WASTE-TO-ENERGY POLLUTANTS & EMISSIONS MANAGEMENT AND ECONOMIC VIABILITY

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1. Introduction

Waste generation and inadequate waste collection, treatment and disposal are one of the most pressing environmental issues in the world today. Waste-to-Energy (WTE) is the process of generating energy in the form of electricity and/or heat from the primary treatment of waste. This research study focuses on how WTE emissions are managed and how economically viable the program is for Greece. Taking advantage of a variety of filters and treatments, the emissions produced by the combustion of waste can be minimized. The application of such a method will not only solve the waste management issues, but also generate electricity, heat, metals and bring extra money to the government.

2. Research Methods

This research belongs to the field of meta-analysis as it was conducted by searching, comparing and analyzing the results of 42 scientific papers, articles & libraries as in order to reach a single, and more precise result.

3. Results

Currently, Greece pays fines that come up to 100 million EUR per year due to environmental damage, including waste landfilling.

There are two types of variants for a WTE plant. In the first variant, dry and semi-dry flue gas treatments are applied, while in the second one wet flue gas treatments are applied. Moreover, there are six types of filters/treatments for emission management. Fabric Filters (Shaker, Reverse Air, Pulse Jet)[3], Electrostatic Precipitators, Wet Scrubbers (Chlorine, Ammonia, Sulfuric Acid, Water)[2], Selective Non-Catalytic Reduction (SNCR), Selective Catalytic Reduction (SCR) and Semi-dry treatment. Table 1 shows treatments that are similar, but are used in different WTE plant variants.

Table 1: Similar types of management comparison

SNCR	SCR
Fabric Filters	Electrostatic Precipitators
Semi-dry Treatment	Wet Scrubbers

Table 2: Cost of each emission management component[4]

System Component	Cost (EUR)
Fabric Filter	2.200.000
SNCR Process	800.000
Semi-dry Treatment	1.200.000
SCR Process	1.500.000
Wet Scrubbers	5.000.000
Electrostatic Precipitators	1.200.000

Via these tables, it is clear that the first Variant is cheaper, while the second one is more effective. However is WTE a viable, economically, solution? Can it be applied in Greece and other countries? Table 3 illustrates comparisons of the costs and revenues. In initial costs factors such as infrastructure, design, labor, filters etc. have been calculated. In the annual costs factors such as working wages, operating materials, maintenance etc. have been calculated. In annual revenues, electricity selling (with current prices in Greece) and gate fees have been taken into account. It is obvious that the first year of operation, due to the initial construction costs, profits won't be able to overcome costs. However, from the second year onwards, profits will be more, making pure profit in the third year.

Table 3: Cost/Revenue/Profit Analysis[4]

Type of Cost/Revenue	Quantity (EUR)
Initial Costs	62.000.000
Annual Costs	7.613.859 / year
Annual Revenues	36.464.334,6 / year
Profit for the 1st Year	- 35.149.524,4
Annual Profit after 1st Year	+ 28.850.475,6

4. Conclusions

To summarize, although in the past the WTE process has been identified as one of the most pollutant-producing processes, with the extremely sophisticated environment protecting measures shown, it is the future of energy and will probably be the biggest source of it in the coming years. The reason for this is its connection with a resource that is naturally produced constantly by all of us: waste. Technology will evolve and progress, and in the near future it will grow cleaner and more efficient. New ways of managing pollutants will be invented, as well as new control systems and new techniques of combustion. Thus, as the need of electricity is rising year by year, it is a must for this method to be applied more widely in every country in the world and upgrade it constantly as much as possible in terms of both efficiency and safety for the environment and those working in WTE plants. On top of that, it is a method completely viable for every country, including Greece, because from the third year of the investment there will be pure profit produced and the problem of waste landfilling will be over by the end of the first year. Every country that cannot afford the initial investment can seek financial assistance within the framework of European or other Funding Programs, loans or investments from private sources.

5. References

[1]Salonikidou Foteini, (2015). *Combustion as a technique of waste management and energy production in industry. Environmental and public consequences*, Thessaloniki, Published by: AUT

[2]https://www.pollutionsystems.com/wet-scrubbers.html

[3]https://www.globalspec.com/learnmore/manufacturing_process_equipment/air_quality/baghouses

[4]http://www.cleaverbrooks.com/products-and-solutions/exhaust-solutions/selective-catalytic-reduction-(scr)/selective-catalytic-reduction-(scr)/index.aspx

[5] Željko Bogdan, Dražen Lončar and Daniel Rolph Schneider, *Cost Analysis of Waste-To-Energy Plant*, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb