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Risk Sharing Mechanism (RSM) Program in Türkiye: Methodology and Lessons Learned

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ABSTRACT

The Risk Sharing Mechanism (RSM) program which is a risk mitigation scheme for the early-stage geothermal resources in Türkiye, is implemented as an insurance program. Owing to this program, it is aimed to reveal the geothermal fields in Türkiye potential of which has not been discovered yet. The RSM program funded by the World Bank and the Clean Technology Fund (CTF) under the Türkiye Geothermal Development Project. The Engineering Department of Development and Investment Bank of Türkiye (the Bank) is responsible for the coordination of this fund. The program was implemented for the first time in Türkiye in 2016. This paper investigates the main features of the RSM program, the progress of the program that has been realized since 2016, the point and development of the program are revealed within the framework of the experiences gained over time and the lessons learned.

1. INTRODUCTION

Energy consumption and the demand for energy have been increasing day by day in all over the world. Cases such as the covid- 19 pandemic, which endured in the last years and whose impacts still continue on a global scale, or tension among countries directly affecting the raw material supply and supply chain operation has revealed the significance of energy supply security. Renewable energy sources have come to play a crucial role during the last 20 years. In general, hydro power, wind power, solar power, biomass power, and geothermal energy are the most common renewable energy sources in the world. The fact that renewable, infinite and sustainable nature of sources has led these energy sources to come back to the fore.

Türkiye is considered to be one of the richest countries in the world in terms of renewable energy potential. Türkiye is the fourth-largest country in the world in terms of the installed capacity for electricity generation from geothermal. The most common geothermal energy installations are binary type geothermal power plants in Türkiye. In a binary type geothermal power plant, facility generates energy by transferring the heat of the underground fluid to a secondary fluid. When generation cannot be realized at the specified capacity application rates for several reasons, the demand for drilling new geothermal wells becomes a new issue. The drilling cost of these wells is high and they are frequently inadequate to increase the generation amount. It is also difficult to know how the new wells to be drilled will affect the power and generation. Rather than these high-cost solutions, hybridization in renewable energy has begun to come to the fore in recent years. In particular, solar power, having a more stable and guaranteed generation profile is considered for this hybridization.

The Development and Investment Bank of Türkiye is one of the pioneer development banks of Türkiye. The Bank was established in 1975 and finances several development angles such as energy, energy efficiency, manufacturing, tourism, health, and education. The funding sources of the Bank are multinational development banks like China Development Bank (CDB), World Bank (WB), Kreditanstalt für Wiederaufbau (KfW), European Investment Bank (EIB), Council of Europe Development Bank (CEB), Asian Infrastructure Investment Bank (AIIB), Japan Bank of International Cooperation (JBIC), Agence Française de Development (AFD), and Islamic Development Bank (IsDB). As of 2022 November, several renewable energy systems with more than 6,500 MW installed power have been assessed by the Bank. The Bank has been carrying out the evaluation process under four main headlines:

- Technical evaluation;
- Market & price evaluation;
- Fiscal analysis and evaluation; and
- Environmental & social evaluation.

The technical part including capital expenditure, operational cost, installed capacity, and electricity generation of the projects is assessed by the Engineering Department of the Bank. The Engineering Department consists of experienced engineers graduated from various engineering disciplines. Also, a specialized technical consultancy service is performed by the Engineering Department of the Bank.

The Risk Sharing Mechanism (RSM) program, enforced in Türkiye for geothermal disquisition/resource validation has become active with the specific agreements signed between the World Bank (IBRD) and the Development and Investment Bank of Türkiye (TKYB, the Bank) (Republic of Türkiye Ministry of Treasury and Finance, the Guarantor) under the 'Türkiye Geothermal Development Project' and 'CTF Grant Agreement'. The program is open to geothermal investors to increase the investments in technical disquisition and resource validation drillings. The Bank is acting as the implementing agency of the RSM program. The first and second rounds of this program are ongoing and two projects have been funded under the RSM program up to date.

