



1. Project Data

Project ID P152653	Project Name Sustainable Energy Industry Development	
Country Pacific Islands	Practice Area(Lead) Energy & Extractives	
L/C/TF Number(s) TF-A1235,TF-A1342,TF-A1505	Closing Date (Original) 31-Aug-2020	Total Project Cost (USD) 5,176,220.19
Bank Approval Date 29-Sep-2015	Closing Date (Actual) 28-Feb-2023	
	IBRD/IDA (USD)	Grants (USD)
Original Commitment	5,660,000.00	5,660,000.00
Revised Commitment	5,589,579.90	5,176,220.19
Actual	5,195,722.45	5,176,220.19

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2. Project Objectives and Components

a. Objectives

The Project Development Objective (PDO) of the Regional Sustainable Energy Industry Development Project (SEIDP) as articulated in the Grant Agreement (GA, page 5) was identical to the one stated in the Project Appraisal Document (PAD, paragraph 30) and aimed to:



"Increase the data availability and capacity of power utilities of the Pacific Island Countries* (PICs) and Papua New Guinea (PNG) to enhance their ability to incorporate and manage renewable energy technologies and long-term disaster risk planning."

*The World Bank Group's 10 Pacific Island member countries are: Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

Parsing the PDO. The PDO will be parsed based on the following three objectives:

1. To increase the data availability of power utilities of the PICs and PNG .
2. To increase capacity of power utilities of the PICs and PNG to enhance their ability to incorporate and manage renewable energy technologies.
3. To increase capacity of power utilities of the PICs and PNG for long-term disaster risk planning.

b. Were the project objectives/key associated outcome targets revised during implementation?

No

c. Will a split evaluation be undertaken?

No

d. Components

The PDO was supported by the following three components:

1. Renewable Energy Resource Mapping Phase 1 to 3 (appraisal cost: US\$2.27 million, actual cost: US\$1.69 million). This component funded solar and wind resource assessments/mapping across ten Pacific Islands Countries (PICs) in three phases: i) initial resource estimate at the country level using satellite atmospheric and meteorological data in phase 1, ii) solar and wind measurement campaigns to collect ground-based higher quality data in phase 2, and iii) the validation of collected data.

2. Technical Assistance (appraisal cost: US\$2.57 million, actual cost: US\$2.55 million). This component supported several activities including: i) acquisition of power modeling software and consultancy services for renewable energy (RE) integration and capacity building, ii) development of an online benchmarking platform, iii) development of industry guidelines and competency standards, iv) training and workshops, v) development of utilities' career development assessment plan, and vi) development of disaster-recovery/risk-reduction tools based on targeted country assessment.

3. Project Implementation Support (appraisal cost: US\$0.82 million, actual cost: US\$0.952 million). This component provided the Pacific Power Association (PPA) with resources to conduct and manage the project, including: (a) hiring required expertise such as project implementation officers (PIOs) and procurement advisors, (b) acquiring office equipment, and (c) covering incremental operating costs.

Revised Components. Component 1 was scaled down as part of the first restructuring, approved in December 2017. The scope adjustment consisted of transferring the satellite-based resource assessment (phase 1) and collected data validation (phase 3) from the PPA to the WB's Energy Sector Management



Assistance Program (ESMAP) and increasing the number of sites for ground-measurement (phase 2) to be led by PPA with the budget associated with the removal of two phases.

e. Comments on Project Cost, Financing, Borrower Contribution, and Dates

Project Cost. The total project cost was estimated at US\$5.66 million. The actual cost according to the ICR (Data Sheet, page 2) was US\$5.20 million or 91% of the appraisal estimate.

Financing. The project was financed with a US\$1.92 million Grant from South Pacific Regional Environment Programme (SREP), a US\$3.47 million Grant from the Small Island Developing States Initiative (SIDS DOCK), and a US\$0.27 million Grant from the Government of Japan under the Global Facility for Disaster Reduction and Recovery (GFDRR). The total financing was US\$5.66 million. The actual amounts disbursed were US\$0.2 million, US\$3.47 million, and US\$1.92 million for the GFDR, SIDS-DOCK, and SREP, respectively, totaling US\$5.20 million.

Borrower Contribution. The project was fully financed through the above-mentioned Grants with no Borrower contribution.

Dates. The project was approved on September 29, 2015 and became effective six months later on March 23, 2016. The Mid-Term Review (MTR) was conducted on May 8, 2018. The PAD did not explicitly state a date for the MTR, but mentioned that it would be at the mid-point of implementation, which was approximately where the MTR was conducted in relation to the original closing date. The project closed on February 28, 2023, which was thirty months beyond the original closing date on August 21, 2020. Each TF had a different closing date, the closing date of the SIDS DOCK was extended four times, while that of the SREP was extended twice, and the GFDRR closing was extended once. The first and second closing date extensions of the SIDS DOCK were done due to mismatched closing dates of the SREP and the SIDS DOCK grant which was expected to close in December 2017. The subsequent two extensions of the grants were done to accommodate various delays according to the ICR (paragraph 16) that stemmed from more time needed to: "(i) select a firm to conduct the ground measurement campaigns, (ii) secure land to install equipment for on-ground measurements, (iii) replace defective wind measuring equipment - Light Detection and Ranging (LiDAR), and (iv) to deliver training/workshops delayed due to PICs' border closing during the COVID-19 pandemic."

The project was restructured four times all of which were Level 2 Restructuring as follows:

1. On December 15, 2017, when the amount disbursed was US\$0.62 million, in order to change components and cost, extend the Loan closing date of the SIDS DOCK Grant from December 31, 2017 to December 30, 2019, and change the implementation schedule.
2. On April 22, 2020, when the amount disbursed was US\$2.71 million, in order to extend the Loan closing date of SIDS DOCK Grant to June 30, 2020, and change the implementation schedule.
3. On June 29, 2020, when the amount disbursed was US\$3.43 million, in order to extend the Loan closing dates of the SIDS DOCK and the SREP to February 28, 2022.



