Feasibility analysis and optimization of new energy technologies for sustainable development

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by

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DECLARATION

By electronically submitting this thesis, I, Hagreaves Kumba, solemnly affirm that the entire content contained within is of my own creation. This dissertation does not incorporate external data, images, charts, or supplementary information except where it is explicitly recognized as being sourced from external contributors. Furthermore, I confirm that this dissertation has not been presented for any degree or examination at any other university.

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ABSTRACT

Energy is essential for crucial development in Africa. The current electricity shortages or load shedding in South Africa show the country faces significant challenges in reaching positive economic growth. For industries to operate sustainably, an innovative mechanism must be tailored to solve the negative impacts of industrial energy use, particularly climate change. Even though fossil fuels generate the majority of produced electricity in South Africa, the country's potential for renewable energy sources is vast. In contrast, solar irradiance and wind offer considerable commercial potential.

New renewable energy resources are widely seen as a means to address the challenges of climate change and energy insecurity. They can be of crucial importance in developing a sustainable economy in the country. The study aims to show how renewable energy technologies can provide new economic opportunities, contribute to higher standards of living, and reduce the impacts of society on ecosystems, among other things. This thesis presents a feasibility analysis and optimization of new energy technologies by designing and simulating a grid-connected PV system for sustainable development.

The PVsyst software was used to simulate and optimize the PV system. The software was used to design and model the PV systems and to calculate the energy production, economic performance, and environmental impact. The researcher utilized simulation data to compare PV system performance in three scenarios and identify the optimal one.

Overall, the findings of this thesis suggest that grid-connected PV systems are a feasible and sustainable option to meet South Africa's energy needs. By implementing

the results and recommendations, the government, investors, and community can work together to develop and deploy a successful PV system that will benefit all.