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A LIFESAVER, NOT A JOB KILLER

EPA's proposed "air toxics rule" is no threat to job growth

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Introduction

On March 16th, the Environmental Protection Agency proposed national emissions standards for mercury, arsenic, and other toxic air pollution from power plants. Known as the "toxics rule," it was a preliminary proposal meant for public comment, with a final ruling set for November 2011.

As part of the toxics rule proposal, the EPA also released a regulatory impact analysis (RIA), which tallied up many of the costs and benefits of the new rule. While the EPA cautions that "a standalone analysis of employment impacts is not included in a standard cost-benefit analysis," the RIA does look at some (but not all) possible channels through which rule changes translate into changes in labor demand.

The EPA explores in some detail two particular channels—changes in employment in the directly regulated industry (utilities), and the increased demand for labor directly stemming from the construction and installation of pollution abatement and control (PAC) equipment. The EPA also identifies one particular industry (steel) that may see job gains stemming from its role as a supplier industry to PAC construction and installation.

While the EPA analysis on jobs is informative, it is not close to an exhaustive review of how the rule changes may affect overall labor demand. Other potential channels through which the proposed rule could affect the demand for labor and hence employment are largely missed in the RIA's analysis. The analysis misses the effect that rising energy costs may have on demand for labor in energy-using industries. It also overlooks the spur to *all* (i.e., steel plus non-steel) supplier industries from the increase in PAC investments. Finally, the analysis fails to consider the

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"re-spending effect" of net job creation (or destruction) through all other channels; because the U.S. economy is currently operating far below potential, anything that spurs (or depresses) output and employment will be amplified as income earned by newly hired workers and firms is re-spent in the economy.

This report aims to provide a more complete picture of the toxics rule's effect on employment by examining each of these areas in some detail. Essentially, this paper assesses the overall job impacts of the economic projections provided by the EPA regarding the proposed rule.

This analysis incorporates multiple, offsetting effects to produce an estimate of net effects. Higher energy prices arising from the rule would likely lead to small increases in costs across industries, which would lead to small reductions in final demand for their output and hence small reductions in their demand for labor.

However, these depressing effects would be swamped by the job growth spurred by new investments in pollution abatement and control, as well as by small increases within the utility sector itself. Furthermore, gains from job growth would be amplified through re-spending effects, as those who gain jobs increase their consumption thereby generating jobs throughout the economy.

The report details the following major findings:

- The toxics rule would have a modest positive net impact on overall employment, likely leading to the creation of 28,000 to 158,000 jobs between now and 2015. (This estimate reflects the specific findings that follow below.)
- The employment effect of the toxics rule on the utility industry itself could range from 17,000 jobs lost to 35,000 jobs gained.
- The toxics rule would create between 81,000 and 101,000 jobs in the pollution abatement and control industry (which includes suppliers such as steelmakers).
- Between 31,000 and 46,000 jobs would be lost due to higher energy prices leading to reductions in output.
- Assuming a re-spending multiplier of 0.5, and since the net impact of the above impacts is positive, another 9,000 to 53,000 jobs would be created through re-spending.

The clearest take-away from the RIA and other analyses of pollution standards is that the primary economic impact of these rules is on health and quality-of-life outcomes. The improvements to health and quality of life stemming from the proposed rule changes would be very large and make the regulatory change worthy of support in and of itself. Specifically, the EPA estimates (based on the state-of-the-art research) that adoption of the proposed toxics rule would lead to the following outcomes:

- 6,800 to 17,000 lives saved (which the EPA describes as "avoiding premature mortality")
- 11,000 fewer heart attacks
- 12,200 fewer hospital and emergency room visits
- 225,000 fewer cases of respiratory symptoms
- 850,000 more work days (because workers are healthier)

The "monetized" value of these and certain other health benefits would amount to $55–146 billion per year, dramatically exceeding the $11.3 billion annual cost of the program (figures in 2010 dollars).[1]

Channels that lead from proposed rule changes to employment

Given that regulations are often reflexively opposed on the assertion that they always lead to job losses (often allegedly very large job losses), and that the very slow economic recovery from the Great Recession has kept insecurity over jobs front-and-center in American political debates, it is useful to take a rigorous, comprehensive look at how these regulatory changes are likely to affect jobs. Again, it should be noted that this paper assesses only the job impacts of the economic projections provided by EPA: If their estimates of key economic parameters (the number of coal plant retirements, the price impacts of regulation, or the amount of capital spending induced by the rule) prove wrong, this analysis would change as well.

It should also be noted at the outset that the job impacts of regulatory changes are very different depending both on the time-horizon examined as well as the macroeconomic context. The following section sketches out the differing

employment effects over these different time horizons and macroeconomic contexts.

Employment over the long run in well-functioning economies

In the long run and during times when the economy is functioning well, the job impacts of these regulations would likely be quite small. First, in the long-run, industries would have time to adjust inputs to reflect changing relative prices (say, substituting more capital and labor for energy inputs as regulatory changes make energy more expensive). Second, job losses in energy-intensive industries that see demand for their output fall due to rising energy prices will be substantially offset by job *gains* in non-energy-intensive industries that benefit from changed consumption patterns induced by the regulatory change.

Furthermore, in a well-functioning economy, any depressing effect on aggregate demand stemming from regulatory changes (declines in consumers' purchasing power driven by increased energy prices, for example) can be offset with other macroeconomic policy levers—reducing interest rates to spur business investment, for example.