4. On February 16, 2020, when the amount disbursed was US\$4.21 million, in order to revise the Results Framework (RF), and extend the Loan closing date of the SIDS DOCK and the SREP by twelve months from February 28, 2022 to February 28, 2023.

3. Relevance of Objectives

Rationale

Context at Appraisal. The Pacific Islands Countries (PICs) and Papua New Guinea (PNG) continue to be highly vulnerable to climate change impacts and natural disasters. Also, they are highly reliant on costly imported fossil fuels for power generation, and have weak capacity of power utilities. The heavy reliance on petroleum fuels contributed to very high retail electricity tariffs in some PICs, ranging from 18 to 79 US cents per kilowatt hour (kWh). Also, PICs and PNG Governments have ambitious targets to increase the share of renewable energy (RE) in their power generation mix. This project had a key objective to enhance knowledge and capacity of Pacific power utilities for the integration and management of RE technologies and disaster risk planning, with a regional implementation approach.

Previous Bank Experience. The project benefited from the Bank's experience in designing and implementing projects in other islands and PICs. There was a previous World Bank-supported regional approach for RE resource mapping and disaster risk management (The Renewable Energy Resource Mapping and Geospatial Planning Project - P145864) that was leveraged by the project. Also, the project benefited from the World Bank's Pacific Regional Data Repository for Sustainable Energy for All (PRDR-P153190) as a basis for strengthening the availability, quality and comparability of energy data and statistics in the region. The Bank also drew on the experience of other countries that were rapidly transitioning to very high penetration of renewables, such as Tokelau (PV, batteries), Aruba (wind), and Cape Verde (wind, PV). This project complemented existing work being undertaken by other development partners in the sector as noted in the PAD (paragraph 20).

Consistency with Bank Strategies. At appraisal, the PDO was in line with the Bank's twin goals of ending extreme poverty and promoting shared prosperity by facilitating PICs' efforts to adopt cleaner and more sustainable electricity in the medium term. The PDO was also in line with the Pacific Regional Framework for Action on Disaster Risk Management (2005–2015) and with the Strategy for Climate and Disaster Resilient Development in the Pacific (SRDP), where both documents identify the needs and priorities for responding to the PICs' extreme vulnerability to the effects of climate change and natural hazards.

At completion, the PDO continued to be in line with two focus areas reflected in the Bank's Regional Partnership Framework for the Pacific Islands (RPF, FY2017-FY2021). Specifically, the RPF's focus area 3 (Protecting Incomes and Livelihoods), objective 3.1: of strengthened preparedness and resilience to natural disasters and climate change, where the SEIDP activities contributed to: (i) training PIC and PNG power utilities to assess the impacts of potential natural disasters or climate change hazards on their infrastructure and operations, and (ii) developing actions that can be incorporated to better prepare for natural and climate hazards or/and implemented to enhance resilience. Also, under the RPF's focus area 4 (Strengthening the Enablers of Growth Opportunities), the SEIDP supported objective 4.2: increased access to basic services and improved connective infrastructure by mapping RE resources and training power utility staff so that they can add RE generation to improve access to electricity in a cleaner and more affordable manner (cheaper than the fossil fuel-based generation it displaces). Further, the RPF (page



66) explicitly indicated that the SEIDP was one of the projects that supported the achievement of the objective 4.2. In addition, the RPF (pages 29, 62 and 97) emphasized that an appropriate balance of regional and country-specific approaches was needed across the PICs and highlighted the role of the PPA. Finally, at project closing, the extended FY22-23 RPF's three objectives that are supported by the SEIDP remained relevant.

Consistency with Country Strategies and Priorities. At appraisal, the PDO was in line with the Framework for Action on Energy Security in the Pacific (FAESP) adopted at the 41st Pacific Islands Forum meeting in August 2010. The FAESP encompassed the leaders' vision for an energy-secure Pacific where Pacific people at all times have access to sufficient sustainable sources of clean and affordable energy and services to enhance their social and economic well-being. The PDO was also in line with objective of PICs and PNG to increase energy security and lower energy usage costs. Governments were expected to accelerate investments in RE and energy efficiency (EE). The PICs were addressing these issues through the formulation of long-term energy policies and plans for implementing policy targets. At completion, the PDO continued to be in line with the PICs' current development strategies that emphasized the need to scale up RE generation and adapt to climate change. At the 5th Pacific Regional Energy and Transport Ministers' Meeting held from May 8 to 12, 2023 in Vanuatu, PICs energy ministers reaffirmed, in the outcome statement, the critical importance for a clear pathway for energy security, the urgent need for decarbonization of energy systems (moving away from fossil fuels-based power generation), and the need to address rising costs of fuel and knowledge gaps. The meeting outcome statement also highlighted that climate change continued to be an existential threat facing the PICs. In addition, updated country Nationally Determined Contribution (NDC) targets included objectives to transition to RE technologies. For example, Nauru committed to achieve 50% RE in its national grid system by 2030. While FSM, PNG and Tonga were set to move to more than 70% RE generation by 2030. Samoa also made a commitment for 100% RE by 2025, and Fiji and Vanuatu set to reach 100% RE by 2030.

Summary of Relevance of Objectives Assessment. The PDO was ambitious. Specifically, the element of the PDO pertaining to disaster risk management was clearly challenging to achieve-given the limited funding designated to the disaster risk management activities. Also, the formulation of the PDO statement suggested that "increased data availability" could inform two separate objectives (one objective being data availability to support the deployment of RE technologies and another objective being data availability to support effective disaster risk planning). However, there were no PDO-level indicator(s) or intermediate results indicator(s) that referred to increased data availability to support disaster risk planning. Furthermore, the element of the PDO pertaining to increased technical and institutional capacity was not sufficiently monitorable. At completion, the PDO continued to be line with the Bank's FY17-21 RPF, as well as with the FY22-23 RPF. Also, the PDO continued to in line with the PICs energy and climate change mitigation and adaptation priorities. Therefore, Relevance of Objectives is rated Substantial.

