

Biogas utilization for energy production in wastewater treatment facilities

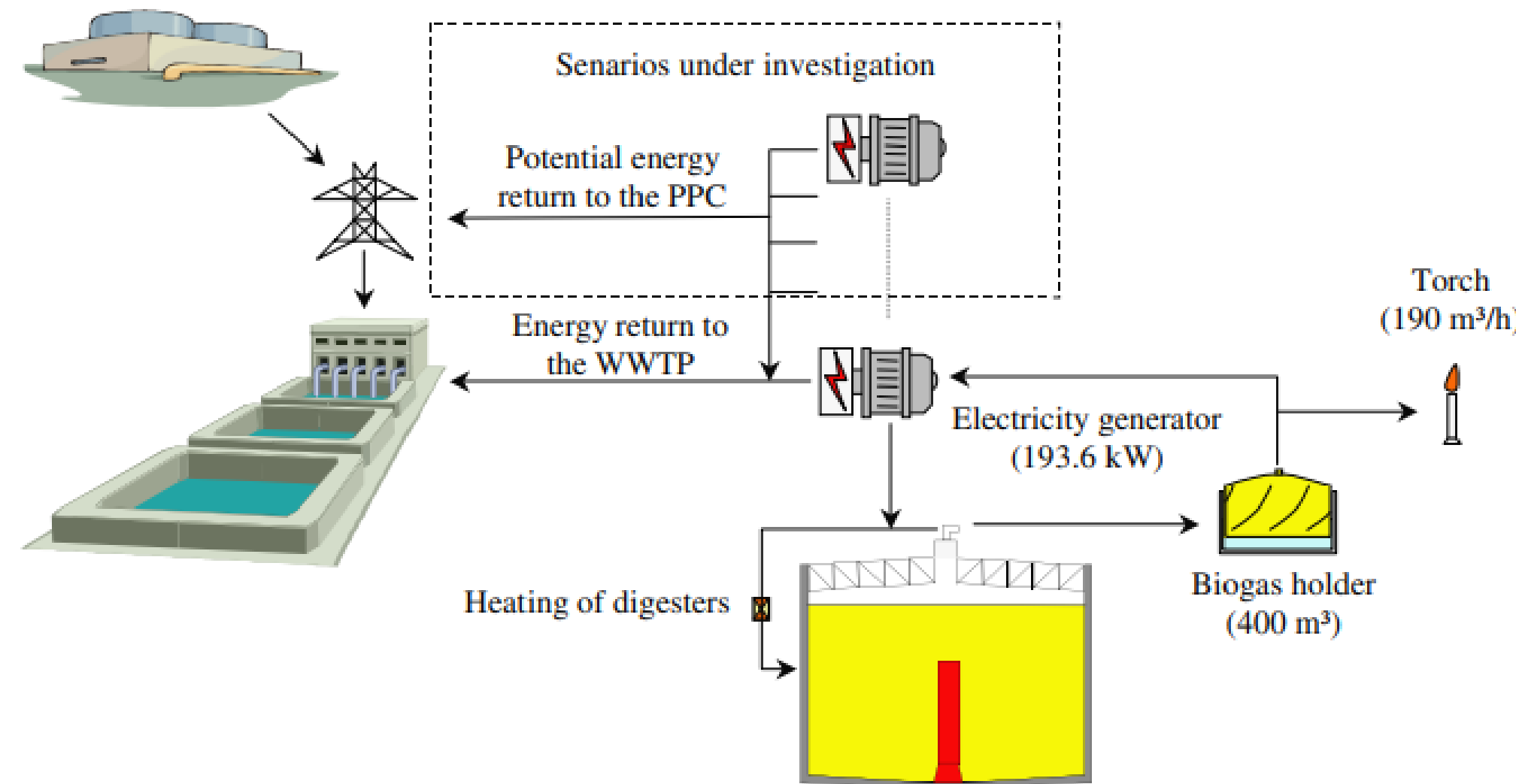


Kristallia Sifakaki¹, Kalliopi Sifakaki², Konstantinos P. Tsagarakis*

¹ Municipal Enterprise for Water Supply and Sewerage of Heraklion, 74500 Heraklion, Greece

