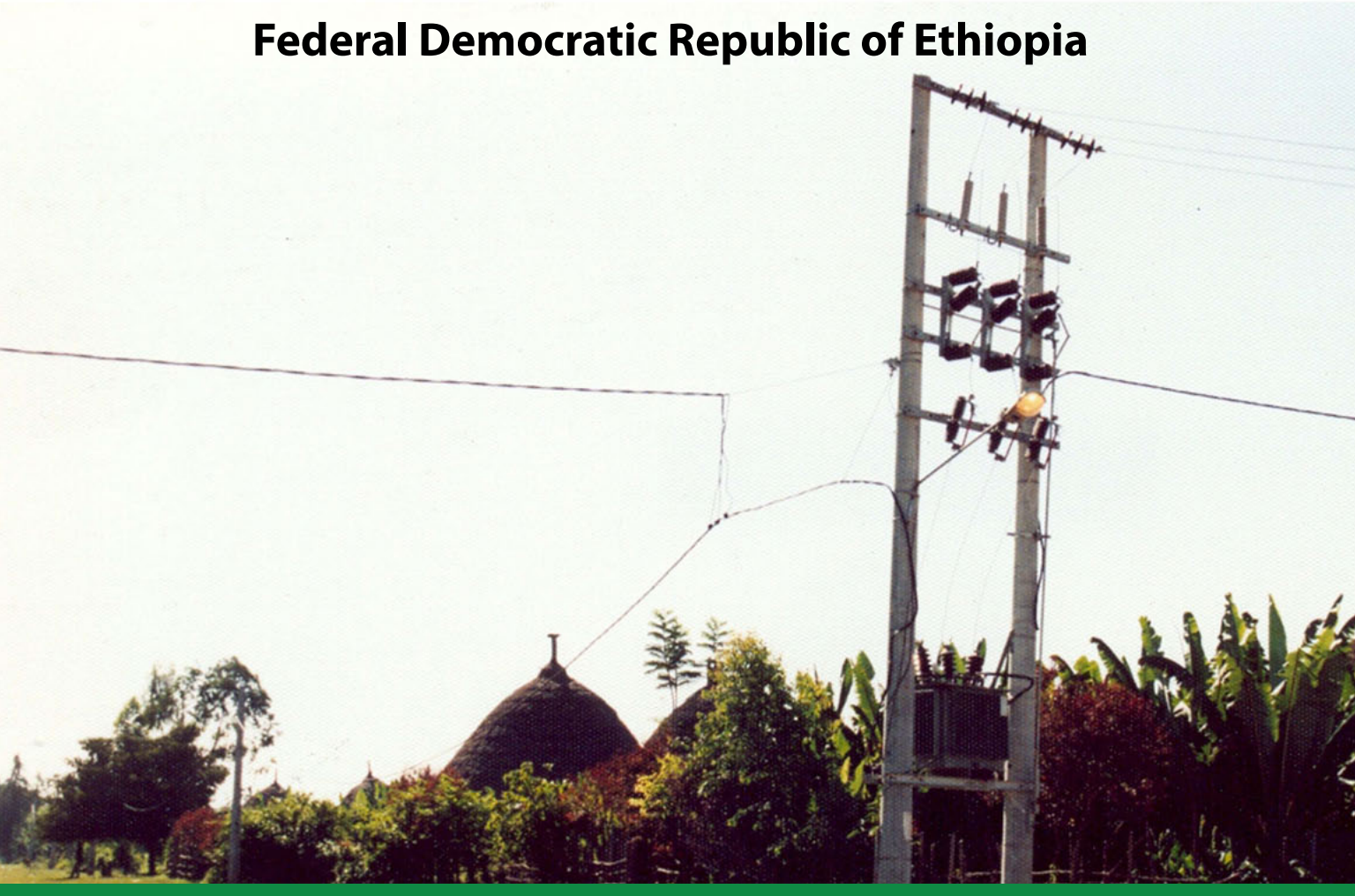
Federal Democratic Republic of Ethiopia



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Light to All

National Electrification Program

Implementation Road Map and Financing Prospectus

2017

National Electrification Program

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Back cover: Ministry of Water, Irrigation, and Electricity and Ethiopian Electric Utility.

National Electrification Program

Implementation Road Map and Financing Prospectus

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Light to All

2017

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Acronyms and Abbreviations

BPR	Business Process Reengineering
CE	Citizen Engagement
CFL	Compact Fluorescent Lamp
CO_2	Carbon Dioxide
CRGE	Climate Resilient Green Economy
DBE	Development Bank of Ethiopia
DoE	Directorate of Electrification
DP	Development Partner
EAPP	East Africa Power Pool
EEA	Ethiopian Energy Authority
EEP	Ethiopian Electric Power
EEPCo	Ethiopia Electric Power Corporation
EEU	Ethiopian Electric Utility
ERP	Enterprise Resource Planning
ESDP	Education Sector Development Programme
GDP	Gross Domestic Product
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoE	Government of Ethiopia
GTP	Growth and Transformation Plan
GW	Gigawatt
GWh	Gigawatt/hour
HDI	Human Development Index
HH	Household
HSPD	Health Sector Development Programme
IAIP	Integrated Agro-Industrial Parks
ICT	Information and Communication Technology
IDA	International Development Association
IPP	Independent Power Producer
IRM	Implementation Roadmap
Km	Kilometers
Kw	Kilowatt
kWh	Kilowatt/hour
LED	Light-Emitting Diodes
LV	Low voltage
M&E	Monitoring and Evaluation

MFI	Micro Financial Instituttion
MIS	Management Information System
MOFEC	Ministry of Finance and Economic Cooperation
MoWIE	Minister of Water, Irrigation and Electricity
MSME	Micro, Small and Medium Enterprises
Mt	Metric tons
MTF	Multi-Tier Framework
MV	Medium voltage
MW	Megawatt
NBPE	National Biogas Program of Ethiopia
NEP	National Electrification Program
NES	Natural Electrification Strategy
NGO	Nongovernmental Organization
NICSP	National Improved Cook Stove Program
OPEC	Organization of the Petroleum Exporting Countries
PAYG	Pay as You Go
PPA	Power Purchasing Agreement
PPP	Public Private Partnership; Power Purchasing Parity
PSE	Private Sector Enterprise
REB	Regional Energy Bureau
REF	Rural Electrification Fund
SC	Steering Committee
SDG	Sustainable Development Goals
SE4All	Sustainable Energy for All
SHS	Solar Home System
SME	Small and Medium Enterprises
SSA	Sub-Saharan Africa
UEAP	Universal Electricity Access Program
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Program
USAID	United States Agency for International Development
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization
Wp	Watt Peak

Foreword

Ethiopia's electrification needs are huge and urgent. In line with its climate resilient green economy strategy, the country has registered success and rapid growth in energy generation from renewable resources, particularly hydropower. It has a generation capacity of 4.3 GW and, double of this, 8.9 GW is under construction, and many other diverse sources of energy are in the pipeline. By 2025, at which time Ethiopia desires to attain middle-income country status, rural and urban areas electricity access is expected to reach 100 percent, from the current 30 percent access rate. Achieving Ethiopia's development vision of transformative growth and widely shared prosperity requires timely provision of adequate, affordable, and reliable electricity access and connections to all. Electricity access is an essential pillar of sustainable development, economic prosperity, and social and environmental developments. It is at the very foundation of the modernization of the national economy and well-being of our citizens and communities; enabling efficient, timely, and essential services delivery in education and health, access to water, telecoms, as well as informational, administrative, and financial services.

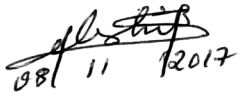
There is no time to lose.

It brings me great pleasure to write this foreword for Ethiopia's National Electrification Program-Implementation Road Map (NEP-IRM) to achieve universal access (connectivity) by 2025. The NEP-IRM is a transformative sector-wide implementation program, and its design is guided by best practice, including the organizing principle of "Many Players, One Team, One Plan" bringing together all sector stakeholders and Development Partners and led by the Government. The traditional way of expanding energy access—increasing electricity generation capacity and extending the grid—is still vital. But it is slow and grid expansion alone is not sufficient. Meeting the double electrification imperative—to increase both the scale and the pace of electrification—is a huge task. But it's also an exceptional opportunity to develop Ethiopia in tandem with its aspiration of becoming a middle-income country with its 100 million population. The immediate first phase of the NEP-IRM (2018–2022) will implement: (i) 4.5 million new grid connections, and (ii) launch alongside, a coordinated off-grid implementation program plan, designed for accelerated scale-up of solar systems and mini grid solutions in rural and deep rural areas.

The investment and directly related program implementation support requirements of the NEP-IRM are substantial and require mobilizing financing, sustained in a programmatic mode over time. Toward this specific end, the IRM includes a Prospectus for syndicating (mobilizing) about $1.5 billion of financing—investment and Technical Assistance, on-grid and off-grid—for the initial five-year program implementation period (2018–2022). It

identifies clear expectations, mandates, and accountability for performance and for achieving results and outcomes by the designated sector institutions, agents and intermediaries—public, private, for grid and off-grid access targets. Enabling mechanisms include decentralization of institutions with corporate capacities at the regional level and reforming electrification actions at all levels. It also provides a clear focus and wide scope for all stakeholders to participate in Ethiopia's energy sector progress. I hope that Ethiopia's Development Partners will rally forth their support in alignment with our national goal and priorities, and with scaled up support for financing the rapid electrification of the nation.

I wish to thank government agencies and our Development Partners for their contributions to date, toward preparation of this first IRM. Going forward, the NEP-IRM clearly needs to be a living document, periodically updated, to respond to significantly changed circumstances or information about key technical, economic, or other variables underpinning its design. A number of specialized initiatives including putting in place a GIS-enabled planning system, are under way, with others to be launched in the near future. Their outputs in the coming months, together with actual implementation experience on the ground early on, will provide the basis for the next updated version of the IRM and Prospectus.



Minister Dr. Seleshi Bekele
Ministry of Water, Irrigation, and Electricity
8 November 2017, Addis Ababa, Ethiopia

Executive Summary

ES.1 Introduction—from vision to action

Adequate, reliable, and affordable electricity access connectivity nationwide is a critical enabler for realizing Ethiopia's future growth and transformation, economic prosperity, and well-being of all its citizens nationwide. Today, grid connected household connectivity is about 20+ percent of the population. And many priority social services delivery institutions especially in rural areas—schools and clinics—also have limited access connectivity and reliability. There is no time to lose.

Following release of the Government's National Energy Strategy (NES–2016) and reflecting its recommendations, the Ethiopia's National Electrification Program (NEP)—Implementation Roadmap (IRM) presents the Government's action plan for ***achieving universal electricity access nationwide by 2025,*** in a strategic and comprehensive as well as efficient and transparent manner, for the benefit of all its citizens.

Toward this end, the key operational action elements of the NEP-IRM target are:

(i) ***fast-paced ambitious grid connections rollout program implemented by Ethiopian Electric Utility (EEU) starting in 2018,*** and designed for scaling up connectivity nearly five-fold from today by 2025, to over 14 million households in customer count terms (equivalent to about 65 percent of the population in 2025 of about 22 million households); and a coordinated and

(ii) ***enhanced design and reach of an off-grid access rollout program alongside grid connections for the achievement of universal access by 2025,*** targeted to provide access for the remaining 5.7 million rural and deep rural households without grid connectivity (equivalently to about 35 percent of the population in 2025). The off-grid program component designs—deploying individual solar systems and isolated mini/micro grids as feasible—and respective implementation and financing frameworks will incorporate the relevant and proven international experience from country specific program instances where such a scale has been achieved demonstrably and sustainably, especially for rural areas.

(iii) ***explicit cross-sectoral linkages with the productive and social services sectors***—especially health, education, and water supply points—to achieve 100 percent access at the latest by 2022 in the case of secondary schools and primary health centers.

Overall, the estimated financing requirement for the first phase implementation of the program dimensioned above—grid and off-grid together (2018–2022)—is about US$1.5 billion; of which slightly over 3 percent is for program implementation support and Technical Assistance directly related to accomplish the target objectives and outcomes (Table ES.1).

ES.2 Key elements of the roadmap design framework

The NEP-IRM is a homegrown design and emphasizes a practical and action-oriented focus on the near-term high priority actions. It is informed by

Table ES.1 Summary of program financing requirements (2018–2022) (public share)

	Investment (US$ million)	Immediate Technical Implementation Support (US$ million)	Subtotal
Grid	975	42	1,017
Off-grid	478	6	484
Total	**1,453m**	**48m**	**1,501m**

international best practice experience from countries that have achieved near universal access or are well advanced in implementation. While the successful national electrification programs were undertaken in diverse country contexts and environments, they all share—in essence—a few core driving principles to effectively address and strike a workable balance between the key interrelated set of challenges centrally relevant to the provision of affordable electricity access for all.

Specifically, Ethiopia's NEP-IRM directly addresses the crucial interplay of technical and planning, institutional and policy, and financing frameworks that must all come together, and in a sustained manner, to enable the efficient and timely achievement of the ambitious connection targets and outcomes sought.

Key building blocks of NEP-IRM are depicted schematically in Figure ES1.

Notably, the overarching core principles and policy considerations underlying the detailed design of the NEP-IRM building blocks are:

- ***Government leadership and sustained commitment for the duration of NEP-IRM.*** The Government of Ethiopia has set up a high level Steering Committee—with cross-sectoral members and other experts—supported by MoWIE to provide strategic oversight and monitor progress toward ensuring efficiency, effectiveness, and timeliness in program delivery and target outcomes consistent with available financing;
- ***Least-cost rollout strategy*** (grid and off-grid coordinated) and investment program driven by national development perspective; and anchoring the NEP-IRM Financing Prospectus for mobilization (syndication) of financing on a programmatic basis;
- ***Clarity of roles and accountability for sector performance and results*** to ensure efficient and effective management and operation of the sector;
- ***Financial viability*** of the sector financing program and designated delivery agents in the public and private sector over the program implementation period;
- ***Equity and inclusion,*** ensuring customer affordability especially for the disadvantaged groups, including women and the poor nationwide;
- ***Environmental and social sustainability;*** and
- ***Consultative process*** orchestrated by GoE and sector wide, bringing together key stakeholders under the organizing principles of ***"Many Partners, One Team, One Plan."***

Figure ES.1 Foundational building blocks of the NEP-IRM

The overall scope of the first NEP-IRM presented in this document—whose preparation was guided by the principles outlined above—is the Government's comprehensive blueprint and action plan for financing and implementation of the electricity sector access (connectivity) to achieve universal access by 2025. It lays out a structured pathway and a balanced multipronged action plan for implementation starting in 2018, including specific near- and mid-term investments (on- and off-grid), with corresponding technology choices for expanding access at least cost nationwide. The following subsections of this Executive Summary section are organized to highlight the defining dimensions of the NEP-IRM above:

ES.3 Capital expenditure least-cost staged program

Overall capital expenditure (capex) for grid rollout (medium and low voltage lines and final connections, excluding upstream costs of generating and transmission), is estimated at about US$19 billion[1] for universal on-grid access through network densification and expansion by 2030. Table ES.2 provides the buildup differentiated by the spatial distribution of household segments, based on the review of available technical reports and information. For costing purposes, three customer segments—labeled A, B, and C—are broadly delineated. Of the estimated 2016 population of 18 million households (HHs),[2] EEU records indicate 2.4 million customer accounts.[3] Available data on spatial settlement patterns further indicate that of the remaining 15.6 million HHs unconnected in 2016, about 42 percent (7.6 million) were settled "proximately" to the existing low voltage (LV) network of EEU. These mostly require service drops and limited LV extension, with estimated cost per connection ranging from US$150 to US$600, depending on location;[4] while the other 8 million are "not proximate," and connecting them will typically require limited medium voltage (MV) extensions as well as new LV networks, increasing the cost per connection to US$900. These are labeled, respectively, as Components A and B.

Spatial Component C represents the estimated 7 million new HHs formation, resulting from the growth in today's population of 100 million and projected to reach about 138 million by 2030. Providing grid access to this segment will require full-scale MV extensions and LV network reticulation nationwide, optimized to the emerging settlements geo-spatially defined. The capex for Component C is estimated to be US$8.4 billion, at an average unit capex of US$1,200.

Figure ES.2 depicts the segmentation of the potential customer segments A, B, and C identified above, with a different focus; the widening circles symbolize *within each circle*, increasing spatial spread, and lower spatial density will be encountered as grid rollout implementation over time advances in its reach geo-spatially. The newer grid connections on the margin will be increasingly situated further away from the existing EEU network infrastructure footprint[5]—urban, peri-urban, and rural toward the furthest deep rural area households and communities—where there typically will be on average fewer connections per unit of network line and investment required to connect them to the grid.

Responding to these spatial and structural characteristics and demographic settlement patterns, the

Table ES.2 NEP Capital Expenditure (Capex)—least-cost staged program

(order of magnitude estimate)

HHs Segments	Spatial Proximity Segmentation	US$/Connection	Estimated Capex (US$ billion)
A. Existing—"Proximate" (mostly LV investment—of which first stage "densification program" targets approx. 4.5m cheapest connections)	(First) 2.5m	US$150	0.375
	(Next) 2.0m	US$300	0.6
	Average US$/conn. for 4.5 million	US$222	US$0.975m
	(Next) 3.1m	US$600*	1.86b
	(Subtotal) 7.6m		~US$2.9b
B. Existing—"Not Proximate" (LV + some MV)	8m	US$900	US$7.2b
C. Population Growth (2016–2030)[a] MV + LV	7m	US$1,200	US$8.4b
Total A + B + C	22.6m	Average US$820/ connection	US$18.5[b]

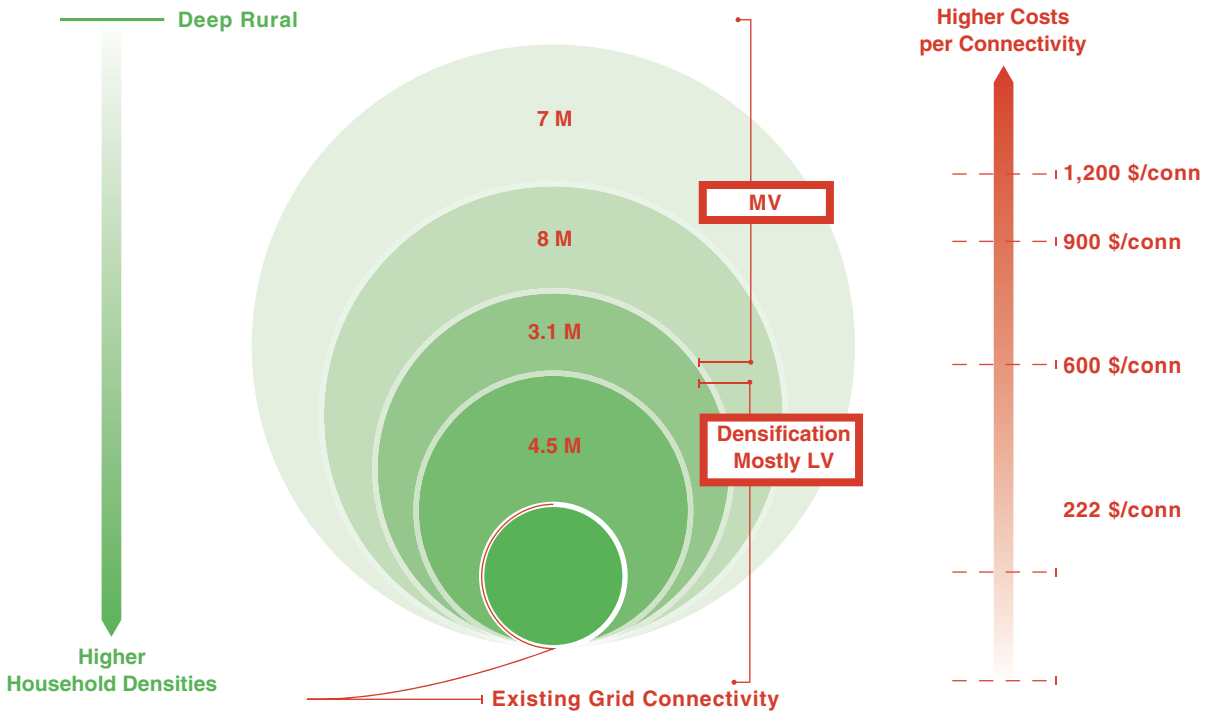
Note: Estimates do not include: (i) capex for MV network strengthening and reinforcements in all 15 regions necessary to enable densification of customer connections; (ii) capex required for the off-grid program rollout, and (iii) the cost of Technical Assistance necessary for strengthening institutional capacity directly linked to facilitate and support the achievement NEP implementation targets (DoE, EEU, as well as off-grid program implementing agents and key intermediaries).

[a] Population estimates: UN Statistical Office, Ethiopia. Assumes 5.5 people per HH (Source: Central Statistical Agency, CSA). 2016 population (est.): 100m (18 million HH); 2020 population (est.): 110m (20 million HH); 2025 population (est.): 120m (22 million HH); 2030 population (est.): 140m (25 million HH).

[b] Comparable estimates for the program through 2025: estimated cumulative capex = US$15 billion at the average unit connection cost of US$765.

* Average based on the US$450 cost for three poles.

Figure ES.2 Schematic least-cost access delivery to household segments spatially differentiated



-Grid connections in each circle will be complemented by off-grid preelectrification solutions

least-cost rollout strategy under NEP-IRM comprises a multipronged complementary set of delivery modalities and technology options: least-cost grid-based electrification rollout including introduction of innovative network designs and appropriate equipment specifications as grid extensions reach out further in lower density and remoter areas—and alongside the grid connectivity rollout programs in each of the circles (Figure ES.2); and a well-designed and comprehensive off-grid access scale-up program—individual solar systems and isolated mini/micro grids—will be implemented.

ES.4 Grid densification program implementation (2018–2022)

Consistent with the least-cost rollout strategy outlined in the preceding section, the focus of this immediate phase of NEP-IRM implementation (2018–2022) is systematically connecting the approximately 4.5 million new customers (Table ES.3) situated very close to the existing network infrastructure of EEU. These connections mostly require short LV service drops and metering. As such, they are marked by the lowest unit cost per new connection (under US$300). The estimated overall capital expenditure requirement of this program is about US$1 billion.

Alongside the grid connections program, Table ES.3 also indicates the scaling required for the off-grid preelectrification program rollout in order to achieve the NEP's goal of universal access by 2025. Beyond 2025, as the grid extensions and connections program progresses, a substantial number of the off-grid preelectrification program communities and beneficiaries will be absorbed into the grid system and provided connectivity. By the time the grid rollout advances to its identified economic limits (sometime between 2026 and 2030), grid access is projected to be of the order of 97 percent with the remaining household (3 percent) population provided off-grid access.

Table ES.3 Grid and off-grid connections program and electricity access (2018–2025)

Time Period		Population (million HHS)	On-Grid Connections Added[a]	On-Grid Cumulative Connections (million)	On-Grid Access Rate	Off-Grid Access Rate	Total Access Rate
GTP II	2016	18	0.1	3.6	20%[b]	11%*	31%
	2017	18.5	0.2	3.8	21%	11%*	33%
	2018	19	0.5	4.3	23%	11%*	34%
	2019	19.5	0.7	5	26%	11%*	37%
	2020	20	0.8	5.8	29%	13%	42%
GTP III	2021	20.4	1	6.8	33%	16%	49%
	2022	20.8	1.5	8.3	40%	20%	60%
	2023	21.2	2	10.3	49%	24%	73%
	2024	21.6	2	12.3	57%	29%	86%
	2025	**22**	**2**	**14.3m**	**65%****	**35%**	**100%**
GTP IV	2026	22.6	2	16.3	72%	28%	100%
	2027	23.2	2	18.3	79%	21%	100%
	2028	23.8	2	20.3	85%	15%	100%
	2029	24.4	2	22.3	91%	9%	100%
	2030	**25**	**2**	**24.3m**	**97%*****	**3%**	**100%**

[a] Based on population assumptions described in the notes of Table ES.2. Source: UN Statistical Office, Ethiopia.

[b] Consistent with the footnote to Table ES.1, the 20 percent grid connection indicated for 2016 is representative of the estimates reported in other reports; and by inference this implies about 3.6 million grid connections (instead of the 2.4m recorded in EEU's customer account records). The following rows in this Table are projected on the baseline of 20 percent.

* The baseline for 2016 is based on about 2,046,000 stand-alone solar (including lanterns) and 8,000 mini grid customer connections. For subsequent years (2017, 2018, and 2019) the rate for off-grid does not change because increases in off-grid solutions are not expected to be greater than population growth.

** To achieve NEP's goal of universal access by 2025, the off-grid rollout program will target the remaining 5.7 million households not grid connected in 2025. The off-grid strategy and implementation roadmap will further detail the targets for off-grid technologies and the institutional and implementation arrangements. The strategic directions for off-grid are presented in Section ES.6.

*** The Table reflects the expectation, pending confirmation by the detailed geo-spatial planning study, that the grid is expected to be a least-cost solution for the overwhelming majority of Ethiopia's population (of the order of 97 percent). Depending upon the implementation rates achieved beyond 2020, and availability of financing, least-grid connectivity can be achieved even prior. The residual 3 percent reflects the share of population for which the grid is not projected to be the least-cost solution.

The off-grid program strategy and rollout plan details are presented subsequently in Section ES.6.

In respect of the 4.5 million grid connections program implementation over 2018–2025, the Densification Program will target connections in a balanced manner across the 15 regions of EEU,[6] to the extent technically feasible. Specifically, connections will be selected not only in the proximate urban and peri-urban areas—where to start with, a substantial waiting list of paid customers exists and expectations are that this list can be readily augmented with promotion—but in particular accord priority as well to densification in the vicinity of the outer reaches of the UEAP program network, in communities where the MV network has been extended but connectivity still remains limited after several years in waiting and the network can support new connections (and/or require limited upgrading).[7]

Over the course of this implementation, the Government expects a steady buildup of EEU's managerial, organizational, and functional capacity—a detailed network design based upon annually updated ground level 2-year forward horizon rollout plans, materials procurement, warehousing and delivery logistics, and construction and connections program management—commensurate with implementation rates approaching 2 million connections per year and possibly even higher. Depending upon the actual implementation rates achieved beyond 2020, and availability of financing at the time, the economic limits of grid connectivity of about 97 percent can be achieved even prior to 2030.

Implementation capacity readiness for the Phase 1 program target of 4.5 million new grid connections—The Government is mindful that the year-on-year connections targets of this program (Table ES.2) are ambitious and seemingly daunting, if viewed only retrospectively in comparison to the annual connection rates of on-grid connections achieved historically, on average. They call for a

quantum shift and fast-paced acceleration in the scale of new connections each year, by several orders of magnitude (over ten-fold plus) by 2022. These challenges are surmountable and are purposefully and systematically addressed in the NEP-IRM immediate program implementation support design (Table ES.7), supported by the high priority near-term actions that have been identified for a well-targeted program of strengthening key functions of EEU's Distribution Operations Directorate in the near term (outlined later). Specifically, going forward, several factors come into play to enable breaking out of the "business-as-usual" trajectory of the past. Taken together, they are transformative in respect of EEU's implementation readiness for the grid Densification Program:

(a) ***Building on the base of consolidated and proven technical skills and operational experience with access coverage scale-up since 2005.*** With the unbundling of the sector and creation of EEU (and ongoing integration well under way of UEAP functions within and across the expanded EEU), the Government has established a professional institution with an exclusive focus and mandate for expanding access on two interrelated fronts: (i) continued access coverage of priority towns and community programs (UEAP) initiated in 2005, that has a proven and professional track record of achievement; and (ii) with the introduction of the NEP-IRM access connections scale-up is accorded top priority alongside coverage scale-up, enabling a combined simultaneous least-cost timely implementation of both. Crucially as well, UEAP staff bring long-established experience and proven professional skills and capacity into the entire range of functions called for connection scale-up: network planning and design of medium voltage network extension, organizing and managing procurement, warehousing, and construction of the distribution network and distribution transformers.[8]

(b) ***Targeted and focused strengthening of institutional capacity in specific high priority functions and skills identified that are directly linked to the scaled up implementation program in the immediate term.*** These near-term high priority actions (studies and Technical Assistance outlined subsequently) target and appropriately strengthen EEU's capacity across the key functions and business units that are involved with the connections scale-up program initiatives under the NEP-IRM and open the pathway toward achieving the ambitious targets set by GoE and described hereafter.

(c) ***Introducing affordable connection fee policy and structure to lower a key first cost barrier to becoming an EEU customer.*** Consistent with good practice experience and based on the findings and recommendations of a high priority special study provisioned for under the program implementation support component of Phase 1, the existing customer connection fee policy will be appropriately revised, including introducing the option for qualifying customers to pay the fee in easy installments collected by their EEU bill.

(d) ***Detailed design and preparation of the rollout of the first 500,000 connections starting January 2018.*** EEU, working closely with UEAP directorate—recently folded into EEU—has established a high level technical and management team with specific focus on detailing the calendar year 2018 implementation program. A comprehensive nationwide MV feeder-level technical network analysis has been completed, including demand assessment of all MV feeders in the country—over 550—with active participation of regional and district offices. The output of this rapid nationwide assessment of each MV feeder has led to an initial determination of the number of new connections that can be added on each feeder. Additionally, the team is preparing the corresponding Procurement Plan for the 500,000 connections (by major equipment category), identifying the number of items: (i) available in warehouses, (ii) to be procured in-country, and (iii) to be imported.

(e) **Improvement of business and commercial practices.** EEU has embarked on a multiyear, multifaceted process of comprehensively modernizing its back-office information technology (IT) systems, tools, and resources, to allow it to become a service delivery oriented and efficient corporation. EEU is in parallel undergoing a business process reengineering (BPR) exercise to improve and streamline delivery functions and further strengthen its quality of service delivery to its customers.

ES.5 Grid program—investment financing prospectus (2018–2022)

Table ES.4 shows the estimated year-by-year investment requirements (capex) for the Densification Program (2018–2022), rounded to about US$1 billion. Further, Table ES.4 illustrates one scenario for potentially mobilizing (syndication) this amount from three principal groups and revenue sources: broadly identified as within sector (40 percent), and the balance syndicated from Development Partners (DPs) under concessional terms and grants (60 percent). Specifically, in this illustration, within the sector US$225 million revenues are projected to be sourced from the one-time connection fee charged for new connections (at US$50 per connection, consistent with current practice). Additionally, GoE's equity contributions toward NEP-IRM financing requirement and totaling US$175 million over the five-year period are channeled via EEU. For the first year, the contribution for the government reflects past commitments, and for the following ones will be adjusted based on the connection policy to be adopted in 2019. The balance of a 60 percent share of the overall financing requirement (US$600 million) under this scenario will be raised from Development Partners.

The magnitude of capital expenditure required for achieving the NEP-IRM target of universal access (connectivity) is nothing short of daunting. The Government is mindful of the concomitant requirement over the same time frame for sustained mobilization of commensurate levels of financing (syndication). It looks to supplementing its own considerable resources invested in the sector, in partnership with its Development Partners,[9] within an overall sector-level programmatic financing framework mode through 2025.

Essential to the success of this joint endeavor is putting in place a "bankable" sector financing strategy, anchored by a soundly designed, transparent, and stable financing framework. It must effectively achieve a workable balance between (i) the Government's social equity objective of maintaining affordability of electricity access, especially to the poor; (ii) at the same time ensuring the sector entities' financial health, a prerequisite for operationally and sustainably scaling up access in a timely manner; and (iii) that it will be fiscally "affordable" for the Government. Specifically, directly or indirectly the Government influences the following interlinked defining considerations underlying the sector financing strategy and the sector's long-term financial viability and sustainability:

- ***Affordability for poor beneficiaries***—influenced by connection fee policy and the monthly bill, determined by the retail tariff structure and average price level per unit consumed;
- ***Improved financial health and commercial viability of EEU***—ability of EEU to fully recover at a minimum all its recurrent costs of service provision via retail tariffs set to full cost recovery of operating expenditures, in which event all investments for the access program are provided as equity contribution by the Government; and

Table ES.4 Grid program investment prospectus (2018–2022)—indicative syndication scenario

Year	Connections (incremental number, US$ million)	Investment Requirements (incremental, US$ million)[a]	Investment Financing Mobilization—Syndication (indicative, USD million)		
			DPs share 60%		
			Customer Contributions	GoE/EEU	DPs
2018	0.5	111	25	45	67
2019	0.7	155	35	32.5	93
2020	0.8	178	40	32.5	107
2021	1	222	50	32.5	133
2022	1.5	333	75	32.5	200
Subtotal	**4.5**	**US$1,000m**	**US$225m**	**US$175m**	**US$600m**

[a] Calculation based on the weighted average of unit connection cost of US$222 (see Table ES.2). Final investment requirement Figures are rounded. Technical Assistance is identified separately in Section ES.8.

- ***Draw on public funds—***no nation has achieved universal access without public funds for a substantial portion of the capex for "last-mile" customer connections (MV, LV, and service drops).[10]

In light of the above considerations, for the past seven years, the Government has funded a substantial share of the capital investment requirement under the Growth and Transformation Plan (GTP) I and to date under GTP II, associated with the UEAP implementation to extend network coverage (medium voltage network) to priority towns and villages nationwide.[11] Financing for capital expenditure of the priority UEAP program implementation provided by the Government to Ethiopian Electric Power (EEP) was sourced from several funding sources: including the fiscal and development budget of GoE, Development Partner funds on concessional terms, and grants.

Looking forward—rapid pace of several structural changes in process, with implications for sector financial health and sustainability

The NEP-IRM is a linchpin for enabling the Government's priority efforts aimed at achieving a structural transformation of the economy and society. Toward ensuring that the electricity sector steps up its performance commensurately and plays the required role called for in the nation's development going forward, the Government has undertaken a series of key initiatives to restructure the power sector institutional framework and structure (these are highlighted in Chapter 1). The underlying strategic objectives include: ensuring power supply adequacy in line with the demand associated with (i) strong economic growth projections, (ii) scaling up affordable and reliable access to all, and (iii) power export markets (more below), as well as diversification of the generation mix (geothermal, solar, and wind) and increased private sector participation in generation.

Underpinning achievement of all the objectives above is strengthening the long-term financial health and viability of the electricity sector and the financial health of key implementing agents. The future looks very different from the past in several key respects:

- ***Retail electricity tariffs***—Historically, Ethiopia's cost of electricity service and hence retail tariffs have been among the lowest in Africa. The nation's unique power sector endowment of low-cost, low-carbon hydropower sources with minimal recurrent costs (opex) is a major factor. Additionally, compared to regional peers, the aggregate technical and commercial losses are relatively low (about 23 percent) and the bill collection rate is quite high (80–85 percent). These factors combined have supported an average domestic tariff rate, one of the lowest in the region (US$0.03/kWh), and last revised in 2006. Looking ahead, the sector will register progressively and rapidly increasing levels of a bulk power supply cost—capex and opex. While efforts for technical and commercial performance efficiency will be aggressively pursued by the utility, in and of themselves they will not be sufficient to absorb the higher unit costs of bulk power supplies over time.
- ***Sector cash flow overall***—The sector as a whole maintains a positive but slim operating cash flow presently. However, the sector revenue growth lags in pace with rising borrowing costs. Further, growing future debt service obligations will bear upon the sector finances in the coming years.
- ***Regional power trade revenues are projected to provide significant additional revenues to the sector.*** Ethiopia's power sector is positioning itself to become a power export hub in East Africa. Exports to Sudan, Djibouti, and Kenya could boost the country's export revenue potential, estimated around US$600 million, per annum, by the end of the decade. By 2020, Ethiopia could achieve as much revenue from power exporting as it does from domestic sources. Subject to further analysis, a portion of the export revenue in-flows could be earmarked for infrastructure investments and cross-subsidies for consumers, thereby abating the need for large tariff increases in the future.

Ensuring long-term financial health and viability of the electricity sector—course of action

The following efforts are under way toward developing a workable long-term sector financial sustainability framework and implantation plan:

- **Retail Tariff Framework Revision**—A draft tariff framework was prepared in January 2017, with tariffs reflecting a full cost of service provision for periodic adjustments every four years. Under the draft framework, the proposed average domestic tariff rate would be set at US$0.06/kWh. This proposal is currently under review by the management of the EEU, EEP, and the sector regulator, the Ethiopian Energy Authority (EEA). Following this, the proposal is expected to be presented to the Ministry of Water, Irrigation, and Electricity (MoWIE), and

then to the National Parliament for review by the end of calendar year 2017.

- **Sector Financial Viability Study**—The NEP-IRM provides for urgently conducting (Table ES.7) a comprehensive and detailed study to analyze the implications for long-term financial sustainability of the electricity sector and identify recommended course(s) of action for the Government's consideration toward implementation of a soundly designed, transparent, and stable financing framework to underpin NEP-IRM financing mobilization (syndication) in a programmatic framework, through 2025 and beyond.

This scope of the latter study will include: development of an appropriately structured and detailed sector financial model for projecting financial flows in and out of the electricity sector, reflecting inter alia appropriate domestic tariff regimes; options, such as augmenting domestic revenue with exports of power, possible rollover, and restructuring of existing debt; and finding innovative ways of reducing the public investment obligations and introducing sustainable financing mechanisms, such as, increased private participation.

ES.6 Off-grid program strategy and plan of action—universal access by 2025

The NEP-IRM responds purposefully to the Government of Ethiopia's priority for advancing equity, inclusion, and shared prosperity, irrespective of where one happens to live. This especially means not leaving behind traditionally underserved rural area populations nor rural institutions such as schools, health centers, and administrative buildings. There is no time to lose. Achieving NEP's goal of universal access by 2025—alongside an estimated 14 million projected to have grid connectivity by then (Table ES.2)—the off-grid access rollout program scale, scope, and design elements will be informed and organized along two strategic drivers:

- ***Off-grid preelectrification program (transitional):*** The target beneficiaries are settlements, communities, towns, and villages where grid connectivity is projected as least cost, but that may have to wait several years before they receive grid access. By 2025, about 5.7 million households will need to be provided access (solar systems of 10 watt peak (Wp) and above) and mini grids as and where appropriate. Delineation of the geo-spatial locations, numbers, and nature of prospective beneficiaries by spatial distribution will be determined in coordination with the scale and speed of grid developments and the national geo-spatial least-cost high level rollout plan (expected completion by mid-2018).
- ***Off-grid program targeted where grid connectivity is not the least-cost solution.*** Typically, the potential beneficiaries are remote and scattered household settlements and villages that are unlikely to be cost effectively served by grid connectivity. They may also include some homes that are not far from the existing grid but their isolation from neighbors' settlements and transformers raises the cost of connectivity greatly. The size of this component is preliminarily estimated at under one million households. Again, the spatial delineation of this target segment of beneficiaries will be analytically informed once the results of the national geo-spatial planning study are available (mid-2018).

