Reclaiming Water: Assessing the Water Resources Released by the Decommissioning of Lignite Facilities in Western Macedonia

FARMAKI P.[1], TRANOULIDIS A.[2]

[1]Assistant Professor Department of Accounting and Finance University of Western Macedonia, Koila Kozanis 50132

[2] Phd, MBA, Department of Chemical Engineering, University of Western Macedonia, 50100 Kozani, Greece, tranoulidisap@gmail.com

*corresponding author: Farmaki Polytimi
e-mail: pfarmaki@uowm.gr

Abstract

The decommissioning of lignite power plants in Western Macedonia is a key point for the energy transition at a national level in Greece but also marks a turning point for the regional resources management. One of the resources of special interest would be water, a central ingredient in the lignite-powered steam plants, used to propel generators, cool the energy production media and suppress the harmful dust byproducts. The present study investigates the potential of reallocating the released water resources used in the lignite plants and investing water in other activities such as agriculture, public use, tourism or ecosystem reinforcement-restoration, aligned with sustainable development and circular economy rules. The water the plants consumed before decommissioning was estimated based on operators and governmental sources. Different scenarios of alternative use are investigated and presented.

Keywords: Water Resources, Management, Natural Resources, Energy, Delignitization

1. Introduction

Lignite power plant decommissioning in Greece aligns with the plan of the EU for net zero emissions (Chatzinikolaou, 2025). As a result, Greece already has put in a place a delignitization plan that involves investing in Renewable Energy Sources (RES) (Ioannidis, 2025) instead. Shutting down such plants, except for various challenges, gives rise to different opportunities due to the resources that are to be released. One of the most important is water. Lignite power plant operation, based on the steam cycle, requires considerable amounts of water (Liu, 2015), which is used for multiple purposes. Water is used to drive the steam turbine generators, cool the boilers, perform various other processes, and suppress or concentrate dust byproducts so they are not released into the atmosphere. Lignite power generation is considered already a water intensive process and various studies exist up to date for efficient water management in it.

The decommissioning of the power plants presents therefore an opportunity for the local regions to reallocate and take advantage of the released water resources. The present study focuses on the region of Western Macedonia (WM) in Greece. WM is considered the energy production hub of the whole country having the most lignite plants and now is under rapid RES investments in solar and wind power generation. Delignitization on the other hand is steadily progressing in shutting down the remaining units.

We investigate the potential of allocation of the released water resources in other sectors that could benefit from it such as agriculture, tourism, public use, drought-storage or tourism. The study comes at an important time when climate change effects dictate not only emissions reductions, but also resource management like water. This is especially useful for Western Macedonia and the whole Greece in general for the coming years of predicted water shortages (Georgoulias, 2025).

2. Methodology

We proceed with the study in 4 stages. In the first stage, data is collected from historical water usage in Western Macedonia plants, namely the plants of Agios Dimitrios, Kardia, Amyntaio and Meliti. The data was collected based on numbers provided by the Public Power Corporation (PPC), which is the operator, in conjunction with the Ministry of Environment and Energy. Indicative values for the 2018 period are shown in Table 1.

Table 1. Reported water consumption per plant

Power plant	Water consumption in million m^3
Agios Dim.	18.1
Kardia	12.8
Amyntaio	4.1
Meliti	5.6
Total	**40.6**

In the second stage, the collected data was processed and values like the water consumption of power stations before decommissioning were estimated. The third stage included calculations to adapt the regional hydrological balance, given the newly available water resources. The fourth stage included investigation of various scenarios for water management and allocation. Different scenarios investigated the benefit of: 1) Irrigation in water-stressed regions of WM or nearby areas (Pananastasiou, 2023) (Soulis, 2017) 2) Restoration of areas affected by the lignite mines and power plants 3) Reinforcement of public reservoirs to improve drought resilience (JRC, 2025) (Politi, 2022) 4) Investment in hydroelectric reservoirs for energy storage

3. Results and Discussion

The initial results indicate that cessation of plant operations leaves space for around 40 million m^3 annually with conservative estimations, close to older reported values (Zarifakis, 2014). However, challenges are present regarding storage and transport. Balanced scenarios of use for the released wat could be proposed as in Figure 1, which is the safest route. Future research could consider detailed interactions between precipitation, temperature, human activities and hydrogeological data, along with the needs of different economic sectors of the area.

