Climate Investment Funds

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Meeting of the SREP Sub-Committee
Montego Bay, Jamaica
June 27, 2014

RESPONSES OF GOVERNMENT OF ARMENIA TO COMMENTS OF SUB-COMMITTEE MEMBERS ON SREP INVESTMENT PLAN

Government reply to comments by Sub-Committee members

Country	Category/topic	Comments	Government response
Switzerland	RE Resource Potential in Armenia	**Comment 1.a**: The identified capacity for small hydro power (100 MW) is lower than the target for 2020 (377 MW). This would indicate a much larger potential for small hydropower than indicated. Please explain.	The remaining potential for small hydro is indeed 100 MW because 277 MW of small hydro has already been developed or is under construction. There are 151 small hydropower plants in operation with total installed capacity of 265 MW and another 50 plants with installed capacity of 112 MW are under construction.
Switzerland	RE Resource Potential in Armenia	**Question 1.b:** It is noted that utility-scale solar potential depends on the deployed PV technology. What is the potential in each of the three cases (fixed PV, single-axis tracking PV, concentrated PV)? Which technology is proposed for the investments to be supported with SREP contributions?	The potential of each technology was estimated as follows: Fixed-tilt PV: 835 MWac; 1,760 GWh/year Single-axis tracking: 835 MWac; 2,118 GWh/year Dual axis tracking CSP: 1,169 MW; 1,735 GWh/year Parabolic trough CSP: 1,169 MW; 2,358 GWh/year. Fixed-tilt PV is assumed to be the technology for the proposed solar project.
Switzerland	RE Resource Potential in Armenia	**Question 1.c:** What are the estimates of the energy potential (in an equivalent to power capacity) for geothermal heat pumps and solar thermal heating/hot water technologies?	Around 3,500 MW for geothermal heat pumps and 200 MW for solar thermal.
Switzerland	RE Resource Potential in Armenia	**Question/Comment 1.d**: For geothermal potential, the stated figures assume flash technology is used. This requires a high temperature resource. What would be the estimated potential if the temperatures of the identified resource were not high enough for flash technology and binary plants would have to be deployed? Note: It shall be noticed that at 150 MW the	As mentioned in the report, please note that 150 MW refers to the potential of only four geothermal sites for which at least some basic technical and geological field works were done. However, Armenia has at least 5-6 other potential geothermal sites in the Southern and North-Western parts of the country, which require further studies. All those areas suffer from the lack of exploration investments to confirm the commercial viability of the geothermal resources.

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		overall geothermal potential of Armenia is in any case very small	The estimate of the potential is very conservative. This potential is indicative and remains to be confirmed through drillings at depth. In case high-temperature resource is discovered, the power generation potential could be larger than 150 MW for those four sites. The key point we are trying to make is that the site is almost 100% geothermal in nature (which means it will allow for power generation), and the only un-certainty is the temperature of the resource. However, please note that even in case a resource with temperature around 150^{o}C is confirmed, it will still be useful for power generation (using binary cycle technologies instead of Flash). As mentioned above, 150 MW refers only to four sites. The actual potential maybe larger. Moreover, 150 MW is material for the power system with available capacity of 2600 MW and the need for 1000 MW of new capacity by 2030 to avoid capacity shortage (due to planned retirement of some large plants).
Switzerland	RE targets in the Government Strategy for RE	**Question 2.a:** What is the presently installed capacity for each of the listed RE technologies in table 3.5 (p.37)?	Small Hydro – 265 MW Wind – 2.6 MW Geothermal – 0 MW PV – 0.1 MW
Switzerland	RE targets in the Government Strategy for RE	**Question 2.b**: How realistic do you see the targets of bringing the RE energy share in Armenia's energy mix (excluding large hydro power) up from 6% in 2012 to 21% in 2020 and 26% in 2025? What important power plants are expected to be put on the network until 2020?	We believe Armenia can increase the share of RE to 21% by 2020 and 26% by 2025 given the need for new capacity to avoid supply gap and large priority placed on development of RE. Until 2020, the country plans to bring online:

