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Report No: ICR00003092

IMPLEMENTATION COMPLETION AND RESULTS REPORT (TF-14767 TF-94928 TF-95444 TF-99863)

ON A

GLOBAL ENVIRONMENTAL FACILITY GRANT IN THE AMOUNT OF US\$4.5 MILLION

AND

AFRICA RENEWABLE ENERGY ACCESS TRUST FUND GRANT IN THE AMOUNT OF US\$3.8 MILLION

TO THE

REPUBLIC OF RWANDA

FOR A

RWANDA SUSTAINABLE ENERGY DEVELOPMENT PROJECT

July 29, 2014

Global Practice Energy and Extractives

CURRENCY EQUIVALENTS

(Exchange Rate Effective June 2014)

Currency Unit	=	Rwanda Francs
US\$1	=	RFW 695
US\$1	=	SDR 0.65

FISCAL YEAR 2015

ABBREVIATIONS AND ACRONYMS

- AFREA Africa Renewable Energy and Access program
- BTC Belgian Development Cooperation
- CCT Controlled Cooking Test
- CEDP Competitiveness and Enterprise Development Project
- CO₂ Carbon Dioxide
- CPS Country Partnership Strategy
- DRC Democratic Republic of Congo
- DSM Demand side management
- EA Environmental Assessment
- EE energy efficiency
- EDPRS Economic Development and Poverty Reduction Strategy
- EMF Environmental Management Framework
- EoI Expression of interest
- ESME Energy Small and Medium Enterprise Trust Fund
- ESMF Environmental and Social Management Framework

EWSA	Energy Water and Sanitation Authority
FiT	Feed in Tariff
FM	Financial management
GDP	Gross Domestic Product
GEF	Global Environment Fund
GEO	Global Environment Objectives
GIZ	<i>Gesellschaft für Internationale Zusammenarbeit</i> (German International Technical Cooperation)
GoR	Government of Rwanda
GVEP	Global Village Energy Partnership
ICR	Implementation Completion and Results report
ICS	Improved Cook Stoves
IDA	International Development Association
IFC	International Finance Corporation
IRR	Internal rate of return
ISR	Implementation Status Report
KIST	Kigali Institute of Science and Technology
LPG	Liquefied petroleum gas
M&E	Monitoring and Evaluation
MININFRA	Ministry of Infrastructure
MoU	Memorandum of Understanding
MTR	Mid-Term Review
MW	Megawatt
MWh	Megawatt per hour
NDF	Nordic Development Fund

NEAP	National Electricity Access Program
NPV	Net present value
PAD	Project Appraisal Document
PDO	Project Development Objective
PIU	Project Implementation Unit
РРА	Power Purchase Agreements
РРР	Public Private Partnership
PV	Photovoltaic
RAP	Resettlement action plan
RE	Renewable energy
REFIT	Renewable Energy Feed in Tariff
RET	Renewable energy technology
RECO	Rwanda Electricity Corporation
RfP	Request for proposals
RPF	Resettlement Policy Framework
RURA	Rwanda Utility Regulatory Agency
RwF	Rwanda Franc
SEDP	Sustainable Energy Development Project
SIL	Specific Investment Loan
SINELAC	Société Internationale des Pays des Grands Lacs (Joint International Entity for Electricity Generation among Burundi, the DRC and Rwanda)
SME	Small and Medium Enterprise
SNEL	Société Nationale d'Electricité (National Power Utility in the DRC)
SHS	Solar Home System
SWAp	Electricity Access Scale-up and Sector-wide Approach Project

SWH	Solar water heater
ТА	Technical assistance
TBIF	Technology Business Incubator Facility
ToR	Terms of Reference
UERP	Urgent Electricity Rehabilitation Project
US\$	United States Dollar
WB	World Bank

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REPUBLIC OF RWANDA

SUSTAINABLE ENERGY DEVELOPMENT PROJECT

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A. Basic Information				
Country:	Rwanda	Project Name:	Sustainable Energy Development Project (GEF)	
Project ID:	P097818	L/C/TF Number (s):	TF-14767,TF-94928,TF- 95444,TF-99863	
ICR Date:	07/22/2014	ICR Type:	Core ICR	
Lending Instrument:	SIL	Borrower:	REPUBLIC OF RWANDA	
Original Total Commitment:	USD 8.30M	Disbursed Amount:	USD 8.22M	
Revised Amount:	USD 8.30M			
Environmental Category: B Global Focal Area: C				
Implementing Agencies:				
Ministry of Infrastructure (MININFRA)				
Energy, Water and Sanitation Authority (EWSA)				
Cofinanciers and Other External Partners:				

B. Key Dates

Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	12/21/2005	Effectiveness:	12/14/2009	06/09/2010
				12/17/2010
Appraisal:	04/20/2009	Restructuring(s):		11/30/2011
				11/30/2012
Approval:	10/15/2009	Mid-term Review:	07/09/2012	07/16/2012
		Closing:	01/31/2014	01/31/2014

C. Ratings Summary C.1 Performance Rating by ICR

Outcomes:	Satisfactory
Risk to Global Environment Outcome	Moderate
Bank Performance:	Satisfactory
Borrower Performance:	Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance				
Bank	Ratings	Borrower	Ratings	
Quality at Entry:	Moderately Satisfactory	Government:	Satisfactory	
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Moderately Satisfactory	
Overall Bank Performance:	Satisfactory	Overall Borrower Performance:	Satisfactory	

C.3 Quality at Entry and Implementation Performance Indicators				
Implementation Performance	Indicators	QAG Assessments (if any)	Rating	
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None	
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA):	None	
GEO rating before Closing/Inactive status	Satisfactory			

D. Sector and Theme Codes

	Original	Actual
Sector Code (as % of total Bank financing)		
General energy sector	10	10
Hydropower	17	17
Other Renewable Energy	17	17
Public administration- Energy and mining	56	56

Theme Code (as % of total Bank financing)		
Climate change	69	69
Micro, Small and Medium Enterprise support	5	5
Rural services and infrastructure	26	26

E. Bank Staff

Positions	At ICR	At Approval
Vice President:	Makhtar Diop	Obiageli Katryn Ezekwesili
Country Director:	Diarietou Gaye	Johannes C.M. Zutt
Sector Manager:	Lucio Monari	Subramaniam V. Iyer
Project Team Leader:	Paul Baringanire	Erik Magnus Fernstrom
ICR Team Leader:	Paul Baringanire and David Vilar	
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F. Results Framework Analysis

Global Environment Objectives (GEO) and Key Indicators(as approved)

The overall goal of the project is to strengthen and consolidate the Rwandan Renewable Energy market. The development objectives for Sustainable Energy Development project (SEDP) are:

1. Improve the policy and institutional framework of the renewable energy and energy efficiency sub-sectors.

2. Increase private sector participation in the renewable energy sector.

Revised Global Environment Objectives (as approved by original approving authority) and Key Indicators and reasons/justifications

(a) GEO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years	
Indicator 1 :	Renewable Energy and Ener	gy Efficiency strategy	study adopted	by MININFRA	
Value					
(quantitative or	No	Yes		Yes	
Qualitative)					
Date achieved	12/02/2009	02/08/2010		09/30/2013	
Comments		1	1	1	
(incl. %	Target achieved. Study adopted and report presented to sector stakeholders July17, 2012.				
achievement)					
Indicator 2 :	Micro-Hydro Feed-in and Bulk-purchase tariffs agreed with RECO and approved by				

	RURA					
Value						
(quantitative or	No	Yes		Yes		
Qualitative)						
Date achieved	12/02/2009	02/08/2010		09/30/2013		
Comments		1		1		
(incl. %	Target achieved. Approved	February 2012				
achievement)						
Indicator 3 :	Solar PV Dealers with field p	presence in at least or	ie			
	province outside Kigali offe	ring sales and mainter	nance services			
Value						
(quantitative or	0	4		11		
Qualitative)						
Date achieved	12/09/2009	02/08/2010		01/31/2014		
Comments				1		
(incl. %	Target exceeded.					
achievement)						
Indicator 4 :	Increase in number of staff	employed in RE firms				
Value						
(quantitative or	0	75		1461		
Qualitative)						
Date achieved	12/01/2009	02/08/2010 01/31/2014				
Comments				1		
(incl. %	Target exceeded. Data from survey results conducted January 2014					
achievement)						
Indicator 5 :	Avoided CO ₂ emissions					

Value (quantitative mTonsCO ₂))	0.0	0.646		0.52		
Date achieved	12/02/2009	02/08/2010		09/30/2013		
Comments	Target Partially achieved (80 percent). An additional 8.20mtonsCO ₂ equivalent will be subject to 4 ENW of misra budra power plants, that were under construction					
achievement)	avoided when the 4.5MW of micro hydro power plants, that were under construction at project close, are commissioned.					

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years		
Indicator 1 :	M&E framework for all RE a	ctivities in place				
Value						
(quantitative or	No	Yes		Yes		
Qualitative)						
Date achieved	12/02/2009	02/08/2010 0		09/30/2013		
Comments		1		1		
(incl. %	Target achieved. Most of the of the findings and assessments' recommendations have been used to inform decision making.					
achievement)						
Indicator 2 :	% of households using improved stoves in the Kigali area					
Value						
(quantitative or	40	75		82		
Qualitative)						
Date achieved	12/02/2009	02/08/2010		01/31/2014		

Comments							
(incl. %	Target achieved. Result based on the findings of a survey conducted in January 2014.						
achievement)							
Indicator 3 :	Business Plans for public mi	cro-hydro under imple	ementation.				
Value							
(quantitative or	0	16		13			
Qualitative)							
Date achieved	12/02/2009	02/08/2010		09/30/2013			
Comments (incl. % achievement)	Target partially achieved (80%). A detailed audit which reviewed the operational performance of 11 grid connected small hydropower plants and two hydropower plants connected to isolated grids with recommendation for improved operations was concluded March 2013. EWSA has initiated actions to implement the performance improvement recommendations among which are contracting out the operations and maintenance of the plants.						
Indicator 4 :	Installation and user guideli	nes for Solar PVs in pu	Iblic institutions	approved.			
Value							
(quantitative or	No	Yes		Yes			
Qualitative)							
Date achieved	12/02/2009	02/08/2010		09/30/2013			
Comments		11					
(incl. %	Target achieved. Guidelines	prepared and approve	ed in July 2013.				
achievement)							
Indicator 5 :	Approved investment plan b	based on the national	grid energy aud	it			
Value							
(quantitative or	No	Yes		Yes			
Qualitative)							
Date achieved	12/02/2009	02/08/2010		09/30/2013			
Comments	Target achieved. Grid audit completed in March 2013. Investment Plan prepared and endorsed by the Energy Sector Working Group in November 19, 2013.						

(incl. %	
achievement)	

G. Ratings of Project Performance in ISRs

No.	Date ISR	GEO	IP	Actual Disbursements
	Archived			(USD millions)
1	12/11/2009	Satisfactory	Satisfactory	0.00
2	06/01/2010	Satisfactory	Satisfactory	0.00
3	03/24/2011	Moderately Satisfactory	Moderately Satisfactory	1.68
4	10/19/2011	Moderately Satisfactory	Moderately Satisfactory	2.19
5	06/13/2012	Satisfactory	Satisfactory	3.01
6	12/28/2012	Satisfactory	Satisfactory	3.65
7	07/07/2013	Satisfactory	Satisfactory	4.79
8	02/11/2014	Satisfactory	Satisfactory	6.19

H. Restructuring (if any)

Restructuring Date(s)	Board Approved GEO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in	Reason for Restructuring & Key Changes Made ¹
		GEO	IP	USD millions	
12/17/2010	Ν	S	S	1.60	1st extension closing date to 30 September 2012. It was an administrative extension related

¹ All extensions only refer to the AFREA TF that was co-financing the project. The GEF grant closing date (the project closing) not extended.

Restructuring Date(s)	Board Approved GEO Change	ISR Rat Restru GEO	tings at cturing IP	Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made ¹
					to the AFREA TF.
11/30/2011	N	MS	MS	2.28	2nd extension closing date to 30 November 2012. It was an administrative extension related to the AFREA TF.
11/30/2012	N	S	S	3.42	3rd extension closing date to 31 January 2014. It was an administrative extension related to the AFREA TF.

I. Disbursement Profile



1. Project Context, Global Environment Objectives and Design

1.1. Context at Appraisal

Economy

1. Rwanda was ravaged by civil war and genocide in the early 1990s, followed by border wars that finally ended in 2002-3. The domestic population had fluctuated considerably due to genocide and migrations associated with conflict and was estimated to be about 9.7 million (2007). Habitation patterns had also changed considerably – Kigali, the capital city, had grown to close to 1 million, and new rural agglomerations known as "Imidugudus" were emerging.

