ISSN: 2755-0214

Journal of Economics & Management Research

SCIENTIFIC Research and Community

Review Article

Open Access

Demand Side Management and Its Impact on the Gambia Energy Sector

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ABSTRACT

Demand Side Management (DSM) in electricity market is a tool that can improved energy efficiency as well as achieve socio-economic and environmental targets through controlled consumption. For the past two decade or more, DSM programs have registered significant results for many countries. However, detailed analysis of its real impact as observed by a large number of pilot studies suggest that such programs need to be fine-tuned to suit clearly identified energy mix conditions in different countries. This article aims to provide recommendations for the policy instruments to be used for prompt demand response with a view to maximizing energy and environmental efficiencies of The Gambia. This article suggests a DSM pilot model program that can be used in the generation mix of the country. Beside the natural increase electricity access benefits from IPPs and cross border interconnection, DSM's fully implementation will improve the flexibility and reliability of the Gambia energy system. In recent years, we show fast increase demand for electricity access but a slow response in meeting generation capacity, simple DSM tools can be used to solve this ordeal.

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Received: June 09, 2021; **Accepted:** June 17, 2021; **Published:** June 20, 2021

Keywords: Demand Side Management, Energy Efficiency, Demand Side Pilot Programs, Energy Policy

Introduction

The energy systems of many developing countries today like the Gambia are facing the interrelated challenges of energy poverty, energy insecurity and energy inefficiency. Many of these countries have now adapted energy efficiency measures as one of the means of achieving their set energy targets as well as alleviating interrelated energy challenges of their respective countries. The Energy access target strategy of the Gambia through 2030 pronounces a need for a shift from the old monopoly of power generation to a modern efficient smart liberalize energy generation that is centered on advance technological innovations. The new Electricity Roadmap document points out that attaining the goal necessitates investing some 289 million dollars in the energy sector in the next 15 years on power generation. Most of this investment is expected to come from the private sector, with Independent Power Producers (IPPs) and cross boarder imports being the governments preferred choice for future generation expansion [1].

Meanwhile, one of the innovative solutions to a highly increase access, efficiency and investment in the electrical power industry has been used in several countries abroad but due consideration is not given to it in the Gambia is Demand Side Management, or DMS. DSM is a mechanism in which a utility or some other state-designated entity uses funds derived from the electrical system to promote energy efficiency through targeted educational or incentive programs whose effects are measured quantitatively. Demand Side Management is an important mechanism that can complement and extend government, private sector as well as international assistance efforts to help electricity end users capture the full range of efficiency opportunities available today in Gambia in addition to induce the development of next-generation energy efficiency measures [2-4].

Although DSM programs in a number of countries have faltered in the wake of electric utility restructuring, new approaches to financing, administering DSM and incorporating demand-side resources into competitive markets are facing considerable challenges. A number of barriers stand in the way of implementing effective DSM programs in many countries and most of these barriers are not very much different from one country to another [2,3].

Literature Review

Energy Efficiency

The utmost effective tool and program of energy efficiency application in the most countries today is Demand Side Management. The application of Demand-Side Management (DSM) is a proactive method of economic interaction between energy supply and consumption that ensure mutually beneficial modification of the quantity and patterns of electricity consumption. The concept of Demand-Side Management emerged in the early 1970s in the USA and has been successfully adopted in over 30 countries today. Therefore, DMS is essentially a systematic utility activity that influences the quantity, timing and patterns of

electricity use in a service area or a country [2,3].

Furthermore, Demand Side Management also refers to a mechanism in which a utility corporation or some other government-designated entity uses ratepayer funds to promote energy efficiency through targeted educational or incentive programs, the effects of which are measured quantitatively. In addition, DSM programs are designed to reduce the market barriers that prevent consumers from taking advantage of energy efficiency opportunities such as lack of information and limited investment capital [3].

DSM energy efficiency programs can be applied in a variety of ways such as providing financial incentives to end-users to modify energy use or change end-use equipment (e.g. switching to more efficient light bulbs or refrigerators), entering into energy efficiency performance contracts and other third-party initiatives, educating end-users on available efficiency opportunities and developing suppliers or end-use energy products and services by Energy Service Companies or ESCOs [5].

