National Energy Efficiency Action Plan (NEEAP) of São Tomé and Príncipe

Period 2021-2030/2050

In the framework of the vision
"São Tomé and Príncipe 2030: The country we need to build"

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Validated for approval: January 17, 2022

With technical and financial assistance from the United Nations Industrial Development Organization (UNIDO) and the Global Environment Facility (GEF) under the project "Strategic program to promote renewable energy and energy efficiency investments in the electricity sector."

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With consulting support from:

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ACRONYMS AND ABBREVIATIONS

AFAP	Project Administration Supervision Agency (Agência Fiduciária de Administração de Projectos)
AfDB	African Development Bank (BAD – Banco Africano de Desenvolvimento)
AGER	General Regulatory Authority (Autoridade Geral de Regulação)
ANP	National Petroleum Agency (Agência Nacional do Petróleo)
BAU	Business as Usual
CC-PTSE	Coordination Committee for the Electricity Sector Transformation Program (Comité de Coordenação do Programa de Transformação do Sector Eléctrico)
CP-PTSE	Steering Committee for the Electricity Sector Transformation Program (Comité Piloto do Programa de Transformação do Sector Eléctrico)
CT-PTSE	Technical Committee to support the Electricity Sector Transformation Program (Comité Técnico de apoio ao Programa de Transformação do Sector Eléctrico)
DGE	Directorate General of Environment (Direcção Geral do Ambiente)
DGRNE	Directorate General for Natural Resources and Energy (DGRNE – Direcção Geral dos Recursos Naturais e Energia)
DL	Decree Law
ECCAS	Economic Community of Central African States (CEEAC – Comunidade Económica dos Estados da África Central)
EE	Energy Efficiency
EIB	European Investment Bank (BEI – Banco Europeu de Investimento)
EMAE	Water and Electricity Company (Empresa de Água e Electricidade)
GCF	Green Climate Fund
GDP	Gross Domestic Product (PIB – Produto Interno Bruto)
GEF	Global Environment Facility
GHG	Greenhouse Gases (GEE – Gases com Efeito de Estufa)
GHI	Global Horizontal Irradiation
GT-PTSE	Technical Group supporting the Electricity Sector Transformation Program (Grupo Técnico de apoio ao Programa de Transformação do Sector Eléctrico)
INPIEG	National Institute for the Promotion of Gender Equality and Equity (Instituto Nacional para a Promoção da Igualdade e da Equidade de Género)
LCDP	Least Cost Development Plan (PDMC – Plano de Desenvolvimento de Menor Custo)
LCOE	Levelized Cost of Energy

LPG	Liquefied Petroleum Gas (GPL – Gás de Petróleo Liquefeito)
MIRN	Ministry of Infrastructure and Natural Resources (MIRN – Ministério das Infraestruturas e Recursos Naturais)
MPFEA	Ministry of Planning, Finance and Blue Economy (Ministério do Planeamento, Finanças e Economia Azul)
NA	Not Available
NEB	National Energy Balance (BEN – Balanço Energético Nacional)
NEEAP	National Energy Efficiency Action Plan (Plano de Acção Nacional de Eficiência Energética)
NREAP	National Renewable Energy Action Plan (PANER – Plano de Acção Nacional das Energias Renováveis)
PNES	National Sustainable Energy Platform (Plataforma Nacional de Energia Sustentável)
PPA	Power Purchase Agreement (CAE – Contrato de Aquisição de Energia)
PPP	Public-Private Partnerships
PV	Photovoltaic (FV – Fotovoltáicas)
RAP	Autonomous Region of Príncipe (Região Autónoma do Príncipe)
RE	Renewable Energies (ER – Energias renováveis)
RJSE	Legal Regime of the Electricity Sector (Regime Jurídico do Sector Eléctrico)
SIDS	Small Island Developing States (PEID – Pequenos Estados Insulares em Desenvolvimento)
STP	São Tomé and Príncipe
UNDP	United Nations Development Programme (PNUD – Programa das Nações Unidas para o Desenvolvimento)
UNIDO	United Nations Industrial Development Organization (ONUDI – Organização das Nações Unidas para o Desenvolvimento Industrial)
WB	World Bank (BM – Banco Mundial)

INTRODUCTION

The sustainable industrial and socio-economic development of São Tomé and Príncipe (STP) is heavily dependent on reforming the energy sector and transitioning from an almost complete reliance on fossil fuels to renewable energy (RE) coupled with energy efficiency (EE). However, introducing RE and EE products and services into the market is hampered by a wide range of demand-side and supply-side barriers, which need to be addressed simultaneously.

To address the existing barriers, the STP Government, with the support of the United Nations Industrial Development Organization (UNIDO), has developed the National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP) under the project: "Strategic program to promote renewable energy and energy efficiency investments in the electricity sector."

These were prepared during 2020 and 2021 under the leadership of the General Directorate of Natural Resources and Energy (DGRNE) of the Ministry of Infrastructure and Natural Resources (MIRN) and by the National Sustainable Energy Platform (PNES). The targets described in the NEEAP and the NREAP were validated by the STP Government through a participatory process led by PNES/DGRNE, involving the exchange of opinions and information, a series of meetings and discussions with PNES/DGRNE, and revisions of the draft plans by PNES/DGRNE and UNIDO. The process was coordinated with the United Nations Development Programme (UNDP), the World Bank (WB), the African Development Bank (AfDB) and others.

The NREAP and NEEAP provide the Government with practical guidance on how to make the energy transition a reality by 2030 and 2050. Based on energy modeling using Low Emissions Analysis Platform (LEAP) software, the NREAP and NEEAP propose a low-carbon scenario that will significantly reduce the country's energy costs and greenhouse gas (GHG) emissions. Energy transition is a prerequisite for the achievement of important national, regional and global policy goals.

The main reference documents used in developing the NREAP and the NEEAP are: Vision 2030 "São Tomé and Príncipe 2030: the country we need to build", the Blue Economy Transition Strategy for São Tomé and Príncipe, Agenda 2030 and Agenda 2063: "The Africa We Want", the Nationally Determined Contributions (NDC, 2021), the Third National Communication (TNC) on Climate Change, the National Action Plan for Adaptation to Climate Change (NAPA) and ECCAS/CAEMC regional policies. Implementing the action plans will enable the country to achieve Sustainable Development Goal 7 (SDG-7), which aims for universal access to affordable, reliable, sustainable and modern energy services by 2030.

The NREAP and NEEAP propose a set of targets and measures to be implemented by 2030 and 2050. The well-integrated documents consider urban and rural contexts, electricity and heat aspects, and important cross-sectoral policies (e.g. climate mitigation/adaptation, trade, education, research, buildings, transport, tourism, health, agriculture, fisheries and other sectors of the economy). The NREAP targets complement the targets established in the NEEAP, while also complementing the targets for reduction of GHG emissions and for universal access to energy.

The NREAP and NEEAP are tightly interconnected and mutually reinforcing. For example, introducing EE standards and the related reductions in energy demand will have a positive impact on RE penetration in the grid. The NEEAP defines specific targets for the EE sector, the main target being increasing the country's EE. Section 5 describes the specific EE targets in terms of reducing power grid losses, replacing incandescent light bulbs with LED light bulbs in public and residential/commercial lighting, labeling of appliances, electrical appliances and other equipment. In addition, the NEEAP also include targets for home cooking applications that aim to gradually replace traditional cooking sources with cleaner and safer ones that have a lower impact on household health and, in general, on the environment. The aim is to replace traditional stoves with improved high-efficiency stoves, and to promote the use of liquid fuels for cooking, mainly Liquefied Petroleum Gas (LPG), and, to a lesser extent, to include the use of electricity or solar stoves.

The plans also aim to change the inefficient, fossil-fuel based transport system to a more efficient one. This will be achieved with a low-carbon transport strategy and the introduction of EE vehicle standards, as well as the gradual introduction of electric mobility. It is proposed to replace cars, motorcycles and buses that currently burn diesel and gasoline with electric units starting in 2040, when there is expected to be high penetration of RE on the grid. The first demonstration projects could already have been implemented in the tourism sector or on motorcycles.

In addition to goals and targets, the NEEAP defines trajectories and identifies all the measures and programs that will have to be implemented in order to achieve the targets. The plan also identifies in the

proposed measures the need to develop specific legislation and regulations to introduce incentive mechanisms for the promotion of EE (financial and access to finance, especially for the population to acquire more energy-efficient devices), institutional strengthening measures (e.g. creation of the EE department in DGRNE), as well as the need for capacity building of technical and professional cadres (including the support and coordination by local and foreign universities), information dissemination and awareness raising among the population, as well as measures for carrying out supplementary studies in order to improve the local availability of information about the EE potential in the country, and also defining specific programs in the energy sector (such as the widespread use of smart meters).

The LEAP (Low Emissions Analysis Platform, https://leap.sei.org/) software was used in the NEEAP (and the accompanying NREAP) as a tool for modeling possible future scenarios for 2030 and 2050. The following two scenarios were modeled:

- The BAU (Business-as-Usual) scenario, which could imply that no mitigation measures are implemented; and

- The mitigation scenario, which considers the implementation of all mitigation measures proposed in the two plans (NREAP and NEEAP).

Various projections were made under the two scenarios, including energy demand by sector and by fuel type. For each of the scenarios, the end result modeled by LEAP was the greenhouse gas (GHG) emissions, such that the difference between the two scenarios will be the estimated reductions in such emissions. In addition to GHG reductions, LEAP also made it possible to calculate the energy savings (from which the reductions come) in terms of electricity or fuel saved per sector, etc. Knowing the estimate of these savings is relevant for the national economy since STP still does not produce fossil fuels and, considering this is all imported at the international price, reduced consumption will have a significant positive impact on government expenditure, enabling savings to be redirected to spending in areas such as health, education and others.

Based on these projections (which includes data on grid losses, efficient lighting and equipment, and more efficient cooking and transport), the country would reduce energy demand by 8.7% by 2030 and by 12.9% by 2050, relative to BAU. STP has decided to adopt these two figures as the two targets in the NEEAP for demand reduction (in terms of primary energy) by 2030 and by 2050.

The sources of information for the baseline data that were entered into LEAP and also used to develop the two plans are described in Annex V (Bibliography). The methodology used for this work is described in Annex IV.

1 EXECUTIVE SUMMARY

Socio-Economic Challenges and Integrated Energy

São Tomé and Príncipe (STP) is a small country in sub-Saharan Africa, which is part of the Small Island Developing States (SIDS) and, as such, faces specific challenges in relation to its size (1,001 km^2, 219,161 inhabitants), remoteness from major markets, dependence on a small number of economic sectors, direct investment and remittance inflows, lack of resources and a significant trade deficit. The economic sector consists essentially of the production and export of cocoa, which accounts for about 90% of total export revenues.

The largely informal tertiary sector accounts for about 60% of Gross Domestic Product (GDP), employing 60% of the working population, while the primary and secondary sectors each contribute 20% of GDP (USD 418.6 million in 2019). With regard to agricultural production, STP imports about 15% of the food it needs. However, it faces a rural exodus, with the countryside being abandoned, while traditional and subsistence cultural practices prevail. In addition, key sectors of the economy are highly vulnerable to natural, climatic and external economic shocks.

Industry has a limited share in the national economy, contributing 13.3% to the country's GDP, of which 6.3% is attributed to the construction industry. There is no heavy industry in the country and its current capacity and technological development for transforming raw materials into manufactured goods is low, mainly due to the lack of know-how. The private sector is limited to a few small and medium enterprises (SMEs) in areas such as baking, brewing, distillation of spirits from local produce (rum), palm oil, natural juices from local fruits, mineral waters, paints, soap, coconut oil, manufacturing of building materials, bricks, metal locks, wood processing, shipbuilding, energy production, clothing and furniture production. However, despite the small size of local private industry, STP offers significant business potential in the agri-food sector, both for processing and adding value to local products, and for meeting the needs of local consumption.

Currently, STP has one of the highest power generation costs in sub-Saharan Africa. The energy sector continues to be subsidized and tariffs are not cost reflective, so the national utility company, Water and Electricity Company (EMAE), is unable to recover its costs and the country faces challenges resulting from an outdated transmission and distribution system, a power generation mix highly dependent on expensive diesel, and poor management. In addition, grid losses are worryingly high, being about 33% of power generated in 2019, according to EMAE. Energy losses are associated with inefficiencies in the transmission and distribution networks, accompanied by theft and fraud in the use of electricity.

STP does not yet produce fossil fuels and, therefore, all those consumed in the country are imported, making the country dependent on imports and international price fluctuations. The electricity supply is characterized by frequent power cuts and load shedding, forcing businesses and providers of essential social services to run on diesel generators.

Access to electricity services has evolved positively and it is estimated that 84% of the population of São Tomé had access to electricity in 2019. STP's energy policy includes a target of achieving a 100% electrification rate by 2030, thereby ensuring that the entire population has access to reliable electricity services. In the case of grid-connected power generation, the installed generation capacity in 2019 was estimated at 29.7 MW, of which only 19.9 MW had guaranteed availability. Only 1.22 MW is hydropower, the remaining capacity being thermoelectric (diesel). In addition to grid-connected generation, the island of São Tomé had three isolated (diesel) power plants in 2019, with a total installed capacity of 544 kW, of which only 178 kW had guaranteed availability. There are also a number of self-producers, not connected to the power grid, which generate locally for their own consumption, consisting mainly of hotels in the tourism sector.

It is important to stress the role of transport in the country's energy demand. Air (commercial and bunker flights), sea and land transport exist in STP. Air transport consumes aviation fuel, while shipping consumes diesel and lubricants. Land transport consumes gasoline, in addition to diesel and lubricants. The land transport sub-sector is considered the second largest consumer of fossil fuels.

The majority of the population does not have access to sustainable cooking services and relies significantly on traditional biomass (firewood) and charcoal. It is estimated that about 72% of the population uses solid fuels (firewood and charcoal) for cooking, with firewood used by 45.6% of households, followed by charcoal (26.5%) and oil (25.5%), with LPG used by only 1.5% of households. In addition to firewood, charcoal is also used for cooking and is produced locally. It is estimated that

almost 75% of the wood consumed in the country is mostly illegally and irrationally exploited without any regulation or inspection.

Sustainable industrial and socio-economic development is heavily dependent on reforming the energy sector and transitioning from an almost complete reliance on fossil fuels to renewable energy (RE) coupled with energy efficiency (EE). Such a transition will lead to a significant reduction in fossil fuel import costs and release scarce monetary resources for social and economic development (e.g. education, health care, transport, export diversification, development of Small and Medium Enterprises (SMEs), and climate change adaptation). In addition, it will help the island's main industries and income-generating activities (e.g. water supply, agriculture, food processing, tourism, fishing and the blue economy in general) to become more productive and competitive.

Energy efficiency potential and barriers

STP has a huge potential for EE that should be exploited, principally with regard to reducing the electricity consumption of air conditioning equipment and replacing common incandescent light bulbs and compact fluorescent lamps, as well as using more efficient stoves for cooking and reducing grid losses. There is also potential for EE in the transport sector, as well as the industrial sector, including manufacturing, agribusiness and food, but this requires study. Despite the potential, the only EE initiatives implemented to date have been by EMAE, which puts the institution in a position of being an example of best practice. Any EE measures to be implemented must be accompanied by campaigns to raise awareness about the rational use of energy and avoiding energy wastage.

However, the country has not yet taken advantage of these potential savings. There has been no significant progress regarding the integration of RE and EE in the last decade. The RE baseline remains limited to micro/mini-hydropower plants from colonial times, of which only one is partially operational, and small solar photovoltaic applications for rural households and productive activities. The baseline with regard to EE is low and largely unknown. Previous international support to the RE and EE sector in STP has been very fragmented and uncoordinated. These efforts have focused only on the electricity sector and existing barriers have not been addressed in a coherent, cross-sectoral manner. The impact of these scattered interventions has been very limited.

In STP, introducing RE and EE products and services into the market is hampered by a wide range of demand-side and supply-side barriers, which need to be addressed simultaneously. These relate to institutional capacity, policy and regulation, knowledge management, skills, and entrepreneurship, as well as access to finance and technology. The introduction of new products and services into the market for RE and EE technologies requires specific "push and pull" actions directed at overcoming barriers on the demand side (consumers of products and services) and the supply side (suppliers of products and services).

The National Renewable Energy and Energy Efficiency Action Plans

To address the existing barriers, the STP Government, with the support of the United Nations Industrial Development Organization (UNIDO), has developed the National Energy Efficiency Action Plan (NEEAP) and the Renewable Energy Action Plan (NREAP) and the National under the project: "Strategic program to promote renewable energy and energy efficiency investments in the electricity sector".

These were prepared during 2020 and 2021 under the leadership of the General Directorate of Natural Resources and Energy (DGRNE) of the Ministry of Infrastructure and Natural Resources (MIRN) and by the National Sustainable Energy Platform (PNES). The targets described in the NEEAP and the NREAP were validated by the STP Government through a participatory process led by PNES/DGRNE, involving the exchange of opinions and information, a series of meetings and discussions with PNES/DGRNE, and revisions of the draft plans by PNES/DGRNE and UNIDO. The process was coordinated with the United Nations Development Programme (UNDP), the World Bank (WB), the African Development Bank (AfDB) and others.

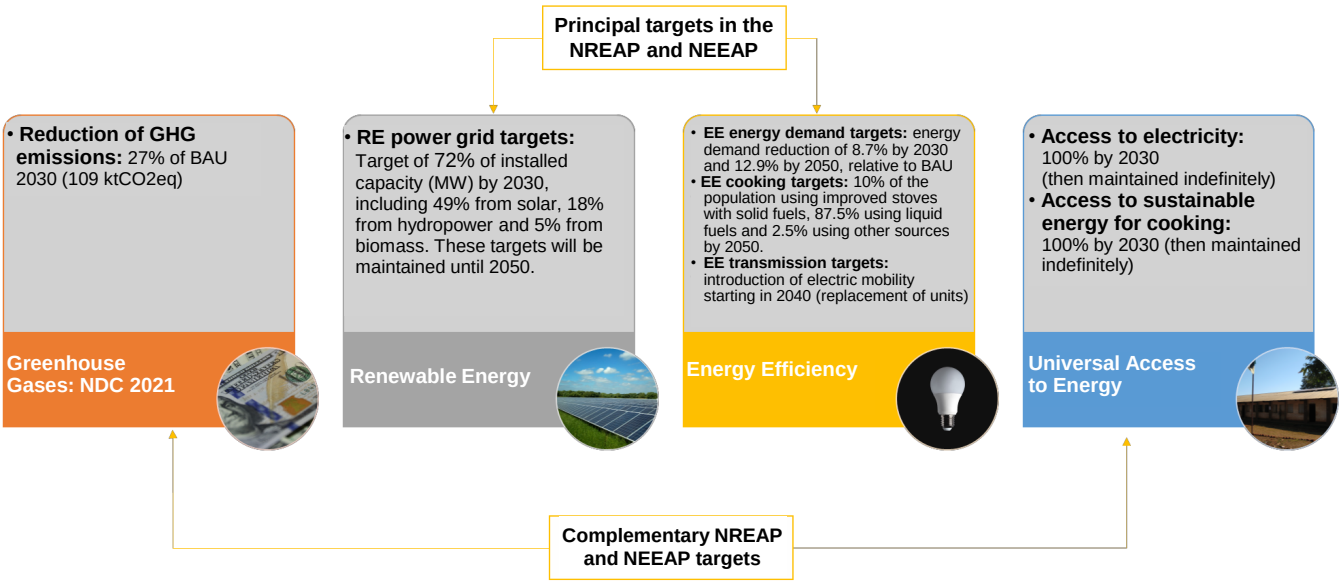
The NREAP and NEEAP provide the STP Government with practical guidance on how to make the energy transition a reality by 2030 and 2050. Based on energy modeling using Low Emissions Analysis Platform (LEAP) software, the NREAP and NEEAP propose a low-carbon scenario that will significantly reduce the country's energy costs and GHG emissions. Energy transition is a prerequisite for the achievement of important national, regional and global policy goals.

The main reference documents used in developing the NREAP and the NEEAP are: Vision 2030 "São Tomé and Príncipe 2030: the country we need to build", the Blue Economy Transition Strategy for São Tomé and

Príncipe, Agenda 2030 and Agenda 2063: "The Africa We Want", the Nationally Determined Contributions (NDC, 2021), the Third National Communication (TNC) on Climate Change, the National Action Plan for Adaptation to Climate Change (NAPA) and ECCAS/CAEMC regional policies. Implementing the action plans will enable the country to achieve Sustainable Development Goal 7 (SDG-7), which aims for universal access to affordable, reliable, sustainable and modern energy services by 2030.

The NREAP and NEEAP propose a set of targets and measures to be implemented by 2030 and 2050. The well-integrated documents consider urban and rural contexts, electricity and heat aspects, and important cross-sectoral policies (e.g. climate mitigation/adaptation, trade, education, research, buildings, transport, tourism, health, agriculture, fisheries and other sectors of the economy).

The NREAP and NEEAP are tightly interconnected and mutually reinforcing. For example, introducing EE standards and the related reductions in energy demand will have a positive impact on RE penetration in the grid. The targets for integrating EE into the São Tomé energy matrix given in the NEEAP complement the targets established in the NREAP and, in addition, are complementary to those for GHG emission reduction and universal access to energy, as shown in the following figure:



Under the NEEAP, STP aims to achieve in the 2020-2050 timeframe an overall EE demand reduction target of 8.7% and 12.9% by, respectively, 2030 and by 2050 under the mitigation scenario versus BAU, through the following sectoral EE targets and measures:

- EE in the electricity system: (i) gradual reduction of technical and non-technical (commercial) energy losses to achieve levels of 8% total energy losses in 2050, with an intermediate step of reducing electricity system losses to 30% total energy losses in 2030 (currently 33%). It is important to stress that to achieve economic savings in terms of fossil fuels, it is not only necessary to generate energy through cleaner sources (as established in the NREAP), but also vital to reduce network energy losses and to raise consumer awareness so that this energy is not wasted and is consumed correctly.
- EE in public and domestic lighting: reduction of electricity consumption associated with public lighting by replacing more than 600,000 inefficient light bulbs with low consumption ones (LED). In addition, the NEEAP proposes energy labeling measures for electrical appliances with the aim of increasing consumption efficiency and reducing demand.
- Replacing 39,600 traditional stoves with improved high-efficiency ones (with solid fuels), progressive increase in the use of LPG (and, to a lesser degree, kerosene), which is a cleaner and more efficient fuel for cooking, and inclusion of a small percentage of other cooking technologies (solar, electricity).
- Improving transport efficiency by introducing and enforcing minimum energy performance standards for vehicles and fuels, as well as in ports and shipping. Replacing 1,000 current cars

with more efficient ones and introducing electric mobility, including more than 12,000 electric vehicles.

The estimated cumulative savings by 2030 (estimated at 8.7%) considering the annual savings in the period 2020-2030; and the cumulative savings by 2050 (estimated at 12.9%) considering the annual savings in the period 2020-2050, took into account the mitigation measures contained in the two plans (the NEEAP and the NREAP).

The projects will also be complemented by other ongoing ones for the rehabilitation of the energy transmission, transformation and distribution infrastructure, and by support projects for strengthening the institutional, policy and regulatory framework, and training and capacity building of the government areas involved in the management of the energy sector, as well as other stakeholders. Smart grid management, energy storage to handle high RE penetration, and digitalization are important elements of these projects.

In addition, the NREAP and NEEAP also include targets for home cooking applications that aim to gradually replace traditional cooking sources with cleaner and safer ones that have a lower impact on household health and the environment. The goal is to replace traditional stoves with improved high-efficiency ones, to promote the use of liquid fuels for cooking, mainly LPG, and, to a lesser extent, to include the use of electricity and solar stoves. The target of 100% access to efficient energy for cooking by 2030 complements the goal of 100% access to electricity services by that same year, thereby ensuring that the population of São Tomé have universal access to energy by 2030. These targets are directly aligned with the seventh United Nations Sustainable Development Goal (SDG-7): "*Ensure access to affordable, reliable, sustainable and modern energy for all".*

The plans also aim to improve the inefficient, fossil fuel-based transport system, transforming it into a more efficient, low-carbon system. This will be achieved with a low-carbon transport strategy and the introduction of EE vehicle standards, as well as the gradual introduction of electric mobility. This work will also include aspects of maritime transport and ports. It is proposed to replace cars, motorcycles and buses that currently run on diesel and gasoline with electric units starting in 2040, when there is expected to be high RE penetration in the grid. The first demonstration projects could already have been implemented in the tourism sector or on motorcycles.

In addition to goals and targets, the NEEAP defines trajectories and identifies all the measures and programs that will have to be implemented in order to achieve the targets. The plan also identifies and classifies the measures into several categories, which include the development of specific legislation and regulations to introduce incentive mechanisms for the implementation of EE (financial and access to finance), institutional strengthening measures (e.g. creation of the EE department in DGRNE), measures to meet the need for capacity building of technical and professional cadres (including the support and coordination of local and foreign universities), information dissemination and awareness raising among the population, as well as measures for carrying out supplementary studies in order to improve the local availability of information about the EE potential in the country. It also defines specific programs in the energy sector (e.g. for the adoption of efficient charcoal production techniques), and specific measures for implementing EE projects to reduce grid losses, reduce energy demand and achieve more sustainable and energy efficient economic development. The NEEAP contains a set of 53 proposed measures, distributed among the aforementioned categories. Some of the measures are contained in both plans as they relate to EE as well as to RE.

Socio-economic and environmental benefits of the Action Plans

Implementing the NEEAP and NREAP will bring significant economic, social and environmental benefits to STP. The LEAP software was used in the NEEAP (and the accompanying NREAP) as a tool for modeling possible future scenarios for 2030 and 2050. The following two scenarios were modeled:

- The BAU (Business-as-Usual) scenario, which could imply that no mitigation measures are implemented; and
- The mitigation scenario, which considers the implementation of all mitigation measures proposed in the two plans (NREAP and NEEAP).

The economic benefits of implementing the NEEAP and the NREAP are significant and will have a positive impact on the country's economy. Using the renewable resources present in STP will reduce dependence on fossil fuels that are currently imported and constitute a significant portion of the GDP

(Gross Domestic Product). The BAU scenario shows that there will be an increase in fossil fuel demand, whereas in the mitigation scenario a portion of this demand will be avoided through the implementation of the RE and EE measures.

In this scenario, it is estimated that there would be an approximate saving of 984,187.8 tons of diesel by 2050, which represents approximately USD 1.16 billion considering the forecast for diesel prices. The estimated cumulative net benefits far outweigh the projected initial investment costs for the established RE project pipeline, which totals about USD 171 million by 2030. This is particularly true if the projects attract private capital, concessional financing and foreign direct investment.

In 2019 (the base year adopted in the NREAP and the NEEAP), expenditure on diesel imports corresponds to 8.4% of STP's GDP[1] (USD 23,627,631). With the implementation of the measures, this percentage is reduced to 0.6% in 2030 (USD 2,529,826) and to 0.9% in 2050 (USD 8,447,240.71). The reduction in expenditure on imported fuel will allow funds to be redirected to other areas, such as health and education.

Implementing the NEEAP measures will also guarantee universal access to reliable and efficient energy services for the entire population and, together with the NREAP measures, will provide opportunities for productive uses, particularly in rural areas. In addition, the development of the RE and EE market will offer local "green employment" opportunities in terms of product manufacturing, assembly and maintenance. Increased productivity and employment opportunities will be of particular benefit to women and young people in rural areas. Urban industrial and commercial sectors (including the blue economy) will benefit from lower energy costs and energy service reliability.

The most relevant social benefit for the population is the improved access to reliable electricity services, which will directly impact its quality of life. Access to electricity services in rural areas has a positive impact on the provision of health and education services. When health institutions (e.g. hospitals) and educational institutions (e.g. rural schools) have access to electricity they can offer better services through electrical equipment and better communication, lighting, internet, etc. It is also expected that health will be improved by reducing the use of traditional stoves, which will be replaced by improved ones and cleaner fuels or cooking technologies. At the same time, improved health will reduce the pressure on the health care system and the incidence of respiratory diseases (principally in women and children). Access to electricity services will also positively impact other services (for example, the implementation of certain measures related to improving water and sanitation management, such as technologies to purify water in isolated communities).

The overall environmental benefit of implementing the NREAP and NEEAP is to significantly reduce GHG emissions in the power sector and to achieve the target of a 27% emission reduction by 2030 set in the NDC (2021). As noted earlier, STP is currently a "non-emitting" country for GHG, as the amount of forest and plant cover makes it a natural carbon sink and, therefore, offsets its GHG emissions. Considering the projections made with LEAP in the BAU scenario, this condition could change in, approximately, 2037. In the mitigation scenario modeled with LEAP, this change would be delayed until, approximately, 2049, thanks to the RE and EE measures proposed in the NREAP and NEEAP.

Another positive impact of the NEEAP is the reduction in deforestation associated with the collection of firewood for cooking and charcoal production and, therefore, the plan will contribute to better conservation and management of forest resources. Furthermore, reducing the use of diesel generators and reusing organic waste for energy generation will bring additional environmental benefits. This could reduce the impact of waste burning and discharge of wastewater and agribusiness effluents into the sea.

[1] The country's estimated GDP in 2019 was USD 279,700,465 in constant 2010 prices (source: World Bank); in 2030, it is estimated at USD 423,039,635.68 and in 2050 at USD 910,596,621.18

2 THE CURRENT STATE OF ENERGY IN THE COUNTRY AND THE POTENTIAL OF ENERGY EFFICIENCY

2.1 Context

STP is a State in the Gulf of Guinea consisting of two islands located about 150 km apart from each other and several islets. Its total area is 1,001 km^2 and it is approximately 300 km from continental Africa (Gabon). The country's Exclusive Economic Zone covers 170,000 km² of the sea. Due to its volcanic origin, it is characterized by a very rugged relief, with mountainous areas of volcanic basalt predominating in the interior, with the peak of the island of São Tomé, at 2,024 m, standing out, and plains in the coastal areas. More gradual slopes and a wider coastal zone with larger and more elongated watersheds form the landscape in the northern and eastern region of the island, while the southern region is characterized by plains (CECI Engineering Consultants, 2008). STP's population of 219,161 (WB, 2021) is strikingly young, with 62% in the 0-25 age range (STP Government, 2019). The population continues to suffer greatly from the limited and insular internal market, weak purchasing power and poor diversification of the economy. The Family Budget Survey (IOF, 2010) found that 66.2% of the population of São Tomé is poor; that poverty predominantly affects female-headed households and that rural populations are most affected, being, therefore, the main cause of the rural exodus (STP Government, 2019). This trend is reflected in the disparities in population concentration between rural and urban areas, with 67% of the population being in urban areas and 33% in rural areas (ALER/ STP Government, 2019).

São Tomé's economy is heavily dependent on Official Development Assistance (ODA), which funded 97.3% of the 2019 State Budget. The economic sector continues to be fragile and not very diversified, consisting mainly of the production and **export of cocoa**, which accounts for about 90% of total export revenues. The largely informal tertiary sector accounts for about 60% of GDP, employing 60% of the working population, while the primary and secondary sectors each contribute 20% of GDP (STP Government, 2019). With regard to agricultural production, STP imports about 15% of the food it needs. However, it faces a rural exodus, with the countryside being abandoned, while traditional and subsistence cultural practices prevail.