There are various studies carried out on geothermal energy risks in the literature. Mignan et al. (2019) stated importance of the optimal siting for geothermal energy and seismic risk mitigation precautions. Spada et al. (2013) reviewed and compared risk of geothermal energy in OECD countries. Kazmierczak et al. (2022) assessed geothermal energy risks of Denmark by using hydrogeochemical methodology. Zhang et al. (2022) analyzed the re-injection risks for geological formations. Mohsen and Fereshteh (2017) evaluated error risk mode of geothermal facility by using enhanced methodology. Chelminski (2022) analyzed and compared geothermal energy in Indonesia and Philippines. Aksoy (2014) examined the energy production from geothermal reservoirs in Türkiye. Karytsas et al. (2022) reviewed the risk mitigation items in Greece. Falcone et al. (2018) examined the depth drilling well's risk and evaluation. Agemar et al. (2014) reviewed the depth drilling well's risk and evaluation in Germany. Miranda et al. (2020) assessed the district heating project and electricity generation in terms of obscurity and risk pattern perception for the off-centered areas. Jolie et al. (2021) reviewed geothermal energy in terms of control and generation. Shortall et al. (2015) evaluated multi-function effects of geothermal energy. Fuentes et al. (2022) analyzed geothermal energy in terms of public acceptance and crowdfunding. Fan and Nam (2018) reviewed geothermal energy development in Indonesia. Ehyaei et al. (2020) assessed the geothermal energy optimization by using artificial intelligence. Coro and Trumpy (2020) assessed the geographical convenience of geothermal energy facilities. Moya et al. (2018) reviewed the recent and most updated developments in geothermal power. Cardemil et al. (2016) analyzed hybrid power plants with geothermal and solar energy resources in Chile. Jiang et al. (2017) reviewed hybrid energy power systems consisting of geothermal energy. Astolfi et al. (2011) reviewed binary gas behavior by using hybrid energy facility including geothermal power. Bassetti et al. (2018) analyzed storage capability of hybrid energy including geothermal power. Li et al. (2020) assessed oscillation and intersection of geothermal energy hybridization by using solar energy. Alibaba et al. (2020) reviewed hybrid energy and geothermal power from economic and environmental perspectives. Bokelman et al. (2020) reviewed storage capability of the geothermal power plants.

2. STRUCTURE AND METHODS

The RSM program was defined in the contract signed between the World Bank and the Development and Investment Bank of Türkiye in 2016. Consultant selection and procurement process were defined in the contract to assist the RSM unit of the Bank for the implementation of the program. The main purpose of this program is to reveal the geothermal energy potential of unknown zones in Türkiye. In general, the period in which the highest cost and risk of failure in geothermal energy projects encountered is the first geothermal resource exploration period. The RSM program actively encourages Beneficiaries to invest in the first stage of the geothermal resource exploration period.

The general structure of the RSM program is given below. It is seen in the below figure that the funding source is covered by the World Bank and the CTF. The Development and Investment Bank of Türkiye has taken part in the program as the implementing agency, and the Engineering Department of the Bank is also responsible for coordination of this process. The RSM consultant provides support and consultancy service to the Engineering Department, which is expressed as the RSM Unit, in all processes of this program. The general relationship with the Beneficiaries is also shown in the figure below.

