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The Economic Impact of Replacing Coal with Natural Gas for Electricity Production

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EXECUTIVE SUMMARY

In the quest to diversify Michigan's energy portfolio and reduce our state's reliance on imported fossil fuels, natural gas has come to be viewed as an important component in the state's energy mix. Coal is by far the dominant feedstock for electricity generation in Michigan, dwarfing natural gas. However unlike coal, which must be imported from outside the state, natural gas is in abundant supply and is domestically produced in Michigan.

This study attempts to estimate the overall economic impact of replacing imported coal with domestically available natural gas, with regards to job creation and economic activity. This study analyzes three scenarios and comes to the following conclusions:

- Substituting domestically produced natural gas, that is natural gas produced in Michigan for imported coal, that is coal produced in other states, will increase output, employment and tax revenues in Michigan.
- Replacing coal with natural gas will create Michigan jobs, including nearly 19,000 jobs during the construction phase and between approximately 1,200 and 6,300 direct and indirect jobs as a result of increasing natural gas use for electricity.
- The benefits increase as more natural gas displaces coal.

ABOUT THE AUTHOR OF THIS STUDY, PROFESSOR BILL KNUDSON

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METHODOLOGY

IMPLAN, a standard economic impact software package, is used to generate the results. IMPLAN estimates the economic impact at three levels. The first is the direct impact, changes in output and employment based on the actual activity. In this case, the one-time impact of construction of facilities, pipelines and the ongoing impact of increased natural gas use. The second is indirect economic activity resulting from changes in input industries that support natural gas or construction. The final impact is

induced economic activity resulting from a general change in economic conditions related to increased natural gas production and utilization or construction. The impact of increased land owner royalties resulting from increased natural gas production is reflected in the higher level of economic output. IMPLAN does not explicitly estimate the amount of royalties. The results are summarized in the following tables. Assumptions underlying the study are found in the Appendix.

IMPLAN also estimates the tax impacts of economic activity. The taxes considered are excise taxes, property taxes, fees, licenses and sales taxes paid by businesses. This includes some state and local taxes. They do not consider taxes on profit or income (MIG, p.126). Given the changing nature of the Michigan business tax environment these figures should be considered very rough estimates. The net indirect business taxes raised by natural gas generation once the gas facilities a fully up and running is $$24.6 million per year in scenario I; $61.5 million per year in scenario II; and $123.0 million per year in scenario III.

Table 1 shows the one-time impact of construction of the plant and pipeline to support natural gas. Based on the assumptions outlined in the appendix, it is assumed that 1,000 MW per year are added to the state's capacity. This would be about four 250 MWh facilities per year. While this is technically feasible given the current level of slack in the Michigan economy, access to credit may be an issue. In the case of 10 million MWh, it takes 21 months to get up to full capacity; in the case of 25 million MWh it takes 4 years and 5 months to get up to full capacity; and in the case of 50 million MWh it takes 8 years and 10 months to get to full capacity. The pipelines are constructed somewhat more quickly to service the plants as they go online over time.

Table 1: Summary of the Economic Impact of Construction					
	Output Per Year (Millions of $)		Employment		
	Direct	Total	Direct	Total	Months to Completion
Scenario I - 10 Million MWh					
Pipeline Construction	$100.0	$192.1	931	1,650	12
Plant Construction	$1,125.0	$2,218.2	9,094	17,346	21
Total Per Year	$1,225.0	$2,410.3	10,025	18,996	
Total for the Life of the Construction Period	$2,243.7	$4,073.6	10,025	18,996	
Scenario II - 25 Million MWh					
Pipeline Construction	$100.0	$192.1	931	1,650	30
Plant Construction	$1,125.0	$2,218.0	9,094	17,346	53
Total Per Year	$1,225.0	$911.7	10,025	18,996	
Total for the Life of the Construction Period	$5,609.2	$10,184.0	10,025	18,996	
Scenario III - 50 Million MWh					
Pipeline Construction	$100.00	$192.1	931	1,650	60
Plant Constrution	$1,125.0	$2,218.0	9,094	17,346	106
Total Per Year	$1,225.0	$2,410.3	10,025	18,996	
Total for the Life of the Construction Period	$11,218.0	$20,368.0	10,025	18,996	

Note: Numbers may not add up due to rounding.