STP faces specific challenges to its sustainable development and growth that is often hampered by high transport and communication costs, as well as expensive public administration and infrastructure, as it is small in size and there are limited or non-existent opportunities to foster economies of scale (STP Government, 2019).

In terms of the share of activities in GDP, the activity with most weight in the STP economy is commerce, representing 25.4% of GDP in 2017 (see Figure 1). In the case of the industrial sector, there is no heavy industry in STP. The private sector is limited to a few small and medium enterprises (SMEs) in areas such as baking, brewing, brick making (blocks), palm oil manufacture, production of natural juice using local fruits, mineral water, building materials, paint, local spirits (rum), soap, coconut oil, metal locks, wood processing, shipbuilding, and energy, clothing and furniture production. The country's current technological capacity to transform raw materials into manufactured goods is low. The low level of technological development for processing local products, as well as the lack of know-how, immediately limits the likelihood of expanding and promoting industry in the country. However, despite the small size of local private industry, STP's economic circumstances offer significant business potential in the agri-food sector, both for processing and adding value to local products, and for meeting the needs of local consumption.

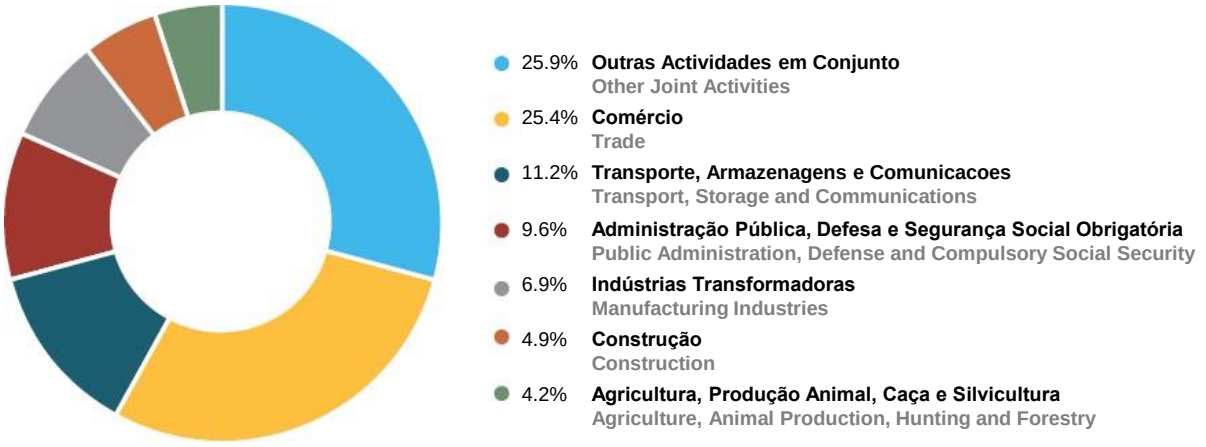


Figure 1: Contribution of the activities in different sectors to GDP (ALER/STP Government, 2019)

2.2 The energy sector in STP

The energy matrix of STP is characterized by the high use of biomass (firewood and charcoal) for household consumption, and the consumption of diesel, predominantly for electricity generation. **Total primary energy consumption in 2019 was 984.9 TJ**, of which 97.9% came from biomass resources (firewood) and 2.1% from water resources (STP Government, 2021).

It is estimated that about 72% of the population uses solid fuels for cooking, with firewood used by 45.6% of households, followed by charcoal (26.5%) and oil (25.5%), and finally liquefied petroleum gas (LPG)(only 1.5%) (UNDP, 2021). The latest information collected for preparing the GHG Inventory finalized in June 2021 shows that in 2019, 52% of the inhabitants consumed firewood and charcoal (DGRNE, 2021). Unfortunately, forest biomass is not consumed in a sustainable way, and, therefore, from an environmental point of view, this practice poses a threat to the stability of the ecosystem. This is why the NEEAP and the NREEP propose measures with the aim of gradually replacing the consumption of solid fuels for cooking with liquid fuels, mainly LPG, as well as introducing improved (more efficient) stoves to replace the traditional three-stone ones. In addition, the measures aim to introduce other cooking technologies, specifically solar or electric stoves, but in a small percentage and in the long term.

Few initiatives or projects have studied the potential for EE and the rational use of energy in STP. However, the current state of the electricity infrastructure, with high energy losses and inefficiencies in thermal power plants and in electricity transmission and distribution, suggests there is enormous potential for improving the EE of the national grid. Information collected to prepare the GHG Inventory finalized in June 2021 indicates that total grid losses are around 35%, of which 14% are technical and 21% commercial (DGRNE, 2021). Considering the gaps and losses in the energy and electricity system, energy efficiency can play a crucial role in the sustainability of the sector at a national level, with associated economic and financial savings. Although few initiatives have been implemented to date, and almost all of those have been to replace incandescent light bulbs, there is enormous potential for savings through behavioral change, such as turning off the air conditioning and lights at night in empty public buildings.

STP does not yet produce fossil fuels and, therefore, all those consumed in the country are imported. STP households and professional energy consumers currently consume fossil fuels such as diesel (for electricity generation), kerosene (for lighting and cooking) and LPG (for cooking). Candles and battery-operated lanterns are also used for lighting in some places. There are oil reserves in the Gulf of Guinea, which are exploited by several countries in the region. Oil production in the area started in the 1970s, mainly in Nigeria (which continues to be the largest exporting-producing country in the Gulf), Angola and the Republic of Congo. These were later joined by Cameroon, Gabon and Equatorial Guinea. Ghana has also recently gained importance as an oil producer on the west coast of Africa. In the case of STP, there have been some hydrocarbon discoveries (e.g. by Chevron in 2006), mainly in the Joint Development Zone shared by STP and Nigeria (Offshore Magazine, 2006). In 2020, STP and Equatorial Guinea agreed to establish a Special Zone for Joint Exploration to explore and develop cross-border oil and gas reserves believed to be in the blocks that border each country's maritime zone (Offshore Energy

Today, 2020). Its commercial viability still has to be verified. However, since STP has no oil refinery, the country would have to export crude oil and will continue importing refined products (e.g. diesel).

Although a potential oil resource has been identified nationally, experience to date has shown that its depth makes it unlikely that commercial exploitation will take place in the near future. Currently, all petroleum products are imported, making the country dependent on imports and international price fluctuations (ALER/STP Government, 2019).

The industrial sector in STP has a limited share in the national economy, contributing 13.3% to the country's Gross Domestic Product (GDP) (USD 418.6 million in 2019), of which 6.3% is attributed to the construction industry (STP Government, 2019). **These industries represent only 7% of the number of "large electricity consumers" in the customer database of the Water and Electricity Company (EMAE) and less than 4% of total sales within that category** (Ricardo Energy and Environment, 2018)**.** However, applying EE measures in industry and commerce could help reduce the country's energy demand, particularly EE in the agribusiness sector, as expansion of agricultural production is expected to be the main economic driver in the coming years. This expansion will require the use of agricultural equipment that must be efficient to prevent fuel or electricity consumption from increasing excessively.

Inefficient energy systems directly impact the cost of the country's industrial and commercial activities, making them less competitive, which affects the household consumption of goods and services, as well as exports.

Electricity tariffs, which have not been updated since 2007, are "social" in nature and do not reflect the cost of electricity production. It is critical, therefore, to implement a new tariff structure to ensure the financial and technical sustainability of EMAE, and for this purpose a tariff study has already been prepared. With regard to electricity tariffs, there is no calculation model with specific criteria for determining prices (ALER/STP Government, 2019).

Furthermore, STP's banking sector is very small, the financial system is very weak, and the State is unable to provide the sovereign guarantees necessary to cover EMAE’s risk in the Power Purchase Agreements (PPAs) to be executed, which makes it difficult for private investors to access credit. For this reason, most projects are funded by international institutions and organized by the public sector or Non-Governmental Organizations (NGOs) (ALER/STP Government, 2019).

In terms of education, only limited higher, technical and professional education is offered nationally and does not include specialized courses in the energy sector, but only more general ones, which may equip students for further studies in the area of renewable energy. The renewable energy projects that have been implemented have provided training at the local level to the beneficiaries and those responsible for management and maintenance of the projects, which has enabled some local technicians, in particular young people, to be trained. There have been no initiatives in the areas of research, certification and audits. This gap at the level of capacity building of local human resources has been one of the main barriers in the sector, which may be addressed in the training and certification activities planned under the projects of international partners (ALER/STP Government, 2019).

2.2.1 Projections of energy demand in BAU

BAU (Business-as-Usual) is primarily a projection of the expected trend of STP's energy systems under current policies and the resulting GHG emissions. No new energy or GHG reduction policies are included in the BAU scenario. Methods vary by sector, but are mainly driven by external assumptions regarding population and GDP growth:

- The historical population data and projections by 2050 are taken from the medium variant in the UN population prospect. The UN's historical data are similar to the country's own census. Household size is derived from population data from the STP Household Budget Survey 2017.
- Historical GDP data are taken from a set of World Bank Development Indicators (NY.GDP.MKTP.KD) measured in USD at the 2010 value. GDP growth estimates by 2025 are taken from the IMF's World Economic Prospect for STP. For the period 2025-2050, we assume slowly declining growth (declining from 4.5% per year in 2025 to 3.7% per year in 2050, reflecting a gradually aging population and, consequently, less rapid growth in the labor force). Value added in each major subsector (industry, services and agriculture) has also been

obtained from the World Bank's World Development Indicators. The GDP share of each subsector has been considered constant over the study period.

These key macroeconomic and demographic variables are the basis for the calculation of energy demands in each scenario. The number of households is used as the basis for projecting residential energy demand. The GDP share or value added relating to the major sectors are used as a basis for projecting demand in other sectors. The population and GDP projections are the same in each scenario (BAU and mitigation).

To project energy demands, it is necessary to calculate energy intensities from historical data. To do so, fuel consumption data are taken from STP's National Energy Balance (NEB) and divided by the relevant activity levels to generate energy intensities. Future energy demands are simply the product of future activity levels and future energy intensities. We take a conservative approach by assuming that the energy intensities remain constant, in the most part, in BAU.

For each fuel in each sector, we specify standard emission factors that correspond to the IPCC Tier 1 methodology to calculate the overall emissions of GHG emissions and air pollutants.

Figure 2 and **Figure 3** show the energy demand projections by 2050, by fuel type and by sector, respectively, in the baseline scenario (BAU), that is, the scenario without mitigation measures being implemented. As can be seen, firewood would be the most predominant fuel as it is the most frequently used as an energy source for household cooking and in the commercial/institutional sector. According to **Figure 2**, in the BAU scenario there will also be an increase in the demand for fossil fuels, particularly gasoline and diesel, which are mainly used in the transport sector.

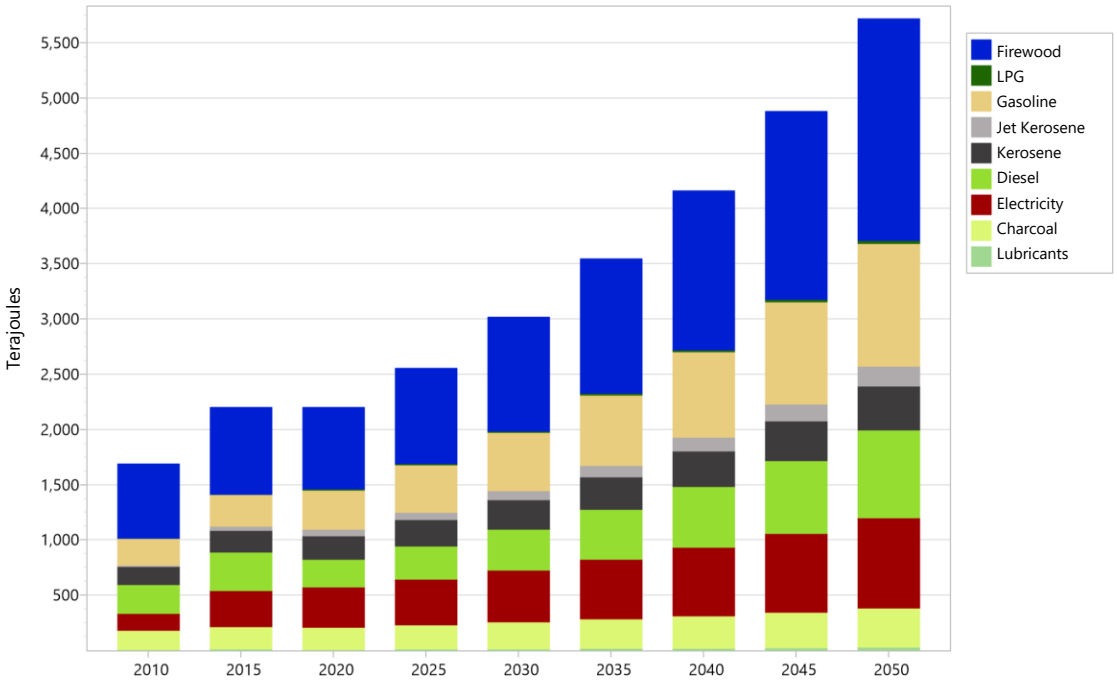


Figure 2: Projection of energy demand in the BAU scenario (2010 - 2050), by fuel type (in TJ)

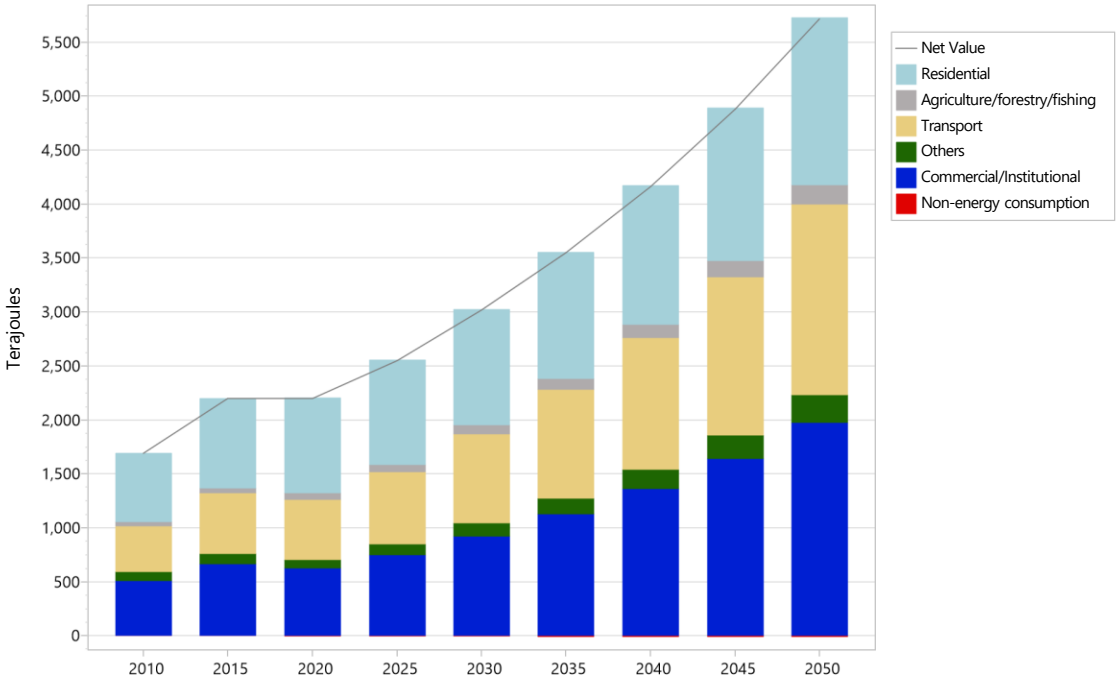


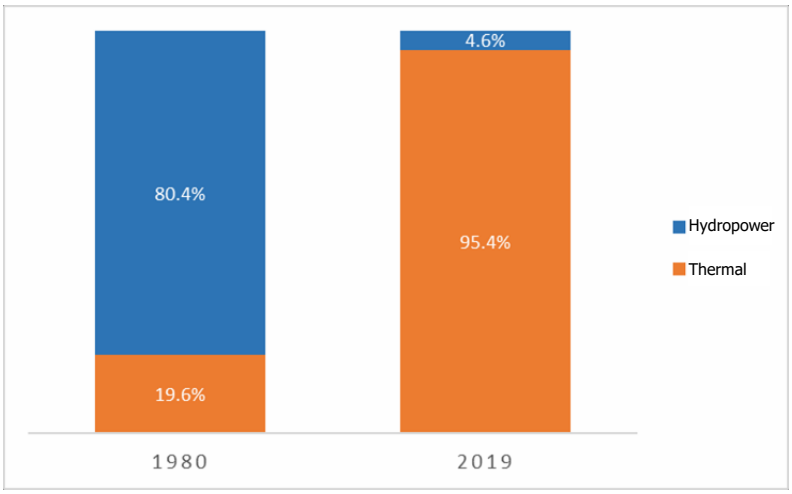
Figure 3: Projection of energy demand in the BAU scenario (2010 - 2050) by sector (in TJ)

The numerical data for the energy demand projections shown in **Figure 2** and **Figure 3** are indicated in two tables in Annex I.

Based on the information obtained from the data collection used in the development of the IGEE 2021 report for the energy sector, it is important to highlight the role of transport in the country's energy demand. Air (commercial and bunker flights), sea and land transport exist in STP. Air transport consumes Jet-A1 or aviation fuel (Jet kerosene), while shipping consumes diesel and lubricants. Land transport consumes gasoline, in addition to diesel and lubricants. According to the IGEE data, the transport sector, in particular the land transport subcategory, is considered the second largest consumer, with 80% of gasoline and 17% of diesel, as percentages of overall consumption. Under the

NEEAP, STP aims to make land transport more efficient, eco-friendly and sustainable in the long term, proposing not only to develop strategies to decarbonize the transport sector as a whole, but also to replace cars, motorcycles and buses that currently run on diesel and gasoline with electric units from 2040. By 2040, it is expected to have already achieved a high penetration of renewables in the power grid, which would help support the transport sector's transition to electricity with no significant increase in diesel use.

2.2.2 Electricity subsector



Electricity production in STP has been increasing over the last 40 years due to increased consumption resulting from the electrification of the country, in line with the growth of the population and São Tomé's economy. There has been a sharp increase in electricity generation since 2009 with the commissioning of new thermal power plants. In 2010, production was 57.9 GWh, while in 2019 it reached 109.1 GWh, an increase of approximately 90% in 9 years. Unfortunately, the hydropower plants that supplied the country's electricity needs in the 1980s began to stagnate and degrade in the post-independence era, and thermal power plants were installed to compensate this (see Figure 4). The following figure shows the increasing electricity demand by sector in BAU (Figure 5), considering the potential evolution of the economy.

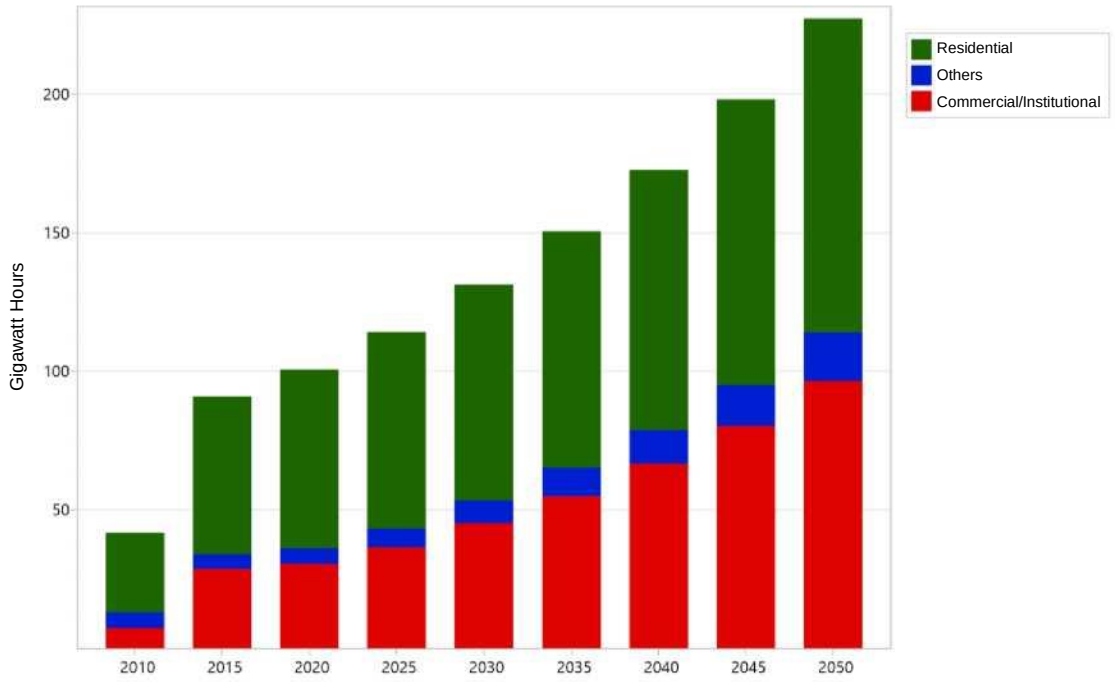


Figure 5: Evolution of final demand for electricity by sector in the BAU scenario (2010-2050) in GWh

STP's electricity matrix is poorly diversified, being predominantly six diesel-fired power plants, five of which are located on São Tomé and one in RAP, with just one hydropower plant located on São Tomé. The majority of the thermal power plants have been in operation for more than 10 years and have a guaranteed availability well below the total installed capacity, as can be seen in Table 1.

Table 1: Installed capacity of power plants in STP (EMAE, 2019)

Type	Power Plants	Generator Sets	Year commissioned	Installed power (kW)	Guaranteed output (kW)	Energy Produced (kWh)	Percent. (%)
São Tomé Interconnected Thermal	São Tomé	ABC 3	1996	1,280	675	4,479,850	52.73%
		Caterpillar	2009	1,300	1,000	2,187,000	76.92%
		Deutz 1	2001	1,450	872	6,851,750	60.14%
		Deutz 3	2001	1,450	830	1,835,850	57.24%
		Perkins 1	2015	1,000	584	1,092,775	58.40%
	Subtotal São Tomé			**6,480**	**3,961**	**16,447,225**	**61.13%**
	Sto. Amaro 1	Himsen #2	2010	1,701	1,359	10,543,560	79.89%
		Himsen #3	2010	1,701	1,358	10,831,140	79.84%
		Himsen #4	2010	1,701	1,398	8,758,170	82.19%
		Himsen #5	2010	1,701	1,355	10,285,910	79.66%
	Sto. Amaro 1 subtotal			**6,804**	**5,470**	**40,418,780**	**80.39%**
	Sto. Amaro 2	ABC #1	2016	2,000	1,641	12,834,884	82.05%
		ABC #2	2016	2,000	1,618	11,558,885	80.90%
		ABC #3	2016	2,000	1,624	12,065,227	81.20%
	Sto. Amaro 2 subtotal			**6,000**	**4,883**	**36,458,996**	**81.38%**
	Bobô-Forro 1	Group no. 2	2011	800	499	309,686	62.38%
		Group #5	2011	800	174	1,390	21.75%
		Group no. 9	2011	800	598	954,238	74.75%
	Bobô-Forro 1 subtotal			**2,400**	**1,271**	**1,265,314**	**52.96%**
	Bobô-Forro 2	Perkins no. 1	2015	1,636	-	-	0.00%
		Perkins no. 2	2015	1,636	1,300	2,015,000	79.46%
	Bobô-Forro 2 subtotal			**3,272**	**1,300**	**2,015,000**	39.73%
	São Tomé interconnected thermal subtotal			**24,956**	**16,885**	**96,605,315**	**67.66%**
São Tomé Hydro	Contador	Turbine 1	1967	960	547	2,447,000	56.98%
		Turbine 2	1967	960	674	3,386,000	70.21%
	S. Tomé hydropower subtotal			**1,920**	**1,221**	**5,833,000**	**63.59%**
SÂO TOMÉ INTERCONNECTED TOTAL				**26,876**	**18,106**	**102,438,315**	**67.37%**
São Tomé isolated	Porto Alegre	Perkins	2015	328	130	405,600	39.63%
	Ribeira Peixe	Deutz		108	30	91,800	27.78%
	Monte Mario	Perkins		108	18	53,838	16.67%
	S. Tomé isolated subtotal			**544**	**178**	**551,238**	**32.72%**
TOTAL ON SÂO TOMÉ				**27,420**	**18,284**	**102,989,553**	**66.68%**
Príncipe	Thermoelectric	Caterpillar 2	2014	700	450	198,000	64.29%
		Caterpillar 3	2019	700	494	80,000	70.57%
		Caterpillar 4	2014	700	440	1,936,880	62.86%
		Caterpillar 5	2014	700	440	2,944,727	62.86%
	Príncipe thermal subtotal			**2,800**	**1,824**	**5,159,607**	**65.14%**
	TOTAL ON PRÍNCIPE			**2,800.00**	**1,824**	**5,159,607.00**	**65.14%**
GRAND TOTAL ON SÂO TOMÉ AND PRÍNCIPE				**30,220.00**	**20,108**	**108,149,160.00**	**66.54%**

In the case of **grid-connected** power generation, the installed generation capacity in 2019 was estimated at 29.7 MW, of which only 19.9 MW had guaranteed availability, in other words, useful power, the maximum that the system can provide to customers. **Only 7.5% (1.22 MW) is hydropower and the remaining 92.5% (18.7 MW of installed capacity) is thermoelectric (diesel)** (EMAE, 2019). This is insufficient to meet peak demand, which was estimated to be 20.8 MW in 2017 (Ricardo Energy & Environment, 2018). In addition to grid-connected generation, the island of São Tomé had three isolated (diesel) power plants in 2019, with a total installed capacity of 544 kW, of which only 178 kW had guaranteed availability. The capacities installed on the two islands are detailed separately in Table 1.

With regard to access to electricity services, it is estimated that **84% of the population of São Tomé has access today (74% on the island of São Tomé and 100% in the Autonomous Region of Príncipe (RAP)** (ALER/STP Government, 2019). São Tomé's energy policy includes a target to achieve a 100% electrification rate by 2030, according to the Least Cost Development Plan (LCDP) of 2018.

SÃO TOMÉ'S ENERGY POLICY INCLUDES THE TARGET OF ACHIEVING AN ELECTRIFICATION RATE OF 100% BY 2030

STP Government

According to the EMAE Report of 2019, total energy produced was 109.1 GWh. The energy injected into the grid by EMAE was 102.3 GWh, of which only 68.7 GWh was billed, so it can be concluded that there was a **worrying volume of energy losses (of about 32.9% of the energy generated),** associated with energy losses and inefficiencies in the transmission and distribution networks, accompanied by theft and fraud in the use of electricity (EMAE, 2019). This situation is considered positive because even higher energy losses were recorded in previous years (40.6% in 2014 and 37.6% in 2016). This improvement is a result of the gradual upgrading of the low-voltage distribution network and residential branches. The amount not billed in 2019 due to technical and technical losses can be estimated at 147.65 million São Tomé Dobras.

EMAE's electricity consumers can be grouped into four categories, specifically: 1) residential, 2) small commercial, 3) large commercial and industrial, and 4) the State, institutional consumer and others. Consumption by the large commercial and industrial consumer category, consisting of hotel complexes and processing industries, etc., is almost non-existent (in 2018, they represented 4% of the total, equivalent to 2.8 GWh), and the growth trend has been practically nil in the last five years. This is due to several factors, specifically the unreliability of the electricity supply, reflected in power failures, the low quality and quantity of electricity supplied, and the lack of transmission infrastructure throughout the territory. Accordingly, the 250 largest electricity consumers existing today often turn to self-production in order to fill these gaps (ALER/STP Government, 2019).

In STP, in addition to grid-connected generators, there are a number of self-producers, not connected to the power grid, which generate electricity for their own consumption on site, consisting mainly of hotels in the tourism sector.

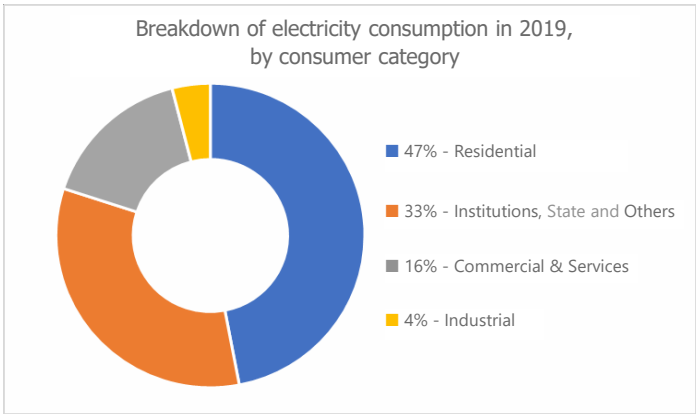


Figure 6: Breakdown of electricity consumption in 2019 by consumer category, EMAE

In 2019, most of the volume of electricity was consumed by household (private) customers, accounting for just over 47% of the volume of electricity consumed, corresponding to 32.6 GWh. In second place were the commercial/service customers, accounting for just over 16% of the volume of electricity consumed, corresponding to 10.9 GWh, as shown in the graph in Figure 6.

STP is one of the Small Island Developing States (SIDS) and, as such, it is challenging to achieve its development goals in a sustainable way, due to limited resources.

In the National Sustainable Development Plan 2020-2024, STP aims to reduce dependence on energy from abroad (which is around 25%), focusing on EE, alternative sources and RE.

In the **National Sustainable Development Plan 2020-2024**, STP, in consultation and partnership with local authorities, has undertaken to promote national energy autonomy and to encourage EE in homes and buildings, and with other public and private commercial and industrial facilities. In addition, it is planned to establish regulations for public and private building infrastructure projects, which will require the incorporation of EE and photovoltaic (PV) technology and/or other RE sources appropriate for the economy.

STP has a huge potential for EE that should be exploited, principally with regard to reducing the electricity consumption of air conditioning equipment and replacing common incandescent light bulbs

and compact fluorescent lamps, as well as using more efficient stoves for cooking and reducing grid losses. There is also potential for EE in the transport and industrial sectors, including manufacturing, agribusiness and food, but this must be studied.

Despite the great potential, the only EE initiatives implemented to date have been by EMAE, which puts the institution in a position of being an example of best practice. Any EE measures to be implemented must be accompanied by campaigns to raise awareness about the rational use of energy and avoiding energy wastage.

3 SUMMARY OF CURRENT NATIONAL ENERGY EFFICIENCY POLICIES AND MEASURES

The objective of the STP Government is to maximize efforts to ensure adequate power generation and distribution to all sectors in order to boost the country's socio-economic growth. The government wants to have programs aimed at implementing an energy model based on economic rationality and on sustainability, though, combining the use of energy from endogenous renewable sources, on the one hand, and reducing the extra costs that burden energy prices, on the other. This is intended to reduce the dependence on fossil fuels in the country's energy matrix and, simultaneously, to guarantee the security of supply by promoting its balance.

