FINAL TECHNICAL ASSESSMENT

Nigeria Distribution Sector Recovery Program (P172891)

The World Bank

TECHNICAL ASSESSMENT

A. Strategic Relevance

1. **The FGN has developed the PSRP to restore the financial viability of the sector, strengthen the sector's institutional framework and increase transparency, and to create an enabling environment for attracting private investment.** The PSRP was developed to support Nigeria's ERGP, which sets out the medium-term structural reforms to diversify Nigeria's economy, including expanding power sector infrastructure as one of the top priorities. The proposed Program supports two components of the PSRP – Component II (Improve DISCO performance) and Component III (Restore proper sector governance; and improve sector transparency). Accordingly, it can be seen that the proposed Program is of strategic relevance to Nigeria.

2. **The Program is timely given the Nigerian distribution sector is in urgent need for support given its current situation.** The current installed generation capacity of 13,500 MW is translating to less than 4,000 MW of capacity reaching customers, due to a combination of reasons. ATC&C losses averaged around 40 percent across the system in 2018 and include low efficiency and poor reliability of generation; technical transmission losses; and technical distribution losses. An average collection rate of 66 percent across the DISCOs, electricity theft; a tariff structure that until recently did not reflect the current costs of the network; and a widespread lack of distribution infrastructure to "absorb" generated power for final consumption further compounds the problem by reducing the revenues received for the power sent out. Insufficient revenue has a feedback effect on the network, limiting the ability of generators to purchase fuel and maintain generation assets, and preventing TCN and DISCOs from investing adequately in transmission and distribution: maintenance; improvements of infrastructure and operations; and network expansion. Performance does vary significantly between DISCOs (See
3. Table **1**) but all DISCOs are performing below international benchmarks.

Table 1: DISCO 2018 ATC&C losses and collection rates

DISCO	ATC&C losses (percent)	Collection Rate (percent)
Jos	71	56
Yola	66	48
Kaduna	63	24
Port Harcourt	63	49
Enugu	52	67
Benin	52	56
Kano	50	59
Ibadan	49	59
Abuja	48	78
Eko	31	78
Ikeja	24	83

Source: NERC 2018.

B. Technical Soundness

4. **The Program is based on proven technologies and approaches that have been widely deployed internationally to affect performance improvements in the electricity distribution sector with respect to quality and quantity of electricity provision and access.** The Program aligns with the PSRP which is accepted as a sound framework for the turn-around of the Nigerian electricity sector, based on rigorous analytical foundations. Specific Program investments are defined and implemented by

those in the best position to determine the needs on the ground – DISCOs – as articulated in their PIPs and approved by the regulator – NERC. Further to the analytical work undertaken by DISCOs, NERC and other Nigerian counterparts, extensive analysis has been undertaken by the World Bank as part of the preparation of this Program which adds further justification for the interventions proposed in this Program. The Program will be undertaken in two parts – a PforR with funding being on-lent to DISCOs for investment in distribution infrastructure and operations; and an IPF with funding going towards the bulk procurement of customer meters and to the establishment of a DAP in NERC. Both elements of the Program align with the FGN's PSRP framework.

5. **The PSRP, which was developed in close consultation with the World Bank and is underpinned by significant analytical work, identifies the distribution sector as one of the primary constraints to the effective functioning of the electricity sector as a whole.** Analysis undertaken for the preparation of the PSRP concludes that:

(i) The distribution sector is central to the financial challenges of the power sector as a whole. In particular, high system losses of DISCOs and low electricity volumes resulting from distribution constraints contribute to deteriorating payment performance of the DISCOs which in turn affects the financial viability of the entire supply chain.
(ii) The main constraints for power evacuation and end-consumer delivery are bottlenecks in distribution and to a lesser extent transmission constraints and disruptions of the gas supply to generators. Generation capacity is not currently a constraint; rather, the generation assets risk becoming increasingly stranded if these constraints, particularly in the distribution segment, are not addressed.
(iii) The power sector institutional and regulatory framework is comprehensive and in accordance with international good practices, but there has been little enforcement. Full enforcement may be difficult, given that current conditions considerably diverge from the conditions assumed in the key contracts and regulations.

6. To address these issues, the PSRP includes a component focused specifically on improving DISCO performance (Component II). The DISREP has been scoped to address this component of the PSRP as well as the distribution aspects of Component III (Restore proper sector governance; and improve sector transparency).

7. **Since its approval in 2017, the FGN has remained strongly committed to implementing the critical actions of the PSRP, as evidenced by the recent implementation progress.** The implementation of the PSRP is overseen at the highest level on Nigerian government, through the Office of the President, together with the Minister of Finance, Budget and National Planning and the Minister of Power. High-level leadership for PSRP implementation has ensured continued progress, with a number of important actions undertaken in 2020, including:

- Long-awaited tariff reform commenced from September 1, 2020. The reform process will see tariffs brought close to cost-reflective levels in parallel with improved quality of service. The approach to tariff reform was informed by customer consultation where it was indicated that customers in higher tariff bands are willing to pay more for improved supply. Customers in lower tariff bands, specifically those receiving 12 hours or less of daily supply will not experience any increase in tariffs. Such an approach both protects the poor as well as incentivizes DISCOs to improve quality of service. Lifeline tariffs for the poorest connected households using less than 50 kWh per month is maintained at the same level established in 2012 (approximately Usc1 per kWh).
- NERC's installation of an estimated billing cap so bills for unmetered customers are capped to levels observed in metered customers in equivalent local areas. This rule is expected to reduce bill disputes, reduce "overbilling" for unmetered customers (who are likely to be poorer), and

incentivize meter roll-out. The President has also directed the mass metering program to be accelerated – a process which is supported by the DISREP operation.

- Submission of PIPs by DISCOs, in line with Nigerian NERC PIP Guidelines. NERC PIP Guidance, developed with input from the World Bank, was issued in May 2019. All eleven DISCOs have submitted their PIPs to NERC for approval and three of them had been approved. The PIPs include detailed technical and operation improvement plans, as well as investment plans, for each DISCOs to address their specific infrastructure and operational needs.
- Explicitly recognizing that tariff shortfalls are not the payment obligation of DISCOs by approving minimum remittance shortfalls and enforcing DISCOs' payment discipline on that basis.
- New CBN and NERC measures to enforce payment discipline on DISCOs. In 2018, the estimated average remittance by DISCOs for power received from NBET was about 29 percent. A requirement of power supply contracts is the provision of a bank guarantee which can be drawn upon to fill payment shortfalls. In collaboration with NERC, CBN has instructed the commercial banks providing these guarantees to ensure full settlement of electricity invoices received by DISCOs through their central collection accounts. Over the long-term, this measure is expected to instill payment discipline and reduce the incidence of non-tariff shortfalls which impede the financial sustainability of the sector. In the near-term such a measure may further constrain DISCOs access to capital and therefore limit DISCOs ability to invest in infrastructure and operational improvements.
- Establishing an Accountability Framework for the CBN PAF expansion that makes the CBN funding to the sector conditional upon the implementation of several critical actions of the PSRP.
- Developing a Financing Plan for 2020-2027 and identifying financing sources to fund the plan. The key policy decisions underpinning the Financing Plan have been approved by the FGN to ensure that the Financing Plan assumptions are credible and realistic. The FGN budgetary contribution for 2020 envisaged in the Financing Plan is included in the 2020 FGN budget approved by the National Assembly.

