



# 2012 Minerals Yearbook

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## RECYCLING—METALS

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# RECYCLING—METALS

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In 2012, the United States recycled 69.0 million metric tons (Mt) of selected metals, an amount equivalent to 59% of the apparent supply of those metals (table 1). More than 91% of recycled metal was steel, and more than 90% of apparent supply was steel. The United States exported 26.7 Mt of scrap metal and imported 5.3 Mt of these same metals (table 2).

Metals are important, reusable resources. Although the ultimate supply of metal is fixed by nature, human ingenuity determines the quantity available for use in developing economical processes to recover metal from the Earth and recycle metal from the use/process stream. The reusable nature of metals contributes to the sustainability of their use. Recycling, a significant factor in the supply of many of the metals used by society, provides environmental and economic benefits such as energy savings and reduced volumes of waste.

The term “primary” indicates material from ore deposits, and the term “secondary” indicates material from recycling, including used products and residuals from manufacturing. Recycling practices vary substantially among the metal industries. Generally, scrap is categorized as “new” or “old.” “New” indicates preconsumer sources, and “old,” postconsumer sources. The many stages of industrial processing that precede formation of an end product are the sources of new scrap. For example, when metal is converted into shapes—bars, plates, rods, or sheets—new scrap is generated in the form of cuttings, trimmings, and off-specification forms. When these shapes are converted to parts, additional new scrap may be generated in the form of cuttings, stampings, turnings, and off-specification parts. Similarly, when parts are assembled into products, new scrap may be generated. A wide variety of descriptive terms, many duplicative, including external scrap, home scrap, internal scrap, mill scrap, prompt scrap, and purchased scrap, has evolved to describe scrap generated by diverse industry practices.

Once a product completes its useful life, it becomes a source of old scrap. Used appliances, automobiles, and beverage cans are examples of sources of old consumer scrap; used jet engine

blades and vanes, junked machinery and ships, and metal recovered from commercial buildings or industrial plants are examples of old industrial scrap. The material flow of recycled metal commodities in the United States has been documented in a series of reports published by the U.S. Geological Survey (Sibley, 2006–11).

World recycling may be characterized by recycled content of materials and end-of-life recycling rate. One study on the recycling rate of 60 elements showed that the recycling rate of commonly used base metals, such as some of those reported for the United States in this chapter, exceeds 50% and that numerous elements used for very specific technical reasons are seldom recycled (Reck and Graedel, 2012). Another study developed recycling options for select waste electronic equipment to recover raw materials anticipated to be critical to future technologies. Recommended were increased collection rate, reduced illegal export, supportive national policy, improved disassembly, improved recycling methods, temporary storage of waste, and design (of equipment) for recycling (of that equipment) (Buchert and others, 2012).

Individual annual reviews for each of the metals listed in the tables are in the respective chapters in this volume of the U.S. Geological Survey Minerals Yearbook, volume I, Metals and Minerals.

## References Cited

- Buchert, Matthias, Manhart, Andreas, Bleher, Daniel, and Pingel, Detlef, 2012, Recycling critical raw materials from waste electronic equipment: Freiburg, Germany, Öko-Institut e.V., February 24, 80 p.
- Reck, B.K., and Graedel, T.E., 2012, Challenges in recycling: Science, August 10, v. 337, no. 6095, p. 690–695. (Accessed January 14, 2014, at [http://www.mmta.co.uk/uploads/2012/08/29/144558\\_science\\_recycling\\_review.pdf](http://www.mmta.co.uk/uploads/2012/08/29/144558_science_recycling_review.pdf).)
- Sibley, S.F., ed., 2006–11, Flow studies for recycling metal commodities in the United States: U.S. Geological Survey Circular 1196–A–Z–AA, the 27 chapters are separately paged and are available at <http://pubs.usgs.gov/circ/circ1196/>. (Accessed May 29, 2012, via <http://minerals.usgs.gov/minerals/pubs/commodity/recycle/>.)

