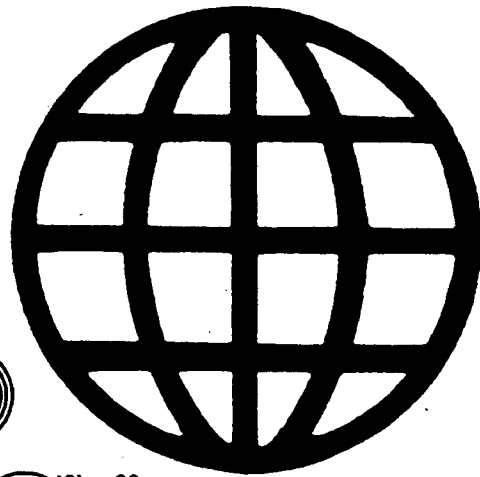


INDUSTRY  
TRADE AND  
TECHNOLOGY  
REVIEW



## 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 it contains are those of the authors and do not necessarily reflect the views of the Commission 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.

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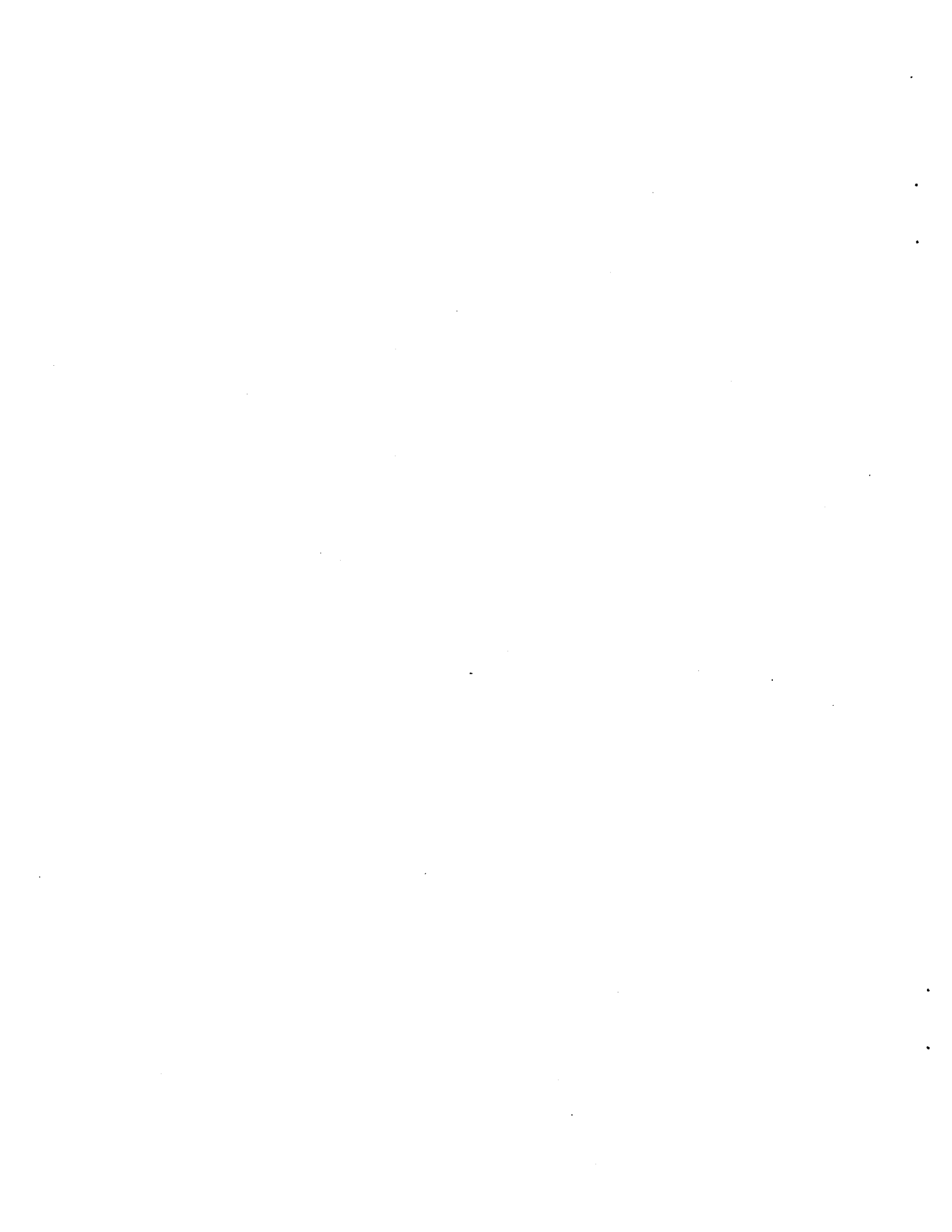
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- Direct ironmaking: A case study in government and industry cooperation to commercialize new manufacturing processes for materials



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## SECTION 22: URUGUAY ROUND AGREEMENT CHANGES U.S. OPERATION OF AGRICULTURAL PROGRAM<sup>1</sup>

One of the most significant aspects of the recently completed Uruguay Round Agreements (URA) concerns agricultural trade. The Uruguay Round Agreement on Agriculture (Agreement) replaces longstanding trade-distorting policies with specific rules that govern acceptable agricultural trade practices.<sup>2</sup> These changes were motivated in part because the previous world trade rules in the General Agreement on Tariffs and Trade (GATT), permitting import restrictions and export subsidies on agricultural products since the GATT began in 1947, were deemed no longer appropriate for the agricultural trading environment of the 1980s and beyond.<sup>3</sup> By the early 1980s, 80 percent of the trade disputes in the GATT concerned agricultural trade; many of these involved the United States and the European Union.

According to U.S. Trade Representative Michael Kantor, the United States was successful in its efforts to develop meaningful rules and explicit reduction commitments in three areas--export subsidies, domestic subsidies and market access.<sup>4</sup> In the market access area, signatories agreed to convert nontariff barriers (for instance, import quotas) to tariffs, to maintain current levels of market access or to increase such access to a minimum level, and to reduce or bind current tariff levels for all agricultural products.

As part of the Agreement, the United States will change its own system of import protection for those agricultural products that are assisted by government farm programs. Thus, the Agreement effectively required the United States to convert to tariffs all existing section 22 fees and quotas applicable to imports from World Trade Organization (WTO) countries.<sup>5</sup> However, the Agreement also authorizes importing countries to apply a "special safeguard" during at least its 6-year implementation period to products they have "tariffed" in order to protect domestic producers from increased imports or price declines, as measured against historic levels.

This article briefly describes section 22 and its history, explains how existing section 22 quotas and fees applied to WTO members were affected by the Agreement, and describes the new safeguard measures provided for in U.S. implementing legislation under the Uruguay Round Agreements Act (URAA).<sup>6</sup> There are a number of legal authorities, other than section 22, that have restricted agricultural imports into the United States and were affected by the Agreement, but which are outside the scope of this article.<sup>7</sup>

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<sup>1</sup> This article summarizes several important developments and is not intended to be a legal analysis. Because this is only a summary, readers are encouraged to consult the actual statutes and regulations referenced before attempting to make use of these provisions.

<sup>2</sup> Not discussed in this article is the URA Agreement on the Application of Sanitary and Phytosanitary Measures, which sets up a science-based system for sanitary and phytosanitary measures.

<sup>3</sup> U.S. Trade Representative Michael Kantor, testimony to the House Committee on Agriculture, U.S. Congress, Mar. 16, 1994.

<sup>4</sup> Ibid.

<sup>5</sup> The World Trade Organization is the successor organization to the GATT.

<sup>6</sup> Public Law 103-465, approved Dec. 8, 1994, 108 Stat. 4809.

<sup>7</sup> There are at least seven other legal authorities that have specifically provided for restrictions of certain agricultural imports: The Agricultural Act of 1949, the Agricultural Act of 1956, the Meat Import Act of 1979, the Trade Agreements Act of 1979, the Agricultural Adjustment Act of 1938, the Ford Amendment to the Omnibus Budget Reconciliation Act of 1993, and finally, Chapter 17 of the *U.S. Harmonized Tariff Schedule*. A description of these other statutes is given by the Committee on Ways and Means, U.S. House of Representatives, *Overview and Compilation of U.S. Trade Statutes*, Jan. 6, 1993, pp. 101-113. These authorities were modified under the URAA, whereas the Meat Import Act was repealed.

### Section 22 of the Agricultural Adjustment Act

Section 22 of the U.S. Agricultural Adjustment Act (AAA) authorizes the President to impose fees or quotas on imports of certain agricultural products<sup>8</sup> that have been found to impact<sup>9</sup> support programs of the U.S. Department of Agriculture or the processing of agricultural commodities in the United States. Proceedings leading to the imposition of a fee or quota also involve the Secretary of Agriculture and the U.S. International Trade Commission (USITC). Under section 22, the Secretary of Agriculture, who oversees the USDA programs and operations, is required to advise the President when there is "reason to believe" that an article is being or is likely to be imported into the United States under such conditions and in such quantities as to impact any program administered by the USDA or impact the processing of agricultural commodities in the United States. If the President agrees, he is to request that the USITC conduct an investigation, although the President is also authorized (in section 22 (b)) to take emergency action without waiting for the ITC report. During the investigation, the USITC must hold a public hearing and, then report its findings and recommendations for remedial action.

Following the USITC's report, the President may impose an import fee of up to 50 percent ad valorem or a quantitative restriction. However, any quantitative restriction may not reduce imports of the article to a level that is less than 50 percent of the amount imported in a representative period. Section 22 also permits the President to suspend or terminate existing section 22 restrictions and to adjust existing restrictions to account for changed conditions and circumstances based on advice from the Secretary of Agriculture and on the results of a USITC investigation.

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<sup>8</sup> Agricultural products regulated by the programs include wheat, coarse grains, soybeans, cotton, oilseeds, rice, sugar, milk, tobacco, wool, peanuts, and honey.

<sup>9</sup> "Impact" as used here refers to the specific statutory language "to render or tend to render ineffective or materially interfere with any program or operations undertaken by USDA, or to reduce substantially the amount of any product processed in the United States from any agricultural commodity covered by a USDA program."

Although there were no general provisions under section 22 allowing the exclusion of or preference for products from specific countries,<sup>10</sup> Canada has been treated differently since 1988. In that year, section 22(f) was amended to authorize the President to exempt certain products of Canada from import restrictions imposed under section 22, in accordance with the United States-Canada Free Trade Agreement (CFTA).<sup>11</sup> However, article 707.5 of the CFTA did provide that restrictions may be imposed on grains and grain products from Canada under certain conditions.<sup>12</sup> Subsequently, the United States imposed section 22 fees on U.S. imports of wheat, including Canadian wheat, through September 11, 1995.<sup>13</sup> The CFTA also prohibited the United States from imposing import quotas or fees on Canadian products containing 10 percent or less sugar, by dry weight, for the purpose of restricting the sugar content of such products.

### Highlights of the Statute's Evolution<sup>14</sup>

Section 22 was first enacted in 1935 as an amendment to the AAA of 1933.<sup>15</sup> Although portions of the AAA relating to production control

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<sup>10</sup> Committee on Ways and Means, U.S. House of Representatives, *Overview and Compilation of U.S. Trade Statutes*, Jan. 6, 1993, p. 107.

<sup>11</sup> Section 301(c) of Public Law 100-449, approved Sept. 28, 1988; 102 Stat. 1868.

<sup>12</sup> Committee on Ways and Means, U.S. House of Representatives, *Overview and Compilation of U.S. Trade Statutes*, Jan. 6, 1993, pp. 105-113.

<sup>13</sup> The Memorandum of Understanding between the United States and Canada limiting U.S. imports of wheat under tariff-rate quotas to 1.5 million metric tons was taken under authority of section 22. USTR staff, interviewed by USITC staff, Dec. 2, 1994.

<sup>14</sup> A full description of the section 22 is given in Russell N. Shewmaker, *Section 22: Legislative History of Section 22 of the Agricultural Adjustment Act, as Amended*, U.S. Tariff Commission, 1960.

<sup>15</sup> The Agricultural Adjustment Act sought to address the sharp decline in the exchange value of farm commodities in comparison with industrial goods that occurred in the early years of the Depression. The Act authorized the Secretary of Agriculture to control production by providing rental payments to farmers who voluntarily curtailed production of basic commodities, and authorized various marketing arrangements between the Secretary and private entities.

programs were declared unconstitutional in 1936 in *United States v. Butler*,<sup>16</sup> a subsequent reenactment of agricultural legislation (the Agricultural Marketing Agreement Act of 1937) left section 22 unchanged. A particularly important amendment to section 22 was enacted in 1951 that sought to clarify the relationship of section 22 and international obligations of the United States under the GATT. The 1951 amendment provided that no international agreement should be applied in a manner inconsistent with the requirements of section 22, thereby effectively putting U.S. law into conflict with GATT rules related to import fees (article II) and import quotas (article XI).

Since 1947, the GATT had treated agricultural products differently from industrial products. Notably, article XI (Quantitative Restrictions) provided three exemptions from the general GATT prohibition on quantitative import restrictions for agricultural or fishery products receiving government support.<sup>17</sup> However, these exemptions would not permit import quotas to be used against excessive imports if government support took the form of a price-support system, similar to the principal U.S. support measure.<sup>18</sup>

Notwithstanding the exemptions for agricultural products contained in article XI, the GATT Contracting Parties concluded in 1951 that U.S.-imposed import restrictions against dairy products from the Netherlands were inconsistent with article XI, and authorized the Netherlands to impose limitations on imports of wheat flour from the United States.<sup>19</sup> In 1955, the United States sought and was granted a waiver of article XI, thus permitting the

continued use of section 22 programs.<sup>20</sup> This waiver was not limited to any particular time period and required only that the United States file an annual report explaining what action had been taken and consult with any country adversely affected.

#### *Application of Section 22*

Since the enactment of section 22 in 1935, the USITC has conducted 55 separate section 22 investigations, covering a wide number of products. The largest number of cases have involved dairy products, such as cheese, nonfat dry milk, butter, and ice cream. During the 1980s and 1990s, sugar and sugar-containing products were the focus of the largest number of section 22 investigations, followed by investigations on dairy products and peanuts. To provide a historical perspective, a chronology of cases, of their effective period, and of their outcome is shown in table 1.

At the close of 1994, just before the URAA entered into force, section 22 restrictions were in place for cotton and cotton waste, wheat,<sup>21</sup> dairy products and certain products containing dairy products, refined sugar and certain sugar-containing products, and peanuts. U.S. imports of these products subject to section 22 restrictions amounted to \$2.8 billion in 1994 (table 2).

Dairy and products containing dairy accounted for nearly 45 percent of the total value of U.S. imports subject to section 22 restrictions in 1994; sugar and sugar-containing products represented 44 percent (figure 1). Wheat represented 10 percent of the total in 1994.

#### **The Uruguay Round Changes**

Under the Uruguay Round Agreement on Agriculture, WTO members agreed to replace nontariff barriers for agricultural products with

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<sup>16</sup> 297 U.S. 1 (1936) The production control and processing tax parts of the adjustment program were declared unconstitutional on the ground that the control of agricultural production was within the exclusive jurisdiction of the states, and that one group of taxpayers (the processors) could not be taxed for the benefit of another group (the farmers).

<sup>17</sup> Kenneth Dam, *The GATT: Law and International Economic Organization*, 1970, pp. 258-260, and Shewmaker, *Section 22: Legislative History*, p. 42.

<sup>18</sup> *Ibid.*

<sup>19</sup> For further explanation, see GATT, *Basic Instruments*, 1st Supp. (1953), p. 32.; also in Dam, p. 260.

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<sup>20</sup> GATT, 3d Supp. BISD 142 (1955). For a discussion of the waiver, see J. Jackson, *World Trade and the Law of GATT* (Bobbs-Merrill Co., Inc., 1969), pp. 733-36.

<sup>21</sup> The Memorandum of Understanding between the United States and Canada limiting U.S. imports of wheat under tariff-rate quotas to 1.5 million metric tons was taken under the authority of section 22. USTR staff, interviewed by USITC staff, Dec. 2, 1994.

Table 1

Section 22 investigations: Chronology of Section 22 cases, by commodities, 1939-94

Commodity <sup>1</sup>	Effective period/institution date
<b>Commodities under import control on October 1, 1994:</b>	
Cotton and certain cotton waste	Beg. Sept. 20, 1939, and subsequently modified
Certain cotton products	Sept. 11, 1961
Wheat and wheat products	May 29, 1941-June 30, 1974; suspended on June 30, 1974; tariff-rate quotas on wheat were imposed on Sept. 12, 1994
Dairy products, including dried milk, cheese, butter, chocolate crumb, and certain animal feed containing milk or milk derivatives	Restrictions initiated on July 1, 1953; modified (Comm. investigation instituted: June 11, 1968; June 26, 1970; Mar. 18, 1971; Jan. 5, 1973; Mar. 9, 1973; May 15, 1973; July 19, 1973; July 26, 1973; Aug. 29, 1973; Nov. 7, 1973; Jan. 7, 1974; Apr. 26, 1976; Mar. 5, 1993
Peanuts	July 1, 1953; modified Oct. 16, 1980 and Oct. 12, 1990
Sugar and sugar-containing products	Nov. 25, 1977; Jan. 15, 1982; July 7, 1982; Apr. 25, 1985; and Apr. 25, 1985 (two separate investigations)
<b>Commodities formerly under import control:</b>	
Harsh or rough cotton less than 3/4 inch in staple length	Sept. 20, 1946 - Jan. 28, 1958
Card strips from cotton	Sept. 20, 1939 - Mar. 31, 1942
Barley, rolled barley, and barley malt	Oct. 1, 1954 - Sept. 30, 1955
Oats and ground oats	Oct. 1, 1951 - Sept. 30, 1955
Shelled and prepared almonds	Oct. 1, 1951 - Sept. 30, 1955; Oct. 23, 1957 - Sept. 30, 1958
Shelled filberts	Oct. 1, 1952 - Sept. 30, 1953
Peanut oil	July 1, 1953 - May 5, 1961
Tung nuts and tung oil: Tung oil Tung nuts	Sept. 9, 1957 - May 2, 1962 Apr. 28, 1958 - May 2, 1962
Flaxseed and linseed oil	July 1, 1953 - May 5, 1961
Rye, rye flour and meal	Apr. 1, 1954 - June 30, 1961

See footnotes at end of table.

Table 1--Continued  
 Section 22 investigations: Chronology of Section 22 cases, by commodities, 1939-94

Commodity <sup>1</sup>	Effective period/institution date
<i>Commodities investigated under Sec. 22, but import controls not imposed:</i>	
Articles containing cotton	July 26, 1939; June 27, 1960; Sept. 6, 1962
Wool, wool tops and carbonized wool	Feb. 19, 1954
Dried figs and fig paste	Dec. 17, 1956; Sept. 17, 1957
Dates	Feb. 5, 1957; Nov. 4, 1957
Certain edible tree nuts	Nov. 24, 1950; Nov. 28, 1951; Sept. 25, 1952; Sept. 21, 1953; Sept. 24, 1954; July 1, 1955
Shelled almonds	Sept. 23, 1957; Sept. 25, 1959
Italian-type cheeses <sup>3</sup>	July 13, 1955; Sept. 25, 1967
Processed Edam and Gouda cheese <sup>3</sup>	June 15, 1967
Condensed or evaporated milk or cream <sup>3</sup>	June 15, 1967
Casein	Aug. 25, 1981
Peanut butter and paste	Jan. 19, 1994; inv. suspended on June 29, 1994
Ice cream	May 18, 1989
Tobacco	Mar. 5, 1981; Oct. 5, 1981

<sup>1</sup> Commodity names refer to generic groupings and are not meant to be the definitive commodities examined by the associated investigations.

<sup>2</sup> The "control" measures for these section 22 products include fees, quotas, or tariff-rate quotas.

<sup>3</sup> Controls on these products were imposed under other investigations.

Source: For the period 1939-67, USDA, Foreign Agricultural Service, *U.S. Import Duties on Agricultural Products*; and, for 1968-94, U.S. International Trade Commission files.

