Hazardous Waste and Tire Incineration in the U.S. and Mexican Cement Industries: Environmental and Health Problems

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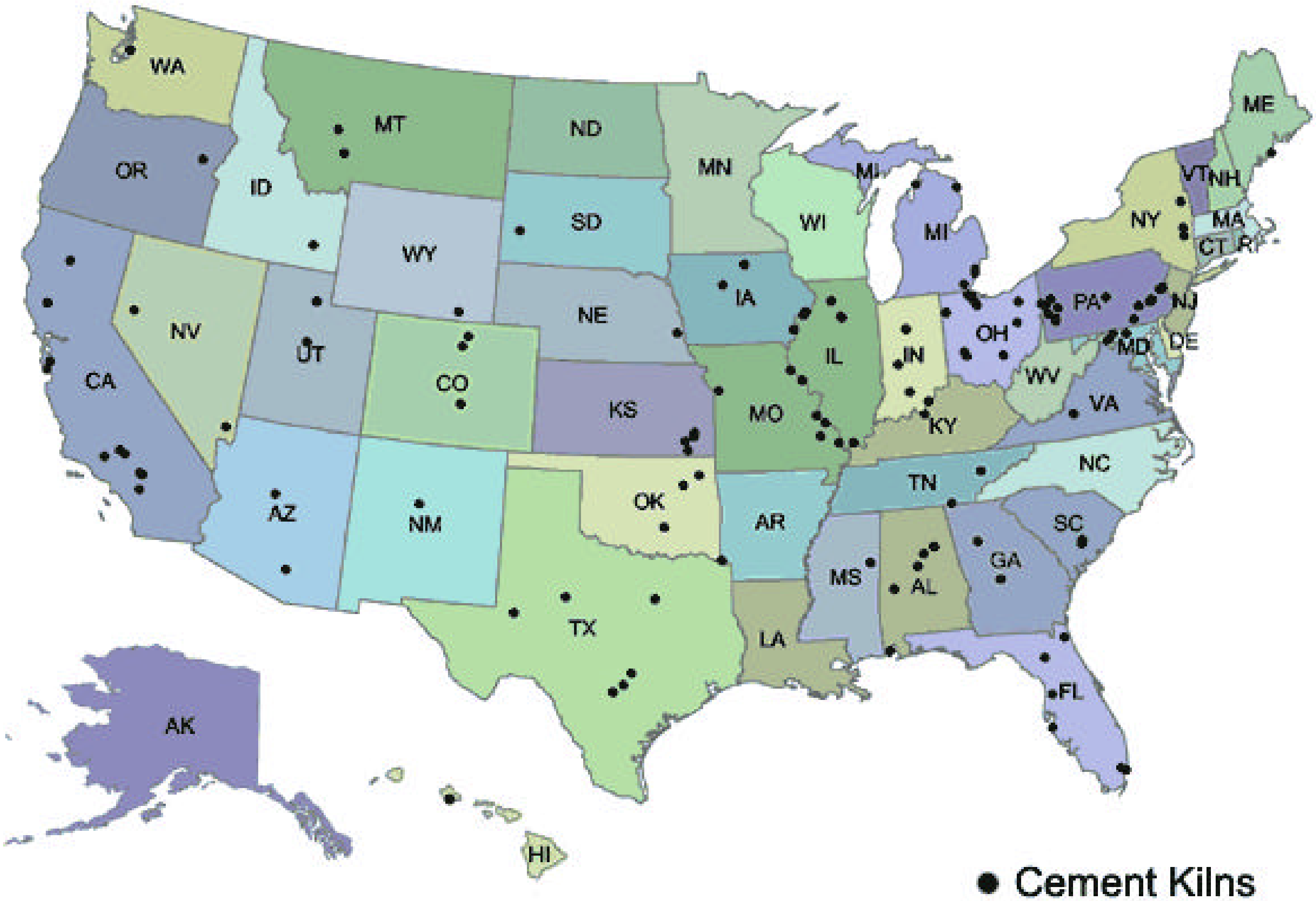
(Nov 2005; updated Nov 2007)

www.EnergyJustice.net/cementkilns/

Cement Processing in US



Source: *Map*, EarthJustice (http://www.earthjustice.org/news/cement_kilns/cement_kilns.html),
List of Plants, EPA Dec 31st, 1997 (http://www.epa.gov/ttn/atw/pcem/plantlis.pdf),
Original List, US and Canadian Portland Cement Industry: Plant Information Summary, 2003 (For Purchase)

Cement Plants in Mexico

- 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

Source: “Energy Use in the Cement Industry in North America, Emissions, Waste Generation and Pollution Control, 1990-2001,” 2003, p11. (http://www.cec.org/files/pdf/ECONOMY/Session1-2-Jacott-Reed-Winfield_en.pdf)

Making Cement

- Entire process is environmentally destructive
  - Extraction and mining of limestone
  - Transportation of materials
  - Combustion in kilns
  - Toxic ash (cement kiln dust)

- Cement Kilns
  - Very energy-intensive, especially wet kilns.
  - Major air pollution sources, even when only burning fossil fuels. Worse when burning tires or hazardous waste.

Cement Production Process

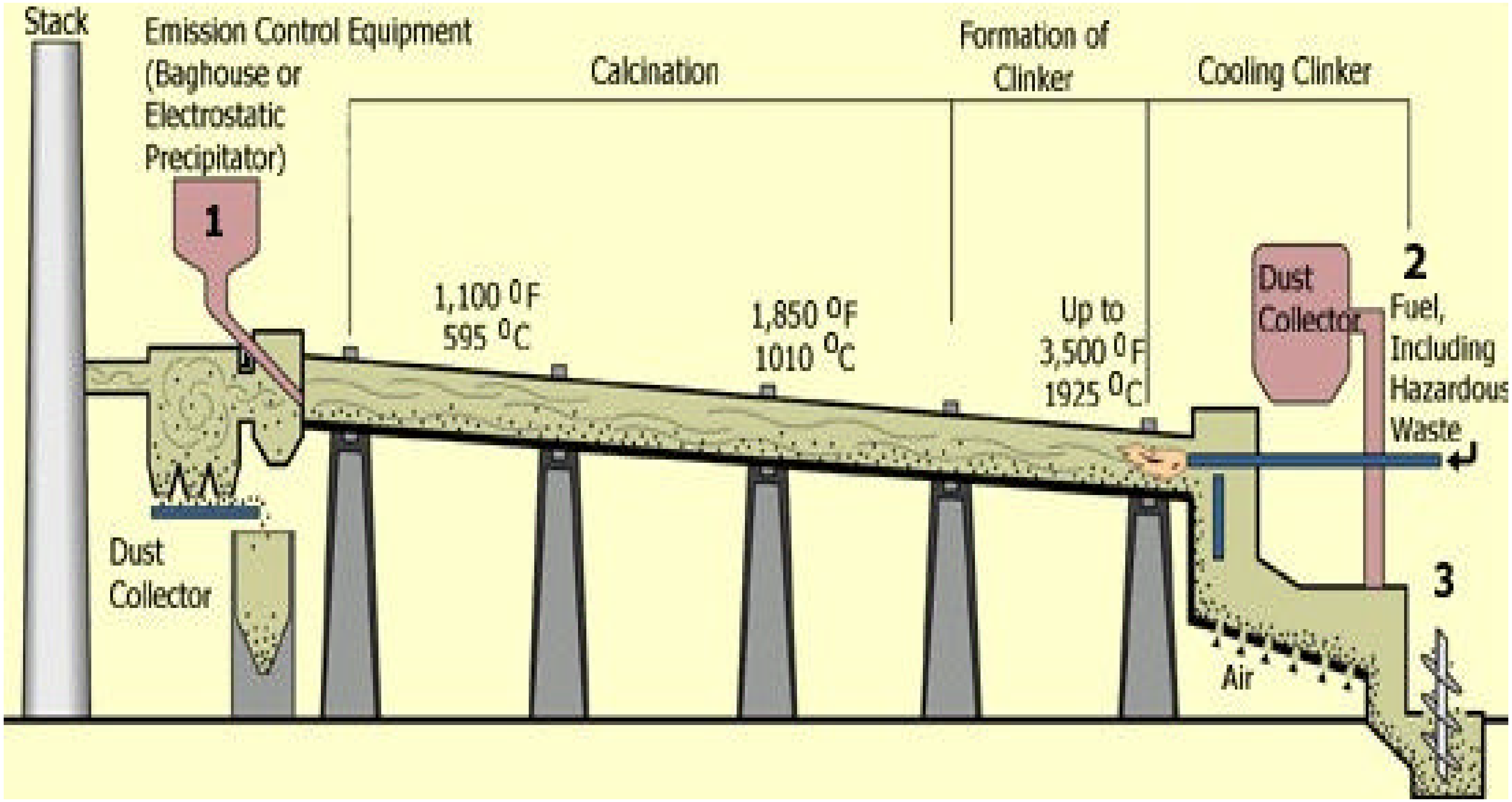
- Extraction of prime materials: limestone (70%) and other materials like clay, aluminum oxide, iron, shale and silica.
- Materials are ground and stored separately.
- Material is measured to achieve a specific combination, depending upon the type of cement desired, and ground to produce a very fine powder. Powder is pumped to silos, where the blend is standardized.
- The blend is placed in long, rotating kilns, where it is heated at high temperatures (approximately 1,500 degrees centigrade), causing chemical and physical reactions. This process where heat is used to break down the material is called "calcination." A new material is formed, which is called pre-cement or "clinker," which are composed of small balls about the size of a nut.
- The clinker is ground up, combined with gypsum and packaged. When this product – cement – is mixed with sand, stone, other materials and water, concrete is produced.
- The calcination process, turning the limestone into clinker in the kiln, is the fundamental step described above. This process requires a substantial amount of energy, provided by the burning of fuels, which are injected at the opposite end of the kiln, and it represents the major economic cost in cement production.