2. Rwanda was largely an agricultural economy with small-holder farming and some commercial agriculture (tea, coffee, which is being privatized). Agriculture accounted for about thirty-five percent of Gross Domestic Product (GDP), though up to fifty percent of the farmers did not effectively participate in the economy. The manufacturing sector comprised a few enterprises in small-scale industry - agro-processing, brewery, textiles, mining, sugar, and cement. In the aftermath of the genocide and associated conflicts (1996-2000), real GDP grew at over ten percent per year as the economy recovered from a low base. GDP growth was in the range of 4-6 percent during the period 2004-06. In 2007, GDP growth was about 7.9 percent driven by growth in the services and manufacturing sectors while agricultural output expanded by just less than 1 percent due mainly to poor weather conditions which also contributed to a 50 percent decline in coffee output. Estimates were that the economy grew by 8.5 percent in 2008, fueled in large part, by a strong recovery in agriculture, which grew by nearly 15 percent, with the then ongoing expansion of the crop intensification program.

3. Overall, the business environment was still weak, and specialized institutions to support private sector development in the early stages of development. The pace of reform increased during 2007-08 and this was reflected in the improvement in overall ranking for Rwanda from 148 in 2007 to 139 in 2008 on the Doing Business Report. Rwanda was also one of the ten fastest reforming countries among the 181 nations scrutinized in the report. Infrastructure bottlenecks in the urban areas and limited access in the rural areas still emerged as a significant constraint to continuing economic growth and human capital development. In the 2008 Investment Climate Assessment survey carried out by the World Bank, 340 Rwandan private enterprises identified Infrastructure, or the lack of it, as the primary barrier to growth with the quality of Electricity, Transportation and Telecom services all among the top 10 constraints.

Energy sector:

4. At project preparation in 1998, most of the energy consumption was in the form of wood fuels; the modern energy sector was very small - consisting of about 55 MW of peak electricity demand on the national utility, Rwanda Electricity Corporation (RECO, formerly Electrogaz), and about 182,000 cubic meters of oil products' consumption. So far, the majority of electricity supplies to Rwanda was generated from hydroelectric power produced domestically and imports from Société Internationale des Pays des Grands Lacs (SINELAC) – an electricity company owned jointly by Burundi and the Democratic Republic of Congo (DRC) - as well as from Société Nationale d'Electricité (SNEL), the national electricity company in DRC. In addition to high inland transport costs from Eldoret or even Mombasa, oil products imports were also subject to various duties and taxes, so that on average, retail prices of petroleum products were about 100 percent higher than acquisition costs f.o.b. main supply sources (e.g., Arab Gulf markets). Development of Rwanda's energy resources – additional hydroelectricity, natural gas dissolved in Lake Kivu, peat, geothermal, solar - has been constrained by small market size, lack of financing and an inadequate institutional framework. RECO had only approximately 110,000 customers and barely about 6 percent of the households had access to electricity, almost entirely in the urban areas. Kigali alone accounted for about two-thirds of the total number of customers and total demand of electricity.

Renewable energy development

5. Renewable energy sources and technologies were still an untapped potential in Rwanda. Although optimal utilization of locally available renewable energy resources and efficient end-use would help Rwanda alleviate the supply gap and minimize its dependency on costly fuel imports, the potential benefits for rural, non-grid areas constituted the primary driver. Donor-driven projects and financing increased in this area during the last decade but interventions remained scattered and largely outside of the national energy planning process and government efforts had only recently taken off. The level of local capacity in the area of renewable energy also remained low, both in the public as well as private sectors. Solar irradiation is abundant but the Rwandan solar market was very small and mainly limited to the 'project' market driven by donor funding. Micro-hydro, after many years of neglect, had recently received considerable attention in Rwanda and a number of projects were in pipeline. The use of traditional fuels, such as biomass, was accelerated due to increased population and urbanization reaching unsustainable levels, resulting in deforestation and soil deterioration.

Sector reforms had accelerated, though much remained to be done

6. During the years following the energy crisis, progress was made in establishing the legal and regulatory frameworks for the energy sector and safeguarding the rights of consumers and a new breed of small-scale operators emerging in rural areas. A multi-sectoral Rwanda Utility Regulatory Agency (RURA) was established and key staff was

recruited. RURA received start-up support through the International Development Association (IDA) financed Competitiveness and Enterprise Development Project (CEDP) and the Urgent Electricity Rehabilitation Project (UERP) but had yet to gain sufficient experience to fully carry out its mandate. New Electricity and Gas laws clearly delineating the role of the private sector, the government, and the utility regulator were expected to be approved by Parliament during 2009.

Rationale for Bank involvement

7. As the largest donor in the sector, the World Bank (WB) was uniquely positioned to support the Government of Rwanda (GoR) to build functioning energy markets for all the three renewable energy technologies (RETs), namely solar, hydro and biomass, and integrate private sector actors by providing incentives and helping to establish regulatory frameworks. The IDA project portfolio included the following: (i) The Urgent Electricity Rehabilitation Project (UERP) (FY06): the UERP was instrumental in supporting the sector turn-around. It funded key technical assistance (TA) support, such as the preparation of the new Electricity and Gas laws, as well as investments to diversify power generation resources and rehabilitate priority grid infrastructure including a new main substation for the capital, Kigali; (ii) The Electricity Access Scale-up and Sectorwide Approach Development Project (SWAp) (FY09): In 2008, the GoR designated, and donors endorsed, the Bank's role as the lead donor in the energy sector, as well as the "donor representative" of the energy sector cluster. The Sector Working Group was formalized in the signed Energy SWAp Memorandum of Understanding (MoU) dated July 2008. Under this framework, the Bank assisted the GoR in preparing a National Electricity Access Program (NEAP) to triple access to electricity services in four years; (iii) A Poverty Reduction Support Grant (PRSG) Series (FY09): the PRSG Series supports reform of the energy sector through policy dialogue; and (iv) Technical assistance and transaction advisory support (FY08) for Nyabarongo hydro power plant, and Lake Kivu methane gas.

Rationale for the GEF and AFREA involvement

8. The involvement of the Global Environment Fund (GEF) and the Africa Renewable Energy and Access Program (AFREA)² was highly complementary to the Bank's existing and planned energy portfolio as it facilitated the balancing of grid extension activities with strategic and technical support to the emerging off-grid and renewable energy (RE) sector, dominated by small and medium enterprise (SME) operated schemes. The project would help the Government in mainstreaming renewable energy development within the national Energy-SWAp, complementing the efforts made

 $^{^2}$ The AFREA program was managed by AFTEG and funded through a contribution from the Government of the Netherlands to the ESMAP CEIF (Clean Energy Investment Framework) Multi Donor Trust Fund

on grid extension, through the IDA financed Electricity Access Scale-up and SWAp Development project (EASSDP), to reach rural growth centers where grid connection is not economically viable. In addition, the support was expected to be instrumental in mainstreaming energy efficiency/DSM capacity within the electric and water utilities, minimizing Rwanda's costly dependence on thermal generation based on imported fuels.

9. The main rationale for GEF support was to complement existing and on-going investment in the RE sector, in a synergistic manner, by giving a special emphasis to technical assistance (TA), which would contribute to the sustainability of the sector. The GEF support aimed to bring together components that had been sparingly addressed in national programs and other donor-funded programs, to help create a transparent base for the private sector by establishing a regulatory framework that would provide clear guidelines for investors as well as additional incentives involving temporary tax refunds/subsidies.

10. Other ongoing initiatives that would complement/benefit the project included the following:

- a. The Nordic Development Fund (€4.0 million) This is parallel financing for the SEDP for the development of a commercial Solar Water Heater program.
- b. Support for Energy Small and Medium Enterprises (ESME) trust fund (US\$3.50 million) - This parallel financing for the SEDP supports the scaling up of activities under SEDP, by in particular: (i) providing grants to help to buy down the capital cost of private sector led micro hydro projects, to enable the leveraging of funds from banks and investors; and (ii) providing matching grants to entrepreneurs for low cost modern offgrid lighting products.
- c. EnDev/GIZ PSP Hydro Program (€3.30 million) This is a Dutch-German partnership with two components focusing on micro hydropower and biomass development. The micro hydropower component is aimed at creating new access to energy in rural areas by providing technical and business development assistance as well as co-financing for the development of micro hydro power projects. The program is designed to support the participation of private sector companies in the development and management of micro hydro sites (50kW-2MW).
- d. GoR/Netherlands funded National Domestic Biomass program which supports setting up of institutional biogas digesters and improved cook stoves for households and institutions.
- e. Belgium Technical Cooperation (€12.0 million) supports renewable energy development with financing for: (i) the construction of several micro hydro-sites totaling approximately 3.2MW and associated distribution networks; and (ii) the installation of solar photovoltaic systems to 50 remote rural health centers to improve service delivery.
- f. European Union Energy Facility (€4.12 million) provides solar photovoltaic systems to 300 schools.

g. Electricity Access Roll-Out Program (US\$380 million) - is a multi-donor program (World Bank, Government of Netherlands, BTC, African Development Bank, BADEA, OFID, AFD, JICA and Saudi Fund) aimed at increasing connections to the national electricity grid. The program includes technical assistance and investments for grid reinforcement and extensions; energy efficiency; and household connections to the national electricity grid.

1.2. Original Global Environment Objectives (GEO) and Key Indicators (*as approved*)

11. Economic transformation to create employment and generate exports was one of the three flagship programs called for in the GoR's **Economic Development and Poverty Reduction Strategy (EDPRS 2008-2012)**. Within this flagship program, a key priority was to expand electricity access rapidly while also improving the quality and lowering the cost of economic infrastructure – especially transport, power, and communications. The project was to contribute to achieving the GoR's priorities by: (i) providing incentives for private sector investment in renewable domestic power resources, such as solar and hydro, for expanding access beyond the grid; (ii) increasing the efficiency of biomass usage for household energy uses; and (iii) building capacity in the area of utility and institutional DSM.

12. The overall goal of the project was to strengthen and consolidate the Rwandan RE market. The GEO were to: (i) improve the policy and institutional framework of the renewable energy and energy efficiency sub-sectors; and (ii) increase private sector participation in the renewable energy sector.

13. The original *GEO indicators* were: (i) Renewable Energy and Energy Efficiency strategy study adopted by the Ministry of Infrastructure (MININFRA); (ii) Micro-Hydro Feed-in and Bulk-purchase tariffs agreed with RECO and approved by RURA; (iii) Solar PV dealers with field presence in at least one province outside Kigali offering sales and maintenance services; (iv) Increase in number of staff employed in RE firms; and (v) Avoided CO_2 emissions.

1.3. Revised GEO (as approved by original approving authority) and Key Indicators, and reasons/justification

14. None

1.4. Main Beneficiaries

15. The main beneficiaries of the project were: (i) The general populace of Rwanda who benefitted from enhanced energy policies and increased private investments in the renewable energy sector and biomass use efficiency; and (ii) Enterprises and

entrepreneurs of the RE sector benefitted from the new laws and regulations, which made the Rwanda RE sector business friendly and more attractive.

1.5. Original Components (*as approved*)

16. <u>Component A: Strengthening of Renewable Energy policy, strategy and</u> <u>management (US\$3.5 million (GEF US\$1.7 million, AFREA US\$1.8 million))</u>. The objective of this component was to support the Ministry of Infrastructure (MININFRA) to streamline and coordinate activities related to RE project design and implementation including increased private sector participation in the process. This was to be achieved by having the necessary operational guidelines. Activities under this component included: (i) preparing the renewable energy policy and strategy; (ii) setting up the Lake Kivu Monitoring Unit; (iii) conducting an Energy Entrepreneurship incubation program for RE SMEs; and (iv) providing renewable energy advisory services and technical support.

17. <u>Component B: Efficient utilization of biomass resources (US\$1.4 million (GEF</u> <u>US\$0.9 million, AFREA US\$0.5 million)</u>). The objective of this component was to increase efficiency in the use of biomass in order to reduce the unsustainable use of firewood and charcoal. It included activities focusing on increasing the use of improved cook stoves and charcoaling efficiency.

18. <u>Component C: Sustainable development of micro hydro resources (US\$1.2</u> <u>million (GEF US\$0.9 million, AFREA US\$0.3 million))</u>. The objective of this component was to enable private sector investment in micro-hydro power plants, by addressing the following issues among others: (i) lack of access to credit from local banking institutions; and (ii) lack of capacity to prepare detailed feasibility studies, including clarity of tender procedures or other principles for identifying and selecting investors. Proposed activities included: (i) private-sector led micro-hydro expansion; (ii) technical assistance to ensure long-term sustainable operation of the existing micro-hydro plants commissioned by the GoR; and (iii) establishing a micro-hydro helpdesk.

