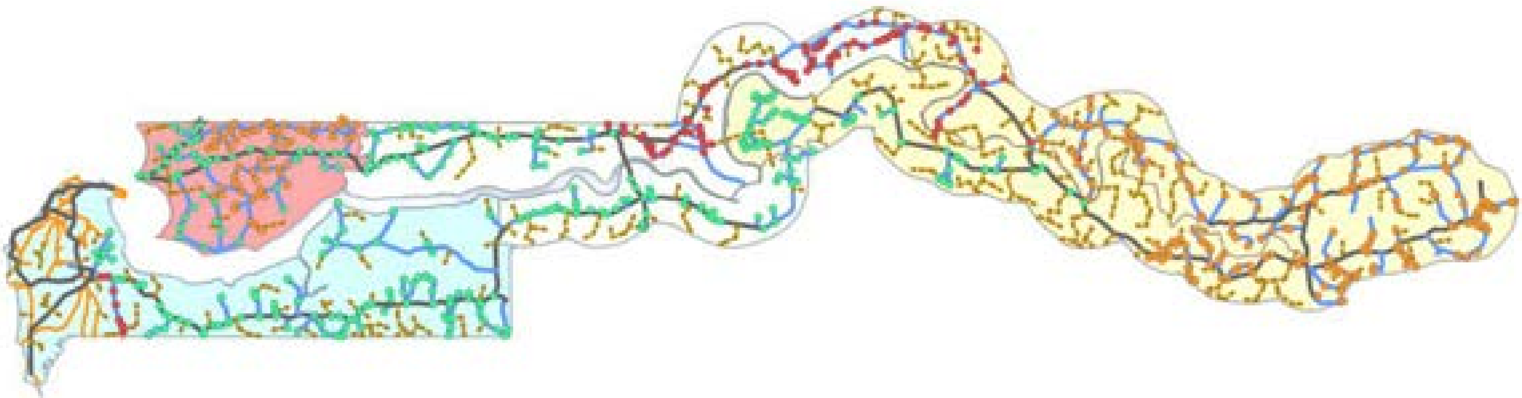
Universal Access by 2025 and Transforming The Gambia Electricity Sub-sector

Strategic Roadmap 2021-2040



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November 2021

Acknowledgments

This Update of Gambia's Electricity Sector Roadmap commenced in November 2019 and was successfully completed despite the challenges that arose due to the COVID-19 pandemic. The Roadmap process was coordinated by the Permanent Secretary of the Ministry of Petroleum and Energy (MoPE), Lamin Camara and the Managing Director of NAWEC, Nani Juwara, and managed by Ousman Njie from NAWEC and Babucarr Bittaye from MoPE.

The technical work was carried out under the leadership of Grigorios Varympopiotis of Economic Consulting Associates (ECA) and a team of experts drawn from ECA, Waya Energy, 3E and Norconsult. The Roadmap was financed by the World Bank, and Task Team Leader Chris Trimble played a key role in reviewing all of the technical background reports.

Foreword

The first electricity roadmap for The Gambia was developed in 2015 and updated in 2017, to serve as the development blueprint for the electricity sub-sector in the short-to-medium term. Since the adoption of the roadmap in 2017, the electricity sub-sector has undergone major positive changes, demonstrated by the expanded and more reliable electricity supply, the close-up of the electricity generation gap due to additional local generation capacity, and increased electricity access in the peri-urban and rural areas.

The regional and global energy landscape is ever evolving, necessitating the need to update the Gambia's high-level energy sector plans and strategies to account for new market realities and opportunities. This is the main reason for the 2021 update of the strategic electricity roadmap, which exemplifies the government's drive and commitment to modernize the electricity sub-sector by building on the past gains, but also to capitalize on the opportunity for low-cost imports available in the emerging WAPP regional electricity market, and the falling costs of renewable technologies, particularly solar PV, which is the least cost form of renewable energy in The Gambia.

Providing access to electricity to support inclusive and sustainable socio-economic development is one of the pivotal cornerstones of the Gambia government's priorities as articulated in the national energy sector policies and strategies, and highlighted in the National Development Plan (2018-2021). The roadmap represents the strategic masterplan for the electricity sub-sector of The Gambia fully consistent with the macroeconomic, energy, investment and climate-related policies of the government of The Gambia and embodies the high-level vision of the Government for the development of the sector over the next 20 years.

The strategic roadmap projects the electricity demand of the Gambia up to 2040, and establishes the medium and long-term investments in generation, and transmission and distribution infrastructure necessary to meet the national electricity demand forecast while meeting specific sector policy objectives such as the President's ambitious universal electricity access by 2025, increased domestic generation, low-cost import and export possibilities, and the systematic deployment of solar energy in the electricity generation mix.

The full implementation of the roadmap will require concerted efforts from government and all national stakeholders, a strong and holistic coordination of development partners' interventions in the electricity sub-sector, institutional strengthening, inflow of public and private sector investments, utility operations and governance reforms reinforced by effective and consistent policies and regulatory framework.

I wish to specially thank the World Bank for their continued support to the Gambia energy sector and I look forward to more fruitful engagements with the Bank and other development partners for the successful implementation of the strategic electricity roadmap.

Hon. Fafa Sanyang
Minister of Petroleum and Energy

Contents

Tables and Figures

Tables

Figures

Abbreviations and acronyms

AAG	Annual Average Growth
ACD	Aid Coordination Directorate (in Ministry of Finance)
CAPEX	Capital expenditure
CCGT	Combined Cycle Gas Turbines
CdI / CI	Cote d'Ivoire
CLSG	Cote d'Ivoire-Liberia-Sierra Leone-Guinea
DOE	Department of Energy
ECA	Economic Consulting Associates
ECOWAS	Economic Community of West African States
EDG	Électricité de Guinée
EPC	Engineering, Procurement and Construction
EREAP	ECOWAS Regional Electricity Access Project
ERERA	ECOWAS Regional Electricity Regulatory Authority
EU	European Union
FLNG	Floating liquefied natural gas
FRSB	Floating storage and regasification barge
GBA	Greater Banjul Area
GDP	Gross domestic product
GEAP	Gambia Electricity Access Project
GERM	Gambia Electricity Restoration and Modernization Project
GHG	Greenhouse gas
GIEPA	Gambia Investment and Export Promotion Agency
GIS	Geographic Information System
GMD	Gambian Dalasi
GW	Gigawatt
GWh	Gigawatt hours
HFO	Heavy fuel oil
HH	Household
HV	High voltage
ICE	Internal Combustion Engine
IMF WEO	International Monetary Fund World Economic Outlook
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
kWh	Kilowatt hour
LCOE	Levelised cost of energy

LCPDP	Least cost power development plan
LED	Light emitting diode
LFO	Light fuel oil
LNG	Liquefied natural gas
LV	Low voltage
MDA	Ministries, Departments, Agencies
MECCNAR	Ministry of Environment, Climate Change and Natural Resources
MOFEA	Ministry of Finance and Economic Affairs
MOJ	Ministry of Justice
MOLGL	Ministry of Local Government and Lands
MOPE	Ministry of Petroleum Energy
MOU	Memorandum of understanding
MV	Medium voltage
MW	Megawatt
MWh	Megawatt hour
MWp	Megawatt-peak
NAMA	Nationally Appropriate Mitigation Actions
NAWEC	National Water and Electricity Company
NDP	National Development Plan
NEA	National Environment Agency
NEP	National Energy Policy
NPV	Net present value
O&M	Operations and maintenance
OCCRP	Organized Crime and Corruption Reporting Project
OCGT	Open cycle gas turbine
OMVG	Gambia River Basin Development Organization (Organisation pour la Mise en Valeur du Fleuve Gambie).
OP	Office of the President
OPEX	Operating expenditure
PPA	Power purchase agreement
PURA	Public Utilities Regulatory Authority
PV	Photovoltaic
RACI	Responsible, Accountable, Consulted and Informed
RE	Renewable Energy
REM	Reference Electrification Model
RES	Renewable energy sources
SDG	Sustainable Development Goals
SHS	Solar home system

T&D	Transmission and distribution
TOR	Terms of reference
TSA	Transmission Service Agreement
UA	Universal Access
USD / $	United States Dollar
WACC	Weighted average cost of capital
WAPP	West African Power Pool
WB	World Bank
WTP	Willingness to Pay

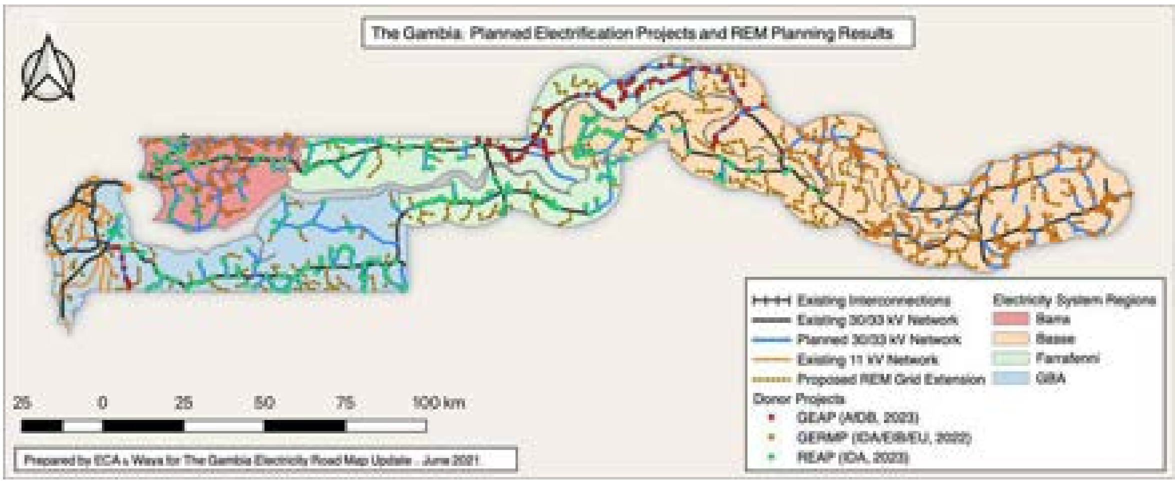
Executive Summary

The Gambia's energy sector is in the middle of a major transition. Since The Gambia entered a new political chapter in 2017, electricity supply has been stabilized and villages in the North Bank have been connected. NAWEC has made significant strides to improve operational efficiency and financial performance, and is in the middle of a major organizational restructuring. At the same, time, the OMVG interconnector is at an advanced stage of construction bringing with it the first High Voltage network in The Gambia and the opportunity to access large quantities of cleaner and lower cost electricity from the West Africa Power Pool (WAPP). An unprecedented level of support from the international community provides The Gambia with the opportunity to transform the energy sector and emerge as one of the leading energy sectors in the sub-region and the African continent.

In this context, the Electricity Roadmap has undergone its third update since 2015. It is the primary planning instrument, and a strategic reference point for all stakeholders in the sector. This update outlines what is needed to achieve the President's ambitious 2025 Universal Access target, and at the same time to transform the electricity sector so that Gambians can in future benefit from reliable and affordable electricity, with NAWEC becoming an efficient, financially sustainable power utility. The roadmap identifies a clear set of priorities for the energy sector to achieve its vision of 24/7 affordable access to all Gambians.

Key message 1: Universal access by 2025 is an achievable goal for The Gambia, which would make it one of the first countries in Africa to achieve universal access. Many large-scale access activities are already financed by existing donor projects and are under implementation. However, urgent action is required on the Eastern Backbone to prepare and implement this 225 kV line which is required to achieve universal access, and to construct the remaining medium voltage (MV) and low voltage (LV) lines. Including an allowance for design costs, these investments require an estimated $169 million of additional funding.

Map showing Universal Access projects to 2025



Source: Transmission and Distribution Master Plan and Universal Access Strategy

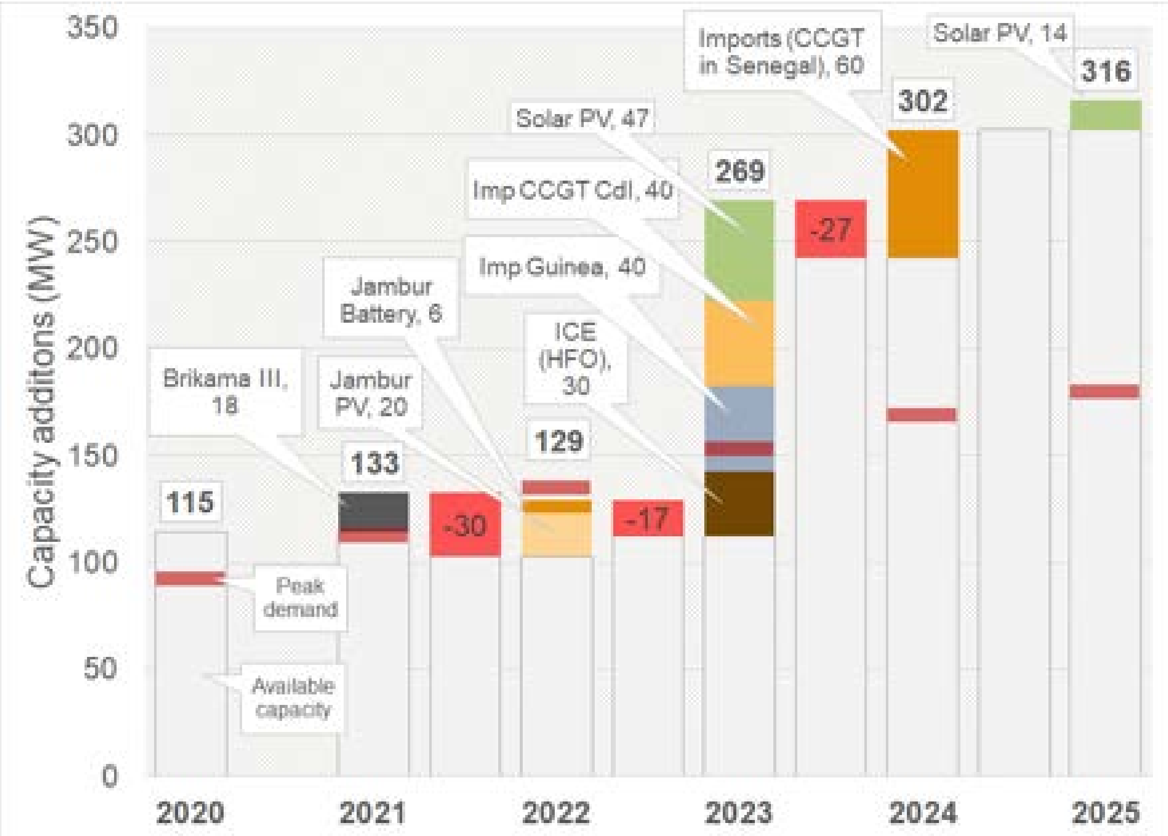
Key message 2: New sources of supply from solar energy and imports: there are two clear least cost sources of electricity supply to serve The Gambian population:

- **Solar**: with dramatically falling solar and battery storage costs, and abundant solar resources in The Gambia, competitively procured solar-with-storage IPPs offer The Gambia an excellent opportunity to introduce clean and low cost energy into the mix.

- **Imports**: solar can be complemented with imports from the West Africa Power Pool including hydro from Guinea and gas-to-power from Senegal and the Ivory Coast. MoPE and NAWEC urgently need to start the preparation process for both opportunities.

The main elements of the generation and imports least cost plan for the period up to 2025 are shown in the diagram below. These are imports from WAPP partners (140 MW) and Solar PV (80 MW), together with new thermal capacity (48 MW). Negative values over the period 2021-2023 are the end of the Karpower contract and retirement of old plants.

Domestic generation and imports least cost plan



Source: Least Cost Generation Plan.

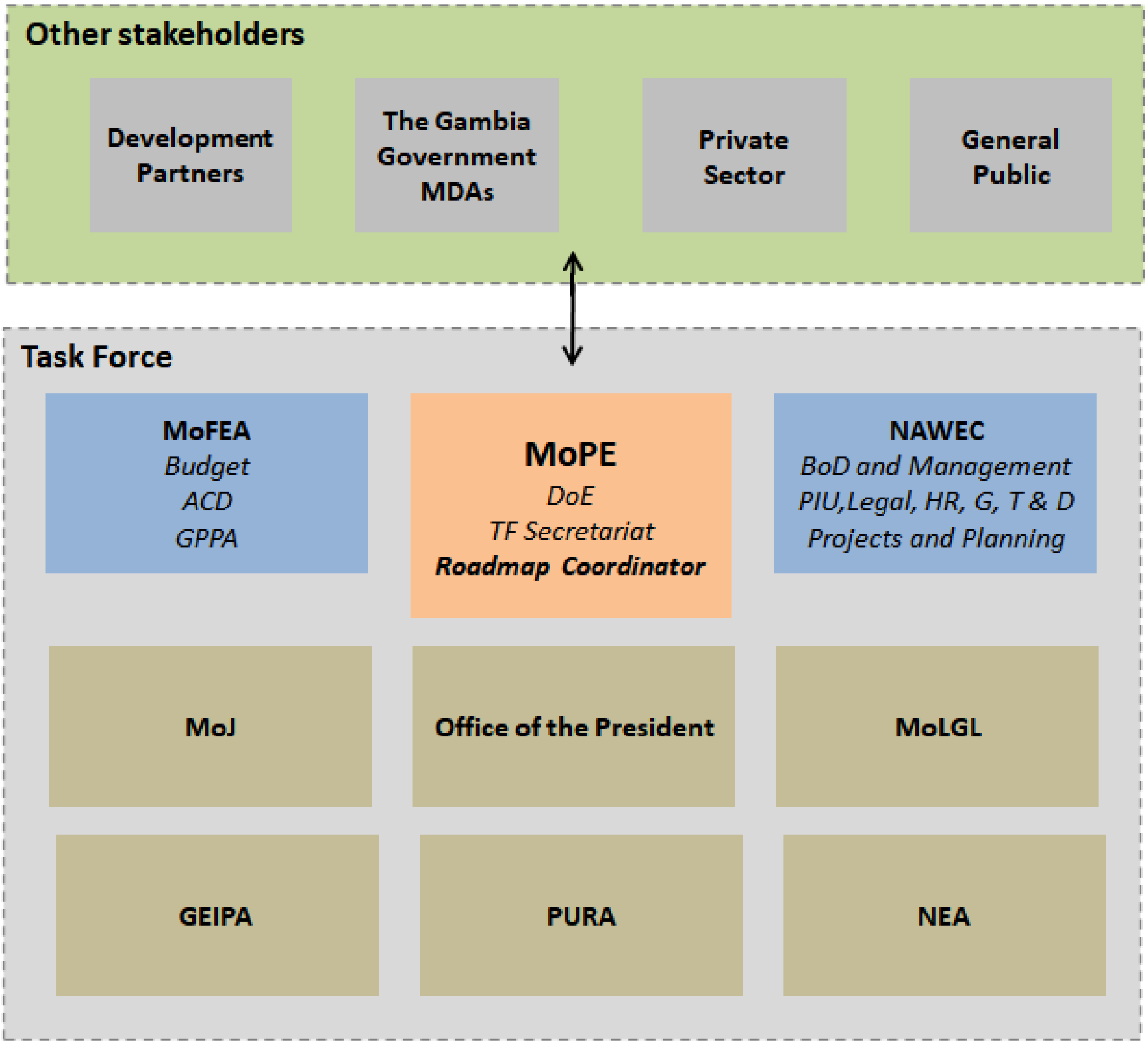
Driven mainly by reduced supply costs but also by operational performances in NAWEC, the Roadmap is set to deliver **lower electricity tariffs**. Tariff requirements for cost recovery are likely to reduce from GMD 12 / kwh (23,5 c/kwh) in 2020 to GMDD 8-9.6 / kWh (15,7 c/kWh – 18,8 c/kWh) by 2030.

Key message 3: The institutional framework to realize the goals outlined in the roadmap require several areas of focus

- **Continue to drive the reform process for NAWEC to become an operationally efficient and financially viable company**. This starts with the full implementation of the 2019-25 Strategic Development Plan.

- **A high level Task Force will drive implementation of the Roadmap**: this will be chaired by MoPE, with the Office of the President (OP), Ministry of Finance and Economic Affairs (MoFEA), Ministry of Justice (MoJ), Ministry of Local Government and Lands (MoLGL), NAWEC, Public Utilities Regulatory Agency (PURA), national Environmental Agency (NEA) and Gambia Investment and Export Promotion Agency (GIEPA) as members. The Department of Energy of MoPE, with a dedicated ***Roadmap Implementation Coordinator***, will provide the Secretariat to the Taskforce: convening meetings; taking minutes, providing briefing notes, and following up on decisions of the Task Force.