Wet and Dry Process Kilns

- **Wet Process (old process)**
  - Material ground using a rotating ball mill with water
  - Resulting slurry is fed to rotary kiln
  - Processing temperatures of 1450°C
  - Uses more energy (burns more fuels) than dry process
- **Dry Process (new process)**
  - Material ground using a rotating ball or vertical roller mill
  - Resulting kiln feed blended and sent to a preheater tower and rotary kiln
- For both – rotary kiln fired with energy-intense flame
- "Clinker" is cooled for handling

Source: Essroc Italcementi Group (http://www.essroc.com/default.aspx?pageid=183)

Dry Process of a Cement Kiln



Source: Texas Environmental Profiles (http://www.texasep.org/html/wst/wst_4imn_incin.html)

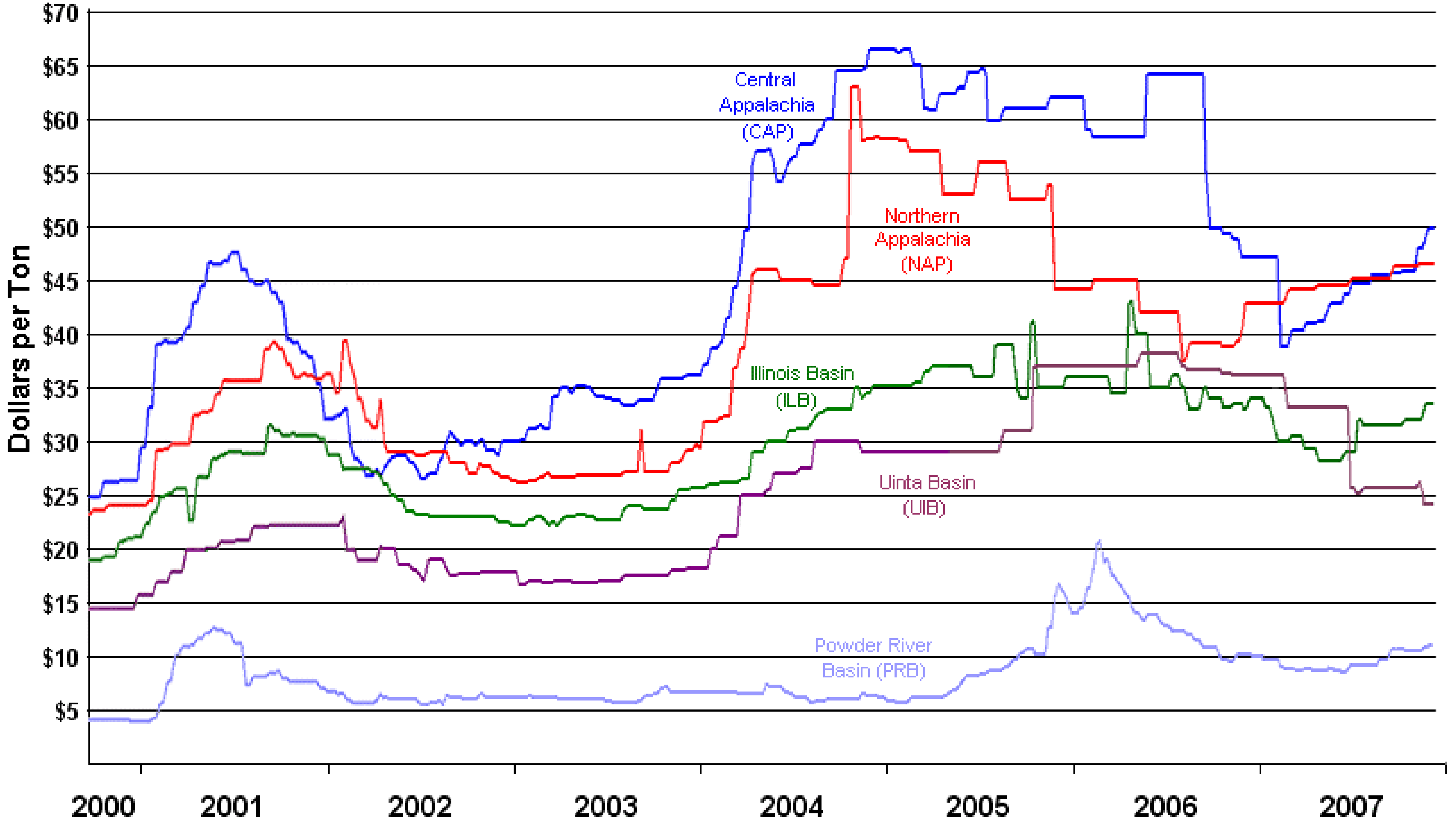
Energy Use in Cement Kilns

- One ton of cement requires an average of 4.4 million Btu
- Equivalent to 400 pounds of coal
- Types of Fuel Used
  - Coal
  - Oil
  - Petroleum coke
  - Natural gas
  - Hazardous Waste
  - Tire Derived Fuel
  - Municipal Solid Waste
  - Plastics
  - Sewage Sludge

Source: American Lung Association (http://www.mindfully.org/Air/Cement-Kilns-Burning-Waste4.htm)