TABLE 1  
SALIENT U.S. RECYCLING STATISTICS FOR SELECTED METALS<sup>1</sup>

Year	Quantity of metal (metric tons)				Percentage recycled <sup>6</sup>	Value of metal (thousands)			
	Recycled from new scrap <sup>2</sup>	Recycled from old scrap <sup>3</sup>	Recycled <sup>4</sup>	Apparent supply <sup>5</sup>		Recycled from new scrap <sup>2</sup>	Recycled from old scrap <sup>3</sup>	Recycled <sup>4</sup>	Apparent supply <sup>7</sup>
<b>Aluminum:</b> <sup>8</sup>									
2008	2,130,000	1,500,000	3,630,000	6,070,000	60	\$5,660,000	\$3,970,000	\$9,640,000	\$16,100,000
2009	1,570,000	1,260,000	2,820,000	4,890,000	58	2,740,000	2,200,000	4,940,000	8,550,000
2010	1,540,000	1,250,000	2,790,000	5,000,000	56	3,550,000	2,880,000	6,430,000	11,500,000
2011	1,640,000 <sup>r</sup>	1,470,000 <sup>r</sup>	3,120,000 <sup>r</sup>	5,210,000 <sup>r</sup>	60	4,200,000 <sup>r</sup>	3,770,000 <sup>r</sup>	7,980,000 <sup>r</sup>	13,300,000
2012	1,830,000	1,440,000	3,270,000	5,780,000	57	4,080,000	3,210,000	7,290,000	12,900,000
<b>Chromium:</b> <sup>9</sup>									
2008	NA	NA	146,000	432,000	34	NA	NA	491,000	2,600,000
2009	NA	NA	141,000	160,000	88	NA	NA	218,000	234,000
2010	NA	NA	144,000	384,000	37	NA	NA	329,000	800,000
2011	NA	NA	147,000	450,000 <sup>r</sup>	33	NA	NA	334,000 <sup>r</sup>	825,000 <sup>r</sup>
2012	NA	NA	146,000	470,000	31	NA	NA	491,000	999,000
<b>Copper:</b> <sup>10</sup>									
2008	700,000	159,000	859,000	2,700,000	32	4,930,000	1,120,000	6,050,000	18,900,000
2009	639,000	138,000	777,000	2,220,000	35	3,400,000	734,000	4,130,000	11,800,000
2010	642,000	143,000	785,000	2,400,000	33	4,930,000	1,100,000	6,030,000	18,400,000
2011	649,000	153,000	802,000	2,380,000	34	5,810,000	1,370,000	7,180,000	21,300,000
2012	629,000	163,000	792,000	2,400,000	33	5,090,000	1,320,000	6,410,000	19,400,000
<b>Iron and steel:</b> <sup>11</sup>									
2008	NA	NA	67,600,000	109,000,000	62	NA	NA	23,600,000	37,600,000
2009	NA	NA	53,500,000	69,300,000	77	NA	NA	10,900,000 <sup>r</sup>	12,600,000
2010	NA	NA	59,700,000	90,200,000	66	NA	NA	19,500,000 <sup>r</sup>	27,100,000
2011	NA	NA	62,800,000 <sup>r</sup>	99,300,000 <sup>r</sup>	63	NA	NA	25,400,000 <sup>r</sup>	37,000,000
2012	NA	NA	63,100,000	106,000,000	59	NA	NA	22,800,000	35,400,000
<b>Lead:</b> <sup>12</sup>									
2008	20,100	1,120,000	1,140,000	1,540,000	75	53,300	2,980,000	3,040,000	4,080,000
