

The Obsolete Copper Scrap Inventory

Accumulation and Availability, 1982-2003

SUBMITTED TO

Bureau of Industry and Security
U.S. Department of Commerce
Docket No. 040419121-4121-01



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May 19, 2004

Executive Summary

The U.S. inventory of obsolete copper scrap has grown steadily since 1982 (Table 1). Net additions to inventory through 2003 totaled 36.5 billion pounds, or 1.7 billion pounds per year.

The U.S. inventory of obsolete copper scrap has been and will continue to be an adequate source of supply for copper scrap demand. At the end of 2003, inventory had reached 112.4 billion pounds. Recycled new (prompt) and obsolete copper scrap in 2003 was equivalent to only 3.6% of the inventory of obsolete copper scrap, the average percentage from 1982 through 2003.

Obsolete copper scrap consists of copper contained in installed or in-place products in the U.S. economy. These products, which can be grouped into five end-use product categories, are manufactured by at least 35 industries defined at the 6-digit level of the North American Industrial Classification System (Figure 1). Whether in the form of electrical wiring in a building, plumbing pipes and fixtures, sheet roofing, or other products, the defining characteristic of obsolete copper scrap is that it is used and in a position to be reclaimed.

Generally, the inventory of obsolete copper scrap can be thought of as a pool of copper-containing products, the size of which fluctuates according to rates of additions to and withdrawals from the pool. Additions to the pool occur as products containing copper reach the ends of their useful economic lives. Withdrawals occur as the copper in these products is removed and recycled by industries that utilize copper as a manufacturing or fabricating input.

In the normal business sense of the word, inventory is a stock of immediately available materials or products used to even out market fluctuations in supply and demand. But not all obsolete copper scrap is immediately available for use. Products containing copper must first reach the ends of their useful lives, and then their copper content must be extracted and recycled.

For determining the size of the inventory of obsolete copper scrap, the narrow notion of business inventories must be broadened by incorporating geologic concepts of resources and reserves. In geology, resources are concentrations of elements in the earth's crust or under the sea existing in such a form that they may be extracted and used. Reserves are masses of rock whose extent and grade are known to a lesser degree and whose physical natures are such that they may be extracted at a profit with existing technology and present price levels.

These concepts have technical discovery and economic dimensions, only the latter of which is especially relevant to defining the inventory of obsolete copper scrap. In geology, resources are presumed to exist but must be discovered; measured as “proved” in terms of composition, grade, and quantity; and either employed, held for future use, or abandoned. The technical discovery dimension is not relevant to copper scrap. Copper scrap exists in and can be derived from copper-containing products that have reached the ends of their useful lives.

Focusing on the technical economic dimension leads to a three-part classification that provides insight into the different ways in which the inventory of obsolete copper scrap can be defined.

- Resources of copper scrap: Copper-containing products located on the earth’s surface or in land fills, existing in a form that allows extraction and use.
- Potential reserves of copper scrap: Concentrations of known or inferred quantity in an immediately usable condition that can be recovered within the constraints of high but realistic prices, *i.e.*, prices possibly several times higher than current prices.
- Reserves of copper scrap: Concentrations of known extent and quality economically recoverable at generally prevailing prices using known technology.

The most appropriate definition of the inventory of obsolete copper scrap is potential reserves. As a concept, potential reserves include only material that is relatively accessible and that offers the advantage of scrap, *i.e.*, existing in a metallic state not needing further reduction. Therefore, potential reserves of obsolete copper scrap can be drawn from within a short time frame when scrap is demanded by the economy and prices reach appropriate levels.

In contrast to potential reserves, a measure of the larger pool of “resources” includes material that is economical to access only in emergency situations such as wartime conditions.

A measure of the smaller pool of “reserves” inadequately accounts for the relationship between scrap price fluctuations that have occurred during the past and movements of obsolete copper scrap from the pool of resources to the pool of potential reserves.

Inventory defined as the potential reserves of obsolete copper scrap recognizes the economic relationship between the availability and price of copper scrap. Measuring potential reserves reflects the reality that additional scrap will be available at higher than current, but still realistic prices. The quantity of copper scrap recycled varies with the price of copper scrap. As price increases, the amount of copper scrap recycled increases.