² Municipal Enterprise for Water Supply and Sewerage of Ioannina, 45441 Ioannina, Greece

³ School of Production Engineering and Management, Technical University of Crete, 73100 Chania, Greece



Research questions

Feasibility studies should consider

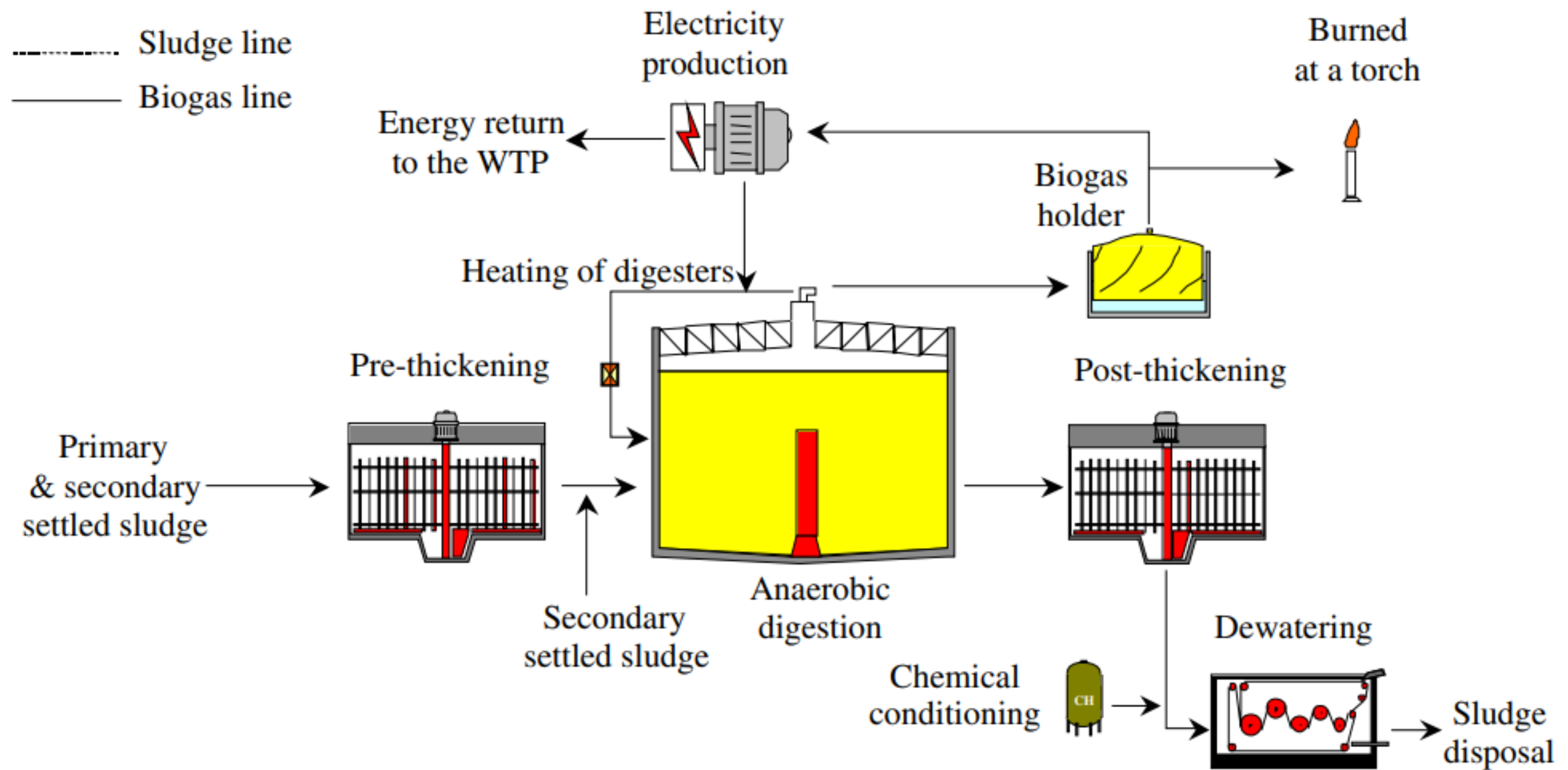
- Number/capacity of Generators
- Number/Capacity of Biogas holders
- Storage Capacity
- Operational alternatives (Bioaugmentation)
- Locally produced energy and costs

