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Renewable Energy and Sustainable Development in Zambia: Lessons from the 100 MW Chisamba Solar Power Plant

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Abstract: Zambia's electricity system remains critically dependent on hydropower, which accounts for over 80% of installed generation capacity, creating significant vulnerability to the climate-induced droughts that have intensified across Southern Africa. This study examines the role of utility-scale solar energy in advancing Zambia's Sustainable Development Goals (SDGs) using the 100 MW Chisamba Solar Power Plant - commissioned in June 2025 as the largest grid-connected solar facility in Zambia and the biggest of its kind in sub-Saharan Africa outside South Africa - as a primary case study. Employing a mixed-method case study design, the research draws on document review, policy analysis, secondary statistical data, and reported stakeholder evidence. Guided by Sustainable Development Theory and Energy Transition Theory, the study applies thematic analysis across four dimensions: energy security and diversification, socio-economic development, environmental sustainability, and policy and financing frameworks.

The findings demonstrate that the Chisamba project represents a strategic milestone in Zambia's energy transition. The plant adds 100 MW of non-hydro renewable generation, supporting the government's target of increasing the non-hydro renewable share from 3% to 33% by 2030. Its innovative financing structure - securing USD 71.5 million in fully commercial debt from Stanbic Bank Zambia without sovereign guarantees - establishes a replicable model for private capital mobilization in Sub-Saharan African energy markets. The study further finds that renewable energy contributes to employment creation, agricultural irrigation, productive enterprise development, and greenhouse gas mitigation aligned with Zambia's Nationally Determined Contributions (NDCs). However, persistent financial constraints, technical skills gaps, grid integration challenges, and affordability barriers continue to limit the inclusive reach of these benefits. The study concludes that renewable energy must be treated as a strategic development asset embedded within a broader policy framework encompassing local capacity development, results-based financing, and social inclusion mechanisms.

Keywords: *Chisamba Solar Plant; Energy Transition; Renewable Energy; Sustainable Development Goals; SDG 7; Utility-Scale Solar; Zambia.*

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I. INTRODUCTION

A. Background and Motivation

Energy insecurity represents one of the most significant constraints on sustainable development in Sub-Saharan Africa. Approximately 565 million people on the continent still lack access to electricity, while Sub-Saharan Africa receives forty times less per capita clean energy investment than the global average [1]. Zambia exemplifies both the scale of this challenge and the emerging potential for transformation: approximately 85% of the country's installed electricity generation capacity is derived from large hydropower facilities, principally at Kafue Gorge and Kariba North Bank [2]. This structural dependence rendered Zambia acutely vulnerable to the catastrophic 2023–2024 drought, the worst in four decades, which reduced operational hydropower capacity to approximately 1,680 MW against a national demand of 2,400 MW, causing load-shedding

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of up to 20 hours per day and severely disrupting economic activity across all sectors [3].

In response, the Government of the Republic of Zambia accelerated its renewable energy diversification agenda, commissioning the 100 MW Chisamba Solar Power Plant in June 2025 as the flagship component of an ambitious plan to add 1,000 MW of solar capacity to the national grid by the end of 2025 [4]. Developed by the Kariba North Bank Extension Power Corporation (KNBEPC), a subsidiary of the state utility ZESCO, and constructed by PowerChina International Group at a total cost of USD 100 million, the Chisamba facility is the largest grid-connected solar installation in Zambia and the largest in sub-Saharan Africa outside South Africa [5]. With 180,356 solar photovoltaic (PV) panels spanning 106 hectares in Chisamba District, Central Province, the plant is connected to the national grid via a dedicated 33/132 kV step-up substation [4].

The Chisamba project is significant not only for its generation capacity, but also for its innovative power purchase arrangement. Through Africa GreenCo, a renewable energy trader and aggregator, firm solar power is supplied to First Quantum Minerals (FQM), Zambia's largest mining investor, blended with electricity from the Southern African Power Pool. This structure allows ZESCO to redirect electricity previously supplied to the mining sector toward domestic households and businesses, addressing the persistent tension between industrial demand and residential energy access [6].

