Document of
The World Bank

FOR OFFICIAL USE ONLY

Report No: PAD662

INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED GRANT

IN THE AMOUNT OF SDR 4.8 MILLION
(USD 7 MILLION EQUIVALENT)

AND A PROPOSED SMALL ISLAND DEVELOPING STATES INITIATIVE GRANT

IN THE AMOUNT OF USD 2.1 MILLION

TO

TUVALU

FOR AN

ENERGY SECTOR DEVELOPMENT PROJECT

December 30, 2014

Energy & Extractives Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective October 31, 2014)

Currency Unit	=	AUD
AUD 1	=	USD 0.88
SDR 1	=	USD 1.4783

FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ACS	Administrative and Client Support
ADB	Asian Development Bank
ARAP	Abbreviated Resettlement Action Plan
AUD	Australian Dollar
BA	Bids Administrator
BP	Bank Procedure
CAS	Country Assistance Strategy
CIF	Consolidated Investment Fund
CPI	Consumer Price Index
CQS	Selection Based on Consultant's Qualifications
DA	Designated Account
DC	Direct Current
DP	Development Partner
DSM	Demand-side Management
EA	Environmental Assessment
EE	Energy Efficiency
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EOCK	Economic Opportunity Cost of Capital
ESDP	Energy Sector Development Project
ESMF	Environmental and Social Management Framework
EU	European Union
FCM	Finance and Contracts Manager
FEP	Foreign Exchange Premium
FIRR	Financial Internal Rate of Return
FNPV	Financial Net Present Value
FM	Financial Management
GAD	Gender Affairs Department
GAP	Gender Action Plan
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoT	Government of Tuvalu

GWh	Gigawatt-hour
HIES	Household Income and Expenditure Survey
IBRD	International Bank for Reconstruction and Development
ICB	International Competitive Bidding
IDA	International Development Association
IDCC	Island Development Coordinating Committee
IEA	International Energy Agency
IFC	International Finance Corporation
IFR	Interim Financial Report
IP	Indigenous Peoples
IRENA	International Renewable Energy Agency
IRR	Internal Rate of Return
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
JPA	Junior Professional Associate
KB	Kilobyte
KBps	Kilobytes per second
KEMA	Keuring van Elektrotechnische Materialen te Arnhem
km	Kilometer
KPMG	Klynveld Peat Marwick Goerdeler
kV	Kilovolts
kW	Kilowatts
kWh	Kilowatt-hour
kWp	Kilowatts-peak
LCS	Least-cost Selection
LED	Light-emitting Diode
M&E	Monitoring and evaluation
MB	Megabyte
MDG	Millennium Development Goals
MHA	Ministry of Home Affairs
MOF	Ministry of Finance
MPREEE	Master Plan for Renewable Energy and Energy Efficiency
MW	Megawatts
MWh	Megawatt-hour
NGO	Nongovernmental Organization
NOx	Nitrogen Oxide
NPV	Net Present Value
NZ	New Zealand
NZAID	New Zealand Aid
NZMFAT	New Zealand Ministry of Foreign Affairs and Trade
O&M	Operation and Maintenance
OMMP	Operational Monitoring and Maintenance Plan
OP	Operational Policy
OTEC	Ocean Thermal Energy Conversion
PAD	Project Appraisal Document
PAIP	Pacific Aviation Investment Program

PCR	Physical Cultural Resources
PEAR	Preliminary Environmental Assessment Report
PDO	Project Development Objective
PIB	Project Information Bulletin
PIGGAREP	Pacific Island Green Gas Abatement of Renewable Energy Project
PLC	Power-line communication
PMU	Project Management Unit
PNA	Parties to Nauru Agreement
PPA	Pacific Power Association
PV	Photovoltaic
QBS	Quality-based Selection
QCBS	Quality and Cost-based Selection
RE	Renewable Energy
RP	Resettlement Plan
RPF	Resettlement Policy Framework
s	Second
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SI	Sensitivity Indicator
SIDS	Small Island Developing States
SIDS DOCK	Small Island Developing States Initiative
SOE	State-Owned Enterprise
SPREP	Secretariat of the Pacific Regional Environment Programme
SSS	Single-source Selection
SV	Switching Value
TEC	Tuvalu Electricity Corporation
TJ	Terajoules
TMTI	Tuvalu Maritime Training Institute
TNCW	Tuvalu National Council of Women
TNEP	Tuvalu National Energy Policy
TORs	Terms of Reference
TTL	Task Team Leader
TvAIP	Tuvalu Aviation Investment Project
UAE	United Arab Emirates
UK	United Kingdom
UNDP	United Nations Development Programme
USD	United States Dollar
V	Volt
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal

Regional Vice President:	Axel van Trotsenburg
Country Director:	Franz R. Drees-Gross
Sector Director:	John A. Roome (through June 30, 2014)
Global Practice Senior Director	Anita M. George (from July 1, 2014)
Global Practice Director:	Charles M. Feinstein (from July 1, 2014)
Sector Manager	Michel Kerf (through June 30, 2014)
Practice Manager	Julia M. Fraser (from July 1, 2014)
Task Team Leader:	Roberto Gabriel Aiello
Co-Task Team Leader:	Natsuko Toba

TUVALU
Energy Sector Development Project

TABLE OF CONTENTS

PAD DATA SHEET

Tuvalu

Energy Sector Development Project (P144573)

PROJECT APPRAISAL DOCUMENT

EAST ASIA AND PACIFIC

GEEDR

Report No.: PAD662

Basic Information			
Project ID: P144573	EA Category: B - Partial Assessment		Team Leader: Roberto Gabriel Aiello
Lending Instrument Investment Project Financing	Fragile and/or Capacity Constraints [ ] Financial Intermediaries [ ] Series of Projects [ ]		
Project Implementation Start Date April 1, 2015	Project Implementation End Date March 31, 2019		
Expected Effectiveness Date April 1, 2015	Expected Closing Date March 31, 2019		
Joint IFC No			
Practice Manager/Manager: Julia M. Fraser	Senior Global Practice Director: Anita Marangoly George	Country Director: Franz R. Drees-Gross	Regional Vice President: Axel van Trotsenburg

Borrower:			
Responsible Agency: Tuvalu			
Contact:	Ms. Limasene Teatu	Title:	Permanent Secretary, MFED
Telephone No.:	+688 20408	Email:	lteatu@gov.tv
Responsible Agency: Tuvalu Electricity Corporation			
Contact:	Mafalu Lotolua	Title:	General Manager
Telephone No.:	+688 20357	Email:	mafaluloto2@gmail.com

Project Financing Data(in USD Million)					
[ ]	Loan	[X]	Grant	[ ]	Other
[ ]	Credit	[ ]	Guarantee		

Total Project Cost:	9.10	Total Bank Financing:	9.10
Financing Gap:	0.00		

Financing Source	Amount
BORROWER/RECIPIENT	0.00
International Development Association (IDA)	7.00
Small Island Developing States Initiative (SIDS DOCK) Multi-Donor Trust Funds	2.10
Total	9.10

.

Expected Disbursements (in USD Million)

Fiscal Year	2015	2016	2017	2018	2019	0000	0000	0000	0000
Annual	0.10	1.90	6.00	1.00	0.10	0.00	0.00	0.00	0.00
Cumulative	0.10	2.00	8.00	9.00	9.10	0.00	0.00	0.00	0.00

Institutional Data

Practice Area/Cross-Cutting Solution Area

Energy & Extractives

Cross-Cutting Areas

[X] Climate Change

[ ] Fragile, Conflict & Violence

[X] Gender

[ ] Jobs

[ ] Public–Private Partnership

Sectors/Climate Change

Sector (Maximum 5 and total % must equal 100)

Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Energy and Mining	Other Renewable Energy	80	80	80
Energy and Mining	Energy Efficiency in Heat and Power	20	20	20
Total		100		

☐ I certify that there is no Adaptation and Mitigation Climate Change Co-benefits information applicable to this project.

.

Themes

Theme (Maximum 5 and total % must equal 100)		
Major theme	Theme	%
Rural development	Other rural development	50
Urban development	Other urban development	50
Total		100

Proposed Development Objective(s)

The project development objective is to enhance Tuvalu's energy security by reducing its dependence on imported fuel for power generation and by improving the efficiency and sustainability of its electricity system.

Components

Component Name	**Cost (USD Millions)**
Renewable Energy Investments	7.40
Energy Efficiency Investments	1.20
Technical Assistance and Project Management Support	0.50

.

Systematic Operations Risk- Rating Tool (SORT)

Risk Category	**Rating**
1. Political and Governance	Moderate
2. Macroeconomic	Substantial
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Substantial
6. Fiduciary	Substantial
7. Environmental and Social	Substantial
8. Stakeholders	Moderate
9. Other	n.a.
OVERALL	Substantial

Compliance

Policy

Does the project depart from the CAS in content or in other significant respects?	Yes [ ]	No [X]

.

Does the project require any waivers of Bank policies?	Yes [ ]	No [X]
Have these been approved by Bank management?	Yes [ ]	No [ ]
Is approval for any policy waiver sought from the Board?	Yes [ ]	No [X]

Does the project meet the Regional criteria for readiness for implementation?	Yes [X] No [ ]

.

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

.

Legal Covenants

Name	Recurrent	Due Date	Frequency
Project Operations Manual		Two months after Effective Date	Dated Covenant

Description of Covenant

The Recipient shall cause TEC to prepare, by not later than two months after Effective Date, and thereafter adopt a Project Operations Manual.

.

Conditions

Name	Due Date	Type
Project Implementation Agreement	Effectiveness	Effectiveness Condition

Description of Condition

The Project Implementation Agreement has been executed on behalf of the Recipient and the TEC.

The SIDS Grant Agreement has been executed and delivered and all conditions precedent to its effectiveness or to the right of the Recipient to make withdrawals under it (other than the effectiveness of this Agreement) have been fulfilled.

Team Composition

Bank Staff

Name	Title	Specialization	Unit
Roberto Gabriel Aiello	Senior Energy Specialist	Task Team Leader	GEEDR
Jinan Shi	Senior Procurement Specialist	Senior Procurement Specialist	GGODR

Natsuko Toba	Senior Economist	Co-Task Team Leader	GEEDR
Stephen Paul Hartung	Financial Management Specialist	Financial Management Specialist	GGODR
Marjorie Mpundu	Senior Counsel	Legal	LEGES
Nicole Jenner	Program Assistant	Gender	EACNF

Non-Bank Staff

Name	Title	Office Phone	City
Luis M. Vaca-Soto	Energy/Procurement Consultant	(301) 873-7564	Rockville
Ross James Butler	Social Safeguards Consultant	+61 2 9235 6511	Sydney
Penelope Ferguson	Environment Safeguards Consultant	+64 21 277 3632	Christchurch
Paul Thomas Fulton	Renewable Energy Consultant	+61 (0)439 338 288	West Hobart
Kim Dagmar Baverstock	Team Assistant Consultant	+61 2 9235 6558	Sydney
Daniel Jason Toga	Operations Consultant	(631) 974-7937	Washington, DC
Ernesto N. Terrado	Energy Consultant	(703) 218-6936	Fairfax
Rosemary Faletoese	Gender Consultant	+61 415179002	Kenmore

.

Locations

Country	First Administrative Division	Location	Planned	Actual	Comments
Tuvalu	Fogafale	Fogafale	**X**		

I. STRATEGIC CONTEXT

A. COUNTRY CONTEXT[1]

1. Tuvalu joined the World Bank Group in June 2010 and is the smallest and second-newest member of the Bank Group. Tuvalu is a group of nine inhabited islands (four reef islands and five coral atolls) with a land area of 26 km^2 and a maximum elevation of 4.5 m. A few of the atolls are more than 800 m wide. Roughly half the country's population of 9,876[2] lives on the main atoll, Funafuti. This small group of atolls is particularly vulnerable due to its geographic isolation, lack of fertile land, susceptibility to the impacts of climate change, and inability to reap economies of scale in the provision of public goods and services.

2. Tuvalu's gross domestic product (GDP) was estimated at USD 39.7 million in 2013 and was the smallest of any independent state. GDP growth in the past was volatile and this is expected to continue into the future due to Tuvalu's dependence on fishing and internet domain licensing fees, remittances, and trust fund returns, all of which are dependent on exogenous factors beyond the government's control. Due to the small population and lack of land area and resources, the scope for economic diversification, including exports, is minimal. Nearly everything, including skilled services, is imported. Fuel and food constitute nearly half of total imports of goods. Tuvalu uses the Australian dollar (AUD) as its currency and has no central bank. The main sources of foreign exchange have been the earnings of Tuvaluans working abroad, particularly as seafarers, and assistance from development partners (DPs).[3] Absolute poverty is rare and access to primary education is effectively universal. Although the provision of health services is limited by the country's small size, the health targets of the Millennium Development Goals (MDG) are on track to be reached by 2015.

3. Deficits have been persistent even in good times. These are generally closed through DPs' support and disbursements from the country's budget support fund, the Consolidated Investment Fund (CIF). The country's external public debt was 35.3 percent of GDP in 2013. Including its roles in health and education, the public sector employs around one-tenth of the country's population. Cash employment prospects outside of the public sector rely largely on employment opportunities abroad, especially as seafarers and seasonal laborers. Industry barely exists. Small numbers of Tuvaluans work in the services sector, including the retail and tourism industries.

4. Most crucially, climate change is a fundamental risk to the world's second lowest-lying country. Rising sea temperatures and irregular rainfall are already cited as reasons for declining income from fish and crops, and higher sea levels could render much of the country uninhabitable.

5. Subsistence farming is prevalent, and its productivity is low due to poor soils, limited use of fertilizers, small plot size, lack of access to credit, and inadequate market infrastructure. Only

[1] Macroeconomic data are drawn from the International Monetary Fund Report, August 2014 Article IV Consultation—Staff Report; Press Release; and Statement by the Executive Director for Tuvalu.
[2] Source: World Bank data, World Development Indicators for Tuvalu 2013
http://data.worldbank.org/country/tuvalu
[3] Tuvalu is a member of the Parties to Nauru Agreement (PNA). Approximately 40 percent of government revenue comes from licensing/fishing access fees from foreign tuna vessels.

coconuts and pandanus grow naturally. Banana, papaya, and breadfruit are cultivated and a variety of taro is grown in pits excavated in coral rock. Reef fish and tuna are the main dietary proteins. Tuvalu is a net food importer and three-quarters of the food consumed on Funafuti is imported.

6. Owing to the introduction of the Vessel Day Scheme[4] and the establishment of fishing joint ventures with Asian companies, both fishing exports and fishing license fees have more than doubled between 2010-2013, with each accounting for about half of GDP in 2013. Since 2013, fish accounts for nearly all exports.

7. Tuvalu has continued to benefit from regional projects in the areas of economic management and governance, climate change, solid waste management, and support from the Pacific Infrastructure Advisory Center in the energy and utilities sectors.

B. SECTORAL AND INSTITUTIONAL CONTEXT

8. *Institutional arrangements.* The energy sector is managed by the Department of Energy within the Ministry of Public Utilities. The government established the Tuvalu Electricity Corporation (TEC) in 1991. In 2010, TEC became a fully state-owned enterprise (SOE), with the responsibility of managing and operating grid-connected systems on the eight islands.

9. *Electricity use.* Tuvalu has 1,764 households: 846 on Funafuti and 918 on the outer islands.[5] Over 90 percent of Tuvaluans have access to electricity.[6] The main electricity consumer is the government, which accounts for approximately 27 percent of total electricity consumption. Residential users account for approximately 45 percent, while commercial users account for approximately 28 percent. TEC faces an issue with overdue payments, particularly from its largest customers.

