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The World Bank

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Report No: PAD2041

INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED CREDIT

IN THE AMOUNT OF EUR 42.7 MILLION
(US$45.55 MILLION EQUIVALENT)

AND

PROPOSED GRANT

IN THE AMOUNT OF SDR 3.2 MILLION
(US$4.34 MILLION EQUIVALENT)

TO THE

REPUBLIC OF NIGER

FOR A

NIGER SOLAR ELECTRICITY ACCESS PROJECT

May 16, 2017

Energy and Extractives Global Practice
Africa Region

CURRENCY EQUIVALENTS
(Exchange Rate Effective March 31, 2017)

Currency Unit =	EUR
US$1 =	EUR 0.93624192
US$1 =	SDR 0.73700114

FISCAL YEAR
January 1 - December 31

ABBREVIATIONS AND ACRONYMS

AFD	*Agence Francaise de Développement* (French Development Agency)
AHA	*Amenagements Hydro Agricole* (Irrigation Schemes)
ANPER	*Agence Nigérienne de Promotion de l'Electrification en milieu Rural* (Nigerien Agency for the Promotion of Rural Electrification)
ARSM	*Agence de Regulation et Supervision de Microfinance* (National Supervisory Agency of Microfinance)
BCEAO	Banque Centrale des Etats de l'Afrique de l'Ouest (Central Bank of West African States)
BEEEI	Bureau d'Evaluation Environnementale et des Etudes d'Impacts (Environmental Evaluation and Impact Studies Office)
CDM	Clean Development Mechanism
CGP	*Cellule des Grands Projets* (Large Projects Unit)
CNES	*Centre National d'Energie Solaire* (National Center for Solar Energy)
CPS	Country Partnership Strategy
DGI	*Direction Générale des Impôts* (Directorate General of Taxes)
DGOFR	*Direction Générale des Opérations Financières et des Réformes* (Directorate General of Financial Operations and Reforms in the Ministry of Finance)
ECREEE	Economic Community of West African States Center for Renewable Energy and Energy Efficiency
EIRR	Economic Internal Rate of Return
EPC	Engineering, Procurement, and Construction
ESDP	Energy Sector Directions Paper
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
FCFA	*Franc CFA* (CFA Franc)
FIRR	Financial Internal Rate of Return
FM	Financial Management
FSDS	Financial Sector Development Strategy
GBV	Gender-based Violence
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoN	Government of Niger
GRS	Grievance Redress Service
IDA	International Development Association

IEC	International Electrotechnical Commission
IMF	International Monetary Fund
kW	Kilowatt
LV	Low Voltage
M&E	Monitoring and Evaluation
MFI	Microfinance Institution
MNO	Mobile Network Operator
MoE	Ministry of Energy
MoF	Ministry of Finance
MTF	Multi-Tier Framework for Energy Access
MW	Megawatt
NELACEP	Niger Electricity Access Expansion Project
NES	National Electrification Strategy
NESAP	Niger Solar Electricity Access Project
NGO	Nongovernmental Organization
NIGELEC	*Sociéte Nigerienne d'Electricité* (Nigerien Electricity Society)
NPV	Net Present Value
O&M	Operations and Maintenance
ONAHA	*Office National des Aménagements Hydro Agricoles* (National Office for Irrigation Schemes)
OM	Operations Manual of the Line of Credit
PASE-Safo	*Programme d'Accès aux Services Energétiques pour la Commune rurale de Safo* (Energy Access Program for the Rural Commune of Safo)
PC	Project Coordinator
PDES	*Plan de Développement Economique et Social* (Plan for Social and Economic Development)
PEFA	Public Expenditure and Financial Accountability
PFI	Participating Financial Institution
PFM	Public Financial Management
PIM	Project Implementation Manual
PIU	Project Implementation Unit
PP	Procurement Plan
PPA	Project Preparation Advance
PPP	Public-Private Partnership
PSC	Project Steering Committee
PSE	Private Sector Enterprise
PV	Photovoltaic
RAP	Resettlement Action Plan
REIF	Rural Electrification Implementation Framework
RPF	Resettlement Policy Framework
SAHFI	*Société Sahélienne de Financement* (Niger's National Credit Guarantee Agency)
SCD	Systematic Country Diagnostic
SDG	Sustainable Development Goals
SE4ALL	Sustainable Energy for All
SHS	Solar Home Systems
SME	Small and Medium Enterprise
SWP	Solar Water Pumping
TA	Technical Assistance

UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WAPP	West African Power Pool
WAEMU	West African Economic and Monetary Union

Regional Vice President:	Makhtar Diop
Country Director:	Soukeyna Kane
Senior Global Practice Director:	Riccardo Puliti
Practice Manager:	Charles Cormier
Task Team Leader(s):	David Vilar Ferrenbach

BASIC INFORMATION

Is this a regionally tagged project?	Country(ies)	Financing Instrument
No		Investment Project Financing

[ ] Situations of Urgent Need of Assistance or Capacity Constraints

[✔] Financial Intermediaries

[ ] Series of Projects

Approval Date	Closing Date	Environmental Assessment Category
07-Jun-2017	31-Jan-2024	B - Partial Assessment

Bank/IFC Collaboration
No

Proposed Development Objective(s)

The objective of the project is to increase access to electricity through solar energy in rural and peri-urban areas of the Republic of Niger.

Components

Component Name	Cost (US$, millions)
Component 1:Market Development of Stand-alone Solar Systems	7.00
Component 2: Rural Electrification through Service-based Solar Hybrid Mini-grids	10.00
Component 3: Solar PV Hybridization of Isolated Thermal Mini-grids and Expansion of Access	25.00
Component 4: Implementation Support and Technical Assistance	7.89

Organizations

Borrower : Government of the Republic of Niger

Implementing Agency :	Société Nigerienne d'Electricité (NIGELEC) Agence Nigérienne pour la Promotion de l'Electrification Rurale (ANPER) Direction Générale des Opérations Financières et des Réformes (DGOFR) - Ministry of Finance

Safeguards Deferral

Will the review of safeguards be deferred?

[ ] Yes [X] No

PROJECT FINANCING DATA (IN USD MILLION)

[ ] Counterpart Funding	[ ] IBRD	[✔] IDA Credit [ ] Crisis Response Window [ ] Regional Projects Window	[✔] IDA Grant [ ] Crisis Response Window [ ] Regional Projects Window	[ ] Trust Funds	[ ] Parallel Financing

Total Project Cost:	Total Financing:	Financing Gap:
49.89	49.89	0.00
	Of Which Bank Financing (IBRD/IDA):	
	49.89	

Financing (in US$, millions)

Financing Source	Amount
International Development Association (IDA)	45.55
IDA Grant	4.34
Total	**49.89**

Expected Disbursements (in US$, millions)

Fiscal Year	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.00	2.70	12.00	13.50	12.50	5.05	2.50	1.75
Cumulative	0.00	2.70	14.70	28.20	40.70	45.75	48.25	50.00

INSTITUTIONAL DATA

Practice Area (Lead)

Energy & Extractives

Contributing Practice Areas

Agriculture
Finance & Markets
Water

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

Gender Tag

Does the project plan to undertake any of the following?

a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF

Yes

b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment

Yes

c. Include Indicators in results framework to monitor outcomes from actions identified in (b)

Yes

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	Substantial
2. Macroeconomic	Substantial

3. Sector Strategies and Policies	Substantial
4. Technical Design of Project or Program	High
5. Institutional Capacity for Implementation and Sustainability	High
6. Fiduciary	High
7. Environment and Social	Moderate
8. Stakeholders	Moderate
9. Other	Low
10. Overall	High

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

[ ] Yes [✔] No

Does the project require any waivers of Bank policies?

[ ] Yes [✔] No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✔	
Natural Habitats OP/BP 4.04		✔
Forests OP/BP 4.36		✔
Pest Management OP 4.09		✔
Physical Cultural Resources OP/BP 4.11	✔	
Indigenous Peoples OP/BP 4.10		✔
Involuntary Resettlement OP/BP 4.12	✔	
Safety of Dams OP/BP 4.37		✔
Projects on International Waterways OP/BP 7.50		✔
Projects in Disputed Areas OP/BP 7.60		✔

Legal Covenants

Sections and Description

The Recipient shall cause ANPER to acquire and make functional, not later than ninety (90) days from the Effective Date, a multi-donor and multi-project accounting system. (Schedule 2, Section V.1 of the Financing Agreement.)

Sections and Description

The Recipient shall cause the ANPER PIU, not later than one hundred and twenty (120) days from the Effective Date, to (i) appoint an independent auditor, and (ii) to recruit an additional accountant to support the ANPER PIU. (Schedule 2, Section V.2 of the Financing Agreement.)

Sections and Description

The Recipient shall, in conformity with Article 69 of the Electricity Law 2016 and not later than one-hundred and twenty (120) days from the Effective Date, adopt the Inter-Ministerial Decision, and ensure that the Inter-Ministerial Decision is implemented through any necessary acts required to be adopted by the fiscal administration and domestic customs authorities. Any amendments to the Inter-Ministerial Decision during the period of implementation of the Project will be made in form and substance satisfactory to the Association. (Schedule 2, Section V.3 of the Financing Agreement.)

Sections and Description

The Recipient shall ensure that the Project Implementing Entities, maintain and cause to be maintained, during the period of implementation, the following, with terms of reference and resources satisfactory to the Association, and with qualified and experienced staff in adequate numbers, to carry out their respective responsibilities related to the implementation of the Project: (a) the ANPER Project Implementation Unit established within ANPER, adequately staffed, and responsible for the day-to-day operations of the Project, including oversight of the planning, provision of specialized technical support, procuring service providers, coordination with other authorities, carrying out of fiduciary, safeguards and monitoring oversight of the project as well as preparation of reports and the AWPB for Part 2 and Part 4 (except Part 4.2) of the Project. In addition, the ANPER PIU will consolidate the AWPB for the entire project for submission to and approval by the World Bank. The ANPER PIU will be headed by a project manager and will be supported by the following officers: environmental and social safeguard specialist, procurement specialist, financial officer, accountant, rural electrification specialist, a business development specialist, a monitoring and evaluation specialist and an independent auditor for the entire Project. (b) that the unit Cellule des Grands Projets at NIGELEC acts as NIGELEC Project Implementation Unit responsible for the day-to-day operations of the Project, including oversight of the planning, provision of specialized technical support, procuring service providers, coordination with other authorities, carrying out of fiduciary, safeguards and monitoring oversight of the project as well as preparation of reports and the AWPB for Part 3 and Part 4.2 of the Project, to be submitted to ANPER PIU for consolidation. The NIGELEC PIU will be supported by the following officers: environmental and social safeguard specialist and an accountant. (Schedule 2, Section I.2 of the Financing Agreement.)

Conditions

Type	Description
Effectiveness	The Recipient and each Project Implementing Entity has adopted the Project Implementation Manual satisfactory to the Association in accordance with Section I.B of Schedule 2 to the Financing Agreement. (Article V, 5.01(b) of the Financing Agreement)
Effectiveness	The DGOFR PIU, the ANPER PIU and the NIGELEC PIU, each has been established in accordance with Section I.A. of Schedule 2 to the Financing Agreement. (Article V, 5.01(c) of the Financing Agreement)
Effectiveness	Subsidiary Agreements have been executed on behalf of the Recipient and each of the Project Implementing Entities, in form and substance satisfactory to the Association. (Article V, 5.01(a) of the Financing Agreement)
Disbursement	Notwithstanding the provisions of Part A of this Section, no withdrawal shall be made: (a) for payments made prior to the date of this Agreement except that withdrawals up to an aggregate amount not to exceed EUR 1,000,000 may be made for payments made prior to this date but on or after May 1, 2017 for Eligible Expenditures under Categories 2 and 4. (Schedule 2, Section IV.B.1(a) of the Financing Agreement)
Disbursement	Notwithstanding the provisions of Part A of this Section, no withdrawal shall be made: (b) for payments under Category 1 unless the Recipient has furnished evidence satisfactory to the Association that the Recipient has established the DGOFR PIU, with staff selected competitively with terms of reference, qualifications, and relevant experience satisfactory to the Association. (Schedule 2, Section IV.B.1(b) of the Financing Agreement)
Disbursement	Notwithstanding the provisions of Part A of this Section, no withdrawal shall be made: (c) for payments under Category 1 unless the Recipient has furnished evidence satisfactory to the Association that the Recipient, in conformity with the Article 69 of the Electricity Law 2016, has approved, enacted and published a Finance Law providing for tax and customs duties exemptions of solar energy equipment and material as defined in the Inter-Ministerial Decision. (Schedule 2, Section IV.B.1(c) of the Financing Agreement)
Disbursement	Notwithstanding the provisions of Part A of this Section, no withdrawal shall be made: (d) for payments under Category 2 and 3 unless the Recipient has adopted the Rural Electrification Implementation Framework, in form and substance

	satisfactory to the Association, and has provided evidence that the Rural Electrification Implementation Framework has been duly signed, approved, and published. (Schedule 2, Section IV.B.1(d) of the Financing Agreement)
Type Effectiveness	Description The Subsidiary Agreements have been duly authorized or ratified by the Recipient and each of the Project Implementing Entities, and is legally binding upon the Recipient and each of the Project Implementing Entities in accordance with its terms. (Article V, 5.02 (a) of the Financing Agreement)

PROJECT TEAM

Bank Staff

Name	Role	Specialization	Unit
David Vilar Ferrenbach	Team Leader(ADM Responsible)	Energy Specialist	GEE07
Prosper Nindorera	Procurement Specialist(ADM Responsible)	Procurement	GGO07
Sylvain Auguste Rambeloson	Procurement Specialist	Procurement	GGO07
Josue Akre	Financial Management Specialist	Financial Management	GGO26
Affouda Leon Biaou	Team Member	Rural Electrification	GCCFM
Alain Ouedraogo	Team Member	Rural Electrification	GEE07
Angela Maria Lopes Delfino	Counsel	Legal	LEGEN
Arsh Sharma	Team Member	Financial Analayst	GEE08
Bougadare Kone	Safeguards Specialist	Environment	GEN07
Faly Diallo	Team Member	Loan and disbursement	WFALA
Julie Rieger	Counsel	Legal	LEGAM
Karidjatou Kragbe	Team Member	Assistant	GEE07
Manuel Luengo	Team Member	Energy Specialist	GEE08
Maria Ayuso Olmedo	Team Member	Energy Specialist	GEE07
Natalie Tchoumba Bitnga	Team Member		GEE07
Paivi Koskinen-Lewis	Safeguards Specialist	Social	OPSPF

Peter McConaghy	Team Member	Financial Sector	GFM05
Raihan Elahi	Team Member	Lighting Africa	GEE01
Thomas Flochel	Team Member	Economist	GEEES

Extended Team

Name	Title	Organization	Location
Lucia Fort	Consultant		
Susan V. Bogach	Consultant		

NIGER
NIGER SOLAR ELECTRICITY ACCESS PROJECT

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I. STRATEGIC CONTEXT

A. Country Context

1. **Niger is a large, landlocked, and mostly arid country in Western Africa.** With a total land area of 1,267,000 km^2, Niger is the sixth biggest country in Africa and the biggest in West Africa. It is divided into eight regions, 63 departments, and 266 communes. The Sahara Desert, mainly in the north, covers two-thirds of the land area. About three quarters of the population is concentrated along the Niger River in the west and along the southern border with Nigeria, which is 1,500 km in length. Conversely, some parts of the north are almost uninhabited with the exception of a few smaller cities along the route to Algeria. In 2016, the population was estimated at 20.7 million, of which the majority, about 82 percent, lived in rural areas. The population is growing rapidly, at a rate of 3.9 percent per year, and is expected to reach 36 million inhabitants by 2030.

2. **Niger is rebuilding its democratic governance mechanisms.** Since independence in 1960, there have been seven regimes and four military coups. The latest coup, in 2010, was followed by the restoration of constitutional order in 2011. Since then, the Government of Niger (GoN) has been pursuing measures to combat organized crime and terrorism and to promote the safety and property rights of its citizens, as the country is located at the heart of a turbulent region marked by political and religious violence in northern Nigeria, Tuareg separatist and armed Islamist movements in northern Mali, and state collapse in southern Libya. Military and law enforcement agencies have created new crisis response units, and border security has been strengthened in close coordination with regional and international partners. As a result, unrest in Niger's tribal areas and the threat posed by the conflict in neighboring Mali have diminished. Nevertheless, the country continues to face significant risks from domestic and regional instability, as well as organized crime and transnational terrorism. The rise of Boko Haram in Nigeria and the recent expansion of its operations to neighboring countries, including Niger, are of particular concern.

3. **Poverty, though declining, remains high.** The incidence of poverty declined from 53.7 percent in 2005 to 44.5 percent in 2014. However, the absolute number of people living in poverty has increased by 1.8 million because the annual population growth rate of 3.9 percent between 2001 and 2012 was four times the annual rate of poverty reduction. In 2014, 8.2 million people were poor, with the majority living in rural areas where food insecurity is high. Human development indicators are also low. The average level of education is 1.4 years; only 52 percent of children have received a complete set of vaccinations, and 44 percent of children under five are stunted. Niger was ranked 187 out of 188 countries on the 2015 United Nations Human Development Index. The country's low per capita gross domestic product (GDP) of US$895 (constant 2011 US$) in 2015 made it one of the poorest nations in the world.

4. **The economy grew over the past decade and a half, but sustained growth remains a challenge.** Growth reached 11.1 percent in 2012, 6.9 percent in 2014, and 3.5 percent in 2015. Recent growth occurred under favorable circumstances with respect to weather, commodity prices, and security. The main sectors supporting economic growth have been rain-fed agriculture and animal husbandry, which together account for 40 percent of GDP and employ more than 80 percent of the workforce. Agricultural productivity is expected to remain low due to the limited mechanization in farming techniques. Climate variability and climate change effects are becoming more pronounced. The contribution of extractive

industries such as uranium, gold, coal mining and, recently, crude oil production, has increased (4 percent of GDP in 2007 to 9 percent in 2016). The financial sector, led by banking and microfinance, has grown substantially over the past six years and has supported economic expansion (private credit to GDP is 14.8 percent in 2016). Outstanding loans from commercial banks increased from 18 percent of GDP in 2005 to 31 percent in 2015. External security threats are putting an increasing strain on public finances. Rapid population growth increases the vulnerability of the economy, placing stresses on natural resources (fertile land, water, and forests) that increase with time. Looking ahead, an economic slowdown is avoidable provided there is a concerted effort to diversify the economy and increase productivity.

5. **While the banking sector is generally considered well-regulated and stable, it is developing rapidly and there are moderate signs of stress.** In its most recent Article IV consultation assessment published in March 2017, the International Monetary Fund (IMF) notes that the banking sector is adequately capitalized and efficient, relative to other countries in the region. At end September 2016, indicators suggest that capital adequacy ratios for most banks remain above the regulatory threshold of 8 percent. Although gross non-performing loans are at reasonable levels (18.5 percent of total loans at end-September 2016), they have risen slightly and are a source of concern for two banks. The sector has experienced deteriorating systemic liquidity (from *Franc CFA* (FCFA) 4 billion in 2014 to FCFA -83 billion in 2015).[1] Refinancing arrangements with the Central Bank, *la Banque Centrale des Etats de l'Afrique de l'Ouest (BCEAO),* assists in providing liquidity to banks. Impending regulatory changes are also placing pressure on liquidity positions. The minimum capital for banks is set to increase from FCFA 5 billion to FCFA 10 billion in June 2017. Rising non-performing loans are in part due to deteriorating macroeconomic conditions related to declining commodity (oil and uranium) prices and economic stress in neighboring Nigeria, Niger's largest export partner. Similarly, payment delays of large government-contracts are common and put further stress on on-time repayment of enterprise loans.

6. **Niger's financial sector has grown in recent years but access to finance remains a constraint.** The level of financial depth, as measured by the ratio of broad money to GDP, is among the lowest in the world, at 26 percent in 2015 compared to an average of 37 percent for countries in Sub-Saharan Africa. Financial access and inclusion remain key issues across the continent. According to 2014 Findex data, 6.7 percent of the population in Niger has access to a transaction account. While this is a significant improvement from 2011, when only 1.5 percent of adults had an account, it remains far below the 34 percent average in the Sub-Saharan Africa. According to the World Bank Investment Climate Assessment data, 70 percent of companies in Niger consider access to financing as one of their major constraints to growth. According to the survey results, the cost of credit is 2.2 percent higher for Small and Medium Enterprises (SME) than for large companies and just under 30 percent of firms have a loan or drawdown a line of credit. Loans to SMEs are constrained by an insistence on physical collateral (usually land and representing over 100 percent of the value of the loan), underdeveloped procedures related to credit risk quantification and asset-liability management, nascent credit information systems, and the dominance of short-term capital (12 months).

7. **Women in Niger face challenges in health, education, and access to economic opportunities.** Social and cultural norms dictate the specific activities women and men can perform, and these norms work to restrict women's economic opportunities. Niger is a predominantly rural country where the majority of the population engages in subsistence agriculture, pastoralism, or a combination of the two.

[1] Based on 2015 Banking Commission report.

Consequently, women's economic opportunities are directly linked to access to land, agricultural production, and commercial activities. Women largely engage in unpaid labor and their restricted mobility is an impediment to their engagement in productive activities, such as selling their products outside the home or taking their animals to pasture or to the market. Moreover, women cannot legally get a job without permission from their husbands.

8. **Electricity access is a critical enabler of economic diversification and growth.** Recent assessments[2] have concluded that electricity access can assist transformative progress in many dimensions of human development (education, health care, access to water, essential communications, and information), as well as in access to financial services and opportunities for income generation (in particular, in the agricultural sector) and productive uses. Estimates suggest that the alleviation of power constraints in Niger could add up to 1.5 percentage points to per capita growth if generation capacity and national access rates—which as of today are among the lowest in the region—were increased.[3] These impacts occur directly or through economic multiplier effects. On the other hand, inadequate electricity access can have adverse effects on the productivity of manufacturing and commerce. In Niger, as described in its Economic and Social Development Plan (2012–2015), one critical element underpinning future sustainable economic growth is the improvement of electricity access to support a competitive and diversified economy. Women in particular can benefit because they are the main managers of energy within the household. Providing access to electricity for public facilities would improve the delivery of basic health and education services, which can contribute to more girls going to school and better reproductive health services for women. Access to modern energy, such as electricity, can improve health in the household by reducing fire hazards and inhalation of smoke from kerosene lamps. Access to electricity for small and micro businesses owned by women could also help increase their productivity and sustainability.

B. Sectoral and Institutional Context

9. **Niger's electricity access rate of 10 percent is far below Sub-Saharan Africa's average rate of 31 percent and is one of the lowest in the region.** The overall rate masks significant disparities between urban and rural areas. Electricity access is below 1 percent in rural areas, while urban access rate varies between 20 percent and 40 percent in smaller cities and stands at around 50 percent in Niamey. In 2016, nationwide aggregated peak electricity demand was only about 230 megawatt (MW), excluding mining operations.

10. **The electricity system in Niger is small, fragmented, and dependent on imports from Nigeria.** Niger's power system comprises four grids that are interconnected with Nigeria, which sells electricity at low cost; one grid supplied by a coal plant operated by Sonichar (a private company); and a number of diesel-based isolated grids. Decentralized mini-grids operated by the national utility supply 82 centers with electricity service levels ranging from continuous power to a few hours of power per day, using small diesel generators at prohibitive costs.

11. **Off-grid electricity access in Niger has been limited, based mostly on unsustainable delivery models.** While the total installed capacity of solar photovoltaic (PV) soared from 416 Kilowatt (kW) in

[2] Bhatia, Mikul; Angelou, Niki. 2015. Beyond Connections: Energy Access Redefined. ESMAP Technical Report;008/15. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/24368 License: CC BY 3.0 IGO

[3] Niger Constraints Analysis, Millennium Challenge Corporation, January 2014.

2000 to about 5.2 MW (located in 2,311 sites) by 2014, the *Centre National d'Energie Solaire* (National Center for Solar Energy - CNES) has estimated that the largest share of installed capacity, at 39 percent, is dedicated to telecommunications, while 15 percent is for households. Most off-grid initiatives have focused on stand-alone solar PV systems that meet the lowest tiers of electricity service, providing up to four hours of electricity per day but, so far, these have not included adequate measures to build the technical and commercial capacity of markets (availability of technicians and spare parts and product quality guarantee) nor a sustainable revenue stream to ensure maintenance and/or renewal of the systems.

12. **The GoN has acted to improve the institutional and legal framework in the power sector, but further work is required, specifically for off-grid electrification.** The Ministry of Energy (MoE) is responsible for modern energy access policies and overseeing the implementation of access programs. *Sociéte Nigerienne d'Electricité* (NIGELEC), the state-owned power utility, is the key driver of on-grid access. It operates most of Niger's grid systems and provides electricity to 275,000 customers (2016). NIGELEC used to have a monopoly in generation, transmission, and distribution, but the market has been liberalized under the Electricity Act of May 2016 allowing the involvement of the private sector. The Electricity Act also refers to the establishment of (a) a new energy sector regulator, the *Autorité de Régulation du Secteur de l'Energie au Niger* (Energy Sector Regulatory Authority of Niger), created in December 2015; and (b) a rural electrification agency, the *Agence Nigérienne de Promotion de l'Electrification en milieu Rural* (Nigerien Agency for the Promotion of Rural Electrification, ANPER), created in May 2013 and set up in December 2014, for which a number of decrees regarding its implementation have already been issued. In addition to these institutions, the CNES played an important role in manufacturing and disseminating solar technologies and today plays the role of promotion of renewable energy and technical control of equipment. The enabling policy and regulatory frameworks for rural off-grid electrification in Niger are yet to be developed. These are required to specify aspects of the operation of rural electricity systems and the participation of the private sector, such as tariffs/prices, licensing, quality standards, and a bidding strategy that could attract private sector investments for larger infrastructure, such as mini-grids.

13. **To address fast-growing electricity demand and heavy reliance on electricity imports from Nigeria, the GoN and NIGELEC have embarked on major power generation investments to enable expansion in well-populated areas.** Imports of cheap electricity from Nigeria have enabled strong growth in electricity consumption during the last decade. Imports from Nigeria reached 86.5 percent of total supply in 2010, but declined to 76.4 percent in 2015 because demand growth exceeded the capacity of the transmission line from Nigeria. Over the period 2001–2015, electricity consumption grew at 16 percent per year, much faster than GDP growth of about 4 percent, and it is expected to grow more than 10 percent during the period 2015–2020,[4] albeit from a low consumption base. To meet this increase, an ambitious generation plan for 2016–2027 has been developed. This plan includes the following four major projects: (a) Gorou Banda dual thermal power plant (100 MW, 2017); (b) Kandadji hydroelectric plant (130 MW, 2023); (c) Salkadamna coal power plant (200 MW up to 600 MW, 2023); and (d) a new interconnection line with the West African Power Pool (WAPP) system to increase imports from Nigeria (400 MW, 2021), which is referred to as the Northcore Project. The Gorou Banda plant has been commissioned in 2017 and will provide enough power to meet the demand increase for the next five years, although at a high generation cost. In the following five years, until cheaper options are available (hydro, coal, or WAPP imports), all the additional demand will be covered by diesel/heavy fuel

[4] *Plan d'Affaires*, NIGELEC, 2016–2027.

oil based power generation. In this context, up to 100 MW solar PV generation is considered to complement thermal generation. Two grid-connected solar PV projects, 30 MW in Gorou Banda and 30 MW in Guessel Bodi, have been identified and are under preparation.

14. **The GoN plans to accelerate on- and off-grid electrification to provide a spectrum of service levels.** The GoN is developing a National Electrification Strategy (NES) that will ramp up access in urban, peri-urban, and rural areas. The NES, supported by the IDA-funded Niger Electricity Access Expansion Project (NELACEP, P153743), is expected to be finalized at the end of 2017 and will outline the technical, financial, and institutional requirements to achieve the ambitious target of 60 percent access by 2027. The NES will define the 'rules of the game' for expanding electricity access from the highest level of service using extension of the main grids to the middle level using isolated mini-grids, and the most basic level for dispersed populations using individual solar systems (pico-PV and solar home systems [SHS]). The NES will include quality standards and cost-recovery tariffs that will be compatible with people's ability to pay (possibly considering subsidy mechanisms to assist the poorest with affordability).

15. **The NES will include a planned, systematic approach to effective geo-spatial implementation of electrification, aiming to realize the GoN's ambitious goal of 60 percent access by 2027.** A prioritized, geo-spatial electrification plan will be prepared for investments needed in five-year phases over the next 20 years. The plan will define investments needed to provide electricity through parallel efforts involving three major technology approaches: (a) densification and extension of the existing national grid to provide the highest level of service; (b) establishment of new, isolated mini-grids powered by renewable energy and/or diesel generation to provide the next level of service to populations with sufficient density and demand; and (c) provision of off-grid electrification using independent, renewable energy systems, mainly solar systems, for dispersed populations or those who cannot afford electricity connections or live in areas where electricity service is unreliable. In geo-spatial terms, these three types of service areas will radiate outward from densely populated areas served by the national grid. Technical geo-spatial planning will encompass defining electricity demand, service quality levels, and technology options to reach populations in various areas on a least-cost basis. Preliminary analysis indicates that 70 percent of the population, living mainly in the south, could be served with grid extension and densification, while 15 percent would have access to electricity through isolated mini-grids (including solar-diesel hybrid mini-grids), and the remaining 15 percent, dispersed throughout the country, would have basic service for light and cell phone charging through stand-alone solar systems (including solar home and pico-PV systems). When demand grows, the geospatial analysis will provide guidance on whether capital investments need to be made for grid-based solutions.

Solar and off-grid electricity market

16. **There is a significant demand for access to modern, off-grid electricity services in the agriculture sector, where solar pumps for irrigation could increase agricultural productivity of key food crops and livestock.** Where water is available, sustainable irrigation can make a critical difference. It reduces dependence on the weather, as multiple harvests are possible during the year, and may reduce under-employment and land pressure. Solar water pumping (SWP) is poised to grow tremendously over the next decade due to declining costs, high reliability, and increased commercial availability in rural areas of less developed countries. SWP systems are reliable and have become much more affordable due to decreases in costs of PV modules—system costs have dropped by 80 percent since 2009 and many systems installed 20 or more years ago are still operational. The off-grid water pumping market in Niger consists mainly of farms and water providers that use water pumps for crop

irrigation. Irrigation is by far the largest market and needs to be broken down into medium to large commercial farms and smallholder farms. Overall, the annual market size, if consumer financing is made available, is estimated at around US$30 million for smallholder farmers, US$10 million for commercial farms, and around US$10 million for public irrigation plots. Without consumer financing, the current integrated solar pumping kits are not affordable to Nigerien smallholder farmers and, consequently, current distribution of such kits is mainly through development programs.

17. **With respect to the most basic level of off-grid electricity access for lighting and phone charging (Tiers 1 and 2),[5] pico-PV systems and solar lanterns have been introduced recently in Niger, but barriers impede their market development.** Some key market players exist, but penetration of these systems is modest. In general, the systems sold by retailers are generic and of poor quality. The adoption of these stand-alone solar systems is impeded by several barriers including: (a) an import tax of 52 percent that significantly increases the final retail price; (b) limited access by solar companies and retailers to credit from commercial banks that charge high interest rates and require high collateral/guarantees; (c) a lack of quality assurance mechanisms and technical standards for solar systems leading to the proliferation of poor quality systems and consumer mistrust; (d) weak distribution links all along the solar system supply chain, from the importer to the distributor and retailer; and (e) a lack of familiarity of consumers with the technologies leading to an inability to differentiate product quality. While the potential for wider adoption of such technologies needs to be fully assessed, removing market barriers may significantly contribute to increasing access to the lowest tier of electricity.

18. **Niger's potential household electricity demand that can be served through the solar off-grid market is a function of the ability of households to pay for the systems.** Given the low-income levels in Niger, the private household market depends on the ability of households to obtain consumer finance from solar providers or banks and MFIs. Without consumer financing, the annual market for sales of solar lanterns and SHS is estimated at around US$9 million, representing sales of around 600,000 systems, mainly basic solar lanterns. Consumer financing would unlock an additional US$34 million of sales, reach an additional 350,000 households, and raise levels of energy access to include higher capacity SHS that provide more services, including TV.[6]

19. **Private sector companies in Niger dedicated to distributing and installing independent solar systems have not yet reached scale.** To date, supply-side activities have consisted almost entirely of around 20 Engineering, Procurement, and Construction (EPC) firms installing and maintaining solar installations in response to tenders by large institutional clients, such as nongovernmental organizations (NGOs), development finance institutions, and the GoN. These tenders cover a broad range of activities, from solar irrigation to solar street lighting, to community electrification projects, but to date few

[5] The Multi-tier Framework for Energy Access, developed by the Global Tracking Framework of Sustainable Energy for All (http://trackingenergy4all.worldbank.org), moves beyond the traditional binary way of defining electrification to adopt a tiered definition (Tier 1 to Tier 5) based on attributes of energy service total hours of service, as well as hours of service during the night (which may require energy storage). Tier 1 is defined to have access to basic applications such as lighting of 1,000 lmhr/day for at least four hours a day and one at night. Tier 2 is defined to have access to applications such as lighting, air circulation, television, and phone charging for at least four hours a day and two at night.

[6] Assumptions used to calculate the annual demand include: (i) consumers, by income deciles, will purchase the most expensive product they can afford based on current expenditures for lighting; (ii) average monthly household expenditure for traditional lighting equates to willingness-to-pay for solar products; and (iii) 50 percent of grid-connected households are also prospective buyers of solar systems as grid backup options.

businesses have attempted to supply solar products directly to end-consumers (for example, households, farmers, communities) in a scalable, market-driven way. A few companies have been successful either in the solar business or in the provision of basic services in rural areas. Most retailers sell low-quality solar systems. Today, approximately 121,500 units of solar multiroom lighting systems are sold annually in Niger, with focus groups revealing a strong preference for products with phone charging capabilities.

20. **The solar retail market is beginning to expand and is becoming more professional as a function of demand and opportunity.** In 2013, an association of solar companies was established in Niger (APE-Solaire) that brings together eight importers/installers of solar lanterns/pico-PV/home systems; a major microfinance institution (MFI), ASUSU, the leading MFI in Niger with a client base of over 500,000 with gross loan portfolio of US$36,500,000, and US$470,000 in total deposits; and an NGO. Besides APE-Solaire, other electricity companies provide installation services for PV systems, but not as a primary line of business. In addition, more than 10 companies have expertise in managing water systems and have shown a willingness to expand their business not only to solar water systems, but also to solar electricity services.

21. **Banks and MFIs have played a limited role in financing the solar energy market in Niger, except for providing trade finance to existing clients for import of solar energy products.** Key barriers to financing for the small-scale, independent solar system businesses include credit risks given the nascent market conditions as well as limited long-term financing (over 12 months) required for MFIs or solar companies to provide consumer financing for solar energy products. The limited availability of long-term finance presents a particular challenge given long inventory periods for solar lanterns and SHS. Challenges to commercial financing of solar technology include the poor quality of systems on the market, maintenance issues, and the nascent regulatory and legal framework underpinning the sector.

22. **The financial sector in Niger and the region has experience in directed credit to the solar energy market and other small-scale energy and rural technologies, and the banking sector has expressed interest in providing medium term financing mechanisms.** ASUSU has provided microcredit to small importers of Lighting Africa-certified solar systems. It has also worked with international donors on providing subsidized household financing for solar kits. At the regional level, a commercial bank, ORABANK, has set up a credit line from the *Agence Francaise de Développement* (French Development Agency, AFD) for renewable and energy efficiency investments of US$30 million in a fund available to all commercial banks in the West African Economic and Monetary Union (WAEMU) zone. The United States Agency for International Development (USAID) is providing a US$2 million partial credit guarantee to Ecobank for energy efficiency financing. Banks have existing relationships with larger importers and distributors of solar energy products. Several bilateral donors have put in place concessional financing schemes that combine grants with credit to promote agricultural and rural finance, working mainly through MFIs and state-linked financial institutions, such as BAGRI, Niger's state-owned agricultural bank. Early results from these programs are largely encouraging, although strong oversight and technical assistance (TA) are necessary.

23. **The World Bank is deeply engaged in the electricity sector in Niger and in regional off-grid and other solar initiatives.** The proposed project will be implemented in close collaboration with the IDA-funded Regional Off-Grid Electrification Project (P160708) that is under preparation. A regional program to promote off-grid solar PV electrification is being prepared in the broader western African region, including the Sahel. This program will address some of the key barriers to attract private sector

investment to off-grid electrification in West Africa, including access to finance along the supply chain of off-grid electrification, adherence to quality assurance standards,[7] and the lack of a quality assurance framework for off-grid solar electricity systems for institutional applications, such as health clinics, schools, and other public administration offices. The proposed project in Niger will benefit from the TA provided by the regional program and will also serve as a pilot to test some activities, such as the development of quality standards for off-grid solar electricity systems for institutional applications and the implementation of the financing mechanism under the proposed Niger Solar Electricity Access Project (NESAP) through lines of credit to Participating Financial Institutions (PFIs).

C. Higher Level Objectives to which the Project Contributes

24. **This proposed project aims to support GoN's aspirations to significantly scale-up electricity access by 2027 as well as harness agricultural demand as anchor load for rural electrification.** By meeting energy needs for agriculture and household use purposes, this project could improve socio-economic outcomes of rural areas in a profound manner. Complementary off-grid solutions, greenfield and hybridized mini-grids and standalone systems, will be deployed to meet the energy needs of rural areas. The proposed project also introduces new instruments in the market, in the form of a debt and grant facility, to promote private sector participation in hitherto unattractive off-grid areas that allows service provision to rural Nigeriens in an efficient, affordable, and sustainable manner.

25. **NESAP is fully aligned with the GoN's 2012 *Plan de Développement Economique et Social* (Plan for Social and Economic Development, PDES).** In particular, the proposed project is consistent with the PDES objective of creating a competitive and diversified economy for accelerated, inclusive growth. Sustainable expansion of basic services to the general population, including access to energy services, plays a key role in the national development strategy.

