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IMPLEMENTATION COMPLETION AND RESULTS REPORT (ICR)

ON

SMALL RETF GRANTS

US\$1,000,000 GLOBAL ENVIRONMENTAL FACILITY

AND

US\$1,000,000 SIDS DOCK SUPPORT PROGRAM

TO

THE GOVERNMENT OF SAINT LUCIA

FOR A

GEOHERMAL RESOURCE DEVELOPMENT PROJECT IN SAINT LUCIA

August 26, 2019

Energy and Extractives
Latin America and the Caribbean Region

| | At Approval | At Completion |
|----------------------------------|-------------------------|----------------------|
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ABBREVIATIONS AND ACRONYMS

| | |
|----------|--|
| CIP | Clean Infra Partners |
| CTF | Clean Technology Fund |
| DEDTCA | Department of Economic Development, Transport and Civil Aviation |
| DIPE | Department for Infrastructure, Port Services, Energy |
| ECERA | Eastern Caribbean Energy Regulatory Agency |
| EMC | Exploration Management Consultant |
| ESIA | Environmental and Social Impact Assessment |
| ESMAP | Energy Sector Management Assistance Program |
| GDA | Geothermal Development Agreement |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| GoSL | Government of Saint Lucia |
| HQ | Head Quarters |
| LFO | Light Fuel Oil |
| LUCELEC | Saint Lucia Electricity Services Limited |
| MIPEL | Ministry of Infrastructure, Port, Energy, and Labour |
| MoF | Ministry of Finance, Economic Growth, Job Creation, External Affairs, and the Public Service |
| MoSDEST | Ministry of Sustainable Development, Energy, Science and Technology |
| MOU | Memorandum of Understanding |
| OECS | Organization of Eastern Caribbean States |
| PDO | Project Development Objective |
| PPA | Power Purchase Agreement |
| NURC | National Utility Regulatory Commission |
| PCU | Project Coordination Unit |
| PMA | Pitons Management Area |
| PPSD | Project Procurement Strategy for Development |
| RESDP | Renewable Energy Strategy Development project |
| RPS | Regional Partnership Strategy |
| SIDSDOCK | Small Island Developing States Program (under ESMAP) |
| TTL | Task Team Leader |
| UNEC | United Network of the Eastern Caribbean ¹ |
| WBG | World Bank Group |

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DATA SHEET

| A. Basic Information | | | |
|-------------------------|---|------------------------|---|
| Region: | Latin America and the Caribbean Region | Country: | Saint Lucia |
| Global Practice | Energy and Extractives | Joint with IFC: | no |
| Recipient: | Government of Saint Lucia | Implementing Agencies: | Initially, the Ministry of Sustainable Development, Energy, Science and Technology; subsequently, the Ministry of Infrastructure, Port Services, Energy and Labor |
| Sector(s)/Theme(s): | Sectors: Energy and Extractives Global Practice Themes: Environment and Natural Resource Management {as `percent of financing} | | |
| Executed by: | Recipient | | |
| Project ID: | P149959 | TF Name and Number(s): | TF018581 Geothermal Resource Development in Saint Lucia GEF RETF; TF018390 Geothermal Resource Development in Saint Lucia SIDS DOCK RETF |
| Original Grant Amount: | US\$2,000,000 | Donor(s): | GEF SIDS DOCK |
| Revised Amount: | | Disbursed Amount: | US\$1,661,510 |
| Environmental Category: | Not Required (C) | Safeguards Triggered: | |

| B. Key Dates | | | |
|---------------------|-------------------|---------------------------------------|--|
| Process | Date | Process | Date |
| Concept Review: | April 30, 2014 | Effectiveness: | December 22, 2014 |
| Appraisal: | | Restructuring(s): | January 4, 2017 Key Revisions: Change in Loan Closing Date(s) June 27, 2018 Key Revisions: Change in Loan Closing Date(s), Change in Disbursement Estimates, Change in Institutional Arrangements |
| Approval: | December 03, 2014 | Closing: | TF018581 and TF018390 January 31, 2017 |
| | | Revised Closing Date: <i>(if any)</i> | TF018581 January 25, 2019 TF018390 December 31, 2017 |

| C. Ratings Summary | |
|---------------------------|--------------------------------|
| Outcomes: | Satisfactory |
| Implementation: | Moderately Satisfactory |
| Risk to Sustainability: | Substantial |

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| Name | Title | Specialization | Unit | Location |
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Recipient Organization(s)

| Organization Name | Role | Contact | Title | Phone | Email |
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| Ministry of Economic Development, Housing, Urban Renewal, Transport and Civil Aviation | PCU, implementing team | Mr. Claudius Emmanuel | Permanent Secretary | | cemmanuel@gosl.gov.lc |
| Ministry of Infrastructure, Ports, Energy and Labour | Line ministry, Co-implementing team | Mr. Ivor Daniel | Permanent Secretary | | ivor.daniel@govt.lc |

I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVE

Context

1. Saint Lucia is a small island nation (606 square km) in the Eastern Caribbean with a population of about 183,000 and GDP per capita of US\$9,574 (2017 data). More than 1.1 million tourists visited the island in 2017. Saint Lucia is highly dependent on imported fossil fuels to meet its energy demand. Nearly all of its energy is imported, principally from Trinidad and Tobago. The dependence on oil for electricity generation, transportation and other energy needs leads to high and volatile prices in the sector. This is a major impediment that erodes the country's competitiveness, specifically as it seeks to attract a larger share of tourism revenues. High electricity costs weaken growth in business and services, create hardship and burden private consumers, especially the poor, while price volatility discourages local investments. Although global oil prices dropped dramatically in the middle of this decade, diesel-based electricity supply remains relatively expensive.

2. Saint Lucia Electricity Services Limited (LUCELEC) is the island's only licensed power utility. LUCELEC was granted an exclusive license by Ordinance No. 27 of 1964, later replaced by the Electricity Supply Act No. 10 of 1994. It is publicly traded with a shareholder base including Government (GoSL) entities², and has a concession to generate, transmit, distribute and sell electricity in Saint Lucia until 2045. LUCELEC operates 88.4 MW of generation capacity at a single power plant utilizing diesel, of which 68 MW was counted as firm capacity in 2017. It has just commissioned a 3 MW ground-mounted solar PV project that became operational in November 2018. The utility is also working to develop a 12 MW wind farm. Peak demand reached 61.7 MW in 2017, while the annual average demand was about 41 MW. Electricity sales increased at just under 2 percent per annum over the ten years from 2008 to 2017. The utility is consistently profitable and efficiently run with system losses in the region of 7 percent. The average retail electricity tariff has been in line with the Caribbean regional average - falling from about US\$0.38 per kWh in 2014 to around US\$0.27 per kWh in 2016 due to the fall in global oil prices. The fuel cost component is a direct pass-through to the electric tariff. LUCELEC implements a fuel price hedging strategy that may dampen the price volatility. Based on current consumption and growth rates, and the age and condition of the current diesel plants that were commissioned in 1990, LUCELEC is looking to make an investment decision in the near term to install new base-load generating capacity. The utility has indicated a willingness to consider alternatives to its default option of a tri-fuel (natural gas, light fuel oil (LFO), or heavy fuel oil (HFO)) fossil-based power plant that would lock in carbon-intensive, oil import dependent electricity generation.