8. **The DISREP Program supports the implementation of PIPs that have been developed by DISCOs based on their detailed knowledge of their technical and operational requirements.** Individual DISCOs are best placed to understand the technical and operational constraints that impact performance in each of their regional networks. Following guidelines set out by NERC and developed with input from the World Bank, each DISCO has undertaken extensive needs assessments of their operations to determine specifically where investment is required and what outcomes such investment can be expected to deliver. In consultation with NERC, each PIP is developed in a way that it is both realistic to achieve as well and being ambitious enough to ensure together PIP implementation across the DISCOs will advance the collective aims of increasing electricity access and improving quality of supply across Nigeria. By focusing on the implementation of approved PIPs, the DISREP Program is ensuring the investments made are scoped to address specific on-the-ground issues and that DISCOs assume ownership of the sector interventions to accompany their responsibility for repayment of the DISREP on-lending.

9. **The technical and operational investments detailed in PIPs are not unique nor do they include any untested technologies or processes.** The infrastructure and operational investments detailed in the PIPs are standard DISCO practices applied extensively globally and, in many cases, already by Nigerian DISCOs. The PIPs include proposed investment in new infrastructure and infrastructure rehabilitation as well as investments in commercial and management technologies and processes. Infrastructure investments identified across the PIPs include, but are not limited to:

- New injection substations;
- Upgrade of existing injection substations;
- New medium-voltage (33-kV and 11-kV) lines;
- New low-voltage (0.415-kV) lines;

- Medium-voltage (33-kV and 11-kV) line rehabilitation;
- Low-voltage (0.415-kV) line rehabilitation;
- New DTs;
- New PTs;
- DT rehabilitation and upgrade;
- PT rehabilitation and upgrade;
- Customer metering;
- Theft reduction technology;
- New connections to feeders; and
- New feeders.

10. Commercial and management investments identified across the PIPs include:
    - Customer services;
    - Technologies and processes for the management of requests for new connections;
    - Deployment of CMS;
    - Customer Relationship Management (CRM);
    - Billing automation and accuracy improvement;
    - Deployment of ERP;
    - Deployment of GIS;
    - Deployment of Project Management and WMS;
    - Deployment of IRMS;
    - Deployment of SCADA to operate high-voltage and medium voltage infrastructure;
    - Revenue Protection Planning;
    - Health, Safety and the Environment (HSE) applications/implementation;
    - Outage management systems for Quality of Service (QoS) tariff application;
    - Distribution management system/Distribution automation; and
    - Capacity building.

11. In each case, infrastructure and operational investments detailed in the PIPs represent standard distribution sector practice and as such can draw on extensive local and international experience and lessons learned. Such investments also represent standard World Bank supported interventions in the distribution sector and therefore can benefit from internal World Bank experience.

12. **Customer metering is accepted as a critical step in customer regularization, network management and service delivery.** It is currently estimated, based on MAP contracts and DISCOs' PIP metering plans, that the customer metering gap in Nigeria is in the region of 10 million meters. Even the simplest, cheapest meter assists with DISCOs operations relating to system monitoring and analysis as well as customer billing. Through the installation of meters, DISCOs can move away from the process of estimated billing which has been a significant issue in Nigeria often resulting in customer "overbilling" of unmetered customers (in extreme cases referred to as "crazy billing") which in-turn leads to additional DISCO administration and at the same time heavily impacts customer satisfaction. Metering also improves bill collection rates, which currently average just 66 percent across the DISCOs, through the use of pre-paid meters but also through the detection of electricity theft and through the ability to disconnect customers remotely. In addition to these basic benefits, the application of smart meters and advanced metering infrastructure (AMI), where appropriate, allows for more advanced network operation including time of day usage tariffs, net metering, demand response, advanced network diagnostics and analysis through two-way communication, and remote meter updating and control. The importance of metering is accepted across the Nigerian power sector as seen in the ambitious meter installation plans detailed within the DISCOs' PIPs as well as at the FGN level with initiatives such as the MAP program and CBN meter financing program.

13. **The DISREP operation can bring significant cost-savings to DISCO operations through support for the bulk procurement of meters.** The World Bank recently provided support the to the Mozambique national power utility to procure supply of 300,000 meters. The meter specification was detailed by the national power utility in partnership with the regulator. The World Bank then supported an international competitive bidding process which saw the award of three contracts (from a total of 18 bids received) each for 100,000 metering at an average price of US$30/meter. In contrast, the exact same meters (Inhemeter DDZ1513) were procured by Abuja DISCO as a price of US$100/meter. The significant expected reduction in cost from the World Bank's involvement in the bulk metering process is due to economies of scale and low risk assessment by vendors based on confidence in transparency of World Bank procurement processes and maximum certainty of payment. The bulk procurement of meters in Nigeria will align with the NERC meter code and will be done in close consultation with DISCOs to ensure the meters procured address the needs of each DISCO, while at the same time adhering to the network integration and data aggregation requirements of NERC.

14. **Data access and aggregation is a key tool for regulators to oversee network operations and ensure regulatory compliance.** Central to NERC's role as the electricity network regulator in Nigeria is their ability to have an accurate and timely understanding of the status of network operations and performance. Currently NERC relies on manual reporting from DISCOs which in practice results in inconsistent data quality, non-availability of critical information and irregular reporting of the DISCOs. This in-turn compromises NERC's mandate on performance monitoring and oversight of DISCOs and of the power sector as a whole. Through the establishment of an automated DAP, NERC will be able to access accurate and timely data on how the distribution network is functioning, whether DISCOs are complying with network regulations and protocols and whether over time their performance is progressing in line with PIP targets. Given the DAP will be populated automatically with system generated network data, it will support NERC in enforcing regulatory compliance and PIP implementation and reduce the likelihood of disputes between the DISCOs and the regulator. The DAP will be established in parallel with the complementary Presidential Power Initiative national metering data platform (NMP) that is being supported by Siemens.

15. **To support the scoping and preparation of the DISREP operation, the World Bank undertook a significant amount of analytical work, in addition to analysis undertaken as part of the PSR PforR preparations and by Nigerian power sector stakeholders.** The analytical work undertaken supports the need for urgent distribution sector interventions in order to turn around the Nigerian power sector. The analysis also supports the type and method of interventions outlined in the DISREP and confirms the capacity of the organizations involved in the Program implementation. A summary of the key analytical work supporting the DISREP operation scoping and preparations can be seen in Table **2**2.

