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As we write this article, our nation appears to be in the midst of the deepest economic recession since the 1930s. On the negative side of the ledger, it appears that the cost of capital has steadily risen in recent months, with the Wall Street meltdown forcing some sectors of the economy to shed workers; revenues from the sale of recyclables have also declined dramatically with the downturn in once lucrative Asian markets. On the positive side of the ledger, oil prices, which had risen to nearly $150 a barrel in early summer have now declined to roughly $40 a barrel. Similarly, prices for metals, which greatly affect those of us in the collection business, have taken a significant nosedive this past year as well.

Like the economic pundits who seem to have taken over our 24-hour news channels with grim news, we could regurgitate these same facts as they relate to ways in which the economy might affect the solid waste collection industry. The reality is that our industry has been focused on efficiency and cost effectiveness for quite some time. Whether in the private or the public sector, we have constantly been asked to provide our services quicker, cheaper, and faster. These have been reflected in the business plans of private haulers and the annual budgets and performance measures adopted by solid waste agencies. Our focus in this paper, therefore, is to provide concrete examples of how to cope with current market variability through implementation of adjustments to contracts and deployment of new and novel technologies.

The 500-Pound Gorilla in the Room

The Energy Index, which rose 17.4% during 2007, has declined at a seasonally adjusted annualized rate of 16% through the first 11 months of 2008, according to the Bureau of Labor Statistics. Accounting for this variability of energy costs has become a key issue for those managing collection and transfer contracts. If you contract or franchise collection services in your community, chances are you are familiar with the Consumer Price Index (CPI), and what it means to the collection rates charged by your hauler. It has been common practice to use a CPI to adjust rates annually in collection contracts since communities began contracting for collection services. Figure 1 shows what the CPI had done historically since 1998. Communities can look to region-specific CPI for adjustments; however, this figure shows the US City Average, All Urban Consumers, All Items CPI.

While the CPI is a very common adjustment mechanism in collection contracts, it contains many components that do not directly affect collection services. One could argue, therefore, that the CPI is not a realistic representation of what is affecting the true cost to collect. The other side of this argument, however, is the indirect effect of the cost of goods and services—when things cost more, people consume less; when people consume less, they set out less garbage and recyclables; when people set out less garbage and recyclables, haulers' variable costs go down. Therefore, an increase in the CPI and hauler rates could, in theory, occur when the hauler's variable costs are actually going down (though the fixed costs are likely increasing). Either way you look at it, CPI is a flawed collection rate adjustment mechanism, but not so flawed that it does not serve to generally reflect the cost of doing business.

In recent years, because of the dramatic increases in fuel costs, haulers have pushed to include a fuel index adjustment in addition to other rate adjustment mechanisms in collection contracts. This raises the question: If a community already has a CPI adjustment mechanism in place, and CPI contains a fuel component, would a fuel index adjustment in addition to CPI be double-counting? The answer to that question depends on how, when, and where the rate adjustments are applied.

How: The fuel adjustment should only be applied to the percent of the rate that represents fuel costs. The fuel cost component should not be subject to the CPI increase. Determining the appropriate percentage of the rate representing fuel costs should be done in an equitable way, which may include an annual auditable operating cost statement.
When: Some communities' billing procedures may be structured in such a way that adjustments could be made monthly, to more closely track the volatility in fuel. However, most communities either do not bill customers monthly, or it is too administratively burdensome to change customer rates on a monthly or even a quarterly basis. Taking an annual average of the fuel volatility for the year would be a more equitable and administratively friendly approach. The hauler is essentially making up for fuel volatility in arrears.
Where: The two most common places to look for information on fuel prices are the *Weekly Retail On-Highway Diesel Prices*, published by Energy Information Administration of the Department of *Energy, and the Producer Price Index, No. 2 Diesel Fuel*, published by the Bureau of Labor Statistics.