Demand Side Management and Its Benefit

More than 30 countries around the world today have successfully applied DSM to increase energy savings, reduce the need for new power plants, improve economy and reliability in power network operation, control tariff escalation, lower customer electric expenses, save energy resources, and improve environmental quality. Therefore, DSM has become an important strategy for achieving sustainable energy as well as electricity development. Applications of DSM programs differ in each country according to local conditions [2,3]. This shows the dynamic nature of DSM, it is implemented mostly on the bases of a country's energy situation.

In addition, investing in DSM energy efficiency is often cheaper, cleaner, safer, faster, reliable and more secure than investing in new supply. Besides reducing the need to construct new generation, transmission and distribution facilities, improving efficiency also reduces maintenance and equipment replacement costs, as many efficient industrial technologies have longer lifetimes than their less efficient counterparts. Likewise, relying on efficiency also avoids a number of costly risks associated with generation such as lack of demand, cost overruns, interest rate risk, volatile fuel cost, technological obsolescence and catastrophic failure, political as well as national security risk. For example DSM energy efficiency measures help China to address some key energy challenges by providing a number of reliability benefits such as reducing load, wear and maintenance needs on the entire generation, transmission and distribution chain plus reducing demand for generation fuels across both peak and nonpeak hours, thus improving fuel availability in general [2-5].

Additionally, DSM energy efficiency program can come online much faster than expanding energy supply without any problems of surplus or shortage. Retrofitting motors and pumps, adding installation to buildings or even changing a light bulb takes much less time than constructing a new power plant [6]. Moreover, as earlier mention in the literature, Demand Response (DR) can yield significant economic and environmental gains. DR economic gains are linked with the decrease in peak load prices with lower price volatility and consequently with the reduction of the risk borne by the energy actors. For example, reducing the American annual peak load by 5% would allow between $5- $10 billion benefits per year, corresponding to the short term drop of wholesale market's energy prices [4].

Implementation of DSM Programs

Demand-Side Management (DSM) refers to measure's sponsors funding and/or implemented by utilities corporation that modify end-use electrical energy consumption, either reducing overall consumption through energy efficiency or using load management to reduce demand at times when the cost of reducing demand is less than the cost of servicing it. Cost-effective efficiency and load management measures could significantly improve the reliability of a country's electric system and close the gap between supply and demand whiles lowering the economic and environmental cost of electric service [6].

Load management programs involve reducing load on a utility's system during periods of peak power consumption or allowing customers to reduce electricity use in response to price signals. Such programs use mechanisms like interruptible load tariffs, time-of-use rates, real-time pricing, direct load control and voluntary demand response programs. Load management programs can be effective in reducing peak demand, which in turn helps to reduce utility construction costs as well as lower electric rates. Yet load management programs are largely short-term responses that alone do not exhaust the cost-effective demand-side potential. The multiple long-term benefits that investments in energy efficiency can bring to the entire electric system are often overlooked [2,3].

The application of Cost-effective energy efficiency can help reduce market barriers that prevent consumers from taking advantage of energy efficiency opportunities such as lack of information and limited investment capital. DSM energy efficiency programs can also be executed in a variety of ways comprising of providing financial incentives to end-users to modify energy use or change end-use equipment (e.g. switching to more efficient light bulbs or refrigerators); entering into energy efficiency performance contracts and other third-party initiatives; educating end-users on available efficiency opportunities; and developing suppliers or end-use energy products and services by energy service companies or ESCOs [2,3,7]. Therefore, the amalgamation of load management programs with end-use energy efficiency programs can heighten the effectiveness of both approaches in addition to greater demand reductions [3].