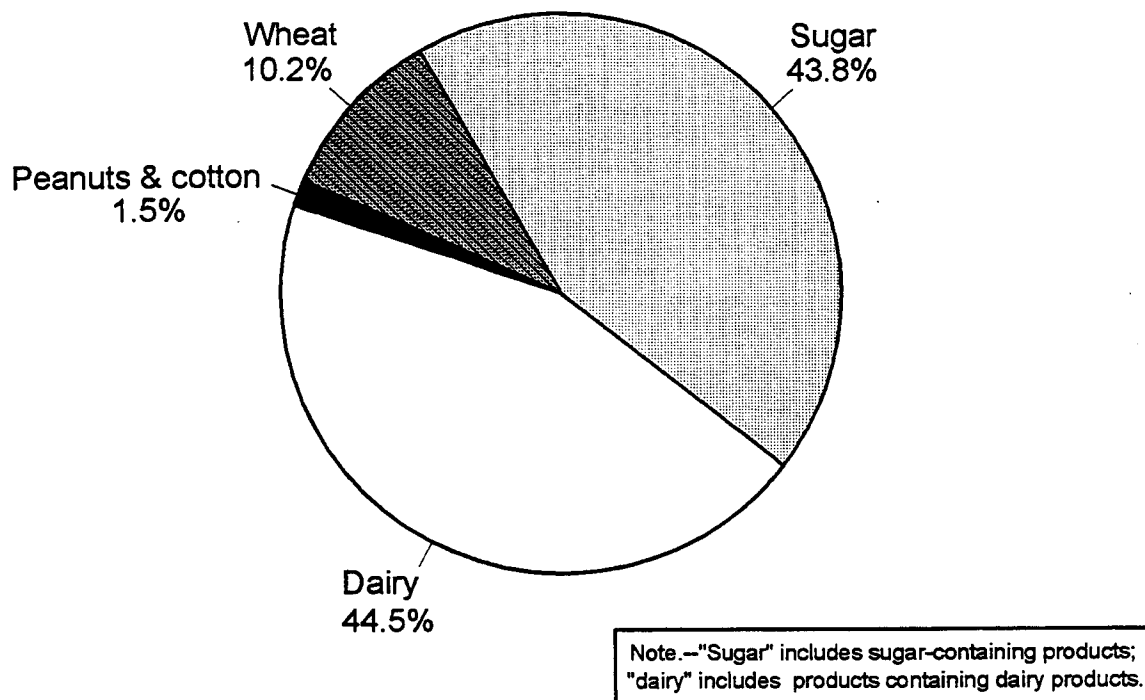
Table 2  
 U.S. imports and production subject to section 22 restrictions

Product	(Million dollars)	
	1994 U.S. imports	Estimated 1994 U.S. production
Dairy and dairy-containing products .....	\$1,245	\$47,000
Refined sugar and sugar-containing products .....	1,224	8,200
Wheat <sup>1</sup> .....	285	7,800
Peanuts .....	29	1,000
Cotton and cotton waste .....	13	4,600
<b>Total .....</b>	<b>\$2,796</b>	<b>\$68,600</b>

<sup>1</sup> Wheat restrictions were imposed on September 12, 1994.

Source: Import data were compiled from official statistics of the U.S. Department of Commerce; Commission staff estimated the value of production. Cotton, wheat, and peanut production data are the farm value for crop year 1993/94.

**Figure 1**  
**Agricultural products affected by section 22 restrictions: U.S. import share of section 22 import value, by products, 1994**



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

new tariff structures (tariff rate quotas)<sup>22</sup> for imports, a process known as "tariffication".<sup>23</sup> The Agreement also establishes special safeguard (SSG) provisions, including volume-based and price-based trigger levels for certain agricultural

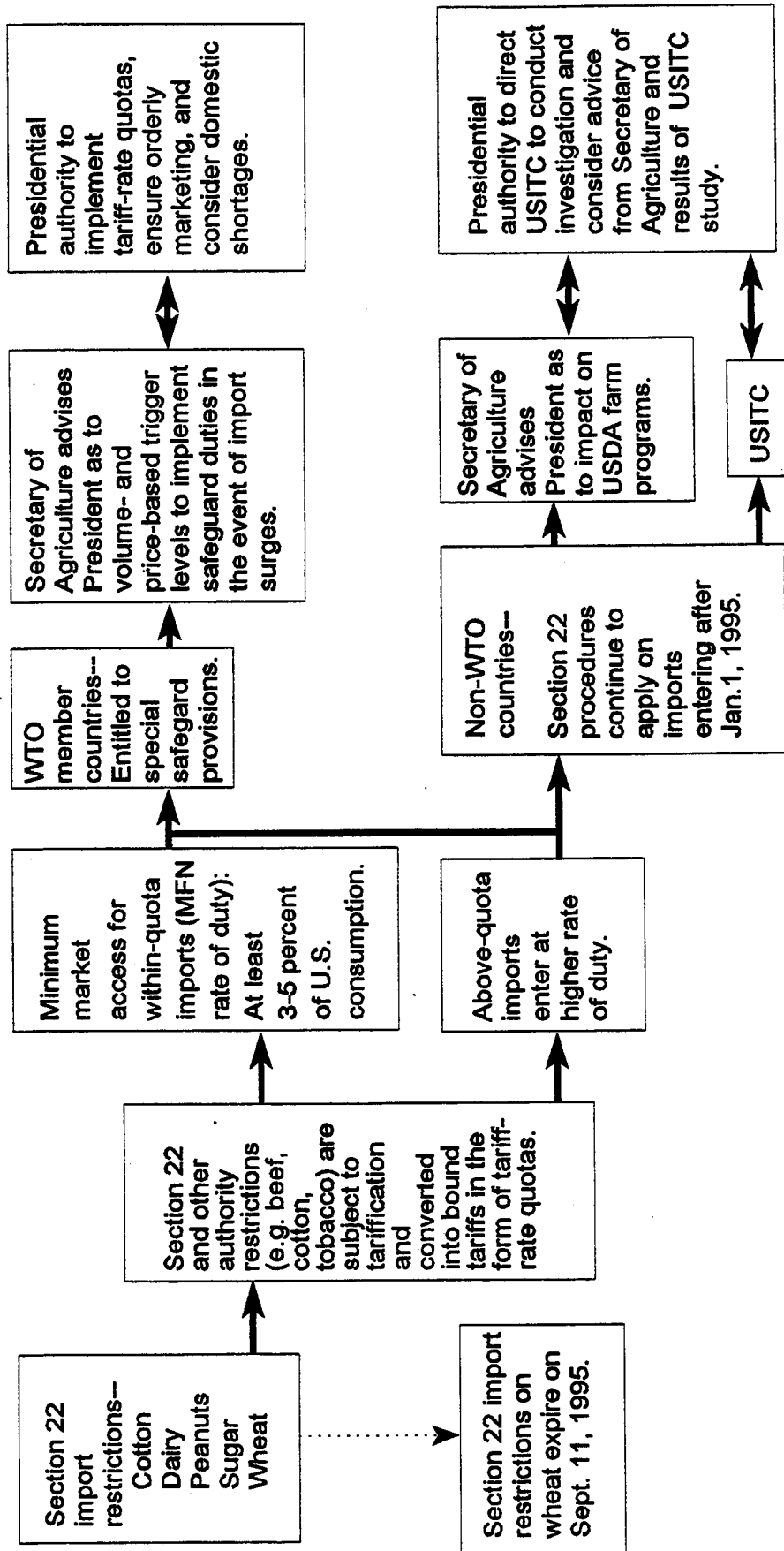
products (hereafter SSG products). The United States implemented the Agreement in title IV of the Uruguay Round Agreements Act (URAA), as signed into law by the President on December 8, 1994.

<sup>22</sup> A tariff-rate quota is a form of tariff. As used for agricultural products subject to tariffication, a specified rate of imports enters at one rate of duty (the within-quota rate), which is generally a column 1 rate of duty. (The column 1 rate of duty for these products is comparatively low, often below 20 percent ad valorem.) Additional imports enter at a higher rate (the over-quota rate).

<sup>23</sup> U.S. Department of Agriculture, Economic Research Service, *Effects of the Uruguay Round Agreement on U.S. Agricultural Commodities*, Mar. 1994, p.2.

How the United States restricts agricultural imports under the URAA depends on whether the origin country of these imports is or is not a member of the World Trade Organization (WTO), the successor organization to the GATT (figure 2). Liberalized import restrictions, such as tariffication, under the URAA apply to agricultural imports from all countries; however, WTO member countries are entitled to SSG provisions. Section 22 authority procedures continue to apply to U.S. agricultural imports from non-WTO countries. Most countries

**Figure 2**  
**Changes to section 22 for agricultural products under the Uruguay Round Agreements Act**



Source: Prepared by staff of the USITC based on provisions of the Uruguay Round Agreements Act.

## Uruguay Round Affects Agriculture

are either WTO-members or likely to join the WTO. China and the former Soviet Union (FSU) are currently the largest non-WTO agricultural trading regions, and these two regions export large volumes of peanuts and cotton that are SSG products.

The non-WTO countries are indirectly affected through the special safeguard procedures. China, for example, has been allocated a portion of the tariff-rate quota's within-quota amount for peanuts and cotton, and the FSU has a portion of the cotton quota.

*Tariffication*

Under tariffication, section 22 quotas and fees for products that had fees or quotas in place at the time the Agreement was signed were converted to "bound" tariffs<sup>24</sup>, specified in Schedule XX of the URA. Under the Agreement, the United States replaced all existing section 22 quotas with tariff-rate quotas for dairy products and certain products containing dairy products, peanuts, sugar-containing products, and cotton.<sup>25</sup> Wheat restrictions, which were not bound, were temporarily provided for through September 11, 1995. The bound agricultural tariffs are subject to the general URA staged rate reduction schedule for all other products (36 percent on average), with a minimum tariff cut of 15 percent for SSG products. The tariff cuts will be phased in over 6 years. Should imports of the agricultural products subject to tariffication exceed specified trigger levels, the United States may invoke certain safeguard measures specified in article 5 of the Agreement (see "Safeguards" below.)

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<sup>24</sup> "Binding" a rate commits a country not to apply a rate of duty higher than the rate specified in its schedule. A member could, of course, apply a lower rate.

<sup>25</sup> U.S. International Trade Commission (USITC), *Potential Impact on the U.S. Economy and Industries of the GATT Uruguay Round Agreements* (investigation No. 332-353), USITC publication 2790, June 1994, p. II-7.

*Minimum Import Market Access*

As well as defining tariff structure, tariff-rate quotas also provide for increased market access; for within-quota imports (which are subject to general most-favored-nation (MFN) column-1 rates of duty), access equal to a minimum of 3 percent of domestic consumption is required, increasing to 5 percent by the year 2000.<sup>26</sup> The United States has agreed to allow access equal to 3 percent of U.S. consumption of an SSG product during the first year of the URAA, rising to 5 percent by the year 2000. The leading SSG products by volume, the respective initial quota quantities for 1995, and the final quota quantity in the year 2000, are shown in table 3.

Beyond the minimum access quantity, imports of the SSG products are dutiable at the so-called "over-quota" tariff. The over-quota tariffs for the SSG products are high. For example, the over-quota tariff exceeds the ad valorem equivalent of 100 percent for peanuts and for many dairy products. Consequently, imports for most of these products are expected to remain at or below the within-quota, minimum access level in most years.

*Safeguard Procedures*

The Agreement on Agriculture also permits a WTO member to impose additional duties on an agricultural product that the WTO member has tariffied if the WTO member designated that product as a product eligible for SSG provisions.<sup>27</sup> All SSG products are identified in Schedule XX of the URA and in subchapter IV of chapter 99 of the *U.S. Harmonized Tariff Schedule (HTS)*, 1995.<sup>28</sup>

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<sup>26</sup> When imports exceeded 5 percent of domestic consumption during the base period, the WTO country is required to maintain a level of access equivalent to that existing during the base period. Statement of Administrative Action, p. 56.

<sup>27</sup> The special safeguard provisions are set out in article 5 of the Agreement.

<sup>28</sup> For these SSG products, Schedule XX of the URA specifies an initial tariff quota quantity level, a final quantity, a within-quota tariff rate, and the implementation period (generally 1995-2000). Any goods entering above the tariff-rate quota are dutiable at the tariffication rate of duty provided in the *HTS*.



Table 3  
 Special safeguard products:<sup>1</sup> U.S. tariff rate quotas, for leading products, 1995 and 2000

Leading SSG products	U.S. tariff-quota quantity		Total increase Percent
	Initial (in year 1995)	Final (in year 2000)	
	Metric tons		
Beef, fresh, frozen or chilled . . . . .	656,621	656,621	0
Butter oil/substitute . . . . .	3,500	6,100	74
Dairy mixtures . . . . .	2,100	4,300	105
Chocolate crumb (high-fat) . . . . .	16,000	26,700	67
Ice cream . . . . .	<sup>2</sup> 3,576	<sup>2</sup> 5,960	67
Cheese . . . . .	110,999	141,991	28
Sugar . . . . .	1,139,195	1,139,195	0
Peanuts . . . . .	33,770	56,283	67
Cotton . . . . .	51,927	86,545	67

<sup>1</sup> The products listed here are only a portion of the large number of SSG products enumerated in Schedule XX of the URA and in subchapter IV of the HTS (1995), among them: beef, sheep meat, cream, milk, butter, butter oil, specific cheeses, other products containing dairy products, chocolate and chocolate crumb containing dairy products, certain animal feeds containing dairy products, ice cream, peanuts, peanut butter and paste, sugar and sugar-containing products, and cotton.

<sup>2</sup> 1,000 liters.

Source: Schedule XX of the URA.

For the United States, most SSG product quotas are allocated to specific countries.<sup>29</sup>

The Agreement authorizes two kinds of safeguard mechanisms to protect agricultural programs and/or producers of SSG products against excessive import levels: (1) volume-based safeguards that are triggered when the import penetration level (imports as a share of domestic consumption) rises above a predetermined level and (2) price-based safeguards that may be imposed when imports enter at a price level below a "trigger" price. In both cases, the URAA requires the President, with the advice of the Secretary of Agriculture, to determine, and publish in the *Federal Register*, the trigger levels and respective duties for each SSG product.<sup>30</sup> The trigger level for the price-based safeguard is fixed (that is, does not change annually as does the volume trigger)

<sup>29</sup> For dairy products, the USDA also issues licenses to specific importers to allocate the within-quota amount. See USDA, Office of the Secretary, "Dairy Tariff-Rate Quota Licensing," Jan. 6, 1995, *Federal Register* (60 F.R. 1989).

<sup>30</sup> The initial trigger levels and duties were also published in Subchapter IV of the *HTS*, 1995.

and is based on the average price during the 1986-88 base period.<sup>31</sup>

Any additional volume-based duties can be maintained only through the end of the year of their imposition, and may not exceed 33.3 percent of the customs duty already in effect. Additional duties cannot be imposed on within-quota imports. The President, with the advice of the Secretary of Agriculture, may invoke volume or price-based safeguards only if such action is deemed appropriate given prevailing conditions.<sup>32</sup>

#### *Orderly Marketing Provisions*

Presidential authority to modify some provisions of tariff rate quotas under the Agricultural Adjustment Act has been retained under the URAA's orderly marketing provisions. The President is authorized to "take such action as may be necessary"<sup>33</sup> in implementing the tariff-rate quotas set out in Schedule XX in order to ensure that

<sup>31</sup> For further discussion, see the Statement of Administrative Action, pp. 58-60.

<sup>32</sup> Section 405(b) of the URAA.

<sup>33</sup> *Ibid.* Section 404(a) of the URAA.

imports of agricultural products do not disrupt the orderly marketing of commodities in the United States.

### Summary

Under the URAA, the application of section 22 is now limited to imports from non-WTO nations. For products from WTO countries formerly subject to section 22 actions, the former section 22 fees and quotas (as well as other import restrictions on agricultural products) have been converted to tariff-rate quotas under the URAA; a minimum access of imports to the U.S. market (the in-quota quantity) is guaranteed; and the new tariffs on imports beyond the minimum access are reduced by an average of 36 percent by the year 2000, and then bound. A "special safeguard" authority is available to protect domestic producers and programs in the event of increased imports or price declines as measured against predetermined historical levels (so-called "trigger price" and "volume trigger" levels).

For WTO countries, the Secretary of Agriculture will be responsible for annual determinations of the trigger levels for special safeguard measures to be imposed. Surges of imports will thus be measured against a quantitative standard (price and volume triggers) rather than the existing section 22 standard of "material interference" with a USDA program.<sup>34</sup>

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<sup>34</sup> See USITC, *Potential Impact on the U.S. Economy and Industries of the GATT Uruguay Round Agreements*, USITC publication 2790, June 1994, pp. II-6 to II-8.

Consequently, there will likely be greater transparency regarding the factors considered by the USDA in advising the President regarding excessive import surges.

In addition, the President retains broad authority to administer tariff-rate quotas to ensure that imports under these quotas do not disrupt the orderly marketing of agricultural commodities in the United States.<sup>35</sup> For example, under section 404 of the URAA, the President could issue licenses or otherwise act to avoid an import surge of a commodity, expand the in-quota quantity in years of inadequate supply, or allocate the in-quota quantity to specific countries.<sup>36</sup> ■

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<sup>35</sup> House, "Statement of Administrative Action," *Uruguay Round Trade Agreements, Texts of Agreements, Implementing Bill, Statement of Administrative Action, and Required Supporting Statements, Message from the President of the United States*, Sept. 27, 1994, House Doc. 103-316, pp. 73-74.

<sup>36</sup> *Ibid.*

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## TELECOMMUNICATION SERVICES: BELL COMPANIES ACT TO JOIN GLOBAL NETWORK ALLIANCES

The competitive environment in the global market for international communications<sup>1</sup> is changing rapidly. The convergence of telecommunication and computer technologies, combined with new transmission technologies, has resulted in the deployment of a vast array of convenient, low cost, and productivity-enhancing services. These innovations have motivated telecommunication firms to rethink lines of business and formulate new strategies for competing in the global market. Additionally, technological innovations have reduced regulatory bodies' ability to monitor new developments and to govern markets rationally, thereby compelling them to deregulate in the interest of efficiency and overall economic competitiveness. In many instances, deregulation has provided telecommunication firms with inroads to lucrative foreign service markets, leading the industry to globalization. The current state of regulation in the global market for telecommunication services is shown in figure 1.

To compete in various service markets in multiple countries is a formidable task. Consequently, telecommunication service providers are forming strategic partnerships with other firms, both foreign and domestic. Some of these partnerships have as their principal objective the construction of global networks. Global networks supply a broad range of international calling and communication services to multinational firms and have grown increasingly popular as firms in diverse industries have globalized.

Among those interested in providing global network services are the regional Bell holding companies (RHCs). Since 1984, the Modification

of Final Judgment (MFJ)<sup>2</sup> largely has confined the domestic activities of the RHCs to providing telephone service within local access and transport areas (LATAs).<sup>3</sup> As such, the RHCs are prohibited from offering long distance service--domestic or international--because this entails transmitting calls across LATA boundaries. In contrast to international and long distance calling, recent projections for growth in the relatively mature local calling market are low, estimated to be about 3 percent per annum (figure 2). The attractiveness of alternative service and geographic markets has prompted the RHCs to pursue both legislative and judicial reform in order to gain entry to these markets. This article examines key factors driving the formation of global telecommunication alliances and the RHCs' efforts to remove restrictions that impede participation in these international alliances.