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			a. At least 28 MW of geothermal at Karkar site b. At least 25 MW of geothermal at Jermaghbyur site c. 50 MW of wind at Karakhach and Pushkin pass d. 50 MW of solar PV for which support is requested from SREP; and e. 112 MW of new SHPP capacity with almost 60 MW already under construction by private developers The targets are quite realistic, since only during last decade RE share in Armenia energy mix increased from 1% in 2004 and to 10% in 2013).
Switzerland	RE targets in the Government Strategy for RE	**Question 2.c**: It is noted that the GoA targets to install 50MW of geothermal power until 2020. How consistent is this with the fact that in the SREP IP it is foreseen to set-up a plant of only 28 MW after the resource of the most promising site (Karkar) is proven, a PPP is structured with a private sector operator and the plant is built and connected to the grid? What other options of geothermal development, as advanced as the Karkar proposition using SREP grant (if approved) does the GoA have in the pipeline?	The target may be too aggressive, but the Government plans to achieve it the following way: (a) complete drilling, structuring of PPP and construction of a plant at Karkar by 2020; and (b) development of 25 MW power plant at Jermaghbyur (neighboring site to Karkar). The exploratory drilling at Karkar may contribute to development of Jermaghbyur pending the outcomes of drilling.
Switzerland	Ranking of RE technologies against selection criteria	**Question 3.a:** We noticed that the ranking of geothermal heat pumps, solar thermal heating and distributed solar PV has been adjusted (to worse) between the draft and the final versions of the IP. Please explain and substantiate these adjustments.	We adjusted the ranking to reflect Government's reassessment of market immaturity. Since (as noted elsewhere in the answers), there is funding available for these technologies, the market immaturity score was adjusted (from "1" to "2") for each technology. We note, however, that the average for distributed solar is consistent with this change, but the score for market immaturity is not. We will revise the draft to correct the

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			error. Specifically, financing for geothermal heat pumps and solar thermal is available under ongoing $9 million Caucasus Energy Efficiency Program (CEEP) of EBRD and expected $20 million Eastern European Energy Efficiency and Environmental Partnership (E5P) energy efficiency program.
Switzerland	Ranking of RE technologies against selection criteria	**Comment 3.b:** We do have concerns that the criterion "market maturity/immaturity" has been overweighed and possibly even wrongly interpreted in the ranking. In the SREP design document, it is explicitly mentioned the SREP should support established RE technologies with large scale-up potential. Therefore the prioritization of the least established (i.e. non-incepted) technologies seems to be contradictory with the request of a large scaling-up potential and also of readiness. This is particularly problematic since the GoA justifies the selection of geothermal development against better ranking technologies (e.g. geothermal heat pumps) only by applying and overweighting this criterion.	We think you misinterpreted the "market maturity/immaturity" criteria we used. By "market maturity" we meant the level of development of RE technologies in terms of availability of private financing, enterprises manufacturing/supplying the required plant and equipment, and other related services. Therefore, technologies like small hydro had a high rank against this criteria because: (a) significant private financing is available for SHPPs and those are developed by private sector; (b) manufacturing/supply/service industry emerged after development of SHPPs was kick-started by donor-supported projects (providing concessional financing) in 2004-2005; and (c) technology is not perceived as risky by investors/developers in Armenia. There is no point using concessional SREP resource for RE technologies that are already being scaled up by the private sector. Thus, the Government decided to pick the technologies that require concessional financing to kick-start development. The scale-up potential and market immaturity were

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			considered as separate criteria and ranking was independently from each other. There is no contradiction with the SREP requirement for large scale-up because both geothermal and solar PV have high scale-up potential in Armenia. The potential for geothermal power may be small in absolute numbers, but that is material for the country with only 2600 MW of maximum available operating capacity.
Switzerland	Ranking of RE technologies against selection criteria	**Comment 3.c**. It is noticed that geothermal heat pumps rank highest by a large margin as RE technologies to be suited for a SREP contribution and that despite this high ranking it was not selected. The justification is that this sector, along with solar thermal, has already sufficient/substantial support from the MDBs and the private sector. On the other hand, it is also stated that so far only one commercial-scale geothermal heating facility has been realized in Armenia. This raises the question of how much support is sufficient and indicates that there could very well be a significant potential for scaling-up these highest ranking technologies. We would like to have an appreciation by the MDBs (WB-IFC, ADB and EBRD) as well as the GoA of this aspect.	1. The Government revised the IP and proposes to allocate $3 million for geothermal heat pumps and solar thermal. Such decision was made given that financing expected under E5P program may not become available until 2016 given some procedural and project preparation delays. It was earlier envisaged that sustainable energy finance project to be financed with E5P funds will be started in 2014/2015. Thus, $3 million of concessional SREP resources added to EBRD's ongoing CEEP will help to ensure sufficient financing is available for geothermal heat pumps and solar heaters until E5P funds (grants) become available (coupled with loans from MDBs). 2. The fact that only one commercial-scale geothermal heating project was done is because the projects that can finance geothermal heat pumps were introduced only recently. 3. Some resources under the EBRD's ongoing CEEP, ($9 million) are available for geothermal heat pumps and solar thermal. Financing for energy efficiency investments as well as geothermal heat pumps and