Table 1

U.S. Inventory of Obsolete Copper Scrap, 1982-2003 (million pounds)

Year	Starting Inventory (1)	Net Change in Inventory of Obsolete Scrap (2)	Year End Inventory (b) (3) = (1) + (2)	Total Copper in Recycled Scrap (c) (4)	Total Copper in Recycled Scrap as a Share of Year End Inventory (5) = (4) / (3)
1982	-	-	75,911	2,870	3.8%
1983	75,911	1,761	77,672	2,610	3.4%
1984	77,672	1,788	79,460	2,802	3.5%
1985	79,460	1,660	81,120	3,008	3.7%
1986	81,120	1,710	82,830	3,002	3.6%
1987	82,830	1,676	84,506	3,181	3.8%
1988	84,506	1,404	85,911	3,432	4.0%
1989	85,911	1,409	87,320	3,532	4.0%
1990	87,320	1,488	88,808	3,464	3.9%
1991	88,808	1,674	90,483	3,205	3.5%
1992	90,483	1,730	92,213	3,267	3.5%
1993	92,213	1,784	93,997	3,330	3.5%
1994	93,997	1,730	95,727	3,584	3.7%
1995	95,727	1,680	97,407	3,766	3.9%
1996	97,407	1,877	99,284	3,623	3.6%
1997	99,284	1,815	101,099	3,932	3.9%
1998	101,099	2,083	103,182	3,694	3.6%
1999	103,182	2,207	105,389	3,511	3.3%
2000	105,389	1,628	107,017	3,803	3.6%
2001	107,017	2,003	109,020	3,542	3.2%
2002	109,020	1,666	110,686	3,927	3.5%
2003	110,686	1,678	112,364	4,054	3.6%
1983-2003	-	36,453	-	72,268	3.6%

[a] See Table 2.

[b] 1982 is the cumulative resource of copper as estimated in Jolly (2002) multiplied by 0.6659 to convert a resource-based measure to a potential reserves measure. Successive years equal starting inventory plus inventory change in column 2.

[c] Equals the sum of Total Copper in Recycled Scrap Consumed in U.S. (Table 10, column 3) and Total Copper in Exports of Copper Scrap (Table 11, column 2). Includes prompt and obsolete scrap.

Source: Nathan Associates Inc.

Figure 1*End-Use Product Categories and Component Industries*

End-Use Category	Component Industry	NAICS Codes Included
Building Construction	Building Wire	331422
	Plumbing and Heating	332913, 332998
	Air Conditioning and Commercial Refrigeration	333415, 334512
	Builders Hardware	335932
	Architectural	332323
Electrical and Electronic Products	Power Utilities	221121
	Telecommunications	234920, 334210
	Business Electronics	334111
	Lighting and Wiring Devices	335121, 335122
Industrial Machinery and Equipment	In-Plant Equipment	
	Industrial Valves and Fittings	332911
	Non-Electrical Instruments	334515, 334513
	Off-Highway Vehicles	333120, 336999
	Heat Exchangers	332410
Transportation Equipment	Automobile	332510
	Truck and Bus	336211, 335931
	Railroad	336510
	Marine	336611
	Aircraft and Aerospace	336413, 332510
Consumer and General Products	Appliances	333319, 335222
	Cord Sets	314991
	Military and Commercial Ordnance	332992, 332993
	Consumer Electronics	334310, 334111
	Fasteners and Closures	332115, 339993
	Coinage	339911
	Utensils and Cutlery	332211
	Miscellaneous	

Source: Nathan Associates Inc.

Table 2

Calculation of Annual Net Changes in the U.S. Inventory of Obsolete Copper Scrap, 1983-2003
(million pounds)

Year	Additions to Potential Reserves (a) (1)	Total New (Prompt) and Obsolete Scrap Recovered (b) (2)	Withdrawals from Potential Reserves (c) (3)	Net Change in Inventory of Obsolete Scrap (4) = (1) - (3)
1983	3,075	2,489	1,315	1,761
1984	3,216	2,681	1,428	1,788
1985	3,257	2,905	1,597	1,660
1986	3,248	2,878	1,538	1,710
1987	3,327	3,035	1,651	1,676
1988	3,271	3,270	1,867	1,404
1989	3,378	3,337	1,968	1,409
1990	3,397	3,228	1,909	1,488
1991	3,365	2,987	1,691	1,674
1992	3,388	2,967	1,658	1,730
1993	3,367	2,984	1,583	1,784
1994	3,516	3,267	1,786	1,730
1995	3,538	3,417	1,857	1,680
1996	3,495	3,230	1,618	1,877
1997	3,678	3,539	1,863	1,815
1998	3,719	3,397	1,636	2,083
1999	3,659	3,273	1,452	2,207
2000	3,410	3,556	1,782	1,628
2001	3,685	3,342	1,682	2,003
2002	3,811	3,703	2,145	1,666
2003	3,960	3,855	2,282	1,678
1983-2001	72,760	67,341	36,307	36,453

[a] See Table 3.

[b] Total copper in recycled scrap consumed in the United States minus total copper in scrap imports plus total copper in scrap exports. See Tables 10 and 11.

[c] Equals column 2 minus the 3-year moving average of prompt scrap generated. See Table 3, column 4.

Source: Nathan Associates Inc.

