Energy Pricing and Manufacturing Competitiveness in Malaysia

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Malaysia's Manufacturing and Energy Challenge

Malaysia has reached a critical juncture in its history. In 2010, Malaysia's GDP grew by 7.156 percent its strong pace in a decade, making it one of Southeast Asia's fastest growing economies. After experiencing an economic boom and rapid development during the late 20th century, Malaysia has moved into what some economists call the third state of economic development, which centers around a growing emphasis on services. In 2010, services accounted for 49.3 percent of the GDP. This was a result of a concerted development of the service industry as part of a national development strategy to go into new growth areas and broaden the economic base for export.[1]

Industry represents an equally important economic driver in Malaysia's economy. In 2010, industry accounted for 41.6 percent of Malaysia's GDP, and had the 37th highest industrial production growth rate in the world at 7.5 percent. Some of the key industries in Peninsular Malaysia include rubber, oil palm processing and manufacturing, light manufacturing, pharmaceuticals, medical technology, electronics, tin mining and smelting, logging, and timber processing. Malaysia also has a large oil and gas industry. Agriculture meanwhile was responsible for 9.1 percent of Malaysia's GDP in 2010. Its two key agricultural projects are rubber and oil palm.[2]

As laid out in the government's *Tenth Malaysia Plan 2011-2015 (TMP),* Malaysia appears poised to make an effort from moving from being a middle-income nation to high-income status by 2020. One goal is for the service sector to achieve 61 percent of the nation's GDP by 2015. However, it is recognized that this will require a comprehensive economic transformation.[3] This will entail moving away from economic policies that once were successful to embracing new strategies that emphasize making a shift toward higher value-added and knowledge-intensive activities.

From an industrial perspective, the new policy framework will need to focus on human capital development, enabling infrastructure and supporting the development of industrial clusters.[4] Manufacturing is a major part of that focus—it accounted for 28.9 percent of Malaysia's GDP in 2008.[5] It also is the nation's major source of exports—Malaysia's exports are expected to grow at 10.6 percent annually mainly comprising manufacturing products, which are expected to grow at 10.8 percent annually and account for 78.8 percent of total exports in 2015.[6] The *TMP*, however, calls for moving up the value chain, which includes deepening and widening the industrial base through investments in new growth areas such as renewable energy, high-end electronic products, machinery and equipment and medical devices.[7]

Removal of subsidies. An important element in the plan is the removal of the generous subsidies the government provides to energy and other domestic goods. Historically, subsidies have been provided to keep the market prices down, below international market prices, in a number of important domestic commodities, in particular, petrol, diesel, natural gas, sugar, rice and flour. A recent estimate shows that the Malaysia government spent RM73 billion on subsidies making Malaysia one of the countries with the highest per capita spending on subsidies.[8]

Subsidies for energy have been an important and popular economic policy, underlying the nation's ability to attract and grow new business. As the *TMP* notes, the "provision of reliable and quality of energy at competitive rates has helped contain the cost of doing business" in Malaysia.[9] Malaysia's electricity sector and many industrial users, in particular, rely on heavily subsidized natural gas. Many industries have switched from diesel, which receives fewer subsidies, to natural gas to power their manufacturing processes, making it the preferred fuel among manufacturers.[10] Table I provides a comparison of subsidized and unsubsidized prices for natural gas for major consumers (December 2009). For example, it shows that subsidized gas price for the electric power sector is 74 percent lower than the actual market price. Of course, this translates into lower electric power prices for industrial facilities as well as commercial and residential electricity consumers.

Table I—Comparison of Natural Gas Price Subsidies in Malaysia

Natural Gas Consumer	**Subsidized Price** (per MMBTU)	**Unsubsidized Price** (per MMBTU)
Electric Power Sector	RM10.70	RM41.16
Large Power Consumers	RM15.35	RM56.20
Gas Malaysia	RM11.05	RM42.35

Source: Zuraimi Abdullah. "Hidden cost to subsidies." *New Straits Times*. April 12, 2010. *HighBeam Research*. (September 18, 2011). http://www.highbeam.com/doc/1P1-178619780.html.

It is clear then, that an important segment of Malaysia's economy has enjoyed substantial benefits from being protected from the impacts of high energy prices and volatile energy markets that they would they otherwise would have been subjected to. Nevertheless, there are compelling economic and social reasons today for going down this path today. For example, it has been noted that the subsidies contribute greatly to Malaysia's national debt while also taking away resources that could be used for social and economic development programs. For example, in 2008, fuel subsidies in Malaysia amounted to $17 billion (approximately RM52 billion), which was four times the combined amount the government pays for national defense, education and health care. As noted in an article on subsidies in the *New Strait Times*, "For Malaysia to be a more competitive economy, ideally, various items cannot continue to be grossly subsidized to the extent it distorts true costs. And the government appears committed to reducing subsidies."[11]

Removal of these subsidies however would undoubtedly raise serious transitional issues for Malaysia's economy, if not spark some political pushback. While Malaysia's electric power sector would be most directly affected, so would major industrial consumers, especially the nation's important energy-intensive manufacturing sector. As the *New Strait Times* article points out, "having been pampered with subsidies for so many years, most of us will naturally baulk at the prospect of higher power tariff."[12]

The issue facing the government therefore, if it is committed to removing subsidies as part of plan to become a high-income nation, may not be not whether or not to cut subsidies, but by how much and how fast, to cushion the potential impacts on its already thriving industrial sector.

An important component of that process, in fact, is another area that the Malaysian government has elevated to a higher priority in its economic planning: promoting greater energy efficiency, especially in its industrial sector. As noted in a recent Asia-Pacific Economic Cooperation Energy Working Group (APEC) report, the Malaysian government has made energy efficiency one of the important elements in its energy policy framework. The governments embracing of the energy efficiency tool, is being driven by concerns over the security of the nation's energy supply, the depletion of indigenous energy resources and climate change, and the need for mitigating the growing energy demand in the economy.[13]

High energy subsidies have been an important factor that hinders energy efficiency improvement efforts, however. At the same time, increasing industrial energy-efficiency can help offset impacts of rising prices as subsidies are removed. The APEC report therefore also has called for a pricing mechanism that while gradually reducing energy subsidies encourages investments on energy efficiency efforts by linking these efforts with incentives that could be sourced by the savings of energy subsidies.[14]

Assessing Energy Subsidy Options

As noted above, if Malaysia ends its energy subsidies, this could potentially have adverse impacts on the competitiveness of its manufacturing industries in global markets. Industries that are especially large consumers of energy fuels and feedstocks—energy-intensive (EI) industries may be hit the hardest by the loss of subsidies that historically have helped to limit the costs of energy for industry. Malaysia's major EI industries include iron and steel, cement, wood food, glass, pulp and paper, ceramics, and rubber. Energy costs typically account for at least 10 percent—and often quite a bit more—of the operating costs of EI industries. Eliminating these subsidies would most likely the increase the energy prices faced by EI manufacturers, perhaps significantly, as well as increase the volatility of energy prices

Even industries not considered energy-intensive ("non-EI industries")—their energy costs are a much smaller share of operating costs, perhaps a few percent and many less than 1 percent—would feel the effects in their bottom-lines. Many have specific production processes operations—e.g., parts stamping, machining, casting, and painting—that consume greater amounts of energy relative to their industries as a whole or other production divisions within industrial plants that do not consume much energy (e.g., assembly and downstream fabrication processes). For example, the energy-intensive rubber industry and non-EI fabricated metals industry both rank as the two of the largest consumers of energy (fuels and electricity) within Malaysia's industrial sector.[15]

In short, both major EI and non-EI manufacturing industries would likely experience energy cost increases arising from a policy that lessens or eliminates energy price subsidies for Malaysian industries. The magnitude and scope of these impacts would depend on the amount the subsidies are reduced how rapidly are phased out. Moreover, since these increases would be limited to Malaysian industries, manufacturers that not only are energy-intensive but are sensitive to international competition—in the United States we call these industries "energy-intensive trade exposed" or EITE industries—could suddenly find themselves at a competitive disadvantage relative to foreign producers who would not be affected by changes in Malaysia's energy subsidies.

