IMPLEMENTATION COMPLETION AND RESULTS REPORT

IDA-H9570
ON AN
IDA GRANT
IN THE AMOUNT OF SDR 9.4 MILLION
(US$12.81 MILLION EQUIVALENT AT CLOSING)
TO THE
FEDERATED STATES OF MICRONESIA
FOR THE
ENERGY SECTOR DEVELOPMENT PROJECT

March 5, 2020

Energy and Extractives Global Practice
East Asia and Pacific Region
CURRENCY EQUIVALENTS

(Exchange Rate Effective September 30, 2019)

Currency Unit = U.S. Dollar ($)

$1.36331 = SDR 1

FISCAL YEAR
July 1 – June 30

ABBREVIATIONS AND ACRONYMS

| ADB     | Asian Development Bank       |
| AMU     | Association of Micronesian Utilities |
| CAPEX   | Capital Expenditure           |
| CIU     | Centralized Implementation Unit |
| CPS     | Country Partnership Strategy  |
| CPUC    | Chuuk Public Utility Corporation |
| CTF     | Compact Trust Fund            |
| DOFA    | Department of Finance and Administration |
| EIB     | European Investment Bank      |
| EIRR    | Economic Internal Rate of Return |
| EMP     | Environmental Management Plan |
| ENPV    | Economic Net Present Value    |
| EOI     | Expression of Interest        |
| ESIA    | Environmental and Social Impact Assessment |
| ESMF    | Environmental and Social Management Framework |
| EU      | European Union                |
| FIRR    | Financial Internal Rate of Return |
| FM      | Financial Management          |
| FNPV    | Financial Net Present Value   |
| FSM     | Federated States of Micronesia |
| GDP     | Gross Domestic Product        |
| GoFSM   | Government of FSM             |
| ICB     | International Competitive Bidding |
| ICR     | Implementation Completion and Results Report |
| ISR     | Implementation Status and Results Report |
| JICA    | Japan International Cooperation Agency |
| KUA     | Kosrae Utilities Authority    |
| M&E     | Monitoring and Evaluation     |
| MOMI    | Mobil Oil Micronesia, Inc.    |
| MTR     | Midterm Review                |
| NDRD    | National Department of Resources and Development |
NEP | National Energy Policy
---|---
NGO | Nongovernmental Organization
O&M | Operation and Maintenance
PAD | Project Appraisal Document
PIC | Pacific Island Country
PIM | Project Implementation Manual
PIU | Project Implementation Unit
PPA | Power Purchase Agreement
PUC | Pohnpei Utilities Corporation
PV | Photovoltaic
RE | Renewable Energy
RPF | Resettlement Policy Framework
SAIDI | System Average Interruption Duration Index
SCADA | Supervisory Control and Data Acquisition
SDP | Strategic Development Plan
SEDAP | Sustainable Energy Sector Development and Access Project
UNDP | United Nations Development Programme
VoLL | Value of Lost Load
YSPSC | Yap State Public Service Corporation

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Country Director: **Michel Kerf**

Regional Director: **Ranjit J. Lamech**

Practice Manager: **Jie Tang**

Task Team Leader(s): **Leopold Sedogo, Takayuki Doi**

ICR Main Contributor: **Paul Dolan**
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### BASIC INFORMATION

**Product Information**

<table>
<thead>
<tr>
<th>Project ID</th>
<th>Project Name</th>
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<tr>
<td>P148560</td>
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**Organizations**

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<td>Federated States of Micronesia</td>
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**Project Development Objective (PDO)**

The PDO is to increase the available generation capacity and efficiency of electricity supply in the state power utilities, and to strengthen the planning and technical capacities of the National Government and the state power utilities in the energy sector.
## FINANCING

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## KEY DATES

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## RESTRUCTURING AND/OR ADDITIONAL FINANCING

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## KEY RATINGS

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### RATINGS OF PROJECT PERFORMANCE IN ISRs

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### SECTORS AND THEMES

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<td>Renewable Energy Solar</td>
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#### Themes

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<tbody>
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<td>Public Sector Management</td>
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<tr>
<td>Public Administration</td>
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<tr>
<td>Transparency, Accountability and Good Governance</td>
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</table>
Urban and Rural Development

Rural Development

Rural Infrastructure and service delivery

Environment and Natural Resource Management

Climate change

Mitigation

Adaptation

ADM STAFF

Role
Regional Vice President:
Country Director:
Director:
Practice Manager:
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At ICR
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Michel Kerf
Ranjit J. Lamech
Jie Tang
Leopold Sedogo, Takayuki Doi
Paul Dolan
I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

Country Context

1. At the time of project appraisal, in early 2014, the Federated States of Micronesia (FSM) comprised 607 small islands (74 inhabited) with a population of just over 100,000. The FSM was established as a federation of four semiautonomous states (Chuuk, Kosrae, Pohnpei, and Yap), each with its own executive and legislative bodies and with considerable autonomy to manage its domestic affairs. Most states had their own development strategy, while the National Government (sitting in Pohnpei, the largest island) provided a coordinating function and national vision.

