PCA
America's Cement Manufacturers™

MARKET INTELLIGENCE

Contact: Brian Schmidt, Director, Policy Analytics, Regional Economist > (847) 972.9042 > bschmidt@cement.org
Trevor Storck, Regional and Policy Economist > (847) 972.9044 > tstorck@cement.org
Emily McCarthy, Policy Economist > (202) 590-7569 > emccarthy@cement.org

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Cement Industry Implications of the Cross-State Air Pollution Rule

Overview

The Environmental Protection Agency (EPA) has proposed a rule that would regulate the power sector and industrial sources, including cement plants, for nitrogen oxide (NOx) emissions, beginning in 2026. The industrial portion of the regulation would establish NOx emissions limitations on certain stationary industrial sources in 23 upwind states to help downwind states comply with the 2015 Ozone (National Ambient Air Quality Standards) NAAQS, set at 70 parts per billion (ppb), and thus meet their Clean Air Act "Good Neighbor" obligations under the 2015 rule.

Unlike power plants, which are allowed to trade emissions, under the proposed Cross-State Air Pollution Rule (CSAPR), industrial sources, including the cement industry, cannot trade emissions allowances with other plants. The EPA proposal contains two limits on NOx emissions. Cement plants in affected states would have to comply with both. The first is an emissions limit on pounds (lb) per ton of clinker with different limits based on kiln technology. The second is a source cap limit expressed in ton per day (tpd) of NO_X for each individual cement plant according to an equation, which is essentially a production-based NOx emissions weighted average, originally created by Texas regulators for plants that have multiple kilns with different technologies. The emissions limits associated with the source cap are more stringent than the first kiln-specific limit.

For a rule that would have such a large impact on the industrial sector, the proposal contains multiple technical inadequacies and misunderstandings about the cement industry. Moreover, the methodological underpinnings that EPA relies on in forming its conclusion that this rule would be net socially beneficial carry significant flaws.

Kiln Type	Proposed NOX Emissions Limit (lb/ton of clinker)
Long Wet	4.0 lb/ton
Long Dry	3.0 lb/ton
Preheater	3.8 lb/ton
Precalciner	2.3 lb/ton
Preheater/Precalciner	2.8 lb/ton

EPA's Cement Source Cap Limit Equation

$$CAP2015\ Ozone\ Transport = \frac{(KW\ x\ NW) + (KD\ x\ ND)}{(2000\frac{pounds}{ton}\ x\ 365\frac{days}{year})}$$

CAP2015 Ozone Transport = total allowable NO_X emissions from all cement kilns located at one cement plant, in tons per day, on a 30-operating day rolling average basis;
KD = 1.7 pounds NO_X per ton of clinker for dry preheater-precalciner or precalciner kilns;
KW = 3.4 pounds NO_X per ton of clinker for long wet kilns;
ND = the average annual production in tons of clinker plus one standard deviation for the three most recent calendar years from all dry preheater-precalciner or precalciner kilns located at one cement plant; and
NW = the average annual production in tons of clinker plus one standard deviation for the 3 most recent calendar years from all long wet kilns located at one cement plant.

Taken at face value, this rule would have tremendous implications for the U.S. cement industry. Roughly a third of the entire U.S. cement industry by clinker capacity would not have been compliant under the proposed limits had they been in force in 2021. When looking at the states specific to the proposed CSPAR, only 49% of clinker capacity would have been compliant. The industry already has significant NOx control technologies in place, with a majority of plants implementing selective non-catalytic reduction (SNCR). The investment necessary to reach the two proposed limits would be massive and the corresponding reduction to total NOx emissions from the cement industry would be relatively small. PCA estimates that total capital costs on cement plants to reach compliance would total roughly $335 million, with tens of millions of dollars added in annual compliance costs. It is almost certain that without any material changes to the proposed rule, there would be cement plant closures and thousands, if not more, of job losses.

The cement industry has experienced tight market supply conditions for the past several years and will soon need to supply tens of millions of tons of cement for public construction projects associated with the implementation of the Infrastructure Investment and Jobs Acts (IIJA). While there is a need for greater investment in U.S. cement production capabilities, costly new regulations with the potential for plant closures would only work to constrain domestic manufacturing. The supply gap has been increasingly filled by imports. This would increasingly be the case if the proposed rule took effect.

NOx Emissions, Its Sources, and Contribution to Ground-Level Ozone

Due to energy limitations, oxygen and nitrogen do not react at ambient temperatures. Rather, NOx is produced during high temperature events like fuel combustion in engines or at power station boilers, and naturally during lightning strikes. Once NOx, along with hydrocarbons, is exposed to sunlight, ozone (O3) is created. While ozone is created naturally in the stratosphere and absorbs harmful ultraviolet rays from the sun, high O3 levels in the troposphere can pose risks to human health and contribute to smog.

