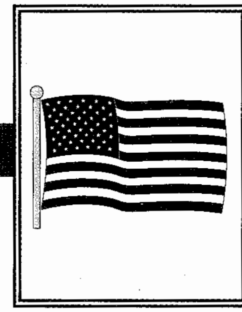

Federal energy subsidies and recycling: A case study

by Douglas Koplow

Subsidizing the energy costs of primary aluminum production artificially slows the expansion of recycling markets.

Aluminum is often held up as a success story in the recycling industry. According to the U.S. Environmental Protection Agency, recovery rates for the material exceeded 38 percent in 1990, surpassed only by automotive batteries and used motor oil (1). In 1993, 63 percent of all aluminum beverage containers were recycled (2), yet the recycling rate for aluminum would likely rise even further if federal government energy subsidies were eliminated.

One of the great benefits of recycling aluminum is the saving in energy over primary aluminum production. The Aluminum Association, an industry trade group, notes that "much of aluminum's recycle value comes from the energy saved when making aluminum from recycled material" (3). Aluminum production from scrap requires only 5 percent of the energy needed to produce the virgin metal from bauxite (4).

Current energy subsidies, however, diminish the market value of the energy savings derived from recycling and hence the value of aluminum scrap. Eliminating federal subsidies to energy would benefit most recyclables, since recycling yields energy savings for most commodities, but would likely have more pronounced impact on aluminum markets because of the high levels of energy required to produce the material.

Energy subsidies to aluminum

The federal government subsidizes energy in many ways. Tax breaks, subsidized loans or loan guarantees, direct grants and losses on federally owned electric plants are the subsidies most relevant to aluminum production. Because electricity represents between 25 and 30 percent of total primary aluminum production costs (5) and 96 percent of energy purchases (6), the magnitude of subsidies to electricity are especially important.

Primary aluminum producers tend to be clustered in regions blessed with inexpensive electricity, often hydroelectricity. The providers of this inexpensive electricity are often government-owned and are generally heavily subsidized. This pattern holds true for both federally and municipally owned power facilities, and applies in many countries, including the U.S.

As a case study in how these subsidies can hinder increased market share for recyclables, this article will examine primary aluminum production in the Bonneville Power Administration Power District. Nearly 40 percent of U.S. primary aluminum production capacity in 1989 was located in this service region (7). BPA is a federally owned power administration consisting primarily of hydroelectric generating capacity, but with some nuclear capacity as well.

BPA benefits greatly from federally sub-

What do energy subsidies mean?

- ✔ Only 5 percent of the energy required to produce primary aluminum from bauxite is needed when secondary aluminum is used.
- ✔ Energy subsidies lower the selling price of primary aluminum, thereby slowing the substitution of secondary aluminum for primary.
- ✔ Of the average market price for primary aluminum in 1989, energy subsidies composed between 5 and 13 percent.
- ✔ It is estimated that incremental energy subsidies amount to 7 to 19 percent of the scrap aluminum price in 1994.

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sidized construction loans. These loans were worth over $426 million per year in reduced borrowing costs during 1989 (8). Because BPA operates some nuclear-fueled capacity, its customers also benefit from a wide range of federal subsidies to nuclear power research and development, waste management and enriched uranium (the fuel used in nuclear reactors). Subsidies to nuclear energy added an incremental benefit to BPA customers of $6 million to $15 million per year. Other energy subsidies to BPA were worth $16 million per year. In total, energy subsidies benefiting BPA electric customers were at least $448 million per year in 1989 (9).

This figure assumes that BPA operates on a break-even, nonprofit basis. Were BPA to operate like a private utility, the subsidy would be much higher. For example, the Energy Information Administration estimates that a private utility providing the same services as BPA would have to charge electric customers $1.18 billion per year more than BPA's current rates to pay market rates on borrowed funds and to earn the average return that the utility industry receives on its invested capital (10). Adding BPA's share of nuclear subsidies yields $1.195 billion. This range of $448 million to $1.195 billion per year is used as the lower and upper bounds of energy subsidies benefiting BPA customers in this case study.

Aluminum smelters, which purchased nearly one-third (32.54 percent) of all electricity produced by BPA in 1989 (11), were (and continue to be) a major beneficiary of these subsidies. Assuming that the subsidies are distributed equally among all BPA customers, energy subsidies to primary smelters in the BPA district were worth $146 million to $389 million per year.

The implications of subsidies

Subsidies to electricity encourage industries and consumers to use more electricity. Overconsumption of electricity, in turn, generates more natural resource depletion and environmental degradation than would occur without the subsidies. The subsidies also change operating decisions made in the consuming industries. In the primary aluminum smelting sector, for example, the plants are large electricity consumers and quite sensitive to electricity prices. Electricity subsidies can keep many inefficient plants operating.

