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Challenges Facing the North American Iron Ore Industry

By J .D. Jorgenson

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Challenges Facing the North American Iron Ore Industry

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Summary

This report is derived from a presentation the author presented in late September at the Iron Ore 2005 Conference sponsored by The Australasian Institute of Mining and Metallurgy and held in Fremantle, Western Australia. Some slight revisions have been made for the new audience.

The report consists of 24 slides; the comments for each slide precede the slide.

Slide 1: This talk is based on a paper that I presented in late September at the Iron Ore 2005 Conference sponsored by The Australasian Institute of Mining and Metallurgy and held in Fremantle, Western Australia. I have made some slight revisions for the new audience.

In my presentation, I will discuss the iron ore industry in Canada and the United States and the market forces that have influenced recent changes. My apologies to our neighbors to the South, since I have not included Mexico in this talk because their logistics and markets for iron ore are quite different from those of her northern neighbors.

Just to put this in context, I'll start out with two slides from the presentation that Dave Menzie and I gave here last year.

January 2006
SME-DC Section Meeting

Challenges Facing the North American Iron Ore Industry

J .D. Jorgenson

Slide 2: On the right, we consider the world's major producers of iron ore -- China, Brazil, and Australia, in that order on a gross tonnage basis.

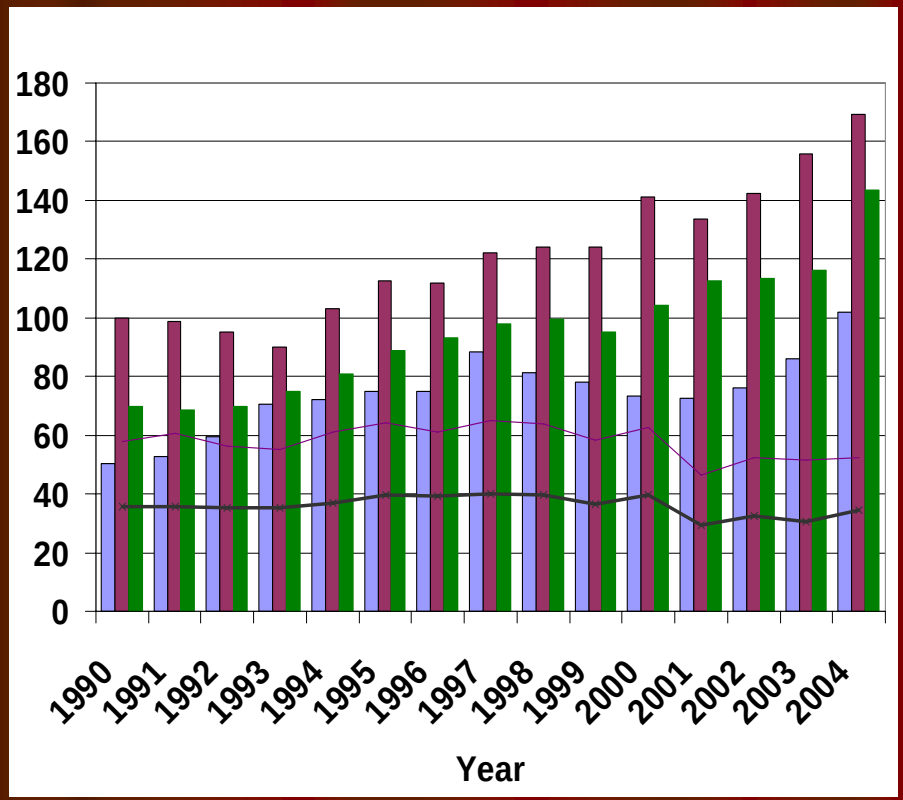
On the left, we consider iron content. The order then becomes Brazil and Australia, followed by China. The gap between Brazil and Australia cannot be seen to be narrowing, as one might expect when considering Australia's proximity to China and therefore reduced shipping costs.

The U.S. and Canadian production is shown, as stacked lines, both in terms of gross tonnage and iron content for comparison with the major world iron ore producers.

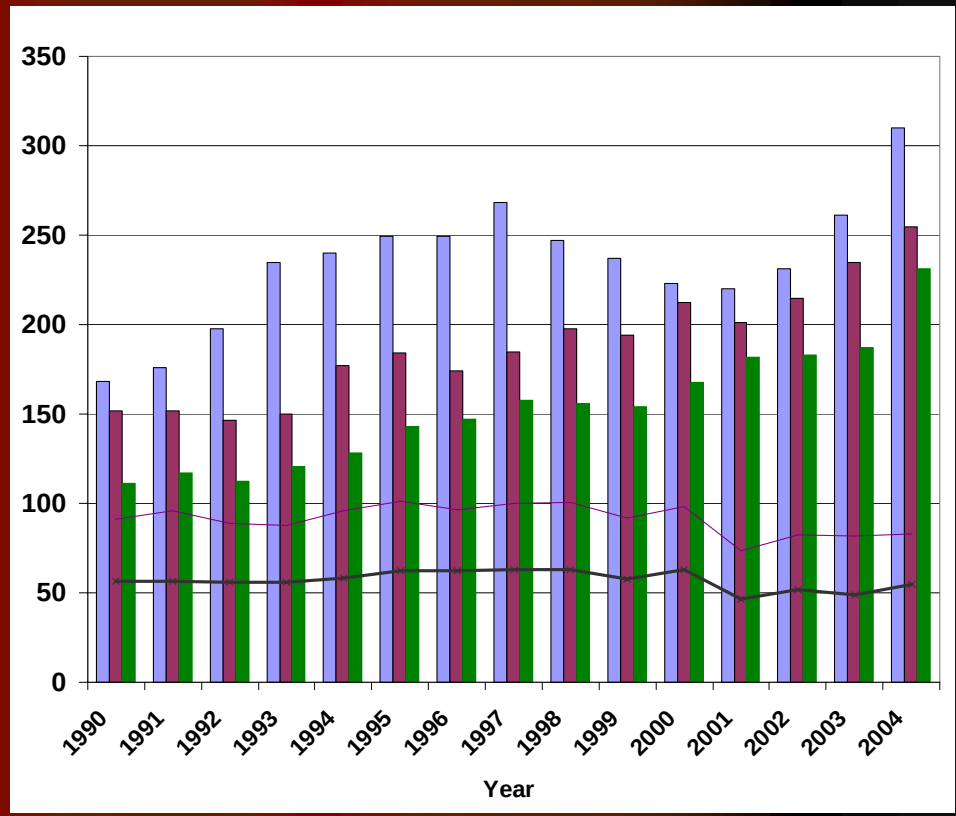
Major Producers of Iron Ore

(million metric tons)

