Document of
The World Bank

Report No: ICR00001960

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IDA-41590 TF-56211)

ON A

CREDIT
IN THE AMOUNT OF SDR 3.5 MILLION
(US$ 5.0 MILLION EQUIVALENT)

AND A

GLOBAL ENVIRONMENTAL FACILITY GRANT
IN THE AMOUNT OF US$ 3.0 MILLION

TO THE

REPUBLIC OF ARMENIA

FOR A

RENEWABLE ENERGY PROJECT

January 30, 2012

Sustainable Development Department
South Caucasus Country Unit
Europe and Central Asia Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective January 30, 2012)

Currency Unit = Armenian Dram (AMD)
AMD382 = US$1
US$0.026 = AMD1

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ABS	Asset backed security
AMD	Armenian dram
BOT	Board of trustees
CAS	Country Assistance Strategy
CDM	Clean Development Mechanism
CC	Cascade Credit CJSC
CBA	Central Bank of Armenia
CER	Certified Emission Reduction
CFF	Cafesjian Family Foundation
DCA	Development Credit Authority of USAID
EBRD	European Bank for Reconstruction and Development
EMP	Environmental Management Plan
ERR	Economic rate of return
FI	Financial institution
FM	Financial management
FMR	Financial monitoring report
FRR	Financial rate of return
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas
GIS	Geographic Information System
GOA	Government of Armenia
ICR	Implementation Completion and Results Report
IDA	International Development Association
KfW	Kreditanstalt für Wiederaufbau
MENR	Ministry of Energy and Natural Resources
NGO	Non-governmental organization
NPV	Net present value
OM	Operations Manual
PPA	Power Purchase Agreement
PRSP	Poverty Reduction Strategy Paper
PSRC	Public Services Regulatory Commission
R2E2 Fund	Renewable Energy and Energy Efficiency Fund
SHPP	Small hydropower power project

WPP	Wind power project
SLA	Subsidiary loan agreement
TA	Technical assistance
UHP	Urban Heating Project
VAT	Value added tax
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development

Vice President:	Philippe H. Le Houerou
Country Director:	Asad Alam
Sector Manager:	Ranjit J. Lamech
Project Team Leader:	Gevorg Sargsyan
ICR Team Leader:	Gevorg Sargsyan
ICR Primary Author:	Arthur Kochnakyan

COUNTRY
RENEWABLE ENERGY PROJECT

CONTENT

A. Basic Information

Country:	Armenia	Project Name:	Renewable Energy Project
Project ID:	P083352,P090058	L/C/TF Number(s):	IDA-41590,TF-56211
ICR Date:	01/30/2012	ICR Type:	Core ICR
Lending Instrument:	SIL,SIL	Borrower:	
Original Total Commitment:	XDR 3.50M,USD 3.00M	Disbursed Amount:	XDR 3.28M,USD 2.77M

Environmental Category: F,F **Focal Area**: C

Implementing Agencies:

Cofinanciers and Other External Partners:

European Bank for Reconstruction and Development (EBRD)

Cafesjian Family Foundation

B. Key Dates

Renewable Energy Project - P083352

Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	10/14/2004	Effectiveness:	08/04/2006	08/04/2006
Appraisal:	12/26/2005	Restructuring(s):		07/19/2010
Approval:	03/29/2006	Mid-term Review:	09/15/2008	08/05/2008
		Closing:	12/31/2010	06/30/2011

Renewable Energy GEF Project - P090058

Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	10/14/2004	Effectiveness:	08/15/2006	08/04/2006
Appraisal:	12/26/2005	Restructuring(s):		07/19/2010
Approval:	03/29/2006	Mid-term Review:	12/31/2008	07/31/2008
		Closing:	12/31/2010	06/30/2011

C. Ratings Summary

C.1 Performance Rating by ICR

Outcomes	Satisfactory
GEO Outcomes	Satisfactory
Risk to Development Outcome	Low or Negligible
Risk to GEO Outcome	Low or Negligible
Bank Performance	Satisfactory
Borrower Performance	Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)			
Bank	**Ratings**	**Borrower**	**Ratings**
Quality at Entry	Satisfactory	Government:	Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Satisfactory
Overall Bank Performance	Satisfactory	Overall Borrower Performance	Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators			
Renewable Energy Project - P083352			
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
DO rating before Closing/Inactive status	Satisfactory		

Renewable Energy GEF Project - P090058			
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

Renewable Energy Project - P083352		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Renewable energy	100	100
Theme Code (as % of total Bank financing)		
Climate change	67	67
Other financial and private sector development	33	33

Renewable Energy GEF Project - P090058		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Banking	18	18

Central government administration	27	27
Other industry	10	10
Renewable energy	45	45
Theme Code (as % of total Bank financing)		
Administrative and civil service reform	14	14
Climate change	29	29
Legal institutions for a market economy	14	14
Other financial and private sector development	14	14
Regulation and competition policy	29	29

E. Bank Staff

Renewable Energy Project - P083352

Positions	At ICR	At Approval
Vice President:	Philippe H. Le Houerou	Shigeo Katsu
Country Director:	Asad Alam	D-M Dowsett-Coirolo
Sector Manager:	Ranjit J. Lamech	Motoo Konishi
Project Team Leader:	Gevorg Sargsyan	Gevorg Sargsyan
ICR Team Leader:	Gevorg Sargsyan	
ICR Primary Author:	Artur Kochnakyan	

Renewable Energy GEF Project - P090058

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F. Results Framework Analysis

Project Development Objectives (from Project Appraisal Document)
The Project Development Objective is to increase privately owned and operated power generation utilizing renewable energy.

Revised Project Development Objectives (as approved by original approving authority)

Global Environment Objectives (from Project Appraisal Document)
The project global objective is to reduce greenhouse gas (carbon dioxide) emissions by overcoming barriers to the development of renewable energy.

Revised Global Environment Objectives (as approved by original approving authority)

(a) PDO 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 :	Installed capacity (MW) of renewables connected to the power grid			
Value (quantitative or Qualitative)	47	127		133
Date achieved	12/30/2005	12/31/2010		06/30/2011
Comments (incl. % achievement)	105% achievement. The over-achievement was primarily due to provision of long-term and affordable financing, strong demonstration effect of early sub-projects and removal of barriers to development of renewable energy			
Indicator 2 :	Renewable generation (GWh) added to the generation mix			
Value (quantitative or Qualitative)	137	336		417
Date achieved	12/30/2005	12/31/2010		06/30/2011
Comments (incl. % achievement)	124% achievement. The over-achievement was primarily due to provision of long-term and affordable financing, strong demonstration effect of early sub-projects and removal of barriers to development of renewable energy			

(b) 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 :	Carbon dioxide emission reductions (tCO2)			
Value (quantitative or Qualitative)	89,050	218,400		270,770
Date achieved	12/30/2005	12/31/2010		06/30/2011
Comments (incl. % achievement)	124% achievement. The over-achievement was due to the project exceeding the target for renewable generation added to the generation mix			

(c) 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 :	Laws and regulations to improve the environment for the development of renewables are prepared and enacted			
Value (quantitative or Qualitative)	N/A	The package is enacted		Several legislative amendments and regulations are enacted
Date achieved	12/30/2005	12/31/2010		06/30/2011
Comments (incl. % achievement)	All of the legislative amendments and regulations to remove obstacles to renewable energy are developed and several were adopted. Some of them will be adopted as part of the larger review of key laws such as the new Water Code			
Indicator 2 :	Number of renewable project developers, which received financial and legal advisory support			
Value (quantitative or Qualitative)	N/A	50		26
Date achieved	12/30/2005	12/31/2010		06/30/2011
Comments (incl. % achievement)	48% under-achievement. The under-achievement was primarily due to low demand from project developers for financial and legal advisory support as a result of removal of information, legal/regulatory and financial barriers to development of renewable energy			
Indicator 3 :	The renewable energy GIS, Integrated Database and web portal provide comprehensive data on renewable resources			
Value (quantitative or Qualitative)	GIS and database for one marz are piloted	GIS, database and web portal for the entire country are prepared		GIS, database and web portal for the entire country are prepared
Date achieved	12/30/2005	12/31/2010		06/30/2011
Comments (incl. % achievement)	100% achievement. The GIS, the associated database and web portal were prepared and made publicly available.			
Indicator 4 :	Aggregate dollar amount of funds for renewable energy development generated through the piloted financial mechanisms ('0 00 US$)			
Value (quantitative or Qualitative)	N/A	300		0
Date achieved	12/30/2005	12/31/2010		06/30/2011
Comments (incl. % achievement)	No innovative financial mechanisms were piloted under the project since there was no lack of financing for small renewable energy projects during implementation of the project			
Indicator 5 :	Aggregate dollar amount of investments financed or leveraged by the PFI or the R2E2 Fund (million US$)			
Value (quantitative or Qualitative)	0	21		28.6
Date achieved	12/30/2005	12/31/2010		06/30/2011

Comments (incl. % achievement)	136% achievement. The over-achievement was due to larger co-financing provided by project developers			
Indicator 6 :	Loan repayment rates by the project beneficiaries			
Value (quantitative or Qualitative)	N/A	95%		99%
Date achieved	12/30/2005	12/31/2010		06/30/2011
Comments (incl. % achievement)	104% achievement. The over-achievement was due to solid due diligence of sub-projects			

G. Ratings of Project Performance in ISRs

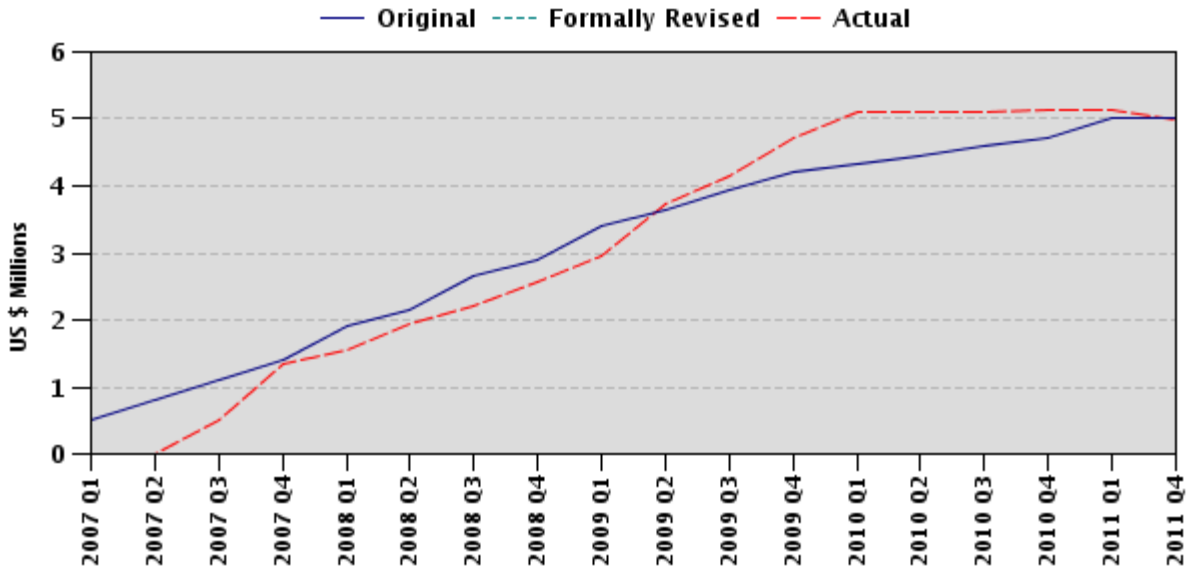
-						
No.	**Date ISR Archived**	**DO**	**GEO**	**IP**	**Actual Disbursements (USD millions)**	
					Project 1	**Project 2**
1	06/27/2006	S	S	S	0.00	0.00
2	10/02/2006	S	S	S	0.00	0.00
3	01/14/2007	S	S	S	0.50	0.30
4	09/11/2007	S	S	S	1.57	0.37
5	02/12/2008	S	S	S	2.23	0.65
6	09/05/2008	S	S	S	2.57	1.01
7	01/21/2009	S	S	S	4.17	1.48
8	06/22/2009	S	S	S	4.72	1.83
9	10/14/2009	S	S	S	5.12	1.98
10	04/13/2010	S	S	S	5.12	2.08
11	10/02/2010	S	S	S	5.13	2.15
12	03/11/2011	S	S	S	5.13	2.43

H. Restructuring (if any)

Restructuring Date(s)	Board Approved		ISR Ratings at Restructuring			Amount Disbursed at Restructuring in USD millions		Reason for Restructuring & Key Changes Made
	PDO Change	GEO Change	DO	GEO	IP	Project1	Project 2	
07/19/2010	N		S		S	5.13		The closing date of IDA credit was extended to ensure both IDA credit and GEF grant closed on the same date.
07/19/2010		N		S	S		2.15	The grant proceeds were reallocated to provide additional incremental operating costs since the R2E2 Fund had exhausted the originally allocated funds due to over 30% depreciation of the US$/AMD exchange rate. Additionally, the Government requested to extend the closing date till June 30, 2011 to allow more time for completion of some activities under the GEF funded TA component.

