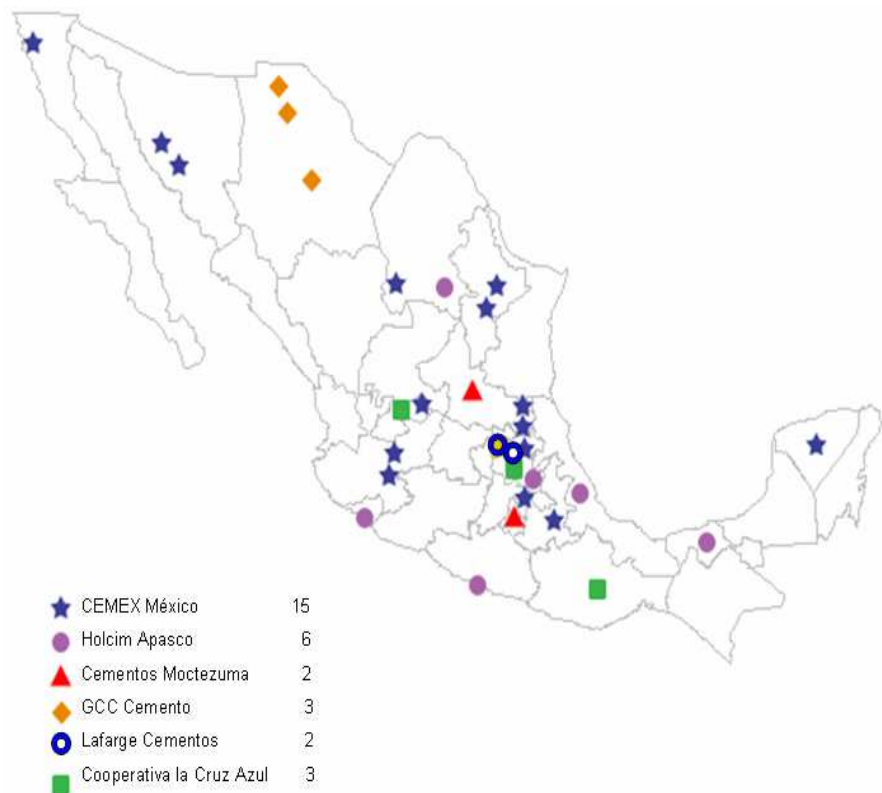


POSSIBILITIES FOR THE REDUCTION OF GREENHOUSE GASES IN THE CEMENT SECTOR

Workshop on sectoral approaches for
mitigation of greenhouse gases in Mexico

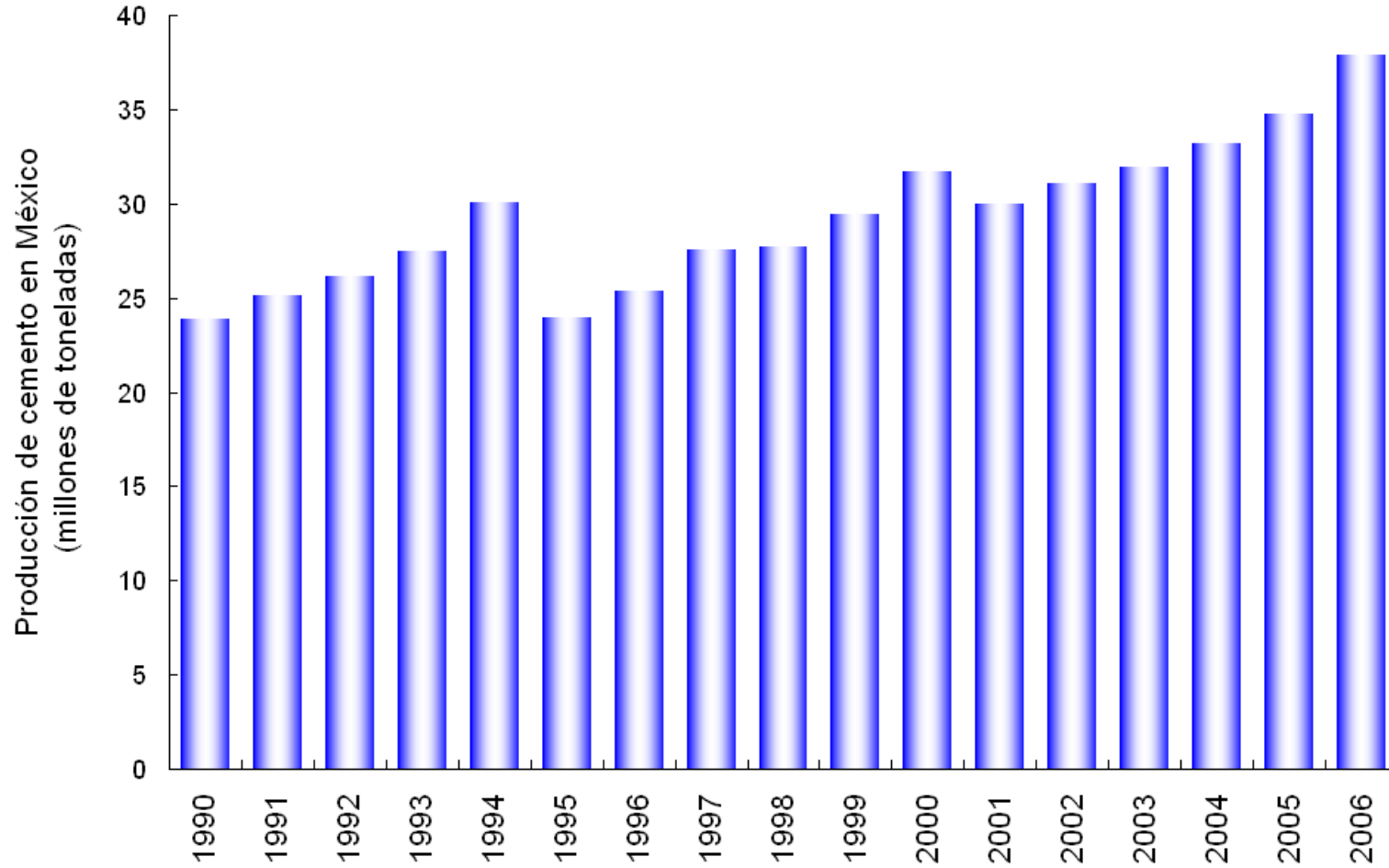
September 2008

DESCRIPTION

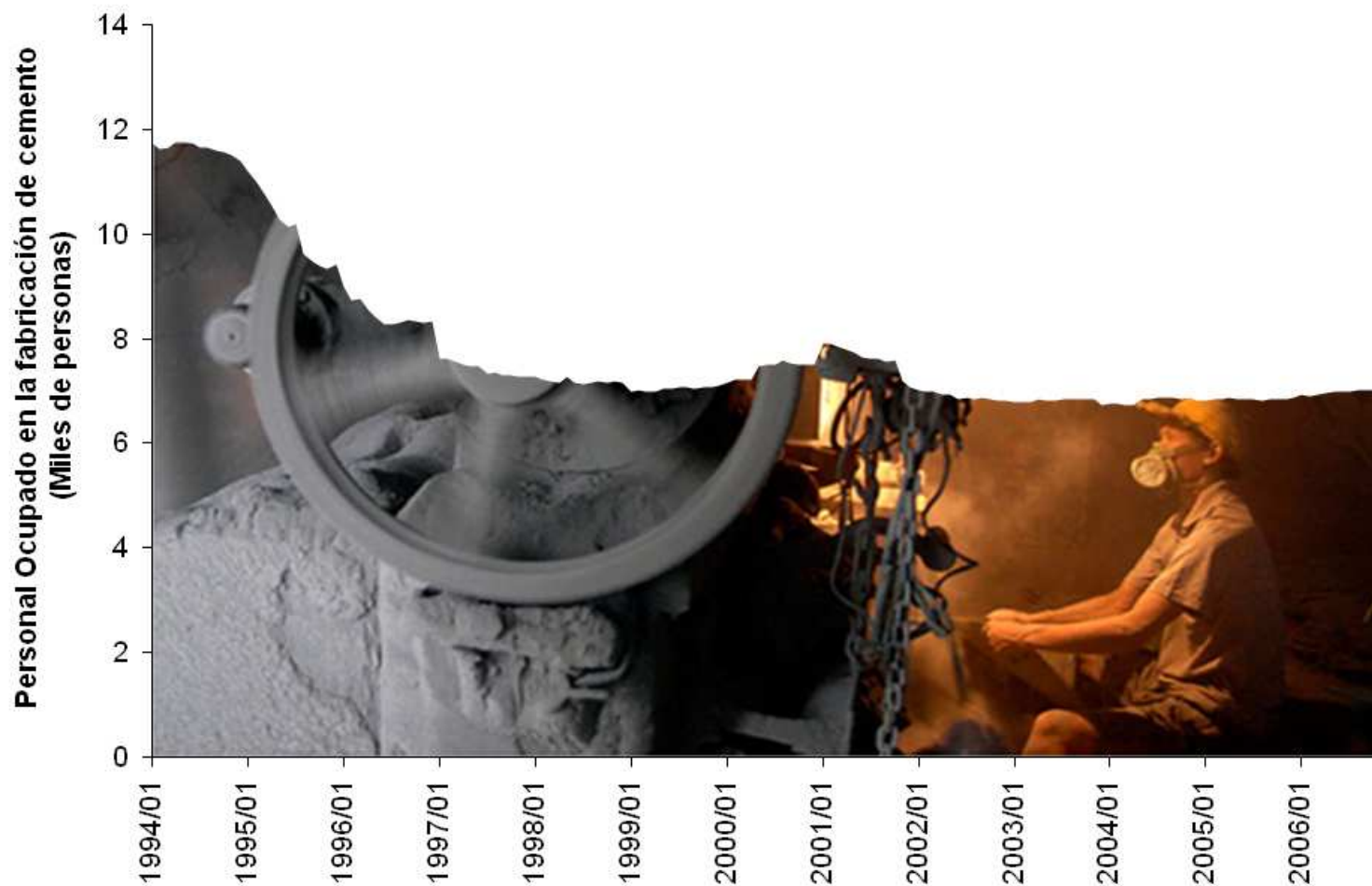


Empresa	No. Plantas	Capacidad (millones de ton/año)	Ubicación
CEMEX México	15	27	Atotonilco, Barrientos, Ensenada, Guadalajara, Hermosillo, Hidalgo, Huichapan, Mérida, Monterrey, Tamuín, Tepeaca, Torreón, Valles, Yaqui y Zapotiltic
Holcim Apasco	6	10	Acapulco, Apaxco, Macuspana, Orizaba, Ramos Arizpe y Tecomán
Cooperativa La Cruz Azul	3	7	Hidalgo, Lagunas y Aguascalientes
Grupo Cementos de Chihuahua	3	4	Chihuahua, Cd. Juárez y Samalayuca
Cementos Moctezuma	2	5	Tepetzingo y Cerritos
Lafarge Cementos	2	1	Vito y Tula
TOTAL	31	54	