It therefore is of some importance to be able to assess these impacts, to better understand the possible competitiveness consequences for Malaysian manufacturers, and for Malaysia's economy as a whole, if the Malaysian government enacts policies to reduce or eliminate energy price subsidies. Also, there will be a need to assess transitional costs and the effectiveness of different options for phasing out the subsidies while also promoting manufacturing competitiveness and economic growth. This includes policies and strategies to promote substantial energy efficiency gains in Malaysia's manufacturing industries. To-date, though, it appears that few such studies have been done.

HRS-MI Climate Policy and Manufacturing Study

However, High Road Strategies ("HRS"), in Arlington, Virginia, USA and the Millennium Institute ("MI") of Washington, DC, have collaborated in *analogous* studies that might lend useful insights about these impacts, though the context, nature and specifics of the problem examined are quite different from the Malaysian situation. Perhaps equally important, the HRS-MI studies present a research and evaluation methodology that could effectively be applied to quantitatively estimate and compare the potential economic and competitiveness impacts of different policy options the Malaysian government might consider regarding the reduction of energy subsidies.

Towards this end, this paper summarizes the principal elements of the HRS-MI studies, below, with attention given how they might apply to the Malaysian energy subsidy policy problem. The first, and most relevant of these studies, was conducted by HRS-MI for the National Commission on Energy Policy of the Bipartisan Policy Center (NCEP/BPC) in Washington, DC, and its findings presented in the report, *Climate Policy and Energy-Intensive Manufacturing: Impacts and Options*, released in June 2009.[16] The intent of this study was to evaluate the implications of enacting a climate policy for the energy-intensive manufacturing sector in the United States. Specifically, our objective was to examine the impacts of energy price changes resulting from CO_2-pricing policies on the competitiveness of five energy-intensive industries—iron and steel, aluminum, paper and paperboard, chlorine and alkalies (or chlor-alkali), and petrochemicals—that are among the largest industrial consumers of fossil fuels in the American economy. In addition, as part of this study and in two subsequent studies[17], we examined policy measures associated with climate legislation in the United States designed to mitigate these cost impacts.

Finally, the study made a preliminary attempt to examine how low-carbon technology investments might contribute to helping U.S. EITE industries achieve significant energy savings and cut GHG emissions, which ultimately is the only long-term sustainable option for maintaining the competitiveness of these industries in an increasingly carbon-constrained world. These findings and those of subsequent work by High Road Strategies examining risk and opportunities for American EITE manufacturing in Ohio, are also discussed below, with attention given to how they might also apply to addressing Malaysia's manufacturing competitiveness challenge.

a. Study background

The HRS-MI study was motivated by concerns about the potential economic and competitiveness impacts of enacting climate change mitigation legislation in the United States. Under these proposals, a mandatory cap would be placed on the total amount of greenhouse gases that could be emitted, generally tightening over time to meet long-term emission reduction goals. The belief was that an increase in fossil fuel energy prices would prompt a shift towards the use of lower-carbon fuels, especially in electricity generation and in industrial processes, as well as encourage gains in energy-efficiency in all sectors of the economy, thereby lowering GHG emissions.

Chances of passing such a bill in the U.S. Congress now seems unlikely in the current political environment, which became hostile towards any efforts at the federal level to address climate change after the 2008 Congressional elections. But at the time of the HRS-MI study, a number of people from the American business, labor and environmental communities, along with various legislators, began focusing on the potential transitional costs from enacting a climate bill, especially in the sectors most heavily reliant on carbon-based fuels.

Of particular concern were the impacts these policies could have on the U.S. manufacturing base, which has undergone significant capacity and job losses for well over a decade, accompanied by a persistent trade goods deficit—a situation made substantially worse as a result of the recent "Great Recession." U.S. industry groups and labor unions worried about the competitive disadvantages a climate policy might impose on U.S. manufacturing–especially energy intensive sectors. For example, iron and steel industry groups argued that American manufacturing is at "a distinct disadvantage in global competition… due to dramatically rising costs associated with energy."[18] They warned that a mandatory cap-and-trade program would consequently hurt the competitiveness and viability of the domestic steel industry. Some argued that their industry was approaching the technical limits of energy efficiency for the processes it operates today. To adjust to rising energy prices, it would need to adopt costly "new and transformational steelmaking technologies to achieve major additional reductions."[19]

Similarly, although most American labor unions today favor enacting a climate policy, industry impacts and international competition remain under scrutiny. American labor leaders have longstanding concerns about the impacts of policies on the competitiveness of the U.S. economy and especially on workers involved in the manufacturing of energy-intensive industry products. They have argued that climate policies should not encourage off-shoring of manufacturing or the sale of assets, and warn against "carbon leakage" that results when companies move their production to regions of the world without comparable GHG emissions reduction commitments. The latter concern was also echoed by several leading environmental organizations. As Robert Baugh, executive director of the American Federation of Labor-Congress of Industrial Organizations (AFL-CIO) Industrial Union Council (IUC), testified before the U.S. Senate Environment and Public Works Committee in 2007, "it is not in our national interest to see our efforts to reduce carbon emissions become yet another advantage that a developing nation uses to attract business."[20]

b. Earlier analyses

Despite this interest, there had been few efforts to rigorously analyze the problem. Until recently, the economic debate had been limited to macroeconomic impacts of climate policies. Analyses of climate legislation by the U.S. Department of Energy's (DOE) Energy Information Administration (EIA) have mostly calculated projected impacts on broad economic indicators, such as GDP, total consumer spending, and industrial output.[21] Other studies, by environmentalists and academic economists, have employed general equilibrium models that also mostly yield economy-wide impacts,[22] though some contain industrial input-out modules, which can calculate distributional effects, but mainly at a high level of sector aggregation.[23] The modest results obtained—for example, from a fraction of a percent to only a couple of percent declines in GDP by 2020 or 2030—were often used to argue that climate policies will have small or minimal impacts on the nation's economy.[24] At worst, they showed that GHG policies are likely to produce output and job losses mainly in the coal and other domestic energy industries.[25]

A small number of studies have attempted to examine climate policies and their implications for manufacturing industries. One set of studies are largely qualitative—they don't quantify policy impacts on industry sectors, but include in-depth industry profiles, and evaluate different energy and climate policy options in light of industry analyses.[26] Another set of studies applies modeling tools in attempts to quantify these impacts. The latter category include Resources For the Future (RFF) studies aimed at understanding how carbon-dioxide charges affect industrial competitiveness, measured as impacts on operating costs, profits, and production output.[27] In addition, two detailed studies of the impacts of the European Union Emissions Trading Scheme (EU ETS) on the competitiveness of European manufacturing industries provide a good degree of detail. Their focus on the other hand was on narrower, more energy-intensive industrial categories than traditional economic studies usually evaluate[28]