26. **The proposed project is aligned with the recently finalized World Bank's Systematic Country Diagnostic (SCD) and the World Bank Group's FY13-16 Niger Country Partnership Strategy (CPS).**[8] The World Bank Group's support to the electricity sector is a critical part of the CPS, which is based on three pillars: (1) promote resilient growth; (2) reduce vulnerability; and (3) strengthen governance and capacity for public service delivery. In particular, the proposed project will support increased access to energy services, which in turn will support the first pillar of promoting resilient growth. As an example of the ways in which improving electricity access contributes to the World Bank's twin goals of reducing poverty and promoting shared prosperity, the SCD identifies solar pumping as a means to address the binding constraint to poverty reduction of low productivity of key food crops and livestock. The project will support adoption of solar pumping for sustainable irrigation that could help improve agricultural and livestock productivity. It will also support the access to finance and development of the private sector that are required to unlock investments in productive assets, such as sustainable irrigation systems, and complement existing World Bank-funded projects in the agricultural sector, such as Sahel Irrigation Initiative Support Project (P154482), Climate Smart Agriculture Support Project (P153420), Regional Sahel Pastoralism Support Project (P147674), and Niger Community Action Program Phase 3 (P132306). Its investments and financing mechanisms aim to serve the poor, attract private sector investment, and improve public service delivery at the local level. The private sector will have access to

[7] The project will extend the quality assurance standards developed by the Lighting Africa Program, and currently housed as Lighting Global Quality Standards, https://www.lightingglobal.org/qa/standards/.
[8] Report No.76232-NE.

finance to develop their business related to solar systems for rural electrification. Finally, the project will develop new business opportunities for the financial sector to finance solar projects.

27. **The proposed project is aligned with Sustainable Development Goal 7 (SDG7), Sustainable Energy for All (SE4ALL), the World Bank's Energy Sector Directions Paper (ESDP) and the Multi-Tier Framework for Energy Access (MTF).** SDG7, SE4ALL, and ESDP all aim to "ensure access to affordable, reliable, sustainable, and modern energy for all." Consistent with the approach of the MTF,[9] the project aims to provide decentralized modern electricity services along a spectrum of service levels that offer appropriate quantity, quality, and affordability of electricity access to different target populations, from Tier 1 and 2 for individual pico-PV lighting kits and SHS, to Tier 3, for hybrid mini-grids to provide at least 16 hours of electricity service.

28. **The proposed project is also aligned with the principles set out by the World Bank's Africa Energy Practice for off-grid solar energy.** The World Bank's Africa Off-Grid Solar Approach Paper (P149497)[10] defines six ways to catalyze the off-grid solar market in Sub-Saharan Africa: develop the policy and regulatory environment for off-grid solar; support governments to mainstream off-grid PV into sector planning; facilitate access to working capital; issue guarantees to reduce risk for commercial lenders that finance off-grid solar projects; use performance-based grants, when and wherever appropriate; and support creation of receptive markets through quality assurance and consumer awareness. These principles have guided the preparation of NESAP. For example, the use of working capital and performance-based grants to incentivize the market and support quality assurance of solar systems and consumer awareness are among the options considered in the proposed project.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

29. The objective of the project is to increase access to electricity through solar energy in rural and peri-urban areas of the Republic of Niger.

B. Project Beneficiaries

30. **The project beneficiaries will be households, businesses, community and public facilities, and farmers located in rural and peri-urban areas of Niger.** Beneficiaries will include around 400,000 people in rural communes where mini-grid services will be developed, as well as those in more dispersed areas, who will benefit from independent solar systems. People living in areas without electricity service and with dispersed population will receive electricity for the first time from solar systems (pico-PV and SHS), at the lowest levels of service (Tiers 1 and 2). The use of electricity will replace consumption of kerosene, diesel, dry cell batteries, and other alternative fuels. People living in areas without electricity

[9] Under the MTF, Tier 1 (minimum 12 Wh per day) and Tier 2 (minimum 200 Wh per day) are defined as providing access up to four hours per day and at least one hour at night and can be used for basic applications such as task lighting, radio, and phone charging (http://trackingenergy4all.worldbank.org). Tier 3 has a minimum of one kWh per day and up to eight hours per day and at least three hours at night. Tier 4 has a minimum of 3.4 kWh per day and up to 16 hours per day and at least four hours at night. Tier 5 consists of safe, reliable, unlimited 24-hour service from a grid system. See BEYOND CONNECTIONS: Energy Access Redefined, Energy Sector Management Assistance Program, 2015.

[10] The Climate Is Right: Scaling Off-Grid Solar Solutions in Sub-Saharan Africa, June 2016

service and with more concentrated population and electricity demand will receive electricity for the first time from newly established solar-diesel hybrid mini-grids that will provide at least 16 hours of service per day (equivalent to Tier 3 service). Some beneficiaries, living in communities with existing diesel mini-grids, will receive more hours of service through the hybridization of these grids with solar generation, to raise them to 16 hours of service per day with higher reliability (equivalent to Tier 3 service). Even households that will not be able to acquire an individual solar system or connect to the mini-grid will benefit from improved public services, such as schools and health clinics with lighting and refrigeration and drinking water systems powered with solar pumps, displacing expensive diesel water pumps. The proposed project will reduce differences in electricity services available to urban, peri-urban, and rural households, and improve opportunities for rural socioeconomic development. Productive uses will be encouraged through power from mini-grids, solar pumps, and individual solar systems.

31. **While the project does not aim for the highest level of service (Tier 5), all project beneficiaries would have an increase in quantity, quality, and affordability of electricity service that would be appropriate to their needs.** The project will focus on the poor and underserved, use renewable energy resources, and create an enabling environment for private sector involvement. NESAP is designed to minimize the financial and environmental costs of expanding reliable energy supply to those beyond the national grids, thereby supporting Niger's efforts to increase electricity access and boost shared prosperity.

32. **The GoN and the World Bank recognize the importance of taking into account gender considerations and including women in the development process as a way to achieve greater social and gender equity.** The GoN's political commitment is demonstrated by provisions included in the 2010 Constitution, the adoption of gender quotas for elective and appointed office (10 percent and 25 percent, respectively), the National Gender Policy adopted in July 2008, and the 10-year plan to implement the policy from 2009–2018. The PDES also intends to play a key role to promote gender equality and equity and human rights. Women will benefit from the project because they are the main managers and users of energy within the household. Providing access to electricity for public facilities will improve the delivery of basic health and education services, which could result in more girls going to school and better reproductive health services for women. Access to modern energy for households can improve health by reducing air pollution and burns from kerosene use. Access to electricity for small- and micro-businesses owned by women also could help increase their productivity and sustainability.

C. PDO-Level Results Indicators

33. The PDO level indicators are the following:

- People provided with new or improved electricity service (number) (Corporate Results Indicator); of which female (percentage).
- Generation capacity of energy constructed or rehabilitated (MW) (Corporate Results Indicator).

34. Section VII presents the full results framework.

III. PROJECT DESCRIPTION

A. Project Components

35. **The proposed project will assist in scaling up access to solar-based electricity services in rural and peri-urban areas.** The scope of the proposed project is nationwide, with a particular focus on rural areas in the agricultural belt (for hybrid solar-diesel mini-grids) and peri-urban areas where electricity services are deficient or absent (for individual solar systems). The project will be both a pilot for off-grid approaches and a financing instrument to scale-up the implementation of the off-grid component of the NES. The project is designed based on three principles: (a) reaching diverse beneficiaries with varied needs, including households and community facilities; (b) maximizing private sector participation in the delivery of off-grid energy services to reach a larger number of beneficiaries, maximize impact, and support sustainability of service; and (c) retaining flexibility with respect to market approaches, from fully market-delivered approaches to more regulated ones where the GoN maintains a leading role in service provision, thereby, using a mix of approaches that leverage the comparative advantages of both public and private sectors.

36. **The project will make use of the geo-spatial plan to be prepared as part of the NES to select priority locations for project investments in solar-diesel hybrid mini-grids.** The geo-spatial plan, expected to be available by the end of 2017, will be used to define priority locations for the new solar-diesel hybrid mini-grids to be established and the existing diesel mini-grids to be hybridized with solar under the project. As noted above, the geo-spatial plan will define priority investments in five-year increments to ensure effective implementation of electricity access, considering electricity demand, technology options, and least-cost approaches. The project's investments to support independent solar systems would not be aimed at specific geographical locations, but rather at market development to help solar system providers to provide electricity service to those difficult-to-reach areas.

37. **Based on consultations with GoN and lessons learned from other Sub-Saharan African countries, the project components will support the increase of electricity access in rural and peri-urban areas based on different electricity service levels and applying different business and delivery models.** The project proposes a comprehensive suite of investments to provide modern energy services to households, enterprises, and community facilities, with pragmatic business models to attract private sector investment, support sustainable services, tap into and develop know-how, and promote efficiencies. A substantial TA component is proposed to support a widespread consumer education campaign to inform and engage with citizens, private sector, and financing institutions; reinforce capacities of the key public institutions of the sector (namely, MoE, ANPER, CNES, and NIGELEC); and create an implementing unit at ANPER to implement rural electrification projects. Component 1 will help develop the commercial market for high quality stand-alone solar systems to provide a basic level of service for at least four hours of lighting and cell phone charging per day. Component 2 will support public-private partnership (PPP) arrangements to install, operate, and maintain new hybrid solar-diesel mini-grids that will provide at least 16 hours of service per day. Component 3 will improve the quality of service through PV hybridization of existing isolated diesel mini-grids to provide at least 16 hours of service per day and expand the number of clients connected to the grids. Component 4 will provide TA to address market, institutional, and regulatory barriers .

38. **Component 1: Market Development of Stand-alone Solar Systems (US$7 million equivalent IDA Credit)**

39. **The objective of this component is to develop a sustainable market for high quality stand-alone solar systems by increasing access to commercial financing to solar energy companies and their clients, namely households and farmers.** The component will (a) set up and operate a local-currency line of credit to provide access to finance in the solar energy market and (b) provide TA to improve the capacity of solar companies to obtain commercial financing. The individual solar systems to be supported will provide electricity at the lowest tiers of electricity service, including pico-PV systems for basic lighting and cell phone charging; SHS to provide a higher level of service for lighting, TV, and phone charging; and SWP systems. The market will determine the distribution of system types, but the minimum level of service would be three Watts for four hours per day. Sustainability of electricity provision will be supported by financing only high quality-certified solar systems and fostering financial and commercial relations between solar service providers and financing institutions.

40. **The direct beneficiaries of this component would be households and farmers that are either outside the grid area or in the grid area but unable to connect or with unsatisfactory service.** Other intermediary beneficiaries will be the distributors and solar companies who will benefit from increased access to finance through the line of credit and TA program. The location of these beneficiaries will be market-determined; the households or businesses that purchase such systems will be those that cannot afford electricity connection or those that are in areas where grid-based electricity service is not available or inadequate.

41. The line of credit, to be managed by the Ministry of Finance (MoF),[11] will consist of two windows:

- **Enterprise financing.** The first window will provide working capital or direct investment capital to solar system importers, wholesalers, retailers, installers, and solar electricity service providers. The financing will enable them to import high-quality solar equipment, develop distribution networks, provide services, and make investments to expand their activities. Up to two commercial banks will be selected to act as the PFI for this window.

- **Microfinance.** The component will leverage Niger's well-developed microfinance sector by providing a second window that will support MFIs to provide credit to households, micro-firms, and farmers for purchase of pico-PV systems and SHS. Up to two MFIs will be selected as the PFI for this window.

42. **The component will benefit from the TA provided by Component 4 (see below) to strengthen the capacity of solar companies,** working through existing SME support platforms provided by the *Société Sahélienne de Financement* (SAHFI), Niger's national credit guarantee agency,[12] and other

[11] Niger lacks a development bank or apex institution typically used as a wholesaler. The MoF was chosen to manage the line of credit because of its technical knowledge of the financial sector and its fiduciary capacity to manage effectively a liquidity support program. See Annex 2 for full fiduciary analysis of the MoF.

[12] SAHFI is incorporated in the project through leveraging existing SME support services for early stage companies seeking bank finance. Financing to expand SAHFI's partial credit guarantee program was considered but it was not deemed a viable option due to capacity constraints. Strengthening SAHFI's role to promote SME finance may form the basis of the future World Bank Group engagements to support access to finance in Niger.

incubators, as well as consumer education programs to promote knowledge of solar products.

43. **The MoF will lead the selection of both the commercial bank and the MFI based on a competitive tender process that assesses the quality and capacity of short-listed institutions.** Criteria used to select both the PFIs include financial performance, business practices, operational capacity, governance, and sectoral experience, in accordance with World Bank Policy on Financial Intermediary Lending (OP 10.00). The GoN will bear the foreign exchange and credit risk of lending to the PFIs.

44. **Given the nascent market conditions, the technical design is simple, involving direct contracts with selected PFIs.** The component is intended as a pilot program that can be scaled up upon successful demonstration of the line of credit. The program is coupled with TA to promote capacity, bankability, and market access for SMEs. Access to financing for both windows will be on a first-come-first-served basis between the two windows to allow for flexibility during project implementation. In accordance with the World Bank operational guidelines, pricing to PFIs and final borrowers will be competitive according to market conditions, and at a minimum, will incorporate the financial costs of mobilizing resources, administrative costs of monitoring the loan and collecting repayments, and risks inherent in lending to the market (including credit risk, liquidity mismatch, and sector-related risks). The PFIs will competitively determine rates to enterprises and households, following standard pricing practices and within ranges to be outlined in the Operations Manual (OM) for this component. Given the nascent nature of the market, the project will consider a subsidy program for solar companies based on results of business development to take into account that few importers and solar companies have a sufficient balance sheet to be able to incur debt even from local institutions.

45. **The CNES will provide market development and TA support for the component** through national communication and sensitization campaigns, as well as activities related to quality control of solar products. The CNES will also provide TA to support building capacity to private companies through incubators.

Component 2: Rural Electrification through Service-based Solar Hybrid Mini-grids (US$8.2 million equivalent IDA Credit, and US$1.8 million equivalent IDA Grant)

46. **This component, to be implemented by ANPER, will subsidize the provision of electricity to rural localities outside the national utility concession area that are not expected to be reached by the national grid in the short-term but have large populations, high density, power demand, and considerable economic and social activity.** The component is expected to result in the installation of about 2 MW of installed PV generation and related mini-grid distribution systems to supply around 6,000 electricity connections to households, community facilities, and productive users, with specific emphasis on agribusinesses and pumping services for irrigation and drinking water supply. The hybrid generation systems will combine solar PV, battery storage, and thermal units as a backup option and will supply energy to small transmission and/or distribution networks extending to service drops for end-users. The selection of locations for implementation of new mini-grids under the project will be consistent with the geo-spatial plans developed under the NES, while considering the specific characteristics required for locations in this component.

47. **Two approaches will be used in this component—top-down and bottom-up.** The top-down approach (similar to that of the *Programme d'Accès aux Services Energétiques pour la Commune rurale de Safo* (PASE-Safo)) will enable ANPER to prioritize the electrification of the biggest population centers

outside the national utility concession through a competitive bidding process for the selection of PPPs to invest, construct, operate, maintain, and further expand access. The second bottom-up approach will encourage subproject developers and investors to submit unsolicited proposals to ANPER for electrification via isolated hybrid PV/diesel mini-grids. The PPP arrangements to be used in both approaches will range from licenses to authorizations to mini-concessions, depending on the size of the installed generation capacity and the private sector's financial ability. In both approaches, investment grants will be provided by the project to private operators to decrease costs of financing and reduce the tariffs ensuring affordability of the end-users and fair profitability for the private company.

48. **The associated principles and policies for rural electrification are to be outlined by the GoN in a strategic implementation framework document to clarify the 'rules of the game' for all stakeholders.** The Rural Electrification Implementation Framework (REIF) will be derived from the Electricity Act and will constitute the key policy instrument governing rural electrification through private operators in Niger. It will be developed and adopted by the GoN and it will be a disbursement condition for this component. The REIF will, among others, define the rural electrification perimeter; identify financing means; and spell out regulatory mechanisms, institutional arrangements for oversight (for example, a steering committee ensured by ANPER's Board) and regulation, and fiscal arrangements. Principles expected to be followed in the REIF are outlined in Annex 2.

49. **Unsolicited proposals will be subject to competition and will have to comply with technical and economic standards approved by ANPER.** ANPER will screen and evaluate all unsolicited subproject proposals that meet a minimum scale to guarantee competition. For the selection of the most appropriate and cost-efficient proposals, a simplified call for proposals will be launched by ANPER allowing institutions and the private sector to submit their proposals. Annex 1 outlines the process of soliciting and selecting proposals. Sponsors to be selected will be responsible for installation, operation, and maintenance, with oversight exercised by ANPER. Subsidies will be disbursed gradually on an output basis, according to the project commissioning schedule. Further, he project will connect new customers in bulk and provide a subsidy for new domestic clients that will reduce the connection fee to a range between US$10 and US$20, covering the administrative costs of the connection.

50. This component will also finance the services of an Owner's Engineer to assist ANPER with (a) overall component management and supervision of the design, procurement, construction, commissioning, and management of the construction contracts; and (b) coordination of the implementation of the Environmental and Social Management Plans (ESMPs) and Resettlement Action Plans (RAPs). Further, the TA required by ANPER and the operators will be provided under Component 4.

Component 3: Solar PV Hybridization of Isolated Thermal Mini-grids and Expansion of Access (US$22.46 million equivalent IDA Credit and US$2.54 million IDA Grant)

51. **This component, to be implemented by NIGELEC, will finance the hybridization of several existing diesel-based, isolated grids with solar PV generation and battery storage in rural areas, and will be managed by NIGELEC to increase the hours of operation of the isolated systems and/or to decrease diesel consumption.** This component will also expand access to electricity to unserved households and businesses in these localities, and will specifically target agribusinesses and pumping services for irrigation and drinking water supply. More specifically, this component aims to increase the electrification rate of the selected isolated centers from 20 percent to 75 percent and to increase the service level from eight hours or 12 hours per day to at least 16 hours of electricity service per day by

2023. The hybridization of the selected isolated grids will result in decreased generation costs for NIGELEC and improve the quality of service to existing clients. The component will install around four MW of solar capacity, together with the connection equipment and meters, and will connect around 7,500 new customers and increase the hours of service for 3,000 existing customers. The selection of locations for implementation of solar hybridization of diesel mini-grids under the project will be consistent with the geo-spatial plans developed under the NES, while considering the specific characteristics required for locations in this component.

52. **This component will target selected diesel-based isolated grids that have an average electrification rate below 20 percent.** Technical, economic, and financial feasibility analyses will enable the selection of the most suitable diesel-based isolated grids for hybridization with PV technology out of the 115 existing grids spread throughout the country. Technically, three options were considered: (a) expand capacity through diesel generators; (b) expand capacity with PV and batteries; and (c) expand capacity through a mix of diesel generators and PV with batteries. The economic analysis showed that the best alternative is the mix of diesel and PV with batteries. The technology and design specifications are expected to allow a share of solar generation between 50 percent and 75 percent in the selected isolated grids. The investments required will include installation of PV power plants and storage systems; adding, replacing, or upgrading distribution lines and substations; installation of meters; and purchase of spare parts and tools. The component will also finance the connection of the new clients.

53. **The GoN will on-lend the financing to NIGELEC.** The on-lending arrangements will be governed by a Subsidiary Agreement to be signed between the MoF and NIGELEC on IDA credit terms for the credit portion and on-grant terms for the grant portion. NIGELEC will be responsible for commercial operations, allowing customers to choose between post and pre-payment of charges according to their needs. The technical and commercial capacities of NIGELEC will need to be reinforced. Further, investments under this component will include a US$2.5 million IDA grant that will serve to subsidize the connection fee of 7,500 customers. Currently, the electricity connection fee to cover NIGELEC's full cost of connection is around US$200, which is a significant amount for households in isolated areas. The project will connect new customers in bulk and provide a subsidy for new domestic clients that will reduce the connection fee to US$20, covering the administrative costs of the connection.

54. **The component will also finance the services of an Owner's Engineer to assist NIGELEC.** Duties of the Owner's Engineer will include supporting NIGELEC with (a) overall component management and supervision of the design, procurement, construction, commissioning, and management of the EPC contracts; and (b) coordination of the implementation of the ESMPs and RAPs. TA to support NIGELEC will be included in Component 4 as described in the next paragraphs.

Component 4: Implementation Support and Technical Assistance (US$8 million equivalent IDA Credit)

55. **This component will support project management and implementation, capacity building, and TA to key off-grid electrification sector stakeholders, as well as monitoring and evaluation (M&E).** Targeted stakeholders will be key government institutions (ANPER, CNES, MoE, NIGELEC, and local authorities), solar service providers, importers/installers, wholesalers and retailers, farmers, general public, and financial sector actors. The component will assist them to fulfill their functions efficiently and develop the solar market.

56. **Subcomponent 4.1. Project Management and Implementation Support to ANPER and MoE**

(US$2.7 million equivalent IDA Credit). This subcomponent will finance the support required for project management and implementation of the Project Implementation Units (PIUs) at ANPER and the MoF's *Direction Générale des Opérations Financières et des Réformes* (Directorate General of Financial Operations and Reforms, DGOFR), as well as at CNES, including technical, fiduciary, auditing, M&E, gender mainstreaming, and operational costs. This subcomponent will also finance project preparatory activities such as feasibility studies, safeguards, and other required analytical work.

57. **Subcomponent 4.2. Project Management and Implementation Support to NIGELEC (US$0.4 million equivalent IDA Credit).** This subcomponent will finance the support required for project management and implementation of the PIU at NIGELEC, including technical, fiduciary, auditing, M&E, gender mainstreaming, and operational costs. This subcomponent will also finance project preparatory activities such as feasibility studies, safeguards, and other required analytical work.

58. **Subcomponent 4.3. Capacity Building and Technical Assistance (US$3.65 million equivalent IDA Credit).** This subcomponent will finance activities associated with strengthening the capacity of key stakeholders to support the implementation of the three project investment components, namely for: (a) government agencies; (b) financial sector actors participating in the project, in particular SAHFI and the PFIs; and (c) TA to private distributors and operators to develop their businesses and reach out to rural households and famers.

59. **Subcomponent 4.4. Information, Education, and Communication (US$1.14 million equivalent IDA Credit).** This subcomponent will finance campaigns to raise consumer awareness and increase knowledge about the systems and services offered and the available financing options and warranties, through information and promotional campaigns using media in rural areas. For solar pumping, a specific campaign will be implemented targeting farmers.

B. Project Cost and Financing

Project Components	Project Cost (US$)	IDA Credit (US$)	IDA Grant (US$)
Component 1: Market Development of Stand-alone Solar Systems	7,000,000	7,000,000	0
Component 2: Rural Electrification through Service-based Solar Hybrid Mini-grids	10,000,000	8,200,000	1,800,000
Component 3: PV Hybridization of Isolated Thermal Mini-grids and Expansion of Access	25,000,000	22,460,000	2,540,000
Component 4: Implementation Support and Technical Assistance	7,890,000	7,890,000	0
Total Financing Required	**49,890,000**	**45,550,000**	**4,340,000**

C. Lessons Learned and Reflected in the Project Design

60. **The proposed project has taken into account lessons from World Bank and other development partner experiences in off-grid rural electrification using renewable energy technologies, especially solar, across Sub-Saharan Africa and other parts of the world.** The following lessons learned from projects in Bangladesh,[13] Ethiopia,[14] Kenya, Mali,[15] Peru, and Senegal,[16] have informed the design of this

[13] Bangladesh - IDCOL Solar Home Systems Project (P107906).
[14] Electricity Network Reinforcement and Expansion Project (P119893).

project, together with experiences in the Safo project and other donor-financed off-grid electricity service projects in Niger. These experiences have been considered together with the striking advances in PV technologies and business models.

Lessons from Individual Solar System Projects

61. **A broad vision, flexibility, and pragmatism are needed to build capacities and adapt to a changing environment.** Individual off-grid systems remain an innovation in many countries. The demand for off-grid systems varies according to factors such as geography, population density, and housing patterns, as well as income segments. Due to these demand variations, a wide range of technological solutions and flexible business models are often needed. The nascent implementation approaches for such systems require long-term vision for building needed capacities. Most off-grid electrification programs have evolved over time. Important design features have changed or new features have been introduced mid-course. In this context, flexibility and pragmatism with regard to the evolving market and regulatory framework is needed to achieve results.

62. **Platforms are needed for coordination and dialogue.** Development of markets for individual off-grid systems involves a large number of stakeholders. Experience in past projects points to the need for an ongoing dialogue and consultation with stakeholders. Results in previous projects have shown that a platform for bringing together key actors of the public, private, and non-profit sectors can catalyze market development and project implementation.

63. **An appropriate legal and fiscal framework is key to attracting private companies to the off-grid market.** Leveraging private sector investments for rural electrification is possible if the legal and regulatory framework includes appropriate incentives. Experience shows that fiscal, legal, and regulatory incentives were key in contributing to an enabling framework and perceived stability for private sector investments in successful rural electrification schemes.

64. **Establishing assurance of high quality product performance at the beginning of a project is key to ensuring credibility and consumer confidence.** The adoption of an international quality standard, such as Lighting Global Certification, has been instrumental to developing markets in East Africa. Projects have set and enforced stringent quality standards, including after-sales service and warranties. At the same time, in the fast evolving technology environment, it is important that the quality standards are adapted to reflect the latest advances in technologies so that they do not become a barrier to introducing more efficient technologies.

65. **Donor-financed off-grid solar PV access projects in Niger have not included adequate measures to build the technical and commercial capacity of markets (availability of technicians and spare parts and product quality guarantee) nor a sustainable revenue stream to ensure maintenance and/or renewal of the systems**. As a result, many SHS and solar streetlights are out of service, causing consumers to distrust the technology. A small but successful solar electricity access initiative has been piloted since 2016 in Safo County in the Maradi region through a PPP scheme. The design of the Safo pilot was informed by lessons learned from international off-grid projects as well as the rural water sector in Niger, where private companies are in charge of operations and maintenance (O&M) of water

[15] Household Energy and Universal Access Project (P073036) and Mali Rural Electrification Hybrid System Project (P131084).
[16] Senegal Electricity Services for Rural Areas (P085708).

supply systems. Financed by the European Union and the United Nations Development Programme (UNDP), the pilot conducted a village-level demand assessment of the electricity needs of community and social services (rural health centers, primary and secondary schools), productive uses with isolated PV systems (irrigation and multifunctional platforms), and households for Tiers 1 and 2 of electricity access. Donors subsidized investments costs. Through a competitive process, a private operator was selected to install and maintain the solar systems (home and pumping systems). The operator is collecting monthly fees from all users through an agreed business plan that allows for recovery of costs of O&M of the systems. While the pilot is in early implementation (installation finalized in June 2016), it has increased the electrification rate in Safo from two percent to 20 percent.

Lessons from Mini-grid Projects

66. **The high cost of mini-grids needs to be mitigated by optimal design, as well as efficiency in operation and energy use to lower life-cycle costs.** In most African countries, with low electrification rates and vast areas without national grids, mini-grids are often the least-cost electrification method. However, the higher costs of mini-grids even when using renewable energy result in higher tariffs to recover investments and operation costs. To decrease costs and enhance sustainability, efficiency measures have proven effective including: (a) the use of renewable energy to reduce the impacts of diesel price volatility on costs; (b) optimization of the grid design for rural consumption; (c) adoption of new business models with respect to customer services and information and communication technologies that can reduce operating costs (such as use of smart prepaid meters, allowing remote monitoring, and balancing of supply and demand); and (d) the promotion of energy use during the day, in particular for productive uses, to optimize the utilization of a mini-grid. Finally, as mini-grids often precede connection to a regional or national grid, it is essential to consider the technical standards, interconnection requirements, and regulatory provisions that will enable the transition to a larger grid.

67. **In the absence of a strong power sector entity that can develop and operate isolated mini-grids, PPPs often emerge as the appropriate model.** However, to attract the private sector, mini-grids need to be financially viable and regulatory risks need to be minimized. The private sector requires clarity regarding tariffs (and, if applicable, subsidies), the licensing regime, service quality, performance standards, time frame during which it is entitled to operate the mini-grid, and rules of what happens when the main grid arrives. Public sector subsidies of capital costs are often required to lower the user tariff to affordable levels while maintaining adequate profitability for the private company.

68. **A careful approach is needed for the scale of concessions. Economies of scale are required to sustain mini-grids for rural electrification.** Private financing is limited for investments in mini-grids except for densely populated urban areas because of the perceived high risk of these capital-intensive technologies in countries where rural consumers have low levels of demand and ability to pay. This has often resulted in higher engagement of the local private sector in small rural electrification concessions and a lesser appetite from the international private sector for larger concessions. Over time, the approach can evolve through the bundling of several small concessions into a larger one with lower investments and operation costs through economies of scale.

69. **Best practice lessons have emerged from evaluations of financial intermediation to catalyze market development.** The project design incorporates lessons from key global evaluations of credit line operations, including the World Bank's Independent Evaluation Group's 2006 Lending for Line of Credit

Report[17] and evaluations of other off-grid solar development projects in Rwanda, Ethiopia, and other African markets. Best practice mechanisms incorporated include ensuring the implementing entity's accountability and strong management, prioritizing suitable systems and delivery mechanisms, use of sound eligibility criteria that meet World Bank Group operational guidelines, and monitoring of financial institutions and MFIs to ensure operational and financial quality. The line of credit will focus on a few precisely defined and measurable indicators. In addition, the line of credit will be closely coordinated with other donors participating in financing the sector.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

70. **ANPER, a government agency of the MoE, will be responsible for overall coordination of the project, which will involve three project implementation entities:** Component 1: MoF, with support from the CNES for TA activities; Components 2 and 4: ANPER (which will coordinate with the CNES, MoE, PFI, and NIGELEC, in particular for the implementation of TA under Component 4); and Component 3: NIGELEC.

71. **A Project Steering Committee (PSC), chaired by the MoE and including representatives of ANPER, the CNES, NIGELEC, and other ministries (that is, finance, planning, interior), will oversee the project.** The primary responsibility of the PSC will be to provide high-level policy guidance and strategic directions, ensure coordination with other sectors during implementation, resolve issues and challenges requiring high-level intervention, and monitor progress of the project.

72. **A PIU will be established at ANPER, headed by a Project Coordinator (PC) responsible for overall project coordination as well as the components carried out by ANPER.** ANPER will report to the PSC on a regular basis to ensure communication with all pertinent ministries and to obtain decisions on issues pertaining to multiple government stakeholders. The PC will report to the Executive Director of ANPER, who ultimately will be responsible for the fiduciary and safeguards aspects of the project. The PC will also receive support from two of ANPER's field offices located in different regions of the country, which will liaise with rural operators and private sector entities, as well as local authorities and final beneficiaries of the project. ANPER has no experience with World Bank-financed projects. The PIU will be staffed to ensure that project fiduciary responsibilities are adequately fulfilled. Experienced project consultants will be retained to assist ANPER with project implementation in key areas such as planning, environmental and social safeguards, procurement, and financial management. In addition, an experienced project design and supervision consultant (Owner's Engineer) will be competitively recruited as part of the project to assist with project implementation and will report directly to ANPER's PC.

73. **NIGELEC has a unit, *Cellule des Grands Projets* (CGP), which manages large projects and which will lead the implementation of Component 3.** This unit already has experience with World Bank-financed projects, such as NELACEP. A PC who reports to NIGELEC's Deputy Chief Executive Officer (*Sécretaire Générale*) leads the unit, which is at the same level as other operational departments, thus

[17] World Bank Lending for Lines of Credit: An IEG Evaluation, Independent Evaluation Group, 2006. Washington, DC: World Bank.

ensuring coordination through the management board. The PC will be supported by a team that includes specialists in procurement, FM, technical, and environmental and social safeguards. Major investments will be contracted out to experienced contractors secured through competitive bidding. In addition, an experienced project design and supervision consultant (Owner's Engineer) will be competitively recruited as part of the project to assist NIGELEC with project implementation and will report directly to NIGELEC's PC.

74. **Under Component 1, the DGOFR will provide lines of credit to a commercial bank and an MFI according to the World Bank's Policy for Financial Intermediary Lending (OP 10.00).** The DGOFR will receive TA to enhance its capacity to manage the line of credits, the extent needed as identified in the assessment. The CNES will provide market development and TA support. The CNES will also use the TA to support building capacity to private companies through incubators. The commercial bank and the MFI that will benefit from the lines of credit will also have to pass the OP 10.00 assessment before disbursing any funds from the lines of credit.

75. **Each implementing agency (ANPER, NIGELEC, and the DGOFR) will have responsibility for the day-to-day management and coordination of their respective project-related activities,** including (a) ensuring timely implementation in accordance with the Project Implementation Manual (PIM); (b) preparing annual work plans and budgets and annual Procurement Plans (PPs); and (c) assuming overall responsibility for, among others, procurement, financial management, M&E, communications, and environmental and social safeguards (ensuring compliance with the safeguard documents of all entities involved in the project's implementation).

76. **A technical group, comprising the institutions responsible for the implementation of the proposed project** (MoE, ANPER, CNES, NIGELEC, and DGOFR) will meet monthly to discuss the progress of the project and coordinate the activities to be implemented. Private sector representatives will be included as and when relevant.

77. **Project implementation arrangements, including fiduciary responsibilities, are described in Annex 2.** A PIM, outlining the roles and responsibilities of each agency, including fiduciary responsibilities, will be prepared and adopted by the three implementing agencies as well as the CNES and the MoE before project effectiveness.

B. Results Monitoring and Evaluation

78. **Section VII presents the project's Results and Monitoring Framework, which defines specific outcomes and targets to be monitored.** ANPER will be responsible for the overall M&E of project activities and submission of periodic reports, but each implementing agency will be responsible to collect data and for producing quarterly progress reports, including on the monitoring indicators. The proposed PC in ANPER will consolidate the quarterly progress reports of NIGELEC and the DGOFR, as well as the TA activities carried out by the CNES and the MoE. An M&E officer will be recruited by ANPER to prepare progress reports for discussion with the technical group and the PSC.

C. Sustainability

79. **Component 1 of the proposed project has been designed to support the sustainability of the solar system market by focusing on business models and financing mechanisms that enable the financial and private sector to take informed risks while providing after-sales service and guarantees for the solar systems.** The TA will reinforce the capacities of the private sector to make sustainable business plans based on cost-recovery of the investments taking into consideration the end beneficiaries' ability to pay while maintaining an appropriate level of electricity service. Emphasis will be placed on ensuring high quality of systems and services. Financing will be provided only to companies selling products in compliance with quality standards of systems (such as Lighting Global and International Electrotechnical Commission [IEC]), as well as appropriate product guarantees and after-sales service.

80. **The financial sustainability of mini-grid investments in Component 2 will be secured through the application of a fee-for-service regime that aims to balance the profitability of a well-performing private operator with an affordable fee for the beneficiaries,** whereby an equilibrium will be reached after the provision of subsidies to investment costs. The PPP operations financed under the project will be regulated by contract. A robust regulatory framework for these PPP arrangements will be elaborated and improved during project implementation based on the experience with initial investments.

81. **Technical sustainability of hybrid mini-grids relies on the engagement of the various stakeholders, in addition to the operator, including the communities and local authorities.** Long-term viability will build on a sound design together with suitable capacity building as part of TA. This will support the continued availability of appropriately trained local technicians and operators for maintenance. The remoteness of the sites and the use of relatively new technology (inverters, battery bank, control units, and PV modules) will likely raise maintenance challenges that need to be properly addressed by reliance on remote control systems, after-sales service plans, and well-trained local operators. Furthermore, at the beginning of the project, a technical assessment by ANPER will propose mini-grid configurations, technology options, technical standards, criteria for optimal system design, and sizing criteria as well as processes for customer service and tariff setting to optimize costs and improve financial sustainability.

82. **Component 3 will focus on improving the performance and reducing the electricity costs of NIGELEC's isolated grids.** This will improve the financial sustainability of NIGELEC, as well as benefit the customers of the grid. Adding solar PV generation and storage to the existing diesel-based generation facilities of NIGELEC's isolated grids will dramatically reduce the operating costs of these facilities and improve their reliability and performance. The project will finance the connection costs of additional customers in these isolated grids that will also benefit from these reduced electricity costs.

D. Role of Partners

83. **The proposed project is framed within the GoN strategy to increase access to electricity in rural areas, which in turn will be integrated in the NES that is currently under development.** Other donors, such as the European Union, UNDP, and the Economic Community of West African States Centre for Renewable Energy and Energy Efficiency (ECREEE), have provided financing support to pilot projects for rural electrification and expressed their willingness to further contribute to this endeavor. The

African Development Bank, through the Sustainable Energy Fund for Africa, is financing TA to the GoN to develop the regulatory framework for PPP in rural electrification as well as the identification of initial investments in rural electrification through hybrid mini-grids to be implemented through a PPP arrangement. The outcomes of this support will inform the implementation of Component 2 of the proposed project. Finally, the Islamic Development Bank has expressed interest in contributing to the financing of rural electrification investments in Niger following the implementing approach of the proposed project. Regarding support to the off-grid solar market, USAID, through Power Africa, is implementing a technical assistance based on mentoring and capacity building for the private sector and financial institutions to reduce the financial risk for commercial debt operations in Niger. Close collaboration will be stablished with USAID to leverage this support and ensure coherence of all the interventions.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

84. **The overall project risk is rated high.** This is mainly because of the weak institutional and regulatory framework in which innovative features of the project will be implemented, the lack of experience with solar and solar hybrid technologies, and the low electricity demand and ability of isolated populations to pay. While implementation challenges are likely to be considerable, the World Bank views the project as high risk/high reward. Key risks and their mitigation measures are discussed in the following paragraphs.