19. Component D: Solar Energy (US\$1.55 million (GEF-US\$0.35, AFREA-US\$1.20)). In this component, activities were aimed at increasing private sector capacity in order to develop the market for solar systems in Rwanda, by: (i) developing national installation and user guidelines for institutional PV applications; (ii) establishing conducive frameworks and build capacity of local private firms to allow them to participate in international tenders for the Rwandan market; and (iii) supporting the development of a commercial Solar Home System (SHS) market for rural areas.

20. <u>Component E: Energy efficiency (EE) strategy development (US\$0.65 million (GEF))</u>. The activities of this subcomponent were aimed at reducing technical losses in the electricity grid network and EE in major electricity users; and included three main

activities: (i) grid audit of the Energy Water and Sanitation Authority (EWSA) grid network; (ii) EE audit of street lighting, water pumping facilities and public buildings; and (iii) preparation of the EE policy that included actions to reduce energy use and increase efficiency for the various electricity consumer categories.

1.6. Revised Components

21. There were no significant changes in the components. An additional parallel financing grant of US\$3.5million, from the Energy Small and Medium Enterprises Trust Fund, was provided to increase private sector participation in the Renewable Energy Sector, specifically for micro-hydropower projects and low cost solar lighting products,

1.7. Other significant changes

22. The official project closing date as set forth in the Project Appraisal Document (PAD) is January 31, 2014. However, the closing date on the initial AFREA Grant Agreement was December 2010 because of the Bank's policy that the Grant Agreement cannot be in force beyond the period of the Parent Trust Fund. As AFREA, the parent trust fund, was extended and funds replenished, the closing date of the AFREA Grant was extended as follows:

- 1st extension closing date: from 31 December 2010 for 21 months to 30 September 2012.
- 2nd extension closing date: from 30 September 2012 for 2 months to 30 November 2012.
- 3rd extension closing date: from 30 November 2012 for 14 months to 31 January 2014.

23. It should be noted that, even with these extensions, project implementation never went beyond the official project closing date at approval of January 31, 2014.

2. Key Factors Affecting Implementation and Outcomes

2.1. Project Preparation, Design and Quality at Entry

24. This project was prepared as a 4-year Specific Investment Loan (SIL) financed by GEF and AFREA. Taking into consideration lessons from previous energy projects in Rwanda, two basic principles guided project preparation: ensuring the readiness of stakeholders for the project as well as simplicity of design and implementation. However, due to the different processing timelines between the AFREA TF and the GEF, the implementation of activities did not begin simultaneously. Additionally, the AFREA TF's closing date had to be extended several times, due to administrative reasons, as highlighted in paragraph 22 above.

25. The project was designed to help the Government in mainstreaming renewable energy development within the national Energy-SWAp, and complemented the grid extension efforts financed by the Electricity Access Scale-up and SWAp Development project (EASSDP) and other initiatives as highlighted in paragraph 10. The project emphasized technical assistance (TA) that would contribute to the long-term sustainability of the RE sector with a focus on accelerating the integration of local private sector into the planning and implementation of renewable energy projects.

26. Project design incorporated best practices of similar projects in Rwanda and internationally, such as GEF supported projects in Uganda and Sri Lanka, the Global Village Energy Partnership (GVEP), and lessons gathered from the RE Toolkit (www.worldbank.org/retoolkit). Several of the project components were designed taking into account regional experience, most notably: (i) PV Solar experience in Kenya and Tanzania, which highlighted the important role of the private sector in driving development, and the need to: (a) increase focus on the policy setting and dialogue with stakeholders, and (b) use flexible market driven approaches to work with the private sector; and (ii) Biomass experience in Tanzania, where there had been limited impact in terms of access to improved cook stoves because of the top-down approach. Incorporating these key lessons and taking into account the Rwanda country context and priorities have contributed greatly to attaining satisfactory outcomes.

27. Project preparation benefited from ongoing projects and leveraged similar activities by other donors, in particular (i) the USAID-financed study to design a program for the promotion of efficient cook stoves; (ii) the Belgian Cooperation's work on health facility service delivery; (iii) the GTZ-Micro Hydro project and the work on the National biomass strategy (BEST, 2008); and a number of upstream studies financed from the UERP. This approach has enhanced the achievement of the PDO especially increasing private sector participation in micro-hydro development and increasing the uptake of improved cook-stoves.

28. The commitment of Government, donors and other stakeholders was ensured as this project supported the joint Government and Donor SWAp, monitored by the Sector Working group as per a signed MoU between the main stakeholders. The project was complementary to the grid extension investments funded within the NEAP and helped streamline and harmonize many dispersed renewable energy activities, thus further leveraging the government's available funding for RE. Moreover, the GoR agreed to provide counterpart funding and other donors committed co-financing for investment activities related to the project.

29. The quality at entry of the project was rated good by the Quality at Entry Review meeting, and two issues in particular merit highlighting: (i) the mix of funding and associated governing arrangements created a mismatch with the closing dates of the grants requiring three closing date extensions, this affected the procurement and execution of some of the activities, though ultimately this was well-managed and the

original project closing date was maintained; and (ii) the project design included many components which could have made implementation complex, however, the design provisioned enough resources and tailored the arrangements to manage each component adequately. A degree of complexity could not have been avoided as the design responded genuinely to the need of the GoR to develop a comprehensive RE and EE regulatory framework and enable private sector participation in several sub sectors (solar, micro hydro, biomass and energy efficiency) which were in a very early stage of development.

Assessment of Risks

30. Several risk factors were assessed and mitigation measures considered. The relevance of risks identified at appraisal and effectiveness of mitigation measures is summarized in the table below.

Dials at Annuaical	Duanaged Mitigation Maggunag	Aggagement of the offectiveness of the
Kisk at Appraisai	Proposed Willgauon Wieasures	Assessment of the effectiveness of the
		Mitigation measures
Slow	Support provided in the SEDP would	The risk was substantial at the initial
implementation due	be complementary to already ongoing	phase of project implementation with
to weak sector	activities where implementation	delays attributed to lack of experience
institutions and large	capacity had been built in the Ministry	with Bank procurement procedures,
investment program	and RECO. To further accelerate	which led to a delay in preparing Terms
within the SWAp	project implementation, a resident	of Reference (ToR) and Request for
	advisor was hired for MinInfra/EWSA	Proposals (RfP). Overall, the risk was not
	to help supervise the TA components	adequately addressed at project
	and ensure progress towards the	preparation and impacted the initial
	development objectives.	project implementation period by about
		12 months due to the slow start but this
		delay was compensated during
		implementation and, at the end, the
		project ended within the original
		timeframe.
Overlap with	The RE portfolio was largely focused	During the project implementation there
existing RE portfolio	on investments and installations in the	was strong coordination with other
and ongoing donor	field and the project was considered	stakeholders such as Deutsche
funded activities	complementary to these activities. The	Gesellschaft für Internationale
	SWAp secretariat in MinInfra and	Zusammenarbeit (GIZ), Belgian
	EWSA was established to add further	Development Agency (BTC) and the
	oversight to ensure that potential over-	private sector, which contributed to the
	laps were identified early	risk impacting neither the project
		objectives nor implementation.
Slow growth of the	SEDP was designed to support the	By project close, EWSA/MININFRA had
RE market due to a	growth of local RE SMEs by: (i) the	yet to create the "micro-hydro help desk"
weak private sector	cooperation with the Kigali Institute	to provide technical and operational
	of Science and Technology (KIST)	advice to operators. Overall this risk was
	and Technology & Business Incubator	not adequately addressed, as other
	Facility (TBIF) to support RE	challenges emerged during
	enterprises develop bankable business	implementation, such as the need to
	plans and quality product offerings;	address upfront project preparatory risks

Table 1: Relevance of risks identified at appraisal and effectiveness of mitigation
measures

(ii) direct support to Solar DV SME's	(faggibility studies and evoilability of the
(ii) direct support to solar r v SME s	(leasibility studies and availability of the
to grow their maintenance network	resource data such as hydrology records)
outside the capital; and (iii) a Micro-	to have the projects ready for the market.
Hydro help desk in RECO, where	This resulted in developers having to wait
SME's could draw on the utilities'	for about a year to have basic data to use
resources to address operational	in the site feasibility studies. This was a
problems etc.	significant risk and has greatly reduced
	the number of transactions reaching
	financial closure by project close.

2.2. Implementation

31. **Overall Project Implementation.** The project was complementary to the grid extension investments, other initiatives by Government and other Donors, and was aimed at assisting in streamlining and harmonizing the many other dispersed renewable energy activities to further leverage the government's available funding for RE. Key factors that affected project implementation are summarized below.

32. *Initial Delays related to lack of capacity at the PIU*. There were implementation delays during the initial stages of the project implementation, mainly due to the delay in recruiting the project coordinator and the staff not being familiar with Bank procurement guidelines. This situation led to delays in preparing the assignment activities ToRs and in the recruitment of consultants to undertake various activities. Key staff to supervise the project activities was eventually recruited by end June 2011.

33. *Findings of the Mid-term Review (MTR)*. The MTR conducted in June 2012 concluded that most of the activities had substantially progressed and were expected to be completed by end 2013, within the project closing date of January 31, 2014. The MTR also noted the following:

- (i) Due to the late start of some of the components supported by the Africa Renewable Energy and Access program (AFREA) Trust Fund, some of the activities financed by the Trust Fund (TF), would not be completed by its closing date of September 30, 2012 and recommended extension of the AFREA TF closing date to coincide with the GEF supported activities.
- (ii) Project implementation was impacted by the change in the institutional set-up. Initially, the project was expected to be anchored in a Ministry of Energy department, which was later transferred to the newly created Energy Water and Sanitation Authority (EWSA), starting July 2011. The Bank missions noted that the EWSA human resources to support the biomass, solar and micro hydro subsectors were overstretched and that activities were not being mainstreamed in the respective EWSA department/sections, which led to delays in implementation in addition to posing a sustainability risk after project closure. In addition, as the operationalizing of the EWSA Law (enacted in January 2011) took root, effective July 2011, the change in the MININFRA/EWSA structure led to overlaps between policy setting at the MININFRA and the implementation function at the EWSA.

This resulted in a weakened coordinated approach to various activities, which posed challenges to the integration and promotion of the participation of the private sector in the RE activities as well as to the adoption of needed policies to support RE development.

(iii) In view of the above sustainability risk, the project Implementation Status and Results Report (ISR) DO rating was downgraded to moderately satisfactory in 2011, with an action plan to improve performance.

2.3. Monitoring and Evaluation (M&E) Design, Implementation and Utilization

34. The performance indicators covered both institutional development related to the management of the sector, as well as project outcomes and outputs, mainly studies and plans, in light of the TA nature of the project. The results framework could have been more robust, if more clear linkages had been made between the GEO, outcome indicators and the components/outputs. Further, as required by the GEF, the results framework included a specific indicator on avoidance of CO_2 emissions, even though this indicator could not be used directly to measure the attainment of the GEO.

35. The data identified in the M&E plan was regularly collected by the Project Implementation Unit (PIU) and was used to monitor progress. The evaluations informed decision making, for example, after approval of the Renewable Energy Feed-in-Tariff (REFIT) in 2012, the continuous monitoring of the number of micro hydro projects in the pipeline to reach financial close led to the revision of REFIT in 2014.

36. The GEO indicator, avoided CO_2 emissions, was not monitored during implementation, as it was difficult to attribute a direct reduction of CO_2 emissions to specific activities, during the project timeframe. During the ICR elaboration, it was possible to assess the CO_2 emissions reduction only in relation to *Component 2: Efficient utilization of biomass resources*, based on the impact survey of the awareness raising campaign.

2.4. Safeguard and Fiduciary Compliance

<u>Safeguards</u>

37. Although the project did not include investment components, guidance provided under this technical assistance project could have resulted in certain downstream risks (for example, promoting micro-hydro project with potential environmental and social implications, or some adverse environmental implications due to the "industrialization" of efficient stoves and kilns). In light of these potential downstream risks, the project was

rated Category B under the World Bank Policy on Environmental Assessment (OP4.01), requiring a partial Environmental Assessment (EA).

38. The Environmental and Social Management Framework (ESMF) and Resettlement Policy Framework (RPF) which had already been adopted for the UERP was updated to provide guidelines on how to avoid, manage or mitigate potential adverse impacts under this project. In addition, an updated Environmental Management Framework (EMF) was prepared for the micro-hydro sub-projects. By project closing, none of the activities supported by the project triggered any undertakings under the EMF provisions related to preparation of Resettlement Action Plans (RAPs) in the event of land or any other asset acquisition.