In this sense, and in fulfillment of **Vision 2030 "São Tomé and Príncipe 2030: the country we need to build",** the São Tomé government aims to achieve the following goals, among others:

- Ensure that the energy sector is reformed and measures implemented to guarantee the development of an energy-economic model, which will ensure that energy costs are sustainable and that the competitiveness of companies and the quality of life of citizens are not compromised;
- Ensure that the EE of the country improves substantially, through the implementation of the NEEAP. After the NEEAP has been prepared, the Government aims to use it to strengthen the coordination of EE support programs and to foster innovation and technology transfer.

As a SIDS, STP currently faces the challenge of increasing access to energy and energy security for its population, while simultaneously mitigating climate change. STP has one of the highest power generation costs in sub-Saharan Africa. The energy sector continues to be subsidized and tariffs are not cost-reflective, affecting the country's macroeconomic stability. The country is highly dependent on imported diesel for electricity generation and the associated expenditure in terms of foreign currency has grown in recent years, as shown in Table 2. In 2013, expenditure related to diesel increased by more than 100% compared to 2009.

Table 2: Import of diesel/lubricant for electricity generation in thermal power plants (ALER/STP Government, 2019)

Diesel/Lubricant Diesel/Oil	2009	2010	2011	2012	2013
Diesel (litros) Diesel (liters)	11,743,334	9,473,229	13,315,861	18,101,521	19,095,025
Lubricante (litros) Lubricant (liters)	51,558	35,761	34,541	46,617	59,428
Custo Total (x 10^3 Dobras) Total Cost (x 10^3 STD)	137,176,456	113,291,764	193,367,754	267,024,011	289,494,914
Custo Total (USD) Total Cost (USD)	7,838,655	6,473,815	11,049,586	15,258,515	16,542,567

According to the National Energy Balance prepared under IGEE 2021, STP imported approximately 30 million liters of diesel for electricity generation (26,700 tons[2]) in 2019, which cost the country approximately USD 23.6 million. A cost analysis was conducted estimating the fuel price up to 2050. Fuel price forecasts were derived from:

- Commodity price forecasts (including oil price forecasts) published by the WB in October 2021;
- A historical regression of the prices of crude oil and diesel, based on monthly data sets from January 1990 to December 2017, as published by the French Institute of Statistics (INSEE); and
- The base price paid for the purchase of diesel by EMAE in 2019, according to EMAE's 2019 Financial Report and Balance Sheet.

Table 3 shows the price trend and the projection for diesel imports to STP for electricity generation by 2050.

Table 3: Projections for diesel prices and imports to STP by 2050, adapted from (Ricardo Energy & Environment, 2018) and (EMAE, 2019)

Year	2019 (Base Year)	2020	2025	2030	2035	2040	2045	2050
Diesel Price (USD/ton)	884.93	876.20	834.80	793.55	759.97	726.25	690.57	657.00
Projection of the amount of diesel imported in the BAU scenario (ton)	26,700	27,617	31,125	35,725	41,560	48,002	55,242	63,392
Total Cost (million USD)	23.6	24.2	25.9	28.3	31.6	34.9	38.1	41.6

The approximate cost of diesel imports for electricity generation by 2050 could reach more than USD 1 billion in the BAU scenario.

[2] *Considering a diesel density of 0.89 kg/l.*

In addition, there are high energy losses and inefficiencies in the thermoelectric power plants due to the current state of the country's electrical infrastructure, requiring new strategies to be adopted in the energy subsector. The NEEAP presents a series of measures and targets based on including EE measures in the sector in order to increase access to energy and energy security, reducing the costs of importing fossil fuels for generating electricity and, simultaneously, mitigating climate change, considering the commitment to reduce GHG emissions by 27% from the baseline scenario (or "BAU - Business As Usual") contained in the NDC updated and published in 2021.

IN THE NDC, STP HAS COMMITTED TOA 27% REDUCTION IN GHG EMISSIONS, AND AIMS TO DO THIS BY REDUCING GRID LOSSES AND IMPLEMENTING ELECTRIFICATION MEASURES IN THE TRANSPORT SECTOR, IN ADDITION TO INCLUDING RE IN THE ELECTRICITY GENERATION MATRIX
NDC 2021, STP Government

At the regional level, a meeting of Energy Ministers from ECCAS member states, which includes STP, was recently held (in June 2021), the objective of which was to **validate the roadmap for the promotion of EE in Central Africa and to finalize/validate the study regarding the implementation of a dedicated structure for RE and EE in Central Africa – the Center for Renewable Energy and Energy Efficiency for Central Africa (CEREEAC)**. CEREEAC will be part of the Global Network of Regional Sustainable Energy Centers (GN-SEC) coordinated by UNIDO in partnership with economic communities and will cooperate with centers covering the SIDS (SACREEE, ECREEE, CCREEE and PCREEE) on island issues.

The document has been adopted by the Member States and includes a series of key actions for the region to take advantage of its RE and EE potential (IRENA, 2021):

- *Assess the cost-effectiveness of renewable energy with the support of international technical partners.*
- *Improve the collection and processing of reliable data on RE by enabling relevant stakeholders to effectively play an active role throughout the policy development process and conduct market and socio-economic analyses related to RE implementation.*
- *Strengthen the technical capacities of relevant national and regional stakeholders to establish realistic RE targets, policies and an enabling environment to reduce industry risk and to attract private investment.*
- *Increase private participation and financing of RE projects.*
- *Introduce non-hydro renewable energy into national and regional planning.*
- *Develop skills for preparing fundable RE project proposals and implementing them.*
- *Develop a critical mass of professionals capable of installing, operating and maintaining RE systems.*
- *Establish a dedicated regional entity to promote the widespread use of RE in a coordinated and homogeneous manner throughout the region.*

3.1 Institutional framework

Institutionally, the energy sector in STP is under the responsibility of the **Ministry of Infrastructure and Natural Resources (MIRN – Ministério das Infraestruturas e Recursos Naturais)**, through the **Directorate General of Natural Resources and Energy (DGRNE – Direcção Geral dos Recursos Naturais e Energia),** and in the Autonomous Region of Príncipe (RAP – Região Autónoma do Príncipe) it comes under the **Regional Secretariat for Environment and Sustainable Development (SRADS – Secretaria Regional de Ambiente e Desenvolvimento Sustentável)**. In addition to the State, its dependent bodies and public companies, local authorities and the RAP also play an important role. At the local level, the districts only have regulatory powers in the energy field, although, informally, they are very actively involved in the design of public policies and in the regulation of the sector.

With regard to regulation in general, no specific regulator has been assigned to the energy sector, with the electricity sector alone being governed by the **General Regulation Authority (AGER – Autoridade Geral de Regulação)**, created by Decree Law no. 14/2005. The generation, transmission, distribution and marketing of electricity are performed by **EMAE** in a vertically integrated monopoly. It is the only entity that markets electricity in the country and functions as a Regional Delegation in the RAP.

In addition to the aforementioned institutions, the energy sector also includes the STP **National Oil Agency (ANP – Agência Nacional do Petróleo)**, which is the public body that regulates and promotes the activities of the oil and gas industry in the national territory; and the **Directorate General of the Environment (DGA – Direcção Geral do Ambiente)**, which is linked to the MIRN and is the body through which the Government exercises its environmental policy. The DGE has a broad and transversal competence that inevitably addresses the energy sector.

AFAP is an autonomous body, created in 2004 for Project Administration Supervision, operating under the Ministry of Planning, Finance and Blue Economy (MPFEA – Ministério do Planeamento, Finanças e Economia Azul). In the energy sector, AFAP manages the STP Electricity Sector Rehabilitation Project.

There is also the **Committee for the Coordination of the Transformation Program for the Electricity Sector (CC- PTSE)** and the **Technical Support Group for the Transformation Program for the Electricity Sector (GT- PTSE),** which, as the name indicates, support the Government in implementing the Transformation Program for the Electricity Sector. In addition, the Creating Order for these coordination platforms designated:

- The Steering Committee for the Electricity Sector Transformation Program (CP-PTSE – Comité Piloto do Programa de Transformação do Sector Eléctrico). This committee includes the Ministers of Finance and Blue Economy and has two ordinary meetings scheduled per year.
- Technical coordination is through regular monthly meetings of the Technical Committee supporting the Electricity Sector Transformation Program (CT-PTSE).

The **National Sustainable Energy Platform (PNES)** was established under the UNIDO/GEF project. The PNES includes representatives from public and private institutions that operate/participate directly and indirectly in the STP energy sector. The PNES, coordinated by MIRN/DGRNE, is scheduled to meet regularly, and to bring together the following institutions: MIRN/DGRNE, MIRN/DGE, AGER, EMAE, AFAP, Industry Directorate, APCI, UNDP, ADB, European Investment Bank (EIB) and National Institute for the Promotion of Equality and Gender Equity (INPIEG – Instituto Nacional para a Promoção da Igualdade e da Equidade de Género).

3.1.1 Gender equity and energy

In STP, the **National Institute for the Promotion of Gender Equality and Equity (INPIEG)**, established in 2007, conducts activities to promote women, and gender equality and equity in the country. Its main responsibility is to ensure that the government policy translated into the **National Strategy for Gender Equality and Equity (ENIEG – Estratégia Nacional para a Igualdade e Equidade de Género)** is properly executed and implemented. The ENIEG, developed with technical and financial support from the United Nations Population Fund, was adopted in 2007 and revised in 2013. In addition to the ENIEG, in the normative framework at the national level, the Constitution of the Republic of STP also defends gender equity in the Principle of Equality (Article 15). In the normative framework at the international level, STP signed the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (2003) in February 2010, although it has still not ratified it. In September 2015, STP participated in the Fourth World Conference on Women in Beijing (ALER/STP Government, 2019).

STP has evolved positively in promoting women's rights, but inequalities still exist and there is room for improvement in promoting gender equality. Specifically, in the energy sector, it is necessary to better integrate gender issues at all levels, including in energy policy-making processes and energy projects. Gender issues have still not been included in most energy-related policies and regulations, in part because of challenges on how to do so. However, as noted in the "National Action and Action for the Beijing Strategy on January 20, 2015", actions such as increasing access to energy and access to water and basic sanitation services, which improve living conditions for all households in general, have a very positive effect on women, as household chores such as the collection of water or biomass are time-consuming and usually performed by them (ALER/STP Government, 2019).

In this sense, the NEEAP aims to include the issues of equity and gender equality transversally, as topics of particular interest to be addressed in the majority of the measures proposed in the plan.

3.2 Regulatory and legal framework

There are still few regulations applicable to the energy sector in STP, in keeping with the degree of regulation of other sectors of the economy. Hence, there is no general law on EE, but there are different pieces of legislation focused on the various ways to capture or use energy that have a bearing on EE. There is also no overall energy policy that links all dimensions of energy or related cross-cutting issues. In an effort to partially overcome this gap, STP decided to develop the NEEAP and the NREAP, but these do not replace what a general energy policy could and should contain.

3.2.1 EE and RE policies and strategies

Various policies and strategies have been identified at sectoral, regional and national levels that aim to increase access to energy and promote EE, including:

- **2021: Law 4/2021,** the **Great Options Plan (GOP)**, published in February 2021, in which the Government indicates that it aims to accelerate energy transition in STP, through a progressive migration from thermal energy to RE, and to promote EE in STP. Actions include: increasing energy production and distribution capacity; EE projects; maintenance of generator sets at Santo Amaro 2 Power Plant and of Deutz 3 Caterpillar and ABC 3 generator sets at São Tomé Power Plant; upgrading of the MV 30 KV grid from Angolares to Porto Alegre (BP); construction and rehabilitation of solar and hydro plants; regulation of the energy efficiency rules, regulation of the inspection process of low quality electrical equipment; and development of energy map studies.
- **2019:** The **Third National Communication on Climate Change (TNC)** of 2019 identified mitigation options in the energy sector that include **EE initiatives** (efficient lighting equipment and its adoption, high energy performance building materials, more energy efficient appliances), in addition to proposals for the transport, agriculture, forestry and soil sectors. With regard to the RE area, the mitigation measures in the TNC included conducting studies to evaluate the potential for alternative energy production (wind, solar, biomass) and the development of RE production, particularly solar and hydropower.
- **2019:** The **STP National Sustainable Development Plan 2020-2024 (PNDS – Plano Nacional De Desenvolvimento Sustentável)** published by the STP Government in 2019, focused on four strategic axes of intervention: (i) Strengthening the democratic rule of law; (ii) Robust economic growth and accelerated job creation; (iii) Improving the quality of health and social protection; and (iv) Developmental foreign policy. In the energy field, the strategy highlights the need to reverse the current situation by implementing **EE measures**. The operational framework of the PNDS is represented by a matrix with 34 programs distributed among the 4 goals and in the 3 programmatic pillars of the plan, as well as an additional Management and General Administration Program that involves them (see Annex II).
- **2015:** The **STP 2030 Transformation Agenda**, published in 2015 and based on the United Nations Agenda 2030, sets out some key projects, those regarding energy coming under "Challenge IX - Infrastructure Development to Promote Economic Development and Growth", in which the rehabilitation of electricity generation, transmission and distribution is specified.
- **2006: The National Action Plan for Adaptation to Climate Change (NAPA)** presented in 2006 contained some adaptation solutions for the energy sector, including curbing forest degradation, introducing technologies that reduce the consumption of wood for energy production, for example, through the implementation of **EE measures** such as improved stoves, with accessible technologies and knowledge at the national level. On the issue of climate change adaptation, in June 2020 the Green Climate Fund (GCF) and the United Nations Environment Programme (UNEP) received STP's proposal for the implementation of the program "Reduce São Tomé and Príncipe's vulnerability to climate change impacts by strengthening the Country's capacity to implement an integrated approach to adaptation planning", the expected outcomes of which are: 1. Actors mobilized, institutional framework established and national capacity strengthened to develop and implement the National Adaptation Plan (NAP) in STP; 2. Evidence base for the adaptation plan developed through the

production of preparatory elements and gathering of background information for the NAP process; 3. NAP priorities operationalized in plans at local and national levels and supported by an iterative planning framework and monitoring process; 4. Access to resources and investments facilitated to implement adaptation priorities in STP (GCF, 2020).

- There are also other policies and strategies in different sectors that include aspects of EE and RE. STP's **National Employment Policy (NEP)** promotes green jobs, which include EE and RE, seeking to significantly reduce environmental risks and resource scarcity, as well as considering the environmental dimension at all stages of production, exchange and consumption systems. The **Guide for Entrepreneurs** includes RE as one of the business sectors in STP with good investment opportunities. **The National Investment Plan for Agriculture and Food Security and Nutrition (PNIASAN – Plano Nacional de Investimento agrícola e de segurança alimentar e nutricional)** promotes the development of RE and EE in STP, including support for the installation of hydro, wind and solar power plants, as well as the use of improved stoves.

3.2.2 Energy sector policies and strategies

In this field, the most developed sector is electric power, given its growing role in the country's economic and social development. This is regulated by the **Legal Regime of the Electricity Sector (RJSE – Regime Jurídico do Sector Eléctrico)**.

- **2014:** The **RJSE** – Decree-Law no. 26/2014 represents the **Basic Law for the Electricity Sector** in STP, defining the State policy for the sector, as well as planning and management, issuance of electricity generation licenses and concessions, and the approval of legal statutes. The RJSE was adopted on the basis of three considerations. The first addressed the need to clarify the regulatory framework to meet the various challenges facing the sector, with emphasis on the need to improve the supply of electricity in the country in order to meet growing demand, the frequent power cuts resulting from the fragility of the production system, and the weaknesses of the already obsolete grid. The second dealt with the definition of a regulatory framework facilitating private investment with security and transparency to supplement the energy supply of the traditional producer, EMAE. The third, without exhausting other factors that may have contributed, focuses on the strong political will to strengthen the technical and economic regulatory framework for the sector (ALER/STP Government, 2019). The RJSE provides the general rules applicable to the activities of the electricity sector. Although the RJSE was approved, the current organizational model for the market has not yet been adapted to the model stipulated in the RJSE, suggesting it is necessary to strengthen the legal framework, reinforce the capabilities and resources of the different actors, and attract private investment. The majority of the RJSE regulations have been stipulated, but certain legal provisions are under development.

3.2.3 Programs and projects of interest for the development of EE

Few EE initiatives have been implemented in STP to date, and those that have are almost all in the area of replacing incandescent light bulbs with efficient ones. The following list includes the most significant projects and programs that have been or are in the process of being implemented:

a) **Initiatives for improving EE, implemented by EMAE** – completed;

b) **STP Power Sector Recovery Project,** implemented by the WB/EIN – in progress (WB, 2020);

c) **Project to Promote RE and EE investments in the electricity sector of STP**, implemented by GEF/UNIDO – in progress (GEF, 2018);

d) **LED Lighting Project - EE in electricity and demand management in STP, implemented by the WB** – in progress.

e) **Project Proposal "Building institutional capacity for a renewable energy and energy efficiency investment program for São Tomé and Príncipe",** submitted to the GCF with support from UNIDO, August 2021.

Detailed background information on STP's energy sector, as well as details of policies, programs, plans and other actors in the EE and RE sector can be found in the *Status Report on RE and EE in STP* published by ALER and in the *Energy Policy and Data Gap Analysis Report* prepared as part of the consultancy undertaken for the development of the NEEAP and NREAP.

4 NATIONAL ENERGY CONSUMPTION INDICATORS

4.1 Total energy consumption

STP developed its NEB for the period 2010-2019 in the context of updating the national GHG inventory. The only two endogenous sources considered in the STP NEB are **hydropower and firewood, as primary energy sources.** Figure 7 gives an overview of how energy consumption has evolved over the past 10 years. This includes primary energy and secondary energy (which in the NEB includes butane gas (LPG), Gasoline, Diesel, Jet-A1 (aviation kerosene), Petroleum (common kerosene), Lubricants, Electricity and Charcoal).

On the basis of the data in the NEB (see Table 4), it is estimated that total energy consumption (primary and secondary) increased by 35% in the last ten years. In general terms, **firewood** and **diesel** are the fuels most consumed in STP due to firewood being used for cooking by the majority of the population and diesel being used for electricity generation in thermal power plants and generator sets.

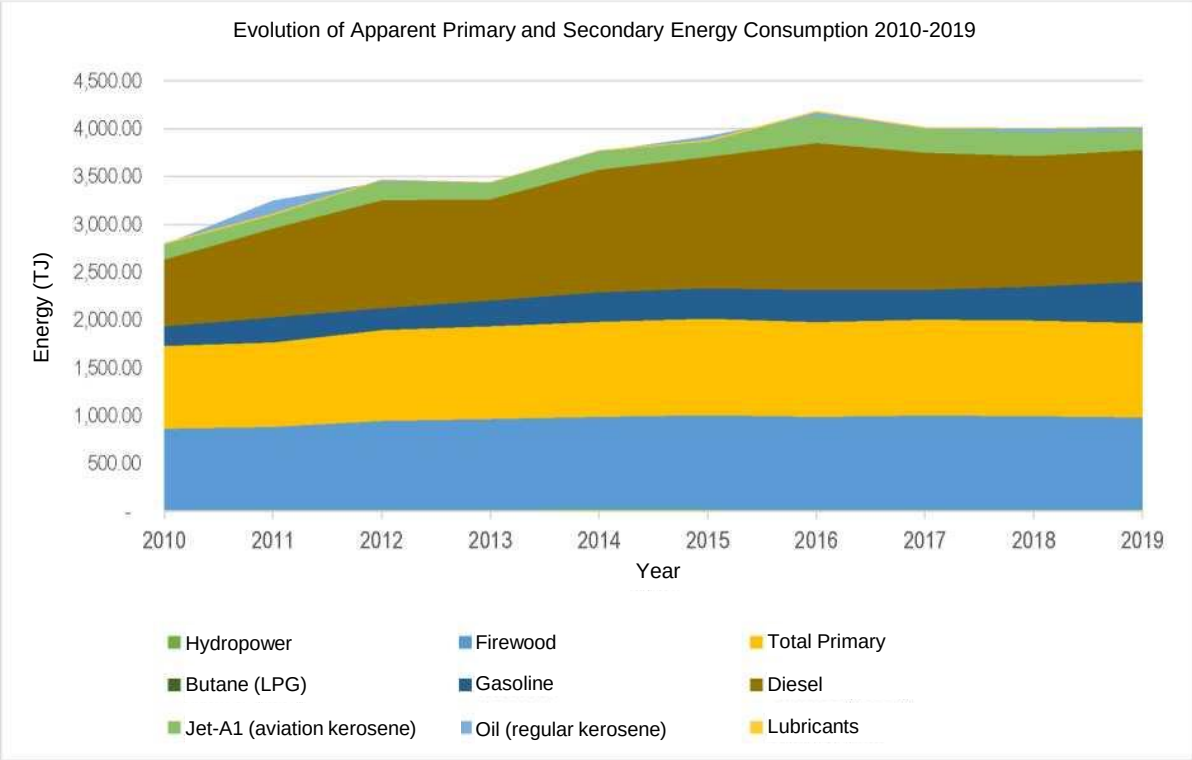


Figure 7: Evolution of the apparent consumption of primary and secondary energy in the period 2010-2019 (STP Government, 2021)

Table 4: NEB data for the period 2010-2019, Apparent energy consumption (TJ)

Years	Apparent Primary Energy Consumption (TJ)			Apparent Secondary Energy Consumption (TJ)									Primary + Secondary Total (TJ)
	Hydropower	Firewood	Primary Total	Butane (LPG)	Gasoline	Diesel	Jet-A1 (aviation kerosene)	Oil (regular kerosene)	Lubricants	Electricity	Charcoal	Secondary total	
2010	17.24	848.53	865.77	0.95	203.04	1.006.41	151.45	9.54	7.46			1,378.85	2,244.63
2011	20.67	863.79	884.46	0.61	258.60	930.19	286.71	(145.66)	9.22			1,339.67	2,224.12
2012	22.99	926.02	949.01	0.51	227.66	1,127.32	187.27	22.04	3.51			1,568.31	2,517.32
2013	23.01	944.61	967.62	0.71	268.53	1,058.27	170.24	3.00	4.75			1,505.50	2,473.12
2014	27.71	963.76	991.47	1.70	308.45	1,278.30	187.41	8.50	3.52			1,787.87	2,779.34
2015	23.93	983.42	1,007.36	2.18	317.92	1,371.94	212.53	(52.66)	11.20			1,863.11	2,870.46
2016	20.88	968.74	989.63	2.34	333.39	1,536.83	283.90	38.58	8.07			2,203.11	3,192.73
2017	18.17	985.13	1,003.30	3.16	307.60	1,434.47	245.88	7.97	7.12			2,006.20	3,009.50
2018	18.45	980.43	998.89	6.83	346.46	1,365.70	248.52	35.00	3.14			2,005.64	3,004.53
2019	21,00	963.88	984.89	10.91	419.14	1,382.31	196.46	35.00	8.30			2,052.11	3,037.00
Change over 10 years	*22%*	*14%*	*14%*	*1047%*	*106%*	*98%*	*30%*	*267%*	*11%*			*92%*	*57%*

4.2 Energy consumption by sector

Table 5 presents the country's total final energy consumption for 2019, which is the baseline year adopted for the NEEAP and NREAP. This includes energy use in households, industry, services, agriculture and the transport sector, as well as electricity and fuels (such as oil, gas, charcoal, wood, etc.). As noted above, firewood was the most consumed source. Its dominant role in the consumption of the commercial/institutional and residential sectors can be clearly seen in Figure 8.

Table 5: Total final energy consumption (TJ) in STP in 2019 (STP Government, 2021)

Sector	Consumption by energy source (TJ) - Year 2019									Total per sector (TJ)
	Firewood	Butane (LPG)	Gasoline	Diesel	Jet-A1 (aviation kerosene)	Oil (regular kerosene)	Lubricants	Electricity	Charcoal	
Industry	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
Transport	-	-	304.14	219.59	61.41	-	10.97	-	-	596.12
Residential	231.33	4.87	9.50	-	-	199.82	-	129.82	192.91	768.26
Commercial / Institutional	539.77	3.82	1.90	-	-	-	-	117.44	3.94	666.87
Agriculture/ forestry/ fishing	-	-	60.83	-	-	-	-	-	-	60.83
Other	-	0.86	3.80	48.20	-	12.75	1.22	21.40	-	88.24
Total TJ 2019:	771.11	9.56	380.18	267.79	61.41	212.57	12.19	268.66	196.84	2,180.31

**NA: Not Available*

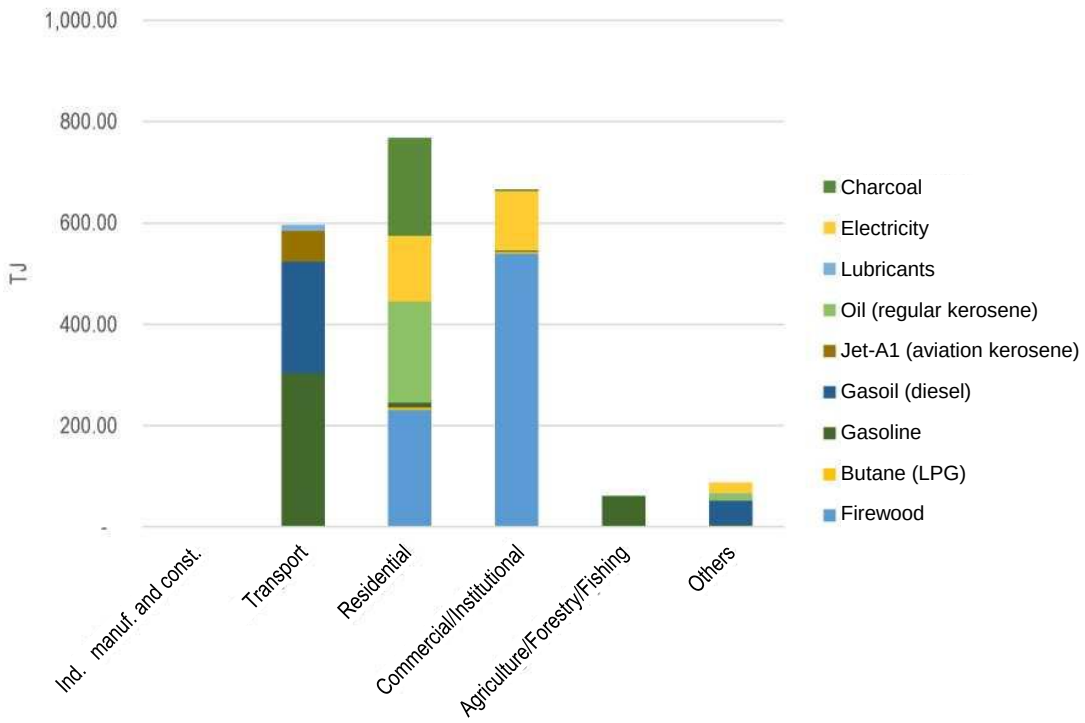


Figure 8: Consumption of energy sources by activity sector, 2019 (EMAE, 2019)

Figure 8 also shows that the residential sector is the one that consumes the most energy. The transport sector mainly consumes gasoline, diesel and, to a lesser extent, aviation fuel (Jet A1).

According to the NEB data, final energy consumption grew by about **15%,** in comparison to 2010, to 2,180.31 TJ. The sources with the most significant increases between 2010 and 2019 were **butane (LPG), Jet A-1 and electricity**. Conversely, the source for which consumption decreased the most was diesel, due to the shift from diesel to gasoline in the transport sector observed during the period.

Table 6: Total final energy consumption (TJ) in STP in 2010 (STP Government, 2021)

Sector	Consumption by energy source (TJ) - Year 2010									Total per sector (TJ)
	Firewood	Butane (LPG)	Gasoline	Diesel	Jet-A1 (aviation kerosene)	Oil (common kerosene)	Lubricants	Electricity	Charcoal	
Ind. Manuf. and const.	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
Transport	-	-	195.98	436.29	9.18	-	7.40	-	-	648.85
Residential	203.65	0.47	8.57	-	-	152.12	-	52.21	169.82	586.85
Commercial / Institutional	475.18	0.37	1.22	-	-	-	-	26.77	3.47	507.01
Agriculture / forestry/ fishing	-	-	36.75	-	-	-	-	-	-	36.75
Other	-	0.08	2.45	89.36	-	9.71	0.82	19.84	-	122.26
Total TJ 2010:	**678.83**	**0.93**	**244.97**	**525.65**	**9.18**	**161.83**	**8.22**	**98.82**	**173.29**	**1,901.71**

Comparing the results of Table 6 and Table 5, it can be seen that energy consumption has increased in almost all activity sectors, except in the transport and "other" sectors. No significant increases were recorded in the other sectors.

As can be seen in 2019(Table 5), the distribution of consumption among the different sectors shows the predominance of the commercial/institutional, residential and transport sectors, which together account for almost all of the energy consumption (see Figure 9).