Only a few studies over the past decade have attempted to evaluate climate policies and their potential impact on the U.S. manufacturing sector, especially on energy-intensive industries, using dynamic modeling tools. These include a set of pioneering research studies performed by University of Maryland environmental economics professor Matthias Ruth and several of his graduate students in the late 1990s and early 2000s with U.S. Environmental Protection Agency support.[29] These studies employed System Dynamics models to assess climate policy impacts on the steel, paper, and ethylene manufacturing industries. This approach enables examination of complex, dynamic economic interrelationships at the industrial sector level, which few traditional economic models are capable of carrying out.

c. The HRS-MI study

The HRS-MI study was a new addition to this small group. Like the others, it employed a System Dynamics modeling approach to quantify and evaluate the increased production costs resulting from policies that impose a price on carbon emissions, and their subsequent, long-term (through 2030) impacts on manufacturers bottom-lines and production output. It evaluated these industries under several carbon-policy scenarios as well under different assumptions concerning the ability of import-sensitive manufacturers to pass along their new cost increases to consumers of their products, both domestically and in global markets.

The System Dynamics methodology allows for the representation the context in which policies are formulated and evaluated, characterized by feedback loops, non-linearity and delays[30] One of the first objectives of the analysis was to identify the main causal relations and feedback loops underlying the structure of energy intensive manufacturing. Such loops are then responsible for the creation of the behavior of the system and allow for the identification of the main levers driving it. The model therefore can provide inputs on both policy formulation and evaluation.

In particular, the HRS-MI study was aimed at analyzing and estimating the impacts of major proposed climate change legislation on the competitiveness of five of the most energy-intensive trade-exposed industries in the U.S. economy: iron and steel and ferroalloy products, aluminum (primary and secondary aluminum), paper and paperboard mills, petrochemicals, and alkalies and chlorine (chlor-alkali) manufacturing. The definitions of these industries used to guide the data gathering and modeling work in the study were based on the North American Industrial Classification System (NAICS),[31] the classification schemed used by U.S. statistical agencies for collecting and organizing industrial data, such as value of shipments, employment, number of establishments and energy consumption.

Climate legislation and price projections. The climate legislation considered by the U.S. Congress before 2008 would have established a cap-and-trade regime in the United States, requiring large emitters of greenhouse gas (GHG) emissions to purchase emission allowance permits ("allowances") to cover their emissions. In effect, consumers of fossil-fuel based energy sources would be required to internalize a carbon-charge, based on the fuel's' carbon content.

The specific climate legislation that the first HRS-MI study evaluated was the *America's Climate Security Act of 2008* (S. 2101), introduced by U.S. Senators Joseph Lieberman (I-CT) and John Warner (R-VA). Popularly known as the "Lieberman-Warner" climate bill, and referred to in the HRS-MI report as the "Mid-CO2 Price Policy," the HRS-MI study compared this policy to a "business-as-usual" (BAU) case that assumes no climate policies are enacted into law throughout the study period (1992-2030). The EIA analysis of the Lieberman-Warner bill projected inflation-adjusted (USD 2006) the emission allowance price to rise to $30 per metric ton of CO_2-equivalent ("CO2-e") emissions by 2020 and $61 by 2030. The policy case was assumed not to go into effect until 2012.

The energy price projections the study used—for electricity and five fuel types, including metallurgical coal and coke, natural gas, liquefied petroleum gas, residual fuel oil and distillate fuel oil—were based on the EIA's analysis of the Lieberman-Warner bill. Staff from the NCEP/BPC worked with the EIA, using the National Energy Modeling System (NEMS) to generate energy fuel and price projections associated with the alternative policy scenarios evaluated in the HRS-MI study (see below). That is, the price projections for each policy scenario were the principal independent (i.e., exogenous) variables employed in calculating industry cost and market impacts associated with that policy. As shown in table II, these energy sources would experience steady hikes in their prices over time, resulting from the policy change imposed by the climate legislation—*a situation that could be seen as analogous to when energy price subsidies are phased out in Malaysia*.

d. Research approach

Generally, the study investigated three questions:

- How will climate policy-driven energy price increases affect the production costs of manufacturers in energy-intensive manufacturing sectors?

- In the face of energy-driven cost increases, and constraints on manufacturers' ability to pass these costs along to consumers, how will international competition affect the industries' competitiveness (i.e., profitability and market share)?

- How will manufacturers respond to the energy price increases and possible threats to their competitiveness? For example, would firms adopt new energy-saving practices and technologies, expand or reduce production capacity, or move operations or plants offshore?

Table II—Energy Price Scenarios

($2000/MBtu and % above BAU)

Energy Source	Real Energy Prices ($2000)		
	BAU 2006	Mid-CO_2 Price 2020	Mid-CO_2 Price 2030
Electricity	15.42	16.09	17.11
Percent above BAU	—	*9.6*	*12.1*
Natural Gas	6.57	6.51	8.69
Percent above BAU	—	*22.2*	*39.0*
Metallurgical Coal	3.04	6.01	8.65
Percent above BAU	—	*104.7*	*180.0*
Liquefied Petroleum Gas	16.91	14.48	15.25
Percent above BAU	—	*0.5*	*-0.1*
Coal Coke	9.11	18.02	25.94
Percent above BAU	—	*104.7*	*180.0*
Residual Fuel	7.77	9.01	11.81
Percent above BAU	—	*26.7*	*47.1*
Distillate Fuel	13.15	14.31	17.30
Percent above BAU	—	*14.1*	*24.0*

Source: EIA, NCEP, HRS-MI

Source: J. Yudken and A. Bassi, *Climate Policy and Energy-Intensive Manufacturing*, June 2009.