### The Importance of Alliances

Strategic cross-border alliances increasingly are used as vehicles for competing in a global marketplace. Effective long-term partnerships are often those that bring together firms whose core businesses are similar or complementary and fully

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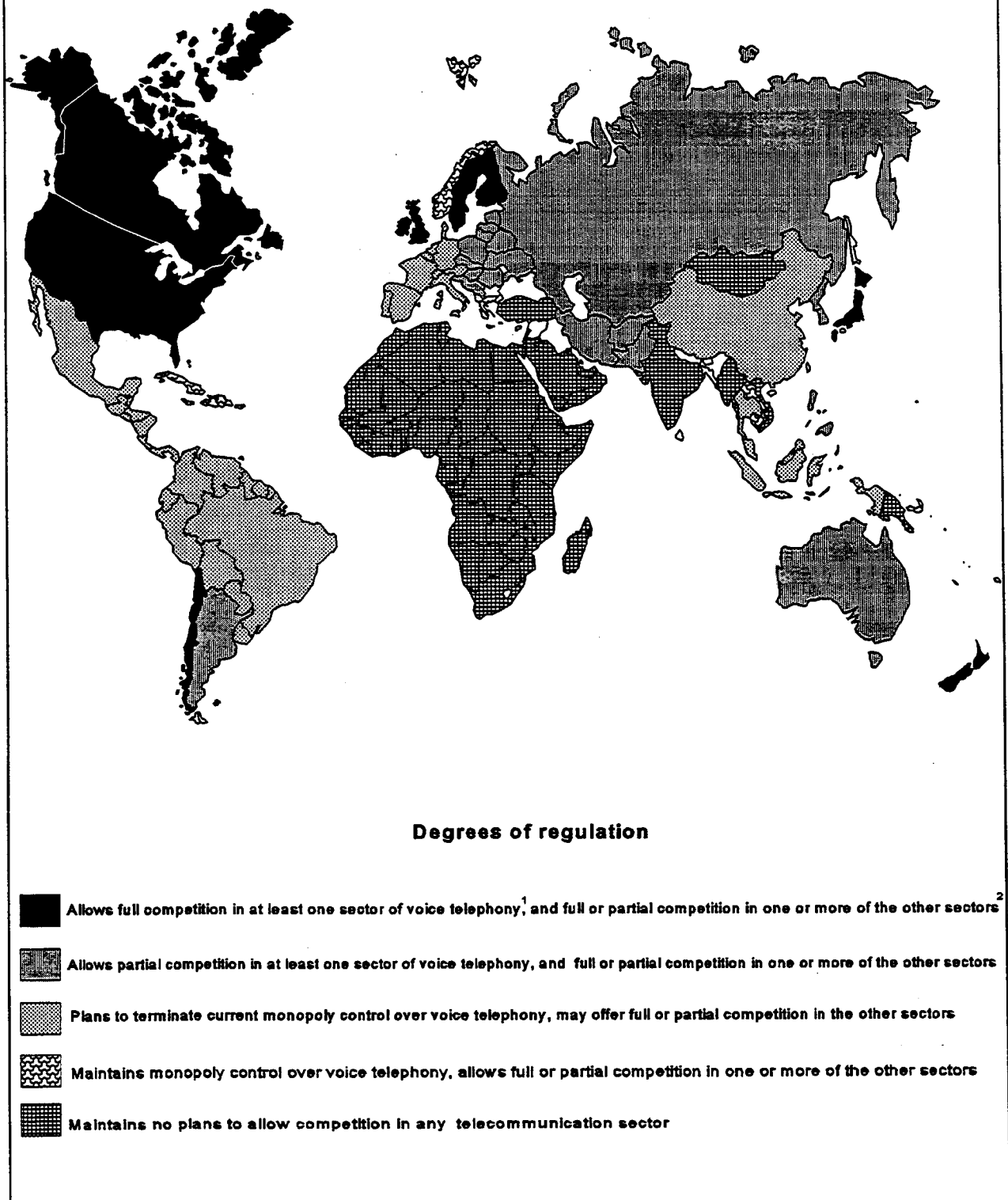
<sup>2</sup> The MFJ is a Department of Justice Consent Decree that divested AT&T, the former telephone service monopoly, of its local calling service--a service considered by theorists at that time to be a natural monopoly. The local calling segment of the U.S. market subsequently was reorganized into seven regional Bell holding companies. It was felt that the new structure would 1) ensure the continued delivery of affordable universal telephone service to all citizens by maintaining the regulated monopoly structure over local calling markets and 2) provide for competition in those service markets that would produce greater economic benefits under a competitive framework. These markets included those for long-distance service and telecommunications equipment.

<sup>3</sup> There are 195 LATAs that compose the U.S. market for local telephone service. Each generally consists of a large metropolitan area and a surrounding countryside.

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<sup>1</sup> Total worldwide telecommunication service revenues for 1994, as estimated by USITC staff, amounted to \$480 billion. Total worldwide telecommunication service revenues for 1993 amounted to \$455 billion, as reported by the International Telecommunication Union (ITU), press release, Oct. 11, 1994.

**Figure 1**  
**The state of regulation in global telecommunication markets**

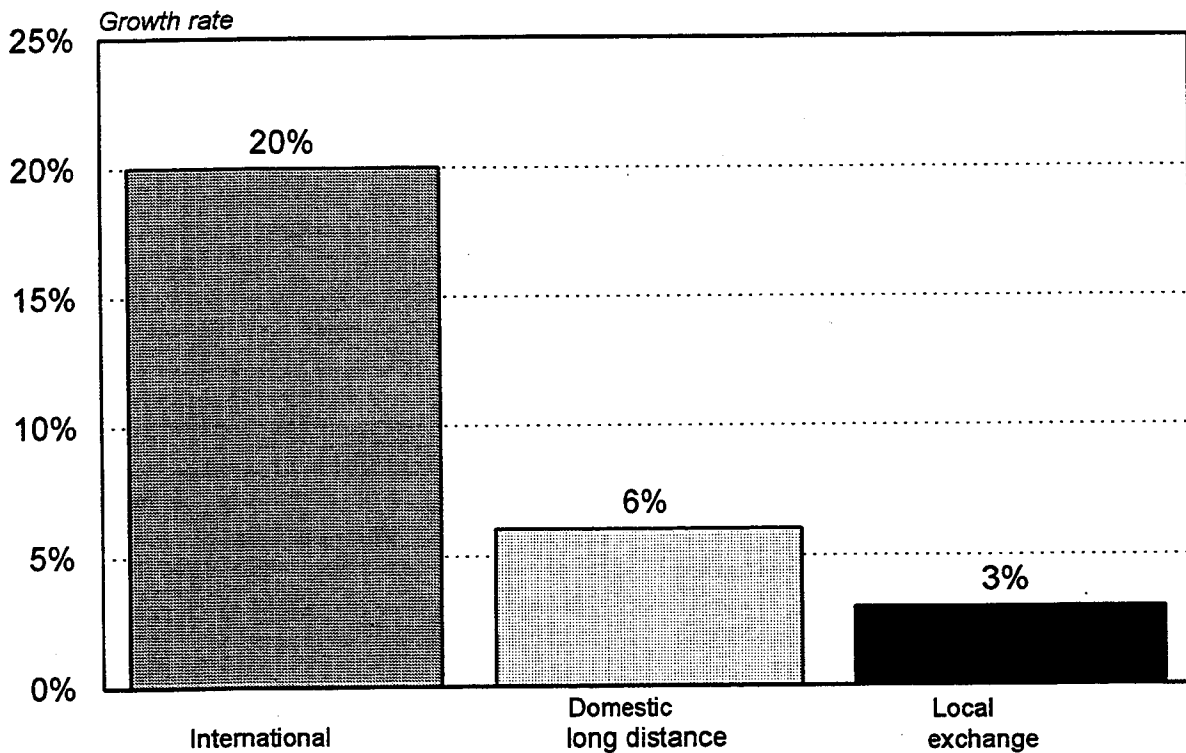


<sup>1</sup> Voice telephony includes local telephone, domestic long distance, and international long distance services.

<sup>2</sup> Other sectors comprise data communications, private networks, mobile communications, and equipment.

Source: Compiled by staff of the USITC based on data from the International Telecommunication Union and various private sector and government sources.

Figure 2  
Projected revenue growth in the international, long distance, and local calling markets, 1994



Source: U.S. Industrial Outlook, 1994.

exploit their relative strengths. Alliances frequently entail sharing and trading decision-making responsibilities, costs, capital, technology, information, and access to markets, potentially allowing firms to increase sales revenues and to reduce time-to-market for new service offerings.<sup>4</sup> Alliances also equip firms with better abilities to contend with risks and difficulties common to global endeavors. These include exchange rate fluctuations, financial and credit concerns, cultural and linguistic barriers, and, sometimes, political instability.<sup>5</sup> Furthermore, alliances provide new entrants with knowledge and

insights regarding regulatory and legal environments that prevail in foreign markets.

### Global Networks

One of the primary factors currently shaping the direction of international telecommunications is the growing demand by multinational corporations for global network services that link geographically dispersed offices through the use of advanced communication technologies. These technologies include virtual private networks (VPNs) for voice service and frame relay for data transmission. Almost all large carriers, including AT&T, Sprint, KDD, and MCI, either offer services based on these technologies or plan to offer them in the near future.<sup>6</sup> VPNs provide the advantages of a private

<sup>4</sup> Joel Bleeke and David Ernst, "Collaborating to Compete," *Directors and Boards*, vol 18, No. 2 (winter 1994), pp. 7-11.

<sup>5</sup> Russ Banham, "Global Strategies and Changing," *Risk Management*, July 1994, p. 24.

<sup>6</sup> Monica Snell, "Global Mission," *Global Telephony*, Nov. 1994, p. 27.

## Global Telecommunication Alliances

voice network<sup>7</sup> plus substantial cost savings, lower staff requirements to manage the network, automatic upgrades of service, and a wide array of advanced calling features currently available only through private networks.<sup>8</sup> Frame relay is a low-cost transmission technology that is extremely efficient at handling high-speed, noncontinuous data. The market for these services is growing rapidly. It is estimated that revenues for multinational country-to-country calling total around \$30 billion.<sup>9</sup> As global networks become more available, it is expected that demand for these services will be stimulated, generating double-digit growth rates in revenue perhaps through the rest of the decade.<sup>10</sup>

The ability of public operators to provide global network services has been enhanced as governments have replaced regulated markets with competition, particularly in markets that host many multinational firms that require sophisticated telecommunication services. Regulators recognize that an increasing share of all firms' overhead costs are being allocated to communication. As such, the competitiveness of telecommunication users can be affected significantly by variations in the costs of communicating. In fact, significant price differentials that currently exist among several of the largest European markets have been instrumental in motivating many multinational corporations to organize and seek faster relief from

EU-mandated regulations, currently scheduled to be liberalized by 1998.<sup>11</sup>

In light of increasing demand for global network services, three international partnerships have formed recently to target this market (table 1). Each partnership's primary strategy is to pool resources and respective expertise to create one-stop, seamless<sup>12</sup> international voice and data communications. The alliances, which include five of the largest telecommunication carriers in the world, are called Concert, WorldPartners, and Phoenix. Combined, the members of these three consortia currently provide long distance service to more than 50 percent of the multinational corporations in the world,<sup>13</sup> an ability which places them in a position to capture a substantial share of the current market for global networking services. Concert and WorldPartners already offer a wide array of global network services, including VPN and frame relay data transmission, and Phoenix plans to make the services available to its members pending approval of the alliance by U.S., German, and French authorities.

## MFJ Restrictions and Alliance-Building

The RHCs reportedly maintain an interest in pursuing memberships in global long-distance alliances. And, it is likely that the RHCs could pose significant challenges to established alliances,

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<sup>7</sup> Private networks consist of a series of offices connected by leased and nonleased phone lines with switching facilities and transmission equipment owned and operated by the user or by the carrier and leased to the user for the exclusive use of one customer. *Newton's Telecom Dictionary*, 7th ed., 1994.

<sup>8</sup> Advanced features include seven-digit dialing, switched video-conferencing, file transfer, facsimile, caller id, international call forwarding, private network interfacing, third-party dialing, and customized bill reporting. Andrew Burroughs, "Making Worldwide Virtual Private Networking a Reality," *Telecommunications*, Mar. 1993, p. 63, and Monica Snell, "Global Mission," *Global Telephony*, Nov. 1994, p. 26.

<sup>9</sup> "Long-Distance Industry: Global Growth, Telecommunications," Salomon Brothers, Aug. 19, 1994, p. 5.

<sup>10</sup> *Ibid.*

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<sup>11</sup> A group of 40 European multinational companies have joined to form the European Virtual Private Network Users Association in an attempt to spur the EU to allow the use of alternate telecommunication systems using virtual private networks. The association asserts its membership that it could reduce current phone bills by 50 percent. Richard L. Hudson, "Calls for Change: Liberalization of Europe's Telecommunications Industry Is Sure To Benefit Business as a Whole," *The Wall Street Journal*, World Business, Sept. 30, 1994, p. R20.

<sup>12</sup> Seamless communication results from interoperability (i.e., the ability to operate software and exchange information in a heterogeneous network) among technically diverse computer and telecommunication systems and networks. When successful, users are not able to perceive whether programs or information are being processed locally or remotely.

<sup>13</sup> "Long-Distance Industry: Global Growth, Telecommunications," Salomon Brothers, Aug. 19, 1994, p. 5.

Table 1  
 Global telecommunication alliances

ALLIANCE	PARTNERS	PROFILE
Phoenix	Sprint Deutsche Telekom France Telecom	<ul style="list-style-type: none"> <li>Proposed alliance announced in June 1994</li> <li>Combined revenues of \$70 billion</li> <li>Market reach: U.S. and Europe, excluding France and Germany</li> <li>Joint venture between Deutsche Telekom and France Telecom purchased 20 percent of Sprint for \$4.2 billion, although the United States is likely to delay approval until France and Germany open their telephone markets</li> <li>Plans to offer full range of global networking services to corporate, consumer, and resale markets</li> </ul>
Concert	MCI British Telecom	<ul style="list-style-type: none"> <li>Joint venture launched in Summer 1994, approved by federal regulatory authorities in September 1994</li> <li>Combined revenues of \$33 billion</li> <li>Market reach: U.S. and U.K.</li> <li>British Telecom purchased 20 percent stake in MCI for \$4.2 billion</li> <li>\$1-billion joint venture to build global network service for international corporations</li> <li>Offers full range of global networking services to multinational corporations in the United States and Europe</li> </ul>
WorldPartners	<ul style="list-style-type: none"> <li>AT&amp;T</li> <li>KDD</li> <li>Singapore Telecom</li> <li>Hong Kong Telecom</li> <li>Telstra (Australia)</li> <li>Unitel (Canada)</li> <li>Korea Telecom</li> <li>Uniworld (European partner):                             <ul style="list-style-type: none"> <li>AT&amp;T</li> <li>Unisource                                     <ul style="list-style-type: none"> <li>Swiss Telecom</li> <li>Telia (Sweden)</li> <li>PTT Telecom Netherlands</li> <li>Telefonica de Espana International</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Initial alliance (AT&amp;T, KDD, and Singapore Telecom) formed in May 1993; others have since joined</li> <li>Combined revenues exceeding \$100 billion</li> <li>Market reach: United States, Europe, Asia</li> <li>No equity exchanges among members, rather a loose coalition of telephone operators offering corporate customers compatible data and voice network services</li> <li>Offers full range of global networking services (private line, frame relay, and virtual private networks) to multinational clients worldwide</li> </ul>

Source: Compiled by staff of the USITC.

particularly in markets where they successfully have established their presence in cellular or basic telephony services.<sup>14</sup> However, the RHCs are unable to fully participate in global networks since they are restricted from terminating or originating

international long distance calls.<sup>15</sup> This limitation on RHCs' operations poses a barrier to forming

<sup>14</sup> Sharon Watson, "U.S. Carriers Go Overseas in Search of Telecom's Holy Grail," *Telephony*, Dec. 20, 1993, p. 25.

<sup>15</sup> In certain cases, the Department of Justice has granted waivers to several RHCs exempting them from the international calling restriction. Under the conditions of the waivers, the RHC, through its association with a foreign carrier, is exempted from the long distance prohibition, but with additional restrictions and qualifications which make the process lengthy and cumbersome. Industry representative, telephone interview with USITC staff, Mar. 30, 1995.

partnerships with foreign carriers seeking global alliances since the U.S. market for international services represents a significant share of the international calling market. During 1993, nearly one-fourth of all international telephone traffic either originated or terminated in the United States.<sup>16</sup>

Industry representatives have reported specific instances in which MFJ restrictions have affected alliance building adversely. For example, in selecting a partner for its ventures in Mexico, AT&T opted to team with Grupo Alfa, a Mexican-based conglomerate, over Telefonos de Mexico SA (Telmex), the country's current monopoly provider of wireline voice telephony. One of the reasons cited for this selection was the fact that SBC (formerly Southwestern Bell Corporation) owned 10 percent of Telmex.<sup>17</sup> Because of SBC's association with Telmex, a partnership between AT&T and Telmex would have been subject to the MFJ line-of-business restriction barring the RHCs from carrying calls terminating or originating in the U.S. market.<sup>18</sup> Similarly, it is reported that MFJ restrictions also have prevented the consideration of RHCs in other global alliances, including the one that was ultimately established between British Telecom (BT) and MCI.<sup>19</sup>

### RHCs in Foreign Markets

In instances where regulatory barriers have not inhibited the RHCs' entrance to new service markets, the RHCs have established successful foreign operations (table 2). One of the most effective strategies has been to export core competencies in network management, wireless

services, and the management and operation of local telecommunications to countries which have introduced competition. While each of the seven RHCs has followed different international strategies, its foreign ventures have focused predominately on such operations as local telephone service, cellular communication, and cable television projects. The RHCs also are widely represented in privatization efforts of local telecommunication operators, where they have acquired equity ownership in countries such as New Zealand, Australia, Hungary, Poland, Argentina, and Mexico.

Unimpeded by domestic regulation, the RHCs have made inroads in the global cellular communication market<sup>20</sup> partly because they have demonstrated the expertise and domestic experience necessary to attract foreign partners (figure 3). In other ventures, including those in the United Kingdom<sup>21</sup> and New Zealand,<sup>22</sup> it is often U.S. firms that have introduced the new services. For example, a wholly-owned subsidiary of NYNEX, CableComms, is licensed to provide cable television and telephone service to 16 franchises in the U.K. market. Of the 14 operating franchises,<sup>23</sup> CableComms markets a bundled cable television/telephone service package to 13 franchises, covering nearly 800,000 total households. As of March 1995, CableComms registered 116,000 residential telephone subscribers, and expects to

<sup>16</sup> Total incoming and outgoing telephone traffic for the United States amounted to 10.8 billion minutes out of a world total of 47 billion minutes. "Telegeography and the ITU," press release, Oct. 11, 1994.

<sup>17</sup> In competing for the Mexican license, SBC had to obtain a waiver from Judge Greene exempting the RHC from the international long-distance restriction. Otherwise, SBC would have been forced to divest itself of the long-distance portion of the new business. Industry representative, telephone interview with USITC staff, Nov. 1994.

<sup>18</sup> Ibid.

<sup>19</sup> Eugene A. Sekulow, "International Information Infrastructure" seminar, the Columbia Institute for Tele-Information (CITT), Sept. 30, 1994.

<sup>20</sup> For added information, see U. S. International Trade Commission (USITC), *Global Competitiveness of U.S. Advanced-Technology Industries: Cellular Communications* (investigation No. 332-329), USITC publication 2646, June 1993.

<sup>21</sup> Cable companies in the United Kingdom have been allowed to offer telephone service since 1991. However, British telephone service providers, British Telecom and Mercury, will not be eligible to enter the cable market until 2001, according to the agreement that opened the British telephone market to cable/telephone service providers.

<sup>22</sup> Two RHCs, Bell Atlantic and Ameritech, hold equity interest in the Telecom Corporation of New Zealand (Telecom). Unlike the United States, which segregates the long distance and local exchange markets, Telecom provides both services throughout New Zealand.

<sup>23</sup> NYNEX is scheduled to begin providing cable television and telephone service to the remaining two franchises sometime in 1995.