2. Economic activity has been constrained by the extreme geographic dispersion (extending over 3 million km$^2$), extreme remoteness to markets (over 3,700 km from Japan, the nearest major market), limited transportation links, and the vulnerability to natural disasters. All petroleum products and a very high proportion of food, capital goods, and construction materials are imported.

3. FSM, formerly the Trust Territory of the Pacific Islands, entered into a Compact of Free Association with the United States in 1986. The original Compact, which extended for 15 years, provided large external financial transfers to support the operations of the Government of the FSM (GoFSM) and substantial public sector investment at the state level. The Compact was designed to assist the FSM with the development of its infrastructure and economy. Infrastructure development was relatively successful: roads, electric utilities, harbors, airports, schools, hospitals, and public facilities were constructed during the Compact. However, they were not always maintained sufficiently and thus deteriorated, an effect particularly noticeable in the electricity sector.

4. In 2003, the United States and FSM entered into an Amended Compact Agreement, under which the FSM was entitled to payments of an inflation-adjusted $92.7 million$^1$ per year starting in 2004: $76.2 million in the form of grants, $16.0 million in a Compact Trust Fund (CTF), and $0.5 million allocated each year for an annual audit. After the Amended Compact is scheduled to expire in 2023$^2$, investment income from the Trust Fund is expected to replace the grants. However, financial trends indicated that the FSM CTF will not provide the same level of income after 2023 when the financial provisions of the Amended Compact ends.

5. When the project was appraised, the FSM’s heavy dependence on imported petroleum fuels was an enormous drain on the economy and made the country highly vulnerable to petroleum price volatility and price shocks. The FSM was spending about $40 million annually on imported fuels. This represented...
over 50 percent of the aggregate annual sectoral grants that the nation has received from the United States under the Amended Compact and nearly 15 percent of nominal gross domestic product (GDP).

**Sectoral and Institutional Context**

6. Each of the four states has established a state-owned utility, responsible for the provision of electricity, water, and sewerage services, plus waste management services, in the case of Yap. Each utility is responsible for electricity generation, transmission, and distribution; has its own tariff structure; and is regulated by the Utility Board at the state level. This Board, appointed by the respective State Governor and confirmed by the state legislature, governs the utility. The Board has the power to approve and adjust tariffs (as proposed by the utility’s management) upon the presentation of a tariff review proposal. Tariffs cover basic operation and maintenance (O&M) cost at different levels in each state, and some include a fuel price pass-through. None of the utilities were able to generate enough revenue to support large-scale infrastructure rehabilitation or new investments in conventional or renewable energy (RE) without further donor support.

7. Table 1 presents a summary by state of the electricity mix, cost, installed capacity, coverage, and the number of customers for 2014, adapted from the Project Appraisal Document (PAD).

<table>
<thead>
<tr>
<th>State (Utility)</th>
<th>Total State Population (2009)</th>
<th>Estimated Electric Access(a) (%)</th>
<th>Utility Customers (number)</th>
<th>Installed Capacity (kW)</th>
<th>Available Firm Capacity(b) (kW)</th>
<th>Peak Load (kW)</th>
<th>Weighted Average Tariff(c) (¢ per kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuuk (CPUC)</td>
<td>53,500 (25% on main island Weno)</td>
<td>25</td>
<td>1,500</td>
<td>Diesel: 5,900 RE(d): 156</td>
<td>5,400</td>
<td>2,300</td>
<td>44</td>
</tr>
<tr>
<td>Yap (YSPSC)</td>
<td>11,700 (65% on main island)</td>
<td>70</td>
<td>2,164</td>
<td>Diesel: 11,500 RE: 293</td>
<td>6,900</td>
<td>2,400</td>
<td>44 (Yap) 109 (outer islands)</td>
</tr>
<tr>
<td>Pohnpei (PUC)</td>
<td>34,300 (&gt;90% on main island)</td>
<td>87</td>
<td>6,399</td>
<td>Diesel: 8,600 RE: 1,105 (including hydro rehabilitation)</td>
<td>6,100</td>
<td>6,600</td>
<td>41</td>
</tr>
<tr>
<td>Kosrae (KUA)</td>
<td>6,600 (single island)</td>
<td>100</td>
<td>1,900</td>
<td>Diesel: 6,415 RE: 55</td>
<td>2,060</td>
<td>1,300</td>
<td>43</td>
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</tbody>
</table>

*Note: CPUC = Chuuk Public Utility Corporation; YSPSC = Yap State Public Service Corporation; PUC = Pohnpei Utilities Corporation; KUA = Kosrae Utilities Authority.