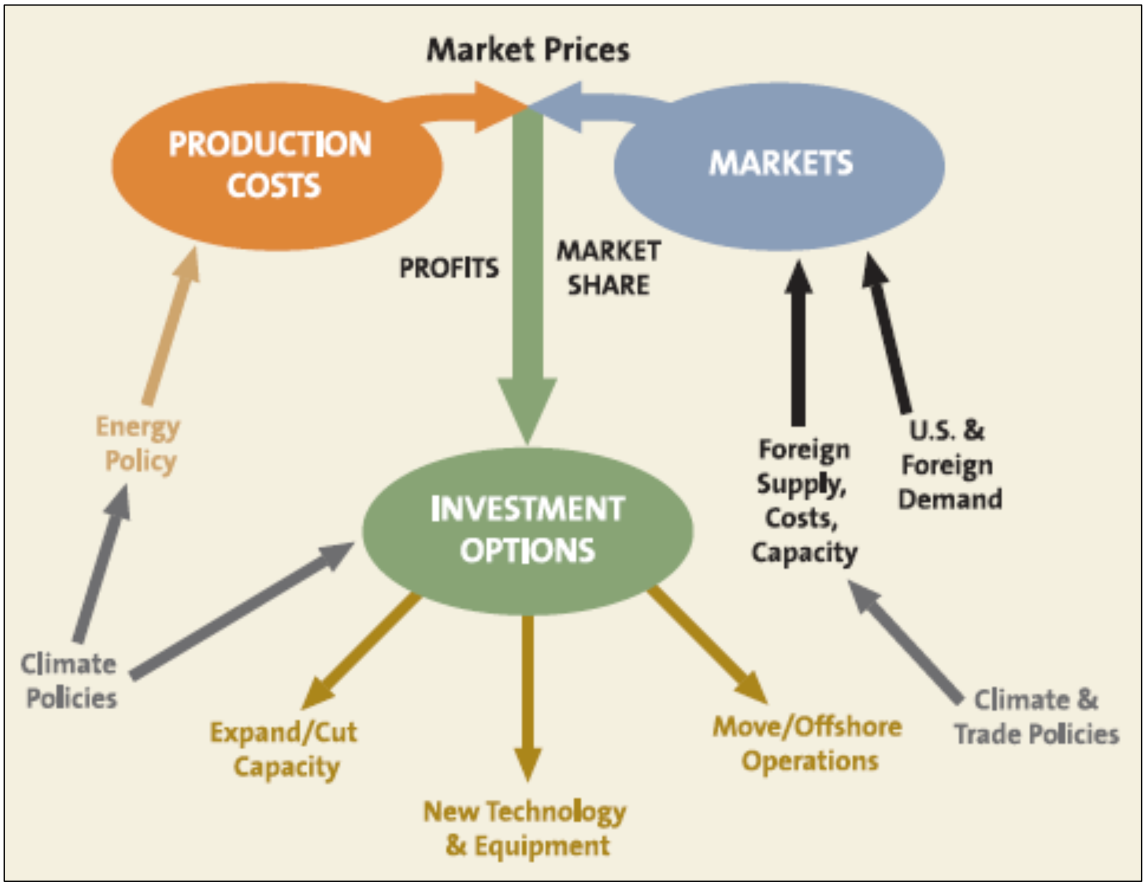
To address these questions, the HRS-MI study involved developing detailed economic and energy profiles of these manufacturing industries, including the collection and processing of historical economic data, and construction of substantial, System Dynamics industry sector models, supported by group model building sessions. These steps are briefly described below.

- Profile development and data gathering. This involved extensive gathering and analysis of statistical data and information from multiple sources, including the professional literature, U.S. government databases and studies, domestic and international industry sources, and academic research. Drawing on this large body of information, economic and energy profiles of each industry sector being examined were developed. That is, the profiles summarized descriptive, historical and statistical information on fundamental production processes and technologies, industrial organization and structures, markets and trade flows, economic and financial trends (production outputs, shipments, costs and expenditures (materials, labor, capital, energy)), and energy use and flows associated with the industries' production processes.[32]
- Model development. Employing a powerful, flexible, transparent, and interactive system dynamics modeling tool based on the Vensim® modeling platform, the HRS-MI team constructed a computer-based systems dynamic model—the *Integrated Industry-Climate Policy Model* (II-CPM)—supplemented by econometric and qualitative analyses applied to each industry sector. These models enabled simulations of alternative climate policy scenarios and their impacts on the industry's cost structure and market dynamics.
- Group Modeling Sessions and Interviews. Many group modeling sessions were held involving representatives of industry trade associations and their corporate members from each of the subject industries.[33] These meetings enabled the collection of a substantial amount of primary industrial data, provided perspectives and information about industry behavior and trends, and elicited invaluable feedback about industry model structures, assumptions and data.[34]

Three-pronged modeling strategy. The modeling work in the project followed a three-pronged approach schematically represented in figure 1, and outlined below. First, we constructed basic *production cost* (labor, materials, capital expenditures, and energy) models for each of the chosen industries. These were then extended and broadened to enable modeling of market dynamic features, that accounted for international trade flows and their impacts on the industries' bottom-lines and outputs, under the different GHG emissions pricing scenarios and under different market assumptions (e.g., regarding cost pass along). Finally, the modeling results helped to inform our analyses of investment and policy options, the third leg of the study, for the different industries.

- ***Modeling Production Costs.*** Models of production cost structures for all the industries were constructed, which were used to calculate the impacts of carbon pricing policies on these costs. Production cost calculations were based on a cost component model that summed the operating (or variable) costs associated with production outputs for the selected industries—i.e., materials and capital expenditures, labor expenditures (full compensation including wages, salaries and benefits), and energy expenditures (i.e. direct use and feedstock, non-fuel, energy).[35] The models dynamically calibrated their costs projections back to 1992 based on historical data, and then out to 2030 for the policy and BAU cases. They incorporated assumptions about future materials, investment and labor cost trends based on historical trends and feedback from industry experts. Care was taken to include costs associated with carbon-fuel based feedstock (coke in steelmaking, natural gas in petrochemicals) in the overall energy cost..

Figure 1—Climate and Energy-Intensive Manufacturing: Modeling Framework



Source: Joel S. Yudken and Andrea M. Bassi, *Climate Policy and Energy-Intensive Manufacturing.* June 2009.

- *Modeling Market Dynamics*. Market dynamics models for all the industries were constructed, incorporating import and export trends and integrated with the production cost models. The expanded models were used to assess the consequences of carbon-policy driven production cost increases on the sectors' profitability, production output and market share. An important consideration in manufacturing firms' decisions regarding production capacity, output and investment, is whether additional costs resulting from government-imposed policies, can be passed through to their customers (i.e., "cost pass-along" or CPA). The HRS-MI simulations assumed both zero pass-through and 100 percent pass-through of these additional costs.[36]

- *Assessing Investment Options and Policy Alternatives.* Potential investment options—from capacity changes (e.g., cutbacks and off-shoring) to energy saving technologies—available for each sector, were identified, and evaluated in light of the production cost-market dynamics simulations. This phase of the work included: (i) a review of technology investment options; (ii) a modeling-based assessment of energy-efficiency requirements; and, (iii) a preliminary alternative policy option for offsetting costs. We interpreted these results through the prism of one of the fundamental questions we are most concerned with: how will domestic energy-intensive manufacturers adjust to rising climate policy-driven energy costs under different policy and economic assumptions? This includes a preliminary assessment of the extent to which, and under what conditions, manufacturers would reduce their production capacity (close facilities and/or move offshore) in response to the cost changes.

Modeling scenarios. Using the II-CPM, the primary scenarios we modeled include the following:

- *Core Scenarios*. These simulations estimated the impacts of the Mid-CO_2 Price Policy relative to BAU on the selected energy-intensive industries. They assumed that the industries did not pass additional energy costs along to their customers (the "no-cost-pass-along" scenario, or NCPA). In addition to measuring energy and production cost impacts in the simulations, we defined new variables, the *operating surplus,* to serve as a proxy for an industry's profits, and the *operating margin,* as a proxy for its profit margin, and therefore are indicators of an industry's profitability. At the unit of production level, the operating surplus is defined as difference between an industry's aggregate market price and its unit production cost. The operating margin is defined as the ratio of an industry's total operating surplus and total revenues. [37]

- *Cost Pass-Along Scenarios.* According to economic studies and industry experts, the ability of these industries is generally constrained, especially in the short-to-medium run, depending on economic conditions and the strength of market demand. Historically, material and energy costs driven by global forces and market imbalances have been passed along. But uncertainty remains about whether U.S. EITE firms would normally transfer policy-driven energy costs onto their customers, especially when faced with foreign competitors unencumbered by comparable energy cost increase. Indeed, the evidence suggests the NCPA scenario would more realistically represent the energy-intensive industries' market situation under a climate policy.[38] Nevertheless, to provide a full spectrum of possible industry responses to energy costs increases, we simulated cost pass-along (CPA) cases as well.

