Energy Use in the Cement Industry in North America Emissions, Waste Generation and Pollution Controls, 1990-2001

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Research Questions

- **How has energy use –including fuel type -- in the cement manufacturing industry changed over the last ten years, and what have been the the environmental impacts of that change?**
- **How has the regulatory structure governing the sector changed, Re: energy efficiency and the pollution prevention and control?**
- **What has been the impact of trade liberalization on these trends? Specifically:**
  - **Are companies investing in cement manufacturing in any country to take advantage of less stringent environmental regulations and enforcement; or**
- **Has foreign investment led to improvements in energy efficiency and pollution prevention.**

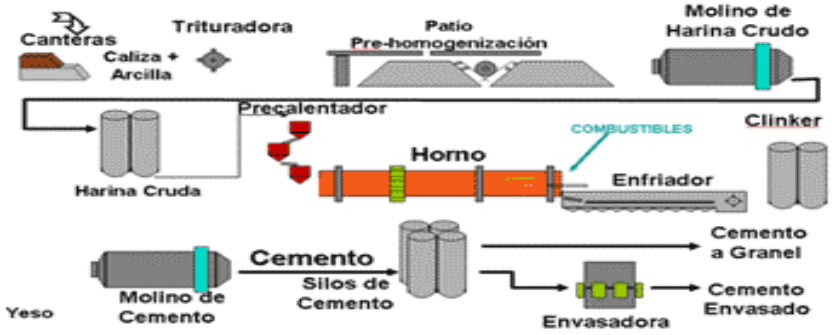
CAVEATS

- **Focuses narrowly on the cement production process itself, not**
  - **mining of inputs;**
  - **Transportation of clinker or inputs;**
  - **final mixing of concrete or other batch plants.**
- **Important Data Limitations – Data is often based on surveys and estimates or in some cases simply unavailable**
- **We did not have time or resources to do direct plant surveys and visits, and thus relied on secondary data analysis.**

Methodology

- **Looked at Production, Imports and Exports, Energy Use, Fuels, Greenhouse Gas Emissions, Air Pollutants and Waste Generation, Regulations Governing Pollution Control, 1990 - 2001**
- **Analyzed Trends and Asked if were influenced by trade liberalization**

The Cement Production Process



- **A) It begins with the extraction of its prime materials, principally limestone (70%), but also clay, aluminum oxide, iron, shale and silica.**
- **B) The materials are ground and stored separately.**
- **C) The material is measured to achieve a specific combination, and ground to produce a very fine powder.**
- **D) The powder is pumped to silos, where the blend is standardized before being placed in long, rotating kilns, where the material is calcinated at high temperatures (approximately 1,500 degrees centigrade), causing chemical and physical reactions. A new material is formed, which is called clinker, which are composed of small balls about the size of a nut.**
- **E) Finally, the clinker is ground up, combined with calcium sulfate – usually gypsum -- and other materials and packaged.**

Findings: NAFTA Connection

- **Tariffs were low already and phased out by 1998; however, continued dispute between Mexico and U.S. over Anti-Dumping Duties through Chapter 19 has led to tariffs against imports of Mexican cement**
- **NAFTA provisions to protect investors may have helped spur investment in cement industry**
- **NAFTA allows transport of wastes as fuels, but also allows certain restrictions**
- **Sound Management of Chemicals program could have impact on cement industry as calls for control and phase-out of dioxins and other pollutants**

U.S. Cement Findings: 90-2001

- **Overall Trends in Industry**

Category	Number of Thousand Metric Tons, 2001	% Change, 90-2001
Production of Cement	88,900	27.08%
Consumption	114,000	40.21%
Imports of Cement	23,700	96.83%
Imports from Mexico	1,645	353.17%
Imports from Canada	5,110	688.58%
Exports	746	48.31%
Net Import Reliance	20.79%	40.21%