According to the International Primary Aluminum Institute, North American smelters had the highest electricity consumption per metric ton of primary metal produced in the world for both 1990 and 1991 (12). BPA, with some of the older smelters in the country, uses more electricity per ton of aluminum than the average level for the United States (13).

Because a portion of the energy subsidy is likely to lead to a lower selling price for primary aluminum, energy subsidies also slow down the replacement of virgin aluminum production with recycled aluminum production. Without energy subsidies, primary aluminum would cost more because the energy to produce each pound would be more expensive.

Because this increased cost leads to higher prices for primary aluminum, market opportunities for less energy-intensive virgin substitutes (potentially including steel and plastic) would increase. Equally important, the price of secondary aluminum would rise as the energy savings embedded in each pound of scrap become worth more, increasing the incentive to recycle aluminum. Current gluts in world primary aluminum production capacity and inventories may delay the point at which subsidy elimination leads to higher aluminum prices; however, over a period of years, these price increases will very likely take place.

The current situation is quite different. Despite rapid growth in aluminum recycling in the United States, secondary aluminum capacity remains at only 40 percent of virgin capacity (14). In addition, a large amount of new virgin aluminum production has recently been built in Quebec — plants that also benefit from government-subsidized energy (see the box). The net result is to slow the shift to less-polluting, energy-efficient recycled aluminum, or to substitute materials that require less energy to manufacture.

Size of the subsidies

As shown in Table 1, energy subsidies to aluminum producers in the BPA power district are significant. Energy subsidies equaled between 4.8 and 12.7 percent of the average market price for the primary aluminum pro-

Variable rate power contracts are subsidies, too

Despite the large size of the energy subsidies that benefit primary aluminum producers, primary aluminum producers enjoy other subsidies as well. The most important of these are the variable rate contracts, which govern how much aluminum smelters pay for their electricity. These contracts were first instituted by BPA in the mid-1980s, but now apply to much of the primary aluminum smelting capacity throughout the United States and Canada.

Although a dollar estimate of the value of the variable rate contract subsidy could not be produced, it is clear that these contracts benefit primary aluminum smelters more than secondary producers. Recycling proponents should evaluate the contracts carefully for their impact on aluminum recycling.

Variable rates

Variable rate contracts between electric utilities and aluminum smelters tie the price of electricity to the market price of aluminum. As with electricity subsidies in general, variable rate contracts are much more important to primary aluminum producers than to secondary producers, because virgin production is so much more energy-intensive.

The concept is a simple one: If prices for aluminum are low, smelters pay a below-market price for electricity; if prices are high, smelters pay an above-market price for electricity. In theory, this pricing strategy keeps the smelters operating on a more regular basis, and allows the utility to better predict demand for its electricity. On average, the price that smelters pay for their electricity should roughly equal the price the utility would have received under a standard contract.

There is no doubt that these contracts keep primary aluminum smelters open and people employed. What is less clear is whether variable rate contracts make sense in any other context than the political arena of protecting local jobs. If a utility has excess generating capacity that would go unused were a large smelter to shut down, an agreement that encourages heavy power users to keep producing may make sense.

When electricity generating capacity is tight, however, and the utility could easily sell the power that an inefficient primary aluminum smelter is no longer using, long-term variable rate power contracts are unlikely to be a smart policy. With trading electricity between different regions becoming more common, the circumstances under which variable rate contracts with aluminum smelters make sense are likely to diminish.

In addition, these contracts create a risk for the utility that it will lose money. Aluminum prices may not rise enough to recover discounts given during periods of low aluminum prices. Similarly, aluminum prices may fall so far that the utility is obligated to sell electricity at below its cost of generating the power. Although BPA sets a minimum price for electricity sales to aluminum smelters to protect itself from this problem, Hydro Quebec does not (1). In either case, low prices on electricity generate subsidies to primary aluminum production and reduce recycling and substitution of alternative materials.

These subsidies hurt other primary producers as well. In 1992, Hydro Quebec's power contracts with another electricity-intensive industry — magnesium — was the subject of a dumping lawsuit filed by a U.S. magnesium producer. By paying only 50 to 60 percent of the going industrial rate for power in the initial years, the Canadian operation, owned by Norsk Hydro, gained an unfair market advantage over U.S. producers (2).

It is not surprising that the lawsuit involved magnesium producers rather than aluminum producers. Because the same companies own aluminum production facilities in both the U.S. and Canada, a similar dumping suit over electricity pricing to aluminum smelters is not likely.

Footnotes

(1) Robert McCullough & Associates, "Expert Report of Robert McCullough for The Grand Council of the Crees (of Quebec)," circa 1991.