2009	21,600	1,090,000	1,110,000	1,380,000	80	41,400	2,090,000	2,130,000	2,640,000
2010	24,100	1,120,000	1,140,000	1,380,000	81	57,900	2,680,000	2,740,000	3,310,000
2011	21,600	1,110,000	1,130,000	1,520,000	73	58,000	2,980,000	3,040,000	4,080,000
2012	19,200	1,090,000	1,110,000	1,490,000	74	47,100	2,680,000	2,720,000	3,670,000
<b>Magnesium:</b> <sup>13</sup>									
2008	61,100	22,600	83,700	170,000	49	451,000	167,000	618,000	1,250,000
2009	47,100	20,500	67,600	118,000	57 <sup>r</sup>	269,000	117,000	386,000	672,000
2010	51,500	20,500	72,000	137,000	53 <sup>r</sup>	291,000	116,000	407,000	741,000
2011	43,100 <sup>r</sup>	24,100	67,200 <sup>r</sup>	133,000 <sup>r</sup>	50 <sup>r</sup>	228,000 <sup>r</sup>	127,000	355,000 <sup>r</sup>	702,000 <sup>r</sup>
2012	52,000	25,200	77,200	137,000	56	224,000	108,000	332,000	588,000
<b>Nickel:</b> <sup>14</sup>									
2008	NA	NA	86,700	186,000 <sup>r</sup>	47 <sup>r</sup>	NA	NA	1,830,000	3,940,000 <sup>r</sup>
2009	NA	NA	79,900	172,000 <sup>r</sup>	46	NA	NA	1,170,000	2,520,000 <sup>r</sup>
2010	NA	NA	82,000	200,000 <sup>r</sup>	41 <sup>r</sup>	NA	NA	1,790,000	4,370,000 <sup>r</sup>
2011	NA	NA	86,600 <sup>r</sup>	213,000 <sup>r</sup>	41 <sup>r</sup>	NA	NA	1,980,000 <sup>r</sup>	4,880,000 <sup>r</sup>
2012	NA	NA	89,900	216,000	42	NA	NA	1,580,000	3,780,000
<b>Tin:</b> <sup>15</sup>									
2008	2,100	11,700	13,800	40,900 <sup>r</sup>	34 <sup>r</sup>	52,200 <sup>r</sup>	291,000	343,000 <sup>r</sup>	1,020,000 <sup>r</sup>
2009	2,310	11,100	13,400	44,700 <sup>r</sup>	30 <sup>r</sup>	42,500 <sup>r</sup>	204,000 <sup>r</sup>	247,000	825,000 <sup>r</sup>
2010	2,680	11,100	13,800	44,100 <sup>r</sup>	31 <sup>r</sup>	73,400 <sup>r</sup>	303,000	376,000 <sup>r</sup>	1,200,000 <sup>r</sup>
2011	2,530	11,000	13,600 <sup>r</sup>	42,800 <sup>r</sup>	32	87,900 <sup>r</sup>	383,000 <sup>r</sup>	470,000	1,490,000 <sup>r</sup>
2012	2,440	11,200	13,600	44,700	30	69,000	316,000	385,000	1,260,000
<b>Titanium:</b> <sup>16</sup>									
2008	NA	NA	23,200	W	W	NA	NA	148,000	NA
2009	24,700 <sup>c</sup>	1,000 <sup>c</sup>	25,700 <sup>c</sup>	W	W	NA	NA	101,000	NA
2010	28,200	1,000 <sup>c</sup>	29,200	W	46	NA	NA	212,000	NA
2011	30,900	1,000 <sup>c</sup>	31,900	W	39	NA	NA	270,000 <sup>r</sup>	NA
2012	38,700	1,000	39,700	W	52	NA	NA	278,000	NA