I. Disbursement Profile

P083352



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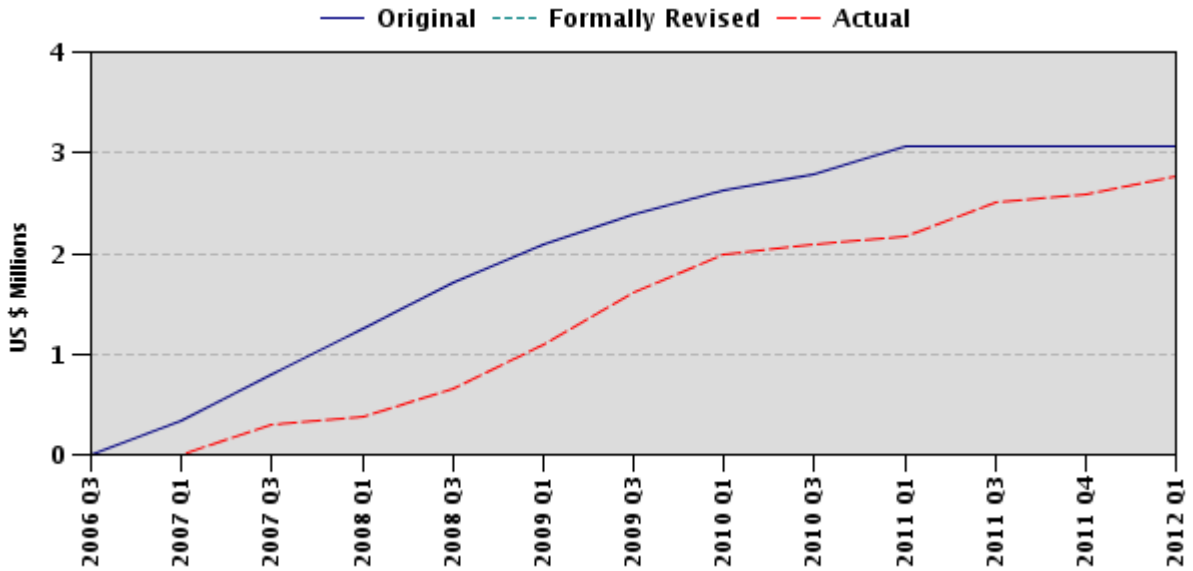

1. Project Context, Development and Global Environment Objectives Design

1.1 Context at Appraisal

The Republic of Armenia is a small landlocked country with limited energy resources to satisfy its needs. Armenia does not have fossil fuel reserves and imports nearly all its energy (oil and oil products from Georgia, Iran, Russia and Europe). Given the regional geopolitical instability and Armenia's closed borders with two of its neighbors, high reliance of electricity generation on imported fuels (more than 60 percent is generated by imported natural gas and nuclear) makes the Armenian economy vulnerable to fluctuations in fuel prices and their supply. The severe consequences of fuel supply disruptions on the Armenian economy and people's lives surfaced during the energy crisis (1992-95) when electricity supply declined to 2-4 hours a day and the collapse in industrial activity and national income was massive. Armenia continues to receive natural gas from Russia at subsidized prices. However, if the geopolitical situation were to change and the subsidy were to be removed, the magnitude of gas price increase, especially in the light of rising international oil and gas prices, would be significant.

Since 1996, the Government undertook structural reforms in the power sector and the sector substantially recovered from the severe deterioration of the early 1990s. The key challenge the power sector faced at appraisal was to ensure sustainable and reliable power supply by: (a) shifting reliance from costly sources of energy (e.g. electricity for heating) to lower cost alternatives (home insulation, gas, solar heating); and (b) increasing the energy diversification and achieving a higher degree of energy security through the utilization of indigenous renewable energy resources.

Armenia was estimated to have significant renewable energy resources, but they played a limited role in the country's energy supply. Approximately 740 MW of small hydropower, wind and geothermal resources was identified, which, if implemented, would represent approximately 25 percent of the total installed capacity at appraisal. Hydropower and some of the wind resources were estimated to be the most attractive. According to various estimates, over 250 MW of capacity could be added through small hydropower plants (SHPPs) that were estimated to be competitive with other forms of new generation. As part of the project preparation activities, 65 SHPPs were identified with the total capacity of 120 MW that were suitable for development. A wind resource assessment estimated the wind energy potential of Armenia at 470 MW with an estimated annual generation of 1360 GWh.

Overall, at appraisal, the existing legal and regulatory framework in Armenia was supportive to development of renewable resources. The Energy Law and the Law on Renewable Energy and Energy Efficiency clearly articulated the importance of renewable resources and provided a framework for facilitating their development. Among others, the legal framework guaranteed off-take of electricity produced for all small renewable power plants at the tariffs set by the Public Services Regulatory Commission (PSRC) and provided payment assurance.

Despite the significant opportunities for renewable projects, private investments in such projects were impeded by a number of barriers and constraints: (a) high capital outlay and preparation costs for small renewable projects; (b) limited access to long-term finance and management capacity constraints; (c) unfamiliar risk profile of borrowers and related perception of high risk for renewable energy projects; (d) lack of experience of project sponsors, local financial institutions (FIs) and engineering and consulting industry with renewable technologies and the appropriate project structures; (e) legal and regulatory barriers in regulations and procedures for resource

allocation; (f) long and often unclear and non-transparent process for obtaining the necessary permits, licenses and other required approvals; and (g) lack of reliable information about potential sites for renewable energy projects.

The project was well aligned with the strategic objectives of the Government as stipulated in the Poverty Reduction Strategy Paper (PRSP) adopted by the Government in October 2003. The PRSP emphasized the need for policy reforms in five key areas, including promotion of private sector development and improvement of public infrastructure. More specifically, the PRSP emphasized the importance of maintaining and strengthening energy independence by developing indigenous and alternative energy sources and promoting energy efficiency. The project was also consistent with the CAS objective of promoting private sector growth by strengthening the financial sector and reducing infrastructure bottlenecks.

1.2 Original Project Development Objectives (PDO) and Key Indicators (as approved)
The PDO was to increase privately owned and operated power generation utilizing renewable energy.

The key performance indicators of the project at appraisal were:

- Installed capacity (MW) of renewables added to the power grid;
- Renewable generation (GWh) added to the generation mix; and
- Carbon dioxide emission reductions (tCO_2).

1.3 Original Global Environment Objectives (GEO) and Key Indicators (as approved)
The project's GEO was to reduce greenhouse gas (carbon dioxide) emissions by overcoming barriers to the development of renewable energy.

1.4 Revised PDO (as approved by original approving authority) and Key Indicators, and reasons/justification
The PDO and the key performance indicators were not revised.

1.5 Revised GEO (as approved by original approving authority) and Key Indicators, and reasons/justification
The GEO and the key indicators were not revised.

1.6 Main Beneficiaries
The main beneficiaries of the "financing of investments" component were the project developers, who were able to access long-term sub-loans provided by the participating financial institution (PFI) – Cascade Credit (CC) Universal Credit Organization, for development of small hydropower projects. Specifically, 26 project developers directly benefited from such sub-loans. Moreover, the success of "financing of investments" component contributed to the uptake of renewable energy financing by the local financial institutions, which created substantial benefits for project developers and electricity consumers in general.

The main beneficiaries of the "technical assistance" component were investors, project developers and financial institutions interested in renewable energy. Specifically, several studies, resource potential updates/assessments, legislative amendments, as well as several public renewable energy events contributed to improved data and information on renewable energy. Also, improvements in

regulatory framework for renewable energy supported creation of enabling environment for investments in renewable energy.

Moreover, all electricity consumers benefited from the project given that electricity generated at SHPPs was cost-competitive and contributed to lower average power system costs, which enabled to reduce the upward pressure on end-user tariffs. At completion, the electricity from SHPPs was purchased at around US$0.060/kWh, whereas the tariff for electricity generated at old and inefficient gas-fired thermal power plants was around US$0.10/kWh.

1.7 Original Components (as approved)

A. Assistance to remove barriers and support project implementation (estimated at US$3.65 million, of which US$3.0 million from the GEF): This component was planned to support the following key areas:

1. Improvement of legal and regulatory framework and capacity building for state agencies: (a) revising the existing legislation and regulations to improve and streamline procedures for transparent and fair allocation of resources (e.g. land rights, water permits, and licenses); (b) developing sub-legislation to operationalize the law on renewable energy and energy efficiency; (c) reviewing and amending the rules of acceptance for small renewable generation for the system operator; (d) strengthening the capacity of the PSRC, the Ministry of Energy and Natural Resources (MENR), State Water Committee, and Meteorological Service; (e) limited commodity support to the PSRC and MOE.
2. Support in facilitating investments in renewable sub-projects: (a) TA and capacity building for local FIs, private investors, local engineering and consulting industries, including information on incentives for new renewable energy technologies and associated benefits; (b) developing a comprehensive database of renewable energy resources, with a related open source Geographic Information System (GIS), and a web portal for identification, assessment, and monitoring of potential renewable energy projects; (c) field survey of potential sites; (d) establishing a one-stop-shop for potential investors to facilitate the process of obtaining required permits, licences, and other documents; (e) TA to potential investors for project preparation activities, such as business plans, feasibility studies, and preliminary designs.
3. Mechanisms to leverage additional financing: Assistance to the R2E2 Fund and other implementing agencies to prepare a long-term strategy for the mobilization of additional financing for developing renewable energy, including: (a) roadshows and conferences for potential investors; (b) design and piloting of different financial instruments to accelerate lending to sub-borrowers, replenish funds and enhance the leveraging impact of the Project.
4. Project implementation and monitoring: (a) TA, equipment, and logistical support to implementing agencies for project implementation, monitoring, supervision, collection and dissemination of lessons learned; (b) institutional support to the R2E2 Fund to act as an umbrella institution for CDM transactions relating to the sub-projects.[1]

B. Financing of investments (estimated at US$21.4 million, of which US$5 million from the IDA credit): This component was to enable private investors to access financing for the development of renewable energy projects. Based on comparative analysis of economic and

[1] CDM capacity-building was to be funded by the Government.

financial viability of different types of renewable projects, it was expected that the financing would be mainly targeted at SHPPs on natural (run-of-the-river) and artificial (drinking water, irrigation pipes and canals) water flows and WPPs. The sub-loans were expected to be in the range of US$100,000 to US$2 million with an average project size of US$500,000.

IDA funds were to be channeled through the R2E2 Fund. The R2E2 Fund would provide financing to project beneficiaries through on-lending to CC, licensed with the Central Bank of Armenia and owned by the Cafesjian Family Foundation (CFF), a US based Armenian Diaspora organization. CC would pool IDA and EBRD funds and its own co-financing in pre-determined proportions and extend loans to beneficiaries.

1.8 Revised Components

The original project components were not revised.

1.9 Other significant changes

Reallocation of grant proceeds and project closing date extension: The grant proceeds were reallocated from "training" and "unallocated" categories of the project to "incremental operating costs." The reallocation was necessary because the R2E2 Fund exhausted the original allocation of funds for incremental operating costs due to significant depreciation of the US$/AMD exchange rate. In particular, the AMD depreciated by over 30 percent since project appraisal in December of 2005. Additionally, those funds were needed to cover the incremental operating costs of the 6-month project closing date extension.

Given that implementation of some activities under the GEF funded TA component was progressing slowly, the Government requested the Bank to extend the closing date of the project from December 31, 2010 until June 30, 2011. The Bank concurred with the Government's request and the proposed changes were approved by the Country Director in June 2010.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

Below is the analysis of major factors that contributed to project achievement and shortcomings.

Sound background analysis and solid project preparatory work: The GEF project preparation grant supported a number of key project preparatory activities, including:(a) identification of the key barriers impeding development of renewable energy in the country; (b) development of a pipeline of small renewable energy projects; (c) identification and development of recommendation for removal of barriers to renewable energy; (d) development of key performance indicators and M&E arrangements for the project; and (e) capacity building for the R2E2 Fund, PSRC and other public agencies.

Therefore, the project was well focused on removal of the key barriers to development of renewable energy in Armenia: information (e.g. availability of data and information on potential renewable sites, energy potential estimates, and viability of various renewable energy resources), gaps and deficiencies in the legal and regulatory framework as well as lack of long-term concessional financing for small renewable energy projects.

The project design also drew upon the lessons learned from design and implementation of similar renewable energy projects, including Turkey Renewable Energy Project (2004), Hungary Small Hydro Project financed by GEF (2003), Macedonia Power System Improvement Project, which had a component on rehabilitation of mini hydropower plants (1998), India Renewable Resources Development Project (1992), and a number of Mexican renewable energy projects.

Assessment of the project design: The PDO was well-defined and realistic. The PDO was consistent with one of the main goals of the FY 2005-2008 CAS for Armenia - promoting private sector growth by strengthening the financial sector and reducing infrastructure bottlenecks. The project components and key outcome indicators were consistent with the PDO. The design of project components reflected the following key lessons learned from project preparation, other Bank projects and analytical work:

a. *Government commitment to development of renewable energy*. Development of renewable energy was a priority for the Government, as identified in the Energy Sector Strategy (2006), due to cost competitiveness as well as environmental and energy security considerations.
b. *Adequate policy and regulatory framework for renewable energy*. The international experience suggested that the policy and regulatory framework for renewable energy should be clear and supportive for long-term sustainability of investments. Two key factors that contribute to growth of grid-connected renewable energy are the power purchase agreements and the feed-in tariffs. During the project preparation, the PSRC established attractive feed-in tariffs for renewable energy based power plants (higher than for any other generation plants at the time of appraisal) and the Government introduced mandatory off-take of all the electricity generated for the period of 15 years after receipt of an operating license.
c. *Management of credit lines by existing, preferably private, financial institutions*. The "financing of investments" component of the project was well designed and planned to be implemented by CC, a non-bank financial institution, which had a solid management and strong professional team to review and approve the sub-loan applications from project developers. Additionally, financing of renewable energy was one of the strategic business priorities of CC, thus, it also provided US$3.0 million of equity co-financing.
d. *Flexible project design given the knowledge-intensive nature of renewable energy*. Some aspects/technologies of renewable energy are quite knowledge-intensive and involve significant "learning-by-doing." Therefore, the project design should allow sufficient flexibility to adjust project implementation accordingly. The TA component of the project was flexible enough to allow changes in the focus of activities given the results/findings of various feasibility studies/estimates of renewable energy resource potential. Moreover, the "financing of investments" component was flexible in terms of the types of renewable energy based power generation plants, which could be financed.

