United States
International Trade Commission

INDUSTRY TRADE AND TECHNOLOGY REVIEW

OFFICE OF INDUSTRIES

USITC Publication 3574

December 2002

PREFACE

The *Industry Trade and Technology Review* (*ITTR*) is a quarterly staff publication of the Office of Industries, U.S. International Trade Commission. The opinions and conclusions contained in this report are those of the authors and are not the views of the Commission as a whole or of any individual Commissioner. The report is intended to provide analysis of important issues and insights into the global position of U.S. industries, the technological competitiveness of the United States, and implications of trade and policy developments.

The information and analysis in this series are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under any statutory authority.

Inquiries or comments on items in this report may be made directly to the author, or to:

Director of Industries
U. S. International Trade Commission
500 E Street, SW
Washington, DC 20436
Fax: 202-205-3161

Industry Trade and Technology Review is posted on the Commission's Internet site at *www.usitc.gov* (Publications). Requests for copies of the *ITTR*, or to be added to the mailing list, should be addressed to the Office of the Secretary, U.S. International Trade Commission, 500 E Street SW, Washington, DC 20436, or by fax: 202-205-2104

Quarterly Review Staff

Larry Brookhart
Karl Tsuji

assisted by

Zema Tucker
Sharon Greenfield

Contributing Authors

Christopher B. Mapes
John T. Cutchin
Judith-Anne Webster

assisted by

David Lundy
Ralph Watkins

Robert A. Rogowsky
Director of Operations

Vern Simpson
Director of Industries

Listing of Published Articles

(September 1998 - December 2002)

Listing of Published Articles—*Continued*

CONTENTS

Page

CONTENTS—*Continued*

Page

Appendix A: Key performance indicators of selected industries and regions

ITC READER SATISFACTION SURVEY

Industry Trade and Technology Review

The U.S. International Trade Commission (USITC) is interested in your voluntary comments (burden less than 10 minutes) to help assess the value and quality of our reports, and to assist in improving future products. Please **return survey by facsimile (202-205-3161) or by mail** to the USITC, or visit the USITC Internet home page (*http://reportweb.usitc.gov/reader_survey/readersurvey.html*) to electronically submit a Web version of the survey.

(Please print; r*esponses below not for attribution):*

Your name and title: ____________________

Organization (if applicable): ____________________

Which format is most useful to you? ❑ CD-ROM ❑ Hardcopy ❑ USITC Internet site

Circle your assessment of each factor below: **SA** = strongly agree, **A** = agree, **N** = no opinion, **D** = disagree, or **SD** = strongly disagree.

Value of this report:					
▶ Statistical data are useful	SA	A	N	D	SD
▶ Other non-numerical facts are useful	SA	A	N	D	SD
▶ Analysis augments statistical data/other facts	SA	A	N	D	SD
▶ Relevant topic(s)/subject matter	SA	A	N	D	SD
▶ Primary or leading source of information on this subject	SA	A	N	D	SD
Quality of this report:					
▶ Clearly written	SA	A	N	D	SD
▶ Key issues are addressed	SA	A	N	D	SD
▶ Charts and graphs aid understanding	SA	A	N	D	SD
▶ References cite pertinent sources	SA	A	N	D	SD

Other preferred source of information on this subject: ____________________

Specify chapters, sections, or topics in report that are most useful: ____________________

____

____

Identify any type of additional information that should have been included in report: ____________________

____

____

Suggestions for improving report: ____________________

____

____

Please update your mailing and electronic addresses below (voluntary)-

Mailing address: ____________________

City, state, and zip code: ____________________

E-mail address: ____________________

OMB No.: 3117–0188

FOLD

UNITED STATES
INTERNATIONAL TRADE COMMISSION
WASHINGTON, DC 20436

OFFICIAL BUSINESS
PENALTY FOR PRIVATE, USE $300

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS   PERMIT NO. 12840   WASHINGTON, DC

POSTAGE WILL BE PAID BY ADDRESSEE

U.S INTERNATIONAL TRADE COMMISSION
500 E STREET, SW.
WASHINGTON, DC 20277-2840

ATTN:
OFFICE OF INDUSTRY
INDUSTRY TRADE AND
TECHNOLOGY REVIEW (ITTR)

Major Contraction of the Domestic Refined Copper Industry

Christopher B. Mapes[1]
cmapes@usitc.gov
(202) 205-3034

Refined copper production in the United States, both from primary (mined) material and secondary (recycled) material, has declined substantially in the past 5 years whereas worldwide production has materially increased. U.S. primary production has fallen by one-fourth and all secondary refined production has ceased. The United States is one of the world's largest consumers of refined copper, using over 2.5 million metric tons in 2001. However, U.S. import reliance has increased by over seventy-five percent in the recent 5-year period on what is considered a crucial material for an industrialized economy. High domestic production costs, declining ore grades, strict U.S. land-use and environmental regulations, expansion of low-cost foreign production, and a slowing global economy all have contributed significantly to the challenges currently faced by the domestic industry. This article examines the domestic refined copper industry's competitive position, its attempts to remain competitive, and the prospects for its future.

For much of 1997-2002, the price of copper[2] remained at historically low values, and at one point fell below 60 cents per pound, the lowest inflation-adjusted value since 1932.[3] This price nadir reflected excessive worldwide inventories accumulating since 1996. Since that year, global production has greatly exceeded worldwide consumption. The events of September 11, 2001, further depressed consumption, reflecting a general downward economic trend that began in 2000.

The low copper price and rising global production caused the U.S. refined copper industry (box 1) to incur substantial financial difficulties. Many primary facilities have been forced to shut down and others have curtailed production. The secondary industry has ceased production. The number of domestic facilities (mines, smelters, and refineries) decreased by 28 percent from 1997 to 2001, whereas U.S. refined copper production declined by 32 percent, and employment declined by 46 percent (table 1).[4] Despite the past characterization

[1] The views expressed in this article are the author's. They are not the views of the U.S. International Trade Commission (USITC) as a whole or of any individual Commissioner.

[2] The London Metal Exchange (LME) spot (cash) Grade A refined copper price (the most widely recognized worldwide benchmark price). Hereafter in this article, this price is used in all cases where price is discussed.

[3] Inflation adjustments are based upon the U.S. Department of Labor, Bureau of Labor Statistics, Consumer Products Index (CPI) inflation calculator found at *http://www.bls.gov/cpi/*. This article refers to nominal (current) dollar or inflation-adjusted (constant) 1990 dollar prices.

[4] This effect is being seen in other base and industrial metals as well. According to the National Mining Association (NMA), total domestic metal mining employment dropped below 50,000 for the first time in 2001.

Box 1
Refined Copper

Background and Uses

Copper's properties—high ductility, malleability, and thermal and electrical conductivity—and decorative appeal, make it a major industrial metal, ranking third after iron and aluminum in terms of quantity of metal consumed. Per-capita consumption in the United States is approximately 25 pounds per year. Copper is the major constituent in many valuable alloys, including brass and bronze. As an electrical conductor, copper is critical in electrical and electronic systems, which account for about three-quarters of total copper use. Building construction is the single largest end-use market, followed by electronics products, transportation, industrial machinery, and consumer and general products. Copper is widely recycled; almost one-half of the copper in use worldwide is derived from recycled copper products.

Production Methods

Primary refined copper originates from mined ore, and is conventionally produced by concentrating ores (i.e., removing waste minerals), smelting the concentrate (i.e., melting and driving off waste elements), and electrolytically refining the smelted product (i.e., dissolving the copper, allowing impurities to separate, and re-depositing the copper). It is also produced by a method in which an acidic solution is percolated through an ore stockpile; this process leaches (i.e., dissolves) the copper out of the ore. The copper solution is then processed into refined copper by solution extraction (i.e., chemically concentrating the solution) and electrowinning (i.e., electrically depositing the copper, similar to the last part of the electro-refining process described before)–the SX-EW process. (Many of the leachable ores were uneconomic until the development of the SX-EW process.) In 2001, conventional processing accounted for 81 percent of world mined copper. Secondary refined copper is produced by feeding used, separated, copper scrap into a smelter, and electrolytically refining the smelter product. Secondary production was 12 percent of the 15.5 million metric ton total 2001 worldwide refined copper production. The refined copper product of all three processes is a 99.999 percent pure cathode sheet.

U.S. Industry Structure

In the United States, companies specialize in refining either primary or secondary copper. The primary producers are principally in Arizona, New Mexico, Texas, and Utah. These producers are integrated upstream with concentrators, smelters, electrolytic refineries, and electrowinning operations near the mines. Certain producers also operate downstream fabricating facilities closer to end-use customers. In 2001, the United States was the second-largest producer of refined copper (12 percent) behind only Chile (19 percent). Phelps Dodge Corp. is the largest U.S. and privately-held world producer, and is second in production to the state-run Corporacion National del Cobre (Codelco) of Chile. Foreign companies operating in the United States include BHP Billiton (Australia), which owns Magma Copper Co.; Grupo Mexico (Mexico), which owns Asarco; and Rio Tinto (United Kingdom), which owns Kennecott Copper Co.

The U.S. secondary refined producers are near major industrial centers in the Southeast (Southwire in Gaston, SC, and Carrollton, GA), Midwest (Cerro in Sauget, IL, and Chemetco in Alton, IL), and Northeast (Franklin, in Philadelphia, PA).

Refined copper, whether from primary or secondary materials, is consumed at downstream plants that produce copper and copper alloy wire or mill products (i.e, plates, sheets, strips, bars, and rods). The major wire and mill products are typically independent of the primary and secondary refined copper industry, and are located throughout the East, Southeast, and Midwest States.

Source: U.S. Geological Survey, Copper Development Association, and World Bureau of Metal Statistics.

Table 1
U.S. refined copper industry: Establishments, employment, production, trade, and consumption, 1997-2001

						Change, 2001 from 1997	
Item	**1997**	**1998**	**1999**	**2000**	**2001**	**Absolute**	***Percent***
	Number of operating establishments						
Mines[1]	20	19	18	16	15	-5	-25
Smelters:							
Primary	7	7	7	4	4	-3	-43
Secondary	4	3	2	2	1	-3	-75
Refineries:							
Primary:							
Electrolytic	6	6	6	5	5	-1	-17
Electrowinning (EW)[2]	15	15	15	14	14	-1	-7
Secondary	2	2	1	0	0	-2	-100
Total	54	52	49	41	39	-15	-28
	Employment (*1,000*)						
Mines	13.2	12.3	10.4	9.1	8.2	-5.0	-38
Smelters and refineries:							
Primary	7.4	6.5	4.9	4.1	3.0	-4.4	-59
Secondary	0.5	0.4	0.3	0.3	0.2	-0.3	-60
Total	21.1	19.2	15.6	13.5	11.4	-9.7	-46
	Production, trade, and consumption (*1,000 metric tons copper*)						
Mine production[3]	1,940	1,860	1,600	1,440	1,340	-600	-31
Primary and secondary smelter production[3]	1,725	1,722	1,295	999	952	-773	-45
Refined:							
Production:							
Primary	2,070	2,140	1,890	1,590	1,600	-470	-23
Secondary	279	232	113	92	0	-279	-100
Total refined production	2,349	2,372	2,003	1,682	1,600	-749	-32
Imports	632	683	837	1,056	991	359	57
Exports	93	86	25	94	23	-70	-75
Apparent consumption[4]	2,888	2,969	2,815	2,644	2,568	-320	-11
Ratio of imports to refined copper consumption (*percent*)	22	23	30	40	39	17	77

[1] Excludes minor mines, which account for approximately 1 percent of production.
[2] Includes solution extraction (SX) facilities.
[3] Contained copper.
[4] Excludes inventory adjustments. Apparent consumption is the sum of production and imports less exports.

Note.–Each mine typically has an associated concentrator and/or solution extraction-electrowinning plant. Certain high-quality copper scrap does not have to be smelted, and is typically upgraded at downstream operations using a simple fire-refining process (statistics for these operations not included in this table).

Source: Compiled from official statistics of the U.S. Geological Survey and the U.S. Department of Commerce.

of copper as a strategic U.S. element,[5] and the Nation's self-sufficiency and ample reserves, import reliance for copper has risen from 22 to 39 percent over the same 5-year period.

A combination of factors has led to this U.S. production decline. Chief among them has been redirection of investment toward discovery and development of primary operations abroad. Foreign production (especially in Chile) has overtaken U.S. production because of accessible, relatively high-grade resources, low-cost (and in some cases highly educated[6]) labor, and pro-investment governmental policies.[7] According to industry sources, U.S. copper production costs and the U.S. mining investment environment now rank among the least competitive in the world despite the high U.S. mineral potential.[8] Declining domestic production in the face of worldwide growth in production underscores this assessment. From 1997 through 2001, 32 percent of domestic refined production has been shut down, whereas worldwide refined copper production has increased by 14 percent. This trend continues in 2002.[9] Operations that have been shut down or cut back are shown in table 2.

The Domestic Refined Copper Industry: Competitive Conditions

The sustained low price of copper is presently the most significant obstacle for both the primary and secondary producers of the U.S. refined copper industry. Typically this price is inversely related to the level of copper inventories. In mid-1993, major commodity exchange inventories began to increase significantly as a result of increasing worldwide primary refined copper production that began in 1992.[10] Global annualized production growth exceeded consumption growth (3.3 percent versus 3.0 percent, respectively, during

[5] The United States provided government loans and capital funding to increase domestic production during World War II, and provided draft exemptions to ensure that the facilities were well staffed.

[6] According to copper company representatives, as much as two-thirds of the Chilean mining labor workforce has a college degree. Interviews by USITC staff, Aug. and Sept., 2001.

[7] These policies include land access, land use, and land ownership laws being enacted in many developing countries (e.g., Bolivia, Colombia, Tanzania, Uganda, and the West African Economic and Monetary Union countries) and former communist-bloc countries (e.g., Bulgaria, Kazakhstan, and Uzbekistan) that help investors obtain loans and insurance for exploration and development. Additionally, many existing mineral-producing countries also are creating financial incentives, such as reduced or deferred business taxes for mining ventures (e.g., the Democratic Republic of Congo, Mexico, and Peru), accelerated depreciation schedules (e.g., Chile), and liberalized capital repatriation laws (e.g., Indonesia and Peru).

[8] The Fraser Institute, "Annual Survey of Mining Companies: Mining Companies Rate Investment Attractiveness of Jurisdictions Around the World," Dec. 18, 2001, found at Internet address *http://www.fraserinstitute.ca/publications/surveys/2001mining/*, retrieved Dec. 19, 2001. The Fraser Institute is an independent Canadian public policy organization focusing on the economic and social well-being roles of competitive markets.

[9] Through October 2002, U.S. refined copper production is down 7 percent (393,000 metric tons) from the same period in 2001, versus a 1 percent (91,000 metric tons) decrease worldwide. This indicates the rest of the world has increased refined production 302,000 metric tons, or 4 percent, since 2001. World Bureau of Metal Statistics (WBMS), "World Metal Statistics."

[10] Daniel L. Edelstein, "Copper," *U.S. Geological Survey-Minerals Information-1997*, found at Internet address *http://minerals.usgs.gov/minerals/pubs/commodity/copper/240497.pdf*, retrieved Dec. 3, 2001.

Table 2
Major shutdowns or cutbacks by refined copper producers in the United States, through 2002

Company	Refinery location	Curtailment amount	Status
		(*1,000 metric tons*)	
Primary producers:			
Electrolytic Operations:			
Asarco (Grupo Mexico)	Amarillo, TX	290	Curtailed refinery due to El Paso, (TX) smelter shutdown, and loss of feed from the Chemetco (IL) shutdown; Hayden smelter curtailment, and cutbacks at the Mission (AZ) mine and concentrator.
BHP Copper	San Manuel, AZ	320	Permanently closed refinery due to smelter shutdown and loss of feed from Pinto Valley, San Manuel, and Superior (AZ) and Robinson (NV) mines and concentrators.
Kennecott	Garfield, UT	60	Permanently closed North Concentrator.
Phelps Dodge	El Paso, TX	220	Curtailed El Paso refinery and closed Miami refinery due to loss of feed from Chino and Hidalgo (NM) smelters and from Bagdad, Miami, Morenci, and Sierrita (AZ) and Chino (NM) mines and concentrators.
	Claypool, AZ	170	
SX-EW Operations:			
Arimetco International	Lyon, NV	10	Permanently closed [1]
BHP Copper	Pinto Valley, AZ	10	Permanently closed [1]
	San Manuel, AZ	28	Permanently closed [1]
Phelps Dodge	Bagdad, AZ	14	One-half capacity until copper prices rise
	Casa Grande, AZ	10	Permanently closed [1]
	Globe/ Miami, AZ	90	Temporarily closed until copper prices rise [1]
	Green Valley, AZ	25	One-half capacity until copper prices rise
PD/Mitsubishi	Santa Rita, NM	68	Permanently closed [1]
Secondary producers:			
Chemetco[2]	Alton, IL	135	Permanently closed
Cerro Copper Products	Sauget, IL	55	Permanently closed
Southwire	Carrollton, GA	140	Permanently closed
	Gaston, SC	120	Permanently closed

[1] Small amount of inventory processing remains.
[2] Chemetco produced unrefined copper from scrap that was processed by Asarco's Amarillo electrolytic refining facility.

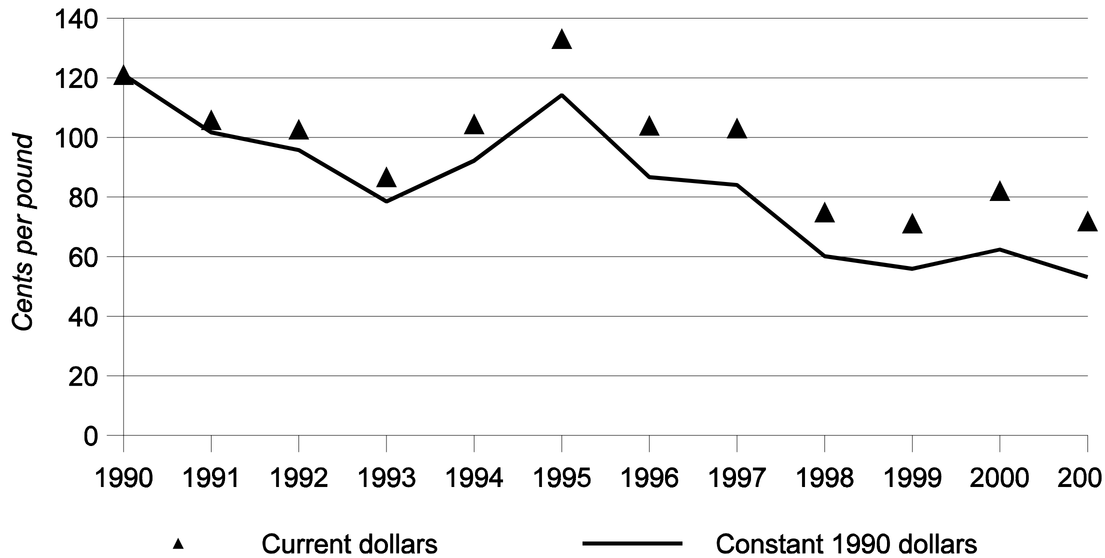
Source: Compiled from official statistics of the U.S. Geological Survey and multiple published news reports.

1992-2001)[11] as new, large-scale copper mines in Argentina, Chile, Indonesia, and Peru commenced operations. The output of Chile expanded from 1.2 million metric tons (from 1990 through 1992) to 2.9 million metric tons (2001) annually.[12] In addition, many existing mines expanded, notably in Australia, Chile, and Indonesia. Even the United States increased production by 23 percent from 1990-1998. Refined copper inventories at the major exchanges reached a record peak of 1.3 million metric tons on May 3, 2002.[13]

[11] WBMS, "World Metal Statistics."
[12] Ibid. This growth was fueled by major foreign direct investment that began in the late 1980s. Chile surpassed the United States as the largest world producer of mined copper in 1990, and of refined copper in 1999.
[13] Daniel Roling, "Nonferrous Metals Inventories on Commodity Exchanges," Merrill Lynch, weekly email distribution.

In 1995, the price of copper began to significantly decline (figure 1). Despite a slight rebound in 1999 through 2000, as Asian (primarily Chinese) consumption rebounded, inventory accumulations continued to exert downward pressure on this price. In 2001, world refined copper consumption declined for the first time in a decade, further depressing the price.

Figure 1
Refined copper price, London Metal Exchange (LME) average annual cash value, 1990-2001



Source: Official statistics of the U.S. Geological Survey, LME, and U.S. Bureau of Labor Statistics.

In constant-dollar terms, the price has fallen by more than 50 percent during the last decade. U.S. producers have been able to cut costs during the 1990's, but at a much smaller percentage as compared with the price decrease. Competitive conditions specific to primary and secondary producers are discussed below.

Primary Industry

Contraction of the domestic primary refined copper industry is generally attributed to low ore grades at present operations; restrictions on access to domestic land that may have additional deposits with potentially higher grades,[14] or are amenable to newer processing technologies; and regulatory compliance costs at existing processing facilities. These factors are important competitive issues; however, competitiveness is not meaningful based on only a single factor. Rather, all must be considered together. High-grade prospects are not necessarily economic to develop. Further, there are numerous low-grade facilities being economically operated, typically in developing countries that have low wage rates. Finally, although land-use and environmental regulations may affect the ability of the primary refined copper industry to compete globally, as discussed in this article, these regulations also have

[14] Yvette Alt and David Lundy, "U.S. Metal Mining: Recent Trends and Uncertainty Discourage Domestic Exploration and Investment," *Industry Trade and Technology Review*, publication 3390, USITC, Jan. 2001, pp. 1-16.

recognized beneficial objectives. While a detailed treatment of such regulatory benefits are not within the scope of this article, instances are cited in which unregulated activities have resulted in environmental problems.

According to an annual survey of worldwide mining executives,[15] the United States is considered the second-least favorable location for mining despite several States that rank high in mineral potential. Perceptions of competitive impediments cited in the survey include (1) an uncertain permitting process that remains in flux, (2) strict environmental regulations, (3) a large caseload of objections filed in court by mining opponents who protract the adjudication process, and (4) large tracts of mineral-rich areas being set aside for non-use. No new primary copper operation has emerged since the early 1980's, despite the availability of favorable prospects. The U.S. industry did expand production during 1986-1997, the longest period since WWII–and longest peacetime expansion since the 1920's–but this was the first expansion without a startup of a significant new domestic producing property.[16]

The primary metal mining and related processing sector (which includes the primary copper industry) is highly visible, with numerous interested parties, including producers and related industry associations; Federal, State, and local executive and legislative bodies; environmental groups; and research organizations. Typically, these parties have diametrically opposing viewpoints on many issues that affect the competitiveness of the sector, especially in regard to present and potential environmental effects. These and other issues are discussed below.

Present Ore Grades

Unit production costs are inversely related to the metal content of a deposit, with all other production cost factors being equal. Most copper deposits typically contain other metals that are recovered during the mining and processing stages. These byproducts effectively reduce unit production costs. Currently mined deposits in the United States have relatively low copper grades and low amounts of byproducts (although one mine does produce a significant amount of gold and several mines produce significant amounts of molybdenum). In general, current operations in developing countries such as Mexico, Papua New Guinea, the Philippines, Peru, and South Africa have comparable copper grades and byproducts but have labor rate and environmental compliance cost advantages that result in unit production costs advantages compared with the United States. Other developing countries, such as Chile, have higher copper grades and comparable byproduct amounts.[17] Many current operations in developed countries such as Australia and Canada have comparable labor rates and environmental compliance costs, but higher copper grades and significantly higher amounts of byproducts yield unit production cost advantages compared with the United States.

---

[15] The Fraser Institute, "Annual Survey of Mining Companies."

[16] The Magma Robinson (NV) mine did commence production, but this was a restart of an old mine.

[17] For example, copper grades at U.S. open-pit mines for ores that are processed conventionally (i.e., concentration, smelting, and refining) are typically less than 0.6 percent. In Chile, the comparable copper grades are greater than 1 percent.

Land Access and Deposit Development

The domestic primary industry is inhibited from developing higher grade deposits to offset low-grade ore at present operations because of land access and deposit development issues.[18] Exploration expenditures for new ore bodies in the United States began to fall in the early 1990s and began to drop precipitously in 1998.[19] Despite a doubling of worldwide exploration expenditures between 1999 and 2000, the U.S. share dropped by more than one-half.[20] Likewise, the number of operating domestic exploration drill rigs (which are used to search for ore deposits) in 2002 has been down as much as 60 percent from 2001.[21]

Land access and deposit development issues are especially constraining to the primary producers because they affect further expansion into ore bodies that can use leaching to feed the low-cost SX-EW process. World SX-EW production has increased by 36 percent since 1996. However, in the United States, SX-EW production has increased by only 3 percent, and only at existing operations. Almost all of this has been accomplished at one facility, Phelps Dodge Morenci, AZ. Despite inventing and being the first to implement the technology and substantially benefit from this method of producing refined copper, the United States is lagging in its use. Outside of Morenci, SX-EW is declining at existing facilities because they have nearly exhausted ores amenable to leaching. Access to new sources of ore is required to expand production using low-cost SX-EW. Further competitive impediments concerning land access and development issues are addressed below.

General mining law

The most significant land access issue is the 1872 Mining Law governing access to Federal lands for exploration and deposit development. The ongoing, thus far unsuccessful, attempts to reform the 1872 Mining Law have jeopardized investor confidence in new ventures for more than a decade. According to an independent study, extensive Federal, State, and local regulations have effectively superceded the Mining Law during the last three decades, leading to unclear policy goals, unclear enforcement, and unclear jurisdiction.[22] Insofar as much of the American West is managed by the U.S. Government, and most of the Nation's mineral potential is located in those areas (roughly along the Rocky Mountains), mining access to these lands is important.[23] Principal issues cited by industry sources include (1) land ownership provisions–called patenting–once a deposit is located and claimed, (2) royalty payments, and (3) environmental protection provisions.[24]

---

[18] Public land withdrawal is cited as the number one issue for the U.S. mining sector, according to Alistair MacDonald, Talmac Consulting, "Industry in Transition: A Profile of the North American Mining Sector," *International Institute for Sustainable Development*, 2002, p. 83.

[19] Alt and Lundy, "U.S. Metal Mining."

[20] Fraser Institute, "Annual Survey of Mining Companies."

[21] "Drill Rig Count . . . .," *American Metal Market (AMM)*, found at Internet address *http://www.amm.com/index2.htm*, various issues.

[22] Alistair MacDonald, "Industry in Transition," *International Institute for Sustainable Development*.

[23] Jack Gerard, President and Chief Executive Officer (CEO), NMA, speech at the U.S. Bureau of Land Management Solid Minerals Conference, Las Vegas, Nevada, Nov. 28, 2001, found at Internet address *http://www.nma.org/*, retrieved Nov. 30, 2001.

[24] For further explanation, see Alt and Lundy, "U.S. Metal Mining."

The industry claims that it must have the guarantee of ownership to secure the large capital funding required for development. Proponents of mining law reform seek to change the ownership provisions, suggesting for example that the Government retain ownership and license deposit development. Proponents also favor royalty payments for mineral extraction, claiming that the industry is receiving an unwarranted benefit. The industry is amenable to paying royalties, although a royalty scheme will increase operating costs, both reducing the financial attractiveness of developing deposits and shortening the economic life of existing mines.[25] Further, proposed mining law revisions have included significant environmental protection and reclamation provisions designed to ensure all environmental concerns are addressed prior to patenting. Industry sources claim that all such laws and regulations are in place already and that all facilities must meet them, adding that another regulatory layer could only lend further uncertainty to the existing regulations required to secure and maintain operating permits.[26] Partially due to a lack of resolution on Mining Law revisions, the U.S. Department of the Interior instituted a moratorium on all new patents in 1994.[27]

Permitting

Reportedly, deposit development is affected by the large number of regulatory agencies and public comment/review requirements that yield a lengthy approval process at both the Federal[28] and State levels.[29] In contrast, the permitting process in many other copper-producing countries, including Australia and Canada, is conducted at the state or regional level only, resulting in less overlapping permitting requirements.[30] According to U.S. regulators, the lack of a clear approval process has had a negative effect on the viability of the domestic industry.[31] Industry sources also point out that various compliance standards among enforcement agencies often change after further scientific studies are completed, which complicates the process of permitting within time frames that enable an acceptable return on investment.

---

[25] Statements of Douglas Yearley, Chairman and CEO of Phelps Dodge Corp. and Stephen D. Alfers, Alfers & Carver, LLC to the Senate Committee on Energy and Natural Resources, Subcommittee on Forests and Public Management Hearing on Mining Law Reform, Apr. 28, 1998, found at Internet address *http://www.nma.org/newsroom/congtest_pop/042898.html* and *http://www.nma.org/newsroom/congtest_pop/042898d.html*, respectively, retrieved Jan. 21, 2003.

[26] Douglas Yearley, Hearing on Mining Law Reform.

[27] Then-Secretary of the Interior Bruce Babbitt instructed the Bureau of Land Management (BLM), in Memorandum No. 95-01 dated Oct. 4, 1994, to only process applications that were pending in Washington, DC, as of Sept. 30, 1994, and let all others remain idle. See John D. Leshy, "Entitlement to a Mineral Patent Under the Mining Law of 1872," internal memorandum to the BLM Director, Nov. 12, 1997, found at Internet address *http://www.doi.gov/sol/M36990.pdf* .

[28] Examples include the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers, the U.S. Forest Service, the U.S. Fish and Wildlife Service, the BLM, and similar state and local agencies.

[29] Alistair MacDonald, "Industry in Transition," *International Institute for Sustainable Development*, and Alfredo Gurmendi, U.S. Geological Survey, interview by USITC staff, Jan. 9, 2003. For a summary on the multiple state jurisdictions and types of permits required for a mine, see James M. McElfish, Jr. et al, *Hard Rock Mining: State Approaches to Environmental Protection*, Environmental Law Institute, Washington, D.C.

[30] Numerous government, industry and association representatives, including Alfredo Gurmendi, U.S. Geological Survey, and Martin Ruhrberg, International Copper Study Group, interviews by USITC staff, Jan. 2002-Jan. 2003.

[31] EPA staff presentation to the Committee on Earth Resources at the National Academy of Sciences, Washington, DC, Nov. 20, 2002.

Some large-scale domestic projects that began the permitting process as early as 1994 have not gained approval. A notable example is Nicolet's Crandon Mine (NCM), WI, a high-grade zinc, copper, lead, gold, and silver ore body that is described as among the 10 largest ore bodies of its type in North America. Attempts to permit it have been sporadic since 1976, and continuous since 1994 with its present plan of operations.[32] The project received all Federal permits, and a Wisconsin "Mining Moratorium Law" compliance document was submitted to the Wisconsin Department of Natural Resources in January, 1999.[33] Approval reportedly was denied in May, 2002, because there was not enough scientific evidence to draw a conclusion regarding the adequacy of the post-production clean-up plan.[34] Due to continued delays, and despite significant financial potential over a projected 33-year mine life,[35] BHP Billion announced its intent to sell the NCM mine project on September 17, 2002.[36] Another example is the Safford Project, AZ, a historic mining district with significant ore reserves at a grade equivalent to many foreign operations that is amenable to low-cost leaching and SX-EW production, that began permitting in 1994 and remains in progress.[37]

In contrast, the permitting process in many foreign countries is significantly shorter.[38] For example, in Australia, which has similar compliance standards to the United States, several mine operations were permitted in under 5 years, a competitive advantage because these mines have contributed to a 50 percent increase in the country's copper mine production during the last 5 years. In Canada, the permitting process is roughly of the same duration as in Australia. Permitting in foreign countries, both developing and developed, is characterized by various sources as more of a cooperative effort between interested parties than is evident in the United States.[39]

Other land access restrictions

Other constraints on land access include wilderness designation efforts that are traced back to the Wilderness Act of 1964, one of the first laws designed to protect undeveloped areas in the United States. There are several recent examples where land was set aside pursuant to this Act by Federal agencies. Two are Asarco's Silverbell and Rosemont facilities near

---

[32] "Nicolet Throwing in Towel, Puts Crandon Mine on the Market," *Pay Dirt*, Oct. 2002, p. 39.

[33] "What's New on the Crandon Mine Site?," found at Internet site *http://www.dnr.state.wi.us*, *Wisconsin Department of Natural Resources*, retrieved Oct. 17, 2002.

[34] Ibid.

[35] According to "Economics of the Crandon Mine", found at Internet address *http://geology.beloit.edu/davidson/IDST276/IDST276.1999/Mine.html/BrianZ.html*, retrieved Oct. 30, 2002, the $5 billion dollar resource would have paid approximately $10 million per year to the local and State communities alone, which is $4 million (67 percent) more than the entire state's annual tourism industry.

[36] "Nicolet Throwing in Towel, Puts Crandon Mine on the Market," *Pay Dirt*.

[37] J. Steven Whisler, President and CEO, Phelps Dodge Corp., "Phelps Dodge 2nd Quarter Analysts Conference Call", webcast through Internet address *http://www.phelpsdodge.com*, July 24, 2002.

[38] Industry representative, interview by USITC staff, Nov. 8, 2002.

[39] Numerous government, industry and association representatives, including Alfredo Gurmendi, U.S. Geological Survey, and Martin Ruhrberg, International Copper Study Group, interviews by USITC staff, Jan. 2002-Jan. 2003.

Tucson, AZ.[40] The former is an extension of existing leaching and SX-EW facilities into the rest of the ore body. This was precluded by designation of a monument in all surrounding lands.[41] The latter was a land exchange intended to consolidate multiple deposits under one ownership for future use. The land exchange consideration was terminated by the U.S. Forest Service but the issue is the subject of ongoing litigation.[42]

The Endangered Species Act (ESA), designed to protect animal habitats and plants, and similar laws also have been reported to result in land access problems for the industry. Pursuant to the ESA, an undeveloped area can be designated as a critical habitat, which precludes industrial development, including road construction. The ESA has directly affected the primary industry. For example, the high-grade Rock Creek underground mine (Sterling Mining Co., Noxon, MT, an extension of the historic Troy Mining district using new technology), was claimed, among other issues, to have potential effects on grizzly bears and bull trout despite State and Federal environmental impact studies indicating compliance with the law, and has been in litigation for 15 years.[43] Also, the National Wild and Scenic Rivers Act was used as the basis to oppose the high-grade, low-cost, leach-SX-EW Carlota Project mine (Cambior, Pinto Valley, AZ), due to the effect a possible mishap could have on the Pinto Creek riparian area and associated flora and fauna (the developing company went bankrupt after a permitting process that took 7 years).[44]

Environmental Regulatory Issues

Industry remediation efforts have helped mitigate the waste and emissions generated by copper mining and related processing that create air and water quality problems affecting workers and surrounding communities. However, public concerns about air and water quality have resulted in the promulgation of numerous regulations that affect copper operations. Since the passage of the Clean Air and Clean Water Acts in the 1970s, the domestic industry has been required to address pre-existing environmental issues and prevention of future problems. The closure of many U.S. operations, including five of the seven recently idled domestic copper smelters, have been attributed in part to high compliance costs by industry sources.

Compliance costs

Air pollution abatement laws reportedly have increased costs for the industry, particularly laws establishing air quality rules for particulate matter and sulfur dioxide in the workplace, and those regulating sulfur, arsenic, and lead emissions to the atmosphere from copper smelters. Industry sources claim that such laws require large expenditures for pollution

---

[40] Dr. William H. Dresher, "Domestic Copper Ore Grades," CDA, emails of Nov. 2-5, 2002.

[41] Ibid. The Ironwood Forest National Monument (IFNM) was established by President Clinton in June, 2000. The IFNM surrounds the active Silverbell Mining site, and encompasses state trust land, grazing allotments, private in-holdings, and 387 active mining claims for a total of 189,777 acres.

[42] Ibid. See also "Stop the Mines," *Southwest Center for Biological Diversity*, found at Internet address *http://www.biologicaldiversity.org/swcbd/activist/mine.html*.

[43] The mine reportedly will be required to provide over $15 million in mitigation to ensure no significant effects on these protected species, but other issues are still being litigated. Found at Internet address *http://www.sterlingminingcompany.com*, retrieved Oct. 22, 2002.

[44] Dr. Dresher, CDA.

control and decontamination.[45] Recent silica dust limits, for example, have increased capture and hygiene requirements, with strict regulations for mine and crushing facilities.[46]

Clean water regulations also have impacted the industry. For example, development of the high-grade underground Montanore Project Mine (Libby, MT) was halted because blasting was reportedly allowing nitrates to enter Libby Creek in violation of State water laws.[47] Despite later receiving permits and a favorable appeals court verdict, the company was then sued directly, at which point the company ceased development.[48] Recent regulations to enforce the Clean Water Laws have required that all water exiting a facility must pass drinking water standards. This requires facilities to build catchments and basins to hold, and processes to treat, rainwater and other natural sources of water along with the process water and bring them to drinking water quality. This has particularly impacted refineries, some of which are in metropolitan areas with limited land availability.[49] Clean water protection standards have been extended to dry creek beds in the desert Southwest, requiring extensive permitting before land use.[50]

Regulators claim that current law requires developing and enforcing standards, such as water quality standards, often within very narrow time frames, that sometimes preclude appropriate scientific studies and analysis. Occasionally the effect is that industry is compelled to design and build facilities to meet standards that change once further scientific studies are completed. Thus, there may be little to no confidence that capital expenditures on best available technologies will bring the facilities into compliance.[51] Alternatively, sometimes health-based standards precede development of technologies to meet them cost-effectively, placing operations at risk of fines and closure.[52] Some clean air targets and technologies, such as those designed to prevent acid rain, have not been able to be applied uniformly

[45] For example, typical equipment to improve sulfur gas capture and recovery for a midsized primary copper smelter costs approximately $140 million. Industry representative, telephone interview Dec. 24, 2002.

