Ohio | Department of Development

Policy Research and Strategic Planning
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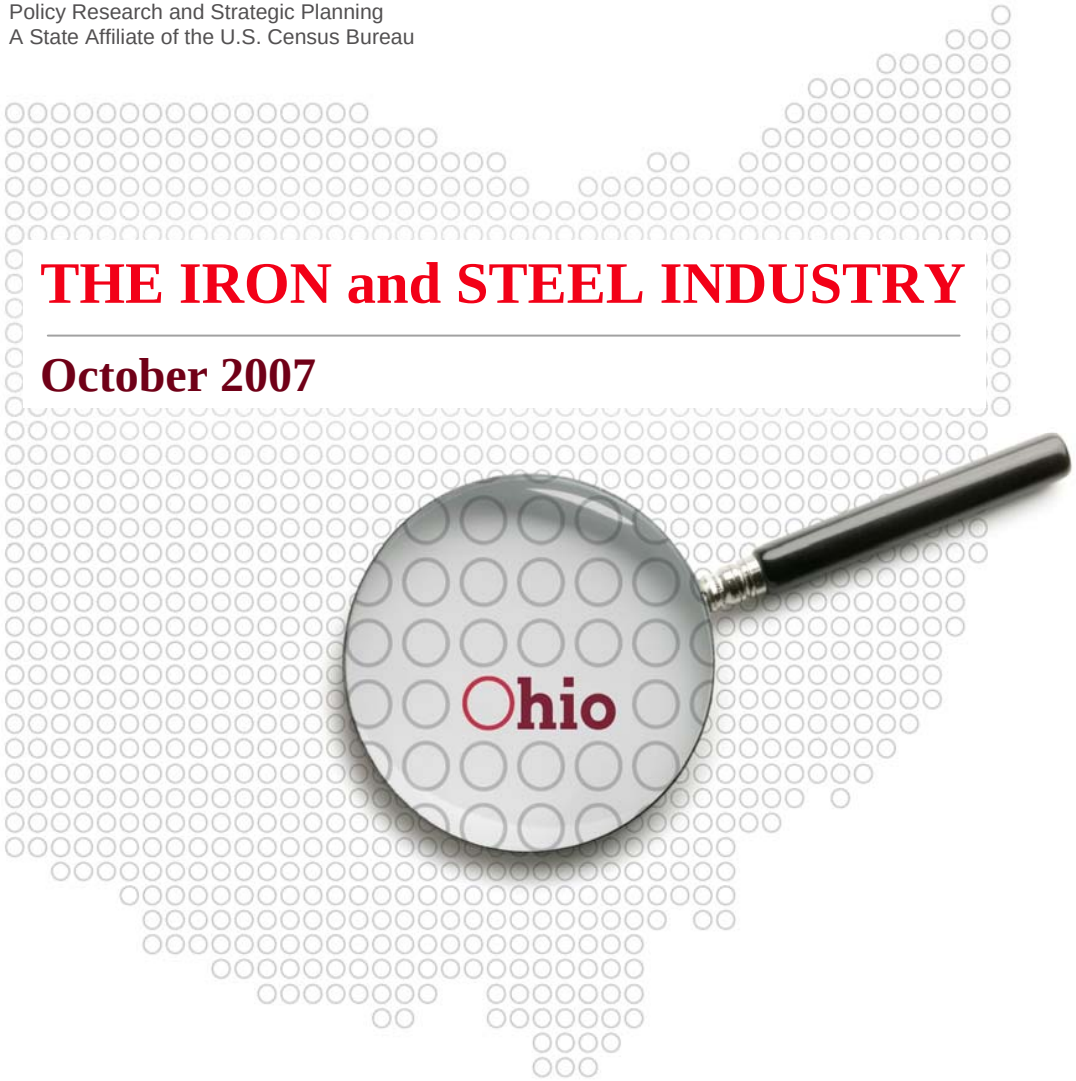
THE IRON and STEEL INDUSTRY

October 2007



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Ohio | Department of Development

THE OHIO IRON AND STEEL INDUSTRY

OCTOBER 2007

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Table A1: Notable Iron and Steel Industry Companies in Ohio, 2007

Parent/Company/Division	Primary NAICS	City	Jobs# Total	Jobs# at Site
AK Steel Holding Corp.*			4,059	
AK Steel Corp.	331111	Coshocton		584
AK Steel Corp.	331111	Dover		218
AK Steel Corp.[1]	331111	Mansfield		389
AK Steel Corp.[2]	331111	Middletown		2,200
AK Steel Holding Corp.[3]	331111	West Chester		150
AK Steel Corp.[1]	331111	Zanesville		218
AK Steel Corp./AK Tube LLC	33121	Walbridge		300
Allegheny Technologies, Inc.*/Allegheny Ludlum Corp.	331111	Louisville		145
American Spring Wire Corp.[1]	331222	Cleveland		238
Apollo Advisors, LP/Metals USA, Inc.*/Metals USA Carbon Flat Rolled	331111	Wooster		112
ArcelorMittal Steel Co. NV*			2,546	
Mittal Steel USA, Inc./International Steel Group	331111	Warren		135
Mittal Steel USA-Warren, Inc.	331111	Cleveland		1,600
Dofasco Tubular Products Corp.[1]	33121	Shelby		666
Marion Dofasco, Inc.[4]	33121	Marion		125
Skyline Steel Corp.	331221	Belpre		20
Asahi Tec Corp./Metaldyne Corp.	331111	Cleveland		200
BlueScope Steel Ltd.-Cargill, Inc./North Star BlueScope Steel LLC	331111	Delta		330
Charter Manufacturing Co., Inc.			1,012	
Charter Steel - Cleveland, Inc.	331111	Cleveland		992
Charter Manufacturing Co., Inc.[1]	331111	Rising Sun		20
Columbus Steel Castings Co.	331513	Columbus		750
Eramet SA/Marietta Eramet, Inc.	331112	Marietta		550
Ford Motor Co.*[5, 13]	331511	Cleveland		1,218
General Motors Corp.*[1]	331511	Defiance		1,454
Greer Industries, Inc./Greer Steel Co.	331221	Dover		250
Industrias CH, SA de CV/Grupo Simec			2,225	
Republic Engineered Products	331111	Fairlawn		150
Republic Engineered Products[6]	331111	Canton		644

Table A1: Notable Iron and Steel Industry Companies in Ohio, 2007

Parent/Company/Division	Primary NAICS	City	Jobs# Total	Jobs# at Site
Industrias CH (continued)				
Republic Engineered Products[7]	331111	Lorain		1,200
Republic Engineered Products - Central Machine/Fabrication[8]	331111	Massillon		215
Republic Engineered Products - Cold Finished Plant	331221	Massillon		16
Jackson Tube Service, Inc.[1]	33121	Piqua		313
McWane, Inc.	331511	Coshocton		400
Mitsubishi Corp.*-Sojitz Corp./Coilplus-Ohio, Inc.	331221	Springfield		55
Nucor Corp.*/Nucor Steel Marion, Inc.[4]	331111	Marion		405
OSCO Industries, Inc.			477	
OSCO Industries, Inc.	331511	Portsmouth		285
OSCO Industries, Inc.	331511	Jackson		125
OSCO Industries, Inc.	331511	Portsmouth		67
PTC Alliance Corp.			273	
PTC Alliance Corp.	33121	Salem		23
Alliance Tubular Products Co.[14]	33121	Alliance		250
Quality Castings Co.	331511	Orrville		290
Renco Group, Inc./WCI Steel, Inc.	331111	Warren		1,280
Ryerson, Inc.*/Ryerson, Tull Corp./J & F Steel Corp.	331221	Middletown		26
Salzgitter AG/V & M Star LP	33121	Youngstown		430
Shiloh Industries, Inc.			301	
Liverpool Coil Processing, Inc.	331111	Valley City		101
Medina Blanking, Inc.	331513	Valley City		150
Medina Blanking, Inc.	331513	Valley City		50
Tata Group/Tata Steel/Corus Group*/Thomas Strip Steel Corp.[9]	331221	Warren		500
TI Group plc			263	
TI Group Automotive Systems[13]	33121	Hebron		195
TI Group Automotive Systems	33121	Washington Court House		68
Timken Co.*[10]			1,700	
Timken Co. (Faircrest)	331111	Canton		n.a.
Timken Co. (Gambrinus)	33121	Canton		n.a.

