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Eswatini Just Energy Transition

A People-Centred Approach

ESWATINI'S GREEN LEAP: POWERING A SUSTAINABLE FUTURE THROUGH JUST ENERGY | A People-Centred Approach

1. Introduction
1.1 Contextual setting and purpose of the Document

This policy brief examines the complex interplay of factors shaping Eswatini's energy landscape, from security to coal development's environmental, economic, and social implications. It outlines a roadmap for a Just Energy Transition in the Kingdom. It aims to align growth and development with Eswatini's NDC commitment to generate 50% of energy from renewable sources by 2030 and COP 28 goals to shift from fossil fuels to green energy by 2048.

The Eswatini Electricity Company (EEC), a state-owned utility, operates four hydropower plants with a combined capacity of 60.4 MW, meeting 15-17% of the country's energy needs. Five independent power producers (IPPs) also contribute around 110 MW using hydro, biomass, and solar PV technologies. However, over 80% of Eswatini's electricity is imported, mainly from South Africa's ageing coal- fired plants, leaving Eswatini vulnerable to price fluctuations and supply disruptions due to South Africa's unreliable power supply.

Access to electricity stands at 85%, with a current demand of 233 MW and growing. Areas of unmet needs are in hard-to-reach places, where homesteads are widely dispersed and far from the current grid system, making connection economically unviable. Only 49% of households use clean cooking methods, and much of cooking in rural areas still relies on woodlands, impacting the environment 1 . Electricity in rural areas is mainly used for lighting, not for productive needs, due principally to affordability. Therefore, there is a need to ensure energy reaches the last mile and is used to drive catalytic sectors to facilitate SDG achievement.

The government has launched several initiatives to accelerate the generation of sustainable baseload power to meet the country's growing needs. Such initiatives include the recently commissioned 10 MW solar plant in Lavumisa and a competitive bidding process to establish an additional 40 MW solar and 80 MW biomass generation capacity through IPPs. These strategic efforts aim to enhance energy security and sustainability, reducing reliance on imported electricity while supporting domestic energy production. However, these can only meet 71% of the current energy needs, not factoring in private sector-led growth and development.

A seemingly straightforward solution to Eswatini's energy security dilemma is constructing a 300MW coal thermal plant. This facility could effectively meet the country's baseload power requirements. Investment in this thermal plant would fuel the plant itself and stimulate the growth of the coal mining industry in Eswatini, boosting both domestic usage and exports.

Under the preferred future scenario of the Energy Master Plan 2018, Eswatini aims to achieve 676MW of domestic capacity (including coal and renewable energy sources) by 2034 to meet the projected demand and provide adequate reserves. The impending expiration of Eswatini's contract with ESKOM in 2025 further amplifies the urgency to secure a reliable and affordable energy future.

This intricate situation necessitates a nuanced approach to the just energy transition, carefully balancing economic development with environmental stewardship and social equity.

2. The Case For and Against Coal

Taking an evidence-based approach The economic calculus of coal development is far from straightforward. While the initial capital investment in a coal-fired power plant may seem substantial, the long- term financial viability of such a project is increasingly uncertain. The global energy landscape is rapidly evolving, with renewable energy technologies like solar and wind becoming increasingly cost-competitive with fossil fuels. Furthermore, the global shift away from coal, driven by environmental concerns and technological advancements, puts downward pressure on coal prices.

The Lubhuku Power Station in Mpaka, Lubombo Region, is set to begin operation in 2026 with an initial capacity of 150 MW, increasing to 300 MW by 2028. The plant will use coal from local deposits, such as Maloma Coal Mine, which is expected to last 30 years. This project aims to ensure energy self-sufficiency, create 700-1000 direct jobs, and stimulate economic growth through increased domestic energy production and reduced energy import costs. It could save Eswatini E1.2 to E1.6 billion (USD 67M-88M) annually on energy imports and potentially add 2-3% to the country's GDP, translating to an annual increase of USD 80 million to 120 million.

https://trackingsdg[7].esmap.org/country/eswatini

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However, the costs of the above approach are steep. Issues to consider in making the move towards a coal plant include the following:

- **Falling coal prices** - Coal prices have plummeted more than 60% from their peaks in 2022, driven by soft economic activity and lower gas prices, which negatively affected demand for coal in the power sector. This significant drop has been bolstered by robust supply and gradually increasing penetration of renewable electricity. Further reductions are anticipated in 2025 as renewable power generation meets rising electricity demand, though stronger-than-expected growth in China's power output and hydropower shortfalls might mitigate this fall. For Eswatini, this fall in coal prices could upend the business case for new coal mining as the cost of production increases and revenue falls[2] .

