Integration of the Chira–Soria Pumped Storage Hydropower Plant into the Gran Canaria Energy System and Analysis of 2023 Demand Patterns

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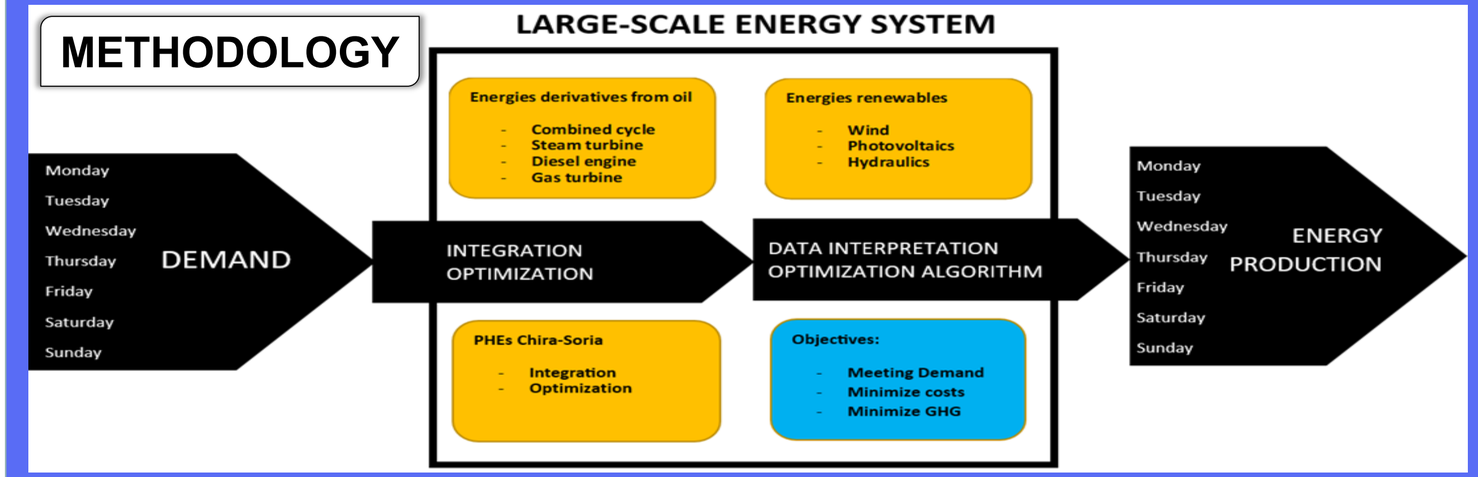
ABSTRACT

Gran Canaria operates as an isolated energy system that must ensure high self-sufficiency to meet an annual demand of approximately 3.3 TWh. The planned integration of the Chira–Soria Pumped Hydroelectric Power Plant (PHES), expected by 2030, will significantly transform the island's energy dynamics, presenting both challenges and opportunities [1]. The main challenges involve the need for greater system flexibility due to the increasing share of renewables — projected to grow from 381 MW to over 750 MW — and potential operational constraints related to environmental and hydrological factors. Conversely, the PHES facility will enhance grid stability by providing energy storage and balancing services, facilitating the integration of intermittent sources such as wind and solar power. As a mature and efficient technology, PHES will play a crucial role in improving energy management and system efficiency [2]. This study analyzes weekly and daily electricity demand patterns for 2023 and develops a simulation and optimization model to assess the optimal integration of the Chira–Soria plant into Gran Canaria's energy system.

METHODOLOGY



EXPERIMENTAL PART

CONCLUSIONS

During the analysis process, the Chira-Soria hydroelectric pumping station has been integrated into the energy production system in Gran Canaria in the year 2023, and it has been technically determined at the production level what this integration into the system means according to patterns established by days of the week.

The analysis of the Chira-Soria pumped-storage hydroelectric power station, studied and integrated by days of the week, shows that the flat energy production in the high step is estimated at a maximum value of 308.70 MW on Tuesdays and a minimum value of 272.10 MW on Sundays, while the flat energy production in the low step is estimated at a maximum value of 253.79 MW on Mondays and Tuesdays and a minimum value of 219.27 MW on Sundays.

- The ideal operating conditions are established in these integrations as follows:
- Plant factor: 59.98%.
- Pumping-Turbine balance: 43.84% turbine and 56.16% pumping.
- Daily production (MWh): 1,262.13 MWh turbined and 1,778.33 MWh pumped.
- Average power used (MW): 52.59 MW turbined and 74.10 MW pumped.
- Hours/day of operation (h/day): 15.92 (h/day) turbined and 8.08 (h/day) pumped.