Achieving the off-grid preelectrification target of providing access to 5.7 million households by 2025—deploying a combination of solar systems and mini/micro grid network connections—represents a daunting implementation challenge. The NEP-IRM recognizes and addresses the quantum shifts required operationally from business as usual. Specifically, to date, the off-grid program has provided access to about 2 million beneficiaries; broadly differentiated by the delivery modality deployed (public and private sector-led), and spatially (rural and deep rural vs. proximate urban locations) along the following lines:

- *About 8,000 households* are served by 33 isolated mini grids operated by EEU, mostly in deep rural areas.
- *About 40,000 solar systems*, mostly in rural and deep rural areas. The Rural Electrification Fund (REF) unit established in MoWIE, subject to availability of funds from time to time, procured and arranged delivery of stand-alone solar home systems (SHS) to two beneficiary segments: (i) homes in unelectrified remote communities, facilitated by the Regional Energy Bureaus (REBs); and (ii) schools, health centers, and Government offices, working with the Ministries of Health and Education.
- Over *2 million lanterns* and other quality verified Pico-solar PV products (not solar systems), have been sold to the Ethiopian population, living "under-the-grid" or settled proximate to it. In particular, since 2013, this market has been facilitated by credit lines at the Development Bank of Ethiopia (DBE), which played the role of financial

intermediary to facilitate microfinance institutions (MFIs) lending to qualified private sector market enterprises engaged in provision of solar lighting and charging products, predominantly concentrated in urban/peri-urban areas.

- *Pilot scale initiatives*—Noteworthy as well are the several ongoing pilot scale mini grid activities funded by Development Partners. Emerging lessons of experience with these various schemes (technology, institutional framework, and business model being tested) hold promise in terms of their scalability potential for rural area access rollout going forward.

Off-grid program design—strategic directions and key considerations going forward

The preceding discussion, highlighting achievements to date, underscores that continuation of business as usual will not be sufficient to roll out access to 5.7 million off-grid households by 2025 (mostly preelectrification).[12] Simply mobilizing more financing cannot get the job done, and a strategically driven redesign of the off-grid program components is called for. The plan of action proposed by the NEP-IRM aims for a substantially redesigned off-grid program, broadly organized into four subprogram components and outlined in the following text. The scope and design principles underlying each component are informed by relevant best practice experience (such as Kenya, Bangladesh, Peru, and Argentina), and respond effectively to the following strategic drivers that have been largely absent to date:

- ***Scale and speed of program delivery***—going forward, the redesigned off-grid program sub-components, should—together—be capable of rapidly and sustainably scaling up the off-grid access implementation over one million new households per year, on average, over the period 2019 through 2025 (combination of solar systems and mini/micro grids).
- ***Spatial reach of the off-grid program***—the NEP-IRM accords priority focus on the underserved rural and deep rural area beneficiaries where the majority of the nation's population lives, with incomes under $2 per day, and where the development need and imperativeness of inclusion is paramount.
- ***Priority for solar systems—***the Government policy gives priority to increasing the penetration of solar *systems* in rural and deep rural areas (while continuing to support private market development of the solar *products* market "under the grid").
- ***Institutional framework***—the NEP-IRM strategy aims to enable both ***public sector and private sector-based*** delivery modalities to roll out off-grid access. It seeks to build on the comparative advantage of each sector, and their potential for scale-up in the Ethiopian context.

The NEP-IRM action plan going forward calls for a detailed design study to be undertaken in 2018, informed by the results of the national geo-spatial least-cost access rollout plan, to prepare a detailed operational off-grid program on par with best practices for the four operational subprogram components. As a head start to the planned off-grid detailed operational design study planned for 2018, the Government is considering—in the interim—the development of an Off-Grid Strategy to broadly structure the strategic pillars and drivers of the NEP Off-grid Program. The strategy will be informed by best practices that have scaled up fast, and in a sustainable manner, and off-grid technologies in their respective NEPs that are directly relevant for Ethiopia's target of achieving 5.7 million off-grid access connections for preelectrification within eight years' time (2018–2025) and universal access by 2025. The strategy will in turn inform the detailed implementation operational design to be developed in 2018.

Off-grid program components—dimensioning the broad contours

Table ES.5 depicts an illustrative rollout trajectory of the two main technical delivery modalities for off-grid access scale-up through 2025.

These numbers are not intended to pre-allocate targets by technology or delivery modality or by subprogram, but only serve as initial guides for undertaking a detailed operational designing of the four operational subcomponents outlined below. With unfolding implementation experience and results achieved on the ground vis-a-vis target expectations, adjustments in program subcomponent design along the way and when warranted will be proposed to the Government for review, guidance and, as necessary, approvals.

A. Public sector delivery in deep rural areas and underserved environs—spearheaded by REF and EEU

1. Rural Electrification Fund Redesigned (REF-2.0) The case for public sector-led delivery of off-grid access is clear, especially for the more distant and remoter rural areas' beneficiaries where private market-based options are far less commercially

Table ES.5 Illustrative contours of the off-grid program to achieve universal access by 2025

(5.7 million households of which about 5.5 million represent preelectrification)

Year	Yearly Connections	Solar Systems	Mini Grids
2019	200,000	190,000	10,000
2020	450,000	430,000	20,000
2021	650,000	620,000	30,000
2022	800,000	760,000	40,000
2023	1,000,000	950,000	50,000
2024	1,200,000	1,140,000	60,000
2025	1,400,000	1,330,000	70,000
Total	**5,700,000**	**5,420,000**	**280,000**

attractive. In this context, the NEP recognizes that a key instrument utilized in the past (the REF mechanism) requires a complete redesign for the scale and speed in delivery called for going forward.

Specifically, a key area of focus in the 2018 off-grid program operational design and implementation study will address the redesign of REF. The detailed design of the "REF version 2" will be guided by the following principles and essential features to achieve the scale of deployment needed in deep rural areas and environs on a sustained programmatic basis: (i) design and preparation of consolidated packages for solar systems delivery and after sales maintenance services provision, (ii) deep rural areas and environs targeting, aggregated by region, and (iii) competitive bidding (with technical specifications and performance design) from qualified enterprises. The solar system components and system design will be optimized to weather and insolation variation by region.

2. Ethiopia's national distribution utility EEU has proven competence, professional experience, reach, and presence in deep rural areas and environs. It currently operates 33 mini grids serving over 8,000 beneficiaries in remote locations. While the newly integrated EEU/UEAP has a big task ahead in delivering on the grid connectivity and achieving the targets set under NEP, the Government is mindful from lessons of good practice experience highlighted above that many Governments, in their endeavors to scale up rural access implementation, have successfully and routinely tapped the comparative advantage offered by their national or regional utility companies: in respect of technical, professional, and management expertise, and frontline presence and proximity to the target beneficiary population. These countries have smartly structured a framework wherein the national/regional utilities have set up subsidiary/distinct business units that function on a full cost reimbursement basis as a Program Management Agent for the Government in designated areas, such as: maintenance and after sales services, billing after installment by private sector enterprise, and even procuring and installation of solar systems by the utility. Along similar lines, utilities have been present with mini grids in rural areas where the private sector has not been forthcoming. After weighing the pros and cons in the context of Ethiopia, a key element of the NEP-IRM strategy is to assess on a pilot basis—yet at a sufficient scale to draw valid implications for informing their mainstreaming potential—the following modalities for expanded scope for participation by EEU:

- *Solar systems*—within the proximate and contiguous environs of its 33 mini grid operations, EEU to function as a designated Program Management Agent for Government's activities (REF) and otherwise on its own, to undertake and manage solar systems delivery, installation, maintenance, and billing, and offer charging stations and services for those who prefer that service option instead. The alternative business model is often challenged by the lack of responsive after-sales maintenance services and readily available spare parts as well as battery replacements. These challenges can be substantially and cost effectively delegated to EEU as the Program Management Agent.
- *Mini/micro grids*—on a pilot basis, EEU to design, construct, and deploy green-site mini/micro grids, especially in areas where qualified private sector providers are not forthcoming. Specifically, an ongoing 'Beyond the Grid' study by a consultant team working closely with EEU is geo-spatially mapping and screening remote area village clusters

with sufficient loads for a mini/micro grid network solution. This study, coupled with EEU's own information and data base from Regional Offices, can help identify suitable candidates for this pilot component to get under way.

B. Private market-based off-grid delivery in rural areas

3. Solar systems scale-up in *rural areas* building upon the experience and results achieved by the "Lighting Africa" Program framework, the NEP-IRM provides for the design and deployment of a tailored program for Ethiopia to systematically address the full range of barrier removal support interventions appropriate to tackle the rapid scale-up of rural area solar systems markets. These include market intelligence, quality assurance and quality verified products, access to finance (to dealers and potentially consumers), consumer awareness, business development support (training, and a consumer education campaign), and Government enabling policies as appropriate (e.g., tax breaks on access equipment imported, finance facility to support forex bulk procurement, and working capital credit lines, etc.)

4. Mini/micro grids predominantly for pre-electrification in rural areas till grid access is extended. The GoE intends to apply uniform network design and equipment standards appropriate for rural area's mini/micro grids to ensure their smooth integration into the network when the grid arrives. The draft energy regulation establishes the regulatory framework for mini grids licensing, and adequate provisions to address in a fair, equitable, and transparent manner any "stranded assets" of the private operator when integrating with grid arrival. The NEP-IRM strategy calls for bundling the potential sites into three or four lots to be bid out competitively to qualified and licensed private operators of mini grids.

Financing requirements (2018–2022)

Capital expenditure—the public expenditure share of the off-grid program financing requirements for the first phase (2018–2022), is approximately US$478 million.

Technical Assistance—the detailed design of the off-grid program completed in 2018 to enable full-scale launch of implementation of the operational program immediately thereafter, is estimated at US$6 million (Table ES.8).

ES.7 Cross-sectoral linkages

Ethiopia's NEP-IRM goes well beyond a household connections program, be it on-grid or off-grid. To maximize development impact, implementation will build linkages with key social service delivery sectors with a targeted focus on health, education, and water, to achieve universal access for all social services delivery institutions on a top priority basis.

Table ES.6 highlights the baseline access statistics reported. About 70 percent of secondary schools (out of 2,830) and 24 percent of primary schools are reported to have electricity access provided by a variety of means or combination thereof—grid connection, self-generation, or solar PV power.

Table ES.6 Access of education and health facilities to reliable electricity services, 2015

Institution Type	Number	Electricity Access (%)[a]	Grid Connected
Education facilities			
Primary schools	33,373	24	NA
Secondary schools	2,830	70	NA
Total	**36,203**		
Health facilities[b]			
Hospitals[c]	202	95	97
Health centers	3,292	57	54
Health posts	15,618	29	5
Total	**19,112**		

Source: Federal Ministry of Education (2015) and Federal Ministry of Health and ICF International (2015).

[a] Includes connection to a central power grid, solar power, or both, or has a functioning generator with fuel.

[b] Access rates are based on the findings of the Ethiopia Service Provision Assessment Plus Survey 2014 and total sample size of 1,327 health facilities.

[c] Includes referral, general and primary hospitals. The access rate is a weighted average. Referral hospitals all have grid connections.

Table ES.7 Connection targets for public institutions

	2018	2020	2022	2025
Education facilities				
Secondary schools		80%	100%	
Primary schools		40%	70%	100%
Health facilities				
Hospitals	100%			
Health centers		70%	100%	
Health posts		40%	70%	100%

In the health sector, 97 percent of hospitals, 54 percent of health centers, and 5 percent of health posts are grid connected. Especially in the case of service delivery facilities that are off-grid and rely on a solar powered access provision, the IRM focus looking ahead is to also facilitate not only adequacy of power available, but crucially as well, its reliability, maintainability, and sustainability over time informed with the recent best practice experience gained in other countries.

Table ES.7 highlights the preliminary connection targets for public institutions, subject to completion of the Technical Assistance component study identified in the following section.

The NEP-IRM provides for a Technical Assistance study—working closely with Ethiopia's Ministries of Health and of Education counterparts and in the water sector—to conduct a rapid assessment of the electricity access connectivity baseline of public sector institutions, estimate electricity requirements for major end-use categories, and identify a least-cost means of providing access to the appropriate service standard. Based on the study findings, and taking into consideration the grid connections spatial rollout year by year under the first phase of program implementation, the study will prepare the detailed design of an operational plan for implementation—grid and off-grid—to achieve the access targets specified in Table ES.7. Financing will be provided from the NEP-IRM funds.

ES.8 NEP-IRM implementation framework

Essential features of the NEP-IRM implementation framework are depicted schematically in Figure ES.3, broadly identifying key sector institutions and agents, and their designated functional roles and responsibilities along the following dimensions: Policy, Strategic Oversight, and Progress Monitoring; Financing; Regulation; and Implementation of approved targets on-grid and off-grid by designated sector agents. These are summarized in the following:

Policy guidance, overall program coordination and monitoring, strategic oversight

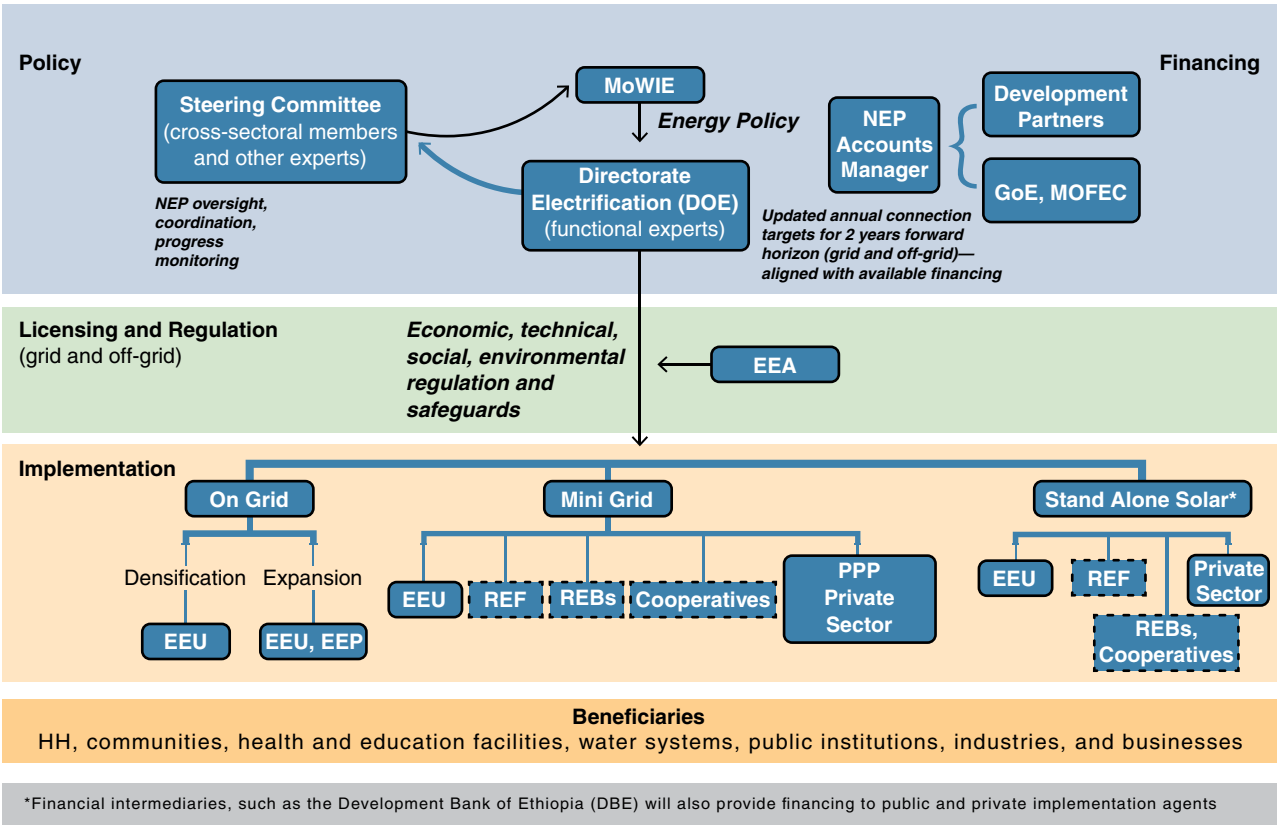
Responsibility overall for the progress achieved by the implementation agents indicated in Figure ES.3—on-grid and off-grid—rests with MoWIE. The Ministry, through its Directorate of Electrification, will coordinate and provide oversight for the effective and timely execution of all components of the NEP-IRM program via:

(i) The *NEP Steering Committee* convened and constituted by the Hon. Minister of MoWIE, and comprised of cross-sectoral ministerial members and other experts, as needed.

The NEP-IRM Steering Committee will provide high-level strategic direction and policy guidance, as well as facilitate effective coordination across Government Departments and Ministries, and monitor the sector level "dashboard" of key indicators of progress and performance, with a view toward accountability of results by institution, as well as ensuring the effectiveness and sustainability of the program implementation and results, and beneficiary experience and concerns. The Steering Committee will also review and approve updated connection targets of a two-year forward implementation plan (grid and off-grid) submitted by the DoE and a corresponding authorization of funds to the respective implementing agents to undertake an efficient implementation of their approved plans.

(ii) *The Directorate of Electrification (DoE)* is being established as a central institutional locus of the Government to provide day-to-day oversight and coordination of NEP implementation for the grid and off-grid programs. It will serve as the coordinator of a sector-wide geo-spatial data, network,

Figure ES.3 NEP-IRM implementation framework



*Financial intermediaries, such as the Development Bank of Ethiopia (DBE) will also provide financing to public and private implementation agents

and connections planning platform, and facilitate a coordinated consultative process (coordinating the DoE, REBs representing regional and provincial priorities, EEP, EEU, and sector Ministry of Health, of Education, of Water) leading to the preparation of updated geo-spatial plans and a ground level detailed rollout construction program designed to achieve the targets—national and regional—aligned with the national least-cost geo-spatial plan. The DoE will design and manage the sector-wide dashboard of key indicators of implementation progress, as well as other measures of program effectiveness and sustainability.

Additionally, the DoE will be responsible for liaising regularly with the key sector implementing agents in the process of updating rollout plans. To undertake this role effectively, the DoE will be staffed with a portfolio of complementary functional experts, and grid and off-grid operational program specialists, covering the entire range of NEP's components and dimensions.

The DoE will support the Steering Committee's functions. It will be responsible for facilitating the day-to-day logistical support necessary for its effective functioning, including: organizing and facilitating quarterly meetings (more frequent as and when appropriate); preparing the relevant information, such as progress reports and other briefing inputs as appropriate; circulating in advance the relevant agenda and the supporting information package appropriate for the Steering Committee's deliberations; and drafting of minutes, and special occasional briefs for the Steering Committee when necessary.

Informed by the national consultations organized by the DoE Task Force in August 2017 in Addis Ababa—with representatives from several REBs and EEU/UEAP regional offices staff—the NEP will leverage as deemed most effectively and appropriately, the capacity and drive for engagement of REBs and cooperatives on a location specific basis, including selectively targeted capacity building in such instances.

Mobilizing financing—The sector-wide programmatic approach to Development Partners participation

Given the large-scale investments called for under the NEP-IRM, concessional financing from Development Partners and grant financing are essential to complement in-country resources mobilized by the Government/EEU, new customers, and the private sector, particularly in the off-grid space.

Consistent with the 2005 Paris Declaration on Enhancing Aid Effectiveness, the objective of the sector-wide framework of the NEP-IRM and its organizing principle of "Many Players, One Team, One Plan" underlying the Financing Prospectus (2018–2022), includes:

- *Increasing the magnitude of programmatic flow of partner funds for the access program implementation*;
- *Alignment of donor program support with the NEP-IRM targets* (grid and off-grid by subprograms) and Technical Assistance components identified;
- *Establishment of a common sector-wide progress monitoring framework and system*, to foster joint ownership, transparency, and mutual accountability; and
- *Fostering harmonization across partner participation and funding with respect to the country systems for procurement, funds flow, and disbursements, and other safeguards arrangements, as appropriate.*

Licensing and regulation

The Ethiopian Energy Authority (EEA) was established as an independent sector regulator in 2013. Consistent with its mandate, the EEA will have licensing and regulatory oversight, including for private sector entry, across the functional value chain of generation, transmission, distribution, and sales functions within the power sector. The regulator will be responsible for establishing standards and regulations required for the implementation of the grid and off-grid programs, including social, safety, and environmental safeguards, as well as their compliance. More specifically, the EEA will define and enforce: licensing requirements, rights and obligations of parties, amendments, and certificates of competency. It will also advise the Government on tariff proposals submitted by a licensee (for grid and off-grid). It will also promote energy efficiency and conservation, and standards for electric equipment, appliances, and labeling. Finally, it will be responsible for settlement of disputes, mediation, and arbitration.

Implementation

Grid connectivity scale-up and network extensions component of NEP-IRM—EEU will be responsible and accountable for network planning, design, and implementation of the grid component. EEU will prepare a NEP-IRM operations program manual as the umbrella framework to plan, procure, organize, construct, and connect new customers to the distribution network, irrespective of the funding source, while proceeding with the extension of the grid.

Off-grid program—Consistent with the strategic directions outlined for the off-grid connections rollout program, and building on the results achieved to date, an expanded set of best-practice experiences will be deployed for scale-up, encompassing:

- *Public sector delivery in deep rural areas*—REF unit redesigned (solar systems); EEU (solar systems and mini grids);
- *Private sector market-based supply, delivery, and after sales service chains in rural areas*, with a focus on solar systems; and
- *Private sector mini/micro grids predominantly for pre-electrification* in rural areas until the outreach of the grid distribution network access is extended. The Government intends to apply uniform network design and equipment standards, appropriate for rural area mini/micro grids, to ensure their smooth integration into the network when the grid arrives. The Government will also address explicitly in the regulatory framework the adequate provisions to address in a fair, equitable, and transparent manner any "stranded assets" of private operators, should that circumstance occur.

Monitoring

Establishment and monitoring of key performance indicators will be implemented for efficiency, effectiveness, and progress against grid and off-grid targets and for course adjustments as and when appropriate by relevant actors (e.g., EEU, DoE). The system will include regular reporting (e.g., quarterly and annually) of program progress, analysis of impacts, and the creation of a performance-based dashboard with inputs from relevant Ministries (e.g., Health and Education), and will appropriately interface with the Geographic Information System (GIS) information and the Management Information System (MIS) system.

ES.9 Program implementation support and Technical Assistance (2018–2022) and immediate next steps

Investments alone will not be sufficient to enable effective implementation of the NEP-IRM program. Table ES.8 provides summary highlights of the immediate priority Technical Assistance support components—studies directly supporting the detailed design of operational implementation plans on grid, off grid, and related capacity strengthening. Table ES.9 indicates the immediate actions to be undertaken to the launching of the NEP.

The remainder of the NEP-IRM document is organized as follows:

Chapter 1 provides an overview of Ethiopia's power sector context as well as the foundational best practice principles and drivers guiding the NEP-IRM design.

Chapter 2 describes the technical plan for connections rollout for the achievement of universal access by 2025 and the key program technical implementation support studies and activities required in the immediate term for the launching of the program.

Chapter 3 presents the prospectus for mobilizing financing (syndication) of investments and Technical Assistance needs for grid and off-grid access scale-up for the first phase of the program (2018–2022).

Chapter 4 describes the overarching sector-wide framework, and the implementation and monitoring of the program with the coordination of all sector stakeholders' participation, aligned to country priorities and harmonized with country systems.

Finally, the list of Annexes contains supporting detailed background information, analyses, and best practices underpinning the NEP-IRM.

Table ES.8 NEP—Implementation support activities, completed by end-2018

Activity	Scope	US$ Million	Leading Agency
1. Technical, operational and management plan for the 4.5 million customer connection program (2018–2022)	Detailed network design and costing of 4.5m connections, staged across regions and feeders by quarter for each year; corresponding procurement, warehousing and logistics plan, construction works, and technical services mobilization.	5	EEU
2. Nationwide power system distribution master plan (2018–2025)	Distribution network technical design and investment program—feeder level—for all 15 regions to support the NEP connections rollout; assess adequacy of demand-supply power balance at each bulk power delivery substation via the transmission grid. The assessment will include the update of transmission and generation investment needs, informed by the bottom-up information provided by the distribution network assessment and informed by the geo-spatial least-cost plan.	4	EEU, EEP
3. GIS least-cost rollout plan for grid and off-grid and high level investment financing prospectus	Optimal modality (grid and off-grid) for access provision, taking into account technical and economic viability, geo-referenced demand centers, and load forecasts; anchoring yearly rollout plans and targets as well as the financing prospectus and financing gap.	1.5	EEU
4. Off-grid operational program strategy and design for stand-alone systems and mini grids (2018–2025)	Operational implementation design for the off-grid preelectrification program for the scale-up of stand-alone solar systems solutions and mini grids through public, private, and PPP delivery systems (complementing grid rollout); informed by the GIS least-cost plan.	6	DoE
5. Comprehensive NEP-IRM performance monitoring and tracking system	Monitoring of key performance indicators for efficiency, effectiveness, and progress against NEP-IRM targets and for course adjustments as and when appropriate.	5.5	DoE
6. Cost of connection study	Design of an affordable connection policy for achieving universal access.	1	DoE, EEU
7. Social institutions priority connection implementation program design	Detailed assessment of numbers and types of facilities (including water points), mapping and dimensioning of key end uses requiring electricity for service delivery (cold chain, simple vaccine and medicine refrigeration, lighting, sterilization). For off-grid solar powered facilities, assessment of service quality, reliability, power equipment and maintenance standards. Detailed design of targeted implementation rollout to achieve program targets.	2	DoE
8. Sector financial viability study	Analysis of sector revenues and cost structures with ongoing and planned revenues allocation to the program.	1.5	DoE
9. Special topical studies: **a. low-cost technical standards** **b. manufacturing capacity** **c. productive uses**	a. Lowering of network design and construction and demand-side management measures; b. development of local manufacturing for network and service equipment; c. design of a program for productive uses of electricity services.	1.5	a. EEU b. DoE c. DoE
10. Sector-wide capacity building	Training, capacity building, and financial support to sector stakeholders for NEP implementation for the successful implementation of the NEP, informed, inter alia, by the immediate and key needs identified for the successful ramp-up of grid connections and preelectrification program. Includes capacity building for financial management, procurement, Monitoring and Evaluation (M&E), verification, and day-to-day administration of the NEP.	20	DoE, EEU
Total		**48m**	

Table ES.9 Summary of immediate support activities for grid and off-grid rollout, to be completed by December 2017

Action	Leading Agent
1. Detailed Implementation Plan and Operational Manual for 500,000 connections under US$300 (includes geographic spread, procurement packages for bidding, and workforce organization) to be implemented in 2018	EEU
2. Establishment of Steering Committee (appointment of ex-officio members)	MoWIE
3. Hiring of Steering Committee professional experts (GIS, M&E, modeling and planning, economics; utility distribution engineer, donor liaison)	Task Force
4. Establishment of GIS Platforms	Task Force, EEU

Figure ES.4 Summary of NEP implementation timeline

Notes

1. More precise estimates will become available upon completion of the detailed high-level geo-spatial least-cost plan study to be completed by mid-year 2018. Additionally, there will be investment costs for the ongoing program of systematically upgrading—reconfiguring, strengthening, and re-conducting, as appropriate—the existing medium voltage feeders network nationwide to enable them to support the access scale-up program under the NEP-IRM. For this latter component, a strengthening program costing study (especially for the network in the eleven regions outside of the four Addis Ababa Regions of EEU) is outlined later in Section ES.9.
2. The calculations are based on the assumption of average household size of 5.5 persons.
3. By this measure, grid access is about 13 percent. However, findings from partial investigations reported in other sources—including MoWIE, EEU—indicate this baseline connectivity statistic to be higher (around 20+ percent). A World Bank Group supported household survey utilizing the SE4All Multi-Tier Measurement Framework for Energy Access is under way in Ethiopia and results are expected later this year to provide an updated estimate representative of the baseline connectivity today.
4. Table ES.2 shows the unit connection cost variation within the densification Component A depending on household location. For the first NEP target of 4.5 million connections, least-cost connection costs range from US$150–300, with an average of US$222. These capex variations do not include MV extension capex nor network rehabilitation investment costs. During implementation, the technical analysis of network capacity for a network design and connections rollout will eventually determine: (i) location of households that can be connected within Component A, and (ii) possible network strengthening and reinforcement requirements.
5. Including the network infrastructure developed by Universal Electricity Access Program (UEAP) since 2005.
6. EEU is currently undertaking a process of internal restructuring to increase the autonomy of regional offices.
7. Detailed design and preparation of a NEP implementation program for the outer years (2019 and beyond) will be informed by completion of the comprehensive geo-spatial least-cost rollout plan—for coordinated grid and off-grid rollout expected to be completed by the end of 2018, together with the findings and recommendations of other high level priority studies being launched under the NEP and to be completed during 2018 (Table ES.8).
8. UEAP professional staff have systematically developed substantial experience in institutional capacity to effectively undertake the entire chain of technical, engineering, and managerial functions and processes that need to be brought to bear by a professional utility to achieve the results at the scale delivered so far, including: (a) at the upstream stage, systematic techno-economic screening framework for selection and sequencing of the list of towns and communities nominated as priorities by regional authorities; (b) informed by the outputs of the upstream stage, undertaking detailed MV network technical design and costing; (c) managing procurement, logistics of material handling, warehousing and inventory management of a diverse catalogue of poles, conductors, insulators, transformers, switches, and a myriad of other component parts; and (d) downstream program management associated with orchestrating construction crews for works.
9. And leveraging private sector resources to the extent feasible in the off-grid program.
10. Best practices are summarized in Annex 1.
11. The UEAP program has been a successful development program in many essential respects and is yielding significant economic and social development benefits to the frontline communities in rural areas across Ethiopia. This priority program of the Government has registered remarkable results in terms of rural access and at a national as well as regional geographic coverage provided rural households, communities, institutions, businesses, and the local economy. A significant number of people in the rural communities benefited from the UEAP program. The most visible benefit of the electric connection is the availability of light, on community services and security (Economic and Social Impact Evaluation (ESIE) of the Universal Electrification Access Program in Ethiopia, Final Interim Report, August, 2015).
12. After the grid arrives, off-grid technologies can be used as back-up solutions in case of unreliable grid electricity services.

CHAPTER 1

Electricity Sector and Development Context

Ethiopia has achieved impressive results in economic growth and social development indicators, enhancing good governance, and advancing toward the Government's goal of middle-income nation status by 2025. Over the past decade, real GDP growth overall averaged almost 11 percent annually (8 percent per capita), and extreme poverty fell from 55 percent in 2000 (one of the highest levels recorded internationally) to 34 percent in 2011, placing the country among the topmost performers in poverty reduction results recorded internationally.

Ethiopia also ranks among the high performing countries that have achieved improved well-being of its peoples. Specifically, over the past two decades, there has been significant progress in key human development indicators: primary school enrollments have quadrupled, child mortality has been cut in half, and the number of people with access to clean water has more than doubled.[1] With only two exceptions, Ethiopia attained the Millennium Development Goals and a steady improvement in the United Nations Development Program (UNDP) Human Development Index.

Massive and sustained public investment in economic infrastructure (including roads, energy, rail, and telecom) has been at the center of Ethiopia's economic and social development strategy. The sole development plan under implementation going forward is the Sustainable Development Group (SDG)-integrated Growth and Transformation (GTP II, 2015–2020). Building on the first phase of the program (GTP I, 2010–2015), GTP II places strong emphasis on structural transformation, industrialization, urbanization, and export promotion.

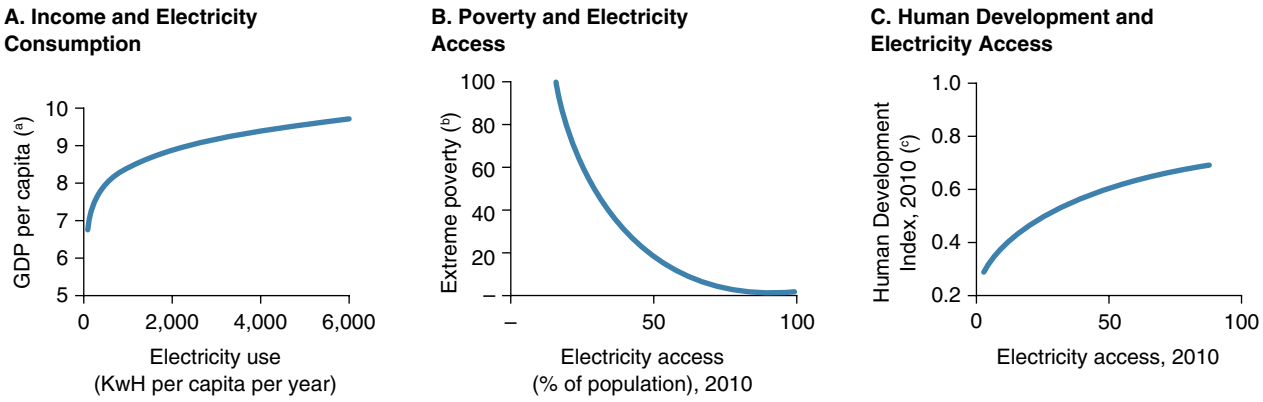
The energy sector is a pivotal enabling driver of Ethiopia's GTP II targets, and the sector is well positioned to become a power hub for East African neighbors by 2025[2] without compromising the nation's resilience to climate change nor weakening its role as a green economy front-runner.[3] Furthermore, achieving universal electrification (connectivity) is at the core of its 2025 poverty reduction and development agenda, embedded in the ongoing GTP II.[4]

Specifically, adequate, affordable, and reliable access (connectivity) to electricity is vital for enabling structural transformation of Ethiopia's economy and society, including further poverty reduction and a shift toward higher productivity rates and industrialization. Simply put, without electricity Ethiopia cannot develop a domestic manufacturing capacity adequate for local needs and exports, industrial parks, private sector entrepreneurship, the information and communication technology (ICT), and financial sectors—nor graduate to a middle-income country. Indeed, the highly correlated and mutually reinforcing relationship between electricity use, economic growth, and human development is widely accepted from irrefutable established worldwide experience (Figure 1.1).

Directly or indirectly, electricity is central to achieving progress on almost all dimensions of human welfare and development. Electricity access is crucial for achieving almost all of the Sustainable Development Goals (SDGs), from its role in the eradication of poverty through advancements in health, education, water supply, and industrialization, to mitigating climate change.[5]

The Government's commitment to the provision of electricity services dates back to the launching of the Universal Electricity Access Program (UEAP) in 2005. The UEAP now ranks among the most successful grid electrification programs in Africa, with the extension of the MV grid network to about 60 percent of towns and villages in the country (2005–2015),[6] and

Figure 1.1 Socioeconomic indicators and electricity



(a) GDP per capita, purchasing power parity (PPP; constant 2011 international).
(b) Poverty headcount ratio at $1.25 a day (PPP) (percent of population).
(c) Human Development Index, 2010.

Source: World Development Indicators (2010), United Nations (2012), Human Development Index.

an estimated 87 percent of the national population spatially located within 60 km of the existing 'MV grid radius'. The UEAP program investments undertaken have set the stage for technically enabling the major shift in strategic priority going forward under the NEP-IRM: from infrastructure development to service delivery (implementing electricity connectivity in all Ethiopian homes, businesses, and social institutions, and fast).

Specifically toward realizing this shift, the GoE has undertaken the following key steps for setting the stage for preparation of Ethiopia's National Electrification Program-Implementation Road Map (NEP-IRM), for implementing the goal of universal access (connectivity) by 2025:

- Ethiopia joined the Sustainable Energy for All (SE4ALL) Initiative in 2011, and the Ministry of Water, Irrigation and Electricity (MoWIE), with support from the European Union and in consultation with key stakeholders, ***prepared 'The Ethiopia SE4ALL National Action Plan' (2012–2013),*** for achieving universal electricity access by 2025.[7]
- ***National Electrification Strategy (NES) issued June 2016—***which formally shifted the strategic focus and priority of the Government from the development and expansion of the network distribution infrastructure to last-mile delivery and connections for all. Specifically, the NES broadly identifies the three key categories of challenges in the sector—Institutional and Policy, Planning and Technical, and Financial (detailed in Annex 1)—and recommends strategic direction(s) to inform preparation of Ethiopia's National Electrification Program (NEP).
- ***Multi-Tier Framework (MTF) for measuring and tracking access connectivity indicators on-grid and off-grid.*** Recently, the Government launched the nationwide Multi-Tier Framework (MTF) Energy Access Survey, being implemented by the World Bank in its partnership role under the SE4All Initiative. The MTF instrument provides a more granular baseline measurement of electricity access differentiated by "tiers" representative of the range of delivery modalities on-grid and off-grid (solar products, solar systems, mini grids, and main grid). The results of the MTF survey are currently undergoing data validation,[8] and once mainstreamed within the Government and EEU, they will be a valuable tool to more accurately track year-to-year progress in connectivity nationally, as well as differentiated by region, and for grid and off-grid provisioned connectivity (see Annex 2).

1.1 Sector context

By 2025, Ethiopia aims at achieving universal access to electricity services and becoming a power hub in Eastern Africa. Toward this goal, in 2012 the Government embarked on implementing an aggressive set of initiatives to transform the structure and institutional framework of the power sector to better position it for the achievement of key strategic goals: expanding and diversifying power supply adequacy

and energy exports, providing universal network coverage to priority towns and villages, and achieving universal electricity access.

Ensuring adequacy and diversity of supply

Ethiopia is blessed with an abundant clean and diversified energy resources base: large and small hydro, sunshine, geothermal, and wind energy (Table 1.1) and has become an outlier in the East Africa region with 90 percent of its generation coming from clean energy sources (hydropower). The GoE has purposefully undertaken large-scale generation projects to substantially expand the national generation capacity and ensure supply adequacy for the cost-effective powering of Ethiopia's future economic growth and productivity (agriculture, industry, small business) and service delivery to all citizens.

Within a decade, the national power generation capacity has quadrupled from about 850 MW available to 4,256 MW at the end of 2016 (second highest in Africa) with the commissioning of the Gibe-III Hydropower Project (1,870 MW). The capacity mix is roughly 89 percent hydro, 10 percent wind and geothermal, and only 1 percent diesel based. Other large-scale hydropower projects, most notably the Grand Ethiopian Renaissance Dam (GERD 6,000 MW), are in advanced stages of procurement and construction, and the Government is aiming at achieving 12,300 MW in installed capacity by 2020.

Given its massive clean energy reserves that can be developed cost competitively, the country aims at becoming a cornerstone of the regional power market of the East Africa Power Pool (EAPP). A key strategic driver of the Government strategy in the power generation sector is tapping into Ethiopia's comparative advantage as a cost competitive exporter of power to the higher cost regional power markets, mostly to Sudan, Djibouti, Kenya, and Tanzania (see Table 1. 2).

The country's export revenue potential is estimated to be as much as US$600 million, per annum, by the end of the decade. By 2020, we project that revenues from power exports will be at par with those from domestic demand.

The GoE has also focused on aggressively diversifying its energy mix with wind, solar, and geothermal sources to complement the large base of hydro resources development. A diversified mix of supply resources not only ensures adequacy of supply, but also contributes to mitigate climate change, in line with Pillar Three of Ethiopia's 2011 'Climate Resilient Green Economy (CRGE) Strategy', which requires 15–20 percent of the energy supply to come from non-hydropower based renewable resources by 2020.[9] Committed capacity planned to come online by the end of 2020 includes 340 MW of new geothermal, 450 MW of new solar, and over 910 MW of new wind capacity, bringing Ethiopia's total installed capacity to roughly 12,300 MW.