Rating

Substantial

4. Achievement of Objectives (Efficacy)



OBJECTIVE 1

Objective

To increase the data availability of power utilities of the Pacific Island Countries (PICs) and Papua New Guinea (PNG) to enhance their ability to incorporate and manage renewable energy technologies.

Rationale

Theory of Change (ToC). To achieve the stated objective, the project supported renewable energy (RE) resource mapping assessment of solar and wind capacity across 10 PICs. This aimed to enhance the awareness and knowledge among governments, utilities and the private sector about the resource potential for renewable technologies (solar and wind), and to provide the governments with a spatial planning framework to guide investment in the renewable energy sector. The project also provided technical assistance to increase capacity within the utilities in 10 PICs and PNG on planning for and management of the integration of variable RE in their systems, data collection and management, and knowledge sharing across jurisdictions. The expected outputs included 8 data sets of solar resource mapping, 5 data sets of wind resource mapping, organizing one workshop on resource mapping, developing an online benchmarking platform, and preparing 7 benchmarking reports. The intermediate outcome was the availability of publicly resource mapping assessments across the 10 PICs. The expected outcomes were increased data availability on solar/wind resources potential in 13 sites across the 10 PICs, and 7 years of utilities' benchmarking data including Key performance indicators (KPIs). All this would contribute to increasing the data availability of power utilities of the Pacific Island Countries and Papua New Guinea to enhance their ability to incorporate and manage renewable energy technologies. Anticipated long-term outcomes included enhancing the capacity of PIC and PNG utilities to incorporate and manage RE technologies, which was expected to contribute to affordable, reliable, and sustainable electricity service.

The achievement of this PDO was underpinned by the following critical assumptions: PPA has adequate implementing capacity, utility staff has baseline capacity to utilize acquired knowledge, and no natural disasters that would disrupt implementation.

Overall, the stated activities in the ToC were directly connected to the outputs, intermediate outcomes and outcomes in a plausible causal chain. The critical assumptions were logical and realistic.

Outputs/Intermediate Results

- Phase 1 (satellite based) resource mapping assessment of solar and/or wind capacity across 10 PICs to be completed and available. The project collected solar irradiation and other meteorological data at eight sites in the Federated States of Micronesia (FSM), Nauru, Republic of the Marshall Islands (RMI), Palau, PNG, Solomon Islands, Tuvalu, and Vanuatu over 24 months, from February 2020 to March 2022. In addition, it installed wind monitoring stations with Light detection and ranging (LiDAR) and collected wind data at five sites in RMI, Samoa, Solomon Islands, Tonga and Tuvalu over different periods. However, the ICR (Annex 1) noted that the phase 1 activity was transferred from the PPA to the World Bank's Energy Sector Management Assistance Program (ESMAP) at the first restructuring in 2017, and was completed by ESMAP. This intermediate indicator should have been removed in the result framework.
- Phase 2 (ground measurements) resource mapping assessment of solar and/or wind capacity across 10 PICs were completed and available. 13 solar and wind resource datasets in 9 PICs and PNG were



collected and available online on the open data platform, which could also be accessible through the PPA website (target achieved).

- Phase 3 (validation) resource mapping assessment of solar and/or wind capacity across 10 PICs completed and available. While the target of validation of resource mapping (phase3) was achieved, this activity was transferred from PPA to ESMAP at the first restructuring in 2017, and was completed by ESMAP. This intermediate indicator should have been removed (ICR, Annex 1).
- 59 training courses/workshops were provided significantly exceeding the target of 6. The 11 face-to-face trainings on Power Factory, energy resilience assessment tools, Variable RE, power purchase agreement, and project management were carried out, and the 48 workshops including 32 workshops on industry guidelines on RE, storage and Supervisory Control and Data Acquisition (SCADA) were delivered.
- During the seven years of the project implementation, PPA surveyed all its power utility members, and compiled and shared yearly reports that provide data on the utilities' governance, operational, and financial performance, captured through 46 key performance indicators (KPIs).

Outcome

- By project completion, the target of increasing public information on RE resources and variability (PDO outcome indicator) was achieved. Ground-measured resource data and the utilities' benchmarking data was made available on the PPA website including 13 ground-measured solar and wind resource data for nine PICs and PNG. Also, solar ground-measured data for 8 sites in FSM, Nauru, RMI, Palau, PNG, Solomon Islands, Tuvalu, and Vanuatu was collected over 24 months, and wind data for 5 sites in RMI, Samoa, Solomon Islands, Tonga and Tuvalu was collected for a different period.
- The resource data was uploaded on the WB's open energy data platform had been viewed by 395 users by June 2023, and was used to inform the site identification, the preparation and implementation of solar/wind power projects for the utilities.
- In addition, the online benchmarking platform improved the availability and accessibility of key performance data of power utilities. Seven benchmarking reports (intermediate outcome achieved) were released throughout the implementation in a timely manner. According to the ICR (annex 1) the online benchmarking data contributed to improving operations for many power utilities in Tonga, Vanuatu and Solomon Power, helping them to reduce system losses (by comparing the efficiency of their operations with their peers) and to address grid reliability issue through setting up a reliability committee. It also notable that Tonga Power Limited (TPL), the national power utility in Tonga, planned to share the wind data with the engineering, procurement, and contractor firm that is implementing the 2.25 MW wind project at the eastern side of Tonga Tapu, the main island of Tonga (ICR, paragraph 26).

Summary of Efficacy Assessment. The project supported renewable energy (RE) resource mapping assessment of solar and wind capacity across 10 PICs in three phases. During implementation, phase 1 and 3 were moved from under the project to be implemented by and achieved by ESMAP. Phase 2 was fully implemented and achieved under this project as noted above. The project achieved its outcome indicator target and met all its intermediate outcomes and most outputs. It is therefore plausible to assume that the improved accessibility to solar and wind data could have potentially increased PICs and PNG governments' and utilities' awareness of their RE potential. Therefore, the efficacy with which this objective was achieved is rated Substantial.