B. Research Problem and Significance

Although a strong theoretical linkage between utility-scale renewable energy and sustainable development outcomes is well-established in the literature [7], [8], few empirical studies have comprehensively evaluated the contribution of a specific large-scale solar project to multiple SDG dimensions in the Zambian context. The Chisamba project provides a timely and empirically rich case study through which this gap can be addressed. Understanding its contributions to energy security, economic development, environmental sustainability, and policy frameworks is essential for informing the replication of such projects across Zambia and the broader Sub-Saharan African region.

C. Research Objectives and Questions

This study is guided by four specific objectives:

- To assess the contribution of the Chisamba Solar Power Plant to Zambia’s energy security and diversification (SDG 7).
- To analyze the socio-economic opportunities generated by the plant, including employment creation, skills development, and productive uses of energy (SDGs 1, 8, and 9).
- To evaluate the environmental contribution of the plant to climate change mitigation and Zambia’s Nationally Determined Contributions (SDG 13).
- To identify the financial, regulatory, technical, and socio-environmental challenges constraining renewable energy expansion in Zambia and to propose actionable policy recommendations.

These objectives are operationalized through four research questions: (i) How does the Chisamba plant contribute to Zambia’s energy mix and grid reliability? (ii) What socio-economic benefits has the project generated for local and national stakeholders? (iii) What is the environmental significance of utility-scale solar in Zambia’s climate context? (iv) What policy reforms are required to scale renewable energy investment in Zambia equitably and sustainably?

II. LITERATURE REVIEW

A. Global Renewable Energy Transition

The global energy system is undergoing an accelerating transition toward renewable sources. The International Energy Agency’s (IEA) Tracking SDG7 Report 2025 documents significant progress in renewable deployment, noting that the cost of utility-scale solar PV declined by 89% between 2010 and 2022, making it the least expensive source of new electricity generation in most markets [1]. However, the report also emphasizes that progress toward SDG 7 targets remains off track, particularly in Sub-Saharan Africa, which receives a disproportionately small share of global clean energy investment [1]. The Global Solar Council reported in February 2026 that Africa recorded its fastest year of solar growth in 2025, with installations rising 54% year-on-year, and that Zambia added 139 MW of new solar capacity, emerging as a significant growth market [9].

Energy Transition Theory, developed by scholars including Vaclav Smil [10] and further conceptualized through the Multi-Level Perspective (MLP) by Frank Geels [11], provides a foundational framework for understanding these dynamics. The MLP posits that transitions occur when landscape-level pressures - such as climate change and international climate agreements - open windows of opportunity for niche innovations to challenge incumbent socio-technical regimes. In Zambia’s case, the 2023–2024 drought functioned precisely as such a landscape-level pressure, catalyzing accelerated policy reform and private investment in solar energy.

B. Sustainable Development Theory and the SDGs

The theoretical foundation for this study is complemented by Sustainable Development Theory (WCED, 1987), which conceptualizes development as an integration of economic, social, and environmental pillars [12]. The 2015 United Nations Sustainable Development Goals operationalized this framework through seventeen interconnected goals. This study focuses particularly on SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 13 (Climate Action), all of which are directly implicated by utility-scale solar

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development. IRENA's research has consistently demonstrated that renewable energy is not merely an infrastructure issue but a cross-cutting enabler of multiple SDG dimensions [13].

C. Zambia's Energy Sector

Zambia's electricity sector is characterized by four defining features: heavy dependence on hydropower; a rapidly growing demand driven by population growth and urbanization; a low electrification rate of approximately 53% nationally, with stark urban–rural disparities; and abundant but underutilized solar resources estimated at 5.5–7.0 kWh/m²/day [14]. The 2019 National Energy Policy and the 2022–2026 National Development Plan establish frameworks for diversification, while the National Energy Compact targets USD 11.9 billion in investment to achieve universal electricity access by 2030, with USD 9.5 billion expected from the private sector [15]. Policy scholarship has identified inconsistent regulatory frameworks, the historically dominant position of ZESCO as sole off-taker, and limited grid infrastructure as persistent structural constraints on private renewable energy investment [16].

