The Economic Impact of Proposed EPA Boiler/Process Heater MACT Rule on Industrial, Commercial, and Institutional Boiler and Process Heater Operators

GLOBAL INSIGHT

Prepared For:

Council of Industrial Boiler Owners

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A B O U T I H S G L O B A L I N S IG H T

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F O R M O R E I N F O R M A T I O N

Richard Fullenbaum
(202) 481-9212
richard.fullenbaum@ihsglobalinsight.com

Brendan O'Neil
(202) 481-9239
brendan.oneil@ihsglobalinsight.com

IHS Global Insight
1150 Connecticut Avenue NW
Suite 200
Washington, DC 20036

Executive Summary

Every billion dollars spent on MACT upgrade and compliance costs will put 16,000 jobs at risk and reduce US GDP by as much as $1.2 billion.

In June 2010, the Environmental Protection Agency (EPA) proposed new Maximum Achievable Control Technology (MACT) standards for industrial boilers and process heaters, which would impose stringent emission limits and monitoring requirements for eleven subcategories of boilers and process heaters, based on fuel type and unit design. These standards, which are intended to address hazardous air pollutant (HAP) emissions, would impose tight limits on five HAP/"surrogate" pollutants:

- Mercury (Hg),
- Hydrogen Chloride (HCl),
- Particulate Matter (PM),
- Carbon monoxide (CO), and
- Dioxins/Furans (D/F).

EPA contends that implementing the proposed MACT standards for these five pollutants will minimize emissions of all HAPs. Under the proposed rule, sources (boilers and process heaters) 10 MMBtu/hr and greater will be required to comply with numerical emission limits for PM, HCl, Hg, CO, and dioxin/furan. Sources 100 MMBtu/hr and greater will be required to install CO CEMS and sources 250 MMBtu/hr and greater that fire solid fuels or residual fuel oil will be required to install PM CEMS. Compliance with the other emission limits would be determined through fuel analyses, performance tests, and parametric monitoring.

The Council of Industrial Boiler Operators (CIBO) believes its members may be subject to significant economic hardship should the proposed EPA rules regulating boiler emissions be adopted. Potential consequences include the shuttering of domestic manufacturing capacity – and the associated jobs loses -- for those CIBO members that find the capital costs associated with compliance via plant retrofitting make it economically unfeasible to continue operations.

CIBO commissioned IHS Global Insight to conduct a study to quantify the economic impact of compliance by all affected sources to the proposed standards under three scenarios.

- **Scenario 1:** The impact of upgrade costs for all proposed standards
- **Scenario 2:** The impact of the HCl upgrade costs only
- **Scenario 3:** The impact of upgrading Gas 1 units to comply with all of the potential standards described by EPA in the proposed rule Preamble if they were to impose emission limits instead of the proposed work practice standard approach

This report presents the results of IHS Global Insight's assessment of the economic impact of compliance to the MACT standards for all affected boiler and process heater owners. For each of the three scenarios, we utilized a methodology that determined the direct (vendor- or regulated entity in this case), indirect (supplier) and induced (wage) impact of the MACT standards on five primary areas of economic activity:

- **Employment:** the number of jobs potentially "at risk" of being eliminated as a consequence of compliance with the standards;
- **Labor Income:** The employee compensation potentially forfeited due to compliance to the new standards;
- **Value Added:** The economic contribution to the US Gross Domestic Product that could be affected by implementing the standards;
- **Industry Output:** The industry sales lost as CIBO members either shutter plants or attempt to pass the costs on to their customers.
- **Tax Implications:** the potential loss of federal as well as state and local tax receipts.

This report presents the detailed findings of the study, which are summarized in the table below. Across all three scenarios we found that, ***every $1B spent on upgrade and compliance costs will put 16,000 jobs at risk and reduce US GDP by as much as $1.2B.*** A significant portion of this economic pain will be felt in supplier networks.

Potential Total Economic Impact			
	Scenario 1	Scenario 2	Scenario 3
Employment	**337,703**	**152,552**	**798,250**
Labor Income	**$15.2B**	**$6.9B**	**$38.0B**
Value Added	**$25.2B**	**$11.4B**	**$63.3B**
Output	**$67.4B**	**$30.4B**	**$172.5B**
Taxes	**$5.7B**	**$2.6B**	**$14.3B**

Source: Results generated by IHS Global Insight from IMPLAN model

Introduction

In June 2010, the Environmental Protection Agency (EPA) proposed new Maximum Achievable Control Technology (MACT) standards for industrial boilers and process heaters, which would impose stringent emission limits and monitoring requirements for eleven subcategories of boilers, based on fuel type and unit design. These standards, which are intended to address hazardous air pollutant (HAP) emissions, would impose tight limits on five HAP/"surrogate" pollutants:

- Mercury (Hg),
- Hydrogen Chloride (HCl),
- Particulate Matter (PM),
- Carbon monoxide (CO), and
- Dioxins/Furans (D/F).

The proposed limits, by source-type are detailed in the following table.

EMISSION LIMITS FOR BOILERS AND PROCESS HEATERS

	Particulate matter (PM)[1]	Hydrogen chloride (HCl)[1]	Mercury (Hg)[1]	Carbon monoxide (CO)[2]	Dioxins/ furans (total TEQ)[3]
Existing					
Coal Stoker	.02	.02	.000003	50	.003
Coal Fluidized Bed	.02	.02	.000003	30	.002
Pulverized Coal	.02	.02	.000003	90	.004
Biomass Stoker	.02	.006	.0000009	560	.004
Biomass Fluidized Bed	.02	.006	.0000009	250	.02
Biomass Suspension	.02	.006	.0000009	1010	.03
Biomass Fuel Cells	.02	.006	.0000009	270	.02
Liquid	.004	.0009	.000004	1	.002
Gas (Other Process Gases)	.05	.000003	.0000002	1	.009
New					
Coal Stoker	.001	.00006	.000002	7	.003
Coal Fluidized Bed	.001	.00006	.000002	30	.00003
Pulverized Coal	.001	.00006	.000002	90	.002
Biomass Stoker	.008	.004	.0000002	560	.00005
Biomass Fluidized Bed	.008	.004	.0000002	40	.007
Biomass Suspension	.008	.004	.0000002	1010	.03
Biomass Fuel Cells	.008	.004	.0000002	270	.0005
Liquid	.002	.0004	.0000003	1	.002
Gas (Other Process Gases)	.003	.000003	.0000002	1	.009

[1] Pounds per million British Thermal Units (BTUs)
[2] (ppm @3% oxygen)
[3] (ng/dscm @7% oxygen)
Source: EPA

EPA contends that implementing the proposed MACT standards for these five pollutants will minimize emissions of all HAPs. Sources (boilers and process heaters) with heat input greater than or equal to 100 MMBtu/hr would be required to install continuous emission monitors for CO and coal, biomass, or residual oil fired boilers and process heaters with heat input greater than or equal to 250 MMBtu/hr would be required to install continuous emission monitors for PM in order to demonstrate compliance with the corresponding limits. Compliance with the other emission limits would be determined through fuel analyses, performance tests, and parametric monitoring.

The Council of Industrial Boiler Operators (CIBO) is the trade association representing the interests of non-utility energy producers and users in the United States. As such, CIBO's membership represents a diverse set of major manufacturing industries that use industrial boilers and process heaters and related technologies. CIBO believes its members may be subject to significant economic hardship should the proposed EPA rules regulating boiler and process heater emissions be adopted. Potential consequences include the shuttering of domestic manufacturing capacity – and the associated jobs loses -- for those CIBO members that find the capital costs associated with compliance via plant retrofitting make it economically unfeasible to continue operations.

CIBO commissioned IHS Global Insight to conduct a study to quantify the economic impact of compliance by all affected sources to the proposed standards under three scenarios. The study, which focused on upgrade costs only, did not include on-going operations and maintenance costs companies would incur in subsequent years.

- **Scenario 1:** The impact of upgrade costs for all proposed standards
- **Scenario 2:** The impact of the HCl upgrade costs only
- **Scenario 3:** The impact of upgrading Gas 1 units to comply with all of the potential standards described by EPA in the proposed rule Preamble if they were to impose emission limits instead of the proposed work practice standard approach

IHS Global Insight utilized a methodology that determined the impact of the MACT standards on five primary areas of economic activity:

- **Employment:** the number of jobs potentially "at risk" of being eliminated as a consequence of compliance with the standards;
- **Labor Income:** The employee compensation potentially forfeited due to compliance to the new standards;
- **Value Added:** The economic contribution to the US Gross Domestic Product that could be affected by implementing the standards;
- **Industry Output:** The industry sales lost as affected sources either shutter plants or attempt to pass the costs on to their customers.
- **Tax Implications:** the potential lose of federal as well as state and local tax receipts.

Because any change to the economic conditions of a given industry sector or commercial/institutional entity can have far-reaching consequences on other industries and entities and the overall economy, IHS Global Insight's analyses captured the economic impact on three levels. The first quantifies the impact on those facilities that will bear the direct costs of

upgrading their boilers and process heaters to comply with the standards (***direct impact***). The second level measures the impact on the supply chains of the direct industries (***indirect impact***). The third level assesses the impact on economic activity attributable to spending by employees of the direct and indirect industries (***induced impact***). These classes of economic impact are discussed in-depth in the following section and in Appendix B.

The total economic impact (direct + indirect + induced) for each of the scenarios is shown in the table below. Across all three scenarios we found that, ***every $1B spent on upgrade and compliance costs will put 16,000 jobs at risk and reduce US GDP by as much as $1.2B.*** A significant portion of this economic pain will be felt in supplier networks.