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			solar thermal are also expected under the potential E5P program ($20 million) expected to be effective in 2016.
Switzerland	Ranking of RE technologies against selection criteria	**Question 3.d**: What stakeholders have been consulted regarding the substance and the sufficiency of funding for the geothermal heat pump and solar thermal sectors? Is there a summary of the statements of the different groups of stakeholders in this respect? What is/was the position of the independent observers?	Annex C of the IP provides information on stakeholder consultation. During each MDB mission large conference, round table discussion was organized with participation of representatives of Government /different ministries, energy regulator, Central Bank, etc/, MDBs, development partners /USAID, UNDP,GIZ/ and their projects, commercial banks, private sector, NGOs, academia and other R&D, foreign and local experts. In addition to the round table discussions and conferences, special separate meetings were organized, including meetings with the suppliers of solar heaters and heat pumps.
Switzerland	Ranking of RE technologies against selection criteria	**Comment 3.e**: It is stated that the deployment of utility-scale solar PV in Armenia has the potential to create an entire industry in terms of job creation. We doubt that the construction of a limited number of large plants will have this effect. An "entire industry" will be created most likely with technologies that offer large replication potential and easy access to small and medium sized private enterprises in its deployment. This is the case for geothermal heat pumps, solar thermal and distributed solar PV systems, as correctly assessed in the ranking.	We agree that investments in introduction and scale-up of geothermal heat pumps and solar heaters will help creating an industry around those RE technologies (suppliers, service providers, etc.). That is why the Government proposes to allocate $3 million of SREP resources for geothermal heat pumps and solar heaters. The Government also believes that deployment of utility-scale solar PV will have help creating an industry (and R&D given strong scientific interest and activity in this field in Armenia, including technology start-ups) around it as was the case with small hydropower plants (SHPPs) in mid 2000s. The first donor-funded projects helped to finance 20-30 MW of SHPPs, and then an industry evolved (e.g. local equipment and pipe manufacturers, equipment suppliers, financial services, design services).

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			Armenia was assessed to have some comparative advantage to participate in the global value chain for solar PV as assessed under the GEF/World Bank financed study in 2011 (can be accessed using the following link: http://r2e2.am/wp-content/uploads/2012/07/%E2%80%9CAssessment-of-PV-Industry-Development-Potential-In-Armenia%E2%80%9D.pdf)
Switzerland	Geothermal power development	**Question 4.a**: Please substantiate the expectations that the private sector will make the capital investment (power plant) if the resource potential is confirmed (at 28 MW) and that the MDBs (IBRD, ADB, EBRD) or their commercial arms will be ready to support the project with loans. Are there any statements of intent by private sector investors in this direction? What are the positions of the cited MDBs?	We are confident that there will be significant private sector interest in construction of a geothermal power plant since: (a) overall legal and regulatory framework of the energy sector is quite conducive to private investments; in particular, nearly 70% of the generation is privately owned, including all small renewable energy plants; (b) several foreign companies have already expressed interest in constructing geothermal power plant after the Government confirms availability of resource. Several European companies contacted the Armenian Development Agency expressing their interest for geothermal in Armenia, including NOX holding AG (Switzerland), that visited Armenia and had a conference and separate meetings with stakeholders. We revised the financing table to indicate potential financing mix for a geothermal power plant. All MDBs which participated in the preparation plan as well as a number of bilateral agencies are willing to support construction of a geothermal power plant, including their private arms..
Switzerland	Geothermal	**Question 4.b**: With regards to your (GoA) answers	There is no probability assessment whether the site is high