10. *Tariff structure.* Because 98 percent of Tuvalu's electricity generation is diesel based, power costs are very sensitive to increasing fuel prices. Tuvalu's energy costs are above average for the region and in the top third of Pacific power utilities. The total electricity cost is around AUD 0.90 per kWh (USD 0.79) and the average fuel cost is AUD 0.59 per kWh (USD 0.52).[7] Current tariffs for private use on Funafuti are set at AUD 0.30 per kWh (USD 0.26) for the first 50 kWh ("lifeline tariff"), AUD 0.39 per kWh (USD 0.34) for the next 50 kWh, and AUD 0.56 per kWh (USD 0.49) thereafter. For commercial and government use, the rate is AUD 0.56 per kWh (USD 0.49) on Funafuti and AUD 0.55 per kWh (USD 0.48) for the outer islands.

Electricity Systems

11. *Fogafale system.* The Fogafale system accounts for about 60 percent of the country's installed capacity. The generation system in Fogafale comprises a recently installed (Japan International Cooperation Agency [JICA] 2007) power station comprising three 600 kW diesel generators with an 11 kV/415 V/230 V distribution system. The total installed power capacity of these diesel generators is 1,800 kW. Since the new diesel power station was commissioned, the

[4] A scheme under which vessel owners can purchase and trade days fishing at sea in places subject to the PNA.
[5] Source: Government of Tuvalu. 2012 Population & Housing Census Preliminary Analytical Report.
[6] Source: Energy National Profile 2009. International Renewable Energy Agency (IRENA).
[7] Source: KEMA 2014. Consultancy Study on the Electricity Tariff Reforms including the Development of a Feed-In Tariff Policy in Tuvalu.

number of power blackouts has substantially reduced on the island of Fogafale.

12. The generators are run using diesel fuel and were substantially subsidized through the Japan non-project grant assistance for 2005-2012[8], which covered approximately 37 percent of the cost of annual fuel consumption. The Japanese fuel subsidy assistance program of Japanese Yen (JPY) 100 million per year (~USD 0.97 million), which began in 2005, formally concluded at the end of 2013. However, the 2013 subsidy was not disbursed until January 2014 and was used to finance fuel purchases in 2014. TEC was forced to use its bank overdraft to finance fuel in 2013 (approximately AUD 0.5 million overdraft to cover the AUD 3 million cost).

13. In 2008, the e8[9] and the Japanese government, through the Kansai Electric Company (Japan), established a grid-connected 40 kWp solar system on Fogafale. This system contributes 1 percent of electricity production.

14. Fogafale has a peak demand of less than 1 MW. Residents demand an estimated 969 kWh of electricity per person per year. The bulk of electricity is utilized in refrigeration (34 percent) followed by air conditioning (30 percent). Electronics, mechanical and lighting requirements comprise the remaining demand (~12 percent each). For Fogafale, this results in an average total demand of 5.1 GWh during 2008–2013, with a peak of 5.6 GWh in 2011, well within TEC's supply envelope. With the small projected population growth (~2 percent), demand was expected to rise a modest 2 percent per year in the business-as-usual scenario. However, the energy efficiency (EE) activities that form part of the project are expected to keep total consumption growing at about 1 percent per year, with an average consumption of about 5.5 GWh in the near future.

15. *Outer islands.* The outer islands have been prioritized in the strategy toward 100 percent renewable energy (RE) for Tuvalu (Master Plan for Renewable Energy and Energy Efficiency, MPREEE) due to the escalating costs of transporting diesel fuel to these remote locations. Their low electricity demands (20 to 39 kWp for Nukulaelae, Nukufetau, Nui, Niutao, Nanumaga and Nanumea, and 95 kWp for Vaitupu) make them suitable for small-scale RE projects.

16. Currently, seven of the eight outer islands are powered by 48–80 kW diesel generators, which are typically oversized. This makes them inefficient to operate and they use more diesel fuel than necessary. Blackouts are a regular occurrence, more often from a lack of diesel fuel and spare parts than from mechanical breakdown. The diesel generators run for 12 to 18 hours per day to save fuel and maintenance and are reported to be in reasonable condition, but they may require replacement by 2020.

17. The New Zealand Ministry of Foreign Affairs and Trade (NZMFAT) is currently implementing a solar photovoltaic (PV) project on Funafuti and the outer islands. The outer-island component consists of the installation of 1,030 kW of solar PV, batteries and ancillary equipment on four outer islands (Nanumea, Nanumaga, Niutao and Vaitupu) that are currently 100 percent reliant on diesel generators. When construction is completed as expected in early 2015, the diesel generators will only be used for standby power. On three of the other outer islands that are also currently 100 percent reliant on diesel generators (Nukulaelae, Nukufetau

[8] Source: Embassy of Japan in the Republic of the Fiji Islands, 2006, Press Release http://www.fj.emb-japan.go.jp/pr_Japan_Provides_Grant_Assistance_to_Tuvalu.html; Ibid, 2014, Speech http://www.fj.emb-japan.go.jp/eco_corporation/tuvalu/NPGA/tuvalu_NPGA2011_EN_sp.html.

[9] The e8 is an alliance of leading energy utilities from the G8 countries; founded in 1992.

and Nui), the European Union (EU) is financing the installation of 182 kW of solar PV, batteries, and ancillary equipment, to be completed by early 2015. The solar PV installations under this project will be capable of remote monitoring, but due to limited funding the EU will not be financing the communication equipment necessary to do so. The proposed project will install necessary communications equipment to allow for remote monitoring of these PV installations from Funafuti.

18. Once both the NZMFAT and EU projects are completed in 2015, all the inhabited outer islands of Tuvalu (aside from Niulakita, population 42, which has no central grid) will be generating 100 percent of their electricity needs from renewable resources and saving more than 300,000 liters of diesel fuel per year, approximately.

19. *Distribution system.* Power generated from the diesel and solar generators is transmitted through an 11 kV underground ring main system before it is distributed at 415 V for the three-phase system and 230 V for single-phase users. The underground transmissions and distribution have recorded only 7 percent of system losses since the JICA upgrade (2007), according to a Keuring van Elektrotechnische Materialen te Arnhem (KEMA) study conducted in 2009. However, conflicting data exist for these results, with up to 17 percent reported by the 2012 Pacific Power Association (PPA) benchmarking study that used 2011 data.[10] Maintenance problems are still high due to saltwater corrosion at substations and in-house connections. However, in general, Fogafale residents are provided with a high level of reliable electricity supply throughout the island. Outage data recording has improved dramatically since December 2012; this will allow fairly sound calculations of the System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) to be made and monitored going forward.

Key Issues and Country Strategies

20. *Main electricity sector challenges.* The major issues that the power sector currently faces include (a) high dependency on costly imported fuels; (b) TEC's insufficient revenues from tariffs to meet operating and maintenance (O&M) costs (thus requiring additional subsidies from the government); (c) the high maintenance cost of generation and distribution systems in a marine environment; and (d) the need for capital to finance the power infrastructure requirements of Funafuti and the outer islands.

21. *Energy policy and the RE target by 2020.* Tuvalu is addressing these issues through the formulation of a long-term energy policy and a master plan for implementing the policy targets. The Tuvalu National Energy Policy (TNEP), which was formulated in 2009, clearly defines and directs current and future energy developments. The TNEP highlighted an ambitious target of 100 percent RE for power generation by 2020. Seven strategic areas were identified as priorities to ensure that the policy's objectives improve the people's livelihoods. TEC, with assistance from NZMFAT, published the MPREEE in 2013. This plan provides guidance to the sector on achieving the TNEP's 100 percent RE target and establishes a 30 percent EE improvement goal.

[10] In the PPA study, TEC was rated Low in data reliability. Part of the capacity-building work under the proposed project will be to support TEC in improving its data reliability.

Initiatives Underway and Rationale for Bank Involvement

22. New Zealand and other donors, including Australia, the EU, Japan, and the United Arab Emirates (UAE), have various activities already underway to assist Tuvalu's energy development plan (see Annex 2). Most of these activities are focused on the replacement of diesel generation with RE technologies. The NZMFAT is providing funds for the installation of 650 kWp of grid-connected solar PV, starting with 150 kWp on Funafuti. The UAE, through their Masdar initiative, will finance the installation of an additional 350 kWp of solar PV. Both projects are expected to be commissioned by mid-2015. Between 2016 and 2020, TEC's plan is to install up to 750 kWp of extra renewable generation capacity each year.

23. In support of the government's goals in the energy sector, as detailed in the MPREEE, the proposed Bank effort will provide additional energy generation from solar PV and will include investment in modest wind-power capacity. The size and components of the RE investments proposed in the project are the result of extensive least-cost optimization modeling. Even if, for various reasons, the role of wind in Tuvalu's future power mix is likely to be smaller than solar PV, it is important to begin to build TEC's capacity in this technology. The solar PV investment will provide sufficient battery storage and a power-conditioning system to ensure grid stability, as intermittent RE sources become an increasingly dominant portion of Fogafale's power mix. In addition, the project will finance strategic EE investments in the largest electricity-consuming sectors. These investments could significantly reduce the need for future investments on the generation side.

24. The Bank's involvement will bring a longer-term perspective on RE investments from all sources by including battery storage and grid-forming inverters that represent major investments but are critical for long-term grid stability. Thus, this project will facilitate the planned and other future incremental RE additions without leading to grid instability and other system problems that would seriously set back the country's plans toward achieving the goal of 100 percent penetration of RE in the future.

C. HIGHER-LEVEL OBJECTIVES TO WHICH THE PROJECT CONTRIBUTES

25. The Tuvalu Country Assistance Strategy (CAS), presented to the Bank's Board of Executive Directors on November 4, 2011, identifies "building resilience against exogenous shocks" as a major theme of the World Bank's engagement. Reducing Tuvalu's dependence on imported diesel fuel will reduce its exposure to oil price shocks, such as the one that severely affected the region in 2008. The proposed project forms an integral part of the Bank's overall energy sector engagement in the Pacific. A Development Policy Operation is currently being prepared and the Government of Tuvalu (GoT) has expressed an interest in pursuing reforms and including a policy action or trigger related to the energy sector in a proposed second operation of the series. These policy reforms would support efforts to improve the efficiency of Tuvalu's electricity system and increase RE in the generation mix.

26. The project is also in line with the Bank's twin goals of ending extreme poverty and promoting shared prosperity by facilitating Tuvalu's efforts to improve the efficiency of electricity use in the short term, and to provide cleaner and less expensive electricity in the medium term. This will benefit the extreme poor by increasing the system's efficiency and sustainability and reducing dependence on imported fuels that not only affect electricity-connected households and businesses, but also the price of all goods and services linked to the

high cost of retail energy products. Moreover, the increase in the share of RE and a more efficient use of electricity will result in immediate fuel savings and reduced greenhouse gas and other harmful gas emissions while enhancing the reliability of electricity supply, especially for the poor who are least able to protect themselves against outages. A strong and lasting correlation exists between access to electricity services and core human development measures including poverty reduction, improved health, and education. Electricity is also an important enabler in terms of driving gender equity and equality.

II. PROJECT DEVELOPMENT OBJECTIVE

A. PDO

27. The project development objective (PDO) is to enhance Tuvalu's energy security by reducing its dependence on imported fuel for power generation and by improving the efficiency and sustainability of its electricity system.

B. PROJECT BENEFICIARIES

28. The project's potential beneficiaries are:

- All electricity customers in Tuvalu, including residential, commercial and government users, who will obtain improved service and be able to manage their own electricity consumption through the prepayment meters and smart meters that will be installed under the project.
- TEC, whose revenues will increase due to more efficient bill collection enabled by the installed meters and whose financial status will thereby improve. Through the satellite-based communication system to be installed, TEC will also significantly improve its capability to remotely monitor, control and maintain the power system.
- The GoT, through reduced subsidies to the electricity sector resulting from improved bill collection, reduced fuel imports due to EE measures and investments, and the use of RE sources for power generation.

29. The project's investment in an improved communication system between Funafuti and three outer islands (Nukulaelae, Nukufetau and Nui) will enable TEC to better manage operations from the Fogafale station. In turn, residents of the outer islands will benefit from significantly improved service through more timely action on customer complaints and avoidance of supply disruptions. With the ability of residential customers to have more control over their electricity consumption through prepayment and smart meters, women in the household, who typically manage household expenditures, will directly benefit through savings in terms of time and electricity costs and less disruption to their electricity service due to lack of payment.

C. PDO-LEVEL RESULTS INDICATORS

30. The following indicators will be used to measure progress toward PDO-level results:

Table 1. Indicators to Measure PDO Results

PDO Result	Indicator
Reduction in the use of diesel fuel for electricity generation	Projected life time fuel savings (TJ)
Reduction in energy consumption among consumers provided with energy-efficiency assistance	Projected life time energy savings (GWh)
Reduction in the number of outstanding accounts/debtor days for TEC	Debtor days

III. PROJECT DESCRIPTION

A. PROJECT COMPONENTS

31. The proposed project, which is estimated to cost a total of USD 9.1 million, will include the following three components to be implemented by TEC.

Component 1. Renewable Energy Investments. Estimated Cost: USD 7.4 million

32. Supply and installation, for TEC, of power-generation and grid-management equipment to increase the contribution of RE in Tuvalu's hybrid generation system and to reduce diesel generation. This equipment will include (a) solar PV (about 925 kWp) and wind-power generation (about 200 kW); (b) batteries, sufficient for the hybrid system's storage requirements, including the expected energy spillovers from the New Zealand (NZ) and Masdar solar PV systems that are now being built without storage; (c) battery inverters and an integrated power-control system to provide grid stability and other ancillary services; and (d) a satellite-based communications system on Funafuti and three of the seven outer islands[11] to enable TEC—with the support of external contractors and advisors, as needed—to remotely monitor, control, and improve the operation and maintenance of its hybrid power system and enhance customer service.

33. The contract for the implementation of the RE subcomponent will be awarded using the Bank's standard bidding document for plant design, supply and installation. Bidders will be responsible for the final design of the RE package—including the optimal combination of solar- and wind-power generation and storage—to deliver an RE fraction target of about 40 percent of the energy delivered to the grid, taking into consideration the cost and technical characteristics of the equipment to be supplied and local conditions.

Component 2. Energy Efficiency Investments. Estimated Cost: USD 1.2 million

34. A program of activities designed to enhance efficient use of energy will be carried out. These activities include:

(a) Supply and installation of prepayment meters for TEC consumers and smart meters for the largest electricity consumers;

(b) Supply and installation of selected EE investments, such as enhanced insulation in buildings to be selected by TEC in accordance with criteria agreed with the Bank, and replacement of inefficient lighting and appliances in said buildings;

[11] Nukulaelae, Nukufetau and Nui. The hybrid systems financed by NZ and being installed on the other four outer islands include remote monitoring capability.

(c) Development of policy, standards and labeling for EE; and

(d) Activities aimed at raising consumer awareness on EE and related capacity-building activities and training.

35. This component will complement Component 1 by reducing energy demand and postponing the need for more costly future investments in generation. Besides helping consumers to manage their electricity use more effectively, this investment will help TEC's demand-side management (DSM) planning and considerably improve its revenue collection and overall financial status.

Component 3. Technical Assistance and Project Management Support. Estimated Cost: USD 0.5 million

36. A program of activities designed to enhance the capacity of TEC and other GoT staff for project implementation will be carried out. These activities include coordination, administration, technical operation, procurement, financial management, environmental and social management, monitoring, evaluation, and reporting. The project's incremental operating costs will also be financed through this component. Provision of technical assistance to support mainstreaming of gender dimensions in the Project.