Rating

Substantial

OBJECTIVE 2

Objective

To increase capacity of power utilities of the PICs and PNG to incorporate and manage RE technologies.

Rationale

Theory of Change (ToC). To achieve the stated objective, the project provided technical assistance to utilities including: the acquisition of a power modeling tool combined with capacity building, development of an on-line benchmarking platform, development of industry guidelines and competency standards, support training and workshops, and supporting a utility career development assessment plan. These activities aimed to increase capacity within the utilities in 10 PICs and PNG on data collection and management, and knowledge sharing across jurisdictions. The expected outputs included: establishing an online portal, producing 7 bench marking reports, organizing 5 workshops, designing two power modeling tools with two training sessions, and conducting a utility training need analysis. Intermediate outcomes included: reports on industry guidelines and competency standards available through PPA. The expected outcomes included: improved technical and institutional capacity of the Pacific Power Association (PPA) and utilities to monitor grid key indicators, to develop in-house power analysis systems using power system modeling tools, to design; install and operate RE storage systems, and to plan technical specifications for VRE integration. The anticipated long-term outcomes included enhancing the capacity of PIC utilities to incorporate and manage RE technologies, which was expected to contribute to affordable, reliable, and sustainable electricity service.

The achievement of this PDO was underpinned by the following critical assumptions: the PPA has adequate implementing capacity, utility staff has baseline capacity to utilize acquired knowledge, increased capacities are measurable to some extent, and no natural disasters that would disrupt implementation. Another assumption emphasized by this Review is that training of staff will automatically lead to increased capacity (which might not be the case). It is therefore important that the increased capacity is measured (in terms of actual changed behavior/changed working practices).

Overall, the stated activities in the ToC were directly connected to the outputs, intermediate outcomes and outcomes in a plausible causal chain. However, the ToC did not explicitly capture the improvement in the technical capacity of utilities. While the critical assumptions were logical, the project should have included some measure of improved capacity.

Outputs/Intermediate Results

- 59 training courses/workshops were provided exceeding the target of 6. These included 11 trainings on Power Factory, energy resilience assessment tools, Variable RE, power purchase agreement, and project management were carried out, and the 48 workshops including 32 workshops on industry guidelines on RE, storage and SCADA.



- Planning tool was available (target achieved). The PPA purchased two power system modeling software, DigSilent's Power Factory and Homer, and the software was accessible through a designated link of the PPA webpage, allowing simultaneous access by two users. Also, two training sessions were provided to the utilities by DigSilent in 2017 and 2023 to help utilities to utilize the software. The DigSilent's Power Factory was used by at least 4 utilities including Solomon Power, Samoa EPC, Vanuatu's UNELCO and PUB of Kiribati.
- 16 industry guidelines and competency standards were available through PPA (target achieved). The industry guidelines covered aspects of design/installation/maintenance of solar photovoltaic (PV), storage and SCADA were developed. Out of 16 guidelines, 4 were updated, and 12 were newly developed.
- Other notable achievements that were not part of the RF included a Bank-executed variable renewable energy (VRE) assessment. This was composed eight individual VRE assessments conducted by a private consulting firm from 2017 to 2019 for eight utilities in Samoa, FSM (Chuuk, Kosrae, Pohnpei, Yap), Tonga, RMI, and Tuvalu, and carried out workshops in February 2019 to disseminate the assessment findings. The assessment suggested the addition of battery energy storage system to optimize the expected output of a solar PV plant that was being procured for installation under an ADB -financed project for the Kosrae Utility Authority (KUA) in the state of Kosrae.

Outcome

- By project completion, two planning tools were available and training was provided to both PPA and utilities in the use of these tools (PDO outcome indicator, achieved). The PPA purchased two power system modeling software, DigSilent's Power Factory and Homer, and provided utilities with two training sessions in 2017 and 2023 in Fiji, attended by 44 utility staff. The DigSilent's Power Factory was used by at least 4 utilities including Solomon Power, EPC (Samoa's power utility), UNELCO (power utility in Vanuatu) and PUB (Kiribati's power utility). The online benchmarking platform was developed and improved the accessibility of technical, operational, and financial data among PICs and PNG utilities.
- Also, the project contributed to improved technical and institutional capacity of the PPA and power utilities (PDO outcome indicator, substantially achieved). The project identified training needs of PICs and PNG utilities and delivered 11 training and 48 workshops according to the identified needs. According to the ICR (Annex 1), these project-supported activities increased the in-house technical capacity of PICs and PNG power utilities "to design, install and maintain solar PV/storage/SCADA systems and informed the operation of power systems or its institutionalization like setting up and/or updating grid code." Specifically, the Electric Power Corporation (the power utility in Samoa) reported that the training empowered the utility engineers to address protection systems issues in the network. Vanuatu's UNELCO indicated that the training timely provided its recently recruited engineers with critical knowledge that enabled continuity of planning and design services in the utility. Also, Solomon Power was able to produce in-house conceptual designs of solar hybrid mini grid systems and to prepare technical specifications of bidding documents to select a contractor for procurement and construction. It is noted that the target value of implementation of the capacity-building plan, measured in percentage unit, would not be enough measurable and attributable to demonstrate improved technical and institutional capacity, as the plan did not specify training activities and their timeframe.

Summary of Efficacy Assessment. While the RF lacked specific indicators to measure improvement in capacity, the ICR provided evidence (as noted above) that this happened to some extent. For example, the



project-supported training enabled power utility staff to do in-house design, such as the case of Solomon Power, maintain solar home systems, and use knowledge and data provided to make improvements (case with the benchmarking data). It is plausible to assume that the project contributed to increasing the capacity of power utilities of the PICs and PNG to enhance their ability to incorporate and manage RE technologies. This was possible through supporting training sessions, and establishing RE design, installation and maintenance guidelines. These activities in combination with the Bank-executed VRE assessment contributed to enhancing the ability of PICs and PNG power utility staff and contractors to design, incorporate, and manage RE technologies. Therefore, the efficacy with which this objective was achieved is rated Substantial with moderate shortcomings.