Suggestions

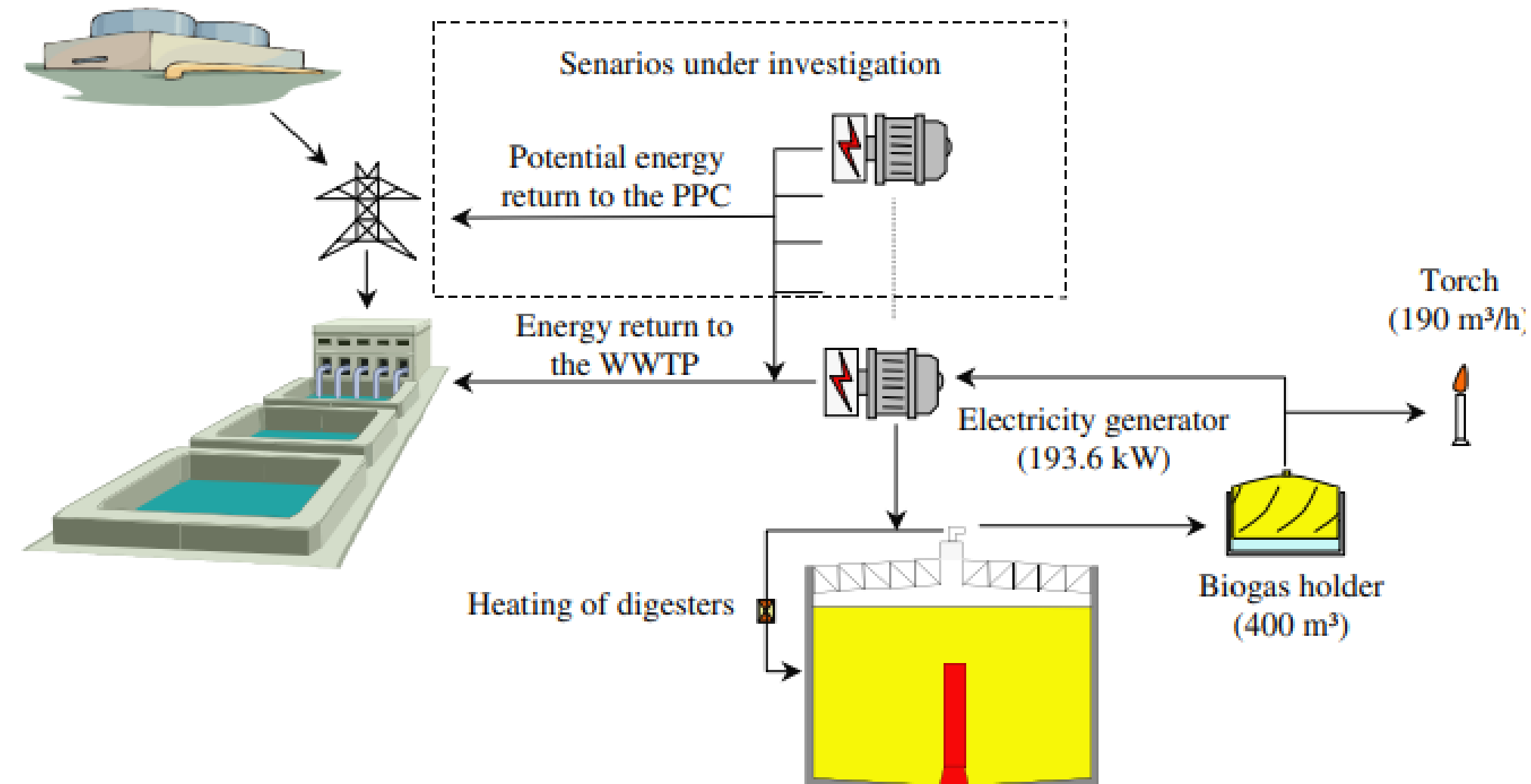
The installation of generators could be considered at national level for suitable WWTP