Fe content



Gross Weight



China Brazil Australia U.S. U.S. + Canada

Source: U.S. Geological Survey Minerals Yearbook

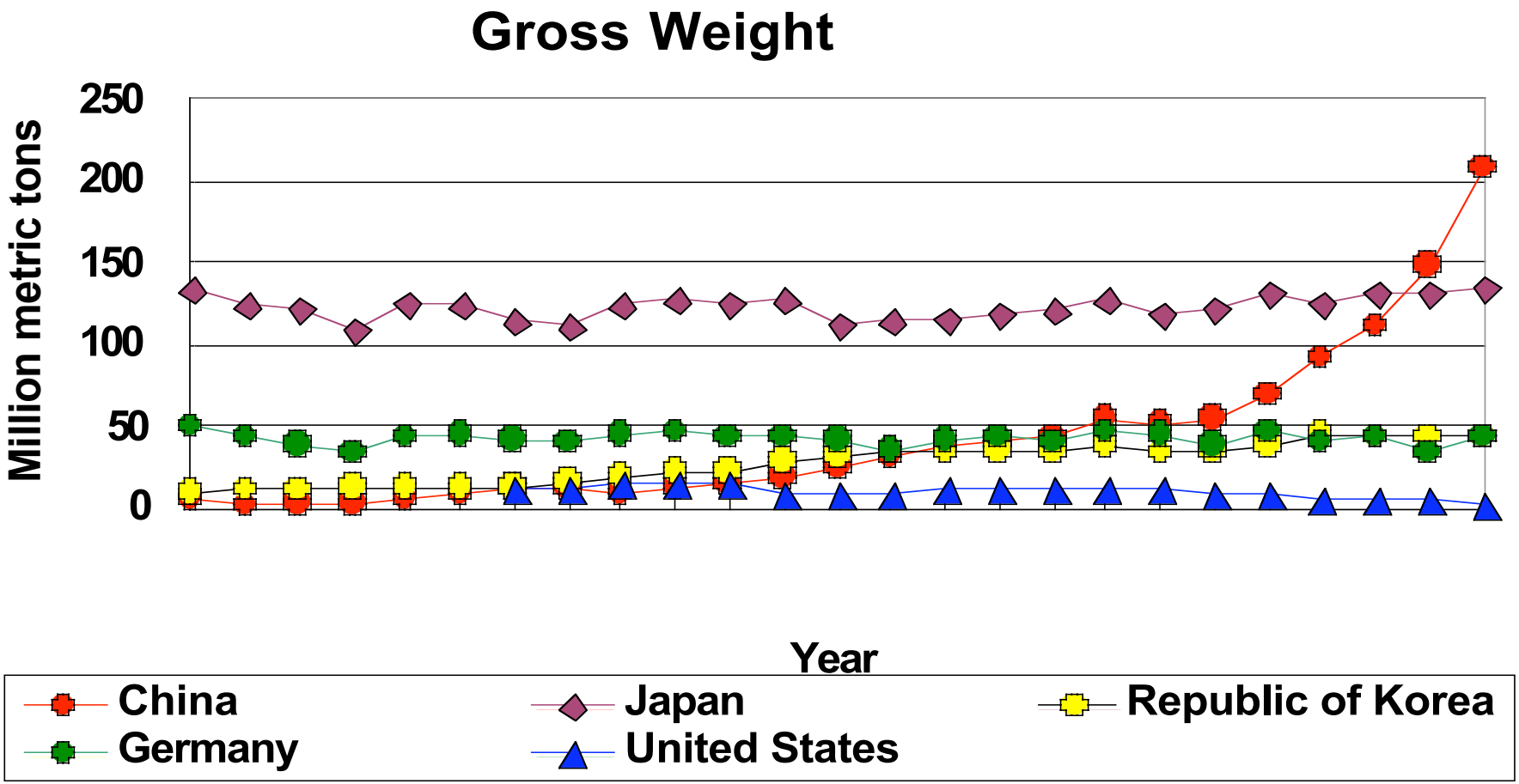
Slide 3: This graph shows iron ore imports from 1980 through 2004 for the four major importing nations – China, Germany, Japan, and the Republic of Korea. The United States net imports are also shown for comparison.

It shows a more or less steady level of imports by Japan and Germany, a steady increase by the Republic of Korea, and a steady increase followed by a steep increase beginning in 2000 by China.

Two major items can be observed in 2003. China surpassed Japan as the No. 1 importer of iron ore, and in Germany, the largest consumer in the European Union, imports reached the lowest levels in over 20 years.

U.S. imports in 2004 were 11.8 Mt, while exports were 8.4 Mt for net imports of 3.4 Mt – the lowest in over 18 years. In 1990, Chinese expansion became evident, while U.S. production decreased slightly.

Leading Importers of Iron Ore—1980–2004



Sources: U.S. Geological Survey Minerals Yearbook; United Nations Conference on Trade and Development.

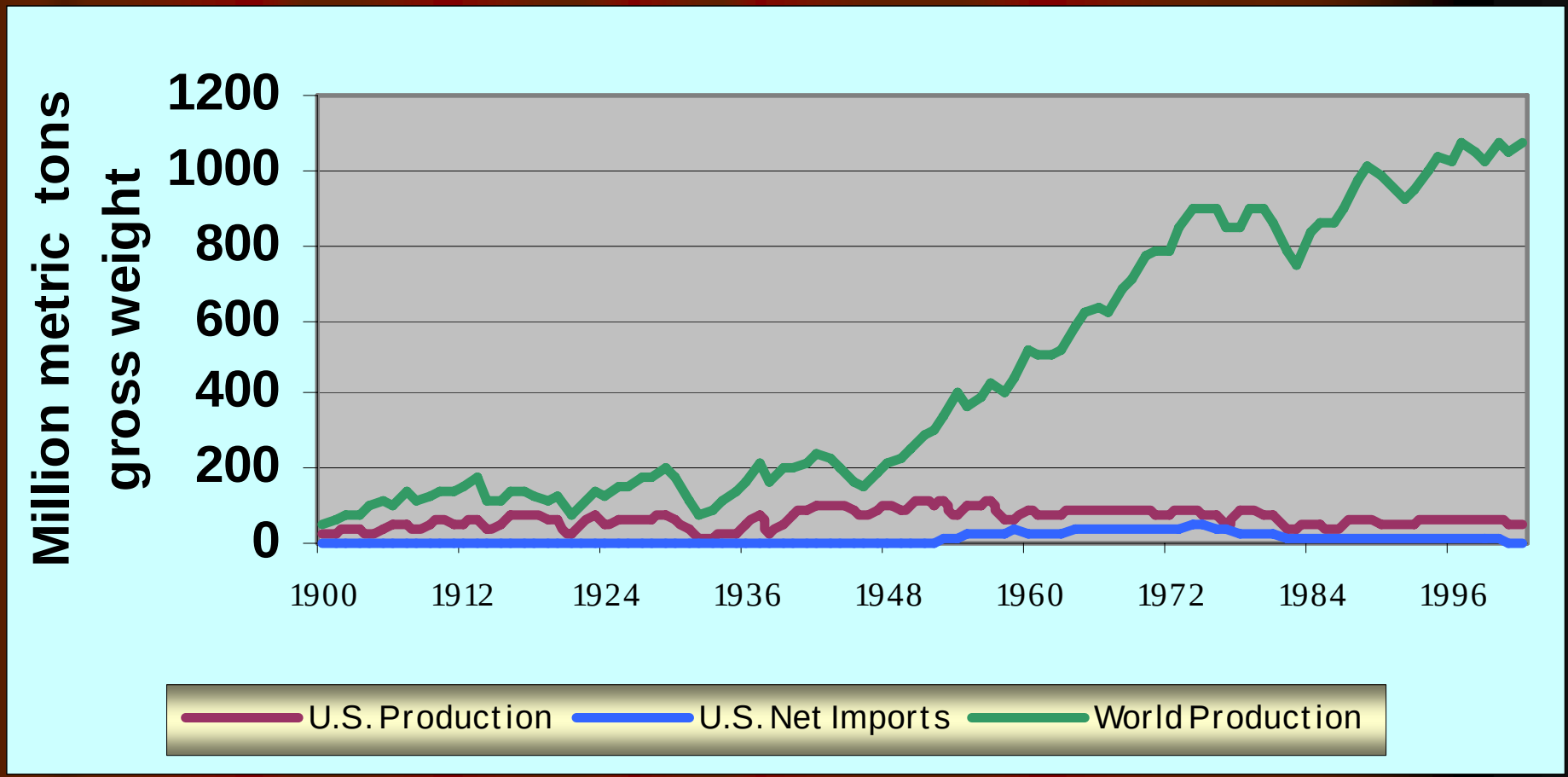
Slide 4: As an introduction to my presentation, I will briefly discuss the North American iron ore industry in the 20th Century. U.S. domestic production represented a very large share of world production until after World War II.

