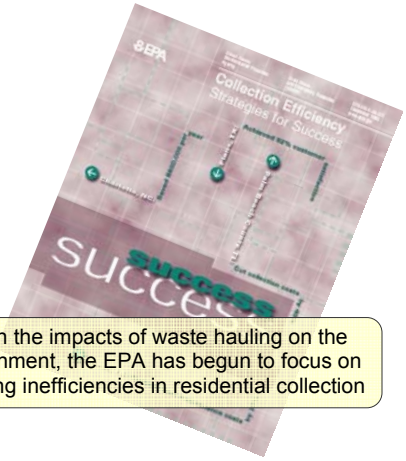
Introduction – The Waste Hauling Industry and the Need for A Different Solution

Introduction and Purpose

With the recent advent of "greening" various vehicle fleets across the nation, the waste hauling industry has shared the spotlight as an area for potential improvement in Greenhouse Gas emissions. While a small fraction of the industry has made the switch to cleaner burning fuels, the proposed solutions fail to decrease emissions in the simplest way possible – by reducing the number of miles that these trucks spend on the road. While route optimization took off long ago in the residential sector[1], it is common practice for commercial compactors to be hauled away when they are at half, and often less, of their potential capacity.



Given the impacts of waste hauling on the environment, the EPA has begun to focus on reducing inefficiencies in residential collection

It is imperative that the commercial waste hauling industry shifts towards an on-demand business model through the use of automated equipment monitoring and control. This resulting reduction in truck force allows for a number of additional benefits that improved fuel efficiency alone cannot provide, such as reduced wear on our roadways, decreased inner-city traffic, and less road noise. With waste receptacles being picked up at near-full capacity, the potential reduction in pollutant emissions is both significant and measurable. This shift in the business model is one that is best encouraged through government support and advocacy.

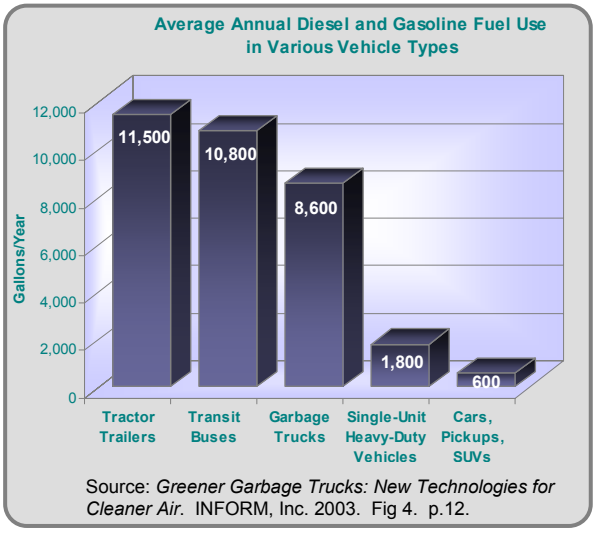
Overview of the Waste Hauling Industry

Nearly 180,000 waste collection and recycling trucks hit the pavement in America each and every day. Hauling nearly 1.5 million tons of waste and recyclable materials to refuse sites on a daily basis, the solid waste and recycling business draws in over $83.1 billion in revenues each year.[2] The waste hauling industry is an extremely profitable, highly privatized sector that is a staple of American commerce and residence.

The amount of solid waste collected in the U.S. each year has increased to over 530 million tons, with the commercial sector representing 300 million tons.[3] With each refuse collection vehicle driving an estimated 25,000 miles each year, the waste hauling industry uses a total of one billion gallons of fuel on an annual basis. Representing one-third of all emissions from the solid waste industry as a whole, the waste collection and transportation sector is the only segment of the industry with a lack of improvement in its net Greenhouse Gas emissions in the past 30 years.[4]

Waste Hauling and the Environment

Waste collection trucks have been noted in particular as the "least fuel-efficient vehicles on America's roads today." This is due to the older than average fleet age, the stop-and-go nature inherent in waste collection routes, and the lowest fuel efficiency of any known vehicle fleet at 2.8 miles per gallon.[1] Across the waste hauling sector, these trucks log 3.4 billion miles on the roads per year. Each truck burns an estimated 8,600 gallons per year, with a use of 1 billion gallons of fuel sector-wide composing 3% of the U.S. annual consumption of diesel.[1]



Source: *Greener Garbage Trucks: New Technologies for Cleaner Air.* INFORM, Inc. 2003. Fig 4. p.12.