Summary of Potential Total Economic Impact

	Scenario 1	Scenario 2	Scenario 3
Employment	**337,702**	**152,553**	**798,250**
Labor Income	**$15.2B**	**$6.9B**	**$38.0B**
Value Added	**$25.2B**	**$11.4B**	**$63.3B**
Output	**$67.4B**	**$30.4B**	**$172.5B**
Taxes	**$5.7B**	**$2.6B**	**$14.3B**

Source: Results generated by IHS Global Insight from IMPLAN model

APPROACH

Changes to business operating climates, regulatory or policy environments, or capital project priorities affect economic activity. The total economic impact of these changes is separated into three distinct parts: direct, indirect, and induced. The direct impacts measure the degree to which economic activities are altered within those industries directly affected by the changes. The indirect impact represents the corresponding effects on suppliers to the direct sectors. This would include, for example, steel tube suppliers to a drill operator. The induced impact adds the effect of spending from wage and other income derived from the direct and indirect sectors.

In assessing the economic impact of the EPA rule changes on the US economy, IHS Global Insight assumed that the upgrade costs borne by each industry due to the regulations result in a corresponding and equal loss in potential output. An increase in capital costs, impacting specific facilities across a broad range of industries, will likely be managed in a variety of ways by those directly affected. The impacted companies could choose outside financing, or finance it through cash reserves/ profits, pass the cost along to their customers, or decide to avoid the upgrade costs and cease operations. Because of this, the methodology of treating the upgrade costs as a corresponding and equal loss in potential output is a direct and standard methodology to examine such a situation that provides clarity to the process and consistency across industries.

Building off a boiler and process heater inventory database provided by CIBO[1], we were able to estimate the following upgrade costs by industry sector.

- **Scenario 1:** The upgrade costs for all proposed standards totaled $20.7B
- **Scenario 2:** The HCl-only upgrade costs summed to $9.3B
- **Scenario 3:** The costs of upgrading Gas 1 units were estimated at $51.7B

These industry-level capital costs served as primary inputs to the IMPLAN[2] modeling framework, which was used to quantify the economic impact (employment, labor income, value added, output, and tax receipts) along the following dimensions:

- **Direct Impact:** The impact on economic activity in the facilities that must incur the costs of implementing the required boiler upgrades. Leveraging the boiler and process heater inventory database, we determined the cross-industry distribution of the capital costs required to implement the proposed changes. For each affected sector, these capital expenditures were assumed to result in corresponding and equal decreases in output.

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[1] The boiler inventory database used in this study based on work by URS Corporation that was commissioned by CIBO, based on EPA'a major source boiler inventory database table. Please see Appendix A for an overview of the methodology used to determine the upgrade and compliance costs.

[2] IHS Global Insight used the IMPLAN model for the entire US economy to quantify the economic impact of the proposed EPA rule changes. The IMPLAN model closely follows the accounting conventions used in the U.S. Department of Commerce Bureau of Economic Analysis (BEA)'s definitive 1980 study, Input-Output Study of the U.S. Economy, and is flexible enough to evaluate the change via the value of output or employment from the source industry. (Additional details related to this modeling approach are presented in Appendix B).

- **Indirect Impact:** The impact in those industries that supply the direct industries.
- **Induced Impact:** The impact attributable to spending by employees of the direct and indirect industries in the general economy.
- **Total Impact:** The sum of the direct, indirect and induced impacts.

The results of the simulation for each scenario are presented in the following three sections.

Results: Scenario 1

In Scenario 1, IHS Global Insight assessed the economic impact of the capital costs required to upgrade boilers and process heaters to comply with the EPA proposed rule for all five pollutant categories.

Using the boiler/process heater inventory database, the capital costs for the upgrades were determined to total $20.7B, distributed across 24 industry subsectors[3]. The upgrade expenditures were subtracted from the output of each subsector and used as inputs to the IMPLAN model.

The results of the Scenario 1 analysis are summarized in the table below. Incurring the capital costs of compliance will put 338,000 jobs potentially at risk, of which nearly 70,000 are directly tied to the affected industries/facilities. This does not mean that all of the "at risk" jobs will be eliminated. Some larger organizations will absorb the costs with minimal changes to employment levels; however they will likely pass both the compliance and on-going operating and maintenance costs downstream to their customers or absorb a hit to their profitability and therefore pass that cost along to their shareholders. Smaller or marginally-profitable firms, on the other hand, may be faced with either reducing staff or shutting down operations.

Summary of Economic Impact of Scenario 1

	Direct	Indirect	Induced	Total
Employment	**69,934**	**157,824**	**109,944**	**337,702**
Labor Income	**$3.6B**	**$6.4B**	**$5.2B**	**$15.2B**
Value Added	**$4.4B**	**$11.7B**	**$9.1B**	**$25.2B**
Output	**$20.7B**	**$29.5B**	**$17.2B**	**$67.4B**
Taxes				**$5.7B**

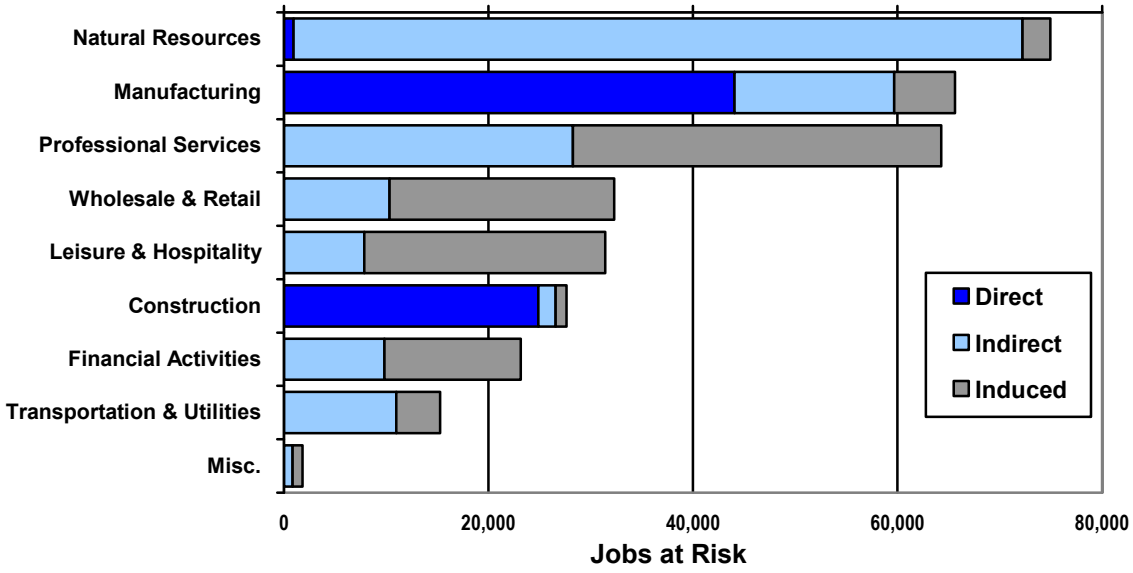
Source: Results generated by IHS Global Insight from IMPLAN model

As shown below, the 24 industry subsectors that will incur capital costs of $20.7B aggregate under three industry supersectors: construction, manufacturing and natural resources (mining, farming, etc). However, as shown in the charts on the following pages, the indirect and induced impacts will be felt in other supersectors, such as professional services.

[3] The relationship between IMPLAN industry sectors and NAICS categories is explained further in Appendix B.

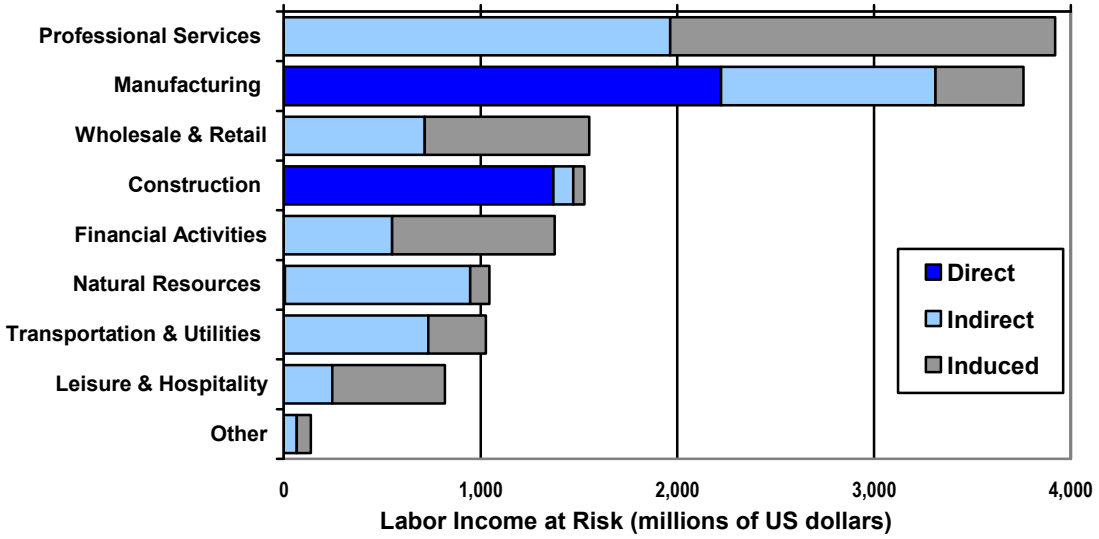
Industry Supersector	Capital Costs (millions of dollars)
Construction	$3,718
Manufacturing	$16,951
Natural Resources	$65
Total	$20,734

