PCA Portland Cement Association
THE Monitor Flash Report
Breaking Analysis of the Economy, Construction and Cement Industries

Contact: > Ed Sullivan, Chief Economist 847.972.9006 > esullivan@cement.org

January 2011

Overview Impact of Existing and Proposed Regulatory Standards on Domestic Cement Capacity

Executive Summary

Already a heavily regulated industry, the U.S. cement industry is currently faced with seven different existing or proposed Environmental Protection Agency (EPA) regulatory standards:

- National Ambient Air Quality Standards (NAAQS)—Currently effective
- Greenhouse gas reporting—Currently effective
- New Source Performance Standards (NSPS)—Currently effective
- Clean Air Act's "Tailoring Rule"—Currently effective
- National Emission Standards for Hazardous Air Pollutants (NESHAP)—Currently effective, with compliance required in 2013
- New standards for Commercial and Industrial Solid Waste Incinerators (CISWI)—Proposed and compliance to be effective in 2015
- Fly Ash determination as a hazardous waste—Proposed and assumed to be effective in 2015

PCA examined the cumulative impact of these regulations on United States cement, concrete, and construction industries, especially potential impact on construction costs, employment, and the environment.

The EPA regulations will hinder the cement industry's ongoing modernization efforts to remain globally competitive. This is a subtle message to the industry to shut down plants and source cement from foreign sources – thereby exporting emissions along with the jobs associated with cement production.

Regulations will export jobs

EPA regulations could result in the direct loss of 3,000 to 4,000 jobs in the cement industry by 2015. Cement industry jobs are typically high-wage jobs. These industry job losses translate into $200 million to $260 million in lost wages annually. PCA estimates that 18 plants could be forced to close because of the inability to meet standards or because the compliance investment required may not be financially justifiable. The construction industry could lose another 12,000 to 19,000 jobs because of higher construction costs.

These direct job losses could be amplified if indirect impacts are considered. The indirect job and wage loses would be the result of less regional economic activity, mostly in areas concentrated near the plant shutdowns, and magnifying the potential distress in these communities. In total, more than 80,000 jobs could be lost due to EPA regulations targeting the cement industry. These job losses will stem from a combination of closed plants, reduced national construction due to increased costs, and amplified by downstream multiplier effects.

The combination of the industry's pre-existing financial commitment to provide a reliable and efficient supply of cement to the U.S. market, coupled with sustained harsh economic and financial realities may overwhelm the industry's financial capability to comply with the EPA standards. EPA's short three-year compliance period for NESHAP, which addresses mercury and three other pollutants, requires compliance investments to begin soon. PCA estimates 2009 cement industry ***revenues*** at approximately $6.5 billion. For 2010-2012, total industry revenues are projected at $19 billion. The $3.4 billion in investment required to comply with NESHAP standards equates to more than 18 percent of industry ***revenues*** accumulated during the years preceding NESHAP compliance (2010-2012).

The study estimates that current and proposed EPA regulations could add $2.4 to $3.9 billion to annual construction costs. Increased cement /concrete construction costs would raise the concrete costs for a construction project 22 to 36 percent.

Moreover, as the country's largest consumer of cement/concrete, the public sector would be hardest hit. PCA calculates that EPA compliance costs could add as much as $1.2 to $2 billion annually to state and local governments' expenditures just to maintain existing roadways and bridges. The addition of **new** roads and bridges would increase the price tag even further.

The nation's current construction downturn has already caused low capacity utilization rates at cement plants and a slowdown in capital investment. An uncertain regulatory environment could reduce expected returns on investments in the United States and contribute to corporate decisions to wait-and-see before making further investments in the United States.

Regulations will export emissions

Lacking further investment in capacity expansion, the United States cement industry will become increasingly dependent on imports as a source of supply.

At the same time that many of these regulations require compliance, an anticipated increase in population will result in additional demand for housing, commercial buildings, public buildings and infrastructure – all boosting demand for cement consumption. Population in the United States is expected to grow by 35 million persons by 2020 and 48 million persons by 2025 compared to 2007 levels.

The cumulative impact of these regulations will force increased reliance on imports to meet expected future consumption. Assuming all of the EPA regulations are enacted, from approximate 2010 levels of 5.9 million metric tons, imports are expected to reach 82 million metric tons in 2025—or roughly 56 percent of the US consumption. Keep in mind, the industry currently operates roughly 125 import terminals with an estimated capacity of 45 million metric tons. Increased reliance on imports dramatically increases the probability of future material supply shortages in the U.S. construction industry.

Because a significant portion of the improvement in emissions due to EPA regulations comes from plant closures, the EPA standards effectively export our emissions and our jobs to other cement supplying countries, while at the same time, absent global cement plant emission standards, increasing overall global emissions.

For example, EPA's potential classification of fly ash as a hazardous waste, without an exemption for beneficial re-use, will virtually eliminate its use in concrete mixes, increasing net CO_2 and other emissions associated with cement manufacture, and reduce the performance characteristics of concrete in some cases.

If EPA designates fly ash as a hazardous waste under the proposed rule, it would reverse decades of progress in sustainability of building materials. Use of fly ash in concrete production is recognized worldwide as a practice that improves the performance and sustainability of concrete by adding decades to the life of construction projects, and greatly reducing carbon dioxide emissions and resource consumption in cement production.

Another regulation that will have a negative environmental impact is the new standards for Commercial and Industrial Solid Waste Incinerators (CISWI), which negates the incentive for cement plants to burn alternative fuels, like tire-derived fuel (TDF). The CISWI standard potentially reverses decades of environmental cleanup success and EPA support for using TDF as a fuel. A significant reduction in the use of TDF would materialize under potential CISWI standards and could lead to a seven-fold increase in scrapped tires that must be land filled by 2025 – creating a new environmental concern.

Overview

PCA's Market Intelligence Group is tasked to provide a rough estimate of the potential impact on domestic cement production resulting from seven different existing or proposed Environmental Protection Agency (EPA) regulatory standards. These standards are at different stages of potential enactment, ranging from in-place standards to the public comment stage. As a result, in some instances, PCA must make assumptions regarding the substance and timing of these potential regulations. The standards include:

- National Ambient Air Quality Standards (NAAQS) (Currently effective);
- Greenhouse gas reporting (Currently effective).
- New Source Performance Standards (NSPS) (Currently effective).
- Clean Air Act's "Tailoring Rule" (Currently effective).
- National Emission Standards for Hazardous Air Pollutants (NESHAP) (Compliance 2013).
- Potential new standards for Commercial and Industrial Solid Waste Incinerators (CISWI) (Proposed compliance to be effective 2015).
- Fly Ash determination as a hazardous waste (Assumed to be effective 2015).

PCA assesses the impacts of EPA regulatory standards by presenting a scenario representing an environment with no new EPA regulations (Baseline Scenario) and comparing those conclusions against a scenario that includes all EPA regulatory standards (Compliance Scenario). The difference between the two scenarios represents the aggregated impact of EPA regulations. While a myriad of impacts could also arise from the enforcement of more rigorous EPA standards, this report focuses on the impact on United States cement consumption, cement production, cement capacity, import volume and penetration, the cost to the cement industry attached to compliance, potential impacts on construction costs, and the potential impacts on employment.

EPA has been vague regarding the meshing of these standards into a coherent regulatory strategy directed at emitting industries, including those targeting cement producers. PCA, as a result, is forced to make assumptions regarding the coherency and consistency of EPA's regulatory policies targeting the cement industry. Actual form and substance of EPA regulations that characterize the compliance scenario may differ significantly from the regulations that eventually materialize. As a result, risk should be attached to PCA's impact estimates.

Key Findings

- The EPA's potential classification of fly ash as a hazardous waste, without an exemption for beneficial re-use, will virtually eliminate its use in concrete mixes leading to a 30 million metric ton increase in cement consumption by 2025, reduce domestic cement supply by roughly 2.0 million metric tons, increase costs, net CO_2 and other emissions associated with cement manufacture, and reduce the performance characteristics of concrete in some cases.

- The NESHAP standards alone could force the closure of 18 cement plants representing 11 million metric tons of capacity. An additional 3 plants are at high risk of closure, representing an additional 2.5 million metric tons. These high risk plants are assumed to continue to operate.

- EPA's regulations that trigger "new source" designations under the NESHAP, CISWI or NSPS standards could hinder the cement industry's ongoing modernization efforts to remain world class competitive, and as a result, could eventually lead to an additional 4 plant closures representing another 3.4 million metric tons of capacity beyond NESHAP. Furthermore, this aspect of the EPA's standards is a subtle message to the industry to shut down plants and source cement from foreign sources – thereby exporting emissions along with jobs, associated with cement production.

- EPA regulations will result in a dependence on cement imports. Imports are expected to increase from roughly 5.9 million metric tons in 2010 to an estimated 36 million metric tons in 2015, 62 million metric tons by 2020, and 82 million metric tons by 2025. The industry currently operates roughly 125 import terminals with an estimated capacity of 45 million metric tons. Increased reliance on imports dramatically increases the probability of future material supply shortages in the U.S. construction industry.

- EPA regulations could potentially lead to higher overall concrete costs to the construction industry of at least $2.5 to nearly $4 billion annually.

- EPA regulations could result in the direct loss of 3,000 to 4,000 jobs in the cement industry and potentially another 12,000 to 19,000 direct jobs in the construction industry due to higher construction costs. These direct job losses could be amplified if up and downstream indirect impacts are considered. In total, more than 80,000 jobs could be lost due to EPA regulations.

- To meet NESHAP standards, PCA estimates that 90% of all cement plants will be forced to invest in bag houses to meet particulate matter standards. To comply with the combined Hg, THC, and HCl standards, PCA estimates that 9% of all plants will be required to invest in stand-alone wet scrubber systems, 75% of all plants will be required to invest in ACI systems, 20% of all plants will be required to invest in wet scrubber-ACI combination systems, and 65% of all plants will be required to invest in Regenerative Thermal Oxidizer (RTO) systems.

- To meet CISWI standards, PCA estimates that 87% of all alternative fuel burning cement plants, a subset of the total universe of plants, will be forced to invest in bag houses to meet particulate matter, lead and cadmium standards. This includes investments to existing bag houses and in some cases the construction of new bag houses. To comply with the combined Hg, SOx and HCI standards, PCA estimates that 22% of all plants will be required to invest in a stand-alone wet scrubber system, and 62% of all plants will be required to invest in wet scrubber-ACI systems. To comply with NOx, 22% of all plants will be required to invest in SNCR systems. To comply with carbon monoxide, 39% of plants will be required to invest in burner systems.

- To comply with NESHAP standards, the industry must invest at least $3.4 billion. An additional $2.0 billion must be invested to meet CISWI standards. This excludes potential spending by plants PCA estimates will close due to the inability to meet standards or due to the excessive financial burdens.

- The combination of the industry's pre-existing financial commitment to provide a reliable and efficient supply of cement to the U.S. market, coupled with sustained harsh economic and financial realities may overwhelm the industry's financial capability to comply with the NESHAP standards and proposed CISWI standards. NESHAP will be in force in three short years, which means that compliance investments must begin soon. PCA estimates total industry revenues during 2010-

2012 at $19 billion. The $3.4 billion in investment required to comply with NESHAP standards equates to more than 18% of industry revenues accumulated during the years preceding NESHAP compliance (2010-2012).

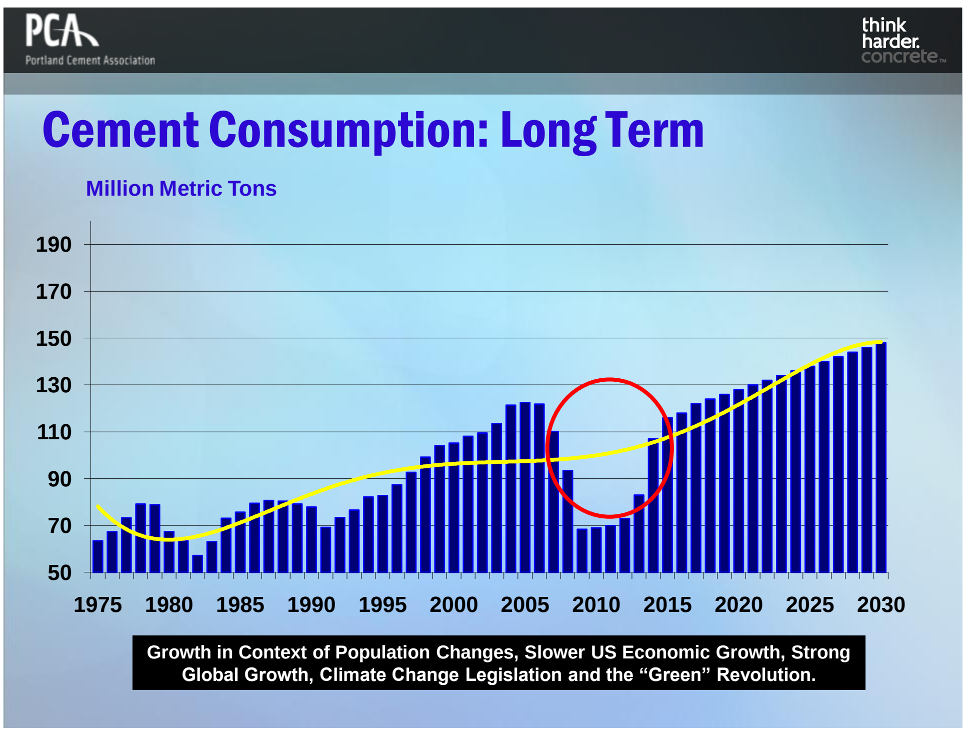
Baseline Scenario (No Emission Policy)

U.S. Cement Consumption Projections

Longer term cement consumption will be dictated by population gains, and this implies cement consumption will reach nearly 150 million metric tons by 2025.

