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The State of Ohio's Steel Industry

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Prepared for:

OHIO STEEL COUNCIL

The State of Ohio's Steel Industry

September 2012

**Center for
Economic
Development**

2121 Euclid Avenue | Cleveland, Ohio 44115

<http://urban.csuohio.edu/economicdevelopment>

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INTRODUCTION

The competitive environment of the steel industry today seems to mirror the increasing demands of the product itself: Steel must be rigid yet flexible, ever stronger yet even lighter, able to take a punishing environment and hold a polish. Expecting both high quality and low cost may seem a tall order, but it's a world-class expectation that now guides successful steelmakers in their continuous improvement of products and processes.

Ask top executives, plant managers and mid-level administrators at steel companies with operations in Ohio what world-class steel companies need to do to succeed in today's competitive global environment, and they say success hinges on two critical areas: core competencies and costs. "Globally capable companies must first understand what their core capabilities are, where their competitive advantages are. They have to have as intense a customer-service focus as it's possible to maintain. They have to be cost-competitive – have increases in yield and decreases in energy-intensity per pound. ... They don't have to be best in class but they have to be competitive in that arena," said one top executive interviewed. "Every different world-oriented and -capable steel company will have some particular competency. High focus on that performance metric, coupled with a competitive attempt to take costs down, is what is necessary. Different companies will focus on different competencies and that's great. That creates different values for the end user. It also gives them the opportunity introspectively to ask is this competency of real value. If [companies are] not still standing, then they didn't focus and maintain cost competitiveness."

"World-class equals low cost. You don't have to be the lowest cost. Lowest cost is a competitive term for the package and value you offer. But if you aren't a low-cost competitor, you're not competitive," said one participant in the focus group discussion with purchasing, sales and marketing managers. "Can you do something that somebody else can't do? Have you figured out the system that you can deliver at the lowest possible cost?"

"Nimble" may not be a term that traditionally has been associated with the steel industry, but focus group participants described a demanding environment that requires a certain dexterity. "You have to be flexible," said one steel industry manager. "Cycle up and cycle down. Can you flex into certain segments up and down? ... [I]t's the portfolio of what you bring."

Without a doubt, top executives on down to mid-level managers shared the kind of optimism that comes from weathering a particularly devastating storm and seeing the sun finally emerge. In discussion after discussion, they gave voice to a can-do spirit expected of those whose product enables automobiles and infrastructure, housing construction and appliances, oil and gas extraction and wind turbines, airplanes and freighters.

Many of those interviewed for this report have spent decades watching their once-brawny industry shrink – both in numbers employed and world dominance. They have continued to ply their trade, working to make their products better and their organizations leaner and more effective. Many now express a measured confidence that U.S. steelmaking is poised

either for a rebound or for a move into a new era of American steelmaking.

One big cause for optimism is the new techniques for extracting oil and natural gas from shale deposits in Ohio, Pennsylvania and other parts of the country and world. Natural gas and oil extraction has the potential to spark "game-changing" direct and indirect benefits for the U.S. steel industry and manufacturing, in general. "I really believe that one of the greatest opportunities for Ohio steel right now is the emergence of the shale gas – not just in Ohio and Pennsylvania, but in Texas and North Dakota. It's spread around the country," said one industry executive. "All of those things are going to need pipe and infrastructure to support their growth needs." Increased need for drill bits, pipes, roads, highways, buildings and bridges equals an increased demand for steel. In other words, shale oil and gas production is viewed as a new and large source of demand for steel. An April 2012 article in the New York Times summarized the potential under the headline "As Demand Rises, Ohio's Steel Mills Shake Off the Rust and Expand." The article noted that Ohio steelmakers planned to invest \$1.5 billion collectively to add 2 million square feet of production capacity.

The long-term prospects of manufacturing in general, and of steelmaking in particular, look promising when the prospect for low energy prices is combined with new sources of product demand. The discovery of significant volumes of natural gas in the Marcellus and Utica shale formations is the second structural change for the steel industry in Ohio. Steel uses large volumes of energy in its production processes. The global expansion of natural gas reserves due to hydraulic fracturing, or "fracking," promises an era of low natural gas prices, and

the presence of large volumes of natural gas in Ohio and Pennsylvania means that the region will have long-term dependable sources of energy supplies.

Another top executive noted that the indirect benefits of lower energy costs and economic growth will help drive down production costs, drive up customer demand and result in greater profitability for steel companies. Newspaper articles and media reports have chronicled the opportunity. An October 2011 report from National Public Radio asserted that the natural gas drilling boom was breathing "new life" into the steel industry and reviving Rust Belt economies.

"The steel industry is a part of the puzzle, but, more importantly for the whole of North America, these same deposits exist in China and Europe. The leaders in that technology are North American so there will be a huge export opportunity for taking this know-how elsewhere. It will help with cleaner, lower-emission fuels as we figure out how to get to green fuels," said a steel industry executive. "I think the Ohio administration is extraordinarily receptive to these opportunities and is doing a yeoman's job of trying to put the necessary things in place to capitalize on them."

Steel executives and managers also point to a revving up of the automotive industry as driving demand for the product. According to the June 2012 Global Auto Report, assembly plants across North America were on pace to produce 15.6 million cars and light trucks in 2012, compared to 13.3 million units in 2011. U.S. automotive sales for May jumped 26 percent over the sales for May 2011. Increased automotive sales is good news for steelmakers in general, but those manufacturers that can innovate to produce stronger, lighter weight

steel will have a competitive edge. Pending federal Corporate Average Fuel Economy (CAFE) standards will mandate that automakers increase fuel economy 5 percent each year, raising their fleet average to 54.5 miles per gallon by 2025.

Those steel mills that are best-positioned to take advantage of the recovery of the North American automobile and truck industries are those in proximity to the assembly plants. The mills of Ohio and Indiana are positioned to serve the demands of the assembly plants located from Chicago to Youngstown and from the shores of the eastern Great Lakes to Kentucky. However, the future use of steel in vehicle production is challenged by the ways automobile and truck assemblers respond to the CAFE standards and the steel industry responds to innovations in competing materials.

Typically, a 10 percent reduction in vehicle weight results in a 7 percent increase in fuel economy. This has led automakers to aggressively investigate alternatives to steel in their efforts to lose weight, with a spotlight being placed on aluminum. Currently, only Volkswagen's Audi and Tata's Jaguar and Land Rover are extensively using aluminum body panels and roofs in production models.¹ Each claims 600- and 700-pound vehicle weight losses. And each is a high-end model with solid margins, allowing for the substitution of more expensive aluminum for steel. A bigger challenge the assemblers face is getting the material into more popularly priced vehicles. Mazda has announced that it can weld

aluminum to steel, merging the advantages of both materials.² Before the 2008 auto crisis, Ford owned Jaguar and Land Rover and had a controlling interest in Mazda; now Ford is showing the most interest in the use of aluminum in the North American market.

The Wall Street Journal revealed that the 2014 model of the F-150 pickup truck is expected to use 700 pounds less steel than the current model.³ The news report does not indicate which parts will be transformed. However, the reporter noted an engineering study by Ducker Worldwide that showed that 800 pounds of steel could be replaced in a pickup truck for an additional \$1,500 in material cost. Ducker projected that 232 pounds could come out of the cargo box, doors, and tailgate; 190 pounds could come from the passenger cab; another 32 pounds from the hood and fenders, and a 92-pound savings could be realized by replacing the steel control arms and steering knuckles.

What makes the F-150 an important experiment for both the steel industry and Ford is the popularity of the truck and the contribution this model makes to Ford's profits. The F-150 is a popularly priced mass-produced vehicle. Ford is either risking that customers will be willing to pay more for the new model or that the company can withstand lower margins in return for the contribution the truck can make in meeting CAFE standards for its fleet. Ford is also betting that its customers will accept aluminum as a steel substitute in a work truck. There is a lot riding on this truck model.

¹ The Aluminum Association, "Jaguar, Land Rover to go all aluminum;" and "2012 Range Rover Evoque Features Novelis' Ac-600 PX Aluminum Sheet." Also see: <http://www.audiworld.com/news/02/aluminum/content1.shtml>; <http://www.aluminiumleader.com/en/around/transport/cars>.

² Industrial research on the use of composite materials is accelerating, focusing on out-of-sight structural members. Composites are already making a mark in structural components of Formula 1 racing cars.

³ "Ford's Trade-In: Truck to use aluminum in place of steel," Wall Street Journal, July 27, 2012.

GM is taking a different road. It will introduce a major update to its full-sized Silverado/Sierra twin competitors to the F-150 in 2013, followed by a smaller truck targeted for release in 2015. All will use hybrid engine technology as a way of meeting tougher CAFE standards, but they are expected to maintain their current mix of body parts.

Despite the transformative potential of the shale boom and the driving demand coming from the auto industry, steelmaking veterans remain cautiously optimistic. They've seen booms go bust before. One industry executive recalled the anticipated "supercycle," in which world demand would exceed steel supply and capacity. The 2008 Great Recession and subsequent financial and housing crises superseded such predictions with a simple goal of survival. The steel industry buckled under the weight of a protracted slowdown in construction and overall weak consumer demand. Ohio's raw steel production fell by more than 55 percent from 2008 to 2009 alone. Those companies that survived that precipitous decline saw the industry expand by 25 percent from 2010 to 2011 and were lifted by media reports and industry predictions of the drilling boom.

In a seemingly even quicker reversal of fortune, a June 20, 2012, Wall Street Journal article reported that the steel industry faced its "worst prospects in four years, with prices and demand falling." Fiscal turmoil in Europe, a slowdown in domestic demand but not production in China, and stubborn weakness in the U.S economy combined to send steel prices tumbling by 12 percent since February, dropping the price of benchmark hot rolled steel from \$827 a ton to \$723. Hot rolled coil is a critical reference price in the market because it is the material used in

the high-quality, high-valued portion of the steel market, such as automotive production and pipe making. The article cited industry researcher World Steel Dynamics in predicting that the price would continue to fall below \$700 a ton over the summer. Just weeks earlier, German steelmaker ThyssenKrupp signaled it may change course and sell its Alabama plant, which had been anticipated as a foothold in North America, and in late May RG Steel filed for bankruptcy and petitioned the courts to close Baltimore's famed Sparrows Point, Maryland, mill and its associated steelmaking plants in Warren, Ohio, and Wheeling, West Virginia. RG purchased the plants from Russia's OAO Severstal in 2010 and blamed the proposed closure on "sustained liquidity problems ... driven by a rapid decline in steel prices [while] raw material prices remained at peak levels."⁴ RG is the fourth-largest maker of flat rolled steel in the United States.

The Steel Index, a service of Platts/McGraw Hill, tracks prices for steel globally, and its data bear out the news reports.⁵ As of late June 2012, the average price of a ton of hot rolled coil (HRC) to be delivered in the Midwest was \$605. The price in January was \$748 a ton. Delivery times have been cut in half, from January's high of 6.1 weeks on average to 2.5 weeks in mid-June. Similar volatility is seen in the Steel Index's pricing data coming out of China for HRC to be delivered in the United States or Europe. The January price was \$650 per ton, and the June price was \$603.

The volatility of steel prices is just part of the nature of the product and market. Steelmaking has huge fixed costs, which are an incentive to

⁴ "RG Steel Wins Approval of Asset Auction, Bankruptcy Loan," Bloomberg Businessweek, June 21, 2012.

⁵ All prices quoted were obtained from the Steel Index on July 4, 2012.

keep plants running as close to capacity as possible. Also, steel is not a rapidly evolving product so materials from different suppliers are close substitutes for each another. The global price swings experienced during the Great Recession are testament. Prices peaked for a ton of HRC in the United States on July 21, 2008, at \$1,095 and hit bottom nearly a year later on June 1, 2009, at \$382. A similar swing was experienced in Chinese product bound for Europe and North America. The pricing peak was reached in June 2008 at \$1,075 a ton before crashing to \$428 a ton in April 2009.

Such are the extreme challenges and uncertainties of a mature cyclical industry in a global market of increasingly rapid change. "It's a global market in the industry now. We have a lot of steel coming in and going out," said an industry executive. "We are more directly impacted by what is going on in Europe, which has reduced demand. That is compounded by an increase in supply coming out of China. ... They're making more than they [can consume] in China."

The overcapacity in China is worrisome to industry executives and managers alike. China produces nearly 50 percent of the world's crude steel, more than 683 million tons in 2011, compared to 86 million tons produced by U.S. steelmakers (Table 1). U.S. steelmakers said they began to feel the effects of "dumping" of Chinese steel in the latter part of 2011, with an escalation since the beginning of 2012.

Table 1. Crude Steel Production by Nation, 2000 to 2011

Ranked by Total Production in 2011	Nation	Year												2011 World
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Market Share
	World ¹	848,935	851,071	904,054	969,916	1,061,248	1,146,579	1,248,991	1,347,002	1,341,205	1,235,205	1,428,711	1,490,060	100.0%
1	China	128,500	151,634	182,249	222,336	272,798	355,790	421,024	489,712	512,339	577,070	637,400	683,265	45.9%
2	European Union ²	193,387	187,452	188,246	192,511	202,328	195,518	206,903	210,179	198,195	139,366	172,630	177,431	11.9%
3	Japan	106,444	102,866	107,745	110,511	112,718	112,471	116,226	120,203	118,739	87,534	109,599	107,595	7.2%
4	United States	101,803	90,104	91,587	93,677	99,681	94,897	98,557	98,102	91,350	58,196	80,495	86,247	5.8%
5	India	26,924	27,291	28,814	31,779	32,626	45,780	49,450	53,468	57,791	63,527	68,321	72,200	4.8%
6	Russia	59,136	58,970	59,777	61,450	65,583	66,146	70,830	72,387	68,510	60,011	66,942	68,743	4.6%
7	South Korea	43,107	43,852	45,390	46,310	47,521	47,820	48,455	51,517	53,625	48,572	68,914	68,471	4.6%
8	Ukraine	31,767	33,108	34,050	36,932	38,738	38,641	40,891	42,830	37,279	29,855	33,432	35,332	2.4%
9	Brazil	27,865	26,717	29,604	31,147	32,909	31,610	30,901	33,782	33,719	26,506	32,928	35,162	2.4%
10	Taiwan, China	16,896	17,261	18,230	18,832	19,599	18,942	20,000	20,903	19,882	15,873	19,755	22,660	1.5%
11	Mexico	15,631	13,300	14,010	15,159	16,737	16,195	16,447	17,573	17,209	14,132	16,870	18,145	1.2%
12	Canada	16,595	15,276	16,002	15,929	16,305	15,327	15,493	15,572	14,845	9,286	13,013	13,090	0.9%
13	Iran	6,600	6,916	7,321	7,869	8,682	9,404	9,789	10,051	9,964	10,908	11,995	13,040	0.9%

1 The countries and trading unions included accounted for approximately 94% of total world crude steel production in 2011.

2 Totals are for the 27 member nations in the European Union.

Source: Worldsteel Association, <http://www.worldsteel.org/statistics>

Table 2. Global Market Share of Crude Steel Production by Nation

Ranked by Total Production in 2011	Nation	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012 (Jan-May)
	World ¹	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1	China	15.1%	17.8%	20.2%	22.9%	25.7%	31.0%	33.7%	36.4%	38.2%	46.7%	44.6%	45.9%	45.9%
2	European Union ²	22.8%	22.0%	20.8%	19.8%	19.1%	17.1%	16.6%	15.6%	14.8%	11.3%	12.1%	11.9%	11.9%
3	Japan	12.5%	12.1%	11.9%	11.4%	10.6%	9.8%	9.3%	8.9%	8.9%	7.1%	7.7%	7.2%	7.2%
4	United States	12.0%	10.6%	10.1%	9.7%	9.4%	8.3%	7.9%	7.3%	6.8%	4.7%	5.6%	5.8%	5.8%
5	India	3.2%	3.2%	3.2%	3.3%	3.1%	4.0%	4.0%	4.0%	4.3%	5.1%	4.8%	4.8%	4.8%
6	Russia	7.0%	6.9%	6.6%	6.3%	6.2%	5.8%	5.7%	5.4%	5.1%	4.9%	4.7%	4.6%	4.6%
7	South Korea	5.1%	5.2%	5.0%	4.8%	4.5%	4.2%	3.9%	3.8%	4.0%	3.9%	4.8%	4.6%	4.6%
8	Ukraine	3.7%	3.9%	3.8%	3.8%	3.7%	3.4%	3.3%	3.2%	2.8%	2.4%	2.3%	2.4%	2.4%
9	Brazil	3.3%	3.1%	3.3%	3.2%	3.1%	2.8%	2.5%	2.5%	2.5%	2.1%	2.3%	2.4%	2.4%
10	Taiwan, China	2.0%	2.0%	2.0%	1.9%	1.8%	1.7%	1.6%	1.6%	1.5%	1.3%	1.4%	1.5%	1.5%
11	Mexico	1.8%	1.6%	1.5%	1.6%	1.6%	1.4%	1.3%	1.3%	1.3%	1.1%	1.2%	1.2%	1.2%
12	Canada	2.0%	1.8%	1.8%	1.6%	1.5%	1.3%	1.2%	1.2%	1.1%	0.8%	0.9%	0.9%	0.9%
13	Iran	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.9%	0.8%	0.9%	0.9%

1 The countries and trading unions included accounted for approximately 99% of total world blast furnace iron production in 2011.

2 Totals are for the 27 member nations in the European Union.

In June 2011, the U.S. International Trade Administration released a Steel Industry Executive Summary that focused on the impact of the global economic stall on the steel industry, noting that in April 2012 the U.S. trade deficit in steel with the rest of the world grew by 1.8 metric tons while domestic steel production decreased by 0.8 percent, or 7.7 million metric tons.⁶ The data in Tables 1 and 2 show that the global steel market is extremely volatile due to the differential impacts of the slow global recovery from the Great Recession. The tables clearly show the growth in China's global market share. What is not clear in the tables is the reason for China's growth and its impetus to export. China's steel companies most likely over-expanded in an attempt to gain domestic market share and to accommodate anticipated infrastructure growth. China's building boom was facilitated by its domestic steel industry. Now that growth rates have slowed, the country's plants are exporting. One country's dumping is another's attempt to minimize losses when faced with overcapacity.

Steel is a capital-intensive industry with significant economies of scale. Management has a strong incentive to run loss-making facilities as long as the price exceeds the marginal cost of production, thus earning some money to pay for the fixed costs of plant and equipment. It also explains why steel companies prefer to run a smaller number of plants at close to full capacity rather than to throttle back capacity across all of their plants.

"China is a wild card," an Ohio-based industry executive continued. "If steel consumption

drops by 5 percent [in China], that's 35 million tons that has to go somewhere else, and that's likely to be here. Think about what that does to the supply in the U.S." The U.S. International Trade Commission noted in its report that steel imports from China increased by nearly 50 percent from April 2011 to April 2012. This is against a backdrop of an increase in the annual (April to April) trade deficit in steel of 30 percent.

"China actually gives export subsidies, which in my opinion puts us in position of having to compete with the Chinese government," said an industry leader. "That kind of puts us at a pretty unfair advantage. It's a problem for the whole United States, not just Ohio. It's a magnification of the problem that existed because of manipulation of the Chinese currency. The lack of reduction in output from the Chinese steel industry just puts more focus on boats to go elsewhere. ... To push into subsidies is an export model that becomes very dangerous."

Although the global threats to their competitiveness are ever-present, plant managers and mid-level leaders who participated in a series of focus groups have worries that are closer to home: workforce. Managers describe a skilled workforce nearing retirement age and a difficult task of attracting a new generation of workers with the skills and willingness to take jobs in steel mills in Ohio. "We have openings, but I can't fill them," said one plant manager. "Between now and 2017, 25 percent of our industrial electricians will retire. We've got jobs sitting empty right now. We're using contractors. We don't really want to, but the talent isn't available. We're paying \$30 an hour with benefits for jobs that we can't fill."

⁶ "Steel Industry Executive Summary: June 2012. International Trade Administration, U.S. Department of Commerce, [http://hqweb03hqweb03.ita.doc.gov/License/Surge.nsf/webfiles/SteelMillDevelopments/\\$file/exec%20summm.pdf?openelement](http://hqweb03hqweb03.ita.doc.gov/License/Surge.nsf/webfiles/SteelMillDevelopments/$file/exec%20summm.pdf?openelement)

Echoed another: "In the next 4 to 5 years, 50 percent of our workforce will be pension eligible. So knowledge transfer is important to us." Ohio's steel employers are not sitting still in the face of a looming labor and talent shortage. ArcelorMittal is teaming up with community colleges to start the Steel Workers of the Future training program in Ohio, Indiana, Illinois, Pennsylvania and West Virginia.⁷ And all of the companies interviewed have beefed up their recruiting and training efforts and restarted apprenticeship programs.