[1] *Collection Efficiency Strategies for Success.* EPA, 1999.
[2] *Greening Garbage Trucks: New Technologies for Cleaner Air.* INFORM, Inc. 2003.
[3] *Municipal Solid Waste – Basic Facts.* Environmental Protection Agency. http://www.epa.gov/msw/facts.htm
[4] *Municipal Solid Waste Industry Reduces Greenhouse Gases through Technical Innovation and Operational Improvements.* NSWMA. 2006. ***Updated with 2003 waste management data.*

The Collection & Transportation Sector Falls Short

As a whole, the waste industry has made great strides in decreasing the environmental impact of emissions and pollutants involved in the waste stream process. A National Solid Wastes Management Association (NSWMA) study of the reduction of GHG emissions in the waste industry tells of the success of these efforts. Net GHG emissions were reduced from 60.5 $MMTCO_2E$ (*million metric tons of carbon dioxide equivalent*) in 1970 to 7.8 $MMTCO_2E$ in 2003, despite the significant and continuous growth of the waste disposal industry during this time.[5]

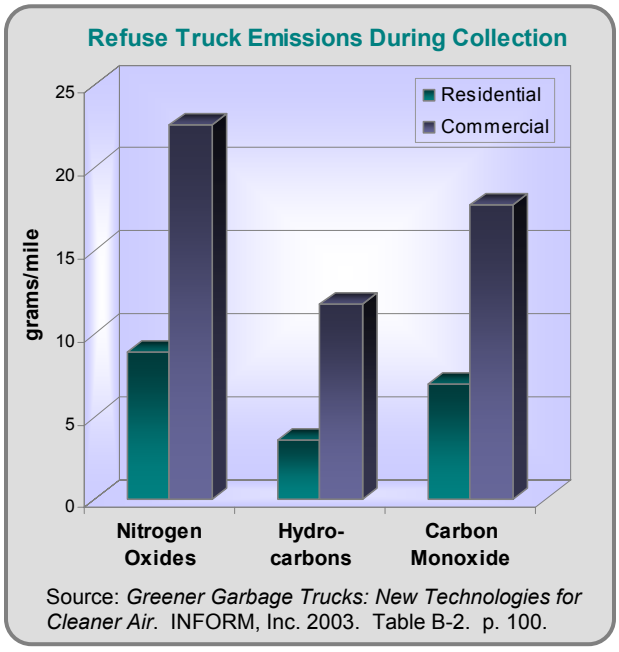
Each of the five waste industry segments defined in the study contributed to decreases in this pollution over the past 30 years, except for the collections and transportation segment. Total GHG emissions from this segment increased from 1.2 to 2.9 $MMTCO_2E$ during this same time period. This increase of 1.7 represents the use of 2,770,663 barrels of oil or adding 257,275 cars to the road. The NSWMA study targets hauling emissions as an area of focus in the future.[4]

In a sample of diesel-powered refuse hauling truck fleets, it was found that diesel refuse trucks displace an average of 31.3 grams of Nitrogen Oxides, 0.4 grams of Particulate Matter, and 4.8 grams of Carbon Monoxide for each mile driven.[6] With an industry total of 3.4 billion miles per year, this equates to a total of over 1,499 tons of Particulate Matter, 116,845 tons of Nitrogen Oxides and 17,990 tons of Carbon Monoxide entering our environment.

Commercial Outweighs Residential

While many studies focus on solid waste collection as a whole, it is important to note that commercial waste collection vehicles contribute to emissions significantly more than their residential counterparts. Of the "heavy heavy-duty" labeled trucks that make up the commercial collection fleets, over 99% are diesel-fueled and weigh in at over 33,000 pounds when fully loaded.[5]

Observation of the emissions of a diesel powered refuse fleet in Japan showed that commercial collection trucks displace an average of 250% more Carbon Monoxide emissions and 255% more Nitrogen Oxides than residential collection.[5] Efforts to reduce emissions within the commercial sector will bring considerable impact to the entire industry.



Source: *Greener Garbage Trucks: New Technologies for Cleaner Air*. INFORM, Inc. 2003. Table B-2. p. 100.

[5] *Municipal Solid Waste Industry Reduces Greenhouse Gases through Technical Innovation and Operational Improvements*. NSWMA. 2006. ***Updated with 2003 waste management data.*

[6] *Greening Garbage Trucks: New Technologies for Cleaner Air*. INFORM, Inc. 2003.