85. **Political and macroeconomic.** Risks in this area are considered substantial. Despite improvement over the past months, the security situation remains complex and may have an impact on the macroeconomic risks. Persisting security concerns would have an impact on foreign investment, affect domestic production, and divert public spending to security. An unfavorable external environment could delay further projects in natural resources. Niger also remains vulnerable to spillovers from its main trading partner Nigeria. The economic slowdown and income losses in Nigeria that followed the collapse in international oil prices in late 2014 spilled over to Niger as its conventional exports to Nigeria fell 16 percent in 2015, causing significant custom revenue losses. Niger's growth prospects are also vulnerable to spillovers in neighboring Chad, as the construction of the crude oil pipeline connection will depend on security in Chad.

86. **Sector strategies and policies.** Risks in this area are considered substantial. Key sector strategies and policies related to off-grid electrification have yet to be developed. A new Electricity Act was passed in May 2016, and the bylaws were approved—including one related to rural electrification. In November 2016, the GoN launched the development of the NES, which is expected to provide further guidance on rural electrification and will be completed in late 2017. The absence of strategic and policy guidance creates uncertainties for the implementation framework of the project. To mitigate this risk, the GoN will approve, before disbursement of Component 2, a sector-wide REIF that will provide clarity on some key policy elements, such as appropriate differentiated off-grid electricity tariffs, provision of capital and connection cost subsidies to assist with affordability, and financing of rural electrification. Also, with regard to the involvement of the private sector, the project will draw on the experience of the rural water supply sector.

87. **Technical design of the project.** Risks in this area are considered high. The project includes innovative features where implementation will require learning-by-doing. This will be the first time in Niger that a financial intermediary scheme will be put in place to enable the provision of a line of credit for the development of the individual solar PV system market. Also, the bottom-up rural electrification approach that may be used for hybrid mini-grids in areas outside of NIGELEC's operations, based on private sector engagement, will be innovative. To address the inherent risks, implementation will adopt a learning-by-doing approach and maintain flexibility in the type of financing and TA to be provided in each component of the project. Also, the project implementation time line is longer than the usual five-year period, to reflect the need for a learning curve.

88. **Institutional capacity for implementation and sustainability.** Risks in this area are considered high. Key institutions involved in rural electrification are new to these operations and lack implementation experience. ANPER has recently become operational and has not yet implemented any major rural electrification subproject. Subprojects under development or implementation by ANPER lack mechanisms to ensure sustainable O&M. On the private sector side, small enterprises importing and selling SHS and lanterns have little experience in service-based business models and applications, such as water pumping, while rural water private operators lack expertise on SWP systems. Finally, financing institutions have limited experience providing lines of credit to solar companies and the perceived risk of the technology is high. The project intends to tackle these major institutional capacity risks by providing comprehensive TA and appropriate incentives to all key actors. The PIU in ANPER will be staffed with adequate technical, fiduciary, environmental, social, and M&E staff.

89. **Fiduciary.** Risks in this area are considered high. As indicated above, ANPER, which will be responsible for overall project coordination and will implement two project components, has been recently staffed and begun operations. It therefore lacks a track record in implementing or overseeing rural electrification subprojects, and will be implementing a World Bank-financed project for the first time. Given its weak fiduciary and implementation capacity, the project will ensure that the PIU in ANPER is adequately staffed with FM and procurement specialists; will enable on-the job learning and training from NIGELEC, which has been implementing the World Bank-financed NELACEP satisfactorily; and will provide further TA as required.

90. **Climate and disaster risks.** A climate and disaster risk screening has been completed for the proposed project. The screening identified three key drivers for climate hazards in Niger, namely extreme temperature, drought, and winds. The team has confirmed that the overall climate risk to the project's outcomes is low in regard to these hazards. Risks will be addressed through proper design, operation, and maintenance of the investments. All civil works and distribution systems (lines, poles, and so on) will be designed to resist to high temperatures and wind effects, building on strong international and proven national standards. Great attention will be given to the maintenance of the solar PV systems and the diesel generators, including aeration of the battery house and cleaning of solar panels to remove dust and operate at an optimum efficiency. The project will support capacity building of relevant stakeholders and the development of necessary standards.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

91. **The rationale for public sector financing of investments under the proposed project rests primarily on the characteristics of the project, given its aim to increase access in rural areas far from existing grids.** It is widely recognized that rural electrification in such areas requires concessional financing given the recognition of electricity access as a global public good that benefits the poor and the fact that financial returns in such areas are not attractive. The project will provide financing to facilitate the development of a market for off-grid individual solar PV technologies and new isolated solar PV mini-grids, as well as to increase the number of connections, lower the production costs, and improve the reliability of existing diesel mini-grid systems through hybridization with solar PV generation and storage. It will also provide TA to help establish the institutional and regulatory framework for solar off-grid electrification and build capacity among key public and private stakeholders to enable the sustainable provision of solar-based off-grid electricity for households and productive and community uses.

92. **The high-risk country environment, a legal, regulatory, and institutional framework for off-grid electrification that is under development, and the high capital costs of renewable energy make necessary the use of public funding to crowd-in private investments.** The concessional terms of the financing to the GoN will help the off-grid electricity services to be affordable and sustainable, through on-lending to solar service providers and households through MFIs. The new solar/PV mini-grids operated by the private sector will be subsidized through capital cost subsidies and structured for a financially sustainable, but affordable, operation of the mini-grids. Concessional loans will be provided to NIGELEC to expand and hybridize existing isolated diesel mini-grids with solar PV generation.

93. **The private sector will play a crucial role in off-grid electricity service provision under the project and beyond.** Solar companies will sell and service individual solar systems and will be partners in PPP arrangements to provide service through new solar-diesel hybrid mini-grids. Furthermore, the project will help demonstrate possible models for private sector investment in off-grid electricity service provision that can be scaled-up in the future. Such a demonstration under the project will help develop capacity for implementation of a rural off-grid strategy and planning and quality standards for independent solar systems and solar PV/diesel mini-grids and enable greater regulatory clarity.

94. **In the context of this project, the World Bank provides significant value added.** It is already a close partner of the GoN in the energy sector by (a) supporting the GoN in its development of the NES to ramp up access in urban, peri-urban, and rural areas (under the IDA-financed NELACEP); (b) bringing experience with renewable energy-based electricity services from other countries in Africa; and (c) applying the lessons learned from the GoN's national access expansion program and its first pilot to the design of the two access approaches for Component 2.

95. **Economic and financial analyses have been carried out that demonstrate the economic and financial viability of each component of the project.** The economic internal rate of return (EIRR) and net present value (NPV) of the project as a whole, and of each of Components 1, 2, and 3, have been calculated using a standard cost-benefit methodology. The project is economically viable with an EIRR of 10.2 percent and an NPV of US$12.5 million (at a six percent economic discount rate). Once greenhouse gas (GHG) emissions reductions resulting from the project are considered, the EIRR rises to 10.9 percent.

The economic evaluation is confined to activities that generate quantifiable benefits for which an economic value can be clearly identified and measured and is restricted to benefits associated with investments under Components 1, 2, and 3. The financial analyses focus on the financial internal rate of return (FIRR) and the NPV of cash flows for the three components. For Components 1 and 2, additional analyses are conducted to calibrate the share of concessional finance so that the project yields a reasonable rate of return to ensure sustainable operation by the private sector operators.

96. **Component 1 - Economic Analysis.** Component 1 is deemed economically viable with an EIRR for the main solar systems targeted—solar lanterns, SHS, and water pumps—of 33.1 percent and an NPV of US$2.1 million (at a six percent discount rate). The analysis estimates economic benefits conservatively based on avoided costs of electricity substitutes for each consumer group. Specifically, for households this includes the costs of lamps using dry cell batteries, kerosene lamps, candles, and cell phone chargers. In the case of water pumps for irrigation, the avoided cost is the cost of a diesel-powered water pump.

97. **Component 1 - Financial Analysis.** The analysis indicates a substantive NPV and FIRR for the sale of solar lanterns and SHS. The analysis finds that the retailer business models for the main solar systems targeted by the component—solar lanterns, SHS, and solar water pumps—are financially viable. The financial analysis showed FIRRs of 21 percent on sales of lanterns and 25 percent on sales of SHS for a composite representative retail company. The financial analysis for water pumps for irrigation demonstrates the financial viability to farmers by calculating the financial savings to farmers from switching from diesel water pumps to solar-powered water pumps. With an average cost per cubic meter of water declining from US$0.13 to US$0.11, the savings are in excess of 20 percent. Switching value analysis is performed on some of the key parameters to test the robustness of the financial viability of these retail models.

98. **Component 2 - Economic Analysis.** The results of the analysis show that Component 2 is economically viable with an EIRR of 7.5 percent and an NPV of US$1.5 million (at a six percent discount rate). The analysis of Component 2 conservatively estimates economic benefits based on the avoided cost of electricity substitutes (lighting substitutes and cell phone charging costs) for households that previously did not have access to electricity and on avoided cost of electricity from diesel generators for public facilities and commercial clients. The analysis is highly conservative as no consumer surplus was included in the benefits for households and, although CO_2 reduction was calculated, neither global nor local benefits of reduced emissions of other pollutants from use of kerosene and diesel were considered.

Table 1. Summary of Analyses of Component 2

Economic Analysis		Financial Analysis	
NPV (US$)	**EIRR**	**NPV (US$)**	**FIRR**
1,494,000	7.5%	94,002	24%

99. **While the EIRR is not far above the six percent target rate, it is important to recognize several factors that mean that further projects would likely have a higher EIRR.** First, the analysis is highly conservative in estimating benefits as the limited data available from the 2014 Survey on Household Living Conditions and Agriculture meant that calculating a consumer surplus for households was not considered useful. As Niger is now a participant in global surveys as part of the MTF for Energy Access, more detailed data on energy use will be available that will improve benefits estimates. Also, the global

benefits of CO_2 reduction and the local environmental and health benefits of switching to cleaner fuel were not considered. Second, the component is a pilot application of an innovative institutional and technological approach to rural electrification in one of the world's poorest countries—PPPs for hybrid solar-diesel mini-grids—and as such, the benefits are likely underestimated. The experience gained through the pilot will in many ways be more valuable than the specific returns on the individual subprojects and will help improve the design of future projects. Third, the costs of solar PV technologies are expected to continue to decline dramatically in the near and medium term. For all of these reasons, future scale-up of the activities would likely have considerably higher EIRRs.

100. **Component 2 - Financial Analysis.** The financing for the mini-grids is structured so that the grant component brings down the capital investment costs sufficiently to yield a rate of return on the investment by the operator equal to 20 percent (pre-tax). The financial viability of the project was determined by setting a fee-for-service structure that reflects a conservative estimation of ability to pay in Niger while generating revenues sufficient to cover recurring costs (including generation costs, client service within the area of the mini-grid, O&M activities, and insurance) and the costs of debt to cover the costs of battery replacement. The FIRR of a typical subproject was estimated at 24 percent while the NPV at a 10 percent discount rate was estimated to be US$94,002.

101. **Component 3 - Economic Analysis.** The economic analysis shows that Component 3 is economically viable with an EIRR of 11.2 percent and an NPV of US$10.4 million (at a six percent discount rate). Once CO_2 emissions savings are taken into account, the EIRR is increased to 11.5 percent and the NPV to US$11.2 million (taking a carbon price of US$30 per ton of CO_2). The analysis estimates economic benefits based on the avoided cost of electricity substitutes (lighting and cell phone charging costs) for residential consumers that previously did not have access to an electricity source, as in Components 1 and 2. For consumers who were previously connected to the mini-grid, economic benefits are calculated based on the avoided costs of diesel generation through hybridization of diesel generation with solar PV and batteries. The analysis is conservative as it does not take into account a consumer surplus in the case of new customers or the local environmental and health benefits of switching to cleaner fuel.

102. **Component 3 - Financial Analysis.** The component is financially viable with an FIRR of 21 percent, and an NPV of US$785,000 (at a 10 percent discount rate). The financial benefits are derived from the increase in revenue from sales of electricity to the newly connected customers at the current tariff, as well as the reduction in costs of running the expanded grid with hybrid generation instead of diesel generation only.

103. **GHG accounting of the project.**[18] GHG accounting has been undertaken for the project, which will result in significant GHG emission avoidance by replacing diesel consumption in public facilities and farms. Most project activities will not directly emit GHG due to the use of solar technologies, except for mini-grids that are already partially fueled by diesel. For larger systems, such as mini-grids, community SHS, and solar pumps, GHG emissions over 20 years have been analyzed. For household systems, such as solar lanterns and household SHS, GHG emissions have been analyzed over five years, due to shorter economic life of the systems. Total baseline emissions are estimated to be 364,000 tCO_2, whereas the

[18] Approved Clean Development Mechanism methodologies are used: AMS-III.AR - Substituting fossil fuel based lighting with LED/CFL lighting systems and AMS-III.BL Integrated methodology for electrification of communities.

project emissions total 121,000 tCO_2. Therefore, the project will result in 243,000 tons of avoided CO_2 emissions.

B. Technical

104. **The solar systems promoted under Component 1 of the proposed project must meet Lighting Africa Minimum Quality Assurance Standards that ensure high energy system performance.** These include lighting output and run time, as well as high quality and durability in terms of physical ingress and water and battery protection. Although little experience with these systems exists in Niger, consumer surveys in other African countries where they are more widely sold show that consumers consider the performance of these solar systems high and that they are preferred over alternative lighting sources because they are safer, economical, and higher quality.

105. **Hybrid solar mini-grids were selected for Component 2 based on a comparative analysis of a number of alternatives taking into account local circumstances.** The investments to be financed under this component will be located more than 30 km from the existing and planned grid, making grid extension not economically feasible. For these dense and populated localities, mini-grids are needed to provide grid-level access. Solar potential in Niger is high, while wind and hydro potential are either low or insufficiently known. Solar mini-grids have been selected as an alternative to diesel only or solar/diesel hybrid mini-grids because of their lower levelized cost of energy. Project financing will be provided to lower private investment needs that will result in an affordable tariff for the end-user while maintaining sufficient profitability to attract private sector interest to build and operate the mini-grids.

106. **The hybridization with PV of the existing diesel-based isolated grids managed by NIGELEC under Component 3 was chosen based on the results of a pre-feasibility study.** The study analyzed the economic benefit of PV generation against the fuel savings resulting from the replacement of diesel generation. The PV technologies, including panels, batteries, and regulators, are commercially available. The assessment of grid technologies and equipment to rehabilitate and expand access in these isolated grids will use the 'appropriate engineering' approach to adapt the available and tested reticulation methods, including low-cost technologies, to the conditions in Niger.

C. Financial Management

107. **The World Bank conducted a financial management (FM) assessment of the three implementing entities of the project, ANPER, MoF, and NIGELEC.** The conclusion of the assessment was that the FM residual risk for ANPER, MoF, and NIGELEC is substantial.

108. **Although the FM arrangements satisfy the World Bank's minimum requirements under OP/BP 10.00, improvements are needed for the system to be well-performing.** The system must provide, with reasonable assurance, accurate and timely information on the status of the project as required by IDA. The assessment revealed that ANPER has only recently become operational and does not have any experience of the World Bank-funded project FM procedures. In addition, ANPER will face staffing issues.

109. **Key undertakings need to be fulfilled by ANPER.** These include: (a) within three months after effectiveness, ANPER needs to acquire and make functional an accounting system under multidonors

and multiprojects version to handle the project's activities; and (b) within six months of effectiveness, ANPER needs to recruit the project external auditor using terms of reference satisfactory to IDA.

110. **The assessment of NIGELEC shows that it has experience with World Bank-funded project management.** NIGELEC is implementing the NELACEP (P153743), which was approved in December 2015. However, the World Bank FM team identified the following undertakings that need to be fulfilled by NIGELEC: within three months after effectiveness, NIGELEC needs to calibrate the existing TOM2PRO accounting system to reflect project activities.

111. **The residual FM risk rating is substantial.** Other actions needed to reduce the FM residual risk of NIGELEC and ANPER are documented under the FM section in Annex 2.

112.

D. Procurement

113. **The proposed project will be implemented by NIGELEC for Component 3 and ANPER for Components 2 and 4, while Component 1 will be implemented by the MoF.** The project will be under the supervision of a PC to be recruited by ANPER. ANPER is recently operational and has no specific fiduciary experience to be considered for the implementation of World Bank-financed operations. Therefore, the procurement risk for this agency is rated high. Given its weak fiduciary and implementation capacity, the recommendation for ANPER to recruit a procurement specialist is underway under the financing of the Project Preparation Advance (PPA). In terms of fiduciary capacity, NIGELEC has now acquired some experience in implementing World Bank financed activities in the context of the NELACEP. This agency, acting as the implementing agency of Component 3, is staffed with a procurement specialist. The procurement risk for NIGELEC is rated substantial. Nevertheless, since ANPER has no procurement experience yet in World Bank-financed projects, the overall procurement risk for the whole project is rated high. Procurement for the project will be carried out in accordance with the 'World Bank Procurement Regulations for Borrowers under Investment Project Financing,' dated July 1, 2016, and hereafter, referred to as 'Procurement Regulations'. The implementing agencies shall follow the Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by International Bank for Reconstruction and Development (IBRD) Loans and IDA Credits and Grants, dated October 15, 2006, and revised in January 2011. A Project Procurement Strategy for Development has been finalized prior to appraisal, based on which the Procurement Plan (PP) was prepared and finalized. The main conclusions of the PPSD were: (i) the need to learn from similar projects in the region; (ii) the procurement capacity of NIGELEC is sufficient and the capacity of ANPER will need to be reinforced; and (iii) the national and international market is adequate to the needs of the project. See Annex 2 for further details.

E. Social (including Safeguards)

114. **The project safeguard category is 'B' as the type of interventions foreseen will not have major impacts on the population or the environment.** No physical displacement is anticipated due to the nature of the project. However, Components 2 and 3 may require small amounts of land for the stations/poles and/or low-voltage transmission lines that may involve land acquisition and limited change in land use (permanent or temporary). OP/BP 4.12, Involuntary Resettlement, is therefore

triggered to address any adverse impacts of the potential land acquisition, which may cause loss of assets. Since the locations of the activities will be determined during implementation, a Resettlement Policy Framework (RPF) is the appropriate safeguards document to address the potential impacts.

115. **The RPF includes the guidelines and procedures for compensation and/or resettlement.** These will be applied in the event that future activities should require land acquisition, leading to involuntary resettlement, or cause losses of assets or loss of access to livelihoods or assets and resources, taking into account gender differences in land or assets access, control, and use, and the resulting losses for both women and men. It contains (a) an assessment of the country regulatory and institutional framework for land acquisition and compensation; (b) likely categories of affected assets and parties as well as the scope of impacts on women and men; (c) a gap analysis and a compensation framework (including an entitlement matrix) consistent with OP 4.12 and the national legislation; (d) measures to assist vulnerable groups; (e) a consultation framework to enable the participation of affected populations, including women, in the preparation of specific resettlement plans; (f) an institutional framework to implement the RPF; (g) a grievance redress mechanism; and (h) an M&E framework and budget that uses sex-disaggregated data to monitor and assess the results and impact on women and men. In case any land acquisition or compensation becomes necessary, the cost would be covered by the GoN.

116. **The RPF was consulted upon and disclosed in country and by the World Bank on April 8, 2017 and April 10, 2017, respectively.** An RPF was prepared for NELACEP. To avoid duplication, that RPF was used as the basis for this project with relevant revisions and updates to reflect the project components. The RPF will guide the preparation of RAPs if and when necessary during project implementation.

117. **Bringing in large numbers of outside workers to complete mini-grid construction and off-grid installations could pose a social risk.** Setting up temporary workers' camps may result in gender-based violence (GBV), sex trafficking, and child abuse. The types of civil works envisaged in the project are not expected to result in large numbers of foreign workers; however, the project will be mindful of this risk and take appropriate measures to prevent and address the negative consequences. This will be done by incorporating obligations in contracts, working with local governments, public employees, and community-based organizations and NGOs working on human rights and on preventing GBV, trafficking, and child abuse; adopting and enforcing a code of conduct for the workers and educating them, as well as the affected communities on the code; and building capacity among contractors and front-line staff to address these issues; and rigorously monitoring these issues and reporting on them among others.

118. **In terms of capacity on safeguards, NIGELEC has now acquired some experience in implementing the World Bank's safeguards policies in the context of NELACEP.** Its capacity will need to be further enhanced through training on the specific safeguards issues that might emerge in this solar project, including gender differences and implications. NIGELEC is also hiring environmental and social specialists, with experience on gender differences, to ensure proper implementation and supervision of safeguards.

119. **Since ANPER has limited, if almost inexistent, experience in piloting projects which are applying the World Bank's and Niger's national environmental and social safeguards policies, it will need additional support to strengthen its technical capacity on both social and environmental safeguards management.** This institutional capacity enhancement will be provided under NESAP Component 4 (TA to strengthen institutions) and supported by hiring an environmental and social

safeguard specialist as an ANPER PIU team member. The World Bank supervision mission teams will include environmental and social specialists.

Gender

120. The project will (a) use sex-disaggregated and gender analysis to identify the key gender gaps the project can help prevent or reduce, such as rural households lack of access to modern energy sources; (b) adopt strategic actions within the project's components to promote greater gender equality and women's economic empowerment, such as ensuring equal access opportunities to energy connections for households and businesses headed by women, working with women-owned businesses to sell solar appliances and hiring women as sales agents for solar-powered appliances, and educating female users about how to use modern energy to improve the productivity of their businesses; and (c) identify and adopt sex-disaggregated and gender-related indicators as part of the M&E system to track the implementation and performance of the gender actions and assess their results. Data from the MTF survey will help identify women's and men's differences and gaps in energy use, needs, and constraints. This will inform and improve the design of the actions to address the gender gaps.

Beneficiary Feedback

121. ANPER will be responsible to report on beneficiary feedback. ANPER will conduct annually a field-based beneficiary feedback survey and cell phone surveys as part of the M&E efforts under the proposed project. The mechanism will benefit from the remote control technology currently used in solar technologies and mini-grids. Solar companies and operators benefitting from project financing, as well as NIGELEC, will be required to maintain a customer database that provides customer contacts and basic profiles, along with commercial information regarding consumption and payments.

F. Environment (including Safeguards)

122. **The project safeguard category is 'B' as the type of interventions foreseen will not have major impacts on the population or the environment.** OP/BP 4.01, Environmental Assessment, is triggered. As a result, an Environmental and Social Management Framework (ESMF) was prepared, consulted upon, and disclosed in-country and by the World Bank on April 8, 2017 and April 10, 2017, respectively. The proposed project is intended to generate positive environment benefits (including GHG emission reductions) mainly derived from the switch of power generation from a fossil fuel source (isolated grids with diesel generators) and from fuel-burning lighting devices like kerosene lamps, oil lamps, gas lamps, and candles used in rural areas to a renewable source (solar energy).

123. **While the project interventions bear some environmental and health safety risks, no significant and/or irreversible adverse environmental and social issues are expected.** The potential impacts on local environment of the project will be very small and limited to the disposal of lead acid or nickel-cadmium batteries. Those impacts are expected to be local, site-specific, and easily manageable.

124. **In addition, OP 4.03, Performance Standards for Private Sector Activities, will be triggered since private companies will construct and operate the activities under Components 1 and 2**. Notwithstanding OP 4.01, the World Bank applies the World Bank Performance Standards to Component 1 and 2 of the project and the World Bank Safeguard Policies to the rest of the project.

125. **It is worth noting that the Borrower is already implementing NELACEP with an approved ESMF and RPF for the energy sector.** However, further capacity building support, especially for environmental and social safeguards related to Performance Standards for Private Sector Activities will be needed since limited or unknown experience of the private sector including the financial intermediary institutions in Niger dealing with International Finance Corporation standards has been recorded.

126. **OP/BP 4.11, Physical Cultural Resources, has been triggered, therefore the project will take a careful approach regarding cultural issues ('chance finds' procedure).** The eligibility criteria for investment projects will ensure that no investments are selected in areas with a cultural heritage potential.

127. **Since ANPER has limited, if almost inexistent, experience in piloting projects which are applying the World Bank's and Niger's national environmental and social safeguards policies, it will need additional support to strengthen its technical capacity on both social and environmental safeguards management.** Under Component 2, ANPER will provide subsidies for companies to invest, construct, operate, maintain, and further expand mini-grids projects. It will also conduct technical feasibility studies for those projects preparation and implementation support including environmental and social safeguards assessment and supervision. The needed institutional capacity enhancement for ANPER will be provided under the NESAP Component 4 and supported by hiring an environmental and social safeguards specialist as part of the ANPER PIU. ANPER will also work closely with the CNES for integration of environmental and social risks analysis in solar technologies developed and disseminated under the project.

128. **The specialist will take responsibility for overseeing compliance with the environmental and social guidelines established under the ESMF and RPF in accordance with national and World Bank policies and procedures.** The safeguards management plans' monitoring and reporting requirements will be discussed at the project launch workshop. The stakeholder's institutional capacity, including NIGELEC, ANPER, financial intermediaries, and the private sector, to implement the safeguards management plans will be periodically reviewed and accordingly enhanced.

129. **The World Bank supervision teams will include environmental and social safeguard experts.** Regular monitoring reports on the implementation of environmental and social safeguards provisions will be provided to the World Bank for approval. These reports will be verified during project supervision missions, which will include environmental and social safeguard experts. At the national level, the Environmental Evaluation and Impact Studies Office (BEEEI) of the Ministry of the Environment will be in charge of external M&E of safeguards. A Memorandum of Understanding will clearly describe the type of support, attributions, and modus operandi of the BEEEI and other structures involved in project compliance monitoring with national and applicable World Bank safeguard policies and procedures.

G. Other Safeguard Policies (if applicable)

130. No other safeguard policies are triggered for the project.

H. World Bank Grievance Redress

131. **Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress**

mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit *http://www.worldbank.org/en/projects-operations/systems-and-services/grievance-redress-service*. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

VII. RESULTS FRAMEWORK AND MONITORING

Results Framework

COUNTRY : Niger

Niger Solar Electricity Access Project (NESAP)

Project Development Objectives

The objective of the project is to increase access to electricity through solar energy in rural and peri-urban areas of the Republic of Niger.

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: People provided with new or improved electricity service (Corporate Results Indicator)		Number	0.00	399000.00	Quarterly and Annual	CNES, ANPER and NIGELEC's reports and Quarterly Project reports	ANPER, NIGELEC and CNES
of which females (percentage)		Percentage	0.00	50.00	Quarterly	ANPER and NIGELEC's reports and Quarterly Project reports National Statistics	ANPER and NIGELEC

Description: The indicator measures the number of people that have received new or improved electricity service under the Project. It is calculated as the sum of the beneficiaries of Component 1 (Lighting Africa products equivalence in people), Component 2 (number of people per new household connected to the mini-grid) and Component 3 (number of people per new household connected and household with improved electricity service in NIGELEC mini-grids)

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Generation capacity of energy constructed or rehabilitated (Corporate Results Indicator)		Megawatt	0.00	9.50	Quarterly and Annual	ANPER and NIGELEC's reports and Quarterly Project reports	ANPER and NIGELEC
Description: The indicator measures in megawatts (MW) the generation capacity of renewable energy facilities constructed or rehabilitated through Component 2 and Component 3 of the Project supported by the World Bank. This project promotes solar generation. The baseline value for this indicator will be zero.							

Intermediate Results Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Number of Lighting Africa-certified solar products sold (Component 1)		Number	0.00	100000.00	Quarterly	ANPER's reports and Quarterly Project reports; In coordination with the Ministry of Finance.	ANPER and CNES
Description: This indicates the sales volume of certified solar energy products financed under the Project.							

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: People provided with electricity access from solar standalone systems (Component 1)		Number	0.00	300000.00	Quarterly	ANPER's reports and Quarterly Project reports	ANPER and CNES
Description: The indicator measures the number of people that have received solar kits/lanterns and solar home systems through the Project interventions.							

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Number of solar companies financed by the Project (Component 1)		Number	0.00	10.00	Quarterly	ANPER's reports and Quarterly Project reports	ANPER and CNES
Description: This measures the number of private companies offering solar products through the Project.							
Name: Number of farmers acquiring solar pumps through solar companies financed by the Project (Component 1)		Number	0.00	1000.00	Quarterly and Annual	ANPER's reports Quarterly Project reports	ANPER and CNES; in coordination with Ministry of Finance
Description: The indicator measures the number of farmers with access to solar pumping technology for irrigation under the Project.							
Name: Volume of Project Funding: Line of Credit - Solar Energy Sector (Households and Enterprises) (Component 1)		Amount(USD)	0.00	8500000.00	Quarterly	MoF's and CNES reports and Quarterly Project reports	MoF, ANPER and CNES
Description: This indicator measures the total volume of financing to the solar energy sector as a result of the line of credit financed by the project. Report the cumulative amounts disbursed as of most recent data available. "Solar energy sector" here refers to financing meeting the eligibility criteria under both the enterprise finance (via commercial banking sector) and household finance (via the microfinance sector) and applies to solar companies, electronic traders, households, and farmers.							
Name: Number of households provided with electricity access from new		Number	0.00	6000.00	Quarterly	ANPER's reports and Quarterly Project reports	ANPER

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
solar mini-grid systems (Component 2)							
of which women headed households (percentage)		Percentage	0.00	16.00	Quarterly and Annual	ANPER's reports and Quarterly Project reports	ANPER
Description: The indicator measures the number of households that have received new electricity service through solar mini-grids supported by the Project under Component 2.							
Name: Annual electricity output from renewable energy (Component 2)		MWh/year	0.00	3300.00	Quarterly and Annual	ANPER's reports Quarterly Project reports	ANPER
Description: The indicator measures in megawatts hour per year (MWh/yr) the generation of renewable energy (solar) facilities constructed under the Project							
Name: Number of Private operators managing solar mini-grids in rural areas (Component 2)		Number	0.00	10.00	Quarterly	ANPER's reports and Quarterly Project reports	ANPER
of which percentage of women workers of the operators (percentage)		Percentage	0.00	15.00	Quarterly and Annual	ANPER's reports Quarterly Project reports	ANPER

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Description: This measures the number of private operators operating a mini-grid under Component 2 of the Project.							
Name: Households provided with new electricity access from solar hybridization of existing NIGELEC mini-grids (Component 3)		Number	0.00	7500.00	Quarterly	NIGELEC's reports and Quarterly Project reports	NIGELEC
of which women headed households (percentage)		Percentage	0.00	16.00	Quarterly and Annual	NIGELEC's reports Quarterly Project reports	NIGELEC
Description: The indicator measures the number of people that have received new electricity service through NIGELEC operated solar mini-grids financed under the Project.							
Name: Households provided with additional hours of electricity from solar hybridization of existing NIGELEC mini-grids (Component 3)		Number	0.00	3000.00	Quarterly	NIGELEC's reports and Quarterly Project reports	NIGELEC
of which women headed households (percentage)		Percentage	0.00	16.00	Quarterly and Annual	NIGELEC's reports Quarterly Project reports	NIGELEC

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Description: The indicator measures the number of people that have received improved electricity service (increase in hours of supply) through solar hybridization of existing NIGELEC mini-grids under Component 3							
Name: Annual electricity output from renewable energy (Component 3)		MWh/year	0.00	12700.00	Quarterly and Annual	NIGELEC's reports Quarterly Project reports	NIGELEC
Description: The indicator measures in megawatts hour per year (MWh/yr) the generation of renewable energy (solar) facilities constructed under the Project							
Name: Average electricity generation cost (US$/kWh) of isolated grids in hybridized mini-grids (Component 3)		Amount(USD)	0.38	0.24	Quarterly	NIGELEC's reports and Quarterly Project reports	NIGELEC
Description: This captures the average generation cost savings through the solar hybridization of existing diesel-based isolated mini-grids.							
Name: Number of productive users provided with electricity access from mini-grid systems		Number	0.00	675.00	Quarterly and Annually	ANPER and NIGELEC's reports and Quarterly Project reports	ANPER and NIGELEC
Description: This indicator measures the number of small businesses with access to electricity for produce through mini-grids financed under the Project							
Name: Project-related		Percentage	0.00	100.00	Quarterly	ANPER and NIGELEC's	ANPER, NIGELEC

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
grievances registered under the project grievance redress mechanism and addressed						reports and Quarterly Project reports	and CNES
Description:							
Name: ANPER published reports on beneficiary feedback and how it has been incorporated in the Project		Yes/No	N	Y	Quarterly	ANPER and NIGELEC's reports and Quarterly Project reports	ANPER, NIGELEC and CNES
Description:							

Target Values

Project Development Objective Indicators

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	YR6	End Target
People provided with new or improved electricity service (Corporate Results Indicator)	0.00	0.00	57600.00	144000.00	223800.00	318000.00	399000.00	399000.00
of which females (percentage)	0.00	0.00	50.00	50.00	50.00	50.00	50.00	50.00
Generation capacity of energy constructed or rehabilitated (Corporate Results Indicator)	0.00	0.00	2.40	4.35	8.38	9.30	9.50	9.50

Intermediate Results Indicators

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	YR6	End Target
Number of Lighting Africa-certified solar products sold (Component 1)	0.00	0.00	15000.00	30000.00	50000.00	75000.00	100000.00	100000.00
People provided with electricity access from solar standalone systems (Component 1)	0.00	0.00	45000.00	90000.00	150000.00	225000.00	300000.00	300000.00
Number of solar companies financed by the Project (Component 1)	0.00	0.00	2.00	4.00	6.00	8.00	10.00	10.00
Number of farmers acquiring solar pumps through solar companies	0.00	0.00	100.00	400.00	600.00	8600.00	1000.00	1000.00

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	YR6	End Target
financed by the Project (Component 1)								
Volume of Project Funding: Line of Credit - Solar Energy Sector (Households and Enterprises) (Component 1)	0.00	42700.00	1275000.00	2125000.00	4250000.00	6375000.00	8500000.00	8500000.00
Number of households provided with electricity access from new solar mini-grid systems (Component 2)	0.00	0.00	800.00	2500.00	4100.00	5000.00	6000.00	6000.00
of which women headed households (percentage)	0.00	0.00	16.00	16.00	16.00	16.00	16.00	16.00
Annual electricity output from renewable energy (Component 2)	0.00	0.00	500.00	1400.00	1800.00	2800.00	3300.00	3300.00
Number of Private operators managing solar mini-grids in rural areas (Component 2)	0.00	0.00	2.00	4.00	8.00	10.00	10.00	10.00
of which percentage of women workers of the operators (percentage)	0.00	0.00	15.00	15.00	15.00	15.00	15.00	15.00
Households provided with new electricity access from solar hybridization of existing NIGELEC mini-grids (Component 3)	0.00	0.00	800.00	5000.00	5800.00	7500.00	7500.00	7500.00
of which women headed households	0.00	0.00	16.00	16.00	16.00	16.00	16.00	16.00

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	YR6	End Target
(percentage)								
Households provided with additional hours of electricity from solar hybridization of existing NIGELEC mini-grids (Component 3)	0.00	0.00	500.00	1500.00	2400.00	3000.00	3000.00	3000.00
of which women headed households (percentage)	0.00	0.00	16.00	16.00	16.00	16.00	16.00	16.00
Annual electricity output from renewable energy (Component 3)	0.00		2500.00	5900.00	9700.00	11700.00	12700.00	12700.00
Average electricity generation cost (US$/kWh) of isolated grids in hybridized mini-grids (Component 3)	0.38	0.38	0.37	0.29	0.24	0.24	0.24	0.24
Number of productive users provided with electricity access from mini-grid systems	0.00	0.00	80.00	150.00	200.00	325.00	400.00	675.00
Project-related grievances registered under the project grievance redress mechanism and addressed	0.00	5.00	15.00	35.00	60.00	80.00	100.00	100.00
ANPER published reports on beneficiary feedback and how it has been incorporated in the Project	N	N	Y	Y	Y	Y	Y	Y

ANNEX 1: DETAILED PROJECT DESCRIPTION

COUNTRY: Niger
Niger Solar Electricity Access Project

1. The proposed project will assist in establishing the foundation for scaling up access to solar-based electricity services in rural areas. Its scope is nationwide, with a particular focus on rural areas in the agricultural belt and peri-urban areas where electricity services are deficient or absent. The project will include three investment components and a TA component. Component 1 will support the provision of the lowest level of electricity services to dispersed populations nationwide through the development of the market for solar pico-PV systems and stand-alone solar systems. Support will be provided to a financing intermediary that will on-lend to private companies investing in the solar business and to microcredit institutions that will provide credit to purchasers. Component 2 will support a higher level of electricity grid service of at least 16 hours to concentrated populations with sufficient demand in areas that are too far to benefit from grid extension in the medium term through the establishment of isolated hybrid solar mini-grids in areas outside the national utility concession, through PPPs to install and operate the systems. Component 3 will support improvement and expansion of electricity service in areas with existing diesel mini-grids through investment in existing diesel-based isolated grids operated by the national utility to add hybrid PV generation and storage technologies to provide at least four additional hours of service as well as extend the grids and provide additional connections.

2. **The project will make use of the geo-spatial plan to be prepared as part of the NES to select priority locations for project investments in solar-diesel hybrid mini-grids.** The geo-spatial plan, expected to be finalized by the end of 2017, will be used to define priority locations for the new solar-diesel hybrid mini-grids to be established and the existing diesel mini-grids to be hybridized with solar under the project. As noted above, the geo-spatial plan will define priority investments in five-year increments to ensure effective implementation of electricity access, considering electricity demand, technology options, and least-cost approaches. The project's investments to support independent solar systems would not be aimed at specific geographical locations but rather at market development to help solar system providers to provide electricity service to those households or businesses that cannot afford electricity connections and are in areas of unreliable service or difficult-to-reach areas where population is not sufficiently concentrated to justify service from the national grid or isolated renewable-diesel mini-grids.