Remaining globally competitive is another concern, which is why environmental regulations also ranked high among steel industry worries. Executives and managers question the wisdom of pursuing policies that aim to reduce pollution at the expense of U.S. manufacturers. Added costs from such measures ultimately make U.S. companies less competitive, they say, and uncompetitive companies don't survive. In the end, proposed regulations to reduce greenhouse gases would result in steel being bought not in the United States but from lower-cost countries that have even worse records on pollution. "In our goal to be environmentally responsible, we're going to impose rules that don't achieve [global] pollution reduction," said one industry executive.

Echoed another manager: "Most nations see steel as core to their competitiveness except for the U.S."

⁷ Cuyahoga County (Cleveland), Lakeland (Kirtland), and Eastern Gateway Community (Steubenville) Colleges are participating in Ohio. The other participating community colleges are: Ivy Tech in Northwest Indiana, Prairie State in Northeast Illinois, the Penn State campuses in Harrisburg and York in Pennsylvania, and West Virginia Northern Community College in Weirton. Graduates are not committed to go to work for ArcelorMittal. <http://www.steelworkerforthefuture.com>

Despite ongoing uncertainty hanging over U.S. and world markets, steel industry executives note that many of the same factors that led to predictions of a steel "supercycle" still exist: As world population grows and nations develop, that should fuel demand for products as diverse as automobiles, infrastructure, energy and food. Those who supply such products or enable them should see increased demand. "The demand for food stuffs go up and the people making agriculture equipment will see strong demand." Because steel is an essential part of all of these products, the supercycle is good news for steelmakers, especially U.S. steelmakers.

"The United States is one of the most advantageous places in the world to get the raw material to make steel. We start with some excellent advantages," said one focus group participant. "To make steel, one of the biggest factors is raw material. China doesn't have it in their back yard. They go a long way and then pay extra cost [to acquire it]. ... We are in a place in the U.S. where we have raw material, and it's a good place to make steel."

He continued: "In terms of safety, quality, efficiency, process, technology, it would be hard to find a better place than the U.S. ... I think that message does not really get out. We all recognized massive offshoring 10 to 20 years ago. But over the last 5 years, we have been seeing more reshoring because they found out that the supply chain elsewhere wasn't as good as they thought."

"Metal is the beginning of something. It gets processed into something. ... Why wouldn't you want to do business with U.S. steel companies and the supply chain they connect to? U.S. manufacturing is still the largest manufacturing center in the world. So that means there are

pretty good companies downstream from steel companies here. So if steel companies are competitive and connected to this chain, then why wouldn't this be an industry set to really flourish in the next 10 to 20 years? ... [I]s a steel factory in China going to kick our butt? I say no."

"If our energy policy really got to the next level, that has a multiplier effect on a whole range of economies in the U.S.," said the focus group participant. "We are sitting on advantaged raw material and if we are sitting on advantaged energy as well, then you add quality, safety, technology, innovation. ... How do other supply chains beat this one? I think that message is a little bit lost. Do we really appreciate that?"

"The steel industry is probably the poster child of manufacturing in Ohio," added another participant in the focus group of purchasing, sales and marketing managers. "So it's good to point out that we're not dead and dying; instead, we're alive and vibrant and growing. It's a powerful message."

ABOUT THIS STUDY

The Ohio Steel Council commissioned the Center for Economic Development at Cleveland State University's Maxine Goodman Levin College of Urban Affairs to conduct this analysis of the state's steel industry. The OSC consists of steel producers, processors and suppliers and aims to provide insight on the potential effects of policy issues on Ohio's steel industry and its overall economy.

This report is divided into two sections: Part 1 discusses findings from the quantitative analysis of Ohio's steel industry. Part 2 offers a qualitative exploration of Ohio's steel industry through the shared experiences and insights of industry executives and managers.

For the quantitative analysis, we relied on data from the American Iron and Steel Institute on raw steel production, estimates from Moody's Analytics⁸ of gross state product (GSP), and employment data from the Census of Quarterly Employment and Wages. The last year of real data in Moody's Economy.com is 2010; data for 2011 are projections. The latest employment data include the first two quarters of 2011.

For the purposes of this analysis, the **Raw Steel Industry** includes *Iron and Steel Mills and Ferroalloy Manufacturing* (NAICS 3311) and *Steel Product Manufacturing from Purchased Steel* (NAICS 3312). The **Total Raw Steel Products and Fabrication Industry** (also called **Total Steel** in figures) includes the raw steel industry (NAICS 3311 and 3312), as well as *Fabricated Metal Product Manufacturing* (NAICS 332). In total, the steel cluster includes NAICS 3311, 3312, and 332.

To complement the quantitative analysis, we set about gathering qualitative information about Ohio's steel industry. We held four focus groups around the state, inviting plant managers; purchasing, sales and marketing managers; and human resources personnel to share their insights regarding challenges, threats and opportunities. We also solicited their views of Ohio as a place for making steel. In addition to the focus groups, we conducted interviews with top executives at steel companies with operations in Ohio. The corporate executives were asked questions similar to those of their senior managers.

⁸ Moody's Analytics was previously known as Economy.com.

PART 1: STEEL BY THE NUMBERS

Ohio is a steel-producing state. The steel industry sits at the base of a number of supply chains that are critical sources of income and work opportunities for the state's residents – from autos and aircraft parts to energy production and appliances. Steel production in Ohio only trails Indiana's in volume, as can be seen in Table 3. In 2011, 11.6 million net tons of steel were produced in Ohio, accounting for 12.2 percent of all steel produced in the United

States. Ohio increased its volume of raw steel production by more than 76 percent from 2009 to 2011, surpassing the U.S. growth rate. (The national growth rate in production was 45 percent over this timeframe.) Although the 12.2 percent of total U.S. production that came from Ohio in 2011 represents significant growth from the previous two years, the level of production remains far below the 18.3 million tons the state produced in 2000.

Table 3. Raw Steel Production by States (Thousands of Net Tons)

State(s)	2000	2006	2007	2008	2009	2010	2011	Share of Total Production, 2011	2010 - 2011, % Change
Indiana	25,667	26,252	25,857	25,731	18,414	22,050	24,669	25.9%	11.9%
Ohio	18,263	15,856	16,146	14,778	6,590	9,257	11,596	12.2%	25.3%
Michigan	7,121	6,662	5,867	5,251	2,858	6,124	5,990	6.3%	-2.2%
Pennsylvania	7,926	6,817	6,790	6,395	5,705	6,299	5,883	6.2%	-6.6%
Illinois	6,575	4,398	4,239	3,968	2,105	4,332	4,194	4.4%	-3.2%
Texas	4,186	4,162	4,592	3,710	2,244	3,081	3,290	3.5%	6.8%
6 Largest Raw Steel Producing States	69,738	64,147	63,491	59,833	37,916	51,143	55,622	58.4%	8.8%
AL, TN, KY, MS, AR	16,085	20,465	20,445	19,478	13,274	19,420	19,973	21.0%	2.8%
VA, WV, GA, FL, NC, SC, LA	10,053	10,825	11,386	9,864	6,534	9,486	10,684	11.2%	12.6%
CO, UT, WA, OR, CA, AZ, HI	6,577	3,860	3,992	3,899	2,747	3,540	3,648	3.8%	3.1%
MN, WI, MO, OK, NE, IA	4,152	3,869	3,990	3,529	2,226	2,747	2,927	3.1%	6.5%
RI, CT, NJ, NY, DE, MD	5,637	5,067	4,834	4,693	2,762	2,395	2,383	2.5%	-0.5%
Total	112,242	108,234	108,138	101,297	65,460	88,731	95,237	100.0%	7.3%
Ohio as Percent of U.S.	16.3%	14.6%	14.9%	14.6%	10.1%	10.4%	12.2%		16.7%

Source: American Iron and Steel Institute

The data displayed in Table 3 hint at the production relationship between Ohio's steel cluster and its competing cluster in Northwestern Indiana. Despite the huge swings in the national and global business cycle that took place from 2000 to 2011, there was remarkable stability in Indiana's output, which typically fluctuated between 25 and 26 million tons but experienced major erosion in the volume produced in 2009. This erosion is associated with the Great Recession and the slow recovery over the following two years. The relative stability among Indiana's steel producers compared to more volatility among Ohio's may reflect how companies allocate production across multiple locations and may suggest the importance of local demand within a global market.

Steel manufacturing companies with mills in multiple locations with similar capabilities have a strong incentive to keep their most productive mills, and those with the greatest fixed costs, operating as close to capacity as possible during all phases of the business cycle. These multi-plant companies would then use their less-productive mills for "peaking" capacity – bringing them in later during a recovery and shutting them down more quickly during a downturn. The larger volatility of output in Ohio compared to that of Indiana might partially be explained by this production relationship. What can offset such decision-making driven by production cost is the location of customers and the delivered price of the product, along with just-in-time delivery demands. In other words, if there is a large source of demand for steel product that is located closer to Ohio's mills, then the transportation costs differential can change the calculus of multi-plant operations. This is why developing the oil, natural gas, and natural gas liquids of the Utica and Marcellus

Shale deposits, and the associated processing opportunities, are important sales opportunities for Ohio's steel industry.

Ohio's steel industry is not alone in looking to regain the volume of production exhibited little more than a decade ago; since 2000, raw steel production nationwide has been corroded by the effects of the short 2001 recession, followed by the Great Recession of 2008 to 2009, and has been compounded by protracted housing and financial crises and the financial reorganization of the domestic automotive industry. Figure 1 depicts the dramatic downturn in U.S. steel production from 2000 to 2001, recovery to near 2000 levels in the middle of the decade and then near implosion in 2009, as dwindling new home construction and new car sales took a heavy toll.

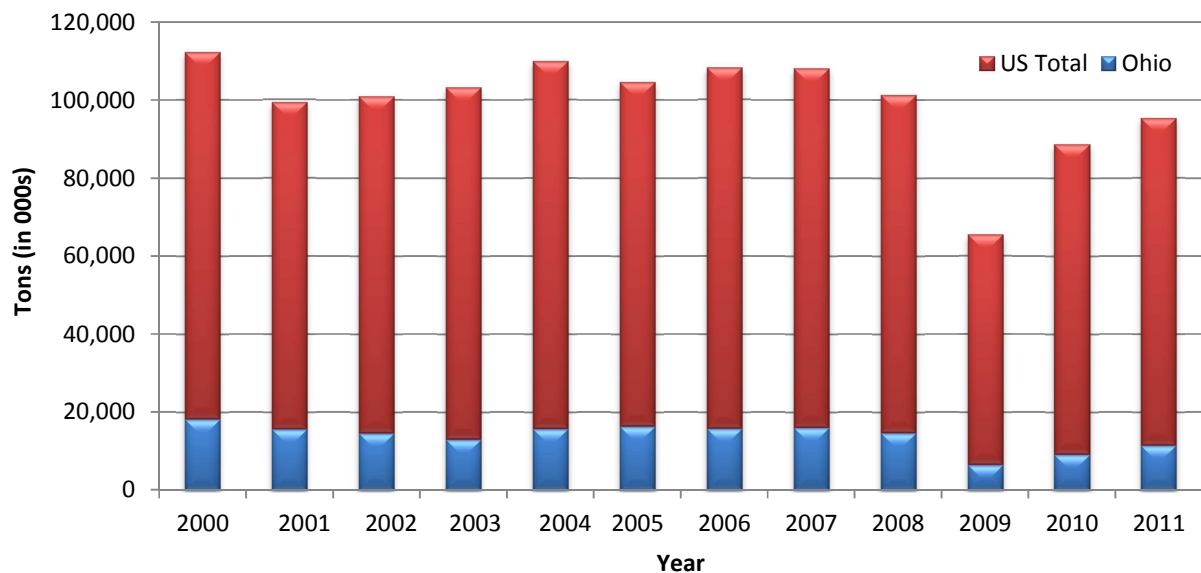
In 2009, the domestic production of cars and light trucks in the United States was less than it was 1960. Domestic production peaked in 1999 at 13.0 million units; a decade later, it plummeted to 5.7 million. Domestic production recovered in 2010 to 7.7 million units, equaling 1960 production levels.⁹ Compounding the challenge facing steelmakers in Ohio and Indiana is the fact that, in 1960, the automotive assembly industry in the United States was located in the north, along the shores of the Great Lakes. Today the southeastern United States has a vibrant assembly industry with a large presence of international brands.

⁹ Passenger car and light truck production data were obtained from the Research and Innovation Technology Administration, Bureau of Transportation Statistics, U.S. Department of Transportation. The original data were obtained from: WardsAuto.com, *Motor Vehicle Facts & Figures*, (Southfield, MI: Annual Issues): http://www.bts.gov/publications/national_transportation_statistics/html/table_01_15.html

Ohio's raw steel production roughly tracked the performance of the U.S. steel industry overall, but, as noted above, it has been more volatile. For both the state and the nation, 2009 sent a painful spasm – a sharp, involuntary contraction – throughout the industry. From 2008 to 2009, U.S. raw steel production shrank by 35 percent. In Ohio, the convulsion was more severe, as production plummeted by 55 percent. The good news is that the seizure in production eased

nearly as quickly as it took hold, with big gains posted in 2010 and 2011. Just as the pain of muscle spasms have a tendency to linger long after the contraction has eased, the nation and state have yet to fully recover from the 2009 losses. As Figure 1 shows, U.S. raw steel production in 2011 was still 6 percent below 2008 levels. Recovery in Ohio lags even more, with 2011 raw steel production nearly 22 percent off the 2008 mark.

Figure 1. Raw Steel Production in Ohio and the United States, 2000-2011



Ohio is not only an important contributor to U.S. steel production; it is a critical contributor to world production. Six steel producers on Worldsteel's list of 2010 top world producers have operations in Ohio. ArcelorMittal, with Ohio facilities in Cleveland, Columbus, Obetz and Pioneer, tops the list as the world's largest steel producer. Tata Steel, with Ohio operations in Warren, ranked No. 7, followed by U.S. Steel, with tubular operations in Lorain and a joint venture with PRO-TEC Coating Company in Leipsic, at No. 8. Gerdau, with facilities in

Cincinnati and Orrville, placed No. 10, followed by Nucor at No. 11 and Severstal at No. 12 (Severstal sold its operations to RG Steel LLC in 2011).¹⁰ Nucor has facilities in Marion, and

¹⁰ RG Steel was the fourth-largest steelmaker in the nation before it entered bankruptcy proceedings on May 31, 2012. According to press reports, the company's assets are to be auctioned off by a "drop-dead date" of August 24, 2012. RG Steel is jointly owned by Renco Group, Limited (75 percent) with Cerberus RG Investor LLC owning the remaining shares (Bloomberg Business Week, June 21, 2012). RG's main plants are at Sparrows Point, Maryland; Warren, Ohio; and Wheeling, West Virginia. Severstal

Severstal/RG Steel has operations in Columbus and Warren. Representatives from several of these locations, among others, were interviewed for this report.

Ohio's importance to the worldwide steel "backbone" – which supports and enables so many other industries, from oil drilling and natural gas fracking to automotive manufacturing and building construction – is not only as a steel producer, but also as a metal fabricator. Measured in terms of 2010 Gross Domestic Product, Ohio ranks No. 3 in raw steel production, behind only Indiana and Pennsylvania. In terms of total raw steel products and fabrication – what we term Total Steel in Figure 2 below – Ohio is ranked No. 2 (behind Texas), producing 8.2 percent of total U.S. GDP for the industry.

The point to be taken from these various rankings is that Ohio has a demonstrated competitive advantage in the domestic steel industry and one that will become stronger as major steel users increase their in-state investments.

Ohio ranks second in a national industry that struggles with long-term contraction and declining real GDP or real value added. Figure 2 illustrates the roller coaster the industry has been on for the past four decades. In 1978, the total U.S. steel industry contributed \$211 billion to the nation's gross domestic product. After the double-dip recession of the early 1980s, industry GDP had fallen to less than \$160 million.¹¹ By 2000, the industry had recovered about half of the value it lost in the early 1980s, only to fall below that previous nadir in 2003 to

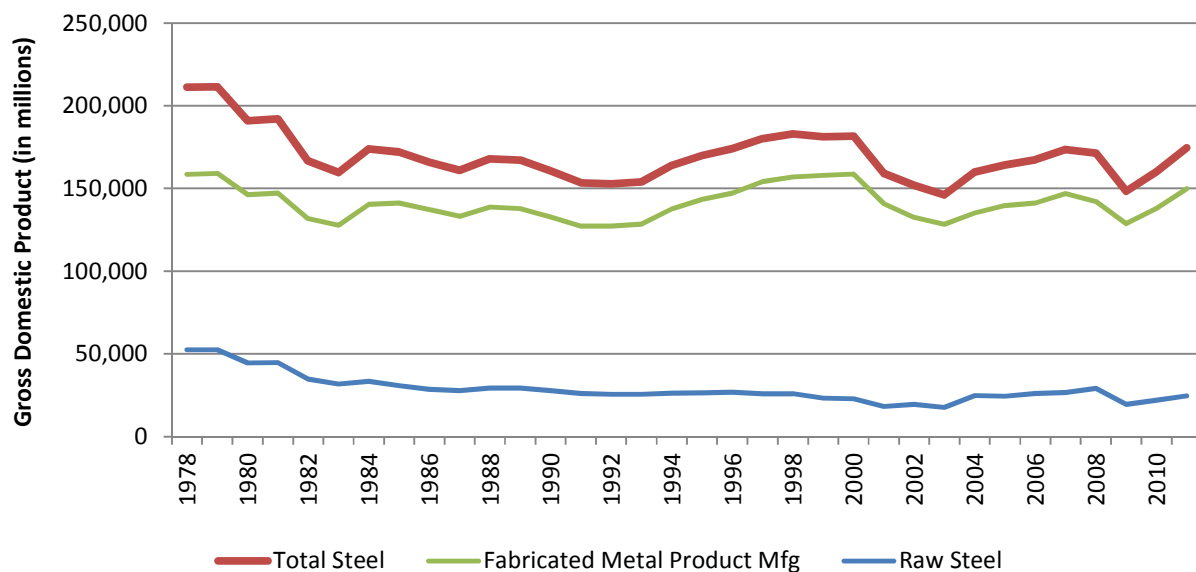
\$146 billion. The industry then rebounded and within four years recovered much of the losses from the 2001 recession, contributing nearly \$174 billion to the nation's GDP in 2007.

However, that rosy outlook was short-lived as the recession of 2007 and the accompanying financial and housing crises wiped out nearly all of the gains of the previous years. Since hitting a low of \$148 billion in GDP in 2009, the industry has come roaring back and was projected to contribute nearly \$175 billion to GDP in 2011.

acquired the steelmaking assets in 2008 for \$2.2 billion, later selling the package to RG for \$1.2 billion.

¹¹ All dollar figures are adjusted for inflation and are expressed in terms of 2012 real dollars.

Figure 2. GDP in U.S. Steel Industry, 1978-2011 (in 2012 real dollars)



The total steel industry encompasses two separately classified but related industries: raw steel production and fabricated metal product manufacturing. For this report, "raw steel" encompasses two distinct industry classifications – iron and steel mills and ferroalloy manufacturing and steel product manufacturing from purchased steel. Activities from all of these industry sectors are prominent in Ohio and, thus, were included in this analysis. Fabricated metal product manufacturing in Ohio is significantly larger than raw steel production, but the two activities are integrally tied.

As can be seen in Figure 2, the performance of the two components of the U.S. steel industry (production and fabrication) has diverged. Steel production has been in long-term decline, while the fabrication portion of the industry has tracked with the business cycle. It is more difficult to substitute imported fabricated steel products for domestically fabricated products than it is to substitute imported billets of steel for domestic billets or coils due to the way in

which each enters the production process. Steel coils and billets are easily substituted for one another as long as they are the same metallurgical properties. The fabricated metal products industry, on the other hand, is partially sheltered from distant competition by their design, specialized production processes or inventory demands. These all can require close interactions with customers.¹²

¹² Digital communications isare whittling away at this defense against distance, however. Electronic sharing of blueprints, CAD and CAM files, and Internet-based video conferencing is lowering the insulation that face-to-face communications once provided local suppliers. However, manufacturing experience is beginning to find that what looks good on a spreadsheet can prove to be costly in the real world. There is a balance point between the estimated cost of fabrication and the cost of getting the job done right. A major test is under way as California has contracted to have the new Oakland Bridge fabricated by Shanghai Zhenhua Heavy Industries ("Bridge comes to San Francisco with a made-in-China label," New York Times, June 25, 2011). California's Department of Transportation claims that the contract will save \$400 million. The general contract is held by a joint venture of the American Bridge Company and Fluor Enterprises and is priced at \$7.2 billion. Shanghai Zhenhua is a subcontractor. Brian A. Petersen, project director for the American Bridge/Fluor

The 35-year story of the raw steel side of the industry has largely been one of declining volumes and declining GDP. In 1978, U.S. raw steel activities contributed \$52.6 billion to GDP. A relentless shrinking of the industry continued until it became about a third of its previous size, bottoming out at \$17.7 billion in GDP in 2003. Yet, 2003 was an important inflection point for U.S. raw steel production. By 2008, the industry had grown by 65 percent to \$29.1 billion, returning to a level of GDP not seen since the 1980s. As with the total steel industry and with fabricated metals manufacturing, the recession led to another steep decline in the value of U.S. raw steel GDP, dropping back to \$19.5 billion but remaining significantly above the low point reached in 2003. By 2011, U.S. GDP from the production of raw steel was expected to contribute \$24.7 billion to GDP, growing by more than 26 percent in two years.