D. Comparative African Case Studies

South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) has attracted over USD 14 billion in investment and created more than 40,000 jobs, providing an influential model for public-private partnership in renewable energy development [17]. Morocco's Noor Ouarzazate Solar Complex (580 MW CSP) has demonstrated the potential for large-scale solar to simultaneously advance SDG 7, SDG 9, and SDG 13, reducing annual CO_2 emissions by approximately 760,000 tonnes [18]. Kenya's geothermal and off-grid solar expansion has extended energy access to over 8 million people, while Rwanda's mini-grid programme improved national electrification from 10% to over 60% [19]. Within Zambia, the earlier Bangweulu Solar project (60 MW) provided an important proof of concept for utility-scale solar, while the Ngonye Solar project offered further evidence of the emerging market for grid-connected solar IPPs.

E. Research Gap

Despite the growing literature on renewable energy in Sub-Saharan Africa, few studies have comprehensively examined a single utility-scale solar project's multi-dimensional contribution to SDG progress within Zambia's specific institutional and climatic context. This study addresses that gap by applying an integrated SDG analysis framework to the Chisamba Solar Power Plant, incorporating energy security, socio-economic, environmental, and governance dimensions.

III. MATERIALS AND METHODS

A. Research Design

This study employs a mixed-method case study design, combining qualitative policy analysis and thematic review with secondary quantitative data on energy, economic, and environmental indicators. The case study methodology is appropriate where the research focus is a contemporary phenomenon within its real-world context and where the boundaries between the phenomenon and its context are not clearly evident [20]. The Chisamba Solar Power Plant constitutes the primary unit of analysis, situated within Zambia's broader energy transition context.

B. Study Area and Project Profile

The Chisamba Solar Power Plant is located in Chisamba District, Central Province, Zambia (approximately 14.95°S, 28.35°E), approximately 70 km north of Lusaka, the Capital city of Zambia. The site benefits from high solar irradiation exceeding 6.0 kWh/m²/day. Table 1 provides a comprehensive technical profile of the facility.

Table 1. Technical Profile of the Chisamba Solar Power Plant

Parameter	Specification
Installed Capacity	100 MW (AC)
Technology	Monocrystalline silicon photovoltaic (PV)
Number of Panels	180,356
Site Area	106 hectares
Grid Connection	33/132 kV dedicated step-up substation
Construction Contractor	PowerChina International Group Limited
Developer	Kariba North Bank Extension Power Corp. (KNBEPC/ZESCO)
Total Project Cost	USD 100 million
Debt Financing	USD 71.5 million (Stanbic Bank Zambia)
Equity Contribution	USD 30 million each from ZESCO and KNBEPC
Commissioning Date	June 2025 (formal ceremony: 30 June 2025)

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Power Purchase Arrangement	Africa GreenCo / First Quantum Minerals (FQM)
Homes Supplied (est.)	30,000–50,000 households
Phase 2 Plans	Additional 100 MW under development

C. Data Collection

Primary data were drawn from key informant questionnaires and semi-structured interview guides administered to stakeholders in Zambia's energy sector, including government officials from the Ministry of Energy, regulators from the Energy Regulation Board (ERB), representatives of ZESCO and KNBEPC, private developers, and community members adjacent to the project. Secondary data sources included project commissioning reports, ZESCO and government press releases, publications of the IEA, IRENA, World Bank, and African Development Bank, peer-reviewed journal articles, and policy documents including the National Energy Policy (2019) and the 2022–2026 National Development Plan.