3. **The project will also provide TA to address market, institutional, and regulatory barriers and support the implementation of sustainable off-grid rural electrification.** TA will be provided to the private sector and financing institutions (financial intermediaries and MFIs) to catalyze transactions. TA will also be provided to help establish the institutional and regulatory framework, technical and quality of service standards, and monitoring mechanisms and to strengthen the capacity of public institutions and private operators for the implementation and operation of the rural electrification schemes. The proposed project will include four components as described in the following paragraphs.

Project Components

Component 1: Market Development of Stand-alone Solar Systems (estimated cost US$7 million equivalent IDA Credit)

4. The objective of this component is to increase access to commercial financing to solar energy companies and develop a sustainable market for high-quality, stand-alone solar systems. The project utilizes a line of credit in accordance with World Bank OP/BP 10.00, where World Bank financing is channeled through financial institutions on an efficient and commercial basis to promote greater availability of credit to underserved markets. The development of the market for stand-alone solar systems (such as SHS, solar lanterns, solar water pumps) will provide opportunities for households, farmers, social services (such as health centers and schools), and small businesses and agribusinesses (SMEs) to get access to services using electricity (including lighting, appliances, and productive uses such as pumping for irrigation schemes and water supply networks). In the absence of consumer financing, the annualized market for solar lanterns and SHS is estimated at around US$9 million, representing a sales volume of around 600,000 mainly basic, low-functionality solar lanterns. Consumer financing would unlock an additional US$34 million, reach an additional 350,000 households, and raise levels of energy access to include more sophisticated SHS.[19]

5. Several factors constrain importation of quality-certified systems by private actors and the growth of this market,[20] including; (a) lack of access to financing for importers, retailers, and consumers; (b) lack of an enabling policy and regulatory framework, including the 52 percent of import duties to solar products; (c) lack of national quality standards for PV systems and the resulting risk of competition from low-quality systems; (d) low levels of awareness of solar systems and their advantages as well as ways for buyers to distinguish good quality systems, especially in rural areas; (e) technical and business skills constraints; and (f) high in-country transportation costs and lack of distribution networks in rural areas. There are also concerns surrounding the ability-to-pay and the general risk profile of households/end customers. This component will tackle the financing barrier through the investment activities described in the following paragraphs and the other barriers will be supported through TA under Component 4.

6. Today, the overwhelming majority of solar energy companies cite constraints on access to financing and households cite the lack of longer-term (over 12 months) retail financing as key barriers to development of this market (see also Box 1.1 on Islamic finance). Financial inclusion of households and SMEs is the dominant challenge for Niger's financial sector—in 2014, only 6.7 percent had access to a formal transaction account. Niger's financial depth[21] is among the lowest in the world. While the banking sector is considered generally stable, despite recent mild deterioration of portfolio quality of banks,[22] resources are generally short-term (less than 12 months), which make consumer financing for solar products difficult given the affordability profile of consumers and the longer-term financing needs

[19] Figures are based on the market assessment analysis conducted by the World Bank team, in accordance with Open Capital Advisors, and are a function of affordability measures.
[20] Constraints were identified in off-grid solar PV market assessment in Niger (January 2017).
[21] Proxied by the ratio of broad money to GDP—28 percent in Niger versus 37 percent for countries in Sub-Saharan Africa.
[22] Loan-to-deposit ratio is high (approximately 85 percent) most resources are short-term maturity, suggesting the relevance of a line of credit to promote medium-term (two years) financing of solar energy products. In December 2015, capital adequacy ratios were significantly exceeding the regulatory threshold of 8 percent. While most banks comply with financial soundness indicators, nonperforming loans to total loans stand at approximately 15 percent to 17 percent.

of importers and solar energy companies. The financial sector is also shallow and characterized by high levels of collateralization (immovable), limited credit information systems (no credit bureau), and the lack of modern bank management procedures, such as asset-liability management, credit risk quantification, and pricing. Despite their acknowledgement of the significant potential in the sector, banks lack experience financing the solar energy market, including appropriate market analysis, and require prompting to successfully intermediate credit to unlock/develop the solar energy market. To date, banks are providing financing to a small number of established companies active in importing and distributing solar energy products.

Box 1.1. Islamic Finance in Niger

Lack of access to finance for both households and firms is exacerbated by the lack of Islamic financing in Niger. Niger is over 95 percent Muslim and, although no current surveys have been identified that quantify the local demand for Islamic finance, market participants have identified this as a key and growing constraint, especially among rural households. One of the MFIs identified under the project, ASUSU, has launched an Islamic finance unit (funded separately) and its management has reported increasing demand for Islamic products, which is preferred to conventional financing. ASUSU's main constraint to expansion to meet demand has been the small size of its shari'ah compliant line from the (Islamic Development Bank and its lack of internally generated profit-sharing accounts. The regulatory regime in Niger to permit Islamic finance is being developed. The approaches identified to finance the purchase of solar units fit well with existing Islamic financial products, given the existences of a tangible asset, either through purchase via installment payments *(murabaha)* or via a lease-to-own arrangement *(ijara).*

7. Given the successful experience of partnerships between Mobile Network Operators (MNOs) and solar operators in other countries, MNOs have the potential to become a key distribution, branding, and payment partner for Niger's solar sector. Brand risk to MNOs from failed partnerships is substantial, especially in an unproven sector made up of unproven entities. Niger's fragmented MNO distribution network may prove incongruous with structuring far-reaching distribution partnerships with solar businesses. The largest MNO networks, Airtel and Orange, have a total of 45,000 and 30,000 points of sales, respectively, the vast majority of which are small, independent agents served by a network of a few dozen intermediary dealers who serve as primary distribution partners for different parts of the countries. At present, however, only around 7 percent of Nigeriens subscribe to mobile money services, and only around 1.5 percent are active users. Given Niger's large unbanked population, mobile money could enable solar distributors to reach end-users through direct consumer finance, enabling scale beyond current MFI client bases and avoiding potentially cumbersome partnerships with financial institutions on sales and distribution. In addition, mobile money—whether used by an MFI or directly by a solar distributor—can significantly reduce consumer finance transaction costs compared to typical high-touch MFI models that incur significant administrative costs in client screening, selection, monitoring, and collection.

Technical Design

8. This component will (a) set up and operate a local-currency line of credit to assist in addressing financing constraints in the solar energy market; and (b) provide TA to improve the capacity of solar companies to access commercial financing. Given the nascent market condition, the technical design is simple, involving direct contracts with one and no more than two banks and one and no more than two MFIs, and is intended as a pilot program that can be scaled up upon successful demonstration of the line

of credit. The program is coupled with TA to promote capacity, bankability, and market access for SMEs (described in Component 4). The design explicitly incorporates Niger's microfinance sector as it is well developed, has expansive outreach,[23] and utilizes group lending that can assist in counterbalancing traditional collateral requirements. MFIs in Niger also have past experience through related donor projects in financing household solar energy kits at the village level.

9. This component has been designed based on the lessons learned and the experience gained from Lighting Africa in East African countries, especially Ethiopia and Kenya, and other past World Bank interventions with financing institutions in Niger. Lessons from Lighting Africa's experiences include: (a) providing access to finance through a line of credit to a financial intermediary can work well—in Ethiopia, a US$20 million Access to Finance Facility resulted in more than 750,000 quality-approved solar lanterns being imported and distributed by the private sector, providing access to about 3.9 million people; and (b) a robust quality assurance framework is essential—Kenya adopted/applied the Lighting Africa quality standards, which provided clarity to the private sector, and imports of solar systems increased after application of the standards.

10. Reliability, affordability, and sustainability considerations are at the core of the market-based approach of this component. The project will only support companies that sell quality verified systems, as determined by the IEC and Lighting Global specifications. The loans provided by the project will be designed to match the financing needs of the solar companies, which will be expected to extend financing to users. A demand assessment shows that over half a million households in rural areas will be able to afford solar systems offering Tier 1 electricity service, whereas an additional 800,000 households could afford solar systems offering Tier 1 and 2 electricity service if a consumer financing mechanism such as Pay-As-You-Go (PAYG), is established.[24] For this reason, the financing mechanism of the project will provide incentives to solar companies to offer an extended repayment period to make product purchases more affordable. By extending the tenor, instead of offering the consumer subsidies, the project also aims at increasing sustainability of services. The long-term relationship between the customer and the off-grid service providers encourages the latter to provide after-sales service, including honoring product warranties that will be required under the project. Since customers pay full market price for energy services, they are also expected to be able to afford parts and system replacements in the future. In fact, this is the core tenet of the PAYG relationship, whereby, the system provider aspires to become the long-term service provider to their customers (see Box 1.2).

[23] The number of people with a bank account in 2014 was 438,170 versus 722,322 adults with a microfinance account. *Source:* Central Bank and MoF data.
[24] Off-grid solar market assessment in Niger 2017, Open Capital Advisors.

Box 1.2. Current Business Models of Solar Companies: Sales versus PAYG

Two types of business models underpin the majority of solar companies that operate in African countries. The first model includes companies that sell solar systems (for example, lanterns, SHS, and water pumping systems) on an over-the-counter (cash sale) basis. These companies require short-term, debt-to-finance costs associated with hardware manufacture and transportation (typically from China). This cycle typically lasts anywhere from three to six months. A second model offers consumer credit such as PAYG, whereby, customers pay for the systems in monthly installments (typically between 12–36 months), and solar companies carry the default risk during the payback period. These businesses typically require debt financing that is commensurate with the lending terms that they extend to their customers.

Given that companies' revenues are in local currency, the debt instrument needed to support the PAYG type approach will also offer loans in the local currency. This instrument will address a critical failure in the market—the limited debt financing that is available for the industry is denominated in hard currency and the cost of hedging instruments is too high to be borne by the companies. As such, using IDA to deliver local currency debt constitutes a major incentive for the industry, and will also create a demonstration effect that can later be followed by local commercial banks.

11. The direct beneficiaries of this component would be households, farmers, micro-firms, and solar companies who will benefit from increased access to finance through the line of credit and TA program. The beneficiaries of this component will also include financial institutions who will build institutional capacity in serving the solar energy market. The location of these beneficiaries will be market determined; the households or businesses that purchase such systems will be those that cannot afford electricity connections or are in areas where grid-based electricity service is not available or inadequate.

12. The line of credit, which will be managed by the MoF,[25] will consist of two windows:

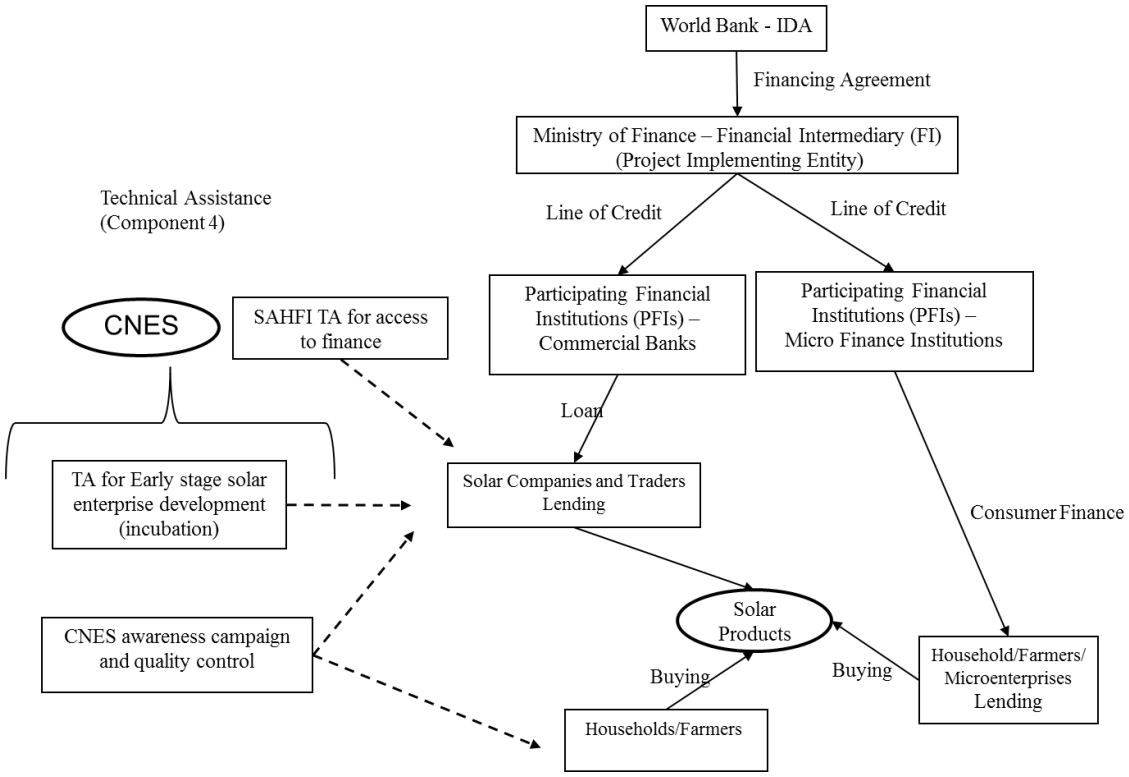
- **Enterprise financing.** The first window will provide working capital or direct investment capital to solar system importers, wholesalers, retailers, installers, and solar electricity service providers. The financing will enable them to import high-quality solar equipment, develop distribution channels, provide services, and make investments to expand their activities. Up to two commercial banks will be selected to act as the PFI for this window.

- **Microfinance.** The component will leverage Niger's well-developed microfinance sector by providing a second window that will provide support to MFIs to provide credit to households, micro-firms, and farmers for purchase of pico-PV systems and SHS. One microfinance institution (MFI), and possibly two, will be selected as the PFI for this window.

13. A TA program to strengthen the capacity of solar companies working through existing SME support platforms provided by start-up incubators and SAHFI, Niger's national credit guarantee agency[26] (see Component 4 for more details).

[25] Niger lacks a development bank or apex institution typically used as a wholesaler. The MoF was chosen as the PIU for this component because of its technical knowledge of the financial sector and its fiduciary capacity to effectively manage a liquidity support program. See Annex II for full fiduciary analysis of the MoF.

Figure 1.1. Operational Scheme of Component 1 of NESAP



Commercial Bank Window - Enterprise Financing

14. The commercial bank will appraise the eligibility and creditworthiness of the borrowing importer/solar company, as well as the eligibility and feasibility of the solar-system related investment. If the bank is satisfied that the borrower is creditworthy and the solar-system investment makes business sense and that all applicable eligibility criteria are met, the bank shall submit the sub-loan for approval by the bank's Credit Committee, following its own applicable credit risk appraisal and management procedures.

15. The first two sub-loans from each commercial bank will require prior review by the World Bank. Once the World Bank completes the review, it provides no-objection. If the World Bank has any issues or notes any deficiencies, the MoF will be informed, in writing, about details of the World Bank's assessment and any remedial actions required. If any remedial actions are required, the MoF shall inform the commercial bank on how to address the noted issues or deficiencies. Once the issues have been adequately addressed, the World Bank may ask for the second review. All sub-loans issued by banks can be subject to ex post review as decided by the MoF and/or the World Bank.

16. The interest rate between the bank and the final borrower will be competitive according to market conditions. The MoF will lend the financing received from IDA to the PFI, charging a spread to

[26] SAHFI is incorporated in the project through leveraging existing SME support services for early stage companies seeking bank finance. Financing to expand SAHFI's partial credit guarantee program was considered but not followed through on because of capacity constraints. Strengthening SAHFI's role to promote SME finance may form the basis of future World Bank Group engagements to support access to finance in Niger.

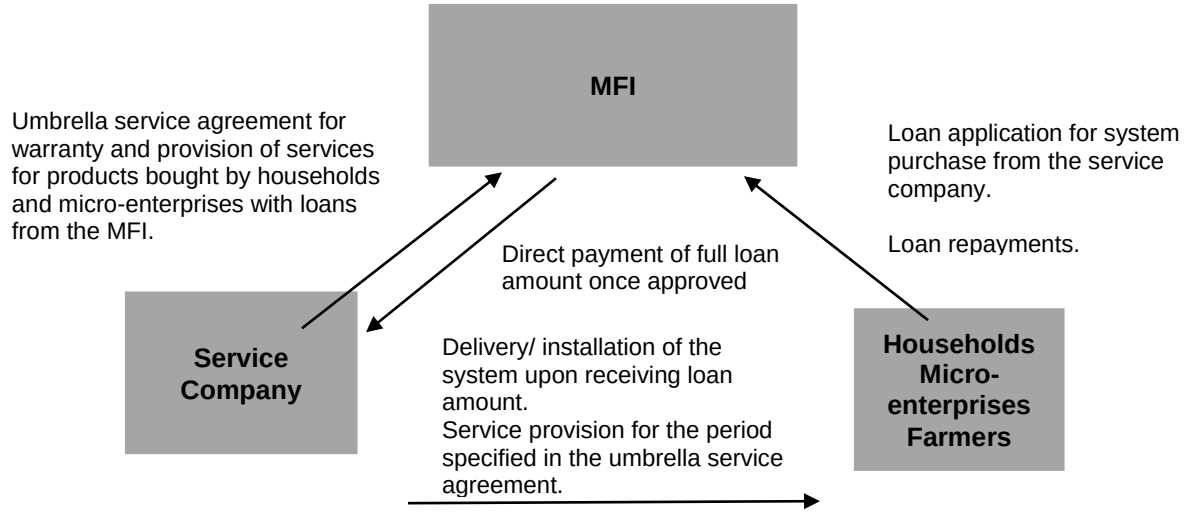
cover its costs of administering and managing the liquidity facility. This spread will be in addition to the spread that the MoF will charge for taking the currency risk. The bank will charge an interest rate to their customers, taking into account the cost of funding, operational costs, and an appropriate credit risk premium based on the credit risk assessment of the borrower. Banks will assume full credit risk for all sub-loans extended.

17. Financing will be provided to eligible, locally-registered off-grid solar companies and/or established electronics importers that comply with the eligibility criteria that will be described in the Operations Manual of the line of credit (OM). Once prequalified, the borrowing companies will be expected to meet the eligibility criteria at all times. The OM will be part of the Project Implementation Manual (PIM)

Microfinance Window - Household Financing

18. The MoF will enter into sub-financing agreements with the MFI, which will specify the terms and conditions applicable to the local currency financing, as agreed with the World Bank. Financing will be provided in tranches and extended in local currency, with loan maturity of up to 36 months (including three months of grace period). The MFI will use the financing to extend sub-loans to individuals, farmers, households, and micro-enterprises based on a drawdown model. The MFI will take full credit risk in onlending to their customers. The MFI will enter into service agreements with off-grid solar companies. Under the agreement, companies will need to provide product warranty and servicing for the whole duration of loan tenors. The OM will provide a template of the agreement. Figure 1.2 illustrates the partnership model for the microfinance window.

Figure 1.2. Partnership Model for Microfinance Window Operations



19. The MFI window will include the following types of financing: (a) sub-loans to individuals; (b) sub-loans to households; (c) sub-loans to farmers; and (d) sub-loans to micro-enterprises. The first two tranches to the MFI will be subject to prior review and no-objection by the World Bank. The OM will specify details regarding the processes, terms, and conditions.

20. Under the drawdown model, the approval process will be as follows. The client submits an application to the MFI for a sub-loan for the purchase of a solar system or product of at least Tier 1 access level or solar pump. The MFI will appraise the eligibility and creditworthiness of the final borrower, as well as the feasibility of the investment in case of micro-enterprises. If the MFI is satisfied that the final borrower is creditworthy and that all applicable eligibility criteria are met, the sub-loan will be approved by the MFI Credit Committee following applicable credit risk appraisal and management procedures. If the MFI Credit Committee approves the sub-loan, a sub-loan agreement with the borrower (including mandatory clauses, as specified) will be signed and followed by disbursements to the borrower. The MFI will submit to the MoF all required documentation specified in the OM. The MoF may decide to do a post-review of the appraisal and/or lending process and of the related sub-loan documentation.

21. All sub-loans issued by the MFI can be subject to ex post reviews as decided by the MoF and/or the World Bank. The OM will specify the processes to be followed in evaluating and approving the applications, monitoring mechanisms on active loans, and reporting and further disbursing to the intermediaries. The MFI will have the full responsibility, vis-a-vis the MoF and the World Bank, to ensure that the sub-loan and lending terms are in compliance with the eligibility requirements and all other requirements imposed by the OM and the applicable credit policies. Any sub-loan could be subject to ex-post review of all the sub-loan documentation by the MoF and the World Bank for verification of compliance.

22. Once the MFI has fully utilized the tranche, it can apply to the MoF for an additional tranche. The application can be started when the tranche is 70 percent utilized. The MFI must demonstrate it is using the facility effectively and have a nonperforming loan ratio of less than 5 percent to receive a higher drawdown amount and a higher loan cumulative amount if approved by the MoF and the World Bank.

23. Criteria for financing household and microenterprises through the MFI window will be based on adherence to customer due diligence requirements and general client assessment principles (credit worthiness, account history, and so on). The criteria will be agreed and detailed in the OM.

Flow of Funds, Operational Principles, and Pricing

24. Component 1 finances a financial intermediary loan with the GoN as the Borrower. The World Bank will extend NESAP funds denominated in U.S. dollars to the GoN. Selection of both the commercial bank and the MFI acting as PFIs is led by the MoF and based on a competitive tender process assessing the quality and capacity of short-listed institutions. The World Bank will provide the no-objection to the selection based on OP 10.00 evaluation criteria. The evaluation criteria to establish these two institutions include: (a) applicable prudential regulations and supervision framework (see Box 1.3 for more details); (b) governance structure and organization; (c) business plan and performance targets; (d) financial condition and risk management capacity; (e) financial instruments and services offered; (f) experience in providing and managing services and instruments that will be offered/used under the component; and (g) quality and effectiveness of support functions, including accounting and bookkeeping, effective internal audit function, good information systems and management reporting, and interconnectivity and IT support/staffing. The GoN will bear the foreign exchange and credit risk of lending to the two PFIs. The appraised financial institutions that almost meet the criteria could still

participate in the facility subject to the signing of a Memorandum of Understanding with the MoF, which confirms the commitment of the bank to remedy the issues identified within six months' time.

Box 1.3. Financial Criteria for Selecting the PFIs

(a) **Compliance with prudential regulations issued by the *Banque Centrale des Etats de l'Afrique de l'Ouest* (BCEAO).**

(b) **Adequate organization and governance -** 'fit and proper' owners, competent management, adequate organization, and institutional capacity for its specific risk profile.

(c) **Capital adequacy -** compliance with BCEAO regulations with a minimum capital of 15 percent calculated as the ratio of total capital to total assets.

(d) **Adequate liquidity -** compliance with BCEAO regulations (that is, liquid assets to total deposits at 30 percent), well managed or no maturity gaps.

(e) **Adequate profitability** - positive profitability and stable earnings trend, well-managed cost structure.

(f) **Adequate credit portfolio structure and portfolio quality -** well-defined lending policies and procedures, acceptable credit portfolio structure, regular loan classification and provisioning,[27] low concentration, lending to connected parties within prudential limits, low-level of nonperforming loans (that is, a nonperforming loan ratio as percentage of total assets not exceeding 5 percent), and effective collection practices.

(g) **Adequate internal controls, overseen by the Audit Committee** - independent internal control function with defined procedures, annual internal controls plans, regular reviews by the Audit Committee, and follow-up on issues raised in internal controls reports.

(h) **Adequate accounting, bookkeeping, and management information system, with adequate internal controls.**

(i) **Appropriate implementation capacity -** for carrying out client and sub-loan appraisals and for supervision of the use of funds and micro-enterprise subproject implementation.

25. Access to financing for both windows will be on a first-come, first-served basis between the two windows to allow for flexibility during project implementation. In accordance with World Bank Group operational guidelines, pricing to the PFIs and final borrowers will be competitive according to market conditions and, at a minimum, will incorporate the financial costs of mobilizing resources, the administrative costs of monitoring the loan and collecting repayments, and the risks inherent in lending to the market (including credit risk, liquidity mismatch, and sector-related risks). The minimum cost of mobilizing funding in the banking sector is 2.4 percent with an average credit risk markup between 3–4.5 percent. The usury rate in the banking sector is 15 percent. The average cost of funding for microfinance borrowers is higher (14 percent) with a credit risk markup in the range of 16–20 percent and a usury rate of 24 percent. PFIs will competitively determine rates to enterprises and households, following standard pricing practices and within ranges that will be outlined in the OM for this component. Credit will be provided up to 24 months to PFIs and will be cycled back into the line of credit upon successful repayments of PFIs to MoF during the course of the project.

26. The credit line will be implemented following the terms and conditions (a) between the World Bank and the MoF; (b) between the MoF and the PFI; and (c) between PFIs and borrowers. Some of the terms and conditions may need to be modified during project implementation with prior consent of the World Bank. They are outlined in the OM, which is a live operational document.

[27] At least four times per year and adequate provisioning.

(a) Loan terms and conditions between the World Bank and the MoF:

- The MoF will maintain, during project implementation, an implementing unit with procedures, responsibilities, and qualified personnel capable of implementing all aspects of the component in a satisfactory manner.

(b) Loan terms and conditions between the MoF and the PFIs:

- The PFIs must be in compliance with the fiduciary and safeguards requirements listed in the PIM.
- The PFIs must start and remain in compliance with eligibility criteria as stated during the expression of interest process.
- For the duration of the project implementation period, the PFIs will submit an audit report annually in accordance with the International Standards on Auditing and International Financial Reporting Standards.
- The PFIs must submit relevant reports including the semiannual, unaudited interim financial reports (IFRs) certified by its management.
- The PFIs will be subject to monitoring of the PDO and intermediate results indicators in the relevant section of the results framework and monitoring, and the additional indicators in the PIM.
- The PFIs will be responsible for verifying that sub-beneficiaries comply with applicable Nigerien environmental legislation and regulations and the World Bank policies on environmental assessment, natural habitats, forest, physical cultural resources, pest management, and indigenous peoples.
- The PFIs will provide the MoF with a set of documentation for all sub-finance to enable it to maintain all project records and make them available for ex post review by the World Bank or external auditors as necessary.
- The PFIs and borrowers will be required to provide reasonable information during the life of the project (and for a certain period after the project) as requested by the World Bank and the MoF.

Component 2: Rural Electrification through Service-based Solar Hybrid Mini-grids (US$8.2 million equivalent IDA Credit and US$1.8 million equivalent IDA Grant)

27. This component, to be implemented by ANPER, will subsidize the provision of electricity to rural localities outside the national utility concession area that are not expected to be reached by the national grid in the short term but have large populations, high density, power demand, and considerable economic and social activity. The component is expected to result in about 2 MW of installed PV generation and associated distribution facilities for the mini-grid to provide 6,000 electricity connections to households, community facilities, and productive users, with specific emphasis on agribusinesses and

pumping services for irrigation and drinking water supply. The hybrid generation systems will combine solar PV, battery storage, and thermal units as a backup option and will feed energy into small transmission and/or distribution networks extending to service drops for end users. The selection of the locations for implementation of new mini-grids under the project will be consistent with the geo-spatial plans developed under the NES, while considering the specific characteristics required for locations in this component.

28. The approaches for the electrification of the isolated localities are drawn from the recent PASE-Safo pilot, the operator's model of water supply in rural areas in Niger, and the Mali rural electrification scheme. PASE-Safo was designed based on a study that assessed energy demand of households and productive and community users, identified constraints in sustaining adequate O&M, and led to the competitive recruitment of a private operator (following the operator model approach applied in the rural water supply sub-sector in Niger) under a lease (*affermage*) contract (*contrat de service délégué*) for the installation and O&M of SHS. A similar top-down approach is being followed for the development of a mini-grid with support from ECREEE and Plan International. Such a top-down approach with further improvement in contract oversight and regulation could be utilized in the proposed project. Another approach has been applied in Mali with significant success. The *Agence malienne pour le développement de l'énergie domestique et l'électrification rurale*, the rural electrification and household energy agency of Mali, assessed unsolicited electrification proposals from local sponsors, competitively selected proposals and business plans, and provided up to 80 percent of capital subsidy for infrastructure construction. In less than 10 years, this bottom-up approach resulted in over 50 domestic private operators running mini-grids that are providing electricity services in rural areas.

29. Two approaches will be promoted in this component. The first top-down approach (similar to that of PASE-Safo) will enable ANPER to prioritize the electrification of the biggest population centers outside the national utility concession through a competitive bidding process for the selection of PPPs to invest, construct, operate, maintain, and further expand access. The second bottom-up approach will encourage subproject developers and investors to submit unsolicited proposals to ANPER for electrification through isolated hybrid PV/diesel mini-grids. This is consistent with the NES that is under preparation, which encourages the use of geo-spatial planning for the selection of localities to be served by mini-grids. PPP arrangements to be used in both approaches will range from licenses to authorizations to mini-concessions, depending on the size of the installed generation capacity and the private sector's financial ability. In both approaches, investment grants will be provided by the project to private operators to decrease costs of financing and reduce the tariffs ensuring affordability of the end users and fair profitability for the private company.

30. The associated principles and policies for rural electrification will be outlined in a strategic framework document to clarify the 'rules of the game' for all stakeholders. The REIF will be derived from the Electricity Act and constitutes the key policy instrument governing rural electrification through private operators in Niger. The adoption of the REIF by the GoN will be a disbursement condition of this component. The REIF will, among others, define the rural electrification perimeter; identify financing means; and spell out regulatory mechanisms, institutional arrangements for oversight (for example, the steering committee ensured by ANPER's Board) and regulation, and fiscal arrangements.

31. To ensure financial sustainability of the private sector-based rural electrification schemes, key policies and/or principles, such as the following, would be adopted and implemented:

- **Provision of investment and connection cost subsidies.** Rural electrification experiences in developing countries have revealed the necessity of subsidies. Subsidies will be provided to bridge financial viability gaps of electrification subprojects, make electricity tariffs affordable for users, incentivize the private sector to provide adequate electricity services in unattractive rural areas, and allow a fair profit for the private sector. The subsidy amounts will be determined on the basis of the service level proposed and the viability of the projects as shown by the business plans of the developers and will be disbursed in an output-based manner to enable smooth infrastructure construction and electricity connections.

- **Differentiated and cost-recovery tariffs.** Given the diversity of rural areas in terms of remoteness from grid/urban centers, density, economic and productive activity, household-income levels, investments in power infrastructure and revenues required are expected to differ. To reflect the inherent characteristics of each area and ensure financial sustainability, differentiated and cost-recovery tariffs are needed.

- **Careful definition of the concession area.** The scope or coverage of the concession area is closely linked to its attractiveness to the private sector as it drives the amount of equity and or debt to be brought in by private operators as well as the possible revenues. Given the challenges that private operators face to access financing, the definition of the concession area should seek to balance attractiveness with debt/equity requirement.

- **Light-handed regulations.** Rural electrification experiences in Sub-Saharan African countries, such as Mali and Tanzania, have highlighted the effectiveness of light-handed regulations in accelerating service expansion. Thus, Niger's REIF envisions developing and delegating light-handed regulations to ANPER.

32. The REIF, which is under development, will provide guidance on the technology for mini-grids. The project expects to support mini-grids powered by hybrid solar generation systems, such as PV-diesel, PV-battery (with diesel as backup only), or PV-diesel-battery systems. Selection of the appropriate hybrid solar generation system will take into consideration criteria including technology costs, reliability and quality of service, and technical standards that would promote low-cost designs and enable compatibility with the NIGELEC network to facilitate future possible integration with the main grid. Installed capacity of mini-grids would be in the range of 10 kW to one MW. Depending on the typology of the villages/communities, several mini-grids could be combined and decentralized SHS could be considered for dispersed households in the concession area.

Top-down Electrification Approach

33. **The top-down electrification approach will allow ANPER to prioritize the electrification of localities outside NIGELEC concession and according to the socioeconomic criteria.** Using this approach, ANPER would (a) identify priority electrification zones, based on population and economic potential criteria; (b) conduct feasibility studies and prepare bidding documents; and (c) launch a call for proposals to competitively select a private operator that would install and operate the electricity infrastructure for a fixed period (for example, 10–15 years). Proposals will be assessed against a number of criteria, such as leveraged financing (least subsidy requirement), number of electricity connections, quality of service, and economic and financial viability of the subproject. The selected private operator is

expected to bring equity and/or debt as a key contribution to the overall capital investment and initial operation/maintenance costs. ANPER will provide up to 80 percent of subsidy on the investment cost, to bring down the tariffs to affordable levels for households and community users. An electrification authorization, based on a PPP model would be signed between ANPER and the private operator.

34. This approach will be implemented in a phased manner, so that that lessons learned from the first phase would be incorporated in the second phase. The first phase would pilot the top-down approach in five priority zones or localities and develop detailed guidelines to roll out the bottom-up approach. As orientations on priority off-grid areas from the NES are not yet available, the zones to be piloted first would be selected in close collaboration with various stakeholders, using findings from the ongoing solar market assessment study, the geo-spatial plan, and taking into consideration the GoN's views. Subsequent zones, for the second phase, would be selected using refined criteria and inputs from the NES, expected to be completed at the end of 2017, and the geo-spatial plan. The second phase will seek to replicate the first pilots in up to 10 additional zones. It will incorporate adjustments identified from learning in the first phase, and develop a revised PIM that spells out revised procedures.

Bottom-up Electrification Approach

35. In a context where rural electrification infrastructure in Niger outside NIGELEC concession is almost inexistent, local initiatives would likely materialize if the appropriate public support were provided, as has happened in Mali in the last 10 years. This component could support the implementation of subprojects developed by various sponsors including rural water service operators, cooperatives, NGOs, women's groups, and private partnerships with rural municipalities. It will complement the top-down rural electrification approach and provide an alternative means for addressing pressing demand for electricity services in rural areas. It, therefore, would also provide grant subsidies to bridge the financial viability gap of subproject proposals that are not centrally planned and developed, but initiated by local entrepreneurs/sponsors. Key targeted types of sponsors include: (a) rural water service operators—about 56 domestic private utilities were operating 860 (75 percent of the total) rural water supply systems by the end of 2014 in Niger, and may be keen to engage in the electricity service provision space; (b) solar companies interested in expanding from equipment sales and installation to a service provision model; and (c) local entrepreneurs aiming to expand their business lines to the provision of rural electricity services. Given the limited capacity of the domestic private sector, TA will be provided through Component 4 to provide business development services to local sponsors to facilitate the preparation of adequate subproject proposals and business plans.

36. Similar to the top-down approach, the bottom-up approach will also be implemented in two phases. The first would be a preparatory phase in which ANPER will develop detailed guidelines, including low-cost technical standards to be used and pre-qualification criteria of operators. The guidelines would be validated by a steering committee comprising its Board. In addition, ANPER will conduct extensive communication and sensitization campaigns targeting potential operators, subnational governments/municipalities, and local associations to inform the public of this innovative path for rural electrification. ANPER will also be assisted to provide comprehensive training on the development of business plans to potential operators.

37. Under the second phase, unsolicited proposals will be subject to competition and will have to comply with technical and economic standards approved by ANPER. ANPER will screen and evaluate all subproject proposals that meet a minimum scale (for example, 50 kW of installed capacity for mini-grids

and 250 stand-alone systems for SHS mini-concessions). To guarantee competition and the selection of the most appropriate and cost-efficient proposals, a simplified call for proposals will be launched by ANPER allowing institutions and the private sector to submit their proposals. This process could be as follows: (a) once subproject proposals are submitted to ANPER, provisional authorizations would be issued and made public immediately; (b) this provisional authorization will include a call for proposals period (for example, two months) allowed for the reception of alternative proposals; (c) all proposals in the same zone will go through a preliminary assessment, and pre-selected proposals are required to provide, within six months, firm business plans that should include the equity/debt brought in by the sponsors; (d) a technical committee established by ANPER will thoroughly assess submitted business plans and proposals against clearly defined and agreed criteria, determine eligibility for grant subsidies, and make recommendation for approval. In parallel, required public-private arrangements will be defined. Approved subprojects' sponsors will be responsible for tendering, commissioning, installation, operation, and maintenance, with oversight exercised by ANPER. Subsidies will be disbursed gradually in an output basis, according to the project commissioning schedule.

38. For both approaches, the TA required by ANPER and the operators will be provided under Component 4. TA will be provided to support the competitive recruitment of private operators in a participatory manner. The assistance will include: (a) workshops/conferences with interested local and regional private operators; (b) definition of required equity/debt to be brought by the private operator and expected tariffs; (c) definition and drafting/validation of the appropriate PPP contract with envisioned support from the Public Private Infrastructure Advisory Facility; and (d) definition of specific mechanisms to monitor and control performance of the private operator (including role of local municipalities, ANPER, and the regulatory agency).

39. This component will also finance the services of an Owner's Engineer to assist ANPER with (a) overall component management and supervision of the design, procurement, construction, commissioning, and management of the construction contracts; and (b) coordination of the implementation of the ESMPs and RAPs.

40. The TA will, first and foremost, ensure a competitive selection of the investment options and operators by elaborating standards and templates for business plans of operators and appropriate appraisal tools for ANPER providing related training. Second, the TA will support ANPER and private operators to deliver sustainable electrification service to rural population through hands-on training on the operation of hybrid mini-grids and application of innovative and cost-efficient customer services and platforms such as smart meters and mobile payments.

Component 3: Solar PV Hybridization of Isolated Thermal Mini-grids and Expansion of Access (US$22.46 million equivalent IDA Credit and US$2.54 million equivalent IDA Grant)

41. This component, to be implemented by NIGELEC, will finance the hybridization of several existing diesel-based isolated grids with solar PV generation and battery storage in rural areas and managed by NIGELEC. This component will also expand access to electricity to unserved households and businesses, and will specifically target agribusiness and farmers in these localities. PV generation capacity, and eventually storage, will be installed to increase the hours of operation of the isolated systems and/or to decrease diesel consumption. More specifically, the objective of this component is to increase the electrification rate of a number of selected isolated centers from 20 percent to 75 percent and increase the service level from the current 8 hours or 12 hours per day to at least 16 hours of

electricity service per day by 2023. The hybridization of the selected isolated grids will result in decreased generation costs for NIGELEC and improve the quality of service to existing clients. This component will install around 9 MW of solar capacity together with the connection equipment and meters and connect around 7,500 new customers and will increase the hours of service for 3,000 existing customers. The selection of locations for implementation of solar hybridization of diesel mini-grids under the project will be consistent with the geo-spatial plans developed under the NES, while considering the specific characteristics required for locations in this component.