² At its inception in 1964, LUCELEC was owned by three entities: Government of Saint Lucia with 18.7 percent of the shares, Castries City Council with 28.2 percent of the shares, and Commonwealth Development Corporation (CDC) with 53.1 percent of the shares. In 1994 LUCELEC went public. The makeup of shareholders per the 2017 Annual Report include: EMERA (St. Lucia) Limited (20 percent), First Citizens Bank Ltd. (20 percent), National Insurance Corporation (20 percent), Castries Constituencies Council (15.50 percent), Government of Saint Lucia (10.05 percent), and individual shareholders (14.45 percent). LUCELEC's shares are traded on the Eastern Caribbean Securities Exchange under the symbol SLEC.

3. Geothermal development in Saint Lucia has a long history, and there have been numerous efforts to explore the country's resources in the past. The Sulphur Springs area in the Soufriere region (south-western part of the island) had long been considered the center of geothermal potential in Saint Lucia. It has been studied since 1951 via reconnaissance investigations sponsored by the United Nations, and via drilling in the 1970s and 1980s. The previous deep drilling program in the Sulphur Springs area and at Belfond did not validate all major field characteristics necessary to confirm commercial viability, and the location of the first deep successful well at the Sulphur Springs is within the Pitons Management Area (PMA), which is a UNESCO-designated World Heritage Site.³

4. Despite the disappointing historical exploration experiences, geothermal power generation has continued to be seen by GoSL as a potentially attractive way to address some of the challenges faced by the power sector in Saint Lucia. It is clean, reliable, and could be a lower-cost energy source that could help diversify Saint Lucia's power generation mix. Once developed, geothermal power can provide base-load, with a high capacity factor in the region of 90 percent. As an indigenous resource, it will enhance energy security of the country and improve resilience, while serving as a natural hedge against the volatility and unpredictability of petroleum-based commodity prices. With modern technology and processes including reinjection of the geothermal fluid, emissions to air are negligible. Geothermal power would thus enable Saint Lucia to establish a reliable and environmentally friendly path to power development and economic growth in all the sectors. Geothermal energy would also maximize the use of Saint Lucia's indigenous renewable energy sources; with the inclusion of 30MW of geothermal energy, the government could increase its share of indigenous renewable energy to approximately 70 percent of total generation, thus facilitating energy independence and affordable electric tariffs.

5. In 2004, GoSL attempted to advance geothermal development by entering into a Memorandum of Understanding (MoU) and a Geothermal Exploration Agreement with UNEC Holdings, Inc. (UNEC). In 2010 GoSL and UNEC entered into a new MOU and a Geothermal Development Agreement (GDA), which replaced the 2004 documents. No development activities have been undertaken by UNEC, and in 2012 a qualified global geothermal developer, Ormat Inc, was identified by UNEC to potentially assume UNEC's rights and obligations.

6. In 2014, GoSL sought World Bank's technical assistance under this Project, with the support of grant funding from the Global Environmental Facility (GEF) and the SIDS DOCK Support Program (SIDS DOCK SP). Parallel work was funded by the Government of New Zealand and the Clinton Climate Initiative. Critical tasks under the Project included field reconnaissance, ESIA studies and pre-feasibility assessment to evaluate the technical feasibility of developing a geothermal resource away from the Sulphur Springs area and outside the PMA. This was designed to enable GoSL to make an informed decision on an optimal approach to proceed with the next

³ In 1974, seven wells in depth from 116 to 725 meters were drilled and indicated the existence of a shallow, medium to low permeability resource having temperatures up to 220C with high salinity and high non-condensable gas content. In 1986, a three well drilling program was designed. Maximum temperature of 292C was recorded, but permeability was very low, non-condensable gas concentrations were high (25%) and the presence of hydrochloric acid showed a severe tendency to scale.

phase of exploration drilling, to help minimize the costs and reduce the risks of the exploration drilling program, and to enhance the viability of the overall geothermal investment. The Project was also designed to include transaction support and legislative and regulatory support to facilitate geothermal exploration and development with a private developer.

7. The Project is fully consistent with the objectives of the World Bank's OECS Regional Partnership Strategy (RPS) for the period 2015-2019. The RPS identifies three thematic areas for support (a) enhancing productivity, competitiveness and employment; (b) modernizing the public sector; and (c) building social and climate resilience. To this end, the RPS aims to support activities aimed at contributing to more predictable and lower energy prices to enhance competitiveness and inclusion and specifically mentions the objective of advancing geothermal development in the region.

Project Development Objective (PDO)

8. The Project Development Objective (PDO) is to provide support to the Recipient [GoSL] to make an informed decision regarding geothermal exploration and development in Saint Lucia by undertaking key preparatory activities.

Outcome Indicators

9. The three PDO-level result indicators are as follows:
- (a) Pre-feasibility assessment technically confirming up to three areas as being sound for exploration drilling for geothermal resources, informing the government strategy for advancement;
 - (b) Agreement reached with a qualified developer as a partner to carry out exploration drilling, informing the developmental finance for the program;
 - (c) Funding for implementing an exploration drilling program is confirmed.

Components

10. The two Project components are as follows:
- (a) Component 1: Upstream geothermal development preparation and project management (\$1,135,000 from GEF and SIDS DOCK SP, \$125,000 in-kind GoSL, \$800,000 parallel financing support from the Government of New Zealand);
 - (b) Component 2: Transaction and regulatory support (\$865,000 from GEF and SIDS DOCK SP, \$150,000 in-kind GoSL + \$500,000 parallel financing support from CCI).

II. OUTCOME

11. The PDO remained relevant throughout the implementation of the Project and was fully consistent with the objectives of the World Bank's OECS Regional Partnership Strategy (RPS, 2015-2019) throughout implementation by contributing to development of more predictable and lower energy prices to enhance competitiveness and inclusion. Two of the three PDO-level

indicators remained relevant, and based on their achievement (see below), the PDO is considered as having been fully achieved. **The overall outcome is rated as Satisfactory.** The degree of the Project's attainment of each of the PDO-level indicators, and their relevance to the attainment of the PDO, are detailed below.

Indicator (a): Pre-feasibility assessment technically confirming up to three areas as being sound for exploration drilling for geothermal resources.