The cost of installing new gas equipment is $1.12 million per megawatt (MW). This is based on the National Renewable Energy Laboratory's (NREL) estimate that it costs approximately $1.25 million per MW, but that 10 percent of the cost is reduced by converting existing coal-based electric sites to gas-fired electric sites. This translates into the need to install 1,756 MW to generate 10 million MWh; 4,390 MW to generate 25 million MWh; and 8,780 MW to generate 50 million MWh. This assumes a 65 - percent utilization factor in accordance with NREL data. These facilities do not run at full capacity for 24 hours a day, 365 days a year. Additional investment is $2.2 billion for 10 million MWh; $5.6 billion for 25 million MWh, and $11.2 billion for 50 million MWh. Some sources indicate that new state of the art facilities operate at an 87 percent capacity factor (Tegen, p.2). If that is the case the level of investment would be lower and the economic impact smaller.

The annual economic impact is the same under each scenario at $1.2 billion per year in direct activity and $2.4 billion a year in total economic activity, but the total economic impact for the life of the construction period is greater as more capacity is generated. The total economic impact during the life of the construction phase varies from under $4.1 billion in the 10 million MWh case to almost $20.4 billion in the 50 million MWh case. Nonetheless, this additional economic activity will take several years to achieve. It should be noted that the number of jobs in the construction period remains unchanged at roughly 10,000 jobs in the actual construction industries and a total of almost 19,000 jobs in the Michigan economy, including direct, indirect and induced employment. The number of workers remains unchanged due to the fact that there is a maximum amount of capacity added each year. One simple way of looking at this is that workers move from one project to another as plants are built. Additional

economic activity and employment ceases in the construction phase after the natural gas plants are constructed.

It should be noted that this study only looks at the economic impact of retrofitting coal fired plants with natural gas. It does not consider the economic impact of retrofitting coal fired plants to meet potential increased demand or environmental or other regulations. This would also generate additional economic activity. This study does not analyze the impact of construction new coal plants for a number of reasons. The cost of coal plants is now approaching $3,500 a KW, which means that a 600 MW coal plant could cost $2 billion (Schlissel, Smith, and Wilson, p.1) not including escalation or financing costs, this has reduced the number of coal plants being constructed. Another factor is that the demand for electricity has declined. Both Consumers Energy and DTE have forecasted that the demand for electricity will be less in the near future – two to seven from now - than it was in the late 2000s (Fisher et al, p.4). Overall electricity sales have been flat since 2002 (Fisher et al, p.14). In the near term future electricity from one source primarily coal, will be substituted by electricity from other sources such as natural gas and renewables.

There are several examples of utilities moving from coal to natural gas. The Lansing Board of Water and Light is building a new natural gas power facility. Xcel Energy is converting its Black Dog Electric Plant in Minnesota from coal based power to natural gas (Xcel, p.1-19), and We Energies is moving forward with plans to convert it Menomonee River Valley Electricity Plant in Milwaukee from coal based to natural gas (Content).

Table 2 summarizes the impacts of increased Michigan based natural gas as an input in electricity production. Unlike the construction figures, this is permanent ongoing activity that continues after the natural gas electric plants are constructed.

Table 2: Economic Impact of Increased Natural Gas Production					
	Output (Millions of $)			**Impact on Employment**	
Annual Increase	**Direct**	**Total**		**Direct**	**Total**
Increased Natural Gas	$199.3	$317.8		121	854
Less Reduction Due to Coal Replacement	$0.0	$27.8		0	212
Net Increase	$199.3	$290.0		121	642
Total Increase After Full Adoption					
Scenario I - 10 Million MWh	$350.0	$526.0		213	1,268
Scenario II - 25 Million MWh	$875.0	$1,315.1		532	3,170
Scenario III - 50 Million MWh	$1,750.0	$2,630.0		1,064	6,340

Note: Numbers may not add up due to rounding.

