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JOHN DOE'S WALLET AND JANE DOE'S PURSE
LOOK AT HOMETOWN RECYCLING AND ENERGY CONSERVATION

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Abstract

A national shift from the use of virgin raw materials to greater use of recycled raw materials could significantly reduce our nation's energy needs. Local governments are slowly but increasingly establishing solid waste recycling programs, but they are commonly operated as "add ons" to the existing solid waste disposal system rather than being an integral part of it. The result is both energy and monetary waste, and the taxpayers have to pick up the bill. A case study from Rolla, Missouri, quantifies the energy conservation and monetary costs and benefits of a coordinated solid waste disposal-recycling system.

1. INTRODUCTION

Rather than dealing directly with the session topic of "Energy from Solid Wastes," this paper more properly deals with how to save energy by recycling a selected portion of our solid waste supply. "A penny saved is a penny earned," just as much today as it was 200 years ago when an enterprising gentlemen by the name of Ben Franklin coined that unforgettable phrase. Whether or not he coined it before or after the lightning bolt came down the kite string and lit him up like a Christmas tree has been lost in the mists of time, but he can't have been too far wrong for his words to have lasted this long (thus ends the Bicentennial portion of our paper).

We hope that everyone here already knows that manufacturing many products from salvaged waste materials often requires less energy expenditure than equivalent products from virgin raw mater-

ials. One of the most widely publicized examples is aluminum, which takes only about 5 percent as much energy to recover from salvaged materials as from the ore. Manufacturing recycled paper requires only about 37 percent of the energy expenditure (2,520 Kwh per ton) needed to make paper from raw wood (6,730 Kwh per ton).

We also hope that everyone here already knows that manufacturing processes utilizing salvaged waste materials often require less energy investment in pollution control systems than do processes utilizing virgin materials. We also hope that everyone here also realizes that large supplies of many salvaged waste materials often exist closer to the manufacturing and product market areas than do the comparable virgin materials, thus reducing energy expenditures on raw material and finished product transportation.

As significant as these recycling advantages may be in relation to our national energy supply, they are so remote and impersonal that few people are motivated by them to personally participate in the recycling process. For solid waste recycling to assume a more significant role in the nation's energy and resource conservation efforts, it must personally touch those innermost sanctums of American motivational response, John Doe's wallet and Jane Doe's purse.

2. RECYCLING DEFINED

Before proceeding, and to keep ourselves out of trouble, we should define what we mean by recycling. It is our experience that at least three perceptions of recycling prevail, both among the general public and the more learned.

The first perception is typified by the Boy Scout newspaper drive that everyone has participated in at one time or another. While such drives do indeed provide large quantities of some kinds of solid waste materials to the recycling industry on a national basis, they lack the day-to-day dependability, long-term continuity, and large tonnage capability to significantly impact any local solid waste disposal program. Neither are they very energy efficient, because they invariably involve extra trucks using extra gasoline to drive extra miles collecting the materials and delivering them to the point of sale.

At the other end of the scale, there are those who envision recycling as the classical "black box" where every conceivable form of mixed solid waste goes in one end, something mystical and marvelous happens inside, and something "good" pops out the other end. The best example we've seen was a magazine cartoon of some years ago which showed a packer truck emptying its contents into a large building with "Recycling Plant" boldly painted on the side. In the foreground, an executive-type was pointing out the factory to a group of sightseers and saying, "And what's more, it makes 20,000 gallons per day of the best darn soda pop you ever tasted." Although recycling "black boxes" are in various states of

conception, design, construction, and operation around the country, it would be unfair to say that they are the mainstay of the industry, or that they will be in the near future. It is questionable whether they will ever be the mainstay of the paper recycling industry because of the immense technical difficulties involved in mechanically separating various paper grades.

Somewhere in between these two extremes is the neighborhood or hometown recycling center, an institution that has both waxed and waned in recent years. Most often manned by spare-time volunteers, they usually have a fixed location where materials are delivered, concentrated, and given varying degrees of purification before being sent either directly to the point of re-manufacture or to a larger concentration and purification facility. Although they have provided an impressive tonnage of salvaged waste material to the recycling industry on a national basis, their impact on local solid waste disposal problems has almost invariably been small. Perhaps their greatest contribution has been to demonstrate that a significant portion of the American public is very receptive to the idea of recycling if given the chance. As for their energy efficiency, most would rank quite low.