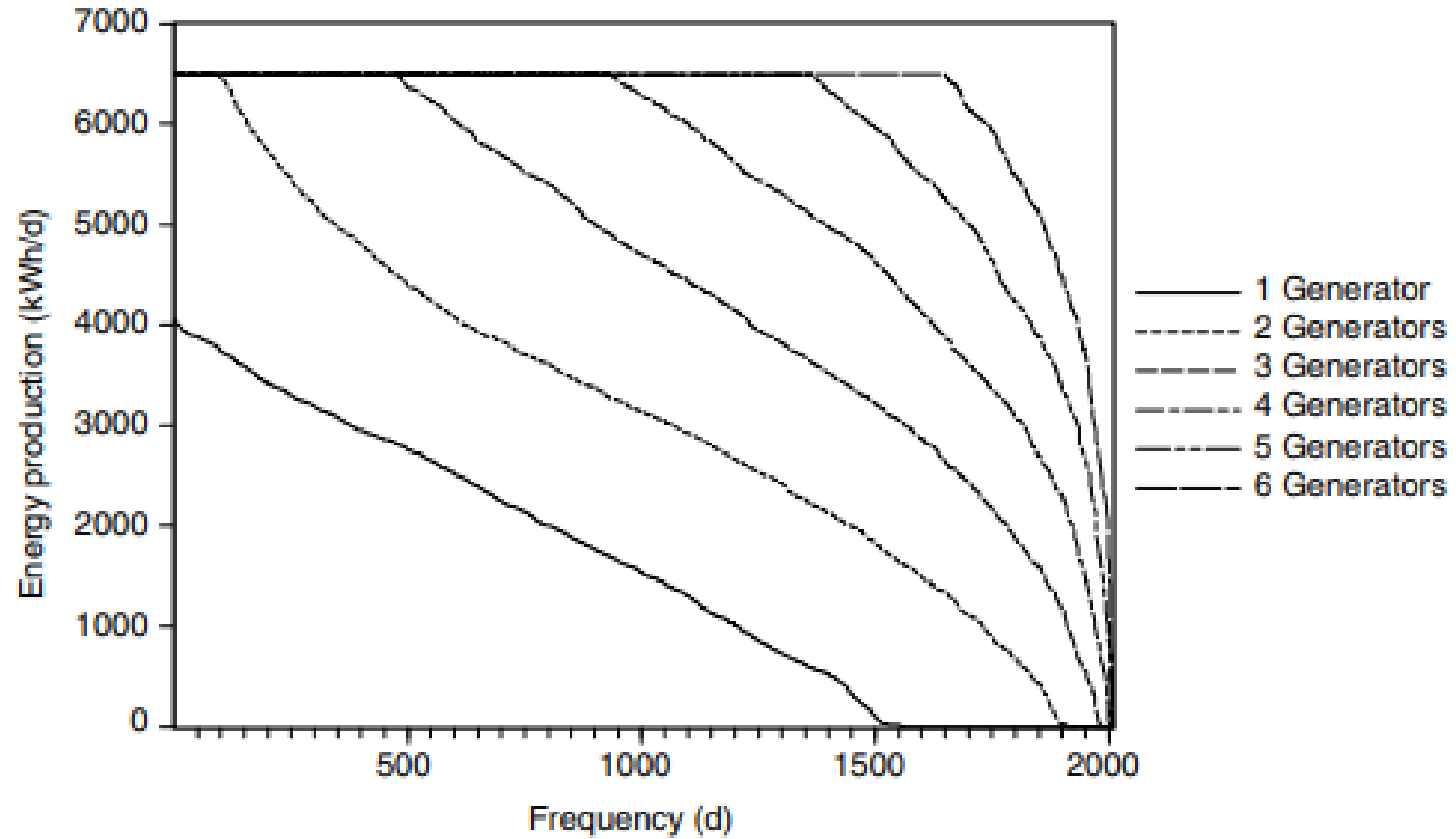
The wastewater treatment plant (WWTP) of Heraklion started its operation in 1996 to serve 164.000 population equivalent with 30.500 m³/d sewerage and 1.500 m³/d septic flowrates. Its operation is based on a conventional activated sludge system with anaerobic sludge digestion.