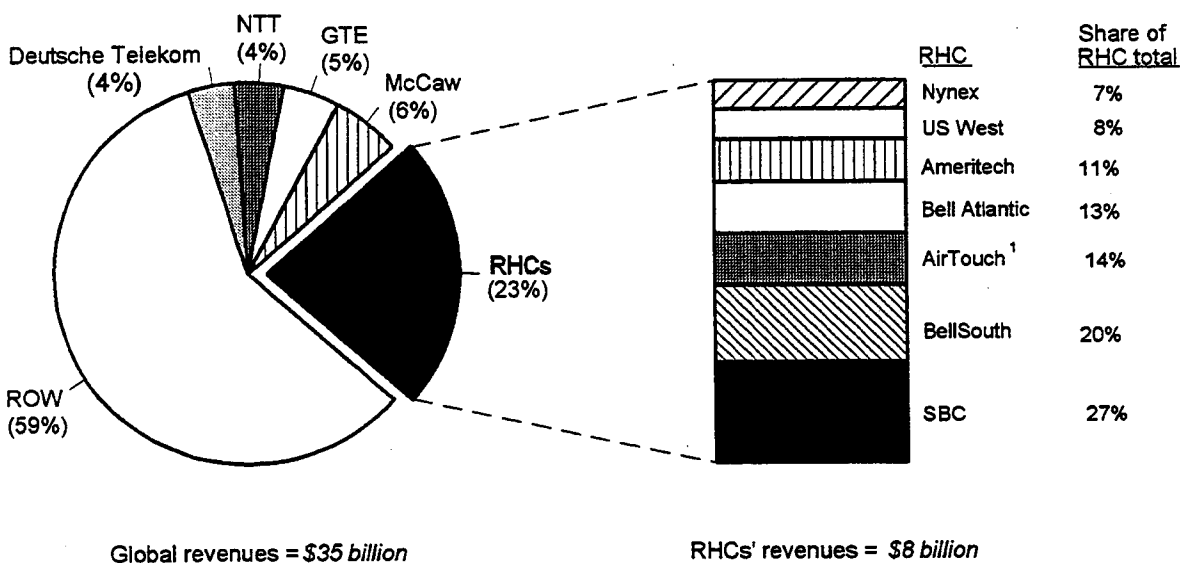
Table 2  
RHCs' foreign telecommunication ventures

Ameritech	Bell Atlantic	BellSouth	Nynex	AirTouch <sup>1</sup>	SBC	US West
<p><b>New Zealand:</b></p> <ul style="list-style-type: none"> <li>• Domestic service</li> <li>• International long distance</li> <li>• Cellular</li> <li>• Switched packet data networks</li> </ul> <p><b>Czech Republic:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> <li>• Switched packet data networks</li> </ul> <p><b>India:</b></p> <ul style="list-style-type: none"> <li>• VSAT</li> <li>• Cellular</li> </ul> <p><b>Italy:</b></p> <ul style="list-style-type: none"> <li>• Large operating system software</li> <li>• Development and delivery of multimedia TV applications</li> </ul> <p><b>South Korea:</b></p> <ul style="list-style-type: none"> <li>• Wireless training and standards implementation</li> </ul> <p><b>Mexico:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>New Zealand:</b></p> <ul style="list-style-type: none"> <li>• Domestic service</li> <li>• International long distance</li> <li>• Cellular</li> <li>• Telephone directory</li> </ul> <p><b>Slovakia:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> </ul> <p><b>Sweden:</b></p> <ul style="list-style-type: none"> <li>• AIN</li> </ul>	<p><b>Argentina:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>Australia:</b></p> <ul style="list-style-type: none"> <li>• Radio paging</li> <li>• Telephone answering service</li> </ul> <ul style="list-style-type: none"> <li>• Domestic service</li> <li>• International long distance</li> </ul> <ul style="list-style-type: none"> <li>• PCS</li> <li>• Digital cellular</li> </ul> <p><b>Belgium:</b></p> <ul style="list-style-type: none"> <li>• Wireless data</li> </ul> <p><b>Chile:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <ul style="list-style-type: none"> <li>• Domestic service</li> </ul> <p><b>China:</b></p> <ul style="list-style-type: none"> <li>• Private network services</li> <li>• Voice and data communications equipment services</li> </ul> <p><b>Denmark:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> </ul> <p><b>France:</b></p> <ul style="list-style-type: none"> <li>• Cable network</li> <li>• Digital cellular</li> <li>• Direct marketing, customer service</li> </ul> <p><b>Germany:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> <li>• Wireless data</li> </ul> <p><b>India:</b></p> <ul style="list-style-type: none"> <li>• Telecommunications software and services</li> </ul> <p><b>Israel:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>Mexico:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>New Zealand:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> </ul> <p><b>Singapore:</b></p> <ul style="list-style-type: none"> <li>• Wireless data</li> </ul> <p><b>United Kingdom:</b></p> <ul style="list-style-type: none"> <li>• Paging</li> <li>• Wireless data</li> </ul> <p><b>Uruguay:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>Venezuela:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul>	<p><b>China:</b></p> <ul style="list-style-type: none"> <li>• Feasibility studies for telecommunications</li> <li>• Directory service</li> </ul> <p><b>Czech Republic:</b></p> <ul style="list-style-type: none"> <li>• Domestic service</li> <li>• Telephone directory</li> </ul> <p><b>Gibraltar:</b></p> <ul style="list-style-type: none"> <li>• Domestic service</li> </ul> <p><b>Greece:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>Indonesia:</b></p> <ul style="list-style-type: none"> <li>• Network expansion</li> <li>• Cellular</li> </ul> <p><b>Japan:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> <li>• Cable TV</li> </ul> <p><b>Philippines:</b></p> <ul style="list-style-type: none"> <li>• Domestic service (through Telecom Holdings)</li> </ul> <p><b>Poland:</b></p> <ul style="list-style-type: none"> <li>• Telephone directory</li> </ul> <p><b>Slovakia:</b></p> <ul style="list-style-type: none"> <li>• Directory service</li> </ul> <p><b>Thailand:</b></p> <ul style="list-style-type: none"> <li>• Network expansion</li> <li>• Cable TV over fiber, coaxial cable</li> <li>• Long distance</li> </ul> <p><b>United Kingdom:</b></p> <ul style="list-style-type: none"> <li>• Cable TV/telephony</li> <li>• Multimedia services</li> </ul> <p><b>Other:</b></p> <ul style="list-style-type: none"> <li>• FLAG: Fiber cable linking traffic among Europe, Middle East, Asia</li> <li>• On-line international business directory</li> </ul>	<p><b>Belgium:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> </ul> <p><b>France:</b></p> <ul style="list-style-type: none"> <li>• Digital paging</li> </ul> <p><b>Germany:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> </ul> <p><b>Italy:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> </ul> <p><b>Japan:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> <li>• International carriage, switched long distance</li> </ul> <p><b>Portugal:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> </ul> <p><b>Spain:</b></p> <ul style="list-style-type: none"> <li>• Paging</li> </ul> <p><b>South Korea:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> </ul> <p><b>Sweden:</b></p> <ul style="list-style-type: none"> <li>• Credit card verification</li> </ul> <p><b>Thailand:</b></p> <ul style="list-style-type: none"> <li>• Paging</li> </ul>	<p><b>Chile:</b></p> <ul style="list-style-type: none"> <li>• Domestic service</li> <li>• Domestic long distance</li> <li>• Cellular</li> <li>• Cable TV</li> </ul> <p><b>France:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>South Korea:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>Mexico:</b></p> <ul style="list-style-type: none"> <li>• Domestic service</li> <li>• Cellular</li> </ul> <p><b>Domestic long-distance:</b></p> <ul style="list-style-type: none"> <li>• Telephone directory</li> </ul> <p><b>Israel:</b></p> <ul style="list-style-type: none"> <li>• Cable TV</li> </ul> <p><b>United Kingdom:</b></p> <ul style="list-style-type: none"> <li>• Telephone directory</li> </ul> <p><b>Australia:</b></p> <ul style="list-style-type: none"> <li>• Telephone directory</li> </ul>	<p><b>Bulgaria:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> </ul> <p><b>Czech Republic:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> <li>• Switched packet data network</li> </ul> <p><b>Hungary:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> <li>• Cable TV</li> </ul> <p><b>Japan:</b></p> <ul style="list-style-type: none"> <li>• Digital cellular</li> <li>• Cable TV</li> </ul> <p><b>Lithuania:</b></p> <ul style="list-style-type: none"> <li>• International gateway services</li> </ul> <p><b>Malaysia:</b></p> <ul style="list-style-type: none"> <li>• Domestic service</li> <li>• International gateway switch</li> </ul> <p><b>Digital cellular:</b></p> <ul style="list-style-type: none"> <li>• Satellite</li> </ul> <p><b>Russia:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> <li>• International gateway services</li> </ul> <p><b>Slovakia:</b></p> <ul style="list-style-type: none"> <li>• Cellular</li> <li>• Switched packet data network</li> </ul> <p><b>United Kingdom:</b></p> <ul style="list-style-type: none"> <li>• Cable TV/telephony</li> <li>• Personal communication services</li> <li>• Telephone directory</li> </ul>	

<sup>1</sup> Formerly PacTel Corporation. In December 1993, Pacific Telesis separated its core business into two entities: Pacific Telesis Group and AirTouch Communications, which currently operates outside of MFJ restrictions. AirTouch Communications assumed all of Pacific Telesis' international operations.

Source: Compiled by staff of the USITC.

**Figure 3**  
**Leading operators' share of global cellular communications market, ranked by total subscribers, 1993**



<sup>1</sup> Formerly PacTel Corporation. In December 1993, Pacific Telesis separated its core business into two entities: Pacific Telesis Group and AirTouch Communications, which currently operates outside of MFJ restrictions. AirTouch Communications inherited all of Pacific Telesis' cellular operations.

Source: International Telecommunication Union.

expand its telephone service by 35,000 homes per month. In addition, CableComms provides cable television services to 130,000 U.K. subscribers, and subscribership appears likely to increase as the firm's penetration of the telecommunication service market increases.<sup>24</sup> Where CableComms markets a bundled cable television and telephony package, 70 percent of its customers subscribe to both services.<sup>25</sup>

**Pursuit of Domestic Reform**

To enter new geographic and service markets including international calling, the RHCs have

pursued relief from domestic regulations.<sup>26</sup> On the legislative front, the RHCs have been instrumental in urging Congress to draft telecommunication reform bills. In 1994, the 103d Congress produced two such bills, one in the House and one in the Senate. In June 1994, the House passed H.R. 3626, the Antitrust and Communications Reform Act of 1994, which was intended to dissolve the MFJ and open the U.S. telecommunication market to competition in the local, long distance, and cable

<sup>24</sup> Nynex, *Annual Report 1994*.

<sup>25</sup> Richard Blackburn, President and Group Executive, NYNEX Worldwide Services, speaking at the Center for Strategic & International Studies (CSIS) seminar on "The U.K. Cable-Telco Tango: The Dance with Reality," November 17, 1994.

<sup>26</sup> On April 3, 1995, the Department of Justice Antitrust Department filed a motion on behalf of Ameritech, the Consumer Union, and MFS Communications to allow Ameritech to provide long distance service to its 4 million residential and business local service subscribers in Michigan and Illinois. In the motion, Ameritech will be allowed to enter the region's long distance market only after it has demonstrated actual competition in the local exchange market. AT&T has stated that it will pursue available opportunities in Ameritech's market if the motion is approved.

television markets.<sup>27</sup> In contrast, its counterpart in the Senate, the Communications Act of 1994, did not reach full Senate consideration reportedly because of disagreement regarding the timing and conditions of entry by local, long distance, and cable firms into one another's domestic markets.

In 1995, the 104th Congress continues to work on telecommunication legislation. So far, the Senate Commerce Committee has produced a bill that would eliminate current MFJ restrictions and provide for increased competition in telecommunication and cable markets. The bill, the Telecommunications Competition and Deregulation Act of 1995 (S.652), proposes that local telephone companies complete a 14-point "competitive checklist" before they are allowed to enter the long distance market. The House Energy and Commerce Committee has also introduced legislation proposing to reform telecommunications. Two bills, the Communications Act of 1995 (H.R. 1555) and the Anti-Trust Consent Decree Reform Act of 1995 (H.R. 1528) recently were introduced to promote competition in the U.S. telecommunication market and dissolve the MFJ. In addition, the House has chosen to confront the issue of foreign ownership of U.S. telecommunication companies in a separate bill, H.R. 514. This bill contains provisions which aim to repeal section 310(b) of the Communications Act of 1934 which currently limits foreign ownership of U.S. telecommunication companies to 25 percent.

The RHCs have also initiated litigation to remove MFJ restrictions. On July 6, 1994, four of the seven RHCs--Bell Atlantic, BellSouth, Nynex, and SBC--filed a motion to vacate the 1982 Consent Decree, which provides the basis for the MFJ.<sup>28</sup> Reportedly, AT&T's announcement to acquire McCaw Cellular Communications, Inc., the largest cellular operator in the United States, was a

contributing factor.<sup>29</sup> The acquisition provides AT&T with access to the local exchange, thereby placing AT&T in direct competition with RHCs' cellular operations.

### Outlook

The future of domestic telecommunication reform is currently unfolding in Congress. Although most issues that remain in contention revolve around the domestic industry, there will be implications for international competitiveness. In addition to allowing the RHCs to enter the international calling market, the reform may remove the ban that prevents the RHCs from vertically integrating into equipment manufacturing. Both of these factors will enhance the attractiveness of the RHCs as participants in global alliances.

If enacted, reform would have broad consequences also for entities other than telecommunication firms. Indeed, there are far-reaching implications for all information-intensive firms. The structure of the new telecommunication regime will directly influence the development of the rapidly emerging national information infrastructure (NII).<sup>30</sup> In establishing the framework for the development of the NII, U.S. policy makers assert that minimally regulated provision of new telecommunication services led by the private sector will encourage faster deployment of new services, provide the broadest array of quality communication services, and produce the lowest prices when compared with alternative competitive models. The potential impact will have economy-wide implications

<sup>27</sup> Original House bills, HR 3636 and HR 3626, were both passed overwhelmingly by the full House in a vote in June 1994. They were subsequently combined into one bill, HR 3626, entitled the Antitrust and Communications Reform Act of 1994.

<sup>28</sup> In December 1994, Bell Atlantic withdrew its participation from the Motion to Vacate the Consent Decree.

<sup>29</sup> The merger was strongly opposed by the RHCs, two of which, Nynex and Bell Atlantic, filed an antitrust lawsuit to halt the merger. The 1982 decree, which divested AT&T of its local business, also forbid the long distant giant from acquiring stock or assets of the RHCs. In seeking approval for the merger, AT&T had to seek a waiver of that condition since some RHCs are majority owners of cellular systems jointly held by McCaw in Houston, Los Angeles, and St. Louis. Jeffrey Silva, "Ruling Lets AT&T Hold Systems Jointly Owned by McCaw, Bells," *RCR*, Sept. 5, 1994, p. 5.

<sup>30</sup> For more information, see Danna Blattman, "The Information Superhighway: Global Implications From Current Test Projects," in this issue of *Industry, Trade, and Technology Review*.

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including job creation and growth, wealth, and living standards. Progress on the domestic front will, in turn, influence the United States' position with respect to the global information

infrastructure, which ultimately will allow a transparent flow of information across all borders. ■

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## THE INFORMATION SUPERHIGHWAY: GLOBAL IMPLICATIONS FROM CURRENT TEST PROJECTS

Improved communications technology and liberalization of regulatory regimes are ushering in a new age of global interconnectivity.<sup>1</sup> Nonetheless, much uncertainty exists surrounding the so-called "information superhighway" and its implementation. The variety of private and public players involved in the development of applicable technology, its content and infrastructure, heightens the complexity of the information technology (IT) arena.

A convergence of interests--business, technology, and politics--is driving the new commitment to worldwide communications. The reason for this concerted, fast-paced action is simple. Knowledge is the driving force determining competitiveness in the international economy. Reflecting views of the U.S. private sector, the Council on Competitiveness recently summed up the motivation toward urgency in this arena: "Advances in technology and the rise of international competition have made knowledge the new currency of the global economy .... To a large extent, information infrastructure will determine the comparative advantage of nations in the information age."<sup>2</sup>

To companies in the IT market, the prospects for increased sales and profits are immense. John Scully, chairman of Apple Computer Inc., predicted that by 2001 the various components of the global infrastructure would add up to an industry that is \$3.5 trillion (over half the size of the entire U.S. economy).<sup>3</sup> Consumers of IT also have much to gain. A study by the Economic Strategy Institute showed that the installation of broadband<sup>4</sup> communications technologies applicable to the

information superhighway could increase U.S. national productivity between 3.9 percent and 6.4 percent and generate between \$194 and \$321 billion of added GNP by the year 2008.<sup>5</sup> To accommodate private-sector market expansion, international policy makers are striving to provide liberalized regulatory environments. Supported by a combination of public and private efforts internationally, several test network<sup>6</sup> projects are currently underway, which are designed to serve as models for the future global information infrastructure. These projects are helping to identify opportunities and difficulties relevant to the implementation of new technologies and user applications. This article discusses the state of the information superhighway, including IT test networks and applications, progress toward global infrastructure implementation, and some preliminary findings of test applications.

### Recent Developments and Players

The United States innovated many of the original information infrastructure technologies and continues to lead the pursuit of research and development in this field.<sup>7</sup> For example, today's Internet<sup>8</sup> evolved from an open communications channel used by U.S. universities and research labs

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<sup>1</sup> The term "interconnectivity" refers to the seamless connection of technically diverse computer and telecommunication networks.

<sup>2</sup> *Industry Week*, Aug. 2, 1993, p. 34.

<sup>3</sup> *Ibid.*

<sup>4</sup> The term "broadband" is synonymous to "wideband," referring to circuits with a wider frequency bandwidth occupied by data signals (usually meaning wider than voice circuits). Faster data rates require more circuits of wider bandwidth.

<sup>5</sup> This performance level would be between 0.2 and 0.4 percent per year above the aggregate productivity growth widely expected for this period. Robert Cohen, Economic Strategy Institute (ESI), *Special Report: The Impact of Broadband Communications on the U.S. Economy and on Competitiveness*, 1992.

<sup>6</sup> Such networks are often referred to as "testbed" projects by IT specialists.

<sup>7</sup> Larry Landweber, Vice President of the Internet Society and Professor of Computer Sciences at the University of Wisconsin - Madison, telephone interview by ITC staff, Mar. 6, 1995.

<sup>8</sup> The Internet, often referred to as a "network of networks," is a global collection of networks currently located predominantly in the United States. The Internet allows users to communicate through electronic mail, to retrieve data stored in databases, and to access distant computers.

## Evolution of the Information Superhighway

beginning in the late 1960s.<sup>9</sup> Today, however, the government and educational institutions, which originally built and guided the Internet, are gradually being displaced to a large extent by commercial interests,<sup>10</sup> although the U.S. Government is actively involved in coordinating the development of information networks.<sup>11</sup>

Proponents of the information superhighway envision a national information infrastructure (NII)<sup>12</sup> as a large, interconnected resource of computers and communications networks that "enhance information access and delivery and that will be essential to the nation's economic competitiveness."<sup>13</sup> The NII is believed to have the capacity to "improve computerized support for areas that affect all Americans, such as health care, education, and manufacturing" through increased public access and efficiency.<sup>14</sup> In addition to the United States, many other countries are adopting the

NII concept and pursuing information superhighway programs.<sup>15</sup> The Global Information Infrastructure (GII) is the theoretical expansion of the NII to a worldwide, seamless<sup>16</sup> interconnection framework.<sup>17</sup> The information superhighway is proving to be the catalyst for many new and unusual private and public sector alliances globally.<sup>18</sup> These alliances hope to commercialize the IT applications currently under development. Another significant factor is that market demand for IT is driving worldwide deregulation, thereby removing nontariff barriers to international competition.<sup>19</sup> In addition to increased and diversified competition within the computer industry, information infrastructure development has attracted cable companies to offer telephone service, telephone companies to offer movies and video-game devices, and public utilities to provide "third wire"<sup>20</sup> multimedia<sup>21</sup> access links

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<sup>9</sup> Since 1990, the National Science Foundation's network (NSFNET) has become the major national U.S. research network, providing a major backbone communication service that has evolved into the National Research and Education Network (NREN).

<sup>10</sup> Cummings and Knight, "Internet Service Providers to Ride a Familiar Roller Coaster," *Business Communications Review*, Jan. 1995, pp. 67-68.

<sup>11</sup> The current administration coined the term "National Information Infrastructure" or "NII" to describe the initiative providing on demand ("any where, any time") broadband interactive communications services. This administration has created a U.S. National Information Infrastructure Advisory Council and Taskforce that unites interagency experts to coordinate policy on NII development. Their goals are to promote private-sector investment; reform communications regulation; ensure universal service; promote applications in education, health care, manufacturing, and government information; promote standards for seamless networking; ensure security and reliability; protect intellectual property rights; and improve management of the frequency spectrum.