PRODUCTION

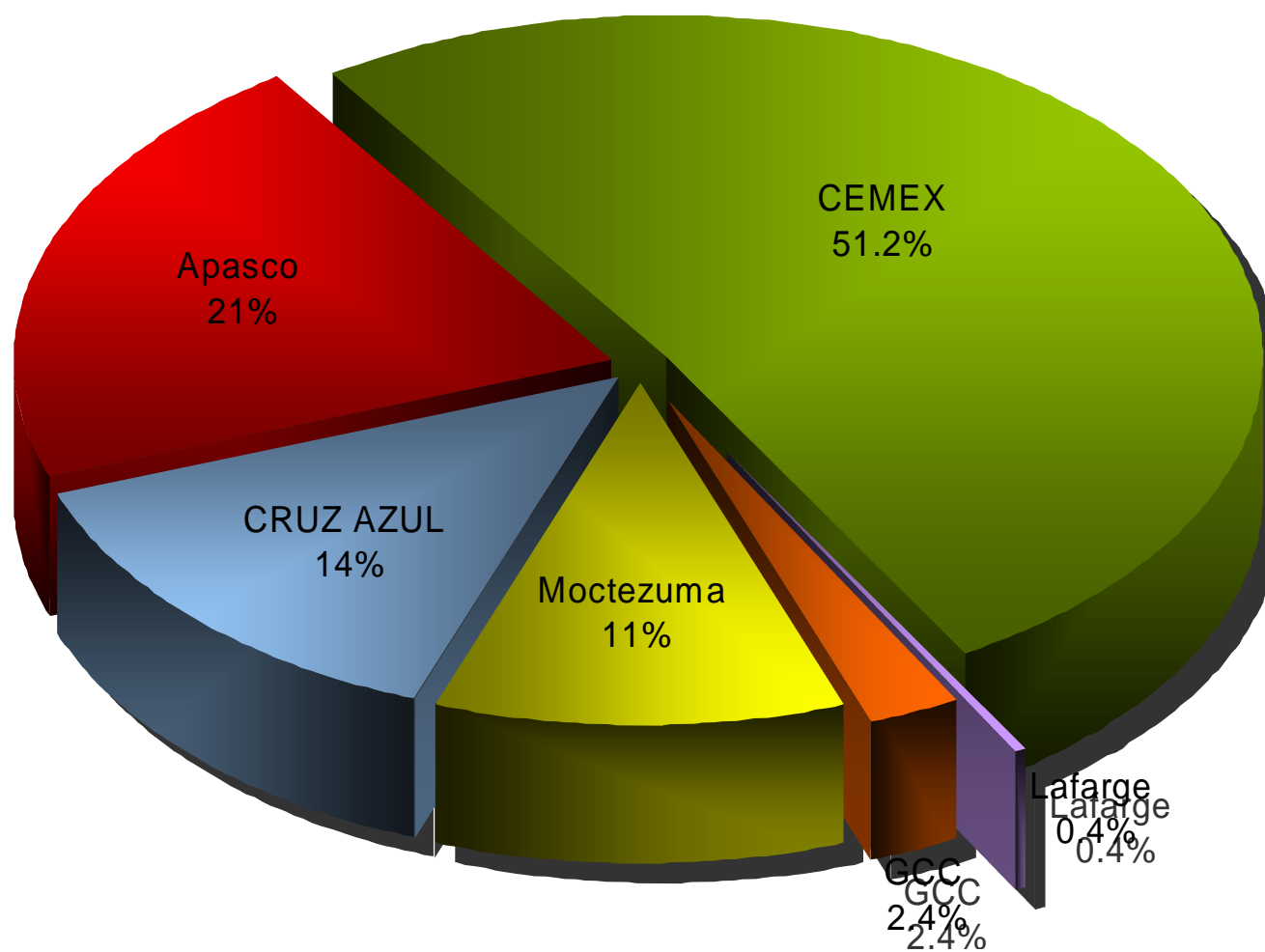


Employment



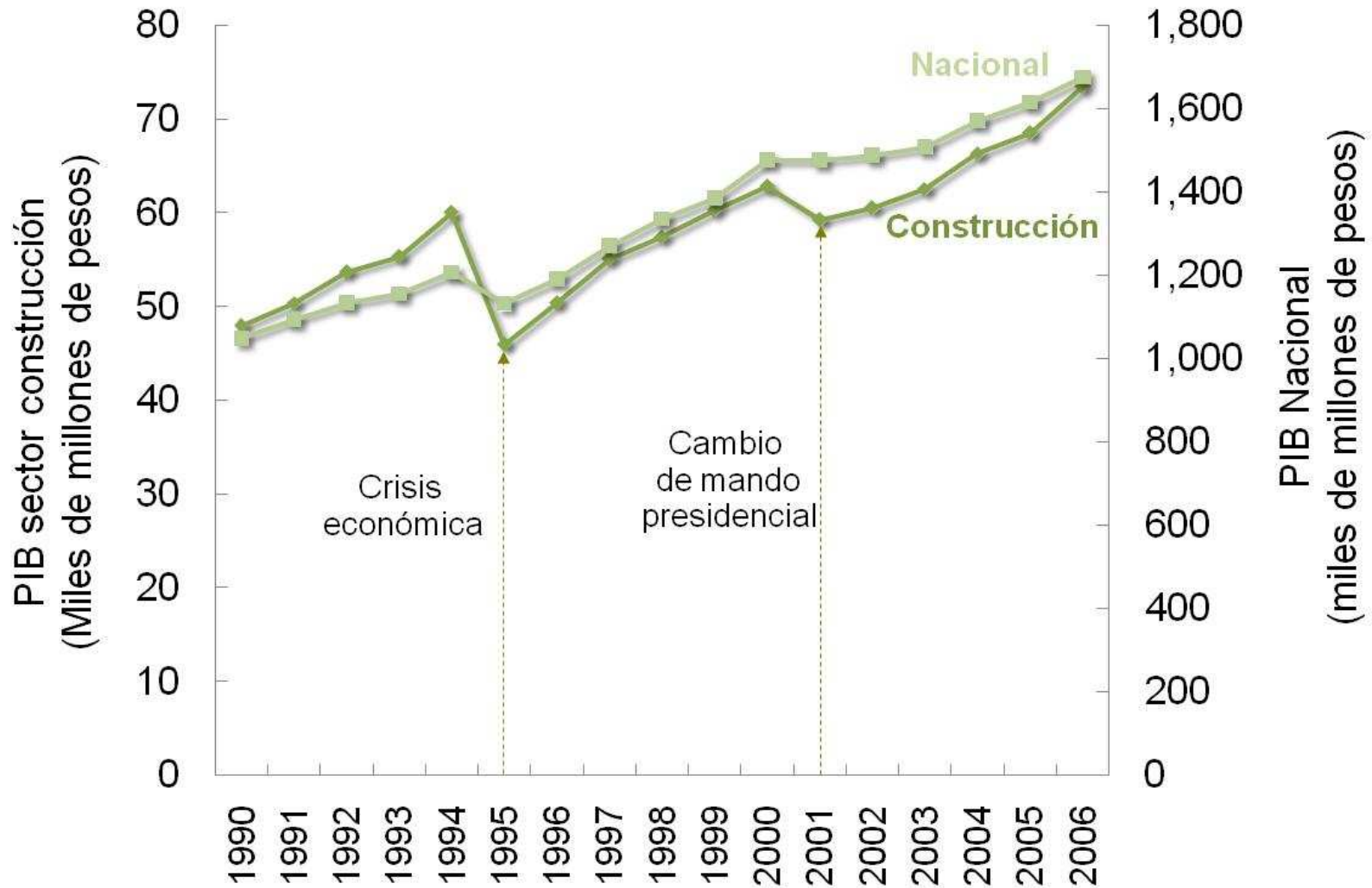
Source: INEGI