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	power development	to the issues raised by the independent expert, do you have any indications about the probabilities whether the Karkar resource is high temperature or low/medium temperature	or low-temperature. No geological or other technical study can assign probability to the site being high or low-temperature. However, the Government assessed both the economic and financial viability of the potential geothermal plant for both low and high-temperature scenarios.
Switzerland	Geothermal power development	**Comment 4.c:** Please provide a copy of the ISOR (Iceland) assessment on which you base your statement about the justification for exploratory drilling	It is included in the Annex H to the revised IP.
Switzerland	Geothermal power development	**Comment 4.d:** Given the low potential, the still unproven nature of the Karkar geothermal resource (temperature), the SREP investment in the proposed geothermal power development component seems extremely risky and likely to end up in a single 28 MW pilot plant in the best case. Even in this best case, there would be no transformational impact. Therefore, we strongly support the recommendation of the independent expert regarding the reduction of the geothermal power development component in the IP	Geothermal energy has always been and will continue to be risky. This is precisely the reason why globally, successful geothermal development has systematically required some form of risk sharing with public support at the exploration stages. All of the required surface studies were completed for Karkar and the results clearly indicate that exploratory drilling is justified. The independent reviewer may have been confused by the fact that unit energy costs of potential plant were estimated assuming high-temperature resource (which was done only for indicative purposes). As we mentioned above, even if the resource is relatively lower temperature, that will still be suitable for power generation, and the Government still plans to pursue the geothermal plant. There are no surface exploration methods, which can provide definitive answer about the nature of the resource. Test drillings at depth are the only way of confirming the

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			nature of the resource and its potential for power generation. International experience shows that about 15-20% of geothermal project costs are incurred before the resource can be confirmed (i.e. before production drilling). This contributes to the unique risk-profile of geothermal, which has required strong government support in the upstream development phases in all the countries where geothermal development has been successful. On the other hand, once resources are confirmed and production drilling is completed, the risk profile of a geothermal project is similar to that of other base-load technologies, without the uncertainty of fuel price volatility during the operation phase. Also, the levelized energy costs for geothermal can be rather competitive, around 8 USc/kWh, which is below the cost of the estimated least-cost supply portfolio for Armenia. If the exploratory drilling at Karkar site confirms availability of geothermal resource with potential for power generation, we strongly believe that this will have transformational impact because: (a) It will significantly increase the likelihood of existence of high reservoir temperature in another neighboring site, Jermaghbyur, with estimated potential of at least 25 MW, which, as we mentioned before, is relatively better explored than several other sites. (b) Additional field investigation works will be justified in the other neighboring areas with geothermal potential since the prospective underground reservoir is believed to be quite wide based on the studies previously

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			conducted. (c) If drilling at Karkar is successful, the private sector may be willing to fully or partially take the risk of exploration drilling in some other sites. Karkar is also a prospective site as it is an extension of the same seismic zone of the North Tabriz fault area, which extends from Northwest Iran to Eastern Turkey. 300 km South of Karkar, on the Iranian side, geothermal electricity production has already started with the development of a 55 MW power plant at the Meshginshahr site, an area with a mix of high and medium temperature geothermal resources. To ensure the SREP resources are spent with maximum efficiency and prudence, we will structure the drilling program in a way to ensure that a decision can be made not to drill Well#2 if the results from Well #1 clearly indicate that Karkar does not hold a viable resource. The drilling contract would include the appropriate clauses to allow for this possibility, which is not uncommon in drilling contract. This way we will ensure most prudent utilization of valuable SREP resources. Moreover, if drilling of Well #2 is deemed un-necessary, then we will relocate the remaining funds (around $4-4.5 million) to solar PV.
Switzerland	Utility-scale solar PV	**Comment 5.a**: It is doubtful that the construction of 40-50 MW of utility-sized solar PV plant will have a sufficient impact on the long-term supply	We believe that even 40-50 MW will have sufficient impact on long-term supply cost of solar PV in Armenia: 1. 50% of the cost of solar energy is installation and