37. A training needs assessment will identify specific training and skills-enhancement activities. Accordingly, a training plan will be prepared and implemented. Several essential training activities are expected to be provided by equipment providers as part of their contracts.

B. PROJECT FINANCING

38. The lending instruments will be an IDA credit in the amount of USD 7.0 million. In addition, a USD 2.1 million grant from the Small Island Developing States Initiative (SIDS DOCK) is in the process of being approved. Tuvalu is an IDA country, and energy security is one of its most pressing development issues, as identified in the most recent CAS.

39. Due to the country's current high dependency on fuel oil and its lack of economies of scale and scope, public-sector intervention is needed, at least in the short term, to provide electricity services to the entire population and increase RE penetration in the system. The Bank will help the GoT to explore how to reduce the level of public-sector provision/financing by attracting private-sector participation.

C. PROJECT COST AND FINANCING

Table 2. Project Financing by Component and Source

Components	Subcomponents	Cost USD million	Total USD million	Financing Source	
				IDA	SIDS DOCK
Component 1	Renewable energy investments	7.20	7.40	5.30	2.10
	Satellite-based communications system	0.20			0
Component 2	Prepayment meters	0.75	1.20	1.20	0
	Other energy efficiency investments	0.45			

Component 3	Technical assistance and project management support	0.50	0.50	0.50	0
TOTAL			9.10	7.00	2.10

D. Lessons Learned and Reflected in the Project Design

40. Based on the experience of other countries[12] that are rapidly transitioning to very high penetration of renewables, the project design needed to ensure the maintenance of grid stability—voltage and frequency regulation—as generation from intermittent energy sources increasingly becomes the dominant portion of the Tuvalu power mix. Therefore, a sizeable portion of the project's investments is allocated to battery storage, inverters and ancillary equipment needed to handle not only the impact of the Bank's proposed RE investments but also the impacts of upcoming solar PV investments by other donors.

41. Another lesson drawn from past infrastructure projects, particularly in the Pacific Region, is the critical role of maintenance in ensuring sustainability. The present project's investment in the connection to a satellite-based communications system will enable TEC to remotely monitor the performance of solar PV and other RE installations on the three outer islands that lack such remote monitoring capability, diagnose impending problems, and provide timely intervention. Maintenance of PV installations will also be facilitated by ensuring that all equipment and installations under the project conform to the set of standards that NZMFAT has developed for Pacific Region PV systems and components, or other standards that promise at least substantial equivalence.

42. The inclusion of prepayment and smart meters in the project design, along with other EE investments, reflects the generally positive experience with such equipment in other projects in the South Pacific and worldwide. There is overwhelming evidence that these devices curb payment defaults, considerably ease bill collection by eliminating manual meter reading, detect outages, and enable utilities to resolve power-quality problems more quickly.[13] Evidence has shown that with the information provided by the meters, after a time, consumers learn to manage their usage of lights and appliances as they aim to reduce their monthly electricity bills. However, some social acceptance problems have also been encountered in past projects, particularly at the initial stages. These have included complaints about traveling too far to purchase the top-up codes, too-quick disconnection by the utility when payment is delayed, and even some concerns about privacy (electricity usage can reveal the type of appliances used and correlate with the user's economic status).[14] There were initial issues of faulty meters and meter tampering, but these have mostly been eliminated by replacement with new meters and by the levying of heavy fines for meter tampering. The lessons learned from these experiences include (a) the importance of launching community consultations and intensive consumer awareness and education campaigns before and periodically after installation of the meters, and (b) the need for proper training of TEC personnel who will install the meters, collect the data, and manage the program. These lessons have been incorporated in the design of the present project.

[12] The countries referred to are island countries that have transitioned or are on the way toward achieving close to 100 percent renewables, such as Tokelau (PV, batteries), Aruba (wind), and Cape Verde (wind, PV). Such projects were not financed by the World Bank.
[13] Public Utilities Commission of Sri Lanka (2013). Applicability of Smart Metering Technology in Sri Lanka.
[14] Wendy Annecke and Marialba Endelli, 2006. ENERGIA News Vol. 9, no. 1.

IV. IMPLEMENTATION

A. INSTITUTIONAL AND IMPLEMENTATION ARRANGEMENTS

43. The project will be implemented by TEC, with TEC's general manager serving as the project manager. The government will enter into a Project Implementation Agreement with TEC pursuant to which TEC shall be required, on behalf and acting as agent of the government, to carry out the project's day-to-day activities to ensure timely implementation, maintain at all times competent and qualified staff for project implementation, and prepare reports on the progress in project implementation. The Energy Sector Development Project (ESDP) will fund a full-time project officer to support the project manager on day-to-day implementation, monitoring and reporting of project activities, including the completion of the project's financial management (FM) requirements; coordination with relevant national government institutions and development partners; procurement of goods and consultancies under the guidance of the Bids Administrator (BA) and the Finance and Contracts Manager (FCM); and monitoring and reporting on results achieved by activities financed under the project. A part-time procurement advisor will be hired to assist with procurement activities. The ESDP consulting staff will be jointly located with the Tuvalu Aviation Investment Project (TvAIP).

44. An RE technical specialist will support TEC during the installation and commissioning stages of project implementation and will provide inputs on Terms of Reference (TORs) and studies and expert technical guidance as needed.

45. A part-time safeguards advisor will assist TEC in implementing and monitoring the project's safeguard requirements. Although they have not previously worked with the Bank, TEC, the Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour, and the Ministry of Natural Resources' Department of Land are aware of the Bank's safeguard policies and are supportive, especially with reference to effective public consultation aimed at managing environmental and social risks, resettlement principles, and impact monitoring.

B. RESULTS MONITORING AND EVALUATION

46. The implementing agency will conduct overall monitoring and coordination of project activities in accordance with the indicators included in the Results Framework (Annex 1), including the monitoring of compliance with safeguard policies. No later than 45 days after the end of each semester, the implementing agency will submit biannual progress reports to the Bank, covering all project activities, including a procurement and financial summary report. Quarterly financial reports will also be provided to the Bank no later than 45 days after the end of each quarter. Biannual reviews, the first one to take place six months after IDA grant effectiveness, will provide a detailed analysis of implementation progress toward achievement of the PDO and will include an evaluation of financial management and a post review of procurement.

47. The implementing agency will (a) not later than two years after the effectiveness date (or such other date as agreed with the Bank), carry out a midterm review of the project, and prepare and furnish to the Bank a midterm report documenting progress achieved in the implementation of the project during the period preceding the date of such report, taking into account the monitoring and evaluation activities performed and setting out the measures recommended to ensure the continued efficient implementation of the project and the achievement of its

objectives during the period following such date; and (b) review with the Bank said midterm report, on or about one month after its submission, and thereafter take all measures required to ensure the continued efficient implementation of the project and the achievement of its objectives.

C. SUSTAINABILITY

48. *Sustainability*. The project's sustainability is supported by the government's strong commitment, the expected savings in fuel imports, the foreseen improvements in TEC's efficiency and financial prospects, and the use of established technologies.

49. *Government commitment.* The GoT's commitment is reflected by the approval in 2008 of the TNEP, which includes the target of 100 percent RE for power generation by 2020. The MPREEE, approved in 2013, also includes the 100 percent RE target for 2020 and the goal of a 30 percent EE improvement on Funafuti.

50. *Expected savings in fuel imports*. At projected fuel prices during the 2015–2036 period,[15] a 30.1 percent reduction in fuel usage due to increased RE penetration and EE measures represents a cost saving of AUD 877,241 per year, which provides a strong incentive for project implementation and future operation of the hybrid diesel oil-RE power system.

51. *Improvements in TEC's efficiency and financial prospects*. The installation of a prepayment metering system will reduce bills in arrears and electricity commercialization costs and will thus improve TEC's financial standing, efficiency, and service quality.

52. *Reduction of technical risks.* The project's procurement arrangements aim to reduce TEC's implementation and operational risks while incorporating the most advanced technologies in the final design of the RE component. These arrangements will aid the long-term sustainability of the power system's infrastructure.

V. KEY RISKS

A. OVERALL RISK RATING AND EXPLANATION OF KEY RISKS

53. *Overall risk rating is substantial.* This is mainly due to the implementing agency's limited capacity for executing the project, the technical coordination challenge due to the multiple projects of development partners in the sector, and the potential price premium due to the country's distance from major markets and the vulnerability of its economy to external shocks.

54. *Political and governance risk is moderate.* A general election is scheduled in Tuvalu before March 2015. However, this risk is mitigated by the strong commitment and bipartisan support to the proposed project, which will help the GoT to achieve the national targets of increasing the share of RE and EE. A de-corporatization of TEC seems unlikely. Tuvalu ranks in the 90th to 100th percentile on Political Stability and Absence of Violence for 1996–2013 under the World Bank's governance indicators.

55. *Macroeconomic risk is substantial*. Tuvalu's macroeconomic and fiscal framework is

[15] The average diesel fuel price projected for the 2014 period is USD 1.71 per liter.

vulnerable to shocks that are characteristic of small Pacific economies. Commodity price shocks could be readily translated into higher domestic prices due to the extent to which consumption relies on imported goods, particularly food and fuel, although the proposed project will reduce diesel fuel imports for power generation. Global or regional economic downturns could impact Tuvalu's remittance flows and diminish employment opportunities abroad. Similarly, returns on the Tuvalu Trust Fund are exposed to the unpredictable fluctuations of international financial markets. Finally, an unexpected decline in receipts from fishery contracts or donor grants would cause a strain on Tuvalu's fiscal position. Tuvalu is also vulnerable to weather events that could incur high recovery costs. All these risks could have an impact on project costs and timing.

56. *Sector strategies and policies risks are moderate*. As noted in the political and governance risk, the government and TEC are committed to the project and the past elections results did not change the TNEP.

57. *Technical design project risk is substantial*. The project must be designed in close coordination with other financial projects of development partners in the sector.

58. *Institutional capacity for implementation and sustainability risk is substantial*. The capacity building of TEC staff to maintain and operate prepayment meters, communications systems, RE storage equipment, and power conditioning systems will be conducted during project implementation as part of the execution of the respective components. Remote monitoring and online support will help build capacity and keep it current after project implementation. The Monitoring and Maintenance Plan will address the proper O&M of generation, storage and ancillary service equipment.

59. *Fiduciary risk is substantial.* TEC's lack of procurement experience using Bank guidelines and standard bidding documents will be addressed through the provision of Bank support in all stages of the bidding process. Due to TEC's limited FM resources and capacity, the FM risk will be mitigated in part by the employment of a part-time bookkeeper/accountant. Under the Bank's OP/BP 10 with respect to projects financed by the Bank, the borrower and implementing agency are required to maintain adequate FM systems—including accounting, financial reporting, and auditing systems—to ensure that they can provide the Bank with accurate and timely information regarding the project resources and expenditures. Overall, the FM arrangements meet the FM requirement as stipulated in OP/BP 10, subject to the successful implementation of agreed actions and mitigating measures.

60. *Environmental and social risk is substantial*. Social acceptance of prepayment meters will be achieved through community consultation and incentives, such as providing the equivalent of one month's electricity use up front when they transfer to the new system.[16] Educating consumers on how they can reduce their energy consumption and access payment/top-up facilities will encourage them to make the transition. Inclusion of a demonstration prepayment meter in an RE and EE demonstration house, supported by SIDS DOCK through the United Nations Development Programme (UNDP), will also help support social awareness and acceptance of the change. The house will be built in the first half of 2015. The project could consider choosing supportive advocates for the system who can pilot the meters to demonstrate the benefits to their respective communities.

[16] At present, customers pay the bill at the end of each month. The new prepayment system will require payment in advance. At the time of moving to the new system, TEC will defer payment of the service for the first month so that customers will not have to pay two bills concurrently.

61. There is some community expectation that RE would be "free." To manage this expectation, TEC will use the information included in tariff reviews, such as that made in January 2014, as a tool to educate the public on the costs associated with RE generation for different RE scenarios, such as 20, 40, 60, 80 and 100 percent of RE penetration.

62. Environmental and disaster risks are substantial. These include tropical cyclones and storm surges (especially in the northern sites) that could damage wind and solar PV installations.

63. *Stakeholder risk is moderate*. During project preparation, interviews with focus groups and individuals from Funafuti and the outer islands were carried out to develop a Gender Action Plan for Tuvalu. The Deputy Prime Minister and other ministers, high-level government officials, local nongovernmental organizations (NGOs), the private sector, international organizations, and local communities actively participated in various meetings and a workshop on gender, safeguards and the tariff study. TEC also conducted consultations with local communities. These stakeholders are supportive and welcome the project in general. Their concerns (for example, how the prepayment meter works and cost of RE) were answered and/or incorporated in the project design.

VI. APPRAISAL SUMMARY

A. ECONOMIC ANALYSIS

64. The proposed priority capital-expenditure investments for Tuvalu's power system create significant economic benefits by leading the country toward the path of achieving the national goals of 100 percent power generation from RE sources and a 30 percent improvement in EE by 2020, thereby significantly reducing fuel imports and Tuvalu's vulnerability to volatile fuel prices and supply risks. The country's increased capacity and utilization of the RE technologies and EE measures under the proposed project are estimated to generate an economic internal rate of return (EIRR) of 13 percent and a net present value (NPV) of USD 0.32 million (0.8 percent of Tuvalu's GDP in 2013). Sensitivity analysis for key variables shows that the NPV and EIRR values are sensitive to changes in the capital cost. Annex 8 provides details about the methodology and assumptions made, and a tabulated summary of the results of the economic analysis.

B. FINANCIAL ANALYSIS

65. The Bank assessed TEC's financial performance based on simulated revenue and cost streams, "with and without project," to determine the financial viability and sustainability of the proposed investments. The three indicators against which the financial impacts toward the PDO were measured are (a) reduction in the use of diesel fuel for electricity generation; (b) increase in EE; and (c) reduction in the number of outstanding accounts/debtor days. Annex 8 presents details of the assumptions made and the methodology used in the analysis. The conclusion is that the proposed investments will have a significant positive impact on TEC's financial position through the reduction of fuel and operating costs due to the migration to RE sources and an increase in efficiency. The proposed investments will generate a financial net present value (FNPV) of AUD 9.8 million, a financial internal rate of return (FIRR) of 45 percent, and an estimated annual saving of AUD 1.7 million. As a whole, the financial analysis estimates that the investment of USD 9.1 million (AUD 9.579 million) will return a financial benefit of AUD 91.13

million over the 2015–2036 period. Table 14 in Annex 8 provides a summary of the results of the financial analysis.

C. TECHNICAL

66. No technical issues are expected with the project's EE component, including the installation of prepayment and smart meters for electricity consumers. All activities will involve established technologies and practices on which substantial experience has already been accumulated in past projects.

67. The technical design of the renewable-energy component has required more consideration. Based on least-cost optimization studies performed during project preparation, it was estimated that the project's major investment in generation would be for the solar PV system, with a capacity of approximately 925 kWp. This decision is due mainly to the Pacific islands' long track record on this technology: various donors have already installed about 175 kWp in Tuvalu itself, and 500 kWp are expected to be commissioned by mid-2015. This sizeable addition by the project supports the GoT's goal of achieving full RE generation by 2020 while limiting itself for now to a practical level of about a 40 percent annual energy supply from RE sources.[17] A major expense that has been factored into the project is the provision of sufficient battery storage and inverter capacity to ensure grid stability—to maintain grid voltage and frequency—as diesel generation is reduced due to the higher output from RE sources. The modeling undertaken assumes that the diesel engines can be switched off when high volumes of RE are available. However, the main constraint to solar PV in Tuvalu is the lack of space for the solar arrays due to scarcity of land. For the Bank project, a consultant study has preliminarily identified sufficient space consisting of various areas spread over Funafuti, thus precluding the need to resort to the more problematic option of using the roofs of individual houses on Funafuti.

