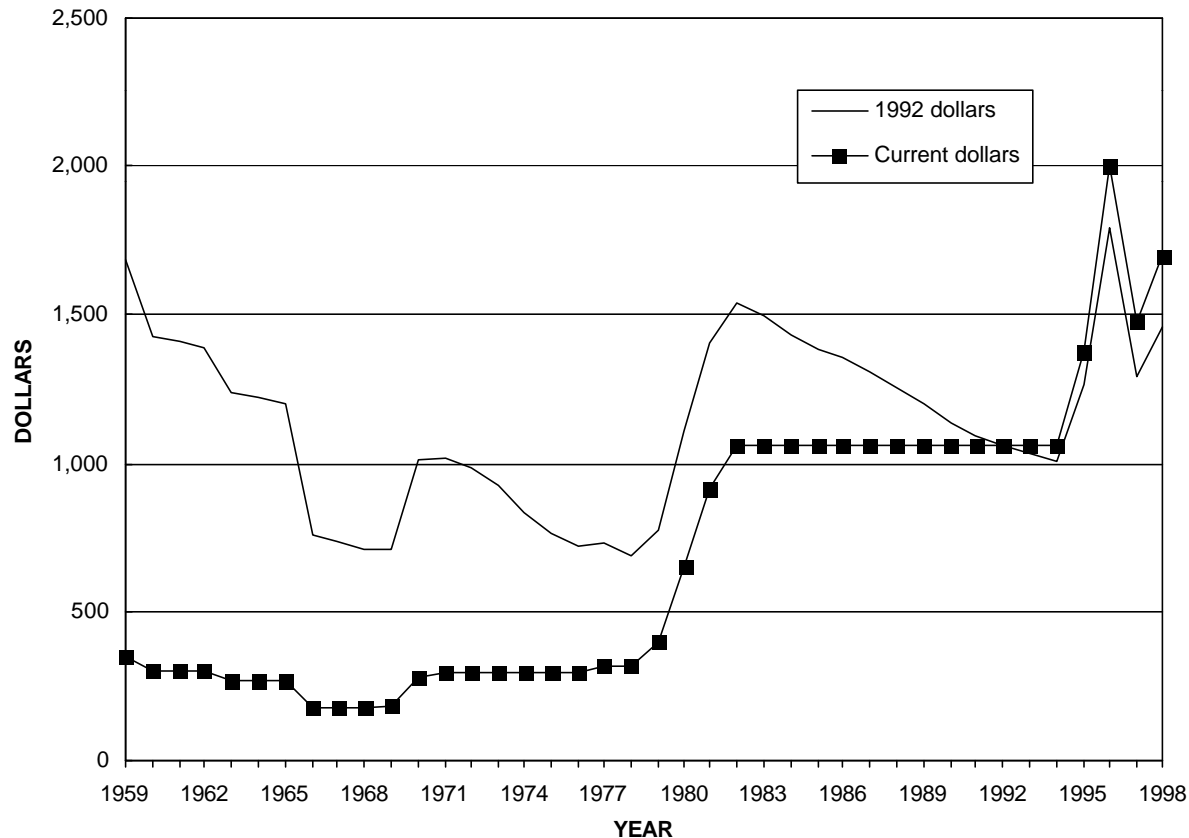


**Annual Average Germanium Price**  
(Dollars per kilogram)



### Significant events affecting germanium prices since 1958

1979-82	Increased demand, tight supply
1984	National Defense Stockpile (NDS) authorization, goal 30,000 kilograms
1987	New authorized NDS goal of 146,000 kilograms
1991	NDS goal lowered to 68,000 kilograms
1996	Increased demand, production shortages
1997	NDS stockpile sales begin

Germanium was discovered by Clemens Winkler in 1886, although its existence had been predicted by D.I. Mendeleev in his periodic table of elements in 1869. Germanium is a hard, grayish-white element; has a metallic luster; has the same crystal structure as diamond; and is brittle, like glass. It is a semiconductor, with electrical properties between those of

a metal and an insulator. Germanium and its compounds remained almost entirely items of interest for research until World War II, although the use of germanium dioxide in treating anemia was reported in 1922 (Gregory, 1942).