[46] According to industry sources, dust collection can cost up to 5 percent of total concentrator costs, not counting the personal hygiene protections.

[47] "Canadian Firm Abandons Montana Mining Project," *Associated Press*, found at Internet address *http://www.montanaforum.com/rednews/2002/08/19/build/mining/cabinetmine.php?nnn=4*, retrieved Dec. 27, 2002.

[48] Noranda, of Canada, received permits and a 9th Circuit Court of Appeals verdict in its favor for a new high-grade mine after 10-year process and a $100 million investment. When the environmental groups sought litigation, Noranda ceased all development activity and put the land up for sale. See Laura E. Skaer, Executive Director, Northwest Mining Association, testimony before the Committee on Resources, Subcommittee on Energy and Mineral Resources, U.S. House of Representatives, Spokane Field Hearing Sep. 11, 1999, found at Internet address *http://propertyrightsresearch.org/committee_.htm*, retrieved Nov. 6, 2002. According to the testimony to Congress, the environmental groups knew they could not win, but their strategy was to prolong the process and increase expenses in hopes that the company would give up.

[49] Most industry and legal experts agree that the intent of the law was to regulate process water discharge. However, in many cases it is impossible to differentiate between water sources–or the costs and time to do so are significant–so all effluents must be treated.

[50] Southwest Center for Biological Diversity, "Stop the Mines."

[51] EPA presentation, Committee on Earth Resources.

[52] For example, according to industry sources, silica capture requirements under consideration are not economically feasible using present technology.

across industries or regions due to processing and environmental differences.[53] Clean water standards also require varied levels of effort to achieve compliance.[54]

Finally, because there are many examples of facilities that have polluted the local environment in the past, present case and regulatory law requires private bonds to secure long-term maintenance and remediation, if necessary, of facilities that permanently cease operation. However, the process remains undefined, and as with securing operating permits reportedly has become problematic and unpredictable. In one case, for example, after obtaining all the necessary state lower-agency approvals, the Chino, NM, facilities' closure plan was not approved by the New Mexico Mining Commission because of a disagreement regarding closure bond financing.[55] Escalating bond requirements not only adversely affect costs, but render liability insurance difficult and costly to obtain which also deters development of new domestic deposits.

Overall, U.S. compliance-cost estimates vary widely, but generally are acknowledged to be on the order of 10-20 percent of operating costs, according to industry sources.[56] A Bureau of Census survey shows that pollution abatement expenditures in 1999 (latest data available) for the industry total \$51.7 to \$62.6 million for capital costs and \$49.0 million for operating costs.[57] The refined copper industry is unable to pass on compliance costs to consumers because of commodity pricing, and these costs have a direct impact on profitability.[58]

In comparison, the majority of international producers face significantly less stringent requirements.[59] In many foreign countries, environmental regulations and enforcement do not lead to lengthy operational delays. The experiences of Australia and Canada with

---

[53] For example, smelters used in the secondary industry cannot reduce sulfur emissions to the level achieved by the primary industry.

[54] Many ore bodies were discovered because the natural water resources near mines were high in metal content due to proximity to the ore bodies. Companies intending to operate a production facility often incur considerable compliance costs in meeting a higher clean water standard than existed before discovery.

[55] New Mexico state law requires closure plans, and facilities that do not have an approved plan are subject to fines. J. S. Whisler, President and CEO, Phelps Dodge, "Phelps Dodge 3rd Quarter 2002 Analysts Conference Call," webcast through Internet address *http://www.phelpsdodge.com/*, October 31, 2002. Silver City News and Gila Resources Information Project, interviews with USITC staff, Nov. 2002 - Jan. 2003.

[56] Industry analysts, interviews with USITC staff, Aug. - Nov. 2001.

[57] U.S. Census Bureau, *Pollution Abatement Costs and Expenditures: 1999*, found at Internet site *http://www.census.gov/prod/www/abs/pollu.html*, retrieved Jan. 15, 2003. A range is shown for capital costs because not all of these costs are separately provided for in this Census report. These figures include only those costs that are primarily for protecting the environment and could significantly understate total environmental expenditures. Expenditures that are primarily for other reasons, such as increasing production efficiencies, and that may have pollution abatement effects are not included.

[58] Phelps Dodge Corp., "Phelps Dodge Profiles–Government Affairs: Acting as Our Eyes, Ears and Voice in Washington," *Workscapes*, vol. 02, Issue No. 128, Nov. 22, 2002.

[59] However, significant environmental damage is evident in many cases both at foreign and domestic operations. For example, in Papua New Guinea (PNG), the Ok Tedi mine, one of the world's largest producers, was permitted to discharge tailings (mine waste material) into a river, which is causing deleterious effects according to the PNG Government. For more details, see Internet site *http://basemetals.bhpbilliton.com/oktedi/legalclaims.osp*, retrieved Jan. 13, 2003. In comparison, typical tailing impoundment and maintenance costs in the United States are on the order of 2 cents per pound at average grades.

industry growth even in an economic downturn and with similar environmental safeguards indicate that these measures can be implemented in a way that doesn't draw out the regulatory process. Chile's Environmental Law that became effective in 1992 prescribes a cooperative effort between the government and industry to preserve and protect the industry and the environment. Specific agreements pursuant to this law can take many years, and during this time companies are able to operate and are not subject to penalties.[60]

Technology implementation

Aggressive adoption of technology, such as the SX-EW process, used to be a major advantage for the U.S. producers. However, an increase in regulation of the domestic industry during the 1990s contributed to inhibiting technological implementation. As a result, several major developments initially have been applied abroad due to the relative ease of implementation.

One of the reasons is that most existing facilities in the United States operate with permits that cap emissions at a level appropriate to the older technology, but new processes are required to meet more stringent standards, even if installed at the same facility. This has the effect of discouraging technology trials because of the large capital exposure and uncertainty of the review process as previously noted. Therefore, only small incremental changes are often possible as opposed to large step-change improvements. Also, many of the newer technologies offer economies of scale whereby the economic benefit is in increased production for similar cost. Thus, the capital upgrade can only be justified if the new technology is applied alongside, or retrofitted to, existing production machinery; this can extend the facility above the cap unless overall production is reduced, which negates the benefit.[61] Other new technologies are so significantly different as to require an environmental review of the entire facility under greenfield emission standards because they create a different type of exposure.

These issues have served to preclude the domestic producers from adopting some state-of-the-art technologies that are applied almost universally elsewhere around the world. The result of the extensive environmental review procedures is to either require a reduction in existing production levels or removal of previously agreed to permits, in effect, threatening closure of facilities. Typically, foreign countries do not have environmental regulations that are as intricate, and producers are better able to exploit technological developments.[62]

One notable example is the introduction of crush-for-leach process technologies in Chile a decade ahead of introduction in the United States. This process uses updated operating technologies that enable efficient leaching of crushed ore, which has served to increase the

[60] The first major remediation agreement in Chile, which concerned cleanup and environmental protection at El Teniente's Salvador smelter, was announced in late 2001, 9 years after the Chilean Environmental Law was written. Codelco is spending $736 million to resolve the issues and expand production.

[61] Mining operation mobile equipment requires regular replacement and readily converts to larger, more efficient sizes. Fixed processing facilities, such as mills, SX-EW plants, smelters, and refineries, cannot be readily replaced as a whole. The level of capital investment to retrofit is often larger than that required for a greenfield operation, which makes such a transition uneconomic, particularly while maintaining production.

[62] Numerous government, industry and association representatives, including Kalle Pukki, Outokompu Mintek, and Alfredo Gurmendi, U.S. Geological Survey, interviews by USITC staff, Jan. 2002-Jan. 2003.

number of ores amenable to SX-EW processing worldwide.[63] However, crushing is a process that generates silica dust, which is becoming heavily controlled due to health effects. Until 2001, the Southwestern United States was the only major copper-producing area of the world not to have such facilities. Phelps Dodge Morenci, AZ, was able to acquire the appropriate permits to convert its operation, but only by closing its concentrating operations to keep total operation dust emissions below existing permit levels. This compromise reportedly reduced total production by approximately 30 percent and also was a major contributing factor to the closure of the Hidalgo (Playas), NM smelter operation and one-half of the El Paso, TX, refinery. Ultimately, the company claims these measures will reduce cash costs by 7 to 9 cents per pound, but at the loss of over 180,000 metric tons per year of output and significant job losses.[64]

There are other technologies presently in development that appear likely to find earliest implementation abroad. An example is inert anode technology, which improves the efficiency of the electrowinning process. This technology would reduce electrical power requirements and enhance product quality. However, according to industry sources, environmental concerns about changes in acid discharge and capture requirements may encourage transfer of this U.S.-developed technology to Chile, where the regulatory climate appears to be more favorable.[65] Another technology is the use of autonomous vehicles that use robotic and sensor apparatus for certain mine operations, which could significantly reduce labor costs. This technology is being implemented at some foreign locations, but is encountering resistance in the United States due to liability issues involving personal and property loss if vehicle control is lost.

Secondary Industry

In the United States, secondary refined production dropped from 12 percent of total refined production in 1997 to zero in 2001 (i.e., the U.S. secondary smelting and electrolytic refiners have completely shut down). To date, approximately 200,000 metric tons of domestic processing capability have been dismantled.[66]

Despite the status of the United States as the largest copper scrap generator in the world and its extensive infrastructure for collecting and transporting scrap, the financial viability of the U.S. secondary industry has declined dramatically during 1997-2001. Decreasing profit margins and environmental regulations have contributed to the closure of secondary industry.[67] Although U.S. environmental regulations may affect the ability of the secondary refined copper industry to compete globally, as discussed in this article, these regulations also have recognized beneficial objectives (however, a detailed treatment of such regulatory

[63] Crushing enables a higher and faster metal recovery by reducing the rock size to increase the surface area exposed to the leaching solution. Despite the cost of the crushing, the increased metal recovery lowers unit costs as compared with present leaching methods on certain ores. The leach solution is the feed for the SX-EW process.

[64] Phelps Dodge, press releases, annual, and quarterly reports (various issues).

[65] Industry representatives, interviews with USITC staff, 2001-2002.

[66] Peter Müller, as reported in "Secondary Copper Smelters Facing Challenge," *AMM*, Feb. 19, 2002, from a speech at Metal Bulletin's 15th International Copper Conference, Florence, Italy, week of Feb. 11, 2002, found at Internet website *http://www.amm.com/index2.htm*, retrieved on Feb. 20, 2002.

[67] Janice L. Jolley, "The U.S. Copper-base Scrap Industry and its By-products - 2001," 2d ed., CDA Technical Report, July 2001, pg. 1.

benefits is not within the scope of this article). Competitive challenges faced by the secondary industry are discussed below.

Profit Margins

The sustained low copper price coupled with flat-to-increasing production costs have considerably narrowed profit margins which have been further eroded by rising raw material costs. Copper scrap prices in recent years have increased relative to the price of copper in response to increasing Chinese consumption. China is a low-cost secondary producer and is able to pay a higher price to attract scrap from all over the world. Because scrap is traded globally, this results in higher scrap prices in the United States.

Environmental Regulatory Issues

Environmental issues have impacted secondary producers as most facilities are old and in urban areas. The largest U.S. secondary producer, Southwire, closed its smelter and refinery facilities in 2000, citing the increasing cost of regulatory compliance in the Atlanta metropolitan area as rendering copper refining unprofitable.[68] Unlike the majority of primary production facilities, located in rural areas, almost all secondary producers are in densely populated areas and face added regulatory issues. In addition to water and air quality, other issues unique to scrap include hazardous materials transport and handling. Since scrap is generally impure, a significant share of costs is associated with handling and transport of the other metal impurities, such as lead, associated with the recovery of copper scrap. Processing requires additional facilities for the capture of these metals.[69]

Attempts to Improve Competitiveness

Consolidation

Mergers and acquisitions have been an important mechanism to improve the competitiveness of the U.S. primary industry. These activities have largely occurred to reduce overhead as a percentage of total costs. Major domestic consolidations include: the BHP (Australia) buy out of Magma Copper (AZ) in 1996, Cyprus (CO) and Amax (CO) merger in 1996, Phelps Dodge (AZ) buy out of Cyprus Amax in 1999 and Grupo Mexico (Mexico) acquisition of Asarco (NY) in 1999.[70]

---

[68] Roberta C. Yafie, "Southwire Plan May Disrupt Supply Lines," Copper News, *AMM*, Apr. 4, 2000, found at Internet address *http://www.amm.com/index2.htm*, retrieved Oct. 1, 2001.

[69] For example, in 2001, the Illinois Environmental Protection Agency issued an order to permanently close the Chemetco, Inc. facility (which processed scrap that contained metal impurities) in Hartford due to environmental concerns. The closure removed 95,000 metric tons of unrefined copper capacity from the market (the facility was previously operating 29 percent under capacity). "Illinois EPA Seals Chemetco Facility," Dec. 11, 2001, found at *http://www.epa.state.il.us/news-releases/2001/2001-146-chemetco-order.html*, retrieved Jan. 21, 2002.

[70] These trends also occurred abroad, notably Teck acquiring Cominco (Canada), and BHP (Australia) merging with Billiton (United Kingdom), in 2001. The latter merger created the second-largest mining company in the world, after Rio Tinto (United Kingdom). "BHP Billiton Clears the Decks," *Mining Magazine*, Oct. 2001, p. 192. Similar trends also occurred among mining and processing equipment suppliers.

Divestitures

Some companies have sold noncore assets to generate operating cash for their primary facilities. Spinoffs have been attempted to maintain cash positions necessary to fund continued maintenance and pay down acquisition debt. Divestitures reportedly have proved largely unsuccessful inasmuch as there is little return evident in offerings on the present market. In late 2000, Phelps Dodge retained Goldman Sachs & Co. and J.P. Morgan & Co. to explore strategic alternatives for sale of the Phelps Dodge Wire & Cable Group and Columbian Chemicals Company. The announced purpose was to apply the proceeds to reduce debt and provide the financial flexibility necessary to pursue longer-term strategic goals for the mining portion of the company.[71] A buyer with a sufficient purchase price was not found and the business was removed from sale in 2001. Other announced spinoffs include divestiture of Cyprus Amax's coal and lithium operations and Exxon's ongoing sale of its Disputada (Chile) property.

Companies are also selling joint venture and other exploration and greenfield rights to generate cash. Notable is Phelps Dodge's sale of its 50-percent equity in Sossego, a copper-gold property in Brazil, to Cia Vale Rio Doce (Brazil) in late 2001 after many years of exploratory and metallurgical testwork and financing of a feasibility study.

Closures

Consolidation has provided opportunities to rationalize excess in-process inventories and production facilities. Closures have been primarily at high-cost producers that have little to no reliance on cost-efficient SX-EW processing, although the low copper price has caused the shut down of some SX-EW operations. All domestic underground copper mines have been idled. Historically more expensive to operate, these mines were among the first properties to close in the United States. In comparison, Chile's state copper corporation (Codelco) is investing $736 million in its El Teniente division, owner of the largest underground copper mine in the world, to address environmental issues and expand production from 350,000 to 480,000 metric tons per year by 2003.[72]

Production Strategy

In a departure from historic practices of "high grading"[73] during pricing troughs, many primary producers, including those with low production costs, have decided to cut production by mining lower grade portions of existing deposits to reduce global refined copper inventories.[74] Although seemingly counterintuitive, as it raises unit costs, analysts suggest that this strategy will improve the long-term financial prospects for the industry and

---

[71] Phelps Dodge, "Phelps Dodge to Sharpen Focus on Mining," news release, Dec. 8, 2000.

[72] BNA, *"More LatAm Mining News - Regional,"* daily news service email, received Jan. 30, 2002.

[73] "High grading" refers to mining only the highest-grade portion of the ore body. This practice delivers greater amounts of salable product for roughly the same total production costs. However, high grading may result in more copper on the market, thus exerting more downward pressure on the price of copper. It also effectively mismanages the ore body by lowering the average ore grade of the remaining material, which may cause higher unit operating costs in the future.

[74] Bloomsbury Minerals Economics, Aug. 2001, as reported in *Mining Journal*, Sept. 2001.

generate a greater life-cycle value for the individual mines and companies. This is especially true if shutdowns would cause separation or closure costs. Almost all of the major facilities worldwide, including U.S. operators, have taken this step during this current cycle.[75]

This scenario has been noted by one domestic producer as the cause for halving production at two separate facilities, thus raising costs at both, rather than entirely closing down one. This approach was selected to more easily return to previous production levels when prices warranted and to avoid incurring closure and restart costs that include re-permitting if the existing permits lapse upon shutdown.[76] One senior mining company executive has commented further that it made no economic sense to produce copper at only a few cents per pound profit, when it could be saved for prices that would yield much higher returns. Companies with enough cash on hand to absorb losses associated with higher production costs are now focusing on mine development activities.[77]

New Production Technology

Adopting new technology is probably one of the most important factors in improving the competitiveness of the U.S. primary refined copper industry. Much of the recent technological research and development has focused on improving leaching and metallurgical processes. Technology advances have expanded the range of ore types amenable to leaching, and hence has broadened opportunities to use the SX-EW process. This has allowed for the economic processing of low-grade material. In one case, Phelps Dodge Morenci, the entire operation has been converted to a leaching facility.

Many industry representatives predict that the industry is only a few years away from widespread hydrometallurgical treatment of copper-iron sulfide ores[78] (likely through bacteriological leaching[79]) and copper concentrates (through reacting in a high temperature pressure vessel). In both cases, refined copper could be produced without the need for smelting and refining. A large number of U.S. low-grade copper-sulfide ore bodies that are presently treatable only by conventional processing, but subeconomic due to the costs of such processing, could become economically viable. An expansion of hydrometallurgical processing would likely decrease average production costs.

There is already one mine in Chile that is economically leaching copper-iron sulfide ores, reportedly with a native bacterial organism. Successful transfer of this technology to other mines will enable processing of low-grade copper-iron sulfide ores presently not amenable to conventional leaching. Similarly, concentrate leaching facilities have been developed on

---

[75] Tony Warwick-Ching, "Copper–Recession and Recovery."
[76] Industry representative, email to USITC staff, Dec. 10, 2001.
[77] Industry executives, interviews with USITC staff, through 2000.
[78] Hydrometallurgical processing involves separating copper from ores using chemicals, and is typically achieved through leaching. Copper-iron sulfide ores are almost exclusively processed using pyrometallurgical processes (i.e., smelting), which is a higher-energy, higher-cost process as compared with hydrometallurgical methods.
[79] Over the last 20 years, the mining industry has formed, in concert with many microbiology research centers, at least a dozen companies specializing in bacterial processing. The total research effort is in the hundreds of millions of dollars, targeting both remediation and ore recovery. Research efforts include numerous Federal and state government-sponsored programs, for example, through the Department of Energy's Industry of Tomorrow program and the Idaho National Engineering and Environmental Laboratory.

a pilot or production scale in Australia, Canada, and Chile, but without application in the United States. However, a domestic pilot facility is planned for 2003.

There are several technologies improving the competitiveness of the domestic industry. Examples include artificial intelligence process control using sophisticated sensing and control devices; robotics; new blasting technologies; and ever larger, more efficient and reliable mine, transport, and processing equipment. Many of these technologies provide only incremental cost benefits but are nevertheless important for the industry's viability.

Outlook

Refined copper consumption is expected to recover from its present depressed levels and to grow in the future. Power generation and distribution, and high-technology applications will likely expand copper consumption. Also on the forefront are electric vehicles,[80] advanced computer chips, automotive radiators (improved fabrication techniques may recapture this market from aluminum), and numerous heat sinks and heat-exchange applications. Moreover, even moderate increases in per-capita consumption in China and India would drive refined copper consumption growth for many years.

However, numerous competitive challenges face the U.S. refined copper industry, suggesting that long-term contraction of the industry is possible.[81] The low quality of presently-mined deposits and exploring for and developing new deposits are the foremost challenges. In many cases, prospective new deposits are of substantially higher quality or allow the use of low-cost processing methods, and have the potential to significantly lower U.S. production costs. Uncertainty regarding potential Mining Law changes, the permitting process, and environmental regulations have greatly increased the risk associated with developing refined copper operations, contributing to declining investment in the United States and a redirection of such investment to foreign countries. Another challenge is that the majority of U.S. primary producers are high cost, both as a result of low copper grades and strict environmental regulations as compared with most foreign producers. Specific factors affecting the industry's outlook are described below.

Copper Price Prospects

The price of copper began recovering in late 2002 on the strength of consumption growth indicators and an announced mine closure.[82] However, significant worldwide inventories would need to be consumed to sustain a price recovery, and there are additional foreign production expansions underway. Examples include the announced Phase IV expansion at Escondida (Chile), and the expansions at Collahuasi and El Teniente (Chile), among others. Therefore, many analysts anticipate that it may be 2005 before a significant price increase

[80] For example, TruMack Assembly Co. of Detroit, MI, has begun building low-speed neighborhood vehicles for Ford Motor Co., which designed the electric-drive vehicles for use in gated communities and resorts. *AMM,* found at Internet website *http://www.amm.com/index2.htm*, retrieved December 3, 2001.

[81] Recent industry trends indicate that reinvestment into existing facilities increases during boom years, as much as doubling their production, but few new facilities are opened.

[82] In December 2002, Asarco announced that Mission would curtail production to 15 percent of capacity, which also reduces the Hayden smelter output by 33 percent and the Amarillo refinery output by 13 percent. Asarco, news release, Dec. 20, 2002.

occurs. Without price appreciation, the U.S. industry will continue to experience financial difficulties, and most operations shut down to date likely will remain closed.

Land And Environmental Regulatory Issues

Access to new deposits and developing such deposits is problematic because many parts of the United States are protected from development through conservation laws and land withdrawals. Potential Mining Law changes could preclude ownership of remaining lands that are available for development.

In many cases, environmental regulations are costly to implement and may contribute to difficulties in adopting new technologies which could significantly lower production costs. Permitting an operation, often constrained by environmental concerns, can be a lengthy, time-consuming process.

Industry Restructuring

The U.S. primary industry largely has restructured to increasingly rely on lower-cost leaching production. This trend likely will continue in the future at present operations. High-cost conventional milling, smelting, and refining facilities are at most risk for closure. A primary industry more reliant on leaching (which is less labor intensive compared with conventional processing), especially if sulfide leaching technology is more fully implemented, likely will be a much smaller industry in terms of employment, even if production increases. The prospects for the U.S. secondary industry are limited, and industry experts foresee little chance for the startup of secondary smelters and refineries in the United States.[83] ■

[83] Janice L. Jolley, copper scrap industry specialist, interview with USITC staff, Dec. 6, 2002.

Power Generation and Transmission Equipment in the Latin American Market

John T. Cutchin[1]
cutchin@usitc.gov
(202) 205-3396

Judith-Anne Webster[1]
jwebster@usitc.gov
(202) 205-3489

Every country needs the basic infrastructure of electric power-generating facilities and transmission lines because industrial and commercial sectors as well as a rising standard of living depend on the availability of electricity. During the 1990s, Latin America represented one of the regions of most rapidly expanding electricity demand and, consequently, an attractive market for the equipment that generates and transmits this energy. Beginning in 2001, a series of developments dimmed the short-term prospects for the power generation projects in Latin America. Nevertheless, long-term prospects in the market look promising. This article[2] examines the market potential for power generation and transmission equipment in Latin America, considers factors influencing competition among U.S. and foreign suppliers, and presents profiles of leading markets in the region.[3]

Despite recent economic and fiscal constraints, Latin America[4] is expected by industry observers to remain an expanding market for power generation and transmission equipment[5] as the electricity resources of the region feel strain under unprecedented demand growth. Until recently, for example, a rapid rise in manufacturing and increased commercial and residential consumption in Monterrey, Mexico, contributed to a 10- to 12-percent annual growth rate for electricity demand in that city. In 2002, a downturn in the economy of

[1] The views expressed in this article are the author's. They are not the views of the U.S. International Trade Commission (USITC) as a whole or of any individual Commissioner. International trade analysts in the USITC Office of Industries assisting with market profiles include William Greene (Argentina), Ruben Mata (Mexico), Michelle Vaca-Senecal (Brazil), Norman Van Toai (Peru), and Judith-Anne Webster (Chile, Colombia, and Venezuela).

[2] The information in this article is based upon USITC staff interviews with representatives of equipment manufacturers, their customers (chiefly independent power producers), and international financial institutions; as well as a review of secondary sources including trade journals and publications, corporate web sites, independent studies, and official and public databases.

[3] Whereas this article focuses on market access and competitive conditions for U.S. manufacturers of power generation and transmission equipment throughout Latin America, a complementary study published by the USITC in Nov. 2000, focused on regulatory reforms in foreign markets for electric power services, including Argentina, Brazil, Chile, and Venezuela. See *Electric Power Services: Recent Reforms in Selected Foreign Markets*, Investigation No. 332-411, USITC publication 3370, Nov. 2002 (posted on USITC Internet site at *www.usitc.gov/webpubs.htm*).

[4] For the purpose of this article, Latin America has been defined as including Mexico and the countries in Central America, the Caribbean Basin, and South America.

[5] Power generation and transmission equipment consists of gas, steam, and hydraulic turbines; steam-generating boilers; electrical generators; gasoline- and diesel-engine driven generator sets; power transformers and circuit breakers; and related auxiliary equipment.

Mexico has resulted in a more moderate growth rate of 4 to 5 percent. Similar growth rates are prevalent throughout Latin America (analysts project the annual growth rate for electricity within the region as a whole to be 6 percent). With a gross domestic product (GDP) of about $2.0 trillion, Latin America's manufacturing activity as a share of GDP grew from 30 percent in 1999 to nearly 34 percent in 2001, a trend that is expected to continue. Computer and telephone use, a common indicator of economic development, has significantly expanded. The number of telephone lines has grown from 134 to 271 per 1,000 persons and ownership of personal computers has nearly doubled between 1999 and 2000.[6] Per capita consumption of electrical energy has almost doubled within the last 10 years.[7]

Another key element to the anticipated future growth of electricity demand has been the policies of state and local governments to improve electrical infrastructure. Current electrification rates within Latin America remain low, and many remote villages are without electric power.[8] Peru, for example, has an electrification rate estimated at 73 percent, among the lowest in Latin America, and it plans to improve its electrification rate to 90 percent by 2010.[9] Consequently, Peru's Rural Electrification Plan has been among the key forces prompting growth of the local power industry. Until 2002, Mexico presented an example of the successful expansion of a Latin American power generation system where, over the last 40 years, the Government has increased capacity by as much as 10 percent annually. As a result, the share of the population of Mexico that has access to electricity grew from 50 percent in 1960 to 95 percent by 2001. Over the next 5 years, it is anticipated that investments to augment power generation capacity in Mexico will require up to $120 billion. However, economic and political constraints may delay these investments.

Governments also are striving to improve aging power generation and transmission lines. For example, in Mexico approximately 40 percent of the power generating facilities is more than 30 years old. Industry observers note that transmission and distribution losses are considered excessive by international standards, and approximately 35 percent of all electricity transmitted is reportedly lost due to equipment inefficiencies and pilferage.[10] The Government of Mexico estimates that about 13 gigawatts (GW) of new capacity is needed at a cost of $25 billion through 2006.[11] Similar problems have occurred in Venezuela where a majority of the large power plants of the country has been operating since the 1950s and 1960s, and new units have not been added in the last 5 to 6 years. By 2004, the age of

---

[6] World Bank, "Latin America & Caribbean Data Profile," found at Internet address *http://devdata.worldbank.org/external/CPProfile.asp?SelectedCountry=LAC&CCODE=LAC&CNAME=Latin+America+%26+Caribbean&PTYPE=CP*, retrieved Dec. 11, 2002.

[7] Economic Commission for Latin America and the Caribbean, "Per Capita Consumption of Electrical Energy," found at *http://www.eclac.org/publicaciones/Estadisticas/1/LCG2151PB/c1_II.pdf,p. 88*, retrieved Dec. 16, 2002

[8] U.S. Department of State, *Country Commercial Guide: Colombia*, Mar. 2001, found at Internet *http://www.mac.doc.gov/atpa/Colombia/colombia_ccg2001.pdf*, retrieved Aug. 20, 2001.

[9] U.S. Department of Commerce, International Trade Administration, found at Internet address *http://www.stat-usa.gov/mrd.nsf/vw*, retrieved July 9, 2002, p. 3.

[10] Ivan Grillo, "Energy Company to Crack Down on Power Theft," *Mexico City News*, Oct. 8, 2002.

[11] George Baker and Eric R. Blume, "Zedillo's Revolution," *Electric Perspective*, July/Aug. 1999, pp. 24-36.

79 percent of Venezuela's indigenous thermogeneration capacity will be 20 years or older. Renovation of this capacity alone is reportedly estimated to cost at least $197 million.[12]

As a result, growth in demand for power generation capacity in many regions of Latin America for the foreseeable future is currently being projected at 6 percent annually. This growth rate is expected to continue until 2015. To meet anticipated demand, Brazil's total installed power-generating capacity is expected to grow from its current 58 GW to between 74 GW and 107 GW by 2009.[13] Collectively, as reported by various industry sources, it is projected that Latin American and Caribbean Basin countries will install 64 GW of new power generation capacity between 1998 and 2008 (about a $50 billion investment).

Trends in the Latin American Market

To meet the anticipated growth in electricity demand, the trend in Latin America has been toward privatization of state-owned electrical utilities, interconnection of electrical grids between countries, and a shift away from a traditional reliance on hydropower. Until recent years, most investment in power generation facilities in Latin America was directed towards hydroelectric complexes: dams, hydraulic turbines, and associated power plants. The United States does not produce large hydroelectric turbines, so most of this equipment was supplied to Latin America by producers in Europe and Japan.[14] The current market for power generation equipment in Latin America, however, is moving predominately towards power plants in which gas turbines (with, in certain cases, steam turbine supplements) are the principal method of generation. This is due in large part to the emerging supplies of natural gas in the region, as well as to the relative speed with which these facilities can be brought into operation. Consequently, the principal suppliers of power generation equipment to the region are major worldwide producers of gas turbine generator units, including Alstom Power, the General Electric Co. (GE), Mitsubishi, Rolls Royce, Siemens Westinghouse Power (Siemens), and Hitachi. Company profiles of these and other notable suppliers of power generation equipment to Latin America are presented in annex A at the end of this article.

One of the key changes in the structure of many of the power generation markets in Latin America over the last 10 years has been the shift away from state ownership toward private ownership. Because of the increase in electricity demand, coupled with a shortage of domestic capital, Latin American governments sought to attract foreign investment. Although Chile initially implemented privatization, Argentina is furthest along, with 60 percent of generation facilities, 100 percent of transmission facilities, and 70 percent of distribution networks owned by the private sector.[15] Although most countries reportedly have begun some type of privatization process, not all countries have progressed very far. Many countries have passed laws to open their energy sector to competition, but have not

---

[12] "Daily Power Losses Total $1.43 Million," *Business News Americas*, Dec. 28, 2000,

[13] U.S. Department of Commerce (USDOC), International Trade Administration (ITA), "Brazil, The Energy Division," found at Internet address *http://www.ita.doc.gov/td/energy/brazil1.html*, retrieved Oct. 21, 2002.

[14] General Electric supplies hydroelectric turbines to the Latin American market from its manufacturing subsidiaries in Canada and Brazil.

[15] "Latin American Power Guide," found at Internet address *http://www.platts.com/features/LatinAmericanpower/index.shtml*, retrieved Dec. 11, 2002.

yet implemented the necessary policies.[16] Those countries that are in the early stages of private involvement in their power generation systems include Brazil, Mexico, and Venezuela.

As a result of privatization, foreign capital has flowed into the power generation sector in Latin America. For example, until this year liberal interpretation of laws governing foreign participation in the electricity generation sector paved the way for foreign direct investment in power plants in Mexico.[17] Prominent among foreign investors are a number of U.S. electric utilities as well as some non-U.S. foreign utilities.[18] Leading investors in the region are Hydro Quebec, Chilectra, Spanish Endesa, Tractabel, Iberdrola, Electricite de France (EdF), and Applied Energy Services (AES). The increased pace of public utility privatization in the region made Latin America an attractive market for power generation equipment. These utility sales reflected efforts to increase the efficiency of indigenous electricity generators, introduce competition into certain markets, bring new investment capital and generating capacity into the region, and gain an influx of foreign exchange to reduce international debt.

The shift away from hydroelectric power as the primary method of generating electricity has also altered the market in Latin America by creating more demand for equipment used in gas- and coal-fired facilities. This development was predicated upon the fact that most of the major, easily dammed rivers in the region already have been developed; that severe cyclical droughts in the region occasionally have compromised the reliability of hydropower generation; and that new hydroelectric projects take many years to bring online and thus are not readily responsive to rapid changes in demand for electric power. The most significant complement to hydroelectric resources has been the use of newly developed natural-gas resources to fuel electricity generation plants. Natural gas, long ignored in some parts of Latin America, is emerging as a significant source of many nations' energy mix.[19] Argentina, Bolivia, Brazil, Chile, Mexico, and Peru have led the development of generation resources fueled by natural gas.

Another significant shift within the Latin American power generation sector has been a rebound in the number of interconnection projects underway throughout the region as countries determine that linking their electrical grids captures the synergies from the varying strengths of their respective generating assets.[20] For example, to meet under-served demand in its southwest, Venezuela's grid is joined with neighboring Colombia's, allowing

---

[16] Ibid.

[17] President Fox of Mexico made privatization of the electrical power industry a top priority after entering office in 2000. However, in April 2002, the Mexican Supreme Court ruled against the Fox Administration's interpretation of the law and also cast doubt on the constitutionality of privatizing the electrical power industry. In its last session, which ended in Dec. 2002, the Mexican Congress did not act on proposals to reform Mexico's electricity regulations that would have expanded conditions whereby privately owned power plants can supply electricity to the nation grid.

[18] U.S. Department of Energy (USDOE), Energy Information Administration (EIA), "Privatization and the Globalization of Energy Markets," found at Internet address *http://www.itcilo.it/english/actrav/telearn/global/ilo/frame/energy2.htm*, retrieved Dec. 11, 2002.

[19] Hector Gutierrez, "Developing the Natural Gas Industry in Latin America," presentation at Andean Energy '98, Miami, FL, Dec. 8, 1998.

[20] Interconnection is the joining of two energy grids to allow power to be sent over further distance and to be diverted to areas of greater need.

electricity trade between the two countries.[21] A recently completed Brazil-Venezuela interconnection that supplies power from Venezuela's Raul Leoni hydroelectric plant to Boa Vista, the capital of Brazil's Roraima state, reportedly transports 200 megawatts (MW) of power.[22] The Inter-American Development Bank (IDB) and other lending institutions are providing financial assistance to a project that will link the national electricity grids of Guatemala, El Salvador, Honduras, Nicaragua and Costa Rica over the next 5 years. As part of Mexico's "Puebla to Panama" development program, a pipeline will be built from Mexico's Campeche state to Guatemala that will supply natural gas to new co-generation plants providing electricity to the integrated Central American power grid.

Factors Influencing Competition

In the Latin American markets, several nonprice factors influence equipment sales. These include technical performance, delivery, financing, a local presence to develop personal relationships with equipment purchasers and regulators, product quality, after-sales service, adequate stocks of spare parts, and compliance with sales conditions and commitments. These considerations determine whether a particular supplier is invited to bid on larger projects and whether the purchaser includes a supplier's products in its suppliers manual.[23]

Long-established relationships and long-term contracts that discourage alternative suppliers have been key factors influencing trade and investment in Latin America's power generation sector. For example, having been active in Peru for decades, ABB Alstom and Siemens have developed a strong and loyal customer base, and consequently, most of Peru's power facilities and equipment were provided by ABB Alstom.[24] In recent years, however, as new investment has shifted towards natural-gas fired generation plants instead of hydropower facilities, the United States, where firms have a competitive advantage in gas-fired equipment, has become the leading supplier of power equipment to Peru. In Venezuela, U.S. industry sources indicate that U.S. companies currently have an advantage over other foreign suppliers due to their well-established relationships with purchasers and U.S. suppliers will likely be chosen to replace or upgrade older equipment.[25]

Exchange rates and interest rates are also important competitive factors for global suppliers of power generation and transmission equipment. U.S. manufacturers of thermoelectric power generation equipment found it very difficult to compete with Japanese and European firms during the 1980s and 1990s, due to both the strong U.S. dollar and these competitors' lower interest rate offers. For example, Japanese manufacturers, such as Mitsubishi and Hitachi, may be able to increase exports of replacement equipment to Latin American markets because the relatively low value of the yen and low interest rates in Japan make their equipment more affordable to Latin American customers.

---

[21] USDOE, EIA, "Venezuela: Country Analysis Brief," Mar. 2001, found at *www.eia.doe.gov/emeu.gov/cabs/venez.html*, retrieved June 16, 2001.

[22] "Ministry Confirms Interconnection for August," *BN Americas*, July 17, 2001.

[23] Yuri Flores, "Venezuela: Electrical Power Systems," *Industry Sector Analysis,* Sept. 1, 2000; and Mario Cedeil, "Colombia: Energy Services," *Industry Sector Analysis*, Apr. 1, 2000.

[24] USDOC, ITA, found at Internet address *http://www.stat-usa.gov/mrd.nsf/vw*, retrieved, July 9, 2002, p. 9.

