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Economic Impact Analysis of a Respirable Crystalline Silica Permissible Exposure Limit of 50 ug/m^3 Using the Business Size Insight Module

Executive Summary

Crystalline silica is of vital importance to private industry, used heavily in construction, manufacturing, agriculture, transportation, defense, and high-tech industries. It is contained in sand, brick, and concrete and is also a key material in the production of steel, abrasives, paints, high-tech equipment, glass, ceramics, and thousands of consumer products. However, the use of silica also carries with it risks: respirable crystalline silica can cause silica-related illnesses, including silicosis, among workers exposed to it. Under existing regulation, silicosis-related fatalities have decreased by 89 percent over the past four plus decades. A proposed OSHA rule attempts to further reduce the health risks posed by the use of silica in industry by reducing the permissible exposure limit (PEL) of respirable crystalline silica from its current level of 100 ug/m^3 to 50 ug/m^3 (micrograms per cubic meter).

Additional reductions in silica-related illnesses and fatalities are desirable for all stakeholders. Achieving such reductions through regulation entails economic costs due to the increased regulatory burden imposed on firms that utilize crystalline silica. The question of what balance to strike when deciding regulatory thresholds is one for policymakers. That policymakers should be privy to as much relevant information prior to decision-making is a best practice, and we aim to contribute to ensuring that policymakers have as much pertinent information as possible concerning the reduction of the PEL by providing an economic impact analysis of the proposed new PEL based on government cost estimates.

According to OSHA, this rule will generate estimated new annual compliance costs for employers in excess of $637 million (in 2009 dollars). The NFIB's Business Size Insight Module (BSIM) estimates these annual costs equate to the loss of more than 27,000 jobs and over $72 billion in lost real output in the long run, with at least half of the jobs lost and reduction in real output projected to occur in the small business sector of the economy.

Introduction

Last August, OSHA proposed a rule to reduce the permissible exposure limit of airborne crystalline silica in industry. The new rule would cut the PEL in half from its current level of 100 ug/m^3 to 50 ug/m^3. The motivation for the proposed rule is the reduction of health risks associated with exposure to airborne crystalline silica to workers. According to OSHA's estimates, the proposed rule could affect a total of 2.1 million employees in 533,000 firms who are potentially at risk from exposure to respirable crystalline silica. Of these totals, an estimated 1.8 million employees and 486,000 firms are in the construction industry, and an estimated 295,000 employees and 47,000 firms are in general industry and maritime.[1] Thus, while the proposed rule may reduce the health risks to workers exposed to airborne crystalline silica, it also impacts a large segment of private industry and, consequently, may also have material implications for private sector firms in the form of significant additional regulatory burdens.[2]

The importance of crystalline silica to private industry cannot be overstated. According to the American Chemistry Council (ACC), crystalline silica is the second most abundant mineral in the earth's crust and, in the form of quartz, is perhaps the most common construction, manufacturing, and agricultural material in the world. It is also a critical component in many transportation, defense, and high-tech industries. Crystalline silica is contained in sand, brick, and concrete and is also a key material in the production of steel, abrasives, paints, high-tech equipment, glass, ceramics, and thousands of consumer products.[3]

Although crystalline silica is a basic material in many industries, occupational exposure to silica particles carries health risks. According to the Centers for Disease Control and Prevention (CDC), occupational exposure to respirable crystalline silica (also known as silica dust) can lead to silicosis, a lung disease that is irreversible but preventable. In addition, the CDC observes that occupational exposure to silica dust is associated with the development of lung cancer, pulmonary tuberculosis, and airway diseases.[4] Clearly, the medical consequences of health risks associated with silica exposure can be serious. Fortunately, considerable progress has been made in reducing health risks—at least in the form of silicosis, the most serious of these risks—over the past few decades. **Figure 1** presents CDC data on mortality rates associated with silicosis and the number of fatalities per year in which silicosis was an underlying or contributing cause from 1968 to 2007.

[1] Federal Register/Vol.78, No. 177/Thursday, September 12, 2013/Proposed Rules, p. 56337

[2] The most recent data from the U.S. Census Bureau shows there are just over 5.7 million employer firms in the United States. According to OSHA's estimates, the proposed rule would therefore affect approximately 9.3 percent of U.S. employers. Data on the number of employer firms in the United States is published in the Census Bureau's Statistics on U.S. Businesses dataset, available at http://www2.census.gov/econ/susb/data/2010/us_state_totals_2010.xls.

[3] "OSHA's Proposed Crystalline Silica Standard," OMB/OIRA Meeting, ACC Crystalline Silica Panel, American Chemistry Council, March 31, 2011.

[4] "NIOSH Workplace Safety and Health Topics: Silica," Centers for Disease Control and Prevention, http://www.cdc.gov/niosh/topics/silica/, accessed on December 6, 2013.

Number of Deaths and Mortality Rates Associated with Silicosis, U.S. Residents Age 15 and Over, 1968-2007