PARTICIPATION



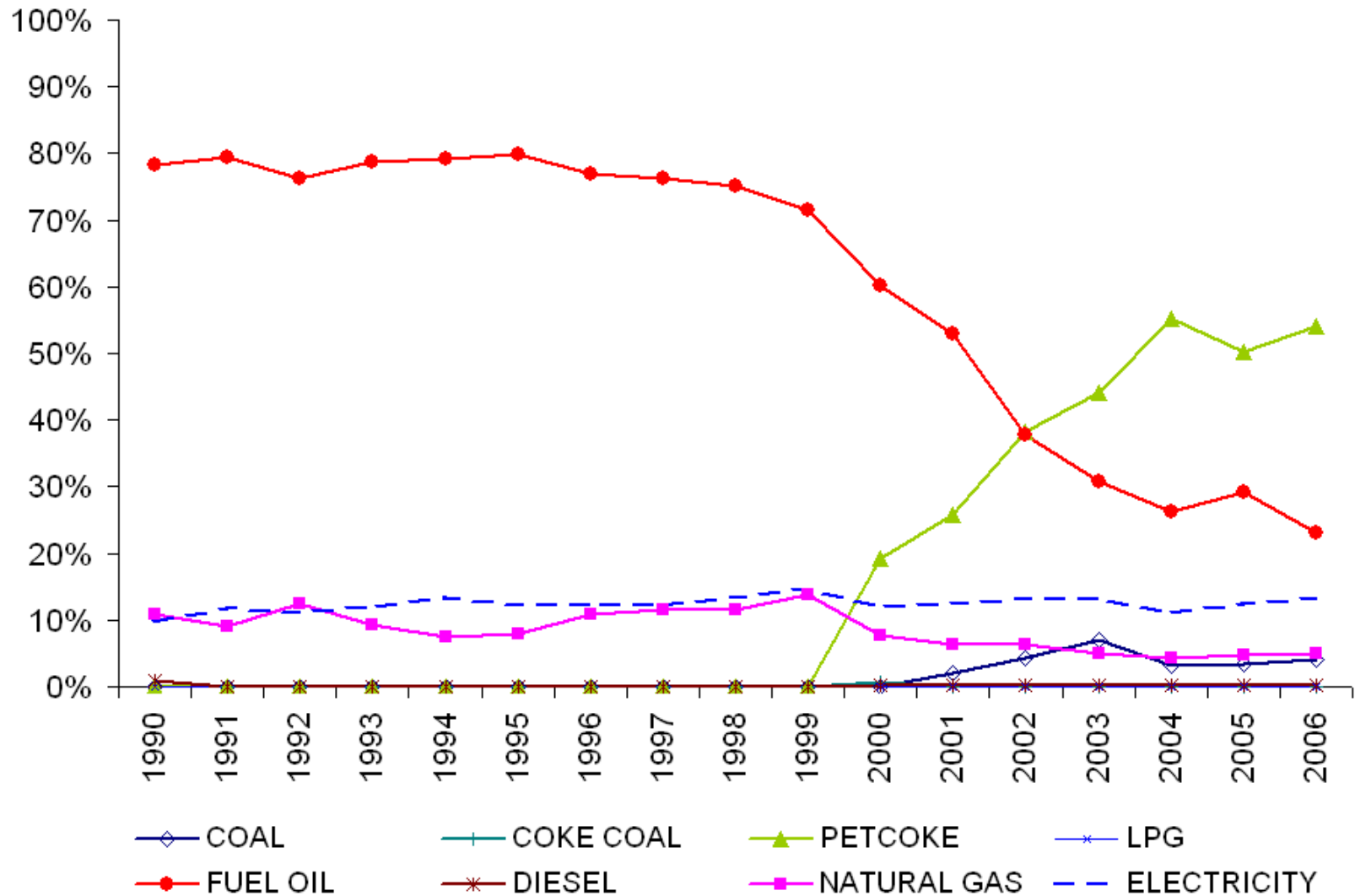
Source: JP Morgan, 2008

National and construction sector GDP (PIB)