U.S. cement consumption reached nearly 70 million metric tons in 2010, compared to near record levels of 128 million metric tons recorded in 2005. This decline reflects current economic adversities. With economic recovery, cement consumption is expected to reach 112 million metric tons in 2015, 131 million metric tons in 2020, and 147 million metric tons in 2025.

All market segments and regions recorded significant declines in cement consumption through 2009. This reflects a peak-to-trough decline in cement volumes of nearly 59 million metric tons – the worst in U.S. history. Tightened lending standards, weak labor markets and rising foreclosures continue to hamper an oversupplied residential construction market. Nonresidential construction is experiencing the brunt of the financial credit crisis as many projects have been delayed or canceled. This, coupled with rising vacancy rates and long project planning timelines, creates an expectation of a long recovery for commercial construction is expected. Public construction markets have demonstrated dramatic weakness as state governments struggle with soaring fiscal deficits from falling tax revenues. With public construction accounting for roughly 50% of cement consumption, this sector will play an important role in determining the industry's outlook. These underlying fundamentals suggest a recovery in cement consumption during 2010-2012 could be extremely modest.



Beyond 2012, volume gains in cement consumption are expected to become more robust. A new highway bill may materialize in 2013. In addition, substantive job gains during 2009-2012 will improve state fiscal conditions – leading to a revival in state construction spending. In the context of sustained economic growth, residential and nonresidential construction is also expected to record significant gains. By 2013, it is likely that all three construction sectors (public, residential and nonresidential) will record strong positive growth. Even with this, PCA believes the peak-to-peak recovery period (past peak 2005) will take eleven to twelve years.

Longer term, PCA expects the U.S. economic growth rate will underperform consensus projections of 3% annually. As the U.S. population ages, slower economic growth may materialize. The argument for slower, future long-term economic growth rates is anchored in future demographic changes and its likely impact on spending habits among age groups. The persistent and sustained aging of the population will slow consumer spending. This will be compounded by other issues. PCA calculates that the aging of America will result in a 50 basis point reduction in growth of consumer spending and overall economic activity by 2020. PCA's long-term cement consumption projections are based on 2.4% real GDP growth. Upside risks are contained in PCA projections.

PCA projects long-term cement consumption will reach 131 million metric tons by 2020 and 147 million metric tons by 2025 – reflecting growth of 32 million tons compared to 2007 levels and growing at a 1.0% compound annual rate. Roughly 78% of the growth in cement consumption is driven by growth in population. The remaining 19% is driven by gains in growth in per capita cement consumption[1]. In comparison, during 1994-2007, cement consumption grew 29 million metric tons at a compound annual growth rate of 2.3%. During 1994-2007, 83% of the market growth was driven by population gains and 17% by gains in cement consumption per capita.

Long-term cement projections are calculated by combining Bureau of Census' (BOC) population projections with per capita cement consumption estimates to yield total cement consumption. Changes in per capita cement consumption are driven by projected economic activity at the state level and measured by real gross state product.

The anticipated increase in population will result in additional demand for housing, commercial buildings, public buildings and infrastructure – all boosting demand for cement consumption. Population in the United States is expected to grow by 35 million persons by 2020 and 48 million persons by 2025 compared to 2007 levels. According to the Bureau of Census (BOC) April 2005 forecast, U.S. 2007 population is estimated at almost 302 million persons and is expected to reach 344 million persons by 2020 and 348 million persons by 2025 – reflecting a 16% increase over 2007 levels.

PCA projections may be conservative. Nationally, per capita cement consumption is expected to reach 0.392 metric tons per capita by 2020, compared to 0.382metric tons per capita recorded in 2007. This reflects an increase of slightly more than 3%. The projections fall well below those experienced during the previous 13 year period when per capita cement consumption grew by nearly 17.2%. Economic growth directly impacts growth in per capita cement consumption. Stronger economic activity leads to higher household formation, stronger fiscal conditions at the state level, and higher expected return on real investments, leading to higher levels of residential, public, and nonresidential construction activity. Stronger long-term economic growth will encourage greater construction activity and hence cement consumption per capita. According to PCA estimates, per capita cement consumption grows 0.5% for every one percent increase in real GDP growth.

[1] The projected per capita growth rate is exaggerated by the current depressed market, lowering the jump-off point.

Fly Ash Usage

Fly ash usage by the concrete/cement industry is expected to increase on a sustained basis – reducing CO_2 emissions as well as other emissions associated with the manufacture of cement and lowering costs to end users of concrete.

Since fly ash can be a substitute for cement in concrete mixes, its' usage could directly impact cement consumption projections. The baseline scenario assumes continued gains in the use of fly ash in concrete mixes – at the expense of cement consumption growth. The use of fly ash in concrete mixes has been increasing steadily – constituting roughly 15 million metric tons, or 10.5% of total cementitious material consumption (cement, slag cement and fly ash in 2010). By 2030, PCA expects fly ash will account for 14%-15% of total cementitious material consumption. Given this increase and fly ash use as raw feed in cement kilns, PCA expects fly ash consumption will reach nearly 33 million tons by 2030. Not only will the use of this fly ash reduce construction costs and improve concrete's durability characteristics for some applications, but for every ton used, it directly replaces cement in the concrete mix. Since fly ash requires no calcination, it reduces CO2 emissions and other emissions associated with the manufacture of cement.

U.S. Cement Capacity Projections

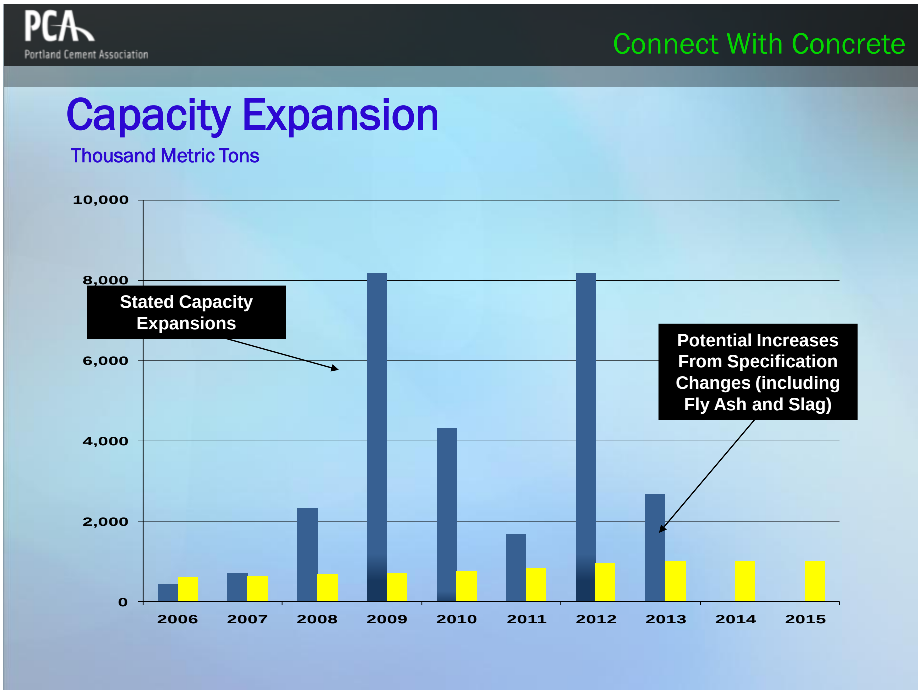
Increases in cement capacity and additives will likely be offset by the structural decline in wet kiln capacity.

The portland cement industry in the United States is currently comprised of more than 30 producers operating more than 167 kilns in 2008 with an estimated domestic ***clinker*** capacity of nearly 92 million metric tons. Gypsum is mixed with clinker to form portland cement. Gypsum/limestone currently accounts for 7.5% of the mix. Including gypsum and limestone additions, domestic ***cement*** capacity is currently estimated at 99 million metric tons.

Domestic cement capacity is expected to reach roughly 107 million metric tons in 2015 and beyond. These estimates reflect planned capacity expansions. Capacity estimates also include assumptions regarding the continued retirement of older wet kilns.

PCA assumes no new capacity is added beyond these announced plans. This assumption may have merit. Large multinational companies dominate ownership of the United States cement industry. Within a multinational company, each geographic region, such as the United States, competes against other global regions for scarce corporate investment dollars (keep in mind, expanding cement capacity is extremely expensive – a two million metric ton plant now costs upwards of $575 million). The rate of return on new capacity investment in the United States is compared against returns in other countries. Current financial distress caused by low utilization rates and an uncertain regulatory environment could reduce expected returns on investments in the United States and contribute to corporate decisions to wait-and-see before making further investments in the United States. The bottom line is that investment in cement plants in the U.S. is now facing higher risk, because of difficulty to achieve environmental compliance, and lower returns due to increased environmental compliance cost. Higher risk and lower returns drives off investment.

In addition to clinker capacity expansions, changes in U.S. specifications allowing for increased use of limestone in portland cement could increase the potential domestic supply. Further changes in U.S. specifications occurred in 2010 allowing for increased use of inorganic cementitious materials such as fly ash and slag. How much these specification changes increase cement capacity depends on how plants



elect to exercise these options. Gypsum/limestone allowances currently add 7.5%. PCA expects that total additions will grow to 10% by 2025, adding more than 2.0 million metric tons to domestic cement supply.

Expansions in cement supply are expected to be largely offset by displacements of capacity. Economic stress and declining cement consumption have resulted in commissioning delays and slower planned ramp-ups for new plants. Two planned "greenfield" plants have been postponed indefinitely. Permanent or temporary shutdowns at 16 plants have been announced or are planned. Plant shutdowns since 2008 have reduced domestic clinker capacity by 9.7 million metric tons. Some, but not all, of these capacity displacements may be permanent. Of the closure announcements, seven plants are considered permanent, reflecting nearly 4 million metric tons. Of the remaining temporary closures, PCA assumes these plants will remain closed until stronger market conditions may dictate reopening. Plants that are idled for more than 2 years have an added risk of being considered as 'New Sources'. This designation would greatly reduce the probability of a kiln re-start and may result in downside risk to PCA capacity projections.

In addition to cyclical displacement of capacity, the cement industry has been gradually phasing out its wet kiln clinker capacity, reducing its clinker capacity by approximately one million metric tons annually during the past ten years. The wet kiln process is an older process and is typically less energy efficient[2] . During the past two years, the phase-out of wet kilns has accelerated – reducing wet kiln clinker capacity by nearly 5.6 million metric tons. In the context of current economic distress, the potential for higher energy prices in the future, and impending federal GHG controls, the accelerated pace of wet kiln retirement is expected to continue. PCA assumes total wet kiln clinker capacity will decline to 2.7 million metric tons in 2020 and beyond compared to 12 million metric tons in 2007. This assumption suggests a 9.3 million ton reduction in existing wet-kiln clinker capacity by 2020-2025.

[2] Note: the last wet kiln was installed 35 years ago.

Combining estimates of capacity expansion, changes in specification standards, and the structural shut down of wet kilns, translates into domestic clinker capacity estimates at roughly 97 million metric tons in 2015 and 95 million metric tons in 2025. With gypsum and limestone additives, this translates into 107 million metric tons of cement capacity by 2015.

U.S. Baseline Imported Cement Projections

Lacking further investment in capacity expansion, the United States cement industry will become increasingly dependent on imports as a source of supply.

Aside from domestic supply, the cement industry operates roughly 125 import terminals with an estimated capacity of 45 million metric tons. The ability and willingness to import cement is determined by demand conditions, prevailing global shipping rates, and the availability of ships to carry cement. Imports are viewed as swing supply, with volume increasing and decreasing depending upon the shortfall between domestic capacity and total United States consumption.

Imports have declined since 2006 from 36 million metric tons to roughly 5.9 million metric tons in 2010. Weak demand is largely responsible for this decline. In the context of weak demand conditions and low domestic utilization rates, imports share declined to 9.3% market share in 2010, compared to a 28.2% market share in 2006. With a gradual economic recovery expected, higher domestic utilization rates will emerge slowly and import shares are expected to remain near 9% through 2012. In the context of sustained growth, a recovery in utilization rates is expected to materialize, prompting import market shares to increase. From expected 2010 levels of 5.9 million metric tons, imports are expected to reach 12 million metric tons by 2015 (11% market share), 32 million metric tons in 2020 (24%), and 48 million metric tons in 2025 (nearly 33%).

U.S. Baseline Clinker Production Projections

Longer term cement production will be capped by high utilization rates and a possible hiatus on further expansion initiatives.

Actual domestic clinker production declined from 90 million metric tons in 2006 to less than 60 million metric tons in 2010. With the economic recovery, cement production is expected to reach 90 million metric tons in 2015 and beyond. These projections reflect PCA’s estimates regarding domestic capacity, cement consumption, import volume, exports, and probable inventory changes.