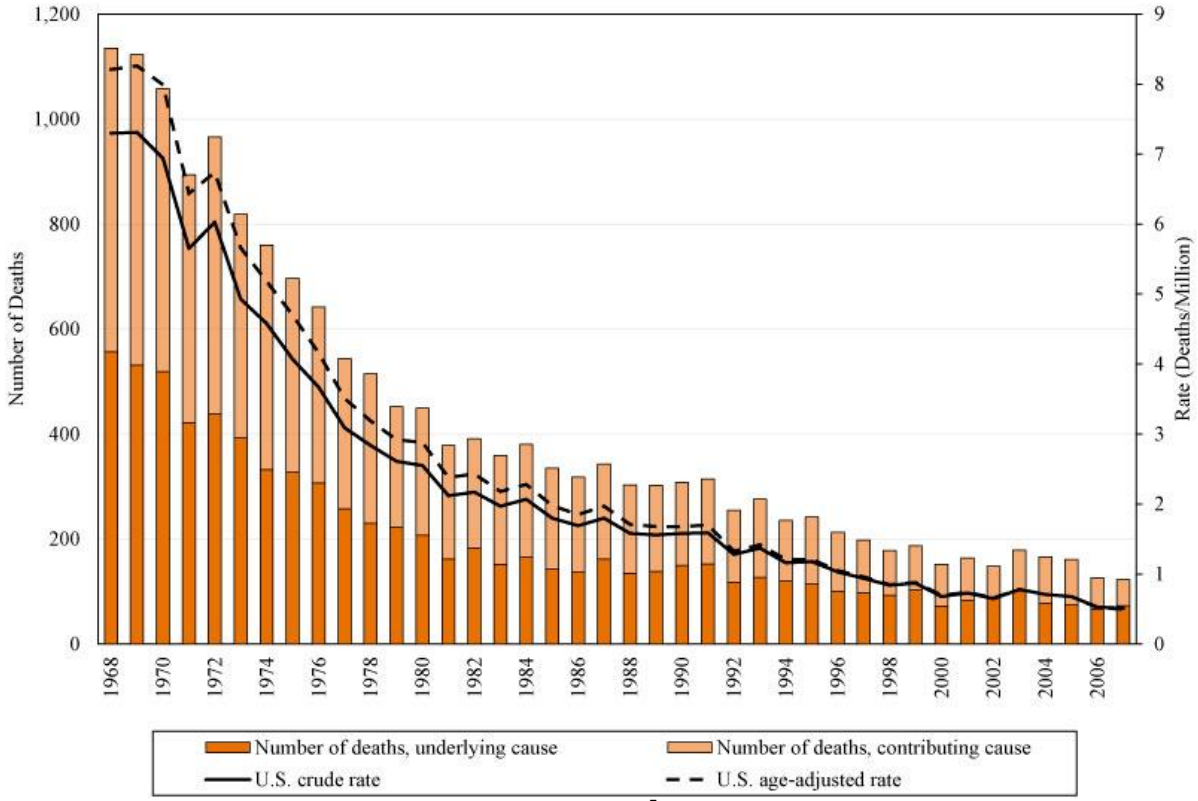


Figure 1[5]

As Figure 1 demonstrates, significant progress has been made since 1968 in preventing silicosis-related fatalities under existing regulation. This progress has coincided with the adoption of the current PEL of 100 ug/m^3 and simultaneous improvements in industrial practices.[6] According to the CDC data, silicosis-related deaths have decreased by 89.2 percent since 1968 from over 1,100 deaths per year to just over 120 deaths per year. While the dramatic reduction in silicosis-related deaths since 1968 constitutes a marked improvement, all stakeholders will acknowledge that further reductions are desirable.

OSHA's proposed rule to reduce the PEL of silica dust to 50 ug/m^3 could possibly prove helpful in this regard, although the efficacy of the proposed rule toward achieving further reductions in health risks associated with the use of crystalline silica is unknown. What is known is that the proposed rule will generate material economic costs that will impact a large segment of private industry. These costs are outlined in OSHA's preamble to the proposed standard, where the agency estimates that the total annualized cost (in 2009 dollars) to the 9.3 percent of private sector firms the standard will impact is $637.3 million (using a three percent discount rate). OSHA segments the total annualized cost into separate costs for six broad expense categories (Engineering Controls, Respirators, Exposure Assessment,

[5] Figure courtesy of the Centers for Disease Control and Prevention. Original image and data available at http://www2a.cdc.gov/drds/WorldReportData/FigureTableDetails.asp?FigureTableID=2595&GroupRefNumber=F03-01.

[6] "Silica Rule," The Associated General Contractors of America, http://www.agc.org/cs/silica_rule, accessed on November 12, 2013.

Medical Surveillance, Training, and Regulated Area or Access Control) which are reproduced below in **Table 1**.

Table 1: Annualized Costs Due to OSHA's Proposed Silica Standard of 50 ug/m^3, by Industry

Cost Type	Annualized Cost
Engineering Controls	$329,994,068
Respirators	$90,573,449
Exposure Assessment	$72,504,999
Medical Surveillance	$76,233,932
Training	$48,779,433
Regulated Area or Access Control	$19,243,500
All Categories (Cumulative Total)	**$637,329,230**

Source: Federal Register/Vol.78, No. 177/Thursday, September 12, 2013/Proposed Rules, p. 56277, Table SI-1

While the magnitude of these costs may be small compared to the annual gross receipts taken in by construction firms and general and maritime industry,[7] the costs are still large in absolute terms and can be expected to have a material impact on the performance of firms in industries directly impacted by the proposed new PEL. The impact on directly-affected firms will largely be in the form of reduced employment and production, which in turn has implications for other firms with whom they do business as well as the broader economy. Quantifying these effects is the subject of the remainder of this report.

Estimating the Economic Impact of a Silica Dust PEL of 50 ug/m^3 Using the BSIM: New Costs

Quantifying the economic impact the new proposed silica rule would have on private sector employers and employees was achieved by first modeling (a) anticipated new employer costs, (b) changes to private sector demand, and (c) changes to state and local government spending associated with the proposed rule, and then forecasting their effects by inputting these changes in economic variables into the NFIB's Business Size Impact Module and running a simulation. The BSIM is a dynamic, multi-region model based on the Regional Economic Models, Inc.[8] structural economic forecasting and policy analysis model which integrates input-output, computable general equilibrium, econometric, and economic geography methodologies. It has the unique ability to forecast the economic impact of public policy and proposed legislation on different categories of U.S. businesses differentiated by size of firm. Variables forecast by the BSIM include levels of private sector employment and real output. By comparing simulation results for scenarios which include proposed or yet-to-be-implemented policy changes with the model's baseline forecast, the BSIM is able to obtain estimates of how these policy changes might impact employer firms and their workers.

The BSIM is a 12-region, 70-sector industry-level model and, as such, is capable of accepting region-specific as well as industry-specific cost inputs. The industry specification used by the BSIM is

[7] According the Census Bureau's Statistics on U.S. Businesses dataset, in 2007 (the latest year with receipts data available) construction and manufacturing firms brought in a combined $7.0 trillion in receipts.

[8] Regional Economic Models, Inc. (REMI) is a private, non-partisan company that has developed forecasting models for policy analysis for over two decades. REMI's flagship product is the Policy Insight model, which is used by government agencies, state governments, consulting firms, nonprofit institutions, universities, and public utilities. REMI client lists by sector, topic, major region, and sub-region are available at http://www.remi.com/clients. A sample of clients includes the Massachusetts Institute of Technology, the AARP, the Urban Institute, and the Florida legislature.

the North American Industry Classification System (NAICS), the standard used by federal statistical agencies to classify business establishments by industry.[9] OSHA suggests that the new annualized costs due to the proposed rule will fall on a handful of industries where crystalline silica is used in the production or provision of goods and services. These industries consist primarily of the construction, general industry (*i.e.*, manufacturing) and maritime, and rail transportation industries.[10] State and local governments are also projected by OSHA to bear material financial costs due to the proposed rule. According to OSHA's analysis, what OSHA terms "general industry and maritime" will bear approximately 22.3 percent of the annualized compliance costs, and what OSHA terms "construction" will bear approximately 77.7 percent of the annualized compliance costs.[11]

The reader should note that while the annualized compliance costs estimated by OSHA constitute direct costs to employers distributed across specific industries, these costs also represent new private sector demand for firms who assist affected employers in complying with the new PEL: new demand which is also distributed across specific industries. In particular, each cost type presented above in Table 1 is associated with a particular NAICS industry category. The precise mapping of cost type to NAICS category for this new demand is discussed later, but it should be emphasized that both new employer costs and new private sector demand need to be inputted into the BSIM in an industry-specific fashion to obtain the most realistic forecast possible.

