ENERGY SECTOR STRATEGIC PLAN (ESSP)

2023/24-2029/30

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Ministry of Infrastructure
KG 1 Roundabout,
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LIST OF ACRONYMS

BMZ	Federal Ministry for Economic Cooperation and Development of Germany
CNG	Compressed Natural Gas
DMS	Distribution Management System
EPC	Electrical Pressure cookers
ESSP	Energy Sector Strategic Plan
GGCRS	Green Growth and Climate Resilient Strategy
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HHs	Households
HV	High-Voltage
ICS	Improved Cook Stoves
IDPs	Internally Displaced Persons
LPG	ILiquefied Petroleum Gas
LV	Low Voltage
MINIFRA	Ministry of Infrastructure
MOE	Ministry of Environment
MV	Midium Voltage
MW	Megawatt
NDC	Nationally Determined Contributions
NEP	National Electrification Plan
NST	National Strategy for Transformation
PUEs	Productive Energy Use
RBF	Results-Based Financing
REP	National Energy Policy
RUEAP	Rwanda Universal Energy Access Program
SCADA	Supervisory Control and Data Acquisition
SDGS	Sustainable Development Goals
SEZS	Special Economic Zones
SHS)	Solar Home systems
USSP	Universal Service and Access Program

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EXECUTIVE SUMMARY

The Sector Strategy Key Highlights and Focus Areas

The Energy Sector Strategic Plan (ESSP) 2025–2030 serves as a cornerstone document guiding Rwanda's energy sector development in tandem with national aspirations outlined in Vision 2050 and the National Strategy for Transformation (NST-2) which is under development. Funded by the Federal Ministry for Economic Cooperation and Development (BMZ) and spearheaded by GIZ in collaboration with the Ministry of Infrastructure of Rwanda (MININFRA) and other various stakeholders, this strategic blueprint endeavours to provide guidance in addressing sectoral challenges while seizing opportunities for sustainable growth.

The strategic plan development process has been marked by extensive stakeholder engagement, rigorous sectoral analysis on the progress made thus far with focus on economic, social, governance, cross cutting aspects, environment and climate change as well as other relevant aspects. From the analytical results, the strategic framework outlines the implementation arrangements, monitoring and evaluation mechanisms, and financial strategies, to catalyse Rwanda's energy sector development towards sustainability and resilience.

The ESSP, aligned with Rwanda's commitments to the Nationally Determined Contributions (NDC), the Green Growth and Climate Resilient Strategy (GGCRS), it prioritizes the integration of climate change adaptation and mitigation measures. Furthermore, it delineates six key priorities namely:

- scaling up electricity access through both grid and of grid
- implementation of on-going generation projects
- promoting the use of clean cooking solutions to ensure households transit from using traditional to cleaner cooking technologies
- ensuring national grid network strengthening and expansion
- continuing with the installation of streetlights on the existing major national and urban roads.

Progress trend of the current ESSP

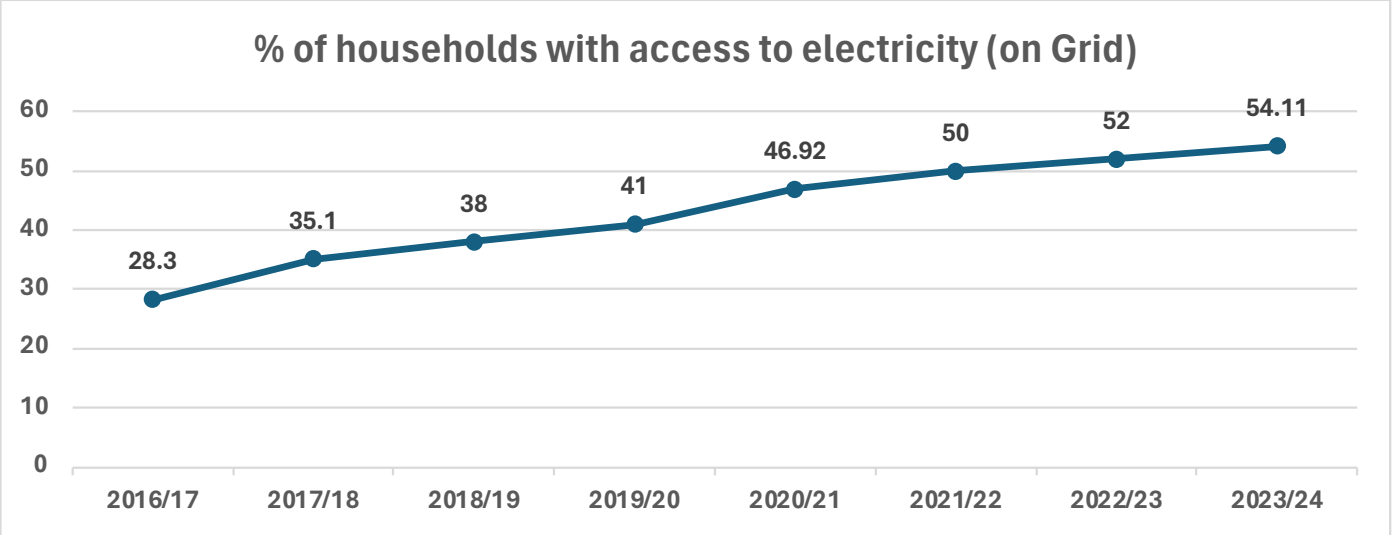
An in-depth analysis of the current state of Rwanda's energy sector reflects on statistics on **electricity access, reliability, and affordability,** as well as **an assessment of biomass and petroleum utilization.** Moreover, it examines the sector's **contribution to greenhouse gases emissions and outlines projections for future growth**. The strategic framework outlines the vision, objectives, and key priorities of the Energy Sector Strategic Plan (ESSP) 2025-2030.

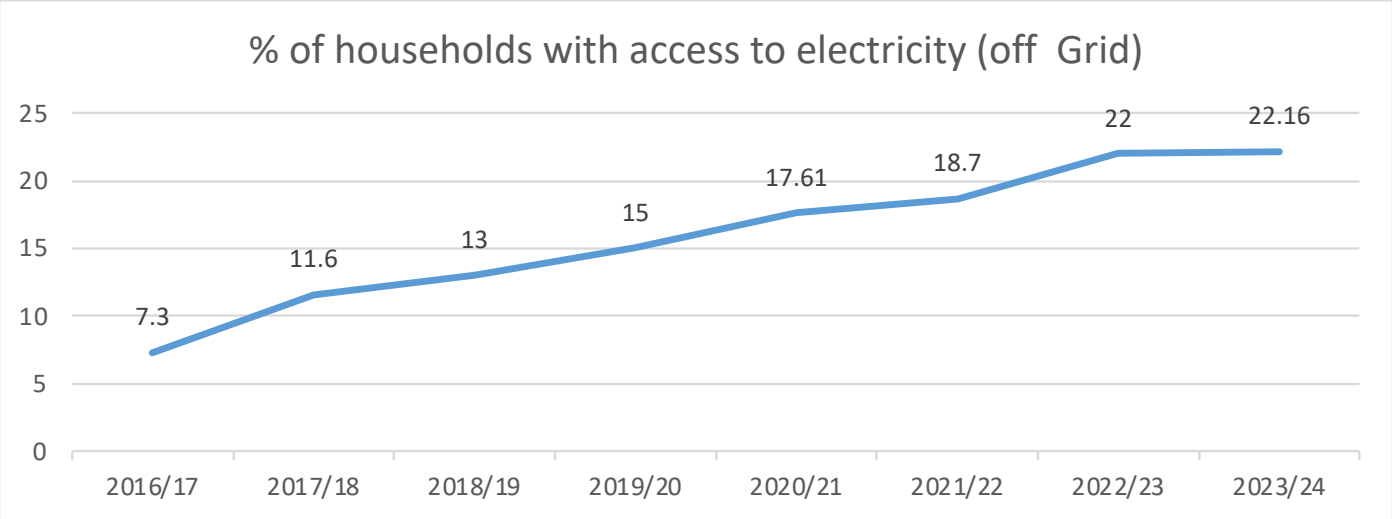
The existing Energy Sector Strategic Plan (ESSP) has significantly advanced Rwanda's energy sector towards sustainability and resilience. It has achieved substantial improvements in electricity access, reliability of energy supply, and promotion of renewable energy sources, the sector witnessed substantial growth in electricity generation capacity, nearly doubling from 208.8 MW to 400 MW to the initial target of 550MW which couldn't be achieved mainly to low demand and delays of some of vital power projects.

The strategic increase in petroleum reserves to 118 million litters ensures three months' supply coverage, crucial for economic stability and security. While infrastructure development extended beyond electricity generation to include the expansion of street lighting across populated areas and main roads, covering 2205.1km of national and district roads. Efforts to reduce reliance on biomass and traditional cooking methods

were evident, with a notable decrease in households using firewood for cooking from 83.3% to 76.1%, there has been also the distribution of over 1,489,810 improved cook stoves and the increased uptake of LPG from 1% to 4.5% this affirms the progress towards cleaner and more efficient cooking solutions.

On/Off – Grid Access Development Trend





The current situation analysis reveals notable achievements alongside persistent challenges, including slower-than-anticipated energy demand growth and a 23.8% gap in household electricity access. Limited budget allocations have hindered infrastructure projects like street lighting and off-grid electrification, exacerbating access disparities. Global disruptions, such as the COVID-19 pandemic and supply chain constraints, have further delayed project timelines, particularly in petroleum storage and distribution. Key gaps and challenges include underfunding, outdated distribution networks, and implementation gaps, hindering progress towards universal electricity access. Addressing these challenges requires strategic interventions, improved coordination, and increased resource mobilization to ensure sustainable energy access for all.

The Path to ESSP 2024/25 – 2029/30

Aligned to Rwanda's Vision 2050 strategic actions, the next-generation Energy Sector Strategic Plan (ESSP) for Rwanda, spanning from 2024/25 to 2029/30, is poised to build upon the achievements of its predecessor while addressing the gaps and emerging challenges, and seizing new opportunities.

Central to the success of this plan are the major indicators, targets, and delivery mechanisms outlined to guide its implementation. This section elaborates on these critical components, highlighting the key performance metrics, objectives, and strategies envisioned for the future of Rwanda's energy sector.

The targets set forth in the new ESSP are ambitious yet attainable, reflecting Rwanda's commitment to advancing its energy sector while contributing to broader development objectives. These targets are informed by national priorities, international commitments, and sectoral assessments, aiming to address key challenges and capitalize on emerging opportunities. The proposed priorities for the Strategic Sector Plan (SSP) for the period 2024-2029 focus on expediting ongoing generation projects such as Nyabarongo II with 43.5MW and Rusizi-III with 206 MW.

The new ESSP targets a significant growth and development over the next five years,. Key metrics indicate substantial progress in expanding access to electricity, with on-grid access projected to increase from 53% to 76%, and off-grid access maintaining at around 24% to 30%. Access for productive users is expected to reach 100% by 2027/28, indicating a strong emphasis on supporting economic development through reliable energy access.

In terms of electricity generation capacity, significant increases are anticipated, with installed capacity expected to rise from the current 400.1 MW to 79.525 MW by 2028/29. This expansion is complemented by efforts to enhance transmission and distribution infrastructure, with new 473.8Km of high-voltage (HV) and 6,133.6 km of MV Lines, and 21,673km of LV lines will be constructed to improve reliability and efficiency while the reducing the system losses from the current 16.9% to 14.7% by 2029.

Additionally, the promotion of efficient cook stoves is evident, with a steady increase in the number of households adopting biomass and non-biomass stoves, highlighting efforts towards cleaner and more sustainable cooking solutions from the current 1,489,810 households to 2,676,085 households HHs while increasing the number of HHs using improved cook stoves, clean and efficient cooking from 22,253HHs to 477,766 HHs. The efforts also include constructing new fuel storage facilities and upgrading existing ones to increase petroleum strategic reserves to cover a three-month supply up to 230 million liters from the current 118 million liters.

While optimizing existing (Ntaruka and Mukungwa, Rukarara, Nyabarongo hydropower plants, etc, etc) and the new plants like Hakan (peat), Ntaruka (hydro), and Kivuwatt (methane), Shema (methane), Rusumo (hydro), more studies will be conducted to explore generation expansion options and new technologies like hydrogen. Efforts to stimulate demand is paramount, particularly in sectors like transport, where e-Mobility and streetlight expansion are prioritized, and in industrial areas and special economic zones across various regions. Furthermore, emphasis is placed on supporting agriculture through projects involving high-value trade commodities, irrigation, and water pumping and treatment projects nationwide, alongside urbanization initiatives like the Kigali Green City and Innovation City, and the development of commercial and modern markets, and residential settlements for internally displaced persons (IDPs).

The successful implementation of the next-generation ESSP relies on effective delivery mechanisms that ensure the timely execution of planned initiatives and interventions. These mechanisms encompass among initiatives the following:

- institutional arrangements
- coordination frameworks
- financing strategies
- stakeholder engagement approaches designed to mobilize resources, streamline decision-making, and foster collaboration across various actors.

Key delivery mechanisms may include:

- Institutional structures and coordination mechanisms that clarify roles, responsibilities, and reporting lines among government agencies, development partners, private sector entities, and civil society organizations
- financing strategies that leverage diverse funding sources, including public budgets, international grants and loans, private investments, and innovative financing mechanisms such as carbon financing and public-private partnerships
- capacity-building initiatives to strengthen the technical and managerial capabilities of energy sector institutions, ensuring effective planning, implementation, and monitoring of ESSP activities
- stakeholder engagement processes that promote inclusivity, transparency, and accountability, enabling meaningful participation of communities, businesses, academia, and other stakeholders in decision-making and implementation.

CHAPTER 1: INTRODUCTION

The Sector Strategic Plan (SSP) serves as a guiding document outlining the strategic direction and objectives for a particular sector within a country. It provides a framework for coordinated action and resource allocation to achieve sectoral goals and contribute to broader national development objectives. The purpose of the SSP is to ensure systematic and comprehensive planning, implementation, and monitoring of sector-specific initiatives, policies, and programs. In the context of Rwanda, the Sector Strategic Plan plays a crucial role in driving the development of key sectors such as energy, agriculture, health, education, and infrastructure. These plans are aligned with Rwanda's long-term vision 2050, and the National Strategy for Transformation (NST-2), outlining the country's aspirations for socio-economic development and poverty reduction. In this regard therefore, the Energy Sector Strategic Plan (ESSP 2024/2025-2029/2030) outlines priorities, targets, and strategies to enhance energy access, reliability, and sustainability while integrating climate change adaptation and mitigation measures.

The existing Energy Sector Strategic Plan (ESSP) 2018/19 - 2023/24 has propelled Rwanda's energy sector towards sustainability, accessibility, and resilience, with significant progress achieved across various dimensions, achieving notable milestones in various facets of sustainability and resilience. With a substantial increase in electricity generation capacity from 208.8 MW to 400 MW, the sector nearly doubled its output, albeit falling short of the initial target of 550 MW due to factors like low demand and project delays. This capacity expansion has been instrumental in meeting the escalating energy needs, maintaining a reserve margin of 26.60% to ensure energy security. Moreover, efforts to enhance electricity access have been fruitful, with grid connections rising from 28% to 54.11% and off-grid solutions expanding from 7.6% to 22.16%, signifying significant progress in extending energy services to previously underserved areas. The strategic increase in petroleum reserves to 118 million liters, providing three months' supply coverage, has bolstered economic stability and security, mitigating risks associated with supply disruptions.

In advancing electricity generation, infrastructure development under the ESSP has extended to other critical areas, such as the expansion of street lighting across populated areas and main roads, covering 2205.1 km of national and district roads. Efforts to transition away from biomass and traditional cooking methods have also been evident, with a notable reduction in households using firewood for cooking from 83.3% to 76.1%. Moreover, initiatives such as the distribution of over 1,489,810 improved cook stoves and the increased uptake of LPG from 1% to 4.5% underscore the progress towards cleaner and more efficient cooking solutions, contributing to environmental sustainability and public health improvement. Despite these achievements, the sector faces persistent challenges, including slower-than-anticipated energy demand growth and a significant gap of 23.8% in household electricity access. Limited budget allocations have hindered crucial infrastructure projects, exacerbating access disparities, while global disruptions like the COVID-19 pandemic have further impeded progress. Addressing these challenges requires concerted efforts, including strategic interventions, improved

coordination, and increased resource mobilization to ensure sustainable energy access for all Rwandans.

The ESSP serves as a guiding beacon for Rwanda's energy sector, steering its trajectory in alignment with the nation's long-term development goals. As outlined in Vision 2050 and NST-2, Rwanda aspires to become a knowledge-based, middle-income economy, with the energy sector playing a pivotal role in driving economic growth, industrialization, and improved living standards for its citizens. The ESSP, funded by the Federal Ministry for Economic Cooperation and Development (BMZ) and spearheaded by GIZ in collaboration with the Ministry of Infrastructure of Rwanda (MININFRA) and various stakeholders, is instrumental in translating these aspirations into actionable strategies and interventions.

Energy Sector Strategic Plan (ESSP) 2025–2030, highlighting its significance within Rwanda's developmental landscape, its alignment with national and global commitments, and the meticulous process undertaken for its formulation. By encapsulating Rwanda's aspirations for sustainable energy development, the ESSP emerges as a pivotal instrument for steering the nation towards a future characterized by inclusive growth, environmental stewardship, and resilience to the challenges of the 21st century.

The development of Energy Sector Strategic Plan (ESSP 2025-2030) involved a comprehensive and collaborative process aimed at developing a roadmap for the country's energy sector development. Led by the Ministry of Infrastructure (MININFRA) in close partnership with the Ministry of Environment (MoE), the process engaged a wide range of stakeholders, including government agencies, development partners, private sector entities, civil society organizations, and other relevant actors. The process began with a thorough analysis of the sector's current situation, including achievements, challenges, and future trends, to inform the strategic planning process. This analysis involved reviewing existing policies, strategies, and sectoral data, as well as conducting consultations and stakeholder interviews to gather input and insights.

Based on the sector situation analysis, the strategic framework of the ESSP was developed, outlining the vision, objectives, and key priorities for the energy sector. Special attention was given to mainstreaming climate change adaptation and mitigation measures throughout the strategic framework to align with Rwanda's climate goals and commitments. Implementation plan was carefully designed to ensure effective coordination, collaboration, and accountability among all stakeholders involved in the plan's execution. Clear roles and responsibilities were established, and mechanisms for monitoring, reporting, and evaluation were put in place to track progress and address any challenges that may arise.

Throughout the process, active engagement and participation of SSP development participants were crucial. Annexed to the ESSP document is a list of these participants, including representatives from government ministries and agencies, development partners, private sector entities, civil society organizations, and other relevant stakeholders. Their contributions, expertise, and commitment were instrumental in shaping the ESSP and ensuring its alignment with Rwanda's development objectives and priorities.

CHAPTER 2: SECTOR OVERVIEW

The energy sector in Rwanda has indeed experienced significant advancements in recent years, with notable achievements contributing to the nation's socio-economic development goals. One of the primary objectives set by the government of Rwanda is to achieve universal access to electricity by 2024. While progress has been made towards this target, challenges remain evident, particularly in meeting ambitious goals within the designated timeframe. The sector situation analysis provided in this chapter is based on previous Energy Sector Strategic Plan 2018/19 - 2023/24, on the latest Joint Sector Review (Forward Looking JSR for FY 2023/24 Report, Energy Sector June 2023) as well as on the Energy Joint Sector Review Report (backward looking) expected in June 2024 (FY 2023-2024). Data for these upcoming reports are provided by MININFRA and REG.

The Energy Sector Strategic Plan (ESSP) has been pivotal in advancing Rwanda's energy sector, achieving significant milestones in sustainability and resilience. The sector experienced a substantial increase in electricity generation capacity, nearly doubling from 208.8 MW to 400 MW, although it fell short of the initial target of 550 MW due to factors like low demand and project delays. This capacity expansion has played a crucial role in meeting the escalating energy needs of the country while maintaining a reserve margin of 26.60% to ensure energy security. Efforts to enhance electricity access have yielded positive results, with grid connections rising from 28% to 54.11% and off-grid solutions expanding from 7.6% to 22.16%, marking substantial progress in extending energy services to previously underserved areas. As of the end of January 2024, the cumulative connectivity rate in Rwanda stands at 75.9% of households, including 54% connected to the national grid and 21.9% connected through off-grid solutions, with productive user access reaching 86.1%.

Moreover, infrastructure development under the ESSP has extended beyond electricity provision to encompass critical areas such as the expansion of street lighting across populated areas and main roads, covering 2205.1 km of national and district roads. Efforts to transition away from biomass and traditional cooking methods have also been evident, with a notable reduction in households using firewood for cooking from 83.3% to 76.1%. Initiatives like the distribution of over 1,489,810 improved cook stoves and the increased uptake of LPG from 1% to 4.5% underscore the progress toward cleaner and more efficient cooking solutions, contributing to environmental sustainability and public health improvement. Despite these achievements, the sector faces persistent challenges, including slower-than-anticipated energy demand growth and a significant gap of 23.8% in household electricity access. System losses of 16.9% and limited budget allocations hindering crucial infrastructure projects exacerbate access disparities, while global disruptions like the COVID-19 pandemic have further impeded progress.

Rwanda has set a new ambitious targets to improve the availability and reliability of electricity, expand access to clean energy sources of renewable energy targets include generating at least 60% of electricity from renewable energy sources. Energy efficiency objectives are to double the efficiency in the use of biomass, and to extend the current rate of improvement of energy efficiency in the electricity sector by 2030 that will foster economic growth through sustainable energy development. This chapter offers a comprehensive analysis of the current state of the energy sector, providing insights into key dimensions such as electricity access, reliability, affordability, sustainability, and the utilization of biomass and petroleum resources. By examining these facets, policymakers and stakeholders can gain a holistic understanding of the sector's strengths, weaknesses, opportunities, and challenges, thereby informing evidence-based decision-making and strategic planning processes.

One of the primary focal points of the analysis is electricity access, which serves as a cornerstone of Rwanda's development agenda. Despite notable progress in recent years, challenges persist in ensuring universal access to electricity, particularly in rural and remote areas. By assessing the current status of electricity access, including grid connectivity and off-grid solutions, stakeholders can identify priority areas for intervention and investment to bridge the electricity gap and improve energy equity across the country. Moreover, the analysis delves into the reliability and affordability of energy services, evaluating factors such as power outages, voltage fluctuations, and tariff structures that impact consumers' access to reliable and affordable electricity. By addressing these challenges, Rwanda can enhance energy security, promote economic development, and improve the quality of life for its citizens.

Furthermore, the analysis explores the sustainability of Rwanda's energy sector, examining the country's utilization of biomass and petroleum resources and its implications for environmental conservation and climate change mitigation. Given the sector's significant contribution to greenhouse gas emissions, there is a growing imperative to transition towards cleaner and more sustainable energy sources, such as renewable energy and energy efficiency measures. Additionally, the chapter assesses the challenges posed by climate change on energy infrastructure and operations, including risks related to extreme weather events, water scarcity, and temperature variability. By understanding these challenges, stakeholders can develop proactive strategies to enhance the resilience of the energy sector and mitigate the adverse impacts of climate change on energy systems and services. Through a comprehensive analysis of these dimensions, this chapter provides valuable insights and recommendations to guide the formulation of policies and initiatives aimed at advancing Rwanda's energy transition agenda and achieving its sustainable development goals.

2.1 Energy Guidance Frameworks

In Rwanda, the energy sector is guided by several policy frameworks that outline the main orientations and goals for the sector's development. These policies align with national and international goals and frameworks, including the National Strategy for Transformation (NST1), Vision 2050, Sustainable Development Goals (SDGs) Agenda 2030, and the African Union (AU) Agenda 2063. The main orientations for the energy sector are reflected in these policies, which emphasize various sub-sectors within the energy domain.

I. **National Energy Policy (REP, 2015):** The Renewable Energy Policy (REP) stands as the cornerstone of Rwanda's energy sector, providing a comprehensive framework for sustainable development, energy security, and the promotion of renewable energy sources. This paper explores the pivotal role of the REP in guiding Rwanda's energy sector, emphasizing its objectives, targets, and strategies for expanding electricity access, promoting alternative energy solutions, and enhancing energy efficiency. Furthermore, it examines the integration of the REP into a new Energy Sector Strategic Plan (ESSP), highlighting the synergies between policy objectives and strategic planning initiatives aimed at advancing Rwanda's energy sector.