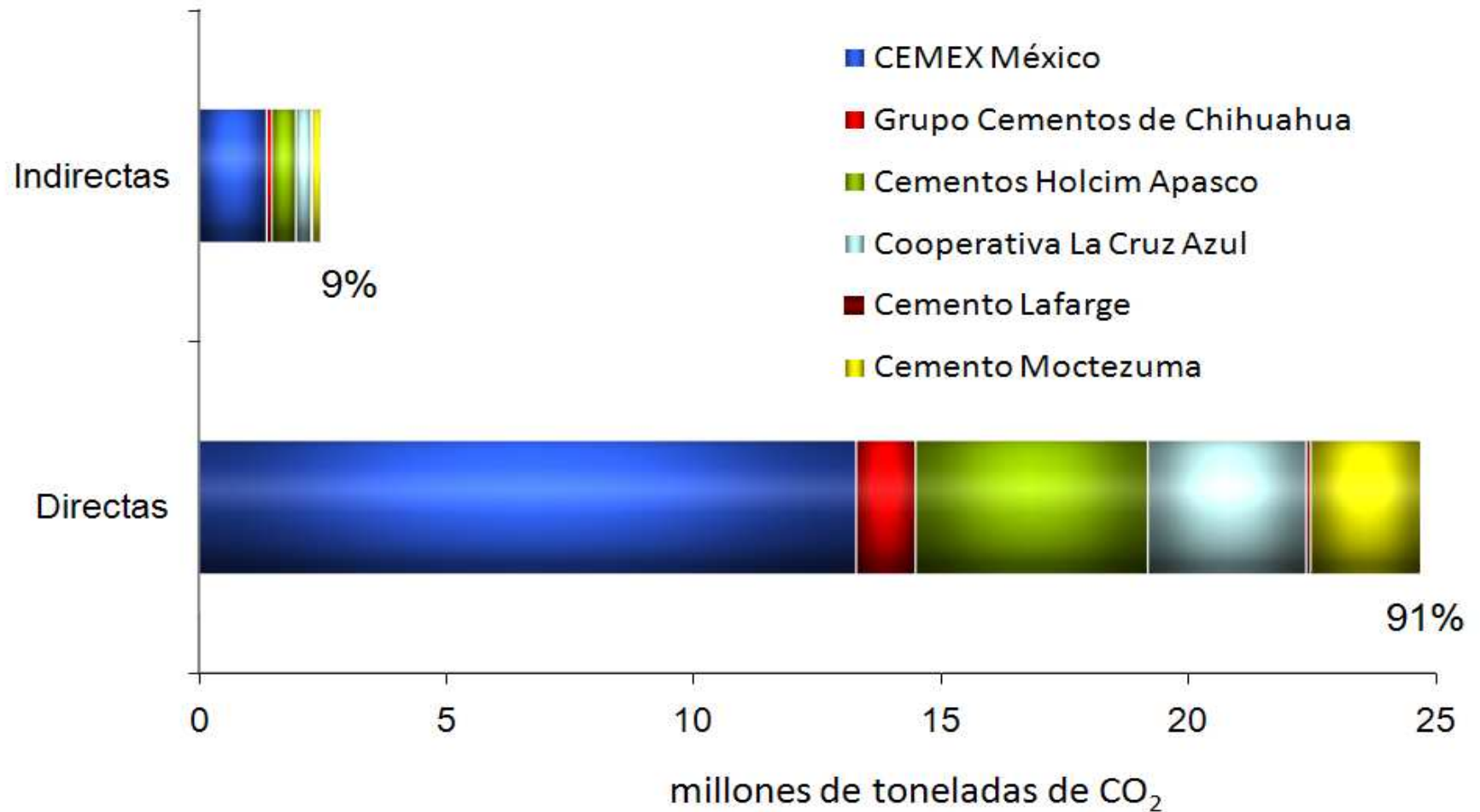
Source: INEGI

ENERGY CONSUMPTION



Source: SENER

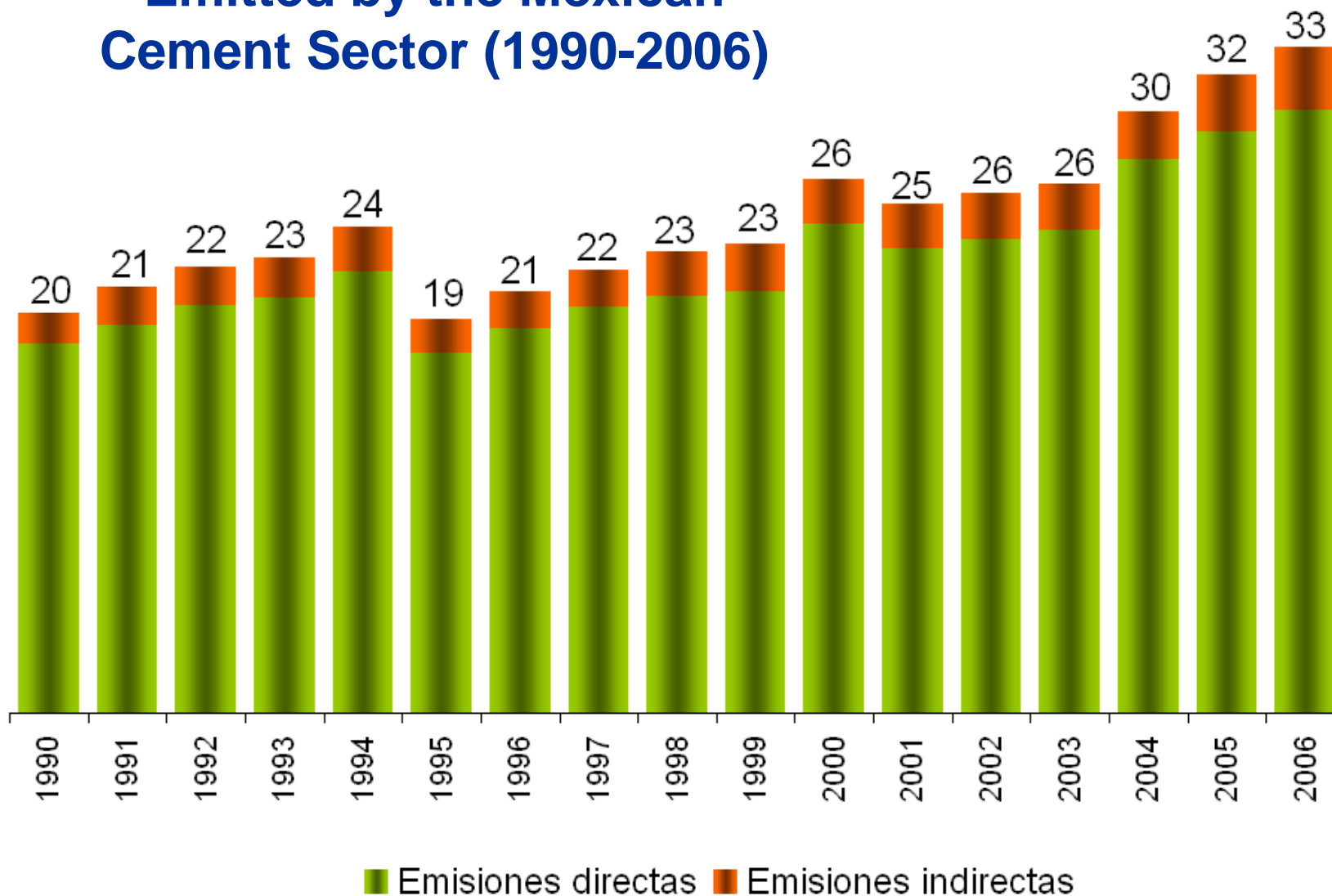
GHG Emissions 2005



27.2 million tons of CO₂

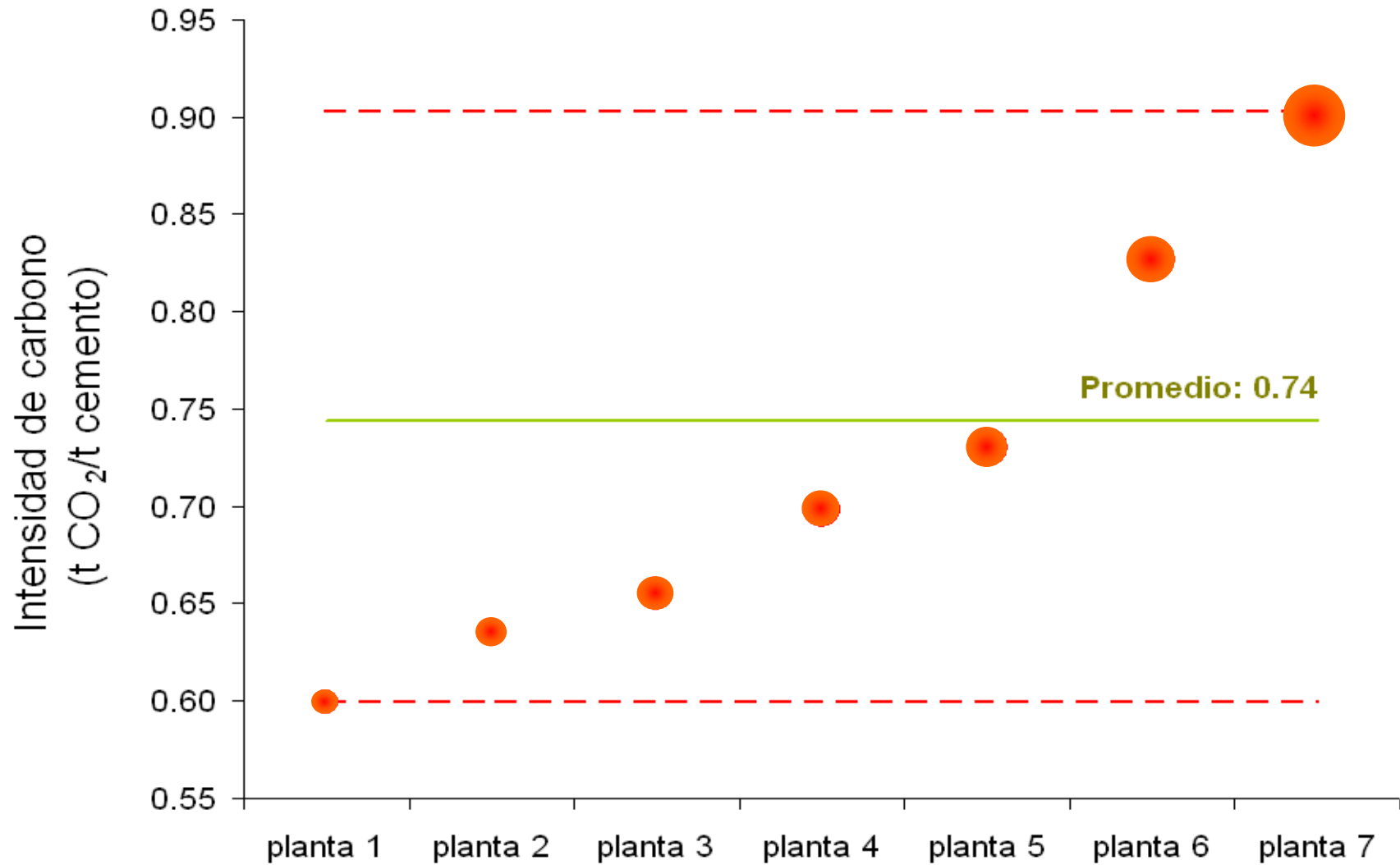
Source: GEI México Program, 2005

Million Tons of CO₂ Emitted by the Mexican Cement Sector (1990-2006)

