APPENDIX 3A. CORE STEEL MARKET ANALYSIS

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APPENDIX 3A. CORE STEEL MARKET ANALYSIS

Core steel is one of the major cost drivers of a distribution transformer and is fundamentally linked to the efficiency of the finished transformer. When looking at the impact of energy conservation standards on the distribution transformer industry, it is therefore important to understand the core steel market.

Starting in late 2003, transformer manufacturers began to experience increases in the price of core steel. While prices vary across the industry (i.e., generally based on the volume of an order and negotiated contracts), some manufacturers have witnessed approximately a doubling in the core steel prices in 2005, as compared with 2002.

After publishing its advance notice of proposed rulemaking (ANOPR) in July 2004 and during its manufacturer impact analysis (MIA) interviews in May 2005 (see Chapter 12), the Department received comments about the recent rapid increase in core steel prices. The two main issues raised were: 1) the cost-effectiveness of higher standards given higher core steel prices, and 2) the availability of sufficient quantities of higher grade steels needed to manufacture more efficient transformers. These issues were raised again by stakeholders in response to the DOE's notice of proposed rulemaking (NOPR), published in August 2006.

To address these comments and concerns, the Department studied the electrical core steel market, seeking to understand what has recently occurred and to gain insight into the permanence of these changes. In conducting this study, the Department reviewed publicly available reports, press-releases, and articles pertaining to both the steel industry and the global core steel market. The Department also consulted with the two U.S. core steel manufacturers, several core steel processing companies, and transformer manufacturer purchasing managers. Finally, the Department conducted additional engineering and life-cycle cost analyses using material prices from the first quarter of 2005 to understand how the higher material prices might impact the cost effectiveness of the standard levels being considered (see Appendix 5C).

Section 3A.1 of this appendix provides background on the U.S. and international core steel markets and U.S. import/export data. Section 3A.2 describes the current global core steel market. Section 3A.3 presents U.S. electrical steel pricing data. Finally, section 3A.4 provides views from industry experts concerning the longevity of current electrical steel pricing levels.

3A.1 INTRODUCTION

Energy-efficient, grain-oriented electrical steel is a unique product. It has a high silicon content, which complicates its manufacture. It has to be carefully processed, rolled to the correct thickness, and heated and cooled at controlled rates to facilitate the growth of steel grains. Globally, grain-oriented electrical steel is consumed at an annual rate of about 1.6 million tons,

representing just a fraction of one percent of the global steel market. It is, essentially, a highly specialized niche-market product that is essential for the production of distribution transformers.

3A.1.1 U.S. Steel Market History

The U.S. steel market has experienced volatility over the last two decades. During the 1980s and the 1990s, mills were closed, and producers reduced their workforce and capacity, while investing in new steel processing technologies. This restructuring resulted in productivity increases, with the U.S. emerging as a world leader in low-cost steel production. Prosperity in the steel industry continued through 1996 as capacity and demand increased.

However, in 1997 the steel market began to change as imports increased to meet the growing U.S. demand. Steel imports increased seven percent from 1996 to 1997, in part due to the relative strength of the dollar in the late 1990s.[1] In 1998 the change was noticed as hot rolled steel imports increased by 70 percent, prices dropped nearly 20 percent, capacity utilization rates decreased to 75 percent, and six steel companies declared bankruptcy.[2] The "1998 steel import crisis" was caused in part by the Asian financial crisis that began in 1997, in which the currencies of several countries plummeted, in concert with sharp declines in steel consumption in these countries.[1]

The years 1998, 1999, and 2000 were the three highest import years in U.S. steel history, driving down prices. Imports for several major product lines, including rebar, coiled plates, and cold rolled steel, continued to increase and some U.S. producers were forced to declare bankruptcy. The high value of the U.S. dollar during that time period contributed to the crisis.

Since this time, the U.S. steel market, and more specifically the US electrical steel market, has experienced pressure from several other directions. The demand in China and India for high-efficiency, grain-oriented core steel is limiting availability to the rest of the world and driving up prices. Combined with cost-cutting programs and technical innovation at their respective facilities, the lower value of the U.S. dollar in recent years has enabled domestic core steel suppliers to become globally competitive exporters.

3A.1.2 U.S. Electrical Steel Market Key Players

There are two domestic manufacturers of grain-oriented electrical steels, AK Steel and Allegheny Ludlum. Both companies produce grain-oriented electrical steel for domestic use and export. AK Steel is the only domestic producer of non-oriented electrical steel, sometimes used in low-cost stacked cores. AK Steel is also the only domestic producer of high-permeability, domain-refined (laser-scribed) core steel, used in high-efficiency stacked cores.

AK Steel, founded in 1899 and headquartered in Middletown, Ohio, employs more than 8,400 people in Ohio, Kentucky, Indiana, and Pennsylvania. The company, with over $5 billion

in sales, produces flat-rolled carbon, stainless, and electrical steel products. AK Steel produces a range of electrical steels, including oriented steel grades of M2, M3, M4, M5 and M6, non-oriented standard steel grades of M15 to M47, and domain-refined, laser-scribed steels, H-O DR, H-1 DR, and H-2 DR.[3]

Allegheny Ludlum Corporation, headquartered in Pittsburgh, PA, operates specialty metals manufacturing facilities in Pennsylvania, Connecticut, Massachusetts, Indiana, and Ohio. Allegheny Ludlum employs approximately 3,800 people, and in addition to its other stainless and specialty steel products, produces grain-oriented steel with grades from M2 to M6.[4]

Other key players in the U.S. core steel market include core steel wholesalers and processors. National Materials LP, an electrical steel processing and distribution company, has locations in Pennsylvania, Illinois, California, and Mexico, and provides U.S. transformer manufacturers with both grain-oriented and non-oriented slit core steel. Tempel Steel Company, located in Chicago, Illinois, produces shunt and cut core sections and E-I laminations. The Ontario, Canada plant of Cogent Power, Inc., a joint venture between two international steel manufacturers, produces finished wound and stacked transformer cores and slits core steel for U.S. transformer manufacturers.