42. The cost of electricity supply in isolated grids is a heavy burden for NIGELEC because of the high cost of diesel-based generation, as well as the higher fuel costs and logistical challenges of these remote areas that can also disrupt service provision. These higher costs for isolated electricity supply are equalized under the national uniform tariff of NIGELEC clients, which benefits from the lower cost of Nigerian imports of electricity. Moreover, households in isolated areas generally have low-income levels and limited ability to pay as well as low consumption, posing a barrier to extension of electricity service. This results in a lack of financial incentives for NIGELEC to expand service to clients on isolated grids and to provide continuous service throughout the day. In similar contexts, hybridization with PV generation has been demonstrated to be a realistic solution to reduce electricity costs and increase service provision of current users, as well as expand energy access to new customers.

43. Overall, 115 existing diesel-based isolated grids are identified across the country. Most of these isolated grids provide either eight hours or 12 hours of electricity service per day while the two biggest grids offer 24 hours' service. This component will target selected isolated grids with an average electrification rate below 20 percent for their expansion and hybridization with PV technology. Technical, economic, and financial feasibility analyses enabled the selection of the most suitable diesel-based isolated grids for hybridization with PV technology. Table 1.1 provides a long list of possible candidate diesel-based isolated grids to be financed by this component and will be further evaluated before finalizing the selection. The main criteria used to select these isolated grids is based on the following factors: (a) distance to existing and planned grids and whether the extension cost are higher than US$3,000 per household; (b) potential to increase access to electricity, based on the number of new households to be connected; (c) reduction of the electricity production costs; (d) reduction of the amount of diesel; and (e) the socioeconomic development potential, specially through social services and productive uses from agricultural products (irrigation and transformation).

Table 1.1. Preliminary Long List of Possible Thermal Mini-Grids for Further Evaluation and Selection

Locality	Region	Number of Households (2015)	Electrification Rate (2015) (%)	Number of New Connections to Reach 75% Electrification Rate	Existing Diesel Capacity (kW)	Capacity PV to Install (kW)	Total Investment (US$, thousands)
FACHI	Agadez	566	22	300	68	192	530
GADABEDJI	Maradi	125	—	94	41	75	214
TESKER	Zinder	193	31	86	158	280	708
AZAGOR	Maradi	124	—	93	41	74	212
YARI	Zinder	138	20	75	24	33	113
BAZAGOR	Tahoua	182	35	73	82	91	255
BADER GOULA	Maradi	164	—	123	41	99	281

Locality	Region	Number of Households (2015)	Electrification Rate (2015) (%)	Number of New Connections to Reach 75% Electrification Rate	Existing Diesel Capacity (kW)	Capacity PV to Install (kW)	Total Investment (US$, thousands)
DINARA	Tillaberi	189	—	142	41	28	120
BILMA	Agadez	804	53	174	338	544	1,436
TIMIA	Agadez	455	42	148	41	272	737
TASSARA	Tahoua	376	29	174	144	300	798
TAGRISS	Maradi	188	—	141	41	113	321
N'GOURTI	Diffa	360	39	131	144	392	1,006
BOUNE	Zinder	200	—	150	41	120	342
FOULATARI	Diffa	122	16	71	24	36	116
IFEROUANE	Agadez	465	30	209	173	320	865
TARBIAT	Tillaberi	429	—	322	140	193	518
DIRKOU	Agadez	1,675	36	661	911	3,000	5,599
DINGAZI BANDA	Tillaberi	242	—	182	41	15	100
CHERI	Diffa	314	19	174	41	74	229
TAMAYA	Tahoua	459	29	209	68	165	442
TILLIA	Tahoua	684	22	364	144	345	873
MOA HAOUSSA	Zinder	364	—	273	80	164	439
DJADJIRI	Diffa	404	17	236	41	112	332
TELEMCES	Tahoua	658	20	363	105	297	771
ADERBISSINAT	Agadez	891	13	552	140	378	1,006
BANIBANGOU	Tillaberi	868	20	480	144	219	662
GOUDOUMARIA	Diffa	918	19	512	110	387	1,020
MANGAIZE	Tillaberi	789	—	592	68	195	625
INGALL	Agadez	1,386	16	820	338	657	1,699
TOTAL		**14,730**	**21**	**7,923**	**3,813**	**9,169**	**22,368**

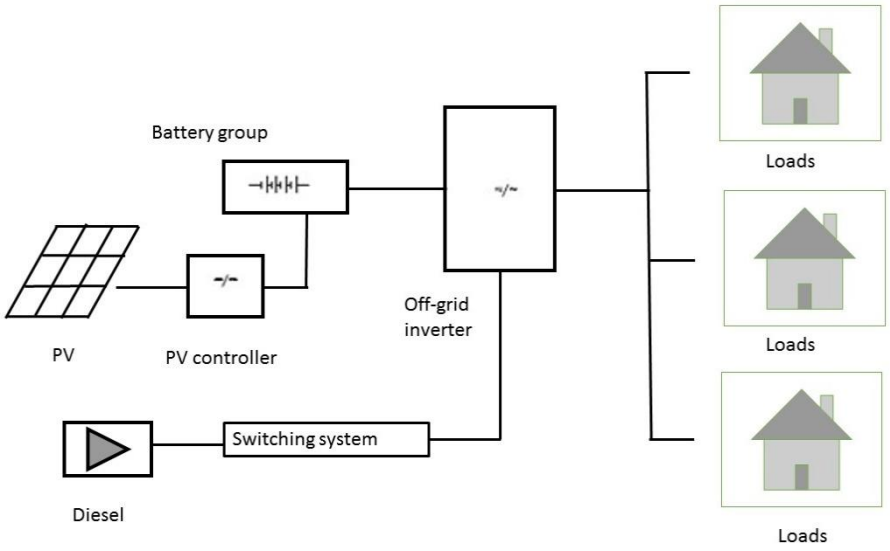
44. The economic feasibility will be determined considering the economic benefits of the component, in relation to its costs. The benefits will be estimated as the reduction in fuel costs and GHG emissions; avoided costs for customers and for commercial, industrial, and public customers; dependency on fossil fuel volatile costs; and improved reliability of supply. Regarding costs, feasibility studies will analyze the cost of works, engineering, management, transportation, infrastructure, storage, generation and distribution equipment, fees, taxes and duties, and provisions for environmental and social related-issues. The feasibility studies are expected to be finalized in August 2017. Expenses representing transfer of funds and financing costs were not considered.

45. The financial feasibility of the component was determined by the profitability of the investments (FIRR) when compared to the alternative of investing in diesel generation to expand service on each mini-grid.

46. For the technical design, three options were considered: (a) expand capacity through diesel generators; (b) expand capacity through PV and batteries; and (c) expand capacity through a mix of diesel generators and PV with batteries. The economic analysis showed that the best alternative is the mix of diesel generation and PV with batteries. The technological components for the hybridization of

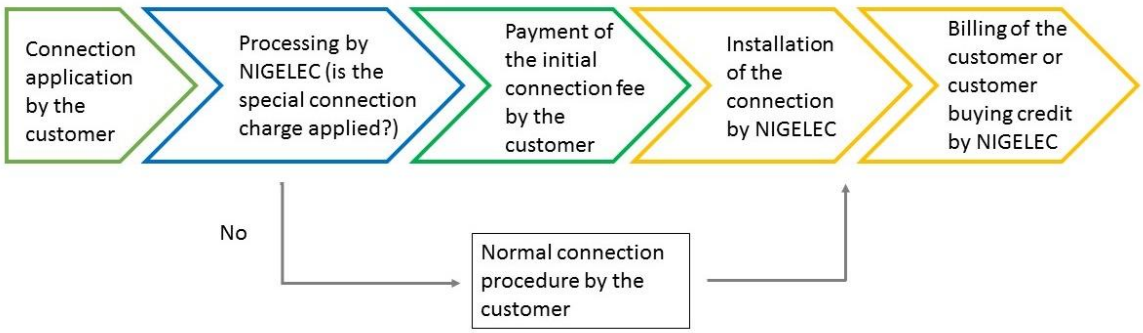
current diesel-based isolated grids and their expansion will include PV panels and inverters, battery storage and diesel generators, and control systems (see Figure 1.3). Energy storage is the most expensive component of the hybrid systems and thus, batteries will be considered in the systems where economically justified (when diesel generation will be more expensive than investment in batteries). Lead-acid and lithium-ion batteries are the most widespread in hybridizing the type of isolated selected centers. Although lead-acid batteries have lower installed costs than lithium-ion batteries, their life cycle can present less moderate discharge rates. Another factor considered in the design of the hybrid system refers to the operating temperature, which, above 30ºC, can significantly decrease lead-acid batteries' longevity. PV modules mono or polycrystalline silicon cells were used when modeling the sizing of the hybrid systems. The selection of technologies, design specifications, and site layout will be made based on the most economic cost through a 20-year cycle, interoperability of the different components, and integration of the PV power system into the isolated grids. Other specifications considered during the design will be the O&M requirements. The technology and design specifications will be expected to allow a share of solar generation between 50 percent and 75 percent in the selected isolated grids.

Figure 1.3. Technological Components of a Hybrid PV-Diesel Grid



47. As the operator of the system, NIGELEC will be responsible for the commercial aspects of the connections, allowing customers to choose between post and prepayment options according to their needs. The technical and commercial capacities of NIGELEC will need to be reinforced. Further, investments under this component will include US$2.5 million of IDA Grant, which will serve to subsidize the connection fee of almost 7,500 new customers. Electricity connection fees are around US$200, representing a significant challenge to households in isolated areas. The project will seek to connect new customers in bulk and will provide a subsidy for the connection fee of households (special connection charge) that will reduce the fee to US$20 to cover the administrative costs of the connection (see Figure 1.4).

Figure 1.4. Electricity Connections Mechanism



48. The investments of this component will include installation of PV power plants and storage systems; adding, replacing, or upgrading distribution lines and substations; installation of meters; and purchase of spare parts and tools. Finally, the investments will finance the connection of the new clients. The connection charges will be subsidized through IDA financing and determined based on the existing practices of the utility. The component will also finance the services of an Owner's Engineer to assist NIGELEC with (a) overall component management and supervision of the design, procurement, construction, commissioning, and management of the EPC contracts; and (b) coordination of the implementation of the ESMPs and RAPs.

Component 4: Implementation Support and Technical Assistance (US$8 million equivalent IDA Credit)

49. This component will support project management and implementation, capacity building, and TA to key off-grid electrification sector stakeholders, as well as M&E. Targeted stakeholders will be key Government institutions (ANPER, CNES, MoE, and local authorities), NIGELEC, solar service providers, importers/installers, wholesalers and retailers, farmers, general public, and financial sector actors. The component will assist them to fulfill their functions efficiently and develop the solar market.

50. **Subcomponent 4.1. Project Management and Implementation Support to ANPER and MoE (US$2.7 million equivalent IDA Credit).** This component will finance the support required for project management and implementation, including auditing and the hiring of experts and operational costs. Activities could include, among others, the following:

- **Technical, procurement, and FM capacity for ANPER.** This activity will strengthen ANPER´s capacity for project implementation including hiring technical experts and procurement and FM specialists to assist in the implementation of the stand-alone solar (Component 1) and solar PV hybrid mini-systems (Components 2). Staff from the MoE and CNES could also benefit from the strengthening of fiduciary capacity by being involved in the transactions. Component 3 will rely on NIGELEC's existing fiduciary capacity.

- **Project management support and operating costs.** This activity will finance the acquisition of equipment, materials, software, and vehicles for project implementation. It will support supervision cost of the PIUs in ANPER, the financial institutions, and NIGELEC.

- **M&E activities** to capture key indicators and derive lessons learned to inform project implementation and the design and implementation of off-grid rural electrification

activities in Niger. To set further standards and approaches for off-grid rural electrification with private sector participation, it will be necessary to assess project impacts in terms of the effectiveness of the approaches used, adequacy of electricity access levels, and implementation and results of gender-responsive actions.

- **Studies and audits.** This activity will finance studies and consultancies required for implementation and M&E, including the audits of the project annual financial statements. It will also finance key studies for the sector or preparatory activities for future investments.

- **Support for implementing and monitoring strategic gender activities.** The project will (a) use sex-disaggregated and gender analysis to identify the key gender gaps the project can help prevent or reduce, such as rural households' lack of access to modern energy sources; (b) adopt strategic actions within the project's components to promote greater gender equality and women's economic empowerment, such as ensuring equal access opportunities to energy connections for households and businesses headed by women, working with women-owned businesses to sell solar appliances and hiring women as sales agents for solar-powered appliances, and educating female users about how to use modern energy to improve the productivity of their businesses; and (c) identify and adopt sex-disaggregated and gender-related indicators as part of the M&E system to track the implementation and performance of the gender actions and assess their results, a current corporate gender commitment for IDA countries like Niger. Data from the MTF survey will help identify women's and men's differences and gaps in energy use, needs, and constraints. This will inform and improve the design of the actions to address the gender gaps.

51. **Subcomponent 4.2. Project Management and Implementation Support to NIGELEC (US$0.4 million equivalent IDA Credit).** This subcomponent will finance the support required for project management and implementation of the PIU at NIGELEC, including technical, fiduciary, auditing, and M&E, gender mainstreaming, and operational costs. This subcomponent will also finance project preparatory activities such as feasibility studies, safeguards, and other required analytical work.

52. **Subcomponent 4.3. Capacity Building and Technical Assistance (US$3.65 million equivalent IDA Credit).** This subcomponent will include four main activities associated with strengthening capacity of key stakeholders to support the implementation of the three components described earlier.

- **For government agencies.** The assistance will aim to (a) help develop a regulatory and institutional framework of off-grid electrification such as quality standards of solar systems, quality of service in renewable hybrid mini-grids, tariffs in such mini-grids, further work on the NES; (b) enhance planning and implementation capacities for off-grid rural electrification projects; and (c) assess the benefits of reducing the import tax on solar systems, currently set at 52 percent, to promote the affordability of high quality PV systems. The project will finance the development of technical standards for solar technologies and mini-grids systems, templates for business plans, and appraisal tools for ANPER. It will also develop application forms/templates for solar companies as well as standard agreements and MoUs between various stakeholders. Targeted training will also be financed to support the capacity of ANPER, CNES, and the MoE.

- **For financial sector actors participating in the project.** The project will provide TA to the PFIs to improve tools and capacity related to appraising and financing rural electrification proposals and business plans. This will include assistance in managing the proposed credit facility including credit and risk management, execution, and reporting of the credit line, and market research and quality control. This TA will help manage credit risk, reduce administrative costs (particularly surrounding due diligence and credit assessment), and build experience in financing solar electricity transactions.

- **TA to private distributors and operators.** Private solar companies will receive capacity building on solar systems and services and advisory services to enhance their business plans. TA will provide tailored business development services for solar companies to improve the operational capacity, bankability, and market access of solar companies. This support includes (a) an incubation program designed to assist existing solar companies to successfully complete applications for commercial bank financing and to create consumer credit capabilities such as PAYG; (b) production of training tools to improve internal capacity and operational performance (for example, developing business plans, financial statements, and managerial capacity); and (c) market linkage programs to provide training and information to both consumers and enterprises to facilitate market access and expansion. It is expected that companies benefitting from this TA may be eligible to participate in existing credit guarantee programs offered by SAHFI. Thus, synergies are expected between liquidity support provided under NESAP and credit guarantee mechanisms. TA and specialized training will be tailored to the personnel of the solar companies, private mini-grids operators, and NIGELEC. Particular attention will be given to ensuring that hybrid systems are installed, operated, and maintained safely and in a manner that ensures system performance and reliability.

53. **Subcomponent 4.4. Information, Education, and Communication (US$1.14 million equivalent IDA Credit).** This subcomponent will finance campaigns to raise consumer awareness and increase knowledge about the systems and services offered and the available financing options and warranties, through information and promotional campaigns using media in rural areas (through flyers, radio/TV ads) and publicity (roadshows, fairs, prizes, and so on). It is key to legitimatize the activities of the private sector enterprises (PSEs) and operators through proper communication and support from the MoE, CNES, and ANPER. Since women traditionally have less access to information about new forms of energy, communications activities will include gender-sensitive information, promote outreach activities through grassroots associations, and involve both men and women in the design of campaigns, to overcome the barriers they might face. For solar pumping, a specific campaign will be implemented targeting farmers.

ANNEX 2: IMPLEMENTATION ARRANGEMENTS

COUNTRY: Niger
Niger Solar Electricity Access Project

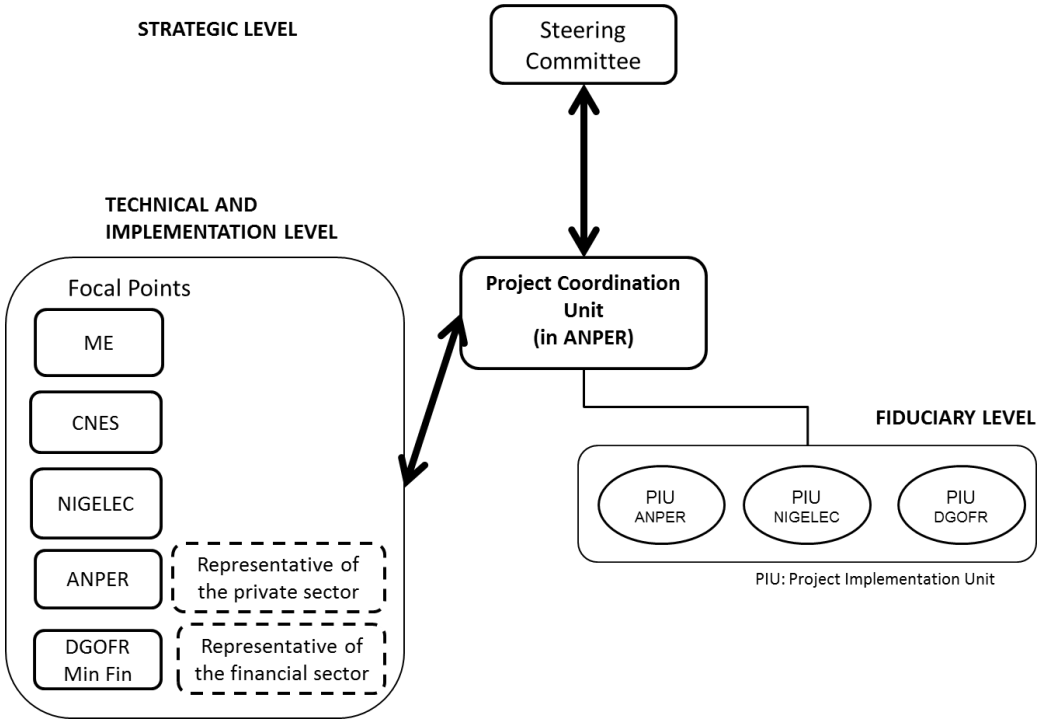
Project Institutional and Implementation Arrangements

1. ANPER will be responsible for overall coordination of the project, and the following entities will be responsible for implementing the project components:

- Component 1: The MoF, with support from the CNES for TA activities;
- Components 2 and 4: ANPER (with ANPER coordinating with the CNES, MoE, MoF, PFIs, and NIGELEC for implementation of TA under Component 4); and
- Component 3: NIGELEC.

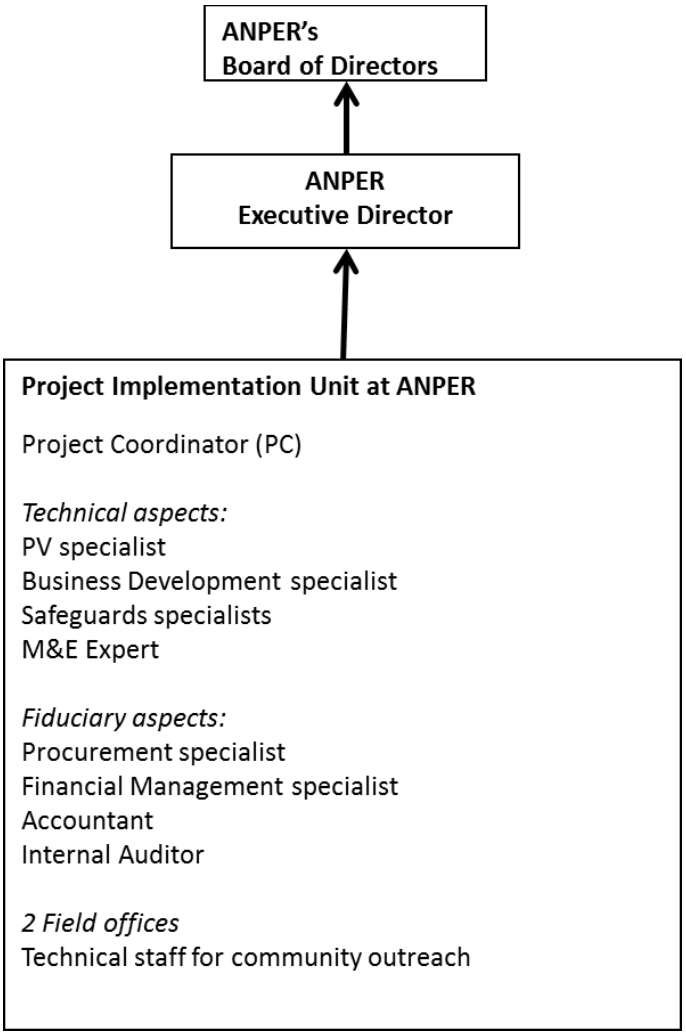
2. The project will have oversight from a PSC, chaired by the MoE, including representatives of ANPER, CNES, NIGELEC, and other ministries (that is, Finance, Planning, and Interior). The primary responsibility of the PSC will be to provide high-level policy guidance and strategic directions, ensure coordination with other sectors during implementation, resolve issues and challenges requiring high-level intervention, and monitoring progress of the project (see Figure 2.1).

Figure 2.1. Overall Institutional Arrangements for Project Implementation



3. ANPER's PIU will be headed by a PC responsible for overall project coordination and the components carried out by ANPER. ANPER will report to the PSC on a regular basis to ensure communication with all pertinent ministries and obtain decisions on issues pertaining to multiple government stakeholders. The PC will report to the Executive Director of ANPER and will receive procurement, safeguards, and other administrative support from ANPER (see Figure 2.2). The PC will also receive support from two ANPER field offices located in different regions of the country, which will liaise with rural operators and the private sector as well as local authorities and final beneficiaries of the project. ANPER has no experience with World Bank-financed projects. The PIU will be staffed to ensure that project fiduciary responsibilities are adequately fulfilled. Experienced project consultants will be retained to assist ANPER with project implementation in key areas such as planning, social and environment safeguards, procurement, and FM. In addition, an experienced project design and supervision consultant (Owner's Engineer) will be competitively recruited as part of the project to assist with project implementation and will report directly to ANPER's PC. Contracts with private operators will be signed by the Minister of Energy following evaluation by ANPER.

Figure 2.2. Implementation Arrangements for Component 2



4. NIGELEC has a unit (*Cellule des Grands Projets*) that manages large projects, which will be the PIU of Component 3. This unit already has experience with World Bank-financed projects, such as NELACEP. A PC who reports to NIGELEC's Deputy Chief Executive Officer (*Sécretaire Générale*) leads the unit, which is at the same level as other operational departments, thus ensuring coordination through the management board. The PC will be supported by a team that includes specialists in procurement, FM, technical, and environmental and social safeguards. Major investments will be contracted out to experienced contractors secured through public competitive bidding. In addition, an experienced project design and supervision consultant (Owner's Engineer) will be competitively recruited as part of the project to assist NIGELEC with project implementation and will report directly to NIGELEC's PC.

5. Under Component 1, the MoF will provide lines of credit to up to two commercial banks and up to two MFI in accordance to the World Bank's Policy for Financial Intermediary Lending (OP 10.00). A financial analyst at the DGOFR will be financed to manage the line of credits. The CNES will provide market development and TA support. The CNES will also utilize the TA to support building capacity to private companies through incubators. The commercial banks and the MFIs that benefit from the lines of credit will also have to undergo an OP 10.00 assessment before any disbursements under the credit lines.

6. Each implementing agency (ANPER, NIGELEC, and the MoF) will have responsibility for the day-to-day management of their respective components and coordination of related activities, including (a) ensuring timely implementation in accordance with the PIM; (b) preparing annual work plans and budgets and annual PPs; and (c) among others, fiduciary tasks such as procurement, FM, M&E (for example, developing and maintaining a system for monitoring the project's key performance indicators), communications, and environmental and social safeguards (ensuring adherence to the safeguard documents of all entities involved in the project's implementation).

7. A technical group, comprised of the institutions responsible for the implementation of the proposed project (MoE, ANPER, CNES, NIGELEC, and the MoF) will meet monthly to discuss the progress of the project and coordinate the activities to be implemented. Representatives from the private sector and financial institutions will also participate in the technical group when invited to discuss relevant matters of their concern.

8. A PIM will be prepared and adopted by the three implementing agencies, as well as the CNES and the MoE before project effectiveness.

Financial Management

9. The World Bank's FM team conducted an FM assessment of ANPER, NIGELEC, and DGOFR within the MoF in October 2016, December 2016, and March 2017, respectively.

10. The objective of the assessment is to determine (a) whether the three entities have adequate FM arrangements to ensure that the funds of the proposed project will be used for the purposes intended in an efficient and economical manner; (b) the financial reports will be prepared in accurately, reliably, and on timel; and (c) the proposed project's assets will be safely guarded within these project implementing entities. The FM assessment was carried out in accordance with the FM Manual for World Bank-financed Investment Operations that became effective on March 1, 2010, and retrofitted on February 4, 2015.

11. The 2016 Public Expenditure and Financial Accountability (PEFA) assessment for Niger highlighted limited progress in comparison with the situation reflected in the 2012 PEFA report. Only seven indicators were upgraded, in particular in the areas of: policy-based budgeting, multiyear perspective in fiscal planning and public expenditure policy, public access to key fiscal information, predictability in the availability of funds for commitment of expenditures, and timeliness of submission of audit reports to legislature. The reports identified a number of critical shortcomings in budget credibility and execution processes as well as accounting, financial reporting, and internal and external controls. The GoN has a Public Financial Management (PFM) Reform Program supported by several international development organizations, including the World Bank, which is helping address these risks. In response to the Second PEFA Review in 2008, the GoN, among other actions, introduced measures to progressively implement PFM reform and (a) proposed in the short term the recruitment of agents to reinforce the fiscal actions capacity of the Directorate General of Taxes (DGI) under the DGI's action plan; (b) accompanied installation of the Supreme Audit Institution (SAI) since May 18, 2010, under ordinance n°2010-2017 of April 15, 2010, taken by the President—this ordinance has since been upgraded to Organic Law per WAEMU directives; (c) elaborated an institutional support project aimed at strengthening the SAI; and (d) installed the *Direction Générale du Trésor et de la Comptabilité Publique* under ordinance n°2010-15 of April 15, 2010. Considering the weaknesses identified in Niger's PFM, the country risk rating is deemed Substantial. Within the MoF, the Directorate of Public Financial Management Reforms is charged with initiating and following through the implementation of the PFM reform action plan, adopted by the Council of Ministers in December 2011. The translation of WAEMU PFM directives into national law and their timely implementation will also accelerate the PFM reforms in Niger. As of the date of this report, Niger has fully translated the eight WAEMU PFM directives into national laws.

12. A review of the FM arrangements of ANPER revealed that the entity does not have a recent experience of the World Bank-funded projects management. In addition, the following were noted:

- ANPER was created in 2013 and became functional in 2014;
- The Administrative, Financial, and Accounting Procedures Manual is not yet effective;
- The FM team is not yet in place;
- ANPER does not have any computerized accounting system in place to properly handle the project activities; and
- There is no evidence that ANPER is familiar with the external audit arrangements.

13. A review of the FM arrangements of NIGELEC revealed that the company has been implementing the World Bank-funded NELACEP (P153743) through the CGP. Thus, CGP has a fully-fledged FM unit operating under a Chief of Fiduciary unit. The following were however noted:

- Delay in installing the TOM2PRO accounting system;
- Delays in funds flow have been noted for the IDA Credit 57550 (the Designated Account B was inactive for four months at the date of the report); and

- Delay in recruiting the external auditor for the IDA-funded NELACEP.

14. A review of the FM arrangements of DGOFR revealed that the Directorate General is a department of the MoF, and it does not have recent experience of World Bank-funded projects management. In addition, the following were noted:

- DGOFR does not have any Procedures Manual in place;
- The FM team at DGOFR is not familiar with any development donor's procedures;
- DGOFR does not have any computerized accounting system in place to properly handle the project activities;
- Though the MoF has its own financial controllers, they do not have any experience to properly monitor the project's activities; and
- There is no evidence that DGOFR is familiar with the external audit arrangements.

15. All implementing entities will have to ensure that appropriate staffing arrangements are maintained throughout the proposed project life.

16. The conclusion of the assessment is that the FM arrangements have an overall residual risk rating of substantial. The arrangements satisfy the World Bank's minimum requirements under OP/BP 10.00, and therefore, are adequate to provide, with reasonable assurance, accurate and timely information on the status of the project required by IDA.

Table 2.1. Risk Assessment and Mitigation Table

Type of Risk	Risk Rating	Brief Explanation	Risk Mitigation Measures Incorporated in Project Implementation	Condition of Effectiveness (Y/N)	Residual Risk Rating
INHERENT RISK					
Country level	S	This is based on the country PFM environment and it takes into consideration relevant country governance issues, for example, corruption concerns mostly due to low salaries and weak administration controls.	Issues are being addressed at the country level through the country's PFM reforms programs supported by the World Bank, European Union, IMF, and other development agencies.	**No**	S
Entity level	M	**NIGELEC**: The company is a state corporation but is run almost like a private company. NIGELEC had created its CGP to manage all the projects under its responsibility, including NESAP. However, due to the delays in preparing and approving its own financial statements, the rating is moderate rather than low.	NIGELEC to address the issues raised in the FY2014 Management Letter as highlighted under Internal control section of this table.	**No**	M
	H	**ANPER**: The entity is fairly new and could face challenges in staffing.	Address the staffing issues	**No**, maintaining an experienced and dedicated accountant will be a dated covenant	S
	H	**DGOFR**: The entity is a department of the MoF, without any recent experience of World Bank-funded projects.	Address the staffing issues	**No**, recruiting an experienced and dedicated accountant will be a disbursement condition under Component 1 of the project.	S
Project level	H	Because of the weak institutional and regulatory framework in which innovative features of the project will be	FM risks under each of the FM arrangements have been identified and mitigated for each of the implementing	**No**	S

Type of Risk	Risk Rating	Brief Explanation	Risk Mitigation Measures Incorporated in Project Implementation	Condition of Effectiveness (Y/N)	Residual Risk Rating
		implemented, the rating is High.	entities.		
OVERALL INHERENT RISK	**S**				**S**

Note: H = High; M = Moderate; S = Substantial.

Type of Risk	Residual Risk Rating	Brief Explanation	Risk Mitigation Measures Incorporated in Project Implementation	Condition of Effectiveness (Y/N)	Residual Risk Rating
CONTROL RISK					
Budgeting	M	**NIGELEC:** There are qualified staff within the CGP who undertake budgeting and monitoring under the World Bank-funded NELACEP. FM procedures in regard to budgeting are in place and are considered adequate. The budgeting process is deemed adequate. Budgeting follows procedures set out in the NELACEP Financial and Accounting Manual.	A detailed budget of the project will be developed and annual allocations will be reviewed and agreed with the World Bank.	**No**	M
	H	**ANPER**: The agency, which will implement most of the project components, has been recently staffed and operational. It, therefore, lacks a solid track record in implementing (or overseeing the implementation of) rural electrification subprojects, and would be implementing a World Bank-financed project for the first time.	The project will adequately staff ANPER with FM and procurement specialists, enable on-the-job learning and training from NIGELEC, which has been implementing the World Bank-financed NELACEP satisfactorily, and provide further TA as required. A detailed budget of the project will be developed and annual allocations will be reviewed and agreed with the World Bank.	**No**, maintaining an experienced and dedicated accountant will be a dated covenant **No**,	S

Type of Risk	Residual Risk Rating	Brief Explanation	Risk Mitigation Measures Incorporated in Project Implementation	Condition of Effectiveness (Y/N)	Residual Risk Rating
	H	**DGOFR**: The ministerial department which will implement project's Component 1, does not have any recent experience of the World Bank-funded operations. It, therefore, lacks a solid track record in implementing (or overseeing the implementation of) rural electrification subprojects, and would be implementing a World Bank-financed project for the first time.	The project will adequately staff DGOFR with an FM officer, enable on-the job learning and training from NIGELEC, which has been implementing the World Bank-financed NELACEP satisfactorily, and provide further TA as required. A detailed budget of the project will be developed and annual allocations will be reviewed and agreed with the World Bank.	recruiting an experienced and dedicated accountant will be the disbursement condition under Component 1.	S
Accounting	M	**NIGELEC**: The TOM2PRO system of accounting under the World Bank-funded NELACEP is able to capture expenditures and generate reports and this is adequate for accounting and financial reporting purposes. The staff are qualified and the FM Manuals in place are adequate.	Due to the workload involved by NESAP, a qualified and experienced accountant will be recruited to reinforce the CGP FM team.	**No**, recruiting an additional accountant will be a dated covenant.	L
	H	**ANPER**: The agency does not use any specific accounting system because its FM activities are limited to manage the operating budget granted by the parent ministry. There are no qualified FM staff in place to properly handle the project activities.	An accounting system will be acquired and installed by ANPER based on ToRs acceptable to the World Bank. Staffing issue to be addressed in accordance with the work load	**No** **No**, maintaining an experienced and dedicated accountant will be a dated	S

Type of Risk	Residual Risk Rating	Brief Explanation	Risk Mitigation Measures Incorporated in Project Implementation	Condition of Effectiveness (Y/N)	Residual Risk Rating
			assessment.	covenant	
	H	**DGOFR**: The ministerial department does not use any specific accounting system because its FM activities are limited to manage the operating budget granted by the parent ministry.	TOM2PRO accounting system will be acquired by ANPER.	**No**	S
		There are no qualified FM staff in place to properly handle the project activities.	Staffing issue to be addressed in accordance with the work load assessment.	**No**, recruiting an experienced and dedicated accountant will be the disbursement condition under Component 1	
Internal control	H	**DGOFR**: The ministerial department does not have any FM Manual in place nor the internal audit functions.	A detailed OM will be elaborated and adopted for the project activities managed by DGOFR.	**Yes** Adoption of the OM, as part of the PIM, will be an effectiveness condition	M
	M	**NIGELEC**: All major elements of internal control are in place including segregation of duties and internal audit functions.	To update the existing Financial and Accounting Manual to reflect the project activities.	**No**	S
	H	**ANPER**: The agency has been recently created and has been putting in place its internal controls system, including the internal audit functions.	To elaborate and get adopted a Financial and Accounting Manual.	**No,**	S
Funds Flow	S	Each of the three entities (ANPER, NIGELEC, and DGOFR), will open a Designated Account denominated in CFA Francs in a local and acceptable commercial bank.	Measures to be taken to minimize procurement-related funds flow delays.	**No**	M

Type of Risk	Residual Risk Rating	Brief Explanation	Risk Mitigation Measures Incorporated in Project Implementation	Condition of Effectiveness (Y/N)	Residual Risk Rating
		Under the World Bank-funded NELACEP, delays in disbursements have been experienced hence the risk is assessed as Substantial rather than Moderate.			
Financial Reporting	M	**NIGELEC**: The financial statements of the company are prepared by qualified staff. Under the World Bank-funded NELACEP, the first IFR due on February 14, 2017, was received on time at the World Bank and found acceptable. The audited institutional financial statements (which incorporate sufficient project financial information) for FY2015 were submitted to the World Bank during NESAP preparation.	None	**No**	L
	H	**ANPER**: The entity is fairly new and could face challenges in staffing capable of handling these tasks. ANPER will prepare quarterly consolidated unaudited IFRs in form and content satisfactory to the World Bank, which will be submitted to the World Bank within 45 days after the end of the quarter to which they relate.	Train ANPER staff on World Bank's procedures.	**No**	S
	H	**DGOFR**: The entity will use a simplified IFR to report the use of funds under Component 1.	Train DGOFR FM staff on World Bank's procedures.	**No**	S
Auditing	M	**NIGELEC**: The auditors issued an unqualified audit opinion on the 2015 institutional financial statements. At the date of the report, the FY2015 contractual	NIGELEC to address the issues if raised in the Management Letter of FY2015	**No**	L

Type of Risk	Residual Risk Rating	Brief Explanation	Risk Mitigation Measures Incorporated in Project Implementation	Condition of Effectiveness (Y/N)	Residual Risk Rating
		audit reports were not available.			
	S	**ANPER**: The agency has only the administrative autonomy and has been newly created; it is not subject to any national audit requirements. However, during the assessment, the World Bank team was informed that the agency was controlled by the financial services of the MoF for the FY2014 management.	ANPER to address the issues if raised in the FY2014 management report.	**No**	M
		An independent auditor will be recruited by ANPER to perform the annual audit of the project's consolidated accounts. The external auditors are expected to conduct the audit of the project and submit the report within six months after the end of the financial year. NIGELEC already has a TOR used for the World Bank-funded NELACEP which will be adequate for this project.	It was agreed that the ToRs and contract of the current external auditor of NIGELEC will be updated to include the project activities.	**No**	
	S	**DGOFR**: The entity does not have any audit experience.	A single external auditor will be recruited to perform the overall activities of the project.	**No**	M
OVERALL CONTROL RISK	**H**				**S**
OVERALL RISK	**H**				**S**

Note: H = High; M = Moderate; S = Substantial.