Table A1: Notable Iron and Steel Industry Companies in Ohio, 2007

Parent/Company/Division	Primary NAICS	City	Jobs# Total	Jobs# at Site
Timken Co.* (continued)				
Timken Co. (Harrison)	331111	Canton		n.a.
Timken Co.	n.a.	Eaton		n.a.
Timken Co.[1]	331111	Wauseon		41
United States Steel Corp.*/Lorain Pipe Mill	331111	Lorain		550
Welded Tube of Canada, Inc.	33121	Delta		350
Wheeling-Pittsburgh Steel Corp.*[1, 11]			1,854	
Wheeling-Pittsburgh Steel Corp.	331111	Martins Ferry		n.a.
Wheeling-Pittsburgh Steel Corp.[1]	331111	Mingo Junction		1,140
Wheeling-Pittsburgh Steel Corp.	331111	Steubenville		n.a.
Wheeling-Pittsburgh Steel Corp.	331221	Yorkville		n.a.
Worthington Industries, Inc.*			1,080	
Dietrich Industries, Inc.	331111	Warren		180
Worthington Industries, Inc.[12]	331221	Columbus		400
Worthington Industries, Inc.	331221	Columbus		10
Worthington Industries, Inc.	331221	Worthington		250
Worthington Industries, Inc.	331513	Columbus		75
Worthington Industries, Inc.	331513	Monroe		165

Notes: # - Jobs figures are from Harris (2007) unless otherwise noted; * - A Fortune U.S. 1000 or global 500 company; 1 - Jobs figure from ODOD (2007), usually the Enterprise Zone reports; 2 - Pittsburgh Business Times (2007); 3 - This figure is expected to grow to 300 Pittsburgh Business Times (2007); 4 - Jobs figure is from Marion Chamber of Commerce (2007); 5 - Jobs figure is from Ford Motor Co. (2007); 6 - Jobs figure is from Balint (2007); 7 - Jobs figure is from ODOT (2005); 8 - Union jobs only, according to the Canton Repository (2007); 9 - Tata Steel, a subsidiary of the Tata Group, completed acquiring the Corus Group in March, 2007 (Larkin, 2007: 5); 10 - Jobs figure is from Kelley (2005); the Harris (2007) figure for Eaton and the summary figure for Canton are thought to be too low; n.a. - not available; 11 - In March, 2007, the company announced an agreement to merge with Esmark, a steel service center and manufacturer of fabricated metal products (Larkin, 2007); subsequently Giannamore (2007) reports that the roles of the plants will change; therefore, Harris (2007) figures for Martins Ferry, Steubenville, and Yorkville may be too high; 12 - Jobs figure is from Lexis-Nexis (2007); 13 - Closing soon; 14 - Jobs figure is from

Table A1: Notable Iron and Steel Industry Companies in Ohio, 2007

Parent/Company/Division	Primary NAICS	City	Jobs# Total	Jobs# at Site

Times-Reporter (2007) and PR Newswire (2007) combined, and is approximate.

Sources: Balint (2007), Canton Repository (2007), Ford Motor Co. (2007), Fortune (2007), Giannamore (2007), Harris (2007), Kelley (2005), Larkin (2007), Lexis-Nexis (2007), Marion Chamber of Commerce (2007), ODOD (2007), ODOT (2005), Pittsburgh Business Times (2007), PR Newswire (2007), Times-Reporter (2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Telephone 800-848-1300, or 614-466-2116 (DL, 10/07).

Table A2: Expansion and Attraction Announcements in Ohio's Iron and Steel Industry, 2004-2006

Year	Company	City or Township	NAICS Code	Product	New or Expanded	Total Invested	Jobs	Space (Sq. Ft.)
2004	AK Steel Corp.	Middletown	331111	Steel	Expanded	$65,000,000		
2004	Ambassador Steel	Marion	33121	Steel pipe	New	$1,200,000	16	27,000
2004	ArcelorMittal Steel Co. NV/International Steel Group	Cleveland	331111	Steel	Expanded	$10,000,000	140	
2004	ArcelorMittal Steel Co. NV/International Steel Group	Cuyahoga Heights	331111	Galvanized steel	Expanded	$40,000,000	50	
2004	CANDO	Marion	331511	Steel foundry	New	$4,000,000	75	
2004	Charter Steel	Cuyahoga Heights	331111	Steel rods/wire	Expanded	$90,000,000		
2004	Columbus Steel Castings Co.	Columbus	331511	Steel castings	Expanded	$4,800,000	25	
2004	General Motors Corp.	Defiance	331511	Iron castings	Expanded	$58,400,000		
2004	Industrias CH, SA de CV/Republic Engineered Products	Canton	331111	Steel	Expanded	$54,000,000		
2004	New Dimension Metals Corp.	Moraine	331111	Steel	Expanded	$1,200,000		
2004	Parker Hannifin Corp.	Columbus	33121	Steel tubes	Expanded	$1,500,000		12,000
2004	Salzgitter AG/V & M Star LP	Youngstown	331111	Steel	Expanded	$5,000,000		
2004	Steel Technologies, Inc.	Ottawa	331111	Steel processing	Expanded	$6,000,000	10	70,000
2004 Subtotals*:						$341,100,000	316	109,000
2005	Allegheny Technologies, Inc./Allegheny Ludlum Corp.	Louisville	331111	Stainless steel coils	Expanded	$24,000,000		
2005	Charter Steel	Perry Twp.	331111	Steel products	Expanded	$12,800,000	16	72,000
2005	Ferrolux Metals Co.	Macedonia	331221	Cold rolled steel	New	$3,600,000	23	
2005	Liberty Casting Co.	Delaware	331513	Iron castings	Expanded	$1,300,000	20	
2005	McDonald Steel Corp.	McDonald	331111	Steel	Expanded	$7,000,000	25	
2005	PTC Alliance Corp.	Massillon	331111	Steel tubing	New	$2,000,000	30	
2005	Warren Fabricating Steel	Hubbard Twp.	331111	Plate steel	New	$130,000,000	100	150,000
2005	Wheeling-Pittsburgh Steel Corp.	Steubenville	331111	Steel	Expanded	$14,500,000		
2005	Xtek, Inc.	Sharonville	331513	Steel parts	Expanded	$1,000,000		29,000
2005	Youngstown Pipe & Supply	Youngstown	331111	Pipe products	New	$1,080,000	18	
2005 Subtotals:						$197,280,000	232	251,000
2006	AK Steel Corp.	Walbridge	33121	Steel tubing	Expanded	$8,500,000		
2006	Columbus Steel Castings Co.	Columbus	331513	Steel castings	Expanded	$1,800,000		
2006	General Motors Corp.	Defiance	331511	Engine blocks	Expanded	$109,500,000		
2006	Liberty Steel Products	Jackson Twp.	331111	Steel products	Expanded	$5,000,000		50,000
2006	N.V. Bekaert SA/Bekaert Corp.	Orrville	331111	Steel tire cord	Expanded	$4,558,000		35,100
2006	OSCO Industries, Inc.	Jackson	331511	Foundry	Expanded	$3,000,000	1	
2006	OSCO Industries, Inc.	Portsmouth	331511	Foundry	Expanded	$3,000,000		
2006	Pro-Tec Coating Co.	Leipsic	331111	Steel galvanizing	Expanded	$2,000,000	4	
2006	Renco Group, Inc./WCI Steel, Inc.	Warren	331111	Steel	Expanded	$66,000,000		
2006	Slob & Sons Pipe Casing	Marion	33121	Steel pipe	New	$3,800,000	10	31,500

Table A2: Expansion and Attraction Announcements in Ohio's Iron and Steel Industry, 2004-2006

Year	Company	City or Township	NAICS Code	Product	New or Expanded	Total Invested	Jobs	Space (Sq. Ft.)
2006	Youngstown Tube Co., Inc.	Youngstown	331111	Steel sprinkler pipe	Expanded	$1,500,000		20,000
2006 Subtotals:						$208,658,000	15	136,600
Grand Totals 2004-2006:						$747,038,000	563	496,600

Note: * - Excludes three coke oven operation announcements valued at $504,000,000 with 199 new jobs. Coke ovens are excluded from the iron and steel industry if they are not part of the iron smelting complex.