Oddly enough, the least well perceived image of recycling is the industry as it actually does exist. It is an industry with many different, non-mysterious levels of material collection, separation, purification, and concentration between the solid waste discarder and the finished product manufacturer. It uses solid waste rather than virgin raw materials not out of patriotism or concern for energy or ecology, but to make a profit. Still dominated by private enterprise, it is an industry being increasingly entered at its lower levels by various governmental and non-profit groups, albeit at a snail's pace.

When we speak of recycling to you today, we will be referring to city or county owned operations which conform relatively closely to the existing collection, separation, purification, and concen-

tration portions of the industry. Above all, we will be talking about unsubsidized operations that at least break even financially when all costs and monetary income, benefits, and savings are considered.

3. THE PROBLEM

In our experience, such operations are extremely rare in the local governmental sector. Most governmentally owned recycling operations known to us are rather heavily subsidized, either by tax monies or by financial accounting methods which hide or ignore many costs and carrying charges. That's not necessarily bad, but it's often less than what is realistically attainable with properly inspired and directed effort. John Doe's wallet and Jane Doe's purse -- the ultimate sources of all governmental funds -- deserve to get back just as much as they shell out whenever possible. Just because tax subsidization of governmental operations is common doesn't mean that it's invariably necessary.

Most local governments throughout the nation have at least thought or talked about the possibility of solid waste recycling. With some significant exceptions, most have dismissed it as being too expensive in comparison to more conventional solid waste disposal methods such as landfilling. Often that conclusion has undoubtedly been correct. In other instances, however, that conclusion has probably been false for one or more of the following most common reasons:

- (1) Costs have been overestimated because inefficient operations were proposed for analysis;
- (2) Potential income has been underestimated because inferior grade materials were proposed for sale;
- (3) Potential income has been underestimated because only the most obvious forms were considered, and equally as real but more hidden forms were left out.

As most of you know, particularly those of you in the private enterprise sector, most businesses operate on a fairly small profit margin, in spite

of what your critics may say. Many seemingly insignificant costs can be financially disastrous when added together. On the other hand, many small individual incomes can often be your only profit when they are added together.

One of these small but potentially real sources of local government recycling income is an energy saving in the form of reduced packer truck gasoline use. Its magnitude is not enormous, but its existence can be very real, a fact not to be ignored by consciencious local governments drawing their operating capital from a taxpaying constituency whose political fuse is of a finite length.

4. CASE STUDY

To illustrate our point, we would like to go through a case study of the solid waste disposal-recycling situation here in Rolla, Missouri, where you now sit, and where you are contributing to the local solid waste load every day that you are here.

Almost five years ago, CURE, Incorporated -- a local, volunteer, non-profit, environmental organization -- went into the recycling business here in Rolla. It started just as most other local recycling groups did in the early 1970's, receiving materials brought to it by concerned individuals and businesses, sorting and processing the materials entirely by volunteer hand labor, storing them in an abandoned, rent-free building, and selling relatively low value materials on a fairly local basis. Today, however, and in marked contrast to most similar operations elsewhere, CURE, Inc., is a relatively mechanized, relatively low manpower operation which sells relatively high value materials throughout the Midwest.

Within the next two years, CURE's operation will be replaced by a city owned operation which is fully capable of breaking even financially without subsidization. Although the city's operation will be different from CURE's in a number of ways, it is possible to use CURE's records and experience to estimate what the city's energy usage will be.

As part of the city's recycling operation, a pick-up truck packer unit will make a five-days-per-week collection of corrugated cardboard, metal cans, and large lots of specialty paper grades from selected commercial areas which have a high concentration of these items. As they presently occur, the cardboard and cans are high bulk, extremely low density items that fill dumpsters to volumetric capacity very quickly, and the City Sanitation Department's packer trucks have to empty them every day. By collecting the cardboard and cans with a smaller truck each day, the dumpsters will fill much less rapidly, and packer truck service can be cut back from the present five days per week to only three without creating a hardship on the merchants involved. Besides lightening the workload on the Sanitation Department, the packer truck gasoline usage can be reduced by a surprisingly impressive figure.

In our case study, we will compare this packer truck gasoline saving to the entire energy usage of the city's recycling operation. We'll estimate the recycling operation's usage first. Our common unit of measurement will be gallons of gas per year.

By measuring distances on a detailed city map, we know that the recycling truck will drive 31 miles per week, or 1,600 miles per year, on the commercial cardboard and metal can routes where packer truck collection frequency can be reduced. In addition, we estimate that the recycling truck will average another 10 miles per week, or 520 miles per year, on other local runs. It will also drive another 450 miles per year between Rolla and St. Louis. The annual total is 2,600 miles per year. At an estimated eight miles per gallon that's 325 gallons of gas per year.

