

## THE IMPACT OF SOURCE SEPARATION ON THE COST OF MUNICIPAL SOLID WASTE MANAGEMENT SYSTEMS

DODIS<sup>a</sup>, C., K. KITIS<sup>a</sup>, D. PANAGIOTAKOPOULOS<sup>b</sup> and V. AIVALIOTIS<sup>c</sup>

<sup>a</sup>Student, Department of Environmental Engineering

<sup>b</sup> Professor ([dpanag@civil.duth.gr](mailto:dpanag@civil.duth.gr)), <sup>c</sup>Lecturer, Laboratory of Project Management,  
Department of Civil Eng., Democritus University of Thrace, 67100 Xanthi

### EXTENDED ABSTRACT

Economic and legal pressures are put on municipalities for separation-at-source (SS) practices for their municipal solid waste (MSW). Specific deadlines for introducing SS practices are set. Yet, no reliable cost figures are available for system planning purposes. The purpose of this paper is to contribute to the analysis of the questions: How much do SS systems cost? How is the cost/ton affected by various arrangements for SS?

Specific functions are presented (for real-world prices and conditions, in Greece) relating cost/ton with city size, for different SS arrangements, taking into consideration practical ranges of values for the following parameters: *Waste per capita* (0.70 to 2.50 kg/day); *population density*; *crew size*; *crew productivity* (15 to 35 m<sup>3</sup>, in the bin, per hour); *collection frequency* (1 to 7 times/wk, depending on the waste stream and legal restrictions); *distance to disposal site and Recycling Center* (5 to 30 km); % of households participating in SS (0 to 95 %).

The total system cost includes *temporary storage, collection, transport, temporary storage of recovered materials at recycling centers, and landfilling*. Revenue from recovered material is considered at market prices. Three SS arrangements are analyzed here:

- a. **Stream 1:** Mixed dry recyclables (paper/carton, plastics, glass, metals); collected 3 times/week; compression factor 2; 1 collector/vehicle.  
**Stream 2:** Remaining; 3 times/week, compression factor 4; 2 collectors/vehicle.
- b. **Stream 1:** paper/carton, **stream 2:** plastics, **stream 3:** glass, **stream 4:** Remaining. Streams 1 to 3: collected once/wk, 1 collector/vehicle. Stream 4: 3 times/week; 2 collectors/vehicle. Compression factor: 4 for streams 1, 2, 4 and 1 for stream 3.
- c. **Stream 1:** Food waste; collected 6 times/wk, 1 collector/vehicle, compression factor 4.  
**Stream 2:** Remaining, collected 3 times/week, 2 collectors/CV compression factor 4.

A large variety of bins and of collection trucks is considered for different waste recovery streams. The cost per ton is computed taking into consideration capital cost, operation and maintenance, labor, end-of-life cost, reserved capacity, etc. The least cost combination (types and numbers of bins and trucks) is chosen for each case.

Practical conclusions are drawn which could improve the planning process. The cost of temporary storage, collection and transport is over 50% of the total MSW management cost. Economies of scale seem to be dampened out for sizes over 70000 people, for all SS scenarios. There are cases where SS schemes cost less than no-SS, if one considers benefits from recyclables, less expensive vehicles, lower collection frequencies for "dry" recyclables and lower LF costs. For sizes of >80000 people, separation of food waste at source and introducing separate storage and collection-transport system, might lead to savings over mixed waste collection and transport. LF costs correspond to about 10 to 30 % and recycling centers costs to about 2 to 10 % of the total MSW management cost.

**Key words:** Municipal waste, waste management, source separation, costs.