Source: Office of Strategic Research (2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Telephone 800/848-1300, or 614/466-2116 (DL, 7/07).

Table A3a: Distribution of Iron and Steel Value-Added in Ohio, 2002

NAICS Code	Industries	Value Added (in millions)	Percent Distri-bution
	Iron & steel industry	$4,412.9	100.0%
3311	Iron & steel mills & ferroalloys	$2,409.5	54.6%
331111	Iron & steel mills	$2,214.7	50.2%
331112	Electrometallurgical ferroalloy products	$194.8	4.4%
3312	Steel product mfg. from purchased steel	$1,180.2	26.7%
33121	Iron, steel pipe & tube mfg. from purchased steel	$423.0	9.6%
33122	Rolling & drawing of purchased steel	$757.2	17.2%
331221	Rolled steel shapes	$633.5	14.4%
331222	Steel wire drawing	$123.7	2.8%
33151	Ferrous metal foundries	$823.2	18.7%
331511	Iron foundries	$569.2	12.9%
331512	Steel investment foundries	$152.3	3.5%
331513	Steel foundries (exc. investment)	$101.6	2.3%

Abbreviations: exc. - except; mfg. - manufacturing.

Source: U.S. Bureau of the Census (2005c).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Phone 614/466-2116 (DL, 8/05).

Table A3b: Value-Added in the Iron and Steel Industry by Group, 2005 (in millions)

Area	Subtotal	Industry Group* 3311	3312
U.S.	$40,116.6	$32,932.8	$7,183.8
Alabama	$1,727.9	$1,727.9	$0.0
Alaska	$0.0	$0.0	$0.0
Arizona	$0.0	$0.0	$0.0
Arkansas	$1,598.0	$1,372.3	$225.7
California	$1,315.5	$1,076.1	$239.3
Colorado	$0.0	$0.0	$0.0
Connecticut	$86.5	$0.0	$86.5
Delaware	$0.0	$0.0	$0.0
District of Columbia	$0.0	$0.0	$0.0
Florida	$0.0	$0.0	$0.0
Georgia	$0.0	$0.0	$0.0
Hawaii	$0.0	$0.0	$0.0
Idaho	$0.0	$0.0	$0.0
Illinois	$3,500.4	$3,125.4	$375.0
Indiana	$5,701.4	$5,298.6	$402.8
Iowa	$0.0	$0.0	$0.0
Kansas	$0.0	$0.0	$0.0
Kentucky	$940.5	$940.5	$0.0
Louisiana	$0.0	$0.0	$0.0
Maine	$0.0	$0.0	$0.0
Maryland	D	D	$0.0
Massachusetts	$0.0	$0.0	$0.0
Michigan	$933.2	$688.2	$244.9
Minnesota	$0.0	$0.0	$0.0
Mississippi	$0.0	$0.0	$0.0
Missouri	$206.0	$0.0	$206.0
Montana	$0.0	$0.0	$0.0
Nebraska	$0.0	$0.0	$0.0
Nevada	$0.0	$0.0	$0.0
New Hampshire	$0.0	$0.0	$0.0
New Jersey	$164.6	$0.0	$164.6
New Mexico	$0.0	$0.0	$0.0
New York	$529.7	$529.7	$0.0
North Carolina	$0.0	$0.0	$0.0
North Dakota	$0.0	$0.0	$0.0
Ohio	$6,181.7	$4,883.3	$1,298.3
Oklahoma	$202.8	$0.0	$202.8
Oregon	D	D	$0.0
Pennsylvania	$7,833.0	$6,137.1	$1,695.9
Rhode Island	$0.0	$0.0	$0.0
South Carolina	D	D	$136.1
South Dakota	$0.0	$0.0	$0.0
Tennessee	$265.7	$0.0	$265.7
Texas	$1,622.1	$1,337.5	$284.6
Utah	$0.0	$0.0	$0.0
Vermont	$0.0	$0.0	$0.0
Virginia	$306.9	$306.9	$0.0
Washington	$0.0	$0.0	$0.0
West Virginia	$186.4	$186.4	$0.0
Wisconsin	$177.2	$0.0	$177.2
Wyoming	$0.0	$0.0	$0.0

Notes: D - Suppressed to maintain confidentiality. $0.0. - may only indicate that the state and industry combination was too small to be covered by the survey. * - No data available for ferrous metal foundries (NAICS 33151).

Source: U.S. Bureau of the Census (2006a).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Telephone 614/466-2116 (DL, 7/07).

Table A4: Iron and Steel Industry Establishments and Employment, 2005 Means and Percentages

NAICS Code	Industries	Ohio: Number of Establishments	Ohio: Number of Employees	Ohio: Mean per Establishment	U.S.: Number of Establishments	U.S.: Number of Employees	U.S.: Mean per Establishment	Ohio as a Percentage of U.S.: Establishments	Ohio as a Percentage of U.S.: Employment
	Total Covered Employment	270,968	4,762,618	17.6	7,499,702	116,317,003	15.5	3.6%	4.1%
	Iron & steel industry	234	34,013	145.4	2,468	249,853	101.2	9.5%	13.6%
3311	Iron & steel mills & ferroalloys	73	17,072	233.9	839	109,957	131.1	8.7%	15.5%
331111	Iron & steel mills	67	15,341	229.0	814	107,474	132.0	8.2%	14.3%
331112	Electrometallurgical ferroalloy products	6	1,731	288.5	25	2,483	99.3	24.0%	69.7%
3312	Steel product mfg. from purchased steel	71	6,600	93.0	716	46,193	64.5	9.9%	14.3%
33121	Iron, steel pipe & tube mfg. from purchased steel	28	3,231	115.4	229	20,571	89.8	12.2%	15.7%
33122	Rolling & drawing of purchased steel	43	3,369	78.3	487	25,622	52.6	8.8%	13.1%
331221	Rolled steel shapes	30	2,903	96.8	189	10,322	54.6	15.9%	28.1%
331222	Steel wire drawing	13	466	35.8	298	15,300	51.3	4.4%	3.0%
33151	Ferrous metal foundries	90	10,341	114.9	913	93,703	102.6	9.9%	11.0%
331511	Iron foundries	62	7,827	126.2	572	60,892	106.5	10.8%	12.9%
331512	Steel investment foundries	14	1,735	123.9	128	15,847	123.8	10.9%	10.9%
331513	Steel foundries (exc. investment)	14	779	55.6	213	16,964	79.6	6.6%	4.6%

Abbreviations: exc. - except; mfg. - manufacturing.

Source: U.S. Bureau of the Census (2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Phone 614/466-2116 (DL, 7/07).