The annualized compliance costs in 2009 dollars (using a three percent discount rate) estimated by OSHA are presented below by broad industry category (**Table 2**) and, within each broad industry category, by employee-size-of-firm category (**Table 3** through **Table 6**). For Tables 3, 4, 5, and 6, compliance costs were projected forward to year 2023 using an assumed annual inflation rate of three percent (commensurate with the discount rate of three percent used by OSHA). The application of the inflation rate to the annualized compliance costs in 2009 dollars provided by OSHA is necessary because employer costs inputted into the BSIM must be in nominal terms. Costs were forecast forward through year 2023 to allow for time paths of economic variables to be simulated for years 2014 through 2023, a ten-year forecast window. It is assumed that implementation of the proposed rule begins in 2014. The mapping of industry-specific costs to different employee-size-of-firm categories within industries was achieved by applying region-specific *and* industry-specific employee-size-of-firm distributions to the broad industry costs for the entire United States taken directly from OSHA's analysis in the Federal Register (reproduced in Table 2). The region-specific and industry-specific employee-size-of-firm distributions are those provided by the Census Bureau's Statistics of U.S. Businesses (SUSB) dataset.

[9] Detailed information on the North American Industry Classification System is available from the U.S. Census Bureau at http://www.census.gov/naics.

[10] Other industries that OSHA expects will face new costs due to the proposed rule include industrial suppliers, wholesalers, and dental offices. The costs these industries are expected to bear were deemed negligible (less than 0.1 percent of total annualized costs) and were therefore not accounted for separately in the modeling process. Instead, these costs were subsumed into the general industry and maritime category (NAICS code 33) during the modeling of industry-specific costs.

[11] These percent shares are derived from Table VIII-9 in Vol. 78, No. 177 of the Federal Register, which uses annualized cost figures due to the proposed rule that have been annualized using a seven percent discount rate. According to OSHA, annualized costs to be borne by employers due to the new PEL will total $657,892,211 when a seven percent discount rate is used. Why OSHA's annualized cost estimates using a seven percent discount rate are larger than its annualized cost estimates when a three percent discount rate is used is unclear.

Table 2: Estimated Percent Contributions of Major Industry Categories to Estimated Total Annualized Costs Due to a Change in the PEL to 50 ug/m^3

Industry Category	NAICS Code	Estimated Annualized Compliance Costs*	Percent Share of Total Annualized Compliance Costs
General Industry and Maritime (Less Railroad Transportation)	33	$144,274,522	21.9%
Railroad Transportation	482110	$2,452,073	0.4%
Construction	23	$487,827,382	74.2%
State and Local Government	999000	$23,338,234	3.5%
All Industries	N/A	$657,892,211	100.0%

*Annualized Compliance Costs Here Are Expressed in 2009 Dollars Using a Discount Rate of Seven Percent

Table 3: Estimated Annual General and Maritime Industry Costs (in Nominal Millions of $s) by Size of Firm, 2014-2023

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1 to 4 Employees	$104.392	$107.524	$110.750	$114.072	$117.495	$121.019	$124.650	$128.389	$132.241	$136.208
5 to 9 Employees	$22.647	$23.326	$24.026	$24.747	$25.489	$26.254	$27.041	$27.852	$28.688	$29.549
10 to 19 Employees	$15.872	$16.349	$16.839	$17.344	$17.865	$18.400	$18.952	$19.521	$20.107	$20.710
20 to 99 Employees	$13.512	$13.918	$14.335	$14.765	$15.208	$15.665	$16.135	$16.619	$17.117	$17.631
100 to 499 Employees	$3.478	$3.582	$3.690	$3.800	$3.914	$4.032	$4.153	$4.277	$4.406	$4.538
500+ Employees	$2.124	$2.188	$2.254	$2.321	$2.391	$2.463	$2.537	$2.613	$2.691	$2.772
All Firms	$162.026	$166.887	$171.893	$177.050	$182.362	$187.833	$193.468	$199.272	$205.250	$211.407

Table 4: Estimated Total Annual Rail Transportation Costs (in Nominal Millions of $s) by Size of Firm, 2014-2023

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1 to 4 Employees	$1.909	$1.967	$2.026	$2.086	$2.149	$2.214	$2.280	$2.348	$2.419	$2.491
5 to 9 Employees	$0.400	$0.412	$0.425	$0.437	$0.450	$0.464	$0.478	$0.492	$0.507	$0.522
10 to 19 Employees	$0.253	$0.261	$0.269	$0.277	$0.285	$0.294	$0.302	$0.311	$0.321	$0.330
20 to 99 Employees	$0.165	$0.170	$0.175	$0.180	$0.186	$0.191	$0.197	$0.203	$0.209	$0.215
100 to 499 Employees	$0.022	$0.023	$0.024	$0.024	$0.025	$0.026	$0.027	$0.027	$0.028	$0.029
500+ Employees	$0.004	$0.004	$0.004	$0.004	$0.004	$0.004	$0.004	$0.005	$0.005	$0.005
All Firms	$2.754	$2.836	$2.921	$3.009	$3.099	$3.192	$3.288	$3.387	$3.488	$3.593

Table 5: Estimated Total Annual Construction Industry Costs (in Nominal Millions of $s) by Size of Firm, 2014-2023