Nearly half (49%) of NOx emissions in the U.S. are attributed to gas and mobile sources. Another quarter (24%) are emitted from a myriad of fuel combustion points, approximately 14% from industry, 11% from biogenic sources, 3% from fires, and around 1% from waste disposal.

The production of cement contributes to ozone by emitting NOx and volatile organic compounds (VOCs) emissions. Of these two emissions, NOx is by far the largest contributor to ozone, which is the focus of the new proposed regulation and this report. In the 23 states which would be impacted by the proposed rule, the cement industry accounts for a mere 0.9% of total NOx emissions.

Affected Areas

In 2015, the EPA lowered the 8-Hour Ozone NAAQS standard from 75 ppb to 70 ppb, which at the time EPA concluded that the best and latest science showed that the tightened standard would adequately protect public health with an ample margin for safety. This increased the footprint of nonattainment areas and, in turn, states regulated additional sources of NOx through a variety of methods according to their state implementation plans (SIP). This is the typical regulatory framework undertaken to address Criteria Air Pollutants (CAP), such as NOx. At the time it was considering the rule change in 2015, the EPA characterized the effect of the rule in the following way: “EPA projections show the vast majority of U.S. counties will meet the standards by 2025 with federal and state rules and programs now in place or underway.”

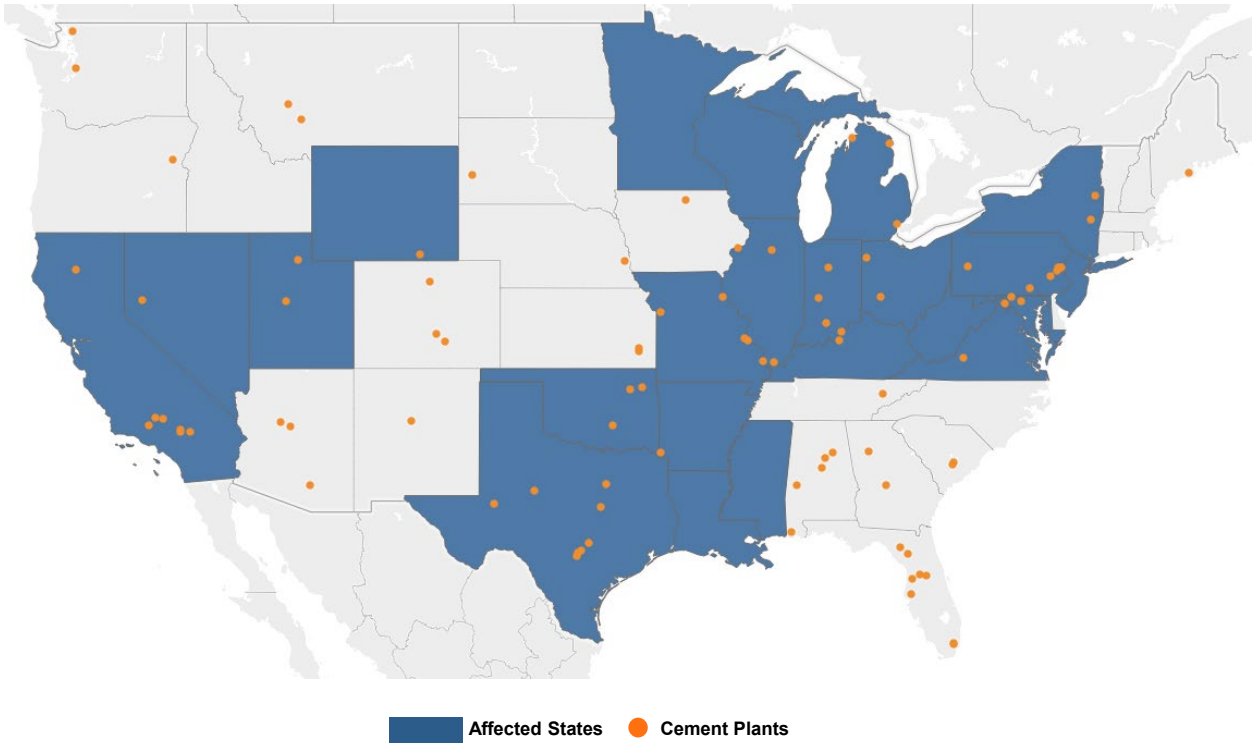
Yet, through the CSAPR, in an attempt to ensure states meet their obligations under the Clean Air Act’s “Good Neighbor” provision for the 2015 Ozone NAAQS, the EPA is aiming to regulate entire states that contribute above an arbitrary one percent of the NAAQS to downwind air quality problems. The regulatory justification for this comes from a provision in the 2015 rule that “requires upwind states to eliminate their significant contribution to nonattainment, or interference with maintenance, of the NAAQS in other downwind states.”