[25] USDOE, EIA, "Venezuela: Country Analysis Brief," Mar. 2001, found at Internet address *www.eia.doe.gov/emeu.gov/cabs/venez.html*, retrieved June 16, 2001.

Another key competitive factor is the type of energy project under development. Leading U.S. equipment manufacturers indicate they are not particularly competitive in equipment for developing hydroelectric capabilities, as the industry has traditionally focused on fossil fuel-burning equipment (particularly gas turbines). Hence, in a market where hydroelectricity was the dominant energy source, power-generation equipment was supplied primarily by European manufacturers (or, in the case of Brazil, local subsidiaries of U.S. and European producers).[26] As a result, European producers have established themselves as the preeminent suppliers of hydro-related equipment to Argentina, Colombia, Brazil, Peru, and Chile. However, U.S. suppliers are steadily increasing their share of Latin American markets for power generation equipment as the market gradually shifts away from hydroelectric generation as its power base.

An important recent development that may limit the share of the Latin American power generation market supplied by exports from the United States is the emergence of domestic capabilities within the region. South American suppliers, particularly Brazilian firms that have expanded their capabilities within the last 5 years, may affect the cost-competitiveness of U.S. electric power systems suppliers due to lower labor rates and transportation costs. Colombia's domestic power generation equipment industry is also quite strong and may inhibit foreign companies from gaining a strong hold in Colombia. According to the U.S. Department of State, local producers supplied 58 percent of the Colombian market in 2000 for electrical power systems.[27] Many of the boiler systems currently operating in thermal power plants were locally produced and reportedly are competitive with U.S.-made boilers. In Argentina, domestically produced equipment accounted for 73 percent of the market in 2001. Equipment imported from the United States accounted for 36 percent of Argentina's total imports of power generation and transmission equipment in 2001.

The most significant force behind the development of new power generation and transmission facilities in Latin America in recent years has been the entry of independent power producers (IPPs) into the marketplace. Many of these companies are subsidiaries of U.S. or European electrical utilities; still others are engineering- or construction-oriented firms. The vast majority of these concerns gained their expertise in power plant construction while participating in U.S., European, or Asian markets for power generation and transmission infrastructure projects. These companies have few direct ties to manufacturers of power generation or transmission equipment, choosing instead to select equipment vendors based upon project requirements and other competitive factors. Profiles of the leading IPPs that are currently participating in the Latin American market for power generation and transmission equipment are presented in annex B at the end of this article.

U.S. Trade

The leading markets for U.S. power generation and transmission equipment in Latin America during 1996-2001 were Mexico, Brazil, and Colombia (table 1). The peak year for U.S. sales was 2001, largely due to a substantial increase in sales of power generation and transmission equipment to Brazil (accounting for 59 percent of equipment exports to the

[26] Further background is provided in USITC, *Market Developments in Mercosur Countries Affecting Leading U.S. Exporters*, USITC publication 3117, July 1998.
[27] U.S. Department of State, *Country Commercial Guide: Colombia*.

Table 1
Power generation and transmission equipment: U.S. exports of domestic merchandise to Latin America, by market, 1996-2001
(*Million dollars*)

Market	1996	1997	1998	1999	2000	2001	Total 1996-2001
Mexico	53	184	185	93	182	239	936
Brazil	18	80	70	37	17	536	758
Colombia	32	116	18	56	45	29	296
Argentina	32	33	76	20	6	12	179
Ecuador	95	33	14	1	3	8	155
Venezuela	19	7	31	36	44	10	146
Chile	30	20	13	32	3	5	104
Peru	20	5	11	7	4	5	51
Dominican Republic	7	1	17	8	10	9	51
Guatemala	3	5	22	1	9	8	47
Bolivia	1	([1])	4	39	2	([1])	46
Trinidad & Tobago	([1])	7	3	26	1	1	37
Honduras	3	2	7	2	3	19	35
Panama	4	1	16	3	5	3	31
Costa Rica	3	3	4	5	5	5	24
Nicaragua	3	1	13	([1])	([1])	5	22
Jamaica	1	5	2	3	2	2	16
Haiti	1	([1])	1	1	([1])	12	15
El Salvador	1	2	1	1	1	1	6
Belize	([1])	([1])	([1])	([1])	1	1	3
Suriname	([1])	1	([1])	([1])	([1])	([1])	2
Uruguay	([1])	([1])	([1])	([1])	([1])	([1])	1
Paraguay	([1])	([1])	([1])	([1])	([1])	([1])	1
Total	326	505	507	372	343	909	2,962

[1] Less than $500,000.

Note.–Data may not add to the totals shown due to rounding.

Source: Compiled from official statistics of the U.S. Department of Commerce.

region in 2001). A prolonged, severe drought forced Brazil to approve partnerships between regional utilities and foreign IPPs for the accelerated construction of co-generation and other thermal power plants to compensate for the reduced electricity output from its extensive network of hydroelectric plants. These events led to a surge in U.S. exports of power generation equipment to Brazil in 2001.[28]

Although U.S. exports to many markets in Latin America have followed a “boom and bust” cycle, particularly due to shipments in conjunction with the construction of major power projects, U.S. exports to Mexico during 1996-2001 have been fairly consistent. This, in part, reflects the strong growth of annual expansion of generating capacity from 1996-2001,

[28] The drought ended in 2002 just as the Brazilian economy slowed, largely due to uncertainty over the presidential election that year and future debt management. With the depreciation of the reál in fall 2002 and a sharp increase in interest rates, consumer spending and manufacturing output both decreased. In sharp contrast to 2001, Brazil experienced a surplus of generating capacity in 2002 and a shortage of foreign exchange to pay for equipment already in transit. As a result, Brazil reportedly ordered a halt to all construction of power plants in fall 2002. Presentation on financing power projects by Francisco Roberto Andre Gros, President, Petrobras, at the Latin American Financial Summit, Washington, DC, Oct. 2, 2002.

the proximity of U.S. suppliers to Mexican customers, and Mexico's greater use of thermal power sources in contrast to some other Latin American countries.

The leading equipment category exported to Latin America during 1996-2001 (table 2) was gas turbines and gas turbine generating sets (consisting of turbines and generators shipped together, table 3), principally shipped to Mexico and Brazil. These export trends through 2001 are attributed to two factors: a surge in the construction and rehabilitation of power plants following privatization in the industry and the entrance of U.S. companies as independent power producers. U.S. producers have traditionally been strong competitors in global markets for gas turbines and generators as reflected by the fact that these were the leading U.S. export within the power generation and transmission equipment category during 1996-2001, with $1.9 billion exported to Latin America (63 percent of the total exported to the region during the period).

Unreliable supply of electricity from national electrical grids, particularly as water levels in reservoirs dropped in 2001, explains the surge in exports of internal-combustion-engine driven generator sets, which jumped from $26 million in 2000 to $149 million in 2001, and accounted for 11 percent of total sector exports during 1996-2001. Caterpillar Corp. of Peoria, IL, is a major world supplier of these diesel-fueled portable generators. Markets for other types of equipment, such as transmission equipment (electrical conductors) and electricity meters were much more stable during 1996-2001.

Table 2
Power generation and transmission equipment: U.S. exports of domestic merchandise to Latin America, by product, 1996-2001

(*Million dollars*)

Product	1996	1997	1998	1999	2000	2001	Total 1996-2001
Gas turbines	69	156	217	133	88	338	1,001
Gas turbine generating units and other generating sets	141	150	137	106	42	302	878
Internal-combustion-engine driven generator sets	31	48	39	26	26	149	320
High-voltage electrical conductors	29	24	23	38	65	28	207
Electric generators over 10 MW	18	64	33	18	33	32	196
Electricity meters	16	19	20	22	42	43	161
Power circuit breakers and switchgear assembles	12	18	9	8	8	8	64
Steam turbines	3	16	6	7	28	2	61
Steam generating boilers	5	8	20	13	4	6	57
Power transformers rated above 10,000 kVA	3	3	2	2	5	1	16
Hydraulic turbines[1]	([2])	([2])	([2])	1	([2])	([2])	1
Total	326	505	507	372	343	909	2,962

[1] U.S. exports of hydraulic turbines ranged from $3,000 in 1997 to $676,000 in 1999, and totaled $1.1 million during 1996-2001.
[2] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3
Key types of power generation and transmission equipment

Product	Background and details
Turbines:	
Hydraulic	The blades or buckets of a hydraulic turbine are positioned along a long central rotating shaft (rotor) so that the force of water flowing through the penstock (pipeline) of a dam or down the course of a river applies rotational energy to the rotor, which drives the associated power generator. The most widely used hydraulic turbines are the Pelton wheel, the Francis turbine, and the Kaplan turbine. The Francis turbine, resembling a large disc with curved blades, is most common in large hydroelectric reservoir projects. Such turbines can weigh up to 172 tons and turn at approximately 90 revolutions per minute. A series of adjustable vanes (wicket gates), resembling vertical blinds, often encircle hydraulic turbines and help regulate the flow of water to control the output of the entire generating unit for optimum performance.
Steam	In the steam turbine, heat from the combustion of fossil fuels (notably coal, but also oil) or biomass (such as wood, municipal solid waste, and agricultural waste), or from a controlled nuclear reaction produces high-pressure steam in a boiler. This rapidly expanding steam is directed through several stages of blades attached to a rotor in the steam turbine to convert the linear motion of the steam into rotational energy. The rotor is connected to an alternating current (AC) generator, which when rotated converts the mechanical energy (torque) into electrical energy.
Gas	Typically smaller and more self-contained than steam turbines, gas turbines consist of a compressor, combustion area, and turbine section in their most basic configuration. Air is drawn from the atmosphere, compressed by blades in the compressor stage and forced into the combustion area where it is mixed with fuel introduced by injectors and ignited. The most common fuels are natural gas, kerosene, jet fuel, or propane. The high-pressure, high-velocity gaseous byproducts from the rapid expansion associated with combustion are directed by nozzles into the turbine section, where blades arranged on the rotor shaft convert the linear motion of the combustion gases into the rotational torque required to turn an attached AC generator. In the turbine or compressor, a row of fixed blades and a corresponding row of moving blades attached to a rotor is called a stage. Larger, land-based turbine generator units are typically of multistage design in which an initial stage (stages) powers the compressor and a later stage (stages) powers the external load.
Gas turbine generator sets	When a gas turbine is imported or exported with its associated generator attached on a common base or as part of the same shipment, the U.S. Customs Service classifies the equipment as a “generating set” because it is “more than” a gas turbine.
Auxiliary equipment, including combined-cycle and co-generation units	Auxiliary equipment such as intercoolers, regenerators, and reheaters may also be used to boost the thermal efficiencies of simple-cycle gas generator units above approximately 35 percent. The high costs of these systems, however, are sometimes prohibitive. Another method of increasing the overall efficiency of gas turbine generators is the combined-cycle power plant in which the high-temperature exhaust of one or more gas turbines is directed through heat recovery systems to produce a sufficient volume of steam to power an auxiliary steam turbine. The resulting total output is about 50 percent higher than that of a stand-alone gas turbine. Recent technological developments have enabled production of gas turbine generator units rated in excess of 200 megawatts (MW) with combined cycle ratings exceeding 300 MW. Heat from the high-temperature gases exhausted from gas turbines can also be recycled by heat exchange equipment to co-generate steam (for industrial or commercial processes), hot water, or air heat. Such installations are typically referred to as co-generation projects because they produce both electricity and other forms of useable energy.

Table 3—*Continued*
Key types of power generation and transmission equipment

Product	Background and details
Alternating current (AC) generators	A generator is an electrical device that converts mechanical energy (typically rotational torque) into electrical energy by means of electromagnetic induction. Induction occurs when an electrical conductor is passed through a magnetic field. A generator in its simplest form consists of a coil of insulated wire (magnet wire) wound around a central rotating shaft (the armature or rotor) and a stationary outer core of magnetic or electromagnetic material (the stator). As the armature is rotated by an external drive source (gas turbine or other prime mover) one side of the coiled wire passes through the magnetic field created by the stator, moving first in one direction and then in the other. This creates an alternating current (AC) that moves in one direction and then in another. Brushes resting on the slip rings attached to each end of the armature carry the induced electric current to an external circuit. To overcome a number of difficulties in constructing large AC generators, these devices are most often designed with stationary armatures and rotating electromagnetic rotors.
Power transformers	Power transformers are electrical devices used primarily to step up (increase) generation voltage levels (20,000 volts or higher) to transmission line voltages (138,000 volts or higher), or to step down (reduce) transmission line voltages to levels (13,800 or lower) appropriate for distributing electrical energy to residential, commercial, and industrial consumers. Higher voltages are desirable for long-distance transmission of electrical energy to significantly reduce electrical losses associated with the passage of an electrical current through an electrical conductor.
	A transformer is constructed of two or more coils of electrical wire wound around a core of laminated iron or steel. When a voltage is impressed on the input coil or primary winding of the transformer, a voltage (typically of a different value) is induced in the output coil(s) or secondary winding(s). The voltage induced in the secondary winding(s) is directly proportional to the ratio of the number of turns (revolutions) of the electrical conductor in the secondary winding relative to the primary winding. Thus, if there are twice as many turns in the secondary windings versus the primary windings the voltage into the transformer will be doubled (stepped up). The same is true in reverse, in which case, the output voltage would be reduced (stepped down) by one-half.
Power circuit breakers	Circuit breakers protect electrical equipment from catastrophic damage resulting from an excessive current overload. Overloads can result from a number of external factors including lightning strikes, short circuits, or excessive demand load. When the current level in an electrical circuit reaches a predetermined maximum, the circuit breaker automatically opens, thereby disabling the circuit through the separation of a set of electrical contacts within the breaker, which in high-voltage circuits are opened by electromagnetic, pneumatic, or hydraulic force. Opening the set of contacts in the breaker, however, collapses the electrical field in which the breaker is placed, thus producing an arc of high temperature, ionized gas which will continue to conduct an electrical current. The design of all breakers is principally determined by how the high-temperature gas arc is extinguished. In air-blast breakers, the most common type of high-voltage circuit breaker, the arc is extinguished with a high-pressure blast of compressed air, akin to blowing out a candle flame. Oil-filled circuit breakers contain a special oil that decomposes in the high heat of the arc, creating gas and other byproducts that rapidly expand and carry heat away from the arc until it is quenched.

Table 3—*Continued*
Key types of power generation and transmission equipment

Product	Background and details
Steam generating boilers	Steam generating boilers serve as heat transfer vessels when used in conjunction with electric power generating equipment by transferring the heat produced by the combustion of fossil or other fuels into water circulated through tubes around which combustion gases are passed (watertube design) or into water circulated around tubes through which combustion gases are directed (firetube design). In both designs, baffles effect the most efficient transfer of heat into the water to convert it into high-pressure steam, which can drive a steam turbine. Boilers for power generating applications are designed to withstand high steam pressures ranging from 75 to 300 pounds per square inch (psi). Depending upon the arrangement of the tubes, a boiler is a "one pass," "two pass," "three pass," or "four pass" design to indicate the number of times that combustion gases are conducted through the boiler before being vented. The furnace in which the fossil fuel is burned represents a single pass. Each subsequent 180 degree turn in the tubes farther from the furnace constitutes an additional pass. Each pass represents additional surfaces through which heat transfer can be effected and the resulting efficiency of the heat transfer process enhanced.
	Heat-recovery steam generating boilers are also used in conjunction with gas turbine generator units to recover the exhaust heat from the gas turbine for generating steam to power a separate steam turbine. In such an installation, two or more gas turbines typically provide the heat necessary to drive a single independent steam turbine in a combined cycle power plant. The advantage of this installation is that exhaust heat, normally vented to the atmosphere, can be converted into additional power, thus increasing the overall thermal efficiency of a generating facility.
Other power generating equipment[1]	Meters, instrumentation, and control equipment are used by the power generation industry to monitor and regulate the ongoing generation process, transmission towers, and transmission lines.

[1] Such equipment for use in power plants is not identified separately in the Harmonized Tariff System from similar goods used for other purposes.

Source: Compiled by USITC staff from various industry sources.

Outlook

Since the 1990s, privatization and deregulation of Latin America's electric power-generating and transmission sectors have provided foreign developers with access to developing markets for electricity. However, economic, political, and even weather-related developments over the last 2 years have combined to temper investor enthusiasm for many power projects in the region (see "Market Profiles" that follow). Nevertheless, Latin American countries will need to install 100,000 MW of new generating capacity through 2010 to accommodate the estimated growth in regional electricity demand.[29]

In order to meet anticipated long-term demand during this lull of investor confidence, Latin American countries are formulating new strategies to promote development of power generation capacity and are seeking alternative project-finance mechanisms. These

[29] Projection of a senior energy specialist at the International Finance Corp., the private-sector arm of The World Bank. Maria O'Brien, "Project Finance: Making the Connection, *LatinFinance*," May 2002, p. 21.

initiatives are intended to complement privatization efforts already in progress, a shift towards alternative energy sources, and development of regional interconnections.

To bolster investor confidence, host governments are taking a stronger role in directing the appropriate types of facilities to be built by private firms. For example, the Chilean CNE has indicated that it will support the construction of 10 combined cycle plants and 1 hydroelectric plant.[30] A rural electrification program sponsored by the Peruvian Government consists of a portfolio of projects, including 36 rural transmission lines, 270 small electricity systems, 36 small-scale hydroelectric facilities, and 211 thermal generators, anticipated to cost $4.0 billion by 2007.[31] The Ministry of Energy in Mexico has designated $2.3 billion towards renewable energy projects through 2010. Despite the Mexican Government's historic resistance to private participation in the energy sector, the Ministry granted permission to a Mexican company to construct a wind power generation plant near Mexico City with five more such projects currently under consideration.[32] In Brazil, the Federal Government granted a 1-year extension to the required start-up date for new gas-fired generating plants. This extension allows many planned projects, which otherwise would have been cancelled, to continue as part of the Thermal Electric Priority Program.[33]

Following the decline of private investment in the region, funding from multilateral institutions for the power generation and transmission projects needed to meet anticipated long-term demand has grown. For example, the IDB is funding a major interconnection project in Central America.[34] Likewise, the International Monetary Fund recently approved an $18-million loan to finance two transmission lines connecting previously unserved Amazonian regions in Peru.[35] In addition, the Argentine government and the World Bank are implementing a project that will supply electricity to about 70,000 rural households and 1,100 provincial public service institutions.[36] Latin American governments are also adopting alternative project finance mechanisms. For example, the Rural Electrification Program in Peru will be financed through a 2-percent tax on the profits of certain electricity generation, transmission, and distribution companies.[37] In Mexico, the Federal Government plans to phase out electricity subsidies, which cost $6.8 billion in 2001, and redirect the savings towards upgrading the country's electricity infrastructure.[38]

---

[30] "Chile," *Platts Latin American Power Guide*, Sept. 2002, found at *http://www.platts.com/features/latinamericanpower/chile.shtm*l, retrieved Dec. 27, 2002.

[31] "Peru," *Platts Latin American Power Guide*, Sept. 2002, found at *http://www.platts.com/features/latinamericanpower/peru.shtml*, retrieved Dec. 27, 2002.

[32] "Mexico," *Platts Latin American Power Guide*, Sept. 2002, found at *http://www.platts.com/features/latinamericanpower/mexico.shtml,* retrieved Dec. 27, 2002.

[33] "Brazil," *Platts Latin American Power Guide*, Sept. 2002, found at *http://www.platts.com/features/latinamericanpower/brazil.shtml*, retrieved Dec. 27, 2002.

[34] "Central American Interconnection System," Inter-American Development Bank, found at *http://www.iadb.org/exr/doc98/apr/rg1001e.pdf*, retrieved Dec. 30, 2002.

[35] "Peru - Letter of Intent and Technical Memorandum of Understanding," found at *http://www.imf.org/external/np/loi/2002/per/01/index.htm*, retrieved Dec. 30, 2002.

[36] "Argentina, Project Profile," World Bank, found at *http://www4.worldbank.org/sprojects/Project.asp?pid=P045048*, retrieved Dec. 30, 2002; and "Renewable Energy in the Rural Market Project Profile," found at *http://www4.worldbank.org/sprojects/Project.asp?pid=P006043*, retrieved Dec. 30, 2002.

[37] "Peru," *Platts Latin American Power Guide*.

[38] "Mexico," *Platts Latin American Power Guide.*

These strategies may support U.S. export opportunities during the current lull and provide a solid foundation for U.S.-based investors when these economies rebound. Key opportunities for U.S. exports include transmission infrastructure equipment as Latin American countries seek to improve rural electrification and limit blackouts by upgrading older transmission lines and installing new ones (particularly in Colombia, Mexico, Peru, and Venezuela). This equipment includes switches, insulators, electrical connectors, and batteries. Also, gas and steam turbine generators (regionwide) remain a leading opportunity for U.S. firms as thermal replacements to traditional (and weather-vulnerable) hydroelectric capacity. Finally, equipment such as diesel and gasoline engine-driven generator sets will be needed as rural villages and industrial sites (such as mines and gas wells) not yet connected to the electrical grid will require electricity.

Market Profiles

Seven of the largest Latin America economies (in terms of GDP) were selected for more detailed assessment of market trends, market competitiveness factors, and U.S. export sales for power generation and transmission equipment. Economic performance is a key determinant of demand for power generation equipment. Indicators of economic performance in each of these markets are provided in table 4.

Table 4
Economic indicators for selected Latin American markets, 2001 (unless otherwise noted)

Indicator	Mexico	Brazil	Argentina	Venezuela	Colombia	Chile	Peru
Gross domestic product (GDP) (*billion dollars*)	618.2	503.7	268.7	128.4	82.4	66.5	54.0
Real GDP growth (*percent*):							
2001	-0.3	1.5	-4.4	2.8	1.4	2.8	0.2
2002e	1.7	1.6	-14.3	-4.8	1.4	2.7	3.3
2003f	4.6	3.5	0.8	1.2	2.9	4.7	3.8
Population (*millions*)	100.4	172.9	37.5	24.6	43.1	15.4	26.3
GDP per capita (*dollars*)	6,157	2,913	7,165	5,220	1,913	4,318	2,053
Inflation (*percent*):							
2001	4.4	7.7	-1.5	12.3	9.0	2.6	-0.1
2002e	4.8	5.9	83.3	31.9	6.4	2.6	1.6
2003f	3.7	4.5	52.9	25.0	5.8	2.9	2.4
Exchange rate (*currency per U.S. dollar*):							
2001	9.16	2.32	1.00	758	2,278	661	3.44
2002e	9.85	2.57	5.13	1,475	2,513	673	3.54
2003f	10.22	2.70	6.38	1,735	2,685	678	3.60
Current account as a share of GDP (*percent*):							
2001	-2.9	-4.6	-1.6	3.4	-2.0	-1.9	-2.2
2002e	-2.3	-3.9	8.3	4.5	-2.6	-1.4	-2.0
2003f	-2.6	-3.9	9.2	4.1	-3.0	-1.9	-2.4
International reserves (*billion dollars*)	44.7	35.7	14.5	9.2	10.2	14.2	8.7
Trade (*billion dollars*):							
Exports	158.5	58.2	26.7	27.4	12.3	18.5	7.1
Imports	168.3	55.6	20.3	16.2	12.8	17.8	7.2

Note.–e indicates estimate and f indicates forecast.

Source: Mike Zellner, “2003 Forecast: Playing the Rebound,” *Latin Trade*, Oct. 2002, pp. 38-41.

Mexico

- Mexico is the largest market for U.S. exports of power generation and transmission equipment in Latin America (see table 1). To meet a projected 4- to 5-percent average annual growth in electric power demand during this decade, the Mexican power sector will require $70 billion in investment, with $50 billion from foreign sources. Forty percent of the power generating facilities are more than 30 years old and need to be replaced.

- Unlike other leading markets in Latin America, the electric power utilities in Mexico have not been privatized. Further, Mexico is the most reliant on thermal-based power generation plants for electricity, giving U.S. equipment suppliers an advantage over European and Japanese equipment producers.

Trends in the Mexican Market

- Expansion of the electric power system has increased the share of Mexico's population that has access to electricity from 50 percent in 1960 to 95 percent in 2001. Industrial users account for 60 percent of demand, whereas residential demand accounts for less than one-quarter of total demand.

- In 2001, total investment in electric energy projects in Mexico amounted to $4.5 billion, up 8.3 percent from 2000. Of this amount, $2.5 billion was derived from private industry, a 34-percent increase over 2000 electric power investment, and the first time in 5 years that private investment had outstripped investment by Comision Federal de Electricidad (CFE), Mexico's principal state-owned electricity utility.[39] Mexico's power generating capacity was 43 gigawatts (GW) in 2001, but CFE estimates that the country will need 13 GW of additional capacity by 2006 at a cost of $25 billion.[40]

- Rapid industrial development associated with the cross-border integration of manufacturing in North America led to sustained GDP growth in Mexico and rising demand for electricity during 1996-2000. Increasing labor costs in Mexico and the slowdown of the U.S. economy, however, resulted in minimal growth of the Mexican economy in 2001 and 2002. These recent developments have not altered the urgency that the Mexican Government places on the development of additional generation resources and the modernization of the aging electricity transmission network.

- The electric power system is burdened by inefficiencies and other growing impediments. Transmission and distribution losses are considered excessive by international standards. Approximately 25 percent of all electricity transmitted is reportedly lost to pilferage, technical problems, and poor accounting management.[41]

---

[39] "Ministry: Energy Investment on Track to Avoid Crisis -Mexico," *Business News Americas*, Sept. 20, 2001.

[40] George Baker and Eric R Blume, "Zedillo's Revolution," *Electric Perspective*, July/Aug. 1999, pp. 24-36.

[41] In 2001, Luz y Fuerza del Centro (the utility supplying Mexico City) reported 25 percent losses because of faulty transmission lines or unauthorized access, which cost the company $690 million. Ioan Grillo, "Energy Company to Crack Down on Power Theft," *The Mexico City News,* Oct. 8, 2002.

- In recent years, escalating electricity costs have begun to reduce the international competitiveness of goods produced in Mexico. The absence of an open electric power market, coupled with discounted rates on electricity to agricultural and residential consumers, have created electricity rates for industrial customers that are above international averages.[42]

Privatization and Foreign Participation in the Electricity Sector

- The Mexican Constitution mandates that all electricity be owned and distributed by two vertically integrated state-owned companies, CFE and Luz y Fuerza del Centro (LYF).[43] Foreign firms are not permitted to participate in the transmission or distribution of electricity to national grid customers. However, the private sector may engage in electrical power generation by participating in the CFE's bidding process, "inside-the-fence" bids, and evaluating or developing small power-generation projects.[44]

- In 1992, the Government of Mexico amended its electrical energy law to permit private investors, such as independent power producers (IPPs), to build and own power generating facilities. Power from these facilities can be purchased by Mexican industrial companies or sold under long-term contracts to CFE in wholesale transactions. Electric power also may be exported or imported by large users or groups of users after rerouting the electricity through the public transmission grid.[45]

- By Presidential Decree on May 24, 2001, the Government of Mexico authorized "self suppliers" (companies with specified "off the grid" customers) to sell up to 50 percent of their excess electricity to the CFE; previously CFE could buy no more than 20 MW from any one self supplier.[46] Companies using more efficient co-generation technology could supply all of the electricity they generated to the national grid.

- In late May 2002, the Mexican Supreme Court ruled that Mexican law permits private companies to sell minimal amounts of excess production after meeting captive consumption, but dismissed the Fox administration interpretation of the law that would have permitted IPPs with self-supply permits to sell large amounts of power to the CFE. The ruling places an estimated $9.29 billion in power generation investments from 1994-2002 in legal limbo and permits the Mexican Congress to annul all private sector investments in the power generation sector, potentially forcing CFE to buy back all foreign investments in the power generation sector.[47]

---

[42] David Shields, "Government Prepares Energy Reform," *Mexico City News,* Mar. 8, 2001.

[43] CFE generates 92 percent of the country's electricity and serves approximately 16.5 million customers, whereas, LYF generates just over 2 percent of the power, distributing it to 4.9 million customers nearly all in the Mexico City metropolitan area. Pemex generates 4 percent and the remaining 2 percent is generated by the private sector.

[44] U.S. Department of State telegram 001219, "Energy Sector Scene-Setter for the February 16 Presidential Meeting at San Cristobal," prepared by U.S. Embassy, Mexico City, Feb. 14, 2001.

[45] U.S. Department of State telegram 0056122, "2001 Investment Climate Statement For Mexico," prepared by U.S. Embassy, Mexico City, July 11, 2001.

[46] U.S. Department of State telegram 005397, "Mexican Congress Challenges Presidential Authority in Electric Sector," prepared by U.S. Embassy Mexico City, June 29, 2001.

[47] "Supreme Court Rules Against Private Generation Investments - Mexico," *Business News Americas*, May 29, 2002.

- In response, the Fox administration proposed new electric industry reform legislation in July 2002. The bill would have permitted the publicly owned electrical utilities to contract out generation services to privately owned power plants and would have allowed certain industrial customers the choice of purchasing electricity from the two government monopolies or from private distributers.[48] The bill would have provided transparent regulations and incentives to private operators to minimize operating costs and to expand the generation and distribution system, but did not include the privatization of either CFE or LYF.[49] The Mexican Congress, however, adjourned in December 2002 without acting on the proposal.[50]

- Due to the Mexican Government's shortage of resources to invest in power plants, the CFE has been awarding contracts to private investors to undertake most of the needed power generation expansion. CFE's contracts with IPPs for these projects typically have a maximum duration of 25 years. As of February 2001, 12 IPP permits had been issued for a total investment of $3 billion. The IPP projects are expected to add an estimated 13,529 MW of capacity by 2005.

Other Factors of Competition

- CFE is responsible for overseeing 183 generating plants and 75,000 employees.[51] CFE plans to invest $50 billion over the period 2001-10 to increase its generating capacity by another 27 GW, using predominantly conventional fuel sources. According to government officials, 20.5 GW of the total 26-GW increase would be provided by 47 combined-cycle natural gas plants, with coal power generation plants adding another 1.9 GW. Other future power generation projects include six diesel plants (166 MW), three geothermic (115 MW), five turbogas (517 MW), and five hydroelectric sites (3.2 GW).[52]

- Mexico's interconnected national electric transmission grid (32,250 km) is controlled and managed by CFE. CFE planned to accept bids on 18 tenders in 2002 for private companies to build new transmission lines to augment the country's aging grids. Approximately, 430 miles of new lines are planned for northern Mexico with work commencing May 2002 and concluding November 2003. In the southeast and northeast,

[48] Latin American Weekly Report, "Electrical Sector Reform Still on Hold,"*Latin American Newsletters,* July 16, 2002, p. 327.

[49] David Shields, "Government Prepares Energy Reform," *Mexico City News,* Mar. 8, 2001, pp. 1-2.

[50] PRI Senator Bartlett, Chairman of the Energy Committee, reportedly stated at the end of the Congressional session on Dec. 31, 2002, that no legislative action on electricity reform would be taken in 2003 as well, provided the PRI and PRD collectively retain control in the Mexican Congress following the 2003 midyear election. *Mexico City News*, Dec. 31, 2002.

[51] David Shields, "CFE Presses Ahead With Plan to Boost Mexico's Energy Capacity," *Mexico City News,* Oct. 3, 2001.

[52] U.S. Department of State telegram 08759, "Enviropro Conference Focuses on Mexican Air Quality, Water, Energy, and Development," prepared by U.S. Embassy, Mexico City, Oct. 25, 2001.

the grids are over extended such that new power generation cannot be added without bolstering the transmission network.[53]

- Since 1997, numerous major international companies, such as Electricite de France, Iberdrola[54] and Union Fenosa of Spain, Transalta of Canada, Tractebel of Belgium, and AES and InterGen of the United States, have made major power generation investments in Mexico's electrical industry.[55] All of the facilities put in place by the IPPs have been powered by gas, steam, or combined cycle (table 5). Mexico's investment in thermal powered facilities rather than hydroelectric plants affords U.S. companies a better chance to compete for equipment sales.

Table 5
Mexico: Leading participants in the power generation sector

Owner/operator	Facility type (*Ordered by capacity generated*)	Number of facilities per category	Capacity (*Megawatts*)
Comision Federal de Electricidad (CFE)			35,908
	Steam turbine	168	21,206
	Hydroelectric	184	9,870
	Gas turbine	100	4,757
	Diesel engine	105	275
Iberdrola (Spain)	Combined cycle	4	2,520
Electricite de France (EdF)			2,158
	Gas turbine	6	1,088
	Steam turbine	2	170
Union Fenosa	Combined cycle	4	1,484
InterGen Corp. (United States)			1,300
	Steam turbine	4	700
	Gas turbine	3	600
Mitsubishi International Corp. (Japan)		2	906
Luz y Fuerza del Centro (LYF)			902
	Gas turbine	11	381
	Hydroelectric	40	293
	Steam turbine	4	228
Sithe Energies (United States)	Steam turbine	3	730
Sempra Energy International (United States)	Combined cycle	1	600
AES (United States)			480
	Gas turbine	2	320
	Steam turbine	1	160
Total			46,988

Source: Compiled by the United States International Trade Commission (USITC) from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

[53] USDOE, EIA, "An Energy Overview of Mexico," found at Internet address *http:www.doe.gov/international/mexiover.html*, retrieved Nov. 22, 2002.

[54] Iberdrola announced in Dec. 2002 that it had awarded a contract to the U.S.-Mexican industrial-engineering joint venture ICA Flour Daniel to construct a 498 MW gas-fired combined-cycle power plant in the State of Durango, to be completed in Apr. 2005. "ICA-Flour Daniel Snags Power Plant Deal," *Mexico Watch*, Jan. 1, 2003, p. 13.

[55] David Shields, "Power Plant Developers Are Uneasy on Legal Issues," *Mexico City News,* May 29,2002.

- U.S. firms have traditionally maintained a strong presence in the Mexican power generation market, particularly in the supply of turbines and generators. Major turbine and generator competitors in Mexico typically provide CFE with long-term competitive financing, exceptional after-sales service, and competitive pricing.

- Of the 22 leading non-CFE power generation projects in Mexico scheduled for completion by the end of 2003, table 6 lists the suppliers of turbines and/or generators for 14 projects. Although IPPs may tend to purchase equipment from their home regions, there are certainly many exceptions in the case of projects in Mexico.

- A recent shortage of natural gas and electricity in the U.S. market and the collapse of the U.S. power trading market likely have contributed to the low level of interest by U.S. companies in new projects offered by CFE.[56] Of the 12 IPP projects in progress, 10 are in northern Mexico; 5 of these are totally dependent on natural gas imported from the United States, whereas the other 5 are partially dependent on U.S. imports.

- To address the issue of reliance on relatively high-priced natural gas from the United States in most of Mexico's newest power generation facilities, three groups of investors are seeking approval from the Government of Mexico to build separate port facilities in Baja California to receive liquid natural gas (LNG) from Indonesia and Ecuador, and to construct pipelines to supply natural gas to power plants that would furnish electricity to customers in both the United States and Mexico. In addition, CFE plans to build an LNG terminal along Mexico's Gulf Coast in the state of Tamaulipas to supply natural gas to its power generation plants by 2006.[57]

U.S. Exports to Mexico

- U.S. exports of power generation and transmission equipment to Mexico totaled $936 million during 1996-2001, peaking at $239 million in 2001 (table 7). Gas turbines, large generators, and gas turbine and other generating sets accounted for 69 percent ($642 million) of all U.S. exports of power generation equipment to Mexico during the period.

- The upward trend in U.S. exports to Mexico reflects increased FDI in combined cycle plants, particularly by the Spanish and French utilities that are the most active IPPs in Mexico and by U.S.-based InterGen. Fairly consistent year-to-year shipments of high-voltage electrical conductors accounted for 16 percent ($151 million) of all U.S. exports during the period, reflecting CFE efforts to upgrade Mexico's transmission grid.

---

[56] USDOE, EIA, "Mexico Country Analysis," Feb. 2001.

[57] "Business Moves," *Mexico Watch*, Dec. 1, 2002, p. 15. In addition, three pipelines are under construction to supply natural gas from the United States to power generation plants in northern Mexico owned by Iberdrola, El Paso Energy, and EdF. "Corporate Monitor," *Mexico Watch*, Dec. 1, 2002, p. 11.

