

**WORK PLAN FOR
U.S. CEMENT INDUSTRY'S CLIMATE CHANGE PROGRAM
PORTLAND CEMENT ASSOCIATION**

The U.S. cement industry began a concerted effort to address the issue of climate change in the mid-90s. A key step was the decision to work with EPA through the Climate Wise Program to develop a CO₂ emissions protocol and a means by which to record emissions reductions through the DOE 1605 (b) program. The U.S. industry was then able to accurately quantify cement industry CO₂ emissions and to begin a process of examining ways to reduce them. The product of this assessment culminated in the adoption of a voluntary CO₂ emission reduction goal in July 2001. Similar efforts have since been initiated around the world, resulting in the development of a global cement industry greenhouse gas emissions protocol, prepared under the auspices of the World Business Council on Sustainable Development.

Cement Industry Voluntary Goal: A 10 percent reduction in CO₂ 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 greenhouse gas emissions.

1. Process: 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: continue 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: utilize alternatives to conventional fuels and raw materials to reduce greenhouse gas and other pollutant emissions all the while attending to the goal of reducing the amount of energy required to produce a ton of cement.
 - Demand-side energy management: reduce 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.

Actions:

- Prepare Cement Industry Emissions Protocol: Develop a comprehensive and consistent means of measuring greenhouse gas emissions that result from the production of cement. The GHG Protocol—developed under the auspices of the World Resources Institute and the World Business Council for Sustainable

Development—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 planning to conduct a workshop to instruct our members in utilizing this tool. PCA is also currently assessing whether this protocol can be further enhanced with some minor adjustments or should be utilized for Climate VISION purposes as it stands.

- Prepare 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.
- Prepare Emission Trend Diagrams: Develop projections for industry emissions through the PCA goal endpoint of 2020, with an interim projection for the Climate VISION endpoint of 2012.
- Identify Near-Term Cost Effective Options: This could include achievable means of reducing or benchmarking emissions or factors contributing to emissions, such as:
 - Plant modernizations
 - Use of alternative fuels and raw materials
 - Strengthening energy management through the ENERGY STAR focus on energy efficiency in U.S. cement manufacturing including supporting meetings, aiding the development of the cement plant energy performance indicator, and applying energy management guidance and other ENERGY STAR opportunities
 - Introducing and implementing DOE energy efficiency tools, training, software and assessment opportunities to cement companies
 - Creating links to websites for ENERGY STAR and DOE's Energy Savers on the PCA website
 - Participating in the Resource Conservation Challenge.
- Research Long-term Cement Technology Alternatives: Contribute to research that could identify or develop emission-reductions technologies or options that are not currently envisioned.

2. Product Formulation: develop cement-production techniques that require a lower proportion of calcined materials, thereby reducing CO₂ emissions per unit of product. PCA anticipates that approximately half of the projected reductions will come from these activities.

Actions:

- Finalize Changes to Portland Cement Standard through ASTM: The U.S. cement industry supports changes to the standard recipe for portland cement developed by the American Society for Testing and Materials (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 CO₂ emissions per unit of cement.

- Harmonize ASTM and AASHTO Cement Standards: Some states use a portland cement standard developed by the American Association of State Highway Transportation Organizations, 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 CO₂-reduction goal.

3. Product Application: promote the use of concrete as a climate change solution based upon the following considerations. This is the area that provides the greatest promise for reductions, yet it is largely beyond the industry's control and therefore will not contribute toward implementation of the 2020 CO₂-reduction goal.

- 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.
- Lifecycle Analysis: because of the three applications above, and other benefits, cement-based concrete compares favorably to competing products; these results should be taken into account in product-selection guidance.

Actions:

- Promote the life-cycle benefits of concrete use to architects, builders, state and federal procurement officials.
- Encourage tax benefits and other incentives for applications of concrete products for paving and building that demonstrate positive life-cycle attributes.
- Participate in ongoing programs such as the U.S. Green Building Council, DOE's Industrial Technologies Program, and ENERGY STAR.

Develop Cross-Sector Projects for Reducing Greenhouse Gas Emission Intensity:

The obvious cross-sector partner for the cement industry is the ready-mix concrete industry. Together, these industries can achieve the product application reductions

described above. Other opportunities for cross-sector participation are the steel industry, utilities, and other manufacturing fields that can provide waste products that can be utilized as fuels and raw materials at cement kilns. The use of alternative fuels and raw materials can result in emission reductions in the process and product formulation elements of the workplan by reducing the use of traditional fuels or the clinker content of cement.

On the product application side, the cement industry could team with architects, builders, city planners, paving contractors, procurement officers and others responsible for selecting building and paving materials to demonstrate the environmental benefits of cement and concrete and promote its enhanced market penetration.