However, only 31 counties in the entire 27 state downwind geographic area are in either nonattainment or maintenance for 8-Hour Ozone. This seems to run counter to the original intent for two plainly understandable reasons: 1) The contributions are not significant and 2) only 2.3% of counties in downwind states are actually in nonattainment or maintenance; many of the other counties are well below the 70-ppb standard. Kern County, CA, for instance, which houses three cement plants, barely contributes to other states' Ozone levels.

Instead of continuing to focus on areas of nonattainment, the EPA has chosen an incredibly broad regulatory mechanism of imposing emissions limits on NOx emissions sources in entire states. Even in the impacted 23 upwind states, the vast majority of counties are below 70 ppb (1,627 counties are below the standard versus 183 counties being partially or fully in nonattainment or maintenance), yet counties still face potential rigid new emissions limits. This would also represent the first time since the National Emissions Standards for Hazardous Air Pollutants (NESHAP) that hard emissions limits were imposed on the cement industry. Such a sudden and capricious shift in environmental standards creates more uncertain regulatory conditions and the concern that other pollutants may be regulated in such a manner in the future.

The 23 states that would be affected by the proposed rule account for 64.8% of U.S. gross domestic product (GDP) and 66.2% of domestic manufacturing output. Fifty-six cement plants reside in these 23 states with a combined clinker capacity of 62.7 million metric tons (mmt), or 64.2% of total industry production capacity.

States Affected by the Non-EGU Good Neighbor Plan



Technical Inadequacies in the Rule Proposal

The rule proposal itself contains several technical inadequacies, including the potential of fundamental misunderstandings about cement plant operations. In the rule's first limit, which caps NOx emission by kiln type, it lists long wet, long dry, preheater, precalciner, and preheater/precalciner. Since precalciner

systems depend upon preheater technology, all precalciner kilns are also preheater/precalciner. It is unclear why preheater/precalciner is listed separately from precalciner with a different limit. Under the source cap limit for individual plants, the only two kiln technology limits listed are for precalciner and wet kilns. It is uncertain what limit a plant with a long dry or preheater kiln would use. Would the limits be below the kiln limits in a similar proportion to that of the precalciner and wet kiln from the source cap, or some other limits entirely?

The rationale of the source cap limit seems to be that it's more stringent than the limits on specific kiln technologies, but it is for the entire plant. This would allow for a legacy wet kiln, for example, that's more NOx intensive to continue operating, as long as it's "offset" by a newer and more efficient kiln that produces more of the plant's volumes, and the wet kiln still meets the 4.0 lb/ton of clinker requirement. The trend over the past several decades among cement plants has been expansion to larger, single precalcincer kilns. Plants with multiple kilns, and especially multiple kiln technologies, have become increasingly rare, but do exist throughout the country. The result of this phenomenon is that for most U.S. cement plants, the first limit, which caps NOx emissions by kiln type, is a moot point, and the limit for most plants under the proposed rule would simply be 1.7 lb/ton of clinker.

The fact that the source cap equation is based on a three-year average of production would mean that plants that produce more than the average of those three years will be forced to comply with a lower de facto lb per ton limit. Adding in one standard deviation provides plants with a small buffer, but if a plant significantly increase production in a given year, they will be confronted with a lower limit. This would become a systemic problem, especially in the years coming out of a market downturn when utilization rates were depressed. Keep in mind, the cement industry was hit hard by the Great Recession. Industry average utilization rates cratered to 56.5% in 2009. Unforeseen plant closures and reduced production levels during the recent pandemic associated with social distancing requirements, or trouble getting parts, or both, occurred. A plant's ability to surpass its daily NOx limit if it were to increase its production, even without its NOx intensity changing – being bound simply by movements in the business cycle or an unexpected event – creates unnecessary uncertainty.

The source cap limit is based on a 30-operating day rolling average basis. Plants do not produce 365 days a year. Planned closures for scheduled maintenance and repair occur annually. In 2019, the industry averaged 38 down days. Despite the indication that this fact may be taken into consideration by the EPA's use of the term "operating days," they nevertheless use 365 days in the denominator of the equation instead of subtracting a plant's down days. Since plants can't surpass a calculated daily limit, their actual daily limit would be lower than what's implied by the equation's limit in the numerator.

Take, for instance, a precalciner plant that produced 1 million, 1.05 million and 1.1 million tons over the past three years. Averaging these values and adding one standard deviation yields 1,090,825 ('ND' in the source cap formula). The 'KD' in the numerator is 1.7 lb/ton of clinker. Converting this to a daily limit using the equation would result in a 2.54 30-day rolling limit. Assuming this plant operates approximately 323 days a year, this theoretical plant would need to target a limit of 1.5 lb per ton of clinker – a real world limit far lower than 1.7 lb/ton for precaliner kilns and the same limit that is currently on new sources.