<u>Procurement</u>

39. Overall procurement processes were rated *satisfactory*. Procurement training provided to the PIU procurement staff during the initial years of implementation and continued hand holding by the Bank team during the project implementation period enhanced the procurement staff's capacity. As a result, despite a slow start in preparation of procurement documents (ToR, EoI, RfP), the PIU performed it procurement functions well.

Financial Management (FM)

40. From a fiduciary perspective, FM arrangements under the project were implemented in an adequate manner and maintained throughout the life of the project. The audits of the implementing agency and project financial statements were submitted on a regular basis. Overall, financial management systems were considered *moderately satisfactory*.

2.5. Post-completion Operation/Next Phase

41. The project has been instrumental in strengthening and consolidating the RE market in Rwanda by supporting several activities related to the energy policy, strategy and management. As a result of the project supported activities and policy actions adopted by GoR, a number of private firms are participating in the Rwanda renewable energy market, and, several follow-on and new operations/activities have been developed as highlighted in the following paragraphs.

42. *Component A. Strengthening of Renewable Energy Policy and Strategy:* The activity proposed eighteen framework strategy programs in order to ensure a long-term and sustainable contribution by RE resources to Rwanda's energy balance. The findings and recommendations were incorporated in the Energy Sector Strategy.

43. *Component B. Biomass:* The sustainable and efficient use of biomass resources remains a priority of the GoR in the medium-term. The latest Economic Development and Poverty Reduction Strategy (*EDPRS* II) for the period 2013/18 notes that over eighty-five percent Rwanda's primary cooking energy source comes from biomass (illustrating the need for sustainable, safe and efficient usage) and includes interventions related to: (i) ensuring a sustainable supply of wood; and (ii) promotion of the use of improved energy efficient cooking stoves among others. EWSA and MININFRA will engage other stakeholders, such as the Private Sector Foundation and local government authorities to support sustainable use of fuel wood, increased uptake of charcoaling techniques and an enhanced charcoal value supply chain by linking charcoal producers to transporters and wholesalers.

44. *Component C. Sustainable Development of Micro Hydro Resources:* Following on the assessments conducted during the project, EWSA and MININFRA is undertaking an evaluation of about 69 potential micro hydro sites for possible development in the next two years. Contracts for the development of the various sites were at different stages by project close. In addition, and with the support of the IFC, RURA is preparing light regulations, including standardized Power Purchase Agreements (PPAs), that are expected to provide a conducive regulatory environment for the development and operations of micro hydropower plants. The Russian Trust Fund for Energy Small and Medium Enterprise development in Sub-Saharan Africa (ESME TF) will further support the Incubation Program (Component A4) by funding private developers of microhydropower projects and building up the capacity of the local stakeholders in the picohydro sector. ESME TF will support about 5 private sector companies to develop sites whose combined generation capacity is estimated at 4MW.

45. *Component D. Solar Energy:* The ongoing Bank-funded *Increased Access to Electricity Project (P111567)* will use the standards developed during the project to support the installation of Solar PV systems in selected health institutions. In the case of Solar Water Heater (SWH), additional parallel financing from the Nordic Development Fund (NDF) equivalent to Euro 4.0 million would support the installation of up to 11,500 SWH systems, over and above the current 623 systems, by end 2015.

46. *Component E. Energy efficiency Strategy Development:* As a follow up to the assessment of the EWSA grid technical audit conducted during the project, EWSA set up a committee to review the recommendations and prepare an investment plan to reduce losses in the system, with various actions to be undertaken in the short-medium and long-term. In addition, EWSA is already implementing several energy efficiency initiatives

related to the rational and efficient use of grid electricity, such as public awareness on energy saving in homes and workplaces through good housekeeping methods.

3. Assessment of Outcomes

3.1. Relevance of Objectives, Design and Implementation Rating: **High**

47. The PDOs remain fully relevant to Rwanda's development priorities and are consistent with the EDPRS as well as the Bank Country Partnership Strategy (CPS). Current GoR's sector objectives focus on: reducing the cost of electricity and introducing cost reflective tariffs through the use of cheaper energy sources, reducing system losses, and increasing energy efficiency; energy diversification; and strengthening the governance framework and the institutional capacity to facilitate private sector participation in the sector. To help achieve these broad objectives, a new sector policy and several laws have been prepared. These regulatory instruments define the emerging sector structure and institutional framework, including GoR's policy to increase private sector investments and off-grid electricity distribution. The objectives were clearly linked to the results framework outcomes and indicators (some of them had a direct impact on the EDPRS) as the policy support actions were aligned with the different components of the project.

48. The project *design* followed a participatory process. The choice of technology options (solar, biomass, and hydro) and the work at the policy level remain priority areas for the country as the current strategy is to tap into these renewable energy sources for further development of the electricity sector in Rwanda.

49. The *implementation* of the SEDP has played a supportive role in the development of RE and EE markets in Rwanda. The project provided timely support to the ongoing development of the sector, particularly activities related to legal, policy, and regulatory frameworks as well as capacity building. Thus, the project addressed critical issues related to RE and EE development as well as provided assistance to put in place a policy framework to support future investment and the start-up of RE entrepreneurs. The project also leveraged GoR's and other donors' funding to attract private investment.

3.2. Achievement of Global Environmental Objectives Rating: Satisfactory

50. The achievement of the Global Environmental Objectives is rated **Satisfactory**. The GEOs: improving the policy and institutional framework of the renewable energy (RE) and energy efficiency subsectors and increasing private sector participation in the

renewable energy sectors are linked. Progress in achieving the first objective lays the foundation for achieving the second objective, i.e. improving the policy and institutional framework of the RE subsector will encourage the participation of the private sector in that subsector. As such, some of the project outputs indirectly support both project objectives.

51. The project efficiently supported activities related to strengthening the legal and regulatory frameworks for both RE and EE by, among other things, supporting the development of guidelines and recommendations for a RE and EE strategy to govern the sector for the next 10 years, and the adoption of the renewable energy feed-in tariff. These actions created an enabling environment for private sector participation. Though the project did not directly support physical investments, it helped put in place the needed institutional and regulatory framework and capacity within the government. The project reinforced the preparation of pre-investment analysis, such as the EWSA grid audits, all of which provide the requisite environment for sector development and increased private sector participation. Four (4) of the five (5) GEO indicators were fully or partially achieved.

52. The project, complemented by other initiatives highlighted in paragraph 10, supported investment promotion and capacity building for the private sector of both RE and EE in the country. As a result, a number of private firms are participating in the Rwanda RE market, for example: (i) several micro-hydro sites are being developed (4.5MW under construction, whereas additional sites totaling about 5MW are at various stages of feasibility and financial close); (ii) ten (10) local firms had been registered as eligible participating firms for the Solar Rwanda program and about 450 SWH systems had been installed, with an estimated capacity of 1,200m², translating into an annual energy saving of about 400MWh. The results show that the project contributed significantly to strengthening and consolidating the RE and EE market in Rwanda. The specific achievements can be disaggregated as follows (according to the GEO indicators):

GEO Indicator 1: RE and EE strategy study adopted by MININFRA

53. The project helped MININFRA and EWSA to streamline and coordinate activities related to the RE and EE strategy by: (i) supporting the development of operational guidelines for project design and implementation; and (ii) integrating the private sector in the process. The project outputs included preparation of a RE policy and strategy which covered solar, hydro, geothermal and wind technologies. Based on the findings and recommendations of the study, and timely technical assistance, MININFRA has prepared a new sector policy which seeks to integrate renewable energy and energy efficiency activities in sector development.

GEO Indicator 2: Micro-Hydro Feed-in and Bulk-purchase tariffs agreed with RECO and approved by RURA

54. The project provided transparent market regulation and guidelines to facilitate small distributed power production and distribution services, while building local private sector capacity that can plan, design, implement and operate the small power plants. For the specific case of micro-hydro power generation, GoR has put in place various incentives to attract private sector, among which include, Renewable Energy Feed-in tariff and light handed regulations including standardized Power Purchase Agreements (PPAs) that will ease the regulatory requirements for the development and operations of micro hydropower plants.

GEO Indicator 3: Solar PV Dealers with field presence in at least one province outside Kigali offering sales and maintenance services

55. The project developed guidelines for installation and use of institutional PV systems and promoted the establishment of solar PV suppliers and dealers networks outside the capital city of Kigali. The PV Solar Market assessment conducted during the project indicated that there were eleven distribution outlets present in the major towns outside Kigali. In addition to the market analysis, other outputs of the TA include: (i) capacity building/technical assistance to private PV companies/technicians and technical schools; (ii) creation of a Solar Association; and (iii) promotion of solar equipment and improved organization of the distribution sector. Building on the TA outputs, the ESME TF is supporting scale up of (iii) above by: (i) building linkages between companies selling high quality equipment, trained and qualified technicians, and consumer groups and possible other stakeholders, and (ii) raising the awareness of the public and media about the quality of solar systems to complement the private sector's activities.

GEO Indicator 4: Increase in number of staff employed in RE firms

56. The project promoted the concept of business incubation program in the RE sector by financing a practical oriented short course on "Entrepreneurs Skill & Renewable Energy Development" to local energy entrepreneurs facilitated by Kigali Institute of Science and Technology (KIST). Results of the surveys conducted in December 2013 indicate that about forty-five enterprises are now involved in RE Business (Solar, Pico and Micro hydro) and sixty-nine are involved in the biomass efficient utilization related businesses (improved cook stoves, biogas and efficient charcoaling). The survey results also indicated that the above enterprises employ about 1,460 personnel, a number well above the project target of 75.

57. The increased private sector participation in the renewable energy business was complemented by efforts, financed by other donors, to reach rural growth centers, among which are: (i) GIZ's Private Sector Participation in Micro-hydro Power Supply for Rural

Development project (PSP Hydro) which is aimed at creating new access to energy in rural areas by providing technical and business development assistance as well as cofinancing the development of micro hydro power projects promoted by private developers, and (ii) GIZ/GoR National Domestic Biomass program which supports setting up of institutional biogas digesters and improved cook stoves for households and institutions including training of trainers.

GEO Indicator 5: Avoided CO₂ emissions

58. Various project activities were implemented to promote RE and EE regulatory actions and investments, which resulted in an avoidance of CO_2 emissions when compared with the more pollutant energy sources on the ground at the time.. Even though the impacts of some of the components were difficult to unequivocally quantify in terms of avoided CO_2 emissions, all of them had a positive impact with respect to this indicator. Avoided CO_2 emissions by project closing are estimated at 0.560 mtons CO_2 equivalent (attributed to the use of SWHs instead of grid electricity and efficiency from Improved Cook Stoves (ICSs)). An additional 8.20mtons CO_2 equivalent will be avoided when the 4.5MW of micro hydro power plants are commissioned that were under construction by project close.

3.3. Efficiency Rating: **High**

59. The efficiency assessment of the project is rated as **High** when assessed either qualitatively or quantitatively.

60. Qualitatively, the project outcome is deemed efficient based on the following outcomes: (i) the set targets at project design were achieved (Four (4) of the five (5) of the GEO indicators were fully or partially achieved) within the project time frame (time efficiency) and within the allocated budget without any cost overruns; and (ii) the project facilitated the establishment of a conducive policy and regulatory environment for increased investment and uptake of renewable energy technologies. The project has facilitated approximately 9.5MW from several micro-hydro sites, which are at different stages; an annual energy saving of about 400MWh from the installed SWHs, saving in biomass of about 30-39% by using ICSs, and 30% of wood savings by using improved carbonization techniques.

61. The project did not lend itself to conventional economic and financial analyses as it was not a typical investment project, but mainly provided TA. The benefits are indirect and mainly as a result of guaranteeing the operations of already installed capacity. The PAD (Annex 9) prepared "with and without" GEF Project case to show and demonstrate how barriers to renewable energy use would be removed using GEF funds. By fully

integrating renewable energy into all project activities, it was expected that the project would result in a considerable expansion of the solar, micro-hydro, and improved stoves markets. In total, use of renewable energy sources was estimated to reduce CO_2 emissions by an estimated 0.63 million tons over the lifetime of the equipment installed whereas overall the project would reduce CO_2 emissions by an estimated 0.646 million tons. Using the incremental costs analysis between the 'with scenario' and the 'without scenario', the efficiency of the project has been quantitatively assessed depending on the characteristics and outcomes of each component (details in Annex 3). A summary is highlighted in the table below.