- **SACU Receipts** - The country would lose about E400 to E500 million in SACU revenue associated with electricity imports.

2.1 Potential Trade Impact - The EU's Carbon Border Adjustment Mechanism (CBAM) is an EU tool to put a fair price on the carbon emitted during the production of carbon-intensive goods entering the EU and encourage cleaner industrial production in non-EU countries. All goods entering the EU must be CBAM certificated or attract additional tariffs effective 2026. Though this is a nontariff barrier to trade that will be vigorously debated and challenged through the World Trade Organization, the implications for Eswatini are enormous. In 2023, Eswatini exported Euro 54M value of goods and products into the EU, with 91% of these exports being industrial products[3]. If Eswatini energy consumption shifts to principally domestically produced fossil-fueled energy, this trade is at risk of higher tariffs, potentially making Eswatini products less competitive in the global market.

This could lead to further closures and job losses in sectors such as textiles, which job gains in the energy sector will not offset. Given the many women and youth working in these industrial sectors, this will increase unemployment and widen the inequality gap. The textile sector, for example, currently has 20 textile companies operating in the country, collectively employing around 22,000 people, over 80% of whom are women. The industry contributes an estimated 7.6% to Eswatini's gross domestic product each year 4 . This sector would be at risk of running afoul CBAM, risking 22,000 jobs as opposed to the 1000 jobs expected to be created by the thermal plant. The economic impact could be significant, potentially reducing export revenues by $10-$20 million annually.

2.2 Other Issues of Concern:

- Air Pollution – Coal combustion emits sulfur dioxide (SO_2), nitrogenoxides (NO_x), and particle pollution. Though Eswatini contributes significantly less than larger coal-consuming nations such as South Africa, a coal-fueled thermal power plant will increase GHG emissions. The carbon emissions associated with burning this amount of coal are significant. For example, burning one ton of coal produces about 2.86 tons of CO2. Therefore, the Lubhuku power station would emit approximately 4.29 million tons of CO2 annually. Methane is also an issue of concern in coal-fired plants 5 . This level of emissions poses a severe challenge to Eswatini's commitments under its Nationally Determined Contributions (NDCs) to reduce greenhouse gas emissions and transition to renewable energy.

- **Water Pollution** – The coal mine at Maloma Colliery has also severely contaminated the river's water quality, and local communities are forced to get their water from outsourced water tanks 6 , thus shifting the cost of affordable energy supply to those who can least afford it.

- **Water Scarcity** – Coal thermal power plants use vast amounts of water for cooling and steam generation. A 300MW coal-fired power plant would require approximately 1.5 million tons of coal annually, based on typical coal consumption rates for such facilities. The project proposes using the adjacent Mbuluzi River, which is already highly affected by intensive use by the sugar industry, as well as residents in the water-scarce lowveld. This project could easily push the Mbuluzi past its limits at the risk of all other beneficiaries of the river[7].

- **Community Health and Well-being** – Coal-related health issues (e.g., black lung disease) impose economic burdens on affected communities and healthcare systems. A review of studies over the past 30 years provides a body of evidence that people living near coal-fired power plants have higher death rates and at earlier ages, along with

[2] Coal market developments: Falling prices amid record-high output (worldbank.org)
[3] EU Directorate of Trade 2024
[4] Eswatini: Growing Importance of Textiles | Ruskin Felix Consulting
[5] https://ember-climate.org/press-releases/methane-emissions-from-coal-mines-may-be-double-official-estimates/
[6] What's wrong with the proposed Lubhuku Coal Power Plant? – Eswatini Climate Coalition
[7] ibid

increased risks of respiratory disease, lung cancer, cardiovascular disease and other health problems[8] . The economic cost of pollution-related health issues can be substantial, potentially offsetting a significant portion of the economic gains. For instance, if pollution-related health costs amount to 1% of GDP annually, this could reduce GDP by $40 million annually.

- **Displacement and Land Use** – Coal mining often displaces communities and disrupts ecosystems. Though the land being used for the thermal plant is not inhabited, it did provide grazing for communities, which will now be curtailed and non-available to the communities. Given potential adverse environmental impacts, a potentially wider land catchment area will be unfit for agricultural livelihood[9] .