3A.1.3 International Electrical Steel Market Key Players

In addition to the two domestic producers, AK Steel and Allegheny Ludlum, there are six major international companies producing grain-oriented electrical steel. These companies are Nippon Steel and JFE Steel Corporation in Japan, Duferco Viz Stal Metallurgical Plant and Novolipetsk Metallurgical Plant in Russia, Wuhan Iron and Steel in China, and ThyssenKrupp Steel in Germany and France. Additionally, Cogent Power, Ltd. in the UK, Acesita in Brazil, Posco in South Korea, Stalprodukt S.A. in Poland, and Valcovny Plechu A.S. in the Czech Republic produce grain-oriented electrical steel. All of these players, except Allegheny Ludlum, also offer non-oriented electrical steels.

Nippon Steel produces eight types (each with several grades) of grain-oriented electrical steel and five types of non-oriented electrical steel. JFE Steel produces nine types (each with several grades) of grain-oriented electrical steel and six types of non-oriented electrical steel. Duferco Viz Stal produced 500,000 tonnes of grain-oriented and non-oriented electrical steel from 1999 to 2003. Novolipetsk has an annual capacity of 500,000 tonnes of electrical steel. Wuhan has an annual capacity of 123,300 tonnes of grain-oriented electrical steel and 281,700 tonnes of non-oriented electrical steel. ThyssenKrupp Electrical Steel (TKES) produces grain-oriented steel, while ThyssenKrupp Stahl AG produces non-oriented electrical steel grades. See section 3A.5 at the end of this document for brief profiles on each of these players in the core steel market.

3A.1.4 U.S. Import/Export Data

Since the import crisis of 1998, the Federal government has monitored steel imports more closely. The Steel Import Monitoring and Analysis (SIMA) System[a] was established in 2003 and has recently been extended to operate until March 2009. The system reports amounts and types of steels being imported monthly, the steel value, and the port of entry.

From 2003 to 2004, import penetration dropped one percentage point from 23 to 22 percent. The Specialty Steel Industry of North America, a Washington, DC-based trade association, reports that the U.S. imported 86,702 tons of electrical grade steel in 2004, an eight percent increase over 2003. Also, U.S. consumption of electrical grade steel equaled 396,924 tons in 2004, a two percent increase over 2003.[5] This U.S. consumption total includes core steel for more equipment than simply distribution transformers. However, the Department did prepare an estimate of the total consumption of core steel for distribution transformers by evaluating the shipment and engineering analyses. The Department estimated that approximately 228,000 tons of core steel are used each year for producing distribution transformers in the United States.

On the exporting side, the U.S. shipped 111,022 tons of electrical grade steel outside its borders in 2003. Of this total, 87 percent was grain-oriented electrical steel. The countries of China and India imported over 15 percent of the 96,941 tons of U.S. exported grain-oriented electrical steel in 2003. Over 86 percent of the 14,081 tons of U.S. exported non-oriented electrical steel went to Canada and Mexico.[6]

3A.2 CURRENT GLOBAL ELECTRICAL STEEL MARKET

The Department was informed by a range of experts that the prices of core steel started to increase in 2004 due primarily to three factors:

1. An increase in global demand for grain-oriented electrical steel, particularly in China and India;

2. Higher raw material prices to the core steel manufacturers (e.g., iron ore, scrap steel) and higher processing energy costs; and

3. Value of the U.S. dollar (low value increases cost of imported steel and encourages domestic suppliers to export).

These factors are discussed in the following sections.

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[a] The U.S. Department of Commerce - International Trade Administration's Steel Import Monitoring and Analysis System is available online at <www.ia.ita.doc.gov/steel/license>.

3A.2.1 Asian Steel Consumption

In recent years, Asia's demand in the electrical steel market has become apparent, and the growing continent shows no signs of slowing down. In particular, the countries of China and India, with economic growth rates of 9.5 percent and 8 percent, respectively, have both become large producers and importers of electrical steel as they expand their electrical grids.

China has the largest steel consumption in the world, surpassing the consumption of the United States and Japan, combined, in 2003.[7] Between 1997 and 2003, Chinese steel consumption increased from 100 million tons to around 260 million tons, a 160 percent increase.[8] Electrical steel is of great importance in China, due to the country's increasing energy consumption, concomitant with their strong economic growth. Not only is China putting new transformers into use, they are also replacing older transformers to improve grid reliability. China is seeking higher efficiency, grain-oriented steels to reduce energy losses. Construction of a highly efficient grid will offset some of China's need for generation capacity. This high level of demand in China is causing prices of electrical grade steel to increase. In turn, these high international prices affect core steel pricing and availability in the United States.

Steel consumption has also increased rapidly in India since 1999, when consumption increased 13.6 percent.[9] The International Iron and Steel Institute (IISI) forecasts that steel demand in India will increase 6.2 percent in 2005 and another 6.4 percent in 2006, bringing total 2006 demand to 36.5 million tons.[10] In terms of growth in demand for finished steel, India is expected to remain third in the world over the next two years.[11]

3A.2.2 Core Steel Manufacturer Input Prices

A shortage of raw materials for making steel, particularly iron ore, is contributing to the price increases. The New York Times reports that China's steel production is expected to double between 2004 and 2010; however, their iron ore production is not planned to increase.[12] Sydney-based AME Mineral Economics projects that the traditional iron ore producers in Europe, North America, and Japan will also have flat production; however, production increases are expected in India, Brazil, and South Korea.[13]

In 2004, worldwide production of iron ore was at an all-time high, reaching 1,203 million tonnes, up nine percent from production in 2003.[14] Three companies supply over three quarters of the world’s iron ore: Brazil's Companhia Vale do Rio Doce SA (CVRD) and the Anglo-Australian companies in Australia: Rio Tinto and BHP Billiton. To secure sufficient quantities of iron ore for its growing economy, China is entering into long-term supply contracts with mining companies that supply these raw materials. For example, on February 28, 2005 CVRD announced that the Chinese Iron and Steel Association, made up of 13 steelmakers in

China, contracted to purchase 35.4 million tons of iron ore at a price point 71.5 percent above the previous year's prices.[15]