Impact on Employment by Industry Super-Sector, Scenario 1



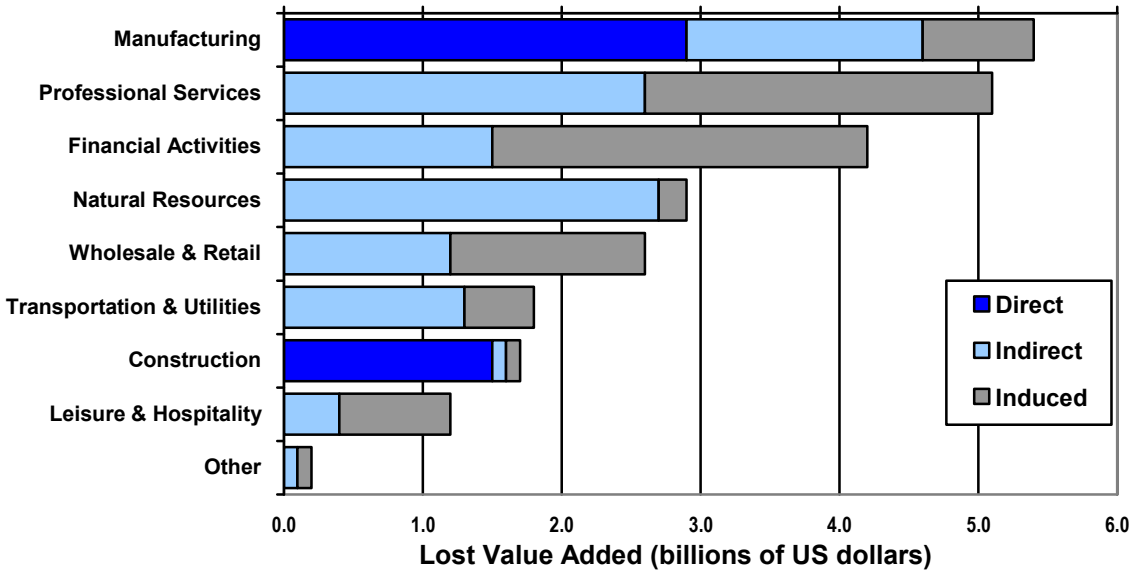
Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Labor Income by Industry Super-Sector, Scenario 1



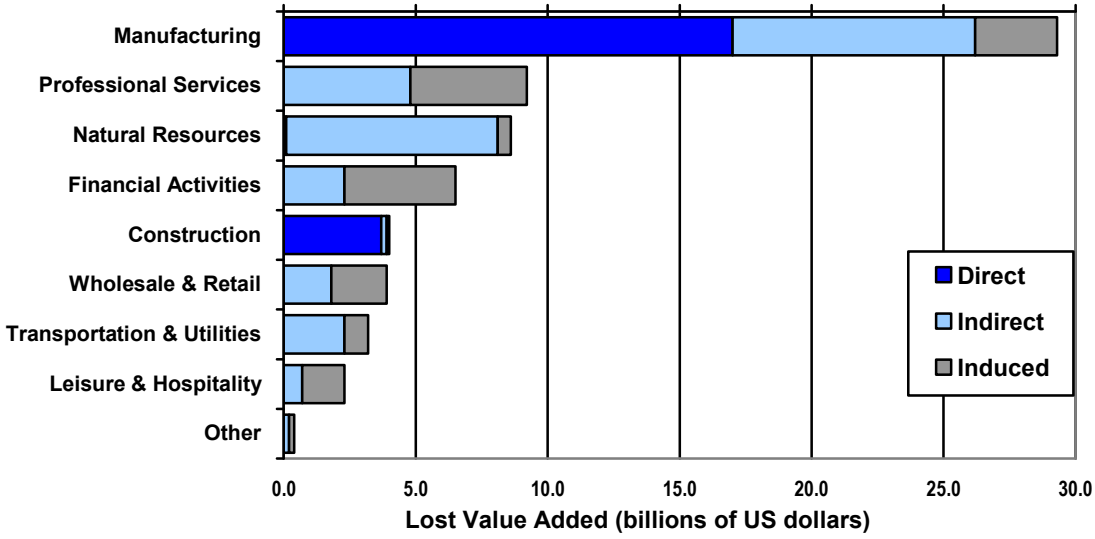
Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Value Added by Industry Super-Sector, Scenario 1



Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Output by Industry Super-Sector, Scenario 1



Source: Results generated by IHS Global Insight from IMPLAN model

In reviewing the summary tables shown above, the significance of the downstream effects becomes clear. For a sector like Natural Resources, the direct effect of the regulations is relatively small, but the employment impact on this industry as a supplier to the Manufacturing and Construction sectors is extremely significant. Additionally, the employment impact on the professional services sector is also significant, but even more so is the labor income impact on this sector, which highlights the fact that the jobs in this particular sector are high paying and high value jobs which might not normally come into focus when assessing the impact of standards such as these.

Detailed Economic Impact of Scenario 1

	Direct	Indirect	Induced	Total
Jobs at Risk	**69,934**	**157,824**	**109,944**	**337,702**
Construction	24,879	1,683	1,075	27,637
Financial Activities	-	9,855	13,295	23,149
Professional Services	-	28,251	36,039	64,290
Leisure & Hospitality	-	7,889	23,554	31,443
Manufacturing	44,072	15,621	5,947	65,640
Natural Resources	983	72,291	2,835	76,109
Transportation & Utilities	-	11,005	4,275	15,280
Wholesale & Retail	-	10,343	21,963	32,306
Other	-	887	962	1,849
Labor Income (US$M)	**3,599.7**	**6,427.7**	**5,157.4**	**15,184.8**
Construction	1,372.2	100.4	57.1	1,529.7
Financial Activities	-	551.5	827.1	1,378.6
Professional Services	-	1,964.7	1,955.0	3,919.7
Leisure & Hospitality	-	246.6	571.5	818.2
Manufacturing	2,221.8	1,090.9	446.7	3,759.3
Natural Resources	5.6	956.1	99.9	1,061.7
Transportation & Utilities	-	734.3	292.0	1,026.3
Wholesale & Retail	-	716.5	837.0	1,553.5
Other	-	66.7	71.1	137.7
Value Added (US$M)	**4,425.0**	**11,579.6**	**9,124.6**	**25,129.2**
Construction	1,458.6	106.2	69.7	1,634.5
Financial Activities	-	1,507.6	2,723.8	4,231.4
Professional Services	-	2,645.2	2,504.8	5,150.1
Leisure & Hospitality	-	371.1	821.4	1,192.5
Manufacturing	2,937.7	1,660.7	752.7	5,351.0
Natural Resources	28.7	2,726.8	247.4	3,003.0
Transportation & Utilities	-	1,327.2	533.1	1,860.3
Wholesale & Retail	-	1,227.6	1,400.3	2,627.8
Other	-	79.0	79.6	158.6
Industry Output (US$M)	**20,734.1**	**29,520.3**	**17,174.6**	**67,428.9**
Construction	3,718.3	192.6	119.3	4,030.1
Financial Activities	-	2,287.2	4,182.8	6,470.0
Professional Services	-	4,803.1	4,424.5	9,227.6
Leisure & Hospitality	-	666.8	1,618.5	2,285.3
Manufacturing	16,951.1	9,172.5	3,145.4	29,269.0
Natural Resources	64.6	8,026.4	510.4	8,601.4
Transportation & Utilities	-	2,299.9	862.4	3,162.3
Wholesale & Retail	-	1,828.0	2,078.0	3,906.1
Other	-	243.7	233.4	477.1

Source: Results generated by IHS Global Insight from IMPLAN model

Results: Scenario 2:

In Scenario 2, IHS Global Insight performed a similar assessment to that done in Scenario 1, but narrowed the focus to analyze the impact of only the HCl standard costs. This was done to provide a maximum potential impact assessment of the value of implementing a compliance flexibility provision such as a health based alternative under CAA §112(d)(4) instead of the proposed HCl emission limits.

Using the boiler/process heater inventory database, the capital costs for the HCl controls were determined to total $9.3B, distributed across 24 industry subsectors[4]. The controls expenditures were subtracted from the output of each subsector and used as inputs to the IMPLAN model.

The results of the Scenario 2 analysis are summarized in the table below. Incurring the capital costs of compliance will over 152,000 jobs potentially at risk, of which over 31,000 are directly tied to the affected industries/facilities. This does not mean that all of the "at risk" jobs will be eliminated. Some larger organizations will absorb the costs with minimal changes to employment levels; however they will likely pass the both the compliance and on-going maintenance costs downstream to their customers or absorb a hit to their profitability and therefore pass that cost along to their shareholders. Smaller or marginally-profitable firms, on the other hand, may be faced with either reducing staff or shutting down operations.