12. GRDP supported the GoSL to undertake surface reconnaissance and related studies to identify potential locations for exploration drilling, including geological structural mapping, three-dimensional magneto-telluric resistivity testing, and Light Detection and Ranging (LiDAR) surveys based on aerial remote sensing technology.

13. Following the completion of these studies, a pre-feasibility study of a proposed geothermal development was carried out by the firm GeothermEx during 2017. The final report concluded that it was reasonable to proceed immediately with a program of exploratory drilling at 3 sites – Belle Plaine, Fond St Jacques and Mondesir-Saltibus. These newly identified sites are not in the Sulphur Springs area that was the focus of the earlier, disappointing exploration efforts.

14. After the identification of the recommended sites, an Environmental and Social Impact Assessment (ESIA) was led by the firm Panorama and was completed in April 2018. It concluded that most impacts of geothermal development would be temporary and would not result in significant residual negative impacts that could not be mitigated. In March 2018, formal public consultations (townhalls) were then undertaken in the three communities in the identified site areas as well as Castries (capital city).

15. The key Project activities - the surface exploration studies, pre-feasibility study and the completion and publication of the ESIA - have all been successfully completed. This work has informed the decision of GoSL to proceed to the next phase of exploratory drilling with support from a follow-on Bank operation, the Renewable Energy Sector Development Project (RESDP, P161316). The Project outcome in this area is assessed as **Satisfactory.**

Indicator (b): Agreement reached with a qualified developer as a partner to carry out exploration drilling

16. The 2014 Project Paper identified the following key issues: a) reaching an agreement with UNEC to transfer its development rights to a new qualified developer, b) reaching an equitable agreement and a well-structured public-private partnership arrangement with a qualified developer, and c) reaching consensus with LUCELEC regarding power offtake from the proposed geothermal project. Furthermore, the Project Paper (in paragraph 12) reflected the fact that private developers will typically find it difficult to fully mobilize the US\$ 20 to 30 million in risk capital for the exploration drilling given the inherent risks and the high cost, as proven by international experience. A "risk-sharing" arrangement was therefore contemplated, with GoSL jointly funding the Phase II exploratory drilling with a private developer. The public financing component was expected to materialize through additional donor grant and concessional funding, including a potential contingent grant from the Clean Technology Fund (CTF), and GoSL was already in discussion with the Bank in 2014 regarding the potential mobilization of such additional funding.

17. GoSL recognized that it would require considerable assistance in designing and negotiating a favorable deal structure with a qualified developer, and it engaged a Transaction Advisor, Clean Infra Partners (CIP) to assist it as part of this Project. CIP was initially funded by the Clinton Climate Initiative (CCI) and later supported under this Project to develop a financial model for the geothermal project and support ongoing negotiations. Negotiations took place between Ormat, GoSL and LUCELEC between 2014 and 2016 in an attempt to move forward with key contractual agreements, particularly a Rights Transfer Agreement (transfer from UNEC), a term sheet for a Geothermal Development Agreement (GDA, between GoSL and Ormat), and a term sheet for a Power Purchase Agreement (PPA) for the long-term sale of power to LUCELEC from a new geothermal power plant to be developed by Ormat. However, the negotiations failed to reconcile several outstanding issues between the parties and none of these documents were signed.

18. Following the further identification of grant and concessional funding deemed sufficient to complete the Phase II exploration drilling without the need for private sector co-investment, GoSL decided to implement the exploration drilling program using only public resources to finance the drilling of deep exploration wells to a depth of around 2000 meters. The successor RESDP (under preparation) intends to confirm the quality of the geothermal resources through a publicly-financed exploration drilling program in the three areas, where the Project-supported preliminary surface studies suggest the possible existence of a geothermal reservoir. The approach of public funding for the risky exploration drilling phase can mitigate the high resource risks associated with developing the first geothermal power plant in Saint Lucia, thereby strongly improving the overall economics of geothermal development and facilitating attracting private investment for subsequent phases of development.

19. As such, the GoSL does not intend to reach an agreement with a qualified developer as a partner to carry out Phase II exploration drilling, as this approach has been superseded by circumstances that materialized during the implementation period of the Project, including the failure of negotiations with a qualified private developer and the identification of sufficient additional grant and concessional funding to pursue a feasible public investment approach to the exploration drilling. The GoSL's current approach, in line with international good practice, is to facilitate arrangements, including a long-term PPA between a to-be-selected qualified developer and LUCELEC, once the quality of the geothermal resources has been shown to be suitable for further Phase III confirmatory development (i.e. provided the future exploratory drilling has already demonstrated the existence of a geothermal resource of suitable quality).

20. In conclusion, **this outcome indicator is no longer relevant**, given that the GoSL has secured funding to support a publicly-led and funded approach to Phase II exploratory drilling. Since negotiations with a qualified private developer stalled in 2016 and public funding was secured for exploration drilling, the indicator could have been removed during one of the two Project restructurings (July 2017 and June 2018). **The realization of the other two Project PDO indicators, when taken together, result in a fully satisfactory overall Project outcome:** the successful surface exploration effort and pre-feasibility analysis are sufficient for GoSL to decide to continue with the geothermal development, and the successful identification of sufficient funding to complete the Phase II exploratory drilling as part of the follow-on Bank-supported RESDP.

Indicator (c): Funding for implementing an exploration drilling program is confirmed

21. An additional financing package of more than US\$22 million of grant and concessional funding has been identified to proceed with the Phase II exploration drilling and related capacity building activities under the RESDP. This includes: US\$5 million IDA credit, US\$4.2 million DFID grant, US\$2.6 million SIDS DOCK SP grant, US\$9.575 million CTF contingent recovery grant and a CTF project` preparation grant, and US\$1 million of GoSL counterpart funding. RESDP is currently under preparation and is set to proceed to WBG Board in FY 2020. This is surely a robust indication of the successful outcome of the Project. The Project outcome in this area is assessed as **Satisfactory (S)**.

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

22. The Project was approved on December 3, 2014 and became effective on December 22, 2014. The original implementing agency for the Project was the Department of Sustainable Development within the Ministry of Sustainable Development, Energy, Science and Technology (MoSDEST). In 2016, a new administration reorganized the GoSL energy portfolio and, as a result, the implementing agency was transferred from MoSDEST to the Department for Infrastructure, Ports and Energy (DIPE) within the Ministry of Infrastructure, Ports, Energy and Labour (MIPEL). This change in the implementation arrangements led to some delays in project implementation, as it took time for the new team to get up to speed with the project objectives and activities.

23. Throughout the project, the PCU provided fiduciary support from the Department of Economic Development, Transport and Civil Aviation (DEDTCA) within the Ministry of Economic Development, Housing, Urban Renewal, Transport and Civil Aviation. Thus, the PCU was very important to ensure continuity during the changes in the implementing agency. On the other hand, the project suffered at times due to capacity constraints within the PCU, particularly regarded to insufficient resources available to support PCU procurement work related to this project. The Project was also affected by high turn-over of World Bank staff – the project had five TTLs and five procurement specialists over its four-year life. This led to delays in providing clearances for some procurement activities, etc.