Table 3

Calculation of Additions to Potential Reserves of Obsolete Copper Scrap, 1983-2003 (million pounds)

Year	Copper in U.S. End-Use Markets (a) (1)	3-Year Moving Average (2)	New (Prompt) Copper Scrap Generated (b) (3)	3-Year Moving Average (4)	Copper in U.S. Consumed End-Use Products (c) (5) = (2) - (4)	Newly Obsolete Copper Scrap (d) (6)	Non-Recoverable Obsolete Copper Scrap (e) (7)	Additions to Potential Reserves (d) - (6) - (7) (8)
1982	4,908	-	1,040	-	-	4,984	2,063	2,921
1983	5,346	5,481	1,149	1,174	4,307	5,122	2,047	3,075
1984	6,188	5,786	1,334	1,253	4,533	5,388	2,171	3,216
1985	5,823	6,001	1,275	1,308	4,693	5,488	2,231	3,257
1986	5,992	6,091	1,316	1,340	4,751	5,479	2,231	3,248
1987	6,456	6,290	1,429	1,385	4,906	5,647	2,320	3,327
1988	6,423	6,379	1,409	1,403	4,976	5,518	2,247	3,271
1989	6,258	6,249	1,372	1,368	4,881	5,681	2,304	3,378
1990	6,067	6,024	1,324	1,319	4,705	5,664	2,267	3,397
1991	5,745	5,932	1,261	1,297	4,635	5,619	2,254	3,365
1992	5,983	5,988	1,306	1,309	4,679	5,731	2,343	3,388
1993	6,234	6,423	1,359	1,401	5,021	5,626	2,259	3,367
1994	7,051	6,785	1,539	1,481	5,304	5,848	2,332	3,516
1995	7,070	7,151	1,544	1,560	5,592	5,930	2,393	3,538
1996	7,333	7,349	1,596	1,612	5,737	5,860	2,365	3,495
1997	7,645	7,652	1,696	1,677	5,975	6,116	2,438	3,678
1998	7,977	8,015	1,738	1,761	6,254	6,188	2,469	3,719
1999	8,423	8,334	1,850	1,822	6,512	6,086	2,428	3,659
2000	8,602	8,072	1,877	1,774	6,298	5,791	2,381	3,410
2001	7,192	7,501	1,596	1,659	5,842	6,221	2,535	3,685
2002	6,711	7,014	1,504	1,558	5,456	6,442	2,632	3,811
2003	7,140	7,140	1,573	1,573	5,567	6,668	2,708	3,960
1983-2003	141,660	-	31,047	-	110,624	122,114	49,354	72,760

[a] See Table 4 column 7.

[b] Equals sum of column 4 in Tables 5 through 9.

[c] Equals consumption of U.S. production and imports.

[d] Equals sum of column 7 in Tables 5 through 9.

[e] Equals sum of column 8 in Tables 5 through 9.

Source: Nathan Associates Inc.

Table 4

Calculation of Copper in U.S. End-Use Markets, 1982-2003 (million pounds)

Year	Copper and Alloys in U.S. Produced Products (a) (1)	Alloying Metals in U.S. Produced Products (b) (2)	Copper Content in U.S. Produced Products (3) = (1) - (2)	Copper Content Percentage (4) = (3)/(1)	Imports of Copper and Alloys (c) (5)	Copper Content of Imports (6) = (5) x (4)	Copper in U.S. End-Use Markets (7) = (3) + (6)
1982	5,158	464	4,694	91.0	235	214	4,908
1983	5,612	572	5,040	89.8	341	306	5,346
1984	6,351	664	5,687	89.5	560	501	6,188
1985	5,911	530	5,381	91.0	486	442	5,823
1986	6,072	546	5,526	91.0	512	466	5,992
1987	6,652	610	6,042	90.8	456	414	6,456
1988	6,731	642	6,089	90.5	369	334	6,423
1989	6,598	598	6,000	90.9	284	258	6,258
1990	6,468	580	5,888	91.0	197	179	6,067
1991	6,266	576	5,690	90.8	61	55	5,745
1992	6,586	640	5,946	90.3	41	37	5,983
1993	6,862	662	6,200	90.4	38	34	6,234
1994	7,675	746	6,929	90.3	135	122	7,051
1995	7,492	570	6,922	92.4	160	148	7,070
1996	7,849	590	7,259	92.5	80	74	7,333
1997	8,157	600	7,557	92.6	95	88	7,645
1998	8,436	614	7,822	92.7	167	155	7,977
1999	8,775	642	8,133	92.7	313	290	8,423
2000	8,800	672	8,128	92.4	513	474	8,602
2001	7,581	574	7,007	92.4	200	185	7,192
2002	7,139	588	6,551	91.8	174	160	6,711
2003	7,606	626	6,980	91.8	174	160	7,140

[a] See Cooper Development Association, Annual Data 2003: Copper, Brass and Bronze, 1982-2002, Table 4, line 20.

[b] See Cooper Development Association, Annual Data 2003: Copper, Brass and Bronze, 1982-2002, Table 3, item 12.