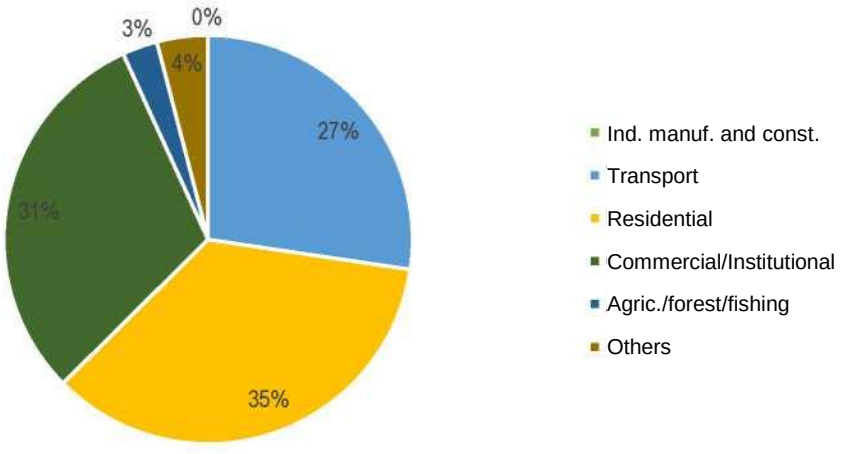


Figure 9: Breakdown of total energy consumption in 2019, by sector

5 STP TARGETS FOR ENERGY EFFICIENCY AND COMPLEMENTARY TARGETS

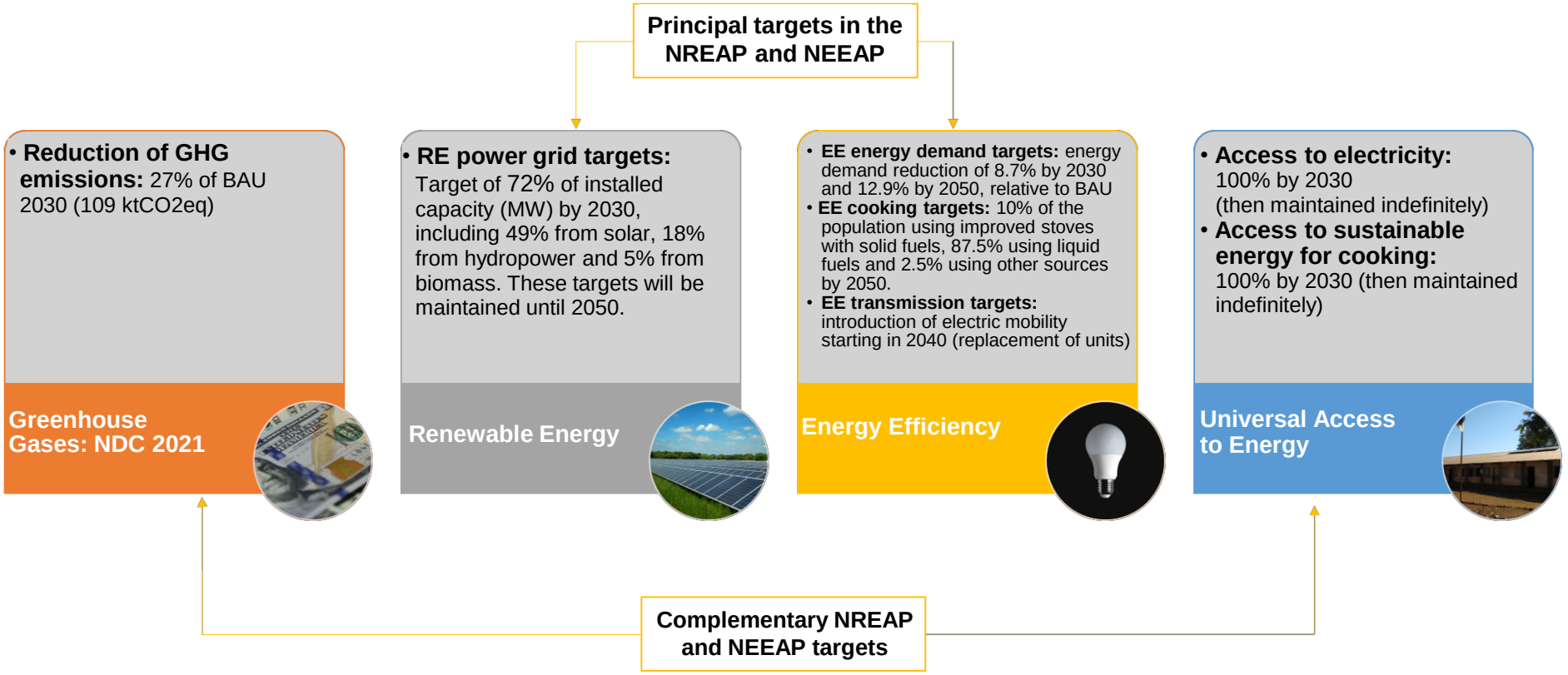


Figure 10: NREAP, NEEAP and complementary targets

The targets described in the NEEAP (and the NREAP) were adopted by the STP Government through a participatory process led by PNES/DGRNE, involving the exchange of opinions and information, a series of meetings and discussions with PNES/DGRNE, and revisions of the draft plans by PNES/DGRNE and UNIDO. The end result of this process was the adoption of the targets and measures contained in the NEEAP and the NREAP.

The NEEAP and NREAP provide the STP Government with practical guidance on how to make the energy transition a reality by 2030 and 2050. Based on energy modeling using Low Emissions Analysis Platform (LEAP) software, the NEEAP and NREAP propose a low-carbon scenario that will significantly reduce the country's energy costs and GHG emissions. Energy transition is a prerequisite for the achievement of important national, regional and global policy goals.

The main reference documents used in developing the NREAP and the NEEAP are: Vision 2030 "São Tomé and Príncipe 2030: the country we need to build", the Blue Economy Transition Strategy for São Tomé and Príncipe, Agenda 2030 and Agenda 2063: "The Africa We Want", the Nationally Determined Contributions (NDC, 2021), the Third National Communication (TCN) on Climate Change, the National Action Plan for Adaptation to Climate Change (NAPA) and regional CEEAC/CEMAC policies. Implementing the action plans will enable the country to achieve Sustainable Development Goal 7 (SDG-7), which aims for universal access to affordable, reliable, sustainable and modern energy services by 2030.

The NEEAP and NREAP propose a set of targets and measures to be implemented by 2030 and 2050. The well-integrated documents consider urban and rural contexts, electricity and heat aspects, and important cross-sectoral policies (e.g. climate mitigation/adaptation, trade, education, research, buildings, transport, tourism, health, agriculture, fisheries and other sectors of the economy).

The NEEAP and NREAP are tightly interconnected and mutually reinforcing. For example, introducing EE standards and the related reductions in energy demand will have a positive impact on RE penetration in the grid. The NEEAP targets complement those established in the NREAP, as well as others for the reduction of GHG emissions and for universal access to energy.

With the NEEAP, STP aims to achieve in the 2020-2050 timeframe an overall EE demand reduction target of 8.7% and 12.9% by 2030 and by 2050, respectively, under the mitigation scenario versus BAU (as shown in **Figure 10**),through the following sectoral EE targets and measures:

- EE in the electricity system: (i) gradual reduction of technical and non-technical (commercial) electricity losses to achieve levels of 8% total energy losses in 2050, with an intermediate step of reducing electricity system losses to 30% total energy losses in 2030 (currently 33%). It is important to stress that to achieve economic savings in terms of fossil fuels, it is not only necessary to generate energy through cleaner sources (as established in the NREAP), but also vital to reduce network energy losses and to raise consumer awareness so that this energy is not wasted and is consumed correctly.
- EE in public and domestic lighting: reduction of electricity consumption associated with public lighting by replacing more than 600,000 inefficient light bulbs with low consumption light bulbs (LED). In addition, the NEEAP proposes energy labeling measures for electrical appliances with the aim of increasing consumption efficiency and reducing demand.
- Replacing 39,600 traditional stoves with improved high-efficiency ones (with solid fuels), progressive increase in the use of LPG (and, to a lesser degree, kerosene), which is a cleaner and more efficient fuel for cooking, and inclusion of a small percentage of other cooking technologies (solar, electricity).
- Improving the efficiency of transport by introducing and enforcing minimum standards for vehicles and fuels, as well as ports and maritime transport. Replacing 1,000 current cars with more efficient ones and introducing electric mobility, including more than 12,000 electric vehicles.

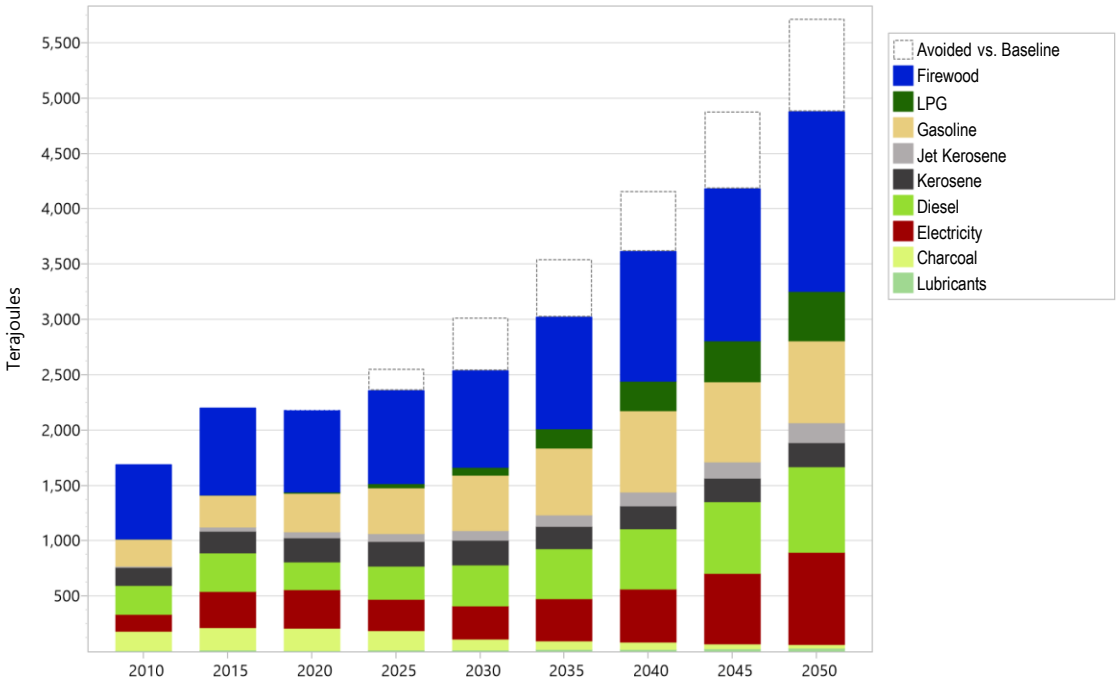


Figure 11: Energy demand savings (white rectangles), mitigation scenario (in color) vs. BAU (colors plus white rectangles)

Figure 11 compares the final energy demand between the baseline scenario (BAU) and the mitigation scenario. The BAU, represented until 2050 by the white plus colored rectangles, was developed considering the estimated energy demand by source type or fuel without implementing mitigation measures. A reduction in demand is expected from implementing the mitigation measures, that is, the demand consists of only the colored rectangles shown in the figure. The assumptions considered in the estimates in Figure 11 are:

- Implementation of EE measures (distribution of improved stoves and increase in LPG used (in addition to other efficient forms of cooking, as already mentioned), replacement of incandescent or inefficient light bulbs by LED, reduction of technical grid losses, replacement of energy inefficient cars and subsequent electrification of transport)
- Implementation of RE measures (rehabilitation and construction of mini-hydropower plants, and development of solar PV and biomass energy installations, as described in the NREAP)

The estimated cumulative savings by 2030 (estimated at 8.7%) considering the annual savings in the period 2020-2030; and the cumulative savings by 2050 (estimated at 12.9%) considering the annual savings in the period 2020-2050 are a result of the LEAP modeling of the mitigation measures contained in the two plans (the NEEAP and the NREAP) and described above, which the STP Government has decided to adopt.

It is important to note that energy consumption (both final and electrical) is expected to increase significantly, and by the end of 2030, 100% of the country's population should have access to electricity services and more efficient energy for cooking. The following table summarizes the EE macroeconomic indicators expected for STP.

Table 7: EE Macroeconomic Indicators

Indicator	2019 (Base Year)	2030	2050
Final energy intensity (final energy consumption/GDP) in kWh/USD @ 2010 constant prices)	**2.25**	**1.98**	**1.74**
Final energy consumption per capita (kWh/capita/year)	2,923	3,166	4,121
Annual electricity consumption per capita (kWh/capita/year)	459	313	603
Electricity Intensity (kWh/USD @ 2010 constant prices)	0.35	0.20	0.26
Electrification rate (energy access rate) (%)	84%	100%	100%

The final energy intensity is expected to decrease over time, meaning that the country becomes more efficient as it needs less energy to generate one unit of GDP. At the same time, per capita energy consumption is expected to increase as the economy develops. Note that electricity intensity and annual per capita electricity consumption decrease in 2030 and then increase in 2050. This decrease in 2030 is due to final electricity generation being lower in that year compared to 2019 (base year), which is the consequence of implementing energy efficiency measures focused on reducing energy losses and replacing light bulbs, which has a positive impact on final electricity demand. Then, in the next 20 years (period 2030-2050) the electrification of land transport takes place, as well as the growth in demand due to the growth of the economy, and, accordingly, the demand for electricity will increase, but the final energy intensity, which is the most relevant macroeconomic indicator, will not.

The targets indicated in the NEEAP in Section 3 complement those set in the NREAP and, furthermore, the two are complementary to the targets for GHG emission reduction and access to energy, as can be seen in Figure 10.

5.1 Summary of targets

The targets proposed for EE in this action plan are as follows:

Table 8: Summary of the main EE targets in the STP NEEAP

Energy Efficiency Targets	Base Year	Target Medium Term	Target Long Term
Transmission and distribution network energy losses	**2019**	**2030**	**2050**
Total energy losses (%)	33%	30%	8%
More efficient cooking	**2019**	**2030**	**2050**
Percentage of population using safe, sustainable and efficient cooking technologies and fuels (% of population)	27.1% (2020)*[3]	100%	100%
More efficient equipment and appliances	**2019**	**2030**	**2050**
Number of incandescent light bulbs replaced with LED light bulbs (public and commercial/household lighting)	NA[4]	611,750 (cumulative to 2030)	618,000 (cumulative to 2050)
More efficient land transport	**2019**	**2030**	**2050**
Replacement of current cars with more efficient (fossil fuel) cars (units replaced, cumulative)	-	500	1,000
Introduction of electric vehicles (cars, motorcycles and buses) (units introduced, cumulative)	-	0	12,100

[3] *Information based on 2020 data. Source: (UNDP, 2021)*
[4] *NA: Not Available*

5.2 Sectoral energy efficiency targets and indicators

5.2.1 EE in the electricity distribution network

Total electricity losses (technical and non-technical) in the STP distribution network are one of the major barriers facing the electricity system in the country. In 2019, EMAE estimated that total energy losses were around 33% of total electricity production. The energy losses come from transmission, distribution (technical losses) and marketing (non-technical or technical losses). The Least Cost Development Plan produced in 2018 shows that energy losses in 2017 were also around 33%, split between technical losses of 9.8% and technical losses of 23.2% (see Figure 12).

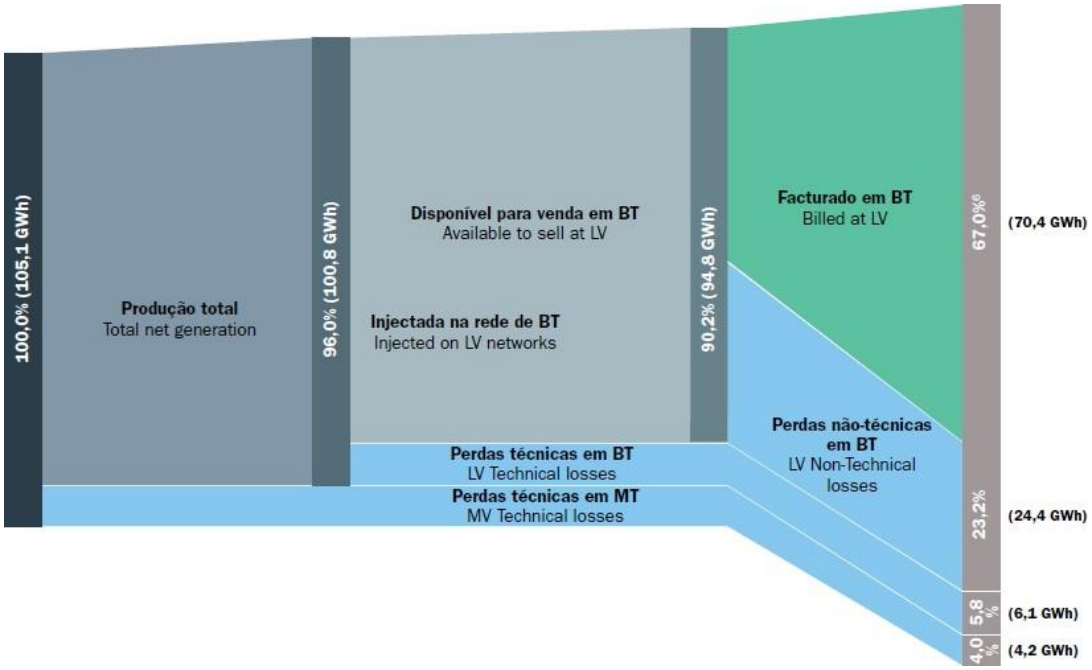


Figure 12: Grid losses in 2017 according to Ricardo Energy and Environment LCDP (ALER/STP Government, 2019)

The technical losses are associated with the precarious situation of the electricity transmission and distribution system, which does not receive proper maintenance due to lack of funding. The non-technical losses are due to a significant percentage of electricity theft and illegal connections, payment default, and the lack of permanent inspection and control. Due to poor procurement practices and reduced liquidity, EMAE is not able to install meters at all final consumers. As a result, 34% of customers have no meter (ALER/STP Government, 2019). Installing electricity meters would allow EMAE to both improve the electricity billing process, charging for electricity actually consumed, and control, so it would be able to identify customers in arrears.

The EE scenario presented here is based on the assumption of continued technical and social intervention, with a reduction in energy losses from 33% in 2019, to 30% by 2030 and to 8% by 2050. Since STP is a geographically small country, the technical losses in the network should not be high, since the transmission and distribution distances are short, assuming that maintenance tasks are carried out with the required frequency and quality.

Table 9: Estimated national targets for EE in the network for the 2030 and 2050 timescales

Energy Efficiency Targets	Base Year	Target Medium Term	Target Long Term
Grid losses	**2019**	**2030**	**2050**
Total energy losses (%)	**33%**	**30%**	**8%**
Technical energy losses (%)	11%	10%	5%
Non-technical or technical losses (%)	22%	20%	3%

5.2.2 EE in cooking

The report prepared by UNDP in the period 2020-2021 "Characterization of the charcoal value chain in São Tomé and Príncipe and assessment of economic displacement risks under initiatives related to forest sustainability" offers recent statistical data regarding the use of cleaner cooking sources, and shows that approximately 27% of the STP population uses safe and modern sources for cooking (e.g. oil (kerosene) (25.5%) or LPG (1.5%)). The rest of the population uses solid fuels.

It is STP's goal for its population to have access to sustainable energy sources for cooking. In this regard, STP, in the context of the NREAP and NEEAP, aims to achieve universal access to energy by 2030 (see Figure 10), including access to electricity services and access to efficient and cleaner sources for cooking. The target of 100% access to clean energy for cooking involves individual targets for each energy source and includes improved stoves using solid fuels and others using liquid fuels, such as LPG and kerosene, plus a small proportion of solar and electric stoves (see Table 10 for percentages for each source). The target of 100% access to efficient energy for cooking by 2030 complements the goal of 100% access to electricity services by that same year, **thereby ensuring that the population of São Tomé have universal access to energy by 2030**. These targets are directly aligned with the seventh United Nations Sustainable Development Goal (SDG-7): "*Ensure access to affordable, reliable, sustainable and modern energy for all".*

The aim is to achieve the target of access to sustainable energy for cooking through the population using improved stoves for burning firewood or charcoal; liquid fuel stoves (LPG and kerosene); and others using other alternative technologies (solar, electric, etc.). Details of the percentages for each are given in Table 10.

Table 10: Targets for safe, sustainable and efficient cooking for 2030 and 2050

Targets for cooking with EE (and RE) implemented	2019 (Base Year)	2030	2050
Percentage of population using improved solid fuel stoves (%)	NA	62.9%	10.0%
Number of existing improved stoves (in use)	*NA*	*39,600*	*9,206*
Percentage of population using liquid fuel for cooking – LPG	1.5% (2020)	15.8%	75.0%
Percentage of population using liquid fuels for cooking – kerosene	25.5% (2020)	21.1%	12.5%
Percentage of population using electricity, solar energy or another efficient technology for cooking	0.1%	0.2%	2.5%
Total percentage of population with access to more efficient sources for cooking	**27.1%** (2020)[5]	**100%**	**100%**
Percentage of charcoal produced by efficient techniques (%)	NA	NA*	100%

There are measures and targets for cooking with RE (biomass, solar) and EE (cleaner fuels, more efficient production techniques). Accordingly, **Table 10** is in both the NEEAP and the NREAP (as Table 9).

*it was not possible to set a target for charcoal production to 2030 as there are no records of the current percentage of charcoal that is produced through efficient and non-efficient techniques, but STP has stipulated that all charcoal will be produced efficiently by 2050, which is aligned with the target of ensuring 100% access to sustainable and secure energy by 2030 and maintaining it indefinitely.

The figure below (Figure 13) shows the evolution of the introduction and change in cooking technologies by 2030 and 2050, as well as the increase in access to safe, cleaner and more efficient cooking sources. This shows the evolution of the introduction of improved stoves together with fossil-fuel stoves by 2030, as well as the increase in the use of liquid fuels (LPG and kerosene), and, after 2030, the progressive decrease in the use of improved stoves and fossil-fuel stoves, and the significant increase of LPG, in addition to other cooking sources or technologies, but to a lesser extent.

[5] *Information based on 2020 data. Source:* (UNDP, 2021)

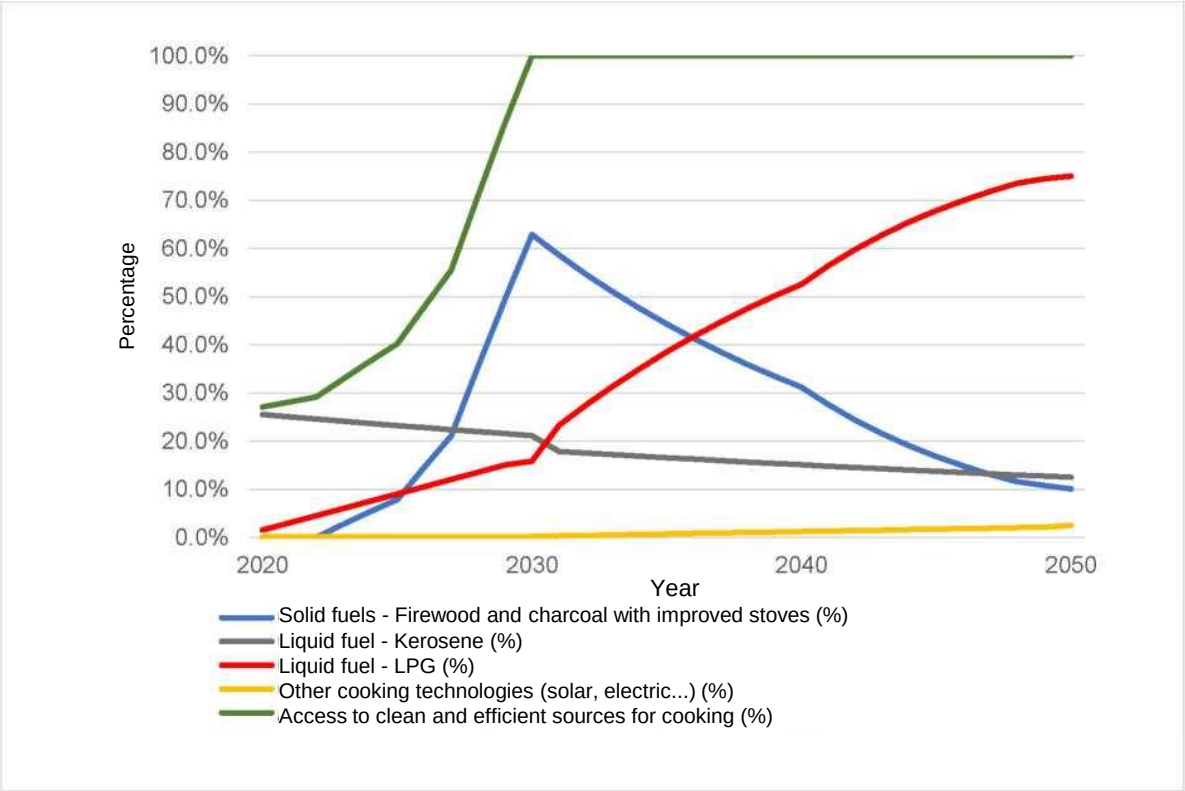


Figure 13: Access to clean and efficient cooking sources (% of population)

5.2.3 EE of equipment and appliances: national labeling system

To create an EE market, it is important to establish energy standards and/or regulations that equipment and appliances must meet. Energy labels are a means of making EE information, specifically the energy characteristics of the equipment, available to consumers. An informed consumer is expected to always make the most appropriate choices. These regulations should apply to all products marketed in STP, whether imported or manufactured/assembled locally.

EE and labeling standards are expected to be developed in the 2021-2022 period in STP for three basic appliances in particular: refrigerators, air conditioners and light bulbs (since these appliances are the largest contributors to household energy consumption), and the regulations are expected to come into effect by the end of 2022. Additional equipment (televisions, water heaters, washing machines, etc.) will be included in the regulations by 2030.

Table 11: National targets and trajectories for EE labels for 2030 and 2050

Equipment and Appliances*	Effective 2019	Effective 2022	Effective 2030	Effective 2050
Refrigerators/Freezers	No	X		X
Air conditioning	No	X		X
Washing machines	No		X	X
Light bulbs	No	X		X
Others covered by the regulations to be developed*	No		X	X

**Caption: EE labels and regulations in effect (the "X" in the table indicates when they come into effect, with no end date)*

5.2.4 EE of equipment and appliances: Efficient Lighting

The use of efficient lighting, both public, residential and commercial, is given special attention in this NEEAP. It is essential to apply EE to lighting to reduce demand on the network. The following table summarizes the targets for efficient lighting in STP, implementation of which began in 2020 and will continue until 2035. The impact of reduced demand will continue after 2035, assuming that the light bulbs continue to operate.

Table 12: National lighting targets for 2030 and 2050

Efficient Lighting – residential, commercial and public	2019 (Base Year)	Period 2020-2030	Period 2031-2050	Total replaced / saved
Total number of incandescent (or inefficient) light bulbs replaced with LED (low energy) light bulbs, and type:	-	**611,750**	**6,250**	**618,000**
Public lighting (units replaced)	-	*13,750*	*6,250*	*20,000*
Residential or commercial lighting (units replaced)	-	*598,000*	*0*	*598,000*
Cumulative energy savings in public lighting (GWh)	-	13.3	70.5	83.89
Cumulative energy savings in residential lighting (GWh)	-	310.4	855.6	1,166.03

In this case, the result of implementing the efficient lighting measures is presented separately to give an idea of the savings potential, but it should be kept in mind that the final result of the mitigation scenario produced by LEAP assumes the joint implementation of all measures (RE and EE) and the possible interactions between them, so the final result of the that scenario is not necessarily the simple sum of the individual measures.

5.2.5 Targets for more efficient transport

Considering that the transport sector in STP is the second largest GHG emitter (after the electricity generation sector) due to its fuel consumption (see **Figure 3**), and that in BAU this trend will continue if no EE measures are adopted, it is of vital importance to implement measures to increase the efficiency of the sector in reducing fossil fuel consumption and, consequently, the associated emissions. The measures contained in the NEEAP focus on land transport. The vehicles that are currently used in STP are more than 20 or 30 years old, often require repairs/maintenance, and consume fuel inefficiently compared to newer models available on the market in other countries.

STP's goal in the area of land transport is to build the foundation for the development and implementation of a national low-carbon transport strategy, firstly by replacing old vehicles with newer (and therefore more efficient) models, and secondly, through the progressive adoption of electric vehicles for public passenger transport (buses) and light vehicles (cars and motorcycles) (STP Government, 2021). The strategy would include the development and enforcement of minimum standards for vehicles and fuels as priority activities. This work will be extended to maritime transport and ports.

The development of such transport standards is part of the new UNIDO project "Building institutional capacity for a renewable energy and energy efficiency investment program for Sao Tome and Principe," financed by the Green Climate Fund (GCF). Table 13 presents the national targets in this sector.

Table 13: National targets for more efficient land transport for 2030 and 2050

More efficient land transport	2019 (Base Year)	Period 2020-2030	Period 2031-2050	Total
Replacement of current cars with more efficient (fossil fuel) ones (units replaced)	-	500	500	1,000
Introduction of electric vehicles (cars, motorcycles and buses) (units introduced), and type:	-	-	12,100	12,100
Electric Cars	-	-	*10,000*	*10,000*
Electric Motorcycles	-	-	*2,000*	*2,000*
Electric buses	-	-	*100*	*100*
Electric vehicle charging stations to be installed	-	-	5,000	5,000

5.2.6 Context required to develop the EE market

It is expected that in the coming years the energy sector in STP will diversify, with more companies and professionals entering the market, both in RE production, and demand management and EE, contributing significantly to the production of national wealth.

It is hoped that by creating the legal and regulatory framework necessary to facilitate and establish an EE market, with the creation of qualified cadres in the area and building the capacity of institutions for management, coordination, supervision and monitoring, the targets set for STP will be achieved. It is important to state that economic stability and the regional integration of STP are crucial factors for this to happen.

6 SECTORAL ENERGY EFFICIENCY MEASURES

This chapter of the NEEAP captures all of the different measures that could be implemented in the EE sector in order to achieve the main goals described in Figure 10, while also contributing to achieving the complementary ones.

Subsection 6.1 below presents the measures considered in the present NEEAP, organized by themes within the energy sector with specific focus on EE:

i. Table 14: Overview of all policies and measures for the energy and electricity sector Table 15: EE measures: Transmission and Distribution Network
ii. Table 16: EE measures: Efficient lighting
iii. Table 17: Overview of all policies and measures for modern energy for cooking
iv. Table 18: Overview of all policies and measures for sustainable agriculture and cattle raising, reducing deforestation
v. Table 19: Overview of all policies and measures for the transport sector

The purpose of these tables is to summarize and provide an overview of all the proposed EE measures and the results to be obtained. A detailed description of each individual measure and additional information can be found in Subsection 6.3.

Finally, Subsection 6.2 provides a general implementation schedule for the measures over the period covered by the plan, that is, until 2050, indicating the order in which the measures will be implemented and which ones will be implemented simultaneously.