Alongside the diversification of the energy supply, the Government is promoting private sector entry and participation with Independent Power Producers (IPPs) and Public Private Partnerships (PPPs) agreements. The Adama 1 and 2 and Ashegoda wind power projects, for a total capacity of 324 MW, have started generating electricity. The International Finance Corporation (IFC) has signed an agreement to develop up to 500 MW of solar IPPS—the "Scaling Solar Initiative." Other Development Partners are also supporting the diversification of the energy mix. USAID is supporting Metehara (100 MW Solar), Mekele (100 MW Solar), Humera (100 MW Solar), Tams (1,700 MW Hydro), Corbetti (500 MW

Table 1.1 Ethiopia indigenous energy resources

Resource	Unit	Exploitable Reserve	Exploited Percent
Hydropower	MW	45,000	<5 percent
Solar/day	kWh/m^2	Avg. 5.5	<1 percent
Wind power	GW	1,350	<1 percent
Wind speed	m/s	> 6.5	
Geothermal	MW	7,000	<1 percent
Wood	Million tons	1,120	50 percent
Agricultural waste	Million tons	15–20	30 percent
Natural gas	Billion m^3	113	0 percent
Coal	Million tons	300	0 percent
Oil shale	Million tons	253	0 percent

Source: NES, 2016.

Table 1.2 Ethiopia export projections (MW), 2017–2030

Year	Djibouti	Sudan	Sudan or Egypt	Kenya	Kenya II	Tanzania	Total
2017	100	100					200
2018	100	100					200
2019	100	100		200			400
2020	100	100		400		412	1,012
2021	100	100		400		412	1,012
2022	100	100		400	200	412	1,212
2023	100	100	1,500	400	200	412	2,712
2024	100	100	1,500	400	400	412	2,912
2025	100	100	3,000	400	600	412	4,612
2026	100	100	3,000	400	600	412	4,612
2027	100	100	3,000	400	800	412	4,812
2028	100	100	3,000	400	1,000	412	5,012
2029	100	100	3,000	400	1,000	412	5,012
2030	100	100	3,000	400	1,000	412	5,012

Source: Power Africa, 2017; World Bank, 2016.

Geothermal), and Tulu Moye/Abaya (500 MW Geothermal). Denmark is working with the World Bank to provide support for wind resource mapping as well as wind IPP framework development, expected to lead to development of wind IPPs (about 500 MW). Agence Francaise de Développement (AFD) is supporting the development of geothermal sites in the Tendaho area, while the World Bank International Development Association[10] is supporting test drilling in the Aluto Langano fields.

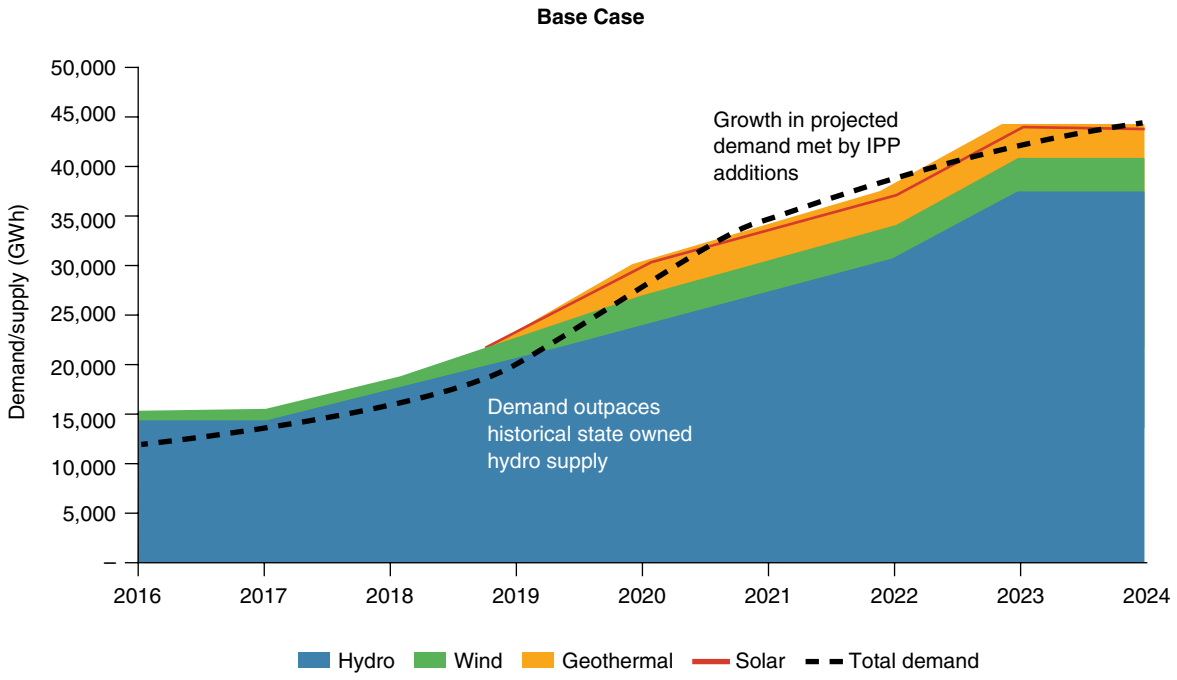
With the planned commissioning of new hydro, solar, wind and geothermal energy, Ethiopia is expected to have over 7,000 MW of installed capacity by 2020, which would provide sufficient energy (about 30,000 GWh) to supply the expected growth in demand (see Figure 1.2, energy demand includes exports). Main drivers of aggressive demand growth in Ethiopia include the acceleration of residential electricity connections as outlined in Chapter 2; increased exports to Djibouti, Sudan, Kenya, and Tanzania (as per Table 1.2); and industrial demand growth of roughly 8 to 10 percent per year. It is also assumed that during this time, countrywide losses decrease by about 10 percent from 22 percent today. A detailed energy supply-demand balance assessment is under preparation.

Figure 1.2 depicts the projected electricity supply and demand balance gigawatt/hour (GWh). With the planned commissioning of new hydro, solar, wind, and geothermal generation, there will be adequate power supply overall, to meet increased demand resulting from the proposed program.

Incremental demand from NEP—The cumulative energy demand from the NEP-IRM connections program, as a share of the overall system demand projected in Figure 1.2, is estimated as follows: 2018 (300 GWh); 2019 (420 GWh); 2020 (480 GWh); 2021 (600 GWh); 2022 (900 GWh).[11]

Transfer capability of transmission system—The electric power grid of Ethiopia has experienced high load growth particularly over the last five years. In many parts of the country and locations, transmission lines and substations are overloaded at peak times. In response, EEP has embarked on an ambitious multi-year program plan, supported by donor partners for systematically addressing and upgrading the transfer capability of the bulk power system. Additionally, EEP, in coordination with EEU/UEAP, are in the process of developing a program plan to appropriately reconfigure and upgrade sub-transmission system network capacity, and to evaluate their ability to evacuate and transfer power between generators and the injection points for the medium voltage networks in anticipation of the demand growth form NEP connections projected. For the NEP program implementation horizon time period 2018–2022, basic modeling/analysis has been undertaken by EEP, indicating there is adequate transmission transfer capability.

Figure 1.2 Power supply adequacy: overall electricity supply demand balance (2016–2024)



Source: World Bank estimates based on available information on progress of various projects.

Sector reform—unbundling, regulatory framework, and climate investment

The GoE has instituted a series of key initiatives toward transforming the power sector structure and regulatory framework to effectively underpin and enable the achievement of its strategic objectives for the sector. These initiatives include power supply adequacy, exports, diversification of generation mix, private sector participation (outlined above), and scaling up access to all (outlined below).

To focus on performance and accountability for results, enhanced efficiency and effectiveness of key sector institutions, and private sector entry:

1. In 2013, the Government ***unbundled the vertically integrated Ethiopian Electric Power Corporation (EEPCo)*** with the establishment of two separate public enterprises, each with a very different business, technical focus, and accountability for performance and results: The Ethiopian Electric Power (EEP), responsible for the upstream functions of generation and transmission; and the Ethiopian Electric Utility (EEU), responsible for power distribution, sales, and customer service.
2. ***Established the Ethiopian Energy Authority (EEA) as the sector regulator.***
3. ***Integrated the Universal Electricity Access Program (UEAP) within EEU*** (January 2016)[12] as part of the unbundling. This will ensure, going forward, a singularly focused, coordinated, and simultaneous response to the mission of increasing grid connectivity—which entails both medium voltage network extensions and at the same time connecting final beneficiaries aligned with targets set under the NEP-IRM.
4. ***Establishment of a dedicated PPP unit within the Ministry of Finance and Economic Cooperative (MOFEC) to function as the focal point for PPP transactions.*** When fully functional, PPP units at the MOFEC will include the focal point for PPP transactions and the relevant skill set and expertise that are required to invite, support, and develop PPP transactions in various sectors in Ethiopia.
5. ***Draft a PPP Proclamation to support sustainable financing for infrastructure projects.*** The proclamation highlights the key role of private sector participation for infrastructure development

in the country. Among its provisions are the establishment of a PPP administration Board, its objectives, duties, and responsibilities; duties and responsibilities of contracting authorities; PPP projects' approval process; selection of private parties (qualification criteria); bidding processes and negotiations; unsolicited proposals; and content and implementation of agreements.

6. ***Draft energy regulation for licensing and regulation of new entrance in the functions of generation, transmission, and distribution and sales.*** The proposed regulation encompasses existing and potential licensees in the entire value chain of the electricity sector. It covers licensing requirements, rights and obligations, amendments, certificates of competency, tariff setting and review (grid and off-grid) grid access, energy efficiency and conservation, standards for electric equipment and appliances and labeling, and settlement of disputes, mediation, and arbitration.

From infrastructure development to service delivery—customer connections for all and the National Electrification Program (NEP)

Universal Electrification Access Program (UEAP) was launched in 2005 with the objective to promote the socioeconomic development of rural areas in Ethiopia by expanding the electricity network. The Program has also become a key driver for the achievement of the goals set by the Growth and Transformation Plans (I and II) for the modernization and industrialization of the economy.

Implementation of the Government's Universal Electrification Access Program (UEAP) was initiated in 2005, with the following objectives:

- Provision of equitable access to electricity in all regional states of the country;
- Reduction of cost of electricity distribution systems through the introduction of new standards like a mixed three-phase single-phase system;
- Building nationwide human, manufacturing, and contracting capacity for implementation of the program;
- Introduction of new institutional arrangement for implementation of UEAP and the future operation of the newly electrified areas to provide efficient services, reduce costs of overheads, and produce a rapid growth in revenues of Ethiopian Electric Power (EEP) (formally known as EEPCo); and
- Building generation and transmission capacity of the existing facilities to supply the new load to be connected to the system.

Since 2005, the UEAP has steadily acquired experience-based institutional and professional capacity for undertaking large-scale programs. Within a decade since its establishment (2005–2015), UEAP spread the electricity grid to about 6,000 towns and villages from the initial 667, and grid coverage has reached 60 percent of towns and villages across the nation from the initial 15 percent. The number of EEU customers has also grown from 800,000 to about 2.3–2.4 million. By 2020, UEAP will provide network coverage to 90 percent of the country and to 10,000 towns and villages.

The UEAP workforce has increased to about 5,000 employees over time, and a training program was launched in 2014 to increase the size of the organization to more adequate levels. UEAP has also expanded the production of LV concrete poles with the creation of 122 associations (cooperatives) and training of about 320 individuals since mid-2015.

The UEAP has also successfully mobilized funding from different stakeholders, including the GoE and Development Partners (Figure 1.3), such as World Bank, African Development Bank (AfDB), Bank of Arab for Economic Development in Africa (BADEA), Saudi Fund, OPEC Fund for International Development (OFID), and bilateral cooperation from Development Partner countries.

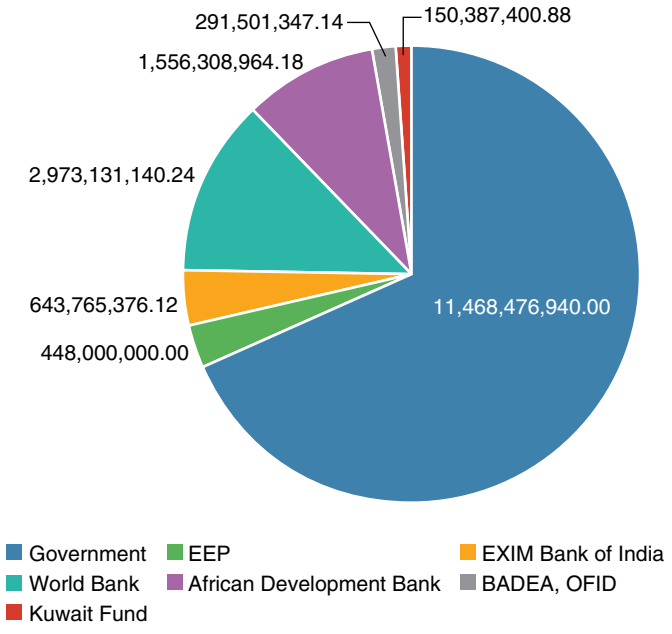
In the last 10 years (2005–2015) almost US$560 million were allocated for rural electrification.[13]

A significant number of households in rural communities benefited from UEAP (see also Annex 3), most notably with improvements in:

- Income generation activities,
- Improved health (also for less reliance on kerosene) and educational services,
- Improved lifestyle and well-being, including use of electric appliances,
- Savings in financial resources and time, and
- Reduction in criminal activities.[14]

While impressive results in grid access coverage have been achieved in a relatively short amount of time with the expansion of the transmission infrastructure (MV lines) across the country, last-mile connections to households, businesses, schools, and clinics, and connections for service delivery to end beneficiaries have not kept pace with network expansion. Consequently, the corresponding targets set by

Figure 1.3 Fund allocated to UEAP in the last 10 years (2005–2015)



Source: EEP and SMEC (2015).

GTP I for connectivity were unfortunately not met as expected.[15]

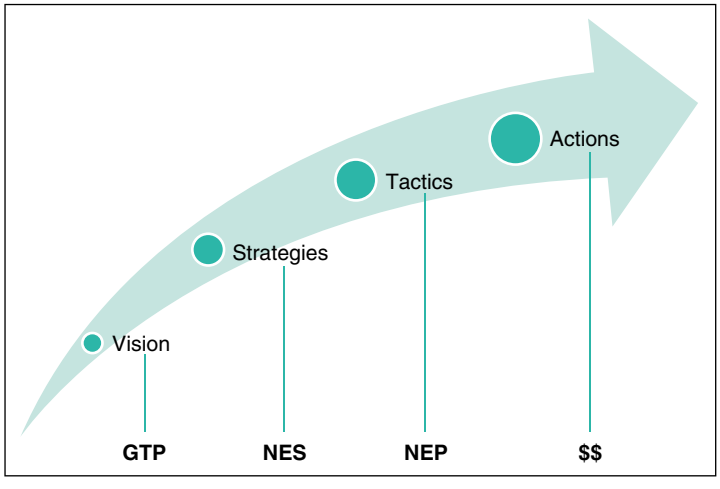
Historically, household connections have lagged behind for several reasons, including the absence of: (i) adequate coordination between UEAP and EEU and related planning, procurement, and construction works, (ii) a programmatic approach to service delivery, as well as (iii) financial resources proportional to the new customers' targets sought and earmarked for social institutions such as schools and clinics.

The National Electrification Program-Implementation Roadmap (NEP-IRM) responds to the challenges outlined above as well as the Government's priority to rapidly scale up service delivery—both quality and access. Informed by relevant international best practice (Annex 1), and the National Electrification Strategy adopted in June 2016, the NEP-IRM's homegrown design outlines a comprehensive, technically sound, and achievable operational Program for connectivity scale-up under the organizing principles of a sector-wide approach to rally all stakeholders and Development Partners.

The National Electrification Program (NEP)—achieving connections for all

Timely achievement of the Government's aspiration to universal electricity access by 2025 is the central objective of the National Electrification Program (NEP). Specifically, the Government is now launching this NEP-IRM as the centerpiece for the physical implementation of the connections rollout—a comprehensive and coordinated program of grid and off-grid rollout—in an effective, efficient, and sustainable manner (Figure 1.4).

Figure 1.4 Delivery of electricity services—from plans to implementation



1.2 Building blocks of the NEP-IRM

The Implementation Roadmap for the National Electrification Program is anchored in the specific recommendations provided by the NES (see also Annex 1), and its operational design builds on the successful experiences of countries across the world that have achieved near universal access or are well advanced in implementation and have done so in an effective and fast-paced manner.

While successful national electrification programs have been undertaken in diverse country contexts and environments, they all share, in essence, few core driving principles that effectively address and strike a workable balance among the key interrelated set of challenges centrally relevant to the provision of affordable electricity access for all (Annex 4).

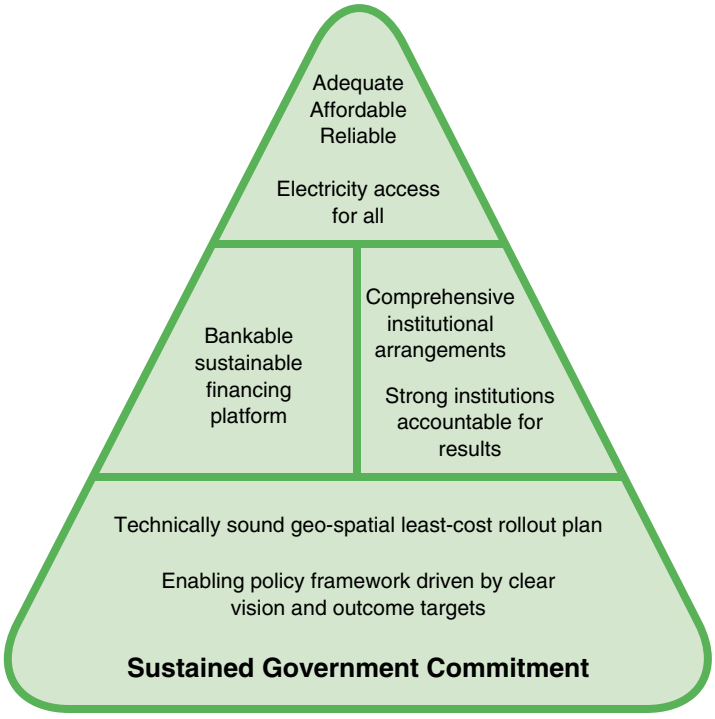
An evaluation of country experiences over the past fifteen years reveals that the key driver of performance and success in achieving higher degrees of access to electricity services are the following: (i) Government commitment and vision of the electrification program as a key development goal for the country, (ii) an enabling environment (policy, institutional, regulatory) for sector public and private stakeholders, (iii) sustained funding over the duration of the program, and (iv) a sector-wide coordinated approach of stakeholders toward the achievement of a common goal.[16]

While informed by international experiences, the NEP-IRM is a homegrown design and emphasizes a practical and action-oriented focus on the near-term high priority actions. Specifically, the Implementation Roadmap directly addresses the crucial interplay of institutional, planning, technical, and financing frameworks that must all come together, and in a sustained manner, to enable the timely achievement of the connection targets established by the Government and the related development outcomes. Key building blocks of NEP-IRM are depicted schematically in Figure 1.5.

The core principles and considerations underlying the detailed design of the NEP-IRM framework building blocks include:

- ***Sustained Government leadership and commitment for the duration of NEP-IRM and enabling policy framework.*** As shown in Figure 1.5, this constitutes the very fundaments of the Program. In GTP I and II the Government set national electrification at the core of the development agenda

Figure 1.5 Foundational building blocks of the NEP-IRM



of the country. The NEP-IRM establishes clear and credible targets and timetables for electricity access over the program life that are essential for realizing the broader modernization of the country, development of social services, and social inclusion. A high level Steering Committee supported by MoWIE will provide strategic oversight and monitor progress toward ensuring efficiency, effectiveness, and timeliness in program delivery and outcomes.

- ***A comprehensive sector-wide least-cost geo-spatial connections rollout strategy*** and implementation plan driven by a national development perspective, defined by grid and off-grid connection targets, and anchoring the NEP-IRM Financing Prospectus for mobilization (syndication) of financing on a programmatic basis. The geo-spatial least-cost plan will identify the optimal modality for access provision in time and space, coordinating grid and off-grid efforts and guiding the physical rollout of the NEP-IRM with local subprograms. The GIS-based least-cost plan will update the NEP-IRM in 2018.
- ***Clarity of roles and accountability for sector performance and results*** to ensure efficient and effective management and operation of the sector. While granting autonomy, the GoE will hold accountable the key energy sector institutions and delivery agents—be they public or private—for implementation progress and results, measured against annual access targets. MoWIE and the Steering Committee will coordinate and oversee the NEP-IRM, both for the grid and the off-grid program.
- ***Ensuring financial viability*** of the delivery agents on an ongoing basis over the program implementation period (centrally EEU); while ensuring the medium-term financial health and sustainability of the sector itself, within which the NEP-IRM must function.
- ***Equity and inclusion***—targeting disadvantaged groups and the poor nationwide; and due consideration to ensuring customer affordability, especially for the poor.
- ***Environmental and social sustainability.***
- ***Sector-wide*** framework and consultative process orchestrated by GoE, bringing together all key stakeholders ***under the organizing principles and architecture of "Many Partners, One Team, One Plan."***

The NEP-IRM also welcomes and acknowledges other sector policies adopted and efforts launched by the Government in recent years. The implementation of the Program will ensure synergies whenever possible and adequate with:

Ethiopia's Climate-Resilient Green Economy Strategy (CRGE), 2011

The GoE intends to achieve the middle-income status by 2025 through the modernization and diversification of the economy, boosting agricultural productivity, and fostering exports while becoming a climate-resilient "green economy frontrunner."[17]

The expansion of electricity generation from renewable sources of energy for domestic and regional markets constitutes one of the four pillars of the green economy,[18] and the Government is committed to expanding electricity services through clean energy sources—whether grid or off-grid—to achieve the target set by 2030 of limiting the country's emissions to today's 150 Mt CO_2 (around 250 Mt CO_2 savings more than under a business-as-usual path)[19] and improve the resilience of generation capacity to weather conditions.[20]

The National Improved Cook Stove Program (NICSP)

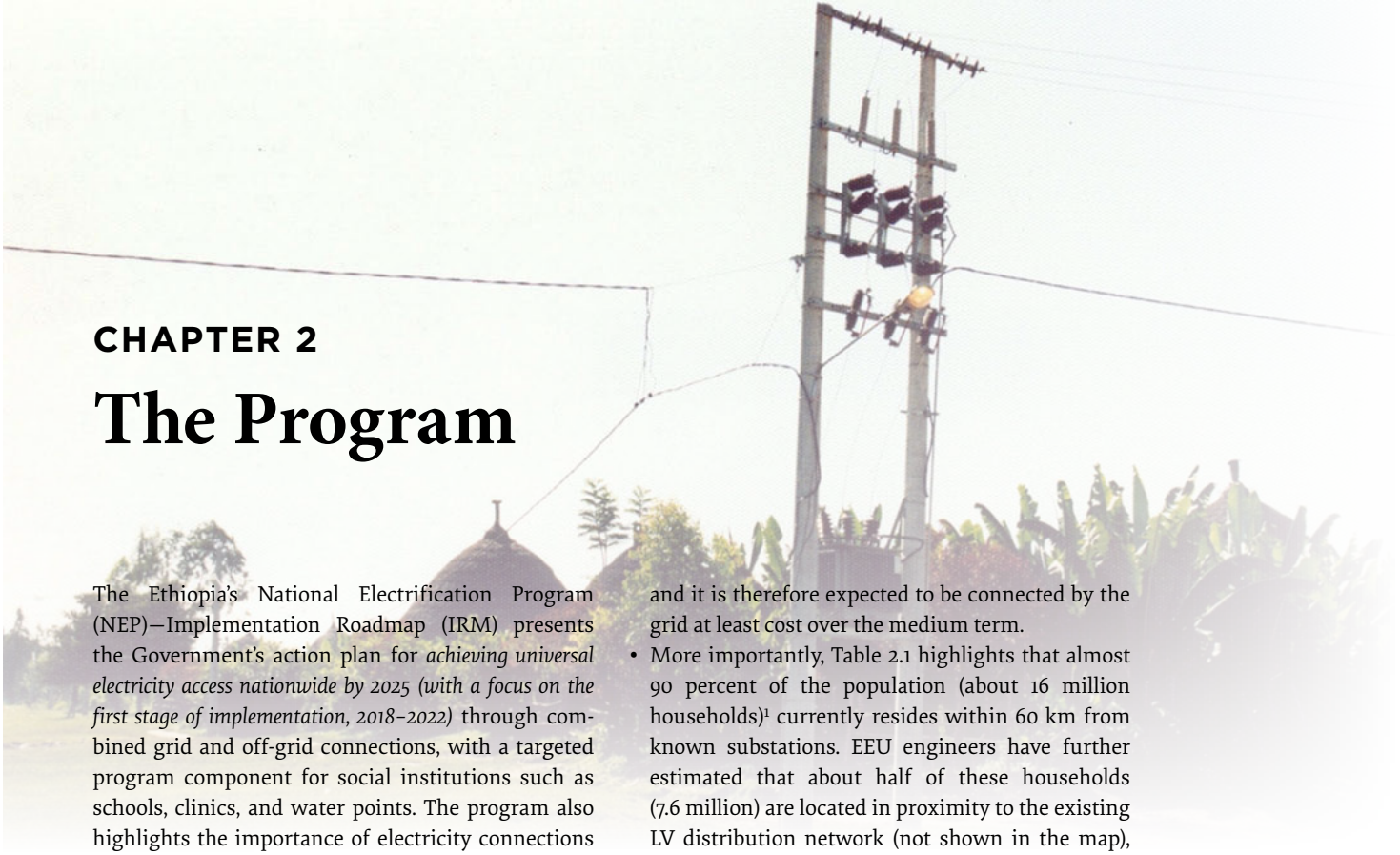
Traditional biomass currently accounts for more than 90 percent of total primary energy in Ethiopian households.[21] The NICSP constitutes a key component of the CRGE strategy to reduce the population's dependence on biomass-based fuel (firewood and charcoal) by promoting the use of cleaner cooking technologies. In 2010–2015, the NICSP distributed almost 9 million improved cook stoves in the country, and by 2020 the Government is targeting the distribution of almost 12 million extra cook stoves. Access to electricity services will lead to fuel substitution away from biomass sources, with attendant health benefits, reduced time spent on traditional fuels gathering, and mitigation of climate change and deforestation.[22]

The National Biogas Program (NBPE)

The NBPE Program was launched in 2009 and is now in its second phase of implementation with over 14,000 rural household beneficiaries of biogas digesters. Phase II targets 360,000 low-income households aimed at: (i) scaling up and expansion of the Program to the whole country; (ii) consolidating of public-private partnership; (iii) improving access to credit; (iv) strengthening quality for improved functionality; (v) introduction of new products; and (vi) support for pro-poor.

Notes

1. Federal Democratic Republic of Ethiopia—National Planning Commission (2017). Second Growth and Transformation Plan (GTP II) Annual Progress report for 2015/16, Addis Ababa.
2. Federal Ministry of Finance and Economic Development (2010). Growth and Transformation Plan 2010/2011–2014/2015 and 2015/2016–2020/2021, Addis Ababa.
3. Federal Democratic Republic of Ethiopia (2011). Ethiopia's Climate-Resilient Green Economy Strategy, Addis Ababa.
4. Federal Ministry of Finance and Economic Development (2010). Growth and Transformation Plan 2015/2016–2020/2021, Addis Ababa.
5. World Health Organization and UNDP (2009). The Energy Access Situation in Developing Countries.
6. The target for the ongoing GTP II is coverage of 90 percent of all towns and villages nationwide by 2020.
7. For the purpose of the SE4ALL National Action Plan, electricity access is defined as the supply of power though an electricity connection in the home, or the use of electricity as the primary power source for lighting (and other basic and highly valued uses such as radio, TV, phone charging) through decentralized systems (solar products and home systems, mini grids).
8. The results of the survey and their analysis are expected to be finalized by the summer of 2017.
9. Further impetus for the diversification of the energy mix was given by the impact of El Nino in 2015, which caused countrywide blackouts.
10. The International Development Association (IDA) is the part of the World Bank that helps the world's poorest countries. IDA lends money on concessional terms, with a zero or very low interest charge and repayments stretched over 25 to 40 years, including a 5- to 10-year grace period. IDA also provides grants to countries at risk of debt distress.
11. Available results from the MTF survey indicate approximately average urban household demand at 1,800 kWh/year, and 300 kWh/year on average for a rural household.
12. From 2013 (when the sector was unbundled) to 2016, UEAP was under EEP.
13. EEP and SMEC (2015). Economic and Social Impact Evaluation (ESIE) of the Universal Electrification Access Program in Ethiopia, Addis Ababa.
14. *Ibid*.
15. GTP I targeted to double the number of electricity connections from 2 to 4 million.
16. World Bank, Independent Evaluation Group (2015).
17. Federal Democratic Republic of Ethiopia (2011). Ethiopia's Climate-Resilient Green Economy Strategy, Addis Ababa.
18. The remaining three pillars of the Strategy are: (1) Improving crop and livestock production practices for higher food security and farmer income while reducing emissions; (2) Protecting and reestablishing forests for their economic and ecosystem services, including as carbon stocks; and (3) Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings.
19. Federal Democratic Republic of Ethiopia (2011). Ethiopia's Climate-Resilient Green Economy Strategy, Addis Ababa.
20. See also the Climate Resilient Strategy for Water and Electricity developed under the CRGE Strategy.
21. Johnson and Tadesse (2013). Alternative Future Pathways for Household Biomass Use in Ethiopia. Stockholm Environment Institute (SEI), Stockholm.
22. Traditional fuel consumption has been estimated to account for 46 percent of annual forest loss and, in turn, forest degradation for 37 percent of total CO_2 emissions. Federal Democratic Republic of Ethiopia (2011). Ethiopia's Climate-Resilient Green Economy Strategy, Addis Ababa.



CHAPTER 2

The Program

The Ethiopia's National Electrification Program (NEP)—Implementation Roadmap (IRM) presents the Government's action plan for *achieving universal electricity access nationwide by 2025 (with a focus on the first stage of implementation, 2018–2022)* through combined grid and off-grid connections, with a targeted program component for social institutions such as schools, clinics, and water points. The program also highlights the importance of electricity connections for productive uses within the industrial parks Government program and for the development of micro, small, and medium enterprises (MSME).

The least-cost NEP-IRM is based on the best technical information available. The Government is currently launching a nationwide GIS least-cost rollout plan which will accurately geo-locate demographic and economic load centers as well as the existing distribution network to inform the optimal connections sequencing, whether on-grid or off-grid. The NEP-IRM will be updated on the basis of the findings of the geo-spatial analysis, as well as the inputs and policy decisions stemming from the program implementation support provided for under the Program (described in Section 2.7), including studies for the adoption of a connection policy, lowering network design and construction standards, adoption of demand side management measures, and a detailed distribution technical design investment program.

The NEP-IRM least-cost rollout strategic plan (Tables 2.1 and 2.2) is underpinned and informed across Ethiopia by two defining metrics of the spatial distribution of population clusters:

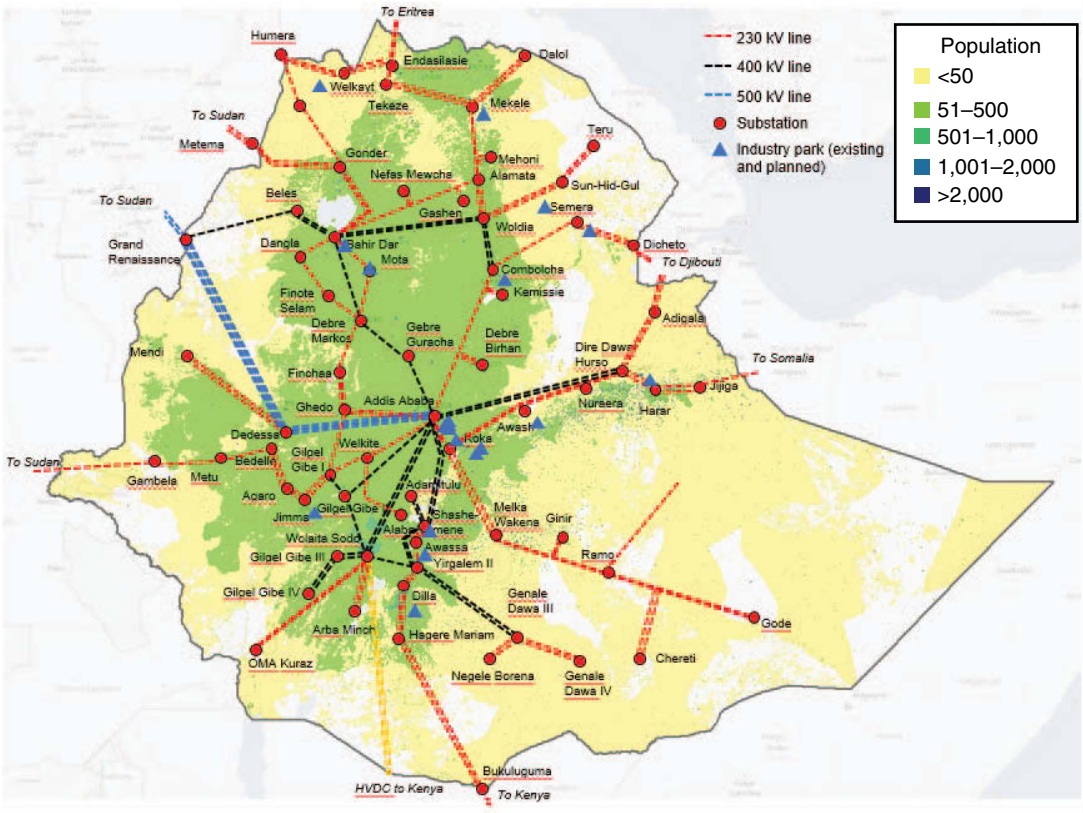
- Currently, EEU provides connections to customers within 100 km from a substation ("grid radius"). The spatial spread of the population, as mapped by the distribution heat map shown in Figure 2.1, indicates that most of the Ethiopian population (96 percent) falls within EEU's service area network "footprint," and it is therefore expected to be connected by the grid at least cost over the medium term.
- More importantly, Table 2.1 highlights that almost 90 percent of the population (about 16 million households)[1] currently resides within 60 km from known substations. EEU engineers have further estimated that about half of these households (7.6 million) are located in proximity to the existing LV distribution network (not shown in the map), mostly requiring connection drops and some LV to be connected, whereas the other half of HHs (8 million) will also require some MV. The NEP-IRM off-grid program will proceed alongside grid developments, and its final size and scope will be determined by the speed and geographic focus of grid connections.

2.1 Least-cost staged program of grid capital expenditure (2016–2030)

Based on the review of available technical reports and information, Table 2.1 provides the buildup differentiated by the spatial distribution of household segments. The overall capital expenditure (capex) for the grid rollout (medium and low voltage lines and final connections, excluding upstream costs of generating and transmission) program—providing universal on-grid access through densification and expansion by 2030—is estimated at about US$19 billion, at an average capex cost of US$820 for a total number of 22.6 million household connections.[2]

For costing purposes, three customer segments—labeled A, B, and C—are broadly delineated. Of the estimated 2016 population of 18 million HHs, EEU records indicate 2.4 million customer accounts. Available data on spatial settlement patterns further indicate that of the remaining 15.6 million HHs

Figure 2.1 Ethiopia population distribution heat map overlaid with transmission grid, and population coverage based on on-grid coverage radius



Grid radius	40km	60km	80km	100km
Population (%)	69	87	94	96

Source: McKinsey, 2016; WorldPopData.org, 2010.

unconnected in 2016, about 42 percent (7.6 million) are settled "proximately" to the existing low voltage (LV) network of EEU; while the other 8 million are "not proximate," and connecting them typically requires limited medium voltage (MV) extensions as well as new LV networks. These are labeled, respectively, as Components A and B.

Further, the Table identifies three subsegments of households within segment A. Of these, the first two subsegments (together about 4.5 million households) are very proximate to the existing network infrastructure in place. These represent the "very low cost hanging fruit" and under the least-cost strategy driver of the NEP-IRM, have been targeted for implementation of new connections under the first phase of the NEP-IRM (2018–2022), termed "densification." These connections require mostly LV network-related capital expenditures—such as service drops, household metering, and possibly shared pole top transformers.

Table 2.1 shows in column 3 that the unit connection cost variation within the densification Component A depends on household location. For the first NEP target of 4.5 million connections, least-cost connection costs range from US$150–300, with an average of US$222. These capex variations for the Densification Program represent professionally informed estimates broadly consistent with the technical experience of many other countries with similar spatial settlement patterns in respect to densification. They do not include MV extension capex nor network rehabilitation investment costs. The capex estimates service drops and limited LV extension for 4.5 new million connections is about US$1 billion.[3]

Spatial Component C represents the estimated 7 million new HHs formation resulting from the

Table 2.1 Grid capital expenditure (capex)—least-cost staged program

(order of magnitude estimates)

HHs Segments	Spatial Proximity Segmentation	US$/Connection	Estimated Capex (US$ billion)
A. Existing—"Proximate" *(mostly LV investment—of which first stage "densification program" targets approx. 4.5m cheapest connections)*	(First) 2.5m	US$150	0.375
	(Next) 2.0m	US$300	0.6
	Average US$/conn. for 4.5 million	US$222	US$0.975m
	(Next) 3.1m	US$600*	1.86b
	(Subtotal) 7.6m		~US$2.9b
B. Existing—"Not Proximate" (LV + some MV)	8m	US$900	US$7.2b
C. Population Growth (2016–2030)[a] MV + LV	7m	US$1,200	US$8.4b
Total A + B + C	22.6m	Average US$820/connection	US$18.5[b]

Note: Order of magnitude estimate, not including: (i) capex for MV network strengthening and reinforcements in all 15 regions necessary to enable densification of customer connections; (ii) capex required for the off-grid program rollout, and (iii) the cost of Technical Assistance necessary for strengthening institutional capacity directly linked to facilitate and support the achievement NEP implementation targets (DoE, EEU as well as off-grid program implementing agents and key intermediaries).

[a] Population estimates: UN Statistical Office, Ethiopia. Assumes 5.5 people per HH (Source: Central Statistical Agency, CSA). 2016 population (est.): 100m (18 million HH); 2020 population (est.): 110m (20 million HH); 2025 population (est.): 120m (22 million HH); 2030 population (est.): 140m (25 million HH).

[b] Comparable estimates for the program through 2025: estimated cumulative capex = US$15 billion at the average unit connection cost of US$765.

*Average based on the US$450 cost for three poles.

growth in today's population and projected to reach about 138 million by 2030. Providing grid access to this segment will require full-scale MV extensions and LV network reticulation nationwide, optimized to the emerging settlements geo-spatially defined. The capex for Component C is estimated to be US$8.4 billion, at an average unit capex of US$1,200.