24. To account for delays in implementation, the Project was restructured twice (July 2017 and June 2018) to extend the project closing date to allow more time to complete activities and utilize the grant funding, particularly for the ESIA consultant, PCU staffing, and public awareness materials. Additional regulatory and transaction advisory work was envisioned to be completed after the extensions but ultimately were not implemented under GRDP, as described further below.

25. Despite some implementation delays, all the Project activities under Component 1 were completed by mid-2018, including:

- Surface reconnaissance studies indicating a potential resource based on: (i) Geologic Structural Mapping to identify and characterize fractures that could comprise conduits for thermal fluid circulation within a geothermal reservoir, (ii) LiDAR surveys based on aerial remote sensing technology to generate high resolution digital elevation maps for detecting faults and other topographic feature; (iii) Three-Dimensional MT Resistivity

Testing to characterize the sub-surface electrical regime and find areas of low electrical resistivity that are commonly associated with geothermal reservoirs.

- Mobilization of specialized just-in-time experts to help address technical issues from survey results.
- Preparation and presentation of a prefeasibility assessment by GeothermEx that incorporates the results of the various technical analyses as well as initial financial, economic and power systems evaluation.
- Preparation and presentation of an ESIA by Panorama, including gathering of initial environmental and social baseline data and assistance in conducting stakeholder information collection, participation and consultation process.
- Advisory services from experienced geothermal energy specialists who advised the GoSL on key technical decisions.

26. Under Component 2, the two main activities envisioned were transaction advisory support and legislative and regulatory work. The transaction advisory work was implemented, and negotiations took place between 2014 – 2016. However, the work did not lead to the envisioned outcome of bringing a qualified developer on board for geothermal exploration drilling. This was due to (i) changes in leadership of the negotiating teams from the GoSL and Ormat, which resulted in delays in the negotiations; (ii) challenges to align incentives of all parties, particularly prior to having more information about the quality of the geothermal resource; and (iii) the GoSL's identification of a potential financing package for exploration drilling under RESDP. In fact, the result of the transaction advisory support fed into a GoSL decision to proceed with the Phase II exploratory drilling as a publicly funded activity and not to continue with its previously contemplated approach of partnering with a private developer to undertake these activities. Nonetheless, future transaction and regulatory support will be required to advance the development process if suitable geothermal resource quality is demonstrated following the Phase II exploratory drilling, and support activities of this kind are already contemplated to be funded as part of the follow-on RESDP.

27. Regarding the legislative and regulatory work, an individual consultant was proposed by the PCU for Bank "No Objection" in mid-2017 to provide a suite of services, including assisting the GoSL in developing a legislative and regulatory framework for geothermal resource development in Saint Lucia, and this approach was queried by the Bank. A shortlist of consultants was then requested to express interest for the services, but issues surfaced with the technically preferred bidder regarding the scope of services and no price quotation was then sought. In any case, the legislative and regulatory work was not prioritized at the time. MIPEL and the National Utilities Regulatory Commission (NURC) is currently contemplating to bundle a package of regulatory studies for funding under the follow-on RESDP. The rationale for this is to ensure consistency among different regulatory activities being progressed.

28. Activities under this Component 2 were also intended to include external legal advisory work to assist GoSL in its analysis of the pre-existing MOU and GDA between GoSL and UNEC and their impact. However, the legal firm could not be contracted in time to utilize GEF funds prior to their expiry due to additional time required to define the activity's scope. This work is continuing with funding from the follow-on RESDP as a precursor to launch the Phase II exploration drilling program.

29. Additional activities were undertaken under Component 2 that were not initially envisioned, including training, capacity building, and the hiring of a Communications firm, which provided critical support to the GoSL during the ESIA and stakeholder engagement process.

30. In summary, despite challenges faced during implementation, the majority of planned activities were completed under the Project. The PDO, which is to provide support to the GoSL to make an informed decision regarding geothermal exploration and development, was successfully achieved. In fact, during 2017 the GoSL decided to request the Bank to proceed with the preparation of the follow-on RESDP, that will fund and support the Phase II exploratory drilling. In line with the recent ISR (October 2018), the Overall Implementation Progress is assessed as **Moderately Satisfactory**.

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

Bank Performance

31. Multiple changes in the TTL-ship of this activity with insufficient hand-over documentation has led to a loss of institutional memory on this Project. On the other hand, the client has required a significant amount of capacity building through the Project implementation, and Bank support to the client has been helpful to the Project meeting its development objectives. In line with previous Project ISR assessments, the Bank performance is rated as Moderately Satisfactory.

Safeguard and Fiduciary Compliance

32. **Safeguards.** Although the Project was a technical assistance operation, safeguards were triggered for environmental assessment, natural habitats, physical cultural resources and involuntary settlement. An ESIA was performed under the Project, and community consultations were held in three potentially affected communities. Safeguards were rated as Satisfactory in the first Project ISR (January 2018) and were not specifically rated in the second ISR (October 2018), however there is no reason to expect a reduction in rating as the relevant activities were completed by January 2018. No compliance issues were identified.

33. **Procurement.** The procurement performance under this Project was previously assessed as Moderately Unsatisfactory due to delays on the procurement processes, delayed processing of necessary contract amendments, and lack of internal quality control of packages submitted for the Bank's review. During the Bank mission to Saint Lucia in May 2019, discussions were held with PCU personnel responsible for procurement. It was clarified that some of the procurements proceeded quickly, and others were delayed. Valuable lessons were learned that are expected to result in strengthening the GoSL's procurement capacity for the follow-on RESDP, including the creation of a dedicated PIU.

34. **Financial management.** The PCU had financial management arrangements in place that provided reasonable assurance that the funds were used for the purposes intended. The final Financial Management Implementation Support and Supervision Report (December 2018)

indicated that the external audit report for the SIDS-DOCK Trust Fund was acceptable to the Bank, and that the report for the GEF Trust Fund was still awaited as the GEF grant was extended to January 2019. A list of the Project's closing procedures was also identified to be completed by the PCU. The report rated the Recipient's financial management as Moderately Satisfactory.

Quality of Monitoring and Evaluation

35. The PDO is low on specificity; however, adequate PDO-level and intermediate indicators were identified. As reported above, one of the three PDO-level indicators lost its relevance during Project implementation and this indicator should have been adjusted during implementation. However, the other two PDO-level indicators were sufficient on their own to measure the successful outcome of the Project.

36. The M&E framework was simple, which was appropriate given the nature of this operation. However, all PDO level and intermediate results level indicators were binary in nature, making them less useful for tracking incremental progress throughout implementation.