68. Wind power faces similar space limitations as those of PV. Although wind turbines have a small footprint, adequate space must be provided for guyed masts and for tilting the turbine down during storms. However, wind power has additional constraints of its own, including the need for multiyear wind data on specific sites to reduce the investment risk, larger potential for damage from tropical cyclones, and the unsuitability of the volcanic atoll soils—which comprise much of the island—for larger installations. For these reasons, wind is expected to play a more limited role than that of PV in Tuvalu's future power mix. Nevertheless, because wind turbines can operate even at night, it is a good strategy to maximize wind in the power mix in order to reduce the need for expensive battery storage in the future. The need to start building the capacity of TEC staff in this technology as part of the strategy is the rationale for the inclusion of a modest wind component in the project. The determination of final capacities for the most cost-effective solar/wind/battery/inverter package to achieve the desired RE penetration will be further refined as part of the bidding process.

D. FINANCIAL MANAGEMENT

69. The FM for this project has been assessed as adequate, subject to the successful implementation of the following recommended mitigation measures: (a) submission of the initial project budget to the Bank for review and clearance; (b) hiring of a part-time

[17] The RE fraction is the ratio of the electrical energy actually generated by solar and wind to total electricity consumption in the system, on an annual basis.

bookkeeper/accountant; (c) purchase of an appropriate accounting software package to record project financial transactions; and (d) inclusion of the FM requirements in the Project Operations Manual. The project accountant will be jointly located in the TvAIP office.

70. No FM effectiveness or disbursement conditions are recommended. The Grant Agreement will require submission of quarterly interim financial reports (IFRs) and annual audited project financial statements for the life of the project.

E. PROCUREMENT

71. As an implementing agency, TEC will be responsible for project implementation. TEC, with the assistance of the procurement advisor and the project officer to be hired under the project, will be responsible for procurement activities. Annex 3 provides a summary of procurement risks, mitigating actions, and procurement arrangements.

F. SOCIAL (INCLUDING SAFEGUARDS)

72. The change to prepayment meters will require community consultation and social awareness. Along with the installation of the new meters, information must be provided to consumers to help them manage and optimize their electricity consumption. Because women manage most household expenditures, they will largely be responsible for using the meters to manage power consumption. The consultation plan (Annex 6) and any other communications with consumers (information sent out with tariff reviews) will target women.

73. OP/BP 4.12-Involuntary Resettlement is triggered in case the satellite and wireless communications equipment and the installation of RE power plants under Component 1 cannot be accommodated on existing government buildings or lands, or through the voluntary donation of land for a public purpose. Where possible, solar structures will be designed to allow the use of land under them (such as for hog pens), to the extent allowed by safety and security considerations.

74. During the concept stage, in addition to OP 4.01 and OP 4.12 the policy on Indigenous Peoples (OP 4.10) was triggered. Subsequently the Bank undertook a country-level social analysis as part of preparation of the Pacific islands countries safeguard procedures and confirmed that OP 4.10 is typically not triggered in Tuvalu given the homogenous nature of the population. Based on this finding, it was agreed that OP 4.10 is not triggered in this project.

75. Although the expected land requirement is very low, some land is likely to be required. Both voluntary land donations and involuntary land acquisition are provided for in the project safeguard documents. The Environmental and Social Management Framework (ESMF) provides a detailed process for voluntary land donation including assessment against criteria established by the Voluntary Land Donation Protocol in the Environment & Social Instruments for the Pacific. The project's Resettlement Policy Framework (RPF), which was prepared and disclosed to the public in Tuvalu on August 16, 2013, and to the general public through the World Bank's InfoShop website on August 27, 2013, includes the activities for the TvAIP. The two projects were integrated into one RPF due to the limited nature of impacts for both projects and the ability to consult with and disclose to the community at the same time. The RPF provides the detailed steps to be taken when any land is involuntarily acquired.

76. A draft Gender and Energy Scoping Study for Tuvalu, undertaken in March 2014,

provides background and a qualitative analysis of the social, cultural, economic and human rights characteristics of Tuvalu's energy-related environment. Women and men in Tuvalu have similar access to costly nonrenewable energy fuels that provide effective but not always reliable energy services. The *Falekaupule* (Traditional Assembly of Elders) system dominates governance and all decision making in Tuvalu, especially at the community level. This cultural system favors men in decision making. Although women have been accorded the right to sit within a *Falekaupule* assembly since 2013, they have largely continued to be silent observers in decision-making forums. A Gender Action Plan (GAP) and monitoring and evaluation (M&E) framework (Annex 9) have been prepared for the project, with the key objective of mainstreaming gender equity and equality throughout the implementation of the ESDP.

77. The GAP is consistent with Tuvalu's National Development Strategy/Tuvalu's Kakega II and the National Equality and Women's Empowerment Policy (the National Gender Policy), which both emphasize the mainstreaming of gender into sectoral activities, the strengthening of institutional capacity in aspects of gender equality, and the empowerment of women in decision making and entrepreneurship.

G. ENVIRONMENT (INCLUDING SAFEGUARDS)

78. The screening of environmental and social risks and issues has been based on the preliminary information currently available on proposed solar, wind and EE investments and technical advisory studies. The project is considered Category B under Safeguard Policy OP/BP 4.01-Environmental Assessment. The specific investments will be developed in detail during project implementation, including the final location and scale of investments, but it is envisaged that the potential impacts will be manageable with good project design, implementation of industry-standard mitigation measures, and good oversight and monitoring. The key environmental issues are land acquisition for solar and wind investments (including the risk that scarce "fertile" or "high" land will be used for electricity generation), using aggregates from sustainable sources for land leveling and foundations (avoiding the use of coastal or lagoon sands/muds) and the removal of waste offshore for recycling or responsible disposal (avoiding legacy issues with toxic and inorganic wastes on Fogafale). The pond site for solar investments is brackish or salt water and currently receives effluents from hog pens, and therefore is considered degraded.

79. No other environmental policies are triggered. OP 4.04-Natural Habitats is not triggered because the investments and studies will focus on land already developed and not in a natural condition, and investments are not expected to affect wildlife. There is very little natural habitat left on Fogafale because of intense urban development. No marine areas will be impacted by project components. OP 4.11-Physical Cultural Resources is not triggered because physical cultural resources can be avoided during the site-selection process.

80. An ESMF has been prepared to cover the foreseeable environmental and social impacts based on current project design, and provides processes for screening and managing new or unforeseen risks. The processes for screening and scoping projects and preparing project-specific safeguard tools are consistent with both the World Bank's safeguard policies and the Tuvalu Environment Protection Act and Environment Protection (Environmental Impact Assessment) Regulations 2014. Under the regulation, any "electricity generation station" will require a development permit and the submission of a Preliminary Environmental Assessment Report

(PEAR) with the Department of Environment. The PEAR will be prepared in accordance with the regulations and OP/BP 4.01-Environmental Assessment. Minor impacts from other activities, such as the installation and use of communications equipment, the installation of prepayment meters, and the installation and use of batteries, will be managed by Codes of Practice, which are appended to the ESMF. The draft ESMF was disclosed in Tuvalu during the period of the August 2014 Consultation Workshop. The final ESMF was disclosed in Tuvalu and on the World Bank's Infoshop on November 17, 2014.

ANNEX 1. RESULTS FRAMEWORK AND MONITORING

Country: Tuvalu

Project Name: **Energy Sector Development Project (P144573)**

Project Development Objectives

PDO Statement

The project development objective is to enhance Tuvalu's energy security by reducing its dependence on imported fuel for power generation and by improving the efficiency and sustainability of its electricity system.

These results are at | Project Level

Project Development Objective Indicators

Indicator Name	Baseline	Cumulative Target Values			
		YR1	**YR2**	**YR3**	**End Target**
Direct project beneficiaries[18] (Number) - (Core)	0.00	0.00	0.00	200.00	1,500.00
Female beneficiaries (Percentage - Sub-Type: Supplemental) - (Core)	0.00	0.00	0.00	50.00	50.00
Projected lifetime fuel savings (Mega Joules (MJ)) - (Core)	0.00	0.00	0.00	7,064,047.00	15,693,382.00
Projected lifetime energy savings (Megawatt hour(MWh)) - (Core)	0.00	0.00	0.00	838.00	1,724.00
Debtor days (Days)	100.00	100.00	80.00	30.00	10.00

[18] Number of households. Over 90 percent of Tuvaluans have access to electricity according to IRENA's Energy National Profile 2009. The Tuvalu Census Report estimated a total of 1,764 households in 2012. It is reasonable to set a target of 1,500 households.

Intermediate Results Indicators

Indicator Name	Baseline	Cumulative Target Values			
		YR1	YR2	YR3	End Target
Generation Capacity of Renewable Energy (other than hydropower) constructed (Megawatt) - (Core)	0.00	0.00	0.00	1.13	1.13
Generation Capacity of Renewable Energy constructed – Wind (Megawatt - Sub-Type: Breakdown) - (Core)	0.00	0.00	0.00	0.20	0.20
Generation Capacity of Renewable Energy constructed-Solar (Megawatt - Sub-Type: Breakdown) - (Core)	0.00	0.00	0.00	0.93	0.93
Enable remote monitoring of RE Projects in 3 outer islands (Percentage)	0.00	0.00	0.00	100.00	100.00
Percentage of customers with prepaid meters (Percentage)	0.00	0.00	0.00	50.00	100.00
Prepaid Customers Feedback (Percentage - Sub-Type: Supplemental)	0.00	0.00	0.00	0.00	50.00
Achievement of agreed Training Plan (Percentage)	0.00	0.00	30.00	65.00	100.00

Indicator Description

Project Development Objective Indicators

Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
Direct project beneficiaries	Direct beneficiaries are people or groups who directly derive benefits from an intervention (i.e., children who benefit from an immunization program; families that have a new piped water connection). Please note that this indicator requires supplemental information. Supplemental Value: Female beneficiaries (percentage). Based on the assessment and definition of direct project beneficiaries, specify what proportion of the direct project beneficiaries are female. This indicator is calculated as a percentage.	The end of the project	Project reports, accounting information, and new information systems	TEC
Female beneficiaries	Based on the assessment and definition of direct project beneficiaries, specify what percentage of the beneficiaries are female.	The end of the project	Project reports, accounting information, and new information systems	TEC
Projected lifetime fuel savings	This indicator projects lifetime fuel use that is avoided by energy efficiency measures. The baseline value for this indicator should be zero.	As needed	Project reports, accounting information and new information systems	TEC
Projected lifetime energy savings	This indicator projects lifetime energy savings directly attributable to the project, converted to MWh. The baseline value is expected to be zero.	As needed	Project reports, audits and measurement and verification activities	TEC
Debtor days	Payments in arrears of TEC's clients divided by average daily sales.	As needed	Project reports and accounting information	TEC

Intermediate Results Indicators

Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
Generation Capacity of Renewable Energy (other than hydropower) constructed	This measures the capacity of renewable energy constructed under the project, including (i) wind and (ii) solar. The baseline value for this indicator is zero.	As needed	Project reports and new information system	TEC
Generation Capacity of Renewable Energy constructed – Wind	This measure's the capacity of solar power constructed under the project. The baseline value for this indicator is zero.	As needed	Project reports and new information system	TEC
Generation Capacity of Renewable Energy constructed-Solar	This measure's the capacity of solar power constructed under the project. The baseline value for this indicator is zero.	As needed	Project reports and new information system	TEC
Enable remote monitoring of RE Projects in 3 outer islands	This measures how much percentage of renewable energy projects in three outer islands that TEC can access to data and monitor these projects due to the communication system installed by this World Bank Project.	As needed	Project reports and new information system	TEC
Percentage of customers with prepaid meters	Percentage of prepaid meters installed and in operation.	As needed	Project reports and information system	TEC
Prepaid Customers Feedback	Percentage of customers providing feedback on the use of prepaid meters installed under the project.	As needed	Project reports and information system	TEC
Achievement of agreed Training Plan	Progress in training in project implementation, data and information system.	As needed	Ongoing supervision and new information system	TEC

ANNEX 2. DETAILED PROJECT DESCRIPTION

Tuvalu: Energy Sector Development Project (P144573)

1. The Project Development Objective (PDO) is to enhance Tuvalu's energy security by reducing its dependence on imported fuel for power generation and by improving the efficiency and sustainability of its electricity system. To achieve this PDO, the project will be supported by a USD 7 million IDA credit and also a USD 2.1 million grant from SIDS DOCK, which is in the process of being approved. The project contains three components: (a) RE investments; (b) EE investments; and (c) technical assistance and project management support.

Component 1: Renewable Energy Investments. Estimated Cost: USD 7.4 million

2. Supply and installation of power-generation and grid-management equipment to increase the contribution of RE in Tuvalu's hybrid generation system and to reduce diesel generation. This equipment will include (a) solar PV (about 925 kWp) and wind-power generation (about 200 kW); (b) batteries, sufficient for the hybrid system's storage requirements, including the expected energy spillovers from the NZ and Masdar solar PV systems that are now being built without storage; (c) battery inverters and an integrated power-control system to provide grid stability and other ancillary services; and (d) a satellite-based communications system on Funafuti and three of the seven outer islands[19] to enable TEC—with the support of external contractors and advisors, as needed—to remotely monitor, control and improve the operation and maintenance of its hybrid power system and enhance customer service.

3. The contract for implementation of the RE subcomponent will be awarded using the Bank's standard bidding document for plant design, supply and installation. Bidders will be responsible for the final design of the RE package—including the optimal combination of solar- and wind-power generation and storage—to deliver an RE fraction target of about 40 percent of the energy delivered to the grid, taking into consideration the cost and technical characteristics of the equipment to be supplied and local conditions.

4. *Additional RE generation.* The approximate capacities of additional RE investments stem from the results of preliminary economic modeling that investigated a range of solar PV and individual 50 kW wind-turbine additions to the base case. The best-case scenario was found to be a combination of 925 kWp solar PV and 4 x 50 kW wind turbines, which would raise the RE fraction[20] to about 40 percent from 17 percent (counting outputs from the UAE and NZMFAT solar PV installations that are expected to be completed by mid-2015). The total investment cost for the RE systems is estimated at around USD 4.5 million.

5. The projects financed by the NZMFAT and UAE will increase the RE fraction to about 17 percent, and the World Bank project is expected to increase the RE fraction to about 40 percent. As a result of the fuel savings, TEC will be in a much better position to manage its cash flow and operations.

[19] Nukulaelae, Nukufetau and Nui. The hybrid systems financed by NZ being installed on the other four outer islands include remote monitoring capability.

[20] The RE fraction is the ratio of the electrical energy generated by solar and wind to the total electricity generated in the system, including diesel generation, on an annual basis.

6. *Grid management system.* The Bank investment at completion would bring the total RE capacity on Funafuti to about 1,800 kW, out of a total installed capacity by that time of 3,600 kW (including three 600 kW diesel generators). At this level of RE penetration, rapid changes in system output when solar insolation and wind velocity fluctuate, due to clouds or wind gusts, would become too high to be handled through automatic adjustments in operation by the existing diesel generators. The approximately 934 kWh of storage batteries and 900 kW inverter/rectifier capacity to be installed have the critical role of smoothing out the effect of these fluctuations and ensuring grid stability in terms of voltage and frequency. Despite being much more expensive than lead-acid batteries (estimated at USD 1,200 per kWh versus USD 350 per kWh), lithium-ion batteries came out as optimal in the modeling because they can be discharged faster and more deeply than lead-acid batteries and still last several thousand cycles. The modeling used the characteristics of the Saft M-Type Energy Storage System Unit (medium-power lithium ion) in stackable battery cabinets of 58 kWh capacity each. The estimated cost of required storage batteries, inverters, and associated control equipment is USD 2.7 million.