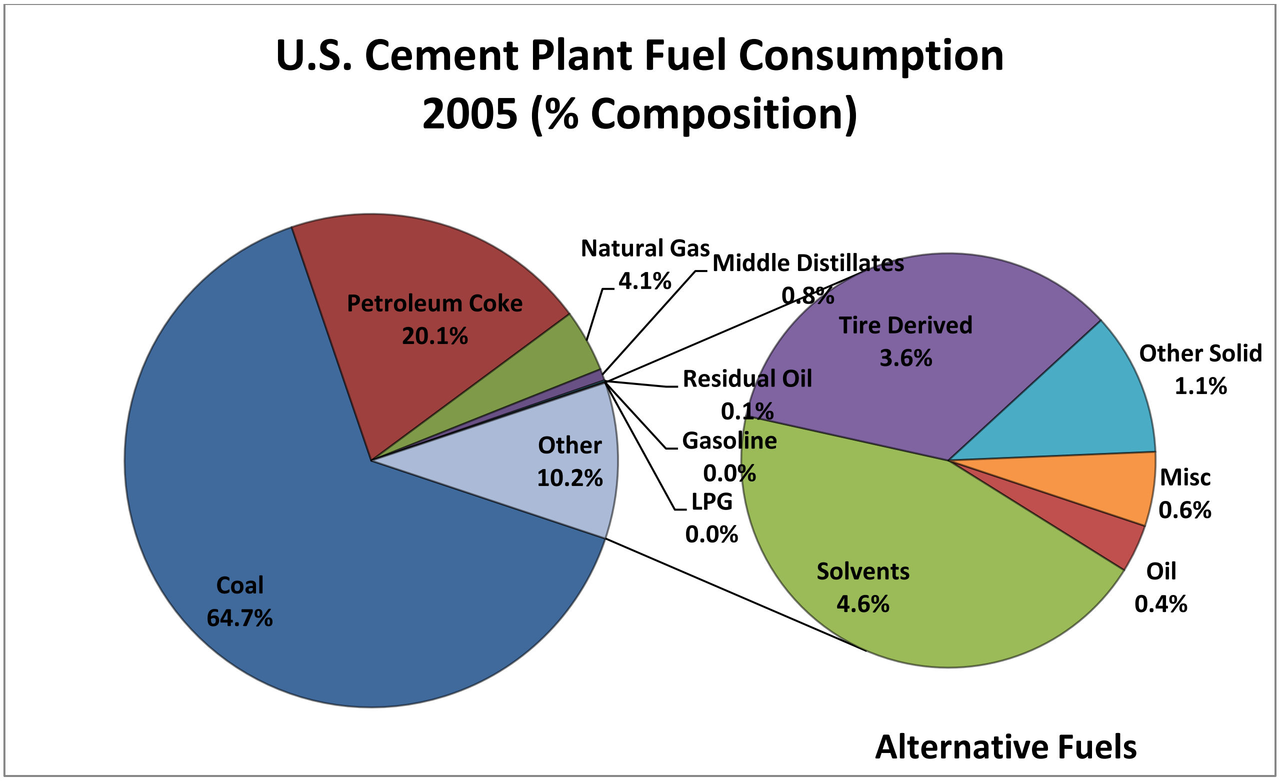
U.S. Kiln Fuel Composition Characteristics

While coal will continue to be the main source of kiln fuel, the industry will increase its reliance on alternative fuels.

The cement industry has made large strides in improving fuel efficiency over the past two decades. On average, the industry currently requires 4.1 million British Thermal Units (BTUs) of fuel per equivalent metric ton. This compares to roughly 4.5 million BTUs per equivalent metric ton in 2000, indicating an improvement in fuel efficiency of roughly 9% over the past decade.

During 2007-2009, an average of 12 percent of total fuel consumption in BTUs was composed of alternative fuel sources. Of these alternative fuel sources, approximately one-third were tire-derived, almost 40% were from solvents, 3% were from oil, and one quarter were from other solid wastes and miscellaneous

Baseline: No Emission Policy					
	2005	**2010**	**2015**	**2020**	**2025**
US Cement Industry					
US Cement Consumption (000 tons)	128,035	68,879	111,831	131,388	147,112
US Clinker Capacity (000 tons)	94,693	96,877	107,467	106,403	105,824
US Production (000 tons)	89,981	58,286	90,480	90,359	90,148
Imports (000 tons)	27,305	5,900	12,000	32,000	48,000
Total Fuel Consumption (billion BTU, bbtu)	341,999	233,144	361,919	361,436	360,593
Primary Fuel Consumption (bbtu)	307,009	207,123	321,828	318,163	310,957
Alternative Fuel Consumption (bbtu)	34,989	26,021	40,091	43,273	49,636
Alternative Fuel Plants (AFP)					
Capacity at AFP (000 tons)	48,209	49,923	55,370	54,941	54,941
Production at AFP (000 tons)	44,496	30,036	46,618	46,656	46,803
Total Fuel Consumption (bbtu)	177,984	120,146	186,471	186,625	187,213
Primary Fuel Consumption (bbtu)	142,995	94,125	146,380	143,353	137,577
Plant Alternative Fuel Consumption (bbtu)	34,989	26,021	40,091	43,273	49,636
Plant Tire Derived Fuel (bbtu)	12,143	8,587	13,230	14,280	16,380
Scrapped Tires Consumed (millions)	58	39	63	68	78
Scrapped Tire Stockpile (millions)	188	222	392	311	126
Fly Ash					
Fly Ash Production Million Metric Tons	71,100	65,568	71,520	73,632	75,616
Beneficial Use Consumption	29,118	27,392	44,376	50,625	56,358
Concrete Consumption	14,504	8,898	15,565	19,842	23,721
Cement Kiln Consumption as raw material	2,834	3,017	4,404	4,458	4,458
Cement/Concrete Share of Beneficial Use	59.6%	43.5%	45.0%	48.0%	50.0%
Estimated Landfill	41,982	38,176	27,144	23,007	19,258
Sources: PCA, USGS, Various EPA emissions documents. Note: No credible Cadmium emissions data for cement kilns could be found and is omitted from analysis.					



alternate fuel sources. Tire-derived fuel (TDF) is a significant energy source due to its relatively high BTU value. A decrease in its use would lead to higher fuel costs and higher emissions rates[3]. As for primary fuels during this period, coal and coke represented over 80% of total fuel consumption, whereas natural gas represented around 3.5%. These are supplemented by middle distillates, gasoline, residual oil, and liquefied propane gas (LPG).

Compliance With EPA Standards Scenario

The EPA emission compliance scenario includes all assessments regarding cement consumption and capacity changes contained in the baseline scenario. The compliance scenario assumes the EPA declares fly ash as a hazardous waste, but provides allowances for beneficial use of fly ash in cement production and concrete. This assumption changes the cement consumption outlook significantly. Potential impacts on cement capacity, domestic cement production, capacity utilization and imports are estimated in the context of assumed EPA imposed emission policies.

Seven different, existing or proposed, EPA regulatory standards are considered in the compliance scenario. These standards are at different stages of potential enactment, ranging from in-place standards to the public comment stage. The existing and proposed standards, with enforcement dates in parenthesis, include:

[3] The EPA states on its website (epa.gov/epawaste/conserve/materials/tires/tdf.htm#cement) "based on over 15 years of experience with more than 80 individual facilities, EPA recognizes that the use of tire-derived fuels is a viable alternative to the use of fossil fuels. EPA testing shows that TDF has a higher BTU value than coal.

- National Ambient Air Quality Standards (NAAQS) (Currently effective);
- Greenhouse gas reporting (Currently effective).
- Clean Air Act's "Tailoring Rule" (Currently effective).
- New Source Performance Standards (Currently effective).
- National Emission Standards for Hazardous Airborne Pollutants (NESHAP) (Compliance 2013).
- Potential new standards for Commercial and Industrial Solid Waste Incineration (CISWI) (Proposed compliance 2015).
- Fly Ash determination as a hazardous waste (Assumed to be effective 2015).

The EPA has been vague regarding the meshing of these standards into a coherent regulatory strategy directed at emitting industries, including those targeting cement producers. Lacking definitive rulings on EPA standards, PCA is forced to make assumptions regarding the timing, coverage and scope of EPA policies that impact cement plant emissions.

Compliance Scenario: Fly Ash Ruling

PCA assumes the EPA will not classify fly ash used in concrete mixes and cement as a hazardous waste. While the EPA has yet to reach a final ruling on fly ash, this report assumes an enforcement date of 2015.

Most EPA standards impact the cement industry's supply side by mandating compliance cost investments and the annual operating costs associated with those investments. EPA's proposal on fly ash, however, has potentially large impacts on cement consumption, with smaller impacts on the supply side. Consumption levels play a role in determining plant operating rates, expected return on investments (ROI), and imports. As a result, the fly ash rule must be addressed first in the compliance scenario. Otherwise, all other assumptions and assessments made in the baseline scenario pertaining to consumption remain in place for the compliance scenario.

Fly ash is a by-product of coal combustion from electric utilities and independent power producers. A large portion of fly ash generated from electricity generation is recycled in cement and concrete. The benefits of using fly ash in concrete come from improved durability, increased ultimate compressive and flexural strengths, reduced permeability, and mitigation of alkali silica reactivity (ASR). Concrete made with fly ash often extends the life of construction projects by decades, minimizing environmental impacts of rebuilding. Since fly ash requires no calcination (converting limestone to cement) and therefore produces no carbon dioxide (CO2) or other emissions excluding those associated with the initial coal combustion, it is environmentally attractive. Finally, fly ash is less expensive than cement, reducing the cost of construction projects.

Coal powered electric utilities account for roughly 22.5% of total United States electric power, or roughly 100 quadrillion BTUs. Total energy consumption will grow in the years ahead. Based on statistics from the American Coal Ash Association (ACAA), roughly 70 million tons of fly ash is produced as a by-product of this energy generation annually. According to the Energy Information Agency (EIA), coal powered electricity generation will account for slightly less than 22% of total electric power by 2030 – or roughly 110 quadrillion BTUs. This implies that the fly ash by-product of coal combustion from electric utilities will increase from current levels, despite efforts to pursue renewable energy power sources. PCA estimates that 78 million tons of fly ash will be produced in 2025.

Roughly 30 million tons of fly ash produced annually is re-used for beneficial purposes. This implies that roughly 40 million tons of fly ash is committed to landfills. The ACAA identifies 15 major users of fly ash ranging from construction to agricultural industries. Cement and concrete are the largest consumers of fly ash for beneficial purposes. Fly ash is normally contained in the concrete mix, accounting for roughly 12 million tons of consumption annually. Fly ash is also used in cement kilns as raw feed, accounting for roughly 3 million tons of consumption annually.

Coal combustion residuals, often referred to as coal ash, are currently considered exempt wastes under an amendment to the Resource Conservation and Recovery Act (RCRA). EPA is proposing to regulate, for the first time, coal ash, in order to address the risks posed by the disposal of the wastes generated by electric utilities and independent power producers. EPA is considering reclassifying fly ash as a hazardous waste under Subtitle C of the Resource Conservation and Recovery Act. EPA may exclude from the hazardous designation material used for beneficial purposes (as specified by EPA).

Should the EPA designate fly ash as a hazardous waste under the proposed rule, it would reverse decades of progress in sustainability of building materials. Use of fly ash in concrete production has become recognized worldwide as a practice that improves the performance and sustainability of concrete by adding decades to the life of construction projects, and greatly reducing carbon dioxide emissions and resource consumption in cement production. Moreover, the proposal would be inconsistent with the EPA's Comprehensive Procurement Guideline program mandating procuring agencies to purchase certain designated products containing recycled materials, including, in particular, cement and concrete containing fly ash. These standards are often amplified by state mandates for fly ash usage in public construction projects.

EPA concluded the public comment stage regarding fly ash's designation as a hazardous waste. EPA is currently considering two options; (1) designation of all fly ash as a hazardous waste when disposed or as a solid waste and (2) omitting the designation of fly ash as a hazardous waste if its use has beneficial purposes. For this report, PCA assumes EPA will omit the designation of fly ash as a hazardous waste for concrete mixes and cement kiln use. While EPA has yet to reach a final ruling on fly ash, this report assumes an enforcement date of 2015.