Cement Plant NOx Control Technologies

Kiln Technology Changes: Preheater kilns generally have a lower NOx intensity than other kiln types. It is possible that a lower NOx lb/ton of clinker could be achieved through upgrading a long-dry or preheater kiln to a precalciner. Given the financial magnitude of such a capital investment, it would not likely be considered as a viable option for NOx abatement alone. As such, this was dismissed as a realistic approach.

Low NOx Burner (LNB): Low NOx Burners (LNB) operate through a design where fuel and air are injected into the kiln through coordinated tubes. By controlling this mixture, burners are able to create larger and more branched flames. The proportion of air is reduced allowing for earlier ignition. Another channel is issued to swirl air. The net effect reduces peak flame temperatures and with less oxygen, this

reduces the formation of NOx. Based on EPA guidance, PCA assumes a 25% reduction in NOx efficiency improvement with LNB.

Selective Noncatalytic Reduction (SNCR): The SNCR process is the injection of ammonia in the form of ammonia water or urea in the flue-gas at a suitable temperature. An ammonia solution (~20%) is the reagent that has been most often used for cement kilns, and experience indicates that SNCR is most effective for PH/PC cement kiln applications. A SNCR system's performance depends on temperature, residence time, turbulence, oxygen content, and a number of factors specific to the given gas stream. A drawback to SNCR is the potential for "ammonia slip" generated by ammonia in excess of that required to react with the NOx. Limits on ammonia slip are imposed by permits or design requirements. These limits place a constraint on the NOx reduction achieved by an SNCR system. PCA assumes that SNCR achieves a 50% reduction in uncontrolled NOx emissions based upon published data from the Environmental Protection Agency.

Selective Catalytic Reduction (SCR): The SCR process is the injection of ammonia in the presence of a catalyst to selectively reduce NOx emissions to nitrogen and water. There are significant technical, design, and operational issues associated with installing a high dust SCR on a cement kiln. Byproducts produced during SCR operations can form a fine aerosol and sticky deposits that can lead to corrosion, plugging of downstream equipment, blinding of downstream fabric filters, and visible plumes. Blinding of downstream fabric filters can adversely impact particulate matter emissions while visible plumes may violate a plant's permitted opacity limits.

PCA assumes that SCR achieves a 90% reduction in uncontrolled NOx emissions based on published data from the Environmental Protection Agency. PCA recognizes that these reductions may not be fully realized given the variability in cement manufacturing and emissions reduction technologies previously outlined. When SCR systems are applied to kilns with an existing SNCR system in place, PCA assumes an 80% efficiency rate for the SCR system. SNCR and SCR are two separate control technologies and their efficiency rates are not considered additive. With the significant technical, design, and operational issues of implementing SCR on cement plants, it is difficult to actually realize these potential additional NOx reductions through SCR.

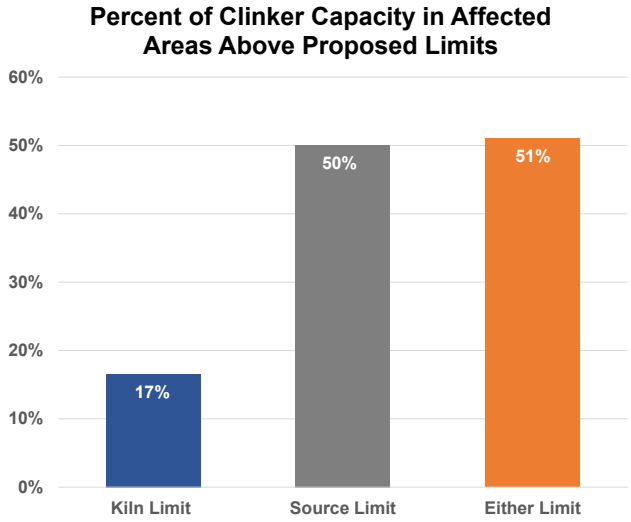
Current Cement Plant Compliance Status of Proposed Limits

The proposed emission caps have flaws, however PCA has examined the potential impacts of the ruling on a plant-by-plant basis in the affected states. To do so, a survey of PCA's members was conducted to analyze current in place control technologies for NOx emissions and performance against the proposed daily and source cap limits. The results demonstrate the current proposal could have a severe impact on the industry's ability to meet standards and supply the domestic market with sufficient product. Production levels for plants that did not participate in the survey were estimated.