\(a\) Refers to household access. \(b\) Estimated generating capacity that is fully dispatchable and available to meet demand whenever required. \(c\) Weighted across customer categories. \(d\) RE refers to solar photovoltaic (PV), also 725 kW of hydro on Pohnpei.

8. Key issues that affected the FSM electricity sector included the following:

- **Tariffs were not cost reflective.** Electricity tariffs for all the utilities, although relatively high in the range of $41–44 per kWh on the four main islands and over $1 per kWh on outlying islands in Yap, were insufficient to cover their full costs. This ongoing revenue shortfall contributed to operational challenges including insufficient routine maintenance. This resulted in reduced efficiency, increased fuel costs, and increased major maintenance...
requirements due to premature damage that further undermined their financial and operational condition, particularly in the case of PUC.

- **PUC had insufficient available firm generation capacity to cover peak demand and unscheduled generator shutdowns.** PUC had suffered from a substantial energy crisis since 2011, when the existing medium-speed Daihatsu diesel generator sets (gensets) experienced a series of failures. The gensets had already been assessed to be at the end of their design life, and without an effective replacement strategy, the main island of Pohnpei was left with insufficient generating capacity, widespread outages, and rotational load shedding.

- **Cross-subsidies to other utility services.** Electricity revenues cross-subsidized the other loss-making utility operations (water, wastewater, and solid waste).

- **Wide variation in household access to electricity.** There were large differences in household electricity access between utilities, from 98 percent in Kosrae (which is a single island) to 26 percent in Chuuk (with substantial population on outlying islands). Overall average household access was 55 percent.

- **Low penetration of RE sources despite high potential.** The FSM National Energy Policy (NEP) (2012) called for 30 percent RE penetration by 2020. Data for RE capacity at project appraisal are shown in Table 1. The Nampil hydropower plant on Pohnpei (built in the 1980s) was rehabilitated in 2014 at 725 kW capacity. The other operational RE generation consisted of numerous small solar PV plants. All the islands have very good solar PV potential. Pohnpei has approximately 2.7 MW of additional untapped hydropower potential. The main island in Yap is suitable for wind power (which had not been developed at project appraisal).

9. **Energy policy context.** The Strategic Development Plan (SDP) for the FSM provided a road map for the country’s social and economic development over 20 years (2004–2023). Energy is an integral component of the SDP. The NEP, which was adopted in 2012, was developed based on four primary components: policy and planning, conventional energy from fossil fuel, energy efficiency (EE) and conservation, and RE. In terms of conventional energy, the NEP aimed to secure a safe, reliable, and affordable supply of conventional energy, including regional bulk purchase of fuel, centralized storage, and state and national coordination to obtain secure and efficient supply by 2015 and thereafter. The NEP also aims to increase the share of RE with the aim of reaching 30 percent of energy supply by 2020. Each of the four states prepared its own action plan for meeting NEP goals. As part of the ‘Green Micronesia Initiative’, the FSM aimed to increase EE by 50 percent, also by 2020.

10. Other development partners are active in the FSM energy sector, especially the Asian Development Bank (ADB), which has been providing assistance in strengthening the states’ legal and regulatory framework to enable private sector participation, as well as supporting various ongoing and planned investment projects in the four states. It would also complement the existing and/or planned support from the European Union (EU), Japan International Cooperation Agency (JICA), United Nations Development Programme (UNDP), and the European Investment Bank (EIB).
Theory of Change (Results Chain) of the Project

11. The project was designed to “increase the available generation capacity and efficiency of electricity supply in the state power utilities, and to strengthen the planning and technical capacities of the National Government and the state power utilities in the energy sector” (per the wording of its Project Development Objectives [PDOs]). It incorporated three components: (1) increasing the available generation capacity and efficiency of electricity supply in the state power utilities, (2) national and state energy planning, and (3) technical assistance and project management.

12. Figure 1 illustrates how the planned IDA grant-funded tangible investments and technical assistance produced specific outputs: (a) increased capacity of new diesel-based generation, (b) improved quality and efficiency of electricity supply system, (c) a national energy sector master plan adopted by the national and state governments, (d) a sustainability reform program agreed with each utility, and (e) a feasibility study prepared and O&M plans agreed. These in turn allow the achievement of the PDOs. The key outcomes of the project are (a) increased reserve margin of generation, (b) reduced cost of electricity supply through reduced fuel consumption and more efficient operations, and (c) strengthened planning capability of the National Government and state power utilities and strengthened technical capability of the state power utilities, as shown in Figure 1. The long-term target (in line with Energy Master Plans commissioned by the project) is to make electricity supply service (a) reliable, (b) affordable, (c) high quality, (d) less vulnerable to variable fossil fuel prices, and (e) expanded to more people.