Strengths and Weaknesses of the FM System

17. The project FM is strengthened by the following features:

- NIGELEC, within its CGP, has a set of FM Manuals/accounting guidelines, which describe the FM systems and related internal control systems and other set procedures;
- NIGELEC is implementing a World Bank-funded project; and
- Strong budget preparation processes for NIGELEC exist.

18. The project FM is challenged by the following features:

- ANPER is fairly new and would face staffing issues;
- Delays in submission of withdrawal applications by NIGELEC level under the World Bank-funded NELACEP;
- Delays in closing of accounts and late submission of the entity audit reports by NIGELEC;
- ANPER and DGOFR do not have any experience of the external audit requirements; and
- ANPER and DGOFR do not have their FM Manuals—this makes the agencies' FM environment weak and unsatisfactory.

Financial Management Arrangements

Budgeting

19. **NIGELEC.** There are qualified staff who undertake budgeting and monitoring within its CGP. FM procedures are in place and are considered adequate.

20. **ANPER.** As an effectiveness conditions, ANPER will recruit at minimum, a financial specialist and a procurement specialist, with qualifications and experiences satisfactory to the World Bank, who will undertake budgeting and monitoring. FM procedures will be detailed in the Project Implementation Manual, which will be an effectiveness condition.

21. Each implementing agency (ANPER, NIGELEC, and DGOFR) will prepare annual work plans and budgets and annual PPs for the activities related to their respective components.

22. ANPER will then consolidate the annual work plans and budgets into a single document and furnish it to the Association not later than November 30 of each calendar year throughout the implementation of the project, along with a consolidated work plan of activities proposed for inclusion in the project for the next calendar year, a consolidated budget for such activities, and a timetable for their implementation. ANPER shall (a) afford the Association a reasonable opportunity to exchange views with the recipient on such proposed work plan, and thereafter, (b) carry out such work plan

during the period covered by the said plan, according to such budget, both as shall have been approved by the Association ('Annual Work Plan').

23. Only such activities as shall have been included in the Annual Work Plan shall be eligible for inclusion in the project and for financing out of the proceeds of the financing.

24. Actual expenditure will be monitored against planned expenditure on a quarterly basis and this will be done in the accounting system which is in use.

Accounting Arrangements

25. **FM Manuals.** NIGELEC is using the Finance Procedures and Accounting Manual, which is adequate for the project and describes the principles and procedures used by the World Bank. However, the existing manual will need to be updated to reflect the proposed project's activities. This will be an effectiveness condition. The internal control and appropriate segregation of duties and responsibilities will be defined in the administrative, accounting, and financial chapter of the Procedures Manual to be used by ANPER. DGOFR will have an adopted manual which includes eligibility criteria for selecting financial institutions and final beneficiaries (PSEs, individuals, or households), and templates for sub-credit agreements.

26. **Accounting staff.** In addition to the existing FM staff working under the World Bank-funded NELACEP, NIGELEC will need to recruit a qualified and experienced accountant to prepare the project accounts, and this will be an effectiveness condition. ANPER is not well-staffed to handle the project activities. Thus, ANPER will also need to recruit a dedicated, qualified, and experienced accountant to prepare the project accounts, and this will be an effectiveness condition. Within six months of project effectiveness, ANPER will need to recruit an accountant to support the accounting of the overall project. The staff who will be handling this project at NIGELEC and ANPER will have to be specially trained in World Bank Financial Management and Disbursement Guidelines, and this training will be done by the World Bank FM system upon the recruitment of such staff.

27. **Accounting software.** NIGELEC will use its TOM2PRO accounting software, in place under the World Bank-funded NELACEP, to prepare the project accounts. When well-calibrated, the TOM2PRO system is able to capture expenditures and generate reports adequate for accounting and financial reporting purposes. However, the existing TOM2PRO will need to be migrated to reflect the proposed project's activities. ANPER does not use any specific system of accounting. Under the proposed project, ANPER shall acquire and install, as NIGELEC, an accounting system that will be able to capture expenditures and generate reports. This system shall be adequate for accounting and financial reporting purposes, and this will be an effectiveness condition. ANPER shall install and make functional the accounting system within three months of the project effectiveness date. As mentioned above, ANPER shall recruit qualified experts and have an FM Manual in place for the purposes of the proposed project. DGOFR does not use any specific system of accounting. Under the proposed project, DGOFR shall acquire and install, as NIGELEC and ANPER, an accounting system that will be able to capture expenditures and generate reports. This system shall be adequate for accounting and financial reporting purposes, and this will be an effectiveness condition.

Internal Control and Internal Audit Arrangements

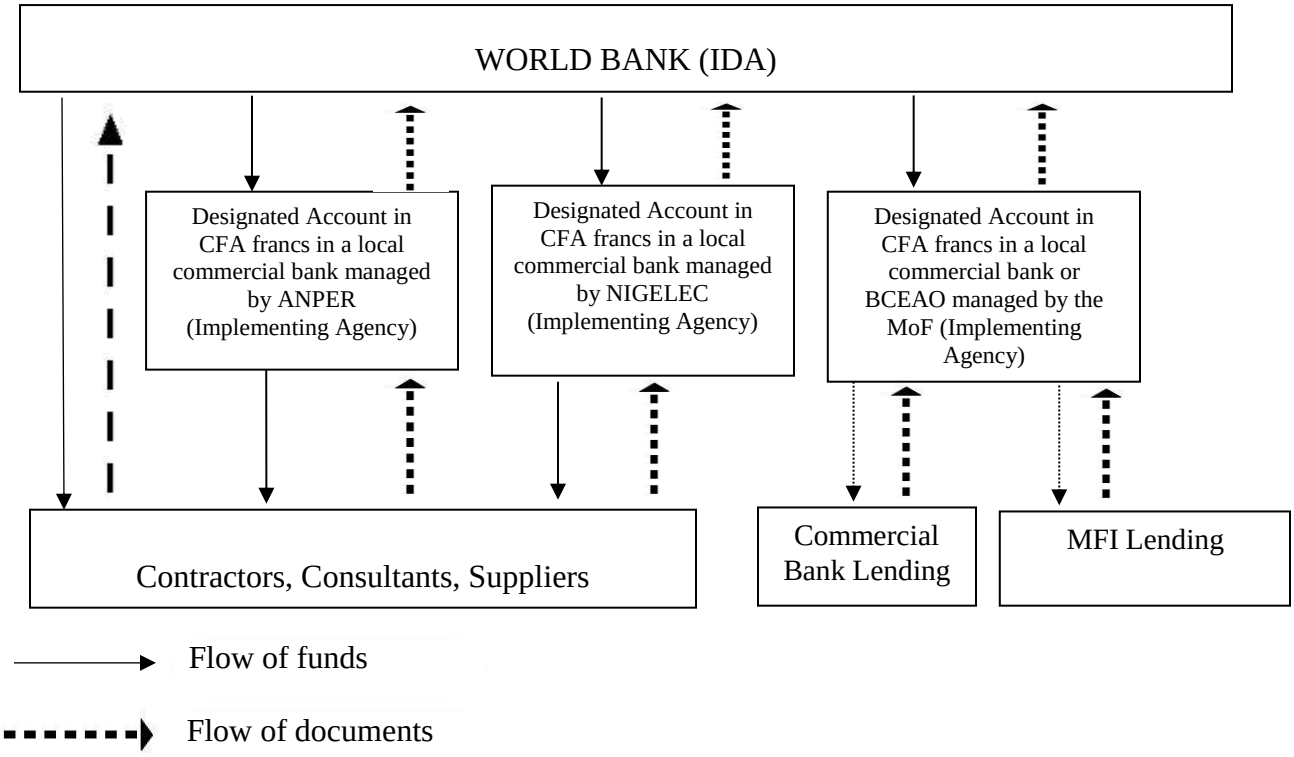
28. **Internal audit.** NIGELEC has an internal audit and control department made up of two departments: pool of auditors and Management Control Department. The key staff are qualified and experienced. The Internal Audit Department has its own Procedures Manual. The NIGELEC's internal auditors will also cover the activities of the proposed project. NIGELEC will submit the internal audit plan to ensure that the project's activities are covered by the company's internal audit department. This will be done at the beginning of each fiscal year of the recipient. ANPER will recruit an experienced internal auditor for the project to strengthen the monitoring of internal control systems for the project.

29. **Internal control system.** NIGELEC has relatively good internal control system as described in the Financial Procedures and Accounting Manual in use under the World Bank-financed NELACEP to help the management of the project in achieving the project objectives in an orderly and efficient manner. The entity's Financial Policies and Procedures Manual specify the detailed internal control procedures to be applied in managing funds. The main focus of the internal control is placed on segregation of duties, project assets safeguard, authorization and approval, clear lines of communication, arithmetic and accounting accuracy, and integrity and performance of staff at all levels and supervision. At the date of this report, NIGELEC did not transmit to the World Bank the Management Letter for the entity audit for the fiscal year ended December 31, 2015. This does not allow follow-up of the implementation of the action plan for the prior periods. ANPER will have its FM Manual adopted within six months after the project effectiveness date. DGOFR will have its manual adopted, which includes eligibility criteria for selecting financial institutions and final beneficiaries (PSEs, individuals, or households) and templates for sub-credit agreements. This manual will be a disbursement condition under Component 1 of the project.

Flow of Funds and Disbursement Arrangements

30. Within one month of the project effectiveness date, each of the three entities will open a Designated Account denominated in CFA francs in a local, commercial bank acceptable to IDA. Funds will flow from the World Bank to the Designated Account where payments of the various project activities, such as consultancies, can be made in CFA francs. Other methods of disbursements are detailed below. Under the ongoing World Bank-funded NELACEP, delays in disbursements have been experienced, making the Designated Account inactive for several months, but mitigating measures as pointed out in the risk table aim to address this. The funds flow diagram for the each of the four implementing agencies is in Figure 2.3.

Figure 2.3. Flow of funds of the project



IDA Disbursement Methods

31. **Statement of Expenditure-based disbursements.** At the beginning of the project, initial advances will be transferred to the Designated Account to be determined and stated in the Disbursement Letter. Subsequent replenishments to this Designated Account will be made on the basis of statements of expenditures. This project will use traditional or statement of expenditure-based disbursement arrangements. Thresholds are set in the Disbursement Letter.

32. **Other methods.** In addition, whenever needed, the direct payment method of disbursement, involving direct payments to suppliers for works, goods, and services upon the Borrower's request, may also be used. Payments may also be made to a commercial bank for expenditures against pre-agreed special commitments. Reimbursements can also be made to the Designated Account. These payments will also be reported in quarterly IFRs. The IDA Disbursement Letter stipulates the minimum application value for direct payment and special commitment procedures as well as the detailed procedures to be complied with under these disbursement arrangements.

Financial Reporting Arrangements

33. NIGELEC and ANPER will prepare quarterly unaudited IFRs for the project in form and content satisfactory to the World Bank, which will be submitted to the World Bank within 45 days after the end

of the quarter to which they relate. The contents of the IFR will include (a) Statement of Sources and Uses of Funds and (b) Statement of Uses of Funds by Project Activity/Component.

34. The project will also prepare the projects annual accounts/financial statements within three months after the end of the accounting year in accordance with accounting standards acceptable to the World Bank. The audited financial statements should be submitted to the World Bank within six months after the end of the accounting year. NIGELEC and ANPER will prepare their accounts in accordance with the *Organisation pour l'Harmonisation en Afrique du Droit des Affaires (*OHADA) accounting principles.

35. The format and contents of the IFRs, has been agreed between the World Bank, NIGELEC, and ANPER and will be included in the project's FM Procedures Manual.

Auditing Arrangements

36. The project audit will be done using an acceptable auditor to the World Bank. The audit will be done using International Standards on Auditing and the audit report together with the Management Letter has to be submitted to the World Bank within six months after the end of the financial year. The audit report will be disclosed in accordance with the World Bank's Access to Information Policy. The project shall be audited annually at the end of each financial year. The terms of reference have already been agreed between the World Bank and NIGELEC under the World Bank-funded NELACEP and will also be included in the project's FM Procedures Manual. ANPER shall recruit, within six months of the project effectiveness date, the project's external auditor. For this end, it was agreed that the terms of reference and contract of the current external auditor of NIGELEC will be updated to reflect NESAP activities.

37. NIGELEC will provide to the World Bank a copy of the audited accounts of NIGELEC and the external auditor's report thereof, within 15 days of these becoming public documents by reason of being presented to the Executive Board of NIGELEC.

38. A review of NIGELEC's most recent audited accounts, for the period ended December 31, 2015, showed that NIGELEC had an unqualified opinion stating that the financial statements present fairly, in all material respects, the financial position of NIGELEC as of December 31, 2015, and the results of its operations and its cash flows for the year then ended. However, without qualifying their opinion expressed above, the auditors drew attention to the matters discussed in the following paragraphs.

39. Reasons for the delay in approving the company's accounts by the Board of Directors:

- Debts in the amount of CFAF 15 billion arising from the execution of the construction of the electric power of GOROU BANDA, for which the auditors stated that they did not get any evidence of the modalities and conditionalities of the acceptance of such expenses and their reimbursement;

- The company did not record provisions for growth funds authorized by the concession agreement, at a rate equal to 1 percent up to 4 percent; and

- The company did not record provision for a pending legal affair against a former staff member—the auditors estimated the risk in the amount of CFAF 11 million.

40. The first audited financial statements of the World Bank-funded NELACEP will be due on June 30, 2018. At the date of this report, NELACEP's external audit recruitment has been delayed.

41. ANPER, which is an agency with only administrative autonomy, is subject to the national external audit rules.

42. The audit reports that will be required to be submitted by NIGELEC and ANPER and the due dates for submission are provided in Tables 2.2 and 2.3.

Table 2.2. Audit reporting requirements

Audit Report	Due Date
Project's financial statements and opinion (incorporating Designated Account opinion) and Management Letter	Submitted within six months after the end of each fiscal/financial year.

FM Action Plan

43. The action plan in Table 2.3 indicates the actions to be taken and the dates by which the actions are due to be completed, as well as the persons responsible for the specific actions. The FM Action Plan has been discussed and agreed with the project management.

Table 2.3. FM Action Plan

	Action to be Taken	Expected COMPLETION date	Responsible Body
1.	**Manuals** As part of the Project Implementation Manual, adopt a Procedures Manual in conditions acceptable to the World Bank.	Effectiveness	ANPER
	As part of the Project Implementation Manual, submit to the World Bank a manual which includes eligibility criteria for selecting financial institutions and final beneficiaries (PSEs, individuals, or households), and templates for sub-credit agreements. It will be part of the Project Implementation Manual.	Effectiveness	DGOFR
	As part of the Project Implementation Manual, detail FM arrangements stated in the Procedures Manual in use under the World Bank-financed NELACEP will be updated or strengthened in the area of budgeting, accounting, internal control, fund flows, reporting, and audit areas consistent with the PAD.	Effectiveness	NIGELEC
2.	**Budget monitoring challenge** An integrated work plan and budget to be funded by NESAP will be produced by ANPER, DGOFR, and NIEGELEC and submitted to the PSC for approval no later than 2 months prior to the start of each fiscal year. IFRs will disclose and explain financial performance with emphasis on budget utilization and variance analysis.	Regularly	ANPER DGOFR NIGELEC
3.	**Accounting staffing challenge**		

	Recruit an experienced and dedicated accountant at ANPER Recruit an experienced and dedicated FM officer at DGOFR	Before effectiveness Before disbursement under Component 1	ANPER DGOFR
4	**Financial and accounting system** Acquire and install an accounting software acceptable to the Association, for the project. Update and calibrate the existing TOM2PRO accounting software in use under the World Bank-funded NELACEP to include the proposed project.	Within 90 days of effectiveness Within 90 days of effectiveness	ANPER DGOFR NIGELEC
5	**Internal control** Assign a qualified and experienced internal auditor for the project to strengthen the monitoring of internal control systems for the project. Recruit a qualified and experienced internal auditor for the project to strengthen the monitoring of internal control systems for the project. Internal auditors will perform an audit of the project and report to the management regularly	Within 120 days of effectiveness Within 120 days of effectiveness Quarterly or semiannually	NIGELEC ANPER ANPER NIGELEC
6	**Disbursement and funds flow** Opening of bank accounts at a local commercial bank	One month after effectiveness	ANPER DGOFR NIGELEC
7	**Reporting** Submit to the World Bank consolidated IFRs	Within 45 days of the end of the quarter	ANPER
8	**Regarding Audit** ANPER will submit audit reports of the project within 6 months of the end of the fiscal year and will publicly disclose the audited financial statements in a manner acceptable to the World Bank. NIGELEC will provide to the World Bank a copy of the audited accounts of NIGELEC and the external auditor's report thereof, within 15 days of these becoming public documents by reason of being presented to the Executive Board of NIGELEC.	Within 6 months of the end of the Recipient's fiscal year Within 15 days of the submission to the Executive Board	ANPER NIGELEC

Conditionality

44. The above FM Action Plan covers these aspects.

Financial Covenants

45. Financial covenants are the standard ones as stated in the Financing Agreement Schedule 2, Section II (B) on Financial Management, Financial Reports and Audits, and Section 4.09 of the General Conditions.

Implementation Support Plan

46. Based on the outcome of the FM risk assessment, the implementation support plan in Table 2.4 is proposed.

Table 2.4. FM Support Plan

FM Activity	Frequency
Desk reviews	
IFRs review	Quarterly
Audit report review of the project	Annually
Review of other relevant information such as interim internal control systems reports.	Continuous as they become available
On-site visits	
Review of overall operation of the FM system	Annually (implementation support mission)
Monitoring of actions taken on issues highlighted in audit reports, auditors' Management Letters, internal audit, and other reports	As needed
Transaction reviews (if needed)	As needed
Capacity-building support	
FM training sessions	Before project start and thereafter as needed

Procurement

47. Procurement for the project will be carried out in accordance with the 'World Bank Procurement Regulations for Borrowers under Investment Project Financing,' dated July 1, 2016, and hereafter referred to as 'Procurement Regulations.' The project will be subject to the World Bank's Anticorruption Guidelines, dated July 1, 2016.

48. According to the requirement in the Procurement Regulations, a Project Procurement Strategy for Development has been finalized prior to appraisal, based on which the Procurement Plan (PP) was prepared and finalized. The PP sets out the selection methods to be followed by the Borrower during project implementation in the procurement of goods, works, non-consulting, and consulting services financed by the World Bank. The PP will be updated at least annually or as required to reflect the actual project implementation needs and improvements in institutional capacity.

49. **Systematic Tracking of Exchanges in Procurement (STEP).** The project will use STEP, a planning and tracking system, which will provide data on procurement activities, establish benchmarks, monitor delays, and measure procurement performance.

50. The proposed project will be implemented by NIGELEC for Component 3 and ANPER for Components 2 and 4. Component 1 will be devoted to the financial intermediaries managed by the MoF. The project will be under the supervision of a PC to be recruited by ANPER. ANPER has been recently operational and has no specific procurement experience to be taken in account for the implementation of World Bank-financed operations, therefore the procurement risk for this agency is rated high. Given its weak procurement and implementation capacity, the recommendation for ANPER to recruit a procurement specialist is underway with support of the PPA. In terms of procurement capacity, NIGELEC has now acquired some experience in implementing the World Bank's financed activities in the context

of the NELACEP and this agency, acting as the implementing agency of Component 3, is staffed with a procurement specialist. In view to continue to lead the implementation of additional activities it will be necessary to recruit a procurement assistant who will assist the actual procurement officer. The procurement risk for NIGELEC is rated substantial. Nevertheless, because the financial intermediaries have not yet been selected and ANPER has no fiduciary experience yet in World Bank-financed projects, the overall procurement risk for the whole project is rated high.

51. **Procurement methods.** For Niger, International Competitive Bidding (ICB) thresholds have been set at US$5 million for works and US$500,000 for goods. Table 2.5 summarizes the procurement and selection thresholds applicable to this project.

Table 2.5. Procurement Methods Thresholds

NO	Expenditure Category	Contract Value Threshold**(US$)	Procurement Method
1.	Works	≥5, 000,000	ICB
		100,000–5,000,000	NCB
		<100,000	Shopping
		All values	DC
2.	Goods and non-consulting services	≥500,000	ICB
		50,000 –500,000	NCB
		<50,000	Shopping
		All values	DC
3.	Consulting services firms	≥200,000	QCBS, QBS
		<200,000	QCBS, FBS, CQS, LCS
		All Values	SSS
	Individual consultant	All values	Based on comparison of CVs
		All Values	SSS
4.	Training, workshops, study tours	All Values	With the approval of the TTL

Note: CQS = Selection based on Consultants' Qualification; DC = Direct Contracting; FBS = Fixed Budget Selection; LCS = Least Cost Selection; NCB = National Competitive Bidding; QBS = Quality Based Selection; QCBS = Quality- and Cost-Based Selection method; SSS = Single Source Selection. All terms of reference, regardless of the value of the contract and the selection method, are subject to prior review.

Table 2.6. Procurement Prior Review Thresholds (US$, millions)

Type of Procurement	Thresholds (US$ m)
Works including turnkey, supply, and installation of plant and equipment, and PPP	5.0
Goods, IT, and non-consulting services	1.5
Consulting firms	0.5
Individual consultants	0.2

52. Contracts estimated to cost above these thresholds for works, goods, and consulting services will be subject to prior review by IDA. Further, it was agreed on the following additional mitigation measures:

(a) All terms of reference for consulting services will be subject to prior review by the World Bank irrespective of the cost estimate.

(b) At least once a year, the World Bank and the GoN will agree on a PP that will detail the procurement methods to be used and contracts to be prior reviewed by the World Bank.

53. **Revision.** The prior review thresholds and other measures to be taken to mitigate the procurement risk should be reevaluated once a year with a view of adjusting them to reflect changes in the procurement risk that may have taken place in the meantime and to adapt them to specific situations. In case of failure to comply with the agreed mitigation measures or procurement regulations, a reevaluation measure of both types of thresholds, ICB and prior review, may be required by IDA.

54. **Additional notes:**

(a) Operating expenditures are normally verified by task team leaders and FM specialists.

(b) Irrespective of the thresholds and category of risk, the selection of all consultants (firms or individuals) hired for legal work or for procurement activities are respectively cleared by the Legal Vice President Unit with the relevant expertise and the designated procurement specialist/procurement assistant, or regional procurement manager as required.

(c) Prior review contracts for the hiring of individual consultants: apart from legal work and procurement assignments, review of the selection process for all other individual consultants (technical experts) shall be solely reviewed by the task team leader and the relevant technical specialist within the World Bank team.

55. A PP for the first 18 months of program implementation has been prepared (see Table 2.7). The final version of this PP has been discussed and approved during project negotiations. During implementation, the PP will be updated—at least annually—to reflect actual program implementation needs and improvements in institutional capacity.

Table 2.7. Procurement Packages with Methods and Time Schedule - Goods and Works

Ref.	Contract (Description)	Estimated Cost (Million US$)	Procurement Method	Prequalification (yes/no)	Domestic Preference (yes/no)	Review by World Bank (prior / post)	Expected bid-opening Date	Expected contract signature Date
1	Solar hybridization & expansion of the distribution systems & rehabilitation and reinforcement of substations - First batch	10	ICB	No	No	Prior	11/10/2017	1/24/2018
2	Solar hybridization & expansion of the distribution systems & rehabilitation and reinforcement of substations - Second batch	11.97	ICB	No	No	Prior	11/10/2018	1/24/2019
3	Procurement of connection equipment	2.54	ICB	No	No	Post	3/1/2018	5/15/2018
4	Vehicles	0.3	NCB	No	No	Post	6/20/2017	7/10/2017
5	Equipment and software	0.15	NCB	No	No	Post	6/20/2017	7/10/2017
6	Demonstration equipment	0.07	ICB	No	No	Post	8/20/2017	9/10/2017
7	Equipment NIGELEC	0.01	NCB	No	No	Post	6/20/2017	7/10/2017

Table 2.8. Procurement Packages with Methods and Time Schedule - Consulting Services

Ref.	Description of assignment	Estimated Cost (Million US$)	Selection Method	Review by World Bank (prior / post)	Expected proposals submission Date	Expected contract signature Date
1	Owner's Engineer - Construction supervision implementation of solar hybridization & expansion of the distribution systems (Component 3)	2.2	QCBS	Prior	Oct-17	Dec-17
2	Owner's Engineer - Construction supervision implementation of new solar mini-grids (Component 2)	0.9	QCBS	Prior	Oct-17	Dec-17
3	Communication and Sensitization Campaign (support to Component 1)	0.6	CQS	Post	Jul-17	Oct-17
4	Technical Assistance to incubate solar companies (support to Component 1)	0.55	QCBS	Prior	Jul-17	Oct-17
5	Feasibility studies for new investments	0.25	QCBS	Prior	Jul-19	Oct-19

Ref.	Description of assignment	Estimated Cost (Million US$)	Selection Method	Review by World Bank (prior / post)	Expected proposals submission Date	Expected contract signature Date
6	Technical Assistance to SAHFI (support to Component 1)	0.4	QCBS	Prior	Nov-17	Dec-17
7	Technical Assistance for the implementation of Component 1	0.3	IC	Prior	Jul-17	Oct-17
8	Technical Assistance for the implementation of Component 2	0.3	IC	Prior	Jul-17	Oct-17
9	Elaboration of ESIA and RAP for Component 3	0.27	QCBS	Post	Sep-17	Dec-17
10	Technical Assistance to incubate solar pumping companies (support to Component 1)	0.2	QCBS	Post	Oct-17	Dec-17
11	Technical Assistance for the implementation of Component 3 (solar expert)	0.15	IC	Post	Oct-17	Dec-17
12	Elaboration of GIS and M&E system for ANPER	0.15	CQS	Post	Jan-18	Mar-18
13	Communication Campaign for Component 2	0.15	CQS	Post	Jan-18	Mar-18
14	Elaboration of ESIA and RAP for Component 2	0.1	QCBS	Post	Sep-17	Dec-17
15	External Audit	0.125	QCBS	Post	Sep-17	Dec-17
16	Elaboration of M&E system for Component 1	0.05	CQS	Post	Jan-18	Mar-18
17	Training to operators	0.07	CQS	Post	Jan-18	Mar-18
18	Operations Manual	0.015	IC	Post	Apr-17	Jun-17
19	Communication specialist for Component 1	0.06	IC	Post	Jul-17	Oct-17
20	Technical Assistance to elaborate financing products for PFIs	0.05	IC	Post	Jul-17	Oct-17
21	FM specialist DGOFR	0.025	IC	Post	May-17	Jun-17
22	Procurement specialist ANPER	0.024	IC	Post	Mar-17	Apr-17
23	FM specialist 1 ANPER	0.024	IC	Post	Mar-17	Apr-17
23	FM specialist 2 ANPER	0.024	IC	Post	Oct-17	Nov-17
24	Internal Audit specialist ANPER	0.024	IC	Post	Mar-17	Apr-17
25	Business Development specialist ANPER	0.024	IC	Post	May-17	Jun-17
26	Safeguards specialist ANPER	0.024	IC	Post	May-17	Jun-17
27	M&E specialist ANPER	0.024	IC	Post	May-17	Jun-17
28	Communication specialist CNES	0.024	IC	Post	May-17	Jun-17
29	Technical control specialist CNES	0.024	IC	Post	May-17	Jun-17

Ref.	Description of assignment	Estimated Cost (Million US$)	Selection Method	Review by World Bank (prior / post)	Expected proposals submission Date	Expected contract signature Date
30	Procurement specialist NIGELEC	0.024	IC	Post	May-17	Jun-17
31	Safeguards specialist NIGELEC	0.024	IC	Post	May-17	Jun-17

Note: CQS = Selection based on Consultants' Qualification; QCBS = Quality- and Cost-Based Selection method.

56. **Procurement information and documentation - filing and database**. Procurement information will be recorded and reported as follows:

- Complete procurement documentation for each contract, including bidding documents, advertisements, bids received, bid evaluations, letters of acceptance, contract agreements, securities, related correspondence, and so on, will be maintained at the level of respective ministries in an orderly manner, readily available for audit.

- Contract award information will be promptly recorded and contract rosters as agreed will be maintained.

- Comprehensive quarterly reports indicating (a) revised cost estimates, where applicable, for each contract; (b) status of ongoing procurement, including a comparison of originally planned and actual dates of the procurement actions, preparation of bidding documents, advertising, bidding, evaluation, contract award, and completion time for each contract; and (c) updated PPs, including revised dates, wherever applicable, for all procurement actions.

Environmental and Social (including safeguards)

57. The project has an environmental assessment category of B. Overall, the potential impacts of the project are expected to be localized, site-specific, and easily manageable. No large-scale, irreversible impacts are foreseen. The project, if successfully implemented, will have significant environment benefits (including GHG emission reductions) mainly derived from the switch of power generation from a fossil fuel source (isolated grids running with diesel generators), including fuel-run lighting devices like kerosene lamps, oil lamps, gas lamps, and candles mostly used in rural areas to a renewable source (solar energy). However, the project interventions bear some environmental and health safety risks but no significant and/or irreversible adverse environmental and social issues are expected. The potential impacts on local environment of the project will be very small and limited to the disposal of used lead acid or nickel-cadmium batteries and those are expected to be local, site-specific, and easily manageable.

58. No physical displacement is anticipated due to the nature of the project. However, Components 2 and 3 may require small amounts of land acquisition and OP/BP 4.12 is therefore triggered to address any adverse impacts. In terms of positive impacts, the project will reduce differences in electricity services available to urban, peri-urban, and rural households some of whom have never had electricity services, to improve opportunities for rural socioeconomic development. Productive uses will be encouraged through electricity from mini-grids, solar pumps, and individual solar systems.

59. In addition, since the project activities will be designed, constructed, operated, and/or owned, by a private entity, which is a company participating in the supply and distribution of pico-PV and SHS products, OP/BP 4.03 on Performance Standards for Private Sector Activities will apply.

60. As the specific subprojects are not yet clearly defined and the exact sites of the proposed investments are not yet known, an ESMF and an RPF were prepared, consulted upon and disclosed in country and by the World Bank on April 8, 2017 and April 10, 2017, respectively. The RPF will guide the preparation of site-specific RAPs if and when necessary during project implementation.

61. Environmental and social safeguards experts with experience in addressing gender considerations will be part of the PIU at ANPER and NIGELEC and will take responsibility for overseeing compliance of all components with the guidelines, including gender differences, established under the ESMF and RPF in accordance with national and World Bank policies and procedures. NIGELEC has some experience implementing a World Bank-financed project, but the capacity of its staff will need improving, which will be done through hiring designated environmental and social specialists to manage the day-to-day safeguards work in implementation and supervision. ANPER, which will implement Component 2 has very limited capacity on safeguards. To improve the capacity, a designated staff member will be hired to oversee safeguards aspects. The staff at both NIGELEC and ANPER will also be trained in World Bank Group's safeguards policies. The World Bank supervision teams will include environmental and social safeguard specialists with experience in addressing gender considerations. Regular quarterly monitoring reports on the implementation of environmental, social safeguards, and gender provisions will be provided to the World Bank for approval. These reports will be verified during project supervision missions, which will include environmental social safeguards and gender specialists. At the national level, the BEEEI will be in charge of external M&E of safeguards. A MoU will clearly describe the type of support, attributions, and modus operandi of the BEEEI and other structures involved in project compliance monitoring with national and applicable World Bank safeguard policies and procedures.

Monitoring and Evaluation

62. Overall monitoring and coordination of project activities will be performed by ANPER but each implementing institution will be responsible to periodically report the values of indicators related to their respective component: the MoF for Component 1, ANPER for Components 2 and 4, and NIGELEC for Component 3. The CNES and MoE will report on progress of the TA activities under their responsibility. The PC in ANPER will consolidate the quarterly progress reports sent by these institutions and perform project monitoring, including regular reporting on the agreed project indicators and results. Sex-disaggregated data will be obtained through the project monitoring system to adequately monitor and report on the outcome and impact of improved energy services for female and male beneficiaries. A dedicated M&E officer, responsible for M&E of the proposed project and preparing monthly progress reports for discussion by the technical group and the PSC, will be recruited in ANPER. The PIM will further develop the institutional and reporting arrangements to ensure efficient M&E of the proposed project, including adopting gender-relevant indicators to track and assess the implementation and performance on gender-responsive actions.

63. For Component 1, the MoF will monitor and report on the number of financing applications submitted to the PFIs and the size of the loans requested and granted, as well as the reimbursements schedules and progress. The CNES will be responsible for tracking the number of solar systems sold or installed throughout the country. To do so, solar companies benefitting from project financing will be required to maintain a customer database that provides customer contacts and basic profiles, along with repayment history (in the case of PAYG businesses). An independent verification agent will validate a sample of installations made under the project. This component will also consider gathering feedback from consumers on a frequent basis, such as through cell phone surveys.

64. For Component 2, ANPER will monitor aspects related to the timely, efficient, and transparent selection and implementation of operators and mini-concession contracts of the rural electrification projects. Once projects are implemented, ANPER will monitor the number of connections and the

quality of service provided by the private operators. Emphasis will be placed on obtaining sex-disaggregated data and including gender-relevant indicators about direct project household beneficiaries and non-household clients to adequately monitor and report on the outcome and impact of improved energy services on female and male beneficiaries.

65. For Component 3, activities to be monitored include the timely, efficient, and transparent procurement and contract management; the construction and commissioning of the hybrid systems and grid extension of NIGELEC's isolated grids; effective implementation of the ESMP and the RAP; and successful completion of studies and training activities. In addition, NIGELEC's data system will generate sex-disaggregated data and include gender-relevant indicators about direct project household beneficiaries and non-household clients to adequately monitor and report on the outcome and impact of improved energy services on female and male beneficiaries.

66. In addition, the World Bank will carry out the normal review procedures for procurement and regular supervision missions, prepare the financial monitoring reports, and review the quarterly reports provided by the MoF, ANPER, and NIGELEC, including updated monitoring tables, independent annual financial audits of the project, and the financial statements of the MoF, ANPER, and NIGELEC. The World Bank will also carry out a midterm review after about 30 months from effectiveness of the project and prepare an Implementation Completion and Results Report at the end of the project.

ANNEX 3: IMPLEMENTATION SUPPORT PLAN

COUNTRY: Niger
Niger Solar Electricity Access Project

Strategy and Approach for Implementation Support

1. The strategy for implementation support has been developed on the basis of the nature of the project and responds to the complexities of the project given the capacity for implementation in Niger. The implementation support objective is to ensure that the government agencies involved are enabled to properly implement the project. It also ensures that the World Bank's resources and staff are sufficient to supervise and support this implementation.

2. The innovative design of the proposed project will require a substantial level of implementation support particularly in the early years. Technical specialists and consultants from the World Bank will continue to be involved in the design of the project and provide implementation support. At least three full team missions per year in the first two years of the project are envisaged.

Implementation Support Plan and Resource Requirements

Financial Management Aspects

3. FM supervision will start by assessing the progress of the PIU staffing and reviewing the plan in place for disbursements following FM guidance. This supervision will take place before contracts are awarded in case improvements are needed before disbursement takes place. The FM supervision will also review quarterly progress and financial audits. In terms of resources, a country-office-based staff specialist is expected to be required for eight weeks.

4. Based on the outcome of the FM risk assessment, the following implementation support plan is proposed. The objective of the implementation support plan is to ensure the project maintains a satisfactory FM system throughout the project's life.

Environmental and Social Aspects

5. Environmental, social, and resettlement safeguard support will include visits to project areas and the monitoring of mitigation measures. During and after construction, monitoring is necessary to ensure compliance with environmental and social safeguards related to the infrastructure works in Components 2 and 3, including attention to gender gaps and impacts.

Overall Support Implementation Requirements

6. The World Bank team will be composed of a mix of skills and experience for successful project implementation. The table below outlines the expected staff weeks and travel required to make sure the actions and schedule are appropriately resourced.

Implementation Support Plan

Time	Focus	Skills Needed	Annual Resource Estimate (US$, thousands)
First 24 months	Establishment of the project management team at ANPER and the MoF Development and improvement of FM/procurement/safeguard/O&M systems Component 1: Supporting a functioning operating arrangement with the MoF and the PFIs; launching national awareness campaign on quality solar systems; and quality control of solar systems. Component 2: Supporting the design of a functioning regulatory environment for rollout of rural electrification through private operators; supporting the establishment of strategic planning and program management of ANPER; and implementation of environmental and social safeguard studies—Environmental Impact Assessment and RAP, as required. Component 3: Elaboration of bidding documents, launching and conduct of public procurement; review of construction progress of infrastructure; and implementation of environmental and social safeguard studies—Environmental Impact Assessment and RAP, as required. Component 4: Supporting the detailed design and rollout of consumer awareness program; supporting the rollout of program of activities of county capacity-building program for public institutions, private companies, and financing institutions.	Engineering; solar technology; communications; procurement; environmental, social, and resettlement safeguards; FM	200
Year 3–6	Supervision of procurement and FM systems and the operation of PIUs; monitoring the performance of contracts and construction works for Components 2 and 3; supporting a functioning operating arrangement among the MoF and the PFIs; supporting the implementation of consumer awareness and communication programs; supporting the rollout of program of activities of county capacity-building program; supporting a review of mid-course correction of project design; and implementation of environmental and social safeguards—Environmental Impact Assessment and RAP, as required.	Engineering; sector regulatory and planning specialists; M&E specialist; FM; environmental and social and gender specialist	150

7. The staff skill mix and focus in terms of implementation support is summarized in the table below.

Skills Mix Required

Skills Needed	Number of Staff Weeks	Number of Trips (per year)	Comments
Senior Energy Specialist (Task Team Lead)	8	2 (3 in first two years)	Headquarter-based
Power Engineer	5	2	Region-based
F&M Specialist	5	2	Headquarter-based
T&C Specialist	4	0	Country office-based
FM Specialist	3	0	Country office-based
Procurement Specialist	2	0	Country office-based
Social Specialist	4	1	Headquarter-based
Environmental Specialist	4	0	Country office-based
Gender and Energy Specialist	2	1	Headquarter-based

ANNEX 4: ECONOMIC AND FINANCIAL ANALYSIS

COUNTRY: Niger
Niger Solar Electricity Access Project

1. The rationale for public sector financing for investments under the proposed project rests primarily on the characteristics of the project. The project will provide financing to facilitate the development of a market for off-grid individual solar PV technologies and new isolated hybrid solar PV-diesel mini-grids; as well as to increase the number of connections, lower the production costs, and improve the reliability of existing diesel mini-grid systems through hybridization with solar PV generation and storage. It will also provide TA to help establish the institutional and regulatory framework for solar off-grid electrification and build capacity among key public and private stakeholders to enable the sustainable provision of solar-based off-grid electricity for households and productive and community uses. The high-risk country environment, a legal, regulatory, and institutional framework for off-grid electrification that is under development, and the high capital costs of renewable energy make necessary the use of public funding to catalyze the development of the private sector. The concessional terms of the financing to the GoN will ensure that the off-grid electricity services are affordable and sustainable, through onlending to solar service providers and to households through MFIs. The new solar/PV mini-grids operated by the private sector will be subsidized through capital cost subsidies and structured to ensure financially sustainable, but affordable operation of the mini-grids. Concessional loans will be provided to NIGELEC to expand and hybridize existing isolated diesel mini-grids with solar PV generation.