Summary of Economic Impact of Scenario 2

	Direct	Indirect	Induced	Total
Employment	**31,639**	**71,246**	**49,668**	**152,552**
Labor Income	**$1.6B**	**$2.9B**	**$2.3B**	**$6.9B**
Value Added	**$2.0B**	**$5.2B**	**$4.1B**	**$11.4B**
Output	**$9.3B**	**$13.3B**	**$7.8B**	**$30.4B**
Taxes				**$2.6B**

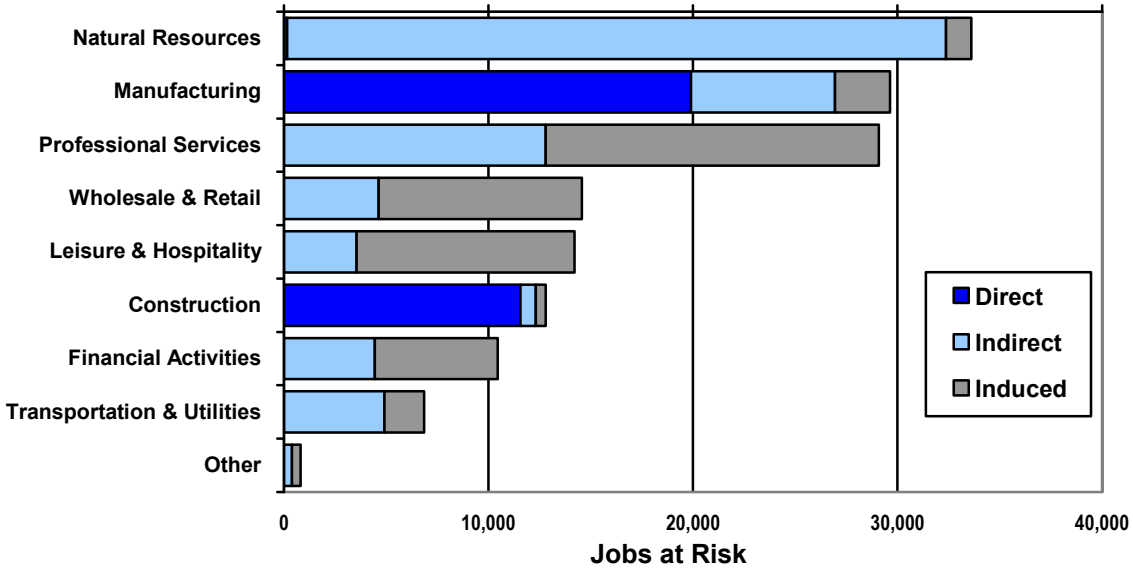
Source: Results generated by IHS Global Insight from IMPLAN model

As shown below, the 24 industry subsectors that will incur capital costs of $9.3B aggregate under three industry supersectors: construction, manufacturing and natural resources. However, as shown in the charts on the following pages, the indirect and induced impacts will be felt in other supersectors, such as professional services.

[4] The relationship between IMPLAN industry sectors and NAICS categories is explained further in Appendix B.

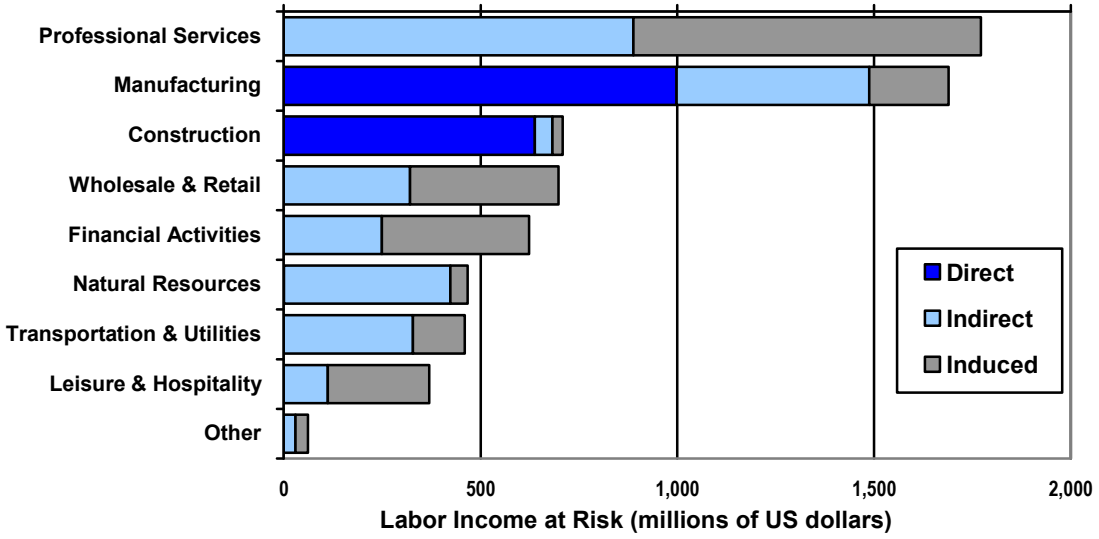
Industry Supersector	Capital Costs (millions of dollars)
Construction	$1,727
Manufacturing	$7,571
Natural Resources	$15
Total	$9,313

Impact on Employment by Industry Super-Sector, Scenario 2



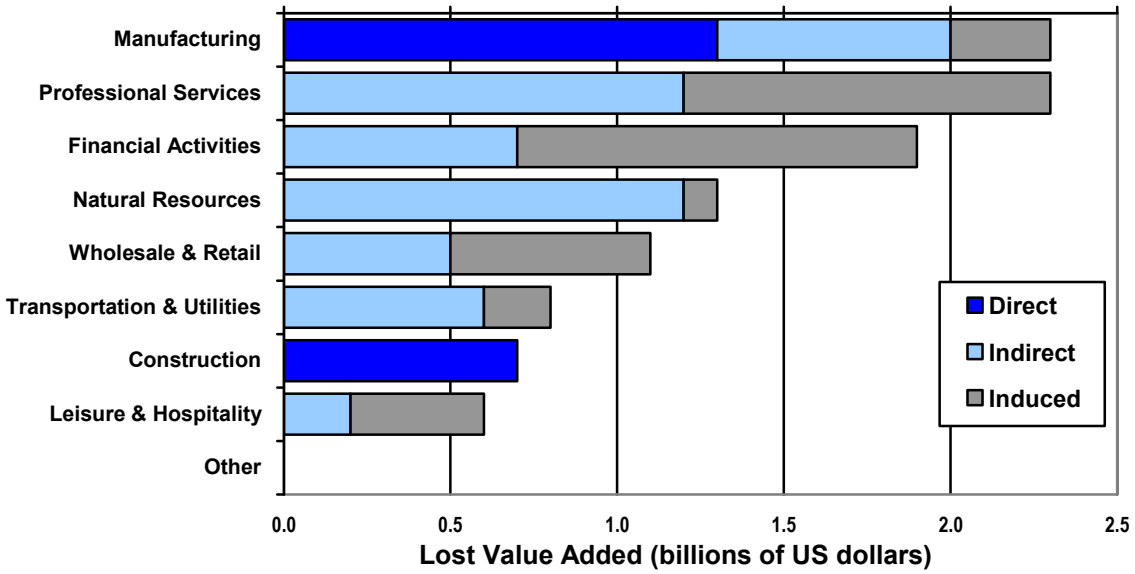
Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Labor Income by Industry Super-Sector, Scenario 2



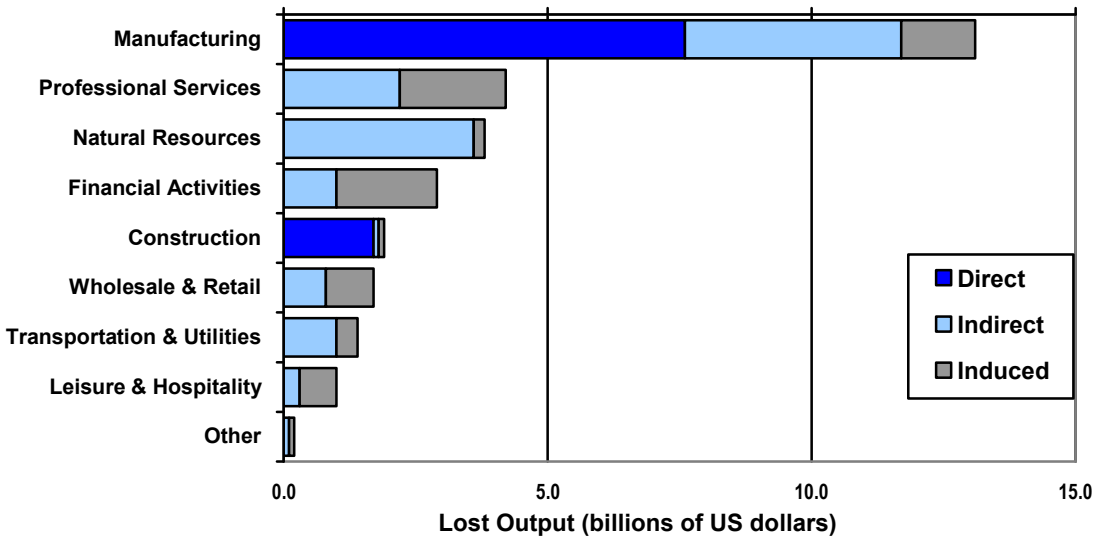
Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Value Added by Industry Super-Sector, Scenario 2



Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Output by Industry Super-Sector, Scenario 2



Source: Results generated by IHS Global Insight from IMPLAN model

In reviewing the summary tables shown above, the significance of the downstream effects becomes clear. For a sector like Natural Resources, the direct effect of the regulations is relatively small, but the employment impact on this industry as a supplier to the Manufacturing and Construction sectors is extremely significant. Additionally, the employment impact on the professional services sector is also significant, but even more so is the labor income impact on this sector, which highlights the fact that the jobs in this particular sector are high paying and high value jobs which might not normally come into focus when assessing the impact of standards such as these.