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		costs of solar PV products sufficient to make the technology commercially viable	operation and, hence, there is potential for reduction due to learning-by-doing and knowledge spillover effects (from foreign companies). 2. The long-run electricity supply cost for Armenia is estimated at 10-19 c/kWh depending on investment scenarios and cost of financing. Thus, solar PV will increasingly become attractive. The supply cost in Armenia increased almost 30% during the last two years, reaching 8.5 c/kWh. 3. Even 40-50 MW will account for roughly 3% of available operating capacity in the country. 4. There are good foundations for promoting R&D given long-standing interest of Armenian academia in solar PV. 5. The experience of Armenia with development of SHPPs suggests that such transformational impact is possible with even small investments in new RE technologies. Specifically, in 2005-2008, donors supported around 30 MW of investments in small hydro, which helped to kick-start this technology, and create an entire industry around it. This allows commercial financiers and equity investors to become familiar and comfortable with the technology.
Switzerland	Utility-scale solar PV	**Comment 5.b**: Utility-scale solar PV will contribute to job creation but a scale-up in this respect will happen only in conjunction with distributed solar PV. It is therefore recommended to identify and favor synergies with the (existing) distributed solar PV sector in the implementation of the utility-scale solar PV program.	We recognize that utility-scale solar PV, on its own, contributes only in a limited way to job creation. We also agree that there are synergies should be identified between utility-scale solar PV and distributed solar PV. We expect, however, that the private sector will identify these synergies. Bidders for the solar plant will look to local solar expertise in staffing their teams who design, build,

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			and operate the plants. If, at bidding stage, it appears there is a risk that local expertise will be overlooked or not utilized, Government can build into the tender documents requirements for the use of some percentage of local staff as a criterion of the technical scoring. The Government recognizes importance of distributed solar, so it has removed licensing requirement for solar PV with less than 150 MW capacity. The draft amendment to Law on Energy proposes guaranteed purchase of solar PV generation for 20 years after commissioning.
Switzerland	Other technologies	**Comment 6.a**: Having noticed that geothermal heat pumps and solar thermal heating technologies ranked highest in the appraisal of potential RE technologies, we do not understand why none of these technologies appear in the IP.	Given that the Government does not expect E5P funds to be available earlier than 2016, the Government reconsidered its approach and suggests allocating $3 million of SREP resources to further contribute to deployment of geothermal heat pumps and solar thermal systems. The demonstration effect from such investments will help to promote scale-up in other sectors. The Government does not allocate a larger share of SREP resources for such high-priority RE technologies because: (a) financing for heat pumps and solar heaters can be secured from EBRD's CEEP for industrial and residential sectors ($9 million); (b) the Government requested $20 million from E5P to finance energy efficiency investments. Geothermal heat pumps and solar heaters can be financed under E5P as part of the comprehensive energy efficiency retrofits. Thus, there will be sufficient financing available

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			for heat pumps and solar heaters.
Switzerland	Other technologies	**Comment 6.b**: We see in these technologies a particularly large potential for scaling-up, precisely because they have already been successfully incepted in Armenia.	Those technologies do have a large scale-up potential, but please also note that they cannot be used for power generation, which is a higher priority for the Government. Geothermal heat pumps and solar heaters can help reduce electricity consumption to some extent, but not significantly since the share of electricity based heating and/or hot water supply is relatively low in Armenia. Moreover, implementation of geothermal heat pumps in existing multi-apartment buildings is an issue given that most of the households have already installed individual heating boilers or heaters. Therefore, geothermal heat pumps can be installed in only newly constructed multi-apartment buildings, detached houses, and commercial/industrial sector.
Switzerland	Other technologies	**Comment 6.c:** We see in these technologies a larger potential for the private sector and job creation than in any of the proposed technologies in the IP.	Please note that the job creation potential refers only to jobs created as a result of construction and operation/maintenance activities for the RE technologies. This does not include broader catalytic impact of various RE technologies. Considering the above, neither geothermal heat pumps nor solar heaters are labor-intensive technologies.
Switzerland	Other technologies	**Comment 6.d**: We therefore recommend to integrate the geothermal heat pump technology into the IP, instead of the geothermal power development and to propose an incentivization program to induce the private sector to deploy this technology in Armenia.	The Government reconsidered its approach and decided to proposed allocating $3 million of SREP funds to promote deployment of geothermal heat pumps and solar heaters.
Switzerland	Other technologies	**Comment 6.e:** As the independent expert also indicated, small hydro power could be another	As we mentioned before, SHPPs are a well-established and scaled-up technology in Armenia with most of the

