

**Aide-Memoire  
for  
Scaling-up Renewable Energy Program in Low Income Countries (SREP)  
Joint MDB Mission to Armenia  
August 28 – September 3, 2013**

**I. Introduction**

1. A Joint World Bank/IFC, European Bank for Reconstruction and Development (EBRD), Asian Development Bank (ADB), and team<sup>1</sup> visited Armenia on August 28-September 3, 2013 to: (a) review the progress with preparation of the SREP Investment Plan (IP); (b) discuss and agree with the Government on priority renewable energy projects to be supported under SREP; and (c) discuss the next steps to finalize the Investment Plan to be submitted to SREP sub-committee approval.

**II. Mission Activities and Status of the Project**

2. The MDB team held discussions with the Ministry of Energy and Natural Resources, the Renewable Resources and Energy Efficiency Fund (R2E2 Fund), and other key stakeholders. A detailed list of stakeholders met by the MDB team is provided in Annex 2.

3. **Status of the Project:** Preparation of the IP is underway and the Government’s Consultant substantially completed preparation of the IP. The draft final report of the IP is expected to be submitted for the Government and MDB review by September 13, 2013.

**SUMMARY OF IMPLEMENTATION PROGRESS**

<b>Preparation of SREP Investment Plan Project</b>			
<b>Project Number:</b>	P133831	<b>Grant Number:</b>	TF014245
<b>Effectiveness Date:</b>	05/07/2013	<b>Closing Date:</b>	06/30/2014
<b>Total Grant Amount:</b>	US\$300,000	<b>Total Disbursements:</b>	US\$23,000 <sup>2</sup>
<b>Date of Restructuring/AF:</b>	N/A	<b>Additional Financing:</b>	N/A
<b>PDO Rating</b>	Satisfactory	<b>Overall IP Rating</b>	Satisfactory

<sup>1</sup> The team comprised: **World Bank** – Mr. Gevorg Sargsyan, SREP Program Coordinator and Mr. Artur Kochnakyan, Energy Economist; **EBRD** – Mr. Remon Zakaria, Energy Efficiency and Climate Change Business Development Manager at EBRD; **ADB** – Cindy Tiangco, Energy Specialist, Energy Division, Central and West Asia Department and Areg Barseghyan, Senior Country Coordination Officer; **IFC** - Tigran Parvanyan, Project Manager, IFC Eastern Europe and Central Asia; **CIF Admin Unit** – Natalia Magradze, Program Analyst; **USAID** – Zephyr Taylor, Clean Energy Advisor, Office of Global Climate Change.

<sup>2</sup> As of August 30, 2013.

### **III. Summary of Mission Findings and Agreements:**

4. **Comprehensive assessment of renewable energy (RE) technologies:** The Government conducted comprehensive assessment of renewable energy technologies identified during the last mission (June 2013) in consultations with the stakeholders, including MDBs. Those technologies included: wind; utility-scale solar PV; concentrating solar PV, distributed solar PV, small hydropower, wastewater treatment plant (WWTP) biogas-to-power, agricultural biogas-to-power, landfill biogas-to-power, biomass (wood/grain), geothermal power, solar thermal water heating, geothermal district heating and geothermal heat pumps.

5. The analysis suggested that of the above RE technologies the following were not technically viable: (a) concentrating solar PV due to poor resource quality; (b) WWTP biogas-to-power due to significant new investments for reconfiguration and redesign of WWTP to allow for installation of biogas digester; (c) biomass due to limited availability of feedstock; and (d) district geothermal heating due to almost full collapse of district heating infrastructure in Armenia in early 1990s.

6. **Stakeholder and public consultations:** On August 30, 2013, the Government conducted stakeholder consultations to discuss the main findings of the comprehensive analysis of various RE technologies and the proposed priority RE technologies to be supported under the SREP. Specifically, the proposed priority RE technologies to be developed in Armenia were presented to the multi-sectoral task force established in 2011 for review/discussion of issues pertaining to development of renewable energy and energy efficiency in the country. The task force approved the priority RE technologies proposed to be supported under the SREP IP. The Government also conducted broader public consultations. Specifically, the main findings of the analysis and proposed RE priorities were posted on the web-site of the R2E2 Fund for public comments on August 24, 2013. On September 2, 2013, the Government also organized open public consultations with representatives of civil society, NGOs, private sector, project developers, research institutions, academia, and donor organizations. The participants were overall supportive of main findings, conclusions and recommendations regarding priority RE technologies to be supported in Armenia. There was unanimous support for development of utility-scale PV given consensus on the estimated large potential and increasingly attractive unit costs of energy given significant reduction in module costs over the last several years. The participants also suggested to include in the priority list some RE technologies, which had low levelized energy costs (LEC) and other benefits, such as biogas, however, the Government noted the limited potential for scaling up those technologies in the country.