Coke is another raw material needed for steel production which is in short supply. Within the U.S., the domestic steel depression had caused the closing of many coke production sites, resulting in a 15 percent decrease in U.S. coke production capacity since 2002.[16] A fire in 2003 at the Pinnacle mine in West Virginia started a chain reaction in which US Steel had to curtail shipments to their coke customers, which in turn caused one customer to file for bankruptcy.[17] China, a large producer of coke, has decided to keep much of this material within their borders to meet their growing steel production demand. These factors caused coke prices to rise over 300 percent between 2002 and 2004, from only about $75 per ton to over $350 per ton.[18]

An alternative method to fabricate steel using iron ore and coke is the use of scrap steel. However, prices for iron scrap have also increased in recent months, rising more than 70 percent in 2004 compared to its average price in 2003.[19] The volatile scrap market has caused some steel producers to ask the U.S. Department of Commerce to place limitations on the export of the material. Several large steel producers and many steel-consuming companies formed the Emergency Steel Scrap Coalition in February 2004 and discussed petitioning the Commerce Department for temporary restrictions on U.S. steel scrap exports.[20] However, after the Commerce Department rejected a petition submitted by another group to place temporary restrictions on the export of copper scrap, the Emergency Steel Scrap Coalition began lobbying for the removal of export taxes on steel scrap in Russia and the Ukraine.[21]

These rising raw material prices, in conjunction with high energy prices, have caused large U.S. steel producers to place surcharges on core steel. U.S. electrical steel manufacturers say these surcharges are needed to protect against raw material and energy cost fluctuations. Table 3A.2.1 presents the January 2004–August 2005 electrical steel surcharges implemented by Allegheny Ludlum and AK Steel. Each month these surcharges are adjusted based on the prices of raw materials and energy used to manufacture the products.

Table 3A.2.1 Alloy Surcharge for Electrical Steels ($US/ton)

2004	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Allegheny Ludlum	0	30	90	135	150	120	95	135	240	295	255	315
AK Steel	0	30	90	140	150	110	80	105	240	295	250	260

2005	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Allegheny Ludlum	400	360	340	300	270	285	235	155
AK Steel	400	410	340	295	215	170	200	115

Source: AK Steel and Allegheny Ludlum press releases.

These surcharges have decreased in 2005, as raw material prices have come down. For example, the AK Steel surcharge has decreased 71 percent from January 2005 to August 2005. However, U.S. steel producers anticipate higher raw material prices in the near future. Both Allegheny Ludlum and AK Steel published notices that they are increasing the base price of electrical steel effective August 1, 2005.

3A.2.3 Value of the U.S. Dollar

The value of the U.S. dollar has dropped in recent years against other currencies, affecting the U.S. core steel market. As the value of the dollar declines, the cost of imported core steel paid by domestic transformer manufacturers increases. The cost of raw materials, particularly scrap, to domestic steel manufacturers also increases, creating higher steel prices. Conversely, core steel produced in the U.S. becomes an attractive export, since its cost to foreign consumers is lower. These factors drive up core steel prices paid by U.S. transformer manufacturers.

Table 5E.2.2 illustrates the decrease in value of the U.S. dollar between 2002 (the year in the range between 2000 and 2004 with the least expensive M6 core steel) and 2005. The currency conversion rates are provided with those of several other countries.

Table 3A.2.2 Selected International Currency Rates per U.S. Dollar

	1 Unit / USD		
Currency	**July 2002**	**July 2005**	**Percent Change**
Euro	0.989	0.830	-16%
Chinese Yuan	8.287	8.118	-2%
Japanese Yen	116.590	111.940	-4%
Indian Rupee	48.867	43.585	-11%
Russian Rouble	31.570	28.685	-9%
Canadian Dollar	1.546	1.218	-21%
South Korean Won	1170.100	1034.100	-12%
British Pound	0.636	0.573	-10%

Source: *The Economist* online currency converter, www.economist.com/markets/currency/md_conv.cfm.

3A.3 U.S. ELECTRIC STEEL PRICING

3A.3.1 U.S. Electrical Steel Producers

3A.3.1.1 AK Steel

AK Steel's annual report gives insight into the outlook of the domestic steel market. AK Steel expects that higher average selling prices, due to double-digit price increases negotiated with 90 percent of their contract customers, will more than offset the projected increases in raw material and energy costs. Surcharges were added to steel shipments beginning in February 2004 to mitigate the impacts of rising raw material and energy costs; however, 70 percent of the company's sales in 2004 were made under long-term contracts which did not permit the adjustment of selling prices. In 2005, 50 percent of the company's sales permit these adjustments. Finally, AK Steel entered into multi-year purchase agreements for certain raw materials to help stabilize pricing for their customers in the long term.[22]

On June 30, 2005, AK Steel announced that the price of their glass film and Light CARLITE[b] finished grain-oriented electrical steels will increase 18 percent and prices of TRAN-COR H[c] and Full CARLITE[c] grain-oriented electrical steels will increase 43 percent over current base market prices, effective August 1, 2005. Additionally, the raw material surcharge will continue to be applied to each ton shipped.[23] In absolute terms, the recent decrease in the material surcharge is less than the increase of the electrical steel base price.

3A.3.1.2 Allegheny Ludlum

Allegheny Ludlum also expresses expectations of continued success of their electrical steel products. Following the first quarter of 2005, Allegheny Ludlum stated "the global electrical steel markets for power distribution are looking for added supply as that market gains momentum."[24]

On July 7, 2005, Allegheny announced a 26 percent increase in the base price for grain-oriented electrical steel, beginning on August 1, 2005. The raw material surcharge is to stay in effect and, as with AK Steel, the recent decrease in the material surcharge is less than the increase of the electrical steel base price. The company cited needs for capital investment and profitable growth as reasons for the base price increase.[25]

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[b] Registered trademarks of AK Steel, Middletown, Ohio.

3A.3.2 Steel Pricing

Since demand exceeded supply in late 2003, steel prices, including grain-oriented electrical steel, started to increase. In early 2005, prices of other types of steel have started to decrease, but those of grain-oriented electrical steels have not. Apparently, there are other factors exerting pressure on this market. First, the global demand for electrical steels has increased substantially in the last few years. This demand is particularly strong in China and India. Both countries are purchasing high-quality, low-loss electrical steels, as they upgrade and expand their respective national transmission and distribution networks. This development, coupled with a relatively weak dollar, has contributed to even higher prices for imported electrical steel.