2. In the context of this project, the World Bank provides significant value added. It is already a close partner of the GoN in other energy sector activities and has played a critical role in development of the project, including (a) supporting the development of an NES to ramp up access in urban, peri-urban, and rural areas, through the World Bank-financed NELACEP; (b) bringing experience with renewable energy-based electricity services from other countries in Africa; and (c) designing the two access approaches for Component 2, based on lessons learned from the GoN's strategic access orientations through a national access expansion program, the *Programme Rural d'Accès aux Services Energétiques du Niger* (National Reference Program for Access to Energy Services), and its first pilot in Safo.

3. **Overall net economic benefits of the project.** The EIRR and NPV of the project as a whole and of each of Components 1–3 have been calculated using a standard cost-benefit methodology. The project is economically viable with an EIRR of 10.2 percent and an NPV of US$12.5 million (at a 6 percent economic discount rate). Once GHG emission reductions resulting from the project are considered, the EIRR rises to 10.9 percent. The economic evaluation is confined to activities that generate quantifiable benefits for which an economic value can be clearly identified and measured and is restricted to benefits associated with investments under Components 1, 2, and 3. Figures 4.1 and 4.2 show the distribution of benefits across components and the evolution of the NPV of net benefits and the EIRR of the project at a 20-year horizon.

Figure 4 1. NPV and EIRR of the Project

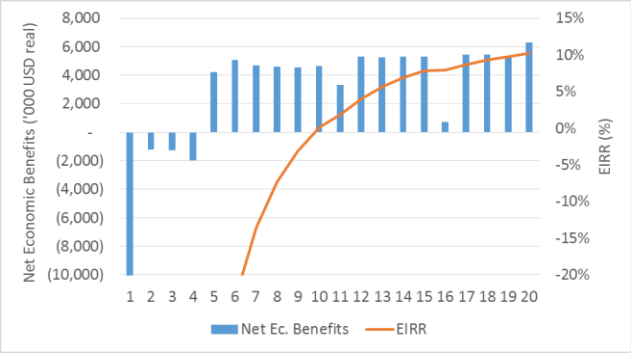
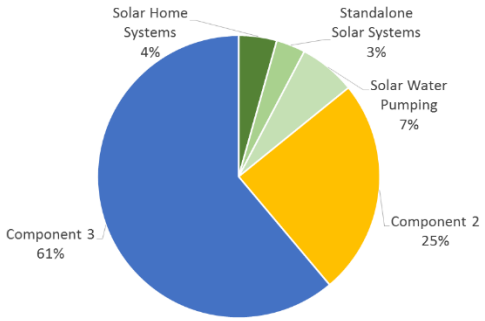


Figure 4 2. Share of Benefits from Each Component



Economic Analysis of Component 1

4. The analysis of Component 1 finds that it is economically viable with an EIRR of 33.1 percent and an NPV of US$2.1 million (at a six percent discount rate). The analysis estimates economic benefits conservatively, based on avoided costs of electricity substitutes for each consumer group. This component includes a range of technologies including SHS for households, varying from lanterns to basic solar systems for several rooms, and solar water pumps for irrigation. Based on the market analysis for SHS, it is conservatively estimated that 100,000 solar lanterns, 18,750 SHS, and 2,000 solar water pumps would be sold in the five-year period of the project.

Solar Lanterns and Solar Home Systems

5. **Benefits.** Economic benefits accrue to households from the avoided costs of lamps using dry cell batteries, kerosene lamps, candles, and mobile phone chargers. There are no specific energy/lighting consumption surveys in Niger. The analysis therefore uses expenditure data from the 2014 Niger National Survey on Household Living Conditions and Agriculture to assess average energy expenditure for lighting per household, of different deciles of the population, by region. This is a highly conservative source of data, since the questions asked in the survey do not elicit the full expenditure of households on energy or even lighting, as the only items covered related to lighting are candles, dry cell batteries for lamps, and kerosene. Households in deciles one to three of the population are the target customers for solar lanterns, while the households in deciles four to seven are the potential customers for the SHS. The corresponding expenditures on energy for lighting (candles, batteries, and kerosene), plus the estimated costs for mobile phone charging, are used to estimate the economic benefits. The analysis provides a lower bound for the economic benefits, because it does not account for the solar systems providing a greater level of service by providing more lumens of better quality light. It also does not take into account the local environmental and health benefits in comparison with the alternatives based on fossil fuel or disposable batteries or the global benefits of reducing CO_2.

6. **Costs.** The costs of the PV systems for the purposes of the analysis exclude duties and taxes. The economic cost of each solar lantern with a capacity of 3 W is estimated at US$20 per unit and the average selling price is estimated at US$30, while for SHS with a capacity of 6 W each, the cost is estimated at US$40 and sales price at US$80 per unit. The assumed lifetime of solar lanterns is two years, and four years for SHS. Tables 4.1 and 4.2 shows the flow of economic costs and benefits during a

six-year horizon for lanterns and an eight-year horizon for SHS (after which cash flows end as the solar products are not assumed to be replaced).

Table 4.1. Economic Analysis Solar Lantern

Economic Analysis - Lanterns		1	2	3	4	5	6
Solar lantern							
Lanterns sold (yr 1)	#	5,000	5,000	-	-	-	-
Lanterns sold (yr 2)	#		10,000	10,000		-	-
Lanterns sold (yr 3)	#			20,000	20,000		-
Lanterns sold (yr 4)	#				30,000	30,000	
Lanterns sold (yr 5)	#					35,000	35,000
Lanterns sold annually	#	5,000	10,000	20,000	30,000	35,000	-
Total lanterns sold	#	5,000	25,000	45,000	65,000	85,000	85,000
Total lanterns in use	#	5,000	15,000	30,000	50,000	65,000	35,000
Gross benefits	USD	$85,800	$257,400	$514,800	$858,000	$1,115,400	$600,600
Cost of goods	USD	($200,000)	($300,000)	($500,000)	($650,000)	($350,000)	$0
Setup costs	USD	($125,000)	$0	$0	$0	$0	$0
Fixed costs & OPEX	USD	($30,000)	($60,000)	($120,000)	($180,000)	($210,000)	$0
Total costs	USD	($355,000)	($360,000)	($620,000)	($830,000)	($560,000)	$0
Total net benefits	**USD**	**($269,200)**	**($102,600)**	**($105,200)**	**$28,000**	**$555,400**	**$600,600**

NPV (@6%)	kUSD	**$453**
EIRR	%	**27%**

Table 4.2. Economic Analysis of SHS

Economic Analysis - Solar Home Systems		1	2	3	4	5	6	7	8
Solar Home Systems									
SHS sold (yr 1)	#	1,000	1,000	1,000	1,000		-	-	-
SHS sold (yr 2)	#		3,000	3,000	3,000	3,000		-	-
SHS sold (yr 3)	#			4,000	4,000	4,000	4,000		-
SHS sold (yr 4)	#				5,000	5,000	5,000	5,000	
SHS sold (yr 5)	#					5,750	5,750	5,750	5,750
SHS sold annually	#	1,000	3,000	4,000	5,000	5,750	-	-	-
Total SHS sold	#	1,000	4,000	8,000	13,000	18,750	18,750	18,750	18,750
Total SHS in use	#	1,000	4,000	8,000	13,000	17,750	14,750	10,750	5,750
Gross benefits	USD	$36,600	$146,400	$292,800	$475,800	$649,650	$539,850	$393,450	$210,450
Cost of goods	USD	($100,000)	($140,000)	($180,000)	($215,000)	($115,000)	$0	$0	$0
Set up costs	USD	($125,000)	$0	$0	$0	$0	$0	$0	$0
Fixed costs & OPEX	USD	($24,000)	($72,000)	($96,000)	($120,000)	($138,000)	$0	$0	$0
Total costs	USD	($249,000)	($212,000)	($276,000)	($335,000)	($253,000)	$0	$0	$0
Total net benefits	**USD**	**($212,400)**	**($65,600)**	**$16,800**	**$140,800**	**$396,650**	**$539,850**	**$393,450**	**$210,450**

NPV (@6%)	kUSD	**$994**
EIRR	%	**49%**

7. **EIRRs.** The EIRR of use of a solar lantern compared with traditional sources is estimated at 27 percent while the EIRR of use of a SHS kit, as compared to traditional sources is estimated at 49 percent (see Tables 4.1 and 4.2).

Solar Water Pumps

8. This analysis focuses on the substitution of solar power for diesel generation to power water pumps for irrigation. Benefits accrue from the avoided cost of purchasing and running a diesel powered water pump. The sizing of the required water pump is based on an assumed average plot size and water needs for a typical small-scale farmhold. Net economic benefits are calculated on a 20-year horizon from the saved cost of the diesel pump, which would be replaced by solar pumps. The economic leveled cost per cubic meter of water is calculated to decrease from US$0.12 to US$0.09. The replacement of a diesel

water pump with a solar pump is estimated to have an EIRR of 46 percent and each water pump generates an NPV of net benefits of US$5,325 (see Table 4.3 below).

Table 4.3. Economic Analysis of Solar Water Pump for Agriculture

	Economic Analysis	Unit	1	2	3	4	5
	Diesel Water Pump						
	Water pumped	m3	1,859	1,859	1,859	1,859	1,859
	Pumping costs						
	Capital costs	USD	259				
	Fuel	USD	48	48	48	48	48
	Lube oil	USD	0.23	0	0	0	0
	O&M Cost	USD	13.76	14	14	14	14
	Labor & COWSO	USD	117.08	117	117	117	117
$0.12	Total Costs	USD	437	179	179	179	179
	Unit cost	USD/m3	0.24	0.10	0.10	0.10	0.10
	Solar PV Water Pump						
	Water pumped	m3	1,859	1,859	1,859	1,859	1,859
	Pumping costs						
	Capital costs	USD	539				
	O&M Cost	USD	1.89	2	2	2	2
	Labor & COWSO	USD	88.45	88	88	88	88
$0.09	Total Costs	USD	629	90	90	90	90
	Unit cost	USD/m3	0.34	0.05	0.05	0.05	0.05
	Economic Benefits	**USD/m3**	**-0.10**	**0.05**	**0.05**	**0.05**	**0.05**
	EIRR	**%**	**46%**				
	NPV	**USD**	**5,325**				

9. **Weighted average EIRR for Component 1.** Summing the net benefits of solar lanterns, SHS, and solar water pumps, the weighted average EIRR of Component 1 is estimated to be 33.1 percent. While these shares are based on reasonable estimates of sales volumes over the five-year period of the project, based on market studies, the actual share of different products will be determined by the market.

Financial Analysis of Component 1

10. The financial analysis assumes that the project's retail network will consist of organizations selling high quality systems in peri-urban and rural Niger to the different classes of customers. The analysis assumes the lifetime of the project would be five years, at the end of which it is expected that the market participants would have accumulated enough capital and experience with the technology to continue to operate on a financially viable basis, while the support by the GoN is scaled down.

Table 4.4. Financial Analysis Solar Systems - Component 1

Financial Analysis - Lanterns		1	2	3	4	5
Investment CFs		**($125,000)**	**$0**	**$0**	**$0**	**$0**
Cost of goods		($200,000)	($300,000)	($500,000)	($650,000)	($350,000)
OPEX and Taxes		($30,000.0)	($60,000.0)	($120,000.0)	($180,000.0)	($210,000.0)
Revenues		$150,000	$300,000	$600,000	$900,000	$1,050,000
Project CFs		**($80,000)**	**($60,000)**	**($20,000)**	**$70,000**	**$490,000**
		($205,000)	($60,000)	($20,000)	$70,000	$490,000
Project NPV (@10%)	kUSD	**$101.09**				
Project FIRR	%	**21%**				
Financial Analysis - Solar Home Systems		1	2	3	4	5
Investment CFs		**($125,000)**	**$0**	**$0**	**$0**	**$0**
Cost of goods		($100,000)	($140,000)	($180,000)	($215,000)	($115,000)
OPEX and Taxes		($24,000.0)	($72,000.0)	($96,000.0)	($120,000.0)	($138,000.0)
Revenues		$80,000.00	$240,000.00	$320,000.00	$400,000.00	$460,000.00
Project CFs		**($44,000)**	**$28,000**	**$44,000**	**$65,000**	**$207,000**
		($169,000)	$28,000	$44,000	$65,000	$207,000
Project NPV (@10%)	kUSD	**$75.49**				
Project FIRR	%	**25%**				

11. The proposed project will promote the sale of SHS through the provision of financing to local banks that will on-lend to local private sector operators (retailers of SHS) and solar service providers (for stand-alone solar systems). Local private sector operators are expected to provide an initial small amount of capital, assumed to be a 5 percent equity share of the initial capital expenditure, in addition to the financing provided by the bank to finance (a) an initial purchase of solar systems from the project; (b) the purchase of equipment needed to perform sales (laptops, mobile phones, and so on); and (c) working capital needs. Based on the analysis of on-lending rates, an affordable sales price that covers these costs is estimated at US$30 for solar lanterns and US$80 for SHS. The purchase cost and taxes are included in the financial analysis. The results, reported below, show that the projects are both individually highly financially viable, with an NPV of US$101,000 and an FIRR of 21 percent for solar lanterns and an NPV of US$75,490 and FIRR of 25 percent for SHS.

12. **Sensitivity analysis.** The financial viability of these retail business models was tested to make sure they are robust to different assumptions for the volume of sales, sales price, and recurring costs. The results are reported in Table 4.5. While the assumed volume of sales for both products is very conservatively based on the market assessment conducted in Niger, the FIRR would fall to 10 percent if the volume of sales decreased by 47 percent for solar lanterns and 40 percent for SHS. Similar falls in FIRR would result for a price decrease of six percent and seven percent, respectively, and an increase in operating expenditures of 23 percent and 24 percent.

Table 4.5. Financial Viability of Retail Business

	Switching Value (at which FIRR = 10%)	
	Solar Lanterns (%)	**Solar Home Systems (%)**
Volume of sales	−47	−40
Sales price	−6	−7
Operating costs	+23	+24

13. **Solar water pumps.** The approach for the financial analysis of the solar water pumps compares the financial costs of a farmer using a diesel-powered water pump for irrigating a typical small-scale commercial field with the costs of irrigating it using a solar water pump. The financial viability is measured by the financial savings for the farmer as the difference in leveled cost of a cubic meter of water calculated at a 20-year horizon. As reported in Table 4.6, the savings are estimated to be of the order of 21 percent.

Table 4.6. Financial Viability of Solar Pumps

Financial Analysis	Unit	1	2	3	4	5
Diesel Water Pump						
Water pumped	m3		1,859	1,859	1,859	1,859
Pumping costs						
Capital costs	USD	259				
Fuel	USD	48	48	48	48	48
Lube oil	USD	0.01	0	0	0	0
O&M Cost	USD	14	14	14	14	14
Labor & COWSO	USD	117	117	117	117	117
Total Costs	USD	437	179	179	179	179
Water supply Tarif	**USD/m3**	**0.13**				
Solar PV Water Pump						
Water pumped	m3		1,859	1,859	1,859	1,859
Pumping costs						
Capital costs	USD	539				
O&M Cost	USD	2	2	2	2	2
Labor & COWSO	USD	88	88	88	88	88
Total Costs	USD	629	90	90	90	90
Water supply Tarif	**USD/m3**	**0.11**				
Savings	**%**	**-21%**				

Component 2

14. **Demand and energy bundles.** The analysis assumes a typical mini-grid to be installed in a locality of 260 households, with an initial connection rate of 70 percent for residential customers, eight public facilities including schools, health centers, and administrative buildings, and 18 commercial clients, ranging from small revenue-generating activities to larger irrigation schemes. Residential customers are assumed to grow at 0.5 percent per year, while income-generating commercial demand is assumed to grow at one percent annually. The energy service is structured as a menu of Energy Daily Allowances, ranging from 550 Wh per day (level 1) to 5500 Wh per day (level 5), or respectively from Tier 2 service (under the SE4ALL Multi-Tier Framework) to Tier 4 service (see Table 4.7). This reflects the range of customer needs in such a village in Niger and is in line with another mini-grid example in Niger (Gourou I). The mini-grid is sized for potential demand in its fifth year of operation to account for the growth and change in composition in demand.

Table 4.7.Service Levels According to Multi-Tier Framework for Energy Access Applied to Niger Village

ATTRIBUTES			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
	1. Peak Capacity	Power capacity ratings[28] (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 is paid to the utility, pre-paid card seller, or authorized representative	
	7. Health & Safety						Absence of past accidents and perception of high risk in the future	

Number of customers and Energy Daily Allowance		**EDA** (Wh/day)					
Residential	#		260	261	263	264	265
Not connected	%	0	30%	25%	20%	15%	10%
Level 1	%	550	35%	40%	40%	45%	50%
Level 2	%	1100	35%	35%	40%	40%	40%
Level 3	%	2200	0%	0%	0%	0%	0%
Total Residential allowance	Wh/day		150150	158087	173320	181445	189646
Public Facilities	#		8	8	8	8	8
Level 2	%	1100	70%	70%	70%	70%	70%
Level 4	%	3850	30%	30%	30%	30%	30%
Total Public allowance	Wh/day		15400	15477	15554	15632	15710
Commercial	#		18	18	18	19	19
Level 2	%	1100	35%	35%	35%	35%	35%
Level 3	%	2200	25%	25%	25%	25%	25%
Level 4	%	3850	25%	25%	25%	25%	25%
Level 5	%	5500	15%	15%	15%	15%	15%
Total Commercial allowance	Wh/day		49005	49495	49990	50490	50995
TOTAL energy allowance	kWh/day		215	223	239	248	**256**
TOTAL energy allowance	kWh/year		78313	81416	87186	90362	93568
TOTAL connections	#		208	222	237	251	266

15. **Mini-grid size and capital costs.** The investment costs of this component include the capital costs for generation, storage, conversion, and distribution as well as associated labor costs for installing the new solar PV mini-grids and connecting customers and international and local transportation costs. These costs were estimated, for example, for the new hybrid village grid analyzed in Niger based on the actual costs of capital for the mini-grid in Gourou I, adjusted for the estimated size of demand described above. In addition to these initial capital expenditures, recurring project costs include the cost of insurance, investment in replacement batteries and associated equipment at least every eight years, and labor costs for the operation, client management, supervision, and maintenance of the mini-grid.

Table 4.8. Investment Costs of Mini-grid under Component 2

CAPEX calculation		Equipment	Costs
			USD
1. Generation			
PV modules	kWp	85	142,637
Labour	%	5%	7,131.83
2. Storage and powerhouse			
Battery (incl. cells, cabling, protections)	kWh	549	96,901
Labour	%	5%	4,845.05
3. Conversion			
Battery inverter incl. cabling	kVA	51	29,197
Genset	kVA	0	
Labour	%	5%	1,459.85
4. Distribution (incl. meters)	calculated per number users		
LV distribution grid (incl. poles, cabling and protections)	m	274	130,315
MV distribution grid	m	0	
Labour	%	5%	6,515.76
Total Equipment	kUSD		399.05
Total Installation Labour	kUSD		19.95
5. Services			
Project Management and engineering	Market maturi	12%	50.28
Capacity building (technicians and beneficiaries)	Market maturi	2%	8.38
6. Logistics			
International shipping costs (maritime), incl. customs	Miles from po	7%	26.55
Local transportation costs (road)	Km from port (	1%	5.53
Storage of equipment	% CAPEX		-
Insurance , security staff			
CAPEX TOTAL	kUSD		509.74

Economic Analysis of Component 2

16. The economic analysis for Component 2 shows it is economically viable with an EIRR of 7.5 percent and an NPV of US$1.5 million at a six percent discount rate, estimating economic benefits based on avoided cost of electricity substitutes. The project financing allows to cover a total of 26 mini-grids installed over a four-year period (see financial analysis for details of this calculation), for a total of nearly 58,000 residential beneficiaries.

Table 4.9. Key Outcomes of Component 2

Total IDA budget	Number of minigrids	Total new connections	of which residential	total residential beneficiairies	Solar MW installed
10,000,000	26	7,246	7,213	57,704	2.2

17. **Project costs.** Project costs include the initial capital investment costs and costs of replacing batteries every eight years, as well as the costs of operating (and insuring) the mini-grid, excluding the impact of both tax or subsidy for the purposes of the economic analysis. This amounts to US$512,000 in the first year of the example mini-grid, and recurring operational costs of approximately US$5,000 annually, with approximately US$100,000 every eight years in battery replacement costs.

18. **Economic benefits.** The economic benefits are estimated based on avoided costs of electricity substitutes[28] for consumers, including the cost of batteries, kerosene, and candles, plus an allowance for mobile phone charging for households, and on avoided costs of diesel generation for public facilities or commercial customers (including economic capital and fixed operating costs of generation equipment and using the border price of diesel plus economic cost of diesel transport to site). Avoided energy costs for households are estimated at US$4.5 per month for the poorest households and US$14.26 for relatively wealthier households (from 2014 Living Standards Measurement Survey data), while saved generation costs for public and commercial customers are estimated at US$0.50 per kWh. The part of each of the avoided costs related to petroleum products is assumed to change in relation to the forecasts of real crude oil prices in the World Bank's latest Commodity Markets Outlook publication. Average household demand for electricity from the mini-grid would be around 17 kWh per month, based on the average residential consumption in existing mini-grids in Niger. Institutional customers are assumed to consume on average 703 kWh per month while the average for commercial customers is at 994 kWh per month. Residential demand is assumed to grow at the rate of 0.5 percent per year and at 1.5 percent for commercial demand for the first eight years after project implementation.

Table 4.10 Economic Benefits for Consumers

Residential				
Monthy avoided cost for electr. Substitutes/hh	USD/mth/hh	10.4	11.1	11.8
Demand (per customer)	kWh/hh/year	210.8	220.8	240.9
Customers	#	182	196	210
Public Facilities				
Avoided cost self generation	USD/kWh	0.50	0.53	0.57
Demand (per customer)	kWh/unit/yr	703	713	724
Customers	#	8	8	8
Commercial				
Avoided cost self generation	USD/kWh	0.50	0.53	0.57
Demand (per customer)	kWh/unit/yr	994	1,009	1,024
Customers	#	18	18	18

19. The table below shows the structure of the economic analysis for one typical mini-grid. The full analysis then assumes the construction of 26 such mini-grids over the four years of project implementation. The resulting NPV and EIRR for the component are reported above.

[28] See previous section for details on those costs.

Table 4.11. Sample Economic Analysis of a Typical Mini-grid

Economic Cashflow (real USD)		2017	2018	2019	2020	2021
Benefits		**1**	**2**	**3**	**4**	**5**
Benefits based on Avoided Cost						
Residential	000 USD	18	26	30	34	37
Public Facilities	000 USD	2	3	3	4	4
Commercial	000 USD	7	10	11	12	12
Total	**000 USD**	**28**	**39**	**44**	**49**	**54**
Costs						
CAPEX						
Subtotal	*000 USD*	*-510*	*0*	*0*	*0*	*0*
OPEX						
Subtotal	*000 USD*	*-2*	*-5*	*-5*	*-5*	*-5*
Total	**000 USD**	**-512**	**-5**	**-5**	**-5**	**-5**
Annual Benefit / Cost	**000 USD**	**-484**	**33**	**38**	**44**	**48**
NPV	**000 USD**	**64**				
EIRR	%	7.5%				

20. While the EIRR is not far above the 6 percent target rate, it is important to recognize several factors that mean that further similar projects would likely have a higher EIRR. First, the analysis is highly conservative in estimating benefits as the limited data available from the 2014 Living Standards Measurement Survey meant that calculating a consumer surplus for households was not considered useful. As Niger is now a participant in global surveys on behalf of the MTF for Energy Access, more detailed data on energy use will be available that will improve and likely increase benefits estimates. Also, the global benefits of CO_2 reduction and the local environmental and health benefits of switching to cleaner fuel were not considered. Second, the component is a pilot application of an innovative institutional and technological approach to rural electrification in one of the worlds' poorest countries—PPPs for hybrid solar-diesel mini-grids. The experience gained through the pilot will be more valuable than the specific returns on the individual subprojects and will help improve the design of future projects. Third, the costs of solar PV technologies are expected to continue to decline dramatically in the near- and mid-term future. For all of these reasons, future scale-up of the activities would likely have considerably higher economic rates of return.

21. **CO_2 emissions reduction.** The project economic analysis takes into account the impact of CO_2 derived from the use of diesel generation as a backup but does not account for the positive impact of the displaced diesel self-generation by productive, commercial, and public entities or other positive externalities directly or indirectly derived from the project.

Financial Analysis of Component 2

22. The financial analysis shows that this component is financially viable, with an NPV for a sample mini-grid of US$94,002 at a 10 percent discount rate, and an FIRR of 24 percent. The financing for each mini-grid is structured so that the World Bank grant buys down the operators' initial capital investment costs sufficiently to yield a project rate of return equal to a minimum of 20 percent (pretax) and support

a positive cash position for the operator through the project period of 15 years, taking into account all operation, maintenance, and replacement expenditures and a reasonable fee for service.

23. **Structure of fee-for-service.** The energy service is structured as a menu of Energy Daily Allowances (as defined above) that reflect the average daily demand of different customer classes. The prices for these energy bundles under the baseline scenario are based on the estimated ability of customers to pay, derived from the estimated cost of electricity substitutes. Hence, fees for Levels 1 and 2 of service for example are sold at respectively US$6.25 and US$17 per month. These fees are also in line with the existing tariffs of the Gourou I rural mini-grid.

Table 4.12. Fees for Different Levels of Service of a Typical Mini-Grid

		Scenario	Level 1	Level 2	Level 3	Level 4	Level 5
MTF Tier			2	3	3	4	4
EDA	Wh per day		550	1100	2200	3850	5500
Tariff chosen scenario:	FCFA	1	4100	11200	22000	38600	52680
	USD		6.25	17.07	33.54	58.85	80.31
	USc/kWh		37.36	51.03	50.12	50.25	48.01

24. **Subsidy calculation.** Given the project investment costs of US$510,000, it is calculated that a 75 percent grant to the initial capital investment allows the operator to secure a sufficient return on the project to cover recurring costs (including battery replacement, client service within the area of the mini-grid, O&M activities, and insurance) and the debt repayment and maintain a positive cash flow.

Table 4.13. Sample Financial Analysis of a Typical Mini-Grid

Cash Flows	Y0	Y1	Y2	Y3	Y4	Y5
Project costs	(1,995)	(5,395)	(5,395)	(5,395)	(5,395)	(5,395)
Tariff revenue	9,443.94	38,825.84	41,694.32	42,949.28	43,999.35	44,204.24
Project CFs	**7,449**	**33,431**	**36,299**	**37,554**	**38,604**	**38,809**
Investment CFs	**(509,736)**	**0**	**0**	**0**	**0**	**0**
Loan drawdown	105,399	0	0	0	0	0
Grant amount	373,752	0	0	0	0	0
Equity contribution	30,584	0	0	0	0	0
Interest rate payments	0	(18,972)	(15,177)	(11,383)	(7,589)	(3,794)
Principal repayment	0	(21,080)	(21,080)	(21,080)	(21,080)	(21,080)
Financing CFs	**509,736**	**(40,052)**	**(36,257)**	**(32,463)**	**(28,669)**	**(24,874)**
Net Cash Flows	**7,449**	**(6,621)**	**42**	**5,091**	**9,936**	**13,935**
Cash at beginnging	0	7,449	828	869	5,960	15,896
Cash at end	7,449	828	869	5,960	15,896	29,831

NPV, IRR, ROE	Y0	Y1	Y2	Y3	Y4	Y5
	(128,535)	33,431	36,299	37,554	38,604	38,809
	(53,720)	(6,621)	42	5,091	9,936	13,935
Project NPV	94,002					
Project IRR	**24%**					

Economic Analysis of Component 3

25. The economic analysis for Component 3 shows that it is economically viable with an EIRR of 11.2 percent and an NPV of US$10.4 million at a 6 percent discount rate. The 30 mini-grids included in the analysis were selected from a larger sample of existing mini-grids on the basis of the cost of connecting them to the grid, the distance between households and number of households. These criteria also determine the degree of hybridization of each mini-grid's diesel generation capacity with solar and batteries, which varies with the cost of fuel supply, to minimize production costs. The mini-grids are hybridized to have a share of 50 percent or 75 percent PV of total capacity, depending on the mini-grid.

The low voltage (LV) network will be reinforced and extended, increasing the number of connections to reach a 75 percent access rate in the communities where these mini-grids are located. On average, the localities in which the mini-grids are located currently have a 26 percent access rate.

26. The main investment costs include the capital investments and O&M activities related to the PV hybridization of 30 existing mini-grids, as well as the capital costs for the expansion and densification of these mini-grids, excluding the impact of both taxes and subsidies for the purposes of the economic analysis (see Table 4.14). The analysis assumes a cost of US$200 per connection, in addition to US$8,400 per kilometer of LV line for densification of the network, and US$12,600 per kilometer of LV line for reinforcement. Investment costs for PV generation are assumed to run at US$1,400 per kW peak, with US$10 per kW peak for maintenance. Battery costs run at US$650 per kWh; batteries are to be replaced every 15 years (Li-Ion batteries are chosen for all but one site, based on the results of the pre-feasibility study).

Table 4.14. Main Assumptions for Economic Costs Component 3

		2017	2018	2019	2020
		0	1	2	3
Economic Cashflow (real USD)					
Costs					
CAPEX					
Generation					
Diesel	kUSD	0	0	0	0
Solar PV	kUSD	12,837	0	0	0
Batteries	kUSD	5,952	0	0	0
Distribution					
Network reinforcement	kUSD	760	0	0	0
Network densification	kUSD	1,235	0	0	0
Connections	kUSD	1,436	0	0	0
Subtotal	*kUSD*	*22,220*	*0*	*0*	*0*
OPEX					
Generation					
Diesel	kUSD	297	267	275	283
Solar	kUSD	23	92	92	92
Subtotal	*kUSD*	*320*	*359*	*366*	*375*
Total	kUSD	**-22,539**	**-359**	**-366**	**-375**

27. Economic benefits are estimated using two methods, to account for the benefits accruing to customers that were already connected to the mini-grid, as well as those newly connected customers (see Table 4.15). The economic benefits are based on avoided costs of electricity substitutes for consumers previously not connected. These include the costs of lighting substitutes and of mobile charging. For consumers previously connected to these mini-grids, the economic benefits are based on the avoided costs of generation due to the partial replacement of diesel generation by solar and batteries.

Table 4.15. Main Assumptions for Economic Benefits Component 3

		2017	2018	2019	2020
		0	1	2	3
Economic Cashflow (real USD)					
Benefits					
Benefits based on avoided cost for newly connected households					
Avoided spending on subsitutes for newly connected hh	kUSD	225	948	995	1,047
Benefits based on avoided production costs from shifting to part PV for existing customers					
Baseline generation costs for diesel generation	USD/kWh	0.51	0.55	0.58	0.62
Solar power share for existing customers	MWh	2,240	2,307	2,377	2,448
Avoided cost of generation	kUSD	**1,153**	**1,266**	**1,387**	**1,522**
Total benefits	kUSD	**1,378**	**2,213**	**2,382**	**2,569**

28. The analysis is performed on the basis of discounted cash flow in real 2016 U.S. dollars over a 20-year period. The results are indicated in Table 4.16. Once the benefits of GHG emission reductions are taken into account, the NPV rises to US$11.2 million and the EIRR to 11.5 percent.

Table 4.16. Results of Economic Analysis for Component 3

		2017	2018	2019	2020	2021	2022
		0	1	2	3	4	5
Economic Cashflow (real USD)							
Total benefits	kUSD	**1,378**	**2,213**	**2,382**	**2,569**	**2,715**	**2,943**
Total costs	kUSD	**-22,539**	**-359**	**-366**	**-375**	**-377**	**-394**
Annual Benefit / Cost	kUSD	**-21,161**	**1,854**	**2,016**	**2,194**	**2,338**	**2,550**
NPV (@DR)	kUSD	**10,387**					
EIRR	%	**11.2%**					
Environmental Costs							
CO2 emissions saved	ton	1,792	1,846	1,901	1,958	2,017	2,078
Total	kUSD	**54**	**55**	**57**	**59**	**61**	**62**
YR Benefit (w/externalities)	kUSD	**-21,108**	**1,910**	**2,073**	**2,253**	**2,398**	**2,612**
NPV (@DR w/extern.)	kUSD	**11,198**					
EIRR	%	**11.5%**					

Financial Analysis of Component 3

29. The financial analysis finds that Component 3 is financially viable, with an FIRR of 21 percent and NPV of US$785,000 at a 10 percent discount rate (see Table 4.17). The financial benefits accrue from the increase in revenues from sales of electricity to the newly connected customers at the prevailing tariff, which is assumed to remain the same in real terms, while consumption per customer is assumed to rise at 3 percent annually. Costs include all capital and operation costs mentioned above to which a 19 percent value-added tax (VAT) has been added. The low O&M costs for the solar PV and batteries allow to keep costs down.

Table 4.17. Financial Analysis Component 3

		2017	2018	2019	2020	2021
		0	1	2	3	4
Financial Cashflow (nominal USD)						
Financing flows						
Equity	000 USD	0	0	0	0	0
IDA Grant	000 USD	2000	0	0	0	0
IDA Loan	000 USD	23,000	0	0	0	0
Subtotal	*000 USD*	*25,000*	*0*	*0*	*0*	*0*
Revenues						
Electricity Collections						
Tariff revenues	000 USD	0	789	813	837	862
Total	**000 USD**	**0**	**789**	**813**	**837**	**862**
Project Costs						
CAPEX						
Initial CAPEX	000 USD	-22,220	0	0	0	0
Taxes	000 USD	-4,222	0	0	0	0
Concessional financing	000 USD	25,000	0	0	0	0
subtotal	*000 USD*	*-1,441*	*0*	*0*	*0*	*0*
OPEX						
Generation						
Solar	000 USD	-92	-92	-92	-92	-92
Diesel	000 USD	-297	-267	-275	-283	-285
Subtotal	*000 USD*	*-389*	*-359*	*-366*	*-375*	*-377*
Total	**000 USD**	**-1,830**	**-359**	**-366**	**-375**	**-377**
Annual Benefit / Cost	**000 USD**	**-1,830**	**430**	**447**	**462**	**485**
NPV (@WACC)	**000 USD**	**785**				
FIRR	%	**21%**				

Sensitivity analysis of Project

30. The project EIRR is tested for robustness to changes in some key parameters through a switching value analysis. It is found that the EIRR would be reduced to 6 percent by a 13 percent capital expenditure cost overrun or an operating expense cost overrun of 242 percent.

ANNEX 5: FINANCIAL SECTOR IN NIGER – BACKGROUND NOTE

COUNTRY: Niger
Niger Solar Electricity Access Project

A. Overview

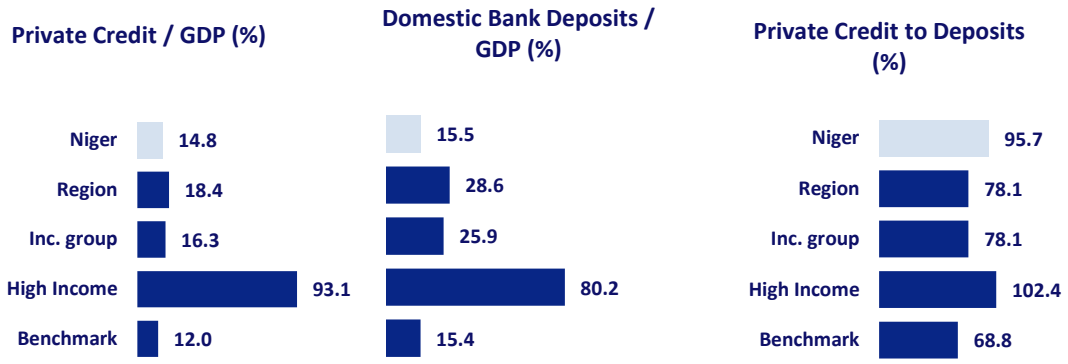
1. While Niger's financial sector is small, it has experienced growth and development in recent years. The level of financial depth as measured by proxy by the ratio of money to GDP is among the lowest in the world—at 26 percent in 2015 compared to an average of 37 percent for countries in Sub-Saharan Africa. Private credit to GDP is 14.8 percent, below the regional median of 18.4 percent. Niger's financial sector is affected by broader economic development challenges. These include economic stagnancy in Nigeria, a decrease in commodity (uranium and oil) prices, and ongoing security concerns, all of which have aggravated state fiscal deficits and led to a slowdown of commercial activity.[29] GDP growth is expected to be 5.2 percent in 2016. According to IMF, medium-term prospects are closely linked to returns on major projects in oil and mineral extraction that are underway.