[c] See Cooper Development Association, Annual Data 2003: Copper, Brass and Bronze, 1982-2002, Table 4, line 21.

Source: Nathan Associates Inc.

Table 5

Calculation of Additions to Potential Reserves in Building Construction End-Use Market, 1982-2003 (million pounds)

Year	Copper and Alloys Consumed in U.S. Production of End-Use Products (a)	Copper Consumed in U.S. Production of End-Use Products (b)	3-Year Moving Average (c)	Prompt Scrap Generation in U.S. Production of End-Use Products (d)	3-Year Moving Average (e)	Copper in U.S. Produced End-Use Products (f) = (a) - (b)	Newly Obsolete Copper Scrap (g)	Non-Recoverable Scrap (h)	Additions to Potential Reserves (i) = (g) - (h)
1982	1,857	1,690	-	477	-	-	1,334	427	907
1983	2,197	1,973	1,988	556	560	1,427	1,792	574	1,219
1984	2,568	2,300	2,209	648	623	1,586	1,756	562	1,194
1985	2,587	2,355	2,376	664	670	1,706	1,847	591	1,256
1986	2,719	2,475	2,532	698	714	1,818	1,753	561	1,192
1987	3,047	2,768	2,624	780	740	1,884	1,684	539	1,145
1988	2,908	2,631	2,648	742	747	1,901	1,634	523	1,111
1989	2,799	2,545	2,543	718	717	1,826	1,678	537	1,141
1990	2,696	2,454	2,464	692	695	1,769	1,700	544	1,156
1991	2,635	2,393	2,429	675	685	1,744	1,512	484	1,028
1992	2,702	2,439	2,462	688	694	1,767	1,622	519	1,103
1993	2,825	2,552	2,621	720	739	1,882	1,663	532	1,131
1994	3,179	2,870	2,763	809	779	1,984	1,771	567	1,204
1995	3,104	2,868	2,905	809	819	2,086	1,825	584	1,241
1996	3,220	2,978	3,020	840	852	2,168	1,724	552	1,172
1997	3,469	3,214	3,178	906	896	2,282	1,859	595	1,264
1998	3,604	3,342	3,390	942	956	2,434	1,805	577	1,227
1999	3,900	3,615	3,514	1,019	991	2,523	1,755	562	1,193
2000	3,881	3,585	3,485	1,011	983	2,502	1,576	504	1,072
2001	3,522	3,255	3,315	918	935	2,380	1,793	574	1,219
2002	3,384	3,105	3,122	876	880	2,242	1,833	586	1,246
2003	3,275	3,005	3,005	848	848	2,158	1,885	603	1,282
1983-2003	64,221	58,721	58,594	16,559	-	42,070	37,801	12,096	25,705

[a] See Table 15, column 1.

[b] Equals column 1 times copper as a percentage of copper and alloys. See Table 4, column 4.

[c] Equals column 2 times prompt scrap generation rate for Building Construction category in Table 12.

[d] Includes copper in U.S. produced and exported products.

[e] Newly obsolete copper scrap is based on existing copper-containing products in the U.S. end-use market and the useful economic lives of these products. Existing products include imports. Data from Table 15, column 1 are multiplied by the net import factor for Building Construction in Table 13 to yield annual net imports of Building Construction end-use products. Each year's newly obsolete copper scrap is the copper content of products that reached the end of their useful economic lives during the year.

[f] Equals column 7 times 1 minus the recovery rate for the Building Construction category in Table 14.

Source: Nathan Associates Inc.

Table 6

Calculation of Additions to Potential Reserves in the Electrical and Electronics End-Use Market, 1982-2003 (million pounds)

Year	Copper and Alloys Consumed in U.S. Production of End-Use Products (a)	Copper Consumed in U.S. Production of End-Use Products (b)	3-Year Moving Average (c)	Prompt Scrap Generated in U.S. Production of End-Use Products (d)	3-Year Moving Average (e)	Copper in U.S. Produced End-Use Products (f) (f) = (a) - (e)	Newly Obsolete Copper Scrap (g)	Non-Recoverable Scrap (h)	Additions to Potential Reserves (i) = (g) - (h)
1982	1,489	1,355	-	194	-	-	1,612	903	709
1983	1,517	1,362	1,413	195	202	1,211	1,312	735	577
1984	1,699	1,521	1,408	218	201	1,207	1,507	844	663
1985	1,472	1,340	1,419	192	203	1,216	1,574	882	693
1986	1,533	1,395	1,406	200	201	1,205	1,620	907	713
1987	1,633	1,483	1,460	212	209	1,251	1,769	990	778
1988	1,660	1,502	1,484	215	212	1,271	1,665	933	733
1989	1,612	1,466	1,491	210	213	1,278	1,688	945	743
1990	1,655	1,507	1,456	215	208	1,248	1,602	897	705
1991	1,537	1,396	1,465	200	210	1,256	1,609	901	708
1992	1,655	1,494	1,494	214	214	1,280	1,752	981	771
1993	1,761	1,591	1,610	228	230	1,380	1,556	871	685
1994	1,934	1,746	1,714	250	245	1,469	1,612	902	709
1995	1,955	1,806	1,813	258	259	1,553	1,691	947	744
1996	2,039	1,886	1,896	270	271	1,625	1,697	951	747
1997	2,154	1,996	2,013	285	288	1,725	1,689	946	743
1998	2,327	2,158	2,115	309	302	1,813	1,764	988	776
1999	2,366	2,193	2,220	314	317	1,903	1,685	944	741
2000	2,501	2,310	2,115	330	302	1,813	1,778	996	782
2001	1,994	1,843	1,893	264	271	1,622	1,880	1,053	827
2002	1,662	1,525	1,694	218	242	1,452	2,018	1,130	888
2003	1,869	1,715	1,715	245	245	1,470	2,057	1,152	905
1983-2003	38,535	35,235	-	5,039	-	30,248	35,526	19,894	15,631