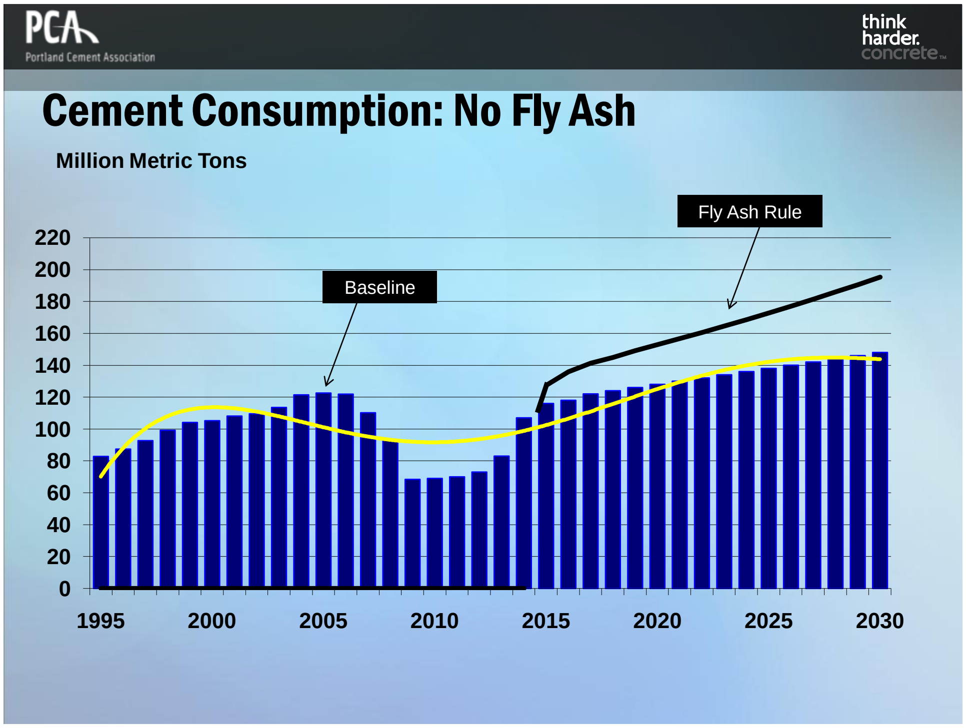
While this may seem a generous assumption, in all likelihood fly ash usage, even if beneficial, will be open to legal actions, with similar results as if it were declared a hazardous waste. Fly ash's designation as a hazardous waste, whether for beneficial use or not, would have several impacts including; stigmatization of its use as an ingredient in concrete or cement, raise the potential of law suits against producers and end-users of fly ash, including electric utilities, cement and concrete producers, and construction companies, and potentially raise insurance premiums for principals that continue to employ the use of fly ash.

The exposure to legal action will dramatically hinder, and possibly eliminate, the use of fly ash use in concrete mixes. Typically, parties with the largest financial resources are the most exposed to law suits – namely the electric utilities. PCA assumes that rather than sell fly ash for beneficial use and risk exposure to legal action, most electric utilities will landfill fly ash[4]. The additional costs associated with this decision are likely to be built into the rate base for the coal burning electric utility. In such a scenario, it makes little difference whether concrete producers and construction companies opt to accept legal risks associated with fly ash usage because coal burning electric utility companies will stop selling fly ash.

This scenario implies that the fly ash ruling could increase electricity costs to consumers. According to this scenario, coal burning utilities will forego revenues associated with fly ash sales and incur landfill costs (estimated at $300 per ton). At 15 million tons of fly ash used by the cement/concrete industry annually, this implies a net incremental cost to coal burning utilities of roughly $5.7 billion annually. Keep in mind,

[4] "The stigma of being associated with hazardous waste is real and is already affecting the markets". Thomas A Adams, Executive Director of the American Coal Ash Association. EPA public hearing, October 27, 2010, Knoxville, Tennessee.

cement/concrete usage of fly ash is expected to increase according to the baseline scenario, implying even larger potential net incremental costs to coal burning utilities. PCA estimates that this could translate into roughly a 4% increase in incremental costs to coal burning utilities which will likely be passed onto consumers in the form of higher electricity rates. As a significant consumer of electricity, cement production cost would significantly increase resulting in upward price pressure on cement.



Fly Ash Ruling Impact: Higher Cement Consumption

Without the use of fly ash in concrete mixes, cement consumption will increase dramatically.

The elimination of fly ash usage suggests a significant increase in cement consumption. While the ratio can vary depending upon the application, one ton of fly ash in the concrete mix is assumed to displace one ton of cement consumption. The baseline scenario assumes the use of fly ash in concrete mixes has been increasing steadily, constituting roughly 10.5% of total cementitious material consumption (cement, slag cement and fly ash). By 2025, PCA expects fly ash will account for 14%-15% of total cementitious material consumption. PCA expects fly ash consumption used in concrete mixes will reach nearly 30 million tons by 2025. This implies that cement consumption will increase by an equal amount.

Fly Ash Ruling Impact: Increases Construction Costs

Concrete construction costs will increase, adding nearly $1 billion annually to total United States construction costs.

In most construction projects, fly ash accounts for 15% to 40% of the cementitious material mix. This will vary by project and region depending upon the availability of slag as well as user preferences. During 2001-

2010 the price of fly ash averaged $65.55 per ton compared to $90.52 per ton for cement. Using these averages implies that concrete mixes using:

- A 15% fly ash mix averaged $86.77 per ton, or a savings of $3.74 per ton - translating into a 4.1% reduction in concrete costs for a construction project;

- A 25% fly ash mix (most common) averaged $84.27 per ton, or a savings of $6.24 per ton, translating into a 6.9% reduction in concrete costs for a construction project.

- A 40% fly ash mix averaged $80.53 per ton, or a savings of $9.99 per ton, translating into an 11% reduction in concrete costs for a construction project.

Using a five year average of cementitious material intensities, out of every one million real 1996 dollars of construction activity, roughly $14,500 is attributed to cementitious material costs. Prior to the recession's collapse of construction activity, the construction market was averaging roughly $750 billion in real construction spending. This translates into roughly $11 billion in cementitious material spending. A hazardous waste designation for fly ash would likely increase construction costs 4% to 11% per construction project.

Fly Ash Ruling Impact: Lowers Domestic Cement Supply

Use of supplementary cementitious material could be reduced by 25%, reducing domestic cement supply by more than 2.0 million metric tons.

Specification changes have allowed for an increase in the amount of limestone and added to ground clinker to form cement. Recently, specification changes have permitted the use of inorganic materials, or fly ash, to be added to limestone, gypsum, and ground clinker to form cement. PCA's baseline scenario assumed that "inorganic" additions (fly ash and slag) would represents a 2.5% national average of the cement mix by 2015 and beyond. Under the proposed fly ash ruling, these additions cease. This implies that while domestic supply of clinker remains unchanged by the fly ash rule, domestic supply of cement is reduced by roughly 2.5 million metric tons annually by 2015.

The combination of increased demand of roughly 16 million metric tons in 2015, 20 million metric tons in 2020, and 24 million metric tons in 2025 and reduced domestic supply of roughly 2.5 to 3.0 million metric tons annually suggests that the fly ash rule will push domestic production to its limits and add significantly to either domestic manufacturers' incentive to invest or increase their volume of imports. Given the context of a harsh regulatory environment facing domestic producers, aside from the fly ash rule, it is unlikely additional investment will be forthcoming. The disparity between increased cement demand and reduced cement supply suggests a dramatic increase in imports beginning in 2015.

To compensate for the elimination of fly ash as an addition to the cement mix, PCA assumes that domestic cement production will increase to offset the shortfall. This implies a higher utilization rate among existing domestic plants beginning in 2015 (2.5% increase in production). Compared to cement production, this implies that the absence of fly ash additions to the cement mix increases:

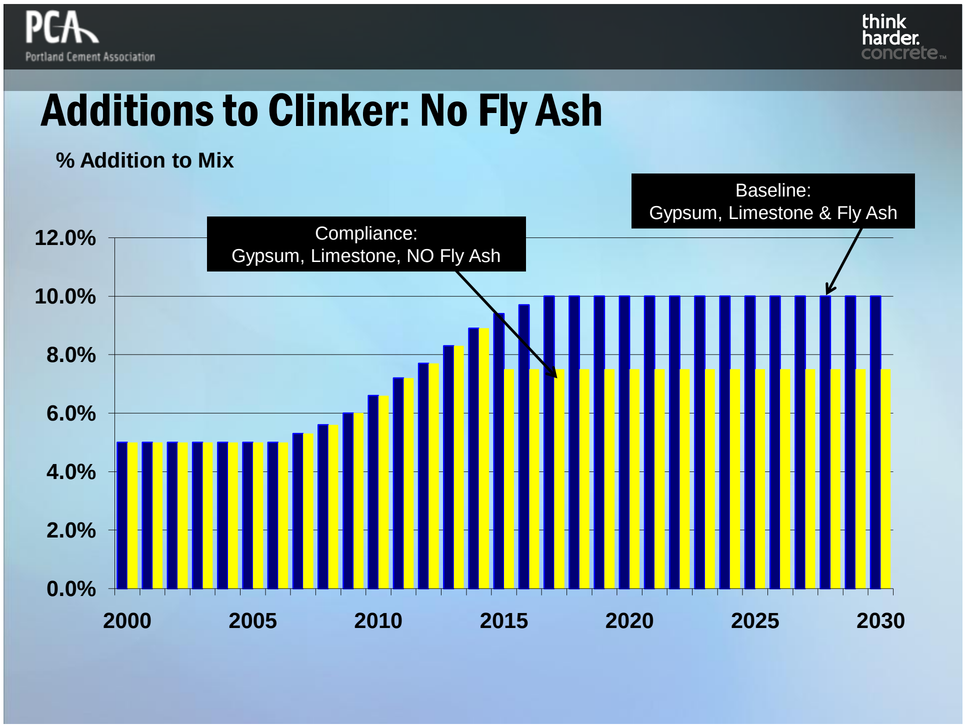
- CO2 emissions by more than 2.5 million tons annually.

- Mercury (Hg) emissions by 820 pounds lbs annually.

- Total hydrocarbons (THC) emissions by 1.5 million pounds annually.

- Particulate Matter (PM) emissions by 1.2 million pounds annually.

- Nitrogen oxide (NOx), sulfur dioxide (Sox), dioxin/furans (D/F), carbon monoxide (CO), lead (Pb), cadmium (Cd) generated by alternative fuel burning plants will also increase.



These assessments dramatically underestimate the potential increase in emissions associated with the fly ash ruling due to PCA's assumption that it is unlikely additional investment in capacity expansion will be forthcoming given the context of a harsh regulatory environment facing domestic producers. By itself, the fly ash ruling would imply an increase in more than 25 million metric tons by 2025 of cement consumption in the United States due to fly ash's elimination in concrete mixes. Absent other existing and potential regulations this ruling would encourage increases in investment to expand domestic cement capacity to meet the increase in forced consumption. Assuming 25% of this new, forced demand would be met by imports, this implies capacity expansion equivalent to 11 new cement plants at an average capacity of 2 million tons operating at 90% utilization. This equates to an increase in domestic production eventually reaching 20 million metric tons annually, adding to economic activity (GDP) and employment.

If PCA's assumption regarding additional capacity investment is relaxed, cement production would increase significantly and the emissions associated with cement production would increase as well, even with optimal emission capture technologies in place. Accordingly, the absence of fly ash additions to the concrete mixes increases domestic production and hence emissions by the following:

- CO_2 emissions by 16-24 million tons annually during 2015-2025;
- Mercury (Hg) emissions by 3.3 to 4.5 thousand pounds annually during 2015-2025.
- Hydrochloric Acid (HCL) emissions by 1.2 to 1.7 million pounds annually during 2015-2025.

- Total hydrocarbons (THC) emissions by 6 to 8 million pounds annually during 2015-2025.
- Particulate Matter (PM) emissions by 4.8 to 6.7 million pounds annually during 2015-2025.

The ruling on its surface, seems to run counter to a coordinated EPA emission reduction strategy (fly ash all about "off coal"; EPA assumes no stigma). Or, it implies a coordinated EPA strategy that successfully reduces wastes by exporting the problem. PCA's assumption that is unlikely additional investment will be forthcoming given the context of a harsh regulatory environment facing domestic producers falls in-line with the latter. Keep in mind, removing fly ash from concrete mixes increases cement production – either domestically or in foreign source countries or both. The extent to which the corresponding emission increases are realized in the United States is dependent on further investment in United States cement capacity. World-wide emissions arising from increased cement production will result from the fly ash ruling. If the additional cement is not produced in the United States, it will be produced elsewhere and the emissions associated with additional cement production will be released, plus the emissions associated with its transportation back to the U.S.

Fly Ash Ruling Impact: Domestic Kiln Usage and Cost Impacts

Raw feed costs will increase – adding to the costs of cement and concrete.

The fly ash ruling not only impacts the volume of cement consumption and its supply, but would also have an impact on the cost of producing cement in the United States. Fly ash is used in cement kilns as raw feed, accounting for roughly 3 million tons of fly ash consumption annually. Fly ash is used mainly for its alumina in cement kilns but also contributes silica, iron and calcium to the raw material mix. It improves clinker quality, mainly due to its lower alkali content and fineness. The rate of substitution is generally 3–5% of the raw materials. Use of fly ash in cement kilns may also release unburned carbon – reducing energy requirements at the kiln. The fly ash ruling would end its use in the kiln. This ruling, therefore, seems to run contrary to the EPA's Tailoring Rule aimed at best practices to reduce CO2 emissions.

Other materials would be used to offset fly ash's displacement in the kilns. One benefit of fly ash usage is low cost. It is likely that the replacement materials would be more expensive than fly ash – potentially increasing the manufacturing cost per ton of cement. PCA estimates roughly a $4 increase in material cost per ton for the replacement of fly ash in the kiln. At roughly 3 million metric tons of fly ash consumed annually this translates into a $12 million increase in kiln material costs per year or roughly $0.15 to $0.20 per ton when dispersed across national production.

Fly Ash Ruling Impact: Demolition Costs

A hazardous waste designation could lead to substantive increase in demolition costs associated with the containment of fly ash.