Rating

Substantial

OBJECTIVE 3

Objective

To increase capacity of power utilities of the PICs and PNG for long-term disaster risk planning.

Rationale

Theory of Change (ToC). To achieve the stated objective, the project supported disaster-recovery and risk-reduction activities to support PICs power utilities' efforts to improve their preparedness for responding to natural hazards/climate shocks and to reduce economic losses when disasters occur. This included the provision of advisory services to the utilities on the planning and prioritization of investments in resilience in the power sector, as well as an emergency response window to assist utilities with post-disaster damage assessment reports. Also, risk-reduction/adaptation measures included engineering (e.g., designing more robust design specifications; relocating or retrofitting extremely vulnerable existing infrastructure; designing new systems better able to capture the energy of increased wind speeds, flood protection, underground distribution for protection against wind, high temperatures, corrosion, and flooding), and non-engineering options (more robust O&M procedures, improved and better-coordinated land-use planning; for example, rezoning land use so that future power infrastructure is located in less vulnerable areas). The expected outputs were the development of two resilience tools with relevant training, and three resilience investments plans. The expected outcome was increased in-house capacity of utilities to develop resilience plans. Anticipated long-term outcome was enhancing the utilities' ability for long-term disaster risk planning.

The achievement of this PDO was underpinned by the following critical assumptions: The PPA has adequate implementing capacity, utility staff has baseline capacity to utilize acquired knowledge, increased capacities are measurable to some extent, and no natural disasters that would disrupt implementation.

Overall, the stated activities in the ToC were directly connected to the outputs, and outcome in a plausible causal chain. The critical assumptions were logical, however, the project should have included some measure of improved capacity.

Outputs/Intermediate Results

- Post-disaster and/or disaster-risk reduction needs assessment was developed (target achieved). The project funded the development of energy resilience enhancement plans for three utilities: PNG,



Samoa, and Tuvalu (representing large, medium and small size PICs power utilities) based on assessment of the vulnerabilities of their power infrastructure against climate change and extreme weather events. As the SEIDP's resilience funding (GFDRR grant of US\$270,000) was limited and given the fact that energy resilience is a relatively new concept for PICs that needs to be further demonstrated, the Bank team leveraged Bank-Executed Trust Funds from GFDRR (US\$ 400,000) and funded the development of additional energy resilience enhancement plans for utilities in FSM and RMI as well as a prefeasibility study to set up a mutual disaster assistance fund in the Pacific, which together help build a stronger case to promote energy resilience in the Pacific.

Outcome

- The project increased planning capacity for disaster recovery and risk reduction for 9 utilities exceeding the target of 3.
- Investment plans on energy resilience for three utilities in Tuvalu, Samoa, and PNG, representing small, medium and large utility of PICs were developed. The project also delivered training on the tools to assess resilience of a utility's power system and viability of mitigation measures.
- Additionally, the Bank team leveraged Bank-executed TF from GFDRR, which developed energy resilience enhancement plans for six utilities in FSM and RMI.
- The SEIDP-funded activities influenced Tonga Power limited to improve its disaster recovery plan, which was focusing only on cyclones, to now incorporate various kinds of disasters like volcanic eruptions, and tsunami events.

Summary of Efficacy Assessment. The RF lacked specific indicators to measure improvement in capacity of power utilities for long-term disaster risk planning. That said, to verify improved capacity the utilities need to face a disaster to assess their increased capacity, which did not happen during the project implementation duration. The project provided utilities with energy resilience assessment and enhancement tools, which were expected to result in improving disaster management plans. The project exceeded its outcome indicator target. It is worth noting that the disaster risk plans supported by the project were yet to be tested under an real disaster situation. Overall, the efficacy with which this objective was achieved is rated Substantial with moderate shortcomings due to limited evidence on improved capacity.

Rating
Substantial

OVERALL EFFICACY

Rationale

Overall Efficacy is rated Substantial with moderate shortcomings, as two of the three objectives had limited evidence for achievements at the outcome level. The project supported activities that resulted in availing utility benchmarking data and ground-measured solar/wind data. This enabled utilities to use the data for operational improvements as well as informing design of other donor-funded projects. In addition, and with



the support of the project, some utility staff could plan/simulate RE integration using DigSilent Power Factory software. Further, utilities were trained on disaster risk management (energy resilience enhancement) tools and one utility (Tonga Power Limited) improved its disaster management plan. However, the project lacked adequate indicators to measure enhanced technical capacity, a core part of the PDO. The overall Efficacy rating is therefore Substantial with moderate shortcomings.

Overall Efficacy Rating

Substantial

5. Efficiency

Economic and Financial Analysis (EFA)

ex ante

- The PAD did not include a typical EFA and there was no overall economic rate of return (ERR) for the project investments, but it stated that "an economic analysis will be conducted prior to the midterm review for a minimum of two participating countries to gauge the economic benefits that could be derived through the proposed project (paragraph 59)."
- The economic benefits from component 1 could include among others, reduced cost, duplication, overlap, and / or inconsistencies from country specific RE resource mapping. While the economic benefits of component 2 would include costs saving due to: (i) development of local capacity for network planning and renewable energy integration; (ii) improved efficiency in producing the annual Power Benchmarking Report; (iii) improved network performance due to the availability of industry guidelines and standards; (iv) improved capability of utility staff (hiring fewer international consultants); and (v) improved preparedness, resilience and restoration capacity in the face of potential disasters.

ex post

- The ICR (paragraph 47) reported that no ground-based data sets were completed at the time of the MTR in mid-2018, and the anticipated economic analysis was not conducted at MTR. Further, the ICR highlighted that an economic analysis either at MTR or by closing was unrealistic, given the technical assistance nature of the project, which made it challenging to value data availability and enhanced capacity.
- Despite the lack of an economic analysis, there were evidence of key economic benefits achieved due to the project investment, which included: cost savings through enhanced capacity, operational improvements from use of benchmarking, identification of sites with strong RE potential and associated development cost savings, and increased power generation output from use of technical guidelines (ICR, paragraph 49).
- It is also worth noting that the regional nature of the project resulted in cost savings, for example, the two training sessions on DigSilent costed US\$50,000 and was attended by 14 utilities from 10 countries compared to a cost of US\$250,000 if each country conducted the training alone.