First, all kilns within the scope of the rule were assessed against the NOx emission factor hard limit based on kiln types. Those limits described above are expressed in pounds of NOx emitted per ton of clinker produced in a given year. Of the 73 cement kilns operating in the states that would be covered by the rule, 25 kilns would not have met the NOx emissions limit for the year 2021. These kilns total 10.2 million metric tons of clinker capacity or roughly 11% of total U.S. clinker capacity. Over 60% of the kiln above the cap utilize long dry technology. This trend is seen because the proposed rule has misassigned long dry kilns with a lower limit than the preheater category. If these limits were swapped, four additional kilns would meet the requirement. Additionally, 25% of the kilns not meeting the hard cap operate with a precalciner, the kiln type generally associated with lower NOx emissions, already.

Under the proposed rule, it is likely nearly all the identified 25 kilns would need to invest in upgraded NOx control technologies. Of the 25 kilns over the limit, PCA's survey identified eight that currently operate selective non-catalytic reduction (SNCR). Of the kilns from the survey base that did not have SNCR and were above the limit, PCA has estimated that the NOx reductions that would result from installing SNCR would not be robust enough alone to meet the threshold. This leaves the expectation that selective catalytic reduction (SCR) would be necessary. PCA has identified at least ten plants that would likely

need to install SCR to theoretically meet the kiln NOx emissions limit. This number is likely conservative as PCA cannot make assumptions regarding those plants that did not participate in the survey.



The second rule establishes a source cap limit for NOx emissions for cement plants. PCA used the current proposed equation to calculate the cap, while acknowledging that there are flaws inherent in the calculation. The equation only provides NOx intensity factors for precalciner and long wet kiln types. PCA has assumed a constant scale between these variables to account more accurately for preheater and long dry limit calculations. The results were striking. Twenty-nine of the 55 plants would not have met the daily cap in 2021. This translates to 31.1 MMT of clinker capacity that would likely be impacted by the rule or 32% of the total industry. Roughly two-thirds of the plants above the source cap operate with a precalciner. Only 6 of the surveyed plants above the limit do not have SNCR already installed. PCA estimates that only two of the 29 plants would make sufficient emissions improvements through installing SNCR alone. The remaining plants would need to move to the much costlier and technically more difficult option of SCR technology.

Industry Costs to Comply with New Emission Standards

Cement producers in the affected states are currently regulated for NOx by a mix of consent decrees, permits, Best Available Control Technology (BACT), or Reasonably Available Control Technology (RACT). Of the survey base, 47% of impacted plants are currently operating under a consent decree for NOx emissions. Title V permits were reported by 29% of plants. Another 13% reported requirements under BACT or RACT II. Only 5% did not report having any basis for NOx control requirements currently in place. Since all plants in affected states would need to comply with the proposed standards, control technology costs must be estimated and applied to plants where appropriate.

To estimate the compliance costs associated with the proposed CSAPR limits, PCA employed the kiln and plant emission information collected by PCA's survey to determine whether a kiln must expend capital to reach compliance. Technologies are applied in sequence starting with the least cost solution and proceeding to the highest cost solutions. A plant with an extremely low level of NOx but above the target rate, for example, would likely be forced to invest in the least cost emission control technology, or an SNCR system. A plant with extremely high levels of NOx, for example, would likely by-pass the SNCR system and be forced to implement more emission efficient control technology, like SCR. Kilns that meet NOx standards require no further investment in emission control systems. However, the majority of plants have already made significant investments in their NOx control systems. SNCR systems were reported in place at 75% of the kilns based on PCA's survey. For many plants, the only option left for further NOx reductions would be the installation of SCR, bringing huge costs and significant technical hurdles to overcome for the industry.

Cost estimates have been made based upon publicly available sources as well as industry-specific information from PCA member companies. Adjustments to this information were made to account for differences in the type of plant, such as a long dry or wet kiln. In the context of likely market conditions facing emission equipment suppliers, there are reasons to believe there are significant upside risks to these cost estimates. Additional control measures for NOx would need to be in place relatively quickly for over half the domestic cement industry, among other regulated industries. However, there are a limited number of equipment suppliers. Demand for their services from the cement industry would likely increase

dramatically. A premium will likely be placed on the urgent need to install the systems over a short period of time. The likely outcome would be 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. With high running inflation, labor shortages, and raw material scarcity, this markup is probably conservative.