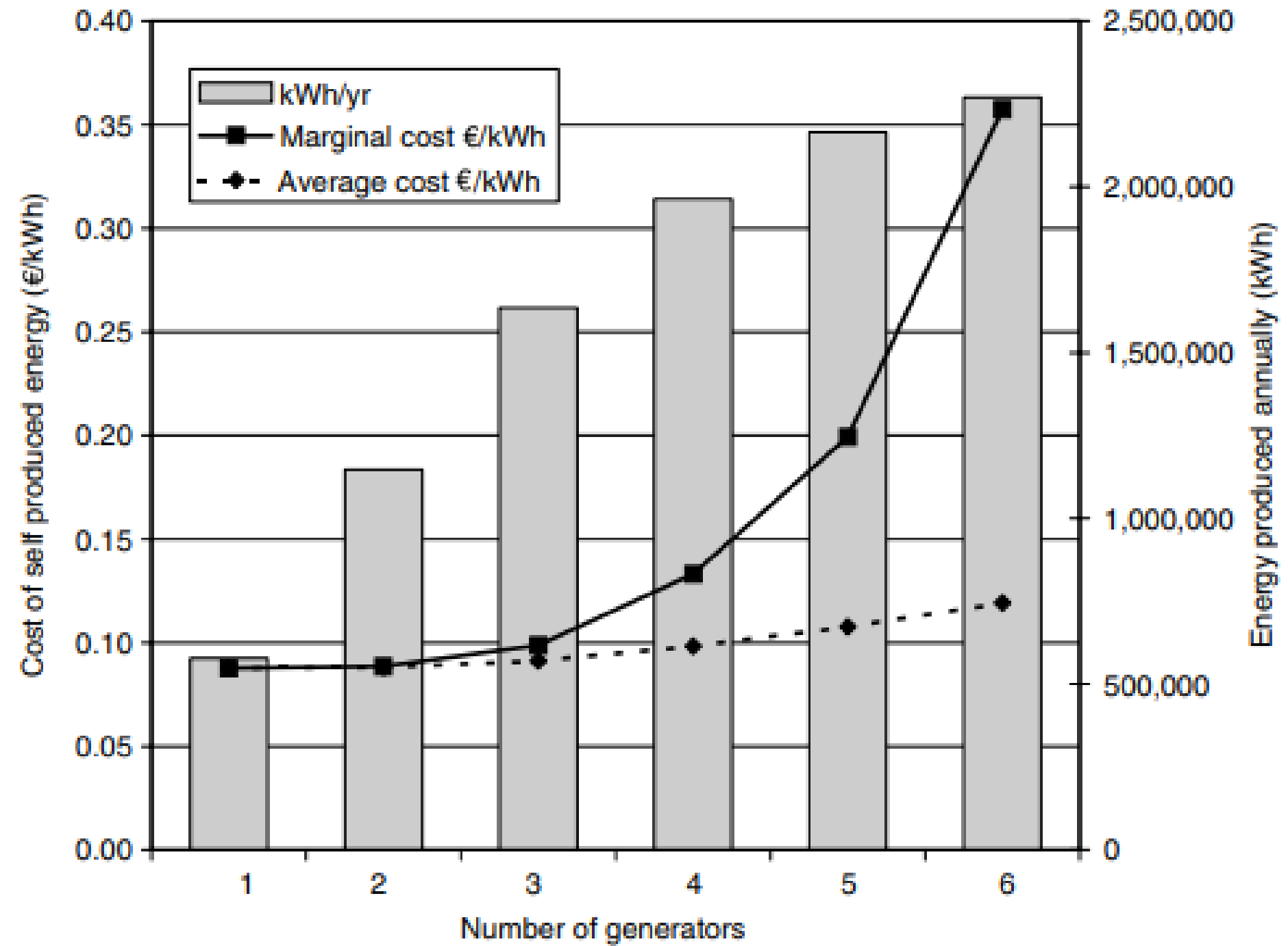
Wastewater treatment flow chart of the sludge and biogas line of the WWTP of Iraklio



Flow chart of the energy supply production of the WWTP of Iraklio.