6.1 Summary of the measures

Table 14: Overview of all policies and measures for the energy and electricity sector

TYPE			MEASURE	TARGET GROUP	IN PROGRESS / PLANNED	PERIOD / ENTRY INTO OPERATION
Development of Preliminary Studies and Information Collection (Political and Technical)	**M**	**1**	Preparation of studies and collection of information regarding the potential of energy efficiency in STP and its contribution to mitigation and adaptation	Decision makers in the public and private sector	Planned	2021-2025
Organizational (Institutional) Strengthening	**M**	**2**	Creation and integration of the EE department at DGRNE	Public Sector / Energy Service Companies	Planned	2021-2025
	M	**3**	Establishment of a National Body or Entity for Energy Certification (ENCE – Entidade Nacional de Certificação Energética)	Public Sector / Energy Service Companies	Planned	2021-2025
Market Development (Regulatory and Legal)	**M**	**4**	Establish regulations for the energy efficiency of appliances available on the market	General public	Planned	2021-2023
	M	**5**	Establish regulations for energy labeling of equipment (development of MEPS – *Minimum Energy Performance Standards*)	General public	In progress (call for proposals launched in 2021)	2021-2022
	M	**6**	Establish regulations for minimum energy performance standards for new buildings	Civil construction professionals / Building users and owners	Planned	2021-2035
	M	**7**	Establish regulations for minimum energy efficiency standards for appliance imports	Customs/DGRNE/DGE/Business staff	Planned	2021-2030
	M	**8**	Establish regulations for energy-intensive consumers	Intensive consumers and Industry	Planned	2021-2025
	M	**9**	Establish regulations for the design and installation of industrial equipment	Industrial companies	Planned	2021-2025
	M	**10**	Establish regulations for incorporating appropriate energy-saving and energy-efficient technologies in public and private real estate infrastructure projects, with emphasis on the tourism sector, such as hotels	Private sector with emphasis on the hotel sector	Planned	2021-2025
Creation of incentive mechanisms and guarantees (Financial and Fiscal)	**M**	**11**	Creation of incentives and financial mechanisms to increase the population's access to energy-efficient appliances (e.g. discounts for exchanging old appliances for new ones, installment payment system, among others)	General population	Planned	2021-2025

	M	**12**	Creation of tailored financing solutions	Private sector / General population	Planned	2020-2030
Transparency and Decision Support (Policy and Information)	**M**	**13**	Creation of a centralized system including an energy efficiency database	Political and business decision makers/General population	In progress	2020-2023
	M	**14**	Creation and implementation of an MRV*(Monitoring, Recording and Verification*) system for the implementation of EE measures	DGRNE/Policymakers	Planned	2022-2030
EE training, qualification and certification initiatives (for products and services)	**M**	**15**	Creation, updating and continuous implementation of a training program for specialists on specific EE themes (creation of technicians and auditors)	Energy sector professionals	In progress (and in need of more funding)	2020-2050
	M	**16**	Continuous capacity building for institutional managers in structuring complete proposals for energy efficiency projects and project management for fundraising	Energy sector professionals	Planned	2021-2050
	M	**17**	Creation of competencies within DGRNE for centralization and management of energy efficiency data, including calculation standards	Professionals from MIRN / DGRNE, DGE, EMAE, AGER and other institutions related to EE	Planned	2021-2023
	M	**18**	Continuous actions to support the capacity building of national associations and entrepreneurs	EE associations and organizations in STP	Planned	2021-2050
	M	**19**	Development and ongoing implementation of an EE training and capacity building plan for technical staff	Energy sector professionals	Planned	2021-2050
	M	**20**	Training activities for EMAE technicians on the use of the IMS and on O&M	Energy sector professionals	Planned	2021-2025
	M	**21**	Creation and installation of laboratories in the RE area	Researchers, students and professionals in the energy and related fields	Planned	2021-2035
	M	**22**	Promotion of technical and technological training for the staff of training centers and universities, on a continuous basis	Universities and professional training centers	Planned	2021-2050
	M	**23**	Establish cooperation agreements with international universities and technological research centers in the EE area	Universities and technology centers	Planned	2021-2030
Development of programs and action plans	**M**	**24**	Create an action plan to promote national energy autonomy and encourage energy efficiency in homes, commercial/industrial buildings and public lighting	Homes / Commercial and industrial buildings / Public administration	Planned	2021-2023
	M	**25**	Create a program to adopt innovative technologies for energy-efficient cooling and air conditioning systems	Homes / Commercial buildings	Planned	2021-2030

	M	**26**	Create a program to accelerate the development of smart grids and mass use of smart meters	Electricity Sector	Planned	2022-2050
Information and Awareness Raising Initiatives	**M**	**27**	Implementation of the SEforALL awareness raising campaign in STP, which includes energy efficiency	General population	Planned	2021-2023
	M	**28**	Conduct continuous communication campaigns from a gender perspective to increase bill collection and combat technical losses	General population and commercial sector	In progress / Planned	2020-2050
	M	**29**	Conduct continuous information and awareness raising campaigns about the rational use of energy for the general population	General population	Planned	2020-2050
	M	**30**	Conduct continuous information and awareness raising campaigns about the rational use of energy in hotels and other tourist accommodation	Tourism sector	Planned	2020-2050
	M	**31**	Publicize information about EE projects that have been successfully implemented at the national level	Private sector / General population	Planned	2021-2050

Table 15: EE measures: Transmission and Distribution Network

TYPE			MEASURE	TARGET GROUP	IN PROGRESS / PLANNED	PERIOD / ENTRY INTO OPERATION
Infrastructure investment (Political and Economic)	**M**	**32**	Modernization of the transmission/distribution network with the aim of reducing energy losses (reduce 5%, 10 GWh by 2030)	Electricity Sector	In progress	2020-2040
	M	**33**	Installation of intelligent metering systems in transformer stations	Electricity Sector	Planned	2021-2024
	M	**34**	Installation of meters and load measuring equipment at all consumers	Electricity Sector	Planned	2021-2050
	M	**35**	Improvement of EMAE's operation and maintenance system, including a continuous O&M plan	Electricity Sector	Planned	2021-2050
	M	**36**	Reinforcement of the selected grid (12 km of transmission lines / 5 km of overhead distribution and supply lines / 3 new 30 kV sectioning stations)	South Zone / Electricity Sector	Planned	2021-2030
	M	**37**	Maintenance interventions in selected thermal plants	Electricity Sector	Planned	2021-2022
	M	**38**	Extension of the power grid next to the hydropower plants on the River Iô Grande	Population of São Tomé / Electricity Sector	Planned	2021-2030

Table 16: EE measures: Efficient lighting

TYPE			MEASURE	TARGET GROUP	IN PROGRESS / PLANNED	PERIOD / ENTRY INTO OPERATION
Infrastructure investment (Political and Economic)	**M**	**39**	Replacement of approximately 300,000 incandescent light bulbs with LED ones (10 light bulbs in 60,000 homes over 10 years)	Residential and commercial sector	In progress	2020-2024
	M	**40**	Replacement of 100,000 conventional light bulbs with LED ones in poorer households (5 bulbs in 20,000 households)	Vulnerable population of STP	Planned	2021-2030
	M	**41**	Replacement of 198,000 incandescent light bulbs with LED ones in public buildings	Public buildings in STP	Planned	2021-2030
	M	**42**	Replacement of 20,000 inefficient light bulbs with LED ones in public lighting	Public lighting in STP	Planned	2021-2035

Table 17: Overview of all policies and measures for modern energy for cooking

TYPE			MEASURE	TARGET GROUP	IN PROGRESS / PLANNED	PERIOD / ENTRY INTO OPERATION
Development of Preliminary Studies and Information Collection (Political and Technical)	**M**	**43**	Study to define the strategy to achieve universal (100%) access to clean and safe cooking sources in STP by 2050	General population	Planned	2021-2022
Development of programs and action plans	**M**	**44**	Implementation of a program to replace 39,600 traditional stoves with improved high-efficiency ones	General population	Planned	2021-2050
	M	**45**	Implementation of a program for the adoption of modern alternative fuels for cooking (e.g. LPG, biogas, solar stoves, kerosene)	General population	Planned	2021-2050
	M	**46**	Implementation of a program for the adoption of efficient charcoal production techniques	General population	Planned	2021-2050

Table 18: Overview of all policies and measures for sustainable agriculture and cattle raising, reducing deforestation and using biomass as an energy source

TYPE			MEASURE	TARGET GROUP	IN PROGRESS / PLANNED	PERIOD / ENTRY INTO OPERATION
Transparency and Decision Support (Policy and Information)	**M**	**47**	Creation of a centralized information system for forests, land use and land use change, forest resources, agriculture and associated climate change, under the DFB and INM	Political and business decision makers/General population	Planned	2021-2025

Table 19: Overview of all policies and measures for the transport sector

TYPE			MEASURE	TARGET GROUP	IN PROGRESS / PLANNED	PERIOD / ENTRY INTO OPERATION
Development of Preliminary Studies and Information Collection (Political and Technical)	**M**	**48**	Development and implementation of the national electric mobility strategy and the introduction of efficient, low-carbon public transport systems	Decision makers in the public and private sector	Planned	2031-2040
	M	**49**	Development of the strategy to introduce more than 10,000 electric vehicles, being 10,000 light vehicles, 2,000 motorcycles and 100 (buses) for public transport and the installation of about 5,000 recharging points or stations	Automotive sector / General population	Planned	2041-2050
	M	**50**	Development of the study for the improvement of road network to reduce congestion	Decision makers in the public and private sector	Planned	2021-2050
	M	**51**	Development of the study on the need for the implementation of capacity building initiatives and the training strategy for the transport sector on issues related to low carbon and more efficient transport.	Decision makers in the public and private sector	Planned	2022-2030
Market Development (Regulatory and Legal)	**M**	**52**	Development and enforcement of standards and regulations for both efficient and electric vehicles	Decision makers in the public and private sector	Planned	2022-2030
Creation of incentive mechanisms and guarantees (Financial and Fiscal)	**M**	**53**	Creation of financial incentives and replacement of 1,000 gasoline or diesel taxis (500+500) with more efficient cars	Decision makers in the public and private sector	Planned	2026-2035

6.2 Timeline for implementing the measures

	Measure	Implementation years																															
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	**2030**	2031	2032	2033	2034	2035	2036	2037	2038	2039	**2040**	2041	2042	2043	2044	2045	2046	2047	2048	2049	**2050**
Overview of all policies and measures for the energy and electricity sector																																	
1	Preparation of studies and collection of information regarding the potential of energy efficiency in STP and its contribution to mitigation and adaptation																																
2	Creation and integration of the EE department at DGRNE																																
3	Establishment of a National Body or Entity for Energy Certification (ENCE – Entidade Nacional de Certificação Energética)																																
4	Establish regulations for the energy efficiency of appliances available on the market																																
5	Establish regulations for energy labeling of equipment (development of MEPS – Minimum Energy Performance Standards)																																
6	Establish regulations for minimum energy performance standards for new buildings																																
7	Establish regulations for minimum energy efficiency standards for appliance imports																																
8	Establish regulations for energy-intensive consumers																																
9	Establish regulations for the design and installation of industrial equipment																																
10	Establish regulations for incorporating appropriate energy-saving and energy-efficient technologies in public and private real estate infrastructure projects, with emphasis on the tourism sector, such as hotels																																
11	Creation of incentives and financial mechanisms to increase the population's access to energy-efficient appliances																																
12	Creation of tailored financing solutions																																
13	Creation of a centralized system including an energy efficiency database																																
14	Creation and implementation of an MRV (Monitoring, Recording and Verification) system for the implementation of EE measures																																

15	Creation, updating and continuous implementation of a training program for specialists on specific EE themes (creation of technicians and auditors)																													
16	Continuous capacity building for institutional managers in structuring complete proposals for energy efficiency projects and project management for fundraising																													
17	Creation of competencies within DGRNE for centralization and management of energy efficiency data, including calculation standards																													
18	Continuous actions to support the capacity building of national associations and entrepreneurs																													
19	Development and ongoing implementation of an EE training and capacity building plan for technical staff																													
20	Training activities for EMAE technicians on the use of the IMS and on O&M																													
21	Creation and installation of laboratories in the RE area																													
22	Promotion of technical and technological training for the staff of training centers and universities, on a continuous basis																													
23	Establish cooperation agreements with international universities and technological research centers in the EE area																													
24	Create an action plan to promote national energy autonomy and encourage energy efficiency in homes, commercial/industrial buildings and public lighting																													
25	Create a program to adopt innovative technologies for energy-efficient cooling and air conditioning systems																													
26	Create a program to accelerate the development of smart grids and mass use of smart meters																													
27	Implementation of the SEforALL awareness raising campaign in STP, which includes energy efficiency																													
28	Conduct continuous communication campaigns from a gender perspective to increase bill collection and combat technical losses																													

29	Conduct continuous information and awareness raising campaigns about the rational use of energy for the general population																														
30	Conduct continuous information and awareness raising campaigns about the rational use of energy in hotels and other tourist accommodation																														
31	Publicize information about EE projects that have been successfully implemented at the national level																														
EE measures: Transmission and Distribution Network																															
32	Modernization of the transmission/distribution network with the aim of reducing energy losses (reduce 5%, 10 GWh by 2030)																														
33	Installation of intelligent metering systems in transformer stations																														
34	Installation of meters and load measuring equipment at all consumers																														
35	Improvement of EMAE's operation and maintenance system, including a continuous O&M plan																														
36	Reinforcement of the grid in selected thermal installations (12 km of transmission lines / 5 km of overhead distribution and supply lines / 3 new 30 kV sectioning stations)																														
37	Maintenance interventions in selected thermal plants																														
38	Extension of the power grid next to the hydropower plants on the River Iô Grande																														
EE measures: Efficient lighting																															
39	Replacement of approximately 300,000 incandescent light bulbs with LED light bulbs (10 light bulbs in 60,000 homes over 5 years)																														
40	Replacement of 100,000 conventional light bulbs with LED ones in poorer households (5 bulbs in 20,000 households)																														
41	Replacement of 198,000 incandescent bulbs with LED ones in buildings																														
42	Replacement of 20,000 inefficient light bulbs with LED ones in public lighting																														

Overview of all policies and measures for modern energy for cooking																															
43	Study to define the strategy to achieve universal (100%) access to clean and safe cooking sources in STP by 2050																														
44	Implementation of a program to replace 39,600 traditional stoves with improved high-efficiency ones																														
45	Implementation of a program for the adoption of modern alternative cooking fuels (e.g. LPG, biogas, solar stoves, kerosene)																														
46	Implementation of a program for the adoption of efficient charcoal production techniques																														
Overview of all policies and measures for sustainable agriculture and cattle raising, reducing deforestation and using biomass as an energy source																															
47	Creation of a centralized information system for forests, land use and land use change, forest resources, agriculture and associated climate change, under the DFB and INM																														
Overview of all policies and measures for the transport sector																															
48	Development and implementation of the national electric mobility strategy and the introduction of efficient, low-carbon public transport systems																														
49	Development of the strategy to introduce more than 10,000 electric vehicles, being 10,000 light vehicles, 2,000 motorcycles and 100 (buses) for public transport and the installation of about 5,000 recharging points or stations																														
50	Development of the study for the improvement of road network to reduce congestion																														
51	Development of the study on the need for capacity building and the training strategy for the transport sector on issues related to low carbon and more efficient transport.																														
52	Development and enforcement of standards and regulations for both efficient and electric vehicles																														
53	Creation of financial incentives and replacement of 1,000 gasoline or diesel taxis (500+500) with more efficient cars																														

6.3 Detailed description of the measures

Taking into account the reality and ambition of STP to achieve the proposed targets, the action plan proposes a trajectory based on a series of relevant measures to be implemented. To this end, with the aim of achieving the proposed goals, the detailed description of each measure adopted is presented below, including its priority with regard to implementation and its expected results/impacts.

6.3.1 Measures concerning the energy and electricity sector

Prior knowledge of the alternatives for reducing energy demand, their constraints, benefits and costs, as well as the impacts of adopting future EE measures, is crucial to ensure adequate energy intensity in STP. This also reduces spending on fuel imports and optimizes the investments for the construction of new power generation plants. This requires technical and preparatory studies to facilitate decision making. The most significant technical study for STP is presented in the following measure:

No.: EE 1

MEASURE	TECHNICAL STUDIES - EE POTENTIAL AND ITS CONTRIBUTION TO MITIGATION AND ADAPTATION
TYPE OF MEASURE	Studies/preparations
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	A detailed analysis should be conducted to identify the potential for EE in STP. Including among others: • Cost Curves and Energy Conservation Potential; • Priority intervention areas depending on their EE potential: industrial sector, transport sector (land, sea, air), construction sector for buildings and other infrastructures, etc. • Identification of pilot/demonstration projects to be implemented (considering gender perspectives during the identification process). • Analysis of measures and recommendations for the integration of gender equality and equity in the planning and implementation of the EE (and RE) sector, to be developed in close coordination with INPIEG. The study should consider an analysis of "frontier technologies" that increase energy efficiency and their applicability and potential in STP, and should be complemented by a study of the effective contribution that this potential and its development could have on mitigating GHG emissions, in the context of the NDCs, in addition to the contribution that different technologies could have as climate change adaptation options (to be developed considering the outcome of the GCF/UNEP project: "*Reduce São Tomé and Príncipe's vulnerability to climate change impacts by strengthening the Country's capacity to implement an integrated approach to adaptation planning.*"
TARGET GROUP/SECTOR	Decision makers in the public and private sector
IMPLEMENTING BODY(IES)	EE Department (creation planned) at DGRNE / INPIEG (in aspects relating to gender)
EXPECTED RESULTS / IMPACTS	R1. Analysis and decision support on technical and legal issues related to EE implementation R2. Analysis and decision support on approaches and strategies for developing EE integration into the regional energy efficiency strategy R3. Analysis and decision support for EE policy development at the national level, as well as policy support mechanisms R4. Analysis and identification of the potential and application of EE in industry (for example heat or water recovery) R5. Contribution of EE technologies and potential in mitigating GHG emissions and adapting to climate change.

In this strategy, which is based on creating an adequate EE market, it will be **imperative to create and strengthen the necessary institutions for supervising, monitoring, regulating and tracking the market**, in addition to structuring the institutional frameworks. Accordingly, creating the complete, transparent facilitating institutional mechanism necessarily requires the successful implementation of the following measures:

No.: EE 2

MEASURE	ESTABLISHMENT OF THE EE DEPARTMENT AT DGRNE
TYPE OF MEASURE	Organizational Strengthening
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	This EE strategy requires Coordination, Monitoring & Evaluation components, which could be facilitated by creating and establishing an EE department. This department will be responsible for mobilizing, coordinating activities and monitoring the implementation of the EE projects in the field in coordination with the RE department that will be created (see the NREAP). Being responsible for monitoring the policy, it will be the main instrument for intervention and promotion of activities in the sector, including planning, prospecting, monitoring and introduction of new technologies and processes, as well as the strengthening of institutional capacity and human resources. This type of measure will have the electricity sector's institutional guidance manual as a reference, and should be aligned with it. The RE department, in close coordination with the EE department, will be responsible under DGRNE to ensure the active participation of DGRNE in RE and EE related events, training or other activities promoted by CEREEAC.
TARGET GROUP/SECTOR	Public Sector / Energy Service Companies
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Structured EE institutional framework R2. Tracking of technical, financial, logistical and other operations achieved

No.: EE 3

MEASURE	ESTABLISHMENT OF A NATIONAL ENERGY CERTIFICATION BODY (ENCE – ENTIDADE NACIONAL DE CERTIFICAÇÃO ENERGÉTICA)
TYPE OF MEASURE	Organizational Strengthening
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	The aim of ENCE is to establish the legal, regulatory and operational framework for energy performance requirements for buildings, some equipment and production facilities, as well as the requirements for the implementation and use of RE/EE systems, both in terms of energy performance and the quality of these systems. This system will also serve as a basis for training technicians to install and maintain RE and EE equipment for duly certified buildings.
TARGET GROUP/SECTOR	Public Sector / Energy Service Companies
IMPLEMENTING BODY(IES)	DGRNE / AGER
EXPECTED RESULTS / IMPACTS	R1. Governance of the EE sector improved R2. Creation of conditions for the improvement of the energy performance of buildings and main energy-consuming equipment R3. Greater confidence in the EE market

It is crucial to the development of the EE market to create the legal, regulatory and economic conditions necessary to ensure investor and business confidence. The rules, procedures and market mechanisms, as well as requirements for energy-intensive consumers, should be as transparent as possible and brought to the attention of all interested parties in advance. The following measures aim to develop the legal, regulatory and economic framework of the EE market:

No. : EE 4

MEASURE	REGULATION OF THE EE OF THE APPLIANCES AVAILABLE ON THE MARKET
TYPE OF MEASURE	Market Development (Regulatory and Legal)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2023
DESCRIPTION OF THE MEASURE	A technical regulation for the EE of equipment and appliances used in STP should be established. This measure will develop standards for products traded in STP, whether imported or locally manufactured/assembled, in addition to phasing out inefficient appliances from the STP market. The procedures and mechanisms for national testing and certification of imported appliances and equipment will also be developed. The appliances will also include those used in cooking. This includes the development of compliance frameworks for efficient devices.
TARGET GROUP/SECTOR	General public
IMPLEMENTING BODY(IES)	DGRNE / AGER
EXPECTED RESULTS / IMPACTS	R1. Inefficient appliances removed from the market R2. Quality equipment on the market with great impact on energy savings

No. : EE 5

MEASURE	ENERGY LABELING OF EQUIPMENT AND APPLIANCES
TYPE OF MEASURE	Market Development (Regulatory and Legal)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	In progress
IMPLEMENTATION PERIOD	2021-2022
DESCRIPTION OF THE MEASURE	Labeling of equipment and appliances used in STP should be established. This measure will develop MEPS (Minimum Energy Performance Standards) informing the consumer of the following aspects: • Supplier, brand and model of the product; • EE class; • EE scale; • Annual energy consumption (kWh/year); The procedures and mechanisms for national testing and certification of imported appliances and equipment will also be developed, as well as the regulatory framework for the implementation of the MEPS. This measure is directly correlated with measure #7.
TARGET GROUP/SECTOR	General public
IMPLEMENTING BODY(IES)	DGRNE / AGER / Chamber of Commerce / EE Associations
EXPECTED RESULTS / IMPACTS	R1. Quality equipment guaranteed to be on the market with great impact on energy savings R2. Energy demand reduced R3. Rational use of energy resources

No. : EE 6

MEASURE	REGULATION OF THE ENERGY PERFORMANCE OF BUILDINGS
TYPE OF MEASURE	Market Development (Regulatory and Legal)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2035
DESCRIPTION OF THE MEASURE	Regulations should be established with minimum construction criteria for new buildings, providing conditions of thermal and visual comfort for the occupants in accordance with the climate of STP. The codes will be established based on a detailed analysis of the different typologies of buildings constructed in other parts of the world, and especially in the sub-region, and

	mathematical modeling of them, taking into account the climate, architectural features, building materials, orientation and utility of each building and room. The code will be accompanied by: • Validation and Compliance Control Mechanisms for each building typology, with a system for measuring and tracking energy consumption, as well as institutional responsibilities, procedures, and code enforcement rules. • User Guides: a guiding and informative document about the building code, its implications and the map of all those involved in the process. The objective is to develop energy-efficient buildings and to contribute to intelligent energy use, socio-economic sustainability, inhabitant comfort and resilience to climate change. An issue of vital importance will be applying the Codes in the area of tourism, especially in hotels and tourist accommodation due to their high energy consumption, and the ways of providing this energy, such as the use of solar thermal energy for water heating (taking into account the results of the RE potential studies to be developed under the NREAP)
TARGET GROUP/SECTOR	Civil construction professionals / Building users and owners
IMPLEMENTING BODY(IES)	DGRNE / AGER / EE Associations
EXPECTED RESULTS / IMPACTS	R1. Thermal comfort of buildings improved R2. Energy consumption in air conditioning and lighting reduced R3. Construction quality and sustainability of buildings improved

No. : EE 7

MEASURE	REGULATION OF THE ENERGY EFFICIENCY OF IMPORTED APPLIANCES
TYPE OF MEASURE	Market Development (Regulatory and Legal)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2030
DESCRIPTION OF THE MEASURE	Regulations should be established for the maximum specific energy consumption levels, or minimum energy efficiency levels, of energy-consuming machinery and appliances imported into STP. These levels should be established based on technically and economically feasible values, considering the useful life of the energy-consuming machines and appliances. Within a year of the publication of these levels, a Program of Targets should be defined for their progressive evolution. This measure is directly correlated with measure #5.
TARGET GROUP/SECTOR	Customs/DGRNE/DGE/Vendors
IMPLEMENTING BODY(IES)	DGRNE / AGER / EE Associations
EXPECTED RESULTS / IMPACTS	R1. Entry of equipment and appliances into the country controlled R2. Energy demand reduced R3. Provision of a record of the types of equipment and appliances in use in STP

No. : EE 8

MEASURE	REGULATION OF ENERGY-INTENSIVE CONSUMERS
TYPE OF MEASURE	Market Development (Regulatory and Legal)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	One of the measures to promote EE includes planning to reform the regulation of energy consumption management in order to make it compatible with the rational use of energy. The regulation should explain and classify energy-intensive consumers and stipulate the EE rules with which they must comply. The EE targets and strategies will be defined by the companies themselves, while validation and supervision will be the responsibility of the DGRNE / EE Department (creation planned).
TARGET GROUP/SECTOR	Intensive consumers and Industry
IMPLEMENTING BODY(IES)	DGRNE / AGER / EE Associations
EXPECTED RESULTS / IMPACTS	R1. Consumption by intensive consumers/industry reduced.

No. : EE 9

MEASURE	REGULATION OF THE DESIGN AND INSTALLATION OF INDUSTRIAL EQUIPMENT
TYPE OF MEASURE	Market Development (Regulatory and Legal)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	After an analysis of sector consumption, some industrial equipment will be selected and equally subjected to certification of the design and installation. The activity will mainly involve the regulation, training and certification of designers and installers.
TARGET GROUP/SECTOR	Industrial companies
IMPLEMENTING BODY(IES)	DGRNE / AGER
EXPECTED RESULTS / IMPACTS	R1. Energy consumption in industry reduced substantially. R2. Qualified and certified designers and installers available

No. : EE 10

MEASURE	REGULATION OF THE INCORPORATION OF EE TECHNOLOGIES INTO BUILDINGS
TYPE OF MEASURE	Market Development (Regulatory and Legal)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	Regulations should be established for incorporating appropriate energy-saving and energy-efficient technologies in public and private real estate infrastructure projects, with emphasis on the hotel sector. After an analysis of sector consumption, the technologies will be identified and equally subjected to certification of the design and installation.
TARGET GROUP/SECTOR	Private sector with emphasis on the hotel sector
IMPLEMENTING BODY(IES)	DGRNE / AGER
EXPECTED RESULTS / IMPACTS	R1. Energy saving and bioclimatic construction measures applied R2. Incentives for distributed electricity generation in public buildings

No. : EE 11

MEASURE	CREATING INCENTIVES TO INCREASE ACCESS TO EFFICIENT APPLIANCES
TYPE OF MEASURE	Creation of incentive mechanisms and guarantees
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	Fiscal and financial incentives should be created to encourage consumers (individuals and organizations) to reject the use of inefficient appliances and adopt more efficient equipment. To do so, it will be necessary to: • Offer discounts for exchanging old appliances for new ones; • Establish an installment payment system, among others.
TARGET GROUP/SECTOR	General population
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Package of incentives developed and established

No. : EE 12

MEASURE	CREATION OF FINANCING SOLUTIONS ADAPTED TO EE PROJECTS
TYPE OF MEASURE	Creation of incentive mechanisms and guarantees

PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2020-2030
DESCRIPTION OF THE MEASURE	Incentive systems for financing EE systems should be created, in partnership with banks and private investors. The incentive systems will be defined by conducting a study that will identify the model(s) to be adopted, which may also include interest subsidies, guarantees, etc.
TARGET GROUP/SECTOR	Private sector / General population
IMPLEMENTING BODY(IES)	DGRNE / Banks / Investment funds
EXPECTED RESULTS / IMPACTS	R1. Financing options established

With an adequate institutional framework and the removal of bureaucratic and financing barriers, favorable conditions will be created for the EE market to develop freely in STP. To this end, **the creation of tools that guarantee the availability of transparency and decision support will be essential elements to ensure a dynamic and innovative EE market**.

Evaluation and validation of the effectiveness and impact of the measures must be constant and must be accompanied by data collection, organization and analysis. The availability of these data will allow the development of sectoral and thematic studies, which will be useful for learning and decision support. In particular, they will enable energy modeling and planning exercises to be conducted with a more robust information base. The aim of the following measures is to promote transparency and decision support to develop an EE market:

No. : EE 13

MEASURE	CREATION OF A CENTRALIZED INFORMATION SYSTEM
TYPE OF MEASURE	Transparency and decision support
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	2
IN PROGRESS OR PLANNED	In progress
IMPLEMENTATION PERIOD	2020-2023
DESCRIPTION OF THE MEASURE	A centralized EE information system should be created. Periodic, systematic and exhaustive collection of statistical data on the energy sector will be carried out. Compiled, organized and analyzed data will be made available for consultation, including: • Preparation of the balance sheet of technical and technical losses; • Preparation of EE indicators in priority sectors; • Preparation of prospective analysis. This system will facilitate access to reliable information and enable decision making, together with the MRV system that will also be created. Wherever possible, the system will include the collection of energy indicators that describe women's impact on or relationship with the energy sector, such as the percentage of women with access to clean or more efficient energy for cooking.
TARGET GROUP/SECTOR	Political and business decision makers / General population
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. EE Information System created and implemented R2. EE indicator analysis system available

No. : EE 14

MEASURE	MRV SYSTEM CREATION
TYPE OF MEASURE	Transparency and decision support
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2022-2030

DESCRIPTION OF THE MEASURE	A Monitoring, Recording and Verification (MRV) System for tracking the implementation of the RE measures should be created. The MRV system will be used to evaluate the efficiency and effectiveness of the implementation of the EE measures, and to monitor the actual implementation timescale against the planned schedule. To do so, it will be necessary to: • Define the indicators to be included in the MRV system (including indicators broken down by gender and, if possible, by age, in order to calculate the impact of the measures on both children and women); • Ensure access to relevant professionals and decision makers.
TARGET GROUP/SECTOR	DGRNE/Policymakers
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. MRV system created and implemented R2. Implementation of the national energy policy monitored and evaluated

The training of professionals in the electricity and energy sector is a fundamental measure in the strategy to promote EE. The strategy outlined for the energy sector for the next 30 years will require, in the first place, the empowerment and training of human resources in sufficient quantity and quality to meet the challenges faced by the sector. Accordingly, it will be necessary to provide specialized high-level training, associated with research and development activities, as required to maintain constant innovation, with improvements in processes and technologies and, consequently, greater competitiveness. The following capacity building activities proposed here are:

No. : EE 15

MEASURE	CREATION OF A SPECIALIZED EE TRAINING PROGRAM
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	In progress (and in need of more funding)
IMPLEMENTATION PERIOD	2020-2050
DESCRIPTION OF THE MEASURE	It is intended to organize the creation of a training program for professionals in the EE field, providing qualification, certification and accreditation for the installation, operation and maintenance of EE systems, through collaboration with national and international universities or training centers, covering the following aspects: • EE technologies; • EE in homes; • EE in industry; • Energy meters; • Technical and technical losses in the energy transmission and distribution system; • EE audit (including verification of the correct application of technical standards and regulations in the different sectors). The training courses should include theoretical and practical classes, and provide certification for professionals who demonstrate good academic and practical performance. The courses should implement measures to promote women's participation in them and thereby increase the percentage of (young) women professionals in the energy field. This could be achieved by implementing a Sustainable Energy Training Program for Women.
TARGET GROUP/SECTOR	Energy sector professionals
IMPLEMENTING BODY(IES)	DGRNE / Universities / Training Centers / Research Institute
EXPECTED RESULTS / IMPACTS	R1. Capacity building for professionals in the local EE market, with a focus on female participation R2. Availability of information and expertise R3. Opportunity for constant updating for energy professionals R4. Female participation encouraged and thereby the training of women in the energy field.

No. : EE 16

MEASURE	CAPACITY BUILDING ACTIVITIES – STRUCTURING OF PROPOSALS
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5

IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	Short training courses will be developed and provided for institutional managers in structuring complete proposals for EE projects and project management for fundraising, covering the following aspects: • Technical analysis of EE projects; • Financial analysis of EE projects; • Fundraising sources; • Templates for budget spreadsheets; • Project management: Prospecting, Initiation, Planning, Execution, Control and Closure. • The role of ESCos (Energy Services Companies) The training should include theoretical and practical classes. The training should implement measures to promote women's participation in it and thereby increase the percentage of trained women in the energy field.
TARGET GROUP/SECTOR	Energy sector professionals
IMPLEMENTING BODY(IES)	DGRNE / Universities / Training Centers
EXPECTED RESULTS / IMPACTS	R1. Capacity building for institutional managers in the EE sector R2. Female participation encouraged and thereby the training of women in the energy field.

No. : EE 17

MEASURE	SKILL BUILDING – CENTRALIZATION AND MANAGEMENT OF EE DATA
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2023
DESCRIPTION OF THE MEASURE	Short training courses will be developed and provided to strengthen the capacity of the staff of institutions directly involved in the EE sector for integrating and managing EE systems, covering the following aspects: • Integration of EE into the electrical system; • Decision analysis for sustainability; • EE systems management; • Standards for calculating EE, including EE indicators. • Digitalization of energy systems, demand management, modern systems for energy management, flexible payment systems, etc. The training should include theoretical and practical classes. The training should implement measures to promote women's participation in it and thereby increase the percentage of trained women in the energy field.
TARGET GROUP/SECTOR	Professionals from MIRN / DGRNE, DGE, EMAE, AGER and other institutions related to EE
IMPLEMENTING BODY(IES)	DGRNE / Universities / Training Centers
EXPECTED RESULTS / IMPACTS	R1. Technicians in the relevant institutions trained R2. Capacity building of professionals from institutions in the sector on the centralization and management of EE data, including calculation standards R3. Female participation encouraged and thereby the training of women in the energy field.