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		sector where a scaling-up, supported by SREP, could yield promising results. We feel that this potential was underestimated in the IP.	estimated potential already realized. There is significant private financing available from commercial banks for SHPP projects. Therefore, no need to use concessional SREP resources for SHPPs.
Switzerland	Improvement of enabling environment for RE	**Question 7.a**: What specific measures are planned by the GoA to improve the enabling environment for RE, both for utility-scale plants and for distributed power generation?	The overall environment for RE and overall energy sector investments is quite conducive. Nevertheless, it is being improved further, including with the support of donor community. Specifically, the following activities are in progress or have been recently completed: (a) the PPA for solar and wind energy projects was extended to 20 years; (b) coordination between state bodies on licensing and issuance of permits is currently being reviewed with the objective of streamlining.
Switzerland	Improvement of enabling environment for RE	**Question 7.b:** What about targeted incentives, such as duty and VAT exemptions for renewable energy investment goods	According to legislation, the Government can grant a 3-year deferral of VAT payment to all importers of industrial plant and equipment with total value of more than $0.5 million. Therefore, importers of RE equipment can be eligible for such VAT payment deferrals. Armenia does not levy a customs duty on imported capital goods.
Switzerland	Financing plan	**Question 8.a**: Why are no private sector investments and commercial loans foreseen in the utility-scale solar PV project share of the WB, contrary to the program managed by the ADB?	It is a table formatting issue. We apologize for misleading you. ADB and WB will provide $30 million in sovereign loans, and the rest will be raised from private arms of all interested MDBs and the private sector.
Switzerland	Financing plan	**Comment 8.b:** Given the lack of any details, we consider that the $106 million foreseen for the geothermal power development is/would be essentially a funding gap with high uncertainty regarding its materialization. This amount should thus not be included as a leverage investment in	$106 million is not a funding gap because, as we mentioned above, there is private sector interest in geothermal plant once the resource is confirmed. Please note that at this stage we cannot provide exact financing structure for a potential geothermal power plant. Nevertheless, we revised the financing plan to provide indicative financing structure.

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		the IP.	
Switzerland	Financing plan	**Question 8.c:** What is the share of grant and capital requested by the GoA and what components are foreseen to benefit of grants/capital	The Government requests $14 million grant and $26 million loan from SREP: $9 million grant for geothermal energy $2 million grant for TA component of utility-scale solar PV $3 million grant for geothermal heat pumps and solar thermal $26 million of concessional loans for financing of capital investments in utility-scale solar PV.
Netherlands	Support for direct use of geothermal energy	**Comment N1**: We have been interested to see that the analysis of renewable energy options prioritizes thermal application of geothermal energy ("direct use") as most suitable for SREP. Why does the investment plan not include an element of such direct use of geothermal energy, either as stand-alone SREP project or as specific component in the proposed Geothermal Power Exploration and Development project (could feasibility of direct use be anticipated as possible outcome of the resource assessment for the Karkar site)?	As mentioned above, the Government reconsidered its approach and decided to propose allocating $3 million of SREP funds for geothermal heat pumps and solar heaters. Despite high-priority rank of geothermal heat pumps, the proposed SREP allocation is not large because there are other sources of financing available/to become available. Geothermal heat pumps do not need resources that are as concessional as SREP to be promoted given their estimated unit energy costs (please see Figure 3.5). Meanwhile, the Government has no other sources to finance exploratory drilling at Karkar site. Besides, as we mentioned above, the Government stands ready to consider phased exploratory drilling project for Karkar site. Specifically, if results of exploratory drilling of the Well #1 suggest that drilling of the Well #2 is not warranted, then the Government will use the resources to install more utility-scale solar PV.
Netherlands	Options for use of SREP funds	**Comment N2**: We have also been interested to see that the investment plan presents two options for use of the SREP funds (either a grant	The decision whether the geothermal exploratory drilling project will be funded through: (i) an SREP grant to government, or (ii) a guarantee to private sector entities,

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		to government or a guarantee to private sector investors/developers). How will this decision be made? Our domestic experience has been that a guarantee-type mechanism has been very effective for private sector development of thermal applications of geothermal energy (with a medium temperature resource). If the government of Armenia would consider to include the option of direct use mentioned above, would that have implications for how to best apply the SREP funds?	which might want to undertake the drilling as part of early site development, will be made during the preparation of the drilling project. However, the results of the initial market sounding, conducted by the Government, suggest that private sector entities would prefer to be involved in the project after the exploratory drilling is completed.
United Kingdom	Geothermal power	**Comment N1**: We appreciate the process that the Government of Armenia and World Bank have gone through to identify which technologies and sectors should be chosen. However, we have some concerns particularly regarding the substantial objections noted by the independent reviewer regarding the focus on geothermal power. This does not appear to be satisfactorily resolved, and would like to see additional evidence and/or review before the sub-committee is asked to endorse the plan.	We would like to provide the following additional clarifications regarding independent peer reviewer comments on geothermal: 1. The Government is still committed to development of geothermal even if relatively low-resource temperature is confirmed. It is a matter of national energy security. 2. There has been no geothermal development experience in Armenia, however, we think that the exploratory drilling project has high level of reediness because: (a) the ESMAP/World Bank have already allocated financing for precise well siting studies; (b) the comprehensive drilling program is ready (including types of wells, all of the associated services required; contract management, etc.); and (c) bidding documents for drilling (based on World Bank's standard bidding documents for small works) are almost ready. 3. All of the geothermal studies/reports were independently reviewed during implementation of the GeoFund2/World Bank Armenia Geothermal TA Project