See footnotes at end of table.

TABLE 1—Continued  
SALIENT U.S. RECYCLING STATISTICS FOR SELECTED METALS<sup>1</sup>

Year	Quantity of metal (metric tons)				Percentage recycled <sup>6</sup>	Value of metal (thousands)			
	Recycled from new scrap <sup>2</sup>	Recycled from old scrap <sup>3</sup>	Recycled <sup>4</sup>	Apparent supply <sup>5</sup>		Recycled from new scrap <sup>2</sup>	Recycled from old scrap <sup>3</sup>	Recycled <sup>4</sup>	Apparent supply <sup>7</sup>
Zinc: <sup>17</sup>									
2008	247,000	92,900	339,000	1,180,000	29	483,000	182,000	665,000	2,310,000
2009	194,000	78,900	273,000	1,060,000	26	334,000	135,000	469,000	1,810,000
2010	208,000	123,000	332,000	1,120,000	30	468,000	277,000	746,000	2,520,000
2011	213,000	123,000	336,000	1,160,000	29	500,000	288,000	788,000	2,710,000
2012	205,000	129,000	334,000	1,080,000	31	432,000	273,000	705,000	2,280,000

<sup>5</sup>Estimated. <sup>1</sup>Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Scrap that results from the manufacturing process, including metal and alloy production. New scrap of aluminum, copper, lead, tin, and zinc excludes home scrap, which is scrap generated and recycled in the metal producing plant.

<sup>3</sup>Scrap that results from consumer products.

<sup>4</sup>Metal recovered from new plus old scrap.

<sup>5</sup>Apparent supply is production plus net imports plus stock changes. Production is primary production plus recycled metal. Net imports are imports minus exports. Apparent supply is calculated on a contained-weight basis.

<sup>6</sup>Also referred to as recycling rate.

<sup>7</sup>Same as apparent supply defined in footnote 5 above but calculated based on a monetary value.

<sup>8</sup>Quantity of metal is the calculated metallic recovery from purchased new and old aluminum-base scrap, estimated for full industry coverage. Monetary value is estimated based on average U.S. market price for primary aluminum metal ingot. Series revised by removing imported scrap to avoid double counting.

<sup>9</sup>Chromium quantity of metal recycled was estimated as chromium content of stainless steel scrap receipts (reported by the iron and steel and pig iron industries). For the calculation of apparent supply, trade includes reported or estimated chromium content of chromite ore, ferrochromium, chromium metal and scrap, a variety of chromium-containing chemicals, and stainless steel mill products and scrap. Stocks include estimated chromium content of reported and estimated producer, consumer, and Government stocks. Recycled monetary value estimated as recycled quantity times the average import value of high-carbon ferrochromium. Apparent supply monetary value estimated like apparent supply quantity with monetary value substituted for chromium content.

<sup>10</sup>Includes copper recovered from unalloyed and alloyed copper-base scrap, as refined copper or in alloy forms, as well as copper recovered from aluminum-, nickel-, and zinc-base scrap. Monetary value based on annual average refined copper prices.

<sup>11</sup>Recycled scrap reported from consuming manufacturers. Apparent supply measured as shipments of iron and steel products plus castings corrected for imported semifinished products. Recycled unit value is the U.S. annual average composite price for No. 1 heavy-melting steel calculated from prices published in American Metal Market. Unit value for the year used to calculate values of recycled scrap and apparent supply of scrap.

<sup>12</sup>Monetary value of scrap and apparent supply estimated based upon average quoted price of common lead.

<sup>13</sup>Includes magnesium content of aluminum-base scrap. Monetary value based on the annual average Platts Metals Week U.S. spot Western magnesium price.

<sup>14</sup>Nickel statistics were derived from the following:

Production, consumption, receipts

- Reported nickel content of products made from reclaimed stainless steel dust, spent nickel-cadmium batteries, plating solutions, and other products.
- Estimated nickel content of reported net receipts of alloy and stainless steel scrap.
- Reported nickel content of recovered copper-base scrap.
- Reported nickel content of obsolete and prompt purchased nickel-base scrap.
- Estimated nickel content of various types of reported obsolete and prompt aluminum scrap.