<sup>12</sup> From a technical perspective, the NII is basically an infrastructure bearing broadband consumer and commercial applications, such as video on demand and satellite and cable television projects.

<sup>13</sup> *General Accounting Office (GAO) Report*, Nov. 4, 1994.

<sup>14</sup> *Ibid.*

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<sup>15</sup> For a comparison of U.S., European, and Japanese proposals for national information and communications infrastructures, see Office of Industries, U.S. International Trade Commission (USITC), *Global Competitiveness of the U.S. Computer Software and Service Industries*, staff research study 21, June 1995.

<sup>16</sup> "Seamless" networking refers to the connection of heterogeneous networks such that users do not perceive a difference in protocol standards employed.

<sup>17</sup> A Group of Seven ministerial-level conference on the "information society" was held on February 25-26, 1995, in Brussels. Country representatives discussed the principles and competition policies for a global information society and the plans for infrastructure development.

<sup>18</sup> For more information, see Lori Huthoefer, "Telecommunication Services: Bell Companies Act to Join Global Network Alliances," in this issue of *Industry Trade and Technology Review*.

<sup>19</sup> In addition, the 1984 Modification of Final Judgement (MFJ) ruling in the United States that barred the regional Bell holding companies from competing in other regions domestically, spurred these firms to seek partners to compete for profitable market niches abroad.

<sup>20</sup> Electric and energy companies, as well as water utilities and railways, are now successfully competing with traditional telephones and cable TV to provide communications infrastructure to the public. "Utilities and Telecoms," *The Economist*, Jan. 28, 1995, pp. 62-63.

<sup>21</sup> "Multimedia" applications use images, video, text, and sound to provide information.

internationally.<sup>22</sup> Satellite companies are also competing effectively in IT markets.

### NII Services

Three distinct, yet interwoven, layers of services comprise the NII (figure 1). These include applications for end users, middleware services, and a telecommunications network. Applications are accessible services that could include coverage of regional trade or education, information offered by a provider such as banking services, or repackaged information in an on-line<sup>23</sup> format subscribed by consumers. Middleware services are provided for use by all applications on the NII, such as directory, billing, or security services. A telecommunications network consists of both wired and wireless infrastructures and carries information from point to point via telephony, data communication, multimedia communication, or broadcasting interfaces. Users access information services (figure 2) through the information infrastructure.

### Current Information Infrastructure Test Projects

In order to research and develop advanced telecommunications infrastructure for the future, several nations have embarked upon broadband or high-speed network test projects.<sup>24</sup> Such research projects are underway on networks in the United States, Canada, Europe, Japan, Korea, Singapore, Thailand, and Vietnam.<sup>25</sup> Current research tends to focus on technological advancement and applications. In the area of technology

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<sup>22</sup> For example, public utilities in the United Kingdom have been enjoying profits in the home access market for some time.

<sup>23</sup> The term "on-line" refers to the use of information infrastructure technology, describing the use of the Internet, via such services as Prodigy, America-on-Line, and others.

<sup>24</sup> Many of these countries have chosen to use the existing Internet as the infrastructure for some of these test network projects. Other countries are developing their own infrastructure outside the Internet.

<sup>25</sup> Mui-Hoon Poh, Program Manager for the NII Division of the National Computer Board (NCB), Singapore, and Larry Landweber, Vice President of the Internet Society and Professor of Computer Sciences at the University of Wisconsin - Madison, telephone and facsimile interviews with ITC staff, Mar. 1995.

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development, researchers are pursuing improvements in linkage<sup>26</sup> quality, speed, and cost reduction. Application developments present the end user with networking capabilities in such fields as business, education, community service, medicine, and regional trade and development. For example, in the area of business applications, researchers and participants in the growing on-line business community<sup>27</sup> are seeking to improve competitive positions by streamlining sales, procurement, delivery, and financial services through real-time communications to facilitate order placement.<sup>28</sup> In addition, medical and community service applications are providing increased public access to the information infrastructure and expanded medical coverage to rural areas.

### U.S. Network Research Efforts

#### *Federal Initiatives*

In the United States, researchers are developing both technological and application advances. The extent of existing information infrastructure in the United States is vast and rapidly growing. Federal backbone<sup>29</sup> networks form the core of the existing Internet. In addition, campus or corporate networks on the Internet connect users within a university or a company. These networks may in turn be interconnected by regional networks to the NSFNET backbone that carries traffic to other regions.

The High Performance Computing Act of 1991 called for the upgrading of Federal computer networks that connect universities and Federal laboratories to "gigabit networks" by 1996.<sup>30</sup> As a result, six prototype gigabit networks are in

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<sup>26</sup> The term "linkage" here refers to what IT specialists often term "connectivity."

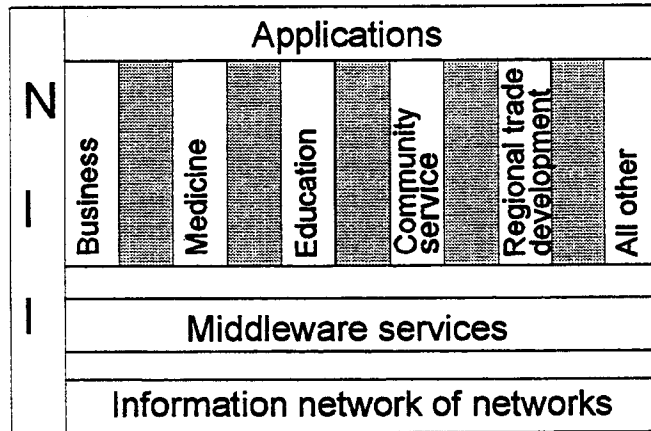
<sup>27</sup> Business use of the Internet has increased by at least 132 percent from 1993 to 1994 to 1.3 million commercial addresses. "Review of Information Technology," *Financial Times*, Mar. 1, 1995, p. 18.

<sup>28</sup> CommerceNet Project Leader, interview by ITC staff, Mar. 1, 1995.

<sup>29</sup> The term "backbone" refers to the idea of a core computer network that connects to other networks.

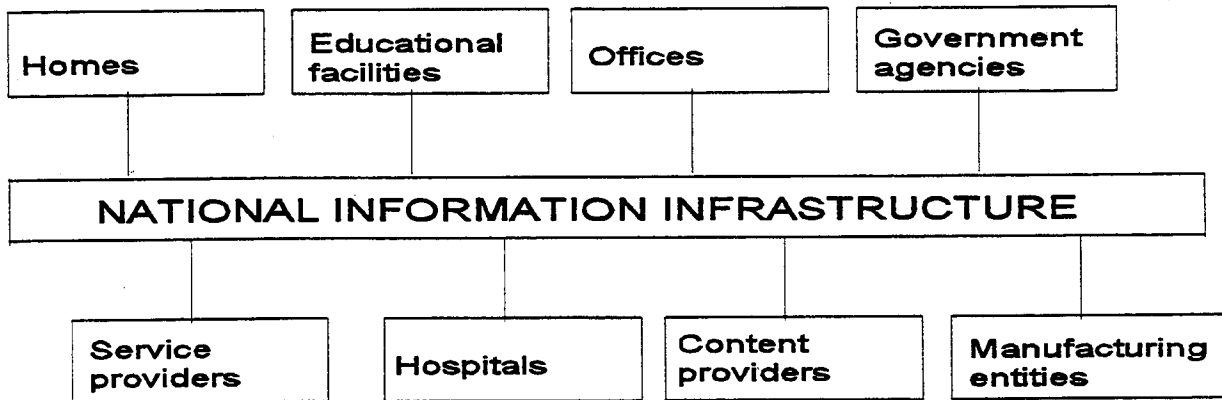
<sup>30</sup> Because such broadband networks can transmit data at one billion bits per second or more, this represents a twentyfold increase in speed over most links that currently serve the research and education community.

**Figure 1**  
Principal services components of the National Information Infrastructure (NII)



Source: Prepared by staff of the USITC from presentation by National Computer Board (Singapore) at the NECTEC Annual Conference in Thailand, Oct. 21, 1994.

**Figure 2**  
Information services accessed via the NII



Source: Prepared by staff of the USITC from presentation by National Computer Board (Singapore) at the NECTEC Annual Conference in Thailand, Oct. 21, 1994.



operation with collaborative participation and administration from the public and private sectors. These Federal High Performance Computing and Communications Initiative (HPCCI) research networks<sup>31</sup> are called AURORA, BLANCA, CASA, NECTAR, VISTAnet, and MAGIC (table 1). Each of these interactive projects typically addresses a separate set of problems related to high-speed broadband networking, such as research on advanced supercomputers, software, networks, computer science, and mathematics. Another component of the HPCCI includes the development of a National Research and Education Network (NREN) by using broadband technology. The NREN's mission is to develop from the current Internet a "network of networks" that connects users throughout the United States and around the world.<sup>32</sup> The NREN acts as a research-oriented support system and precommercialization test network for scientists and engineers in a wide array of high-bandwidth applications, such as video, multimedia, and remote, high-speed computing. An important, additional goal of the NREN is to encourage the continued private sector commercialization process of the IT applications employed, given the increased competition level of private network service providers.<sup>33</sup>

#### *State and Regional Initiatives*

In addition to Federal initiatives, the information infrastructure is also being tested at

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<sup>31</sup> Beginning in 1990 under the auspices of the HPCCI, the gigabit test networks were coordinated under a cooperative agreement with the NREN and the nonprofit Corporation for National Research Initiatives and have been co-funded by the Advanced Research Projects Agency and the National Science Foundation.

<sup>32</sup> The Internet also includes several networks that provide service on a for-profit basis. In 1991, three Internet service providers -- PSI (Reston, VA), General Atomics (San Diego), and UUNET (Falls Church, VA) -- established the Commercial Internet Exchange (CIX) to facilitate the "network of networks" nature of Internet linkage. The field of providers linking people and companies to the Internet is evolving due to recent mergers, acquisitions, and new market entries.

<sup>33</sup> Office of Technology Assessment (OTA), *Background Paper: Advanced Network Technology*, June 1993, p. 7.

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state and regional levels. For example, North Carolina has been progressive in implementing advanced telecommunications services for administrative applications--converting to a fully digital network in 1986 and initiating the first statewide information highway connecting over 100 sites in 1994 by using broadband technology.<sup>34</sup> In its first decade, the North Carolina Information Highway (NCIH) is scheduled to link more than 3,000 State government sites, providing applications focused on improving education, health care, criminal justice, economic development, and government efficiency. The NCIH is the result of a partnership between the public and private sectors in which the State government has guaranteed a level of usage that justifies the substantial investment by telephone companies in the state to build the NCIH network. To date, a wide variety of benefits has been associated with the NCIH, ranging from educational equity to economic development.<sup>35</sup> Increased savings and public safety have also been cited as results of NCIH links between the East Carolina University and the North Carolina Central Prison, which provides on-site medical attention to inmates.<sup>36</sup>

Regionally, a nonprofit initiative named Smart Valley, Inc.,<sup>37</sup> currently connects the San Francisco Bay Area via Internet providing a broad variety of collaborative pilot applications to support interconnectivity among the education, healthcare, government access, government services, commercial, community, and nonprofit sectors. Its goal is to enhance U.S. competitiveness and user quality of life by delivering the "real-world benefits of a regional version of the NII" and by serving as "a role model for the global implementation and

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<sup>34</sup> Grovenstein (GTE), Pittman (Carolina Telephone), and Smith (BellSouth Telecommunications), "The North Carolina Information Highway," 1994.

<sup>35</sup> Ibid.

<sup>36</sup> Director of the Public Relations Committee, Office of the Governor of the State of North Carolina, telephone interview by ITC staff, Mar. 7, 1995.

<sup>37</sup> Smart Valley, Inc. is affiliated with a regional economic effort called Joint Venture: Silicon Valley (JV:SV).

Table 1  
U.S. gigabit test networks

Test network	Area	Purpose	Corporate participants	Federal laboratories	Supercomputer centers	Educational facilities
AURORA	Northeast	Links universities	IBM	Not applicable	Not applicable	MIT University of Pennsylvania
BLANCA	Nationwide	Links Bell Labs to research universities	AT&T	Lawrence Berkeley	National Center for Supercomputing Applications	University of Illinois University of Wisconsin University of California Berkeley
CASA	Southwest	Supercomputing network	MCI Pacific Bell	Jet Propulsion Laboratory Los Alamos National Laboratory	San Diego Supercomputer Center	California Institute of Technology
NECTAR	Pittsburgh	Links two large LANS	Bellcore Bell Atlantic	Not applicable	Pittsburgh Supercomputer Center	Carnegie Mellon University
VISTAnet	North Carolina	Radiotherapy network	BellSouth GTE	Not applicable	North Carolina Supercomputer Center	University of North Carolina-Chapel Hill North Carolina State University
MAGIC	South Dakota Kansas Minnesota	Offers distance virtual reality research capabilities at army, government, and university sites	Sprint MITRE Digital Equipment Corp. Southwestern Bell Northern Telecom Split Rock Telecom SRI International	U.S. Army Future Battle Laboratory U.S. Army High-Performance Computing Research Center U.S. Geological Survey Lawrence Berkeley Laboratory	Minnesota Supercomputer Center	University of Kansas

Source: Prepared by USITC staff from Elsevier Advanced Technology, Profile of the Worldwide Telecommunications Industry to 1997, Oct. 1994; Office of Technology Assessment, Advanced Network Technology, June 1993.

commercialization of information technology."<sup>38</sup> For example, in March 1994, with \$6 million of defense conversion funding from the Technology Reinvestment Project (TRP),<sup>39</sup> CommerceNet<sup>40</sup> was launched to provide an information infrastructure for electronic commerce in Silicon Valley, serving primarily individuals, firms, and institutions in the electronics, financial services, computer technology, and education communities. It has been widely regarded as a successful program because of high membership-participation rates, cooperative Internet application research among members through on-line forums, and high rates of directory use to locate business partners and suppliers.<sup>41</sup>

Applications reported to improve users' quality of life include the "Smart Schools" project (in operation since February 1994) that brings the Internet and communications technologies into the schools of Santa Clara and San Mateo Counties, while public or community Internet access is provided at libraries, city and county administrative centers, and retail outlets. Smart Valley, Inc. is also involved in regional emergency planning by providing operational capabilities via the Bay Area Digital GeoResource (BADGER) project.<sup>42</sup> In addition, the Telecommuting Project offers businesses in Silicon Valley innovative ways "to maintain their competitive edge, to recruit and retain key individuals, and to enhance the quality of employees' lives through telecommuting."<sup>43</sup>

### International Test Research Efforts

Outside the United States, other countries are also pursuing NII implementation through a wide

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<sup>38</sup> Smart Valley, Inc., *Business Plan, Calendar Year 1994*, rev. May 1994.

<sup>39</sup> CommerceNet Project Leader, telephone interview by ITC staff, Mar. 1, 1995.

<sup>40</sup> The Smart Valley, Inc. project, CommerceNet, was launched in association with the California Trade and Commerce Agency and JV:SV Network.

<sup>41</sup> CommerceNet Project Leader, telephone interview by ITC staff, Mar. 1, 1995.

<sup>42</sup> BADGER applications include environmental impact reporting, hazardous materials management, utility planning and maintenance, traffic congestion management, commercial marketing, and land development.

<sup>43</sup> CommerceNet Project Leader, telephone interview by ITC staff, Mar. 1, 1995.

### Evolution of the Information Superhighway

variety of international test research network projects.

#### *Singapore IT2000*

Singapore launched its "IT2000" plan in August 1991 to "transform the nation into an Intelligent Island" by implementing information technology to "create national competitive advantages and enhance the quality of life in Singapore."<sup>44</sup> Today, this vision includes the development of an information superhighway that will facilitate information flow within the country and connect Singapore to the rest of the world. An integral portion of this program is the construction of a broadband network, designed to accommodate high-speed applications, such as telemedicine<sup>45</sup> and full-video media. Singapore's "National High Speed Network Testbed" is scheduled to be officially launched in the second quarter of 1995,<sup>46</sup> although preliminary work on this project is underway to establish collaboration among technology providers, research institutions, academia, industry users for development of high-speed network applications and architectures (middleware services). Singapore's "IT2000 Project" includes several interesting network applications that benefit the business community and the quality of users' lives. In addition to providing education and library access via public integrated networking,<sup>47</sup> the cost

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<sup>44</sup> Poh Mui Hoon, Programme Manager (Business Development) National Computer Board, Republic of Singapore, excerpt from a presentation, the NECTEC Annual Conference, Thailand, Oct. 21, 1994.

<sup>45</sup> The term "telemedicine" refers to medical applications that facilitate distant medical care via on-line communications.

<sup>46</sup> National Computer Board (NCB) manager, discussion with ITC staff, Feb. 22, 1995.

<sup>47</sup> For example, a collaborative application effort between the Ministry of Education (MOE) and the National Computer Board (NCB), called the Student and Teacher's Workbench (STW), enhances the learning environment by providing courseware using diverse media. Other such applications include the Electronic Services Booth Network, a public platform to access NII services, such as event ticketing, banking services, and electronic retailing; a Borderless Library Network, which provides continual information access to all publicly funded libraries in Singapore; and a National Smart Card designed to enhance Singapore's productivity by moving  
(continued...)

of completing business transactions in some sectors is reported to be reduced in Singapore.<sup>48</sup> For example, the Construction and Real Estate Network (CORENET) links public- and private-sector organizations in the construction and real estate industries to facilitate the exchange and processing of required documentation for regulatory approval and automation of the construction procurement process. This system is reported to reduce regulatory approval turnaround time and to decrease staffing requirements and expenses.<sup>49</sup>

#### *Other International Test Research Efforts*

In addition to Singapore, many other countries are actively pursuing NII test network research and development. In Canada, a national Advisory Council on the Information Highway, comprised of members from Canadian industry, labor, and consumer groups, advises on the building of an open and accessible information infrastructure.<sup>50</sup> Canadian national strategy includes "an interconnected and interoperable network of networks to create links between businesses and clients, communities large and small all across Canada."<sup>51</sup> For example, Canada has actively pursued both telemedicine and educational communication network applications in recent years. In Japan, the Government is investing in a multibillion dollar communications network to connect every home and business with optical fibers by the year 2010.<sup>52</sup> Nippon Telephone and Telegraph and a consortium of private companies currently are linking cable television networks and telecommunications systems to provide a wide range of multimedia services. In addition, as a part of Japan's "Frontier Research in

Telecommunications" project, advanced networking and application research is being conducted in the areas of high-speed and high-performance telecommunications and of biological informatics.<sup>53</sup> In the European Union, much attention is focused on efforts to join the global information society.<sup>54</sup> While narrowband Integrated Service Digital Network (ISDN) development has proceeded within the EU for some time, efforts are underway to research and develop integrated ATM broadband infrastructure to provide multimedia services.<sup>55</sup> In addition, the Group of Seven (G7) are expressing interest in working together to develop international broadband networks.<sup>56</sup>

#### **Implications and Outlook**

Immense technological gains have been made in recent years in the fields of high-speed connectivity and multimedia applications, as demonstrated by improved speed and performance of broadband test networks and by increased usage of video, voice, and data applications. Further,

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<sup>53</sup> The term biological informatics refers to computer researching in the field of biology, often with medical applications. Ministry of Posts and Telecommunications, Annual Report, Japan, 1993, p. 47.

<sup>54</sup> The Bangemann Report presented in Corfu to the European Council in June 1994 states the intentions of the EU "to advance as part of the global information society." See High-level Group on the Information Society Report to the European Council, Brussels, May 26, 1994.

<sup>55</sup> Although several European countries, particularly Germany and France, currently have highly developed broadband distribution capabilities, the EU debates as to whether member states should continue to pursue information infrastructure alone or in concert. As of July 1994, 18 European public network operators were involved in integrated broadband communications (IBC) within the EU. At present, the European Commission is encouraging the creation of a European Broadband Steering Committee. For more information, see "Europe's Way to the Information Society, An Action Plan," European Commission, Brussels, July 19, 1994.

