2010

Building a Sustainable Tomorrow

Canadian Cement Industry

Sustainability Report

Cement Association of Canada

Association Canadienne du Ciment

The Cement Association of Canada

The Cement Association of Canada (CAC) is the voice of Canada's cement industry. Its membership includes companies with clinker and cement manufacturing plants, grinding facilities and distribution terminals from the Atlantic to the Pacific coasts.

The Canadian Cement Industry

Canada's cement producers are important participants in the global marketplace and provide a reliable supply of the cement required to build Canada's critical network of transportation infrastructure, buildings and homes, waterworks and dams, and to remediate contaminated sites.

Canada's cement companies include CalPortland, Ciment Québec, Essroc Italcementi, Federal White, Holcim Canada, Lafarge Canada, Lehigh Hanson Canada and St Marys Cement. Until recently, our eight member companies operated one white and 15 grey cement manufacturing facilities in five provinces.

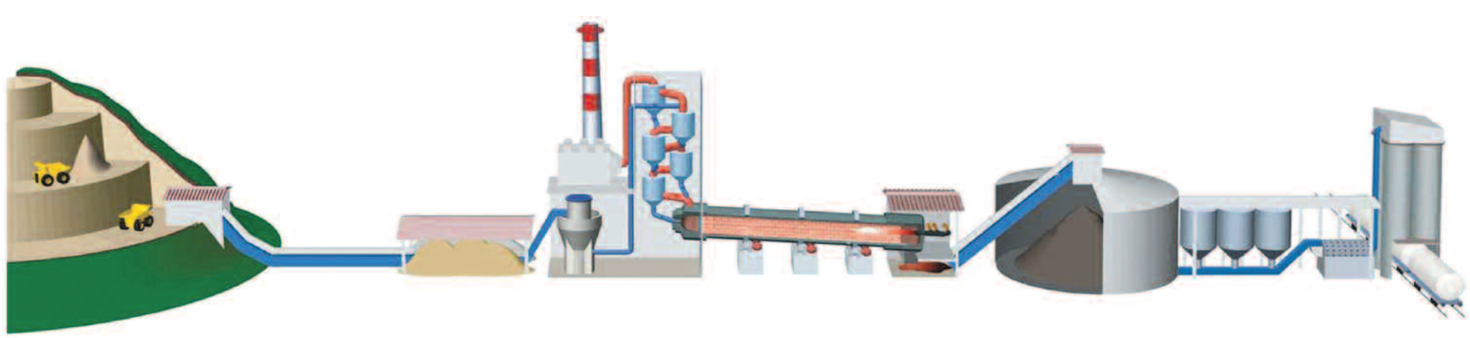
In December 2008, the Lafarge Canada Woodstock grey cement plant – the last wet technology cement kilns operating in Canada – suspended production and became a grinding and packaging operation.

During 2008, member companies produced 15 million tonnes of cement, worth in excess of $1.7 billion. The cement industry directly employed nearly 2,000 Canadians in the manufacture of cement, and 27,000 Canadians were employed in the production of ready-mix concrete and concrete construction products. When both cement and concrete product sales are added together, the industry contributed over $3.2 billion to Canada's gross domestic product. Typically, 65% of Canada's cement is produced for the Canadian market, and 35% is exported to the United States.

Did You Know?

- Cement is the essential ingredient in concrete. Cement is a powder that, when mixed with water, sand and aggregates, produces concrete. Cement typically represents 11 % of a concrete mix, and acts as the glue that holds concrete together.
- The cement making process can be divided into two basic steps:
  - **Clinker production:** Clinker is an intermediate product in cement manufacturing, and is the main substance in cement. Clinker is made in a rotary kiln at temperatures of 1,450 Celsius.
  - **Grinding:** The clinker is then ground with other minerals to produce the powder we know as cement.
- Cement is mostly used to make concrete and concrete is always manufactured to meet the specific requirements of each construction project.

How cement is made



Source: Holcim (Canada) Inc.

Quarrying

Limestone and small amounts of sand and clay are extracted, usually from a quarry located near the cement manufacturing plant.

Raw Materials Preparation

The extracted materials are analyzed, blended with additional mineral components depending on the type of limestone available, and finely ground for further processing.

Clinker Production

The materials are heated in a kiln reaching a temperature of 1,450°C. The heat transforms the materials into a molten product called clinker, which is then rapidly cooled.

Cement Grinding and Distribution

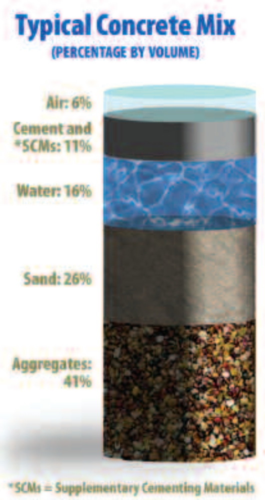
The clinker is stored and then finely ground. Gypsum is added to control setting time, along with supplementary cementing materials, such as fly ash or slag, to obtain a fine powder called cement, with the desired properties of strength and chemical resistance.

Concrete—Canada's Strategic Construction Material

Concrete is a sustainable construction material. It can endure for centuries with limited costs for maintenance and repair.

Concrete is versatile, durable and is the most used man-made construction material in the world. In 2007, 2.7 billion tonnes of cement were produced globally; enough to make 9 billion cubic metres of concrete. As a construction material, there is no global alternative for concrete that can be applied so broadly.

The trend towards urban densification, infrastructure renewal and the need for highly energy-efficient homes and buildings will lead to increased use of concrete. When compared to the life cycle assessment and cost benefits of other construction materials, concrete is very often the environmentally responsible construction material of choice.



Energy Efficiency in Concrete Buildings

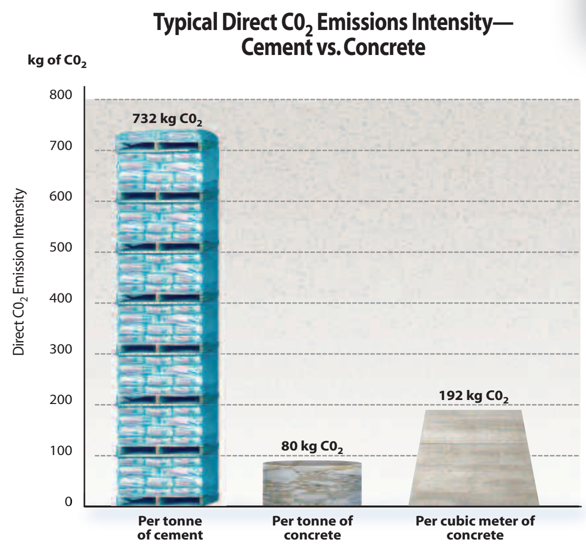
The use of concrete is one of the most efficient and cost-effective means of building energy-efficient homes and buildings. According to the *Building Thermal Mass and Energy Savings Report* published by Cobalt Engineering in 2006, the thermal mass (the capacity of a material to store energy) of a concrete building can reduce space heating and cooling energy requirements by as much as 29%, when combined with active radiant heating and cooling systems.

Sustainable Attributes of Concrete Applications

- Long-lasting and durable
- Energy and resource efficient
- Reusable and recyclable
- Cost-effective

A 2008 building energy use study by Stantec Consultants, *Thermal Mass Analysis at ICICS Building, UBC*, measured the energy use requirements of two similar occupancy buildings at the University of British Columbia. The concrete building with integrated in-floor heating systems demonstrated a 59% energy use saving over an older similar occupancy building that was not able to combine the thermal mass of the structure with integrated in-floor heating systems. Since operational energy requirements typically represent 85% of the total energy a building uses over its service life, concrete buildings with in-floor heating systems lead to significant energy savings.