In addition to these scenarios, the HRS-MI team the calculated *energy-efficiency gains* that would needed to offset the increasing energy costs from a climate policy. We also modeled an *allowance allocation scenario*, wherein allowances are distributed to energy-intensive industries to mitigate a portion of the increased energy prices, which proved to be a precursor to later studies we conducted that examined similar cost-mitigation measures proposed in subsequent climate legislation.[39] Finally, we carried out several sensitivity studies to examine variations in our results from different assumptions about key model variables, notably materials costs, domestic and world prices, elasticities of demand and energy efficiency improvement rates.

e. Summary of Findings

The findings from the HRS-MI study showed that climate change policies that put a price on CO_2 and other greenhouse gas emissions in the economy, when applied only in the United States and with no relevant energy efficiency investments, could have substantial impacts on the competitiveness of U.S. energy-intensive manufacturing industries over the next two decades. In general, they supported the following conclusions:

- *Climate policies that impose a modest to high cost on carbon-based energy sources would increase most of the energy-intensive industries' production costs, reduce their operating surpluses and margins, and shrink their domestic market shares.*[40] As shown in table III, and figure 2, energy price increases associated with the climate policy case would drive up total production costs while causing declines in the operating surpluses and operating margins of the energy-intensive industries. The impacts, however, would vary considerably across the industries—the iron and steel industry would experience the largest real production cost increases, while secondary aluminum and petrochemicals would experience the most modest cost impacts. Correspondingly, the industries with the greatest production cost increases would suffer the largest operating surplus and margin declines—i.e., iron and steel, paper and paperboard, and chlor-alkali, followed by primary aluminum.

- *Since these industries typically are constrained in their ability to pass along domestic policy-driven energy costs* (because of international competition, market conditions, the nature of their markets, and other factors), *they likely would feel increasing pressure to take actions to reduce their costs and prevent their profitability from decreasing to undesired levels.*

- *The adoption of both readily available and more cutting-edge technology, and the achievement of high energy efficiency gains on a large scale could offset increased costs and generate additional profits.* All the industries investigated have been exploring a range of energy-saving technologies that could help mitigate these impacts, but face financial, technological, and other limitations (such as the age and sunk costs of their existing equipment) on their ability to successfully invest and adopt these alternatives over the short-to-mid-term.

Table III—Production Cost Impacts, Study on Climate Policy and EI Manufacturing

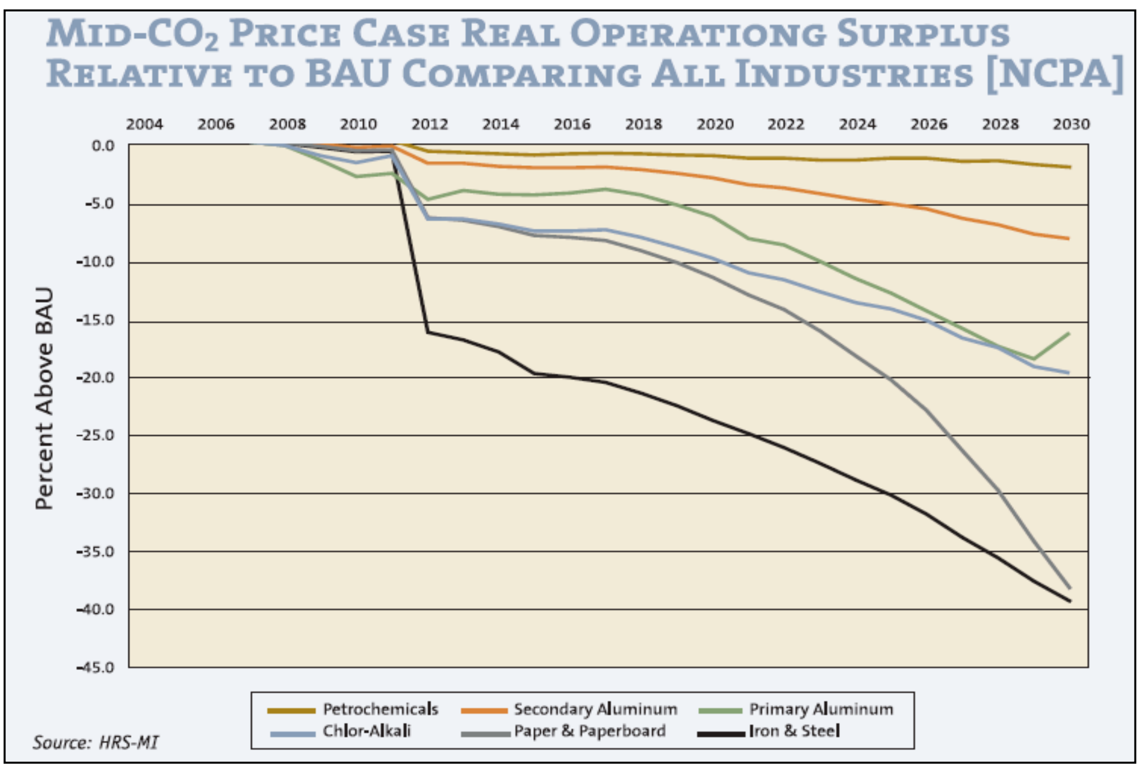
Real Unit Production Costs Above BAU, Mid-CO_2 Price Policy

Industry Sector (Unit)	2012		2020		2030	
	$2000	Percent	$2000	Percent	$2000	Percent
Primary Aluminum (mt)	38	2.2	40	2.6	64	4.6
Secondary Aluminum (mt)	7	0.5	10	0.8	19	1.7
Iron & Steel & Ferroalloys (ton)	29	4.0	50	6.7	90	11.4
Paper & Paperboard (ton)	11	2.1	17	4.0	31	8.7
Petrochemicals (ton)	3	0.6	5	1.0	9	1.5
Chlor-Alkali (mt)	4	3.6	6	5.5	10	9.9

mt=metric ton

Source: J. Yudken and A. Bassi, *Climate Policy and Energy-Intensive Manufacturing*, June 2009.

Figure 2—Operating Surplus Impacts



Source: J. Yudken and A. Bassi, *Climate Policy and Energy-Intensive Manufacturing*, June 2009.

- *An allowance allocation policy that substantially offsets energy cost impacts, at least through 2025, could buy time for these industries to make the adjustments and energy-saving technology investments required for maintaining their domestic production capacity and competitiveness.* On the other hand, if industries do not invest early enough, making use of the time window provided by the allowance allocation, they could face even harder times toward 2025-2030.
- *Other policies, nevertheless, will likely be needed to encourage and enable industries to make these investments,* as an alternative to cutting production or moving their operations to low-cost, low-regulation locations.