North American Iron Ore in the 20th Century

- U.S. domestic production peaked following WWII at 120 Mt in 1953
- Pellet production increased, as high-grade ores decreased
- Until 1982 recession, most U.S. iron ore mines owned by steel companies
- Large Canadian iron ore mines brought into production after 1950

Slide 5: This graph shows U.S. iron ore production and net imports from 1900 through 2000. As one can see, until World War II, U.S. production represented a sizeable portion of the world's production of iron ore, but after WWII, large high-grade deposits were discovered and put into production in Canada, Brazil, and Australia.

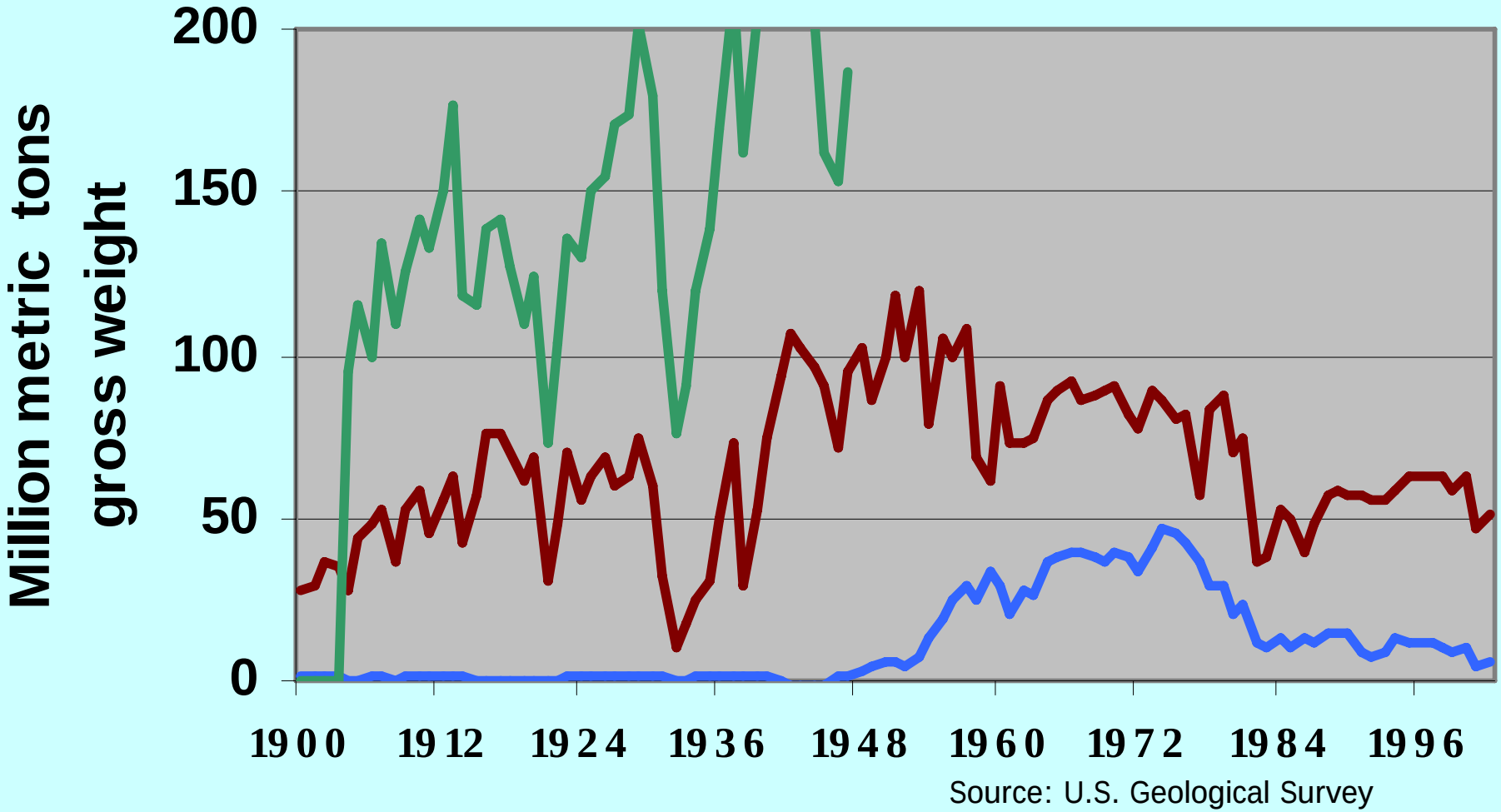
U.S. Iron Ore Production in the 20th Century



Source: U.S. Geological Survey

Slide 6: This is the same graph, emphasizing U.S. production figures and our net imports, a large part of which come from Canada.

U.S. Iron Ore Production in the 20th Century



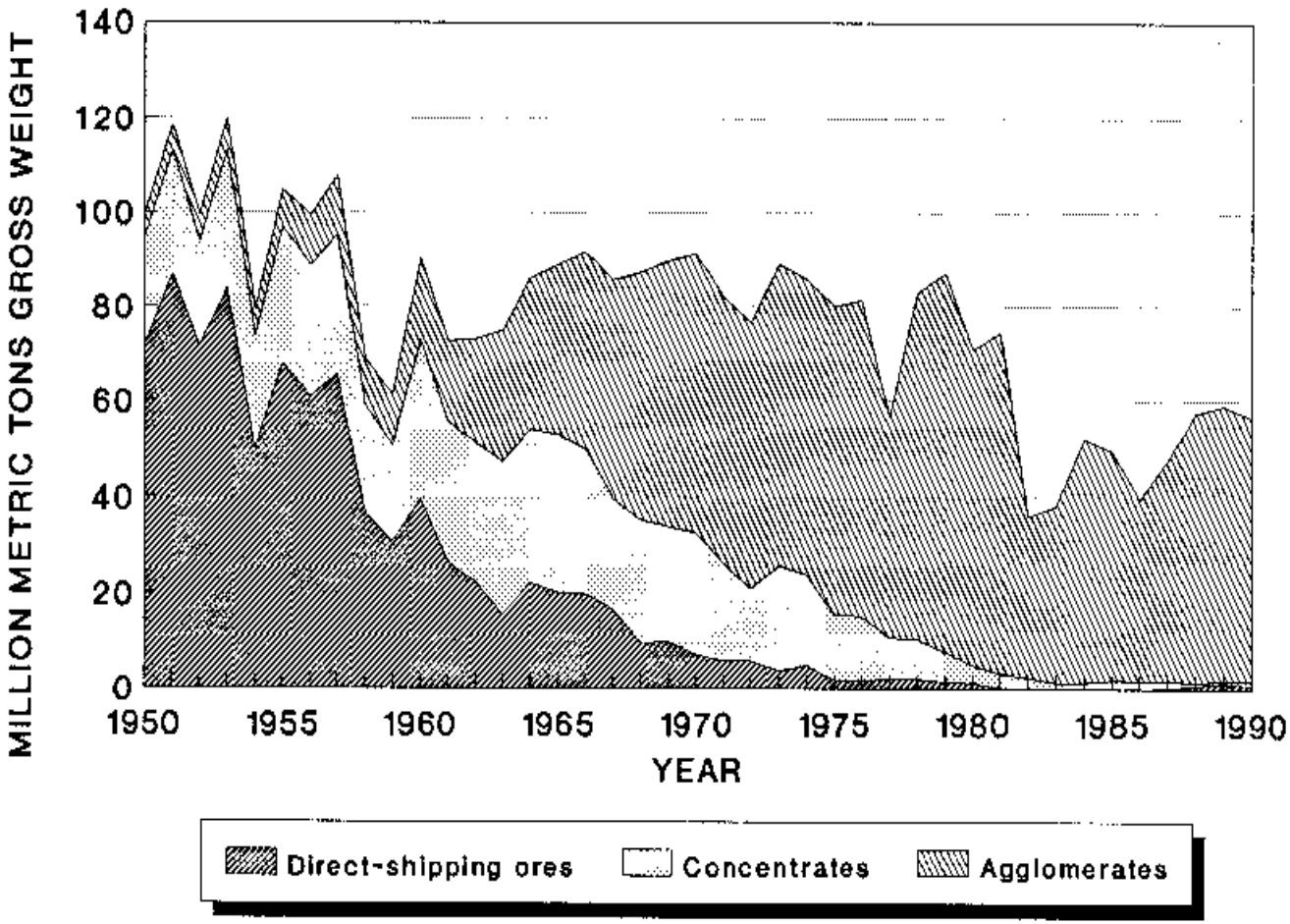
Slide 7: In the mid-50s, high-grade ores declined and upgrading taconite ores for pellet production increased.