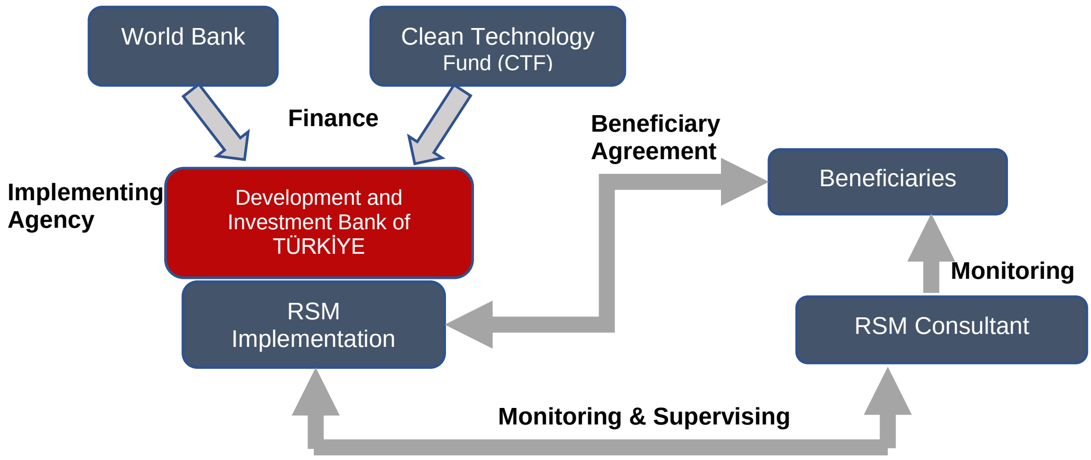

Figure 1: The main structure of RSM program

The geothermal fields in Türkiye have been evaluated with respect to the geothermal potential. The RSM program makes a rating based on the location of the planned project site. Depending on the location of the exploration wells, 40% or 60% of the cost of the well is funded by the RSM program as a grant disbursement to the Beneficiaries. In the below figure, information with regards to the grant rate on the basis of province and districts is given in detail. The grant rates have been determined entirely by considering the geothermal potential and related parameters of the region.