Roadmap Implementation High Level task Force



Source: Roadmap institutional arrangements report

The main elements of the Roadmap are summarized in the table below. These include the Universal Access strategy and the accompanying transmission and distribution (T&D) and generation investments to support it, particularly Solar PV. Domestic supplies will be complemented by imports from the West African power Pool. The final key element of the Roadmap is institutional strengthening, particularly in NAWEC becoming an efficient and reliable supplier of power to the nation.

Electricity Sector Roadmap summary 2021-2040

	2021-2025	2026-2040
Sub-period strategic objectives	***Big push to achieve Universal Access to electricity by 2025***	***Electricity sector consolidation: stable supplies at lower tariffs***
Universal Access Strategy / DMP	• Accelerate grid connection and grid densification projects	• Further densification, building on Universal Access in 2025
Transmission Master Plan	• 225 kV Eastern Backbone for Basse and strengthen Barra grid	• Complete sub-stations at Bansang and Basse
Domestic generation	• Committed ICE & Solar PV projects and further 60 MW PV	• Continue with vigorous Solar PV roll-out (250 MW by 20400
Importation of electricity	• Negotiate import PPAs with Senegal and Cote d'Ivoire	• Monitor imports contracts
Institutional strengthening	• NAWEC - implement Strategic Development Plan and meet the Performance Contract Targets	• Capacity building to continue at multiple levels within the energy sector
Roadmap implementation	• MoPE Roadmap Coordinator working with Roadmap Implementation Task Force	• Under Mope's leadership, Task Force to continue to provide momentum to the Roadmap

AS regards financing, the main components of the Roadmap that are to be financed are the generation investments, the Universal Access projects and the associated T&D investments. The table below provides a summary broken down into 2021-2025 ($526 million) and 2026-2030 ($210 million). The overall total for the period 2020-2030 is $736 million. A large proportion of this is already financed through on-going national and regional projects sponsored by development partners.

Financing Requirements Summary for 2020-2030 ($ million)

Item	2020-2025	2026-2030	Total	Source
(1) Generation	$225 m	$125 m	$350 m	Private sector IPPs + NAWEC
(2) On-going Universal Access projects	$92 m	$39 m	$131 m	GERMP, EREAP and GEAP
(3) New Universal Access projects	$66 m	$29 m	$95 m	Donor and government financing
(4) Gambian component of OMVG project	$86 m		$86 m	Donor financing
(5) Transmission projects	$57 m	$17 m	$74 m	NAWEC, donor financing
Total	**$526 m**	**$210 m**	**$736 m**	

Note: Generation and UA project costs are overnight capex (reported elsewhere in this report) plus 3% for design costs etc. GERMP, EREAP and GEAP financing goes beyond UA sub-components of these projects

1 Strategic Roadmap Summary Overview

1.1 A New Era for Gambia's Electricity Sector

The Gambia is poised to provide access to electricity for all its people. His Excellency, President Adama Barrow has stipulated that there is to be **Universal Access by 2025.** Given its unique geography, the country is fortunate in being able to achieve universal access almost exclusively through connections to the NAWEC grid. This Roadmap is the planning instrument designed to reach the President's 2025 Universal Access target and at the same time to transform the electricity sector so that Gambians can in future benefit from reliable and affordable electricity, with NAWEC becoming an efficient, self-sustaining national power utility.

Electricity is a catalyst for development. Universal Access will improve the lives of households which previously relied on inferior forms of energy, bringing immediate benefits in education and opening new opportunities for income-generating activities. Giving national priority to achieving Universal Access as early as 2025 is a far-sighted initiative which will enhance the country's economic development as well as improving the quality of life of all Gambians.

An important element in the overall transformation of the electricity sector during the Roadmap period (2021-2040) is the development of the **regional electricity grid** of the West African Power Pool (WAPP). This provides the opportunity for the Gambia's electricity system to be reinforced with interconnections to its larger neighbours, and for the country to benefit from trade in electricity. This will deliver the following benefits:

- ***Technical benefits*** – frequency stability, security of supply through shared reserves
- ***Planning benefits*** – greater flexibility in developing generation projects
- ***Financial benefits*** – reduced investment and operational costs of meeting demand, improved utility viability and hence the opportunity for reductions in electricity tariffs.

Within the wider economy, this will free up resources for investment in the productive sectors, leading to higher economic growth. Gambian industries will also be more competitive due to lower electricity tariffs.

1.2 Building on Recent Improvements in the Electricity Sector

The first electricity sector Roadmap for The Gambia was produced in 2015, and partially updated in 2017. That update, together with the National Development Plan (2018-2021), helped to mobilise over $400 million in donor funding. Over the last 4 years there have been significant improvements in a number of key areas:

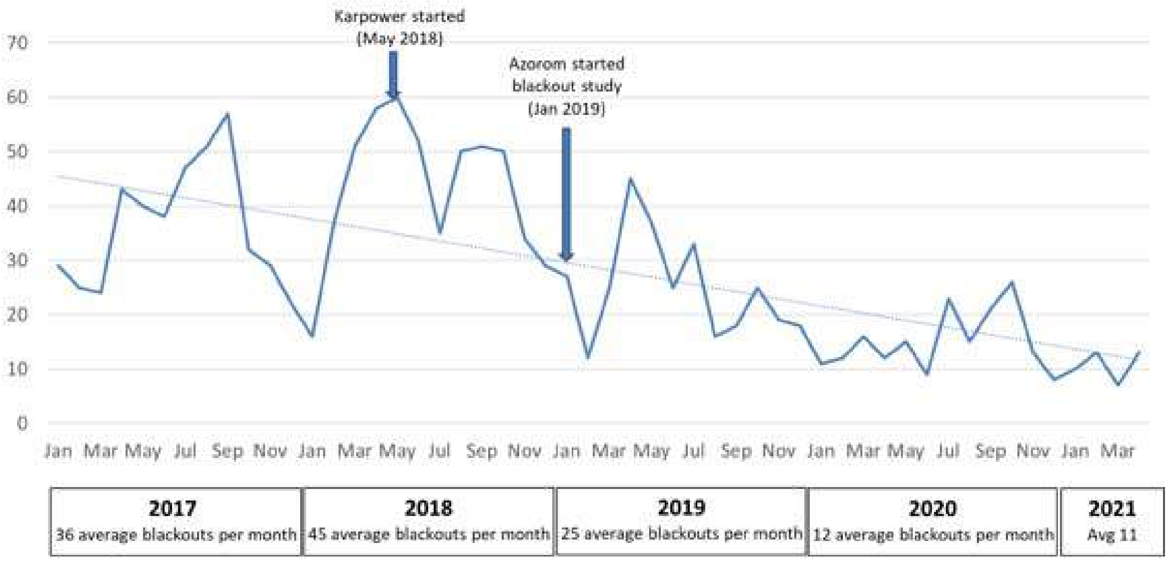
- **More stable power supply** replacing frequent blackouts (an average of 45 per month in 2018).

- **Reduced transmission and distribution losses**: technical and non-technical losses reduced from 28% in 2015 to 20% in 2020, largely through installing pre-payment meters.

- **Least cost plan for orderly investments**, reducing the heavy stream of unsolicited proposals. Preparations are underway for a competitive IPP process.

The reduction in blackouts has been of direct benefit to NAWEC customers. The graph below shows the continuous decline in the number of system-wide blackouts in the great Banjul Area (GBA) since 2017. However, there have also been supply interruptions due to localised faults in the distribution network.

Figure 1 GBA System-wide Blackouts (2017- May 2021)



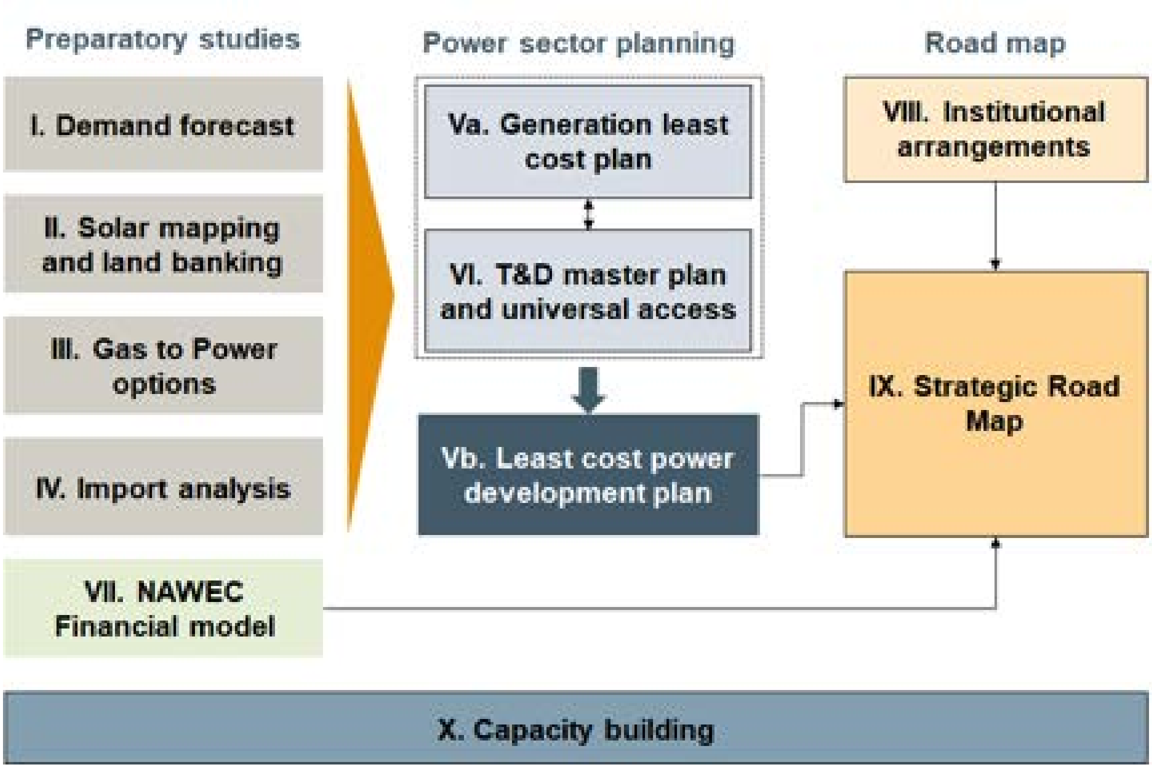
Source: World Bank

Reduction in losses has allowed growth in sales of 8.5% per year, higher than the 7% per year growth in dispatched energy. With higher sales and improved revenue collection rate (particularly from public sector customers) **NAWEC's commercial performance has improved**. NAWEC did not need direct subsidies from the Ministry of Finance & Economic Affairs (MOFEA) in 2019 or 2020. While NAWEC's financial statements are still weak, through the NAWEC Strategic Development Plan (2019-2025) and the NAWEC / MOFEA Performance Contract (2021-2023) the basis has been laid to make progressive and sustained improvements in performance.

1.3 Roadmap for 2021-2040 Builds on Previous Sector Planning

As already mentioned, the first electricity sector Roadmap for The Gambia was produced in 2015, and partially updated in 2017. This Roadmap is a thorough update, with the accompanying study having ten components that are shown in Figure 2 below.

Figure 2 Components of the 2021-2040 Roadmap Study



The different components are shown as discrete tasks, but in practice the work was often done in parallel and iteration was needed between the generation least cost planning and the T&D Master Plan to produce the final Least Cost Power Development Plan.

It is important to emphasize that this update of the Roadmap is not just a consultancy output but is rather the outcome of an **inclusive process** involving the key Gambian institutions in establishing the assumptions to be used in the models, choosing the scenarios to be analysed and agreeing on the consultations and recommendations arising from the analysis. Particularly important in this regard are the commitments made to the **implementation of the Roadmap** (see Section 6.3).

This Capstone Report is a synthesis of the technical work that was carried out. It includes sections describing the methodologies employed and giving the main assumptions, but the details of these are to be found in the preceding technical reports. These are listed in Annex A1.1.

1.4 Main elements of the 2021-2040 Roadmap

As shown in the table below, the main elements of the Roadmap are the Universal Access strategy and the accompanying transmission and distribution (T&D) and generation investments to support it. Also significant is the development of the regional electricity grid of the West African Power Pool (WAPP), which provides the opportunity for the Gambia's electricity system to be reinforced with interconnections to its larger neighbours, and to import low-cost bulk supplies. The final key element of the Roadmap is institutional strengthening, particularly in NAWEC becoming an efficient and reliable supplier of power to the nation.

Table 1 Electricity Sector Roadmap 2020-2040

	2021-2025	2026-2040
Sub-period strategic objectives	***Big push to achieve Universal Access to electricity by 2025***	***Electricity sector consolidation: stable supplies at lower tariffs***
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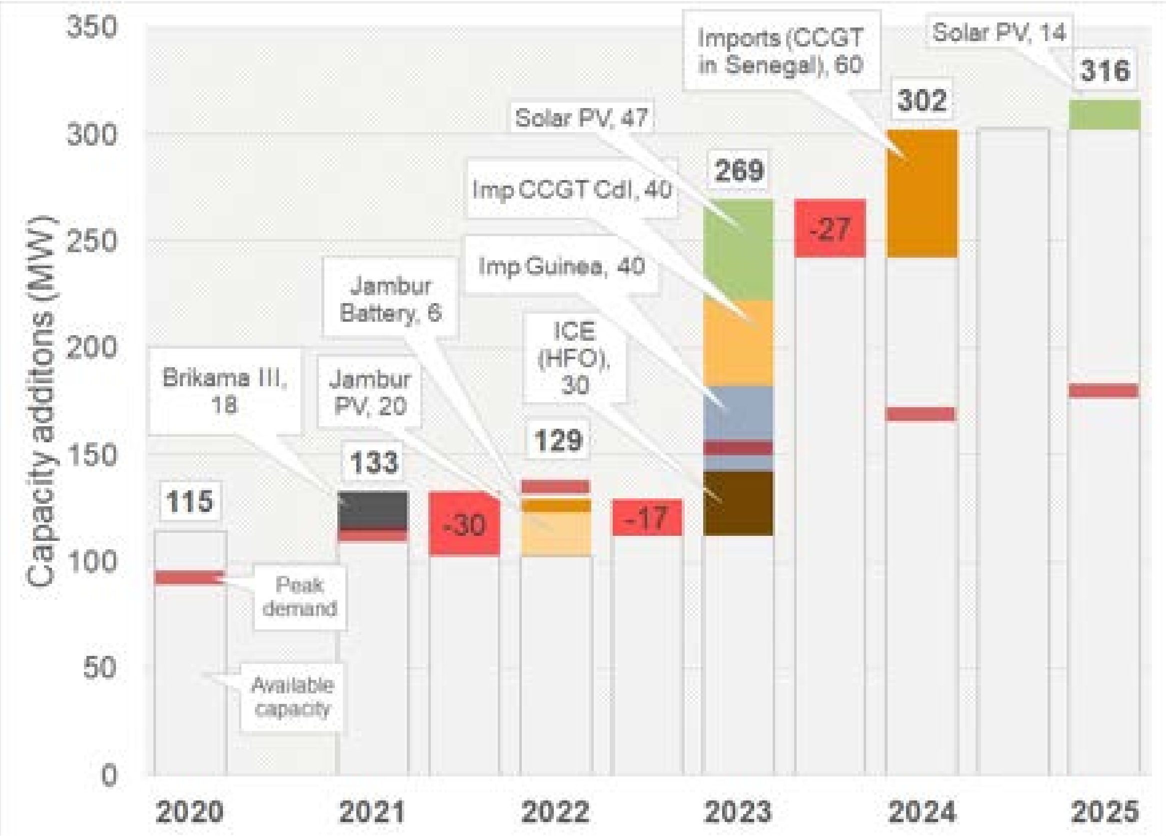
Importation of electricity	• Negotiate import PPAs with Senegal and Cote d'Ivoire	• Monitor imports contracts
Institutional strengthening	• NAWEC - implement Strategic Development Plan and meet the Performance Contract Targets	• Capacity building to continue at multiple levels within the energy sector
Roadmap implementation	• MoPE Roadmap Coordinator working with Roadmap Implementation Task Force	• Under Mope's leadership, Task Force to continue to provide momentum to the Roadmap

The main elements of the generation and imports least cost plan for the period up to 2025 are shown in the diagram below. These are imports from WAPP partners (140 MW) and solar PV (80 MW), together with new thermal capacity (48 MW). Negative values over the period 2021-23 are the end of the Karpower contract and retirement of old plants.

Figure 3 Domestic Generation and Imports Least Cost Plan



Source: Least Cost Generation Plan.

This diagram makes cautious assumptions about commissioning dates of imports and domestic generation projects. Earlier commissioning would provide reserve capacity in 2022 but failing this the Karpower contract may have to be renewed for another year and/or retirement of antiquated domestic generation plant postponed.

2 Demand forecast[1]

Statistics from NAWEC show that sent-out energy grew at an average rate of 11% per year from 2010 to 2018, reaching 341 GWh in 2018. Peak demand grew from 45 MW in 2017 to 65 MW in 2018. Historical energy and peak demand were constrained by generation and network shortages or outages.

The 2025 Universal Access demand forecast in the Roadmap has energy sent out growing by 6.7% per year from 418 GWh in 2019 to 1,928 GWh in 2040. Over the same period maximum demand grows from 80 MW in 2019 to 333 MW in 2040.

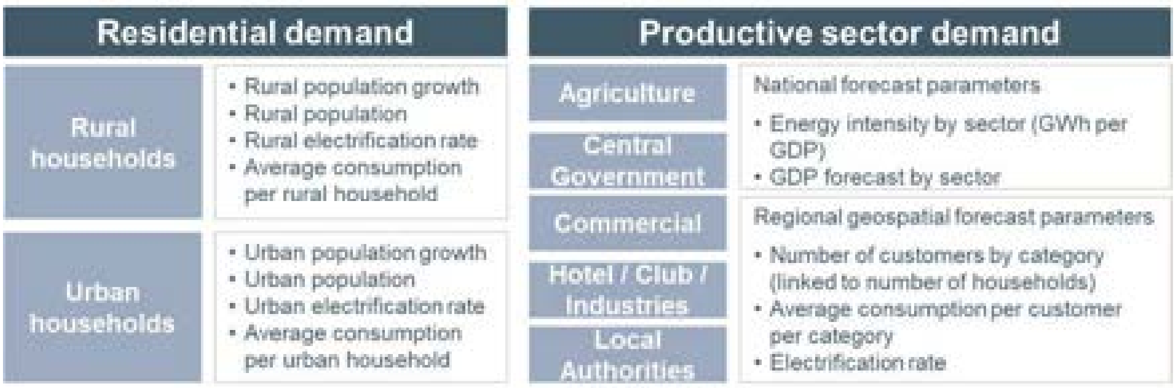
The Roadmap forecasts are derived from a model which forecasts demand separately for urban and rural households and for each of the major sectors of the economy.

- **Household demand**: is based on (1) changes in the number of electrified households, which is driven by the government's electrification targets and (2) the consumption per household for urban and rural households.

- **Other demand**: Demand for the productive sectors of the economy is forecast by projecting changes in economic output for each sector and calculating energy demand using the sector energy intensity (energy use per unit of GDP).

The model takes into account **system losses** to estimate sent-out energy and predicts peak demand by estimating a load factor for each year of the forecast using information on the load factor for each customer group and their contribution to the peak demand.

Figure 4 Summary of Demand Forecast Modelling



Source: Demand Forecast Report

A second model provides the **geographic forecast of the demand**. Using GIS data, this model estimates the location of customers and forecasts the demand by area using the forecast number of customers by customer class and the forecast average consumption of each class.

[1] Full details are available in the Demand Forecast Report.

2.1 Demand Forecast Assumptions

Table 2 summarises the main assumptions used to generate the demand forecast. The main drivers of the rapid growth that is forecast are GDP growth and a combination of population growth and rapid attainment of electrification targets. Average consumption per household is assumed to rise over time as higher incomes enable households to consume more electricity each month[2].