North American Iron Ore in the 20th Century

- U.S. domestic production peaked following WWII at 120 Mt in 1953
- Pellet production increased, as high-grade ores decreased
- Until 1982 recession, most U.S. iron ore mines owned by steel companies
- Large Canadian iron ore mines brought into production after 1950

Slide 8: And that is the most important story told by this graph -- that as U.S. ore grades declined, less direct-shipping ores were produced and low-grade taconite ores began to be developed. The upgrade of these ores through pelletizing became important and by the mid-1980s made up over 95% of U.S. production.

U.S. Iron Ore, By Type of Product



Source: U.S. Geological Survey

Slide 9: Until 1982 most iron ore mines were owned by steel companies. Then many steel companies began to sell off what they considered as non-core businesses or businesses they felt were taking up too much of management's decision-making efforts. Early in the 21st Century changes away from this philosophy of divesting non-core businesses began to stabilize, as steel companies realized that the control of feedstocks was a critical issue.

Iron Ore Company of Canada (IOC), the largest producer in Canada, came into operation in 1954, Quebec Cartier Mines started up in 1957, and Wabush Mines, the second largest producer, in the late 1960s.

North American Iron Ore in the 20th Century

- U.S. domestic production peaked following WWII at 120 Mt in 1953
- Pellet production increased, as high-grade ores decreased
- Until 1982 recession, most U.S. iron ore mines owned by steel companies
- Large Canadian iron ore mines brought into production after 1950

Slide 10: Canadian iron ore is mainly produced in Quebec and Newfoundland-Labrador, where three major operations are found.

Iron Ore Company of Canada is owned by Rio Tinto, Mitsubishi, and a State trust fund. In 2004, they produced 11.9 Mt of pellets and 9.9 Mt of concentrates, which they ship out through their port at Sept-Iles.

Wabush Mines, which is owned by Stelco, Dofasco, and Cleveland-Cliffs, has capacity for about 6 Mt of pellets per year.

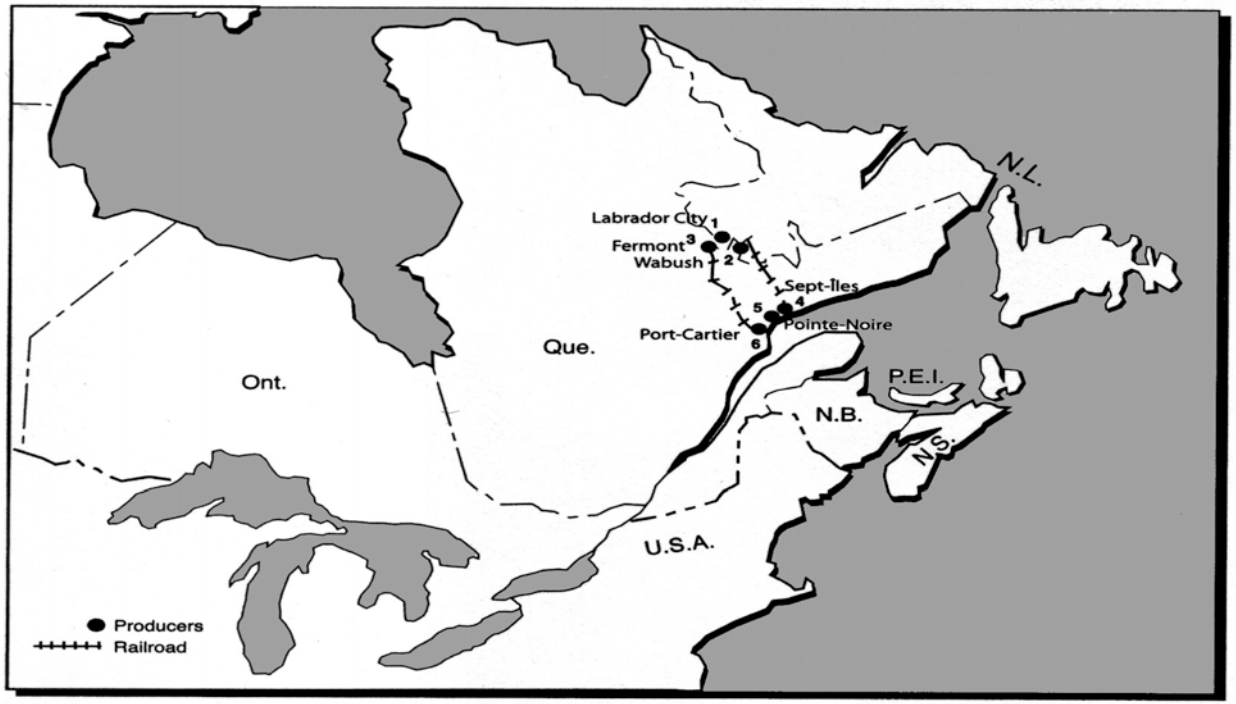
And Quebec Cartier has capacity for 9 Mt of pellets and can also produce concentrates.

Each of these operations has ports on the St. Lawrence Seaway and exports to Asia, Europe, and the United States.

British Colombia produces a minor amount of byproduct iron ore in Western Canada.

Iron Ore in Canada 2002

Iron Ore in Canada, 2002



Numbers refer to locations on map above.