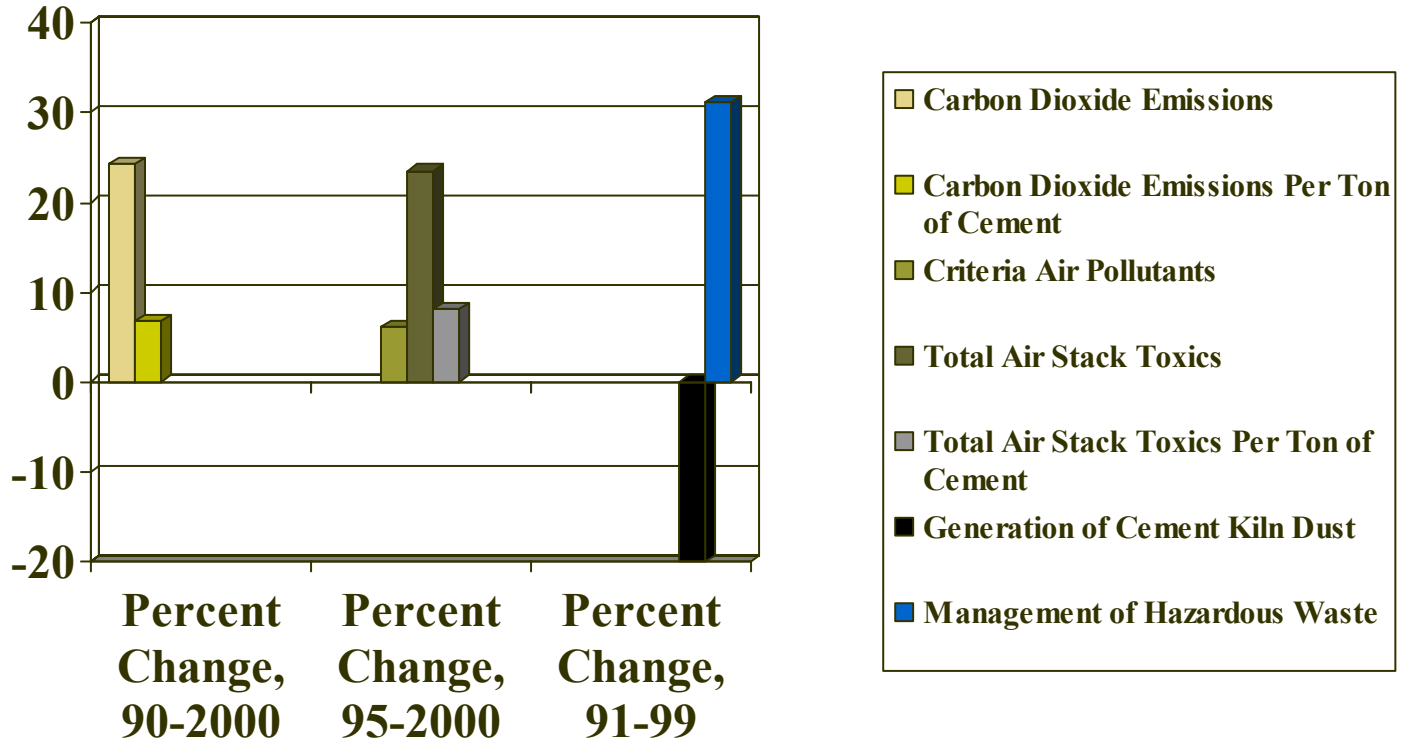
US Cement Findings: Energy Use

- **Consolidation of industry – 10 companies have 75% of US market do**
- **– 8 are foreign**
- **Cemex –12 plants --and Grupo Chihuahua – 2 plants -- have become major players in U.S.**
- **Between 93 and 2001, Increasing use of Tires (330%), Solid Wastes(255%) and Liquid Waste (12%)– Decrease in Natural Gas (-40%)- Coal and coal products stable**

	1990	1993	2001	Change, 93-2001
Total Number of Active Plants	104	113	111	-1.77%
Total Number of Plants, Dry	67	72	77	6.94%
Total Number of Plants, Wet Kiln	43	37	32	-13.51%
Electricity Use – Kilowatt Hour Per Ton	147	142	146	2.82%
Total Energy Use –GJs per Ton Cement Produced	4.61	NA	5.18 (2000)	12.36%