7. *Wind turbine.* The modeling used the characteristics of the United Kingdom-made Endurance E-3120 50 kW wind turbine, which has a cut-in wind speed of only 3.5 m per sec and a small footprint. The turbine has a tilting guyed tower and a hub height of 20 meters. The estimated cost, including a five-year warranty, is USD 7,000 per kW installed or USD 1.4 million for the four 50 kW turbines. Other wind-turbine brands that meet performance, cost and space requirements will also be considered.

8. *Potential sites.* Although choices for sites are severely limited by the general lack of available space, the atoll soil characteristics, and low elevation, some potential sites have been preliminarily identified for the solar PV and wind-turbine installations: for solar: (a) distributed sites in urban Funafuti (for example, near the sports grounds, TEC's rooftop, the borrow pit north of the runway and the pond near the hog pens); for wind: (a) distributed sites in the wharf area and (b) the northern tip of Fongafale. The solar arrays will be facing north and tilted at an angle of about 20 degrees, at which position they are expected to receive an average solar insolation of about 5.4 kWh per m^2 per day. There may be a need to build elevated supporting structures to face potential storm surges and allow continued use of the land underneath. More detailed ground assessments will be carried out during project implementation to select the final sites.

9. *Satellite-based communication system.* The system to be installed under the project will include the following components:

- Very small aperture terminal (VSAT) equipment, including a 1.8 or 2.4 meter antenna for Funafuti and three outer islands; and
- Ancillary equipment such as a router with Virtual Private Network (VPN) capability for secure communication and WiFi equipment for local connectivity.

10. These are the main off-island communication requirements:

- Continuous reporting of measurement results of the PV power systems to cloud-based services hosted somewhere abroad. On the three outer islands, continuous uploading of measurement data is the key requirement in terms of dimensioning.
- Modest data volumes, with initial vendor estimates of 100 MB per day.
- Remote access to the cloud-based service for remote monitoring and control. This will be regularly required on Funafuti and only occasionally on the outer islands.

- Remote access directly to the PV equipment.
- Occasional Internet Protocol Telephony traffic and general internet access to support local operational staff.

11. This system will allow TEC to secure data communication for 24/7 measurement reporting and remote monitoring of power plants on four islands (the other four islands will be provided with connectivity by the NZMFAT project) at a much faster speed than they currently enjoy. The system can also be used for occasional voice communication between TEC's offices. It will allow TEC to monitor the prepayment meters to be installed on the outer islands as well as the solar PV installations currently being installed on the outer islands by the EU and NZMFAT, among other uses. TEC will also not have to rely on the public Tuvalu Telecom system, which is prone to breakdowns and slow speeds, especially during adverse weather events.

12. Because all communications from Tuvalu and the outer islands rely on satellite-connectivity bandwidth, efficient use of bandwidth is important considering the relatively high cost of satellite capacity. Measurement reporting and remote monitoring on a 24/7 basis can be implemented cost efficiently at relatively modest bandwidth requirements. The remaining capacity can be used for other supporting purposes.

13. The estimated cost is approximately USD 200,000, including USD 15,000 per site for goods and installation for four sites (Funafuti plus three outer islands); other minor investments and the first year of recurring cost to TEC of approximately USD 775 per site per month for bandwidth for Funafuti, based on a standard service available in the Pacific of 512 kilobytes per second (KBps) downlink and 256 KBps uplink with a 1:10 overbooking ratio; and approximately USD 395 per site per month for the four outer islands based on a standard service available in the Pacific of 256 KBps downlink and 128 KBps uplink with a 1:10 overbooking ratio.

Component 2: Energy Efficiency Investments. Estimated Cost: USD 1.2 million

14. A program of activities designed to enhance efficient use of energy will be carried out. These activities include:

(a) Supply and installation of prepayment meters for TEC consumers and smart meters for the largest electricity consumers;
(b) Supply and installation of selected EE investments, such as enhanced insulation in buildings to be selected by TEC in accordance with criteria agreed with the Bank, and replacement of inefficient lighting and appliances in those buildings;
(c) Development of policy, standards and labeling for EE; and
(d) Activities aimed at raising consumer awareness on EE and related capacity-building activities and training.

15. This component will complement Component 1 by reducing energy demand and postponing the need for more costly future investments in generation. Besides helping consumers to manage their electricity use more effectively, this investment will help TEC's DSM planning and considerably improve its revenue collection and overall financial status.

16. The prepayment meters will be installed in all TEC connections, estimated at around 2,500[21]. About 15 percent, or 380 connections, are institutions or businesses with loads that

[21] Some households may have more than one connection, e.g. one in Funafuti and others in outer islands.

require three-phase connections. With the standard single-phase or three-phase keypad meters, the utility can monitor the user's energy consumption through the amount of tokens purchased, or directly by tapping into an optical or communications port on the meter. The customer pays up front for electricity by purchasing a code (token) from the utility office or an authorized agent. Tokens are easily accessible to people. The code is entered using the meter's keypad. When power is turned on, the meter interface displays the remaining credits. Power is automatically switched off when the credit is exhausted. The consumer tops up the meter by purchasing more tokens or recharge cards.

17. The smart meters will be installed for some of the largest electricity consumers, such as the Government Building, the wharf, and Princess Margaret Hospital, which comprise about 15 percent of Tuvalu's total annual consumption. More sophisticated devices can collect data on energy usage in real time and transmit such data and other information over a communications network connected to a control system in TEC, where the data would be stored and analyzed. Instantaneous energy-usage data are also displayed on the meter for the consumer's information. The communication system to be set up for the smart meters would be a two-way system, enabling TEC to remotely control the meter, connect or disconnect power, change the tariff, shift from credit mode to prepayment mode and vice versa, detect outages, and diagnose and resolve various maintenance problems. The communication system for the prepayment meters will utilize the existing power lines (power-line communication [PLC] technology). The estimated total cost of the prepayment meters, smart meters, and associated communication system is USD 0.70 million.

18. Consultant studies have identified other EE investments and measures in various large energy-consuming sectors. Some measures have small financial requirements but potentially high energy savings. These include sealing drafts, installing window shades, replacing LED lamps in all large buildings, and replacing old refrigerators and freezers at Princess Margaret Hospital. Others would require much higher capital outlays, such as installing a cold room at the wharf or changing the air-conditioning system in the Government Building. The costs and benefits of each potential investment will be further examined during implementation. A budget of USD 0.45 million is allocated for these EE subprojects.

19. EE in the domestic sector is already being addressed by the recent implementation of labeling and standards for appliances and by the proposed legislation restricting the importation of non-energy-efficient appliances. The present project will support these initiatives through measures such as financing further public education campaigns on energy conservation.

Component 3: Technical Assistance and Project Management Support. Estimated Cost: USD 0.5 million

20. A program of activities designed to enhance the capacity of TEC and other GoT staff for project implementation will be conducted. These activities include coordination, administration, technical operation, procurement, financial management, environmental and social management, monitoring, evaluation and reporting. The incremental operating costs of this project will also be financed through this component. Provision of technical assistance to support mainstreaming of gender dimensions in the Project.

21. A training needs assessment will identify the specific training and skills-enhancement activities. Accordingly, a training plan will be prepared and implemented. Several essential

training activities are expected to be provided by equipment providers as part of their contracts. These include training TEC staff in the satellite-based communications system, data management for prepayment and smart meters, and wind-power technology.

22. Project costs, totaling USD 9.1 million, are summarized in Table 3.

Table 3. Summary of Project Costs

Components	Subcomponents	Cost USD million	Total USD million
Component 1	Renewable energy investments	7.20	7.40
	Satellite-based communications system	0.20	
Component 2	Prepayment meters	0.75	1.20
	Other energy efficiency investments	0.45	
Component 3	Technical assistance and project management support	0.50	0.50
TOTAL			9.10

NZMFAT Projects in Tuvalu

23. NZMFAT is funding the installation of grid-connected PV capacity on the roof of the Government Building (130 kW) and the Media Building on Fogafale (40 kW). NZMFAT has indicated that it may install PV on the hospital roof and at the wharf; the combined capacity of these two systems would be approximately 130 kWp. NZMFAT is funding 635 kW of solar PV systems on Tuvalu's outer islands of Nanumaga, Nanumea and Niutao, and 410 kW PV systems on Vaitupu (all ground-mounted systems). NZMFAT predicts that the outer island systems it is installing will reduce diesel usage by 90 percent. The systems being installed include battery/inverter storage systems jointly located in a power house with the diesel generation sets. The systems will be owned by TEC, which will be responsible for ongoing operation and maintenance. The projects are expected to be fully commissioned by mid-2015.

UAE Projects in Tuvalu

24. The UAE, through Masdar, are installing a 350 kWp PV array next to the power station, on a new raised steel structure. The project is expected to produce approximately 540 MWh per year, thereby reducing diesel fuel usage by 142,000 liters per year. The UAE have conducted energy-system modeling on their project, taking into account New Zealand's planned projects. The installed array and inverters will be owned by TEC, which will be responsible for the ongoing operation and maintenance. The modeling suggests that approximately 14 percent of the energy from the array will have to be rejected on weekdays and approximately 80 percent of the energy will have to be rejected on weekends due to system constraints. The battery and inverter systems envisaged for the World Bank project will greatly reduce the magnitude of this lost energy. The projects are expected to be fully commissioned by mid-2015.

ANNEX 3. IMPLEMENTATION ARRANGEMENTS

Tuvalu: Energy Sector Development Project (P144573)

Project Institutional and Implementation Arrangements

1. The project will be implemented by TEC, with TEC's general manager serving as the project manager. The government will enter into a Project Implementation Agreement with TEC, pursuant to which TEC shall be required, on behalf and acting as agent of the government, to carry out the project's day-to-day activities to ensure timely implementation, maintain at all times competent and qualified staff for project implementation, and prepare reports on the progress in project implementation. The ESDP will fund a full-time project officer to support the project manager on day-to-day implementation, monitoring and reporting of project activities, including the completion the project's FM requirements; coordination with relevant national government institutions and development partners; procurement of goods and consultancies under the guidance of the BA and the FCM; and monitoring and reporting on results achieved by activities financed under the project. A part-time procurement advisor will be hired to assist with procurement activities. The ESDP consulting staff will be jointly located with the TvAIP.

2. An RE technical specialist will support TEC during the installation and commissioning stages of project implementation and will provide inputs on TORs, studies and expert technical guidance as needed.

3. A part-time safeguards advisor will assist TEC in implementing and monitoring the project's safeguard requirements. The advisor will have the following key duties:

a) Conducting training on the Bank's safeguard policies and the Environmental Management Plan (EMP) and ESMF for the implementing agency and relevant government entities;
b) Integrating the EMP and ESMF requirements with local legal and regulatory requirements in standard operating procedures and the Project Operations Manual; and
c) Integrating the EMP and ESMF in the TORs and contracts of all suppliers and consultants; reviewing and commenting on bid responses to the TORs; reviewing and commenting on the safeguard components of the activities financed by the project; assisting with consultation strategies; and otherwise assisting TEC in the implementation and supervision of actions under the EMP and the ESMF.

4. TEC is one of the first corporations that the GoT has approved, and it was declared a government corporation entity in December 1990. TEC is wholly owned by the GoT, and it is the sole power supplier in Tuvalu. In 2012, TEC reported a net operating profit of AUD 403,152, although fuel subsidies and donor assistance were received. However, in 2013 TEC reported a loss of AUD 1,279,211 because the fuel subsidy was only available in 2014. Operating profit has been increasing steadily from a deficit in 2009 to a net profit of AUD 25,638 in 2010 and AUD 301,318 in 2011.

5. TEC's electricity tariffs are low relative to other Pacific island utilities. Without subsidies these tariffs are inadequate to recover O&M costs. Political pressures make it difficult to increase tariffs, which are required to make the operations more sustainable. The proposed project will contribute to improving TEC's financial viability, in particular by the installation of prepayment and smart meters and the fuel savings resulting from the higher penetration of RE.

6. In November 2011, the GoT announced it would de-corporatize TEC. However, in December 2012, the GoT informed the Bank that this would not take place, as was reconfirmed during the Bank's mission in November 2014. A covenant contained in the Legal Agreement states that the utility will maintain its status as a corporation.

7. In operational terms, TEC scored poorly in overall performance (an aggregate factor of generation efficiency, capacity utilization, system losses, and overall labor productivity), as reported in the 2012 PPA Benchmarking Report. It was ranked in the Lower group (from Higher, Medium and Lower). Data reliability was rated as B-Reliable on an A-to-D scale in which A was Highly Reliable and D was Highly Unreliable. This is important to note because it provides a sound basis for decision making on project planning.

8. TEC's current capacity to implement the project needs to be strengthened. Although TEC has not previously acted as an implementing agency for a similar project, key managerial staff members are capable and can be trained to carry out additional tasks that will be required to integrate the project's components. Capacity-building activities have been included in the proposed project along with a technical assistance allocation to support project implementation. Adequate M&E arrangements are critical during project implementation.

9. In Tuvalu, as in other Pacific islands, proper equipment maintenance is an issue due to the connectivity challenges that the country faces. An Operational Monitoring and Maintenance Plan (OMMP), which will be part of the RE supply contract, will address this critical situation by including a condition-based maintenance system with remote monitoring. This system continuously assesses the equipment condition online to monitor significant working device parameters and automatically compare them with average values and performance. Maintenance is carried out when the indicators signal that the equipment is deteriorating and failure probabilities are increasing.

10. The OMMP will include remote support and guidance to TEC's technicians to perform routine maintenance and the contractor's obligations to provide on-site maintenance services by technicians located in the South Pacific Region in the case of more complex works or emergencies. Spare parts will be purchased and kept in Fogafale as part of the RE package, and the OMMP will also include the contractor's obligation to maintain in the region qualified technicians and an inventory of the spare parts required to provide maintenance services in emergency situations.

11. Although they have not previously worked with the Bank, TEC, the Ministry of Foreign Affairs, Trade, Tourism, Environment, and Labour, and the Ministry of Natural Resources' Department of Land are aware of the Bank's safeguard policies and are supportive, especially with reference to effective public consultation aimed at managing environmental and social risks, resettlement principles, and impact monitoring.

Financial Management, Disbursements, and Procurement

Financial Management

12. Overall, the FM arrangements meet the FM requirement as stipulated in OP/BP 10, subject to the implementation of agreed actions and mitigating measures. The FM mitigating measures recommended for this project are the submission of the initial project budget to the Bank for review and clearance within 30 days of project effectiveness, the employment of a part-

time project bookkeeper/accountant, the purchase of an accounting software package suitable for recording the project's financial transactions, and the inclusion of the FM requirements in the Project Operations Manual.

13. No FM effectiveness or disbursement conditions are recommended. The Grant Agreement will require quarterly IFRs and annual submission to the Bank of both a project and an entity audit for the life of the project.

14. *Budgeting arrangements.* The project team must prepare a broad budget for the life of the project, including detailed budgets for 2015 and 2016. This initial budget will require Bank approval. The budget will be subject to biannual reviews, as well as a review after the signing of each large contract, to ensure adequate monitoring of available project funds. The budget will be consistent with a procurement plan but will also include additional nonprocurable item expenditures not covered in the procurement plan. The majority of the project costs are expected to be procurable items. The initial project budget, broadly covering the life of the project and details for 2015 and 2016, will require Bank approval.