Figure 2.2 depicts the segmentation of the potential customer segments A, B, and C identified above, with a different focus; the widening cycles symbolize *within each circle,* increasing spatial spread, and lower spatial density will be encountered as grid rollout implementation over time advances in its reach geo-spatially. The newer grid connections on the margin will be increasingly situated further away from the existing EEU network infrastructure footprint[4]—urban, peri-urban, and rural toward the furthest deep rural area households and communities—where there typically will be on average fewer connections per unit of network line and investment required to connect them to the grid.

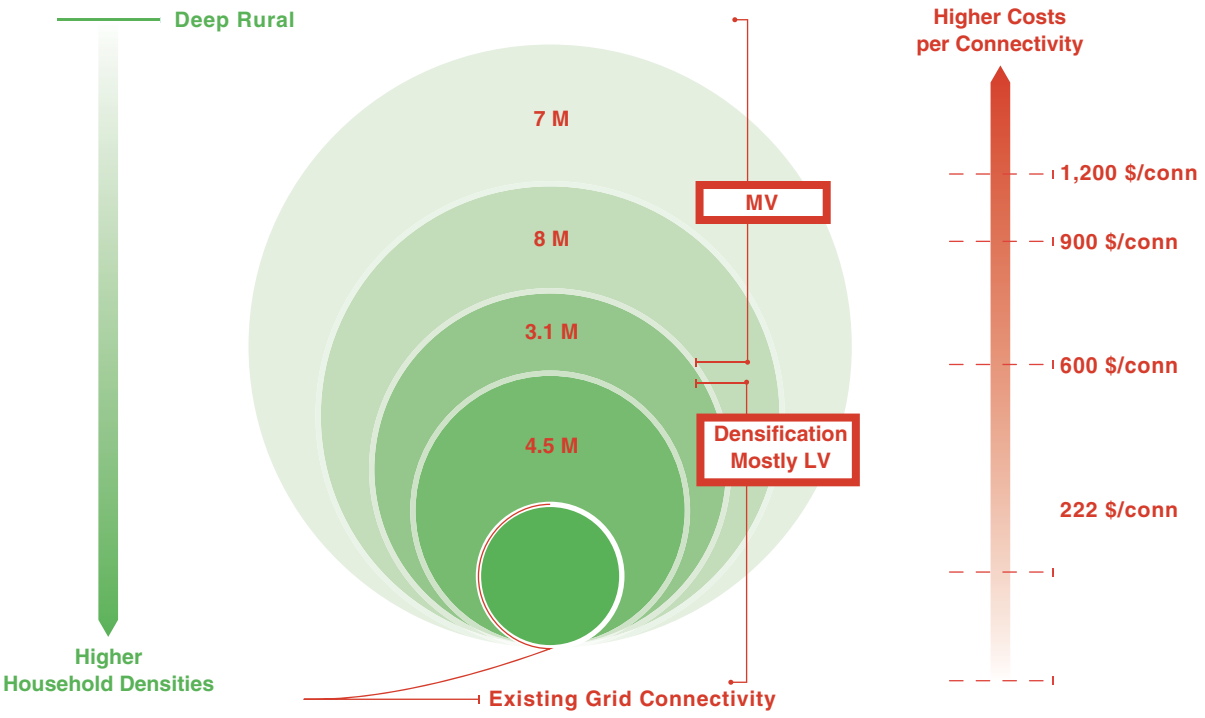
Responding to these spatial and structural characteristics and demographic settlement patterns, the least-cost rollout strategy under NEP-IRM comprises a multipronged complementary set of delivery modalities and technology options: least-cost grid-based electrification rollout including introduction of innovative network designs and appropriate equipment specifications as grid extensions reach out further in lower density and remoter areas—and alongside the grid connectivity rollout programs in each of the circles (Figure 2.2); and a well-designed and comprehensive off-grid access scale-up program—individual solar systems and isolated mini/micro grids (described in Section 2.3)—will be implemented.

2.2 Grid densification program implementation (2018–2022)

The first phase of implementation of the National Electrification Program responds to two main goals of the GoE:

- Achieving 4.5 million connections in the short term at least cost; and
- Giving priority to the paid and unpaid waiting list, including HHs that have already paid for the connection and those that have submitted a formal application to EEU offices. It is estimated that, overall, about 300,000 HHs are currently waiting for electricity services to be delivered, out of which about 50,000 have already paid in full for the connection.

Figure 2.2 Schematic least-cost access delivery to household segments spatially differentiated



▪Grid connections in each circle will be complemented by off-grid preelectrification solutions

Physical program for scaled up grid customer connections

Consistently with the least-cost rollout spatial costing and the goals of the Government, the focus of this immediate phase of NEP-IRM implementation is systematically connecting the approximately 4.5 million new customers (Table 2.2), situated very close to the existing network infrastructure of EEU.[5] These connections mostly require short LV service drops and metering. As such, they are marked by the lowest unit cost per new connection (under US$300). The estimated overall capital expenditure requirement of this program is about US$1 billion (Table 2.1).

The year-on-year connection targets for providing 4.5 million new grid connections at the lowest unit cost are shown in Table 2.2. Alongside the grid connections program, Table 2.2 also indicates the scaling required for the off-grid preelectrification program rollout in order to achieve the NEP's goal of universal access by 2025. Beyond 2025, as the grid extensions and connections program progresses, a substantial number of the off-grid preelectrification program communities and beneficiaries will be absorbed into the grid system and provided connectivity. By the time the grid rollout advances to its identified economic limits (sometime between 2026 and 2030), grid access is projected to be of the order of 97 percent with the remaining household (3 percent) population provided off-grid access. The off-grid program strategy and rollout plan details are presented in Section 2.3.

In respect of the 4.5 million grid connections program implementation over 2018–2025, the Densification Program will target connections in a balanced manner across the 15 regions of EEU,[6] to the extent technically feasible. Specifically, connections will be selected not only in the proximate urban and peri-urban areas—where to start with, a substantial waiting list of paid customers exists and expectations are that this list can be readily augmented with promotion—but in particular accord priority as well to densification in the vicinity of the outer reaches of the UEAP program network, in communities where

Table 2.2 Grid and off-grid connections program and electricity access (2018–2025)

Time Period		Population (million HHS)	On-Grid Connections Added[a]	On-Grid Cumulative Connections (million)	On-Grid Access Rate	Off-Grid Access Rate	Total Access Rate
GTP II	2016	18	0.1	3.6	20%[b]	11%*	31%
	2017	18.5	0.2	3.8	21%	11%*	33%
	2018	19	0.5	4.3	23%	11%*	34%
	2019	19.5	0.7	5	26%	11%*	37%
	2020	20	0.8	5.8	29%	13%	42%
GTP III	2021	20.4	1	6.8	33%	16%	49%
	2022	20.8	1.5	8.3	40%	20%	60%
	2023	21.2	2	10.3	49%	24%	73%
	2024	21.6	2	12.3	57%	29%	86%
	2025	**22**	**2**	**14.3m**	**65%****	**35%**	**100%**
GTP IV	2026	22.6	2	16.3	72%	28%	100%
	2027	23.2	2	18.3	79%	21%	100%
	2028	23.8	2	20.3	85%	15%	100%
	2029	24.4	2	22.3	91%	9%	100%
	2030	**25**	**2**	**24.3m**	**97%*****	**3%**	**100%**

[a] Based on population assumptions described in the notes of Table ES.2. Source: UN Statistical Office, Ethiopia.

[b] Consistent with the footnote to Table ES.1, the 20 percent grid connection indicated for 2016 is representative of the estimates reported in other reports; and by inference this implies about 3.6 million grid connections (instead of the 2.4m recorded in EEU's customer account records). The following rows in this Table are projected on the baseline of 20 percent.

* The baseline for 2016 is based on about 2,046,000 stand-alone solar (including lanterns) and 8,000 mini grid customer connections. For subsequent years (2017, 2018, and 2019) the rate for off-grid does not change because increases in off-grid solutions are not expected to be greater than population growth.

** To achieve NEP's goal of universal access by 2025, the off-grid rollout program will target the remaining 5.7 million households not grid connected in 2025. The off-grid strategy and implementation roadmap will further detail the targets for off-grid technologies and the institutional and implementation arrangements. The strategic directions for off-grid are presented in Section 2.3.

*** The Table reflects the expectation, pending confirmation by the detailed geo-spatial planning study, that the grid is expected to be a least-cost solution for the overwhelming majority of Ethiopia's population (of the order of 97 percent). Depending upon the implementation rates achieved beyond 2020, and availability of financing, least-grid connectivity can be achieved even prior. The residual 3 percent reflects the share of population for which the grid is not projected to be the least-cost solution.

the MV network has been extended but connectivity still remains limited after several years in waiting and the network can support new connections (and/or require limited upgrading).[7]

This represents a fast-paced acceleration in the scale of new connections each year recorded in the recent past, by several orders of magnitude (over ten-fold plus) by 2022. These challenges are surmountable and are purposefully and systematically addressed in the NEP-IRM immediate program implementation support (Section 2.7).

High priority near-term actions have been identified for a well-targeted program of support strengthening key functions of EEU's Distribution Operations Directorate in the near term. Depending upon the actual implementation rates achieved beyond 2020, and availability of financing at the time, the economic limits of grid connectivity of about 97 percent can be achieved even prior to 2030.

Implementation readiness for achieving of 4.5 million new grid connections through densification

The Government is mindful that the year-on-year connections targets driving the Implementation Roadmap (Table 2.2) are ambitious and seemingly daunting, but only if viewed retrospectively in comparison to the annual on-grid connection rates achieved historically. They call for a quantum shift and fast-paced acceleration in the scale of new connections each year, by several orders of magnitude (over ten-fold plus) by 2022.

These challenges are surmountable and are purposefully and systematically addressed in the NEP-IRM immediate program implementation support design for 2018 (Table 2.7). Going forward, several factors come into play to enable breaking out of the "business-as-usual" trajectory of the past. Taken together, these factors are transformative in respect

of EEU's implementation readiness for the NEP Densification Phase (see also Annex 5):

(a) ***Building on the base of consolidated and proven technical skills and operational experience with access coverage scale-up since 2005.*** With the unbundling of the sector and creation of EEU (and well underway integration of UEAP functions within and across the expanded utility), the Government has established a professional institution with an exclusive focus and mandate for expanding access on two interrelated fronts:
   (i) continued access coverage of priority towns and communities program (UEAP) initiated in 2005, that has a proven and professional track record of achievement (see Table 2.2); and
   (ii) with the introduction of the NEP-IRM, the scale-up in electricity access through connections scale-up is accorded top priority alongside coverage scale-up, enabling a timely combination and simultaneous implementation of both at least cost.

Crucially as well, UEAP staff brings long-established experience and proven professional skills and capacity for the entire range of functions called for in connections scale-up. Since 2005, UEAP has steadily acquired proven experience-based institutional and professional capacity to effectively undertake the entire chain of technical, engineering, and managerial functions and processes that need to be brought to bear by a professional utility to achieve the results at the scale delivered so far, including: (i) at the upstream stage, systematic techno-economic screening framework for selection and sequencing of the list of towns and communities nominated as priorities by regional authorities; (ii) informed by the outputs of undertaking detailed MV network technical design and costing; (iii) managing procurement, logistics of material handling, warehousing, and inventory management of a diverse catalogue of poles, conductors, insulators, transformers, switches, and myriad of other component parts; and (iv) downstream program management associated with orchestrating construction crews for work.

(b) ***Targeted and focused strengthening of institutional capacity in specific high priority functions and skills identified that are directly linked to the scaled up implementation program in the immediate term.*** These near-term high priority actions (studies and Technical Assistance outlined subsequently) target and appropriately strengthen EEU's capacity across the key functions and business units that are involved with the connections scale-up program initiatives under the NEP-IRM and open the pathway toward achieving the ambitious targets set by GoE and described hereunder.

(c) I***ntroducing affordable connection fee policy and structure to lower a key first cost barrier to becoming an EEU customer.*** Consistent with good practice experience and based on the findings and recommendations of a high priority special study provisioned for under the Technical Assistance component of the NEP Densification Phase, the existing customer connection fee policy will be appropriately revised, including introducing the facility for qualifying customers to pay the fee in easy installments collected by their EEU bill.

(d) ***Detailed design and preparation of the rollout of the first 500,000 connections starting January 2018.*** EEU, working closely with UEAP directorate—recently folded into EEU—has established a high level technical and management team with specific focus on detailing the calendar year 2018 implementation program. A comprehensive nationwide MV feeder-level technical network analysis has been completed, including demand assessment of all MV feeders in the country—over 550—with active participation of regional and district offices. The output of this rapid nationwide assessment of each MV feeder has led to an initial determination of the number of new connections that can be added on each. Additionally, the team is preparing the corresponding Procurement Plan for the 500,000 connections (by major equipment category), identifying the number of items: (i) available in warehouses, (ii) to be procured in-country, and (iii) to be imported.

(e) **Improvement of business and commercial functions.** EEU has embarked on a multiyear, multifaceted process of comprehensively modernizing its back-office information technology (IT) systems, tools, and resources, to allow it to become a service delivery oriented and efficient corporation. This includes the installation of a state-of-the-art Enterprise Resource Planning (ERP) system and a comprehensive GIS system for asset management, planning, and monitoring. This will not only revolutionize EEU's technical planning capabilities, but will also improve the reliability of information on customers and

the infrastructure used to serve them. Furthermore, EEU is in parallel undergoing a business process reengineering (BPR) exercise to improve and streamline delivery functions and further strengthen its quality of service delivery to its customers. The utility is also improving its complaint handling mechanisms.

2.2.1 Lowering cost in electricity network distribution and consumption

Providing electricity services to the Ethiopian population is a capital intensive effort. To ensure the rapid spread of the grid's reach and connections, the wide range of existing low-cost methods, technologies, and equipment for service provision and electricity consumption will be taken into account. EEA will be accountable for promptly approving required technical standards and regulations.

International experience shows that cost reductions in the order of 20–30 percent are realizable through improved engineering and material selection and by simplifying design of low voltage networks, without compromising safety and security (see Annex 6). The implementation of the NEP-IRM will aggressively pursue cost reduction methods, both on the supply and on the demand side, ensuring that, overall, a holistic cost reduction culture permeates the design and construction of the distribution network and electricity consumption.

EEA has already adopted the Draft Energy Efficiency Standards and Labeling Guideline (2015), which lays the foundation for the launching of an Energy Efficiency Labeling and Standards Program.[8] Furthermore, the Regulator is currently receiving Technical Assistance to address the lack of regional regulation framework and practices of electrical works in power generation, transmission, distribution, building installations, industrial works, and related businesses, and provide professionals with technical guidelines to assist their practices. Capacity building is also aimed at empowering the Regional Energy Bureaus (REBs) and the Regulator across several dimensions: institutional, skilled man power, equipment facility, and system development.[9]

EEU has already launched several initiatives and pilots to reduce infrastructure and consumption costs. In particular, on:

Network design and construction

- Deployed Single Wire Earth Return (SWER) for over 10,000 households and 100 towns;[10]
- Reduced number of poles and accessories required per km (UEAP); [11]
- Developed a network optimization scheme (UEAP);
- Investigated best poles mix (poles constitute up to 25 percent of network investment costs);
- Launched an initiative to harmonize and customize IEC standards for network materials;
- Developed concrete poles production and related training (UEAP);[12]
- Conducted network analysis to map network capacity with existing and potential new costumers (including those on the paid and unpaid waiting list);[13] and
- Installed 879 Power Factor Correctors (particularly for large customers) and made them mandatory.[14]

Procurement

- Adopted bulk procurement contract framework; and
- Created a list of preselected vendors.[15]

Energy efficiency

- 15 million compact fluorescent lamp (CFL) bulbs have been deployed since 2010;[16]
- Evaluated schemes for substituting CFLs with light-emitting diodes (LED) solutions;
- Launched a power factor saving program financed by customers to reduce their electricity bill;
- Launched a pilot for smart meters;[17] and
- Launched a study for reducing condominium electricity consumption by 40 percent through embedded solar rooftop generation.

The implementation of the NEP will require a programmatic expansion of these undertakings as well as the identification of a portfolio of cost reduction methods. To support the identification of the best mix of cost reduction methods, a specific implementation support study is provided for under the NEP-IRM. Informed by the best practice experience of other countries, while focusing on the specific Ethiopian geographic and climate context, the analysis will provide specific inputs to lower the cost of network design and construction and electricity consumption to inform implementation from 2019 onward. The program implementation support study will also comply with the 2017 EEA Draft Distribution Code Regulation (currently under review by MoWIE), legally establishing technical grid requirements for the connection to and use of an electrical distribution system and ensuring a safe, secure, reliable, and efficient operation.[18]

In particular, the implementation support study—to be developed closely with EEU—will take into account the cost reduction methods emerged

worldwide as the most effective, such as (a comprehensive list and cost comparison is provided in Annex 6):

- Network design and equipment based on local load forecast, with flexibility to upgrade (up to 50 percent savings);
- Large-scale SWER development (up to 40 percent savings) and Shield Wire System (30–50 percent savings);
- Standardization of technical features and all equipment and components used for construction of distribution systems;
- Reliance on local manufacturing and strategic location of facilities (30–50 percent savings);
- Centralization of procurement process and bulk purchases and incorporation of incentives for cost reduction in open and transparent bidding;
- Warehouse management and quality control; and
- Deployment of ready boards, particularly for poorest consumers and premises currently not eligible for connections as per EEU regulation[19] (50–75 percent savings).

2.3 Off-grid program strategy and plan of action—universal access by 2025

The NEP-IRM responds purposefully to the Government of Ethiopia's priority for advancing equity and inclusion, and shared prosperity, irrespective of where one happens to live. This also means not leaving behind traditionally underserved rural area populations and rural institutions such as schools, health centers, and administrative buildings.

Alongside the grid Densification Program of 4.5 million grid connections (2018–2022), the NEP-IRM includes the priority preparation and launching of a revamped off-grid program whose implementation framework and operational design is informed by best practice established international experience, especially in the solar products and systems market segment. For the achievement of universal access by 2025, off-grid solutions are preliminarily expected to provide services to 35 percent of the population (Table 2.2).

In the pursuit of universal access, there is no dichotomy or trade-off simply based on a narrow least-cost calculus between grid-based access provision and off-grid solutions. Rather, off-grid access provision plays a complementary and coordinated role alongside grid rollout. The manner in which the off-grid and grid combination plays out during implementation varies by country and is dynamic in space and over time.

GoE's priority is the preparation of a detailed operational design for off-grid rollout, scale, scope, and design organized along two strategic drivers:

- **Off-grid preelectrification program (transitional):**[20] targeting settlements, communities, towns, and villages where grid connectivity is projected as least cost, but that may have to wait several years before they receive grid access. By 2025, about 5.7 million households will need to be provided access (solar systems above 10 Wp) and mini grids as and where appropriate. Delineation of the geo-spatial locations, numbers, and nature of prospective beneficiaries by spatial distribution will be determined in coordination with the scale and speed of grid developments and the national geo-spatial least-cost high level rollout plan (expected completion by mid-2018).
- **Off-grid targeted where grid connectivity is not the least-cost solution:** serving remote and scattered household settlements and villages that are unlikely to be cost effectively served by grid connectivity. They may also include some homes that are not far from the existing grid, but their isolation from neighbors' settlements and transformers raises the cost of connectivity greatly. The size of this component is preliminarily estimated at 2 percent of the population (about 0.5 million HHs). Again, the spatial delineation of this target segment of beneficiaries will be analytically informed once the results of the national geo-spatial planning study are available (mid-2018).

The NEP-IRM builds on the experience with two technology modalities for serving both population segments: (i) portable cash and carry and Pico solar lighting and charging products, including solar lanterns, and stand-alone home-sized systems (up to 200Wp); and (ii) isolated mini grids, as well as a coordinated combination of these technology solutions. To date the off-grid program has provided access to about 2.5 million beneficiaries, broadly differentiated by the delivery modality deployed (public and private sector-led), and spatially (rural and deep rural vs. proximate urban locations).

Solar lighting and stand-alone systems: achievements to date

Ethiopia has already achieved significant results in the availability and distribution of off-grid solutions, and shows the potential for large scale-up. By the end

Table 2.3 Summary of REF solar home system project completed and ongoing

REF Project from Phase I to Phase IV Implementations							
S. No.	**System Type (Wp)**	**Phase II SHS Quantity**	**Phase III SHS Quantity**	**Phase IV SHS Quantity**	**Phase V (4004) SHS Quantity**	**Total**	**Estimated Total Power (Wp)**
1	8	5,954	906	2,148	717	9,725	**77,800**
2	10	6,207	636	2,514	920	10,277	**102,7770**
3	20	1,896	680	1,559	732	4,867	**97,340**
4	40	650	324	699	980	2,653	**106,120**
5	60	2,792	464	1,196	655	5,107	**306,420**
6	75	3,821	40	1,164	0	5,025	**376,875**
7	80	1,311	241	861	0	2,413	**193,040**
8	100	1,953	128	794	0	2,875	**287,500**
9	130	416	316	553	0	1,285	**167,050**
	Total	**25,000**	**3,735**	**11,488**	**4,004**	**44,227**	**1,714,915**
	Phase I project benefited seven cooperatives					**1,138**	
	Grand total					**45,365**	

Source: MoWIE, 2016.

of 2016, through Government supported initiatives and private sector involvement, over 46,000 solar home systems and about 2 million lanterns were sold to the Ethiopian population.

In 2003, the Government established the **Rural Electrification Fund (REF)** with the mandate to oversee off-grid electrification.[21] The REF supports public sector initiatives, cooperatives and other community-based organizations, NGOs, and other relevant developers through provision of sub-loans and Technical Assistance.

REF public sector activities have been focusing on two main efforts:

(i) *Implementation of stand-alone solar home systems (SHS)*
These technologies provide a fast and cheap solution for providing sufficient power while waiting for the grid, including household lighting, phone charging, and powering of basic appliances (e.g., fans, TV, computers). The REF program was launched in 2005 and has already financed and provided more than 45,000 SHS[22] to the unelectrified communities identified by Regional Energy Bureaus (REBs)[23] through almost 500 Energy Service Cooperatives (ESCOs),[24] who are given access to lower interest loans from the Development Bank of Ethiopia (acting as a trust agent) and become owners of the stand-alone systems.[25] To ensure loan repayment, ESCOs are also responsible for assessing households demand. REBs also conduct off-grid information and promotion campaigns.

Up to now, REF has trained over 200 micro-technicians in operation and maintenance of SHS and a solar PV system facility was acquired and handed over to the Ethiopian Conformity Assessment Enterprise for quality control of products.[26]

(ii) *Public facilities program*
Through REF, the Government has also launched a program for public facilities, mostly schools and health centers, which are provided with solar systems financed at no cost. The list of unelectrified facilities is provided by the REBs, while REF designs the technologies based on the size and needs of the institution. The REF program has already served 370 schools and almost 2,000 health posts and centers in collaboration with the Ministry of Health (Table 2.4).

The Program has seen improved service standards over the years on the basis of the facilities' needs. Schools were initially provided with solar lamps, but are now served with 300 Wp solar systems for the lighting of 2–3 classrooms.[27] Health posts and clinics are currently provided with 600 Wp systems (at the launch of the Program only 200 Wp were distributed) which allow

Table 2.4 Social facilities provided with off-grid stand-alone systems, 2016

Electrified by	Health Post	Primary Schools	Health Centers	Subtotal
Rural Electrification Fund (REF)	545	370		915
Federal Ministry of Health*	1,109		467*	1,576
Total				**2,491**

Source: MoWIE and Ministry of Health, 2017.

**Note:* The provision of PV systems to 167 health clinics is currently under implementation with support of United Nations Office for Project Services (UNOPS).

for six light bulbs, refrigeration, radio, and TV for five to six hours a day.

Private sector initiatives supported by the Development Bank of Ethiopia

Micro Financial institutions (MFIs) and private sector enterprises (PSEs) have also been important players in the provision of solar lighting and charging products and solar home systems. Through credit lines at the Development Bank of Ethiopia (serving as a financial intermediary for funding provided by the World Bank), over 1,000[28] solar home systems and 779,514 Lighting Global Certified solar lanterns have been distributed to the Ethiopian population.[29]

Training was provided to ensure proper appraisal of technologies, products, and services as well as to set and adhere to quality standards of the sector.[30] Supplemental capacity building activities to strengthen the capacity of MFIs in administering their credit line as well as their coordination with other stakeholders (i.e., Regional Energy Bureaus), business development, and community engagement are ongoing.[31]

Approved MFIs provide affordable financing to rural communities entering into tripartite agreements with Regional Energy Bureaus (REBs) and selected PSEs to procure and install off-grid products for the customer.[32] DBE has been mostly working with five MFIs, within a network of fourteen.[33] The eight PSEs currently involved are approved retailers that can access credit and foreign exchange to import and commercialize products. The enterprises have already sold about 530,000 units, out of which 600 were solar home systems (6–12 Wp), and the remaining were lanterns and mobile charging units.[34] About 100 technicians have been trained to provide after-sale services in support to PSEs.

Isolated mini grids: achievements to date

EEU operates a number of isolated diesel generation distribution systems where grid power is not yet available. Out of 36 mini grids constructed,[35] 5 have been successfully connected to the grid and the remaining ones are mostly located in the Somali region (see Table 2.5). About 35 percent of the mini grids have an installed capacity of 100 kW, with one site at 520 kW and the remainder between 150 kW and 360 kw, and about 8,000 connections are estimated to be currently provided through these existing installations.

The Government is also collaborating with Development Partners for the piloting of mini grids powered by renewable energy sources. USAID is conducting a feasibility analysis for the conversion of EEU's diesel mini grids to renewable energy power, five hydroelectric sites identified by Water Works Enterprise,[36] and several clusters of unelectrified villages to evaluate mini grid solutions for access provision. The European Union is financing five hydro mini grids implemented by GIZ testing a model for renewable energy distributed generation that is currently based on cooperatives, but aims at scaling up the market for private or public agencies, as well as by a combination of both. In collaboration with the

Table 2.5 Installed capacity and number of connections provided by EEU diesel mini grids

Installed kW	No. Sites	%
100 & 150 kW	14	39%
200 & 250 kW	8	22%
320 & 360 kW	8	22%
520 kW	1	3%
Grid connected	5	14%

Connections	No. Sites	%
No data	17	47%
1–250	11	31%
251–500	4	11%
501–750	2	6%
1,001–1,250	1	3%
1,251–1,500	1	3%

Source: NRECA, EEU (2016).

Table 2.6 Summary of main mini grid investment and Technical Assistance activities for EEU

Project #	Status
1.	The proposal for feasibility study has been approved and a road map for study development submitted
2.	Finalization of feasibility study for pilot
3.	Submission of final technical and financial proposal

Source: EEU.

Korean International Agency Cooperation, UEAP will also launch in 2017 two hydro mini grids. A summary of ongoing mini grid activities in the country is provided in Table 2.6, and a complete overview is in Annex 7.

2.3.1 Off-grid program design—strategic directions and key considerations going forward

Continuation of business as usual will not be sufficient to roll out access at the scale required to set the stage for achieving 5.7 million off-grid households by 2025 (35 percent of electricity access). Simply mobilizing more financing cannot get the job done, and a strategically driven redesign of the off-grid program components is called for. The plan of action proposed by the NEP-IRM aims for a substantially redesigned off-grid program, broadly organized into four subprogram components and outlined in the following text and informed by best practices, such as in Kenya, Bangladesh, Peru, and Argentina (Annex 4).

The scope and design principles underlying each component are informed by relevant best practice experience and respond effectively to the following strategic drivers that have been largely absent to date:

- ***Scale and speed of program delivery***—going forward, the redesigned off-grid program subcomponents, should—together—be capable of rapidly and sustainably scaling up the off-grid access implementation of over 1 million new households per year, on average, over the period 2019 through 2025 (combination of solar systems and mini/micro grids).
- ***Spatial reach of the off-grid program***—the NEP-IRM accords priority focus on the underserved rural and deep rural area beneficiaries, where the majority of the nation's population lives, with incomes under $2 per day, and where the development need and imperative of inclusion is paramount.
- ***Priority for solar systems***—the Government policy gives priority to increasing the penetration of solar *systems* in rural and deep rural areas (while continuing to support private market development of the solar *products* market "under the grid").
- ***Institutional framework***—the NEP-IRM strategy aims to enable both public sector and private sector-based delivery modalities to roll out off-grid access. It seeks to build on the comparative advantage of each, and their potential for scale-up in the Ethiopian context.

In this context, the GoE is mindful of the relevant international experience with the challenges confronting rapid and sustained scale-up of off-grid programs (Annex 4). The NEP-IRM action plan going forward calls for a detailed design study to be undertaken in 2018 (see Section 2.7), informed by the results of the national geo-spatial least-cost access rollout plan, to prepare a detailed operational off-grid program on par with best practices for the four operational subprogram components. To ensure the timely launch of the off-grid program, the Government is also considering the development of an Off-Grid Strategy to further structure the strategic approach for achieving 5.7 million off-grid connections by 2025 (2.1 million connection by 2022), the establishment of an enabling environment for off-grid scale-up, and the readiness of sector institutions for the planning, implementation, and monitoring of the off-grid program, which would also inform the subsequent detailed implementation operational design in 2018.

Off-grid program components—dimensioning the broad contours

Table 2.7 depicts an illustrative rollout trajectory of the two main technical delivery modalities for off-grid access scale-up through 2022. The investment requirements are based on a weighted average cost per stand-alone solar systems (without replacement cost, as not expected during the first phase of

Table 2.7 Indicative off-grid connections rollout and related financing requirements (2019–2022)

Year	Stand-alone Solar Systems	Mini Grids	Total
2019	190,000	10,000	200,000
2020	430,000	20,000	450,000
2021	620,000	30,000	650,000
2022	760,000	40,000	800,000
Subtotal	**2,000,000**	**100,000**	**2,100,000**
Financing requirements (US$ million)	**US$278m**	**US$200m**	**US$478m**

implementation of the program) of US$140 (with service standards ranging from 10 Wp to 130 Wp),[37] and an average cost of about US$1.2 million per mini grid (about US$2,000/connection).

These numbers are not intended to pre-allocate targets by technology or delivery modality or by subprogram, but only serve as initial guides for undertaking a detailed operational designing of the four operational subcomponents outlined below. With unfolding implementation experience and results achieved on the ground vis-a-vis target expectations, adjustments in program subcomponent design along the way as and when warranted will be proposed to the Government for review, guidance and, as necessary, approvals.

A. Public sector delivery in deep rural areas and underserved environs—spearheaded by REF and EEU

1. Rural Electrification Fund (REF)—The case for public sector-led delivery of off-grid access is clear, especially for the more distant and remoter rural areas' beneficiaries where private market-based options are far less commercially attractive. In this context, the NEP recognizes that a key instrument utilized in the past (the REF mechanism), requires a complete redesign for the scale and speed in delivery called for going forward.

Specifically, a key area of focus in the 2018 off-grid program operational design and implementation study will address the redesign of REF. The detailed design of the "REF version 2" will be guided by the following principles and essential features to achieve the scale of deployment needed in deep rural areas and environs on a sustained programmatic basis: (i) design and preparation of consolidated packages for solar systems delivery and after-sales maintenance services provision, (ii) deep rural areas and environs targeting, aggregated by region, and (iii) competitive bidding (with technical specifications and performance design) to qualified enterprises. The solar system components and system design will be optimized to weather and insolation variation by region.

2. Ethiopia's national distribution utility EEU has proven competence, professional experience, reach, and presence in deep rural areas and environs. It currently operates 33 mini grids serving over 8,000 beneficiaries in remote locations. While the newly integrated EEU/UEAP has a big task ahead in delivering on the grid connectivity and achieving the targets set under NEP, the Government is mindful from lessons of good practice experience highlighted above that many Governments, in their endeavors to scale up rural access implementation, have successfully and routinely tapped the comparative advantage offered by their national or regional utility companies: in respect of technical, professional, and management expertise, and frontline presence and proximity to the target beneficiary population. These countries have smartly structured a framework wherein national/regional utilities have set up subsidiary/distinct business units that function on a full cost reimbursement basis as a Program Management Agent for the Government in designated areas, such as maintenance and after-sales services, billing after installment by private sector enterprise, and even procuring and installations of solar systems by the utility. Along similar lines, utilities have been present with mini grids in rural areas where the private sector has not been forthcoming.

After weighing the pros and cons in the context of Ethiopia, a key element of the NEP-IRM strategy is to assess on a pilot basis—yet at a sufficient scale to draw valid implications for informing their mainstreaming—the following modalities for expanded scope for participation by EEU:

- *Solar systems*—within the proximate and contiguous environs of its 33 mini grid operations, EEU is to function as a designated Program Management

Agent for the Government activities (REF), and otherwise on its own, to undertake and manage solar system delivery, installation, maintenance, and billing, and also offer charging stations and services for those who prefer that service option instead. The alternative business model is often challenged by the lack of responsive after-sales maintenance services and readily available spare parts, as well as battery replacements. These challenges can be substantially and cost effectively delegated to EEU as the Program Management Agent.

- *Mini/micro grids*—on a pilot basis, EEU is to design, construct, and deploy green-site mini/micro grids, especially in areas where qualified private sector providers are not forthcoming. Specifically, an ongoing 'Beyond the Grid' study by a consultant team working closely with EEU is geo-spatially mapping and screening remote area village clusters with sufficient loads for a mini/micro grid network solution. This study, coupled with EEU's own information and database from Regional Offices, can help identify suitable candidates for this pilot component to get under way.

B. Private market-based off-grid delivery in rural areas

3. Solar systems scale-up in deep rural areas—building upon the experience and results achieved by the "Lighting Africa" Program framework, the NEP-IRM provides for the design and deployment of a tailored program for Ethiopia to systematically address the full range of barrier removal support interventions appropriate to tackle the rapid scale-up of rural area solar systems markets. These interventions include market intelligence, quality assurance and quality verified products, access to finance (to dealers and potential consumers), consumer awareness, business development support (training, consumer education campaign), and Government enabling policies as appropriate (e.g., tax breaks on access imported equipment, finance facility to support forex bulk procurement, and working capital credit lines, etc.).

4. Mini/micro grids predominantly for pre-electrification in rural areas till grid access is extended. The Government intends to apply uniform network design and equipment standards appropriate for rural area's mini/micro grids to ensure their smooth integration into the network when the grid arrives. The draft energy regulation establishes the regulatory framework for mini grids licensing and adequate provisions to address in a fair, equitable, and transparent manner any "stranded assets" of the private operator when integrating with grid arrival. The NEP-IRM strategy calls for bundling the potential sites into three or four lots, to be bid out competitively to qualified and licensed private operators of mini grids.

Finally, the Government is mindful of the key challenges, emerged from international experience, in the development and scale-up of micro and mini grids solutions (Box 2.1).

Box 2.1 Main challenges in micro and mini grids scale-up

Although mini grids have not yet experienced a major breakthrough at a worldwide scale, several countries (e.g., Kenya, Tanzania, Rwanda, Ghana, Sri Lanka, Argentina, and Peru) have started piloting and testing different business models to provide a higher level of electricity services to their citizens and support productive uses. Their experience illustrates the main challenges encountered for scale-up of mini grid technologies:

- Lack of reliable market demand information, such as demographics and ability to pay, to guide investment decisions;
- Lack of a supportive policy and regulatory environment that does not adequately provide for:
  - Clarity on the role of mini grids in rural electrification efforts,
  - Coordination and facilitation of private sector participation by defining potential off-grid service zones, concessions, or other service arrangements,
  - Approaches to tariff setting that are suitable for mini grids, and
  - Streamlined approval and permitting processes for mini grid installation and operation; and
- Limited availability of appropriate financial solutions that provide for:
  - Greater up-front capital expenditure and longer payback periods than other off-grid electrification solutions, and
  - Potential currency mismatches, where mini grids typically rely on dollar denominated inputs but receive income in local currencies.

Source: IFC, 2017.

2.4 Targeted program for connecting public institutions

Under the NEP Implementation Roadmap, the GoE accords a targeted focus for achieving universal access for all social services delivery institutions as a top priority—especially in the education and health sector. While electricity access rates achieved to date in schools and health facilities are relatively higher than for households, they still remain short for providing universal access and they will hence be given priority.

Table 2.8 highlights the baseline access statistics reported. As a result of heavy investment of the Government in the education and health sector, there are currently about 55,000 facilities across the country, more than 36,000 schools and 19,000 health facilities.

About 24 percent of primary schools and 70 percent of secondary schools are reported[38] to have electricity access provided by a variety of means or combination thereof—grid connection, self-generation, or solar PV power. The city regions of Harari, Dire Dawa, and Addis Ababa have higher proportions of schools with electricity as schools there are more easily accessible to electricity grid networks. Tigray also has a large proportion of schools with electricity at 99 percent. In the health sector, 97 percent of hospitals, 54 percent of health centers, and 5 percent of health posts are grid connected.

Secondary schools

Secondary education is critical for the modernization and industrialization of the economy and achievement of middle-income status by 2025 (the analysis for primary schools is provided in Annex 8).

There are currently about 3,000 secondary school facilities in Ethiopia and the majority of them—70 percent—already have access to electricity services (Table 2.9). The Government is committed to providing all secondary schools with electricity access by 2022, and priority will be given to the regions of Afar, Benishangul, and Gambella that currently have the lowest access rates (48, 52, and 22 percent, respectively).

Health facilities

There are currently over 20,000 formal sector health facilities in the country, with 206 hospitals, almost 4,000 health centers and over 16,000 health posts.

As shown by Table 2.10, the reported access to reliable electricity services[39] declines with the size of the health facility. All hospitals regardless of type (referral hospitals have 100 percent of access, general 95 percent, whereas primary ones have 88 percent) and higher clinics (84 percent) are more likely than health centers (57 percent) to have regular, uninterrupted electricity. Fewer than three in ten health posts have regular, uninterrupted electricity.[40]

There are currently 508 additional facilities under construction (103 hospitals, 180 health centers, and 225 posts). Under the implementation of the NEP, hospitals will be provided with full access as a priority in 2018, health centers in 2022, and health posts in 2025.

Table 2.8 Access of education and health facilities to reliable electricity services, 2015

Institution Type	Number	Electricity Access (%)[a]	Grid Connected
Education facilities			
Primary schools	33,374	24	NA
Secondary schools	2,830	70	NA
Total	**36,203**		
Health facilities[b]			
Hospitals[c]	202	95	97
Health centers	3,292	57	54
Health posts	15,618	29	5
Total	**19,112**		

Source: Federal Ministry of Education (2015) and Federal Ministry of Health and ICF International (2015).

[a] Includes connection to a central power grid, solar power or both, or has a functioning generator with fuel. b Access rates are based on the findings of the Ethiopia Service Provision Assessment Plus Survey 2014 and total sample size of 1,327 health facilities. c Includes referral, general and primary hospitals. The access rate is a weighted average. Referral hospitals all have grid connections.