Hence, in the long run and in a well-functioning economy, it is accurate to say that there are *no aggregate job losses at all* stemming from regulatory actions like the toxics rule. Instead, because regulations may slightly raise the price of energy and this cuts the purchasing power of workers' wages, there may be very small voluntary reductions in hours supplied to the labor market by American workers. By all accounts, however, the price increase spurred by the toxics rule as well as the labor-supply response stemming from them will be vanishingly small.

The fact that there are no *aggregate* job losses does not mean, of course, that each and every industry escapes job losses. Some industries will see job losses (energy-producing and heavy energy-using industries) and some will see job gains (light energy-using industries and some that provide alternative sources of energy-generation that do not emit the regulated toxics). The degree to which job-losing industries should be aided with complementary policies is an important question, but it should remain clear that, in the long run, regulatory action like the toxics rule does not lead to overall involuntary job loss.

Employment effects in the short run in economies with excess capacity

The analysis is very different in the short run, especially a short run characterized by chronic excess capacity and historically high rates of unemployment. Under these conditions, the job impacts of regulatory changes can be substantial.

On the negative side, any depressing effect these regulatory changes have on aggregate demand are harder to counterbalance with traditional macroeconomic policy levers (for example, the "policy" interest rates controlled by the Federal Reserve are sitting essentially at zero today, so lowering these is not a viable option—though fiscal stimulus could still be used to counterbalance any declines in demand stemming from regulatory changes), and job losses in energy-intensive industries are not likely to be recouped quickly through job gains in less energy-intensive sectors. In fact, these job losses may well just be amplified through multiplier effects.

On the positive side, capital investments made in order to bring power plants into compliance with new rules also spur multiplier effects, and may well represent net new spending in an economy where both businesses and households are extremely reluctant to make new purchases.

Given the actual context in the U.S. economy today as these rules are being debated, this briefing paper mostly focuses on the short-run impacts of regulatory change occurring in an economy with chronic excess capacity. Furthermore, economists and policymakers should be mindful of a key lesson of not only the Great Recession but also the Japanese lost decade of the 1990s: While in theory it is easy to imagine ways to keep aggregate demand shortfalls from being problematic for economies, in practice this demand-management might be considerably harder. Given these historical episodes and given academic research on the positive externality benefits of spurs to aggregate demand, economists and policymakers should not be too quick in assuming problems of excess capacity will necessarily be solved in the long-run.

The role of complementary policies

Another issue that is made even more salient by today's context of high rates of joblessness and economic under-

performance is the role of complementary policies to aid the adjustments that will be needed should the proposed rule become law.

Some industries will see job losses (even as overall job changes are positive), and workers will need to find alternative employment in a very tough labor market. Complementary policies should cushion the amount of industry loss and help those workers who must change jobs. Most importantly, complementary policies that help to both achieve the explicit goals of the regulation (reduced emissions from power plants) as well as minimize the labor-market adjustments needed should be front and center in the policy debate.

Methodology

In this section, we quickly sketch out the different channels that are relevant to the debate over the effect of the proposed toxics rule on jobs, given the context of a U.S. economy still facing clear shortfalls in aggregate demand. We would note that an analysis that attempts to capture the incremental employment effects stemming from the proposed rule through all of these channels has not yet, to our knowledge, been undertaken. As mentioned before (and documented below), the EPA technical analysis released with the proposed rule quantified the employment implications of some channels of the rule, but was far from exhaustive. And other studies (see Heintz el al., 2010, for example) have looked at the likely activities of the utility sector in light of a set of assumptions regarding the combined effects of the final toxics rule as well as other regulations, but have not isolated the incremental job effects of the toxics rule alone, apart from other regulatory changes and (importantly) apart from the presumed baseline path of employment and investment in the utility sector. This paper aims to quantify solely the incremental employment changes to be expected from adoption of the proposed toxics rule.

The channels that link the proposed rule change to employment changes are as follows:

Impact on directly regulated utilities themselves

The most obvious effect of regulations is on the industries that are directly regulated. In the case of the toxic-rule, this means utilities. The toxics rule RIA provides a very good assessment of the likely employment effects of the rule on the utilities themselves, following the approach of Morgenstern, Pizer, and Shih (2002), who provided an empirically rigorous examination of the employment effects of regulation on four industries (none of them utilities). Morgenstern et al. identify three channels through which regulatory change can impact an industry that is directly regulated:

- ***The output effect.*** This is simply the reduction in demand for industries' output that can occur if regulatory changes raise the price of this output.
- ***The cost effect.*** The cost-effect reflects the fact that if production costs rise due to regulatory change, more inputs (including labor) are needed to produce the same amount of output.
- ***The factor-shift effect.*** The factor-shift effect reflects the fact that environmental activities *within* a given sector may be more labor intensive than conventional production.

Impact on the environmental protection (EP) sector

Meeting the new standards will, according to the EPA RIA, lead to substantial investments in pollution abatement and control (PAC) – and these investments will spur output in what Bezdek, Wendling, and DiPerna (2008) call the "environmental protection" (EP) sector of the economy. For example, utilities are forecast to purchase and install scrubbers and filters and other equipment meant to capture pollutants before they are released into the atmosphere. These PAC investments will lead to job-growth—scrubbers must be manufactured and installed.

Impact on industries that supply the EP sector. It is important to note as well that a given amount of final demand in the environmental protection sector does not just create jobs *within* that sector; it also creates jobs in industries that *supply* this sector. For example, if steel is a key intermediate good used in the production of scrubbers, then increased demand for scrubbers will lead to employment gains in the steel sector as well.

Impact on energy-using industries

If the proposed rule leads to increases in the price of energy, industries that are intensive users of energy could see noticeable increases in their own production costs. These price increases could lead to reduced demand for their output, harming employment in these sectors.