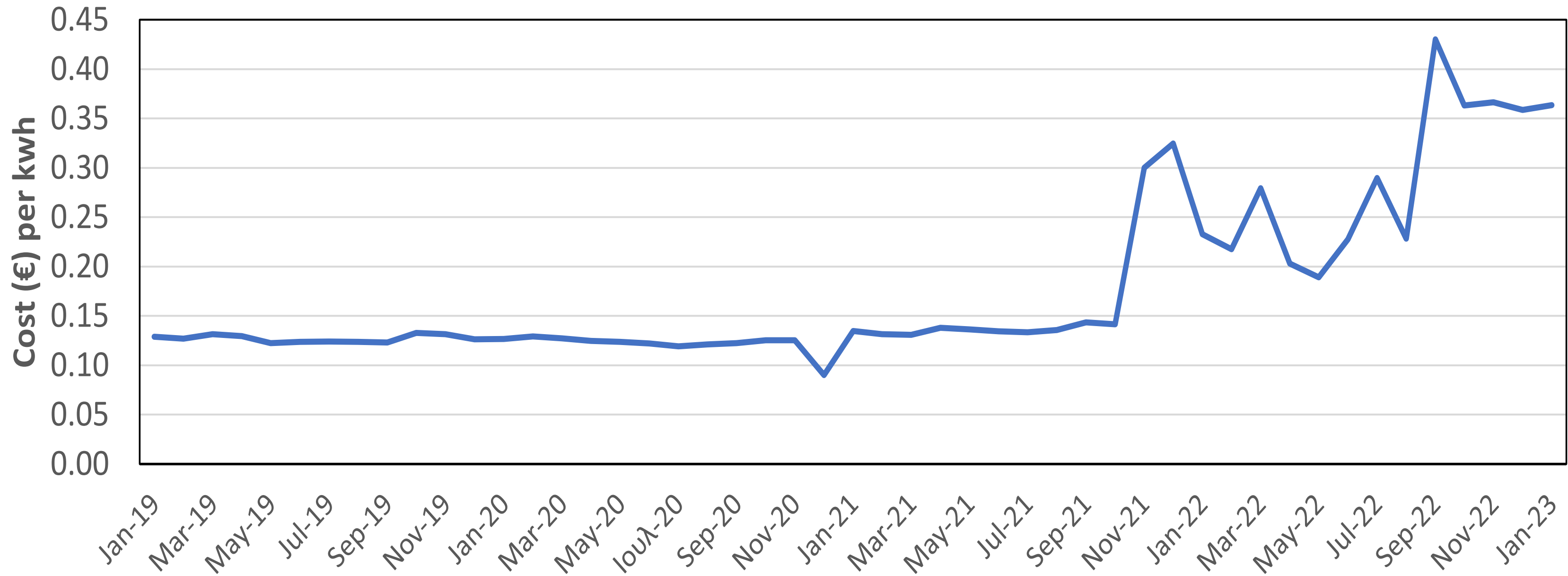
Frequency distribution of the energy produced per day according to the number of generators installed.



Energy quantities produced and the corresponding costs according to the number of generators installed



Today the facility treats 32.400 and 36.000 m³/d wastewater during winter and summer, respectively, equivalent to 198.500 population and 1400 m³/d septic wastewaters. The sludge production is about 15 tn/d. The mean biogas production was about 550 m³/d in 2020, 760 m³ in 2021 and 680 m³ in 2022. Two new generators have been installed in 2019.



Cost of energy to the wastewater treatment facility

The average cost for the energy production units during the first 3 years of operation is estimated at about **0.34 €/kWh**. Considering that the purchasing of the generators was fully subsidized, the real cost to the water company was **0.12€/ kWh**. This is an ongoing work assessing alternative operating technical and policy scenarios for the cost of energy production.