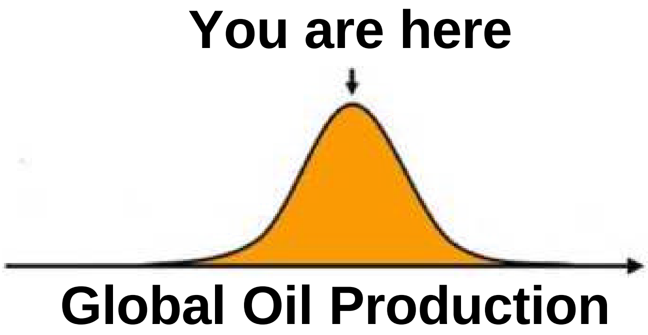
Fossil Fuels Becoming Expensive

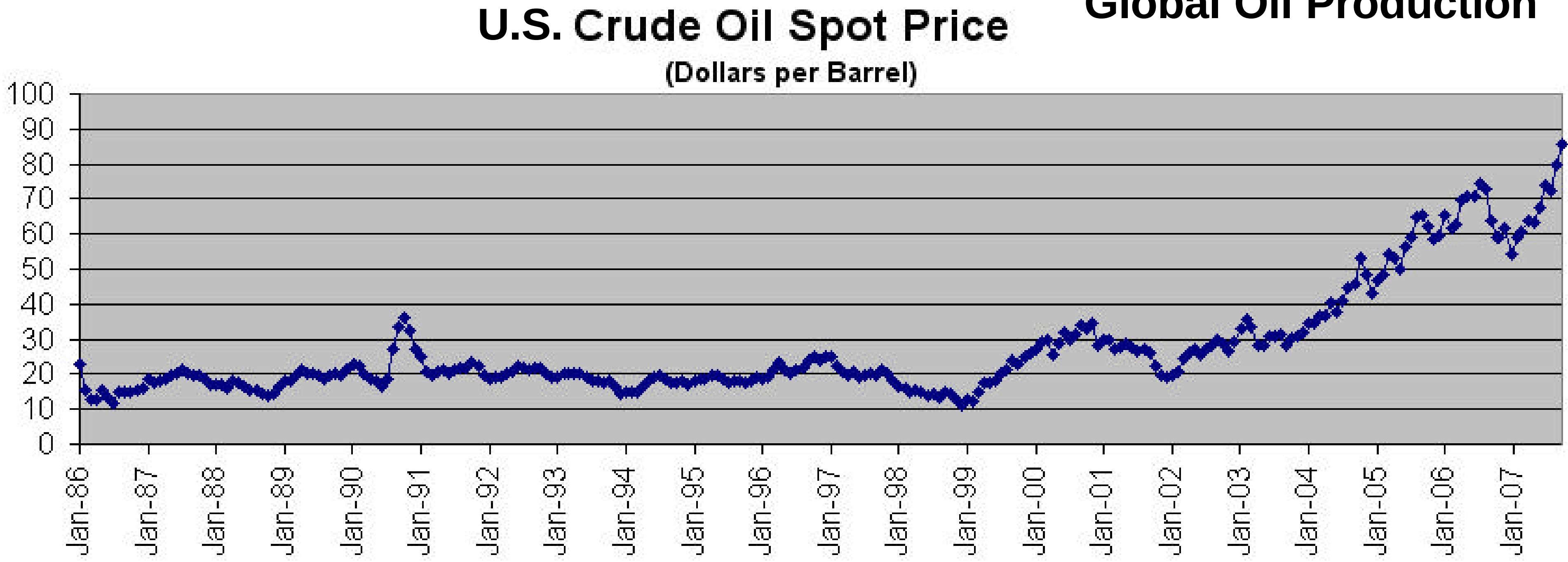
- Coal prices climbing as global demand increases (U.S., China…), partially due to rising oil and gas prices



Fossil Fuels Becoming Expensive

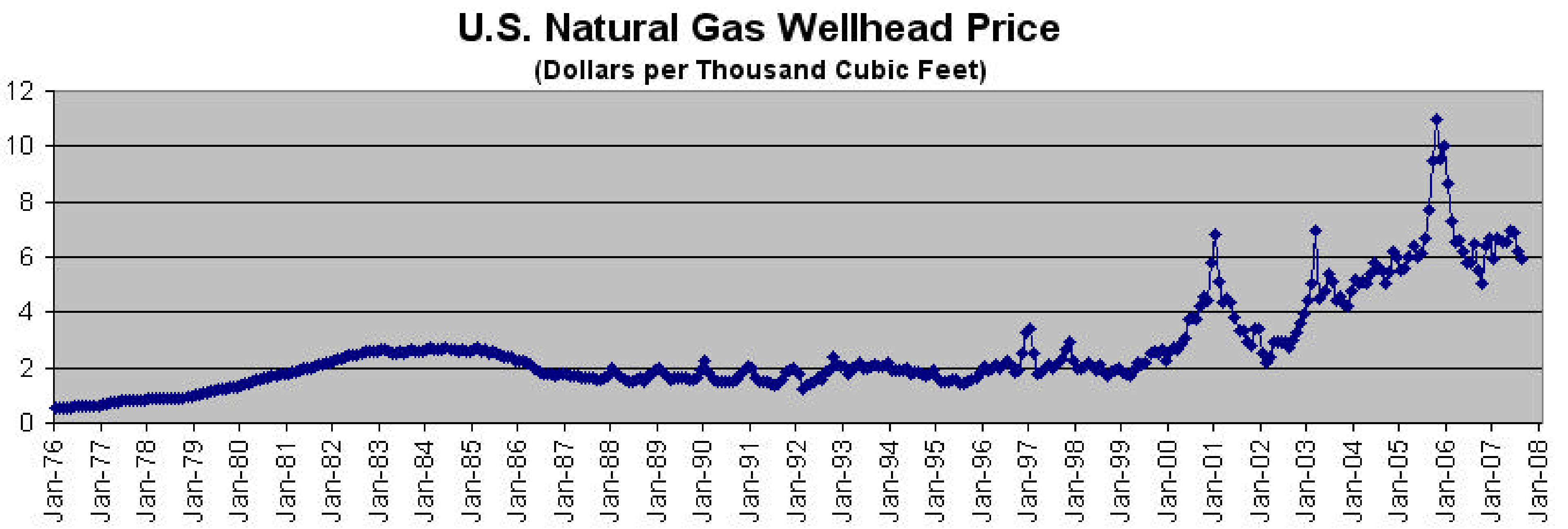
- Oil production is peaking globally, meaning supply can no longer meet increasing demand, causing prices to rise





Fossil Fuels Becoming Expensive

- Natural gas production peaked in North America; will peak globally around 2020
- Prices have tripled in recent years
- Mexico used to export gas to the U.S. and now imports from U.S.

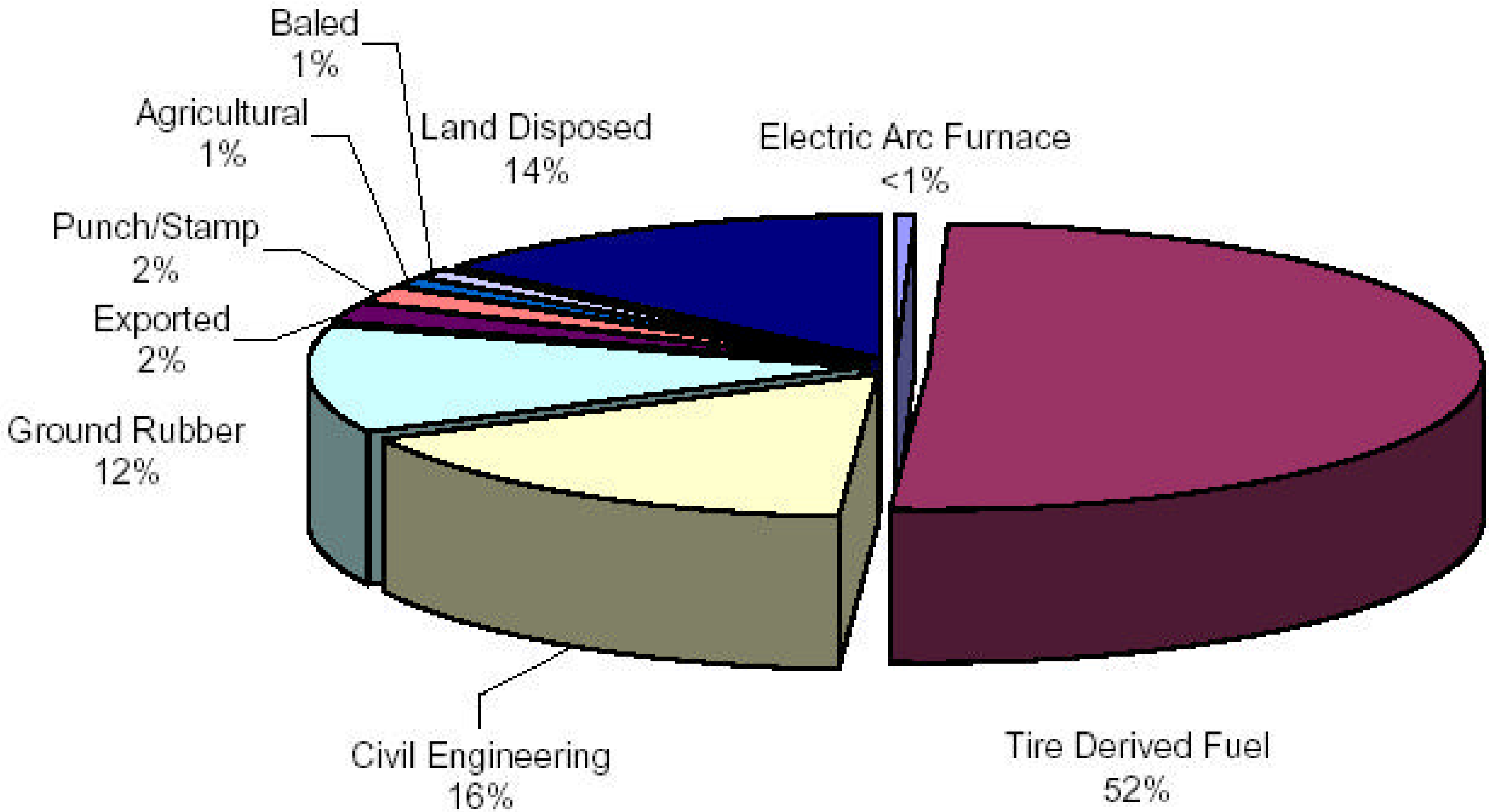


Why use Alternative Fuels?