[a] See Table 15, column 2.

[b] Equals column 1 times copper as a percentage of copper and alloys. See Table 4, column 4.

[c] Equals column 2 times prompt scrap generation rate for electrical and electronic products category in Table 12.

[d] Includes copper in U.S. produced and exported products.

[e] Newly obsolete copper scrap is based on existing copper-containing products in the U.S. end-use market and the useful economic lives of these products. Existing products include imports. Data from Table 15, column 2 are multiplied by the net import factor for electrical and electronic products in Table 13 to yield annual net imports of electrical and electronic end-use products. Each year's newly obsolete copper scrap is the copper content of products that reached the end of their useful economic lives during the year.

[f] Equals column 7 times 1 minus the recovery rate for the electrical and electronic products category in Table 14.

Source: Nathan Associates Inc.

Table 7

Calculation of Additions to Potential Reserves in the Industrial Machinery and Equipment End-Use Market, 1982-2003 (million pounds)

Year	Copper and Alloys Consumed in U.S. Production of End-Use Products (a)	Copper Consumed in U.S. Production of End-Use Products (b)	3-Year Moving Average (c)	Prompt Scrap Generation in U.S. Production of End-Use Products (d)	3-Year Moving Average (e)	Copper in U.S. Produced End-Use Products (f) (b) - (d) - (e)	Newly Obsolete Copper Scrap (g)	Non-Recoverable Scrap (h)	Additions to Potential Reserves (i) = (f) - (g) - (h)
1982	849	773	-	156	-	-	686	130	556
1983	906	814	826	164	167	659	637	121	516
1984	995	891	841	180	170	671	711	135	576
1985	898	817	842	165	170	672	645	123	523
1986	899	818	830	165	168	663	695	132	563
1987	942	856	857	173	173	684	747	142	605
1988	993	898	882	181	178	704	779	148	631
1989	981	892	870	180	176	695	840	160	680
1990	902	821	819	166	165	654	891	169	722
1991	820	745	780	150	158	623	955	181	773
1992	858	775	755	156	152	602	810	154	656
1993	825	745	796	151	161	635	857	163	694
1994	962	868	824	175	167	658	925	176	749
1995	934	860	869	174	176	693	841	160	682
1996	950	879	864	177	175	690	869	165	704
1997	942	855	872	173	176	695	961	183	779
1998	948	881	889	178	180	710	1,006	191	815
1999	1,005	931	895	188	181	715	992	188	803
2000	946	874	832	176	168	664	778	148	630
2001	748	691	743	140	150	593	875	166	708
2002	725	665	665	134	139	526	928	176	751
2003	734	708	708	143	143	565	1,020	194	826
1983-2003	18,913	17,284	-	3,489	-	13,771	17,763	3,375	14,388

[a] See Table 15, column 3.

[b] Equals column 1 times copper as a percentage of copper and alloys. See Table 4, column 4.

[c] Equals column 2 times prompt scrap generation rate for industrial machinery and equipment category in Table 12.

[d] Includes copper in U.S. produced and exported products.

[e] Newly obsolete copper scrap is based on existing copper-containing products in the U.S. end-use market and the useful economic lives of these products. Existing products include imports. Data from Table 15, column 3 are multiplied by the net import factor for industrial machinery and equipment products in Table 13 to yield annual net imports of end-use products. Each year's newly obsolete copper scrap is the copper content of products that reached the end of their useful economic lives during the year.

[f] Equals column 7 times 1 minus the recovery rate for the industrial machinery and equipment category in Table 14.

Source: Nathan Associates Inc.