It is important to note that, while made from the same raw materials, the prices of electrical steel do not necessarily follow general steel market trends.

3A.3.3 U.S. Electrical Steel Pricing

The Department contracted Optimized Program Service, Inc. (OPS) to develop material price estimates for the engineering analysis. OPS used data from their own records as well as data provided by transformer manufacturers and material suppliers and wholesalers. Although not all U.S. transformer manufacturers pay the same amount per pound for electrical-grade steels due to varied contract negotiations, these prices are intended to be representative of a standard quantity order for a medium- to large-scale U.S. transformer manufacturer.

Toward the end of 2004, electrical steel prices began to climb, with some grades increasing more than 100 percent by early 2005. Figure 3A.3.1 illustrates the recent price increase for grain-oriented steels.

Non-oriented electrical steels did not exhibit price increases as large as those for the grain-oriented steels, although they did increase about 40 percent on average. Figure 3A.3.2 illustrates the pricing trend for non-oriented electrical steels.

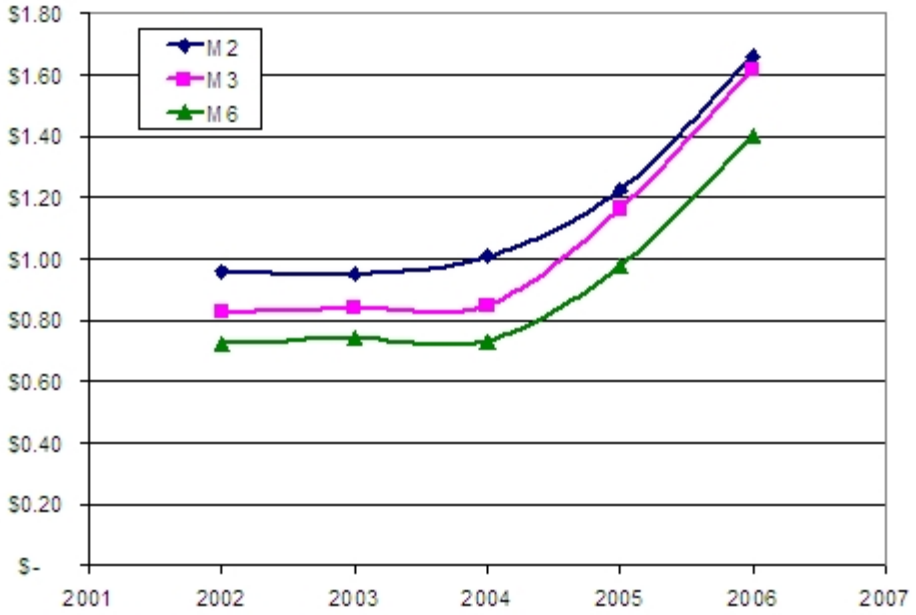

Figure 3A.3.1 Average Annual Prices for Grain-Oriented Steels in the US (2006$/lb)

The engineering analysis also examined three types of specialty electrical steels: ZDMH, SA1, and H-O DR. ZDMH—mechanically-scribed, deep domain-refined core steel—is a patented product manufactured by Nippon Steel Corporation in Japan. The domain refinement is

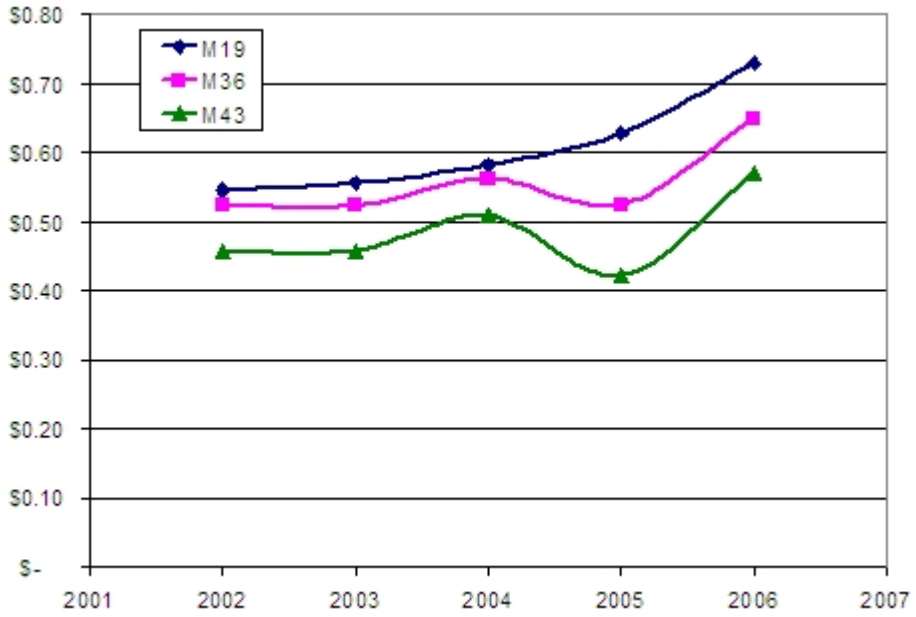

Figure 3A.3.2 Average Annual Prices for Non-Oriented Steels in the US (2006$/lb)

able to survive the annealing furnace; therefore, this steel is used for highly efficient wound cores. SA1, Metglas[c] amorphous material, is highly efficient and is also used in wound-core configurations. H-O DR, the most efficient steel used in stacked core configurations, is manufactured domestically by AK Steel. H-O DR undergoes a laser scribing process that decreases the losses associated with the steel by as much as 10 percent.[26] Figure 3A.3.3 illustrates the historical price trends of these steels from 2002 to 2006. Note that the amorphous material (SA1) represents the cost per pound of a finished core, while the other two steels represent the raw material (ribbon) price.

[c] Registered trademark of Metglas, Inc., a wholly owned subsidiary of Hitachi Metals, Ltd., Tokyo, Japan.