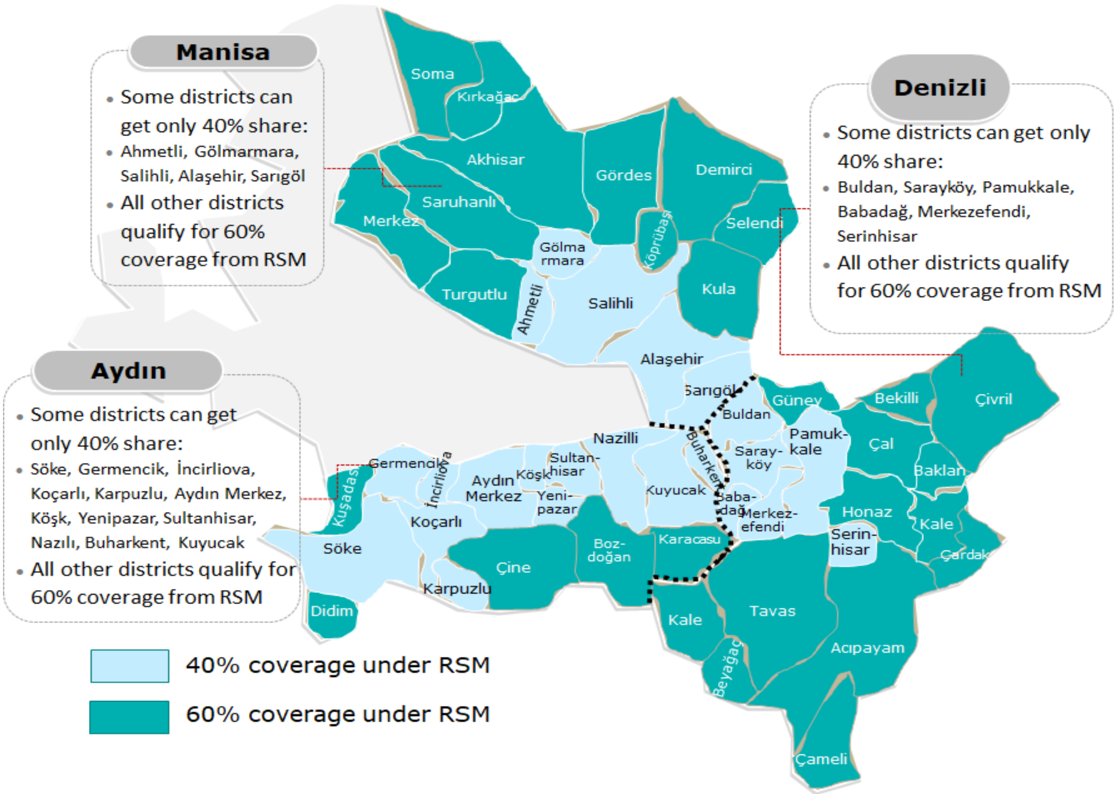

Figure 2: Representation of location coverage

In the first stage of the RSM program, the program is announced and the Beneficiaries are expected to provide a letter of intent. After the intentions are collected, a training is given to the Beneficiaries on application process within the scope of the RSM program. Afterwards, with the announcement, applications are received and evaluated. The assessment mainly includes geothermal conceptual models, resource capacity, investment costs, business plans, risk mitigation plans, and environmental & social assessments. Grant supports at 40% or 60% are decided after evaluating the applications depending on the project location. Within the framework of the proposed business plans for the wells, grants are paid to the unsuccessful wells, and a 5% success premium is received from the successful wells. The evaluation flow of the well test results is depicted in detail in the below diagram. The success criteria of the well tests results are directly correlated with the CO_2 emission value which is the national grid emission factor announced by the Ministry of Energy and Natural Resources (MENR) every year. The threshold value of CO_2 concentration is assumed as 555 gr/kWh, accordingly.

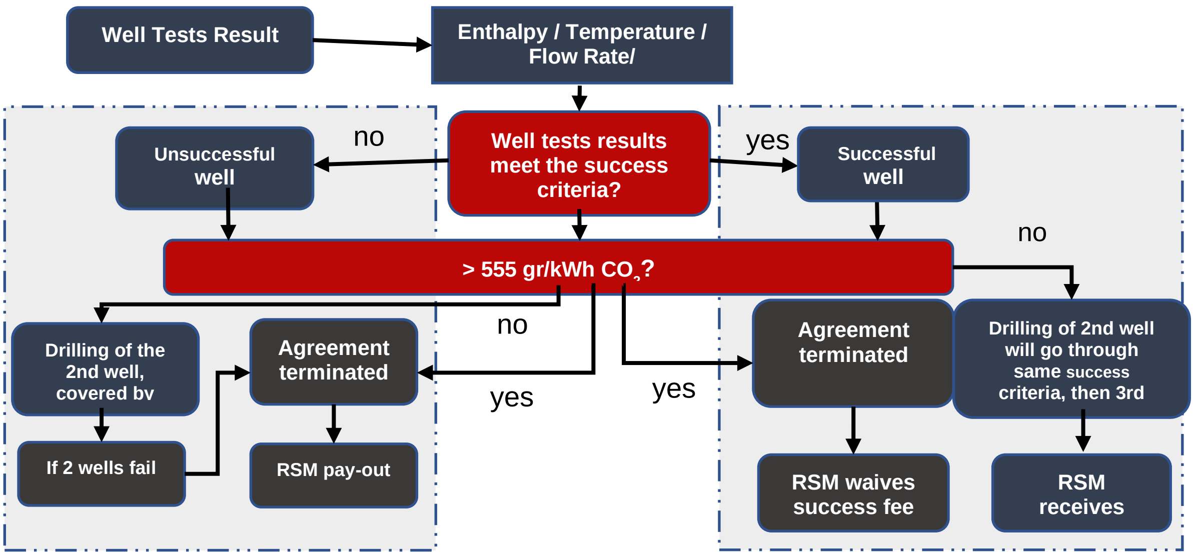

Figure 3: The well evaluation flow diagram

In addition to this, all projects within the scope of RSM program are examined from an environmental and social perspective. The following figure provides a summary of the main areas and expected studies as listed below:

- Project risk categorization;
- Public participation meeting;
- Environmental and social assessment;
- Land acquisition plan;
- Environmental and social management plan;
- Resettlement action plan;
- Environment and social impact assessment report;
- Stakeholder engagement plan; and
- Grievance mechanism.