Impact stemming from re-spending effects of net job creation outcomes from other channels

The net impact of the previous channels will, given the vast amounts of unused capacity in today's U.S. economy, be amplified by "re-spending" effects. As workers are, on net, either hired or displaced through the channels sketched out previously, this will either increase or decrease overall purchasing power in the economy and this initial change in spending will be subject to a re-spending "multiplier" as it ripples through the economy. So, if net job creation stemming from the other channels is positive, then newly hired workers will buy more food and clothes and other goods and their spending will add to incomes in these other sectors. If the net job creation from other channels is negative, the reduced spending on food and clothes and other goods will subtract from incomes in these other sectors.

Calculating a comprehensive jobs estimate

In sections that follow, an estimate of the magnitude of the jobs-effect from each of these channels is derived. Then the effects stemming from of each of these channels is aggregated up to an overall estimate.

Impact on directly regulated utilities

The clearest channel through which the proposed toxics rule could impact employment is its effects on the directly regulated industry—utilities. In the toxics-rule RIA, the EPA relies on the methodology of Morgenstern, Pizer, and Shih (2002) to provide its employment-impact estimates on the utility sector. Morgenstern et al. provide three channels through which direct regulations can affect an industry: the cost effect, the factor-shift effect, and the output effect.

The ***cost effect*** identifies what happens to industry employment when a regulation makes production more expensive, holding all else (including industry output) constant. Rising input costs in the case of environmental regulations could include the need to hire more staff to undertake environmental monitoring and compliance as well as the use of new materials to change production processes to make them cleaner. This need to hire a larger bundle of inputs to produce a given unit of output (i.e., the definition of rising input costs) has the potential to increase employment in an industry, all else equal.

The ***factor-shift effect*** identifies the impact of changing the *composition* of industry inputs on employment. Environmental activities may be more labor intensive than conventional production in the utility industry; if so, this means that changing the industry production mix toward environmental activities and away from conventional production will require more labor and boost industry employment.

It is important to keep in mind that the cost and factor-shift effects refer exclusively to environmental activities that may be undertaken *within the utility sector itself*. It may well be the case (and is forecast to be) that much economic activity aimed at reducing pollutants is expected to happen outside the utility sector, in parts of the economy that are increasingly recognized as the environmental protection (EP) sector. The construction and installation of scrubbers and filtration systems that capture pollutants, for example, are economic activities that generate output and employment outside the utility sector and will hence not be included in the cost and factor-shift effects.

The ***output effect*** measures the reduced demand for overall utility output stemming from the rise in production costs associated with the need to bring electrical power production into compliance with the new standards. This is probably the most intuitive effect: As utility prices rise, customers purchase less utility output and the derived demand for labor subsequently falls. This output effect includes reallocations among facilities within the utility sector—some power plants may be retired while others may expand output.

The toxics-rule RIA essentially uses the overall averages from the Morgenstern et al. study of four regulated

TABLE 1

Price elasticities of demand and import shares, utilities vs. Morgenstern et al. industries

	Utilities	Pulp and paper	Plastics	Steel	Petroleum
Elasticity	-0.16	-0.698	-0.987	-0.953	-0.071
Import share of domestic consumption	0.5%	33.2%	15.3%	22.1%	10.0%

SOURCE: Morgenstern, Pizer, and Shih (2002) and Ho, Morgenstern, and Shih (2008).

industries to estimate the likely impact on employment in the utilities sector. While none of the four industries studied by Morgenstern et al. are utilities, there is still a strong case to be made that the Morgenstern et al. results can provide a useful benchmark and, if anything, actually paint a too-pessimistic picture of the likely impact of regulations on job trends in the utility sector. This is because the average output effect measured for the industries studied by Morgenstern et al. is likely to be far larger (in the negative direction) than that faced by the utility sector, for two reasons.

First, the price elasticity of demand for utility sector output is much lower (by a factor of four) than that facing three of the four industries examined in Morgenstern et al. This means that a change in the prices of the output of the utility industry has much less effect on demand for its output (and consequently on employment) than do changes in prices of the products of the other industries. Second, the utility sector is much less exposed to international competition than the four industries examined by Morgenstern et al. The relevant elasticities and import shares are displayed above in **Table 1**.

Given that the output effect is by far the largest negative contributor to employment growth in the directly regulated industries studied by Morgenstern et al., and given that this effect is sure to be much smaller for the utility sector than for the average of the industries they studied, it seems clear that the Morgenstern et al. results are likely to be quite pessimistic about the jobs impact of the proposed toxics rule. In other words, the true jobs impact in this area may be significantly more positive than that shown by applying Morgenstern et al.

There is very little in regards to the cost effect or the factor-shift effect that would indicate that predictions of the job impacts of regulations aimed at utilities should be notably different from those predicted for the industries studied by Morgenstern et al.

The size of the cost effect is largely determined by the raw labor intensity of a sector. If regulations increase input costs for a given amount of output, then this will lead to larger employment gains in more labor-intensive sectors. The utility sector is about as labor intensive as three of the four industries (steel, paper and pulp, and plastics), shown in **Table 2** below. It is notably more labor

TABLE 2

Labor intensities, utilities vs. Morgenstern et al. industries

	Utilities	Pulp and paper	Plastics	Steel	Petroleum
Labor payments/output	15.6%	19.1%	20.8%	14.5%	3.2%
Materials/output	24.0	47.7	52.1	55.9	71.2

SOURCE: Author's analysis of Bureau of Economic Analysis data and Morgenstern, Pizer, and Shih (2002), and EPA (2011a).

intensive than the petroleum refining industry, but intermediate goods (i.e., oil) make up more than 75% of this sector, making it a clear outlier in the U.S. economy.[2]

The size of the factor-shift effect is largely determined by the difference in labor intensity between conventional production (or, the labor intensity of the utility sector today) versus the labor intensity of environmental activities undertaken *within* a given sector following a regulatory change. If environmental activities within the sector are more labor intensive than conventional production, then meeting the proposed standards will lead to job gains through this channel.