- Diversify Fuel Use
- Tax Incentives
- Government grants and loans
- Environmental “Benefits”
- Waste Disposal Profits

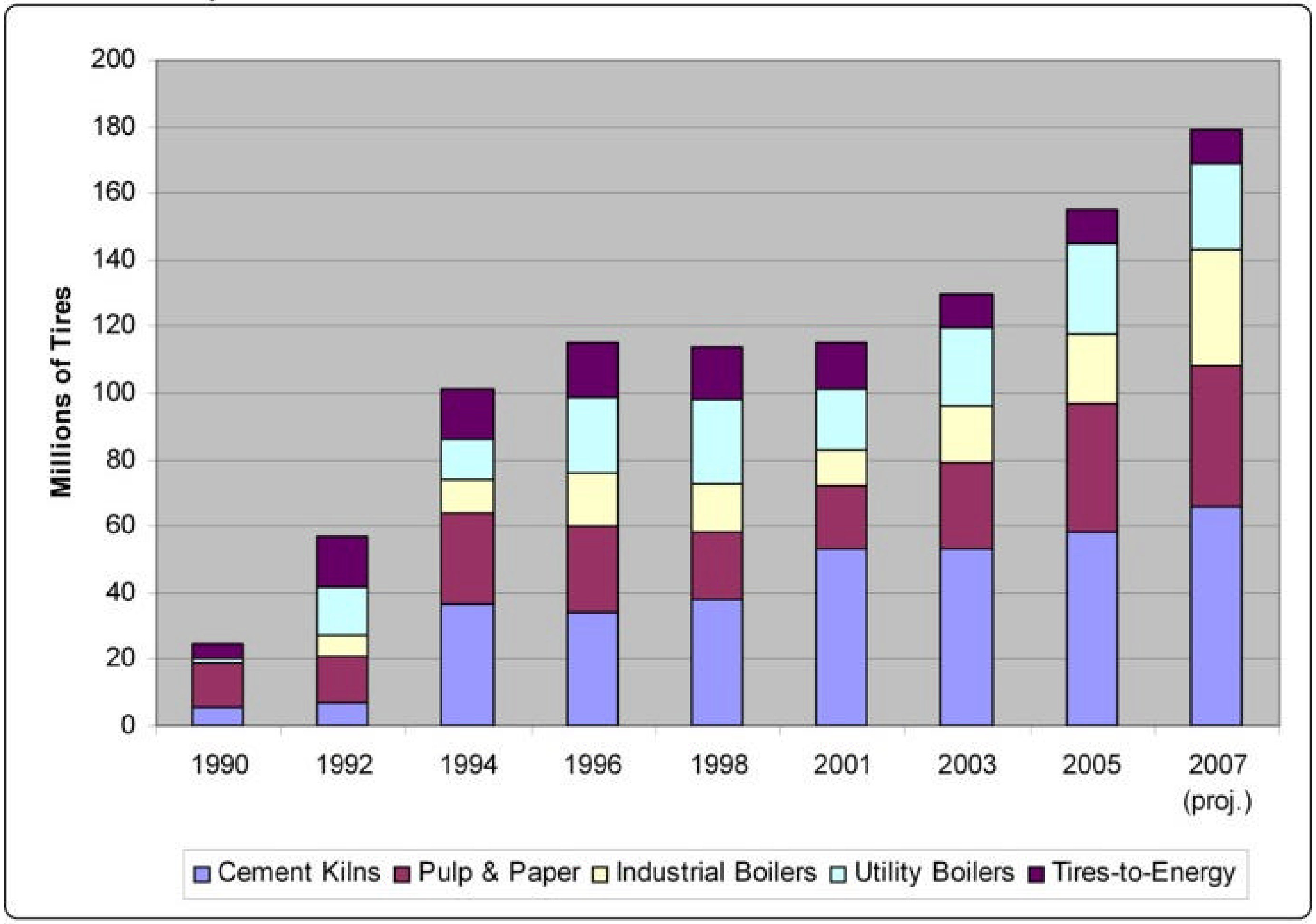
Tire Incineration in U.S.

- 52% of U.S. scrap tires are burned



Tire Incineration Increasing in U.S.

U.S. Tire-derived Fuel Market Distribution Trends, 1990 – 2007



2005 US Scrap Tire Market Summary

(millions of tires)

Tire-Derived Fuel (TDF)	
Cement Kilns	58.0
Pulp & Paper Mills	39.0
Electric Utilities	27.0
Dedicated Tire Incineration	10.0
Industrial Boilers	21.0
Total TDF	155.1
Products	
Ground Rubber	37.5
Cut/Punched/Stamped	6.1
Civil Engineering	49.2
Misc./Agriculture	3.1
Electric Arc Furnaces	1.3
Export	6.9
TOTAL USE	259.2
TOTAL GENERATION	299.2

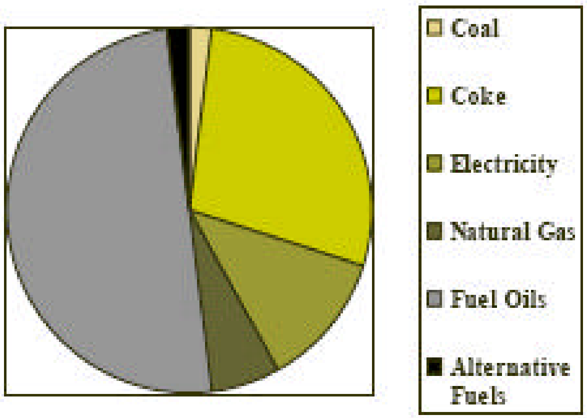
- 37% of U.S. tire burning is done in cement kilns
- U.S. Cement kilns burn 19% of all U.S. scrap tires
- These are also very polluting and have been fought by community groups

Cement Kiln Incineration in Mexico

- Early 1990s – cement companies allowed to burn "alternative fuels" on one-year authorizations
- 1996 – SEMARNAT signs agreement with cement companies to continue allowing waste burning and to develop standards
- 2001 – agreement with cement industry is extended
- Dec 2002 – official standards for burning "alternative wastes" approved
- Nearly all cement kilns now allowed to burn 5%-30% alternative fuels
- Currently six cement kilns in Mexico that are burning tires:
  - CEMEX Ensenada
  - CEMEX Hermosillo
  - CEMEX Monterrey
  - CEMEX Colima
  - Cementos Apasco plant in Apaxco
  - Cementos de Chihuahua plant in Samalayuca

Fuels in Mexican Cement Industry

- 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

Source: "Energy Use in the Cement Industry in North America, Emissions, Waste Generation and Pollution Control, 1990-2001," 2003, p12. (http://www.cec.org/files/pdf/ECONOMY/Session1-2-Jacott-Reed-Winfield_en.pdf)

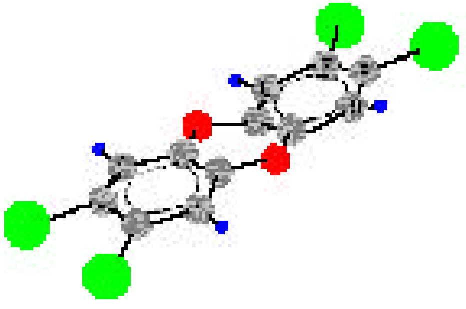
Alternative Fuels in Mexican Cement Industry

Used Oils and Solvents	Resins
Bottoms of Distillation Columns	Textiles
Paints, Thinners, Varnishes	Leather
Contaminated Hydrocarbons	Rubber
Greases and Waxes	Woods
Organic and Refining Sludge	Plastics
Perforation Cuts	Papers
Contaminated Solids	Tires
Used Catalytic Converters	Contaminated Soils