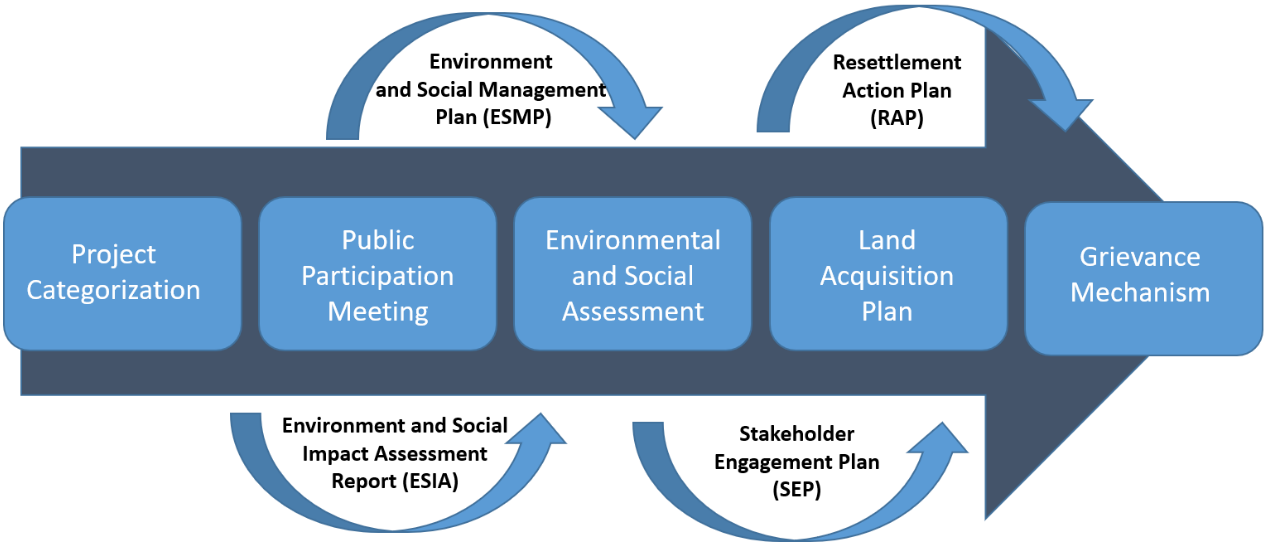

Figure 4: The scope of E&S evaluation

With respect to the program progress, two rounds have been held within the scope of the RSM program so far. A total of 21 Beneficiaries has applied in the first round, seven of these applications were deemed to be sufficient within the framework of the evaluation criteria as mentioned in the previous paragraph. Three of these projects has been withdrawn from the RSM program in the process, and the process continues with four projects within the scope of this round. In the second round, a total of 18 applications were received, and 14 applications were considered to have sufficient maturity. The locations of the relevant projects are demonstrated on the Türkiye geothermal resources map below.