The annual net impact resulting from the increased use of natural gas is $199.3 million in direct economic activity and $290.0 million in total economic activity as capacity is added. During the construction phase 121 additional jobs are added per year in the affected sectors and a total of 642 jobs per year are added during the construction phase. Once the capacity is added, the total net economic

activity is increased by $526.0 million per year and employment is increased by 1,268 in scenario I, the 10 million MWh case; $1.3 billion and 3,170 jobs in scenario II, the 25 million MWh case and $2.6 billion per year and employment is increased by 6,340 in scenario III, the 50 million MWh case. As previously noted this is a permanent ongoing increase in economic activity that exists after the construction phase is finished

It should be noted that Michigan does not produce coal and as a result there *is no direct in loss output* and employment from replacing coal based electricity with natural gas based electricity. Nonetheless there are some sectors that are adversely affected with the reduction in the use of coal. This is reflected in the total columns for employment and output.

INTRODUCTION

This study analyzes what would happen if Michigan substituted electricity generated by coal with electricity generated by natural gas. According to the Energy Information Adminstration, electricity generated by natural gas accounted for 8.3 percent of all electricity produced in Michigan 2009 (8.4 million MWh). Electric generation accounted for 83,805 million cubic feet of natural gas consumption, this represented 11.9 percent of all natural gas used in Michigan. In 2009, Michigan utilities produced 101.2 million MWh of electricity of which 66.8 million MWh or 66.1 percent was generated by coal.

To estimate the economic impact and job creating potential of increasing electricity generation through natural gas, this study analyzes three scenarios:

1. The first scenario analyzes displacing 10 million megawatt hours (MWh) of coal-based electricity with natural gas.

2. The second scenario analyzes displacing 25 million MWh of coal-based electricity with natural gas.

3. The third scenario analyzes displacing 50 million MWh of coal based electricity with natural gas.

Implicit in this analysis is that electricity generated by natural gas is cost competitive with electricity generated by coal. Figures from the Energy Information Administration and Lazard indicate that this is a reasonable assumption. As a result of increased natural gas production and other factors, natural gas is becoming more cost competitive compared to coal. Increased environmental regulation also makes natural gas a lower cost substitute for coal for generating electricity.

This study looks at three aspects of economic impact: the impact on output, the impact on employment and the impact on state tax revenue. There are two aspects of the economic impact. The first is the impact of construction of new pipelines and electric facilities that use natural gas. This should be considered a one-time event, although this conversion will take several years. The second is the ongoing economic activity generated by the use of natural gas that is produced and piped within the state of Michigan. The economic impact of reduced electricity production from coal is also analyzed.

In the first scenario, the construction phase leads to an increase of almost $4.1 billion in economic activity and an increase of employment of about 19,000 for 21 months. The total impact of increased natural gas production is $526.0 million and more than 1,200 additional jobs.

In the second scenario, the construction phase generates $10.2 billion in economic activity over four-plus years, and the total impact of increased natural gas production is $1.3 billion and almost 3,200 additional jobs.

In the third scenario the total economic impact during the construction phase is almost $20.4 billion over 8 plus years, and the total impact of increased natural gas production is $2.6 billion and more than 6,300 jobs.

SCENARIO 1: 10 MILLION MEGAWATT HOURS

Scenario I looks at the economic impact of a real by relatively minor shift of 10 million MWh hours of electricity generated by coal to 10 million MWh generated by natural gas. This represents replacing 15 percent of the electricity generated by coal with natural gas. The impacts related to construction are shown in Table 3.

Table 3: Impact of Construction Scenario I				
	Direct	**Indirect**	**Induced**	**Total**
Impact on Output (Millions $)				
Pipeline	$100.0	$37.2	$54.9	$192.1
Plant Construction	$1,125.0	$487.8	$605.4	$2,218.2
Total Per Year	$1,225.0	$525.0	$660.3	$2,410.3
Impact on Employment				
Pipeline	931	260	458	1,650
Plant Construction	9,094	3,193	5,058	17,346
Total	10,025	3,453	5,516	18,996
Months to Completion	**Months**			
Pipeline Construction	12			
Plant Construction	21			

Note: Numbers may not add up due to rounding.