15. *Accounting arrangements.* Project accounting functions will be located in the TvAIP office. The part-time bookkeeper/accountant may request some initial assistance from the TvAIP project accountant if required. The part-time bookkeeper/accountant will prepare project documentation, maintain day-to-day project records, and prepare project financial reports.

16. The project will use QuickBooks, the accounting package used by the TvAIP. It will use a similar chart-of-accounts structure but will be clearly segregated from TvAIP accounts. Accounts will be maintained on a cash basis, consistent with other projects in Tuvalu. Because the project will operate out of the same space currently leased by the TvAIP, some negotiations will be needed on the allocation of property expenses, including rent and electricity.

17. *Internal controls.* Project funds will be held in a designated account (DA) with the Ministry of Finance (MOF). The signatories for the DA will be the secretary of finance, the senior assistant secretary, the assistant secretary, the government accountant, and the secretary of the Ministry of Public Utilities. The bookkeeper/accountant will prepare financial documentation, including the payment voucher and checks. This system ensures that accounting processes and authorization/payment processes are clearly segregated. Any assets purchased under the project will be recorded in an assets register maintained by the project. The project will prepare monthly bank reconciliations.

18. A brief FM section will be included in the Operations Manual to provide guidelines on the project's internal controls and procedures. Neither the MOF nor TEC has an internal audit service. However, the migration measures identified in this assessment will provide the necessary assurance that adequate controls are in place.

19. *Flow of funds.* The DA will be opened in the National Bank of Tuvalu and will be managed by the MOF, and there will be monthly reconciliations of the account. Larger payments will be paid through direct payments from the Bank to suppliers. There may be some incidental prefinancing either by TEC or the MOF for purposes of project preparation, such as recruitment costs.

20. *Financial reporting.* The project will be required to prepare quarterly IFRs in a format agreed with the Bank. These must be submitted no later than 45 days after the end of the reporting period. Because IFRs will also be used as a monitoring tool, they should report project

progress with adequate descriptions, explanations, and analyses of variances. These should include breakdowns by component and activity for the reporting quarter, year to date, and cumulative amount. A commitment register should also be included.

21. *External audit.* The Tuvalu Auditor General's Office has agreed to audit project accounts. Project accounts will be audited annually, with the exception that the first audit will cover the period from the start of the project to the end of its first full financial year. Therefore, it is likely that the first audit will cover the period from the start of the project to December 31, 2016. The project audit must be received by the Bank within six months of the end of each reporting period: June 30 of the following year.

Procurement

22. *Procurement arrangements.* Procurement for the proposed project will be carried out in accordance with the World Bank's Guidelines: Procurement under IBRD Loans and IDA Credits, dated January 2011 and revised July 2014 (Procurement Guidelines); Guidelines: Selection and Employment of Consultants by World Bank Borrowers, dated January 2011 and revised July 2014 (Consultant Guidelines); and the provisions stipulated in the financing agreement. The description of various items under different expenditure categories is summarized below. For each contract to be financed by the grant, different procurement or selection methods, estimated costs, prior-review requirements, and a time frame will be agreed by the recipient and the Bank in the Procurement Plan.

23. *Procurement of goods, works and non-consulting services.* Procurement under the proposed project includes (a) a prepayment meter system; (b) solar PV systems, storage, and grid-control equipment; (c) wind turbines; and (d) a satellite-based communications system. International competitive bidding (ICB) procedures shall be used for procurement of goods estimated to cost USD 500,000 or more per contract and for procurement of works estimated to cost USD 1 million or more per contract. Shopping may be used to procure goods and non-consulting services estimated to cost less than USD 500,000 per contract and works estimated to cost less than USD 1 million per contract. Direct contracting may be used in circumstances that meet the criteria set out in paragraph 3.7 of the Procurement Guidelines.

24. *Selection of consultants.* Consultants will be selected in accordance with the following procedures.

- *Selection of consulting firms.* Consulting contracts expected to cost more than USD 300,000 equivalent per contract will use Quality- and Cost-based Selection (QCBS) or Quality-based Selection (QBS) in accordance with the Consultant Guidelines. Consulting services estimated to cost under USD 300,000 equivalent per contract will follow Selection Based on Consultant's Qualifications (CQS). Under the circumstances described in paragraph 3.9 of the Consultant Guidelines, consultants may be selected and awarded contracts on the basis of a Single-source Selection (SSS), subject to the Bank's prior approval.
- *Selection of individual consultants (ICs).* ICs will be selected and contracts awarded in accordance with the provisions of paragraphs 5.1 through 5.5 of the Consultant Guidelines. Under the circumstances described in paragraph 5.6 of the Consultant Guidelines, ICs may be selected and awarded on a single-source basis, subject to the Bank's prior approval.

25. *Prior-review thresholds.* Prior-review and procurement thresholds for the proposed project are shown in Table 4.

Table 4. Prior-review and Procurement Thresholds

Procurement Methods	**Procurement Thresholds**	**Prior-Review Thresholds**
Goods		
ICB	≥USD 500,000	All contracts subject to prior review
Shopping	<USD 500,000	First two contracts subject to prior review
Direct contracting	Meet the criteria set out in paragraph 3.7 of Procurement Guidelines	All contracts subject to prior review
Works including Design, Supply, and Installation		
ICB	≥USD 1 million	All contracts subject to prior review
Shopping	<USD 1 million	First two contracts subject to prior review
Consultant Selection Methods	**Applicability**	**Prior-Review Thresholds**
Firms (QCBS, QBS, Least-cost Selection [LCS], CQS, and SSS)	In accordance with the Bank's Consultant Guidelines	≥USD 100,000, and all SSS contracts
IC		≥USD 50,000 (exception made for SSS, legal- and procurement-related assignments, in which all contracts are subject to prior review)

26. *Implementation arrangements.* As an implementing agency, TEC will be responsible for project implementation. TEC, with the assistance of the procurement advisor and the project officer to be hired under the project, will be responsible for procurement activities.

27. *Procurement risks and mitigation actions.* A procurement-capacity assessment was conducted by the Bank. As an implementing agency, TEC is facing major challenges in terms of procurement complexity, capacity, and market availability constraints and logistics. The main procurement-related risks identified include (a) hiring of a procurement advisor to assist TEC in handling procurement; (b) hiring of technical consultants to assist TEC in preparing basic engineering designs and technical specifications, in bid evaluations and in contract supervision; (c) adoption of a relatively large-value contract packaging strategy to attract the participation of more bidders, and use of a supply and installation approach, due to remoteness, logistical challenges, and lack of local installation capacity; (d) consideration of factors of potential market supply, logistical costs, lead time of delivery, supply and installation, and maintenance services in cost estimating and procurement planning; (e) use of the procurement database system developed for the Pacific; and (f) sharing with TEC a standard procurement checklist of records for procurement recordkeeping purposes.

28. The overall procurement-related risk is High. Subject to implementation of mitigation measures, this risk could be reduced to Substantial.

29. *Frequency of procurement supervision.* In addition to the prior review to be carried out by the Bank, procurement supervision missions will visit the field to carry out post reviews of procurement activities every 12 months. The post-review sampling ratio will be one out of five contracts.

30. *Procurement plan.* A procurement plan for the proposed project has been prepared and was agreed at appraisal. This plan will be available in the project's database and on the Bank's external website once it is approved by the Bank. The procurement plan will be updated in agreement with the Bank annually, or as required, to reflect project implementation needs and improvements in institutional capacity. A summary of the Procurement Plan is presented in Tables 5 and 6.

Table 5. Procurement of Goods, Works, and Non-consulting Services

Contract No.	Description	Estimated Cost (USD Million)	Procurement Method	Prequalification	Domestic Preference	Review by Bank
01	Satellite-based communications system for 3 outer islands	0.10	Shopping	NO	n.a.	Prior
02	Prepayment meter system	0.75	ICB	NO	n.a.	Prior
03	PV systems, storage, and grid-control equipment	5.80	ICB	NO	n.a.	Prior
04	Wind turbines	1.40	ICB	NO	n.a.	Prior

Table 6. Selection of Consultants

Contract No.	Description	Estimated Cost (USD Million)	Selection Method	Bank Review	Expected Proposal Submission Date
01	Project officer	0.04	IC	Prior	March 2015
02	Procurement advisor	0.03	IC	Post	April 2015
03	Implementation of a gender action plan	0.03	IC	Post	April 2015
04	Safeguards advisor	0.02	IC	Post	June 2015
05	Technical support	0.13	CQS	Prior	June 2016

Environmental and Social (including safeguards)

31. Table 7 summarizes roles and responsibilities in safeguard implementation. Project reporting to the Bank will coincide with project reporting as per the Operations Manual and will contain a section on safeguard actions and any issues that have arisen. TEC currently has limited capacity to implement the tasks and processes described in the ESMF, RPF and GAP and therefore will require training in the initial phases of the project and ongoing support by the Bank task team.

Table 7. Safeguard Implementation Plan and Responsibilities

Action	Timing	Responsibility
Social and environmental safeguards training, including how to implement ESMF and RPF	Immediately following project start-up	World Bank to provide training to TEC staff, Project Management Unit (PMU) safeguards advisor, and other staff
Gender training, including how to implement GAP	Immediately following project start-up	World Bank to provide training to TEC staff, PMU safeguards advisor, and other staff
Implementation of ESMF	Ongoing throughout project implementation	TEC with the support of the PMU safeguards advisor
Preparation of project-specific PEAR/EMP	During preparation of solar and wind investments	TEC to employ a suitably qualified consultant or design-build contractor (depending on contractual arrangements)
Implementation of PEAR/EMP	During preconstruction and construction of solar and wind investments	Contractor
Supervision of PEAR/EMP implementation	During preconstruction and construction of solar and wind investments	TEC with the support of the PMU safeguards advisor
Implementation of GAP	Ongoing throughout project implementation	TEC with the support of the PMU safeguards advisor
Implementation of voluntary land donation process, if applicable	Following identification of any land requirements	TEC with the support of the PMU safeguards advisor, independent NGO/community leaders as witnesses, GoT if required to register land transactions
Drafting of Resettlement Plan (RP)/Abbreviated Resettlement Action Plan (ARAP), if applicable	Following identification of any private land required	TEC with the support of the PMU safeguards advisor
Disclosure of RP/ARAP, if applicable	Following affected persons census and asset inventory establishment, agreement of basis for eligibility, valuation, institutional arrangements, budget, complaints, appeals, and monitoring mechanism	TEC, World Bank
Implementation of RP/ARAP, if applicable	Following disclosure and before commencement of any civil works	TEC, independent NGO if required, community leaders as witnesses, GoT to register land transactions
Monitoring of RP implementation and impacts, if applicable	During implementation and post-project impact monitoring	TEC, community leaders/members, independent NGO if required

Monitoring & Evaluation

32. TEC will conduct overall monitoring and coordination of project activities, in accordance

with the indicators included in the Results Framework (Annex 1), including the monitoring of compliance with safeguard policies. No later than 45 days after the end of each semester, the implementing agency will submit biannual progress reports to the Bank, covering all project activities, including a procurement and financial summary report. Quarterly financial reports will also be provided to the Bank no later than 45 days after the end of each quarter. Biannual reviews, the first one to take place six months after IDA grant effectiveness, will provide a detailed analysis of implementation progress toward achievement of the PDO and will include an evaluation of FM and a post review of procurement.

Role of Partners

33. A number of development partners are currently assisting Tuvalu's energy sector with the implementation or preparation of projects. Good communication and coordination among the development partners and with the GoT will remain necessary to ensure that overlaps are kept to a minimum and each project's outcomes contribute to the energy sector's overall goals. Table 8 shows current and proposed projects in the sector.

Table 8. Activities Undertaken by Development Partners in Tuvalu's Energy Sector

Funding Agency	Description
SIDS DOCK/ UNDP	Construction of an RE and EE demonstration house. The goal is to demonstrate energy-efficient appliances such as freezers and refrigerators, lights, air-conditioning units and fans, and compare them with non-efficient ones. This is a demonstration project for the local population to physically see the consumption pattern of these appliances and to help motivate them to buy efficient appliances.
UNDP	A Funafuti household energy survey. The survey is currently underway; its aim is to cover a total of 400 households on Funafuti. Two outer islands' households may also be surveyed.
EU	Renewable Energy Project (€2.5 million) for three outer islands—Nukulaelae, Nukufetau and Nui—is financing 182 kW of solar PV, batteries, and ancillary equipment, to be completed by December 2014.
NZMFAT	The installation of 650 kWp of grid-connected solar PV, starting with 150 kWp on Funafuti (completion expected by mid-2015). The outer-island component consists of the installation of 1,030 kW of solar PV, batteries, and ancillary equipment on four outer islands (Nanumea, Nanumaga, Niutao and Vaitupu). Proposed project to install up to 299 kW of wind generation in Fogafale, four 6 kW wind turbines, and one 275 kW wind turbine by June 2016 (early concept stage).
Japan	Fuel-subsidy assistance program of JPY 100 million per year was concluded in 2013 but 2013 payment was delayed and was used for 2014.
Secretariat of the Pacific Regional Environment Programme (SPREP) through the Pacific Island Green Gas Abatement of Renewable Energy Project (PIGGAREP)	A tariff study to find the profitability level of supplying electricity in Tuvalu and the development of a feed-in tariff policy for grid-connected projects. The final report was delivered in March 2014. Also supporting TEC with USD 263,000 for the following activities: - Community consultation - TEC staff external training - Development of TEC web page - On-the-job training - Flyers - Awareness program in media - Documentary video

	- Social impact study This program is providing cofinancing to the EU project.
Government of Finland, through the Embassy of Finland in Australia	The Government of Finland is providing €60,000 for 10 kWp solar PV grid connected at the Tuvalu Maritime Training Institute (TMTI). The project is managed by TEC. Finland's assistance is also providing cofinancing to the EU project.
International Union for Conservation of Nature (IUCN), to be funded by the Government of Italy	TEC and the Tuvalu Development Bank have developed and submitted a concept note to the IUCN for energy-efficient appliances to provide the public with a subsidy under a loan scheme to purchase energy-efficient appliances (refrigerators and freezers, air-conditioning units, lighting, and fans) and have requested a USD 210,000 grant.
UAE Pacific Partnership Fund	The UAE, through their Masdar initiative, will finance the installation of 350 kWp of solar PV on Funafuti.

ANNEX 4. IMPLEMENTATION SUPPORT PLAN

Tuvalu: Energy Sector Development Project (P144573)

Implementation Support Plan

1. The strategy for implementation support has been developed based on the nature of the project and its risk profile. The aim is to make implementation support to the client more flexible and efficient by focusing on implementing the risk-mitigation measures defined in the Systematic Operations Risk-rating Tool (SORT).

2. The Bank task team leader (TTL) will provide ongoing support by coordinating with the client and among World Bank staff who will provide implementation support on technical, fiduciary (FM and procurement), and safeguards aspects. Implementation will be supported by task team members based in the World Bank's Sydney and Washington, DC offices. This will ensure that field missions can be organized quickly should the need arise and that international expertise can also be mobilized to provide global best practices. Formal missions will be conducted at least three times during the first two years of implementation and at least biannually thereafter.

3. In conjunction with government counterparts, the Bank will monitor progress against the monitoring indicators in the Results Framework. The Bank will also monitor risks and update the risk assessment and risk management measures, as needed. A midterm review would encompass a more in-depth stocktaking of performance under the project. Based on the assessment of progress at the midpoint of the project, government counterparts and the Bank would consider recommendations for improvements or changes, and use of contingency funds assigned to the project.