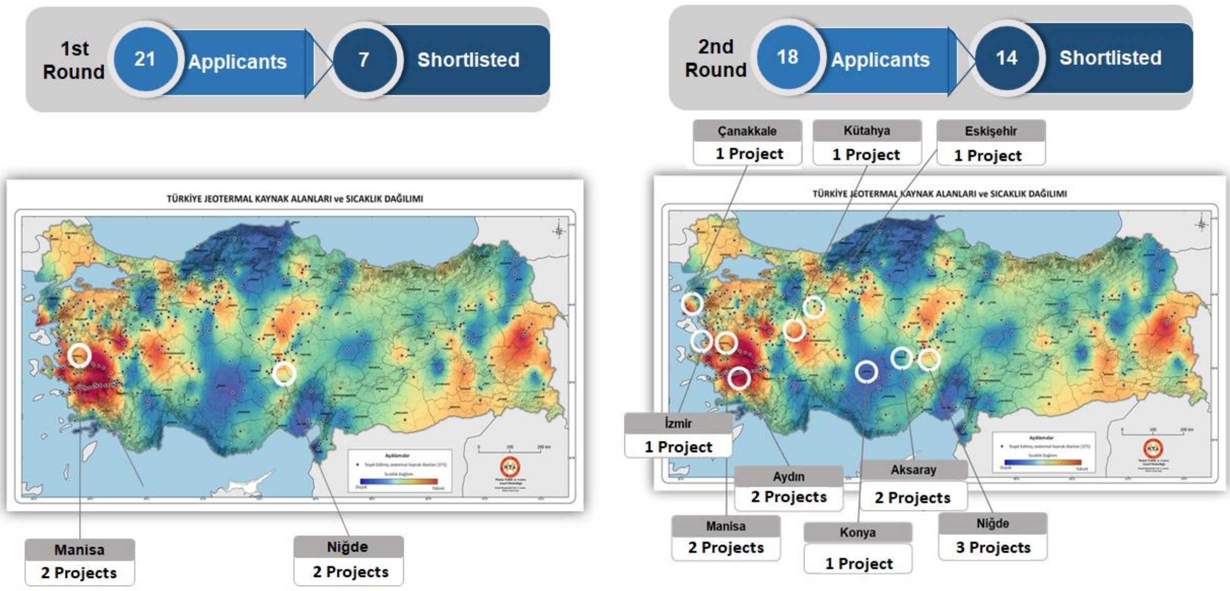

Figure 5: Locations of the RSM projects

In the First Round of the RSM Program;

- Seven Projects were shortlisted and three Beneficiary Agreements were signed.
- Two projects were completed in Niğde province.
- Three exploration wells were completed under the two projects as an unsuccessful well in accordance with the success criteria determined.
- USD 5 million RSM coverage has been paid to the Beneficiary for three unsuccessful wells.
- E&S permits and license processes of two projects are ongoing in Manisa province.

The location of the first drilled well is demonstrated in the figure below.