Estimated Cement Industry Compliance Costs		
	Capital Costs	Annual Costs
Low NOx Burner	$ 15,645,750	$ 2,715,000
SNCR	$ 10,262,600	$ 2,440,000
SCR	$ 308,918,750	$ 57,716,000
Total	**$ 334,827,100**	**$ 62,871,000**

PCA has analyzed each plant's emissions performance against the proposed limits to estimate each plants' needs to meet compliance. Plants above either limit were assigned a NOx control technology (Low NOx Burner, SNCR, SCR) that may allow their plant to meet compliance with both rules. Capital costs associated with the installation of Low NOx Burners (LNB) at plants were estimated at $15.6 million with the corresponding annual costs at $2.7 million. For plants moving to an SNCR system, the capital costs were estimated at $10.3 million and annual costs were $2.4 million. The capital costs are lower than LNB because SNCR is already so common within the cement industry. Finally, the bulk of the costs come from the installation and annual costs of the very expensive SCR technology. Many plants would also be forced into this option due to their emissions intensity significantly exceeding the proposed limits. Capital costs to the industry for the installation of SCR would amount to $308.9 million. Annual operating costs were estimated at $57.7 million. This totals roughly $334.8 million in capital costs to the industry to meet the proposed CSAPR limits. The annual costs to operate the new emissions controls are estimated to be $62.8 million.

Impact on U.S. Cement Industry Capacity, Production and Jobs

The proposed CSPAR limits will impose such high compliance costs that some cement plants will likely be forced to close. Closures are expected to result in two forms. First, for some plants, even with the installation of emission reduction systems will not allow them to meet the new limits. Second, even if a plant can technically meet the new CSPAR rules, the compliance investment required may not be justified on a financial basis. In either case, PCA assumes closure of that plant.

CSAPR Region Scenarios		
	Baseline 2026	Rule Face Value 2026
Clinker Capacity (000, short tons)	68,345	59,372
Production (000, short tons)	61,511	53,435
NOx Reductions from Control Technologies	-	18,001
NOx Reductions from Plant Closures	-	13,027
Total NOx Emissions (short tons)	74,208	43,179
Jobs	8,580	7,453
Industry Wages	$ 839,038,200	$ 728,828,870

PCA has identified two categories for such plants: likely closure and at-risk of closure. For the purposes of this analysis, all likely closures are assumed to close. For the at-risk category, the assumption is 50% of the total capacity will close. Under this scenario, the proposed rule would lead to the closure of an estimated 8.1 million metric tons of clinker capacity in the U.S. This number represents 8.5% of all domestic production capacity. Of cement plants only in the 23 affected states, this share grows to 13.1% of production capacity.

These closures would mean job loss. PCA estimates that the proposed rules would equate to 1,127 jobs lost in the cement industry alone. This loss of employment amounts to an annualized cost of roughly $110 million in lost wages. With most plants located in rural communities, potential plant closures and job losses will likely have a disproportionately negative impact on small, rural communities.

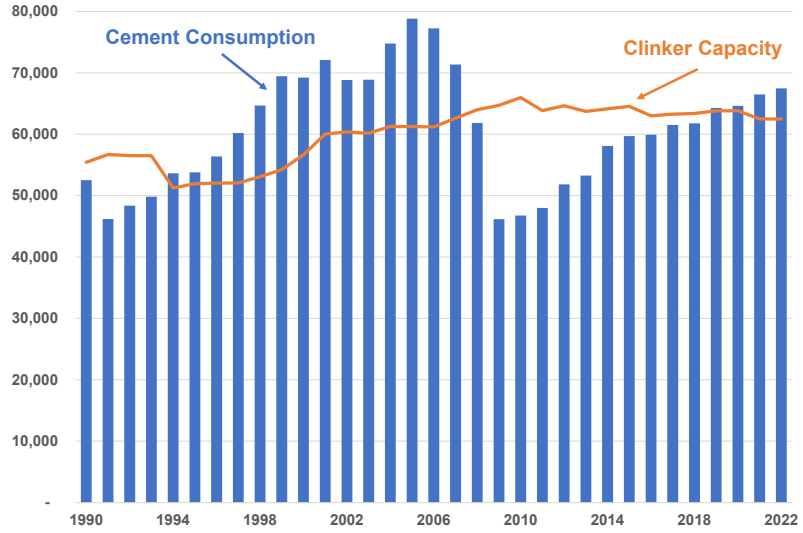
PCA has also analyzed the potential NOx emission savings associated with the estimated technology improvements against the NOx savings that would arise from plant closures. Two scenarios were run and compared against each other to observe the ruling's potential impacts on the region. A 'Baseline 2026' and 'Rule Face Value 2026' were calculated. The exercise began with removing any plants deemed to have closed from the proposed rule. Next, a 90% capacity utilization rate was assumed to arrive at clinker production levels. PCA held with NOx emissions intensity per ton of clinker at 2021 levels in the baseline scenario. In the 'Rule Face Value' scenario, adjustments were made for the estimated technology improvements as well as plant closures. The associated NOx reductions from technology implementation equals 18,001 tons and the number of emissions reduced from plant closures represents 13,027. This means that roughly 42% of the NOx reductions arise from the shuttering of plants.