During the construction phase the total annual economic impact is $2.4 billion. The direct impact of constructing pipeline and the electricity generating facilities is $1.2 billion per year. It is anticipated that it will take 12 months to build the pipeline and 21 months to build the electricity generating capacity. The total level of investment during the construction phase is $2.2 billion which generates a total economic impact of almost $4.1 billion. The indirect business taxes generated during the construction phase cannot be determined but total tax revenues will likely increase due to increased economic activity. It should be noted that these impacts represent one-time economic activity and the economic activity, employment and tax revenue related to construction will cease once 10 million MWh of capacity has been achieved.

Table 4 shows the ongoing impact of converting coal based electricity with Michigan sourced natural

Table 4: Economic Impact of Increased Natural Gas Production - Scenario I				
	Direct	**Indirect**	**Induced**	**Total**
Annual Economic Impact (Millions $)	$199.3	$79.3	$39.1	$317.8
Less Reduction Due to Coal Replacement	$0.0	$12.9	$14.9	$27.8
Net Increase	$199.3	$66.4	$24.2	$290.0
Total Increase After Full Adoption	$350.0	$124.4	$51.6	$526.0
Annual Impact on Employment	121	405	327	854
Less Reduction Due to Coal Replacement	0	86	126	212
Net Increase	121	319	187	642
Total Increase After Full Adoption	213	619	433	1,268

Note: Numbers may not add up due to rounding.

gas. The annual economic impact shows the impact as output is ramped up. The rows show the total increase in output and employment represent the change in output and the change in employment resulting from the full 10 million MWh transfer from coal to natural gas sourced electricity. As a result of the transfer, economic output increases by $526.0 million per year and employment increases by 1,268 compared to the use of coal for electricity. There is some reduction in economic activity due to the reduction in coal use. Some of the industries most impacted are the rail and shipping sectors that bring coal into Michigan (Tegen, p.7).

Net indirect tax revenue is estimated to be $24.6 million higher per year once the full 10 million MWh are switched from coal to natural gas. This includes additional property tax revenues from newer, updated facilities. Due to the changing nature of the business tax climate, this should be considered a very rough estimate.

Scenario II: 25 MILLION MWH

Scenario II looks at the economic impact of a fairly large shift of 25 million MWh hours of electricity generated by coal to 25 million MWh generated by natural gas. This represents replacing approximately 37 percent of the electricity generated by coal with natural gas. The economic and employment impacts for the construction phase are shown in table 5.

Table 5: Impact of Construction Scenario II				
	Direct	**Indirect**	**Induced**	**Total**
Impact on Output (Millions $)				
Pipeline	$100.0	$37.2	$54.9	$192.1
Plant Construction	$1,125.0	$487.8	$605.4	$2,218.2
Total Per Year	$1,225.0	$525.0	$660.3	$2,410.3
Impact on Employment				
Pipeline	931	260	458	1,650
Plant Construction	9,094	3,193	5,058	17,346
Total	10,025	3453	5,516	18,996
Months to Completion	**Months**			
Pipeline Construction	30			
Plant Construction	53			

Note: Numbers may not add up due to rounding.

As is the case for scenario I, during the construction phase the total annual economic impact is $2.4 billion. The direct impact of constructing pipeline and the electricity generating facilities is $1.2 billion per year. It is anticipated that it will take 2 years and 6 months to build the pipeline and 4 years and 5 months to build the electricity generating capacity. Given that this is a longer time frame than scenario I, the actual conditions are more likely to be different than the estimate shown here. The total level of investment during the construction phase is approximately $5.6 billion which generates a total economic impact of more than $10.1 billion. As is the case with scenario I, tax revenues are likely to rise as a result of greater economic activity generated by the electric plant construction. It should be noted that these impacts represent one-time economic activity and the economic activity, employment and tax revenue will cease once 25 million MWh of capacity have been achieved.