As can be seen in Figure 2, fabricated metal product manufacturing has virtually mirrored the turbulent ride of the total U.S. steel industry. Fabricated metal product manufacturing contributed nearly \$159 billion to GDP in 1978. Over that time, it has experienced multiple valleys and even peaked above 1978 values in 2000, only to hit a new nadir of \$128.5 billion in GDP in 2003. Fabricated metal product manufacturing came close to matching that low point in 2009 before rebounding to nearly \$150 billion in 2011.

Enterprises joint venture, was quoted by the Times as saying: "I don't think the U.S. fabrication industry could put a project like this together. ... Most U.S. companies don't have these types of warehouses, equipment or the cash flow. The Chinese load the ships, and it's their ships that deliver to our piers."

Steel's Value Chain: A Central Part of Ohio's Economic Infrastructure

Earlier we argued that the central position of the industry in Ohio's economy lies in the steel users that it attracts and retains. Ohio's steel industry is the foundation of a vast value chain of customers and suppliers that extends throughout disparate but interconnected industries. Ohio steel's customers range from automotive to infrastructure, from construction to appliances, from energy to defense. The supply chain, in contrast, is comparatively short: Steelmakers take raw or scrap materials; add energy, a good deal of equipment, and metallurgical knowledge; and produce metal and metal products. Despite having a compact supply chain, there is money to be made in

serving the demands of the industry's purchasing agents.

The IMPLAN input-output model, a software program that helps analyze how the local economy functions, was used to map the contours of the steel industry's value chain in Ohio. Purchases made *from* the steel industry by in-state customers in 2010 are dollar values calculated from the forward linkages of the input-output model. These are displayed in Table 4. The purchases made *by* Ohio's steel industry from in-state suppliers are listed in Table 5. These are dollar values calculated from the model's backward linkages.

In-state Customers

Ohio's steel industry directly sold \$8.6 billion worth of product to in-state customers in 2010. The 69 industries identified as the direct customers of the two major segments of Ohio's steel industry, raw steel production and fabricated metals, are listed in Table 4 and are ranked according to the value of their purchases. The raw steel segment of the industry sold \$3.8 billion worth of material, and the fabricated metals industry shipped \$4.9 billion worth of manufactured goods to in-state customers. One steel executive interviewed referred to steel as a "gozinta" product. It is a material that goes into components that make their way into subassemblies that an original equipment manufacturer (OEM) then combines with other subassemblies to make a finished product. The data in Table 4 bear out his comment.

Transportation: Automotive, truck, and aircraft

The most significant direct purchaser of steel is the automobile industry, or thinking more broadly the transportation industry. The largest purchaser of Ohio-made steel is the auto parts industry, with more than \$1.2 billion in purchases. The purchases are split nearly in half between the two segments of the steel industry, with 55 percent coming from fabricated metals. The model places automobile engine manufacturers within the auto parts industry. The automobile manufacturing industry is the 17th largest purchaser, with \$99 million in purchases of fabricated metals, and the motor vehicle body manufacturing industry is credited with the direct purchase of \$15 million in raw steel. Automotive products show up in other industries, as well. Military armored vehicles and tank components purchased \$93.6 million in raw steel and \$84.1 million in fabricated metals (9th place). Light truck and

utility vehicle assembly purchased nearly \$50 million worth of steel, mostly fabricated metal (33rd).

Ohio's automobile industry is listed as purchasing no raw steel products, and the motor vehicle body (assembly) industry only made \$15.6 million in direct purchases of raw steel, placing it in the No. 62 spot in Table 4. The same purchasing pattern holds for truck assembly. These results are surprising, given the large amounts of high-strength sheet steel that are used by the OEMs in their Ohio assembly plants.¹³ There are two complementary explanations: The first is sheet is purchased from the steel products industry, including steel service centers, after being transformed. The second is that, with the exception of Honda of America Manufacturing, the purchasing departments of the Michigan and Illinois-based OEMs made the purchases but had product shipped directly to their Ohio assembly plants.

Related to transportation is construction machinery, with \$20.7 million in raw steel purchases and \$31.3 million in fabricated metal purchases, and farm equipment manufacturing, with \$51.4 million in purchases split nearly evenly between raw and fabricated steel.

Engines and motors made several appearances in the table. Aircraft engines purchased \$50 million in fabricated metals (32nd position). Turbine and turbine generator units came in 44th place, with \$32.7 million in purchases. Motor and generator manufacturing, which consists of generators and electric motors, purchased \$26 million of raw steel (51st place) and "other engine manufacturing," which consists of internal combustion engines that are

used in devices other than gasoline engines for automobiles and aircraft, purchased \$30 million in fabricated metals. Air and gas compressor manufacturers purchased nearly \$50 million in fabricated metal parts.

Ohio's aircraft parts industry purchased \$28.8 million worth of fabricated steel.

Metals manufacturers

The second-largest purchaser was the steel product manufacturing industry itself, with \$620 million in direct purchases – \$554 million from the raw steel segment and \$65.5 million from the fabricated metals industry. Fourth were iron and steel mills and ferroalloy manufacturing, with \$422 million (only 8.5% of their purchases came from fabricated metals). The ball and roller bearing manufacturing industry made \$416 million in purchases, with 18 percent coming from the raw steel segment. The bearing industry was the fifth-largest direct customer of the steel industry. Ferrous metal foundries purchased \$53 million in raw steel materials; nonferrous metal factories (with the exception of aluminum and copper plants) purchased \$27.4 million in raw steel products; spring and wire manufacturers purchased \$34.9 million in raw steel, and "other fabricated metals manufacturers" purchased \$33.5 million in raw steel products.

Industries that add value to metal have a strong Ohio presence, which is tightly linked to the cluster of metal makers and metal users in the state:

- Forging and stamping operations used \$115.3 million in raw steel and \$28.1 million in fabricated metal.

¹³ The plants are in Lordstown, Avon Lake, Marysville, East Liberty, Springfield, and Toledo.

- Crown and closure manufacturers and metal stamping companies used \$127.8 million in steel.
- Coating, engraving and heat treating companies purchased \$102.1 million in raw steel and \$31.0 million in fabricated metal.

Building construction

Ohio is home to a number of major steel-using industrial plants that service the construction industry. Despite the effects of the Great Recession on the values of homes and commercial buildings, this industry was the third-largest direct purchaser of steel and fabricated metals, with nearly a half-billion dollars in purchases. These products went into residential, commercial and other nonresidential structures. These include new construction and repair, manufactured housing, multifamily housing, and traditional home construction. Nearly all (97%) of the purchases were made from the fabricated steel industry.

Related to residential construction are the “white goods,” or home appliance, industries, which are well-established in western Ohio, with both laundry and kitchen equipment manufacturers present. Even in a year with an extremely depressed new home sales market, the laundry equipment industry purchased \$209 million in steel products. Also related to the construction industry are the ornamental and architectural metal products industry, which had the 12th largest volume of direct purchases in 2010 at nearly \$146 million, and plate and fabricated structural product manufacturing, which had \$117.2 million in raw steel purchases and \$37.6 million in fabricated steel purchases, making the industry the 11th largest purchaser.

Rounding out construction-related sales are the manufacturers of air conditioning, refrigeration, and heating equipment (HVAC), with \$41 million in raw steel purchases and \$31.2 million in purchased fabricated metal parts; power boilers and heat exchange manufacturers, which used \$24.7 million in raw steel; and the paint industry, which made \$41.2 million in fabricated metals purchases from Ohio-based suppliers in 2010.

Purchases from two other industries are related to construction, but not as tightly as those listed above. The hand-tool manufacturing industry has deep roots in Ohio. It had \$36.8 million in raw steel purchases. Ohio’s restaurants and food services establishments purchased \$62.2 million in fabricated metal products, mainly fixtures, which can be considered related to the construction industry.

Nondurable consumer goods

The consumer market for nondurable goods is also evident in the sales data. Light-gauge metal cans, boxes and containers are the fifth-largest purchaser of steel, with \$120 million in raw steel purchases and \$206 million in fabricated metals. The fruit and vegetable industry used \$158 million in fabricated metals (10th place), which was nearly three times the size of the dollar volume of sales to dog and cat food manufacturers, which purchased \$57.1 million in fabricated metals.

Ohio’s breweries purchased \$143 million in fabricated metals, while the soft drink industry used \$44.3 million. The dairy product industry was the 38th largest user of steel in the state, purchasing \$39.4 million in fabricated metals.

Soap and cleaning compounds purchased \$33 million of fabricated metal parts for use in their production processes.

Machine building and capital equipment

After a decade bracketed by recessions that challenged the finances of domestic manufacturers, the lack of investment in plant and equipment has begun to catch up. The result is a burst of activity in the state's machine-building, or capital goods, companies.

The eighth-largest purchaser of steel in 2010 was the material handling and equipment industry, using \$93.0 million in raw steel and another \$84.1 million in fabricated metals. The industrial machinery industry purchased \$42.1 million in raw steel and \$54.8 million in fabricated metal. The general-purpose machinery industry was the 25th largest steel user in the state, with \$61 million in purchases fairly evenly split between the two sources. A critical component in many manufacturing processes is metal cutting and forming. This industry used \$20.1 million in raw steel in its machine making.

There are a number of smaller, but critical, industries that make capital goods equipment. These are the tool makers for those companies that make tools for others. The industrial mold manufacturing industry used \$17.0 million in Ohio raw steel in 2010. The custom roll forming industry, which contours metal products by bending them, used \$12.6 million in raw steel from Ohio. A very specialized set of industrial equipment companies is grouped in the special tool, die, jig, and fixture manufacturing industry. Such companies were the 36th largest users of steel in Ohio, making \$42.8 million in raw steel purchases. Ohio's plastics and rubber

industry machinery manufacturers generated \$10.5 million in raw steel sales.

Three capital equipment industries differ from those mentioned above due to their products. The telecommunications industry uses significant amounts of steel as part of its infrastructure. In 2010, Ohio's telecommunications firms used \$31.0 million in Ohio-sourced fabricated metal products. The power distribution and specialty transformer industry used \$18.2 million in raw steel, while the wiring device industry used \$12.6 million in fabricated metal.

The fastener industry (or turned products: screws, nuts, and bolts) can be thought of as an industry that holds all others together. The fastener industry used \$55 million in raw steel.

Mining and fluids

Ohio's steel industry is banking on the development of the Utica and Marcellus Shale energy deposits as a source of steel sales in the future. Steel industry leaders also see Ohio-made steel products as being competitive in energy development opportunities in other areas of North America. However, the sale of steel into these markets was not well-represented in the sales data for 2010. The resource was just being identified at that time.

Despite this fact, sales into industries that will directly benefit from the development of Ohio's shale oil, gas, and natural gas liquids were substantial:

- The industrial valve industry purchased \$92.2 million of product and was the 19th largest in-state customer; 62.5 percent of its purchases was of fabricated metal products.

- The heavy gauge metal tank manufacturing industry purchased \$60.5 million in raw steel product.
- In-state sales of raw steel to pipe manufacturers totaled \$24.8 million.
- Builders of fluid power processing machinery consumed \$20.8 million in raw steel.

manufacturing industry used \$11 million in raw steel in its production processes in 2010.

The last industry is Ohio's cooperative electricity industry, which used \$71.0 million in fabricated steel product.

Mining and oil and gas field machinery manufacturing purchased \$10.2 million in raw steel, making the industry the 65th largest customer of Ohio steel.

Miscellaneous steel-using industries

Five steel-using industries were difficult to classify because their customer bases are either very diversified or unique. Four of these are manufacturing industries. Machine shops are general-purpose manufacturers commonly referred to as "job shops." They frequently occupy the third tier of the manufacturing hierarchy.¹⁴ In Ohio, they are also major steel users, purchasing \$28.9 million in raw steel and \$50.9 million in fabricated steel products and ranking 20th in Table 4. The rubber products industry used \$34.5 million in fabricated steel products in 2010, and the plastics products manufacturing industry used \$26.9 million in fabricated steel. Ohio's dye and pigment

¹⁴ The OEMs are at the top of the food chain. The providers of major subassemblies or components to the OEMs are considered to be Tier 1 suppliers, and they are in direct communication with the OEM. The Tier 1s are the customers of the Tier 2 suppliers, who tend to supply components or specialized parts of the subassemblies. Tier 3 suppliers make more generic parts that can be shipped to any of the tiers above them. Another way of thinking about the tiers in manufacturing is about the degree to which the products are generic and the amount of intellectual property or proprietary knowledge the company has in its product.

Table 4. Sales by Ohio's Steel Industry to Customers Located in Ohio

IMPLAN Industry Sector	Corresponding NAICS	Total Raw Steel Industry's Sales in Ohio	Total Fabricated Metal Industry's Sales in Ohio	Total Ohio Sales
Motor vehicle parts manufacturing	3363	\$575,262,802	\$696,291,778	\$1,271,554,580
Steel product manufacturing from purchased steel	33121, 33122	\$554,493,033	\$65,539,885	\$620,032,918
Construction and repair of structures	23*	\$13,766,804	\$462,719,423	\$476,486,227
Iron and steel mills and ferroalloy manufacturing	3311	\$386,364,142	\$35,855,917	\$422,220,059
Ball and roller bearing manufacturing	332991	\$78,162,358	\$338,032,071	\$416,194,429
Metal can, box, and other metal container (light gauge) manufacturing	33243	\$119,777,923	\$206,273,954	\$326,051,877
Household laundry equipment manufacturing	335224	\$163,048,594	\$46,357,612	\$209,406,206
Material handling equipment manufacturing	333921-4	\$93,605,106	\$84,072,082	\$177,677,188
Military armored vehicle, tank, and tank component manufacturing	336992	\$26,697,410	\$145,221,953	\$171,919,363
Fruit and vegetable canning, pickling, and drying	31142		\$158,758,854	\$158,758,854
Plate work and fabricated structural product manufacturing	33231	\$117,242,799	\$37,650,552	\$154,893,351
Ornamental and architectural metal products manufacturing	33232	\$104,215,055	\$41,665,724	\$145,880,779
Breweries	31212		\$143,644,518	\$143,644,518
All other forging, stamping, and sintering	332111-2, 332117	\$115,351,777	\$28,142,038	\$143,493,815
Coating, engraving, heat treating and allied activities	3328	\$102,138,359	\$30,996,374	\$133,134,733
Crown and closure manufacturing and metal stamping	332115-6	\$98,372,628	\$29,396,519	\$127,769,147
Automobile manufacturing	336111		\$99,237,874	\$99,237,874
Other industrial machinery manufacturing	33321, 333291-4, 333298	\$42,115,065	\$54,765,815	\$96,880,880
Valve and fittings other than plumbing	332911-2, 332919	\$34,678,639	\$57,564,480	\$92,243,119
Machine shops	33271	\$28,686,815	\$50,858,194	\$79,545,009
Maintenance and repair construction of nonresidential maintenance and repair	23	\$16,472,504	\$57,173,643	\$73,646,147
Air conditioning, refrigeration, and warm air heating equipment manufacturing	333415	\$40,999,262	\$31,231,744	\$72,231,006
State and local government electric utilities*	n.a.		\$71,048,081	\$71,048,081
Food services and drinking places	722		\$62,220,878	\$62,220,878
Other general purpose machinery manufacturing	333992, 333997, 333999	\$31,227,375	\$30,197,069	\$61,424,444
Metal tank (heavy gauge) manufacturing	33242	\$60,543,772		\$60,543,772
Dog and cat food manufacturing	311111		\$57,076,323	\$57,076,323

IMPLAN Industry Sector	Corresponding NAICS	Total Raw Steel Industry's Sales in Ohio	Total Fabricated Metal Industry's Sales in Ohio	Total Ohio Sales
Turned product and screw, nut, and bolt manufacturing	33272	\$55,280,416		\$55,280,416
Ferrous metal foundries	33151	\$53,131,061		\$53,131,061
Construction machinery manufacturing	33312	\$20,657,338	\$31,267,511	\$51,924,849
Farm machinery and equipment manufacturing	333111	\$22,828,546	\$28,626,961	\$51,455,507
Aircraft engine and engine parts manufacturing	336412		\$50,443,151	\$50,443,151
Light truck and utility vehicle manufacturing	336112	\$12,404,754	\$37,090,627	\$49,495,381
Air and gas compressor manufacturing	333912		\$49,358,474	\$49,358,474
Soft drink and ice manufacturing	31211		\$44,296,499	\$44,296,499
Special tool, die, jig, and fixture manufacturing	333514	\$42,770,215		\$42,770,215
Paint and coating manufacturing	32551		\$41,207,668	\$41,207,668
Dry, condensed, and evaporated dairy product manufacturing	311514		\$39,395,022	\$39,395,022
Handtool manufacturing	332212-3	\$36,836,336		\$36,836,336
Spring and wire product manufacturing	3326	\$34,854,945		\$34,854,945
Other rubber product manufacturing	32629		\$34,479,865	\$34,479,865
Other fabricated metal manufacturing	332997-9	\$33,469,552		\$33,469,552
Soap and cleaning compound manufacturing	32561		\$33,053,523	\$33,053,523
Turbine and turbine generator set units manufacturing	333611		\$32,693,628	\$32,693,628
Toilet preparation manufacturing	32562		\$32,410,906	\$32,410,906
Telecommunications	517		\$30,949,540	\$30,949,540
Other engine equipment manufacturing	333618		\$30,444,914	\$30,444,914
Other aircraft parts and auxiliary equipment manufacturing	336413		\$28,797,325	\$28,797,325
Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	33149	\$27,367,445		\$27,367,445
Other plastics product manufacturing	32619		\$26,946,264	\$26,946,264
Motor and generator manufacturing	335312	\$26,020,104		\$26,020,104
Fabricated pipe and pipe fitting manufacturing	332996	\$24,828,448		\$24,828,448
Power boiler and heat exchanger manufacturing	33241	\$24,720,782		\$24,720,782
Showcase, partition, shelving, and locker manufacturing	337215	\$21,596,534		\$21,596,534
Fluid power process machinery	333995-6	\$20,772,299		\$20,772,299
Metal cutting and forming machine tool manufacturing	333512-3	\$20,079,778		\$20,079,778
Power, distribution, and specialty transformer manufacturing	335311	\$18,244,165		\$18,244,165
Industrial mold manufacturing	333511	\$17,008,226		\$17,008,226

IMPLAN Industry Sector	Corresponding NAICS	Total Raw Steel Industry's Sales in Ohio	Total Fabricated Metal Industry's Sales in Ohio	Total Ohio Sales
Motor vehicle body manufacturing	336211	\$15,581,748		\$15,581,748
Wiring device manufacturing	33593	\$12,614,383		\$12,614,383
Custom roll forming	332114	\$12,564,258		\$12,564,258
Synthetic dye and pigment manufacturing	32513	\$10,999,791		\$10,999,791
Other commercial and service industry machinery manufacturing	333319	\$10,839,193		\$10,839,193
Plastics and rubber industry machinery manufacturing	33322	\$10,455,379		\$10,455,379
Mining and oil and gas field machinery manufacturing	33313	\$10,238,752		\$10,238,752
TOTAL (All Industries)		\$3,754,950,092	\$4,884,208,390	\$8,639,158,482

In-state Suppliers

In total, Ohio's steel industry spent more than \$10.2 billion in 2010 purchasing goods and services produced in Ohio; nearly \$6.6 billion in spending came from the fabricated metals industry and \$3.7 billion from the raw steel sector. Table 5 shows the main in-state suppliers to the industry. As can be seen, the supply chain for raw steel varies greatly from the one serving the state's fabricated metal product manufacturing industry.