Energy Efficiency Plan Measures in the Gambia

The Electricity Roadmap policy document by Ministry of Petroleum and Energy the Gambia underlined that National Water and Electricity Company (NAWEC) plus other relevant stakeholders will implement energy efficiency measures in public building areas in the Gambia. This is an emergency measure that include replacement of 5,000 street lamps in government offices with LED bulbs. The current lamps are 250W (less than 1000 are 400W) incandescent and run approximately from 7pm to 7am daily. The LED bulbs are approximately 100W and could reduce electricity demand by 1-2 MW during the night. This emergency measure will be supplemented by a communication campaign. NAWEC and the local councils will jointly implement the LED street laps replacement. In addition, the medium term measures (4-6 months) include reducing commercial losses through meter reading improvement. Smart meters will be distributed for 300 large customers as part of GESP. Furthermore, 13,000 additional prepayment meters will be deployed to residential customers. Currently, about 85 percent of GBA consumers will be provided with prepayment meters while the long term includes limiting the A/C temperature in government buildings to 25C [8].

International Experience with DMS

According to the literature, DSM energy efficiency programs evolved in the United States during the 1980s primarily as utility demand-side resource investments. Regulators considered efficiency investments as an integral part of a utility's overall resource portfolios and required these investments when they lowered cost as compared to utility supply-side resources, a process known as integrated resource planning, or IRP. Utilities designed and implement energy efficiency programs for their customers, while regulators determined how to measure cost effectiveness, approved budgets, verified results in many jurisdictions, provided regulatory incentives designed to align utility financial motives with ratepayer interest in achieving cost-effective efficiency investment, thus avoiding more expensive supply-side alternatives [9].

The literature further alluded that, today more than 30 countries around the world have successfully applied DSM to increase energy savings, reduce the need for new power plants, improve economy and reliability in power network operation, control tariff escalation, lower customer electric expenses, save energy resources and improve environmental quality. DSM has become an important strategy for achieving sustainable energy and electricity development. Specific applications differ in each country according to local conditions.

As point out by DMS programs is experienced in both developed and developing countries [2-5,10]. Some key examples in Asia include China, Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand, Sri Lanka and Vietnam. North and South American countries with DSM experience comprises of USA, Argentina, Brazil, Mexico and Peru. In the meantime, the literature deliberates the experiences of United Kingdom, Belgium, Denmark, France, Greece Ireland, Italy, Sweden, Netherlands, Norway and Spain as European Union countries who implement DSM policies and tools. Meanwhile Australia and New Zealand have also implemented DSM programs.

Barriers of Demand Side Management Implementation

A number of barriers stand in the way of implementing effective energy efficiency measures in countries. These barriers are similar to those of countries with earlier DSM experience. The summary of these barriers are a traditional rate design that provides a built-in disincentive to utility DSM programs; lack of a sustainable mechanism to generate necessary funding for DSM programs and absence of positive incentives that would motivate utilities to maximize energy savings. Despite the restructures of electric power industry in most countries today, DSM experience still have valuable opportunities to take advantage of lessons learned (both positive and negative) in their counterpart DSM experience countries. This will help harness full benefits of demand-side resources in a manner that will suit their countries particular circumstances as well as fulfill national energy goals [2-5].

Energy Market Structure of the Gambia

The key stakeholders of the Gambian electricity sector are National Water and Electricity Utility (NAWEC), the Public Utilities Regulatory Authority (PURA), the Ministry of Petroleum and Energy (MoPE). Electricity water and sewerage services in The Gambia are provided by NAWEC, a vertically integrated public utility corporation that handles generation, transmission and distribution of electricity as well as water production and distribution in addition to sewerage. The MoPE is responsible for the implementation of Government policy in relation to electricity supply and distribution [11].

The total installed electricity capacity of The Gambia is just over 100 megawatts (MW) with actual generation level at approximately 50MW and excess demand level at 50 MW. Nationwide, about 42 percent of Gambians have access to electricity, leaving significant room for growth in the energy market to bolster economic activity throughout the country. The National Water and Electricity Company (NAWEC) manage the supply and distribution of electricity in The Gambia. Transmission and distribution remains the exclusive domain of the government and is also where the largest challenges lie. In the rural areas only 13 percent of the population has access to electricity, whereas 71 percent of urban dwellers have access to electricity. The Electricity Act of 2004 partially liberalized the energy market, essentially opening up electricity generation to Independent Power Producers (IPPs). Currently, there are two independent power producers (IPP) operating in the Gambia, supplying approximately half of the power generated in the country besides the cross boarder -interconnection from Senegal [8].