The REP is a base line in Rwanda's commitment to sustainable energy development by prioritizing the expansion of electricity access, improvement of reliability, and enhancement of energy efficiency. With specific targets set to increase electricity generation capacity from 160MW to 235MW, the policy aims to meet the growing energy demands of Rwanda's economy and population. Additionally, the REP sets ambitious goals for increasing access to electricity, targeting 560,000 households to provide reliable energy infrastructure to underserved communities. Moreover, the REP promotes the adoption of alternative energy solutions, including solar home systems and biogas technology, to diversify the energy mix and reduce dependency on traditional fuel sources. By facilitating the dissemination of solar home systems to rural households and promoting biogas technology in institutional settings, the policy contributes to environmental sustainability and climate change mitigation. Furthermore, the REP prioritizes energy efficiency measures, such as the dissemination of improved cook stoves, to reduce energy consumption and enhance fuel efficiency. Additionally, it addresses energy security concerns by increasing fuel storage capacity, ensuring a reliable supply of energy resources to meet national demand.

The integration of the REP into a new ESSP signifies a coordinated approach towards advancing Rwanda's energy sector objectives and aligning policy priorities with strategic planning initiatives. By incorporating the goals and strategies outlined in the REP into the ESSP, Rwanda aims to streamline efforts towards achieving sustainable energy development, enhancing energy access, and promoting renewable energy sources. The ESSP serves as a roadmap for implementing the objectives outlined in the REP, providing a framework for coordinating sectoral activities, mobilizing resources, and monitoring progress towards energy sector goals. Furthermore, the integration of the REP into the ESSP ensures continuity and coherence in energy sector policies and initiatives, fostering long-term sustainability and resilience in Rwanda's energy sector.

The Renewable Energy Policy (REP) plays a pivotal role in guiding Rwanda's energy sector towards sustainable development, energy security, and environmental stewardship. By promoting renewable energy sources, enhancing energy access, and prioritizing energy efficiency measures, the REP provides a comprehensive framework for addressing Rwanda's energy needs in an efficient and environmentally responsible manner. Moreover, the integration of the REP into a new Energy Sector Strategic Plan (ESSP) underscores Rwanda's commitment to advancing energy sector objectives and aligning policy priorities with strategic planning initiatives. Through coordinated efforts, Rwanda is poised to achieve significant progress towards its energy sector goals, driving socio-economic development and environmental sustainability in the country.

Iii. **NST1:** The National Strategy for Transformation (NST1) serves as a blueprint for Rwanda's socio-economic development, with a particular focus on the energy sector's pivotal role in driving economic growth, industrialization, and improved living standards. This paper delves into the ambitious targets outlined in NST1 for Rwanda's energy sector, emphasizing its objectives to increase electricity generation capacity, expand access to electricity, and transition towards sustainable energy sources. Furthermore, it explores the integration of NST1 priorities into a new Energy Sector Strategic Plan (ESSP), highlighting the synergies between national development objectives and strategic planning initiatives aimed at advancing Rwanda's energy sector.

NST1 outlines ambitious targets for Rwanda's energy sector, emphasizing the need to significantly increase electricity generation capacity to meet the growing demands of a rapidly developing economy. With targets set to increase the number of households with access to electricity from 34.4% per EICV5 to 71.5% by 2021 and achieve universal access by 2024, NST1 underscores the importance of electrification in enhancing the quality of life for Rwandan citizens and supporting industrialization and socio-economic activities. Moreover, NST1 prioritizes the transition towards sustainable energy sources and reducing dependency on traditional biomass for cooking. By aiming to halve the number of households depending on firewood as a source of energy for cooking, from 79.9% in 2016/17 to 42% by 2024, NST1 contributes to improving air quality, reducing deforestation, and mitigating climate change. Through these objectives, NST1 aligns the energy sector's goals with broader development priorities, fostering Rwanda's socio-economic advancement while promoting environmental sustainability and resilience.

The integration of NST1 priorities into a new ESSP signifies Rwanda's commitment to advancing energy sector objectives and aligning national development strategies with strategic planning initiatives. By incorporating the targets and strategies outlined in NST1 into the ESSP, Rwanda aims to streamline efforts towards achieving sustainable energy development, enhancing energy access, and promoting renewable energy sources. The ESSP serves as a roadmap for implementing NST1 objectives, providing a framework for coordinating sectoral activities, mobilizing resources, and monitoring progress towards energy sector goals. Furthermore, the integration of NST1 into the ESSP ensures coherence and continuity in energy sector policies and initiatives, facilitating long-term sustainability and resilience in Rwanda's energy sector. Through coordinated efforts, Rwanda is poised to achieve significant progress towards its socio-economic ambitions, driving inclusive growth, and environmental stewardship.

III. **Vision 2050:** Vision 2050 serves as Rwanda's blueprint for the long-term development of its energy sector, envisioning sustainable energy access for all citizens while minimizing environmental impacts. Central to this vision is a concerted effort to transition towards renewable energy sources, thereby reducing dependency on fossil fuels. The vision sets ambitious targets for electricity access, aiming for 56% access by 2020 and universal access by 2050. Additionally, it emphasizes the importance of increasing the share of renewable energy in the power generation mix, with a target of 53.78% by 2020 and at least 60% by 2050. This shift towards renewables aligns with global trends towards clean energy and underscores Rwanda's commitment to mitigating climate change and promoting environmental sustainability.

Vision 2050 outlines projections for per capita energy consumption as a proxy for improvements in income contributing to increased energy demand. In 2019, per capita energy consumption stood at 50 kWh, with significant growth anticipated in the coming years. By 2035, Rwanda aims to achieve a per capita energy consumption of 1,026 kWh, signalling substantial economic growth and development. Looking ahead to 2050, the target is to reach 3,080 kWh per capita, reflecting a transformative shift towards higher living standards and increased energy usage. These targets underscore Rwanda's vision of harnessing the power of sustainable energy to drive socio-economic development, improve livelihoods, and ensure a prosperous future for its citizens while prioritizing environmental stewardship.

IV. **Africa Agenda 2063:** Africa Agenda 2063 envisions a continent where sustainable energy plays a central role in driving economic growth, promoting environmental sustainability, and improving the quality of life for all Africans. By setting the ambitious target of increasing the share of renewable energy sources to 50% of total energy production by 2063, Agenda 2063 aligns with global efforts to mitigate climate change and transition towards a low-carbon economy. This objective reflects Africa's commitment to reducing its dependency on fossil fuels, harnessing its abundant renewable energy resources, and promoting energy access and security for its growing population.

The role of Africa Agenda 2063 extends beyond energy sector transformation to encompass broader socio-economic development objectives. By prioritizing renewable energy sources such as wind, solar, hydro, bioenergy, and geothermal, Agenda 2063 seeks to stimulate innovation, create employment opportunities, and foster inclusive growth across the continent. The integration of Agenda 2063 priorities into a new Energy Sector Strategic Plan (ESSP) for Rwanda provides an opportunity to align national energy sector objectives with continental development frameworks. By incorporating the principles and targets of Agenda 2063 into the ESSP, Rwanda can contribute to Africa's collective efforts towards sustainable energy development, environmental conservation, and socio-economic progress. Through coordinated action and collaboration, Rwanda and other African nations can work towards achieving the transformative goals outlined in Africa Agenda 2063, paving the way for a prosperous and sustainable future for the continent.

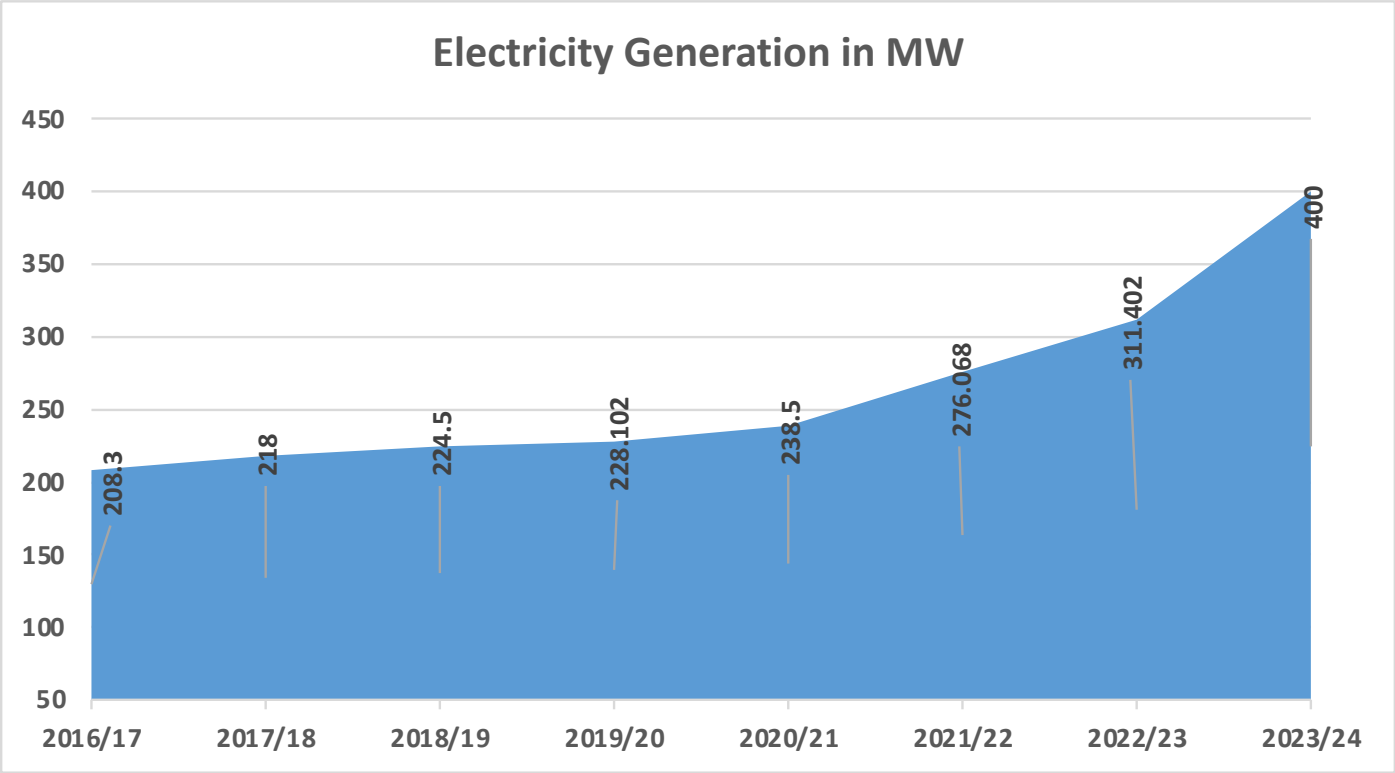
V. **SDG: Goal 7:** Access to affordable and clean Energy. Sustainable Development Goal 7 (SDG 7) serves as a crucial framework for guiding energy sector development towards sustainability and inclusivity. As Rwanda endeavours to develop a new Energy Sector Strategic Plan (ESSP), the principles and targets outlined in SDG 7 provide valuable guidance for aligning national energy policies and strategies with global development priorities. By incorporating the objectives of SDG 7 into the ESSP, Rwanda can enhance its efforts to expand access to affordable, reliable, and modern energy services, thereby contributing to poverty reduction, improved health outcomes, and enhanced economic opportunities for its citizens. Additionally, integrating renewable energy technologies and energy efficiency measures into the ESSP aligns with the goals of SDG 7, enabling Rwanda to promote clean energy sources, mitigate climate change impacts, and enhance energy security for sustainable development.
The role of SDG 7 in shaping the new ESSP extends beyond domestic objectives to encompass Rwanda's commitment to international development agendas and partnerships. By aligning its energy sector strategies with the global goals outlined in SDG 7, Rwanda demonstrates its dedication to advancing sustainable development on a global scale. Through collaboration with international partners, including United Nations agencies, development organizations, and donor agencies, Rwanda can leverage expertise, resources, and best practices to accelerate progress towards achieving the targets of SDG 7. By integrating SDG 7 principles into the development process of the new ESSP, Rwanda reaffirms its commitment to sustainable energy development, environmental conservation, and inclusive growth, positioning itself as a leader in the global transition towards a more sustainable and resilient future.

2.2 Analysis of ESSP 2017/2024

2.2.1 Electricity Generation

During the strategic plan of 2017 to 2024, the sector made significant strides in the power generation sector, marked by a substantial increase in installed electricity generation capacity almost doubled from 208.8 MW to 400 MW, reflecting a commendable rise of 92%. This achievement is indicative of the country's concerted efforts to enhance its energy infrastructure to meet the growing demands of its population and economy.

As part of this effort, generation capacity was augmented to meet all demand requirements while maintaining a reserve margin of 15% of peak demand. This strategic approach aims to safeguard against potential disruptions or shortages in power supply, thereby bolstering energy security and reliability. The following graphs present the growth of electricity generation from 2015/16 to 2023/24



During that period, five challenges have been observed and concerned: (i) Relatively Slow Energy Demand Growth; (ii) Delays in Project Implementation; (iii) Long Decision-Making Processes; (iv) Inadequate Studies and Resource Estimations and (v) Difficulties in Peat Extraction During Rainy Seasons. Following paragraphs describes these enumerated challenges:

Relatively Slow Energy Demand Growth: One of the primary challenges faced by Rwanda's energy sector is the slower-than-expected growth in energy demand. Despite ambitious targets set by the National Strategy for Transformation (NST-1), which aimed for a 15% annual electricity demand growth, the actual growth realized over the NST1 period (2017-2023) was only 9.20%. This slower growth rate has posed challenges for the sector, as it indicates a mismatch between projected demand and actual consumption patterns, potentially leading to underutilization of existing infrastructure and investments.

Delays in Project Implementation: Another major cause of challenge is the delays in implementing key projects aimed at driving energy demand, particularly those related to the development of industrial zones and special economic zones (SEZs) across the country. These projects, which are crucial for stimulating economic growth and increasing energy consumption, have faced significant delays from their inception/initiation to operationalization stages. The protracted timelines have been attributed to bureaucratic hurdles, funding shortages, and logistical challenges, hindering the sector's ability to meet growing energy demands effectively.

Long Decision-Making Processes: Lengthy decision-making processes and procedural complexities have also contributed to challenges in implementing generation projects, especially those involving collaboration among partner states. The multilateral nature of such projects often leads to prolonged negotiations, bureaucratic bottlenecks, and legal hurdles, delaying project timelines and increasing overall costs. These challenges highlight the need for streamlined decision-making

mechanisms and enhanced coordination among stakeholders to expedite project implementation and address energy demand gaps effectively.

Inadequate Studies and Resource Estimations: Inadequate studies and resource estimations have been identified as a significant challenge, particularly concerning the availability of peat resources required for peat-fired power plants. Overestimations of peat reserves have led to unrealistic expectations regarding the feasibility and sustainability of peat-based energy projects. As a result, plants like Hakan and Gishoma have faced operational difficulties, operating on a seasonal basis due to insufficient peat availability. This highlights the importance of conducting comprehensive feasibility studies and resource assessments to ensure the viability and success of energy projects.

Difficulties in Peat Extraction During Rainy Seasons: The extraction of peat, a key resource for peat-fired power plants, is further complicated by difficulties encountered during rainy seasons. Heavy rainfall and waterlogged conditions hamper peat extraction activities, leading to disruptions in plant operations and reduced energy output. These seasonal challenges underscore the need for adaptive strategies and contingency plans to mitigate the impact of weather-related constraints on energy production and supply.

Major causes of challenge and Evidence based analysis of the current situation are hereby explained:

Relatively Slow Energy Demand Growth: One major challenge faced by Rwanda's energy sector is the slower-than-anticipated growth in energy demand. Evidence from the National Strategy for Transformation (NST-1) plan indicates that while the target was a 15% annual electricity demand growth, the actual growth realized over the NST1 period (2017-2023) was only 9.20%. This slower growth rate suggests a disparity between projected and actual energy demand, which could lead to underutilization of existing infrastructure and investment resources.

Delays in Project Implementation: Another significant challenge stems from delays in implementing key projects essential for driving energy demand, such as the development of industrial zones and special economic zones across the country. For instance, major power plants like Rusizi III and Nyabarongo II, which were crucial for meeting energy demand targets, faced delays in commissioning. Despite expectations for commissioning in 2024, these projects were stalled due to factors like prolonged negotiations and funding shortages, as evidenced by reports from the Ministry of Infrastructure (MININFRA) and regulatory agencies (REG).

Long Decision-Making Processes: Lengthy decision-making processes and procedural complexities have also hindered the timely implementation of generation projects, particularly those involving collaboration among partner states. The bureaucracy involved in reaching agreements and securing funding for regional projects like the Rusizi Hydro Power plant has led to significant delays. Such delays not only hamper progress but also increase project costs and undermine overall energy sector development.

Inadequate Studies and Resource Estimations: Inadequate studies that overestimate the availability of peat resources necessary for peat-fired power plants have contributed to operational challenges in plants like Hakan and Gishoma. Despite initial estimations, the actual availability of peat resources fell short, leading to these plants operating on a seasonal availability basis. The Hakan Peat-to-Power Plant, for example, with an installed capacity of 70 MW, has faced constraints, generating only a maximum of 40 MW due to insufficient peat resources. Similarly, the Gishoma Peat-to-Power Plant, with a capacity of 15 MW, can only produce 10 MW for four months in a year during the peat extraction season. These discrepancies highlight the importance of accurate resource assessments in energy project planning and execution.

Beside challenges and their evidence based they are for Emerging Opportunities:

Zonal Demand Analysis: Conducting an in-house zonal demand analysis has unveiled numerous projects across Rwanda with the potential to contribute significantly to energy demand, totaling 274 MW over the next five years. This analysis provides valuable insights into localized energy needs, enabling targeted investments and infrastructure development to meet growing demand in specific regions. By identifying these opportunities, Rwanda can strategically allocate resources to address energy deficits and enhance access to reliable electricity, driving economic growth and social development.

Regional Power Trade: Rwanda can capitalize on regional mechanisms, such as harmonized regulations and grid synchronization, to facilitate power trade with neighboring countries. By leveraging potential regional power generation projects, the country can engage in both imports and exports, enhancing energy security and promoting cooperation within the broader East African energy market. This approach not only diversifies Rwanda's energy sources but also fosters integration and collaboration across borders, unlocking new avenues for sustainable energy development and cross-border investments.

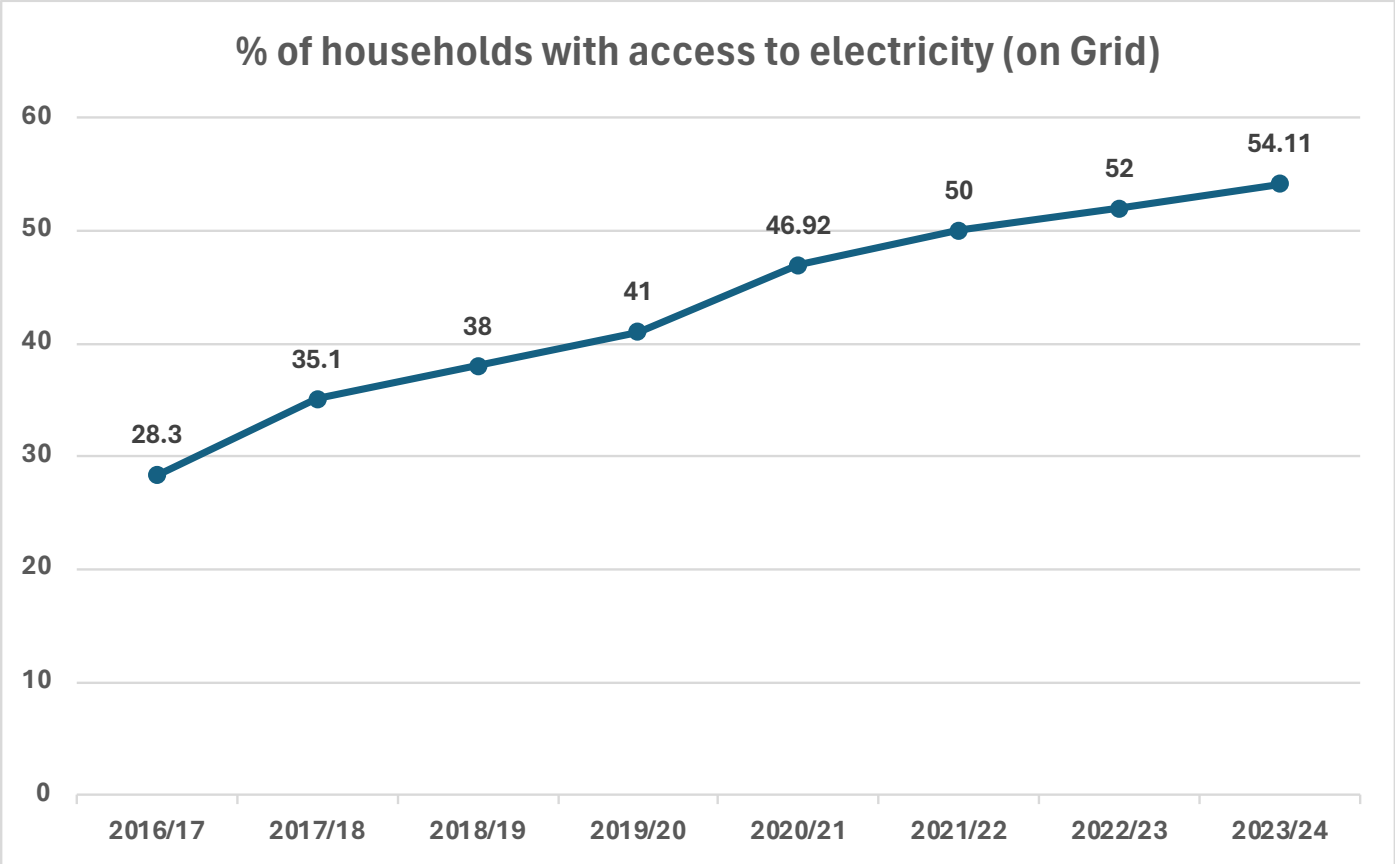
Plant Optimization and Fuel Conversion: Plans to progressively optimize existing power plants and transition from peat-fired facilities to alternative, efficient, and locally available resources, such as Lake Kivu methane gas, present promising opportunities for Rwanda's energy sector. By improving plant efficiency and reducing reliance on environmentally detrimental fuels like peat, Rwanda can enhance energy sustainability and mitigate climate change impacts. Furthermore, leveraging Lake Kivu methane gas offers a cleaner and more reliable energy source, aligning with Rwanda's commitment to renewable energy and environmental stewardship.

Integration of Renewable Generation Technologies: Exploring the integration of emerging renewable generation technologies, including solar, hydro pumped storage, nuclear, hydrogen, and geothermal power, presents another avenue for Rwanda to diversify its energy mix and bolster energy resilience. By undertaking comprehensive studies and assessments, Rwanda can identify the most suitable technologies for its unique energy landscape and leverage its abundant renewable resources to enhance energy security and sustainability. This strategic approach fosters innovation and positions Rwanda as a leader in adopting cutting-edge technologies, driving economic competitiveness and environmental conservation.

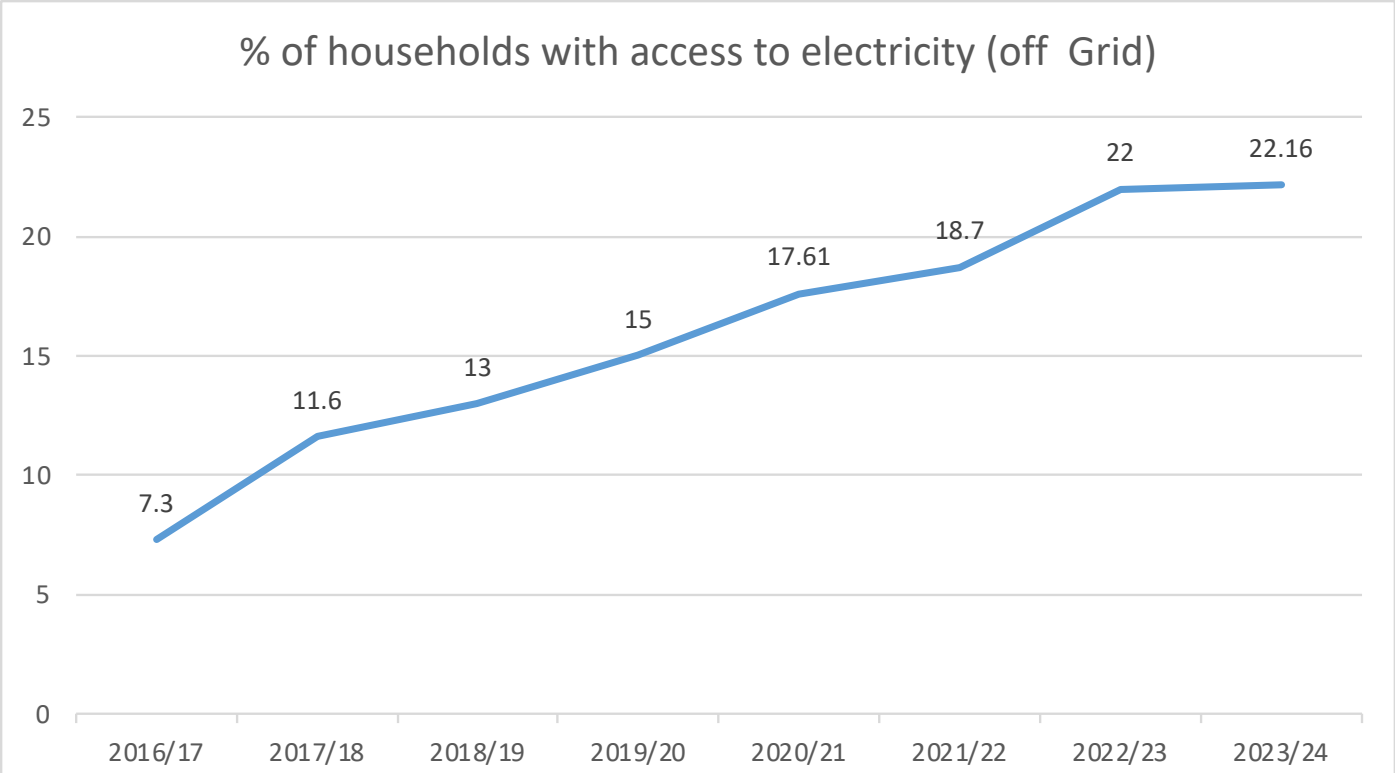
2.2.2 Electricity Access

One of the significant achievements during the ESSP period has been the substantial increase in electricity access among households. The percentage of households with access to electricity as a basic infrastructure more than doubled, rising from 35.6% to 76.2%. This remarkable progress signifies a significant improvement in the quality of life for a large portion of the population, providing them with access to essential services and opportunities for economic development.