Metals manufacturers

The largest purchases made in the state by Ohio steelmakers was, in fact, within the industry. The state's fabricated metals industry purchased \$751.4 million from Ohio iron and steel mills and ferroalloy manufacturers, and the state's raw steel industry purchased another \$629.7 million. All told, more than \$1.38 billion went to that sector, accounting for 13.5 percent of all spending by the steel industry within the state. Ohio's steel industry spent another \$656 million purchasing product from manufacturers making steel product from purchased steel. Another \$89.5 million was

spent with the state's ferrous metal foundries, with the bulk (\$77.2 million) going to Ohio's fabricated metal manufacturers.

Other suppliers of metals and metal products within the state benefited from the production demands of Ohio's steel industry. The fabricated metal industry spent \$62.4 million with Ohio's nonferrous metal foundries, \$71.6 million with manufacturers in the state making aluminum product from purchased aluminum, \$59.9 million with machine shops in the state, and \$58.4 million with Ohio's copper rolling, drawing, extruding and alloying industry.

The Ohio steel industry purchased \$332.8 million from ball and roller bearing manufacturers in the state, with \$308.6 million going to the fabricated metal industry alone. The fabricated metal industry spent another \$186 million with Ohio manufacturers of metal can, box and other metal containers; \$107.3 million on all other forging, stamping, and sintering; \$48 million on coating, engraving, heat treating and allied activities (Ohio's raw steel industry purchased an additional \$10 million from such suppliers); \$46.5 million with

Ohio manufacturers of ornamental and architectural metal products; \$44.2 million with the state's turned product and screw, nut, and bolt manufacturing industry; \$33.9 million on crown and closure manufacturing and metal stamping; and \$30.9 million with manufacturers of fabricated pipe and pipe fitting; and \$30.5 million on plate work and fabricated structural product manufacturing.

The metal product needs of the raw steel industry vary greatly from those of fabricated steel manufacturers. In addition to the \$24.1 million spent on ball and roller bearing manufacturing, Ohio's raw steel industry purchased \$37.4 million from spring and wire product manufacturers in the state.

Wholesale trade

Ohio's steel industry purchased more than \$1 billion from suppliers from the state's wholesale trade industry. This industry classification includes merchant wholesalers of durable goods, such as motor vehicle parts and supplies; professional and commercial equipment and supplies; metal and mineral (except petroleum); machinery, equipment, and supplies, as well as merchant wholesalers of non-durable goods, such as paper and paper product; grocery and related product; chemical and allied products; and petroleum and petroleum products. The amount spent by the steel industry on wholesale trade is fairly evenly split between the raw steel and fabricated metal industries, but the \$472.5 million purchased by raw steel manufacturers accounts for a higher percentage of the total spent with Ohio suppliers.

Energy

Steel is an energy-intensive industry. Not surprisingly, electric power generation, transmission and distribution ranked No. 5 on the list of Ohio steel industry suppliers, accounting for \$380.2 million in purchases. Raw steel is a particularly energy-intensive industry. At \$201.4 million, electric power generation made up 5.5 percent of the total amount spent in the state by Ohio's raw steel industry. The raw steel industry also purchased \$114.8 million from Ohio's natural gas distributors, spent \$59.8 million with the state's coal mining industry, and bought \$10.5 million from manufacturers of all other petroleum and coal products. In addition, Ohio's raw steel industry spent \$45.8 million with electrical utilities run by municipalities or governmental cooperatives. All told, energy needs accounted for roughly 12 percent of all purchases made by Ohio's raw steel industry within the state.

Transportation

Ohio's steel industry purchased \$368.6 million from truck transportation suppliers in the state, with the amount spent split relatively evenly between the raw steel and fabricated metal industries. Ohio's raw steel industry spent an additional \$153.3 million for rail transportation and \$11.6 million on support activities for transportation. All told, about 9 percent of the total amount Ohio's raw steel industry spent with suppliers in the state went toward transportation needs. Warehousing and storage, a related activity, accounted for \$17.7 million spent by Ohio's raw steel industry and \$76.4 million spent by the fabricated metals industry in the state.

Professional services

Management of companies and enterprises accounted for \$440.6 million spent by the Ohio steel industry with suppliers located in the state. The fabricated metal industry alone spent \$308.6 million on headquarters-related activities. Ohio's steel industry purchased \$149 million from state suppliers of securities, commodity contracts, investments and related activities; \$122.1 million from state suppliers of all other miscellaneous professional, scientific, and technical services; \$119.3 million from suppliers of accounting, tax preparation, bookkeeping, and payroll services; \$113.7 million from suppliers of architectural, engineering, and related services; \$102.9 million from suppliers of specialized design services; \$102.7 million from suppliers of legal services; \$93.3 million from suppliers of business support services; \$81.4 million for employment services; and \$45.3 million from suppliers of management, scientific, and technical consulting services. In addition, Ohio's fabricated metal manufacturers spent \$45 million on custom computer programming services; \$34.3 million on scientific research and

development services, and \$31.4 million on advertising and related services. Ohio's raw steel industry spent \$39 million on monetary authorities and depository credit intermediation; \$26.5 million on waste management and remediation services; \$22.7 million on nondepository credit intermediation and related activities; \$15.8 million on other support services; and \$13.9 million on real estate services.

Manufacturing

Beyond metals manufacturers noted earlier, many manufacturing industries in the state supply Ohio's steel industry. Fabricated metal manufacturers purchased \$114.9 million from Ohio manufacturers of paints and coatings. The raw steel industry spent \$38.7 million with clay and nonclay refractory manufacturers in the state; \$37.4 million with material handling equipment manufacturers; \$23.2 million with paperboard container manufacturers; \$22.2 million with industrial gas manufacturers; and \$15.3 million with lime and gypsum product manufacturers.

Table 5. Purchases Made by Ohio's Steel Industry From Suppliers Located in Ohio

IMPLAN Industry Sector	Corresponding NAICS	Raw Steel Industry		Fabricated Metals		Total Ohio Purchases
		Purchases from Ohio Suppliers	Percent of Total Ohio Purchases	Purchases from Ohio Suppliers	Percent of Total Ohio Purchases	
Wholesale trade	42	\$472,543,548	12.90%	\$575,918,121	8.70%	\$1,048,461,669
Iron and steel mills and ferroalloy manufacturing	3311	\$629,703,235	17.20%	\$751,395,133	11.40%	\$1,381,098,368
Steel product manufacturing from purchased steel	33121, 33122	\$311,153,939	8.50%	\$344,833,167	5.20%	\$655,987,106
Management of companies and enterprises	55	\$131,955,185	3.60%	\$308,623,993	4.70%	\$440,579,178
Electric power generation, transmission, and distribution	2211	\$201,380,450	5.50%	\$178,829,836	2.70%	\$380,210,286
Truck transportation	484	\$191,476,382	5.20%	\$177,172,350	2.70%	\$368,648,732
Ball and roller bearing manufacturing	332991	\$24,142,187	0.70%	\$308,643,800	4.70%	\$332,785,987
Maintenance and repair construction of nonresidential maintenance and repair	23	\$88,683,061	2.40%	\$114,057,398	1.70%	\$202,740,459
Metal can, box, and other metal container (light gauge) manufacturing	33243			\$186,012,109	2.80%	\$186,012,109
Services to buildings and dwellings	5617	\$73,681,498	2.00%	\$104,156,005	1.60%	\$177,837,503
Telecommunications	517	\$23,658,013	0.60%	\$137,806,942	2.10%	\$161,464,955
Rail transportation	482	\$153,389,421	4.20%			\$153,389,421
Securities, commodity contracts, investments, and related activities	523	\$30,223,187	0.80%	\$118,821,688	1.80%	\$149,044,875
All other miscellaneous professional, scientific, and technical services	54191, 54193, 54199	\$20,578,858	0.60%	\$101,480,427	1.50%	\$122,059,285
Accounting, tax preparation, bookkeeping, and payroll services	5412	\$15,499,920	0.40%	\$103,816,996	1.60%	\$119,316,916
Paint and coating manufacturing				\$114,902,657	1.70%	\$114,902,657
Natural gas distribution	2212	\$114,782,364	3.10%			\$114,782,364
Architectural, engineering, and related services	5413	\$36,957,531	1.00%	\$76,719,270	1.20%	\$113,676,801
Food services and drinking places	722	\$19,906,494	0.50%	\$92,284,951	1.40%	\$112,191,445
All other forging, stamping, and sintering	332111-2, 332117			\$107,298,566	1.60%	\$107,298,566
Specialized design services	5414	\$36,950,876	1.00%	\$65,941,702	1.00%	\$102,892,578
Legal services	5411	\$26,655,412	0.70%	\$76,080,367	1.20%	\$102,735,779
Warehousing and storage	493	\$17,701,916	0.50%	\$76,360,912	1.20%	\$94,062,828
Business support services	5614	\$28,789,462	0.80%	\$64,487,426	1.00%	\$93,276,888
Automotive repair and maintenance, except car washes	81111-2, 811191, 811198	\$39,551,812	1.10%	\$50,870,243	0.80%	\$90,422,055
Ferrous metal foundries	33151	\$12,268,325	0.30%	\$77,248,576	1.20%	\$89,516,901
Employment services	5613*	\$27,057,121	0.70%	\$54,372,669	0.80%	\$81,429,790
Aluminum product manufacturing from purchased aluminum	331315, 331316, 331319			\$71,610,045	1.10%	\$71,610,045
Lessors of nonfinancial intangible assets				\$70,604,324	1.10%	\$70,604,324
Commercial and industrial machinery and equipment repair and maintenance	8113	\$30,028,778	0.80%	\$38,590,066	0.60%	\$68,618,844
Nonferrous metal foundries	33152			\$62,429,298	0.90%	\$62,429,298
Machine shops				\$59,932,789	0.90%	\$59,932,789

IMPLAN Industry Sector	Corresponding NAICS	Raw Steel Industry		Fabricated Metals		Total Ohio Purchases
		Purchases from Ohio Suppliers	Percent of Total Ohio Purchases	Purchases from Ohio Suppliers	Percent of Total Ohio Purchases	
Coal mining	2121	\$59,772,047	1.60%			\$59,772,047
Copper rolling, drawing, extruding and alloying	33142			\$58,369,074	0.90%	\$58,369,074
Coating, engraving, heat treating and allied activities	3328	\$10,004,979	0.30%	\$48,023,562	0.70%	\$58,028,541
Automotive equipment rental and leasing	5321	\$10,390,913	0.30%	\$38,819,165	0.60%	\$49,210,078
Ornamental and architectural metal products manufacturing	33232			\$46,461,012	0.70%	\$46,461,012
Other state and local government enterprises*	n.a.	\$45,819,870	1.30%			\$45,819,870
Management, scientific, and technical consulting services	54161, 5613	\$11,439,853	0.30%	\$33,840,486	0.50%	\$45,280,339
Custom computer programming services	541511			\$45,036,322	0.70%	\$45,036,322
Turned product and screw, nut, and bolt manufacturing	33272			\$44,245,123	0.70%	\$44,245,123
Monetary authorities and depository credit intermediation	521, 5221	\$39,010,072	1.10%			\$39,010,072
Clay and nonclay refractory manufacturing	327124-5	\$38,675,135	1.10%			\$38,675,135
Material handling equipment manufacturing	333921-4	\$37,430,687	1.00%			\$37,430,687
Spring and wire product manufacturing	3326	\$37,357,841	1.00%			\$37,357,841
Scientific research and development services	5417			\$34,288,903	0.50%	\$34,288,903
Crown and closure manufacturing and metal stamping	332115-6			\$33,944,913	0.50%	\$33,944,913
Advertising and related services	5418			\$31,415,796	0.50%	\$31,415,796
Fabricated pipe and pipe fitting manufacturing				\$30,866,963	0.50%	\$30,866,963
Plate work and fabricated structural product manufacturing				\$30,475,078	0.50%	\$30,475,078
Waste management and remediation services	562	\$26,477,049	0.70%			\$26,477,049
Paperboard container manufacturing	32221	\$23,286,277	0.60%			\$23,286,277
Nondepository credit intermediation and related activities	5222-3	\$22,726,325	0.60%			\$22,726,325
Industrial gas manufacturing	32512	\$22,170,332	0.60%			\$22,170,332
Petroleum refineries	32411	\$16,618,388	0.50%			\$16,618,388
Other support services	5619	\$15,834,398	0.40%			\$15,834,398
Lime and gypsum product manufacturing	3274	\$15,266,974	0.40%			\$15,266,974
Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	33149	\$14,488,778	0.40%			\$14,488,778
Real estate	531	\$13,947,940	0.40%			\$13,947,940
Scenic and sightseeing transportation and support activities for transportation	487, 488	\$11,632,408	0.30%			\$11,632,408
Investigation and security services	5616	\$10,706,539	0.30%			\$10,706,539
All other petroleum and coal products manufacturing	324199	\$10,514,729	0.30%			\$10,514,729
TOTAL (All Industries)		\$3,661,517,941	100.00%	\$6,583,836,459	100.00%	\$10,245,354,400

* Electrical Utilities run by municipalities or governmental cooperatives

Benchmarking the Industry

Tables 6 to 9 present variants of a measure of capacity utilization commonly employed by steel analysts. The denominator, or base, of the measure is the average of the variable in question over a period of time – five-year and 10-year averages are used, along with a one-year lag in each of these four tables. The numerator is the current measure of the variable in question. In this way, performance relative to recent capacity can be explored. Table 6 analyzes Real GDP, Table 7

Employment, Table 8 Real Annual Payroll and Table 9 Real Annual Earnings. The current levels in each of these variables relative to 2009 has been calculated to capture movement from the trough of the Great Recession. Finally, the one-year growth rate from 2010 to 2011 is included. The data on employment, payroll and earnings for 2011 are actual figures obtained from aggregated unemployment tax filings. Data on 2011 GDP are projections obtained from Moody's Analytics, Economy.com.

Table 6. Gross Domestic Product in Ohio Steel Industry (000s in 2012 \$)

	2010			Compared to 5 Yr. Avg.		Compared to 10 Yr. Avg.		Compared to 2009 (last business cycle trough)		2011 (projections)		Projected Growth 2010-2011	
	Ohio	USA	% of US	Ohio	USA	Ohio	USA	Ohio	USA	Ohio	USA	Ohio	USA
Raw Steel	1,943,353	22,029,550	8.8%	-34.0%	-10.9%	-34.2%	-3.6%	15.0%	12.7%	2,256,859	24,676,534	16.1%	12.0%
Iron and Steel Mills and Ferroalloy Mfg.	1,198,129	14,993,319	8.0%	-36.8%	-11.6%	-37.4%	-4.2%	16.8%	12.6%	1,355,502	16,565,489	13.1%	10.5%
Steel Product Mfg. from Purchased Steel	745,224	7,036,231	10.6%	-28.8%	-9.4%	-28.2%	-2.3%	12.4%	12.9%	901,357	8,111,044	21.0%	15.3%
Fabricated Metal Product Mfg.	11,211,828	138,062,148	8.1%	-3.8%	-1.0%	-3.0%	0.5%	8.0%	7.2%	12,340,958	149,984,258	14.4%	8.6%
Total Raw Steel Products and Fabrication	13,155,182	160,091,698	8.2%	-9.9%	-2.5%	-9.4%	-0.1%	9.0%	7.9%	14,692,503	174,660,792	11.7%	9.1%

Source: Moody's Economy.com

Table 7. Employment in Ohio Steel Industry

	2010			Compared to 5 Yr. Avg.		Compared to 10 Yr. Avg.		Compared to 2009 (last business cycle trough)		2011		Growth 2010-2011	
	Ohio	USA	% of US	Ohio	USA	Ohio	USA	Ohio	USA	Ohio	USA	Ohio	USA
Raw Steel	17,148	138,028	12.4%	-13.8%	-8.4%	-25.4%	-12.8%	3.9%	0.4%	17,642	145,828	2.9%	5.7%
Iron and Steel Mills and Ferroalloy Mfg.	9,629	85,809	11.2%	-16.1%	-8.4%	-28.5%	-13.2%	5.1%	-0.8%	9,889	90,046	2.7%	4.9%
Steel Product Mfg. from Purchased Steel	7,519	52,219	14.4%	-10.7%	-8.5%	-20.9%	-12.2%	2.3%	2.4%	7,753	55,782	3.1%	6.8%
Fabricated Metal Product Mfg.	94,340	1,282,156	7.4%	-12.3%	-11.5%	-16.3%	-14.4%	-1.0%	-2.2%	98,016	1,329,162	3.9%	3.7%
Total Raw Steel Products and Fabrication	111,488	1,420,184	7.9%	-12.6%	-11.2%	-17.9%	-14.2%	-0.3%	-1.9%	115,658	1,474,990	3.7%	3.9%

Source: Quarterly Census of Employment and Wages

Gross Domestic Product, a Version of Value Added

In 2010 Ohio's steel industry generated \$13.1 billion in Gross Domestic Product (Table 6). This is 8.2 percent of the industry's national contribution to GDP. More than 85 percent of industry GDP comes from fabricated metals, both in Ohio and nationally. Producers in the state lost national market share over both the five- and 10-year periods in all three portions of the industry. This can be attributed to the nature of the recessions; Great Lakes automobile assembly plants and white goods (appliance) manufacturers were especially hard hit. It will be shown later in this section that the economic vitality of the steel industry is particularly tied to the fortunes of its customers and the location of those customers. Although households use a good deal of steel in their daily lives, that consumption is indirect. Steel is an embedded product. It is in everything from soft drink cans to soft-top cars.

What is encouraging is the bounce back being experienced from the Great Recession. Particularly encouraging are two observations: The recovery is happening most quickly in the raw steel manufacturing portion of the industry, and the accelerated recovery continued through 2011. Ohio's steel industry is expected to add \$1.5 billion in GDP through 2011. What is worrisome, however, is the increasing prospect of a global economic slowdown in 2013 and 2014, as the United States stalemates over economic policy, the Euro Zone confronts shock after shock, and China's growth rate dips below 8 percent. For steelmakers in Ohio, future prospects may increasingly revolve around replacement demand for worn-out automobiles and trucks and energy development.

The declines in GDP relative to the five- and 10-year capacity measures were largest in raw steel production, where declines exceeded one-third of capacity; iron and steel mills and ferroalloy manufacturing lost 34.0 percent of capacity. But, amazingly, nearly half of those losses have been recovered since the end of the recession and further gains are expected when the final data for 2011 are made available.

As noted earlier, fabricated metal products manufacturing is by far the largest portion of the steel industry, both in the state and nation. Its decline was mild compared to the other portion of the industry, and its recovery much quicker. This is most likely a result of recovered production in the Great Lakes auto plants and the development of oil and gas plays across the nation. The research team also received reports that steel used by capital equipment manufacturers is in demand as manufacturers rush to replace equipment that has worn out after a decade in which companies have been reluctant to spend money on plant and equipment.

Employment

In terms of steel industry employment, Ohio's losses over the decade were proportionately larger than those experienced by the industry nationwide. As can be seen in Table 7, Ohio accounted for nearly 8 percent of the U.S. steel industry workforce in 2010, employing more than 111,500 workers. Employment levels were 12.6 percent lower than the average for the preceding five-year period and nearly 18 percent below the 10-year average; both are larger proportional losses than experienced nationally. Employment did increase by more

than 4,000 positions from 2010 to 2011, with nearly all of the gain coming from the fabricated metals sector. Employment grew from 2010 to 2011 in the raw steel sectors in Ohio but did not keep pace with the industry nationally.

The steel sector with the largest number of jobs is fabricated metal products manufacturing. This sector provided 94,000 jobs in Ohio in 2010, out of a total of 111,500 steel jobs. Ohio's steel industry employment in 2010 was 16.3 percent lower than its average employment over the previous 10 years, and 12.3 percent below the five-year average. But the industry gained nearly 4,000 positions from 2010 to 2011, adding jobs at a slightly faster rate than for the industry nationwide.

The sector where Ohio holds the highest share of industry employment is steel product manufacturing from purchased steel. Notably, the 7,519 Ohio workers engaged in this industry represent 14.4 percent of all U.S. workers in the industry. It is the highest share of employment among the three portions of the steel industry. It is also the sector that experienced the lowest employment loss rates compared to the five and 10-year averages.

Employment in the U.S. steel industry in 2010 was 14.2 percent below its 10-year average. Fabricated metal product manufacturing saw the largest loss of employment. The nation also saw shrinking numbers of workers engaged in steelmaking activities in 2010, but the declines were not as steep as in Ohio. Ohio's employment in iron and steel mills and ferroalloy manufacturing had declined by nearly 29 percent, compared to its 10-year average. Projections for 2011 suggest that steel industry employment in Ohio and the nation will experience similar growth of nearly 4 percent overall, but Ohio job growth in raw steel is

expected to significantly lag the increase for the industry nationwide.