Table 2: Analytical work supporting the DISREP preparation

Analytical work	Scope	Key findings
DISCO legal analysis	To review the legal, regulatory and contractual bases for operations of the DISCOs in the Nigerian electricity sector	• The existing legal, regulatory, contractual and institutional framework for the operation of the DISCOs is sufficiently flexible and robust to accommodate the proposed shareholder loans • The ultimate beneficiary of the loan should continue to be the DISCO, irrespective of changes in ownership
DAP architecture assessment	To develop proposals and implementation guidelines for enabling remote access of data by NERC of the MIS and other management systems of Discos to monitoring capacity of NERS of service quality that DISCOs offer to their various customers	• The DAP architecture assessment covered identification of infrastructure, integration and security specifications to enable understanding of the required hardware and application programming interface (API) requirements for integration with DISCOs' systems • The DAP should also include capabilities such as accessibility, scalability, ease of use, mobility and above all, comprehensive security features.
DISCO corporate governance assessment	• To establish the extent of adherence by DISCOs to the corporate governance code • To strengthen the corporate governance processes in the management of the companies • To provide information on areas of adherence and scope of improvement/support required for the DISCOs	• NERC Code of Corporate Governances including requirements relating to: leadership responsibilities; roles and functions of directors; composition of Boards; reporting and controls; conflicts of interest; relationships and responsibilities to shareholders; code of ethics; etc. • The average adherence to the corporate governance code by DISCOs is about 52 percent which indicates the need to devote time and energy to address the gaps identified • Corporate governance performance was found to vary significantly between DISCOs, from as low as 20 percent compliance up to 73 percent compliance with the NERC Code of Corporate Governance
DISCO PIP and metering and capacity needs assessment	• To review the DISCOs' PIPs to ensure they are aligned with the PSRP and NERC approved PIP Guidelines • To determine if DISCOs have the institutional and organizational set-up and capacity to implement PIPs • To assess DISCOs metering needs/gap, including the number and type of meters required as well as the necessary infrastructure requirements	• The DISCO PIPs, especially the revised versions, are substantially aligned with the PSRP and NERC guidelines; some gaps exist in the alignment of infrastructure requirement and financing structure/allocation including efficiency of costing. The regulator has requested further clarification from the DISCOs before final approval • DISCOs have been implementing similar projects and works contained in the PIPs and therefore have reasonable institutional and organizational capacity to implement the PIP; but the larger scope of works will require engagement of third party assistance in project management, monitoring, evaluation and outcome reporting, including some capacity development in program management • The metering gaps and type specifications for DISCOs have been well assessed and documented by the DISCOs and approved by NERC and reviewed by stakeholders and has formed the background for meter procurement process
PSR PfR assessments	To scope the PSR PfR program interventions and to determine if the program will be able to development objective of improving the reliability of electricity supply, achieve financial and fiscal sustainability, and enhance accountability.	• The distribution sector is central to the financial challenges of the power sector as a whole • High system losses of DISCOs and low electricity volumes resulting from distribution constraints contribute to deteriorating payment performance of the DISCOs and the entire supply chain • The main constraints for power evacuation and end-consumer delivery are bottlenecks in distribution and to a lesser extent transmission constraints • The power sector institutional and regulatory framework is comprehensive and in accordance with international good practices, but there has been little enforcement
TCN-DISCO transmission-distribution interface assessment	To establish the gaps in the transmission and distribution networks that prevent the dispatch and distribution of the available generation capacity; and identify and recommend the necessary investments to close them, on Regional bases	Causes of transmission and distribution network under capacity and bottlenecks include: • Feeder outages • High occurrence of faults on the distribution network • Load shedding, either to ration power due to supply deficit or for the purpose of protecting an equipment from damage

Institutional arrangements

16. **Institutional arrangements for the Program have been tailored to the specific scope and requirements for each of the two Program elements – the PforR and IPF.** For the PforR component, BPE will be the Implementing Agency with responsibility for on-lending funds to DISCOs in the form of shareholder loans. For the IPF components of the program, TCN will be the implementing agency for the bulk procurement of meters and for the procurement of the DAP system. The TA components of the program will be undertaken by the appropriated agency with procurement support provided by TCN.

17. **BPE will be the Implementing Agency for the PforR on-lending of funding for DISCOs' PIP implementation.** BPE is a 40 percent shareholder of all eleven DISCOs on behalf of FGN and therefore the most appropriate Implementing Agency for the PforR on-lending to DISCOs. In their role as Implementing agency, BPE will receive funds from the MoF and on-lend to DISCOs on commencement of the program (25 percent of lending will be paid as an advance) and on the verified completion of the agreed DLIs. BPE will be responsible for negotiating and agreeing the terms of the on lending with DISCOs, including interest rates and tenures. Participation in the PforR program will be voluntary and therefore some DISCOs may elect not to participate. BPE have no recent experience with World Bank project implementation and therefore will receive capacity building support to ensure they have the capability and capacity for their role as Implementing Agency. Given their role is largely financial administration however capacity building is expected to focus primarily on adhering to World Bank FM and reporting requirements. Under the PforR component of the Program, all procurement and field activities will be undertaken by DISCOs. The nature of infrastructure and operational interventions undertaken by the DISCOs under the DISREP Program are common practice amongst the DISCOs and therefore falls well within their expertise and capacities. Similarly, to BPE however some capacity building may be required by DISCOs specially regarding World Bank requirements, including those around procurement and E&S safeguards.

18. **TCN will be the Implementing Agency for the IPF support for bulk metering and DAP system procurement.** The bulk procurement of meters is a critical and urgent component of PIP implementation and of the DISREP Program. TCN is currently the Implementing Agency for the World Bank NETAP which involves significant procurement of transmission network capital infrastructure and works contracts, such as new substations, rehabilitation of substations, conductors and circuit breakers, and other essential power equipment. Accordingly, TCN has in-house capacity in place and extensive experience in undertaking procurement in accordance with World Bank procurement requirements and therefore is best placed to fast-track the procurement of bulk meters for the DISREP operation. TCN also has in place a PMU which will be able to provide additional support to TCN in their role of Implementing Agency. To inform the procurement process, NERC has in place a Metering Code which outlines the technical requirements of meters. In addition, DISCOs will specify their specific meter requirements in line with the NERC Metering Code. For similar reasons TCN will be Implementing Agency for the NERC DAP procurement with the specifications of the DAP being provided to TCN by NERC. Following the completion of the procurement processes, BPE and will be responsible for overseeing the roll-out of meters by DISCOs and NERC will be responsible for the implementation of the DAP system within NERC and in partnership with DISCOs.

19. **Implementation of the TA components of the Program will be undertaken by the appropriate agency for each component.** Capacity building support will be undertaken in partnership with BPE, MoP,

and DISCOs. The preparation and design of the Consumer Assistance Fund will be undertaken in partnership with MoP and the gender access strategy development with DISCOs. In all cases, procurement associated with the capacity building TA will be undertaken by TCN on behalf of the target agency.

C. Expenditure Framework

20. **The Program expenditure is the total investment requirements for the 5-year implementation of the eleven DISCO PIPs.** PIPs submitted by DISCOs and approved by NERC stipulate two estimates of levels of investment required by each DISCO: 1) based on the current Multi-Year Tariff Order (MYTO) regulatory capex investment limits imposed by NERC, and 2) based on the DISCOs' self-determined optimum capex investment. Based on current MYTO investment limits which are currently in place, the total investment required by DISCOs amounts to US$1.708 billion (see Table 3). If caps were to be removed, the uncapped investment requirements by DISCOs increases to US$2.52 billion. For the purposes of this analysis total expenditure is based on the current MYTO capital investment limits, given this represents the prevailing Program regulatory context. A further US$35 million in NERC DAP investment requirements and required TA is included in the operation bringing the total FGN Program investment requirement to US$1.743 billion.

21. **The eligibility of investments under the Program are determined by the approved PIPs, that have been reviewed and determined appropriate by NERC**. These investments may include procurement of new infrastructure and the rehabilitation of existing infrastructure as well as investment in processes and procurement of software to support DISCO operations. The specific investments to be made under the Program will be determined by DISCOs during project implementation.