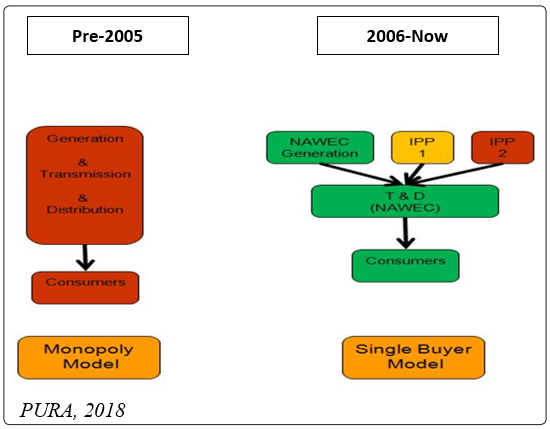


Figure 1: Shift in Electricity Generation, Transmission and Distribution in the Gambia

The best future opportunity for investors is the liberalized electricity generation segment. The Gambia needs to significantly increase electricity generation to meet the projected energy demand in the country. This demand is increasing due to several factors including a rising urbanization rate (60 percent). The main challenge in electricity generation is transmission bottlenecks that would persist as well as hamper transmission and distribution even if extra generation occurs [8].

Following an extensive review, tariffs in The Gambia were increased by 17% in 2017. At present, consumers pay the highest electricity tariffs in the West Africa region at USD 0.28/kWh (table 4). This situation can be explained partly by the country's reliance on imported fossil fuel for electricity generation as well as its poor transmission and distribution infrastructure. Electricity generation and transmission cost are passed onto consumers resulting in high tariffs [12].

Nevertheless, tariffs are not reflective of costs and the utility has been experiencing major financial difficulties. Resources allocated to cover operation and maintenance costs are inadequate. The typical distance of villages from the grid in The Gambia is 5-25 km. The cost of transmission lines to connect these communities with low electricity demand to the grid could amount to USD50 000-100 000/km. While this is a financial liability for the utility it opens a window of opportunity for decentralized generation through Public Private Arrangement or Public Private Partnership with IPPs [14]. Comparison of tariff affordability in select West African countries is highlighted in table 1 below:

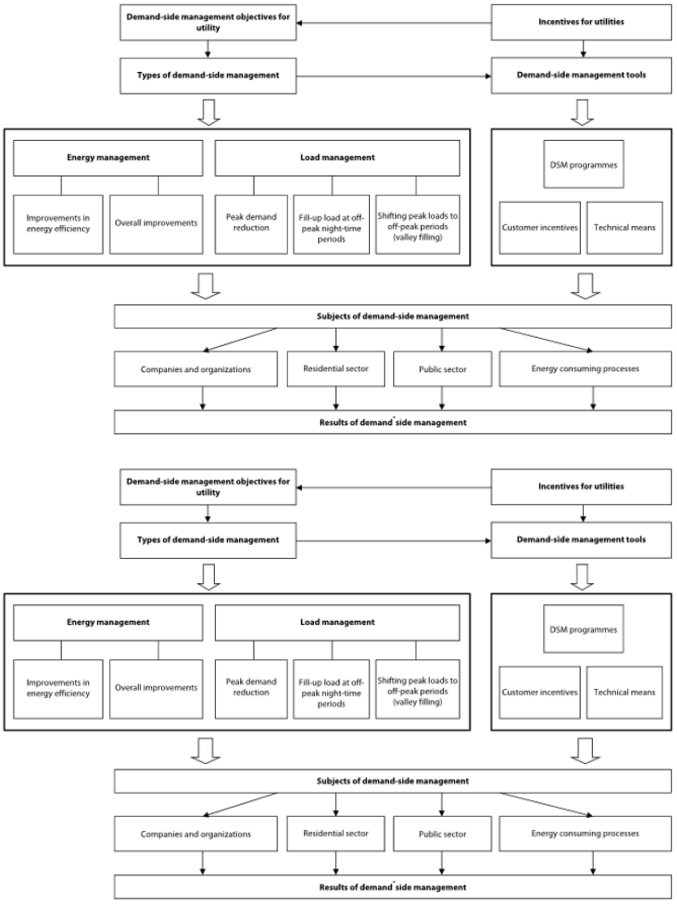
Table 1: Tariff Comparison of Select West African Countries