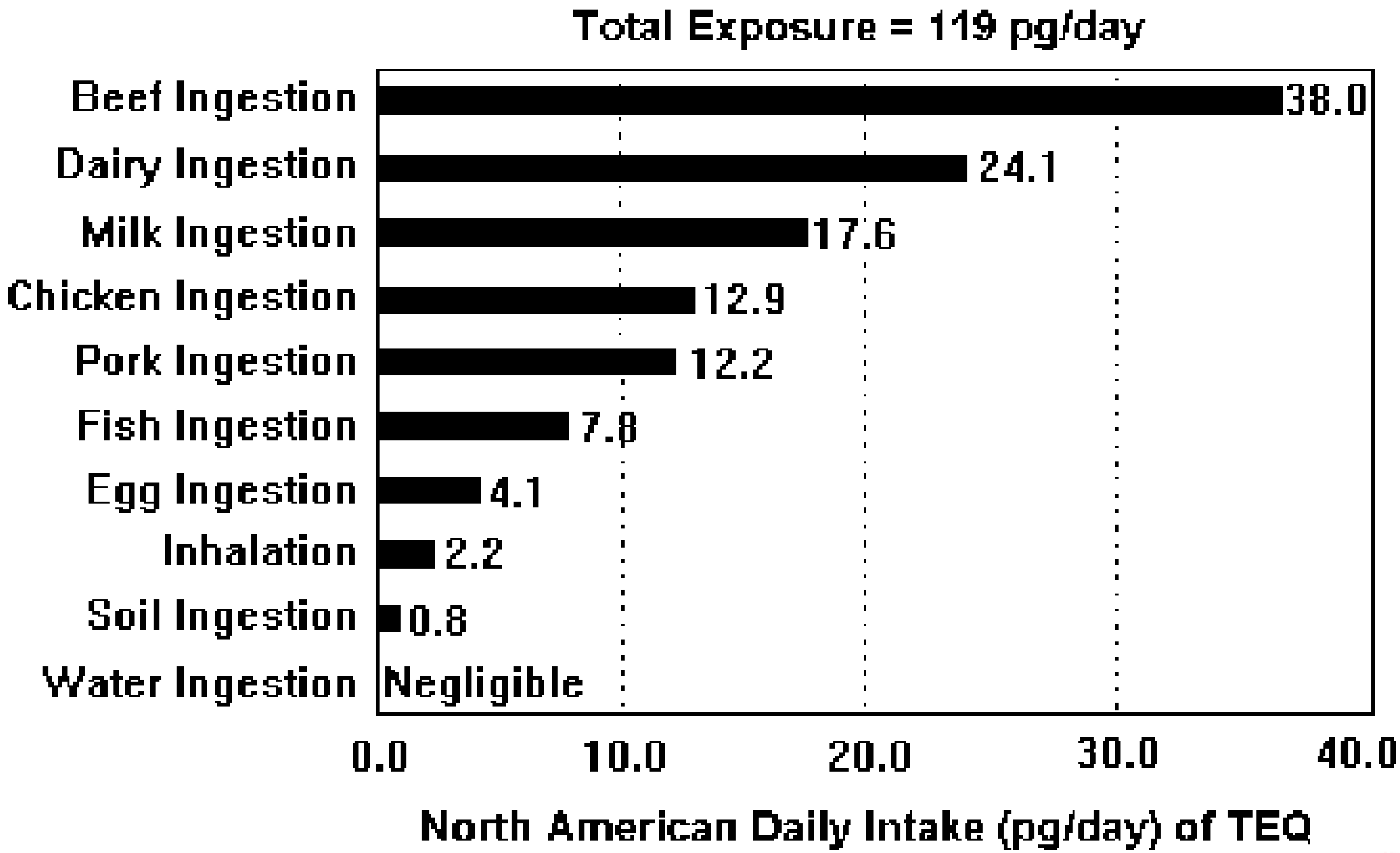
Source: Table 31 (p46) in Jacott, M., et al. "Energy Use in the Cement Industry in North America: Emissions, Waste Generation and Pollution Control, 1990-2001," May 2003. http://www.texascenter.org/publications/cement.pdf

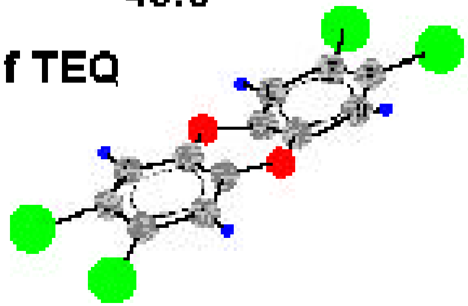
Dioxin Facts

- Dioxins and furans are the most toxic chemicals known to science
- Dioxins cause infertility, learning disabilities, endometriosis, birth defects, sexual reproductive disorders, damage to the immune system, cancer and more.
- 93% of dioxin exposure is from eating meat and dairy products.



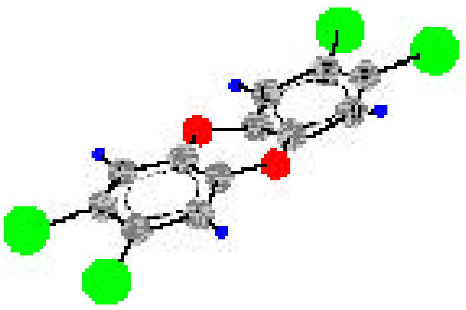
Exposure to Dioxins





How to make dioxin

- Dioxins are created by burning hydrocarbons (fossil fuels, tires, hazardous wastes) with chlorine (present in coal, tires and some hazardous wastes) in the presence of oxygen.
- Dioxin emissions increase when:
  - More chlorine is in the fuel/waste stream
  - Certain metal catalysts are present
  - The gases stay in a low temperature range (200-450^{o} C)



Pollutants Released by Cement Kilns

- Carbon dioxide (global warming gas)
- Acid Gases, Nitrogen Oxides, Sulfur Dioxide, Particulate Matter
- 19 heavy metals, including lead, mercury, cadmium and chromium VI
- Products of Incomplete Combustion (PICs), including dioxins, furans and Polycyclic Aromatic Hydrocarbons (PAHs)

Source: http://www.texascenter.org/publications/kiln.htm

Pollutants Released by Cement Kilns

- “Upset” events in cement kilns operation trigger increased emissions from the stack and “fugitive” (non-stack) emissions from the cement kiln itself.
- When handling, storing and burning liquid hazardous wastes, fugitive emissions can be released from numerous points at ground level such as the seals on the cement kiln, vents and pressure release valves, the storage tanks, and transfer points from the storage tanks through the pumps and into the rotary kiln.

Test Burns are Unreliable

- Emissions estimates and regulatory enforcement usually based on infrequent testing under optimal conditions
- Tests don’t reflect startup, shutdown and upset conditions
- Tests are usually done with careful attention paid to temperature, air flow and other operating conditions
- May take multiple samples until one passes
- Tests are very infrequent

Continuous Emissions Monitors

- Only generally used for sulfur oxides (SOx), nitrogen oxides (NOx), oxygen (O2), carbon monoxide (CO) and opacity (indirectly monitoring particulate matter)
- Technology now exists to continuously monitor:

Ammonia (NH4)

Carbon Dioxide (CO2)

Hydrogen Sulfide (H2S)

Acid Gases:
- Sulfuric Acid (H2SO4)
- Hydrofluoric Acid (HF)
- Hydrochloric Acid (HCl)

Products of Incomplete Combustion (PICs):
- Dioxins & Furans
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Volatile Organic Compounds (VOCs)

Metals:
- Antimony (Sb)
- Arsenic (As)
- Barium (Ba)
- Cadmium (Cd)
- Chromium (Cr)
- Lead (Pb)
- Manganese (Mn)
- Mercury (Hg)
- Silver (Ag)
- Nickel (Ni)
- Zinc (Zn)
- …and more

www.ejnet.org/toxics/cems.html

Cement Kiln Dust (CKD) in U.S.

- Large amounts of fine material given off and carried out by flow of hot gas within cement kiln
- Collected using pollution control systems like cyclones, electrostatic precipitators, or baghouses, and is then landfilled either on or off site.
- 4 million tons of CKD disposed of each year
- In 1990, average of 9 tons of CKD produced for every 100 tons of clinker.
- Dry process cement kilns generally produce more CKD
- Some CKD is “recycled” into the cement product.

Source: Beneficial Use of Solid Waste in Maine (http://useit.umaine.edu/materials/ckd/general_information.htm)

“Beneficial” Uses

- Not considered hazardous waste by US EPA
- Soil Stabilization
- Stabilization and Solidification of Waste
- Cement Replacement
- Asphalt Pavement
- Mine Fill
- Crop Enhancer

What's in Cement Kiln Dust?

- Calcium Oxide
- Toxic metals: Arsenic, Chromium, Cadmium, Antimony, Barium, Beryllium, Lead, Silver, Mercury, Thallium, Selenium, Nickel
- Dioxin, Furans

The whistle-blower's video shows piles of dust almost three feet deep that bury the roof of a small building at Cemex.