13. The project sought to respond to the Government’s and states’ priorities regarding the critical need to improve the performance of power utilities in the short term and to diversify their energy matrix in the long term to reduce reliance on expensive petroleum products. Direct project beneficiaries included electricity consumers (residential, commercial, industrial, and government) in the FSM who would benefit from an improved and more efficient and reliable electricity supply and eventually from more affordable and sustainable tariffs. Direct project beneficiaries were estimated at 50,000 (50 percent of whom are female). Women and children would benefit from improved electricity services because electricity is critical for completing basic education and health activities, the efficient handling of household tasks, and small-scale income-generating activities that help families. Policy and decision makers, as well as planners and managers of the utilities in the four states and the National Government, would also benefit from strengthened energy planning capacity at the state and national levels and from recommended actions for the development and long-term sustainability of the country’s electricity sector.

14. Based on the information provided in the PAD at approval (and specifically the Results Framework), a ‘theory of change’ was constructed to frame the analysis for this Implementation Completion and Results Report (ICR). The theory of change is based on two critical assumptions. First, new plants will be operated and maintained properly to ensure ongoing availability and efficiency. Second, the technical assistance, particularly the program to improve the technical performance of the utilities, will in fact achieve its intended results on a sustainable basis, even in the absence of tariff adjustments or other financial enhancement measures.

---

3 The older medium-speed diesel gensets at PUC, which failed, were quite fuel-efficient when operating at or near their design specifications.
Figure 1. Results Chain of the Project

**Activities**

**Tangible Investments**
- Installation of new gensets for PUC, KUA and YSPSC
- Installation of equipment such as capacitors, temperature compensated digital fuel meters and prepaid meters for YSPSC
- Installation of grid connected Solar PV plants and upgrading of the public street lighting system to a more efficient system for CPUC

**Technical assistance**
- Preparation of energy master plans for each of the FSM states and the National government
- Capacity building for planning capability of the Energy Division (NDRD) and Association of Micronesian Utilities (AMU) in sector data collection, utility benchmarking and policy dialogue including utilities reform
- Program to improve technical performance of the utilities,

**Outputs**

- Increased capacity of new diesel-based generation
- Improved quality and efficiency of electricity supply system through the installation of new gensets, solar PVs, capacitors, meters, LED lighting products

**Key Outcomes in the Project**

- A. Increased reserve margin of generation (at least, generators' N-1 criterion* (mot), which reduces the duration and frequency of power outages
- B. Reduced cost of electricity supply through reduced fuel consumption and more efficient operations, which will lead to lower tariffs in the long run
- C. Strengthened planning capability of the national government and state power utilities; and strengthened technical capability of the State power utilities

**Long-term Objective**

Assumption (i): New plants will be operated and maintained properly to ensure ongoing availability and efficiency.

Assumption (ii): The technical assistance, particularly the program to improve the technical performance of the utilities, will in fact achieve its intended results on a sustainable basis, even in the absence of tariff adjustments or other financial enhancement measures.
Project Development Objectives (PDO)

15. According to the Financing Agreement, the objectives of the Project were “to increase the available generation capacity and efficiency of electricity supply in the state power utilities, and to strengthen the planning and technical capacities of the Recipient and the state power utilities in the energy sector.”

Key Expected Outcomes and Outcome Indicators

16. For the purpose of this ICR, progress in the achievement of these outcomes is measured with the results indicators shown in Table 2. Although the PDO does not specifically require the relevant outcomes to be achieved for each of the state utilities separately, the analysis of the project implementation and associated results found that this was in fact achieved.

Table 2. Outcome and Relevant Indicators

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Relevant Outcome Indicators from the Results Framework</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| A: Increased available generation capacity in the state power utilities, resulting in increased reserve margin of generation, which reduces the duration and frequency of power outages | • PDO Indicator 1: Generation capacity of conventional generation constructed under the project (megawatts [MW]). Baseline: zero. Target: 4.70.  
• PDO Indicator 2: Generation capacity of RE constructed - solar under the project (MW). Baseline: zero. Target: 0.20.  
• IR Indicator 1.1: Commissioning of conventional energy generation equipment (percentage). Baseline: zero. Target: 100.  
• IR Indicator 1.2: Commissioning of solar generation equipment (percentage). Baseline: zero. Target: 100.  
• PDO Indicator 4: Direct project beneficiaries (Number of people, % of whom are female). Baseline: zero. Target: 50,000 (50% female).  
• Proxy Indicator: Generation N-1 criterion met. Baseline: No. Target: Yes. | PDO Indicators 1 and 2 are taken together as indicating the extent of generation capacity.  
IR Indicators 1.1 and 1.2 show the percentage of commissioning.  
PDO Indicator 4 shows the number of beneficiaries benefit from increased reliability. Proxy indicator is added to assess Outcome A. |
| B: Increased efficiency of electricity supply in the state power utilities (Reduced cost of electricity supply) | • PDO Indicator 3: Projected lifetime fuel savings (megajoules [MJ]). Baseline: zero. End target: 124 million.  
• IR Indicator 1.3: Commissioning of efficient streetlights (percentage). Baseline: zero. | PDO Indicator 3 shows the impact of increased efficiency.  
IR Indicator 1.3 shows the level of commissioning up to 100% |