Table A5: Iron and Steel Industry Employment and Payroll, 2005 Means and Ratios

NAICS Code	Industries	Ohio Number of Employees	Ohio Annual Payroll ($millions)	Ohio Mean per Employee	U.S. Number of Employees	U.S. Annual Payroll ($millions)	U.S. Mean per Employee	Ratio: Ohio to U.S. Means
	Total Covered Employment	4,762,618	$168,350.5	$35,348	116,317,003	$4,482,722.5	$38,539	91.7%
	Iron & steel industry	34,013	$2,030.1	$59,686	249,853	$13,330.1	$53,352	111.9%
3311	Iron & steel mills & ferroalloys	17,072	$1,117.8	$65,476	109,957	$7,076.1	$64,353	101.7%
331111	Iron & steel mills	15,341	$1,031.9	$67,262	107,474	$6,950.8	$64,675	104.0%
331112	Electrometallurgical ferroalloy products	1,731	$85.9	$49,642	2,483	$125.3	$50,444	98.4%
3312	Steel product mfg. from purchased steel	6,600	$339.4	$51,423	46,193	$2,069.1	$44,792	114.8%
33121	Iron, steel pipe & tube mfg. from purchased steel	3,231	$155.0	$47,962	20,571	$959.3	$46,635	102.8%
33122	Rolling & drawing of purchased steel	3,369	$184.4	$54,742	25,622	$1,109.8	$43,313	126.4%
331221	Rolled steel shapes	2,903	$159.8	$55,042	10,322	$515.1	$49,901	110.3%
331222	Steel wire drawing	466	$24.6	$52,873	15,300	$594.7	$38,868	136.0%
33151	Ferrous metal foundries	10,341	$572.9	$55,403	93,703	$4,185.0	$44,662	124.0%
331511	Iron foundries	7,827	$475.9	$60,808	60,892	$2,838.0	$46,607	130.5%
331512	Steel investment foundries	1,735	$63.3	$36,474	15,847	$619.4	$39,086	93.3%
331513	Steel foundries (exc. investment)	779	$33.7	$43,252	16,964	$727.6	$42,889	100.8%

Abbreviations: exc. - except; mfg. - manufacturing.

Source: U.S. Bureau of the Census (2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Phone 614/466-2116 (DL, 7/07).

Table A6: Iron and Steel Industry Establishments and Employment by County, 2005

Area Name	Establishments	Employees	Area Name	Establishments	Employees	Area Name	Establishments	Employees
Ohio	234	34,013	Greene*	1	28	Morrow	0	0
			Guernsey*	1	143	Muskingum*	2	476
Adams*	1	7	Hamilton*	5	628	Noble	0	0
Allen*	2	115	Hancock*	3	60	Ottawa*	1	666
Ashland	0	0	Hardin*	2	70	Paulding	0	0
Ashtabula*	2	115	Harrison	0	0	Perry*	1	333
Athens	0	0	Henry*	1	28	Pickaway	0	0
Auglaize*	1	143	Highland	0	0	Pike	0	0
Belmont	0	0	Hocking	0	0	Portage*	1	15
Brown	0	0	Holmes*	2	10	Preble	0	0
Butler*	6	3,953	Huron	0	0	Putnam*	1	66
Carroll	0	0	Jackson*	2	120	Richland*	5	971
Champaign	0	0	Jefferson*	3	1,166	Ross	0	0
Clark*	1	28	Knox*	2	81	Sandusky*	1	7
Clermont	0	0	Lake*	7	1,114	Scioto*	2	209
Clinton*	1	15	Lawrence	0	0	Seneca*	2	43
Columbiana*	11	284	Licking*	1	7	Shelby*	1	15
Coshocton*	3	1,250	Logan*	1	66	Stark*	15	4,003
Crawford	0	0	Lorain*	4	1,333	Summit*	10	67
Cuyahoga*	34	5,376	Lucas*	5	202	Trumbull*	11	2,761
Darke	0	0	Madison*	2	31	Tuscarawas*	4	165
Defiance	1	4,000	Mahoning*	8	405	Union	0	0
Delaware*	2	143	Marion*	3	491	Van Wert	0	0
Erie*	2	285	Medina*	5	222	Vinton	0	0
Fairfield*	2	5	Meigs	0	0	Warren*	1	28
Fayette	0	0	Mercer*	1	28	Washington*	7	809
Franklin*	9	809	Miami*	5	518	Wayne*	5	478
Fulton*	5	383	Monroe	0	0	Williams*	2	73
Gallia	0	0	Montgomery*	11	498	Wood*	2	158
Geauga*	1	3	Morgan	0	0	Wyandot*	1	66

Note: * - Employment figure is, or contains, an estimate - which is why the county employment figures sum to 35,572 and not the state total of 34,013. That, in turn, means that the estimates tend to be a little high.

Sources: Harris (2005), U.S. Bureau of the Census (2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Phone 614/466-2116 (DL, 7/07).

Table A7: Iron and Steel Industry Establishment Trends, Ohio and the U.S.: 1998-2005

NAICS Code	Shorter Industry Title	1998	1999	2000	2001	2002	2003	2004	2005	Changes: 1998-2005 Number	Percent
Ohio	Total	270,343	270,766	270,509	269,944	271,181	270,255	271,733	270,968	625	0.2%
31-33	Manufacturing	18,052	17,930	17,704	17,597	17,189	17,082	16,887	16,617	-1,435	-7.9%
3311-2-51	Iron & steel industry	231	248	279	318	293	268	242	234	3	1.3%
3311	Iron & steel mills & ferroalloys	41	59	84	111	100	87	76	73	32	78.0%
331111	Iron & steel mills	36	54	79	106	95	80	69	67	31	86.1%
331112	Electrometallurgical ferroalloys	5	5	5	5	5	7	7	6	1	20.0%
3312	Steel products from purchased steel	71	66	72	81	84	82	71	71	0	0.0%
33121	Iron, steel pipe & tubes	28	26	29	31	34	31	27	28	0	0.0%
33122	Rolling & drawing	43	40	43	50	50	51	44	43	0	0.0%
331221	Rolled steel shapes	30	28	29	32	35	34	31	30	0	0.0%
331222	Steel wire drawing	13	12	14	18	15	17	13	13	0	0.0%
33151	Ferrous metal foundries	119	123	123	126	109	99	95	90	-29	-24.4%
331511	Iron foundries	76	81	83	85	77	69	64	62	-14	-18.4%
331512	Steel investment foundries	16	17	17	17	16	15	15	14	-2	-12.5%
331513	Steel foundries (exc. investment)	27	25	23	24	16	15	16	14	-13	-48.1%
U.S.	Total	6,941,822	7,008,444	7,070,048	7,095,302	7,200,770	7,254,745	7,387,724	7,499,702	557,880	8.0%
31-33	Manufacturing	366,249	360,244	354,498	352,619	344,341	341,849	339,083	333,460	-32,789	-9.0%
3311-2-51	Iron & steel industry	2,321	2,726	3,134	3,525	3,205	2,708	2,473	2,468	147	6.3%
3311	Iron & steel mills & ferroalloys	410	702	1,003	1,374	1,259	876	799	839	429	104.6%
331111	Iron & steel mills	381	672	970	1,345	1,242	853	769	814	433	113.6%
331112	Electrometallurgical ferroalloys	29	30	33	29	17	23	30	25	-4	-13.8%
3312	Steel products from purchased steel	762	824	933	939	870	828	734	716	-46	-6.0%
33121	Iron, steel pipe & tubes	252	265	290	281	281	221	205	229	-23	-9.1%
33122	Rolling & drawing	510	559	643	658	589	607	529	487	-23	-4.5%
331221	Rolled steel shapes	213	242	286	295	230	226	181	189	-24	-11.3%
331222	Steel wire drawing	297	317	357	363	359	381	348	298	1	0.3%
33151	Ferrous metal foundries	1,149	1,200	1,198	1,212	1,076	1,004	940	913	-236	-20.5%
331511	Iron foundries	683	731	739	747	655	623	584	572	-111	-16.3%
331512	Steel investment foundries	162	159	160	156	143	147	135	128	-34	-21.0%
331513	Steel foundries (exc. investment)	304	310	299	309	278	234	221	213	-91	-29.9%

Sources: U.S. Census Bureau (2000-2002, 2003b, 2004, 2005b, 2006b, 2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Phone 614/466-2116 (DL, 7/07).