22. **IBRD DISREP funding represents twenty seven percent of the total FGN program financing**. In addition to World Bank funding, up to US$700 million will be financed by AfDB in two US$350 million tranches and US$236 million will be financed by the MoP's DEP. The CBN will contribute funding of US$250 million for the procurement of meters for DISCOs. The IFC is assessing potential involvement using the sub-franchising arrangements and Premium Customer schemes, already employed by some DISCOs. Total Program funding can be seen in Table 3.

23. **Currently committed funding amounts to US$1.651 billion resulting in a gap of US$57 million**. FGN and World Bank DISREP investments, as well as investments from development partners are expected to increase the overall viability of DISCO operations, such that they are in position to secure commercial financing for the later stages of PIP implementation, addressing the current funding gap. The financing gap, estimated on the current investment needs included in the DISCOs' PIPs and approved by NERC, will be re-assessed by the MTR (three years) based on the outcomes of subsequent NERC conducted tariff order reviews and tariff adjustments, and performance of DISCOs in respect of implementation of their individual PIPs and achievement of DLIs. The DISREP Expenditure Framework is shown in Table **3**3 with expenditure by category shown in Table 4.

Table 3: DISREP Expenditure Framework

Use of Funds/PEF	Naira (million)	US$ (million)	%
ABUJA	67,510	175	10.0%
BENIN	44,840	116	6.7%
EKO	83,300	216	12.4%
ENUGU	50,220	130	7.5%
IBADAN	80,880	210	12.0%
IKEJA	108,320	281	16.1%
JOS	41,950	109	6.2%
KADUNA	52,850	137	7.9%
KANO	56,020	145	8.3%
PORT HARCOUR	47,050	122	7.0%
YOLA	26,320	68	3.9%
NERC and other	13,510	35	2.0%
TOTAL Expenditure	**672,770**	**1,743**	
Source of Funds	**Naira (million)**	**US$ (million)**	**%**
FGN Program contribution	186,596	486	27.9%
MoP DEP	*91,096*	*236*	*13.5%*
CBN meter funding	*95,500*	*250*	*14.3 %*
AfDB	270,200	700	40.2%
Tranche 1	*135,100*	*350*	*20.1%*
Potential Tranche 2	*135,100*	*350*	*20.1%*
IBRD DISREP	**193,00**	**500**	**28.7%**
IBRD DISREP – PfR funding allocated to DISCOs	*133,170*	*345*	*19.8%*
IBRD DISREP – IPF funding of bulk meter procurement on behalf of DISCOs	*46,320*	*120*	*6.9%*
IBRD DISREP – IPF funding of DAP for NERC and TA	*13,510*	*35*	*2.0%*
Program gap	21,974	57	3.3%
TOTAL Funding	**672,770**	**1,743**	

Table 4: Program Expenditure by Category

	Total Program investment (US$ million)	Goods, non-consulting services (US$ million)	Works (US$ million)	Consulting services (US$ million)	Operating costs and training US$ million
ABUJA	175	26	114	13	22
BENIN	116	17	76	9	15

	Total Program investment (US$ million)	Goods, non-consulting services (US$ million)	Works (US$ million)	Consulting services (US$ million)	Operating costs and training US$ million
EKO	216	32	140	16	27
ENUGU	130	20	85	10	16
IBADAN	210	31	136	16	26
IKEJA	281	42	182	21	35
JOS	109	16	71	8	14
KADUNA	137	21	89	10	17
KANO	145	22	94	11	18
PORT HARCOUR	122	18	79	9	15
YOLA	68	10	44	5	9
NERC and other	35	10	0	21	4
TOTAL Expenditure	**1,743**	**266**	**1,110**	**149**	**217**

24. **DISREP PforR funding will be allocated between DISCOs proportionally based on the PIP investment requirements**. The DISREP US$345 million in PforR funding will be allocated to individual DISCOs and individual DLIs based on the following methodology:

(i) **Each DISCO will be allocated a base funding of US$12 million**. Given the large disparity in DISCO sizes and in investment needs, a base allocation of US$12 million will be made available to each of the eleven DISCOs, ensuring that even the smallest DISCOs are provided with a useful allocation of capital. Total base funding across DISCOs will equal US$132 million, leaving a balance of US$213 million in PforR funding.

(ii) **The remaining US$213 million will be allocated across the DISCOs in proportion to their investment needs**. Approved PIPs outline a total of US$1,708 billion in funding requirements across all DISCOs. Each DISCOs' investment requirements as a proportion of total PIP investment can be seen in Table **3**3. The bulk of DISREP PforR funds are allocated proportional to investment needs to ensure that all DISCOs are able to access a level of funding sufficient to meaningfully impact their ability to invest in PIP implementation.

(iii) **Each DLI is weighted relative to its importance to the DISREP development objective and to its relative investment requirements.** The funding allocation for each DISCO is allocated across the five DISREP DLIs in accordance with the DLI weighting seen in

(iv) Table **5**. The DLI weightings are used to determine the proportion of DISCOs' allocations that will be disbursed for each DLI e.g. if a DLI has a weighting of 20 percent, a DISCO is able to receive 20 percent of their total DISREP PforR allocation based on the verified completion of this DLI.

Table 5: DISREP DLI weightings

DLI	Weighting
DLI#1: Number of new metered connections by DISCOs	20%
DLI#2: Kilometers of medium voltage (MV) distribution lines rehabilitated by DISCOs	28%
DLI#3: Reduction in transformer technical losses in existing distribution networks	28%

DLI	Weighting
DLI#4: Compliance with NERC Code of Corporate Governance by DISCOs	10%
DLI#5: Implementation of MIS by DISCOs	14%

(v) **For each DLI for each DISCO a baseline, target, and minimum disbursement threshold are determined.** These DISCO-specific figures are determined based on the cost estimates in DISCOs' PIPs along with their specific circumstances and context, taking into account how it may impact of the costs of achieving individual DLIs, e.g. degree of urbanization, geography, terrain, etc. Based on this determination, a cost per unit can be determined for each DLI for each DISCO. The DISCO costs per unit have been reviewed by NERC and agreed with DISCOs.

(vi) **DLI#1 is based on a composite MCS that comprises both the connection and metering of new customers to the distribution network as well as the installation of new metered connections for existing unmetered customers.** A DISCO's MCS is calculated based on the weighted combination of progress in meeting their new customer connection targets as well as their targets for installation of meters at previously unmeted connections, as defined in DISCOs individual PIPs. New meters on existing connections is weighted by one sixth as the cost of installing a new meter at an existing unmetered is approximately on sixth the cost of a establishing a new metered connection for a new customer. The formula for calculating the MCS is:

- (New connections + 1/6 * New meters on existing connections)/(DISCO connection target + 1/6 * DISCO meter target).

