

Techno-economic evaluation of solid waste treatment technologies- An implementation in the region of Attica (Greece)

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1. Introduction

In this paper, recycling, composting, incineration and co-incineration technologies of MSW management are examined. These methods are considered as a significant part of solid waste management, in the direction of zero waste and circular economy. Therefore, the analysis aims to study the implementation perspectives of these technologies in the region of Attica, Greece. Economic and technical parameters are examined, based on data found in literature review, the results from technical and economic analysis of case studies, and the waste management practices currently applied in Greece. The advantages and disadvantages generated from those methods are also discussed.

2. Material and methods

2.1. European and national waste management legislation

In order to improve waste management of each member state, EU has established a legal framework. This framework includes directions, policies and quantity goals. Specifically, Directive 2008/98/EC, states that household waste such as at least paper, metal, plastic and glass should be recycled and recovered up to a percentage of 50 % by 2020 in member States. The EU has established a legal framework that targets the reduction of quantity of waste that landfilled. Specifically, up to 2020, the biodegradable municipal waste that heading to landfills must not exceed the 35% of the total amount of biodegradable municipal waste produced in 1995 (Directive 99/31 EC). EU legislation has incorporated to Greek laws and in the National Waste Management Plan (Official Journal of EU, 2008, Official Journal of EC, 1999, National Waste Management Plan, 2015).

2.2. Solid waste management hierarchy

Municipal solid waste effective management is essential in order to avoid environmental, social and economic impacts (air/ water pollution, solid contamination, etc). According to the waste management hierarchy, waste must be prevented, recycled or composted (anaerobic or aerobic composting). If these options aren't feasible, then waste- to- energy treatment and landfilling in modern landfills with methane recovery should be used (Directive 2008/98/EC, Gharfalkar et al, 2015).

2.3. Waste management in Attica

More than one third of the population of Greece resides in the region of Attica. More specifically, due to data from the Hellenic Statistic Authority, there are 3,827,624 inhabitants. (ELSTAT) As a result, a significant amount of municipal solid waste is produced (about 1.9 million tons per year). The waste treatment methods that are widely used include recycling, composting and landfilling (with methane recovery). There existing facilities includes separation at source systems, one factory of mechanical biological treatment (MBT), two sorting centers for recyclable materials (mainly packaging waste and printed paper), etc. Treatment facilities are inadequate for an ecologically proper waste management, while the participation of the population at the separation at source programs is low. Furthermore, municipal waste from other regions is transferred into landfills in Attica. As a result, more than 1.5 million tons of waste per year is being disposed into landfills in Attica (ESDNA, 2016).

3. Results and discussion

In order to improve waste management, the construction of several waste treatment facilities is proposed. More specifically, the construction of three mechanical treatment plants for recyclable waste, two composting plants and three treatment plants for mixed waste is proposed. Additionally, in order to process the streams that cannot recovered, an incineration plant is also studied. In this plant, RDF will be used as a fuel. RDF can be obtained from the aforementioned mechanical treatment facilities, and other sources. A significant part of processing residue from these plants can be converted to RDF and be transferred for incineration. RDF consists mainly of small pieces of plastic and paper and has significant calorific value. In addition, metals and other improper materials have already been removed.

The total capacity of the proposed plants is about 850,000 tones/ year. The construction of the proposed waste treatment plants costs about 200-225 million Euros. However, the current gate fee in landfill is 45 €/tone and there is an additional fee that has already incorporated into legislation. Furthermore, the products from the factories can be sold (recyclable materials, energy (heat and / or electricity), compost etc) and can generate significant incomes. Additionally, fines that may be imposed by the EU, in case that Greece fails to achieve goals in waste management. As a result, the proposed facilities can be economically viable (Aleluia et Ferrão, 2017, Panagiotakopoulos, 2002, Tsilemou et Panagiotakopoulos, 2006, Economopoulos, 2010).

Significant environmental benefits can be offered by the proposed plants. The reduction of the amount of waste that heading into landfills can reduce the greenhouse gasses and other environmental impacts. Recycling and composting reduce the need for new resources. Incineration reduces the use of fossil fuels and as a result, reduces greenhouse gasses compared to landfilling (even with methane recovery) (Milutinovic et al, 2014).

4. Conclusions

As mentioned, the existing facilities are inadequate for the management of MSW. In the current situation, the rate of recovery is low. This rate, compared with the target of 50% implies that drastic measures must be taken. The rate of biodegradable waste dumped in landfills is also quite far from the specified from national and European legislation target. As a result, there is a need for immediate action in the field. If these rates do not meet the EU legislation targets, Greece might be fined. The proposed factories will increase significantly the capacity of waste treatment plants and can contribute to reduce the environmental impacts of waste management in Attica. Moreover, these plants can contribute in order to Greece comply with the objectives of national and European legislation. Additionally, in areas with large population density (like Attica) it is crucial to reduce the required area of landfills. The results also show that recycling, can offer economic benefits (apart from the environmental). Composting can also be economically viable for the municipalities. Note that the aforementioned facilities are proposed as the first phase in a total waste management. This means that the facilities (or at least some of them) may have the potential of a future expansion. More plants may also be constructed.

5. References

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