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			(2009-2012) and subsequently by Iceland Geosurvey (ISOR; 2013). All those reviews confirmed that the methodology was robust and findings were sound. 4. We disagree that it may be difficult to attract private investments into geothermal. The Government intends to use a tender mechanism whereby the participants will bid on tariff. Otherwise, the legal and regulatory environment in the country is conducive to private investments as evidence by significant private investments in the energy sector in the last 10 years. 5. As mentioned in the report, please note that 150 MW refers to the potential of only four geothermal sites for which at least some basic technical and geological field works were done. However, Armenia has at least another 5-6 potential geothermal sites in the Southern and North-Western parts of the country, which require further studies. 6. The estimate of the geothermal potential in the IP was very conservative. In case high-temperature resource is discovered, the power generation potential could be larger than 150 MW for those four sites. However, please note that even in case a resource with temperature around 150^{o}C is confirmed, it will still be useful for power generation (although at a higher unit cost of energy). As mentioned above, 150 MW refers only to four sites (as it is clearly mentioned in the IP). The actual potential maybe larger. Moreover, 150 MW is material for the power system with available capacity of 2600 MW and the need for 1000 MW of new capacity by 2030 to avoid capacity

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			shortage (due to planned retirement of some large plants).
United Kingdom	Energy efficiency	**Comment N2**: Further to the above, in a context where 100% of the population is grid-connected – not typical for SREP countries - we also wonder whether there might be some important energy efficiency opportunities, noting also that Armenia is in the EBRD's E5P program.	It is our understanding that SREP funds cannot be used to finance energy efficiency measures. However, we acknowledge that there is unrealized energy efficiency potential in Armenia. To that end, there are a number of projects in implementation/preparation to help realize that potential. Specifically, the Government is currently implementing GEF/World Bank $10 million energy efficiency project for public and social facilities (schools, kindergartens, hospitals, street lighting) to do energy efficiency retrofits in those facilities. The project will help to improve energy efficiency of around 100 facilities with 200 million kWh equivalent of energy savings and 40,000 tCO2 emission reductions. Moreover, as you correctly noted, the Government requested E5P funds to scale up its energy efficiency program in the country.
United Kingdom	Geothermal heat pumps	**Comment 3**: We also noted that the geothermal heating scored well in the analysis, but was not prioritized and we would appreciate any further information on this given the large potential for scale, which presumably exceeds available support through existing programs?	Please see above the Government responses to Swiss **Comments 3.c and 6.a.**
United Kingdom	M&E	**Comment 4**: We believe that the IP could be strengthened with a stronger monitoring and evaluation plan that would help to learn lessons that could increase the chances that SREP finance will be catalytic to more renewable energy investment, seizing the capacity gap opportunity	We agree with your comment about the importance of lessons learned and knowledge sharing for scaling-up renewable energies in Armenia. In view of this, the GoA will allocate $100,000 of SREP resources to further strengthen the monitoring and evaluation system in the energy sector and therefore enhance the catalytic impact

