UTRC Research Project

Trucks, Trains, Tugs, and Tubes: A Model for More-Efficient Collection and Transfer of Solid Waste, the Predominant Form of First-Mile Urban Freight

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Project Objectives: This research was designed to compare the truck kilometers, truck trips, energy use, greenhouse gas emissions (GHG), and capital and operating costs associated with the kind of conventional waste-collection practiced in all North American cities with the costs and impacts of pneumatic collection. Case-specific waste sources, volumes, and composition; transfer, processing, disposal, and garage locations; waste-collection capital and operating costs; truck routes and rail networks; and existing adaptable infrastructure and rights-of-way are used to assess likely outcomes in an actual locale in a way that may offer realistic implications for other localities. The analysis further compares the effects of truck transport of pneumatically collected material, compacted in shipping containers, with transport to the "first-dump" location by truck or by rail. An additional objective was to assess the feasibility and practicality of re-purposing abandoned or under-utilized historic urban rail assets (a rail viaduct now used as park and a freight rail line now under-used for passenger rail) to facilitate the development of non-conventional waste-management systems that may offer potential advantages over existing legacy systems.

Project Description: A trunk tube running the two-km-length of the High Line Park, affixed to its side or underside, could transport waste inserted in inlets on top of the High Line and in buildings adjacent to the High Line (which would be connected by branch tubes joined to the trunk line) to a terminal at its northern end. There would be three inlets at each location where waste is inserted into the system: one each for recyclables (metal, glass, plastic, paper), organics, and refuse. These separate fractions would be pulsed from their respective inlets, one fraction at a time, so that they could be transported separately through the trunk line and compacted into separate containers at the terminal. These containers of compacted waste fractions could be

transported from the pneumatic terminal to centralized transfer, processing, or disposal locations either by roll-on/roll-off truck (RoRos) or by railcars.

Research Methodology: Using data from public and private sources, waste volumes and composition were estimated for each waste generator in the designated zone. Current truck trips, miles, fuel use, greenhouse gas emissions, and capital and operating costs were calculated and adjusted—since existing operations produce an unreasonable excess of truck miles, costs, and environmental impacts—to produce the minimum number of truck miles (and costs and impacts) that could be achieved with truck collection given the locations of the city's long-term waste-management facilities. These miles, costs, and impacts were compared to those associated with an alternative pneumatic system that is shown to be physically and operationally practicable in this location. Since pneumatic collection still requires containers of compacted waste to be transported from the network terminal to centralized transfer, processing, or disposal facilities, a second comparison of miles, costs, and impacts was made between the customary use of RoRo trucks (and barges, in the case of recyclables) or the use of direct transfer to railcars—another option that was shown to be physically and operationally feasible in the case-study area.

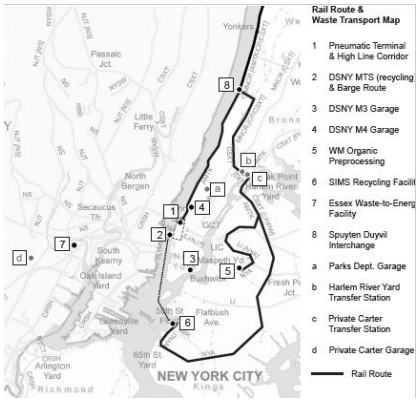

Table 8. Annual Impacts of Truck v. Pneumatic Collection With and Without Rail

	Trks, Zoned/Brge	Pneu/Trk/Brge	Pneu/Rail	*Ratio Pneu-Tr-Bar/Trks*	*Ratio Pneu-Rail/Trks*
Tonnes	8,226	8,226	8,226		
Truck Kilometers	29,702	20,162	0	*68%*	
Rail Kilometers	0	0	7,147		
Barge Kilometers	417	417	0	*100%*	
Diesel Fuel (Liters)	25,761	15,283	6,306	*59%*	*24%*
Electricity Use (Kwh)	0	453,365	453,365		
Combined Energy (Btus)	945,271,478	2,107,726,055	1,778,341,194	*223%*	*188%*
GHG (Tonnes)	70	180	155	*259%*	*223%*
Capital Cost	$2,080,785	$8,715,295	$9,429,375	*419%*	*453%*
Operating Cost	$1,632,246	$956,762	$714,766	*59%*	*44%*
Equivalent Annual Cost	$2,099,646	$1,419,541	$1,259,819	*68%*	*60%*

Numerical Results: Truck kilometers are reduced by a third in the scenario where collection trucks are replaced by pneumatic collection, but trucks are used for draying pneumatically collected containers to central dump points (since 2/3s of the kilometers in the conventional scenario occur before or after the collection route). Truck kilometers are eliminated in the pneumatic-to-rail scenario. Though initial capital costs for both pneumatic scenarios are more than four times greater, overall costs on an annual basis are roughly halved. Overall energy use, since the reduction in diesel-fuel use is more than off-set by increases in electricity demand, are about double. Since New York City's electricity is primarily generated, at present, by natural gas, overall GHG emissions are about 2 ½ times greater.