4. The Bank's implementation plan is supported by a series of technical reviews and capacity-building activities. In addition to periodic reviews by the task team and inputs from procurement, FM and safeguard specialists, the plan identifies appropriate technical expertise to be retained during critical implementation periods.

5. It is important to note that the Bank team will be in close coordination with relevant development partners who are assist with the energy sector in Tuvalu, notably the NZMFAT and the UAE/Masdar, and will seek to coordinate supervision missions at the same time with those development partners.

Table 9. Implementation Support Main Focus and Skills

Time	Focus	Skills Needed	Resource Estimate (Staff Weeks)
First twelve months	Team leadership	TTL/Co-TTL	10
	Review of procurement documents	Procurement specialist	6
	Review of FM	FM specialist	4
	Technical reviews	Renewable energy specialist	4
	Social and environmental safeguards and gender training and support	Social specialist environmental specialist; Gender specialist	9
	Implementation support	Junior professional associate (JPA)/ administrative and client support (ACS)	6
12–48 months	Team leadership	TTL/Co-TTL	20
	Review of procurement documents	Procurement specialist	10
	Review of FM	FM specialist	8
	Technical reviews	Renewable energy specialist	8
	Social and environmental safeguard review	Social specialist; environmental specialist	4
	Gender implementation support	Gender specialist	2
	Implementation support	JPA/ACS	15

Table 10. Skills Mix Required

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
TTL/Co-TTL	30	8	
Procurement	15	4	
FM	12	4	
JPA/ACS	20	8	
Environmental specialist	6	2	
Social specialist	6	2	
Gender specialist	6	2	

Table 11. Partners

Name	Country
NZMFAT	New Zealand
Masdar	UAE

ANNEX 5. PROJECT INFORMATION BULLETIN CONTENTS

1. A Project Information Bulletin (PIB) will be issued to the media (radio, press) before consultations with affected communities to provide initial project information to the general public. The intention is to ensure transparency and public acceptance of the project. It will be written in nontechnical, informal Tuvaluan as well as in English. The PIB will be updated at least to (a) disclose the draft RP (if required); (b) publicize the finalized RP (if required); and (c) convey the results of end-of-project monitoring. News bulletins will be released at other intervals, as required, to inform the public about work progress, prepayment meters, and the draft solar and wind PEAR/EMP.

2. Contents of the PIB will include:

- Complete project description, as well as a description of subcomponents;
- Project rationale and expected benefits;
- Description of anticipated environmental, social, and economic impacts, both positive and negative, noting that, except for fuel, RE is not free;
- Information about community meeting plans;
- Reassurance that negative impacts will be avoided or compensated;
- If land acquisition is required, an explanation about voluntary land-donation mechanisms and broad principles of involuntary resettlement (as prescribed in the RPF):
    a. Eligibility criteria: affected persons and impacts that will be recognized in resettlement;
    b. Cut-off date for entitlements (the day of the PIB's release);
    c. Description of the type of impacts that would be recognized;
    d. Description of the proposed consultation process;
    e. Information about how to register as a potentially affected person;
    f. Indication of the proposed process thereafter; and
    g. Description of the proposed grievance system.
- Maps and other visuals, when appropriate.

3. The contents of subsequent bulletins will be influenced by initial consultations and the final form of the PEAR/EMP, RP, grievance and/or monitoring processes.

ANNEX 6. CONSULTATION PLAN

1. This plan outlines the actions needed to keep non-institutional stakeholders informed of progress throughout the project cycle. The GoT stakeholders and shareholders will be briefed about the project through meetings and briefings with the PMU. Regular reports to the Bank will contain a section on communications, including those that have taken place in the context of safeguards and gender actions and plans (see Table 12).

Table 12. Consultation Plan

Stakeholder	Content	Method and Responsibility	Outcome
Project Preparation			
1. General public	See Annex 5. Project Information Bulletin Contents	Department of Energy to release PIB to local radio and press on each island.	General public is aware of project.
2. Communities that may be affected by site selection and civil works[22]	Details of project benefits and impacts in the area; provisions under the ESMF and the RPF	TEC to arrange consultations with a group of local leaders (*Kaupule*, other respected persons in the community: for example, teachers, health officers, religious leaders, and relevant NGO representatives), followed by a public meeting in the local meeting hall with men, women, youth, and occupational groups as appropriate; copies of the PIB; map sketches, site and equipment photographs, if available, to be used as visual aids. Target is attendance by at least 40 percent of women. Timing of meetings to enable women and working people to attend.	Community can give informed comments on design options. Broad community support is obtained. Any potentially affected person knows where he or she can submit comments and seek redress for any involuntary loss or for damage to the environment.

[22] Persons affected by involuntary impacts on land or livelihoods will also be engaged in consultations about resettlement measures under the RPF or subsequent plan.

Stakeholder	Content	Method and Responsibility	Outcome
3. All Fogafale consumers	Advise one week in advance about when their meter will be changed, what works will be undertaken, and any requirements for safe installation of the meter on their premises; provide contact details for further information. Basic consumer information about how the new meter works, payment arrangements, and smart use of electricity	TEC advice about the process and timing of meter changing in the area, through radio and in writing to be posted at, and publicized through, the office of the *Fono-o-Kaupule*, school, or other easily accessible local public agency. Consumer information sheet delivered to customer along with new meter.	Consumers can make any necessary arrangements on their premises and seek advice and information. Consumers understand how to optimize their use of power under the new arrangements.
4. Contractors	Consumer-relations requirements	TEC to include as part of contract; contractor to report as part of normal reporting requirements.	TEC's consumer relations are maintained.
Implementation			
5. General public	Project progress	Department of Energy media release.	General public is informed; complaints mechanism is known; project and process enjoy public acceptance.
6. Consumers	Project impacts: quality improvements due to power modeling activities, prepayment meters	TEC questionnaire available; to be completed at sales points.	Feedback, in addition to that received through complaints mechanism, included in reports on what worked and lessons learned.
7. Contractors	Feedback from consumers and members of general public	Part of contractors' standard activity reports.	Positive and negative feedback; steps taken or recommended as a result.

Stakeholder	Content	Method and Responsibility	Outcome
Monitoring			
8. General public	Post-implementation media release and PIB	Department of Energy information release on conduction and results of project.	Good public relations for TEC and GoT.
9. Consumers (continued from item 6)	Consumer impacts and experiences	TEC questionnaire at sales points and, if required, independent monitoring, for example, by an NGO.	Feedback on what worked and lessons learned included in reports for GoT and World Bank.

ANNEX 7: INCREASING THE PENETRATION OF RENEWABLE ENERGY IN TUVALU[23]

SUITABILITY OF RENEWABLE ENERGY SOURCES IN TUVALU

1. Tuvalu's remoteness, restricted land area, small population, and limited technical capacity pose challenges for RE development. The suitability of RE technologies needs to be evaluated with consideration of these factors. Proven, sustainable and financially viable technologies are required to support Tuvalu's energy-sector goal of 100 percent RE generation by 2020.

2. The Tuvalu Master Plan proposes that the 100 percent RE solution for Tuvalu will predominantly comprise solar PV and wind-energy generation. On the outer islands, coconut-oil fuel backup of the diesel generators appears to be the most feasible way to reach the 100 percent RE target. Biomass, biogas, wave energy and ocean thermal energy conversion (OTEC) do not appear to be viable for electricity production in Tuvalu at this stage, for the reasons provided below.

3. *Solar energy*. Tuvalu has a proven viable solar resource with irradiation of 5.5 kWh per m^2 per day. At the present time, approximately 2 percent of Tuvalu's energy is provided by RE sources, 100 percent of which is solar. Due to Tuvalu's land constraints, the use of existing building structures to mount solar PV panels has benefits in terms of saving the additional use of scarce land. However, structures must be proven to be structurally sound for their safe and reliable use as foundations for the solar panels. The NZMFAT project has identified four or five of the largest public buildings for the mounting of a total of 440 kWp of solar PV panels. Solar thermal energy is not considered economically viable due to the limited land space and scale that can be achieved in Tuvalu.

4. *Wind energy.* The Master Plan identifies wind as the secondary source of RE generation in Tuvalu. This plan identifies the suitability of small 20 to 50 kW wind turbines that can be easily managed. Wind data are currently being collected in Tuvalu at heights of 30 m and 5 m, at two locations: one on Funafuti and the other on Nukufetau. Data collection commenced in mid-July 2012 and a sound data set is being established that will allow more in-depth analysis of wind-energy potential at these two locations. Preliminary analysis indicates an average wind speed of 5.5 m/s. Although further analysis is required, the results suggest that a 275 kW turbine may also be viable on Funafuti, which accounts for approximately 85 percent of Tuvalu's total energy demand.

5. *Biofuel and biomass:* Biofuel from coconut oil may be viable on a small scale on Tuvalu's outer islands and is proposed to make up the last 5 to 15 percent of RE generation in the country. Because approximately 60 percent of Tuvalu's land area is covered with coconut trees, this raises the possibility of biofuel or biomass generation. Coconut-oil production has significantly dwindled in Tuvalu because the poor prices obtained for the harvest are insufficient to sustain supply. Challenges exist in transporting coconut oil among the islands, but production for local use may be feasible if supply chains can be developed and sustained to the point where biofuel is cost-competitive with diesel. The best economic use of mature trees will be for biofuel,

[23] IRENA (The International Renewable Energy Agency). 2013. *Pacific Lighthouses: Renewable energy opportunities and challenges in the Pacific Islands region, Tuvalu.*

biomass generation, or wood products.

6. *Biogas.* The largest potential source of biogas in Tuvalu is from pig manure. Traditionally, householders in Tuvalu own several penned pigs. However, by combining community resources, a large number of pigs would be required to concentrate the manure to a sufficient quantity that can be used for biogas. Small-scale biogas digesters have been used in other Pacific island countries but have been abandoned due to very modest outputs that were not sufficient to motivate the upkeep of the digesters.

7. *Wave energy and OTEC.* Although measurements show moderate wave-energy resources, no commercially viable wave-energy conversion machines are currently available to install in Tuvalu. Likewise, with OTEC, Tuvalu has an abundant resource, but to date no commercially viable technologies are available. Even when such technologies are developed, Tuvalu's small scale is likely to limit the opportunity for finding a financially viable solution to harness this resource.

THE PATHWAY TOWARD ACHIEVING 100 PERCENT RENEWABLE ENERGY IN TUVALU

8. Currently, Fogafale has 156 kW of solar PV generation capacity installed, generating 3 to 4 percent of the atoll's electric energy requirements of 5.6 GWh per year. Three diesel generator sets, each with a 600 kW capacity, provide the rest of the energy required. The project, together with solar PV generation capacity installed on Fogafale by other donors (NZMFAT and UAE) is expected to enable about 40 percent of Fogafale's long-term electrical energy needs to be met from RE sources. The NZMFAT, in partnership with the UAE, are proposing to install approximately 520 kW of solar PV generation. The battery, inverter and control equipment proposed will not only enable the 925 kW of solar PV installed during Component 1 of the project to operate successfully, it will dramatically decrease the spilled energy from the combined NZMFAT/UAE installations.

9. The project will result in approximately 1,175 kW of renewable generation capacity, supplying a load that varies between 400 kW and 900 kW. The battery and the inverter will enable the diesel generation sets to be turned off rather than being operated at their minimum load point of 30 percent of the 600 kW rating (180 kW). The ability to turn off the diesel generation sets reduces diesel-engine running hours, thereby reducing O&M costs and extending the longevity of the diesel generation sets. It is envisaged that the grid-forming inverter and battery combination will be able to manage the frequency and voltage control typically provided by rotating machinery such as the diesel generation sets. Discussions with reputable suppliers have indicated that the technology to achieve this in a system the size of Fogafale's is now available.

10. The solar PV technologies that will be used are well-proven common technologies. The technical innovation in this project is due to the inverter and battery systems and the control systems that integrate the solar PV technologies to control the energy balance on the system. The procurement contracts will have performance guarantees and robust warranties to ensure that these systems operate as envisaged.

11. This project, which enables the move from 2 to 3 percent RE penetration to approximately 40 percent RE penetration, is a technically and financially appropriate step to take toward achieving the ultimate 100 percent RE target. The project has been extensively modeled in a software package that determines the most cost-effective mix of RE technologies and energy

storage systems. Further optimization will occur during project tendering, when more rigorous data are available on the exact costs and specifications of the different technologies available at that time.

12. Moving toward 100 percent RE in the future is technically possible, depending on the cost and availability of the required technologies and energy sources. Wind and biomass would enable higher RE penetration. Experience in the use of wind turbines in the Pacific island countries is growing. Biomass or biofuel offers promises but is less viable in Tuvalu due to its limited availability and historically high cost. The cost of integrated control systems, including batteries, needed to manage demand and dispatch conventional and intermittent generation sources is expected to continue its downtrend over the next years. These developments could facilitate an increase in the participation of RE sources in the generation mix over the coming years, and further reduce diesel-based generation.

ANNEX 8: ECONOMIC AND FINANCIAL ANALYSIS

ECONOMIC ANALYSIS

1. An economic cost-benefit analysis was conducted for the two investments in Components 1 and 2 (representing 95 percent of the total project cost). These components represent priority capital expenditures for Tuvalu's power systems: (a) solar PV (about 925 kWp) and wind-power generation (about 200 kW); (b) batteries sufficient for the hybrid system's storage requirements, including the expected energy spillovers from the NZMFAT and Masdar solar PV systems that are now being built without storage; (c) battery inverters and an integrated power-control system to provide grid stability and other ancillary services; (d) a satellite-based communications system between Funafuti and the three outer islands; (e) the supply and installation of prepayment meters for all TEC customers and smart meters for the largest electricity consumers; and (f) the implementation of selected EE investments and measures in various large energy-consuming sectors.

Methodology and Key Assumptions for Cost–Benefit Analysis

2. Economic analysis for the proposed activities was conducted using two scenarios—with project and without project—based on the World Bank's Handbook of Economic Analysis on Investment Operations.[24] Net social costs and benefits were estimated as the difference in the costs and benefits of these scenarios for each of the proposed investments. The Bank has traditionally used a 12 percent discount rate for most project appraisals in the Pacific islands. The estimated average economic opportunity cost of capital (EOCK) for 2008–2011 was also approximately 12 percent. Therefore, a discount rate of 12 percent was used in the present analysis. A foreign exchange premium (FEP) of 12 percent was used, based on the estimated average of FEP for 2008–2011.

3. Against the project cost of the two investment components described above, the project's benefits are due to increased RE capacity and utilization in the system (solar PV and wind-power installations, and the associated battery storage and control system). This translates to reduced fuel and O&M costs for the diesel generators, with annual diesel generation growth in the "without-project" case of 2.1 percent compared to 1.08 percent in the "with-project" scenario.[25] The investment in the satellite-based communication system would reduce the incidence of outages and maintenance costs of the installed RE systems and thus reduce the amount of backup diesel power generation in the three outer islands, due to the ability provided to TEC to remotely and continuously monitor the functions of every RE system on the three islands, diagnose potential failures, and conduct routine maintenance. Consumers will benefit from the EE investments and measures to be financed by the project. There are also payment transfers between nonpaying consumers, including the government and TEC, due to the use of prepayment meters.

4. The Bank's measures of global environmental benefits are in greenhouse gas (GHG) emission reductions, including CO_2, CH_4 and N_2O, which are evaluated in terms of carbon dioxide equivalent (CO_2e). Local environmental benefits, for information only, are in the form of

[24] The World Bank. 1998. *Handbook of Economic Analysis of Investment Operations*.
[25] Estimated based on the real GDP growth rate estimated by the International Monetary Fund from 2015–2034.

reduced health and social welfare damages from reduced nitrogen oxide (NOx) emissions from diesel-fired power plants, including premature respiratory ailments (70 percent), adult chronic morbidity (10 percent), material soiling (5 percent), acute morbidity (10 percent), and visibility reduction (5 percent). However, these are for information only and are not included in the total NPV and EIRR of this economic analysis.