Detailed Economic Impact of Scenario 2

	Direct	Indirect	Induced	Total
Jobs at Risk	**31,639**	**71,246**	**49,668**	**152,553**
Construction	11,564	754	486	12,804
Financial Activities	-	4,452	6,006	10,458
Professional Services	-	12,800	16,281	29,081
Leisure & Hospitality	-	3,569	10,640	14,209
Manufacturing	19,900	7,040	2,687	29,627
Natural Resources	174	32,663	1,281	34,118
Transportation & Utilities	-	4,928	1,931	6,860
Wholesale & Retail	-	4,642	9,922	14,563
Other	-	399	435	833
Labor Income (US$M)	**1,637.3**	**2,892.6**	**2,329.8**	**6,859.8**
Construction	637.8	44.9	25.8	708.6
Financial Activities	-	249.0	373.6	622.7
Professional Services	-	888.9	883.2	1,772.1
Leisure & Hospitality	-	111.6	258.2	369.8
Manufacturing	998.1	490.2	201.8	1,690.1
Natural Resources	1.3	428.7	45.1	475.2
Transportation & Utilities	-	328.5	131.9	460.4
Wholesale & Retail	-	320.8	378.1	698.9
Other	-	30.0	32.1	62.1
Value Added (US$M)	**1,992.3**	**5,239.8**	**4,125.7**	**11,357.8**
Construction	677.6	47.5	31.5	756.7
Financial Activities	-	680.8	1,230.5	1,911.3
Professional Services	-	1,195.8	1,131.6	2,327.3
Leisure & Hospitality	-	168.0	371.1	539.0
Manufacturing	1,308.9	745.6	340.0	2,394.5
Natural Resources	5.8	1,223.8	111.8	1,341.3
Transportation & Utilities	-	593.3	240.8	834.1
Wholesale & Retail	-	549.6	632.6	1,182.2
Other	-	35.4	36.0	71.4
Industry Output (US$M)	**9,313.1**	**13,280.6**	**7,758.6**	**30,352.2**
Construction	1,727.4	86.2	53.9	1,867.5
Financial Activities	-	1,032.7	1,889.6	2,922.3
Professional Services	-	2,170.7	1,998.7	4,169.4
Leisure & Hospitality	-	301.8	731.2	1,032.9
Manufacturing	7,570.6	4,120.4	1,420.9	13,111.9
Natural Resources	15.0	3,612.8	230.6	3,858.3
Transportation & Utilities	-	1,028.3	389.6	1,417.9
Wholesale & Retail	-	818.4	938.7	1,757.2
Other	-	109.4	105.4	214.8

Source: Results generated by IHS Global Insight from IMPLAN model

Results: Scenario 3

In Scenario 3, IHS Global Insight assessed the economic impact should the EPA rules be expanded to include emission limits for Gas 1 units for all five pollutant categories instead of the work practice standard approach proposed.

Using the Gas I unit specific inventory database and the projected emission limits provided by EPA in the proposed rule Preamble, the capital costs for the emissions controls were determined to total $51.5B, distributed across 26 industry subsectors[5]. The upgrade expenditures were subtracted from the output of each subsector and used as inputs to the IMPLAN model.

The results of the Scenario 3 analysis are summarized in the table below. Incurring the capital costs of compliance will put almost 800,000 jobs potentially at risk, of which over 180,000 are directly tied to the affected industries. This does not mean that all of the "at risk" jobs will be eliminated. Some larger organizations will absorb the costs with minimal changes to employment levels; however they will likely pass both the compliance and on-going operating and maintenance costs downstream to their customers or absorb a hit to their profitability and therefore pass that cost along to their shareholders. Smaller or marginally-profitable firms, on the other hand, may be faced with either reducing staff or shutting down operations.

Summary of Economic Impact of Scenario 3

	Direct	Indirect	Induced	Total
Employment	**181,099**	**341,800**	**275,351**	**798,250**
Labor Income	**$8.5B**	**$16.6B**	**$12.9B**	**$38.0B**
Value Added	**$11.1B**	**$29.3B**	**$22.9B**	**$63.3B**
Output	**$51.5B**	**$77.9B**	**$43.0B**	**$172.5B**
Taxes				**$14.3B**

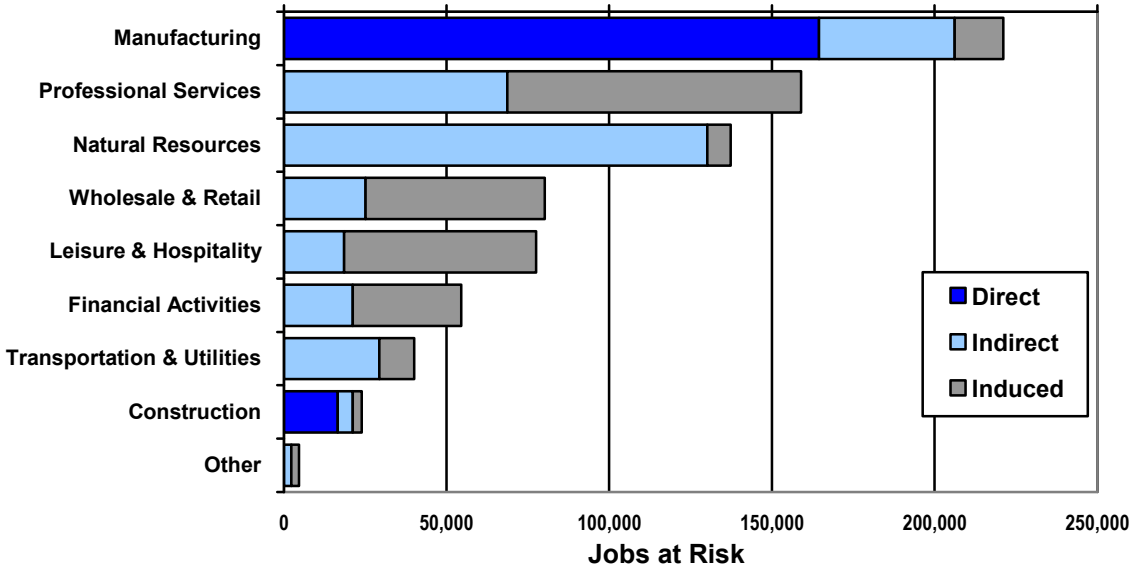
Source: Results generated by IHS Global Insight from IMPLAN model

As shown below, the 26 industry subsectors that will incur capital costs of $51.4B aggregate under three industry supersectors: construction, manufacturing and natural resources. In this scenario, the manufacturing subsector will incur approximately 96% of the upgrade cost. However, as shown in the charts on the following pages, the indirect and induced impacts will be felt in other supersectors, such as professional services.

[5] The relationship between IMPLAN industry sectors and NAICS categories is explained further in Appendix B.

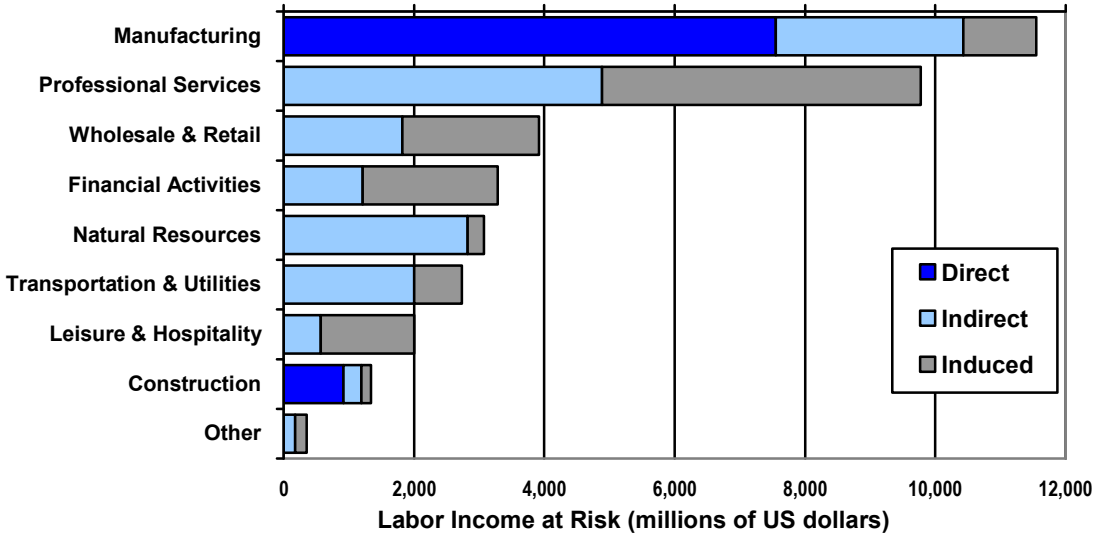
Industry Supersector	Capital Costs (millions of dollars)
Construction	$2,571
Manufacturing	$48,966
Natural Resources	$3
Total	$51,540

Impact on Employment by Industry Super-Sector, Scenario 3



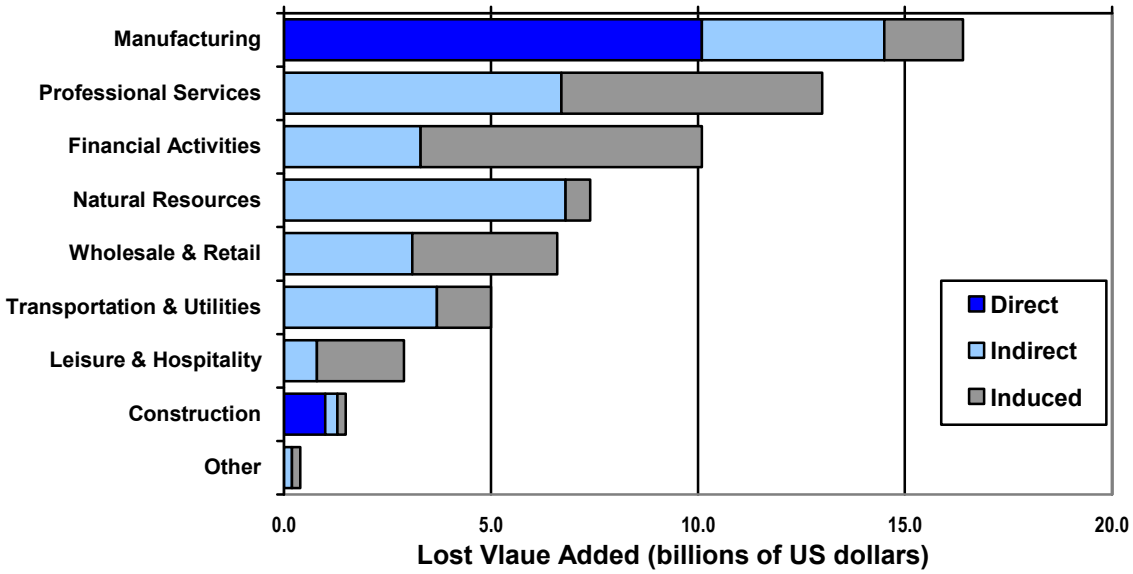
Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Labor Income by Industry Super-Sector, Scenario 3