The past two years have been characterized by tight cement supply conditions. The U.S. cement industry will soon need to supply tens of millions of tons of cement for public construction projects associated with the implementation of the Infrastructure Investment and Jobs Acts (IIJA) over its five-year statutory life. However, many of its large, complex projects will extend well beyond this time frame. In terms of cement consumption associated with IIJA, 2026 is expected to be one of the peak years, which is when this rule would commence.

A Supply Gap Already Exists in Impacted States

Cement Consumption & Clinker Capacity

Thousands of Metric Tons



Even though the rule would encompass the first (Texas), second (California), and third (Missouri) largest states in terms of clinker production capacity, a supply gap already exists between how much these states consume and how much they are able to produce. Since clinker is ground and mixed with gypsum and other additives, more cement can be produced at a plant than implied by its clinker capacity.

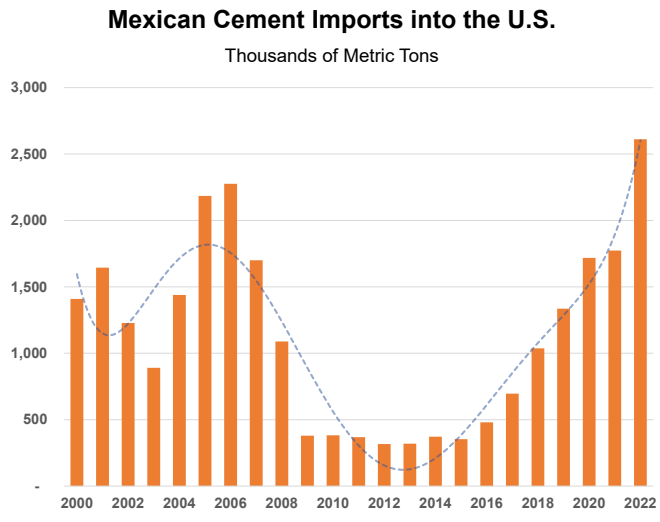
However, cement plants' theoretical maximum sustained utilization rate is assumed to be 90%, given the need for planned shutdowns for maintenance and repair. A historical analysis of industry utilization supports this assumption. Given this, long-term cement capacity is not expected to be consequentially higher than clinker capacity, even with increased production of blended cements.

Many of the states in the affected region are poised for expected large long-term growth in cement consumption, not even considering the projected tonnage needs associated with IIJA. For instance, Texas' cement consumption has nearly doubled over the past 25 years. Surrounding states also rely on their production.

There is no guarantee new plants will take the place of lost capacity. The last two new cement plants to come online in the U.S. occurred more than 13 years ago. With the lion's share of the U.S. cement industry owned by large multinational companies, decisions to invest scarce corporate dollars are weighed against investment options in other geographic regions throughout the world. When U.S. regulatory conditions become more uncertain, funds can easily be redirected outside the U.S. This is not just a concern with the recent proposed regulation of NOx. New sources would have to comply with a similar standard regardless of this rule. Rather, it reflects a systemic pattern of regulatory ambiguity, resulting in uncertainty about whether a costly investment will suddenly face expensive emission control measures or face closure. This makes investment in the U.S. increasingly less attractive.

The U.S. has increasingly been reliant on imports to close the domestic supply gap. Not only does this run contrary to spirit of Buy American and the Administration's goal of bolstering the U.S. manufacturing sector, there are several other problems with a growing dependence on cement imports from both a public policy and environmental standpoint.

For one, continuing to fill the domestic supply gap with imports leaves the U.S. vulnerable to economic conditions outside its control. Then there is the issue of both lost American jobs and the opportunity cost of forgoing expanding manufacturing employment by forgoing American made projects to imports. Cement manufacturing jobs are highly technical and well-paying, with an average wage of $97,790 per year. Hiring a worker translates to hiring a taxpayer. Plant workers eat at restaurants and shop at stores in the surrounding area – further multiplying their economic impact and contributions to local taxes. Cement plants themselves contribute significantly to the local and state tax base. PCA expects this rule could result in 1,127 jobs lost, totaling to approximately $110 million in lost wages. These job losses represent cement plant employment, or direct employment. Domestic cement jobs also support employment in the broader concrete and masonry professions. When taking into consideration indirect employment, the job losses are expected to grow to approximately 52,000.



From an environmental perspective, the EPA's goal of a 15% reduction in NOx emissions from heavy industry and thus reduced ground-level ozone will likely not actually materialize to that stated degree due to an increased reliance on imports and the NOx associated with the production of those imports. Ozone is not necessarily a global problem in the same way carbon dioxide (CO_2) emissions are, given its more limited ability to travel across long oceanic distances. It certainly will cross North American borders, however. Decreased domestic production levels will likely be filled in part by imports from Mexico, which would not have the same level of NOx control measures in place. Imports from Mexico have already risen more than eight-fold over the past decade and would likely rise even further in the event of enactment of the proposed lower limits. This could actually increase ground-level ozone in certain border counties relative to current levels.