25. Based on the above methodology, the allocation of funds across DISCOs and DLIs can be seen in Table 6.

Efficiency of program expenditure

26. **DISCOs' PIPs have been developed and scrutinized to ensure efficiency across all planned investments**. In line with NERC PIP Guidance, DISCOs were required to demonstrate in their PIPs the efficiency of all planned investments, including applying established economic models and providing internal and external benchmarking evidence, market testing and references to relevant comparators and precedents. Once draft PIPs were submitted, NERC then reviewed the evidence provided and compared and contrasted the investment plans across all DISCOs to establish industry efficiency frontiers that ensures all PIPs are as efficient as possible. Further to the NERC review, the World Bank team reviewed the planned PIP investments and compared against international benchmarks, including as part of the *DISCO PIP and Metering Capacity and Needs Assessment*. In addition, the bulk procurement of meters under the IPF component of the Program is expected to significantly reduce the costs/meter when compared to each DISCO undertaking meters individually. The costs savings through bulk meter procurement, as demonstrated elsewhere under World Bank programs, are due to economies of scale and low risk assessment by vendors based on confidence in transparency of World Bank procurement processes and maximum certainty of payment**.**

Table 6: DISREP PforR Funds Allocation

DISCO	PIP investment requirement (million US$)	Proportion of total investment	Base DISREP allocation (million US$)	Proportional DISREP allocation (million US$)	Total DISREP allocation (million US$)	Funding per DLI (million US$)				
						DLI#1	DLI#2	DLI#3	DLI#4	DLI#5
						20%	28%	28%	10%	14%
Abuja	175	10.2%	12.0	21.8	33.8	6.8	9.5	9.5	3.4	4.7
Benin	116	6.8%	12.0	14.5	26.5	5.3	7.4	7.4	2.6	3.7
Eko	216	12.6%	12.0	26.9	38.9	7.8	10.9	10.9	3.9	5.4
Enugu	130	7.6%	12.0	16.2	28.2	5.6	7.9	7.9	2.8	4.0
Ibadan	210	12.3%	12.0	26.1	38.1	7.6	10.7	10.7	3.8	5.3
Ikeja	281	16.4%	12.0	35.0	47.0	9.4	13.2	13.2	4.7	6.6
Jos	109	6.4%	12.0	13.6	25.6	5.1	7.2	7.2	2.6	3.6
Kaduna	137	8.0%	12.0	17.1	29.1	5.8	8.1	8.1	2.9	4.1
Kano	145	8.5%	12.0	18.1	30.1	6.0	8.4	8.4	3.0	4.2
P/H	122	7.1%	12.0	15.2	27.2	5.4	7.6	7.6	2.7	3.8
Yola	68	4.0%	12.0	8.5	20.5	4.1	5.7	5.7	2.1	2.9
TOTAL	1,708	100.0%	132.0	213.0	345.0	69.0	96.6	96.6	34.5	48.3

D. Results Framework and Monitoring and Evaluation

27. **The capacity to monitor results will be key to ensure Program success and effectiveness.** DISCOs already have in place frameworks to monitor network performance and connections however these frameworks are not always adhered to or enforced. The requirement for DISCOs to demonstrate performance improvement in order to meet Program DLIs is expected to improve DISCO performance monitoring and reporting to NERC. The Results Framework has been established, with BPE in charge of monitoring results at the national level through collection of data inputs on key tracking indicators of progress and performance of DISCOs. Monitoring DISCO performance is a central mandate of BPE which aligns directly with their role in the DISREP. To support BPE in this function, NERC's mandate as network regulator includes oversight of PIP implementation. Given the alignment of the DISREP to the PIPs, NERC's monitoring of PIP will also support BPE in the oversight of DISREP implementation. The establishment of the DAP at NERC will enable them to access accurate and timely data on how the distribution network is functioning, determine if DISCOs are in regulatory compliance, and assess performance against PIP targets and DISREP DLIs. Given the DAP will be populated automatically with system generated network data, it reduces the likelihood of disputes regarding performance outcomes of DISCOs.

E. Economic Analysis

28. **The World Bank team has carried out an economic assessment of the proposed operation in accordance with World Bank guidelines[1].** The rationale for public sector financing and World Bank value added are presented in addition to analysis undertaken regarding the expected costs and benefit of the Program.

Rationale for public provision and financing

29. **There is strong rationale for public financing and provision of interventions detailed in DISCOs' PIPs, under the framework of the PSRP.** Given the poor financial position of DISCOs they are unable to access commercial financing and therefore, without public sector support, will be unable to turn-around their performance. In its current state, the distribution sector undermines the performance and financial viability of the power sector as a whole, in-turn severely impacting all parts of the Nigerian economy and population. DISCO operational and financial underperformance creates a vicious cycle where investments in DISCO improvements are limited due to lack of capital and access to capital is limited due to poor performance and associated risks. By providing public financing into the sector, DISCOs will be able to make the initial distribution sector interventions required to realize preliminary PIP outcomes, including increasing connections and access to electricity, decreasing network losses, increasing the quality and quantity of electricity supplied, increasing revenues and remittances to NBET. Early gains from these interventions are expected to improve their access to private capital, thus breaking the cycle. Through the provision of public financing now, DISCOs will be able to reach a point where they can access private financing to support the future developments and commercial operations of the network.

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[1] This economic analysis is consistent with the following World Bank guidelines: Operational Policy and Bank Procedure, Program-for-Results, ii) Power Sector Policy and Investment Projects: Guidelines for Economic Analysis, iii) Social Value of Carbon in Project Appraisal, 2014 and iv) Discounting Costs and Benefits in Economic Analysis of World Bank Projects, 2016.

Value added of the World Bank's support

30. **World Bank support for PIP implementation adds significant value to the overarching FGN effort.** The World Bank is in a position to draw upon a wealth of global experience and expertise in areas directly related to Program interventions. Achievements from the successful implementation of the ongoing World Bank-supported operations focused on electricity distribution networks and operations, electricity access, and metering also provide a strong background for the proposed DISREP operation.

31. **The DISREP Program is a critical part of the World Bank's programmatic approach to address the sector problems, complementing other ongoing programs of work.** In particular, DISREP in conjunction with the recently approved PSRO PforR, represent a holistic approach to support the recovery of the Nigerian power sector, and together support the implementation of the critical elements of the FGN's PSRP – the PSR PforR addressing the PSRP key pillars of regulatory environment, operational efficiency and financial sustainability, with the DISREP the remaining two PSRP pillars – network infrastructure; and operational efficiency. Regarding the IPF bulk metering component of the DISREP, World Bank involvement is expected to decrease the overall costs of addressing Nigeria's customer metering gap by as much as 70 percent.

Methodology and assumptions

32. **The economic viability of the Program has been assessed through a cost-benefit analysis.** Net benefits for the Program were calculated by comparing total system costs and benefits for the "with Program" and "without Program" scenarios. A range of scenarios and sensitivities that meaningfully reflect the uncertainties of key input variables have been evaluated. The analysis includes a consideration of the relevant E&S externalities.

33. **The "with Program" scenario used in this analysis is conservatively based on the PIPs developed by DISCOs.** Based on PIP data, assumptions around increases in power supply, increases in customer demand, reductions in ATC&C losses, and increases in collection rates have been made. In all cases assumptions are made conservatively so as not to overestimate economic returns. Scenario assumptions used in the analysis can be seen in

34. Table **7**. Performance improvements have also been capped in the model at modest levels. PIP data is supplemented with data from the World Bank regarding the macroeconomic and fuel costs. The economic analysis is limited to economic benefits and costs that can be quantified. Commonly recognized but non-quantified economic benefits[2] and opportunity cost for the implementing the Program, are excluded for the analysis.