PRODUCERS

1. Iron Ore Company of Canada, Carol Lake Division (mine/concentrator/pellet plant)
2. Wabush Mines (mine/concentrator)
3. Quebec Cartier Mining Company (mine/concentrator)
4. Iron Ore Company of Canada (port)
5. Wabush Mines (pellet plant/port)
6. Quebec Cartier Mining Company (pellet plant/port)

Source: Natural Resources Canada, Perron, 2002

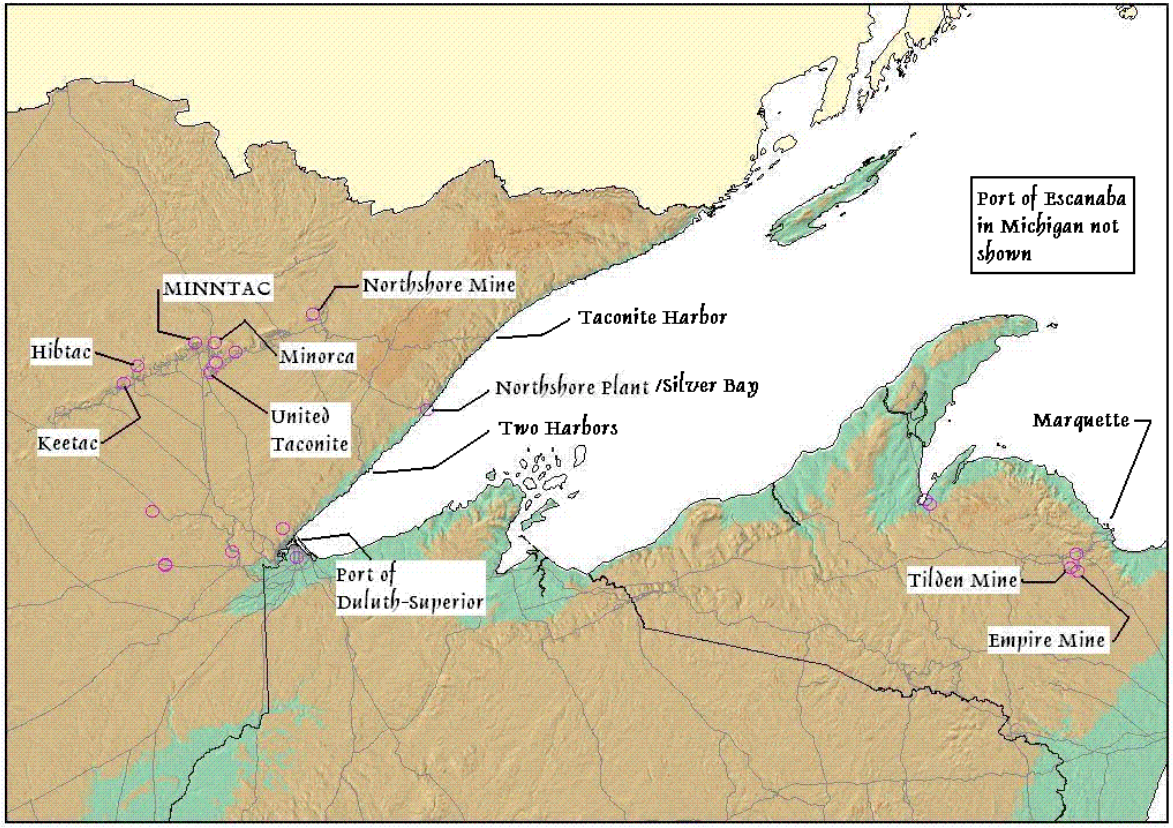
Slide 11: Major U.S. operations include the Tilden and Empire mines in Michigan; United Taconite, the Northshore Mine, and Hibbing Taconite all managed by Cleveland-Cliffs, Minntac and Keewinaw Taconite (Keetac), owned and operated by U.S. Steel, and Minorca, owned and operated by Mittal Steel, in Minnesota.

Almost all ore is moved through Lake Superior ports to Lower Lakes ports in Ontario, Canada, and Ohio, Indiana, and Michigan in the United States.

China's Laiwu Steel exchanges its share of United Taconite production for part of Cliffs production from the Wabush Mines in Canada in order to lower shipping cost to Asia.

U.S. Steel ships some of their product by rail to its Granite City plant on the Mississippi and as far as its steel plant in Alabama.

Minnesota - Michigan Iron Ore Mining District



USA

USA

Outside USA

Active Mines and Mineral Plants

Railroads

Elevation Shaded Relief

Image

N

30 0 30 60 90 Miles

USGS Mineral Resources Spatial Data
http://mrdata.usgs.gov

Mar 28, 2005

Slide 12: As the steel market deteriorated in the 2001 to 2002 period, the high cost producers dropped out. Consolidations were seen in both the iron ore and steel industries.

Unions made concessions to keep mines operating (for example, U.S. Steel was able to restructure the union contract at Keewatin Taconite before it finalized the purchase of this property, and Iron Ore Company of Canada achieved reductions of personnel at their operations over a number of years through an agreement to accept normal rates of attrition that resulted in a reduction of operating costs by about $5 per metric ton).

Examples of operating efficiencies include the combining of staff functions and infrastructure at the Tilden and Empire operations in Michigan under one entity – Cliffs Michigan Mining Company; alteration of pelletizing systems to use less expensive fuels, such as coal and petcoke.

And new processing technology has been introduced to upgrade ore to iron nuggets with an iron content of between 96 and 98%.

North American Iron Ore (2000 – 04)

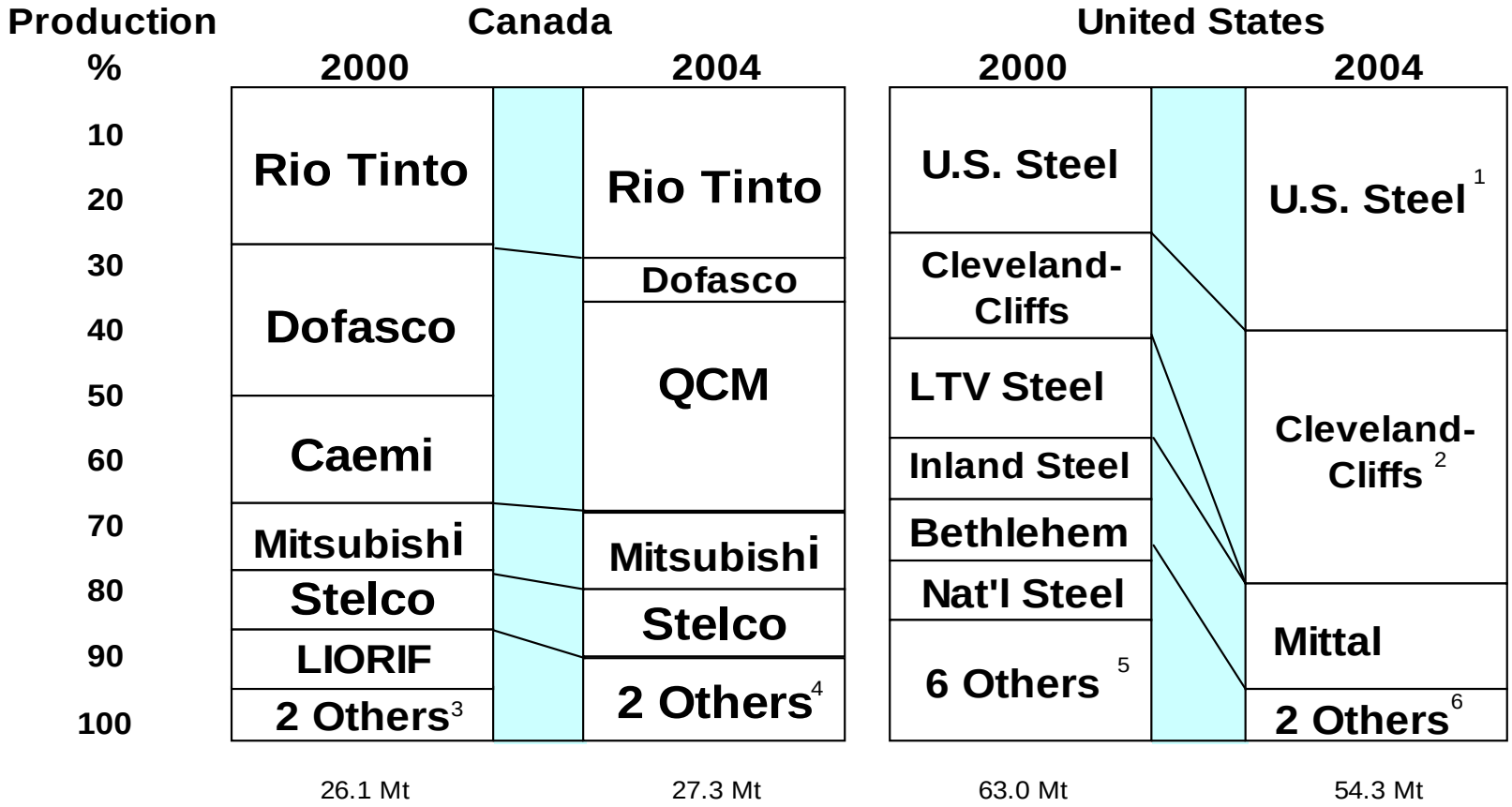
- Poor markets in 2001-02
  - High cost producers drop out
  - Consolidation of iron ore and steel producers
  - Union concessions
  - Operating efficiencies increase
- High price of natural gas affects pelletizing
- New processing technology
  - Mesabi Nugget project