- In addition, there were notable cost savings under the project including saving US\$ 200,000 by transferring two phases of the resource mapping to the ESMAP project and securing more wind sites for measurement campaigns with the saved budget. The project also saved US\$10,000 by engaging the Bank gender experts instead of hiring a gender advisor (ICR, paragraph 51).
- **Implementation Efficiency.** The project closed on February 28, 2023, which was about thirty months beyond the original closing date on August 21, 2020. Four extensions were needed, the first two were to adjust the mismatched closing dates of the project and SIDS DOCK grant while the last two extensions were to accommodate implementation delays. There were implementation delays that stemmed from the procurement of solar and wind mapping activities, in addition to delays that resulted from the COVID-19 restrictions.

Summary of Efficiency Analysis. The lack of an EFA at both the appraisal and completion stages of the project makes assessing efficiency challenging. While the ICR (as noted above) cited several cost savings achieved under the project, those were cost-savings of the project implementation budget, not of the project outcomes. The project also experienced significant delays (30 months). Overall, efficiency is rated Modest, due to the lack of economic analysis at either appraisal, MTR or at closure and a 30 months extension.

Efficiency Rating

Modest

a. If available, enter the Economic Rate of Return (ERR) and/or Financial Rate of Return (FRR) at appraisal and the re-estimated value at evaluation:

	Rate Available?	Point value (%)	*Coverage/Scope (%)
Appraisal		0	0 <input type="checkbox"/> Not Applicable
ICR Estimate		0	0 <input type="checkbox"/> Not Applicable

* Refers to percent of total project cost for which ERR/FRR was calculated.

6. Outcome

Relevance of Objectives was rated Substantial. Overall Efficacy was rated Substantial with moderate shortcomings. The project supported activities that resulted in availing utility benchmarking data and ground-measured solar/wind data. The ICR also provided evidence that pointed to increased the capacity of power utilities of the PICS and PNG to incorporate and manage renewable energy technologies. Utilities were also trained on disaster risk management (energy resilience enhancement) tools and one utility (Tonga Power Limited) improved its disaster management plan. However, improved capacity of utilities was not comprehensively assessed due to M&E design shortcomings. Efficiency was rated Modest due to the lack of an EFA at both the appraisal and completion stages and the substantial project delays.



Based on the assigned ratings for the three outcome criteria, Outcome is rated Moderately Satisfactory due to moderate shortcomings pertaining to the operation's efficacy, and Modest efficiency.

a. **Outcome Rating**
Moderately Satisfactory

7. Risk to Development Outcome

The following risk could potentially impact the Development Outcome:

Institutional risk. The enhanced ability from some project-supported utilities materialized and is likely to be sustained. Trained utility staff have been sharing their capacity with other utility staff and some practices (e.g. using benchmarking to improve performance, setting up a reliability committee, and offering training courses) are already established or almost mainstreamed. To support smaller utilities and improve their capacity, the Bank team mobilized US\$0.2 million to provide one-on-one assistance. In addition, the Asian Development Bank (ADB) is funding a follow-on utility performance benchmarking reporting. Also, the Australian Government's Department of Foreign Affairs and Trade is considering funding follow-on training. These follow-on initiatives will further reinforce and improve the capacity of Pacific Islands Country utilities (ICR, paragraph 77).

8. Assessment of Bank Performance

a. **Quality-at-Entry**

- **Strategic relevance and approach.** The project was strategically relevant and in line with the goals of the PICs and PNG governments. The PDO was also in line with the Bank strategies (see section 3 for details).
- **Technical, financial, and economic aspects.** The project supported established technologies and practices on which substantial experience was already accumulated in past projects. The PAD lacked a typical economic and financial analysis, which could have provided a better justification of the project investment. The inclusion of the third objective "to enhance ability to incorporate and manage long term disaster risk planning" was overly ambitious and unrealistic given the limited funding available (only US\$0.27 million) for disaster risk management. Overall, design suffered from three notable shortcomings, first, the limited funding for the disaster risk planning activities; second, a composite PDO statement that was open to more than one interpretation; and third, the lack of adequate indicators to capture the project outcome results.
- **Poverty, gender, and social development aspects.** The project was a TA operation that focused on capacity building and data availability. The PPA's attention to gender mainstreaming in the PICs' energy sector included work on the Pacific Power Utilities Benchmarking Report produced annually.
- **Environmental and fiduciary aspects.** Screening of environmental and social risks and issues was based on the preliminary information available on the proposed technical advisory studies



and the installation of wind and solar monitoring equipment. The Bank conducted a procurement capacity and financial management capacity assessment, and risk-mitigation actions were in place. The PPA prepared a procurement plan for the first 18 months of the project. However, procurement proved to be challenging during implementation and contributed to significant delays.

- **Implementation arrangements.** The PPA was in charge of the project implementation as it had experience in managing other donor projects. However, implementation readiness was not adequate at the approval in terms of staffing, identification of the resource mapping scope and needs assessment of utilities' training (ICR, paragraph 61). Hiring a procurement advisor and an electrical engineer to start implementation took 12 months. Also, the utilities' training needs assessment was not conducted during the preparation but was initiated in April 2017, a year after effectiveness.
- **Risk assessment.** Six main risks were identified at appraisal and the overall risk was rated moderate. The identified risks related to political and governance, technical design, institutional capacity for implementation and sustainability, fiduciary, environmental and social risks. However, inadequate utility staff baseline capacity and lack of coordination with national governments were two critical risks that were not adequately reflected at appraisal. Also, technical risk proved to be more challenging as technical staff from Tuvalu, RMI, and FSM faced challenges in using DigSilent software and applying other knowledge materials even after the training sessions.
- **M&E arrangements.** M&E design suffered notable shortcomings as the Results Framework lacked indicators that measured increased technical and institutional capacity (See section 9 for details).