Country	Effective residential tariff (US cents) @ 100kWh/month	Monthly per capita GDP (USD)	% of monthly per capita GDP spent on 100kWh of electricity
The Gambia	28.0	98	21.7
Senegal	23.8	139	17.2
Burkina Faso	20.0	103	19.5
Cote d' Ivoire	11.9	134	8.9
Ghana	8.2	128	6.4

Source: Energy Data, 2018

Discussions on the DSM Literure Review

From the literature review, it is crystal clear that adopting and implementing tailor made DSM programme and tools will have a significant positive impact on the Gambia's energy sector especially the power generation. This is simply justified by positive impact experience of other developing countries, who share similar economic and energy industry characteristics with the Gambia. By extension, the literature identify two interconnections of DSM programme applications namely energy control and energy management. This paper therefore recommends the use of a Demand Side Management model that includes the use of both interconnections (Fig.1).



Source: L. D. Gitelman et al 2013.
Figure 2: Demand-Side Management Model

This means that, adopting a customized local DSM model will help Gambia to reach its national energy efficiency policy objective describe in the electricity roadmap document [2].

In addition, it seems that Gambia has favorable condition for adopting demand side management base on the government market economic policy adoption of shifting from monopoly to liberalized energy market with consumer focus. This is further vindicated by the government derive to become a full charter member of the International Energy Charter (IEC). A full membership of the IEC will enable the Gambia to have a comprehensive energy investment, legal and efficiency plan strategic policy. However, the literature shows that the energy policy plan measure only includes changing energy saving bulbs and appliances in government offices but there is no clear-cut energy efficiency policy, law or strategy that will enable the adoption and implementation of Demand Side Management tools as well as programs for efficient and cost-effective energy service delivery in the Gambia. Therefore, this paper is of the view that, the energy sector stakeholders in the Gambia should developed a tailor-made DSM energy efficiency policy and

strategy that will be able to attract utility investment through cost effective energy production, cheaper tariff for final energy consumers and surplus of energy revenue over expenditure to the government. This national DSM policy should include the technical demand respond plan as well as energy investment plan.

Nevertheless, there are a number of barriers that could hinder the progress of this highly promising demand-side management approach as highlighted in literature. These barriers include institutional operations management, mindset mentality and cost-effectiveness monitoring and evaluation of the DSM program. In this regards, this paper is suggesting a consumer energy conversation education campaign by the stakeholders of the energy industry in the Gambia as well as a cost effective demand side management technical Program guideline (Table 2).

Table 2: Cost effectiveness of demand side programmes

Measure	Benefits	Costs
PCT (Participant Cost Test) — from the perspective of the Customer	Incentive payments Bill savings Tax rebates or incentives	Incremental equipment and installation Costs
PACT (Programm Administrator Cost Test) — from the perspective of government agencies and third party entities	Capacity-related costs avoided thanks to programme (deferred investment)	Overhead costs Utility incentive costs Installation costs
RIM (Ratepayer Impact Measure) — impact of energy efficiency programs on ratepayers overall	Capacity-related costs avoided thanks to programme (deferred investment)	Program overhead costs Utility incentive costs Installation costs Lost revenue due to reduced energy bills
TRC (Total Resource Cost Test) — from the perspective of all utility customers (participants and nonparticipants) in the utility service territory	Capacity-related costs avoided thanks to programme (deferred investment) Additional resource savings (e.g., gas and water) Monetized environmental and non-energy benefits Applicable tax credits	Overhead costs Installation costs Incremental measure costs (whether paid by the customer or the utility)
SCT (Societal Cost Test) — costs and benefits to all in the service territory, region, or nation as a whole	Capacity-related costs avoided thanks to programme (deferred investment) Additional resource savings (e. g., gas and water) Non-monetized benefits such as cleaner air	Overhead costs Installation costs Incremental measure costs (whether paid by the customer or the utility)

