

Analysis of Alternative Scenarios for Reaching Governmental Waste Recycling Target in Santiago de Chile

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Abstract

The economic growth that Chile has sustained in recent decades has come accompanied by the generation of huge amount of wastes. The country has historically put emphasis on the appropriate final disposal of the waste through sanitary landfill.

However the environmental problems generated by this activity has put in evidence, that concentrating efforts on solving the final disposal in a sanitary and environmental friendly way is not enough. Therefore it is necessary to improve the national solid waste management approach.

In Santiago, the Capital of Chile, which generates about 43% of the national solid waste, a study conducted by the Ministry of Environment in 2011 found that 14% of the waste generated is recycled and it's done mostly thanks to local campaigns and informal collectors.

Santiago region launched a recycling project called "Santiago recicla" (Santiago recycles) that set the target to recycle 25 % of inorganic materials by 2020. In order to meet the government goal this study propose the evaluation of different alternatives for municipal solid waste collection, treatment and recovery for inorganics. The scenarios will be analyzed using the Life Cycle Assessment technique.

Keywords: Sanitary landfill, Recycling, Inorganic materials, Life Cycle Assessment

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Introduction

Chile has enjoyed a rapid and sustained economic growth in recent decades. However this economic growth has been accompanied by severe environmental degradation. One of the most serious environmental issues now is how to deal with the huge amount of wastes that are generated daily. In the case of Santiago, The Capital of Chile, which generates about 43% of the national solid waste, nearly 40% of it ends up in landfill or dump sites (CONAMA, 2011). Even if historically in Chile, the solid waste management has put emphasis on proper final disposal, the environmental problems generated by the hoarding of solid waste on the landfills, such as GHG emissions, water pollution, land erosion and others, has put in evidence, that putting efforts on solving the final disposal in a sanitary and environmental friendly way is not enough. Therefore it is necessary to improve the national solid waste management approach. Which also is a way to contribute to our progress toward a green growth and sustainable development, which is one of the topics of the OECD from which Chile is a member since 2010.

In Chile, local governments are responsible for the management of solid waste in their areas, defined as the collection, transportation, and disposal systems of the municipal solid waste management (SESMA). For that purpose, municipalities pay an average of USD120.000 per month (Ministry of Environment, 2013).

In the paper, “Towards the Estimation of Demand for Recycling in Chile: The Case of Santiago”, published in 2013, it is mentioned that 50% of the Chilean population has a positive attitude towards the separation of municipal solid waste, and 90% of the inhabitants identified recycling as the solution to the municipal solid waste management system (Oscar C. Vasquez, 2013).

In the denominated Gran Santiago area, there are 32 municipalities with their own waste management system. The study done by CONAMA in 2011 says that 14% of the waste generated is recycled and it’s done mostly thanks to local campaigns and informal collectors. (Ministry of Environment, 2013). See annex 1 for details.

Nowadays, and as part of the National Policies of Solid Waste Management strategic plans, there is one big recycling project in development called “Santiago recicla” (Santiago recycles).

This project has set the target to recycle 25% of inorganic wastes by 2020. This is the goal were the efforts of the government are focusing now, especially in the distribution of drop off stations. However, this big project doesn't consider organics wastes, which take over 48% of the total generated waste.

This study propose the evaluation of different alternatives for municipal solid waste collection, treatment and recovery for inorganic and organic materials. In order to meet the government goal this study propose the evaluation of different alternatives for municipal solid waste collection, treatment and recovery for inorganics. The scenarios will be analyzed using the Life Cycle Assessment technique.

Methodology

The scenarios were evaluated by using Life Cycle Assessment techniques. (This study used the IWM-2 Software).

Design of the scenarios

This study proposed 4 scenarios.

- **Scenario 1 (S1):** This scenario is based on the actual situation of waste management in Santiago, and is considered as the base line. The recovery of the generated waste is 14.5% as detailed in Table 1.

	Waste Generated Composition		Actual Recovery (S1)	
	%	Ton/Year	%	Tons/Year
Paper and Cardboard	16%	433,515	49.5%	214,500
Plastics	13%	344,705	5.7%	19,500
Metals	7%	199,655	44.4%	88,600
Glass	6%	154,620	12.6%	19,500
Kitchen	37%	996,130	0.9%	10,000
Garden	6%	162,930	1.8%	2,960
Tetra packs	1%	15,655	0.0%	0
Others	15%	408,290	9.6%	39,000
Total	100%	2,715,500		394,060
				14.5%

Table 1: Santiago waste generation composition and actual recovery raters per material. Data source from “Estudio de Factibilidad Tecnico Ambiental, Social y Economica para la Implementacion del Plan de Accion “Santiago Recicla”.