Table 6
Mexico: Leading projects in the power generation sector other than Comision Federal de Electricidad (CFE)[1]

Project	Capacity (*Mega-watts*)	Facility	Location	Year	Owner/ operator	Principal equipment suppliers	
						Turbines	Generators
Tuxpan Fenosa I & II	1,048	Combined cycle	Tuxpan, Veracruz	2003	Union Fenosa (Spain)	TBD	General Electric (GE)
Altamira III & IV	1,036	Combined cycle	Altamira, Tamaulipas	2003	Iberdrola (Spain)	TBD	TBD
Monterrey III	1,000	Combined cycle	Pesqueria, Nuevo Leon	2002	Iberdrola	Alstom (France)	Alstom
Rosarito	750	Combined cycle	Rosarito, Baja California	2003	InterGen (Netherlands & US)[2]	TBD	TBD
Samalayuca II	700	Combined cycle	Samalayuca Chihuahua	2002	El Paso Corp. (US) InterGen	GE (US)	GE
Electricidad de Veracruz	651	Cogenerat ion	Boca del Rio, Veracruz	2003	Ispat Group (Mexico) & Iberdrola[3]	TBD	GE
Thermoelectrica de Mexicali	600	Combined cycle	Mexicali, Baja California	2003	Sempra Energy International (US)	TBD	TBD
Bajio	600	Combined cycle	San Luis de la Paz, Guanajuato	2003	InterGen[4]	GE	GE
Rio Bravo	569	Combined cycle	Rio Bravo, Tamaulipas	2001	Electricite de France (EdF)	Westinghouse (US)	Westinghouse
Rosarito IV	550	Natural gas	Rosarito, Baja California	2003	InterGen	Alstom	Alstom
Altamira II	525	Combined cycle	Altimira, Tamaulipas	2003	EdF	Mitsubishi Heavy Industries (MHI) (Japan)	Mitsubishi Electric Co. (Melco) (Japan)
El Aguila (T2)	495	Combined cycle	Veracruz City, Veracruz	2002	Mitsubishi International (Japan)	MHI	Melco
Saltillo	495	Combined cycle	Ramos Arizpe, Coahuila	2001	EdF	ABB (Switzerland)	ABB
Monterrey II	484	Combined cycle	Monterrey, Nuevo Leon	2001	Iberdrola	Not available	Not available
Merida III	480	Gas & steam turbine	Merida, Yucatan	2000	AES (US)	Siemens (Germany)	Westinghouse
Rosarito III	450	Combined cycle	Rosarito, Baja California	2002	ABB Energy Ventures (Switzerland)[5]	Alstom	Alstom

Table 6—*Continued*
Mexico: Leading projects in the power generation sector other than Comision Federal de Electricidad (CFE)[1]

Project	Capacity (*Mega-watts*)	Facility	Location	Year	Owner/ operator	Principal equipment suppliers: Turbines	Generators
El Encino	411	Combined cycle	Chihuahua City, Chihuahua	2002	Mitsubishi International	MHI	Melco
Naco-Nogales	302	Combined cycle	Naco, Sonora	2002	Union Fenosa	Not available	Not available
Chihuahua III	259	Combined cycle	Samalayuca Chihuahua	2003	TransAlta (Canada)	TBD	TBD
Campeche	252	Combined cycle	Palizada, Campeche	2003	TransAlta	Westinghouse	Westinghouse
Hermosillo Fenosa	250	Combined cycle	Hermosillo, Sonora	2001	Union Fenosa	ABB	ABB
Tamuin Golfo	250	Steam turbine	San Luis Potosi	2003	Sithe Energies (US)	Alstom	Alstom

[1] Includes all non-CFE projects with a current or projected capacity of 250 megawatts or greater by the end of 2003.
[2] Aztec Energy Group (Mexico) is a partner in this project.
[3] Kimberly Clark de Mexico (U.S./Mexico) is a partner in this project.
[4] AEP (U.S.) is a partner in this project.
[5] Niisho Iwai (Japan) is a partner in this project.

Note.–For several projects still under construction, the supplier for the turbines and generators had yet to be determined (TBD) as of fall 2002.

Source: Utility Data International and the Government of Mexico's Secreatariat of Energy, "Investment Opportunities in Mexico's Electricity Sector," found at internet address http://www.energia.gob.mx/ingles/electricity___.1.html., retrieved May 7, 2002.

Table 7
Mexico: U.S. exports of power generation and transmission equipment, by product, 1996-2001

(*1,000 dollars*)

Product	1996	1997	1998	1999	2000	2001	Total 1996-2001
Gas turbines	5,097	73,962	95,068	10,026	57,493	95,356	337,002
Gas turbine and other generating sets	3,441	27,486	34,547	28,806	36,218	75,117	205,615
High-voltage electrical conductors	26,182	18,430	20,964	31,399	29,907	23,960	150,842
Electric generators over 10 MW	2,222	42,786	16,126	1,209	18,669	18,612	99,624
Electricity meters	2,523	2,934	4,559	10,480	16,239	15,964	52,699
Internal-combustion-engine driven generator sets	6,306	7,475	8,381	6,400	8,435	6,206	43,203
Power circuit breakers and switchgear assemblies	6,146	6,350	1,720	2,164	3,022	1,408	20,810
Steam turbines	148	2,383	604	692	7,596	1,198	12,621
Steam generating boilers	1,053	1,739	1,310	1,860	1,291	1,114	8,367
Power transformers rated above 10,000 kVA	167	([1])	1,184	410	2,700	151	4,612
Hydraulic turbines	([1])	3	68	44	9	20	144
Total	53,286	183,547	184,532	93,490	181,577	239,108	935,540

[1] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Brazil

- U.S. exports of power generation and transmission equipment to Brazil surged in 2001 as State and Federal institutions facilitated investments from foreign IPPs in thermal power-generating plants as several years of drought drastically reduced the generating capacity of Brazil's hydroelectric facilities. The market collapsed in 2002, however, as rains filled reservoirs, electricity rationing reduced consumption patterns, and industrial power usage declined in the midst of the falling value of the reál.

- Authority over the generation, transmission, and distribution of electricity in Brazil has largely devolved to the States and regional authorities. Typically, foreign IPPs desiring to participate in the Brazilian power markets must enter bids for the right to build or upgrade power plants and to sell electricity to State and regional authorities (or to licensed independent power transmitters and distributors) under a regulated price structure.

Trends in the Brazilian Market

- Brazil had the second-largest GDP in Latin America in 2001 (see table 4) and was the second-leading market for U.S. exports of power generation equipment (see table 1). Brazil's economy grew 1.5 percent in 2001 and was projected to advance at a similar pace in 2002 prior to the flight of capital and the steep depreciation of the reál associated with uncertainty regarding governmental policies that might follow the fall 2002 Brazilian presidential election.

- Endowed with two of the great river systems of the world (the Amazon and the Paraná), Brazil's electricity sector has focused on the development of hydroelectric resources. As a result, hydroelectric facilities supply 92 percent of Brazil's electricity needs. As noted above, periods of drought, however, can lead to critical shortages of electricity to meet the nation's residential and industrial needs.

- Although drought-induced electricity shortages were forecast in 2000, the Brazilian Congress initially was reluctant to pass legislation easing the way for greater FDI in the power generation sector but later enacted reforms after manufacturers started closing plants because of electricity blackouts. Whereas Brazil accounted for only 5 percent ($17 million) of all U.S. exports of power generation equipment to Latin America in 2000 (see table 1), the next year, Brazil accounted for nearly three-fifths ($536 million) of the total.

- Given recent market developments (i.e., the end of the drought) and election results in Brazil, however, the surge in U.S. exports of power generation equipment in 2002 may not reflect the beginning of a new trend. After the election of Luis Inacio Lula da Silva as President in fall 2002, reported details of the Workers' Party Energy Plan indicated that the Party favors continued emphasis on the expansion of hydroelectric capacity and views thermal-powered plants only as a complement to hydro resources.[58]

---

[58] E-mail correspondence to USITC staff from the Senior Commercial Specialist, U.S. & Foreign Commercial Service (USFCS), U.S. Consulate, Rio de Janeiro, Brazil, Dec. 19, 2002.

- A U.S. & Foreign Commercial Service (USFCS) representative in Rio de Janeiro has concluded that if President Lula endorses the Workers' Party Energy Plan, IPPs could have little financial incentive to invest in power plants fueled by natural gas and likely would invest in hydroelectric facilities instead.[59] Such a result could move the market away from the strength of U.S. equipment exporters and toward the strength of European and Japanese equipment producers, several of whom already have manufacturing subsidiaries in Brazil. GE is also well positioned to take advantage of this development through its production facilities in Brazil. Despite this potential development, USFCS officials predict that the market will be strong for power system upgrades as IPPs attempt to meet contractual obligations to ANEEL, Brazil's electric power regulatory authority.[60]

Privatization and Foreign Participation in the Electricity Sector

- Prior to 1995, virtually all of Brazil's electricity sector was controlled by Federal-, regional-, or State-owned monopolies. Legal guidelines encouraging reform of the sector were passed by Congress during the 1980s through 1995, paving the way for privatization.

- Privatization has come in the form of licenses or permits granted by individual states or regional entities, operating under federal guidelines.[61] The first foreign company to win an auction of a generating asset under Brazil's privatization program was Endesa (Spain) in 1997, followed by Tractabel (Belgium) in 1998, and U.S. firms Duke and AES in 1999.

- Brazil's drought of 1998-2001, high dependence on hydroelectric power, and subsequent rolling blackouts in 2001 sped up the privatization process, opening up bids, licenses, and permits to foreign-based IPPs. Simultaneously, the government initiated a power rationing program from June 2001 through March 2002.[62]

- In conjunction with the electricity crisis, the Government of Brazil encouraged completion of a natural gas pipeline connecting gas fields in Bolivia with gas-fired power plants under construction in southern Brazil. New power plants in that region were also supplied with natural gas via an existing pipeline from Argentina.[63] A pipeline

[59] Ibid. Hydroelectric generating capacity in Brazil had been projected by the U.S. Department of Commerce (USDOC) to grow from 58 GW in July 2002 to between 74 and 107 GW by 2009.

[60] USDOC, USFCS, "Country Commercial Guide: Brazil," June 2002.

[61] For more information about the privatization process and regulatory environment in Brazil, see U.S. International Trade Commission, *Electric Power Services: Recent Reforms in Selected Foreign Markets*, Investigation No. 332-411, USITC publication 3370, Nov. 2002 (posted on USITC Internet site at *www.usitc.gov/webpubs.htm*).

[62] USDOE, EIA, "Country Analysis Brief: Brazil," found at *http://www.eia.doe.gov/emeu/cabs/brazil.html*, retrieved on Dec. 18, 2002.

[63] According to USDOE's EIA, Brazil has two existing international pipeline connections: the Bolivia-to-Brazil pipeline and the *Transportada de Gas del Mercosur*. Additional Argentina-Brazil pipelines are in the planning phase pending discoveries in Bolivia and Brazil.

connecting gas fields in Venezuela and Brazil's perpetually drought-prone Northeast is still under consideration.[64]

- Nearly all of the IPPs profiled in annex B have participated to some extent in the Brazilian energy market. Brazilian laws encourage investors to form consortiums, with at least one partner based in Brazil. The result has been a myriad of partnership combinations.

- Despite the flurry of investment activity by foreign IPPs in 2001, all of the leading suppliers of electricity to the Brazilian market are utilities that are at least partially owned by State Governments or regional authorities (table 8). IPPs may have minority stakes in these entities. All of the leading power generators are heavily reliant on hydroelectric facilities.[65]

Table 8
Brazil: Leading participants in the power generation sector

Owner/operator	Facility type (*Ordered by capacity generated*)	Number of facilities per category	Capacity (*Megawatts*)
Itaipu Binacional (Brazil/Paraguay)	Hydroelectric	1	13,320
CIA Hidro Do Sao Francisco			10,412
	Hydroelectric	14	10,237
	Gas turbine	1	175
Furnas Centrais Eletricas SA			7,848
	Hydroelectric	12	7,218
	Steam turbine	2	630
CA Energia Minas Gerais (CEMIG)			6,106
	Hydroelectric	35	5,901
	Diesel engine	1	1
	Wind	1	1
	Steam turbine	2	204
Centro Eletrica Do Norte Do Brasil			4,897
	Hydroelectric	5	3,930
	Diesel engine	4	142
	Gas turbine	7	675
	Steam turbine	1	150
CIA Paranaense De Energia Eletrica			4,624
	Hydroelectric	21	4,604
	Steam turbine	1	20
Centrais Geradoras Sul Do Brasil			4,460
	Hydroelectric	4	3,490
	Steam turbine	3	970
CIA Energia Eletrica Tiete	Hydroelectric	9	2,577
CESP Parana	Hydroelectric	9	1,896
VBC Energia	Hydroelectric	1	1,290
Total			57,430

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News America*, 2001 and 2002.

[64] U.S. Department of State, "Background Notes: Brazil," found at Internet address *http://www.stat.gov/www/background_notes/brazil_0700_bgn.html*, retrieved on June 3, 2002.

[65] The generator with the largest capacity is a venture jointly owned by Paraguay and Brazil, Itaipu Binacional, which operates a complex of dams on the Paraná River. That complex accounts for almost one-quarter (13.3 gigawatts) of Brazil's total power generating capacity.

- According to a representative of the USFCS, the Workers' Party Electricity Plan would permit IPPs to offer electricity generated at their facilities to a regulated electricity pool. Power distributors could then buy electricity from various parties in the pool. However, given the higher cost of producing electricity from gas-fired plants than from hydroelectric dams, it is unlikely that IPPs using thermal generating facilities could find distributors willing to sign power purchase agreements at their higher prices.[66]

Other Factors of Competition

- All of the 21 largest power generation projects in Brazil are hydroelectric facilities (table 9). Most of the turbines and generators for these plants were imported from Europe, Japan, and Canada or were produced in Brazil by subsidiaries of foreign-based manufacturers. General Electric (GE) supplies turbines and generators for the Brazilian hydroelectric market from its subsidiaries in Canada and Brazil. Westinghouse supplied generators for two of these projects, but that was over 20 years ago.

- Brazil's domestic hydroelectric power generation equipment industry is strong and it is unlikely that U.S. exporters, which specialize in gas-fired generating equipment, can compete to supply the anticipated Brazilian market unless President Lula's administration and Brazil's Congress decide to restructure the utility regulations in a way that IPPs investing in thermal generating units will be guaranteed a sufficient return on their investments.

U.S. Exports to Brazil

- During the surge in U.S. exports of power generation and transmission equipment to Brazil in 2001, gas turbines and gas turbine generator units accounted for 79 percent ($421 million) of such U.S. exports to Brazil (table 10). Gas turbines and related generators are the key components of the combined cycle generating plants that were the focus of efforts to lessen dependency on hydro sources of electric power in Brazil in 2001. GE and Siemens' Westinghouse subsidiary are among the leading world suppliers of such equipment and benefitted from the recent spike in the construction of gas-fired power plants in Brazil to complement existing hydroelectric facilities.

- Caterpillar Corp. of Peoria, Illinois, was a beneficiary of rolling blackouts and electricity rationing in Brazil as these events created a sudden and very large market for portable, internal-combustion-engine driven generator sets. Caterpillar is a world leader in the production of diesel-powered generators. U.S. exports of such equipment to Brazil rose from $3 million in 2000 to $93 million in 2001, 17 percent of all U.S. exports of power generation equipment to Brazil in 2001.

- Prior to the drought, most of GE sales in Brazil were equipment for hydroelectric plants and equipment for transmission lines, the bulk of which were manufactured by its subsidiary in Brazil. GE officials estimated the company's sales in Brazil at $1.4 billion in 2000.[67]

---

[66] E-mail correspondence to USITC staff from the Senior Commercial Specialist, U.S. & USFCS, U.S. Consulate, Rio de Janeiro, Brazil, Dec. 19, 2002.
[67] USITC staff interview with GE officials in Spring 2001.

Table 9
Brazil: Leading projects in the power generation sector
(Projects currently in operation with a capacity of over 1,000 megawatts (*MW*))

Project	Capacity (*MW*)	Facility	Location	Year	Owner/ operator	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Itaipu 20 units	13,320	Hydro-electric	Parana	1984-1991	ITAIPU Binacional Brazil/Paraguay	Voith (Austria); Mecanica Pesada SA (Brazil); Voith/Alsthom (Austria, France)	Siemens (Germany); ASEA Brown Boveri (ABB) (Switzerland)
Tucurui 1 12 units	4200	Hydro-electric	Para	1984-1988, 1992	Centro Eletrica do Norte do Brasil	Neyrpic/Mecanica de la Pena (NEY/MP) (France/Brazil)	ABB; Axel Johnson (AJ) (Canada); Alsthom-Jeumont (France); General Electric Canada (CGE)
Ilha Solteira 20 units	3,230	Hydro-electric	Sao Paulo	1973-1975, 1977-1978	CESP Parana	Hitachi (Japan); Voith/Escher Wyss (VOI/EW) (Austria/Germany); Voith/Societe des Forges et Ateleiers de Creusot (SFAG)/ Alsthom (Austria/ France); Voith/Riva/ Escher Wyss (VOI/R/EW) (Austria/Italy); Voith/Alsthom (VOI/ALST) (Austria/ France); Voith/Riva/ Alsthom (VOI/R/A) (Austria/Italy/ France); Voith/ SFAG (VOI/SFAG) (Austria/ France); Voith/Tosi/ SFAG (VOI/T/S) (Austria, Italy, France); Voith/ Riva/SFAG (VOI/R/S) (Austria/Italy, France); Neyrpic (France)	Mitshubi Electric Corp. (MELCO) (Japan); Toshiba (Japan); Siemens/CGE Asgen/Ansaldo Coemsa (SIE/ ASG/COE) (Germany/ Canada/Italy); Brown Boveri & Cie (BBC) (Switzerland)
Xingo 6 units	3,012	Hydro-electric	Algoas	1994-1997	CIA Hidro do Sao Francisco	Voith	Siemens
Paulo Afonso IV 6 units	2,460	Hydro-electric	Bahia	1979-1981, 1983	CIA Hidro do Sao Francisco	Voith/Bardella/ BSI Industrias Mecanicas (VOI/B/B) (Austria/ Brazil)	Siemens
Itumbiara 6 units	2,082	Hydro-electric	Minas Gerais	1980-1981	Furnas Centrais Eletricas SA	Voith/Bardella SA (VOI/BD) (Brazil)	CGE
Rocha Netto (Foz Areia) 4 units	1,674	Hydro-electric	Parana	1980	CIA Paranaense de Energia Eletrica	Hitachi/Riva Hydroart Spa (Japan/Italy)	Brown Boveri Brazil (BBB)

Table 9—*Continued*
Brazil: Leading projects in the power generation sector
(Projects currently in operation with a capacity of over 1,000 megawatts (*MW*))

Project	Capacity (*MW*)	Facility	Location	Year	Owner/ operator	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Sao Simao 10 units	1,635	Hydro-electric	Minas Gerais	1978/ 1979	CA Energia Minas Gerais (CEMIG)	NEY/MP	Voith
Luis Gonzaga 6 units	1,500	Hydro-electric	Pernam-buco	1988-1990	CIA Hidro do Sao Francisco	Voith/Riva/ Coemsa (VOI/ RIV/COE) (Austria/Italy)	Ansaldo/ Siemens/ Coemsa (AN/SIE/COE) (Italy/Germany)
Marimbondo 8 units	1,440	Hydro-electric	Minas Gerais	1975-1977	Furnas Centrais Eletricas SA	Voith/Neyrpic/ MEP (VOI/N/M) (Austria/ France/Italy)	ASEA (Sweden)
Souza Dias 14 units	1,411	Hydro-electric	Minas Gerais	1969-1972, 1974	CESP Parana	Riva (Italy); CGE Asgen (Canada); Escher Wyss (Germany)	CGE; CGE Asgen; Ercole Marelli Nuova Spa (Italy)
Jose Ermirio de Moraes 6 units	1,380	Hydro-electric	Sao Paulo	1978-1979	CIA Energia Eletrica Tiete	Neyrpic (France)	Alsthom-Jeumont (France)
Salto Santiago 4 units	1,332	Hydro-electric	Parana	1982	Cent Geradoras Sul do Brasil	CGE	Westinghouse Electric Corp. (WH) (U.S.)
Sera da Mesa 3 units	1,290	Hydro-electric	Goia	1998	VBC Energia	GE Hydro Inepar (Brazil)	ABB
Segredo 4 units	1,280	Hydro-electric	Parana	1993-1995	CIA Paranaense de Energia Eletrica	Voith	GE Hydro Inepar (T/G supplier)
Salto Caxias 4 units	1,260	Hydro-electric	Parana	1999	CIA Paranaense de Energia Eletrica	Kvaerner/ Coemesa Ansaldo (KV/COE) (Sweden, Italy)	ABB/Coemsa (ABB/COE) (Sweden/(Italy)
Furnas 8 units	1,216	Hydro-electric	Minas Gerais	1963-1965, 1973-1974	Furnas Centrais Eletricas SA	NOHAB (Sweden)	Siemens, CGE
Theodomiro Sampaio 4 units	1,192	Hydro-electric	Minas Gerais	1982/ 1983	CA Energia Minas Gerais (CEMIG	VOI/B/B	Siemens
Salto Osorio 6 units	1,050	Hydro-electric	Parana	1970, 1972, 1974	Centro Geradoras Sul do Brasil	Hitachi	WH
Sobradinho 6 units	1,050	Hydro-electric	Bahia	1979, 1980-1982	CIA Hidro do Sao Francisco	Leningrad Machine Works (USSR)	Electrosila (USSR)
Luiz Carlos Barreto 6 units	1,050	Hydro-electric	Minas Gerais	1969, 1972	Furnas Centrais Eletricas SA	Voith	ASEA

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

Table 10
Brazil: U.S. exports of power generation and transmission equipment, by product, 1996-2001

(*1,000 dollars*)

Product	1996	1997	1998	1999	2000	2001	Total 1996-2001
Gas turbine and other generating sets	11,984	35,348	31,542	27,142	([1])	225,608	331,624
Gas turbines	([1])	19,184	22,013	([1])	7,510	195,734	244,441
Internal-combustion-engine driven generator sets	3,062	21,251	8,215	3,542	3,310	93,058	132,438
Electric generators over 10 MW	([1])	416	([1])	45	2,869	12,014	15,344
Electricity meters	535	1,485	1,255	2,609	2,026	1,991	9,901
Power circuit breakers and switchgear assemblies	1,145	129	1,295	1,610	232	1,953	6,364
Steam generating boilers	103	93	2,003	375	173	3,481	6,228
Steam turbines	174	379	3,081	596	14	619	4,863
High-voltage electrical conductors	617	1,089	499	469	850	439	3,963
Power transformers rated above 10,000 kVA	([1])	835	([1])	183	([1])	860	1,878
Hydraulic turbines	([1])	([1])	([1])	600	([1])	([1])	600
Total	17,620	80,209	69,905	37,171	16,985	535,756	757,646

[1] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

- Prior to the depreciation of the reál in the last half of 2002, the USFCS estimated that the Brazilian market for power generation equipment would grow by 13 percent in 2002 to $2.2 billion.[68] The USFCS also estimated that Brazil needs to add over 4,000 MW each year over the next decade, which translates into future investments of about $14 billion from 2002-08.[69]

- According to a representative of CMS Energy in August 2001, many IPPs view Brazil as an increasingly attractive growth market, both from a contractual standpoint and from a regulatory point of view, since the markets are evolving toward first-world standards, thus enabling higher returns than those available in more mature markets, for medium- and long-term investments.[70] Although enthusiasm may have dampened somewhat since that assessment, Brazil still offers significant potential for investors in the electricity sector once short-term economic challenges are addressed.

[68] USDOC, USFCS, “Country Commercial Guide: Brazil,” June 2002. This includes generation, transmission, and distribution segments. The USDOC noted that their growth estimate was only half that estimated by the Brazilian Association of Electrical and Electronic Industries.

[69] Ibid.

[70] USITC staff interview with representatives of CMS Energy on Aug. 23, 2001. This evolving market provides potential for higher returns than those that can be obtained in the mature first-world markets, for medium- and long-term investments.

Argentina

- Argentina's electric power generation capacity nominally meets domestic demand, but some remote areas of the country are still under-served and have yet to be connected to the national grid. The estimated per capita consumption of electricity in Argentina in 1999 was 1,670 kwh compared with 12,900 kwh in the United States and 8,089 kwh in France.[71]

- Nearly 80 percent of all Argentines reside in urban areas, with 17 million (46 percent) in the Province of Buenos Aires. That province also accounted for 54 percent of Argentina's electricity consumption in 2001.[72]

Trends in the Argentine Market

- Argentina benefits from abundant natural-gas resources and world-class hydroelectric dams. In 2001, hydroelectric sources accounted for approximately 45 percent of Argentina's electricity generation followed by natural gas (28 percent) and oil (17 percent).[73] The country's largest hydroelectric facility is Yacyretá, a binational facility operated jointly with Paraguay. Located on the Paraná River, the $8.5 billion facility is also one of the largest hydroelectric installations in the world, with 20 generators producing 2,700 MW of electricity, about 10 percent of Argentina's annual power production.[74] Argentina and Paraguay have announced plans to build a second binational 3,000 MW dam (Corpus Christi) 124 miles up river from the Yacyretá.

- The other leading binational hydroelectric facility is Salto Grande, jointly administered with Uruguay. Salto Grande is situated on the Uruguay River and generates 1,800 MW of electricity, 7 percent of Argentina's annual power production. Argentina and Uruguay have discussed plans to construct a second $350 million hydroelectric dam on the Uruguay River.

- Argentina has Latin America's most advanced nuclear energy program. Presently, two plants are operational and a third is near completion. The Atucha I plant has a generating capacity of 350 MW and the Embalse plant, 650 MW.

- Steady economic growth in Argentina in the 1990s placed additional strain on an electrical grid that was already experiencing recurring power outages caused by an aging distribution and transmission infrastructure and dependence on hydroelectric sources of energy, further pushing up the price of electricity.[75] In response, the Argentine

---

[71] Fundacion INVERTIR *Argentina, The Electric Power Boom*, found at Internet address *http://www.invertir.com/news/nr5821.htm*, retrieved Sept. 12, 2001.

[72] Platts Utility Data Base.

[73] Platts Utility Data Base.

[74] In 2000, Argentina possessed an installed power generation capacity of 23.3 gigawatts (GW), a generation capacity of 78,957 megawatts, and electricity consumption totaled of 80.8 billion kilowatt hours. USDOC, *Electric Power Systems*, U.S. & Foreign Commercial Service, May 2001.

[75] Electricity was so expensive that it was often stolen by consumers either through fraud, illegal hookups, or by failure to pay bills. International Labor Organization (ILO), *Electricity*

(continued...)

Government implemented the Argentine Electricity Act of 1992 to privatize its electricity industry.

- During the 1990s, heavy domestic and foreign investment permitted electricity consumption to grow by 5 to 6 percent annually. Total generating capacity increased by more than 40 percent during the decade.[76] More than $7 billion was invested in Argentina's electricity sector during 1992-2000.

- However, in the third quarter of 1998, Argentina's economy began to slow and eventually entered recession, with GDP declining each year during 1999-2001. Energy consumption and foreign investment fell as well.[77] The inability of the government to meet its $130 billion international financial obligations at the end of 2001 led Argentina to default on its foreign debt in January 2002.

- By June 2002, the peso had lost over two-thirds of its value[78] and unemployment rose to approximately 25 percent.[79] By October, Argentina's GDP had shrunk by 15 percent since the January devaluation.[80] Since most of Argentina's leading electricity generation, transmission, and distribution companies had high dollar-denominated debts, they were hit hard by the peso's depreciation.

- Most construction on new projects has been suspended due to the current economic crisis, although several projects are still under construction. Neuquen provincial officials announced that they would accept bids during third quarter 2002 for the construction of a 228 MW hydroelectric plant (Chihuido II) that will also supply water to industrial and agricultural customers. Projects already under construction include two thermal plants, valued at $370 million, with a combined capacity of 460 MW under construction by Italian Group ENEL.[81] Enersis, the Hispano-Chilean power group, announced plans to invest $100 million in Edesur in 2002 to improve and extend its distribution network by installing new transformers and distribution lines.[82]

---

[75] (...continued)
Reform Abroad and U.S. Investment, found at Internet address *http://www.itcilo.it/english/actrav/telearn/global/ilo/frame/elect4-ht*; retrieved May 7, 2002.

[76] USDOC, "Electricity Surge - Argentina's Most Successful Deregulation Story," May 17, 2001, found at Internet address *http://www.usatrade.gov/website/Fo...D/00C038BF07ED499C85256A4F006F7072*, retrieved August 22, 2001.

[77] USDOE, Office of Fossil Energy (OFE), *An Energy Overview of Argentina*, found at Internet address *http://www.fe.doe.gov/international/argnover.html*, retrieved Sept. 12, 2001.

[78] As of May 2002, the Argentine peso was trading at 3.5 per U.S. dollar.

[79] The Economist Intelligence Unit (EIU), "Argentina's brave new world," Jan. 14, 2002, found at Internet address *http://eb.eiu.com/search_view.asp?doc_id=DB959...h=electricity&date_restrict=&hits=25&x=38&y=1*, retrieved May 16, 2002.

[80] "Argentina's Collapse: The Death of Peronism?" *The Economist*, Nov. 16, 2002, p. 31.

[81] "ENEL to Build Two Thermal Power Plants in Argentina," *Latin American Power Watch,* vol. 6; No. 2, Mar. 2000, found at Internet address *http://toolkit.dialog.com/intranet/egi/present...= DB,=16,AN=7154367, FM=9,SEARCH=MD.genericsearch*, retrieved May 16, 2002.

[82] "Enersis Allocates $100mn for Edesur-Argentina," *Business News Americas*, Mar. 8, 2002.

Privatization and Foreign Participation in the Electricity Sector

- During the late 1980s and the early 1990s Argentina passed several pieces of legislation designed to facilitate foreign participation in its economy.[83] Privatization of the electric power industry created a market for gas-fired power generation as Argentina moved to replace its antiquated liquid and solid fossil fuel power plants with modern natural gas, combined cycle plants. This shift required new generators and turbines, transmission systems, and other equipment, creating opportunities for U.S. manufacturers of such equipment.

- In 1992, the government divided the nation's electricity industry into separate generation, transmission, and distribution sectors, coordinated by the Sistema Interconectado Nacional (SIN), Argentina's electricity dispatch system. Privatization was expected to produce greater efficiencies, lower prices, and attract much needed direct foreign investment.

- Argentina's privatization program was modeled on that of Chile and its price-cap regulations were modeled on those of the United Kingdom. According to the U.S. Department of Energy, features adopted from Chile's privatization program included "open access to the wholesale electricity market guaranteed by law despite widely dispersed generation plants, and dispatch of electricity based on the production costs of the available generators, with the lowest-cost generation dispatched first."[84] Unlike Chile, Argentina required complete separation of transmission from generation and distribution. Other differences include Argentina's insistence that no single generator could provide more than 10 percent of national generation capacity.

- By 1999, 28 state-owned and -operated public utilities and 70 percent of Argentina's electric power generation sector had been privatized. However, the major hydroelectric plants, Yacyretá and Salto Grande, and the nuclear power stations have yet to be privatized.[85] Through 2001, there were approximately 40 generating plants in Argentina owned by 30 private companies, many of which are owned by foreign consortiums with representatives from the United States, Europe, and Chile.

- Since the early 1990s, electricity prices have dropped to some of the lowest in the world and at the same time producers have earned additional income from exporting electricity to Brazil and Uruguay. In 2001, industry experts estimated that electricity prices were

---

[83] Principal among these were the Economic Emergency Law (1989), Reform Law (1989), Bilateral Investment Treaty (1992), the Argentine Electricity Act (1992), and Decree 1853.

[84] USDOE, EIA, "Argentina," Aug. 2000, found at Internet address *http://www.eia.doe.gov/emeu/cabs/argentina.html*, retrieved Aug. 22, 2001.

[85] EIU, "Privatisation Recharges Energy Sector," Jan. 23, 1998, found at Internet address *http://www.viewswire.com/index.asp?layout=display_print&doc_id=43886*, retrieved Oct. 26, 2001.

one-third those in 1992,[86] falling from $60 per megawatt hour (MWh) to $20 per MWh in 2001.[87]

- The largest power company to be privatized was Servicios Electricos del Gran Buenos Aires (Segba), which enjoyed a monopoly on the generation and distribution of electricity in the greater Buenos Aires area and the city of La Plata. Most of Segba's 32 power stations were divided into 6 companies and sold in 1992-93.[88] Segba's distribution assets were divided into three companies: Empresa Distribudora Electrica Norte (Edenor), Empresa Distribudora Electrica Sur (Edesur), and Empresa Distribudora Electrica de la Plata (Edelap). In 2001, Electricité de France (EdF) assumed control over Edenor when it increased its holdings in Spain's Endesa, Edenor's principal shareholder.[89]

- Wind energy plants are presently located in the provinces of Chubut and Santa Cruz. A Danish company currently dominates the wind energy market, but Spanish companies, Endesa and Elecnor, have submitted proposals to build and operate three wind mill farms in Patagonia. The two Spanish companies have joined to form Energias Argentinas (Enarsa) and to build wind turbines capable of generating 3,000 MW, or 12 percent of the country's needs, by 2010 at a cost of $2.3 billion.[90]

- Segba's transmission assets were joined with those of Agua y Energia Electrica (Ayee) and Hidroelectrica Norpatagonia (Hidronor) to create a single high-voltage transmission company (Transener) and 6 regional low-voltage companies.[91] These assets have been sold to private companies and regulated as natural monopolies. The high-voltage transmission company, Compania de Transporte de Energia en Alta Tension Red (Transener) transmits approximately 90 percent of Argentina's generated power. Of the six regional companies, only Distro Cuyo and Transnea have been at least partially privatized. Potential transmission companies can enter the industry only after successfully bidding for a fixed-duration concession from the government for a particular area and may charge no more than a regulated price for their services.

- This follows a 1992 agreement entered into by Argentina and Chile that enabled private sector companies to invest in a transmission system joining the two countries' primary electricity grids. Argentina is pursuing agreements with Brazil, Ecuador, and Venezuela

---

[86] USDOC, "Electricity Surge-Successful Deregulation," June 5, 2001, found at Internet address *http://www.stat-usa.gov/mrd.nsf/vw...penDocument&sessID=F01409F720A15FA*, retrieved Sept. 20, 2001.

[87] Christi Hangey, "Argentina's Debt: Will the Region's Power Generation Sector Feel the Effect?" *Frost.com,* Aug. 20, 2001, found at Internet address *http://www.frost.com/prod/news.nsf/o/ DA3DBE9916D3E9D886256A AE007FD658?Open Document*, retrieved May 7, 2002.

[88] Agua del Cajon, Central Costanera, Central Dock Sud, Central Pedrode Medoza, Central Puerto, and Central Termoelectrica Buenos Aires.

[89] EdF, "Electricite de France Increases Its Stakes in Edenor, Argentina," Communiqué de Presse, Apr. 27, 2001, found at Internet address *http://www.edf.fr*, retrieved May 15, 2002.

[90] USDOE, *Argentina*, August 2000, found at Internet address *http://www.eia.doe.gov/emeu/cabs/argentina.html*, retrieved Aug. 22, 2001.

[91] ILO, *Electricity Reform Abroad and U.S. Investment.*

to link their transmission systems in order to lessen electricity shortages caused by periodic drought.[92]

- Since 1991, many of the world's leading generation, distribution, and transmission companies have entered the Argentine market through purchasing formerly state-owned utilities and investing in new projects (box 1). Some of the companies participating in Argentina's power generation sector have also invested in cross-border natural-gas pipelines that support natural gas-fired power plants in Brazil, Chile, and Uruguay.[93]

Box 1
Leading participants in the Argentine market

Company	Country	Activity	Company	Country	Activity
AES	United States	G, D	Eneresis	Chile	G,D
Amoco	United States	G	Entergy	United States	G,D,T
Camuzzi Gazometri	Italy	G, D	Houston Industries	United States	G,T,D
Chilectra/Energis	Chile	G, D	Hydroelectrica de Ribagorzana	Spain	D
Chilgener	Chile	G	Kansas Power & Light	United States	G
Cinergy Global	United States	G, D	LG&E Energy	United States	G
Citicorp Capital	United States	G, D	National Electricity Co.	Chile	G
CMS Energy	United States	G	Northeast Utilities	United States	G
Dominion Resources	United States	G	PSI Energy	United States	G,D
Duke Power	United States	G	Southern Co.	United States	G
Electricite de France	France	G, T, D	TotalFinaElf SA	France	G
El Paso Electric	United States	G, D, T	TransAlta Energy	Canada	G
Endesa	Chile, Spain	G, D, T			
ENEL	Italy	G			

Note.– G = generation, T = transmission, and D = distribution.

Source: U.S. Department of Commerce, International Trade Administration, "Overview of Argentina's Electric Sector," Feb. 2000.

- Although Argentine-owned public utilities continue to supply most of the electricity to the national market (table 11), investments by U.S., European, and Chilean companies accounted for much of the growth in capacity following privatization. The upgrade of thermal generators following privatization created export opportunities for U.S. equipment manufacturers.

[92] USDOC, ITA, "Argentina," Feb. 2002, found at Internet address *http://www.ita.doc.gov/td/energy/argentina.html*, retrieved May 16, 2002.
[93] USDOC, ITA, "Overview of Argentina's Energy Sector," Feb. 2000, found at Internet address *http://www.ita.doc.gov/td/energy/argentina.html*, retrieved June 14, 2001.

Table 11
Argentina: Leading participants in the power generation sector

Owner/operator	Facility type (*Ordered by capacity generated*)	Number of facilities per category	Capacity (*Megawatts*)
Entidad Binacional Yacyreta	Hydroelectric	24	3,690
Central Costaners		11	2,276
	Gas turbine with combined cycle	3	739
	Steam	6	1,090
	Steam with combined cycle	2	447
Com Tenica Mixta Salto Grande	Hydroelectric	13	1,755
Central Puerto		11	1,627
	Gas turbine	3	369
	Gas turbine with combined cycle	1	229
	Steam	6	909
	Steam with combined cycle	1	120
Hidroelectrica el Chocon	Hydroelectric	9	1,320
Total		68	10,668

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

Other Factors of Competition

- Production of power generation equipment in Argentina is dominated by 5 large and 10 medium-sized companies. Foreign companies, however, supply a significant portion of Argentina's power generation equipment.