While no one but the hauler wants to see the hauler make a windfall, consider that if your hauler is not reasonably profitable, everyone loses—the hauler, the community, and its customers. Should you amend your agreement to include a fuel adjuster? You could simply say no to a separate fuel adjustment. Your contract likely contains an "Unusual Costs" clause (or something like it) that allows the hauler to petition the community at any time for an additional rate adjustment on the basis of extraordinary and unusual changes in the costs of operation that could not reasonably be foreseen. This approach puts the burden on the hauler to demonstrate the need for a rate increase, and is not automatically given every year. However, make sure to address what will occur when the costs of operation go back down (especially given the recent decrease in fuel costs).

If your contract is up for renegotiations or soon going out to bid, consider the fact that not including a fuel adjustment mechanism in today's uncertain economic times means that haulers are taking on the full risk of fuel volatility. Haulers will likely hedge their risks associated with the potential for skyrocketing fuel costs, which could mean higher rates than necessary. To protect your community from artificially high rates, sharing the risk of fuel volatility is certainly something to consider.

Another rate adjustment mechanism, though less common in collection contracts, and arguably more on-point than the CPI, is referred to as the Refuse Rate Index (RRI). This approach includes several indexes and should require the hauler to annually provide an auditable operating cost statement. The operating cost statement divides actual expenses into five categories: labor, fuel, vehicle replacement, vehicle maintenance, and "other" (overhead). Each component of the operating cost statement is tied to an agreed-upon index. The RRI adjustment is determined by actual expenses as shown in the hauler's annual operating cost statement, by percentage of overall operating costs. Table 1 demonstrates an example of how the RRI could be calculated.

Automated Collection—Has Its Time Finally Come?

More and more communities are making the switch to automated technology for garbage collection. In communities where single-stream recycling facilities are available, automated recyclables collection is also gaining ground. Even where single-stream facilities are not available, split carts make it possible to provide recyclables collection using automated technology. What is the draw to automated technology? Let's take a closer look at the main components to any collection system: customers, employees, operational metrics, equipment, and maintenance. Table 2 summarizes some of the more typical advantages and disadvantages of automation.

Customers

It is common for communities to switch from twice-per-week garbage collection to once-per-week garbage collection when making the change to automated collection. While some customers view this as a decrease in the level of service, consider that one 90-gallon automated cart can hold as much as four 32-gallon garbage cans. However, setout restrictions are typically stricter in an automated collection system, which may be an adjustment for customers, but ultimately contributes to the efficiency of automated collection. Storage of the containers is also a common initial complaint from customers. Most customers, however, would not want to give up their carts once they have adjusted to the new system.

It is important to recognize that not every home can be serviced with automated technology. In every system, there is at least a route or two that remains manual. Geographic limitations should be considered: on-street parking, low-hanging tree limbs, and power lines, to name a few.

Employees
While drivers of automated trucks typically make more than drivers of manual trucks, the lack of helpers on the back of the truck in an automated system means lower overall employee costs. There are reductions in annual workers compensation claims based on both a reduction in number of employees and a reduction in work-related accidents. The elimination of manual loading also means a reduction in workdays lost because of on-the-job injuries. And absenteeism typically decreases in an automated system because of improved working conditions.

Operational Metrics
Automated collection reduces the amount of time it takes to service each household, which means more households are covered in the same amount of time. The usable capacity of automated trucks is also typically slightly larger. Both of these factors mean fewer trips to the disposal facility, and larger (fewer) routes.

Equipment and Maintenance
New automated trucks, on average, sell for $250,000 each, compared with new manual rear-load trucks, which sell for $225,000 on average. New trucks will last, on average, about eight years. While the maintenance cost per truck can be as much as 20% to 30% higher for an automated vehicle, the overall maintenance costs for an automated collection system is typically lower due to the lower number of trucks needed. Carts are another expense to consider. Ninety-gallon carts typically cost between $50 and $60 per cart (though the decrease in oil prices may bring the cost of a cart down in the near future). Buying in bulk may provide some cost savings. Carts can last up to 10 years.

While the initial capital outlay can be great, planning ahead can go a long way. Some communities begin saving for the capital outlay of converting to automated collection several years in advance. This allows the community to be ready to purchase vehicles and carts for their customers without having to substantially raise rates.