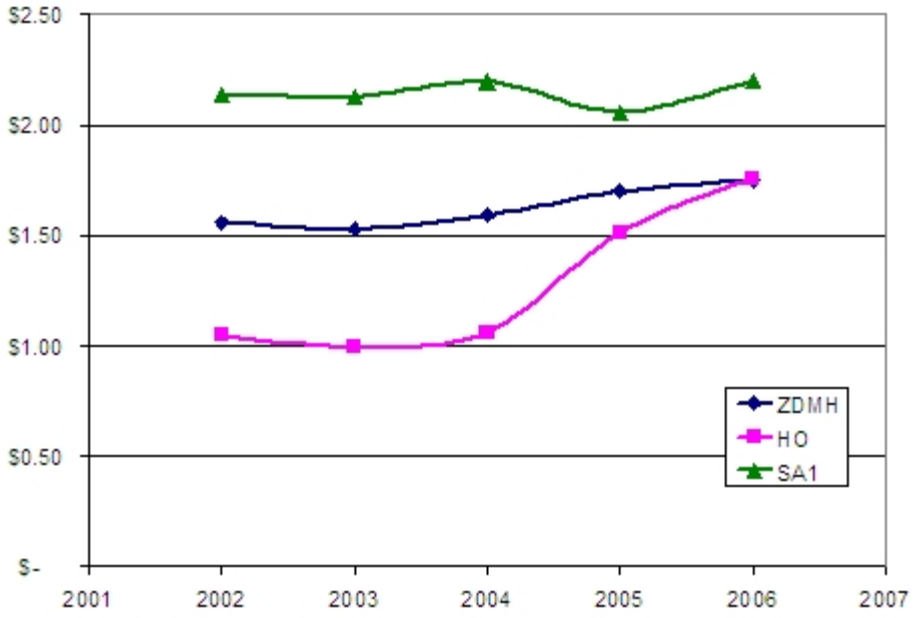

Figure 3A.3.3 Average Annual Prices for Specialty Steels in the US (2006$/lb, note: SA1 is finished core)

Amorphous core material has been in existence for more than 30 years; however, the total worldwide capacity is only 60,000 tons,[27] which is approximately four percent of worldwide grain-oriented, electrical steel consumption. There is one domestic amorphous material supplier, and this supplier does not have the capacity to supply the distribution transformer market. Additionally, there are patents on the material, manufacturing processes, and core construction techniques, making use of amorphous material even more complex.

3A.3.4 The Department's Material Price Sensitivity Analysis

The Department used an average material prices (in constant 2006 dollars) from 2002, 2003, 2004, 2005, and 2006 to determine the five-year average price used in the engineering analysis. The Department was informed that some years in this time period included historical lows for grain-oriented electrical steels, and thus the prices were unsustainable from the standpoint of the companies that produce these steels.

In response to manufacturer comments and concerns about increasing material prices, the Department completed an additional engineering analysis and life-cycle cost assessment using 2006 material prices (see Appendix 5C). OPS gathered the 2006 material prices in the same manner as the five-year average prices, providing consistency to the two pricing scenarios used in the engineering analysis. Table 3A.3.1 presents the five-year average and the 2006 material prices for liquid-immersed distribution transformers, illustrating the price increases that concern U.S. transformer manufacturers.

Table 3A.3.1 Liquid-Immersed Material Prices Used in the Engineering Analyses

Material	**2006** *$/lb.*	**5-yr Avg.** *2006$/lb.*
M2 core steel	$1.66	$1.16
M3 core steel	$1.62	$1.06
M4 core steel	$1.59	$1.02
M6 core steel	$1.40	$0.92
ZDMH (mechanically-scribed core steel)	$1.75	$1.63
SA1 (amorphous) - finished core, volume production	$2.20	$2.14
Copper wire, formvar, round #10-20	$4.99	$2.58
Copper wire, enameled, round #7-10 flattened	$5.28	$2.62
Copper wire, enameled, rectangular sizes	$4.45	$2.80
Aluminum wire, formvar, round #9-17	$1.68	$1.53
Aluminum wire, formvar, round #7-10	$1.71	$1.55
Copper strip, thickness range 0.020-0.045	$3.15	$2.69
Copper strip, thickness range 0.030-0.060	$3.05	$2.61
Aluminum strip, thickness range 0.020-0.045	$2.01	$1.70
Aluminum strip, thickness range 0.045-0.080	$2.12	$1.67
Kraft insulating paper with diamond adhesive	$1.66	$1.65
Mineral oil	$1.82	$1.83
Tank steel	$0.50	$0.44

Likewise, the Department used material prices from 2006 to conduct an additional engineering material price sensitivity analysis for dry-type units. Table 3A.3.2 presents the five-year average and 2006 material prices for dry-type distribution transformers, illustrating the substantial increase raised by transformer manufacturers as a concern.

Table 3A.3.2 Dry-Type Material Prices Used in the Engineering Analyses

Material	2006 *$/lb.*	5-yr Avg. *2006$/lb.*
H-O DR core steel (domain-refined)	$1.76	$1.27
M3 core steel	$1.62	$1.07
M4 core steel	$1.59	$1.02
M5 core steel	$1.55	$0.97
M6 core steel	$1.50	$0.95
M19 core steel (26 gauge)	$0.73	$0.61
M36 core steel (29 gauge)	$0.65	$0.56
M36 core steel (26 gauge)	$0.60	$0.51
M43 core steel (26 gauge)	$0.57	$0.48
Rectangular copper wire 0.1 x 0.2, Nomex	$5.20	$2.87
Rectangular aluminum wire 0.1 x 0.2, Nomex	$1.91	$2.06
Copper strip, thickness range 0.020-0.045	$4.74	$2.99
Aluminum strip, thickness range 0.020-0.045	$2.01	$1.70
Nomex insulation (per pound)	$17.07	$18.14
Cequin insulation (per pound)	$8.50	$11.07
Impregnation (per gallon)	$21.35	$18.57
Winding combs (per pound)	$7.56	$9.47
Enclosure Steel (per pound)	$0.50	$0.44

The Department used the same markup percentages for both engineering analyses, including markups of 2.5 percent for the scrap factor, 4 percent for additional scrap due to the core steel mitering process, 12.5 percent for factory overhead, and 25 percent for non-production costs.