- Prior to the 1980s, power generation equipment was supplied primarily by European manufacturers. Since most of the power generated in Argentina is hydroelectric and major U.S. suppliers of generation equipment at the time were heavily committed to fossil fuel-burning equipment (particularly gas turbines), Argentina did not afford U.S. producers significant market potential. As a result, European producers have established themselves as the preeminent suppliers of hydro-related equipment in the Argentine market.[94]

- General Electric (GE) has been the principal U.S. company to supply turbines and generators to Argentina's largest power generation projects (table 12). GE's chief competitors in the Argentine market for combined cycle generating equipment for these large projects have been ABB (Switzerland), Mitsubishi (Japan), Brown Boveri (Italy), and Siemens (Germany).

- The Russian companies Hygenergo and ELSL supplied the turbines and generators, respectively, for the largest hydroelectric facilities built in Argentina in the 1990s. German and Italian companies (Siemens and Ansaldo) supplied the turbines and generators for Argentina's nuclear power plants built in 1974 and 1984.

[94] Further background is provided in USITC, *Market Developments in Mercosur Countries Affecting Leading U.S. Exporters*, USITC publication 3117, July 1998.

Table 12
Argentina: Leading projects in the power generation sector

Project	Capacity (*Mega-watts*)	Facility	Location	Year	Owner/ operator	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Embalse 1	600	Nuclear-steam	Cordoba	1984	Nucleoelectrica Argentina	Anslado (Italy)	Ansaldo
Atucha 1	370	Nuclear-steam	Buenos Aires	1974	Nucleoelectrica Argentina	Siemens (Germany)	Siemens
Piedra del Aguila 1	350	Hydro-electric	Neuquen	1993	Hydroelectrica Piedra del Aguila	Hygenergo (Russia)	ELSL (Russia)
Piedra del Aguila 2	350	Hydro-electric	Neuquen	1993	Hydroelectrica Piedra del Aguila	Hygenergo	ELSL
Piedra del Aguila 3	350	Hydro-electric	Neuquen	1994	Hydroelectrica Piedra del Aguila	Hygenergo	ELSL
Piedra del Aguila 4	350	Hydro-electric	Neuquen	1995	Hydroelectrica Piedra del Aguila	Hygenergo	ELSL
San Nicolas II 1	350	Steam	Buenos Aires	1976	AES Andes	Ansaldo	Marelli (Italy)
Central Costanera 6	300	Steam	Buenos Aires	1977	Central Costanera	LMZ (USSR)	TEPLO (USSR)
Agua del Cajon 3	285	Steam with combined cycle	Neuquen	1999	Capex	Not available	Not available
Dock Sud 2 SCI	284	Steam with combined cycle	Buenos Aires	2000	Central Dock Sud	ABB (Switzerland)	ABB
Costanera CC GT1	262	Gas turbine with combined cycle	Buenos Aires	1999	Central Costanera	Mitsubishi Heavy Industries (MHI) (Japan)	Mitsubishi Electric Corp. (Melco) (Japan)
Costanera CC GT2	262	Gas turbine with combined cycle	Buenos Aires	1999	Central Costanera	MHI	Melco
Central Puerto 6	250	Steam	Buenos Aires	1969	Central Puerto	Brown Boveri & CIE (BBC) Italy	BBC
Central Puerto 9	250	Steam	Buenos Aires	1973	Central Puerto	BBC	BBC
Dock Sud 2 GT1	248	Gas turbine with combined cycle	Buenos Aires	2000	Central Dock Sud	ABB	ABB
Central Puerto Nuevo GT1	229	Gas turbine with combined cycle	Buenos Aires	2000	Central Puerto	General Electric (GE) (U.S.)	GE
Genelba-1 GT2	220	Gas turbine with combined cycle	Salta	Salta	Perez Companc	Siemens	Siemens

Table 12—*Continued*
Argentina: Leading projects in the power generation sector

Project	Capacity (*Mega-watts*)	Facility	Location	Year	Owner/ operator	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Genelba-1 GT1	220	Gas turbine with combined cycle	Salta	Salta	Perez Companc	Siemens	Siemens

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

U.S. Exports to Argentina

- The U.S. Department of Commerce U.S. & Foreign Commercial Service reported from Buenos Aires in 2002 that Argentine-produced electric power equipment supplied 73 percent ($680 million) of the national market in 2001. Equipment imported from the United States accounted for 36 percent ($103 million) of Argentina's imports of electric power equipment that year and supplied 11 percent of the entire national market.

- U.S. exports of power generation equipment to Argentina peaked in 1998 (table 13), with the shipment of gas turbines by GE for the Centro Puerto Nuevo GT 1 project, which was completed in 2000 (see table 12). Gas turbines accounted for over one-half of all U.S. exports of power generation and transmission equipment to Argentina during 1996-2001. Other leading types of equipment exported to Argentina from the United States during that period were steam-generating boilers, internal-combustion-engine driven generator sets, and electrical generators over 10 MW.

Table 13
Argentina: U.S. exports of power generation and transmission equipment, by product, 1996-2001

(*1,000 dollars*)

Product	1996	1997	1998	1999	2000	2001	Total 1996-2001
Gas turbines	22,225	17,270	42,414	6,013	4,465	7,440	99,827
Steam generating boilers	316	18	13,778	6,742	129	([1])	20,983
Internal-combustion-engine driven generator sets	5,040	3,997	5,219	2,323	521	3,752	20,852
Electric generators over 10 MW	3,288	4,828	8,650	686	79	267	17,798
Gas turbine and other generating sets	([1])	5,548	5,203	2,973	([1])	([1])	13,724
Electricity meters	872	957	528	418	396	371	3,542
High-voltage electrical conductors	59	210	4	198	28	91	590
Steam turbines	([1])	6	([1])	275	47	258	586
Power circuit breakers and switchgear assemblies	100	104	([1])	75	242	59	580
Hydraulic turbines	([1])	([1])	128	([1])	([1])	([1])	128
Total	31,900	32,938	75,925	19,703	5,908	12,238	178,612

[1] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Venezuela

- Venezuela's consumption of electricity varies widely by region, creating pockets of relatively high demand throughout the country. Eighty-seven percent of the population lives in urban areas in the north,[95] whereas continued expansion of the mining and petroleum industries has led to high consumption for electricity along the Orinoco Belt[96] in the center of the country.

- Government subsidization allows residential consumers to pay as little as 16 percent of the actual cost of the electricity they receive, and industrial consumers to pay less than 50 percent.[97] As a result, Venezuela has one of the highest electrification rates in Latin America and Venezuelans are the highest per capita users of electricity in Latin America.[98]

- The ongoing general strike to force an early presidential election, begun by workers at the state-owned oil company, Petroleos de Venezuela (PDVSA), in December 2002, has created many challenges for foreign investors operating in the country.[99] Although the sharp reduction in oil receipts, which account for one-half of government revenues, has slowed the pace of infrastructure projects, analysts anticipate a renewed market for power generation equipment when the crisis abates.

Trends in the Venezuelan Market

- A majority of the country's large power plants have been in operation since the 1950s and 1960s and only three significant units have been added in the last 5 years. By 2004, 79 percent of the indigenous thermal capacity will be 20 or more years in age. In addition, upgrades to the transmission system are reported to be the most critical issue facing Venezuela's power system in the next 2 years. Improvements to modernize the power generation, transmission and distribution system are expected to cost up to $589 million.[100]

- A recent shift in Venezuelan electricity consumption has occurred as certain industries have begun to construct their own on-site facilities for power generation. For example, PDVSA, Venezuela's state-owned oil company, now operates generation facilities at many of its refineries.[101]

---

[95] Venezuelan Embassy, Washington, D.C., "Population and Social Patterns," found at *www.embavenez-us.org/kids.venezuela/population.social.htm*, retrieved June 16, 2001.

[96] The Orinoco Belt is an oil-rich area in central Venezuela adjacent to the country's main river system..

[97] USDOE, EIA, Venezuela: Environmental Issues," found at *http://www.eia.doe.gov/cabs/venenv.html#ENVIRO*, retrieved June 16, 2001.

[98] USDOE, EIA, Venezuela: Country Analysis Brief," found at *www.eia.doe.gov/emeu.gov/cabs/venez.htm*, retrieved June 16, 2001.

[99] "Venezuela's General Strike: Pyrrhus of Caracas," *The Economist*, Jan. 4, 2003, p. 27.

[100] "Daily Power Losses Total US$1.43 million," *Business News Americas*, Dec. 28, 2000.

[101] USDOE, OFE, "An Energy Overview of Venezuela: Hydroelectric Energy and Renewables," found at Internet address *www.fe.doe.gov/international/venzover.html,* retrieved June 6, 2001.

- Like many other Latin American countries, interconnection projects are underway between Venezuela and its neighbors. To provide additional electricity in the southwest, Venezuela's grid is joined with Colombia and Brazil, allowing electricity trade between these countries.[102]

Privatization and Foreign Participation in the Electricity Sector

- Privatization is deemed as essential to expand, operate, and maintain the nation's generation units, and transmission and distribution grids.[103] In 1998, Venezuela completed the first privatization of an electric asset, Nueva Esparta SENECA. These facilities were sold through auction to U.S.-based CMS. The privatization process has stalled in intervening years because legal reforms, which were initiated in 1999, have not yet been fully implemented.

- The reforms created the framework for unbundling generation, transmission, and distribution services to promote competition and efficient delivery of electricity. Specifically, competition was to be introduced into the generation segment while transmission and distribution services were to be provided under concession (including provisions for the concession holder to pay damages in the event of a service failure) to ensure open access to network facilities.[104]

- Currently, electric power is supplied by seven privately owned and five government utilities. The government-owned utilities dominate the market, accounting for over 80 percent of generating capacity and providing electricity to two-thirds of all consumers (table 14).

- The largest private firm is Electricidad de Caracas (EdC), with a total capacity of 13,180 MW, and accounts for 91 percent of Venezuela's private-sector capacity.[105] EdC operates three steam and/or gas-fueled power generation plants in partnership with U.S.-based AES (table 15).

Other Factors of Competition

- Due to its extensive network of rivers, Venezuela has not experienced significant drought conditions. Therefore, the development of thermoelectric power has not been a priority. Hydroelectric power capacity should continue to expand as Venezuela is expected to add about 8 GW of such generating capacity over the next 5 to 10 years.

---

[102] SDOE, EIA, "Venezuela: Country Analysis Brief," Mar. 2001, found at Internet address *www.eia.doe.gov/emeu.gov/cabs/venez.html*, retrieved June 16, 2001.

[103] Yuri Flores, "Venezuela: Electrical Power Systems," *VenezuelaIndustry Sector Analysis*, U.S. Department of State, Sept. 1, 2000.

[104] Ibid.

[105] USDOE, OFE, "An Energy Overview of Venezuela: Hydroelectric Energy and Renewables,"*www.fe.doe.gov/international/venzover.html,* retrieved June 6, 2001.

Table 14
Venezuela: Leading participants in the power generation sector

Owner/operator	**Facility type** (*Ordered by capacity generated*)	**Number of facilities per category**	**Capacity** (*Megawatts*)
CVG Electrificacion del Caroni (CVG EDELCA)*	Hydroelectric	8	13,180
Ca Admin y Fomento Electrico (Cadafe)*			3,599
	Gas turbine	8	1,073
	Hydroelectric	4	620
	Steam turbine	1	1,900
	Internal combustion	1	6
Electricidad de Caracas (EdC)			2,509
	Steam turbine	1	1,679
	Gas turbine	1	507
	Hydroelectric	2	8
	Gas turbine with steam sendout	1	315
Energia Electricidad de Venezuela			1,163
	Gas turbine	3	448
	Steam turbine	1	660
	Gas turbine with internal combustion	1	55
Petroleos de Venezuela (PDVSA)*			832
	Gas turbine	8	471
	Steam turbine with steam sendout	1	48
	Gas and steam turbine with steam sendout	2	313
Sistema Electricidad Estado Nueva Esparta	Gas turbine	1	240
Petroquimica de Venezuela, SA (Pequiven)*	Gas and steam turbine	1	150
Manufacturas de Papel (MANPA)	Gas turbine	1	100
Energia Electricidad de Barquisimeto	Gas turbine	1	100
Electricidad de Valencia	Gas turbine	2	190
TURBOVEN	Gas turbine	1	60
Venezolana de Cementos	Gas turbine	1	54
Others			222
Total			22,399

* Denotes wholly government-owned entity.

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

Table 15
Venezuela: Leading projects in the power generation sector

Project	Capacity (MW)	Facility type	Location	Year[1]	Owner/operator	Partner	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Raul Leoni	10,055	Hydroelectric	Puerto Ordaz	1969-1987	CVG Edelca*	Venezuelan Government	Hitachi (Japan)	Westinghouse Electric Corp. (U.S.), Mitsubishi Electric Corp. (Japan), Hitachi, GE Canada
Macagua	3,124	Hydroelectric	Puerto Ordaz	1959-1996	CVG Edelca*	Venezuelan Government	Voith (Austria), Hitachi, Harbin Power Equipment Co (China)	AEG Kanis (Germany) Hitachi
Planta Centro	1,900	Steam turbine	Carabobo	1979-1981	Cadafe*	Venezuelan Government	Brown Boveri & Cie (Switzerland), Siemens (Germany)	Brown Boveri & Cie, Hitachi
Ricardo Zuloaga	1,679	Steam turbine	Edo Vargas	1950-1981	Electridid de Caracas	AES	Brown Boveri & Cie (Switzerland), GE (U.S.), Westinghouse Electric Corp, Toshiba (Japan), Dresser (U.S.), Allis-Chalmers (U.S.)	Brown Boveri & Cie, GE, Toshiba, Westinghouse Electric Corp Allis-Chalmers
Ramon Laguna	660	Steam turbine	Zulia	1960-1986	Energia Electricidad de Venezuela	([2])	Metropolitan Vickers (England), GE	Metropolitan Vickers, GE
Oscar Machado	507	Gas turbine	Caracas	1969-2000	Electridid de Caracas	AES	Dresser, Westinghouse Electric Corp	Ateliers de Constructions Electricques de Charleroi SA (France), Brush Electric Machines Ltd (England)

* Denotes wholly government-owned entity.

See footnote at end of table.

Table 15—*Continued*
Venezuela: Leading projects in the power generation sector

Project	Capacity (MW)	Facility type	Location	Year[1]	Owner/operator	Partners	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Rafael Urdaneta	397	Gas turbine	Zulia	1972-1981	Energia Electricidad de Venezuela	([2])	Brown Boveri & Cie, GE, John Brown Engineering Ltd (Scotland)	Brown Boveri & Cie, GE, Brush Electric Machines Ltd
Cardon Genevapca	315	Gas turbine with steam sendout	Edo Flacon		Electridid de Caracas	AES	Westinghouse Electric Company	Westinghouse Electric Company, Brush Electric Machines Ltd
San Agaton	300	Hydroelectric	Tachira	1987	Cadafe*	Venezuelan Government	Sulzer-Escher Wyss (Switzerland)	Toshiba
Tachira	250	Gas turbine	Tachira	1977-1986	Cadafe*	Venezuelan Government	GE, Hitachi AEG Kanis	GE, Hitachi AEG Kanis
Luisa Caceres	240	Gas turbine	Nueva Esparta	1975-2000	Sistema Electridad Estado Nueva Esparta	([2])	Fiat TTG SpA (Italy), AEG Kanis, Hitachi, GE	Fiat TTG SpA (Italy),AEG Kanis, Ercole Marelli Nuova SpA (Italy), GE
Jose Antonio Paez	240	Hydroelectric	Merida	1973	Cadafe*	Venezuelan Government	Charmilles (Switzerland)	A/S Norsk Elektrisk Brown Boveri
Alfredo Salazar	210	Gas turbine	Anaco	1983	Cadafe*	Venezuelan Government	GE	GE
Amuay Refinery	196	Steam turbine with steam sendout Gas turbine	Falcon	1940-1993	PDVSA	Venezuelan Government	Westinghouse Parsons (U.K.) GE	Westinghouse Parsons, GE Hitachi
Pequiven	150	Gas and steam turbines	Zulia	1977-1992	Pequiven	([2])	GE, Hitachi	GE
Punto Fijo	143	Gas turbines	Falcon	1975-1989	Cadafe*	Venezuelan Government	Hitachi, GE	Hitachi

See footnote at end of table.

Table 15—*Continued*
Venezuela: Leading projects in the power generation sector

Project	Capacity (MW)	Facility type	Location	Year[1]	Owner/operator	Partners	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Guanta	140	Gas turbines	Anzoategui	1984	Cadafe*	Venezuelan Government	GE	GE
La Cabrera	140	Gas turbines	Carabobo	1972-1978	Cadafe*	Venezuelan Government	Hitachi, GE	Hitachi, GE
Planta del Este	130	Gas turbines	Carabobo	1962-1982	Eletricidad de Valencia	([2])	GE, ABB Stal (Sweden)	GE, ASEA Atom (Sweden)
Las Morochas	117	Steam turbines Gas turbines	Zuilia	1954-1994	PDVSA	Venezuelan Government	Parsons (U.K.), GE, Brown Boveri & Cie	Brown Boveri & Cie, Parsons, GE Brush Electric
Muscar el Caritofie	113	Gas turbines	Monagas	1996	PDVSA	Venezuelan Government	Nuovo Pignone SpA (Italy)	([2])
Enelbar	100	Gas turbine	Lara	1970-1982	Energia Electricidad de Barquisimeto	([2])	GE, Hitachi	GE, Hitachi
Maraca y Manpa	100	Gas turbine	Carabobo	1977 2000	Manpa	([2])	GE	Hitachi

[1] Indicates completion of project phases.
[2] Not available,

Note.–Asterisk (*) denotes wholly government-owned entity.

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

- U.S. power generation equipment producers have an advantage over other foreign suppliers to the Venezuelan market due to their well-established relationships with purchasers.[106] The successful implementation of legal reforms will likely renew the momentum for privatization efforts, attracting the interest of U.S. IPPs, and U.S. equipment producers will likely retain their market share.

- The U.S. advantage as a reliable supplier of power generation equipment may be challenged by aggressive marketing and offers from non-U.S. companies.[107] South American suppliers, particularly Brazilian firms that have expanded their capabilities within the last 5 years, may also affect the cost-competitiveness of U.S. electric power systems suppliers.

- Aging infrastructure may not result in increased opportunities for U.S. suppliers. Many of Venezuela's facilities needing to replace or upgrade non-U.S.-made equipment could opt to purchase new equipment from the original supplier. Therefore, Hitachi and other non-U.S. manufacturers may be able to increase exports to the Venezuelan market.

- An examination of the generation equipment incorporated into recently constructed power plants indicates the strong presence of GE in the Venezuelan market. Larger and older plants, such as Raúl Leoni, which came online during 1969-87 and accounts for 45 percent of total generating capacity in Venezuela, relied on a more varied complement of equipment suppliers, such as GE, Westinghouse, Hitachi, and Mitsubishi (see table 15).

U.S. Exports to Venezuela

- The United States supplies about 50 percent of the electrical power systems import market in Venezuela.[108] The United States has recorded consistent growth in sales of identifiable power generation equipment to that market over the last 4 years.

- High-voltage electrical conductors accounted for 26 percent of U.S. power equipment exports to Venezuela during 1996-2001 (table 16). The sharp rise in U.S. exports of such equipment in 1999 and 2000 reflects necessary repairs to the transmission system following heavy flooding, completion of the power interconnection to Brazil, and commencement of system repairs in preparation for privatization.

- U.S. exports of gas turbines and of gas turbine and other generating sets accounted for 45 percent of all U.S. exports of power generation and transmission equipment to Venezuela during 1996-2001 (see table 16). Most of these shipments were prior to 2000, with the completion of three gas-powered facilities, including Oscar Machado and Luis Caceres, which used equipment produced in the United States by GE and Siemens-Westinghouse (see table 15).

[106] USDOE, EIA, "Venezuela: Country Analysis Brief," Mar. 2001, found at Internet address *www.eia.doe.gov/emeu.gov/cabs/venez.html*, retrieved June 16, 2001.

[107] Yuri Flores, "Venezuela: Electrical Power Systems," *Venezuela Industry Sector Analysis*, USDOC, USFCS, Sept. 1, 2000.

[108] Ibid.

Table 16
Venezuela: U.S. exports of power generation and transmission equipment, by product, 1996-2001

(*1,000 dollars*)

Product	1996	1997	1998	1999	2000	2001	Total 1996-2001
High-voltage electrical conductors	210	1,981	306	3,611	31,924	647	38,679
Gas turbines	20	670	15,363	19,744	346	1,042	37,185
Gas turbine and other generating sets	16,054	([1])	8,302	1,004	3,500	([1])	28,860
Internal-combustion-engine driven generator sets	843	1,515	5,125	5,349	1,775	2,564	17,171
Electricity meters	618	428	1,142	640	2,505	3,869	9,202
Electric generators over 10 MW	145	249	219	4,532	634	64	5,843
Power circuit breakers and switchgear assemblies	734	1,221	125	1,021	236	940	4,277
Steam generating boilers	222	419	603	105	1,097	691	3,137
Power transformers rated above 10,000 kVA	([1])	([1])	([1])	([1])	1,486	([1])	1,486
Steam turbines	([1])	115	35	27	([1])	19	196
Hydraulic turbines	([1])	([1])	([1])	([1])	([1])	5	5
Total	18,845	6,599	31,220	36,033	43,503	9,841	146,041

[1] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Colombia

- About 75 percent of Colombia's population, and consequently energy demand, is concentrated in the urban centers. Installed generating capacity is roughly 13,000 MW, of which hydroelectric power accounts for 63 percent and fossil fuels, mainly natural gas, account for almost all of the remainder (about 36 percent).[109]

- Colombia needs an additional 6,200 MW of generating capacity during 2001-10 to meet electricity demand that is expected to grow by 5.9 percent annually during this period.[110]

Trends in the Colombian Market

- In response to industry concerns about the electricity shortages during seasonal droughts stemming from Colombia's reliance on hydroelectric power, the government has authorized the construction or upgrade of 10 thermoelectric power plants.[111] However, Colombia's heavy reliance on hydroelectric power is anticipated to continue as more than one-half of the new electrical generating capacity planned or under construction during 2001-07 is designated as hydroelectric.

- Unlike some other Latin American countries where one facility can supply over 50 percent of their electricity, there is no such plant in Colombia. Six generators each supply over 1000 MW of installed capacity from a total of 36 facilities (table 17). The leading power projects are equally diverse; four plants supply over 1 GW each, whereas a number of medium-sized facilities each supply over 200 MW of electricity (table 18).

[109] "Installed Capacity Increases 1,407MW in 2000," *Business News Americas*, Dec. 22, 2000.
[110] USDOC, USFCS, "Country Commercial Guide: Colombia," Mar. 2001.
[111] U.S. Department of State, "Background Notes: Colombia," Apr. 2001.

Table 17
Colombia: Leading participants in the power generation sector

Owner/operator	Facility type (*Ordered by capacity generated*)	Number of facilities per category	Capacity (*Megawatts*)
Energia Electrica Bogota (EEB)			2,404
	Hydroelectric	8	2,305
	Steam turbine	1	99
Empresas Publicas Medellin (EPM)			2,039
	Hydroelectric	12	1,739
	Gas turbine	1	300
Interconexion Electrica (ISA)			1,749
	Hydroelectric	3	1,410
	Gas turbine	1	200
	Steam turbine	1	132
	Internal combustion	1	7
Electrica Costa Atlantica			1,241
	Steam turbine	2	470
	Hydroelectric	1	340
	Gas and steam turbine	1	280
	Gas turbine	2	151
Termobarranquilla (TEBSA)	Gas and steam turbine with combined cycle	1	1,165
Gener SA (Chile)	Hydroelectric	1	1,000
Empresas Energia del Pacifico			855
	Hydroelectric	4	807
	Steam turbine	1	48
Central Hidroelectrica Betania	Hydroelectric	1	500
AES Corporation (U.S.)			486
	Gas turbine	1	320
	Gas turbine with steam	1	166
Consorcio Colombiano Industrial (CCI)	Gas turbine	1	350
Intergen	Gas and steam turbine with combined cycle	1	245
KMR Power Corporation	Gas and steam turbine with combined cycle	1	199
Termocartegena	Steam turbine	1	189
Central Hidro de Caldas	Hydroelectric	4	188
Steag IPP, International (Germany)	Steam turbine	1	165
Merilectrica	Gas turbine	1	157
Colombiano de Energia Electrico			142
	Steam turbine	1	75
	Hydroelectric	2	55
	Internal combustion	1	12
Ecopetrol/S & S	Gas turbine with steam	1	121
Electrificadora de Boyaca			108
	Steam turbine	1	107
	Hydroelectric	1	1
Others			1,659
Total			13,962

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News* Americas, 2001 and 2002.

Table 18
Colombia: Leading projects in the power generation sector

							Principal equipment suppliers	
Project	Capacity (MW)	Facility type	Location	Year[1]	Owner/operator	Partners	Turbines	Generators
San Carlos 1 San Carlos 2	1,240	Hydroelectric	San Carlos	1984 1987	Interconexion Electrica (ISA)	State - 76.8%, EPM -12.95%, EEB - 2.5%	Sulzer-Escher Wyss (Switzerland)	([2])
Guavio	1,188	Hydroelectric	([2])	1992-1994	Energia Electrica Bogota (EEB)	Endesa	Sulzer-Escher Wyss	General Electric (GE) Canada
Termobarranquila	1,165	Gas and steam turbines with combined cycle	([2])	1996-1998	Termobarranquila (TEBSA)	ASEA Brown Bovari (ABB) (Switzerland), First Energy, Energy Initiatives, Lancaster Steel, and Distral	ABB (Switzerland)	ABB
Chivor	1,000	Hydroelectric	Santa Maria	1977 1982	Gener, SA (Chile)	AES (U.S.)	Sulzer Brothers, Riva Calzoni (Italy)	Ansaldo (Italy)
Guatepe	560	Hydroelectric	([2])	1968-1980	Empresas Publicas Medellin (EPM)*	Medellin municpality*	Sulzer-Escher Wyss	GEC-Alsthom (U.K./France), ABB
Betania	500	Hydroelectric	Huila	1987	Central Hidroelectrica Betania	Emgesa (Spain)	Riva Calzoni	Ansaldo
Guadalupe	471	Hydroelectric	([2])	1966 1985	EPM*	Medellin municpality*	Hitachi (Japan), Neyrpic (France), Voest-Alpine (Austria)	ABB
Porce	392		([2])	([2])	([2])	([2])	([2])	([2])
Termoflores	350	Gas turbine	Barranquilla	1995 1997	Consortio Colombiano Industrial (CCI)	CCI and Sevillana de Electricidad	Westinghouse Electric Corp. (U.S.)	Brush Electric Machines Ltd. (U.K.)
Anchicaya Alto	345	Hydroelectric	Buenaventura	1973	Empresas Energia del Pacifico (EPSA)	Union Fenosa (Spain) - 64.3%, Valle del Cauca government - 8.5%, Emcali - 17%	GE Canada	GE Canada

* Denotes wholly government-owned entity.

See footnotes at end of table.

Table 18—*Continued*
Colombia: Leading projects in the power generation sector

Project	Capacity (in MW)	Facility type	Location	Year[1]	Owner/operator	Partners	Principal equipment suppliers	
							Turbines	Generators
Urra	340	Hydroelectric	Cordoba	2000	Corp. Electrica Costa Atlantica	(2)	Leningrad Machine Works (Russia)	(2)
Guajira	320	Steam turbine	(2)	1987 1988	Corp. Electrica Costa Atlantica	(2)	Mitsubishi (Japan)	(2)
Termocandelaria	320	Gas turbine	Cartegena	2000	AES Corp	AES	Westinghouse Electric Corp.	Westinghouse Electric Corp.
Guaca	311	Hydroelectric	(2)	1987	EEB	Endesa	Kvaerner (Sweden)	(2)
La Tasajera	311	Hydroelectric	(2)	1994	EPM*	Medellin municpality	Neyrpic (France)	Ansaldo
Colegio	300	Hydroelectric	(2)	1967 1970	EEB	Endesa	Voith (Austria)	ABB
Termosierra	300	Gas turbine	(2)	1998	EPM*	Medellin municpality	GE (U.S.)	GE
Barranquilla	280	Gas turbine Steam turbine	Barranquilla	1971-1980	Corp. Electrica Costa Atlantica	(2)	GE, Siemens (Germany)	GE, Siemens
Salvajina	270	Hydroelectric	Suarez	1985	EPSA	Union Fenosa - 64.3%, Valle del Cauca government - 8.5%, Emcali - 17%	Mitsubishi	(2)
Paraiso EEB	270	Hydroelectric	(2)	1987	EEB	Endesa	Kvaerner	(2)
Termoemcali	245	Gas and steam turbines with combined cycle	Cali	1998 1999	Intergen	Shell (U.K./Neth.), Bechtel (U.S.)	Westinghouse Electric Corp	(2)
Termocentro	200	Gas turbine	Puerto Alaya	1997	ISA	State - 76.8%, EPM - 12.95%, EEB - 2.5%	Sulzer-Escher Wyss	(2)

* Denotes wholly government-owned entity.

[1] Indicates completion of project phases.
[2] Not available or not known.

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

- The transmission system reportedly faces two major challenges to increasing its efficiency over the next decade. First, a large portion of the network is aging, resulting in significant electricity losses and leading to frequent short-term blackouts throughout the country. These losses are estimated at about 20 percent of the total electricity generated by the interconnected system. [112]

- A USFCS report warned that corruption had been a problem at a large number of utilities, mainly those that are still owned by the central government.[113] With few exceptions, these firms were electricity distribution companies reportedly controlled by political interests rather than those with technical expertise. Consequently, the facilities reportedly were inefficient and experienced serious financial difficulties. In many regions, power producers and marketing companies reportedly are required to negotiate with these entities to bring electricity to the end-users (residences, commercial entities, or industries).

- In addition, the transmission and distribution system infrastructure as a whole has been subject to repeated attacks by two armed, insurgent revolutionary groups, which have damaged grid interconnections, leaving the country divided into several, smaller grids.[114] In 2000, 42 GWh of electricity reportedly was not supplied because of the infrastructure attacks, which cut transmission to the Caribbean coast for 4 months and to the northeast of the country for 1 month.[115] The damage has become progressively worse recent years. For example, there were more than 100 attacks on transmission lines or towers in 1999 and 281 in 2000.[116] To illustrate the magnitude of the damage, sabotage to the electrical grid cost about $175 million in 2000.[117]

- The Colombian transmission system is also interconnected to Ecuador and Venezuela; however, this portion of the system has relatively little volume at present. During periods of electricity supply shortages, Colombia has access to power from Venezuela through two 230 kV transmission lines. Colombia is expected to increase its interconnected capacity with Ecuador, with the majority of the increase slated as electricity sales to purchasers in Ecuador.[118]

Privatization and Foreign Participation in the Electricity Sector

- The Colombian electricity sector is currently a mix of public and private holdings. Until 1995, government entities owned all of the electric power generation assets. During 1995-2000, Colombia privatized a large number of its major facilities and companies, producing some $6 billion dollars in revenue. Currently, about 55 percent of the

---

[112] Mario Cedeil, "Colombia: Energy Services," *Colombia Industry Sector Analysis*, USDOC, USFCS, May 2001.
[113] Ibid.
[114] USDOE, EIA, "Colombia: Country Brief," found at Internet address *http://www.eia.doe.gov/emeu/cabs/colombia.html*, retrieved Feb. 6, 2002.
[115] "Attacks on Energy Infrastructure Cost US$3mn/day," *Business News Americas*, Aug. 8, 2001.
[116] "ISA to Maintain Present Rates for 6 Months," *Business News Americas,* July 26, 2001.
[117] "Colombia - Drugs, War and Democracy," *The Economist*, Apr. 21, 2001.
[118] USDOE, OFE, "An Energy Overview of Colombia," Feb. 21, 2001, found at Internet address *www.fe.doe.gov/international/colbover.html*, retrieved June 9, 2001.

country's generating capacity and 25 percent of the transmission capacity is supplied by the private sector.

- Privatization efforts have stalled in recent years largely because the paucity of interested parties has resulted in low bid prices, and because there has been a general resistance to selling national assets.

- Currently, the Colombian electricity market is diverse, with a large number of participants. According to one U.S. Embassy report, 160 companies (including 76 traders) were involved in the electricity sector in 2000 (90 public and 70 private).[119] Some of the leading public companies are ISA (1,749 MW capacity), Isagen, EPM (2039 MW, owned by the city of Medellin), and Energia Electrica Bogota (EEB - 2404 MW) (see table 17). Some of the key private companies include EPSA (owned by the Spanish utility Union Fenosa) with 835 MW of generating capacity and TEBSA (owned by Asea Brown Boveri (ABB), GPU) with 1,165 MW of capacity (see table 18).

Other Factors of Competition

- Colombia's domestic power generation equipment industry is rather robust and may inhibit foreign companies from gaining market share in Colombia. According to the USFCS, local production in 2000 supplied 58 percent of the Colombian market for electrical power systems.[120] Many of the boiler systems currently operating in thermoelectric power generation plants were locally produced. These steam boilers are reportedly competitive with U.S.-made boilers. Important local producers of boilers are Colmaquinas, Proton, Comesa, Industria Metalmecanica S.A., and Continental. Agro-Industrial (which produces small hydroelectric turbines of up to 1,200 KW) and Energia Andina Ltda. (which is capable of assembling hydroelectric plants with 10 to 10,000 KW capacity) are two other relatively important local manufacturers of electric power generation equipment.

- Many factors influence the choice of equipment suppliers in Colombia. Competitive strength in a particular product segment can encourage purchases of U.S. equipment (e.g., equipment for thermoelectric facilities). This has been evidenced by the rise in U.S. exports of steam turbines following Colombia's decision to begin constructing thermoelectric plants over the past two years (table 19). Another factor is whether there are U.S. engineering and construction companies participating in the project. During the past 5 years, U.S. equipment exports to Colombia have increased as U.S. companies, including IPPs, became involved in the market through power purchase agreements or privatization. Since 1995, a number of U.S. investors have constructed power plants and the equipment for these facilities came from U.S. companies or from European producers with U.S. manufacturing facilities from which they supply markets in the Western Hemisphere.[121]

[119] Cedeil, "Colombia: Energy Services."
[120] USDOC, USFCS, "Country Commercial Guide: Colombia," Mar. 2001, found at Internet address *http://www.mac.doc.gov/atpa/Colombia/colombia_ccg2001.pdf* retrieved Aug. 20, 2001.
[121] Mario Cedeil, "Colombia: Electrical Power Systems," *Colombia Industry Sector Analysis*, USDOC, USFCS, Apr. 1, 2000.

Table 19
Colombia: U.S. exports of power generation and transmission equipment, by product, 1996-2001

(*1,000 dollars*)

Product	1996	1997	1998	1999	2000	2001	Total 1996-2001
Gas turbines	4,020	35,992	13,787	39,479	12,460	24,242	129,980
Gas turbine and other generating sets	23,408	56,251	2,000	1,700	2,730	([1])	86,089
Steam turbines	1,266	3,841	76	4,633	20,395	([1])	30,211
Electric generators over 10 MW	1,048	11,609	76	5,873	8,581	([1])	27,187
Internal-combustion-engine driven generator sets	1,045	6,989	553	846	461	3,001	12,895
Electricity meters	466	1,155	787	555	153	457	3,573
Power circuit breakers and switchgear assemblies	476	415	350	868	22	([1])	2,131
Steam generating boilers	19	6	([1])	1,450	231	([1])	1,706
High-voltage electrical conductors	115	97	62	91	124	882	1,371
Power transformers rated above 10,000 kVA	500	([1])	([1])	([1])	252	([1])	752
Hydraulic turbines	([1])	([1])	([1])	14	([1])	([1])	14
Total	32,362	116,355	17,690	55,510	45,408	28,582	295,907

[1] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

U.S. Exports to Colombia

- During the 1980s and early 1990s, the U.S. share of Colombian electric power generation equipment imports was very small, as Colombia concentrated its efforts on developing hydroelectric projects, a sector in which U.S. exports typically are not competitive. In addition, U.S. manufacturers of thermoelectric power generation equipment found it rather difficult to compete with Japanese and European firms due to the strong dollar during the 1980s and to lower financing rates offered by major competitors.
- The United States has become a leading exporter of power generation equipment to Colombia with the latter's efforts to lessen the dependency on hydroelectric sources of electricity. U.S. exports peaked in 1997 at $116 million (see table 19). Relatively strong exports in 1996 and 1997 likely represent shipments of gas turbines and gas turbine generator sets by Westinghouse to the Termoflores and Termobarranquilla projects, which were completed in 1997 and 1998, respectively (see table 18).
- U.S. producers have traditionally been strong competitors in global markets for gas turbines as reflected by the fact that gas turbines were the leading U.S. export to Colombia during 1997-2001, valued at $130 million. This amount was 34-percent higher than the next highest export product category, gas turbine and other generation sets, valued at $86 million. These two product categories accounted for 73 percent of all U.S. exports of power generation and transmission equipment during 1996-2001.
- Table 18 shows great the diversity in the principal equipment suppliers of turbines and generators. However, there seems to be a trend based on the year of project development. For example, projects developed in the 1980s and early 1990s utilized many European suppliers, such as ABB and Sulzer-Escher Wyss of Switzerland, Riva Calzoni and Ansaldo of Italy. However, more recent projects indicate a greater prevalence of U.S. products, such as those from GE and Siemens-Westinghouse. This is likely due to entrance of U.S. companies as investors or project developers into the Colombian market after privatization.

Chile

- Forty percent of Chile's 15 million people live within 100 miles of the capital city of Santiago, and most manufacturing, trade, and service activities are managed from this location.[122] As a result, Chile's consumption of electricity is concentrated around this city.