The project was implemented in cooperation with other donors and partners involved in supporting penetration of renewable energy in Armenia. Specifically, EBRD and CFF provided US$7.0 and US$3.0 million respectively to co-finance the "financing of investments" component of the project. CC pooled IDA project funds with co-financing provided by EBRD and CFF and on-lent to project developers. In addition, implementation of the TA component of the project was coordinated with USAID, which provided some technical assistance to the private sector for appraisal of renewable energy projects and to the PSRC for improvement of the regulatory framework for renewable energy. Additionally, the R2E2 Fund coordinated with TACIS financed project supporting energy sector policy in Armenia.

The project was geographically dispersed. The "financing of investments" component financed a total of 26 SHPPs in 8 regions (marzes) of Armenia. The TA component of the project also had broad geographical coverage. For example, the update of SHPP scheme, the GIS and the associated database on renewable energy potential covered the entire territory of the country.

The implementing agency of the project, the R2E2 Fund, had adequate capacity to implement the project. The R2E2 Fund had a solid management team with adequate qualifications and extensive experience, including a project coordinator. The operations of the R2E2 Fund were overseen by the Board of Trustees, originally chaired by the Prime Minister and subsequently by the Minster of Energy and Natural Resources (MENR).

Adequacy of Government commitment: The Government commitment to project objectives and ownership of the project were strong. Overall, the Government was committed to implement the activities under the project given its commitment to development of renewable energy as specified in the Energy Sector Strategy (2006) and the National Program on Renewable Energy and Energy Efficiency (2007).

Assessment of risks: The risk assessment was thorough and focused on both PDO level risks and component result risks. The identified mitigation measures were appropriate and took into account the experience of similar projects implemented by the Bank. During the project implementation none of the risks materialized. Specifically, there were no changes in legal and regulatory framework for renewable energy, which could jeopardize sustainable of ongoing sub-projects or impeded new investments in the sector. The requirement for off-take of electricity generated at renewable energy based power plants was retained and the tariffs were regularly revised to reflect the changes in inflation and US$/AMD exchange rate. Although the management and some key staff of CC changed during the project implementation, it did not have material impact on performance of portfolio and overall implementation of the "financing of investments" component. The Bank and EBRD closely observed developments at CC, monitored lending and pipeline development activities, and regularly met with the management to ensure that the institution did not have major issues related to the project. Additionally, both the Bank and EBRD provided capacity building support to ensure that the key staff involved in the project had the necessary expertise to review, appraise and efficiently monitor sub-projects.

2.2 Implementation

Overall, the implementation of the project was sound. The project exceeded all of the target outcome indicators. The project funds under "financing of investments" component of the project were almost entirely disbursed by the end of 2009. There have been some delays with implementation of the TA component given the Government delays in deciding which critical activities to finance.

The mid-term review of the project was conducted on July 15 - August 5, 2008. The mid-term review established that the PDO and outcome indicators continued to be relevant given increasing prices of natural gas, and the need for new generation capacity considering the aging power generation assets and the planned decommissioning of the existing nuclear power plant. The mid-term review found that the project made satisfactory progress towards achievement of PDO.

The mid-term review did not recommend any changes to the project design, PDO, key outcome indicators, and/or implementation arrangements. The Government was only advised to revise one of the results indicators for the TA component of the project. Specifically, the mid-term review recommended replacing results indicator of "the number of applications/business plans for small renewable project developed" with "the number of renewable project developers, which received financial and legal advisory support" indicator to measure how successful the project was in facilitating investments in renewable sub-projects. The project implementation suggested that the market did not need specific support with preparation of applications/business plans for renewable energy projects. Instead, the R2E2 Fund received requests from the project developers for financial and legal advisory support.

The following key factors contributed to successful implementation of the project:

- Solid project design incorporating lessons from best practice regional and international experience of similar Bank supported projects: The project design reflected the lessons learned from design and implementation of similar Bank projects globally. Specifically, the project relied on competent PFI to implement the on-lending component, envisaged substantial TA to remove obstacles to development of renewable energy, and did not prescribe application of specific renewable energy technologies as well as ensured solid project monitoring systems.
- Continuous Government commitment: The Government remained committed to the project objectives throughout project implementation. Moreover, throughout the project implementation the key counterpart, the MENR, provided the needed support to facilitate implementation and resolve various project related issues.
- Strong and competent PFI: Sound implementation of the "financing of investments" component was substantially due to competent and experienced professional team and management of CC, which was willing to try new lending products and develop a new line of business.
- Effective and professional project implementing agency: The project implementing agency had experienced project management, fiduciary and technical staff and ensured effective and timely implementation and sound supervision of the project.

The delays in implementation of the project were caused by slow decision-making by the Government on spending directions of TA funds in the final years of project implementation. Those delays resulted in US$230,000 of unspent GEF grant funds, which were cancelled at project closing. The delays were primarily due to absence of consensus within the Government on spending directions for the remaining TA funds. The Government initially planned to use those funds to finance preparation of a pilot solar PV project, technical and economic/financial assessments for the Loriberd hydropower project, and a study on innovative financial mechanisms for financing of renewable energy projects. However, the Government found a private investor for the pilot solar PV project and decided to pursue construction of the Loriberd power plant as a private project. Moreover, the Government decided not to finance the study on innovative financial mechanisms given sufficient long-term financing available on the market for small renewable energy projects.

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

The key outcome indicators for the project were relevant to the PDO and consistent with the project components. The outcome indicators were well defined. The baseline data for all outcome indicators was available at appraisal. The R2E2 Fund had overall responsibility for monitoring and evaluation of the project and developed a management information system meeting the project needs. The management information system provided information and data on the pipeline of

renewable energy sub-projects; types of sub-projects; disbursed, committed and invested amounts, cost-sharing with financing partners; repayment delays; and fund reflows. Based on that information system, the R2E2 Fund submitted regular and on-demand implementation progress reports to the Bank, which also contained the key outcome and intermediate results indicators.

The data on key outcome indicators was reliable. The R2E2 Fund received most of it from the PSRC. Specifically, data on installed capacity of renewable generation added to the power grid and renewable energy generation added to the generation mix was provided by the PSRC – an independent multi-sectoral regulator with well-established data collection and reporting systems. Additionally, CC submitted to the R2E2 Fund quarterly reports on pipelines of projects, disbursements, repayments, etc. The M&E system was a useful feedback to the implementing agency and the Government during project implementation and supported decision-making.

2.4 Safeguard and Fiduciary Compliance

Environmental and Social Safeguards: The project was designed and implemented in compliance with Bank safeguard policies and procedures. The project was assigned the "Financial Intermediary" environmental screening category and triggered OP 4.01 (Environmental Assessment), OP 7.50 (Projects on International Waterways) and OP 4.37 (Dam Safety). The EMP adequately described the potential threats and their mitigations. The Operations Manual (OM) of the project contained an elaborate description of the environmental assessment process as well as requirements for compliance monitoring.

The project did not have significant or irreversible long-term environmental impacts. On the contrary, it contributed to reduction of GHG emissions by replacing some inefficient gas-fired thermal generation. The environmental impacts were temporary and caused by the construction of SHPPs. CC had a designated specialist, who reviewed all of the 26 sub-project financing applications to ensure that the environmental assessment report and EMPs of specific projects were in compliance with the Bank's safeguard procedures. Moreover, the R2E2 Fund hired a qualified environmental consultant to review the environmental due diligence process at CC and conduct site visits during construction and operation of SHPPs financed under the project. As part of the supervision missions, the Bank's environmental specialist also did not identify any major environmental issues and deviations from the EMP.

Procurement: Procurement under the project was carried out in accordance with the project design and in compliance with the legal agreements. The R2E2 Fund had adequate procurement capacity with a qualified procurement specialist and accurate as well as comprehensive procurement filing. The bidding documents, evaluation reports and contracts were prepared and presented in a competent manner. No major procurement issues were identified during project implementation.

Financial Management: Financial management under the project was conducted in accordance with the Bank guidelines and rules. The FM staffing and organization arrangements were overall adequate and acceptable to the Bank. The Interim un-audited financial reports (IFRs) as well as the project and the R2E2 Fund annual financial audits were submitted without delays and were of adequate quality. The level and timeliness of government co-financing was satisfactory.

2.5 Post-completion Operation/Next Phase

In order to ensure sustainability of project results, the following key activities need to be implemented:

- Improved enforcement of compliance with minimum environmental flow requirements of rivers: The Government needs to improve enforcement of rules regulating minimum environmental flow of rivers. Specifically, some rivers have low annual average flow rates and strong seasonal fluctuations of those rates. Therefore, the daily flows might be well below the water required to operate the SHPPs at full capacity. This creates strong economic incentive for SHPP owners to utilize the technically possible maximum of river volume and not honor the minimum environmental flow regulations. Therefore, monitoring and enforcement of the minimum environmental flow requirements by the water authorities should be improved. Besides, the Government needs to expedite adoption of the revised methodology for calculation of the environmental flow of rivers and maximum allowed intake from surface waters since the existing methodology is not sufficiently clear and creates room for misinterpretations. The proposed legislative amendments are expected to be adopted by the National Parliament by the end of 2012.
- Adoption of remaining legislative amendments to promote development of renewable energy in the country: The Government needs to adopt the legislative amendments to the Water Code and the Law on Environmental Impact Assessment as recommended by the Inter-Sectoral Committee established to pursue enactment of legislative changes proposed under the project to further improve the regulatory framework for renewable energy. Specifically, the Government needs to extend the validity period of water use permits from the current period of 3 years, which is short and creates regulatory risks for investors. Moreover, the review period allowed for the Ministry of Nature Protection for the reports on Environmental Impact Assessment should be reduced from the current maximum of 12 months, so not to hinder timely development of projects due to bureaucratic delays. The proposed legislative amendments are planned to be adopted together with the new Water Code by the end of 2012.
- Revision of tariffs: The project contributed to realization of economically and financially most attractive small hydropower potential. The SHPP projects with estimated high rates of return at current tariffs were mostly developed. The existing tariffs for SHPPs will start becoming increasingly unattractive for utilization of remaining small hydropower potential. Therefore, to inform the Government thinking on potential feed-in tariffs required to promote realization of remaining renewable energy potential, the project supported preparation of the Renewable Energy Roadmap. The Roadmap recommended targets for penetration of renewable energy, including SHPPs, and proposed policy instruments, including estimates of required feed-in tariffs, to achieve those targets. The Roadmap will help the Government to make informed decision on feed-in tariffs required for further utilization of small hydropower potential.

Armenia can further increase the share of renewable energy based power generation through development of the mid-size Loriberd and Shnogh Hydropower Plants on the Dzoraget river in the North of the country. The Government plans to develop those projects with involvement of the private sector. The Loriberd project was assessed to be technically and economically viable with substantial benefits to the country. In particular, the Loriberd HPP could have an installed capacity of 66 MW and generate around 200 billion kWh of electricity per year.[2] There has been no feasibility study for Shnogh HPP, but its potential power output is estimated at 245 billion kWh per year. The projects will: (a) help to reduce the possible electricity supply gap given that the

[2] Estimated at 3 percent of total electricity generated in the country in 2010.

country will need new generation capacity once the existing nuclear power plant is decommissioned and operation of old and inefficient thermal units is discontinued; (b) further improve the country's energy security by reducing the reliance on imported gas for thermal generation; and (c) supply power to meet daily peak demand at competitive costs.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

The project is relevant to current priorities of the country and the Bank's assistance strategy. In particular, the project is well aligned with the Energy Sector Strategy (2006) and the National Program on Renewable Energy and Energy Efficiency (2007), which prioritize development of renewable energy as a means of improving the country's energy security and ensuring sustainable energy supply.

The project objective is consistent with the current development priorities as reflected in the Country Partnership Strategy (CPS) with Armenia for FY 2009-2012. One of the key objectives of the current CPS is to strengthen the foundations for competitiveness through investments in new power generation capacity, including renewable energy based.

3.2 Achievement of Project Development Objectives and Global Environment Objectives

Achievement of the PDO and GEO is rated Satisfactory. The project made significant progress in meeting these objectives and exceeded all of the outcome indicators:

(i) 133 MW of renewable capacity was added to the power grid compared to the project target of 127 MW.
(ii) 417 GWh of renewable generation was added to the generation mix compared to the project target of 336 GWh.
(iii) Carbon dioxide emission reductions were 270,770 tCO_2 compared to the project target of 218,400 tCO_2.