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1 to 4 Employees	$379.862	$391.258	$402.996	$415.086	$427.538	$440.365	$453.575	$467.183	$481.198	$495.634
5 to 9 Employees	$79.619	$82.007	$84.467	$87.001	$89.611	$92.300	$95.069	$97.921	$100.858	$103.884
10 to 19 Employees	$50.382	$51.893	$53.450	$55.053	$56.705	$58.406	$60.158	$61.963	$63.822	$65.737
20 to 99 Employees	$32.834	$33.819	$34.833	$35.878	$36.954	$38.063	$39.205	$40.381	$41.593	$42.840
100 to 499 Employees	$4.417	$4.550	$4.686	$4.827	$4.972	$5.121	$5.274	$5.433	$5.596	$5.764
500+ Employees	$0.736	$0.759	$0.781	$0.805	$0.829	$0.854	$0.879	$0.906	$0.933	$0.961
All Firms	$547.850	$564.285	$581.214	$598.650	$616.610	$635.108	$654.161	$673.786	$694.000	$714.820

Table 6: Estimated Total Annual New Spending by State and Local Governments (in Nominal Millions of $s) by Size of Firm, 2014-2023

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
State and Local Government	-$26.2	-$27.0	-$27.8	-$28.6	-$29.5	-$30.4	-$31.3	-$32.2	-$33.2	-$34.2

As discussed previously, the BSIM is a regional model, in addition to being an industry-specific model. The ability to tailor inputs for distinct regions (states, in the case of the BSIM), adds to the realism of the generated forecasts since doing so allows for regional differences to be accounted for in, for example, industry composition. The BSIM is comprised of 12 separate regions: California, Colorado, Florida, Illinois, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, Texas, West Virginia, and a residual region representing the rest of the United States. The new costs and spending presented in Tables 3 through 6 were distributed across these 12 regions *by industry* according to each region's industry share (as a percentage of the U.S. total).[12]

On a *per-firm* basis, the costs to small businesses in affected industries can be considerable. **Table 7** presents the per-firm annual compliance cost in 2014 due to the new PEL for U.S. small businesses in the general industry and maritime and construction industry categories.[13] For small businesses in general industry and maritime, the cost of the new PEL in 2014 ranges from $345 per firm to as much as $2,211 per firm. The largest per-firm costs for this industry are borne by the smallest firms—those with one to four employees. Costs per firm are typically larger for the construction industry with the exception of firms with 100 to 499 employees. Costs for this employee-size-of-firm category are negligible due to the very small share of construction firms with 100 to 499 employees (less than one percent of all construction firms). For other employee-size-of-firm categories, new per-firm costs in 2014 resulting from compliance with the proposed rule are at least $1,200 per firm. The estimated cost to the

[12] A region's "industry share" is defined as the number of firms in that region for a particular industry divided by the total number of firms in the U.S. for that particular industry.

[13] This analysis adopts the Small Business Administration's size-of-business threshold of 500 employees to distinguish between small businesses and large businesses. The 500-employee threshold is frequently used by researchers to delineate the small business sector when working with firm-size data.

smallest firms is $3,900 per firm. Firms with 20 to 99 employees are estimated to face the highest per-firm cost: over $6,000 in new costs per firm.

Table 7: Cost per Firm of Annualized Compliance Costs in 2014 Due to PEL of 50 ug/m^3 for General Industry and Maritime and Construction Industries

Employee-Size-of-Firm Category	General Industry and Maritime	Construction
1 to 4 Employees	$2,211	$3,900
5 to 9 Employees	$564	$1,292
10 to 19 Employees	$345	$1,254
20 to 99 Employees	$1,174	$6,076
100 to 499 Employees	$1,008	$7

Estimating the Economic Impact of a Silica Dust PEL of 50 ug/m^3 Using the BSIM: Estimated Annualized Benefits in the Context of Input Modeling for the BSIM

Rigorous policy impact analysis accounts for both the costs as well as any benefits that may result from the analyzed change in policy. NFIB Research Foundation impact analyses using the BSIM consistently fulfill this requirement. As mentioned previously, the annualized costs presented in Table 2 also represent new demand for private sector goods and services for firms who assist businesses affected by the new PEL in complying with the proposed rule. This new demand for goods and services provided by the private sector acts as a countervailing force to any negative impact on employers the new annualized compliance costs may have. Each cost line item in Table 2 is associated with a specific industry as defined by the North American Industry Classification System.

The formal association between the above costs and NAICS codes is as follows: Engineering Controls (541330), Respirators (3391), Exposure Assessment (54162), Medical Surveillance (6219), Training (61), Regulated Area or Access Control (54162). Because the industries available in the BSIM are not as detailed as the complete NAICS compendium, the mapping of some cost types to their higher-order NAICS "parent" categories was necessary. For modeling purposes, the following association between the above cost types and available BSIM industry categories was used: Engineering Controls, Exposure Assessment, and Regulated Area or Access Control costs were inputted as new demand for professional, scientific, and technical services; Respirator costs were inputted as new demand for miscellaneous manufacturing; Medical Surveillance costs were inputted as new demand for ambulatory healthcare services; Training costs were inputted as new demand for educational services.

Table 8 presents the estimated new private sector demand for the forecast window based on OSHA's estimated annualized compliance costs for affected employers using the industry association described above. As with the schedule of employer costs and government spending figures above, commensurate with the discount rate OSHA used to obtain the annualized compliance costs in Table 2, a three percent inflation rate was applied to obtain spending figures in years beyond 2009.

Table 8: New Industry Demand Generated by the New Proposed Silica Standard (in Nominal Millions of $s), 2014-2023

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Ambulatory Healthcare Services	$88.4	$91.0	$93.8	$96.6	$99.5	$102.5	$105.5	$108.7	$112.0	$115.3

Educational Services	$56.5	$58.2	$60.0	$61.8	$63.6	$65.6	$67.5	$69.5	$71.6	$73.8
Miscellaneous Manufacturing	$105.0	$108.1	$111.4	$114.7	$118.2	$121.7	$125.4	$129.1	$133.0	$137.0
Professional, Scientific, and Technical Services	$488.9	$503.6	$518.7	$534.3	$550.3	$566.8	$583.8	$601.3	$619.3	$637.9

Besides this new private sector demand which functions as a countervailing force against any negative impact the proposed rule may have on firm employment and production, OSHA also estimates that the new PEL will produce monetized annual benefits (in 2009 dollars) of $5.3 billion. Balanced against the estimated annualized costs of $637 million, OSHA asserts that the new PEL will produce a net benefit (in 2009 dollars) of $4.6 billion. While these monetized benefits are large, for modeling purposes, they cannot be used as inputs into BSIM, as they are not concrete economic costs. It should be emphasized that the BSIM can only accept as inputs "real" economic costs in the sense that the costs have a direct impact on the cost of doing business (whether positive or negative) for employers.