<sup>56</sup> Regarding the G7 Information Society Conference in Brussels, the European Commission President, Jacques Santer, said in a statement issued February 21, 1995, that he hoped "around ten projects will be agreed by the G7 partners" covering issues such as R&D cooperation and interconnection and interoperability of broadband networks internationally.

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<sup>47</sup> (...continued)

toward a cashless transaction society.

<sup>48</sup> Poh Mui Hoon, Programme Manager (Business Development) National Computer Board, Republic of Singapore, presentation, the NECTEC Annual Conference, Thailand, Oct. 21, 1994.

<sup>49</sup> Ibid.

<sup>50</sup> U.S. Patent and Trademark Office, 1993, quoted in survey compiled by NIID Policy & Survey Research Group, Singapore, 1994.

<sup>51</sup> Ibid.

<sup>52</sup> Survey compiled by NIID Policy & Survey Research Group, Singapore, 1994.

advances in network applications are improving productivity<sup>57</sup> and, therefore, competitiveness at the company,<sup>58</sup> industry, and national levels. In addition, the information infrastructure applications in education, healthcare, and telecommuting appear to be improving the quality of life through increasing human capital, wellness, and leisure time.

Despite these accomplishments, NII and GII expansion still must overcome some hurdles. For example, funding is a primary concern. In the United States alone, it has been estimated that, over a period of 10 years, approximately \$350 billion will be required to fund the NII.<sup>59</sup> The Federal Government expects to provide very limited funds (about \$1 billion annually) in continued support of the HPCCI. The remainder of U.S. investment in information technology will come from the private sector, mainly from regional Bell operating companies and cable companies.<sup>60</sup> Consumers will also bear some of the expense. Despite future economies of scale from increases in information infrastructure users, developers of the NII may pass some costs to consumers through a monthly or per use service fee despite current calls for free universal service.

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<sup>57</sup> "Technology-driven" and "early technology user" industries are estimated to enjoy higher rates of productivity than "later technology users" do, Robert Cohen, Economic Strategy Institute (ESI), *Special Report: The Impact of Broadband Communications on the U.S. Economy and on Competitiveness, 1992*.

<sup>58</sup> It is interesting to note that small businesses are predicted to increase their competitiveness significantly vis a vis larger businesses because the expense involved in accessing the NII is relatively minor once a company has invested in the necessary hardware.

<sup>59</sup> Robin Gaster, *The National Information Infrastructure: A Preliminary Report*, North Atlantic Research, Inc., Mar. 1994, p. 24.

<sup>60</sup> *Ibid.*

## Evolution of the Information Superhighway

Additional challenges to overcome in the ongoing development and implementation of national and global information infrastructures include infrastructure liberalization, standardization of computer protocols and other items to provide interconnection and interoperability of networks, global tariff adjustments, intellectual property rights, training, privacy, and security issues.

Although each nation may differ in its NII implementation method, for the most part, each has the same motivation, namely, the promise of new national competitive edge and of better quality of life for its people. Yet, the international pace of information technology advancement is extraordinary. Therefore, countries, such as the United States, which pool research and commercialization efforts of the public, private, and educational sectors, will most likely continue to lead in R&D efforts in IT fields and to set the standards for those who follow.<sup>61</sup> ■

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<sup>61</sup> As the European Commission declared recently on the urgency of this issue: "The race is on at the global level, notably in the United States and Japan. Those countries which will adapt themselves most readily will de facto set technological standards for those who follow." European Commission, "Europe's Way to the Information Society: An Action Plan," Brussels, July 19, 1994.



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**DIRECT IRONMAKING:  
A CASE STUDY IN GOVERNMENT AND INDUSTRY COOPERATION  
TO COMMERCIALIZE NEW MANUFACTURING PROCESSES FOR MATERIALS**

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*About this article...*

*The commercialization of new technology is considered an important factor in improving the competitiveness of national industries. This is the second article in a series of ongoing USITC Office of Industries research on the commercialization of new manufacturing processes for materials (NMPM). NMPM are viewed as potentially cost-effective means of ensuring increased productivity and efficiency.*

*This article examines a U.S. government-industry project to develop and commercialize one such NMPM—direct ironmaking. This process eliminates the traditional and increasingly expensive coke processing element of steelmaking, which is considered important to improving the competitiveness of the U.S. steel industry. This article explores key factors affecting commercialization of direct ironmaking, the role of industry and government institutions involved in its research and development, the status of competing processes abroad, and the result of the joint project.*

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**Note:**

A glossary of technical terms and abbreviations appears at the end of this article.

Increasing competition abroad and rising costs at home have spurred efforts by the U.S. steel industry to develop and commercialize new technologies that will increase efficiency and productivity, lower production costs, and improve material characteristics. A recently concluded 5-year pilot project funded by the U.S. Department of Energy (DOE) and the American Iron and Steel Institute (AISI) explored the technical and

economic viability of direct ironmaking,<sup>1</sup> pursuing a process based on bath smelting.<sup>2</sup> The consensus of the domestic and international steel industry is that bath smelting is the prime technology of the future of high quality iron production for steelmaking.<sup>3</sup> The joint project to develop direct ironmaking in the United States is one of several efforts underway worldwide to incorporate the smelting technology into the steelmaking process.

The purpose of the AISI-DOE direct ironmaking project was to develop a cost-effective, efficient, and environmentally safe technology that will reduce costs and, in the long run, increase the productivity of steel producers. For the integrated steelmaker, the blast furnace is the primary vehicle for producing molten iron, of which coke<sup>4</sup> is a major input. As metallurgical coal reserves in the United States declined and the costs associated with cokemaking rose, steelmakers began to pursue the

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<sup>1</sup> The phrase "direct steelmaking" is often used interchangeably with the term "direct ironmaking." Because products resulting from this process are expected to be high carbon iron, not steel, this article will refer to the process as "direct ironmaking."

<sup>2</sup> In bath smelting, oxygen, prereduced iron ore pellets, coal and flux are charged into a molten slag bath containing a high percentage of carbon. Slag is an accumulation of the impurities released from the ore that collect on the surface of the bath during smelting. The carbon removes oxygen from the iron ore and generates carbon monoxide and liquid iron. Oxygen is then injected to burn some of the carbon monoxide gas before it leaves the smelting vessel (post combustion). The heat from the burning gas then generates a portion of the energy used in the reduction of the ore in the bath. The partially combusted gas is used to preheat and prereduce the ore, which means removing a portion of the oxygen content before the ore is injected into the bath. American Iron and Steel Institute, *Direct Steelmaking Program*, AISI, p. 4.

<sup>3</sup> Paul Millbank. "Direct Route To Iron Gathers Momentum," *Metal Bulletin Monthly Supplement*, Apr. 1995, p. 24.

<sup>4</sup> Coke is a lumpy, porous form of carbon produced by the baking of coal to drive off its volatile elements.

direct use of coal in ironmaking, including pulverized coal injection (PCI) in blast furnaces. These methods can partially reduce the amount of coke needed to produce iron (known as the coke rate), whereas cokeless bath smelting technology would replace coke altogether.

There are several reasons the direct ironmaking project was initiated. The American steel industry is facing potential capital investment costs, running into billions of dollars, as a large portion of its cokemaking capacity nears the end of its design life. Increasingly stringent environmental regulations<sup>5</sup> have raised both the capital and operating costs of coke oven batteries, generating the need to explore technologies that would eliminate this step from the integrated steelmaking process. A description of the past, current, and anticipated future processing methods of steelmaking are outlined in figure 1.

Foreign steel industries, facing similar challenges, have also pursued research in the area of direct ironmaking technology, and two have been identified as front-runners in the race to commercialize the technology: Corex, which has already been commercialized by Austria's Voest-Alpine Industrieanlagenbau (VAI), and DIOS of Japan. The status of these technologies is discussed later.

The challenge for these new processes, however, is that adoption by the industry depends not only on the technical proficiency of the new technology, but also on proven, significant potential for economic advantage over the traditional coke oven or blast furnace method.

Confirming that these two criteria were achievable through the direct ironmaking process was the goal of the AISI-DOE pilot project.

DOE's involvement in this project was made possible through legislation known as the Steel Initiative of 1986.<sup>6</sup> This legislation was a result of

proposals by the President's Council on Industrial Competitiveness to support joint research efforts by the industry and national laboratories. The substance of the bill was developed by a DOE-AISI joint task force, and mandates that costs of research and development of new technology be shared toward achieving the purpose of saving energy, increasing competitiveness, and generating benefits for the entire industry.

The DOE-AISI collaboration is an example of government involvement to enhance the competitiveness of U.S. industries through cooperative technology development. The effort to develop the direct ironmaking process for commercial use demonstrates a convergence of interests, and is unique in light of multiple company-industry-government cooperation and the role of environmental regulation driving new process adoption. The results of the joint AISI-DOE direct ironmaking program have direct implications not only for future government-industry cooperative initiatives in steel production but for the ability of the U.S. steel industry to compete in the global marketplace.

#### *DOE-AISI Pilot Project*

In 1987, AISI assembled a task force to select the process most likely to improve competitiveness of the U.S. steel industry and to outline a program of research and development to facilitate rapid implementation of the technology. After an extensive review of cokeless iron and steelmaking technologies that were already under development worldwide, the task force concluded that future steelmaking should be based on a coke-free,

<sup>5</sup> The 1990 amendments to the Clean Air Act tightened regulations on coke oven emissions.

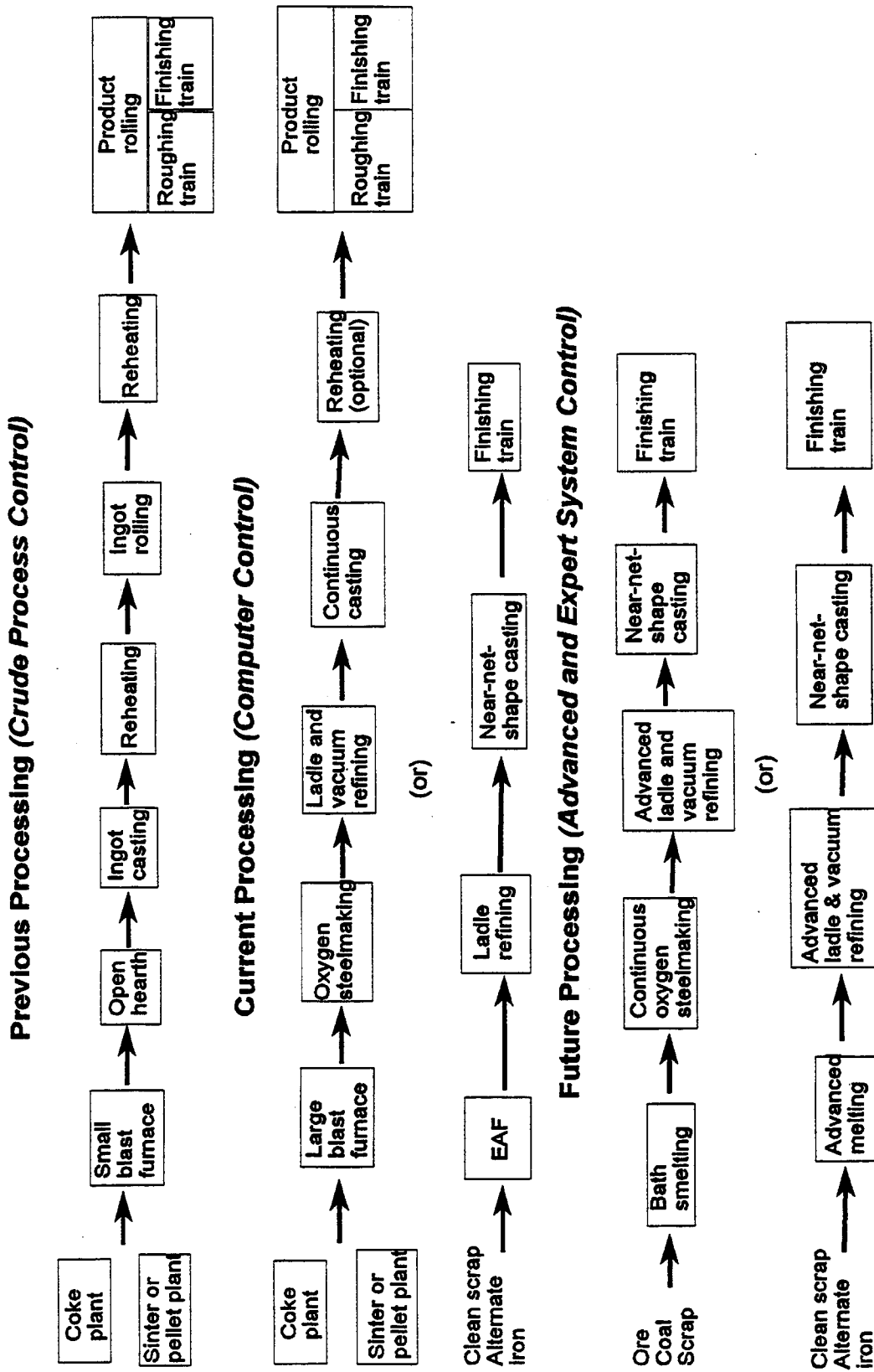
<sup>6</sup> The Metals Initiative Program of 1988, which was created by the Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988, augments the Steel Initiative by expanding its mandate to encompass a wider variety of metals. Its purpose is (continued...)

<sup>6</sup> (...continued)

twofold: (1) to "increase the energy efficiency and enhance the competitiveness of American steel, aluminum and copper industries...; and (2) to continue steel research and development efforts begun under the Department of Energy (DOE) program known as the Steel Initiative." *Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988 Annual Report* (Washington, DC: U.S. Department of Energy, Feb. 1990).



**Figure 1**  
**Past, current, and anticipated steelmaking processing methods**



Source: Based on Fruehan, R.J., "Challenges and Opportunities in the Steel Industry," *Iron and Steelmaker*, Mar. 3, 1993, p. 59.

coal-based bath smelting process for the production of the hot metal that is subsequently refined to steel.<sup>7</sup> However, the task force determined that foreign technologies under development did not adequately meet certain requirements of the North American steel producer, including<sup>8</sup> a coal-based operation that utilized pelletized iron ore feed<sup>9</sup>, a process that maintained the flexibility to melt scrap as well as the ability to generate excess energy for other uses, and a process that resulted in substantial reductions in capital and operating costs. As a result, the task force recommended that AISI propose a research and development program for joint funding by the industry and DOE. Two years of proposal development and assessment were involved before work on the DOE-AISI program actually began in November 1988. The chronology of project development is outlined in table 1.

#### Management and Funding

The projected budget of the joint AISI-DOE project was \$30 million for 3 years. Subsequent amendments extended the project to March 31, 1994, a total of 5 1/2 years, with a total cost of \$60.3 million. DOE provided \$46.3 million (77 percent), while AISI provided the remaining \$13.9 million (23 percent).

Cooperating organizations provided services, personnel, equipment, and technical expertise to the project. Research encompassed three coordinated efforts: university research<sup>10</sup> on pellet-slag-coal

Table 1

#### Chronology of project development

Apr. 1987	DOE issues Steel Initiative Management Plan, which provides a framework for implementation of research programs, and follows with a research plan identifying a number of key areas where the steel industry could benefit from advanced technology, including direct ironmaking.
Aug. 1987	AISI assembles a task force to explore existing domestic and foreign technologies that could be further developed to enhance the U.S. steel industry's competitiveness.
July 1988	AISI submits a research proposal to the DOE for development of a direct ironmaking process.
Nov. 1988	Work begins on the AISI-DOE direct ironmaking project.
Dec. 1988	On recommendation from the House Committee on Science, Space and Technology, Congress enacts an amendment to the Steel Initiative, which substantially increased funding of the direct ironmaking project.
May 1989	The AISI-DOE Cooperative Agreement for the direct ironmaking project is approved by the DOE.

Source: AISI.

<sup>7</sup> Egil Aukrust, *AISI Direct Steelmaking Program Final Technical Report*, U.S. Department of Commerce, Technology Administration, National Technical Information Service, Springfield, VA, Aug. 1994, p. 2.

<sup>8</sup> J.M. Farley and P.J. Koros, *AISI-DOE Direct Steelmaking Program*, AISI, Jan. 30, 1992, p. 1.

<sup>9</sup> There is a large, modern installed capacity for production and transport of pellets in North America. According to statistics compiled by *Skilling's Mining Review* (July 30, 1994), total U.S. and Canadian iron ore pellet plant production in 1993 was 73.7 million metric tons, with an estimated 9 percent increase in 1994 to 80.3 million metric tons. Total annual capacity is 87.1 million metric tons.

<sup>10</sup> Research related to the program was conducted at Carnegie Mellon University (CMU), Massachusetts Institute of Technology (MIT), University of British (continued...)

reactions; industrial research<sup>11</sup> on prereduction, BOF postcombustion, and heat transfer; and research conducted at the pilot plant to experiment

<sup>10</sup> (...continued)

Columbia (UBC), McGill University (McG), McMaster University (MU), and at the U.S. Steel (USS) and the Union Carbide Industrial Gases Technical Centers. Farley and Koros, *AISI-DOE Direct Steelmaking Program*, pp. 2-3.

<sup>11</sup> Involved organizations included International Business Machines (IBM), North American Refractories Co. (NARCO), Linde Industrial Gases, EG&G, U.S. Steel and Dofasco Steel, Inc., among others.

at the 15 ton scale with process performance. No national laboratories were involved in this project.<sup>12</sup>

A Technical Advisory Committee consisting of senior professional personnel from the steel industry was created to oversee technical issues and to provide individual project managers.<sup>13</sup> The pilot plant was located at a donated U.S. Steel site in Universal, Pennsylvania, under the management of the AISI through a board of directors composed primarily of industry experts from the various AISI member companies. DOE maintained a significant involvement in the project through its membership on the board, its review of all technical activities, and its joint effort with AISI in developing detailed progress reports on the project. The relationships are depicted in figure 2.

### Foreign Government Support of Competing Technologies

There are several competing cokeless ironmaking processes that are in various stages of development around the world. A brief comparison of these processes and of their current status provides a useful perspective on which to gauge the progress and objectives of the AISI-DOE research initiative. The principal competing foreign technologies include the Corex process, DIOS (direct iron ore smelting), HISMelt, and Jupiter. The development of these direct ironmaking processes have benefitted from foreign government involvement to varying degrees.

#### *Corex*

The Corex process<sup>14</sup> was developed when gas prices increased significantly at the end of the 1970s. As a result, interest in natural gas-based

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<sup>12</sup> Egil Aukrust, AISI, conversation with USITC staff, Mar. 13, 1995.

<sup>13</sup> Farley and Koros, p. 3.

<sup>14</sup> Corex utilizes a dual chamber operation where solid iron ore is reduced in the upper chamber and then melted in the lower chamber where coal and oxygen are generating heat and reducing gases. Because the reactions are compartmentalized, coke is no longer needed to provide burden support. In addition, lower grade coals and ores, which are more readily available worldwide, can be utilized.

iron ore reduction processes waned, and interest in coal-based processes increased.