Trade data

- Reported nickel content of International Nickel Study Group (INSG) class I primary products, including briquets, cathode, flake, pellets, and powder.
- Reported or estimated nickel content of INSG class II primary products, including ferronickel, metallurgical-grade nickel oxide, and a variety of nickel-containing chemicals.
- Estimated nickel content of secondary products, including nickel waste and scrap and stainless steel scrap.

Stock data

- Reported or estimated nickel content of all scrap stocks, except copper.
- Reported nickel content of primary products held by world producers in U.S. warehouses.
- Reported nickel content of primary products held by U.S. consumers.
- Reported nickel content of U.S. Government stocks.

Monetary value based on annual average cash price for cathode, as reported by the London Metal Exchange.

<sup>15</sup>Monetary value based on Platts Metals Week composite price for tin. Apparent supply excludes withheld stock changes.

<sup>16</sup>Percentage recycled based on titanium scrap consumed divided by primary sponge and scrap consumption.

<sup>17</sup>Monetary value based on annual average Platts Metals Week metal price for North American Special High-Grade zinc.

TABLE 2  
SALIENT U.S. RECYCLING TRADE STATISTICS FOR SELECTED METALS<sup>1</sup>

Year	Exports			Imports for consumption		
	Quantity		Value (thousands)	Quantity		Value <sup>2</sup> (thousands)
	Gross weight (metric tons)	Contained weight (metric tons)		Gross weight (metric tons)	Contained weight (metric tons)	
<b>Aluminum:</b>						
2008	1,980,000	NA	\$3,420,000	494,000	NA	\$853,000
2009	1,660,000	NA	2,120,000	433,000	NA	503,000
2010	1,910,000	NA	3,190,000	504,000	NA	763,000
2011	2,140,000	NA	4,050,000	579,000	NA	1,020,000
2012	2,040,000	NA	3,490,000	589,000	NA	905,000
<b>Chromium:</b> <sup>3</sup>						
2008	1,000,000	170,000	1,190,000	140,000	24,300	220,000
2009	1,130,000	192,000	778,000	124,000	21,200	138,000
2010	937,000	159,000	937,000	196,000	33,700	307,000
2011	656,000	111,000	959,000	170,000	29,400	297,000
2012	624,000	106,000	804,000	156,000	26,800	238,000
<b>Copper:</b> <sup>4</sup>						
2008	908,000	688,000	2,960,000	106,000	85,700	480,000 <sup>r</sup>
2009	843,000	633,000	2,010,000	71,800	56,300	234,000 <sup>r</sup>
2010	1,030,000	788,000	3,550,000	95,800	75,000	399,000 <sup>r</sup>
2011	1,240,000	981,000	4,980,000	110,000	87,600	547,000 <sup>r</sup>
2012	1,200,000	945,000	4,400,000	105,000	83,800	528,000
<b>Iron and steel:</b>						
2008	21,500,000	21,500,000	10,400,000	3,600,000	3,600,000	1,450,000
2009	22,400,000	22,400,000	7,120,000	2,990,000	2,990,000	814,000
2010	20,500,000	20,500,000	8,380,000	3,780,000	3,780,000	1,420,000
2011	24,300,000	24,300,000	11,400,000	4,010,000	4,010,000	1,650,000
2012	21,400,000	21,400,000	9,430,000	3,720,000	3,720,000	1,590,000
<b>Lead:</b> <sup>5</sup>						
2008	175,000	175,000	92,800	5,190 <sup>r</sup>	3,520 <sup>r</sup>	4,530 <sup>r</sup>
2009	140,000	140,000	72,000	11,200 <sup>r</sup>	7,160 <sup>r</sup>	8,520 <sup>r</sup>
2010	43,500	43,500	33,800	20,100 <sup>r</sup>	13,300 <sup>r</sup>	21,700 <sup>r</sup>
2011	31,100	31,100	36,800	25,400 <sup>r</sup>	16,100 <sup>r</sup>	23,700 <sup>r</sup>
2012	25,900	25,900	30,600	19,900	13,100	18,300
<b>Magnesium:</b>						
2008	2,600	2,600	5,420	24,100	24,100	58,800
2009	2,280	2,280	5,200	20,900	20,900	40,300
2010	481	481	802	22,100	22,100	56,500
2011	1,680	1,680	3,960	22,000	22,000	48,700
2012	2,100	2,100	5,290	20,900	20,900	47,800
<b>Nickel:</b> <sup>6</sup>						
2008	2,720,000	101,000	2,670,000	788,000	22,600	613,000
2009	2,420,000	95,100	1,710,000	699,000	20,000	442,000
2010	1,870,000	84,000	1,870,000	954,000	26,700	711,000
2011	1,630,000	68,600	1,670,000	983,000	24,500	794,000
2012	1,370,000	62,600	1,460,000	631,000	24,100	759,000
<b>Tin:</b> <sup>7</sup>						
2008	10,300	NA	26,600	23,300	NA	17,700
2009	9,430	NA	25,600	80,600	NA	16,200
2010	10,700	NA	26,500	57,300	NA	18,300
2011	14,800	NA	31,300	57,700	NA	23,400
2012	10,300	NA	27,200	72,500	NA	24,800
<b>Titanium:</b> <sup>8</sup>						
2008	8,180	NA	52,000	10,400	NA	68,900
2009	4,200	NA	14,000	4,770	NA	17,600
2010	3,480	NA	19,200	10,700	NA	75,500
2011	5,150	NA	33,300	13,900	NA	116,000
2012	8,760	NA	45,300	14,400	NA	98,500