The size of this effect in the utility sector relative to the industries studied in Morgenstern et al. is hard to pin down given off-the-shelf data. The utility sector uses relatively little labor when compared with the rest of the economy, but Morgenstern et al. econometrically estimate the industry-specific labor intensity of environmental production and find a very large variance among industries—environmental activities in the petroleum refining sector, for example, have a labor share in total costs of 7%, while steel manufacturing has a labor share of 36%.

Three of the four industries examined by Morgenstern et al. display a positive factor-shift effect, meaning that environmental activities are more labor intensive in these industries, and the only statistically significant factor-shift effects (in plastics and petroleum) are both positive. In short, while the utility sector is not very labor intensive, the very large between-industry variance in the labor intensity of environmental activities means that it is hard to infer from this that the factor-shift effect will be unambiguously positive.

However, there is one bit of suggestive evidence on this regard: The EPA RIA estimates new jobs supported by the need to purchase new materials and to undertake routine operations within the utility sector resulting from the proposed rule. The ratio of the *jobs supported by the new materials needs to the jobs supported by new operating needs* is roughly 1-to-1. However, looking at the Bureau of Labor Statistics (BLS) employment requirements matrix (ERM) shows that the ratio of direct jobs to supplier jobs for the electricity generation sector as a whole is closer to 1-to-3, meaning that on this very blunt comparison, the *existing* activities of the electricity generation sector seem less labor intensive than what is being forecast by the EPA for new labor demands within the sector generated by undertaking environmental activities.

Given this, there seems little reason to think that the factor-shift effect will work against job creation in the utilities sector to a qualitatively different degree than the other industries examined by Morgenstern et al., and this effect was positive in three of these four other industries. Given this, the EPA estimate, based on Morgenstern et al., that the toxics rule will result in somewhere between 17,000 jobs lost and 35,000 jobs gained (with a gain of 9,000 jobs being the midpoint), seems the most reasonable to use.

Impact on the environmental protection sector

The toxics rule RIA assumes that utilities will respond to the new standards in part by undertaking significant investments in PAC construction and installation. Bezdek, Wendling, and DiPerna (2008) identify the industries that supply the goods and services used to mitigate pollutants as a separate sector of the economy: the environmental protection (EP) sector. While their primary contribution is simply characterizing this sector empirically, the larger point they make is a key one to keep in mind: While investments made by firms as a result of tougher environmental standards are often considered under the rubric of "compliance costs," it is important to realize that these costs are not foregone economic activity, but instead are largely a reorientation of this activity.[3] In short, spending on goods and services that are needed to reduce pollution is an activity every bit as capable of creating jobs as spending on anything else.

The RIA forecasts that $8 billion will be spent in the construction and installation of PAC equipment between now and 2015 as a result of the proposed rules. The RIA further estimates that this $8 billion results in roughly 31,000 job-years supported directly in the EP sector. A technical supporting document (TSD) to the RIA breaks out these jobs and allocates them to installation of pollution control equipment and jobs spurred by the need to hire operators and materials used in the PAC processes. **Table 3**, next page, replicates their job break-outs.

TABLE 3

Employment effects using the environmental sector approach

Jobs associated with PAC construction and installation	Number of jobs
Construction jobs	30,440
Steel jobs	430
Subtotal	30,870

Jobs associated with new operational needs	Number of jobs
Increased resource use[1]	5,230
Increased operational needs[2]	5,500
Subtotal	10,730

Total	41,600

(1) These jobs are supplier jobs.
(2) These jobs are probably already estimated in the "effects on directly regulated industry" methodology following Morgenstern et al. (2002).

SOURCE: EPA (2011a).

On balance, the toxics rule technical supporting document likely undercounts EP jobs

The EPA's analysis of the jobs generated by the toxics rule undercounts the employment generated by these EP investments in certain respects and, to a lesser degree, overcounts such employment in one respect. However, the net effect is surely that the RIA understates total job-gains stemming from the construction and installation of PAC equipment.

There are two reasons to believe that the EPA analysis is undercounting jobs in the EP sector.

First, the implied direct-job multiplier of one job-year created for every $259,000 in spending seems low when compared to other data sources. When data sources like the employment requirements matrix (ERM) of the Bureau of Labor Statistics (BLS 2011) or the Census of Construction are consulted, one gets a much higher direct-job multiplier (between roughly one job per $134,000 to $158,000; see Table 4).

Second, the RIA identifies only the jobs *directly* related to the construction and installation of PAC equipment—mostly missing in this analysis are the jobs supported by final demand for the construction and installation of PAC equipment in *supplier* industries, like those that manufacture the PAC components that are installed. The toxics rule RIA *does* show jobs supported in the steel industry stemming from PAC construction and installation, but these jobs are likely far too small a fraction of the direct jobs to fully reflect the impact of increased PAC construction and installation on supplier industries.

To get a rough sense of how many supplier jobs are being missed in the toxics rule RIA, one can consult the BLS ERM and examine the employment vector in the overall construction industry associated with each $1 million in final demand in that sector.

