RESOURCES *for the* FUTURE

Clean Energy Standard for Industry: Scoping Analysis

Issue Brief 20-06 by **Vincent Gonzales**, **Joshua Linn**, and **Richard Morgenstern** — April 2020

1. Introduction

Electrification, hydrogen, enhanced efficiency, and other technological innovations are essential for long term greenhouse gas (GHG) emission reductions in the industrial sector (**Rissman, et. al. 2020**). At the same time, greater use of existing technologies already in place in some facilities can yield near-term emissions reductions and help achieve climate objectives.

In 2018, the US industrial sector accounted for **about one-fourth** of total net GHG emissions, including direct combustion of fossil fuels as heat sources or feedstock, electricity use, and the release of non-CO_2 gases via various industrial processes. Within the industrial sector, iron and steel, cement, and petrochemicals are among the largest emitters. Although the electric power and transportation sectors have been the focus of multiple climate policies, the industrial sector has seen relatively little policy action to reduce emissions, particularly at the federal level. Near-term policy options to reduce emissions do exist, however. The US Environmental Protection Agency (EPA) could establish clean energy standards for industry under the Clean Air Act (CAA) to bring up the laggards via use of existing technologies; additionally, the US Congress could mandate new emissions standards, as it did in 1990 when it amended the Clean Air Act to more tightly restrict certain air pollutants. For example, the EPA used its regulatory authority under the CAA to create the Clean Power Plan and Affordable Clean Energy Rule, which set performance standards for carbon dioxide emissions from existing power plants. Taken together, developing new technologies and broadening adoption of existing technologies are distinct but complementary means of reducing industrial GHG emissions.[1]

This Issue Brief presents a scoping analysis and demonstration of methods for estimating the potential emissions reductions achievable via regulation in three major industrial sectors: iron and steel, cement, and petrochemicals. We consider performance standards of varying levels of stringency. For practical reasons we use data from 2012. The main conclusion is that substantial emission reductions from these industries appear to be feasible. Future work will expand the nature and breadth of the analyses conducted, and consider the most recent data.

2. Methods

The first step in establishing minimum performance standards for major industries is to measure the performance differences in emissions intensities among facilities in each industry. For the electric utility sector, publicly available data sets and disaggregate models

1 There are many examples of the use of minimum standards based on the performance of existing industrial facilities, under both the CAA and the Clean Water Act. For instance, Section 112 of the CAA establishes specific technology-based emissions limits for air toxics, known as maximum achievable control technology (MACT) standards. Although Congress allowed some flexibility in defining source categories, the so-called MACT floor—based on the average emissions of the best-performing 12 percent of sources within the relevant industry—targeted the performance of the high emitting facilities. We expect that regulators acting under the provisions of the existing CAA, or any future Congressional mandate, would likely promulgate industry-based regulations that are keyed to technologies already used in the United States.

with detailed information on generating facilities have made analyses feasible. In contrast, data for the manufacturing sector are often proprietary, and few disaggregate models lie in the public domain. Analyses of the manufacturing sector are also hampered by the heterogeneous product mix within each six-digit North American Industrial Classification System (NAICS) industry: the more heterogeneous the regulated sector, the more challenging it is to attribute differences in CO_2 emissions per unit of output to differences in best practice rather than differences in product mix.

The aim of this scoping analysis is to provide a rough sense of the emissions reductions potentially achievable by setting CO_2 emissions standards for three major manufacturing industries. The preferred approach for filling the data gaps is to rely on the highly disaggregate economic and technical information collected on manufacturing facilities every five years in the US Census of Manufactures, which details expenditures on fuel consumption and electricity. This information can be readily used to calculate total CO_2 emissions for individual plants. The most recent Census of Manufactures data, for 2017, are available on a confidential basis to qualified researchers. However, because of the lead times involved, the present scoping analysis relies on limited published data derived from the 2012 Census of Manufactures, including a recent RFF working paper that reports summary information on the emissions intensity distributions for selected sectors ("**Carbon Tax Competitiveness Concerns: Assessing a Best Practices Carbon Credit**," by Wayne Gray and Gilbert Metcalf, February 2017).

3. Results

Figure 1 displays the CO_2 emissions intensities for typical facilities in each of three six-digit NAICS industries: cement manufacturing (NAICS 327310), iron and steel mills and ferroalloy manufacturing (NAICS 331111), and petrochemical manufacturing (NAICS 325110). These industries were selected because they were among the highest-emitting six-digit industries in 2012 in the entire manufacturing sector. Among the industries typically classified as energy intensive and trade exposed, these three industries account for about 29 percent of total CO_2 emissions (Gray and Metcalf 2017). Emissions intensity differs substantially across the three industries: the average cement plant emits more than 15 times as much CO_2 per dollar of shipments as the average iron and steel mill, and typical petrochemical plants emit slightly less per sales dollar than iron and steel mills.