See footnotes at end of table.

TABLE 2—Continued  
SALIENT U.S. RECYCLING TRADE STATISTICS FOR SELECTED METALS<sup>1</sup>

Year	Exports			Imports for consumption		
	Quantity		Value (thousands)	Quantity		Value <sup>2</sup> (thousands)
	Gross weight (metric tons)	Contained weight (metric tons)		Gross weight (metric tons)	Contained weight (metric tons)	
Zinc: <sup>9</sup>						
2008	91,000	NA	99,100	17,000	NA	20,300
2009	47,100	NA	54,300	9,100	NA	8,800
2010	77,900	NA	85,200	15,600	NA	19,400
2011	85,600	NA	93,900	18,500	NA	23,400
2012	90,500	NA	107,000	20,000	NA	24,600

<sup>1</sup>Revised. NA Not available.

<sup>2</sup>Contained weight based upon 100% of gross, unless otherwise specified.

<sup>3</sup>Imports value is customs value.

<sup>4</sup>Includes stainless steel scrap and chromium metal waste and scrap. Contained weight for import and export quantities of Harmonized Tariff Schedule of the United States (HTS) code 7204.21.0000 is 17% of gross weight; 8112.22.0000 is 100% of gross weight.

<sup>5</sup>For HTS codes 7404.00.0045, 7404.00.0062, and 7404.00.0080 contained weight for import quantity is 65% of gross weight. For HTS codes 7404.00.3045, 7404.00.3055, 7404.00.3065, 7404.00.3090, 7404.00.6045, 7404.00.6055, 7404.00.6065, and 7404.00.6090 contained weight for import quantity is 72%.

<sup>6</sup>Includes lead content of waste and scrap obtained from lead-acid batteries HTS codes 7802.00.0030 and 7802.00.0060.

<sup>7</sup>Contained weight for import and export quantities is 0.4% of gross quantity for HTS code 7204.29.0000, 50% for HTS code 7503.00.0000, and 7.5% for HTS code 7204.21.0000.

<sup>8</sup>Includes tin waste and scrap HTS code 8002.00.0000.

<sup>9</sup>Includes titanium waste and scrap HTS code 8108.30.0000.

<sup>9</sup>Includes zinc waste and scrap HTS code 7902.00.00.