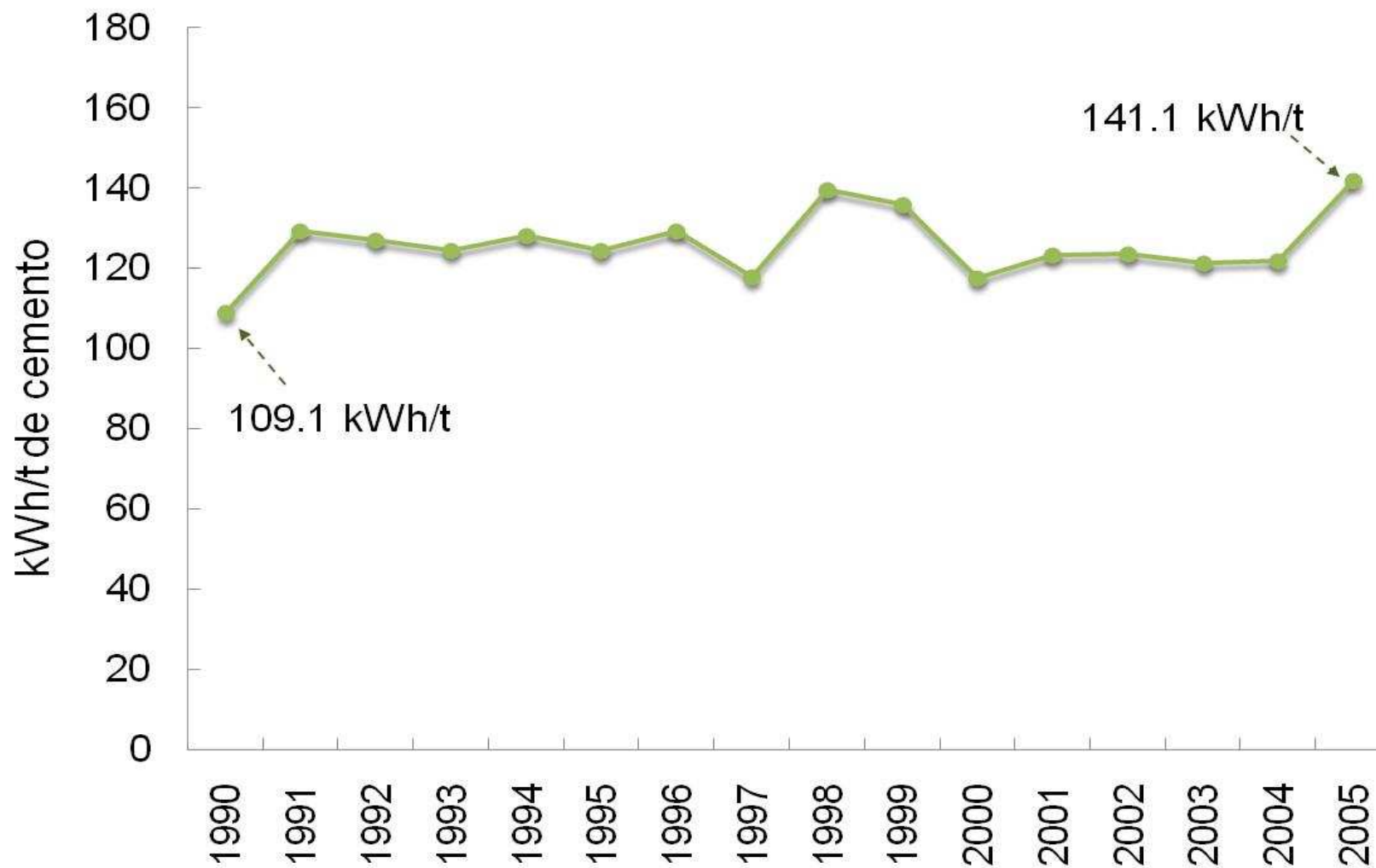


Source: CMM

CO₂ INTENSITY



ELECTRICITY INTENSITY



Source: CMM with data from SENER

ASSUMPTIONS PRE-2000 AND PRE-2006:

- HISTORICAL DATA FOR:
 - Energy Consumption
 - Cement Production
 - Population
 - Electricity Intensity
 - GDP of the Construction Sector
 - National GDP
 - National GDP projections from 2006-2030
- GDP: 3.5% average annual growth for the pre-2000 scenario and 3.25% for the recent policy scenario (pre-2006).

ADDITIONAL ASSUMPTIONS PRE-2006:

- *US-Mexico Agreement about Cement Trade.* Entered into force on April 3, 2006. In that year, 3 million tons of cement were exported. For 2007, 3.08 million tons were exported.
- *Growth of Housing in Mexico.* We assume a growth rate of 1.6% in the period 2005-2030.

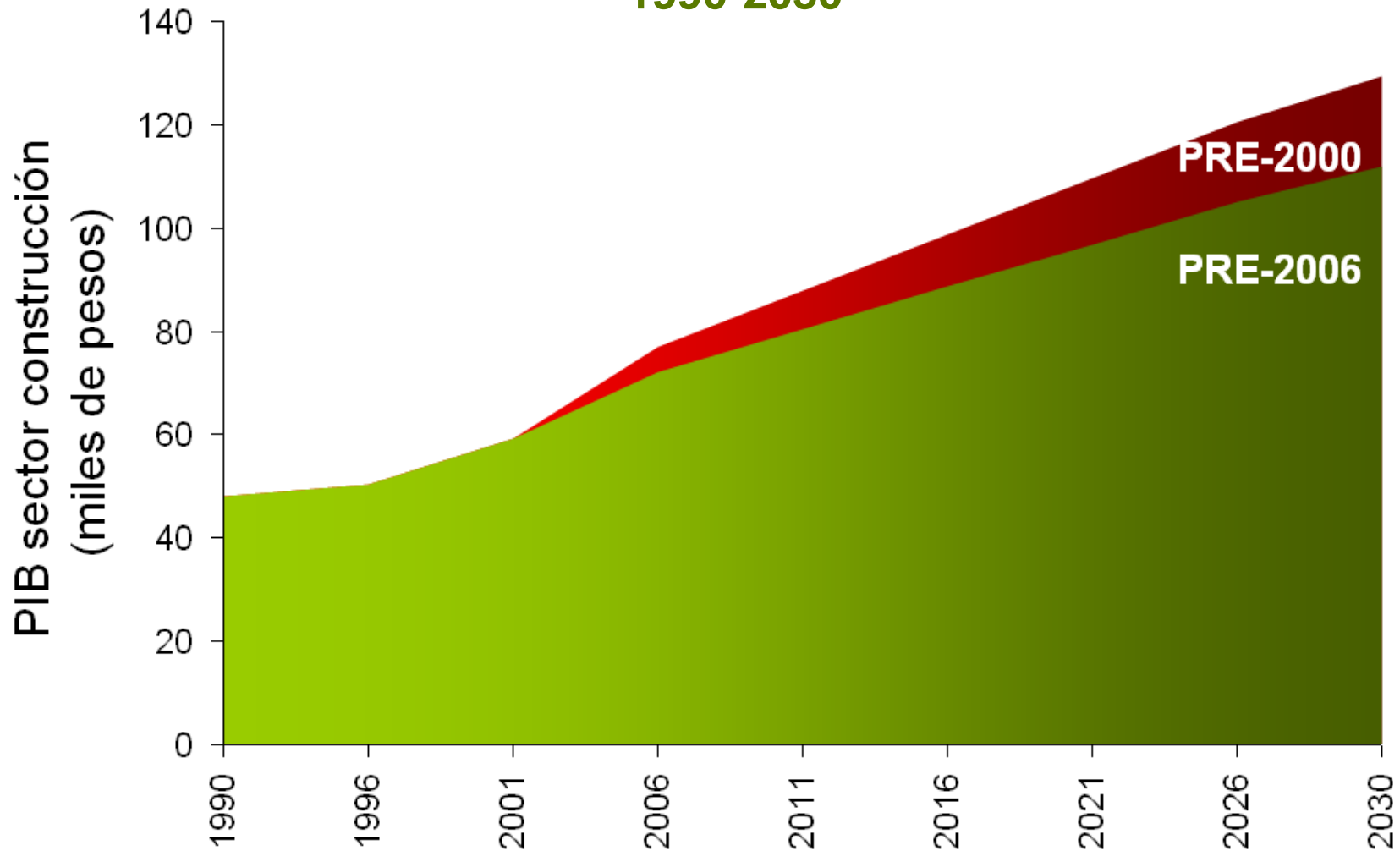
GDP and PRODUCTION (historical and estimated)