Cement Kiln Dust More Toxic when Burning Hazardous Waste

Hazardous Waste Fuels vs. Traditional Fuels

- Hazardous Waste either emitted into air, absorbed into CKD, or into clinker (final product)
- Using hazardous waste produces 104% more cement kiln dust by volume
- Lead concentrations 250% higher
- Cadmium concentrations 150% higher
- Chromium concentrations 50% higher
- Selenium concentrations 100% higher
- 700 times more dioxin

Source: EPA, Report to Congress on CKD, December 1993)

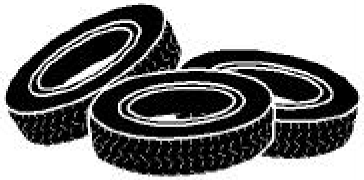
Source: Downwinders (http://www.downwindersatrisk.org/DownwindersAtRisk-100FactsAboutTheIncineration.htm)

Tire Pile Problems

- Tires cause health problems (mosquitoes)
- Can catch fire
- Expensive to get rid of
- Not many import restrictions on tires being sent to Mexico
- 40 million tires per year go obsolete in Mexico

Stockpiled Tires in Border Cities.

México	**Estimated tires in piles**
Mexicali	5,000,000
Ciudad Juárez	3,000,000
Matamoros	800,000
Reynosa	500,000
Nuevo Laredo	100,000
Piedras Negras	50,000
Ciudad Acuna	50,000
Texas	
El Paso	75,000



Tire Derived Fuel – US EPA

General Information

• In 2003: 130 million scrap tires used as fuel (45% of amount generated)

• Shredded or whole tires used

Claimed Advantages

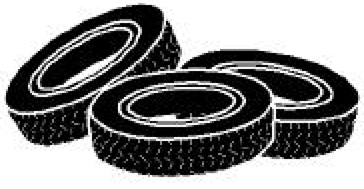
• Tires produce the same amount of energy as oil and 25% more energy than coal

• The ash residues from TDF may contain a lower heavy metals content than some coals.

• Results in lower NOx emissions when compared to many U.S. coals, particularly the high-sulfur coals.

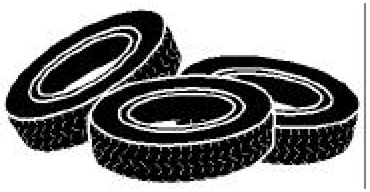
EPA

• The Agency supports the responsible use of tires in Portland cement kilns and other industrial facilities



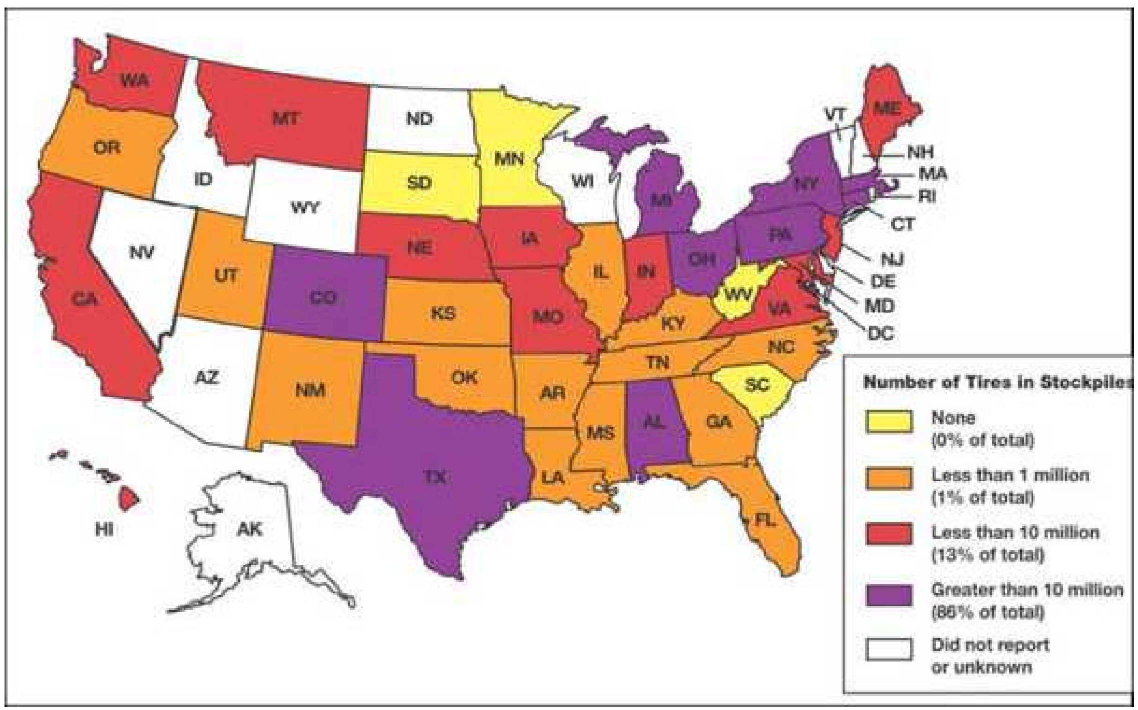
Mexico – US Tires

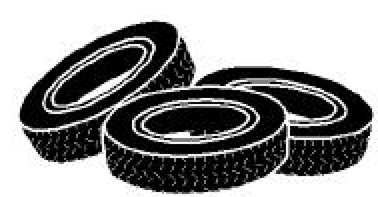
- Many millions of scrap tires are located on the Mexico-U.S. border
- “Border 2012 has the intention of reutilizing the tires generated by the clean-up for productive purposes, such as recycling or reuse”
- Border 2012 is a ten-year program lead by the U.S. Environmental Protectin Agency and Mexico’s Secretaria de Medio Ambiente y Rucursos Naturales (SEMARNAT).



Mexico – US Tires

- Texas, California and Colorado are among the U.S. states with the largest stockpiles of tires



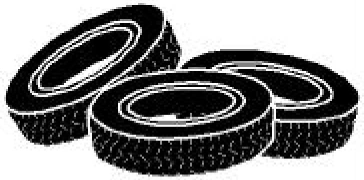


Chemical Composition of Tires

Typical types of materials used to manufacture tires:

Synthetic Rubber
Natural Rubber
Sulfur and sulfur compounds
Silica
Phenolic resin
Oil: aromatic, naphthenic, paraffinic
Fabric: Polyester, Nylon, Etc.
Petroleum waxes
Pigments: zinc oxide, titanium dioxide, etc.
Carbon black
Fatty acids
Inert materials
Steel Wire

Source: U.S. Rubber Manufacturers Association / Scrap Tire Management Council



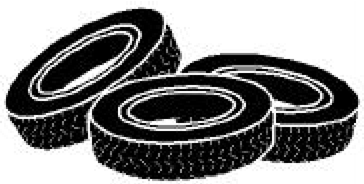
Chemical Composition of Tires

Description	% By Weight, as Received
Moisture	0.62
Ash	4.78
Carbon	83.87
Hydrogen	7.09
Nitrogen	0.24
Sulfur	1.23
Oxygen (by difference)	2.17
Total	100
Elemental Mineral Analysis (Oxide Form)	
Zinc	1.52
Calcium	0.378
Iron	0.321
Chlorine	0.149
Chromium	0.0097
Fluoride	0.001
Cadmium	0.0006
Lead	0.0065

High zinc levels in tires prevent cement kilns from using high percentages of tire-derived fuel, as the zinc presents a problem for formation of Portland cement, making it harden too quickly

Tires have lots of zinc in the steel belted radials and since tires may be burned whole rather than removing the steel belts, there are major challenges if the zinc content is too high.

Representative Analysis of TDF Produced By WRI
(Source: TDF Produced From Scrap Tires with 96+% Wire Removed)
Source: U.S. Rubber Manufacturers Association / Scrap Tire Management Council

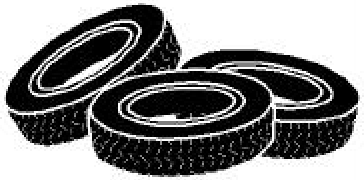


Chemical Composition of Tire Ash

COMPOUND	SAMPLE 1	SAMPLE 2	AVERAGE
Total Carbon -- %	0.071	0.258	0.164
Aluminum	0.128	0.283	0.206
Arsenic	0.002	----	0.001
Cadmium	0.001	0.001	0.001
Chromium	0.978	0.068	0.523
Copper	0.255	0.32	0.288
Iron	95.713	96.721	96.217
Lead	0.001	0.001	0.001
Magnesium	0.058	0.059	0.058
Manganese	0.058	0.307	0.416
Nickel	0.241	0.093	0.167
Potassium	0.01	0.015	0.012
Silicon	0.34	0.246	0.293
Sodium	0.851	0.701	0.776
Zinc	0.052	0.16	0.106
Tin	0.007	0.006	0.006
Sulfur	0.766	0.762	0.764

Preliminary Results Of Slag (Bottom Ash) Analysis

Source: U.S. Rubber Manufacturers Association / Scrap Tire Management Council



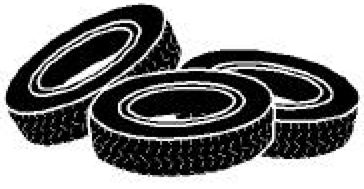
Chemical Composition of Tire Ash

Contents	Weight by Percentage	
Zinc		51.48%
Lead		0.22%
Iron		6.33%
Chromium		0.03%
Copper		0.55%
Nickel		0.03%
Arsenic		0.02%
Aluminum		0.76%
Magnesium		0.50%
Sodium		0.01%
Potassium		0.01%
Magesium Dioxide		0.36%
Tin		0.03%
Silicon		6.85%
Cadmium		0.05%
Carbon		32.20%
	Total	99.43%

Note: These results are from incineration of 100% tire fuel.