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Technical and economic evaluation of the biogas utilization for energy production at Iraklio Municipality, Greece

K.P. Tsagarakis ^{a,*}, Ch. Papadogiannis ^b

^a Department of Economics, University of Crete, Gallos Campus, 74100 Rethymno, Greece

^b Municipal Enterprise for Water Supply and Sewerage of Iraklio, Vironos 1, 71202 Iraklio, Greece

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Abstract

Biogas utilization for electricity production has become a common practice in recent years. Its management is a demanding work that if it is not properly done, a considerable part of the energy will be foregone. With the available data of 5.5 years of operation from the wastewater treatment facility of Iraklio city (120,000 inhabitants), we undertake a technical–economic evaluation. It was concluded that the cost per kiloWatt hour produced is 0.072€, while it is purchased at 0.07€, a highly subsidized price, since the cost of the primary material for producing 1 kW h is 0.085€. It was shown that energy produced is covering 15.9% of the total electricity needs of the facility. This percentage is really low since, according to the analysis pursued in this paper, it could go up to 39% if the recorded problems were successfully solved. The ultimate objective of this paper is to provide a methodology for accessing the electricity produced from other such facilities by tracking and analyzing the problems reported in the examined plant.

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Keywords: Biogas use; Energy cost; Energy production; Life cycle cost analysis

Optimal number of energy generators for biogas utilization in wastewater treatment facility

Konstantinos P. Tsagarakis ^{*}

University of Crete, Department of Economics, University Campus, 74100 Rethymno, Crete, Greece