The construction vector in the ERM indicates that each $1 million is associated with roughly 11 jobs in the overall economy, with just fewer than seven of these jobs being accounted for directly in construction. This means that four of the 11 overall jobs (or about 37% of the total) associated with each $1 million in construction spending are actually supplier jobs. Of the supplier jobs associated with a given level of spending in the overall construction sector, over a *quarter* come from the manufacturing sector.

In short, the toxics rule RIA, by not accounting fully for supplier jobs supported by spending on installation and construction of PAC equipment, could well be

undercounting jobs through this channel by almost 40%, and manufacturing jobs are some of the most significantly undercounted jobs. Counting the steel jobs alone does not nearly give one a good order of magnitude of the supplier jobs supported through the construction and installation of PAC equipment.

Conversely, there is one way in which the EPA may be slightly overcounting jobs supported: In the toxics rule technical supporting document, the EPA includes jobs used for pollution control operations *within the utility* sector as jobs gained in the environmental protection (EP) sector. However, it is likely that these effects are likely picked up in the "cost effect" and "factor-shift" estimates that are based on the Morgenstern et al. methodology—it is exactly the need to hire more (and more labor-intensive) inputs into production after a regulatory change that is meant to be picked up by the Morgenstern et al. estimates, so it is probably safest to not include these jobs in the totals for risk of double-counting.

A more complete number on PAC investments and jobs

The safest method to estimate the number of jobs (including both direct and supplier jobs) that are supported by a given amount of spending on PAC construction and installation is to use the BLS ERM and plug in the forecast amount of induced PAC investment as the input. This approach will be the preferred estimate used in this paper for identifying the overall job effects; this approach indicates a central estimate of 91,000 jobs (56,000 direct and 35,000 indirect) created through the $8 billion in PAC spending by 2015, at a per job cost of $87,000 (see column two, **Table 4**).

However, because the ERM construction category is a large aggregate—lumping together residential real estate improvements with civil engineering projects with the construction of air ventilation and purification equipment (an activity that is much more analogous to the PAC investments that will take place as a result of the toxics rule)—this paper does some probing with other data sources to make sure that this overall construction number is not a gross over- or underestimate of jobs likely to be created through PAC construction and installation.

Sensitivity check using information from the Census of Construction

One way that using the *overall* construction sector from the ERM may over- or understate jobs supported through PAC investments is if this overall construction sector is noticeably more or less labor intensive than that construction sub-sector that more tightly corresponds to the activities actually spurred by the toxics proposal. It should be noted, however, that any degree of over- or understatement gleaned from using one industry instead of another as the input vector in the ERM model is going to be small, certainly less than +/- 20% of total jobs created in the EP sector. This can be said with such confidence simply because there is not that much variation in the ERM model in terms of jobs supported through $1 million in final demand across all industries, and certainly not much variation across industries even remotely plausible as first-round inputs in EP activities.

If anything, it seems likely that the construction and installation of PAC equipment is more labor intensive than overall construction. The sub-sector most closely associated with PAC construction and installation is NAICS code 238220, *plumbing, heating, and air-conditioning contractors*. Data from the Census of Construction indicates that this sub-sector is significantly more labor intensive in terms of direct jobs relative to the overall sector average; it averages 7.5 jobs supported directly through each $1 million in value of shipments compared with 6.3 for the overall construction industry.[4] It should be noted that this is not directly comparable to the number of jobs supported by a given amount of final demand found in the BLS ERM—final demand does not include inventory accumulations and it removes intra-industry material purchases. That said, it should provide useful information for a simple ranking of labor intensity of construction sub-sectors.

If the 18% difference in labor intensity is applied to the overall number of direct jobs supported through $1 million in final demand provided by the BLS ERM, this would result in 8.2 jobs—not 7—directly supported through the construction and installation of PAC equipment.

However, the Census of Construction also indicates that this more relevant construction sub-sector has a

TABLE 4

Job impacts of PAC investments spurred by proposed toxics rule
($8 billion in total investments specified)

	Toxics rule RIA	ERM construction, overall[1]	Census of Construction, overall[2]	Census of Construction, NAICS code # 238220[3,4]	ERM, adjusted[5]
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Direct Jobs	30,870	55,618	50,720	59,600	65,356
Dollars per job	$259,151	$143,838	$157,729	$134,228	$122,407
Supplier jobs	430	35,458	29,788	41,210	30,494
Dollars per job	-	-	-	-	-
Total	31,300	91,076	80,508	100,810	95,850
Dollars per job	$255,591	$ 87,838	$99,369	$79,357	$83,464

(1) Results from using $8 billion in final demand for overall construction services, from BLS employment requirements matrix.
(2) Direct jobs per $1 million in final spending calculated directly from the Census of Construction; indirect jobs inferred by assuming supplier jobs are same proportion of total employment supported as valued-added is to value-of-shipments.
(3) Same method as used for overall construction taken from Census of Construction.
(4) Ventilation, heating, and air-conditioning equipment.
(5) Column (2) multiplied by the ratio of column (4) over column (3), adjusting the BLS ERM to reflect higher labor intensity in the construction sub-sector more relevant to PAC construction and installation (NAICS #238220).

SOURCE: EPA (2011a), author's calculations using the Bureau of Labor Statistics (BLS) Employment Requirements Matrix (ERM) and the Census of Construction (COC).

higher ratio of value-added to value of shipments, which indicates that this sector supports *fewer* indirect jobs than the overall construction industry: about 14% fewer, if the ratio of value-added to value of shipments is used as a barometer for this. So, instead of $1 million in final demand supporting 4 indirect jobs in supplier industries, it would instead only generate 3.3 jobs.[5]

Combining these two pieces of information—higher direct jobs created in this sub-sector and fewer indirect jobs—can give one a sense of which way to "assign the bias" in terms of using the overall construction sector from the ERM to get a number of jobs supported through the construction and installation of PAC equipment. Essentially, if one adjusted the overall ERM numbers with information from the Census of Construction, each $1 million in final demand in PAC investments would generate about 11.5 jobs rather than the 11 jobs indicated in the overall ERM. In short, it would seem that using the overall construction sector from the ERM provides a conservative measure of jobs supported through the increased demand for PAC investments.