Slide 13: The next two slides depict iron and steel ownership changes early in the 21st Century. Production is shown at the bottom of the graphic with the quantity of the Canadian iron ore production increasing and that of the U.S. decreasing.

In Canada, the change in ownership of Quebec Cartier Mining has continued into 2005. Previously, Dofasco and Caemi of Brazil had agreed to divest and buy preferred shares in QCM, but earlier in 2005 Dofasco bought out Caemi's portion of ownership entirely. Now, Arcelor and Thyssen Krupp are both interested in purchasing Dofasco, as much for its iron ore reserves as for its steel business.

In the U.S. changes have been even more dramatic, as LTV Steel closed up its operations and such companies as Bethlehem Steel and National Steel went out of business. U.S. Steel, which had been trying to sell its only iron ore operation – Minntac -- at the end of 2003, decided instead to purchase the iron ore assets of bankrupt National Steel Corporation. Cleveland-Cliffs increased its holdings in Hibbing Taconite, United Taconite, and the Empire and Tilden mines in Michigan. Mittal Steel took over Inland Steel with its Minorca Mine and International Steel Group's holdings in Hibbing Taconite. A new player entered the market – China's Laiwu Steel purchased 30% of the iron ore assets of Eveleth Taconite.

Iron Ore Ownership (Canada and the U.S.)



Notes 1: U.S. Steel purchased the assets of National Steel
2: Cleveland-Cliffs increased holdings in Hibtac, United Taconite, Empire, and Tilden
3: Cleveland-Cliffs, Acme Steel
4: LIORIF, Cleveland-Cliffs
5: Wheeling-Pittsburgh, Stelco, Rouge Steel, AK Steel, Algoma, Auburn
6: Laiwu Steel, Stelco

Source: Cliffs Iron Ore Analyses (2000-04); Skillings Mining Review ; USGS Minerals Yearbook (2000-04)

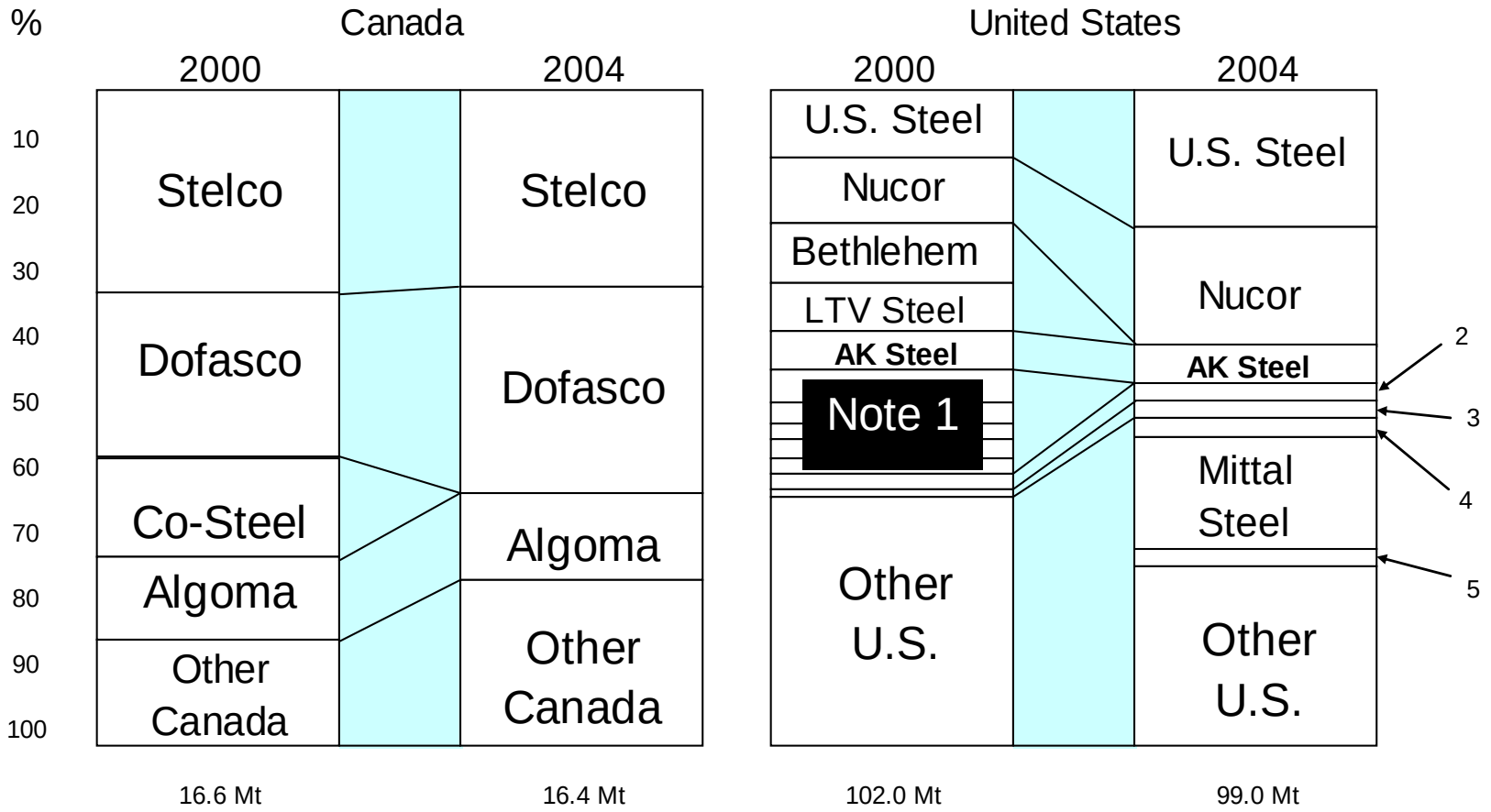
* Production tonnages referred to are gross weight.

Slide 14: Looking at Steel ownership.

In Canada, as shown on the left-hand side of this diagram, we can see that between 2000 and 2004, Stelco and Algoma maintained their market share, while Dofasco increased its share. Co-Steel was absorbed by Gerdau Ameristeel and is now shown as the increase in Other Canada.

In the United States, U.S. Steel and Nucor increased their market shares; Bethlehem and LTV filed for bankruptcy; and Mittal Steel formed from Ispat Inland and Wilbur Ross's International Steel Group. Many of the smaller producers in the United States went out of business – in 2000, they represented over one-third of the U.S. Steel industry; by 2004 they represented less than one-fourth.

Ownership of Steel Production (Canada and the U.S.)