Table 2 Demand Forecast Assumptions

Item	Case	F'cast:	2020	2025	2030	2035	2040
GDP growth rate (%)	Low case		4.4%	3.5%	3.5%	3.5%	3.5%
	2025 UA		4.4%	5.8%	5.8%	5.8%	5.8%
	High case		4.4%	5.8%	5.8%	5.8%	5.8%
Population growth rate (%)		Urban	4.1%	4.0%	3.9%	3.8%	3.7%
		Rural	1.4%	1.4%	1.4%	1.4%	1.4%
Electrification targets (% of households)	Low case	Urban			100%		
		Rural					100%
	2025 Universal Access	Urban		100%			
		Rural		100%			
	High case	Urban		100%			
		Rural			100%		
Average consumption per household (kWh/month)	Low case	Urban	124	128	129	130	131
		Rural	66	68	69	69	70
	2025 Universal Access	Urban	124	161	175	191	207
		Rural	66	79	86	93	102
	High case	Urban	148	189	210	233	259
		Rural	73	88	97	108	120
Network losses (%)	Low, 2025 UA case		22%	21%	18%	17%	15%
	High case		22%	22%	20%	19%	18%

Source: Least Cost Power Development Plan

During the Roadmap process, there was considerable discussion about the assumptions to be used for average consumption per household. Following a sampling of customer data, the base figures agreed to by NAWEC and the MOPE for the demand forecast at the 2020 start of the projection period are shown in Table 3 below.

[2] The growth in monthly household energy consumption is related to GDP growth via an elasticity. Details are provided in the *Demand Forecast Report*

The demand forecast takes into account the impact of COVID-19. Household consumption of electricity is expected to fall as a result of the pandemic. The primary reason for this is loss of income and lack of available cash as a result of slowing economic activity, lack of employment and a sharp reduction in remittances.

A drop in average household consumption in 2020 has been factored into the forecast model. The modelling scenarios examined also reflect the range of possible post-pandemic recovery paths for household consumption:

- The low case assumes a slow recovery path with long lasting changes on the economy and the average consumption per household.
- The base case and 2025 Universal Access case assume a gradual rebound of the economy (and the average consumption per household) in 2021 and 2022 after the impact of COVID-19, with full recovery occurring in 2023.
- The high case assumes a quick rebound of the economy in 2021 after the impact of COVID-19, with full recovery occurring in 2022.

The final assumptions on the average consumption per household with and without the implications imposed by COVID-19 pandemic are presented in the table above.

Table 3 Average Consumption per Household – Demand Forecast Assumptions

Item	Unit	Forecast 2020	Forecast 2021	Forecast 2022	Forecast 2023	Forecast 2024	Forecast 2025
Average consumption per household							
Low case - assumes a slow rebound of the economy after the impact of COVID-19.							
Average consumption per household	kWh/month	119	121	122	123	123	123
Urban	kWh/month	124	126	127	127	128	128
Rural	kWh/month	66	67	68	68	68	68
Base case - assumes a gradual rebound of the economy in 2021 and 2022 with full recovery in 2023.							
Average consumption per household	kWh/month	119	128	138	147	149	152
Urban without COVID-19	kWh/month	148	151	153	156	158	161
Rural without COVID-19	kWh/month	73	74	75	76	78	79
Urban	kWh/month	124	135	145	156	158	161
Rural	kWh/month	66	69	73	76	78	79
High case - assumes a quick rebound of the economy in 2021 with full recovery occurring in 2022.							
Average consumption per household	kWh/month	142	155	168	171	174	177
Urban without COVID-19	kWh/month	170	174	177	181	185	189
Rural without COVID-19	kWh/month	79	81	82	84	86	88
Urban	kWh/month	148	163	177	181	185	189
Rural	kWh/month	73	78	82	84	86	88

Source: Least Cost Power Development Plan

Perspectives from the Willingness to Pay Survey[3]

A Willingness to Pay Survey was conducted to ascertain the willingness to pay (WTP) for electricity services of different categories of present and future customers. In the survey, four groups were assessed: households connected and not connected to the grid and businesses connected and not connected to the grid. Households connected to the grid are largely urban households. Their average monthly consumption, calculated from reported monthly expenditure and the prevailing tariff of 9.9 Dalasi per kWh, is shown in Table 4 below.

[3] Details are available in the *Willingness to Pay Survey Report.*

Table 4 Current Household Monthly Consumption of Grid Electricity

Area	Monthly electricity expenditure (Dalasi)	Monthly consumption (kWh per month)
Urban	1,784	90
Rural	1,152	58
Total	**1,719**	**87**

Source: WTP survey

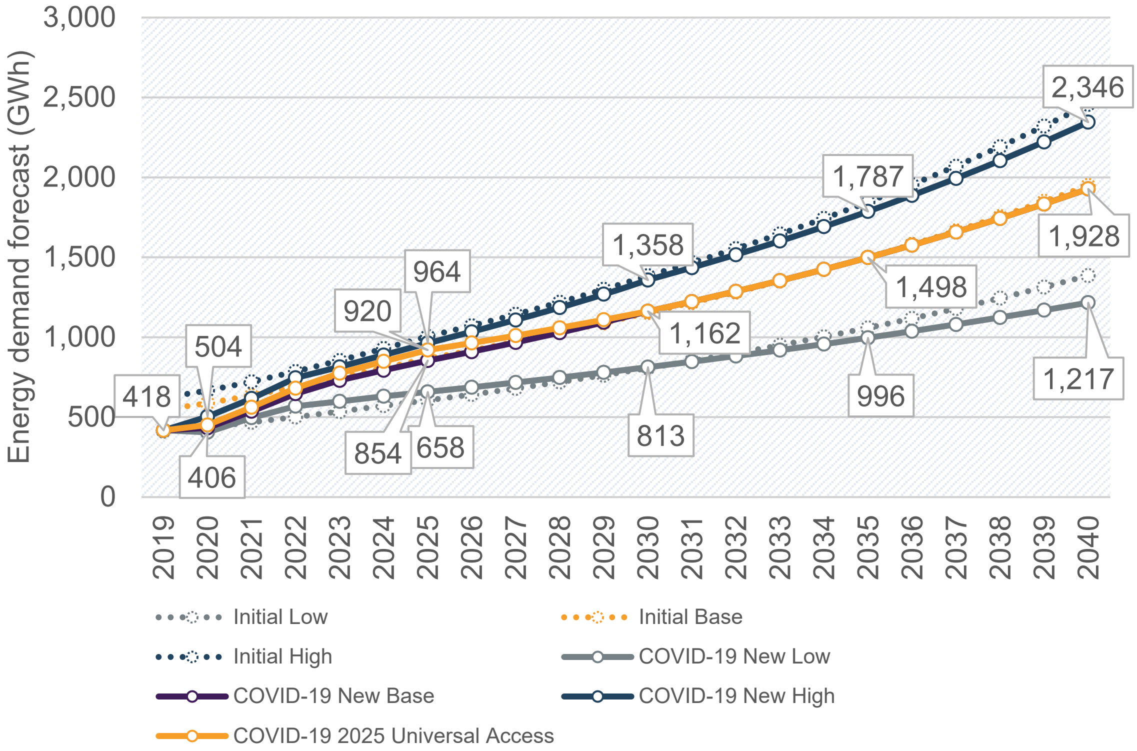
The monthly consumption figures for urban and rural households are lower than those agreed for the demand forecast. This was justified in terms of customers presently consuming less than they would like to due to frequent interruptions in supply. For these customers, the WTP questions were about how much more they would be willing to pay for an improved level of service from NAWEC. The survey found that household customers would be willing to pay 11% more while business would be willing to pay 16% more for an improved level of service.

Households which do not currently have electricity, which are mainly rural households, were asked about their willingness to spend on average 351 Dalasi per month (3% of their income) for basic electricity services (enough for lights, phone charging, and radio) and 2,850 Dalasi (24% of their income) for additional electricity services (enough for lights, phone charging, fan, small TV and refrigerator). On a unit cost basis, WTP was similar between basic and additional levels of services. Non-connected households were willing to pay 25.0 Dalasi/kWh for basic services and 26.0 Dalasi/kWh for additional services. However, asking respondents about a hypothetical situation they are not familiar with (having access to electricity) is problematic. There may have been an upward bias in the responses, because the results for households not currently connected translating into an implausibly high proportion of mean monthly income.

2.2 Demand Forecasts adopted for the Roadmap

The main output of the demand forecast that is required for the load forecast is the sent-out energy (GWh) and maximum demand (MW). The tables and graphs below summarise these figures on a five year interval (year-by-year forecasts are available in Annex A2) with the central case being the demand associated with achieving Universal Access in 2025. The annual average growth rates (AAG) are calculated from a regression formula.

Figure 5 Revised Energy Demand Sent-out Forecast



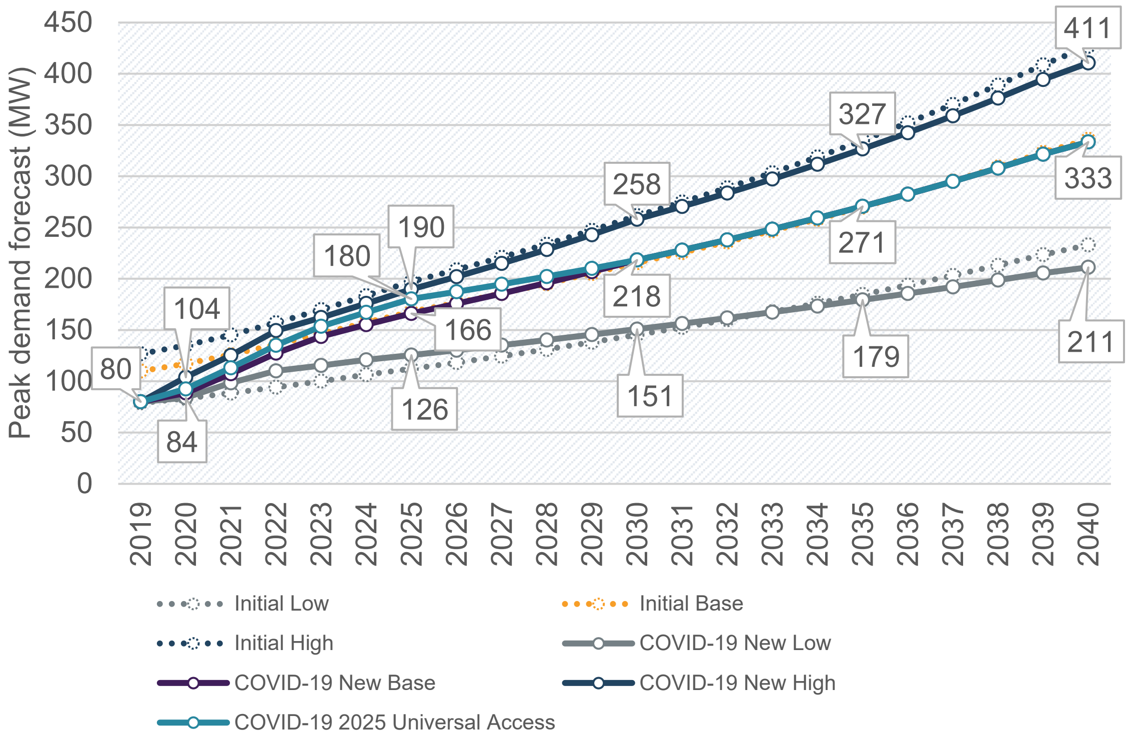
Source: Demand Forecast Report

Table 5 Revised Energy Demand Sent-out Forecast (GWh)

Year	COVID-19 New Low	COVID-19 2025 UA	COVID-19 New High
2020	406	451	504
2025	658	920	964
2030	813	1,162	1,358
2040	1,217	1,928	2,346
AAG 2019-2040	4.9%	6.7%	7.6%

Source: Demand Forecast Report

Figure 6 Revised Peak Demand Forecast



Source: Demand Forecast Report

Table 6 Peak Demand Forecast (MW)

Year	COVID-19 New Low	COVID-19 2025 UA	COVID-19 New High
2020	84	93	104
2025	126	180	190
2030	151	218	258
2035	179	271	327
2040	211	333	411
AAG 2019-2040	4.3%	5.9%	6.8%

Source: Demand Forecast Report

2.3 Geospatial Breakdown of Forecast Demand

The geospatial forecast allows for a granular view of demand by regional electricity systems and customer type. The tables below show our estimate of this distribution for electricity demand in 2030 in both energy and maximum demand terms. These estimations represent the final electricity sales, and do not account for losses in transmission and distribution, and hence are different to the sent out forecasts. The Greater Banjul Area (GBA) accounts for around 80% of total national demand.

Table 7 Energy Demand Forecasts by Region with Universal Access in 2025

Year	Unit	Barra	Basse	Farafenni	GBA	Total
2020	GWh	11	15	21	305	352
2025	GWh	22	60	41	600	724
2030	GWh	30	117	53	753	953
2020	% of total	3%	4%	6%	87%	100%
2025	% of total	3%	8%	6%	83%	100%
2030	% of total	3%	12%	6%	79%	100%
AAG	% pr year	11%	24%	10%	10%	11%

Source: Transmission and Distribution Master Plan and Universal Access Strategy

Table 8 Maximum Demand Forecasts by Region with Universal Access in 2025

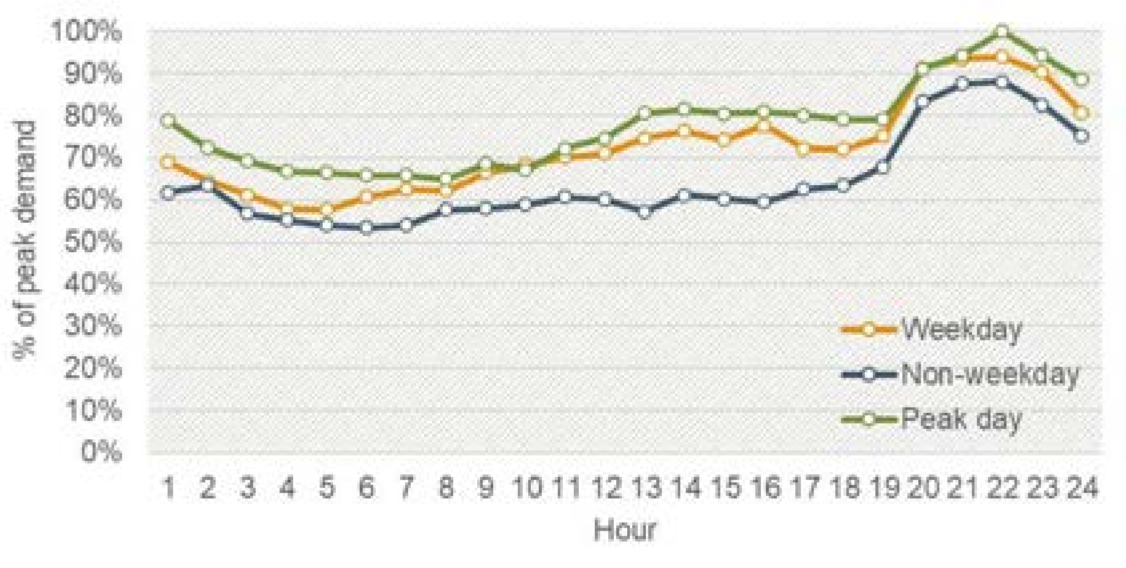
Year	Unit	Barra	Basse	Farafenni	GBA	Total
2020	GWh	3	4	5	77	89
2025	GWh	6	15	10	149	180
2030	GWh	7	27	12	172	219
2020	% of total	3%	4%	6%	87%	100%
2025	% of total	3%	8%	6%	83%	100%
2030	% of total	3%	12%	6%	79%	100%
AAG	% pr year	10%	22%	9%	9%	10%

Source: Transmission and Distribution Master Plan and Universal Access Strategy

2.4 Daily Load Curves

For generation planning, where different types of plant are to be despatched in merit order, it is necessary to have the load profiles, that is the variation in demand for power (measured in MW) over the course of typical days. The load profiles used in this Roadmap (Figure 7) are those that presently apply in GBA.

Figure 7 GBA Daily Load Curves and Patterns of Dispatch



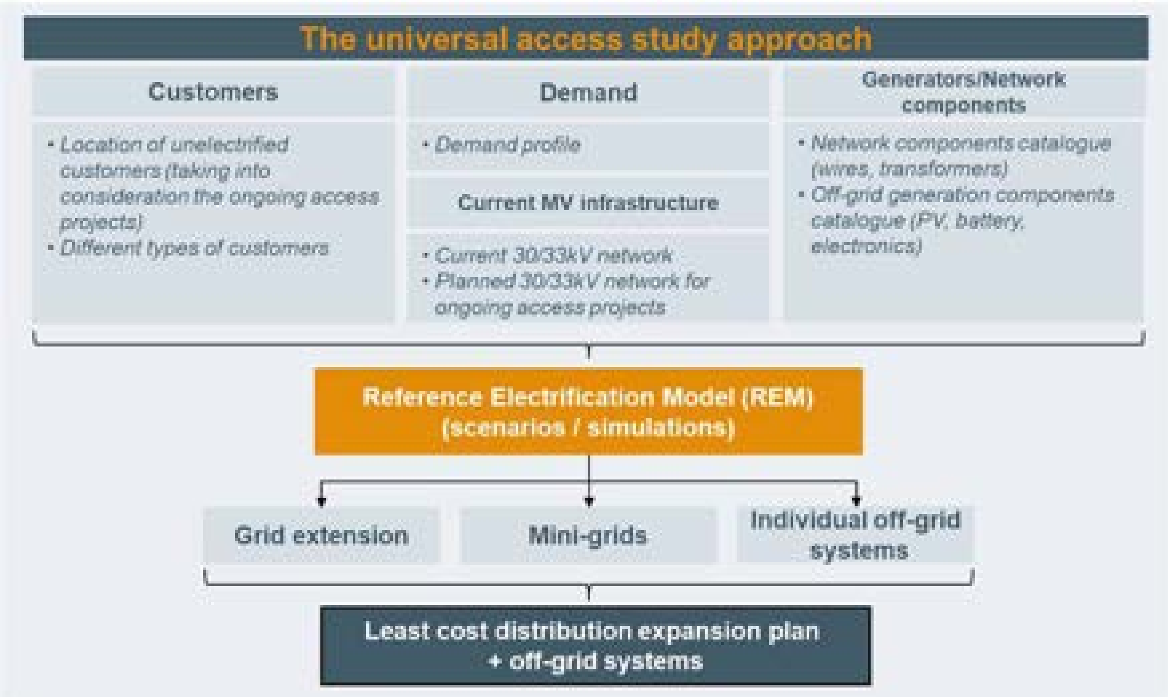
Source: Demand Forecast Report

3 Universal Access Strategy and T&D Master Plan

3.1 Universal Access and Distribution Planning

As highlighted in Section1, The Gambia is fortunate in having the opportunity to achieve universal access to electricity by 2025. The approach adopted to derive the least cost universal access plan is summarised in Figure 8. The Reference Electrification Model (REM) is a powerful GIS-based planning tool used to determine the mix of on-grid and off-grid systems that meets the forecast electricity demand and provides access to all unelectrified customers at the lowest economic cost. The off-grid options considered are mini-grids and individual off-grid systems (solar home systems for households and stand-alone generators for productive or commercial enterprises).

Figure 8 Approach to Derive the Least Cost Universal Access Plan



Source: Transmission and Distribution Master Plan and Universal Access Strategy

The least cost electrification results of the REM model confirm that there is a clear mandate for The Gambia to achieve universal access through grid extension projects.

- In the least cost solution, 98% of the overall unelectrified customers should be connected to the grid
- average per customer CAPEX cost for densification is $500 and for the proposed grid extensions is $1,230; off-grid costs per customer are much higher.
- electrifying all customers via grid interconnection would add only $4 million to the costs, and this small cost extension is more than compensated for by avoiding the

costs of establishing implementation mechanisms for a very small number of off-grid customers (412 individual systems and 1 mini-grid).

Although the REM model was run with a 2030 time horizon, it is appropriate to anticipate 2030 requirements by adopting the same infrastructural investment plan for 2025, the Universal Access target year. The infrastructural investment costs to 2025 are shown in Table 9[4]. The total to 2025 is $63.5 million[5]. To cater for population growth in the period from 2026, a further $28 million will need to be invested in grid densification up to 2030.

Table 9 Summary of Universal Access Costs through 2025 (REM simulation results)

Indicator	Unit	New Grid Extensions	Grid Densification	Total
Number of new customers	*Number of households*	18,995	67,000	86,564
Fraction of New Customers		0.22	0.78	1
Cost of Demand Served	*$/kWh*	0.28	0.15	-
Total CAPEX	*$ m*	**30.0**	**33.5**	**63.5**
Total OPEX	*$ m/yr*	5.1	-	-
Avg. OPEX	*$/yr/customer*	271	-	-
Avg. CAPEX	*$/customer*	1,583	500	-

Source: Transmission and Distribution Master Plan and Universal Access Strategy

These results are based on estimates of the numbers of customers to be connected by 2025 to achieve Universal Access and the densification[6] that will be needed between 2025 and 2030 to cater for population growth (at an estimated 2.9% per year). The cumulative existing and new customers in 2025 and 2030 are summarised in Table 10 below.

Table 10 Existing and New Customers to have Access by 2025 and by 2030

Customers	Estimated Existing Customers 2019	Estimated Existing Customers 2020	New Customers Densification By 2025/30	New Customers Grid Extension or Off-Grid By 2025/30	Total Potential Customers (2025/30)
Total - 2025	204,036	224,211	137,000*	18,995	380,206
Total - 2030	204,036	224,211	194,960*	18,995	438,166

Source: Transmission and Distribution Master Plan and Universal Access Strategy Note: *This includes 70,000 new customers to be electrified through ongoing access projects.

As indicated in the table, around half of the new densification customers by 2025 are already scheduled to be connected through on-going grids access projects. These are:

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[4] In this report, costs are reported in USD and all references to dollars ($) and cents are USD and cents of the USD respectively. The common units used for LCOE are c/kWh and $/MWh.
[5] In Table 23, an allowance of 3% is added to this base cost to cover design etc.
[6] Customers who are less than 2 km away from the current infrastructure are considered for grid densification.

- **Gambia Electricity Restoration and Modernization Project (GERMP)** funded through IDA, EIB and EU – completion 2022

- **The Gambia Electricity Access Project (GEAP)** funded through AfDB – completion 2023

- **ECOWAS Regional Electricity Access Project (EREAP)** funded through IDA – completion 2023

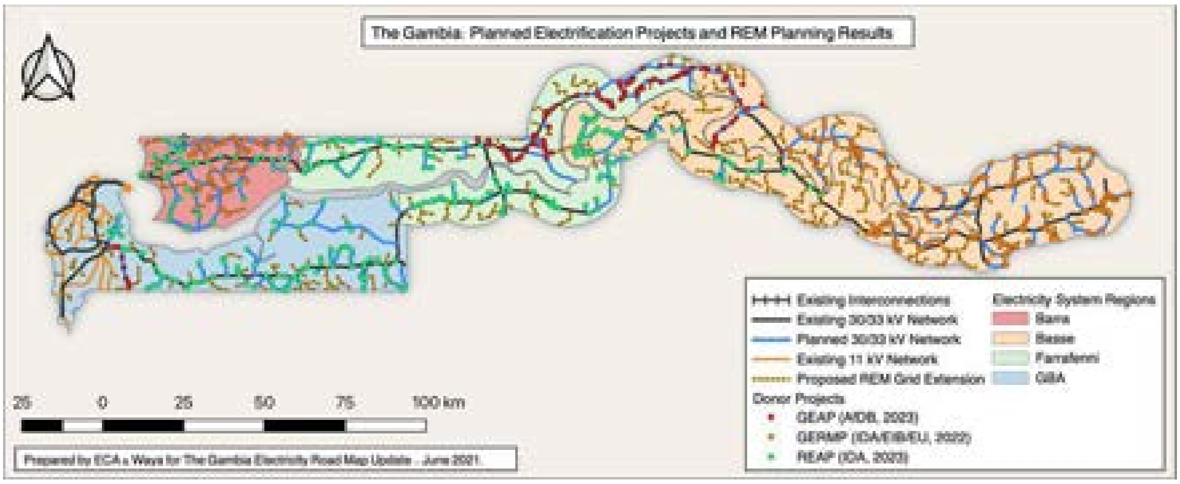
The distribution of sites (numbering 776 in total) across the regions for these three projects and the additional grid extensions needed to reach Universal Access in 2025 is shown in the table and map below.

Table 11 Distribution of Sites by Region of the GERMP, REAP and GEAP Projects

Region	Sites electrified through GERMP (IDA/EIB/EU 2022)	Sites electrified through GEAP (AfDB, 2023)	Sites electrified through EREAP (IDA, 2023)	Sites electrified through REM projects (2025)
GBA	-	8	95	25
Basse	208	27	56	43
Farafenni	-	71	95	29
Barra	60	-	51	2
Other	5	1	-	
TOTAL	273	107	297	99

Source: Transmission and Distribution Master Plan and Universal Access Strategy

Figure 9 Electrification Projects to Achieve Universal Access by 2025



Source: Transmission and Distribution Master Plan and Universal Access Strategy

The grid extensions are to be made at the same time as multiple different MV networks are being integrated. As is elaborated in the next section, there is need for a high voltage transmission line to act as an Eastern backbone both to cater for growth in demand in Basse and to support the rapid electrification and universal access projects.

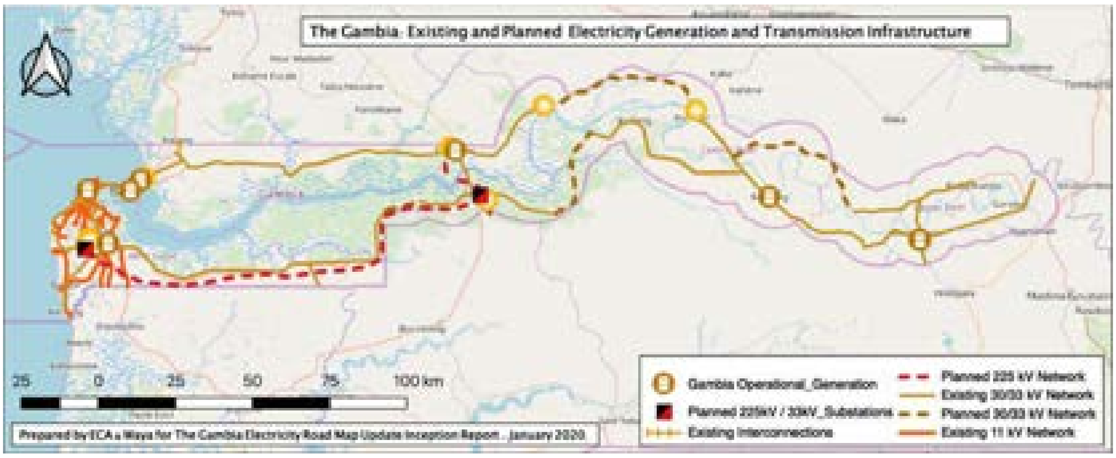
3.2 Transmission Planning

The existing electricity network in The Gambia consists of a number of separate 33 kV and 30 kV systems fed from local power plants throughout the country. On-going projects are developing the transmission grid to interconnect these systems and establish interconnections with neighbouring systems. The main project is the regional **225 kV OMVG[7] grid** (discussed in Section 4.3) which will interconnect The Gambia with Senegal and other countries in the region and constitutes the critical first step in the development of a full transmission grid in the country.

- The interconnection with Senegal will provide a link with a high capacity for power purchases from Senegal and other power providers throughout the region.
- The Soma 225/30 kV substation will connect to the planned 225 kV line running from north to south in the central part of The Gambia. A double circuit 225 kV line will be added from the Soma substation to a new 225/33 kV substation at Brikama. This substation will be integrated with the existing 33 kV system at Brikama and will provide support to the system in Banjul.
- An on-going NAWEC project (started in mid 2021 for completion by the end of 2022) will add a 225 kV line from Brikama to Jabang. This will feed a new, centrally located 225/33 kV substation in Banjul. It is part of a contract which will construct a National Control Centre and SCADA.

The existing and committed networks are shown in the map below.

Figure 10 Existing and Committed Network (main lines only on MV grid)



Source: Demand forecast report

An extension of the transmission network to Bansang and Basse is needed to support load growth in these centres and would also provide supply and voltage support to the extended MV network being developed in the Basse region through the Universal Access Plan. For security of supply in the region and for the 2025 Universal Access targets to be met, this **Eastern transmission backbone** needs to be in service by 2025. To mitigate the risk of delays, there

[7] The Gambia River Basin Development Organisation (OMVG – Organisation pour la Mise en Valeur du Fleuve Gambie).

needs also to be a contingency plan involving local generation being developed to provide adequate capacity and voltage support.

Different voltage levels and configurations have been discussed for the Eastern transmission backbone. An important recommendation from the Roadmap transmission study is that a full feasibility study needs to be conducted as a matter of urgency. This should consider:

- **Alternative voltage levels**: deploying the same voltage as the 225 kV GBA/OMVG system is the obvious option, but 132 kV should also be analysed. Previously a lower voltage has been proposed, but 66 kV is not suitable for the expected level of demand.

- **Alternative configurations**: assuming 225 kV is selected, small 225/30 kV substations at Bansang and Basse will be required. These could be interconnected with Soma, or with Tambacounda, or both, or could be fed from the Tambacounga-Kolda transmission line. The options involving Senegal would provide links for further integration of the power systems in the WAPP region.

- **Contingency plans to ensure Universal Access in 2025**:, if there are delays in developing the Eastern Backbone capacity, voltage support in Basse would need to be provided from local generators. Various options should be considered in the feasibility study, including leasing thermal generators and/or increasing the capacity and adding batteries to the solar PV plants scheduled to be developed in the Eastern part of the country by 2025[8]. Consideration would also need to be given to the design of the PV inverters so that some reactive power support can be provided even when active power output is zero.

Supply to the **Barra region** will also become difficult unless imports via the MV grid from Senegal are continued. Alternatives which also need to be examined by a second (or else combined) feasibility study are:

- Development of a 225 kV link from Senegal in a western corridor may provide an option for a 225/30 kV substation in the area, possibly developed to support both the MV grid in The Gambia and in areas across the border in Senegal.

- Reinforcement of the MV grid from Farafenni or via a cable across the river from Banjul are alternatives that may be considered if the western corridor does not present a viable solution.

Transmission developments in The Gambia should be considered in relation to regional options. To ensure optimal regional development, it is important for there to be coordination of the on-going or proposed regional studies, which include Basse-Tambacounda, Brikama-Ziguinchor and Brikama / Jabang / Kotu-Kaolack.

The detailed analysis and the timing of the transmission developments need to be confirmed through the feasibility studies, but the recommendations at this juncture are to add a 225 kV line from Soma towards Basse and build two new, small 225/30 kV substations in the east – one at

[8] Solar PV projects in the base case of the least cost generation plan are Basse NAMA 6.5 MW by 2022; Bansang 2 MW in 2022 rising to 5 MW by 2026 (this could be targeted earlier if the Eastern Backbone is delayed); N'Joben 5 MW from 2022 and the IDB projects, 3 MW at Njaw and 2 MW at Nyanga Batang, both due in 2025. About 10 MW in total would be needed in Bansang and Basse by 2025 and 10-11 MW in Bansang and 15 MW in Basse by 2030.

Bansang and one at Basse. Furthermore, to increase the reliability of supply in the Banjul area, the second circuit on the 225 kV line from Brikama to Jabang should be added. The expected timing and costs of these projects are summarised in the table below.

Table 12 Transmission Development Plan Investment Cost per year (total $74.3 m)

Project	2024	2025	2028	2029	2030
225 kV Soma – Bansang – Basse	$ 22.8 m	$ 34.3 m	-	-	-
225/30 kV substations in the Barra region	-	-	$ 4.4 m	$ 6.7 m	-
2nd circuit on the 225 kV line Soma – Bansang	-	-	-	-	$ 6.1 m

Source: Technical Reports. Transmission investments to be finalised via detailed feasibility studies.

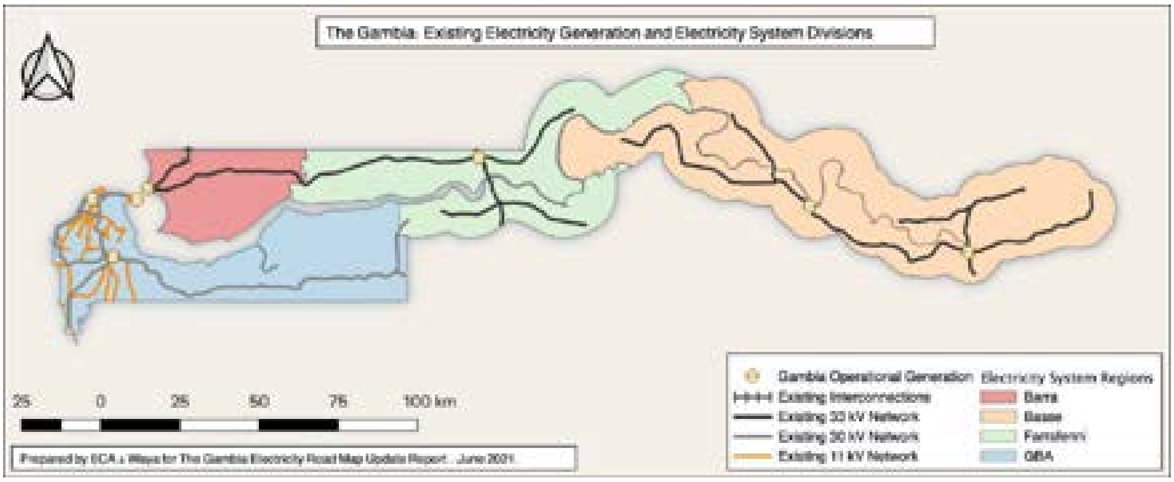
4 New Electricity Supply Options

The electricity system in The Gambia is composed of four individual networks:

- **GBA System -** the GBA is supplied by two large power stations in Kotu and Brikama and has one common transmission and distribution network. It is also currently supplied by rented electricity generators.
- **Three isolated grids (Basse, Barra and Farafenni) in the provinces –** Basse and Farafenni provinces are supplied by NAWEC owned power stations and their respective microgrids. Barra is supplied via an interconnector with Senegal. An interconnector with Senegal also supplies the Farafenni region.

The following map depicts the four systems in The Gambia, the location of the power stations and the existing 33kV, 30kV and 11kV networks. As described in the previous section, transmission linkages will create a unified national network by 2022-23.

Figure 11 Existing Power Plants Map



Source: Least Cost Power Development Plan

As of mid 2021, the total net installed capacity in The Gambia is 154.5 MW of reciprocating engines, but only 97.0 MW are currently available for power generation. Of the reciprocating engines, 67.0 MW of available capacity are NAWEC owned. The remaining 30 MW are rented under a contract with Karpower that was due to expire in 2020 but has been extended for two more years.

In previous electricity master plans for The Gambia, generation options have been essentially limited to investing in domestic generation plants that would use imported liquid fuels, predominantly heavy fuel oil (HFO). The update of the Roadmap represents a major departure in making it possible as candidate generation projects a number of different technologies. A variety of generation options were discussed with NAWEC and key stakeholders as candidate power plants for consideration in the generation plan. The final technologies that were selected as candidates for the least cost generation plan are summarised in the table below.

Table 13 Examination of Candidate Power Plant Options

Candidate options	Operating fuel	Comment
Generic CCGT and OCGT	LNG	*An analysis summarising candidate CCGT and OCGT options operating with LNG is presented in Sections 4.2 and 5.2. Generic CCGT (LNG) candidate power plants were included as candidate options in the analysis with the costs of the gas infrastructure attached to the development of the candidate power plant option.*
Generic OCGT	LFO	*OCGTs (LFO) were excluded from the analysis as they were considered by NAWEC inadequate technologies for The Gambia.*
Generic Biomass	Waste	*The Gambia is considered to have approximately 25 MW of potential biomass capacity with the primary fuel being waste[9]. However, biomass candidate power plants were excluded from the analysis as they were considered by NAWEC inadequate technologies for The Gambia.*
Generic Wind	Wind	*The potential of wind capacity in The Gambia is estimated to be approximately 197 MW with a capacity factor below 20% and 5 MW with a capacity factor higher than 30%[10]. Generic wind farms were included in the least cost planning analysis and were modelled in blocks of 3.6 MW.*
Generic Solar PV	Solar	*The analysis of candidate Solar PV projects was summarised in Section 4.1. The final list of candidate Solar PV projects is shown in Section 5.2. The capacity of Solar PV presented for each project is the maximum available capacity in the identified area. The modelling approach that was followed allows the model to select the least cost capacity that should be developed in each area up to the maximum capacity available.*
Generic battery	n/a	*Two types of batteries were considered as suitable options for The Gambia power system. The analysis focused on Li-on battery systems which can provide peaking capacity for at least 4-6 hours and for batteries ranging from 1-10 MW. The maximum capacity of batteries that could be developed was left unconstrained in the modelling approach.*

Source: Least Cost Power Development Plan

The main new options are solar photovoltaic (PV), natural gas and importation options. The sub-studies on each of these options are briefly summarised in the sub-sections below.

4.1 Solar Photovoltaic[11]

The Gambia has significant solar energy resources which can be deployed via solar PV plants, which have become price competitive with thermal plants and attractive for advancing national renewable energy and greenhouse gas (GHG) reduction targets. IRENA (2018) has estimated national solar potential at 428 MW. The base case of the Roadmap includes 13 solar projects with a total capacity of 250 MW.

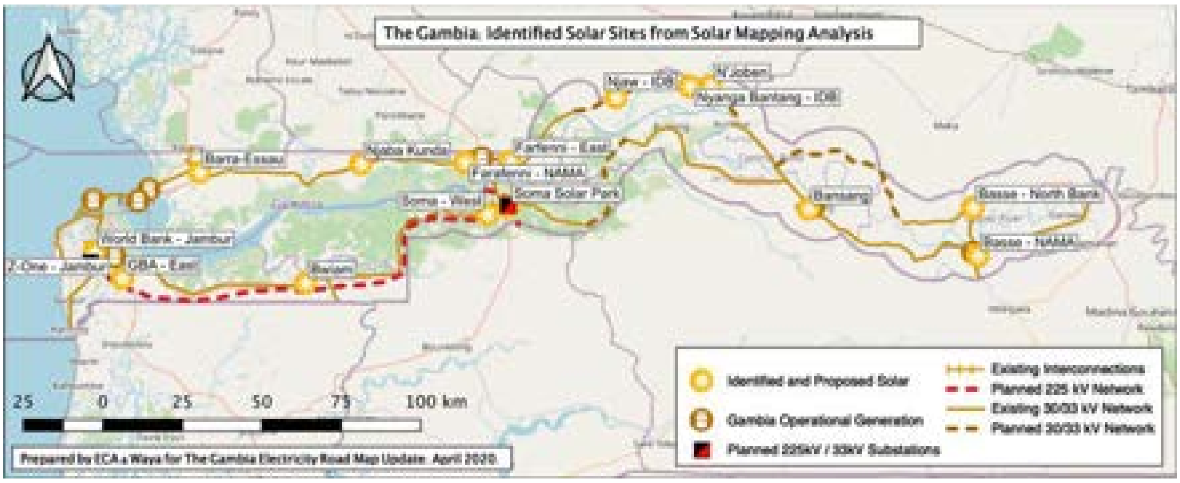
[9] Source: Update of the ECOWAS revised master plan for the development of power generation and transmission of electrical energy Final Report, 2018

[10] Source: Update of the ECOWAS revised master plan for the development of power generation and transmission of electrical energy Final Report, 2018

[11] Details are available in Section 3 of the *Least Cost Power Development Plan.*

The identification of potential sites for solar PV projects started with progressively narrowing the options by considering areas which need to be excluded due to high population densities, environmental sensitivity, protected areas (such as national parks) or unsuitability (steep elevations and slopes). Solar development zones were then grouped and sites ranked using a multi-criteria analysis of key attributes (site location, land-use, generation potential, cost estimates, environmental factors, and other constraints). The costs were based on the levelised cost of energy (LCOE) approach. A total of 16 sites were identified which are shown on the map and in Table 14 below.