Table A8: Iron and Steel Industry Employment Trends, Ohio and the U.S.: 1998-2005

NAICS Code	Shorter Industry Title	1998	1999	2000	2001	2002	2003	2004	2005	Changes: 1998-2005 Number	Percent
Ohio	Total	4,806,046	4,867,368	5,001,980	4,932,943	4,743,151	4,770,283	4,762,205	4,762,618	-43,428	-0.9%
31-33	Manufacturing	994,788	982,853	988,612	936,161	829,456	838,725	814,662	792,783	-202,005	-20.3%
3311-2-51	Iron & steel industry	52,777	51,540	54,239	51,891	43,666	41,627	34,397	34,013	-18,764	-35.6%
3311	Iron & steel mills & ferroalloys	24,479	24,306	27,101	26,700	21,353	21,783	16,315	17,072	-7,407	-30.3%
331111	Iron & steel mills	22,948	22,669	25,351	25,061	19,822	20,159	14,610	15,341	-7,607	-33.1%
331112	Electrometallurgical ferroalloys	1,531	1,637	1,750	1,639	1,531	1,624	1,705	1,731	200	13.1%
3312	Steel products from purchased steel	9,958	9,263	10,597	10,464	10,234	9,013	7,148	6,600	-3,358	-33.7%
33121	Iron, steel pipe & tubes	4,961	4,459	4,617	4,368	4,512	3,837	3,139	3,231	-1,730	-34.9%
33122	Rolling & drawing	4,997	4,804	5,980	6,096	5,722	5,176	4,009	3,369	-1,628	-32.6%
331221	Rolled steel shapes	3,676	3,466	4,515	4,631	4,583	4,263	3,306	2,903	-773	-21.0%
331222	Steel wire drawing	1,321	1,338	1,465	1,465	1,139	913	703	466	-855	-64.7%
33151	Ferrous metal foundries	18,340	17,971	16,541	14,727	12,079	10,831	10,934	10,341	-7,999	-43.6%
331511	Iron foundries	13,197	12,791	12,037	10,650	9,154	8,579	8,526	7,827	-5,370	-40.7%
331512	Steel investment foundries	2,983	2,894	2,805	2,310	2,132	1,488	1,725	1,735	-1,248	-41.8%
331513	Steel foundries (exc. investment)	2,160	2,286	1,699	1,767	793	764	683	779	-1,381	-63.9%
U.S.	Total	108,117,731	110,705,661	114,064,976	115,061,184	112,400,654	113,398,043	115,074,924	116,317,003	8,199,272	7.6%
31-33	Manufacturing	16,945,834	16,659,930	16,473,994	15,950,424	14,393,609	14,132,020	13,821,976	13,667,337	-3,278,497	-19.3%
3311-2-51	Iron & steel industry	349,739	338,509	343,299	330,496	287,205	270,090	250,690	249,853	-99,886	-28.6%
3311	Iron & steel mills & ferroalloys	148,969	144,194	149,128	148,381	126,969	125,871	114,097	109,957	-39,012	-26.2%
331111	Iron & steel mills	145,386	140,417	145,232	144,938	124,703	123,543	111,709	107,474	-37,912	-26.1%
331112	Electrometallurgical ferroalloys	3,583	3,777	3,896	3,443	2,266	2,328	2,388	2,483	-1,100	-30.7%
3312	Steel products from purchased steel	65,827	64,799	68,030	65,597	58,699	52,401	47,183	46,193	-19,634	-29.8%
33121	Iron, steel pipe & tubes	27,759	26,759	27,681	27,490	25,191	20,181	19,182	20,571	-7,188	-25.9%
33122	Rolling & drawing	38,068	38,040	40,349	38,107	33,508	32,220	28,001	25,622	-12,446	-32.7%
331221	Rolled steel shapes	14,169	13,268	15,521	14,349	13,962	13,079	10,786	10,322	-3,847	-27.2%
331222	Steel wire drawing	23,899	24,772	24,828	23,758	19,546	19,141	17,215	15,300	-8,599	-36.0%
33151	Ferrous metal foundries	134,943	129,516	126,141	116,518	101,537	91,818	89,410	93,703	-41,240	-30.6%
331511	Iron foundries	85,684	83,760	82,106	75,053	66,380	62,382	59,511	60,892	-24,792	-28.9%
331512	Steel investment foundries	24,251	22,315	21,166	20,260	17,252	15,036	14,794	15,847	-8,404	-34.7%
331513	Steel foundries (exc. investment)	25,008	23,441	22,869	21,205	17,905	14,400	15,105	16,964	-8,044	-32.2%

Sources: U.S. Census Bureau (2000-2002, 2003b, 2004, 2005b, 2006b, 2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Phone 614/466-2116 (DL, 7/07).

Table A9: Raw Steel Production in Ohio and the U.S., 1969-2006 (in thousands if net tons, except ranks and percentages)

	Ohio		U.S.					Ohio		U.S.			
Year	Raw Steel Output	Percent Change from Prior Period	Raw Steel Output	Percent Change from Prior Period	Ohio as Percent of U.S. Output	Ohio's Rank in U.S.	Year	Raw Steel Output	Percent Change from Prior Period	Raw Steel Output	Percent Change from Prior Period	Ohio as Percent of U.S. Output	Ohio's Rank in U.S.
1969	24,202	n.a.	141,262	n.a.	17.1%	2	1989	16,506	-6.5%	97,943	-2.0%	16.9%	2
1970	21,684	-10.4%	131,514	-6.9%	16.5%	2	1990	16,769	1.6%	98,906	1.0%	17.0%	2
1971	20,064	-7.5%	120,443	-8.4%	16.7%	2	1991	14,210	-15.3%	87,896	-11.1%	16.2%	2
1972	23,851	18.9%	133,241	10.6%	17.9%	2	1992	15,524	9.2%	92,949	5.7%	16.7%	2
1973	26,510	11.1%	150,799	13.2%	17.6%	2	1993	16,101	3.7%	97,877	5.3%	16.5%	2
1974	25,251	-4.7%	145,720	-3.4%	17.3%	2	1994	16,683	3.6%	100,579	2.8%	16.6%	2
1975	19,620	-22.3%	116,642	-20.0%	16.8%	3	1995	16,444	-1.4%	104,930	4.3%	15.7%	2
1976	22,419	14.3%	128,000	9.7%	17.5%	2	1996	16,837	2.4%	105,309	0.4%	16.0%	2
1977	21,466	-4.3%	125,333	-2.1%	17.1%	3	1997	15,827	-6.0%	108,561	3.1%	14.6%	2
1978	21,268	-0.9%	137,031	9.3%	15.5%	3	1998	16,758	5.9%	108,752	0.2%	15.4%	2
1979	21,082	-0.9%	136,341	-0.5%	15.5%	3	1999	17,499	4.4%	107,395	-1.2%	16.3%	2
1980	16,100	-23.6%	111,835	-18.0%	14.4%	3	2000	18,263	4.4%	112,242	4.5%	16.3%	2
1981	18,096	12.4%	120,828	8.0%	15.0%	3	2001	15,726	-13.9%	99,321	-11.5%	15.8%	2
1982	12,181	-32.7%	74,577	-38.3%	16.3%	2	2002	14,646	-6.9%	100,958	1.6%	14.5%	2
1983	14,586	19.7%	84,615	13.5%	17.2%	2	2003	13,100	-10.6%	103,261	2.3%	12.7%	2
1984	15,438	5.8%	92,528	9.4%	16.7%	2	2004*	14,907	13.8%	108,601	5.2%	13.7%	n.a.
1985	14,094	-8.7%	88,259	-4.6%	16.0%	2	2005*	14,539	-2.5%	102,752	-5.4%	14.2%	n.a.
1986	14,522	3.0%	81,606	-7.5%	17.8%	2	2006*	14,741	1.4%	108,620	5.7%	13.6%	n.a.
1987	16,267	12.0%	89,151	9.2%	18.2%	2	2006: 1st qtr.*	3,822	n.a.	27,193	n.a.	14.1%	n.a.
1988	17,662	8.6%	99,924	12.1%	17.7%	2	2007: 1st qtr.*	3,406	-10.9%	25,908	-4.7%	13.1%	n.a.

Notes: * - Ohio data from Ohio Steel Council, U.S. data from International Iron and Steel Institute (2007); n.a. - not available.

Sources: American Iron and Steel Institute (1970-2004), International Iron and Steel Institute (2007), Ohio Steel Council (2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Telephone 614/466-2116 (DL, 9/07).