	<u> </u>	
Component		
Component 1: Strengthening of	N/A. This component provided support to develop RE in the	
RE policy strategy and	electricity sector of the country. The impact of policy and strategy is	
management	viewed as indirect and not easily measured but it is a necessary	
	platform for the success of the other components. The environmental	
	benefits are also indirect since this component focuses on soft	
	technical aspects rather than direct investments. By providing O&M	
	guidelines, standards and quality regulations, this component	
	enabled private sector entry to the RE market and facilitated the	
	presence of competent local firms	
Component 2: Efficient	IRR Fuel wood Cook-stoves: 900 %	
utilization of biomass resources	IRR Charcoal Cook-stoves: 120 %	
	IRR Awareness Raising campaign: 25.9 %	
	16,084 tons of CO2 emissions annual savings	
Component 3: Sustainable	60% of economic savings for consuming small hydropower	
development of micro hydro	generation instead of stand-alone diesel generators.	
resources		
Component 4: Solar Energy	IRR Solar Water Heaters (SWH): 20%	
	0.502 million tons of CO_2 of annual avoided emissions	
Component 5: Energy	Recommendations are yet to be implemented so no assessment of	
efficiency	efficiency could be made	

 Table 2: Efficiency indicators per component

3.4. Justification of Overall Outcome Rating Rating: Satisfactory

62. The project is rated overall as **Satisfactory**, based on the above ratings of relevance, achievement of GEOs, and efficiency.

3.5. Overarching Themes, Other Outcomes and Impacts (a) Poverty Impacts, Gender Aspects, and Social Development³

³ The ICR assessment has only considered qualitative assessment based on evidence from other similar operations.

63. Because of the relationship between power supply, economic development and poverty alleviation, as stated in the EDPRS and the Country Partnership Strategy (CPS), the project intended to contribute to the reduction of poverty by leveraging limited available public resources for the development of the RE sector through increasing private sector participation. In addition, by supporting RE development and increased EE, the project advanced the country's longer term green growth strategy.

64. The biomass component had significant social and poverty-related impacts by improving living conditions for users through the increased use of improved cook stoves as well as by sustaining local jobs linked to the manufacturing of this technology. Visible benefits include a high reduction of smoke in kitchens as well as savings in fuel wood and charcoal purchasing. This is an important step in the government's poverty reduction strategy, particularly in rural areas, where it is most visible.

65. The micro hydro resources component focused on the promotion of private sector participation in the power sector of rural areas, which, at the implementation stage, could have a huge poverty impact and socio-economic development in areas where there is no access to electricity.

66. The solar energy component, particularly the development of commercial SHS market for rural areas and the SWH program, also focused on job creation and economic development in rural areas.

67. The project indirectly supported vulnerable groups that include women and children as most of the rural households rely on biomass energy to meet their cooking and thermal needs.

(b) Institutional Change/Strengthening

68. The project has provided several useful outputs for strengthening the Rwandan RE and EE sector, both for the public sector (ministry, regulator and utility) and for the private sector (project developers, commercial lenders, and service providers), including several strategies, codes and regulatory proposals.

(c) Other Unintended Outcomes and Impacts (*positive or negative, if any*)

69. The project assessments and policy actions initiated thereby are now being used as to guide the development of the Sustainable Energy for All (SE4ALL) Rwanda program.

3.6. Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops *Not Applicable.*

4. Assessment of Risk to Development Outcome Rating: Moderate

70. The overall Risk to Development Outcome is rated as **Moderate** taking into consideration the strong ownership of the project and financial, social and institutional aspects. The GoR's commitment to a private sector presence in the country's energy sector is strong. GoR has recently initiated several actions to promote increased private sector participation which include unbundling and corporatization of the utility (EWSA), into separate electricity and water companies to ensure improved financial sustainability of sector and reduced perceived risk by the private sector. Other ongoing/post project undertakings also assure the project sustainability, among which are (i) regular review of the feed-in tariff, (ii) GoR commitment to scale up use of ICSs and alternative energy sources such as biogas digesters, and (iii) increased private sector participation in micro hydropower development, low cost solar lighting products and other renewable energy business, as detailed in paragraphs 42 to 46.

5. Assessment of Bank and Borrower Performance

5.1. Bank

(a) Bank Performance in Ensuring Quality at Entry

Rating: Moderately Satisfactory

71. The development objectives were realistic, the design was appropriate to achieve these objectives, and the project had a high relevance for the government's rural energy strategy. In addition, the Bank provided adequate resources, in terms of staff weeks and budget, to ensure quality preparation and appraisal work and maintained a good working relationship with the Borrower.

72. However, there were also a few shortcomings in project preparation which were to impact later project implementation. While 'slow implementation due to weak sector institutions' was anticipated in the PAD as one of the critical risks, steps were not taken during project preparation, to strengthen institutional capacity, which led to a slow start of implementation. A more advanced stage of procurement activities during project preparation would have enabled start of activities once the project was declared effective.

Also, the economic and financial analysis at project appraisal was not comprehensive enough to provide a sound basis to assess the efficiency of the project activities.

73. Taking into consideration the above mentioned, the World Bank's quality at Entry is rated as **Moderately Satisfactory**.

(b) Quality of Supervision

Rating: Satisfactory

74. The project was thoroughly supervised by a stable Bank team, with multidisciplinary skills, and without significant changes in team composition throughout implementation. Supervision teams were supported by specialists to address specific issues which had been identified. At the project's early stage, the start-up of activities was considerably slower than planned. The Bank had intensive discussion with MININFRA to identify the causes: (i) limited capacity built within MININFRA to prepare the necessary terms of references for the studies; and (ii) unclear distribution of responsibilities between RECO (later on taken over to EWSA) and MININFRA with regard to procurement and general management of the project work stream. The quality and frequency of supervision missions have been of a high standard, due in part to the team being based in the country office. Issues which could affect project implementation were identified in a timely manner, documented, and brought to the attention of Numerous extensions of the AFREA Trust Fund closing date and management. additional parallel financing from ESME Trust Fund reflected the Bank's flexibility in responding to changing circumstances.

75. Procurement was regularly monitored, including post-reviews conducted as part of the supervision missions' activities. Financial Management supervision was satisfactory and the adequacy of financial management arrangements and implementation of recommendations of external audits were reviewed regularly. The project prepared a Resettlement Policy Framework (RPF) and ESMF and supervision included environmental and social due diligence, though none of the identified applicable probable policies were triggered during implementation. The quality and candor of supervision reports were good, including reporting on the outcome indicators.

76. Taking into consideration the abovementioned aspects, the Bank's quality of supervision is rated as **Satisfactory**.

(c) Justification of Rating for Overall Bank Performance

Rating: Satisfactory
77. The ICR rates the Bank's overall performance as **Satisfactory.** The Bank's proactivity during supervision buttressed the PIU's weak capacity, which overall led to project being completed on time and on budget.

5.2. Borrower

(a) Government Performance

Rating: Satisfactory

78. The high level of GoR's commitment to the project is seen in its policy to increase private sector investment in RE. Several laws and policies have been approved that together define the emerging sector structure and institutional framework, including the GoR's policy to increase private sector investment, primarily in generation and off-grid electricity distribution with a number of signed MoUs for investments. Other key initiatives included: (i) adoption of feed-in tariffs, and (ii) unbundling and corporatization of the utility (EWSA), into separate electricity and water companies to ensure improved financial sustainability of the sector.

(b) Implementing Agency or Agencies Performance

Rating: Moderately Satisfactory

79. The performance of the implementation agency is considered **Moderately Satisfactory,** especially during implementation of the project. There were delays at the outset in the recruitment of the project coordinator and a lack of clear responsibilities within MININFRA in coordinating the various components, which led to a slow start of the project implementation.

(c) Justification of Rating for Overall Borrower Performance

Rating: Satisfactory

80. The overall Borrower Performance is rated **Satisfactory** based on the GoR's strong and sustained commitment throughout implementation to expand RE supply by increasing private sector participation. Despite implementation weaknesses that led to delays in project implementation, government commitment to the development objectives has been sustained and has played an important role in initiating the development of the country's renewable energy potential.

6. Lessons Learned

81. Government leadership with a focus on results and impact is paramount in achieving expected impact from technical assistance. Financiers and project implementers should be aware that a strong and sustained government commitment is key in driving the development agenda, especially where policy actions and incentives are required. In the case of this project, Government followed up and acted on the several recommendations that were the outcomes of assessments under the project, such as the renewable energy tariff and light handed regulations including standardized PPAs. These regulations have greatly reduced the transactions cost for micro hydro developers by shortening the time required to negotiate PPAs and having forehand information about the price of the generated energy.

82. **Realism in project funding from multiple donors co-financing the project**. Task team leaders preparing projects with multiple sources of financing need to structure the project in such a manner that takes into account the different administrative procedures governing funding so as to optimize and leverage financing and minimize the risks of mismatches in the funding of project activities. As highlighted in the ICR, the AFREA funds could not be utilized prior to formal Board approval of the project and its effectiveness and the TF had to be extended several times to enable completion of activities. A lesson from this project was the need to have ensured that either the funds from AFREA were considered as parallel financing instead of co-financing, funding complementary components. The co-financing with GEF, posed a risk, that in the event the AFREA TF was not extended, the intended outcomes could not have been attained due to the partial completion of the activities or could have led project restructuring to cover the funding gap, whereas in the case of parallel financing the GEF operation could have continued, albeit the reduced targeted impact.

83. An Incubation Program is a useful approach to build up local capacity of private companies. Knowledge of specialized sectors, such as emerging RE technologies, sometimes hinders local entrepreneurs in venturing into such businesses because of a lack of local skilled labor. The approach of an entrepreneur incubator, helping to develop business plans and feasibility studies in addition to training local technicians and trainers at institutions, could be instrumental equipping small and medium start-up companies with the basic framework to understand the business, and take advantage of local skills. This is particularly important as small companies may not have adequate financial capacity to invest in training of their staff.

84. Using Public resources in awareness raising and promotion campaign is a key tool in promoting increased uptake of new products especially those offered by small and medium businesses. Use of Improved Cook Stoves (ICS) has a huge impact, but in most cases the end users may not be aware of such products. In addition, the ESMEs that would take lead in availing these products to households in rural areas do not have adequate finances to undertake the requisite awareness and marketing campaigns. Thus using public funding to facilitate the private sector led market development by supporting activities related to awareness could greatly enhance the uptake of technologies.

85. **Balancing the project complexity/number of activities with project impact**. Operations that target policy and institutional development need to be addressed holistically, as lack of one intervention could render the outputs of the support activities not attaining the intended outcome. In addition, lessons from this project also highlight the need for realism with regard to what the project and other complementary operations can directly influence. By undertaking specific actions, such as assessment of the biomass use, including training and the incubator program as well as awareness campaigns, all complemented each other to increase the uptake of ICS. On the other hand, the assessments, the incubator program, the complementary support from GIZ, having in place the feed-in tariff and light handed regulation though having contributed to initiating the micro-hydro market, have not reduced the feasibility study risk due to the lack of detailed information about the resource (historical hydrological data).

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

(a) Borrower/implementing agencies

None

(b) Cofinanciers

Not applicable

(c) Other partners and stakeholders

Not Applicable

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in US\$ Million equivalent)

Components	Appraisal Estimate (US\$ millions)	Actual/Latest Estimate (US\$ millions)	Percentage of Appraisal
Total Baseline Cost	8.30	8.22	99.0
Physical Contingencies	0.00		
Price Contingencies	0.00		
Total Project Costs			
Project Preparation Facility (PPF)	0.00		
Front-end fee IBRD	0.00		
Total Financing Required	8.30	8.22	99.0

(b) Financing

Source of Funds	Type of Cofinancing	Appraisal Estimate (US\$ millions)	Actual/Latest Estimate (US\$ millions)	Percentage of Appraisal
Borrower		0.00	0.00	0.00
AFREA		3.80	3.75	98.70
Global Environment Facility (GEF)		4.50	4.47	99.33

Annex 2. Outputs by Component

1. <u>Component A: Strengthening of Renewable Energy policy, strategy and</u> <u>management (US\$3.50 million. (GEF US\$1.7, AFREA-US\$1.80))</u>. The objective of this component was to support the Ministry of Infrastructure (MININFRA) to streamline and coordinate activities related to Renewable Energy (RE) project design and implementation including increased private sector participation in the process. This was to be achieved by having the necessary operational guidelines. Activities undertaken under this component included: (i) preparation of the RE policy and strategy; (ii) setting up of the Lake Kivu Monitoring Unit; and (iiii) incubation program for RE SMEs; and (iv) renewable energy advisory services and technical support.