The expansion of grid connections played a crucial role in enhancing electricity access. The percentage of households connected to the national grid increased significantly, rising from 28% to 54.11%. This expansion of grid infrastructure extended electricity services to previously underserved areas, bringing reliable power to households and enabling them to access modern amenities and improve their living standards. The following graphs present the percentage of on grid household access to the electricity from 2015/16 to 2023/24



In addition, a notable achievement was the adoption and leveraging of off-grid solutions and renewable energy (RE) solutions for electrification. The percentage of households with access to off-grid electricity increased substantially, moving from 7.6% to 22.16%. This increase can be attributed to the implementation of various RE solutions such as micro-grids and solar home systems (SHS). These decentralized energy solutions have played a pivotal role in reaching remote and off-grid areas where grid extension may be economically or logistically challenging, thus accelerating electrification efforts nationwide.



In the framework of improving social service provision as well as support economic development through increased productive user; the access to electricity of PUEs increased from 6,434 in 2017 to estimated 9,103 out of the current estimated 10,383 representing 88% of the total connected PUEs. The connection of Productive Users to electricity was not fully achieved at 100% as planned. This can be attributed to the effects of COVID 19 and various wars affected global supply chain hindering timely supply of electric materials thus delaying completion and commissioning of some distribution & electrification projects.

Despite significant progress, the ultimate goal of achieving 100% electricity access for households was not fully realized. While access increased to 76.2%, there remains a gap between the current status and the target. One of the primary reasons for this shortfall was the lower-than-anticipated performance of off-grid electrification initiatives. The actual off-grid electrification rate reached only 22.16%, falling short of the planned 48%. This discrepancy highlights challenges in the implementation and effectiveness of off-grid electrification programs.

Furthermore, another significant challenge is the presence of unconnected households within grid-connected areas. Despite being located in regions covered by the national grid, 37.2% of households remain unconnected. Among these unconnected households, 21.7% have resorted to using solar home systems (SHS) as an alternative energy source. However, a considerable portion, accounting for 78.3% of unconnected households, still lack access to electricity altogether. This underscores the need for more robust efforts to extend grid connections to these households and address barriers preventing their access to electricity.
To appropriately formulate the mitigation measures, major causes of highlighted challenges have been identified. External factors such as the COVID-19 pandemic and geopolitical instabilities in regions like Ukraine, Russia, and the Middle East have significantly disrupted the global supply chain for electric materials. These disruptions have led to delays in the timely supply of materials needed for distribution and electrification projects. Moreover, the increased prices of electric materials on the global market further exacerbate the challenges, resulting in delays in the completion and commissioning of essential projects.

The settlement patterns in Rwanda contribute to the high costs associated with electricity connections. The proportion of households living in grouped settlements has increased from 61.7% in 2017 to 65% in the Census of 2022. However, this growth falls short of the planned 72% outlined in the Universal Service and Access Program (USSP). The dispersed nature of settlements complicates the infrastructure development process and leads to higher connection costs, posing a significant challenge to achieving universal electricity access. This is associated with the insufficient budget allocated for electrification initiatives. Out of the estimated $1.5 billion USD required for comprehensive electrification efforts, only a fraction has been allocated. This budgetary constraint limits the scale and pace of electrification projects, delaying progress towards universal access goals.

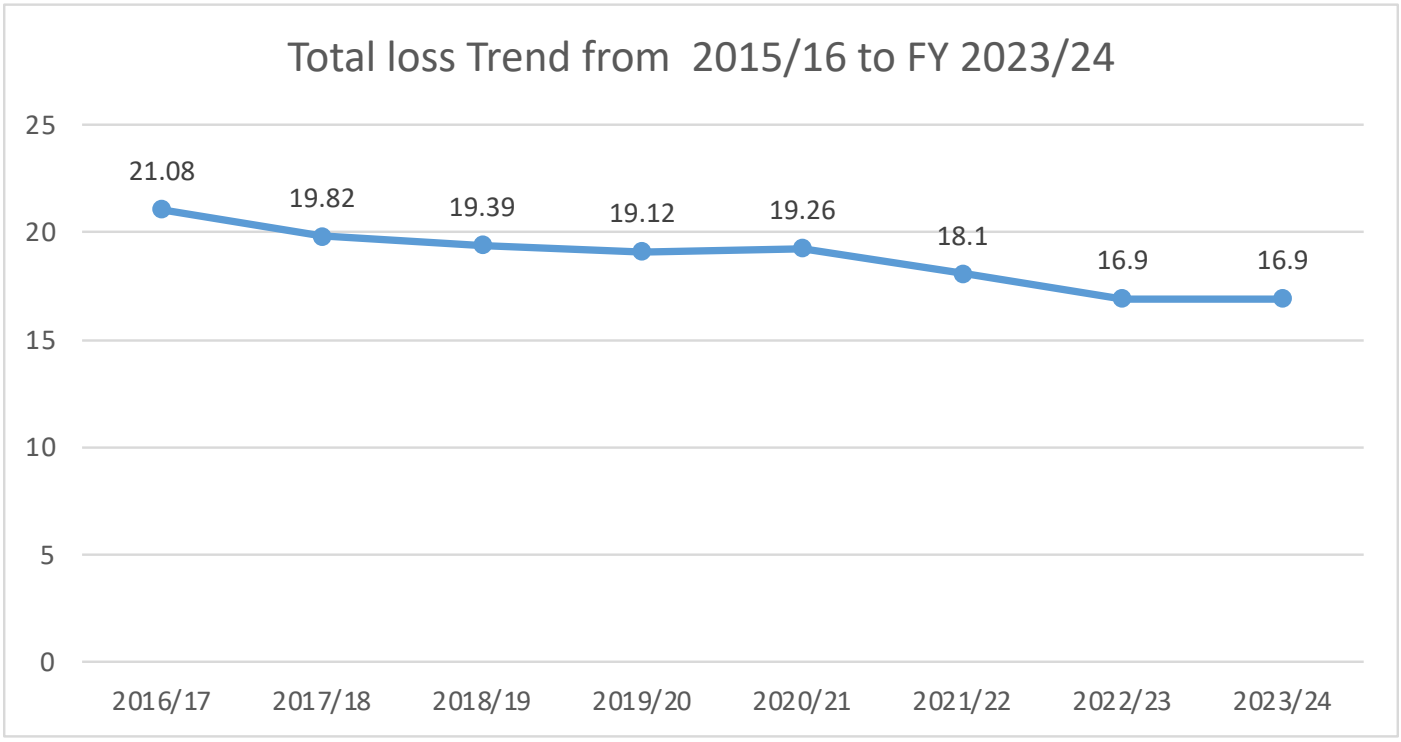
The off-grid electrification targets set, particularly the ambitious goal of reaching 48% penetration, have proven to be challenging to achieve. The actual progress falls short of this target, indicating that the initial goal may have been overly optimistic. Revisiting and recalibrating these targets to align with realistic expectations can help in setting more achievable milestones for off-grid electrification efforts. Additionally, affordability of Off-grid Systems remains a significant barrier to the widespread adoption of off-grid systems such as standalone solar systems and mini-grids. Despite their potential to extend electricity access to remote and underserved areas, the upfront costs associated with these systems pose challenges for households, particularly those with limited financial resources.

Lastly, many households in grid-connected areas still lack electricity due to barriers such as the inability to afford the initial connection costs and the distance from the grid infrastructure. These households face financial constraints in covering the upfront expenses required for grid connections, while the geographical remoteness further complicates the feasibility and cost-effectiveness of extending grid infrastructure to these areas.

2.2.3 Network Reliability and Affordability

Ensuring the reliability and affordability of electricity is paramount for Rwanda's sustainable development and economic growth. Reliable electricity supply is essential for powering industries, supporting businesses, and enhancing the overall quality of life for citizens. Statistical indicators provide insight into the reliability of the electricity supply chain, including system losses, average interruptions, and hours without power.

During the period from 2017 to 2024, significant progress was made in reducing electric system losses. The losses decreased from 22% to 16.9%, showing an improvement in the efficiency of the electricity network. While the target set by the Strategic Service Plan (SSP) was 15%, the achieved reduction demonstrates substantial efforts to enhance the reliability and effectiveness of the electricity transmission and distribution systems. This achievement reflects the successful implementation of measures to minimize technical and non-technical losses, contributing to the overall stability and sustainability of the electricity network. The following graph presents the total loss trends from 2015/16 to 2023/24.



Another notable achievement during the 2017-2024 period was the reduction in the average number of power interruptions per year. The number decreased from 229 to 21.71 times, indicating a significant improvement in the reliability and continuity of electricity supply to consumers. This achievement is particularly crucial for ensuring uninterrupted access to electricity, which is essential for various economic activities, households, and public services. The substantial decrease in power interruptions reflects effective maintenance practices, infrastructure upgrades, and investment in grid modernization initiatives, all aimed at enhancing the reliability of the electricity network.

Additionally, there was a remarkable reduction in the average number of hours without power experienced by consumers. The duration decreased from 36 to 14.43 hours, signifying a substantial improvement in the responsiveness and restoration efforts of the electricity distribution system. This achievement underscores the successful implementation of outage

management strategies, rapid response mechanisms, and investment in resilient infrastructure. By minimizing the duration of power outages, the electricity network becomes more dependable and resilient, meeting the needs of consumers and supporting economic activities more effectively.

While there has been an overall decline in network losses, it's essential to recognize that this reduction is primarily driven by a decrease in commercial losses, which decreased from 8% to 3.3%. However, a concerning trend is the increase in technical losses from 11% to 13.6%. Technical losses refer to losses incurred due to the physical characteristics of the distribution system, such as resistance in power lines and transformers. The rise in technical losses suggests challenges in maintaining and optimizing the efficiency of the distribution infrastructure. Addressing this imbalance is critical to ensure the overall sustainability and reliability of the electricity network.

Concerning challenges, one of the significant challenges faced by the electricity network is the presence of old and overextended distribution networks, particularly in medium-voltage (MV) and low-voltage (LV) lines. These networks may suffer from deterioration over time, leading to increased technical losses and decreased reliability. Moreover, the overextension of these networks beyond their intended capacity can result in voltage drops and overloading, further exacerbating the efficiency and reliability issues. Investing in the modernization and expansion of distribution infrastructure is essential to mitigate these challenges and ensure the long-term viability of the electricity network.

Another critical challenge is the occurrence of voltage drops and overloading in MV and LV lines of the distribution network. Voltage drops can lead to inadequate power supply to consumers, affecting the quality of electricity service and causing operational inefficiencies. Simultaneously, overloading of network lines can result in overheating, equipment damage, and increased technical losses. These issues pose significant reliability concerns and impact the overall performance of the electricity distribution system. Addressing voltage regulation and load management strategies are necessary to mitigate these challenges and enhance the resilience of the network infrastructure. Implementing measures such as voltage regulation equipment, load balancing, and capacity upgrades can help alleviate these issues and improve the reliability of electricity supply to consumers.

The primary cause of the challenge lies in the disproportionate emphasis on network expansion to meet the increasing demand for electricity access. While expanding the network is essential for extending electricity services to underserved areas and accommodating growing consumer needs, an overemphasis on expansion can lead to neglecting the existing infrastructure's maintenance and optimization. In this context, the focus on expanding the network to cater to rising demand may have diverted attention and resources away from critical reinforcement and rehabilitation projects necessary for ensuring the reliability and efficiency of the electricity distribution system.

An evident improvement in the electricity distribution network is observed through a decline in outage instances from 11,707 instances in 2017/2018 to 7,106 instances in 2023. This reduction suggests progress in network maintenance and management practices, potentially resulting from investments in infrastructure upgrades, equipment modernization, and operational efficiency enhancements. Despite this positive trend, the duration of outages remains high, indicating persistent challenges in promptly restoring power supply following disruptions. The sustained duration of outages highlights the need for further improvements in outage response mechanisms, such as faster fault detection, repair, and restoration procedures, to minimize service interruptions and enhance reliability for consumers.

Another significant cause of the challenge is the under-funding of network reinforcement and rehabilitation projects. Limited financial resources allocated to these critical initiatives have resulted in delays in project implementation. For example, the project aimed at upgrading single-phase lines to three-phase lines countrywide and reducing the length of long low-voltage (LV) lines to mitigate voltage drop issues may have been hindered due to inadequate funding. Insufficient funding can lead to project delays, as resources are insufficient to procure materials, hire skilled labor, and execute necessary upgrades or repairs. As a result, the delay in implementing essential network reinforcement and rehabilitation projects exacerbates reliability challenges and compromises the overall performance of the electricity distribution network.

A significant challenge contributing to the current situation is the underfunding of network strengthening projects relative to other programs within the National Strategy for Transformation (NST1) implementation period. Insufficient financial resources allocated to critical reinforcement projects, such as the Supervisory Control and Data Acquisition (SCADA) and Distribution Management System (DMS) implementation, replacement of single-phase with three-phase lines nationwide, and rehabilitation of medium-voltage (MV) and low-voltage (LV) lines countrywide, have resulted in project delays. These delays hamper the timely execution of essential network enhancement initiatives necessary for improving reliability, reducing technical losses, and ensuring the resilience of the electricity distribution infrastructure. Consequently, the underfunding of network strengthening projects underscores the importance of prioritizing adequate financial resources to address infrastructure gaps and enhance the overall performance of the electricity distribution network.

The Emerging Opportunities for Network Reliability and Affordability are the (i) Scale-up of Plant Optimization and Conversion of Peat-fired Plants; (ii) the Increase in Financing for Network Reinforcement; (iii) Implementation of State-of-the-Art Technology for Network Management. Following paragraphs details Emerging Opportunities.

There are plans to progressively optimize existing power plants and convert peat-fired plants to more sustainable alternatives. This initiative aims to improve the efficiency and environmental sustainability of power generation by transitioning away from peat, which is a carbon-intensive fuel source. By optimizing plant operations and exploring alternative energy sources, such as renewable energy or cleaner fuels, the energy sector can reduce its carbon footprint and contribute to environmental conservation efforts.

Securing additional financing for network reinforcement projects presents an opportunity to enhance the reliability and efficiency of the electricity distribution network. With funding from development partners, various projects aimed at reducing losses and improving infrastructure resilience can be implemented. This includes initiatives such as the replacement of single-phase lines with three-phase lines and the rehabilitation of medium-voltage (MV) and low-voltage (LV) lines nationwide. By investing in network reinforcement, the energy sector can address existing challenges and improve the quality of electricity supply to consumers.

The ongoing implementation of state-of-the-art technology, such as Supervisory Control and Data Acquisition (SCADA) systems and Distribution Management Systems (DMS), presents an opportunity to modernize and improve the management of the distribution system. These technologies enable real-time monitoring, control, and optimization of network operations, allowing for better response to outages and more efficient management of electricity distribution. Additionally, the continued deployment of smart meters enhances consumer engagement and enables more accurate billing and demand management practices.

2.2.4 Sustainability

Sustainability lies at the heart of Rwanda's energy sector development efforts, with a focus on balancing economic growth, environmental stewardship, and social equity. Statistical evidence underscores the country's commitment to sustainable energy practices and highlights progress made in this regard. Key indicators, such as the expansion of renewable energy sources and the promotion of energy efficiency, provide insights into Rwanda's transition towards a more sustainable energy landscape.

One prominent aspect of sustainability is the adoption of renewable energy sources, which offer clean and environmentally friendly alternatives to fossil fuels. Rwanda has made significant strides in this area, with renewable energy contributing a growing share to the country's energy mix. Statistical data on renewable energy capacity, such as installed solar, and hydroelectric power capacity, showcase Rwanda's efforts to diversify its energy sources and reduce reliance on non-renewable resources. For instance, the installation of solar photovoltaic systems and small-scale hydropower plants has expanded access to electricity in rural areas while minimizing environmental impact.

Furthermore, energy efficiency measures play a crucial role in promoting sustainability by maximizing energy productivity and reducing waste. Statistical evidence on energy intensity, energy consumption per capita, and energy efficiency improvements offer insights into Rwanda's progress in this area. By investing in energy-efficient technologies and practices, Rwanda aims to optimize energy use across various sectors, from manufacturing and transportation to residential and commercial buildings. Initiatives such as energy-efficient lighting, appliance standards, and industrial processes contribute to lowering energy consumption and greenhouse gas emissions, aligning with Rwanda's sustainable development goals. Overall, statistical evidence serves as a valuable tool for monitoring progress, identifying areas for improvement, and guiding policy decisions to advance sustainability in the energy sector and beyond.

2.2.5 Biomass

Rwanda's efforts to address the reliance on biomass for cooking have shown promising progress in recent years, as indicated by statistical data reflecting a decline in the percentage of households using firewood. The percentage of households relying on firewood for cooking decreased significantly from 83.3% to 76.1%. This achievement indicates progress in transitioning households away from traditional, biomass-based cooking methods, which are often associated with indoor air pollution, deforestation, and adverse health effects.

One significant contributing factor to this trend has been the distribution of improved cookstoves (ICS) through various government programs, with a substantial number of 1,489,810 ICS distributed to date. These improved cookstoves offer

higher efficiency and lower emissions compared to traditional cooking methods, making them an attractive alternative for households seeking to reduce their reliance on firewood and charcoal.

The uptake of Liquefied Petroleum Gas (LPG) as a cooking fuel has witnessed significant growth, rising from 1% in 2017 to 4.5% in 2022 according to data from the Integrated Household Living Conditions Survey (EICV) and Census, respectively. This increase reflects efforts to promote the use of clean and modern cooking fuels, which can contribute to reduced indoor air pollution, improved health outcomes, and enhanced energy access.

Furthermore, the adoption of improved cook stoves (ICS) has gained traction among Rwandan households, with 34% reported to be using such devices. These efficient cook stoves not only contribute to reducing fuel consumption and emissions but also offer cost savings and health benefits for users. The widespread use of efficient cook stoves demonstrates a positive shift towards more sustainable cooking practices and underscores Rwanda's commitment to promoting clean energy solutions. Moving forward, continued investment in the dissemination of improved cook stoves, expansion of LPG distribution networks, and awareness campaigns on the benefits of cleaner cooking fuels will be essential to further reduce biomass dependency and achieve long-term sustainability goals in Rwanda's energy sector.

In previous ESSP, the biomass and clean cooking stoves presented several gaps and challenges including among others: Unmet Reduction Targets, Lack of Coordination, Affordability Concerns, Dependency on Imports, Limited Indicator Scope, Misalignment between Intervention and Target.

Unmet Reduction Targets: The objective to decrease the proportion of households using traditional cooking methods (firewood) from 79% to 42% was not achieved. Despite efforts to promote clean cooking technologies, the target reduction rate was not met, highlighting the persistent reliance on traditional cooking practices in many households.

Lack of Coordination: Inadequate coordination within the clean cooking subsector has hindered effective implementation of projects. The involvement of multiple institutions such as MININFRA, MoE, and MINEDUC in coordinating various initiatives has led to fragmented efforts and inefficiencies in resource allocation and program delivery.

Affordability Concerns: The affordability of clean cooking technologies and fuels remains a significant barrier to adoption. The high cost of efficient cook stoves (EPC) and LPG packages, averaging around $90 and $100 USD, respectively, poses challenges for households, particularly those with limited financial resources. Additionally, Tier 3 stoves, priced at $50 USD in the local market, may still be inaccessible to many.

Dependency on Imports: Rwanda's reliance on imported LPG fuels and electric/LPG appliances has increased, with LPG imports rising from 10 million KG in 2017 to 38 million KG by 2023. This heightened dependency exposes Rwanda to external price shocks and supply disruptions, posing risks to the sustainability of clean cooking initiatives.

Limited Indicator Scope: The NST1 indicator focused solely on reducing firewood usage and did not consider other cooking technologies and fuels. This narrow scope may have overlooked alternative solutions and underestimated the complexity of transitioning to clean cooking practices, leading to gaps in intervention strategies.

Misalignment between Intervention and Target: There appears to be a misalignment between the intervention, such as the distribution of improved cookstoves, and the intended target outcomes. This misalignment stemmed from insufficient planning and monitoring mechanisms, resulting in discrepancies between program objectives and actual impact on household cooking practices.

They are three major causes of challenge. These include the (i) Higher Dependence on Traditional Non-Efficient Cooking Solutions, (ii) Affordability and Budget Constraints and (iii) Scattered Clean Cooking Responsibilities and Lack of Coordination.

Higher Dependence on Traditional Non-Efficient Cooking Solutions: The significant reliance on traditional biomass-based cooking solutions, such as firewood, charcoal, and crop residue, among over 90% of the population poses a fundamental challenge. These traditional fuels are inefficient, environmentally harmful, and contribute to indoor air pollution, respiratory diseases, and deforestation. Despite the known drawbacks, the widespread availability and affordability of traditional fuels perpetuate their continued use, hindering the transition to cleaner and more efficient cooking technologies.

Affordability and Budget Constraints: Affordability concerns and budget constraints act as barriers to the adoption of improved cooking solutions (ICS). The Multi-tier Framework survey revealed that 26% of households were unwilling to pay for ICS, primarily due to affordability issues. Clean cooking technologies, such as improved cook stoves, may have

higher upfront costs compared to traditional alternatives, making them inaccessible to households with limited financial resources. Budget constraints at both the household and governmental levels impede efforts to subsidize or promote the widespread adoption of clean cooking technologies.

Scattered Clean Cooking Responsibilities and Lack of Coordination: The dispersion of clean cooking responsibilities across different sectors leads to coordination challenges and inefficiencies in program implementation. Fragmented oversight and coordination among various governmental departments and agencies result in duplicated efforts, conflicting policies, and suboptimal resource allocation. This lack of centralized coordination hampers the effectiveness of clean cooking programs, including those promoting domestically generated fuels like compressed natural gas (CNG) and electricity as cooking alternatives.

Two evidence-Based Analysis of the Current Situation arising from Private Sector-Led Interventions and Government Funding and Subsidies.

Private sector-led initiatives have shown moderate success in enhancing access to efficient and clean cooking solutions. The involvement of the private sector in clean cooking programs has increased, with 18 companies participating in the Results-Based Financing (RBF) program since 2018. While these interventions have contributed to the distribution of clean cooking stoves, their impact remains modest, indicating the need for further engagement and support to drive significant improvements in clean cooking access and adoption.

The government has demonstrated commitment to addressing clean cooking challenges by mobilizing substantial funding for clean cooking systems. Approximately 20 million USD has been allocated for subsidizing clean cooking technologies, marking a significant turnaround in efforts to promote their dissemination and distribution.

The subside Levels per Tier aim to make clean cooking solutions more affordable and accessible to households, thereby accelerating the transition away from traditional biomass-based fuels. However, the effectiveness of these subsidies may be influenced by factors such as implementation mechanisms, targeting criteria, and outreach strategies.

Government-led programs have facilitated the distribution of a substantial number of improved cookstoves (ICS) to households. More than 1,489,810 ICS have been distributed through various government initiatives, albeit falling short of the planned target of 1,839,684. While this indicates progress in promoting the adoption of cleaner cooking technologies, the shortfall underscores the importance of addressing challenges related to affordability, distribution logistics, and demand generation to achieve broader coverage and impact.