Energy Cost Mitigation Studies

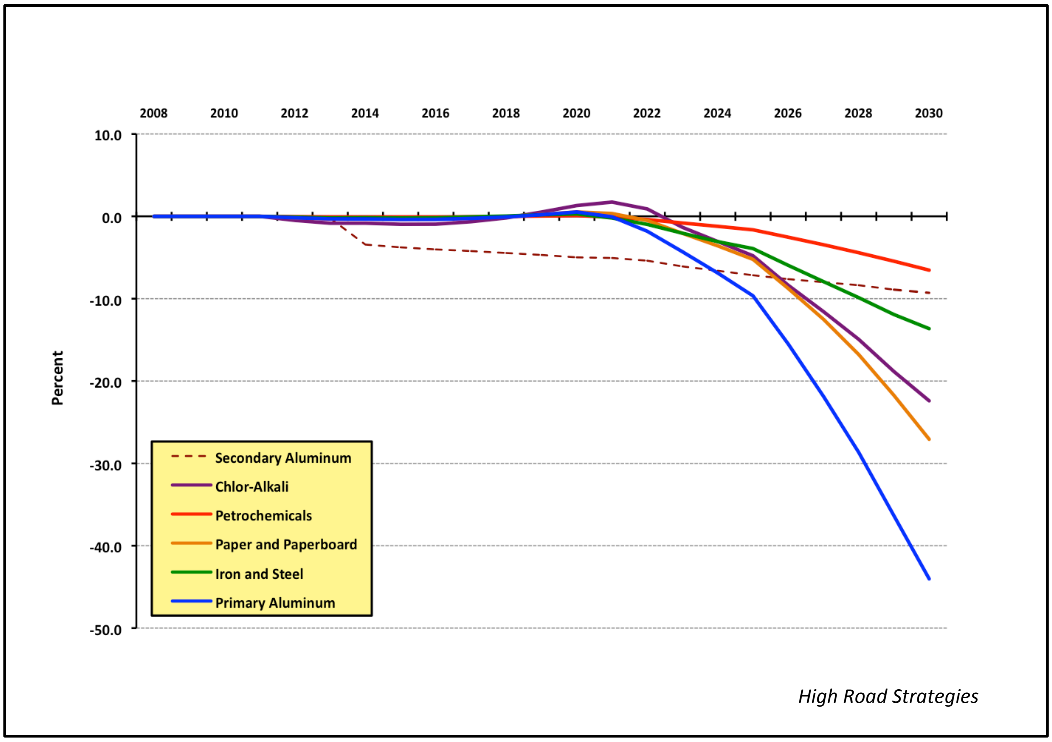
Driven by concerns about the potential energy cost impacts on U.S. energy-intensive industries associated with climate policy-driven energy price increases, which had been projected by the HRS-MI and other studies, the U.S. House of Representatives passed the *American Clean Energy and Security Act* in June 2009 (H.R. 2454), introduced by U.S. Representatives Henry Waxman (D-CA) and Ed Markey (D-MA), (a.k.a. *ACESA* or the "Waxman-Markey" bill), which included two provisions designed to mitigate these cost impacts. The first measure, called the "output-based rebate," would reimburse EITE industries for the projected costs they would incur from having to purchase GHG emission allowances. The rebates would be keyed to the industries' production output and start to phase out after 2020.

The second measure, the "border adjustment fee," would impose a surcharge on the imports of countries that have not enacted carbon-constraining policies comparable to that of the United States, as enacted in the Waxman-Markey bill. The fee would be based on estimates of the carbon-content of the imports from the "non-compliant" countries.

The HRS-MI team subsequently conducted two new studies, building on its original research, which evaluated the effectiveness of these measures in mitigating the costs of climate policy that EITE industries would incur. The first study assessed the "output-based" rebate measure in the ACESA (sponsored by the Environmental Defense Fund (EDF)),[41] while the second attempted to evaluate the border adjustment measure in the bill, as well examining alternative policy scenarios (sponsored by NCEP/BPC and the AFL-CIO Working for America Institute).[42]

A detailed discussion of these studies is beyond the scope of the current paper. However, it should be noted that the first study found that the output-based rebate would in fact substantially mitigate cost impacts from the climate policy for the short-to-mid-term—from 2014, when the policy would first be implemented until around 2020-2022 (see figure 3). After 2022, the industries would first start to see a slow rise in additional costs arising from emission allowances, and then a very rapid rise in added costs as the rebates phase out. The second study concluded that although border adjustments might help mitigate cost impacts in some instances, their effectiveness was seen to be somewhat limited and uncertain.

Figure 3—Operating Surplus Impacts, ACESA With Output-Based Rebates



Industrial Energy Efficiency Opportunities

Although the HRS-MI team did not attempt to model technology investment opportunities, we applied the model findings to estimate the energy efficiency gains that would be required the offset increasing energy costs associated with climate policy, which also allows potential avoided costs associated with reducing energy consumption to be calculated. We also conducted a preliminary review of the principal near-, mid-, and long-term technology options available to reduce energy use, improve efficiency, and offset the impacts of higher production costs arising from a climate policy.

Manufacturers have several options when confronted with higher production costs, including investments in energy-saving technologies. In this review, we found that many technology investment and policy options exist that could mitigate the industries' policy-driven cost increases, improve their energy-efficiency, and ultimately enhance their economic performance. This study, and the two subsequent studies conducted by the HRS-MI team concluded that more research is needed to further identify, explore and analyze these options, as well as policies that enable and encourage.

Over the last year High Road Strategies has been involved in two more recent studies that entailed analyzing the risks and opportunities associated with energy and climate policies, with a focus on manufacturing industries in the U.S. state of Ohio.[43] As in the HRS-MI study, both Ohio studies (the second is still underway) have recognized that there are both short-and-medium-term "low hanging fruit" with respect to industrial energy efficiency (IEE) technology options as well as more advanced, longer-term "next generation" process-specific technologies that could result in significant energy-savings if implemented. These options are schematically represented in table IV.

Table IV—Industrial Energy Efficiency Technology Options

INDUSTRY	PROCESS-SPECIFIC TECHNOLOGIES		EMERGING TECHNOLOGIES
Iron & Steel and Ferroalloy Products	• Pulverized coal and natural gas injection • Direct smelting—eliminating coke oven • Thin slab casting	• EAF—oxy-fuel burners • DC-arc furnace • Scrap preheating • Improved blast furnace controls	• Paired straight hearth furnace • Molten oxide electrolysis • Hydrogen flash melting
Petroleum Refineries	• Improved separation efficiency for distillation • Advanced separation technology	• Improved pre-heater efficiency • Improved catalyst efficiency • Convert condensing turbine to electric motor drive	• Alternative hyrdotreater and desalter designs • Progressive distillation design
Chemicals	• Improved efficiency of cold fractionation and refrigeration systems • Improved "cracking" processes and transfer line exchangers		• High temperature furnaces • Gas-turbine integration • Advanced distillation columns • Biomass-based systems
Pulp and Paper	• Cradle and dry debarking • Automated chip handling and thickness screening technology • Improving digester efficiency • Chemical recovery boilers that generate steam	• Heat chlorine dioxide with waste heat • Advanced dryer control systems • Optimize water removal in forming and pressing	• Black liquor gasification • Advanced dryer technologies (impulse, gas-fired, multi-port)
Cement	• High efficiency roller mills and classifiers • Replace energy-intensive-"clinker" with fly ash, slag, or other mineral components	• Switch from older, less efficient "wet process" • State-of-the-art dry processing • Improve efficiency of "finishing grinding"	• Oxy-combustion for CCS • Alternative fuels-biomass • Pre-combustion membranes • Superheated Calcium Oxide (Cao)