The legal risk associated with fly ash's designation as a hazardous waste pertains to both continued use in construction and for the demolition of existing concrete structures. A hazardous waste designation could lead to substantive demolition costs associated with the containment of fly ash. Presumably these costs will be borne by the demolition company and passed onto the site developer. Even in this context, legal risks remain. PCA has not addressed this issue in the current study.

Compliance Scenario: NESHAP & CISWI Impact

EPA has recently ruled on National Emission Standards for Hazardous Air Pollutants (NESHAP). This regulation requires compliance in 2013, requiring cement producers to invest billions of dollars in compliance equipment targeting specific emissions prior to the compliance date. At the same time, EPA recently proposed a broader set of emission standards, and at different levels of tolerance and measurement, than NESHAP, for emissions generated by alternative fuel burning plants under Commercial and Industrial Solid Waste Incineration (CISWI). CISWI is scheduled for enactment in 2015.

EPA has not issued guidance regarding compliance for alternative fuel burning plants during the time gap between NESHAP and CISWI implementation, or the 2013-2015 period. Conceivably, an alternative fuel burning plant (which has been encouraged by the EPA) could be faced with investing by 2013 in compliance equipment for NESHAP and a different set of compliance equipment for CISWI by 2015. Such a scenario suggests a lack of coordination between the two policies. At issue is the EPA's designation of specific cement plants as either a cement kiln or an incinerator – not both. Such a scenario amounts to double jeopardy.

As a result, PCA assumes alternative fuel burning plants, or potential CISWI plants, do not have to conform to NESHAP standards in 2013, but must commit to a CISWI designation at that time. These plants would then be forced to comply with CISWI standards in 2015.

In any case, the proposed CISWI standards must be analyzed in the context of NESHAP. The proposed CISWI standard presents cement plant executives with two options including; (1) continue to burn alternative fuels and invest in compliance technologies, or (2) discontinue the burning of alternative fuels, avoid CISWI compliance, and then become subject to NESHAP standards. Which option is chosen will be based on cement industry executives weighing the potential marginal change in CISWI compliance costs against NESHAP compliance costs and considering the potential fuel costs savings resulting from the continued burning of alternative fuels. PCA's assumption suggests these decisions must be made well in advance of 2013 so facilities can prepare for compliance.

PCA's NESHAP and CISWI analysis includes all assessments regarding cement consumption and capacity changes contained in the baseline scenario. Potential impacts on cement capacity, domestic cement production, imports, and total U.S. cement emissions are estimated in the context of the existing NESHAP standards and the EPA proposed CISWI standards.

Three layers of analysis were performed to determine emission control policy impacts on cement capacity. First, PCA must split the universe of cement plants into CISWI plants and NESHAP plants.

Second, emission control technologies are applied to each plant's expected emissions. Expected emissions by plant were calculated using the same method identified in the baseline scenario. Six emission control technologies were applied to bring plants into compliance including enhanced bag house/ESP controls, ACI systems, wet scrubber systems, RTO systems, selective non-catalytic reduction systems (SNCR), and kiln burner design enhancements. Bag house/ESP controls, ACI systems, and wet scrubber systems address emission compliance efforts for both the NESHAP and CISWI standards. RTO systems are targeted at reducing total hydrocarbons contained only in the NESHAP standard. SNCR enhancements are targeted at reducing nitrogen oxide (NO_X). Kiln burner designs are targeted at carbon monoxide emissions. Regulations aimed at reducing nitrogen oxide and carbon monoxide are only in the proposed CISWI standard. No other systems or technology measures are considered in the context of this analysis. Technology efficiencies were assumed in the capture of emissions by each system. Regardless of costs, if a plant failed to meet the standard, it was assumed to be a forced closure.

In the third layer of analysis, plants capable of meeting the NESHAP and CISWI standards were subjected to cost analysis. PCA assumes a 15 year horizon for the capitalization of fixed costs. For plants with less than an estimated 15 years left in quarry life, fixed emission compliance costs are capitalized over the longest period possible. Annual operating costs for the compliance systems were also included in the analysis. Finally, these estimates are based on a 90% utilization rate.

Each these EPA standards also include provisions for "new source" emitters that imposed emission limits which are considerably more severe than "existing source emitters". New greenfield plants that are commissioned after 2013 are assumed to be subject to these tighter standards. Major modifications to existing plants could force a reclassification of a plant from an existing source to a new source.

Designation of NESHAP and CISWI Plants

According to PCA's Labor/Energy data, sixty one plants used alternative fuels in their kilns on a sustained basis during 2006-2008. Of these, 16 plants' alternative fuel usage accounted for less than one percent of their total fuel consumption. Those plants were excluded from the analysis in this report. This report includes only the remaining 45 plants that burn alternative fuels accounting for more than 1% of their total fuel usage. In the context of regulation uncertainty, PCA assumes no additional cement plants will begin burning alternative fuels. Alternative fuels include scrap tires, solvents, waste oil and other solids and liquids. Coal, petroleum coke, natural gas, middle distillates, residual oil, and liquids/gases are considered primary fuels and plants burning only these fuels are not considered subject to CISWI standards.

PCA compares the CISWI compliance costs against NESHAP compliance costs. This results in the incremental increase in investment to comply with CISWI over the existing NESHAP standards. Finally, these incremental changes in CISWI compliance costs were weighed against the potential fuel cost savings arising from alternative fuel usage. If the marginal increase in compliance costs for CISWI are more than offset by fuel savings, then plants are assumed to continue burning alternative fuels and comply with CISWI. Plants lacking this return are assumed to discontinue burning alternative fuels and would then fall under NESHAP rules. PCA assumes this compliance decision must be performed well before the onset of NESHAP compliance.

Emission Control Technology Assumptions

Technology assumptions were made regarding the effectiveness of various emission control systems. Sparse evidence exists regarding the actual effectiveness of emission control technologies applied to cement kilns. The emissions captured by the various technologies are often based on theoretical estimates of capture efficiencies and may not reflect actual operating efficiencies. Furthermore, it should be noted that emission capture efficiencies used in this report may differ from the estimates indicated elsewhere in the PCA comments. Due to uncertainties regarding emission control efficiencies, PCA has assigned its own estimates regarding emission capture efficiencies. Considerable effort was undertaken by PCA to yield fair and realistic emission capture efficiencies. PCA's emission capture assumptions are typically less optimistic than those assumed by EPA.

Mercury (Hg) Emission Control Assumptions (NESHAP and CISWI)

The bulk of mercury emission control is likely to occur through the use of ACI systems, wet scrubber systems, or a combination of both. According to some experts, ACI systems are preferred. PCA estimates that ACI systems can potentially capture 75% of Hg emissions. EPA estimates the capture efficiency at 90%. Wet scrubber systems alone are believed to be less effective than ACI systems as they do not capture the elemental form of mercury. PCA estimates that wet scrubber systems could potentially capture 50% of Hg emissions. The EPA estimates the capture efficiency at 80%. Use of an ACI system coupled with a wet scrubber is expected to capture 85% of mercury emissions. EPA estimates the capture efficiency of this combination at 98%. Keep in mind, most research regarding Hg emission control and capture has targeted coal burning utilities. These form the basis of EPA's high emission capture

	Technology Assumptions Regarding the Recapture of Emissions									
	THC	H	HCL	D/F	PM	NOx	SOx	CO	Pb	Cd
Bag house	--	--	--	--	99%	--	--	--	99%	99%
RTO	95%	--	--	--	--	--	--	--	--	--
RTO-Wet Scrubber	95%	--	--	--	--	--	--	--	--	--
SNCR		--	--	--	--	90%	--	--	--	--
Web Scrubber		50%	99%	--	--	--	80%	--	--	
ACI		75%	--	80%	--	--	--	--	--	
Wet Scrubber-ACI		85%	99%	--	--	--	--	--	--	
Cooling & Burning Design		--	--	99%	--	--	--	90%	--	--
Source: PCA										

assumptions. The chemical dynamics inside a cement kiln, however, are far different than those of a utility boiler . The lower capture rate assumed by PCA suggests that fewer plants can meet the NESHAP standards and therefore would likely shut down.

Total Hydrocarbons (THC) Emission Control Assumptions (NESHAP Only)

The bulk of total hydrocarbon emission control is likely to occur through the use of an ACI system, RTO system, or a wet scrubber combined with an RTO system. PCA estimates an ACI system can capture 50% of total hydrocarbon emissions. The EPA estimates the emission capture at 75%. The addition of an RTO system, increases hydrocarbon capture to 95%, compared to 98% estimated by the EPA. An RTO's emission capture cannot be guaranteed at emission rates below 10 ppmv regardless of inlet THC concentration.

Particulate Matter (PM) Emission Control Assumptions (NESHAP and CISWI)

The bulk of particulate matter emission control is likely to occur through the use of bag houses and enhancements to existing bag houses. Bag house systems capture nearly all particulate matter emissions. PCA accepts EPA's estimate of 99.9% emission capture.

Hydrochloric Acid (HCL) Emission Control Assumptions (NESHAP and CISWI)

The bulk of hydrochloric acid emission control is likely to occur through the use of wet scrubber systems. PCA and EPA agree that wet scrubber systems will likely capture 99.9% of all hydrochloric acid emissions. PCA notes that EPA has not considered that the capture of mercury in a wet scrubber may result in the added concentration of mercury in the by-products generated by wet scrubbers. EPA has also not considered that many plants do not have availability of water to supply a wet scrubber system.

Sulfur Dioxide (SO_2) Emission Control Assumptions (CISWI Only)

Several strategies could be employed to address SOx emissions including the use of wet scrubber systems, lime injection and hydration systems, as well as calcinatory slip steam systems. PCA assumes the bulk of sulfur dioxide control is likely to occur through the use of wet scrubber systems. PCA assumes that wet scrubber systems will likely capture 80% of all sulfur dioxide.

Nitrogen Oxide (NO_X) Emission Control Assumptions (CISWI Only)

The bulk of nitrogen oxide emission control is likely to occur through the use of selective non-catalytic reduction systems (SNCR). PCA assumes that SNCR systems will capture at most 50% of all nitrogen oxide emissions. It should be noted, the performance of an SNCR system is very variable, almost as variable as the pyroprocessing systems on which they are installed. NO_x reduction is dependent on how much NO_x emissions is generated. The more NO_x available, the more efficient is the NO_x reduction process. In a perverse way, a plant with relatively low NO_x may have less reduction than a plant with a higher NO_x.

Carbon Monoxide (CO) Emission Control Assumptions (CISWI Only)

The bulk of carbon monoxide emission control is likely to occur through enhancements to burner systems and strict adherence to good combustion practices. PCA assumes that these enhancements will likely capture 99% of all carbon monoxide emissions.

Dioxin/Furan (D/F) Emission Control Assumptions (CISWI Only)

The bulk of dioxin/furan emission control is likely to occur by achieving cooler exhaust temperatures to the kiln system air pollution control devise (APCD), or bag house. Enhancements to ACPD design including the use of ACI will likely capture 99% of all dioxin/furan emission.

Lead (Pb) Emission Control Assumptions (CISWI Only)

The bulk of lead emission control is likely to occur through the use of bag houses and enhancements to existing bag houses. Bag house systems capture nearly all lead emissions. PCA assumes 99% of all lead emissions are captured.

Cadmium (Cd) Emission Control Assumptions (CISWI Only)

PCA's search for cadmium emissions data for cement kilns was more than ten years old and covered only 13 plants. Analysis of cadmium emissions, therefore has been omitted from this report. It is likely that the bulk of cadmium emission (99%) will be captured through the use of bag houses and enhancements to existing bag houses. Since nearly all CISWI plants will require investment in bag house systems to capture other emissions, omission of Cadmium in this analysis is unlikely to result in any significant skewing of the conclusions.

Industry Capital Costs to Comply with EPA Emission Standards

Total industry investments to comply with NESHAP standards are estimated at $3.4 billion and an additional $2.0 billion to comply with CISWI.

No cement plant in the United States can currently meet all NESHAP and/or CISWI standards simultaneously. As a result, all cement plants will require investment in emission capture systems. PCA employs EPA and PCA kiln and plant emission information to determine whether a plant must expend capital to reach compliance.

The emission standards differ between NESHAP and CISWI. The standards use different measures for compliance limits. All emission data by plant, used in this report were sourced from one of several sources including: (1) EPA's ISIS model used for NESHAP, (2) EPA's National Emission Inventory database, (3) PCA SN3048 - Air Emissions Data Summary for Portland Cement Pyroprocessing, (4) PCA SN3050 - Air Emissions Data Summary for Portland Cement Pyroprocessing Operations Firing Tire-Derived Fuels, (5) PCA's annual Labor/Energy Input Survey. Units of measurement for the toxic air pollutants available from these various sources often did not map directly to CISWI and/or NESHAP emission limit units, therefore conversions were required. For mercury (Hg) emissions, PCA used the EPA plant-by-plant study on Hg emissions from the cement industry, reflecting 2006 information. (EPA: The Toxics Release Inventory (TRI) 2006)[5]. A follow-up study was performed reflecting 2007 information for some 50 cement plants. Historical benchmarks on plant-by-plant Hg emissions reflect the most recently available data for each plant.