Table 2.9 Access to electricity of secondary schools by region, 2015

	Population[a]	Secondary Schools (#)	Secondary Schools with Electricity (#)	Rate of Access (%)
Tigray	5,056,000	173	143	83
Afar	1,723,000	25	12	48
Amhara	20,401,000	409	286	70
Oromiya	33,692,000	1,100	828	75
SNNP	18,276,000	640	351	55
Somali	5,453,000	129	82	64
Benishangul	1,005,000	60	31	52
Gambella	409,000	51	11	22
Harari	232,000	14	14	100
Addis Ababa	3,373,000	209	198	95
Dire Dawa	440,000	20	18	90
Total	**90,060,000**	**2,830**	**1,974**	**70**

Source: Calculation based on Federal Ministry of Education (2015). Education Statistics 2007 E.C. (2014/2015).

[a] Central Statistical Agency, projections for 2015.

Table 2.10 Distribution of GoE owned health institutions by region, 2016

Regions	Distribution of Health Facilities by Regions				Total
	Population[a]	Hospitals[b]	Health Centers	Health Posts	
Tigray	5,056,000	33	213	672	918
Afar	1,723,000	6	78	378	462
Amhara	20,401,000	73	849	3,317	4,239
Oromia	33,692,000	102	1,317	6,428	7,847
SNNPR	18,276,000	28	731	3,835	4,597
Somali	5,453,000	10	165	1,062	1,237
Benishangul	1,005,000	6	41	384	431
Gambella	409,000	3	32	111	146
Harari	232,000	2	8	33	43
Addis Ababa	3,373,000	14	97	—	111
Dire Dawa	440,000	3	13	31	47
Total	**90,060,000**	**280**	**3,544**	**16,251**	**20,078**

Source: Federal Ministry of Health Infrastructure Directorate, July 2016.

[a] Central Statistical Agency, projections for 2015.

[b] Includes referral, general and primary hospitals.

Summary of NEP-IRM targets, 2018–2025

The summary of the priority connection program under the NEP for social institutions is depicted in Table 2.11. By 2025, all primary and secondary schools and health facilities will be provided with adequate and reliable electricity services, whether on- or off-grid, and in compliance with standards and guidelines set by the World Health Organization, United Nations International Children's Emergency Fund (UNICEF), the World Health Organization (WHO), and other appropriate organizations.

The focus will be not only on access, but also on the crucial upgrading required to ensure service reliability, maintainability, and sustainability over time, particularly in the case of service delivery facilities that are off-grid who rely on solar powered access provision. The IRM provides for a Technical Assistance study to conduct a rapid assessment of

Table 2.11 Connection targets for public institutions, 2018–2025

	2018	2020	2022	2025
Education facilities				
Secondary schools		90%	100%	
Primary schools		35%	70%	100%
Health facilities				
Hospitals	100%			
Health centers		70%	95%	100%

the performance of electricity services provided and a dimensioning of key end-uses requiring electricity for service delivery, particularly in the health sector (cold chain, simple vaccine and medicine refrigeration, lighting, and sterilization). The assessment and design will be conducted working closely with the federal Ministries of Health and of Education counterparts.

Based on the findings, the study will prepare the detailed design of an operational plan for implementation—grid and off-grid—to achieve the access targets identified, reflecting the grid connections spatial rollout year by year under the densification phase of program implementation.

2.5 Productive uses

With the NEP Implementation Roadmap, the Government will provide electricity to 4.5 million customers and more will come from the targets set by the off-grid rollout. Even in small quantities, electricity can catalyze economic activities and improve incomes. A cross-cutting firm analysis indicates that achieving universal access would lead to an increase of 4.1 percent in labor productivity.[41]

The NEP-IRM provides for a rapid appraisal of entrepreneurship in Ethiopia and current reactions and challenges encountered with the arrival of the grid to inform the scope and design of a specific productive uses program. The appraisal will be conducted in 2018 and the program is expected to be launched in 2019.

The Government is committed to ensuring access to adequate and reliable electricity services for the modernization and industrialization of the economy. Within the 4.5 million connections to be rolled out in 2018–2022, priority will be given to micro, small, and medium enterprises—key engines for economic growth and transformation—and densification of areas surrounding industrial parks. As regards the latter, the implementation of the NEP-IRM will also ensure coordination and synergies between the EEU, responsible for customer connections, and the Industrial Parks Development Corporation (IPDC), responsible for connecting industrial parks with transmission lines.

Micro, small, and medium enterprises

The development of micro, small, and medium enterprises (MSMEs) is a core aspect of the development agenda of the Government: micro (0–9 employees) and small (10–20 employees) enterprises are expected to contribute with more than 3 million jobs over the GTP II reference period.

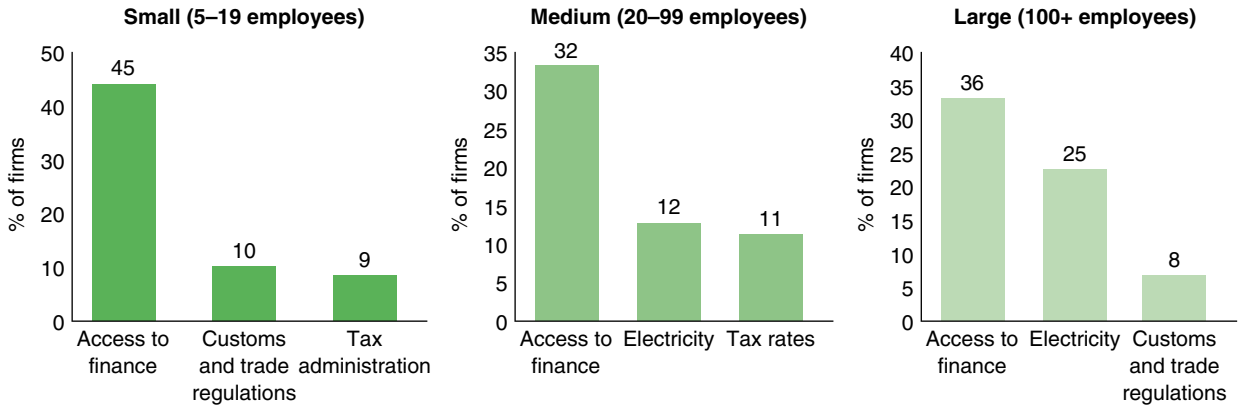
The driving objective of GTP II[42] is: "*Ensuring rapid economic growth, creating job opportunities in urban and rural areas and ensuring equitable growth helps to improve the income of the people and thereby reduce poverty. To enable micro and small enterprises register rapid and sustainable growth and sustain rural development and lay the foundation for industry development, focus will be on the expansion of enterprises by creating substantial developmental investors. (. . .) massive efforts will be made to promote small and micro enterprises to the level of developing medium enterprises or company level.*"[43]

In 2014–2015 the industrial sector, which mainly comprises of small and medium (20–99 employees) enterprises, accounted for about 15.2 percent of the GDP.[44] In 2008, the aggregate Figure of 43,338 MSMEs contributed to 50 percent of total employment,[45] and 2.2 million women benefited from MSMEs.[46]

After finance, access to electricity services currently represents the main constraint for medium and large enterprises (Figure 2.3). Currently, it takes up to 195 days to get an electricity connection in the country.[47]

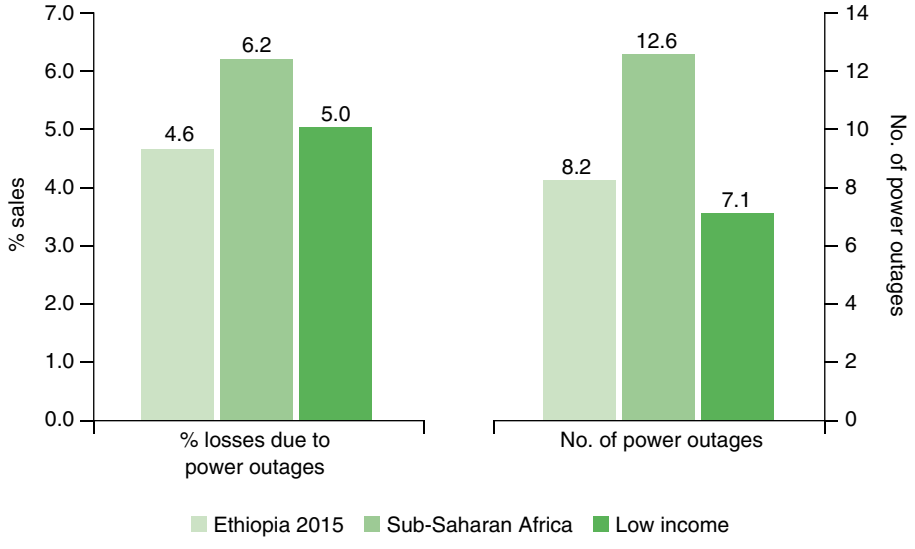
Efficiency in the operation of the private sector also requires a reliable supply of electricity. Figure 2.4 shows the extent to which firms face failures in the provision of electricity and their effect on sales as

Figure 2.3 Top three business environment constraints by size (percent of firms)



Source: Ethiopia Central Statistical Agency and WB, 2014.

Figure 2.4 Reliability of electricity supply and related losses



Source: WB, 2014.

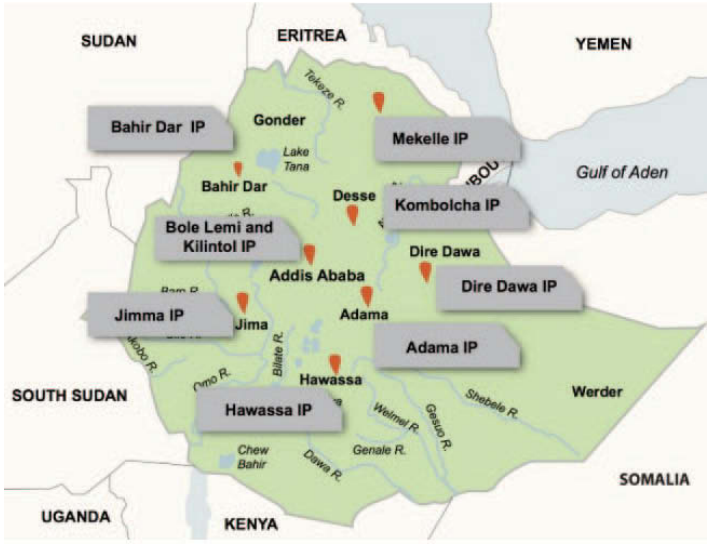
measured by the losses they generate. Inadequate electricity provision supply can increase costs, disrupt production, and reduce profitability.

Industrial parks

To realize the ambitious development plan of the country aiming for rapid industrialization nurturing manufacturing and agro-processing industries, and to accelerate economic transformation and attract domestic and foreign direct investment, the GoE launched the development of industrial parks to provide the necessary services and facilities for industries. Industrial Parks are part of the overall goal of achieving a 24 percent growth in the manufacturing sector and increasing contribution export revenues from the current 10 percent to 25 percent (Figure 2.5).[48]

Two kinds of industrial parks are being developed: (i) large, medium and light scale, and (ii) integrated agro-industrial parks. In 2014, the Government established the Industrial Parks Development Corporation (IPDC)[49] with a mandate to develop, operate, and administer the industrial parks in the country through lease, transfer, and sale of land and constructions for large, medium, and light industrial parks. About 12 industrial parks have been established.

Figure 2.5 Existing and planned industrial parks, 2016



Source: IPDC.

The Ministry of Industry and of Agriculture are responsible for the development of the Integrated Agro-Industrial Parks (IAIP), aiming at transforming the agriculture sector. So far, 17 areas with agro-industrial potential (Agro-Industrial Growth Corridors—AIGCs) have been identified across the country,[50] and feasibility studies for four pilots have been completed. Overall, the agro-industrial parks represent over US$1.5 billion in investments, and will create over 400 business opportunities and over 400,000 direct employments.

The implementation of the NEP will build synergies and optimize the infrastructure network being developed to serve industrial parks. Consultations among MoWIE, EEP, EEU, and IPDC will be held to ensure that network design and connection of industrial parks is conducted in sync with densification efforts (industrial parks are currently served by 33kV). Cooperation among sector institutions will leverage on the establishment, in 2017, of the Energy Supply Directorate within IPDC to improve cooperation with EEP for substation and HV lines construction, and EEU for MV distribution and billing.

2.6 Citizen engagement and gender

The Government is committed to ensure the participation, involvement, and empowerment of its citizen during the implementation of the NEP. Both in urban and rural areas, citizen engagement activities will be tailored to ensure:

(i) Adequate management of expectations concerning the timing of grid rollout (and connectivity), with a specific focus—but not limited to—prospective customers on the paid and unpaid waiting list, as well as service standards' expectations in the case of the off-grid—mostly preelectrification—program. These activities will ensure the integration of citizen voice into service delivery during the implementation of the NEP, which is characterized by one guiding principle: there are no second-class citizens.

(ii) Education and awareness of various stakeholders, ranging from households, communities, and institutions, about the role that electricity can play for their economic and human development, as well as related safety issues, and cost of service. This engagement will also lay the foundation for fostering and establishing a culture of payment, particularly in the case of currently unelectrified communities and in the event of meter lords and illegal connections. Specific emphasis will be placed on poorer community members and women (including girls) who may have less access to information and resources and have a lower ability to voice concerns and preferences, but are often the primary energy producers for the household.

The overall engagement will build on the activities and processes that EEU has already launched in this field, with the possible involvement of REBs and cooperatives, based on the local contexts and comparative strengths of involved agents.

As regards EEU, centrality of customer service ranks among the top four priorities of the utility's strategic themes, as customer engagement is key for:

- New connection/electrification
- Billing and collection
- Maintenance
- Complaints management

EEU has adopted a Citizen Charter which outlines the understanding between citizens and the utility on quality of service and the provision of grievance readdress. EEU has focused on various public relations and communications activities through its Corporate Public Relations Department which has been working on mainly addressing concerns and questions related to service interruptions. Communication channels so far have included short TV broadcasts developed together with the Ethiopian Broadcasting Corporation and radio announcements containing details

related to a service outage in an area and the reason for the service interruption. Pamphlets and informational brochures have been produced for distribution in Regional Energy Bureaus, although information transfer occurs mainly between consumers and EEU retail staff via verbal communication.

The utility has also established various mechanisms for citizens to provide feedback and raise concerns, including public forums, suggestion boxes, call centers (recently doubled in size from 30 to 60 employees), and a vigilance office. In 2016, it hosted 408 public forums across the country with 48,000 participants,[51] mainly focused on access and reliability to electricity services. A Regional Grievance Redress Forum (RGRF) has been established in all of the 15 business regions to handle customer complaints and has been escalated to various levels, i.e., from the regional forum to the central grievance redress one.

Based on consumer interface and feedback, EEU has mapped five key areas of customer dissatisfaction:

- Power outage and quality;
- Delays in rollout of new connection;
- Rent-seeking attitude and behavior;
- Wrong billing; and
- Employee capabilities to deal with consumer complaints and customer interface.

The implementation of the NEP will ensure that the standards set out in the EEU Citizen Charter are met, and that best practices (e.g., Ethiopia in the water, education, and agriculture sectors, and India and the Dominican Republic in the energy one) in citizen engagement are taken into account for the safe, effective, and sustainable rollout of grid connections and off-grid technologies (whether for preelectrification or long-term purposes; see also Annex 9).

For this reason, the implementation of the NEP will also take into account citizen engagement activities, focusing, inter alia, on:

(a) **Establishing and/or strengthening citizen engagement mechanisms at the community level:** to be included in the overall NEP-IRM sector-wide monitoring system. Mechanisms will include tracking the number of customer grievances received and percentage addressed, an annual customer satisfaction survey, piloting community scorecards in selected areas, and strengthening the social accountability aspects of existing public forums by EEU.

(b) **Community-based electricity education programs:** reaching out to households (male and female headed) and enterprises prior to electrification and adoption of off-grid technologies, to manage expectations on the timing and service standards of electricity access, and educate them about its benefits, costs (energy literacy), safety issues, maintenance requirements, and productive uses.

(c) **Media campaigns:** raising awareness about the NEP and electricity services, EEU's efforts, and creating an enabling and equitable environment for service delivery.

(d) **Capacity building to strengthen EEU's customer centric approach:** embracing planning, construction works, and customer and commercial services (billing), with a focus on complaint management and grievance redress.

Gender

The different roles and responsibilities men and women have in the household, the market, and their communities result in different access, control, use, and impact of electricity services, where women are mostly responsible for collecting traditional sources of energy in the absence of electricity services. Experience worldwide indicates that improved electricity access can promote gender equality, employment, and business opportunities, as well as overall well-being. For example, studies in South Africa,[52] Nicaragua,[53] and Guatemala show that women are 9–23 percentage points more likely to gain employment outside the home following electrification.

The GoE is committed to the achievement of gender equality across all sectors, in accordance with the 1995 Constitution and Women's Policy of Ethiopia, and the GTP II targets, such as improving women's economic benefits in rural areas, their role in development, and participation in leadership positions (see also Annex 7).[54] To date, Women's Affairs Directorates have been established in EEU, EEP, EEA, and MoWIE, and various gender specific targets and goals have been set for each institution.

Various gender gaps have been identified in EEU. Women's participation is currently still low, with 80 percent of male staff and only 20 percent of positions held by women (target is to reach 30 percent by 2019). Female workers are more involved in the retail, general service, finance, and administration departments than male workers. EEU has adopted a Women's Affairs Policy and Procedures to guide the institution's actions on gender mainstreaming

focused on various actions including, inter alia, affirmative action and educational opportunities.

The implementation and monitoring of the NEP could include the Ministry of Women, Children, and Youth Affairs (responsible for gender mainstreaming in Government Ministries and Bureaus) within the Steering Committee. Gender disaggregated targets will be elaborated during the update of the NEP, and informed by the findings of the MTF survey, as well as other relevant studies/activities under the NEP-IRM program implementation support (Table 2.12).

Recognizing the inherent gender-based differences in impact and opportunities associated with the provision of electricity services, the implementation of the NEP will also take into account ensuring gender equality in the following two areas, amongst others:

At the institutional EEU level:

(a) **Gender capacity building:** Capacity building will be undertaken in EEU with a focus on: (i) EEU senior management, (ii) integration of key gender concepts in annual training plans, and (iii) training with 15 regional gender focal points.

(b) **Women in Science, Technology, Engineering, and Mathematics (STEM):** A targeted initiative will be developed to foster women's interest in careers in the energy sector and actions undertaken to help close gender gaps in employment in the energy sector through, e.g., affirmative action measures and internships.

(c) **Gender-based violence (GBV):** EEU staff capacity will be increased through a GBV clinic and other related activities focused on enhancing prevention and response to violence.

(d) **Monitoring and evaluation (M&E):** Sex-disaggregated data will be collected and energy sector experts trained, enabling verification of predicted gendered impacts, examination of the effectiveness of mitigation measures, and real-time course correction.

At the sector and service delivery levels:

(a) **Connection cost/assistance:** Attention will be paid toward ensuring that the analysis conducted for the connection policy takes into consideration both male- and female-headed households' affordability for the elaboration of possible subsidy mechanisms, especially in the context of rural areas where a gender gap could possibly arise as the grid is rolled out.

(b) **Productive uses of energy:** In the studies related to demand-side management mechanisms and productive uses of energy, specific focus will be placed on exploring how energy services (off-grid and on-grid) can reduce the time and labor burden of women and how to enhance and create income generating opportunities for women, e.g., through entrepreneurship or enhanced productivity and agro-processing.

2.7 Program implementation support, 2018

The NEP-IRM provides for just-in-time and immediate assistance targeted for launching and sustaining the course of implementation of the program for the achievement of the 4.5 million grid connections target by 2022 (and 10.7 million connections by 2025) and the 2.1 million off-grid connections to be achieved by 2022 (and 5.7 million connections by 2025). Combined together, these interventions will provide the immediate and key policy, operational, regulatory, and monitoring tools for the efficient and effective performance in connections scale-up.

All of the activities are targeted for completion by 2018, and will inform implementation from 2019 onward (with the exception of sector-wide capacity building, which will be undertaken throughout the years of implementation). The EEU detailed technical plan is being designed to promptly launch the first year of NEP-IRM at the beginning of the 2018 calendar year.

Activities under the program implementation support

1. Detailed technical design and operational management plan for the implementation of the 4.5 million grid connections program. The distribution planning consultant will intensively work at EEU premises and provide the full range of expertise required for the identification of customers, detailed technical network design, and strengthening of key functions of the EEU's Distribution Operations Directorate (procurement, warehouse management, construction works, and customer service).

The consultant will work alongside EEU staff and take into account any relevant information and analysis provided by the Transformation team at EEU as well as Development Partners currently supporting the utility.[55]

(i) ***Detailed operational design***—identification and targeting of the 4.5 million connections marked by the lowest unit connection cost (average cost

US$222). Network design will assess power supply adequacy—informing upstream generation and transmission plans—identify overloaded feeders and upgrade key ones. The detailed operational plan will also support EEU procurement, warehousing, logistics, construction works, and retail. Operational design will be organized in two time frames:

- **2018–2019**—For about 1.2 million connections, including the current waiting list (paid and unpaid connections) of about 350,000 HHs (of which 50,000 have already paid in full for the connection), as well as prospective customers across the 15 regions located in proximity of the feeders.[56]
- **2020–2022**—For about 3.3 million connections to be designed on the basis of: (i) nationwide Distribution Master Plan (see below); (ii) the geo-spatial least-cost plan and investment financing prospectus; and (iii) the connection charge policy adopted by 2019 by the GoE.

(ii) ***Program implementation management***—including a program management platform mainstreaming progress tracking and monitoring against the targets, and supporting day-to-day operations across EEU offices. Management support to EEU's operation will include procurement specifications and bidding documents and strengthening of EEU's ability to train an adequate construction workforce for program implementation and sustainability ("training the trainers"). For 2018 and early 2019, EEU is expected to leverage on the inherited organizational structure, while carefully identifying and putting in place what is needed to scale up the program across the 15 regions.

2. Nationwide power system distribution masterplan. A nationwide (15 regions) distribution network investment plan, including the update of the already existing one for the four Addis Ababa regions. The investment plan will be led by EEU and should be largely completed by mid-2018 and no later than July 2019[57] to inform the sufficient detail roll-out planning for 2020, 2021, 2022 (and beyond) and secure adequate investment financing. The distribution investment plan will in turn inform and update transmission and generation investment plans with a bottom-up perspective, ensuring consistency across the value chain of investment requirements and developing a sector-wide investment prospectus. The nationwide power system distribution master-plan will also incorporate the findings of the least-cost geo-spatial plan.

3. A geo-spatial least-cost electrification plan anchoring an investment financing prospectus. The geo-spatial least-cost plan will identify the optimal modality (grid and off-grid) for access provision, taking into account technical and economic viability, geo-referenced demand centers, and load forecasts. The GIS least-cost plan will inform yearly rollout plans and targets, the financing prospectus, and gaps. The establishment of GIS capacity adequate for the scale of the NEP will be required to support the implementation of the least-cost plan and monitor progress, and will be informed by the consultant's recommendations.

4. Off-grid program. The GoE will adopt an off-grid operational program design for 2019–2022 and beyond to be implemented alongside and complement grid developments for the achievement of universal access by 2025. The program will target rural and deep rural beneficiaries, incrementally shifting the geographic focus from current peri-urban beneficiaries. The program will serve: (i) preelectrification—transitional—needs; and (ii) where the grid is not projected to be the least-cost solution due to remoteness, isolation, and scattered household patterns. The program will have two main drivers: public sector and private sector-led efforts to ensure scale and speed of program delivery and comprehensive geographic outreach of electricity services (deep rural areas). The Government is also considering the development of an Off-Grid Strategy in preparation for the detailed operational design of the off-grid program to ensure the strengthening and adequate readiness of sector institutions and enabling environment for the scale-up of off-grid technologies.

5. Comprehensive performance monitoring and tracking system for the NEP-IRM. Monitoring of key performance indicators for efficiency, effectiveness, and progress against NEP-IRM grid and off-grid targets and for course adjustments as and when appropriate by relevant actors (e.g., EEU, DoE). The system will include regular reporting (e.g., quarterly and annual) of program progress, analysis of impacts, and the creation of a performance-based dashboard with inputs from relevant Ministries (e.g., Health and Education), and appropriately interface with GIS information and the MIS system. The consultant will provide the software needed and work in close collaboration with the DoE and EEU for the design of the monitoring and tracking system.

6. Affordable customer connections policy study. Design of an affordable connection policy

for achieving universal access. The study will focus on front-end affordability measures (e.g., connection payment through installments) and demand-side management mechanisms and will be informed by the MTF analysis, the geo-spatial least-cost plan, and other best information available (leveraging on triangulation of sources) to provide recommendations to the GoE for the design of a connection cost policy.[58] The consultant will work in close collaboration with the DoE and EEU.

7. Social institutions priority connection implementation program. A detailed design and operational implementation plan for the achievement of the NEP-IRM targets for the priority social facilities connection program (2018–2022). The consultant will conduct a geo-referencing of social facilities (schools and clinics), a detailed dimensioning of key end-uses that require electricity for service delivery (cold chain, simple vaccine and medicine refrigeration, lighting, and sterilization), and an assessment of the current performance of electricity services provided, whether grid or off-grid, and the upgrading required at existing facilities classified as having some access. For off-grid solar powered facilities, the assessment will include power equipment and maintenance standards and provide options for standardized solar packages appropriate for supporting service delivery and informed by the United Nations International Children's Emergency Fund (UNICEF), the World Health Organization (WHO), and other appropriate guidelines. The consultant will also assess the 10,000 water supply points identified for the development of, e.g., water pumps. Finally, the consultant will work with counterparts in the Federal Ministry of Education or of Health, as well as with MoWIE and EEU. The study is planned to be completed by the end of 2018, in time to inform the detailed ground level design and rollout plans for implementation post mid-2019 onward. It will build upon available geo-spatial data, including the geo-spatial mapping of social institutions and any geo-referenced assessments already conducted by REF, Ministry of Health or Education, and MoWIE. In particular, one output of the study will inform recommendations for the adoption of uniform service standards for social institutions and improved coordination among ministerial and Development Partners programs.

8. Long-term sector financial viability study. Analysis of sector revenues and cost structures (inflows and outflows) with ongoing and planned revenue allocations to the program, including export revenues, and cost reduction resulting from private sector engagement in the sector. More specifically, the study will include: (i) power supply costs, reflecting future shifts in the bulk power supply generation mix and cost structure; (ii) revenue generation projected from regulated cost recovery based electricity tariffs on the basis of commercial principles and best practice of the sector to encourage competition, efficiency and economical use, and maintain reliability and system security; and (iii) the growing stream of revenue inflows from projected power surplus export revenues in the coming years. The study will provide recommendations for Government consideration on possible courses of action to ensure the long-term financial viability of the sector.

9. Special topical studies: low-cost technical standards, manufacturing capacity, and productive uses. The analysis will inform the adoption of efficient network design and development of local manufacturing capacity for the production of low-cost materials and conduct a rapid appraisal of entrepreneurship in Ethiopia and current reactions and challenges encountered with the arrival of the grid to inform the scope and design of a specific program. The study will be conducted in 2018 for the rapid adoption of low-cost construction standards and improved construction works efficiency, and the productive uses program to start implementation in 2019.

10. Sector-wide capacity building. Training and capacity building across sector institutions, including MoWIE (DoE and REF), REBs, woreda administrations, EEU, and EEA for the successful implementation of the NEP and establishment of an enabling environment for grid and off-grid connections rollout. Capacity building activities for DoE will include program and financial management, procurement, and M&E, as well as verification, and will strengthen the capacity of the new staff in DoE to effectively administer the NEP on a day-to-day basis and support the work of the Steering Committee. With the shift in focus toward electricity service delivery, capacity building may be required for EEU to support its ongoing efforts tailor aimed at optimizing its commercial processes and reengineering of policies and business process with a focus on service quality.

Capacity building will be launched in 2018 on the basis of the immediate and key needs identified for the launching of the program and in anticipation of the 4.5 million connections scale-up targeted for 2018–2022. Capacity building may be required to ensure the appropriate establishment of GIS planning for the implementation of the NEP geo-spatial least-cost plan at DoE and EEU levels; REF implementation of the off-grid program and market development;

and EEA capacity for establishing an enabling regulatory framework. Furthermore, specific training and capacity building needs will be identified, and related activities provided in course of implementation.

A summary of the scope of immediate and priority Technical Assistance activities for 2018 is provided in Table 2.12.

Table 2.12 Summary of immediate priority Technical Assistance activities, 2018

Activity	Scope	US$ Million	Leading Agency
1. Technical, operational, and management plan for the 4.5 million customer connection program (2018–2022)	Detailed network design and costing of 4.5m connections, staged across regions and feeders by quarter for each year; corresponding procurement, warehousing and logistics plan, construction works, and technical services mobilization.	5	EEU
2. Nationwide power system distribution master plan (2018–2025)	Distribution network technical design and investment program—feeder level—for all 15 regions to support the NEP connections rollout; assess adequacy of demand-supply power balance at each bulk power delivery substation via the transmission grid. The assessment will include the update of transmission and generation investment needs, informed by the bottom-up information provided by the distribution network assessment and informed by the geo-spatial least-cost plan.	4	EEU, EEP
3. GIS least-cost rollout plan for grid and off-grid and high level investment financing prospectus	Optimal modality (grid and off-grid) for access provision, taking into account technical and economic viability, geo-referenced demand centers, and load forecasts; anchoring yearly rollout plans and targets as well as the financing prospectus and financing gap.	1.5	EEU
4. Off-grid operational program strategy and design for stand-alone systems and mini grids (2018–2025)	Operational implementation design for the off-grid preelectrification program for the scale-up of stand-alone solar solutions and mini grids through public, private, and PPP delivery systems (complementing grid rollout); informed by the GIS least-cost plan.	6	DoE
5. Comprehensive NEP-IRM performance monitoring and tracking system	Monitoring of key performance indicators for efficiency, effectiveness, and progress against NEP-IRM targets and for course adjustments as and when appropriate.	5.5	DoE
6. Cost of connection study	Design of an affordable connection policy for achieving universal access.	1	DoE, EEU
7. Social institutions priority connection implementation program design	Detailed assessment of numbers and types of facilities (including water points), mapping and dimensioning of key end uses requiring electricity for service delivery (cold chain, simple vaccine and medicine refrigeration, lighting, sterilization). For off-grid solar powered facilities, assessment of service quality, reliability, power equipment and maintenance standards. Detailed design of targeted implementation rollout to achieve program targets.	2	DoE
8. Sector financial viability study	Analysis of sector revenues and cost structures with ongoing and planned revenues allocation to the program.	1.5	DoE
9. Special topical studies: a. low-cost technical standards b. manufacturing capacity c. productive uses	a. Lowering of network design and construction and demand-side management measures; b. development of local manufacturing for network and service equipment; c. design of a program for productive uses of electricity services.	1.5	a. EEU b. DoE c. DoE
10. Sector-wide capacity building	Training, capacity building, and financial support to sector stakeholders for NEP implementation for the successful implementation of the NEP, informed, inter alia, by the immediate and key needs identified for the successful ramp-up of grid connections and preelectrification program. Includes capacity building for financial management, procurement, M&E, verification, and day-to-day administration of the NEP.	20	DoE, EEU
Total		**48m**	

Notes

1. As per 2016 estimates. UN Statistical Office, Ethiopia.
2. More precise estimates will become available upon completion of the detailed high level geo-spatial least-cost plan study to be completed by mid-year 2018. Additionally, there will be investment costs for the ongoing program of systematically upgrading—reconfiguring, strengthening, re-conducting as appropriate—the existing medium voltage feeder network nationwide to enable them to support the access scale-up program under the NEP-IRM. For this latter component, a strengthening program costing study (especially for the network in the eleven regions outside of the four Addis Regions of EEU) is outlined later in this report.
3. During implementation, the technical analysis of network capacity for network design and connections rollout will eventually determine: (i) location of households that can be connected within Component A, and (ii) possible network strengthening and reinforcement requirements. The overall costing of US$1 billion for 4.5 million connections is therefore indicative and may become higher.
4. Including the network infrastructure developed by UEAP since 2005.
5. In respect of achieving NEP's overall goal of universal access by 2025, as mentioned earlier, the off-grid rollout program will target the remaining 5.7 million households not connected in 2025. The off-grid strategy and action plan are highlighted in Section ES.6.
6. EEU is currently undertaking a process of internal restructuring to increase the autonomy of regional offices.
7. Detailed design and preparation of a NEP implementation program for the outer years (2019 and beyond) will be informed by completion of the comprehensive geo-spatial least-cost rollout plan—for coordinated grid and off-grid rollout—expected to be completed by a mid-2018 time frame; together with the findings and recommendations of other high level priority studies being launched under the NEP and to be completed during 2018 (Table ES.8).
8. EEA is also currently receiving Technical Assistance.
9. Ethiopian Energy Authority (2015). Energy Sector Regulation; capacity building for regional regulators and electrical works competency certification system development project.
10. EEU started the construction of SWER in 2010.
11. In order to reduce construction cost, UEAP has reduced the number of poles and accessories required per km from 14 to 10 and reduced the span of LV distribution network from 40 metric tons (mt) to 50 mt for concrete poles (reducing the number of accessories required for km from 25 to 20).
12. To face climate and geographic constraints, UEAP launched the production of concrete poles in 2013. Since then, 122 manufacturing associations (cooperatives) were created, and in 2015 a training program was also launched, which has already successfully trained over 320 graduates.
13. EEU 2008 Ethiopian Fiscal Year Annual Report. Further and more detailed network analysis, and at the feeder level, will be undertaken through the distribution master plans and the geo-spatial least-cost analysis.
14. Mandatory power factor correction pole equipment has been adopted to control system voltage, reduce line losses and increase available system capacity.
15. EEU adopted the contract framework for bulk purchases and created a list of preselected vendors in the spring of 2017.
16. The CFL scheme was launched in 2010 with funding from the World Bank.
17. The smart meter pilot is mostly aimed at the adoption of an AMI infrastructure. It involves foreign and local companies (METEC). Power Africa is providing Technical Assistance and supporting the utility with the "Meter 2 Cash" pilot.
18. EEA (2017). Ethiopia National Electricity Distribution Code, Draft.
19. EEU regulation does connections of non-concrete premises for safety reasons.
20. Off-grid technologies can be used as back-up solutions after the arrival of the grid in case of low reliability and quality of electricity services.
21. The Rural Electrification Fund (REF) was established on proclamation No. 317/2003.
22. MoWIE.
23. REBs identify the candidate communities, their demand, number of connections to be provided, and hence the size of service needed.
24. Members of these rural community-based cooperatives range from 10–300.
25. In order to qualify for the REF program, cooperatives must achieve a required working capital level. Once they do so, they can receive low interest, long-term loans provided by the Development Bank of Ethiopia (DBE) based on collaborative arrangements with REF. Such loans are in turn deployed to members for purchasing individual solar home systems.
26. Training activities were funded under the World Bank Electricity Network Reinforcement and Expansion Project (ENREP).
27. The classrooms provided with lighting serve students, teachers, and the schools director.
28. World Bank estimates, 2016.
29. MoWIE and Fichtner (2015). Off-Grid Investment Plan for Ethiopia Assessment Report.
30. Training was provided under the World Bank Electricity Network Reinforcement and Expansion Project (ENREP).
31. These capacity building activities are financed under the World Bank Electricity Network Rein-

forcement and Expansion Additional Financing Project (ENREP AF).

32. Access to finance is provided for off-grid renewable products, encompassing stand-alone solar home systems, solar lanterns, improved cook stoves, and biogas technologies serving households not connected to the grid or unable to afford the connection.
33. There are currently 31 MFIs in Ethiopia. MoWIE and Fichtner (2015). Off-Grid Investment Plan for Ethiopia Assessment Report.
34. World Bank estimates, 2017.
35. Are considered as mini grid installations below 1MW.
36. NRECA Draft Assessment Report, 2016.
37. The vast share of the program is expected to focus on 10Wp and 20Wp service standards.
38. Federal Ministry of Education (2016). Education Statistics 2007 E.C. (2014/2015).
39. Defined by the survey as "power" is routinely available during regular service hours. Ethiopia Service Provision Assessment Plus Survey 2014. Ethiopian Public Health Institute (EPHI). Federal Ministry of Health and ICF International.
40. Ethiopia Service Provision Assessment Plus Survey 2014. Ethiopian Public Health Institute (EPHI). Federal Ministry of Health and ICF International.
41. World Bank (2016). Ethiopia. Priorities for Ending Extreme Poverty and Promoting Shared Prosperity. Systematic Country Diagnostic, Washington.
42. GTP II.
43. GTP II.
44. https://medium.com/@EthiopiaEU/industrial-parks-development-in-ethiopia-f09eb704d741
45. Central Statistical Agency of Ethiopia and IFC, 2015.
46. World Bank (2016). Ethiopia. Priorities for Ending Extreme Poverty and Promoting Shared Prosperity. Systematic Country Diagnostic, Washington.
47. WB (2014). Enterprise Survey. Ethiopia 2015. Country Profile.
48. https://medium.com/@EthiopiaEU/industrial-parks-development-in-ethiopia-f09eb704d741
49. The Industrial Parks Development Corporation was established in 2014 by the Council of Ministers (Regulation 326/2014). The IPDC is designated to prepare a detailed national industrial parks masterplan based on the ones of the Regional States or the two city administrations (Addis Ababa and Dire Dawa).
50. AIGCs' sites selected for the pilot development are located in the regions of Oromia, Gende Arba (Bulbula), Southwest Amhara, Bure, Eastern SNNP (Southern Nations, Nationalities and Peoples), Weynenata, and Western Tigray.
51. Public forums are organized at each region and district level in collaboration with local Government administrations.
52. Taryn Dinkleman (2011). The effects of rural electrification on employment: New evidence from South Africa, *American Economic Review* 101, no. 7.
53. Louise Grogan and Asha Sadanand (2013). Rural electrification and employment in poor countries: Evidence from Nicaragua, World Development No. 43.
54. Women's participation in leadership was also promoted during GTP I. The proportion of women with parliament seats, in a judiciary and political leadership and executive body at the federal level reached almost 28 percent, about 20 percent, and almost 10 percent, respectively. Although this shows a progress from previous periods, women`s participation in leadership is still considered low and is therefore strongly pursued during the implementation of GTP II.
55. Technical Assistance for distribution planning is being provided by USAID/Power Africa and the World Bank. McKinsey has also conducted a loss reduction and connection rollout analysis under the Ethiopia Investment Advisory Facility (EIAF).
56. The highest connection potential is expected to be represented by Tier 2 and 3 cities, and towns and villages recently electrified by UEAP. Addis Ababa may also become a candidate for connections expansion pending ongoing network upgrading investments (financed by China Power and the African Development Bank).
57. The fiscal year for EEU starts on July 1st.
58. The study could identify information gaps (that cannot be filled by triangulation of available sources) that might require conducting further surveys in the frontier areas of the rollout to geo-spatially detail the affordability of connection fees and energy consumption by decile. This effort would constitute a separate analysis.

CHAPTER 3

NEP-IRM Financing Requirements

Table 3.1 provides a high-level summary of the NEP-IRM grid and off-grid program financing requirements prospectus for syndication, both for investments and Technical Assistance. Overall, the first phase of the NEP-IRM program (2018–2022) would require about US$1.5 billion. Capital investments for the grid program are estimates of about US$1 billion. About US$480 million are preliminarily estimated for capital investments in the off-grid.