Source: L. D. Gitelman et al 2013

In addition, the literature also shows evidence of attractive increment of energy sector investment by government, donor agencies and utility companies through DSM program implementation. This is in line with the Gambia's recent power sector liberalization initiative [2]. The Gambia Government in 2005 adopts a shift from monopoly to liberalize energy market model where Independent Power Producers (IPP) enter into Power Purchasing Agreement (PPA) with government through Ministry of Petroleum and Energy (MoPE), Public Utility Regulatory Authority (PURA) and National Water and Electricity Company (NAWEC). This paper is therefore of view that, implementation of a tailor made DSM programme as well as a favorable investment options will considerably increase investment of PPA between policy makers and IPPs with energy efficiency focus. This will further stimulate competition and enhance electricity sector service delivery.

Furthermore, adopting efficiency DSM Program will enhance national energy access through reduction of power generation losses. This will help shape utility corporations and government commitment to energy efficiency, security and environmental protection. Beside, DSM program can enable energy regulators in the Gambia to create a power sector electricity energy mix by encouraging investments in sustainable energy sources such as renewables. The development of an energy mix will solve power shortage problems as well as expand rural electrification coverage through off-grid connection.

A Pilot DSM Programs for the Gambia Energy Sector

The above literature review clearly shows that Gambia's power sector is in a precarious situation with a total installed electricity capacity of just over 100 megawatts (MW) within which the actual generation levels stood at approximately 50MW and leaving the excess demand at 50 MW. By extension, approximately 42 percent of Gambians have access to electricity nationwide, leaving significant room for growth in the energy market to bolster economic activity throughout the country. This shows that, ensuring continuous availability and reliability of electricity supply is still a major challenge, thus adversely affecting not only energy supply but also the prices of goods and services in the country. To remedy this situation, the government through NAWEC can provide more capacity by adding energy supply through building more power plants, increase the number energy generation machines otherwise energy sources, or adopt energy efficiency programs by implementing technologies that are cost-effective under prevailing economic condition to achieve not only reliable, affordable, efficient, effective and economical energy supply but also general price reduction of goods and services in the country. One easy way of achieving this objective is to implement a simple DSM model program or tools to solve this ordeal. As a result, this article suggests a short, medium and term pilot DSM program portfolio for the Gambia power sector. These pilot DSM portfolios range from awareness and attitudinal change of energy consumption program to the use of modern electrification efficiency tools or materials. This suggested DSM portfolios include several tailor-made programs intend for Residential, Commercial, Industrial, Educational and Agricultural sectors as well as government and municipal establishments. This suggested short- and medium-term pilot DSM program portfolio is discussed in table 3 and 4 below.