The recycling operation will also require the use of a front-end loader periodically to crush and load metal cans and glass. The city's present loader uses about four gallons of gas per hour. Fifty hours of work at the recycling operation will use another 200 gallons of gas per year.

The recycling operation will be using CURE's pre-

sent gasoline powered forklift, at least for the first several years. CURE records indicate that the forklift uses about half a gallon of gas per ton of paper processed. Anticipating that the city's operation will recycle about eleven tons of paper per week, that's another 286 gallons of gas usage per year. The grand total gasoline usage, then, is estimated to be about 811 gallons per year.

The recycling operation will also use significant amounts of electricity, mostly for paper baling and lighting. CURE is presently using just under 5,000 Kwh per year. Considering the mechanical and tonnage differences between the two operations, we estimate that the city may use as much as 10,000 Kwh per year at its operation.

Converting 10,000 Kwh of electricity into gallons of gas is fairly simple. One gallon of gas contains about 108,000 BTU's. However, electrical generating plants are only about 33 percent efficient, so one gallon of gas burned in a power plant would only yield about 35,640 BTU's in actual practice (if power plants burned gasoline). It takes 3,412 BTU's to generate one Kwh of electricity, so one Kwh is the equivalent of about 0.096 (3,412/35,640) gallon of gas. Thus, the city's 10,000 Kwh of electrical use is the equivalent of about 960 gallons of gas per year. Total gasoline usage for the entire city recycling operation, then, is 811 gallons of direct usage plus 960 gallons of equivalent usage, or 1,771 gallons per year.

Next, we need to calculate how much gas can be saved by cutting back the packer truck collection frequency from five days per week to three in those selected commercial areas. The Sanitation Department men who gas up and drive the packer trucks indicate that they get only about 1.7 miles per gallon.

By avoiding the selected commercial areas two days per week, the packer trucks will save 5½ miles of in-town driving per week, or 286 miles per year. In addition, there's no doubt that two packer truck trips per week to the landfill can

also be eliminated by the proposed commercial cardboard and metal can recycling scheme and by other route adjustments related to recycling (they presently make 42 trips per week). By the time the city gets into the recycling business, the round-trip distance between Sanitation Department headquarters and the landfill will be 15.6 miles. Two less trips per week at 15.6 miles per trip makes 1,622 fewer miles of driving per year. Adding this to the 286 miles of in-town driving avoided, the total mileage reduction is about 1,908 miles per year. At 1.7 miles per gallon, that's a gas saving of 1,122 gallons per year.

Comparing the packer truck gas saving to the recycling operation's energy usage, we see that the proposed recycling truck-packer truck coordination plan would reduce the city's gasoline usage by 311 (1,122 - 811) gallons per year, but would increase its total energy usage by the equivalent of 649 (1,771 - 1,122) gallons of gas per year. Thus, the city's recycling operation will cause a small net increase in energy demand.

What's the effect on John Doe's wallet and Jane Doe's purse? For that, we have to express energy in terms of dollars rather than gallons of gas. Using present gasoline costs (45.9¢ per gallon) and electric rates (first 1,000 Kwh @ 4.43¢, next 9,000 Kwh @ 3.20¢), the total energy bill for the recycling operation will be about \$705 per year. On the other hand, the packer truck gas saving will amount to \$515 per year. Thus, the city will have to spent \$190 more per year on energy after it starts recycling than it does at present without recycling. This \$190 will not have to come out of John Doe's wallet or Jane Doe's purse, however, because it is well within the recycling operation's break-even budget.

At this point, we need to consider the possibility that the city government will not go to the trouble to coordinate the new recycling operation with the existing solid waste disposal system, that it will regard recycling as an "add-on" rather than a partial substitution for the old way of doing things. Our experience in Missouri indicates that

this is the common municipal practice. Packer truck routes and collection schedules tend to get almost irrevocably institutionalized over time, and it's often easier for part-time elected officials who frequently come and go to let the city departments slide along in the same old way rather than break with tradition and change, even though the change may be to the taxpayer's and voter's benefit.