The monetized benefits estimated by OSHA are not "real" in this sense: they have no direct impact on the cost of doing business. Instead, the monetized benefits are derived using a cost-benefit technique referred to as willingness-to-pay (WTP). Essentially, the WTP approach used by OSHA estimates the amount of money affected individuals would be willing to pay to avoid a marginal increase in the risk of fatality from silica-related illnesses.[14] In other words, the monetized benefits presented by OSHA which derive from the new PEL are the imputed values of fatalities avoided. While a reduction in silica-related illnesses and fatalities is an outcome desired by all stakeholders, these imputed values do not directly impact the cost of doing business and are therefore not acceptable as inputs into the BSIM.

Simulation Results

BSIM simulation results for the above modeled scenario are provided below. **Table 9** and **Figure 2** present the estimated difference in employment over the ten-year forecast window from the baseline economic employment path due to the annualized costs imposed by the new rule. The proposed rule is forecast to have a material negative impact on employment for the duration of the ten-year forecast window. The rule is forecast to have an immediate effect on private sector employment, reducing the number of jobs by nearly 40,000 in 2014. The employment gap grows over the first three years before peaking in 2016, when the private sector is forecast to have nearly 45,000 fewer jobs compared to the baseline scenario. As businesses adjust to the new rule, the employment gap narrows from this peak, although the long-term impact on private sector employment remains significant. In 2023, ten years after the assumed date of rule implementation, the employment gap is projected to exceed 27,000 jobs.

Most (54 percent) of the jobs forecast to be lost are jobs that would have existed in the small business sector of the economy. As with total private sector employment, the employment gap for the small business sector peaks in 2016 with over 25,000 small business jobs forecast to be lost due to the new PEL. And despite a gradual reduction in this employment gap, the BSIM forecasts that there will still be more than 14,700 fewer small business jobs in 2023. **Figure 3** shows the time path of the employment gap for total private sector employment and the small business sector of the economy.

[14] "Preliminary Economic Analysis and Initial Regulatory Flexibility Analysis: Supporting document for the Notice of Proposed Rulemaking for Occupational Exposure to Crystalline Silica," Occupational Safety and Health Administration, U.S. Department of Labor, 2013, p. VII-12.

Table 9: Employment Difference from Baseline (Number of Jobs), 2014-2023

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Percent of All Jobs Lost (2023)
1 to 4 Employees	-2,732	-3,077	-3,183	-3,094	-2,902	-2,667	-2,424	-2,206	-2,009	-1,837	6.75%
5 to 9 Employees	-2,860	-3,209	-3,316	-3,224	-3,023	-2,782	-2,533	-2,308	-2,107	-1,933	7.10%
10 to 19 Employees	-3,272	-3,701	-3,834	-3,732	-3,502	-3,221	-2,929	-2,666	-2,428	-2,224	8.17%
20 to 99 Employees	-7,281	-8,243	-8,550	-8,328	-7,818	-7,195	-6,546	-5,959	-5,431	-4,974	18.28%
100 to 499 Employees	-5,468	-6,139	-6,365	-6,211	-5,851	-5,408	-4,945	-4,526	-4,146	-3,818	14.03%
500+ Employees	-17,873	-19,270	-19,713	-19,184	-18,131	-16,869	-15,573	-14,408	-13,344	-12,421	45.65%
<20 Employees	-8,864	-9,987	-10,333	-10,050	-9,427	-8,670	-7,886	-7,180	-6,544	-5,994	22.03%
<100 Employees	-16,145	-18,230	-18,883	-18,378	-17,245	-15,865	-14,432	-13,139	-11,975	-10,968	40.31%
<500 Employees	-21,613	-24,369	-25,248	-24,589	-23,096	-21,273	-19,377	-17,665	-16,121	-14,786	54.35%
All Firms:	**-39,486**	**-43,639**	**-44,961**	**-43,773**	**-41,227**	**-38,142**	**-34,950**	**-32,073**	**-29,465**	**-27,207**	**100.00%**