4 The formulations of PDO in the PAD and the Financing Agreement are identical except that the word “Recipient” was replaced with “National Government” in the PAD. In the project context, these words are considered as synonyms. Therefore, the PDO formulations in both documents can be considered as identical.

5 This column shows the link between the PDO and outcomes.

6 This indicator was not in the original Results Framework but is being used as additional relevant evidence to assess the achievement of the outcome A. Indicator data were available for tracking from project inception to completion.
### Outcome 5

Through reduced fuel consumption and more efficient operations, which will lead to lower tariffs in the long run

<table>
<thead>
<tr>
<th>Relevant Outcome Indicators from the Results Framework</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target: 100.</td>
<td>for full commissioning.</td>
</tr>
<tr>
<td>- PDO Indicator 4: Direct project beneficiaries (Number of people, % of whom are female). Baseline: zero. Target: 50,000 (50% female).</td>
<td>PDO Indicator 4 shows the number of beneficiaries benefit from reduced cost of electricity.</td>
</tr>
</tbody>
</table>

C: Strengthened planning and technical capabilities of the National Government and the state power utilities in the energy sector

Two sub-outcomes are as follows:

- Strengthen the planning capacity of the National Government and state power utilities in the energy sector
- Strengthen the technical capacity of the state power utilities

<table>
<thead>
<tr>
<th>Relevant Outcome Indicators from the Results Framework</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- PDO Indicator 5: Sustainability reform program agreed with each state power utility (percentage). Baseline: zero. Target: 100.</td>
<td>These Indicators are taken together as indicating the extent of planning and technical capabilities.</td>
</tr>
<tr>
<td>- IR Indicator 2.1: Energy sector master plans completed and accepted. Baseline: No. Target: Yes.</td>
<td></td>
</tr>
<tr>
<td>- IR Indicator 2.2: Energy sector information system in place (percentage). Baseline: zero. Target: 100.</td>
<td></td>
</tr>
<tr>
<td>- IR Indicator 2.3: Improved planning capacity of the state power utilities and National Government. Baseline: No. Target: Yes.</td>
<td></td>
</tr>
<tr>
<td>- IR Indicator 1.4: Improved technical capacity in the state utilities for operation and maintenance. Baseline: No. Target: Yes.</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** IR = Intermediate result.

### Original Components

17. The project, with an estimated cost of SDR 9.4 million (equivalent to $14.40 million) at approval, comprised three components:

**Component 1: Increasing the available generation capacity and efficiency of electricity supply in the state power utilities ($9.27 million at approval, $9.19 million actual at closing)**

(a) Carrying out activities designed to increase available generation capacity and efficiency of electricity supply in the state power utilities, including

- Acquisition and installation of new gensets for PUC, KUA, and YSPSC;
- Acquisition and installation of equipment such as capacitor banks, temperature-compensated digital fuel meters, and prepaid meters for YSPSC; and
- Acquisition and installation of grid-connected PV generators and upgrading of the public street lighting system to a more efficient system for CPUC.
(b) Carrying out activities designed to improve the technical performance of the state power utilities, including capacity building activities and the development and implementation of O&M plans.

**Component 2: National and state energy planning** ($3.40 million at approval, $1.48 million actual at closing)

(a) Preparation of Energy Master Plans for each of the FSM states, including
   - Identifying and prioritizing infrastructure investments in the energy sector and
   - Undertaking feasibility studies and environmental and social impact assessments for the priority investments.

(b) Development of a national energy sector master plan that will build upon the Energy Master Plans developed under Component 2(a).

**Component 3: Technical assistance and project management** ($1.50 million at approval, $1.90 million actual at closing).

(a) Carrying out activities designed to build the capacity of the Energy Division and the AMU for
   - Sector data collection, statistics, and the development of an information management system;
   - Utility benchmarking;
   - Implementation of the NEP; and
   - Broadening of dialogue on matters affecting the energy sector, including developing a reform program for utilities to improve sustainability of their operations.

(b) Carrying out activities designed to enhance the capacity of the Energy Division (NDRD) for overall project coordination, management, and monitoring.