Accelerate Investment in R&D and Commercialization of Advanced Technology:

Once again, the opportunities in the technology-development arena can be divided into process, product formulation and product application. Process technologies could include means of enhancing the efficiency of cement operations or of reducing or capturing the CO₂ produced in cement kilns. Further product formulation reductions could result from experimentation with other materials—including by-products and virgin materials—that could be utilized in cement manufacturing in a way that reduces overall GHG emissions. Product application technologies to expand the use of cement and concrete might include new tools or processes for mixing, pouring, and drying concrete.

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.

Climate VISION
Portland Cement Industry Activity Timeline

Program Area: Manufacturing Process

Activity	Timeline	Outcome
<i>Participate in EPA's Resource Conservation Challenge:</i> Work with government agencies to identify potential alternative fuels and any barriers that affect their use	Ongoing	Alternative fuel use is maximized
Create links to Energy Savers and ENERGY STAR web sites from the PCA web site	Summer 2004	Industry and others are presented with greater information
Utilize World Business Council for Sustainable Development (WBCSD) Greenhouse Gas (GHG) Protocol to track industry emissions	Ongoing	WBCSD Protocol will be used for all reporting and will standardize responses for the industry
Update industry emissions profile	Ongoing	Baseline will be established for measurement of progress
Update emission trend diagrams	Ongoing	Projection of Climate VISION reduction outcome will be made
Identify near-term, cost-effective options such as plant modernizations, alternative fuels and raw materials, and methods for improving the energy efficiency of plants	Ongoing	Opportunities for companies will be made clear
<i>EPA ENERGY STAR Focus:</i> PCA co-hosts with EPA an annual ENERGY STAR Focus for the cement industry	May 2004	Energy efficiency opportunities are identified for the industry; companies are familiarized firsthand with next steps for action
<i>EPA ENERGY STAR Focus:</i> Support the development, use and maintenance of the ENERGY STAR cement plant energy performance indicator (EPI)	Initial - May 2004 and Ongoing	EPI is developed to enable companies to gauge efficiency of cement plants
<i>EPA ENERGY STAR Focus:</i> EPA works with DOE to organize a meeting with the industry to review the efficiency tools available from the DOE Best Practices Program including software, training, plant audit services, etc.	July 2004	DOE tools and resources are made available to companies to support the industry in making improvements
<i>EPA ENERGY STAR Focus:</i> Coordinate the use of and demonstration of energy performance achievements by PCA member companies through use of the EPI	Annual	Annual improvement in energy intensity is demonstrated across member companies
<i>EPA ENERGY STAR Focus:</i> Aid in the finalizing and distributing the ENERGY STAR Energy Guides for cement plant energy efficiency	Completed January 2004	Industry corporate energy managers and plant managers are familiarized with efficiency opportunities identified in the report
Research long-term cement technology alternatives	Ongoing	Emission reduction technologies could be identified

Program Area: Product Formulation

Activity	Timeline	Outcome
-----------------	-----------------	----------------

Finalize changes to the ASTM portland cement standard	Summer 2004	2% of the total Climate VISION goal is expected from this activity
Harmonize ASTM and AASHTO standards	Ongoing	Allow limestone additions in all states
Measure extent of clinker factor reduction in cementitious materials produced	Spring 2005	Information will be made available to PCA member companies

Climate VISION

Portland Cement Industry Activity Timeline - *continued*

Program Area: Product Application

Activity	Timeline	Outcome
Support research into environmental benefits of concrete structures and paving	Ongoing	Users better informed of benefits
Promote environmental lifecycle benefits to architects, builders, and local/state/federal procurement officials	Ongoing	Greater use of efficient materials will occur

Program Area: Cross-Sector Projects

Activity	Timeline	Outcome
<i>Coordinate with Aluminum Industry: Study pot liners</i>	Ongoing	Explore potential use of waste materials
<i>Coordinate with Carpet Industry: Study carpet use</i>	Ongoing	Explore potential use of waste materials
<i>Coordinate with Automobile Industry: Study used gas tanks</i>	Ongoing	Explore potential use of waste materials
Coordinate with other industries	Ongoing	Explore potential uses of waste materials
<i>Coordinate with the Concrete Industry: Support efficiency efforts where possible; example activity supported development of the Concrete Roadmap with DOE</i>	Ongoing	Concrete industry receives support in controlling its greenhouse gas emissions

Program Area: R&D and Advanced Technology

Activity	Timeline	Outcome
Explore R&D opportunities into further emission reduction areas	Ongoing	Further understanding of emission reduction opportunities