Year	GDP Construction Sector (millions of pesos)		Cement National Production (Mt)	
	PRE-2000	PRE-2006	PRE-2000	PRE-2006
1990	48,040		23.8	
1996	50,449		25.4	
2001	63,624	59,292	31	30
2006	76,938	72,032	36	43
2011	87,858	80,325	39	45
2016	98,779	88,618	42	48
2021	109,699	96,911	44	50
2026	120,620	105,204	47	53
2030	129,356	111,839	49	55

Baselines

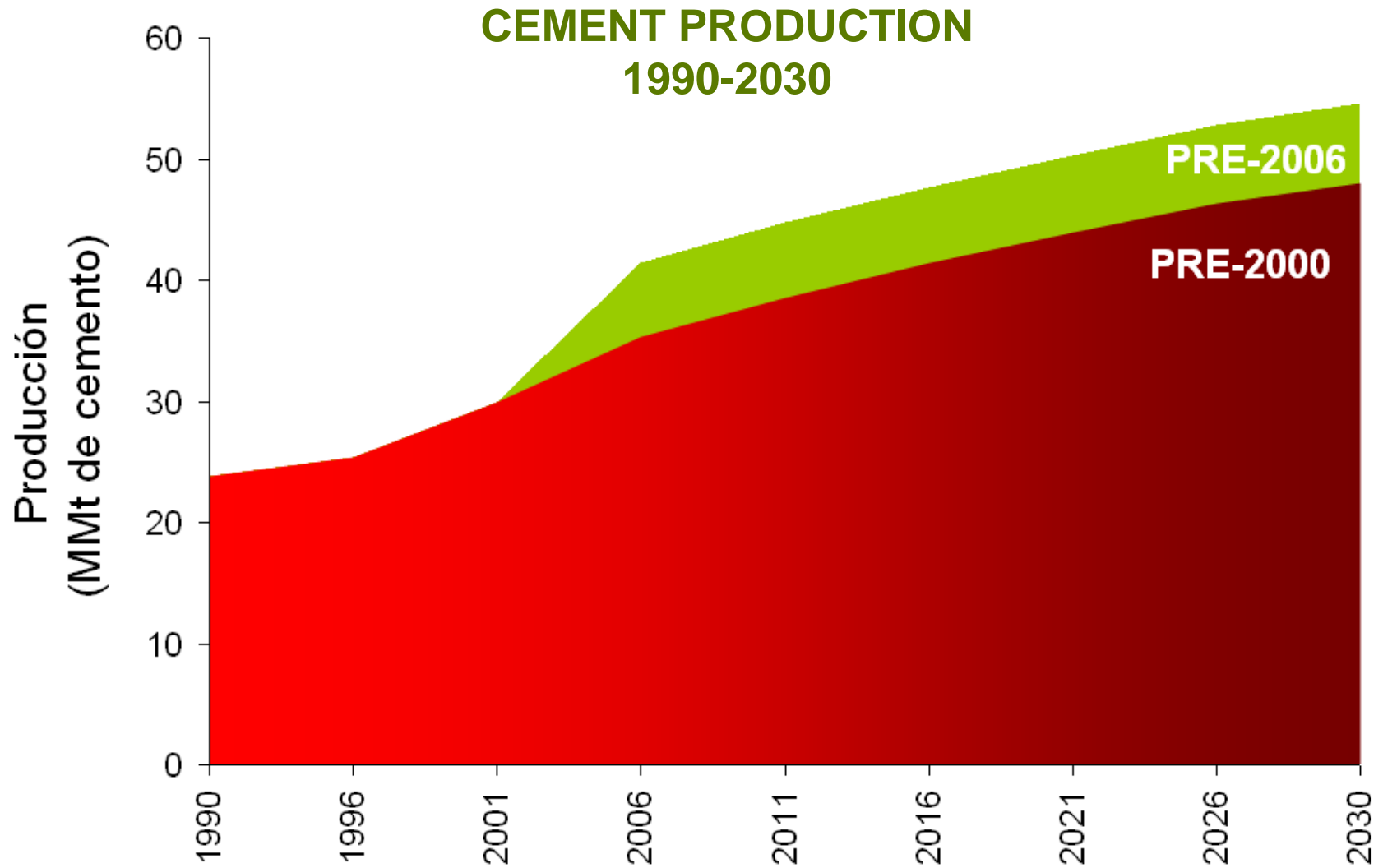


CONSTRUCTION GDP 1990-2030



Source: CMM

Baselines



Source: CMM

Mitigation Options



There are five basic strategies to reduce CO₂ emissions in cement production:

- ✓ 1. **Improve energy efficiency in the manufacture of cement**
- ✓ 2. **Substitute fuels with high carbon content of fuels by low-carbon (alternate fuels)**
- ✓ 3. **Alter the composition of cement using constituents that require less energy to obtain the clinker (cement mixed)**
4. **Capture and geological storage of CO₂**
5. **Auto and Co-electric generation**

Strategy 1: Improve energy efficiency in the manufacture of cement



a Energy efficiency from more efficient kilns

For this option, we assume energy savings of 1.6 GJ / ton clk by the year 2030. These savings reflect the difference between the current intensity (4.5 GJ / ton clk) and the shift to more efficient furnace (2.9 GJ / ton clk)

The investment cost is 7.9 U.S. \$ / ton clk, for a project duration of 30 years.

b Energy efficiency from more efficient equipment

We suppose it's possible to have an electricity intensity of 110 kWh / ton of cement in 2030. This corresponds to a reduction of 22% of the total consumption of electricity.

The total investment for this option is 4.37 U.S. \$ / ton of cement.

Strategy 2: Replace fuels with high carbon content with low-carbon fuels (alternate fuels)



Alternative fuels in kilns

The use of alternative fuels is a practice that now takes place in the cement industry in Mexico with increasing frequency. For this option, we assume that this trend will continue until becoming 15% of the total energy in 2030.

The composition of the waste in this 15% will be: 20% tires, 40% solid waste and 40% liquid waste (these percentages of waste were obtained from historical data of energy consumption from SENER).

With regard to costs, introducing this mitigation option is estimated to cost U.S. \$ 0.81 / tire, 26.3 U.S. \$ / ton of solid waste, and 25.5 U.S. \$ / liter of liquid waste (at 2000 prices). The high cost of the solid and liquid waste is because we assume the cement industry will cover transportation costs, which is currently not the case.

Strategy 3: Modify the composition of cement using constituents that require less energy to obtain clinker (blended cement)



Cement mixed in the replacement of clinker

For this option, we assume that in 2030 there will be a reduction of 7.7% in the production of clinker in Mexico; that is, at present the proportion of clinker on average is 81%, and in 2030, we assume that it will be 74%.