Table 8

Calculation of Additions to Potential Reserves in the Transportation Equipment End-Use Market, 1982-2003 (million pounds)

Year	Copper and Alloys Consumed in U.S. Production of End-Use Products (a)	Copper Consumed in U.S. Production of End-Use Products (b)	3-Year Moving Average (c)	Prompt Scrap Generated in U.S. Production of End-Use Products (d)	3-Year Moving Average (e)	Copper in U.S. Produced End-Use Products (f) = (a) - (e)	Newly Obsolete Copper Scrap (g)	Non-Recoverable Scrap (h)	Additions to Potential Reserves (i) = (g) - (h)
1982	568	517	-	97	-	-	701	245	456
1983	708	636	650	120	122	528	709	248	461
1984	891	798	725	150	136	589	735	257	478
1985	814	741	760	139	143	617	733	256	476
1986	814	741	741	139	139	602	728	255	473
1987	817	742	749	140	141	608	736	258	478
1988	844	763	746	144	140	606	743	260	483
1989	806	733	732	138	138	595	748	262	486
1990	770	701	694	132	131	564	762	267	496
1991	715	649	683	122	128	555	804	281	523
1992	774	699	714	131	134	580	808	283	525
1993	878	793	786	149	148	638	800	280	520
1994	959	866	842	163	158	684	801	280	521
1995	943	868	879	163	165	714	817	286	531
1996	978	904	905	170	170	735	830	291	540
1997	1,038	942	880	177	166	715	844	295	548
1998	855	795	862	149	162	700	872	305	567
1999	915	848	825	159	155	670	880	308	572
2000	902	833	782	157	147	635	896	314	583
2001	719	665	727	125	137	590	887	311	577
2002	744	683	683	128	128	555	882	309	573
2003	718	692	692	130	130	562	895	313	582
1983-2003	17,602	16,092	-	3,025	-	13,042	16,910	5,919	10,992

[a] See Table 15, column 4.

[b] Equals column 1 times copper as a percentage of copper and alloys. See Table 4, column 4.

[c] Equals column 2 times prompt scrap generation rate for transportation equipment category in Table 12.

[d] Includes copper in U.S. produced and exported products.

[e] Newly obsolete copper scrap is based on existing copper-containing products in the U.S. end-use market and the useful economic lives of these products. Existing products include imports. Data from Table 15, column 4 are multiplied by the net import factor for transportation equipment products in Table 13 to yield annual net imports of end-use products. Each year's newly obsolete copper scrap is the copper content of products that reached the end of their useful economic lives during the year.

[f] Equals column 7 times 1 minus the recovery rate for the transportation equipment category in Table 14.

Source: Nathan Associates Inc.

Table 9

Calculation of Additions to Potential Reserves in the Consumer and General Products End-Use Market, 1982-2003 (million pounds)

Year	Copper and Alloys Consumed in U.S. Production of End-Use Products (a)	Copper Consumed in U.S. Production of End-Use Products (b)	3-Year Moving Average (c)	Prompt Scrap Generated in U.S. Production of End-Use Products (d)	3-Year Moving Average (e)	Copper in U.S. Produced End-Use Products (f) = (a) - (e)	Newly Obsolete Copper Scrap (g)	Non-Recoverable Scrap (h)	Additions to Potential Reserves (i) = (g) - (h)
1982	630	573	-	116	-	-	651	358	293
1983	625	561	604	114	123	482	672	369	302
1984	758	679	603	138	122	481	678	373	305
1985	626	570	604	116	123	481	689	379	310
1986	619	563	580	114	118	462	683	376	307
1987	669	608	600	123	122	478	710	390	319
1988	695	629	620	128	126	494	697	383	314
1989	685	623	612	126	124	488	728	400	327
1990	642	584	590	119	120	470	709	390	319
1991	620	563	574	114	117	458	740	407	333
1992	638	576	564	117	114	449	738	406	332
1993	611	552	610	112	124	486	751	413	338
1994	776	701	647	142	131	516	740	407	333
1995	746	689	692	140	140	552	757	416	340
1996	742	686	712	139	145	567	740	407	333
1997	821	761	745	154	151	594	763	420	343
1998	849	787	795	160	161	633	742	408	334
1999	902	836	875	170	178	697	775	426	349
2000	1,083	1,000	858	203	174	684	762	419	343
2001	798	738	823	150	167	656	785	432	353
2002	798	732	830	149	168	661	782	430	352
2003	1,111	1,020	1,020	207	207	813	811	446	365
1983-2003	####	14,205	-	2,884	-	11,319	####	8,497	6,952

[a] See Table 15, column 5.

[b] Equals column 1 times copper as a percentage of copper and alloys. See Table 4, column 4.

[c] Equals column 2 times prompt scrap generation rate for the consumer and general products category in Table 12.

[d] Includes copper in U.S. produced and exported products.

