RHENIUM

(Data in kilograms of rhenium content, unless otherwise noted)

Domestic Production and Use: During 2000, ores containing rhenium were mined by six operations. Rhenium compounds are included in molybdenum concentrates derived from porphyry copper deposits in the Southwestern United States, and rhenium is recovered as a byproduct from roasting such molybdenum concentrates. Rhenium-containing products included ammonium perrhenate, perrhenic acid, and metal powder. The major uses of rhenium were in petroleum-reforming catalysts and in high-temperature superalloys used in turbine engine components, representing about 40% and 50%, respectively, of the total demand. Rhenium was used in petroleum-reforming catalysts for the production of high-octane hydrocarbons, which are used in the production of lead-free gasoline. Bimetallic platinum-rhenium catalysts have replaced many of the monometallic catalysts. Rhenium is used in superalloys, improving the strength properties, at high temperatures (1,000° C), of nickel-based alloys. Some of the uses for rhenium alloys were in thermocouples, temperature controls, heating elements, ionization gauges, mass spectrographs, electron tubes and targets, electrical contacts, metallic coatings, vacuum tubes, crucibles, electromagnets, and semiconductors. The estimated value of rhenium consumed in 2000 was $44.4 million.

Salient Statistics—United States:	**1996**	**1997**	**1998**	**1999**	**2000[e]**
Production[1]	14,000	15,400	14,000	12,000	9,000
Imports for consumption	20,800	15,100	25,200	13,500	20,800
Exports	NA	NA	NA	NA	NA
Consumption: Estimated	24,100	17,900	28,600	32,600	40,000
Apparent	NA	NA	NA	NA	NA
Price, average value, dollars per kilogram:					
Metal powder, 99.99% pure	900	900	500	1,100	1,110
Ammonium perrhenate, kilogram	500	300	400	750	780
Stocks, yearend, consumer, producer, dealer	NA	NA	NA	NA	NA
Employment, number	Small	Small	Small	Small	Small
Net import reliance[2] as a percent of apparent consumption	NA	NA	NA	NA	NA

Recycling: Small amounts of molybdenum-rhenium and tungsten-rhenium scrap have been processed by several companies during the past few years. All spent platinum-rhenium catalysts were recycled.

Import Sources (1996-99): Chile, 59%; Germany 16%; Kazakhstan, 9%; Russia, 7%; and other, 9%.

Tariff: Item	**Number**	**Normal Trade Relations 12/31/00**
Other inorganic acids, other—rhenium, etc.	2811.19.6050	4.2% ad val.
Salts of peroxometallic acids, other—ammonium perrhenate	2841.90.2000	3.1% ad val.
Rhenium, etc., (metals) waste and scrap	8112.91.0500	Free.
Rhenium, (metals) unwrought; powders	8112.91.5000	3% ad val.
Rhenium, etc., (metals) wrought; etc.	8112.99.0000	4% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Prepared by **John W. Blossom [(703) 648-4964, jblossom@usgs.gov, fax: (703) 648-7757]**

RHENIUM

Events, Trends, and Issues: During 2000, the average rhenium prices were $1,110 per kilogram for metal and $780 per kilogram for ammonium perrhenate. The supply increased by 4,300 kilograms, and the consumption increased by 7,400 kilograms. Imports of rhenium increased by about 54% in 2000 compared with those of 1999. Chile and Kazakhstan supplied the majority of the rhenium imported. The United States relied on imports for much of its supply of rhenium. The increased estimated consumption was in the areas of catalysts for petroleum refining and superalloys for turbine engines.

In 2001, U.S. consumption of rhenium has been estimated to be about 50,000 kilograms.

Owing to the scarcity and minor output of rhenium, its production and processing pose no known threat to the environment. In areas where it is recovered, pollution control equipment for sulfur dioxide also prevents most of the rhenium from escaping into the atmosphere.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e]		Reserves[3]	Reserve base[3]
	1999	2000		
United States	12,000	9,000	390,000	4,500,000
Armenia	700	700	95,000	120,000
Canada	1,600	1,600	—	1,500,000
Chile	14,700	14,700	1,300,000	2,500,000
Kazakhstan	2,400	2,400	190,000	250,000
Mexico	5,500	5,300	NA	NA
Peru	4,800	4,800	45,000	550,000
Russia	1,100	1,100	310,000	400,000
Uzbekistan	NA	NA	59,000	400,000
Other countries	3,000	3,000	91,000	360,000
World total (rounded)	46,000	43,000	2,500,000	11,000,000

World Resources: Most rhenium occurs with molybdenum in porphyry copper deposits. Identified U.S. resources are estimated to be about 5 million kilograms, and the identified resources of the rest of the world are approximately 6 million kilograms. In Kazakhstan, rhenium also exists in sedimentary copper deposits.

Substitutes: Substitutes for rhenium in platinum-rhenium catalysts are being evaluated continually. Iridium and tin have achieved commercial success in one such application. Other metals being evaluated for catalytic use include gallium, germanium, indium, selenium, silicon, tungsten, and vanadium. The use of these and other metals in bimetallic catalysts may decrease rhenium's share of the catalyst market. Materials that can substitute for rhenium in various end uses are as follows: cobalt and tungsten for coatings on copper X-ray targets, rhodium and rhodium-iridium for high-temperature thermocouples, tungsten and platinum-ruthenium for coatings on electrical contacts, and tungsten and tantalum for electron emitters.

[e]Estimated. NA Not available.

[1]Calculated rhenium contained in MoS_2 concentrates. Recovered quantities are considerably less and are withheld.

[2]Defined as imports - exports + adjustments for Government and industry stock changes.

[3]See Appendix C for definitions.