The project met the development objective through:

(i) Financing of investments in new SHPPs. The project increased the small renewable capacity, connected to the power grid, by providing financing for construction of new SHPPs. The demand for funds was strong given the lack of long-term financing for renewable projects and excessive collateral requirements as a result of high perceived risks by financial institutions. CC provided sub-loans to project developers with maturity of 7-8 years and annual rate of 11 percent for US$ denominated sub-loans and 12.5 percent for AMD denominated sub-loans (see Annex 1 for more details). The local financial institutions did not offer such loans except for those involved in the KfW financed project. In total, the project financed 26 SHPPs with a total cost of US$28.6 million.[3] The total installed capacity of plants financed was 44.5 MW with total estimated annual generation of 159 GWh.
(ii) Assistance to remove the barriers for development of renewable energy. The project supported scale-up of small renewable energy power plants in the country due to substantial contribution to:

[3] Including EBRD and CFF co-financing and project developers' contribution of at least 30%.

(a) Improvement of regulatory environment for renewable energy. Specifically, the project supported preparation of legislative amendments to remove obstacles to development of renewable energy in the country.
(b) Development and adoption of technical standards for renewable energy and regulations for dispatching and load regulation of grid-connected renewable energy plants. Those enabled to ensure smooth absorption of new small renewable energy plants by the grid.
(c) Support in removal of information barriers to investments in renewable energy. In particular, the project contributed to development of GIS of renewable energy resources in the country and an associated database, which were made publicly available. Additionally, the project supported the update of the SHPP Scheme, which provided critical information/data on potential SHPPs in the country with brief assessment of their economic/financial viability. The updated SHPP Scheme was made publicly available and received positive feedback from project developers and investors as a useful resource to facilitate decision-making. Moreover, the R2E2 Fund prepared a detailed guide for investors/project developers with key legislation and regulations pertaining renewable energy sector and a comprehensive guide on development of business plans, feasibility studies, including financial appraisal of renewable energy projects.

The TA, aimed at improving the investment environment for renewable energy, coupled with strong demonstration effect of early sub-projects contributed to the leveraging of around US$56.4 million of investments in small renewable energy projects, which added 88.5 MW of new renewable energy capacity to the grid with an estimated annual generation of 258 GWh. Those investments included SHPPs financed with support of the KfW and IFC projects. Specifically, in 2009, IFC provided US$15.0 million loan to one of the local commercial banks (Ameriabank) to finance small renewable energy projects. In 2010, the KfW started implementing €18 million (around US$ 24 million) Renewable Energy repeater project, which relied on local FIs to provide sub-loans for construction of SHPPs.

The new renewable energy based generation added to the generation mix led to 270,770 tCO_2 reduction in carbon dioxide emissions given the displacement of more polluting and inefficient gas-fired thermal generation.

3.3 Efficiency

The post-completion economic and financial viability of the project was done using cost-benefit analysis for framework-type projects. The economic and financial analysis was based on the actual outputs of each component, the actual costs during the project implementation and revised projection of costs and benefits. The economic costs and benefits were calculated exclusive of taxes and subsidies and the assessment of the financial costs and benefits was done inclusive of taxes (see Annex 3 for more details).

Economic analysis: The economic costs to achieve the project objectives were reasonable. The financing of investments component of the project provided funding for 26 SHPPs and demonstrated the financial and technical viability of such investments. The demonstration effect coupled with the TA component, which contributed to improvement of the regulatory environment for renewable energy, facilitated leveraging of around US$56.4 million of investments in renewable energy. At completion, the project was estimated to have an NPV of US$71 million and an EIRR of 22 percent, compared to appraisal stage NPV of US$30 million and an EIRR of 17 percent. Improvement of the post-completion economic viability of the project is primarily due to

higher actual total investments in SHPPs and, thus, larger economic benefits from displacement of more expensive and polluting gas-based thermal generation and related GHG emission reductions. Additionally, the project contributed to improvement of the country's energy security by increasing the share of electricity supply based on indigenous energy resources. Specifically, the share of small renewable projects in the total generation mix increased from 0.5 percent at appraisal to 6.5 percent at completion.

Financial analysis: The post-completion financial analysis of the project was conducted for three types of demand-driven sub-projects financed under the financing of investments component of the project: (a) run-of-the-river SHPP, (b) SHPP on irrigation network and (c) SHPP on water supply network. The post-completion analysis confirmed that the project was financially sound despite a substantial increase in key factors affecting the financial viability of the project.

At completion, an average run-of-the-river SHPP was estimated to have an NPV of US$225,147 and an FIRR of 14 percent, compared to an appraisal stage NPV of US$400,000 and an FIRR of 21 percent. The deterioration of financial viability of run-of-the-river SHPPs was primarily due to an estimated 70 percent increase in nominal investment costs.

At completion, an average SHPP on irrigation network was estimated to have an NPV of US$131,639 and an FIRR of 13 percent. At completion, an average SHPP on water supply network was estimated to have an NPV of US$97,794 and an FIRR of 13 percent. The appraisal stage NPV was estimated at US$155,297 and the FIRR at 15 percent. Deterioration of financial viability was due to an estimated 30-35 percent increase in nominal investment costs for SHPPs on artificial water flows and 2 percent lower that estimated plant factor.

3.4 Justification of Overall Outcome and Global Environment Outcome Rating

Rating: Satisfactory

The overall outcome of the project is rated Satisfactory due to high relevance of the project, achievement of PDO and GEO as measured by the key performance indicators, and efficiency. The project contributed to significant increase in privately owned and operated power generation utilizing renewable energy.

The project increased installed renewable-based generation capacity as well as the renewable energy based generation supplied to the grid through: (a) financing of investments in construction of new or expansion of the capacity of existing SHPPs; (b) development and enactment of legislation /regulations, including technical, aimed at improvement of regulatory framework for renewable energy; (c) removal of information barriers, including update of the SHPP scheme and development of renewable energy database and a GIS map; organization of renewable energy weeks; (d) capacity building for lending institutions financing renewable energy sub-projects; and (e) increased public availability of information/data pertaining to renewable energy through the web-site of the R2E2 Fund (www.r2e2.am) and the MENR web-site for renewable energy (www.renewablenergyarmenia.am).

The post-completion economic efficiency of the project was robust given substantial economic benefits from displacement of higher cost electricity generated at old and inefficient gas-fired thermal plants and GHG emission reductions. The post-completion financial efficiency of investments was lower, compared to the appraisal stage estimate; nevertheless, at completion, the project was estimated to be financially robust. The lower post-completion financial efficiency was

due to higher costs driven by increase in prices of key SHPP equipment, including turbines and penstock, and construction materials.

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

The project had both temporary and permanent impact on poverty reduction. Specifically, residents from the local rural areas were temporarily hired to work on construction of 26 SHPPs financed under the project. The average construction time is estimated at around 24-36 months and the average salary for temporary employees was around US$300-400/month. Additionally, the project contributed to long-term poverty reduction by creating permanent jobs. In particular, each new operational SHPP resulted in creation of 3-5 new jobs (e.g. power engineers, janitors). Therefore, the project is estimated to have generated 100 new permanent jobs with an average monthly salary of around US$200-300.

(b) Institutional Change/Strengthening

The project had the following impacts on development and strengthening of institutions in the country:

- Introduction of project financing and improvement of due diligence skills of financial institutions. Implementation of the on-lending component of the project helped CC to strengthen its professional capacity to do project financing and conduct due diligence of small renewable energy projects. Although CC was merged with Cascade Bank and the latter was subsequently overtaken by Ameriabank, there have been substantial "skill spill-over" effects as several of the key staff involved in the Bank project were retained.
- Strengthened capacity of project developers. Training, Renewable Energy Weeks as well as several workshops with sessions on preparation of business plans, technical aspects of renewable technologies, new renewable energy technologies/equipment, preparation of EIAs/EMPs substantially contributed to strengthening of project developers' capacity to prepare and implement renewable energy projects. This was evidenced by reduced demand from project developers for R2E2 assistance in preparation of business plans/financing applications during the final years of project implementation.

(c) Other Unintended Outcomes and Impacts (positive or negative)

The project had positive unintended impacts. It contributed to development of local manufacturing of SHPP equipment. Specifically, the project stimulated local manufacturing of turbines through creation of demand under the SHPP sub-projects financed and indirectly by leveraging additional investments in SHPPs, which increased demand for locally manufactured turbines. Additionally, the project facilitated establishment of local manufacturing of modern metal-plastic pipes used for SHPPs.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

During the implementation of the project several workshops/discussions were held related to development of SHPPs and other renewable energy resources in Armenia. The workshops were diverse and dedicated to various topics related to development of renewable energy, including obstacles to development of renewable energy, modern renewable energy technologies, prospects for development of certain renewable energy technologies in Armenia, renewable energy resource potential assessments, etc. For more details, please see Annex 6.

4. Assessment of Risk to Development Outcome and Global Environmental Outcome

Rating: Low
The risk that changes might occur that would be detrimental to project outcomes is rated Low. The regulatory environment for development of SHPPs continues to be conducive with limited political interference. The feed-in tariff is automatically adjusted for changes in inflation and US$/AMD exchange rate to compensate the owners for changes in the local currency denominated costs of imported equipment and inflation. The SHPPs are run in technically sound manner with adequate operation and maintenance budget.

However, future rate of increase in the share of renewable energy based power generation might be lower given that economically/financially most attractive projects have already been developed. Therefore, to maintain the momentum of small renewable energy development, the Government will need to revisit its interim and long-term renewable energy penetration targets, identify and remove the remaining obstacles to development of renewable energy and make a decision on future feed-in tariffs in order to realize the less attractive renewable energy potential. The Renewable Energy Roadmap developed as part of this project would facilitate the Government decision-making on those issues.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

(a) Bank Performance in Ensuring Quality at Entry
Rating: Satisfactory
The Bank's performance during identification, preparation and appraisal of the project is rated Satisfactory. The project responded to a key development priority of facilitating development of the private sector and developing basic infrastructure as specified in the PRSP. Moreover, the project was consistent with the PRSP focus on increased reliance on indigenous energy resources to improve energy security of the country.

The project design was sound. The project design drew extensively from the experience of similar Bank funded renewable energy projects globally. In particular, the project did not prescribe application of specific renewable energy technologies, but rather relied on demand driven approach. It specified eligibility criteria for sub-projects, including the types of market-ready renewable technologies, and ensured that the PFI under the project had the right mix of skills and expertise to conduct its own due diligence of sub-projects. The project included substantial TA component aimed at creating enabling environment for renewable energy investments through improvement of legal and regulatory framework for renewable energy, capacity building for private sector and state agencies, and removal of information barriers. The project was underpinned by sound economic and financial analysis. Specifically, analysis of costs of small renewable projects (SHPPs on natural and artificial water flows and WPPs) was conducted to demonstrate cost-competitiveness of small renewable projects compared to new mid-size/large hydropower plants, new CCGT plant, and electricity imports. The project team also did thorough cost-benefit analysis for investment component of the project to assess its economic and financial viability.

The safeguards arrangements were adequate. The R2E2 Fund was required to prepare an EMP describing possible environmental impacts and ways to avoid/mitigate them during construction and operation of small renewable energy plants. The project also required the sub-project developers to prepare specific EIAs and EMPs as appropriate, which were to be reviewed by the

environmental specialist at CC. Additionally, the R2E2 Fund was to review the EIAs/EMPs for all sub-projects and conduct site visits to monitor construction and operation of SHPPs financed under the project.

The fiduciary arrangements under the project were sound. The financial management assessment was detailed and identified the key FM risks and proposed adequate mitigation measures. The procurement arrangements reflected the project design and were overall appropriate for a project of this nature.

The implementation arrangements of the project were well-elaborated and considered the lessons learned from other similar Bank projects. The monitoring and evaluation arrangements were adequate. The outcome indicators were clear and the numerical targets were easily measurable.

The risk assessment was thorough and contributed to identification of appropriate mitigation measures. The mitigation measures drew on experience of similar projects in the region and included significant TA and public awareness campaigns.

The Bank team included specialists with required expertise to prepare the project. Several of the key staff members were based in the field, which allowed for cost-effective preparation of the project and provision of timely advice and guidance to the Borrower. Additionally, during project preparation, the team effectively relied on the expertise of Quality Enhancement Review panel members and peer reviewers.

(b) Quality of Supervision
Rating: Satisfactory
The Bank's performance during supervision is rated Satisfactory. The Bank team carried out 12 supervision missions during implementation of the project. The implementation issues encountered were flagged and appropriate actions undertaken to address them. The skill mix of supervision missions ensured that all the key issues arising were adequately handled and the Government received the needed advice and guidance. The project team proactively observed the situation on the ground to ensure that the project design remained relevant. Several of the project team members were field-based, including the operations officer, the energy consultant, the procurement specialist, and the financial management specialist. This allowed for more effective and quick resolution of operational and fiduciary issues. During the project implementation, the task team composition did not change, which increased efficiency of support provided to the Government. During supervision, the task team closely coordinated with EBRD and CC to discuss issues and develop a unified approach in handling them.

The fiduciary and safeguards aspects of the project were adequately supervised. The financial management supervisions and procurement ex-post reviews were conducted as scheduled. The implementation issues were discussed with the Government counterparts in a constructive manner and appropriate action plans were developed and agreed with the Government.

Overall, the supervision missions provided a comprehensive assessment of the implementation progress. The Aide-memoires and ISRs were detailed, well written and highlighted the key issues.

(c) Justification of Rating for Overall Bank Performance
Rating: Satisfactory

The overall Bank performance is rated Satisfactory. The Satisfactory rating of the Bank performance at ensuring quality at entry and Satisfactory rating for quality of supervision justify the overall Satisfactory performance of the Bank.

