The Monthly UnEconomist

A Tale of Two Realities

Now is the best of times for those blessed with access to the flow of wealth created by channeling much of our planet's material and energy resources through relatively few, large-scale production enterprises. Big cars, big houses, big meals, big entertainment, big health care.

Of course big consumption means big work for trash and recycling crews come garbage pickup day. That's where the UnEconomist picks up the story.

After ten years of steady increase in the portion of waste recycled, and some success at leveling growth in per capita waste, recycling has plateaued.[1] Trash is again on the ascendancy – from big news megamergers such that two companies will soon control collecting and dumping of more than half the nation's municipal and industrial solid waste, to everyday cutbacks or failures of local recycling programs and businesses.

Possible reasons for recycling's difficulties are not hard to find – anemic export markets for recycled materials as a result of Asia's economic collapse, increased waste generation by business and industry as the US economy continues to expand, or even the relative decline in enthusiastic support and publicity for recycling. But the UnEconomist wants to suggest that the real problem is more systemic – the huge advantage in free rides and free disposal that virgin materials production has versus recycled materials.

Figures 1 through 3 help to tell the story.[2] These three charts show historical prices for recycled materials – cardboard boxes, aluminum cans, and PET bottles, compared with the virgin material – kraft woodpulp, aluminum ingot, and PET pellets, respectively, with which each recycled material competes.

These three price comparisons illustrate the general rule: virgin material prices set an upper bound for recycling prices. Absent non-market constraints, such as recycled-content requirements, no manufacturer will pay more for recycled materials than for virgin. The latter have more precise specifications and tighter quality controls.

Figure 1

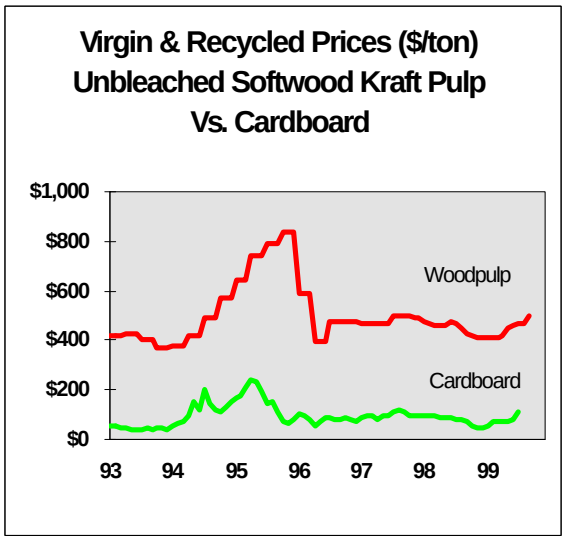
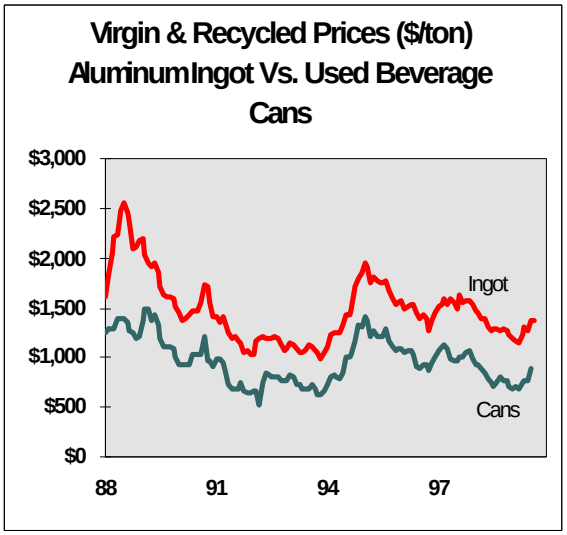