- (i) A1: Policy and strategy development (MININFRA) The Project supported several just-intime support activities related to energy policy, strategy and management among which include: (i) due diligence of feasibility studies and project proposals; (ii) energy policy review; (iii) geothermal development preparatory activities; and (iv) preparation of the energy investor forum. The Advisory and Support has enabled the sector (MININFRA and the EWSA) to take informed decisions related to policy actions, project promotion and private sector engagement. This support is envisaged to continue as discussions and development of specific investments evolves further, especially in the sub-sectors of geothermal and micro hydro, in addition to continued general policy and targeted increased private investments in the sector.
- (ii) A2: Strategy study The objective of preparing the RE Policy and Strategy was to assist the Ministry of Infrastructure in developing a set of renewable energy strategies in order to ensure a long-term and sustainable contribution by renewable energy technologies to Rwanda's energy balance. The project supported Renewable Energy strategy studies which focused on solar, hydro, geothermal and wind technologies and a final report was submitted July, 2012. The RE strategy includes 18 framework strategy programs and investment plan recommendations and project investment needs in the next 5 years. The studies and recommendations thereof support the sub-component objective to pursue sustainably the development of RE resources.
- (iii) A3: Monitoring and Evaluation (M&E), support for project implementation The project supported the design and implementation of a comprehensive M&E framework Renewable Energy projects under implementation to facilitate monitoring of the development and project objectives. An M&E unit was set-up and closely collected data that was used to monitor progress as well inform decision making. Key indicators that were monitored during the project implementation include: (i) solar PV Dealers offering sales and maintenance services; (ii) RE firms and number of staff employed by these firms; and (iii) households use of improved stoves (both urban and rural). In addition, a number of baseline and follow-up surveys were undertaken among which are: (i) Urban and Rural Households Using Improved Cook Stoves Baseline survey (undertaken in 2010) and Impact Survey December 2013; (ii) Firms involved in RE business (January 2014); (iii)

Biomass use in Rural and Urban Areas (2012). The results of the findings were used to inform decision making such as: (i) the Biomass survey use indicated that a majority of households (92% of the surveyed households) use wood or its derivatives for cooking; and that biomass is still the most affordable source of thermal energy relative to the alternatives. Following the results of survey, a study of the Liquefied Petroleum Gas (LPG) market in Rwanda was launched to help inform the possible interventions to promote LPG increased use, as an alternative source of thermal fuel for cooking.

- (iv) In addition to the M&E, the project supported the setting up of the Lake Kivu Monitoring Unit whose objective was to have in place a unit responsible for for scientific and environmental monitoring of the Gas extraction activities on Lake Kivu, including measurements of the lake density gradients that would provide information and data to enable development of the methane resource. The project supported activities related to the setting up of the unit such as laboratory equipment, technical assistance, capacity building and funding to arrange stakeholder workshops. The Unit has been set-up and to date has mainly focused on the near-plant monitoring to check the impact of the reinjected water, established a baseline around future extracting plants in addition to developing a website (www.lakekivu.org) that is used to share important information on the lake. The unit has now been integrated into the recently established Lake Kivu Basin Authority, which will help assure the sustainability and scale up of the unit set up under the project.
- (v) A4: Incubation program for RE SMEs The objective of conducting an incubation program was to assist entrepreneurs involved in the development of micro hydro, biomass, photovoltaic, and energy efficiency activities to prepare business plans, maintenance, and operational procedures.

2. <u>Component B: Efficient utilization of biomass resources (US\$1.40 million. (GEF-US\$0.90, AFREA-US\$0.50)</u>). The objective of this component was to increase efficiency in the use of biomass in order to reduce the unsustainable use of firewood and charcoal. It included activities focusing on increased use of improved cook stoves and charcoaling efficiency. The activities supported by the project include the following: (i) Biomass utilization survey in urban and rural areas; (ii) Enhancing charcoaling efficiency in key districts in three Province (Southern, Western and Northern Provinces); (iii) Promotion Campaign for Improved Cook Stoves; (iii) Study on LPG Market in Rwanda; (iv) The outcome/impact of the Improved Cook Stove campaigns in Rwanda; and (v) Improved Cook Stoves Market Development.</u>

(i) *B1: Improved Cook stoves:* This subcomponent supported activities aimed at promoting the use of improved stoves and development of a sustainable market for efficient stove designs that reduce charcoal use. The implemented activities include the following:

- *Biomass utilization survey urban / rural area:* the survey objective was to establish baseline information on the use of different sources of fuel, in particular fuel for cooking, plus the type of stoves used by the households. The survey was completed March 2012 and highlighted the following: (i) 92% of the surveyed households use wood or its derivatives for cooking; and (ii) biomass is still the most affordable source of thermal energy relative to the alternatives. Following the results of the biomass utilization survey, a study of the LPG market in Rwanda was launched to help guide possible interventions to promote LPG increased use, as an alternative source of thermal fuel.
- *Promotion Campaigns for Improved Cook Stoves (ICS):* The promotion campaigns were completed in July, 2013. The key findings of the survey conducted December 2013 show that ICS use in Urban and Rural areas was about 82 and 48 percent respectively. The survey covered 1,107 households (905-Urban and 202 rural). The activities undertaken under the project supplemented earlier GoR initiatives that included testing and selection of suitable improved cook stoves models that could be promoted for increased use in urban and rural areas.
- Improved Cook Stoves Market Development: The objective of this activity was to improve access to - and sustained use of - ICS through market led production and distribution, with the aim to increase demand and strengthen the supply chain: "last mile retailing system". The activities undertaken in 10 selected districts included support to establishment of a retailing system: (i) (recruitment and training of mobilisers and installers); (ii) establishment of supply chains between producers and retailing cooperatives, mobilisers, and installers; and (iii) increased collaboration with District and Sector administrations for community mobilization and awareness. Through the approach of the engagement of retailers such as cooperatives, social networks, commercial retailers; uptake and selling of stoves increased in the selected districts. In a period of four (4) months during which the activities were undertaken: (i) production significantly increased from about 150 stoves per district per month to about 630 stoves per district per month; (ii) about half (48%) of the total production is fired and with sales of about 79% of the fired stoves.
- (ii) B2: Value Chain Analysis and Transformation: This subcomponent supported activities aimed at increased biomass efficiency and supported activities related to charcoaling techniques through popularization of improved charcoal production / carbonization techniques in the main zones of charcoal production. The project supported training and capacity building in charcoal making in 36 districts and helped individuals involved in charcoal making to form groups/associations. The activities' outputs include: (i) trained charcoal producers reported a saving of about

30% of wood by using improved carbonization techniques; (ii) 40 Charcoal producers' cooperatives have been created, organized and are operational; and (iii) efficient tree cutting, charcoal making and transport permit system is implemented according to the guidelines provided by relevant Ministries. To ensure sustainability after project closure, EWSA and MININFRA propose to engage other stakeholders, such as the Private Sector Foundation and Local Government Authorities to support sustainable use of fuel wood, increased uptake of charcoaling techniques and enhanced charcoal value supply chain by linking charcoal producers to transporters and wholesalers.

3. <u>Component C: Sustainable development of micro hydro resources (US\$1.55 million. (GEF-US\$0.35, AFREA-US\$1.20)</u>). The objective of this component was to addresses a number of issues for speeding up the private sector's investment in micro-hydro mainly related to: (i) lack of access to credit from local banking institutions; and (ii) lack of capacity to prepare detailed feasibility studies, including clear tender procedures or other principles for identifying and selecting investors. Several activities were undertaken to support the development of transparent market regulations and guidelines while building local private sector capacity that can plan, design, implement and operate the micro hydro power plants.

- (i) C1. Private-sector led micro-hydro expansion The activities under this subcomponent were aimed at addressing a number of issues for speeding up the private sector's investment in micro-hydro. The assessment of micro-hydro cross cutting issues was completed in July, 2011 which highlighted that, whereas the legal framework supports the participation of the private sector, there were still significant barriers to increased participation of the private sector in the development of micro-hydro in Rwanda. These barriers were mainly the non-cost-reflective tariffs, high costs, unfavorable loan conditions and limited capacities in both public institutions and private companies. Follow-up undertakings to address the identified issues included the adoption of *Feed-in tariff and Light handed regulation*: A Renewable feed-in tariff was adopted in February 2012. With the support of the International Finance Corporation (IFC), RURA has prepared light handed regulations including standardized Power Purchase Agreements (PPAs) that will ease the regulatory requirements for the development and operations of micro hydropower plants.
- (ii) C2. Sustainable micro-hydro This component was aimed at improving the sustainability of the government-owned micro-hydro schemes beyond the construction phase and to leverage these investments by providing technical assistance to prepare business plans, maintenance and operational arrangements to ensure a long-term sustainable operation of these facilities on a private or Public-Private basis; including training of developers and project promoters to increase the domestic capacity to develop, construct, operate and maintain hydro schemes. Several assessments were undertaken aimed at creating an inventory and technical evaluation of existing facilities to facilitate the potential to transfer these to the private sector. These assessments highlighted the following: (i) the assets were financially viable and could thus attract private sector

investments; and (ii) the power plants have been consistently performing with good generation figures and annual plant load factor, though the plants have not been operated to the best standards in terms of operations & maintenance (O&M) practices. In addition, the assessments made recommendations related to: (i) renovation and modernization of the various plants, which could be undertaken on a Public Private Partnership (PPP) basis; (ii) preparation of a sector policy to address issues related to the ownership structure, private sector participation and management of state-owned generation assets. By project closing, MININFRA/EWSA had started the process of bidding out some of the existing plants to private operators on a concession basis (operations and maintenance). In addition to the project undertakings, other sector activities to address related issues included: (i) the Private Sector Project, supported by GIZ, has assisted private Rwandan SMEs by providing technical and business development assistance as well as co-financing for the development of some plants; and (ii) under the Bank Managed Trust fund for Energy Small and Medium Enterprises (ESME) there is technical support to assist the private sector micro-hydro developers to access the local credit market in addition to supporting them to develop business plans and project appraisal. Also, under the ESME, there has been engagement with the financial sector in Rwanda (commercial banks and other lenders) to encourage and support them to participate in RE financing. The engagement has focused on educating and training to help them to understand the business of lending for energy projects, including supporting the development of specific energy loan portfolios.

(iii) C3: Micro-hydro helpdesk - This subcomponent was aimed at putting in place technical support to sustain operations and maintenance of micro hydro plants. In addition to the assessments undertaken related to the operations and maintenance of micro hydropower plants, a database of skilled personnel in the installation, commissioning and plants operations has been created (*under the activities conducted in the incubation program-component A4*), and it is expected that it will be regularly updated by EWSA.

4. The initiatives undertaken during the project implementation, in addition to the assessments highlighted above and the incubation program, are expected to lead to an increase in private sector participation in the development of micro-hydro power plants in Rwanda over the next two years. By project closing, a number of private firms were involved in the development of several micro-hydro sites (4.5MW under construction, while additional sites, totaling about 5MW, were at various stages of feasibility studies and financial closure).

5. <u>Component D: Solar Energy (US\$0.65 million-GEF)</u> – The activities in this component were aimed at supporting increased private sector capacity in order to develop the market for solar systems in Rwanda. This would be accomplished by three core measures: (i) developing national installation and user guidelines for institutional PV applications, (ii) building capacity and conducive frameworks to allow local private firms to participate in international tendering for the Rwandan market, and (iii) supporting the development of a commercial SHS (Solar Home System) market for rural areas.