No. : EE 18

MEASURE	SUPPORT ACTIVITIES FOR CAPACITY BUILDING OF ASSOCIATIONS AND ENTREPRENEURS
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	Short-term capacity building courses will be developed and provided to build the capacity in STP of EE associations and entrepreneurs in the energy sector, with a focus on female entrepreneurs or activities specially designed for them, covering the following aspects: • EE potential in STP

	• EE legal framework and regulation; • Incentives and financing mechanisms for EE projects • The role of ESCos (Energy Services Companies) • Perspectives on the EE landscape and benefits of implementing EE.
TARGET GROUP/SECTOR	Associations and organizations related to EE in STP / Entrepreneurs in the energy sector (with a focus on female entrepreneurs)
IMPLEMENTING BODY(IES)	DGRNE / Universities / Training Centers
EXPECTED RESULTS / IMPACTS	R1. Increased participation of national EE associations in the development of the sector R2. Increased entrepreneurship and innovation in the EE area R3. Growth of the local EE market

No. : EE 19

MEASURE	PREPARATION OF A TRAINING / CAPACITY BUILDING PLAN FOR TECHNICAL STAFF
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	A training / capacity building plan will be developed for technical staff of EE institutions, covering the following aspects: • Energy demand and projections reduced; • EE technologies; • Application in STP. The plan should consider measures to promote women's participation and thereby increase the percentage of trained women in the energy field.
TARGET GROUP/SECTOR	Energy sector professionals
IMPLEMENTING BODY(IES)	DGRNE / Universities / Training Centers
EXPECTED RESULTS / IMPACTS	R1. Appropriate technical updating of national professionals on specific EE issues R2. Female participation encouraged and thereby the training of women in the energy field.

No. : EE 20

MEASURE	TRAINING ACTIVITIES CONDUCTED ON THE USE OF GIS AND ON O&M
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	Short training courses will be developed and provided to train relevant professionals in the use of GIS and O&M covering the following aspects: • Management of standards, regulations and indicators, • Internal audit and tools. The program should consider measures to promote women's participation and thereby increase the percentage of trained women in the energy field.
TARGET GROUP/SECTOR	Energy sector professionals
IMPLEMENTING BODY(IES)	DGRNE / Universities / Training Centers
EXPECTED RESULTS / IMPACTS	R1. National staff receive suitable updating on the use of GIS and capacity building on O&M

No. : EE 21

MEASURE	CREATION AND INSTALLATION OF EE LABORATORIES
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4

IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2035
DESCRIPTION OF THE MEASURE	It is intended to organize the creation and installation of laboratories relating to different aspects of energy and its relationship with society, the economy and development (including gender perspectives), through collaboration with national and international universities or training centers. To make the research institutes attractive hubs for energy research, they will be equipped with laboratory equipment, enabling them to create new knowledge, and social, economic and technological innovations. The laboratories and projects to be developed will be associated with research under development in the country, encompassing master's and doctorate courses in STP universities. The selection of projects should take into account gender perspectives and encourage the participation of female students. In addition, the creation of specialized EE (and RE) laboratories should take into account the possibility of including evaluation and certification services for products and services in order to guarantee their quality.
TARGET GROUP/SECTOR	Researchers, students and professionals in the energy and related fields
IMPLEMENTING BODY(IES)	Universities / Research Institutes
EXPECTED RESULTS / IMPACTS	R1. Availability of laboratories for technical training and practical application to EE-related systems R2. Availability of information, knowledge and expertise to enable innovative solutions adapted to the country's conditions R3. Research and innovation promoted R4. Female participation in research and innovation promoted

No. : EE 22

MEASURE	TRAINING OF THE STAFF AT UNIVERSITIES AND TRAINING CENTERS
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	It is intended to promote the capacity building of university and training center staff (with a focus on training female staff) so that new trained professionals have access to quality, up-to-date information, through collaboration with national and international universities or training centers. Staff at universities and training centers should have access to courses and initiatives developed specifically for training them on all aspects of EE development.
TARGET GROUP/SECTOR	Universities and professional training centers
IMPLEMENTING BODY(IES)	National and international universities / research institutes
EXPECTED RESULTS / IMPACTS	R1. Increased capacity of specialized EE professionals for different professional training courses (with a focus on capacity building for female professionals)

No. : EE 23

MEASURE	ESTABLISH COOPERATION AGREEMENTS
TYPE OF MEASURE	Training, qualification and certification initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	It is intended to establish cooperation agreements in the EE area with universities, technological research centers and regional centers focused on RE and EE, to foster the transfer of technology and knowledge between institutions. Cooperation agreements should be established with national and international universities and research/investigation centers, with the support of DGRNE. Special attention will be given to establishing cooperation and collaboration agreements with CEREEAC for the development of "Train-the-Trainers" programs, together, through GN-SEC, with other centers in the region and the international network focused on the

	SIDS (CCREEE, PCREE, SACREEE and ECREEE). Gender equity and equality issues will be considered when selecting program participants.
TARGET GROUP/SECTOR	Universities, technological centers or centers with a focus on RE and EE
IMPLEMENTING BODY(IES)	Universities / national and international research institutes / DGRNE / GN-SEC
EXPECTED RESULTS / IMPACTS	R1. Increase in international cooperation and exchange initiatives in the EE area R2. Technology and knowledge transfer encouraged at regional and international level R3. Increase in local capacities in EE

Based on the studies carried out and the definition of the strategy to be followed to promote EE in STP, **programs and action plans should be developed in areas essential to ensuring energy demand in STP is reduced.** The aim of the following measures is to accelerate the adoption of efficient cooling and air conditioning systems, as well as the development of smart grids and use of meters:

No. : EE 25

MEASURE	PROGRAM TO PROMOTE THE ADOPTION OF EFFICIENT REFRIGERATION AND AIR CONDITIONING SYSTEMS
TYPE OF MEASURE	Development of programs and action plans
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2030
DESCRIPTION OF THE MEASURE	Associated with energy certification of buildings, special attention will be given to the design and installation of cooling and air conditioning equipment. A program should be created to foster the adoption of innovative, low-energy consumption system technologies, including: • Benefits of using energy-efficient refrigeration and air conditioning systems; • Regulatory procedures with requirements for refrigeration and air conditioning systems, such as MEPS.
TARGET GROUP/SECTOR	Homes / Commercial buildings
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Energy consumption in homes and commercial buildings reduced

No. : EE 26

MEASURE	PROGRAM TO ACCELERATE THE DEVELOPMENT OF SMART GRIDS AND THE USE OF METERS
TYPE OF MEASURE	Development of programs and action plans
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2022-2050
DESCRIPTION OF THE MEASURE	This axis covers a series of measures aimed at improving efficiency in electricity transmission and distribution networks. To this end, a program should be created to promote smart grids and use of energy meters that will contribute to the reduction of technical losses. The program should include: • The benefits of smart grid development and the use of energy meters; • The definition of the distribution strategy and installation of energy meters.
TARGET GROUP/SECTOR	Electricity Sector
IMPLEMENTING BODY(IES)	MIRN/DGRNE and EMAE
EXPECTED RESULTS / IMPACTS	R1. Management of the electricity transmission and distribution network improved R2. Electricity loss points identified

Creating a permanent communication channel with the EE market and consumers/users to raise awareness of the importance of EE and its benefits is an integral and fundamental part of this strategy. To this end, **it is necessary to prepare awareness raising campaigns, beginning by introducing concepts relating to EE concepts in the residential, commercial and industrial context in various media channels**, principally the Internet. The following measures are proposed for preparing information and awareness raising initiatives:

No. : EE 27

MEASURE	SEforALL AWARENESS RAISING CAMPAIGN
TYPE OF MEASURE	Information and Awareness Raising Initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2023
DESCRIPTION OF THE MEASURE	Associated with the promotion of the EE market, information about the importance of the rational use of energy resources and the adoption of EE measures will be disseminated through the SEforALL campaign. This campaign will be targeted at families, businesses, and the general consumer public. The campaign should provide information about the positive impacts of universal access to energy on women and children through specific gender-focused activities.
TARGET GROUP/SECTOR	General population
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Dissemination of information about the importance of the rational use of energy resources and adoption of EE R2. Public awareness of EE benefits (especially among women and children)

No. : EE 28

MEASURE	CAMPAIGN TO COMBAT FRAUD AND ILLEGAL CONNECTIONS
TYPE OF MEASURE	Information and Awareness Raising Initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	In progress
IMPLEMENTATION PERIOD	2020-2050
DESCRIPTION OF THE MEASURE	Continuous communication campaigns should be conducted from a gender perspective to increase bill collection and combat technical losses. This program will look at the socio-cultural factors linked to fraud, theft and illegal connections. Based on in-depth knowledge of the causes, it will promote education, information and awareness raising campaigns for consumers, focusing on the intelligent and sustainable use of energy. A monitoring and evaluation mechanism will be put in place to ensure a real and lasting impact of the program's effects.
TARGET GROUP/SECTOR	General population and commercial sector
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Dissemination of information about the activities relating to the rational use of energy resources and adoption of EE R2. Public awareness to reduce technical losses and illegal connections

No. : EE 29

MEASURE	INFORMATION AND AWARENESS RAISING CAMPAIGNS
TYPE OF MEASURE	Information and Awareness Raising Initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	4
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2020-2050
DESCRIPTION OF THE MEASURE	Associated with the SEforALL campaign, there should be a continuous dissemination and awareness raising campaign about the rational use of energy, the benefits of EE and the required regulatory procedures. This campaign will be targeted at families, businesses, and the general consumer public. A general campaign to raise awareness and disseminate information regarding the benefits of adopting and implementing EE projects will be carried out through different media, and by conducting events and activities involving communities and energy sector stakeholders. It is important for the disseminated information to include

	the benefits of EE use for women. Special events focused on gender and energy issues should be considered as a fundamental part of the campaign.
TARGET GROUP/SECTOR	General population
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Dissemination of information about the importance of the rational use of energy resources and adoption of EE R2. Public awareness of the benefits of EE

No. : EE 30

MEASURE	AWARENESS RAISING CAMPAIGNS ON EE IN TOURISM
TYPE OF MEASURE	Information and Awareness Raising Initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2020-2050
DESCRIPTION OF THE MEASURE	Considering the significant contribution of the hotel sector to energy consumption, there should be a continuous dissemination and awareness raising campaign on the rational use of energy, the benefits of EE and the required regulatory procedures focused on the tourism sector. This campaign will be targeted at hotels and other tourist accommodation.
TARGET GROUP/SECTOR	Tourism sector
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Dissemination of information about the importance of the rational use of energy resources and adoption of EE in the tourism sector R2. Awareness about the benefits of EE and potential consumption reduction

No. : EE 31

MEASURE	DISSEMINATION OF SUCCESSFUL EE PROJECTS
TYPE OF MEASURE	Information and Awareness Raising Initiatives
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	6
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	The Internet makes it possible to provide content adapted to all needs and purposes. Accordingly, successful EE projects should be publicized on energy sector portals and in the general media to raise awareness about the benefits of EE and its potential applications.
TARGET GROUP/SECTOR	Private sector / General population
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Dissemination of information about EE projects R2. Public awareness of the benefits of EE

The rehabilitation, modernization and expansion of distribution and transmission networks, together with the installation of meters and the replacement of inefficient light bulbs, are a fundamental part of achieving the targets proposed in this plan. The promotion of true energy savings is included in this plan through the following measures:

No. : EE 32 -38

MEASURE	EE PROJECTS - TRANSMISSION AND DISTRIBUTION NETWORK
TYPE OF MEASURE	Investment in Infrastructure & Maintenance
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5

TARGET GROUP/SECTOR	STP Electricity Sector
IMPLEMENTING BODY(IES)	DGRNE / International Organizations
EXPECTED RESULTS / IMPACTS	R1. Increased grid stability due to greater technical reliability in grid maintenance and management R2. Technical and technical losses reduced R3. Better management of the electricity transmission and distribution network (due to the use of modern techniques and digitalization) R4. SIG used correctly by EMAE technicians R4. Increase in electricity consumption monitoring

DESCRIPTION OF THE MEASURE	IN PROGRESS OR PLANNED	LOCATION	IMPLEMENTATION PERIOD
32) Modernization of the transmission/distribution network with the aim of reducing energy losses	In progress	São Tomé and RAP	2020-2040
33) Installation of intelligent metering systems in transformer stations	Planned	São Tomé and RAP	2021-2024
34) Installation of meters at all consumers and load measuring equipment	Planned	São Tomé and RAP	2021-2050
35) Improvement of EMAE's operation and maintenance system, including a continuous O&M plan	Planned	São Tomé and RAP	2021-2050
36) Reinforcement of the grid in selected thermal installations (12 km of transmission lines / 5 km of overhead distribution and supply lines / 3 new 30 kV sectioning stations)	Planned	São Tomé	2021 – 2030
37) Maintenance interventions in selected thermal installations	Planned	São Tomé	2021-2022
Extension of the power grid next to the hydropower plants on the River Iô Grande	Planned	São Tomé	2021-2030

No. : EE 39 – 42

MEASURE	EE PROJECTS – EFFICIENT LIGHTING
TYPE OF MEASURE	Infrastructure Investment
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
TARGET GROUP/SECTOR	Population of STP
IMPLEMENTING BODY(IES)	DGRNE / International Organizations
EXPECTED RESULTS / IMPACTS	R1. STP energy efficiency increased R2. Energy demand reduced R3. Rational use of energy resources

DESCRIPTION OF THE MEASURE	IN PROGRESS OR PLANNED	LOCATION	IMPLEMENTATION PERIOD
39) Replacement of approximately 300,000 incandescent light bulbs with LED light bulbs (10 light bulbs in 60,000 homes over 5 years)	In progress	São Tomé and RAP	2020-2024
Replacement of 100,000 conventional light bulbs with LED light bulbs in poorer households (5 bulbs in 20,000 households)	Planned	São Tomé and RAP	2021-2030
41) Replacement of 198,000 incandescent light bulbs with LED light bulbs in buildings	Planned	São Tomé and RAP	2021-2030
42) Replacement of 20,000 inefficient light bulbs with LED light bulbs in public lighting	Planned	São Tomé and RAP	2021-2035

6.3.2 Modern energy measures for cooking

It is essential to analyze cooking alternatives and define a possible strategy to achieve universal access to clean and safe cooking sources in STP by 2050. Accordingly, it will be necessary to develop technical and preparatory studies to facilitate decision making. The most relevant technical studies for STP concerning clean and safe cooking are presented in the following measure:

No.: EE 43

MEASURE	TECHNICAL STUDIES – UNIVERSAL ACCESS TO CLEAN AND SAFE COOKING
TYPE OF MEASURE	Studies/preparations
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	5
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2022
DESCRIPTION OF THE MEASURE	A detailed study should be conducted to define the strategy to achieve universal (100%) access to clean and safe cooking sources in STP by 2030 and maintain this indefinitely. To this end, the following analyses should be performed: • Analysis of cooking technologies and their sources; • Analysis of the applicability of these technologies in the context of STP; • Definition of measures to develop the market in order to promote safe and clean cooking sources; • Analysis of impact and CO_2 emissions reduction(mitigation), and the contribution of this to climate change adaptation. • Expected impacts on women and children (better health, time available for education or income-generating activities, etc.)
TARGET GROUP/SECTOR	General population
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Information for defining the specific targets for the different fuels and technologies used in cooking

On the basis of the studies conducted and the definition of the strategy to be followed to achieve 100% access to more efficient, cleaner and safer energy sources for cooking for the population, **programs and action plans should be developed for implementing the measures that are essential to ensure the effective fulfillment of the stipulated targets**. The following measures aim to promote the development of a clean cooking market in STP:

No.: EE 44

MEASURE	PROGRAM FOR REPLACING TRADITIONAL STOVES
TYPE OF MEASURE	Development of programs and action plans
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2030
DESCRIPTION OF THE MEASURE	This long-term program should, with the help of the multi-sectoral and multidisciplinary team and the beneficiaries, implement the solutions found in the studies conducted on clean and safe cooking sources. The options should include preparing a program for replacing 39,600 traditional stoves in STP with improved high-efficiency stoves, with the aim of achieving universal access to clean and safe energy sources for cooking by 2030, in line with the NDC. To this end, the following analyses should be performed: • Definition of the distribution strategy; • Definition of the locations for the distribution; • Analysis of the impact and reduction of CO_2 and other pollutant emissions, as well as the impact on family health, with an emphasis on women and children. • Funding requirements The socio-cultural aspect should also be considered and there should be follow-up of the households benefitting for subsequent analysis of the impact.
TARGET GROUP/SECTOR	General population (special focus on women)
IMPLEMENTING BODY(IES)	DGRNE

EXPECTED RESULTS / IMPACTS	R1. Decreased CO_2 emissions from biomass R2. Decreased indoor air pollution (positive health impact) R3. Reduced deforestation R4. Savings in household expenditure on solid fuels for cooking

No.: EE 45

MEASURE	MODERN ALTERNATIVE COOKING FUELS PROGRAM
TYPE OF MEASURE	Development of programs and action plans
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	This long-term program should, with the help of the multi-sectoral and multidisciplinary team and the beneficiaries, implement the solutions found in the studies conducted on clean and safe cooking sources. The options should include implementing a program for the adoption of modern alternative cooking fuels (e.g. LPG, biogas, solar stoves, kerosene), including strategies for the adoption of these sources and for their use to expand among the STP population. To this end, the following analyses should be performed: • Definition of the strategy for expanding the use of each source; • Definition of key locations in STP for expanding the use of each source; • Analysis of the impact and reduction of CO_2 and other pollutant emissions, as well as the impact on family health, with an emphasis on women and children. • Funding requirements.
TARGET GROUP/SECTOR	General population
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Decreased CO_2 emissions from biomass R2. Decreased indoor air pollution R3. Reduced deforestation

No.: EE 46

MEASURE	PROGRAM FOR EFFICIENT CHARCOAL PRODUCTION
TYPE OF MEASURE	Development of programs and action plans
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	A program should be developed for the adoption of efficient charcoal production techniques to increase the economic efficiency and environmental quality of the process. To this end, the following analyses should be performed: • Technologies used in the process for its production; • Value chain analysis based on the UNDP report produced in 2021; • Identification of tree species that combine fast growth with good calorific value for use in charcoal production with other wood and non-wood products; • Analysis of Impact and CO_2 emissions reduction.
TARGET GROUP/SECTOR	General population
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Decreased CO_2 emissions R2. Rational use of energy resources R3. Reduced deforestation R4. Increased cooking efficiency due to better charcoal quality

6.3.3 Measures related to sustainable agriculture and cattle raising, and reducing deforestation

Forest use and agricultural practices have a direct impact on the control of biomass use. Accordingly, it is essential that this use is monitored, which must be accompanied by the collection, organization and analysis of pertinent data. **The data and its analysis should be stored in a centralized system, enabling the development of sectoral and thematic studies, which will be useful for learning and**

decision support. The following measure aims to promote transparency and decision support in the promotion of sustainable agriculture and cattle raising, and reduced deforestation:

No.: EE 47

MEASURE	CREATION OF A CENTRALIZED INFORMATION SYSTEM
TYPE OF MEASURE	Transparency and decision support
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2025
DESCRIPTION OF THE MEASURE	A centralized information system for forest management should be created under the DFB and INM. There will be periodic, systematic and exhaustive collection of statistical data that will be compiled, organized and analyzed and then made available for consultation, including on: • Forest use and deforestation; • Land use, change in land use, and forest resources; • Impact of agriculture and cattle raising activities on forests; • Associated climate change and its impact. This system will facilitate access to reliable information and enable decision making.
TARGET GROUP/SECTOR	Political and business decision makers / General population
IMPLEMENTING BODY(IES)	DGRNE/DGA/DFB/INM
EXPECTED RESULTS / IMPACTS	R1. Information system on forests, agriculture and climate change created and implemented R2. System for analyzing indicators of land use, agricultural activities and climate change

6.3.4 Measures concerning the transport sector

The preparation of studies and strategies regarding the development of the efficient, low-carbon transport system, and the development and future expansion of electric transport are also significant for ensuring the EE of STP vehicles. Accordingly, it will be necessary to develop technical and preparatory studies to facilitate decision making. The most significant technical studies for STP regarding efficient, low-carbon and electric transport are presented in the following measures:

No.: EE 48

MEASURE	EFFICIENT, LOW-CARBON AND ELECTRIC MOBILITY STRATEGY
TYPE OF MEASURE	Studies/preparations
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2031-2040
DESCRIPTION OF THE MEASURE	A study should be conducted to develop and implement a national strategy for low-carbon mobility and introduction of efficient transport systems in the context of land, sea and air transport. Data pertinent to existing modes of transport in STP will be collected to create a database to enable the identification of key areas of intervention, including: • Current energy consumption of the transport sector (private and public); • Impact of the introduction of more efficient and/or electric means of transport (vehicles, ships, boats, etc.); • Impact of electric power for charging electric vehicles on generation and grid stability. • Development of a standard for efficient vehicles and efficient fuels, together with qualified staff to verify its implementation
TARGET GROUP/SECTOR	Decision makers in the public and private sector
IMPLEMENTING BODY(IES)	DGRNE
EXPECTED RESULTS / IMPACTS	R1. Information available for decision making R2. Targets and goals relating to the development of low-carbon transport system in STP defined

No.: EE 49

MEASURE	STRATEGY FOR THE INTRODUCTION OF ELECTRIC VEHICLES AND RECHARGING POINTS
TYPE OF MEASURE	Studies/preparations
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	2
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2041-2050
DESCRIPTION OF THE MEASURE	A study should be conducted for defining the strategy for introducing more than 10,000 electric vehicles, being 10,000 light vehicles, 2,000 motorcycles and 100 buses (for public transport), and the installation of about 5,000 recharging points (considering both grid connected and isolated points), including: • Regulations to be developed to foster the electric vehicle market; • Development of financial incentives for the development of the electric vehicle market; • Impact on the energy matrix and energy demand; • Definition of the location of recharging points and possibilities for demand-side management.
TARGET GROUP/SECTOR	Automotive sector / General population
IMPLEMENTING BODY(IES)	DGRNE and Directorate of Land Transport
EXPECTED RESULTS / IMPACTS	R1. Decreased CO_2 emissions

No.: EE 50

MEASURE	ROAD NETWORK IMPROVEMENT STUDY
TYPE OF MEASURE	Studies/preparations
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2021-2050
DESCRIPTION OF THE MEASURE	A study should be conducted to define the strategy for improving the road network to reduce congestion and, consequently, reduce fuel use by vehicles, including: • Identification of congestion points; • Maintenance and expansion of the existing road network; • Appropriate geometric and structural dimensioning of highways;
TARGET GROUP/SECTOR	Decision makers in the public and private sector
IMPLEMENTING BODY(IES)	DGRNE and Directorate of Land Transport
EXPECTED RESULTS / IMPACTS	R1. Decreased CO_2 emissions

No.: EE 51

MEASURE	STUDY OF CAPACITY BUILDING/TRAINING NEEDS IN THE TRANSPORT SECTOR
TYPE OF MEASURE	Studies/preparations
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2022-2030
DESCRIPTION OF THE MEASURE	A needs study should be conducted for capacity building initiatives and the training strategy for the transport sector on issues related to low carbon and more efficient transport, including: • Sustainable transport; • Intelligent road network; • EE in the transport sector;
TARGET GROUP/SECTOR	Decision makers in the public and private sector
IMPLEMENTING BODY(IES)	DGRNE / Directorate of Land Transport / Universities / Training Centers
EXPECTED RESULTS / IMPACTS	R1. Information for decision making R2. Creation and transfer of knowledge and capacity building of the sector

Creating the legal, regulatory and economic conditions necessary to leverage a more efficient transport system, including the electric transport, is an integral part of an EE strategy. Incentive regulations and mechanisms should be as transparent as possible and brought to the attention of all interested parties in advance. The following measures aim to develop the legal, regulatory and economic framework of the sustainable transport market:

No.: EE 52

MEASURE	INTRODUCTION AND ENFORCEMENT OF STANDARDS, REGULATIONS AND INCENTIVES FOR EFFICIENT AND ELECTRIC VEHICLES
TYPE OF MEASURE	Market Development (Regulatory, Legal and Financial)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2022-2030
DESCRIPTION OF THE MEASURE	Specific minimum energy performance standards, legislation and regulations should be developed for the introduction of efficient cars, fuels for transport, and electric vehicles: • Standards and regulations for imported vehicles • Standards and regulations for fuels for transport • Standards and regulations for air transport, shipping and ports • Standards and regulations for importing electric vehicles and placing them on the market • Taxation of emitting vehicles; • Regulations for the installation of recharging points and definition of those responsible for their installation; • Regulations for benefits for electric vehicle owners (purchase interest exemption / parking fee exemption); • Mechanisms to encourage the importing of efficient and electric cars
TARGET GROUP/SECTOR	Decision makers in the public and private sector
IMPLEMENTING BODY(IES)	DGRNE and Directorate of Land Transport
EXPECTED RESULTS / IMPACTS	R1. Decreased CO_2 emissions R2. The sector's regulatory and legal framework strengthened

No.: EE 53

MEASURE	INCENTIVES FOR MORE EFFICIENT TAXIS
TYPE OF MEASURE	Creation of incentive mechanisms and guarantees (Financial and Fiscal)
PRIORITY (FROM 1 (LOW) to 5 (HIGH))	3
IN PROGRESS OR PLANNED	Planned
IMPLEMENTATION PERIOD	2026-2035
DESCRIPTION OF THE MEASURE	Financial incentives should be created to promote the replacement of 1,000 gasoline or diesel taxis (500+500) with more efficient cars, including: • Better financing conditions for more efficient cars; • Tax exemption for more efficient vehicles.
TARGET GROUP/SECTOR	Decision makers in the public and private sector
IMPLEMENTING BODY(IES)	DGRNE / Directorate of Land Transport
EXPECTED RESULTS / IMPACTS	R1. Decreased CO_2 emissions R2. Rational use of energy resources

7 POTENTIAL BENEFITS OF IMPLEMENTING THE NEEAP

7.1 Economic

The economic benefits of implementing the NREAP are significant and will have a positive impact on the country's economy. Using the renewable resources present in STP will reduce dependence on fossil fuels that are currently imported and require a significant portion of the GDP. The BAU scenario shows that there will be an increase in fossil fuel demand, whereas in the mitigation scenario a portion of this demand will be avoided through the implementation of the RE and EE measures. In the mitigation scenario, it is estimated that there will be an approximate saving of 984,187.8 tons of diesel by 2050, which represents approximately USD 1.16 billion considering forecasts for the diesel price, given in Table 3.

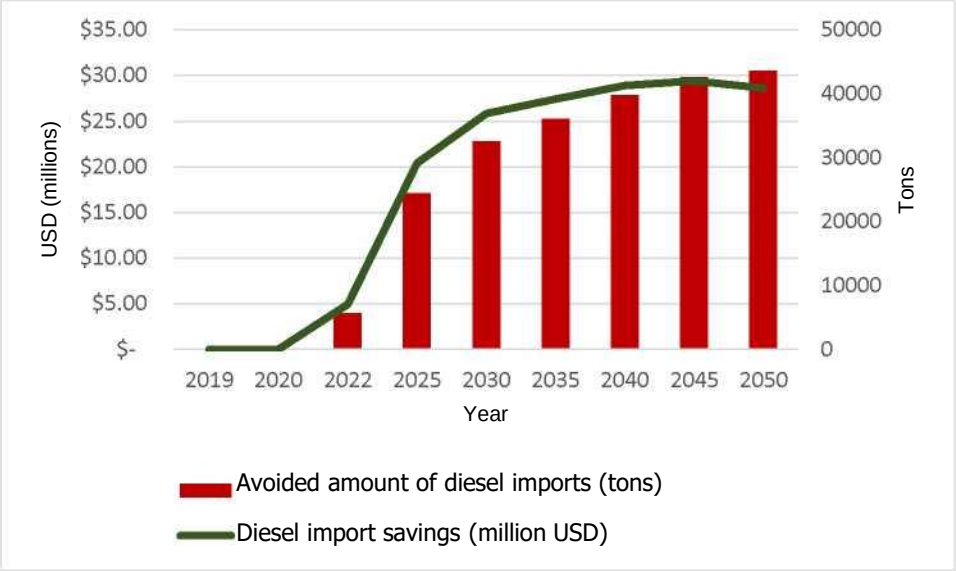


Figure 14: Quantity of diesel imports avoided in the mitigation scenario and the associated savings

The estimated cumulative net benefits far outweigh the projected initial investment costs for the established pipeline of RE projects, which totals about USD 171 million to 2030. This is particularly true if the projects attract private capital, concessional financing and foreign direct investment.

At the same time, the reduction in expenditure on imported fuel will allow funds to be redirected to other areas, such as health and education. In 2019 (the base year adopted in the NREAP and the NEEAP), expenditure on diesel imports corresponds to 8.4% of STP's GDP[6] (USD 23,627,631). With the implementation of the measures, this percentage is reduced to 0.6% in 2030 (USD 2,529,826) and to 0.9% in 2050 (USD 8,447,240.71). It can be seen that in 2050

the cost of diesel Imports in comparison to GDP is higher due to the growing demand for electricity, which will be partially supplied by thermoelectric power plants (diesel). If no new RE projects are implemented after 2050, the diesel import cost relative to GDP follows an upward trend.

The implementation of the NEEAP measures will also guarantee universal access to energy for the entire population, improve their quality of life in general and, above all, contribute to:

- Improved health by reducing the use of traditional stoves, which will be replaced by improved, more efficient stoves and cleaner fuels or cleaner cooking technologies. At the same time, improved health will reduce the pressure on the health care system and the incidence of respiratory diseases (principally in women and children).
- Providing the opportunity to make productive uses of energy and, consequently, generate more job opportunities, which is positive for the country's economy.

[6] *The country's estimated GDP in 2019 was USD 279,700,465 @ constant 2010 prices (source: World Bank), in 2030 is estimated at USD 423,039,635.68 and in 2050 is estimated at USD 910,596,621.18.*

- The use of more efficient stoves, which will allow families to save money on the fuels used for cooking.

Strengthening the institutional, normative, legal and regulatory framework for EE will foster the development of the EE market. Finally, further studies on the potential of EE in different sectors of the economy will provide up-to-date and accurate information that will allow the development of the internal market and business opportunities in STP.

7.2 Social

The most significant benefit for the São Toméan population is that the improved access to energy will impact directly on their quality of life, as previously described. From a gender perspective, this has a direct benefit for women, since they are generally responsible for collecting biomass to supply household energy needs, mainly for lighting and cooking. Access to electricity services and cleaner and more efficient technological options for cooking will allow the population to have more time available for other activities, such as productive activities, studying or simply having more family time. In the specific case of cooking, as mentioned above, there will be savings in monthly family expenditure on fuels for cooking and health benefits from the reduction in the pollution of air inside the home. From a labor inclusion perspective, women would also benefit from training and education measures that would enable them to access technical positions and even participate more actively in decision making and the development of policies and incentives that are more responsive to their needs (such as access to funding for implementing clean technologies).