*The **Police Headquarters in Kingston, Ontario** was awarded a Canada Gold rating in Leadership in Energy and Environmental Design (LEED®) . Concrete can contribute up to 21 points toward the minimum 26 points needed to qualify for a LEED® Canada - NC 1.0 certified level.*

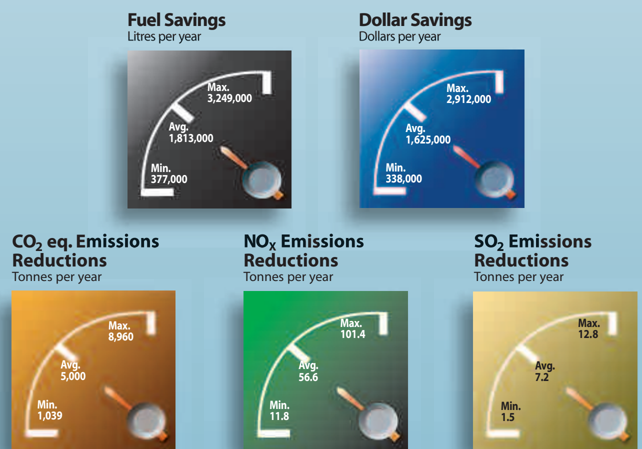


Concrete in Transportation Infrastructure

From airport runways to highways, streets and roads, subways to transit ways, concrete helps develop and maintain a sustainable, environmentally friendly transportation infrastructure for Canadians.

Fuel savings, CO_2 emissions reductions and improved air quality with concrete

Canada's National Research Council concluded that heavy trucks consume 4% less fuel on average when traveling on concrete roads, compared to traveling on asphalt roads. A Swedish study also concluded that cars consume 1% less fuel on average when traveling on concrete roads.



The range of potential fuel savings and reductions in emissions that will be achieved by trucks if a 100 km section of a major urban arterial highway in Canada were to be paved in concrete is presented here. It is assumed 1,095,000 heavy trucks travel on this section of roadway, based on 20,000 vehicles per day at 15% heavy truck traffic.

Benefits of Concrete Highways

- Concrete is more economical than asphalt for high traffic volume roads, and brings several environmental and safety benefits.
- Over a 50-year period, the embodied primary energy required to construct, maintain and rehabilitate a typical high volume concrete highway is one-third that required for an asphalt highway.
- Concrete highways minimize the potential for potholes and eliminate the need for spring thaw weight restrictions.
- Concrete highways require less maintenance and repair over their lifetime.
- Concrete pavements can be placed over existing asphalt pavements since the asphalt provides a strong and stable base for the more durable and sustainable concrete highway.

*The **Golden Ears Bridge** and associated road network in Metro Vancouver, British Columbia opened to traffic on June 16, 2009. The bridge provides a vital new link between communities on the north and south sides of the Fraser River. Approximately 160,000 cubic metres of concrete were used on the bridge itself.*

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About this Report

The Cement Association of Canada (CAC) is pleased to present the **Canadian Cement Industry 2010 Sustainability Report**, documenting the grey cement industry's progress in improving its social, environmental and economical performance. The report presents the most up-to-date information available (2008).

The production of white cement by Federal White is specifically excluded from the data. The production of white cement represents approximately 6% of total Canadian cement production capacity. The fuels, raw materials and processes involved in the manufacture of white cement differ from those employed for grey cement and the resultant product is used in different applications .

Front Cover Photos:

Top right:
Vancouver Sky Train, British Columbia and Chapter House Apartments, Nova Scotia, made with architectural precast concrete panels

Bottom centre:
Ciment Québec Saint-Basile Cement Plant, Quebec

This page:
LEED® certified Vistal condominium complex in Quebec.

Cement Association of Canada National Office

Email: info@cement.ca

www.cement.ca

President's Message

I am pleased to present the *Canadian Cement Industry 2010 Sustainability Report*. Our third biennial Report focuses on the progress the cement industry has made to become increasingly sustainable. It also presents the sustainable attributes of concrete, by far the most widely used construction material in Canada and throughout the world.

The past two years have proven challenging for the Canadian cement industry. The impacts of the global financial and economic crisis and the retraction of the Canadian and U.S. economies significantly reduced demand for Canadian cement. At the same time, our industry is being strongly challenged by global competitors, which in 2008 captured over 11% of the domestic market for cement – significantly more than their historical market share. As a result of these factors, 2008 cement production in Canada declined for the first time since the early 1990s. By the end of 2009, those trends continued and intensified, leading to a number of temporary layoffs and rolling shutdowns at our members' facilities.

Despite the economic uncertainty, the cement industry will continue to move ahead on the execution of its sustainability plans. Our members are implementing the industry's strategy by:

1. Improving the energy efficiency of cement manufacturing;
2. Increasing the use of alternative and renewable energy sources to replace fossil fuels;
3. Increasing the use of supplementary cementing materials in cement manufacturing;
4. Developing and implementing innovative cement and concrete products and processes to minimize our environmental footprint; and
5. Ensuring governments and stakeholders understand, and act on the life cycle benefits of concrete as a sustainable construction material.

Making progress on these strategic actions is not only necessary to reduce the industry's environmental footprint and to meet the expectations of stakeholders, but is also absolutely imperative to ensure the continued competitiveness of cement manufacturing operations in Canada.

We recognize, however, that the cement industry cannot make progress on these actions without the engagement and support of governments and other stakeholders. We remain committed to fostering open dialogue with all levels of government and all stakeholders to fully engage them in the implementation of these strategic actions and the successful achievement of the industry's ambitious sustainability plan.

In closing, I am very pleased to report that a new and more environmentally friendly type of cement called portland-limestone cement (PLC) will be introduced to the Canadian marketplace in 2010. One of its important attributes is that it will contribute up to a 10% reduction in CO_2 emissions for each tonne of PLC that replaces a regular tonne of portland cement.

We invite and welcome your feedback on this report and on our industry's performance.

Pierre Boucher
President and CEO

Building a Sustainable Tomorrow

The Canadian cement industry is committed to improving the social and environmental performance of its operations, and will continue to work on reducing the environmental footprint of cement.

The expectations of Canadians with respect to the cement industry's contribution to building a sustainable tomorrow remain very high. Canadians want us to take action on climate change, air quality and the conservation of natural resources and habitat.

The cement industry is responding to these challenges. Through discussions with governments and stakeholders, we are advocating and implementing our five-part strategy, which builds upon the Cement Sustainability Initiative of the World Business Council for Sustainable Development .

The Cement Sustainability Initiative (CSI) is a global initiative to report progress on actions and commitments by 18 major cement producers with operations in more than 100 countries, who believe there is a strong business case for the pursuit of sustainable development. All

World Business Council for Sustainable Development

CSI members have integrated sustainable development into their business strategies and operations, as they seek strong financial performance with an equally strong commitment to social and environmental responsibility.

Throughout its 10-year history, the CSI has focused on understanding, managing and minimizing the impacts of cement production and use by addressing issues such as climate change, fuel use and employee safety.

All six CAC member companies that produce grey cement in Canada participate in the Cement Sustainability Initiative.