- (i) D1: Solar PV for Public institutions To improve the long-term sustainability of Solar PV systems in public institutions, the activities under this subcomponent supported the development designs, installation and user guidelines for PV applications in public institutions, as well as a framework for coordination among relevant Ministries. Prior to the development of the guidelines, a PV-sector capacity assessment was undertaken in order to evaluate the electricity needs in the rural public institutions, such as the administrative offices of districts and sectors, hospitals, health centers and primary and secondary schools. The assessment evaluated the use of solar photovoltaic systems and highlighted past experience in terms of technical aspects, procurement processes, implementation plans, and commissioning and post commissioning services. Key recommendations of the guidelines included: (i) user ministries to mainstream assessment of the respective institutions energy needs; (ii) quality assurance; and (iii) having in place an operations and maintenance plan to ensure that, once the systems are installed, they are operated in accordance with capacity loading, including regular maintenance and having adequate budget for replacement of the components.
- (ii) D2 Private-led PV for rural electrification the activities under this subcomponent were aimed at promoting the private sector to engage in rural markets for PV systems by supporting existing companies to enable them to build rural distribution channels and outlets. Activities related to the development of solar PV market included: (i) Capacity building/Technical Assistance among private PV companies/technicians and technical schools; (ii) PV solar study and market analysis; (iii) Creation of a Solar Association; and (iv) Promotion of solar equipment and improved organization of the distribution sector. Overall, assessments highlighted that most companies already have developed their own distribution channels and noted the need to raise awareness about the quality of solar systems and to complement their activities. Support activities implemented under the ESME include: (i) building linkages between companies selling high quality equipment, trained and qualified technicians, and consumer groups and possible other stakeholders, and (ii) public and media awareness campaign.
- (iii) D3: Solar Water Heater (SWH) Under this subcomponent, the Solar Water Heater (SWH) Program was implemented. This activity aimed at supporting the development of a commercially viable SWH sector in Rwanda by providing catalytic investment subsidies necessary to get the hot water program off the ground. The activities manly comprised:
 (i) technical Assistance for establishing the technical, financial and institutional set up; and design for the establishment of a subsidy scheme and (ii) implementation of the subsidy scheme (US\$300 for SWHs, with capacities ranging from 120 to 250 liters and US\$450 for SWHs with a capacity of 250 liters or more) and a credit, repayable over 24 months, (US\$600 to US\$900 depending on the capacity of the system). The activities undertaken under this component, including public awareness campaigns, have supported the creation of linkages between the private sector (suppliers of SWHs, either manufacturers or importers (or both) with networks of installers) and the beneficiaries (households) who are customers of EWSA, with the public sector (EWSA) providing the grants. By project closing, ten (10) local firms had been registered as eligible

participating firms and about 450 systems had been installed, with an estimated capacity of 1,200 m², translating into an annual energy saving of about 400 MWh⁴.

6. <u>Component E: Energy efficiency strategy development (US\$1.92 million.</u> <u>US\$0.80 million from IDA</u>). The activities of this subcomponent were aimed at reducing technical losses in the utility and improving energy efficiency in major electricity users. It included the following activities: (i) grid audit of the EWSA grid network; (ii) energy efficiency audit of street lighting, water pumping facilities and public buildings; and (iii) preparation of an Energy Efficiency Policy that included actions to reduce/increase energy use efficiency for the various electricity consumer categories. These actions covered: (i) promotion and use of more efficient equipment; (ii) equipment labelling; (iii) awareness creation; (iv) energy auditing and financing; (v) adopting minimum energy standards for new buildings and retrofits where possible for existing buildings; and (vi) energy efficiency act.

⁴ Estimated energy saving is 0.2MWh/m²/year

Annex 3. Economic and Financial Analysis

Component B. Efficient utilization of biomass resources

1. The objective of this component was the promotion of improved cook stoves (ICS) in the Kigali area. Therefore, the analysis carried out below takes into account the increased number of households in the Kigali area that use ICS which is an indirect result of the awareness and promotion campaign conducted under this component. The economic and financial analysis has been conducted based on the increase in the use of ICS and associated fuel savings.

2. Surveys conducted in 2012 and 2014 to measure the increased use of ICS found out that the number of households using ICS in Kigali area increased from 40% to 82% which represents 88,956 new households using ICS.

Use of Improved Cook Stoves (ICS)

	Baseline	2013
Kigali City	40% (84,720 HH)	82% (173,676 HH)

3. The surveys noted that in Kigali, the main fuel used for cooking is charcoal at 65% followed by fuel wood by 32%. The average annual consumption stands at about 1,891 Kg for fuelwood, while charcoal consumption stands at 771 kg per household and year. On average, Kigali City households and the other largest urban towns' households consume 1 bag and a half of charcoal; therefore, they spend at least Rwf 10,500 (considering the price of one bag at Rwf 7,000). For firewood, the average amount spent per month in the largest towns is Rwf 6,409.

4. The project conducted a Controlled Cooking Test (CCT) to evaluate the savings in fuelwood and charcoal in conditions as close to actual cooking conditions as possible. The results of this test is shown in Table A3-1 below and indicates that the firewood savings for an improved mud stove (the most commonly used in urban areas among firewood improved stoves) is 39.6% and the charcoal savings for an improved metal charcoal stove - single pot (the most commonly used in urban areas among charcoal improved stoves) is 30%.

5. The economic analysis of the technology has been done taking into consideration the investment cost of ICS, the annual fuel savings, and a conservative expected ICS' lifetime (one year for improved mud cook stove and two years for improved metal charcoal stove - single pot). The IRR is above 900% for the improved fuelwood cook

stove and above 120% for the improved charcoal cook stove. Tables A3-2 and A3-3 summarizes these calculations.

Financial analysis

6. The financial analysis has been done taking into consideration the budget for the component (US3.95 million) spent on the awareness and promotion campaign and assuming that 30% of the new households using ICS can be attributed to the awareness raising campaign of the project⁵. Table A3-4 summarizes the financial results of the campaign based on the above considerations. The cash flow yield an economic net present value (NPV) of US6,200,000 and an EIRR of 25.9%.

CO₂ emissions savings

7. Considering that when burned, one kg of traditional wood emits $1,560 \text{ CO}_2$ emissions g^6 , the annual emissions savings of each type of ICS in Rwanda is shown in the table below:

CO ₂ emission savings charcoal cookstove (kg)	360.8
CO ₂ emission savings fuelwood cookstove (kg)	1,150.5

8. Considering the same number of new ICS installed, as a result of the awareness campaign for the project as explained in the previous section, the total tons of CO_2 emissions saved every year are about 16,084.

9. The calculation is shown in the table A3-5.

⁵ Since late 80s the GoR began distributing cook stoves and from that time initiatives have been implemented in the country (SNV, CARE, Practical Action, etc.).

⁶ Stove Performance Inventory Report, UN Foundation (2012)

BOLD =	BOLD = 3-stone fire, Baseline														
BLUE=C	BLUE=Calculated Values														
INITIAL	INITIAL Mass (kg)														
Notation	Stove	Fire wood	Cooking pot	Kg Beans	Pan,H2 0, Beans	Extra H2O (1)	Extra H2O (2)	Extra H2O (3)	Charco al pan, pad	Start Time	End Time	Cooking Time	hou rs		
А	Improved mud stove	7.535	0.605	1.5	5.805	2.65	0	0	0.285	16:47	19:05	2:18	2.3		
в	Ordinary mud stove	6.035	0.73	1.5	5.935	2.53	2.35	0	0.285	16:27	18:44	2:17	2.3		
С	Potable metal wood stove	6.845	0.57	1.5	5.77	2.58	1.54	0	0.285	12:12	14:51	2:39	2.6		
D	3 Stone	6.44	0.6	1.5	5.8	1.54	2.73	0	0.285	12:37	15:10	2:33	2.5		

Tables A3-1 showing the results of the Controlled Cooking Test (CCT) for different type of ICS

	FINAL Mass (kg)												SFC	Saving	%	
Notation	Fire wood	Pan,H20, Beans	Extra H2O (1)	Extra H2O (2)	Extra H2O (3)	Char, pan (1)	Char, pan (2)	Char, pan (3)	Water Added	Char Remain	TOTAL Firewood	Remarks	5			Saving
Α	4.545	4.705	0.82	0	0	0.41			1.83	0.13	2.87	Less wood		1.9	0.396	39.6
В	0.655	4.895	0.105	0.105	0	0.455	0.45	0.4	4.67	0.45	4.50	Most wood	ł	3.0	0.050	5.0
с	2.81	5.385	0.105	0.37	0	0.405	0.405	0.4	3.65	0.36	3.68			2.5	0.224	22.4
D	0.8	4.58	0.105	0.105	0	0.425	0.44	0.89	4.06	0.90	4.74	Baseline		3.2	1	Baselin e

STOVE TESTED	Weight of cooked food (gm)	Weight of fuel used (gms)	Specific fuel consumption in %	Saving	Cooking time (Min)
Ordinary traditional charcoal stove (Baseline)	1500	1460	0.973	0%	176
Canamake ivuguruye	1500	974	0.649	33%	178
Improved metal charcoal stove- Single pot	1500	1026	0.684	30%	176
Improved metal charcoal stove- Double pot	1500	1245	0.830	15%	165

Table A3-2 Economic results of fuelwood ICS

	US\$																			
Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Initial Capex -																				
equipment	-36.7																			
Replacement - equipment			- 36.7																	
Economic Ropofits																				
(savings)		55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5	55.5
Net benefits	-36.7	55.5	18.8	55.5	18.8	55.5	18.8	55.5	18.8	55.5	18.8	55.5	18.8	55.5	18.8	55.5	18.8	55.5	18.8	55.5
Nominal discount rate	10%																			
Inflation	2.5%																			
Initial Investment	36.7	US\$																		
Economic NPV	320.6	US\$																		
EIRR (nominal)	122.4%																			

Table A3-3 Economic results of charcoal ICS

	US\$																			
Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Initial Capex - equipment	-4.4																			
Replacement - equipment		-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4
Economic Benefits (savings)		45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3
Net benefits	-4.4	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9
Nominal discount rate	10%																			
Inflation	2.5%																			
Initial																				
Investment	4.4	US\$																		
Investment Economic NPV	4.4 374.9	US\$ US\$																		

Table A3-4 Financial results of the Awareness Raising campaign



(savings)						
Nominal						
discount rate	10%					
Inflation	2.5%					
Initial						
Investment	4.0	US\$ million				
Economic NPV	6.2	US\$ million				
EIRR (nominal)	25.9%					

Table A3-5 Annual CO2 emissions savings per type of ICS

new ICS	26686.8		% charcoal	65%	charcoal consumption (kg)	771	charcoal savings	30%
			%fuelwood	32%	fuewlwood consumption (kg)	1891	fuelwood savings	39%
							Co2 emissions g/kg dry wood	1560
CO2 emission savings (tons)	1	6,084.0						
CO2 emission savings charcoal cookstove (kg)		360.8						
CO2 emission savings fuelwood cookstove (kg)	:	1,150.5						

Component C: Sustainable development of micro hydro resources

10. By project closing, several micro-hydro sites where either under construction, at feasibility stage, or at financial closure. All these sites had an overall installed capacity of 9.5 MW. To calculate the efficiency of this component, we have considered that these sites would provide electricity in areas where the population had no access to electricity and also the Feed in Tariff (FiT) for small hydro power approved by the GoR. The analysis compared the cost of electricity based on small hydro power with the cost of a diesel generator, which would be the alternative generation source to having access to electricity. With these assumptions, an average FiT for the small hydro sites is estimated at US\$0.10/kWh. In contrast, diesel genesets' cost of generation in Rwanda is estimated at US\$0.25/kWh⁷, which means a 60% of economic savings for the consumers benefitting the small hydropower generation systems.

11. Considering a capacity factor of the small hydro power plants of 40%, the annual electricity generation of all the power plants assessed under this component is 33,288 MWh. Therefore, the annual savings for the consumer with respect to diesel generation are US\$ 4,993,200 if all small hydro power plants were installed.

Component D. Solar Energy

12. This component included a promotion program of SWH for Households (HH) where a subsidy and a soft loan were offered to applicants for the installation of either SWH of 200 or 300 liters.

Economically viability of Solar Water Heaters (SWH)

13. Solar Water Heaters (SWH) are economically viable compared to the use of electricity to heat water. The IRR is above 20% in the two cases analyzed of 200 and 300 liters. For the case of the model of 300 liters, the return is almost 40%. The economic indicators shown in Tables A3-5 and A3-6 give a payback period of 3 years for the model 200 liters and 2 years for the model 300 liters.

Financial analysis of SWH under the Promotion Program

⁷ PAD Rwanda: Urgent Electricity Rehabilitation Project (UERP) 2004

14. The promotion program provided conditional financing (subsidy and soft loan) for the purchase and installation of SWH of two sizes, 200 and 300 liters. These sizes were designed for household use.

15. The financial analysis has been done taking into consideration the financing terms of the subsidy and soft loan, the lifespan of the equipment, and the electricity savings of heating water through solar energy instead of electricity.

16. In the case of 200 liters, the results are shown in Table A3-7 and show a payback period of 3 years and an IRR of 28% and for the case of 300 liters, the results are shown in Table A3-8 and show a payback period of 2 years and an IRR of 66%.

17. In Table A3-6 below, we compare all the economic indicators of each SWH model explained above and detailed in Tables A3-7, A3-8, A3-9 and A3-10.