Development of Corex started in 1981 and is currently the only proven, commercialized direct liquid ironmaking technology. The Austrian and German Governments reportedly funded the pilot plant in full, but the terms are unclear.<sup>15</sup>

Corex has been in commercial use since December 1989<sup>16</sup> when ISCOR, the South African steel producer, brought a 300,000 million ton per year (tpy) facility on line. Pohang Iron and Steel Company (POSCO) of South Korea subsequently began construction of a Corex plant in late 1992 (startup scheduled for late 1995) with an annual capacity of 700,000 million tpy, effectively moving the Corex process into higher volume iron production. At present, Voest Alpine has received new orders from Turkey, India, and Korea<sup>17</sup> for plants with production capacity up to 600,000 tpy, and there is reported significant interest by the former Communist countries.<sup>18</sup>

The Corex process in the United States may get financial support from the DOE. Airproducts and Chemicals Inc., Centerior Energy Corp., and Geneva Steel Co. plan to jointly invest money in a Corex ironmaking plant to be built at Geneva's Vineyard, Utah mill, which will produce 3,000-3,200 tons per day of hot metal and generate 250 megawatts of electricity from byproduct gases. The Department of Energy, through its Clean Coal Technology program, had originally approved partial funding for a Corex installation at another

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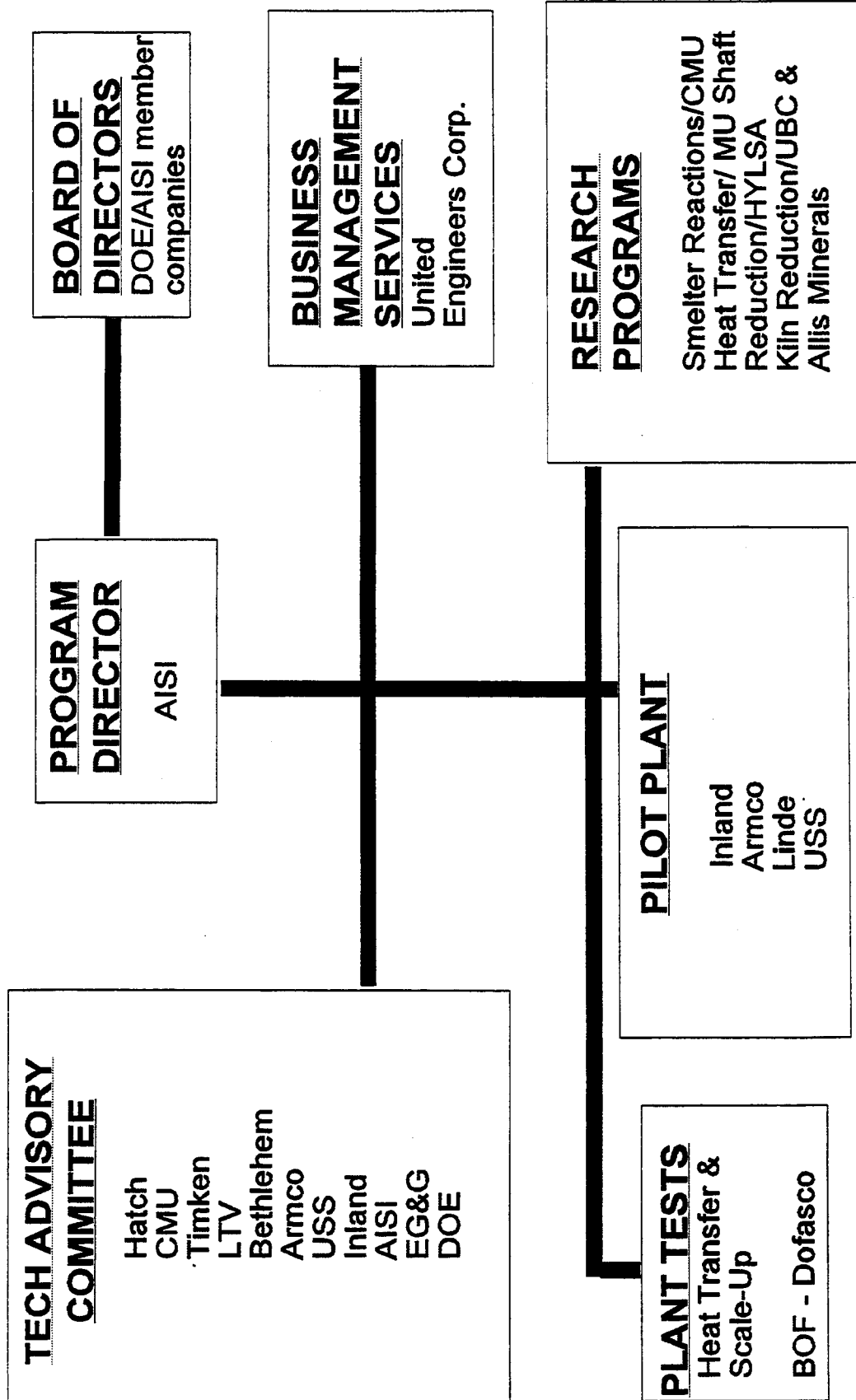
<sup>15</sup> Former Korf official, interviewed by USITC staff, Apr. 28, 1995.

<sup>16</sup> Official of the Robert Westman Co., U.S. licensee for Corex, phone interview with USITC staff, Mar. 22, 1995.

<sup>17</sup> India's Jindal Group placed an order last July for a 640,000 tpy Corex plant to be built in Karnataka state to serve a new hot rolled steel plant, and a letter of intent has been signed for a second unit. The first is expected to be in operation by late 1997. A month after the Jindal order, South Korea's Hanbo Steel and General Construction ordered two 750,000 tpy Corex plants; startup is expected in mid-1997.

<sup>18</sup> "The Impact of Changes in the Iron and Steel Industry on Coal-tar Production from Coke Ovens," *Steel Times*, May 1994, p. 175.

**Figure 2**  
**Framework of Program Management for DOE-AISI Direct Ironmaking Project**



Source: Farley and Koros, p. 8.

steelmaker's facility. The Geneva plan envisions the DOE contributing \$150 million of the project's \$825 million total cost. The partners must obtain DOE approval to relocate<sup>19</sup> the project to Utah, however, and negotiate the Department's cooperative role. Negotiations, presently underway, are expected to conclude in July, 1995. A 1999 operational start-up date is expected.<sup>20</sup>

### DIOS

The DIOS process<sup>21</sup> has been the subject of cooperative research between the Japan Iron and Steel Federation (JISF), Japan's eight integrated steelmakers, and the Center for Coal Utilization in Japan. According to the Japan Iron and Steel Federation, the research project has been supported since 1988 with subsidies and aid by the Ministry of International Trade and Industry (MITI).<sup>22</sup> The 7-year project was budgeted at 13 billion yen (approximately \$100 million), two-thirds of which was provided by MITI.<sup>23</sup> In developing the DIOS process, JISF has been holding technology exchange meetings with counterparts of various countries in an attempt to foster international cooperation in the technology development process.<sup>24</sup>

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<sup>19</sup> DOE had originally approved funding to help install a Corex reactor at LTV Steel Company's Cleveland (OH) Works. However, LTV's plans were tabled in 1994 reportedly because earnings projections on electricity were not satisfactory. "Geneva, At Last, May Get Corex," *33 Metalproducing*, Nov. 1994, p. 9.

<sup>20</sup> Dr. Lowell Miller, Associate Deputy Assistant Secretary, Clean Coal Technology Program, phone interview with USITC staff, May 17, 1995.

<sup>21</sup> The DIOS process uses pressure to retard gas velocity, cut coal consumption, and promote carbon monoxide combustion. Ore pellets are fed into a fluidized bed reduction furnace at the same time that coal is injected through the bottom. Partially reduced ore and tar then move into a smelting furnace that is fed coal and oxygen simultaneously.

<sup>22</sup> "Research On A Next-Generation Ironmaking Process," *Steel Today and Tomorrow*, July-Sept. 1994, p. 7.

<sup>23</sup> Representative of the Japan Steel Information Center, interviewed by USITC staff, Mar. 21, 1995.

<sup>24</sup> "Research On A Next-Generation Ironmaking Process" *Steel Today and Tomorrow*, p. 8.

Operations at the 500 tpd pilot plant at NKK Keihan's works began in December 1993 and will run through 1995, at which time a formal assessment will be made by the participating companies as to the success of the project. According to JISF, the DIOS process is expected to reduce costs by about 10 percent and to cut carbon dioxide emissions 5 to 10 percent compared with blast furnace ironmaking. Other anticipated benefits include the direct use of nonmetallurgical coal for greater flexibility in selecting resources (Japan has no metallurgical coal reserves) and facility and energy cost reductions because of the elimination of the iron ore sintering and cokemaking processes. Full commercialization of DIOS is expected by the year 2000.

### Hismelt

The Australian company CRA Ltd. and Midrex Corporation of North Carolina formed a 50-50 joint venture in 1989 to develop a direct smelting process, known as Hismelt.<sup>25</sup> These partners have spent approximately \$200 million developing the process, including the construction of a 150,000 tpy demonstration plant at the Hismelt Research and Development in Kwinana, Western Australia. Hismelt has been entirely financed by the two partners, without any government support.<sup>26</sup> Hismelt is ideal for Australian steel producers because it is suited to Australia's Pilbara iron ores, and for iron production using low-cost iron ones and nonmetallurgical coals.

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<sup>25</sup> Hismelt uses a circulating fluid bed reactor for preheating and prereluction. Hot blast air is used for the initial combustion of the coal because the nitrogen in the air is believed to promote heat transfer and to control postcombustion temperatures. Smelting begins with the bottom injection of coal which is dissolved in the bath. The dissolved carbon is used to reduce the iron ore, releasing carbon monoxide which is post-combusted by injecting oxygen in the bath.

<sup>26</sup> Official of Midrex Corp., interviewed by USITC staff, Mar. 21, 1995.

*Jupiter*

The European program, Jupiter,<sup>27</sup> was the result of an initiative started in 1989 by the French steelmaker Usinor-Sacilor looking for a smelting reduction process to supply virgin metal to electric steelmaking plants. The development of the Jupiter concept was supported by research work by IRSID (Usinor-Sacilor Process Research Center). Jupiter received partial funding from the European Coal and Steel Community (ECSC), a predecessor to the European Union.<sup>28</sup> The remainder of the financial support was generated by the three European companies: Usinor, Lurgi, and Thyssen Stahl. Although demonstration of the feasibility of the reduction process on a pilot plant scale was under discussion, the Jupiter program was apparently abandoned last year.

**Research Goals and Results**

AISI directed its research efforts in the direct ironmaking project to address perceived deficiencies in the other technologies being developed abroad. For example, the AISI task force had determined that the most advanced process, Corex, which was operating on a demonstration basis in South Africa at the time, was inadequate since it did not employ the post-combustion process needed to ensure thermal balance. In addition, the economic viability of the Corex process, largely based on the significant byproduct production of low-BTU gas, was questioned by the task force.<sup>29</sup>

The AISI-DOE project sought to develop optimum designs and operating techniques for the smelter and associated equipment as well as to solve engineering problems involved in making the process work economically on a commercial scale.<sup>30</sup> AISI initially expected that its process would have reduced direct operating costs by \$10 to \$25 per ton of steel produced, compared to the present coke oven-blast furnace-basic oxygen furnace technology. The energy cost savings are estimated at about 20 percent.<sup>31</sup>

In addition, AISI believed that its research had potential for application by minimill producers using the electric arc furnace (EAF), which account for almost 40 percent of the steel produced in the United States today and 31 percent of steel produced worldwide.<sup>32</sup> AISI's direct ironmaking process was intended to enable the iron to cast into "pigs" that could compete economically as input in EAF production with high-quality scrap, which is becoming more scarce worldwide.

The joint AISI-DOE direct ironmaking project ended in March, 1994, revealing a gap between the actual results obtained at the pilot plant and the established goals for productivity and fuel rate. This gap, which affects both capital and operating costs, is estimated to be approximately 40 percent in the case of high volatile coals. Nevertheless, AISI expressed optimism that the gap can be closed by addressing the deficient aspects of the process.<sup>33</sup> These include improved distribution of oxygen through the application of side-blown tuyeres,<sup>34</sup> better distribution of raw materials in the reaction vessel, the use of newly developed sensors to measure foam height and to observe char distribution and behavior within the pressurized

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<sup>27</sup> The Jupiter process is unique in that coal gasification occurs in the reduction process (the others are based on the gasification of coal in the smelting reaction and on the direct use of the resulting gas in the reduction, both reactors being physically and metallurgically linked), and, therefore, secures the reducing gas and energy requirements. In this first step, it delivers a mixture of directly reduced iron and char, which is used in a melting process using both fossil fuel (residual char) and electric energy. The resulting gas from melting is thus not used for reduction.

<sup>28</sup> Funds for ECSC research grants are drawn from monies collected from producers via a tonnage-based production levy.

<sup>29</sup> AISI, *Direct Steelmaking Program*, p. 4.

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<sup>30</sup> Ibid.

<sup>31</sup> Ibid, p. 2.

<sup>32</sup> International Iron and Steel Institute, *Steel Statistical Yearbook 1994*, Committee on Statistics, Brussels, 1994, pp. 12-13.

<sup>33</sup> American Iron and Steel Institute, "AISI Direct Steelmaking Findings Encouraging, Lead to New Research on Waste Oxide Recycling," press release, AISI, Washington, DC, May 18, 1994, p. 1.

<sup>34</sup> The nozzles through which the hot blast of air is directed into the smelting vessel.

vessel, and cooperative information exchanges with other smelting programs.<sup>35</sup>

According to AISI's final technical report, the pilot plant project indicates that the process fundamentals, on which the joint program was initiated, are valid. Further, it notes that despite the shortfalls, several steel companies view the results to be sufficiently encouraging to consider building a demonstration plant.<sup>36</sup> Comparative savings in the capital and operating costs for the coke oven-blast furnace and AISI processes of ironmaking are projected to be in excess of ten percent.<sup>37</sup> A comparison of relevant costs is reflected in table 2.

Table 2  
 Projected cost advantages of AISI's direct ironmaking process v. existing coke oven/blast furnace<sup>1</sup>

Basis	Coke oven/ blast furnace	AISI process
<u>Dollars per annual metric ton</u>		
Capital costs.....	243	160
<u>Metric tons per day per cubic meter</u>		
Production intensity.....	1.0	4.6
<u>Dollars per metric ton</u>		
Operating costs.....	131	120

<sup>1</sup> Costs are per annual metric ton of hot metal based on plants with hot metal capacity of one million metric tons per year.

Source: Aukrust, AISI Direct Steelmaking Program, pp. 139-40.

The reported significant cost advantage of the AISI process derives in part from its much greater process intensity. These data reflect the much smaller size of the AISI smelter compared with other units of similar production capacity, which substantially reduces construction costs. Finally,

<sup>35</sup> S.M. Nelko, "Final Report on AISI-DOE Direct Steelmaking Program," *Iron and Steelmaker*, Aug. 1994, p. 8.

<sup>36</sup> Aukrust, *AISI Direct Steelmaking Program Final Technical Report*, p. 8.

<sup>37</sup> *Ibid.*, p. 1.

with regard to the variable operating cost estimates for the two processes, certain cost factors could further decrease the AISI cost by up to \$5 per metric ton through scaleup or maturation.<sup>38</sup>

Based on the findings of the direct ironmaking pilot project, AISI and DOE launched another cooperative pilot project, the Steel Plant Waste Oxide Recycling and Resource Recovery by Smelting Program in April, 1994, to determine the feasibility of converting steel plant waste to pig iron for use in steelmaking or foundry industries. According to AISI, the steel industry currently generates three million tons of blast furnace and basic oxygen furnace dusts and one half-million tons of rolling mill sludge each year. The Waste Oxide project is aimed at recovering these wastes, most of which are currently disposed of in landfills, a process that is growing increasingly expensive. Further, it is estimated that widespread recycling of steel plant wastes could save 10 trillion BTU of energy per year.<sup>39</sup>

The Waste Oxide project further broadens and enhances the basic smelting technology developed by the direct ironmaking project. It is directed by the same AISI team and uses the same pilot plant built for the direct iron smelting project. DOE is providing 70 percent of the project's \$7 million cost,<sup>40</sup> and AISI members are responsible for the remaining 30 percent. AISI's portion is funded on an elective basis by 13 of its member companies.<sup>41</sup>

<sup>38</sup> The estimated costs include stirring the bath with nitrogen. It is expected that nitrogen will eventually be replaced with air, at a savings of \$1.40 per metric ton. Other items, including better hot metal desulfurization and the substitution of fluxes, could result in additional savings, according to AISI.

<sup>39</sup> American Iron and Steel Institute, "Waste Oxide Recycling Demonstration Weighed as Pilot Project Successfully Concluded," press release, Jan. 30, 1995.

<sup>40</sup> Like the direct ironmaking project, the DOE's contribution of the waste oxide project is funded by the Metals Initiative.

<sup>41</sup> They include Acme Metals, Cleveland-Cliffs, Geneva Steel, Georgetown Industries, HARSCO, Inland Steel, LTV Steel, Lukens, National Steel, Rouge Steel, Stelco, USS Kobe, and USX. Additional financial assistance will be provided by principal subcontractors and suppliers, including Mannesmann Demag, Hatch Associates, and NARCO Research.

In January, 1995, AISI announced that the waste oxide pilot project had been successfully completed, laying the groundwork for a possible commercial demonstration project. Project directors determined in December that no further trials were required, ending the project 2 months ahead of schedule. The engineering firm of Mannesman DeMag was commissioned to work with AISI on conducting a feasibility study of the economic returns of a full-scale demonstration project for the waste oxide technology.<sup>42</sup> If the feasibility study shows that the process is expected to be viable commercially, AISI will proceed with a proposal to fund the demonstration plant.

### Conclusions

Confirming the potential for the direct ironmaking process examined by AISI-DOE to clearly achieve economic advantages and technical proficiency over existing production methods--the two primary goals of the pilot project--was not sufficiently demonstrated to justify commercialization without further research. However, significant knowledge was gained from laboratory and pilot testing<sup>43</sup> to enable researchers to learn how to optimize the direct ironmaking process and to provide the foundation for future research.<sup>44</sup> Major obstacles stand in the way of the

commercialization and the subsequent adoption of the DOE-AISI, or of any other, direct ironmaking process in the United States, including the level of capital investment that would be required. Given the capital intensity of the modern steel industry, new technologies must ensure a net reduction in cost over the existing process. This has not been proven definitively by the DOE-AISI pilot project.

Although the direct ironmaking project has not proven the economic feasibility of the technology in terms of commercialization, it launched a new step in developing bath smelting for ferrous products, which, as it turns out, will be viable in a wider range of applications, as exemplified by the waste oxide project. The success of the joint AISI-DOE Steel Plant Waste Oxide Recycling and Resource Recovery by Smelting Program, which was spawned by the direct ironmaking project, indicates the value of the basic research which facilitated the development of bath smelting technology to a stage where it could serve as a foundation to launch the new project. It is possible the new information learned during the research trials conducted at the waste oxide pilot plant could further the development of the direct ironmaking process if the project is revisited at a future time. AISI has not announced any specific time frame, however, on this score.

The administrative partnership between the government and the industry seems to have worked well. The industry was able to proceed with research important to its future and leveraged its investment almost three-fold. The joint project lends support to the concept that government-industry cooperation can contribute positively to the drive to increase the competitiveness of the domestic steel industry. ■

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<sup>42</sup> The feasibility study will quantify the potential economic return on a smelter at the Lake Erie Works plant of Stelco and should provide the information necessary for proceeding with a proposal for a demonstration plant by the spring of 1995, according to AISI. The smelter would be designed to process about 600,000 tpy of waste oxides and to produce about 250,000 tons of hot metal per year.

<sup>43</sup> Researchers have learned how to optimize the direct ironmaking process by understanding better such issues as the dissolution of materials, reduction mechanisms and rates, slag foaming and control, the behavior of sulfur, dust generation, and the entire question of energy efficiency--including postcombustion and the role of coal volatile matter.

<sup>44</sup> Aukrust, *AISI Direct Steelmaking Program Final Technical Report*, p. 9.



Glossary of Terms<sup>1</sup>

<b>BOF</b>	Basic Oxygen Furnace. The chief method of producing steel. The furnace is charged with molten iron from a blast furnace and steel scrap. Oxygen is blown into the furnace at high velocity to speed combustion and refine the iron and scrap.
<b>Blast furnace</b>	Cylindrical steel vessel, lined with heat-resistance brick, which, once charged with coke, iron ore, and limestone and heated, produces molten iron for further refining in a steelmaking furnace.
<b>Coke</b>	A lumpy, porous form of carbon produced by the baking of coal to drive off its volatile elements so that the fixed carbon and the ash are fused together.
<b>EAF</b>	Electric Arc Furnace. A furnace in which iron and steel scrap, limestone, and other additives are melted and converted to steel. Heat supplied by an electric arc melts and refines the charge.
<b>Flux</b>	In chemistry and metallurgy, a substance that promotes the fusing of minerals or metals or prevents the formation of oxides.
<b>Iron ore pellet</b>	A blast furnace raw material made by the beneficiation (concentration) of low grade ores. Pellets are marble-sized and increasingly contain flux as well as iron ore and a binder.
<b>Integrated</b>	Method of steelmaking, typically with BOF, that makes steel from the virgin material of iron ore, coal, and limestone.
<b>Non-integrated</b>	Steelmaking methods that make new steel, usually in an electric arc furnace, from scrap steel.
<b>High-volatile coals</b>	Coals containing over 32 percent of volatile matter.
<b>Metallurgical coal</b>	Certain coals possessing characteristics that make them suitable for producing metallurgical coke.
<b>Metallurgical coke</b>	A coke with very high compressive strength at elevated temperatures, used in metallurgical furnaces, not only as a fuel but also as a support for the weight of the charge.
<b>Pig iron</b>	High-carbon iron made by the reduction of iron ore in the blast furnace.
<b>Postcombustion</b>	In smelting, the injection of oxygen to burn off some of the carbon monoxide gas before it leaves the smelting vessel.