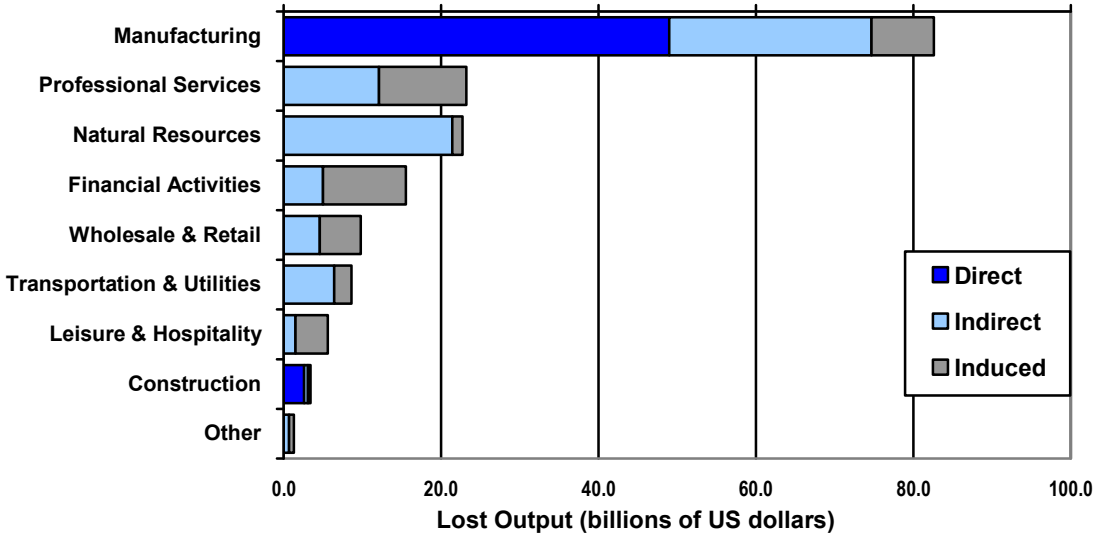
Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Value Added by Industry Super-Sector, Scenario 3



Source: Results generated by IHS Global Insight from IMPLAN model

Impact on Output by Industry Super-Sector, Scenario 3



Source: Results generated by IHS Global Insight from IMPLAN model

In reviewing the summary tables shown above, the significance of the downstream effects becomes clear. For a sector like Natural Resources, there is only a small amount of direct effect on the industry, but the employment impact on this industry as a supplier to the Manufacturing and Construction sectors is extremely significant. Additionally, the employment impact on the professional services sector is also significant, as is the labor income impact on this sector, which highlights the fact that the jobs in this particular sector are high paying and high value jobs which might not normally come into focus when assessing the impact of standards such as these.

Detailed Economic Impact of Scenario 3

	Direct	Indirect	Induced	Total
Jobs at Risk	**181,099**	**341,801**	**275,351**	**798,250**
Construction	16,638	4,611	2,692	23,941
Financial Activities	-	21,245	33,300	54,544
Professional Services	-	68,694	90,260	158,954
Leisure & Hospitality	-	18,528	58,984	77,513
Manufacturing	164,424	41,776	14,896	221,097
Natural Resources	37	130,142	7,102	137,281
Transportation & Utilities	-	29,329	10,707	40,036
Wholesale & Retail	-	25,123	55,001	80,125
Other	-	2,352	2,409	4,761
Labor Income (US$M)	**8,470.5**	**16,641.3**	**12,916.9**	**38,028.7**
Construction	918.9	275.2	143.1	1,337.2
Financial Activities	-	1,211.2	2,071.5	3,282.7
Professional Services	-	4,884.2	4,896.4	9,780.6
Leisure & Hospitality	-	570.8	1,431.2	2,002.0
Manufacturing	7,551.3	2,879.0	1,118.8	11,549.0
Natural Resources	0.3	2,821.9	250.3	3,072.6
Transportation & Utilities	-	2,003.2	731.4	2,734.6
Wholesale & Retail	-	1,818.7	2,096.3	3,915.0
Other	-	177.0	178.0	355.0
Value Added (US$M)	**11,103.0**	**29,307.0**	**22,873.3**	**63,283.3**
Construction	1,007.1	290.9	174.5	1,472.5
Financial Activities	-	3,266.9	6,821.6	10,088.4
Professional Services	-	6,655.4	6,273.7	12,929.0
Leisure & Hospitality	-	847.3	2,057.0	2,904.2
Manufacturing	10,094.6	4,415.1	1,885.3	16,395.0
Natural Resources	1.3	6,807.4	619.8	7,428.6
Transportation & Utilities	-	3,690.5	1,335.2	5,025.6
Wholesale & Retail	-	3,120.0	3,506.9	6,626.9
Other	-	213.6	199.4	412.9
Output (US$M)	**51,540.6**	**77,946.6**	**43,015.0**	**172,502.1**
Construction	2,570.5	527.7	298.7	3,396.8
Financial Activities	-	4,983.6	10,475.3	15,458.8
Professional Services	-	12,060.5	11,081.6	23,142.1
Leisure & Hospitality	-	1,530.7	4,053.1	5,583.9
Manufacturing	48,966.2	25,745.9	7,878.8	82,590.9
Natural Resources	3.8	21,385.4	1,278.5	22,667.8
Transportation & Utilities	-	6,405.0	2,160.0	8,565.1
Wholesale & Retail	-	4,648.4	5,204.3	9,852.7
Other	-	659.4	584.7	1,244.1

Source: Results generated by IHS Global Insight from IMPLAN model

Appendix A: How the MACT Costs were Calculated

Because of the anticipated major financial impact of this rule on the Industrial Commercial and Institutional (ICI) sectors of the country, the Council of Industrial Boiler Owners (CIBO) commissioned URS Corporation to work with our members to estimate the capital costs for installation of additional control technologies on existing boilers. The approach used by CIBO and URS (CIBO/URS) to estimate capital costs differed from EPA's in several respects, as described below.

We developed a detailed spreadsheet to estimate costs for Boiler MACT, based on EPA's major source boiler inventory database table. Based on the information in the EPA emissions database on boiler size, fuel, existing controls, and emissions, we estimated costs of controls that would likely be necessary to comply with the Boiler MACT for coal, biomass, liquid, and gas 2 boilers for those units 10 MMBtu/hr and greater. Because the proposed rule does not include emission limits for natural gas boilers, these units were considered in a separate cost analysis assuming the work practice standards would not be allowed and the proposed Gas 1 limits in the preamble would be applied, requiring application of control technology to these boilers and process heaters for all regulated pollutants.

Information from various sources was used to determine a base capital cost for a 250 MMBtu/hr boiler and process heater for each PM and HCl control technology option and then scaled using an 0.6 power function based on the size of each boiler and process heater in the inventory. For example, the capital cost of a scrubber on a 100 MMBtu/hr boiler is calculated as the base cost of \$8 million times $(100/250)^{0.6}$. A fixed capital cost of \$1 million was assumed for installation of a carbon adsorption system for Hg and/or dioxin control, as these systems do not vary much in cost by boiler size. A fixed capital cost of \$2 million was assumed for CO controls (either projects to improve combustion or fuel feed or installation of a CO catalyst). Base cost estimates represent median costs for the various control scenarios based on published reports, industry and vendor information on specific project costs, EPA reports or control device fact sheets, or actual BACT or BART analyses previously submitted to permitting agencies.

To estimate capital costs for each boiler and process heater, we assumed that if there was no emissions information available for a particular unit, the unit would likely need MACT, which EPA stated in the preamble to the proposed Boiler MACT is a fabric filter (FF) plus carbon injection plus wet scrubber plus combustion improvements (or CO catalyst). For PM, if a unit did not already have a FF or ESP and there was information that indicated the unit cannot meet the proposed limit or there was no emissions information, we assumed a new FF. If the unit already had a FF or ESP and there was information that indicated the unit cannot meet the proposed limit we assumed an upgrade to the existing control equipment. To estimate control costs for HCl, if there was information that indicated the unit cannot meet the proposed limit or if there was no emissions information, we assumed either a scrubber upgrade or new scrubber depending on whether the unit currently had a scrubber. For Hg and dioxin, if there was information that indicated the unit cannot meet the proposed limit or if there was no emissions information, we

added carbon injection. For CO, if there was information that indicated the unit cannot meet the proposed limit and is not a fluidized bed boiler, stoker boiler, suspension boiler, or dutch oven, then we assumed that capital would be necessary to either perform combustion and/or fuel feed improvements or other boiler/process heater improvement projects to reduce CO or install a CO catalyst.

Although EPA's estimates indicate that the total capital cost of the proposed rule will be $9.5 billion, CIBO and URS have estimated that the total capital cost of the rule will be over $20 billion for all affected sources for installation of emissions controls on coal, biomass, liquid, and gas 2 boilers and process heaters. It is evident major capital investments in add-on control technology will be required for continued operation of the ICI power house and energy base of the country.

Our capital cost estimates differ from EPA's cost estimates as follows:

- EPA has used the outdated Control Cost Manual and we have based our cost estimates on more recent information, including actual vendor cost estimates, actual project costs, BACT and BART analyses, industry control cost studies, etc.
- We used a CO catalyst cost 4 times higher than EPA's. The CIBO/URS estimate is based on a recent quote from BASF and EPA's is based on the 1998 Control Cost Manual section on catalytic oxidizers for VOC control.
- EPA has estimated that a tuneup or burner replacement will be adequate for many units to achieve the CO limits. We do not agree with this assumption and have estimated higher costs to implement combustion controls, fuel feed system improvements, or CO catalyst.
- Our estimated CO control capital costs are $1.2 billion for liquid and gas 2 and $1.5 billion for coal and biomass, where EPA's total estimate for CO control capital costs is only $13.9 million, mostly because they have assumed that tune-ups and replacement burners will be adequate for the vast majority of boilers to comply.
- EPA has estimated that activated carbon injection will only be required on 155 existing boilers because installation of a fabric filter is expected to achieve the mercury emission limits, except in cases where a unit already has a fabric filter and does not meet the limits. We do not agree that fabric filters will be sufficient to reduce mercury emissions to the ultra low levels proposed in this rule. There is a flaw in the logic that fabric filters are expected to achieve mercury emission limits when there are many boilers in the database that are equipped with fabric filters and have measured mercury emissions higher than the proposed limits. EPA's estimated industry-wide capital cost for activated carbon injection presented in Table 2 of the cost and emissions impacts memo is extremely low, at only $9.5 million. We do not understand how this can represent 155 boilers; it seems to us to represent the cost 10 boilers would incur to install a carbon injection system. Our estimate for carbon injection required for mercury and dioxin/furan control is $1.7 billion.
- EPA estimated that an ESP would be installed to meet the PM emissions limit unless a unit already had a fabric filter installed. We believe that since sorbent injection will be required for acid gas, mercury, and dioxin control, that fabric filters will likely be chosen for units without existing ESPs in order to maximize the performance of the sorbents and minimize the amount of sorbent used. For example, use of an ESP will require 4 times the carbon

to be injected for mercury/dioxin control than if a fabric filter is used. The capital cost for a fabric filter is higher than the capital cost for an ESP on the same boiler.

- CIBO/URS has estimated a PM control cost for coal, liquid, and gas 2 boilers and process heaters of $7 billion versus EPA's estimated PM control cost of $6.1 billion.
- EPA has estimated costs to install packed bed scrubbers for HCl control. Industrial boilers do not use packed bed scrubbers for acid gas control, as the limitations of these devices make them impractical for use on applications with high flow rates, high PM loading, and high inlet pollutant concentration. EPA's own fact sheet on these devices, located at http://www.epa.gov/ttn/catc/dir1/fpack.pdf, lists these limitations of these devices and indicates that they are only used in applications up to 75,000 scfm, which limits their use to small units only. Facilities will instead install wet scrubbers, dry scrubbers, or semi-dry scrubbers to control acid gas emissions from industrial boilers. EPA has estimated HCl control costs for equipment that industry is not likely to install.
- CIBO/URS has estimated capital costs for coal, liquid, and gas 2 boilers and process heaters for HCl control of $9.3 billion, while EPA's capital cost estimate for wet scrubbers is $3.3 billion.
- EPA presents several cost options in the two ERG memos. Option 2E assumes that facilities will not incur costs to comply with the dioxin/furan standards because they will test for dioxin/furan and be below detection levels. This logic does not make sense, especially because EPA has not outlined in the rule any procedures for handling non-detects when performing compliance testing and there are boilers in the EPA emissions database with dioxin/furan emissions that are non-detect but actually measured emissions higher than the proposed limit. CIBO/URS has estimated carbon injection as the control measure for dioxin/furan emissions and mercury emissions. As stated above, our cost estimate for carbon injection for coal, liquid, and gas 2 boilers and process heaters is $1.7 billion versus EPA's of only $9.5 million.

Capital Cost Estimates for MACT Compliance

Item	EPA Capital Cost	CIBO/URS Capital Cost
CO Controls	**$13.9 million**	**$2.7 billion**
Carbon Injection for Hg and D/F	**$9.5 million**	**$1.7 billion**
PM Controls	**$6.1 billion**	**$7.0 billion**
HCl Controls	**$3.3 billion**	**$9.3 billion**

In the event Work Practice Standards for Natural Gas fired boilers and process heaters are replaced with the numerical standards proposed in the preamble for Gas 1 boilers, the following costs were estimated using the same assumptions as above. We have assumed that gas 1 boilers and process heaters will apply the following technology: FF (for PM), carbon injection (for Hg and D/F), wet scrubber (for HCl), and CO catalyst.

Capital Cost Estimates for MACT Compliance		
Item	**EPA Capital Cost for Gas 1 Boilers >10 MMBtu**	**CIBO/URS Capital Cost**
CO Controls	**$3.5 million**	**$5.8 billion**
Carbon Injection for Hg and D/F	**$32 million**	**$2.9 billion**
PM Controls	**$11.5 billion**	**$19.6 billion**
HCl Controls	**$3.1 billion**	**$23.2 billion**

The above estimates could be considered conservative since they assume that emission controls can be installed on existing units and that controls will actually allow compliance with the proposed emission limits. These are very conservative assumptions since it is known that retrofit of emissions control devices such as these is extremely difficult for some units due to design and space limitations, and major issues with the floor setting methodology make achievability of the emission limits highly uncertain. Therefore, it is likely that some combustion units will need to be replaced rather than retrofitting controls to those existing units. Replacement of combustion units could escalate these costs significantly.

Appendix B: The IMPLAN Model

IMPLAN, short for "**Im**pact Analysis for **Plan**ning," is a widely used commercially available model for input/output analysis. Minnesota IMPLAN Group, Inc., is responsible for the production of the IMPLAN data, model, and software. Using classic input/output analysis in combination with region-specific social accounting matrices and multiplier models, IMPLAN provides a highly accurate and adaptable model for its users. The IMPLAN database contains country, state, zip code, and federal economic statistics, which are specialized by region. IMPLAN accounts closely follow the accounting conventions used in the "Input-Output Study of the U.S. Economy" by the BEA and the rectangular format recommended by the United Nations. The IMPLAN system was designed to serve three functions:

1) Data retrieval,
2) Data reduction, model development, and
3) Impact analysis

Comprehensive and detailed data coverage of the entire United States by geography, and the ability to incorporate user-supplied data at each stage of the model-building process, provides a high degree of flexibility both in terms of geographic coverage and model formulation. There are two components to the IMPLAN system, the software and databases. The databases provide all information to create regional IMPLAN models. The software performs the calculations and provides an interface for the user to make final-demand changes.
The IMPLAN system consists of two major parts:

1) A national-level technology matrix and
2) Estimates of sectoral activity for final demand, final payments, industry output, and employment for each detailed geography in the United States along with the aggregate region.

Input-output accounting describes commodity flows from producers to intermediate and final consumers. The total industry purchases of commodities, services, employment compensation, value added, and imports are equal to the value of the commodities produced.

Purchases for final use (final demand) drive the model. Industries produce goods and services for final demand and purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the region (imports and value added) stop the cycle.

These indirect and induced effects (the effects of household spending) can be mathematically derived. The derivation is called the Leontief inverse. The resulting sets of multipliers describe the change of output for each and every regional industry caused by a one dollar change in final demand for any given industry.

Creating regional input-output models requires a tremendous amount of data. The costs of surveying industries within each region to derive a list of commodity purchases production functions) are prohibitive. IMPLAN was developed as a cost-effective means to develop regional input-output models.

IMPLAN easily allows the user to do the following:

- Develop his/her own multiplier tables;
- Develop a complete set of SAM (Social Accounting Matrix) accounts;
- Change any component of the system, production functions, trade flows, or database;
- Generate type I, II, or any true SAM multiplier internalizing household, government, and/or investment activities
- Create custom impact analysis by entering final-demand changes;
- Obtain any report in the system to examine the model's assumptions and calculations.

There are two components to the IMPLAN system, the software and databases. The databases provide all information to create regional IMPLAN models. The software performs the calculations and provides an interface for the user to make final-demand changes.

IMPLAN SOFTWARE

Minnesota IMPLAN Group developed the current version of IMPLAN Professional® version 3.0 in 2009. It is a Windows-based software package that performs the calculations necessary to create the predictive model. The software reads the database, creates the complete set of social accounting matrices (SAM), the I/O accounts, and integrates all user-defined inputs to produce an alternative scenario.

The IMPLAN Input/Output System derives the predictive multipliers. The software also enables the user to make changes to the data, the trade flows, or technology. It also enables the user to make final-demand changes, which results in the impact assessment.

Features of IMPLAN Professional® include:

1) Windows file and printer management;
2) Economic database editor;
3) Complete Social Accounting Matrix structure;
4) A choice of trade-flow assumptions: Supply-Demand Pooling; Regional Purchase Coefficients; Location
5) quotients;
6) Production function editor, i.e., the tools and opportunity necessary to modify the "absorption"
7) and "byproducts" matrices;

8) Libraries for production functions and impact analysis expenditures;
9) Flexible model aggregation tools;
10) Report generator; many preset reports for all stages of model building and analysis;
11) Export feature to many of the major PC file formats;
12) Flexible assumptions for induced effects;
13) Type SAM – true SAM multipliers which allow internalizing any number of institutions;
    a. Type II - Based on PCE and SAM based local income relationship;
    b. Type II - Based on user-specified disposable income rate;
    c. Type III (CPMM) - Traditional Forest Service employment based multipliers;
14) Menu structure for easy impact analysis;
15) Event-based impact databases;
16) Built-in and editable transaction margins;
17) Built-in and editable deflators;
18) Technical support by MIG, Inc.;
19) Data in Access Database format.