Table A10: Value-Added by Group in Ohio and the U.S., 1997-2005
(in millions of current dollars, except percentages)

	Ohio Industry Group			U.S. Industry Group			Ohio as a Percent of U.S.		
Year	Subtotal	3311	3312	Subtotal	3311	3312	Subtotal	3311	3312
1997	$6,924.7	$5,861.7	$1,063.0	$32,194.4	$25,432.0	$6,762.4	21.5%	23.0%	15.7%
1998	$6,728.0	$5,705.4	$1,022.6	$30,989.0	$24,416.1	$6,572.9	21.7%	23.4%	15.6%
1999	$5,488.6	$4,393.5	$1,095.1	$28,277.4	$21,859.9	$6,417.5	19.4%	20.1%	17.1%
2000	$5,499.7	$4,165.5	$1,334.1	$27,308.6	$20,629.1	$6,679.5	20.1%	20.2%	20.0%
2001	$3,530.5	$2,517.7	$1,012.8	$20,426.6	$14,748.7	$5,677.9	17.3%	17.1%	17.8%
2002	$3,589.7	$2,409.5	$1,180.2	$24,251.6	$18,533.4	$5,718.2	14.8%	13.0%	20.6%
2003	$2,611.1	$1,631.3	$979.8	$22,648.3	$17,600.3	$5,047.9	11.5%	9.3%	19.4%
2004	$4,648.4	$3,656.2	$992.2	$39,210.5	$32,330.7	$6,879.8	11.9%	11.3%	14.4%
2005	$6,181.7	$4,883.3	$1,298.3	$40,116.6	$32,932.8	$7,183.8	15.4%	14.8%	18.1%
Average 1997-2005							17.0%	16.9%	17.5%

Note: 3311 - Iron and steel mills and ferroalloys; 3312 - Steel product manufacturing from purchased steel.

Source: U.S. Bureau of the Census (2003a, 2005a, 2006a).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Telephone 614/466-2116 (DL, 7/07).

Table A11: Capital Expenditures by Group in Ohio and the U.S., 1997-2005
(in millions of current dollars, except percentages)

	Ohio Industry Group			U.S. Industry Group			Ohio as a Percent of U.S.		
Year	Subtotal	3311	3312	Subtotal	3311	3312	Subtotal	3311	3312
1997	$435.9	$347.8	$88.1	$3,207.3	$2,673.7	$533.5	13.6%	13.0%	16.5%
1998	$545.1	$434.6	$110.5	$3,149.5	$2,632.2	$517.3	17.3%	16.5%	21.4%
1999	$539.7	$451.9	$87.8	$2,705.6	$2,265.5	$440.1	19.9%	19.9%	19.9%
2000	$490.0	$402.9	$87.2	$2,572.7	$2,104.0	$468.7	19.0%	19.1%	18.6%
2001	$286.9	$211.4	$75.5	$1,778.1	$1,365.0	$413.1	16.1%	15.5%	18.3%
2002	$242.3	$143.4	$98.8	$1,743.3	$1,332.5	$410.7	13.9%	10.8%	24.1%
2003	$284.1	$154.1	$130.1	$1,359.6	$937.9	$421.8	20.9%	16.4%	30.8%
2004	$312.9	$255.5	$57.4	$1,938.3	$1,489.9	$448.4	16.1%	17.1%	12.8%
2005	$278.4	$226.2	$52.2	$2,162.9	$1,802.5	$360.4	12.9%	12.6%	14.5%
Average 1997-2005							16.6%	15.8%	19.6%

Note: 3311 - Iron and steel mills and ferroalloys; 3312 - Steel product manufacturing from purchased steel.

Source: U.S. Bureau of the Census (2003a, 2005a, 2006a).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Telephone 614/466-2116 (DL, 7/07).

Table A12: U.S. Exports, Imports and Apparent Supply of Steel Mill Products, 1969-2006
(in thousands of net tons, except percentages)

Year	Exports	Imports	Balance of Trade	Total Net Shipments	Exports as Percent of Total Net Shipments	Apparent Supply	Imports as Percent of Apparent Supply	Year	Exports	Imports	Balance of Trade	Total Net Shipments	Exports as Percent of Total Net Shipments	Apparent Supply	Imports as Percent of Apparent Supply
1969	5,229	14,034	-8,805	93,877	5.6%	102,682	13.7%	1988	2,069	20,891	-18,822	83,840	2.5%	102,662	20.3%
1970	7,062	13,364	-6,302	90,798	7.8%	97,100	13.8%	1989	4,578	17,321	-12,743	84,100	5.4%	96,843	17.9%
1971	2,827	18,304	-15,477	87,038	3.2%	102,515	17.9%	1990	4,303	17,169	-12,866	84,981	5.1%	97,847	17.5%
1972	2,873	17,681	-14,808	91,805	3.1%	106,613	16.6%	1991	6,346	15,845	-9,499	78,846	8.0%	88,345	17.9%
1973	4,052	15,150	-11,098	111,430	3.6%	122,528	12.4%	1992	4,288	17,075	-12,787	82,241	5.2%	95,028	18.0%
1974	5,833	15,970	-10,137	109,472	5.3%	119,609	13.4%	1993	3,968	19,501	-15,533	89,022	4.5%	104,555	18.7%
1975	2,953	12,012	-9,059	79,957	3.7%	89,016	13.5%	1994	3,826	30,066	-26,240	95,084	4.0%	121,324	24.8%
1976	2,654	14,285	-11,631	89,447	3.0%	101,078	14.1%	1995	7,080	24,409	-17,329	97,494	7.3%	114,823	21.3%
1977	2,003	19,307	-17,304	91,147	2.2%	108,451	17.8%	1996	5,031	29,164	-24,133	100,878	5.0%	125,011	23.3%
1978	2,422	21,135	-18,713	97,935	2.5%	116,648	18.1%	1997	6,036	31,157	-25,121	105,858	5.7%	130,979	23.8%
1979	2,818	17,518	-14,700	100,262	2.8%	114,962	15.2%	1998	5,520	41,520	-36,000	102,420	5.4%	138,420	30.0%
1980	4,101	15,495	-11,394	83,853	4.9%	95,247	16.3%	1999	5,426	35,731	-30,305	106,201	5.1%	136,506	26.2%
1981	2,904	19,898	-16,994	88,450	3.3%	105,444	18.9%	2000	6,529	37,957	-31,427	109,050	6.0%	140,477	27.0%
1982	1,842	16,663	-14,821	61,567	3.0%	76,388	21.8%	2001	6,144	30,080	-23,936	98,940	6.2%	122,876	24.5%
1983	1,199	17,070	-15,871	67,584	1.8%	83,455	20.5%	2002	6,009	32,686	-26,677	100,000	6.0%	126,677	25.8%
1984	980	26,163	-25,183	73,739	1.3%	98,922	26.4%	2003	8,220	23,125	-14,906	105,974	7.8%	120,880	19.1%
1985	932	24,256	-23,324	73,043	1.3%	96,367	25.2%	2004	7,933	35,808	-27,875	111,384	7.1%	139,259	25.7%
1986	929	20,692	-19,763	70,263	1.3%	90,026	23.0%	2005	9,393	32,109	-22,715	103,474	9.1%	126,189	25.4%
1987	1,129	20,414	-19,285	76,654	1.5%	95,939	21.3%	2006	9,728	45,272	-35,545	108,609	9.0%	144,154	31.4%

Notes: Balance of Trade = Exports - Imports; Apparent supply (equivalent to domestic consumption) = Total net shipments - Exports + Imports.

Sources: American Iron and Steel Institute (1974, 1978, 1982, 1989, 1992, 1996, 1998); Larkin (2007).

Prepared by: Office of Strategic Research, Ohio Dept. of Development. Telephone 800/848-1300, or 614/466-2116 (DL, 8/07).