Figure 2 displays the per facility emissions distributions for each of the three sectors. The vertical axis in this figure shows the percentage of facilities that have an emissions intensity shown along the horizontal axis. For example, the figure illustrates substantially more

Figure 1. Average Emissions Intensities (2012)

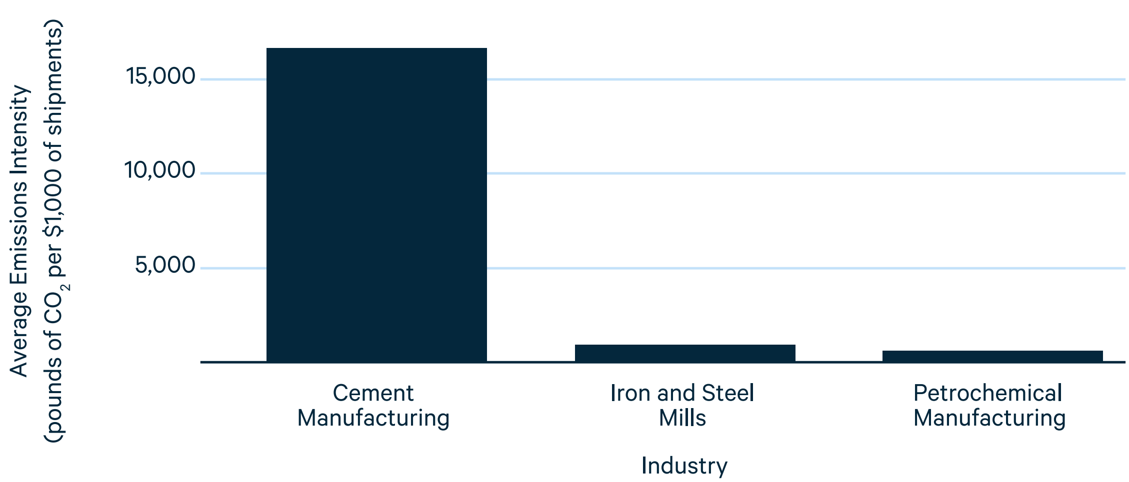
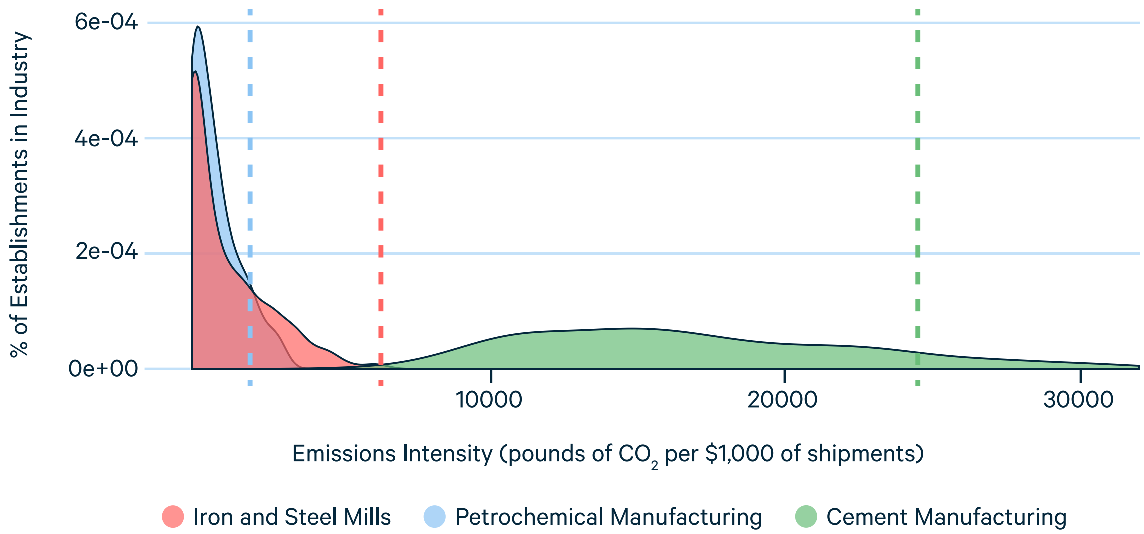


Figure 2. Emissions Intensities Distributions (Generated)



variation in emissions intensity across cement than across iron and steel. The relatively wide range of performance for cement facilities reflects the use of different technologies within the sector. Conversely, the relatively narrow range in emissions intensities across petrochemical plants reflects great similarities among facilities. The iron and steel industry is an intermediate case.