5.2 Borrower Performance

(a) Government Performance

Rating: Satisfactory

Government performance is rated Satisfactory due to the Government's strong commitment to achievement of the PDO and GEO and its substantial supporting role during project preparation and implementation. There was close coordination and dialogue between the Government counterparts and the Bank during implementation of the project.

(b) Implementing Agency or Agencies Performance

Rating: Satisfactory

The R2E2 Fund performance is rated Satisfactory. The R2E2 Fund was adequately staffed and professionally managed to implement the project. The key staff turn-over at the R2E2 Fund was small, which ensured seamless implementation of the project. The R2E2 Fund effectively managed both the investment and TA components of the project. The R2E2 Fund provided guidance and support to the PFI, implementing the financing of investments component of the project. There have been no major issues associated with fiduciary aspects of the project. The R2E2 Fund had an environmental consultant to review the project-specific EIAs/EMPs for SHPPs and the R2E2 Fund engineers supervised construction and operation of SHPPs through random site visits.

Overall, there were no major short-comings in the performance of the R2E2 Fund during the project implementation. The R2E2 Fund was adequately managed and efficiently handled most of the technical, fiduciary, legal and safeguards aspects of the project.

(c) Justification of Rating for Overall Borrower Performance

Rating: Satisfactory

The overall Borrower performance is rated Satisfactory due to the satisfactory performance of the Government and the implementing agency.

6. Lessons Learned

The design and implementation of the project offered some lessons that might be useful in preparation and implementation of similar projects:

- **Market-driven development of renewable energy**. The project did not prescribe financing of only one type of renewable energy technology. It rather specified the eligible types of market-ready renewable energy technologies, considering capacity of the industry, cost-effectiveness and regulatory framework, and relied on demand-driven allocation of investment funds for specific sub-projects.
- **Comprehensive TA is instrumental for sustainability and scaling up of project results**. The TA component of the project focused on removing key policy/regulatory and information barriers and improving the capacity of relevant state agencies (PSRC, MENR) and the private sector in order to ensure sustainability of outcomes and contribute to replication through larger private sector investments in renewable energy.
- **Well-designed financing mechanisms for renewable energy projects are important for scale-up of renewable energy investments**. Introduction of project financing coupled with capacity building support to CC on project financing, technical, environmental and other aspects

of renewable energy projects helped to introduce to the market a new lending product, thus, explicitly displaying the viability of commercial lending for renewable energy projects and eliminating unwarranted perceptions of risks associated with such projects.

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

(a) Borrower/implementing agencies

No issues were raised by the Borrower on the ICR. The Bank team agrees with the Borrower's assessments provided in the letter from the MENR, dated January 27, 2012.

(b) Co-financiers

The Bank team did not have any comments on observations and assessments provided by EBRD on project outcomes, results and implementation.

(c) Other partners and stakeholders

N/A

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in USD Million equivalent)

Renewable Energy Project - P083352			
Components	**Appraisal Estimate (USD millions)**	**Actual/Latest Estimate (USD millions)**	**Percentage of Appraisal**
Investment	**25.05**	**27.7**	**111%**
Total Baseline Cost			
Physical Contingencies	0.00	0.00	-
Price Contingencies	0.00	0.00	-
Total Project Costs	**25.05**	**27.7**	**111%**
PPF	0.00	0.00	0.00
Front-end fee IBRD	0.00	0.00	0.00
Total Financing Required	**25.05**	**27.7**	**111%**
Renewable Energy GEF Project - P090058			
Components	**Appraisal Estimate (USD millions)**	**Actual/Latest Estimate (USD millions)**	**Percentage of Appraisal**
Assistance to remove barriers and support project implementation	**3.65**	**3.18**	**87%**
Total Baseline Cost	**3.65**	**3.18**	**87%**
Physical Contingencies	0.00	0.00	-
Price Contingencies	0.00	0.00	-
Total Project Costs	**3.65**	**3.18**	**87%**
PPF	0.00	0.00	-
Front-end fee IBRD	0.00	0.00	-
Total Financing Required	**3.65**	**3.18**	**87%**

(b) Financing

P083352, P090058 - Renewable Energy Project				
Source of Funds	**Type of Financing**	**Appraisal Estimate (USD millions)**	**Actual/Latest Estimate (USD millions)**	**Percentage of Appraisal**
Borrower		0.45	0.42	93%
European Bank for Reconstruction and Development		7.00	6.30	90%
Global Environmental Facility		3.00	2.77	92%
International Development Association (IDA)		5.00	4.99	99%
Borrowing Country's Fin. Intermediary/ies		3.00	3.00	100%
Sub-borrower(s)		6.60	9.59	145%

Annex 2. Outputs by Component

Component A: Assistance to remove barriers and support project implementation: This component supported the following key areas:

1. Improvement of legal and regulatory framework and capacity building for state agencies:

- *Improvement of regulatory environment for renewable energy*. This sub-component supported identification of legal, regulatory, institutional, financial and informational barriers impeding development of renewable resources and development of legislative amendments to overcome those. Specifically, this sub-component supported development of the following key legislative amendments: (a) revised methodology for calculation of the minimum environmental flow of rivers and maximum allowed intake from surface waters; (b) amendments to the Water Code extending the validity period of the water permits from 3 years to 40 years after the new Water Code is adopted; (c) amendments to the Law on Excise Tax introducing special product category of ethyl alcohol used for motor fuel and setting differentiated excise tax rates for imported (AMD 27,000/tonn) and domestically produced (AMD 1,000/tonn) ethyl alcohol to facilitate domestic production; (d) amendments to the Law on State Duty to differentiate between food-grade ethyl alcohol produced from yeast nutrients and ethyl alcohol to be used in motor fuel and produced from yeast nutrients with the latter subject to lower state duty; (e) amendments to the Law on Environmental Impact Assessment, setting a maximum period of 30 days, instead of the current range of 120-357 days, for review of findings of environmental impact assessment for renewable energy based plants by the agency under the Ministry of Nature Protection.

Several of the legislative amendments developed under the project were adopted and are enforced. However, the Government needs to expedite adoption of the above amendments as part of the new Water Code and the amended Law on Environmental Impact Assessment, which also incorporates several amendments required to operationalize the new Mining Code, adopted by the Government in 2011.

- *Technical standards for renewable energy*. This sub-component supported development of technical standards for various aspects of solar PV and wind turbines.

- *New regulations for dispatching and load regulation of renewable energy aimed at increasing renewable absorption capabilities of the power grid.* This sub-component supported development of technical standards for microprocessor based relay protection, ensuring reliable absorption of all renewable-based electricity generation by the power grid. The printed copies of the technical standards were distributed to the energy sector companies, the research institutes as well as higher education institutions.

- *Development of Renewable Energy Roadmap.* The roadmap focused on review of the role of renewable energy in meeting the country's electricity demand, revision of the final and interim renewable energy targets, and setting of targets for each renewable technology and identification of the obstacles to development of renewable energy. It also included milestones to allow regular tracking of progress towards the established goals.

- *Analytical support to PSRC*. This sub-component supported preparation of SHPP equipment price review, survey on barriers to development of SHPPs, as well as analysis of adequacy of the wind tariff and description of tariff methodologies for wind power adopted by countries, which were successful in promoting wind power. The above analytical exercises were done to further inform the PSRC thinking on the possible changes to the regulatory framework for SHPPs and wind power.

- *Commodity support to MENR and PSRC*. This sub-component supported acquisition of hardware (e.g. servers, work-stations), software (e.g. basic computer software) and some office equipment for the PSRC and MENR.

2. Capacity building and other support to the private sector and support in facilitating investments in renewable sub-projects:

- *Training session on project finance*: The Bank team delivered two training sessions on project financing to loan officers of CC and other staff involved in appraisal of sub-projects.

- *Capacity building and other support to the private sector.* In order to facilitate removal of informational barriers for the development of renewable energy, the R2E2 Fund prepared a booklet containing the list of key legislation and regulations relevant for development and operation of SHPPs as well as detailed description of necessary steps the project developers should follow in order to build and operate a SHPP. The booklet also contained the list of all necessary documents the project developers were required to submit to various agencies/bodies in order to receive necessary permits and licenses.

- *TA to potential investors for project preparation.* This sub-component supported development of a comprehensive guide for preparation of business plans, financial models and feasibility studies for renewable energy projects as well as the software module for financial viability assessment of SHPPs. The guide and the software module were posted on the R2E2 web-site.

- *Support in removal of informational barriers.* The above sub-component supported also development of a comprehensive integrated database and the GIS on available renewable energy resources of the country. The database was made publicly available through the R2E2 web-site. Additionally, the above component supported development of the R2E2 Fund web-site, which was regularly updated and included general and detailed information on the energy sector, relevant legislation, the rules and regulations for obtaining necessary licenses, permits and other documents relevant for development of renewable energy projects. The TA component also financed update of SHPP scheme. The updated scheme has been available electronically on the R2E2 web-site. The updated scheme was approved by the Government decree in 2009.

- *Support in identification of potential non-conventional renewable resources:* This component supported assessment of renewable energy potential for a number of renewable energy resources. Specifically, in discussions with the government, academia, private companies engaged in non-conventional renewables and other sector stakeholders, the following non-conventional renewables were identified for further study:

Bio-ethanol: The project supported a feasibility study on development of bio-ethanol in Armenia. The results of the feasibility study suggested that Jerusalem artichoke and dry milling process with fractionation utilizing feed corn have the highest bio-ethanol potential. The results of the comparative analysis of various bio-ethanol plants suggested the following two financially feasible options: (1) a plant based on an inulin extraction process for Jerusalem artichoke to be situated in the vicinity of Sisian and Goris in Syunik Marz and (2), a plant based on a dry milling process with fractionation utilizing feed corn grown in Tavush Marz as a feedstock. The recommended capacity size of each of these two plants was estimated at 7,000 tons per year.

Photovoltaic industry: The feasibility study identified two economically viable technologies for development of PV industry. First, PV solar modules production based on Siemens process: mining of quartzite, processing for metallurgical silicon, production of poly-silicon via trichlorsilane production and purification, production of ingots, production wafers and solar cells, and production of PV modules. Second, solar module production based on Poly-silicon and Upgraded Metallurgical Grade (UMG) silicon blend as economically viable technology and specialization for Armenia. The proposed technological chain consists of mining of quartzite, processing for metallurgical silicon, production of UMG silicon and poly-silicon, blending process, production of ingots, production of wafers and solar cells, and production of PV modules.

Pumped storage hydropower plant: The proposed study explored the technical viability for constructing a pumped-storage hydropower plant, which would enable to improve the average power system capacity factor as well as reduce the average system costs. The technical study identified four technically feasible sites for pumped storage hydro power plant and recommended to conduct a detailed feasibility study for pumped storage hydropower.

As part of the efforts to facilitate investments in renewable energy, the R2E2 organized two Renewable Energy Weeks in October 6-8, 2008 and October 5-8, 2010. The Weeks were comprehensive events hosting renewable energy project developers, financial institutions, engineering and consulting firms, equipment producers and technology developers. The agenda of the Weeks was focused on the following key topics:

- Overview of resources and opportunities in the renewable energy sector, discussions of policy and tariffs;
- Renewable energy R&D and sessions/exhibitions allowing both vendors and technology companies to exhibit their products and ideas;
- Training on GIS, software for analysis of financial feasibility of projects, preparation of business plans, CDM projects as well as media coverage of renewable energy and;
- Specific inputs and recommendations to development of Armenia's Renewably Energy Roadmap.

3. Mechanisms to leverage additional financing: This component financed preparation of the founding legal documents required for establishment of a UCO under the R2E2 Fund. The UCO was originally planned to use the repayments from revolving funds under the Bank supported Urban Heating Project and Renewable Energy Project. However, the Government changed its approach and is currently contemplating to use the R2E2 Fund to contract directly with energy service providers to implement energy efficiency project and select financial institutions to onlend the repayments from on-lending components of the above projects.

The project did not finance design and piloting of originally planned financial instruments innovative to Armenia, including asset-backed securities and syndicated loans. This was due to lack of demand for such instruments given that there was sufficient financing available on the market for small renewable energy projects. In addition to US$15 million available under the project, around US$20 million was made available by various donors, including €6 million (around US$8 million) KfW Renewable Energy Project, its €18 million (around US$24 million) repeater, and the US$15 million IFC Renewable Energy Finance Project.

4. Project implementation and monitoring: This component primarily financed acquisition of hardware and office equipment for the R2E2 Fund and publications related to key outcomes and outputs of the project.

Component B: Financing of investments: This component provided financing through CC, the financial institution implementing this component of the project, for development small renewable energy sub-projects. Specifically, CC provided financing for 26 sub-projects with total cost of US$28.6 million, including US$4.95 million under the project. Implementation of this component was quite robust given that around 95 percent of the funds were disbursed by the end of 2009. The total installed capacity of SHPPs financed was 44.5 MW. The sub-loan repayment rates were robust at 99 percent for the entire portfolio of loans. 20 of the SHPPs financed under the project were operational as of June 30, 2011.

The terms of sub-loans were quite attractive for project developers given the long maturities (7-8 years) and affordable interest rates. Specifically, CC provided US$ denominated sub-loans to project developers at an average annual rate of 11 percent and AMD denominated sub-loans at an average rate of 12.5 percent.