In biomass and clean cooking, they are five Emerging Opportunities. These include: (i) Promoting Local Manufacturing; (ii) Extraction and Processing of CNG Methane Gas; (iii) Meeting Household Demand for Improved Cookstoves; (iv) Leveraging Climate Financing; (v) Streamlining Building Codes.

Promoting Local Manufacturing: Encouraging the local manufacturing of clean cooking appliances and processing of fuels presents an opportunity to enhance domestic production capacity, create jobs, and reduce dependency on imported technologies and fuels. By investing in local manufacturing, countries can stimulate economic growth, support small and medium-sized enterprises (SMEs), and ensure the availability of affordable and culturally appropriate clean cooking solutions tailored to local needs.

Extraction and Processing of CNG Methane Gas: Exploring the extraction and processing of Compressed Natural Gas (CNG) methane gas for industrial and residential use offers a promising avenue for diversifying energy sources and reducing reliance on traditional biomass fuels. CNG methane gas, derived from organic waste, agricultural residues, or wastewater treatment plants, can serve as a cleaner alternative to conventional cooking fuels, contributing to improved indoor air quality, reduced greenhouse gas emissions, and enhanced energy security.

Meeting Household Demand for Improved Cookstoves: With over 1.7 million households in need of improved cookstoves, there is a significant market opportunity to scale up the production, distribution, and adoption of clean cooking technologies. By addressing this demand gap, governments, development partners, and private sector actors can accelerate the transition to cleaner and more efficient cooking practices, improving health outcomes, reducing environmental pollution, and enhancing energy access for vulnerable populations.

Leveraging Climate Financing: Leveraging climate financing mechanisms presents a strategic approach to subsidizing access to clean cooking solutions, particularly for low-income households and marginalized communities. By tapping into climate finance resources, governments can mobilize additional funding to support the adoption of clean cooking

technologies, implement awareness campaigns, and strengthen institutional capacity for sustainable energy planning and implementation.

Streamlining Building Codes: Streamlining building codes to accommodate clean cooking reticulation model systems installations, especially in urban areas, can facilitate the integration of LPG and natural gas usage as a utility. By incorporating provisions for clean cooking infrastructure in building regulations and standards, policymakers can promote the widespread adoption of cleaner energy technologies in residential and commercial buildings, advancing energy efficiency, safety, and environmental sustainability in urban environments.

2.2.6 Petroleum Utilization

Petroleum utilization within the Energy Sector Strategic Plan (ESSP) is vital for Rwanda's energy security, economic development, and environmental sustainability. With a focus on efficient and sustainable use of petroleum resources, the ESSP aims to meet the country's energy needs while minimizing environmental impact. However, challenges such as insufficient storage capacity and overreliance on biomass for cooking need to be addressed. Rwanda's petroleum infrastructure consists of storage facilities with a total capacity of 111.2 million liters. However, this capacity is projected to be insufficient to ensure essential supply security, particularly considering the estimated monthly consumption of 54.4 million liters by 2024. To address this shortfall, the ESSP sets a target of 198 million liters of storage capacity by 2024, representing a significant increase from the current installed capacity of 118 million liters.

In line with the National Strategy for Transformation (NST 1) 2017 – 2024, which aims to reduce biomass usage for cooking, the ESSP promotes the use of liquefied petroleum gas (LPG) as an alternative cooking fuel. This transition from biomass to LPG is identified as the fastest way to reduce biomass usage and improve energy efficiency in households and institutions. To support this transition, the ESSP includes actions such as the construction of strategic stock facilities to ensure supply security. One such initiative is the development of a new 17,100 cubic meter storage facility in Rusororo, which is currently underway and expected to be completed by 2024. This facility will significantly enhance Rwanda's storage capacity, providing a reliable supply of petroleum products to meet growing energy demands. Additionally, investments in infrastructure and technology are essential to facilitate the efficient distribution and utilization of petroleum resources across the country.

The ESSP outlines plans for infrastructure development to support the efficient distribution and utilization of petroleum products across Rwanda. This includes the construction and maintenance of storage facilities, pipelines, and transportation networks to ensure reliable access to petroleum resources throughout the country. The ESSP emphasizes the importance of promoting energy efficiency and conservation measures to optimize the utilization of petroleum resources. This includes initiatives to improve fuel efficiency in transportation, industry, and other sectors through the adoption of advanced technologies, fuel standards, and regulatory measures.

The ESSP includes provisions for the development of a robust policy and regulatory framework to govern petroleum utilization in Rwanda. This framework will encompass regulations related to petroleum exploration, production, distribution, pricing, and environmental protection, as well as incentives to encourage investment in the petroleum sector.

Furthermore, the ESSP emphasizes the importance of capacity building and technology transfer to enhance the technical expertise and capabilities of stakeholders involved in petroleum utilization. This includes training programs, knowledge sharing initiatives, and partnerships with international organizations and industry experts to promote best practices in petroleum management.

2.3 Contribution to Greenhouse Gas Emissions

The energy sector plays a crucial role in Rwanda's greenhouse gas emissions profile, primarily due to the combustion of biomass and petroleum products for energy generation and transportation. Biomass, including firewood and charcoal, is widely used for cooking and heating purposes, particularly in rural areas where access to modern energy sources is limited. Similarly, petroleum products such as gasoline and diesel are commonly used in transportation, industry, and power generation, contributing to carbon dioxide (CO_2) emissions. Rwanda has an ambitious target to reduce greenhouse gas emissions by 38% by 2030 compared to business as usual, equivalent to an estimated mitigation of up to 4.6 million tonnes of carbon dioxide equivalent (tCO_2e).

According to the Rwanda National Inventory Report published on 9th August 2022 by the UNFCCC , the contribution of

Energy emissions into the total national emission and removals was 2,354.85 over 2,630.11 thousands of Tons of CO2 equivalent. This indicates that, in 2018, the energy accounted for 89.5 % of total national emissions. According to the same report, from 2006 to 2018, the net GHG emissions were dominated by the Energy sector since the GHG emissions from Agriculture are partially offset by removals from forestry and other land use (FOLU). In addition, the share of the Energy sector to total GHG emissions kept increasing predominantly due to the increase in emission from transportation and industries (i.e., energy and manufacturing industries).

The energy sector accounted for a significant percentage of total greenhouse gas emissions in Rwanda, highlighting its substantial contribution to climate change. This is the urgent need to transition to cleaner and more sustainable energy sources to mitigate the impacts of climate change and reduce emissions. Renewable energy sources such as solar, wind, and hydroelectric power offer viable alternatives to traditional biomass and fossil fuels, offering the potential to significantly reduce greenhouse gas emissions while promoting energy security and sustainability.
In addition to transitioning to renewable energy sources, enhancing energy efficiency and promoting sustainable practices are essential strategies for reducing emissions from the energy sector. This includes improving the efficiency of energy generation, distribution, and consumption processes, as well as implementing measures to reduce waste and optimize resource use. Furthermore, investing in low-carbon technologies, electrification of transportation, and promoting energy conservation behaviours can help further reduce emissions and accelerate the transition to a low-carbon economy.

2.4 Implications of Climate Change

Climate change presents a multitude of challenges to Rwanda's energy sector, threatening its stability and reliability. One of the primary concerns is the increased frequency and intensity of extreme weather events, such as floods, droughts, and storms, which can damage energy infrastructure, disrupt supply chains, and cause power outages. Moreover, changes in hydrological patterns, including shifts in rainfall patterns and the melting of glaciers, pose significant risks to hydropower generation, which accounts for a substantial portion of Rwanda's electricity supply.

The Rwanda Third National Communication Report on Climate Change has assessed the vulnerability of Energy due to climate change and following points can be highlighted: The relationship between rainfall and Energy productions for Ntaruka and Mukungwa I power plants between 1998 and 2015 indicate the significant correlation between annual rainfall and power generation estimated at R2_ of 0.45 and 0.46 respectively for both hydropower plan;

On the other hand, a report published by REG in June 2023 on Rwanda Least Cost Power Development Plan 2023-2050 assessed the future climate change impact on energy generation. According to that report:

- Rusumo Hydropower Project, which was under construction at the time, would seem to experience increases in capacity factor throughout the century under all climate change scenarios, especially during the rainy seasons.
- Smaller power plants like the Nyundo (4.5 MW) and Rwaza (2.6 MW) have less variability of available capacity during the year. These power plants should be able to operate at full capacity during the rainy seasons given their lower design flow. During the drier months both power plants experience increased variability. Given the size of the power plants however, this should not be that negatively impactful.
- Other power plants exhibit increased monthly available capacities. This would be beneficial, given that all increases in streamflow can be utilized for power output and do not seem to pose any problems to their structures.

Generally, it is well noted that climate resilience in the energy sector would involve building adaptive capacity and implementing measures to withstand and recover from the impacts of climate-related events. This includes enhancing the robustness of energy infrastructure, such as hydropower dams and resilient sand traps as well as transmission lines to withstand extreme weather conditions and ensure uninterrupted energy supply. Additionally, diversifying the energy mix and investing in renewable energy sources, such as solar energy, that would help to reduce reliance on hydropower and mitigate the risks associated with climate-induced variability in water resources.
Furthermore, adaptation strategies in the energy sector extend beyond infrastructure resilience to encompass policies, regulations, and institutional frameworks that promote climate-resilient energy planning and management. This includes integrating climate risk assessments into energy planning processes, developing early warning systems for climate-related

hazards, and fostering collaboration between government agencies, energy utilities, and other stakeholders to coordinate response efforts. Additionally, capacity building and public awareness initiatives play a crucial role in enhancing climate resilience by empowering communities to adopt energy-efficient practices, reduce vulnerability to climate impacts, and build adaptive capacity at the local level.

CHAPTER 3: STRATEGIC FRAMEWORK

The strategic framework of the Energy Sector Strategic Plan (ESSP) 2025–2030 is meticulously crafted to steer the development and transformation of Rwanda's energy sector towards sustainability and resilience. At its core, the framework encapsulates a comprehensive vision that envisions a modern, inclusive, and environmentally sustainable energy sector. This overarching vision serves as a guiding beacon, illuminating the path towards achieving universal energy access, enhancing livelihoods, and mitigating environmental impacts. By aligning sectoral goals with Rwanda's Nationally Determined Contributions (NDC) and the Green Growth and Climate Resilient Strategy (GGCRS), the strategic framework positions the energy sector as a key driver of sustainable development and climate action, fostering resilience to climate impacts while propelling socio-economic progress.

The Energy Sector Strategy (ESS) of Rwanda is intricately woven into the fabric of the nation's overarching development agenda, as articulated in key policy frameworks such as the National Strategy for Transformation (NST2), Vision 2050, Sustainable Development Goals (SDGs), and Africa Agenda 2063. This alignment ensures that the sector's objectives and initiatives are in harmony with the broader socio-economic priorities of the country, thereby maximizing synergies and amplifying the impact of interventions across various domains.
At the heart of Rwanda's development trajectory lies the NST2, which serves as the cornerstone of the country's medium-term strategic vision. The NST2 outlines ambitious targets and strategic priorities across multiple sectors, providing a macro framework within which the Energy Sector Strategy operates. Key baseline information from the NST2 highlights critical issues such as the need to enhance energy access, improve energy efficiency, and promote renewable energy sources to drive economic growth, enhance resilience, and foster inclusive development. Data sources, including household surveys, energy consumption patterns, and infrastructure assessments, provide valuable insights into prevailing challenges and opportunities, informing evidence-based decision-making within the sector.
Aligned with the NST2 objectives, the Energy Sector Strategy sets forth a comprehensive roadmap to address the identified challenges and capitalize on emerging opportunities. A key focus area of the strategy is to expand electricity access and reliability, in line with national targets to achieve universal access by 2024. Leveraging data from household surveys and electrification mapping, the sector aims to identify underserved areas and implement targeted interventions to bridge energy gaps, particularly in rural and remote communities. Additionally, the strategy prioritizes enhancing energy efficiency across sectors, aligning with national goals to optimize resource utilization and reduce environmental impact. Through initiatives such as promoting energy-efficient technologies and practices, the sector aims to mitigate energy wastage and enhance sustainability.

Furthermore, the Energy Sector Strategy is deeply rooted in Rwanda's long-term vision, as articulated in Vision 2050 and Africa Agenda 2063. These frameworks set ambitious goals to transform the energy sector, including increasing the share of renewable energy sources and promoting sustainable energy development. The strategy embraces these aspirations by prioritizing investments in renewable energy infrastructure, such as solar, wind, hydro, and geothermal power generation, to diversify the energy mix and reduce dependency on fossil fuels. Moreover, aligning with SDG 7 on ensuring access to affordable, reliable, sustainable, and modern energy for all, the sector strategy aims to address energy poverty and promote inclusive development, thereby contributing to the broader global agenda.

The Energy Sector Strategy of Rwanda represents a coherent and integrated approach to advancing national development objectives within the energy domain. By aligning with key policy frameworks, targets, and data-driven insights from the NST2 macro framework and other sources, the sector strategy endeavors to address critical issues, capitalize on emerging opportunities, and propel Rwanda towards a sustainable, inclusive, and resilient energy future.

Through strategic planning, targeted interventions, and collaborative partnerships, the sector aims to unlock the full potential of energy as a catalyst for socio-economic transformation and prosperity for all Rwandans.

3.1 Vision, mission and objectives

3.1.1 Vision

The vision of the ESSP 2025–2030 is to establish a modern, inclusive, and sustainable energy sector that drives socio-economic development, enhances livelihoods, and mitigates environmental impacts. It envisions a future where all Rwandan citizens and industries have access to reliable, affordable, and clean energy services, contributing to national prosperity and climate resilience.

3.1.2 Mission

The mission of the ESSP is to transform Rwanda's energy sector into a dynamic engine of socio-economic progress and environmental sustainability. Our mission is to actualize the vision of a modern, inclusive, and sustainable energy sector by 2030, where every Rwandan citizen and industry has access to reliable, affordable, and clean energy services. We are committed to driving socio-economic development, enhancing livelihoods, and mitigating environmental impacts through strategic initiatives and collaborative efforts with stakeholders across sectors.

3.1.3 Objectives

Aligned with Rwanda's broader development agenda and climate commitments, the ESSP sets forth the following objectives:

A Ensure universal energy access for households and industries, with a focus on underserved communities and marginalized populations.

B Enhance the reliability, affordability, and sustainability of energy services to promote economic growth and improve living standards.

C Integrate climate change adaptation and mitigation measures across all facets of the energy sector to build resilience and reduce greenhouse gas emissions.

D Foster innovation and investment in renewable energy sources and energy efficiency technologies to diversify the energy mix and mitigate environmental impacts.

E Strengthen institutional capacity and governance frameworks to facilitate effective implementation, monitoring, and evaluation of sectoral policies and programs.

F Foster partnerships and collaboration with stakeholders, including government agencies, private sector entities, civil society organizations, and development partners, to mobilize resources and drive collective action towards achieving sectoral goals.

The strategic framework identifies key priorities to guide the implementation of the ESSP, encompassing the following areas:

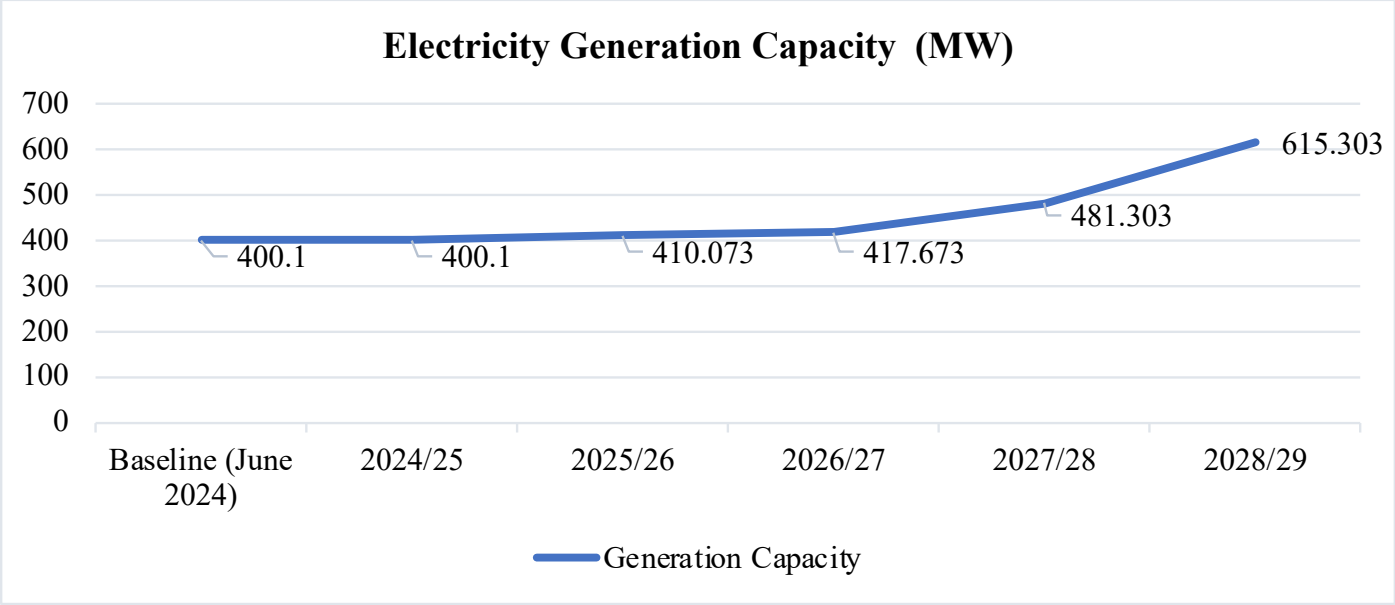
3.2 Power Generation

By increasing electricity generating capacity, Rwanda can strengthen its position as a competitive player in the regional and global economy, aligning with the Competitiveness and Integration pillar of Vision 2050. At the same time, by increasing electricity generating capacity, Rwanda can effectively address the energy needs of its growing urban population, contributing to the realization of the Urbanization and Agglomeration pillar of Vision 2050.

Concerning SDGs and Agenda 2063, the increasing electricity generating capacity aligns with SDG Goal 7.2, which aims to increase the global percentage of renewable energy sources while the increasing electricity generating capacity is pivotal for achieving the strategic objective of Agenda 2063 on enhancing the implementation of the Programme for Infrastructure Development in Africa

During the strategic plan of 2017 to 2024, the sector made significant strides in the power generation sector, marked by a substantial increase in installed electricity generation capacity almost doubled from 208.8 MW to 400 MW, reflecting a

commendable rise of 92%. However, beside the achievement, some main challenges have been highlighted in situation analysis.: These include, the Relatively Slow Energy Demand Growth; Delays in Project Implementation; Long Decision-Making Processes; Inadequate Studies and Resource Estimations and Difficulties in Peat Extraction During Rainy Seasons.



The baseline for generation capacity as of June 2024 is 400.1 MW. Over the course of 2024-2029, the goal is to steadily increase the generation capacity. By the end of 2024/25, the capacity is expected to remain the same, it is projected to increase to 410.073 MW by 2025/26 and further to 417.673 MW by 2026/27.

A significant rise is expected by 2027/28, with the capacity reaching 481.303 MW. While, by the end of the 2028/29 period, the generation capacity is aimed to reach 615.303 MW. This ambitious target will contribute significantly to meeting the growing demand for electricity, thereby supporting economic growth, enhancing living standards, and promoting sustainable development.

Even if the electricity generation faced various challenges, they are four emerging opportunities which can motivate the implementation of ESSP: (i) Zonal Demand Analysis; (ii) Regional Power Trade; (iii) Plant Optimization and Fuel Conversion; Integration of Renewable Generation Technologies.

Considering the general situation analysis, highlighted challenges and opportunities, the following are the proposed electricity generation key priorities for the period 2024-2029, relevance to Vision 2050 and to other commitments and Priority high impact Interventions:

3.2.1 Proposed SSP Priorities for power generation

Fast Track Implementation of Ongoing Generation Projects: Prioritizing the fast-track implementation of ongoing generation projects like Nyabarongo2 (43.5MW) and RusiziIII (206 MW) ensures timely completion and addition of much-needed capacity to Rwanda's power grid. By expediting these projects, Rwanda can address immediate energy needs, bolstering energy security and reliability while laying the foundation for future expansion and development.

Conduct Studies for Generation Expansion Options: Undertaking studies for generation expansion options is crucial for identifying new power projects and assessing the scalability of existing ones, such as Ntaruka, Kivuwatt, and SPLK. These studies enable informed decision-making regarding the most viable and sustainable options for expanding Rwanda's energy infrastructure. By evaluating potential sites, technologies, and investment opportunities, Rwanda can strategically plan for future energy demand and ensure long-term energy sustainability.

Accelerate Demand Growth: To stimulate demand growth, Rwanda aims to focus on various sectors including transport, industrial areas, mining sites, agriculture, and urbanization projects. Initiatives such as promoting e-Mobility and expanding street lighting infrastructure enhance energy usage efficiency and support sustainable urban development. Additionally, targeting industrial zones and special economic zones for energy provision fosters economic growth and attracts investments. Moreover, addressing energy needs in agriculture, mining, and urbanization projects ensures equitable access to electricity and facilitates socio-economic development across different sectors and regions of the country. Through these efforts, Rwanda aims to accelerate demand growth and advance towards universal energy access and economic prosperity.

3.2.2 Priority high impact Interventions for power generation

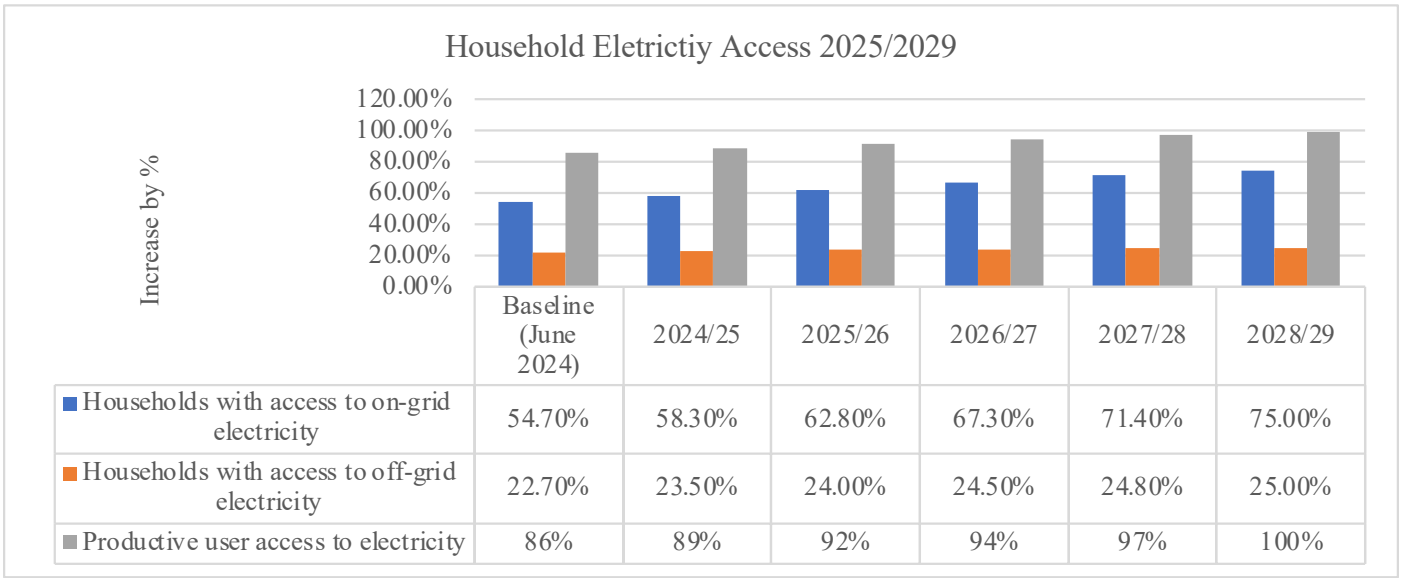
This section highlights the priorities high impact interventions, targets as well as results chain. Currently, the electricity generation is about 400 MWs as of June 2024, and the target is the increment of 163 MW in five years which will results in end target of 563 MW. To achieve this, Rwanda will be required to Construct small and micro hydro power plants (37.7MW), to construct Nyabarongo2 (43.5MW) multipurpose hydro power plant, fast tracking Rusizi III (206 MW:68MW(Rwanda) Regionally shared hydro power plant and to optimize existing power plants to increase generating capacity.

3.3 HHs Electricity access

Over the seven-year period of the National Strategy for Transformation (NST1), the Government of Rwanda (GoR) made substantial investments in the energy sector. As a result, access to electricity increased significantly, reaching 76.2% of Rwandan households. Among these households, 54% are connected to the grid, while the remaining 22% utilize off-grid solutions. This progress demonstrates the effectiveness of investment initiatives in expanding electricity access across the country.