(2) Laura Eggertson, "Quebec Magnesium Hit with Duties of 53%," *The Montreal Gazette*, July 8, 1992; Clyde H. Farnsworth, "Toughest Fight Yet for Hydro Quebec," *The New York Times*, October 6, 1991.

duced by the smelters in the BPA service area in 1989. As a point of comparison, the pretax return on sales for the aluminum industry was 13.2 percent in 1989, dropping to slightly above 1 percent in 1992; the industry generated losses in 1993 (15). Thus, in recent years, energy subsidies have most likely been larger than profits.

When compared to the value added by the smelters, energy subsidies jump to between 12.6 and 33.7 percent. These are extremely high figures, suggesting that up to one-third of the current value added by primary smelters would disappear if they had to pay full market rates for their electricity. The lower aluminum prices of recent years suggest that current energy subsidies as a percent of value added may be even higher.

The subsidies are equivalent to between 8 and 21 percent of the cost of materials for the aluminum producers. Because the cost of materials would rise more for primary producers than for secondary producers once energy subsidies were removed, this ratio suggests that many primary smelters would become less competitive with alternative sources of aluminum supply, such as recycling, if they paid market rates for energy.

Because energy subsidies diminish the value of the embedded energy in aluminum scrap that is recovered through recycling, another useful benchmark for the subsidies is to com-

Table 1 **Energy subsidies to primary aluminum production in the Bonneville Power Administration Service District, 1989**

	Low estimate (1)	High estimate (1)
Total subsidies to primary aluminum production (2)	$146 million	$389 million
Energy subsidy/pound of primary aluminum produced ($/lb.) (3)	$ 0.0417	$ 0.1113
Average price of primary aluminum ($/lb.) (4)	$ 0.878	$ 0.878
Subsidy/market price	4.8%	12.7%
Subsidy/value added in manufacture by primary aluminum smelters (5)	12.6%	33.7%
Subsidy/cost of materials (5)	7.8%	20.9%

(1) Low estimate assumes BPA operates as a nonprofit, break-even utility. High estimate assumes BPA earns a rate of return on invested capital equivalent to the level earned by similar private enterprises.
(2) Total energy subsidies to BPA customers in 1989 ranged from $448 million to $1,195 million. Primary aluminum smelters purchased 32.54 percent of BPA electricity, yielding the numbers shown above.
(3) BPA smelters' share of U.S. primary aluminum production capacity in 1989 was 39.34 percent, or 1,747,000 short tons.
(4) Average U.S. market price for primary aluminum in 1989.
(5) Cost of materials includes purchased energy.
Sources: Douglas Koplow, Alliance to Save Energy, *Federal Energy Subsidies: Energy, Environmental, and Fiscal Impacts*, April 1993; U.S. Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, November 1992; Bonneville Power Administration, *1989 Annual Report*; U.S. Bureau of Mines, *Primary Aluminum Plants Worldwide: Part 1 — Detail*, December 1990; Patricia Plunkert and Errol Sehnke, U.S. Bureau of Mines, *Aluminum, Bauxite, and Alumina*, 1989, 1991; U.S. Bureau of the Census, *1989 Annual Survey of Manufactures, Statistics for Industry Groups and Industries*.

pare them to the current scrap market price. The subsidy equals the maximum amount over the current scrap market price that aluminum producers would be willing to pay to avoid paying the higher energy costs needed to produce virgin aluminum once the subsidies were removed.

The appropriate measure to use in this comparison is the incremental benefit to primary aluminum producers from energy subsidies. Although aluminum recycling requires only 5 percent as much energy as virgin production, this 5 percent does benefit from energy subsidies. Thus, the incremental benefit number (shown in Table 2), subtracts the total energy subsidies that benefit aluminum recycling from the total energy subsidies that benefit primary production, which yields the incremental benefits to primary producers.

Although the actual price of aluminum scrap is unlikely to increase

Table 2 Incremental energy subsidies to primary aluminum in the BPA Power District (1)

	Low estimate	High estimate
Energy subsidy/pound of primary aluminum	$ 0.0417	$ 0.1113
Energy subsidy/pound, assuming secondary aluminum production (2)	$ 0.0021	$ 0.0056
Incremental benefit to primary aluminum (3)	$ 0.0396	$ 0.1057

(1) In cents per pound, unless otherwise indicated.
(2) Calculations assume that the production of secondary aluminum requires only 5 percent of the energy that primary aluminum production does.
(3) Calculated by subtracting energy subsidies to secondary aluminum from subsidies to primary aluminum.
Sources: Richard Porter and Tim Roberts, eds., *Energy Savings by Wastes Recycling*, 1985; Douglas Koplow, 1994.