3.1 Renewable Energy Alternatives – centralised and decentralised energy solutions According to the International Renewable Energy Agency (IRENA), Eswatini's estimated theoretical and technical hydropower potential is 440 MW and 110 MW, respectively, while utility-scale solar potential is estimated at 542 MW. Given a short-term project demand of 310MW, this could plug the energy deficit, plus some. According to the Kingdom of Eswatini Energy Masterplan 2034, sugar companies are interested in increasing their capacity from the current 106MW to 160MW, while timber firms have indicated investment plans to generate 37MW. The sugar firms produce an average of around 1,539,000 tons of bagasse per annum 10 , and depending on the technologies chosen, these can power plants with a combined capacity of approximately 200MW. Over the past two decades, there have been significant developments in renewable energy technologies regarding cost reductions and technological advancements, as reflected below.

3.2 Biomass Electricity Generation Technologies – Eswatini has strong potential in biomass and woodchip electricity generation, including from sugarcane bagasse. To enhance this potential, investments in advanced technologies such as high-pressure boilers and condensing extraction turbines are needed to improve efficiency and capacity. Supportive policies, such as cost-reflective tariffs and better stakeholder coordination, are crucial. Innovations like improved gasification and fast pyrolysis can boost energy extraction from biomass, but their costs and complexities must be weighed against the efficiency benefits.

3.3 Hydro Power Generation Technologies

Hydropower, a longstanding and reliable energy source, remains a cornerstone of electricity generation. Eswatini operates small hydropower plants with a total capacity of about 60 MW. Technological advances are enhancing its efficiency, such as variable speed turbines that adjust to water flow changes, improving integration with intermittent renewable sources like solar and wind. New low-head hydropower technologies harness energy from smaller water sources with minimal environmental impact, which is suitable for Eswatini's potential hydro mini-grids. Additionally, sophisticated control systems and AI-driven data analysis optimise turbine performance and predict power generation more accurately.

3.5 Solar Powered Electricity Generation
3.5.1 Off-grid Solar PV

The International Energy Agency (IEA) finds that off-grid energy solutions are the most cost-effective way to provide electricity to rural areas in sub-Saharan Africa. In rural Eswatini, with its dispersed settlements, off-grid solutions like solar and battery- powered systems are particularly suitable. These solutions include mini-grids, microgrids, commercial and industrial systems, solar home systems, and various productive-use appliances such as solar water pumps, refrigerators, and pico solar lights. Promoting the adoption of solar off-grid solutions can be achieved through supportive policies that encourage private sector involvement. Key measures include providing import duty exemptions for renewable energy appliances, enforcing Minimum Energy Performance Standards (MEPS), raising awareness, and improving supplier's and end user's access to finance.

Recent technological advances concerning solar technologies, including continuous research and development, have led to solar cells with higher conversion efficiency and maximising energy output from the same solar panel area. Using dual-axis tracker systems optimises solar panel orientation throughout the day, increasing energy production by up to 30% compared to fixed-tilt panels. Advances in battery storage technologies are leading to longer-lasting, more efficient, and cost-effective battery technologies that have been crucial for the widespread adoption of energy storage and, when combined with advances in grid integration capabilities through inverters with advanced grid integration features, enhance grid stability.

[8] Microsoft Word - Annexure Health impacts of coal fired generation in South Africa 310317.docx (cer.org.za)
[9] What's wrong with the proposed Lubhuku Coal Power Plant? – Eswatini Climate Coalition
[10] KINGDOM OF ESWATINI – ENERGY MASTERPLAN 2034 (esera.org.sz)

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3.6 Cost of Renewable Energy Projects

The cost of renewable energy technologies has been on a downward trend over the past decade because of several factors, including:

- Increased investment and research by governments and private investors who have poured billions of dollars into renewable energy research and development. This has led to significant improvements in the efficiency and cost-effectiveness of renewable energy technologies.

- The economies of scale enjoyed by the sector as the renewable energy industry has grown leading to lower costs for everything from manufacturing to installation.

- The government's increased policy support includes feed-in tariffs and renewable energy quotas. These policies have created a stable and predictable renewable energy market, encouraging investment and lowering costs.