About 3 percent (US$48 million) of the overall financing requirements (for both the grid and off-grid programs) will be needed for the program implementation support and Technical Assistance directly related to accomplish the target objectives and outcomes, and is expected to be mostly grant raised through Development Partners. Definition and scoping of potential additional program support and capacity building activities will be determined based on early experience with implementation of the NEP.

3.1 Grid program—investment financing prospectus (2018–2022)

The year-by-year investment requirements (capex) for the Densification Program (2018–2022) of the NEP-IRM are presented in Table 3.2. The Table shows the progressive scale-up of annual connections up to 1.5 million/year in 2022, for a total of 4.5 million connections over the 2018–2022 time frame and US$1 billion in capex requirements.

Table 3.2 also illustrates one scenario for potentially mobilizing (syndication) this financing requirement from two main sources, that is, within the sector—40 percent—and the balance—60 percent—syndicated from Development Partners under concessional terms and grants. Within the sector, the two main financing groups and revenue sources are identified with customer contributions (the revenue from customer connection is currently estimated at US$50), and the Government's equity contributions.

More specifically, US$225 million revenues are projected to be sourced within the sector from the one-time connection fee, and US$175 from the Government's equity contribution channeled via EEU over the first five years of NEP implementation. The remaining US$600 million (60 percent of financing requirements) are projected to be raised from Development Partners. For the first year, the contribution for the government reflects past commitments, and for the following ones will be adjusted based on the connection policy to be adopted in 2019.

The Government is mindful of the size of financing requirements for the achievement of the NEP-IRM targets for 2022 and beyond, and the key role

Table 3.1 Summary of program financing requirements (2018–2022) (public share)

	Investment (US$ million)	Immediate Technical Implementation Support (US$ million)	Subtotal
Grid	975	42	1,017
Off-grid	478	6	484
Total	**1,453m**	**48m**	**1,501m**

Table 3.2 Grid program investment prospectus (2018–2022) indicative syndication scenario

Year	Connections (incremental number, US$ million)	Investment Requirements (incremental, US$ million)[a]	Investment Financing Mobilization—Syndication (indicative, US$ million)		
			DPs Share 60%		
			Customer Contributions	GoE/EEU	DPs
2018	0.5	111	25	45	67
2019	0.7	155	35	32.5	93
2020	0.8	178	40	32.5	107
2021	1	222	50	32.5	133
2022	1.5	333	75	32.5	200
Subtotal	**4.5**	**US$1000m**	**US$225m**	**US$175m**	**US$600m**

[a] Calculation based on the weighted average of least-cost unit connection cost of US$222 for densification (see Table 2.1), not including MV extension nor network rehabilitation. The price per connection will eventually be determined by network capacity in EEU connections rollout plan. Final investment requirements Figures are rounded. Technical Assistance is identified separately.

played by the adoption of a sound, programmatic, and transparent financing framework to mobilize commensurate levels of financing (syndication) and establish partnerships with Development Partners, as well as ensure the efficient and effective deployment of resources.

Essential to the success of this joint endeavor, is putting in place a "bankable" sector financing strategy, anchored by a soundly designed, transparent, and stable financing framework. It must effectively achieve a workable balance between: (i) the Government's social equity objective of maintaining affordability of electricity access, especially to the poor; (ii) at the same time ensuring the sector entities' financial health, a prerequisite for operationally and sustainably scaling up access in a timely manner; and, (iii) being fiscally "affordable" for the Government.

In particular, the NEP-IRM financing strategy and long-term financial viability and sustainability will be influenced by the following interlinked pillars:

(a) **Ensuring affordability of electricity services for poor beneficiaries**—to be determined by the connection fee policy to be adopted by 2019; and the monthly bill, defined by the retail tariff structure and the average price level per unit consumed;
(b) **Commercial viability of EEU on an ongoing basis**—that is, the ability of EEU to fully recover (at a minimum) all its recurrent costs of service provision via retail tariffs—set to full cost recovery of operating expenditure (opex)—in which event the Government would provide all investment for the access program as equity contribution; and
(c) **Drawing on public funds**—as demonstrated by the experience of countries that have successfully navigated their transition to high/universal electricity access levels, no nation has achieved universal access without the public financing of a substantial portion of the capital expenditure (capex) required for "last-mile" customer connections (MV, LV, and service drops).

Since 2005, the GoE has been funding a substantial share of the capital investment requirements of the Universal Electricity Access Program (UEAP) and for the achievement of the targets set by GTP I and GTP II (to date). Financing of network coverage expansion (MV lines) to priority towns and villages across the country was successfully secured though a combination of several funding sources, including fiscal and development budgets of the Government and financing on concessional terms and grants from Development Partners.

Moving forward: connection scale-up, structural changes, and key aspects of sector financial health

The NEP-IRM is a linchpin for enabling the Government's priority efforts aimed at achieving a structural transformation of the economy and society. Toward ensuring that the electricity sector steps up its performance commensurately and plays the required role

called for in the nation's development going forward, the Government has undertaken a series of key initiatives to restructure the power sector institutional framework and structure (these are highlighted in Chapter 1). The underlying strategic objectives include: ensuring power supply adequacy in line with the demand associated with (i) strong economic growth projections, (ii) scaling up affordable and reliable access to all, and (iii) power export markets (more below), as well as diversification of the generation mix (geothermal, solar, and wind) and increased private sector participation in generation.

Underpinning achievement of all the objectives above is strengthening the long-term financial health and viability of the electricity sector and the financial health of key implementing agents. The future looks very different from the past, in several key respects:

- ***Retail electricity tariffs***—Historically, Ethiopia's cost of electricity service and hence retail tariffs have been among the lowest in Africa. The nation's unique power sector endowment of low-cost, low-carbon hydropower sources with minimal recurrent costs (opex) is a major factor. Additionally, compared to regional peers, the aggregate technical and commercial losses are relatively low (about 23 percent) and the bill collection rate is quite high (85–90 percent). These factors combined have supported an average domestic tariff rate, one of the lowest in the region (US$0.03/kWh), and last revised in 2006. Looking ahead, the sector will register progressively and rapidly increasing levels of a bulk power supply cost—capex and opex. While efforts for technical and commercial performance efficiency will be aggressively pursued by the utility in and of themselves, they will not be sufficient to absorb the higher unit costs of bulk power supplies over time.
- ***Sector cash flow overall***—The sector as a whole maintains a positive but slim operating cash flow presently. However, the sector revenue growth lags in pace with rising borrowing costs. Further, growing future debt service obligations will bear upon the sector finances in the coming years.
- ***Regional power trade revenues are projected to provide significant additional revenues to the sector.*** Ethiopia's power sector is positioning itself to become a power export hub in East Africa. Exports to Sudan, Djibouti, and Kenya could boost the country's export revenue potential, estimated around US$600 million per annum by the end of the decade. By 2020, Ethiopia could achieve as much revenue from power export as it does from domestic sources. Subject to further analysis, a portion of the export revenue inflows could be earmarked for infrastructure investments and cross-subsidies for consumers, thereby abating the need for large tariff increases in the future.

Ensuring long-term financial health and viability of the electricity sector

The following efforts are under way toward developing a workable long-term sector financial sustainability framework and implantation plan:

- **Retail Tariff Framework Revision**—A draft tariff framework has been prepared in January 2017, with tariffs reflecting the full cost of service provision for periodic adjustments every four years. Under the draft framework, the proposed average domestic tariff rate would be set at US$0.06/kWh. This proposal is currently under review by the management of the EEU, EEP, and the sector regulator (EEA). Following this, the proposal is expected to be presented to the Ministry of Water, Irrigation, and Electricity (MoWIE), and then to the National Parliament for review by end of calendar year 2017.
- **Sector Financial Viability Study**—The NEP-IRM provides for urgently conducting (Table 2.12) a comprehensive and detailed study to analyze the implications for long-term financial sustainability of the electricity sector and identifying recommended course(s) of action for the Government's consideration toward implementation of a soundly designed, transparent and stable financing framework to underpin NEP-IRM financing mobilization (syndication) in a programmatic framework, through 2022 and beyond.

This scope of the financial viability study will take into account the specific characteristics of the Ethiopian energy sector (depicted in Chapter 1). In particular, it will include the development of an appropriately structured and detailed sector financial model for projecting financial flows in and out of the electricity sector, reflecting inter alia: appropriate domestic tariff regimes; options, such as, augmenting domestic revenue with exports of power; possible rollover and restructuring of existing debt; and finding innovative ways of reducing the public investment obligations and introducing sustainable financing mechanisms, such as increased private participation.

3.2 Off-grid program

The capital investment requirements for the off-grid program have been estimated at US$478 million through 2022 (Table 3.1), not including any replacement cost as not incurred during the first phase of implementation of the NEP. These financing requirements refer to the connection of 2.1 million new customers through off-grid technologies, whether stand-alone solar systems or mini grids. This connections pace will set the country on track for achieving universal access by 2025, which requires 5.7 million new connections through the off-grid program (corresponding to 35 percent of access).

While these Figures reflect the public share of off-grid investments, the Government intends to put in place a framework under the NEP-IRM to leverage financing from private sector actors. The Government will also be looking for support from Development Partners to finance the immediate Technical Assistance support for the development of the NEP off-grid program, currently estimated at US$6 million.

3.3 Social institutions program

The capital investment requirements for the Program will be determined as part of the program implementation support studies and become available in 2018.

3.4 Climate financing

Ethiopia has been an outliner in the East Africa region with 90 percent of its power generation coming from clean energy sources, and the Government is committed to ensuring green growth for the future. The country has a significant comparative advantage for attracting climate financing, of which it is already a recipient.

Given the scale of financing requirements for the achievement of the targets set in the NEP-IRM, the Government strongly intends to also pursue climate funds, building on and expanding the partnerships already established.

Ethiopia is already participating in the Pilot Program for Climate Resilience (PPCR) and the Scaling Renewable Energy in Low Income Countries Program (SREP) launched under the Climate Investment Funds (CIF),[1] which provide developing and middle-income countries with urgently needed resources to manage the challenges of climate change and reduce their greenhouse gas emissions. In 2012, Ethiopia became the recipient of US$50 million endorsed for the development of the geothermal sector, and through Lighting Ethiopia and under the Global Environmental Facility (GEF), the country has already received US$461 million.

Furthermore, under the Reducing Emissions from Deforestation and Forest Degradation (REDD) framework, the country has been the beneficiary of US$13.6 million,[2] and a grant of US$18 million (with further disbursements based on results up to US$50 million) was provided under the Bio-Carbon Fund Initiative for Sustainable Forested Landscape.[3] In 2016, Certified Emission Reduction Purchase Agreements for a total amount of US$20.17 million (2016–2024) were signed.[4] Finally, the CRGE facility is receiving technical and financial support from several Development Partners, including the World Bank (US$4.5 million under the Bio-Carbon Fund), UNDP, Global Green Growth Institute, and the Government of the UK.

The country is also registered under the Green Climate Fund,[5] but hasn't become a beneficiary of the institution yet.

Notes

1. For more information, visit: https://www.climateinvestmentfunds.org/
2. Out of which US$3.6 million were provided for the Forest Carbon Partnership Facility (2013–2016) and US$10 million under the Bio-Carbon Fund (2014–2018).
3. For the Oromia Forested Landscape Program. Funding was provided, among others, by the Governments of Norway, UK, and the U.S.
4. Under the World Bank Carbon Initiative for Development (Ci-Dev).
5. The Green Climate Fund was established within the UNFCCC as a mechanism to assist developing countries in their adaptation and mitigation practices. For more information, visit: http://www.greenclimate.fund/home

CHAPTER 4

NEP-IRM Institutional Framework

Successful achievement of the NEP ambitious goals requires both clear and credible targets and timetables, enabled by a comprehensive and consistent programmatic implementation framework design, and coupled with adequate financing, sustained throughout the Program implementation horizon. Toward this end, the NEP-IRM identifies key building blocks for the rollout of grid and off-grid connections: (i) clarity of roles and accountabilities of sector institutions, and designated intermediary agents, to ensure efficient and effective planning, management, and operation of the sector; and (ii) monitoring of Program progress to address significant deviations in progress toward achieving targets, should they materialize.

Effective and fast-paced performance requires strong sector institutions, enabling policies for designated implementation and intermediary agents—be they public or private—and accountability for results delivery, with commensurate autonomy for the operational achievement of targets. Additionally, a transparent sector-wide coordinating mechanism for performance monitoring is being put in place for tracking progress in achieving targets set by the respective implementation agents.

The NEP-IRM provides for sector-wide capacity building and training under the program implementation support activities (Section 2.7) across sector institutions (including MoWIE, DoE, EEA, and REF) to fill the immediate gaps affecting the launching of the program and in anticipation of the 4.5 million connections scale-up targeted for 2018–2022. Capacity building will focus on technical and planning skills development, program management, monitoring and evaluation, fiduciary systems, and safeguards management, as well as for transition to customer-oriented business processes. Other capacity building needs are expected to be identified in course of implementation.

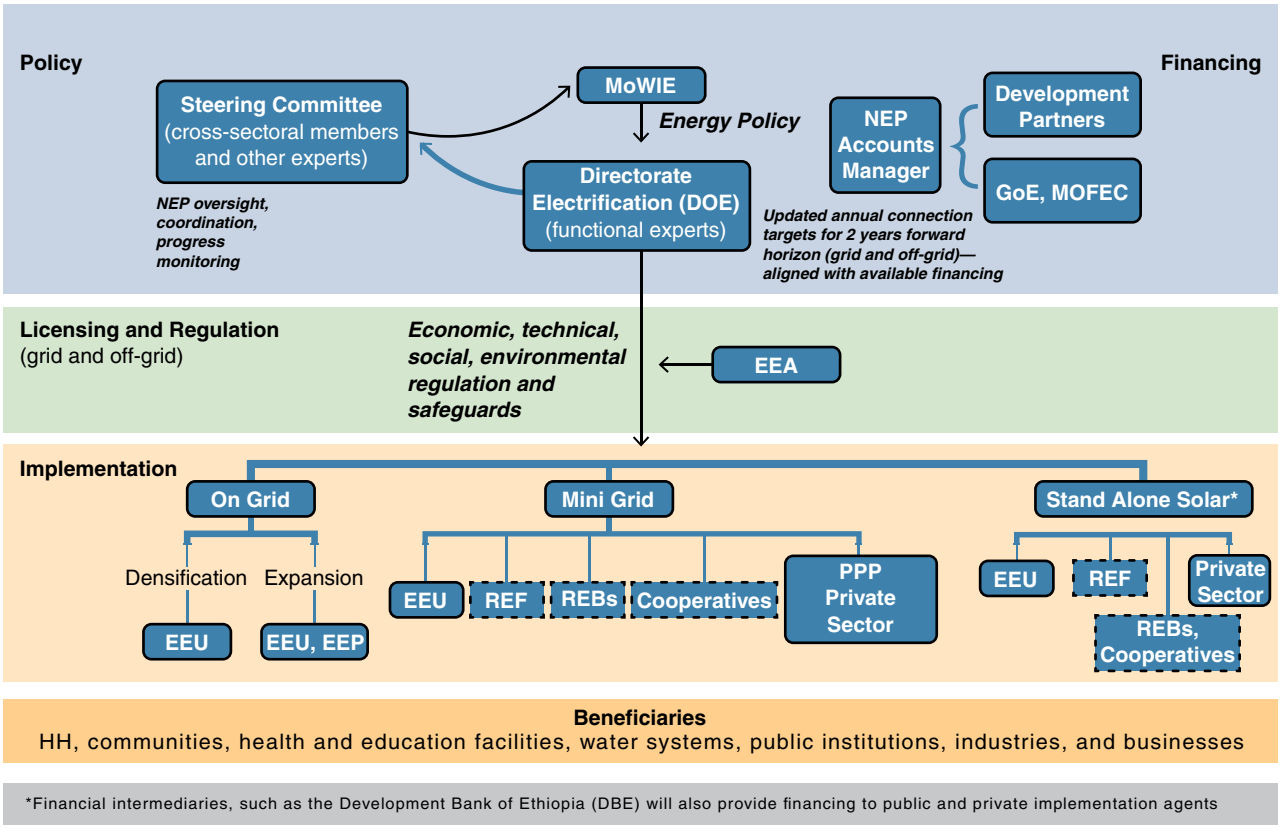
The key enabling pillars of the NEP-IRM institutional framework are depicted schematically in Figure 4.1. The implementation scheme identifies the key sector institutions and agents, and their designated functional roles and responsibilities, for the delivery of electricity services to the Program's beneficiaries. Dashed lines indicate possible roles of sector institutions currently under discussion and discussed below.

Five foundational dimensions are identified for implementation:

1. Policy, strategic oversight, and progress monitoring
2. Financing
3. Regulation
4. Implementation
5. Performance monitoring

1. Policy, strategic oversight, and progress monitoring: The overall responsibility for ensuring that the designated implementation agents—EEU for the grid connectivity program and the designated implementation agents for achieving the off-grid program targets—rests with MoWIE. The Ministry will coordinate and provide oversight for the effective and timely execution of all components of the Program through two institutional channels—Steering Committee and Directorate of Electrification—and, if and as circumstances warrant, facilitate course corrections including updated connectivity targets set for

Figure 4.1 Institutional framework



*Financial intermediaries, such as the Development Bank of Ethiopia (DBE) will also provide financing to public and private implementation agents

grid and off-grid, and within and across the off-grid program components (solar systems and mini grids):

(i) ***NEP Steering Committee (SC)*** to be chaired, convened, and constituted by the Hon. Minister of MoWIE. The Steering Committee will be comprised by permanent members representing sector institutions and cross-sectoral Ministerial delegates, as well as professional experts and sector stakeholders as needed.

The NEP-IRM SC will provide high-level strategic direction and policy guidance for the implementation of the Program, as well as facilitate effective coordination across Government Departments and Ministries, and monitor the sector level "dashboard" of key indicators of progress and performance. Responsible institutions will be held accountable by the SC to ensure the effective and sustainable implementation of the Program and its results, also taking into account the experience and concerns of beneficiaries. On an ongoing basis, the SC will review and approve the connection targets (grid and off-grid) submitted by the Directorate for Electrification (see below) with a two-year implementation horizon, and correspondingly authorize funding for implementing agents.

(ii) ***The Directorate of Electrification (DoE)*** within MoWIE, composed of a portfolio of functional experts (grid and off-grid program specialists) supporting the functions of the Steering Committee. The establishment of the DoE was specifically recommended by the National Electrification Strategy (NES) issued in June 2016. The DoE will be responsible for facilitating the day-to-day logistical support necessary for the effective monitoring and oversight of the NEP. This would include organizing and facilitating quarterly meetings on program progress and impacts (more frequent as and when appropriate); preparing the relevant information, such as progress reports and other briefing inputs as appropriate; circulating in advance the relevant agenda and the supporting information package

appropriate for SC deliberations; and drafting of minutes, and special occasional briefs for SC when necessary.

The DoE will be responsible for liaising regularly with key sector implementing agents for the regular assessment of progress toward the targets and update thereof (near- and medium-term plans, and grid/off-grid program implementation coordination). In this process, EEU, REF, and REBs will play a key role. Upon completion of the geo-spatial least-cost plan, the DoE will be responsible for harmonizing technical, social, and policy inputs for the definition of the NEP grid and off-grid rollout targets, and detailed operational designs for the solar systems and mini grid subprogram components, to be approved by the SC. More specifically, the DoE will integrate EEU's grid rollout connection plans (informed by the least-cost geo-spatial analysis), with bottom-up information on the number and specific needs of beneficiaries in the areas identified, including households and social institutions (schools and clinics), and reflecting regional policy priorities (e.g., regional quotas and emerging regions). REBs have the potential of playing an important role in the facilitation and provision of bottom-up intelligence. These detailed aspects of the institutional framework and the roles of front-line intermediary agents (including potential cooperatives), will be further determined in course of implementation and on the basis of local comparative institutional strengths.

The DoE will also be responsible for creating a performance-based 'dashboard' for the SC, with inputs from all relevant Ministries (e.g., Health or Education) and geo-referenced information (to be mostly collected for the drafting of the geo-spatial least-cost rollout plan). For this purpose, a GIS platform was established in September 2017 at the Ministry (as well as within EEU for geo-spatial planning purposes and to report progress to the DoE). Figure 4.2 provides the preliminary organigram of the DoE structure.

The DoE will also be the lead agent for the conduction of most of the technical studies and activities immediately required for the successful implementation of the NEP and achievement of targets. The DoE will be formally established in the coming months and, in the meantime, a Task Force has been created under the leadership of MoWIE for the drafting of this document and prompt and effective launching of the NEP. The DoE will be comprised of a specific program office for the implementation of the NEP and professional technical and financial experts. The Task Force has already identified the number and typologies of professional figures and experts, with related qualification requirements, for the DoE day-to-day implementation of the NEP, including: NEP coordinator, electrification planning specialists, M&E and quality assurance specialists, GIS specialists, finance management experts, and procurement and accountant specialists. The dotted lines in the bottom section of the organigram (Figure 4.2) indicate implementation details currently under discussions.

2. Mobilizing financing—a sector-wide consultative and programmatic framework to rally Development Partner participation. The NEP-IRM is ambitious, far reaching, and crosscutting in scope, and hence requires proactive and constructive engagement from the outset of a wide range of stakeholders for its implementation, including Federal, Regional, and Local Authorities, EEU, REF, EEA, REBs, Woredas, Development Partners, and private sector agents.

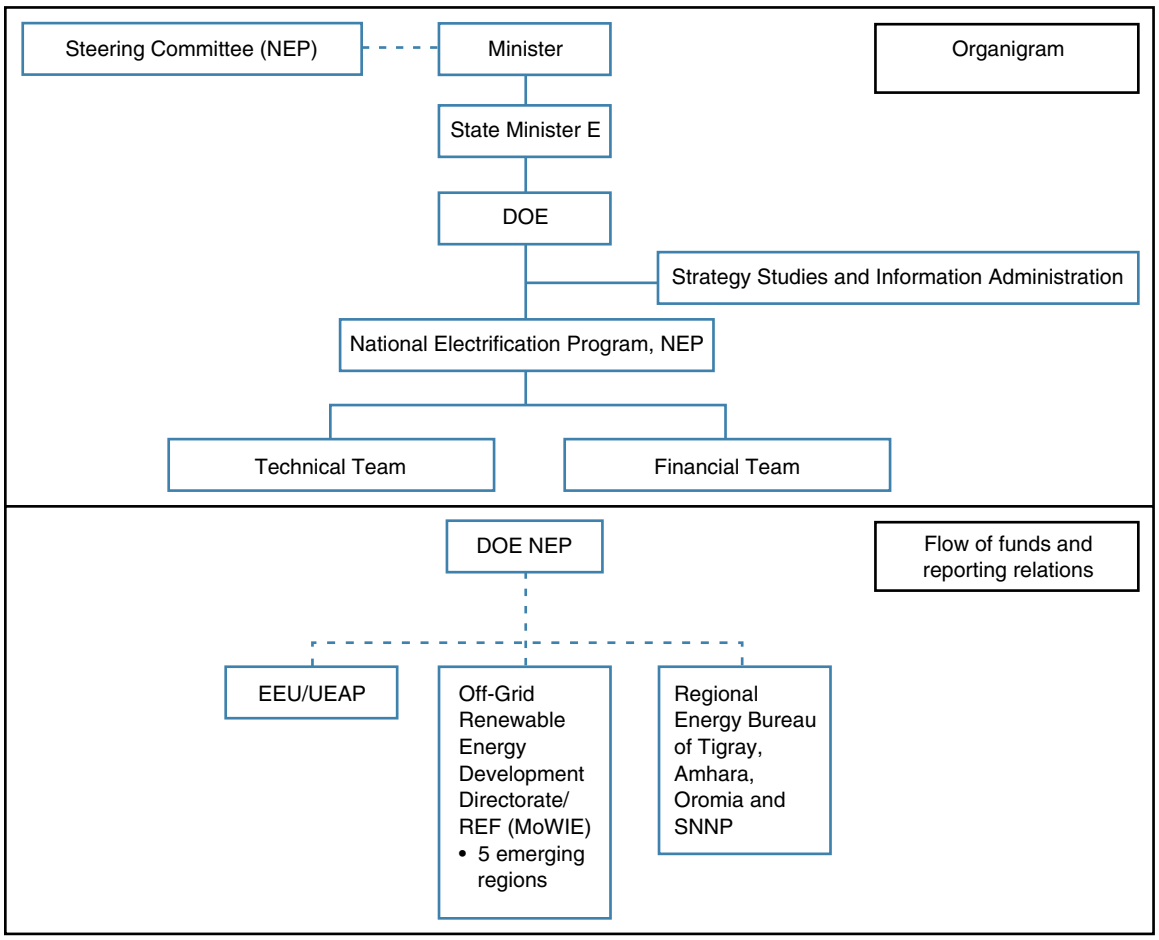
A key building block of the Program is a comprehensive sector-wide approach to implementation, including financing. Given the scale of investment required for the implementation of the NEP-IRM, concessional as well as grant financing from Development Partners will be essential to complement in-country resources mobilized from the Government/EEU, new customers, and the private sector, particularly in the off-grid space.

Consistent with the 2005 Paris Declaration on Aid Effectiveness, the NEP-IRM implementation design and Investment Financing Prospectus (2018–2022) are organized under the principle of "Many Players, One Team, One Plan" (Figure 4.3).

Under the GoE strategic leadership, all sector stakeholders' activities and financing will be coordinated and harmonized, shifting away from fragmented and piecemeal activities to:

- Increase the magnitude of programmatic flow of partner funds for the implementation of the access program;
- Align donor program support with the NEP-IRM targets (grid and off-grid) and technical program implementation support components, as identified;
- Establish a common sector-wide progress monitoring framework and system—the 'NEP-IRM monitoring system'—to foster joint ownership, transparency, and mutual accountability (including MTF, EEU Key Performance Indicators, and GIS tracking); and

Figure 4.2 Preliminary organigram of the Directorate of Electrification (DoE)



Source: MoWIE.

- Foster harmonization across Partner participation and funding with respect to the country systems for procurement, funds flow and disbursements, and other safeguard arrangements, as appropriate.

An independent verification and audit system is being set up to verify achievements against the NEP access targets and other Program key performance indicators reported each year by the designated implementation agents and upon which disbursement of approved financing will be triggered.

3. Licensing and regulation: The Ethiopia Energy Authority (EEA) was established by the Council of Ministers as the sector independent regulator in 2013. Consistent with its mandate, the EEA will have licensing and regulatory oversight, including for private sector entry; and across the functional value chain of generation, transmission, distribution, and sales functions within the power sector. The regulator will be responsible for establishing standards and regulations required for the implementation of the grid and off-grid programs, including social, safety, and environmental safeguards as well as their compliance. More specifically, the EEA will define and enforce licensing requirements, rights and obligations of parties, amendments, and certificates of competency, and advise the Government on tariff proposals submitted by a licensee (for grid and off-grid). It will also promote energy efficiency and conservation, and standards for electric equipment, appliances, and labeling. Finally, it will be responsible for settlement of disputes, mediation, and arbitration.

4. Implementation: of the (i) grid and (ii) off-grid NEP-IRM program components.

(i) Grid connectivity scale-up and network extensions component of NEP-IRM—EEU will be responsible and

accountable for network planning, design, and implementation of the grid component. EEU will prepare a NEP-IRM operations program manual as the umbrella framework to plan, procure, organize, construct, and connect new customers to the distribution network, irrespective of the funding source, while proceeding with the extension of the grid.

(ii) Off grid program—Consistent with the strategic directions outlined for the off-grid connections rollout program (Section 2.3), and building on the results achieved to date, an expanded set of best-practice experiences will be deployed for scale-up, encompassing:

- *Public sector delivery in deeper rural areas that are commercially less attractive for the private sector*—REF unit redesigned (solar systems) and EEU/UEAP (solar systems and mini grids);
- *Private sector market-based supply, delivery and, after-sales service chains in proximate rural areas* but not "under the wires grid"—with focus on solar systems; and
- *Private sector mini/micro grids predominantly for pre-electrification* in rural areas until the outreach of the grid distribution network access is extended. The Government intends to apply uniform network design and equipment standards, appropriate for rural areas mini/micro grids, to ensure their smooth integration into the network when the grid arrives. The Government will also address explicitly in the regulatory framework the adequate provisions to address in a fair, equitable, and transparent manner any "stranded assets" of private operators, should that circumstance occur.

The Regional Energy Bureaus (REBs)—especially the strong and more dynamic among the ones with capacity—could play an important role in informing and monitoring targets—both grid and off-grid—and facilitate the implementation of the NEP. For this purpose, national consultations on the implementation of the NEP were launched in Addis Ababa in August 2017 with REBs and EEU Regional Offices. REBs could provide bottom-up information for ensuring the harmonization of least-cost technical targets (for grid and off-grid rollouts) with the Government's regional socioeconomic priorities. Furthermore, building on their past activities, they could play an important role for communication and citizen engagement purposes, managing expectations about the grid's arrival, service standards in the case of the off-grid preelectrification program, and uses of off-grid technologies after the grid's arrival (e.g., backup purposes in case of service interruptions). The potential roles to be played by REBs in undertaking planning, implementation, and citizen engagement tasks is being examined by MoWIE, taking into account the different comparative strengths of local institutions, particularly EEU, REBs, and strong cooperatives.

Figure 4.3 Consultative organizing framework—"Many Players, One Team, One Plan"

5. Monitoring and evaluation. Establishment and monitoring of key performance indicators for efficiency, effectiveness, and progress against grid and off-grid targets and for course adjustments as and when appropriate by relevant actors (e.g., EEU, DoE). The system will include regular reporting (e.g., quarterly and annually) of program progress, analysis of impacts, and the creation of a performance-based dashboard with inputs from relevant Ministries (e.g., Health or Education), and appropriately interface with GIS information and the MIS system.

4.1 Capacity building and strengthening for NEP implementation

Targeted capacity building and technical support directly linked to the success of key aspects of implementation will be required not only for sector institutions—MoWIE, EEU, REF, and EEA—but also for the broader sector participants such as academic

institutions (universities and vocational training centers), community, and other local stakeholders. Activities will build on the ongoing partnerships established between EEU and educational centers, as well as expend them according to the specific skill needs identified.

The size, qualifications, and skill mix of the workforce required for implementation of the many components and dimension of NEP need to be expanded. EEU has already engaged in the setup of a training center of excellence for the provision of industry-specific education to university, college, and technical and vocational education and training (TVET). [1] EEU is already relying on the 6 months training provided by TVET on electro mechanics and the condominiums project,[2] and intends to support the improvement of TVET curricula to ensure their adequacy with the standards applied in the distribution segment and the different range of technical skills required by the implementation of the NEP (from hydropower modelling to electrification planning engineers to last-mile connections technicians). Past experiences with cooperatives have also shown positive results, and will be further leveraged during implementation.

Academic institutions will also play an important role. EEU already offers 2 and 4 month apprenticeships twice a year (for corporate training, and electrical engineers and ICT, respectively) providing on-the-job training for up to 100 college and university students. Graduate students in electrical engineering and information and communication technologies are provided with a 6 months training prior to being placed in remote areas for 2 years, mainly being responsible for maintenance of the existing mini grids. With the support of MoWIE, EEU will further explore possible synergies with local universities, from electrical engineering programs to GIS planning and utility modernization.

Notes

1. The UEAP program relied on TVET for about 25 percent of construction works.
2. For the main cities in the country, EEU contract out the connection of condominiums to TVET to the grid network.

Annexes

ANNEX 1

National Electrification Strategy (NES), 2016

As part of the shift in strategic focus to last mile connectivity, the GoE issued in June 2016 the National Electrification Strategy to identify persistent challenges and define and implement a strategy for sustainable energy sector development and scaling up electrification in Ethiopia. One year later, the National Electrification Program (NEP) brings the NES into the implementation phase, translating into practice the findings and strategic approach identified by the NES (including program implementation support activities) in an effective and sustainable manner.

The National Electrification Strategy identifies the three key and foundational categories of sector challenges that need to be tackled for the scale-up of customer connections: (A) Institutional and Policy, (B) Planning and Technical, and (C) Financial, and provides corresponding recommendations for immediate interventions.

A. Institutional

The NES highlights the need to set in place a national electrification policy clearly defining targets and timetables for the connections rollout (grid and off-grid); roles and responsibilities as well as coordination of sector institutions and stakeholders (including the private sector); and adequate and sustained funding for the duration of the program. It also identifies the Government's commitment as the key catalyst of change and overseeing institutions for the achievement of the universal electricity access development goal.

In particular, the NES calls for:

1. Developing a national electrification policy statement.

2. Establishing a Directorate of Electrification (DoE) within the MoWIE. DoE is intended to provide improved policy guidance and interagency coordination. The Directorate will not engage directly in implementation of electrification activities but will oversee the electrification program and facilitate successful implementation of the goals and objectives of the NES through the implementation agencies including UEAP, EEU, and REF.

3. Accelerating consumer registration/connection and improved operation of remote electric service. The continual and rapid expansion of the Ethiopian electrification program will require a clear and effective strategy to educate newly electrified communities and community members and to rapidly inscribe them as EEU customers. People and businesses are the ultimate beneficiaries of the electrification program. To ensure they reap the benefits of expanded and improved electricity service, adequate attention must be paid to ensure that the key sector agencies and EEU, in particular, are able to build and manage a growing customer basis.

4. Supporting sustainable and affordable off-grid service provision. Off-grid projects should ideally satisfy two principal criteria to meet more global NES objectives: their technical, financial, and institutional design should be framed to result in long-term sustainability; and the cost of service to consumers should be fair and equitable. To achieve both of these criteria, an electrification program will be launched and entails an attentive selection of options to engage with the private sector. The program will identify towns and housing clusters to be prioritized under the off-grid electrification program in coordination with grid expansion planning priorities.

B. Planning and technical

The NES recommends the following activities:

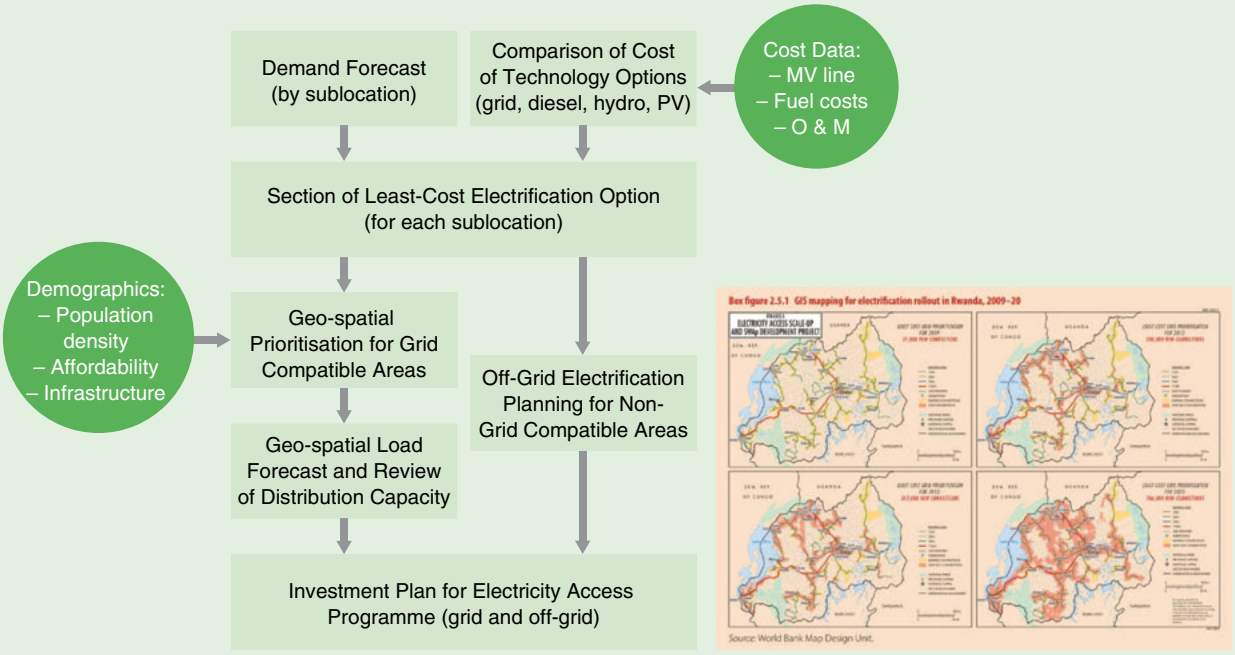
1. **Developing a master planning framework:** A geo-spatial master planning framework is essential toward more effective grid expansion and off-grid coordination. Optimal investment planning for grid and off-grid expansion is facilitated by a holistic, technologically advanced master planning framework (see also Box A1.1). Thus far, the electrification program has relied on manual as opposed to digital planning mechanisms. UEAP will need to acquire

Box A1.1 Geo-spatial least-cost planning and investment prospectus

For the creation of a geo-spatial planning framework, the GoE has already established two geo-spatial platforms, one within MoWIE—to supervise and monitor NEP progress—and one within EEU—for network planning purposes. These platforms will support the GIS least-cost rollout plan, to be launched by the Government in the fall of 2017 and available in 2018 to inform the optimal connections roll-out (grid and off-grid) from 2019 onward. The geo-spatial plan will update the NEP-IRM and constantly be revised to reflect changes in local circumstances as well as progress in target achievements.

GIS-based planning constitutes a data driven framework for the efficient and effective deployment of limited resources while taking into account social and equity concerns. It identifies the optimal technology—in space and time—for access provision, tailored to local circumstances and appropriate in its technical feasibility and economic viability, with geo-referenced demand centers, including schools, clinics, and water points. Geo-spatial planning also improves asset management, particularly with the integration and strengthening of MIS and AMI systems in day-to-day planning and operations. An Enterprise Resource Planning (ERP) system (ENREP AF), including a Decision Support System, is scheduled to be launched by the end of 2017 and be fully operative by the second half of 2018.

Figure A1.1 Spatial planning approach (left) and least-cost planning in Rwanda (right)



Source: World Bank, 2009.

The Investment Financing Prospectus builds on the findings of the geo-spatial analysis to identify the investment requirements—and gaps—for the achievement of NEP yearly connection targets.

software and expertise to develop and share the master planning process with other electrification stakeholders including REF, EEP, EEU, and the MoWIE.

2. **Establishing a Densification Program:** Densification of consumer connections in areas that have been recently electrified will allow to increase connection rates at a more rapid pace and maximize the impact of the ongoing process of geographic expansion of distribution coverage. Densification will result in improved cost efficiency of the electrification program, and significantly increase economic benefits in the targeted areas.

3. **Conducting national willingness to pay (WTP) and affordability analyses:** The NEP-IRM expands the scope of this analysis into the study provided for the design of a connection policy, to be adopted by 2019. The NES underlined the importance of WTP and affordability analyses to consumer price points, to evaluate economic benefits for projects, and to facilitate program decision making regarding the relative value of grid versus off-grid technology options on a geographically specific basis. A national survey program can be designed to gather all of the data required to characterize all market segments in Ethiopia that will support electrification program planning for many years to come. This is an activity that will be managed by the newly formed DoE under the MoWIE.