As with the changes over time in GDP, it's instructive to put Ohio's current steel industry employment data in the context of the employment picture for the U.S. steel industry overall. As can be seen in Figure 3, the number of U.S. workers engaged in steel activities has declined dramatically since the late 1970s. The trend line for employment essentially tracks the ups and downs over the decades with steel industry GDP. In this timeframe, employment peaked for the industry overall in 1979, when nearly 2.3 million workers were forging and forming steel. The workforce contracted by more than 400,000 workers over the next four years and then continued a gradual decline until hitting a low of fewer than 1.7 million workers in 1992. For the next eight years, employment numbers grew slowly and relatively steadily to more than 1.9 million workers in 2000. The two recessions of the 2000s erased all of the employment gains of the previous decade, bottoming out in 2010, when fewer than 1.4 million U.S. workers were engaged in steel-making activities. As can be seen in Figure 3, 2011 issued in a budding rebound in U.S. steel industry employment, adding more than 60,000 workers nationwide.

The trendline for fabricated metal product manufacturing closely tracks the pattern for employment in the U.S. steel industry as a whole. That is not surprising given that most workers in the U.S. steel industry are engaged in fabricated metal product manufacturing. Similar to the trendline for GDP, U.S. employment in raw steel activities has experienced more than 30 years of decline. In 1979, more than 438,000 U.S. workers were engaged in iron and steel mills and ferroalloy

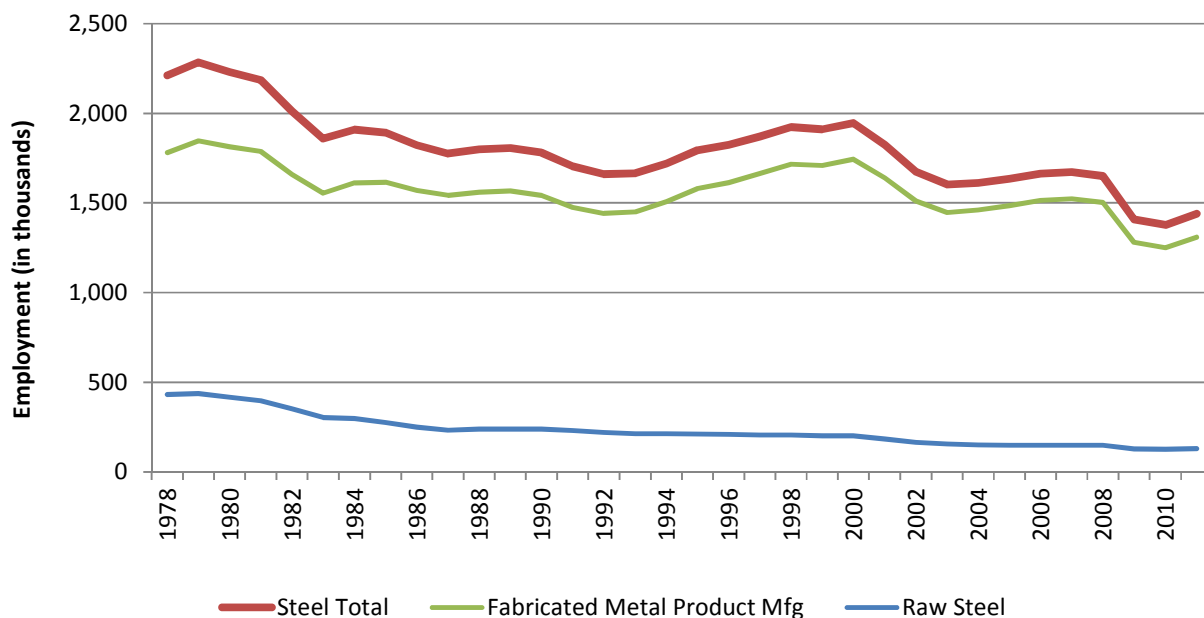
manufacturing and steel product manufacturing from purchased steel. In 2010, only 127,000 raw steel workers remained; employment in the industry had shrunk by 71 percent. However, projections for 2011 predicted that raw steel would add some 3,000 new jobs.

Additionally, interviews held with leaders of Ohio's steel industry, and discussed in the next major section of this report, indicate that the industry is poised for a round of hiring the likes of which have not been seen since the 1990s. Two factors are pushing the projected hiring binge. The first is the "doughnut hole." Many steelworkers are older, over age 50. Because the industry has not hired for nearly 20 years, retirements are driving replacement hiring. In other words, new hires have to be made even if head count does not increase. Second, increased demand for steel and fabricated steel products should trigger modest increases in

head count through the rest of the decade. This trend should be stronger in the eastern Great Lakes region due to the prospect of energy development and growing automobile and truck production in Ohio, Michigan and Indiana.

There are two wild cards that may be played – and neither one is good. The first is the threat of a new global recession, or at least slow growth rates, coming out of Europe and reinforced by slowing growth in China. The second is the threat of continued stalemate in Washington, D.C., over federal macroeconomic policy. The ideological divide in Washington is preventing movement toward measured near-term stimulus coupled with longer-term structural debt reduction. Without broad consensus on balanced macroeconomic public policies, the growth prospects for the nation will be throttled. The American consumer is in no position to drive this economy forward.

Figure 3. Employment in U.S. Steel Industry, 1978 - 2011

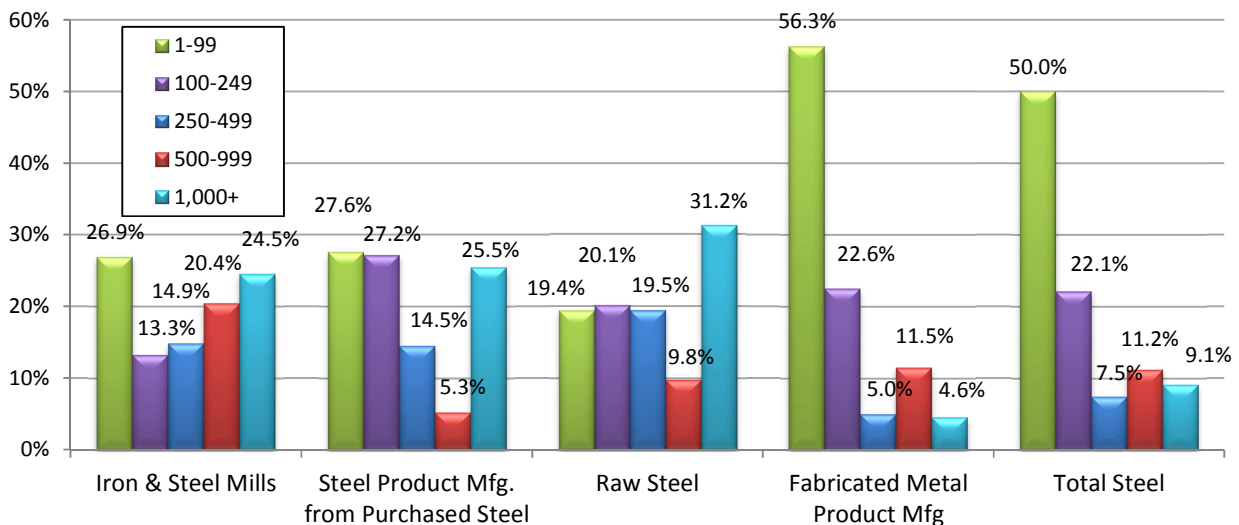


Source: Moody's Economy.com

Not only do the employment trendlines differ between raw steel production and fabricated metal product manufacturing, but these industries also see major differences in where these employees work. As can be seen in Figure 4, half of all Ohio steelworkers in 2010 were

employed in establishments with fewer than 100 workers. Only about 20 percent of Ohio steelworkers were employed in large establishments, those with 500 workers or more.

Figure 4. Employment Distributions by Establishment Size, Ohio Total Steel Industry, 2010



For fabricated metal products manufacturing, an even higher percentage of its workforce was employed in the smallest establishments. In fact, nearly 80 percent of Ohio's fabricated metal product workers were in establishments with fewer than 250 workers. Less than 5 percent were employed at establishments with more than 1,000 workers.

than 250 workers. Nearly 20 percent were in establishments of 250 to 499 workers. Drilling a bit more deeply shows that Ohio's iron and steel mills have the greatest concentration of workers (45%) in establishments with 500 employees or more. Conversely, Ohio's steel product manufacturing from purchased steel had nearly 55 percent of its workforce employed in establishments with fewer than 250 workers.

The employment distribution is different from that of raw steel's two component industries. Figure 4 shows that more than 40 percent of workers in Ohio's raw steel industry were in establishments with at least 500 workers. About 40 percent were in establishments with fewer

Payroll and Annual Earnings

Given that the number of steel jobs declined at a more precipitous rate in Ohio, compared to 10-year averages, it's not surprising that the steel industry's payroll in Ohio saw a greater decline than for the national industry overall. As can be seen in Table 8, Ohio's steel industry payroll for 2010 stood at \$6.1 billion, or roughly 8.1 percent of the \$75.1 billion for the U.S. total. For 2010, Ohio's total steel industry payroll was 16.4 percent below the industry's 10-year average, compared to the 11.6 percent drop experienced by the industry nationwide. There was also a second factor behind this decline. Payroll will tend to be lower because Ohio has a larger concentration of jobs in the fabricated steel products portion of the industry, which has lower earnings. (Table 9)

The decline in state payroll for raw steel activities was nearly twice the rate of the U.S. decline for similar payroll activities (-24.8% to -12.4%). This is in line with the decline in employment examined earlier. However, from 2010 to 2011, total steel industry payroll in the state grew by 3.3 percent, while it remained flat for the industry nationwide. Fabricated metal product manufacturing accounted for most of the difference, with the industry in Ohio growing at 3 percent while declining slightly for the nation overall (-0.8%). The only steel industry activity in Ohio in which payroll grew at a slower pace from 2010-2011 than for the nation overall was iron and steel mills and ferroalloy manufacturing, which grew at 4.4 percent for the state, compared to 5 percent for the nation overall. Again, this is in line with employment.

Table 9 shows average annual earnings for workers in the Ohio steel industry at \$54,799 in

2010, with annual earnings decreasing across the entire sector by \$250 from 2010 to 2011. The decrease is attributed to a decline in the fabricated metal products industry, where earnings fell by \$430. The decline can be put into a national context: Annual earnings were nearly \$2,000 higher in Ohio in 2010 than the national average, and this differential grew to \$3,711 in 2011, despite the drop in average annual earnings. One exception was wages for steel product manufacturing from purchased steel, where Ohio workers earned \$57,215, on average, in 2010, compared to \$59,070 for similar workers nationwide. It's worth noting that the highest steel industry wages were in iron and steel mills and ferroalloy manufacturing, which paid, on average, \$76,813 in the state and \$74,514 nationwide. Growth projections from 2010 to 2011 indicate relatively flat wages for the steel industry in Ohio, with a nearly 4 percent expected decline for the nation overall.

A caution is offered in examining the data on annual earnings. Ohio's workforce is now more experienced, older with more seniority, than is the workforce nationally. This is because jobs are being added more rapidly outside of the state. Younger workers, especially in workplaces that are represented by a labor union, have lower earnings than do workers with more seniority. Increasing head count should drive down earnings costs associated with working a smaller workforce more productively by reducing overtime payments. As Ohio's steel establishments add employment, their average wage bill should decrease. This is exactly what is occurring in Ohio's fabricated metal products industry. Average annual earnings in this industry dropped from \$52,360 in 2010 to \$51,930 in 2011 while the number of jobs increased from 94,340 to 98,016. Over the

same two years, average earnings increased in the other two sectors of the steel industry. (Iron and steel mills saw average earnings increase from \$76,813 to \$78,075, and average annual earnings increased in steel product manufacturing from \$57,215 to \$57,612.)

Table 8. Payroll in Ohio Steel Industry (000s in 2012 \$)

	2010			Compared to 5 Yr. Avg.		Compared to 10 Yr. Avg.		Compared to 2009 (last business cycle trough)		2011		Growth 2010-2011	
	Ohio	USA	% of US	Ohio	USA	Ohio	USA	Ohio	USA	Ohio	USA	Ohio	USA
Raw Steel	1,169,765,171	9,478,587,903	12.3%	-15.4%	-10.6%	-24.8%	-12.4%	10.6%	6.0%	1,218,756,562	9,877,020,946	4.2%	4.2%
Iron and Steel Mills and Ferroalloy Mfg.	739,592,175	6,393,992,083	11.6%	-17.4%	-11.9%	-26.6%	-13.4%	10.7%	5.4%	772,087,780	6,711,331,224	4.4%	5.0%
Steel Product Mfg. from Purchased Steel	430,172,996	3,084,595,820	13.9%	-11.8%	-7.8%	-21.3%	-10.1%	10.3%	7.3%	446,668,782	3,165,689,722	3.8%	2.6%
Fabricated Metal Product Mfg.	4,939,642,017	65,635,043,007	7.5%	-10.6%	-9.7%	-14.1%	-11.5%	2.2%	1.1%	5,089,928,096	65,104,283,865	3.0%	-0.8%
Total Raw Steel Products and Fabrication	6,109,407,188	75,113,630,910	8.1%	-11.6%	-9.8%	-16.4%	-11.6%	3.7%	1.7%	6,308,684,658	74,981,304,811	3.3%	-0.2%

Source: Quarterly Census of Employment and Wages

Table 9. Average Wage in Ohio Steel Industry (000s in 2012 \$)

	2010			Compared to 5 Yr. Avg.		Compared to 10 Yr. Avg.		Compared to 2009 (last business cycle trough)		2011		Growth 2010-2011	
	Ohio	USA	% of US	Ohio	USA	Ohio	USA	Ohio	USA	Ohio	USA	Ohio	USA
Raw Steel	68,216	68,671	99.3%	-1.8%	-2.4%	0.8%	0.5%	6.5%	5.6%	69,083	67,731	1.3%	-1.4%
Iron and Steel Mills and Ferroalloy Mfg.	76,813	74,514	103.1%	-1.5%	-3.9%	2.7%	-0.3%	5.4%	6.2%	78,075	74,532	1.6%	0.0%
Steel Product Mfg. from Purchased Steel	57,215	59,070	96.9%	-1.2%	0.8%	-0.5%	2.4%	7.9%	4.8%	57,612	56,751	0.7%	-3.9%
Fabricated Metal Product Mfg.	52,360	51,191	102.3%	2.0%	2.0%	2.6%	3.4%	3.2%	3.3%	51,930	48,981	-0.8%	-4.3%
Total Raw Steel Products and Fabrication	54,799	52,890	103.6%	1.1%	1.6%	1.8%	3.1%	4.0%	3.7%	54,546	50,835	-0.5%	-3.9%

Source: Quarterly Census of Employment and Wages

The Strength of Ohio Steel: What the numbers tell about Ohio's competitive position

As noted earlier, data on GDP and employment suggest that Ohio's steel industry has been recovering faster from the recent recession than the national industry average. What has triggered the recovery? Is it due to a rebound in the general marcoeconomy? Is it due to specific changes in demand for domestically produced steel and fabricated metal products? Or is it due to a shift in competitive conditions in Ohio, such as increased regional demand for steel products?

We chose to emphasize the changes in real GDP generated by Ohio's steel industry rather than changes in employment for two reasons.¹⁵ First, steel is a capital-intensive industry; as such, its long-term health is predicated on gains in total productivity (value added for every hour worked) and the return to invested capital. In other words, in steel, jobs follow investments in plant, equipment, and the innovation of either new product or the establishment of new sources of product demand. Second, there is a symbiotic relationship between Ohio's steel industry and its customers. In many cases, economic development analysis focuses on an industry's supply chain, attempting to use co-location as a way of enticing the supply chain to enter the local economy. (Think of an automobile assembly plant and the many parts used in assembly.) Steel turns this relationship on its head. The industry has a rather short supply chain, but the weight of its product provides an incentive for steel users (steel's customers) to locate within a short truck haul

from the mill. Think of Ohio's steel industry as a foundational "footer" for the overall economy, where total productivity gains are essential to its future and to the future of major steel users.

A decomposition technique, called shift-share analysis, is used to break down GDP growth into the three component parts mentioned above: national share, industry mix and local competitiveness.

The **national share** carves out the share of measured growth (positive or negative) that can be attributed to growth of the national economy. This measurement answers the question: If the Ohio steel industry grew or shrank at the rate of the national economy overall, what level of growth (or contraction) could be expected?

Industry mix calculates the growth rate of a particular industry at the national level after controlling for the growth rate of all industries at the national level. In other words, what level of change in GDP for Ohio's steel industry could be expected if it grew simply at the rate of the industry overall? In terms of arithmetic, the national average growth rate is subtracted from the industry's national growth rate. This prevents counting the national average growth rate twice in the complete decomposition.

The **local competitive effect** captures an industry's local (or, in this case, state) growth rate that cannot be explained by growth of the national economy and growth in the industry nationwide. This is the residual change in real GDP generated by Ohio's steel industry. What the technique cannot do is identify what local factors have triggered the local competitive

¹⁵ Shift-share analysis is usually conducted on employment data. This was done as part of this research, but we have chosen to emphasize changes in real GDP for the two reasons mentioned in the text.

effect. These have to be identified through case study analysis.

We start by looking at the changes in real GDP over the past decade. The results are presented in Table 10.

Table 10. Shift-share Analysis of Changes in Real GDP for Ohio's Steel Industry from 2000 to 2010
(in thousands of 2012 dollars)

Definition	Total Change	Components		
		Share (National)	Shift	
			Mix	Competitive
Raw Steel	-2,110,182	659,212	-819,977	-1,949,416
<i>Iron and Steel Mills and Ferroalloy Mfg</i>	-1,535,495	444,560	-620,891	-1,359,164
<i>Steel Product Mfg from Purchased Steel</i>	-574,687	214,653	-190,967	-598,372
Fabricated Metal Product Mfg	-2,486,793	2,227,760	-4,018,238	-696,315
Total Steel Industry	-4,596,975	2,886,972	-5,003,288	-2,480,659

Source: Moody's Economy.com

Ohio's steel industry lost \$4.6 billion in real GDP from 2000 to 2010. This period witnessed two recessions – one the largest since the Great Depression – the aftereffects of a very strong dollar in the early part of the decade, the temporary closure of the Detroit-based domestic automobile assembly industry, and a homebuilding industry that was at first artificially stimulated with bad mortgage underwriting practices and then depressed as the speculative and fraudulent asset bubble popped. In the aggregate, American households lost \$6.9 trillion, or 52 percent, in the value of equity from the market peak in 2005. This by itself put a damper on expenditures for consumer durable goods.

If the steel industry in Ohio grew at the same rate as the economy as a whole over this time period real GDP in Ohio's steel industry would have increased by \$2.9 billion instead of decreasing. The decline was caused by a combination of poor overall growth rate for the industry nationally (the industry mix effect

accounted for a loss of \$5.0 billion) and negative local competitive conditions, which rang up another \$2.5 billion in losses. This implies that steel industry nationally had a miserable decade and that losses were disproportionately severe in the state of Ohio.

Just a bit more than half of the entire loss attributed to local competitive conditions (the local competitive effect) was concentrated in iron and steel mills and ferroalloy manufacturing. The competitive effect in this industry alone was a negative \$1.4 billion.

Rebound after bottom was reached in the Great Recession

There is an air of cautious optimism among Ohio's steelmakers, especially for the longer-term future. Demand conditions for regionally sourced product have changed, especially in the automotive and energy sectors. Energy costs are relatively low, and, while it is likely that natural gas prices will increase in the future, they will be far below their peak prices of the

past decade. The negative wild cards are the prospect of a slowdown in global business conditions coming out of Europe's currency

crisis and a slowdown in the planned growth rates from China as that country deals with its real estate bubble.

Table 11. Shift-share Analysis of Changes in Real GDP for Ohio's Steel Industry from 2009 to 2010
(in thousands of 2012 dollars)

Definition	Total Change	Components		
		Share (National)	Shift	
			Mix	Competitive
Raw Steel	254,212	36,411	178,518	39,283
<i>Iron and Steel Mills and Ferroalloy Mfg</i>	172,136	22,116	107,542	42,479
<i>Steel Product Mfg from Purchased Steel</i>	82,075	14,295	71,315	-3,534
Fabricated Metal Product Mfg	833,524	223,711	523,278	86,534
Total Steel	1,087,736	260,122	696,310	131,304

Table 11 puts forward a set of convincing numbers behind the recovery of the steel industry in Ohio. Ohio's steel mills and fabricators experienced \$1.1 billion growth in GDP during 2009 and 2010. About one-quarter of the growth is associated with the national economic recovery; 64 percent is due to the industry mix effect, a shift toward domestic steel usage and domestically sourced fabricated metal products. The remainder, about 12 percent, is due to local competitive factors.