On a plant-by-plant basis, PCA employs a matrix solution that accounts for the plant's emissions of THC, Hg, HCl, PM, NOx, SOx, D/F, Pb and CO and employs PCA technology emission capture assumptions to determine which emission systems must be employed at the plant to comply with EPA standards. A plant with extremely high levels of Hg, HCl, and SOx, for example, would likely be forced to invest in an ACI-wet scrubber system. Investment in the ACI-wet scrubber system to comply with mercury emissions, for example, would presumably also take care of their HCl emissions at the same time. This investment for mercury control would also reduce SO_2 emissions by 80%. Double counting of systems required for compliance is eliminated through this process. Each plant is carefully assessed using this methodology.

For the NESHAP plants, PCA estimates that 90% cement plants will be forced to invest in bag houses to meet particulate matter standards. This includes investments to existing bag houses and in some cases the construction of new bag houses. To comply with the combined Hg, THC, PM, and HCl standards, PCA estimates that 9% of all plants will be required to invest in a stand-alone wet scrubber system, 75% of all plants will be required to invest in ACI systems, 20% of all plants will be required to invest in wet scrubber-ACI systems, and 65% of all plants will be required to invest in RTO systems. The methodology used to arrive at these estimates may differ from estimates indicated elsewhere in other PCA comments.

For the CISWI plants, PCA estimates that 87% of all CISWI cement plants will be forced to invest in bag houses to meet particulate matter, lead and cadmium standards. This includes investments to existing bag houses and in some cases the construction of new bag houses. To comply with the combined Hg, SOx and HCl standards, PCA estimates that 22% of all plants will be required to invest in a stand-alone wet scrubber system, 62% of all plants will be required to invest in wet scrubber-ACI systems. To meet NOx standards

[5] EPA: The Toxics Release Inventory (TRI) 2006

22% of all plants will be required to invest in SNCR systems. To meet carbon monoxide standards 39% will be required to invest in burner systems.

PCA capital cost estimates for each emission control system are based on survey information from cement companies as well as equipment manufacturers and based on an average 1.2 million ton dry kiln cement plant with a pre-calciner and a pre-heater. Adjustments to this information are made to account for differences in the type of plant, such as a long dry or wet kiln. PCA assumes a 29% emission equipment installation cost premium for long dry kilns and a 143% cost premium for a wet kiln. Adjustments to this information are also made to account for size differences among plants.

This survey information reflects current estimated investment costs on emission systems. This information contains significant upside risk in the context of likely market conditions facing emission equipment suppliers. The cement industry will be mandated to install a massive amount of emission control equipment to comply with both NESHAP and CISWI. This equipment must be in-place within three years for NESHAP compliance and five years for CISWI compliance. There are a limited number of emission control equipment suppliers. Keep in mind, while there are 30 or more emission equipment suppliers only 6-8 are cement kiln emission focused. Demand for their services from the cement industry will increase dramatically. A premium will likely be placed on the urgency to install the systems over a short period of time. This dynamic is likely to be amplified as the overall economy regains traction. The likely outcome is an escalation in the costs of these systems. A 10% to 20% premium over existing costs is possible. PCA assumes a 15% increase over the survey information. Please note that these adjusted equipment cost estimates differ from the current equipment cost estimates indicated elsewhere in the PCA comments. Based on these adjustments, PCA's estimates for a 1.2 million ton dry kiln with a pre-calciner and pre-heater are as follows:

- Bag house System = $9.2 million
- Activated carbon injection (ACI) = $17.5 million
- Wet Scrubber System = $22.1 million
- ACI system combined with a wet scrubber system = $39.6 million
- Regenerative thermal oxidizer system (RTO) = $20.2 million
- RTO system combined with a wet scrubber system = $42.3 million
- Selective catalytic reduction systems (SNCR) = $ 8.5 million (wet kiln), $3.5 million (dry kiln).
- Burner Enhancements = $ 1 million

U.S. cement industry will be forced to spend billions of dollars to comply. Six plants would be forced to spend in excess of $100 million to reach compliance. Total industry investments to comply with NESHAP standards are estimated at $3.4 billion. Total industry investments to comply with CISWI standards are estimated at $2.0 billion ($5.4 billion for total NESHAP and CISWI compliance).

Industry's Financial Ability to Comply with NESHAP Emission Standards

Large compliance expenditures are magnified in the context of the short compliance time horizon of three to five years. Further, this expenditure comes at a time when the financial ability of the industry to meet these investment requirements has been greatly reduced by current economic conditions.

The cement industry is still in the midst of aggressive investment in domestic capacity to modernize and expand its kilns. The commitment to these investments were made in response to domestic shortage conditions that materialized during 2003-2006, an understanding that dependence on the free flow of foreign supply is dictated by uncertain international logistic conditions surrounding dry bulk carriers thereby impacting freight rates, and in recognition of the long-term demographic trends that suggest strong demand requirements in the United States. Furthermore, the $6.7 billion commitment to expand and modernize in the domestic industry was undertaken before the current economic hardships were clearly understood. Capitalization and financial commitment to many of these projects are already in-place.

Furthermore, harsh demand conditions currently face the industry. Since 2005, cement consumption declined by 59 million metric tons – or roughly 46%. With the slower than expected economic recovery, these conditions are unlikely to abate soon**.** Utilization rates are likely to remain near 60% through 2012 and hence the industry's financial performance will remain depressed.

The EPA's short three year compliance period for NESHAP suggests that compliance investments must begin soon. PCA estimates total 2009 cement industry ***revenues*** at less than $6.5 billion. For 2010-2012, total industry revenues are estimated at $19 billion. The $3.4 billion in investment required to comply with NESHAP standards equates to more than 18% of industry ***revenues*** accumulated during the years preceding NESHAP compliance (2010-2012).

Investments to comply with CISWI standards do not have to be in-place until 2015. The $2.0 billion in investment required to comply with CISWI standards equates to more than 6% of industry ***revenues*** accumulated during the years preceding CISWI compliance (2010-2014). This assessment assumes a substantive recovery in cement consumption materializes in 2013 and beyond.

The combination of the industry's pre-existing financial commitment to provide reliable and efficient supply of cement to the U.S. market, coupled with sustained harsh economic and financial realities may overwhelm the industry's financial capability to comply with the NESHAP and proposed CISWI standards.

Forced Cement Capacity Closures Due to NESHAP and CISWI Emission Standards

NESHAP standards will force 18 cement plants to close, perhaps more.

NESHAP emission standards will force cement plants to close beginning in 2013. Closures are expected to come in two forms. First, some plant's emissions are sufficiently high that even with the installation of emission capture systems they will not be able to meet NESHAP standards. Second, even if a plant can technically meet the NESHAP standards, the compliance investment required may not be justified on a financial basis. In either case, PCA assumes closure of the plant.

PCA estimates that 18 plants could be forced to close due to the inability to meet NESHAP or CISWI standards or because the compliance investment required may not be justified on a financial basis. These closures represent roughly 11 million metric tons of clinker capacity, or roughly 12% of current capacity. Of these plants, 7 burn alternative fuels and would be subject to CISWI standards. Each of these alternative fuel burning plants would require at least as much compliance investment to meet the more comprehensive and harsher CISWI compliance. These 7 alternative fuel burning plants are assumed to be shut down in 2015 when CISWI enforcement begins. An additional 3 plants, reflecting 2.5 million tons of clinker capacity, are at high risk of closure. These high risk plants are assumed to continue to operate.

Unfortunately, the process of plant closures confronting tight emission standards may have already begun. Since August 2008, seven plants, with an estimated annual capacity of nearly 4 million metric tons, have been announced for permanent closure. Undoubtedly, the harsh recession contributed to the decision to close these plants. Weak cyclical demand conditions, however, would likely dictate temporary – not permanent closures. It is likely that the prospect of tight emission standards, coupled with expectation for a slow recovery in demand, contributed to decisions to permanently close these plants. According to ISIS model runs, each of these plants would have been forced to close under the EPA's NESHAP standards. These plants are not included in PCA's estimate of NESHAP closures. If included, NESHAP expected closures would equate to 25 plants and 15 million metric tons. These plant closures include:

Recent Permanent Plant Closures	
Buzzi Unicem: Independence, Kansas ○ Capacity: 324,000 metric tons annually ○ Employment estimated at 108 workers	**Cemex: Davenport, California** ○ Capacity: 842,000 metric tons annually ○ Employment estimated at 114 workers
Essroc: Frederick, Maryland ○ Capacity: 308,000 metric tons annually ○ Employment estimated at 82 workers	**Essroc: Bessemer, Pennsylvania** ○ Capacity: 605,000 metric tons annually ○ Employment estimated at 111 workers
Holcim: Clarksville, Missouri ○ Capacity: 948,000 metric tons annually ○ Employment estimated at 164 workers	**Holcim: Dundee, Michigan** ○ Capacity: 830,000 metric tons annually ○ Employment estimated at 155 workers
Texas Industries: Riverside, California ○ Capacity: 86,000 metric tons annually ○ Employment estimated at 88 workers	

Compliance Scenario: Impact on Alternative Fuel Practices by the Cement Industry

CISWI standards will force two thirds of all cement plants to eventually discontinue the use of alternative fuels.

CISWI emission standards will force cement plants to opt between compliance or discontinue alternative fuel usage. The decision to discontinue the use of alternative fuels is expected to be based on two factors. First, some plant's emissions are sufficiently high that even with the installation of emission control systems they will not be able to meet CISWI standards. Second, even if a plant can technically meet the CISWI standards, the compliance investment required may not be justified on a financial basis. In either case, PCA assumes the discontinued use of alternative fuels.

According to PCA's Labor/Energy data, sixty one plants used alternative fuels in their kilns on a sustained basis during 2006-2008. Of these, 16 plants' alternative fuel usage accounted for less than one percent of their total fuel consumption. Since the alternative fuel reliance of these plants are relatively small, each of these plants are assumed to discontinue burning alternative fuels rather than incur CISWI compliance costs.

Among the remaining 45 plants that burn alternative fuels, PCA estimates that 18 plants could be forced to discontinue the use of alternative fuels due to the inability to meet “existing facilities” CISWI standards or because the compliance investment required may not be justified on a financial basis. Fifteen of these plants discontinue the use of alternative fuels due to financial criteria. An additional three of these plants cannot meet “existing facilities” CISWI emission standards based on assumptions regarding existing technology and the ability to capture emissions.

Keep in mind, 24 of the 45 cement kilns covered by CISWI are at least 35 years old and may require substantial investment and modification to insure efficiency and remain “world-class” competitive. Such investments could result in existing plants being reclassified as new sources and subject to more severe emission standards. Given this, the technical ability to meet the CISWI standards as well as industry compliance costs could be underestimated if this impact is not taken into consideration. PCA assumes that all plants require a major upgrading or maintenance investment within 35 years of initial plant launch. This suggests that all plants commissioned before 1985 could be subject to a major reinvestment – and could result in an EPA reclassification of the plant as a “new source” within five years after the CISWI standard has been imposed. These 24 plants represent nearly 25 million metric tons of capacity.

Cement Plants Burning Alternative Fuels		
	2015	**2025**
Total Cement Plants Burning Alternative Fuels in 2010	61	61
- Less: Marginal Burners	16	
- Less: Failure to Meet CISWI “Existing Facilities”	3	
- Less: Failure to Meet ROI under CISWI “Existing Facilities”	15	
- Less: Failure to Meet CISWI “New Facilities”		7
Total Cement Plants Burning Alternative Fuels	27	20
- Percent Reduction	55.7%	67.2%
Source: PCA		

Plants originally commissioned during this time period, but which have had significant capacity changes have been excluded from this analysis. ***Even with no new greenfield plants, our analysis suggests the emission standards facing the industry will be essentially tightened as the industry pursues normal investment to maintain efficiency and competitiveness.*** For nitrogen oxide (NO_x), as an example, the effective CISWI emission standard is lowered from 1,100 ppmv to 140 ppmv by 2020 – representing a dramatic tightening of the standard facing the industry. Among those commissioned before 1985, PCA estimates an additional 7 plants will discontinue burning alternative fuels.

Compliance Scenario: CISWI Impact on Scrap Tire Stockpiles

CISWI will dramatically increase the number of tires in landfills.

Three hundred and eleven million scrap tires were generated in 2009 according to the Rubber Manufacturers Association (RMA). The amount of tires scrapped annually is determined by the number of vehicles on the road and vehicle miles travelled. Historically, 1.24 tires annually are scrapped per vehicle on the road. Based on United States Census projections of population growth, licensed drivers and the number of vehicles per driver, PCA estimates the number of scrap tires produced annually will increase by an average of roughly 2.8 million each year - reaching over 356 million scrapped tires per year by 2025.

Scrapped tires are used as alternative fuel, used in products, or placed in landfills. Since 2005, roughly 55% of scrapped tires were used as alternative fuels, 33% used in other products and 24% placed in landfills. Totaling these uses equates to 112% and is explained by a reduction in stockpiled tires. In 2005, stockpiled tires were estimated at 188 million by the RMA. PCA estimates 2009 stockpiles at 125 million tires.

The cement industry is the largest consumer of tire derived fuel (TDF), utilizing nearly 60 million tires annually and accounting for nearly 40% of all scrapped tires used as fuel. Recent adverse economic conditions has forced a decline in domestic cement production, and as a result, prompted a temporary cyclical decline in TDF consumption by the cement industry. As the economy recovers, cement production and its consumption of TDF will recover.