	200 liters	200 liters	300 liters	300 liters
	Without subsidy	With subsidy	With subsidy	Without subsidy
Initial investment (US\$)	1,396	1,444	1,690	1,734
NPV (US\$)	1,020	1,188	3,520	3,963
IRR	21%	28%	39%	66%
Payback (years)	4	3	2	2

Table A3-6. Economic indicato	r per different SWH	configurations
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Table A3-7 Financial results of a 200 liter SWH in Rwanda

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Inflation Index	1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60
Initial Capex - equipment (US\$)	1,396																			
Replacement											1,787									
electricity savings (US\$/year)		326	334	342	351	359	368	378	387	397	407	417	427	438	449	460	472	483	495	508
HH investment	-1396										-1787									
Net savings		326	334	342	351	359	368	378	387	397	407	417	427	438	449	460	472	483	495	508
Interest Payment		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan repayment		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
benefit (cashflow)	-1,396	326	334	342	351	359	368	378	387	397	-1,380	417	427	438	449	460	472	483	495	508
cumulative cashflow	-1,396	-1,070	-737	-395	-44	316	684	1,062	1,449	1,845	465	882	1,309	1,747	2,196	2,656	3,128	3,611	4,106	4,614
Interest rate		10%																		
Nominal discout rate		10%				Initial Investment		1,396.0	US\$											
Inflation		2.5%				Economic NPV		1,019.8	US\$											
						EIRR (nominal)		21%												

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Inflation Index	1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60
Initial Capex - equipment (US\$)	1,690																			
Replacement											2,163									
electricity savings (US\$/year)		649	666	682	699	717	735	753	772	791	811	831	852	873	895	918	941	964	988	1,013
НН	-										-									
investment	1690										2163									
Net savings		649	666	682	699	717	735	753	772	791	811	831	852	873	895	918	941	964	988	1013
Interest Payment		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan repayment		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A3-8 Financial results of a 300 liter SWH in Rwanda

repayment benefit --(cashflow) 1,690 791 1,352 1,013 cumulative cashflow 1,690 -1,040 -375 308 1,007 1,724 2,459 3,212 3,984 4,775 3,423 4,254 5,106 5,980 6,875 7,793 8,733 9,697 10,685 11,698

Interest rate	10%			
Nominal		Initial		
discout rate	10%	Investment	1,689.9	US\$

Inflation	2.5%	

Economic NPV	3,519.8	US\$
EIRR		
(nominal)	39%	

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Inflation Index	1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60
Initial Capex - equipment (US\$)	1,440																			
Replacement											1,787									
electricity savings (US\$/year)		326	334	342	351	359	368	378	387	397	407	417	427	438	449	460	472	483	495	508
Loan																				
BoP balance		547	273	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drawdown	547																			
Repayment		-273	-273																	
EoP balance	547	273	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest	0	55	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HH investment	-664										- 1787									
Net savings		326	334	342	351	359	368	378	387	397	407	417	427	438	449	460	472	483	495	508
Interest Payment		-55	-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan repayment		-273	-273	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
benefit	-664	-2	33	342	351	359	368	378	387	397		417	427	438	449	460	472	483	495	508

Table A3-9 Financial results of a 200 liter SWH in Rwanda financed through the Promotion Program

(cashflow)											1,380									
cumulative cashflow	-664	-667	-633	- 291	59	419	787	1,165	1,552	1,949	568	985	1,412	1,850	2,299	2,759	3,231	3,714	4,210	4,717
Interest rate		10%																		
Nominal discout rate		10%			Initial Investment		1,440.1	US\$												
Inflation		2.5%			Economic NPV		1,188.1	US\$												
					EIRR (nominal)		28%													

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Inflation Index	1.00	1.03	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.56	1.60
Initial Capex - equipment (US\$)	1,734																			
Replacement											0									
electricity savings (US\$/year)		649	666	682	699	717	735	753	772	791	811	831	852	873	895	918	941	964	988	1,013
<u>Loan</u>																				
BoP balance		820	410	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drawdown	820																			
Repayment		-410	-410																	
EoP balance	820	410	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest	0	82	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HH investment	-548										- 1734									
Net savings		649	666	682	699	717	735	753	772	791	811	831	852	873	895	918	941	964	988	1013
Interest Payment		-82	-41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan repayment		-410	-410	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
benefit	-548	157	215	682	699	717	735	753	772	791	-923	831	852	873	895	918	941	964	988	1,013

Table A3-10 Financial results of a 300 liter SWH in Rwanda financed through the Promotion Program

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cumulative cashflow	-548	-391	-176	506	1,206	1,923	2,657	3,410	4,182	4,974	4,051	4,882	5,734	6,608	7,503	8,421	9,361	10,325	11,313	12,326
Interest rate		10%																		
Nominal discout rate		10%					Initial Investment		1,734.0	US\$										
Inflation		2.5%					Economic NPV		3,962.8	US\$										
							EIRR (nominal)		66%											

(cashflow)

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending		_	
Johannes C. Exel	Consultant	CSBO2	
Chandrasekar Govindarajalu	Senior Energy Specialist	CSASB	
Chantal Kajangwe	Procurement Specialist	AFTPE	
Joseph Kizito Mubiru	Lead Financial Management Specialist	LCSFM	
Supervision/ICR		-	
Paul Baringanire	Senior Energy Specialist	GEEDR	
Otieno Ayany	Financial Management Specialist	AFTME	
Lennart Bangens	Consultant	CCGCI	
Bathilde Jyulijyesage	Program Assistant	AFMRW	
Chantal Kajangwe	Procurement Specialist	AFTPE	
Anta Loum Lo	Senior Program Assistant	AFCSN	
Klas Sander	Natural Resources Economist	CCGPT	
Marie Louise Felicite Soue	Temporary	GEEDR	
David Vilar	Energy Specialist	GEEDR	
Rolande Simone Pryce	Senior Operations Officer	GEEDR	
Atsumasa Sakai	Energy Specialist	GEEDR	

(b) Staff Time and Cost

Stage of Project Cycle

Staff Time and Cost (Bank Budget Only)

	No. of staff weeks	US\$ Thousands (including travel and consultant costs)
Lending		
FY06	3.77	54.36
FY07	11.13	71.95
FY08	5.66	47.10
FY10	7.48	44.07
Total:	28.04	217.48
Supervision/ICR		
FY10	4.6	52.21
FY11	7.05	69.07
FY12	7.84	52.25
FY13	2.43	17.79
FY14	12.04	55.76
Total:	33.96	247.08

Annex 5. Summary of Borrower's ICR and/or Comments on Draft ICR

Relevance of Project

1. This project proposed to mainstream renewable energy within the national energy planning process and support renewable energy market development, which is still a priority for the GoR. Of particular and immediate interest to the government is the development three Renewable Energy Technologies (RETs): solar and hydro resources minimizing the need for diesel fired thermal generation, as well as improving the efficiency of the use of traditional fuels. These renewable energy sources and technologies are still an untapped potential in Rwanda. Although optimal utilization of locally available renewable energy resources and efficient end-use could help Rwanda alleviates the current supply gap and minimizes its dependency on costly fuel imports, the rural areas that will not be reached by the central grid that could greatly benefit in the short-medium term. Donor-driven projects and financing have increased in this area during the last decade but interventions remain scattered and largely outside of the national energy planning process and government efforts have only recently taken off. The level of local capacity in the area of renewable energy also remains low both in the public as well as private sector.

2. The challenge for all three RETs is to find sustainable solutions that fit the Rwandan context and will operate under local conditions. Solar irradiation is abundant but the Rwandan solar market is very small and mainly limited to the 'project' market driven by donor funding. Micro-hydro, after many years of neglect, has recently received considerable attention in Rwanda and a number of projects are in pipeline.

3. The use of traditional fuels, such as biomass, has accelerated due to increased population and urbanization reaching unsustainable levels, with deforestation and soil deterioration as a result. The task at hand is to build functioning energy markets for all three RETs integrating private sector actors at an optimal extent by providing incentives and regulatory frameworks.

Evaluation of Outputs

- 4. The Project achieved the following:
 - (i) The Energy Policy and Strategic study was prepared and a National Renewable Energy Strategic Plan is now in place.
 - (ii) The Lake Kivu Monitoring unit was set up and is now functioning as a cost and revenue center, to ensure sustainability of their work.

- (iii) 120 Entrepreneurs in RE were been trained in Entrepreneurship in areas of Biomass, Hydropower, Solar Energy and Energy Efficiency.
- (iv) 82% of households are using improved cook-stoves in the Kigali area comparatively to 70% expected from the impact of the Project activities.
- (v) 1,080 charcoal makers from 36 sectors were been trained on the improved carbonization techniques and 40 Charcoal producers' cooperatives were been created, organized, operational and registered at sector level.
- (vi) Installation and user guidelines for Solar PVs in public institutions approved.
- (vii) A full curriculum of basic solar training was prepared and made available to the trainers. Four sets of high quality training equipment were purchased and handed over to EWSA and the training institutions. Business training modules were created and over 60 technicians participated in business support courses to enable them to better run their businesses. In all, more than 100 technicians received training as part of the "Technical Assistance and Advisory Services for Solar PV Market Development Project".
- (viii) Market creation of Solar Water Heater in Rwanda. Program designed for 11,500 installations in individual households by December 2015. As of end January 2014, about 623 SWH systems had been installed.
- (ix) The investment plan based on the electrical national grid energy loss audit was approved and MININFRA/EWSA is mobilizing resources for its implementation.
- (x) The national building code integrates energy efficiency elements is approved. It is used to plan a technical assistance and implementation feasibility.

Major Lessons learnt

- (i) On the onset of project effectiveness, implementation of Project Procurement plan in the Project Appraisal Document (PAD) was not possible due to the delay in project effectiveness and some earlier anticipated activities had already been implemented using other sources of funding. In future there is need to be realistic with regard to the implementation timelines so as to respond to the needs of the borrower
- (ii) The Project Focal Point was appointed six months after the Project effectiveness. In addition, other key MININFRA and EWSA staff had other responsibilities in addition to the project activities, which led to an initial delay in the implementation of a number of project activities. A fully dedicated team at the MININFRA and EWSA would have enabled speeding up the project implementation. To avoid delays in future, it is proposed to set as Project effectiveness condition the Project implementation team in place to avoid delays in project implementation.
Follow up Actions

- (i) The findings and recommendation from assessment of the performance of the existing micro hydro power plants is in the process of being implemented.
- (ii) The EWSA Commercial Department and Energy Efficiency Unit, with the available financing from NDF, shall continue with the implementation of the SWH Program.
- (iii)The approved Energy Efficiency Strategy has been taken over by EWSA Energy Efficiency Unit for implementation.
- (iv)The MININFRA and EWSA shall continue mobilizing funds to implement the loss reduction investments.

Annex 6. List of Supporting Documents

- 1. ICR Guidelines (August 2006, last updated on October 5, 2011)
- 2. SEDP PAD
- 3. GEF Trust Fund Grant Agreement
- 4. Grant Agreement between the Bank and the MININFRA
- 5. ISRs
- 6. Supervision Aide Memoires
- 7. Midterm Review Report
- 8. Rwanda CAS (2009-2013)
- 9. Restructuring Papers
- 10. Economic Development and Poverty Reduction Strategy
- 11. Danish Energy Management (DEM) (June 2012). National RE Strategy Study
- 12. Africa Energy Services Group (AESG), May 2012. Biomass Utilization Survey in Urban and Rural Areas
- 13. Anicet MUNYEHIRWE, January 2013. Study on LPG Market in Rwanda
- 14. Practical Action Consulting (PAC), June 2013. Promotion Campaign Improved Cook Stoves
- 15. CARE International in Rwanda December, 2012. Enhancing charcoaling efficiency in key districts in Western, Northern and Southern Provinces
- 16. Mario MERCHAN Andrès, July 2011. Micro-Hydro cross-cutting issues
- 17. CRISIL Infrastructure Advisory, April 2013, Sustainable M-H and Private-sector led MH expansion
- 18. Naceur HAMMAMI, December 2010. Technical design of the Solar Water Heater (SWH) Development program
- 19. Trama TecnoAmbiental (TTA) in association with INNOTECH, May 2013. Installation and Sizing Guidelines for Institutional PV systems
- 20. Marchéage et Gestion de l'Environnement (MARGE), January 2014. Technical Assistance and Advisory Services for Solar PV Suppliers and Dealers to establish a countrywide distribution network
- 21. Manitoba Hydro International Ltd. (MHI), December, 2012. Energy audit of EWSA especially focused on efficiency improvements and loss reduction
- 22. ECONOLER & HATCH, January 2014. Energy audit and policy for buildings, street lighting, water pumping and major consumers
- 23. EWSA, January 2014. Renewable Energy Firms in Rwanda-Survey Report
- 24. EWSA, January 2014. The Outcome of the Improved Cook Stove campaigns in Rwanda-Survey Report
- 25. SNV, January 2014. Rwanda Improved Cook Stoves Program Market Based Solutions



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