7. **Final list of priority RE technologies to be supported Armenia:** From the list of technically viable RE technologies, the Government determined the priority RE technologies using the below criteria agreed with the key stakeholders and MDBs, as well as taking into account the suggestions during publication consultations:

**Table 1: Selection Criteria of RE Technologies**

<b>Criteria</b>	<b>Description/Method of Measurement</b>
<b>Effect on Power Grid Stability</b>	<ul style="list-style-type: none"> <li>▪ Frequency regulation</li> <li>▪ Load following capability</li> <li>▪ Minimum load</li> <li>▪ Reactive power</li> </ul>
<b>Cost-Effectiveness</b>	Levelized energy cost (LEC): Present value of capital and operating costs for each technology, per kWh
<b>Potential for Job Creation</b>	Number of jobs created per dollar invested. The ranking of RE technologies was done considering Armenian context.
<b>Potential for Scale-Up of the Technology</b>	Production potential (GWh), given the resources available in Armenia
<b>Market maturity</b>	Extent to which technology is already being used in Armenia

8. Based on trade-off and prioritization analysis, the Government identified the following priority RE technologies it would plan to develop with combination of SREP funds (if SREP IP is approved), public financing and private sector investments: geothermal power, utility-scale PV, geothermal heat pumps, and solar thermal projects. Those technologies were selected based on the above criteria (see Annex 2 for details). Specifically, the Government is keen to develop geothermal energy because it can provide dependable base-load capacity at reasonable cost if high-temperature geothermal resources are confirmed through exploratory drilling. The utility-scale solar PV is becoming increasingly attractive due to reduction of solar PV module costs. Specifically, the Government estimates the average LEC of utility-scale solar PV at US\$0.09/kWh in case of concessional financing and US\$0.19/kWh – in case of commercial. It should be noted that concessional SREP financing can make utility-scale solar PV projects financially viable for private developers even at a lower tariff depending on the share of concessional debt in the financing structure. For example, assuming that 35% of the total capital contribution in the debt structure is financed with concessional SREP funds, the LEC of utility-scale solar can reduce to US\$0.14/kWh. It should be noted that currently the marginal plant in the Armenian power system is Hrazdan TPP with the tariff of US\$0.15/kWh (see Annex 1 for details).

9. **Government commitment to promote development of priority RE technologies:** The MDB team discussed with the Government the need for feed-in tariffs (FIT) to promote development of identified priority RE technologies. Given that there is no geothermal resource yet confirmed by the results of exploratory drilling, in the near-term future the FIT is needed only for solar. If the results of exploratory drilling confirm availability of good quality resource at Karkar site suitable for power generation, the Government should also establish FIT for geothermal to promote development. However, a decision regarding establishment of FIT for utility-scale solar PV should be made soon. In particular, the MDB team discussed two options for potential FITs that could be established:

- a. Establishment of a FIT by the regulator: The Government could request PSRC to adopt a FIT for utility-scale solar PV, which would apply to a specified maximum number of MW of capacity to be developed during certain time period.
- b. Establishment of a FIT through competitive bidding: The Government could tender out the construction of specified amount of MW of utility-scale solar PV capacity and establish the FIT at the level of the winning bid. Under this option the Government can also specify the maximum installed capacity of RE technology to be developed during specified time period.

10. The Government can make the final decision on the preferred option for FITs at a later stage, however, it should clearly indicate its commitment in the SREP IP to establish FITs for identified priority RE technologies at a level sufficient to promote scale-up and private investments.

