Turning weakness into strength - A feasibility analysis and comparison of datacenter deployment in hot and cold climates

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Abstract

Datacenters are major components of the Information and Communication Technologies (ICT) responsible for storing, processing and transmitting enormous amounts of data every second. The significance and importance of datacenters in the world economy can be identified from studies which report that in 2023, datacenter infrastructures consumed a total of 4 % of global electricity and contributed 3–5% of global carbon emissions, whereas between the years of 2017–2021, datacenters added $2.1 trillion to the U.S. Gross Domestic Product (GDP). A big portion of energy supplied in datacenters is consumed by the required cooling systems hence companies do not favor developments in hot climate countries. However, due to environmental and climate change concerns along with the steep increase of energy production costs in recent years made the industry look for alternatives. This work includes an in-depth feasibility and comparative study of datacenter construction and operation in hot and cold European countries and addresses the environmental impact of photovoltaics integration in the electrical supply system. The study considers cost parameters (land, operating expenses, photovoltaic system, etc.), the net present cost and levelized cost of energy which are different for each European country under investigation. Furthermore, for every country under consideration, the PV generation was simulated using the PVsyst software which includes multiple meteorological databases, whereas the feasibility analysis was simulated using the HOMER Pro software which integrates components, resources and economic calculations. An elaborate analysis of the results knocks down the common belief that datacenters have lower operational and running expenses in cold climates because of lower cooling requirements. On the contrary, this study shows that hot climates with high solar radiation levels may favor the operation of datacenters by providing 45 % higher green energy and 35 % lower CO2 emissions, whereas the cooling cost is only 5 % higher. In addition, the break-even period for the photovoltaic system in Southern European countries with hot climates is 3–4 times faster.

Keywords: Datacenter deployment, Hot and cold climates, Hybrid PV supply systems

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The paper was published in Solar Energy Advances as part of the EuroSun 2024 select papers.

https://doi.org/10.1016/j.seja.2024.100068