Table 4 above sums up the estimates of what $8 billion spent in PAC construction and installation would imply for job gains in the environmental protection sector. Because (a) other publicly available sources that report job-multipliers, like the BLS ERM and the Census of construction, imply much larger employment effects of a given $1 in spending in the overall construction sector than what is implied in the toxics rule RIA, and (b) the more-relevant sub-sectors of construction are significantly more labor intensive than overall construction, and (c) the toxics rule RIA does not include intermediate jobs, the EPA's estimate of 31,000 jobs accounted for by PAC investments induced by the new standard seems to capture only about one-third of jobs created.

Is counting job gains stemming from compliance costs an example of the "broken window fallacy"?

Often in regulatory debates, one side will argue that job growth estimates that count jobs gained through business spending to meet new regulatory standards err due to the "broken window fallacy." This alleged fallacy is the notion that replacing a shopkeeper's window that has been broken by a stray baseball generates net new productive employment because the money is spent to replace the broken window. According to some, that notion is a fallacy because the money spent to replace the window would have been spent more productively elsewhere absent the break, and the foregone spending destroys jobs as surely as replacing the broken window creates them.

While the "broken window fallacy" is a useful reminder that each use of resources has opportunity costs that must be considered when making cost-benefit analyses, that does not mean that the jobs gained through investments made to meet regulatory standards never constitute net new additions to overall employment. There are essentially two ways that capital compliance costs can spur net new job growth.

First—and most relevant to today's debate—is if these compliance costs mobilize currently idle financial savings into productive investment flows. This seems extremely likely in today's economy. For one, U.S. corporations sit on massive amounts of liquid cash-holdings that are not being mobilized to finance job-creating investments. For another, the economic channel that is supposed to spur investment of these cash holdings is declining interest rates. But interest rates are already at historic lows and unlikely to be lowered through regulatory inaction that spurs noncompliance investments. In the jargon, the U.S. economy is in a liquidity trap that keeps savings from being channeled into job-creating investments. Regulatory changes that mobilize this financial savings will indeed create jobs in this economic situation.

Second, it is far from clear that the investments undertaken to meet new regulatory standards cannot add to total employment *even in a well-functioning economy and even if the financial resources that financed them would have been spent elsewhere.* For example, if the construction and installation of PAC equipment is significantly more labor intensive than other economic activities spurred by the same amount of spending, then even just switching from these other activities to PAC investments would increase labor demand. This scenario also seems quite likely, especially given likely alternative uses of these investment dollars.

Remember, the economic mechanism that channels financial savings into productive investments is interest rate changes. Under a well-functioning economy, the $8 billion that utilities save by not spending on PAC construction and installation flows into alternative job-creating investments through the lowering of interest rates. This means that the alternative job-creating investments will take place in *interest-sensitive* industries, which are essentially construction (like PAC investments) or durable goods manufacturing. Thus it is far from obvious that investing this $8 billion in non-PAC construction, or durable goods (some of the least labor-intensive production in the entire economy) would lead to more jobs that investing in the typically labor-intensive PAC industry.

Given the large amounts of excess capacity and the failure of interest rates to mediate the savings and investments relationships in the U.S. economy today, it seems very likely that the investments mobilized through the need to meet the new proposed standards would represent a nearly pure net new addition to economy-wide employment. And even if these investments happened in an already well-functioning economy, there is still little reason to believe that they would be anything but a plus for job creation.

It should be noted that this macroeconomic reasoning carries through to the utilities sector as well. Even if the utilities sector had concrete plans to spend the $8 billion on some other investment project, today's historically low interest rates mean that they are free to do both at minimal cost. Furthermore, it is hard to imagine that the utilities sector—which due to its significant infrastructure needs, tends to carry a high debt load and benefit greatly from low interest rates—is currently more cash-constrained than the overall corporate sector today.

Impact on energy-using industries

While the toxics rule RIA likely undercounted the number of jobs supported through investments in the EP sector, it also undercounted the possible job displacements occurring in energy-using industries that see demand falling for their output as costs of production (and hence final prices) rise.

The RIA estimated that the new toxics standards would raise prices of electricity by 3.7% and overall energy prices by 0.8%. To estimate the effect on demand for industrial output (and then employment) in energy-using sectors, one only needs an estimate of each industry's energy intensity (the share of energy costs in total production costs) and an estimate of the elasticity of demand for final output. As energy prices rise, one can assume that overall costs in a sector rise in proportion to energy's share of total costs. Then, the increase in total costs can be multiplied by the elasticity of demand for final output to yield the output losses in each industry stemming from rising energy prices.

One can assume that in the very short run, when other factors of production besides labor are unable to adjust to the output decline, employment falls in proportion to declines in output (an assumption also used by Ho, Morgenstern and Shih, 2008, in their study of how rising energy prices may affect U.S. industries).

Furthermore, besides the direct impact of reduced employment in these sectors as demand falls, supplier jobs depending on final demand within particular industries will fall as well. For each industry, we use data from the BLS ERM to calculate the number of supplier jobs associated with a given amount of final demand within a sector to get a number of direct plus supplier jobs that are displaced as demand falls due to rising energy prices.