The Search for a Solution and the Downfalls of the Current Business Model

The Focus on "Green" Garbage Trucks

As a result of these various studies, a large focus on the search for alternative fuels and hybrid refuse vehicle models has followed. Natural gas powered collection vehicle have shown to reduce much of the air pollution, noise, and water pollution associated with diesel trucks. However, the large capital expenditures and maintenance costs associated with these upgraded vehicles has resulted in only limited reaction from the industry. INFORM's 2003 study points out that "Despite their commercial availability, natural gas garbage trucks make up far less than 1 percent of the garbage trucks in operation today."[7]

Shifting the Business Model

The fuel-inefficient refuse truck fleet and the resulting pollutant emissions are only a part of the problem. Currently, the waste hauling industry is modeled around the concept of scheduled pick-ups of containers, a system that encourages inefficiency and, as a result, increased GHG emissions and extensive harm to the environment. A new system must be put into place that focuses on efficiency in collection as a competitive advantage to the hauler, reducing the costs of maintaining a larger fleet of trucks and a larger than needed staff of drivers. Reversing current incentives to focus on collection efficiency will bring competition to the market and drive down costs for both haulers and their clients simultaneously.

Typically, the frequency of waste receptacle pick-up is determined at the beginning of a contract, when speculation is most frequently used as to how often a unit should be serviced. These estimations are most commonly made by facility supervisors and waste hauler account managers who have only anecdotal knowledge of the equipment's capacity and frequency of fullness. Even staff who have years of first hand experience with the equipment can have a difficult time pinpointing an exact schedule. The typical schedule results in weekly or bi-weekly pick ups – industry averages indicate that this results in loads that are only half full.

Currently, a lack of knowledge and waste management auditing is stopping businesses from taking charge of their waste stream cycle. Armed with the proper information, any business can regain control of these processes, turning the industry into an on-demand system. This type of system dramatically reduces the inefficiencies and waste inherent in the industry, also cutting down on the emission of Greenhouse Gases and other harmful pollutants into the environment.

Creating an On-Demand System

The simple solution for creating an on-demand hauling service environment is through equipment monitoring and control. This kind of system is established through the constant monitoring and management of a compactor's level of fullness.[8] Once it reaches the appropriate level of fullness, an alert is sent to the waste hauler, an on-demand pick up is scheduled, and the load is picked up when it is 90% - 100% full. On-demand scheduling can reduce the number of pick ups of a typical compactor dramatically. The results of a particular monitoring services provider, MGM Services, are shown here.

Trash Monitor Plus
Reduction in Monthly Compactor Pick Ups

Location	Before Monitoring	After Monitoring	% Reduction in Pick Ups
Houston	9	4	56%
Boston	30	15	50%
New York	9	5	44%
Chicago	20	12	40%
Wash. D.C	9	5	44%
California	12	7	42%
AVERAGE	**14.8**	**8.0**	**46%**

Source: MGM Services, Inc. The Trash Monitor Plus.

[7] *Greening Garbage Trucks: New Technologies for Cleaner Air*. INFORM, Inc. 2003.
[8] For an in-depth understanding of how the compactor monitoring process works, see REAC Monitoring System's *How It Works* paper, located at www.reacmonitors.com/content/how_it_works.htm.

Not-So-Small Successes

Various industries have picked up on the environmental improvements and cost savings that monitoring services provides. After installing a test pilot in Brockton, MA, retail giant Sears saw a 50% reduction in the number of pick ups on their waste equipment. Sears has since installed monitoring equipment in 400 stores nation-wide, averaging a 30% reduction in hauling costs.[9] Medline, an international manufacturer and distributor of medical supplies and services, saw a 46% reduction in hauls after installing a monitoring unit in one of their manufacturing facilities.[10]

Case Study: Southwest Airlines

Southwest Airlines is well known for its ability to pass cost savings onto its customers through "no frills" economy airline service. The company has a history of finding creative, innovative solutions throughout its operations – its waste management cycle is no different. While searching for ways to cut costs in their waste stream, Southwest turned to REAC Monitoring Systems for help. REAC began by passively monitoring several compactors to gain an understanding of the typical use and hauling pattern that Southwest had been experiencing. Two compactors located at the Love Field Airport in Dallas, Texas, are referred to as SW#1 and SW#2 below.