U.S. Cement Findings: Emissions and Waste Generation

- Increased production, slow development of regulations, and dirtier fuel mix have increased emissions
- Generation of "non-hazardous" CKD waste down
- Generation and management of hazardous waste has increased
- Cement industry now estimated 4th largest emitter of dioxins and furans
- Accounts for about 8% of air emissions in 2000 TRI

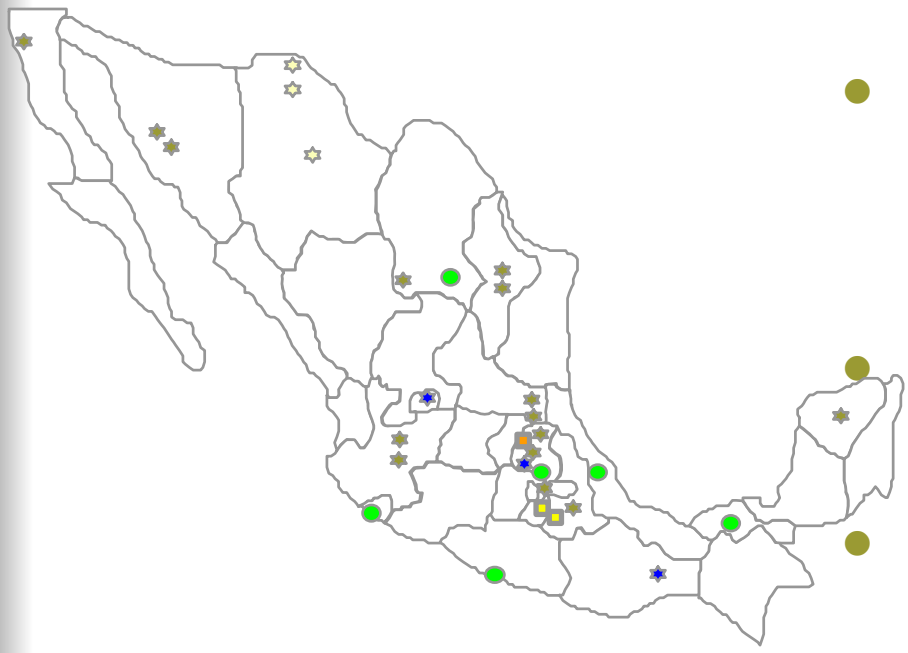


U.S. Findings: Pollution Control

- **Cement Industry operated under BIF rules until development of MACT standards in late-90s – since been delayed**
- **CKD management rules**
- **Ozone Precursors**
- **There has not been an effort directed at energy efficiency or global greenhouse gas emissions in U.S. – instead focus on meeting standards and cost of fuels**

Mexico Findings: Production, Exports and Investments

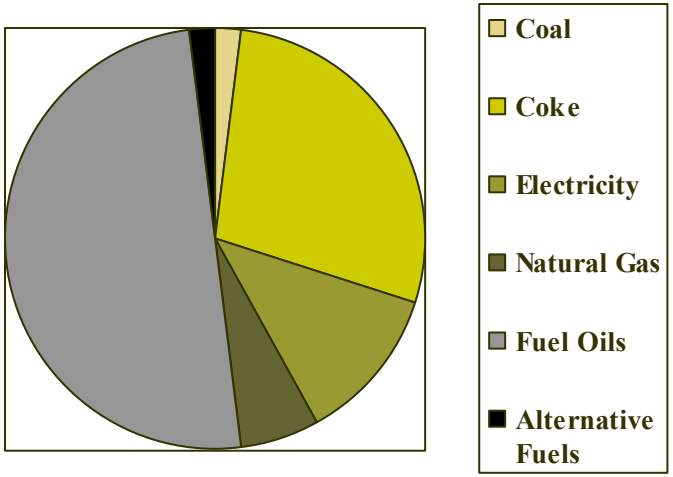
- **30 Plants in 18 states**



- **Dominated by CEMEX (15), APASCO (6).**
- **Production has risen slightly since 93 (9%) and exports substantially (110%), but less than expected**
- **Both GCC and CEMEX have invested directly in U.S. market**
- **Lafarge entered the Mexican market, purchasing a plant in Central Mexico**