Summary of QAE Assessment. The project was strategically relevant, but the disaster risk planning element of the PDO was overly ambitious. The design lacked a typical economic and financial analysis, which made it challenging to assess efficiency at completion. While the design featured established technologies, it suffered from notable shortcomings as noted above. Environmental and fiduciary aspects were adequate, but procurement risk was not adequately mitigated. Implementation readiness was not adequate and contributed to delays. Risk assessment overlooked two risks (utility staff baseline capacity and lack of coordination with national governments) and technical risk was also underestimated. Also, M&E had notable design shortcomings. Overall, Quality at Entry is rated Moderately Satisfactory due to moderate shortcomings as noted.

Quality-at-Entry Rating

Moderately Satisfactory

b. Quality of supervision

- The Bank conducted fourteen supervision missions, which according to the ICR (paragraph 75) were "teamed by necessary specialists." The project benefitted from continuity and consistency in supervision with three consecutive task team leaders (TTLs) during preparation and implementation.
- To support the PPA, the Bank team conducted on-site visits and provided trainings on the Bank's fiduciary systems by financial and procurement staff.
- The Bank supervision team also made notable efforts in leveraging trust funds to complement the project activities. This included writing two proposals for GFDRR and ESMAP review and approvals,



recruiting consultant firms and supervising their work to carry out studies, engaging PPA and country stakeholders to ensure ownership, partnering with the EAP gender and energy team, and reporting on the activity outputs and outcomes to Bank management.

- The Bank also oversaw four restructurings that were necessary to extend the closing dates, adapt to implementation challenges, and improve the project efficiency, including through budget optimization.
- While the shortcomings in the RF persisted, the Bank team partially addressed these shortcomings by capturing achievements through surveys and interviews with beneficiaries.

Summary of Quality of Supervision Assessment. The Bank task team made commendable efforts in supporting the project implementation and leveraging trust funds to complement the project activities. However, RF shortcomings could be addressed to better assess the project outcomes. Overall, the Quality of Supervision is rated Satisfactory.

Based on the assigned rating for QAE and Quality of Supervision, the overall Bank Performance is rated Moderately Satisfactory.

Quality of Supervision Rating

Satisfactory

Overall Bank Performance Rating

Moderately Satisfactory

9. M&E Design, Implementation, & Utilization

a. M&E Design

- The PAD did not include a Theory of Change (ToC) since it was not yet required by the Bank at the time of appraisal. Nonetheless, the ICR included a ToC that reflected the relationship between the project activities, outputs, outcomes and long-term impacts in a plausible causal chain. This Review reconstructed a ToC for each objective based on the detailed project description in the PAD.
- The PDO was composed of three objectives (see section 2). Those were assessed based on the following four PDO outcome indicators: (1) Increased availability of data on RE resources in targeted project areas (Objective 1); (2) Increased available planning tools and training to both PPA and PIC power utilities in the use of these tools (Objective 2); (3) Improved technical and institutional capacity of PPA and PIC power utilities (Objective 2); and (4) Increased planning capacity for disaster recovery and risk reduction within PIC power utilities (Objective 3).
- While the PDO outcome indicators appear relevant and connected to the stated objectives, the outcome indicator target values of “100% of capacity building plan implemented” and “investment plan on resilience available for at least three power utilities” for outcome indicators 2 and 4 respectively, could not clearly and comprehensively capture the “improved technical and institutional capacity of PPA and PIC power utilities” and “increased planning capacity for disaster recovery and risk reduction within PIC power utilities” respectively. Implementing a capacity building plan and supporting a list of investments to be made on resilience could potentially contribute to increased capacity, but this needs to be verified through adequate indicators.



- The Results Framework (RF) included 8 intermediate results indicators (IRIs) to track the progress of the different project activities. The IRIs were measurable, reflected reasonable targets, and were connected to the project activities. However, improved technical and institutional capacity of PPA and PIC power utilities was not clearly captured.
- Overall, M&E design suffered from notable shortcomings pertaining to the PDO outcome indicators and their corresponding targets. The inadequacy of the indicator target values led to PPA not recording outcomes from various activities, which made assessing the project outcomes at completion challenging.

b. M&E Implementation

- The PPA documented and reported values of M&E indicators during implementation through the submission of semi-annual progress reports.
- Despite four restructurings, the M&E design shortcomings persisted.

c. M&E Utilization

- Assessing the outcomes of the project was challenging due to inadequate indicators.
- The ICR (paragrap67) reported that "the Bank ICR team and PPA had to conduct surveys to assess outcomes."
- Despite M&E design shortcomings, the project experience was useful in informing other Bank-funded operations.

Summary of M&E Quality Assessment. M&E design suffered notable shortcomings pertaining to the targets of the outcome indicators, these shortcomings persisted throughout implementation and were not rectified. Utilization was inadequate and the ICR relied on surveys to assess outcomes. Therefore, the Quality of M&E is rated Modest. Despite the Modest rating of the Quality of M&E, there was sufficient evidence to rate Efficacy Substantial with moderate shortcomings, due to the additional evidence provided by the extra surveys conducted by the Bank's ICR team and the PPA.

M&E Quality Rating

Modest

10. Other Issues

a. Safeguards

- The project was classified as a category B project because it focused on building capacity through technical studies and trainings and providing solar and wind maps. Two environmental and two social safeguard policies were triggered: Environmental Assessment (OP/BP 4.01) was triggered based on the screening process and the requirement for a safeguards instrument to manage



potential impacts and ensure safeguards is mainstreamed into training materials; and Physical Cultural Resources (OP 4.11) was triggered on a precautionary basis because such resources may be identified through the site-selection screening process. Involuntary Resettlement (OP 4.12) was triggered because of the installation of temporary wind monitoring equipment; and Indigenous Peoples (OP 4.10) was triggered because the project was to be implemented in a number of countries where Indigenous Peoples reside.