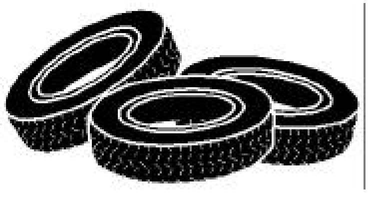
Sources: Radian Corporation, Results From Sampling and Analysis of Wastes From the Gummi Mayer Tire Incinerator, May 1985.

Source: U.S. Rubber Manufacturers Association / Scrap Tire Management Council



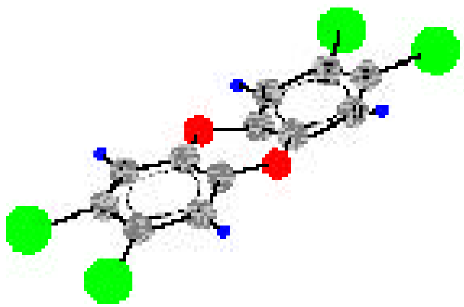
Chlorine in Tires

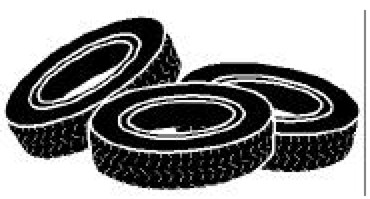
- Aromatic extender oils
- “Salt-bath" vulcanization process
- Halogenated butyl rubber liners
- California study: Tires have 2-5 times the chlorine level of western coal
- EPA survey: chlorine levels in tires to be 2% higher than the national average for bituminous coal



Dioxin Emissions from Tire Burning

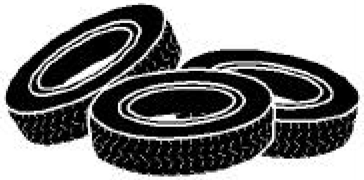
Data From	TDF Content (% TDF compared to 100% coal)	Dioxins/Furans
4 California Cement Kilns	<20%	Increased between 53% and 100%
5 Canadian Cement Kilns		Increased 37% and 247% in two tests Decreased 54% and 55% in two other tests
Victorville, CA Cement Kiln	24.60%	Dioxins increased 139-184% Furans increased 129%
Cupertino, CA Cement Kiln		Increased 30%
Davenport, CA Cement Kiln	30%	Dioxins increased 398% and 1,425% in two tests Furans increased 58% and 2,230% in two tests
Davenport, CA Cement Kiln	20%	Increased 25%
Lucerne Valley, CA Cement Kiln	20%	Dioxins and some dibenzofurans increased
Chester, PA Paper Mill	4-8%	Increased 4,140%
U Iowa, Iowa City, IA Industrial Boiler	4%	Decreased 44%
U Iowa, Iowa City, IA Industrial Boiler	8%	Decreased 83%





Tire Derived Fuel Emissions

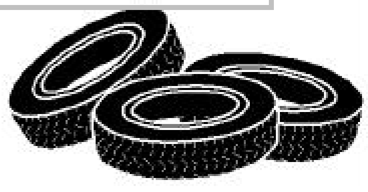
- Data on emissions from tire burning varies
- Some studies compare a mixture of tires and coal to 100% coal; others compare to other mixtures of fuels
- Chemical composition of coal can vary by coal type and region
- Data is from cement kilns, paper mills or other industrial boilers
- Operating conditions may vary



Tire Derived Fuel Emissions

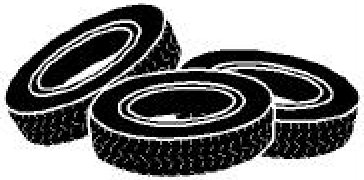
Common trends in comparing TDF/coal mixture to 100% coal

INCREASE	**POSSIBLY INCREASES**	**DECREASE**
Chromium	Arsenic	Fluoride
Copper	Barium	Nitrogen Oxides
Lead	Beryllium	
Nickel	Cadmium	
Zinc	Chlorine	
Dioxins/Furans	Hydrochloric Acid	
PCBs	Magnesium	
PAHs	Manganese	
Sulfur Dioxide	Mercury	
Carbon Monoxide		
Benzene		



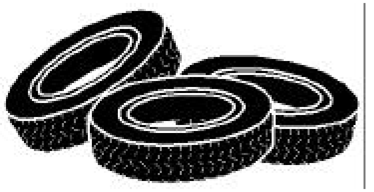
Whole vs. Chipped Tires

- Whole tires are harder to burn, resulting in less complete combustion and more pollution
- Chipping tires is more expensive and the burning of whole tires is increasing



Alternatives to Burning Tires

- Source Reduction
- Toxics Use Reduction
- Reuse (Retreading)
- Recycling
- Devulcanization
- Rubberized Asphalt Concrete
- Monofills



Hazardous Waste Fuel – U.S.

- 14 cement kilns and 3 light-weight aggregate kilns currently burn hazardous waste in the U.S.
- Of the 7.3 million tons of hazardous waste that is managed off-site (commercially) each year in the US
  - 2.4 million tons are burned
  - About 1.4 million tons (about 19%) were burned in cement or light-weight aggregate kilns in 2003
- This is down from 37 kilns in 1994, when 90% of commercially incinerated liquid hazardous wastes were burned in kilns

Hazardous Waste Chemical Composition

- Residues from industrial / commercial painting operations, paint solids, spent solvents
- Metal cleaning fluids
- Electronic industry solvents (these materials include chlorinated/fluorocarbon solvents); trace metals contained become part of the cement
- Cleaning solvents
- Oil refinery wastes
- Tank bottoms / “still bottoms” – sludges can contain metals mixed in with liquids from bottoms of chemical drums

Cement Kilns & Hazardous Waste

- Cement kilns not designed for hazardous waste incineration
- National air pollution regulations are full of loopholes
  - Cement kilns have mass air flows 5-6 times higher than hazardous waste incinerators, but emissions limits allow similar *concentrations*
  - Ashes and scrubber wastes from hazardous waste incinerators are legally considered hazardous waste, but cement kiln dust is not.

Cement Kilns & Hazardous Waste

Facility	Total Annual Emissions	Factor Difference
TXI* =	23,995 tpy	12X higher than all 3 Commercial HWI combined.
AEI* =	744 tpy	32.25X lower than TXI
LAI* =	645 tpy	37.30X lower than TXI
CWM* =	598 tpy	40.12X lower than TXI

Hazardous waste incinerator data is 1995 annual tons; TXI's is 1997 draft air permit.

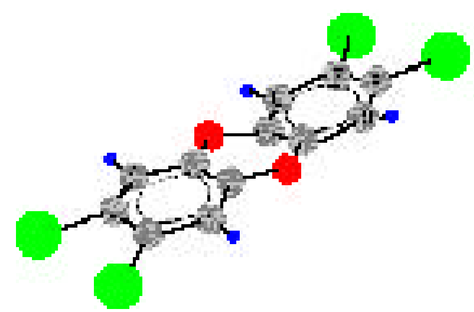
TPY = tons per year

* TXI is Texas Industries Inc. Midlothian Cement Kiln Complex. Data from draft TNRCC air permit.
* AEI is American EnviroTech's commercial hazardous waste incinerator in Channelview, Harris County, Texas that was permitted by TNRCC but never built. Data from TNRCC air permit.
* LAI is Laidlaw's (formerly Rollins Environmental Services) commercial hazardous waste incinerator in Deer Park, Harris County, Texas. Now called Safety-Kleen. Data from TNRCC air permit.
* CWM is Chemical Waste Management's commercial hazardous waste incinerator at Port Arthur, Jefferson County, Texas. Data from TNRCC air permit.