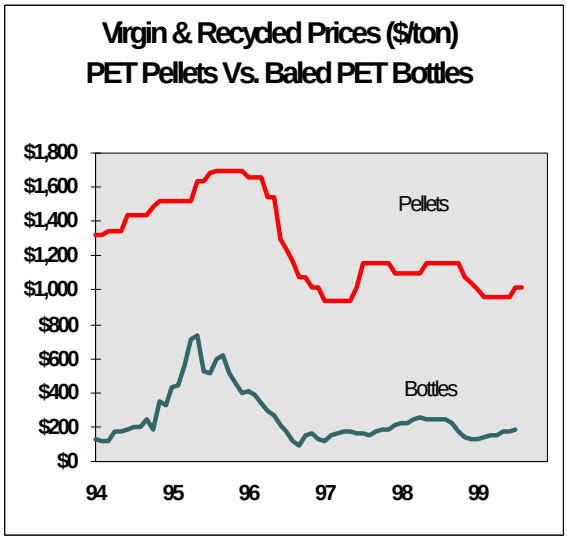
Figure 2



Recycled materials, on the other hand, often require additional handling and purifying before they can be used as manufacturing feedstock. Thus, recycled materials sell below virgin by enough to cover these extra processing costs, as well as provide a hedge against potential difficulties in the manufac-

turing operation that might result from using the less-precisely-suitable recycled feedstock.

Figure 3



Furthermore, virgin materials are sold on international commodity markets subject to cyclical price swings and other influences unrelated to, and uncontrollable by, US recyclers. In fact, recycling, at least in terms of the marketing of recycled materials, is in many ways a quintessential example of perfect competition. No particular recycler has much influence on the price at which they can sell recycled materials, and each usually can sell all they can collect, as long as they accept the going market price.

Recycling Prices vs. Recycling Costs

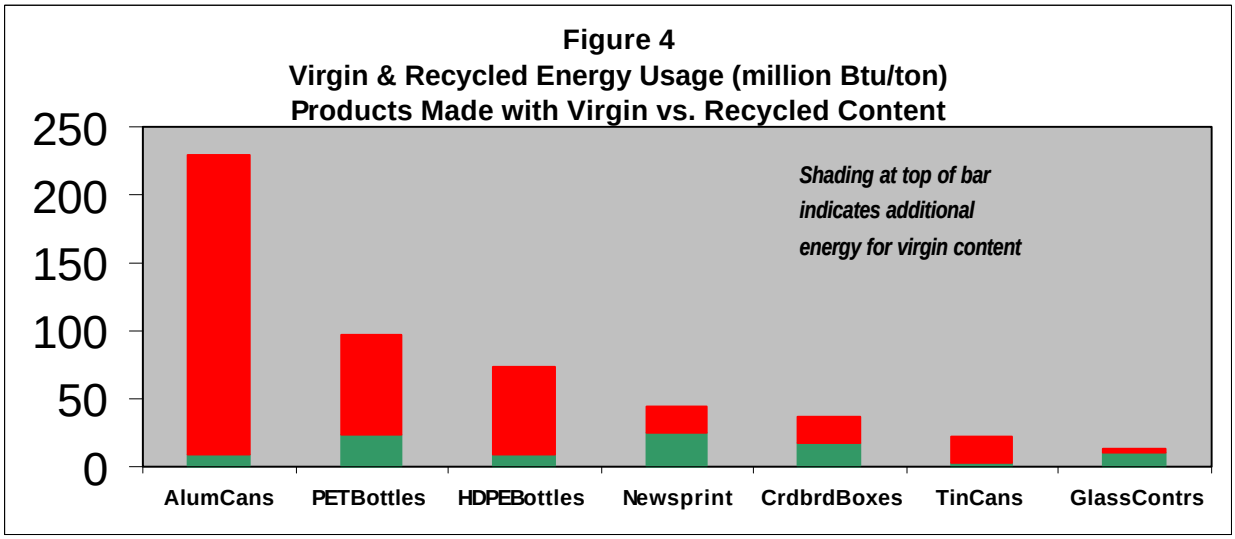
As a result of virgin commodity price cycles, wide and sometimes wild fluctuations in revenue are a fact of life for recyclers. For example, in the Puget Sound region of Washington state during the past ten years, revenues from selling materials collected by residential curbside recycling programs and processed at a material recovery facility (MRF) to manufacturers' specifications averaged $60 per ton.[3] Revenues varied from an annual low of $36 per ton during 1993 (with a monthly low of $31 in June) to a high of $124 during 1995 (with a monthly peak of $169 in June)

Costs for collecting and processing recyclables also vary widely depending on type of recycling program (e.g., curbside or drop-off), degree of separation (commingled or sorted into categories), and local wages, as well as other factors, such as frequency of collection in the case of curbside recycling. Fortunately recycling program managers do have greater control over costs than for revenues. Yet no amount of managerial skill can overcome a fundamental fact: recycling market revenues alone seldom cover recycling program costs.