4. **Developing low-cost electrification design/construction options.** Lowering construction costs will allow UEAP/EEU to reach significantly more consumers in a shorter period of time without sacrificing service quality or safety. Low-cost electrification standards have been successfully introduced in a number of countries and have significantly contributed to the success and efficacy of these programs. Costs can be lowered up to 40–50 percent through improved engineering and material selection by simplifying design of low voltage networks and by using smaller transformers and service materials, without compromising safety and security.

C. Financial

The NES stresses the importance of ensuring the financial viability of the program and recommends the following possible revisions of the current tariff level and structure:

1. **Ensuring long-term sector financial viability.**
2. **Ensuring affordability of electricity services.**
3. **Promoting productive uses of electricity:** These programs are designed specifically to provide training, Technical Assistance, and access to financing to promote income generation through productive use of electric service in newly electrified communities. This activity will also be led by DoE.

ANNEX 2

The Multi-Tier Measurement Framework—Early Results

The Multi-Tier Framework (MTF) Energy Access Household survey has been conducted across the country—in both urban and rural areas—for the development of a baseline indicator to track progress toward the achievement of universal access.[1] The MTF will be incorporated into the NEP monitoring system and provide inputs for also tracking the Sustainable Development Goal (SDG) #7 on access to affordable, reliable, and sustainable modern energy by 2030.

The survey applies an analytical framework known as a MTF approach developed by the World Bank within the Sustainable Energy for All (SE4All) initiative.[2] The MTF redefines energy access from the traditional binary count to a multidimensional and comprehensive definition of access as "the ability to avail energy that is adequate, available when needed, reliable, of good quality, convenient, affordable, legal, healthy, and safe for all required energy services across households."[3]

The survey provides a more accurate picture of the actual services received by end-users (it also includes gender disaggregated and affordability) to inform and guide policy makers in their access interventions and maximize their investments, leading to the best energy access outcomes.

The MTF classifies energy services in a Tiers' spectrum, from Tier 0—no service, to Tier 5—full reliable service (see Box A2.2) with related consumption levels and potential uses. It also stresses neutrality of technology and allows aggregation of different technologies with different service levels. To reflect the benefit of Pico solar and other small-scale devices that contribute to improved lighting but may not meet Tier 1 standards, fractional measurement is used between Tier 0 and Tier 1.

The tier level is determined by the degree by which access attributes are met. For example, electricity Tier 2 requires a combination of capacity and

Box A2.1 The Multi-Tier Framework (MTF) Energy Access Household survey

The MTF nationwide survey was conducted for 4,290 households with the support of the World Bank in January–May 2017, and the information collected is now undergoing the process of data cleaning. The full report will be available in the Fall of 2017.

The main objectives of the survey were:

1. Design and implement baseline surveys;
2. Analysis of data and drafting of a report; and
3. Prepare a GIS database consisting of the GPS coordinates of the survey units (which will be integrated into the GIS platform within MoWIE and EEU as well as for the development of the Geo-spatial Least-Cost Rollout Plan (see Table 2.12)

Box A2.2 The Multi-Tier Framework (MTF) Energy Access Household

			TIER 0	TIER 1	TIER 2	TIER 3	TIER 0	TIER 5
	1. Peak capacity	Power capacity ratings (in W or daily Wh)		Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2 kW
				Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 3.4 kWh	Min 8.2 kWh
		OR Services		Lighting of 1,000 lmhr/ day	Electrical lighting, air circulation, television, and phone charging are possible			
	2. Availability (duration)	Hours per day		Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs
		Hours per evening		Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4 hrs
	3. Reliability						Max 14 disruptions per week	Max 3 disruptions per week of total duration <2 hrs
	4. Quality						Voltage problems do not affect the use of desired appliances	
	5. Afford ability					Cost of a standard consumption package of 365 kWh/year <5% of household income		
	6. Legality						Bill paid to the utility, prepaid card seller, or authorized representative	
	7. Health and safety						Absence of past accidents and perception of high risk in the future	

TIER 0: No electricity is available or it is available for less than four hours per day (or less than one hour every evening). Households use various coping mechanisms such as using candles, kerosene lamps or dry-cell battery powered devices (flashlight or radio).

TIER 1: At least four hours of electricity per day is available (including at least one hour in the evening) and the capacity of the supply is sufficient to power task lighting and phone charging or radio. Any source from solar lighting systems to solar home system, mini grid, or grid may deliver such a level of access.

TIER 2: At least four hours of electricity per day is available (including at least two hours in the evening), and the capacity of the supply is sufficient to power multiple lights, a television or a fan. Any source from rechargeable battery or solar home system, to mini grid and grid may deliver such a level of access.

TIER 3: At least eight hours of electricity per day is available (including at least three hours in the evening), and the capacity of the supply is sufficient to power low power appliances such as a refrigerator, as needed during that time. In addition, the household is able to afford a basic consumption package of 365 kWh per year. Any source from solar home system, generator, mini grid, and grid may deliver such level of access.

TIER 4: At least 16 hours of electricity per day is available (including four hours in the evening), and the capacity of the supply is sufficient to power medium powered appliances, such as a washing machine, iron, or microwave. There are no frequent and long unscheduled interruptions, and the supply is safe. In addition, the connection to the grid is legal and there are no voltage issues. Typically, any source from diesel generator, to mini grid and grid may deliver such a level of access.

TIER 5: At least 23 hours of electricity per day is available (including four hours in the evening), and the capacity of the supply is sufficient to power high and/or continuous powered appliances, such as air conditioning or space heating. Grid is the most likely source to deliver such a level of access.

Source: World Bank, 2015.

hours of supply. However higher tiers, such as Tiers 4 and 5, require meeting additional attributes such as reliability, quality, affordability, safety, and legality.

Measuring access to productive applications of energy and affordability

The lowest tier among all applications determines the energy access rating for the productive use as a whole. The multi-tier framework captures the multiple attributes that influence access to energy for productive uses, in order to inform policy and investment. The index of access to energy for productive enterprises is calculated as the average tier rating across the entire sample of individuals surveyed, adjusted to a scale of 100. Additional indices for specific engagements can be calculated by filtering the survey data for respondents engaged in the particular productive use, such as agriculture, small shops, and artisans.

The affordability issue is treated separately, by assuming that the maximum acceptable level of energy spending is 10 percent of the household's income.

Electricity access for social community facilities and street lighting

This constitutes a key dimension of access to electricity services, as it drives improvements in human capital through education and health services. Energy access in health facilities is a critical enabler of access to health services, and access in education facilities increases the time students spend at school and also improves children's and teachers' experiences.

Street lighting can improve mobility and security and encourage economic and social activity. Access to energy in Government buildings enables e-governance, as well as necessary communications. Energy services in community buildings (such as prayer and celebration halls) allow the use of these institutions during evening hours as well.

Two different approaches for collecting information are considered: direct assessment through a survey of community institutions and an indirect assessment through survey of users. Both approaches entail measurement of various attributes of energy supply—capacity, duration, reliability, quality, affordability, legality, convenience, and health and safety—though the survey of users can only deliver limited information about select attributes. An important aspect of energy supply is the financial sustainability, which refers to the ability of the community institution to pay for utility bills, fuel, spares, maintenance, and batteries. An index representing the level of access to energy at each type of community facility may be compiled based on the multi-tier framework. The lowest tier among all attributes determines the overall access tier.

Gender aspects

The multi-tier approach provides information on several gender-related aspects, including:

- Ownership and regular use of various electrical appliances in the household, by gender of household members;
- Use of various stand-alone lighting devices, by gender of household members;
- Gender of household members who use mobile phones;
- Availability of street lighting in the neighborhood area, facilitating mobility, especially for women;
- Energy access for productive uses by gender of working household members; and
- Energy access for health facilities, facilitating child delivery.

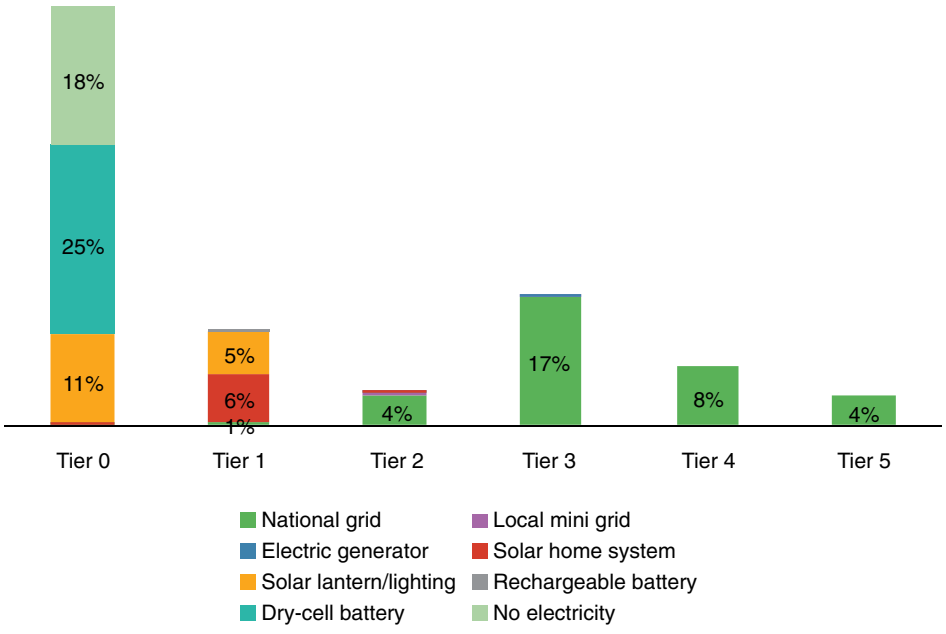
Early findings of the MTF survey

With respect to access rates in Ethiopia, final results of the World Bank MTF survey for services provided through grid and off-grid technologies will be available in the fall of 2017. Some preliminary results are however available for some key dimensions.

Distribution of technologies by tier:

- **As expected, grid access is leading in higher tiers,** whereas off-grid dominates lower ones. Grid households are occupying Tiers 2–5, with the highest concentration in Tier 3, while off-grid solutions are primarily in Tier 0–Tier 1 categories.
- **Solar PV solutions are rapidly increasing Tier 1 access.** Solar off-grid solutions are promising for moving Tier 0 households to at least Tier 1. It is worth noticing that a large share of non-grid connected households use dry-cell batteries to address their energy needs (mainly for lighting), although these are not considered as a reliable source of electricity and hence are categorized as Tier 0. Switching to solar off-grid solutions may help some of these households to move to Tier 1.
- **Access in Ethiopia is mostly a rural challenge.** The vast majority of Tier 0 households live in rural areas. Comparing Figure A2.1 and Figure A2.2 reveals that off-grid electricity appears to be the only technology contributing significantly to access in rural areas (11 percent of off-grid households in Tier 1 appear to correspond to 11 percent of rural households in Tier 1).

Figure A2.1 MTF tier distribution by technology



Overall, the vast majority of households are in Tiers 0–3. This means that Ethiopia's drive toward universal access will include both measures to bring the Tier 0 households to at least Tier 1, while also working on moving Tier 1–3 households to higher tiers.

In order to move to higher tiers, increasing the hours of supply is also key. Figure A2.3 provides an analysis of all MTF attributes. Blue and orange are the key areas holding back households from higher tiers. The analysis shows that the daily duration (hours of supply) seems to be the main constraint for reaching higher tiers, followed by problems with evening duration and quality (voltage fluctuations). Affordability of the service does not appear to be a major issue. For off-grid households, the main constraint is capacity of the systems, as all systems are currently classified only Tier 1 or below.

Figure A2.2 MTF tier distribution by rural and urban areas

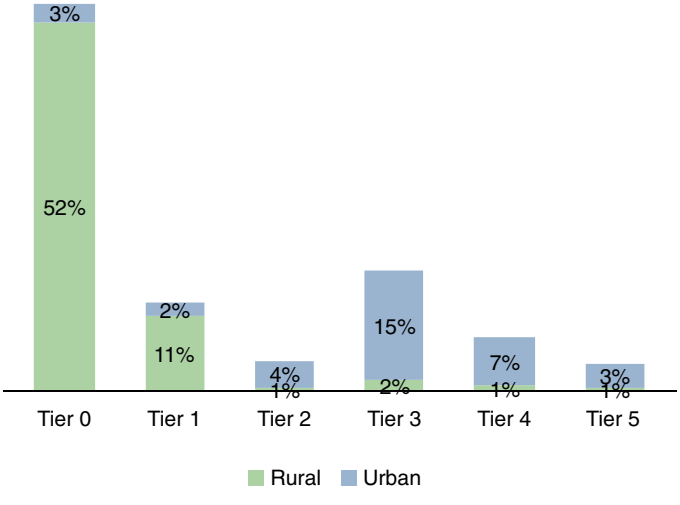
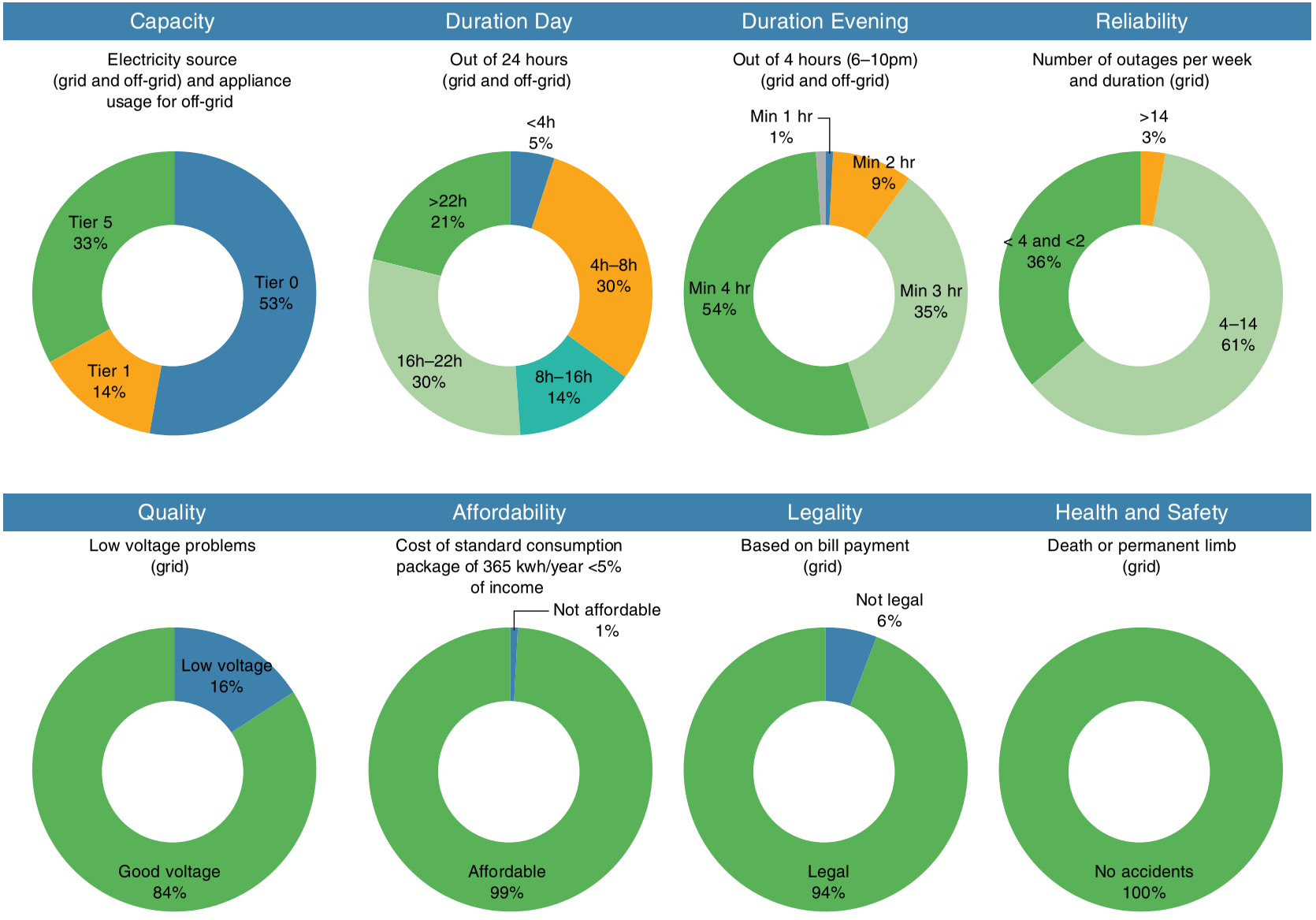


Figure A2.3 Access to household electricity: attributes summary sheet



Notes

1. The MTF survey conducted with the support of the World Bank covers 1,761 households from each analytical domain (urban and rural) for a total of 3,522 households at the national level. A stratified two-stage cluster sample design is used to select the ultimate samples in order to draw urban and rural level representative samples. The baseline survey covers 300 primary sampling units evenly distributed across the rural and urban areas.
2. World Bank (2015). Beyond Connections: Energy Access Redefined, Washington D.C.
3. The MTF includes a separate framework for cooking solutions and space heating. For more information, see World Bank (2015). Beyond Connections: Energy Access Redefined, Washington D.C.

ANNEX 3

The Universal Electricity Access Program (UEAP)—Performance Evaluation

The Government of Ethiopia is committed to provide power to the people and bring them out of the darkness of poverty. The first major rural electrification program was launched in 1999/2000 to implement the Rural Electrification Project. However, the Universal Electrification Access Program (UEAP) was launched as a more ambitious endeavor in 2005 to promote the socioeconomic development of rural areas in Ethiopia by expanding the electricity network. This expansion is based on exploiting the country's energy resources to provide energy to rural consumers and economies, which will contribute to the implementation and achievement of the Government's objectives toward a Growth and Transformation Plan (GTP).

Objectives of the program

UEAP started with the following objectives:

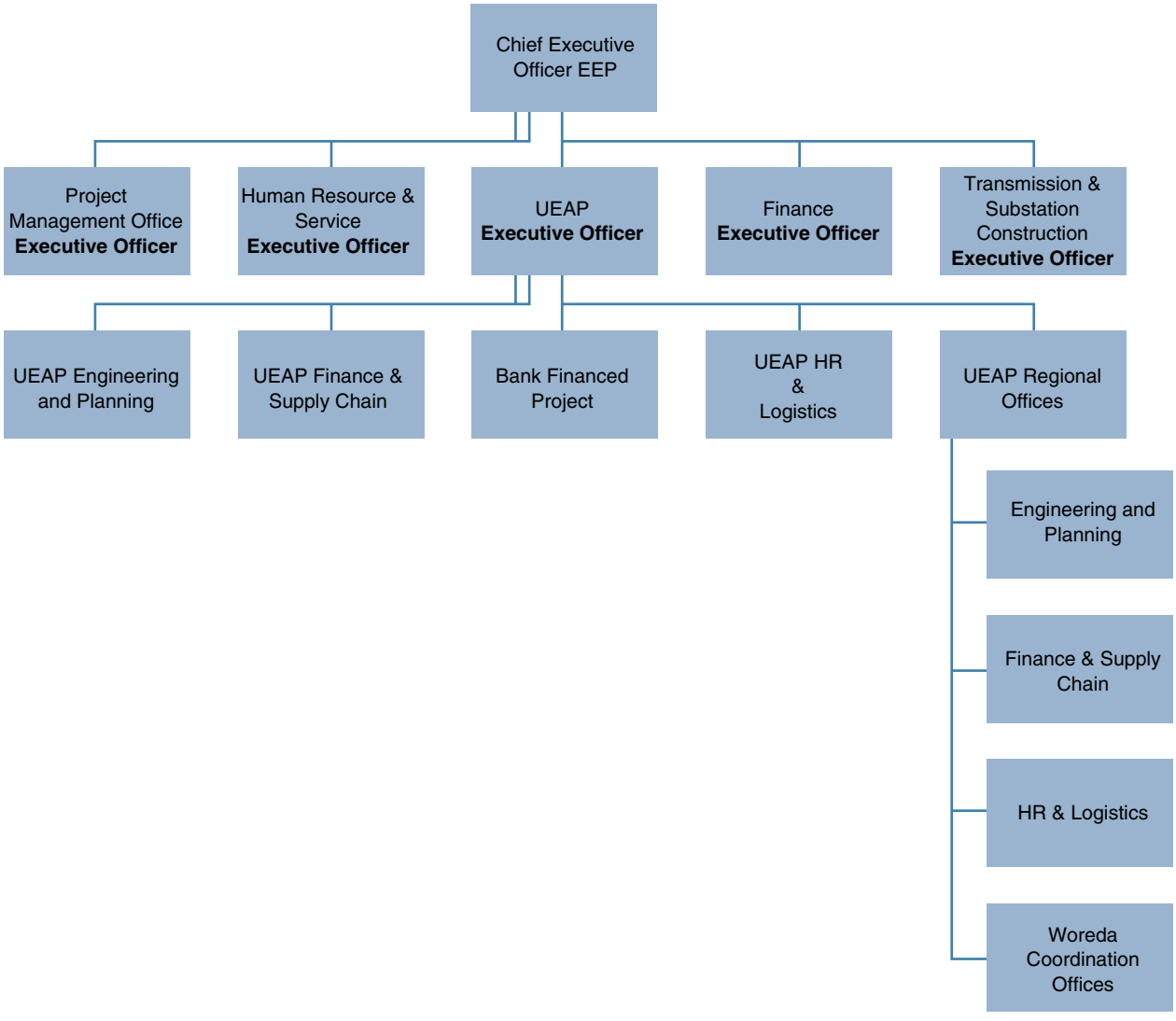
- Provision of equitable access to electricity in all regional states of the country;
- Reduction of cost of electricity distribution systems through the introduction of new standards like mixed three-phase/single-phase system;
- Building nationwide human, manufacturing, and contracting capacity for implementation of the program;
- Introduction of new institutional arrangement for implementation of UEAP and future operation of the newly electrified areas to provide efficient services, reduce costs of overheads, and encourage rapid growth in revenues of Ethiopian Electric Power (EEP) (formally known as EEPCO); and
- Building generation and transmission capacity of the existing facilities to supply the new load to be connected to the system.

Organizational structure of UEAP

Toward the end of GTP I, UEAP was decentralized into eight Regional Offices to improve coordination with the regional administrations and better tailor procurement of materials and a workforce for local expansion plans. This decentralization allowed for the expansion of the UEAP structure to the Regional, Zonal, and Woreda levels which are arms of the Federal UEAP and responsible to jointly carry out the rural electrification activities in the respective regions. The organizational structure of UEAP is depicted in Figure A3.1. Since January 2016, the institution has been moved under EEU, and an internal restructuring is currently under way to ensure better coordination and effectiveness of activities, in light of past performance and future focus on last-mile connections.

UEAP has also supported the creation of 81 associations (mostly in the Addis Ababa regions) providing construction workers for the connection of condominiums. UEAP launched a training program for recent graduates of technical universities and technical vocational schools in January 2014, and about 2,000 workers have joined the existing 200 cooperatives for the extension of network coverage.

Figure A3.1 UEAP organizational structure



Selection of towns and villages

The determination of towns and villages to be electrified each year is the responsibility of the regional states with the assistance of EEU. Each regional state selects towns and villages through the Regional Energy Bureaus (REBs) based on allocated equity quotas (determined by population size) of Government funding. Each REB identifies the towns and villages that have not been electrified yet, and the selection is based on technical, economic, and social criteria: road access, proximity to a substation (15 kw lines are expanded for a 30 km radius whereas 30 kw lines for 100 km) and to a district office, and economic and political importance, as well as location of presence of school and clinics. It is expected that electricity will assist these kebeles and villages in developing new economic activities (currently mainly based on agriculture and commercial activities) and to improve current services such as grain milling, educational services, health services, and irrigation activities, etc.

Stakeholder financing

The UEAP is an ambitious program that the GoE is supporting with the assistance of several Development Partners, such as: World Bank, African Development Bank (AfDB), Bank of Arab for Economic Development in Africa (BADEA), Saudi Fund, OPEC

Fund for international Development (OFID), and bilateral cooperation from Development Partner countries.

Achievements

At the time of UEAP launching in 2005, only 667 were electrified (through the Rural Electrification Project, which focused essentially on extending the network to Woreda towns and major towns located close to substations or existing distribution lines). Between 2005 and 2015, the electricity grid was spread to about 6,000 towns and villages from the initial 667, and grid coverage reached 60 percent of rural towns and villages in the country from the initial 15 percent.

A social and economic impact assessment that was recently undertaken (SMEC, 2015),[1] unveiled the benefits provided by the Program to the Ethiopian population living in rural villages and towns. In particular, the survey reveals that UEAP contributed to growth and development in terms of:

- Business activities/income generation potential: business centers, handicraft (metal and wood), flour mills, bakeries, barbershops, etc. (19% respondents);
- Reduction in criminal activities (17% respondents);
- Use of electric appliances (12% respondents);
- Saving time, labor, and financial resources (12% respondents);
- Improving lifestyle, use of television (9% respondents);
- Reducing costs on kerosene, gas, dry-cell batteries, etc., improve the well-being of the family and induce savings (30% respondents); and
- Improving health and educational services (30% respondents).

Key lessons learned during UEAP implementation, 2005–2015

A significant number of households in rural communities benefited from UEAP programs. However, the implementation of UEAP has also been affected by a few key challenges that are currently being tackled by a joint EEU/UEAP Team to inform the way forward in connections rollout and effectiveness in service provision. Under the NEP-IRM implementation support activities and studies, these challenges will be tackled to ensure proper coordination of activities between EEU and UEAP, and exponential progress in connections rollout.

Below is a summary of the key issues identified during UEAP implementation affecting beneficiaries of electricity services:

- **Increase focus on service delivery:** The UEAP Power Supply Distribution network has been limited to around the center of the villages and along roads.
- **Need for an information system to underpin grid extensions under UEAP:** Which relates to (i) lack of load center size and forecast to inform the prioritization of towns and villages to be connected, and (ii) lack of uniform and harmonized network information collection and storage by UEAP.
- **Improve network and electricity service reliability:** The expansion of the distribution network is not based on network capacity, leading to irregular power supply and sudden interruption.
- **Connection cost barrier encourages meter lords and illegal connections:** It is currently estimated that the number of connections per meter ranges from 1.4 in Addis Ababa to 2.8 in more remote rural areas. Households end up paying a higher price per unit of electricity consumed in order to avoid incurring the whole cost of connection, which has to be bared in order to receive service from EEU.
- **Lack of electricity appliance availability constrains beneficiary demand:** The lack of appliances in rural areas has limited the use of electricity for resource generation and usages other than lighting purposes. Communication and awareness campaigns on the efficient use of appliances are also required.
- **Need for increased focus on street lighting:** Required for providing better institutional services (education and health) and facilities, creating a positive environment for businesses, and creating more small jobs in the rural area. Street lighting for secured atmosphere in the evening and night should receive more emphasis.

Note

1. SMEC (2015). Economic and Social Impact Evaluation (ESIE) of the Universal Electricity Access Program in Ethiopia.

ANNEX 4

International Best Practice in National Electrification Programs

Several countries worldwide that have achieved very-high/near-universal access (grid connections) started their national electrification programs at a time when they were in the low-income category (Figure A4.1). Noteworthy within the Sub-Saharan Region of Africa, are Ghana (72 percent access), and in recent years, impressive progress in scale and pace of implementing grid-connected connections achieved in Rwanda and Kenya.

Each of these nations developed their national electrification rollout program suited to their unique conditions and circumstances; and no single "model of success" can be attributable to all of them. Nevertheless, all of these programs have demonstrated, albeit to a different extent, adherence to a few common underlying principles and drivers. At the core these are:

A. Government's visible hand makes the big difference, and essential are: devoted and purposeful leadership, sustained commitment and high level oversight, facilitation of implementation progress toward achieving universal electrification, and staying the course.

B. Putting in place the enabling policy, institutional, and regulatory frameworks, with due autonomy as well as commensurate accountability for results (targets), and ensuring efficient and effective management and operation of the sector by designated implementation agents (for grid and off-grid service).

C. Sustained public funding is needed over the entire duration of the electrification program for the portion of investment costs for access scale-up that cannot be recovered from consumer tariff revenues.

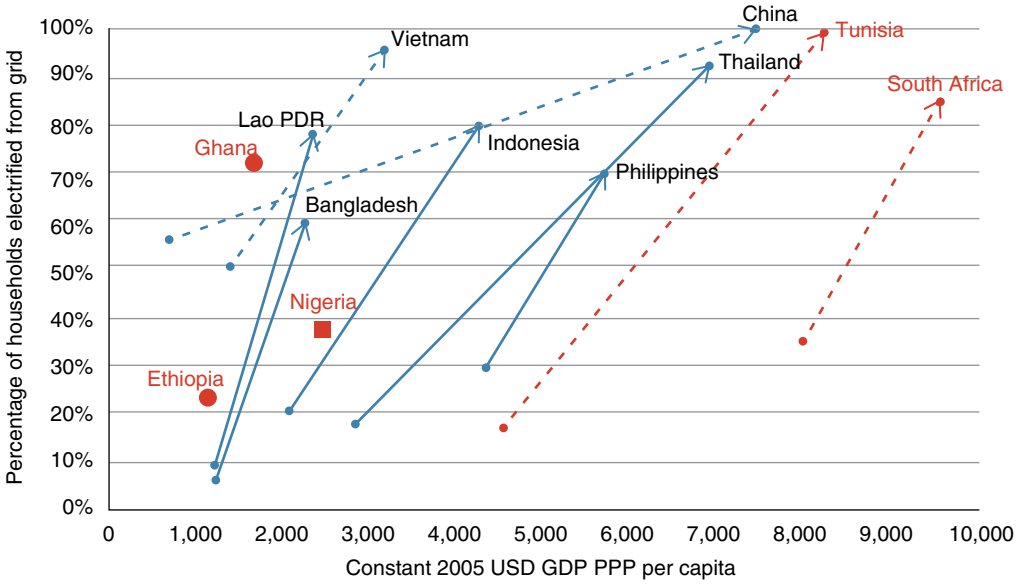
D. Sector-wide organizing architecture and consultative process led by the Government, bringing together all key stakeholders under the organizing architecture of **"Many Partners, One Team, One Plan."**

The NEP-IRM takes into account all of these drivers of successful performance, as described in detail in Section 1.2. Furthermore, although the NEP-IRM constitutes an ambitious, fast-paced acceleration, and quantum change from the past in grid connectivity, as shown in Figure A4.2, many countries have undertaken such an impressive acceleration in speed, breadth, and depth of access scale-up.

Noteworthy for fast-paced and scaled up grid rollout programs are the cases of Indonesia, Kenya, and Rwanda; highlights include the following:

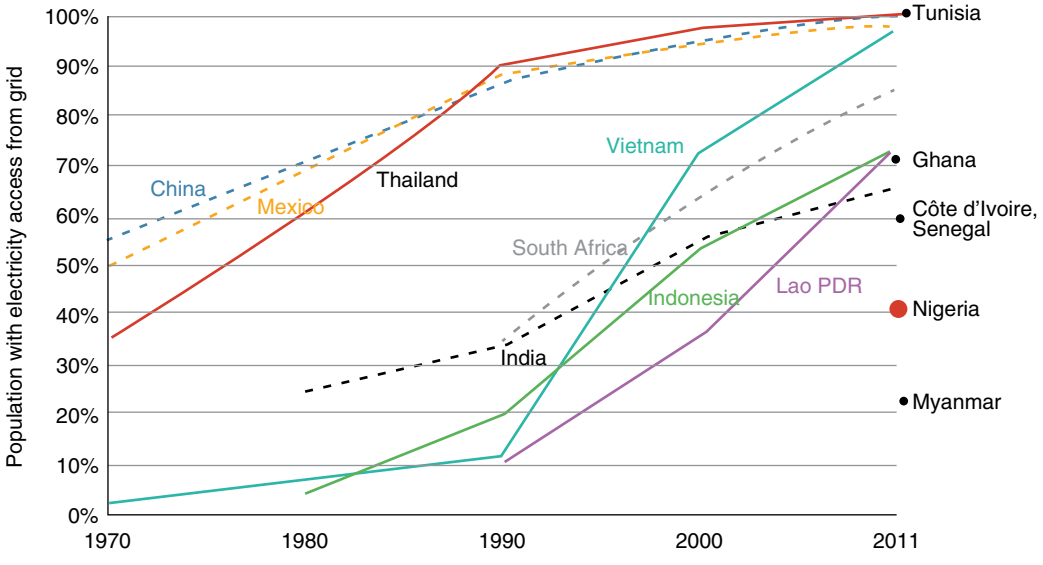
- **Indonesia:** the national electrification rollout program is noteworthy for a sustained annual scale of implementation at levels called for in Ethiopia. Indonesia's national utility—Perusahaan Listrik Negara (PLN)—has averaged around over 2+ million grid connections/year historically, and in recent years it has ramped up that rate to well over 3 million connections per year.
- **Kenya and Rwanda:** in both instances, implementation of their national electrification programs has been guided by a comprehensive geo-spatial least-cost national rollout plan (for coordinated grid and off-grid activities) and the financing gap has been filled by Government-led syndication with participation from a wide range of development partners. The achievements to date are impressive in both country examples in terms of cumulative increase

Figure A4.1 Several countries have scaled up access at relatively low levels of GDP per capita (PPP in constant US$)



Source: World Bank, 2016.

Figure A4.2 Fast-paced national electrification grid rollout programs—selected country examples



Source: World Bank, 2016.

in national grid access, and the steep gradient in the increase in the annual new connections implementation capacity. In Kenya, KPLC reportedly connected over 1 million new customers on-grid in 2016; up from 50,000 connections in the years 2009–2010.

In respect of the **off-grid program** scale-up experiences, the following national programs for standalone solar systems scale-up are notable for good practices (mini grid developments are still at an early stage wordwide):

- **Bangladesh** deployed a strategy and operational program design that has sustainably achieved rapid expansion in market scale, to about 500,000 quality verified solar systems per year; and on a commercial market development basis.
- **Kenya:** the Lighting Africa Program approach has demonstrably contributed to rapidly growing the market share of off-grid access from 2 percent in 2009 to 30 percent by 2012. In 2014, it was reported there were just fewer than 1 million quality certified product sales of solar lamps (compared to 210,000 in 2012). Cumulatively, about 4.5 million lighting products (solar lamps) have been sold over a five-year period (averaging close to 1 million per year).
- **Brazil's** "Programa LUZ Para Todos" (Light for All) program was very successful and connected 15 million people (over 3 million households in deep rural areas) over 10 years (averaging 1.5 million annually). Led by the national Government through its Ministry of Energy (responsible for planning, design, arranging implementation, and supervision)—with support from state Governments, NGOs, communities, and local Governments—the implementing agents were distribution utilities (public and private) with the technical expertise and institutional program management capacity and their regional operational offices, with the best knowledge of local areas for cost-effective service delivery, including maintenance, and spare parts, etc. Indeed, it was common practice for the distribution companies to undertake detailed preparation of project proposals—designs, costing, and implementation plans—on behalf of the Ministry of Energy for their review and authorization of funding as well.
- **Argentina,** and **Peru,** as well as some of the regional utilities, have served as designated Program Management Agents on a cost reimbursement basis, for off-grid program activities sponsored by the provincial and national Government authorities and ministries. In Peru, PMA functions are now taking over all solar home systems installed (handover, verification of technical specifications, and installation standards) and providing after-sale services, including billing, battery replacement, and maintenance.

ANNEX 5

Planning and Operational Readiness for NEP Grid Rollout Implementation for 2018

In preparation for implementation of the grid connections rollout component of the NEP, especially connectivity targets for the 2018 program (calendar year), EEU has launched several head start initiatives toward ensuring that adequate planning, technical procurement, and operations measures are put in place by January 2018:

1. **Establishment of a team devoted to connections scale-up, including integrating UEAP expertise.** The Modernization Team was established in the fall of 2016 with the mandate to improve the pace of connections and identify key bottlenecks to scaling up implementation, including effective coordination across EEU. It is led by the Technical Advisor to the CEO and members representing EEU, and recently folded into the UEAP, including planning, retail, and ICT. The Modernization Team is also represented in the Task Force established by MoWIE for launching of the NEP.

2. **A nationwide MV feeder level technical network analysis has been completed.** In early 2017, the Modernization Team launched a rapid technical and potential demand assessment of all MV feeders in the country—over 550—with active participation of regional and district offices. For each feeder, data on the number of current customers, paid waiting lists, registered customers, and potential new customers have been identified (household and commercial), as well as average energy demand per customer. Further, a simplified technical analysis has been completed to estimate the maximum number of customers that can be connected in the first year of the sector program (2018) without overloading transformers beyond 90 percent of their rated capacity, and reflecting other technical design considerations that can otherwise limit the network carrying capability and reliability. The analysis was conducted through primary (surveys) and secondary information on energy demand collected at the EEU District Office Level.[1] The output of this rapid assessment of each MV feeder nationwide—customer demand and technical considerations—has led to an initial determination of the number of new connections that can be added on each feeder.

3. **Development of the 2018 technical and procurement plan for the rollout of 500,000 connections.** Based on the analysis conducted, EEU has identified the town and villages to be targeted in 2018, mostly second and third tier cities and rural areas recently 'energized' by UEAP. Available interim results indicate that about 500,000 new connections can be undertaken in 2018, provided adequate financing is made available, of which 78 percent of new connections will be in rural areas whereas 24 percent will be in urban areas. Additionally, the Team is preparing the corresponding Procurement Plan for the 500,000 connections (by major equipment category), identifying the number of items: (i) available in warehouses, (ii) to be procured in-country, and (iii) to be imported (with related costing in foreign currency). EEU has estimated MV, LV, and service drop material requirements in accordance with rural and urban standards, to be procured though the list of preselected vendors developed in 2017. EEU is also drafting a plan for the number of connections to be rolled out on a daily basis for the identification of overall staff requirements, as well as detailing of the workforce to be: (i) trained through the EEU Academy (en-course of

establishment), or (ii) outsourced to the list of preselected contractors.