Despite the notable advancements, there remains a substantial access gap, with 23.8% of Rwandan households still lacking access to electricity. This gap underscores the ongoing challenges in achieving universal electricity access and highlights the need for continued efforts to address barriers and expand electrification initiatives.

The Multi-Tier Framework Survey conducted in 2022 revealed that 32% of households residing in grid-connected areas are not connected to the grid. This discrepancy indicates underlying challenges related to grid connectivity, such as affordability barriers, infrastructure limitations, and logistical constraints. Addressing these issues is essential to ensure that households in electrified areas can access and benefit from grid-supplied electricity effectively.



	Baseline (June 2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Households with access to on-grid electricity	54.70%	58.30%	62.80%	67.30%	71.40%	75.00%
Households with access to off-grid electricity	22.70%	23.50%	24.00%	24.50%	24.80%	25.00%
Productive user access to electricity	86%	89%	92%	94%	97%	100%

The households with access to on-grid electricity as of June 2024 is 54.70%. Over the period from 2024 to 2029, the goal is to gradually increase access by the end of 2024/25, the target is to reach 58.30% of households with access to on-grid electricity. Over the following years, the target is set to increase incrementally, achieving 75% by 2028/29. Achieving this target is essential to ensure a steady increase in the electrification rate, contributing significantly to sustainable development, improved living standards, and economic growth.
While households with access to off-grid electricity is 22.70%. The objective is to incrementally increase this number, reaching 25% by the end of 2028/29. This increase is crucial to ensure that even in remote or less accessible areas, households have access to electricity, promoting social welfare and economic development. The target is to reach 25% of households connected to off-grid in 2028/29.

However, a comprehensive plan has been formulated to achieve universal access to electricity, leveraging existing projects and initiatives. These include the Rwanda Universal Energy Access Program (RUEAP), which aims to connect over 486,589 households (HHs), as well as projects supported by organizations like ARC Power, India EximBank, and ASCENT, collectively targeting an additional 560,615 HHs. These efforts signify a concerted push towards closing the electricity

access gap and ensuring that a greater proportion of Rwandan households have reliable energy services.

There is also a proactive initiative to review the National Electrification Plan (NEP), which serves as a guiding framework for electricity expansion planning, monitoring, and investment mobilization. By reassessing and updating the NEP, stakeholders can align strategies with evolving energy needs, technological advancements, and policy priorities, thereby optimizing the effectiveness and impact of electrification initiatives. In addition, a review of the connection policy is underway to accommodate more fill-ins within grid-connected areas. This initiative aims to address the challenge of households in electrified regions that remain unconnected to the grid, often due to logistical or affordability barriers. By revising the connection policy to facilitate easier and more inclusive access to grid electricity, the government can improve energy equity and ensure that all households within electrified zones can benefit from reliable power supply.

To address the highlighted challenges, the following priorities have been identified and proposed for 2024 - 2029 ESSP:

1. **Fast-track MV & LV Network Extension:** Prioritize the rapid extension of medium voltage (MV) and low voltage (LV) networks to connect the remaining households, particularly focusing on districts with low access rates. By expediting the expansion of electricity infrastructure into underserved areas, the government can significantly increase electricity access and improve energy equity across the country.

2. **Continued Off-Grid Electrification:** Maintain momentum in off-grid electrification efforts, with a specific emphasis on encouraging higher tiers (3 & above) of electrification. By promoting the adoption of more advanced off-grid solutions, such as mini-grids and standalone solar systems, the government can ensure that even remote and isolated communities have access to reliable and sustainable electricity services.

3. **Coordination with Urbanization & Settlements:** Strengthen coordination with urbanization and settlements planning to guide and leverage organized settlements for electricity access expansion. By integrating electrification considerations into urban development plans and leveraging organized settlement patterns, the government can optimize resources and infrastructure investments to achieve maximum impact and efficiency.

4. **Regular Zonal Demand Analyses:** Conduct regular zonal demand analyses to inform electrification planning and investment decisions. By continuously assessing electricity demand trends and patterns at the local level, policymakers can tailor electrification strategies to meet the specific needs of different regions and communities, optimizing resource allocation and deployment.

5. **Revision of Connection Policy:** Revise the connection policy to align with new realities and emerging challenges in the electrification landscape. By updating connection policies to address evolving technological, social, and economic factors, the government can ensure that electricity access initiatives remain relevant, efficient, and inclusive, ultimately accelerating progress towards universal electrification.

3.3.1 ESSP Priority Impact Interventions

The Energy Sector Strategic Plan (ESSP) outlines several priority impact interventions aimed at significantly improving access to electricity and enhancing the reliability of power infrastructure. Among these interventions are initiatives to connect new households to the grid, expand off-grid solutions, and strengthen the distribution network through the construction of medium voltage (MV) and low voltage (LV) lines. Additionally, the plan emphasizes the connection of Productive Use Entities (PUEs) to electricity, recognizing their role in driving economic development and improving livelihoods across various sectors.

3.3.2 Electricity Access

1. **Connecting New Households to the Grid:** One of the primary interventions outlined in the ESSP is the connection of 1,127,223 new households to the grid. This ambitious initiative aims to extend the benefits of electricity access to previously underserved areas, thereby improving the quality of life for millions of people. By connecting these households to the grid, individuals and communities gain access to essential services such as lighting, heating, and cooking, which are critical for daily activities and overall well-being. Furthermore, electricity access opens up opportunities for education, healthcare, and economic

empowerment, paving the way for social and economic development in both rural and urban areas.

2 **Expansion of Off-Grid Solutions:** In addition to grid electrification, the ESSP prioritizes the expansion of off-grid solutions to reach areas where grid extension may not be feasible or cost-effective. This intervention involves connecting 223,191 households to off-grid electricity solutions, such as solar home systems, mini-grids, and other decentralized energy solutions. By leveraging renewable energy sources, off-grid solutions provide reliable and sustainable electricity access to remote and marginalized communities, improving their resilience to power outages and reducing their dependence on traditional and polluting energy sources. Furthermore, off-grid electrification promotes energy independence, empowers local communities, and supports the transition towards a more sustainable and environmentally friendly energy sector.

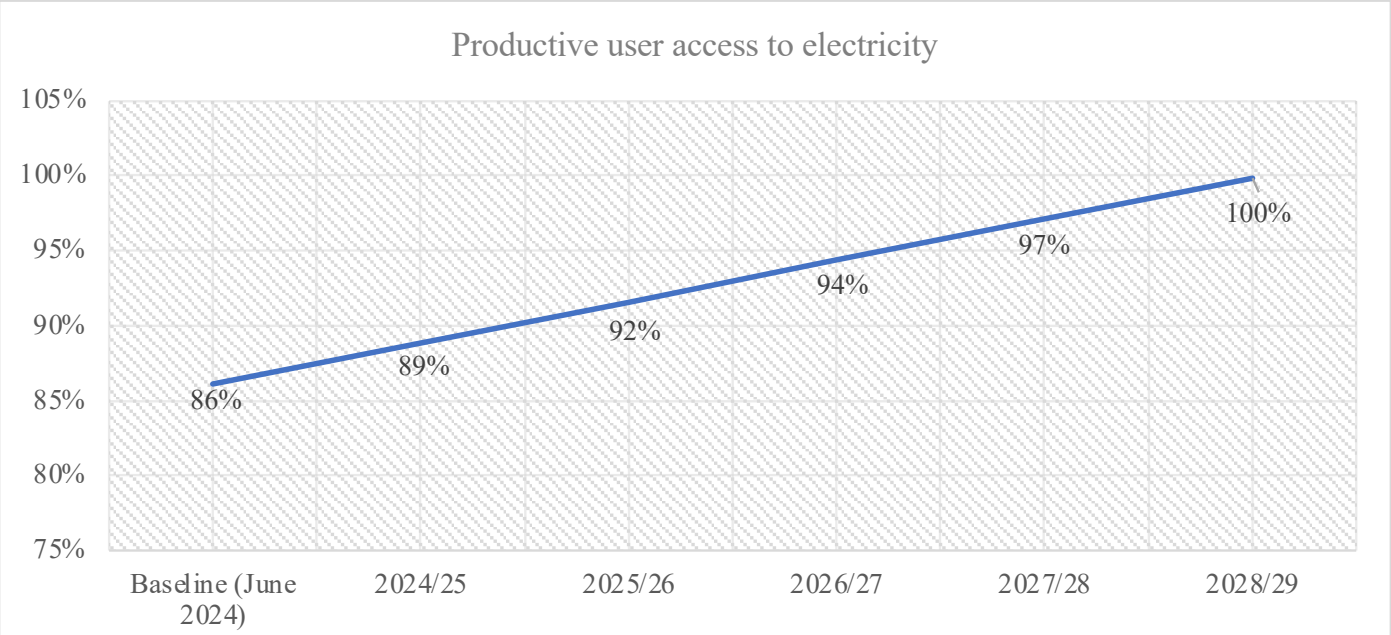
3 **Strengthening Distribution Infrastructure:** Another key intervention under the ESSP is the construction of 6,133.6 kilometers of medium voltage (MV) lines and 21,673 kilometers of low voltage (LV) lines. This infrastructure development initiative aims to enhance the reliability and efficiency of the power distribution network, reducing transmission losses and improving service delivery to end-users. By expanding and upgrading the distribution infrastructure, the energy sector can accommodate the growing demand for electricity, accommodate new connections, and support economic growth and development. Additionally, strengthening the distribution network increases system resilience, mitigating the impact of power disruptions and improving overall power reliability for households, businesses, and industries.

4 **Connection of Productive Use Entities (PUEs):** Recognizing the significant role of Productive Use Entities (PUEs) in driving economic growth and development, the ESSP prioritizes the connection of 2530 PUEs to electricity. These entities encompass various sectors such as agriculture, manufacturing, commerce, and services, and their electrification is crucial for increasing productivity, generating employment, and fostering entrepreneurship. By providing reliable and affordable electricity access to PUEs, the energy sector can unlock the potential for value addition, agro-processing, and industrialization, driving economic transformation and improving livelihoods across the country. Additionally, electrifying PUEs contributes to energy security, diversifies the economy, and promotes sustainable development, aligning with the broader goals of the ESSP and the national development agenda.

3.4 Productive use areas connection to electricity

During the ESSP 2017-2024 period, there was a notable improvement in providing electricity access to Productive Use Areas (PUEs). The efforts to electrify PUEs are not only geared towards fostering economic development but also play a crucial role in improving social service provision. Access to electricity in these areas facilitates the functioning of essential services such as healthcare facilities, educational institutions, and community centers, thereby enhancing the overall quality of life for residents.

The productive user access to electricity is targeted to progressively increase from the current 86% to 100% by the end of 2028/29. Achieving this target is critical to support economic development, increase productivity, and improve the



By achieving the goal of 100% productive user access to electricity by 2028/29, the government aims to bridge the gap and ensure that all areas, both urban and rural, have the necessary electricity access to support development initiatives. This initiative will have a profound impact, boosting economic activities, and fostering an environment conducive to entrepreneurship and innovation. Ultimately, reaching this target will not only drive economic growth but also significantly enhance the living standards and quality of life for citizens across Rwanda.

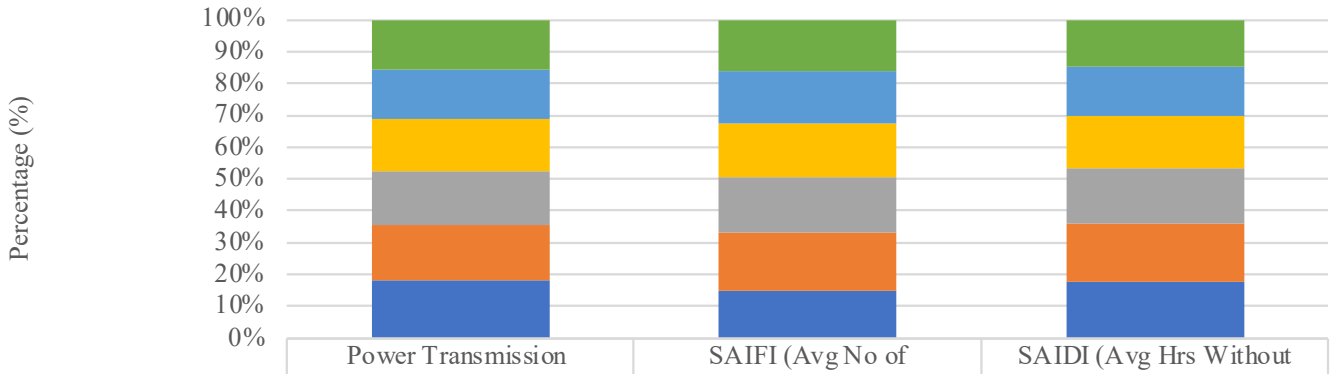
The ongoing review of the National Electrification Plan (NEP) represents a crucial opportunity to enhance electrification efforts targeting productive users. By revising the NEP, stakeholders can refine expansion planning strategies, improve monitoring mechanisms, and mobilize investments more effectively. The review process allows for the identification of gaps or inefficiencies in the existing electrification framework, enabling policymakers to address challenges and capitalize on emerging opportunities.

To address the highlighted challenges, the primary priority is to expedite the connection of all Productive Use Entities (PUEs) to electricity by the year 2029. This ambitious target aims to ensure universal access to electricity for entities engaged in productive activities, such as businesses, workshops, and agricultural operations. By accelerating the electrification process, policymakers seek to improve public service provision and support economic development initiatives across various sectors. This ESSP propose a connection of 2530 PUEs as a **priority high impact intervention.**

3.5 Network reliability

Ensuring a sustainable supply and demand for energy aligns closely with the long-term vision outlined in Vision 2050. By prioritizing initiatives aimed at enhancing energy efficiency, expanding renewable energy sources, and optimizing energy infrastructure, the energy sector contributes to the overarching goal of achieving sustainable energy security. Priorities and initiatives of network reliability are directly relevant to Sustainable Development Goal (SDG) 7.3, which aims to double the global rate of improvement in energy efficiency by 2030. Improved energy efficiency not only reduces energy waste and associated costs but also mitigates greenhouse gas emissions and enhances energy security. Aligning with SDG 7.3 reflects Rwanda's commitment to promoting sustainable energy practices and addressing climate change challenges.

The chapter 2 (Energy overview) details the key achievements in 2017-2024 period, gaps and challenges; Major cause of challenge and Evidence based analysis of the current situation and Emerging opportunities related to the network reliability. Basing on the overview of network reliability, the following sections presents the proposed SSP Priorities from 2024 to 2029 as well as the Priority high impact Interventions.



	Power Transmission Losses	SAIFI (Avg No of Interruptions)	SAIDI (Avg Hrs Without Power)
2028/29	14.70%	18.3%	12
2027/28	14.70%	18.9%	12.7
2026/27	15.20%	19.6%	13.4
2025/26	15.90%	20.3%	14.1
2024/25	16.60%	21.0%	14.9
Baseline (June 2024)	16.90%	16.9%	14.43

The baseline for power transmission losses as of June 2024 was 16.90%. The ESSP to reduce power transmission losses by 14.7% by 2028/29 from the current 16.9%. Achieving this target is crucial to enhance the efficiency of the power

network. Lowering transmission losses ensures that the generated power efficiently reaches the consumers, reducing waste and cost. The reduction in losses would mean more electricity reaches the end-users, making the system more reliable and cost-effective.

3.5.1 Proposed SSP Priorities for Network and reliability

This section highlights the priorities high impact interventions, targets as well as results chain. Currently, the electricity generation is about 400 MWs as of June 2024, and the target is the increment of 163 MW in five years which will results in end target of 563 MW. To achieve this, Rwanda will be required to Construct small and micro hydro power plants (37.7MW), to construct Nyabarongo2 (43.5MW) multipurpose hydro power plant, fast tracking Rusizi III (206 MW:68MW(Rwanda) Regionally shared hydro power plant and to optimize existing power plants to increase generating capacity.

I. Extension of MV Lines, Rehabilitation of LV Lines, and Installation of Distribution Transformers Countrywide:

One of the key priorities outlined in the proposed Strategic Sector Plan (SSP) or Distribution Development Strategy (DDS) is the expansion and enhancement of the distribution network infrastructure. This includes extending medium-voltage (MV) lines to reach underserved areas, rehabilitating existing low-voltage (LV) lines to improve reliability, and installing distribution transformers to facilitate the efficient distribution of electricity. By expanding and upgrading the distribution network, the energy sector aims to improve electricity access and reliability across the country.

II. Reconductoring of Feeders

Another priority identified is the reconditioning of feeders within the distribution network. Reconditioning involves replacing or upgrading the conductors (wires) used in the feeder lines to improve their capacity and efficiency. This initiative aims to enhance the capacity and reliability of the distribution network, allowing it to accommodate increased electricity demand and reduce the risk of outages or voltage fluctuations.

III. Rehabilitation of Cabins and Construction of MV Switching Cabins

The rehabilitation of electrical cabins in urban centers, particularly in Kigali City, is highlighted as a priority. Additionally, the construction of new MV switching cabins is proposed to improve the functionality and efficiency of the distribution network. These cabins serve as key infrastructure components for managing and controlling the flow of electricity within the network, enhancing its reliability and operational flexibility.

IV. Piloting the Move from Overhead to Underground MV & LV Lines in Developed Urban Areas

As part of efforts to modernize the distribution network and improve aesthetics in developed urban areas, there is a proposal to pilot the transition from overhead to underground MV and LV lines. Underground lines offer several advantages, including reduced visual impact, enhanced reliability, and lower susceptibility to weather-related damage. This initiative aims to assess the feasibility and benefits of underground distribution infrastructure in urban environments, with the potential for wider implementation if successful.

3.5.2 Priority high impact Interventions for Network and reliability

The System Average Interruption Frequency Index (SAIFI), indicating the average number of interruptions, stands at 16.9%. The goal for subsequent years, until 2028/29, is to decrease SAIFI progressively to 18.3%. Achieving this target is essential to enhance the reliability of the power network, as a decrease in the number of interruptions will ensure uninterrupted power supply to the consumers. It's particularly important for businesses, industries, and households that rely heavily on electricity for day-to-day activities.

The System Average Interruption Duration Index (SAIDI), indicating the average hours without power is targeted to be reduce SAIDI to 12 hours by 2029 from the current 14.43 hours. Achieving this target is crucial to improve the reliability and efficiency of the power network. Reducing the duration of power interruptions will significantly enhance the quality of life, business continuity, and overall productivity, contributing to economic growth and improved living standards.

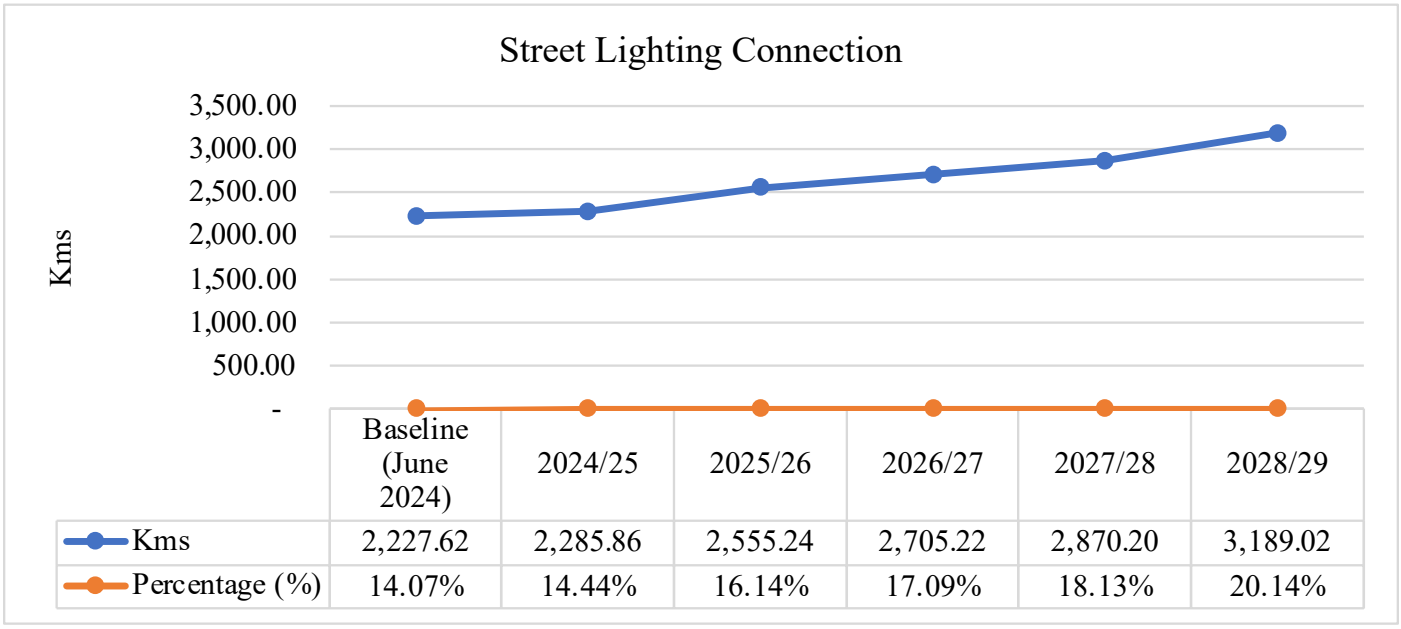
The main priority intervention activities will cover the construction of 499.8Km of new high voltage lines, construction of 14 new substations, extension of MV lines, rehabilitation LV lines, installation of distribution transformers in 17 Districts country wide, rehabilitation of 10 cabins in Kigali City and constructing MV switching cabins.

Street Lighting Connectivity

Today there are 2,227.62 kilometers of street lights accounting for 14.07% target coverage by 2029. By 2024/25, the coverage is expected to increase to 2,285.86 kilometers, equivalent to 14.44%. The progression will continue, with the coverage reaching 2,555.24 kilometers (16.14%) by 2025/26, 2,705.22 kilometers (17.09%) by 2026/27, and 2,870.20 kilometers (18.13%) by 2027/28. while, by 2028/29, the coverage is projected to extend to 3,189.02 kilometers, accounting for 20.14% of the total.

This substantial increase in street lighting coverage aims to enhance safety, security, and public well-being, especially during the night, while also contributing to the beautification and development of urban areas.

The progressive expansion of street lighting is essential for creating safer and more vibrant urban environments. By increasing the coverage, the country aims to enhance road safety, reduce crime rates, and improve the overall quality of life for citizens. The improvement aligns with the ESSP's goal to modernize and develop the country's infrastructure, ensuring a better living environment for its residents. Additionally, improved street lighting contributes to economic growth by promoting night-time activities and extending productive hours, fostering a conducive environment for businesses to thrive. Thus, the consistent increase in street lighting coverage from 2024 to 2029 significantly benefits both urban development and the well-being of the population.



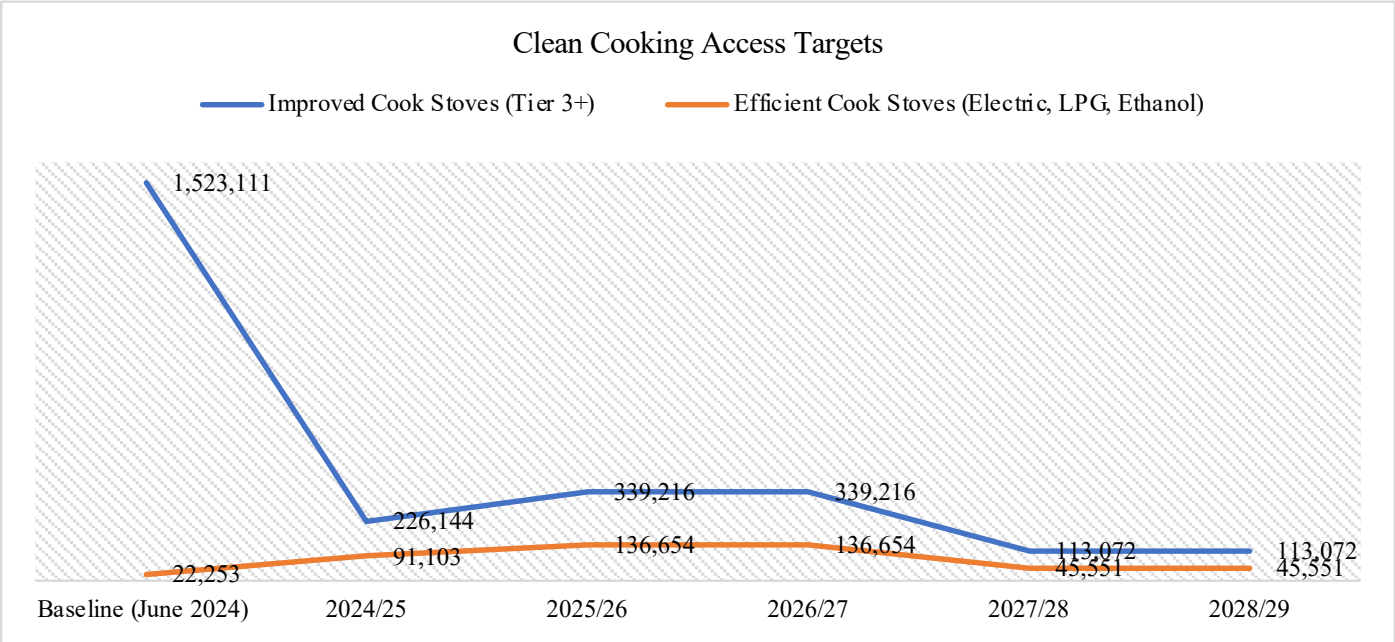
	Baseline (June 2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Kms	2,227.62	2,285.86	2,555.24	2,705.22	2,870.20	3,189.02
Percentage (%)	14.07%	14.44%	16.14%	17.09%	18.13%	20.14%

3.6 Clean cooking Access

In line with Rwanda's Vision 2050, Clean cooking technologies reduce reliance on traditional biomass fuels, which helps to mitigate environmental degradation and deforestation. Therefore, the clean cooking solutions contributes to Vision 2050's goal of ensuring sustainable supply and demand for energy. Concerning SDGs and Agenda 2063, the promotion of clean cooking aligns with SDG 7.1, which aims to ensure universal access to affordable, reliable, and modern energy services while the initiative to promote clean cooking aligns with Agenda 2063's strategy to enhance the standard of living, quality of life, and well-being for all citizens by addressing energy poverty and promoting sustainable energy solutions.