For example, the Puget Sound region has access to robust markets for recycled materials. Yet weekly residential curbside recycling (including collection, processing and marketing) costs about $150 per ton of material recycled, give or take ten per-cent, compared with revenues that have averaged $57 during the past three and a half years. What or who will make up the shortfall?

In parts of the country, such as the Puget Sound region, where solid waste disposal costs are high enough, savings in disposal fees on material that is diverted to recycling, as well as savings in garbage collection and transfer costs, cover the recycling market revenue versus program cost shortfall. In other places, however, garbage collection and disposal costs avoided when material is recycled are not enough to make up the difference.

In the latter case, more recycling means higher total costs for the community's garbage and recycling programs, regardless of whether property taxes, tipping fees, garbage collection fees, recycling fees, or other fees and taxes are used to collect funds from households and businesses to pay for garbage and recycling. Therein lies the conundrum confronting local governments, households, and businesses wanting to control costs and, at the same time, do the right thing by recycling more waste.



Recycling: The Right Thing To Do

Figure 4 illustrates the additional energy required to manufacture products from virgin instead of recycled materials. Except for the fact that mixed paper is not included in the chart, the products depicted are the same materials often targeted by residential curbside recycling programs. [4]

The chart shows, in sum, that the typical mix of used products in a curbside recycling bin requires 2.5 times as much energy when those products are manufactured from virgin instead of recycled feedstock. The energy increment associated with virgin materials amounts to more than 21 million Btu's per ton of curbside recyclables, a kilowatt hour of electricity per pound.[5]

It is significant that every pound of curbside recyclables conserves a kilowatt-hour of electricity. But energy conservation is just one of the environmental benefits attained by manufacturing products from recycled rather than virgin materials.

As noted in our recent study:

"Drilling, digging, or cutting and refining, smelting, or pulping create *virgin* raw materials to feed our industrial system and, at the same time:

- release chemical substances, carbon dioxide, waste heat and processing refuse into air and water and onto land;
- impair the health of people exposed to polluting chemical releases;
- dislocate and destroy habitat for a wide variety of non-human creatures and organisms;
- diminish productivity in natural resource industries that depend on healthy species and ecosystems;
- impair ecological functions and biological diversity in ecosystems; and
- alter the sights, sounds, smells and feelings humans enjoyed in many previously pristine, natural places."[6]

Recycling itself, of course, has negative public health and environmental impacts. The energy comparison is useful precisely because it exemplifies the fact that recycled-beats virgin-content manufacturing in almost every category of environmental impact. As summarized in a review of four major studies on recycling's energy and environmental impacts:

"Recycled production plus recycling results in the lowest air emissions of the three *material acquisition, production and waste management* systems in 9 of 10 major pollutant categories. Virgin production plus incineration results in the lowest emissions in the remaining category. For all 10 categories, virgin production plus landfilling results in greater emissions than does

recycled production plus recycling. Virgin production plus incineration results in the highest emissions of carbon dioxide of the three options…..

"Recycled production plus recycling results in the lowest waterborne waste releases of the three options in six of eight major pollutant categories, while virgin production plus incineration results in the lowest releases in the remaining two categories. For all eight categories, virgin production plus landfilling results in greater releases than does recycled production plus recycling or virgin production plus incineration."[7]

Think Globally, Pay Locally

If recycling is so good for public health and the environment, why are the economics of recycling often so poor? Recall that virgin material prices set the limit for recycling revenues. Thus, costs of virgin materials use that are not reflected in virgin commodity prices may depress recycling revenues.

As an example, consider releases of chemical pollutants into the environment. EPA's Toxics Release Inventory (TRI) requires self-reporting by certain mining operations, industrial facilities, and oil- or coal-fired utilities on large releases to air and water or onto land of just over 900 chemical substances, out of about 70,000 used in commerce.[8]

Actual emissions of the majority of toxic substances covered by TRI, however, are not regulated. Even emissions of regulated toxics that are not prevented by best available control technology, or emissions below prescribed regulatory limits, occur without penalty. Thus, Earth's ecosystems (including human populations) provide, at no cost to the polluter, disposal into air and water and onto land for all but a fraction of the toxic substances generated from virgin materials use.