S1 considers 4 collection types. Out of the 32 communes, 2 have a mixed material bank collection system for plastic, metals and cardboard that will be transferred to a MRF. 1 commune has a single bank collection system for vegetables that will be treated for compost or vermicompost. And there is also drop off collection points in different parts of Santiago and the informal collection per household.

- **Scenario 2 (S2):** This scenario consider the goal of the government for 2010 which was 20% recovery of inorganic materials. The importance of this scenario is determine if, it was possible to reach the goal by only increasing the informal collectors participation and maintaining the formal collection and treatment status quo. The material considered and the ratios for this scenario are shown in Table 2.
- **Scenario 3:** This scenario considers the goal of the government for 2020, which was 20% recovery of inorganic materials (see table 2). It is divided in two sub-scenarios depending on whether the project includes collectors as part of the waste management collection system or not.
 - **Scenario 3.1 (S3.1):** Doesn't consider the informal collection system but only kerbside, material banks and drop off.
 - **Scenario 3.2 (S3.2):** This scenario consider all the formal collection system from S3.1 plus the informal collectors.

	Ratios Recoveries				
	S2	S3.1	S3.2	S4	S5
Paper and Cardboard	60.5%	64.0%	70.0%	60.5%	70.0%
Plastics	20.4%	34.7%	34.7%	20.4%	34.7%
Metals	60.0%	83.5%	70.0%	60.0%	79.0%
Glass	30.0%	45.5%	46.0%	30.0%	35.0%
Kitchen	1.1%	1.1%	1.1%	16.5%	28.0%
Garden	1.2%	1.2%	1.2%	16.0%	29.0%
Tetra packs	0.5%	0.5%	0.5%	0.5%	0.5%
Others	11.0%	11.0%	11.0%	11.0%	11.0%
Total	553,100	688,875	688,875	733,185	1,004,735

Table 2: Ratios recovery for each material and scenario. Own Elaboration.

	Scenarios			
	S1	S2	S3.1	S3.2
Target				
Inorganics	13%	20%	25%	25%
Organics	0.6%	0.6%	0.6%	0.6%
Collection				
Informal	YES	YES	NO	YES
Drop Off	YES	YES	YES	YES
Kerbside	YES	YES	YES	YES
Material Banks	YES	YES	YES	YES

Table 3. Target and collection system considered in each of the scenarios. Own Elaboration.

In table 3 we can see a summary of the target for each of the scenarios and the type of collection system considered.

The efficiencies of treatment for each of the materials in the study are shown in table 3:

	Efficiency of Mono collection	MRF KDM	Compost
Paper and Cardboard	95.5%	50%	
Plastics	65.0%	80%	
Metals	92.5%	90%	
Glass	94.2%	20%	
Kitchen	80.0%		100%
Garden	80.0%		100%
Tetra packs	95.0%	80%	
Others	80.0%		

Table 3: Treatment efficiencies for each material. Source: "Material and energy recovery in integrated waste management systems. An evaluation based on life cycle assessment. Milano, Italy." paper and Lomas Colorado, KDM company presentation.

Future Work and Expected Results

After designing the 4 scenarios in this studio the analysis will be done using the IWM-2 software. The scenarios will be evaluated in terms of important indicators such as avoided GHG

emission per investment and avoided PM_{2.5} per investment as well as feasibility of implementation.

Since transportation to sanitary landfills is the most expensive cost in solid waste management it is expected that the scenario that engage informal collectors, S3.2, will have the lowest cost, but in terms of capability, the amount and volume that they can recycle might not be more that what they are already handling now days.

Considering the low treatment efficiency of paper and glass in MRF it is also expected that scenario 3.1 will require a high collection quantity to reach the recovery target for these materials.

As specified in the scenarios description there is only inorganic materials considered in the government past and future target. Organic materials in Chile cover 48% approximately of the generated waste, occupying a large volume in the trunk waste collector, and damaging other materials, like paper, compromising their recovery because of the high humidity in its composition. There is also the important production of GHG emission while it discompose. Therefore, and based on the studies done by the author of this paper, it must be considered in the government recovery target.

References

CONAMA. (2011). *First Report of Solid Waste Management in Chile*.