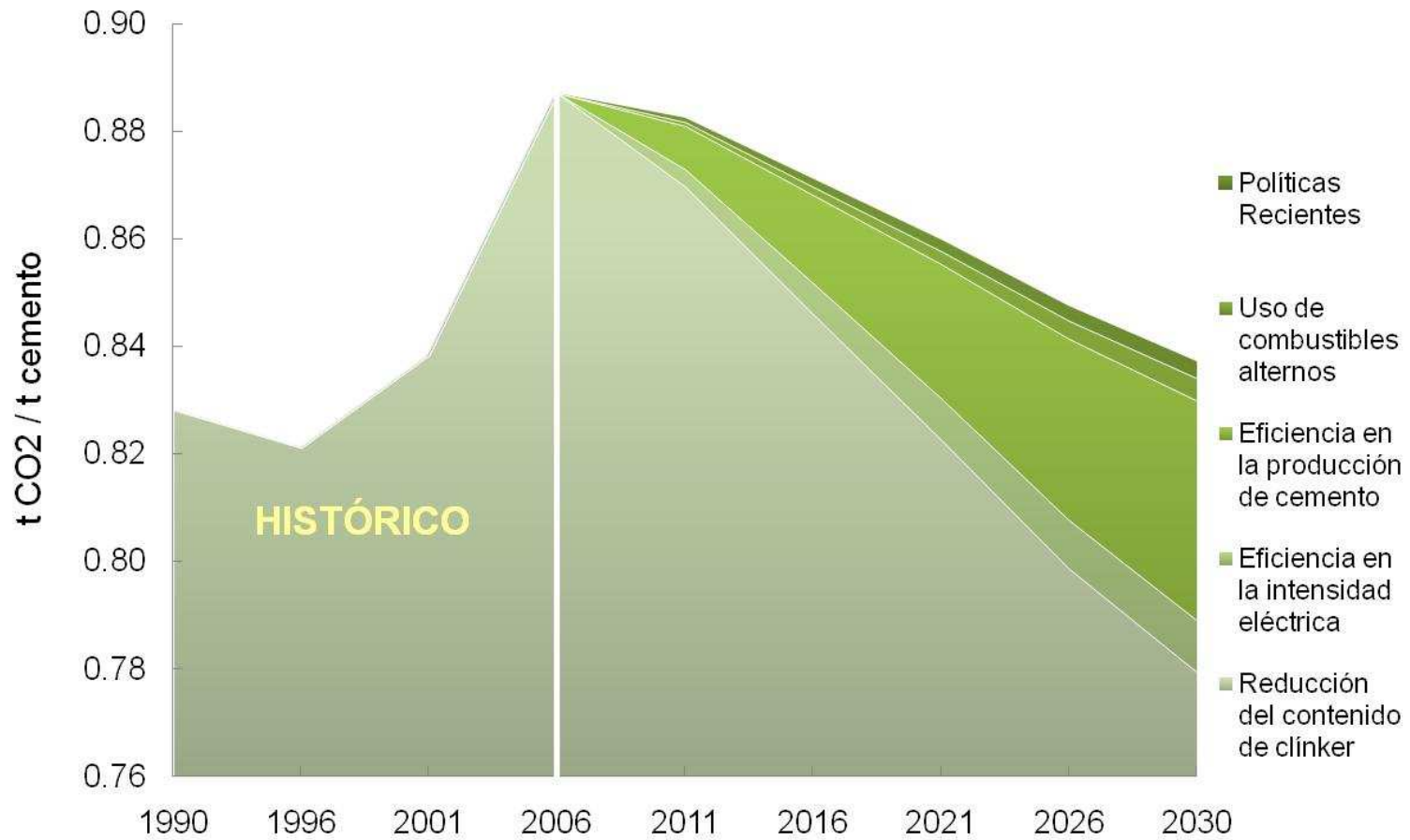
We assume that the material to replace the clinker is the so-called *fly ash* (or that a similar material in terms of physical and chemical properties and cost will cover the demand).

The estimated cost for the introduction of this option is 105 U.S. \$ / ton of additive (at 2000 prices), including transportation of the product.

RESULTS

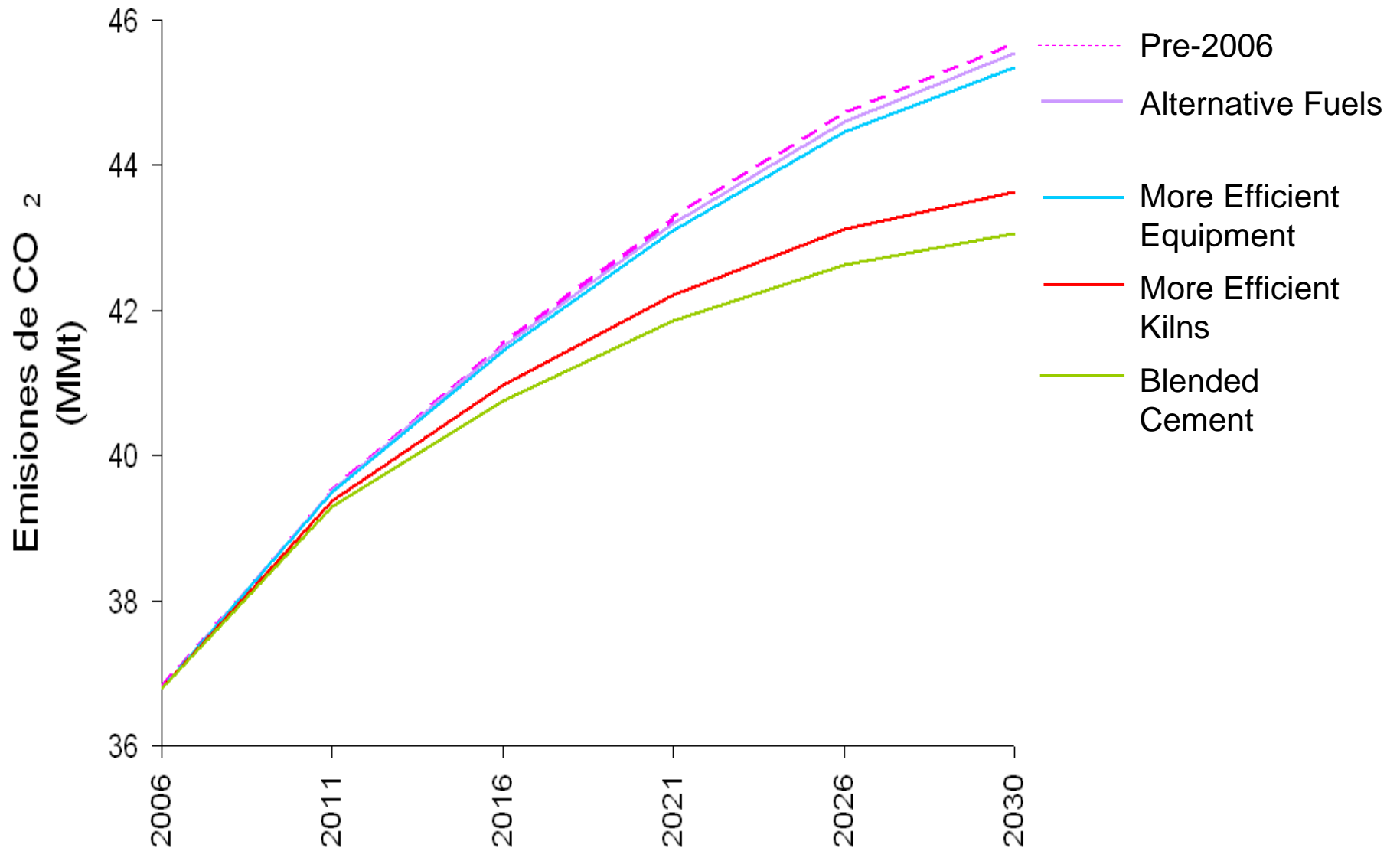


CARBON INTENSITY (ton CO₂/ton cement)