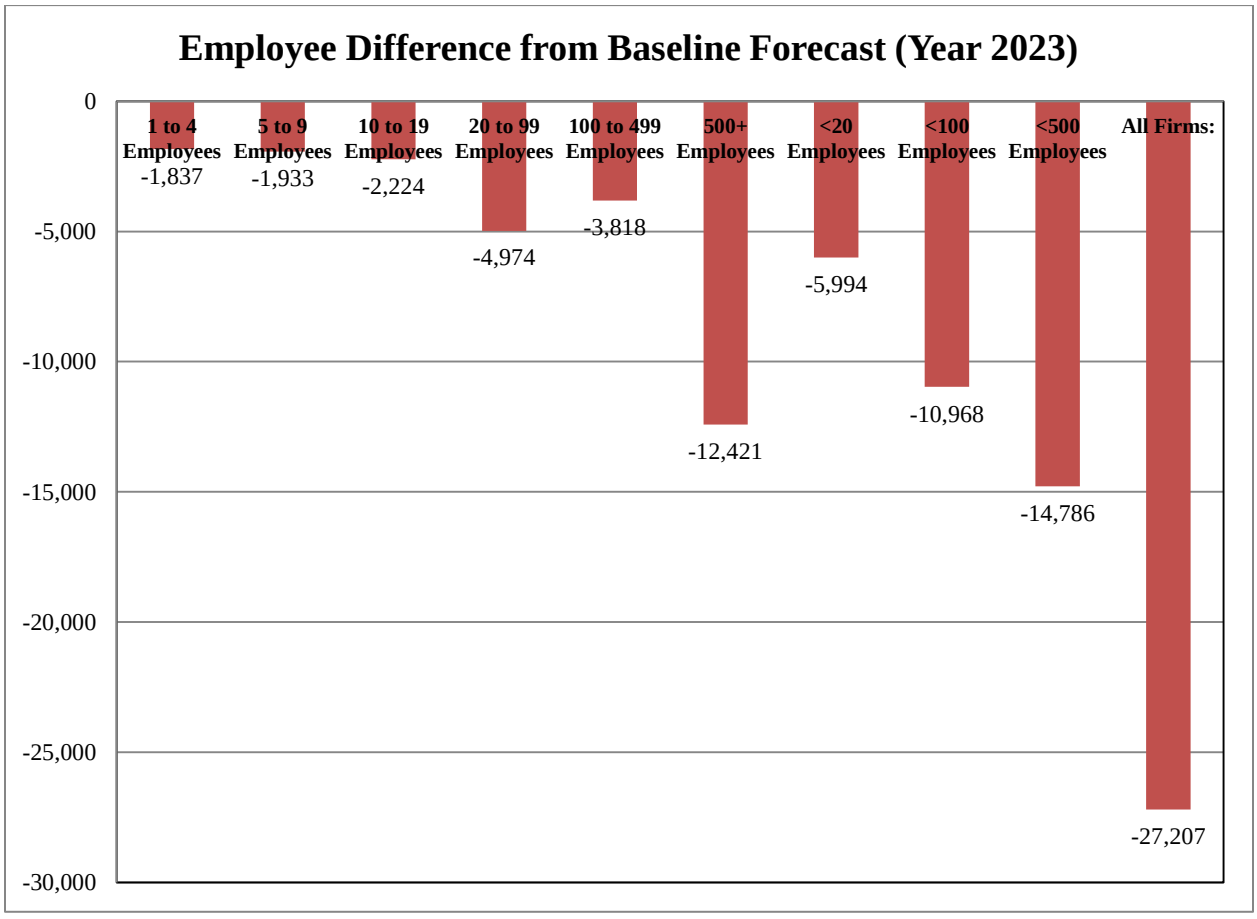


Figure 2

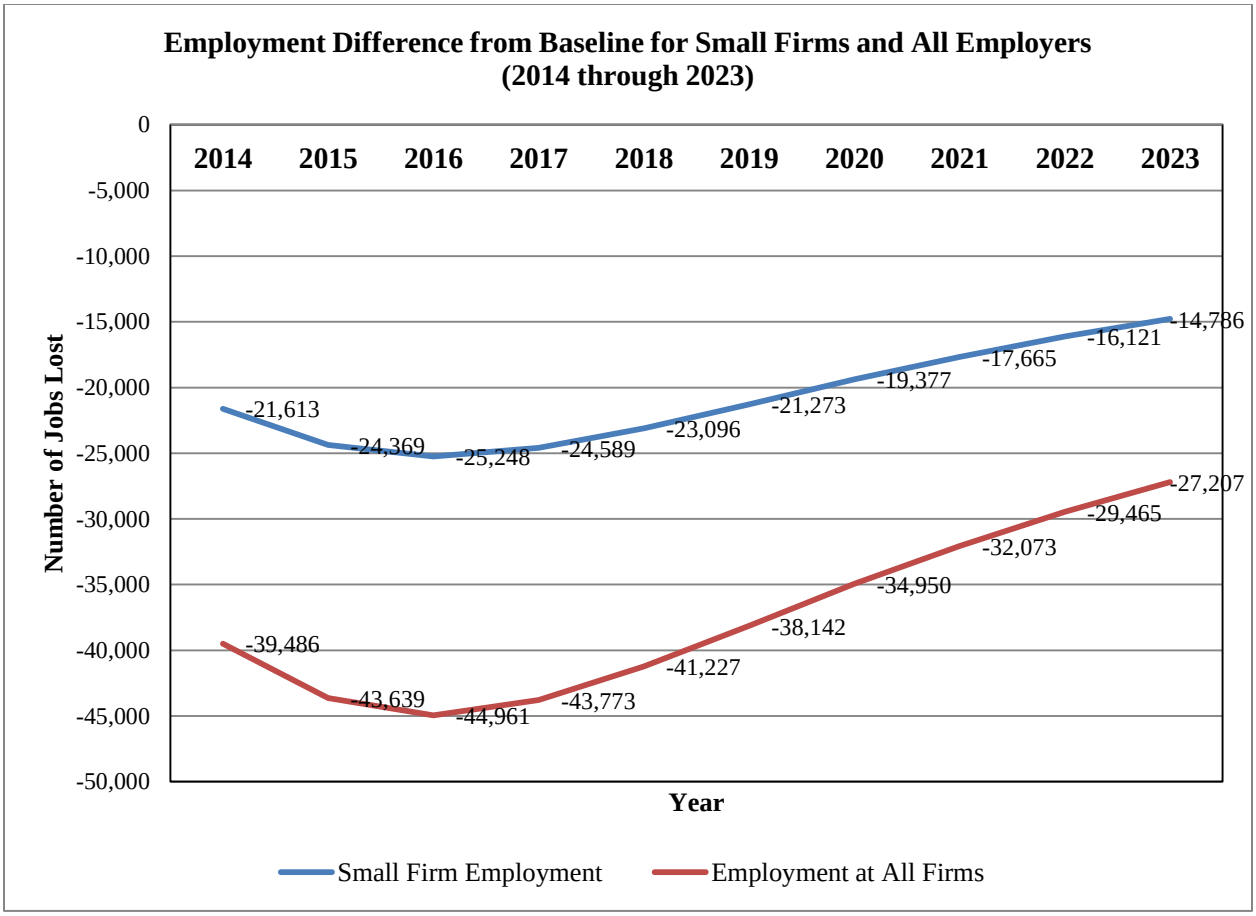


Figure 3

Table 10 and **Figure 4** provide estimates of real output[15] lost for different employee-size-of-firm categories of businesses over the ten-year forecast window as a consequence of the new rule. In total, the new PEL is projected to result in a cumulative loss of $72.9 billion in real output (measured in 2005 dollars) from 2014 to 2023. Half of the lost output is expected to be lost from the small business sector of the economy. The projected output gap follows a similar path to the projected employment gap, with immediate losses for the entire economy forecast at $6.0 billion in 2014. The forecast output gap widens in subsequent years until peaking in 2017 at $7.7 billion, after which it gradually narrows to $7.2 billion in 2023. The percent share of lost employment and cumulative lost output for different employee-size-of-firm categories is presented in **Figure 5**. The chart reemphasizes the fact that at least half of job losses and reductions in real output are expected to occur in the small business sector of the economy.

[15] The term "output" refers to the aggregate output of the U.S. economy (the United States' gross domestic product (GDP)). GDP has three possible definitions: (1) the value of final goods and services produced in an economy during a given period (as opposed to raw materials or intermediate goods which are produced or sourced earlier in the production process), (2) the sum of value added during a given period, or (3) the sum of incomes in the economy during a given period. It is a technical term whose significance may be better understood by the reader if she considers that because of the first definition, output serves as a rough proxy for sales.