**B. SIGNIFICANT CHANGES DURING IMPLEMENTATION (IF APPLICABLE)**

**Revised PDOs and Outcome Targets**

18. No change was made to the PDOs or outcome targets. The target date for some of the outcomes was extended along with extension of project closing date to September 30, 2019 (particularly the increase in available generating capacity at the state utilities, given that the relevant work at CPUC and KUA had not been completed by the original closing date).

**Revised PDO Indicators**
19. No change was made to the PDO indicators.

**Revised Components**

20. **Some activities (in Component 1 especially) were modified**, taking into account revised priorities and other donor-financed projects. These are elaborated in detail in section 3.2 of the recipient’s ICR (attached as Annex 5 to this document). In essence, the modified and newly added activities comprised (a) transformer and switchgear upgrades for YSPSC; (b) a new transformer, efficient street lighting, cash power meters, and supervisory control and data acquisition (SCADA) for KUA; (c) rehabilitation of a diesel genset, bucket trucks, energy assessments, training, funding of an electrical engineer, top-end maintenance for two gensets, and SCADA for PUC; and (d) additional street lighting, cash power meters, and larger PV system for CPUC.

**Other Changes**

21. In July 2018, the project closing date was extended by 14 months from July 31, 2018, to September 30, 2019, for the reasons explained in the next section. In September 2019, a second restructuring of the Energy Sector Development Project (ESDP) was processed to cancel anticipated unused funds of SDR 401,833 (approximately $550,000) before the project closing date (‘partial closure’). This allowed the client to use the cancelled IDA funds for another project within its IDA portfolio.

**Rationale for Changes and Their Implication on the Original Theory of Change**

22. The project was extended by 14 months to allow for the reallocation of over $1.5 million of unspent funds from Component 2 to a revised Component 1 and completion of the installation of new generating capacity at CPUC and KUA, given the slow start to project implementation. The funding envelope for Component 2 was increased from $1.5 million to $3.4 million late in the appraisal stage when additional IDA money became available, and the actual activities carried out did not need this additional funding. This funding was offset by the appreciation of the U.S. dollar during the implementation period, which reduced the U.S. dollar funding envelope by $1.83 million (the funding envelope was fixed at SDR 9.4 million).

23. It was not possible to utilize $550,000 of the project funds because delivery of new equipment in a few cases could not be accomplished by the closing date; therefore, the relevant procurements were stopped. However, these funds have been reallocated by the client for another project within its IDA portfolio.

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7 This category comprised mostly spare parts, which had been considered to be procured within a short period. However, the delivery appeared unlikely to meet the closing date due to the remoteness of each state.
II. OUTCOME

A. RELEVANCE OF PDOs

24. The project was in line with the World Bank Group’s Country Partnership Strategy (CPS) for the FSM for FY14–17 (which was under preparation at the project appraisal stage) and was consistent with the World Bank’s regional engagement strategy in the Pacific Region. The project supported the country’s objective of enhancing its energy security by improving the reliability, affordability, and sustainability of energy services. It also supported the regional strategy’s objective of strengthening capabilities for service delivery. The project remains highly consistent with the current Regional Partnership Framework FY17–21 for nine Pacific Island countries including the FSM (‘PIC9’) that prioritizes specific areas of engagement including “improving electricity supply and efficiency while setting the stage to increase the use of renewable energy.”

25. The project was (and remains) in line with the World Bank’s corporate goals to end extreme poverty and to promote shared prosperity by facilitating the FSM’s efforts to provide more reliable electricity in the short term and cleaner and less expensive electricity in the medium term. It would benefit the extreme poor by increasing reliability and sustainability of the system and by supporting the development of state master plans that aim at increasing connections and reducing energy costs.

26. The project supported the implementation of the NEP\(^8\) by providing financing to address the most urgent investments required at the four state utilities. It also provided financing and tools to develop Energy Master Plans for each state and at the national level. A summary of the new Energy Master Plans prepared under the project is provided in Annex 6. In addition, the project supported improving technical capacity in the sector at the national and state levels.

27. The project complemented assistance from other development partners in the sector, including the ADB’s assistance in strengthening the legal and regulatory framework, as well as various investment projects in Chuuk, Yap, and Pohnpei, and the current and/or planned support from the EU, JICA, UNDP, and the EIB. Following JICA’s demand forecast for Kosrae and discussions with KUA and the Project Implementation Unit (PIU) in late 2017, it was agreed to purchase three 600 kW gensets: the first one to be procured through the project and the other two by JICA once the JICA grant was approved.