Activating the EE market will promote the growth of employment opportunities in the sector. Better access to cleaner and more reliable technologies will also have a positive effect on young people, especially those in rural areas, providing greater and better opportunities to have equitable access to employment opportunities and will foster entrepreneurship. The promotion of entrepreneurship for the development of a local market, such as the manufacturing of improved stoves, would enable reductions in the import of technology and foster the growth of local businesses that could be led by women or young people. This, as well as capacity building and qualification/training opportunities, will encourage the population, especially the youth, to study the subject and increase their interest in innovating, and thereby contribute to the growth of the local market. In addition, access to more efficient technologies will have a positive impact at the production level as it will be possible to save energy in the production of goods and services, and thereby increase the income of the enterprises.

7.3 Environmental

The overall environmental benefit of implementing the NREAP and NEEAP is to significantly reduce GHG emissions in the power sector and to achieve the target of a 27% emission reduction by 2030 set in the NDC (2021). Section 10 presents a detailed comparison of the results of the two scenarios (BAU and mitigation) in regard to GHG emissions reduction. Another positive impact of the NEEAP is the reduction in deforestation associated with the collection of firewood for cooking and charcoal production due to the introduction and use of more efficient cooking technologies and, therefore, the plan will contribute to better conservation and management of forest resources.

8 COORDINATION WITH REGIONAL INITIATIVES

The ECCAS region has a number of regional initiatives underway in the EE field:

- **ECCAS/CAEMC regional policies, including** the ECCAS Green Economy and Renewable Energy Vision, the ECCAS Vision 2025, as well as the CAEMC White Paper and the Energy Policy 2035. The White Paper in particular sets out regional policy for universal access to modern energy services, and economic and social development. These policies are also linked to broader goals around industrial development in the region.
- The revised ECCAS Treaty, in particular the commitments of the Member States to (i) develop the Community's energy resources, and (ii) promote renewable energy within the framework of the policy of diversification of energy sources.
- The roadmap for promoting renewable energy in Central Africa.
- The **CEREEAC** will also be created for the region, its main mission being: *"to ensure coordination of the implementation of the ECCAS Policy on RE and EE and to promote the creation of an integrated and inclusive ECCAS market for related products and services. The CEREEAC will be part of a global network of centers, under the GN-SEC, coordinated by UNIDO.*

The STP NEEAP was developed on the basis of the regional guidelines and strategies for RE and EE, thereby ensuring the benefits from synergies between these programs and the measures proposed in the present plan, and good regional integration.

9 PREPARATION OF THE NEEAP AND TRACKING ITS IMPLEMENTATION AND MONITORING

Plan Preparation:

- This plan was prepared during the period July 2020 to October 2021 by the DGRNE of STP. The plan was supported by UNIDO, MIRN and various Ministries and Governmental Directorates in the country, as well as a number of other intervening and transversal agents in the energy sector, which monitored and guided its execution through their participation in the PNES.

Entity responsible for the Preparation of the Plan and its Implementation

- DGRNE, an integral part of MIRN, will be the main body responsible for the execution and implementation of the NEEAP, as well as the NREAP.

Implementation, supervision and monitoring of the NEEAP:

- The actions and measures must be accompanied by coherent economic and financial policies based on clear and defined goals, vision and missions. In the case of STP, Vision 2030 plays a major role to 2030.
- The entities that handle these policies and plans should create synergies with other entities dedicated to this purpose.
- Mechanisms must be created to implement these actions, which must necessarily follow good public management.
- The mechanism for the supervision and monitoring of the implementation of the NEEAP will be defined by DGRNE, which, in practice, will be responsible for following, evaluating and monitoring the implementation of the plans.
- CEREEAC will play a vital role in coordinating plans and strategies of member countries at the regional level, together with the overall vision regarding the implementation of RE and EE measures, strategies, plans, and policies for the entire region.

10 COMPARISON OF THE SCENARIO RESULTS: BAU VS MITIGATION

Final energy demand

The evolution of final energy demand to 2050 will be reduced by implementing the proposed mitigation measures (in the NREAP and NEEAP), as shown in Figure 15 (the reduction in demand is illustrated in the figure by the white rectangles).

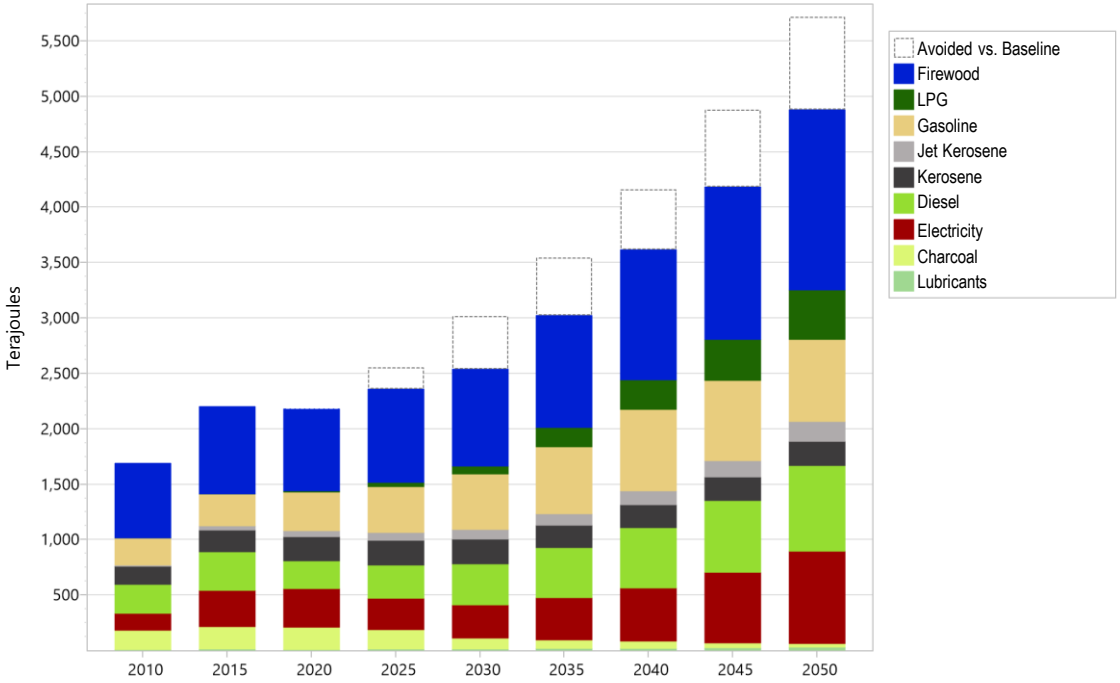


Figure 15: Reduction of final energy demand in TJ (white rectangles) and estimated demand by fuel type up to 2050

By implementing the measures in the mitigation scenario, demand will decrease by approximately 8.7% by 2030 (reduction in the period 2020-2030, relative to BAU) and will decrease by approximately 12.9% by 2050 (reduction in the period 2020-2050, relative to BAU). As explained earlier, the mitigation scenario considers the implementation of the both the RE measures and the EE measures. In addition, the result provided by LEAP includes the possible interactions between the various measures. In other words, the result of modeling all the measures in combination is not necessarily the sum of the results from the individual modeling of each of the measures.

Table 20: Evolution of primary energy demand in the mitigation scenario by fuel type up to 2050 (in TJ), with the difference between the two scenarios in orange

Sector / Years	2010	2015	2020	2025	2030	2035	2040	2045	2050	
Difference in demand (mitigation vs. BAU)	-	-	22.2	192.1	477.0	524.8	544.4	698.7	837.8	
Firewood	678.8	786.7	740.4	846.0	877.2	1,011.1	1,180.1	1,374.6	1,627.0	MITIGATION
LPG	0.9	1.9	9.3	38.0	69.6	176.9	263.1	371.1	450.5	
Gasoline	245.0	290.9	346.6	416.6	503.1	605.0	736.6	722.8	737.6	
Aviation kerosene	9.2	36.6	57.4	69.0	85.1	103.6	125.4	151.2	181.7	
Kerosene	161.8	196.9	219.6	222.0	225.3	200.1	204.7	210.0	216.3	
Diesel	264.5	347.5	250.4	301.0	370.9	451.9	547.0	649.3	772.4	
Electricity	149.3	326.7	345.0	282.9	297.7	380.6	480.2	638.5	836.6	BUSINESS-AS-USUAL

Charcoal	173.3	200.8	200.3	175.1	97.9	78.2	63.4	42.4	33.1	
Lubricants	7.5	11.2	7.8	9.3	11.5	14.0	16.9	20.4	24.5	
Total--- TJ	**1,690.3**	**2,199.2**	**2,198.9**	**2,552.0**	**3,015.3**	**3,546.2**	**4,161.7**	**4,878.9**	**5,717.6**	

By way of example, comparing the two fuels with the highest demand, firewood and diesel, in **Table 20** above with Table 25 (Annex I), it can be seen that the estimated demand for firewood in the BAU scenario in 2050 is 2,011 TJ and in the mitigation scenario is 1,627 TJ for the same year, implying a reduction in demand for this fuel, resulting from the measures implemented in cooking in previous years, which includes a strong introduction of LPG. It is important to note that LPG demand in 2050 would be 22 TJ in BAU and is estimated at 450 TJ in the mitigation scenario for the same year.

By modeling “"mini-scenario”" for each type of measure, it is possible to estimate the impact each would have in terms of demand reduction; this being presented in Figure 16. The main conclusion is that introducing RE into the grid to generate electricity is the measure that has the greatest impact in terms of demand reduction (of diesel in the case of STP). The second biggest impact stems from the measure to implement more efficient residential lighting, since it reduces the demand for electricity (and, therefore, diesel).

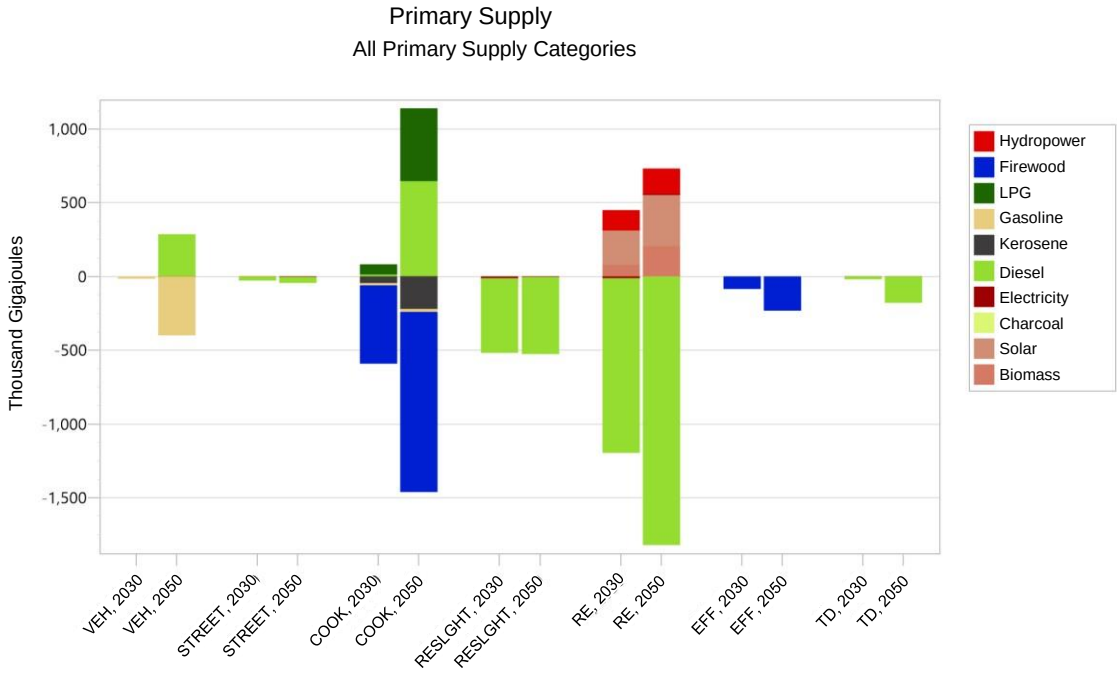


Figure 16: Impact of mitigation measures in 2030 and 2050 in terms of primary energy demand

Electricity Demand

Table 21 and Figure 17 show that electricity demand by 2050 will be reduced by implementing the mitigation measures compared to BAU. The estimated reduction in demand for the period 2020-2050 is approximately 20% relative to BAU. No further reductions are expected after 2050, principally because of the introduction of electrification of transport (which would start in 2040) and the economic development of the country. Note the demand from the residential sector, which represents approximately half of the total electricity demand in 2050, and also the inclusion and progressive increase from 2040 of electrification measures in the transport sector (in green in **Figure 17**).

Table 21: Evolution of electricity demand to 2050, comparing the mitigation scenario to BAU, by sector (in GWh)

Sector / Years	2010	2015	2020	2025	2030	2035	2040	2045	2050
Difference in demand (mitigation scenario vs. BAU)	-	-	4.6	35.5	48.4	44.7	39.2	20.6	-5.1
Residential	28.5	56.8	60.1	38.6	36.4	52.5	70.9	92.1	122.9
Transport	-	-	-	-	-	-	-	12.4	24.9
Other	5.5	5.2	5.6	6.7	8.2	10.0	12.1	14.6	17.6
Commercial Institutional	7.4	28.7	30.2	33.3	38.0	43.2	50.3	58.2	67.0
Total–- GWh	**41.5**	**90.7**	**100.4**	**114.1**	**131.1**	**150.5**	**172.6**	**198.0**	**227.3**

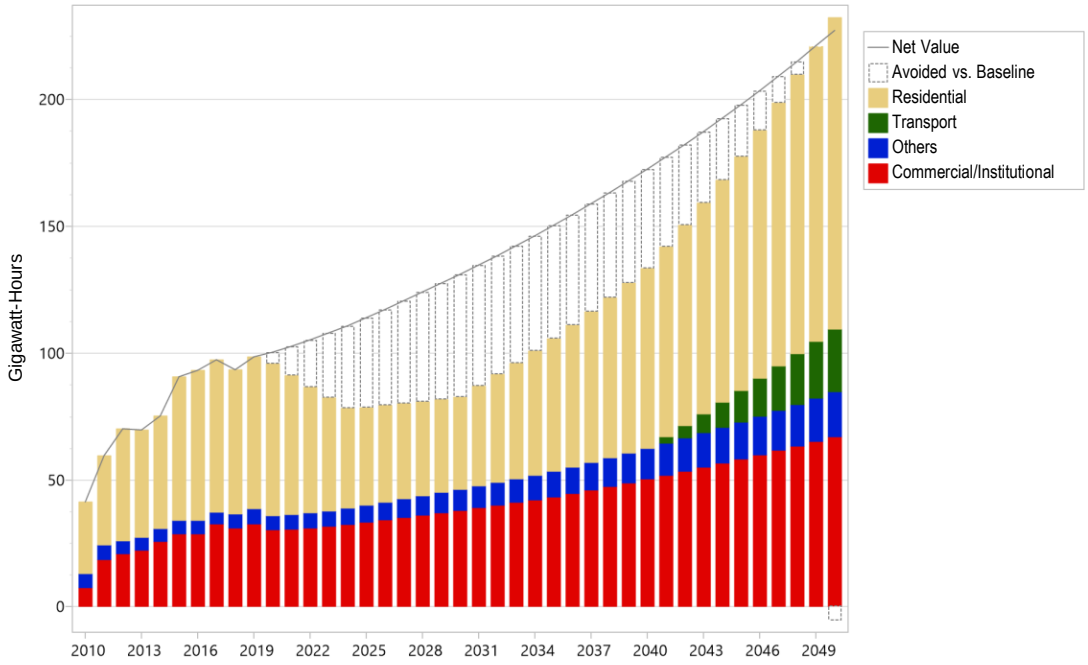


Figure 17: Evolution of electricity demand in the mitigation scenario in GWh to 2050 (with demand reduction indicated in white)

The figure below compares the mitigation scenario ""MI"") and the baseline or BAU scenario ""BAS""), again with respect to electricity demand by sector (Table 22 gives the data corresponding to **Figure 18**). The significant decrease in electricity demand in 2030 and in 2040 is easy to identify in this graph. This decrease in electricity demand is due to implementing the following EE measures: the replacement of incandescent lightbulbs with more efficient ones in residential and public lighting, and the planned measures to reduce grid losses. The inefficient lamp replacement measures will be almost completely implemented by 2030 and 2035. Measures to reduce grid losses are implemented progressively until 2050.

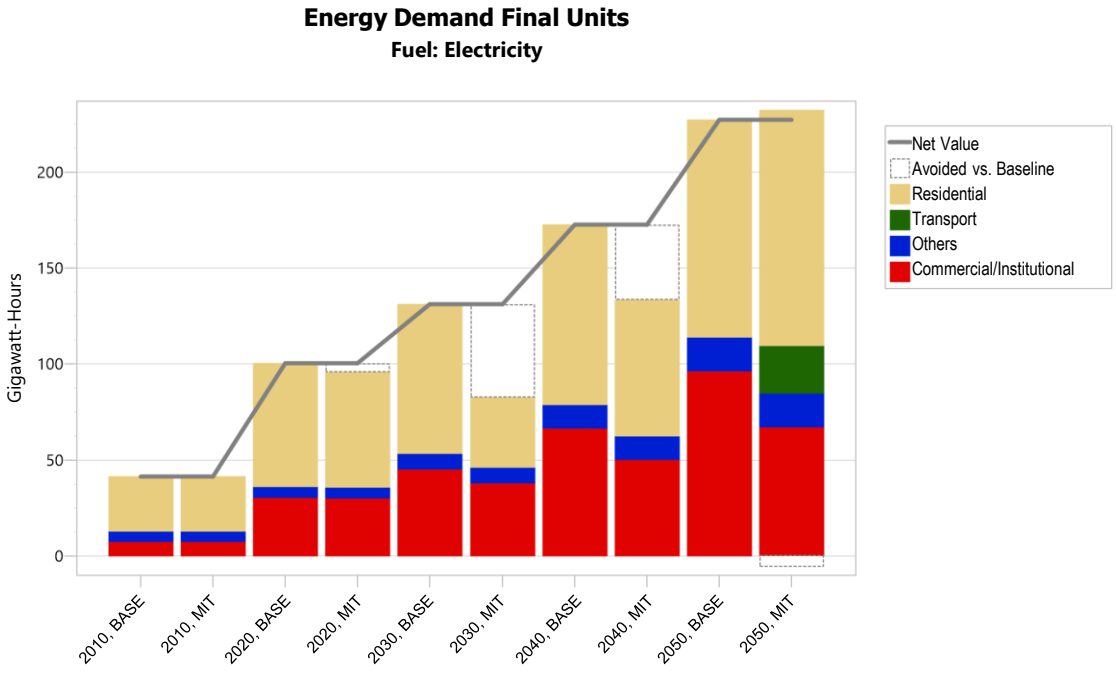


Figure 18: Comparison of baseline and mitigation scenarios on electricity demand by sector (in GWh), in 10-year periods

Table 22: Comparative data of baseline and mitigation scenarios on electricity demand by sector (in GWh), in 10-year periods (complements the previous figure)

Scenario:	2010 BASE	2010 MIT	2020 BASE	2020 MIT	2030 BASE	2030 MIT	2040 BASE	2040 MIT	2050 BASE	2050 MIT
Difference in demand (mitigation vs. baseline scenario)	-	-	-	4.6	-	48.4	-	39.2	-	-5.1
Residential	28.5	28.5	64.4	60.1	77.7	36.4	93.8	70.9	113.2	122.9
Transport	-	-	-	-	-	-	-	-	-	24.9
Other	5.5	5.5	5.6	5.6	8.2	8.2	12.1	12.1	17.6	17.6
Commercial Institutional	7.4	7.4	30.5	30.2	45.2	38.0	66.6	50.3	96.5	67.0

Energy for cooking

The most significant change in the residential sector is the replacement of traditional wood or charcoal-burning stoves with improved cooking stoves, the introduction of liquid fuel stoves (kerosene and LPG) and, to a lesser extent, the use of other cooking technologies (e.g. electric and solar). Figure 19 shows the evolution over time of final energy demand (in TJ) in the residential sector. The evolution of the demand for the different types of energy sources, and the growth and decrease of each one until the end of 2050, is clear. Note how the demand for traditional firewood and charcoal drops to 2030, and how these two sources are gradually replaced by "efficient" firewood and charcoal (i.e. improved stoves), in addition to LPG and kerosene. In the period 2030-2050, STP aims to decrease the use of solid fuels and replace them with liquid fuels (mainly LPG, but also kerosene) and also with electricity, so as to continue increasing efficiency and the quality of life of the population.

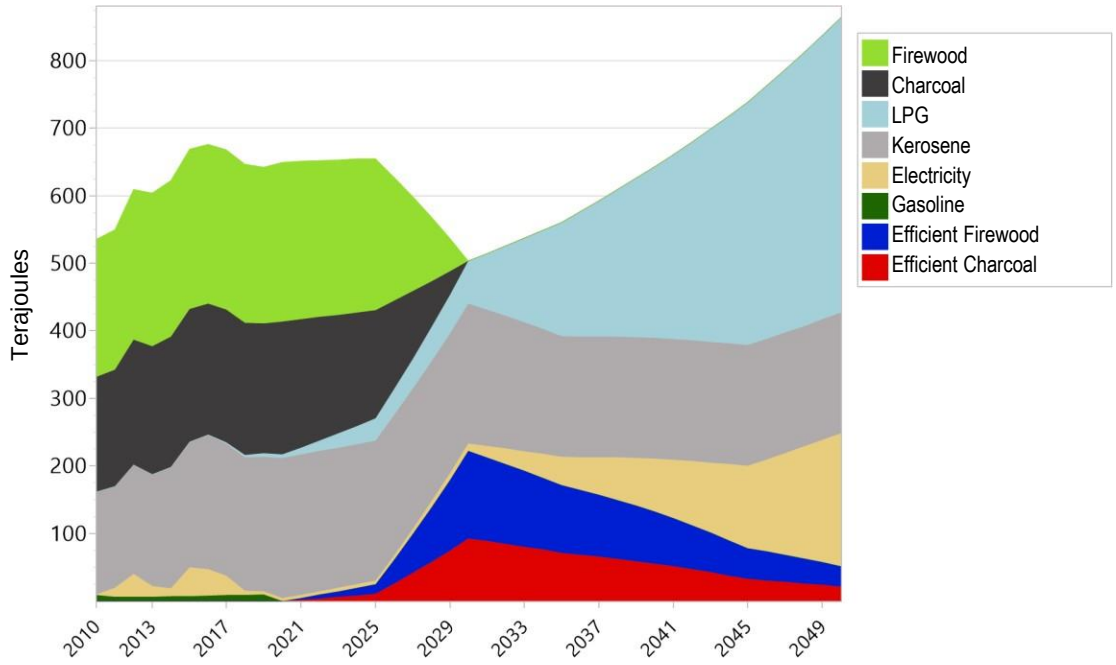


Figure 19: Change in cooking technologies in the period 2020-2050 in the mitigation scenario

GHG Emissions

The overall environmental benefit of implementing the NREAP and NEEAP is to significantly reduce GHG emissions in the power sector and to achieve the target of a 27% emission reduction by 2030 set in the NDC (2021). Today, STP is a "non-emitting" country, as the amount of forest and plant cover makes it a natural carbon sink and, therefore, offsets the GHG emissions due to economic growth. However, it should be noted that this condition could change approximately in 2037, considering the BAU scenario. In the mitigation scenario, this change would happen in 2049, thanks to the RE and EE measures proposed in the NREAP and NEEAP (see **Figure 21**). With these mitigation measures, GHG emissions will decrease and then the "non-emitting" country status would be maintained for longer (see **Table 23** on the following page).

With regard to the contribution of each sector, that is, the total amount of GHG emitted by sector in 2050 (in **Figure 21**), it can be seen that, in general terms, the proportions remain the same, except for electricity generation, for which the contribution to total emissions is reduced from 2030 onwards (see **Figure 22**), when most RE facilities will start operating. **Table 24** shows the difference between GHG emissions for the key sectors in 2050 after the measures contained in the two plans that impact these sectors have been implemented.

Table 23: GHG emissions in the mitigation scenario versus BAU to 2050 (in thousands of tons of CO_2e)

Years																					
Scenarios	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Baseline	-208.2	-183.2	-170.5	-166.8	-154.0	-142.4	-133.9	-124.7	-124.6	-125.1	-128.3	-123.4	-118.0	-112.2	-105.9	-98.9	-91.9	-84.8	-75.3	-67.6	60.0
Mitigation	-208.2	-183.2	-170.5	-166.8	-154.0	-142.4	-133.9	-124.7	-124.6	-125.1	-133.0	-134.6	-136.5	-142.7	-153.3	-176.5	-172.0	-167.5	-162.7	-157.9	165.3
Years																					
Scenarios	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	
Baseline	-50.0	-41.7	-33.3	-22.6	-13.5	-4.2	7.3	17.2	27.2	39.6	50.4	61.3	74.9	86.6	100.8	113.4	128.3	141.7	155.2	171.6	
Mitigation	-158.4	-151.3	-143.9	-136.4	-128.6	-120.3	-111.7	-102.9	-93.9	-84.5	-76.6	-68.4	-59.9	-51.0	-41.3	-31.2	-20.6	-9.5	2.4	15.4	

-

Table 24: Comparison of estimated emissions in 2050 in $tCO_2$and in key energy consuming sectors

Sector	Estimated emissions in BAU, year 2050 (thousand tCO_2e)	Estimated emissions in the mitigation scenario, year 2050 (thousand tCO_2e)
Electricity generation and transmission/distribution	199.97	63.06 ↓
Residential	32.37	40.85 ↑
Transport	128.71	101.24 ↓

In the electricity sector, GHG emissions decrease due to the implementation of generation projects with RE and EE sources (more efficient lighting and reduction of power grid losses). In the residential sector, emissions would increase due to the introduction of more fossil fuels (LPG and kerosene) for cooking instead of biomass, which is renewable (in this case, reductions in the residential sector from the introduction of more efficient lighting are already contained in the previous category of electricity generation and transmission/distribution). In the land transport sector, replacing inefficient units with more efficient ones, as well as replacing fossil fuel burning units with electric ones, reduces emissions from the sector. In total, the increase in the residential sector is offset by the reductions in the other sectors and allows the economy to develop and the quality of life of the population to improve.

Finally, producing charcoal with more efficient methods and the use of improved biomass stoves (which burn it more efficiently) prevent further degradation of forest biomass, since less forest resources are needed to generate the same amount of cooking energy (vegetation cover is conserved).

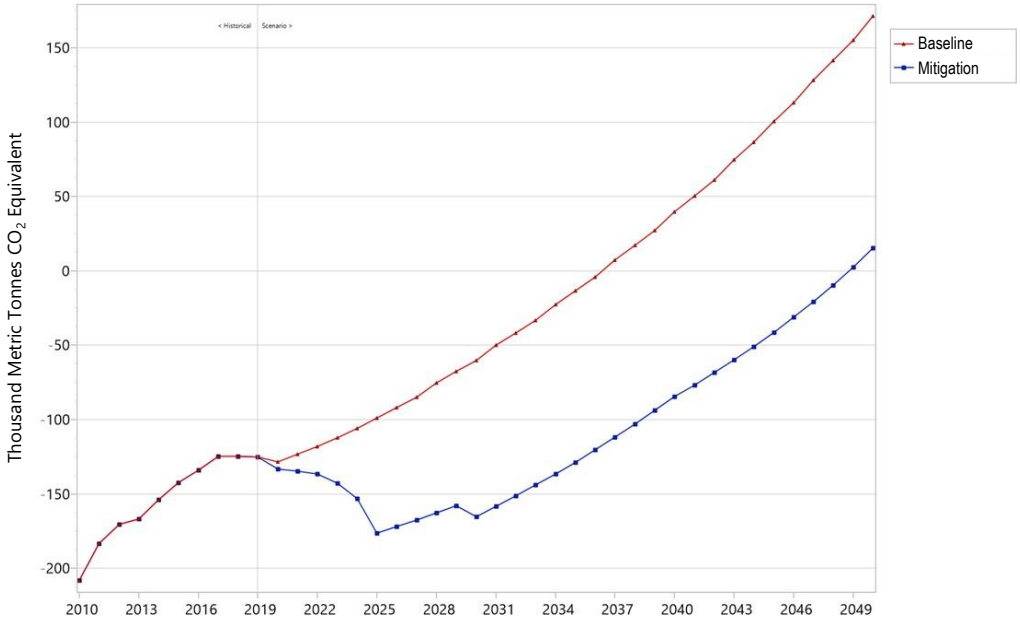


Figure 20: GHG emissions in the baseline (red) and mitigation (blue) scenarios in thousands of metric tons of CO_2e per year

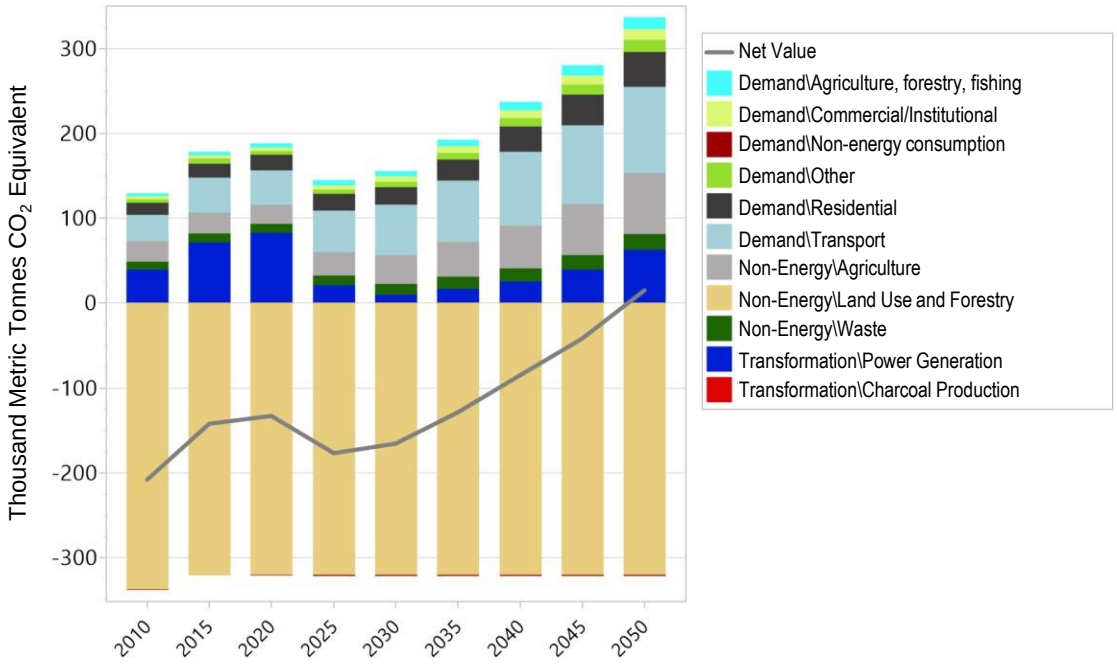


Figure 21: Evolution of GHG emissions by sector in the mitigation scenario to 2050

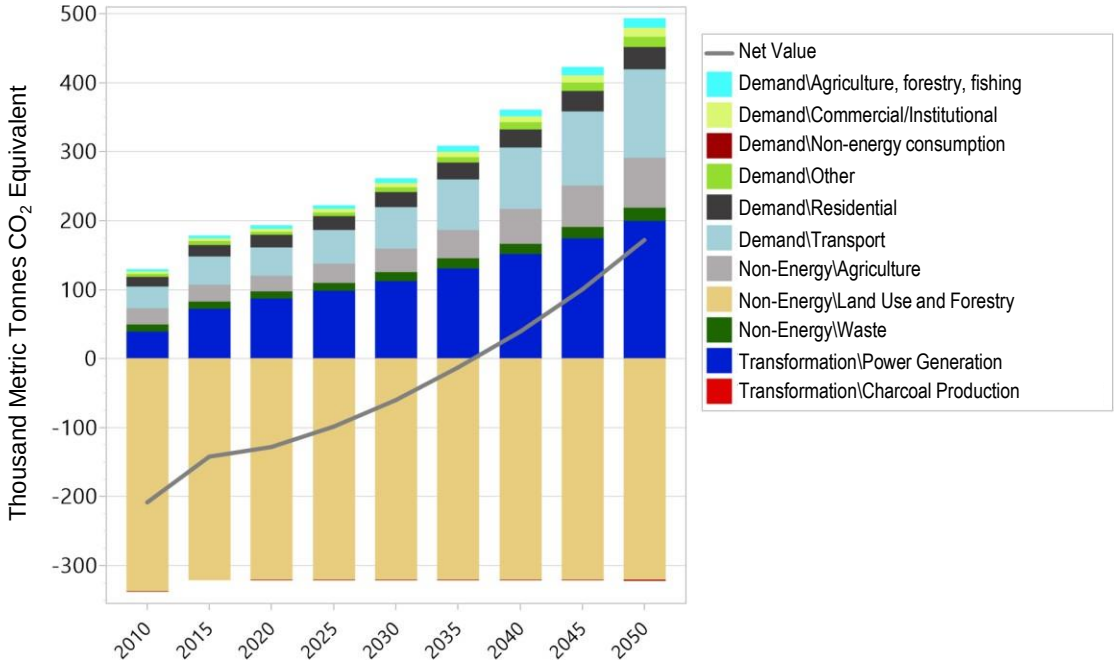


Figure 22: Evolution of GHG emissions by sector in BAU to 2050

Contribution of the plans to the SDGs (Sustainable Development Goals)

Implementing the measures contained in the NREAP, as well as in the NEEAP, has a clear benefit for the São Toméan population and shows the country's commitment to sustainable development and the improvement of its economy. The measures aim to contribute to the both the country's NDC and Vision 2030 goals, as explained in the introduction, but also to have a positive impact on the Sustainable Development Goals (SDGs).