- Electricity consumption is growing faster than the economy as a whole,[123] with significant additional demand expected from the expanding industrial base, especially in the copper mining and chemical industries.

- Although Chile reportedly has adequate energy resources in the near term, industry observers raise concerns that projected consumption may exceed capacity by 2004. Chile has 9.9 GW of installed capacity, but the consumption projected for 2008 will require 40 percent greater capacity.[124]

Trends in the Chilean Market

- Chile's electricity market is undergoing rapid transformation characterized by a need to expand generating capacity, a changing regulatory framework,[125] and a shift away from dependency on hydropower as the primary generation source.

- Currently, hydropower has fallen to around 40 percent of Chile's power supply. Use of coal, which traditionally had functioned as a back-up to hydroelectric sources for power generation, is slated to fall in coming years as natural gas powers more of Chile's electricity.[126]

- Chile faces some problems with its transmission and distribution as generators resist long-term contractual commitments for electrical power supply. This is a result of regulations that impose fines on generators if they are unable to adequately supply power to the transmitters and distributors.[127]

- Chile's national energy commission (CNE), the United Nations Development Program, and the Global Environment Facility are developing a 5-year plan to expand rural

---

[122] USDOC, USFCS, "Chile: Country Commercial Guide," July 2000, found at Internet address *http://www.state.gov/www/about_state/business/com_guides/2001/wha/ chile_ccg2001.pdf*, retrieved Aug. 23, 2001.

[123] In 2000, electricity consumption registered an 8.3-percent increase with 5.5-percent growth in the economy, but the 7.7-percent increase between Jan. and Apr. of 2001 has occurred in the context of a 3.3-percent growth in the economy in the first quarter of 2001. "Electricity Companies' Results Fall 67 percent in First Quarter 2001," *Business News Americas*, May 22, 2001.

[124] Carlos Capurro, "Chile: Electrical Power Equipment," *Chile Industry Sector Analysis*, USDOC, USFCS, Sept. 1, 1999.

[125] "Study: Prices Must be Deregulated to Avoid Crisis," *Business News Americas*, Apr. 10, 2001.

[126] Tara Billingsley, "Chile," USDOE, EIA, May 2001 found at Internet address *www.eia.doe.gov/emeu/cabs/chile.html*, retrieved July 12, 2001.

[127] "Rural Distributors Face Power Supply Shortage," *Business News Americas*, June 19, 2001.

electrification rates from 78 percent to 90 percent by 2005.[128] As in most Latin American countries, interconnection of electrical grids is an important near-term strategy for Chile. The most significant project currently underway is a plan to interconnect the southern and northern grids, with completion anticipated by the end of 2003 or early 2004.[129]

- Interconnection with other countries is also becoming a more predominant energy source as reflected by connection of Chile and Argentina's electrical grids through a 253-mile transmission line that links Salta in Argentina to the Atacama sub-station in northern Chile, providing power for Chile's northern grid. A second interconnection is under consideration. A connection between Chile and Bolivia also is under consideration, proposed by Endesa/CMS and Electroandina (Tractebel), to export Chilean power to the San Cristóbal mine in Bolivia.[130] Interconnection between Peru and Chile has been considered, but reportedly is not particularly feasible, as high investments would be required to make Peru's 60 hertz (hz) system compatible with Chile's 50hz system.[131]

Privatization and Foreign Participation in the Electricity Sector

- In 1986, Chile began full-scale privatization of its government-owned power generation, transmission, and distribution systems to help meet growing electricity demand. The 2 main government power companies, Endesa and Chilectra, were divided into 6 generating companies and 11 distribution companies.

- Currently, the Chilean generation, transmission, and distribution systems are entirely privatized.[132] There are 26 generators, 5 transmission businesses, and 36 distributors.[133] The market is highly competitive with a diverse number of both foreign and domestic participants. Several U.S. companies are involved in the market, and many are developing competing projects. For example, Gas Atacama (CMS/Endesa) and Norandino (Tractebel) will supply the same regional market and both will fuel their power plants using Argentine natural gas.

- The ownership of many power generation facilities in Chile is complex, many involving multi-company partnerships and integrated consortia (with both indigenous and foreign participation) as the predominant investors (table 20). For example, Colburn Machinura is owned by Corfo, Matte, and Tractebel; whereas Tractebel is partnered with Coldelco on the Electroandina facility.

[128] "Government Launches Rural Power Plan ," *Business News Americas*, Nov. 8, 2001.
[129] "Transelec Negotiates Transmission Purchases," *Business News Americas*, June 21, 2001.
[130] Billingsley, "Chile."
[131] "Colbun Prepares Transmission Upgrade Tender," *Business News Americas*, Aug. 6, 2001.
[132] USITC, *Electical Power Services: Recent Reforms in Selected Foreign Markets*, Investigation No. 332-411, USITC publication 3370, Nov. 2000, pp 18-1 through 18-5.
[133] Comision Nacional de Energia, "Sistemas Electrico," found at Internet address *www.cne.cl/electricidad.htm*, retrieved June 19, 2001.

Table 20
Chile: Leading participants in the power generation sector

Owner/operator (*Leading partners*)	**Facility type** (*Ordered by capacity generated*)	**Number of facilities per category**	**Capacity** (*Megawatts*)
Endesa, Chile			3,867
(*Endesa, Spain)*	Hydroelectric	14	2,625
	Gas turbine	4	545
	Gas and steam turbine in combined cycle	1	371
	Steam turbine	1	125
	Gas turbine in combined cycle	1	120
	Steam and gas turbine	1	81
AESGener			1,448
(AES)	Steam turbine	4	769
	Gas and steam turbine with combined cycle	1	398
	Hydroelectric	5	245
	Gas turbine	1	19
	Steam turbine	2	17
Colburn Machicura			1,219
(Electropacifico - Corfo, Matte, Tractabel)	Hydroelectric	4	767
	Combined cycle	1	372
	Gas turbine	1	80
Electroandina *(Inversiones Tocopilla - Codelco, Tractabel)*	Gas and steam turbine, combined cycle	1	1,028
CMS Nopel *(Gas Atacama - CMS, Endesa)*	Gas and steam turbine	1	710
Norte Grande, SA (Edelnor)			698
(Mirant, CPG)	Steam turbine, combined cycle	1	591
	Gas turbine with internal combustion	1	60
	Internal combustion and hydroelectric	1	22
	Internal combustion	1	15
	Hydroelectric	1	10
Gualcolda, SA (*AESGener*)	Gas and steam turbine	1	328
Iberoamer Energia (Iberdrola)	Hydroelectric	2	124
Hidroelectrica Aconcagua	Hydroelectric	4	115
Corp National Cobre de Chile (Codelco)			111
(state-owned copper company)	Hydroelectric	3	71
	Gas turbine with steam sendout	2	40
Empresa Electrica Panquipolli	Hydroelectric	2	95
Petropower Energia, LTDA	Steam turbine	1	68
Cellulosa Arauco y Constitucion			50
	Steam turbine with steam sendout	1	49
	Internal combustion	1	1
Total			9,861

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

- Endesa now has a varied share-holder base. It remains the largest generator in Chile, accounting for 39 percent of the county's generating capacity (table 21). Hydroelectricity accounts for 68 percent of Endesa's capacity. U.S.-affiliated AES Gener is Chile's second largest generator, with 15 percent of national capacity.

Other Factors of Competition

- The Chilean market is open to all sources of equipment, with U.S. suppliers having a competitive advantage in gas turbines. This will likely enhance future purchases of U.S. power generation equipment as Chile is moving toward using natural gas as a power source.

- Growth of U.S. equipment sales to Chile is inhibited by the reluctance of generating firms to invest in new facilities because of reported liability concerns in case of contract defaults.[134] Investment also reportedly is hindered by the CNE pricing structure, which sets node prices for power, but does not allow generators to pass on these costs on to consumers.

U.S. Exports to Chile

- Chile relies almost exclusively on imported power generation equipment as its local production is small. In 1999, the U.S. import share was 25 percent.[135] The leading power generation facilities in Chile purchase their equipment from a variety of sources. Facilities using U.S.-made equipment include Nueva Renca, a gas and steam plant, and Mejillones, a steam plant, which both employ GE equipment (see table 21). Chief foreign competitors in the Chilean market for gas turbines and generators include Alstom, Siemens, and Mitisubishi.

- U.S. exports during 1997-2001 indicate the variable nature of the Chilean market for power generation equipment. Gas turbines, and gas turbine and other generating sets, accounted for 60 percent of all U.S. power equipment exports during 1996-2001 (table 22). The peak of U.S. exports of such equipment in 1999 was likely due to the development of the two large-scale U.S.-led gas projects, Gas Atacama and Norandino, which utilize gas turbine generating sets.

- The USDOC considers the best U.S. prospects in this sector to be gas turbines, water tube boilers, generators, switches, insulators, electric connectors, hydraulic turbines and parts, and dielectric liquid transformers.[136]

---

[134] This refers to the Chilean Government policy that fines generators if they are unable to meet their contracts for power. Most power contracts in Chile are set at predetermined levels, stipulating the generator must provide a certain number of MW in a month. These fines are even levied in instances where the generator is not directly responsible for power shortages, such as drought conditions. U.S. Department of Commerce.

[135] Carlos Capurro, "Chile: Electrical Power Equipment."

[136] City Council of Denver, CO, "International Trade: Argentina and Chile Power Generation," found at Internet address *http://www.denvergov.org/International_Trade/template31911.asp*, retrieved Feb. 19, 2002.

Table 21
Chile: Leading projects in the power generation sector

Project	Capacity (*Megawatts*)	Facility type	Location	Year	Owner/ operator	Partners	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Tocapilla	1,028	Steam turbine gas turbine combined cycle	Tocapilla	1960-2000	Electroandina	Codelco Tractabel	([1])	([1])
Atacama Nopel	710	Gas and steam turbines with combined cycle	Mejillones	1999/2000	Gas Atacama	CMS Endesa	Alstom (France)	Alstom
Mejillones	591	Steam turbine combined cycle	Mejillones	1996-2000	Edelnor	Mirant CPG	Siemens (Germany)	Siemens
Puangue	506	Hydroelectric	Puangue	1996/1997	Endesa, Chile	Endesa (Spain)	Kvaerner (Germany)	General Electric (GE) Canada
Pehuenche	500	Hydroelectric	Pehuenche	1991	Endesa, Chile	Endesa (Spain)	Voest-Alpine (Austria)	Alsthom-Jeumont (France)
Colburn	480	Hydroelectric	([1])	1985	Colburn Machinura	Corfo Matte Tractabel	Voith (Austria)	Siemens
El Toro	400	Hydroelectric	Los Angeles	1973	Endesa, Chile	Endesa (Spain)	Voest-Alpine	ABB (Switzerland)
Nueva Renca	398	Gas and steam turbine with combined cycle	Renca	1998	AESGener	AES	GE (U.S.)	GE
Nuheunco	372	Combined cycle single shaft	Nuhuenco	1999	Colburn Machinura	Corfo Matte Tractabel	Siemens	Siemens

See footnote at end of table.

Table 21—*Continued*
Chile: Leading projects in the power generation sector

Project	Capacity (*Megawatts*)	Facility type	Location	Year	Owner/ operator	Partners	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
San Isidro	371	Gas and steam turbine with combined cycle	Quillota	1998	Endesa, Chile	Endesa, Spain	Mitsubishi (Japan)	Mitsubishi
Rapel	350	Hydroelectric	Melpilla	1972-78	Endesa, Chile	Endesa (Spain)	Hitachi (Japan)	Hitachi
Ventanas	338	Steam turbine	Puchuncavi	1964-77	AESGener	AES	GE	GE
Guacolda	328	Steam turbine gas turbine	Huasco	1977-97	Electrica Guacolda		Mitsubishi Hitachi	Mitsubishi
Antuco	300	Hydroelectric	Los Angeles	1981	Endesa, Chile	Endesa (Spain)	Hitachi	Hitachi
Pan de Azucar	225	Gas turbine	Pan de Azucar	1989-97	Endesa, Chile	Endesa (Spain)	Alsthom Atlantique (France) European Gas Turbines	Alsthom Atlantique
Norgener	276	Steam turbine	Tocapilla	1995-97	AESGener	AES	Mitsubishi	Misubishi
Charrua	197	Gas turbine	Concepcion	1982-99	Endesa, Chile	Endesa (Spain)	Hitachi, Alstom, Pratt & Whitney (U.S.)	Alstom
Alfalfa	160	([1])	([1])	([1])	([1])	([1])	([1])	([1])
Rucue	160	Hydroelectric	([1])	1998	Colburn Machinura	Corfo Matte Tractabel	Sulzer Brothers (Switzerland)	Ansaldo Coemsa SA (Brazil)
Canutillar	145	Hydroelectric	([1])	1990	Endesa, Chile	Endesa (Spain)	Voith	Siemens
Abanico	136	Hydroelectric	El Abanico	1959	Endesa, Chile	Endesa (Spain)	Allis-Chalmers (U.S.), Sulzer-Escher Wyss (Switzerland)	Westinghouse (U.S.) Alstom

[1] Not available.

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

Table 22
Chile: U.S. exports of power generation and transmission equipment, by product, 1996-2001

(*1,000 dollars*)

Product	1996	1997	1998	1999	2000	2001	Total 1996-2001
Gas turbine and other generating sets	23,222	1,285	8,418	27,746	(1)	(1)	60,671
Steam turbines	818	8,632	5	(1)	(1)	37	9,492
Internal-combustion-engine driven generator sets	1,190	2,002	1,048	829	1,063	3,157	9,289
Power circuit breakers and switchgear assemblies	1,263	2,176	2,374	328	22	906	7,069
Electricity meters	975	1,534	827	877	516	921	5,650
Electric generators over 10 MW	1,826	2,267	(1)	(1)	89	59	4,241
High-voltage electrical conductors	324	742	80	433	628	206	2,413
Gas turbines	(1)	(1)	(1)	1,638	417	(1)	2,055
Steam generating boilers	517	320	258	644	209	46	1,994
Power transformers rated above 10,000 kVA	165	1,240	(1)	(1)	(1)	(1)	1,405
Total	30,299	20,196	13,009	32,494	2,944	5,333	104,275

[1] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Peru

- The increasing consumption of power in Peru is influenced by population growth,[137] expansion of the industrial sector due to new and expanding mining projects, the potential for added demand from tourism,[138] and government plans to improve the electrification rate.[139] Peru is currently a net energy importer and a shortage of power generation capacity causes frequent blackouts.[140]

- Approximately 52 percent of Peru's total electric generating capacity of 5.61 GW in 2000 was derived from conventional thermal sources (diesel, fuel oil, and coal), whereas hydroelectric capacity accounted for 48 percent. However, because of its low operation costs, hydroelectric power accounted for 81 percent of Peru's total generation of 19.7 GW.[141] Electroperu (1,200 MW) and Edegel S.A.A. (870 MW) are now Peru's two

[137] Peru's population increased by an average annual rate of 1.75 percent during 1996-2000. USDOE, OFE, *An Energy Overview of Peru*, found at Internet address *http://www.fe.doe.gov/international/peruover.html*, retrieved June 7, 2002; p.1; and EIU, *Economic Data*, found at Internet address *http://www.economist.com*, retrieved July 10, 2002, p.1.

[138] Tourism is a growing prospect of the service sector, accounting for 65 percent of Peru's GDP. EIU, *Economic Data,* found at Internet address *http://www.economist.com,* retrieved July 10, 2002, p.1.

[139] Peru's total installed generating capacity was 5.61GW while serving a population of 26 million and supporting a GDP estimated at $54.1 billion in 2001.

[140] *Craighead's International Business, Travel, and Relocation Guide to 81 Countries: 1998-1999*; vol. 3, p. 3505.

[141] USDOE, OFE, found at Internet address *http://www.fe.doe.gov/international/peruover.html,* retrieved June 7, 2002, p. 12; and IDB, *The Power Sector in Peru*, found at Internet address *http://www.IADB.org/sdc/utility*, retrieved, Aug. 4, 2002. In 2001, Peru's total installed capacity was at 5.9 GW with an actual production level of 20.7 GWH. See USDOE, EIA, *Peru Country Analysis Brief.*

largest companies.[142] Hydroelectric facilities account for 87 percent of Electroperu's generating capacity.

Trends in the Peruvian Market

- Expectations for growth in Peru's electric power consumption reflect a tempered outlook from recent market developments. In 2000, the Ministry of Energy and Mines expected electricity generation to grow by approximately 10 percent per annum in the short term to meet new demand anticipated by economic growth.[143] The Inter-America Development Bank (IDB) more recently projected Peru's future power consumption to grow by 5.5 percent per year, with corresponding annual investment in new generation capacity ranging from $300 million to $350 million.[144]

- The reliability and efficiency of Peru's power supply improved following the interconnection of two main transmission systems with completion of the 700-km Mantaro-Socabya transmission line to form a nationwide network in 2000.[145] This development contributed to growth of rural electrification from 47 percent in 1990 to 73 percent in 2000. The government plans to increase Peru's electrification to 90 percent by 2010.[146] Consequently, the Rural Electrification Plan (in which the government plans to invest $817 million) is among the key forces fostering growth of local power demand.

- In addition, an interconnection agreement between Peru, Colombia, and Ecuador, signed in September 2001,[147] is expected to enhance system efficiency, reliability, and export earnings in the future. The power transmission and distribution systems in southern Peru are being upgraded with the help of a $50 million loan approved in December 2000 by the IDB.[148]

- Despite Peru's dependence on its weather-vulnerable hydroelectric system,[149] a 5-year building moratorium issued in 1999 was lifted at the end of 2000, and construction of hydro facilities has continued.[150] However, electricity privatization has improved the diversification of generation fuels needed to help alleviate Peru's dependence on hydroelectric resources.

---

[142] USDOE, OFE, found at Internet address *http://www.fe.doe.gov/international/peruover.html#Electricity*, retrieved Dec.19, 2002, table 11, p. 15. (Updated Oct. 7, 2002.)

[143] US Department of State, found at Internet address *http://www.stat-usa.gov/searchgl.nsf/permsr*, retrieved Sept. 25, 2000, p. 26.

[144] IDB, *The Power Sector in Peru*, found at Internet address *http://www.IADB.org/sdc/utility*, retrieved Aug. 4, 2002.

[145] The transmission project was completed by Canada's Hydro Quebec International in Oct. 2000.

[146] USDOC, ITA, found at Internet address *http://www.stat-usa.gov/mrd.nsf/vw*, retrieved July 9, 2002, p. 3; and retrieved Sept. 21, 2000, p. 3.

[147] USDOE, EIA, *Peru Country Analysis Brief*, found at Internet address *http://www.eia.doe.gov/emeu/cabs/peru2.html*, retrieved July 9, 2002, p. 5.

[148] USDOE, EIA, found at Internet address *http://www.eia.doe.gov/emeu/cabs/peru2.html*, retrieved July 9, 2002, p. 5.

[149] Hydroelectric power capacity is seriously affected by frequent droughts.

[150] USDOE,OFE, found at Internet address *http://www.fe.doe.gov/international/peruover.html*, retrieved June 7, 2002, p. 8.

Privatization and Foreign Participation in the Electricity Sector

- Privatization in the electricity sector began in 1990 and proceeded successfully through most of the last decade.[151] Open access to Peru's transmission and distribution networks reportedly is enforced and operating concessions are permitted.[152] During the past 2 years, however, electricity privatization has progressed slowly as political opposition and violent protests reportedly have moderated government commitment to the process and discouraged investors.[153] Moreover, several privatization sales have been delayed pending evaluation from the courts.

- Peru's privatization law authorized key measures to attract FDI, including the equivalent of national treatment with unrestricted currency conversion and remittances. It established the Private Investment Promotion Commission (Copri) to implement the national privatization program[154] and the Commission of Foreign Investment and Technology (Conite) to foster FDI.[155]

- Private companies now meet 80 percent of Peru's electricity consumption and account for about 50 percent of the distribution system.[156] The leading targets remaining for privatization in the distribution sector include Electro Nor Oeste, Electro Norte, Hidrandina, and Electrosur.[157]

- To assure a viable and competitive market, Peru's antitrust laws specify that no private entity can control more than a 15-percent share of the market for any electric power business, including distribution, transmission, and generation. If a company owns assets in more than one business, its market share is restricted to less than 5 percent in each sector.[158] The government retains control of corporate policies and standards for

---

[151] The 1992 Electricity Concessions Law provided the legal foundation for the privatization of state-owned electric utilities. Among other changes, the law specified rules for pricing and the unbundling of generation, transmission, and distribution functions to facilitate competition; and established the Energy Tariffs Commission (ETC) to set rates. IDB, *The Power Sector in Peru*, found at Internet address *http://www.IADB.org/sdc/utility*, retrieved, Aug. 4, 2002, p. 1. The ETC and price regulation are expected to be eliminated at the completion of the privatization program. EIU, *Country Commerce, Peru*, Aug. 2000, p. 25. Codification of the reform in the 1993 Peruvian Constitution, and subsequent legislation regarding other sectors, noted the government's commitment to the privatization process.

[152] For example, Canada's Hydro Quebec International, a key partner in the Transmantano consortium, is operating the Mantaro-Socabaya transmission line for a period of 30 years.

[153] *Business News Americas*, July 8, 2002.

[154] EIU, *Country Commerce, Peru,* p. 11.

[155] In Apr. 2002, the agencies were merged (along with the Economic Management Bureau of PROMPERU) as ProInversion to foster private investment in Peru. Industry representative, interview with USITC staff, Dec. 30, 2002.

[156] USDOE, OFE, found at Internet address *http://www.fe.doe.gov/international/peruover.html*, retrieved June 7, 2002, p. 14.

[157] Ibid., p. 16.

[158] The law is regarded by foreign investors as a means to reign in foreign conglomerates, notably Chile's Endesa, Chilectra, and Chilgener, and Spain's Endesa. - USDOE, EIA, *Peru Country Analysis Brief*, found at Internet address *http://www.eia.doe.gov/cabs/peru.html*, retrieved Mar. 13, 2002, p. 5.

investment, pricing, and environmental strategies[159] through the government's ownership of "golden shares."[160]

- International companies that have pursued investment opportunities in generation facilities in Peru include Chilectra (Chile), Dominion Energy Inc. (United States), Duke Energy (United States, controlling Egenor),[161] Entergy Corp. (United States), Sempra Energy International (United States), Endesa (Spain), Banco Santander (Spain), and Tractebel (Belgium).[162] U.S. producers have experienced mixed results with Peruvian investments; Dominion, for example, reportedly has decided instead to focus on opportunities in the U.S. market.

Other Factors of Competition

- Since most electricity in Peru is generated by hydroelectric plants, European and Japanese producers have been the leading suppliers of power equipment to that market as U.S. companies principally have specialized in co-generation power facilities. GE (U.S.), however, is an important supplier of instrumentation and other complementary electrical equipment for hydroelectric plants and transmission systems.

- Depending on the project, equipment suppliers in Peru work with regulatory agencies (most under the jurisdiction of the Ministry of Energy and Mines), utilities, IPPs, and/or project contractors (typically architecture-engineering firms), wherein selection of new equipment typically is by the consortium that wins a bidding process.

- Foreign suppliers to the Peruvian market (including Alcatel, Telemecanique, Ticino, Allen-Bradley, 3M, Lindner, GE, and Siemens) reportedly encounter only modest competition from domestic suppliers such as Ceper, Indeco, and Fametal, which are largely limited to low- and medium-technology products including transformers, copper wires, switches, and electric panels.[163] The Peruvian utility with the most significant capacity based on gas turbine generation, and therefore the largest potential for U.S. equipment suppliers, is Etevensa-EEPSA (table 23).

- All heavy electric equipment (turbines and generators) used in Peru is imported. Having been active in Peru for decades, ABB Alstom Power (AAP)[164] and Siemens (Germany) have developed a strong and loyal consumer base, with AAP supplying turbines and generators for the 155MW Aguaytia gas turbine project in 1998 (table 24).[165]

---

[159] IDBG, *The Power Sector in Peru*, found at Internet address *http://www.IADB.org/sdc/utility*, retrieved Aug. 4, 2002, p. 1.

[160] A "golden share" provides its owner with the decision-making authority regarding company policies. Ibid., p. 2.

[161] *Business News Americas*, July 10, 2002. Duke Energy reportedly obtained a controlling share of Egenor in the fall of 1999 from Dominion.

[162] USDOE, EIA, Peru Country Analysis Brief, found at Internet address *http://www.eia.doe.gov/emeu/cabs/peru2.html*, retrieved July 9, 2002, p. 6.

[163] Ibid, p. 8.

[164] AAP is a subsidiary of Alstom, which is based in Paris but has manufacturing facilities throughout Europe, as well as the United States and Brazil. See annex A.

[165] USDOC, ITA, found at Internet address *http://www.stat-usa.gov/mrd.nsf/vw*, retrieved July 9, 2002, p. 9.

Table 23
Peru: Leading participants in the power generation sector

Owner/operator	Facility Type (*Ordered by capacity generated*)	Number of facilities per category	Capacity (*Megawatts*)
Electroperu SA			1,201
	Hydroelectric	28	1,039
	Gas turbine	5	104
	Internal combustion	6	58
Edegel SAA			870
	Hydroelectric	16	589
	Gas turbine	6	281
Inergia Del Sur SA			553
	Steam turbine	6	518
	Gas turbine	1	35
Etevensa-EEPSA	Gas turbine	4	540
Electro Norte SA			273
	Hydroelectric	9	235
	Internal combustion	14	35
	Steam turbine	1	3
Electro Sur Este SAA			241
	Hydroelectric	15	166
	Internal combustion	15	75
Centromon Det	Hydroelectric	16	183
Aguaytia Energy del Peru	Gas turbine	2	155
EMP Electrica de Piura			119
	Gas turbine	4	74
	Internal combustion	9	32
	Steam turbine	1	13
EMP Generacion Elec San Gaban	Hydroelectric	1	110
Total			4,862

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

Table 24
Peru: Leading projects in the power generation sector

Project	Capacity (Megawatts)	Facility type	Location	Year	Owner/operator	Principal equipment suppliers: Turbines	Principal equipment suppliers: Generators
Mantaro	798	Hydroelectric	Campo Armino	1973-1980	Electroperu	Ansaldo (Italy)	Ansaldo
Ventanilla GT	540	Gas turbine	Ventanilla (Callao)	1993-1997	Etevensa-EEPSA	Westinghouse (WH) (U.S.); Siemens (Germany)	Brush Electric Machines (UK); Siemens
Santa Rosa Central	281	Gas turbine	Lima	1960-1996	Edegel SAA	Brown Bovari (BBC) (Switzerland); Pratt & Whitney (PW) (US); WH	BBC, Brush, Siemens
Ilo New	270	Steam (coal)	Ilo	2000	Energia Del Sur SA (Enersur)	Hitachi (Japan)	([1])
Huinco	258	Hydroelectric	S. Jeromino de Surco	1964-1966	Edegel SAA	Riva (Italy)	BBC
Ilo	248	Steam (oil)	Ilo	1974-1977	Enersur	BBC, General Electric (GE) (US)	BBC,GE
Restitucion	218	Hydroelectric	Campo Amino Tayacaja	1984-1985	Electroperu	Riva	Ansaldo
Canon del Pato	157	Hydroelectric	Hullanca	1958-1981	Electro Norte SA (Egenor)	Voest Alpine (Austria); Neyrpic (France)	([1])
Aguaytia	155	Gas turbine	Pucallpa	1998	Aguaytia del Peru	ABB (Switzerland)	ABB
Charcanie	135	Hydroelectric	Charcani (Arequipa)	1991	Electro Sur Este SAA	Neyrpic	Axel Johnson

[1] Not available.

Source: Compiled by the USITC from statistics of the Utility Data Institute and various issues of *Business News Americas*, 2001 and 2002.

- Japanese companies, including Hitachi, Mitsubishi, Toshiba, and Fuji Electric, also are penetrating Peru's market[166] through Japanese economic development programs or through joint ventures with other foreign firms, such as the Yuncan project.[167] Hitachi supplied turbines for the 270 MW-expansion of the Ilo coal-fired power plant in 2000.

- Although Peru has extensively reformed its electric utility sector, investors reportedly remain concerned that developments may slow or halt the initiation of new power generation projects. Although Peruvian GDP grew by 4 percent in 2002 and inflation was held to 2 percent, potential investors reportedly are waiting for the courts and the government to renew Peru's commitment to the privatization process.[168]

U.S. Exports to Peru

- The United States supplied 43 percent ($192 million) of Peru's market for "power equipment"[169] in 2001.[170] Other foreign suppliers provided 32 percent, and Peruvian producers provided 25 percent. According to the USDOC, the leading types of "power equipment" exported to Peru in 2001 were mechanical equipment (heat exchangers, generator sets, and parts of gas turbines); hydroelectric equipment (turbines and wheels); and electric equipment (interrupters, relays, circuit breakers, static converters, connectors, consoles and supports, panels, and lockers).[171]

- In the more narrowly defined "power generation and transmission equipment" category, Peru was the eighth-leading Latin American market for U.S. exports during 1996-2001. Partly due to the capacity diversification stemming from privatization initiatives, three-fourths of the value of the imports during this period represented equipment for thermal generation. Gas turbines accounted for 42 percent of all U.S. exports to Peru in this product category during 1996-2001 ($52 million), followed by internal-combustion-engine driven generator sets (15 percent) and electricity meters (14 percent) (table 25).

- Nearly one-half of the gas turbine capacity imported from the United States for the period 1996-2001 occurred in 1996. Gas turbine imports tapered off quickly following the lifting of the national moratorium on hydro power construction in 2000. Industry sources anticipate that when natural gas becomes available from the Camisea gas field within the next few years, the market in Peru for gas turbines is expected to recover.[172]

---

[166] USITC staff interview and documents sent by Hitachi, Feb. 7, 2001.

[167] The Overseas Economic Corporation Fund of Japan contributed 75 percent of the financing for the $312-million project. The remaining 25 percent was granted by the Japanese Government. See *Latin American Power Watch*, Mar. 1999, p. 10.

[168] "Recovery in Peru: Too Good to Last?", *The Economist*, Nov. 16-22, 2002, p. 32; Industry sources anticipate privatization activities to gain momentum by the second quarter of 2003. Industry representative, interview with USITC staff, Dec. 30, 2002.

[169] USDOC, USFCS, *Peru Country Commercial Guide FY 2002*, Aug. 21, 2001. The USDOC's definition of "power equipment" is broader than that employed elsewhere in this report.

[170] The largest projects for which U.S. companies supplied gas turbines were the 540-MW Ventanilla GT plant (Westinghouse, 1993-97) and the 281-MW Santa Rosa Central plant (Westinghouse and Pratt &Whitney, 1990-96).

[171] USDOC, ITA, found at Internet address *http://www.stat-usa.gov/mrd.nsf/vw*, retrieved Sept. 21, 2000, p. 7.

[172] Peru's Camisea natural gas project reportedly is on schedule to deliver gas to Lima by August 2004. *Latin Petroleum Analytics*, as reported by Reuters, "Peru to Auction Camisea Power Contract April 25," Dec. 24, 2002, found at Internet address *http:www.latinpetroleum.com/*

(continued...)

Table 25
Peru: U.S. exports of power generation and transmission equipment, by product, 1996-2001
(*1,000 dollars*)

Product	1996	1997	1998	1999	2000	2001	Total 1996-2001
Gas turbines	10,638	5	5,490	5,460	([1])	([1])	21,593
Internal-combustion-engine driven generator sets	2,759	682	469	285	781	2,905	7,881
Electricity meters	2,057	2,254	852	529	878	587	7,157
Electric generators over 10 MW	2,849	467	23	5	([1])	20	3,364
Steam generating boilers	1,396	1,123	275	61	8	([1])	2,863
Gas turbine and other generating sets	([1])	([1])	2,360	([1])	([1])	([1])	2,360
High-voltage electrical conductors	560	290	312	63	655	451	2,331
Power circuit breakers and switchgear assemblies	47	([1])	590	71	744	560	2,012
Power transformers rated above 10,000 kVA	([1])	([1])	723	260	698	([1])	1,681
Steam turbines	41	([1])	([1])	([1])	([1])	([1])	41
Total	20,347	4,821	11,095	6,733	3,763	4,523	51,282

[1] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Annex A
Leading Equipment Producers[173]

Alstom Power

In mid-2000, Paris-based Alstom, a licensee of General Electric (GE) for many years, acquired the turbine manufacturing operations of Asea Brown Boveri (ABB), making it a significant worldwide competitor (particularly in the market for small industrial turbines from 2 to 13 megawatts (MW) capacity). Previously, in March 1999, Alstom had sold two large-frame turbine manufacturers in France and Germany to GE, and in turn purchased a significant manufacturer of small gas turbines in the United Kingdom from GE. These transactions ended Alstom's cooperative efforts with GE. Through its acquisitions, Alstom also secured the capability to produce gas turbines ranging in size from approximately 17 to 265 MW. In addition to its gas turbine business, Alstom has developed a full line of steam turbines ranging up to 1,560 MW; hydro and pump turbines to 800 MW; two-pole electrical generators from 20 to 1,350 megavolt amperes (MVA); generators for diesel applications; and a comprehensive fuel technology line of boilers. In addition, Alstom has designed control systems for all types of power plants.[174]

[172] (...continued)
printer_519.shtml, retrieved Dec. 30, 2002. Also see *Oil & Gas Journal*, "Camisea Project Transforming Peru into a Major Regional Gas Player," Nov. 25, 2002.

[173] Information derived from company reports and websites, and as noted.

[174] Alstom Power, "The "FULL SERVICE PROVIDER" in Power Generation," found at Internet address *http://www.power.alstom.com,* retrieved Jan. 31, 2001.

In December 2001, Alstom opened a new 40,000-sq.-ft. turbine packaging and overhaul facility in Houston, TX. This facility has the capability to package gas turbine generator units ranging up to 50 MW and steam turbines up to 100 MW and is responsible not only for U.S. markets, but for markets throughout the Western Hemisphere. The Houston facility functions as Alstom's principal center for application engineering, technical support, and project management for gas and steam turbine products, with customer service functions being performed at various locations throughout North and South America.[175]

Alstom also has major production facilities (in addition to Houston) in Stuttgart and Mannheim, Germany; Birr, Switzerland; Elblag, Poland; Belfort and La Corneuve, France; Finspong, Sweden; Lincoln and Rugby, United Kingdom; and Brno, Czech Republic; and service facilities in Syracuse, NY, and Anchorage, AK. The company has developed turnkey projects for combined cycle power facilities, coal- and oil-fired plants, hydroelectric plants, and turbine islands for nuclear plants. Its principal Latin American markets are currently Argentina and Mexico.

Caterpillar Inc.

Caterpillar is a manufacturer of small- to medium-sized gasoline- and diesel-engine driven generator sets and power modules, and turbine generator sets and power modules. The Caterpillar electrical generating product line ranges in size from 5 kilowatts (KW) to 10 MW. Caterpillar sells its equipment under its own name as well under the names of its principal wholly owned affiliates including Perkins Engine, F.G. Wilson (Larne, Northern Ireland), Olympian, and Solar Turbines. The company has also established local production of generator sets by expanding its Caterpillar Brasil Limited facility in Piracicaba, Brazil, to better serve this rapidly expanding market.[176] The generator sets assembled in this facility have electrical outputs in the 40 to 370 KW range.

Caterpillar has established regional Latin American offices in Brazil; Santiago, Chile; Monterrey, Mexico; and San Juan, Puerto Rico. In Latin America, Caterpillar sells its electric power products only through the company's established dealer network, which is comprised of 35 full-line dealers and 220 branch stores that employ over 12,200 people.[177] Caterpillar also rents its power modules and finances certain power plants through its Caterpillar Finance subsidiary. The company develops turnkey power plants through its Caterpillar Power Ventures subsidiary that not only supplies all necessary generating and control equipment, but provides full onsite infrastructure development. Caterpillar manufactures all of the engines and turbines that it sells in Latin America in either Europe or the United States.

General Electric Co. (GE)

GE, through its General Electric Power Systems (GEPS) division, is currently one of the world's largest and most diversified manufacturers of power generation equipment, with the

---

[175] Skip Ruch, "Alstom Power: Up and Running in the U.S," *Turbomachinery International*, Jan./Feb. 2002, pp. 28-29.

[176] Caterpillar Inc., "Caterpillar Inc. Expands Electric Power Product Offering in Latin America," found at Internet address *http://www.findarticles.com/cf_0/m...jhtml?term=Caterpillar+Corporation*, retrieved Dec. 17, 2001.

[177] Ibid.

largest installed base of power generation equipment of any manufacturer.[178] The GEPS product line includes gas turbines that range in size from 2 to 480 MW, steam turbines up to 1,100 MW, AC generators, power transformers and circuit breakers, diesel and natural-gas powered reciprocating generators, hydroelectric power generating systems, pure water systems, and power plant control systems. Many of GE's gas turbines are aeroderivative in design, taking advantage of GE's considerable expertise in the manufacture of aircraft turbine engines. GEPS has established major regional production facilities in Monterrey, Mexico, and Buenos Aires, Argentina.

Currently, the most important Latin American market for GE power generation equipment is Brazil, accounting for 60-65 percent of GE's power equipment business in Latin America south of Mexico.[179] GEPS manufactures transmission and hydroelectric equipment in Brazil to supplement its extensive imports from the United States and other foreign sources. GE has indicated that it will be supplying a total of 54 gas turbines to various project facilitators in Brazil that will be responsible for 4.6 gigawatts (GW) of new generating capacity when all installations are in place by 2003.[180] In addition to Brazil, GEPS has also sold sizeable quantities of equipment in Venezuela, Mexico, Peru, and, to a lesser extent, Argentina.