Recently, several scientific studies have illuminated the value of some of these free disposal services. One study estimated the public health and environmental cost for emissions of nearly 200 chemical substances associated with the production of packaging materials, including emissions from acquiring and processing virgin raw materials to manufacture packaging.[9] A second study estimated greenhouse gas emissions associated with virgin materials use.[10]

Using data from these studies, the UnEconomist calculates that each ton of curbside recyclables that replaces virgin materials in manufacturing new products provides net public health and environmental benefits worth $53.[11] This is the value, primarily in human health terms, just for reduced emissions of greenhouse gases and the less than 200 toxic substances whose releases have been systematically studied.

Benefits from the reduction in emissions of all chemical substances that are achieved by recycling would undoubtedly be worth far more than $53 per ton of recycling. Still, even an extra $53 per ton in recycling revenues would make recycling cost effective virtually everywhere in the nation.

On the other hand, charging virgin materials users for all emissions of all chemical substances might not increase virgin material prices enough to raise recycling prices by an average of $53 per ton. Virgin commodity prices are determined on international markets, so emissions charges would have to be imposed worldwide. In addition, subsidies provided here and in other countries for extraction of virgin raw materials might also need to be reduced before virgin material prices would rise enough to substantially boost recycling prices.[12]

Such major changes in worldwide policies regarding virgin materials use are unlikely to occur anytime soon. At the same time, US EPA regulatory limits on sulfur dioxide emissions and the resultant establishment of a market for sulfur dioxide emissions allowances does set a promising

example. If greenhouse gas emissions limits are established and recyclers somehow acquire tradable credits based on the amount and types of recyclables they collect, additional revenues may flow toward recycling.

For the present, recyclers need to continue informing the public about recycling's costs and revenues, and the cost savings achieved by reducing garbage disposal. In addition, recyclers must better educate households and businesses about the public health and environmental benefits of recycling. When most waste generators understand that recycling makes sense globally, but may incur revenue versus cost shortfalls locally, they might be more accepting of the modest increment in local taxes or user fees that helps pay for their recycling programs.

About The UnEconomist

This monthly newsletter intends to provide insight and analysis on the economics of recycling and the unpriced or underpriced environmental benefits of reducing waste disposal and replacing virgin-content products with products manufactured from recycled materials. Reader feedback is encouraged via email to info@ZeroWaste.com, and substantive comments will be published whenever they add to our understanding of recycling.

The UnEconomist will also comment on recycling market prices in the Northwest and Northeast for the eight or nine recyclables tracked by the graphs available along with this newsletter online at ZeroWaste.com. In addition, The UnEconomist will from time to time report on the accuracy of the five-year recycling price forecasts that are provided on each recycling market price history graph.

Users of the price history graphs should be aware that the data depicted on each graph represent average monthly prices, FOB loading dock, received at large-scale MRF's in the Northwest and the Northeast for recycled materials processed and packaged to end-use manufacturer specifications. Price averages include both spot market and contract sales.

Subscribers will notice that price histories on our website graphs show more month-to-month price fluctuation than is often reported in trade journal price data. At least one reason for this is that price data reported on Sound Resource Management's website reflect a multitude of actual transactions consummated throughout each month, rather than survey prices obtained from relatively few buyers and/or sellers. Thus, our price data mirror the small but incessant day-to-day changes in recycling market prices.

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[1] According to US EPA, national recycling increased from 9.6% in 1980 and 16.4% in 1990 to 27.3% by 1996. At the same time, per capita solid waste generation increased from 3.7 pounds in 1980 to 4.5 in 1990, where it leveled off through 1994. Per capita generation then declined to 4.3 pounds per day by 1996, largely due to source reduction of yard debris. (US EPA, *Characterization of Municipal Solid Waste in the United States: 1997 Update*, May 1998.) National recycling rate estimates for 1997 are not yet available, but state reports suggest that the years of steadily increasing recycling rates are over. For example, recycling rates in Massachusetts and Washington State stagnated and declined, respectively, in 1997.

[2] Charts that appear in the UnEconomist are available in full size, downloadable format in the subscriber section of Sound Resource Management's website at www.SoundResource.com.