Figure 23: The SDGs

The two plans will contribute directly to increasing access to clean and sustainable energy (**SDG-7**) by implementing generation projects based on renewable energy sources and by improving the power grid, which will reduce energy losses and offer a more stable and reliable service to consumers. For off-grid consumers, there will be a group of renewable generation projects that will supply power to isolated consumers, which will contribute to achieving 100% access to electricity by 2030. Considering that means of transport are a transversal part of the functioning of cities and access to them and fundamental for commercial exchanges, the proposed projects and measures for greater electrification of land transport, as well as the proposed studies in the scope of transport decarbonization, will contribute to **SDG-11**. The broad group of measures regarding the provision of capacity building, training, awareness raising and qualification in the areas of RE and EE will contribute to the provision of quality education, included in **SDG-4,** as well as to gender equity (**SDG-5**), since all measures in this scope take into account actions aimed at ensuring equitable access to options for training, capacity building and qualification. In addition, the awareness raising campaigns proposed in the plans will have a specific focus on gender issues. It is also important to note that the proposed awareness raising campaigns will include information on responsible energy consumption, thereby contributing to **SDG-12.** There are also measures in the NREAP and NEEAP that aim to enable and foster energy entrepreneurship in order to encourage innovation and the generation of new energy ideas, which contributes to **SDG-9,** in addition to the proposed studies on the use of other new technologies for energy generation, for which applicability to STP still requires further study (e.g. ocean energy, geothermal, floating solar/wind). Finally, despite the fact that STP is currently a "non-emitting" GHG country, it is important to note that the NREAP and NEEAP measures contribute to the reduction of emissions from the energy sector, thereby being a way to collaborate with **SDG-13.** The plans are based on a sustainable economic growth model, taking advantage of natural resources and local human resources (which will be empowered), thereby generating quality work and services locally and decreasing the need for external resources (fossil fuels, other goods and services, etc.), so collaborating with **SDG-8**. This will also allow resources to be redirected to other sectors of the economy (education, health, etc.), as well as to generate a positive cyclicality for the benefit of the São Toméan population.

ANNEX I: DATA TABLES FOR ENERGY DEMAND PROJECTIONS IN BAU

Table 25: Projection of energy demand in BAU (2010 - 2050) by fuel type

Fuel (demand in TJ)	Years								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Firewood	678.8	786.7	740.4	865.6	1,032.1	1,223.4	1,446.0	1,706.1	2,011.4
LPG	0.9	1.9	9.3	10.7	12.5	14.5	16.8	19.5	22.6
Gasoline	245.0	290.9	356.3	427.2	525.1	638.3	771.2	928.0	1,113.6
Jet Kerosene	9.2	36.6	57.4	69.0	85.1	103.6	125.4	151.2	181.7
Kerosene	161.8	196.9	215.5	238.0	263.4	291.6	322.7	357.3	395.8
Diesel	264.5	347.5	250.4	301.0	370.9	451.9	547.0	659.2	792.2
Electricity	149.3	326.7	361.6	410.7	472.0	541.6	621.3	712.8	818.3
Charcoal	173.3	200.8	200.3	220.4	242.7	267.3	294.5	324.4	357.4
Lubricants	7.5	11.2	7.8	9.3	11.5	14.0	16.9	20.4	24.5
Total	1,690.3	2,199.2	2,198.9	2,552.0	3,015.3	3,546.2	4,161.7	4,878.9	5,717.6

Table 26: Projection of energy demand in BAU (2010 - 2050) by sector

Sector (demand in TJ)	Years								
	2010	2015	2020	2025	2030	2035	2040	2045	2050
Residential	637.3	830.6	882.3	969.4	1,065.0	1,170.1	1,285.6	1,412.5	1,551.9
Agriculture forestry fishing	36.7	46.5	56.9	68.4	84.2	102.6	124.2	149.7	179.9
Transport	426.8	564.0	557.4	670.0	825.6	1,005.9	1,217.6	1,467.4	1,763.5
Other	83.2	93.4	82.5	99.2	122.2	148.9	180.2	217.2	261.0
Commercial Institutional	507.0	660.4	623.5	749.5	923.6	1,125.2	1,362.1	1,641.6	1,972.8
Non-energy consumption	-0.8	4.2	-3.6	-4.4	-5.4	-6.6	-7.9	-9.6	-11.5
Total	**1,690.3**	**2,199.2**	**2,198.9**	**2,552.0**	**3,015.3**	**3,546.2**	**4,161.7**	**4,878.9**	**5,717.6**

ANNEX II. THE NATIONAL SUSTAINABLE DEVELOPMENT PLAN (PNDS) PILLARS AND PROGRAMS

OBJECTIVES OF THE PNDS	PROGRAMMATIC PILLARS OF THE PNDS		
	SUSTAINABLE ECONOMY New Development Model based on Service Provision	**SOCIAL DEVELOPMENT** Human Capital, Quality of Life Fighting Inequalities	**SOVEREIGNTY AND DEMOCRACY** New state model; strong, efficient and safe
	PROGRAMS		
Goal **1** **Transform STP into a Service Delivery Economy in the Middle of the Atlantic**	*Tourism sector *Maritime sector *Aviation sector *Commercial and industrial sector *Financial sector *Digital and innovation Sector *Business environment *STP - an accessible and open country *Modern and resilient infrastructure *Energy sustainability *Quality of statistical production and dissemination *Culture and creative industries *Research, science and technology	*Education of excellence *Gender equality *Integrated health development *Export of health services *Sport for inclusion and national cohesion	*Consolidation of democracy *State Reform *Independence and efficiency of justice *Flexible and inclusive labor market *Defense and security *Renewed and intensive diplomacy *Third island diaspora
Goal 2 **Promote Inclusive and Sustainable Economic Growth**	*Tourism sector *Maritime sector *Aviation sector *Commercial and industrial sector *Financial sector *Digital and innovation sector *Business environment *STP - an accessible and open country *Modern and resilient infrastructure *Energy sustainability *Quality of statistical production and dissemination *Culture and creative industries *Research, science and technology *Youth entrepreneurship *Transformation of agriculture *Water and sanitation *Protection of biodiversity *Environmental, climate and geological risk management *Decentralization, local and community development	*Education of excellence; *Decent and qualified employment *Gender equality *Export of health services *Integrated health development *Social Inclusion protection *Sport for inclusion and national cohesion	*Consolidation of democracy *State Reform *Independence and efficiency of justice *Flexible and inclusive labor market *Defense and security *Renewed and intensive diplomacy *Diaspora to third STP island
Goal 3 **Ensure social inclusion and protection, reduce social inequalities**	*Tourism sector *Maritime sector *Aviation sector *Commercial and industrial sector *Financial sector *Digital and innovation sector *Business environment	*Education of excellence; *Dignified and qualified employment *Gender equality; *Integrated health development;	*Consolidation of democracy *State Reform *Independence and efficiency of justice *Flexible and inclusive labor market *Defense and security

and regional asymmetries	*STP – an accessible and open country *Modern and resilient infrastructure *Energy sustainability *Quality of statistical production and dissemination *Culture and creative Industries *Research, science and technology *Youth entrepreneurship *Transformation of agriculture *Water and sanitation *Biodiversity protection *Environmental, climate and geological risk management *Decentralization, local and community development	*Guaranteeing rights and protection of children, adolescents and the elderly *Social Inclusion protection *Sport for inclusion and national cohesion	*Renewed and intensive diplomacy *Third island diaspora
Goal 4 **Strengthening Sovereignty, Deepening Democracy and Renewing Diplomacy for Development**	*STP – an accessible and open country *State Reform *Quality of statistical production and dissemination *Culture and creative Industries	*Gender equality	*Consolidation of democracy *State Reform *Independence and efficiency of justice *Flexible and inclusive labor market *Defense and security *Renewed and intensive diplomacy *Diaspora to third STP island

ANNEX III. DEFINITION OF THE TERMS USED IN THE PLANS (NREAP AND NEEAP)

Biofuels: liquid or gaseous fuels for use in the transport sector, produced from biomass.

Solid biofuels: solid fuels derived from biomass (typically firewood and charcoal)

Liquid biofuels: liquids derived from biomass and generally used as fuels. Liquid biofuels include biogasoline, biodiesel and other liquid fuels (see below for definitions of biogasoline, biodiesel and other liquid fuels).

Biogasoline: liquid fuels derived from biomass and used in spark ignition internal combustion engines. Common examples are: bioethanol, biomethanol, bio ETBE (ethyl-tertiary-butyl-ether) and bio MTBE (methyl-tertiary-butyl-ether)

Biodiesel: liquid fuels that are generally modified so that they can be used as fuel directly in engines or in blends with conventional diesel. Biological sources of biodiesel include, but are not limited to, vegetable oils from rapeseed or canola, soybeans, corn, palm oil, peanuts and sunflower. Some liquid biofuels (direct vegetable oils) can be used without the chemical modifications that are usually required for use in engines.

Other liquid biofuels: liquid biofuels not specified elsewhere in this document.

Biogas: gases derived from the anaerobic fermentation of biomass. The gases are composed mainly of methane and carbon dioxide and include landfill gas, sewage sludge gas and other biogases (see definitions for landfill gas, sewage sludge gas and other biogases). They are mainly used as fuel, but can be used as a raw material in the chemical industry. They are particularly relevant for cooking purposes or in the context of industrial uses (e.g. breweries, slaughterhouses).

Landfill gas: biogas produced from the anaerobic fermentation of organic matter in landfills.

Biomass: the biodegradable fraction of products and waste of biological origin from agriculture (including animal and plant substances), forestry and related industries, including the fishing industry and aquaculture, as well as the biodegradable fraction of industrial and municipal waste. The use of biomass for energy is diverse: from the traditional, inefficient burning of wood in open fires for cooking purposes, to the modern use of wood pellets for electricity and heat production, and the use of biodiesel and bioethanol as a substitute for petroleum-based products in the transport sector.

Base load: the minimum level of electricity demand in a grid during a given period (e.g. a week or a day).

Charcoal: the solid residue resulting from the carbonization of wood or other vegetal matter through pyrolysis. The amount of biomass (usually firewood) needed to produce a given quantity of charcoal depends primarily on three factors:

- The wood density of the parent trees - the main factor in determining the amount of charcoal from fuelwood is the wood density of the parent trees, since the weight of charcoal can vary by a factor of two for equal volumes
- The moisture content - the moisture content of the wood also has a great effect on production - the drier the wood, the higher the production;
- Charcoal production methods: Charcoal is produced in earth-covered holes, oil drums, brick or steel furnaces, and in retorts. The less sophisticated methods of charcoal production usually involve losses of powdered charcoal, incomplete carbonization of the wood and combustion of part of the charcoal obtained, resulting in a lower yield.

Traditional, inefficient methods of charcoal production: traditional methods of charcoal production include open holes, oil barrels and kilns with low efficiency (60-80% of wood energy is lost) and have health and environmental impacts.

Efficient charcoal production: Efficient charcoal is a term used in this model for charcoal produced by modern methods, which are more efficient than traditional methods. Modern methods use sealed containers and have higher efficiency and correspondingly higher yield. Improved carbonization techniques offer yields > 25%.

Conservation: The reduction of energy use through increased efficiency and/or waste reduction.

Distributed Electricity and Microgeneration (micro-grids): This is when the electricity is produced for local distribution and is not directly connected to the national grid. Microgeneration is generally used to describe small-scale energy production technologies.

Efficient equipment: electrical appliances or devices that perform their function using less electricity than low efficiency appliances. The electrical inefficiency of many devices is directly related to the heat they produce. For example, efficient light bulbs use most of the electricity received to produce light, not heat.

Electricity: The transfer of energy through a physical phenomenon involving electrical charges and its effects at rest and in motion. Electricity can be produced by different processes: for example, by converting the energy contained in moving water, wind or waves, or by directly converting solar radiation through photovoltaic processes in semiconductor devices (solar cells); or by burning fuels.

Electricity demand: The total electricity consumption in GWh or MWh of a country within a specified period. The sequence of demand values as a function of time is called the Load Curve. Its graphical representation is called the Load Profile.

Access to energy: universal and affordable access to modern forms of energy. Access to clean and safe cooking fuels is implied, leaving behind the traditional methods of cooking with firewood or charcoal. It also implies access to sustainable electricity that can guarantee energy supply to localities and households, providing access to modern living and paving the way for economic development.

Energy Efficiency (EE): EE is measured as the ratio of actual physical output to maximum possible output. For example, a high-quality motor may have an efficiency of 96%, compared to a theoretical 100% with no energy losses. The energy efficiency of a process is improved if it produces the same service using less energy. Efficient light bulbs produce the same amount of light, but use up to 75% less energy to do so. Improving energy efficiency enables reductions in energy use or the production of more services using the same amount of energy.

Energy Intensity: the energy use/economic benefit ratio in terms of goods and services. Energy intensity is generally considered to be a good macroeconomic indicator of energy efficiency. It can be calculated for an entire nation or for specific economic sectors. The unit of energy intensity is the currency divided by a unit of energy.

Final Energy Consumption: the total energy consumed by final consumers, such as households, industry and agriculture. It is the energy that reaches the door of the final consumer and excludes what is used up in the energy sector. This includes electricity and fuels (such as oil, gas, coal, firewood, etc.)

Gross final energy consumption: Gross final energy consumption is defined as energy products supplied for energy purposes to final consumers (industry, transport, households, services, agriculture, forestry and fishing), including that electricity and heat consumed for power generation and heat production, including electricity and heat losses in distribution and transmission.

Fossil fuel: an energy source formed in the earth's crust through the degradation of organic matter. The most common fossil fuels are oil and its derivatives (diesel, gasoline, kerosene, lubricants, avgas or jet kerosene), coal and natural gas.

Firewood, wood waste and by-products: wood or firewood (in the form of logs, kindling, pellets or chips) obtained from natural or managed forests, or isolated trees. It also include wood waste used as fuel, where the original composition of the wood is not altered.

Grid-connected: a system (photovoltaic, hydro, diesel, etc.) that is connected to a central power grid (electricity grid).

Production or Generation (of electricity): This covers the production of electricity in power plants.

Heat: heat is an energy carrier, generally used for space heating and industrial processes.

Hybrid system: an electrical system consisting of two or more generation subsystems (e.g. combination of a wind turbine or diesel generator and a photovoltaic system)

Mini-grids: a set of power generators and, possibly, energy storage systems connected to a distribution network that supplies the entire energy demand of a localized group of customers. This power supply architecture can be differentiated from single customer systems (e.g. residential solar systems), where there is no distribution network interconnecting the customers, and from centralized grid systems, where power is transmitted over long distances from large power plants for when local generators are not able to meet local demand. Mini-grids are particularly relevant in the rural African context, where hybrid systems can be more cost-effective alternatives.

Improved stoves (also called clean/efficient stoves): are appliances that are designed to consume less fuel and save time in the cooking process, meet the requirements of that process and create a smoke-free environment in the kitchen or reduce the volume of smoke produced during cooking compared to traditional stoves; and, therefore, address the health and environmental impact associated with traditional stoves. Traditional stoves (open fires and rudimentary stoves where solid fuels such as wood, charcoal, crop residue and animal wastes are used) are inefficient, unhealthy and unsafe, and inhaling the smoke and fine particles emitted leads to serious health problems, possibly culminating in death. Traditional stoves also put additional pressure on the ecosystem and forests, contributing to climate change through the emission of greenhouse gases and soot.

Installed capacity: the nominal power of a given electricity production plant, expressed in megawatts (MW) for active power.

Kilowatt (kW): 1000 watts

Kilowatt-hour (kWh): 1000 watt-hours.

LPG: Liquefied Petroleum Gas

Electric load: in an electrical circuit, any appliance or device that uses electricity (such as a lamp or a water pump)

Megawatt (MW): 1,000,000 watts

Megawatt-hour (MWh): 1,000,000 watt-hours

Modern alternative (cooking) fuels: known as non-conventional or advanced fuels, these are any materials or substances that can be used for cooking, in addition to conventional solid fuels such as firewood and charcoal. These alternatives include LPG, biogas, ethanol, solar energy (e.g. solar stoves) and kerosene. These modern alternative fuels are the subject of a separate study In this model and so it does not include analysis of improved stoves using them.

Off-grid applications: a designation for facilities that produce their own energy and are not connected to an external source of energy, such as the power grid.

Photovoltaic (PV) system: a complete set of interconnected components for converting sunlight into electricity through the photovoltaic process, including panels, system balancing components, and the load.

Power grid: a system of high-voltage cables through which electrical power is distributed throughout a region.

Renewable Energies (RE): the term 'Renewable Energy' is used to describe energy produced using inexhaustible natural resources. This includes solar, wind, geothermal, bioenergy, wave and tidal, and hydropower.

Renewable energy options - in this model the renewable energy options refer to the following technologies:

- Small-scale hydropower, up to a maximum of 30 MW installed capacity (mini-hydropower plants);
- Bioenergy/biomass, which includes: wood (firewood and charcoal) used for domestic cooking and commercial applications (restaurants, breweries, potteries and bakeries). Surplus woody resources could be used for electricity generation with other biomass sources (such as by-products of agricultural crop production for electricity generation (stalks, straw, bark, seeds,

etc.). These can be used for electricity generation when grouped together on an agribusiness site. Electricity can also be produced from biogas produced using industrial or municipal waste, as well as animal excrements (concentration of resources in dairies and slaughterhouses or livestock and vegetable markets)).

- Solar PV (photovoltaic), which can be utility scale or distributed solar power (or "rooftop").

Rural electrification: guarantee of a regular supply of electricity to rural populations. It involves extending the power grid into rural areas, or using mini-grids or isolated systems (in the case of STP, these are solar home systems).

Percentage of population served by off-grid (mini-grids and stand-alone) renewable electricity generation: this is the percentage (%) of the total population that is served by mini-grids or stand-alone systems.

Rural communities: these are administrative units in rural areas. This includes the population living in rural centers and towns with between 200 and 2500 inhabitants, and some larger cities that are not covered by the national grid due to their peripheral geographical location.

Solar stoves: are appliances that use the direct energy of the sun's rays (that is the heat coming from the sun) to heat, cook or pasteurize a food or drink.

Stand-alone power systems: also known as power supply systems for remote areas, they are off-grid systems of electricity generation for places that do not have an electricity distribution system. SAPS include one or more methods of electricity generation, energy storage and regulation.

Support scheme: indicates any instrument, scheme or mechanism applied by a country or group of countries that promotes the use of energy from renewable sources by reducing the cost of that energy, increasing the price at which it can be sold or increasing, through a bond or similar means, the volume of energy purchased. This includes, but is not limited to, investment aid, tax exemptions or reductions, tax refunds, renewable energy bond support schemes, such as green certificates, and direct price support schemes, such as feed-in tariffs and premium payments. The support schemes for renewable energy include:

• Production-based incentives:

o Feed-in Tariffs ("FIT"): a policy that supports the development of renewable resources. FITs offer guaranteed payments to renewable energy producers for the energy actually produced ($/kWh). These payments are usually guaranteed as long-term contracts.

o Quota system: a policy that rewards the producer with certificates that can be sold in a market (without price guarantee)

o Quota system with competitive auctions: the setting of mandatory production quotas for the supply of green energy. These quotas are imposed on power plants and/or electricity distribution companies (calculated as a percentage of production/sale). Operators can meet these obligations in three ways: (i) by producing their own green electricity, (ii) by purchasing the electricity under long-term contracts, and (iii) by purchasing on the financial market so-called "Green Certificates" corresponding to the amount of electricity required.

o Decentralized quota system with markets for green certificates, also called tradable green certificates (TGC): the setting of mandatory production quotas for green electricity. These quotas are imposed on power plants and/or electricity distribution companies (calculated as a percentage of production/sales). Operators can meet these obligations in three ways: (i) by producing their own green electricity, (ii) by purchasing the electricity under long-term contracts, and (iii) by purchasing on the financial market "Green Certificates" corresponding to the amount of electricity required.

• Investment-based incentives

o Grants and loans: financing instruments in which governments provide grants or loans for the development of renewable energy projects. Grants do not have to be repaid, whereas loans do.

o Microloans: the extension of small loans (microloans) to poor borrowers, who generally have neither a steady, secure job nor a verifiable credit history.

o VAT exemptions: allow households or investors to avoid paying VAT on renewable energy or energy efficiency equipment.

Technical energy losses: Energy losses in the electrical system that are caused by the physical properties of system components. Technical energy losses occur naturally (caused by internal actions) and consist mainly of the dissipation of electricity in the electrical components of the system, such as transmission lines, transformers, metering systems, etc.

Commercial or non-technical losses: Energy losses in the electricity system caused by theft and fraud in the use of electricity, but also those due to lack of equipment maintenance, miscalculations and accounting errors. Non-technical losses are caused by actions outside the electrical system, or by loads and conditions that the calculation of technical losses did not take into account. Non-technical losses are more difficult to measure because they are often unaccounted for by the system operators, so no information is recorded. Reducing energy losses can contribute considerably to improving energy security in many countries in Africa.

Total energy losses: the sum of the technical losses and the commercial or non-technical losses.

Watt-hour (Wh): a measure of electrical energy equal to the electrical power multiplied by the period of time (hours) during which the power is applied.

Waste: in energy statistics, waste corresponds to the part that is incinerated with heat recovery in facilities designed for mixed waste or co-combustion with other fuels. The heat can be used for heating or electricity generation. Waste is sometimes a mixture of materials of fossil and biomass origin.

Industrial waste : non-renewable waste that is burned with heat recovery in factories, with the exception of those used for urban/municipal waste incineration. Examples are used tires, specific waste from the chemical industry and hazardous waste from healthcare. Combustion includes co-combustion with other fuels. The renewable portions in industrial waste combustion with heat recovery are classified according to the biofuels that best describe them.

Urban/municipal waste: household waste, and company and utility waste that resembles household waste and is collected in facilities specifically designed for mixed waste disposal with recovery of liquid fuels, gases or heat. Municipal waste can be divided into renewable and non-renewable fractions.

ANNEX IV. WORK METHODOLOGY ADOPTED FOR THE DEVELOPMENT OF THE NREAP AND NEEAP

Objective and general approach to the work

The objective of this project was to support UNIDO and DGRNE in developing an integrated and holistic vision of sustainable energy through a National Renewable Energy Action Plan (NREAP) and a National Energy Efficiency Action Plan (NEEAP). The following figure illustrates the approach adopted by the consulting team in performing this service:

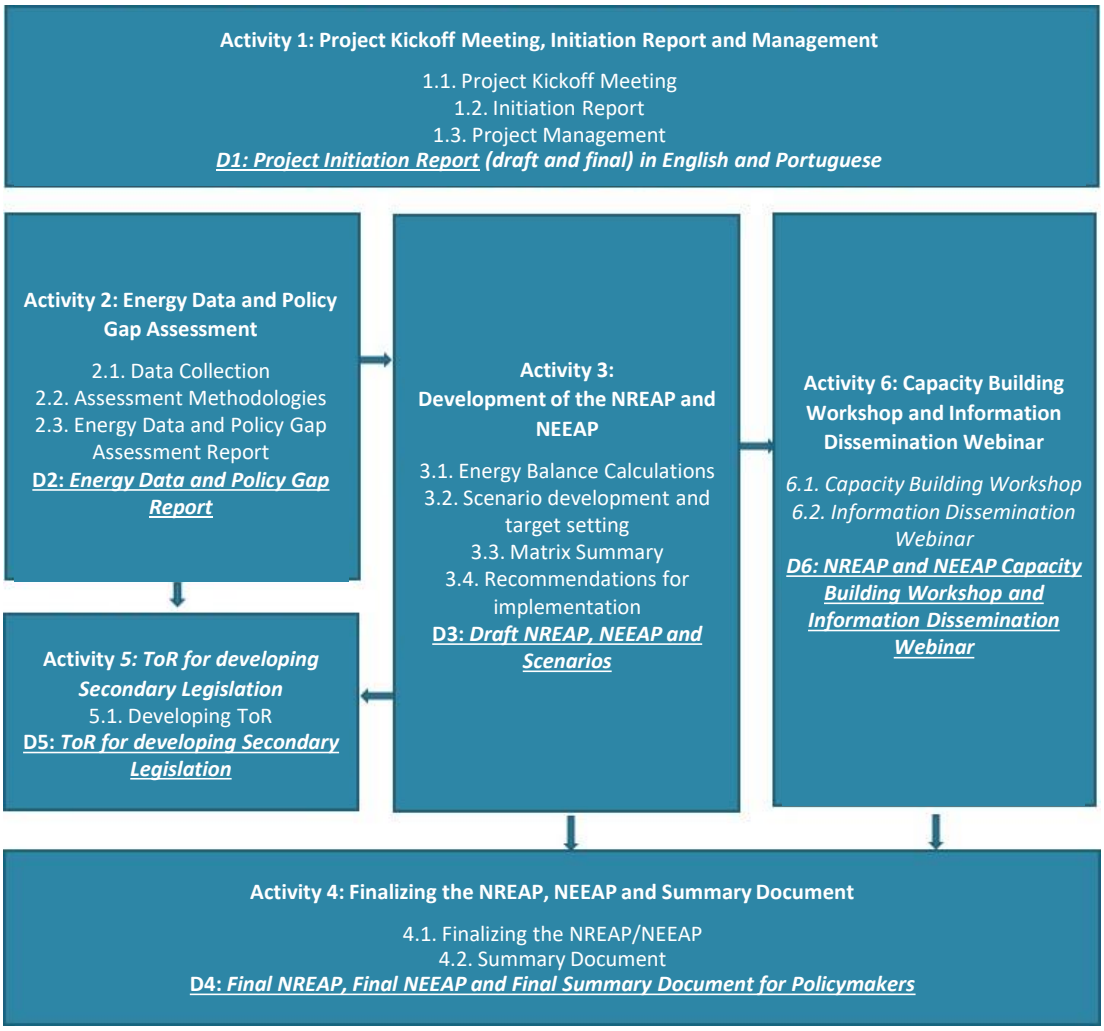


Figure 24: Scope of work

During this process, various stakeholders were involved, mainly through the meetings held with the National Sustainable Energy Platform (PNES – Plataforma Nacional de Energia Sustentável), led by DGRNE. A total of five (5) meetings of the PNES and the consulting team took place, in addition to frequent communications via email and phone with Mr. Gabriel Maquengo and other colleagues from DGRNE to check information when necessary. In addition, the consulting team present locally in STP had the opportunity to interview representatives from other areas of government, such as transport, forestry and biodiversity, customs, etc. in order to collect background information and data to build the model and develop the two plans.

Methodology for developing the scenarios

Energy Balance Calculations

LEAP can automatically generate results as standard format energy balance reports. These closely follow the standard format used by the IEA and most national energy planning agencies. LEAP energy balances can be displayed in table graph, chart and sankey format, and can be customized to

summarize information for detailed or simplified fuel categories, for different years or for different regions. The energy balance results can also be shown by sector or by subsector in any energy unit.

Energy balance calculations will provide an understanding of current power generation capacity, as well as an understanding of the current state of renewable energy penetration and power generation for the grid and transmission, as well as distribution as a source of energy losses. This exercise will also identify the national energy intensity. Installed capacity, annual power generation and imports will also be part of this baseline understanding that provides the basis for creating scenarios.

In addition to globally reproducing historical energy balances, a notable capability of LEAP is that it can present estimates of possible future energy balances and how they could vary between scenarios depending on the implementation of different policies.

Scenario development and target setting:

LEAP was developed around the concept of scenario analysis. Scenarios are consistent stories of how an energy system might evolve over time.

Using LEAP, the Project Team can create and evaluate alternative scenarios, comparing their energy needs, their costs, social benefits and their environmental impacts.

LEAP will be used to explore the potential of renewable resources for the targets - the dataset will be able to illustrate the evolution of energy balances in STP:

- LEAP will consider the potentials of existing resources and the cost-benefit ratio of different technologies (e.g. hydropower; and biomass, geothermal, wind and solar power);
- Other important social, economic and environmental criteria (energy security, national development goals and sustainability).
- It can also be used to examine the local climate and air pollution impacts associated with different scenarios.

The scenarios to be evaluated will be agreed upon with DGRNE and the PNES subcommittee.

They will be intentionally designed to be transparent and relatively simple in terms of modeling methodology to make them readily accessible and easy to interrogate by local stakeholders and policy makers.

ANNEX V. BIBLIOGRAPHY

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