Advantages and Disadvantages
Overall collection system costs are reduced when a community switches from twice-per-week to once-per-week collection, regardless of collection technology. However, automated collection allows a community to continue to pick up about the same amount of garbage in less time and less frequently than manual collection. A change from manual to automated and from twice-per-week to once-per-week garbage collection could yield, on average, a 30% reduction in system costs. Savings could be even greater if the initial capital expenditures are covered through reserve funds or otherwise mitigated. If a community elects to keep a twice-per-week collection schedule when changing to automated collection, that community will likely see overall collection system costs remain about the same but will gain the aesthetic benefit of uniform carts.

The Move to Hybrid Collection Vehicles
Volatile fuel prices and an increasing interest in reducing the environmental impact of solid waste collection has focused new attention on hybrid technology for solid waste collection vehicles. Current solid waste collection vehicles average a fuel efficiency of less than three miles to the gallon. Within the last few years, hybrid technology—whether hydraulic or electric—has been developed for delivery and garbage trucks because of the large numbers of stops and starts required in urban traffic. Typically, this type of driving pattern results in a significant amount of energy lost as heat during braking.

Briefly, hybrid-hydraulic vehicles employ a system that recovers heat energy from the brakes, storing it in a hydraulic accumulator. The pressurized fluid is then used by the driver as the vehicle accelerates as well as in stop-and-go duty cycles along the route. Theoretically, this would result in less diesel fuel being consumed, fewer vehicle emissions, and decreased maintenance expenses.

Prototypes of vehicles utilizing hybrid-hydraulic technologies are being tested in New York City and Los Angeles to evaluate the use of these technologies for refuse trucks. In both tests, Bosch Rexroth will provide its Hydrostatic Regenerative Brake (HRB) system, which uses a hydraulic pump connected to a driveline to pump hydraulic fluid into a nitrogen-pressurized accumulator. In the New York City test, the HRB system will power a Crane Carrier LET2 chassis and integrate it with a Heil refuse body hydraulic system. In Los Angeles, two American LaFrance Condor liquefied natural gas (LNG) trucks already in the city's fleet will be outfitted with vehicle data acquisition systems to monitor operating conditions.

Peterbilt is currently moving ahead with utilizing a hybrid-hydraulic technology to power a similar type of collection truck. The Model 320 HLA, which was displayed at the 2008 Waste Expo, is equipped with Eaton's Hydraulic Launch Assist, which transfers the vehicle's braking energy to the pressurized hydraulic fluid. That fluid is then used to help propel the truck when the driver gets it back under way. Peterbilt has not yet released any specific efficiency numbers, but states

that the reductions in emissions and fuel consumption observed during the testing of the Model 320 are significant.

As of this writing, Waste Management has recently announced that it has begun field-testing four parallel hydraulic hybrid-diesel collection trucks in its Fort Worth fleet to study the hybrid system's efficiency and reliability. According to company representatives, the vehicles will be the first hydraulic hybrids to be deployed in a waste collection application.

There is also significant activity in applying hybrid electric technologies in refuse collection vehicles. The most prominent of these is being tested by Volvo in Sweden, Paris, and London in cooperation with Veolia Proprete, one of the largest waste haulers in Western Europe. The city of Fresno, CA, is currently the testing site of one of the plug-in Volvo hybrid prototypes in the United States.

The collection truck, named "Heidi the Hybrid," is powered by electricity for the main engine and compressed natural gas (CNG) to run all of the lift hydraulics. The hybrid technology consists of a 320-horsepower diesel engine, which shuts down at rest, combined with an electric motor, which powers the truck at speeds up to 12 miles per hour. Regenerative braking is used as a means of recapturing energy to recharge the lithium ion batteries. Besides being much quieter in early morning trash pickup duties, the total gas savings and carbon dioxide emissions are expected to drop 20%–30%. Current tests indicate that the vehicle saves approximately 20–30 gallons of diesel fuel daily compared with the fuel consumption of a typical garbage truck. And at the end of each shift, Heidi is plugged into a commercial electrical outlet and charges overnight.