Alongside in parallel, the 2018 program implementation will also benefit from the early progress on several ongoing initiatives that are aimed at the transformation of EEU, with the shift in its mission, mandate, and primary focus to customer electricity service delivery, instead of a power distribution infrastructure developer per se. Specifically, several concerted efforts are under way at EEU to optimize its commercial processes and to become a world-class, customer-centric utility. This process was started in 2013 with unbundling of the vertically integrated utility EEPCo, into EEU and EEP, to allow for greater strategic and operational control over different segments of the power distribution and retailing value chain:

- ***Upgrading systems and tools:*** EEU has embarked on a multiyear, multifaceted process of comprehensively modernizing its back-office information technology (IT) systems, tools, and resources, to allow it to become a much more efficient corporation. Under this effort, it is in the process of installing a state-of-the-art Enterprise Resource Planning (ERP) system designed for its needs. The EPR system will not only allow automation of EEU's day-to-day workflow (corporate functions, such as, finance and internal controls, human resources, payroll, procurement, inventory, quality management, project management, and asset management), but will also include commercial processes and activities (Customer Relationship Management, CRM), and will allow for integration of billing, accounting, and maintenance systems (customer care, and meter and device management). In addition, these systems will also allow EEU to improve its strategic planning and management activities through business intelligence and data warehouse applications. A comprehensive Geo-spatial Information System (GIS) is also under development, which will allow for digitization of the EEU's network and assets under management. This will not only revolutionize EEU's technical planning capabilities, but will also improve the reliability of information on customers and the infrastructure used to serve them.
- ***Reviewing organizational structures and policies:*** EEU is also carrying out deep diagnostic exercises to isolate bottlenecks in its organization's structure and policies which may be preventing it from scaling up electrification rates significantly. This includes a detailed process of departmental reorganization, as well as reevaluation of its regulated asset base, which will take a complete inventory of EEU's assets for the first time since its unbundling. Furthermore, EEU is also reviewing its policies in handling financial and accounting functions, which would assist it in preparing for more globally accepted benchmarks, such as shifting from GAAP to IFRS accounting standards. Overall, the motivation behind this exercise is to provide focus to its core business processes and activities, such as registration of new users in its customers' database, conducting regular activities of the revenue cycle (metering, billing, collection, and management of unpaid bills, etc.), and attending to customers both in aspects related to electricity supply and commercial issues.
- ***Business process reengineering:*** Building on the outcomes of the above, EEU is undergoing a business process reengineering (BPR) exercise to improve and streamline delivery functions, improve the supply chain, and address past delivery delays related to planning, procurement, and warehousing, etc. One of the major outcomes of the BPR exercise has been EEU's focus on further strengthening its quality of service delivery to its customers. The utility is currently in the process of improving its complaint handling mechanisms—national rollout of the '905 Call Center' is ongoing and is being complmented by 'integrated utility kiosks' at a Woreda level across the country. These kiosks are designed for customers to pay their bills as well as submit complaints.

Over the medium term, taken together, these actions being undertaken by EEU are expected to have a transformational impact on the utility's ability to, as the customer service provider, meet the expectations of its customer base nationwide.

Note

1. Such a comprehensive data collection, validation, and harmonization from the decentralized office was conducted for the first time by EEU.

ANNEX 6

Potential for Lowering Capital Cost of the NEP Implementation—Introducing Low Innovative Low-Cost Designs and Practices

The adoption of low-cost network design standards and technologies will play a key role for lowering capital investments allowing EEU to promptly scale up the pace of connections without sacrificing service quality or safety.

Cost reductions in the order of 20–30 percent are realizable through improved engineering and material selection and by simplifying design of low voltage networks, without compromising safety and security. The international experience of countries that have successfully and rapidly implemented nationwide electrification programs offers a variety of measures to be taken into consideration.

Table A6.1 summarizes the best practices emerged from the experience of countries that have successfully improved distribution network efficiency, such as Tunisia, Ghana, South Africa, Zambia, Mozambique, Tanzania, and Uganda, as well as Australia and New Zealand.

For the highest impact, cost reduction methods will be evaluated as part of a comprehensive approach to cost reduction, encompassing: standardization of technical features and all equipment and components used for construction of distribution systems; better procurement methods (e.g., centralization of procurement processes and bulk purchases); warehouse management and quality control; reliance on locally manufactured materials (often cheaper than imported materials); and efficient construction work.

Low-cost network design and construction

To inform the specific combination of low-cost methods to be employed by EEU, particular attention will be devoted to the key low-cost methods that allow highest cost-saving returns, as have emerged from best practices:

1. Appropriate design engineering and development of a cost-cutting culture;
2. Single Wire Earth Return; and
3. Shield Wire Systems.

1. Appropriate design engineering

As noted, EEU, with the support of the DoE, MoWIE, and EEA, will adopt a holistic approach to reducing for the implementation of the NEP. Cost savings will be realized though looking at the entire network investments: from the MV lines taking power into the region through the transformer tap offs and LV house connections, continuing all the way through the house perimeter including metering, fuses, switches, house wiring, and demand-side management measures.

Courageous changes in network design and construction procedures and abandonment of "business-as-usual" methods will be undertaken to programmatically ramp up connections.

Table A6.1 Overview of cost-reduction potential in distribution network design and construction

	Description	Cost Reduction Potential (%)	Best Practices
MV grid extensions	SWER, two-wire single-phase metallic return and low-cost three-wire three-phase systems	25–40	Tunisia, South Africa, New Zealand, Australia, Brazil, Peru, Uruguay
Shield Wire Systems (SWS)		30–50	Ghana, Brazil, Laos
Poles	Span, length, height, and material	25–50	
LV lines	Single phase networks and voltage upgrade	15–25+	Tunisia
Consumer connections	Ready boards, suited meters	50–75	South Africa, Swaziland
Operations and maintenance		10–20	Tunisia, South Africa
Construction and operating costs	Decentralization of labor, depots; load limitations	30–50	Tunisia, South Africa

Source: World Bank, 2006.

A key cost reduction measure to be taken into account by EEU regards network design and equipment based on local load forecast—**single phase networks, transformers, small size conductors**—to avoid establishing overdesigned distribution systems while ensuring flexibility for future upgrades. When combined with adequately manufactured, sixed and located poles, this approach can save up to **50 percent** of construction cost.

As poles currently represent up to **25 percent** of EEU's total investment costs, the implementation of the NEP will entail the development of local manufacturing capacity, and preference will be given to the procurement of locally manufactured equipment, when possible. Furthermore, to achieve cost reduction of **30–50 percent** in construction and operating expenses, strategic location of poles manufacturing facilities will be taken into account, as well as production processes allowing for "mobile factories" that are easily dismantled and relocated to follow the progress of construction as the network spreads out farther.

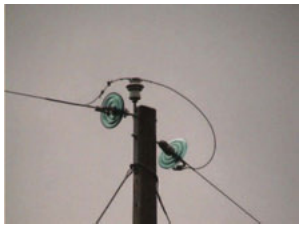
A third key measure to save costs up to **75 percent** entails the deployment of **ready boards,** which can provide cost savings for poorest customers and a key solution for premises that would normally not be approved for electrical installations. Ready boards do not require fixed wiring needs to be provided in the household premises nor seek inspection, and will incorporate a meter.[1]

2. Single Wire Earth Return (SWER)

Single Wire Earth Return provides up to **40 percent** reduction in costs compared to 3-phase configurations and roughly **50 percent** of an equivalent 2-wire single-phase to remote areas at low cost. They constitute a potential key cost reduction component as their design is simple, easy to be constructed,[2] provides reliable services with low maintenance costs, and has no issues for household uses[3] (e.g., refrigerators, color televisions) or small motors (e.g., electric pumps, manual tools). SWER is used to convey power up to 100 km from the source along the line and for 20 km on each side of the line for use by rural communities.

Alternatively, and/or in combination with SWER, a single-phase network with neutral conductor can provide savings of **30–50 percent** compared to three-phase standards. It carries higher loads than the SWER-based systems and can easily be upgraded.

Figure A6.1 SWER in New Zealand



Box A6.1 EEA Draft Energy Efficiency Standards and Labeling Guideline

Energy efficiency and conservation are part of the Growth and Transformation Plans I and II, the 2013 Energy Policy, and Ethiopia's Climate Resilient Green Economy Strategy. The GoE is committed to raising the efficiency of the energy sector and developing the necessary institutional and manpower capabilities by introducing appropriate incentive measures and is currently evaluating several energy efficiency measures to be developed with a national program, such as: CFLs scale-up, loans for customers buying energy efficient appliances, energy audits for industries and commercial centers, voluntary agreements on energy efficiency with industries and the public sector, establishment of an energy saving fund for subsidies, grants, rebates for energy efficiency projects, tax breaks, and energy efficiency advice centers.

In 2015, the Government issued the Draft Energy Efficiency Standards and Labeling Guideline as a milestone laying the foundation for the launching of an Energy Efficiency Labeling and Standards Program aimed at reducing capital investments in the electricity supply infrastructure.

In the industrial sector, in particular, demand is growing at a pace that will lead demand to exceed supply, unless proper measures are put in place. The Government, being the sole supplier of electrical energy, is striving to make sure that new power plants enter the system as fast as possible to mitigate the possible power deficit and is tackling, amongst other things, inefficient consumer appliances.

The implementation of Energy Efficiency Standards and Labeling programs targets the energy efficiency of selected consumer appliances chosen according to their energy consumption to reduce capital investment required for the development of power supply infrastructure. Guidelines currently cover the biggest energy consuming appliances, such as injera baking ovens, refrigerators and freezers, and electric motors.

3. Shield Wire System (SWS)

Shield Wire Systems can reduce cost by **30–50 percent**[4] when serving remote towns. SWS uses the existing shield wires on the top of the transmission lines as power conductors as well as shield wires. Shield Wire Systems address the issue of serving remote towns from high-voltage grids through existing shield wires on the top of the transmission lines as power conductors as well as shield wires.[5]

Reducing cost of electricity consumption

The implementation of the NEP will also entail looking at decreasing the cost of electricity consumption to reduce customers' bills, as well as to improve the balance between electricity supply and demand to increase the outreach of new connections.

Notes

1. With ready boards, the expensive circuit breaker and its housing may be replaced by a fuse or even a piece of fuse wire, and the cable to the house should be an aerial conductor of flat twin and earth construction (dumbbell) cable.
2. Smaller lengths of conductor and fewer pole top assemblies are required, as fewer poles are needed between conductors before being limited by clearances.
3. Adaptations and conversions will have to be made to serve large motor (above 7.5 horsepower), agro-industrial, and deep borehole irrigation loads.
4. In some cases, cost savings have been 85 percent. For more information, see: World Bank (2006). Sub-Saharan Africa: Introducing Low-cost Methods in Electricity Distribution Networks, ESMAP Technical Paper 104/06, Washington D.C.
5. The shield wires are insulated using standard insulators, and optical ground wires may also be used so that there is no restriction on using the shield wires for communication. For more information, see: World Bank (2006). Sub-Saharan Africa: Introducing Low-cost Methods in Electricity Distribution Networks, ESMAP Technical Paper 104/06, Washington D.C.

ANNEX 7

Summary Highlights of Ongoing Mini Grid Activities in Ethiopia—Existing and Planned

Table A7.1 Summary of ongoing mini-grid activities in Ethiopia (investment and capacity building), existing and planned

Organization (private companies names are confidential)	Stage of Development and Timeline	Size (kW installed capacity)	Source of Fuel	Business and Institutional Model	Connections (actual or projected)	Location	Investment Costing (US$)	Capacity Building Description (TA)	TA Costing (US$)	Further Information
NRECA International	Feasibility studies completed for: (i) conversion of 4 EEU diesel mini grids (ii) 5 un-electrified clustered villages[1] (iii) 4 small to micro hydro sites.[2]	(i) 4 diesel mini grids (from 70 kW to 218 kW) (ii) 5 un-electrified village clusters (from 48 kW to 129 kW (iii) small to micro hydro: from 4.7 MW to 360 kW	Hybridized diesel-PV; PV mini/micro grids; SHS, hydro	Private sector engagement	9,000 for (i) and (ii)[3]	4 clusters in SNNPR; 1 cluster in Tigray	Estimated 7,118,450 million for mini grid conversion; 18,039,300 million for solar-battery systems mini grids (activity provides TA only)	Training to EEU/UEAP on feasibility study methodology and approaches.	750,000	

GIZ EnDev Ethiopia	Site identification and selection	20 kW and above	Hydro	Community owned and managed	At least 3,000 HHs connections. More specifically, 30 villages with: (a) 100 HHs min. (b) social institutions (c) up to 10 productive use customers	Amhara, Oromia, SNNPR, and Tigray	140,976/ average per mini grid	(i) Cooperative leader's management training (ii) Operators training (iii) Capacity building for turbine manufacturers and other technical service providers (iv) Awareness creation and training of village community	10,674/ average per mini grid	The investment cost for mini grids is expected to be covered: 54% GIZ 40% Gov. & universities 7% Community
#1	Feasibility study of four sites completed; one site selected and one project under construction[4]	500 kW	Solar and biomass		123 HHs and 1,033 people	Outskirts of Addis	2.5 million	Capacity building distributed generation with renewable sources; focus on grid compatibility		Mini grid with remotely controlled EMS and AMI; Joint implementation team formed with private company, and EEU

(continued)

Table A7.1 Continued

Organization (private companies names are confidential)	Stage of Development and Timeline	Size (kW installed capacity)	Source of Fuel	Business and Institutional Model	Connections (actual or projected)	Location	Investment Costing (US$)	Capacity Building Description (TA)	TA Costing (US$)	Further Information
#2		64 plants of 100 kW each	Hybrid (solar and wind); Business model for 100 kw peak and load average of 67 kw/ 24 hour	US$0.18/kWh (comparing to current diesel cost of US$0.44)			100 million	(i) Training for operation & maintenance (ii) Improvement of EEU's hybrid technology		
#3	Business model completed in May 2017		Models for integration of micro grids, SHS and Wattcoin PAYG Platform				35 million	Design of workforce training programs		End-to-end solution for generation, distribution, and retail

Notes

1. A list of 160 unelectrified villages was provided by EEP based on indications provided REBs. NRECA geo-referenced and clustered 130 villages, out of which the 5 projects for feasibility studies were identified.
2. These components might be dropped due to high investment costs.
3. The overall number of connections for the 160 unelectrified villages, 4 EEU selected mini grids and 5 unelectrified villages projects was estimated as 38,000. However, no accurate population numbers are currently available (to be provided with the geo-spatial analysis).
4. Completion is expected in 2019.

ANNEX 8

Cross-Sectoral Program

The implementation of the NEP will ensure coordination of activities with the efforts conducted by the Ministry of Education and of Health under the Education Sector Development Programme V (ESDP V) and the Health Sector Development Programme IV (HSDP IV) for 2015–2020, respectively. Both policies are instrumental for the rise of Ethiopia to the middle-income status by 2025, as well as the achievement of the Sustainable Development Goals (SGDs), and target an increase in the number of facilities, particularly in rural areas, as well as improvements in the quality of services provided.

Access to adequate and reliable electricity provision will support these targets for schools and clinics, both those existing and to be established during the implementation of the NEP-IRM (see Table A8.1).

The NEP-IRM provides for the detailed design of an operational implementation plan in 2018 for social institutions for the achievement of the NEP targets for 2018–2025. Working in synergy with the Federal Ministries of Education, Health,[1] MoFEC, MoWIE,[2] and Regional Bureaus,[3] and the Central Statistical Agency,[4] the plan will complement the geo-referencing of social facilities[5] and assessment of performance of electricity services (both grid and off-grid) to ensure the adequate quality of educational and health services, in line with ESDP V and HSDP IV targets and activities (e.g., the Ministry of Education is about to launch an assessment for off-grid adequacy of services). Furthermore, the implementation of the NEP social infrastructure program will support coordination across ministries for the establishment of service standards and appliance compatibility (from TVs, smart phones and tables, to refrigerators).

The design of the NEP social infrastructure operational plan will build upon and be consistent with the outcomes of the geo-spatial least-cost plan, and the NEP tracking and monitoring system will leverage upon the trimester and annual performance reporting conducted by the Ministry of Education and Ministry of Health (submitted to the Federal Parliament of Ethiopia). More details on the *social institution priority implementation program* are provided in Section 2.7.

Table A8.1 Current access of education and health facilities (2015) to electricity and NEP-IRM targets, 2018–2025

Institution Type	Electricity Access[a]				
	2015	2018	2020	2022	2025
Education facilities					
Primary schools	24%	—	35%	70%	100%
Secondary schools	70%	—	90%	100%	—
Health facilities[b]					
Hospitals[c]	95%	100%	—	—	—
Health centers	57%		70%	95%	100%

Source: Federal Ministry of Education (2015) and Federal Ministry of Health and ICF International (2015).

[a] Includes: connection to a central power grid, solar power or both, or has a functioning generator with fuel. [b] Access rates are based on the findings of the Ethiopia Service Provision Assessment Plus Survey 2014 and total sample size of 1,327 health facilities. [c] Includes referral, general and primary hospitals. The access rate is a weighted average. Referral hospitals all have grid connections.

Cross-sectoral linkages: The Education Sector Development Programme V, 2015–2020

The GoE recognizes that the structural transformation of the economy and the modernization of the country, as well as demographic pressure, are increasing the demand for a fair and high quality distribution of basic education at all levels.

The application of science, technology, and innovation as the major instruments to create wealth has now taken its place as the foundation for achieving the long-term vision of transforming Ethiopia into a middle-income country. Progressively, greater shares of economic production will come from industry and manufacturing with consequent demands for middle and higher level skilled manpower.

While impressive results have been achieved since the launching of the first ESDP in 1996, the Government recognizes the need to increase the number of primary and secondary schools across the country, particularly in rural areas, where most of the Ethiopian population resides, together with the quality of education services provided. Although the presence of schools has been one of the main criteria for village and town selections by UEAP, a considerable number of primary schools (see Box A8.1) and secondary ones (as described in Section 2.4), still lack access to reliable electricity services.

Furthermore, the more isolated the facility is, the less likely it is to have access to electricity services. Although electricity access is currently prioritized for students (classrooms), the implementation of the NEP will also take into account access of teachers, which has been proven (in the experience of other countries) to be equally important to incentivize adequate quality of education services and presence of teachers on the territory, particularly in remote areas.

The implementation of the NEP and the prompt provision of electricity services to all educational facilities will, in particular, support the Government of Ethiopia's distribution of radios to primary schools, the obligation of all secondary schools to have at least one television, and ongoing pilots for Internet provision and distribution of smart phones and tablets for educational purposes, particularly in pastoral and rural secondary schools.

The Government is currently managing twelve television channels to provide secondary schools with lectures on subjects such as chemistry and physics, which have become an integral part of the education of Ethiopian students, as much as the radio provided to primary schools and communities. The Ministry of Education is also launching a pilot for the provision of Internet services and computer labs in 300 secondary schools across the country and establishing a data center headquartered in Addis Ababa[6] to further expand the educational services provided by the Government. If successful, the pilot will be replicated and expanded to integrate all secondary schools. Similarly, a pilot for the adoption of smart phones and tablets (500,000) in the emerging regions is being launched as an alternative educational tool (classes will be uploaded on the devices).

Box A8.1 Access to electricity of primary schools

Primary education is critical to the nation's development, providing on average the highest public returns to investment for the state, and is the keystone for later education and economic growth. The Government succeeded over the past years in spreading throughout the country 33,374 primary school facilities, and under the NEP priority will be directed to ensure that all of them have access to adequate and reliable electricity services.

As shown by Tables A8.2 and A8.3, the lowest rates of access to electricity services—16 and 22 percent—are inversely correlated with the number of primary school facilities and enrollment rates. Amhara, Oromiya, and SNNP are the most populous regions with the highest concentration of facilities and rate of pupils enrolled.

Under the NEP, all primary schools will be targeted for full access to adequate and reliable electricity access by 2025. Higher propriety will be given to the regions that are currently suffering from lower rates of access to electricity services (Amhara, Oromiya, and SNNP), where population size also demands a more proportional number of primary schools.

Table A8.2 Access to electricity of primary schools by region, 2015

	Population[a]	Primary Schools (#)	Primary Schools with Electricity (#)	Rate of Access (%)
Tigray	5,056,000	2,068	564	27
Afar	1,723,000	573	125	22
Amhara	20,401,000	8,251	1,348	16
Oromiya	33,692,000	13,340	2,916	22
SNNP	18,276,000	6,107	1,354	22
Somali	5,453,000	1,207	529	44
Benishangul	1,005,000	558	95	17
Gambella	409,000	275	30	11
Harari	232,000	84	72	86
Addis Ababa	3,373,000	805	768	95
Dire Dawa	440,000	106	106	100
Total	**90,078,000**	**33,374**	**7,907**	**24**

Source: Calculation based on Ministry of Education (2015). Education Statistics 2007 E.C. (2014/2015).

[a] Central Statistical Agency, projections were for 2015.

The electricity access rate for secondary school is the lowest for Afar, SNNP, and Harari with 48, 55, and 22 percent of access respectively.

Table A8.3 Net enrollment rate in primary schools, 2015

Region	Age 7–to–14 Population			1–to–8 Net Enrollment			NER %		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Tigray	504,887	492,089	996,976	530,653	518,974	1,049,627	105.1	105.5	105.3
Afar	155,721	132,567	228,288	97,438	73,250	170,688	62.6	55.3	59.2
Amhara	1,955,944	1,927,583	3,883,527	1,971,472	1,929,240	3,900,712	100.8	100.1	100.4
Oromia	3,719,401	3,665,213	7,384,614	3,454,708	3,058,515	6,513,223	92.9	83.4	88.2
Somali	476,031	406,094	882,125	410,464	305,237	715,700	86.2	75.2	81.1
SNNPR	2,004,746	1,985,632	3,990,378	2,128,202	1,911,693	4,039,895	106.2	96.3	101.2
Benishangul	104,936	101,067	206,002	99.068	84,933	184,001	94.4	84.0	89.3
Gambella	39,378	35,699	75,077	48,855	39,980	88,835	124.1	112.0	118.3
Harari	20,698	19,920	40,618	20,289	17,118	37,407	98.0	85.9	92.1
Addis Ababa	168,939	173,586	342,525	182,186	207,529	389,715	107.8	119.6	113.8
Dire Dawa	52,579	48,591	101,170	30,194	27,388	57,582	57.4	56.4	56.9
National	9,203,260	8,988,039	18,191,299	8,973,529	8,173,857	17,147,385	97.5	90.9	94.3

Source: Federal Ministry of Education, 2015.

The design of the operational plan for the connection of school facilities takes advantage from the information provided by the already geo-referenced schools across the country. From kindergarten to secondary schools, 25,000 facilities have already been geo-referenced with the support of UNICEF, where 21,557 are primary and secondary schools (out of 36,203) (see Table A8.4). CSA is expected to have mapped all facilities for the conduction of the 2017 census, during which information on the source of electricity will also be collected. Synergies will be established across institutions during the implementation of the NEP to leverage and capitalize on information already gathered.

Table A8.4 Schools geo-referenced by type and owner, 2017

Ownership	ABE Programs	Kindergarten	Primary Education	Secondary Education	Grand Total
Church	3	61	84	13	161
Community	5				5
Development Partners	9				9
Government	1,074	154	19,594	914	21,736
International community	4	25	16	8	53
Local community/public	26	52	23	3	104
Mission	2	59	88	34	183
Mosque	7	10	32	3	52
Other	5	34	27	15	81
Private		586	530	86	1,202
Undefined	33	21	83	4	1,003
Grand total	**1,168**	**1,002**	**20,477**	**1,080**	**24,589**

Source: Ministry of Education and UNICEF, 2017.

Table A8.5 The Health Sector Development Programme IV targets, 2015–2020

Priority Areas	Impact	Outcome	Coverage	Linkages
Maternal and newborn health	MMR 267/100,000	CPR = 66% Deliveries attended by skilled birth attendants = 62%	Health post 1:5,000 population Health centre 1:25,000 population Primary hospital 1:100,000 population General hospital 1:5,000,000 population	Health extension program Supply chain management Regulatory system Harmonisation and alignment Health care financing Human resource development Health information system Continuous quality improvement program Referral system
Child health	U5MR 68/1,000 IMR 31/1,000	Fully immunised = 90% Pneumonia treatment, 81%		
HIV/AIDS	HIV incidence 0.14	ART = 484,966 PMTCT = 77%		
TB	Mortality from all forms of TB = 20/100,000	TB case detection, 75%		
Malaria	Lab confirmed malaria incidence <5 per 1,000	LLITN = 39 million IRS = 77% of targeted households		
Nutrition	Wasting prevalence, 3%			

Source: Ministry of Health, HSDP IV.

Cross-sectoral linkages: The Health Sector Development Programme IV (HSDP), 2015–2020

The Program explicitly refers to the opportunity offered by the expansion of electricity services as an opportunity to expand and improve health services across the country, and sets the targets of universal access of health facilities by the end of GTP II (2020).[7]

The implementation of the NEP will ensure coordination with ongoing and planned activities under the HSDP IV (detailed summary of the Program targets is provided below), as well as among relevant Ministries to avoid duplication of efforts and maximize the impact of different sector activities. For instance, synergies could be built with the ongoing substitution of diesel generators for water pumping in rural areas with solar systems.[8]

The program implementation support study for the development of the NEP social infrastructure program will take into account the ongoing GIS mapping of 300,000 water points, which also includes mapping of schools and clinics, if present.

The HSDP IV is focused on increasing the outreach of health infrastructure across the country (increase access to health services), with a particular focus on rural areas (where most of the population resides, about 80 percent), and quality of services provided. The summary of the Program targets is provided in Table A8.5. The NEP social infrastructure program will focus on providing electricity services to the present health infrastructure, as well as coordinate activities with the construction of new facilities.

Under the HSPD, quality of health is a three-pronged approach: supply side, demand-side interventions, and regulatory aspects. Access to electricity services can play a key role to improve particularly the supply pillar, from quantity and quality of services provided (including presence on the territory of vaccines and other critical medicines), access and usage of technical appliances, and nationwide presence of skilled and motivated professionals. Furthermore, access to electricity will play an important role in supporting HSPD's focus on leveraging the ICT infrastructure present in the country to enhance accessibility and quality of care, including doctor's and nurse's training, and customer management.

Notes

1. A specific Department of Energy and Management Information System already exists within most Ministries and will be leveraged on to ensure synergies and coordination of activities, both at the central and decentralized levels.
2. New facilities are established in consultation with MoFEC, and weekly meetings are already held for this purpose with relevant Ministries.

3. Responsible for setting yearly plans for social infrastructure development, getting budget approval (based on regional quota) by the Regional Council, and construction bidding.
4. The census to be conducted in spring of 2018 by the CSA also includes questions on the source of electricity.
5. Some facilities have already been mapped by the Ministry of Education, and synergies will be established with the CSA, to leverage on the georeferencing work conducted for the 2017 census.
6. All computer labs will be connected to the data center through a cloud computing solution.
7. Federal Democratic Republic of Ethiopia—Ministry of Health, Health Sector Development Programme IV, 2015–2020, Addis Ababa.
8. A pilot is currently being financed by the African Development Bank.

ANNEX 9

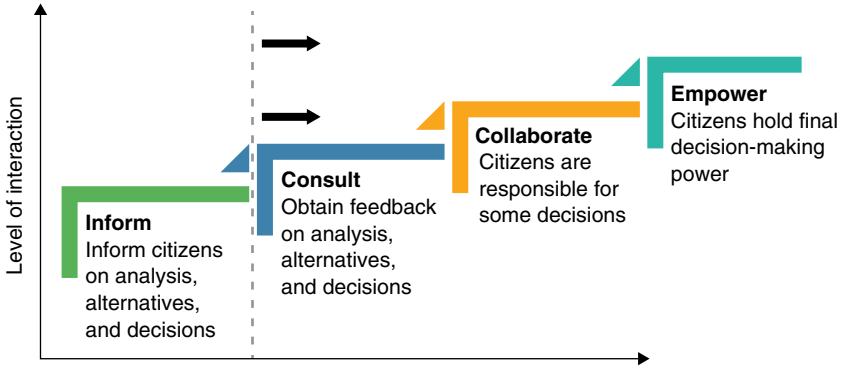
Citizen Engagement and Gender Equality Considerations in the NEP

A number of mechanisms exist for engaging with citizens. They broadly include (a) traditional consultation and feedback mechanisms, such as focus groups and satisfaction surveys; (b) participatory mechanisms, such as community scorecards, participatory planning, and budgeting; and (c) citizen-led mechanisms, such as community management or user management committees. Entry points for the energy sector span across these mechanisms—ranging from outreach and promotion activities on health and safety issues, customer interface and grievance redress, to training and capacity building for staff, local agents, and communities. Various levels of citizen engagement (CE) exist, ranging from informing citizens, on, e.g., alternatives and decisions to higher levels of CE which empowers citizens to actually make their own decisions (see Figure A9.1).

Good practice on CE exists from the Promotion of Basic Services program (PBS) launched in 2006, under which the Ethiopia Social Accountability Program (ESAP 2)[1] was established. The initiative focused on improving citizens' knowledge of their rights and responsibilities with respect to public service delivery across sectors, such as education, agriculture, and water. Actions focused on increasing social accountability through, for instance, community mobilization, access to information, and implementation, and monitoring of jointly agreed action plans for basic service delivery improvements.

The Financial Transparency and Accountability (FTA) component of PBS focused on the disclosure of budget and expenditure information to citizens. The initiative led to over 95 percent of Woredas disclosing their budget and expenditure information for the

Figure A9.1 Levels of citizen participation in decision making



Source: World Bank, 2015.

public every quarter, and a Budget Literacy Training (BLT) was conducted for about 3,000 local Government officials who have so far trained more than 2.3 million citizens on budget process, of which more than 30 percent are female. Pre-budget discussion is a recent FTA initiative which enables citizens to participate in the evaluation of budget performance and prioritization of allocations.[2]

Grievance Redress Mechanism (GRM) is another component of the PBS focusing on strengthening of the GRM system across the country through the Ethiopian Institution of Ombudsman (EIO). The awareness creation on the availability of the GRM system and its procedure through regional mass media has empowered citizens to bring their complaints to the EIO and the Woreda and regional GRM offices.

International best practices in citizen engagement

In the **Dominican Republic,** women became a driving force in the development of 'social compacts' of consumers committed to paying 95 percent of their bills and monitoring illegal connections in exchange for 24/7 electricity services. Because women are more interested in a reliable and adequate service, they were more incentivized to respect established agreements with the utility, and this served as a key factor to motivate the whole community to pay for the service received. Outcomes overall included losses dropping from 36 percent in 2010 to 27 percent in 2012, revenue increasing by 12 percent, over 1,000 monitored conflicts avoided, and customer satisfaction increasing.

In the **Tata Power Slum Electrification** effort, innovative CE and gender approaches were integrated to overcome sector-wide challenges such as lack of effective and transparent communication systems and high nontechnical losses. New connection charges were reduced with an option of paying this sum in easy 24 monthly installments, and women were appointed as "Brand Ambassadors" to raise awareness about the benefits of legal connection, and to help facilitate new connections and bill payments.

Under the Facilitating Power and Gas Market Reform initiative in **Ukraine,**[3] citizen engagement is helping build support for vital energy reforms through a two-pronged approach focused on social protection and on the public's understanding of tariff increases. Focus groups discussions revealed that tariff increases would have welfare impacts and that respondents were also unaware of the available assistance packages. Based on these findings, a TV campaign was rolled out to showcase ways citizens could pursue energy efficiency, explain social assistance packages, and advertise the Government's hotline for assistance or to get more information. As a result of these efforts—in 8 months—enrollment in the subsidy program increased from 1.25 million to 5.5 million households, and energy consumption dropped significantly.

Gender equality

Addressing inequalities between men and women in terms of access to education and decision making, rights, unpaid labor, and land and productive resources is essential for economic growth in Ethiopia. For example, in Ethiopia, 80 percent of the population resides in rural areas, and women provide the majority of the agriculture labor in these communities. In GTP I, bold measures were undertaken to ensure gender equity (see Box A9.1) and GTP II envisages strengthening the empowerment of women to ensure their active participation in the political, social, and economic processes that are taking place in the country.

Access to reliable electricity services—whether grid or off-grid—and public lighting can reduce energy poverty, and give women and men additional income-earning opportunities. Electricity supports income earning activities by extending the working day or enhancing small businesses that depend on reliable electricity. Labor-saving mechanized community services such as electric water pumping and grain grinding yield time savings and reduce the labor burden, which can allow women to set up their own small enterprises or increase leisure time. Last but not least, women can earn income from production, distribution, retail, and maintenance of solar appliances and provision of after-sales services and have proven to be effective entrepreneurs. Key features of the access to energy and gender relationship are outlined in Figure A9.2.

Box A9.1 GTP gender focus

During GTP I, various measures were undertaken to ensure equity in the distribution of economic and social gains to women across all sectors and to increase participation in leadership. As regards to the electricity sector, **3.4 million women benefited from access to alternative energy and other different relevant technologies, which reduced their workload.** Furthermore, 8.6 million women engaged in agricultural and nonagricultural activities, 6.62 million benefited from access to better credit and saving services, and 2.2 million joined small and micro enterprises.

The implementation of the NEP will take into account, as is appropriate, promoting the welfare and economic empowerment of women in line with GTP II objectives. Specific FY19/20 targets under the GTP II are:

- Women benefiting from micro and small enterprises: Target 826,004 (baseline 2,188,567)
- Average crop productivity of female headed households (quintal/ha): Target 38.22 (baseline 19)
- Women trained on different professions: Target 495,603 (baseline 1,131,570)
- Women beneficiaries of vocational adult education program: Target 1,311,658 (baseline 2,972,192)
- Organizations that institutionalized women's affairs: Target 22 (baseline 8)
- Female civil servant benefiting from higher education opportunity in emerging regions: Target 100 (baseline 100)
- Decision-making role of women at the Federal Executive bodies (percent): Target 40 percent (baseline 9.2 percent)

Figure A9.2 Gender-energy interactions

Energy Access (household energy and rural electrification)	Time poverty due to fuel collection and cooking; gender-based violence related to fuel collection; health impacts due to indoor air pollution; and lack of access to information and financing for energy services or technologies.
Electricity Infrastructure (generation, transmission, and distribution)	Displacement, inequity in land ownership during resettlement or loss of livelihood due to land acquisition; inequitable access to new jobs such as engineering, tourism, or services; gender-based violence related to migration and new roadways; and exposure (mostly for men) to hazardous work (e.g., wiring/chemicals).
Clean Energy (renewable energy, energy efficiency, and climate change)	New technology can create opportunities for employment and training; women and female-headed households have less information on energy technologies; lack of access to financing and collateral to purchase energy technologies or services; household decision making about energy use can impact behavior change or adoption of improved energy services.
Energy Policy (subsidies, tariffs, and reforms)	Female-headed households are often poorer and may suffer more from rapid tariff increases; men often have power over household budgets and decision making; men may be more affected than women by direct job losses in heavy manufacturing; women may not be included in policy consultations and decision making due to societal norms.

Source: ESMAP 2015.

International best practices in gender equality

In the **Lao Peoples Democratic Republic (PDR),** the Power to the Poor (P2P) Program provided subsidized affordable connection and indoor wiring financing mechanisms targeted to the poor who cannot afford the entire up-front costs of connection and internal wiring. Connection rates among female-headed households increased from 67 percent to 95 percent, the program proved cost effective, and it is being scaled up nationally.[4]

In **Haiti,** the U.S.-based nonprofit Earth Spark owns and operates a micro grid serving 449 homes and businesses with affordable, reliable electricity. Earth Spark has made a commitment to integrating gender equality in every aspect of their operations. Local women have been trained and employed to install parts of the grid, and 4 of the 10 members of the community management committee are women.

In **Uganda, Nigeria,** and **Tanzania,** Solar Sister is utilizing women's social networks to bring energy access to the most hard-to-reach communities. Solar Sister helps local women launch clean energy businesses and earn an income. Each entrepreneur buys the technologies from Solar Sister, then sells and delivers them—woman-to-woman—to her family, friends, and neighbors. Management staff train and recruit Business Development Associates (BDAs) who are locally hired staff and Solar Sister's link to entrepreneurs. In turn, each BDA recruits, trains, and supports a group of 1–25 self-employed women entrepreneurs (Solar Sister entrepreneurs or SSEs). Since establishing operations in 2010, Solar Sister has empowered 2,000 entrepreneurs in Uganda, Nigeria, and Tanzania, who have in turn provided solar and clean cooking solutions to over 370,000 beneficiaries.

Gender gaps: energy sector Ethiopia

In order to gain insights into key gender gaps, and possible relationships between the gender of the household head and access to electricity, an analysis was conducted for the overall energy sector by the World Bank.[5] Furthermore, cross-sectoral linkages were investigated to identify gender inequalities in education, income, employment, access to finance, and entrepreneurship, etc. The following surveys were used: Census (2007), Welfare Monitoring Survey (WMS, 2011), Demographic and Health Survey (DHS, 2011), Enterprise Survey (ES, 2015), Household Consumption and Expenditure Survey (HCES, 2011), and the Rural Socio-Economic Survey (ERSS, 2011–2012).[6]

Key findings included:

- **Varied gender gaps exist in connection rates with wealth being one proxy for access rates:** Overall 30 percent of female-headed households (FHH) versus 20 percent of male-headed households (MHH) have an electricity account (85 percent of urban households have electricity versus 5 percent of rural households) and 85 percent of those with electricity are concentrated in the highest wealth quintile. Recent MTF data also show that in urban areas electrification rates among FHH are higher than for MHH. On average, rural households are poorer than urban households, and rural FHH are poorer then rural MHH (with a reverse difference in urban areas but not statistically significant).
- **FHH rely on less clean off-grid energy sources:** Regarding off-grid alternative sources, MHH rely more on solar energy, lanterns, and electrical battery, and FHH rely on biogas, kerosene, and firewood, which can be more harmful and time consuming.
- **Women are the primary firewood and water collectors:** Rural female heads of households spend on average 39 minutes a day collecting water and 32 minutes collecting firewood or other fuel material, and male heads of households spend on average 5 minutes collecting water and 11 minutes collecting firewood. Spouses living in MHH, spend 50 minutes collecting water and 41 minutes collecting firewood.
- **Female-owned firm's experience and adoption of energy services is different:** Female participation in entrepreneurship is lower than for men, and female entrepreneurs face more obstacles than males to run their businesses (less access to credit, more delays to connect to the grid, etc.). Female owned firms rely less on an alternative source of energy to run their business: only 38 percent of firms with female owners own a generator versus 44 percent with male owners.
- **Men are more literate than women:** 71 percent of young males and 57 percent of adult males are literate vs. 67 percent of young females and 40 percent of adult females. Male heads of households are more literate (41 percent) than female heads of households (21 percent).
- **Low levels of women in science, technology, engineering, and mathematics (STEM):** Only 12 percent of women pursue research in natural sciences, 7 percent in engineering and technology, 26 percent in medical sciences, and 8 percent in agricultural sciences.

Notes

1. The Ethiopia Social Accountability Program Phase 2 (ESAP 2) is part of the Promotion of Basic Services (PBS) program which is implemented by the Government at regional, woreda, and kebeles levels. Financed through a World Bank-managed multi-donor trust fund, ESAP 2 is guided and supervised by a steering committee formed of representatives of the Government, civil society, and development partners. A management agency outside the Ethiopian Government structure has been established for ensuring efficient implementation of ESAP 2. The responsibilities of the management agency are the overall program coordination and provision of capacity development and training, technical guidance, and support of the implementing civil society partners.
2. This took place in 37 percent of Woredas with 46 percent of female participation in 2016 and will continue to expand to other Woredas in the coming years. The proportion of citizens who responded that they know about their budget increased from 9 percent in 2009 to 42 percent in 2016.
3. http://wbes922r.worldbank.org/citizen_engage/citizen-engagement-ukraine-helps-build-support-vital-energy-reforms
4. World Bank (2012). Lao PDR Power to the People: Twenty Years of National Electrification, Washington D.C.
5. WBG Draft Ethiopia Gender and Energy Gap Analysis 2017.
6. Other reports used to complement these data sources.

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