NOx emissions have a net positive contribution to the greenhouse effect. Given this, if the U.S. increases reliance on European or Asian imports, many of whom have much more lax environmental standards than the U.S., there would still be ecological repercussions to the U.S. even if it isn't in the form of smog.

Finally, domestic markets still need cement in the event of plant shutdowns. This will result in longer average rail routes and more truck vehicle miles traveled, meaning more NOx emissions generated from rail and truck.

Benefits

The benefits of lower levels of ground-level ozone include less incidents of asthma onsets and exacerbations and better lung function, particularly in vulnerable populations. While less well-established, studies have linked higher NOx emissions to heart disease and all-cause mortality.

The EPA claims that by a reduction in NOx emissions of 29% from the power sector and 15% by heavy industry across the affected states, the proposed rule would prevent approximately 1,000 premature deaths, 2,400 hospital and emergency room visits, 1.3 million cases of asthma symptoms, and 470,000 school absence days. The EPA expects these monetized health benefits in 2026 to range from $9.3 billion to $18 billion (using 2016$ and a 3% discount rate). Additionally, the annualized monetized climate benefits are estimated to be worth approximately $1.5 billion (using 2016$ and a 3% discount rate, for each year over the period of 2023-2042).

The models to estimate such sweeping benefits are complex and their methodological assumptions are debatable, including the potential for double counting benefits associated with other pollutants and ascribing them all to the monetized benefits of reducing NOx. All the assumed benefits, however, are accounted for in a complete manner. On the cost side, the EPA's estimates were less than robust.

Costs

In EPA's cost assumptions, they estimate the proposal's present value costs for non-electricity generating unit (EGU) for years 2026-2042 to be $4.8 billion, using a 3% discount rate. This translates to an equivalent annualized cost of $320 million for all non-ERU industries. While every industry facing potential regulation is different, for the cement industry, using a multidecadal time frame for control technologies is not necessarily representative of real world challenges the industry would likely face. It is unlikely that control technologies installed in 2024-2025 would provide the same level of utility during the entire duration that EPA uses absent heavy maintenance costs or potential replacement. It's conceivable that some of the equipment may become antiquated if a new control technology emerges in future years, especially if additional compliance standards are placed on the industry between now and 2042. Such analyses performed by EPA when proposing new rules are seemingly done so in a vacuum without regard given to future regulation and compliance costs of the same or different pollutants.

Compliance Costs refer to all the expenses that a firm incurs to adhere to industry regulations. In the case of this rule, cement plants in the affected states that decide to continue to operate may be required to spend $335 million dollars in capital expenses and $63 million in annual operating expenses.

Opportunity Costs are the potential forgone profit from a missed opportunity; the result of choosing one alternative and forgoing another. It cannot be overstated just how immense this rule would be in terms of opportunity costs, not just for the cement industry but all other potentially regulated sources, for the reasons previously outlined.

Social Costs represent the total burden imposed on the economy; it is the sum of all opportunity costs incurred associated with taking actions. The EPA acknowledges that these social costs must be weighed against benefits when performing an accurate marginal cost-benefit analysis. Despite this, EPA uses industry compliance costs as the sole proxy for social costs in its Regulatory Impact Analysis (RIA).

This represents a serious inherent flaw in their methodology. By definition, installation of equipment means that time wasn't spent on other productive means. The same is true for extra time spent monitoring equipment. When adding in the costs of shuttered plants, lost wages, and ensuing lost tax revenue, the opportunity costs of forgoing expanded domestic production, total social costs are massively understated in EPA's analysis.

By its own admission, the EPA's cost estimates do not include monitoring, record-keeping, reporting, or testing costs, which are not even opportunity costs but real costs.

There is perhaps an even larger point to be made about the exclusion of non-compliance costs. For instance, numerous studies have linked 'deaths of despair' – alcohol and opioid-related deaths and suicides – to deindustrialization and the loss of domestic manufacturing jobs. These deaths are a significant contributing factor to the decline in U.S. life expectancy since 2014. Increasing burdens on domestic manufacturers with expensive new regulation, and thus risking more plant closures, could exacerbate some of the societal problems associated with a contracting manufacturing sector – the potential costs of which cannot be dismissed.

From 2008 to 2017, the cement industry in the 23 impacted states reduced its NOx emissions by 52.3%, compared to a combined 40.9% decline in all other sources in the same states. NOx is currently well regulated in the cement industry through a variety of means. Future reductions will start from very low levels. It is true that NOx could be reduced from current levels. But at what cost? PCA estimates that 31,028 tons of NOx emissions could be curtailed relative to its baseline scenario under the proposed rule. However, 13,027 of that is due to plant closures, thus emitting and producing nothing.