The terms of on-lending of IDA funds to CC did not distort the market and were set at the actual cost of debt capital for CC. Moreover, the rates were not less than the terms applicable to financial intermediation under the now-closed Bank financed Urban Heating Project. At appraisal, the cost of debt capital for US$ denominated funds of CC was estimated at 5 percent. Given the cost of debt capital of CC and the lending rates of EBRD, co-financing the project, the R2E2 Fund on-lent the US$ denominated IDA funds to CC at a rate of LIBOR+1%. For AMD on-lending, the R2E2 Fund charged CC weighted average for 90-180 day deposits in AMD as calculated and published by the Central Bank of Armenia. The on-lending rate for IDA funds was adjusted every six months to reflect the basket of EBRD rate and the reference on-lending terms.

Annex 3. Economic and Financial Analysis

The post-completion economic and financial viability of the project was done using cost-benefit analysis for framework-type projects. The economic and financial analysis was based on the actual outputs of each component, the actual costs during the project implementation and revised projection of costs and benefits. The economic costs and benefits were calculated exclusive of taxes and subsidies and the assessment of the financial costs and benefits was done inclusive of taxes. See below the table on assumptions used for post-completion economic and financial appraisal.

Table 1: Key assumption of economic and financial appraisal

Average investment cost for run-of-the-river SHPP	US$900/kW
Average investment cost for SHPP on irrigation network	US$750/kW
Average investment cost for SHPP on water supply network	US$500/kW
Share of run-of-the-river projects	75%
Share of projects on artificial water flows	25%
Plant factor for run-of-the-river SHPPs	34%
Plant factor for SHPPs on artificial water flows	49%
Tariff for run-of-the-river SHPPs	US$0.060/kWh
Tariff for SHPPs on artificial irrigation network	US$ 0.041/kWh
Tariff for SHPPs on water supply network	US$ 0.027/kWh
Annual depreciation rate for run-of-the-river SHPPs	10%
Annual depreciation rate for SHPPs on artificial water flows	5%
Average estimated CER price	US$10/t$CO_2$
Profit tax	20%
VAT rate	20%
Useful life of investment	20 years
Discount rate	10%

Economic analysis: The post-completion economic analysis confirmed that the project was economically viable. The costs involved in achieving the project benefits were reasonable. At completion, the project was estimated to have an NPV of US$71 million and an EIRR of 24 percent, compared to appraisal stage NPV of US$30 million and an EIRR of 17 percent. The post-completion economic viability of the project improved primarily due to higher actual total investments in small hydropower plants and, thus, larger amount of more expensive gas-based thermal generation displaced and higher GHG emission reductions. The post-completion economic viability of the project was robust despite around 57 percent[4] increase in real economic investment cost[5] per 1kW of installed renewable energy based generation capacity. The project contributed to increase of the share of small renewable based power generation from 0.5 percent at appraisal to 6.5 percent at completion.

[4] The assessment includes all types of SHPPs: run-of-the river, on irrigation networks and on water supply networks. For SHPPs on artificial water flows, the capital cost increase was lower than for SHPPs on natural water flows.

[5] The real economic investment cost was calculated based on estimated share of local and foreign costs for SHPPs and relevant inflation rates.

The investments in small renewable energy during the implementation of the project included only SHPPs on natural and artificial water flows. There has been no investment in WPPs. The total funding mobilized for small renewable energy projects during the project life was estimated at US$85 million, which resulted in addition of 133 MW of new renewable energy capacity in Armenia. The above amount included US$28.6 million mobilized under the project (IDA, EBRD, CC co-financing combined with co-financing by project developers), an estimated US$27 million under IFC financed project on Renewable Energy Finance and KfW financed Renewable Energy Project and its repeater as well as an estimated US$29.4 of private investments. The project substantially contributed to increased private investments in the sector given the improved environment for investments due to TA component and strong demonstration effect of early sub-projects confirming technical and financial viability of investments.

Financial analysis: The post-completion financial analysis of the project was conducted for three types of demand-driven sub-projects financed under the financing of investments component of the project: (a) run-of-the-river SHPP, (b) SHPP on irrigation network and (c) SHPP on water supply network. All of the funding was channeled into the above types of sub-projects given that they were most competitive due to feed-in tariffs, lower investment and recurrent costs. The post-completion financial analysis confirmed that the project was financially viable.

At completion, an average run-of-the-river SHPP was estimated to have an NPV of US$225,147 and an FIRR of 14 percent, compared to an appraisal stage NPV of US$400,000 and an FIRR of 21 percent. The deterioration of financial viability of run-of-the-river SHPPs was due to an estimated 70 percent increase in nominal investment costs. The financial viability of run-of-the-river sub-projects is quite sensitive to investment costs. During the project implementation the feed-in tariff increased from US$0.045/kWh to US$0.060/kWh to reflect the changes in US$/AMD exchange rate and inflation as required by the feed-in tariff adjustment formula adopted by the PSRC.

At completion, an average SHPP on irrigation network was estimated to have an NPV of US$131,639 and an FIRR of 13 percent. At completion, an average SHPP on water supply network was estimated to have an NPV of US$97,794 and an FIRR of 13 percent. The appraisal stage NPV was estimated at US$155,297 and the FIRR at 15 percent. However, at appraisal, there has been no separate analysis of financial viability for SHPPs on irrigation and water supply network. The financial viability was analyzed for an average SHPP on artificial water flow (without detailing whether it was an SHPP on irrigation or water supply pipeline). The deterioration of financial viability of SHPPs on artificial water flows was due to an estimated 30-35 percent increase in nominal investment costs and lower actual plant factor for SHPPs on irrigation networks. However, at completion, the actual tariff was US$ 0.041/kWh for SHPPs on irrigation networks and US$0.027/kWh for SHPPs on water supply pipelines, compared to appraisal stage estimate of US$0.022/kWh.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Gevorg Sargsyan	Program Coordinator	SEGEN	Project team lead
Ani Balabanyan	Operations Officer	CFPTP	Operational support
Bjorn Hamso	Sr. Energy Economist	SASDE	Program team lead
Andrina Ambrose	Sr. Operations Officer	OPCCS	Operational
Junko Funahashi	Sr. Counsel	LEGEN	Legal
Alexander Astvatsatryan	Sr. Procurement Officer	ECSO2	Procurement
Inesis Kiskis	Sr. Environmental Specialist	-	Safeguards
Satoshi Ishihara	Social Development Specialist		Social
Arman Vatyan	Sr. Financial Management Specialist	ECSO3	Financial management
Surekha Jaddoo	Operations Analyst	ECSS2	Operational support
Stratos Tavoulareas	Consultant (Energy/Env.)	ECSS2	Technical
Carlo Segni	Lead Financial Officer	CMD	Financial intermediary
Josephine Kida	Program Assistant	ECSIE	Team support
Supervision/ICR			
Gevorg Sargsyan	Program Coordinator	SEGEN	Project team lead
Arthur Kochnakyan	Energy Economist	ECSS2	Analytical support
Ani Balabanyan	Operations Officer	CFPTP	Operational support
Alexander Astvatsatryan	Procurement Officer	ECSO2	Procurement
Armine Aydinyan	Consultant (Procurement)	ECSO2	Procurement
Arman Vatyan	Sr Financial Management Specia	ECSO3	Financial Management
Garik Sergeyan	Consultant (Financial management)	ECSO3	Financial Management
Wolfhart Pohl	Sr. Environmental Specialist	ECSS3	Safeguards
Stratos Tavoulareas	Consultant (Energy/Env.)	ECSS2	Technical
Irina Tevosyan	Program Assistant	ECCAR	Operational support
Josephine Kida	Program Assistant	ECSIE	Team support
Redemcion Canlas	Temporary	ECSSD	Transaction support
Yolanda Gedse	Program Assistant	ECSSD	Transaction support

(b) Staff Time and Cost

	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	**USD Thousands (including travel and consultant costs)**
Lending		
FY04	0.00	0.00
FY05	4.79	25,973.00
FY06	12.50	19,437.00
FY07	0.00	0.00
FY08	0.00	0.00
FY09	0.00	0.00
FY10	0.00	0.00

FY11	0.00	0.00
FY12	0.00	0.00
Total:	**17.29**	**45,410.00**
Supervision/ICR		
FY04	0.00	0.00
FY05	0.00	0.00
FY06	0.00	0.00
FY07	11.91	47,916.04
FY08	10.71	59,883.58
FY09	14.60	69,537.74
FY10	21.50	78,840.01
FY11	13.79	42,952.39
FY12	0.00	0.00
Total:	**73.51**	**299,129.76**

Annex 5. Beneficiary Survey Results

N/A

Annex 6. Stakeholder Workshop Report and Results

During project implementation regular meetings and several workshops were held with key stakeholders to discuss and solicit feedback on various issues related to renewable energy.

Development of SHPPs: Questions related to SHPP development in Armenia were raised and extensively discussed during several meetings with key stakeholders (MENR, PSRC, Ministry of Nature Protection, Water State Committee, Association of SHPP developers, hydropower plant design institutions, Hydropower, IFIs, local financial institutions, NGOs, etc.). The following key workshops were held on issues related to development of SHPPs.

Armenian Renewable Energy and Energy Efficiency Fund and development of small hydropower plants in the country: Workshop was held on Nov 2, 2006. The availability of sub-loans under the project was first introduced to key stakeholders.

GEF/WB Renewable Energy Project in Armenia: Workshop was held on December 6-7, 2006 in Yerevan. The workshop introduced the key components of the project to key stakeholders, which helped to shape the very specific activities to be undertaken under the TA component.

Resolving conflicts between SHPP developers and agricultural and irrigation projects in Armenia: Workshop was held on November 2, 2007 in Yerevan in the premises of the R2E2 Fund. The main outcome of this workshop was the data/information exchange and better coordination between the project activities and large irrigation projects funded by Millennium Challenge Corporation in Armenia. In particular, the workshop helped to resolve some controversial issues related to the dam of one of the SHPPs and a plan was developed to prevent such issues in the future.

Barriers to development of renewable energy in Armenia and ways to overcome them: Workshop was held on December 24-25, 2007, in the city Tsakhkadzor. During the workshop the findings of the study on "Development of renewable energy in Armenia: lessons learned, existing barriers, and measures for overcoming those barriers" were presented. The most important outcome of the workshop was the recommendation to the Government to establish an Inter-Sectoral Committee to remove the identified barriers. Based on the results of the study, the R2E2 Fund prepared a report on the scope of the works and list of necessary changes in Armenian legislation and regulations.

Other renewable energy: Questions related to renewable energy technologies were raised and extensively discussed during several meetings with key stakeholders (MENR, PSRC, Ministry of Nature Protection, IFIs, Water State Committee, NGOs, etc) as well as with representatives of scientific and business community, local authorities, engineers etc. The following key workshops were held on issues related to development of SHPPs:

Perspectives of biomass energy in Armenia: Workshop was held on October 5, 2007 at MENR premises in response to the request of main stakeholders to present current status of modern biomass energy technologies and prospects in Armenia. One of the main outcomes of the workshop was to request the Government to finance a feasibility study to assess technical and economic viability of producing bio-fuels in Armenia.

Perspectives of geothermal power in Armenia: Workshop was held on October 18-19, 2007 at National Academy of Science. Workshop was jointly organized by R2E2 Fund and Institute of Geology. The final document of the workshop recommended to conduct detailed technical studies to explore the possibility of electricity production on sites with high geothermal potential as well as low-potential applications based on heat pumps.

Perspectives of pumped Storage hydro in Armenia: Workshop was held on February 16, 2008 at the MENR. Workshop emphasized the importance of study of pumped storage hydropower plant (PSHP) in Armenia, taking into account the structure of generation mix and schedule of its modernization. The necessity of peak generation capacities was emphasized. Thus, taking into account the current tendencies (regional power flows, increase of the gap between daily maximum and minimum loads), it was agreed that in addition to basic technical study, a more detailed feasibility study will be required to assess the viability of PSHP.

Perspectives of bio-ethanol and biodiesel production in Armenia: Workshop was held on June 26, 200 at the MENR. The feasibility study consultant presented the key findings of the feasibility study on viability of commercial scale bio-fuel program in Armenia.

Perspectives of solar photovoltaic (PV) industry development in Armenia: Workshop was held on September 5, 2008 at the MENR. The workshop resulted in identification of the list of modern PV technologies which should be further analyzed to assess Armenia's competitive advantages in PV production value chain.

Utilization of hydro potential of Debet river: Workshop was held on March 19, 2010 at MENR. The participants of the workshop agreed that there is a potential to develop a mid-size hydropower plant (Loriberd HPP), which will increase the energy security of the country and help to meet the daily demand peaks if constructed as a peaking plant. A decision was made that update of the 2004 feasibility study for the above plant was warranted.

Renewable Energy Weeks: Two Renewable Energy Weeks were held – on October 6-8, 2008 and October 5-8, 2010. The Weeks were comprehensive events hosting renewable energy project developers, financial institutions, engineering and consulting firms, equipment producers and technology developers. The agenda included the following key topics: (a) overview of resources and opportunities in the renewable energy sector, discussions of policy and tariffs; (b) sessions on renewable R&D and poster sessions/exhibitions allowing both vendors and technology companies to exhibit their products and ideas; (c) training sessions on GIS, software for analysis of financial viability of projects, preparation of business plans, CDM projects as well as media coverage of renewable energy; and (d) working group discussions on obstacles to development of renewable energy in Armenia and measures to eliminate those obstacles.

Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

The Borrower's comments on the draft ICR were submitted in the letter from MENR, dated January 27, 2012.