5. Other key assumptions are used in the economic analysis: (a) all costs are expressed in constant 2014 USD prices;[26] (b) capital investment costs for priority capital-expenditure projects are assumed to be incurred in 2016; (c) project life is covered from 2015 to 2036 and salvage values are included as appropriate, with an annual depreciation rate of 5 percent, based on the Klynveld Peat Marwick Goerdeler (KPMG) Fixed Assets Register for TEC; (d) diesel-oil cost projections are based on the International Energy Agency's (IEA's) World Energy Outlook 2013; and (e) after five years, the communication system will be updated with a new Ka-band VSAT which will have a much lower annual recurrent cost.

Results of Cost-Benefit Analysis

6. Four key indicators are used to summarize the results of the economic cost-benefit analysis for the proposed investments: the NPV of benefit, EIRR, distribution analyses of benefit, and the switching value (SV) and sensitivity indicator (SI) for selected key variables. The economic analysis focuses primarily on the EIRR and NPV of (net) benefits: the discounted value of economic benefits less discounted costs in 2014 dollars. SI is the ratio of the percentage change in the NPV to the percentage change in a selected variable. A High value for the indicator indicates project sensitivity to the variable. SV is the percentage change in a variable for the project's decision to change: for the NPV to become zero or the EIRR to fall to the cutoff rate. Table 13 summarizes the results.

[26] Exchange rate used for economic and financial analysis was 1 USD = 1.04 AUD (World Bank data, 2013).

Table 13. Summary of Cost-benefit Analysis[27]

	Investments USD (million)	Economic Analysis Conducted	% of Economic Analysis Conducted	NPV (USD million) at 12% Discount Rate/EOCK	IRR	CO_2e ton	NOx ton	NOx NPV (USD) at 12% Discount Rate	CO_2e NPV (USD) at 12% Discount Rate
Total	9.10	8.60	95%	0.32	13%	19,757	38,433	827	49,581

Distribution Analysis (USD million)			
NPV	Consumers	TEC	Government of Tuvalu
0.32	1.39	6.23	(7.31)

Sensitivity Analysis				
	Base Case	Capital Cost 20% Increase	Fuel Cost 20% Increase	Power Generation Growth Rate Without Project (kWh) 20% Increase
IRR	13%	10%	13%	14%
NPV	0.32	(1.01)	0.32	0.71

	Capital Cost	Fuel Price	Generation kWh
SV	-5%	346795%	16%
SI	-20.91	0.0003	6.14

7. The overall NPV is USD 0.32 million (0.8 percent of Tuvalu's GDP in 2013) and the EIRR is 13 percent. Distribution analyses of this NPV revealed that TEC is the largest beneficiary due to reduced operation and maintenance, transfer payments from nonpaying consumers including government, and imported diesel-oil cost, which will also affect the country's vulnerability to fuel supply and price shocks and to the trade balance. Consumers also benefit due to the power savings from EE and conservation measures, which outweighed the loss due to transfer payments. Surveys and consultations conducted in Tuvalu during project preparation revealed that the prepayment meters will especially benefit women who usually manage household expenditures and will help them use electricity more efficiently and avoid disconnection of electricity supply. The government's losses are based on the project costs and FEP, as well as transfer payments. Sensitivity analyses, including SV and SI, conducted across selected variables showed the results are sensitive to the capital cost.

8. In conclusion, economic analyses of the project's major capital expenditure investments in RE installations in Tuvalu's power system indicate economic benefits.

FINANCIAL ANALYSIS

Current Financial Situation

9. TEC faces serious financial concerns. It has a deficiency of working capital and continues to incur operating losses. Although income from electricity sales remained relatively stable over from 2011 to 2013, income fell sharply in 2013 as a result of the cessation of a JPY 10 million

[27] CO_2e per ton was estimated at USD 10 and NOx per ton was estimated at USD 86.

grant[28] from the Japanese government that was received annually between 2005 and 2012. The absence of this grant, which equated to AUD 0.88 million and AUD 1.39 million in 2011 and 2012, respectively, resulted in a 69 percent drop in operating income. This drop coincided with a significant increase in operating expenses throughout 2013, particularly in fuel handing and in equipment repair and maintenance. The combination of these factors saw TEC's financial position move from a net profit of AUD 0.31 million in 2012 to a net loss of AUD 1.28 million in 2013. TEC also obtained loans through an overdraft facility and a commercial loan from the Bank of Tuvalu for AUD 0.67 million in 2013, at an interest rate of 11.7 percent, which will be difficult to service going forward. Although the grant from the Japanese government is expected to be received again in 2014, there is little certainty that it would be received beyond that point.

10. The facts that tariff rates are not linked to changes in fuel price or inflation, and are stated in Australian dollars, have detrimental impacts from a financial perspective. First, a fixed tariff exposes TEC to both fuel and exchange-rate risks. Second, although operating expenses are expected to increase at a rate of about 2 percent per year,[29] revenues will increase at a slower pace due to tariffs remaining unchanged. Because sales are already insufficient to cover fuel costs, the funding deficit would widen over time. This deficit is currently being funded by an overdraft facility with an interest rate of 11.7 percent. If this situation continues, and if a cheaper form of financing does not become available, interest costs would increase to AUD 0.34 million per year by 2036.

11. Without any intervention or action, these gradually increasing losses would make TEC progressively more dependent on donations, grants, subsidies, and the GoT for financial support.

Methodology

12. The financial performance of the Tuvalu Electricity Corporation was assessed on the basis of simulated revenue and costs streams, "with and without project," to determine the financial viability and sustainability of the proposed investments. The financial analysis assesses the FIRR and FNPV of the proposed investments based on future revenue and cost streams, "with and without project," from 2015 to 2036. These revenue and cost streams were used to determine simulated profit and loss, balance sheet, cash flow statements, and key financial indicators. These forecasts are in the same format as the financial accounts published by TEC and are based on financial data for 2012 and 2013. Cost streams used include fuel, operation and maintenance costs. The streams of incremental cash flows were discounted to their present value in calculating the FIRR and FNPV. Table 14 shows the FNPV and FIRR for TEC.

13. For purposes of the analysis, the following assumptions have been used:

- The diesel generation growth is 1.08 percent "with project" and 2.11 percent "without project" per year.
- Revenue consists of tariff income and other operating income, including grants and subsidies. Fuel grants are expected to be terminated from 2015 onward.
- Implementation costs of the new equipment are covered by the grants funding the equipment.

[28] JPY 10 million from the government of Japan; see: http://www.fj.emb-japan.go.jp/eco_corporation/tuvalu/tuvalu_NPGA.html.
[29] *IMF's Economic Outlook for Tuvalu (2015–2034)* http://world-economic-outlook.findthebest.com/l/552/Tuvalu.

- Ongoing O&M costs grow at a Consumer Price Index (CPI) of 1.98 percent per year,[30] according to the IMF's Economic Outlook for Tuvalu (2015–2034).
- TEC's target is to maintain a predefined cash position of AUD 235,000.
- Existing investments are reflected in the balance sheet as of December 31, 2013, with depreciation in 2013 used as the starting point. Depreciation is computed on the basis of straight-line depreciation and the following periods have been assumed: plant and machinery (15 years); buildings (20 years); furniture (5 years); and motor vehicles (5 years).
- The fuel price is the average incurred by TEC during 2012 (USD 1.53 per liter). The annual real fuel price growth rates are assumed to be 0.54 percent (2015–2020); 1.14 percent (2021–2025); 1.38 percent (2026–2030), and 1.29 percent (2031–2035). The average fuel price during 2014 was estimated at USD 1.71 per liter.
- The USD/AUD exchange rate used is AUD 1.04 per USD.
- The life of the project is assumed to be from 2015 to 2036, with all investments made in 2016.

14. The financial impacts of two of the indicators against which progress toward the development objectives of the project will be measured are considered here:

- *Reduction in the use of diesel fuel for electricity generation on Funafuti.* For purposes of this analysis, it has been assumed that the quantity of diesel fuel in liters required for electricity production would fall by 30.1 percent as a result of the penetration of RE and EE. Should this occur by 2020, the financial impact would be an annual saving of USD 877,241.

- *Reduction in the number of outstanding accounts/debtor days.* TEC has a high level of outstanding debtors, with many accounts' receivables standing at over 100 debtor days. The project's financing of the procurement and installation of a metering system, including prepayment meters for all accounts and smart meters being considered for large accounts, will have a positive financial impact. In 2013, the bad-debt provision equates to 13.1 percent of total electricity sales. Since a 1 percent change in doubtful debts equates to approximately AUD 25,434 per year, if doubtful debts fall to 5 percent of total sales, the financial impact would be a saving of AUD 207,646 per year.

Results

15. The proposed investments will have a significant positive impact on TEC's financial position through the reduction of fuel and operating costs due to the migration to RE sources and an increase in efficiencies. The proposed investments will generate an FNPV of AUD 9.8 million and an FIRR of 45 percent resulting in an estimated annual saving of AUD 1.7 million. As a whole, the financial analysis estimates that the investment of USD 9.1 million (AUD 9.579 million) will return a financial benefit of AUD 91.13 million over the period from 2015 to 2036.

[30] *IMF's Economic Outlook for Tuvalu (2015–2034)* http://world-economic-outlook.findthebest.com/l/552/Tuvalu.

Table 9. Summary of Financial Analysis

	Total Estimated Capital Expenditure (USD thousands)	Total Estimated Capital Expenditure (AUD thousands)	Financial Net Present Value (FNPV) (AUD thousands)	Financial Internal Rate of Return (FIRR) (%)	Estimated Annual Saving (AUD thousands)
Tuvalu Electricity Corporation	9,100	9,579	9,806	45.3	1,714

ANNEX 9: GENDER ACTION PLAN AND MONITORING AND EVALUATION FRAMEWORK

Table 15. Gender Action Plan Framework

	Related Actions/Activities	Measurable Outputs/Key Performance Indicator (KPI)	Time Frame	Responsible Agency	Resources	Cost (USD)
Strategic Objective 1: To utilize the Tuvalu Energy Policy and other national policy provisions and commitments to recognize energy as a human right for men and women.						
Mainstream gender equity/equality throughout ESDP project activities.	Gender and energy scoping study and quantitative study	• Current disaggregated energy information	2014	TEC, Gender Affairs Department (GAD)	Bank	Nearly complete
	Joint programming with other sectors such as agriculture, fisheries, and health	• Reference to gender and energy in sector reports • Cross-sectoral project planning	2015	TEC, GAD		
	Develop guideline toolkit for gender and energy mainstreaming	• Gender and energy mainstreaming toolkit	2015	TEC, GAD	Bank	10,000
	Community consultations for project design and implementation scheduled at times when women can attend	• Community consultations include at least 40 percent women • Consultation schedules	2014	TEC		
	Incorporate gender and energy aspects into ESMF and PEAR/EMP processes	• Analysis of energy and gender in PEAR/EMP	2015	TEC, Department of Environment		
	Incorporate gender and energy linkages in the outer island climate change framework	• Increased reference to recognition of gender dimensions in outer island framework	2014	Ministry of Home Affairs (MHA), TEC, GAD		
Increase women's representation in decision-making positions in energy sector: senior level	Advocate for affirmative action that encourages women in decision-making roles in the energy sector	• Transparent job recruitment based on qualifications and skills rather than gender	2015	GoT		

	Related Actions/Activities	Measurable Outputs/Key Performance Indicator (KPI)	Time Frame	Responsible Agency	Resources	Cost (USD)
Encourage a gender-responsive operating environment to enable energy and gender-equity objectives.	*Kaupule* governance: integrate linkages between gender and energy in outer islands	• Gender and energy awareness training to *Kaupule* • Increase in women on *Kaupule* councils with an energy focus, especially in the Island Development Coordinating Committee (IDCC) and disaster committees	2015	MHA, TEC, GAD	Bank	10,000
	Mandatory gender mainstreaming training for all levels of TEC and Department of Energy staff and incorporated in social safeguards training as stipulated in ESMF	• Relevant training modules developed for TEC trainings carried out • Participants trained	2015	TEC	Bank	10,000
	Behavioral change training program in community: mindset change to acknowledge energy as a right. This includes training in: • Advocacy and lobbying • Life skills • Basic energy appliance management	• Trainings completed • No. of Participants trained disagreggated by gender and/ or community group (e.g. community level women's group, community leaders, youth e.t.c)	2015	GAD, Tuvalu National Council of Women (TNCW)		
Strategic Objective 2: To ensure that gender is mainstreamed in the current and subsequent energy projects.						
Partnership with non-energy sector projects that focus on improving women's access to energy.	Develop strategic and operational linkages with other sectors such as agriculture, environment, rural development, and health	• Consultative discussions • Community trainings	2015	Sector agencies, TEC, GAD		
Strategic Objective 3: To measure improvements in gender equity and equality through national statistics.						
Systematic monitoring of gender development in the energy sector.	Development of gender-sensitive M&E plans and system for assessment of ESDP activities	• Measurable and achievable gender indicators • Annual M&E reports	2014	TEC, GAD, Statistics	Bank	8,000
	Develop criteria to evaluate gender trainers and programs	• Gender trainer's criteria development • Gender skills training undertaken	2015	GAD		

	Related Actions/Activities	Measurable Outputs/Key Performance Indicator (KPI)	Time Frame	Responsible Agency	Resources	Cost (USD)
	Develop indicators of ESDP project's gender and energy implications	• Gender and energy indicators: for example, share of household income spent on fuel for lighting and cooking • Annual update	2014	TEC, GAD, Consulting	Bank	2,000

Table 16. Gender M&E Framework

Output	Activities	Responsibility	Data Sources	Indicators	Indicative Budget (USD)	Frequency
Gender and energy mainstreaming toolkit	Development of toolkit by gender consultant	Bank, TEC, GAD	Gender and energy toolkit, Household Income and Expenditure Survey (HIES), census focused surveys collected	Gender and energy mainstreaming toolkit developed	10,000	Reviewed and adapted annually to meet changing needs
Gender-responsive capacity building	Mandatory gender mainstreaming training for all levels of TEC and Department of Energy staff	Bank, GAD	Qualitative and quantitative studies, good-practice guides	Trainings conducted; No. of employees trained; percentage female/male	10,000	Annual updates
	Gender and energy awareness training to Department of Rural Development, *Kaupule*, and community councils	Bank, TEC, GAD	Qualitative and quantitative studies	No. of training sessions conducted; No. of community leaders trained; Increased percentage of women on community boards/councils	10,000	Annual updates
M&E systems and operational framework developed	M&E working panel set up; focal gender officers	TEC, GAD, Statistics		Consultations of relevant agencies undertaken to identify focal officers		3 monthly meetings to update
	Develop harmonized gender-responsive data collection system	Statistics, TEC gender focal officer, GAD, Bank	Best-practice informed systems	Data collection systems developed	4,000	

Output	Activities	Responsibility	Data Sources	Indicators	Indicative Budget (USD)	Frequency
	Acquire necessary software and data management systems	Bank, TEC		Quantitative and qualitative software procured	2,000	
	Undertake training for collection, collation, and analysis for relevant officers	Bank, Statistics		Focal officers trained	2,000	Annual updates
Data collection, analysis, and information dissemination	Collect relevant disaggregated data, for example, increased employment opportunities from improved energy access	Gender working group	Surveys: perception and quantitative	Annual report due to the Bank by June each year	2,000	Annual collection