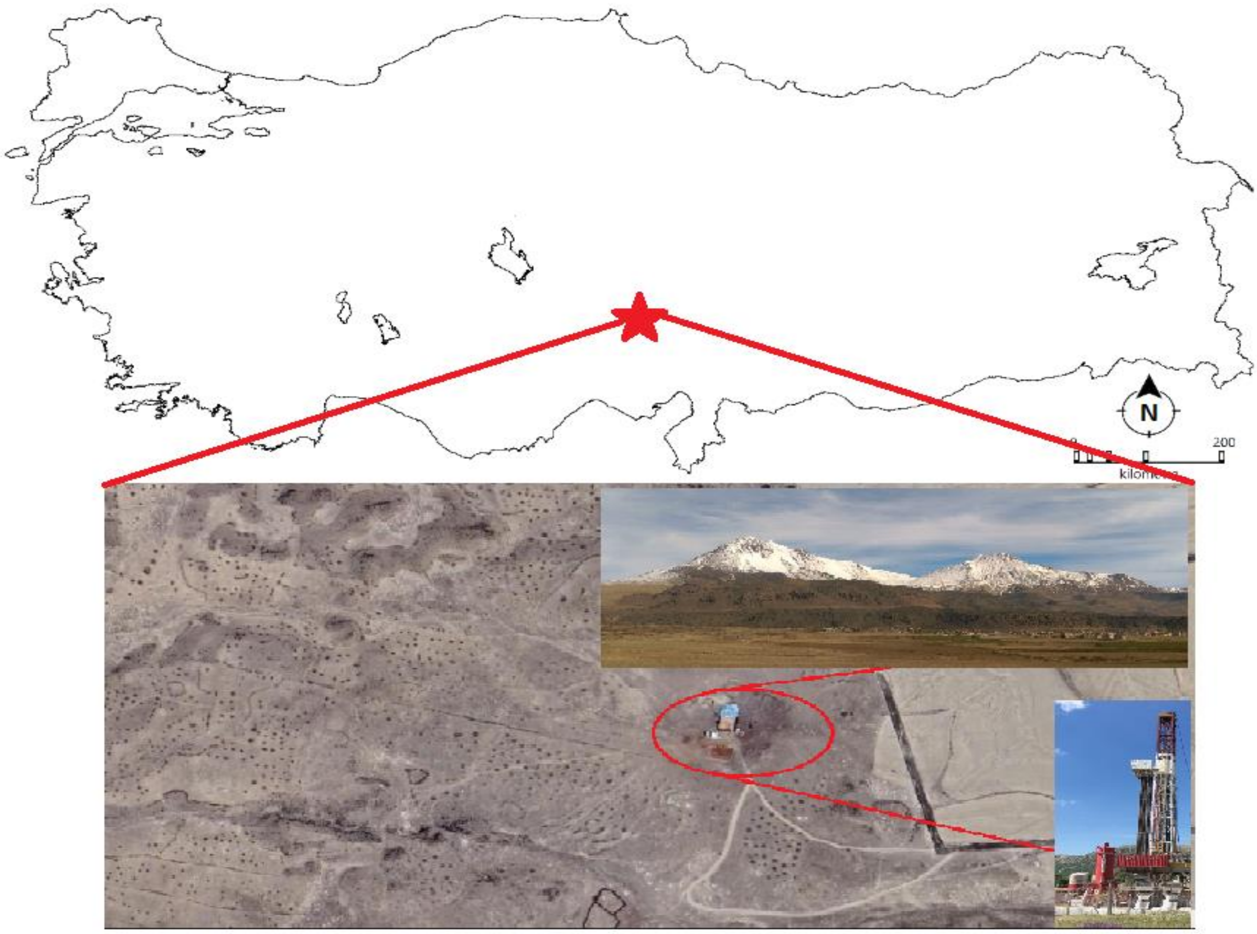

Figure 6: The first project location of the RSM program

In the Second Round of the RSM Program;

- 18 applications were received and 14 projects were shortlisted.
- The implementation process of 10 shortlisted projects (eight power plants and two direct use projects) are ongoing.
- A total of 30 exploration well drilling is projected under the second round, estimating the total power plant capacity to reach at 158 MWe and total heat capacity will be estimated as 112.5 MWth for direct use projects.
- No-objection process of World Bank is completed for two projects. The Beneficiary Agreement will be signed and also drilling operations will start on site accordingly.

3. CONCLUSIONS

The experiences gained and the lessons learned during the RSM program, which has been ongoing for about 6 years, are summarized as follows:

- Developing Expression of Interest (EoI) stage in order to draw up a shortlist of interested developers by gathering information regarding the financial capacity, technical capacity and ability to conduct the project. It is also believed that this stage will avoid delays in the project schedule caused by dealing with less qualified applications.
- Prior to the call for EoI, organizing a day-long workshop with the potential geothermal developers will be beneficial to give feedbacks on the interest in the RSM from the potential Beneficiaries.

- ❖ Following the EoI submission stage, a training for two days will be held regarding technical, financial and environmental and social requirements of the RSM program for the geothermal developers to clarify the RSM program application to support the Beneficiaries.
- ❖ The Beneficiary Manuel is revised to clarify the RSM program so that it become easier to guide the applicants during the all implementation periods of the program.
- ❖ Preparation of a template for the business plan for both type of the sub-projects (i.e., heat and power) for the standardization of all reports under the RSM program to ensure that all key indicators are covered in the applications and the monitoring processes.
- ❖ Closer monitoring and appropriate solutions to be provided for all shortlisted projects under the RSM program to improve the quality in the implementation processes.
- ❖ Conducting frequent site visits to the project areas to understand the current status of the projects better and also to overcome any issues effectively.
- ❖ During the evaluation of the well costs, all related documents covering invoices, payment documents and supported reports provided by the Beneficiary by monthly period in order to avoid any confusion.
- ❖ It is important to complete the environmental and social processes to implement the projects under the RSM program on time. Therefore, the projects which have already completed the E&S permits and land acquisition processes, would be preferred first to avoid any delays caused by the long-lasting E&S issues and court cases.

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