*The International Energy Agency and World Business Council for Sustainable Development published the **Cement Technology Roadmap 2009**, that identifies the key technology and policy priorities that must be advanced to achieve deep reductions in cement CO_2 emissions by mid-century.*

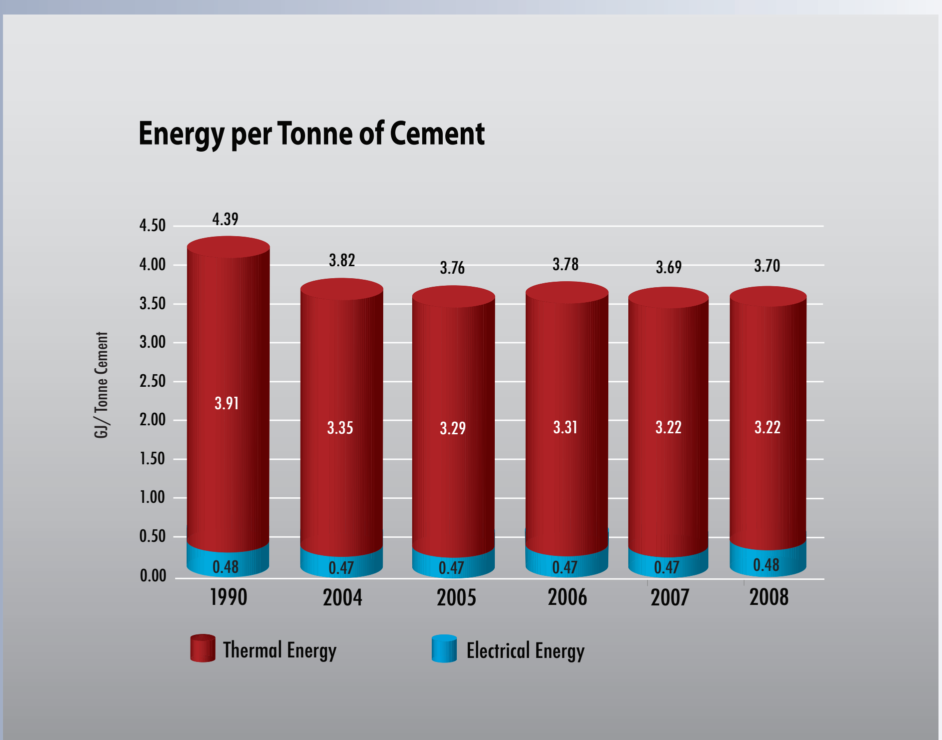
Improving the Energy Efficiency of Cement Manufacturing

Energy management is critical to the sustainability of Canada's cement industry. The Industry has made significant energy efficiency improvements and will continue to do so.

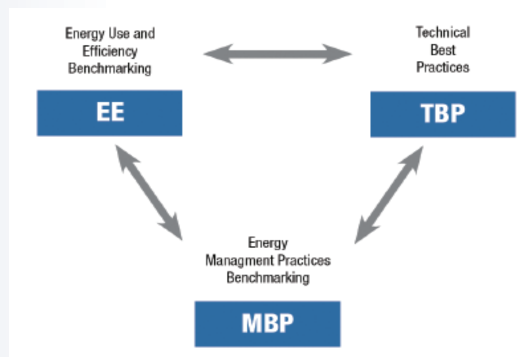
Canadian cement manufacturers are highly motivated to maximize the energy efficiency of their operations. Electricity and fuel costs amount to nearly 40% of total cement manufacturing costs. The consumption of large amounts of energy leads to CO_2 and air pollutants emissions, which in turn require significant resources to manage.

The primary factor determining the efficiency of plant operations is the age and type of kiln technology used. In this regard, Canadian cement manufacturing operations are modern and efficient, with over 55% of current cement production capacity built since 1980. The modernization of the Canadian cement industry has led to significant improvements in the energy efficiency of their operations. In 1990, 4.39 gigajoule (GJ) of electrical and thermal energy were required to produce a tonne of cement. In 2008, 3.70 GJ of energy were required to produce the same tonne of cement – a remarkable 16% improvement in overall energy efficiency.

After kiln technology, plant energy efficiency is most affected by the complex interaction of numerous factors relating to energy management practices, other (non-kiln) installed equipment, and plant operating practices.

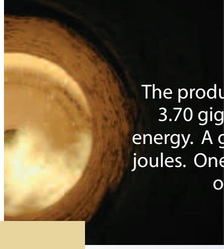


Critical Areas Influencing Overall Energy Use



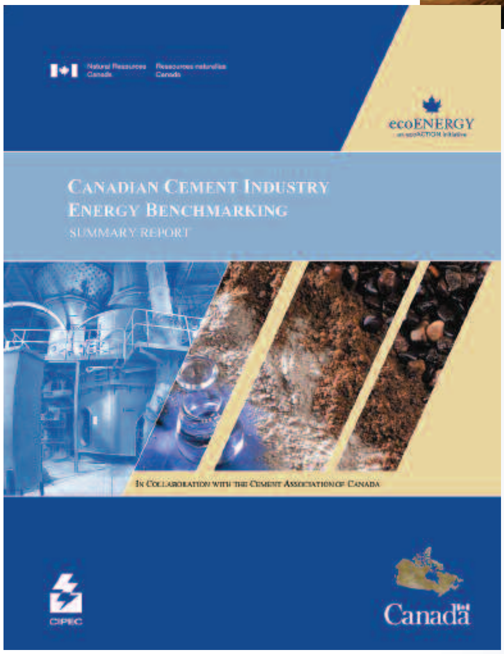
Source: Canadian Cement Industry Benchmarking Summary Report. Natural Resources Canada, 2009.

The Cement Association of Canada, in partnership with Natural Resources Canada's Office of Energy Efficiency, commissioned the *Canadian Cement Industry Energy Benchmarking* study to assess the industry's performance in these three critical areas influencing energy use, and to identify and help guide further energy efficiency improvements. This three-part



Did You Know?

The production of one tonne of cement requires 3.70 gigajoules (GJ) of thermal and electrical energy. A gigajoule is a unit of energy equal to 10^9 joules. One GJ equals approximately 950,000 BTUs or 278 kWh of electrical energy.



study is the first for any industry sector in Canada, and the only review of its kind of a national cement industry anywhere in the world.

The *Canadian Cement Industry Benchmarking* study concluded that the overall energy efficiency of the cement sector was relatively high, with a median energy efficiency index of 76 compared to the theoretical best practices plant with a value of 100. Nine of the 15 facilities achieved a "good practice rating" index of at least 75. Despite this strong performance, the study identified areas that have the potential to yield further energy efficiency and cost savings benefits for the sector.

Further improvements are likely as a result of the industry's positive response to the energy benchmarking study, the suspension in December 2008 of production at Canada's last remaining wet kilns and the anticipated modernization of another plant in the coming years.

Governments and other stakeholders also have a role to play in facilitating improved energy efficiency in the cement sector. Governments can help to improve financial and fiscal conditions to attract the significant capital investment needed to further modernize the industry. Steps to strengthen and broaden the energy efficiency of electrical utilities and co-generation programs will also lead to a more energy-efficient cement industry.

Ciment Québec now a member of the Hydro Quebec Savers' Circle network

In 2009, Hydro Québec welcomed Ciment Québec to its Savers' Circle network. Ciment Québec is the only cement producer in this network, which recognizes businesses with an outstanding commitment to energy efficiency. Working in co-operation with Hydro Québec, Ciment Québec has achieved energy savings through the installation of a bucket elevator – a more efficient means of transporting raw material to the kiln – and by replacing less efficient electrical motors and other equipment with more energy-efficient equivalents. Efforts to date have resulted in a reduction of more than 5% in electricity consumption at the facility.

Energy Excellence at St Marys Cement, Bowmanville

After completing an in-depth, twelve-month, third-party evaluation in 2009, St Marys Cement's Bowmanville operations became the first North American industrial organization to receive *Certification in Energy Excellence* by Energy 360, one of North America's leading energy services firms. Achieving certification requires facilities to demonstrate energy performance improvements over the last three years, and adopt best practices that will continue improving their energy efficiency over the next three years. Efforts to improve energy performance at the St Marys Bowmanville plant have reduced the plant's energy costs by more than $550,000 annually.

Improved Electrical and Energy Efficiency at Lehigh Hanson Canada

In 2008, Lehigh implemented a lighting power management system and upgraded system fans with variable frequency drive technology at its Delta cement plant. Lehigh also converted the kiln feed system to a more energy-efficient mechanical transport system at its Edmonton Plant.