37. Quarterly reports were provided by the PCU, tracking progress of ongoing Project activities, identifying challenges and planned activities for the next period. However, a mid-term review was not done, and the first ISR was completed only in January 2018.

Risk to Development Outcome

38. Geothermal Resource/Exploration Risk. The geothermal reservoir may or may not be one that can be commercially developed. Its actual physical characteristics and thus its suitability for development can only be ascertained by deep exploration drilling up to a total depth (TD) of 1,500 to 2,000 meters. There are no thermal manifestations in the potential areas of interest.

39. Technical Design and Cost Risk. The geothermal exploration requires some flexibility in the design of the project in order to determine the viability of the geothermal resource, mainly due to the uncertainty regarding the exact location and number of holes to be drilled in the project area. This design uncertainty bears a cost risk to the project since changes to the location, additional drillings, and other deviations will adversely impact the up-front project cost. It will be important to build in sufficient financial contingencies. The risk can also be managed to some extent by using an Exploration Management Consultant (EMC) who will oversee the exploration drilling campaign on behalf of the government and convene a Technical Panel comprising of stakeholders to guide implementation, including review of any changes to the plan during implementation.

40. Financing Risk. All greenfield geothermal projects face very high financing risk due to high upfront costs during the exploration and confirmatory drilling phases before resource viability is fully confirmed, and a long lead time from the start of exploration to power plant commissioning and first revenues. Donor grant and concessional funding is therefore an important element to mitigate the financing risk of a greenfield geothermal project, and this Project and the follow-up RESDP help to mitigate the financing risk.

41. Policy, Regulatory and Related Implementation Risks. Commercial success of a greenfield geothermal project after handing it over to a private sector developer depends on the policy and regulatory environment in the country. Therefore, clarity in policy and regulations which impact geothermal development such as pricing and taxation, procurement procedures, environmental

concerns, permitting, location and siting restrictions, etc., as well as capacity constraints of relevant institutions and the ability to successfully structure and execute the transaction, will need to be addressed. The RESDP will include a component that will support the provision of advisory services to address these policy/regulatory gaps and capacity constraints.

42. Market and Country Risks. The Caribbean presents a relatively small market in general, and Saint Lucia has a particularly small economy with a small population. This presents a challenge in attracting qualified developers in significant numbers in the energy and other infrastructure sectors, which is exacerbated by the fact that geothermal is a relatively nascent industry in the region and there is limited domestic sector capacity in the island. At least one reputable, international developer has expressed strong interest in the past, which is an encouraging sign. Nonetheless, lack of effective competition is still a major issue in such a market. The GoSL can address this by market sounding at an appropriate time in the future.

43. Competitiveness of Geothermal Energy: Renewable energy is a dynamic and fast changing sector, and other technologies including solar PV and battery storage have achieved very substantial cost reductions in the last few years. Geothermal power generation does have the important advantages of being a base-load resource with a high firm availability factor and a very compact and low-profile plant footprint. It is also positive from a climate resilience perspective, as geothermal is not affected by changes in precipitation and the installations are less likely to be affected by extreme wind speeds than solar PV and wind. The recently completed National Energy Transition Strategy (NETS), led by internationally well-respected, independent parties of Carbon War Room (CWR) and the Rocky Mountain Institute (RMI) and supported by the DNV-GL, concludes that geothermal energy, if included in the least cost energy mix at the projected 30 MW capacity range and if procured at an affordable price [below US\$0.14 per kWh], may fit the least cost model and substantially benefit the country achieving up to 75.3 percent of renewable energy penetration by 2025.

44. Business model and structuring risks: As exemplified by the failure of the previous business negotiations in an attempt to secure an acceptable deal, there are substantial impediments to achieving a suitable business model and deal structure for geothermal power generation and supply in Saint Lucia that will need to be carefully navigated with the aid of experienced and committed principals and excellent advisory support.

45. Private sector involvement in future resource development. As described above, no concrete development investments have taken place under the GDA between the GoSL and UNEC. Until this issue is addressed, there will be some uncertainty regarding the future geothermal project development in Saint Lucia.

46. **The overall risk to development outcome is rated as Substantial** for the successful and sustainable implementation of geothermally generated electric capacity on the island.

V. LESSONS LEARNED AND RECOMMENDATIONS

47. **The Project has demonstrated that grants to support upstream geosciences and other project preparation work are critical to informing stakeholder decisions to invest in geothermal exploration activities.** In the case of this project, the technical work completed greatly supported consultations with local communities. Some community members questioned the difference between the future exploration activities planned under the upcoming RESDP compared to previous exploration attempts undertaken by the GoSL. The technical and environmental/social studies completed under this activity were able to inform the GoSL responses to local stakeholders, giving them comfort that best scientific and safeguards practices are being deployed for the RESDP.

48. **The successful outcome of the Project was facilitated by the early identification of additional funding that allowed the Project to evolve in the direction of a publicly funded exploration program,** rather than the original plan to partner with a qualified developer to jointly fund the exploratory drilling program. Having a forthcoming lending operation under preparation has allowed this Project to pursue deliverables that are focused, practical, and serve a concrete objective. Moreover, the RESDP preparation has been greatly enhanced through the implementation of this Project, particularly in supporting the preparation of the pre-feasibility study to determine the likely exploration drilling locations, the ESIA including stakeholder consultants, and other community outreach activities.

49. **The implementation of the Project also highlighted the need for strong procurement capacity and clear institutional arrangements.** Overall, the PCU's procurement performance was mixed, with some procurement packages proceeding quickly and others being substantially delayed. The causes of some of the delays could be debated, however the delays did not undermine the progress of the Project in achieving its objectives. A key lesson learned is the need for GoSL to appoint a dedicated Procurement Officer to support the follow-on RESDP, and to have more ownership and specialized skills within a PIU in the line ministry. An Exploration Management Consultant (EMC) will also be appointed prior to the commencement of the exploratory drilling. The EMC will act under the general supervision of a technical staff in the PIU.

50. **Global experience shows that publicly funded exploration drilling can serve to de-risk geothermal development,** allowing private sector financing to enter once resource risk has been greatly reduced, resulting in a better allocation of project risks and – ultimately – a lower tariff. Project development, particularly in the geothermal sector, is a high-risk and uncertain venture, and very significant viability risks will remain throughout the exploration and confirmatory drilling phases. There is no assurance whatsoever that these geothermal resources can be profitably developed for the benefit of the government and citizens of Saint Lucia, and the only rational path is to proceed step by step and make a thorough evaluation and go/no-go decision at the end of (or during) each development step.