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Abstract

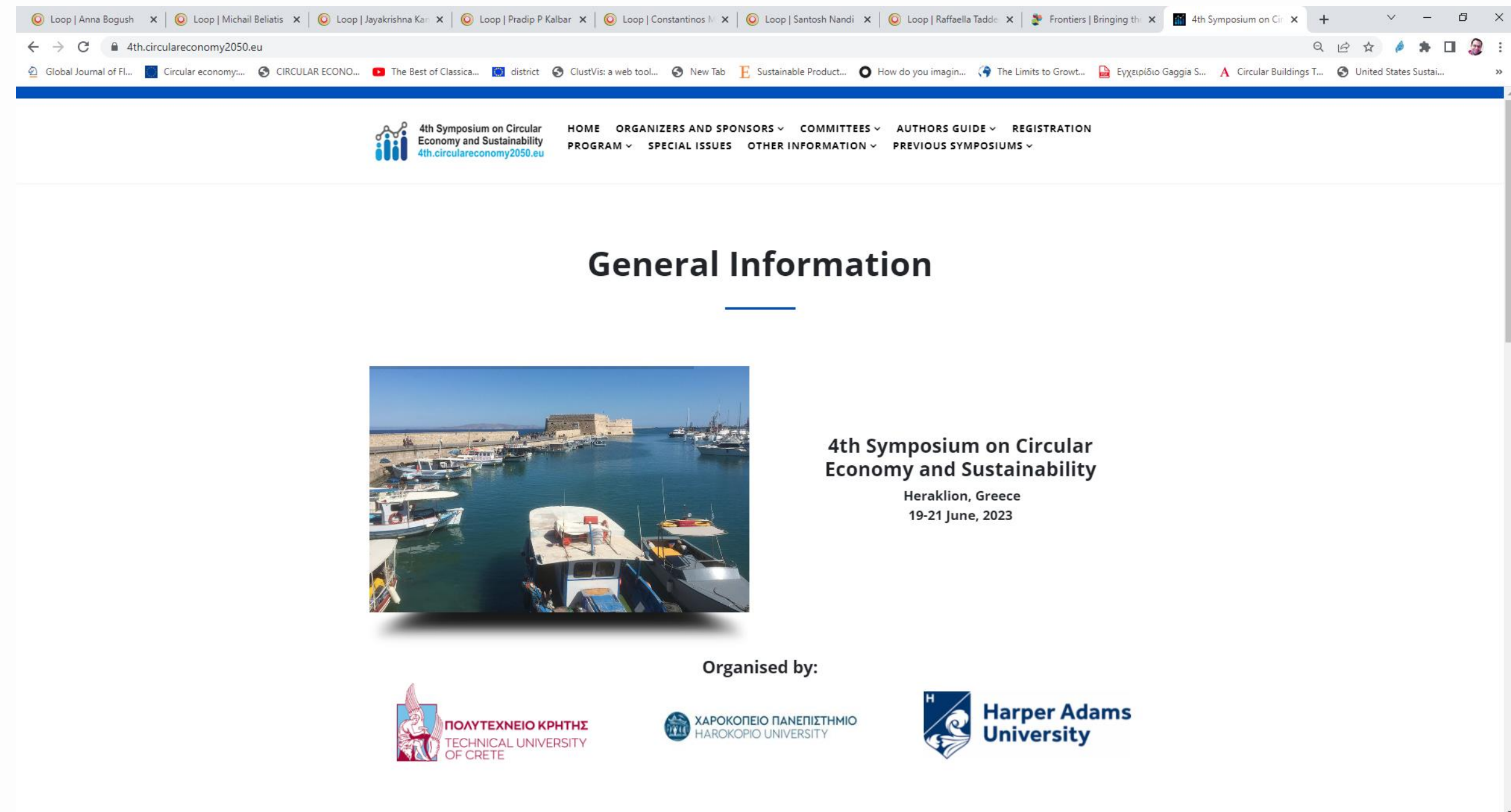
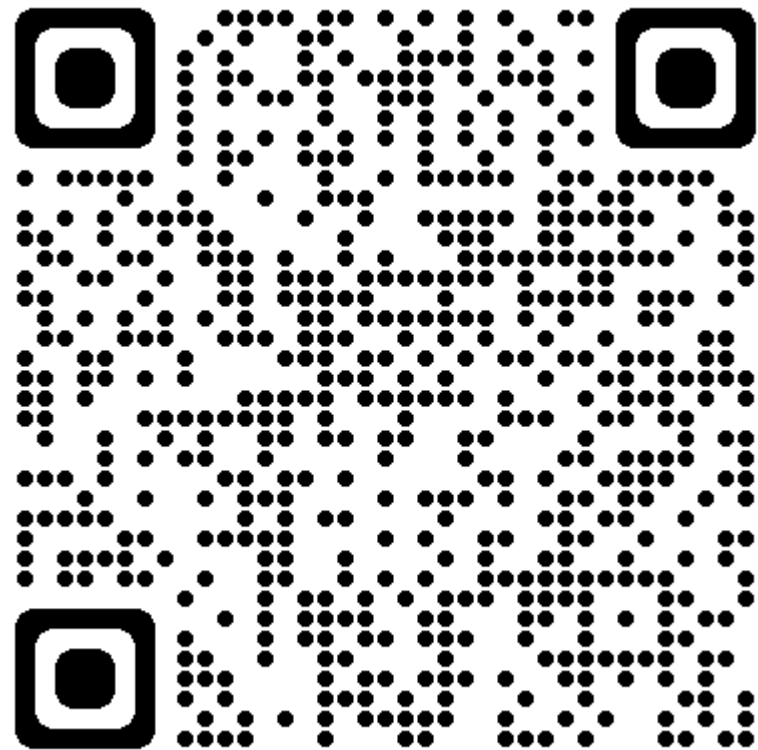
A technoeconomic analysis has been undertaken considering the optimum number of energy producing generators using biogas coming from anaerobic digestion. Inputs for this analysis originate from available data on the first generator for energy production from biogas, installed in Greece at the wastewater treatment facility of Iraklio city. The data spans a period of 5.5 years of operation. It is concluded that the cost per kWh produced is 0.0876 €/kWh if one generator is used covering 15.9% of the facility's needs. If two generators are used, more biogas is utilized contributing 32.6% of the facility's needs at a marginal production cost of 0.0886 €/kWh. Similar estimations have been made for scenarios involving up to six generators. In contrast, the marginal cost of conventionally produced energy is 0.1383–0.2483 €/kWh.

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Keywords: Biogas use; Electricity generators; Energy production; Optimization; Renewable energy

4th Symposium on Circular Economy and Sustainability, Heraklion, Crete, 19-21 June 2023

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