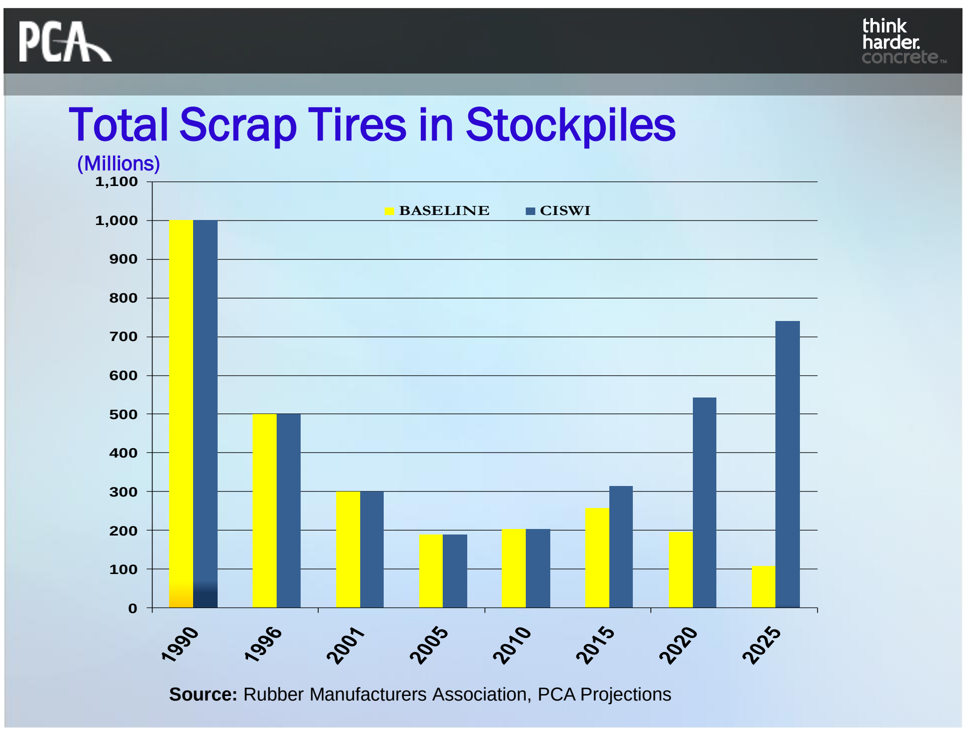
The recovery in consumption of TDF, attributed to stronger production levels, is expected to be supplemented by changes in cement kiln fuel characteristics in the years ahead – favoring alternative fuels. A gradual and sustained recovery in world economic conditions leading to synchronized world growth is expected to emerge in 2013 and beyond. Much of this growth will be fueled by conditions among lesser developed economies. Indeed, the Energy Information Agency (EIA) expects world economic growth will average 3.2% during 2010-2030. In the context of these world growth conditions, it is likely that oil prices will record sustained gains. Indeed, the Energy Information Agency (EIA) expects oil prices will reach $105 per barrel in 2015, $132 per barrel in 2020, and $156 in 2025. Given these increases and potential substitution effects, all fossil fuel prices, including coal, are expected to increase. PCA uses EIA fuel price projections. Lacking EIA guidance, PCA employs rough cross-elasticity of demand estimates to project other fossil fuel prices.

Alternative fuel prices beat to a different drummer. While these fuels are influenced by overall fuel prices, supply of these fuels are dictated by producer and consumer activity of end-products, such as tires. The disparity in price drivers between fossil fuels and alternative fuels suggests a change in the relative fuel costs – favoring alternative fuels. Such a potential implies an incentive for change in kiln fuel characteristics in favor of alternative fuels at the expense of coal.

PCA estimates the current average fuel cost differential between primary and alternative kiln fuels at roughly $15 per ton. As fossil fuel prices increase, the cost differential margin will increase to an estimated $16 per ton in 2015, $18 per ton in 2020, and $20 per ton in 2025. The potential widening in price differentials between primary and alternative kiln fuels suggests cement companies will increasingly rely upon alternative fuels. This point has been borne out by long term trends in cement kiln alternative fuel usage. Keep in mind, use of alternative fuels also reduces greenhouse gas emissions.

Based on the likelihood of the eventual widening in the differential between primary and alternative cement kiln fuels, PCA expects alternative fuel usage will increase in proportion to primary fuels. In 2008, alternative fuels accounted for nearly 11% of total cement kiln fuel consumed. This share is expected to reach 12% in 2015, nearly 15% in 2020, and nearly17% in 2025. These gains are expected to come at the expense of coal.

With the economic slowdown resulting in production declines, TDF usage for all industries is expected to decline. This suggests the proportion of tires going into landfills will increase and the stockpile of scrapped tires will increase as well. PCA estimates the stockpile of tires will increase from 188 million tires in 2005 to 246 million tires in 2010, with further increases in tire stockpiles materializing as long as industrial production remains depressed – reaching a cyclical peak of 392 million tires in 2015. Sustained declines in tire stockpiles are expected to materialize during 2015-2025, reducing stockpiles to 311 million tires in 2020, and 126 million in 2025. The cement industry's consumption of scrapped tires plays an important role in reducing the scrapped tire stockpile. According to this scenario, existing cement kilns using TDF continue - allowing 63 million scrapped tires to be consumed by the cement industry in 2015, 68 million in 2020, and nearly 78 million in 2025.

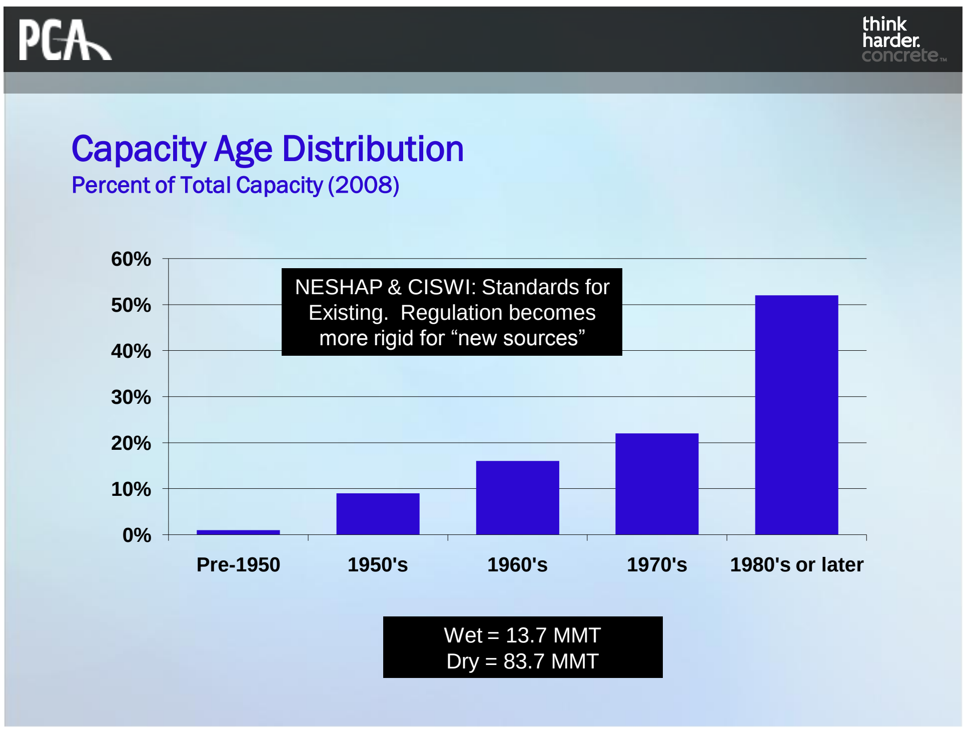


CISWI rules would significantly reduce the amount of scrapped tires consumed by the cement industry. Under CISWI, PCA estimates cement industry scrapped tire consumption would decline to 27 million tires in 2015 and roughly 20 million tires annually during 2020-2025. Holding all other assessments included in our baseline analysis constant, scrapped tire stockpiles would reach 358 million tires in 2015 nearly 534 million tires in 2020, and more than 600 million tires in 2025. The CISWI standard potentially reverses decades of environmental cleanup success and EPA support for using TDF as a fuel.

Compliance Scenario: "New Source" Emitters

EPA's regulatory standards are not static – they are dynamic and are designed to become ever more difficult to meet as time passes.

EPA's regulatory standards are not static – they are dynamic and are designed to become ever more difficult to meet as time passes. This is accomplished by a set of standards for existing sources and much more rigorous standards for new sources. EPA's NESHAP and CISWI standards emission limits, for example, are considerably more severe for new sources than existing sources. New greenfield plants commissioned after 2013 are subject to the new source emission standards. Major modifications to



existing plants could force, or "trigger", a reclassification of the plant from an existing source to a new source – potentially requiring further compliance investment for cement plants. Similarly, the New Source Performance Standards **(**NSPS**)** and the Clean Air Act's Tailoring Rule contain an investment "trigger" prompting compliance investment.

Keep in mind, 63% of all cement kilns are at least 30 years old and may require substantial investment and modification to insure efficiency and to remain "world-class" competitive. Such investments could result in existing plants being reclassified as new sources and then subject to more severe emission standards. Consequently, the technical ability to meet EPA standards, as well as industry compliance costs, could be underestimated if this impact is not taken into consideration. PCA assumes that all plants require a major kiln investment within 35 years of initial plant launch. This suggests that all plants commissioned on or before 1990 could be subject to a major reinvestment during the forecast horizon – and result in an EPA reclassification of the plant as a new source. This represents 33 plants. According to this methodology, 15 plants would have to engage in major investment by 2015, representing nearly 14.5 million metric tons, 14 plants by 2020 representing 14 million metric tons, and 4 plants by 2025 representing 3.3 million metric tons of capacity. Plants originally commissioned during this time period, but which have already had significant capacity changes have been excluded from this analysis. ***Even with no new greenfield plants, our analysis suggests the effective emission standards facing the industry will be tightened as the industry pursues normal investment to maintain efficiency and competitiveness.***

New source triggers are particularly alarming and could lead to decisions to abstain from necessary competitive investments that have always been on-going and, most recently done at an aggressive pace. In some ways the "new source" trigger provisions send a clear signal to cement producers not to invest to remain world-class competitive. Keep in mind, large multinational companies dominate ownership of the United States cement industry. Within a multinational company, each geographic region, such as the North America, competes for scarce corporate investment dollars (expanding cement capacity is extremely expensive – a two million metric ton plant now costs upwards of $600 million). The rate of return on investment for new capacity in the United States is compared against returns in other countries. The new source provisions could reduce expected returns on investments in the United States and contribute to corporate decisions to pursue other options to source the United States cement market.

Compliance Scenario: New Source Performance Standards (NSPS)

New source designations will likely deter investment to remain world-class competitive or force additional plant closures.

The EPA's New Source Performance Standards (NSPS) are aimed at "progressively tightening emission standards over time to achieve steady improvement in air quality without unreasonable economic disruption. This is accomplished by mandating significant improvement in source emitters when they make a substantive investment in plants to modernize to remain competitive. ***In other words, re-investment in domestic production facilities will trigger NSPS compliance.*** For the cement industry, the NSPS targets three key emissions including nitrogen dioxide (NOx), sulfur dioxide (SOx) and particulate matter (PM). The EPA's NSPS requires "new source" cement emitters to comply to:

- NO_x emissions at 1.5 pounds per ton of clinker.
- SO_2 emissions at 0.4 pounds per ton of clinker.
- PM emissions at 0.01 pounds per ton of clinker.

These standards require cement plants to comply with these standards when modernization/investment results in an hourly increase in NO_x, SO_2 or PM emissions. If there is no increase in hourly emissions from the modernization/investment, then the NSPS standards have no impact on cement producers' overall emission compliance strategy.

Unfortunately, many of the older plants that will require modernization investment during the forecast horizon are characterized by smaller sized kilns. According to PCA's Plant Information Survey report, the average kiln size requiring modernization investments during the forecast horizon is 760,000. This compares against an average of 1.8 million metric tons for kilns built between 2000-2010 (950,000 metric tons if one massive new plant is excluded from the calculation). Larger kiln sizes, due to the economies of scale, lowers per ton fixed costs under "normal" operating conditions (greater than 80% utilization rate). These lower costs can improve a plant/company is regional competitiveness, with some of the potential cost savings passed onto users of concrete for the construction of residential, nonresidential and public structures. Given the existing trends to lower fixed costs via larger kiln sizes, it is likely that any major modernization investment at a cement plant will result in an increase in hourly emission rates of NO_x, SO_2 and PM.

Assuming the typical modernization investment patterns are extended into the future, PCA believes that all 34 plants requiring modernization investment during the forecast horizon will be forced to comply with NSPS standards. Compliance with NSPS standards will require investment in bag houses to meet particulate matter emissions standards, SCNR systems to meet NOx emissions standards, and wet scrubber systems to meet SO_2 emission standards. In most instances, these systems may already be in place due to NESHAP (PM) and/or CISWI standards (PM, NOx, SOx).