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МИНИСТЕРСТВО ЭНЕРГЕТИКИ И ПРИРОДНЫХ РЕСУРСОВ РЕСПУБЛИКИ АРМЕНИЯ
MINISTRY OF ENERGY AND NATURAL RESOURCES OF THE REPUBLIC OF ARMENIA

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«27» 01 2012 թ.

To: Mr. Jean-Michel Happi
Country Manager
World Bank Armenia Country Office
Europe and Central Asia Region

Re: Renewable Energy Project ICR

Dear Mr. Happi,

Thank you for sending for our review and comments the Implementation Completion and Results Report (ICR) of the Renewable Energy Project. I am glad to note that the ICR is well written and expresses all outcomes and achievements of the Project. On behalf of the Government of Armenia I would like to extend our gratitude for your support to successful implementation the Renewable Energy Project in Armenia.

The success of the Project was conditioned by the fact that the project was well designed and aligned with the strategic objectives of the Government. The project resulted in significant growth of share of renewable energy generation by privately owned and operated power plants. It also promoted investments into the sector through support in removal of legal, regulatory, financial and informational barriers. As a result, the installed capacity and generation of electricity by renewables almost tripled during the project period. Specifically, the installed capacity increased from 47 MW in 2005 to 133 MW in 2011 and the electricity generation increased from 137 GWh to 417 GWh during the same time period. The project also increased awareness on environmental aspects of development of SHPPs, which is essential for long-term sustainability. Additionally, the project created permanent and temporary jobs in rural areas for qualified engineers and workers, as well as increased capacity of engineering, design and construction companies, and financial institutions. We are confident that the project outcomes will be sustainable given that the legal/regulatory environment remains conducive and the Government of Armenia continues to prioritize development of renewable energy in the country.Given the track record of successful cooperation with the World Bank, I am looking forward to further opportunities for collaboration.

Sincerely,

Minister of Energy and Natural Resources

Mr. Armen Movsisyan

ՀՀ, Երևան 0010, Հանրապետության Հրապարակ, Կառավարության տուն 2, հեռ. (37410) 521 964, ֆաքս (37410) 526 365
РА, Ереван 0010, Площадь Республики, Дом Правительства 2, тел. (37410) 521 964, факс (37410) 526 365
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Presented below is the summary of the Borrower's ICR.

A. Key Factors Affecting Implementation and Outcomes

Project Preparation, Design and Quality at Entry

Below is the analysis of major factors that contributed to project achievement and shortcomings.

Soundness of background analysis: The project design was underpinned by the sector work carried out prior to project preparation and was structured around the Energy Diversification Strategy (EDS) of the Government, adopted in June 2005. The project was designed to help remove the key legal, regulatory, institutional, technical, financial and information barriers for renewable energy development, as well as to increase privately owned and operated power generation utilizing renewable energy. The project drew extensively on the World Bank's sector work and experience of designing and implementing renewable energy projects in Europe and Central Asia Region.

Assessment of the project design: The PDO was well-defined, realistic and consistent with key objective of the EDS to increase privately owned and operated power generation utilizing renewable energy and reduce CO_2 emissions by overcoming barriers to the development of renewable energy. The PDO was consistent with FY 2005-2008 CAS for Armenia. The project components and key outcome indicators were fully compliant with the PDO. The project components were structured to help remove the key legal and regulatory, institutional, financial and information barriers and to increase privately owned renewable energy based generation. The design of project components reflected the following key lessons learned from project preparation, other Bank projects and analytical work:

- Power sector reforms and development of renewable energy should be part of an integrated strategy to avoid the situation of market reforms not reflecting unique characteristics of renewable energy.
- The institutional structures should be in place and the policy framework should be clear and supportive of the long-term sustainability of renewable energy.
- Where possible, existing (preferably private) institutions should be used for managing lines of credit.
- Renewable energy development involves a lot of "learning by doing", which among others highlights the importance of good project monitoring systems and the flexibility to learn and adjust financing and project implementation mechanisms.
- Procedures for reviewing and approving loan applications should be transparent and clear with minimum bureaucracy and without excessive multi-tier control.
- The implementing agency of the project, the R2E2 Fund had adequate capacity to implement the project. The R2E2 Fund was established by the Government Decree No.799N of April 28, 2005 as a non-commercial entity with the objective of facilitating investments in renewable energy and energy efficiency sectors and promoting development of renewable energy and energy efficiency markets in Armenia. The R2E2 Fund had solid management team with adequate qualifications and extensive experience to effectively implement the project. The operations of the R2E2 Fund were overseen by the Board of Trustees, originally chaired by the Prime Minister, and consisting of members from public and private sector and NGOs.

Donor partnership: The investment and TA components of the project were designed considering various donor-funded initiatives supporting renewable energy development in Armenia. Specifically, the project was well coordinated with the German KfW Bank funded German-Armenian Fund for Small hydropower plant development and the USAID US$3 million "Assistance to Energy Sector to Strengthen Energy Security and Regional Integration" project. There was substantial need for coordination especially with the Task 2 and Task 3 Activities of the below USAID project.

Adequacy of Government commitment: The Government commitment to project objectives and ownership of the project were strong.

Assessment of risks: The risk assessment was thorough and focused on both PDO level risks and component result risks. The identified mitigation measures were appropriate and drew on experience of similar projects in the region.

Implementation

The implementation of the project was sound and without any major delays. The project exceeded the expected target outcome indicators.

The following key factors contributed to successful implementation of the project:

- Solid project design and best practice regional and international experience of similar Bank supported projects: The project design reflected the lessons learned from implementation of project preparatory grant implementation (TF 053910) financed under the GEF TF. Additionally, the project design extensively drew upon the experience of RE implemented in the region.
- Continuous Government commitment: The Government remained committed to the project objectives during the project implementation.
- Effective and professional project implementing agency: The project implementing agency had experienced project management, fiduciary and technical staff and ensured effective and timely implementation and sound supervision of the project.

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

The key outcome indicators for the project were relevant to the PDO and consistent with the project components. The outcome indicators were well defined. Most of the results indicators for project components were directly collected by the R2E2 Fund and PSRC. They were regularly reported to the Bank. CC submitted regular reports to the R2E2 Fund on lending to project beneficiaries. Those data reports were combined with the R2E2's own statistics and made available to the Bank.

The R2E2 Fund cooperated with PSRC and MENR on obtaining data for target values.

C. Safeguard and Fiduciary Compliance

Environmental and Social Safeguards: The project design took into account the Bank's safeguard policies and included procedures and implementation arrangements to ensure full consideration of environmental safeguards. The project was assigned the "Financial Intermediary" environmental screening category and triggered only OP 4.01 (Environmental Assessment). The project Operational Manual (OM) had an Environmental Chapter providing detailed description of the process for assessment of sub-projects. The EMP adequately described the potential threats and their mitigations.

The project did not have any significant or irreversible long-term negative environmental impacts. The limited environmental impacts were caused by construction of SHPPs. The special consultant hired by the R2E2 Fund conducted regular field visits to the all sites of SHPPs financed under the project and did not identify any significant environmental issues. The Bank's environmental specialist also did not identify any environmental issues and deviations from the EMP.

Procurement: Procurement under the project was carried out in accordance with the project design and in compliance with the legal agreement. The R2E2 Fund had adequate procurement capacity with qualified procurement specialist and accurate as well as comprehensive procurement filing. The bidding documents, evaluation reports and contracts were prepared and presented in a competent manner.

Financial Management: Financial management of the project was carried out in accordance with project design and the legal agreement. Generally, the accounting and reporting arrangements, internal control procedures, budgeting, external audit, funds flow, organization and staffing arrangements during the project appraisal and implementation were adequate and acceptable to the Bank. Overall, the IFRs were of adequate quality and submitted to the Bank without delays. There was a case when IFRs contained errors due to malfunctioning of the reporting module of accounting software, which was fixed by the vendor. The project and R2E2 Fund audits did not identify any substantial issues and the audit reports and management letters were submitted to the Bank on time.

D. Assessment of Outcomes

Relevance of Objectives, Design and Implementation

Relevance of the project objective is rated high. The project objective, as stated in the PAD, was to increase privately owned and operated power generation utilizing renewable energy. The objective was relevant to and consistent with the development priorities of the Government as reflected in the Energy Development Strategy Paper (2006) and Sustainable Development Program (2008). The Government prioritized increased use of renewable energy, which in addition to direct benefits created significant indirect benefits in the form of technology transfer, jobs, prevented green house gas emissions. The project design remained relevant and reflected the current development priorities of the Government.

The project objective is consistent with the current development priorities as reflected the Country Partnership Strategy with Armenia for FY 2009-2012. The project objective was relevant for the FY 2005-2008 CAS for Armenia since one of the main goals stipulated in the CAS was development of renewable energy and reduction of GHG emissions.

Achievement of Project Development Objectives

Achievement of the project development objective is rated satisfactory. The project made significant progress in meeting the development objective and exceeded all of the key performance indicators. Table bellow summarizes the achievements on main outcome indicators in accordance to the PAD.

Main Outcome Indicators	2006	2007	2008	2009	2010
Installed new RE capacity connected to the power grid, (MW)					
Plan (Target Values)	50	65	80	105	127
Actual	59	75	88	106	133

Renewable generation added to the generation mix, (GWh)					
Plan (Target Values)	140	160	208	256	336
Actual	169	219	232	304	417
Carbone dioxide emission reductions, (ton CO_2)					
Plan (Target Values)	91000	104000	135200	166400	218400
Actual	110000	142200	150800	197750	270770

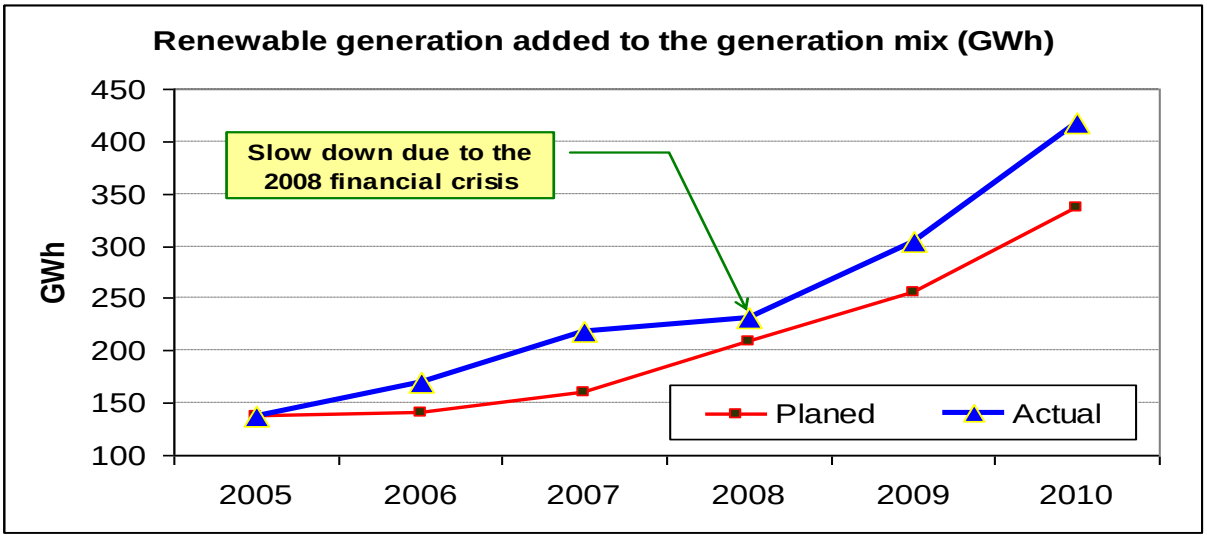
Besides, under the TA component several key activities were accomplished, including:

- Development of laws and regulations to improve the environment for development of renewable energy.
- Development of GIS, data base on renewable energy and renewable energy web portal, which provided comprehensive data on renewable resources.

The table bellow summarizes the achievements of the project objectives under the "financing of investments" component according to the indicators described in PAD of the project.

Outcome Indicators (credit component)	2006	2007	2008	2009	2010
Aggregate dollar amount of investments financed or leveraged by the PFI or the R2E2 Fund (million US$)					
Plan	2	6	11	16	21
Actual	0.0 (from which 0.0 R2E2 fund)	5.4 (from which 1.8 R2E2 fund)	11.8 (from which 3.7 R2E2 fund)	28.32 (from which 5.0 R2E2 fund)	28.6 (from which 5.0 R2E2 fund)
Loan repayment rates by the Project beneficiaries (%)					
Plan	NA	94%	95%	95%	95%
Actual	NA	95%	100%	95%	99%

Figure bellow presents how implementation of the project helped to meet one of the key outcome indicators – new generation capacity added to the generation mix of Armenia. As could be seen from this figure, actual level of new renewable based electricity generation capacity was never below planned level. It only slowed down a little in 2008 due to some effects of global economic and financial crisis on Armenia.