28. Although they are highly relevant, the PDOs could have been made even more relevant by allowing for the explicit inclusion of demand-side measures (demand-side management [DSM] and EE), rather than being limited to efficiency of electricity supply. Some EE measures were contemplated by the recipient late in the implementation period when additional funding became available but were not carried out due to perceived inconsistency with the PDOs.

Assessment of Relevance of PDOs and Rating:

29. The relevance of the PDOs was high and remained high until project closure. The appropriate rating is High.

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\(^{8}\) The NEP remains current as of the date of this document.
B. ACHIEVEMENT OF PDOs (EFFICACY)

Assessment of Achievement of Each Objective/Outcome

30. Efficacy of achievement of the PDOs is assessed against each of the three key expected outcomes contained within the PDOs as follows:

- **Outcome A (increased reserve margin of generation) has been overachieved.** Conventional generation capacity was increased by 6.2 MW (32 percent above the end target), while RE generation capacity was increased by 0.4 MW (100 percent above end target). The amount of additional capacity provided by the project exceeded the original estimate for two of the four utilities (CPUC and PUC), was lower than the original estimate for KUA, and was the same as the original estimate for YSPSC. These changes reflected the evolving investment needs of the utilities and the lower than expected unit cost of the solar PV installation in CPUC that allowed for additional PV capacity at the original budgeted cost. In two cases (PUC and YSPSC), the generation upgrade was completed by the original closing date, and in the other two cases (CPUC and KUA) it was completed by the revised closing date. Each state meets generation N-1 criterion with increased reserve margin of generation, which reduces the duration and frequency of power outages. Reliability of electric supply has improved, most notably at PUC. The improvement was due to a combination of measures that are substantially attributable to the project, including the installation of more reliable generation, electrical protection and control improvement, and the installation of a power line communication/SCADA system. It is estimated that the PUC System Average Interruption Duration Index (SAIDI) was reduced from approximately 8,600 minutes per year to approximately 4,000 minutes per year, resulting from implementing the measures indicated earlier.

- **Outcome B (reduced cost of electricity supply through reduced fuel consumption and more efficient operations) is overachieved:**

  (a) The outcome target is a projected lifetime fuel saving of 124 million MJ (equivalent to 84,600 gallons of diesel per year over an estimated 10-year lifetime). The projected savings substantially exceed the original target of 124 million MJ, with an updated estimate of 915 million MJ over a 10-year lifetime, using initial operating results. The relevant indicator does not restrict the measurement of fuel savings to the immediate or siloed impact of the specific assets installed by the project without consideration of the broader network benefits and attendant fuel savings facilitated by the project, and this is considered entirely appropriate as detailed in Annex 4. These tiny networks should be assessed and addressed on a holistic basis. Efficiency improvements will result from the solar PV installation, network efficiency benefits associated with the new diesel generation including reduction of curtailment of the existing renewables,

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9 The implied annual savings target (84,600 gallons per year) was already exceeded for FY18 and FY19 (years ending September 30), primarily due to the progress at PUC.
and the energy savings resulting from the installation and operation of more efficient street lighting.

(b) Another useful measurement of the efficiency of electricity supply is the improvement in the system-level fuel intensity of supply, measured as kWh generated per gallon of fuel (kWh/gal). Results already available for two of the utilities (PUC and YSPSC) show a substantial improvement during the project implementation period. Detailed data provided by PUC show a 25.8 percent improvement from 11.48 kWh/gal in FY14 to 14.45 kWh/gal in FY19 (year-end September 2019). Data provided by YSPSC show an 11.4 percent improvement from 14.46 kWh/gal to 16.44 kWh/gal in FY19 (year-end September 2019). Updated operational data are still awaited from the other two utilities, as the relevant generating plants have only recently been commissioned.

(c) In addition, a total of 2,733 efficient streetlights were procured under the project and are being continuously installed by the utilities. The original target was only 368 lights, so instead of 100 percent, the project has achieved an impressive 2,733/368 (742 percent). The estimated energy savings are however modest at $31,500 per year.

(d) Each state reduced the cost of electricity supply through reduced fuel consumption and more efficient operations, which will reduce the pressure for tariff increases. Lower tariffs are expected in the long run once additional solar PV and battery storage is incorporated into the networks (except for CPUC where extensive and costly electrification of outlying islands is needed).

