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Experiencing Urban Mining in an Italian Municipality towards a Circular Economy vision

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Abstract

Selective waste collection in Italy has undergone significant changes over the last decade, highlighting very different approaches from one region to another. Research results presented in this paper are underlying differences between geographical regions and use them as a model of good practices to improve the less optimized systems. In the last decade, the Trento City Council has established a goal – the optimization of selective municipal solid waste collection – that led to a very low amount of recyclable materials in the residual fraction. More than that, for the first time sanitary textiles have been considered as a separable fraction at the source; for a long time this type of waste was considered negligible. These actions were transformed in a recycling program coordinated together with local recycling companies. This paper deals with factors associated with waste recycling, like specific criteria (waste containers selections for door-to-door collection, public awareness and tariff) and solutions (door-to-door bins, warnings, criteria for historic centers). The tourist characteristics of Trento makes it an interesting model for similar towns that are facing with the problem of optimization criteria. This opportunity is discussed referring to a Romanian case.

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Keywords: air quality; human exposure; low-cost and portable sensor; reducing gas; unconventional environments

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1. Introduction

Tens of years ago, world's urban population generated in average about 0.6 kg inh.$^{-1}$day^{-1} of Municipal Solid Waste (MSW); today the MSW generation in urban areas has reached up to 1.2 kg inh.$^{-1}$day^{-1}. In the forthcoming future the per capita generation is expected to reach 1.4 kg inh.$^{-1}$day^{-1} [1,2]. The quantitative and qualitative properties of the MSW stream are mainly influenced by demographic change, climate, socio-economic and industrial development, environmental policies, policy makers, and interests of the parties involved in the production and use processes [3-11]. In a long-term vision, the technological, economic and environmental efficiency of any waste management system must take into account three dimensions: sustainability, society and economy [12-17].

Today, the waste management trend towards a zero waste framework is gradually shifting from the linear economy to a circular one [17-21]. The structured "take-make-dispose" approach used as a model in the linear economy has reached its end, being replaced by a refining and advanced concept where the priorities lean on the primary use of renewable energy that reduces the environmental concerns, where all the materials should be exploited (reuse, recycle or recovery) in an infinite number of cycles [22,23]. Considering the above mention, the evaluation of waste management performance is also based on several performance indicators such as: source separate collection (that registers the highest achievements in terms of rate and quality of the collected recyclable materials by type of fraction in comparison with mechanical sorting), waste collection systems (types of containers, schedules for emptying frequency of the containers or waste fraction collected) which is correlated with the effective collection distance, collection time and fuel consumption, waste collection units/deposition of the waste, territory suitability, existence of a competitive and open waste market, overall labor effectiveness which is highly connected with waste management system state of the art, and costs [24-26]. The quantity and quality of the separated collected waste performance relays on its recycling rates in terms of second raw materials recovery but, also, can be substituted in a result of a Solid Recovered Fuel that can be used as raw fuel with energy recovery purpose [27,28].

Waste management in Italy has undergone many transformations in the last decades; one of the consequences is that selective collection (SC) in urban areas is different from one location to another. The overall recycling MSW rates, in 2012, (including material recycling, composting and anaerobic digestion) in the EU-28 countries reached out to 40% (496 kg per capita of MSW generated in 2012), while Italy reached to a 37% rate (529 kg per capita of MSW generated in 2012) [29]. Considering the last European Commission report (2015) on ''Separate collection schemes in the 28 capitals of the EU'', the SC rate in Rome reaches out to 16%, being sixteen, five and four times higher in comparison with Zagreb, Bucharest, Sofia respectively and close to the EU-28 average by capital of 18.5% [30]. On the other hand, in Italy the efficiency of MSW selective collection reached 65% in some regions [31,32].

In this frame, waste management, and especially SC, are priorities for the Municipality of Trento administration. In the last years, a lot of money has been invested in environmental sustainability; particular attention was payed for developing a reliable waste collection system and selective collection mainstream in particular. Waste management reorganization started in 2006 as a pilot project; at that time, waste selective collection was 46.5%.

This paper presents specific aspects derived from the Trento community experience in this field and also points out new criteria and solutions. The work is completed by considerations regarding materials destinations and consequences of SC on the Residual Municipal Solid Waste (RMSW).

2. Material and methods

The strategy set in the town of Trento for SC optimization bases on the Italian regulation integrated with local decisions, specifically at provincial level.

The country has taken and transposed the necessary actions though legislations that along the way has suffered a series of modification and changes introduced by the country itself or by the European community. In this frame in the Province of Trento the first step towards an environmental friendly waste management was in 1982 by the introduction of the regulation L.P. 29/82 that prohibited the uncontrolled waste disposal imposing the sanitary landfill concept.

SC of the organic waste from the MSW was introduced in the province by middle of the '90s.