Table 6 outlines the ongoing economic activity and employment generated by switching 25 million MWh of coal-sourced electricity to natural-gas-sourced electricity.

Table 6: Economic Impact of Increased Natural Gas Production - Scenario I I				
	Direct	**Indirect**	**Induced**	**Total**
Annual Economic Impact (Millions $)	$199.3	$79.3	$39.1	$317.8
Less Reduction Due to Coal Replacement	$0.0	$12.9	$14.9	$27.8
Net Increase	$199.3	$66.4	$24.2	$291.0
Total Increase After Full Adoption	$875.0	$311.0	$129.0	$1,315.1
Annual Impact on Employment	121	405	317	854
Less Reduction Due to Coal Replacement	0	86	126	212
Net Increase	121	319	187	642
Total Increase After Full Adoption	532	1,547	1,082	3,170

Note: Numbers may not add up due to rounding.

The annual impacts for 25 million MWh are the same as in the 10 million MWh case as production increases over time, but the total impact is greater. Once the 25 million MWh are online and operating, the direct economic impact is $875.0 million per year, and the total economic impact is $1.3 billion per year. There are total number of 532 jobs created within the natural gas distribution sector and 3,170 total jobs created. Indirect business taxes are increased by $61.5 million per year including property taxes. Given the current state of flux of Michigan's tax policy and the relatively long time period, this figure should be interpreted very carefully.

SCENARIO III: 50 MILLION MWH

The most aggressive shift from coal to natural gas, scenario III replaces 50 million MWh of coal based electricity with electricity from natural gas. It represents replacing almost 75 percent of coal based electricity with natural gas sourced electricity. Scenario III, coupled with the renewable energy standard will seriously reduce coal as a source of electricity. As a result of this, scenario III should probably be considered an unlikely event, but it does show the economic impact of moving from a coal baseload electricity sector to a natural gas baseload electricity sector if coal is all but eliminated as a feedstock for electricity.

Table 7 outlines the economic impact of constructing 50 million MWh worth of natural gas based electricity plants and pipelines.

Table 7: Impact of Construction Scenario III				
	Direct	**Indirect**	**Induced**	**Total**
Impact on Output (Millions $)				
Pipeline	$100.0	$37.2	$54.9	$192.1
Plant Construction	$1,125.0	$487.8	$605.4	$2,218.2
Total Per Year	$1,225.0	$525.0	$660.3	$2,410.3
Impact on Employment				
Pipeline	931	260	458	1,650
Plant Construction	9,094	3,193	5,058	17,346
Total	10,025	3453	5,516	18,996
Months to Completion	**Months**			
Pipeline Construction	60			
Plant Construction	106			

Note: Numbers may not add up due to rounding.

The annual figures are the same as in the case of scenarios I and II. However, the total level of investment is estimated to be $11.2 billion with a total economic impact during the construction period of approximately $20.4 billion. It should be noted that the estimated time to construct this amount of capacity and pipeline is in excess of eight years. Changes in prices and technologies over time may impact the actual figures.

As is the case with scenarios I and II, tax revenues will increase as a result of expanded economic activity. It should be noted that these represent one-time economic activity and the economic activity, employment and tax revenue will cease once 50 million MWh worth of capacity has been achieved.

Table 8 shows the economic impact of increased natural gas production and distribution needed to meet the demand for 50 million MWh of electricity.

Table 8: Economic Impact of Increased Natural Gas Production - Scenario III				
	Direct	**Indirect**	**Induced**	**Total**
Annual Economic Impact (Millions $)	$199.3	$79.3	$39.1	$317.8
Less Reduction Due to Coal Replacement	$0.0	$12.9	$14.9	$27.8
Net Increase	$199.3	$66.4	$24.2	$291.0
Total Increase After Full Adoption	$1,750.0	$622.0	$258.0	$2,630.0
Annual Impact on Employment	121	405	317	854
Less Reduction Due to Coal Replacement	0	86	126	212
Net Increase	121	319	187	642
Total Increase After Full Adoption	1,064	3,094	2,164	6,340

Note: Numbers may not add up due to rounding.