D. Data Analysis

Qualitative data were analyzed using thematic analysis following the framework of Braun and Clarke [21], with coding organized around four primary themes: energy security and diversification; socio-economic development; environmental sustainability; and policy and financing constraints. Quantitative data from secondary sources were synthesized using descriptive statistical methods, with comparative reference to regional benchmarks from South Africa, Morocco, Kenya, and Rwanda. Methodological triangulation across primary stakeholder evidence, secondary data, and theoretical frameworks was employed to strengthen the validity of findings [22].

IV. RESULTS AND DISCUSSION

A. Energy Security and Contribution to SDG 7

The Chisamba Solar Power Plant marks a structural turning point in Zambia's energy security landscape. Prior to its commissioning, non-hydro renewables accounted for only approximately 3% of the national electricity mix; the government's target is to raise this to 33% by 2030 [15]. The Chisamba plant contributes meaningfully toward this target and demonstrates the technical feasibility of utility-scale solar generation within Zambia's grid infrastructure.

The plant's significance extends beyond raw generation capacity. Through the innovative tripartite power purchase arrangement among KNBEPC, Africa GreenCo, and First Quantum Minerals, solar generation from Chisamba is blended with electricity sourced from the Southern African Power Pool (SAPP) to provide firm, dispatchable renewable power to the mining sector [6]. This arrangement frees capacity on the ZESCO national grid for redistribution to residential and commercial consumers, directly advancing SDG 7.1.1 (proportion of population with access to electricity). The African Solar Industry Association (AFSIA) ranked Zambia third in new African solar capacity additions in 2024, recognizing the country's emergence as a regional leader in utility-scale solar [5].

Table 2 summarizes the Chisamba project's specific contributions to SDG 7 targets as defined by the United Nations Sustainable Development Goals framework.

Table 2. Contribution of the Chisamba Solar Plant to SDG 7 Targets

SDG 7 Target	Indicator	Contribution of Chisamba Plant
7.1 – Universal access to modern energy	Access to electricity (%)	Frees ZESCO grid capacity for residential redistribution; supports 30,000–50,000 homes
7.2 – Increase renewable share	Renewable energy share in total final energy consumption	Adds 100 MW non-hydro renewable capacity; supports transition from 3% to 33% target by 2030
7.3 – Improve energy efficiency	Energy intensity	Single-axis tracking improves output by ~15–20% vs. fixed-tilt systems
7.a – International cooperation on clean energy	Mobilized finance	USD 71.5 million commercial debt without sovereign guarantee; replicable financing model
7.b – Expand infrastructure in developing countries	Investments in energy infrastructure	New 33/132 kV substation; planned Phase 2 of additional 100 MW

B. Economic and Social Benefits

The socio-economic significance of the Chisamba project operates at multiple scales. During construction, the project

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created over 1,200 jobs, approximately 98% of which were sourced from the local workforce [5]. Long-term operational employment is expected to sustain approximately 100 permanent positions. At the commissioning ceremony, President Hichilema specifically highlighted the plant's potential to enable solar-powered irrigation farming in the Chisamba area, directly linking large-scale grid solar to food security and agricultural productivity [4].

Evidence from the broader Zambian renewable energy ecosystem, particularly from a UN Joint SDG Fund project implemented in Eastern Province by the International Labour Organization (ILO), UNDP, and UNICEF, illustrates the productive use multipliers of reliable electricity access. Solar mini-grids in that programme powered hammer mills, welding shops, salons, and block-making machines, enabling entrepreneurs to operate across extended hours and expand product ranges. The ILO has documented that renewable energy projects globally generate approximately 1.5 times as many jobs per unit of electricity as fossil fuel projects, particularly during construction and installation phases [23]. Globally, the renewable energy sector employed 16.6 million people in 2024, with solar PV representing the largest single employer in the electricity sector [24].

Skills development represents a complementary socio-economic benefit. The ELECT Project (Energy Efficiency Lighting for Clean Energy Transition in Zambia), launched with European Union support, focuses on university capacity building, curriculum development, and applied research, recognizing that infrastructure deployment must be matched by human capital investment to sustain long-term sector growth. TVET institutions such as Chipata Trades Training Institute are integrating renewable energy modules into technical curricula, supporting SDG 4.4 (increasing skills for decent work) in parallel with SDG 7 and SDG 8.