For biomass and clean cooking, the chapter 2 (Energy overview) details the key achievements in 2017-2024 period, gaps and challenges; Major cause of challenge and Evidence based analysis of the current situation and Emerging opportunities. Basing on the overview of biomass and clean cooking, the following sections presents the proposed SSP Priorities from 2024 to 2029 as well as the Priority high impact Interventions.

As of June 2024, there are 1,523,111 improved cook stoves (Tier 3+) distributed. Over the subsequent years, the distribution target to vary to 226,144 stoves distributed in 2024/25, 339,216 stoves will be distributed in 2025/26, 339,216 stoves in 2026/27, 113,072 stoves in 2027/28, and 113,072 stoves in 2028/29. These stoves will play a critical role in reducing the dependence on traditional, non-efficient cooking solutions, significantly contributing to environmental sustainability, public health, and the reduction of greenhouse gas emissions. The provision of improved cook stoves helps to alleviate energy poverty, mitigate climate change, and protect forests and other natural resources.



As of the current there are 22,253 efficient cook stoves (Electric, LPG, Ethanol) distributed especially in urban areas. ESSP tragets to distribute more h 91,103 stoves distributed in 2024/25, 136,654 stoves in 2025/26, 136,654 stoves in 2026/27, 45,551 stoves in 2027/28, and 45,551 stoves in 2028/29. These stoves represent a shift towards more sustainable and efficient energy sources for cooking. By introducing electric, LPG, and ethanol-based cook stoves, the goal is to address the challenge of affordability and promote the transition to clean cooking technologies. The distribution of efficient cook stoves is essential for ensuring universal access to modern energy, improving public health, and achieving sustainable development goals.

3.6.1 Proposed SSP Priorities for clean cooking

For clean cooking, two priorities have been identified. The first priority is the Distribution of Efficient Cook Stoves for Households while the second priority is Deployment of Clean Cooking Systems in Institutions:

Distribution of Efficient Cook Stoves for Households: The priority is to continue the distribution of efficient cook stoves to households, with a particular focus on high-tier stoves capable of significantly reducing emissions and fuel consumption. This includes promoting the adoption of electric stoves, LPG (liquefied petroleum gas) stoves, ethanol stoves, and Tier 3+ stoves for biomass fuels such as firewood, charcoal, pellets, and briquettes. By providing households with access to cleaner and more efficient cooking technologies, the aim is to improve indoor air quality, reduce environmental pollution, and enhance energy efficiency, leading to better health outcomes and sustainable livelihoods.

Deployment of Clean Cooking Systems in Institutions: There is a need to intensify the deployment of clean cooking systems in institutions such as schools, hospitals, and community centers, facilitating the transition from traditional biomass fuels (firewood and charcoal) to higher-tier cooking solutions like electricity and biogas. By promoting the use of clean cooking technologies in institutional settings, the objective is to create healthier and safer environments, improve the quality of services delivered, and demonstrate the viability and benefits of transitioning to sustainable energy sources. This initiative can serve as a model for scaling up clean cooking interventions across different sectors and communities, driving broader adoption and impact.

3.6.2 Priority high impact Interventions for Clean cooking

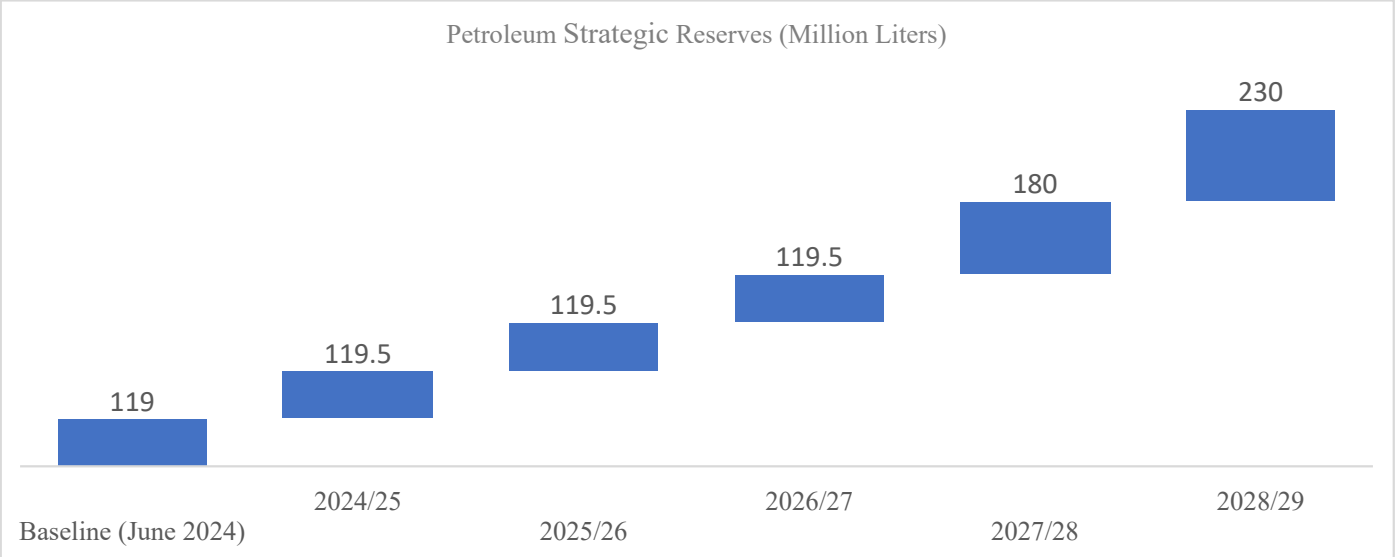
According to 2022 Census the number of HHs using improved cookstoves, clean and efficient cooking (LPG, electricity, biogas and briquettes) was 130,352. The target in the end period of ESSP is to increase this number to 3,931,743.

The main priority intervention activities will cover the Promotion of tier 3 and tier 4 cooking stoves in rural Areas with a target of 2,449,000 HH, Promotion of tier 4 and tier 5 in urban areas
of energy transition in households by using clean non-biomass stoves (Electric, LPG, ethanol, stoves) targeting 1,209,000 HHs.

3.7 Energy petroleum strategic storage

During the Strategic Storage and Security Plan (SSSP) period from 2017 to 2024, significant achievements were made in enhancing the strategic storage capacity of petroleum products. This expansion in storage capacity was crucial for ensuring energy security and stability in the face of potential supply disruptions or emergencies. However, one of the primary challenges faced during the period was the failure to achieve the targeted storage capacity. Despite efforts to expand strategic storage facilities, the intended goal of reaching 198 million liters of installed capacity reserves was not realized. This discrepancy highlights potential gaps in planning, execution, or funding allocation for storage infrastructure projects. Insufficient resources, delays in project implementation, regulatory hurdles, or unexpected technical issues may have contributed to the shortfall in achieving the desired storage capacity.

As of to date the petroleum reserves has capacity of 119 million liters. Over the subsequent years, the capacity aims to maintain consistency, with 119.5 million liters for 2024/25, 2025/26, and 2026/27. However, there will be a substantial increase projected for 2027/28, with the reserves reaching 180 million liters, and further increase to 230 million liters by 2028/29. This significant increase in reserves is crucial for enhancing the security and stability of the petroleum supply, ensuring energy security, and mitigating potential risks associated with supply disruptions. Adequate reserves contribute to maintaining a stable and secure energy supply, especially during times of emergencies or supply chain disruptions.



The steady expansion of petroleum reserves represents a strategic move to enhance the country's energy security. By increasing the reserves, the country can better withstand global oil market fluctuations and ensure a stable supply of petroleum products for both domestic consumption and emergency needs. This expansion aligns with the ESSP's goal to improve the country's energy infrastructure, ensuring a reliable and sustainable energy supply. Moreover, it plays a significant role in supporting economic growth, industrial development, and ensuring the well-being and prosperity of the nation.

The demand for energy products, including petroleum, is anticipated to grow in line with the projected economic expansion. The Mid-Term Macroeconomic Framework forecasts a robust 9% annual GDP growth over the next 5 years, signaling a corresponding increase in energy consumption and fuel demand. This upward trend in demand presents an opportunity for stakeholders in the energy sector to align investment strategies with anticipated market dynamics. By proactively investing in storage infrastructure to accommodate future demand growth, stakeholders can position themselves to capitalize on emerging opportunities and contribute to meeting the energy needs of a rapidly expanding economy.

To address the highlighted challenges, the following priorities have been identified and proposed for 2024 - 2029 ESSP.

1 **Construct New Fuel Storage Facilities:** The construction of new fuel storage facilities emerges as a critical priority to address the existing gap in storage capacity and accommodate future demand growth. By investing in the development of new storage infrastructure, stakeholders can enhance the resilience and reliability of the energy supply chain, ensuring adequate reserves to meet the needs of both domestic consumption and potential re-exports.

These new storage facilities should be strategically located to optimize distribution networks and minimize transportation costs. Consideration should also be given to factors such as proximity to major transportation hubs, regulatory compliance, and environmental impact assessments to ensure sustainable development practices.

2 **Upgrade Existing Storage Facilities:** In addition to constructing new storage facilities, upgrading the existing infrastructure is essential to modernize storage capacity and improve operational efficiency. Upgrades may involve implementing state-of-the-art technologies, enhancing safety standards, and increasing storage capacity through expansion or optimization of existing facilities.

Upgrading existing storage facilities can help extend their lifespan, enhance storage efficiency, and mitigate risks associated with aging infrastructure. Furthermore, modernization efforts can align storage facilities with industry best practices and regulatory requirements, ensuring compliance with evolving standards and enhancing overall operational resilience.

To address the highlighted challenges, the following priorities have been identified and proposed for 2024 - 2029 ESSP. These include, Increase LPG Increase and oil reserves to cover 3 months' supply as well to construct NG/methane gas to supplement LPG strategic reserves.

3.8 Integration of climate change adaptation and mitigation measures

Climate resilience will be mainstreamed into energy sector planning and operations, with a focus on enhancing infrastructure resilience, reducing carbon emissions, and promoting sustainable energy practices.

The integration of climate change adaptation and mitigation measures is a critical aspect of the Energy Sector Strategic Plan (ESSP) 2025–2030, reflecting Rwanda's commitment to building resilience and reducing carbon emissions in the energy sector. Recognizing the increasing risks posed by climate change to energy infrastructure and operations, the plan prioritizes mainstreaming climate resilience into sectoral planning and operations. This entails assessing climate risks and vulnerabilities, incorporating climate adaptation measures into infrastructure design and maintenance, and enhancing the resilience of energy systems to extreme weather events and climate variability.
Moreover, the ESSP emphasizes the importance of reducing carbon emissions from energy generation and consumption to mitigate climate change impacts. This includes promoting the adoption of clean and renewable energy sources, improving energy efficiency, and implementing carbon capture and storage technologies where feasible. By transitioning to low-carbon energy systems, Rwanda aims to contribute to global efforts to limit global warming and minimize the adverse effects of climate change on vulnerable communities and ecosystems.

The ESSP highlights sustainable energy practices that align with climate goals and enhance environmental sustainability. This involves initiatives such as promoting clean cooking technologies to reduce reliance on biomass fuels, promoting sustainable transportation solutions, and supporting green building standards and practices. By integrating climate adaptation and mitigation measures into energy sector planning and operations, Rwanda seeks to enhance its resilience to climate change while advancing towards a low-carbon and sustainable energy future.

3.9 Strengthening of institutional capacity and governance.

The Energy Sector Strategic Plan (ESSP) 2025–2030 recognizes the importance of strengthening institutional capacity and governance to effectively implement energy policies and regulations. With this goal in mind, the plan emphasizes the need for enhanced institutional coordination and collaboration among relevant stakeholders, including government agencies, regulatory bodies, utilities, and the private sector. By fostering partnerships and cooperation, the energy sector can streamline decision-making processes, improve resource allocation, and ensure alignment with national development objectives and priorities.

Capacity building is another key focus area within the ESSP, aiming to enhance the skills and expertise of energy sector professionals and stakeholders. This includes training programs, workshops, and knowledge-sharing initiatives to build technical capacity in areas such as energy planning, project management, and regulatory compliance. By investing in

human capital development, Rwanda can strengthen its energy sector workforce and equip stakeholders with the tools and knowledge needed to navigate complex energy challenges and opportunities.

The ESSP recognizes the importance of robust regulatory frameworks and governance mechanisms to guide the development, operation, and management of the energy sector. This involves establishing clear policies, standards, and guidelines to govern energy infrastructure investments, operations, and tariffs. Additionally, effective monitoring and enforcement mechanisms are essential to ensure compliance with regulatory requirements and standards, promote transparency and accountability, and safeguard the interests of consumers and the public. By strengthening institutional capacity and governance structures, Rwanda can create an enabling environment for sustainable energy development, investment, and innovation, ultimately driving socio-economic growth and prosperity.

3.10 Promotion of public-private partnerships and stakeholder engagement

The Energy Sector Strategic Plan (ESSP) 2025–2030 recognizes the significance of public-private partnerships (PPPs) and stakeholder engagement in driving innovation, mobilizing resources, and achieving sustainable energy outcomes. By fostering collaboration between the public and private sectors, the plan seeks to leverage the strengths and expertise of both entities to address complex energy challenges and unlock opportunities for growth and development. PPPs offer a platform for pooling resources, sharing risks, and implementing projects that contribute to the advancement of the energy sector while promoting socio-economic development.

Stakeholder engagement is another integral component of the ESSP, aiming to foster inclusivity, transparency, and accountability in decision-making processes. The plan acknowledges the importance of engaging a diverse range of stakeholders, including government agencies, civil society organizations, academia, local communities, and the private sector. Through active participation and dialogue, stakeholders can contribute valuable insights, expertise, and perspectives to inform energy sector policies, programs, and projects. Furthermore, stakeholder engagement enhances ownership, builds trust, and fosters a sense of collective responsibility towards achieving shared energy goals and objectives.

Moreover, the promotion of PPPs and stakeholder engagement is expected to drive innovation and knowledge sharing in the energy sector. By facilitating collaboration and information exchange, the ESSP creates opportunities for the co-creation of innovative solutions, technologies, and business models that address emerging energy needs and challenges. Additionally, stakeholder engagement initiatives such as public consultations, workshops, and forums provide platforms for raising awareness, building capacity, and fostering a culture of collaboration and cooperation among diverse stakeholders. Through these collaborative efforts, Rwanda can harness the collective expertise, resources, and creativity of stakeholders to drive sustainable energy development and achieve its socio-economic aspirations.

3.11 Climate Change Adaptation (CCA) Mainstreaming

Integrating climate change adaptation (CCA) measures into the strategic framework of the Energy Sector Strategic Plan (ESSP) 2025–2030 is paramount to enhance the sector's resilience against the escalating impacts of climate change. This strategic imperative necessitates a comprehensive approach that encompasses the identification, assessment, and mitigation of climate risks and vulnerabilities. By conducting robust climate risk assessments, the energy sector can better understand the potential hazards posed by climate change, including extreme weather events, changing precipitation patterns, and rising temperatures. This foundational step enables policymakers and stakeholders to develop targeted adaptation strategies tailored to mitigate the identified risks and safeguard critical energy infrastructure and services.

Incorporating adaptation measures into infrastructure planning and design lies at the heart of enhancing the energy sector's resilience to climate impacts. This entails integrating climate-resilient design principles into the development and maintenance of energy infrastructure, such as power plants, transmission lines, and distribution networks. By adopting climate-smart engineering practices, the energy sector can build infrastructure that is better equipped to withstand climate-induced stresses, including flooding, storms, and heatwaves. Furthermore, the integration of nature-based solutions, such as green infrastructure and ecosystem restoration, can enhance the adaptive capacity of energy systems while providing additional co-benefits such as biodiversity conservation and carbon sequestration.

On the other hand, two activities are proposed to be accomplished or initiated by MININFRA as contribution to Climate change adaptation:

- Strengthening the environmental Impact Assessment before development of Energy infrastructure to cater for Climate resilient Energy.
- Contribution to catchment rehabilitation and management (i.e. trees planting and forest maintenance) in catchments areas surrounding hydropower stations.

3.11.1 Climate Change Adaptation (CCA) Mainstreaming

For climate change adaptation mainstreaming, two activities are proposed to be emphasized by MININFRA for implementation by the Ministry of Environment:

N°	Activities	Intended target	Implementing institution	Indicator	
				Baseline	Target in 2029/30
1	Catering for climate resilient infrastructure in Environmental Impact Assessment before any construction of energy production and distribution	Catering for future climate projection scenarios rather than considering only the historic climate normal and extremes	MoE	0	5
2	Catchment rehabilitation and management (i.e. trees planting and forest maintenance) in catchments areas surrounding hydropower stations	Catchment management and rehabilitation contribute to soil retention, water recharger and therefore protection of energy infrastructure and availability of water in the catchment surrounding hydropower stations	MoE	xxx	xxx

3.11.2 Promotion of Climate resilient Energy infrastructure

The Rwanda Third National Communication Report on Climate Change 6 has assessed the climate impacts or vulnerability as well as adaptation measures for Solar Photovoltaic Systems, thermoelectric power generation, electric power transmission and distribution systems. From that report, we have identified measurable indicators related to Precipitation and flooding as well as to Wind speed hence they are ones most likely affecting the energy infrastructure.

N°	Impacts & vulnerability	Adaptation measures	Indicator		
			Indicator formulation	Baseline	Target in 2029/30
1	Heavy rains and flooding could undermine transmission tower structures through erosion	Build a resilient high-capacity transmission system.	Number of constructed new transmission tower structures resilient to Heavy rains and floods	0	xxx
		Protect masts, antennae, switch boxes, aerials, overhead wires, and cables from precipitation (water ingress,);	Number of vulnerable transmission towers protected from heavy rains and flooding	0	xxx

3.12 Innovations and Key Drivers

Innovations play a crucial role in driving the energy sector forward and unlocking new opportunities for growth and development. The ESS prioritizes innovative approaches such as leveraging digital technologies for energy management and monitoring, enhancing grid efficiency and reliability through smart grid solutions, and promoting decentralized energy systems to enhance energy access in remote areas. Moreover, the strategy fosters innovation in renewable energy technologies, including advancements in solar photovoltaics, wind turbines, and energy storage systems, to drive down costs and improve performance. By embracing these innovations, Rwanda aims to position itself as a regional leader in sustainable energy development and accelerate progress towards its long-term goals.

3.12.1 Digital Technologies for Energy Management and Monitoring.

Embracing digital technologies is a key driver in enhancing energy management and monitoring systems. By leveraging advanced data analytics, Internet of Things (IoT) sensors, and artificial intelligence (AI), Rwanda can optimize energy usage, predict demand patterns, and identify opportunities for efficiency improvements. Smart meters and real-time monitoring systems enable consumers to track their energy consumption and make informed decisions to reduce waste. Additionally, digital platforms can facilitate remote management of energy infrastructure, enabling proactive maintenance and troubleshooting to minimize downtime and enhance reliability.

3.12.2 Smart Grid Solutions for Grid Efficiency and Reliability.

Implementing smart grid solutions is essential for enhancing the efficiency and reliability of Rwanda's energy grid. Smart grids integrate advanced communication and control technologies to optimize the flow of electricity, balance supply and demand, and integrate renewable energy sources seamlessly. This includes deploying smart meters, distribution automation systems, and grid-connected energy storage solutions. By modernizing the grid infrastructure, Rwanda can reduce transmission losses, improve voltage regulation, and enhance overall grid stability, paving the way for a more resilient and sustainable energy system.

3.12.3 Promotion of Decentralized Energy Systems

Promoting decentralized energy systems is crucial for expanding energy access in remote and underserved areas. Decentralized systems, such as mini-grids and off-grid solar solutions, enable communities to generate their own electricity locally, reducing dependency on centralized infrastructure and extending energy access to off-grid populations. By embracing decentralized energy solutions, Rwanda can overcome geographical barriers and reach isolated communities, accelerating progress towards universal electrification. Furthermore, decentralized systems empower local entrepreneurship and job creation, fostering economic development and social empowerment in rural areas.

3.12.4 Innovation in Renewable Energy Technologies

Fostering innovation in renewable energy technologies is fundamental for driving the transition to clean and sustainable energy sources. Rwanda prioritizes advancements in solar photovoltaics, wind turbines, and energy storage systems to increase efficiency, reliability, and affordability of renewable energy solutions. This includes research and development initiatives, pilot projects, and technology demonstrations to showcase the viability and scalability of renewable energy technologies. By embracing innovation in renewables, Rwanda can reduce greenhouse gas emissions, mitigate climate change impacts, and enhance energy security while creating opportunities for green growth and investment.

3.12.5 Aligning of ESSP 2024-2029 with Rwanda NDCs

The project "Capacity Development for the Implementation of Rwanda's Nationally Determined Contributions (NDCs)" is implemented from October 2022 to September 2025 as a technical cooperation module by GIZ in Rwanda with funding from the Federal Ministry for Economic Cooperation and Development (BMZ).

The NDC project's overall objective is to enhance the institutional and financial framework conditions of relevant state and non-state actors in Rwanda for the coordination, implementation and monitoring of the country's Nationally Determined Contribution (NDC).

Under a Business As Usually (BAU) projection, Rwanda's total emissions are forecast to more than double over the 2015-2030 period, rising from 5.3 million tCO2 e in the base year to 12.1 million tCO2 e in 2030. The forecast indicates the growing contribution from fossil fuels to national emissions, arising from increasing demand for power generation, road transport and other modern energy uses. The BAU projection represents the scenario according to which mitigation policies and actions are not implemented. It therefore provides the reference case (or baseline) against which the emissions reduction potential from mitigation actions have been quantified.

With the domestically supported unconditional mitigation measures, 2030 emissions are forecast to instead rise to around 10.2 MtCO2e, representing a reduction against BAU of around 16%. With both domestic and conditional mitigation measures, emissions are forecast to instead total around 7.5 MtCO2e, equal to a reduction of 38% by 2030 against the same baseline.

The five-year planning of the energy sector will mainstream the Nationally Determined Contributions (NDCs), Grean Growth and Climate Resilient Strategy (GGCRS) and the NST2 priorities. Therefore, in line with NDCs, the emission reduction related to ESSP priorities intervention is proposed to support the contribution of emission reduction in Energy sector. This approach will facilitate to identify the sub-projects linked to ESSP 2024-2029 to be proposed for the carbon market contributing to support new technologies planned in ESSP 2024-2029.

3.13 Logical Framework and Results Chains in the Energy Sector

The ESS adopts a logical framework approach to articulate clear targets and timelines for achieving NST2 goals, ensuring a systematic and coordinated approach to implementation. This framework delineates specific interventions, outputs, outcomes, and impacts, providing a roadmap for tracking progress and measuring success. For example, targets will include increasing electricity generation capacity by a certain percentage, reducing energy losses in transmission and distribution networks, and expanding access to clean cooking solutions. Additionally, the ESS outlines results chains that describe the hierarchical chains of results anticipated after full implementation, based on Results-Based Management (RBM) principles. These chains illustrate the causal relationships between interventions, outcomes, and impacts, guiding resource allocation and decision-making to maximize the effectiveness and efficiency of energy sector investments.