Figure 12 Map of Identified and Proposed Solar Sites from Solar Mapping Analysis



Source: NAWEC, ECA, Waya, 2020. Map produced by Waya

Table 14 Solar Generation Sites identified for Generation Planning Analysis

#	Site Name	Potential capacity (MW)	LCOE ($/MWh)	Status	*Comments*
1	Z-One (Jambur)	10	83	On hold	*On hold currently. No expected completion date.*
2	World Bank (Jambur)	20	83	Land Reserved	*Feasibility study completed and procurement process launched.*
3	Solar Park (Soma)	80 + 70	81	Land Identified	*Feasibility study begun in April 2020.*
4	Farafenni Project (NAMA)	4	82	Land Identified	*200 m x 400 m area of land to be developed for solar PV.*
5	Bansang Project	5	81	Land Identified	*Included in past land banking.*
6	Basse Project (NAMA)	6.5	82	Land Identified	*Included in past land banking.*
7a and 7b	Islamic Development Bank	5	81	Land Identified	*5 MW to be split between two nearby sites in Njaw and Nyanga Bantang. This project is designed to relieve some voltage drop in the system.*
8	Bwiam	20	82	NAWEC Proposed Site	*Site selected based on multi-criteria scoring.*
9	Barra/Essau	15-20	82	NAWEC Proposed Site	*Near the Barra generation station. Potentially 15-20 MW available.*

#	Site Name	Potential capacity (MW)	LCOE ($/MWh)	Status	*Comments*
10	Farfenni – East	64.3	82	ECA / Waya Proposed Site	*Site selected based on multi-criteria scoring.*
11	Njaba Kunda	107.7	87	ECA / Waya Proposed Site	*Site selected based on multi-criteria scoring.*
12	N'Joben	5.0	81	ECA / Waya Proposed Site	*Site selected based on multi-criteria scoring.*
13	Soma – West	104.2	82	ECA / Waya Proposed Site	*Site selected based on multi-criteria scoring.*
14	GBA – East	56.2	84	ECA / Waya Proposed Site	*Proposed site in GBA area due to proximity to substation. Site is proposed on the western outer area of the metro area.*
15	Basse – North Bank	22.8	84	ECA / Waya Proposed Site	*Site selected based on multi-criteria scoring.*
	Total	595			

Source: NAWEC, ECA, WB, Waya, 2020. List produced by Waya

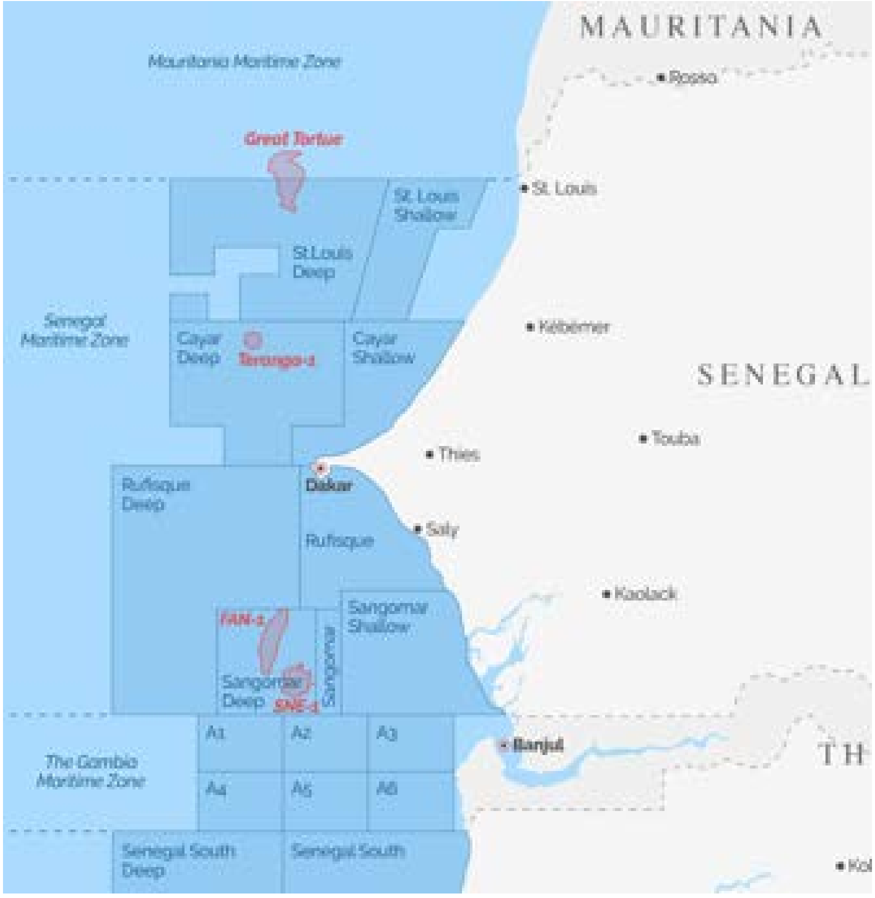
The above candidate options were assessed in the least cost planning simulation to determine which of the above options are part of the least cost generation plan. Of the 16 sites, only Njaba Kunda (#11) and Soma West (#13) were not chosen for inclusion in the least cost plan. The remaining 14 sites were consistently chosen across the different scenarios and these constitute the final list of solar sites for land banking activities.

4.2 Gas to Power[12]

The discovery of significant deposits of natural gas off the coast of The Gambia and Senegal has opened up new opportunities to use natural gas to generate power. Although still a fossil fuel, gas has far lower GHG gas emissions per GWh generated as compared with HFO and diesel. So far the gas that has been found is all in Senegalese waters, but if in future The Gambia secures its own natural gas, there would be the added advantage of using a domestic resource.

[12] Details are available in Section 4 of the *Least Cost Power Development Plan*.

Figure 13 Gambia-Senegal Off-shore Gas Fields



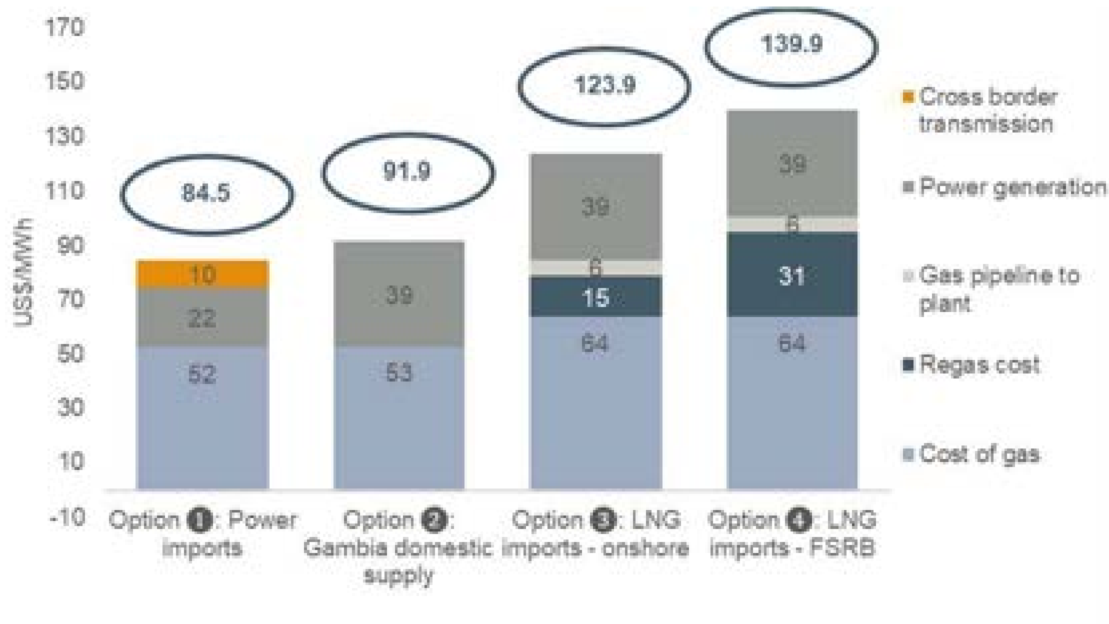
Source: Least Cost Power Development Plan

In the Roadmap process, four possible gas-to-power routes were explored and the LCOE for each option calculated:

- **Option ❶:** Gas-to-power imports from Senegal, specifically a 400 MW CCGT power plant in Senegal (LCOE = 84.5 $/MWh)
- Option ❷: Domestic gas, utilised for domestic a 50 MW CCGT power plant (LCOE = 91.9 $/MWh)
- Option ❸: LNG imports via an onshore LNG regasification terminal, the gas being used for a 50 MW CCGT power plant in The Gambia (LCOE = 123.9 $/MWh)
- Option ❹: LNG imports via a floating LNG regasification terminal, the gas being used for a 50 MW CCGT power plant in The Gambia (LCOE = 139.9 $/MWh)

The LCOEs above are based on assumptions for base load power in 2030 and they show that the preferred gas to power option is imports from a medium sized CCGT plant in Senegal. This conclusion remains robust in sensitivity tests on a range of parameters. The main drivers for the cost differentials that favour Option 1 are (i) economies of scale for larger CCGTs in Senegal, (ii) greater efficiency of larger CCGTs and (ii) no gas or LNG related investment cost.

Figure 14 LCOEs for Gas-to-Power Options



Source: Least Cost Power Development Plan. FSRB = Floating storage and regasification barge

Besides being the least cost option, importation from Senegal is the most flexible option in terms of daily offtake and future unknown developments. It also requires the lowest levels of upfront investments. The option does however rely on Senegalese power generation policy and development, which is a risk.

4.3 Import Options[13]

Deepening regional power sector integration has long been an objective of the Economic Community of West African States (ECOWAS). Working with the West African Power Pool (WAPP), the Gambia River Basin Development Organization (OMVG) and the ECOWAS Regional Electricity Regulatory Authority (ERERA), the completion and synchronisation of the regional grid is now imminent. The interconnectors of relevance to The Gambia are:

- **OMVG network** – to be completed in 2nd half of 2022
  - 225 kV single-circuit line running through The Gambia
  - 350 MVA capacity; likely to become constrained by late 2030s but OMVG Loop- West added in early 2030s
- **CLSG network** (Cote d'Ivoire-Liberia-Sierra Leone-Guinea network which is scheduled to interconnect with OMVG in 2021)

[13] Details are available in Section 5 of the *Least Cost Power Development Plan.*

- Opportunity for The Gambia to import from Cote d'Ivoire and other WAPP countries with low cost generation

The immediate significance of the regional interconnectors is for The Gambia to import electricity, but they also open up the opportunity to export. Given its central location and excellent solar resources, The Gambia has been chosen as the first site for a regional solar PV generation facility (a feasibility study is underway of the 150 MW Soma Park project identified in Section 4.1).

Figure 15 Regional Interconnectors opening Electricity Trade Opportunities

Source: ECOWAS Masterplan 2018

Import options that are treated as committed or candidate options in the least cost generation modelling are as follows[14]:

Kaleta and Souapiti hydropower plants:

- the PPA is signed – this is committed
- 204 GWh is the firm (guaranteed) annual energy available (the amount delivered to The Gambia will be less because of transmission losses)
- This is assumed to be a take-and-pay agreement
- Expected to be commissioned in the second half of 2022
- The price per kWh is 10.7 cents/kWh rising to 15 cents/kWh by 2041
- The energy will be supplied to NAWEC proportional to NAWEC's annual load profile.

[14] Other options considered (128 MW Sambangalou hydro in Senegal, imports from the WAPP short-term market and solar PV in other countries, possibly co-owned by The Gambia) were considered not sufficiently dependable to be treated as candidates at this juncture.

Gas-fired CCGT plant in Senegal:

- This option was shown in the previous sub-section to be the least cost Gas-to-Power option for The Gambia
- Working assumption is that the contractual arrangement would be a power purchase import contract, but a joint venture has also been suggested, with NAWEC investing in dedicated capacity of say 50-100 MW in the short to medium term.
- Available from start of 2024.

Gas-fired CCGT plant in Cote de 'Ivoire:

- Importing power from Cote d'Ivoire is characterised in the same way as for those from Senegal (i.e., similar gas price, the same capital and operating costs and the same heat rates).
- Transmission costs will be higher than imports from Senegal.
- Available from start of 2023.

The main risks associated with the import options are summarised in Table 15 below. In view of import risk, the Government has set a limit of 50% on import capacity. This limit is incorporated in the Base scenario of the least cost plan, but alternative import constraint scenarios are also analysed.

Table 15 Import Risk Matrix

Option	Planning risks	Implementation risks	Operational risks
Kaleta / Souapiti hydro (Guinea)	n/a	n/a	• Timing of commissioning of Souapiti • OMVG transmission capacity (potentially mitigated with terms in transport agreement) • Energy not needed by NAWEC when it is available from EDG • EDG dumping surplus on NAWEC when rains are good and reducing production in other years without penalties
Sambangalou hydro (Senegal)	• Status unknown	• When will a draft PPA be available? At what time of year will the energy be available? • How long will it take to negotiate a PPA? • Will the PPA price be reasonable?	• Timing of commissioning • OMVG transmission capacity (potentially mitigated with terms in transport agreement) • Energy not needed by NAWEC when it is available from Senegal (potentially mitigated with PPA terms)

Option	Planning risks	Implementation risks	Operational risks
Gas-fired power plant (Senegal)	• Will Senegal decide to move ahead with a feasibility study, and when? • Will Senegal or the IPP wish to consider selling some of the output to The Gambia at a price that is acceptable to The Gambia?	• When will a draft PPA be available? • How long will it take to negotiate a PPA? • Will the PPA price be reasonable?	• Gas will be prioritised for alternative uses (LNG) • Grid stability in The Gambia will constrain imports
Power from gas-fired power plants in Cote d'Ivoire via CI Energies	• When will the power be available? • Will there be bottlenecks on the transmission path to The Gambia	• Low risks in relation to the PPA because CI Energies is experienced, and CI Energies should be able to indicate an export price transparently	• CI Energies is experienced at exporting power and it is therefore unlikely to default on PPA obligations • Grid stability in The Gambia will constrain imports

Source: Least Cost Power Development Plan

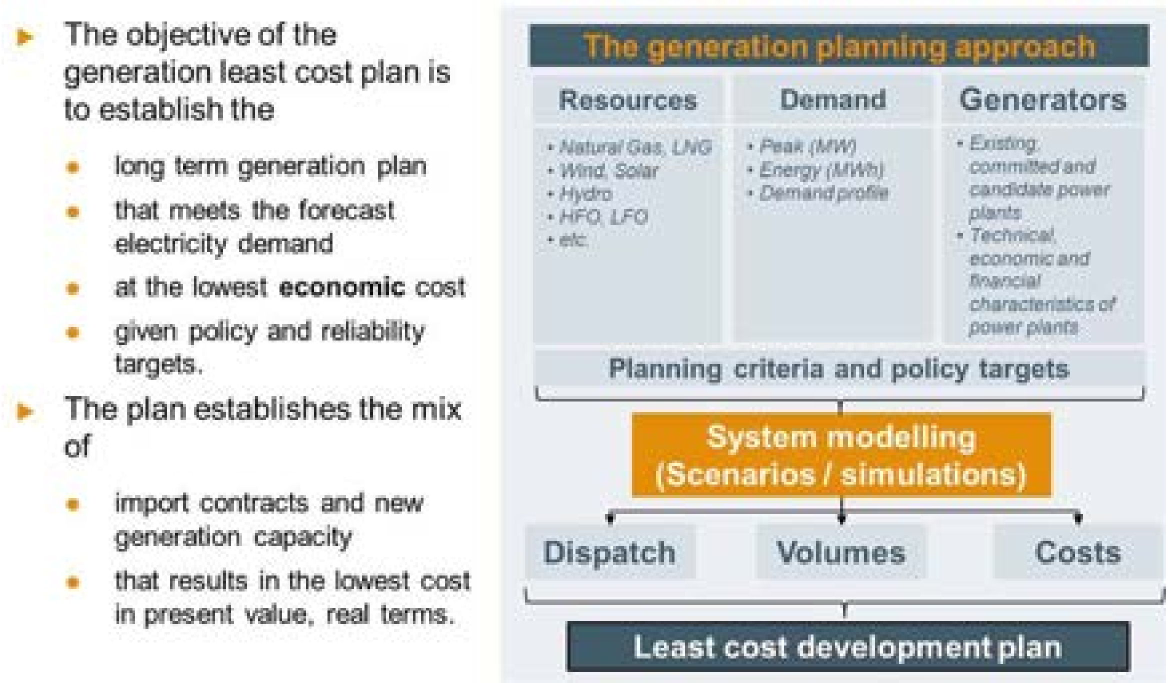
5 Generation Least Cost Plan

5.1 Least Cost Generation Planning

The objective of the generation least cost plan is to establish the long term generation plan that meets the forecast electricity demand at the lowest economic cost, given policy and reliability targets. The plan establishes the mix of import contracts and new generation capacity that results in the lowest cost in present value, real terms. The methodology that is used is illustrated in Figure 16. The least cost planning software used for the current Roadmap update is PLEXOS.

Least-cost generation development plans for any power system are prepared by identifying a set of candidate plants and supply options and assessing the present value of costs (capital, fuel and operating costs) of alternative sequences and combinations of investments that satisfy demand over the planning horizon (to 2040) at a given level of reliability (15% reserve margin).

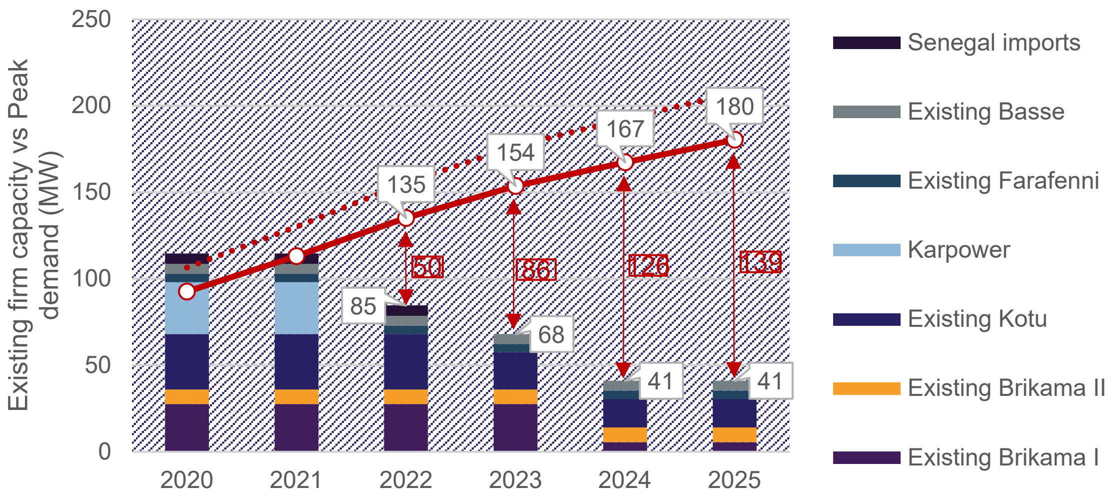
Figure 16 Least Cost Development Plan Methodology



Source: Least Cost Power Development Plan

The Gambia's power sector will soon need additional generation capacity to be able to cover the forecast demand. A gap between available capacity and peak demand is identified from 2022 with the expiration of the Karpower contract and by 2025 nearly 140 MW of new capacity will be needed. This is illustrated in Figure 17 below which compares the forecast peak demand for Universal access in 2025 against the total existing available capacity (after the deduction of scheduled retirement of existing units.

Figure 17 Existing Available Capacity vs 2025 UA Peak Demand



Source: Least Cost Power Development Plan

The addition of committed power plants to the system will provide enough capacity to meet forecast peak demand until 2023. The main risk in relation to the materialisation of committed capacity is the availability of OMVG for the imports from Guinea. The gap between existing (after the deduction of scheduled retirement of existing units) and committed available generation capacity and the forecast peak demand will still be of the order of 100 MW in 2030.

5.2 Existing, Committed and Candidate Power Plants

The following tables summarise the list of existing, committed and candidate power plants that are considered in the least cost planning simulations together with their technical characteristics and assumed costs.