- **Compliance with Environmental and Social Safeguards.** The ICR did not provide an explicit statement on the compliance of the project with the Bank's safeguard policies, but reported that "safeguards have been rated Satisfactory throughout the project implementation (ICR, paragraph 69)." An environmental and social management framework (ESMF) was prepared in 2015, and a web-based GRM link was created at the PPA website in November 2018.

b. Fiduciary Compliance

- **Financial Management (FM).** The PPA oversaw FM which was implemented according to procedures and processes stipulated in the PPA's "Accounts Policy and Procedures Manual", with additional guidance included in the Project Operational Manual. According to the latest formal FM review conducted by the Bank (May 30, 2022), the project submitted all required audits and interim financial reports which were accepted with no major FM issues.
- **Procurement.** Procurement was challenging and resulted in significant implementation delays. Specifically, the resource mapping procurement took over two years to finalize bidding documents, which led to contract signature with a selected bidder in March 2019. Due to significant delays, procurement was rated as unsatisfactory from November 2016 to November 2019 due to significant delays and moderately unsatisfactory from November 2019 until the project closing (except two instances where the rating was moderately satisfactory in September 2020 and in October 2021).

c. Unintended impacts (Positive or Negative)

None.

d. Other

"SEIDP-funded industry guidelines informed the development of similar quality assurance instruments in Africa. The Global Sustainable Energy Solutions (GSES) used the industry guidelines to develop a solar system quality assurance framework for the Uganda Rural Electrification Authority, under a World Bank-financed project. Also, the industry guidelines and SEI-API/PPA certification process are being used as basis to develop a technician certification program for the 15 of the Economic Community of West African States (ECOWAS) states in close collaboration with the Centre for Renewable Energy and Energy Efficiency (ICR, paragraph 58)."



11. Ratings

Ratings	ICR	IEG	Reason for Disagreements/Comment
Outcome	Satisfactory	Moderately Satisfactory	Efficacy had moderate shortcomings and Efficiency was rated Modest.
Bank Performance	Satisfactory	Moderately Satisfactory	QAE had moderate shortcomings.
Quality of M&E	Modest	Modest	
Quality of ICR	---	Substantial	

12. Lessons

The ICR included three lessons which are emphasized below with some adaptation of language:

1. If regional technical assistance projects are well-designed and supported by adequate follow-on support to embed and enhance the progress in utility capacity building, it is likely that utility capacity will be enhanced in a cost-effective way. The project succeeded in enhancing capacity of some utilities, informing the design of donor-funded projects, and leveraging follow-on support. Despite limited funding, ambitious objectives, inadequate indicator target values, and implementation challenges, SEIDP-funded trainings and data collection activities showed that a regional approach saves costs compared to individual county training programs, fosters peer learning (through sharing of challenges and implemented solutions), and can yield positive outcomes. Key SEIDP success factors included the selection of a trusted regional champion as an implementing agency, identification of relevant trainings based on good assessment of utility capacity building needs, selection of a dedicated partner organization with strong links to the RE industry, and inclusion of utility performance benchmarking which drives healthy competition that leads to tangible improvements.

2. If a differentiated approach that addresses various capacity baseline levels is adopted, it is likely that impacts of capacity building activities within a regional project will be maximized. The efficacy assessment of the SEIDP highlighted outcomes mostly from relatively high to medium size power utilities, while fewer substantial outcomes emerged from small utilities. These small power utilities have weaker capacity than the medium to high size ones, as some of them do not even have an electrical engineer. To address the differentiated capacity baseline levels, additional one-on-one follow-on assistance in some areas such as DigSilent Power Factory training, energy resilience enhancement tools training, and benchmarking reporting could be provided. The World Bank plans to help remedy this by providing Bank-executed assistance that targets small utilities.

3. If additional provisions to ensure adoption by sector ministries and policy makers are in place, it is likely that changes in country policies will be institutionalized. Power utilities often do not have the mandate to develop and enforce country policies and regulations, so reaching out to critical policy makers and regulators is key to institutionalize or sustain outputs from regional technical assistance activities. Development agencies are encouraged to include support, collaboration, or other mechanisms to facilitate adoption and/or enforcement of project outputs by



government officials. In the context of this project, greater impacts could be achieved if some of the outputs—such as technical guidelines/grid codes, solar and wind resource data, recommendations from VRE assessment—are adopted and enforced/promoted by Pacific Islands Country ministries in charge of the energy sector, as in the case of Vanuatu, where the technical guidelines were adopted and enforced by the Government, not the utilities.

13. Assessment Recommended?

No

14. Comments on Quality of ICR

Quality of Evidence. While the ICR provided an evidence base to support the achievements reported, it was barely enough to assess the project outcomes due to M&E design shortcomings.

Quality of Analysis. The ICR provided clear linking between evidence and findings to the extent possible and used the evidence base to serve the arguments under the different sections. However, the inadequacy of the outcome indicator targets undermined the assessment of the project outcomes.

Lessons. Lessons reflected the project experience and were based on evidence and analysis.

Results Orientation. The ICR included an adequate discussion on the achievement of the three elements of the PDO. The outcome discussion was balanced between reporting on the achievement of outcome indicators and what the project actually achieved on the ground.

Consistency with guidelines. The ICR used the available data to justify most of the assigned ratings.

Conciseness. The ICR was well written and provided adequate coverage of project activities and candidly reported on most shortcomings in a concise form. However, some sections could have benefited from further details including the sections on M&E implementation and Utilization.

Summary of the Quality of ICR Assessment. The ICR's assessment of outcomes was adequate, and the lessons drawn by the ICR were relevant. Most sections were concise and reflected relevant information. Overall, the Quality of the ICR is rated Substantial.

a. Quality of ICR Rating Substantial