An example of this fall in cost relates to the cost of solar power, which has fallen dramatically over the past decade. In 2010, the average cost of solar power was around $3.29 per watt. By 2020, that cost had dropped to just $0.16 per watt 11 . This makes solar power one of the cheapest forms of electricity in many parts of the world.

The levelized cost of electricity (LCOE) measures the average net present cost of generating electric power over the power plant's entire life. It is widely used to compare different power generation technologies[12]. The LCOE enables comparisons of different generating technologies and power sources irrespective of capital investment costs, project size, and operational and fuel costs.

The table below from the International Renewable Energy Agency (IRENA) shows that between 2010 and 2020, all utility-scale renewable energy-powered generation showed a marked decline in installation costs and LCOE,

	Total installed costs (2022 USD/kW)			Capacity factor (%)			Levelised cost of electricity (2022 USD/kWh)		
	2010	2022	Percent change	2010	2022	Percent change	2010	2022	Percent change
Bioenergy	2 904	2 162	-26%	72	72	1%	0.082	0.061	-25%
Geothermal	2 904	3 478	20%	87	85	-2%	0.053	0.056	6%
Hydropower	1 407	2 881	105%	44	46	4%	0.042	0.061	47%
Solar PV	5 124	876	-83%	14	17	23%	0.445	0.049	-89%
CSP	10 082	4 274	-58%	30	36	19%	0.380	0.118	-69%
Onshore wind	2 179	1 274	-42%	27	37	35%	0.107	0.033	-69%
Offshore wind	5 217	3 461	-34%	38	42	10%	0.197	0.081	-59%

Total installed cost, capacity factor and LCOE trends by technology, 2010 and 2022

Due to the high cost of capital in sub-Saharan Africa and Eswatini, the installation and LCOE are expected to be higher than the global averages presented in the IRENA figures. This is reflected in the installation costs estimates in the Kingdom of Eswatini Energy Masterplan, which estimated the installed costs of hydro at $4,500/Kw, utility solar at $2,344, and bioenergy at $3,200.

[11] https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020
[12] The levelized cost of energy and modifications for use in electricity generation planning - ScienceDirect
[13] Renewable power generation costs in 2022 (irena.org)
[14] KINGDOM OF ESWATINI – ENERGY MASTERPLAN 2034 (esera.org.sz)

Electricity Security and Dispatchable Power

Biomass power and solar PV with storage, like hydropower and fossil fuels, are dispatchable and can adjust to meet electricity demand, unlike intermittent sources such as solar and wind. A significant share of dispatchable generation is essential for grid stability and reliability. Considering their long-term impact, this factor is critical for Eswatini's future investments in electricity generation assets.

Fossil fuel power generation, such as coal, involves straightforward assessments of reserves and resource quality for plant design. Renewable resources like solar have predictable availability, but biomass and hydropower require more complex evaluations. Biomass assessments must ensure sustainability throughout the feedstock lifecycle, including land use, water usage, and emissions. Biomass economics depend on a reliable, long-term feedstock supply at competitive costs.

Hydropower assessments need to consider future climatic impacts on water availability, sedimentation, and ecological changes, in addition to standard economic, social, environmental, technological, and grid integration studies.

Conclusion

The European Union's Carbon Border Adjustment Mechanism (CBAM), which targets imports from countries with weak environmental standards, highlights the global shift towards a low-carbon future. Eswatini's heavy reliance on coal could threaten its access to European markets and harm its export-oriented industries.

In today's green financing climate, a path towards renewable energy can attract concessionary funding from climate investment funds for the capital needed for renewable energy projects. Investing in energy transition technologies creates up to three times as many jobs as fossil fuels per million of dollars spent, and the jobs created in the renewable energy transition will outweigh those lost by moving away from traditional energy[15]. As the world transitions to cleaner energy, Eswatini risks economic losses if it doesn't invest in renewable energy. Coal assets may become stranded, leading to high costs, including unrecovered investments and decommissioning, potentially totalling $100-$150 million for a 300MW plant. Additionally, the opportunity cost of not pursuing renewable energy could be 1-2% of GDP annually, or $40-$80 million, due to lower long-term costs and environmental impacts of renewables. Embracing a just energy transition could position Eswatini as a leader in sustainable development, attracting green investments, fostering innovation, and creating a more resilient and diversified economy.

[15] Renewable Energy Market Analysis: Africa and its Regions (irena.org)

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