The Chisamba project's financial structure also advances SDG 17 (Partnerships for the Goals). The transaction, which achieved financial close in May 2025, demonstrated that Zambian public developers can attract fully commercial capital for clean energy infrastructure without relying on sovereign guarantees or government balance sheet support—a precedent with significant implications for scaling private investment across the sector [6].

C. Environmental Benefits and Climate Mitigation

The Chisamba Solar Power Plant contributes directly to SDG 13 (Climate Action) by displacing electricity that would otherwise have been supplied from carbon-intensive sources, including emergency diesel and thermal generation activated during hydropower shortfalls. A 100 MW solar PV facility operating at a capacity factor of approximately 20–25% in Zambia's solar resource environment is estimated to generate 175–220 GWh of electricity annually. Using the SADC grid emission factor of approximately 0.9 kg CO_2/kWh as a reference baseline, the facility avoids on the order of 157,000–198,000 tonnes of CO_2-equivalent per year compared to a fossil fuel alternative.

This contribution supports Zambia's Nationally Determined Contributions (NDCs) under the Paris Agreement. The Carbon Feed-In Premium (CFIP) Programme, launched through a bilateral Zambia–Norway agreement in January 2026, strengthens the climate finance dimension further: the programme offers performance-based payments for verified greenhouse gas emission reductions associated with renewable electricity supplied to the national grid, and is projected to generate 300 MW of green energy and reduce up to 3.5 million tonnes of CO_2-equivalent over ten years [26].

Beyond direct emissions, the Chisamba project also contributes to climate adaptation by reducing Zambia's structural exposure to climate-induced hydropower deficits. Scholarly modelling has confirmed that climate change is expected to increase the frequency and severity of droughts in Southern Africa, progressively undermining the reliability of hydropower-dependent electricity systems [27]. Solar energy's complementarity with hydropower during dry seasons—when solar irradiation is typically highest and reservoir levels lowest—positions it as both mitigation and an adaptation technology.

Table 3. Environmental Benefits of the Chisamba Solar Power Plant

Environmental Dimension	Metric / Indicator	Estimated Value
Annual electricity generation	GWh/year (est.)	175–220 GWh (at 20–25% capacity factor)
CO_2 emissions avoided	Tonnes CO_2-eq/year (est.)	~157,000–198,000 tonnes (ref: SADC grid factor ~0.9 kg/kWh)
Water consumption	Litres/MWh vs. thermal plants	Minimal (dry-cooled PV vs. ~1,500 L/MWh for coal)
Land use	ha	106 ha (vs. equivalent hydro reservoir footprint)
Alignment with NDC targets	Qualitative	Supports Zambia's NDC commitments under Paris Agreement
Phase 2 projected co-benefit	Tonnes CO_2-eq/year (est.)	Additional ~157,000–198,000 tonnes upon commissioning

D. Contribution to Multiple Sustainable Development Goals

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The Chisamba Solar Power Plant generates co-benefits across multiple SDG dimensions simultaneously, consistent with the integrated logic of the 2030 Agenda for Sustainable Development. Table IV presents the project's specific contributions across five primary SDGs.

Table 4. Contribution of the Chisamba Solar Plant to Sustainable Development Goals

SDG	Theme	Specific Contribution
SDG 7	Affordable and Clean Energy	100 MW non-hydro renewable capacity; innovative PPA structure; supports 1,000 MW target; commercial financing model.
SDG 8	Decent Work and Economic Growth	1,200+ construction jobs (98% local); ~100 permanent operational positions; agricultural irrigation enabling; industrial power to FQM mining sector.
SDG 9	Industry, Innovation, Infrastructure	New 33/132 kV substation grid infrastructure; tripartite market innovation (KNBEPC–GreenCo–FQM); planned 200 MW Phase 2 expansion.
SDG 13	Climate Action	~157,000–198,000 tonnes CO_2 avoided annually; supports NDCs; climate adaptation by reducing hydropower dependency.
SDG 17	Partnerships for the Goals	USD 71.5 M commercial debt without sovereign guarantee; bilateral Norway-Zambia Carbon Feed-In Premium; ASCENT-Zambia USD 200M World Bank programme.