Increasing the Use of Alternative and Renewable Energy Sources

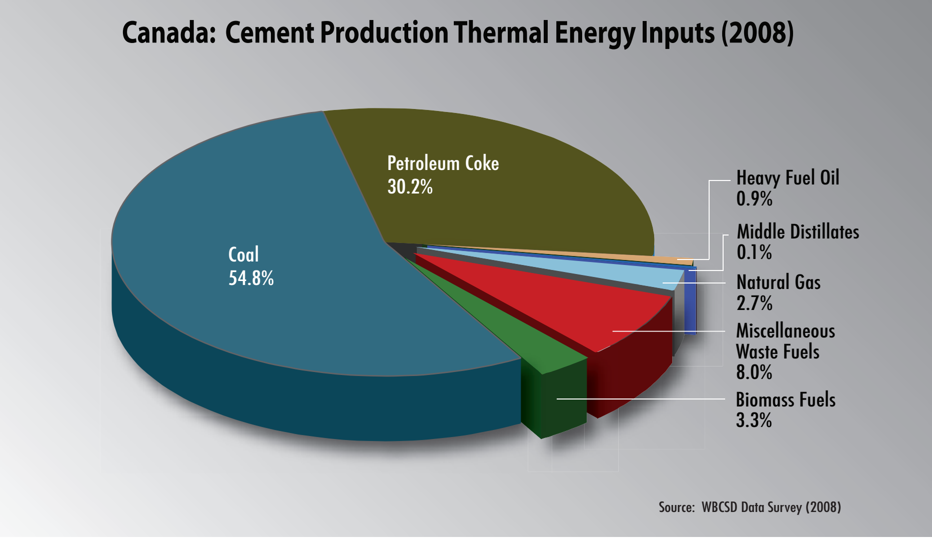
The Canadian cement industry is working closely with governments and other stakeholders to decrease its reliance on carbon-intensive fossil fuels.

Cement manufacturing requires sustained high temperatures in excess of 1,450 degrees Celsius. Fossil fuels, such as coal and petroleum coke, have traditionally been used to achieve these high temperatures, as they are highly efficient and cost-effective energy sources. However, their use contributes to CO_2 and air pollutant emissions.

In 2008, the Canadian cement industry relied on coal (54.8%) and petroleum coke (30.2%) to meet 85% of its thermal energy needs.

In recent years, limited progress has been achieved in introducing alternative, less carbon-intensive energy sources. In 2008, the thermal energy substitution rate in Canada reached 11.3%, which includes a 3.3 % fully carbon-neutral biomass rate.

The alternative and renewable energy sources most commonly used in Canadian cement manufacturing operations are: construction and demolition wood wastes, municipal bio-solids, non-recyclable plastics and textiles, recovered solvents, and discarded tires and the remaining tire fragments left over from tire recycling operations.



Typical Alternative and Renewable Thermal Energy Sources in Cement Manufacturing

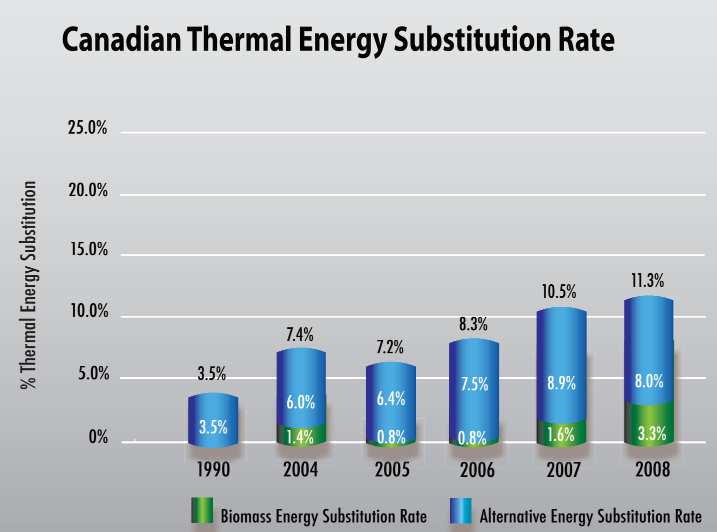
Alternative Thermal Energy Sources

- Used oils
- Recovered solvents
- Recovered asphalt shingles
- Discarded tires and tire fragments
- Non-recyclable plastics
- Textiles

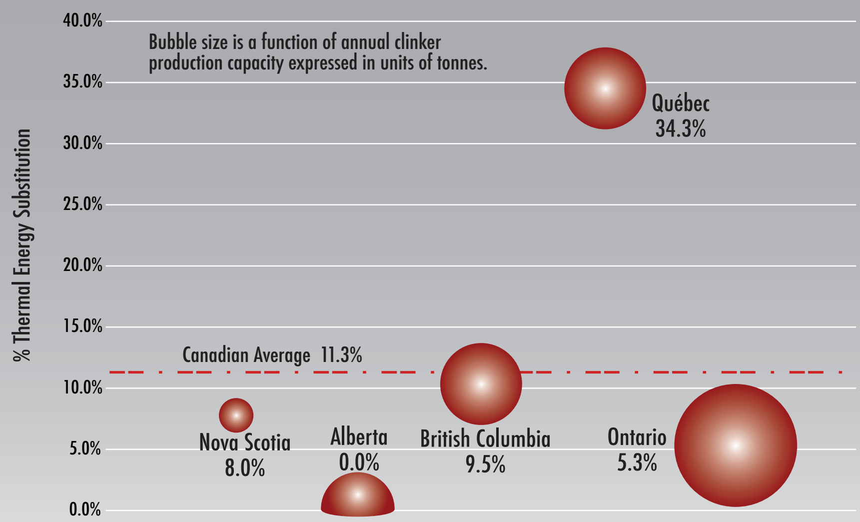
Renewable Thermal Energy Sources

- Fibre residue from forest products manufacturing
- Meat and bone meal
- Municipal solid waste and biosolids
- Agricultural fibre and waste
- Post-consumer, post-recycling paper packaging
- Construction and demolition wood wastes
- Recovered utility poles and rail ties

Cement kilns are well-suited for the use of alternative and renewable fuels, as the kiln process involves long residence times and high temperatures, ensuring complete destruction of organic compounds. As well, the remaining inorganic components (i.e. ashes) are integrated into the clinker product, rather than discarded as waste.



Provincial Thermal Energy Substitution Rates 2008



Furthermore, the thermal energy substitution rate varied significantly across the Canadian provinces - from 0.0% in Alberta to 34.3% in Quebec.

Scientific studies, undertaken by various government agencies, have concluded that the use of such alternative energy sources in the cement sector poses no additional risks to public health or the environment. For instance:

- The UK Public Health Agency has concluded that: "cement kilns, if well managed and maintained, are efficient and effective processes for burning substitute fuels "..."There will consequently be little change in the pollution levels in the air that people breathe"..."We are unaware of any evidence that burning substitute fuel (in cement kilns) has caused adverse health effects." [1]
- The US Environmental Protection Agency has stated that: "The Agency supports the responsible use of (residue derived fuel) in portland cement kilns and other industrial facilities." [2]
- The UK Commission on the Medical Effects of Air Pollution concluded that, when various refuse-derived fuels are use in cement manufacturing facilities, "no changes in stack emissions are likely to occur that would be of significance for human health." [3]

Likewise, experience suggests that the use of alternative energy sources in cement manufacturing contributes to higher community recycling rates. This conclusion is shared by many regulatory bodies. For example, a detailed European Environment Commission study on waste-derived fuel in cement kilns concluded that: "the practice can be a strategic component of an integrated waste management system to reach the recycling and reduction targets for materials going to landfill… as a result of improved sorting, increased participation rates, and the creation of market opportunities." [4] Similarly, the United Nations Environment Program has found that jurisdictions with the highest energy recovery rates also lead the way in total recycling and composting rates. [5]