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<sup>1</sup> Definitions are drawn primarily from U.S. Department of the Interior, Bureau of Mines, *A Dictionary of Mining, Mineral and Related Terms*, Washington, DC, 1968, and from American Iron and Steel Institute, *Steelmaking Flowlines*, Washington, DC, 1982.

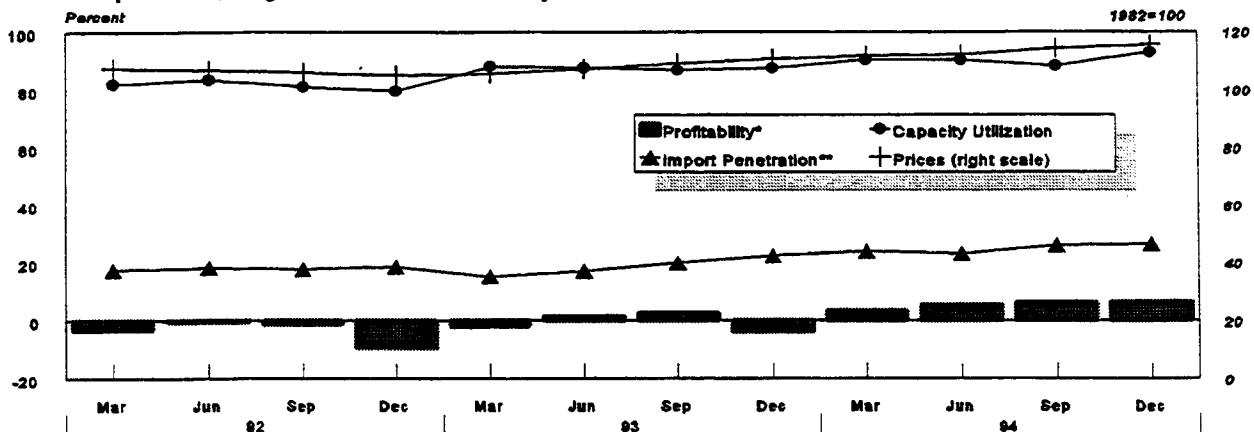
- Scrap** The principal metallic charge to electric furnaces. Scrap is also typically used as part of the charge in BOFs. It is classified as "home scrap" (croppings originating in steel mills), "prompt industrial scrap" (trimmings returned by steel users) and "dormant, or obsolete, scrap" (the materials collected and processed by dealers).
- Sintering** Process that uses the fine, iron-bearing materials recovered from ore handling, iron and steel operations, and environmental control equipment and partially fuses these fine particles into 1/4-inch material to be used in ironmaking.
- Slag** In the smelting process, an accumulation of impurities released from the iron ore that collects on the surface of the molten iron.
- Smelting** The chemical reduction of a metal from its ore by a process usually involving fusion, so that the earthy and other impurities, separating as lighter and more fusible slags, can readily be removed from the reduced metal. ■

**APPENDIX  
KEY PERFORMANCE INDICATORS OF SELECTED  
INDUSTRIES**

- STEEL** (Felix Bello, 202-205-3120)
- AUTOMOBILES** (Michael Hagey, 202-205-3392)
- ALUMINUM** (Charles Yost, 202-205-3432)
- SERVICES** (Christopher Melly, 202-205-3461)

STEEL

Figure A-1  
Steel mill products, all grades: Selected industry conditions



\*Operating income as percent of sales for companies representing about 65% of production.

\*\*Imports share of apparent supply.

Source: American Iron and Steel Institute, U.S. Bureau of Labor Statistics (BLS).

- Domestic shipments remained strong during the fourth quarter of 1994, pushing annual shipments to 95.1 million tons, a 7.9 percent year-on-year increase. Prices continued to rise, contributing to a 3.7 point rise in the BLS index for the year. Strong demand and high capacity utilization rates helped to sustain the upward trend in price increases.
- Sustained strong demand in the automotive, construction, and service center industries contributed to increasing imports of all steel mill products, up 4.2 percent (8.3 million tons) from the previous quarter (8.0 million tons). Although semifinished steel imports fell 8.2 percent, to 2.4 million tons, the growth in such imports, seen throughout 1993, seems to have leveled off in 1994 at approximately twice historical averages. Such imports are used by domestic steelmakers to offset raw steelmaking constraints and processed into finished products that reach consumers as domestic industry shipments. In addition to strong demand, scheduled down-time for maintenance of blast furnaces and a continuing shortfall of steel refining capacity relative to rolling capacity have contributed to these high levels of semifinished imports. Growth in finished steel imports, which began in early 1993, has continued steadily through 1994, with fourth quarter finished imports up 10.3 percent over the third quarter, to 5.9 million tons. Such growth has contributed to an increase in finished product apparent supply of 26 percent since late 1992.
- 1994 represented the most profitable steel market since 1989. Sales by U.S. steelmakers reporting to the American Iron and Steel Institute<sup>1</sup> rose 9.5 percent to \$33.6 billion leading reporting firms to a \$1.8 billion profit. Annual profitability (sales/profits) for these firms was 5.4 percent for 1994. However, a broader sample of data<sup>2</sup>, including integrations, minimills, specialty steelmakers, and processors shows operating profits of \$3.4 billion on sales of \$54.4 billion (6.3 percent), up from \$2.5 and \$47.7 billion (5.2 percent), respectively.<sup>3</sup>

Table A-1  
Steel mill products, all grades

Item	December 1994	Percentage change, December 1994 from September 1994 <sup>1</sup>	Percentage change, Jan.-Dec. 1994 from Jan.-Dec. 1993 <sup>1</sup>	
			January-December 1994	1994
Producers' shipments (1,000 short tons) . . . . .	8,316	1.5	95,136	7.9
Imports (1,000 short tons) . . . . .	2,458	4.2	30,066	54.2
Exports (1,000 short tons) . . . . .	343	-1.0	3,826	-3.6
Apparent supply (1,000 short tons) . . . . .	10,430	2.3	121,377	17.1
Ratio of import to apparent supply (percent) . . . . .	23.6	<sup>2</sup> 1.5	24.8	<sup>2</sup> 32.8

<sup>1</sup> Based on unrounded numbers.

<sup>2</sup> Percentage point change.

Note.—Because of rounding, figures may not add to the totals shown.

Source: American Iron and Steel Institute.

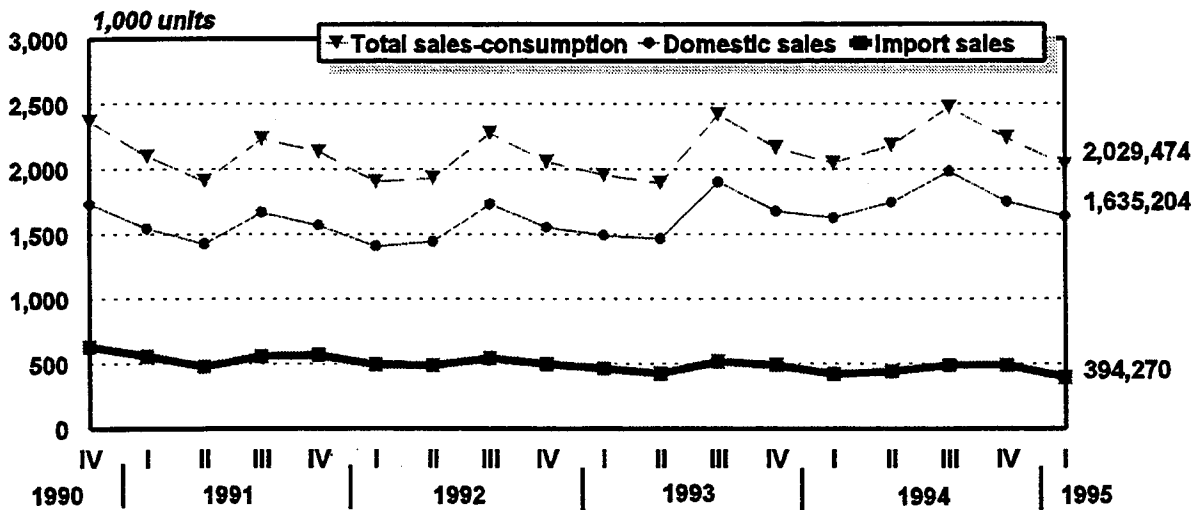
<sup>1</sup> Producers reporting financial data AISI account for approximately 65 percent of domestic shipments.

<sup>2</sup> USITC, *Steel Semiannual Monitoring Report*, April 1995.

<sup>3</sup> AISI and ITC data may differ on the items included or excluded in financial figures calculations.

**AUTOMOBILES**

**Figure A-2**  
**U.S. sales of new passenger automobiles, by quarter**



Note.—Domestic sales include all automobiles assembled in Canada and imported into the United States under the United States-Canadian automobile agreement, these same units are not included in import sales.

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

**Table A-2**  
**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, Jan. 1994-Mar. 1995**

Item	Jan.-Mar. 1995	Percentage change--	
		Jan.-Mar. 1995 from Oct.-Dec. 1994	Jan.-Mar. 1995 from Jan.-Mar. 1994
U.S. sales of domestic autos (1,000 units) <sup>1</sup> .....	1,635	-4.3	-6.0
U.S. sales of imported autos (1,000 units) <sup>2</sup> .....	394	+0.3	-10.9
Total U.S. sales (1,000 units) <sup>1,2</sup> .....	2,030	-3.4	-6.9
Ratio of U.S. sales of imported autos to total U.S. sales (percent) <sup>1,2</sup> .....	19.4	+3.7	-4.4
U.S. sales of Japanese imports as a share of the total U.S. market (percent) <sup>1,2</sup> .....	12.2	-1.6	-14.1

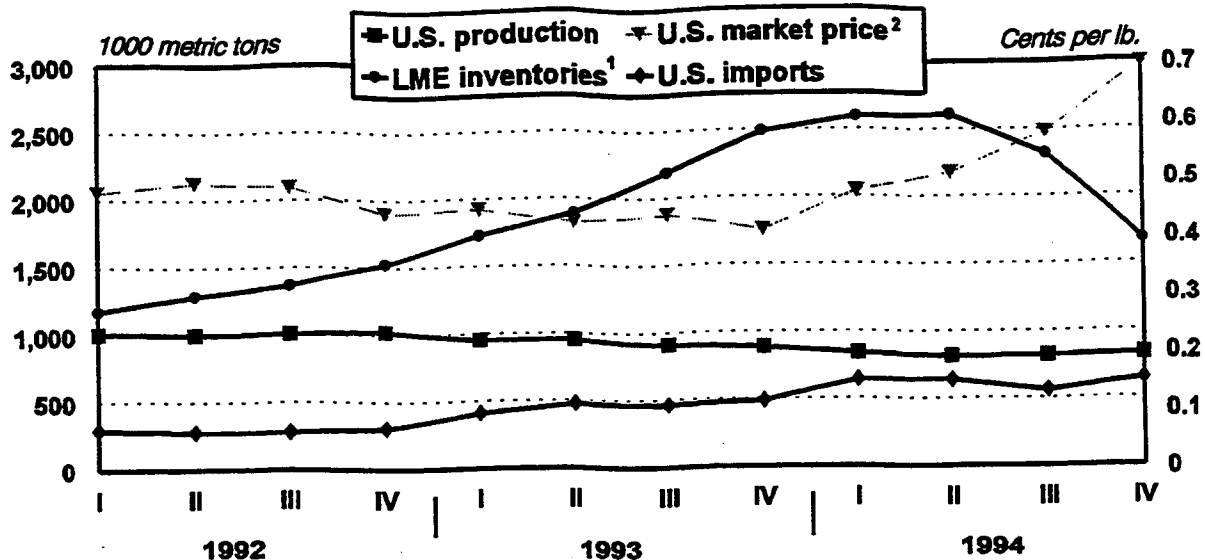
<sup>1</sup> Domestic automobile sales include U.S., Canadian-, and Mexican-built automobiles sold in the United States.

<sup>2</sup> Does not include automobiles imported from Canada and Mexico.

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

## ALUMINUM

**Figure A-3**  
**Primary aluminum: Selected industry conditions**



<sup>1</sup> End of quarter inventory.

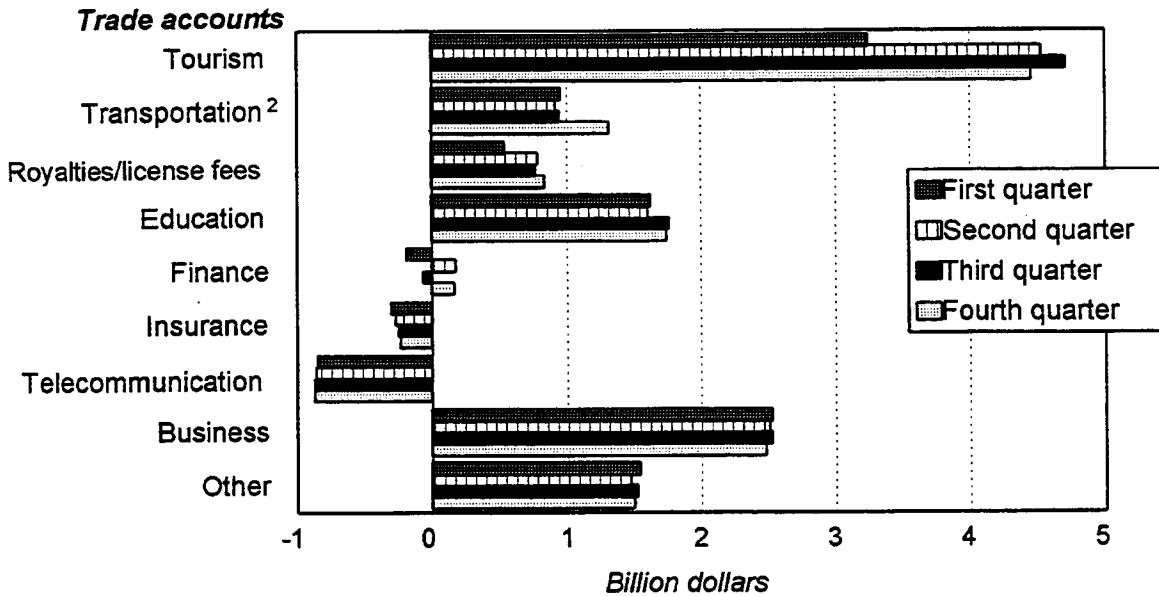
<sup>2</sup> In constant 1987 dollars.

Source: Bureau of Mines, World Bureau of Metal Statistics, Metals Week, and U.S. Department of Commerce.

- Fourth quarter 1994 production of primary aluminum totaled 827,000 metric tons, approximately 7 percent lower than the fourth quarter 1993. Annual production of primary aluminum declined by 11 percent in 1994, largely attributable to rising electricity rates in the U.S. Pacific Northwest (which raised production costs for aluminum producers) and relatively low prices for aluminum during the first three quarters of 1994.
- U.S. market prices (in constant 1987 dollars) rose by 20 percent to 70 cents per pound between the third and fourth quarters of 1994. Current prices increased from approximately 82 cents to 91 cents per pound during the fourth quarter of 1994 (compared with 50 to 55 cents per pound during the same period in 1993); average annual market prices rose approximately 70 percent between 1993 and 1994. Visible stocks (LME inventories) slipped from 2.3 million metric tons at the end of 1993 to 1.7 million tons at yearend 1994. Reports of reduced production among MOU countries and declining LME stocks attracted speculative interest, helping to push LME prices higher.
- U.S. imports increased by 32 percent (to 645,000 metric tons) between the third and fourth quarter 1994, and by 35 percent to 2.5 million metric tons from 1993 to 1994. Canada continued to be the single largest U.S. supplier, accounting for 1.4 million metric tons (57 percent of U.S. imports of primary aluminum). Russia gained second place among suppliers of primary aluminum to the United States in 1994 with U.S. imports reaching 642,822 metric tons (approximately 26 percent of the total).
- Although not shown on the graph, U.S. open market consumption of aluminum rose significantly between 1993 and 1994, by 7 percent to 8.4 million metric tons. Increased domestic economic activity and lower relative prices stimulated the selective substitution of aluminum for other materials, although aluminum prices rose during 1994 to reach a 4-year high. Increased consumption was largely supplied by increased imports as economic conditions in the United States were stronger relative to other countries.
- Over 100 billion aluminum beverage cans reportedly were shipped in 1994, an all-time high despite concerns expressed by the National Soft Drink Association (NSDA) that rising prices threatened the share of the beverage can market held by aluminum. Also, several carmakers announced their intention to expand the use of aluminum in automobile applications (e.g., hoods, and components for engines, drivelines, and chassis). Separately, NSDA asked the Clinton Administration to review the aluminum memorandum of understanding (MOU) in light of rising aluminum prices and possible cartel activity by producers agreeing to MOU provisions.

SERVICES

Figure A-4  
 Balances on U.S. service trade accounts,<sup>1</sup> 1994

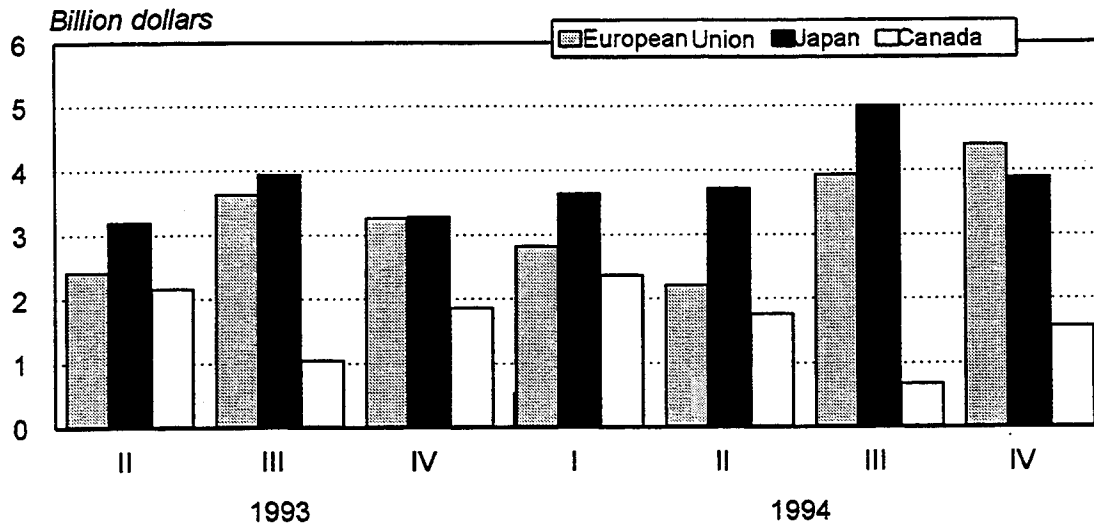


<sup>1</sup> Figures reflect trade among unaffiliated firms only.

<sup>2</sup> Includes port fees.

Source: Bureau of Economic Analysis, *Survey of Current Business*.

Figure A-5  
 Surpluses on cross-border U.S. service transactions with select trading partners,<sup>1</sup> by quarter, 1993-94



<sup>1</sup> Figures reflect private-sector transactions only; military shipments and other public-sector transactions have been excluded.

Source: Bureau of Economic Analysis, *Survey of Current Business*.