Dioxin Emissions Affected by Temperature

Congener/ congener group	Kilns burning hazardous waste mean emission factor (nondetect values set equal to zero) (ng/kg clinker produced)	
	APCD inlet temperature >232 °C	APCD inlet temperature <232 °C
2,3,7,8-TCDD	3.38	0.02
1,2,3,7,8-PeCDD	4.28	0.13
1,2,3,4,7,8-HxCDD	4.85	0.29
1,2,3,6,7,8-HxCDD	6.93	0.42
1,2,3,7,8,9-HxCDD	9.55	0.4
1,2,3,4,6,7,8-HpCDD	27.05	3.16
OCDD	18.61	1.08
2,3,7,8-TCDF	36.26	3.24
1,2,3,7,8-PeCDF	13.36	0.23
2,3,4,7,8-PeCDF	23.48	0.65
1,2,3,4,7,8-HxCDF	22.24	0.55
1,2,3,6,7,8-HxCDF	8.46	0.27
1,2,3,7,8,9-HxCDF	0.96	0.06
2,3,4,6,7,8-HxCDF	13.33	0.52
1,2,3,4,6,7,8-HpCDF	7.73	0.34
1,2,3,4,7,8,9-HpCDF	2.16	0.16
OCDF	2.51	0.37
Total I-TEQ_{DF}	28.58	1.04
Total TEQ_{DF}-WHO_{98}	30.7	1.11
Total TCDD	406.76	1.78
Total PeCDD	608.65	0.89
Total HxCDD	845.99	0.69
Total HpCDD	192.99	0.42
Total OCDD	18.61	1.08
Total TCDF	295.72	11.52
Total PeCDF	127.99	3.83
Total HxCDF	50.75	1.88
Total HpCDF	8.36	0.47
Total OCDF	2.51	0.37
Total CDD/CDF	2,558.33	22.92

APCD = Air pollution control device



Source: The Inventory of Sources and Environmental Releases of Dioxin-Like compounds in the United States: The Year 2000 Update (External Review draft, March 2005; EPA/600/p-03/002A

Hazardous Waste Burning = 21 times higher Dioxin Emissions

Table 5-4. National emission estimates for cement kilns for reference years 1987 and 1995

Category	TEQ emission factor (ng/kg clinker)		Activity level (billion kg clinker/yr)	Annual TEQ emission (g/yr)	
	$I\text{-}TEQ_{DF}$	$TEQ_{DF}\text{-}WHO_{98}$		$I\text{-}TEQ_{DF}$	$TEQ_{DF}\text{-}WHO_{98}$
Reference year 1987					
Hazardous waste >232 °C	28.58	30.7	3.8	108.6	116.7
Hazardous waste <232 °C	1.04	1.11	1	1	1.1
Nonhazardous waste	0.26	0.27	47.2	12.3	12.7
TOTAL			52	122	131
Reference year 1995					
Hazardous waste >232 °C	28.58	30.7	5.04	144	154.7
Hazardous waste <232 °C	1.04	1.11	1.26	1.3	1.4
Nonhazardous waste	0.26	0.27	61.3	15.9	16.6
TOTAL			67.6	161	173

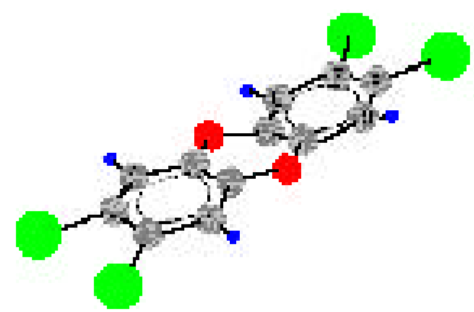


Table 5-5. National emission estimates for cement kilns for reference year 2000

Category	TEQ CCD/CDF concentrations (ng/kg clinker)		Activity level (billion kg clinker/yr)	Annual TEQ emission (g/yr)	
	$I\text{-}TEQ_{DF}$	$TEQ_{DF}\text{-}WHO_{98}$		$I\text{-}TEQ_{DF}$	$TEQ_{DF}\text{-}WHO_{98}$
Hazardous waste	5.49	5.95	11.5	63.3	68.4
Nonhazardous waste	0.26	0.27	63.7	16.6	17.2
TOTAL			75.2	79.9	85.6

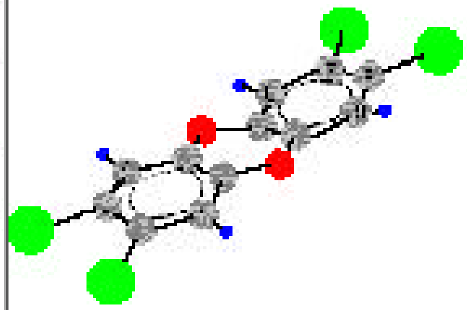
Source: The Inventory of Sources and Environmental Releases of Dioxin-Like compounds in the United States: The Year 2000 Update (External Review draft, March 2005; EPA/600/p-03/002A

Hazardous Waste Burning = 11,667 Times Higher Dioxin Levels in Cement Kiln Dust

Table 5-7. CDD/CDF estimates in cement kiln dust (CKD) for reference years 1987, 1995, and 2000

Category	CDD/CDF concentration (ng I-TEQ_{DF}/kg of CKD)	CKD beneficially reused on or off site		CKD sent to a landfill for disposal	
		Activity level (million kg tons CKD/yr)	Annual TEQ CDD/CDF concentration (g/yr)	Activity level (million kg tons CKD/yr)	Annual TEQ CDD/CDF concentration (g/yr)
Reference year 1987					
HW kilns	35	120	4.2	426	14.9
NHW kilns	0.003	632	0.0019	2,230	0.0067
Reference year 1995					
HW kilns	35	104	3.6	505	17.7
NHW kilns	0.003	547	0.0016	2,642	0.0079
Reference year 2000					
HW kilns	35	94	3.3	365	12.8
NHW kilns	0.003	480	0.0014	1,858	0.0056

HW = Hazardous waste
NHW = Nonhazardous waste



Source: The Inventory of Sources and Environmental Releases of Dioxin-Like compounds in the United States: The Year 2000 Update (External Review draft, March 2005; EPA/600/p-03/002A

Keystone Cement's Dirty History

1976 Started burning hazardous waste
early 1990's Applied for increase in amount of waste burned
Opposed by community group and school parent-teacher group
1992 Revealed that computer data had been altered to hide permit violations
Permit application suspended
1995 Applied to burn 55 additional types of waste and increase burn rate
Opposed by community group and school parent-teacher group
State asked for health risk assessment
7/1997 Reapplied to burn more waste, but...
12/1997 Hazardous waste fuel tank overheated, 1-mile evacuation
Community calls for better safety controls, monitoring & record keeping
8/1999 Application withdrawn

“Green” Cement

- In 2007, the cities of Dallas, Texas and Fort Worth, Texas passed ordinances banning their cities’ purchase of cement produced in energy-intensive wet kilns
- Concentrated solar power can be used for cement manufacturing, avoiding the need for burning fossil fuels or wastes.
- With carbon taxes, this could even be made cost effective

Source: “Economic Assessment Of The Industrial Solar Production Of Lime”
http://solar.web.psi.ch/data/publications/pdf2/lime_Annex2004.pdf

Public Relations / Trade Associations

- Cement Kiln Recycling Coalition (www.ckrc.com)
- Environmental Technology Council (www.etc.org)
- Association for Responsible Thermal Treatment (ARTT) [Hazardous waste incinerator industry group that oposed cement kiln incineration. ARTT shut down in mid-1990s]

For more information…

- Energy Justice Network:
  www.energyjustice.net/tires/
  www.energyjustice.net/cementkilns/
- GAIA: www.no-burn.org
- American Lung Association report:
  www.mindfully.org/Air/Cement-Kilns-Burning-Waste.htm
- Downwinders at Risk www.downwindersatrisk.org
- Montanans Against Toxic Burning www.notoxicburning.org
- Texas Center for Policy Studies www.texascenter.org/tires/
- Alberni Environmental Coalition www.portaec.net/local/tireburning/
- Friends of Hudson www.friendsofhudson.com
- Citizens Against the New Kiln (UK) www.cank.org.uk
- Email lists:
  - To subscribe to email networks for activists fighting tire burning or cement kilns, contact Mike Ewall at catalyst@actionpa.org