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		(particularly for PV, with technical potential estimated to be 6,500MW)	of SREP finance in the country. In addition to facilitating the scale up of deployment locally, the lessons learned would help other countries also embarked into the development of renewable energies, especially geothermal and solar technologies. In particular, the proposed funding will support the implementation of evidence-based learning approaches (e.g., impact evaluation, rapid-stakeholder consultation, real-time learning, etc.) that would enhance learning throughout the lifecycle of investments. The objective is to generate knowledge and share best practices which may be incorporated in the further design and implementation of projects, therefore improving their capacity to deliver results on the ground and facilitating the scaling-up of geothermal and solar energies in Armenia and other countries. The concept proposals for evidence-based learning activities will be elaborated during preparation of SREP-funded geothermal and utility-scale solar projects based on specific context and needs.
United States	Geothermal power	The problems with the geothermal project expressed by the independent reviewer raise some serious concerns and they are not sufficiently addressed by the responses in Annex G. We would like to see a more detailed response to the issues raised by the independent reviewer.	Please see above the Government response to the **Comment N1** from the UK and the response to the **Comment 4.d.** from Switzerland.
United States	Other high-ranking technologies	Why was geothermal power included in the IP, despite having a low scale-up score in the ranking criteria (Table 4.1), while geothermal heat pumps and solar thermal heating were not included even	As described in the IP, the selection of technologies was driven by the average score under all criteria rather than the scale-up score only. Moreover, as mentioned above, the scale-up potential may be small as an absolute number,

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		though they scored higher in the options ranking? What programs will diffuse these higher ranking technologies? Are the other funding mechanisms for the two latter options similar in size and scale to SREP?	but is large for the Armenian power system with only 2600 MW of maximum available generation capacity. The Government revised the IP to allocate $3 million for geothermal heat pumps and solar thermal. We believe that this funding coupled with resources available under CEEP ($9 million) and E5P ($20 million) would be sufficient to promote development of geothermal heat pumps and solar heaters.
United States	Policy reforms	We are concerned about the lack of strong commitment to policy reform tied directly to SREP support, and a strategic framework for implementing it. The document identifies major barriers to investment in renewables, but the mitigation options are not clearly identified enough to provide confidence that the SREP program will help overcome them, nor does there seem to be any clear commitment from the GoA to implement reforms that could increase the likelihood of success stemming from SREP funding. How will the SREP program facilitate energy sector reforms? Additionally, please explain how structural problems–like the poor coordination between government authorities (PSRC and MoNP) on obtaining necessary permits for RE technologies–will be improved in order to catalyze further renewable sector development.	The Government is already making progress with further improvement of legal and regulatory framework for renewable energy. As mentioned in response to **Question 7.a**. from Switzerland: (a) the PPA for solar and wind energy projects was extended to 20 years; (b) coordination between state bodies on licensing and issuance of permits is currently being reviewed with the objective of streamlining. The Government has a very successful track record of energy sector reforms from late 90s to mid-2000s, including establishment of fairly conducive environment for renewable energy. The Government is committed to improve it further and does not need SREP resources for that. Some ongoing renewable energy interventions of other donors are already supporting the Government to improve it further (e.g. ADB and KfW programs). We do not see that any of the barriers mentioned in the IP can inhibit successful deployment of identified priority renewable energy technologies. If the legal and regulatory framework was not conducive to small RE projects, then

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			Armenia would not manage to develop almost 260 MW of entirely privately owned small hydro in just 10 years.
United States	Impacts of geothermal and utility-scale PV	We would appreciate more detail about how the proposed projects with help catalyze private investment and growth in the geothermal or utility-scale solar PV sectors. The geothermal project depends largely on a funding source that is not identified in the investment plan. While we appreciate that a private sector partner has not yet been identified, the IP could provide some examples of potential partners or at least some estimate of expected co-financing levels from the GoA, IBRD, or ADB.	We believe that even 40-50 MW will have sufficient catalytic impact in Armenia because: 1. 50% of the cost of solar energy is installation and operation and, hence, there is potential for reduction due to learning-by-doing and knowledge spillover effects (from foreign companies). 2. The long-run electricity supply cost for Armenia is estimated at 10-19 c/kWh depending on investment scenarios and cost of financing. Thus, solar PV will increasingly become attractive, and promote more investments. 3. As the first 40-50 MW of projects are implemented, the project developers, financial institutions, and other key stakeholders will gain more experience in utility scale solar PV projects as was the case with SHPPs.
United States	Energy efficiency	We echo the UK's comment about energy efficiency opportunities, especially given the aging energy infrastructure in Armenia. Are there substantial opportunities for energy efficiency and how might they fit in the SREP program?	There are energy efficiency opportunities in Armenia and the Government is already implementing/preparing a number of projects to realize that potential. For details, please see the response to **Comment N2** from the UK. We have considered and discussed with SREP the possibility of using SREP resources for energy efficiency projects (or parts of those), however, SREP resources should be targeted only at renewable energy.