Table 3: Suggested Short term Pilot DSM Programs Portfolio in the Gambia

Program	Sector	Program Description	Incentive Mechanism	Expected Result
Awareness creation and attitudinal change of Energy Consumers	Residential, Commercial, Industrial, Educational, Agricultural	Comprehensive portfolio of publicity campaigns for specific DSM measures as well as an energy conservation in general through all media. Programs can include a Green Learning Room in Public Schools to educate students on the importance of energy conservation and the link between energy and the environment.	MoPE, PURA and NAWEC should sponsors public campaigns and advertising, grants to schools to support Green Learning Rooms equipment and training materials.	Substantial increase awareness for energy conservation, targeting 95-100 percentage awareness of energy efficiency issues and operationalizing 100 Green Learning Rooms in Public Schools
Replacement of all forms of lamps to LED lamps in residential and Public Building	Residential, Governmental, Industrial	Agreement with distribution outlets to import and sell LEDs lamps throughout the Gambia. PURA to bear the cost of the program while NAWEC should test the label lamps to ensure consistent in quality.	PURA and GIEPA should facilitate bulk distribution and partnership with franchised retail outlets which can allow substantial reduction in transaction cost.	More than 5,000 LEDs can be sold under program at a significant percentage reduction (appro.40%) below the prevailing market price.
Replacing Street Lighting lamps with LEDs	Municipals	A partnership program with Municipalities to procure and replace street lamps with LED high pressure sodium vapor lamps (**HPS**) to all municipalities throughout the Gambia	Grant funds will be used for the replacement of incremental cost of lamps to reduce cost and demonstrate technology efficiency.	More than 10, 000 LED lamps can be procured and Install with subsidy of an estimate 500 dalasis per lamp. Future promotion contingent can substantially reduce local HPS costs.
Replacing high consuming air conditioners with energy saving air conditioners	Municipal and Government agency building	Agreement between the Gambia Technical Training Institute (GTTI), Municipal Councils and Central Government to manufacture low consuming/ energy efficiency air conditioners to be install in government and municipal buildings	Grand fund to be provided by the National youth Entrepreneurship program through the Global Environment Fund	More than 10,000 low consuming /energy efficiency air conditioners can be manufacture and install cross central Government and municipal council buildings.
Compact Fluorescent Lamps (CFLs)	Residential, Commercial	Agreement with distribution to import and sell CFLs to all consumers. NAWEC will bore the advertising costs of program and tested/ labeled lamps to ensure consistent quality	Bulk import distribution and partnership with franchised retail outlets allowed substantial reduction in transaction costs	More than 500,000 CFLs is estimated to be sold under this program at an estimated 40% below prevailing market price.
Load Management	Commercial, industrial	Voluntary participation program to encourage load management through stand-by generation, interruption load and time-of-use tariff schemes.	Participants will be legible for a concessional tariff scheme	100 or more corporation customers are projected to show interest in this program, however this research recommend for this pilot program to kick start with a registration of 50 entities.
Smart Meters	Residential, commercial, industrial	This program is a compulsory participation gear towards efficient, reliable and effective tariff calculation and reduction of energy consumption.	Compulsory replacement of conventional meters to smart and repaid meters in residential, commercial and industrial energy customers	5000 Smart meters will be distributed to commercial & industrial while13, 000 prepayment meters will be deployed to residential customers.

Source: Researchers suggested short term pilot DSM portfolio, 2020

Table 4: Suggested Medium- and Long-term Pilot DSM Program Portfolio in the Gambia

Program	Sector	Program Description	Incentive Mechanism	Expected Result
Green Leaf	Commercial (hotel)	Audits and certifications of energy-efficiency hotels will be based on predefine measures, dissemination of information on energy efficiency and comprehensive resource management in hotels.	Free workshops and audits/certifications for hotels. Results will be disseminated through Gambia Tourism Board (GTB) publications.	6 Seminars will be conducted, 12 audits will also be conducted, and 30 hotels will be rated. 10 hotels will receive highest rating -5 green energy leaves.
New Buildings	Commercial	Analysis of availability of all efficiency measures in buildings and support to construction companies for all viable efficiency measures that exceed building code requirements.	Demonstration buildings, technical assistance and possible financial incentives.	Program can kick start ones the constraint of finance in new building construction market is resolved.
Brown Rice	Residential, Agricultural, Education	Promotion of less energy –intensive and nutritional brown rice through advertising and labeling, grow and distribution of brown rice in public school lunch programs.	Promotional campaign in partnership with Ministries of Health, Agriculture, Trade and Education.	59 brands of brown Jasmine rice will be grown and receive labels. Evaluation of program will be conducted periodically in phases.
Pilot ESCO	Industrial	Demonstration of ESCO concept through development of four pilot projects and dissemination of results.	NAWEC will bore the development and audit cost for pilots and would seek an interest subsidy from PURA and MoPE	Four investment corporations will be selected based on grade audits process of entity applicants. After which, negotiation with PURA and MoPE together with commercial banks and customers will follow suit in order to finalize and kick start the program.
Industrial Cost Reduction	Industrial	Similar to Green Building Program, this program promotes retrofits and investment in industrial end-user premises.	Audit and Technical advice will be provided to participants as well as assistance in assessing in this Energy Conservation promotion Funding program.	15 industrial audits will be conducted from start to finish. The program implementation will greatly depend upon HEM and ESCO programs as well as availability of suitable financing facilities.
Small and Medium size Enterprises (SME)	Commercial, Industrial, Agricultural	Preparation of action plan and workshop to support predefined efficiency measures in SME premises, proposed plan to include concessional ECF financing.	PURA and NAWEC will sponsor workshops, brochures and standardized applications for certain end-uses, concessional financing.	Negotiations with ECF for large –scale implementation and financing of the program will give rise to fifteen demonstrated projects.
Thermal Storage	Commercial	Demonstration of 35KW thermal storage system should be constructed on NAWEC premises for testing and assessment of commercial viability.	Construction of demonstration facility will be carryout as soon as funding is secured	Promotion of technology will depend on financial viability, which is presently at the marginal level.