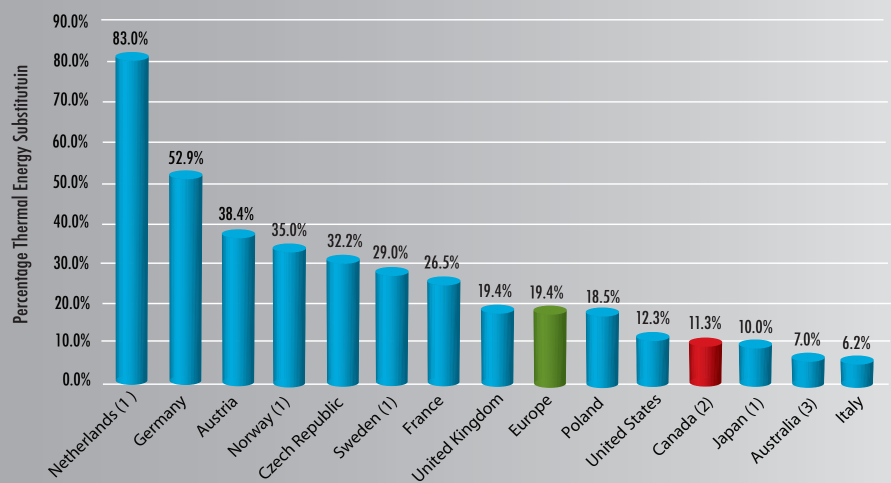
Did You Know?

Replacing a tonne of coal in cement manufacturing with the thermal energy equivalent in biomass fuel will avoid 2.5 tonnes of CO_2 emissions.

As a result of these considerations, the cement manufacturing industry in other countries has achieved significantly higher thermal energy substitution rates over the past two decades. For example, while the average substitution rate across the cement industry in Europe is 19.4 %, the rate in several Western European nations averages over 30 %.

1: Above references are located on the inside back cover.

Thermal Energy Substitution Rates: International Comparison



SOURCE: Unless otherwise noted, energy substitution rates are for the year 2007 and were obtained from the Pricewaterhouse Coopers "Getting the Numbers Right" Survey, 2007.
1. WBCSD Cement Sustainability Initiative. 2005. Guidelines for the Selection and Use of Fuels and Raw Materials in the Cement Manufacturing Process.
URL: www.wbcsdcement.org/pdf/tf2_guidelines.pdf
2. Cement Association of Canada. 2008 WBCSD Data Survey - Canadian Grey Portland Cement Manufacturing Facilities.
3. Australia Cement Industry Federation. 2007 Australian Cement Industry Statistics.
URL: http://cement.org.au/australias-cement-industry/information-about-the-australian-cement-industry

Global Cement Sector Alternative Energy Substitution Rates

Canadian cement manufacturers believe that, with the right mix of supportive public policies in the area of alternative energy, similar energy substitution rates should be achievable within the Canadian industry. To reach such substitution rates will require the industry to work with provincial and local governments and other stakeholders. Approval processes need to be modernized to allow for the burning of fuels other than coal and petroleum coke in cement manufacturing. As well, waste management policies and programs need to be strengthened so that energy-rich materials are diverted from landfills and made available as substitute energy sources for the cement sector.

Lafarge Grows its Own Energy

The Ontario Lafarge Bath Plant demonstration project is to grow fast-growing crops such as maize, hemp, sorghum and switch grass for use as plant-based fuels for cement production.

The project is targeting marginal lands to avoid risk to the food supply, in addition to using only low-energy processing steps to produce the solid biomass fuel used in the Bath plant. Years of scientific research have been invested in producing biomass fuel and the Lafarge project is making it possible to extend this research to a larger scale.

Hemp crop a week before and during harvest, at the Wynn Family Farm

Alternative Fuel Use at Holcim Joliette Cement Plant *(above)*
Holcim Canada's Joliette plant has been successful in steadily increasing energy recovery from suitable waste products. A granular fuel system allows the plant to recover energy from various types of solid waste, such as dried municipal sewer sludge, tire fluff, asphalt shingles, treated wood and plastics, while meeting all the Quebec legislative requirements. The plant has received numerous awards and industry accolades for its efforts in helping society cope with waste by turning waste into energy, reducing emissions and decreasing the consumption of natural resources and fossil fuels.

Biomass Fuels at Lafarge Richmond Plant, BC *(below)*
In partnership with Urban Wood Waste Recyclers Inc., Lafarge has created an engineered fuel that combines waste wood from construction and demolition along with small amounts of non-recyclable plastics. The fuel, which is primarily biomass, will decrease the use of coal and associated greenhouse gas emissions at the Richmond Cement Plant. In conjunction with Offsetters Clean Technology Inc., the greenhouse gas reductions associated with the project have been quantified and validated using KPMG as an independent, qualified third party. These offsets have been purchased by the Pacific Carbon Trust, an arms-length entity mandated to secure greenhouse gas offsets to meet British Columbia's commitment to a carbon neutral public service.

Increasing the Use of Supplementary Cementing Materials

Partially replacing clinker with supplementary cementing materials will reduce the volumes of clinker and the associated CO_2 emissions.

Clinker is the main component in cement. Manufacturing clinker requires significant quantities of thermal energy and results in the release of CO_2 emissions. Each tonne of clinker results in the unavoidable release of approximately 525 kg of CO_2 due to the calcination process, a chemical reaction that takes place in the heated limestone. These process emissions account for approximately 60% of the total CO_2 emissions associated with cement manufacturing and occur regardless of the fuels used to support the kiln process.

The amount of clinker in cement can be reduced by grinding and blending supplementary cementing materials (SCMs) such as fly ash, slag, silica fume, and naturally occurring pozzolanas to produce blended cements.

The clinker content in cement (the "clinker to cement ratio") can vary widely, although the extremes are only used for special applications. Based on 2006 data, the global average clinker to cement ratio was 0.78. In 2008, the Canadian average clinker to cement ratio was 0.83.

Currently, the use of blended cements and SCMs to produce concrete typically replaces 20% of the energy-intensive clinker that would otherwise be required to produce a cubic metre of concrete. In 2008, this resulted in a 1.4 million tonne reduction in CO_2 emissions in Canada. This practice also has the additional environmental benefits of improving air quality and reducing energy consumption, making use of materials otherwise destined for landfill, and increasing production capacity without installing new kilns.

Process Emissions

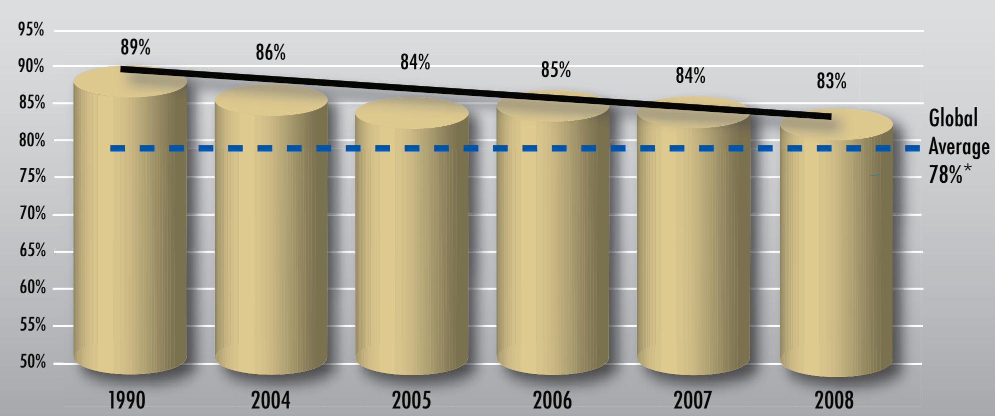
(Calcination of limestone)

$$CaCO_3 \rightarrow CaO + CO_2$$

Heat (945°C to 1,066°C)

Limestone ($CaCO_3$) is the primary raw material in cement manufacturing. In order to undergo the chemical changes required to make clinker, it must be exposed to very high temperatures in the cement kiln. At approximately 900°C, limestone undergoes a fixed chemical reaction known as calcination (or decarbonation). CO_2 is released as a direct by-product of this chemical reaction.