51. **The approach of pursuing a bilateral arrangement for geothermal exploration and development has not delivered results for Saint Lucia to date;** thus, looking beyond the exploration drilling phase, the business model for geothermal power development and structuring of the transaction will need to be carefully considered to ensure the project is economically competitive (part of the least cost pricing scenario) and balances the interests of the key stakeholders. A small island like Saint Lucia is at a disadvantage in terms of attracting adequate competition from experienced geothermal developers, which are few in number. However,

competition should be sought where feasible, and the market should be tested at the appropriate time after the publicly funded exploratory drilling program (assuming it is successful) has de-risked the development. Furthermore, a geothermal resource development can be facilitated by the establishment of a sound enabling and regulatory framework for geothermal power, buy-in to the deal structure by key stakeholders, and optimizing the developer selection process to secure the best value for money.

Annex 1. Results framework and Key Outputs

| A. Results Indicators | | | | |
|-------------------------------------|---|--|---------------------------------------|--|
| A.1 PDO Indicators | | | | |
| Indicator | Baseline Value | Original Target Values | Formally Revised Target Values | Actual Value Achieved at Completion |
| Indicator 1 | Pre-Feasibility assessment technically confirming three to four areas as being sound for exploration drilling for geothermal resources, informing the government strategy for advancement | | | |
| Value (quantitative or qualitative) | Preliminary assessments conducted in 1980s showed differing results ⁴ | 1 assessment confirming up to three areas as being sound for exploration drilling | | 1 assessment confirming up to three areas as being sound for exploration drilling |
| Date | 16-Oct-2014 | 26-Sep-2018 | | 25-Jan-2019 |
| Comments/Explanation | | | | |
| Indicator 2 | Agreement reached with a qualified developer as a partner to carry out exploration drilling, informing the developmental finance for the program | | | |
| Value (quantitative or qualitative) | 0 equitable grant agreements with a qualified developer | Discussion with developer(s) have been ongoing - expectation revised - no final agreement expected until after drilling exploration campaign confirms the resource quality | | No agreement reached with a qualified developer for exploration drilling (irrelevant, as public funding deemed more appropriate and was secured) |
| Date | 16-Oct-2014 | 26-Sep-2018 | | 30-Jun-2022 |
| Comments/Explanation | | | | |

⁴ Preliminary assessment in 1984 by LANL for USAID (3 areas for exploration drilling inside PMA). Preliminary assessment by Aquater in 1982 for GOSL (5 areas for exploration, 4 inside and 1 outside PMA).

| | | | | |
|-------------------------------------|---|--|--|--|
| Indicator 3 | Funding for implementing an exploration drilling program is confirmed | | | |
| Value (quantitative or qualitative) | No funding currently allocated for exploration drilling | Financing package of US\$22.5 million identified; 17 million has been approved; 5 million (IDA credit) proceeding to Board approval in May 2019. | | Financing package of \$22-US million identified; Board approval expected Dec 2019. |
| Date | 16-Oct-2014 | 26-Sep-2018 | | 25-Jan-2019 |
| Comments/Explanation | | | | |

| A.2 Intermedia Results Indicator | | | | |
|---|--|---|---------------------------------------|---|
| Indicator | Baseline Value | Original Target Values | Formally Revised Target Values | Actual Value Achieved at Completion |
| Component 1: | Upstream geothermal development preparation and project management | | | |
| Value (quantitative or qualitative) | No recent studies conducted for Project (see footnote 5 for information on previous studies) | Completed surface reconnaissance studies (Geo Mapping, LiDAR assessment and Magneto-telluric test), hired, technical experts / advisory, completed prefeasibility study, final ESIA to be completed in October 2019 | | Key technical studies (such as Geo Mapping, LiDAR assessment and Magneto-telluric test) for evaluating geothermal resource at surface level completed |
| Date | 16-Oct-2014 | 26-Sep-2018 | | 25-Jan-2019 |
| Comments/Explanation | | | | |

| Component 2 | Transaction and regulatory support | | | |
|-------------------------------------|---|--|--|--|
| Value (quantitative or qualitative) | No support for project | Communications support contracted and underway. Legal and regulatory advisory services to be contracted in coming weeks. | | Transaction advisory services completed, including the development of the financial model for the project; Communications Support provided; Support provided for negotiations on the GDA and related documents, although these were not finalized. |
| Date | 16-Oct-2014 | 26-Sep-2018 | | 25-Jan-2019 |
| Comments/Explanation | | | | |

Annex 2. Project Cost by Component

| Components/Activities | Approval Estimate (USD) | Actual (USD) | Actual as a Percentage of Approval Amount (percent) |
|---|-------------------------|------------------|---|
| 1. Upstream geothermal development preparation and project management | 1,135,000 | 1,555,075 | 137 percent |
| 2. Transaction and regulatory support | 865,000 | 106,434 | 12 percent |
| | | | |
| Total Project Cost | 2,000,000 | 1,661,510 | 83 percent |

Annex 3. Recipient's ICR



IMPLEMENTATION COMPLETION REPORT

ON

**THE GEOTHERMAL RESOURCE DEVELOPMENT
PROJECT**

July 10, 2019

Department of Infrastructure, Ports & Energy
Union
Castries
Saint Lucia

Department of Economic Development,
Transport & Civil Aviation
Finance Administrative Centre
Pointe Seraphine
Castries
Saint Lucia

I. PROJECT DESCRIPTION

1. Background

The Government of Saint Lucia (GOSL) has resumed the active exploration of geothermal energy, in keeping with the country's policy objective of reducing Saint Lucia's reliance on fossil fuels for energy generation.

In light of the foregoing, Government obtained financial assistance and technical support from a number of development partners, in its effort to develop the geothermal resource. Under the Geothermal Resource Development Project (GRDP), the World Bank assisted Saint Lucia in accessing US\$2 million of grant financing from the Global Environmental Facility (GEF) and the SIDS DOCK Support Program (SIDS DOCK SP). In addition, Technical Assistance (TA) valued at US\$800,000 and US\$500,000 was obtained from the Government of New Zealand (GONZ) and the Clinton Climate Initiative (CCI) respectively to aid this initiative. These funds were utilized to provide the necessary technical, transaction and regulatory support to make informed decisions on moving the project forward to the exploratory drilling phase.

2. *Development Objective of the GRDP*

The development objective of the project was to provide support for the Government to make an informed decision regarding geothermal exploration and development in Saint Lucia, by undertaking key upstream activities. The project was structured in two components (i) Upstream Geothermal Development Preparation and Project Management and (ii) Transaction Advice & Regulatory Support.

3. Upstream Geothermal Development Preparation and Project Management

a) Light Detection and Ranging (LiDAR) Survey and Surface Reconnaissance Studies

Objectives

The objectives of LiDAR and the geoscientific surface exploration were (i) to generate high resolution digital elevation maps for detecting faults and other topographical features and (ii) to identify permeable zones and structures where it may be possible to exploit the geothermal resource in areas removed from the highly acidic and high gas content identified from the previous drilling programme.