2. There are 11 commercial banks and one financial institution, five insurance companies, two social security organizations, one intermediation company (SGI-Niger), one subsidiary of the Regional Stock Exchange, 24 authorized exchange bureaus, and 42 MFIs. Niger's financial sector has benefited from regional integration with seven other members of the WAEMU. It shares a common currency and the following common institutions: BCEAO, the Regional Council for Public Savings and Financial Markets, the Regional Stock Exchange, and the Central Deposit and Settlement Organization.

3. Financial intermediation in Niger is done primarily through the banking sector, which has grown over the past decade. Outstanding loans from commercial banks have increased from 18 percent of GDP in 2005 to 31 percent in 2015. Similarly, the number of depositors with commercial banks (per 1,000 adults) increased from 108 in 2005 to 138 in 2015 (see Figure 5.1). Non-bank financial institutions, including leasing, factoring, and capital markets, play a negligible role in financial intermediation in Niger, representing, an estimated, less than 1 percent of total GDP. The microfinance sector, which has been under restructuring for the past three years, is now considered one of the most stable in the region (the number of MFIs was reduced from 118 to 42). See Figure 5.2 for select microfinance indicators.

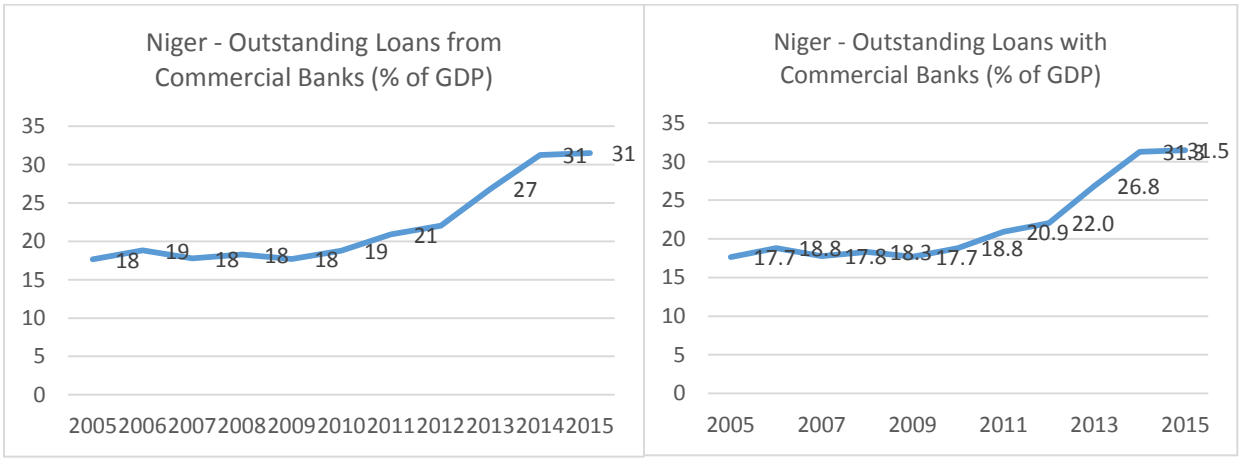
[29] Data from Finstats 2016 and IMF Financial Access Survey, unless otherwise indicated.

Figure 5.1. Select Financial Sector Depth and Stability Indicators



Source: Finstats 2016.

Figure 5.2. Supply-Side Indicators Demonstrate Niger's Financial Sector has Grown in Recent Years



Source: IMF Financial Access Survey.

B. Banking Sector

4. The banking sector remains relatively liquid and stable. In December 2015, capital adequacy ratios significantly exceeded the regulatory threshold of 8 percent (see Table 5.1). Ten of the 11 banks have met prudential requirements in the banking system. Gross nonperforming loans to total loans amounted to 19.7 percent as of June 2015 but banks were on average well-provisioned. Nonperforming loans were mostly related to clients affected by the economic slowdown in Nigeria and the disruption of commercial activities due to security concerns. Outstanding deposits with commercial banks stood at 18.45 percent in 2015. Outstanding commercial loans to GDP were at 18.45 percent in 2015. In comparison, this ratio stood at 24.27 percent in Mali and 31.49 percent in Burkina Faso.

Table 5.1. Overview of the Financial System in Niger

	CFAF, billions	% of GDP	US$, billions
Banking system			
Size (2014)			
Assets	1,171	30	2.2
Credit	635	16	1.2
Deposit	740	19	1.4
Soundness (June 2015)			
Capital adequacy ratio	—	16	—
Gross nonperforming loans to total loans	—	20	—
Net nonperforming loans to capital	—	38	—
Largest bank			
Assets (2014)	245	6	0.5
GDP			
Nominal GDP (2014)	3,961	—	7.3

Sources: Niger Banking Commission and IMF.

C. Financial Access and Inclusion

5. Financial inclusion—access and usage of quality financial services including credit, savings, insurance, and remittances—is a critical priority for Niger's broader financial sector development agenda. Financial inclusion allows low-income households to build up assets, mitigate shocks related to emergencies, illness, or injury, or make productive investments. It also stimulates economic growth and is positively correlated with income inequality.[30] At the household level, according to 2014 Findex data, 6.7 percent of the population have access to a transactions account. This is a significant improvement from 2011, when 1.5 percent had an account; however, it remains much lower than the 34 percent average in Sub-Saharan Africa. An estimated three percent of the population has access to commercial banking services, due to high costs, documentation requirements, and proximity issues. An estimated 2 percent of the population saves at a formal financial institution, while only 1.5 percent of the adult population has access to credit. In Sub-Saharan Africa, the most commonly reported reason for not having an account is poverty (72 percent), lack of money (59 percent), and distance to a financial institution (27 percent).[31]

6. At the enterprise level, credit to the private sector is low compared to peer countries—only 13.4 percent of GDP compared to 26 percent in Burkina Faso. According to World Bank Investment Climate Assessment data, 70 percent of companies in Niger consider access to financing as one of their major constraints to growth. According to survey results, the cost of credit is 2.2 percent higher for SMEs than for large companies.

D. Microfinance

7. Niger has made significant strides in developing its microfinance sector. The microfinance sector has greater outreach than the banking sector (see Table 5.2 for a sectoral overview). It has seen

[30] For a comprehensive analysis of the evidence on financial inclusion, see Cull, Ehrbeck, and Holle. "Financial Inclusion and Development: Recent Impact Evidence." Constulative Group to Assist the Poorest, 2014.
[31] For more, see Financial Inclusion in Sub-Saharan Africa. Global Policy Note Number 2014-8.

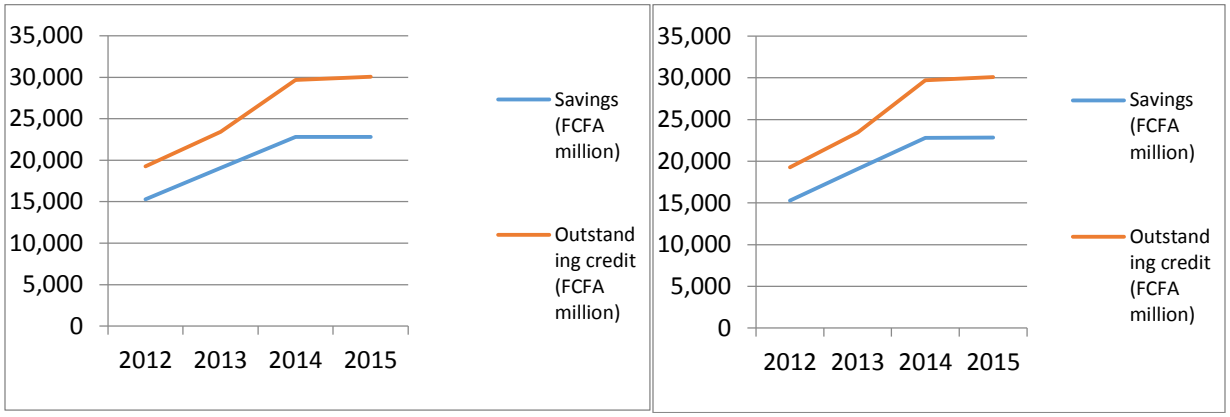
extensive growth in both the number of clients, outstanding credit, and savings systems (see Table 5.3). In 2014, the number of people with a bank account was 438,170[32] compared to 722,322 adult people with a microfinance account.[33] All the MFIs in Niger are formally registered unlike in Benin and other countries in the region. Authorities recently restructured and consolidated the microfinance sector. From 2010 to December 2015, the number of MFIs (including financial cooperatives) was reduced to 42 from 113. Out of 42 MFIs, 3 are corporations and the remaining 39 are cooperatives or group of cooperatives. Thirty-eight of the MFIs take deposits. The MFI sector is profitable overall. The largest MFIs increasingly compete with banks. In 2015, the assets held by the largest MFI, ASUSU, were about the same amount held by the eight largest banks in the country. This MFI, which is a corporation (*Société Anonyme*) is even considering raising its capital and turning into a bank.

Table 5.2. Nigerien Microfinance Sector - Selected Indicators

	2012	2013	2014	2015
Number of MFIs	51	53	47	42
Clients/members	203,237	263,882	265,537	722,533
Assets (CFAF, millions)	34,982	39,876	49,287	64,669
Savings (CFAF, millions)	15,281	19,077	22,798	22,822
Outstanding credit (CFAF, millions)	19,274	23,447	29,693	30,066
Nonperforming loans	11%	10%	9%	n.a.

Source: Agence de Regulation et Supervision de Microfinance (National Supervisory Agency of Microfinance, ARSM), 2015.

Figure 5.3. Microfinance in Niger has Witnessed Strong Growth in Recent Years



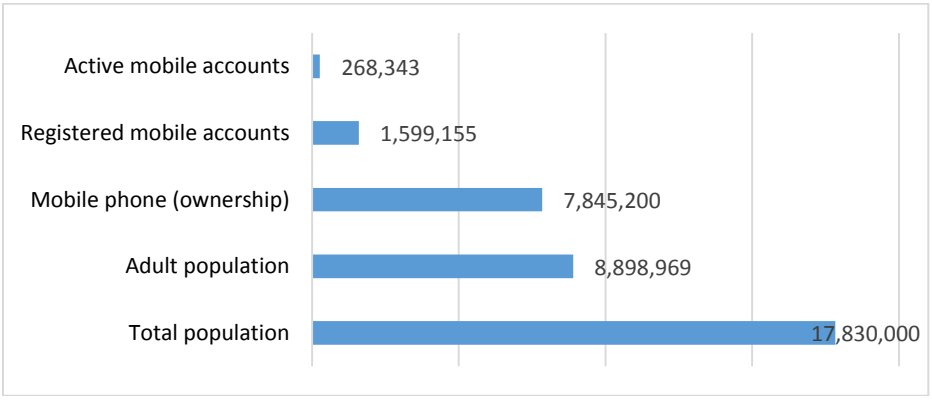
8. Authorities are focused on strengthening the regulatory environment for microfinance in Niger, including improving oversight of lending operations for agriculture microfinance and mobile transactions as well as enhancing credit monitoring and internal controls of smaller MFIs. MFIs are developing new products particularly on the savings side. Certain MFIs do not offer basic savings products despite existing demand (an estimated 27 percent of Nigeriens have registered through savings clubs or friends). There is a need to further develop commercial loans from banks to MFIs to address the lack of liquidity and promote commercial expansion of the sector.

[32] BCEAO data 2015.
[33] ARSM data December 2015.

E. Digital Finance

9. Digital finance has significant potential to drive financial inclusion given the limited presence of traditional brick and mortar financial institutions. Eighty-two percent of the population lives in rural areas where the presence of financial institutions remains low; there are only 1.5 commercial bank branches per 100,000 adults.[34] There are 7.8 million mobile owners; however, only 3 percent have mobile financial accounts. The number of mobile money transactions per 1,000 adults stood at 69.15 in 2014 compared to 86.9 in Burkina Faso, and 636.15 in Ivory Coast. Only an estimated 17 percent of mobile money accounts are active. The main constraints for the take up of mobile finance include lack of awareness, lack of transparency on pricing and cost, and the fact that the GoN does not use digital means for widespread transfers to citizens (see Figure 5.4).

Figure 5.4. Overview of Mobile Money Accounts



Source: World Development Indicators, World Bank staff calculations.

F. Agricultural Finance

10. Agriculture accounts for only two percent of financial sector lending (including banks and MFIs) despite its important contribution to the economy, with 46 percent of GDP and 70 percent of employment.[35] According to a study conducted by the World Bank in 2013, demand for agricultural finance by small-holders was estimated at only US$80 million. Furthermore, development of agricultural finance is limited by structural factors including the lack of value chains, difficult access to markets, lack of farmers' organizations, lack of irrigation, low financial awareness of famers, land issues, and drought. Other factors include high reliance of farmers on subsidies and lack of liquidity of financial players active in agriculture finance. Current efforts center on improving the legal and regulatory framework to encourage the participation of commercial banks and MFIs to develop agricultural finance, specifically the development of a framework for leasing and warehouse receipts.

G. Emerging Experience of Financial Sector Financing Off-Grid Solar Energy Sector

11. In October 2016, a World Bank mission met with key financial sector stakeholders (banks, MFIs, and support institutions) with the following objectives: (a) to determine existing operations and interest

[34] Data from World Development Indicators.
[35] IMF Article IV Report.

in financing solar energy related investments and (b) to assess opportunities for and vulnerabilities of expanding access to solar energy through the commercial financial sector.

12. Institutions expressed willingness to participate in the financing of the solar energy in Niger, although the perceived credit risk of financing operators and households was high given the nascent market conditions. Within the banking sector, lending is concentrated in large private companies and public entities, and, while the loan-to-deposit ratio is high (approximately 85 percent), most loan resources are for short-term maturities, suggesting the relevance of a line of credit to promote medium-term (two years) financing of solar energy systems. While most banks comply with financial soundness indicators, nonperforming loans to total loans stand at approximately 15 percent to 17 percent, in part due to deteriorating macroeconomic conditions related to commodity (oil and uranium) prices and economic stress in neighboring Nigeria, Niger's largest export partner. Similarly, payment delays related to large contracts with the state are common and put further stress on on-time repayment of enterprise loans. Given this context, banks expressed interest in not only lines of credit but risk-sharing mechanisms, including credit guarantee to cover non-payments of loans to finance solar energy in Niger.

13. Existing risk-sharing mechanisms for the financial sector have been established by USAID (US$2 million with Ecobank) and the French Development Agency (US$30 million with ORABANK). These instruments have been implemented with varying degrees of success and generally require a high-level of supervision and related TA for efficient implementation.

14. Concessional financing schemes exist, combining grants with credit put in place by a number of bilateral donors to promote agricultural finance and rural finance, working mainly through MFIs and state-linked financial institutions (for example, BAGRI, Niger's state-owned agricultural bank). These institutions are adequately placed to provide financing to small households for appropriate solar energy systems, although they requested TA and risk-sharing instruments to develop effective systems to serve this segment. All financial institutions consulted expressed concerns about the quality of systems currently on the market, maintenance issues, and the nascent regulatory and legal framework underpinning the sector as further challenges to introduce commercial financing to finance solar technology.

H. Government Policy/Strategy

15. In recent years, the GoN put financial inclusion on top of its agenda. As such, the GoN, with the support of development partners, has prepared the following strategies and background documents:

- The 2014-2019 Financial Sector Development Strategy (FSDS[36]) prepared by the World Bank Group with financial support from FIRST was approved in December 2014 by the GoN. The strategy (a) addresses the fundamental barriers that limit the development of Niger's financial sector and (b) recommends actions to establish a broad and robust enabling environment to support the growth of financial services through different channels. The GoN put into place in 2014 a Steering Committee to coordinate the

[36] The FSDS 2014–2019 was revised in July 2014 to include comments from the Council of Ministers and development partners. This version was adopted on October 13, 2014, by the cabinet council and approved by the Council of Ministers on November 14, 2014.

implementation of the FSDS with technical and financial support from development partners.

- The rural finance study prepared by the World Bank Group in 2013.[37] The main recommendations of this study were to increase MFIs' access to financial resources as well as to develop warehouse receipt finance, leasing, and mobile finance.

- The National Financial Inclusion Strategy (a recommendation of the FSDS 2014–2019) was prepared with support of the United Nations' Capital Development Fund, AFD, European Union, and Belgian Fund for Food Security, and was adopted in August 2015. The National Financial Inclusion Strategy gives priority to lend to small economic operators who are excluded from the traditional banking system, in particular, women, young people, and other disenfranchised segments of the population who do not have access to basic financing to start up income-generating activities.

- The National Supervisory Agency of Microfinance (ARSM) strategy was developed with the support of the United Nations' Capital Development Fund. Main recommendations include improving technical capacities of the ARSM, improving the supervision of the sector, enhancing the soundness of the sector, and advocating for the establishment of microfinance direction/fund within the MoF.

[37] World Bank. 2011. "Niger - Rural Financial Services: Expanding Financial Access to the Rural Poor."

ANNEX 6: SOLAR DEMAND ASSESSMENT

COUNTRY: Niger
Niger Solar Electricity Access Project

Overview

1. Overall, the estimated annualized market for solar technology for all potential customer segments (Table 6.1) is around US$272 million; component systems (that is, PV installations, in which individual components, such as solar panels, batteries, inverters, and if required pumps, are combined) represent around 68 percent of the market. In addition, there is an opportunity for Lighting Africa-approved solar lanterns and SHS, which represent around 21 percent of the market, and small solar pumping kits, which represent around 11 percent of the market.

Table 6.1. Solar Market Size by Different Segments

Segment	Estimated Annualized Market Size[a] (US$, millions)	Thereof Lighting Africa (US$, millions)	Thereof Solar Pumping Kits (US$, millions)
Private households[b]	56.5	56.5	—
Schools	1.6	1.4	—
Health centers	0.4	0.1	—
Public buildings	0.4	—	—
Large irrigation schemes	1.2	—	—
Small scale irrigation	33.4	—	29.5
Crop processing[c]	12.5	—	—
Water provision	165.3	—	—
Street lights	1.0	—	—
Total	**US $ 272.3 million**	**58.0**	**29.5**

Note: a. The annualized market size is defined as the maximum sales revenues achievable in any given year if all potential customers are accessible and interested, and there are no further barriers (for example, affordability) preventing the transaction. 'Annualized' refers to the average annual sales potential under consideration of product lifetimes. If, for example, 100 households want to buy a solar system and the solar system has an expected lifetime of five years, then the 'annualized' sales volume is 20 units (100 units divided by five years); b. The market size shown assumes that consumer financing schemes are available for solar lanterns, SHS, and solar pumping kits for smallholder farmers. The availability of consumer financing schemes makes the market accessible for many households that would not be able to afford the same product in an over-the-counter cash transaction; c. This assumes a crop processing level of 85 percent.

Market Opportunity for Large Market Segments

Households

2. Private households present a huge potential market segment for solar in Niger. With nearly 90 percent of Niger's households being off-grid, distributed home solar devices have the potential to transform the country's household energy access landscape. Given the extreme levels of poverty in Niger, this market depends crucially on the ability of solar providers or banks and MFIs to provide consumer finance.

3. Specifically, the estimated annualized market for solar lanterns and SHS is around US$12 million in the absence of consumer financing, representing an annual sales volume potential of around 760,000 units, for the most part consisting of entry-level solar lantern products. Of these, an estimated 630,000 units are for off-grid customers (since some off-grid households may choose to purchase solar systems as backups), representing nearly 25 percent of off-grid households. Consumer financing would unlock an additional US$44 million in annual market size, reach an additional 460,000 households each year, increase total off-grid household reach to above 40 percent per year, and raise levels of energy access to include more sophisticated SHS.

4. **Impact of custom duties and VAT.** Currently, pico-PV solar systems imports to Niger are subject to 52 percent tax (customs duties and VAT). As shown in Table 6.2, these taxes have a significant impact on the annual sales volume potential. Even in the presence of consumer finance, they reduce the size of the market by 27 percent. This decrease comes mainly at the expense of the poorest end of the market—a significant number of households are locked out of the market as they simply cannot afford to pay US$7.60 for the simple solar lantern, even with consumer financing options available. At the top end of the market, these taxes significantly reduce sales volume potential across all SHS, while households that could afford these devices in the absence of these taxes are pushed down into the market for light and mobile chargers.

Table 6.2. Impact of Custom Duties and Value Added Tax to Solar Products

	Market price in US $		Sales volume potential p.a. in '000s (with consumer financing)			Annualized market size in US $ million (with consumer financing)		
	Benchmark (BM)	BM + 52% custom duties	Benchmark (BM)	BM + 52% custom duties	Change in %	Benchmark (BM)	BM + 52% custom duties	Change in %
Simple study light	5	8	697	219	(69%)	3.5	1.7	(52%)
Standing light	10	15	-	43		-	0.7	
Light & mobile charger	40	61	289	542	88%	11.6	33.0	185%
Small multiroom lighting system	100	152	102	36	(65%)	10.2	5.4	(47%)
Basic solar home system (20W)	220	334	116	47	(60%)	25.6	15.6	(39%)
Medium solar home system (100W)	500	760	9	1	(87%)	4.5	0.9	(80%)
Large solar home system (200W)	1000	1520	1	-	(100%)	1.2	-	(100%)
			1,215	**888**	(27%)	**57**	**57**	1%

Agricultural Irrigation

5. Employing over half of Niger's population, agriculture is a significant economic sector, and accounts for around 67 percent of annual freshwater pumping.[38] A large share of this is used for irrigation to enable cultivation in Niger's dry, hot conditions. This implies a significant market opportunity for irrigation technologies and related water pumping systems. Water pumps allow farmers

[38] The World Bank: World Development Indicators Database.

to channel water into their irrigation systems, either by (a) pumping groundwater to the surface, or (b) pumping water out of nearby rivers and dams. As grid reach is limited in rural, agricultural areas, there is a market opportunity for solar pumps for irrigation systems into large-scale irrigation schemes through the *Office National des Aménagements Hydro Agricoles* (National Office for Irrigation Schemes, ONAHA) and individual farms.

6. Comparing the cost of solar-powered with generator-powered pumping systems—assuming each pumping station covers a maximum surface area of 25 hectares—there is a business case for all *Amenagements Hydro Agricole* (irrigation schemes, AHA) for changing from generator to solar. On the other hand, solar systems do not provide a cost-effective alternative for AHA with grid access, representing around 70 percent of the total surface area of ONAHA plots.

7. The analysis further shows that the strength of the business case is sensitive to two key factors: (a) solar system size, and (b) capacity utilization[39] pumping stations with exceptionally high utilization rates above 85 percent typically have the strongest business case.

8. Table 6.4 shows the viable market size[40] for a range of different scenarios of land area covered per pump. The annualized market size, assuming pumping stations service a maximum land area of 25 hectares, is estimated at around US$1.2 million. The average solar system size for one pumping station is around 22 kW, but sizes have high variability due to different crop types and water sources (ranging from around 6 kW to nearly 120 kW).

Table 6.3. Different Scenarios to Present Potential Annualized Market Size

Scenarios for different pumping station size						
	Max. surface area (ha) per pumping station					
	5	10	25	50	100	200
Annual market size in US $	216,226	836,892	1,187,664	1,403,138	1,110,351	1,308,760
*% of market viable for solar systems**	*3%*	*20%*	*25%*	*26%*	*25%*	*25%*

Small-scale, Individual Irrigation Schemes

9. Total irrigated agricultural land area in Niger is estimated at 135,314 hectares.[41] Of this land area, only around 17,000 hectares (approximately, 12 percent)[42] are part of ONAHA. The remainder is cultivated by independent smallholder and commercial farmers. Currently, irrigation is performed manually or through generator-powered pumping systems, suggesting a potential opportunity for solar-powered water pumping.

[39] The capacity utilization is the extent to which the productive capacity of the pump is being used, for example, if the pumping capacity is 100 liters per hour, but only 80 liters per hour are being pumped, then the pump is running at 80 percent capacity utilization.
[40] Note that the market size displayed in Table 5 does not consider affordability, or what magnitude and type of financing mechanisms would need to be introduced to unlock this full market potential.
[41] Data received from the Ministry of Agriculture.
[42] Data received from ONAHA.

Table 6.4. Annualized Market Size of Solar Pumping for Irrigation

	NIGER
a) Sales volume (# of units)	
Micro SHF	**37,330**
SHF	**12,071**
Small CF	**432**
Medium CF	**51**
Large CF	**10**
Total	**49,894**
thereof integrated kits	*49,401*
b) Market size (revenues in US $)	
Micro SHF	**19,598,225**
SHF	**9,872,312**
Small CF	**2,761,480**
Medium CF	**909,691**
Large CF	**296,413**
Total	**33,438,122**
thereof integrated kits	*29,470,537*
Avg. selling price in US $	*670*

10. Comparing the cost of solar-powered with generator-powered pumping systems, there is a business case across all farm sizes and water sources. In contrast, regardless of land area or water source, the solar systems do not provide a cost-effective alternative for those with grid access. The higher upfront investment for solar relative to generators is rapidly amortized through cost savings on diesel. The analysis reveals an exciting opportunity for solar pumping kits; the solar micropump is well suited for the irrigation needs of micro smallholder farmers accessing water from nearby rivers or dams. The solar micropump sets are available at the market price of US$400, and have a life expectancy of six years, which results in an annualized cost of US$67. This compares with a lifetime cost (over six years) of around US$580 for a generator-powered system; this breaks down into an upfront investment of US$300 (US$200 for the pump, and US$100 for a cheap, short-life generator), US$200 to replace the generator every two years,[43] and an additional annual cost of around US$13 for diesel. As shown in Table 6.5, the annualized market size for SWP technology in the market for small-scale, individual irrigation systems is estimated to be around US$33 million, representing an annual sales volume of around 50,000 units.

Water Provision

11. Besides irrigation, the second large segment for water pumping is nationwide public and private water provision, both for drinking water and productive use (domestic and industrial).

12. In the absence of sufficient data, that is, number of and regional distribution of water providers and their volumes of water pumped or energy consumption, to model the electricity needs of the different private and public sector water providers, the assessment of the market opportunity for SWP is

[43] Consultations in Niger revealed that cheap generators are available at US$100, but these have lifespans of at best around two years.

based on the number of water stations. A water station is defined as a well or a borehole with water pumping activities.

13. A total annualized market size of around US$165 million (representing an annual sales volume of around 812 units, which is, pumping stations equipped) is estimated for Niger. Of the total market size, over 75 percent is for sales of large pumping systems for drinking water supply; further analysis at the individual locations will be required to evaluate if constructing and managing large solar production facilities at the sites of the pumping stations is a feasible opportunity.

Table 6.5. Solar Market for Water Providers by Water Station Type and Region

	AGADEZ	DIFFA	DOSSO	MARADI	NIAMEY	TAHOUA	TILLABERI	ZINDER	**NIGER**
Potential sales volume in units									
PC	6.5	11.9	30.5	41.6	0.4	26.2	26.7	18.6	**162**
FPM H	1.2	1.3	18.2	14.6	0.5	5.2	27.6	31.9	**101**
PEA	0.8	1.7	6.7	2.3	0.2	5.2	9.1	3.1	**29**
SPP	4.1	0.6	0.9	2.7	-	4.5	0.6	0.9	**14**
Mini-AEP	13.0	14.5	96.3	127.0	-	119.1	55.0	75.8	**501**
AEP	0.3	0.1	0.3	0.9	1.9	1.0	0.2	0.8	**5**
Total	**26**	**30**	**153**	**189**	**3**	**161**	**119**	**131**	**812**
Market size in US$									
PC	281,328	94,794	242,880	331,699	2,868	597,351	414,366	422,773	**2,388,059**
FPM H	132,333	39,169	541,245	434,420	14,243	429,648	1,201,841	2,636,667	**5,429,567**
PEA	357,049	177,519	715,456	242,072	16,138	1,149,252	1,192,018	691,783	**4,541,288**
SPP	4,389,983	153,027	216,788	688,622	-	2,582,307	191,280	487,769	**8,709,777**
Mini-AEP	1,393,257	1,200,367	2,194,771	2,894,454	-	5,178,700	2,389,333	3,293,758	**18,544,640**
AEP	17,534,165	7,013,666	17,215,357	23,846,479	3,634,328	30,605,087	10,520,499	15,302,541	**125,672,121**
Total	**24,088,115**	**8,678,542**	**21,126,497**	**28,437,746**	**3,667,577**	**40,542,346**	**15,909,337**	**22,835,290**	**165,285,450**

C. The Supply-Side Landscape

14. The supply side of Niger's solar market is at a early stage. To date, supply-side activities have consisted almost entirely of EPC firms installing and maintaining fixed solar installations in response to tenders by large institutional clients such as NGOs, development finance institutions, and the GoN. These tenders cover a broad range of activities, from solar irrigation to solar street lighting to community electrification projects, but to date very few businesses have attempted to supply solar products directly to end consumers (for example, households, farmers, and communities) in a scalable, market-driven way. A small number of businesses have run small pilots for solar lanterns, but these have been hampered by a number of operational and external challenges—especially the combination of limited customer purchasing power and high market price levels due to 52 percent customs duties levied on solar product imports—and have only reached a very small fraction of the total market. In addition, what little activity has occurred has been concentrated mainly in the periphery of Niamey.

15. Larger international players, though interested in Niger as a long-term opportunity, do not see Niger as a priority market and are already stretched thin by recent expansion efforts in other countries. In addition, ongoing DFI initiatives to stimulate solar sector growth in other Sub-Saharan African countries continue to compete for these businesses' attention. Instead, the end-consumer market has been dominated by informal players selling low-grade imitation products and with little capacity for scale.

Local Businesses

16. Though several businesses in Niger are active in the import, sale, installation, and maintenance of solar technology, only a small number of these are operating or are planning to operate scalable, market-driven businesses models focusing on sales to end consumers (whether these end consumers be households, productive users, or communities). Instead, based on extensive market consultations, the vast majority of solar activity to date has been concentrated in stand-alone, one-off projects for institutional clients such as NGOs, development organizations, and government agencies.

17. At present, the only entity in Niger engaged in direct distribution of solar devices to end consumers is Total through its Awango program. The Awango program sells solar lanterns through Total's network of petrol stations as a Corporate Social Responsibility program in several Sub-Saharan African countries, including Kenya, Cameroon, the Republic of Congo, and Zambia, and was launched in Niger in 2013. Total offers a range of d.light solar lanterns, some also including cell phone charging capabilities, but sales have been 1,000 units in 2014; 4,000 units in 2015; and 2,000 units in 2016. Averaged over Total's network of 80 petrol stations (69 of which are in Niamey), this amounts to sales of around 25 units per station in 2016, or one every other week.

18. Niger's second principal private sector (or semi-private) effort at developing a sustainable off-grid solar market came from a partnership between local solar company Haske Solaire and Dutch NGO SNV, both members of the industry association APE-Solaire, formed in 2013 between a group of solar companies, ASUSU, and SNV. Haske imported several thousand GreenLight Planet solar kits into Niger with the help of SNV, with the aim of unlocking the consumer market through consumer finance partnerships with ASUSU. Consultations revealed that around 3,500 units were sold in Niger, and the remaining 4,500 units were sold in bulk to a client in Benin. Based on consultations with APE members, despite some initial success, the initiative ran into a number of obstacles including a change in country leadership and priorities at SNV, a lower-than-expected proportion of consumers who qualified for ASUSU consumer loans, low levels of consumer awareness around the benefits of high-quality solar products, as well as ongoing concerns about the impact of import duties on commercial sustainability.

19. A few other companies consulted are piloting or designing end consumer business models, though these are at best early stage. Jimafor, for instance, installs up to 500 W solar installations in communities and then charges consumers on a pay-per-use basis for services such as milling, water pumping, or cell phone charging. At present, Jimafor retains ownership of the systems, but is planning to transfer ownership to local entrepreneurs in the near future. To date, however, it only has two systems operational in the field. Jimafor was initially part of the CIPMEN incubation program that has supported three local solar business start-ups, that is, Jimafor, Haske, and Tech-Innov. CIPMEN offers business support, training, networks, and office space and, based on insights gained during consultations, plays a significant role in supporting and promoting innovation and entrepreneurship in Niger.

20. Nexture and Benalya reported being in talks with Greenlight Planet, d.Light, and Forsera to negotiate partnerships to roll out PAYG SHS models in Niger in the near future.

21. The rest of Niger's local solar supply side is made of a small group of 10–15 EPC firms, who source, install, and maintain solar installations as one-off projects for institutional clients. Exact services provided vary by company, but typically include a combination of solar and non-solar offerings such as borehole digging, solar pumping, irrigation projects, solar street lighting, backup power systems for

commercial and administrative buildings, and community electrification projects (for example, mini-grids). Given the nature of these projects, system sizes tend to be relatively large, ranging from 500 W or so to several dozen kW for large irrigation projects. Some of these businesses expressed interest in diversifying into end-consumer distribution, though most still saw plenty of commercial opportunity in their core business lines and very few expressed willingness to manage end-consumer financing in-house, preferring to partner with external finance providers.

D. Recommended Market Interventions for Stand-alone Solar Systems

22. Consultations with solar technology distributors in Niger identified a range of key challenges and barriers to growth for private sector players, including:

- High import duties on solar products (52 percent);
- Low end-user purchasing power;
- Limited access to finance for both business and consumers;
- Lack of formal distribution channels to reach peri-urban and rural off-grid populations; and
- Market spoilage due to inflows of low-grade imitation products.

23. Further, consultations with businesses in the solar market revealed that most businesses provide one-off project services. International solar companies are unlikely to enter Niger in the near future. These players currently consider other markets more attractive, based on considerations such as regulatory environment, size of addressable market, as well as availability of partnerships for sales and distribution (including MNOs). As a result, scaling solar in Niger will likely need to be a home-grown effort in the short term, with sales, distribution, and end-consumer service channels set up by local businesses.

24. Based on this assessment of the Nigerien market, there needs to be significant Government and development sector support for the solar market to accelerate private sector growth. At present, neither the supply side, the financial sector, nor end consumers appear ready to drive solar market growth in the absence of significant interventions. In particular, it is recommended to focus interventions on market stimulation for smaller household systems and solar pumping kits. Solar businesses serving institutional clients and large corporates are generally able to secure project financing from banks, and these sectors are mostly based on discrete tenders and contracts that are less suitable for rapid, market-led growth initiatives. Furthermore, businesses serving institutional clients will likely enjoy collateral benefits from systemic interventions aimed at unlocking household and irrigation markets. Table 6.2 summarizes the recommendations.

Table 6.6. Recommended Interventions for Standalone Solar Systems

Intervention	Description	Rationale (in short)
Tax exemptions on solar technology	Make solar products exempt % import duties and taxes	Currently costs to solar companies are artificially inflated by 52 percent due to import duties; these costs are passed on to customers, making solar less affordable.
Consumer education	Widespread, multichannel consumer education and benefit awareness building	Overcome negative consumer perceptions

Intervention	Description	Rationale (in short)
programs	campaigns Target end users and the supporting ecosystem including distributors and retailers Coordinate efforts of private, public, and development sector	and build benefit awareness Influences purchase decisions and ease access to distribution channels
Inventory financing facility	Concessionary credit line so financial institutions can access liquidity for solar market lending; Financial institutions use liquidity to offer solar companies loans (potentially at subsidized rates) to refinance inventory holding Loans available to all solar companies (small household systems, larger PV installations, and mini-grids) Start with few financial institutions, maybe ASUSU, and one large bank, and gradually expand.	Long inventory financing periods present a key challenge to growth for solar lantern and SHS distributors High up-front financing requirements present a key challenge to distributors of larger PV systems (including pumps)
Credit guarantee scheme for inventory financing facility	Private sector lending portfolio is de-risked through guarantees Loss-sharing agreements to cover irrecoverable inventory loans	De-risking encourages private sector lending to solar sector Initial security until the proof case of economic viability of lending to solar businesses has been established
Consumer loan financing facility	Concessionary credit line so financial institution can access liquidity for solar market lending Financial institution offers consumer lending schemes to finance solar asset purchases Focus on liquidity for private households	Low purchasing power among private households is a key constraint to growth for SHS (and larger solar lanterns) Credit line and underlying guarantee required to establish proof case of economic viability of receivables financing Facility can be expanded or transformed to provide PAYG operators financing of on-balance sheet consumer loans
Credit guarantee scheme for consumer loan financing facility	Private sector lending portfolio is de-risked through guarantees Loss-sharing agreements to cover irrecoverable consumer loans	De-risking encourages private sector lending to solar sector Initial security until the proof case of economic viability for solar consumer loans has been established
Market entry and expansion grants	Combination of up-front grants and results-based financing to invest in infrastructure and working capital Awarded to distributors of small household	Significant up-front investment to build distribution network and source inventories to serve household market Significant up-front investment and long

Intervention	Description	Rationale (in short)
	systems, as well as mini-grid operators	amortization periods for mini-grids
TA	Government: TA related to import regulation, industry standards, and licensing processes Financial institutions: Capacity building related to financial services aimed at solar industry, credit risk assessment, and so on Solar companies: Best practice transfer from international markets and support in setting up technology platforms for PAYG; incubation and acceleration of early stage businesses MNOs: Best practice transfer regarding platforms, interfaces, and market development from international markets Solar technicians: Capacity building for nationwide installation and maintenance of solar equipment	Make the business environment more conducive and profitable Strengthen the overall ecosystem surrounding the solar market Ensure knowledge transfer from abroad for faster, more cost-efficient progress

25. Initiating the overarching systemic interventions, removal of the 52 percent taxes (import duties and value added tax) will be key to further market growth. Consumer education programs will be required to stimulate the demand side, and significant TA will be required to develop a more conducive ecosystem for private sector players operating in the solar industry.

26. The next step is to encourage investment on the supply side through the provision of market entry and expansion grants, launch the inventory financing facility, and put consumer financing schemes in place to reduce affordability-based limitations of demand. As the market grows, overall funding requirements for market interventions will increase.