Clinker Substitution (Clinker to Cement Ratio)



*Based on 2006 "Getting the Numbers Right "data (WBCSD, 2009)

Saving Energy and Reducing Emissions with Portland-Limestone Cement

In 2010, after several years of research and testing, the Canadian cement industry will introduce to the marketplace a new and more environmentally-friendly type of cement called portland-limestone cement (PLC).

Manufacturing PLC reduces CO_2 emissions by up to 10% compared to manufacturing regular portland cement. In addition to significantly reducing CO_2 emissions, PLC produces concrete with strength and durability that is equivalent to concrete made with regular portland cement.


Backgrounder

Cement Association of Canada / Association Canadienne du Ciment

Portland-Limestone Cement

A new category of cement is entering the Canadian market. **Portland-limestone cement** (PLC), used successfully in Europe for over 25 years, will be available in Canada in 2010.

What is Portland-Limestone Cement (PLC)?

While regular portland cement may contain up to 5% limestone, PLC is manufactured by intergrinding portland cement clinker with between 6% and 15% limestone. The clinker used to make PLC is the same clinker that is used to manufacture regular portland cement. The performance of PLC is dependent on the high quality of the limestone. In recognition of this fact, limestone used in PLC is tested for calcium carbonate content, clay content and total organic carbon content. The 15% limestone limit applied to PLC in Canada is well below the maximum limit of 35% permitted in European standards. PLC performance specifications are similar to those of regular portland cement in that PLC must meet the same CSA A3001 physical requirements as regular portland cement.

The CSA A3001-08 Standard lists the four types of PLC as follows.

Note that PLC is not available in either moderate or high sulphate-resistant designations.

How Does It Work?

PLC is manufactured in Canada by intergrinding regular cement clinker with up to 15% limestone. The limestone, being a softer material, is ground more finely than the clinker; however, both the clinker and the limestone in PLC are more finely ground than regular portland cement. Both the size and distribu-

Did You Know?

Each tonne of clinker replaced with supplementary cementing materials (SCMs) will reduce CO_2 emissions by 900kg.

The BC Cancer Agency's Research Centre in Vancouver: Concrete floors and walls, use of SCMs and local materials (concrete) contributed to the attainment of LEED® Gold building certification.

Innovation in Cement Materials and Processes

Ongoing innovation efforts – in new production processes and new product applications – are a key priority for the Canadian cement industry.

As economies and populations continue to grow, demand for cement and concrete products will increase significantly in the coming decades.

The Cement Association of Canada (CAC) and its member companies are partnering with the Asia-Pacific Partnership on Clean Development and Climate (APP). The APP is a public-private partnership of seven countries that seek to accelerate the development, deployment and diffusion of clean energy technologies. APP's work is conducted through eight public-private sector task forces, one of which is the cement task force. The APP countries account for approximately 60% of the world's cement production.

With CAC's involvement, the Government of Canada has approved funding for the following Canadian APP projects:

- The EcoSmart Foundation is finalizing the development of the Supplementary Cementing Material (SCM) Optimization System or SOS, a decision-making tool to optimize the use of SCMs in concrete. The system will be transferred to China as a means to optimize the use of SCMs and reduce CO_2 emissions; and,
- The Athena Institute will develop Life Cycle Analysis and Life Cycle Costing tools to compare equivalent concrete and asphalt pavement designs from a sustainability and cost perspective.

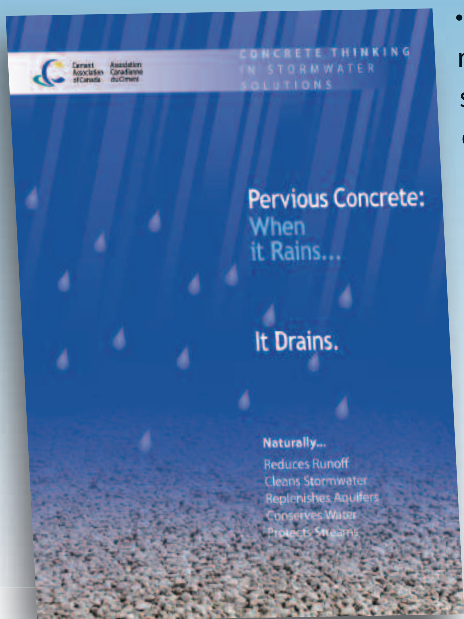
A detailed project roster of the APP Cement Task Force is posted on their website.

Innovation in the production and use of cement can also play a key role in sustainable development. The cement industry is placing an emphasis on innovations such as:

- **Ultra-high-performance concrete** which will permit the construction of exceptionally light, strong and durable structures using less concrete.
- **New photo-catalytic cements** contain materials that act as a catalyst to bind

First PLC Utilization in Canada
In 2009, Lafarge Canada purchased a section of road near its Brookfield, Nova Scotia operations. In undertaking much needed repairs, a section of the road was reconstructed using portland-limestone cement produced at the Brookfield plant.

airborne nitrogen and sulphur oxides into insoluble salts, thereby reducing urban smog. The same properties also significantly reduce the amount of cleaning needed on the exterior of buildings.



• **Pervious concrete** pavement reduces the impact of storm water run-off in urban communities by allowing water to seep through the pavement to recharge groundwater, thereby eliminating the need for expensive retention ponds.

Cement-based Solidification/Stabilization (S/S)

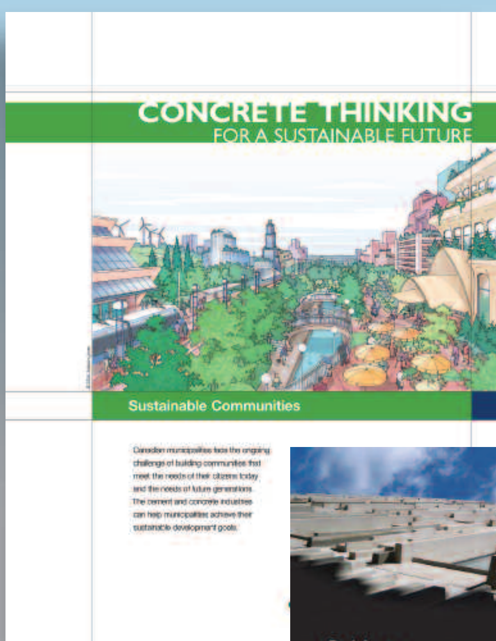
is a common method for the treatment, management and reuse of soil, sediment and waste. The technology involves mixing cement into the subject material to immobilize contaminants within it. Reuse of S/S-treated soil and sediment has been a key component of sustainability award-winning redevelopment projects in the United States. Solidification/Stabilization (S/S) is now being chosen for the remediation of key sites in Canada.

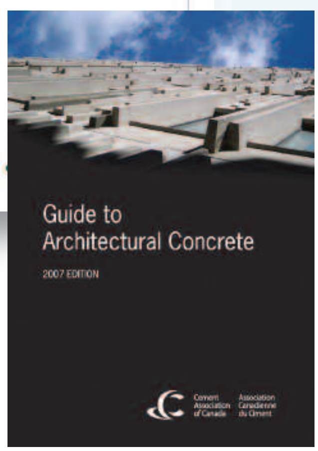
The use of S/S to remediate Nova Scotia's Sydney Tar Ponds is well underway. *When completed, this site will be a Canadian example of how this application of cement contributes to sustainable redevelopment of both urban and industrial properties. Additional opportunities exist for the use of S/S treatment in the management or reuse of mining and industrial waste.*

G. Langille

Concrete: A Sustainable Construction Material

Concrete products help reduce the overall environmental footprint of the built environment. While the right construction material needs to be used for the right project, the move towards modern and highly energy-efficient buildings and infrastructure is a move towards the increased use of concrete.