Mexico Findings: Electricity and Energy Use

- **Fuel Mix in Mexican Cement Industry, 2001**



Energy use in Cement	1990	1996	2001
Kcal per Kgram Cement	963	845	820

- **All plants are more efficient dry variety and cement industry has made substantial improvements in energy efficiency, particularly in early 1990s.**
- **Recent shift in use from Fuel Oils to Fuel Oils, Petroleum Coke, Coal and Alternative Fuels.**
- **Shift due to unstableness of fuel oils, better prices of petroleum coke and regulatory incentives and cost of alternatives**

Mexico Findings: Emissions

- **Little information at plant level in Mexico on GHGs, CACs or Toxics**
- **Kilns tested for dioxin emissions found lower levels than U.S.**
- **Given increased use of petroleum coke, alternative fuels and increased production, likely that emissions are increasing**

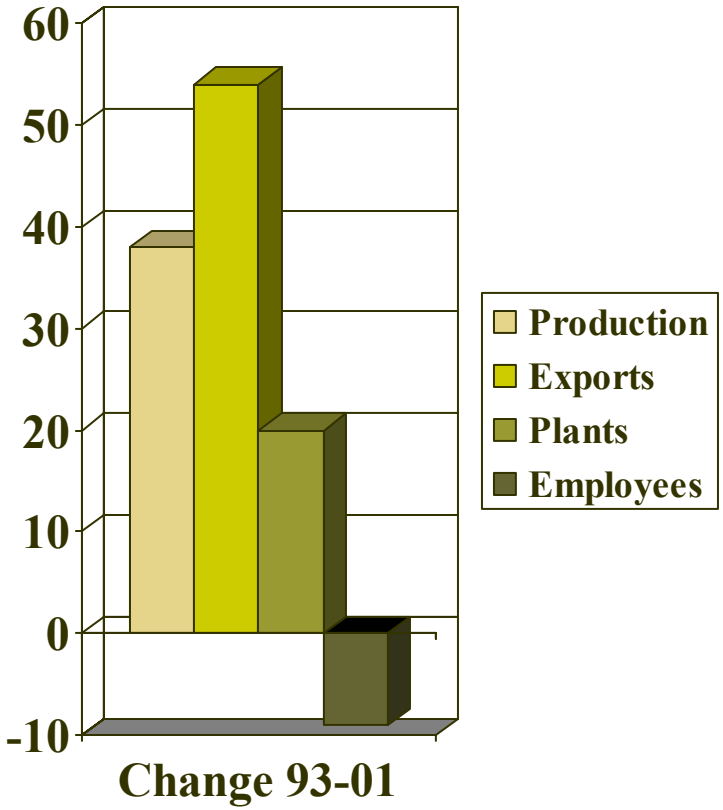
Mexico Findings: Pollution Control

- **Until recently, industry only asked to meet industry-wide standards for PM.**
- **Previous effort to develop emissions control standard was withdrawn due to industry opposition.**
- **Since 1991, cement kilns have used temporary authorizations to burn hazardous wastes.**
- **These authorizations have not permitted citizen oversight or access.**