Diving into the numbers reveals that there was a decline in the local competitive effect for steel product manufacturers from purchased steel over this two-year period of \$3.5 million. Ohio's iron and steel mills experienced a \$39.3 million increase in their contribution to Ohio's GDP and the state's fabricated metal products industry experienced an \$86.5 million increase in GDP.¹⁶

¹⁶ A set of shift-share calculations was also made for employment for the time periods covered in Tables 8 and 9. Over the past decade, industry mix effect accounted for huge losses in Ohio's steel industry. Over the decade, the steel industry in the state lost nearly 52,000 jobs. Nearly 2,600 of the lost positions could be attributed to turgid

Another sign of steel industry recovery is becoming more visible in Northeast Ohio communities: investment. As noted earlier, steel is a capital-intensive industry. Capital expenditures offer two insights: Steel companies are profitable enough to invest in equipment and properties, and they see enough opportunity to make those investments worthwhile. After a dramatic drop-off in capital expenditures in the state (and nation) in 2009, reflecting the sharp spasm in the market, Ohio steelmakers and fabricators invested more than \$1 billion in upgrading equipment and properties in 2010. The exception was seen in the state's steel product manufacturing from purchased steel, where annual capital

macroeconomic growth. The vast majority of the lost jobs were associated with the industry mix effect: 44,000 of those lost jobs were due to challenges the industry faced nationwide. The decline attributed to local competitive conditions was only 4,800 positions. The iron and steel mills and ferroalloy manufacturing portion of the industry had a positive local competitive effect over the decade, meaning that Ohio's local competitive factors actually helped the state's iron and steel mills and ferroalloy manufacturing grow 1,237 jobs despite an overall bleak employment outlook.

expenditures continued to decline. Investments by Ohio steelmakers accounted for roughly 8 percent of capital expenditures made by the U.S. steel industry as a whole. Breaking that investment into the two components of the industry as studied shows significant differences: Capital expenditures of \$221 million for the state's raw steel industries represented only 5.6 percent of the investment in such activities nationwide. Comparatively, the \$780 million in capital expenditures for fabricated metal product manufacturing in Ohio accounted for 9.6 percent of such investments nationwide. However, both industry segments were investing at a greater rate than seen for state manufacturing activities overall, which represented only 4.6 percent of capital expenditures made by the U.S. manufacturing sector as a whole. Based on focus group discussions with plant managers around the state and news media accounts, data for 2011

and 2012 are likely to show that capital expenditures continued apace for the Ohio steel industry. An April 24, 2012, New York Times article noted \$1.5 billion in investment as Ohio steelmakers race to add 2 million square feet of production space. "There's a lot of money going into the industry now," said one steel industry executive.

One participant in the focus group of purchasing, sales and marketing managers struck an even more hopeful tone in offering advice to steel industry executives that they should expend even more capital: "Have confidence, invest. It is a high-return industry for folks who have positioned themselves well. Have confidence that the returns merit investment. The good news is these companies are standing after surviving the most difficult challenges, perhaps ever. These are very good companies. They're leaders."

Table 12. Total Capital Expenditures (in millions of 2012 dollars)

Year	Area	Manufacturing	Raw Steel	Iron and Steel Mills and Ferroalloy Mfg	Steel Product Mfg from Purchased Steel	Fabricated Metal Product Mfg	Total Raw Steel Products and Fabrication
2005	OH	\$7,313	\$324	\$264	\$60	\$867	\$1,190
	U.S.	\$149,717	\$2,532	\$2,101	\$431	\$8,993	\$11,525
2006	OH	\$8,651	\$522	\$441	\$81	\$786	\$1,308
	U.S.	\$153,528	\$2,516	\$2,071	\$445	\$9,429	\$11,945
2007	OH	\$8,517	\$514	\$450	\$64	\$946	\$1,460
	U.S.	\$175,235	\$4,036	\$3,540	\$497	\$11,651	\$15,687
2008	OH	\$8,685	\$341	\$281	\$60	\$931	\$1,272
	U.S.	\$178,370	\$5,261	\$4,761	\$500	\$11,972	\$17,233
2009	OH	\$6,273	\$177	\$120	\$57	\$675	\$852
	U.S.	\$137,289	\$3,674	\$3,209	\$466	\$7,753	\$11,427
2010	OH	\$6,188	\$221	\$183	\$38	\$780	\$1,001
	U.S.	\$133,733	\$3,930	\$3,444	\$486	\$8,121	\$12,051

Source: Annual Survey of Manufactures

PART 2: THE SOFTER SIDE OF STEEL

To complement the quantitative analysis, we set about gathering qualitative information about Ohio's steel industry. We held four focus groups around the state, inviting plant managers and high-ranking purchasing, sales and marketing managers, as well as their peers in human resources and personnel, to share their insights regarding the industry's strengths, weaknesses, opportunities and threats. We also solicited their views of Ohio as a place for making steel. In addition to the focus groups, we conducted separate phone interviews with top executives at steel companies with operations in the state. The executives were asked questions similar to those of their senior staff members. This section reflects the overall tenor of discussions, including specific observations of individual managers. The discussions provide an understanding of what is behind the numbers: What are the thoughts, strategies, and actions that are establishing the future of steelmaking in Ohio?

Without question, discussions with corporate leaders, operations managers and department heads yielded a sense of optimism for the steel industry – at least for those with the wherewithal to engage in continuous improvement, seize on opportunities and control costs. As noted at the beginning of this report, many see greater demand for steel as the automotive industry revs its engine and as increasing age or government mandates drive replacements for everything from appliances and automobiles to bridges and wind turbines. Those interviewed gushed with possibilities for steel that are likely to open up to due to oil and gas extraction using hydraulic fracturing, or “fracking.” Those steelmakers that supply the miles of pipe involved in the drilling, extraction

and distribution processes should see direct benefit from activities in the shale gas reserves in Ohio and Pennsylvania, as well as other parts of the country and world. However, as noted in the introduction section, those interviewed view this opportunity with a *cautious* optimism, recognizing all too well that a global market such as steel is heavily reliant on the overall health of the world economy.

“I’m in the pipe business so I perhaps have a different view,” said one industry executive. “I really believe that one of the greatest opportunities for Ohio steel right now is the emergence of the shale gas. Not just in Ohio and Pennsylvania, but in Texas and North Dakota. It’s spread around the country.”

But shale gas exudes opportunity to go around, he noted. Manufacturers of steel bar, plate and piling should see stepped up demand. Roads, bridges and buildings will be needed to support and enable fracking activities. “All of those things are going to need pipe and infrastructure to support their growth needs,” he said. “It’s not just steel for pipeline and drilling operations. ... Just about every steel company in Ohio is sensitive to potential higher demand.”

In addition, steel manufacturers should benefit from relatively low energy costs; this is especially good news for Ohio, where natural gas powered basic oxygen furnaces still predominate the steelmaking scene. Making public policy changes that encourage the co-generation of electricity from the heat that is a significant by-product of the production process can reinforce the state’s locational advantage. Advantage derived from co-generation for Ohio’s traditional blast furnaces may even bring the added benefit of attracting electric-arc

Well of Support for Shale Gas

Focus group participants – regardless of job description – and steel industry executives were overwhelmingly enthusiastic about the potential benefits from a shale gas and oil boom in Ohio. Gas is viewed as a cheaper source of power. Oil refining is a major user of steel. And natural gas liquids are a feedstock for the petrochemical and plastics industries. Here is a sampling of their comments:

"The shale opportunity is just beginning to be tapped. I think we'll be putting holes all over this country for a long while to come. We have seen our order book change dramatically over the past couple of years. Energy is approaching 30 percent of our business now."

"Steel is going into drilling and mining, and that has a compounding effect."

"The long-term outlook certainly looks positive. These shale plays are global. Other countries need this kind of energy."

"Shale has a big chance to reshore petrochemical and chemistry processing plants. Those are largely steel-intense processing plants. That has huge, huge repercussions. You have a steel-intensive product that has ripple effects."

"We want it to be safe. I think there are best practices to draw on. We've been fracking for 80 years in this country. We have to have a best practice. Hold companies accountable for doing the right thing. Hire inspectors to make sure they're doing the job right."

furnaces to locate and reinvest in the state. Using natural gas to produce electricity for their own use, reinforced by co-generation, offers the prospect of lowering operating costs. This is a discussion where a change in public policy, reinforced by the accountant's spreadsheet and an engineer's ingenuity, may result in more cost-effective U.S. steel operations. Lower energy costs from natural gas, reinforced by co-generation, should also have the effect of improving the outlook for U.S. manufacturing as a whole, which, in turn, will likely increase demand for such a critical input as steel.

"The availability of more cost-effective energy would make [U.S.] companies more competitive globally. That would create jobs and put more people back on the tax rolls. And, in addition, in the balance of trade, for the first time in 100 years, we would have the opportunity to become more energy independent and stop sending money to OPEC nations," said another longtime industry executive. But he worries that the nation may miss out on these potential rewards by overstating perceived risks in favor of promoting a currently unrealistic view of renewable energy options. "There will be a place for wind and solar, but it will never be the answer to the prayer. Natural gas can be," he said. "We can make the conversion today with cheaper products. There's a huge opportunity, but what we're in danger of is looking at the negative side. It's a game-changing opportunity. The steel industry is a part of the puzzle, but, more importantly for the whole of North America, these same deposits exist in China and Europe. The leaders in that technology are North American so there will be a huge export opportunity for taking this know-how elsewhere. It will help with cleaner, lower-emission fuels as we figure out how to get to green fuels."

Weaknesses & Threats

Ask steel industry executives, plant managers and department heads what keeps them up at night, and they list three eminent worries: safety, workforce and China.

“Workplace safety in manufacturing is always an issue. What do we need to do to make our plants safer? That’s a 24/7 concern,” said one industry executive, summarizing comments from several focus group participants.

“Safety has been a steady issue for 30 years,” said a participant in the focus group among human resources managers.

“Definitely,” echoed another, “because you’re always thinking about what you could have missed. We’ve done a 180 with our employees in terms of how we have gotten them to understand the importance of safety and procedures. That’s critical to Lean and Six Sigma,” she said. “Safety is the employees’ responsibility not management’s. They have to work safe. ... Nothing comes before safety. That was a huge culture shift.”

Although several managers cited safety as a top-of-mind worry, it is clear from discussions that safety is in fact viewed, along with quality and productivity, as a core strength and competitive advantage for U.S. steel companies. It’s simply one strong link in a steel supply chain. “In terms of safety, quality, efficiency, process, technology, it would be hard to find a better place than the U.S.,” said one participant in a focus group of purchasing, sales and marketing managers. “I think that message does not really get out. We all recognized massive offshoring 10 to 20 years ago. But over the last five years, we have been seeing more reshoring because [customers] found out that the supply

chain elsewhere wasn’t as good as they thought.”

The implication from this comment and others that followed similar lines of argument is that steel customers will always focus on the delivered price of the product; many steel products are commodities. But, as customers have experienced offshore suppliers, a risk-adjusted idea of price has begun to enter into the minds of purchasers. Reliable delivered quality matters, as does the certainty of delivery. Additionally, customers are not enamored of managing currency risk as their product sits in a boat. The challenge is to educate customers to think beyond the FOB price, beyond the delivered price of the product, and think about the risk-adjusted price by providing assurances of quality and delivery.

The conversations made it clear that worries about China actually encompass three different public policy challenges: currency manipulation, export subsidies and environmental mandates. After spending years focusing on eliminating waste and improving productivity, Ohio (and U.S.) steelmakers believe that they can compete on a “fair” playing field. However, they see China laying two heavy thumbs on the scale – related to currency and subsidies — in favor of their steelmakers and the U.S. government laying a thumb – in terms of environmental mandates – against its own steel manufacturers.

“The reality is that China has built steel capacity that is almost going beyond its need for consumption. We’re starting to see a slowing in the Chinese economy because of the political pressure they feel,” said one steel industry

executive. "They need to find a place or home for the products that they make. Their stocks are swelling." U.S. steelmakers told us that this excess supply is often reduced by the Chinese government providing export incentives, which U.S. domestic producers cite as an unfair pricing advantage.

"China actually gives export subsidies, which in my opinion puts us in position of having to compete with the Chinese government," said another industry leader. "That kind of puts us at a pretty unfair advantage. It's a problem for the whole United States, not just Ohio. It's a magnification of the problem that existed because of manipulation of the Chinese currency. The lack of reduction in output from the Chinese steel industry just puts more focus on boats to go elsewhere. ... To push into subsidies is an export model that becomes very dangerous."

"Currency manipulation is more hidden," said one plant manager who participated in focus group discussions. "That's the biggest subsidy. It's huge and there are ways to address it" if there was the political will in Washington, D.C.

"The biggest issue with imports is the fair value," said a participant in the focus group discussion among purchasing, sales and marketing managers. "I don't think you get much objection to imports at fair market value. But when that market value is affected by subsidy or currency [manipulation], that tends to make the product not reflect the actual cost when it comes over here."

On the other end, environmental regulations that affect U.S. steel producers but not those in China or other parts of the world drive up the cost of U.S. steel. Focus group participants complained bitterly of environmental

regulations that seemed to go beyond being good stewards and made it difficult for their companies to compete with places around the world with laxer standards regarding clean air, water and soil. "We went from a pamphlet on environmental regulation that was ½-inch thick to one that's 3 inches thick," said one plant manager, describing how his company had seen stepped-up requirements due to being deemed as operating on a navigable waterway. "We're 100 employees and we have to do the same thing as in a plant that employs 1,000. They're going to drive small business out."

This last comment was at first blush very perplexing. How can the manager of a steel plant owned by an international company see himself as working in a small business? The plant managers we interviewed acted and spoke as independent business operators. They appeared to compete with one and all, looking to the "mother ship" as a source of capital and at times as a constraint. We also noted that the "branch plants" were leaned out to the point that they had little product development expertise outside of process improvements that they could implement themselves. A weakness in Ohio's steel future is that, with one major exception, technical product development takes place remotely, and metallurgy is rapidly disappearing as a subject taught in engineering schools. The exception to this is the Timken Company, with its extensive labs in North Canton and an emerging research partnership with the University of Akron.

One industry executive described stepped-up enforcement policies that have raised the bar for renewal of permits. Another manager described policies that tie the hands of large plants but do little actually to limit the amount of pollution: He described trying to put in a new

gas-fired furnace that would have been more efficient and less costly to operate, but because his plant was already at its limit for nitric oxide gases, the permit was denied. "At the end of day, I can't buy that gas-fired furnace because we're at our limit. But if I go into business across the street, I can put that plant in because [in that location] I'm not at the limit. So we had to make a business decision" that makes the company less productive and does little truly to eliminate pollutants.

Discussions with steelmakers noted that regulations meant to improve the environment, especially proposed carbon credits designed to reduce greenhouse gases, may, in fact, have the opposite effect. "In our goal to be environmentally responsible, we're going to impose rules that don't achieve pollution reduction," said one steel industry executive. "These are the kinds of things that may help the environment but at enormous cost to us. You

have to weigh the costs against the benefits or you are going to have a phenomenon where we can't be competitive in the U.S. so people buy offshore and we don't get the environmental benefits."

Focus group participants worried how regulations that have led to decisions to close coal-fired power plants, such as the four Ohio plants operated by FirstEnergy said it would shut down by September 1, 2012, would affect their business. An Associated Press survey reported in December 2011 that as many as 68 mostly coal-fired power plants in a dozen states may be forced to close due to stepped-up federal regulations regarding air pollution. "We consume a lot of electricity," said one steel plant manager. "Electric prices [from anticipated rate hikes] will kill us if you shut down coal-fired power plants. That's a huge, huge impact." Where is co-generation when you need it?

Workforce

Worrying about the safety of their workforce is a top-of-mind concern for company managers in an industry that subjects workers to potentially dangerous processes and equipment. Worries related to potentially unfair advantages conferred on foreign competitors due to federal policies – or the lack thereof – represent a threat felt throughout the industry nationwide. However, the purpose of this work is to explore Ohio's steel industry and its particular value proposition. As such, we'll focus more on the third primary concern that arose in discussions with Ohio steelmakers: workforce. Certainly, some workforce challenges are best addressed at the individual company level, and some may be shared throughout an industry

nationwide. But workforce strengths and weaknesses vary state-by-state and region-by-region and, as such, can be honed at those levels.

In all focus group discussions with plant managers and department heads, workforce claimed the most attention. Over and over, focus group participants described a scenario in which a large percentage of current workers with critical skills and knowledge are rapidly approaching retirement age while the supply of new workers willing and able to fill vacated jobs, let alone new ones necessary for expansion opportunities, is increasingly limited. Focus group discussions indicate that there are

different hurdles for hiring based on skill level, but they also suggest that one obstacle keeps workers of all skill levels away: perception. Jobs in the steel industry are perceived largely as dirty, dead-end and undesirable. Add in the necessity of having to run plants around the clock with lowest-seniority workers being assigned to late and overnight shifts, and the lingering Rust Belt perception of Ohio, particularly Northeast Ohio, and the substantial challenge the state's steelmakers face comes into focus. Some mention was made that a perception of layoff threats haunts recruiting. Yet, the risks of a job-ending layoff in the steel industry appeared to these managers to be less than the threat to white-collar employment that has marked the past decade in the economy at large.

Focus group participants admit the industry's role in creating this perception: It's not surprising, after all, that workers would question the likelihood of finding long-term security in an industry that spent decades shedding jobs. But steel managers and department heads complain that the news and entertainment media have created a false impression of today's U.S. steel industry and that the current government and cultural focus on college has undercut the worth and dignity of steelmaking and other traditionally "blue-collar" activities. "We're [as a nation] not encouraging our kids to go down this path."

One plant manager detailed the difficult hiring environment: "We have openings, but I can't fill them. ... Between now and 2017, 25 percent of our industrial electricians will retire. We've got jobs sitting empty right now. We're using contractors. We don't really want to, but the talent isn't available. ... We're paying \$30 an hour with benefits for jobs that we can't fill."

He said he sits on an advisory council at a local technical school. The school had put together a program that would develop skills needed in the steel industry and would award an associate's degree after two years. "They got four people in high school signed up for it." Ultimately, the program was canceled due to such low interest among students.

Echoed another plant manager: "In the next 4 to 5 years, 50 percent of our workforce will be pension eligible. So knowledge transfer is important to us."

Several focus group participants indicated that they have begun to launch or expand efforts to "grow their own," but they said they could use help from industry advocates and state leaders in crafting policies and messaging campaigns that support a reshaping of the steel industry workforce. The following sections reflect focus group discussions regarding skill-level needs and challenges.

High-Skilled: Metallurgists and Engineers

Metallurgy is a critical component of competitive advantage. Nearly half of the plant managers who participated in the focus groups have a background in metallurgy. "We consider material science, metallurgy, a core part of advantage." Operating technology is tightly tied to material science activities, and metallurgy is central to product development.

Most product development "is driven by the customer. They're looking for higher strengths and lighter weights," said one plant manager who is also his plant's metallurgist and human resources manager. "Developing a product, we have the experience to do it internally. But if I go, then [we don't] have that." He said that the leaning of steel operations has contributed to a shortage in skills critical to new product

development. "There's no depth. You can't train a person on the job to be a metallurgist. There's a wide-open vulnerability due to [the history of] downsizing."

Another focus group participant noted change in academic options and career opportunities. "Fewer students are going toward the material sciences. There are sexier things out there like electrical engineering," he said. "Plus it's location. We make offers to new grads, and they'll decline." In other words, nothing seems sexy to new grads about steel or moving to semi-rural Ohio.

"We struggle horribly with getting electrical engineers into our plant," countered another. "We struggle with attracting enough talent into Northeast Ohio who want to work in a steel mill environment."

"A lot of material science folks want to work in a lab setting, not in the mill," said a plant manager, indicating the twin hurdles of cultural change and perception. "It's a challenge to bring people in who want to work in and who understand the mill setting."

"Why did engineering grow in Europe and not in the U. S.?" asked one plant manager. "There's not an infrastructure to support growing mechanical engineers to support manufacturing." An April 2012 New York Times article pointed out that Europe is having its own problems finding workers with engineering skills. According to the article, German businesses, desperate for educated workers to fill open jobs, have begun recruiting young unemployed workers out of southern European nations. Although the move resolves two pressing problems at the moment, it is fueling concern about brain drain out of countries that

will need their "best and brightest" to help revitalize their troubled economies.