3A.4 ELECTRICAL STEEL MARKET FORECAST

This section presents the views and opinions of steel industry experts, U.S. transformer manufacturers, and U.S. electrical steel manufacturers and distributors concerning the electrical steel market.

3A.4.1 Increased Electrical Steel Pricing Longevity

Predicting future electrical steel prices with any certainty is a large challenge, given the volatility of the market. However, while electrical steel prices may ease in upcoming years as new supply comes on line to meet the expanding global demand, prices are not expected to decrease to the record low levels experienced between 2000 and 2003.

3A.4.1.1 Manufacturer Impact Analysis Findings

During the manufacturer impact analysis, the Department interviewed U.S. transformer manufacturers, U.S. electrical steel manufacturers, and electrical steel processors and distributors. In all of the manufacturer interviews, increasing core steel costs and other raw materials were identified as points of concern.

Electrical steel manufacturers reported that the electrical steel business was not profitable from 2000 to 2003, when prices were low. During this time, no U.S. electrical steel manufacturer reported any capital investment and one U.S. manufacturer, WCI Steel, halted electrical steel manufacturing, citing volume deterioration and negative profit margins.[28]

However, at current pricing levels, both U.S. electrical steel manufacturers, AK Steel and Allegheny Ludlum, project a financially robust electrical steel industry. Upon announcing price increases for grain-oriented electrical steels on June 30, 2005, AK Steel said it expects contract prices to increase as well, citing strong worldwide demand for grain-oriented electrical steel.[23] In early 2005, AK Steel President and CEO James Wainscott reported that, "Our production and sales of electrical steel products in 2004 set all-time company records, breaking marks that had stood for over 30 years. The outlook for electrical steel products looks even better for 2005."[29] Allegheny Ludlum sees building momentum in the electrical steel industry[24] and is also increasing base prices of their electrical steel products, citing the need for capital investment and profitable growth.[25]

U.S. transformer manufacturers are increasingly concerned about the high price of core steel. Some manufacturers have not been able to fully pass these material price increases through to their customers, and their profitability is decreasing. Many manufacturers reported that their material supply contracts are expiring this year, forcing them to renegotiate their core steel contracts at the current, higher prices. Due to these concerns and the predictions of domestic electrical manufacturers, the Department considered the life-cycle costs and payback periods

associated with typical transformers at each candidate standard level using current material prices (Q1 2005).

3A.4.1.2 Historically Low Prices: 2000–2003

The historically low electrical steel prices experienced from 2000 to 2003 are not likely to occur again, according to interviews with industry experts. Increasing demand, particularly in China, and higher material prices will likely ensure that prices stay above this level.

Several transformer manufacturers feel that electrical steel demand has fundamentally shifted over the past several years, largely caused by electrification programs and national grid expansions and upgrades in China and India. Economic growth in these two populous countries contributes to very high electrical energy growth in all sectors. Although China's Wuhan plant is expected to add over 100,000 metric tons of grain-oriented electrical steel production capacity, the demand will continue to surpass the supply. By the end of 2004, China's total installed electric generation capacity reached 440 gigawatts (GW). Total installed capacity is expected to increase by 60–70 GW in 2005, reaching 500–510 million GW by the end of this year.[30] This continued rapid increase in installed electric generation capacity will be accompanied by increases in distribution transformer installation and, ultimately, core steel consumption.

Another reason for increasing electrical steel prices is the rising cost of raw materials used in the production of steel. Some industry experts forecast that certain raw material prices will level out, while other raw materials, particularly iron ore, will continue to increase. AME Mineral Economics predicts iron ore prices will increase 20 percent in 2005, following record high prices in 2004 (an 18.6 percent increase over 2003 prices). Beginning in 2006, strong demand will keep prices elevated, but steel price corrections and new iron ore capacity will permit iron ore prices to ease in real terms. This increase is due largely to the use of blast furnace technology in China, which uses iron ore instead of scrap to produce steel products.[13]

It is impossible to know exactly what prices for electrical steel will be in upcoming years. However, industry experts predict that electrical steel pricing levels will settle at or slightly below current pricing levels in nominal terms, due to these structural changes in the electrical steel market. As new capacity comes online to supply growing demand, electrical steel prices may begin to ease, but the experts who discussed this issue with the Department do not expect they will drop to the historical lows of 2000 to 2003. Industry experts believe that historically low core steel prices are insufficient to maintain core steel suppliers, and could trigger further attrition in this strategically important industry.

3A.5 ELECTRICAL STEEL MANUFACTURER PROFILES

AK Steel

AK Steel, founded in 1899 and headquartered in Middletown, Ohio, employs more than 8,400 people in Ohio, Kentucky, Indiana, and Pennsylvania. The company, with over $5 billion in sales, produces flat-rolled carbon, stainless, and electrical steel products. AK Steel produces a range of electrical steels, including oriented steel grades of M2, M3, M4, M5, and M6, non-oriented standard steel grades of M15 to M47, and domain-refined, laser-scribed steels, H-O DR, H-1 DR, and H-2 DR.

Allegheny Ludlum

Allegheny Ludlum Corporation, headquartered in Pittsburgh, PA operates specialty metals manufacturing facilities in Pennsylvania, Connecticut, Massachusetts, Indiana, and Ohio. Allegheny Ludlum employs approximately 3,800 people, and in addition to its other stainless and specialty steel products, produces grain-oriented steel with grades from M2 to M6.

Nippon Steel

In 1970, Yawata Iron and Steel and Fuji Steel merged to form Nippon Steel. Located in Tokyo, Japan, Nippon Steel has 21,500 employees and produces over 27 million metric tons of crude steel annually. Nippon produces eight types of grain-oriented electrical steel and five types of non-oriented electrical steel.

In 2003, 37 percent of Nippon Steel's exports went to China, while only nine percent went to North America. Another 30 percent was distributed among other Asian regions, nine percent to South America, and eight percent to Europe. The remaining seven percent was disbursed between Africa, the Middle East, and Oceania.[32]

JFE Steel Corporation

Another Japanese company, JFE Steel Corporation, the result of a December 2001 merger between Kawasaki Steel and NKK Corp., produces nine types (each with several grades) of grain-oriented electrical steel and six types of non-oriented electrical steel.