If the two programs can be coordinated as proposed in Rolla, the net energy cost to John and Jane Doe for the recycling operation will be about \$190 per year (\$705 spent - \$515 saved). If the two are not coordinated as proposed, and recycling is treated as an "add-on," the net energy cost to John and Jane Doe will be \$705 per year. Whether or not this amount is within the recycling operation's break-even budget is very close to arguable. Even if it is, we don't think many of Rolla's elected officials would be willing to go on the radio before election time and tell the voters they had a chance to save the taxpayers \$515 last year, but they didn't because it was too much trouble.

Actually, the real picture is a little rosier than the one we've painted. Because of the local soils and geology, the area around Rolla is an extremely difficult one in which to find landfill sites with a minimal degree of groundwater pollution hazard. Present, and presumably future, policy is to use the many small, abandoned, relatively seepage-proof clay pits to the northeast of town. Because the nearest ones are being used first, the packer truck driving distance will steadily increase with time. Thus, the energy advantage of recycling in Rolla will also increase over time.

Recycling in Rolla will also present other potential energy saving opportunities, but their implementation will be difficult. CURE presently recycles about 4 percent of Rolla's total solid waste load (plus half again as much from outside the city), and a reasonable goal for the city to achieve is about 8 percent over several years time. It's possible to visualize that packer truck rout-

ing and collection frequency might be further adjusted beyond what has already been proposed to take advantage of this reduction in the solid waste load, but that's still in the realm of speculation, and even more distant from political reality.

We have purposely ignored several aspects of the solid waste recycling - energy conservation relationship in order to keep our topic under control. The initial plan in Rolla is to rely on people to bring their own recyclable household wastes to the city's recycling facility, and they will use an estimated 3,900 gallons of gas per year doing so (3,600 resident and non-resident families driving an extra half mile every other week at 12 miles per gallon of gas). On the other hand, the national energy saving from recycling 11 tons of paper per week alone could be as much as 230,000 gallons of gas per year (11 tons per week x 52 weeks per year x (6,730 Kwh per ton - 2,520 Kwh per ton) x 0.096 gallon of gas per Kwh), although the actual saving would undoubtedly be much less because a lot of recycled paper goes into products for which raw wood is not a substitute (blown building insulation is a good example). Simultaneous collection of recyclable materials and non-recyclable waste by multi-compartment packer trucks represents an energy efficient way of doing both jobs in the future, but the concept and machinery are still in their infancy. The future is full of unknowns, and the difference between a prediction and a guess is often unclear.

5. SUMMARY

Manufacturing many products from salvaged waste materials rather than virgin materials requires significantly smaller amounts of energy expenditure, and a national shift to greater use of recycled materials could make a significant saving in our nation's energy needs. Unfortunately, this fact alone is so remote and impersonal that the average John and Jane Doe are seldom motivated by it to personally participate in the recycling process.

Although recycling "black boxes" that circumvent the need for John and Jane Doe's personal partici-

pation in the recycling process are in various stages of development, it seems clear that their widespread application is many years away. We suggest that appealing directly to John and Jane's personal pocketbooks will be a far more successful motivational approach than flooding them with abstract national energy crisis idealism.

Many communities nation-wide have considered local governmentally operated recycling programs, and a few have actually put them into operation. Commonly, however, they are considered as "add ons" to the existing solid waste disposal program rather than an integral part of it. Thus, opportunities to make both energy and monetary savings by coordinating the two are often ignored. John and Jane Doe ultimately pick up the bill for governmental waste.

The single biggest obstacle to overcome in instituting a coordinated local government solid waste disposal-recycling program is the human and governmental tendency to slide along with business as usual rather than "rocking the bureaucratic boat" and changing institutionally entrenched habits.

6. BIOGRAPHIES

Charles P. Tryon, a native of Indiana, received his BS and MS Degrees in Forest Management from Purdue University, and has additional academic training in hydrology from the Universities of Minnesota and Missouri (Rolla). Employed as a hydrologist by the United States Forest Service, he has devoted much of his spare time during the past seven years to working with CURE, Incorporated. As a result of his water pollution control, conservation education, and solid waste recycling efforts with CURE, he has been the recipient of local, state, and national service awards, and is listed in several "Who's Who" publications.

Sharon S. Tryon, also a native of Indiana, received her BS Degree in Special Education from Indiana State University. Formerly a teacher of the mentally retarded in Indiana and Michigan, she

is presently employed by the Missouri Division of Health as a speech therapist. Her volunteer water pollution control, conservation education, and solid waste recycling activities with CURE, Incorporated, and other civic organizations, and her appointive service as Chairman of the Rolla Housing Authority and Rolla Human Relations Commission, have earned her local and statewide service awards and inclusion in a variety of "Who's Who" publications.