11. **MDB support for development of identified priority RE technologies**: The MDB team discussed with the Government the potential support from MDBs in developing the geothermal and utility-scale solar PV projects in the country with use of a mix of SREP funds, MDB financing and private/public investments. Specifically, the MDB team agreed with the Government on the below potential engagement of MDBs in scale-up of priority RE technologies. The World Bank will support the Government to conduct exploratory drilling at the Karkar geothermal site. At this stage, there is no private interest in Karkar geothermal field given the resource risk. Thus, the Government financing of exploratory drilling will help to confirm availability and quality of the geothermal resource, which will help to attract private investors in further development of the geothermal plant at Karkar field. Thus, use of the grant component of the potential SREP funds to support the full cost of such exploratory drilling (estimated at around US\$10 million) is fully justified given the high-risk of such drilling for private investors. The IFC, EBRD and ADB confirmed their willingness to finance private investments in development of utility-scale solar PV and/or geothermal heat pumps and solar thermal projects. The ADB also confirmed willingness to support the Government and leverage public sector financing for a utility scale solar PV plant using an appropriate public-private partnership transaction model consistent with SREP objectives. However, IFC EBRD and ADB will make the final decision regarding supporting financing of development of utility-scale solar PV projects only after consideration of the FIT tariff to be adopted for utility-scale solar PV and the long-term plan by the Government to scale up RE following phase-out of SREP resources, including further improvement of environment for private investors.

**Table 2: Potential MDB support under SREP**

<b>MDB</b>	<b>Projects</b>	<b>Estimated cost</b>
World Bank	Exploratory drilling at Karkar geothermal site	US\$10 million (grant financing component of potential SREP funds)
IFC, EBRD and ADB	Utility-scale solar PV and/or geothermal heat pumps and solar thermal	US\$30 million to leverage additional financing from MDBs <sup>3</sup> and private sector

<sup>3</sup> Subject to the government commitment to adopt FIT required for making the aforementioned RE technologies feasible.

12. **Financial management review:** The financial management specialist of the Bank conducted financial management implementation and supervision mission of the projects implemented by the R2E2 Fund, including SREP on August 27, 2013. The findings of the FM review will be communicated to the Recipient in a separate letter to follow shortly.

**IV. Time-table for completion of SREP IP and next steps**

13. The Government confirmed its intention to submit the SREP IP to CIF Administrative Unit by September 30, 2013 to be included in the agenda for the next SREP Sub-committee meeting to be held on October 30 - November 2, 2013. The Government and the MDB team agreed on the following time-table for completion of the SREP IP and submission for approval. The MDB team noted that the below time-table is very tight and if the Government does not manage to finalize the SREP IP for submission to SREP sub-committee by the end of September 2013, then it should consider submitting it for the next Sub-committee meeting in March/April, 2014.

<b>Actions</b>	<b>By whom</b>	<b>By when</b>
Independent expert review of the SREP IP (as required by the SREP)	R2E2 Fund/MENR	September 16-23, 2013
MDB internal quality review of the SREP IP	MDBs	September 16-23, 2013
Finalization of the SREP IP to address the independent expert's and MDB comments	R2E2 Fund/MENR	September 23-29, 2013
Formal submission to SREP Sub-committee approval	MENR	September 30, 2013

### Annex 1: Estimated LECs of RE Technologies in Armenian Context

	Renewable Energy Technologies	Average LEC (Concessional Financing) <sup>4</sup>	Average LEC (Commercial Financing) <sup>5</sup>
Power Generation	Landfill gas	0.03	0.04
	Geothermal (Flash technology--Karkar)	0.04	0.09
	Small hydropower	0.04	0.10
	Ag. biogas-to-power	0.04	0.09
	Utility-scale solar PV	0.09	0.19
	Wind	0.11	0.22
	Distributed (rooftop) solar PV	0.29	0.70
Heating	Geothermal heat pumps (multi-floor)	0.05-0.06	0.06-0.08
	Solar thermal hot water (multi-floor)	0.14	0.28

### Annex 2: List of People Met

Name	Position
Mr. Areg Galstyan	Deputy Minister of Energy and Natural Resource
Mr. Hrach Tsughunyan	Head of Development Department, Ministry of Energy and Natural Resources
Ms. Tamara Babayan	Director, Renewable Energy and Energy Efficiency Fund
Ms. Bella Andriasyan	KfW, Senior Project Coordinator
Mr. Jan Blum	KfW, Head of Division

<sup>4</sup> Assuming 100% concessional debt (20-year loan) financing of investments at the cost of debt equal to 3%.

<sup>5</sup> Assuming 70% debt financing (15-year loan) with the average cost of 10.69% and 30% equity financing with the cost of 18%.