Notes 1: Includes National Steel, Birmingham Steel, Rouge Steel, North Star, and Weirton Steel
2: Wheeling-Pittsburgh
3: IPSCO
4: Steel Dynamics
5: Commercial Metals

Sources: Metal Bulletin, USGS Minerals Yearbook 2003, and IISI

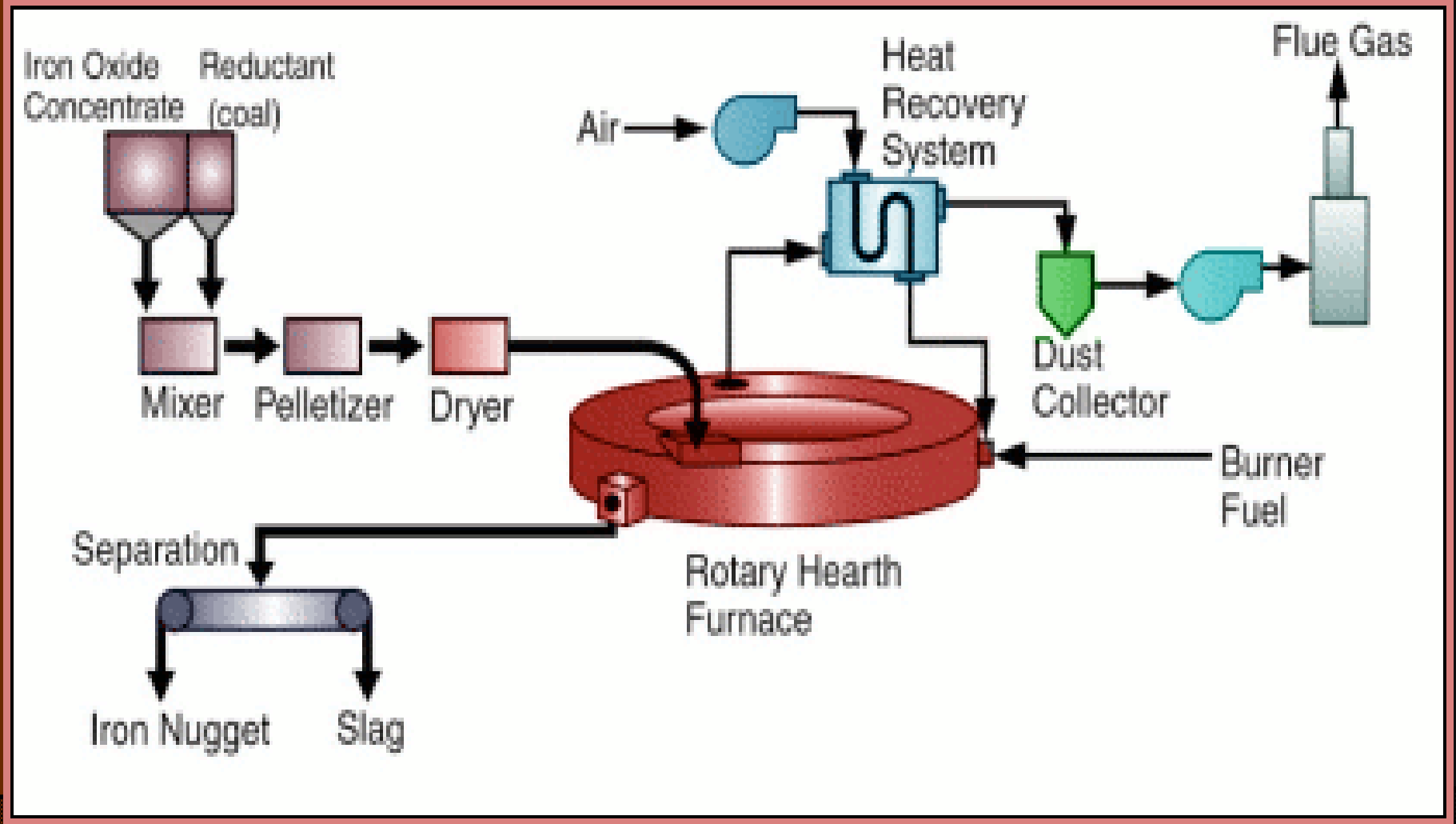
Slide 15: New processing technology is under development to improve the North American iron ore industry.

The ITmk3 process consists of four distinct steps – Feed Preparation, Reduction, Product Discharge, and Offgas Treatment.

A 97% iron, 2% carbon nugget is produced. These nuggets can be fed to either Basic Oxygen Furnaces or Electric Arc Furnaces for steel production.

A Mesabi Nugget plant was successfully run on a pilot plant basis with assistance from the U.S. Department of Energy. A full-scale plant is planned for construction either in Minnesota or Indiana. The eliminating factor probably will be in which of these States environmental permits can be obtained most quickly.

Midrex Technologies ITmk3® Process



Source: Midrex Technologies Inc.

Slide 16: The sustainability issue related to the North American iron ore mining industry I have associated with four major factors –

management of transport; environmental management; reserves; and the availability of funds for investment in regional sustainability.

North American Iron Ore (Sustainability)

- Transportation Management
  - Infrastructure
  - Invasive species
- Environmental management
- Reserves
- Sustainability funds
  - Economic development projects
  - Maintaining funds

Slide 17: The distance from Duluth to the mouth of the St. Lawrence is 2300 miles. Locks are located at the St. Mary River (4 parallel), the Welland Canal (8 locks) and on the St. Lawrence (2 U.S. and 5 Canadian). The locks have a maximum length of about 740 feet and beam of 77 feet, except for the Soo Locks.

On the Great Lakes, a recent 5-year annual average for iron ore transport was 42 Mt traveling through the Soo locks with maximum capacity of over 60,000 t per shipment.

For the St. Lawrence Seaway, a recent 5-year annual average was 12.1 Mt iron ore transport. This does not include ocean transport of pellets and ore.

The 15 locks on the St. Lawrence Seaway, including the Welland Canal, raise ships 174 meters from sea level to the level of Lake Erie. Lake Superior, and this is where all of the iron ore mined in the U.S. is shipped from, is at 184 meters above sea level.

The 5 largest steel producing States in the United States all border the Great Lakes. This region is the home to about one-quarter of North America's population.

Great Lakes - Seaway Shipping

Slide 18: The Poe Lock, the large lock second from the left, can handle Super Lakers, vessels of over 60,000 t draft capacity.

One of the major bottlenecks to the shipping infrastructure is the climate with winter freezing of the lakes, rivers, and canals and summer drought limiting vessel draft capacities. For example, in 2004-05, season traffic from Duluth was halted on December 17 and through the Soo Locks on January 15. Traffic did not reopen on the Soo Locks until March 25 and at the Welland Canal until March 17. In order to offset the icing, large icebreakers assist vessels struggling with the ice on the Great Lakes.

Drought is another climate-related economic risk that recently lowered lake levels on Lakes Michigan and Huron by 22 inches. This was equivalent to a loss of almost 6000 tonnes of capacity on each of the Lake Superfreighters.

And, of course, channel dredging is required to keep ports functioning.