3.13.1 Clear Targets and Timelines

The ESS adopts a logical framework approach to set clear targets and timelines aligned with the objectives of NST2. These targets are designed to measure progress and ensure the timely achievement of sectoral goals. For instance, targets may include increasing electricity generation capacity by a certain percentage over a specified period, such as adding a certain megawatt capacity of renewable energy sources by 2030. Similarly, targets for reducing energy losses in transmission and distribution networks may be set to achieve specific levels of efficiency gains within a defined timeframe. Additionally, the ESS establishes targets for expanding access to clean cooking solutions, aiming to reach a certain percentage of households with modern and clean cooking technologies by a designated year.

3.13.2 Results Chains Based on RBM Principles

The ESS outlines results chains that articulate the hierarchical relationships between interventions, outcomes, and impacts. These chains are based on Results-Based Management (RBM) principles and serve as a roadmap for guiding implementation and resource allocation decisions. For example, interventions such as investing in renewable energy infrastructure and promoting energy efficiency measures are expected to lead to outcomes such as increased energy

access, reduced environmental pollution, and improved socio-economic conditions. These outcomes, in turn, are anticipated to generate broader impacts such as enhanced economic growth, reduced poverty, and improved public health. By mapping out these results chains, the ESS enables stakeholders to understand how interventions contribute to desired outcomes and impacts, facilitating informed decision-making and effective implementation strategies.

The sector drives industrialization and private sector development by expanding electricity generation capacity and enhancing energy access. This enables the growth of manufacturing industries, boosts productivity, and attracts investment, thus fostering economic growth. Additionally, by promoting renewable energy sources and energy efficiency measures, the sector reduces production costs, improves competitiveness, and stimulates economic development.

The energy sector significantly contributes to Human Capital Development by improving access to clean energy services, particularly in rural areas. Reliable electricity and clean cooking solutions enhance health outcomes, quality of life, and educational opportunities, empowering individuals and communities. Collaboration with the education sector and other stakeholders further supports vocational training programs and capacity-building initiatives, facilitating skill development and socio-economic empowerment.

The energy sector's contributions extend to key foundational areas like Infrastructure Development and Urbanization. By expanding energy infrastructure and promoting sustainable urban planning, the sector facilitates the development of resilient and inclusive urban centers. Cross-sectoral collaboration with transportation, agriculture, and other sectors promotes integrated infrastructure development and efficient resource utilization, driving overall socio-economic progress and sustainable development across Rwanda's districts. Through strategic partnerships and coordinated efforts, the energy sector plays a vital role in advancing Rwanda's development objectives and realizing its long-term vision of inclusive growth and prosperity.

3.14 Mainstreaming of Cross-Cutting Aspects (CCA) in the Energy Sector Strategic Plan

The mainstreaming of cross-cutting aspects (CCA) within the Energy Sector Strategic Plan (ESSP) is essential for ensuring that the plan effectively addresses the diverse needs and challenges facing Rwanda's energy sector. CCAs, such as gender equality, environmental sustainability, and climate change resilience, are integrated throughout the ESSP to ensure a comprehensive and inclusive approach to energy sector development. This section details how CCAs have been mainstreamed in the ESSP, utilizing the Priority Identification Matrix to capture and clarify the analysis.
By systematically mapping out the intersection of CCAs with sectoral priorities, the matrix enables stakeholders to identify synergies, gaps, and opportunities for enhancing the inclusivity and effectiveness of the ESSP.

1. Gender Equality; Gender equality is mainstreamed throughout the ESSP to ensure that energy policies and programs are responsive to the needs and priorities of all genders. The plan incorporates gender-responsive approaches in energy access initiatives, recognizing the differential impacts of energy poverty on men and women. For example, the ESSP prioritizes the promotion of clean cooking solutions to reduce the burden of household chores on women and improve their health and well-being. Additionally, the plan includes measures to enhance women's participation and leadership in decision-making processes within the energy sector, fostering greater gender equality and empowerment.

2. Environmental Sustainability; Environmental sustainability is a core consideration in the ESSP, reflecting Rwanda's commitment to promoting green growth and reducing environmental degradation. The plan emphasizes the development and deployment of renewable energy sources, such as solar, wind, and hydropower, to mitigate greenhouse gas emissions and minimize environmental impact. Furthermore, the ESSP integrates energy efficiency measures across all sectors, aiming to optimize resource use and minimize waste. By prioritizing sustainable practices and technologies, the plan seeks to ensure the long-term viability of Rwanda's energy sector while safeguarding the environment for future generations.

3. Climate Change Resilience: Climate change resilience is mainstreamed in the ESSP to enhance Rwanda's adaptive capacity and resilience to climate-related risks and vulnerabilities. The plan incorporates climate-smart solutions in energy infrastructure development, such as integrating climate-resilient design principles into power generation and transmission projects. Moreover, the ESSP emphasizes the importance of diversifying energy sources and enhancing energy security to mitigate the impacts of

climate variability and extreme weather events. By integrating climate change resilience into its strategic objectives and actions, the ESSP aims to build a more resilient and sustainable energy sector that can withstand the challenges of a changing climate.

CHAPTER 4: IMPLEMENTATION ARRANGEMENTS

The Energy Sector Strategic Plan (ESSP) 2025–2030 outlines the implementation arrangements necessary to translate the strategic objectives and priorities into tangible actions and outcomes. At the core of these arrangements is the establishment of clear institutional structures and coordination mechanisms to ensure efficient and effective execution of the plan. This involves identifying lead implementing agencies, defining their roles and responsibilities, and fostering inter-agency collaboration to streamline efforts and avoid duplication of tasks. Additionally, the chapter emphasizes the importance of stakeholder engagement and participation throughout the implementation process, recognizing the diverse expertise and resources that various stakeholders bring to the table.

4.1 Institutional Level and Involvements

Institutional arrangements within the Ministry of Infrastructure (MININFRA) and its relevant agencies, along with collaboration with the Ministry of Finance and Economic Planning (MINICOFIN), are crucial for the effective implementation of the Energy Sector Strategic Plan (ESSP). MININFRA serves as the lead implementing agency responsible for overseeing various aspects of the plan, including policy formulation, regulatory enforcement, infrastructure development, and project implementation. Within MININFRA, specific departments or agencies may be designated to focus on different components of the ESSP, such as the Department of Energy or the Rwanda Energy Group (REG), each tasked with specific responsibilities to ensure comprehensive coverage of the plan's objectives.

Furthermore, close coordination between MININFRA and MINICOFIN is essential to align financial resources with the priorities outlined in the ESSP. MINICOFIN plays a crucial role in budget allocation, resource mobilization, and financial oversight, ensuring that adequate funding is allocated to support the implementation of energy sector projects and initiatives. Collaborative efforts between these ministries facilitate the integration of financial planning and budgetary considerations into the strategic implementation of the ESSP, thereby enhancing resource efficiency and effectiveness.

Inter-agency coordination mechanisms are established to facilitate seamless collaboration and communication between MININFRA, MINICOFIN, and other relevant government bodies involved in energy sector development. These mechanisms provide a platform for stakeholders to exchange information, coordinate activities, resolve challenges, and align strategies towards achieving common objectives. Regular meetings, joint working groups, and shared reporting frameworks are examples of mechanisms that foster synergy and coherence across different agencies, avoiding duplication of efforts and ensuring optimal use of resources.

Clear delineation of roles, responsibilities, and reporting lines within MININFRA and MINICOFIN is critical to avoid confusion, enhance accountability, and streamline decision-making processes. Each agency or department within MININFRA and MINICOFIN should have a defined mandate and specific tasks related to the implementation of the ESSP. Transparent reporting mechanisms enable stakeholders to monitor progress, track expenditures, and evaluate performance against established targets, promoting transparency and accountability in the management of energy sector projects and initiatives.

4.2 Implementation Coordination Mechanisms

Coordination mechanisms play a pivotal role in ensuring the successful implementation of the Energy Sector Strategic Plan (ESSP) by fostering collaboration and alignment of efforts among various stakeholders. At the national level, steering committees or inter-ministerial task forces are often established to provide overarching guidance and strategic direction for the implementation of the plan. These committees typically consist of representatives from relevant government ministries, including the Ministry of Infrastructure, Ministry of Finance and Economic Planning, Ministry of Environment, and others, to ensure comprehensive coverage and coordination across different sectors. Within these steering committees, working groups or technical committees may be formed to focus on specific thematic areas or initiatives outlined in the ESSP. For instance, there might be working groups dedicated to renewable energy development, energy access expansion, climate

change adaptation, or regulatory reforms. These working groups bring together experts and stakeholders with specialized knowledge and expertise to develop detailed action plans, identify key milestones, and monitor progress towards achieving sectoral objectives.
At the regional and local levels, similar coordination mechanisms may be established to ensure alignment with national priorities and facilitate implementation at the grassroots level. Regional energy task forces or local energy committees may be formed to coordinate activities, share best practices, and address localized challenges related to energy access, infrastructure development, and service delivery. These grassroots-level coordination mechanisms enable effective engagement with communities, local authorities, and other relevant stakeholders to ensure that the needs and priorities of different regions are adequately addressed within the framework of the ESSP.

Overall, effective coordination mechanisms provide a structured framework for stakeholder engagement, information sharing, and decision-making, thereby enhancing coherence, efficiency, and accountability in the implementation of the ESSP. By bringing together diverse perspectives, expertise, and resources, these mechanisms facilitate the integration of sectoral priorities, promote synergy among stakeholders, and contribute to the overall success of Rwanda's energy sector development efforts.

4.3 Stakeholder Engagement Strategies

Stakeholder engagement in the successful implementation of the Energy Sector Strategic Plan (ESSP) 2025/2029 in Rwanda requires tailored strategies to involve various stakeholder groups effectively. Each stakeholder group plays a crucial role in shaping energy infrastructure development and policy formulation. Here's a highlight of each stakeholder group and their respective engagement strategies.

Table 1: Summary of Stakeholders Engagement strategies

Stakeholders	Roles and Responsibilities	Strategies
Government Agencies and Ministries	**1. Energy Planning and Regulation:** Government agencies and ministries, such as the Ministry of Infrastructure (MININFRA) and the Rwanda Energy Group (REG), play a vital role in energy planning and regulation. They are responsible for developing strategies, policies, and regulations to guide the development of the energy sector in Rwanda. **2. Setting Targets:** These agencies are also tasked with setting targets for various aspects of energy infrastructure development and access. This includes targets related to household electrification, renewable energy deployment, energy efficiency improvements, and expansion of energy transmission and distribution networks. **3. Implementing Initiatives:** Government agencies and ministries are responsible for implementing initiatives outlined in the Energy Sector Strategic Plan (ESSP). This involves overseeing the execution of projects, coordinating with stakeholders, allocating resources, and ensuring that initiatives are aligned with the overall goals of the ESSP.	**1. Regular Coordination Meetings:** Government agencies and ministries hold regular coordination meetings to discuss progress, challenges, and opportunities related to the implementation of the ESSP. These meetings provide a platform for stakeholders to exchange information, share best practices, and address issues collaboratively. **2. Workshops:** Workshops are organized to facilitate deeper discussions on specific topics relevant to the ESSP. These workshops bring together experts, policymakers, industry representatives, and other stakeholders to explore key challenges, develop solutions, and generate innovative ideas for advancing the energy sector. **3. Working Groups:** Working groups are formed to focus on specific areas or projects within the ESSP. These groups comprise representatives from relevant government agencies, regulatory bodies, private sector entities, and civil society organizations. They work together to develop action plans, monitor progress, and overcome obstacles hindering the achievement of targets. **4. Utilization of Data:** Government agencies and ministries utilize data from various sources, including the Energy Integrated Household Survey (EICV) and reports from the Ministry of Trade and Industry (MINICOM), for evidence-based decision-making. This data-driven approach helps in assessing the effectiveness of energy interventions, identifying areas for improvement, and making informed policy

		decisions to drive the implementation of the ESSP forward.
Non-Governmental Organizations (NGOs), Development Partners, and International Agencies:	**1. Technical Assistance:** Non-Governmental Organizations (NGOs), development partners, and international agencies provide technical expertise and guidance to support the implementation of energy projects. This includes offering specialized knowledge in areas such as renewable energy technologies, energy efficiency measures, and sustainable energy practices. **2. Funding Support:** These stakeholders contribute financial resources to energy projects in Rwanda, helping to bridge funding gaps and finance initiatives outlined in the Energy Sector Strategic Plan (ESSP). Funding support may come in the form of grants, loans, or investments aimed at advancing the development of the energy sector and improving access to energy services. **3. Capacity Building:** NGOs, development partners, and international agencies engage in capacity-building activities to strengthen the capabilities of local stakeholders, including government agencies, regulatory bodies, and community organizations. Capacity-building initiatives may involve training programs, workshops, and knowledge-sharing events to enhance skills, promote institutional development, and build local expertise in energy-related fields.	**1. Technical Assistance:** Non-Governmental Organizations (NGOs), development partners, and international agencies provide technical expertise and guidance to support the implementation of energy projects. This includes offering specialized knowledge in areas such as renewable energy technologies, energy efficiency measures, and sustainable energy practices. **2. Funding Support:** These stakeholders contribute financial resources to energy projects in Rwanda, helping to bridge funding gaps and finance initiatives outlined in the Energy Sector Strategic Plan (ESSP). Funding support may come in the form of grants, loans, or investments aimed at advancing the development of the energy sector and improving access to energy services. **3. Capacity Building:** NGOs, development partners, and international agencies engage in capacity-building activities to strengthen the capabilities of local stakeholders, including government agencies, regulatory bodies, and community organizations. Capacity-building initiatives may involve training programs, workshops, and knowledge-sharing events to enhance skills, promote institutional development, and build local expertise in energy-related fields.
The private Sector	**1. Investment and Financing:** The private sector plays a crucial role in investing in and financing energy infrastructure projects. This includes funding the development, construction, and operation of power plants, transmission and distribution networks, and renewable energy installations. Private sector investment helps to bridge funding gaps, stimulate economic growth, and drive innovation in the energy sector. **2. Project Development and Implementation:** Private companies are often involved in the development, engineering, procurement, and construction (EPC) of energy projects. This includes designing and building power generation facilities, installing renewable energy systems, and deploying energy storage solutions. Private sector entities bring technical expertise, project management capabilities, and efficiency to the implementation process, ensuring timely and cost-effective project delivery. **3. Energy Service Provision:** Private sector firms provide energy services to end-users, including residential, commercial, and industrial customers. This may involve supplying electricity, natural gas, or other forms of energy, as well as offering energy efficiency solutions, demand-side management programs, and energy conservation services. Private sector energy providers play a key role in meeting the diverse energy needs of consumers and businesses.	**1. Public-Private Partnerships (PPPs):** The private sector engages in PPPs with government agencies to develop and operate energy infrastructure projects. PPPs involve collaboration between public and private entities to share risks, responsibilities, and rewards associated with project development. By leveraging the expertise and resources of both sectors, PPPs can accelerate the implementation of energy projects and optimize the use of public funds. **2. Industry Associations and Forums:** Private sector companies participate in industry associations, forums, and trade organizations focused on the energy sector. These platforms provide opportunities for networking, knowledge exchange, and collaboration among industry stakeholders. By engaging in industry associations, private sector firms can stay informed about industry trends, regulations, and market opportunities, and advocate for their interests.

4.4 ESS 2025/2029 Priority Interventions

The Energy Sector Strategic Plan (ESSP) aims to transform Rwanda's energy sector, ensuring reliable and universal access to electricity and clean cooking solutions for all citizens. Below are detailed matrices outlines the key outcomes, corresponding indicators, baseline data, and annual targets of the ESSP, along with responsible entities and data sources for monitoring and evaluation purposes. Each indicator is tracked over the 2024/25 to 2028/29 period to assess progress and inform decision-making for effective energy sector management.

4.4.1 Eletricity Generation

The Energy Sector Strategic Plan (ESSP) aims to transform Rwanda's energy sector, ensuring reliable and universal access to electricity and clean cooking solutions for all citizens. Below are detailed matrices outlines the key outcomes, corresponding indicators, baseline data, and annual targets of the ESSP, along with responsible entities and data sources for monitoring and evaluation purposes. Each indicator is tracked over the 2024/25 to 2028/29 period to assess progress and inform decision-making for effective energy sector management.

Table 2: Eletricity Generation

Indicator	Baseline (June 2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Installed Generation Capacity (MW)	400.1 MW	400.1 MW	410.073 MW	417.673 MW	481.303 MW	615.303 MW

The table above presents the baseline and annual targets for the indicator Installed Generation Capacity (MW) as outlined in the Energy Sector Strategic Plan (ESSP). In June 2024, the baseline for installed generation capacity was recorded at 400.1 MW.

The targets aim for a gradual expansion of the generation capacity, with the goal of reaching 410.073 MW by 2025/26, 417.673 MW by 2026/27, 481.303 MW by 2027/28, and 615.303 MW by the end of 2028/29. These targets reflect a strategic approach to enhancing the country's energy infrastructure, ensuring a reliable and sustainable electricity supply to meet the needs of households, businesses, industries, and other productive sectors. Achieving these targets will contribute to economic growth, job creation, and improved living standards for the citizens of Rwanda

4.4.2 Increased Household Access to Electricity

Table 3: Increased Household Access to Electricity

M&E Indicators	Baseline (June 2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Percentage (%) of households with access to on-grid electricity	54.70%	58.3%	62.8%	67.3%	71.4%	75.0%
Percentage (%) of households with access to off-grid electricity	22.70%	23.5%	24.0%	24.5%	24.8%	25.0%

Percentage (%) of productive users with access to electricity	86%	89%	92%	94%	97%	100%

The table above illustrates the targets and baseline percentages for increased household access to electricity, focusing on both on-grid and off-grid connections as well as access for productive users. In June 2024, the baseline percentage of households with access to on-grid electricity stood at 54.70%. The ESSP aims to progressively increase this figure over the next five years, with annual targets set at 58.3% for 2024/25, 62.8% for 2025/26, 67.3% for 2026/27, 71.4% for 2027/28, and 75.0% for 2028/29. Similarly, the baseline percentage of households with access to off-grid electricity was 22.70%, with annual targets set to increase slightly each year, reaching 25.0% by 2028/29.

The ESSP aims to ensure that productive users have access to electricity, with a baseline of 86% in June 2024. The targets for this indicator are notably higher, with an increase to 89% in 2024/25, followed by successive increases to reach 100% by 2028/29. These targets underscore the commitment to improving electricity access for both residential and productive purposes, aiming for universal access by the end of the strategic planning period.

4.4.3 The access to electricity

Table 4:The access to electricity

Indicator	Baseline (June 2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Percentage (%) of productive users with access to electricity	86%	89%	92%	94%	97%	100%

The table above illustrates the targets and baseline percentage for the indicator Percentage of productive users with access to electricity as outlined in the Energy Sector Strategic Plan (ESSP). In June 2024, the baseline percentage of productive users with access to electricity was recorded at 86%.

The targets aim for steady improvement, with the goal of reaching 89% by 2024/25, 92% by 2025/26, 94% by 2026/27, 97% by 2027/28, and ultimately achieving universal access of 100% by the end of 2028/29. These targets reflect a commitment to ensuring that all productive users, including businesses, industries, and agricultural operations, have reliable access to electricity to support economic growth, increase productivity, and improve the quality of life in both rural and urban areas.

4.4.4 Clean Cooking using Improved and effient cook stoves

Table 5: Clean Cooking using Improved and effient cook stoves

Indicator	Baseline (June 2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Number of households (HHs) using efficient biomass cook stoves (Tier 3+)	1,523,111	226,144	339,216	339,216	113,072	113,072

Number of households (HHs) with access to clean non-biomass stoves	22,253	91,103	136,654	136,654	45,551	45,551

The table above illustrates the baseline and annual targets for two key indicators related to the increased use of efficient cook stoves, as outlined in the Energy Sector Strategic Plan (ESSP).

Number of households using efficient biomass cook stoves (Tier 3+): The baseline recorded in June 2024 was 1,523,111 households. The ESSP sets annual targets to increase the adoption of these stoves, with targets of 226,144 households for 2024/25, 339,216 households for 2025/26, 339,216 households for 2026/27, and 113,072 households for both 2027/28 and 2028/29. This strategy aims to promote the use of cleaner and more efficient cooking technologies, such as Tier 3+ biomass stoves, to reduce reliance on traditional biomass fuels, improve indoor air quality, and mitigate environmental degradation.

Number of households with access to clean non-biomass stoves: The baseline in June 2024 was 22,253 households. The ESSP targets significant increases in the adoption of clean non-biomass stoves, such as electric, LPG, or ethanol stoves, with targets of 91,103 households for 2024/25, 136,654 households for 2025/26, 136,654 households for 2026/27, and 45,551 households for both 2027/28 and 2028/29. This initiative aims to diversify cooking fuel sources, promote cleaner energy alternatives, and improve overall household energy efficiency and safety.

4.4.5 Reliability of Power Network and Supply

Table 6: Reliability of Power Network and Supply

Indicator	Baseline (June 2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Percentage of losses in the transmission and distribution networks	16.90%	16.6%	15.9%	15.2%	14.7%	14.7%
SAIFI (Average number of interruptions)	16.90%	21.0%	20.3%	19.6%	18.9%	18.3%
SAIDI (Average hours without power)	14.43 Hrs	14.9 Hrs	14.1 Hrs	13.4 Hrs	12.7 Hrs	12.0 Hrs

The table above presents key indicators related to the improved power transmission and distribution network for the reliability of power supply, as outlined in the Energy Sector Strategic Plan (ESSP).

Percentage of losses in the transmission and distribution networks: The baseline recorded in June 2024 was 16.90%. The ESSP sets annual targets to reduce losses in the transmission and distribution networks, with targets of 16.6% for 2024/25, 15.9% for 2025/26, 15.2% for 2026/27, and 14.7% for both 2027/28 and 2028/29. This indicator measures the efficiency of the power transmission and distribution infrastructure, with lower percentages indicating reduced energy losses and improved network performance.

SAIFI (Average number of interruptions): The baseline in June 2024 was 16.90%. SAIFI, which stands for System Average Interruption Frequency Index, measures the average number of interruptions experienced by customers over a specific period. The ESSP targets reducing interruptions, with annual targets of 21.0% for 2024/25, 20.3% for 2025/26, 19.6% for 2026/27, 18.9% for 2027/28, and 18.3% for 2028/29. Lower SAIFI values indicate improved network reliability and fewer disruptions in power supply.

SAIDI (Average hours without power): The baseline recorded in June 2024 was 14.43 hours. SAIDI, which stands for System Average Interruption Duration Index, measures the average duration of power interruptions experienced by customers. The ESSP targets reducing the duration of power outages, with annual targets of 14.9 hours for 2024/25, 14.1 hours for 2025/26, 13.4 hours for 2026/27, 12.7 hours for 2027/28, and 12.0 hours for 2028/29. Lower SAIDI values indicate improved network reliability and faster restoration times during power outages.

4.4.6 Petroleum, oil and Gas Strategic Reserves

Table 7: Petroleum, oil and Gas Strategic Reserves

Indicator	Units	Baseline (June 2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Petroleum strategic reserves	Millions of liters	118 Million of Liters	119.5	119.5	119.5	180	230
Gas strategic reserves	Millions of liters	119 Million of Liters	119.5	119.5	119.5	180	230

The table above presents the current baseline and annual targets for petroleum and gas strategic reserves in millions of liters, as outlined in the Energy Sector Strategic Plan (ESSP). By june 2024, the petroleum reserves is at 118 million liters, while for gas reserves, it is 119.5 million liters. From 2024/25 to 2028/29, there is a consistently increased in both petroleum and gas reserves. By the end of 2028/29, the target for petroleum and gas reserves is set at 230 million liters.

These strategic reserves are crucial for ensuring energy security and stability in Rwanda. They serve as a buffer against supply disruptions and price fluctuations in international oil and gas markets. The targets for increasing these reserves demonstrate the government's commitment to enhancing energy resilience and mitigating risks associated with energy supply.

4.5 Risks and Mitigation

The success of the Energy Sector Strategic Plan (ESSP) 2025/2029 is contingent upon the effective management of risks inherent in the execution of such an ambitious initiative. Technical risks, such as delays in project completion and technical failures, can impede progress and hinder the achievement of ESSP goals. Financial risks, including budget overruns and funding shortages, may undermine the financial sustainability of projects and jeopardize their long-term viability. Environmental risks, such as environmental degradation and public health concerns, can arise from inadequate environmental management practices during project implementation.

