGs (2002 = 1.000)	1.000	1.029	1.047	1.067	1.087
Actual Ind.& Power GHG Emissions as Reported by EIA (MMTCO <sub>2</sub> -eq)	3,936.0	3,948.0	4,009.2	4,021.6	3,964.7
Index of Actual Ind.& Power GHG Emissions (2002 = 1.000)	1.000	1.003	1.019	1.022	1.007
<b>Economic Activity</b>					
Index of Baseline Ind.& Power Economic Forecast (2002=1.000)	1.000	1.043	1.078	1.115	1.150
Index of Actual Ind.& Power Economic Activity (2002 = 1.000)	1.000	1.011	1.036	1.069	1.112
<b>GHG Intensity</b>					
Index of Baseline Ind.& Power GHG Intensity Forecast (2002=1.000)	1.000	0.987	0.971	0.956	0.946
<i>GHG Intensity Improvement from 2002</i>	<i>0.00%</i>	<i>1.34%</i>	<i>2.89%</i>	<i>4.37%</i>	<i>5.44%</i>
Index of Actual Ind.& Power GHG Intensity (2002 = 1.000)	1.000	0.993	0.983	0.955	0.906
<i>GHG Intensity Improvement from 2002</i>	<i>0.00%</i>	<i>0.75%</i>	<i>1.65%</i>	<i>4.45%</i>	<i>9.45%</i>
<b>GHG Reductions Due to Intensity Improvements</b>					
Relative to Ind.& Power Baseline (MMTCO <sub>2</sub> -eq)	-	(23.4)	(50.5)	3.4	175.4
Relative to Ind.& Power 2002 Level (MMTCO <sub>2</sub> -eq)	-	29.8	67.4	187.3	413.7

Source: Source: Twenty-First Strategies' memo titled *Industry & Power Group GHG Tracking for Voluntary GHG Programs, 2002-2006*. See: [http://www.climatevision.gov/pdfs/CV\\_TrackingReport\\_2002-2006.pdf](http://www.climatevision.gov/pdfs/CV_TrackingReport_2002-2006.pdf).