- The LiDAR survey was completed in February 2016;
- The geoscientific studies/surface exploration work was completed in March 2016;
- Three (3) potential geothermal resource development areas and possible locations for exploratory drilling were identified by Jacobs New Zealand Ltd.

b) Pre-feasibility Study on the proposed Geothermal Project

Objectives

The objectives of the study were (i) to review and validate the technical findings on the various upstream activities and (ii) evaluate the viability of the geothermal resource data with the power system related data.

- The Pre-feasibility study was completed in December 2017;
- The final Report on the Pre-feasibility study dated December 27, 2017 concluded that additional surface exploration is unlikely to lead to greater confidence in the selection of sites for exploration wells;
- The final Report also concluded that it is reasonable to proceed immediately with a program of exploratory drilling at (i) Belle Plaine (ii) Fond St. Jacques and (iii) Mondesir-Saltibus.

c) Environmental and Social Impact Assessment (ESIA)

Objective

The objective was to undertake an environmental and social impact assessment of geothermal resource development in the project area of interest.

- The final Report on the Environmental and Social Impact Assessment (ESIA) was completed in April 2018;
- The findings presented in the final Report identified environmental and social impacts that would result from the project;
- The final Report concluded that most impacts would be temporary and would focus within the drilling area during well drilling and testing;
- The final Report also concluded that the project would not result in significant residual negative impacts that could not be mitigated.

4. Transaction Advice and Regulatory Support

a) Transaction Advisory Services

Objective

The objective was to engage a Consultant to design and negotiate a favourable deal structure with a qualified geothermal developer.

- Negotiations took place between 2014 and 2016 among Ormat, GOSL and LUCELEC and centered around a Geothermal Development Agreement (GDA) Term Sheet, a Power Purchase Agreement (PPA) Term Sheet and a Geothermal Rights Transfer Agreement (GRTA);
- The negotiations were not concluded and none of the documents above was signed;
- No geothermal developer was selected for the exploration drilling programme;

- With the identification of USD22 million in grant and concessional funding for Phase II of the exploration programme, GOSL has taken the decision to implement the exploration work of 3 - 4 wells, to a depth of up to 2000 meters, using public funds without the need of private sector co-investment.

b) Regulatory Support

Objective

To establish the legal and regulatory framework, for introducing and integrating geothermal energy in the domestic power system.

The key expectations under the regulatory support were:

- Final draft of the Geothermal Resource Development Legislative & Regulatory Framework (Bill);
- Amendment to the Physical Planning Act to include the draft of the of the ESIA Regulations and the Limits of Acceptable Change (LAC) Regulations for the PMA.

Although an Individual Consultant (IC) was proposed for the assignment, the scope of the services became an issue with the first ranked IC, and no financial proposal was submitted by the IC. Consequently, it was decided to undertake the assignment under the proposed Renewable Energy Sector Development Project (RESDP).

5. Project Financing and Resource Allocation

The core activities of the project funded by GEF and SIDS DOCK SP are shown below, with each organization providing a grant of US\$1 million, for a total grant funding of US2 million from these agencies. The GOSL also contributed US\$275,000 in-kind, for project activities. The GEF and SIDS DOCK SP grant funds were being channeled through the World Bank, to GOSL.

| Project Components | Project Cost | Grant Financing |
|--|--------------|-----------------|
| 1. Component 1: Upstream geothermal development preparation and project management | 2,060,000 | 1,135,000 |
| 2. Component 2: Transaction and regulatory support | 1,515,000 | 865,000 |
| Total Financing | 3,575,000 | 2,000,000 |

Note: The grant financing reflected in the table above, does not include the parallel financing by CCI, the GONZ, and the in-kind contribution by GOSL. This is reflected in the table below.

The allocation of resources by the various funding Agencies is presented below.

| Funding Sources | Resource Allocation | Cumulative Expenditure – Financial Year | | | | April 2018 to April 2019 ⁵ |
|----------------------------------|---------------------|---|--------------------------|--------------------------|--------------------------|---------------------------------------|
| | | April 2014 to March 2015 | April 2015 to March 2016 | April 2016 to March 2017 | April 2017 to March 2018 | |
| IBRD (GEF) | US\$1,000,000 | | | | US\$229,159 | US\$515,687 |
| IDA (SIDS DOCK) | US\$1,000,000 | | US\$222,020 | US\$249,060 | US\$436,891 | US\$8,693 |
| GONZ | US\$800,000 | US\$500,000 ⁶ | US\$300,000 | | | |
| Clinton Climate Initiative (CCI) | US\$500,000 | US\$235,000 ⁷ | US\$35,000 | US\$115,000 | US\$115,000 | |
| GOSL | US\$275,000 | | In kind | In kind | In kind | |

II. PROJECT IMPLEMENTATION

6. Comparison of Original and Actual Implementation Schedules

During the implementation of the GRDP, the Implementing Agency was always cognizant of (i) tasks specifically behind schedule (ii) reasons for the delays that have caused the tasks to fall behind schedule and (iii) steps that have been or are being taken (or should be taken) to restore the situation to its initial state.

Consequently, there were time overruns (from signing of contract to completion) on three consultancies. They were: ESIA (1.5 months), Transaction Support (10.5 months) and Public Information and Communications Campaign (6 months).

7. Selection of Consultants

Consulting services were contracted under the GRDP in the following areas of expertise: LiDAR (Consultant's Name – McElhanney), Pre-feasibility study (Consultant's Name – GeothermEx), ESIA (Consultant's Name – Panorama), Transaction Support (Consultant's Name – Clean Infra Partners), as well as Project Management and Public Information & Communications Campaign.

⁵ *The IBRD (GEF) Grant closed on 25th January, 2019.*

⁶ *Actual expenditure before and after World Bank project Effective Date of December, 2014, not available.*

⁷ *Actual expenditure before and after World Bank project Effective Date of December, 2014, not available.*

III. PROJECT EXTENSIONS

8. First Extension of Project Closing Date

The project team was faced with a number of challenges including a re-definition of the scope of work under the Light Detection and Ranging (LiDAR) Survey, resulting in the extension of the field work. Additionally, the geothermal developer, Ormat Inc., decided to re-structure the company, with the appointment of a new management team, including a new head of Business Development and a new Legal Advisor. An extension was processed to allow additional time to complete these activities.

9. Second Extension of Project Closing Date

The extension was necessary to allow the GOSL to complete critical tasks principally:

- the public information and communications campaign;
- the establishment of the institutional arrangements and staffing for overall project management of the exploratory drilling campaign; and,
- the preparation of the project procurement strategy for development (PPSD).

IV. CHALLENGES AND LESSONS LEARNED FROM THE PROJECT

10. Re-definition of the Scope of Work for the LiDAR Survey

There were challenges arising from the re-definition of the Scope of Work under the Light Detection and Ranging (LiDAR) survey, resulting in the extension of the field work.