[e] Newly obsolete copper scrap is based on existing copper-containing products in the U.S. end-use market and the useful economic lives of these products. Existing products include imports. Data from Table 15, column 5 are multiplied by the net import factor for consumer and general products in Table 13 to yield annual net imports of end-use products. Each year's newly obsolete copper scrap is the copper content of products that reached the end of their useful economic lives during the year.

[f] Equals column 7 times 1 minus the recovery rate for the consumer and general products category in Table 14.

Source: Nathan Associates Inc.

Table 10*Total Copper in Recycled Scrap Consumed in U.S., 1982-2001*

Year	Secondary Production (a) (1)	New Scrap (b) (2)	Total Copper in Recycled Scrap Consumed in U.S. (3) = (1) + (2)
1982	1,142	1,477	2,619
1983	990	1,398	2,388
1984	1,016	1,453	2,469
1985	1,109	1,402	2,511
1986	1,052	1,431	2,483
1987	1,098	1,578	2,676
1988	1,142	1,739	2,881
1989	1,208	1,678	2,886
1990	1,182	1,709	2,891
1991	1,175	1,470	2,645
1992	1,221	1,592	2,813
1993	1,197	1,649	2,846
1994	1,102	1,823	2,925
1995	977	1,927	2,904
1996	944	1,964	2,908
1997	1,098	2,132	3,230
1998	1,027	2,108	3,135
1999	840	2,092	2,932
2000	787	2,105	2,892
2001	697	1,836	2,533

[a] As reported by the USGS, secondary production describes the quantity of copper recovered from old scrap. See Copper Worksheet Notes of source below for definition.

[b] The USGS defines new scrap as the "quantity of copper that is recovered from copper and copper alloy scrap generated during manufacturing and returned to smelters, fire refineries, brass mills, etc. for reprocessing." See Copper Worksheet Notes of source below for definition.

Source: U.S. Geological Survey Open-File Report 01-006
 Historical Statistics for Mineral and Material Commodities in the United States, "Copper Statistics" available online at
<http://minerals.usgs.gov/minerals/pubs/of01-006/copper.pdf>

Table 12*Prompt Scrap Generation Percentages by Copper End-Use Category*

End-Use Category	Prompt Scrap Percentage
Building Construction	28.2
Electrical and Electronic Products	14.3
Industrial Machinery and Equipment	20.2
Transportation Equipment	18.8
Consumer and General Products	20.3

Sources: U.S. Business and Defense Services Administration, "Industrial Scrap Generation: Iron and Steel, Copper, Aluminum," 1957 and Nathan Associates Inc.

Table 13*Net Import Factors*

End-Use Category	Factor (a)
Building Construction	8%
Electrical and Electronic Products	5%
Industrial Machinery and Equipment	10%
Transportation Equipment	12%
Consumer and General Products	18%

[a] The net import factor is derived by dividing the dollar value of net imports by the dollar value of output for each end-use category.

Sources: U.S. Department of Commerce, Bureau of Economic Analysis (gross domestic product); Bureau of Labor Statistics, "Occupational Outlook Quarterly Online," Vol. 47, No. 4, Winter 2003-4 (GDP by end-use); U.S. Department of Commerce, International Trade Administration (Imports data); and Nathan Associates Inc.

Table 14*Recovery Rates of Copper by End-Use*

End-Use Category	Recovery Rate (a)
Building Construction	68%
Electrical and Electronic Products	44%
Industrial Machinery and Equipment	81%
Transportation Equipment	65%
Consumer and General Products	45%

[a] Recovery rates for building construction and industrial machinery were taken directly from Ayres, et al. The recovery rate of electrical and electronic products is estimated as the average of electrical products, electrical appliances and computers; transportation equipment is estimated as the average of railroad equipment and automobiles (weighting automobiles twice); consumer and general products is estimated as the average of large appliances and electrical appliances.

Source: Ayres, Robert U. et al., "The Life Cycle of Copper, its Co-Products and By-Products," *Mining, Minerals and Sustainable Development, International Institute for Environment and Development*, January 2002.

Table 15*Copper Consumed in U.S. End Use Markets, 1932-2002 [a] (million pounds)*