Concrete contributes to longer-lasting and more energy-efficient buildings, cost-effective roads, highways and bridges, high-performance transit systems, and buried infrastructure, such as safe and reliable water and sanitary sewer systems. For communities, concrete is increasingly becoming the right choice for sustainable construction. In the hands of an architect, concrete's aesthetic potential is realized.

The Pantheon in Rome *is one of the world's most remarkable interior spaces, and, after nearly two thousand years, it is still the largest unreinforced concrete dome on earth.*

Concrete resists weathering, erosion and natural disasters while maintaining its desired engineering properties. Once concrete has reached the end of its life, it is recycled and reused in new applications, which reduces the amount of landfill and conserves natural resources.

With increasingly scarce public resources and with growing attention to energy use and the emissions associated with the operating life of buildings and infrastructure, it is vitally important that choices between competing construction materials be made on the basis of full life cycle costing (costs of maintenance, operation, safety, convenience and end-of-life disposal). When rigorous attention is paid to such criteria during the design phase, the benefits of concrete as a sustainable construction material become most obvious.

Concrete was used extensively *in the construction of the* ***Canadian War Museum,*** *Ottawa, Ontario. It was the material of choice to support a foot-thick covering of earth on the low-maintenance 10,700 square metre green roof that supports native self-seeding grasses. The roof provides greater thermal insulation than the minimum required by the building code and is one of the largest green roof systems of its kind in North America.*

The Richmond Olympic Oval *boasts a silver LEED® (Leadership in Energy and Environmental Design) rating, and was constructed of concrete, steel, glass and salvaged pine-beetle-kill wood. Approximately 33,000 cubic metres of concrete were used in the creation of the Richmond Olympic Oval. The Oval has already earned several honours and awards, including the Innovation in Architecture Award of Excellence from the Royal Architectural Institute of Canada, the Green Building Practices Award from the Globe Foundation and World Green Building Council, and the Sustainability Star from the Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games.*

Moving Forward:
A Progressive Way of Doing Business

The Canadian cement industry has a reputation for environmental performance, product quality and innovation. We are committed to improving the social and environmental performance of our operations and to producing a sustainable product. We believe that implementing our sustainability agenda will also contribute to the competitiveness of the cement industry.

We will continue to work with governments and stakeholders to build their awareness, understanding and support for our sustainability action plan. This action plan is focused on working towards continuous improvement in energy efficiency; on increasing the use of zero- and low-carbon renewable and alternative energy sources; on increasing the use of supplementary cementing materials; on continuing to develop innovative products and processes; and finally, on the promotion of concrete as a sustainable construction material.

We recognize, however, that we cannot improve our environmental performance without a supportive public policy framework. In particular, we need governments to:

- Keep energy—and resource-rich materials out of landfill;
- Review and update policies and processes to facilitate the substitution of zero and low-carbon renewable and alternative energy sources for fossil fuels;
- Ensure that portland-limestone cement is widely used; and
- Promote the right construction material for the right job, by using a life cycle approach to making decisions about competing construction materials.

The cement industry remains dedicated to making a difference by integrating sustainability in our decision-making. We will continue to foster open dialogue with all levels of government and all stakeholders to fully engage them in the implementation of the industry's ambitious sustainability plan.

The ***Bell Canada Campus****, which houses 4,000 Bell employees, is located on Nun's Island in Montreal. The Silver LEED® certified building has also won the 10th Real Estate Award of Excellence.*

In September 2008, CBM, the building materials division of St. Marys Cement, put the ***first-ever pink ready-mix concrete truck in Canada*** *on the road. In partnership with the Canadian Breast Cancer Foundation,* The Building a Concrete Cure *campaign has two main objectives: to increase awareness about the breast cancer cause and to raise money to support the Foundation.*

Canadian Cement Industry Performance

All CAC member companies producing grey cement in Canada participate in the Cement Sustainability Initiave (CSI). As a condition of membership, the CSI requires commitment to and compliance with the CSI Charter. The CSI Charter calls for individual company action in the following priority areas: CO_2 and climate change, responsible use of fuels and materials, employee health and safety, emissions reduction, local impacts on land and communities, reporting and communications.

The following table and charts summarize the performance of the Canadian grey cement manufacturing industry on these key progress indicators.

Key Progress Indicators

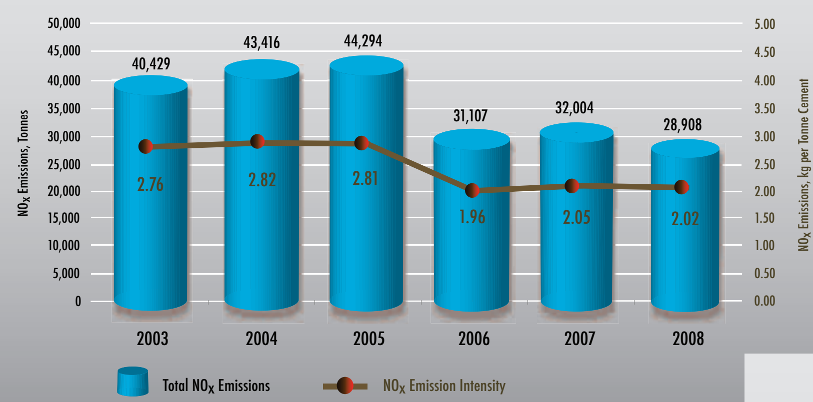
Production Indicators	**1990**	**2004**	**2005**	**2006**	**2007**	**2008**
Clinker Production (Mt)	10.97	13.81	13.88	14.12	13.75	12.45
Cement Production (Mt)	12.37	16.05	16.47	16.55	16.29	15.00
Clinker to Cement Ratio	89%	86%	84%	85%	84%	83%
Energy Use Indicators	**1990**	**2004**	**2005**	**2006**	**2007**	**2008**
Thermal Energy Efficiency (GJ / tonne clinker)	4.407	3.898	3.903	3.882	3.812	3.883
Electrical Energy Efficiency (GJ / tonne cement)	0.485	0.470	0.466	0.474	0.468	0.482
Electrical Energy Efficiency (kWh / tonne cement)	135	131	129	132	130	134
Overall Energy Efficiency (GJ / tonne cement)	4.391	3.825	3.756	3.785	3.685	3.704
Thermal Energy Substitution Rate (%)	3.5%	7.4%	7.2%	8.3%	10.5%	11.3%
Alternative Energy Substitution Rate (%)	3.5%	6.0%	6.4%	7.5%	8.9%	8.0%
Biomass Energy Substitution Rate (%)	0.0%	1.4%	0.8%	0.8%	1.6%	3.3%
CO_2 and Climate Change Indicators	**1990**	**2004**	**2005**	**2006**	**2007**	**2008**
Direct CO_2 Emissions (Mt CO_2)	10.03	12.45	12.57	12.73	12.25	10.99
Direct CO_2 Emissions Intensity (kg CO_2/ tonne cement)	811	776	763	769	752	732
Air Quality Indicators	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Total NO_x Emissions (tonnes / year)	40,429	43,416	44,294	31,107	32,004	28,908
NO_x Emissions Intensity (kg / tonne clinker)	3.06	3.14	3.19	2.20	2.33	2.32
NO_x Emissions Intensity (kg / tonne cement)	2.76	2.82	2.81	1.96	2.05	2.02
Total SO_2 Emissions (tonnes / year)	37,360	42,767	38,356	31,992	28,381	22,309
SO_2 Emissions Intensity (kg / tonne clinker)	2.83	3.10	2.76	2.27	2.06	1.79
SO_2 Emissions Intensity (kg / tonne cement)	2.55	2.78	2.44	2.01	1.82	1.56
Stack Particulate Matter (PM) Emissions (tonnes / year)	2,184	2,383	2,728	2,886	2,790	2,408
Stack PM Emissions Intensity (kg / tonne clinker)	0.17	0.17	0.20	0.20	0.20	0.19
Stack PM Emissions Intensity (kg / tonne cement)	0.15	0.16	0.17	0.18	0.18	0.17
Employee Health and Safety Indicators	**2000**	**2004**	**2005**	**2006**	**2007**	**2008**
Employee Accident Incidence Rate: Lost Time Accidents per 200,000 Employee Hours	2.7	1.0	1.0	0.9	0.9	0.7
Employee Accident Severity Rate: Average Number of Lost Work Days per Lost-Time Accident	71.4	14.4	12.0	17.4	29.0	12.8