[3] Revenue figures are weighted averages for curbside programs that collect the following types and proportions of materials: mixed paper (33.3%), newspaper (33.3%), cardboard (5%), glass containers (21% - of which approximately 25% is clear, 15% brown, 10% green and 50% broken mixed colors), tin-plated steel cans (3.4%), aluminum cans (2.0%), PET plastic bottles (1.0%) and HDPE plastic bottles (1.0%).

[4] The products, in descending order of energy usage per ton of virgin-content product, are aluminum cans, PET plastic bottles, HDPE plastic bottles, newsprint, cardboard boxes, tin-plated steel cans, and glass bottles and jars.

[5] Puget Sound communities with residential curbside recycling programs that are provided at no additional fee to garbage collection subscribers divert more than 700 pounds of recyclables per eligible household each year with an associated energy savings of 725 kilowatt hours.

[6] Morris, Jeffrey, *Economic and Environmental Benefits of Updating Massachusetts' Bottle Bill*, prepared by Sound resource Management for Massachusetts Public Interest Research Group, March 5, 1998, page 6. The word in italics was added by the UnEconomist for clarity.

[7] Denison, Richard A., "Environmental Life-Cycle Comparisons of Recycling, Landfilling, and Incineration: A Review of Recent Studies," *Annual Review of Energy and the Environment*, 1996, Volume 21, pp.191-237. The quoted passage appears on page193. Words in italics were added by the UnEconomist for clarity.

On that same page Denison states, "The reduction in energy use for the system based on recycled production plus recycling is more than three times greater than the net energy generated by virgin production plus incineration of MSW. Virgin production plus landfilling uses over 17 million Btus more energy per ton of material processed than does recycled production plus recycling and over 5 million Btus more per ton than does virgin production plus incineration." Denison calculates that recycling at a national rate of 26% conserves enough energy to provide for the annual energy needs of 9 million households.

[8] The estimate of 70,000 chemicals used in commerce comes from the National Research Council, *Environmental Neurotoxicology*, National Academy Press, 1992, page 2.

[9] Tellus Institute, *CSG/Tellus Packaging Study*, prepared for The Council of State Governments, US Environmental protection Agency, and New Jersey Department of Environmental protection and Energy, May 1992. Estimates for the public health and environmental costs of production system impacts reported herein are based on "The 1994 Update of the Tellus Institute *Packaging Study* Impact Assessment Method," prepared by Brian Zuckerman and Dr. Frank Ackerman. Cost data in this latter report reflect updated information for valuing impacts of criteria air pollutants and toxics.

[10] US EPA, *Greenhouse Gas Emissions from Management of Selected Materials in Municipal Waste Management*, prepared under EPA Contract No. 68-W6-0029, September 1998.

[11] This benefit is based on the reduction in emissions from virgin materials use, offset by increased emissions from using recycled materials, including the impacts of additional trucks for curbside recycling.

Greenhouse gas reductions are valued at $8 per ton of carbon dioxide equivalents. The California Energy Commission estimates that $8 must be spent on reforestation to grow enough trees to absorb one ton of carbon dioxide. (California Energy Commission, Committee Order for Final Policy Analysis, Docket No. 88-ER-8, March 27, 1990, as reported in the Tellus Packaging Study, Report#4, "Impacts of Production and Disposal of Packaging Materials – Methods and Case Studies," page 1-5.)

See Pearce, D., "An economic approach to saving the tropical forests," in D. Helm (ed.), *Economic policy toward the environment*, Blackwell, Oxford, 1991, pp. 239-262, for an argument that a value of $13 per ton for sequestering carbon is a conservative estimate based only on its value in reducing coastal damage from sea level rise. Using $13 to value reduced GHG emissions would increase the net benefit of recycling from $53 to $60 per ton.

[12] A 1999 study by the Grassroots Recycling Network, *et al, Welfare for Waste: How Federal Taxpayer Subsidies Waste resources and Discourage Recycling*, estimates that US federal subsidies and tax breaks for virgin materials amount to $2.6 billion annually, or about 15% of the value of all recycled materials sold in this country each year. However, this $2.6 billion subsidy amounts to a much smaller portion of annual revenues from selling virgin materials.