The Ho et al. study referenced above provides both data points needed to make this calculation. It is a little unclear whether to use the parameter for total energy price increases (0.8%) or electricity-only (3.7%) to calculate the output effects of rising prices. If one assumes that it is relatively easy to change energy sources for an energy-intensive industry, even in the very short run, then overall energy prices should be used. If one does not assume this, then the larger electricity price increases should be used. Doing it both ways, this study finds that the total job loss stemming from lost output in energy-using industries is 31,000 using the overall energy price increase and 46,000 using the electricity-only price increases.

It is important to realize, however, that much of the discussion regarding economic counterfactuals that informed our estimates of jobs gained through PAC construction and installation (i.e., concerns over the "broken window fallacy") apply to the jobs displaced by rising energy prices, but in reverse. This means that while demand for industrial output falls as the price of this output rises in response to rising energy prices, in the longer run and in a better-functioning economy, much of this decline in demand can (and would) be neutralized by using other macroeconomic policy tools: lowering policy interest rates to spur business investment, for example. In short, if one decided that it was utterly inappropriate to look at short-run employment gains that might be counterbalanced by larger macroeconomic policy levers, then it must also be inappropriate to examine short-run employment losses that could also be so counterbalanced.

Impact stemming from re-spending effects of net job impacts from other channels

In the short run in an economy characterized by excess capacity, if the previous channels all sum to a net job gain stemming from the implementation of the proposed toxics rule, then these extra jobs should be multiplied by the "re-spending" effects of newly employed workers to get a total jobs impact.

The intuition is simply that construction workers newly hired to install PAC equipment and manufacturing workers newly hired to produce the intermediate inputs for this construction will have extra income, a portion of which they will spend. This additional spending in the economy will support production (and jobs) in sectors of the economy wholly unrelated to the activities associated with conforming to the toxics rule. For example, waitstaff will be hired by diners that are serving more lunches because more of the newly hired construction workers come through the door, and clerks will be hired by retail clothing stores that will sell more back-to-school clothes to newly hired manufacturing workers who are parents.

These re-spending effects are likely to be particularly large in the present economic moment, when the U.S.

economy is characterized by a severe shortfall of aggregate demand for goods and services relative to what is needed to ensure low rates of unemployment.

Of course, if the combined job impacts of the previous channels sum to less than zero, then the negative shock to employment would also be amplified by the re-spending effects (wait-staff would be laid off as diners served fewer lunches because workers in energy-using industries lost their jobs and these effects dominated others).

The estimates of re-spending effects (or, "re-spending multipliers") stemming from job creation are rather varied. Bivens (2003) uses an estimate of 0.5, noting that the literature provides estimates of the re-spending multiplier that run from 0.25 to 1.7. Given that there's very little objective criteria to judge what is the best value within this range, the re-spending effects are presented spanning the full range of these estimates, with 0.5 being the preferred estimate. With this estimate, and using the midpoint of estimates of job changes from each of the other channels, re-spending effects will add 31,000 jobs stemming from adoption of the proposed toxics rule.

Again, in the longer run and in a better-functioning economy, the boost or decline to aggregate demand stemming from these re-spending multipliers can and will be offset with other macroeconomic policy tools. But in today's economy, characterized by lots of excess capacity, these re-spending effects will be powerful indeed.

Table 5 below sums the effects from the previously mentioned channels, being careful to not double count any effects. It then applies various re-spending multipliers to the results to get a final number on job creation stemming from the proposed toxics rule.

The effects of the proposed rule on employment are not particularly large in any of the columns. Even the largest job gain (284,000) is basically the same magnitude as the forecast job gain over any given month-and-a-half over the next couple of years. What is extremely important to note is that *none* of the columns sum to a number below zero—the extra investments induced by the need to undertake PAC investment swamp the job effects seen in energy-using industries.

This finding should not be a shock—the increases in energy prices driven by the proposed new standards are quite modest and energy has a relatively small (and falling) share in total costs in most industries in the U.S. economy.

TABLE 5

Employment effects from each channel

Channel	Jobs (high)	Jobs (low)	Jobs (average)
Directly regulated utility effects, MPS approach	35,000	-17,000	9,000
Effects from investments in EP sector, direct + supplier jobs	101,000	81,000	91,000
Effects from output changes in energy-using sectors	-31,000	-45,600	-38,300
Subtotals	105,000	18,400	61,700
Re-spending effects channel			
Re-spending multiplier = 0.25	26,250	4,600	15,425
Re-spending multiplier = 0.5	52,500	9,200	30,850
Re-spending multiplier = 1.7	178,500	31,280	104,890
Totals			
Re-spending multiplier = 0.25	131,250	23,000	77,125
Re-spending multiplier = 0.5	157,500	27,600	92,550
Re-spending multiplier = 1.7	283,500	49,680	166,590

SOURCE: EPA (2011a), author's calculations using data from the BLS ERM and HMS (2008), as described in text.

TABLE 6

Employment change by industry under toxics rule

Industry	Jobs	% of employment
Agriculture, forestry, fishing, hunting	92	0.00%
Mining	257	0.04
Utilities	8,205	1.48
Construction	58,410	0.61
Non-durable manufacturing	-553	-0.02
Durable manufacturing	-3,143	-0.08
Industrial supplies manufacturing	-691	-0.01
Wholesale trade	2,747	0.04
Retail trade	5,894	0.04
Transportation and warehousing	486	0.01
Information	994	0.03
Finance and insurance	2,234	0.03
Real estate, rental, leasing	785	0.03
Professional, scientific, technical services	5,796	0.07
Management of companies	840	0.04
Administrative and support and waste management	4,396	0.05
Educational services	219	0.01
Health care and social assistance	698	0.00
Arts, entertainment, and recreation	331	0.01
Accommodation and food services	1,073	0.07
Other services (except public administration)	1,656	0.01
Public administration	1,827	0.01
Total	**92,550**	**0.06%**

SOURCE: Author's calculations using data from Ho et al. (2008) and EPA (2011a).