Soo Locks – Canada-U.S. Border

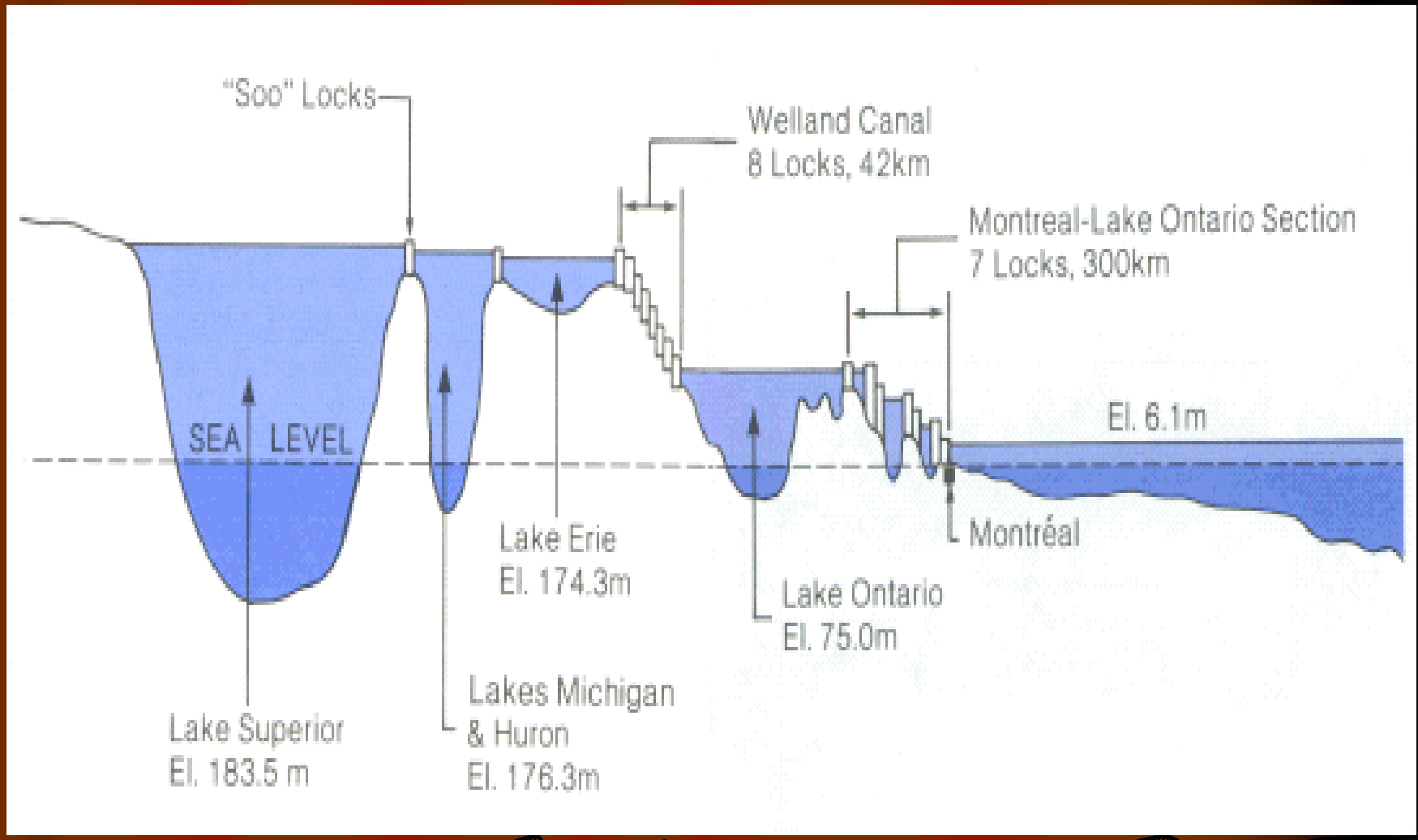
Source: U.S. Army Corps of Engineers

Slide 19: As mentioned 25% of North America's population lives in the Great Lakes region. Recreational fishing generates about $4.5 billion of income per year. Since 1800, more than 160 exotic, non-native species have entered the Great Lakes, including zebra mussels and Asian carp.

Solutions such as electric fish barriers have been tried to restrict fish movement. Ocean-going vessels are required to dump salt water ballast or have shipments transferred.

Some of the solutions being considered bring worse environmental problems than those they are meant to resolve. For example, restricting traffic through the Welland Canal and using truck transshipments would greatly increase air pollution. Restricting traffic altogether would have a profound effect on iron ore, steel, and the automotive industries – all of which are centered around the Great Lakes.

North American Iron Ore Transport



Source: Great Lakes Information Network

Slide 20: In the Canadian and U.S. iron mining areas, there is a net positive rainflow-evaporation balance or better said it rains more than it evaporates. This requires clarification systems be set up in tailings disposal areas to meet mandated discharge requirements.

Environmental management efforts, especially in Minnesota's Mesabi Range, which borders a wilderness area, are critical to area sustainability. Each of the mines has committed to efforts to preserve wetlands for future generations.

A good example of the environmental stewardship is Michigan's exhausted Republic Mine, which Cleveland-Cliffs closed in 1996 and where a wildlife habitat of more than 800 hectares has been created.

Iron Ore Company of Canada (IOC) was among last year's recipients of the North American Waterfowl Management's Award for work in establishing a biodiverse habitat for water fowl. This award resulted from a greater than $30M program in which environmental assessments and engineering design developed a Tailings Management Project, which included input from key external stakeholders in the planning stages.

North American Iron Ore (Sustainability)

- Transportation Management
  - Infrastructure
  - Invasive species
- Environmental management
- Reserves
- Sustainability funds
  - Economic development projects
  - Maintaining funds

Slide 21: Reserves are an essential sustainability issue. Before a mine's reserves run out, the region must have already developed alternative sources of income to remain viable.

North American Iron Ore (Sustainability)

- Transportation Management
  - Infrastructure
  - Invasive species
- Environmental management
- Reserves
- Sustainability funds
  - Economic development projects
  - Maintaining funds

Slide 22: Again, reserves at current and projected mining rates for most of the Canadian and U.S. mining areas extend up to and beyond 20 years, but there are areas of concern. Mining companies, as well as the governments of the regions in which they mine, need to focus on what opportunities will be available for the communities in which they are centered once mining ceases. Local governments will need to determine what alternative sources of revenue can be obtained to minimize the impact on their communities.

Alternatives may include attracting downstream industries to the region, as would be the case for the Mesabi Nugget facilities or the proposed Minnesota Steel Industries project in which the State of Minnesota has invested $5M towards developing a new taconite mine, pelletizing plant, and a direct-reduced-iron steelmaking complex on the Mesabi Iron Range. This project would provide 700 jobs and require a $1.7 billion investment to produce 2.4 Mt/yr of hot-rolled steel.

Iron Ore Reserves and Expected Year of Depletion

Canada	Reserves (Mt)	Year
• Iron Ore Company of Canada	1,400	2040
• Quebec Cartier	836	2040
• Wabush	58	2014
United States		
• Keetac and Minntac (U.S. Steel)	680	2047
• Northshore		2070
• Hibbing Taconite	180	2025
• United Taconite	110[e]	2029
• Empire	29	2008
• Tilden	290	2040

e estimate

Source: Skillings Mining Review; Company Annual Reports

Slide 23: The sustainability issue relates not only to these economic development projects, but also to where seed money for their development will be obtained. Taconite production taxes at more than $1.75 per metric ton in Minnesota need to be wisely invested. Some feel that this revenue should be invested in those regions of the country from which the wealth was produced and the depleting assets removed.

Society will always depend on the industrial managers, engineers, and scientists to increase reserves through greater efficiencies and innovative technology, but local areas will still depend on receiving their share of revenues, which they have generated, in order to survive.

North American Iron Ore (Sustainability)

- Transportation Management
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Slide 24: This is the Silver Bay Terminal in Minnesota, where Cleveland-Cliffs processes its ore from the Northshore Mine and produces about 4.8 Mtpy of pellets.

I just wanted to end the presentation with a terminal. To the iron ore industry this may be an end, but to the steel industry, it's just the beginning.

Source: Cleveland-Cliffs Inc