[2] The additional economic benefits that are difficult to quantify include operating efficiency of the power system, potential promotion of renewable energy through the implementation of LCDP and efficient pricing of electricity.

Table 7: Economic analysis scenario assumptions

Item	Assumption		Comment
	Without Program	With Program	
Electricity supplied to DISCOs	Constant at 2020 levels	Increasing by 0.5% per year from 2020 levels	Increases in electricity supply are expected due to direct power purchases from GENCOs as well as increased embedded power generation
Customer demand	Constant at 2020 levels	Increasing by 2% per year from 2020 levels	Increased demand it expected due to significant increases in customer connections and electricity access
ATC&C losses	Constant at 2017 levels	Decreasing by 2% per year, capped at ATC&C losses of 30%	ATC&C loss reduction is achieved through investment in grid rehabilitation and new grid infrastructure as well as commercial interventions such as RPPs. This figure of 2 percent aligns with historic trends in Nigeria and is in line with results achieved in similar distribution sector reform programs implemented in countries such as Mozambique. ATC&C losses are capped to ensure the performance of the program is not overestimated.

35. **The economic analysis includes the following economic assumptions:**

(i) **Discount rate**. 6 percent. The World Bank's guidance[3] applies the Ramsey formula and recommends using a discount rate between 1 to 2 times the long-term growth rate of the country. However, Nigeria's average real GDP per capita over the last five years was less than zero percent and future projection over 2020-2024 is also close to zero percent. NPV values for 2 percent and 10 percent discount rates are presented as part of the sensitivity analysis.

(ii) **Lifetime of Program**. 10 years. The evaluation period of 10 years considers the 5-year duration of the PIPs (2020-2024) and adds another 5 years to account for the useful life of distribution assets.

(iii) **Others**. Key economic assumptions are provided in

(iv)

(v) Table **8**.

Table 8: Key assumptions applied in economic analysis

Item	Unit	Assumption
Discount Rate	[%]	6.0
WTP	US$/kWh	0.13
Proportion of diesel self-generator replacement	%	50
Proportion of urban population	%	51.2
Exchange rate	NGN/US$	386

Program Costs

[3] OPSPQ, Discounting Costs and Benefits in Economic Analysis of World Bank Projects, May 9, 2016.

36. **The main Program costs are the capital costs.**

(i) **Capital costs.** Additional capital costs (capex) for the Program relate to the total Program expenditure of US$1.708 billion, as defined by DISCOs' PIPs expenditure under the MYTO capex investment limits. Investments are assumed to occur over five years (2020-2024) in line with PIPs (2020: US$300 million, 2021: US$300 million, 2022: US$365 million, 2023: US$371 million, 2024: US$371 million)

Program Benefits

37. **The main Program benefits include additional electricity supplied to customers and avoided global and local externalities.**

(i) **Additional electricity to customers.** Through a combination of loss reduction and increased supply, the Program is estimated to increase the electricity supplied to customers annually from 22,410 GWh in 2020 to 24,759 GWh in 2024. Over the 10-year lifetime of the Program this equates to an additional 9,526 GWh supplied to customers relative to the "without Program" scenario.

(ii) **Valuation of additional electricity made available.** The additional electricity made available by the Program can be valued at the consumers' WTP for electricity supply. The WTP analysis is typically determined by computing the area under a derived demand curve during each year of the Program's life. The key parameters needed to determine the area under the curve include total demand in each year of the project, the price elasticity of demand, and the marginal tariff. However, given the difficulties in reliably establishing these parameters for Nigeria, this economic analysis uses estimates of average WTP for Nigeria of NGN 23.37/kWh in 2012 prices translating into NGN 45.1/kWh (0.13 US$/kWh) in 2018 prices from Oseni (2017)[4], which are based on surveys of 835 households in Lagos and Osun states in Nigeria. This is a conservative estimate of WTP for Nigeria, as it does not include industrial and commercial customers, which are likely to have a higher WTP for electricity than residential customers. This method of estimating the WTP also does not include a consumer surplus from electricity consumption. Given this uncertain estimate of WTP, sensitivity analysis has been carried out around this value, with the cost of diesel self-generation as the upper limit (NGN 115/kWh or 0.32 US$/kWh). The estimated WTP is applied to the additional electricity supplied to customers. Given the benefits of the Program are calculated based on the additional value provided to customers, collection rates are not taken into account given the benefits to the customer are realized irrespective of whether or not they pay for the electricity.

(iii) **Energy cost-savings resulting from reduced losses.** Reduction in losses (from the 2017 baseline of 36 percent to 30 percent over the first five years of the project) also result in a decrease in generation required to service demand, even against the backdrop of increasing "With Program" demand. Decreasing non-technical losses is commonly accepted to in part increase sales of electricity but also in part decrease in demand and therefore result in savings in generation. For the purposes of this analysis it is assumed that 50 percent of non-technical loss reduction results in increased sales and 50 percent results in decreased generation, and in-turn a reduction in DISCOs' invoice from NBET. Only the savings associated with decreased generation constitute an economic benefit under this project. The savings in electricity generation derived from the reduction in losses are valued at the average NBET per kWh charge to DISCOs of US$0.8 per kWh plus 7 percent DISCO O&M costs.

[4] Musiliu O. Oseni, Self-Generation and Households' Willingness to Pay for Reliable Electricity Service in Nigeria, Volume 38, Number 4 of The Quarterly Journal of the IAEE's Energy Economics Education Foundation. 2017.

(iv) **Global externalities.** Global externalities constitute another economic benefit of the proposed Program, given that the Program will lead to a decrease in use of diesel-based generators. The assumption in this analysis is that the additional electricity will go toward replacing diesel self-generation. GHG emissions of the mix of electricity supplied through the grid are lower than GHG emissions from diesel self-generation. The GHG emission factors for different sources of generation are given in Table 9.

Table 9: GHG emissions factors of generation

Item	Unit	Gas	Diesel
IPCC default	kg/GJ	56	74
Converted to MMBtu	kg/MMBtu	53	70
Efficiency	%	50	40
Heat rate	BTU/kWh	7,200	8,530
Emissions	kg/kWh	0.38	0.60

(v) **Avoided local externalities.** Local health damage costs resulting from NO_X, PM_{10} and SO_2 emissions from self-generation are greater in densely populated urban areas than in more remote rural areas, because diesel self-generation units in densely populated areas typically have low stacks and are rarely fitted with pollution controls. Moreover, particulate emissions, largely absent from gas, are particularly damaging to human health. As a result, local damage costs are lower under the "with Program" scenario than under the "without Program" scenario. While no reliable Nigeria-specific health damage study is available to estimate the local emission damage costs associated with electricity generation, a representative damage cost estimate for United States was scaled up by the ratio of purchasing power parity per capita GDP, resulting in a damage cost for US$712/ton, US$1,745/ton, US$847/ton for NO_X, PM_{10}, and SO_2 respectively (see Table 10).

Table 10: Damage costs

Variable	Unit	Nox	PM10	SO2
US Damage costs	US$/ton	7,460	18,280	8,870
US PPP per capital GDP	US$	55,681	55,681	55,681
Nigeria PPP per capita GDP	US$	5,315	5,315	5,315
Nigeria Damage Costs	US$/ton	712	1,745	847

Results

38. **The economic analysis demonstrates that proposed Program is economically viable.** The baseline economic internal rate of return (EIRR) of proposed Program against the "without Program" scenario is 10.03 percent and NPV is US$198 million. The inclusion of local and global environmental benefits increases the economic return by 4.43 percentage points to 14.46 percent with an NPV of US$423 million.