Mid-level Skills: Industrial Electricians and Mechanical Maintenance

Focus group participants indicated a general difficulty in hiring qualified workers, but a particular challenge in finding workers skilled in the trades, such as electricians, millwrights, mechanics and engineering technicians. This is particularly true for some steel mills located in more rural parts of the state.

"We made our living over the years by bringing in young family people," said one human resources manager. "The problem over the last 10 years is those people don't exist anymore. We send lots of young people to Columbus to go to school. None of them come back. Hardly any come back to the area."

"We've had ads out for industrial electricians for two years steady. From the first of 2010 all the way through today. So has everybody else," said one human resources manager. "Of my 18 electricians in the plant, 15 are 60 years old or older. We have to make a decision. We have to start an apprenticeship program quick or we're going to be in trouble."

Lower Skills

In steel mills, lower-skill jobs don't mean low wage. Yet, companies still struggle to find workers. "I hate the term entry-level," said one plant manager. "We bring people in; we expect professionals. Not college graduates, but professionals. They're going to get paid like professionals. They'll be making \$70,000 to \$75,000 within a year. We are not hiring entry-level people."

Lean Manufacturing & the 'Doughnut Hole'

The looming challenge of finding replacements for an aging workforce rapidly approaching retirement prompted the following exchange among three focus group participants:

"We had a decade when this industry was sucking wind and didn't hire anyone."

"I haven't talked to anyone in this industry who doesn't have that doughnut hole."

"Organizations are flatter and leaner but that means that every managerial position is important. The surplus of human talent that was set free in the market, that pool is less and less. Where do you get that next level of talent? Those are all critical positions. How in a lean organization can you train someone for that next position and keep him around until that spot opens up? That is indeed frightening."

"When we were a broader and less efficient organization, then we had more to choose from."

"We're sometimes going to 25-year-olds to take jobs done by senior workers. That's pretty enticing to a new generation. They won't have to take 10 years to work up. Sometimes if you've got the talent and come in as a 26-year-old, you may have the opportunity to get exposed to meaty roles."

"Senior staffs are in their 50s; then their assistants are in their 30s. These are flat organizations. The nature of lean organizations creates this training dilemma. If you train them up and have no place to put them, then you're probably going to lose them."

Plant and human resource managers said they go through 20 or more applicants to find one person to hire for entry-level jobs. "A lot of folks can't pass our entry test," said one plant manager, who indicated that the company tests for math skills, overall aptitude and temperament. "We need a very large pool."

"We have struggled finding people with just general intelligence," said another. "As long as you're smart, you can learn it." Noting that this challenge is for steel operations all across the country, not just in Ohio, he said that many apply, but few are interviewed. Aptitude and problem-solving skills are only part of the challenge. Managers said another factor eliminates huge numbers of applicants: substance abuse. In a workplace environment where strict adherence to safety procedures is critical, drug and alcohol use and abuse are operational threats not to be tolerated. Candidates are reported to be walking away from their chance at employment when confronted with a drug test or are flunking. Drug and alcohol abuse has changed. It is no longer a social problem; it is an economic development barrier.

Several focus group participants said their companies have rigorous screening programs – for workers of all skill levels. Applicants are subjected to online aptitude and personality tests, as well as drug tests. Some companies insist on interviews with industrial psychologists to identify leadership and teamwork skills. Applicants frequently must sit for multiple interviews with company employees, from the executive office down to the mill floor. The goal is to find workers with the right mix of characteristics. Although focus group participants highlighted dire shortages in critical skill areas, they insisted that they look mostly

for workers who "think." One steel company has a list of 11 key characteristics, which include qualities such as integrity, courage and moneymaking know-how.

Experience Gap

Pension funds used to keep experienced workers tied to their jobs, but as steel producers and other manufacturers have reduced their legacy costs by shifting to portable defined contribution retirement plans from defined benefit plans, workplace "handcuffs" have been cast off. This was a financial necessity related to the wave of bankruptcies experienced by legacy steel companies during the 1980s. While a financial necessity, the move is causing a not-so-surprising human resources challenge. Workers have less reason to stay loyal to their jobs. "We as a company are less loyal to our worker, and they are less loyal to us," said one plant manager, noting the downside consequences of efforts to contain business costs and survive. "We've seen a significant change over the years of experienced individuals staying in the role long enough for consistency. ... Older, experienced workers are retiring or moving on. Coming behind them is a less experienced, less patient, more portable workforce." The frequently mentioned doughnut hole lies with workers with 20 years of experience. This is a worker who does not exist in steel mills.

Those aren't the only cuts that U.S. steel companies made over the past three decades in order to survive that now threaten growth. Embracing lean production practices has enabled the Ohio companies examined to survive when the flame went out at "Big Steel" operations, such as mighty Bethlehem. Lean

practices designed to address bloat and eliminate activities that were not producing value has led to thinner, flatter organizations.

How flat? One plant manager said only four management levels separated the blue-collar floor supervisor from the executive overseeing all company operations in North America. Developing those inner levels has become a challenge. "We try to get someone who can work into a superintendent's level. We need the guy who is a supervisor, who knows the floor, who can be the next superintendent. It's very difficult to get that [next] level" of worker.

"That's the worst development level," another manager agreed. "Since I've been here, we haven't been able to entice a single person out of the union because it would be a pay cut" or it would require moving to a less desirable work shift.

"And then they're staying on [the] midnight shift for 10 years because they don't have any opportunity to move up," echoed a third. "We have talent that we start training in leadership, and then they get frustrated."

Lean has become anorexic in too many companies. Rebuilding promotional and experiential ladders is a management problem that can be solved. Figuring out bonus plans and deferred compensation plans for blue-collar workers who are willing to take the risk to become shop floor leaders can be done. Here the challenge of being a small business unit in a global corporation looms large. These changes have to be sold upstream and have to be viewed as an investment in the future of the enterprise. Will corporate accountants who get paid to deliver short-term financial returns care?

Perception Issues

"When you're in the steel industry, you're the closest thing to dirt," said a participant in a focus group for plant managers. "If GM sneezes, we get pneumonia."

One plant manager described steel operations as much more automated and much higher skill than the old "rust belt" image most people have. "We get a lot of people who come through our facility and say, 'Wow, we didn't think it would be like that.'"

"When you go through areas that used to be Big Steel, I think that's a negative," said another plant manager. "It looks derelict. That makes it seem like there is no place for Big Steel in Ohio anymore. [Some old plants] have had lease signs on them for 20 years. People see that as a negative. It's a false impression. Investment has just been sustaining, not really [oriented to] grow [the business]."

"I think we're living with the stigma created a long time ago, and it's still on us." The plant manager said he has worked in six other states and outside the country and has found it to be easier hiring into cities such as Columbus, Indianapolis, Dallas-Fort Worth and Lexington, Kentucky, than Northern Ohio. "People I talk to, especially young people, say why should I come? They have the impression that everything has shut down. They still think of it as the rust belt." He recounted how his company had offered a project to engineering students at a Michigan university who were looking for some hands-on experience. "We were competing with other projects outside of steel, not to hire but for project work," he said. "We had an exciting project, but we couldn't get any takers. We couldn't get engineers in

Michigan to participate because it was steel, Ohio, [and not in a large metropolitan area]."

Although steel mills have changed, focus group participants noted that the work still is heavy manufacturing. It comes with certain job requirements that many younger workers reject. "I work for management who for the last 30 years has had a huge talent pool out there. They have spent an entire career shedding jobs," said one human resources manager. "What that group doesn't understand is that good college grads today have options. We're not necessarily the first choice. ... The ones who don't take drugs and manage to show up every day have options."

"Mills are dirty," said one plant manager. "We've cleaned them up a lot, but it's still dirty. If you have people with a degree, or a master's, and they see that, then they choose to be somewhere else."

"The kids going to school are not studying manufacturing because they see other career pathways as more lucrative or desirable," said a participant in the focus group of purchasing, sales and marketing managers. "Back when I was younger, if you got an offer from US Steel it was exciting and it was like your life was made. Like Apple today."

In addition to other, perhaps more generally desirable, career options, younger workers also have different expectations for work-life balance than their parents and grandparents may have had. "They're not going to work 7 days a week," said another participant in the focus group discussion among human resources managers. "Our people work a lot of 7 days a week. We have mandatory overtime. Third- and

fourth-generation people from our plant are saying, 'I'm not doing that anymore.' We know it's going to be a big issue for us next contract."

We learn in different ways, and the authors had an opportunity to learn by driving. It was easy to pick out the plants that are privately owned or closely held from those of the global giants. One group was painted and the other was colored by rust. One group spent money on grounds and upkeep, while the other seemed to view expenditures on outward appearance as unnecessary. Both groups expressed their

orientation to the future and optimism about their prospects in conversations, but the physical look of their buildings and properties tells very different stories. Yes, there is a competitive advantage in putting expensive equipment in cheap buildings, but there is also a competitive advantage in expressing pride in where you work by maintaining plant. There is no greater contrast than to drive past the large steel complex near Gary, Indiana, and then follow that up a few days later with a drive by gleaming Worthington Steel in Columbus or Timken in Canton.

Battling Back

"We, manufacturing, need to do a better job of selling the jobs and opportunities," said one plant manager. "On TV and in movies, when you see a steel mill, you'll see a ladle pouring molten material into a blast furnace and sparks flying. ... [A]ll this nasty stuff, it's exciting to see, but workers are not doing that anymore. Now they're sitting in a pulpit and punching buttons. That's what you have. We do a lousy job of portraying ourselves."

Echoed another: "We're not selling the work; we're not selling the jobs. We've convinced ourselves and our children that these jobs are not there. But they are. They're back" – albeit not in the numbers of years past.

"There's a lot of woe is me in the steel industry," said a participant in the focus group that included sales and marketing managers. "I think the story of [a] steel renaissance is pretty damn infant and pretty poorly told. That's partly on the steel industry itself. We talk rust

belt and crappy. You've got to start saying there's something here. We don't say that part. Presence, promotion, education are things that we fail on. Maybe we're just a few years of being into a renaissance cycle after 20 years of woe is me."

He went on: "This BS that we look like we did in the 1970s is hurting ourselves. It's stupid. You can start a process here that says steel is pretty core to the country, state and community and actually there are pretty cool challenging things here. Take a look. I think we're doing ourselves a disservice in that arena. There's something awe-inspiring and impressive, actually some pretty sophisticated stuff."

Recruiting Efforts

Plant managers said they have been working to turn a challenge into an advantage. They said that they are actively touting the age of their workforces to showcase the management opportunities due to open up in the industry within a few years. "We're selling that we're growing leadership. We'll see how that turns out. It's relatively new."

"We also tie that back to the investment we're making in the industry. There's a lot of money going into the industry now." Said another: "You have to be able to have people understand what's behind the closed walls. The technological advancement that has been put into the industry over time."

Some companies have started apprenticeship and internship programs to get young people inside the companies, explore different opportunities and find jobs that match their skills and interests. "We have a steel business associate program," where participants get to see every aspect of the business over a 2-year period. "That helps them get a sense of where they fit."

"We're going to have to grow our own," said another plant manager. "We're working on starting apprentice programs, starting from scratch. ... We're saying that we can guarantee a job when they come out of the program. ... Between now and 2017, we will need 25 people. We hope we can get enough in the first round or two from inside, then we will have to go outside, but we worry that we will train them and then they will leave after the 4-year program. There's a lot of demand for those skills."

Noting his own company's efforts to recruit workers, one focus group participant predicted

that the invisible hand of the market will ultimately resolve the skills shortage. "We're about to hear a giant sucking sound as dinosaurs start to leave and there's nobody around to fill the jobs. The remedy is that compensation will go up. Visibility will go up. People will start looking around and saying there are good jobs here."

Additional Worries

Beyond the "big three" worries of safety, unfair foreign competition and workforce, focus group participants highlighted a number of other threats. These can be summarized as:

Deterioration of manufacturing base – "You're losing your customer base in the steel industry."

Rare earth minerals – "There's been a subtle shift of supply to Asia."

Transportation – "Changes in regulation have reduced the number of hours that equipment can be on the road. It's really aimed at the drivers. But, over the last few years, the ability of moving equipment around the country really has been compromised. We are truck dependent." Managers charged with moving product around the region or the country say that the increased demand for trucks related to fracking activity is affecting the demand for drivers, resulting in increased transportation costs for steel producers.

Access to capital – "Steel is not particularly appreciated by the financial industry," said one plant manager. Said another: "Capital is not easily come by. Lending is globally restrictive. There's hesitancy in the world market. There are low rates but nobody qualifies. Can you

generate the rate of return to make that investment seem prudent? Is it better than you can get by investing otherwise?" Added another

manager: "Plus you're competing with the Chinese government that is investing in companies that don't have to make a return."

Innovation

In many ways, steelmakers describe themselves as the nation's problem-solvers. Innovation in the steel industry, whether in product or process, is mostly in response to customer needs. "It's a yard at a time, a bunt, single, every time," said one participant in focus group discussions with purchasing, sales and marketing managers.

The development of new high-strength steels offer opportunities for greater efficiencies and greater yield per unit of raw material. One big driver of demand, however, largely stems from a big "problem" automakers face. In 2011, most automakers serving the U.S. market – including Ford, General Motors, Chrysler, Toyota and Honda – agreed to federal Corporate Average Fuel Economy (CAFE) standards that would raise the fuel economy average for each fleet to 54.5 miles per gallon for cars and light trucks by model year 2025. The regulations are to be finalized in 2012, but passenger cars are expected to achieve 5 percent gains each year. This is driving demand for steel that is stronger

yet lighter. Although the need for stronger and lighter steels is typically described as a driver of new steel products, many industry members see such innovation simply as necessary for maintaining business.

"We're steel guys. Steelmaking is not a particularly new or secretive process," said one participant in the focus group discussion among purchasing, sales and marketing managers. "Those of us who do research and push boundaries are moving millimeters as opposed to other industries that change expectations by feet, yards and miles. There's incremental innovation to meet customer needs ... but overall there's only so many ways to use steel." Yet, the industry has made great strides in squeezing more product out of each unit of raw material. "We're making more stuff with less tons than ever. That's good in terms of efficiency, but it's not so good for some of our [former] colleagues now selling ice cream cones."

The Steel Value Chain

The steel industry serves as the platform of a variety of value chains. As noted earlier, it's the structural underpinning of the automotive, household goods, construction, extraction and defense industries. As such, the weight of demands for better, stronger, lighter products in all these industries delivered ever more

quickly, reliably and cheaply ultimately falls on steel. That demand presents both a burden and an opportunity, focus group participants said. "The performance delivery bar keeps getting raised. The quality and the delivery better be reliable, and customers are very sensitive to cost. You can pick any industry you want ... and

that bar keeps getting raised. That means there are fewer good metal producers who can meet that bar. That helps us in some respects with the competition from outside the country."

Yet, "there is a disconnect in the supply chain. ... The end user wants what he wants when he wants it and doesn't care about what he wanted yesterday. The reality is how good is our planning. If we can tell along the way what we need, then we can plan for it and make it. But in our market, [customers] want the

freedom to change things when they want. Cash is no longer cheap and tying up cash in product is no longer incidental. There's a lot of ping-pong in terms of who is holding the inventory. We're coming to the point that you can either have what you want on time but you have to accept a certain amount of rigidity. You can't get a lower price based on pull-through and then you don't pull through. That is a conversation that wasn't happening but is now taking place in the market because of the cost of cash."

The New Value Proposition

A new value proposition extends from the steel industry to the people of the state of Ohio; it is not yet well-formed, but it exists. How will investments in infrastructure (highways and port facilities); workforce (a sober and numerate workforce); innovation (metallurgical education); and energy regulation (commonsense support for industrial co-generation), along with reaching a common ground on environmental regulation, result in a return from a global leader in materials in terms of opportunity?

"There are advantages to being in the rust belt. Those advantages are things that were disadvantages in the past." The focus group participant ticked off some of Ohio's characteristics that are attractive to steel production: a capable labor force that is familiar with industrial activities, reliable energy at reasonable costs, and a central location. "Personally, I think if you take our labor, access to water and cheaper energy, and central location for distributing products, those are the makings for a resurgence. ... That's nothing overwhelming, but those are good things."

However, he was quick to point out that these characteristics are not exclusive to Ohio; they are shared by other states in the upper Midwest. And he noted that the "central location" is predicated on customers remaining where they are; if customers move their businesses offshore, the calculus will change.

Yet, focus group participants questioned what they see as short-sightedness on the part of state leaders and politicians. One plant manager noted the negative stories circulating about fracking in Ohio, with little effort by state and local leaders to refute misstatements, provide facts on safety and talk up the positives – for businesses directly and indirectly connected and for the state economy. "That's what's going to drive our business," he said. "We don't make oil-country pipe, but we make Caterpillar tractor and other parts. I'm not seeing politicians come in and say this is a positive thing for Ohio."

"As the steel industry died in [rural] western Pennsylvania, there was nothing to replace it. Now you have people at Kohl's selling to Kmart

selling to Wal-mart," said one plant manager. "There was no industry that came back. Those communities are struggling." The plant managers question whether political leaders and government workers understand the need for steel framing in building a healthy economy. "State legislators really need to understand what the industry contributes to the survival of the state," said a focus group participant. "For every one working in steel, you probably have 20 working because of it."

"The most important thing government can do for us is advertise our industry," said another focus group participant. "Corporations vote by moving business. The state needs to understand that. They need to address the infrastructure. Enhance and maintain the highway industry. ... The plant I work out of is 110 years old. But there's nothing about it that couldn't be made somewhere else. Steel will continue to be made. The industry is not going to go away, but, if the state is not supportive of it in ways that other states have been, it will go away. The state doesn't recruit us the same way as those that they want to come in. They don't think about us. The state needs to recognize our place in the relationship. We're more than a collector of our workers' income tax."

CONCLUSION

We began this report by comparing the competitive environment of the steel industry today to the increasing demands of its product: The challenge before U.S. steelmakers to deliver high quality at low cost is the kind of tall order that the industry has grown accustomed to in helping its customers design products that are stronger yet lighter, steadfast yet malleable. Steel products are expected to stand up to sustained high temperatures, heavy loads and intense pressures. The steel industry has faced similar tests. As the data have shown, the past decade was a particularly harsh environment for U.S. steelmakers, who have been adapting to a shrinking industry for four decades. U.S. crude steel production eroded by 10.3 percent from 2000 to 2008, before the effects of the Great Recession and the financial and housing crises in 2009 cut U.S. production to little more than half the level seen in 2000 (Table 1).

U.S. steelmakers have repeatedly demonstrated their ability to rise to challenges. They have developed high-strength steels to help the automotive industry meet federal requirements for greater fuel efficiencies. They have created products to help the oil and gas industry tap energy deposits at greater depths. And by 2011, the industry had rallied to return to a crude steel production level that came close to equaling that of a decade earlier.

The takeaway message is that the U.S. steel industry, like its product, continues to be tested, yet continues to adapt. The same can be said for the Ohio steel industry specifically. As was demonstrated earlier, Ohio steelmakers have, in fact, experienced even deeper contractions than those seen in the industry overall, but they also have witnessed a more

dynamic rebound from recessionary depths. Ohio's raw steel production grew by 76 percent from 2009 to 2011 (Table 3). Ohio continues to be an industry leader, ranking 2nd for raw steel production and for total steel GDP.

The steel industry is a load-bearing beam in the state's economic structure and props up many other Ohio industries, including some seen as critical to a more "knowledge-based" economy. As noted earlier, Ohio's steelmakers spent \$440.6 million in 2010 for services related to company management; \$149 million for securities, commodity contracts and investment services; and \$122 million for professional, scientific and technical services. All told, Ohio's steel industry spent well more than \$1 billion with in-state suppliers of professional services.

Although the steel industry's share of Ohio's gross state product has declined dramatically over the past four decades, it still accounts for nearly 3 percent of the total. In 2011, the steel industry contributed \$14.7 billion of the state's \$499 billion in GSP. Despite shedding huge numbers of jobs since 1978, the Ohio steel industry continues to employ 2.2 percent of the state's workforce. For an understanding of just how much of the state's economy is supported by the steel industry, consider that the steel industry and its customers account for 28.2 percent of Ohio's GSP and 34.3 percent of overall state employment. (Please refer to the appendix.)