Mexico Findings: Pollution Control

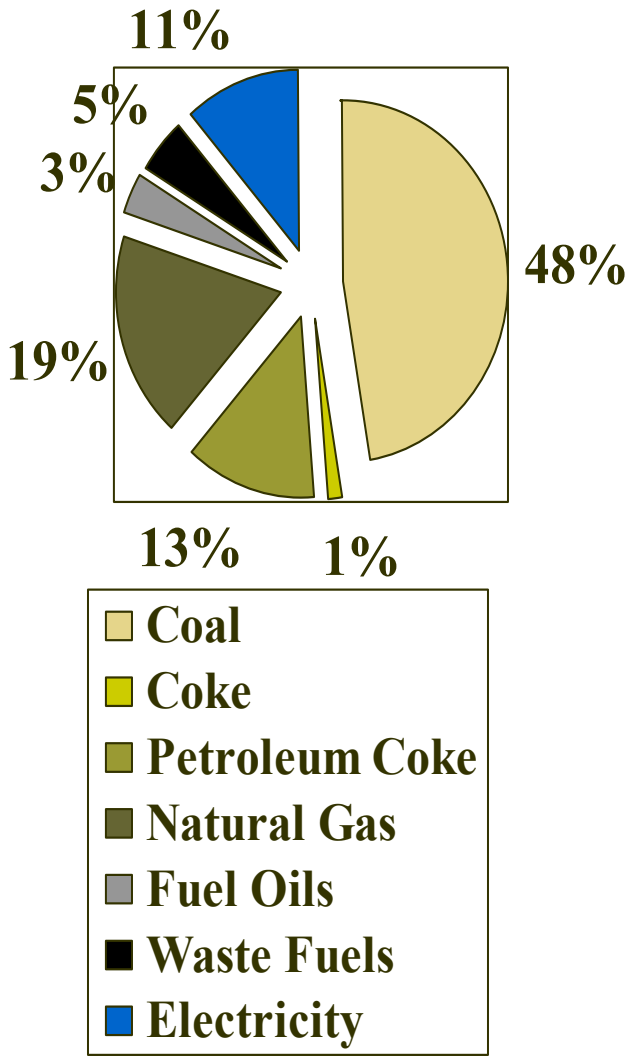
- 1996 and 2001 agreements between government and industry legitimized increased burning of hazardous wastes
- In 2002, Mexico approved new emission standard.
- Applies to all plants
  - monitoring requirements differ depending on % of alternative fuels
- Levels are similar to U.S
  - require limited monitoring
  - difficult to enforce standard.
- No GHG standards, but industry leaders and Mexico's commitment to Kyoto could lead to standards.

Canadian Findings: Production, and Trade



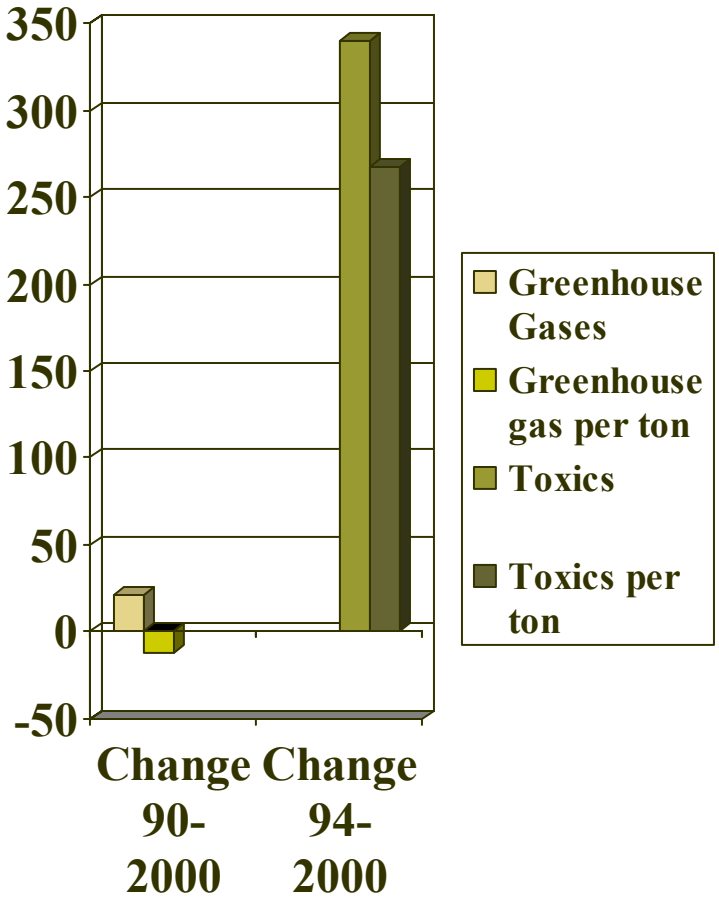
- Cement industry smaller than US and Mexican
- Production increased 38% in 93-2000 period
- Exports increased 54% to meet northern U.S. market