As such, the following amendments to the technical specifications of the survey were made to the TORs:

- Removing the requirement to fly a hyperspectral survey, as the outputs were expected to be of limited value due to the terrain and the challenge of flying the survey in the climatic conditions of the project area of interest (a rainy area of low visibility due to the cloud cover);
- Increasing the coverage of the LiDAR area (from 50 km² to 75 km²) as per the area provided by Jacobs, due to the resistivity lows, encountered to the south east of the Sulphur Springs, well away from the PMA Green Buffer;
- Allowing Orthophotos to be submitted at 20 cm resolution, as opposed to the 10 cm initially specified.

11. Environmental and Social Impact Assessment

- The underlying challenges were:
 - The submission of an enhanced evaluation report (due to issues raised by the World Bank during the selection process) that was deemed responsive to the

- Terms of Reference (TORs) and the Request for Proposals (RFP), given that the ESIA was a prior review contract;
- The estimated cost of the services was USD200,000.00 as approved in the Procurement Plan for the Project. The Consultant's budget exceeded the threshold in the Procurement Plan. The threshold was subsequently increased to USD300,000.00;
- The preparation of a detailed Negotiation Strategy by the PCU, with budget options, was a key task and very likely, prevented a breakdown in contract negotiations;
- Panorama Environmental Inc was able to revise its financial proposal downward to USD249,792.00.

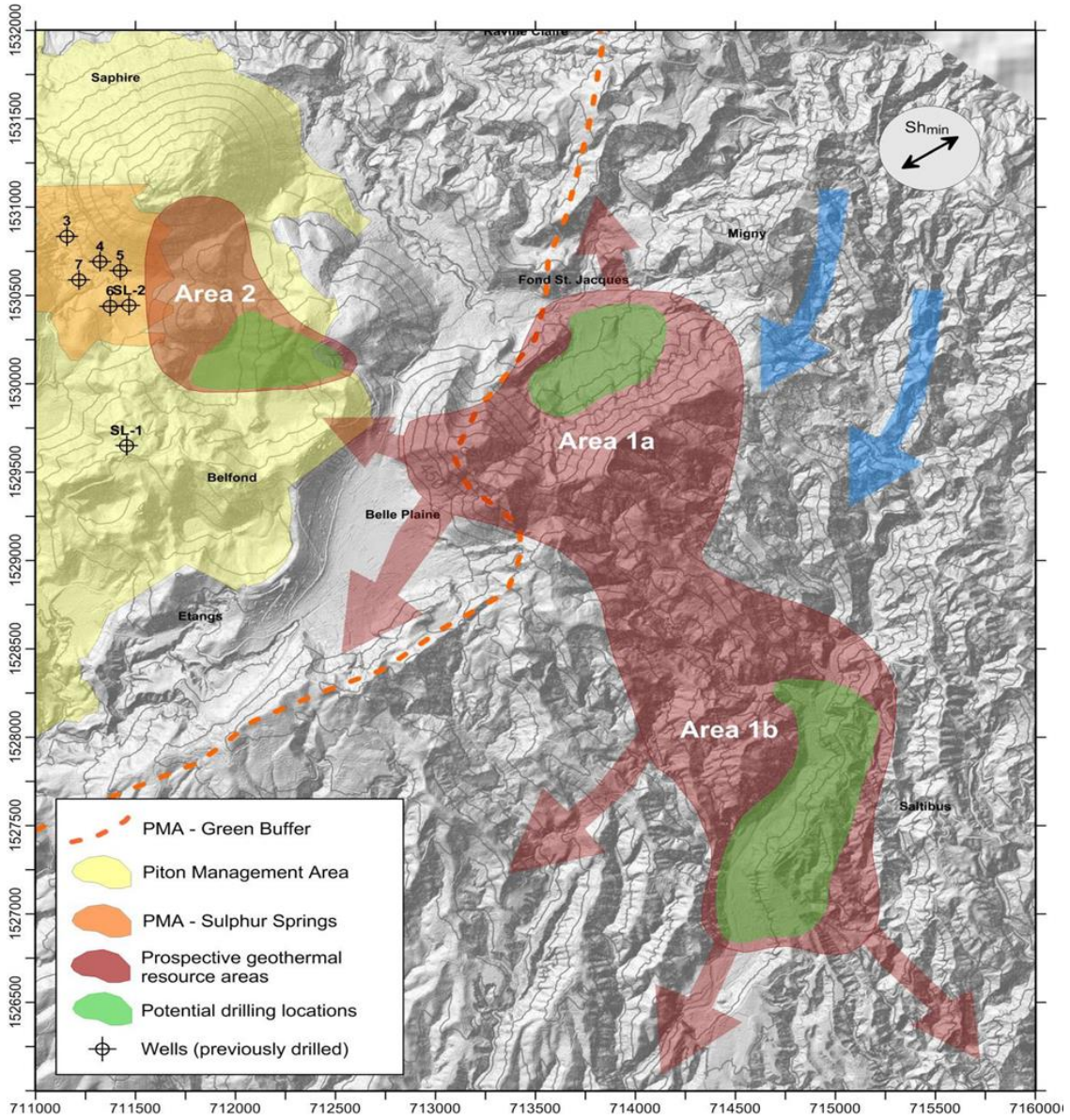
12. Pre-feasibility Study of the proposed Geothermal Project

- The underlying challenges were:
 - The estimated cost of the services was USD150,000.00 as approved in the Procurement Plan for the Project. The Consultant's budget exceeded the threshold in the Procurement Plan. The threshold was subsequently increased to USD300,000.00;
 - Again, the preparation of a detailed Negotiation Strategy by the PCU, with budget options, was a key task and very likely, prevented a breakdown in contract negotiations;
 - GeothermEx was able to revise its financial proposal to USD299,918.00. The revised fee proposal was below the revised procurement post review threshold;
 - The need to avoid the project area of interest within and close to the Piton Management Area (PMA) as part of the drilling strategy and plan;
 - The difficulty in prescribing a geothermal model for the area beyond the PMA Green Buffer because of the lower level of understanding of the stratigraphy/pyroclastic cover.

13. Organizational changes during implementation

In the local context, there was a re-allocation of the energy portfolio within the Government in 2016, resulting a change in the Implementing Agency for the GRDP from MSDEST to DIPE. This led to delays in implementing some of the project activities. In addition, the transaction advisory work was delayed, in part, due to re-structuring of Ormat, with the appointment of a new management team, including a new head of Business Development and a new Legal Advisor.

Annex 4. Area of Exploration Interest Identified during the Surface Exploration Studies



Annex 5. PMA Policy Areas, PMA Green Buffer and Potential Drilling Sites