The steel industry's outsized contribution to Ohio's GSP and employment indicates how the state's industrial past continues to forge and shape its economic future. Ohio's advantaged location near rich pockets of natural resources drove its development as an industrial leader in

steelmaking, energy extraction and manufacturing in the early decades of the past century. And the oil, natural gas, and natural gas liquids of the Utica Shale and Marcellus Shale deposits are poised to again fuel associated industrial activities in the coming decades. In addition, being a location of superior steel, energy resources and sophisticated manufacturing activities means that Ohio encompasses many industries that will be the steel industry's customers. This benefits the state in its ability to develop and attract suppliers, customers and supporting services. The state's "Rust Belt" history also means it has a concentration of workers with the skills and understanding to support the growth in steelmaking, and manufacturing, expected to accompany new energy plays and a "supercycle" of demand. The "supercycle" in the United States is based on the realization that the nation's post-World War II infrastructure needs renewal; trucks and automobiles have not been regularly replaced due to the Great Recession and sluggish recovery; and the nation is in the early stages of shale-based energy development. As world population grows and nations develop, that should fuel demand for products as diverse as automobiles, infrastructure, energy and food. Those who supply such products or enable them should see increased demand.

Despite the opportunities for growth that may accompany a supercycle of demand, Ohio's steelmaking history doesn't ensure its steelmaking future. The state must continue to cultivate and demonstrate a local competitive edge in a global market. This means leveraging Ohio's locational strengths while systematically addressing its weaknesses. Much rests with the vision, investment decisions and skills of the industry's leadership. The most important

decisions that will affect the future of the steel industry and of sophisticated manufacturing in Ohio rest not with government, but with this industry's leadership. Steel industry leaders in the state have taken a step in improving Ohio's value proposition by investing in new plants and equipment and by responding to their labor and talent demands with in-house training programs. They are also expressing their collective vision about a promising future with this study. But shoring up Ohio's economic foundation is not their weight to bear alone. State legislators, governmental agencies and educational institutions must provide needed support.

The following recommendations challenge steelmakers as well as policymakers to:

- **Keep a tight rein on costs.** For the steel industry, this requires a continued drive to increase yield while decreasing energy-intensity per pound and a commitment to adding value to products. For policymakers, this demands an understanding of how government mandates, whether regarding how much nitrogen oxide can be emitted or how many hours truck drivers can be on the road, affect steelmakers' abilities to be globally competitive.

Related to costs is taxation. Steel is a capital-intensive industry, and it is one where job retention and growth are tied to capital investment. Deep thought must be given to any impediment to investment and recapitalization in this industry.

- **Focus on core competencies.** For the steel industry, where customers tend to drive new product development, this requires an intense commitment to quality, competitive

pricing, and customer service. For policymakers and support organizations, this requires acknowledgment of the steel industry's continued importance to the state and an understanding of its challenges and needs.

Steel customers will always focus on the delivered price of the product. But, as customers have experienced offshore suppliers, a risk-adjusted idea of price has begun to enter into the minds of purchasers. Reliable delivered quality matters, as does the certainty of delivery.

Additionally, customers are not enamored of managing currency risk as their product sits in a boat. The challenge is to educate customers to look beyond the FOB price, beyond the delivered price of the product, and think about the risk-adjusted price by providing assurances of quality and delivery.

- **Invest in opportunity.** Ohio steelmakers need to position themselves to seize on a potential boom fueled by energy production and automotive sales by upgrading plants and equipment. Ohio policymakers should value and support such capital expenditures by the industry, as well as invest in enabling infrastructure and services.

A concern about the structure of the steel industry in the state of Ohio is the limited number of company-owned research and development facilities that exist in the state and the weak state of metallurgical education. Nearly half of the plant managers who participated in the focus groups have a background in metallurgy.

"We consider material science, metallurgy, a core part of advantage." The number of metallurgists in the state is small and aging, and decades of leaning operations and staffs has resulted in no bench strength in this important skill area.

Operating technology is tightly tied to material science activities, and metallurgy is central to product development. With one major exception, Ohio's mills are dependent on distant research and development facilities for the development of new product. This is a weakness, especially in the automotive market, where aluminum, alloys and composites are medium-term threats.

- **Develop a new generation of workers.** Ohio steelmakers say finding workers with the right skills who show up for work every day is a growing concern. They have begun to address the challenge through restarting and expanding apprenticeship and internship opportunities. However, they must do more to sell a new generation of workers on job opportunities and career ladders in an industry that has spent 30 years shedding jobs.

Ohio policymakers and educational institutions need to understand the particular STEM needs of steelmaking, such as materials science (specifically metallurgy), electrical engineers and engineering technicians, as well as help to address a looming shortage of industrial electricians, millwrights and mechanics as the steel industry's mature workforce approaches retirement age.

Managers describe a skilled workforce nearing retirement age: "Between now and

2017, 25 percent of our industrial electricians will retire. We've got jobs sitting empty right now. We're using contractors. We don't really want to, but the talent isn't available. We're paying \$30 an hour with benefits for jobs that we can't fill." Echoed another: "In the next 4 to 5 years, 50 percent of our workforce will be pension eligible. So knowledge transfer is important to us."

- **Reinvent industrial relations:** The past 20 years have made the traditional pattern of labor-management relations obsolete, and new models have to be invented. Entering a mill was once viewed as the gateway to a stable middle-class career, but most of today's potential workforce views working in a mill as a job with an uncertain future. The links of pay and benefits to seniority have weakened, which have made established workers more mobile. Workers have less reason to stay loyal to their jobs.

Take pension funds as one example. Pension funds used to help keep experienced workers tied to their jobs, but as steel producers and other manufacturers have reduced their legacy costs by shifting to portable defined-contribution retirement plans from defined-benefit plans, such workplace "handcuffs" have been cast off. This was a financial necessity related to the wave of bankruptcies experienced by legacy steel companies during the 1980s. While a financial necessity, the move has contributed to a not-so-surprising human resources challenge. "We as a company are less loyal to our worker, and they are less loyal to us," said one plant manager, noting the downside consequences of efforts to contain business costs and survive.

Risk-sharing needs to be matched with gain-sharing, and the structure of work rules has to match the demands of world-class production. Additionally, steel mills have to become much more flexible, either in the way that they pay or in the way that they staff. Both management and labor need to rethink how to ensure that experienced workers are retained. The economic futures of both depend on it.

- **Support industrial co-generation.** Co-generation of electricity from the heat that is a significant by-product of the production process should benefit Ohio steelmakers. Ohio policymakers should also recognize the potential locational advantage of low-cost energy and lower operating costs.
- **Speak with one voice on commonsense public policy.** As demonstrated earlier, what hurts Ohio's steel industry ultimately hurts the Ohio economy. Given the integral importance of the industry to the state economy, Ohio steelmakers and policymakers should encourage federal legislators to address threats to the industry that come from within – in the form of continued stalemate on macroeconomic policies and overly restrictive environmental regulations – and without – in the form of Chinese currency manipulation and export subsidies.
- **Polish Ohio's steel story.** Ohio and its steel industry have long suffered under the "Rust Belt" image. But the region's industry rust is a valuable patina of knowledge, capacity and experience.

Telling the steel story means that all need to go beyond traditional public relations.

Recalling the words of one focus group participant: "There's a lot of woe is me in the steel industry; I think the story of [a] steel renaissance is pretty damn infant and pretty poorly told. That's partly on the steel industry itself. We talk rust belt and crappy. You've got to start saying there's something here. We don't say that part. Presence, promotion, education are things that we fail on. Maybe we're just a few years of being into a renaissance cycle after 20 years of woe is me." He went on: "This BS that we look like we did in the 1970s is hurting ourselves. It's stupid. You can start a process here that says steel is pretty core to the country, state and community and actually there are pretty cool challenging things here. Take a look. I think we're doing ourselves a disservice in that arena. There's something awe-inspiring and impressive, actually some pretty sophisticated stuff."

What we learned about the steel industry in Ohio is best expressed by one of our focus group participants:

"The United States is one of the most advantageous places in the world to get the raw material to make steel. We start with some excellent advantages. To make steel, one of the biggest factors is raw material. China doesn't have it in their back yard. They go a long way and then pay extra cost [to acquire it]. ... We are in a place in the U.S. where we have raw material, and it's a good place to make steel." He continued: "In terms of safety, quality, efficiency, process, technology, it would be hard to find a better place than the U.S. ... I think that message does not really get out. We all recognized massive offshoring 10 to 20 years ago. But over the last 5 years, we have been seeing more reshoring because they found out

that the supply chain elsewhere wasn't as good as they thought."

"Metal is the beginning of something. It gets processed into something. ... Why wouldn't you want to do business with U.S. steel companies and the supply chain they connect to? U.S. manufacturing is still the largest manufacturing center in the world. So that means there are pretty good companies downstream from steel companies here. So if steel companies are competitive and connected to this chain, then why wouldn't this be an industry set to really flourish in the next 10 to 20 years? ... [I]s a steel factory in China going to kick our butt? I say no."

Appendix A. Gross Domestic Product in the Steel Industry, United States and Ohio, 1978-2011

Year	US, GDP (2012 Real, Million Dollars)							OH, GDP (2012 Real, Million Dollars)						
	NAICS 3311	NAICS 3312	Raw Steel	Fabricated Metal Product Mfg	Total Steel	% Steel in Total	All Industries	NAICS 3311	NAICS 3312	Raw Steel	Fabricated Metal Product Mfg	Total Steel	% Steel in Total	All Industries
1978	38,698	13,927	52,625	158,609.85	211,235	2.7%	7,778,702	8,382	2,424	10,806	16,175	26,980	7.2%	375,592
1979	38,582	13,861	52,443	159,109	211,552	2.7%	7,751,101	8,331	2,415	10,746	15,843	26,589	7.2%	367,299
1980	32,789	11,835	44,624	146,415	191,039	2.6%	7,441,094	6,853	2,032	8,884	13,700	22,584	6.7%	334,975
1981	32,988	11,852	44,839	147,278	192,118	2.5%	7,596,029	6,935	2,085	9,020	13,649	22,669	6.8%	332,592
1982	25,526	9,345	34,870	131,840	166,711	2.2%	7,516,421	5,291	1,667	6,958	11,708	18,666	5.9%	317,666
1983	23,210	8,635	31,845	127,810	159,655	2.0%	7,816,656	4,879	1,617	6,495	11,979	18,474	5.6%	331,236
1984	24,190	9,291	33,481	140,502	173,983	2.1%	8,382,739	5,261	1,810	7,070	13,338	20,408	5.7%	359,069
1985	22,161	8,683	30,844	141,310	172,154	2.0%	8,669,139	4,740	1,732	6,472	13,504	19,977	5.4%	368,541
1986	20,409	8,167	28,577	137,276	165,853	1.9%	8,958,174	4,358	1,581	5,939	13,169	19,108	5.0%	379,430
1987	19,907	7,899	27,806	133,165	160,970	1.7%	9,257,288	4,491	1,519	6,010	12,447	18,457	4.8%	384,389
1988	21,083	8,281	29,364	138,707	168,071	1.7%	9,663,234	4,706	1,556	6,263	12,848	19,110	4.8%	395,146
1989	21,158	8,220	29,378	137,823	167,201	1.7%	9,790,723	4,650	1,546	6,196	12,635	18,831	4.7%	399,951
1990	20,343	7,583	27,926	132,804	160,729	1.6%	9,782,723	4,598	1,433	6,031	11,868	17,899	4.5%	396,165
1991	19,322	6,843	26,165	127,308	153,473	1.6%	9,706,111	4,390	1,324	5,714	11,101	16,815	4.3%	391,137
1992	18,883	6,677	25,561	127,335	152,896	1.5%	9,948,285	4,205	1,443	5,648	11,074	16,722	4.1%	406,768
1993	19,043	6,505	25,548	128,511	154,059	1.5%	10,129,033	4,005	1,522	5,528	11,360	16,888	4.1%	409,066
1994	18,894	7,427	26,322	137,637	163,959	1.6%	10,555,899	3,966	1,773	5,739	12,535	18,274	4.2%	433,134
1995	19,111	7,466	26,577	143,411	169,988	1.6%	10,838,268	3,910	1,786	5,696	13,076	18,772	4.2%	444,523
1996	19,595	7,289	26,884	147,284	174,167	1.6%	11,176,841	3,888	1,753	5,641	12,949	18,590	4.1%	451,483
1997	18,500	7,522	26,022	154,254	180,276	1.5%	11,679,812	3,599	1,839	5,439	13,370	18,808	4.0%	471,651
1998	18,561	7,392	25,952	157,073	183,025	1.5%	12,135,659	3,654	1,711	5,365	13,872	19,237	3.9%	487,939
1999	16,437	6,873	23,311	158,056	181,367	1.4%	12,635,086	2,986	1,402	4,388	13,913	18,301	3.7%	495,164
2000	16,027	6,912	22,939	158,821	181,760	1.4%	13,010,442	2,811	1,320	4,131	13,699	17,830	3.6%	501,740
2001	12,533	5,733	18,266	140,833	159,099	1.2%	13,077,736	1,933	1,025	2,958	11,468	14,425	2.9%	489,731
2002	13,464	6,045	19,509	132,558	152,067	1.1%	13,320,674	1,665	974	2,639	11,135	13,774	2.7%	501,424
2003	12,185	5,492	17,676	128,526	146,203	1.1%	13,634,080	1,472	796	2,268	11,295	13,563	2.7%	505,032
2004	16,971	7,945	24,917	135,227	160,144	1.1%	14,145,744	2,117	1,088	3,205	11,649	14,854	2.9%	514,741
2005	16,525	7,951	24,477	139,735	164,212	1.1%	14,570,802	2,482	1,267	3,749	11,744	15,493	3.0%	516,132
2006	17,417	8,761	26,179	141,162	167,341	1.1%	14,965,898	2,260	1,289	3,548	12,028	15,577	3.1%	510,609
2007	18,481	8,274	26,755	146,852	173,607	1.1%	15,274,260	2,400	1,276	3,676	11,995	15,671	3.1%	512,487
2008	20,645	8,538	29,183	142,214	171,398	1.1%	15,023,568	2,598	1,263	3,861	12,687	16,548	3.3%	495,476
2009	13,311	6,232	19,543	128,792	148,335	1.0%	14,807,108	1,026	663	1,689	10,378	12,067	2.5%	488,136
2010	14,993	7,036	22,030	138,062	160,092	1.1%	15,126,285	1,198	745	1,943	11,212	13,155	2.6%	496,562
2011	16,565	8,111	24,677	149,984	174,661	1.1%	15,320,825	1,356	901	2,257	12,436	14,693	2.9%	499,165

Appendix B. Employment in the Steel Industry, United States and Ohio, 1978-2011

Year	US Employment (Thousands of People)							OH Employment (Thousands of People)						
	NAICS 3311	NAICS 3312	Raw Steel	Fabricated Metal Product Mfg	Steel Total	% Steel in Total	All Industries	NAICS 3311	NAICS 3312	Raw Steel	Fabricated Metal Product Mfg	Steel Total	% Steel in Total	All Industries
1978	281.4	150.8	432.2	1,779.7	2,211.9	2.4%	93,719.1	43.4	22.3	65.8	169.0	234.8	5.1%	4,573.3
1979	284.9	152.9	437.8	1,846.9	2,284.7	2.4%	96,811.6	43.0	21.9	64.8	172.8	237.6	5.1%	4,660.5
1980	270.7	145.9	416.6	1,814.4	2,231.0	2.3%	97,367.5	40.2	19.8	60.0	164.8	224.8	4.9%	4,545.8
1981	259.2	138.8	398.0	1,787.7	2,185.7	2.2%	98,066.2	37.9	18.3	56.2	159.7	215.9	4.8%	4,492.3
1982	230.1	122.4	352.5	1,659.5	2,012.0	2.1%	96,489.4	34.7	16.5	51.2	145.5	196.7	4.6%	4,300.0
1983	198.6	104.5	303.0	1,554.9	1,857.9	1.9%	97,432.4	30.0	13.8	43.9	133.2	177.1	4.1%	4,274.7
1984	194.5	103.5	298.0	1,611.5	1,909.6	1.9%	101,558.4	29.7	13.8	43.5	137.8	181.3	4.1%	4,436.8
1985	179.5	96.2	275.7	1,615.6	1,891.3	1.8%	104,167.5	26.9	12.5	39.3	138.4	177.7	3.9%	4,550.1
1986	163.1	87.3	250.4	1,571.1	1,821.5	1.7%	106,028.8	23.2	11.3	34.5	135.5	169.9	3.7%	4,651.7
1987	151.6	81.1	232.7	1,542.0	1,774.7	1.6%	108,770.7	21.6	10.7	32.3	131.2	163.6	3.4%	4,758.3
1988	156.6	83.0	239.6	1,560.0	1,799.6	1.6%	111,947.0	24.1	11.4	35.5	132.6	168.1	3.4%	4,872.6
1989	156.1	83.1	239.2	1,567.5	1,806.7	1.6%	114,524.6	25.2	11.7	36.9	135.0	171.8	3.4%	4,989.7
1990	156.5	82.5	239.0	1,541.6	1,780.6	1.5%	115,945.3	25.5	12.0	37.5	133.5	171.1	3.4%	5,053.4
1991	152.1	78.0	230.2	1,474.7	1,704.8	1.5%	114,574.2	24.7	11.1	35.9	127.0	162.9	3.3%	4,987.4
1992	145.9	73.6	219.6	1,441.6	1,661.1	1.4%	115,052.2	22.7	10.2	32.9	124.2	157.1	3.1%	5,010.2
1993	142.6	71.3	214.0	1,451.2	1,665.1	1.4%	117,153.5	21.7	11.0	32.8	125.2	158.0	3.1%	5,081.4
1994	140.7	72.7	213.4	1,507.0	1,720.4	1.4%	120,133.1	21.4	10.9	32.2	131.1	163.3	3.1%	5,232.6
1995	140.1	72.5	212.6	1,581.5	1,794.1	1.5%	122,992.7	21.1	11.2	32.3	136.9	169.2	3.1%	5,374.7
1996	139.0	71.1	210.2	1,613.3	1,823.5	1.5%	125,373.3	20.3	10.9	31.3	136.5	167.8	3.1%	5,446.5
1997	136.9	70.1	207.0	1,663.7	1,870.7	1.5%	128,519.5	19.6	11.0	30.6	136.6	167.2	3.0%	5,542.9
1998	136.2	70.7	206.9	1,715.4	1,922.3	1.5%	131,714.9	20.0	10.5	30.5	138.9	169.3	3.0%	5,629.9
1999	132.6	69.1	201.7	1,709.1	1,910.8	1.4%	134,549.7	19.6	10.3	29.9	138.6	168.5	2.9%	5,712.2
2000	131.7	69.8	201.5	1,743.3	1,944.8	1.4%	137,409.9	18.9	10.2	29.1	139.6	168.7	2.9%	5,776.5
2001	120.8	63.2	184.0	1,639.4	1,823.4	1.3%	137,182.0	17.2	9.0	26.2	127.6	153.8	2.7%	5,690.7
2002	108.1	55.9	164.0	1,511.1	1,675.1	1.2%	135,680.4	15.1	7.6	22.8	117.5	140.3	2.5%	5,585.8
2003	102.9	53.0	155.9	1,446.9	1,602.8	1.2%	135,187.5	14.6	7.5	22.1	112.9	135.0	2.4%	5,535.9
2004	98.5	52.6	151.1	1,461.0	1,612.1	1.2%	136,602.3	13.8	6.9	20.7	115.1	135.7	2.4%	5,542.7
2005	96.9	52.7	149.7	1,485.0	1,634.6	1.2%	138,774.3	13.6	6.8	20.4	115.3	135.7	2.4%	5,558.1
2006	97.0	52.8	149.7	1,514.0	1,663.7	1.2%	141,040.9	13.0	6.9	19.9	116.3	136.2	2.4%	5,566.0
2007	97.3	52.1	149.4	1,523.6	1,673.0	1.2%	142,722.5	13.3	6.8	20.0	115.9	136.0	2.4%	5,556.9
2008	97.3	51.4	148.7	1,502.1	1,650.8	1.2%	142,237.8	12.8	6.6	19.4	114.2	133.6	2.4%	5,487.5
2009	84.7	43.4	128.1	1,280.9	1,409.0	1.0%	136,084.9	10.1	5.3	15.5	94.8	110.3	2.1%	5,196.6
2010	83.1	43.9	127.0	1,251.2	1,378.2	1.0%	135,340.4	9.9	5.9	15.8	92.7	108.5	2.1%	5,160.5
2011	83.4	46.7	130.0	1,309.4	1,439.4	1.1%	136,524.2	10.1	6.3	16.4	98.3	114.7	2.2%	5,228.9

**Appendix C. 2011 Share of Gross State Product and Employment of the Steel Industry
and Its Customers in Ohio**

	Employment (Thousand people)	Gross State Product (2012 Real, Million Dollars)
Total Steel and Steel Customers	1,793	\$140,601
Pct in Total	34.3%	28.2%
All Industries	5,228	\$499,165

Source: Moody's Economy.com

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