The annual impacts for 50 million MWh as production is ramped up are the same as in scenarios I and II, but the total impact is greater. Once the 50 million MWh are online and operating, the direct economic impact is $1.75 billion per year, and the total economic impact is $2.6 billion per year. There are total number of 1,069 jobs created within the natural gas distribution sector and 6,340 total jobs created. Indirect business taxes are increased by $123 million per year. Given the current flux with respect to tax policy and the relatively long time period, this figure should be interpreted very carefully.

CONCLUSION

Converting coal based electricity generation to natural gas based electricity generation will increase employment and increase economic activity and tax revenues in Michigan. This is due to the fact that natural gas produced in the state replaces coal produced in other states. It is important to note that this is true as long a natural gas is cost competitive with coal.

The one-time direct economic impact of construction varies from more than $2.2 billion for 10 million MWh to more than $11.2 billion for 50 million MWh. The one-time total economic impact varies from $4.1 billion for 10 million MWh to more than $20.3 billion for 50 million MWh. The annual economic impact during the construction phase is the same for all three scenarios at $1.2 billion in direct activity and $2.4 billion in total activity. However, the length of time of the construction phase varies across scenarios.

Construction projects create roughly 10,000 jobs building pipelines and facilities and about 19,000 jobs in total. As previously noted, the economic activity and employment related to construction ends when the electricity plants and pipelines are fully built.

As new capacity is added, the annual increase in economic activity is estimated to be $199.3 million a year in direct activity (natural gas distribution), with a total annual increase in economic activity of $290.0 million a year after subtracting out the reduction in activity from reduced coal use. The annual increase in employment is 121 jobs in direct activity and 642 for the Michigan economy.

Total economic impact:

The total economic impact once all the natural gas fired electric facilities are constructed and running is:

- $350.0 million in direct activity and $526.0 million overall in scenario I;
- $875.0 million in direct activity and $1.3 billion overall in scenario II; and
- $1.75 billion in direct activity and $2.6 billion in total economic activity in scenario III.

Job creation:

The annual increase in employment as new capacity is added is estimated to be 121 in direct activity (natural gas distribution), with a total annual increase in employment of 642 after accounting for the reduction in coal use. The total additional new jobs created once all the natural gas facilities are constructed and are running is:

- 213 in direct activity and 1,268 total under scenario I;
- 532 in direct activity and 3,170 in scenario II; and
- 1,064 in direct activity and 6,340 overall in scenario III.

As noted earlier, it is estimated that construction projects will also create 10,025 direct jobs building pipelines and facilities, with a total of 18,996 jobs altogether under all three scenarios.

Increased revenue

Additional tax revenue is also generated by increased economic activity. This study estimates that indirect business taxes paid per year once the facilities are up and running is:

- $24.6 million in scenario I;
- $61.5 million in scenario II; and
- $120.0 million in scenario III.

Note: Given the current state of tax policy, these figures should be considered very rough estimates.

Appendix – Assumptions of the study

Overall assumptions of the study

- The price of natural gas for electricity is estimated to be $5 per 1,000 cubic feet. According to the U.S. Energy Information Administration, current prices for natural gas are slightly less than $5 per 1,000 cubic feet and some estimates believe that gas prices will rise somewhat in the future. According to the NREL it takes 7,000 cubic feet of natural gas to produce one MWh of electricity; cost per MWh is $35. According to the U.S. Energy Information Administration, the electric power price of natural gas was approximately $5 per 1,000 cubic feet in January 2011. Fluctuations in natural gas prices would affect the economic impact figures but should not impact the employment figures. Price fluctuations would also impact the comparative cost of natural gas based electricity compared to coal based electricity.

- Coal plants will be replaced by combined cycle gas plants. This is less expensive than building a new Greenfield plant, with the cost at around 90 percent of a new plant. Net jobs at the plant are unchanged. A gas plant and coal plant use the same number of employees. While good numbers are difficult to find, it may be the case that coal based plants employ a few more people than gas plants. Nonetheless, both coal plants and gas plants are capital intensive enterprises. The primary jobs lost will be in rail transport and other coal dependent activities, and the primary job gain will be in gas supply-related businesses.