Duferco Viz Stal Metallurgical Plant

The Viz Stal plant was founded in 1726 as a pig iron processing facility. In 1914, the plant become the first producer of hot-rolled, non-oriented steel in Russia. The plant then began producing hot-rolled, grain-oriented steel in 1934. In 1973 the plant began producing cold-rolled, grain-oriented electrical steel, and in 1978 Viz Stal became the first manufacturer of cold-rolled, non-oriented electrical steel in the Soviet Union. Duferco, a Swiss international manufacturing and trading company, acquired the plant. Finally, in 2004, Viz Stal gained the capability to supply their customers with slit coils.

From 1999 to 2003, the Duferco Viz Stal plant produced 500,000 metric tons of grain-oriented and non-oriented electrical steel. Viz Stal is currently the only metallurgical works in the world that specializes exclusively in electrical steels.

Novolipetsk Metallurgical Plant

Novolipetsk (NLMK) started in 1931 when iron ore and limestone deposits were discovered in Lipetsk, Russia. NLMK is now the largest steel sheet producer in Russia. The integrated facility can produce 9.5 million metric tons of pig iron and up to 9.9 million metric tons of steel annually. NLMK also has a capacity of 500,000 metric tons of electrical steel annually.

Cogent Power Ltd.

Corus, an international metal company providing steel and aluminum products worldwide, entered into a joint venture with Svenskt Stal AB (SSAB) to form Cogent Power, Ltd. Corus owns 75 percent of the joint venture, while SSAB owns the remaining 25 percent. Cogent Power Ltd. is divided into an electrical steel division and a laminations division. The electrical steel division is comprised of Orb Works, located in South Wales, and Surahammars Bruk, headquartered in Sweden. Orb Works produces both grain-oriented and non-oriented steels. Surahammars Bruk produces grain-oriented steels M3 through M7, and non-oriented steels in grades M15 through M47.

ThyssenKrupp Steel

ThyssenKrupp Steel, a subsidiary of ThyssenKrupp AG, entered the electrical steel market in 1989. In 2002 ThyssenKrupp Electrical Steel (TKES) was formed to consolidate all of the company's electrical steel activities. Further restructuring in 2004 created ThyssenKrupp Stahl AG to handle the company's non-oriented electrical steel products. TKES now deals solely with grain-oriented steels. ThyssenKrupp produces over one million tons of electrical steel each year, making it the largest electrical steel producer in Europe and the second largest producer worldwide.

ThyssenKrupp Steel is headquartered in Essen, Germany and has plants in Germany, India, and France. EBG India, a joint venture between Thyssen Krupp and Raymond Ltd., is a producer of both grain-oriented and non-oriented steels. EBG India is located in Nashik, India. A plant in Isbergues, France was acquired by TKES in 2002.

China Steel Corporation

China Steel Corporation, the only integrated steel producer in Taiwan, was founded in 1971 and exports nearly 30 percent of its steel production volume. It currently produces four grades of non-oriented electrical steel with a thickness of 0.50 mm.

Pohang Iron and Steel (Posco)

Posco, located in the port city of Pohang, South Korea, was founded in 1958, produces 30 million tons of steel annually, and has more than19,000 employees. In 2004, Posco produced 701,000 metric tons of electrical steel, 34 percent of which was exported.[33] Currently, Posco is investing over $250 million to expand the capacity of their electrical steel production facility. The upgrades began in May 2005 and are expected to continue until March 2007.[34]

Posco recently announced a $12 billion deal in the state of Orissa, located in India. Between 2007 and 2010, $3 billion will be invested in a three million ton plant. Then, from 2010 to 2016, three million additional tons will be added every two years, bringing the plant to a full capacity of 12 million tons. This deal is the largest foreign investment in India.

Shanghai Baosteel

Shanghai Baosteel, formerly Baoshan Iron & Steel, is state-owned and China's largest iron and steel maker. Baosteel and its 22 wholly owned subsidiaries produce over 20 million metric tons of crude steel annually. Baosteel produces nearly 500,000 metric tons of non-oriented electrical steel annually, accounting for more than 50 percent of the non-oriented electrical steel produced in China.

Blue Scope Steel

Blue Scope Steel, a manufacturer specializing in flat steel products, is the leading steel producer in Australia and New Zealand. Ly-Core, Blue Scope's non-oriented electrical steel line, is produced in three grades.

WCI Steel

WCI, a U.S. manufacturer based in Warren, Ohio, produced non-oriented electrical steel, until exiting the business in January 2004. In September 2003, WCI filed for protection under Chapter 11 of the U.S. Bankruptcy Code. WCI management cited continuing volume deterioration and negative profit margins for the halt of silicon steel production.

Wuhan Iron and Steel

Wuhan, a Chinese company with an annual steel production capacity of 10 million metric tons, is expected to add significant electrical steel production capacity beginning in September 2006.

Acesita SA

Acesita SA, a Brazilian company with an annual steel production capacity of 850,000 metric tons, was founded in 1944. Acesita offers two types of grain-oriented electrical steel and three types of non-oriented electrical steel.

Stalprodukt S.A.

In 1992, the Polish company Stalprodukt S.A. purchased two former Sendzimir Steel Works production plants. Stalprodukt S.A. produces both grain-oriented and non-oriented electrical steels.

Valcovny Plechu A.S.

Valcovny Plechu is located in Frydek - Místek, Czech Republic, where steel production first started in 1833. Valcovny Plechu A.S. produces both grain-oriented and non-oriented grades of electrical steel.

REFERENCES

1. U.S. Department of Commerce - International Trade Administration, *Global Steel Trade: Structural Problems and Future Solutions, Chapter 2: The U.S. Steel Import Crisis*, 2000, Washington D.C.