Table 16 Existing and Committed Power Plants

Power plant	Unit	System	Type	Fuel	Installed capacity	Available capacity	Heat rate	Forced Outage Rate	Maintenance Outage rate	Commissioning	Assumed decommissioning	Status
					MW	*MW*	*kJ/kWh*	*% per year*		**Year**		
Existing power plants												
Kotu	1	GBA	ICE	LFO	3.2	0.0	-	-	-	1981	-	*Rehabilitation pending*
Kotu	2	GBA	ICE	LFO	0.0	0.0	-	-	-	1981	-	*Decom-missioned*
Kotu	3	GBA	ICE	HFO	3.4	0.0	-	-	-	1997	-	*Rehabilitation pending*
Kotu	4	GBA	ICE	HFO	6.4	5.5	8,480	11%	11%	2001	2023	*Existing*
Kotu	5	GBA	ICE	HFO	12.1	11.0	8,200	16%	9%	2018	2043	*Existing*
Kotu	6	GBA	ICE	HFO	6.4	5.0	8,505	16%	11%	1989	2023	*Existing*
Kotu	7	GBA	ICE	HFO	6.4	5.0	8,440	7%	11%	2001	2024	*Existing*

Power plant	Unit	System	Type	Fuel	Installed capacity	Available capacity	Heat rate	Forced Outage Rate	Maintenance Outage rate	Commissioning	Assumed decommissioning	Status
					MW	*MW*	*kJ/kWh*	*% per year*		**Year**		
Kotu	8	GBA	ICE	HFO	6.4	5.0	9,200	16%	11%	2018	2030	*Existing*
Kotu	9	GBA	ICE	HFO	0.0	0.0	-	-	-	-	-	*Decommissioned in 2009*
Brikama I	1	GBA	ICE	HFO	6.4	5.5	8,760	16%	11%	2006	2024	*Existing*
Brikama I	2	GBA	ICE	HFO	6.4	0.0	-	-	-	2006	-	*Rehabilitation pending*
Brikama I	3	GBA	ICE	HFO	6.4	5.5	8,760	16%	11%	2006	2024	*Existing*
Brikama I	4	GBA	ICE	HFO	6.4	5.5	9,080	16%	11%	2006	2024	*Existing*
Brikama I	5	GBA	ICE	HFO	6.4	5.5	8,212	16%	11%	2013	2024	*Existing*
Brikama I	6	GBA	ICE	HFO	6.4	0.0	-	-	-	2013	-	*Rehabilitation pending*
Brikama I	7	GBA	ICE	HFO	6.4	5.5	8,760	16%	11%	2018	2030	*Existing*
Brikama II	1	GBA	ICE	HFO	8.9	8.5	7,360	16%	12%	2018	2038	*Existing*
Karpower	1	GBA	ICE	HFO	18.9	15.0	8,800	-	-	2018	2nd half of 2022	*Existing Rented*
Karpower	2	GBA	ICE	HFO	18.9	15.0	8,800	-	-	2018	2nd half of 2022	*Existing Rented*
Farafenni	1	Farafenni	ICE	HFO	4.8	4.8	7,400	7%	15%	2018	2038	*Existing*
Bansang	1	Bansang	ICE	LFO	1.2	0.3	8,610	16%	15%	2018	2038	*Existing*
Basse	1	Basse	ICE	HFO	5.4	5.4	7,400	7%	15%	2016	2036	*Existing*
Total					**147**	**108**						

Source: NAWEC, the 2017 Road Map Update, the World Bank and the 2019 ECOWAS master plan. ECA analysis in consultation with NAWEC and key stakeholders.

Power plant name	Type of power plant	Fuel	Available capacity	Annual generation	Heat rate	FOR	MOR	Earliest year	Decommissioning	Capex	Fixed O&M	Variable O&M
			MW	*GWh*	*kJ/kWh*	*% per yr*	*% per yr*			*$/ kW*	*$/kW/yr*	*$/MWh*
					Committed							
PPA for imports with EDG	Imports	Hydro	40	204	-	-	-	2022	-	-	-	-
Brikima III	ICE	HFO	18.4	-	7,360	16%	12%	2021	2041	1,019	0.007	10.0
Jambur Solar PV WB	Solar PV	Solar	20	32.9	-	-	-	2022	2047	980.5	27.3	0
Jambur Battery WB	Battery	Li-on	6 (6 MWh)	-	-	-	-	2022	3037	1,937	10.7	0.3
ICE 30 MW	ICE	HFO	30	-	9,095	10%	7%	2022	2042	1,019	18.5	10.0

Source: NAWEC, the 2017 Road Map Update, the World Bank and the 2019 ECOWAS master plan. ECA analysis in consultation with NAWEC and key stakeholders.

The list of candidate options was agreed after extensive discussions between NAWEC and key stakeholders. Candidate options that were considered in the analysis include solar PV, gas fired power plants and import options, generic batteries, generic internal combustion engines (HFO) and generic wind farms.

Table 17 List of Candidate Power Plants

Power plant name	Type	Fuel	Available capacity	Heat rate	FOR	MOR	Earliest year available	Decommissioning	Capex	Fixed O&M	Variable O&M
			MW	kJ/kWh	% per yr				$/ kW	$/kW/yr	$/MWh
Candidate											
Soma Solar Park I+II	Solar PV	Solar	80 + 70	-	-	-	2022	2042	981	27.3	0
Farafenni NAMA	Solar PV	Solar	4.0	-	-	-	2022	2042	994	27.3	0
Bansang	Solar PV	Solar	5.0	-	-	-	2023	2043	983	27.4	0
Basse NAMA	Solar PV	Solar	6.0	-	-	-	2022	2042	984	27.3	0
Njaw IDB	Solar PV	Solar	3.0	-	-	-	2022	2042	981	27.3	0
Nyanga Bantang	Solar PV	Solar	2.0	-	-	-	2023	2043	981	27.5	0
Bwiam	Solar PV	Solar	20.0	-	-	-	2023	2043	981	27.3	0
Barra-Essau	Solar PV	Solar	15.0	-	-	-	2023	2043	985	27.3	0
Farfenni East	Solar PV	Solar	64.3	-	-	-	2023	2043	1,002	27.3	0
Njaba Kunda	Solar PV	Solar	107.7	-	-	-	2023	2043	1,077	27.3	0
N'Joben	Solar PV	Solar	5.0	-	-	-	2023	2043	981	27.4	0
Soma West	Solar PV	Solar	104.2	-	-	-	2023	2043	1,000	27.3	0
GBA East	Solar PV	Solar	56.2	-	-	-	2023	2043	1,003	27.3	0
Basse North Bank	Solar PV	Solar	22.8	-	-	-	2023	2043	1,017	27.3	0
CCGT Cote d'Ivoire	Imports	NG	400.0	6,926	8%	4%	2023	2047	866	6.2	5.51
CCGT Senegal	Imports	NG	400.0	6,926	8%	4%	2024	2050	866	6.2	5.51
CCGT Gambia	CCGT	LNG	50.0	6,952	8%	4%	2024	2049	1,484	37.1	6.51
ICE Gambia	ICE	HFO	20.0	9,095	10%	7%	2022	2042	1,019	18.5	6.5
OCGT Gambia	OCGT	LNG	20.0	11,310	8%	2%	2024	2049	890	17.4	4.68
Generic wind	Wind	Wind	3.6	-	-	-	2023	2043	1,364	13	7
Generic battery (4h)	Li-on	-	1 MW (4 MWh)	-	-	-	2022	2037	1,395	efficiency: 87%	
Generic battery (6h)	Li-on	-	1 MW (6 MWh)	-	-	-	2022	2037	2,218	efficiency: 87%	

Source: ECA analysis. Note: Capital costs of Solar PV and Wind are for 2020, model has these reducing over time. Battery costs also decrease. Details are in the *Least Cost Power Development Plan.*

5.3 Fuel Price Forecasts

Another important set of assumptions for the generation modelling is the evolution of fuel prices. The following approach was used:

- **Oil products** – prices for HFO and LFO were linked to the international price of crude oil. The international crude oil price forecast was obtained from the World Bank Commodities Price Forecast.

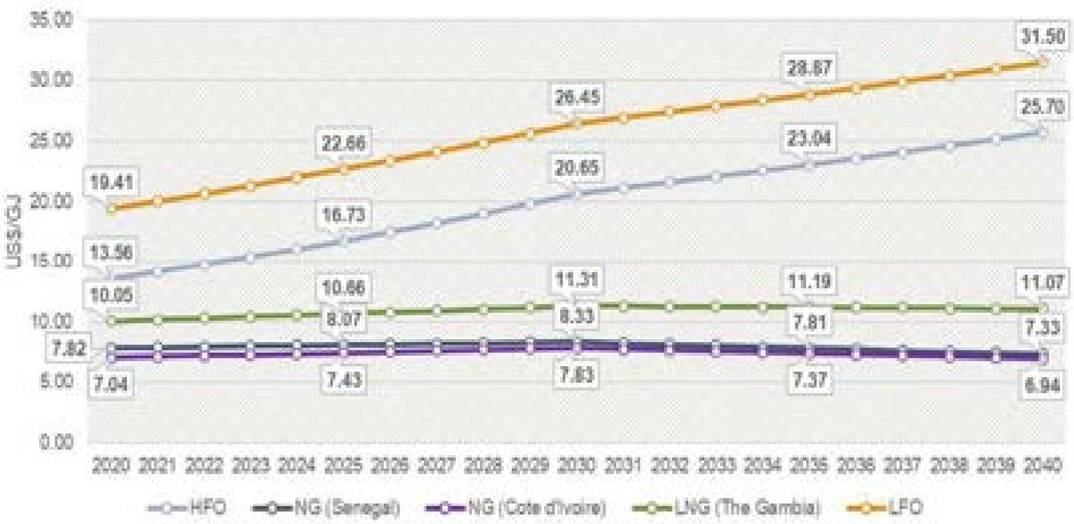
- **Natural gas and LNG** – the World Bank forecasts were adopted. Pipeline costs were added to deliver the gas to the power station.

Figure 18 Base Case Fuel Price Forecasts

Sources: Least Cost Power Development Plan

A high fuel price scenario was also developed. This adopts the high case forecast of the International Energy Agency *2019 World Economic Outlook*. The high case prices are higher than the base case by different percentages (in 2030/2040 11%/0% for natural gas, 26%/30% for oil distillates and 13%/12% for LNG).

Figure 19 High Case Fuel Price Forecasts



Sources: Least Cost Power Development Plan

5.4 Generation Least Cost Plan Scenarios

The least cost plan included policy positions on security of supply and renewable energy targets from the *National Renewable Energy Action Plan*:

- ***Security of supply target*** – Available domestic firm capacity should be at least 50% of the peak demand (energy imports can be more than 50%).

- ***Renewable energy targets*** – Renewable capacity (including imports) should be at least 30% of the total installed capacity (including imports) by 2030. Renewable energy generation (including imports) should be at least 26% of total generation (including imports) by 2030.

Overall, 11 scenarios and 6 sensitivity analysis were simulated to identify the implications of variations in the demand forecast, the risks associated with each candidate option and the impacts from policy decisions. The scenarios are shown below.

Table 18 Generation Least Cost Planning Scenarios

No	Scenario name	Demand scenario	Supply scenario
Scenarios			
1a	**Base case**	COVID-19 updated base case demand	Available domestic capacity able to deliver at least 50% of demand, but energy imports can be more than 50% if lower cost imports are available.
1b	**2025 Universal Access**	Above modified for UA in 2025 (higher demand 2020-25)	Same assumptions as the original base case, but with increased supply needed to deliver UA by 2025. The target for achieving UA in the urban areas remains at 2025, but rural UA is also to be achieved by 2025.
2	**High imports**	COVID-19 updated base case demand	Reduced constraint on domestic capacity to 25% of peak demand, which then allows more low cost imports.
3	**Imports excluding Senegal**	COVID-19 updated base case demand	Imports from Senegal prove to be unavailable or extremely costly.
4	**Delayed imports from Cote de ’Ivoire**	COVID-19 updated base case demand	Imports from Cote de ’Ivoire are available at the same time as imports from Senegal (i.e. 2024, which is two years later than the base case).
5	**CCGT in The Gambia**	COVID-19 updated base case demand	Forcing the building of an economic sized gas-fired CCGT in The Gambia using imported LNG (with the option of using domestic Gambian gas in the future).
6	**Regional-scale solar PV plant in The Gambia**	COVID-19 updated base case demand	Forcing the development of a regional-scale solar PV plant in The Gambia and exporting to the regional market.
7	**Full independence**	COVID-19 updated base case demand	Available domestic capacity able to deliver 100% of demand (peak demand and energy demand).
8	**Unrestricted**	COVID-19 updated base case demand	No restrictions on imports and RES targets.
9	**Delayed imports from Cote de ’Ivoire and Senegal**	COVID-19 updated base case demand	Imports from Cote de ’Ivoire and Senegal are available from 2026.

No	Scenario name	Demand scenario	Supply scenario
10	**Domestic energy >=50%**	COVID-19 updated base case demand	Domestic energy generation should be at least 50% of total generation including imports.
11	**Assumed import costs ($110/MWh)**	COVID-19 updated base case demand	What if cost of imports are higher than expected?
Sensitivity analysis			
1	**High demand**	COVID-19 updated high case demand	Available domestic capacity able to deliver at least 50% of demand, but energy imports can be more than 50% if lower cost imports are available.
2	**Low demand**	COVID-19 updated low case demand	Available domestic capacity able to deliver at least 50% of demand, but energy imports can be more than 50% if lower cost imports are available.
3	**High fuel prices**	COVID-19 updated base case demand	Base case with a high fuel price forecast.
4	**WACC 8%**	COVID-19 updated base case demand	Base case with 8% WACC.
5	**WACC 12%**	COVID-19 updated base case demand	Base case with 12% WACC.
6	**Investment costs**	COVID-19 updated base case demand	Base case with a rapid decrease in battery, wind and Solar PV investment costs.

Source: Least Cost Power Development Plan

The least cost capacity additions for six key scenarios selected by NAWEC are summarised in Table 19 below in five year intervals.

Table 19 Capacity Additions by Scenario

Scenario	Selected MW by scenario by type for the candidate power plants in 5-year intervals																											
	CCGT Cote d'Ivoire				CCGT in Senegal				CCGT in The Gambia (LNG)				ICE (HFO)				Solar PV				Generic Wind				Battery			
	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040
Base	40	0	0	0	60	20	40	40	0	0	0	0	0	0	0	40	54	89	23	84	0	4	0	0	0	40	11	17
2025 universal access	40	0	0	0	60	20	40	40	0	0	0	0	0	0	0	40	61	83	23	82	0	4	0	0	0	40	11	17
Unrestricted	80	0	0	60	20	80	60	0	0	0	0	0	0	0	0	0	13	5	37	15	0	0	0	4	0	0	0	0
Full independence	0	0	0	0	0	0	0	0	100	0	50	50	0	0	0	20	57	86	23	84	0	4	0	0	3	35	0	27
Domestic generation >=50%	40	0	0	0	20	20	60	40	0	50	0	50	0	0	0	0	62	81	71	36	0	4	0	0	0	0	1	7
High import costs ($110/MWh)	0	0	0	0	0	0	40	80	100	0	0	0	0	0	0	0	56	87	23	84	0	4	0	0	3	28	16	18

Source: Least Cost Power Development Plan

The NPV of costs and the average cost of the least cost plan for each scenario are presented in Table 20 below. The 2025 UA total costs are 3% higher than the original base case, but it is notable that the additional energy sent out under 2025 UA results in a slightly lower average cost ($107.8/MWh for 2025 UA vs. $108/MWh for the original base case).

Table 20 Summary Values of the Scenarios

Scenario	NPV Capex	NPV Fixed O&M	NPV variable costs	NPV Wheeling	NPV total costs	NPV Unserved energy	CO2 emissions	Average costs
	(m$)	*(m$)*	*(m$)*	*(m$)*	*(m$)*	*(GWh)*	*(Mt)*	*($/MWh)*
Scenarios								
Unrestricted	212	21	585	104	921	2	10	101.5
High imports (25% domestic capacity)	271	33	577	98	979	2	8	107.8
Base	283	38	591	88	1,000	2	8	108.0
2025 UA base case	287	39	609	91	1,026	2	8	107.8
Delayed imports from Cote de 'Ivoire	283	39	605	78	1,006	2	8	108.1
Force regional-scale Solar PV in the Gambia	310	45	579	83	1,016	2	8	110.1
Imports from Senegal are not available	286	37	573	126	1,022	2	8	110.2
Force CCGT in the Gambia	321	44	608	71	1,045	2	8	115.0
Delayed imports from CdI and Senegal	298	42	659	64	1,063	2	8	115.1
Domestic energy >=50%	338	46	621	57	1,062	2	8	117.2
Assumed import costs ($110/MWh)	331	55	739	19	1,144	2	8	124.4
Full independence	390	60	713	11	1,175	2	8	127.5
Sensitivity analysis								
WACC 8%	353	52	645	106	1,155	2	8	106.3
WACC 12%	230	29	531	78	869	2	8	109.6
Low demand	193	26	461	60	741	1	6	109.0
High demand	341	44	682	116	1,184	3	9	109.3
High fuel prices	293	40	777	102	1,212	2	8	130.9
Investment costs	273	39	590	88	990	2	8	107.1

Source: Least Cost Power Development Plan

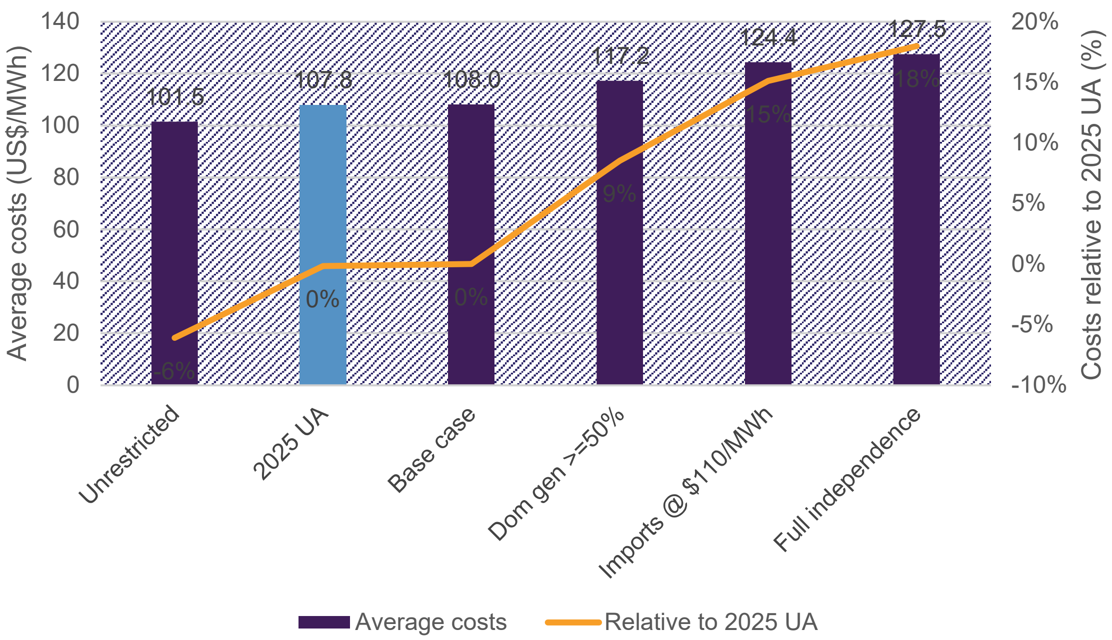
As illustrated by the graphs in Figure 20, there are significant differences between the scenarios. The extreme cases around the 2025 Universal Access and base cases are the unrestricted scenario and the full independence scenario:

- The scenario with the lowest NPV of costs is the **unrestricted scenario** where there are no restrictions on the amount of capacity that has to be developed domestically. In the unrestricted scenario, the model chooses imports and Solar PV as the least cost options to satisfy the demand. The unrestricted scenario has a unit cost that is 6% less that the 2025 UA and base cases.

- When the constraint to develop 50% of capacity domestically is applied in combination with the renewable energy targets, the NPV of costs increase. The least cost option with 50% of capacity available domestically and renewable energy targets is incorporated in both **2025 UA and the base case scenarios**. Higher amounts of Solar PV are selected to satisfy the renewable energy targets and batteries are also selected as least cost options after 2025. In the later years of the analysis ICE are also selected to satisfy the 50% of domestic capacity policy constraint. As noted above the unit costs of the two scenarios is almost the same (~$108.0 per MWh or 10.8 c/kWh).

- The **full independence scenario** quantifies the impact of the Gambia cutting itself off from imports. The resulting unit cost would be 18% above the base case. This provides a measure of the benefits for The Gambia of regional power sector integration. Imports are mainly replaced by domestic CCGT capacity operating with LNG. High import prices (>$110/MWh) would also justify the development of domestic CCGT (LNG) as a least cost option after 2025.