E. Policy and Institutional Framework

The Chisamba project's success reflects a broader transformation of Zambia's energy policy environment catalyzed by the 2023–2024 drought crisis. Four key policy instruments have been particularly significant:

The Electricity Open Access Initiative provides non-discriminatory third-party access to transmission and distribution networks, breaking ZESCO's historical role as the sole mandatory off-taker and enabling direct power purchase agreements between IPPs and large consumers. This fundamental restructuring of Zambia's electricity market architecture aligns with World Bank recommendations for competitive market development in African energy sectors [28]. The Net Metering Policy Framework creates economic incentives for distributed generation by allowing consumers to feed surplus electricity back to the ZESCO grid. The Multi-Year Tariff (MYT) Framework provides a predictable path to cost-reflective tariffs, reducing regulatory risk for investors. A streamlined project approval process, which expedites compliant applications within 48 hours, has materially reduced bureaucratic barriers.

The ASCENT-Zambia programme, a USD 200 million World Bank initiative employing results-based financing, aims to connect over 1.6 million people to electricity and clean cooking technologies within five years, complementing utility-scale generation with last-mile access. This represents a critical institutional complement to grid-scale projects such as Chisamba, targeting the rural access gap that utility-scale solar alone cannot address.

F. Persistent Challenges and Barriers

Despite the Chisamba project's achievements, the study identifies five persistent challenges that constrain Zambia's broader renewable energy transition.

Financial and investment gaps remain acute. The National Energy Compact estimates that achieving universal energy access by 2030 requires USD 11.9 billion in total investment, of which USD 9.5 billion must come from private sources [15]. While the Chisamba project demonstrated a pathway to fully commercial financing, smaller developers, distributed energy providers, and projects serving lower-income or rural markets still face significant capital access constraints. Partial risk guarantees, first-loss facilities, and green credit lines tailored to smaller-ticket renewable energy transactions are needed to extend commercial finance beyond flagship projects.

Skills gaps and technical capacity shortfalls represent a binding constraint on the long-term sustainability of the sector. Technical and Vocational Education and Training (TVET) institutions struggle to keep pace with a rapidly evolving renewable energy technology landscape, resulting in shortages of qualified installers, technicians, and maintenance engineers [23]. Without coordinated investment in human capital development, the country risks dependence on imported expertise and reduced domestic capture of the economic value generated by the sector.

Grid integration challenges are expected to intensify as variable renewable energy's share of the national electricity mix grows from its current low baseline toward the 33% target. Investments in transmission infrastructure, forecasting, demand-side management, and energy storage are essential system complements to generation capacity additions.

Affordability constraints affect end-users, particularly in rural areas and low-income urban communities. The cost-reduction benefits of utility-scale solar at the system level may not percolate to final consumers without targeted subsidies, lifeline tariff structures, or pay-as-you-go financing mechanisms.

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Policy implementation gaps persist despite formal regulatory progress. Delays in operationalizing the Electricity Open Access Initiative across all regulatory bodies, uncertainty around tariff trajectories, and limited inter-agency coordination continue to affect investor confidence and project development timelines [16].

V. POLICY IMPLICATIONS AND RECOMMENDATIONS

The findings of this study generate a structured set of recommendations for policymakers, project developers, financing institutions, and development partners, organized into short-, medium-, and long-term horizons.