2. Association for Iron & Steel Technology. *Steel Industry Bankruptcies: Bankruptcy filings and other major events, 1998-2003*, 2003. (Last accessed August 8, 2005.) <http://www.steelnews.org/companies/steel_bankruptcies.htm>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

3. AK Steel website, 2005. (Last accessed August 8, 2005.) <www.aksteel.com>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

4. Allegheny Ludlum website, 2005. (Last accessed August 8, 2005.) <www.alleghenyludlum.com>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

5. Specialty Steel Industry of North America. *Specialty Metals Industry Group Releases: Year-End 2004 Market Data*, 2005. (Last accessed on August 8, 2005.) <http://www.ssina.com/news/releases/pdf_releases/3_18_05.pdf>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

6. U.S. Department of Commerce - International Trade Administration, *U.S. Trade Quick Reference Tables: December 2003 Imports* and *U.S. Trade Quick Reference Tables: December 2003 Exports*, 2004. (Last accessed on August 8, 2005.) <http://ita.doc.gov/td/industry/otea/submenu1.html>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

7. China Daily, *China's Steel Consumption Not to Peak Before 2010*, 2004. (Last accessed August 8, 2005.) <http://www2.chinadaily.com.cn/en/doc/2004-01/25/content_300957.htm>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW,

Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

8. Moldmaking Technology, *Steel Update: The Rising Cost of Steel*, 2004. (Last accessed on August 8, 2005.) <http://www.moldmakingtechnology.com/articles/080402.html>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

9. India Infoline, *Steel Demand - Supply Scenario*, 2004. (Last accessed on August 8, 2005.) <http://www.indiainfoline.com/sect/stee/ch03.html>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

10. International Iron & Steel Institute, *IISI Short Range Outlook for Use of Finished Steel Products*, 2005. (Last accessed on August 8, 2005.) <http://www.worldsteel.org/news/85>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

12. Brooke, James. *Asian Scavengers Feed China's Hunger for Steel*, 2004. (Last accessed on August 8, 2005.) <http://www.energybulletin.net/593.html>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

13. Mine Box Online Portal, *AME's Latest Iron Ore Industry Market Update*, 2004. (Last accessed on August 8, 2005.) <http://www.minebox.com/story.asp?articleId=4949>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

14. Baffinland Iron Mines Corporation, *Iron Ore Industry Trends and Analysis*, 2005. (Last accessed on August 8, 2005.) <http://www.baffinland.com/investors/pdf/050510-iron-ore-industry-review-update.pdf>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

15. Companhia Vale do Rio Doce, *CVRD and Baosteel Agreement on 2005 Iron Ore Prices*, 2005. (Last accessed on August 8, 2005.) <http://www.cvrd.com.br/cvrd_us/cgi/cgilua.exe/sys/start.htm?infoid=778&sid=307>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of

Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

16. Krouse, Peter. *Heat Back on Steel Makers*, 2004. (Last accessed on August 8, 2005.) <http://www.cleveland.com/indepth/steel/index.ssf?/indepth/steel/more/1077791716314950.html >. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

17. Davis, Christopher. *Rise in Global Steel Demand May Impact Coke Shortage*, 2004. (Last accessed on August 8, 2005.) <http://www.bizjournals.com/pittsburgh/stories/2004/01/26/story2.html>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

18. EGS Electrical Group, *A Roller Coaster Ride in Today's Metal Market: The Current Shortage and its Financial Impact*, 2004. (Last accessed on August 8, 2005.) <http://www.summit.com/images/PDF/egssteel.pdf>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

19. Allegheny Technologies Incorporated. SEC Form 10-K, for the fiscal year ended December 31, 2004.

20. Wiley, Rein, & Fielding LLP, *Emergency Steel Scrap Coalition Calls for Immediate Action as Scrap Prices Reach New Highs*, 2004. (Last accessed on August 8, 2005.) <http://www.wrf.com/press_release.cfm?press_release_id=1291>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

21. Loeffler, Jonas, & Tuggey LLP, *International Trade Review, Volume II Issue 10*, 2004. (Last accessed on August 8, 2005.) <http://www.loefflerllp.com/ljt/newsevents/TradeRevOct04.pdf>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

22. AK Steel Holding Corporation. SEC Form 10-K, for the fiscal year ended December 31, 2004.

23. AK Steel, *AK Steel Announces Price Increases for Oriented Electrical Steel*, 2005. (Last accessed on August 8, 2005.) <http://www.aksteel.com/news/press_release.asp?doc_id=451>.

This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

24. Allegheny Technologies, *Allegheny Technologies Announces Strong First Quarter 2005 Results*, 2005. (Last accessed on August 8, 2005.) <http://www.investquest.com/iq/a/ati/ne/earnings/ati15.htm>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

25. Allegheny Ludlum, *ATI Allegheny Ludlum Announces Grain-Oriented Silicon Electrical Steel Price Increase*, 2005. (Last accessed on August 8, 2005.) <http://www.alleghenyludlum.com/pages/whatsnew/Silicon%20Price%20Announcement%207-7-05_final.pdf>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

26. AK Steel, *Product Data Bulletin: Oriented and Tran-Cor H Electrical Steels*, 2000. (Last accessed on August 8, 2005.) <http://www.aksteel.com/pdf/markets_products/electrical/Oriented_Bulletin.pdf>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

27. Moses, A. J. "Iron-Based Amorphous Ribbon - Challenges and Opportunity for Power Applications." *Journal of Optoelectronics and Advanced Materials* Vol. 4, No. 2, June 2002, p. 231-236.

28. WCI Steel, Inc. *WCI Steel, Inc. To Idle Silicon Line*, 2003. (Last accessed on August 8, 2005.) <http://www.wcisteel.com/new/112503.html>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

29. Petry, Corinna C. *Carbon Market Remains on a Roll*, 2005. (Last accessed on August 8, 2005.) <http://www.metalcenternews.com/2005/March/MCN0503Flat-Roll.htm>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

30. Asian Times Online, *China's Electric Power Sector Reaches Growth Limit*, 2005. (Last accessed on August 8, 2005.) <http://www.atimes.com/atimes/China/GE05Ad07.html>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.

32. Nippon Steel, *Nippon Steel News No. 321. October 2004*. 2004, Tokyo, Japan: Nippon Steel Corporation.

33. Posco, *Posco 2005 Fact Book*. 2005, Pohang, South Korea: Posco.

34. Posco, *Posco to Actively Invest in Korean Steel Facilities*, 2004. (Last accessed on August 11, 2005.) <http://www.posco.co.kr/homepage/docs/en/info/press/s91c1010025v.jsp>. This material is available in Docket # 83. Contact Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121, telephone (202) 586-2945 for more information.