Figure 20 Comparison of Unit Costs of Policy Scenarios

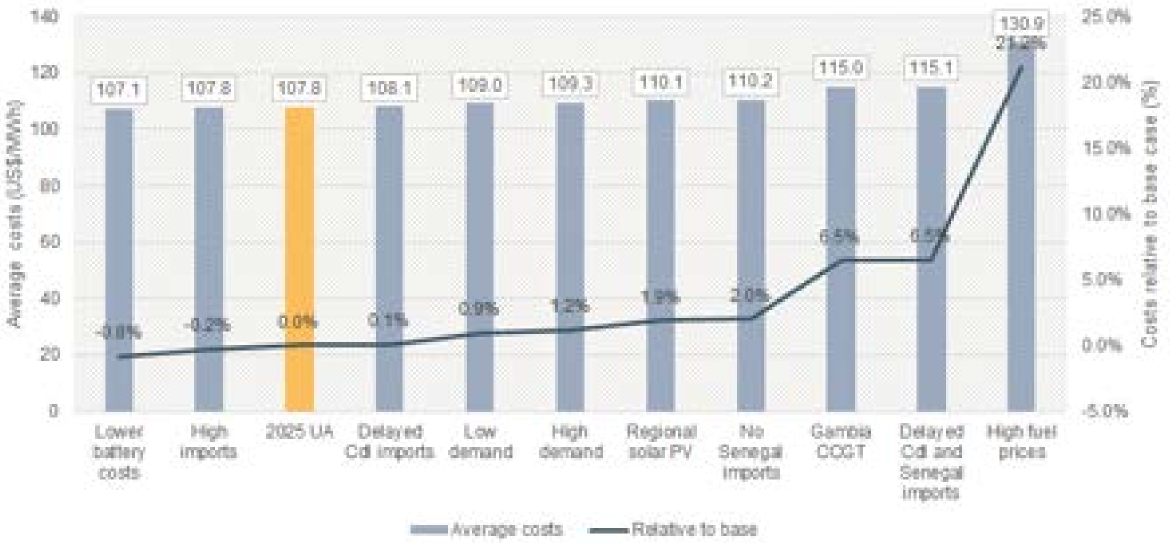


Source: Least Cost Power Development Plan. Unit cost is NPV of total costs divided by NPV of served demand.

The generation planning results provide a clear picture of the centrality of imports for the Roadmap in all scenarios. As illustrated in Figure 20 above, the level of imports has a significant impact on the unit costs of generation (NPV of total costs divided by NPV of served energy). The 2025 UA and base cases incorporate the policy stipulation that domestic ***capacity (MW)*** should be sufficient to deliver at least 50% of peak demand, but imports of ***energy (GWh)*** may exceed this limit if lower cost imports are available.

Figure 21 below is a graphical presentation of the results of the other scenarios. Notable points are as follows:

Figure 21 Comparison of Unit Costs of Sensitivity Scenarios to 2025 Universal Access



Source: Least Cost Power Development Plan.

- The **low and high demand** cases are higher in unit cost terms than the base case.
- The **high fuel costs scenario** significantly increases unit costs by 21%.
- Forcing the development of a **CCGT (LNG) in The Gambia** and the **delayed import scenario** (which results in the development of CCGT (LNG) in The Gambia early on) increase unit costs by 7%.
- Forcing the development of a **regional scale Solar PV** in 2022 increases the unit costs by 2%[15] and the same result is observed in the scenario with **no available imports from Senegal**.
- A **delay in available imports from Cote d 'Ivoire** has a minor impact on unit costs (0.1%) and so does the **high imports scenario** (-0.2%).
- Finally, a steeper decrease in **battery costs** would result in higher amounts of batteries being selected as least cost options in the system and would reduce unit costs by 1%.

[15] The regional solar PV is costly because countervailing export revenues from a facility that is far too large for The Gambia's needs have not been fully factored into the analysis.

5.5 2025 Universal Access Least Cost Generation Investment Plan

The least cost generation investment plan for the 2025 Universal Access central case is summarised in Table 21 below. This incorporates the requirement that domestic capacity should be at least 50% of peak demand and follows the renewable energy targets of the National Renewable Energy Action Plan. The NPV of the investment costs of the 2025 UA case is $287 million, the NPV of fixed O&M costs $39 million, the NPV of variable costs $609 million (in 2020 terms).

Table 21 New Generation Capacity that is Selected for 2025 Universal Access

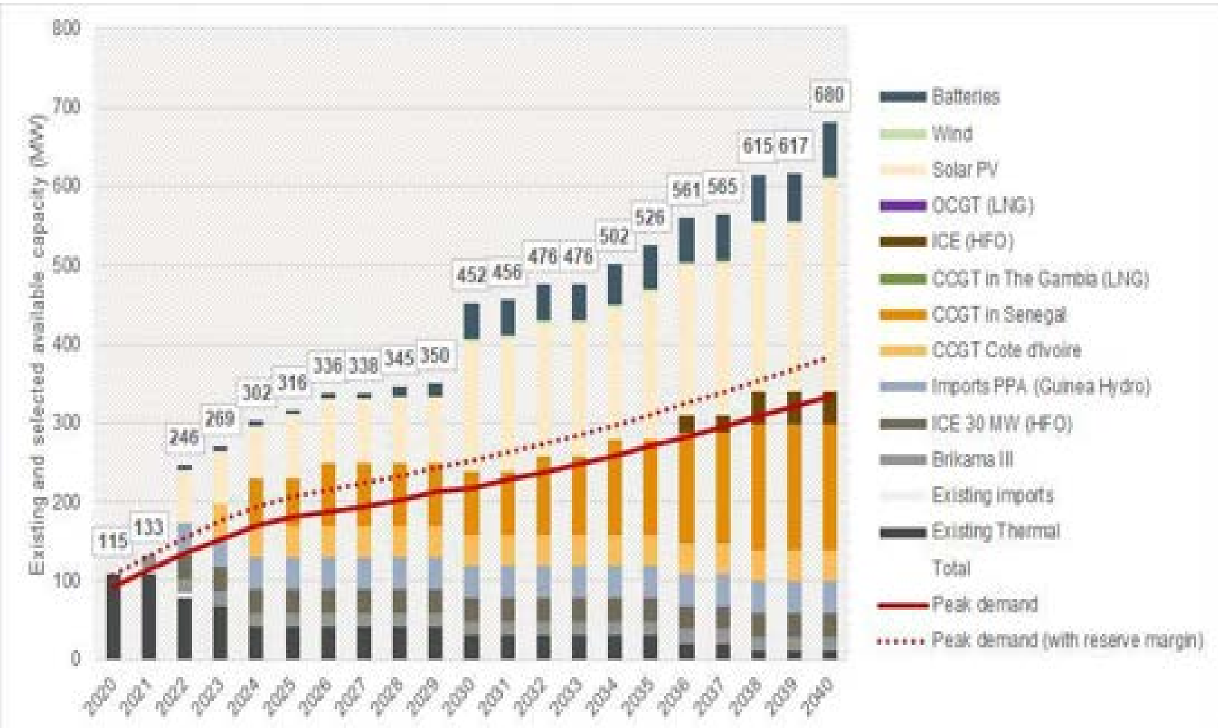
Name	Year commissioned	Capacity (MW)	Overnight capital cost (mUS$)
Brikama III	2021	18.4	18.7
ICE 30 MW (HFO)	2022/23	30	30.6
World Bank - Jambur Solar PV	2022	20	19.9
World Bank Jambur Battery	2022	6	11.6
CCGT Cote d'Ivoire	2023	40	34.6
CCGT in Senegal	2024 2026 2032 2034 2036 2038	60 20 20 20 20 20	52 17.3 17.3 17.3 17.3 17.3
Bansang Solar PV	2022/23 2025	2 3	2 2.6
Barra-Essau Solar PV	2022/23 2025 2028 2031 2035	1 5 3 3 3	1.1 4.6 2.7 2.4 2.1
Basse NAMA Solar PV	2022/23	6	5.9
Basse North Bank Solar PV	2031 2035 2036 2037	1 16 5 1	1.6 23.9 7.5 1.5
Bwiam Solar PV	2022/23	20	19.6
Farafenni - NAMA Solar PV	2025	4	3.6
Farafenni East Solar PV	2040	20	39.7
GBA East Solar PV	2038 2040	19 37	37.1 69.5
Njaw - IDB Solar PV	2022/23	3	2.9
N'Joben Solar PV	2022/23	5	4.9

Name	Year commissioned	Capacity (MW)	Overnight capital cost (mUS$)
Nyanga Bantang Solar PV	2025	2	1.7
Soma Solar Park I+II	2030	80	57.2
Z-One - Jambur	2022/23	10	10.0
Generic Wind	2030	4	4.1
Generic battery 4h	2027	2	2.0
	2028	4	3.8
	2029	5	4.6
	2030	29	25.6
	2034	6	5.0
	2035	5	4.1
	2037	9	7.2
	2039	2	1.5
	2040	6	4.6

Source: Least Cost Power Development Plan

With the selected investments in the 2025 UA case of the least cost plan the total available capacity increases from 115 MW in 2020 to 680 MW in 2040. The main source of energy is imports and domestic Solar PV. The total domestic capacity reduces from 97% in 2020 to 65% in 2040. The renewable energy capacity target is met in 2025 and stays above 30% in all years after 2025. The corresponding RE energy target is met in 2030 and is maintained thereafter. Figure 22 below shows the total available capacity of the 2025 UA least cost plan broken down by technology and compares the total available capacity with the peak demand.

Figure 22 Available Capacity vs Peak Demand – 2025 Universal Access



Source: Least Cost Power Development Plan

Table 22 shows the capacity mix in 2020, 2025, 2030, 2035 and 2040. Domestic thermal comprises all capacity in 2020 but quickly declines to 28% in 2025 and stays at low levels thereafter. It is replaced largely by imports and Solar PV capacity. Capacity from renewable energy technologies grows from 0% in 2020 to 50% of available capacity in 2040.

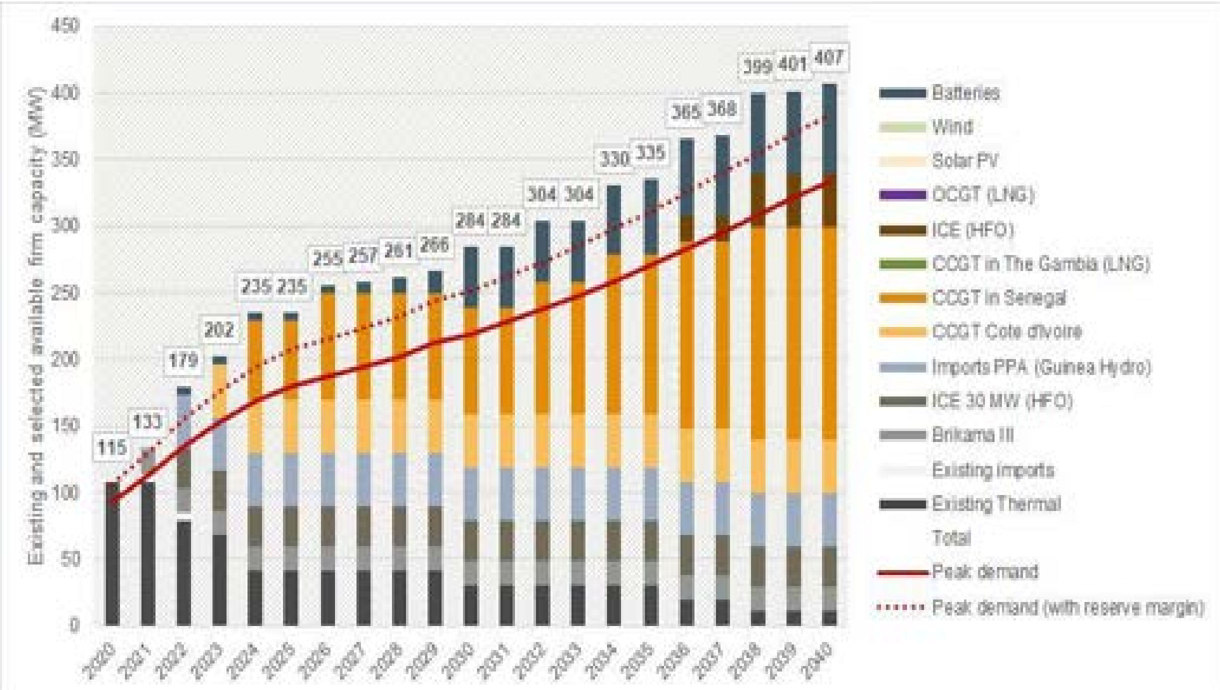
Table 22 Capacity Mix 2020, 2025, 2030, 2035 and 2040 – 2025 UA case

	2020	2025	2030	2035	2040
Domestic thermal	95%	28%	17%	15%	15%
Domestic RES and Batteries	0%	27%	47%	47%	50%
Senegal imports (CCGT)	5%	19%	18%	23%	24%
Cote d'Ivoire imports (CCGT)	0%	13%	9%	8%	6%
Guinea imports (Hydro)	0%	13%	9%	8%	6%
Total (MW)	115	316	452	526	680

Source: Least Cost Power Development Plan

The capacity available at the time of peak demand is compared with the level of peak demand in Figure 23. The reserve margin, including import capacity, is well above 15% in all years. The main difference between the levels of available and firm capacity is that solar PV contributes to available capacity but ***not*** firm capacity, as it does not produce power at times of peak demand.

Figure 23 Available Firm Capacity vs Peak Demand – 2025 Universal Access



Source: Least Cost Power Development Plan

Figure 24 shows the annual average variable costs. Average costs fall from initially high levels of $119/MWh to a lower value of $49/MWh in 2024 as current sources of generation are replaced by cheaper imports and solar generation.

Figure 24 Average Variable Costs – 2025 Universal Access

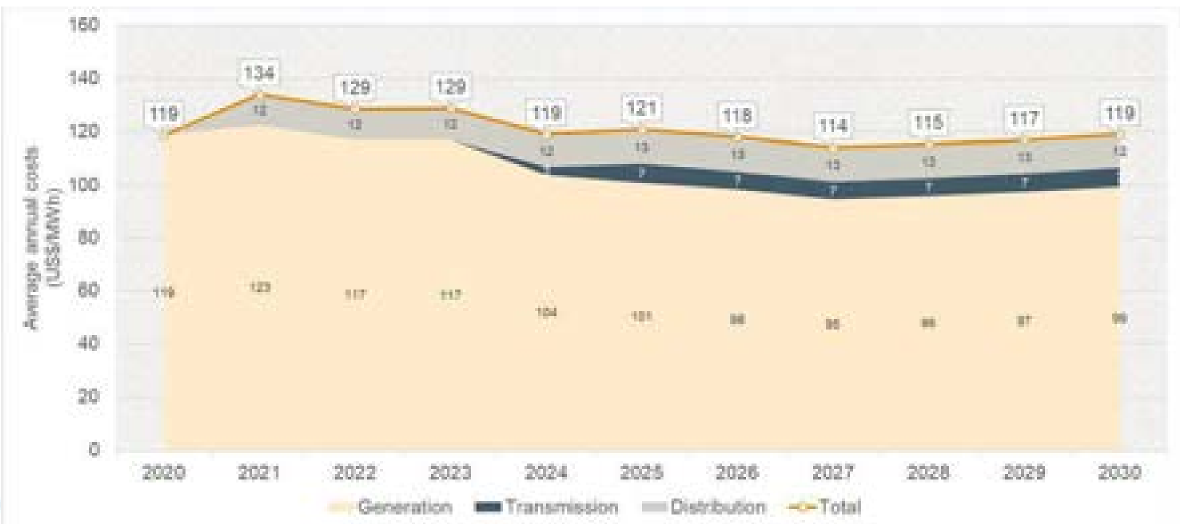
Source: Least Cost Power Development Plan

5.6 Implications for Tariffs

The steep decline over the planning period in average variable costs will in due course translate into welcome tariff reductions for Gambian electricity consumers. A tariff model has been developed for NAWEC, but the full range of data that is required for this is not currently available and it is thus not possible to make an accurate estimate of the potential tariff reductions. However, a levelised cost approach, in which annualised capital costs are added to operational, fuel and maintenance costs, suggests that the total costs by 2030 will be of the order of $120/MWh (12 c/kWh), which in Dalasi is GMD 6,120/MWh or close to GMD 6/kWh.

The graph below shows how the levelised cost is made up. The reduction arises primarily from the decline in generation charges, which more than offsets the higher transmission and distribution charges associated with Universal Access.

Figure 25 Declining Levelised Costs of Generation, Transmission and Distribution



The levelized cost does not include return on assets, existing loan repayments, administrative staff costs and other expenses, so the cost recovery tariff in 2030 would be higher than this. The present cost recovery tariff is approximately GMD 12/kWh and reductions of 20% to GMD 9.6/kWh or 33% to GMD 8/kWh are likely to be possible (the US $ equivalents are present cost recovery level of 23.5 c/kWh reducing to between 18.8 c/kwh and 15.7 c/kWh). This would be an initial reduction and further tariff reductions should follow over the remainder of the Roadmap period to 2040.

5.7 Generation Least Cost Plan Conclusions

The most important conclusion from the generation planning is that **the least cost option for The Gambia is to import electricity from Senegal and/or Cote d'Ivoire**. This conclusion is robust in all scenarios considered. The main risk associated with imports from Senegal is the availability of large CCGTs in the short term and for imports from Cote d'Ivoire the level of the wheeling charge. Imports from Guinea have a role early on, but are hardly utilised after the commissioning of alternative import options due to the PPA's high price.

Solar PVs are a central part of the least cost plan, but they cannot provide peak capacity. At least 70 MW of solar PV is in the category of 'no regret' investments as 70 MW of solar PV is part of the least cost plan in all scenarios. Batteries are selected after 2025 when built costs are expected to reduce. The total installed capacity of batteries varies from 8 MW to 108 MW in all scenarios.

Similar to the import contract with Guinea, the new Brikama III and committed 30 MW ICE plants are important in the short run, but are not utilised after the commissioning of CCGT imports (2023) due to their higher operating costs. Even in the scenario of imports at $110/MWh from Cote d'Ivoire and Senegal, the Brikama III and 30 MW ICE plants are hardly used at all (extremely low capacity factors).

Similar levels of underutilisation are observed even in >=50% energy from domestic sources. Domestic thermal generation capacity is chosen mainly to satisfy the 50% domestic capacity constraint – CCGT (LNG) for base load, ICE (HFO) for peaking. The scenario with import costs at $110/MWh brings CCGT (LNG) into the least cost solution (100 MW in 2025), but at a high cost for The Gambia.

6 Roadmap Directives and Implementation

6.1 Roadmap Directives

Key elements of the Roadmap are the grid extension projects to achieve Universal Access by 2025, domestic investment in solar PV projects and the imperatives of negotiating import arrangements and strengthening the institutional framework:

- **Universal access**: to attain the President's target of achieving universal coverage by 2025 is a major challenge. Concerted efforts are required by all of the agencies and contractors involved.

- **Solar PV**: 70 MW of Solar PV are 'no regret' investments in all scenarios. The role of PV will be enhanced with batteries when their cost becomes competitive (expected after 2030).

- **Import contracts**: PPA negotiations with Senegal and Côte d'Ivoire are to be initiated immediately. Imports from Senegal's CCGT plants should be the least, cost but may not be available in the short term.

- **Institutional strengthening**: the reform process for NAWEC is to be intensified. With the full implementation of the 2019-25 Strategic Development Plan, NAWEC is to become an operationally efficient and financially viable company. The institutional arrangements for the implementation of the Roadmap are discussed in Section 6.3 below.

The import contract negotiations will have to consider the costs of gas-based imports against the costs of the next best alternative for The Gambia over time (e.g. ICE (HFO) or Solar PV + Batteries or CCGT (LNG)).

The PPAs should avoid take-or-pay provisions that force The Gambia to use expensive energy. Where possible PPAs should be structured with capacity and energy components that would allow less costly options to be deployed in the future.

The outcome of the PPA negotiations has a bearing on what priority thermal capacity should be developed in the Gambia. High PPA prices (above ~11c/kWh) would indicate that CCGT using LNG should be developed, a major step for The Gambia which has not deployed this technology before. The familiar technology of ICE generators using HFO would otherwise be indicated.

6.2 Financing Requirements

The main components of the Roadmap that are to be financed are the generation investments, the Universal Access projects and the associated T&D investments. Table 23 provides a summary broken down into 2021-2025 ($526 million) and 2026-2030 ($210 million). The overall total for the period 2020-2030 is $736 million. A large proportion of this is already financed through on-going national and regional projects sponsored by development partners.