Employment changes by industry

The information on employment changes can also be examined by industry to see if there are any particular industries that benefit or need assistance in adapting to the toxics rule. **Table 6** shows net employment change by industry, aggregated to the two-digit NAICS (North American Industry Classification System) level. It uses the average values from the last column of Table 5 and assumes a re-spending multiplier of 0.5.

The employment changes stemming from rising energy prices and from PAC construction and installation fall directly out of their estimation—both estimates are done by allocating either price changes or investment demands to particular industries to see the employment response. The level of industry aggregation is different, but it is straightforward to map the more-aggregated industry responses to energy price changes to the more-detailed industries contained in the BLS ERM. Re-spending effects are calculated for each industry simply in proportion to the current employment shares in the U.S. economy.

The essential findings are that employment changes are vanishingly small for each industry except utilities and construction, where these changes are still quite modest. Net employment changes are under 0.1% in each industry except utilities and construction, and changes in these industries are +1.48% and +0.61%, respectively.

TABLE 7

Characteristics of jobs created under toxics rule

	Jobs stemming from toxics rule			
	(thousands) (A)	(% of total) (B)	% of Economy-wide jobs (C)	Ratio (B/C)
Gender				
Male	72.1	78.9%	60.0%	1.3
Female	19.2	21.1	40.0	0.5
Race/ethnicity				
White	60.8	66.5%	67.0%	1.0
Black	6.3	6.9	11.0	0.6
Hispanic	20.5	22.5	15.0	1.5
Asian	2.1	2.3	4.0	0.6
Other	1.6	1.8	2.0	0.9
Union status				
Covered	11.6	12.7%	12.0%	1.1
Non-covered	79.7	87.3	88.0	1.0
Education				
Less than high school	17.1	18.7%	11.0%	1.7
High school only	34.1	37.3	31.0	1.2
Some college	24.4	26.7	30.0	0.9
BA or greater	15.7	17.2	28.0	0.6
Wage quintiles				
First (lowest)	13.7	15.0%	20.0%	0.8
Second	19.4	21.2	20.0	1.1
Third	20.1	22.0	20.0	1.1
Fourth	20.3	22.2	20.0	1.1
Fifth (highest)	17.9	19.5	20.0	1.0
Totals	92.6	100.0%	100.0%	-

SOURCE: Author's calculations as described in text.

Given this pattern of industry employment changes, one can also estimate what these employment shifts imply for the characteristics of jobs that are created. **Table 7** above shows these job characteristics. Because the overall job changes are dominated by the construction industry, this industry's job characteristics tend to dominate the total.

What this means in practice is that, overall, the jobs created by the toxics rule are heavily male, heavily Latino, heavily concentrated in industries with fewer-than-average four-year college graduates, and disproportionately bunched in the middle of the wage distribution, generating significantly fewer low-wage but slightly fewer high-wage jobs as well.

Conclusion

The EPA RIA on the proposed toxics rule makes a compelling case that the rule passes any reasonable cost-benefit analysis with flying colors—the monetized benefits of longer lives, better health, and greater productivity dwarf the projected costs of compliance.

However, the political debate over regulations tends to ignore the overall benefits and be narrowed down to the jobs impact. It is understandable that there is attention to jobs as they are always a concern and as the concern for jobs is certainly heightened by the current jobs crisis. Whether regulation in general and the toxics rule in particular costs jobs is an empirical question this paper attempts to answer. In particular, this paper examines the possible channels through which the proposed toxics rule could affect employment in the United States and finds that claims that this regulation destroys jobs are flat wrong: The jobs-impact of the rule will be modest, but it will be *positive*.

The claims of this paper are conservative—the toxics rule is not a jobs program. Instead, it is a regulatory change that generates great benefits at moderate costs and, along the way, will likely create a relatively modest number of jobs.

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Endnotes

1. In the EPA RIA these numbers are expressed in 2007 dollars – the monetized benefits in those units are between $53 and $140 billion while the costs are $10.9 billion.
2. Another parameter that determines how large the cost-effect will be is the amount of complementarity between environmental and conventional production within an industry. If money spent in environmental activities actually manages to reduce conventional production costs through economies of scope, then the cost-effect will be reduced. Morgenstern, Pizer, and Shih (1998) find that there was not a statistically significant effect of complementarity across 11 U.S. industries studied, nor were there statistically significant differences in this estimated complementarity across industries. Given this, it seems hard to argue that the utility sector would be an outlier away from the Morgenstern et al. (2002) effects on the basis of greater complementarity between environmental and conventional production.
3. While there are portions of the social costs identified in the RIA that are indeed purely foregone economic activity, costs dedicated to purchase of PAC equipment are not part of them.
4. The overall construction number is calculated by weighting each sub-sector's labor intensity (jobs supported by $1 million in final demand) by the share of construction-wide final demand spent within the sub-sector.
5. To be sure that the supplier jobs supported by the construction and installation of PAC investment are not over-counted stemming from their labor intensity, the manufacturing industry that is the source of manufactured inputs into PAC construction and installation in the ERM – industry #74, or *ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing* – was compared with other sectors. This is a more labor-intensive than average manufacturing industry, so it seems unlikely that PAC investments would create fewer supplier jobs through this channel.

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