Table 10: Real Output Difference from Baseline (Billions of 2005 $s), 2014-2023

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Cumulative Real Output Lost (10 year total)	Percent of Cumulative Real Output Lost
1-4 Employees	-0.384	-0.448	-0.483	-0.493	-0.490	-0.479	-0.466	-0.455	-0.445	-0.438	-4.581	6.28%
5-9 Employees	-0.355	-0.416	-0.450	-0.460	-0.456	-0.445	-0.432	-0.421	-0.411	-0.404	-4.250	5.83%
10-19 Employees	-0.411	-0.487	-0.530	-0.543	-0.540	-0.528	-0.513	-0.500	-0.489	-0.480	-5.021	6.88%
20-99 Employees	-0.996	-1.182	-1.288	-1.325	-1.321	-1.297	-1.267	-1.238	-1.214	-1.195	-12.323	16.89%
100-499 Employees	-0.854	-1.004	-1.093	-1.126	-1.128	-1.113	-1.092	-1.072	-1.056	-1.044	-10.582	14.51%
500 + Employees	-2.967	-3.401	-3.678	-3.792	-3.812	-3.783	-3.738	-3.698	-3.665	-3.648	-36.182	49.61%
<20 Employees	-1.150	-1.351	-1.463	-1.496	-1.486	-1.452	-1.411	-1.376	-1.345	-1.322	-13.852	18.99%
<100 Employees	-2.146	-2.533	-2.751	-2.821	-2.807	-2.749	-2.678	-2.614	-2.559	-2.517	-26.175	35.89%
<500 Employees	-3.000	-3.537	-3.844	-3.947	-3.935	-3.862	-3.770	-3.686	-3.615	-3.561	-36.757	50.39%
All Firms:	**-5.967**	**-6.938**	**-7.522**	**-7.739**	**-7.747**	**-7.645**	**-7.508**	**-7.384**	**-7.280**	**-7.209**	**-72.939**	**100.00%**

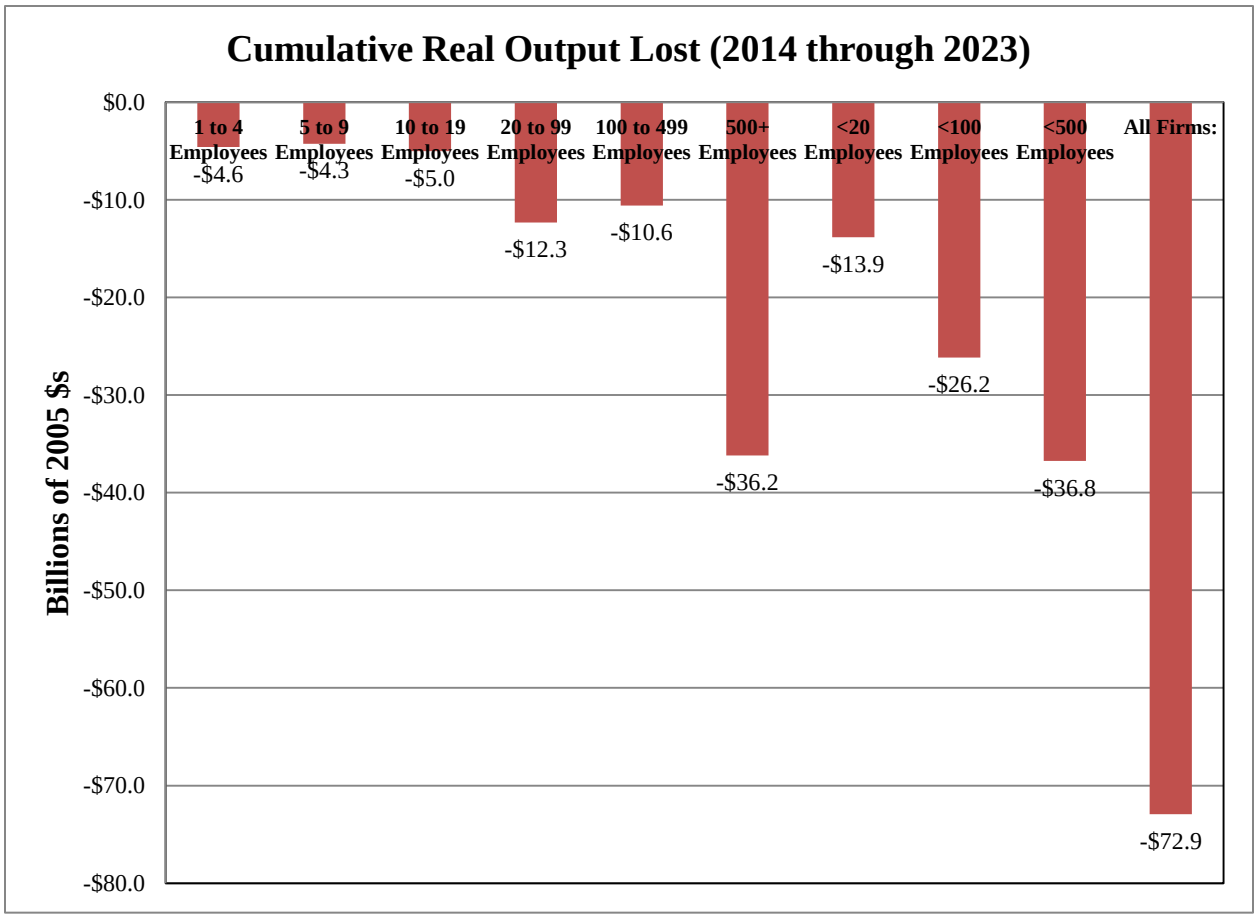
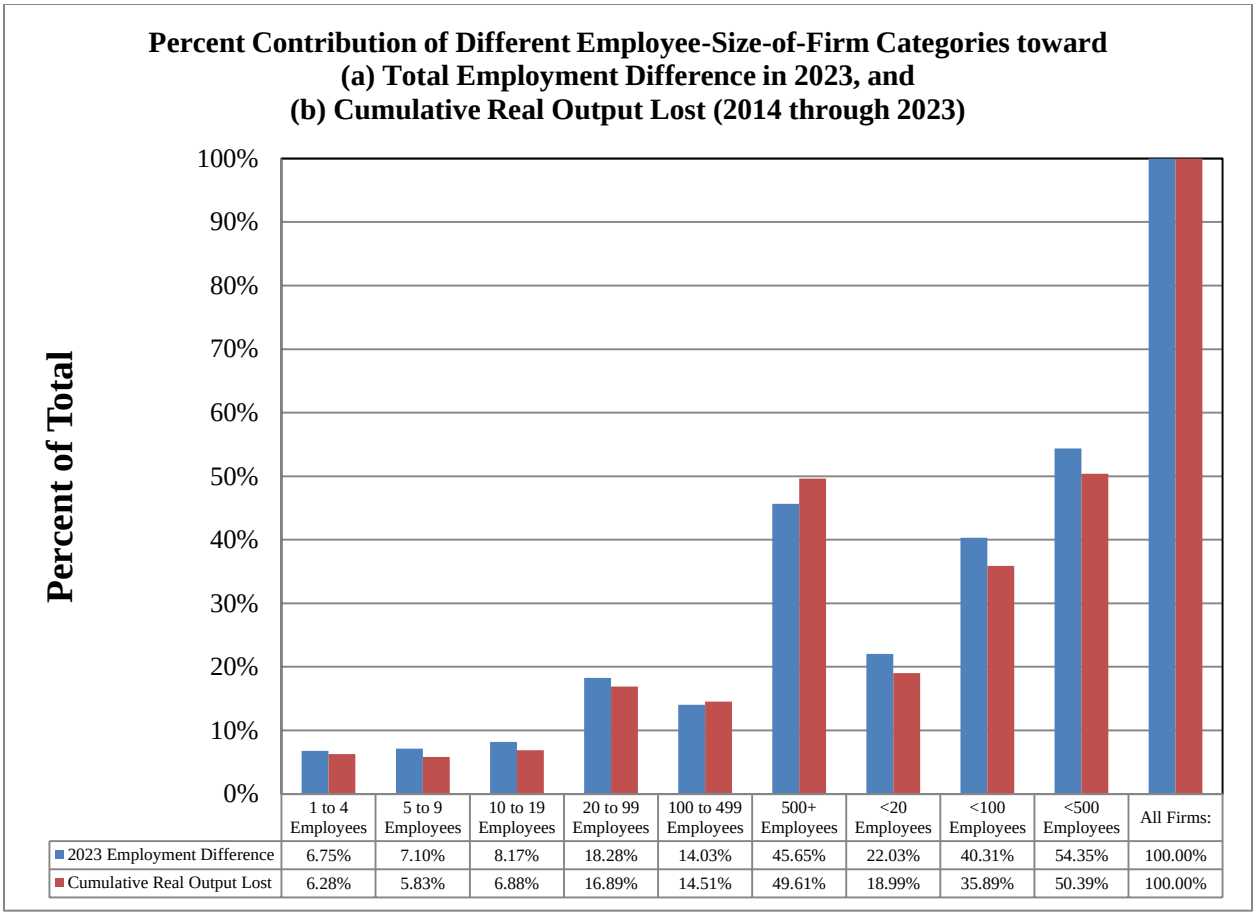