Table 11: Summary of Economic Analysis

	Unit	Result
Economic Internal Rate of Return		
EIRR	%	10.03%
EIRR+local externalities	%	10.28%
EIRR+local externalities+global externalities	**%**	**14.46%**
Composition of NPV		

	Unit	Result
Total costs	US$ million	(1,428)
Total benefits *Decreased electricity generation costs* *Additional electricity to customers*	US$ million *US$ million* *US$ million*	1,626 *862* *765*
NPV (before environmental benefits)	**US$ million**	**198**
Local environmental benefits	US$ million	14
Global environmental benefits	US$ million	211
NPV (including environment benefits)	**US$ million**	**423**

39. **The Program results in a net reduction in GHG emissions.** Over the ten-year assessment period, the full FGN Program is estimated to result in total net CO_2 emissions reductions of 7.6 million tonnes of CO_2, at an average of almost 700 thousand metric ton CO_2 reduction each year. Emissions reductions result from decreased power generation as well as from reduced diesel generation as a result of increased electricity access.

Risks and Sensitivity Analysis

40. **Sensitivity analysis has been conducted against all key parameters that have a significant impact on the Program's economic rate of return.** These include the total ATC&C loss reduction, average WTP, discount rate, and GHG reduction value.

(i) **Total ATC&C loss reduction.** Total ATC&C loss reduction is capped in the analysis so as not to overestimate the impact of Program interventions – the "With Program" scenario reduces losses from a 2017 baseline of 36.6 percent to a minimum of 30 percent. Loss reduction is central to the aims of the FGN program and therefore to the DISREP operation. Quantifying expected loss reduction across a range of interventions is however complex. The switching value for the total loss reduction (to turn NPV to zero) is 32.6 percent – a loss reduction of 4 percent from the 2017 baseline.

Table 12: Sensitivity total ATC&C loss reduction

ATC&C loss limit	NPV (US$ million)	EIRR (%)
31 (-5.6% from baseline)	171	9.62
30 (-6.6%)	423	14.46
26 (-10.6%)	1,160	24.85
		Switching value: 32.6 (-4%)

(ii) **Average WTP.** The additional electricity evacuated by the Program is valued based on surveys of residential households. Since actual WTP should ideally also take into account industrial and commercial customers, the values used in this economic analysis are subject to high uncertainty. The switching value for the WTP (to turn NPV to zero) is less than US$0.058/kWh.

Table 13: Sensitivity Analysis on WTP

WTP (Usc/kWh)	NPV (US$ million)	EIRR (%)

7	70	7.61
13	423	14.46
32	1,540	29.16
		Switching value: US$ 0.058/kWh

(iii) **Discount rate.** The choice of discount rate is a critical assumption that has a significant impact on the NPV of a project. As a result, a sensitivity analysis has been carried on the discount rates used in this analysis.

Table 14: Sensitivity analysis on discount rate

Discount Rate	NPV (US$ million)
2%	791
6%	423
12%	88

(iv) **Carbon emission value. I**n the World Bank's 2017 Guidance Note on Shadow Price of Carbon in Economic Analysis, carbon emissions are valued at "high" and "low" levels, starting US$80/ton and US$40/ton in 2020 and increasing US$100/ton and US$50/ton in 2030, respectively.

Table 15: Sensitivity analysis on cost of carbon

Electricity Supply	NPV (US$ million)	EIRR (%)
Low (2017 Guideline)	451	15.06
High (2017 Guideline)	691	19.79

F. Financial Analysis

Methodology and assumptions

41. **The financial viability of the Program has been assessed through a cost-benefit analysis.** Net benefits for the Program were calculated by comparing additional financial inflows and additional financial outflows incurred by the DISCOs due to implementation of the DISREP operation. This is calculated through analyzing the "Without Program" and "With Program" scenarios developed as part of the economic analysis. A range of scenarios and sensitivities that meaningfully reflect the uncertainties of key input variables have been evaluated.

42. **The data used in this analysis as well as the scenario and macroeconomic assumptions made align with the economic analysis.** The central scenario and macroeconomic assumptions made in the financial analysis can be seen in
43. Table **7**7 and
44.
45. **Table 8**8. Additional assumptions made for the purpose of the financial analysis include the following:

(i) **Tariffs.** Average tariff rate (per DISCO) is assumed to stay constant for the evaluation period and are taken to be the DISCO level tariff figures from the latest (September 2020) MYTO model by NERC. An average tariff rate across different consumer classes is calculated and used for the purpose of the analysis.

(ii) **Collection rates.** An annual increase (betterment of collections) of 7.5% per year is assumed, capped at a collection rate of 85%. Collection rate is assumed to improve significantly through deployment of widespread customer metering ensuring pre-payment of electricity consumed as well as through the implementation of RPPs. Collection rates are capped at 85 percent to ensure the performance of the program is not overestimated.

(iii) **Others**. Key sector assumptions are provided in Table below.

Table 16: Key assumptions used in financial analysis

Item	Unit	Assumption
Average Tariff Rate (per DISCO) – MYTO data	US$/kWh	
Abuja	US$/kWh	0.15
Benin	US$/kWh	0.15
Enugu	US$/kWh	0.15
Eko	US$/kWh	0.13
Ibadan	US$/kWh	0.15
Ikeja	US$/kWh	0.12
Jos	US$/kWh	0.20
Kaduna	US$/kWh	0.15
Kano	US$/kWh	0.14
PH	US$/kWh	0.17
Yola	US$/kWh	0.16
Cost of Electricity in Vesting Contacts	Usc/kWh	8
DISCO Variable O&M costs	%	7%

Program Costs

46. **The main financial outflows are the following:**

(i) **Capital costs.** Additional capital costs (capex) for the Program relate to the total Program expenditure of US$1.708 billion, as defined by DISCOs' PIPs expenditure under the MYTO capex investment limits. Investments are assumed to occur over five years (2020-2024) in line with PIPs (2020: US$300 million, 2021: US$300 million, 2022: US$365 million, 2023: US$371 million, 2024: US$371 million)

(ii) **Cost of electricity purchases.** Additional purchase of electricity from NBET technically makes up for a financial outflow, but the analysis reveals that with the improvement in collections and aggressive loss reductions planned would allow DISCOs to serve the existing and growing demand with the existing supply from GENCOs via NBET. While the analysis reveals a drop in electricity purchases from DISCOs, the model has conservatively assumed the costs to remain the same for the duration of the analysis.

(iii) **Cost of sales.** Additional cost of sales is derived from DISCOs' PIPs and include the increases in both operations and maintenance (O&M) costs and cost incurred during the sale of electricity due to the increase in distributed electricity and customer connections. Cost of sales therefore include costs of additional electricity supply from NBET, additional maintenance and servicing costs for a growing customer base, and financial costs such as debt servicing.