Year	Building Construction (1)	Electrical and Electronic Products (2)	Industrial Machinery and Equipment (3)	Transportation Equipment (4)	Consumer and General Products (5)	Total End Use Consumption (6)	U.S. Apparent Consumption (7)
1932	356	253	148	117	108	982	1,043
1933	468	332	194	153	142	1,290	1,371
1934	351	249	146	115	107	968	1,029
1935	622	442	258	204	189	1,715	1,823
1936	820	582	340	268	249	2,260	2,402
1937	838	595	348	274	255	2,310	2,456
1938	545	387	226	178	166	1,503	1,598
1939	862	613	358	282	262	2,377	2,527
1940	1,077	765	447	353	327	2,970	3,157
1941	1,690	1,201	702	553	514	4,659	4,953
1942	1,666	1,184	692	545	507	4,594	4,883
1943	1,771	1,258	735	580	538	4,883	5,190
1944	1,641	1,166	681	537	499	4,524	4,809
1945	1,583	1,125	658	518	481	4,366	4,640
1946	1,561	1,109	648	511	474	4,303	4,573
1947	1,527	1,085	634	500	464	4,210	4,475
1948	1,526	1,084	634	499	464	4,207	4,472
1949	1,228	872	510	402	373	3,385	3,598
1950	1,342	953	557	439	408	3,699	3,932
1951	1,484	1,054	616	486	451	4,091	4,348
1952	1,549	1,101	643	507	471	4,270	4,539
1953	1,537	1,092	638	503	467	4,239	4,506
1954	1,291	917	536	422	392	3,558	3,782
1955	1,562	1,110	649	511	475	4,307	4,578
1956	1,513	1,075	628	495	460	4,170	4,433
1957	1,363	969	566	446	414	3,759	3,995
1958	1,245	885	517	407	379	3,433	3,649
1959	1,477	1,050	613	483	449	4,073	4,329
1960	1,394	990	579	456	424	3,843	4,085
1961	1,440	1,023	598	471	438	3,971	4,220
1962	1,579	1,122	656	517	480	4,354	4,628
1963	1,665	1,183	691	545	506	4,591	4,880
1964	1,760	1,250	731	576	535	4,851	5,156
1965	1,996	1,418	829	653	607	5,502	5,848
1966	2,213	1,572	919	724	673	6,101	6,485
1967	1,843	1,310	765	603	560	5,081	5,401
1968	1,912	1,359	794	626	581	5,272	5,604
1969	2,095	1,489	870	686	637	5,777	6,140
1970	1,876	1,333	779	614	570	5,171	5,497
1971	1,933	1,373	803	633	588	5,329	5,665
1972	2,185	1,553	908	715	664	6,025	6,404
1973	2,281	1,620	947	746	693	6,288	6,683
1974	2,194	1,559	911	718	667	6,049	6,429

Table 15 continued...

Table 15 (continued)

Year	Building Construction (1)	Electrical and Electronic Products (2)	Industrial Machinery and Equipment (3)	Transportation Equipment (4)	Consumer and General Products (5)	Total End Use Consumption (b) (6)	U.S. Apparent Consumption (c) (7)
1975	1,519	1,080	631	497	462	4,189	4,453
1976	1,943	1,381	807	636	591	5,357	5,694
1977	2,076	1,475	862	679	631	5,723	6,083
1978	2,350	1,670	976	769	714	6,478	6,886
1979	2,545	1,808	1,057	833	773	7,015	7,457
1980	2,259	1,605	938	739	687	6,229	6,621
1981	2,322	1,650	964	760	706	6,402	6,805
1982	1,857	1,489	849	568	630	5,393	5,362
1983	2,197	1,517	906	708	625	5,953	5,890
1984	2,568	1,699	995	891	758	6,911	6,110
1985	2,587	1,472	898	814	626	6,397	6,129
1986	2,719	1,533	899	814	619	6,584	6,140
1987	3,047	1,633	942	817	669	7,108	6,422
1988	2,908	1,660	993	844	695	7,100	6,622
1989	2,799	1,612	981	806	685	6,883	6,493
1990	2,696	1,655	902	770	642	6,665	6,486
1991	2,635	1,537	820	715	620	6,327	6,096
1992	2,702	1,655	858	774	638	6,627	6,674
1993	2,825	1,761	825	878	611	6,900	7,179
1994	3,179	1,934	962	959	776	7,810	7,743
1995	3,104	1,955	934	943	746	7,682	7,522
1996	3,220	2,039	950	978	742	7,929	8,197
1997	3,469	2,154	942	1,038	821	8,424	8,609
1998	3,604	2,327	948	855	849	8,583	8,689
1999	3,900	2,366	1,005	915	902	9,088	8,814
2000	3,881	2,501	946	902	1,083	9,313	9,014
2001	3,522	1,994	748	719	798	7,781	6,917
2002	3,384	1,662	725	744	798	7,313	-

[a] Copper only for 1932-1981. Copper and alloys for 1982-2002.

[b] Total End Use Consumption is estimated for 1932 through 1981. Actual values are reported for 1982 through 2002. The estimation procedure uses Total End Use Consumption as a percentage of Apparent Consumption for the period 1982-2001. This average is multiplied by actual apparent consumption from 1932 to 1981 to estimate End Use Consumption for that period. A second estimation technique is used to parse out consumption by End-Use Category. The average percentages of total end use consumption were calculated for each of the five categories for the period from 1982 through 1984. The resulting percentages were then multiplied in each year by the estimated total end use consumption figure to yield estimated consumption by category.

[c] See Copper Development Association, "The US Copper-base Scrap Industry and its By-products--2002", Table 6.

Sources: See notes.