Figure 4



	1 to 4 Employees	5 to 9 Employees	10 to 19 Employees	20 to 99 Employees	100 to 499 Employees	500+ Employees	<20 Employees	<100 Employees	<500 Employees	All Firms:
2023 Employment Difference	6.75%	7.10%	8.17%	18.28%	14.03%	45.65%	22.03%	40.31%	54.35%	100.00%
Cumulative Real Output Lost	6.28%	5.83%	6.88%	16.89%	14.51%	49.61%	18.99%	35.89%	50.39%	100.00%

Figure 5

Comparison of BSIM Forecasts with Other Analysis

The employment and output forecasts generated by the BSIM compare favorably with another recent impact analysis of the proposed silica rule. A study released in August 2011 performed by the American Chemistry Council (ACC) suggests that the new silica rule would create $5.5 billion per year in annualized compliance costs for businesses, resulting in an estimated revenue loss for affected industries of $1.1 billion per year.[16] According to the study, the estimated revenue loss of $1.1 billion per year would likely result in 17,354 lost jobs per year and $3.1 billion in lost GDP per year.

The revenue loss forecast by the ACC is based on assumptions regarding the supply and demand curves of affected industries consistent with common EPA economic analysis practice. In particular, the ACC study assumes a constant elasticity of supply of 1.0 and an elasticity of demand equal to -1.5 for each affected industry. These assumptions led the ACC to calculate post-equilibrium annual revenue losses equal to 20 percent of the assumed annualized compliance costs ($5.5 billion). The estimated annual revenue losses were then entered as input to the IMPLAN input-output model used by the ACC to generate its estimates of aggregate economic impacts of the proposed rule.

[16] Environomics Incorporated and URS Corporation, "Potential New Silica Standard with a PEL of 50 ug/m^3 and Ancillary Requirements: Analysis of Compliance Costs, Economic Impacts, Measurability," ACC Crystalline Silica Panel, American Chemistry Council, August 2, 2011.

The difference between the results generated by the BSIM and those released by the American Chemistry Council are partially a function of different methodologies used to obtain cost estimates to be used as model inputs. Whereas the above NFIB analysis uses cost estimates presented earlier this year by OSHA in the Federal Register, the inputs used in the ACC analysis were derived from a 2003 Small Business Regulatory Enforcement Fairness Act (SBREFA) cost estimate. Different cost estimates will invariably produce different forecasts, but it is noteworthy that both the BSIM and the ACC's analysis forecast material losses in both employment and output due to the proposed rule's implementation.

Conclusion

Crystalline silica is of vital importance to private industry, used heavily in construction, manufacturing, agriculture, transportation, defense, and high-tech industries. It is contained in sand, brick, and concrete and is also a key material in the production of steel, abrasives, paints, high-tech equipment, glass, ceramics, and thousands of consumer products. The importance of this material to industry cannot be overstated, but it is also important to recognize that the use of silica presents health risks to workers exposed to it. Under existing regulation, silicosis-related fatalities have decreased by 89 percent over the past four plus decades. Additional reductions in silica-related illnesses and fatalities are desirable for all stakeholders. Achieving such reductions through regulation entails economic costs due to the increased regulatory burden imposed on firms that utilize crystalline silica. The question of what balance to strike when deciding regulatory thresholds is one for policymakers, who must in this case decide whether the benefits associated with potential further reductions in silica-related illnesses and fatalities outweigh the economic costs. OSHA estimates that employers will face new annual compliance costs in excess of $637 million (in 2009 dollars) due to the proposed rule. According to the NFIB's Business Size Insight Module, these annual costs are commensurate with the loss of more than 27,000 jobs and over $72 billion in lost real output in the long run, with at least half of the jobs lost and reduction in real output projected to occur in the small business sector of the economy.