Moreover, regulatory risks stemming from changes in government policies and regulations can introduce uncertainties and constraints that impede project development and implementation. Social risks, such as community opposition and conflicts over land acquisition and resettlement, can lead to project delays, reputational damage, and increased costs. To mitigate these risks effectively, it is imperative to develop a comprehensive Risks and Mitigation Plan that addresses each risk category systematically and implements appropriate strategies to mitigate their impacts.

RISKS	RANTIONALE	EVIDENCE FROM HE PAST	LEVEL OF OCUR-RANCE	MITIGATIONS
Technical Risks	These risks relate to the technical aspects of energy infrastructure development, such as project design, construction, and operation. Potential risks include;	For instance, the construction of the KivuWatt Methane Power Plant in Rwanda faced delays due to technical challenges, regulatory issues, and unexpected geological complexities. These delays extended the project	Low	◆ Conduct thorough feasibility studies and technical assessments to identify potential challenges and develop mitigation measures.

Technical Risks	◆ Delays in project completion; ◆ Infrastructure Technical failures; ◆ Inadequate maintenance;	timeline and increased costs, highlighting the susceptibility of energy projects to such risks. Hakan and Gishoma Peat-to-Power Plants have been performing on a seasonal availability basis due to lack of sufficient peat resources	**Low**	◆ Implement robust project management practices, including regular monitoring, quality control, and risk assessments throughout the project lifecycle. ◆ Invest in workforce training and capacity building to ensure that staff have the necessary skills and expertise to address technical challenges effectively.
Financial Risks	Financial risks represent a critical aspect of energy infrastructure development, impacting the implementation and success of projects outlined in the Energy Sector Strategic Plan (ESSP). Budget overruns, often resulting from inaccurate cost estimations, unforeseen expenses, and changes in project scope.	Kivuwatt Methane Gas Extraction and Power Generation Project, aimed at harnessing methane gas from Lake Kivu to generate electricity. The bureaucracy involved in reaching agreements and securing funding for regional projects like the Rusizi Hydro Power plant has led to significant delays. Despite its potential to significantly contribute to Rwanda's energy mix, the project faced budget overruns during its construction phase.	**Medium**	◆ Develop realistic project budgets and financial projections based on comprehensive cost estimates and risk assessments. ◆ Diversify funding sources and explore innovative financing mechanisms, such as public-private partnerships, to mobilize additional resources. ◆ Establish contingency funds and financial reserves to mitigate unforeseen expenses and budget fluctuations.
Environmental and Climate change Risks	Environmental risks pertain to the potential negative impacts of energy projects on ecosystems. Rwanda already is experiencing the heavy effects of climate change ie heavy floods and landslides which may affect the energy infrastructures.	The Nyabarongo hydropower projects, situated along the Nyabarongo River, have raised concerns about their potential impact on local ecosystems and water resources. The construction of dams and reservoirs may alter river flow patterns, disrupt aquatic habitats, and affect fish migration routes, threatening biodiversity in the region.	**High**	◆ Adhere to stringent environmental standards and regulations throughout project planning, construction, and operation. ◆ Implement robust environmental impact assessments (EIAs) and mitigation plans to minimize adverse environmental impacts and protect natural resources. ◆ Designing and installation of climate resilient infrastructures.
Regulatory Risks	Regulatory risks stem from changes in government policies, regulations, and legal frameworks governing the energy sector, low understanding of PPA's, Uncertain or evolving regulatory environments may create challenges for project development and implementation.	In Rwanda, regulatory risks in the energy sector are influenced by changes in government policies, regulations, and legal frameworks, which can impact the investment climate and project viability. One notable example is the introduction of the Renewable Energy Fund (REF) by the Rwandan government to support the	**Medium**	◆ Maintain close communication with government authorities and regulatory bodies to stay informed about changes in policies, regulations, and legal requirements.

		development of renewable energy projects. While initiatives like the REF aim to incentivize investment in clean energy, changes in funding mechanisms and eligibility criteria can introduce regulatory uncertainty, affecting project developers' confidence and willingness to invest.	Medium	◆ Advocate for supportive policy frameworks and regulatory incentives to facilitate project development and implementation. ◆ Establish partnerships and alliances with relevant stakeholders, including government agencies, industry associations, and non-governmental organizations, to influence policy decisions and promote a favorable regulatory environment.

CHAPTER 5: MONITORING AND EVALUATION

Monitoring and Evaluation (M&E) is paramount for ensuring the success and effectiveness of the Energy Sector Strategic Plan (ESSP) within the National Strategy for Transformation 2 (NST2) planning period. This framework is designed to provide a structured approach to measure progress, assess outcomes, and enhance decision-making processes. The M&E framework adopts a systematic approach to measure progress towards achieving the objectives of the ESSP. It involves regular data collection, analysis, and reporting to track the implementation of key initiatives and interventions. By assessing progress against predetermined benchmarks, stakeholders can identify areas of success and areas requiring improvement. Key performance indicators (KPIs) are identified to measure progress on strategic objectives outlined in the ESSP. These indicators are carefully selected based on their relevance, measurability, and alignment with NST2 priorities. Policy actions are also established to support the achievement of these objectives, including regulatory reforms, investment incentives, and capacity-building initiatives.

The M&E framework presents outcomes for the period 2024 to 2029, highlighting progress on strategic objectives and KPIs. These outcomes serve as indicators of the effectiveness of interventions implemented under the ESSP. By analyzing outcomes over time, stakeholders can assess the impact of sectoral policies and programs and make informed decisions for future planning. Sector MIS are integral to the M&E framework, providing the necessary infrastructure to support data collection, analysis, and reporting within the energy sector. These systems enable stakeholders to access real-time information, track progress on key indicators, and make data-driven decisions. By leveraging MIS, stakeholders can enhance transparency, accountability, and efficiency in monitoring and evaluation efforts.

5.1 Monitoring &Evaluation Framework

The Monitoring and Evaluation (M&E) framework will serves as a critical tool to assess progress and effectiveness in implementing the Energy Sector Strategic Plan (ESSP) over the NST2 planning period. This structured approach encompasses several key components:

1. **Strategic Objectives:** Clear and measurable strategic objectives are foundational to the M&E framework. These objectives are carefully aligned with the priorities and thematic areas outlined in NST2. They serve as guiding principles for the development of key performance indicators (KPIs) and policy actions, ensuring that monitoring efforts are closely linked to overarching goals.

2. **KPIs:** Key performance indicators are identified to measure progress towards each strategic objective. These KPIs are selected based on their relevance, measurability, and ability to track the impact of interventions. By defining specific metrics for success, stakeholders can effectively monitor and evaluate the outcomes of the ESSP initiatives.

3 **Data Collection and Sources:** The M&E framework outlines data collection methods and sources to gather relevant information for monitoring progress. These may include surveys, administrative records, stakeholder consultations, and other sources of data. Regular data collection ensures timely monitoring of progress and facilitates the identification of emerging trends and challenges.

4 **Data Analysis and Reporting:** Collected data is subjected to thorough analysis to assess progress on KPIs and identify trends. Data analysis techniques such as statistical analysis, trend analysis, and qualitative interpretation are employed to derive meaningful insights. Regular progress reports are generated to communicate findings to stakeholders, providing transparency and facilitating evidence-based decision-making at all levels.

5 **Stakeholder Engagement:** Stakeholder engagement is integrated into the M&E process to ensure buy-in and ownership of the evaluation efforts. Stakeholders are actively involved in data collection, analysis, and interpretation, fostering collaboration and partnership. By engaging stakeholders throughout the monitoring and evaluation process, the ESSP implementation can benefit from diverse perspectives and collective expertise.

Table 9: Summary of the ESSP 2025/2029

ESSP2025/9 Outcome	Indicators	Units	Baseline (2024)	2024/25	2025/26	2026/27	2027/28	2028/29
Increased Household Access to Electricity	Households with access to on-grid electricity	%	54.70%	58.3%	62.8%	67.3%	71.4%	75.0%
	Households with access to off-grid electricity	%	22.70%	23.5%	24.0%	24.5%	24.8%	25.0%
	Productive user access to electricity	%	86%	89%	92%	94%	97%	100%
Increased network of street lights on new	Number of Km of street lights installed	Kms	2,227.62	2,285.86	2,555.24	2,705.22	2,870.20	3,189.02
Increased Electricity Generation Capacity	MW installed generation capacity	MW	400.1	400.100	410.073	417.673	481.303	615.303
Increased the number of households using	Number of households using efficient biomass cook stoves	Cook Stoves	1,523,111	226,144	339,216	339,216	113,072	113,072
	Number of households with access to clean non-biomass stoves	Cook Stoves	22,253	91,103	136,654	136,654	45,551	45,551
Improved Power Transmission and Distribution	Losses in the transmission and distribution networks	%	16.90%	16.6%	15.9%	15.2%	14.7%	14.7%
Network for reliability of power supply	SAIFI (avg no of interruptions)	Hours	16.90%	21%	20.3%	19.6%	18.9%	18.3%
	SAIFI (avg hrs without power)	Hours	14.43	14.9	14.1	13.4	12.7	12.0
Increased Petroleum Strategic Reserves, Oil and Gas	Petroleum strategic reserves	Millions of liters	118	119.5	119.5	119.5	180	230
	Gas strategic reserves	Millions of liters	119	119.5	119.5	119.5	180	230

5.2 Monitoring and Evaluation Strategyies

Table 10: Monitoring and Evaluation Strategyies

Indicators	Units	Targets by 2028/29	M&E Strategies
Households with access to on-grid electricity	%	75.0%	**1. Regular Surveys:** The Energy Integrated Household Survey (EICV) is a key tool utilized to assess household electricity access regularly. Conducted at intervals determined by the ESSP implementation timeline, these surveys gather comprehensive data on the availability and reliability of electricity supply across different regions and demographic groups. By collecting data directly from households, surveys like EICV provide valuable insights into the progress of increasing household access to electricity. **2. Collaboration with Government Agencies:** Collaboration with the Ministry of Infrastructure (MININFRA) and the Rwanda Energy Group (REG) is essential for effective data collection and analysis. These government agencies have mandates related to energy planning, regulation, and oversight. They possess valuable resources and expertise in data collection methodologies, analysis techniques, and policy implementation. By leveraging their capabilities, stakeholders can ensure that data collected through surveys like EICV are accurately analyzed and used to inform policy decisions and interventions. **3. Data Collection and Analysis:** Collaboration with MININFRA and REG extends beyond data collection to include data analysis. These agencies play a crucial role in analyzing the data gathered from surveys and other sources to assess progress towards ESSP targets. By applying statistical techniques and interpreting the data in the context of energy policies and infrastructure development, MININFRA and REG can provide valuable insights into the effectiveness of interventions aimed at increasing household access to electricity. This collaborative approach ensures that monitoring and evaluation efforts are robust and evidence-based, enabling stakeholders to make informed decisions regarding future energy sector investments and policies.
Households with access to off-grid electricity	%	25.0%	**1. Periodic Assessments:** Conducting periodic assessments of street lighting infrastructure expansion is crucial to track progress towards the ESSP targets. These assessments involve systematic reviews of the installation and expansion of street lighting networks across national and urban roads. By periodically evaluating the extent of infrastructure development, stakeholders can identify areas of success and potential challenges, allowing for timely adjustments to implementation strategies. **2. Collaboration with Relevant Agencies:** Collaboration with relevant agencies such as the Rwanda Energy Group (REG), Rwanda Transport Development Agency (RTDA), and district authorities is essential for effective monitoring and evaluation. These agencies are directly involved in the planning, implementation, and management of street lighting projects. By partnering with them, stakeholders can access reliable data on street lighting installations, operational status, and maintenance activities. Additionally, collaboration facilitates data verification and validation, ensuring the accuracy and integrity of monitoring efforts. **3. Data Collection and Verification:** Robust data collection and verification processes are fundamental to monitoring the expansion of street lighting infrastructure. Through collaboration with REG, RTDA, and district authorities, stakeholders can access comprehensive datasets on the number of kilometers of street lights installed, their geographic distribution, and operational performance. Regular data verification exercises help confirm the accuracy of reported information and address any discrepancies or inconsistencies.
Productive user access to electricity	%	25.0%	**1. Report Analysis:** Regular monitoring of the addition of new generation capacity involves analyzing reports from energy providers and regulatory authorities such as the Rwanda Energy Group (REG) and the Ministry of Infrastructure (MININFRA). These reports provide valuable insights into the progress of generation capacity expansion projects, including the installation of new power plants, upgrades to existing infrastructure, and integration of renewable energy sources. By analyzing these reports, stakeholders can track the implementation of initiatives outlined in the ESSP and assess their impact on increasing electricity generation capacity. **2. Collaboration with Energy Providers and Regulatory Authorities:** Collaboration with energy providers and regulatory authorities is essential for effective monitoring and evaluation. By partnering with organizations like REG and MININFRA, stakeholders gain access to comprehensive data on new generation capacity additions, including technical specifications, project timelines, and operational performance. Regular consultations and coordination meetings ensure that stakeholders are kept informed about progress and challenges in expanding generation capacity, allowing for timely interventions and adjustments to implementation strategies.

Number of Km of street lights installed	**Kms**	**3,189.02**	**1. Street Lights Installation Tracking:** Monitoring the number of kilometers (Km) of street lights installed involves implementing a systematic tracking system to record the expansion of street lighting infrastructure. This can be achieved through collaboration with relevant agencies such as the Rwanda Energy Group (REG), Rwanda Transport Development Agency (RTDA), and district authorities. Regular field assessments, site visits, and data collection exercises are conducted to verify the installation of street lights along new and existing national and urban roads. **2. Generation Capacity Installation Monitoring:** Monitoring the installed generation capacity in megawatts (MW) entails tracking the implementation of projects aimed at expanding electricity generation infrastructure. This involves close collaboration with energy providers, regulatory authorities, and relevant stakeholders to gather data on newly installed generation capacity. Regular reports and updates from energy providers and regulatory agencies such as the Rwanda Energy Group (REG) and the Ministry of Infrastructure (MININFRA) are analyzed to assess the progress of generation capacity installation projects. Additionally, periodic site inspections and technical assessments are conducted to verify the completion and operational status of new power plants and generation facilities.
MW installed generation capacity	**MW**	**615.303**	**1. Regular Progress Tracking:** Implementing a regular progress tracking system to monitor the installation of generation capacity is crucial. This involves setting up mechanisms to receive regular updates from energy providers and regulatory authorities regarding the progress of installation projects. These updates can include reports, project status updates, and technical assessments. By establishing a systematic tracking process, stakeholders can continuously monitor the progress towards achieving the target of 615.303 MW installed generation capacity by 2029. **2. Performance Monitoring of Generation Projects:** Conducting performance monitoring of ongoing generation projects is essential to ensure that they are progressing according to schedule and meeting quality standards. This involves conducting periodic site visits, technical inspections, and performance evaluations of the generation facilities under construction. **3. Collaboration with Energy Providers and Regulatory Authorities:** Collaboration with energy providers such as the Rwanda Energy Group (REG) and regulatory authorities like the Ministry of Infrastructure (MININFRA) is critical for effective monitoring and evaluation. By working closely with these stakeholders, relevant data on the progress of generation capacity installation projects can be obtained, analyzed, and verified. Regular meetings, consultations, and information-sharing sessions can facilitate effective collaboration and ensure that monitoring efforts are aligned with the objectives of the Energy Sector Strategic Plan (ESSP). **4. Utilization of Performance Indicators:** Establishing and utilizing performance indicators related to generation capacity installation can provide valuable insights into progress and performance. These indicators may include the number of MW installed, completion rates of projects, adherence to timelines, and quality standards.
Number of households using efficient biomass cook stoves	**Cook Stoves**	**113,072**	**1. Data Utilization from EICV:** The Energy Integrated Household Survey (EICV) serves as a valuable source of data for monitoring household access to clean cooking technologies. This survey collects comprehensive information on energy usage patterns, including the types of cooking technologies used by households. By analyzing data from the EICV, stakeholders can track trends in the adoption of clean cooking technologies over time, assess progress towards targets, and identify areas for intervention. Regular updates and reports derived from the EICV provide insights into the effectiveness of clean cooking promotion initiatives and inform decision-making processes. **2. Collaboration with MININFRA and REG:** Close collaboration with government agencies such as the Ministry of Infrastructure (MININFRA) and the Rwanda Energy Group (REG) is essential for effective monitoring and promotion of clean cooking technologies. MININFRA plays a key role in policy formulation and regulatory oversight related to energy access, while REG is responsible for implementing energy projects and initiatives. **3. Engagement with NGOs:** Non-governmental organizations (NGOs) play a crucial role in promoting clean cooking technologies and raising awareness about their benefits among households. Collaboration with NGOs working in the energy sector enables stakeholders to leverage their grassroots networks, community outreach programs, and advocacy efforts to accelerate the adoption of clean cooking technologies. NGOs can facilitate training sessions, awareness campaigns, and technology demonstrations to promote behavior change and encourage the use of cleaner and more efficient cooking solutions. By engaging with NGOs, stakeholders can amplify their monitoring efforts and reach a wider audience with targeted interventions. **4. Monitoring and Promotion Synergy:** Integrating monitoring and promotion activities allows stakeholders to simultaneously track progress
Number of households with access to clean non-biomass stoves	**Cook Stoves**	**45,551**	

			and drive adoption of clean cooking technologies. By combining data analysis from sources like the EICV with targeted promotional campaigns and outreach activities, stakeholders can create synergies that enhance the effectiveness of their interventions. For example, insights from monitoring efforts can inform the design of promotional materials, messaging strategies, and community engagement initiatives tailored to specific demographic groups or geographic areas. This holistic approach maximizes the impact of monitoring and evaluation efforts, leading to more sustainable outcomes in the transition to clean cooking technologies.
Losses in the transmission and distribution networks	%	14.7%	**1. Regular Audits and Assessments:** To monitor the performance of power transmission and distribution infrastructure, regular audits and assessments are conducted. These assessments evaluate the condition, efficiency, and reliability of the infrastructure, identifying areas for improvement and optimization. **2. Collaboration with REG and MININFRA:** Collaboration with relevant stakeholders such as the Rwanda Energy Group (REG) and the Ministry of Infrastructure (MININFRA) is essential for data collection and analysis. REG is responsible for managing the transmission and distribution networks, while MININFRA provides oversight and regulatory guidance. By collaborating with these entities, stakeholders can access accurate data on transmission and distribution performance, analyze trends, and identify strategies for improvement. **3. Data Collection and Analysis:** Data on transmission and distribution performance, including losses, SAIFI, and SAIDI, are collected and analyzed regularly. This data enables stakeholders to track progress, assess the impact of interventions, and make informed decisions to enhance the reliability and efficiency of the power supply network. Regular reporting and data sharing facilitate transparency and accountability in the monitoring and evaluation process, driving continuous improvement in power transmission and distribution infrastructure.
SAIFI (avg no of interruptions)	Hours	18.3%	
SAIDI (avg hrs without power)	Hours	12.0	
Petroleum strategic reserves	Millions of liters	230	**1. Collaboration with MINICOM, MININFRA, and REG:** Effective monitoring and maintenance of petroleum and gas strategic reserves require close collaboration among relevant stakeholders, including the Ministry of Trade and Industry (MINICOM), the Ministry of Infrastructure (MININFRA), and the Rwanda Energy Group (REG). MINICOM oversees trade and commerce, while MININFRA provides regulatory oversight, and REG manages energy resources and infrastructure. Collaborative efforts ensure coordination in monitoring and maintaining strategic reserves, aligning actions with policy objectives, and addressing any challenges or issues that may arise. **2. Regular Reporting and Assessments:** Stakeholders conduct regular reporting and assessments to track the status of petroleum and gas strategic reserves. These assessments involve monitoring inventory levels, replenishment rates, and compliance with established targets. Regular reporting ensures transparency and accountability in the management of strategic reserves, enabling stakeholders to identify any deviations from targets and take corrective actions as necessary. **3. Compliance Monitoring:** Monitoring and evaluation efforts also focus on ensuring compliance with targets set for petroleum and gas strategic reserves. By comparing actual reserve levels against target benchmarks, stakeholders can assess progress and identify areas requiring attention or improvement. Compliance monitoring helps maintain sufficient reserves to meet energy demand, enhance resilience to supply disruptions, and support long-term energy security objectives.

5.3 Establishment of Sector Management Information Systems (MIS)

In the context of the energy sector, Management Information Systems (MIS) play a pivotal role in supporting data collection, analysis, and reporting processes. These systems are essential for enhancing transparency, accountability, and efficiency in the management of energy-related activities, programs, and initiatives. The establishment of Sector MIS involves several key components and considerations:

1 **Data Collection Mechanisms:** Sector MIS encompass robust data collection mechanisms designed to capture relevant information on energy sector activities, performance indicators, and outcomes. These mechanisms may include automated data collection tools, surveys, monitoring systems, and reporting mechanisms.

2 **Data Storage and Management:** Sector MIS incorporate secure and reliable data storage and management infrastructure to ensure the integrity, accessibility, and confidentiality of information. Cloud-based platforms, databases, and information management systems are commonly utilized to store and organize data in a structured manner.

3 **Data Analysis and Reporting:** Sector MIS enable comprehensive data analysis and reporting functionalities, allowing stakeholders to derive insights, identify trends, and monitor progress in real-time. Advanced analytical tools, visualization techniques, and dashboards facilitate the generation of reports, dashboards, and performance metrics.

4 **Integration with Stakeholder Systems:** Sector MIS are designed to integrate seamlessly with existing stakeholder systems, including government databases, sectoral platforms, and external data sources. This integration enables data interoperability, collaboration, and information exchange among stakeholders involved in energy sector activities.

5 **User Access and Training:** Sector MIS provide user-friendly interfaces and access controls to ensure that stakeholders can easily access and utilize the system. Training programs, user manuals, and technical support services are offered to enhance the capacity of users to navigate the MIS effectively and leverage its functionalities.

6 **Compliance and Security:** Sector MIS adhere to relevant data protection regulations and security standards to safeguard sensitive information and prevent unauthorized access or breaches. Encryption, authentication measures, and regular security audits are implemented to mitigate cybersecurity risks and vulnerabilities.

CHAPTER 6: COSTING AND FINANCING

Energy Sector Strategic Plan (ESSP) is dedicated to Costing and Financing, which is crucial for determining the financial requirements and securing the necessary resources for successful implementation. This involves a detailed analysis of the costs associated with implementing the strategies outlined in the ESSP, including investments in infrastructure, technology, capacity building, and other relevant areas. Costing involves estimating both capital expenditures (CAPEX) and operational expenditures (OPEX) over the plan's timeframe, typically covering a period of five to ten years.

6.1 Costing Breakdown and Analysis

The Costing Analysis within the ESSP involves a detailed assessment of the financial resources needed to achieve the plan's objectives. It begins with a thorough breakdown of the costs associated with each strategic initiative outlined in the plan, considering factors such as infrastructure development, capacity building, technology adoption, and policy implementation. This analysis utilizes data from feasibility studies, market assessments, and expert consultations to generate accurate cost estimates.

Costing Analysis entails estimating both the initial capital investment required (CAPEX) and the ongoing operational expenses (OPEX) over the duration of the plan (2025-2030). It takes into account various cost components, including material and labor costs, technology prices, inflation rates, and potential risks or uncertainties that may impact project expenses. By conducting a comprehensive Costing Analysis, the ESSP ensures that its financial projections are realistic and aligned with the expected outcomes.

6.2 Climate Change Interventions Costing

The Costing and Financing shall have a special focus specifically on estimating the financial requirements for climate change interventions embedded within the ESSP. It identifies measures necessary to adapt to and mitigate the impacts of climate change on the energy sector, such as enhancing infrastructure resilience, transitioning to cleaner energy sources, and

implementing energy efficiency measures.

The Costing of Climate Change Interventions considers the long-term benefits of investing in resilience and mitigation, such as reduced vulnerability to extreme weather events, enhanced energy security, and mitigation of greenhouse gas emissions. It may incorporate cost-benefit analyses to evaluate the economic viability and return on investment of climate adaptation and mitigation measures, ensuring that financial resources are allocated effectively to address climate-related challenges.

6.3 Financing Plan Development

The Financing Plan Development outlines strategies and mechanisms for mobilizing the financial resources required to implement the ESSP. It explores a diverse range of funding sources, including government budgets, international aid, private sector investments, and innovative financing mechanisms. The Financing Plan aims to diversify funding streams and optimize resource allocation to ensure the effective implementation of priority initiatives.

Strategies within the Financing Plan include leveraging public-private partnerships, accessing climate finance mechanisms such as the Green Climate Fund, and attracting foreign direct investment in the energy sector. It also considers the potential role of innovative financing instruments, such as carbon pricing mechanisms or green bonds, to generate additional revenue for energy projects. Additionally, the Financing Plan addresses the importance of fiscal sustainability and responsible debt management to avoid financial constraints and ensure the long-term viability of the ESSP.

CHAPTER 7: ANNEXES

Annex 1: NST2 MATRICES