Landfill Gas to Fuel

Vehicles that run on natural gas have been around since the 1930s. However, the use of CNG and LNG in solid waste collection fleets is a growing trend where public and private operators are looking for ways to reduce their carbon footprints. A 2006 report on refuse trucks by Inform Inc., a national environmental research organization, revealed that California is home to the four largest fleets in the United States (Fresno, Los Angeles, San Diego, and Sacramento), although as of this article, the total refuse collection vehicles nationwide using such alternative fuels (estimated at 1,500) is still barely 1% of the total estimated number of refuse trucks burning diesel fuel operating today (136,000) in the United States. Inform has estimated that if the United States was able to replace 50% of the current refuse collection vehicles with trucks fueled with CNG or LNG, this would displace about 15 million barrels of oil annually, nearly 60% of which is imported from increasingly unstable areas of the globe.

According to most industry observers, there are currently positives and negatives to CNG and LNG alike. CNG is considered more environmentally clean than diesel, but takes up more space than LNG, which is easier to store and transport but currently costs more to produce. Vehicles modified to run on natural gas also are more expensive to purchase. A clear win-win for the solid waste industry would be to produce either CNG or LNG from landfill gas (LFG).

Waste Management Inc. initially tested seven LNG-fueled waste trucks in 1997 and currently operates about 350 LNG and 150 CNG trucks in various parts of California. Some 300 of these vehicles will soon be fueled by the same trash they now haul. Waste Management has recently announced plans to build the world's largest LFG-to-LNG facility at its Altamont Landfill in Livermore, CA, in concert with Linde North America. The $15.5 million facility is being designed to purify and liquefy up to 13,000 gallons of LNG daily, enabling Waste Management to reduce greenhouse gas emissions by more than an estimated 30,000 tons per year and help commercialize the use of landfill gas as a long-term fuel source for refuse collection.

Also of note, FirmGreen Inc. (FGI), a private energy company, recently developed an LFG-to-CNG project near Columbus, OH, in a public-private partnership with the Solid Waste Authority of Central Ohio. When phase two of the construction has been completed, the plant is anticipated to produce more than 25,000 diesel gallon equivalents per day. The CNG fuel is expected to meet OEM engine manufacturing specifications for CNG fuel.

Sonoma County, CA, also is using a small, pilot LFG-to-CNG fuel system for its transit bus fleet.

Mitigation of Soaring Costs

Within recent years, soaring energy, operational, and maintenance costs have prompted facility managers within the solid waste industry to adopt other concrete means of reducing short and long-term costs. This has taken the path of embracing programs that focus on energy reduction and low environmental impact design and operation ("sustainable," "green," and "environmentally friendly"). These have included the EPA's Energy Star program, the Leadership in Energy and Environmental Design (LEED) program, and the Green Globes program.

Energy Star provides, among other tools, those for achieving meaningful cost savings through energy reduction techniques, systems, and operation. This has seen widespread successful use in the private sector by companies with large real estate portfolios. It is also being used extensively by governmental agencies, such as the GSA, and local

governments with extensive building holdings.

Sponsored by the US Green Building Council, the LEED program is a nationally recognized building certification process that provides a template for guiding the planning, design, and construction of high-performance buildings that incorporate many green and sustainable elements. Several current independent studies indicate that LEED-certified buildings are not necessarily any more costly to construct, are less costly to operate over the long term, and generate a better return on investment than non-LEED buildings. Although not as easily quantified, a side benefit is that the LEED buildings are generally nicer to work in, which, no doubt, can lead to a more productive staff.

For owners wishing to do so, the LEED process incorporates a scoring-rating system that can result in the award of a certification at one of several progressively higher levels, depending on the extent of the building's incorporation of green and sustainable elements, from basic "Certified" to the highest level, "Platinum."

Areas that are covered in the scoring for certification include sustainable sites; water efficiency; energy and atmosphere; materials and resources; indoor air quality; and innovation and design process.

Although originally intended for commercial buildings, the program extends eligibility to all buildings covered by a municipal building code. Some of the facilities that could be eligible for LEED certification include administrative buildings, transfer stations, recycling complexes, resource recovery facilities, special waste management centers, and waste-to-energy plants.