Southwest Airlines: A Significant Impact

Unmonitored 06/05 - 12/05 Monitored 01/06 - 06/06		SW#1		SW# 2	
		Without Monitoring Equipment	With Monitoring Equipment	Without Monitoring Equipment	With Monitoring Equipment
Days between "Tips"	Min	6	13	4	25
	Max	8	19	15	44
	Avg	**7**	**16**	**10**	**34**
Tonnage per "Tip"	Min	3.56	8.99	0.87	6.99
	Max	5.26	12.30	4.06	11.33
	Avg	**4.47**	**11.01**	**2.26**	**9.39**
Decrease in Tip Frequency	Diff	29 tips per year		27 tips per year	
	%	***Reduced 56%***		***Reduced 71%***	
Increase in Tip Efficiency	Diff	6.54 tons		7.13 tons	
	%	***Increased 246%***		***Increased 416%***	

Source: REAC Monitoring Services. Southwest Airlines equipment monitoring data for 06/2005 – 06/2006.

During a six month observation period, SW#1 was picked up weekly, averaging 4.47 tons of material per tip. Using an on-demand system, time between pick ups jumped to an average of 16 days, with average weight increasing to 11.01 tons. ***Pick ups were reduced 56%.***

SW#2 saw even more favorable results. The compactor had been operating far below capacity, tipped with as little as .87 tons of waste. This improved to average of 9.39 tons, with up to 44 days between pick ups. ***Pick ups were reduced 71%.***

In addition to the positive environmental impact of reducing the annual number of pick ups on the two units from 91 to 34, Southwest saw an undeniable impact on the bottom line. At an average tipping fee of $319, Southwest saw a savings of $17,398 in annual hauling fees for these two compactor units alone. Southwest is an excellent example of an otherwise operationally efficient company that found efficiency weaknesses in the management of its waste stream. While a number of organizations across the nation are discovering these inefficiencies, many are still largely unaware as to how their waste stream operates.

[9] *What a Waste System.* Professional Retail Store Maintenance. July/August 2003. p 54-56.
[10] *How a Healthcare Industry Leader Found the Prescription for Waste Removal Costs.* One Plus Corp. – What's New. 2002.

A Real Improvement

The resulting reduction on negative environmental impact is tangible and easily measurable. For each mile that efficient hauling removes a collection vehicle from the road, 31.3g less Nitrogen Oxides, 0.4g less Particulate Matter and 4.8g less Carbon Monoxide is being displaced into the air.[11] For a compactor that was previously being hauled at ½ capacity, this results in a reduction of pick ups by up to 50%. A 50% decrease in miles driven by refuse vehicles represents the potential reduction of the use of 500 million gallons of diesel, a reduction of approximately 1.5% of the nation's annual diesel consumption. At an industry total of 3.4 billion miles per year, this represents a reduction of total emissions as follows: 750 tons of Particulate Matter, 58,423 tons of Nitrogen Oxides and 8,995 tons of Carbon Monoxide.

While these calculations assume a one-to-one ratio of pick-up reductions and a reduction in miles driven, a closer look at reducing the number of pick ups acknowledges that there will be varying correlations in this ratio. This correlation depends on the waste hauler's current route optimization and the varying distances between the waste hauler's starting point, the compactor location, and the tipping site.

Conclusions & Recommendation

It is not argued that the waste hauling industry serves as an opportunity to significantly reduce Greenhouse Gas emissions in the US and even world-wide. However, the industry requires a solution that goes beyond the focus on fuel efficiency and highlights the glaring problem of wasteful route and schedule design. Automated waste equipment monitoring and control provides an avenue to improve the efficiency of commercial waste collection and reduce the number of trucks on the road.

Coupled with the use of alternative fuels and advancements such as route optimization software, the impact of equipment monitoring and on-demand scheduling can be greatly amplified. Monitoring equipment is easily installed and can be retro-fit to virtually all compactors in operation. Unlike the transition to natural gas vehicles, the switch to a monitored system requires little initial investment and provides reduction in cost from the first day of use. This provides a simple, cost-effective solution that can be implemented through a waste generator, a waste hauler, or a recycler.

With an overarching recommendation for government advocacy for the use of commercial compactor monitoring and on-demand container pick ups, the following items represent potential manifestations of this support:

- Legislation initiatives or mandates to use monitoring on equipment exceeding specified metrics (ex: tonnage capacity, frequency of pick up, or geographical location)
- Tax or other various incentives for waste haulers who utilize monitoring services
- Tax or other various incentives for waste generators who utilize monitoring services on current compaction equipment or those who choose to add compaction in their business model as an effort to increase waste stream efficiencies.
- Widespread communication regarding the availability of monitoring services to waste generators, recyclers, and the waste hauling community.

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[11] *Greening Garbage Trucks: New Technologies for Cleaner Air*. INFORM, Inc. 2003.