A significant portion of the gas turbines that GE sells in Latin America are produced in the company's Greenville, SC, and Cincinnati, OH, plants. GE production of steam turbines and AC generators is concentrated in its Schenectady, NY, facility. GE's design and production of hydroelectric generators takes place in facilities in Australia, Brazil, Canada, China, Finland, Norway, Sweden, the United Kingdom, and the United States. In addition, GE has business, licensing, and packaging agreements with over 25 companies worldwide including Nuovo Pignone of Italy and several other companies in Norway, Scotland, the Netherlands, and Japan that provide the company with a significant degree of flexibility in supplying equipment to its far-flung global markets including Latin America.

Mitsubishi Heavy Industries, Ltd. (MHI)

MHI is a major world-class manufacturer of heavy industrial machinery including gas, steam, and hydraulic turbines and related equipment for use in electrical generating plants. MHI gas turbines range in size from 6 to 300 MW; the company's steam turbine offerings are as large as 1,000 MW for fossil-fuel applications and 1,600 MW for nuclear installations; and hydraulic turbines range from 3 to 320 MW. Major Latin American markets for MHI included Mexico (2,003 MW), Argentina (1,157 MW), and Brazil (1,122 MW) for gas turbines; Mexico (11,468 MW), Chile (1,130 MW), and Argentina (945 MW) for steam turbines; and Mexico (3,437 MW) and Brazil (1,446 MW) for hydraulic turbines. MHI has also made significant equipment sales in Colombia, the Dominican Republic, Ecuador, and El Salvador.

In an effort to expand its presence in the Western Hemisphere, MHI opened a service and component manufacturing facility in Orlando, FL, in March 2002. The facility provides repair, manufacturing, and engineering services for MHI's installed base of more than

[178] *Turbomachinery International Handbook 2001-2002*, vol. 42, No. 6, (Norwalk, CT: Business Journals, Inc., 2002), p. 45.
[179] GE officials, teleconference with USITC staff, spring 2001.
[180] "Heavy-duty GTs to Help Brazil," *Power*, Sept./Oct. 2001, p. 7.

30,000 MW of combustion and steam turbine generating units in North and South America.[181]

Rolls-Royce plc (Rolls-Royce)

Rolls-Royce is a significant manufacturer of small- to medium-sized, aeroderivative gas turbines, diesel/gasoline reciprocating engines, and associated power plants. Rolls-Royce gas turbines range in size from 3 to 51 MW, whereas the company's reciprocating engines range from 1MW to 15 MW. Rolls-Royce prime generation movers rely heavily on expertise that the company has acquired from designing power plants for aerospace, marine, and military equipment. The associated power plants that the company constructs typically range from 5 to 150 MW of output.

Although the company is headquartered in London, United Kingdom, and much of the work on Rolls-Royce's larger turbines is performed at various locations in the United Kingdom (including Coventry, Merseyside, and Bedford), the company also has production facilities in the United States (Indianapolis, IN, and Mount Vernon, OH); Calgary, Alberta; and Bergen, Norway. In addition to sales offices in the Latin American region, Rolls-Royce established Rolls-Royce Power Ventures Limited (RRPV) in 1994 to function as a power development organization for potential industrial, utility, and governmental customers. Taking advantage of the financial strength and technical expertise of their parent company, RRPV provides its clients with a full range of power project services including site and facility design, permit and construction authorization acquisition, equipment supply and construction contractor selection, project financing, long-term fuel supply acquisition, and extended operations strategy development.[182]

The company has been responsible for at least two Latin American projects to date: the Capuava cogeneration project (17 MW steam turbine facility) in Santo Andre, Brazil, and the Censa power facility (7.8 MW diesel generator plant) in Santo Domingo, Dominican Republic. Rolls Royce has also won a contract to build a 31 MW combined heat and power plant for Votorantim Celulose e Papel in Jacarei, Brazil; a 125 MW independent power project in Alagoas, Brazil; and a turnkey power plant for Brazilian petroleum utility Petrobras at their refinery in Bahia.[183] In addition, the company has won a $12-million contract to build a 27 MW power station in Ushuaia, Argentina, the main port to service Antarctica.[184]

---

[181] "Dedication Ceremony at Orlando Service Center," found at Internet address *http://www.mhi.co.jp/power/topics/main24.htm*, retrieved June 20, 2002.

[182] "About Rolls-Royce Power Ventures (Introduction)," found at Internet address *http://www.rrpv.com/about/about.htm*, retrieved Jan. 7, 2002.

[183] Rolls-Royce Media room, Rolls-Royce news, "Rolls-Royce Increases Business in Brazil," found at Internet address *http://www.rolls-royce.com/latestn....asp?Filename= RRPR020801091457.txt*, retrieved Jan. 4, 2002.

[184] Rolls-Royce Media room, Rolls-Royce news, "Rolls-Royce Wins $12 Million Contract in Argentina," found at Internet address *http://www.rolls-royce.com/latestn....asp?Filename= RRPR120401132308.txt*, retrieved Jan. 4, 2002.

Siemens AG (Siemens)

Siemens, headquartered in Munich, Germany, is a full product line, worldwide supplier of all types of generating, transmission, and control equipment for electric power plants. Siemens supplies the Latin American market from U.S.-, Canadian-, European-, and Latin American-based production facilities. In the United States, Siemens' principal heavy electrical equipment production arm is Siemens Westinghouse Power Corp., which produces gas and steam turbines and electrical generators, but also designs and builds simple and combined cycle power plants. Siemens Westinghouse produces gas turbines that range from 65 to 265 MW, generators from 25 to 2,000 MVA, steam turbines up to 1,100 MW, and gas turbine power plants from 70 to 780 MW.[185] The subsidiary company came into being in 1998 when Siemens purchased the fossil-fuel fired, power generation assets of Westinghouse Electric. Based in Orlando, FL, Siemens Westinghouse is also involved in other aspects of power plant construction including engineering, projects implementation, supply management, finance, sales, and marketing.

Siemens Power Transmission & Distribution, Inc. (SPT&D) of Raleigh, NC, is another Siemens affiliate company that has an active role in the manufacture of power generating equipment. With operations in Jackson, MS; Lafayette, IN; Minneapolis, MN; Orlando, FL; San Jose, CA; and Reynosa, Mexico. SPT&D produces high-voltage circuit breakers and transformers for power plants and independent transmission line facilities. In addition, Siemens produces and designs power plant instrumentation, including continuous emissions monitoring systems, in its Alpharetta, GA, facility, which is the headquarters for Siemens Power Generation Group Instrumentation and Controls and Ceramics. Other major centers for Siemens production operations involving power generation equipment include Hamilton, Ontario (gas turbines, parts, and refurbishment services); the German cities of Berlin (gas turbines and parts), Mülheim (steam turbine generator units and components), Karlsruhe (power plant instrumentation and controls), and Erfurt (electrical generators and components); Newcastle, United Kingdom (turnkey power plants and refurbishment services); and Fort Payne, AL (electrical generator components).[186]

In April 2000, Siemens entered into a joint venture agreement with J.M. Voith AG (a major German supplier of hydro turbines and automation equipment) in which Voith acquired 65 percent and Siemens 35 percent of a new company, Voith Siemens Hydro Power Generation GmbH (VSHPG). This venture positions the new enterprise to become a global leader in the hydroelectric power sector.[187] In January 2002, VSHPG purchased a controlling interest (51 percent) in Esac Energia located in St. Loup-sur-Sermouse, France, and named the new enterprise Voith Hydro SA.

As an aid in establishing power plants worldwide and encouraging the sale of Siemens generation and transmission equipment, Siemens has established Siemens Project Ventures GmbH (SPV), a wholly owned subsidiary of Siemens Financial Services GmbH. SPV promotes the development of power plants and telecommunication networks worldwide.

---

[185] Siemens Westinghouse Power Generation, "Products and Solutions (various)," found at Internet address *http://www.siemenswestinghouse.com*, retrieved Dec. 27, 2001

[186] Ibid.

[187] Voith Siemens Hydro Power Generation press release, "Voith Siemens Hydro Committed to Becoming Market Leader," found at Internet site: *http://www.vs-hydro.com/1213.htm*, retrieved May 9,2002.

SPV's experience in Latin America to date has been confined to investments in the Caribbean Basin.

Within Latin America, Siemens has been most active in Argentina (1.9 GW), Colombia (1.5 GW), Brazil (1.4 GW), Mexico (1 GW), and Puerto Rico (950 MW). It also has completed substantial power plant projects in Peru (604 MW), Venezuela (554 MW), Chile (372 MW), the Dominican Republic (100 MW), and Ecuador (100 MW).

Wärtsilä Corporation (Wärtsilä)

Wärtsilä is a Helsinki, Finland-based producer of small- to medium-sized, mixed-fuel reciprocating engines, and derivative power plants and modules. Wärtsilä's small- to medium-sized power plants range in size from 1 to 400 MW and include floating or barged power plants rated from 25 to 170 MW. Although many of these plants are designed for baseload or continuous (up to 8,500 hours annually) operation, the company also packages a line of 10 to 50 MW power modules that can be combined to generate up to 100 MW for peaking generation service (up to 4,000 hours annually).

Wärtsilä has manufacturing facilities in Finland, France, and Italy. The company produces simple cycle and well as co-generation plants and had an installed base of nearly 100 power plants and modules in the Latin American region in the middle of 2001, with a combined capacity of nearly 3 GW. The largest of these facilities was a 158 MW plant in Brazil, the smallest were 2-MW facilities in Ecuador, Brazil, and Bolivia, and the average plant size was approximately 30 MW.[188] The Latin American markets in which Wärtsilä has established the greatest presence are the Dominican Republic (609 MW), Brazil (292 MW), El Salvador (290 MW). Guatemala (214 MW), Honduras (198 MW), and Peru (144 MW). Several countries in Central America and the Caribbean Basin supplement hydro-generated electricity on their national grids by leasing Wärtsilä floating power plants that are transported by barge to locations on their coastlines or inland waterways. Wärtsilä floating power plants also provide electricity to industrial parks near port cities in the region.

Annex B
Leading Independent Power Producers[189]

American Electric Power (AEP)[190]

AEP is a U.S.-based electrical utility, headquartered in Colombus, OH, with a base of nearly 5 million customers across 11 Midwestern and Southern States. In 1982-83, AEP filed a request with the U.S. Securities and Exchange Commission to create a separate operating entity, AEP Energy Services, to explore development of generating plants outside the United States. This filing was in large part due to the slow growth in U.S. demand for electrical energy relative to certain foreign markets, including Latin America. Latin America became

[188] "Wärtsilä in Latin America & the Caribbean," found at Internet address *http://www.wartsilausa.com/powerplant/latincaribmap.htm,* retrieved June 4, 2001.

[189] Information derived from company reports and websites, and as noted.

[190] Much of the information relating to the experience of AEP in Latin America that follows is based upon a telephone interview between AEP representatives and USITC staff, Jan. 9, 2002.

particularly attractive for AEP following the opening of the Chilean and Argentine power generation markets to foreign participation and with the beginning of drought-related energy shortages in Brazil. Concerns about currency fluctuations and shifting host-governmental policies led AEP to be a cautious participant in Latin American markets during the 1990s. AEP has acknowledged that–although certain opportunities exist in Mexico for co-generation, independent power producers (IPPs), and self-supply generation projects, the national transmission and distribution markets are essentially closed to foreign participation.

AES Corp. (AES)

Founded in 1981 as Applied Energy Services, the company that was to become AES Corp. in 1991 initially provided energy consulting services. AES has since become one of the largest nonutility IPPs through the acquisition and construction of power-generating facilities. Headquartered in Arlington, VA, AES is a global competitor not only in the United States, but also in Argentina, Australia, Brazil, Canada, Chile, China, Colombia, the Dominican Republic, Hungary, Kazakhstan, Mexico, the Netherlands, Panama, Pakistan, the United Kingdom, and Venezuela. In early 2002, the generating assets of AES totaled 128 facilities with 44 gigawatts (GW) of capacity. As of December 31, 2001, revenues from AES operations in South and Central America represented 39 percent of its corporate total.[191]

Since September 2001, AES has come under increasing pressure to maintain its position in world energy markets. This pressure was prompted in part by weakness in the value of the Brazilian reál relative to the dollar and concern that Argentina might devalue its currency.[192] The company also acknowledged at this time that the book value of more than $1-billion in Argentine facilities may need to be substantially reduced if economic conditions in that country continued to deteriorate. An AES spokesman indicated that the poor operating performance was largely attributable to Brazilian currency losses, the company's failure to obtain the rights to build a California generating plant, and the forced restructuring of two British subsidiaries.[193] AES subsequently announced its intention to sell between $500 million and $1 billion of its $36 billion in total assets, including an energy distribution company and power plant in Brazil if they could not become more profitable.[194]

Over the longer term, AES indicated that it would attempt to sell much of the company's "merchant generation" business, which produces power for more highly volatile deregulated markets. However, industry analysts have speculated that, despite AES's expressed intentions to invoke a business course correction, the company would have difficulty divesting a significant portion of its volatile Latin American holdings or insulating itself from swings in world energy prices.[195] AES officials have acknowledged that their investment in Latin American power plants was much too large in light of the economic and

---

[191] "AES Summary Fact Sheet, Breakdown by Region," found at Internet address: *http://www.aesc.com/print/index.html*, retrieved Feb. 21, 2002.

[192] Mike Trigg, "AES Corp. Hit Hard," *The Motley Fool*, Sept. 26, 2001, found at Internet address: *http://www.fool.com/news/2001/aes010926.htm*, retrieved April 15, 2002.

[193] Ibid, p. E-11.

[194] Neil Irwin, "AES to Dump Its Weakest Plants, Sale of Assets Could Raise Cash Reserve by $1 Billion," *Washington Post,* Feb. 7, 2002, p. E-2.

[195] Ibid., p. E-3.

political collapse in Argentina and more recent economic problems in Venezuela after allowing its currency to float.[196] The collapse of Enron Corp., which filed for bankruptcy protection on December 2, 2001, reportedly has increased the level of scrutiny from the investment community toward companies that may be characterized by complex corporate accounting practices.[197]

The combination of these events led AES stock, which previously traded at a high exceeding $67 in 1999, to close at an all-time low of 95 cents on October 16, 2002. The company recently announced an operating loss of $314 million for the third quarter of 2002 on revenue of $2.14 billion, of which $203 million resulted from transactions involving the Brazilian reál.[198] To avoid a default on debt due December 15, 2002, the company restructured its outstanding debt on December 12, 2002, as a group of 63 banks approved $1.6 billion in loans to be due in 2005 and rescheduled $500 million in notes due in 2003. Analysts project these arrangements will provide AES with a 3-year window to get their finances in order.[199]

Duke Energy International (DEI)

DEI is a wholly owned subsidiary of Duke Energy, headquartered in Charlotte, NC. In addition to offering energy trading and marketing and risk management services, DEI is involved in the development of natural gas and electric power generation and transmission projects and provides services such as the operation and maintenance of installed facilities. In August 1999, DEI announced a major commitment to the Latin American region by purchasing substantial generation assets in Argentina, Belize, Bolivia, Brazil, El Salvador, and Peru. These acquisitions positioned DEI to take over operations and ownership interests in approximately 6,700 megawatts (MW) of generating plants, 1,800 miles of natural-gas pipelines, and 245 miles of electric transmission lines not only in Latin America, but also in Australia and Indonesia.[200]

Prior to this major expansion of DEI operations in Latin America, the company had already established a leading position in the Chilean market by the staged acquisition of a controlling interest in electricity generator Empresa Nacional de Electricidad S.A. (Endesa).[201] Since August 1999, DEI has substantially increased its investments in Brazil, El Salvador, and Peru; and continues to seek to expand its presence in Costa Rica, Ecuador, and Guatemala. To date, virtually all of the more than 2,300 MW of generating assets that DEI owns in Brazil are hydroelectric facilities on the Paranapanema River in the southwestern State of

---

[196] Neil Irwin, "Formula for Corporate Crisis: Enron, Collapsing Currencies and Falling Energy Prices Cause Problems for AES," *Washington Post*, Feb. 25, 2002, p. E-11.

[197] Ibid.

[198] "AES Posts Loss, Warns of Debt Default," *The Washington Post*, Oct. 25, 2002, p. E-3.

[199] Peter Behr, "AES Completes New Loan Deal," *The Washington Post*, Dec. 14, 2002, p. E-3.

[200] DEI, "About Duke Energy, Did You Know?," *A History of Smart Energy*, found at Internet address: *http://www.duke-energy.com/decorp/...t/aboutus/deip9sub.asp?inc=9a17a11*, retrieved Feb. 12, 2002.

[201] DEI, Apr.8, 1999,"Duke Energy Achieves Major Milestone in Proposed Acquisition - Extends Expiration Time of U.S. Tender Offer," news release, found at Internet address: *http://www.duke-energy.com/decorp/...sreleases/1999/apr/1999040801.html*, retrieved Feb. 12, 2002.

São Paulo.[202] The remainder of DEI generation holdings in Latin America are a combination of thermal (principally natural-gas fired) and hydroelectric plants.

Electricite de France (EdF)

EdF is the largest electricity company in France as well as a major player in European markets. The company came into being in 1946 in an effort to consolidate under one nationalized entity all of the fragmented electricity providers that existed within the country. The company currently serves 31 million customers in France and generates annual revenues exceeding 34 billion euros. In 1992, EdF established a holding company, Electricite de France International S.A., to expand its base of operations into international markets.[203] In South America, the principal interest of EdF is in countries that are in the process of privatizing their publicly held electrical utilities.

To date, EdF has been more active in electricity distribution activities than in the generation of electricity in Latin America, having acquired majority positions in Brazilian distributor Light (Rio de Janeiro), and Argentine distributor Edenor S.A. (Buenos Aires). These are two major distribution companies with customer bases of 3.3 million and 2.3 million, respectively, that provide EdF with a substantial foothold in the region. In addition to its distribution assets, Light also owns 780 MW of hydroelectric generating capacity and 2,200 kilometers of transmission lines.[204] In 1994, EdF acquired an interest in two hydroelectric generating facilities (Los Nihuiles and Diamante) in the Mendoza province of Argentina. Located just east of the Andes, these two facilities provide nearly one-half of the electric power of the region.

Mexico has been the focus of EdF efforts to develop power generation assets in Latin America. EdF's initial Mexican venture was the 495-MW Rio Bravo Anahuac combined cycle power plant in Tamaulipas State, which entered into service in January 2002.[205] In 1999, EdF announced that it would build a 247-MW combined cycle gas-fired power plant near Saltillo, Coahuila State.[206] This facility became operational in November 2001, with the power being sold into the transmission grid of the Comisión Federal de Electricidad (CFE) (Mexico's national electrical utility). Finally, in April 2000, EdF acquired a 51-percent share of Mitsubishi Electric's contract to build the Altimira 2, 495-MW combined cycle plant in Tamaulipas State. This facility was completed in May 2002.

---

[202] DEI, "Latin America Business: Brazil," found at Internet address: *http://www.duke-energy.com/la/Brazil/labrazil.asp*, retrieved Feb. 12, 2002.

[203] EdF, "More About Us, International horizons," found at Internet address: *http://www.edf.fr/htm/en/mieux_con...edf/legroupe/histoire/nouveamonde*, retrieved May 28, 2002.

[204] EdF, "Brazil: Light, First Electricity Supplier in Brazil," found at Internet address: *http://www.edf.fr/htm...nsmonde/amerlatine/bresil/services*, retrieved June 4, 2002.

[205] EdF, "Mexico: Rio Bravo Anahuc," found at Internet address: *http://www.edf.fr/htm...onde/amerlatine/mexique/production,* retrieved June 4, 2002.

[206] Ibid. Saltillo is an industrial city with high energy demand for its steel mills and large plants that assemble motor vehicles, engines, and other auto parts.

El Paso Energy International (El Paso)

From its beginning as El Paso Natural Gas in 1928, El Paso has primarily developed and transported (principally via pipeline) natural-gas resources. The company's first major participation in Latin American energy markets was in 1994 when El Paso became part of a consortium created to develop a natural-gas pipeline from Bolivia to Brazil. Subsequently, in 1997, El Paso announced it would develop generation projects in Argentina, Brazil, and Peru. El Paso expanded this presence in 1998 with additional projects in Argentina, Brazil, Chile, and Venezuela.

To date, El Paso operates four wholly owned power plants in Manaus, Brazil, employing 10 engines and 6 turbines to generate 400 MW; 2 joint-venture thermal plants in Porto Velho (Rondônia State) that produce 139 MW (currently being expanded to add 265 MW by mid 2003); and a wholly owned, natural-gas fired plant in Rio de Janeiro State that generates 870 MW.[207] In conjunction with Copel (20-percent share) and Petrobras (20 percent), El Paso is also developing a 480-MW, natural-gas fired, combined cycle plant in Paraná State. The other major connection with Brazilian energy markets is the result of El Paso's 9.6-percent share in the Brazilian portion and 2-percent interest in the Bolivian portion of the Bolivia-to-Brazil natural-gas pipeline.[208] El Paso is partnered in this venture with Petrobras, British Gas, Total Fina, and Shell.

Endesa

Endesa is the largest supplier of electricity in Spain and also the fifth-largest Spanish company. On the basis of stock capitalization, Endesa is the fourth-largest supplier of electricity in Europe. Established as a state-owned utility in 1944, the company became fully privatized in 1998. In 2001, Endesa's installed worldwide generating capacity amounted to approximately 40,000 MW, of which nearly 50 percent (19,278 MW) was outside of Spain (mainly in Latin America).[209]

In 1999, Endesa was restructured through the consolidation of corporate operations into six lines of business. All of Endesa's operations in Latin America, Europe outside Spain, and Africa are now managed by Endesa Internacional. In 2000, Endesa held an interest in Latin American companies with 13,245 MW of installed generating capacity, either directly or through its Latin American subsidiary Enersis. The largest concentration of these holdings was in Chile (4,035 MW), Argentina (3,692 MW), Colombia (3,035 MW), and Peru (1,708 MW).[210] In terms of the actual power generated from these operations, Chile was by far the largest market at 15,346 gigawatt hours (GWh), followed by Argentina (10,470 GWh), Colombia (9,618 GWh), and Peru (4,035 Gwh).

---

[207] El Paso, "Brazil, Power, Developing Energy Infrastructure," found at Internet address : *http://www.elpaso.com.br/power.asp,* retrieved June 12, 2002.

[208] El Paso, found at Internet address: *http://www.elpaso.com.br/pipelines.asp*, retrieved June 12, 2002.

[209] Endesa: Lines of business, energy, generating, presentation, found at Internet address *http://www.endesa.es/english/linea...ctrico/generacion/presentacion.htm*, retrieved June 7, 2002.

[210] Endesa, Lines of business, energy, generation, international generation, found at Internet address: *http://www.endesa.es/english/linea...a/electrico/generacion/gen_int.htm*, retrieved June 7, 2002.

Endesa has indicated that the Brazilian power market will be the focus of future interest in Latin America. To this end, in June 2000, Endesa announced the completion of a 507 kilometer, 500 kilovolt, and 1,000 MW-capacity transmission line linking Argentina and Brazil, and the acceleration of the construction of lines with an additional 1,000 MW capacity between the two countries. This construction was in response to a critical shortage of electricity brought on by an extended drought that had depleted the hydroelectric reservoirs in Brazil. Brazil derives 91 percent of its annual energy supply from hydroelectric facilities. In Brazil, Endesa controls two electricity distribution companies, Cerj (Rio de Janeiro) and Coelce (Fortaleza); a 658-MW hydroelectric plant at Cachoeira Dourada (south of Brasilia); and two electric trading companies, CIEN and CEMSA.[211]

In January 2002, Endesa announced that Endesa Internacional and affiliate Enersis would jointly construct a 310-MW, combined cycle gas turbine generating plant in Pec m under the Brazilian Government's Priority Programme for Thermoelectricity (PPT).[212] The PPT incentives for this project, due to be completed in December 2003, include a guaranteed 20-year supply of natural gas and assistance in securing financing for the purchase of Brazilian-made equipment. The PPT was established to encourage the development of thermal sources for electricity generation that would reduce the need to ration electricity, as had been the case during the recent drought.

Enron

Prior to its much publicized financial and legal difficulties, Enron was a major investor in Latin American energy markets. Beginning in 1992 with the purchase of an ownership interest in Argentina's major natural-gas pipeline (Transportadora de Gas del Sur), Enron, with major financial support from the Overseas Private Investment Corp. (OPIC) and the Export-Import (Ex-Im) Bank, expanded its influence in Latin American energy markets through a series of investments in gas and liquid hydrocarbon pipelines, gas marketing services, natural-gas extraction and compression facilities, electricity distribution and power marketing enterprises, and power-generating facilities. In addition to Argentina, Enron was a major investor in Bolivia (Bolivia-to-Brazil pipeline), Brazil (gas and electricity distribution companies and a gas-fired power generation plant), Colombia (gas pipelines), and Venezuela (natural-gas extraction, distribution, and compression facilities; and an electrical utility company). Enron was also a lesser contributor to the power markets in the Dominican Republic, Mexico, Nicaragua, Panama, and Puerto Rico.

Altogether, Enron's Latin American energy holdings exceeded $3 billion at their peak and reportedly were heavily underwritten by OPIC and Ex-Im Bank.[213] In early February 2002, OPIC moved to reduce its exposure to Enron by cancelling loans associated with a power

---

[211] Endesa, "Endesa Strengthens Its Presence in the Brazilian Market," press release, found at Internet address: *http://www.endesa.es/english/prensa/noticias/19jul00.htm*, retrieved June 12, 2002.

[212] Endesa, "Endesa and Enersis Will Build a 310 MW CCGT Plant in Brazil," press release, found at Internet address: *http://www.endesa.es/english/prensa/noticias/22ene02.htm*, retrieved June 12, 2002.

[213] James V. Grimaldi, "Enron Spanned the Globe With High Risk Projects," *Washington Post*, Feb. 16, 2002, pp. A-1 and A-12.

distributor ($200 million) and a 379-MW power plant ($190 million) in Brazil, and a section of the Bolivia-to-Brazil gas pipeline ($200 million).[214]

Iberdrola

Iberdrola is the second-largest supplier of electric power in Spain. Iberdrola's 13.9 GWh production of electricity in Spain during the first quarter of 2002 was from a mix of thermonuclear (42 percent), oil- and gas-fired turbines (22 percent), hydroelectric (20 percent), and coal-fired steam turbines (16 percent). In Latin American generation markets, Iberdrola has principally targeted the combined cycle, gas turbine generator markets in Brazil and Mexico.[215] In Mexico, the firm's generating projects are concentrated at Monterrey, Altamira, and Durango.[216] At Monterrey, gas-fired, combined cycle generating capacity of 750 MW is already online, with an additional 250 MW scheduled to be complete by year end 2002. Iberdrola has contracts in place to sell all of this power to CFE (the state electricity monopoly) and a number of private purchasers.[217] At Altamira, Iberdrola has brought online 120 MW of generating capacity, with over 1,000 MW more scheduled to be operational by 2003, making the company the largest private generator of electricity in Mexico.[218] In December 2002, Iberdrola awarded a contract to the U.S.-Mexican industrial engineering joint venture ICA Fluor Daniel to construct a 498 MW gas-fired combined cycle power plant in Durango, with completion scheduled for April 2005.[219] Likewise, the company is competing for an additional 2,000 MW in generation contracts and has long-term strategic plans to invest approximately $2.2 billion on a total of 5,000 MW of combined cycle generating capacity in Mexico.[220]

In Brazil, Iberdrola is involved in two electricity distribution companies in the States of Bahia and Pernambuco that provide electricity to nearly 8 million customers. The company's generating activities consist of building and operating a 450-MW hydroelectric plant in Itapebi (southernmost Brazil) and a 520-MW combined-cycle plant in Pernambuco, as well as operating a 340-MW co-generation plant in Rio Grande do Brasil.[221] Iberdrola also markets energy in Pernambuco and provides electricity services in Rio de Janeiro and Salvador de Bahia.

---

[214] Ibid., A-12.

[215] Iberdrola announced in an Apr. 2002 shareholders' meeting that it would sell all of its assets in Chile and consolidate operations in Mexico and Brazil. "Iberdrola to Leave Chile, Consolidate in Mexico, Brazil," *Business News Americas*, found at Internet address: *http://www.bnamericas.com*, retrieved Apr. 16, 2002.

[216] Monterrey is a leading center for energy-intensive manufacturing, including steel, glass, and appliances. Altamira is home to a rapidly growing petrochemical processing complex.

[217] "Iberdrola Starts Monterrey Combined Cycle Ops," *Business News Americas*, found at Internet address: *http://www.bnamericas.com*, retrieved Apr. 5, 2002.

[218] "Iberdrola Pledges US$2.36Bn Investment Through 2006," *Business News Americas*, found at Internet address: *http://www.bnamericas.com*, retrieved June 12, 2002.

[219] "ICA-Fluor Daniel Snags Turnkey Power Plant Deal," *Mexico Watch*, Jan. 1, 2003, p. 13.

[220] Ibid.

[221] Iberdrola, "Presence Overseas-South America Platform,' found at Internet address: *http://www.iberdrola.es/iberdrolaingles/conozca/presenext/central1.htm*, retrieved June 11, 2002.

InterGen

InterGen is a global power generation company with 15,940 MW of generating capacity in operation, and another 5,574 MW under development.[222] The company was founded in 1995 as a joint venture between Shell Generating (Holding) B.V. of the Netherlands (68-percent share) and Bechtel Enterprises Energy B.V. of the United States (32-percent share). InterGen is thus positioned to take advantage of Shell's expertise in fuel supply, and power marketing and trading; and Bechtel's global command of engineering, procurement, and construction services for power generation facilities. Shell's energy businesses currently operate in more than 140 countries worldwide, whereas Bechtel has built more than 450 power plants totaling 250,000 MW in generating capacity. The company's financial arm, Bechtel Enterprises Holdings, Inc. has been involved in arranging more than $20 billion in project financing during the last 10 years.[223]

InterGen's activities in Latin America have been concentrated in Mexico, Brazil, and Colombia. In Mexico, InterGen and American Electric Power (AEP), through their jointly owned Mexican project company Energia Azteca, recently inaugurated the 600-MW, combined cycle, gas-fired Bajio power facility in San Luis de la Paz, Guanajuato. InterGen is also currently in the process of constructing the 1,065-MW La Rosita combined cycle plant in Mexicali, Baja California Norte and is a partner in the 550-MW Samalayuca II power plant in Ciudad Juárez, Chihuahua. The La Rosita plant, scheduled to be operational in the first half of 2003, was built by Bechtel Power under a turnkey contract. Natural gas for the facility is being supplied by a 126-mile, cross-border pipeline from Ehrenberg, AZ, and power from the facility is being sold to Mexico's CFE under a 25-year power-purchase agreement.[224] The Samalayuca II plant, in operation since 1999, was backed by $410 million in political risk insurance from the Ex-Im Bank and was organized under a build-lease-transfer agreement with CFE, which will make lease payments for 20 years before taking over ownership and operation of the facility.[225]

In Brazil, InterGen is currently in the process of constructing a 945 MW, combined cycle generation facility for Brazilian electrical utility Companhia Paulista de Forca e Luz (CPFL) in the municipality of Americana, State of Sao Paulo. When completed in the second half of 2003, the facility (Carioba II), located adjacent to an existing oil-fired plant, will be one of the largest gas-fired plants in Latin America and will result in the largest power purchase agreement contract between private parties in Brazil.[226] The "build, own, operate" facility will be fueled by gas from the Bolivia-to-Brazil pipeline and will meet 9 percent of the total electricity needs of the Sao Paulo region.[227]

---

[222] InterGen, found at Internet address: *http://www.intergen.com/about.html*, retrieved June 20, 2002.

[223] InterGen, found at Internet address: *http://www.intergen.com/8300pr.html*, retrieved June 20, 2002.

[224] InterGen, found at Internet address: *http://www.intergen.com/rosarito.html*, retrieved June 20, 2003.

[225] InterGen, found at Internet address: *http://www.intergen.com/mexico.html*, retrieved June 20, 2002.

[226] InterGen, found at Internet address: *http://www.intergen.com/032801pr.html*, retrieved June 20, 2002.

[227] Ibid.

InterGen began commercial operations at its combined cycle TermoEmcali power plant in Cali, Colombia, in July 1999. The 235-MW gas-fired facility featured state-of-the-art energy and environmental technologies and was the first power project in Colombia to be financed in U.S. capital markets with no local government guarantee.[228] Cali's municipal utility, Emcali, is a 43-percent owner of the plant and purchases the power under a 20-year agreement for sale in the Colombian wholesale electricity market.[229]

Mirant Corporation (Mirant)

Formerly known as Southern Energy, Mirant,[230] headquartered in Atlanta, GA, is one of the leading energy marketers in North America with 22 GW of installed generating capacity and another 7 GW under construction. The company has interests in electricity, natural gas, and other commodities, and provides management services in the United States, Europe, the Asian-Pacific region, South America, and the Caribbean Basin.

On January 2, 2002, Mirant announced the impending sale of its interests in northern Chilean power producer Empresa Electrica del Norte Grande SA (Edelnor) to F.S. Inversiones Ltda. for $4.5 million and the assumption of $340 million in debt.[231] The intention to sell the company was announced in October 2001, following difficulties in maintaining profitability stemming from weakening of the Chilean peso against the U.S. dollar and an over-capacity of electrical generating operations in Chile's northern mining region. With the sale of Edelnor, Mirant reduced its South American electricity generation holdings to a single 3.6-percent interest in fully integrated Brazilian electrical utility Companhia Energetica de Minas Gerais (CEMIG). This relatively small interest is ameliorated by the fact that with 5.6 GW of generating capacity and 207,000 miles of transmission and distribution lines, CEMIG is the single largest electric company in South America, producing more than 97 percent of all electricity consumed in the Brazilian State of Minas Gerais.[232]

Mirant has established a number of joint ventures in the Caribbean Basin. Mirant has a 39-percent interest in the Power Generation Company of Trinidad and Tobago, which has a generating capacity of 1,170 MW from three natural-gas fired power plants that generate approximately three-fourths of the electricity for the country.[233] In Curaçao, Mirant acquired a 25.5-percent interest in a venture with Mitsubishi Corp. and Aqualectra in Curaçao Utilities Co., in September 2001. When completed in 2003, this venture will provide167 MW of electricity, 1,110 metric tons per hour of process steam, 894 normal cubic meters per minute of air compressor capacity, and 950 cubic meters per hour of water distillation capacity.[234] Mirant will operate and manage the facility. In December 2001, Mirant acquired a preferred

---

[228] InterGen, found at Internet address: *http://www.intergen.com/colombia.html*, retrieved June 20, 2002.

[229] Ibid.

[230] As the result of its split from the Southern company, the official name change from Southern Energy, Inc. became effective on Jan. 22, 2001.

[231] *EnergyOnline Daily News*, "Mirant finally unloads Chile's Edelnor," found at Internet address: *http://www.energyonline.com/news/articles/m03-3chile.asp*, retrieved June 21, 2002.

[232] Mirant, found at Internet address: *http://www.mirant.com/cemig/cemig_pop.html*, retrieved June 19, 2002.

[233] Mirant, found at Internet address: *http://www.mirant.com/powergen/powergen_pop.html*, retrieved June 20, 2002.

[234] Mirant, found at Internet address: *http://www.mirant.com/curacao/curacao_pop.html*, retrieved June 19, 2002.

equity interest in Aqualectra, an integrated water and electric company with 235 MW of generating capacity and 69,000 cubic meters of daily drinking water capacity.[235] In 1993, Mirant acquired a 50-percent interest in Grand Bahama Power Co., with an installed generating capacity of 141 MW and transmission and distribution lines totaling 810 miles.[236]

Public Service Enterprise Group (PSEG)

With revenues of $9.8 billion in 2001, PSEG, headquartered in New Jersey, is the fourth-largest independent power producer in the United States and Canada. Originally founded as Public Service Corporation in 1903, PSEG came into existence in 1985 as a holding company for a group of diversified energy-related enterprises. In 1989, PSEG Energy Holdings was created to consolidate the activities of the PSEG unregulated businesses.[237] The company began to extend its reach worldwide in 1993 through its PSEG Global group, with Latin American operations being consolidated under the control of PSEG Americas. With offices in Miami, FL, Argentina, Brazil, Chile, Peru, and Venezuela, PSEG Americas serves Mexico, Central and South America, and the Caribbean Basin.