The Green Globes program is similar in intent to the LEED program, although it is less rigorous than the LEED program and is based on a self-assessment template, whereas LEED requires review by an expert independent panel. Even if the decision is made not to pursue a voluntary certification like LEED, a program that incorporates in a sensible and disciplined manner any of the elements of these programs would still be worthwhile.

In the field of solid waste management, more than five facilities have already achieved either LEED or Green Globes certification. Brief overviews of the most prominent projects are discussed in the following paragraphs.

Bluff City Transfer Station
Located in Elgin, IL, the Bluff City Transfer Facility is a regional transfer station for solid waste collected by Waste Management of Illinois for communities in Kane, Cook, and Du Page counties. The 15-acre transfer facility was awarded LEED Gold Certification, its second-highest LEED rating.

The award-winning project was recognized for a number of innovative environmental and energy-efficient elements. Among them were water use reduction, the diversion of construction waste from landfills, use of wood meeting the requirements of the Forest Stewardship Council certification program, the use of locally manufactured construction materials with high recycled content, and the reduction of energy usage by approximately 65%.

The project's surface-water management system includes a constructed wetland area with a boardwalk featuring environmentally educational signage; erosion and sedimentation control; and water-efficient landscaping that eliminates the use of potable water. The facility merited recognition for a number of elements:

Site selection that avoided habitats for threatened or endangered species
Open space exceeding local zoning requirements by 25%
Stormwater management and vegetated bioswales to reduce discharge rates
Reflective roof paneling on the transfer building and a vegetated green roof on the ticket building to reduce the heat-island effect and adverse impacts on the local climate and habitat
Site exterior and interior lighting designed to reduce light pollution
The design also incorporated other features to increase the site's water efficiency and reduce potable water usage by utilizing the following: native and drought-tolerant landscaping; low-flow faucets, showers, and urinals; dual-flush toilets; and a rainwater cistern to capture water for toilet flushing and for cleanup of the tipping-floor.

Tallahassee Solid Waste Administration Building
In 2006, the city of Tallahassee's Solid Waste Services Administration building received a LEED Silver award. At the time of this recognition, it was the second municipal building in Florida to earn this distinction. The project initially began as a simple design exercise to provide additional space within a 30-year-old building. During initial planning for the building renovation, the city decided that the renovated building should set a standard to promote and encourage environmental design and building practices throughout the city of Tallahassee in its "Go Green Tallahassee" initiative.

The new building includes a variety of features, including occupancy sensors on lights, programmable thermostat, low-

mercury fluorescent lamps, waterless urinals, low-flow toilets, and native, drought-tolerant landscaping. The city was fortunate to offset additional capital costs through grants from the Florida Department of Environmental Protection.

Shoreline Recycling and Transfer Station
King County, WA's Shoreline Recycling and Transfer Station reopened in February 2008 after completing a two-year, $24 million renovation of a former transfer station, which was located at a closed landfill. The facility has achieved LEED's highest distinction, Platinum Certification, as well as winning SWANA's 2008 National Innovation Award and several regional green building awards in the Pacific Northwest and Seattle area.

The Shoreline station has several distinct features:

A rooftop rainwater harvesting system collects water to wash station floors and equipment and to flush toilets. This reduces water needs by 57%, saving 254,000 gallons of drinking water every year.
Solar panels generate electricity even during cloudy days and will provide up to 5% of the building's energy needs.
The facility uses natural daylight as the primary light source through the translucent wall panels and overhead skylights, reducing energy costs by 50% a year.
A natural ventilation system pushes air through the building, reducing energy needs for ventilation by 80%.
Indoor air is made healthier in part by paints and adhesives low in volatile organic compounds.
Green building materials include recycled content steel, Forest Stewardship Council–certified wood, and fly-ash concrete.
Landscaped bioswales slow water flow to reduce erosion along the banks of Thornton Creek, a nearby salmon-bearing stream.
Plants filter contaminants and sediment from surface-water runoff.
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