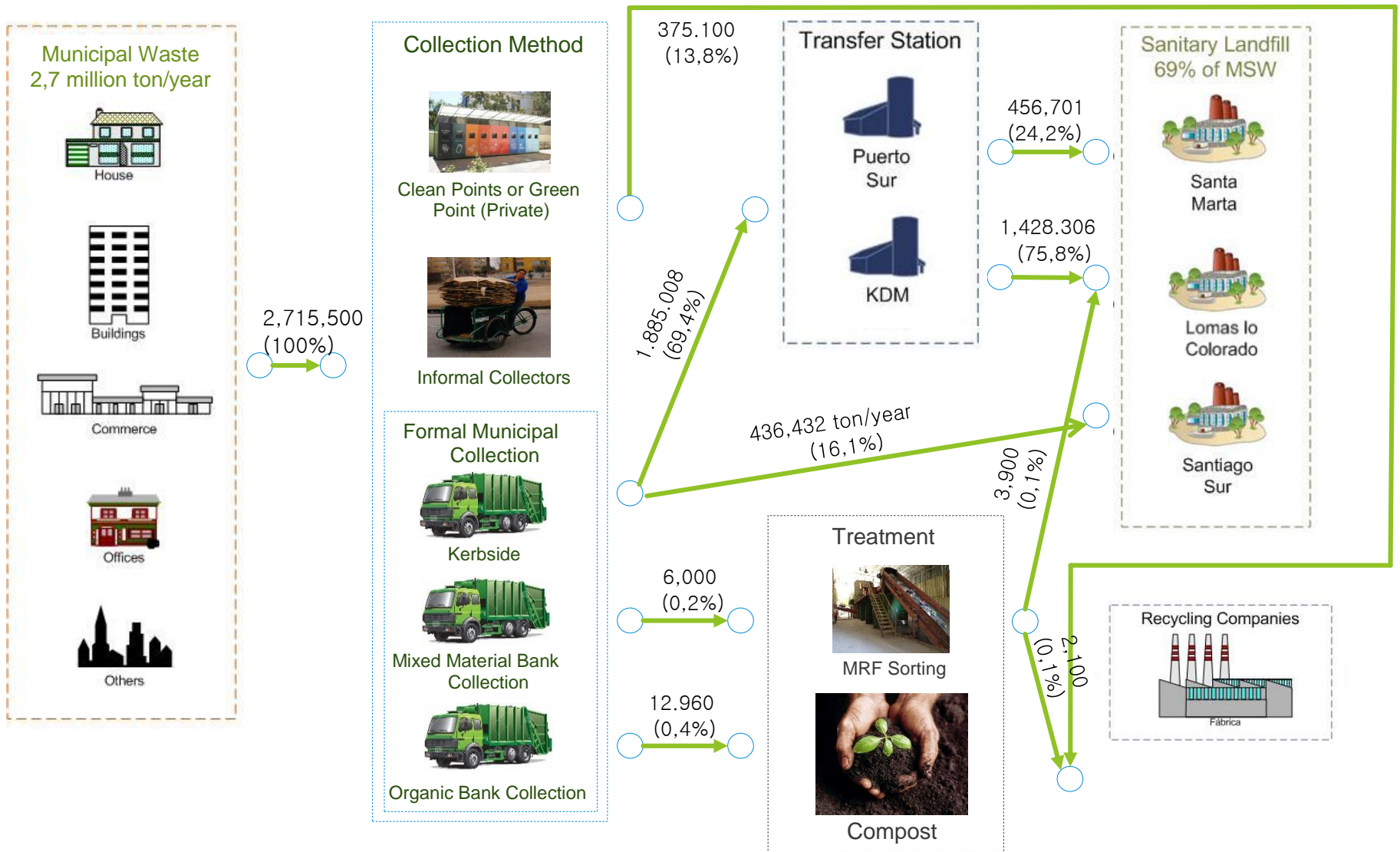
Ministry of Environment. (2013). *Políticas Pblicas para la Inclusion de Recicladores Base al Sistema de Gestion de Residuos Municipaes en Chile*.

Oscar C. Vasquez, A. A. (2013). Towards the Estimation of Demand for Recycling in Chile: The Case of Santiago. *ELSEVIER*.

SESMA. (n.d.). *Informacion General Relativa a Residuos Domicilarios*.

Vasquez, O. C. (2011). Municipal Solid Waste Management in the Gran Santiago of Chile: Challenges and Opportunities. *Revista Internacional de Contaminacion Ambiental*.

Anex1: Waste Flow in the Gran Santiago



Source: Own elaboration