4. Conclusions

The present study estimates the volume and future use impact of released water resources from lignite power plant decommissioning in the region of WM. The released amounts of water can potentially be invested in different sectors that will benefit the region and the products of the present work can serve as a guide for policy making. Future detailed research can take into account various economic and climatic parameters.

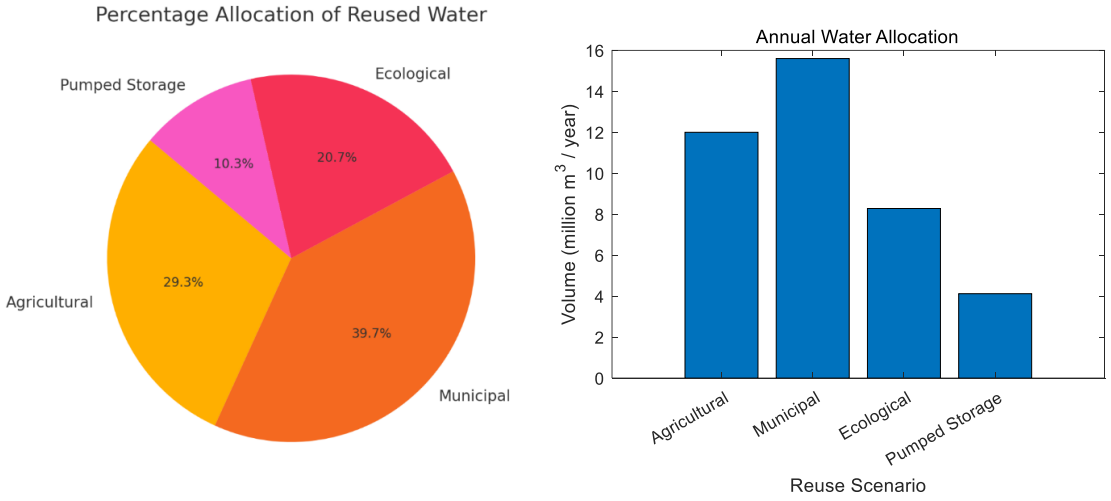

Figure 1. Categorical allocation of water resources after lignite plant shut down in a balanced scenario

References

Chatzinikolaou, D. (2025) Integrating Sustainable Energy Development with Energy Ecosystems: Trends and Future Prospects in Greece, *Sustainability*, **17**, 1487

Liu, M., Qin, Y., Yan, H., Han, X., Chong, D., (2015) Energy and water conservation at lignite-fired power plants using drying and water recovery technologies, *Energy Conversion and Management*, **105**, 118-126

Ioannidis, F., Georgitsioti, T., Kosmidou, K., Zopounidis, C., Andriosopoulos, K, (2025) A simulation model for imbalance costs of renewable energy aggregators: The case of Greek balancing market, *Energy Economics*, **142**, 108155

Georgoulias A., Akritidis, D., Kalisoras, A., Kapsomenakis, J., Melas, D., Zerefos, C., Zanis, P., (2022) Climate change projections for Greece in the 21st century from high-resolution EURO-CORDEX RCM simulations, *Atmospheric Research*, **271**, 106049

Public Power Corporation (PPC), Environmental Reports Available at: https://ypen.gov.gr/category/mitroo-odigias-ied/

Papanastasiou, D. K., Keppas, S., Melas, D., & Katsoulas, N. (2023). Estimation of Crops Future Irrigation Water Needs in a Mediterranean Plain. *Sustainability*, ***15***(21), 15548

Soulis, K. X., & Tsesmelis, D. E. (2017). Calculation of the irrigation water needs spatial and temporal distribution in Greece. *Agricultural Water Management*, 196, 1–12

JRC, Drought in Europe April 2025 (2025), Publications Office of the European Union, Luxembourg, Available at https://data.europa.eu/doi/10.2760/7964287

Politi, N., Vlachogiannis, D., Sfetsos, A., Nastos, P. T., & Dalezios, N. R. (2022). High Resolution Future Projections of Drought Characteristics in Greece Based on SPI and SPEI Indices. *Atmosphere*, ***13***(9), 1468

Zafirakis, Dimitrios & Papapostolou, Christiana & Kondili, Emilia & Kaldellis, John. (2014). Evaluation of Water-Use Needs in the Electricity Generation Sector of Greece. International Journal of Environment and Resource, **3**:39