- Output is measured in 2011 dollars. There is no attempt to adjust for inflation over time, nor has there been a present discounted value estimate done for the construction phase of these scenarios. The results are presented in real dollars. This assumption does not affect the employment results.

- There will be a one-time increase in employment resulting from installing gas equipment and building additional gas pipelines. These impacts are kept separate from the impact generated by ongoing natural gas production and distribution because of their one-time nature. Adding these together would overstate the long-term economic impact.

- Three scenarios are analyzed, displacing 10 million MWh of coal with natural gas; displacing 25 million MWh of coal with natural gas and displacing 50 million MWh of coal with natural gas. In 2009, total electricity generation was 101.2 million MWh. In 2009, 66.8 million MWh were derived from coal. Producing 10 million MWh of electricity will require $350 million in natural gas; 25 million MWh of electricity will require $875 million of natural gas; and 50 million MWh of electricity will require $1.75 billion of natural gas.

- The cost of installing new gas equipment is $1.12 million per megawatt (MW). This is based on the federal government's estimate that it costs approximately $1.25 million per MW for a greenfield plant, but that 10 percent of the cost is reduced by converting existing coal-based

electric sites to gas-fired electric sites. This translates into the need to install 1,756 MW to generate 10 million MWh; 4,390 MW to generate 25 million MWh; and 8,780 MW to generate 50 million MWh. This assumes a 65-percent utilization factor in accordance with the NREL data. This is reflective of current standards. Other sources indicate that state of the art facilities can run at an 87-percent utilization factor (Tegen, p.14). If that is the case then fewer megawatts will need to be installed. In either case these facilities do not run at full capacity for 24 hours a day, 365 days a year.

- The cost of building a natural gas pipeline is $1 million per mile. This figure is derived from a study done by the Bonneville Power Administration and the Northwest Gas Association. It is estimated that the average distance from the main gas line to a power plant is 10 miles. Michigan has a relatively well-built natural gas infrastructure. In actual practice, some of the pipelines would be more than 10 miles long and others will be less. It is estimated that one 10-mile pipeline is installed for 1 million MWh-worth of electricity. For 10 million MWh, the cost is $100 million; for 25 million MWh, the cost is $250 million; and for 50 million MWh, the cost is $500 million. Due to the time it takes to get plants constructed, it is assumed that pipelines that support 10 million MWh per year are installed. The annual construction of pipelines is $100 million per year.

- It is estimated that 1,000 MW are added per year. It is technically feasible to meet this construction schedule. However, access to credit, permitting and other factors may make this schedule optimistic. This may represent an overly aggressive construction schedule but it does show that replacing coal with gas will take several years, especially for the 25 million MWh and 50 million MWh scenarios. This construction schedule does not impact the final level of investment.

- The price of electricity generated by gas is equal to the price of electricity from coal. Both government and private sector sources indicate that this is a reasonable assumption. Consumers are indifferent to and do not distinguish between feedstocks. If rate payers have to pay a higher price for electricity generated from natural gas, there would be an adverse impact on overall economic activity, and funds used to produce and consume other goods and services would have to be used to buy electricity.

Assumptions Related to IMPLAN

The following are assumptions related to IMPLAN. As previously mentioned, IMPLAN is a standard economic impact software package.

- Production functions have constant returns to scale. This means that the inputs used to produce additional output are increased in the same proportion. The results may be overstated somewhat if construction and electricity production exhibit economies of scale, and large capacity facilities are constructed.

- There are no supply constraints. A project or industry has sufficient access to inputs to meet the demand for its output. Given current economic conditions – high unemployment, comparatively low industrial utilization – this assumption is not a major issue. If the national market for natural gas expanded quickly, this assumption may not be accurate.

- It is assumed that input prices are fixed. In this case, the increased demand for natural gas and construction of natural gas electric facilities is not great enough to increase input prices (MIG, p.103).

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