Table A13: Projections of Iron and Steel Employment by Group*, Ohio and the U.S.: 2004-2014

NAICS Code	Shorter Industry Title	Jobs: Actual 2004	Jobs: Projected 2014	Changes: 2004-2014 Number	Changes: 2004-2014 Percent
Ohio	Total	5,822,100	6,247,900	425,800	7.3%
31-33	Manufacturing	824,000	746,300	-77,700	-9.4%
3311-2	Iron & Steel Subtotal	23,000	19,200	-3,800	-16.5%
3311	Iron & Steel Mills & Ferroalloys	13,600	11,100	-2,500	-18.4%
3312	Steel Products from Purchased Steel	9,400	8,100	-1,300	-13.8%
3315	Foundries*	17,900	14,200	-3,700	-20.7%
U.S.	Total	145,612,300	164,539,800	18,927,500	13.0%
31-33	Manufacturing	14,329,600	13,553,300	-776,300	-5.4%
3311-2	Iron & Steel Subtotal	156,200	135,300	-20,900	-13.4%
3311	Iron & Steel Mills & Ferroalloys	95,400	80,300	-15,100	-15.8%
3312	Steel Products from Purchased Steel	60,800	55,000	-5,800	-9.5%
3315	Foundries*	165,400	127,800	-37,600	-22.7%

Note: * - Projections have not been made for ferrous metal foundries (NAICS 33151). Consequently, projections for iron and steel industry totals are not possible. However, ferrous metal foundries are about 56% of all foundry jobs (U.S. Bureau of the Census, 2007). Therefore, it seems probable that employment in ferrous metal foundries also will decline.

Sources: Berman (2005), ODJFS-BLMI (2006), U.S. Bureau of the Census (2007).

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Industry Definition and Examples of Products

Beginning in 1997, the nation's industry statistics have been collected under the North American Industry Classification System (NAICS) (Office of Management and Budget, 2002). Establishments producing goods or services sufficiently alike are classified in the same *industry*, and assigned a six-digit code number. Closely related industries form an *industry group*. The first four digits of the industry code indicate the group to which the industries belong. In this report the iron and steel industry is defined as the combination of two groups and a subgroup: *iron and steel mill and ferroalloy manufacturing* (NAICS 3311), *steel product manufacturing from purchased steel* (3312), and *ferrous metal foundries* (33151). (A five-digit code defines a *subgroup* when it subsumes more than one six-digit code; otherwise, it defines an industry.) Definitions and examples of specific industry products follow.

3311	Iron & Steel Mills & Ferroalloys.
33111	Iron & Steel Mills & Ferroalloys.
331111	Iron & Steel Mills. Activities include the direct reduction of iron ore, producing pig iron, and/or converting pig iron into steel. Steel products such as bars, pipes, plates, rods, sheets, strips, tubes, and wire are included if they are made at the same establishment where the steel is produced are included. Likewise, coke ovens may be included if they are part of the same establishment; otherwise, they are classified elsewhere.
331112	Electrometallurgical Ferroalloy Products. Activities include the production of elements added to molten steel to alter or improve the characteristics of steel. (See alloy steels in the glossary.) Non-ferrous alloy manufacturing is classified elsewhere. Electrometallurgical refers to either the application of electric current for electrolytic deposition or the use of electric current as a source of heat in smelting or refining metals. The actual production of electrometallurgical steel is classified in 331111.
3312	Steel Products from Purchased Steel. Products in this group are not made at the same establishment where the raw iron or steel is produced.
33121	Iron & Steel Pipes & Tubes from Purchased Steel. Examples include welded, riveted, and seamless pipes and tubes.
33122	Rolling & Drawing Purchased Steel.
331221	Rolled Steel Shapes. Activities include rolling and drawing shapes such as plates, sheets, strips, rods and bars from purchased steel. Drawing wire is classified in 331222.
331222	Steel Wire Drawing. Establishments in this industry draw wire from purchased steel. Making wire products such as nails, spikes, and paper clips from purchased steel is classified in fabricated metal products (332).
33151	Ferrous Metal Foundries. Establishments in this sub-group pour molten iron and steel (that they purchased) into molds of a desired shape to make castings. They may also perform further operations such as cleaning and deburring, but activities such as threading or machining that transform castings into more-finished pro-

ducts would lead to classification outside of the industry. Foundry operations at the same establishment where the iron or steel is first made – i.e., with iron and steel not purchased – are classified in 331111.

331511 Iron Foundries. Establishments in this industry melt and pour into molds the pig iron or iron alloys that they have purchased. Examples of products include manhole covers, cast-iron pipes, and cast-iron skillets.

331512 Steel Investment Foundries. Investment foundries create seamless molds by covering a wax shape with refractory slurry. The wax is melted and drained after the slurry hardens. Highly detailed and consistent castings may be made from such molds.

331513 Steel Foundries (exc. Investment). Non-investment castings of purchased steel.

Glossary

Iron and steel terms, presented in approximate order of the primary production process:

Iron ore – rocks or deposits of iron (Fe) compounds. Hematite (Fe_2O_3) is an example.

Directly reduced iron (DRI) – iron ore reduced to the solid metallic state by heating it without melting it. Natural gas usually is the refining agent. 90% to 95% iron, it is a substitute for scrap, used when scrap prices are high. Iron carbide (Fe_3C) and hot briquetted iron are other examples of scrap substitutes.

Coke – derived by baking coal (petroleum-related material may also be used), it is primarily carbon (C); however, other matter and minerals may still be present. Coke supplies the carbon monoxide (CO) to reduce iron ore in a blast furnace and is a heat source for melting the iron. Coke burns hotter than coal.

Fluxes – substances used to promote the reduction of metals. Examples include, but are not limited to, limestone (primarily calcium carbonate ($CaCO_3$), secondarily magnesium carbonate ($MgCO_3$)), dolomite ($CaMg(CO_3)$), lime (an oxide of calcium) and fluorite (CaF_2).

Blast furnace – a furnace operating at $3{,}000^0$F (or higher) for reducing iron ore to pig iron. Air blasted through the fuel increases the combustion rate.

Pig iron – an iron-based product with a carbon content greater than 1.7% but less than 5%.

Slag – a non-metallic product resulting from the interaction of fluxes and impurities in the smelting and refining of metals. Slag is separated from molten steel and solidified outside the mill. It may eventually be recycled into things such as concrete building blocks.

Basic oxygen process (BOP) – making steel from molten pig iron and scrap with fluxes and oxygen (O_2) that is 99% pure to reduce carbon, phosphorus (P) and Sulfur (S) to specified levels without introducing nitrogen (N_2) or hydrogen (H_2).

Electric arc (EA) furnace – a furnace wherein materials are melted by passing an electric current through them, permitting the close control and addition of alloying elements.

Steel – an iron-based product with a carbon content of 1.7% or less.

Carbon steel – the world's most common steel; its properties depend on the specific carbon content and microstructure. Steel with carbon content greater than .5% is considered high-carbon steel.

Alloy steels – steels with elements added to alter or improve their properties. Examples include chromium (Cr – at least 10%) and nickel (Ni) to produce stainless steel (which resists corrosion), and silicon (Si) to reduce energy loss in electrical steel. Other important elements used in alloy steel and high-strength-low-alloy steels are molybdenum (Mo), niobium (Nb), tungsten (W) and vanadium (V) for luster, strength, toughness, wear and/or corrosion resistance.

Raw steel – molten steel before it has been shaped or rolled, including the primary production of steel from iron ore with the BOP and steel produced by recycling in EA furnaces.

Net ton – 2000 pounds; a long ton is a metric ton (1,000 kg.), or about 2,204.6 pounds.
Semi-finished steel – the unrolled basic shapes of billets, blooms and slabs.
- **Billet** – a square or rectangular shape.
- **Bloom** – a square or rectangular shape larger than a billet.
- **Slab** – usually 8-to-10 inches thick, and wider than a bloom. An intermediate slab may be 4-to-6 inches thick, while a thin slab may be 1.5-to-2 inches thick.

Rolling – reducing or changing the cross-sectional area of a work-piece by the compressive forces of rotating rolls. The process is similar to squeezing clothes through the wringers of an old fashion washing machine.
- **Flat rolled** – processed on rolls with smooth faces, as opposed to grooved or cut faces used for structural or shaped products. Common products include sheets, strips and plates.
- **Cold rolled** – processed without first reheating the steel. Cold rolling produces a smooth surface and makes the piece easier to machine.
- **Hot rolled** – processed after it has been reheated.