Canadian Findings: Energy and Fuel Use



- Cement industry uses variety of fuels, led by coal, natural gas, petroleum coke, electricity, waste fuels and heavy fuel oils
- Coal (41%), Fuel Oils (27%) and waste fuels (46%) saw biggest increases in use between 93-2000; Natural Gas Declined 6 percent
- production (38 percent) increased more than fuel use (20 percent)
- 12 percent decrease overall in energy used per ton.

Canadian Findings: Emissions



- Increased reliance on coal, heavy fuel oils and waste fuels increases GHG emissions
- On per-ton basis, GHG emissions declined
- Toxic releases 16 tonnes to 71 tonnes 1994-2000.

Canadian Findings: Pollution Control

- No specific emissions controls on burning of hazardous wastes in kilns
- Voluntary guidelines have been adopted which are not legally binding;
- Guidelines supportive of the use of certain types of hazardous wastes as supplemental fuels.
- The use of hazardous wastes in this way continues to be regulated as a hazardous waste disposal activity.
- The industry has demonstrated a greater interest in the use of scrap tires as supplemental fuel.
- A number of new facilities have been established for the purpose of collecting scrap tires and exporting them to Mexico.

Summary Conclusions

- **Cement production has increased in all three countries, with consumption in U.S. leading to increasing imports from Canada and Mexico;**
- **Mexican companies have invested directly in U.S. as anti-dumping duties remain;**
- **Despite shift from wet kilns to dry kilns, energy use per ton has increased in U.S.**
  - **Energy efficiency improved slightly in Mexico and Canada.**
- **In all three countries, there has been a move to diversify fuel use**
  - **Drive by price volatility, rather than efficiency or cleanliness;**
- **In all three countries, use of alternative hazardous and non-hazardous wastes has increased, although it still makes up a small percentage of overall use.**
- **Toxic emissions in the U.S. and Canada have increased since 1993.**

Summary Conclusions

- **GHGs emissions also up**
  - **less than production in Canada**
  - **more than production in the U.S.**
- **there is little public information on emissions in Mexico and tests of dioxin emissions have been very limited.**
- **In all three countries, a regulatory framework to control emissions and regulate waste management has evolved slowly and been delayed as the industry resists new emission controls;**
- **Emission controls now being implemented in Mexico and U.S., considered short of protecting public health and to have few monitoring or enforcement requirements**
- **In Canada, emissions standards are guidelines not regulations**

Summary Conclusions

- **It does not appear that there is a specific NAFTA effect; countries are not investing to take advantage of regulatory advantages but to avoid tariffs– however, differences in regulations regarding fuel use and emission standards could lead to increased hazardous waste shipments from the U.S. to Mexico and Canada for burning in cement kilns.**
- **It is too early to tell whether investments by the large, international cement companies like CEMEX, Holcim and Lafarge will lead to technology transfers; still, given their stated commitment to energy efficiency and reduction of global gases, there is the potential to learn from lessons in all three countries and improve environmental performance;**

Recommendations

- **Cement kilns burning hazardous wastes should be regulated as hazardous waste disposal facilities**
- **Canada needs to adopt updated enforceable emission standards for kilns burning both conventional fuels and hazardous wastes, as have the US and Mexico.**
- **Energy efficiency standards and greenhouse emission standards for the cement sector should be adopted in all three countries.**
- **The CEC should initiate a dialogue about the burning of alternative wastes in cement kilns with a specific focus on dioxin and furan emissions and the control of CKD.**
- **The CEC should continue to strengthen it's Sound Management of Chemicals program to emphasize a North American management strategy of hazardous wastes and reduction of dioxin and furan emissions.**