CROSS-CUTTING TECHNOLOGIES & PRACTICES	MAJOR CROSS-CUTTING TECHNOLOGIES
• Energy monitoring and management systems • Variable speed drives for pumps and fans • Preventative maintenance • Improved process control • Improved efficiency of boilers, heaters, turbines, conveyors, furnaces, and motors • Facility-wide opportunities (lighting, HVAC) • Insulation for steam distribution systems and boilers	• High efficiency motor systems • Combined Heat and Power (CHP)/Cogeneration • Waste heat recovery • Materials recycling • Carbon capture and storage (CCS) (Long-term)

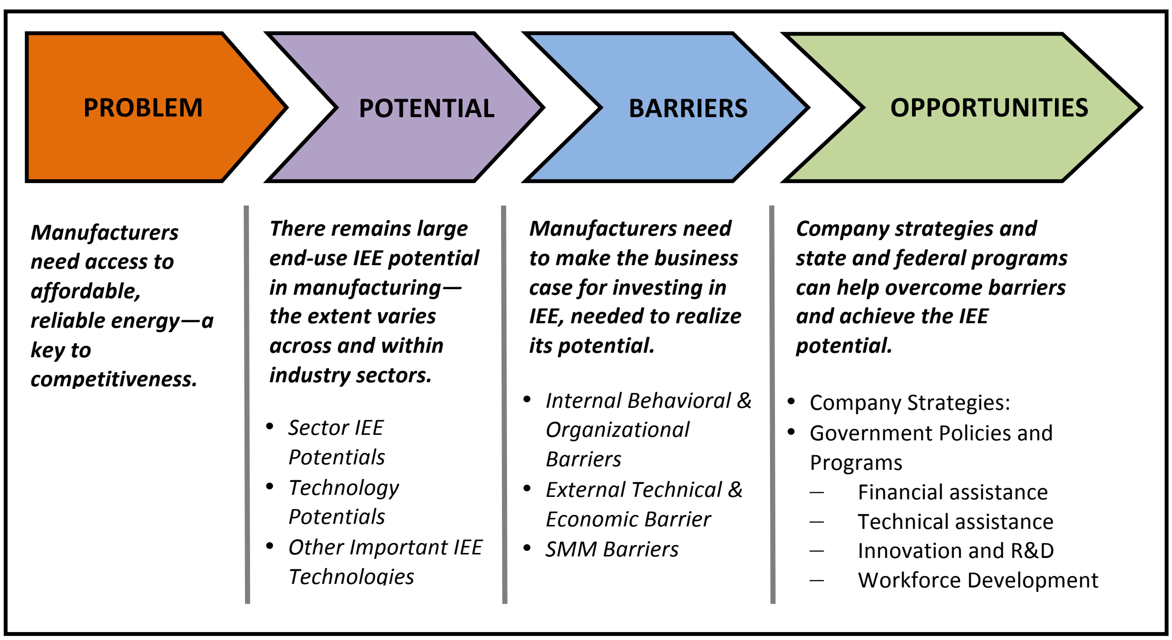
Source: Joel S. Yudken, *Industrial Energy Efficiency Roadmap for Ohio Manufacturing*. (Forthcoming)

The cross-cutting, energy support system technologies can be applied in a wide-range of industrial setting. They include relatively low-cost incremental improvements in energy savings and efficiency such as more efficient electric motors, pumping systems and compressed air systems among other measures that can reduce energy use in production processes. They also can include lighting, HVAC and refrigeration efficiency improvements in facilities.

Especially important are combined heat-and-power (CHP) and waste heat recovery systems, which can apply recycled heat, from production process (such as blast furnaces in iron and steel making) or on-site power generation to other heating processes or electricity generation (CHP systems). However, the energy-efficiency analysis of the first HRS-MI study suggests that much larger gains, requiring substantial investments in advanced and emergent low- or no-carbon processes-specific technologies would be necessary over time.

The second Ohio study laid out a framework, a "roadmap," as shown in figure 4, not only to identify and assess the IEE potential technology options that exists, but also the barriers that constrain manufacturers' ability to achieve this potential, and then the opportunities for overcoming these barriers. The barriers include both internal behavioral and organizational characteristics and external technical and market factors that make it difficult for manufacturers to make the "business case" to make IEE investments. The opportunities refer both the company strategies and government (both federal an state) policies and programs that can encourage and enable manufacturers to undertake actions that realize their IEE potential.

Figure 4—Industrial Energy Efficiency Roadmap



Source: Joel S. Yudken, *An Industrial Energy Efficiency Roadmap for Ohio Manufacturing: Potential, Barriers and Opportunities.* Prepared for the Ohio University Voinovich School and The Ohio Manufacturers' Association. (Forthcoming)

Implications for Malaysia's Competitiveness

There is not sufficient space to discuss this "roadmap" analysis in any depth here. However, although most of the government programs and policies identified in the Ohio studies are specific to the United States, other policies, as well as the barriers and strategies the studies examined might be instructive and relevant to Malaysia's efforts to increase the energy-efficiency and competitiveness of its manufacturing sector—especially its most energy-intensive industries. The roadmap also provides a framework for evaluating this challenge and tailoring policies and programs to Malaysia's needs. For example, would eliminating energy subsidies weaken or strengthen the barriers and opportunities for achieving Malaysia's IEE potential? A case can be made that taking away the price subsidies and driving up energy costs could increase manufacturers incentives to invest in energy-saving technologies. By the same token, however, the higher costs incurred by manufacturers could create a disincentive by reducing the resources available to make such investments. In any event, not taking action to make improvements in energy efficiency in Malaysia's manufacturing sector, even if subsidies are not removed, would still leave the industrial sector vulnerable to volatile and rising energy prices over time, especially if global energy prices increase over the next few years.

As suggested in the discussion of the HRS-MI studies of manufacturers' potential cost impacts tied to price increases driven by adoption of a climate policy, there are analogous features in the Malaysian energy subsidy challenge. There potentially could be increased costs that cut into the profitability and competitiveness of Malaysia's manufacturing industries, though the extent and scope of these cost impacts would vary depending on the industry—EITE industries might suffer the greatest impacts—and how much and how fast the subsidies are reduced.

The discussion above argues, in fact, for measures that mitigate over the short-and medium-term the cost impacts of subsidy reduction—and related market pressures that drive energy prices—just as in the United States lawmakers had tried to introduce such provisions into their latest climate bills. At the same time, this also suggests the need to design policies appropriate to Malaysia's political and economic situation that would encourage and enable these investments.

In this paper, a methodology and approach for evaluating these impacts and options was also presented that could potentially be applied to analyzing both the economic impacts and potential transitional strategies that could help Malaysia effectively follow the "roadmap" that can lead to greater manufacturing competitiveness and economic prosperity.

ENDNOTES

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4 EPU, *Tenth Malaysia Plan,* 14.

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19 American Iron and Steel Institute (AISI), "Climate Change Priorities" *2007 Public Policy Agenda,* Washington, DC, February 22, 2007, 8-10.

20 Robert C. Baugh, "A 21st Century Energy Policy for Environmental and Economic Progress, Testimony Before the Environment and Public Works Committee for the U.S. Senate," July 25, 2007.

21 U.S. Department of Energy, Energy Information Administration (EIA), *Energy Market Impacts of Alternative Greenhouse Gas Intensity Reduction Goals,* SR/OIAF/2006-01 (Washington, DC, March 2006), Tables 2a and 2b, 11-12; U.S Department of Energy, Energy Information Administration (EIA), Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007, SR/OIAF/2008-01 (Washington, DC, April 2008), xii, table ES3.