Finished steel products include, but are not limited to:
- **Bars** – shaped and rolled into various forms from billets, one of the industry's highest volume class of products.
- **Structural shapes** – one example is an I-beam rolled and shaped from a bloom.
- **Sheets** – flat rolled from slabs, wider than 12 inches, far and away the single largest class of products (by volume) of the industry.
- **Strips** – flat rolled from slabs, less than 12 inches wide, but with a more precise control of thickness.
- **Plates** – flat rolled from slabs, thicker and heavier than sheets, a higher-volume class of products, primarily used in the construction and heavy machinery industries.

Near net shape casting – casting iron or steel in a thin and intricate-but-strong form that eliminates or reduces machining requirements before use or installation of the product.
Annealing* – heating and cooling steel to improve formability and surface durability.
Pickling* – removing oxide or mill scale from the surface by immersion in an acidic or alkaline solution in preparation for further processing.
Galvanizing* – coating steel with a layer of zinc (Z) for corrosion resistance.
Slitting* – passing a sheet or strip of steel through rotary knives as part of further processing; often performed at steel service/distribution centers.

* - These activities are not classified under NAICS codes 3311, 3312, or 33151.

A Primer on Iron and Steel Production Processes

There are two basic types of steel mills: primary producers and minimills. Producing pig iron is the first step of the primary steel making process. Iron ore pellets, limestone and coke are loaded into a blast furnace. The heat melts the ore and the limestone. Two general chemical reactions occur: the carbon from the coke removes the oxygen from the ore, and the limestone removes some impurities. (The result of the latter is called slag, and is removed from the blast furnace.[14]) The molten pig iron is transferred to a basic oxygen process (BOP) furnace where contaminants such as phosphorus and sulfur are removed, and carbon, manganese and silicon are either removed or reduced to specified levels. Ferrous scrap, directly reduced iron (DRI), and fluxes may be combined with molten pig iron in this stage of steel making. The defining characteristic of steel is that its carbon content is no greater than 1.7%. Annual production capacities of primary producers typically range from two to four million net tons (Gnidovec, 2003; Larkin, 1994, 1995, 2005; Miller, 1984).

By contrast, minimills neither produce pig iron nor use it as a raw material. They melt ferrous scrap (and, occasionally, DRI) with fluxes in electric arc (EA) furnaces.[15] The capacity of one minimill typically ranges from 150,000 to 400,000 tons per year. (The capacity of a minimill company, though, may be tens of millions of tons.) Historically, primary producers located near their raw material. Minimills locate near their clients because ferrous scrap is ubiquitous (Larkin, 1994, 1995, 2007; Miller, 1984). EA furnaces also are used by both primary producers and minimills to control the addition of various elements when creating alloy steels (Parker, 1984). The elements add desired characteristics such as luster, strength, toughness, wear- and/or corrosion-resistance.

The technology of iron and steel production has changed over the decades. By 1992, BOP furnaces completely replaced the less efficient open-hearths for primary steel production, and the majority of all raw steel production in America now comes from minimills (American Iron and Steel Institute, 1970-2004; Larkin, 2007: 19). The practice of pouring molten iron or steel into ingots for cooling – and then sending the ingots to a breakdown mill for reheating and further processing – has almost disappeared. Nowadays, almost all raw steel is continually cast; i.e., it is poured into a water-cooled mold, and then drawn down through a series of rolls and water sprays, yielding slabs, billets and blooms in a single step. This saves time, energy and money, and creates a better product. Rolling mill machinery is used to further work such semi-finished steel into finished products: slabs are processed into plates, sheets and strips; billets into bars, rods, and tube rounds; and blooms into structural shapes and rails (Larkin, 1994, 1995, 2007; Miller, 1984). Starting in the late 1980s, a related development allowed molten steel to be squeezed to initial thicknesses of 1.5 to 2.0 inches. This thin slab- and strip-casting technology eliminated the intermediate step of reducing stands working on conventional 8- to 10-inch slabs (Larkin, 2007: 9-10), again saving time, energy and money.

NOTES:

1 Other motor vehicle companies may have foundry operations in the state, but the final product of their establishments is an engine. Such establishments are classified in NAICS 336312 if they make gasoline engines or 333618 if they make diesel engines. Classifying establishments with foundries based on their end products – i.e., castings that are subject to further manufacturing technologies *at the same plant* after emerging from the foundries – underestimates the importance of foundry operations in the economy.

2 Ryerson's J & F Steel is counted among the 13 Fortune companies and included in table A1, but is omitted from the text list by this criterion. Similar establishments from other companies are listed only in table A1.

3 The figures for 2004 exclude three announced coke oven projects valued at $504 million with 199 more possible jobs. Coke ovens are excluded from the iron and steel industry if they are not part of the iron smelting complex (OMB, 2002).

4 Value-added is approximately equal to the value of shipments minus the cost of materials and labor. Although value-added still includes the costs of services purchased by the establishment, it is closer to the industry's net contribution to the economy than the value of shipments.

5 Almost all of the employment figures for the counties with industry establishments should be regarded as more or less rough estimates because the U.S. Bureau of the Census (2007) does not disclose precise figures if doing so would violate the confidentiality of respondents. The Bureau merely provides range(s) encompassing the jobs figure(s) for the establishment(s) in the county under such circumstances. The figures in the text and table A6 are the result, at least in part, of an estimation technique thought to be fairly accurate on average, except when data from Harris (2005) could reasonably be incorporated. It should also be noted that the Defiance figure is now 1,454.

6 Undoubtedly LTV's bankruptcy played a significant role in the industry's job losses in Ohio as well as across the nation. Employment reductions at General Motors' casting plant were part of the net loss in iron foundries.

7 To some degree, the relative importance of imports reflects the relative importance of exports because of the mathematical relationship between the two. Apparent supply is calculated by subtracting exports from total shipments and then adding imports. Consequently, as exports increase, imports will, *ceteris paribus*, become a larger portion of apparent supply.

8 Service/distribution centers are predominantly wholesale and warehouse operations that slit and sell steel mill products to a variety of customers (Office of Management and Budget, 2002).

9 For that reason, it is no longer entirely accurate to refer to the companies as integrated; “primary producers” is probably a more accurate description because their product is steel smelted from iron ore.

10 The choice between iron, steel, aluminum, plastics or ceramics turns on the consideration of many factors: costs (of the material, the tooling, and the labor to make the product), weight, aerodynamic qualities, production speed, surface finish and paintability, ease of recycling, operating temperature, and corrosion resistance. The advantages of iron and steel are ease of recycling, the ability to operate in high temperature environments, surface finish, and paintability. Steel can be made corrosion resistant, but it becomes more expensive (Larkin, 2005).

11 Larkin (2005) states that companies divesting their coke ovens did so because they were unwilling to make the financial investments to meet the 1990 Clean Air Act Amendment requirements.

12 In the past, companies such as LTV and Wheeling-Pittsburgh Steel that entered bankruptcy were not acquired by other steel companies because they retained their liabilities for pension and health care benefits (Larkin, 2005).

13 Mittal was required by the Justice Department to sell its Sparrows Point facility before final approval of its merger with Arcelor. This means that antitrust concerns will limit the consolidation of the industry. Esmark, the company which bought Wheeling-Pittsburgh Steel, bought the facility. Sparrows Point will supply slabs to Wheeling-Pittsburgh for further processing (Matthews, 2007a).

14 Slag is mostly lime, silica, and alumina. While it is a byproduct of smelting and refining metals, it becomes an ingredient for other things – mostly road bases and concrete products for road surfaces. It is also spun into mineral wool for insulation, and used in sandblasting, railroad ballast, highway fill, and filters at sewage treatment plants (Gnidovec, 2003).

15 Slag is also produced in BOP and EA furnaces. Again, it is a byproduct of flux use (Gnidovec, 2003).

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