Table 23 Financing Requirements Summary for 2020-2030 ($ million)

Item	2020-2025	2026-2030	Total	Source
(1) Generation	$225 m	$125 m	$350 m	Private sector IPPs + NAWEC
(2) On-going Universal Access projects	$92 m	$39 m	$131 m	GERMP, EREAP and GEAP
(3) New Universal Access projects	$66 m	$29 m	$95 m	Donor and government financing
(4) Gambian component of OMVG project	$86 m		$86 m	Donor financing
(5) Transmission projects	$57 m	$17 m	$74 m	NAWEC, donor financing
Total	**$526 m**	**$210 m**	**$736 m**	

Note: Generation and UA project costs are overnight capex (reported elsewhere in this report) plus 3% for design costs etc. GERMP, EREAP and GEAP financing goes beyond UA sub-components of these projects.

6.3 Institutional Structure and Implementation Arrangements[16]

The electricity sector in The Gambia is governed by a **policy framework** that provides incentives, direction and guidance to sector operators through the National Development Plan (NDP) and the National Energy Policy (NEP). The key **legal and regulatory instruments**, include the Electricity Act 2005, the Renewable Energy Act 2013, the National Environment Management Act 1994, the Public Enterprises Act 1990 and the PURA Act 2001, together with their associated regulations. The main institutions are:

- **NAWEC**, a public utility, continues to be the dominant operator providing electricity, water and sewerage services throughout the country.
- **Ministry of Petroleum and Energy (**MoPE) provides overall policy direction and guidance for the sector and issues licenses.
- **Ministry of Finance and Economic Affairs** (MoFEA) makes budgetary provisions for the sector and coordinates donor interventions.
- **Public Utilities Regulatory Authority** (PURA), a multi-sector regulatory agency, regulates the activities of electricity service providers, including tariff guidelines and advises on the issuance of licences.
- **National Environment Agency (**NEA) ensures compliance with environmental standards and regulations.

Other public institutions involved in the electricity sector are the Office of the President (OP), the Ministry of Justice (MoJ), the Ministry of Local Government and lands (MoLGL) and The Gambia Investment and Export Promotion Agency (GIEPA).

[16] Details are available in the *Roadmap Institutional Arrangements Report*

In addition to chronic under-investment, the electricity sector in the past has suffered from weak corporate governance practices, including unfettered government interference in purely operational matters. Several efforts have been initiated to address this weakness, in particular through collaboration with donors like the World Bank, which has to date approved four different projects aimed at enhancing NAWEC's governance, efficiency, creditworthiness and viability: and ultimately attracting more investors into the sector.

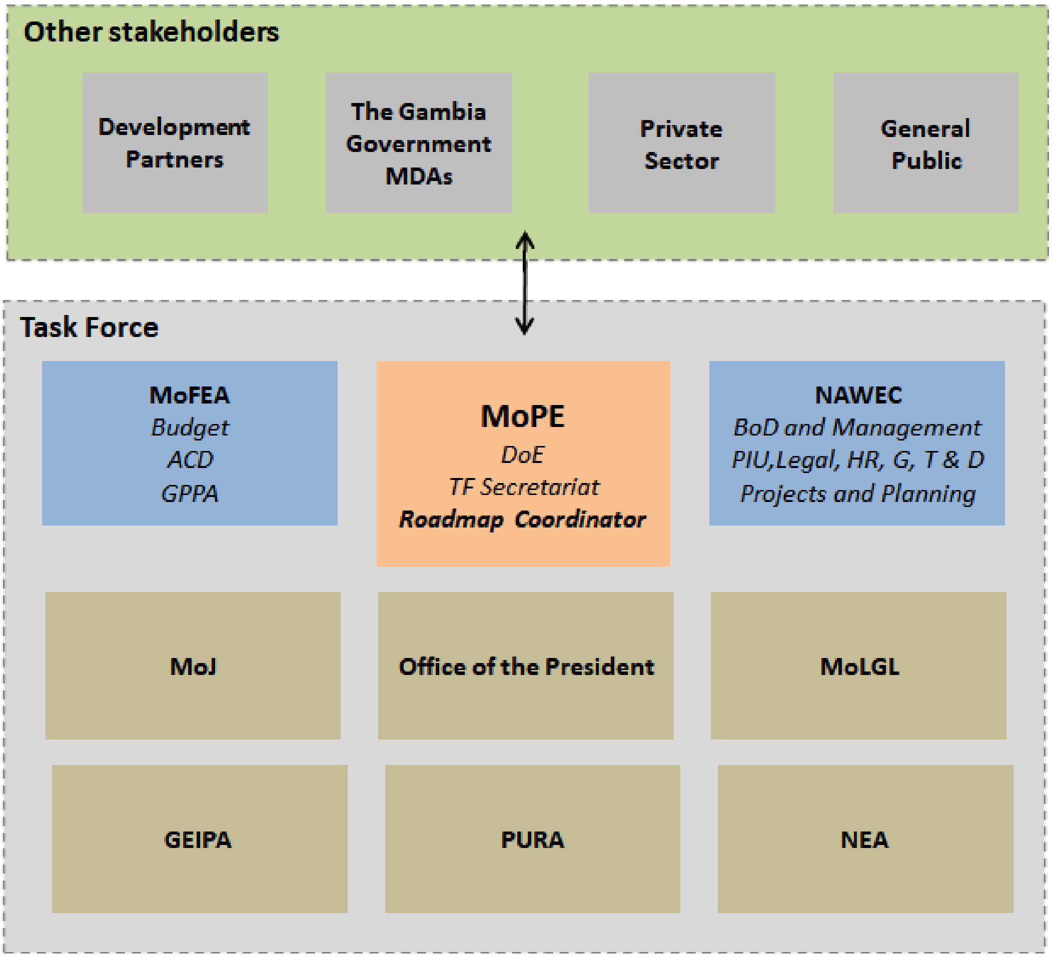
In December 2019, NAWEC signed a **Performance Contract** with Government setting out the agreed range of NAWEC's business profile and responsibilities along with the reciprocal undertakings by Government and NAWEC with regard to each other. It is expected that the full implementation of **NAWEC's 2019-25 Strategic Development Plan** and a pro-active response to the Performance Contract will consolidate the process of NAWEC management meeting the company's objectives, which will in turn have important implications for the electricity sector.

For the coordination and monitoring of the **implementation of the Roadmap** it has been decided that:

- The **Ministry of Energy and Petroleum (MoPE)** will provide strong leadership and will drive the whole process.
- The implementation will be facilitated by the establishment of the **High Level Taskforce,** chaired by MoPE, with the OP, MoFEA, MoJ, MoLGL, NAWEC, PURA, NEA and GIEPA as members.
- The Department of Energy of MoPE, with a dedicated **Roadmap Implementation Coordinator**, will provide the **Secretariat to the Taskforce**: convening meetings; taking minutes, providing briefing notes, and following up on decisions of the Taskforce.

To be successful, the Taskforce needs to have a dedicated membership, with consistency of presence at a senior level. The Task Force members and other important stakeholders are shown in the diagram below.

Figure 26 Institutional Structure for the Implementation of the Roadmap



Two annexes to this report provide summaries of the key tasks and responsibilities in relation to the policy and legal framework (Annex A3.1) as well as envisaged projects (Annex A3.2) required for the implementation of the Roadmap. The Matrices incorporate the **RACI framework,** showing the responsible, accountable, consulted and informed institutions for each task and sub-task. Critical path items are as follows:

- Initiation of electricity **import negotiations** with Senegal and Cote d'Ivoire
- Execution of **transmission feasibility studies**
- Acceleration of **Universal Access** grid connection projects
- Completion of on-going **generation expansion projects** and continuation of preparations for subsequent projects, particularly in solar PV
- Intensification of **institutional strengthening**, particularly through the implementation of NAWEC's 2019-25 Strategic Development Plan.

6.4 The Gambia Leading the Way in Africa

Within the African continent, achieving universal electrification by 2025 will be a significant achievement in which The Gambia will be able to be justifiably proud. To remain on track for this, it is imperative that the structures for implementing the Roadmap are put in place immediately and the critical path items vigorously pursued.

Annexes

A1 References

A1.1 Roadmap Technical Reports

1. Demand Forecast Report
2. Willingness to Pay Survey Report
3. Least Cost Power Development Plan (incorporating sub-reports on Solar mapping, Gas-to-power Options and Import Analysis)
4. Transmission and Distribution Master Plan and Universal Access Strategy
5. NAWEC Financial Model Report
6. Roadmap Institutional Arrangements

A1.2 Other Reference Materials

IRENA (2018): *Planning and prospects for renewable power: WEST AFRICA*. Abu Dhabi.

Government of The Gambia: *National Renewable Energy Action Plan*

NAWEC, Update to the Electricity Sector Roadmap, Final Report, 2017

World Bank, ESMAP, SolarGIS, 2015

INTEC. Feasibility Study for Grid Connected PV, March 2019 (Jambur, Gambia)

ECOWAS Masterplan for the development of regional power generation and transmission infrastructure, 2019-2033, Final Report, Volume 0-5, Tractebel, December 2018

Population and Housing Census in The Gambia, Burke, P. and Csereklyei, Z. (2016), SE4ALL and NAWEC

Lazard's Levelized Cost of Storage Analysis, Lazard and Enovation Partners estimates, 2018

Cost Projections for Utility-Scale Battery Storage, National Renewable Energy Laboratory (NREL) 2018

Battery Capital Cost Projections, Australian Energy Market Operator (AEMO), 2019

European Space Agency, 2016

GBA T&D upgrade feasibility study WB, Tractebel, 2019 - NCC

A2 Detailed Demand Forecast Tables

Table 24 Revised Energy Demand Sent-out Forecast (GWh)

Year	COVID-19 New Low	COVID-19 2025 UA	COVID-19 New High
2019	418	418	418
2020	406	451	504
2021	497	562	617
2022	568	681	746
2023	599	775	814
2024	631	849	888
2025	658	920	964
2026	687	964	1,033
2027	717	1,010	1,107
2028	748	1,058	1,186
2029	780	1,109	1,269
2030	813	1,162	1,358
2031	847	1,223	1,435
2032	882	1,287	1,516
2033	919	1,354	1,602
2034	957	1,424	1,692
2035	996	1,498	1,787
2036	1,037	1,576	1,887
2037	1,080	1,658	1,993
2038	1,124	1,743	2,104
2039	1,169	1,833	2,222
2040	1,217	1,928	2,346
AAG	4.9%	6.7%	7.6%

Source: Demand Forecast Report

Table 25 Peak Demand Forecast (MW)

Year	COVID-19 New Low	COVID-19 2025 UA	COVID-19 New High
2019	80	80	80
2020	84	93	104
2021	98	113	125
2022	110	135	149
2023	115	154	162
2024	121	167	176
2025	126	180	190
2026	130	187	202
2027	135	195	215
2028	140	202	228
2029	145	210	243
2030	151	218	258
2031	156	228	271
2032	162	238	284
2033	167	248	297
2034	173	259	312
2035	179	271	327
2036	186	283	342
2037	192	295	359
2038	199	308	376
2039	205	321	394
2040	211	333	411
AAG	4.3%	5.9%	6.8%

Source: Demand Forecast Report

A3 Implementation Matrices

A3.1 Policy and Legal Framework Enhancement

Main Elements	Action/Activity	Tasks	Sub-tasks	Responsible	Accountable	Consulted	Informed
Policy and Legal Framework	Policy review	Elaborate a new Energy Policy to succeed NEP 2014-2020	Recruit consultant to revise and update NEP if in-house capacity is insufficient	DoE	MoPE	All MDAs, general public, private sector, NGOs, donors	General public
	Sector coordination and resource mobilisation	Strengthen coordination with MoFEA regarding donor interventions in energy sector	Quarterly meetings between DoE (MoPE) and ACD (MoFEA)	DoE	MoPE	N/A	N/A
			Quarterly briefing to Ministers of Energy and Finance	DoE, ACD	PS-MoPE, PS-MoFEA	NAWEC, donors	Minister-MoPE, Minister-MoFEA
			Embark on vigorous resource mobilisation for roadmap implementation	MoPE, MoFEA	PS-MoPE, PS-MoFEA	Donors, private sector, NAWEC	General public
			Conduct annual sector coordination forums	DoE, ACD	PS-MoPE, PS-MoFEA	All MDAs, general public, private sector, NGOs, donors	General public

Main Elements	Action/Activity	Tasks	Sub-tasks	Responsible	Accountable	Consulted	Informed
		1. Build MoPE staff capacity to engage in policy and technical discourse with NAWEC and other operators	Recruit additional staff in DoE (MoPE) if necessary	PMO	MoPE, PMO	MoPE	N/A
			Train DoE staff in power sector planning, investment analysis and decision making, IPP structuring, PPA negotiation, energy efficiency techniques and regulatory compliance	MoPE, PMO, staff	MoPE, PMO	PS-MoPE	Staff
	Driving Roadmap implementation and monitoring	2. Establish Taskforce comprising MoPE as chair, OP, MoFEA, MoJ, MoLGL, NAWEC, PURA, NEA, GEIPA to oversee and report on progress	Ensure high level representation from member institutions	PS-MoPE	PS-MoPE	Heads of member institutions	Minister-MoPE
			Hold quarterly meetings (DoE to provide Secretariat with a dedicated Roadmap Coordinator)	DoE Roadmap Coordinator	PS-MoPE	Taskforce	Minister-MoPE
			Publish quarterly progress reports on roadmap implementation	DoE Roadmap Coordinator	PS-MoPE	Taskforce	Minister-MoPE, Heads of member institutions
			Provide quarterly updates to Cabinet	DoE Roadmap Coordinator	PS-MoPE	Minister-MoPE	Cabinet

Main Elements	Action/Activity	Tasks	Sub-tasks	Responsible	Accountable	Consulted	Informed
			Set up and recruit staff to the Projects and Planning Directorate	NAWEC-M	NAWEC-MD	NAWEC-BoD, NAWEC-HR	N/A
			Strengthen Legal Unit with additional staff	NAWEC-M	NAWEC-MD	NAWEC-HR	N/A
			Set up an environmental unit to liaise with NEA	NAWEC-M	NAWEC-MD	NAWEC-BoD, NAWEC-HR	N/A
		3. Strengthen NAWEC staff capacity	Train staff in power sector planning, investment analysis and decision making, energy efficiency techniques and regulatory compliance	NAWEC-HR	NAWEC-MD	Heads of departments	NAWEC-BoD
			Specialised training in technical and negotiating skills, monitoring and evaluation of regional arrangements	NAWEC-HR	NAWEC-MD	Heads of departments	NAWEC-BoD
	Sector restructuring and promotion of private sector participation	1. Sanitise NAWEC balance sheet (short term)	Pursue and finalise ongoing separation of NAWEC accounts	NAWEC-Finance	NAWEC-M	MoPE, MoFEA	NAWEC-BoD
			Ensure NAWEC viability as a going concern	NAWEC-M	NAWEC-MD, NAWEC-BoD	MoPE, MoFEA, donors	

Main Elements	Action/Activity	Tasks	Sub-tasks	Responsible	Accountable	Consulted	Informed
		2. Unbundle NAWEC services (medium to long term)	Split NAWEC services into 3 entities (electricity, water, sewerage)	MoPE, MoFEA	MoPE, MoFEA	Cabinet	NAWEC, general public
			Hand over sewerage services to municipalities	MoPE, MoFEA	MoPE, MoFEA	Municipalities	General public
			Invite private sector in various forms including IPP	MoPE, MoFEA, GIEPA	MoPE, MoFEA, GIEPA	Private sector	General public
			If privatisation is pursued, float shares to the public	MoFEA	MoFEA	General public	General public
	Review of legal framework	1. Amendment of the Electricity Act 2005	Remove environmental monitoring role from MoPE mandate	MoPE	MoPE	MoJ, NEA, Cabinet, NA	General public
			Clarify MoPE and MoFEA role in restructuring and privatisation of NAWEC	MoPE	MoPE	MoJ, MoFEA, Cabinet, NA	General public
		2. NAWEC legal status	Clarify legal regime governing NAWEC	MoPE, MoFEA	MoPE	MoJ, NAWEC	General public

A3.2 Projects Implementation

Main Elements	Action / Activity	Tasks	Sub-tasks	Responsible	Accountable	Consulted	Informed
Overall coordination of Roadmap activities	Implementation responsibility coordinated by a **Secretariat** in DOE with full time **Roadmap Coordinator**	Initiation, coordination of donor projects and national initiatives, monitoring and reporting	Public information	MoPE	MoPE, Office of the President	MoFEA, MoJ, MoLGL, NAWEC, PURA, NEA, GEIPA	General public
Financing	Secure resources for all activities in the roadmap not yet fully financed	Present applications for financing to potential financers	Identify different financing sources for different activities; prepare applications	DoE, ACD	MoFEA, MoPE	Donor community, banks etc	NAWEC
Generation Projects	Procurement of IPP generation projects	Feasibility study		DoE	MoPE	NAWEC	Prospective IPP investors
		Qualification of bidders	RFQ	DoE	MoPE	NAWEC	Prospective IPP investors
		Tender package	RFP	DoE	MoPE	NAWEC	Shortlisted IPP investors
			Draft Implementation Agreement	DoE	MoPE	NAWEC	
			Draft PPA	NAWEC Legal	NAWEC Management	MoPE	
			Draft ICA				
			Draft TSA if applicable				
			Draft Land Access and Community Engagement Agreement	DoE	MoPE	MLRG	
			Draft Environmental and Social Plan	DoE	MoPE	NEA	

Main Elements	Action / Activity	Tasks	Sub-tasks	Responsible	Accountable	Consulted	Informed
		Selection of IPP	Finalised and signed versions of above	DoE	MoPE	NAWEC	Selected IPP
		Foreign IPP	Work permits for expat staff	GID	MoPE	GIEPA	MoPE
		Licensing	Generation licence	PURA	MoPE	NAWEC, MoPE	
			Construction licence	DPPH	MoPE	NAWEC	MoPE
		Construction stage	RFP for EPC	Process managed by IPP		MoPE, PURA	Prospective EPC contractors
			Contracting EPC				
			Supervision of EPC				
		Interconnection and commissioning	Interconnection	NAWEC, IPP	NAWEC	MoPE, PURA	MLRG
			Testing & commissioning	Equipment supplier, IPP	NAWEC	MoPE, PURA	
		Monitoring and reporting		PURA	PURA	NAWEC	MoPE
	Procurement of NAWEC generation projects	Licensing	Generation license	PURA	MoPE	NAWEC, MoPE	
			Construction licence	DPPH	MoPE	NAWEC	MoPE
		Construction phase	RFP for EPC	NAWEC Projects & Planning	NAWEC Management	MoPE, PURA	Prospective EPC contractors
			Contracting EPC				
			Supervision of EPC				
		Interconnection and commissioning	Interconnection	NAWEC, IPP	NAWEC	MoPE, PURA	MLRG
			Testing & commissioning	Equipment supplier, IPP	NAWEC	MoPE, PURA	
		Monitoring and reporting		PURA	PURA	NAWEC	MoPE

Main Elements	Action / Activity	Tasks	Sub-tasks	Responsible	Accountable	Consulted	Informed
Import and Export Contracts	Guinea, Senegal, Cote d'Ivoire and other ECOWAS members	Identify import and export opportunities	Negotiate PPAs	NAWEC Management & Legal Dept, MoPE, MoJ	NAWEC	MoFEA	PURA
		Monitoring and reporting		NAWEC	MoPE	MoFEA	PURA
Transmission projects	Procurement of NAWEC transmission projects	Licensing	Construction licence	DPPH	NAWEC	MoPE	
		Construction phase	RFP for EPC	NAWEC Projects & Planning	NAWEC Management	MoPE, PURA	Prospective EPC contractors
			Contracting EPC				
			Supervision of EPC				
		Interconnection and commissioning	Interconnection	NAWEC, IPP	NAWEC	MoPE, PURA	MLRG
			Testing & commissioning	Equipment supplier, IPP	NAWEC	MoPE, PURA	
		Monitoring and reporting		PURA	PURA	NAWEC	MoPE
Distribution / on-grid electrification projects	Implementation of existing donor projects	Gambia Electricity Restoration and Modernisation Project (GERMP - IDA, EIB, EU)		PIU	NAWEC Management	MoPE, MLRG, MoFEA, donors	Local communities
		The Gambia Electricity Access Project (GEAP - AfDB)					
		ECOWAS Regional Electricity Access Project (EREAP - IDA)					
	Grid extension and densification projects identified in Universal Access Strategy	Contracting of the already pre-qualified local contractors, plus deployment of additional contractors if needed using the above framework for NAWEC projects		NAWEC Projects & Planning	NAWEC Management	MoPE, MLRG	Local communities

Strategic Electricity Roadmap 2021-2040