New Source Performance Standards (NSPS)

(lbs/ton)

	NESHAP Existing	CISWI Existing	NESHAP New Source	CISWI New Source	NSPS New Source
NO x	-	7.23	-	0.9	1.5
SO x	-	3.83	-	0.03	0.4
PM	0.04	0.24	0.01	0.01	0.01

Sources: Federal Register: V75#174,V75#107

Note: CISWI standards are estimated conversions based on general volumetric emissions, stack moisture, and oxygen levels

PCA assumes that plants with specific emission control equipment already in place to meet "existing source" NESHAP and CISWI standards, but that cannot meet the more rigorous new source standards, will delay modernization investments and let the plants run as long as they remain viable. As long as strong demand conditions prevail, these plants could remain open throughout the forecast horizon. This possibility is heightened in the context of PCA assessments regarding the fly ash ruling. A moderate recession prompting sub-80% utilization rates, however, could necessitate a closing of these plants – some permanently.

The key result of the NSPS and new source initiatives is to thwart modernization investments in the cement industry. Such investments during the past ten years have been responsible for sustained improvement in energy use, emissions and production costs – resulting in a 20% reduction in high carbon fuel consumption, roughly a 6% reduction in emissions per ton of clinker, and cement prices that have remained remarkably stable (absent the cement shortage era that was promulgated by easy lending standards and the industry's dependence on imports). NSPS could increasingly hinder modernization investments diminishing these future beneficial trends.

NESHAP's, CISWI's and NSPS's tighter "new source" emission standards can be triggered by major investments/modernization to existing facilities. If normal modernization/investment strategies were pursued, however, additional cement plants would face closure. The "new source" standards are significantly tighter than "existing source" standards. This could force the 33 older plants, which would normally be subject to investment during the forecast horizon to consider investing or close. ***If normal modernization/investment strategies are not pursued to remain world class competitive it could eventually lead to an additional 4 plant closures representing another 3.4 million metric tons of capacity.*** This estimate is ***not*** included in PCA's compliance scenario estimates.

Compliance Scenario: Clean Air Act Tailoring Rule

The EPA's exercise of the Clean Air Act (CAA) with regard to CO2 emissions targeted at the cement industry could be interpreted as a tacit first step in climate change regulation. Effective in 2011 for all plants that emit at least 100,000 tons of greenhouse gases (GHG) per year, any major investments resulting in a 75,000 ton increase in GHG emissions will be required to invest in "best available control technology" (BACT) to limit CO2 emissions.

The production of cement results in CO2 emissions. For every ton of cement produced, roughly 0.9 tons of CO2 is emitted. The emission of CO2 arises from two sources, namely process emissions and combustion emissions. Process related emissions from cement production are created through a chemical reaction that converts limestone to calcium oxide and CO2. The quantity of process-related emissions from cement production is proportional to the lime content of the clinker. These emissions generated during the calcination process are naturally occurring and as a result BACT compliance has no impact. These emissions account for 55% of CO2 emissions released in the manufacture of one ton of clinker.[6] The remaining CO2 emissions are generated by fuel combustion.

Given the existing trends to lower fixed costs via larger kiln sizes, it is likely that any major modernization investment at a cement plant will result in an increase in production and hence an increase in CO2 emissions in excess of the Tailoring rule thresholds. This implies that all 33 plants requiring a major investment/modernization during the forecast horizon will be subject to the Tailoring Rule. There are a multitude of processes and equipment that can be combined to reduce CO2 emissions. These key "best available control technology" (BACT) to limit CO2 combustion emissions generated during the manufacture of cement focused on in this report include;

- Conversion from the wet process to the dry process, which is significantly less energy intensive
- Installation of pre-heaters and pre-calciners, thereby improving energy efficiency and reducing emissions.
- Substitution of lower carbon content fuels (natural gas) for coal, coke and petroleum coke, an alternative fuels..
- Greater use of limestone in the grinding of cement, thereby reducing the CO2 content per ton of ***cement.***

Major investments trigger compliance with the Tailoring Rule. The industry is already aggressively pursuing the conversion of its capacity from the wet process to the dry process. It is unlikely that any major investment in a wet kiln will materialize, hence there will be no trigger for the Tailoring Rule. The wet kiln process is an older process and is typically less energy efficient.[7] During the past two years, the phase-out

[6] CO_2 Emissions Profile of the U.S. Cement Industry, Lisa J. Hanle, U.S. Environmental Protection Agency

[7] Note: the last wet kiln was installed 35 years ago.

of wet kilns has accelerated – reducing wet kiln clinker capacity by nearly 5.6 million metric tons. In the context of current economic distress, the potential for higher energy prices in the future, the accelerated pace of wet kiln retirement is expected to continue. ***This suggests that cement producers will maintain the operation of wet kilns and let the plants run as long as they remain viable, but will not invest in these plants.***

More than 80% of all dry cement kilns use pre-heaters and pre-calcinators to save on energy consumption. It is likely that older dry kiln plants among the 33 likely to require investment during the forecast horizon are characterized by a smaller presence of these devices. In the context of rising energy prices it is likely that all kilns will install pre-heaters and pre-calciners at a time of major investment – with or without the Tailoring Rule.

Perhaps the most significant impact the Tailoring Rule could exert on costs comes in the form of the possible substitution of lower carbon content fuels (natural gas) for coal, coke and petroleum coke. In order to determine the change in production costs resulting from a change in fuel types, fuel input cost data from the Energy Information Agency was used to determine that natural gas cost almost 140% more than coal on a equivalent BTU basis. As a result, PCA has assessed that the cost per ton of clinker production would increase nearly 12% if the industry were to switch from coal as a kiln fuel source to natural gas[8].

Other EPA Regulations Impacting the Cement Industry

The EPA has also initiated new standards regarding greenhouse gas reporting and the National Ambient Air Quality Standards (NAAQS). While each initiative could impact cement production costs. In the context of NESHAP, CISWI, NSPS and the Tailoring Rule, these initiatives are believed to represent less of an immediate threat to the industry and are not addressed in this report.

EPA Regulations' Impact on U.S. Imported Cement Projections

The increase in cement consumption resulting from the fly ash ruling, combined with the reduction in cement capacity due to NESHAP/CISWI will force increased reliance on imports to meet expected future consumption. Import share is expected to reach 32% in 2015, 47% in 2020 and nearly 56% in 2025, compared to roughly 9% estimated in 2010.

Compared to the baseline scenario, cement consumption estimates increase under the compliance scenario due to the fly ash ruling, adding 16 million metric tons to cement consumption in 2015, 20 million metric tons in 2020, and 23 million metric tons in 2025. With the forced closure of domestic plants due to NESHAP emission standards, an increased reliance on cement imports is expected to materialize. PCA estimates import share is expected to reach 32% in 2015, 47% in 2020 and nearly 56% in 2025, compared to roughly 9% estimated for 2009. These share estimates reflect volume estimates of 36 million metric tons in 2015, nearly 62 million metric tons in 2020, and 82 million metric tons in 2025. The current U.S. import terminal capacity is estimated at 45 million metric tons.

[8] This calculation is based on the conversion rate of relative fuel BTU costs and its impact on clinker costs implied in the study "Fuel Switching from Coal to Natural Gas – California Portland Cement Industry", Environ International Corporation, August 22, 2008.

Compliance Scenario					
	2005	**2010**	**2015**	**2020**	**2025**
US Cement Industry					
US Cement Consumption (000 tons)	128,035	68,879	127,397	151,229	170,833
US Clinker Capacity (000 tons)	94,693	96,877	97,874	95,604	95,604
US Production (000 tons)	89,981	58,286	85,976	83,508	83,186
Imports (000 tons)	27,305	5,900	36,000	62,,000	82,000
Total Fuel Consumption (billion BTU, bbtu)	341,999	237,896	343,904	334,033	332,746
Primary Fuel Consumption (bbtu)	307,009	211,345	315,750	318,091	314,113
Alternative Fuel Consumption (bbtu)	34,989	26,551	18,359	15,942	18,633
Alternative Fuel Plants (AFP)					
Capacity at AFP (000 tons)	48,209	49,923	22,465	22,465	20,219
Production at AFP (000 tons)	48,209	49,923	22,003	21,959	19,737
Total Fuel Consumption (bbtu)	177,984	120,146	194,555	191,958	191,220
Primary Fuel Consumption (bbtu)	142,995	94,125	176,196	176,016	172,587
Plant Alternative Fuel Consumption (bbtu)	34,989	26,021	18,359	15,942	18,633
Plant Tire Derived Fuel (bbtu)	12,143	8,587	5,759	4,532	4,796
Scrapped Tires Consumed (millions)	58	39	27	21	20
Scrapped Tire Stockpile (millions)	188	246	358	534	604
Fly Ash					
Fly Ash Production	71,100	65,568	71,520	73,632	75,616
Beneficial Use Consumption	29,118	27,392	0	0	0
Concrete Consumption	14,504	8,898	0	0	0
Cement Kiln Consumption	2,834	3,017	0	0	0
Cement/Concrete Share of Beneficial Use	59.6%	43.5%	-----	-----	-----
Estimated Landfill	41,982	38,176	71,520	73,632	75,616
Sources: PCA, USGS, Various EPA emissions documents. Note: No credible Cadmium emissions data for cement kilns could be found and is omitted from analysis.					

Impact on Global Emissions

A significant portion of the improvement in emissions due to EPA regulations comes from plant closures. Displaced domestic production implies an increase in foreign production and higher emissions in those countries. The EPA standards effectively export our emissions to cement supplying countries.

Absent global cement plant emission standards, the improvement in global emissions arising from EPA policy is limited to the improvements attributed to the implementation of emission controls at U.S. cement plants and plant closures. Since U.S. cement plant closures necessitate an increase in imports, the potential policy impact of NESHAP emission standards is to export the emission to foreign cement producing countries which have more relaxed emission standards than those proposed under NESHAP.

Indeed, global emissions associated with cement manufacture are likely to increase due to EPA regulations. Removing fly ash from concrete mixes, for example, increases cement production, either domestically or in foreign source countries or both. The extent to which the corresponding emission increases are realized in the United States depends on further investment in United States cement capacity. World-wide emissions arising from increased cement production will be a result of the fly ash ruling. If the additional cement is not produced in the United States, it will be produced elsewhere and the emissions associated with additional cement production will be released.

EPA Regulations Impact on U.S. Construction Costs

EPA regulations could add $2.4 billion to nearly $4 billion in annual construction costs.

The average costs associated with the cement industry's compliance to EPA regulations could increase domestic production costs by $22 to $36 per ton. Keep in mind, the increase in costs by a particular cement plant will depend on its designation as a CISWI or NESHAP plant, the composition of current emissions and the need for compliance equipment, its use of fly ash in its kiln, and dependence on coal fired utilities for electricity. Wide variations in cost increases from EPA regulations among cement producers could exist. This assessment includes;

- Capital costs associated with compliance investments dispersed over a 15 year time horizon,
- Annual operating associated with compliance systems,
- The increase in fuel costs for plants forced to stop burning cheaper alternative fuels,
- The increase in kiln costs associated with the replacement of fly ash by limestone,
- The increase in costs associated with the replacement of fly ash in concrete by cement,
- The increase in electricity costs associated with fly ash's hazardous waste designation,
- The possible substitution of lower carbon content fuels (natural gas) for coal, coke and petroleum coke due to the Tailoring Rule.

Using a five year average of cementitious material intensities, out of every one million real 1996 dollars of construction activity, roughly $14,500 is attributed to cementitious material costs. Prior to the recession's collapse of construction activity, the construction market was averaging roughly $750 billion in real construction spending. This translates into roughly $11 billion in cementitious material spending. Cost increases resulting from EPA regulation could increase cement/concrete construction costs between 22% to 36% per construction project. This translates to an estimated $2.4 billion to $3.9 billion (real 1996 $) in a "typical" $750 billion construction market.

The largest consumer of cement/concrete is the public sector, accounting for 50% of cement consumption. High cement consuming public construction efforts include new highways, bridges, schools, public buildings as well as water, sewer and conservation projects. Of public construction activity, more than 90% is undertaken by state and local governments. PCA estimates that EPA compliance costs could add as much as $1.2 to $2 billion annually to state and local governments' expenditures just to maintain existing roadways and bridges.

EPA Regulations Impact on U.S. Employment

EPA regulations could result in the direct loss of 3,000 to 4,000 jobs in the cement industry and potentially another 12,000 to 19,000 direct jobs in the construction industry due to higher construction costs. These direct job losses could be amplified if up and downstream indirect impacts are considered.

The potential closure of plants in the industry due to EPA regulations could result in a direct job loss of 3,000 to 4,000 jobs. These jobs are typically high paying jobs and translate into $200 million to $260 million in lost wages. Loss of these jobs and wages results in less economic activity and leads to further job losses, often referred to as the "employment multiplier effect". PCA calculates these additional job losses at 6,500 to 10,000 jobs[9]. Most of these job losses would be concentrated in areas near the plant shutdowns, magnifying the potential distress in these communities.

Cost increases in the manufacture of cement and concrete due to EPA compliance will displace some construction activity. In doing so, some jobs that may have been created, might not materialize due to the EPA regulations. PCA roughly estimates these potential direct job losses in the construction sector at 12,000 to 19,000. Employment multiplier effects could add another 30,000 to 50,000 job losses.

NSPS and new source initiatives could thwart modernization and expansion of investments in the cement industry. Based on the age composition of kilns operating in the United States, dozens of large-scale investments could be foregone and the jobs these investments would provide. PCA makes no estimate regarding the magnitude of these potential job losses.

[9] Employment multiplier used is based on a working paper by Josh Bivens, Economic Policy Institute, August 2003.