DATABASE

Each database has information for these components for all 440 industrial sectors in the IMPLAN model. This 440-sector scheme was revised in 2007 and was originally the basis for the Bureau of Economic Analysis's Benchmark Input-Output Study. This scheme is nearly 6 digit NAICS for manufacturing, and more aggregate for service sectors. By necessity IMPLAN's sectoring is very similar. However, in some cases, 6 digit NAICS code data has been aggregated for certain IMPLAN sectors. A full NAICS to IMPLAN mapping document can be downloaded from www.implan.com.

Employment is total wage and salary and self-employed jobs in a region. In the 1985 database, employment was measured as full-time equivalent jobs. This meant that total employment in a region would generally be below most published estimates because these are generally full-time and parttime. In the 1990 and subsequent databases, employment includes both full-time and part-time workers. Employment in the 1990 and subsequent databases are measured in total jobs.

There are four sub-components for value added:

1) Employee Compensation;
2) Proprietary Income;
3) Other Property Type Income;
4) Indirect Business Taxes;

Employee compensation is wage and salary payments as well as benefits, including health and life insurance, retirement payments, and any other non-cash compensation. This provides a measure of income to workers who are paid by employers.

Proprietary income consists of payments received by self-employed individuals as income. This would be recorded on Federal Tax Form 1040C. This includes income received by private business owners, doctors, lawyers, and so forth. Any income a person receives for payment of self-employed work is counted here.

Other property-type income consists of payments from rents royalties and dividends. This includes payments to individuals in the form of rents received on property, royalties from contract, and dividends paid by corporations. This also includes corporate profits earned by corporations.

Indirect business taxes consist primarily of excise and sales taxes paid by individuals to businesses. These taxes are collected during the normal operation of these businesses but do not include taxes on profit or income. Goods and services purchased for their ultimate use by an end user are called final demands. For a region, this would include exports as that is a final use for that product. In an input-output framework, final demands are allocated to producing industries with margins allocated to the service sectors (transportation, wholesale and retail trade, insurance) associated with providing that good to the final user.

Thus, final demands are in producer prices. There are 13 subcomponents for final demands:

1) Personal Consumption Expenditures (PCE)—nine income levels;
2) Federal Government Military Purchases;
3) Federal Government Nonmilitary Purchases;
4) Federal Government Capital Formation Purchases;
5) State and Local Government Non-Education Purchases;
6) State and Local Government Education Purchases;
7) State and Local Government Capital Formation Purchases;
8) Inventory Purchases;
9) Capital Formation;
10) Foreign Exports;
11) State and Local Government Sales;
12) Federal Government Sales;
13) Inventory Sales.

All final demands in the original data are on a commodity basis. The distinction between industries and commodities is as follows from the 1972 I-O Definitions and Conventions Manual:

- An input-output industry is a grouping of establishments, as classified by Standard Industrial Classification (SIC)[6];

[6] The IMPLAN sector scheme is now currently based on NAICS definitions and is revised as necessary after each 5-year Economic Census is released.

- An input-output commodity consists of the characteristic products of the corresponding I-O industry wherever made. There are several industries that have no commodities. This is a result of departures from the strict SIC of industries. Also, some commodities have no associated industry. An example of this is noncomparable imports.

PCE consists of payments by individuals/households to industries for goods and services used for personal consumption. Individuals tend to buy little directly from industries other than retail trade. In an input-output table, though, purchases made by individuals for final consumption are shown as payments made directly to the industry producing the good. PCE is the largest component of final demand.

Federal government purchases are divided between military and nonmilitary uses and capital formation. Federal military purchases are those made to support the national defense. Goods range from food for troops to missile launchers. Nonmilitary purchases are made to supply all other government functions. Payments made to other governmental units are transfers and are not included in federal government purchases.

State and local government purchases are divided between public education and non-education and capital formation. Public education purchases are for elementary, high school, and higher education. Non-education purchases are for all other government activities. These include state government operations, operations including police protection and sanitation. Private-sector education purchases are not counted here. Private education purchases show up in IMPLAN sectors 495 and 496.

Inventory purchases are made when industries do not sell all output created in one year. This is generally the case. Each year, a portion of output goes to inventory. Inventory sales occur when industries sell more than they produce and need to deplete inventory. Inventory purchases and sales generally involve goods-producing industries (e.g., agriculture, mining, and manufacturing).

Capital formation is private expenditures made to obtain capital equipment. The dollar values in the IMPLAN database are expenditures made to an industrial sector producing the capital equipment. The values are not expenditures by the industrial sector.

Foreign exports are demands made to industries for goods for export beyond national borders. These represent goods and services demanded by foreign parties. Domestic exports are calculated during the IMPLAN model creation and are not part of the database.

The national transactions matrix is based on the most current BEA National Benchmark Input-Output Model. It is re-sectored to IMPLAN industrial sectoring. We use our IMPLAN data for the current year to update the most recent National Benchmark study.

IMPLAN MULTIPLIERS

The notion of a multiplier rests upon the difference between the initial effect of a change in final demand and the total effects of that change. Total effects can be calculated either as direct and indirect effects, or as direct, indirect, and induced effects. Direct effects are production changes associated with the immediate effects or final-demand changes. Indirect effects are production changes in backward- linked industries caused by the changing input needs of directly affected industries (for example, additional purchases to produce additional output). Induced effects are the changes in regional household spending patterns caused by changes in household income generated from the direct and indirect effects.

Five different sets of multipliers are estimated by IMPLAN corresponding to five measures of regional economic activity: total industry output, personal income, total income, value added, and employment. For each set of multipliers, four types of multipliers are generated, Type I, Type II, Type SAM, and Type III.

Type I Multiplier

A Type I multiplier is the direct effect, produced by a change in final demand, plus the indirect effect divided by the direct effect. Increased demands are assumed to lead to increased employment and population with the average income level remaining constant. The Leontief inverse (Type I multipliers matrix) is derived by inverting the direct coefficients matrix. The result is a matrix of total requirement coefficients, the amount each industry must produce for the purchasing industry to deliver one dollar's worth of output to final demand.

Type II Multipliers

Type II multipliers incorporate "induced" effects resulting from the household expenditures from new labor income. The linear relationship between labor income and household expenditure can be customized in the IMPLAN Professional® software: 1. The default relationship is PCE and total household expenditures. Each dollar of workplace-based income is spent based on the SAM relationship generated by IMPLAN. 2. The second possibility is a RIMS II style of Type II multiplier, where PCE is adjusted to represent only the spending of the disposable income portion of labor income. In this way, there is a direct one-to-one relationship to labor income and PCE. Then, a ratio which the user can specify is applied to convert total income to disposable income before the rounds of induced effects are calculated.

Type SAM

Type SAM multipliers are the direct, indirect, and induced effects where the induced effect is based on information in the social account matrix. This relationship accounts for social security and income tax leakage, institution savings, and commuting. It also accounts for inter-institutional transfers. This multiplier is flexible in that you can include any institutions you want. In other

words, if you want to create a model closed to households and state and local government, you can. If you select this option, an additional dialog box with be displayed allowing you to select the institutions you want to include.

Output Multipliers

This report shows the total industry output multipliers and per-capita personal consumption expenditures. Output multipliers can be used to gauge the interdependence of sectors; the larger the output multiplier, the greater the interdependence of the sector on the rest of the regional economy. A Type I entry represents the value of production (from direct and indirect effects) required from all sectors by a particular sector to deliver one dollar's worth of output. Type II, SAM, and III adds in the induced requirements.

Example: If a Type I multiplier for the dairy farm industry is 1.0943, for each dollar of output produced by the dairy farm sector, 0.0943 dollars' worth of indirect output is generated in other local industries. If the Type SAM Dairy Farm multiplier is 1.3140, 0.3140 dollars of indirect and induced output is generated in other local industries. The induced output would be 1.3140 minus 1.0943 or 0.2197 dollars for each dollar of output produced by the dairy farm sector.

Labor Income Multipliers

The labor income multiplier report shows the direct, indirect, and induced employee compensation plus proprietor income effects generated per dollar of output. The Type I personal income multiplier is the direct and indirect employee compensation plus proprietor income divided by the direct income. The Type II, Type SAM, and Type III multiplier adds the induced effects component.

Example: If the Type I multiplier for the dairy farm sector is 1.4761 and the Type SAM multiplier is 2.7067, then for each dollar of direct income generated by this industry, 0.4761 dollars of indirect and 1.2306 dollars of induced income are generated.

Employee Compensation Multipliers

Employee compensation represents all payroll costs of wage and salary workers. The Type I, Type SAM, Type II, or Type III total income multipliers are listed in this report along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Proprietor Income Multiplier

Proprietor income is the income earned by the owners of a private—non-incorporated business—i.e., the self-employed. The Type I, Type SAM, Type II, or Type III total income multipliers are

listed in this report along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Other Property-Type Income

Other property-type income represents corporate income, rental income, and interest. The Type I and Type II/Type SAM/Type III total income multipliers are listed in this report along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Value-Added Multipliers

Type I and Type II/Type SAM/Type III value-added multipliers are listed in this report along with the direct, indirect, and induced value-added effects generated from the production of one dollar of output. Value-added includes employee compensation, proprietary income, other property-type income, and indirect business taxes.

Employment Multipliers

Type I and Type II/Type SAM/Type III employment multipliers are listed in this report along with the direct, indirect, and induced employment effects from the production of one million dollars of output. Employment is in terms of full-time and part-time jobs.

Example: if a dairy farm Type I employment multiplier is 1.1158, for each job created directly by the dairy farm industry, 0.1158 jobs are created indirectly.