Program Benefits

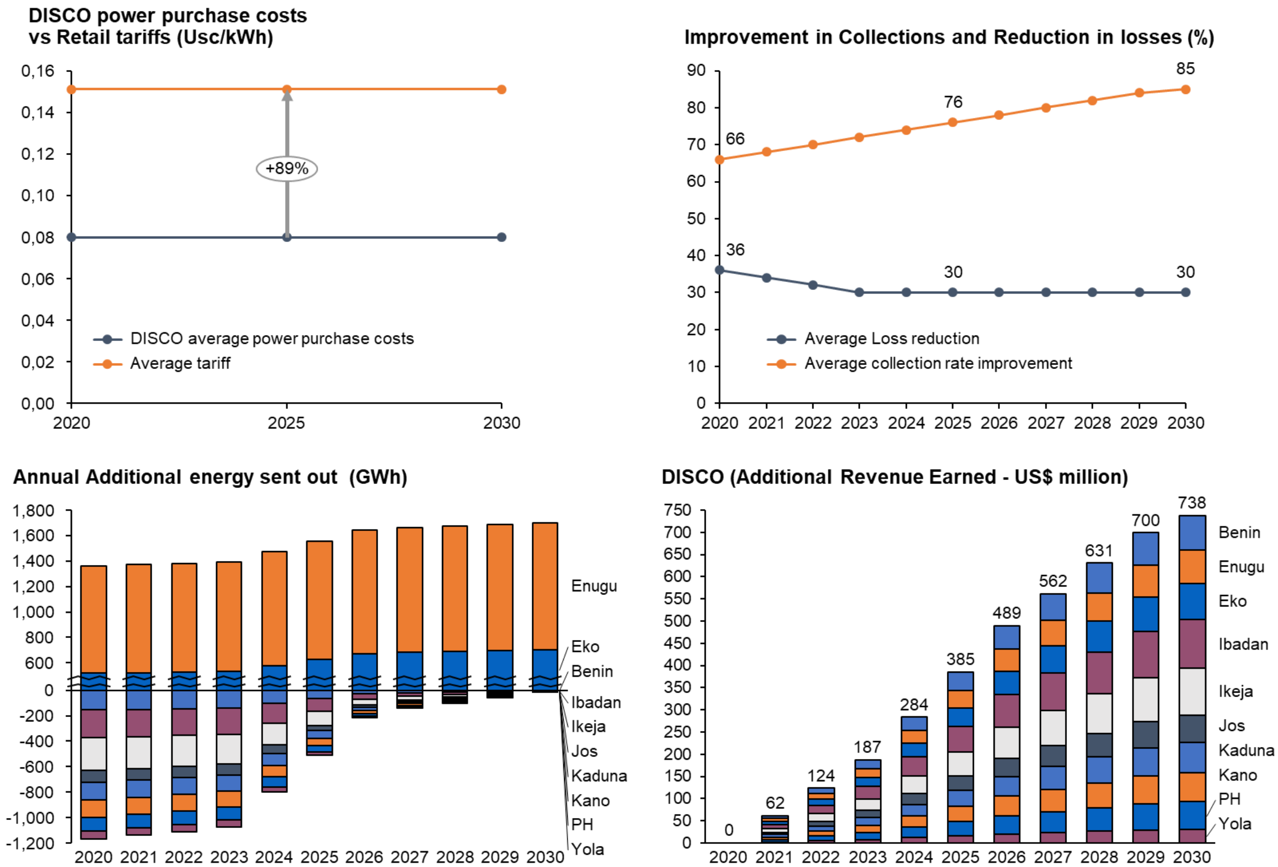
47. **The main financial inflows are due to the additional revenue earned due to additional electricity served to the customers.** DISCOs are expected to earn additional revenues that are projected to grow at a compounded annual growth rate of 32 percent between 2020 and 2030 (from US$62 million in 2021 to US$738 million in 2030) with the implementation of the Program. The key drivers for this additional revenue are (see Figure 1):

(i) **Improved Collection rates and Reduction in Losses.** 19 percent improvement in collections assumed between 2020 and 2030 due to metering rollout combined with a 6 percent reduction in Distribution losses due to infrastructure improvements during the same time period allow the DISCOs to earn additional revenue per kWh of electricity sold to end consumers and recover the investment costs.

(ii) **Spread between the power purchase costs and the MYTO allowed retail tariffs.** The current spread between the average purchase price (average across all DISCOs) and the average 2020 MYTO retail tariff (average across all DISCOs and all consumer classes for simplified model) allows DISCOs to sufficiently cover their operating expenses and debt service obligations related to PIP investments and also earn a return on their investment.

(iii) **Additional energy sent out to customers** is estimated to increase annually from 22,410 GWh in 2020 to 24,099 GWh in 2030. Over the 10-analysis timeframe, this equates to an additional 32,106 GWh supplied to customers relative to the "without Program" scenario cumulatively between 2020 and 2030. This additional energy contributes to the additional revenues earned.

Figure 1: Key drivers for Program benefits



Results

48. **The financial analysis demonstrates that the proposed Program is financially viable for the DISCOs on an aggregate basis.** The baseline financial return of proposed Program for the 2020-2030 horizon against the "without Program" scenario is 25.16 percent and NPV is US$1,555.

Table 17: Summary of Financial Analysis

	Unit	Result
Financial Internal Rate of Return		
FIRR	%	25.16
Composition of NPV		
Total costs	US$ million	1,428
Total benefits	US$ million	2,983
NPV	**US$ million**	**1,555**

Risks and Sensitivity Analysis

49. **Sensitivity analysis has been conducted against all key parameters that have a significant impact on the Program's financial rate of return.** These include the Retail tariff rate, Collections rate and Loss reduction rate.

Table 18: Sensitivity Analysis on WTP

Parameter	Unit	Value	NPV (US$ million)	FIRR (%)
Retail tariff rate	Usc/kWh	15	1,536	25.16
	Usc/kWh	7.5	53.78	6.8
	Usc/kWh	20	2,617	35.74
Collections rate	%	85	1,536	25.16
	%	70	28.67	6.5
	%	90	1,555	25.26
Loss reduction rate	%	2	1,536	25.16
	%	0.5	(US$255.98)	1.9
	%	3	2,252	34.95

(i) **Retail tariff rate.** Retail tariff rate provides the buffer between the purchase price and selling price of electricity and allows for a reasonable return on investment. If this regulatory retail price is not adjusted (as in the past), it erodes the viability of the program to be financially viable. Assuming the increased collections and the loss reductions along with increased supply to consumers – if the retail tariff is reduced to half its existing value (Usc 7.5/kWh), the NPV drops to US$53.78 million with the IRR of 6.8 percent (very close to the discount rate of 6 percent). The switching value for the retail tariff would be below Usc 7/kWh.

(ii) **Collections rate.** A significant effect expected from the implementation of the program is that of increased collection rate. Should there be only very marginal improvements in the collections rate (10 percent) while still maintaining all other improvements constant, the NPV drops to just US$28.67 million with an IRR of 6.5 percent (very close to the discount rate of 6 percent). The switching value for the collections rate is to have no improvement in the collection rate and remain at 65 percent.

(iii) **Loss reduction rate.** Similar to the collections rate, a significant improvement expected from the investment in the infrastructure upgrade is the reduction of aggregate technical and commercial losses. Should the loss reduction rate only yield a return of 0.5 percent per annum, the program would yield a negative NPV of US$256 million with an IRR of 1.9 percent (below the discount rate)**.**

Figure 2: Net Benefits – Sensitivity scenarios vs Base case