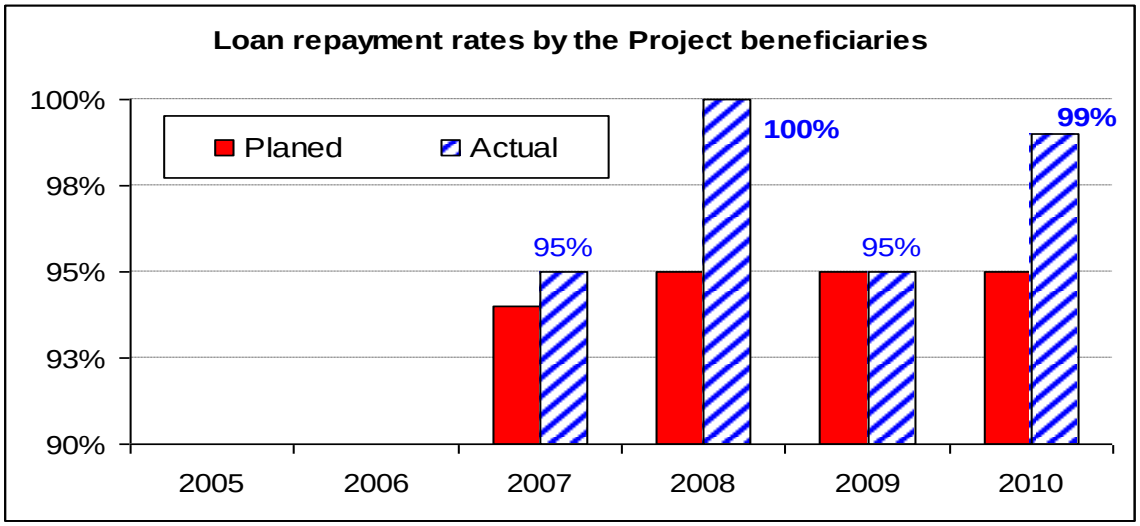


As of June 31, 2011, the total renewable energy based electricity generation (without mid and large hydro) in Armenia was about 417 million kWh or about 6.5 percent of total electricity production in the country. The electricity was generated by about 103 SHPPs with total installed capacity of 133 MW, including 2.64 MW wind farm and one 0.8 MW biomass plant.

The project met the development objective through support to renewable energy project developers in the following key areas:

(i) Support in project identification, design and development. The project supported the project developers to identify perspective sites for SHPPs, prepare design documents, and access affordable financing. Specifically, more than one decade old "SHPP development scheme of Armenia" was completely updated. The new "Updated Scheme" presents 115 new SHPPs with 147 MW of total installed capacity and 540 million kWh of total annual generation. A wide range of modern hydro turbines was considered and designs of SHPPs was not limited only to the derivational type SHPPs, but hydropower plants on irrigation pipelines or canals as well as on water supply network were also considered. Special field investigations were carried out in all 14 river basins of Armenia; geological, hydrological and other data was collected and analyzed. All technical, economic and financial parameters were updated.

(ii) Provision of affordable financing to the developers. Under the "financing of investments" component of the project 26 different SHPPs sub-projects were carried out with total installed capacity of about 44.5 MW and total estimated annual electriicty generation of 159 million kWh. As of June 30, 2011, 20 SHPPs from 26 were operational and the rest of the plants were at final stages of construction. The installed capacity of those power plants ranges from 0.38 MW to 5.7 MW. 15 of the 26 financed SHPPs were power plants on natural water flows (derivational SHPPs), 6 - on irrigation canals, 4 - on irrigation pipes and one plant was constructed on water supply network.



(iii) Capacity building and knowledge transfer. Under TA component of the project, 124 leading experts from Armenia and other countries (e.g. the United States, Denmark, Sweden, Switzerland and Russia) were involved. Under TA component about 24 studies were carried out in various areas related to renewable energy, such as small and mid-size hydropower plants, pumped storage hydropower plant, modern solar photovoltaic, bio-ethanol production, and grid-connected wind power. Beside, several activities were implemented to: (a) improve the regulatory framework for renewable energy and develop standards for several renewable energy technologies; (b) strengthen the capacity of public agencies and private sector; (c) disseminate information about new renewable energy technologies and associated benefits; (d) develop a comprehensive database of renewable energy resources, with a related open source GIS; (e) support development of business plans, feasibility studies, and preliminary designs. One of the key activities under this component was the preparation of Renewable Energy Development Road Map for Armenia.

Justification of Overall Outcome Rating

Rating: Highly Satisfactory

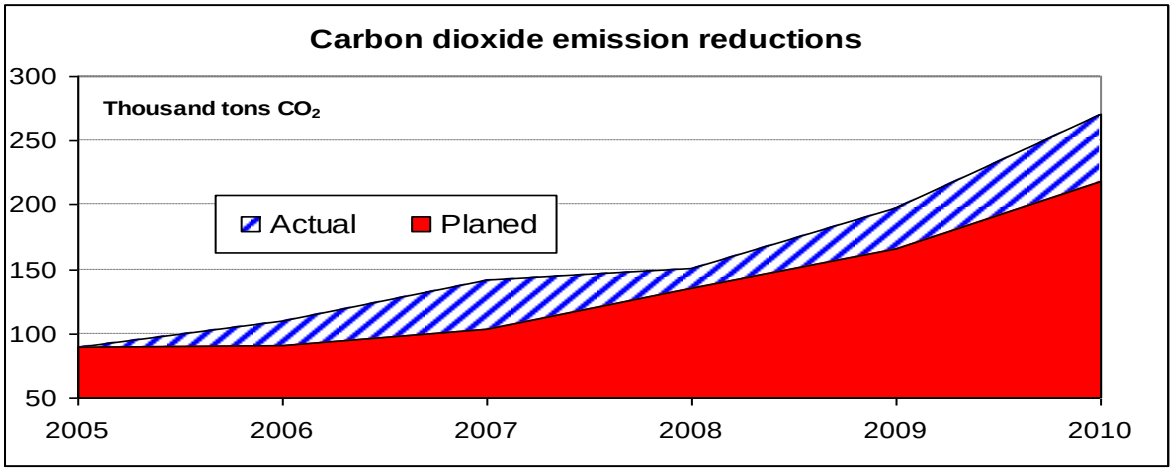
The overall outcome of the project is rated Satisfactory due to high relevance of the project and achievement of the project development objective as measured by the key performance indicators. The project contributed to substantial increase of privately owned and operated renewable energy based power generation in Armenia.

Under the "financing of investments" component of the project, 26 different SHPPs sub-projects were carried out with total installed capacity of about 44.5 MW and total annual estimated generation of 159 million kWh. As it was mentioned above, during project implementation the share of renewable energy generation in Armenia increased to over 6.5 percent of the total. Thus, only this project accounted for almost 40 percent of the increase in renewable energy based generation nationwide.

E. Overarching Themes, Other Outcomes and Impacts

GHG emission reduction and Social Development

Implementation of the project substantially reduced GHG emissions. Figure bellow presents the carbon dioxide reduction target for the project - one of the main outcome indicators, and its actual amount due to implementation of the project.



F. Assessment of Risk to Development Outcome

Rating: Moderate

The risk that some changes might occur that are detrimental to project outcomes is rated Moderate.

There are no technical, social, environmental, political, government ownership, governance and natural disaster exposure risks that may affect the development outcomes of the project.

G. Lessons Learned

The design and implementation of the project offered some lessons that might be useful in preparation and implementation of similar projects:

- Early preparatory work and adequate flexibility of procurement under the TA component are important for timely implementation of the project.
- Regular environmental monitoring of SHPPs by the implementing agency is essential for ensuring environmentally sound operation and adequate maintenance.
- Support for development of regulations, norms and standards for renewable energy is important for ensuring sustainability of project achievements.
- Well-designed and targeted public outreach activities are important for raising the awareness about the modern renewable energy technologies available on the market, their benefits and the support provided under the project to potential beneficiaries.

Annex 8. Comments of Co-financiers and Other Partners/Stakeholders

The EBRD comments were received in an email, dated January 23, 2012, and are presented below.

EBRD financing was part of US$15 million Armenian Renewable Energy Project, with US$5 million loan facility provided by the World Bank (administered by the R2E2 Fund) and a US$3 million in equity provided by CC. Debt and equity were contributed proportionally on a pro rata basis and on-lent to developers of small renewable energy projects (Small Hydro Power Plant sub-projects) in Armenia. The renewable energy project represented about 70 percent of CC's business, and was ring fenced from its other activities by the security assignment structure.

The success of SHPP sub-projects encouraged private sector investment and demonstrated the viability of renewable energy generation in Armenia. This was achieved through careful transaction structuring, thorough monitoring (credit risk, technical and environmental aspects) and capacity building support provided to CC (and subsequently to Cascade Bank after the merger with CC). In addition, EBRD led a regular dialog with the PSRC on the viability of the renewable energy tariffs.

The SHPP sub-projects were subject to detailed assessment by CC, which included assessment of the credit risk, technical and environmental issues, under the supervision of EBRD and the World Bank. The credit risk assessment considered a number of factors such as: (i) the financial information of the sub-borrower, (the business plan, cash generating capacity), (iii) the quality of collateral, (iv) the sub-borrower's credit history, (v) the sub-borrower's related parties, reputation and background etc. Furthermore, each investment had to meet specific lending guidelines, which in addition to addressing questions of commercial risk, included measures to evaluate integrity and reputation of sub-borrowers, and environmental requirements.

The sub-projects, financed under the Armenian Renewable Energy Project, were required to meet national environmental, health and safety regulations and standards, and public disclosure and consultation requirements. The project had an EMP, which included recommended procedures for project appraisal, design measures, construction supervision methods, monitoring actions and public disclosure requirements to help to minimize and avoid potential short and long-term environmental impacts associated with any sub-projects. The project benefited from the active involvement of the R2E2 Fund, which employed an environmental consultant, which screened all project-specific EIAs/EMPs for compliance with the EMP and prepared reports documenting compliance. Those reports were made available to EBRD as well. EBRD's environmental specialists reviewed site-specific EIAs/EMPs for all SHPPs and found them all satisfactory.

EBRD conducted detailed analysis of the first two SHPP sub-projects to ensure that CC had a clear understanding of and gave due consideration to the agreed lending criteria when making investment decisions. As the implementation of the sub-projects progressed, EBRD provided regular capacity building support to ensure that CC (subsequently merged with Cascade Bank) had the necessary expertise to monitor the sub-projects efficiently. As an example in mid-2008, Cascade Credit was encouraged to higher specialist hydro engineers, who performed frequent site visits to check upon the progress of the construction of SHPPs and closely monitored the implementation progress. EBRD also reviewed the staffing arrangements within CC as well as provided presentations on best practices (credit risk management and implementation related) to its staff.

Additionally, CC was to act as a bundling organization under the CDM development framework in order to aggregate and monetize carbon credits, allowing Armenian developers to tap into the international emissions trading market. EBRD's Multilateral Carbon Credit Fund (MCCF) was to be the off-taker. Revenues generated from CDM were expected to improve project economics and provide additional incentive to attract private capital. All the necessary approvals (CDM registration, validation etc) were obtained by the ICF consultants and the draft Agreement with MCFF was agreed with Cascade Bank and subsequently revitalized with Ameriabank post merger.

Annex 9. List of Supporting Documents

- Project Appraisal Document
- Operational Manual
- Development Credit Agreement
- GEF Grant Agreement
- Project Restructuring Papers
- Implementation Status Reports
- Supervision Mission Aide-Memoires
- "Charged Decisions: Difficult Choices in Armenia's Energy Sector." Armenia Energy Sector Note. World Bank. October 2011.
- Collection of presentations/documents of the Renewable Energy Week for 2010.
- Collection of presentations/documents of the Renewable Energy Week for 2009.
- Final Report of the Armenia Renewable Energy Roadmap. Danish Energy Management. August 2011.
- Assessment of the Pumped Storage Power Potential. Arm Hydroenergy Project. Dec.2009.
- Assessment of the PV Industry Development Potential in Armenia. Danish Energy Management & Solaren LLC. Oct. 2009.
- Updated SHPP Scheme of Armenia. Arm Hydroenergy Project. Sep. 2008
- A Preliminary Feasibility Assessment of the Preferred Alternative for Implementing a Commercial Scale Bio-Ethanol Fuels Program for Armenia in the Near to Mid Term. Enertech International Inc. and BBI International. Oct. 2008.

MAP


GEORGIA
TURKEY
AZERBAIJAN
ISLAMIC REPUBLIC OF IRAN
Lesser Caucasus Mountains
Vardenis Range
Zangezur Range
SHIRAK
LORRI
TAVUSH
ARAGATSOTN
KOTAYK'
ARMAVIR
YEREVAN
GEGHARK'UNIK'
ARARAT
VAYOTS' DZOR
SYUNIK'
Tashir
Alaverdi
Stepanavan
Ijevan
Gyumri
Vanadzor
Dilijan
Artik
Aragats (4090 m)
Karmir
Artsvashen
Sevan
Hrazdan
Gavar
Lake Sevan
Ashtarak
Vardenis
Martuni
Armavir
Artashat
Ararat
Jermuk
Yegegnadzor
Vaik
Angekhakot
Goris
Kapan
Megri
Mingechevir Reservoir
Kura
Arpa
Aras
Hrazdan
Varotan
To T'bilisi
To Borjomi
To Kars
To Gäncä
To Naxçivan
To Qubadli
To Füzili
To Ordubad
ARMENIA
SELECTED CITIES AND TOWNS
PROVINCE (MARZ) CAPITALS
NATIONAL CAPITAL
RIVERS
MAIN ROADS
RAILROADS
PROVINCE (MARZ) BOUNDARIES
INTERNATIONAL BOUNDARIES
0 10 20 30 40 50 Kilometers
0 10 20 30 Miles
43°E
44°E
45°E
46°E
47°E
41°N
40°N
39°N
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SEPTEMBER 2004
IBRD 33364