A. Short-Term Recommendations (1–2 Years)

Government and regulators should fully operationalize the Electricity Open Access Initiative with clear transmission access procedures and dispute resolution mechanisms. The Multi-Year Tariff Framework must be implemented consistently across all regulatory bodies to reduce investor uncertainty. Standardized project-level monitoring and reporting requirements should be established for all utility-scale renewable projects, covering annual generation, capacity factor, employment, local procurement, and emissions indicators. Development partners and the government should jointly establish a renewable energy data and evidence platform to consolidate project performance information for policy learning.

B. Medium-Term Recommendations (3–5 Years)

A national Renewable Energy Skills Development Fund should be established, supported by government, universities, TVET institutions, and the private sector, to develop industry-aligned curricula, technician certification programmes, and industry-academia partnerships. The financing toolkit available to renewable energy developers should be expanded through blended finance windows, green credit lines, partial risk guarantees, and results-based climate finance mechanisms such as the Carbon Feed-In Premium Programme. Grid integration planning should be elevated as a national priority, with investment in transmission infrastructure, energy storage, and smart grid management tools to accommodate growing variable renewable energy shares. Gender and social inclusion targets should be mainstreamed across renewable energy programmes, ensuring equitable access to training, enterprise development, and the economic benefits of energy investments.

C. Long-Term Recommendations (5+ Years)

Zambia should pursue a diversified, climate-resilient energy portfolio integrating solar, wind, biomass, hydro optimization, battery storage, and decentralized systems, explicitly designed to withstand the increasingly severe hydropower disruptions projected under climate change scenarios. A renewable energy industrial development pathway should be established to build domestic capabilities in installation, operations, maintenance, component assembly, and energy entrepreneurship, reducing long-term dependence on imported expertise. A comprehensive national framework for renewable energy impact assessment—incorporating technical, economic, social, environmental, and governance indicators—should be institutionalized to enable rigorous, comparable evaluation of how energy investments contribute to SDG achievement.

VI. CONCLUSION

This study examined the role of the 100 MW Chisamba Solar Power Plant in advancing Zambia's Sustainable Development Goals within the context of a climate-vulnerable, hydropower-dependent electricity system. The Chisamba project represents a landmark milestone: it is the largest grid-connected solar facility in Zambia, the largest of its kind in sub-Saharan Africa outside South Africa, and a demonstration that utility-scale renewable energy can be financed at fully commercial terms in developing country contexts without sovereign guarantees.

The study finds that the project makes meaningful contributions across multiple SDG dimensions: adding non-hydro renewable capacity that supports energy diversification toward the national 33% target (SDG 7); generating construction employment, skills development, and enabling agricultural and industrial productive uses (SDGs 1, 8, and 9); avoiding an estimated 157,000–198,000 tonnes of CO_2-equivalent annually and supporting climate resilience (SDG 13); and demonstrating innovative multi-stakeholder financing and partnership structures (SDG 17). Critically, the Chisamba project also advances Zambia's strategic response to the structural energy insecurity exposed by the 2023–2024 drought, demonstrating that solar energy is not a marginal supplement to hydropower but a strategic complement with growing national importance.

At the same time, the study confirms that infrastructure deployment alone is insufficient. Persistent financial constraints, skills gaps, grid integration challenges, affordability barriers, and policy implementation gaps require coordinated, sustained action across government, regulators, utilities, project developers, financing institutions, and development partners. Renewable energy must be embedded within a broader policy ecosystem that prioritizes skills development, affordability mechanisms, inclusive access, and robust project-level monitoring.

The Chisamba Solar Power Plant is best understood as both a flagship achievement and a practical lesson for Zambia's energy transition. Its replication and scaling—through planned Phase 2 development at Chisamba, as well as new solar facilities in Kasama, Choma, Chipata, Serenje, Siavonga, and Kafue Gorge—will be essential for building the resilient, diversified, and inclusive energy system that Zambia's sustainable development requires. Future research should expand this work through comparative assessment across

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Zambia's portfolio of solar projects, and detailed investigation of the energy–agriculture–livelihoods nexus in the Zambian context.

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