22 U.S Department of Energy, Energy Information Administration (EIA), *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007*, SR/OIAF/2008-01 (Washington, DC, April 2008), xii, table ES3; S. Paltsev, J.M. Reilly, H.D. Jacoby, A.C. Gurgel, G.E. Metcalf, A.P. Sokolov and J.F. Holak, "Assessment of U.S. Cap-and-Trade Proposals," MIT Joint Program on the Science and Policy of Global Change, Report 146, April 2007.

[23] Richard D. Morgenstern, Mun Ho, Jhih-Shyang, and Xuehua Zhang, "The near-term impacts of carbon mitigation policies on manufacturing industries," *Energy Policy* 32 (2004) 1825-1841.

[24] Trevor Hauser et al. *Leveling the Carbon Playing Field: International Competition and US Climate Policy Design.* World Resources Institute and Peterson Institute for International Economics (2008); U.S. Department of Energy, Energy Information Administration (EIA), Energy Market Impacts of Alternative Greenhouse Gas Intensity Reduction Goals, SR/OIAF/2006-01 (Washington, DC, March 2006), Tables 2a and 2b, 11-12.

[25] U.S Department of Energy, Energy Information Administration (EIA), Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007, SR/OIAF/2008-01 (Washington, DC, April 2008), xii, table ES3. These findings were a key reason that American labor unions opposed the Kyoto Protocol—another was lack of large developing nation's participation in the agreement—even though only a relatively small number of unions would be directly affected. See also Robert E. Scott, "Accelerating Globalization? The Economic Effects of Climate Change Policies on U.S. Workers," Economic Policy Institute, Washington, DC, September 17, 1997; Standard & Poor's DRI, The Impact of Meeting the Kyoto Protocol on Energy Markets and the Economy. Report prepared for UMWA-BCOA LMPCP Fund, July 1998. This study, using a DRI model, found that implementing the protocol would result in the loss of 1.3-1.7 million jobs by 2005, GDP declines of 1.1-1.6 percent on average during the compliance period, consumer energy price increases from 24-36% and producer energy price increases from 49%-77%, and reductions in real household incomes of $1,021 to $1,403 per family annually.

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[31] U.S. Census Bureau, *Statistics for Industry Groups and Industries,* 2006 (Annual Survey of Manufactures), M05(AS1) (Washington, DC: November 2006)

[32] The primary data source used in modeling industry production costs was the Census Bureau's *Annual Survey of Manufactures* (ASM). Detailed industry import and export data used in modeling market impacts came from United States International Trade Commission (USITC) databases. Production and a wide-range of other statistical data for specific industries were made available by several major industrial trade associations. See U.S. Census Bureau. *Statistics for Industry Groups and Industries*. Washington, DC; and *USITC Interactive Tariff and Trade DataWeb*, available at http://dataweb.usitc.gov/

[33] In particular, on the industry side, we met several times with the American Iron & Steel Institute (AISI), the Aluminum Association, the American Forest & Paper Association (AF&PA), and the American Chemistry Council (ACC). These groups not only gave generously of their time, expertise and insights, they gave us free access to their statistical databases, which were invaluable in our modeling work. On the labor side, we met and talked by phone with several different representatives from the United Steel Workers International union, which has been supportive of our study from the beginning. They also provided important insights, information and guidance. Also very helpful were meetings and discussions with, and documents from, AFL-

CIO Industrial Union Council executive director Robert Baugh, who also heads the AFL-CIO Energy Task Force.

34 The meetings involved PowerPoint presentations and computer-based demonstrations of the model, which helped guide discussion and enabled participants to view and respond to changes in model parameters and assumptions in real time. This enabled the simulation of policy alternatives and scenarios, including those suggested by stakeholders at such meetings, could be simulated and their outcomes readily perceived.

35 As noted above, historical data on the key cost components (materials, capital, labor, purchased fuels and electricity data) and other important industry financial data (i.e., value of shipments, value added), back to 1992, was obtained from the Census Bureau's *Annual Survey of Manufactures* (ASM). Energy costs and intensity for the BAU and policy cases were calculated using industrial energy use data from the Department of Energy's *Manufacturing Energy Consumption Survey* (MECS), and the energy price data generated by EIA's NEMS in the *Annual Energy Outlook 2008* were used to characterize the policy scenarios described above. Industry associations, supplemented by government and other data sources, when available, provided primary data on production output quantities and other important production-related statistics. See: US Department of Energy, Energy Information Administration (EIA), Annual Energy Outlook 2008 (AEO). U.S. Department of Energy, EIA. Manufacturing Energy Consumption Survey (MECS), 2002; U.S. Census Bureau (2006). Statistics for Industry Groups and Industries, 2006 (Annual Survey of Manufactures). Washington, DC; US Department of Energy, Energy Information Administration EIA (2003). *The National Energy Modeling System: An Overview,* 2003.

36 As energy prices drive domestic production costs higher relative to foreign prices, there is a subsequent impact on import market shares and domestic production, depending, however, on assumptions about an industry's capabilities to pass through these costs to consumers. A critical issue in the current policy debate regarding manufacturing, is concern that climate policies that drive up domestic manufacturers' costs would place them at a competitive disadvantage relative to foreign firms not similarly burdened by regulations that constrain GHG-emissions.

37 Total production costs equals total production output multiplied by unit production costs. Total industry revenues equals production output multiplied by market price. For each industry, the II-CPM generated operating surplus and margin projections for the climate policy case and compared to a BAU scenario. At the industry output level, the total operating surplus was calculated by subtracting total production costs from total industry revenues for a given year. The operating surplus includes several overhead-related costs (such as sales, general and administrative (SG&A) costs), depreciation, interest on capital, and other expenses that could be considered part of the industry's fixed production costs, and profits and taxes not yet paid out. When a firm's operating surplus and margin is reduced as a result of increased production costs, this generally leads to lower profits, at least over the short-run unless administrative costs are reduced, as well.

38 Some industries, such as primary aluminum production, cannot pass along their costs because of the structure of their markets—most aluminum is sold on the London Metal Exchange, and therefore prices are set by global markets and cannot be dictated by individual aluminum companies. To a more or lesser extent, most of the other EITE industries are subject to similar constraints in their ability to pass-through there costs or determine their own prices, especially when confronted with lower-cost foreign competitors.

39 The policy option we modeled would allocate to each of the industries allowances mitigating 90 percent of the additional costs incurred as a result of a climate policy, phased out over time.

40 This assumes that no investments or actions are made to mitigate or offset the additional cost impacts. These results also are contingent on each industry's future energy mix and reliance on fossil fuels.

41 Yudken and Bassi, *Competitiveness Impacts of ACESA .*

42 Yudken and Bassi, *Alternative Policies and Effectiveness of Cost Mitigation*.

43 The first study is a collaborative project between Ohio University and The Ohio State University, under a State of Ohio grant. High Road Strategies and Millennium Institute were both contractors in this study. A report, Assuring Ohio's Competitiveness in a Carbon Constrained World, is forthcoming. See in particular, Joel S. Yudken. *Risks and Opportunities for Ohio's Manufacturing Sector in a Carbon-Constrained World*, Chapter Two in that report. The second study, *Ohio: Energy and Manufacturing in the 21st Century*, is led by Ohio University Voinovich School, on behalf of the Ohio Manufacturers' Association, also brought in High Road Strategies, as a contractor.