Table 3 Undervaluation of embedded energy savings of aluminum scrap as a percent of scrap value (1)

	Low estimate	High estimate
Undervaluation of energy savings from scrap recycling (2)	$ 0.0396	$ 0.1057
Scrap aluminum clippings prices in 1989 (3)	$ 0.6313	$ 0.6313
Scrap aluminum clippings prices in September 1994	$ 0.587	$ 0.587
Undervaluation of energy savings from scrap recycling/scrap price in 1989	6.3%	16.7%
Undervaluation of energy savings from scrap recycling/scrap price in September 1994 (4)	6.8%	18.0%

(1) In cents per pound, unless otherwise indicated.
(2) Equal to the incremental energy subsidy aluminum shown in Table 2. This is the maximum amount buyers would bid up the price of scrap to avoid the now higher energy costs of producing primary aluminum.
(3) Scrap prices for used aluminum beverage containers were slightly lower, but yielded the same ratio of energy subsidy to scrap price as shown above for aluminum clippings.
(4) Assuming energy subsidies in 1994 are equal to those in 1989.
Sources: American Metal Market, *Metal Statistics, 1990-91*; "U.S. Non-ferrous Scrap," *Metal Bulletin*, September 12, 1994; Douglas Koplow, 1994.

by the entire amount of the net energy subsidies to primary aluminum, Table 3 offers a useful illustration of how energy subsidies can distort the relative value of primary and secondary commodities. As shown, incremental energy subsidies to primary aluminum in 1989 were equal to between 6.3 and 16.7 percent of market price for scrap at that time.

Assuming that current subsidies remain at this level, they would equal 6.8 to 18.0 percent of the September 1994 price of scrap aluminum (16). If energy subsidies were removed, the price of scrap would rise some portion of this amount to reflect the increased value of the energy savings through recycling. The recovery of, and demand for, secondary aluminum would also increase.

Summary

Federal subsidies to virgin materials can create important barriers to expanded recycling. As illustrated with the case of energy subsidies, even federal policies that do not directly subsidize a material can still impede recycling markets.

Subsidies to key inputs to the extraction or processing of a virgin material can be equally damaging. Federal energy subsidies reduce the use of more energy-efficient packaging and slow the expansion of recycled aluminum markets, needlessly increasing the country's rate of natural resource depletion and environmental destruction.

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Footnotes

(1) Office of Solid Waste, U.S. Environmental Protection Agency, "Environmental Fact Sheet: Recycling Municipal Solid Waste Facts and Figures," July 1992.
(2) The Aluminum Association, "Aluminum Can Recycling Hits 63 Percent in 1993," press release, March 24, 1994.
(3) The Aluminum Association, "Aluminum Pays. Aluminum Gets Recycled," pamphlet, circa 1993.
(4) Average value based on studies in Richard Barnes and Tim Roberts, eds., *Energy Savings by Wastes Recycling*, 1985.
(5) Marc Humphries, Larry Parker and John Blodgett, Congressional Research Service, *Acid Rain Legislation and the Domestic Aluminum Industry*, May 1989.
(6) U.S Bureau of the Census, *Annual Survey of Manufactures: Industry Statistics*, 1989.
(7) U.S. Bureau of Mines, *Primary Aluminum Plants Worldwide: Part 1 — Detail*, December 1990. As of December 1993, 39.06 percent of U.S. production was located in the BPA Power District, down slightly from 39.34 percent in 1989. These plants composed 34.6 percent of the U.S. operating capacity at the end of 1993 (American Metal Market, *Metal Statistics*, 1994).
(8) Based on Douglas Koplow, Alliance to Save Energy, *Federal Energy Subsidies: Energy, Environmental, and Fiscal Impacts*, April 1993.
(9) Ibid.
(10) U.S. Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, November 1992. Original data were in 1990 dollars. Figures shown here have been scaled to 1989 dollars using the Gross Domestic Product implicit price deflator.
(11) Bonneville Power Administration, *1989 Annual Report*.
(12) International Primary Aluminum Institute, *Electric Power Utilization: Annual Report for 1991*. The North American region is defined as Canada and the United States. Canada has significant new smelter capacity.
(13) Calculated from Patricia Plunkert and Errol Sehnke, U.S. Bureau of Mines, *Aluminum, Bauxite, and Alumina*, 1991, 1993; U.S. Bureau of Mines, *Primary Aluminum Plants Worldwide: Part 1 — Detail*; and Bonneville Power Administration, *1989 Annual Report*.
(14) Patricia Plunkert, U.S. Bureau of Mines, "Mineral Commodity Summaries: Aluminum," 1993.
(15) Cameron A. Thompson, "Metal & Mining (Diversified) Industry: Aluminum," *Value Line*, November 6, 1993; Jeffrey J. Baade, "Metals & Mining (Diversified) Industry: Aluminum," *Value Line*, August 5, 1994.
(16) Based on the average price per pound of mixed aluminum clippings, averaged across reporting regions. Pricing data are from "U.S. Non-ferrous Scrap," *Metal Bulletin*, September 12, 1994.