With the invention and development of the crystal diode and the transistor, in the 1940's, germanium became an

important industrial material (Bardeen and Brattain, 1948). Prior to 1945, the amount of germanium produced was very small, a few hundred pounds per year. From 1945 to 1949, the demand for electronic uses resulted in substantial growth of the germanium industry and higher prices for the metal.

After 1953, germanium prices started to decline progressively and, by 1966, bottomed out at \$175 per kilogram of metal, the lowest price ever quoted. This price prevailed for the next 2 years, rose in 1969, and rose again in 1970 because of inflationary trends in the market. Prices remained constant at \$293 per kilogram from 1971 through 1976.

The invention and development of the germanium transistor opened the door for countless applications of solid-state electronics. From 1950 through the early 1970's, this area provided an excellent market for germanium. In the 1970's, demand for germanium in transistors, diodes, and rectifiers declined, owing mainly to the increasing use of electronic-grade silicon as a replacement. The reduced demand for germanium in the electronic field was offset, however, by a dramatic increases in demand in fiber optics communication networks (Roskill's Letter from Japan, 1997), in infrared night vision systems (Metal Bulletin 1975), and as a polymerization catalyst (Metal Bulletin, 1995). These end uses represented 77% of worldwide germanium consumption for 1998.

Increased demand and tight supply caused dramatic increases in both domestic and foreign prices for germanium metal beginning in 1979. By December 1981, the domestic germanium metal quoted price was set at \$1,060 per kilogram and remained there for 13 years. During most of this period, the free market price remained lower than the published producer price for germanium metal, owing to the development of a worldwide excess of supply relative to demand.

Germanium was designated a strategic and critical material and was included in the National Defense Stockpile (NDS) in 1984 with an initial goal of 30,000 kilograms of germanium metal. In 1987, a new NDS goal of 146,000 kilograms was established on the basis of U.S. Department of Defense

estimates for actual emergency conditions of mobilization. In 1991, the goal was adjusted downwards to 68,000 kilograms. In 1995, the Defense Logistics Agency, which manages the NDS, made plans to sell germanium from the stockpile at the rate of 4,000 kilograms per year, through 2005. The release rate was increased to 6,000 kilograms per year in 1997, the first year of actual sales, and to 8,000 kilograms per year in 1998 (U.S. Department of Defense, 1998). Yearend 1998 inventory was 54,300 kilograms (Defense Logistics Agency, oral commun., 1999).

Starting in 1995, the producer price rose again and fluctuated around \$1,500 per kilogram. It reached \$2,000 per kilogram in 1996. The higher price levels were due to increased demand and shortages in production. The gradual releases of germanium from the U.S., Russian, and Ukrainian stockpiles with the lowering of world military tensions tended to stabilize prices.

Historically, the supply of germanium has been more than adequate to meet demand, and throughout its relatively short industrial existence, germanium has remained a "high-tech" material.

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(Dollars per kilogram)

Year	Price	Year	Price	Year	Price	Year	Price
1945	441	1959	350	1973	293	1987	1,060
1946	397	1960	300	1974	293	1988	1,060
1947	397	1961	300	1975	293	1989	1,060
1948	507	1962	300	1976	293	1990	1,060
1949	727	1963	270	1977	314	1991	1,060
1950	397	1964	270	1978	319	1992	1,060
1951	397	1965	270	1979	398	1993	1,060
1952	484	1966	175	1980	653	1994	1,060
1953	720	1967	175	1981	911	1995	1,375
1954	650	1968	175	1982	1,060	1996	2,000
1955	650	1969	185	1983	1,060	1997	1,475
1956	535	1970	280	1984	1,060	1998	1,700
1957	445	1971	293	1985	1,060		
1958	445	1972	293	1986	1,060		

Note:

1945-57, Domestic price for 99.9%-pure germanium, *in* E & MJ Metal and Mineral Markets.

1957-66, Domestic price for zone-refined germanium (99.9999% pure), *in* E & MJ Metal and Mineral Markets.

1967-81, Domestic price for zone-refined germanium (99.9999% pure), *in* Metals Week.

1982-93, U.S. producer price for zone-refined germanium (99.9999% pure), *in* Metals Week [through June 14, 1993].

1993-94, U.S. producer price for zone-refined germanium (99.9999% pure), *in* Platt's Metals Week.

1995-98, U.S. producer price quotes for zone-refined germanium (99.9999% pure), *in* U.S. Geological Survey, Minerals Yearbook.