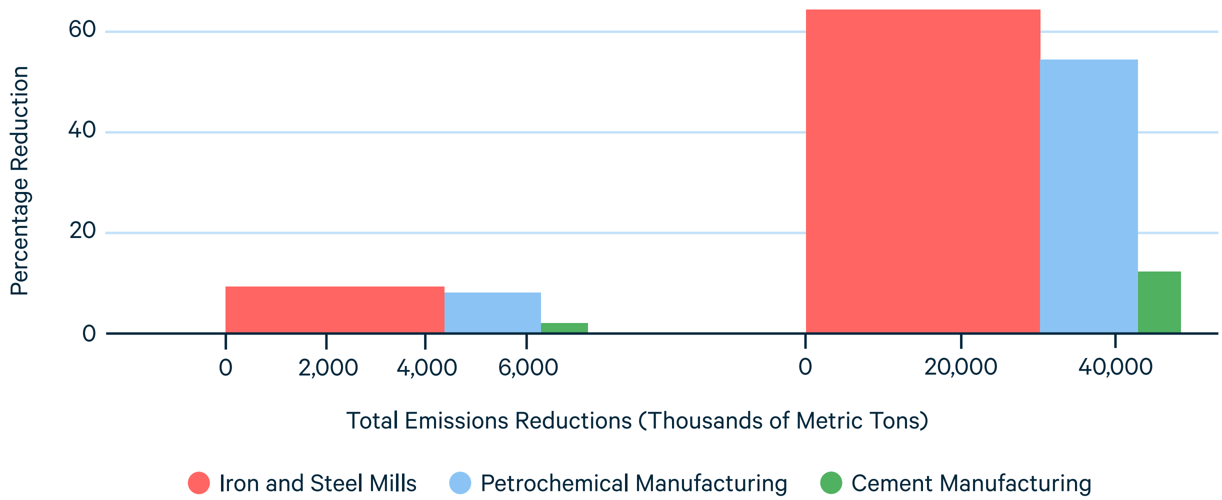
With that sector distribution information, we can estimate potential emissions reductions from the establishment of clean energy standards. Figure 3 displays the case where the clean energy standard, defined as tons of CO_2 emissions per $1,000 of shipments, is set at the level of the worst-performing 10 percent of facilities within an industry. In this scenario, a facility with an emissions intensity above the standard (that is, higher emissions per unit of output than the standard) reduces its emissions intensity sufficiently to achieve the standard. (The 10 percent standard level for each industry is depicted by the vertical dotted lines in Figure 2.) As shown, this standard imposed on iron and steel facilities would reduce CO_2 emissions by about 4 million metric tons per year, or roughly 8 percent of the industry total. For petrochemicals, the analogous standard would reduce CO_2 emissions by about 2 million metric tons per year, or slightly less than 8 percent of the industry total. For the cement industry, 100,000 metric tons of CO_2 would be reduced, or only about 2 percent of the industry total. These cross-sector differences in the effectiveness of a uniform clean energy standard reflect the underlying differences in the distribution of facility-specific emissions across the three industries. Clearly, nonuniform standards (not displayed) could alter these outcomes. For example, standards could be selected to achieve similar percentage reductions in emissions across industries. Note that the scoping analysis does not consider the costs of achieving the standards because of limitations of the public data.

As an alternative to designing the clean energy standard around the 10 percent worst performers, we model a standard set to mandate upgrades for the worst-performing 40 percent of facilities. As shown in Figure 4, much larger reductions would be obtained from this more stringent standard.

Emissions reductions would exceed 60 percent of industry totals for the iron and steel sector and be about 55 percent for petrochemicals. In the cement industry, mandating upgrades at the worst-performing 40 percent of facilities would reduce industry-wide emissions by about 15 percent.

Figure 3. Emissions Reductions from Controlling Worst-Performing* 10%

Figure 4. Emissions Reductions from Controlling Worst-Performing* 40%



The bottom line of this initial scoping analysis is that clean energy standards have considerable potential to reduce GHG emissions in the industrial sector in the near term, especially if they are relatively stringent. Trading of compliance credits is not explicitly considered in these calculations; however, trading might be possible under some statutory interpretations, which would reduce the costs of achieving a particular level of emissions reductions. Several next steps are appropriate, including using micro-level data from the 2017 Census of Manufactures to estimate the full range of potential emissions reductions for the three industries explored here; extending the analysis to include other industries like petroleum refining and to include process emissions; and analyzing the cost effectiveness of clean energy standards, including the possibility of compliance credit trading.

Joshua Linn is an associate professor in the Department of Agricultural and Resource Economics at the University of Maryland and a senior fellow at RFF. His research centers on the effects of environmental policies and economic incentives for new technologies in the transportation, electricity, and industrial sectors. His transportation research assesses passenger vehicle taxation and fuel economy standards in the United States and Europe. He has examined the effects of Beijing's vehicle ownership restrictions on travel behavior, labor supply, and fertility.

Richard Morgenstern is a Senior Fellow at Resources for the Future. His research focuses on the economic analysis of environmental issues with an emphasis on the costs, benefits, evaluation, and design of environmental policies, especially economic incentive measures. His analysis also focuses on climate change, including the design of cost-effective policies to reduce emissions in the United States and abroad.

Vincent Gonzales is a Research Assistant at RFF. He currently works on projects related to the economics of dam removal, voluntary contributions to endangered species conservation, industrial emissions regulation, and innovation modeling in the E4ST model.