Key Trends in Environmental Performance

The Canadian cement industry remains fully committed to reducing the environmental footprint of its operations. Through investments in energy efficiency, the replacement of fossil fuels with alternative and renewable energy sources, the introduction of supplementary cementing materials as clinker substitutes, and through additional investments in pollution control equipment, the industry has made impressive improvements over the past five years.

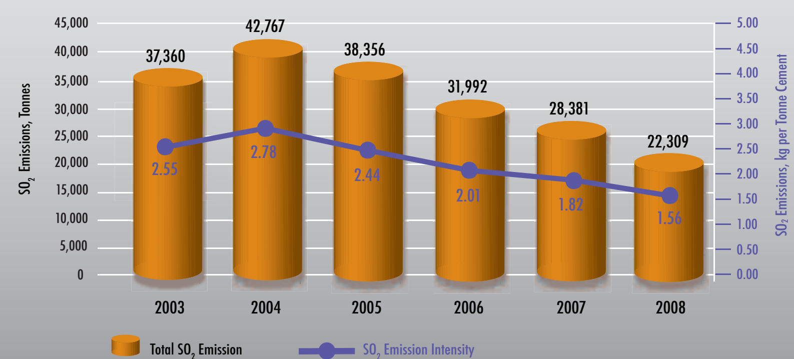
For instance, while overall grey cement production decreased by approximately 9% over the period 2005 through 2008, total nitrogen oxides (NO_X) emissions from Canadian cement manufacturing facilities declined by 35% from 44,294 tonnes in 2005 to 28,908 tonnes in 2008. Likewise, the NO_X emissions intensity per tonne of cement produced has fallen by 28% from 2.81 kg per tonne of cement produced in 2005, to 2.02 kg per tonne of cement produced in 2008.

Air Pollutant Emissions: NO_X



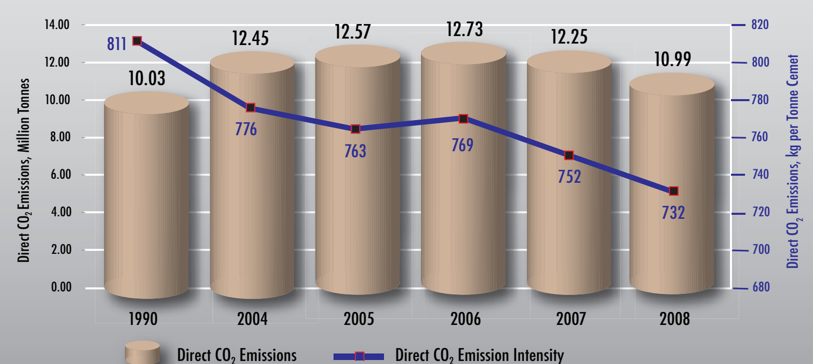
Similarly, and since peaking in 2004 at 42,767 tonnes, total grey cement industry sulphur dioxide (SO_2) emissions declined by nearly 48% by 2008, to 22,309 tonnes. Factoring in the 6.5% reduction in cement production over this period, the SO_2 emissions intensity per tonne of cement produced fell by 44% from 2.78 kg per tonne cement produced in 2004, to 1.56 kg per tonne cement produced in 2008.

Air Pollutant Emissions: SO_2



During the period 1990 to 2008, cement production in Canada increased by 21%. During this time, the growth in the industry's direct CO_2 emissions was constrained to just 10%, rising from 10.03 MT in 1990 to 10.99 MT in 2008. In 1990, the production of one tonne of cement in Canada resulted in 811 kg of CO_2 emissons. By 2008, each tonne of cement produced resulted in 732 kg of CO_2 emissions, representing a 10% improvement in the industry's CO_2 emissions intensity per tonne of cement produced.

Direct CO_2 Emissions



Examples of Innovative Thinking

Essroc Italcementi Group – Essroc's plant in Picton, Ontario recently installed a new particulate matter "baghouse" – an air pollution control device that is designed around the use of engineered fabric filter tubes, envelopes or cartridges that capture, separate or filter dust. Although the electrostatic precipitator (ESP) on kiln #3 had been maintained and modernized since it was installed in 1964, it did not meet current regulatory limits. Essroc decided to build a baghouse to comply with the new, lower emission limits. The new baghouse ensured that all the cement kiln dust (CKD) was returned to the kiln process, thus eliminating landfilling the CKD on company property, reducing dust emissions and eliminating the requirement for hauling this material by truck. Phoenix Process Engineering worked closely with Italcementi's Technical Centre and Essroc's purchasing department to come up with the project's design, and to select suppliers. The new baghouse for kiln #3 provides a better environment for the surrounding community.

The **Cement Association of Canada** (CAC) manages the Ontario Wood Pallet Recycling Program to ensure that wood pallets are reused, rather than sent to landfill sites. The program has:

- Developed a uniform wood pallet standard to allow cement industry-wide interchange and re-use;
- Identified wood pallets by company ownership; and
- Developed a retrieval process to reduce the number of abandoned pallets and pallets going to landfill sites.

Since the program began in 2005, over 17,700 pallets or 322 tonnes of biomass wastes have been diverted from Ontario landfills. The wood pallets are recycled and reused. The CAC program has also helped 13 Ontario pallet recyclers to generate revenue and create employment.

Cement is a powder that, when mixed with water, sand and aggregates, produces concrete. Cement typically represents 11% of a concrete mix, and acts as the glue that holds concrete together.

References for page 8:

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3) http://www.dh.gov.uk/ab/COMEAP/DH_108498

4) European Commission, Directorate general Environment, 2003: "Refuse Derived Fuel, Current Practice and Perspectives. Final Report (B4-3040/2000/306517/MAR/E3) http://ec.europa.eu/environment/waste/studies/pdf/rdf.pdf

5) http://www.grida.no/graphic.aspx?f=series/vg-waste/28-29_graphs_landfillincin.gif

Members of the Cement Association of Canada

Grey Cement Producers

Ciment Québec Inc.
HEAD OFFICE and PLANT:
Saint-Basile (Portneuf), QC
Tel: (418) 329-2100

Essroc Italcementi Group
HEAD OFFICE:
Mississauga, ON
Tel: (905) 826-4333
PLANT: Picton, ON
www.essroc.com

Lafarge Canada Inc.
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Tel: (780) 420-2500
PLANTS: Delta, BC;
Edmonton, AB
www.lehighcement.com

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Concord, ON
Tel: (905) 532-3000
PLANTS:
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www.holcim.ca

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HEAD OFFICE:
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Tel: (416) 696-4411
PLANTS:
St. Marys, ON;
Bowmanville, ON
www.stmaryscement.com

White Cement Producer

Federal White Cement Ltd.
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