Low-Lost Ballasts	Commercial, Residential, Industrial	Promotion of low-Magnetic ballasts through bulk import and distribution arrangement plus through green buildings/industrial cost reduction programs. The program would promote new ballasts only and not retrofits of existing equipment.	Labeling and informational campaign will be sponsored by MoPE and PURA.	After a carefully evaluation, 5 labels will be disseminated to 11 manufacturers/importers although no promotion will carry out. The program could be hold on due to financing constraint of this kind of projects.
High-Efficiency Motors (HEMs)	commercial, Residential, Industrial	Catalyzation of HEM market through testing/ labeling, demonstration, information dissemination and manufacturer/ importer negotiations. Future efforts may include brochures on motor sizing, HEM payback periods and technical assistance for rewinding and drive systems.	GoTG and its energy development partners should sponsor promotional campaigns, interest-free loans and demonstrations.	62 months procurement will be used for demonstrations/testing purposes in motor operational testing lab.

Source: Researcher‘s suggested Medium term pilot DSM portfolio, 2020

Conclusion

The literature clearly shows that, there is no existence of a clear energy utility business model in the Gambia. Consequently, no clear-cut energy efficiency plan or strategy in the energy sector of the Gambia. As a result, the Gambia power sector is currently is in a precarious situation, which needs a tangible cost-effective technology-oriented solution. The author of this paper is of the opinion that an energy efficiency measure through Demand-Side Management is a potential answer to this ordeal. This is simply because Demand-Side Management (DSM) programs can help curb electricity demand growth and promote more energy-efficiency equipment and cost-effective energy services within a particular energy supplied environment. The analysis made in this paper recommend that adopting and implementing DSM programme and tools would be an efficient measure to achieve a great part of Gambia's environmental and energy objectives. This paper discusses main policy recommendations that can propel the objectives of Gambia energy target by 2030 through DSM programs. More precisely, adoption of DSM progamme would help the Gambia energy sector policy to meet its energy efficiency target through less costly electricity generations. Beside the benefit of cross-borders power transmission and distribution, DSM programme can provide additional solutions of effective, efficient and reliable power transmission and distribution in the Gambia at the same time preserve the environment as well as introduce innovative energy infrastructure through smart grid production that enhances energy investment plus development of energy mix market to further stimulate competition within the sector. In addition, the author of this paper also identified a number of barriers that can affect the implementation of DSM in the Gambia to be very similar to those faced by other experienced DSM countries. The summary of barriers that are likely projected to affect the implementation of DSM pilot portfolio programs in the Gambia include an obsolesce traditional rate design energy system that may not support a built-in disincentive to utility DSM programs; the absence of a mechanism to generate critically needed funding for DSM programs and a lack of positive incentives that would motivate utilities to maximize energy savings. Yet if Gambia restructures its electric power industry, it will have a valuable opportunity to take advantage of the lessons learned (both positive and negative) from other countries in order to harness the benefits of demand-side resources in a manner that will suit Gambia's particular circumstances and fulfill its own goals. Finally, the author recommends that, providing Gambia's energy services in the least-cost manner should be the guiding principle governing reform of the electricity sector. This can be achieved by requiring distribution to use a least-cost IRP process to investigate whether DSM alternatives are more cost-effective than building new transmission and distribution capability [13,14].

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