The Latin American generation assets of PSEG are currently limited to Argentina, Chile, Peru, and Venezuela. In Argentina, PSEG has equity interests in generation companies Parana (274 MW) and San Nicolas (124 MW). In December 2001, PSEG purchased Peruvian company Empresa de Electricidad de los Andes S.A. (ElectroAndes), which operates four hydroelectric facilities ranging in size from 9 MW to 108 MW and totaling 183 MW. ElectroAndes also has exclusive rights to a 100-MW expansion of the largest hydro facility (Yaupi) and to a 150-MW greenfield hydroelectric facility.[238]

In August 2001, PSEG acquired 99.9 percent of Chile's second-largest electricity distributor, Sociedad Austral de Electricidad S.A. (SAESA). That purchase included a subsidiary company, Edelaysén, with generation, transmission, and distribution assets serving 25,000 customers; and a transmission company, Sistema de Transmisiòn, with 890 kilometers of transmission lines.[239] SAESA service territory includes approximately 26 percent of Chile's population and provides 21 percent of the exports of the country.[240]

In Venezuela, PSEG is involved in Turboven, a 50-50 joint venture with Corporacion Industrial de Energia that owns two simple-cycle, natural gas-fired generating plants in Maracay and Cagua totaling 120 MW. Turboven also owns an associated electricity generating network in northern Venezuela.[241] The projects, which are approximately 100 kilometers west of Caracas, were developed as part of the Venezuelan Independent System to take advantage of Venezuela's abundant natural-gas resources and bring more reliable

[235] Ibid.
[236] Mirant, found at Internet address: *http://www.mirant.com/grandbahama/grandbahama_pop.html,* retrieved June 19, 2002.
[237] PSEG Inc., found at Internet address: *http://www.pseg.com/about/company_history.html*, retrieved July 5, 2002.
[238] PSEG Inc., found at Internet address: *http://www.pseg.com/companies/global/porfolio.html*, retrieved June 28, 2002.
[239] Ibid.
[240] Ibid.
[241] Ibid.

electrical energy to the growing region. Turboven is also involved in the advanced development of an 80-MW, gas-fired facility in Valencia, Venezuela.[242]

Sempra Energy Global Enterprises (Sempra)

Sempra is a holding company based in San Diego, CA, that controls the natural-gas and electricity businesses of eight subsidiary companies including San Diego Gas & Electric and Southern California Gas Co. Sempra's Latin American operations fall under the control of two operating subsidiaries. Sempra Energy Resources, acquires and develops power plants for the competitive market, and Sempra Energy International, develops, operates, and owns energy projects in international markets.[243] To date, Sempra's principal exposure to Latin American energy markets has been in the acquisition and development of natural-gas pipelines and supply companies and electricity distribution utilities. The single exception is the current development of a $350 million, 600-MW combined cycle power plant (Termoelectrica de Mexicali) in Mexicali, Mexico. The plant, being jointly developed by Sempra Energy Resources and Sempra Energy International, will comply with California environmental standards, obtain cooling water from recycled waste water, and be connected to the U.S. electrical grid by a 15 kilometer, 230,000 volt transmission line.[244] Because the electrical systems of Baja California and California are interconnected, power from the plant, which is expected to come on line in the summer 2003, will be available to customers (including Mexico's CFE) on both sides of the border.[245]

Some of the gas pipeline and liquified natural gas (LNG) projects in which Sempra has an interest will have significant bearing on the development of natural gas-fired power plants in Latin America. In the summer 2000, Sempra completed construction of a 23-mile, 30-inch pipeline from the San Diego area to the Presidente Juarez power plant in Rosarito, south of Tijuana.[246] Sempra energy will supply up to 300 million cubic feet of gas to the plant for at least 10 years. Sempra will also invest $230 million to construct a 215-mile pipeline from Arizona to Baja California. This pipeline, scheduled to become operational in third quarter 2002, will serve new and existing power plants and other industrial customers in the region.[247] In addition, Sempra and CMS Energy are jointly developing a $600 million LNG receiving terminal north of Ensenada, Baja California. The plant is projected to have a distribution capacity of 1 billion cubic feet per day of natural gas for use by customers in Baja California and the southwestern United States. LNG for the terminal will originate in Bolivia's Margarita gas field, which is estimated to contain 13 trillion cubic feet of natural-gas reserves. Sempra has entered into a 20-year agreement with a consortium of companies to establish the requisite gas pipeline and Pacific coast LNG facility to accommodate an average 800 million cubic feet per day of natural gas.[248]

---

[242] Ibid.

[243] Sempra Energy, found at Internet address: *http://www.sempraglobal.com/about_us/about_us.html*, retrieved July 16, 2002.

[244] Sempra Energy Resources, found at Internet address: *http://www.sempraenergyresources.com/tdm.html*, retrieved July 16, 2002.

[245] Ibid.

[246] Sempra Energy, found at Internet address: *http://www.sempraenergy.com/companies/international.html*, retrieved July 16, 2002.

[247] Ibid.

[248] Sempra Energy, found at Internet address: *http://public.sempra.com/newsreleases/viewpr.cfm?id=1050*, retrieved July 16, 2002.

Tractebel Electricity and Gas International (Tractebel)

Tractebel is a Belgium-based subsidiary of diversified French utility Suez Lyonnaise des Eaux (Suez). Suez is involved in global energy and waste management enterprises, and recently has invested more than $9 billion in European, Asian, and North American acquisitions. Tractebel's principal focus in Latin America has been Brazil, Chile, and Peru.

In Brazil, through its controlling (68 percent) interest in Brazilian generator Gerasul, Tractebel has 5,488 MW of installed capacity. Gerasul, which has since been renamed Tractebel Energia, recently received authorization from Brazil's National Electrical Agency (Aneel) to construct, as an independent energy producer, a 355 MW thermoelectric power plant (Jacui).[249] In recent years, Gerasul has invested $1 billion in numerous generating projects in Brazil.

In Chile, Tractebel owns five generating companies ranging from 10 MW (Carena) to 995 MW (Tocopilla) and totaling 2,146 MW. Tractebel recently increased its level of ownership in two other companies, Colbun and Electroandina from 45.11 percent and 21.3 percent, respectively, to 75 percent in each. It has been speculated by industry observers that Tractebel may be increasing its stakes in its Chilean generators, including the purchase of Chilean Government shares, in anticipation of consolidating these holdings into a single company.[250]

Finally, Tractebel currently owns generating assets totaling 330 MW in Peru through its ownership of generating company Ilo. In June 2002, Tractebel was declared the high bidder for two power companies that the Peruvian Government had sought to privatize. Nevertheless, far-reaching public protests over the planned sales reportedly led Peruvian President Alejandro Toledo to suspend the offerings.[251]

Union Fenosa

Union Fenosa is the third-largest utility in Spain, with installed generating capacity of 5,279 MW in Spain and 1,561 MW abroad, predominately in Latin America. Most of the company's Latin American electricity generation activities are concentrated in Mexico, Colombia, and the Dominican Republic. In Mexico, Union Fenosa recently inaugurated a 250 MW gas-fired, combined cycle generating facility in Hermosillo, Sonora. This plant was the first of its kind to be constructed by a privately held foreign company under a 25-year Mexican Government (CFE) energy purchase and sale contract.[252] The Hermosillo plant is Union Fenosa's first ever combined-cycle facility and is part of the company's long-term

---

[249] "Gerasul to install coal-fired plant in RS," *Infrastructure Brazil*, found at Internet address: *http://www.infra-estruturabrasil.g...detalhe.asp?not=978332920&proj=190*, retrieved July 8, 2002.

[250] *Alexander's Gas & Oil Connections*, 'Company News: Latin America," found at Internet address: *http://www.gasandoil.com/goc/company/cn103375.htm*, retrieved July 8, 2002.

[251] The magnitude of the protests, sparked by concern that the sales would lead to job cuts and higher electricity prices, led the Government to declare a 30-day state of emergency. "Privatization of Two Peruvian Companies on Hold," *EnergyOnline Daily News*, found at Internet address: *http://www.energyonline.com/news/articles/rJun20-4.asp*, retrieved June 21, 2002.

[252] Union Fenosa, "Mexico's President Inaugurates Union Fenosa's First Combined Cycle Plant in Mexico," found at Internet address: *http://www.uef.es/english/noticias/noticia.jsp?id=229&actualidad=1*, retrieved June 25, 2002.

strategy to construct state-of-the-art generating facilities in Mexico. The company already has facilities in Nogales (Naco, 300 MW) and Veracruz (Tuxpan III and IV, 1,000 MW total) under development. When completed in 2003, the projects will represent a total of 1,550 MW ($1.1 billion) of installed capacity for Union Fenosa in Mexico.[253]

Elsewhere in Latin America, Union Fenosa has 1,038 MW of electricity generating capacity in Colombia (through its ownership of Colombian company Epsa); 190 MW of capacity in the Dominican Republic (Palamara, 103 MW; and La Vega, 87 MW); and 50 MW of capacity in Costa Rica (La Joya).[254] The goal of the company is to have installed generating capacity in international markets (mainly Latin America) of 5,500 MW by 2005.■

[253] Ibid.

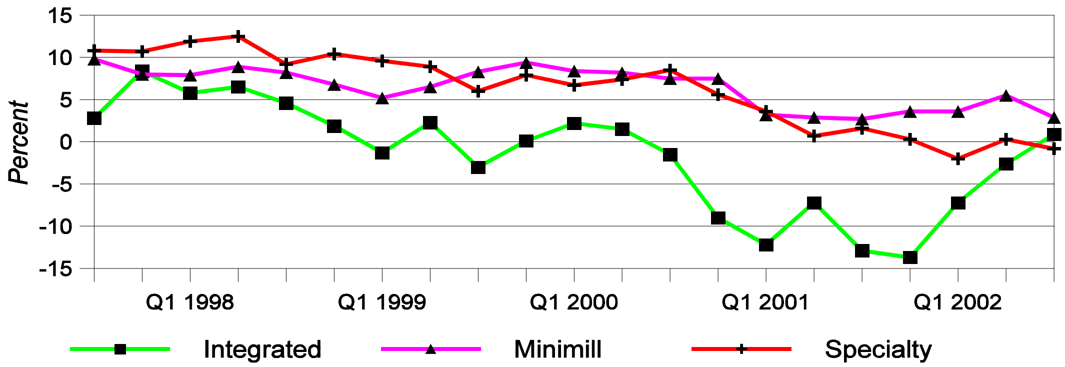
[254] Union Fenosa, found at Internet address: *http://www.uef.es/english/internacional/ce_mapa.htm*, retrieved June 26, 2002.

APPENDIX A
Key Performance Indicators of Selected Industries and Regions[1]

[1] The data and views presented for the following indicators are compiled from the industry sources noted and are those of the authors. They are not the views of the United States International Trade Commission as a whole or of any individual Commissioner. Nothing contained in this information based on published sources should be construed to indicate how the Commission would find in an investigation conducted under any statutory authority.

STEEL

Figure A–1
Integrated producers book modest profits[1] for the first time in more than two years on strengthening prices



[1]Operating income as a percent of sales. Integrated group contains 5 firms. Minimill group contains 7 firms. Specialty group contains 4 firms.

Source: Individual company financial statements.

- The Pension Benefit Guaranty Corp. (PBGC) filed a petition on December 18, 2002, with the U.S. District Court in Philadelphia, PA, to assume responsibility for the pension benefits of 95,000 workers and retirees of Bethlehem Steel Corp. According to PBGC estimates, Bethlehem Steel's pension plan is 45-percent funded, with $3.5 billion in assets to cover $7.8 billion in liabilities. The PBGC expects to be liable for about $3.7 billion of the $4.3 billion in underfunding. In both the number of participants and amount of underfunding, Bethlehem Steel's pension plan would be the largest assumed by the PBGC in its 28-year history. See *http://www.pbgc.gov.*
- Both the United Steelworkers of America (USWA) and Bethlehem Steel Corp. expressed disappointment over the timing of the PBGC filing. They contend that the PBGC's action prevents Bethlehem from offering early retirement pensions to workers as an incentive to reduce the size of the workforce. See *http://www.uswa.org* and *http://www.bethsteel.com.*
- Wheeling-Pittsburgh Steel Corp. filed a reorganization plan in U. S. Bankruptcy Court in Morgantown, WV, on December 20, 2002, to begin the process of emerging from Chapter 11 bankruptcy protection. The plan is contingent upon approval from Wheeling-Pitt's creditors, and of a $250 million loan guarantee from the Emergency Steel Loan Guarantee Board. See *http://www.steelnews.com.*
- On December 23, 2002, International Steel Group Inc. and the USWA reached a tentative agreement to tie compensation and retirement benefits to company performance. Officials for both the company and the union claim the agreement, subject to a ratification vote by some 3,000 union employees, will revitalize integrated steelmaking in the United States. See *http://www.uswa.org*.

Table A–1
Semi-finished imports continue to increase on both a quarterly and a year-to-date basis compared to 2001

Item	Q3 2002	Percentage change, Q3 2002 from Q3 2001[1]	YTD 2002	Percentage change, YTD 2002 from YTD 2001[1]
Producers' shipments *(1,000 short tons)*	25,285	1.9	74,833	-1.4
Finished imports *(1,000 short tons)*	6,684	13.2	17,424	-0.3
Ingots, blooms, billets, and slabs *(1,000 short tons)*	2,469	31.8	6,586	42.8
Exports *(1,000 short tons)*	1,510	1.1	4,428	-4.1
Apparent supply, finished *(1,000 short tons)*	30,459	4.2	87,829	-1.1
Ratio of finished imports to apparent supply *(percent)*	24.6	[2]4.4	19.8	[2]0.1

[1] Based on unrounded numbers.
[2] Percentage point change.
Note.–Because of rounding, figures may not add to the totals shown.

Source: American Iron and Steel Institute.

STEEL

Table A–2
Service Centers: Shipments decline in third quarter 2002 compared to second quarter 2002, but shipments for first nine months of 2002 increase slightly compared to 2001

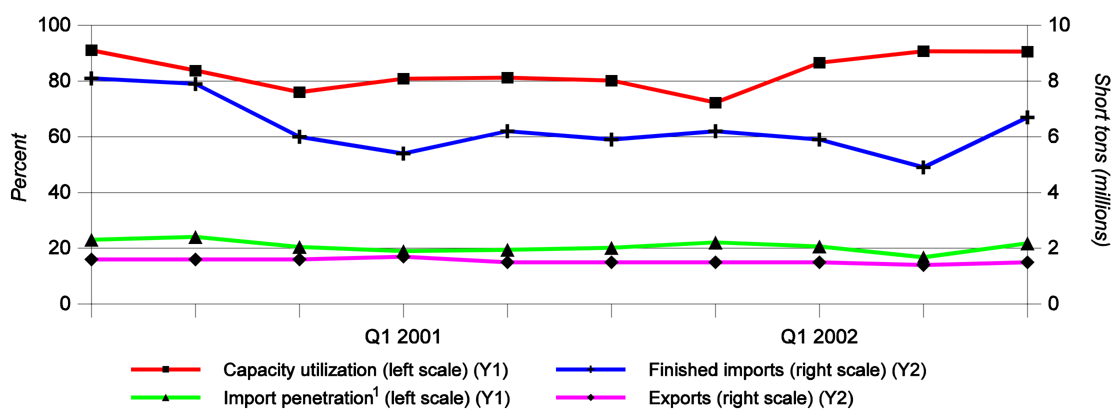
Item	June 2002	Sept. 2002	Percentage change, Sept. 2002 from June 2002[1]	Q3 2001	Q3 2002	Percentage change, Q3 2002 from Q3 2001[1]
Shipments *(1,000 short tons)*	2,105	1,995	-5.2	6,246	6,319	1.2
Ending inventories *(1,000 short tons)* . . .	7,153	7,529	5.3	7,677	7,529	-1.9
Inventories on hand *(months)*	3.2	3.6	([2])	3.6	3.6	([2])

[1] Based on unrounded numbers.
[2] Not applicable.

Source: Metals Service Center Institute.

- According to the Metals Service Center Institute, U.S. service center steel shipments reflect a drop in orders, and a corresponding increase in inventories, during third quarter 2002 compared to second quarter 2002. However, third quarter 2002 shipments are slightly higher than third quarter 2001 shipments (table A-2). See *http://www.ssci.org.*
- The American Institute for International Steel import market survey (November 2002) predicts a supply/demand balance (domestic supply plus imports) of semi-finished steel for the next 1 to 3 months, and a moderate oversupply of finished steel products for the same time period. See *http://www.aiis.org.*
- Government officials from major steel-producing economies, including the United States, formally agreed on December 19, 2002, to hold talks to reduce, and ultimately to eliminate, government subsidies that have impacted the global steel market for decades. The agreement was reached during the Fifth High-Level Meeting on Steel at the Organization for Economic Co-operation and Development in Paris. See *http://www.ita.doc.gov*.
- Domestic capacity utilization remained above 90 percent for the second consecutive quarter whereas export volume remained steady (Figure A-2). See *http://www.steel.org*.

Figure A–2
Steel mill products, all grades: Import penetration returns to multi-year average during third quarter 2002 even as domestic capacity utilization remains above 90 percent



[1] Finished import share of apparent open market supply.

Source: American Iron and Steel Institute.

AUTOMOBILES

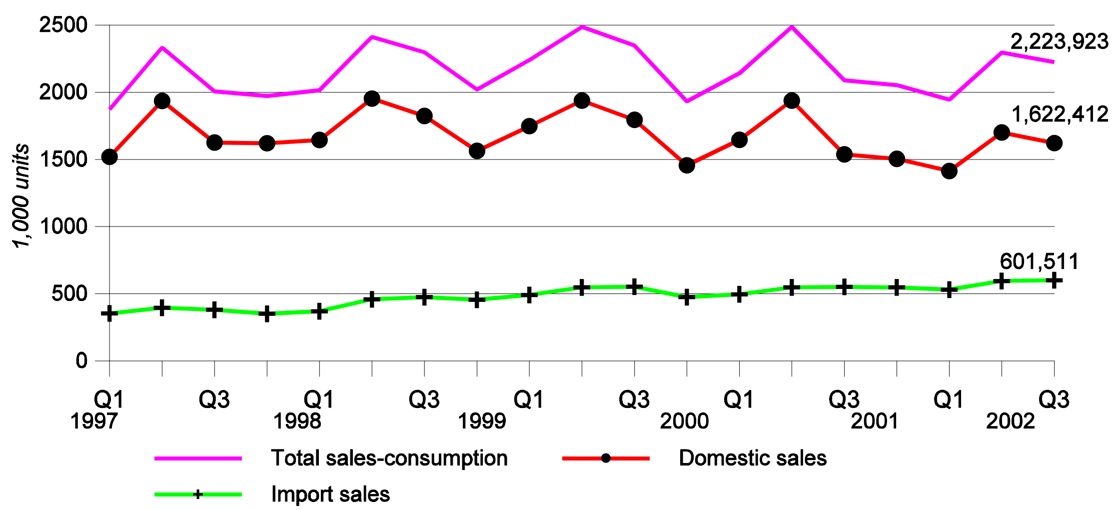
Table A–3
U.S. sales of new automobiles, domestic and imported, and share of U.S. market accounted for by sales of total imports and Japanese imports, by specified periods, January 2001-September 2002

Item	July-Sept. 2002	Jan.-Sept. 2002	Percentage change: July-Sept. 2002 from Apr.-June 2002	Percentage change: Jan.-Sept. 2002 from Jan.-Sept. 2001
U.S. sales of domestic autos (*1,000 units*)[1]	1,622	4,738	-4.6	-5.0
U.S. sales of imported autos (*1,000 units*)[2]	602	1,728	1.1	7.1
Total U.S. sales (*1,000 units*)[1, 2]	2,224	6,466	-3.1	-2.0
Ratio of U.S. sales of imported autos to total U.S. sales (*percent*)[1, 2]	27.0	26.7	4.4	9.3
U.S. sales of Japanese imports as a share of the total U.S. market (*percent*)[1, 2]	12.3	11.6	13.1	14.1

[1] Domestic automobile sales include U.S.-, Canadian-, and Mexican-built automobiles sold in the United States.
[2] Imports do not include automobiles imported from Canada and Mexico.

Source: Compiled from data obtained from *Automotive News*.

Figure A–3
U.S. sales of new passenger automobiles decreased in third quarter 2002; sales of domestic autos as a percentage of total U.S. sales fell nearly 5 percent whereas import share gained slightly compared to second quarter 2002

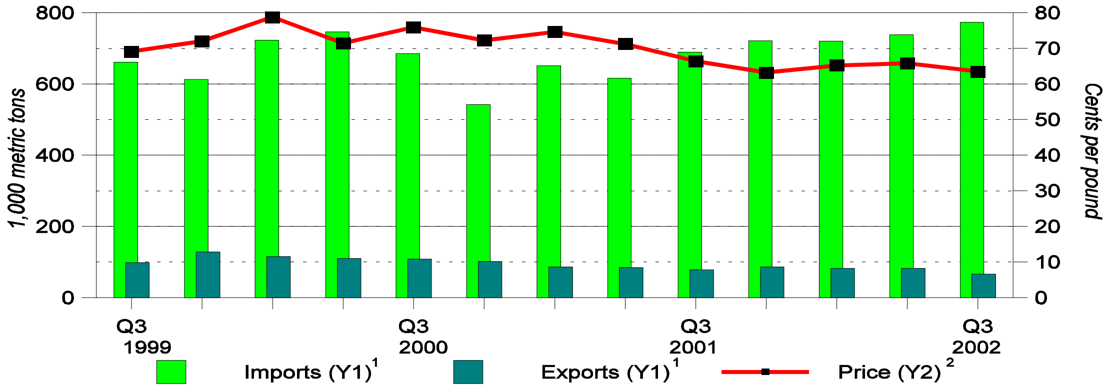


Note.–Domestic automobile sales include U.S.-, Canadian-, and Mexican-built automobiles sold in the United States; these same units are not included in import sales.

Source: *Automotive News*; prepared by the Office of Industries.

UNWROUGHT ALUMINUM[1]

Figure A–4
Import penetration in the 3rd quarter rises to 36.1 percent, the highest quarterly level in over five years



[1] Unwrought aluminum and aluminum alloys.
[2] Quarterly average of the monthly U.S. market price of primary aluminum ingots.

Source: Complied by USITC staff based on data obtained from the U.S. Geological Survey.

- Slowing consumption of aluminum has contributed to the market oversupply (indicated by lower prices and higher stocks). Consumption in industries such as aerospace and telecommunications has not rebounded as quickly as expected. In the housing market, building and construction rates have also started to decline. Higher-than-average production of heavy truck trailers (another key market for aluminum) in early 2002, to meet high demand prior to implementation of a new law,[2] contributed to lower-than-normal consumption in the 3rd quarter of 2002.
- Despite lower global consumption, aluminum production is increasing in Russia and China. China has recently shifted from being a net importer of aluminum to a net exporter and some analysts indicate that China's capacity will grow by 600,000 to 800,000 metric tons in 2003. In addition, current expansion plans in Russia will boost capacity by an additional 670,000 metric tons. Industry observers anticipate that Russia plans to export up to 21 percent more aluminum to the United States in 2003.
- Nalco, the Indian aluminum company, plans to begin privatization in 2003. It is reported that either Pechiney, Alcoa, Kaiser, Alcan, or Norsk Hydro will purchase part of the company, continuing the trend of consolidation in the industry.

Table A–4
Rising U.S. production coupled with record high stocks in LME warehouses contributed to a decrease in the price of aluminum during the 3rd quarter 2002

Item	Q3 2001	Q2 2002	Q3 2002	Percentage change: Q3 2002 from Q3 2001	Percentage change: Q3 2002 from Q2 2002
Primary production (*1,000 metric tons*)	632	669	702	11.1	4.9
Secondary recovery (*1,000 metric tons*)	803r	742r	734	-8.6	-1.1
Imports (*1,000 metric tons*)	689	738	773	12.2	4.7
Import penetration (*percent*)	33.7	35.7	36.1	[1]2.4	[1]0.4
Exports (*1,000 metric tons*)	78	82	66	-15.4	-19.5
Average nominal price (*cents/lb*)	66.4	65.8	63.5	-4.4	-3.6
LME inventory level (*1,000 metric tons*)	722	1,255	1,290	78.7	22.0

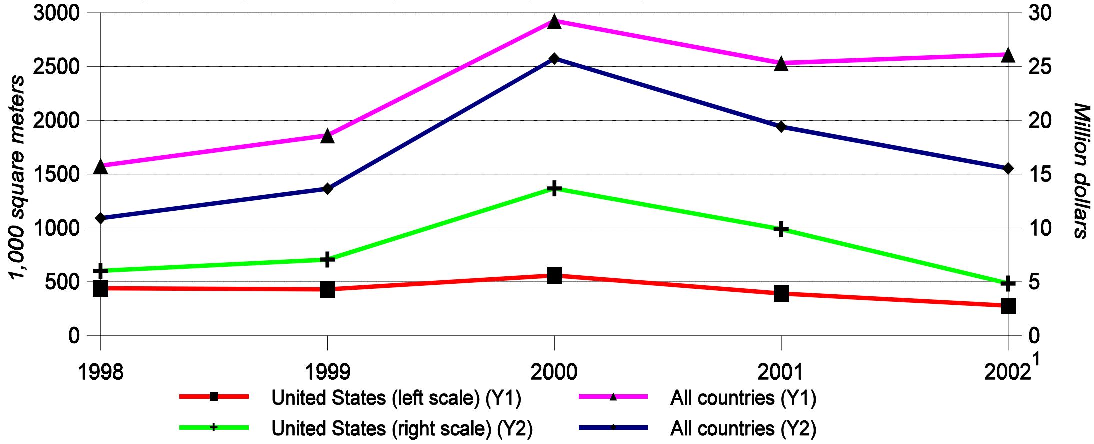
[1] Percentage point change.
Note.–Revised data indicated by "r."

Sources: Compiled from data obtained from U.S. Geological Survey and World Bureau of Metal Statistics.

[1] Product coverage includes only unwrought aluminum and certain aluminum alloys for improved data comparability.
[2] "Heavy Trucks, Engines, Buses - Diesel Programs and Emissions," Environmental Protection Agency, found at *http://www.epa.gov/otaq/hd-hwy.htm*, retrieved Jan. 23, 2002.

FLAT GLASS

Figure A–5
Japanese monthly average imports gain during January-October 2002



[1] Data for 2002 include Jan.-Oct. (Latest available data).

Source: Compiled from "World Trade Atlas: Japan" at *http://www.globaltradeatlas.com* on Dec. 19, 2002, which uses official statistics provided by the Government of Japan.

Background

- Although the U.S.-Japanese agreement on Japanese market access for imports of flat glass which sought to increase access and sales of foreign flat glass in Japan expired on December 31, 1999,[1] the U.S. Government continues to urge the Japanese Government to take steps to promote access and competition in it's glass market and continues to work with U.S. industry to achieve these goals.[2]

Current

- Increased Japanese demand for imported flat glass raised the average monthly quantity of Japanese imports from all countries by 3 percent for the first ten months of 2002 to 2.6 million square meters compared with the same period of 2001, while the average monthly value of such imports decreased by 20 percent to $15.5 million. However, imports from the United States decreased by quantity and value (down 29 percent to 279,000 square meters and 51 percent to $4.9 million, respectively), and imports from the United States lost market share to imports from Thailand and Taiwan during this period.

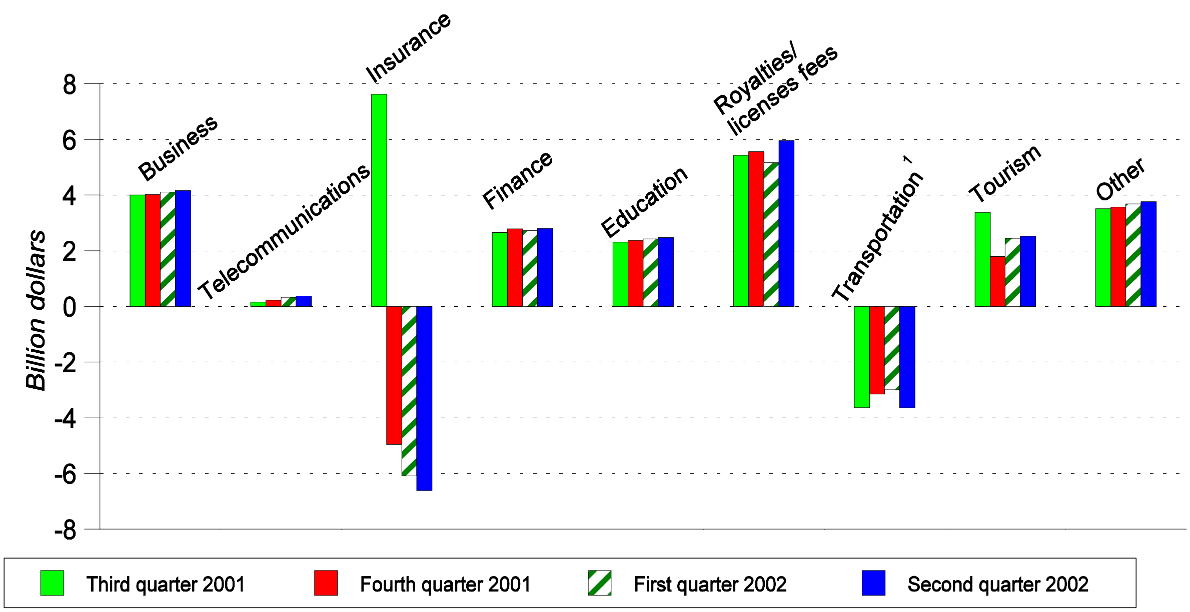
---

[1] Office of the U.S. Trade Representative (USTR), *The President's 1999 Annual Report on the Trade Agreements Program*, p. 227, downloaded from *http://www.ustr.gov/reports/tpa/2000/index.html* on Mar. 3, 2000.

[2] U.S. Department of State cable, *2003 National Trade Estimate Report - Japan*, message reference No. 8640, prepared by U.S. Embassy, Tokyo, Dec. 16, 2002.

SERVICES

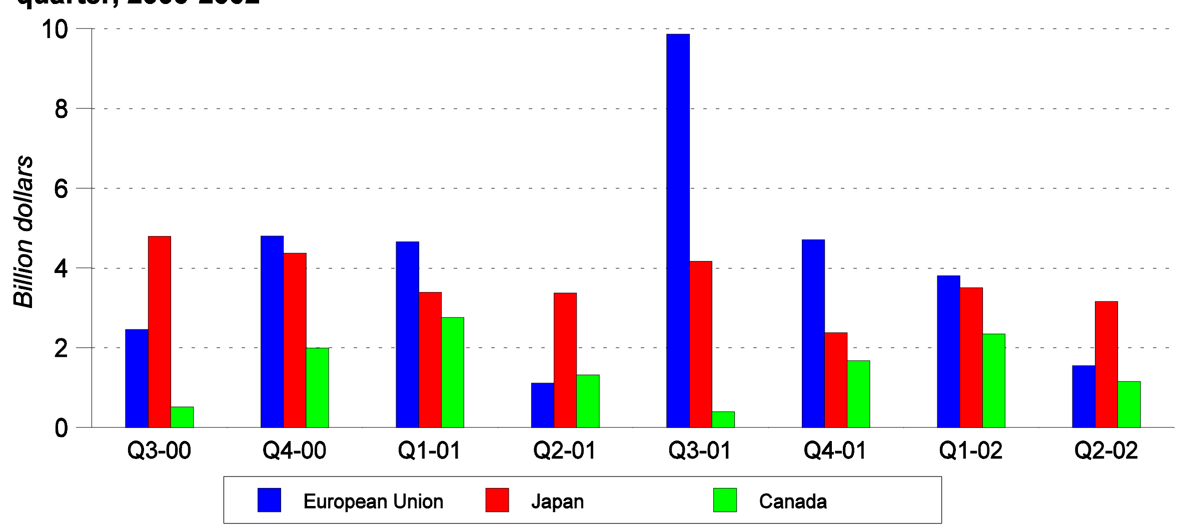
Figure A–6
Balance on U.S. service trade accounts, by quarters, 2001-2002



[1] Includes port fees.

Source: Bureau of Economic Analysis, *Survey of Current Business*, Oct. 2002, p. 53.

Figure A–7
Surpluses on cross-border U.S. services transactions with selected trading partners, by quarter, 2000-2002[1]



[1] Private-sector transactions only; military shipments and other public-sector transactions have been excluded.

Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Oct. 2002, pp. 60-63; July 2002, pp. 78-81; Apr. 2002, pp. 68-71; Jan. 2002, pp. 52-57; and Oct. 2001, pp. 79-91.

NORTH AMERICAN TRADE HIGHLIGHTS

U.S. trade with its North American partners is highlighted in table A-5. The following is a summary of key developments during the first three quarters of 2002.

- U.S. trade with its NAFTA partners ($428 billion) decreased 4 percent ($16 billion) during January-September 2002 compared with the like period of 2002. The U.S. merchandise trade deficit with Canada ($50.6 billion) decreased $5.8 billion during the period, whereas the deficit with Mexico ($35.6 billion) increased $5.4 billion.
- Existing high inventories prompted a decrease in Canadian production of automotive products destined to the United States, and largely was responsible for the decline in merchandise trade deficit with Canada. A contributing factor to the improved U.S. trade balance was the advance inventory build-up by U.S. firms in anticipation of a labor dispute at West Coast ports.[1] The increase in Mexico's trade surplus with the United States largely was due to increased U.S. demand for durable goods, particularly in the residential market as a result of record U.S. low interest rates.
- Mexico's third quarter 2002 GDP expanded 1.8 percent year-on-year despite continued weak demand, principally in the United States, the destination for 88 percent of Mexico's exports. The Government of Mexico projects economic growth of 1.7 percent for full-year 2002 and 3.0 percent for 2003.
    - U.S. exports to Mexico fell 6 percent ($3.9 billion) during January-September 2002 to $64.4 billion. Leading the decline were integrated circuits used in computer equipment, picture tubes for televisions, motor-vehicle parts, and trailers for tractor-trailer trucks.
    - U.S. imports from Mexico increased 1 percent ($1.4 billion) during the same period to $100 billion, led by motor-vehicle parts, crude petroleum, automatic regulating instruments, and medical goods.
    - Foreign direct investment (FDI) in Mexico totaled $9 billion in the first 9 months of 2002, and the Government of Mexico has forecasted $13 billion in FDI for full year 2002 and $14 billion in 2003. Manufacturing FDI in Mexico amounted to only $4.7 billion in 2001, 37 percent below the 1995-2000 average. Much of the FDI in 2001 and 2002 reportedly was directed to financial takeovers, including foreign acquisition of Mexican banks.
    - By October 2002, Mexico's economy reportedly had recovered 40 percent of the 350,000 jobs lost in 2001. Most of the new jobs occurred in services and retail, whereas employment in the maquiladora industry fell 2.5 percent compared with October 2001. The manufacturing sector received a boost, however, when Volkswagen announced in January 2003 that it will shift all production of the Jetta line to Puebla, Mexico, doubling the size of the plant that currently houses global production of the Beetle.
- Canadian GDP grew 3.1 percent during the third quarter 2002, down from annualized rates of 5.7 percent in the first quarter and 4.4 percent in the second quarter of 2002. Domestic demand – consumer, business, and government spending combined – slowed to about one-half the pace of the

[1] For the most part, these goods consisted of coal and lumber from Alberta and British Columbia, respectively, shipped from Vancouver to the ports of Seattle, Portland, and Los Angeles.

NORTH AMERICAN TRADE

Table A-5
North American trade, 1997-2001, January-September 2001, and January-September 2002

Item	1997	1998	1999	2000	2001	January-September 2001	January-September 2002	Percent change 2001/02
	Value *(million dollars)*							
U.S.-Mexico trade:								
Total imports from Mexico	85,005	93,017	109,018	134,734	130,509	98,542	100,004	1
U.S. imports under NAFTA:								
Total value	62,837	68,326	71,317	83,995	81,162	61,141	63,368	4
Percent of total imports	74	73	65	62	62	62	63	[1]1
Total exports to Mexico	68,393	75,369	81,381	100,442	90,537	68,314	64,381	-6
U.S. merchandise trade balance with Mexico[2]	-16,612	-17,648	-27,637	-34,292	-39,971	-30,228	-35,623	-18
U.S. -Canada trade:								
Total imports from Canada	167,881	174,685	198,242	229,060	216,836	166,982	157,323	-6
U.S. imports under NAFTA:								
Total value	88,949	111,675	115,715	123,052	113,179	86,030	86,751	1
Percent of total imports	53	64	58	54	52	52	55	[1]3
Total exports to Canada	134,794	137,768	145,731	155,601	144,621	110,595	106,717	-4
U.S. merchandise trade balance with Canada[3]	-33,087	-36,918	-52,511	-73,459	-72,215	-56,387	-50,606	10

[1] Percentage point change.
[2] The negative (-) symbol indicates a loss or trade deficit. The $40.0-billion deficit in U.S. merchandise trade with Mexico in 2001 was partially offset by a $3.4-billion U.S. surplus in bilateral services trade.
[3] The $72.2-billion deficit in U.S. merchandise trade with Canada in 2001 was partially offset by a $6.0-billion U.S. surplus in bilateral services trade.

Source: Compiled by USITC staff from official statistics of the U.S. Department of Commerce. Statistics on U.S. services trade with Canada and Mexico are based on preliminary data provided in U.S. Department of Commerce, Bureau of Economic Analysis, “U.S. International Transactions Accounts Data,” tables 10 and 10a, found at *http://www.BEA.DOC.GOV/BEA/International/BP_web/list.CFM?ANON=92*.

second quarter, despite vigorous activity in the new housing and export markets. Canadian GDP growth reportedly is expected to be approximately 3.5 percent for full-year 2002.

- U.S. exports to Canada declined 4 percent ($3.9 billion) during January-September 2002, led by decreases in piston engines for automobiles and aircraft, integrated-circuits, digital processing units, telephone equipment, and medical goods.

- U.S. imports from Canada fell 6 percent ($9.7 billion), reflecting decreases in the value of petroleum and related products, electrical energy, aircraft and parts, computers and peripheral equipment, and lumber and other wood products. Boeing reported in January 2003 that the number of aircraft it produced in the United States decreased sharply in 2002, reducing demand for aircraft parts from Canada. Dumping and countervailing duties reportedly reduced U.S. imports of softwood lumber from Canada.