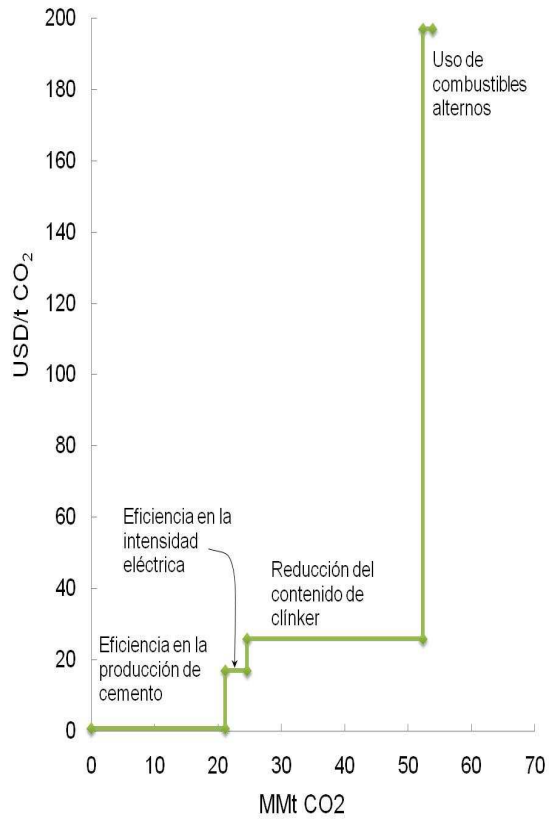


Source: CMM

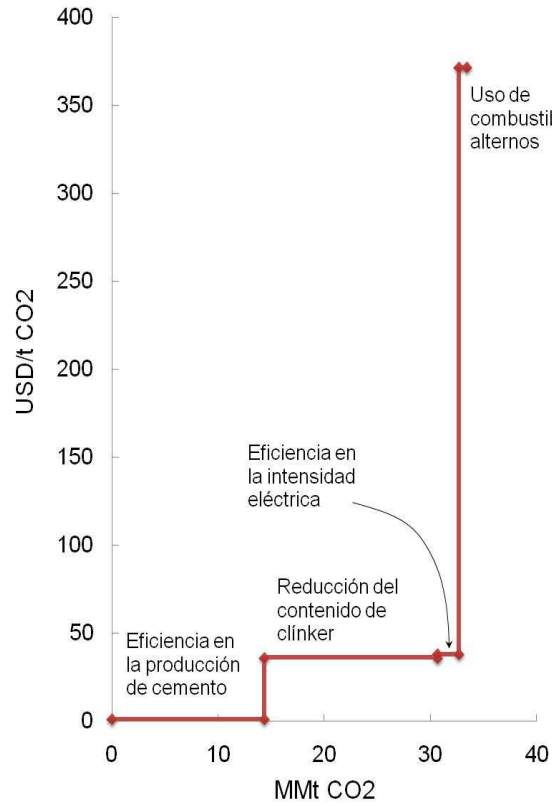
CO₂ EMISSIONS FOR A MITIGATION STRATEGY



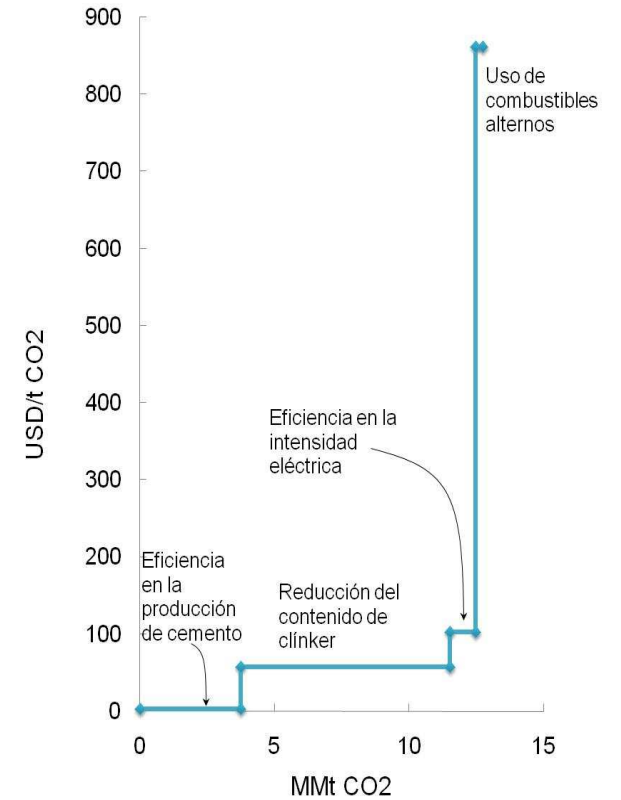
Costs



2010

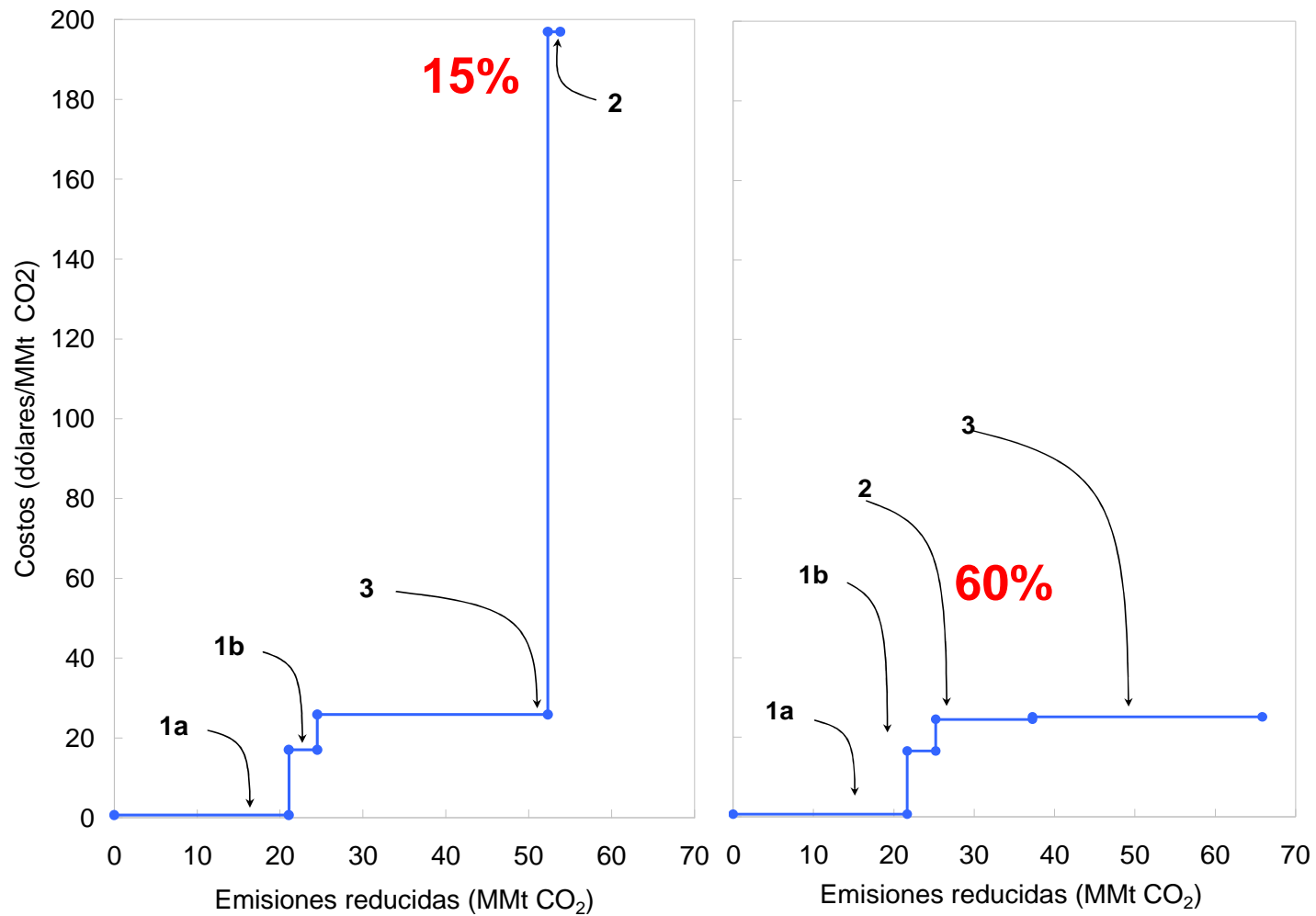


2015



2020

Percentage options for use of alternative fuels



2010

Barriers



The availability of renewable resources (alternate fuels and additives for the replacement of clinker) is a barrier because in the country there is no infrastructure and regulations to encourage the substitution.

There is no guarantee of quality and availability of alternative waste as a whole to meet the demand of plants operating in Mexico, besides the absence of tax incentives for plants that use such resources.

There is no law that requires the energy sector to use more efficient technologies and replace their older equipment. We assume that these actions are carried out and depend on each company.

Barriers



The sector does not provide or release estimates of future growth and CO₂ emissions, nor mitigation strategies for each cement production facility, although it is important to mention that the sector voluntarily reports its annual GHG emissions.

The image of the cement sector within society is not good, due to the burning of waste in its cement kilns and the generation of atmospheric contaminants that this produces.

Finally, there is no database for each operating plant that contains the type of technology, percentage of clinker, sales, etc., which would enable the performance of a more accurate analysis for this sector.

Actions



- Adapt the regulatory framework to promote the use of alternative fuels
 - Fiscal incentives program
 - Reduce emissions in the cement sector
 - Apply the test protocol to all cement plants so as to ensure their compliance in terms of air and waste
 - Voluntary program of information on atmospheric emissions from cement plants
 - Incentivize research and development in energy efficiency, the use of renewable sources of energy and reduction of GHGs
 - Accessible information
-



**centro
mario
molina**

Paseo de los Laureles No 458 Despacho 406,
Col Bosques de las Lomas
México, D.F.
(+52.55) 9177.1670
www.centromariomolina.org