- **Outcome C (strengthened planning capacity of the National Government and state power utilities and strengthened technical capacity of the state power utilities) is on track to be fully achieved:**

  (a) **Planning capacity of the Central Government and utilities in the energy sector.** The FSM and states have adopted their master plans which have paved the way for coordinated, efficient, and planned investments in the energy sector. These plans are now being used by the NDRD, the utilities, and various donors when considering and planning future investments. The plans presented least-cost solutions to meet each state’s access, reliability, social, and environmental objectives. The models, inputs, and calculations that have been provided to the FSM counterparts are designed to be easily and regularly updated, as planning is an ongoing process. The plans present a set of scenarios for the FSM utility sector through to 2037 that can be fully funded and financed. The last few years have seen remarkable and disruptive improvements in RE technologies and battery storage that are highly applicable in the FSM. Further expected reductions in the costs of these technologies will provide the FSM with an opportunity to achieve clean and affordable electricity production and supply along with universal access to electricity. The modeling exercise shows that the needed transformation will be achieved mainly by adding a large amount of new solar PV capacity (plus storage) to reduce reliance on diesel and providing increased access (including mini-grids on outlying islands), thereby meeting demand growth and lowering the overall cost of generating electricity.
(b) **Technical capacity building for the utilities.** During the development of the Energy Master Plan, several specific feasibility studies were conducted. Each utility was involved in each study and proactively made a contribution to the master plan. Together with construction management tasks, utilities’ own experience and practices enhanced technical capacity for the utilities, which resulted in forming engineering units at each utility to perform all the technical work under the next energy project. Specific training support was requested and provided under the project to enhance local capacity and skills to manage and maintain battery storage, SCADA, and solar PV, since these components are included in the World Bank’s new Sustainable Energy Sector Development and Access Project (SEDAP) (P165183).

31. **Attribution.** The key outcomes from the project are principally attributable to the project as it funded key generating plants and other network components and secured the preparation of Energy Master Plans for the utilities and the country as a whole.

(a) **Outcome A** (increased available capacity of the state power utilities resulting in increased reserve margin of generation) is highly attributable to the project, as this additional capacity, and its resultant increased reliability, were directly funded and implemented under the project.

(b) **Outcome B** (increased efficiency of electricity supply in the state power utilities) is substantially attributable to the project. The majority of the expected efficiency improvements (around 70 percent)—measured as fuel savings based on operational data summaries from utilities—will directly result from the installation and operation of the new generation capacity under the project. The remainder (around 30 percent) will accrue from associated benefits including increased system efficiency of supply from facilitating the efficient operation of RE generation (including reduction of RE curtailment to increase the volume of zero fuel cost energy delivered and improve efficiency and sustainability) and highly efficient LED street lighting retrofits.

(c) **Outcome C** (strengthened planning and technical capabilities of the National Government and the state power utilities in the energy sector) is highly attributable to the project. The project has funded and implemented substantial interventions, notably on the energy planning side where unique progress has been made.

32. **Direct project beneficiaries** included electricity consumers (residential, commercial, industrial, and government) in the FSM who would benefit from an improved and more efficient and reliable electricity supply and eventually from more affordable and sustainable tariffs. Direct project beneficiaries were estimated at 50,000 (50 percent of whom are female). Women and children would benefit from improved electricity services because electricity is critical for completing basic education and health activities, the efficient handling of household tasks, and small-scale income-generating activities that help families. Policy and decision makers, as well as planners and managers of the utilities in the four states and the National Government, would also benefit from strengthened energy planning capacity at the state and national levels and from recommended actions for the development and long-term sustainability of the country’s electricity sector.
33. **Counterfactuals.** Without this project, a power supply crisis affecting Pohnpei Island, the major population center, would have been exacerbated due to the lack of sufficient firm power generation. In addition, had the IDA grant funding for this project not been available, increasing available generating capacity and efficiency of electricity supply in the state power utilities would have been delayed, and the Energy Master Plans might not have been completed. A specific counterfactual was presented in Table A7.2 of the PAD, indicating that for CPUC, diesel generation would continue in place of energy production from the new PV, and diesel genset replacements would be delayed for the other three utilities.

### Table 3. Achievement of Each Objective and Outcome

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outcome Indicator</th>
<th>Target Value*</th>
<th>Actual Value at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Increased available generation capacity in the state power utilities results in increased reserve margin of generation, which reduces the duration and frequency of power outages</td>
<td>PDO Indicator 1: Generation capacity of conventional generation constructed under the project (MW)</td>
<td>4.7 MW To be completed by FY18</td>
<td>6.2 MW. Overachieved in FY19, 32% above the end target. Fully attributable to the project</td>
</tr>
<tr>
<td>PDO Indicator 2: Generation capacity of RE constructed - solar under the project (MW)</td>
<td>0.2 MW To be completed by FY18</td>
<td>0.4 MW. Overachieved in FY19, 100% above end target. Fully attributable to the project</td>
<td></td>
</tr>
<tr>
<td>IR Indicator 1.1: Commissioning of conventional energy generation equipment (Percentage)</td>
<td>100% To be completed by FY18</td>
<td>Overachieved in FY19, 32% above end target</td>
<td></td>
</tr>
<tr>
<td>IR Indicator 1.2: Commissioning of solar generation equipment (Percentage)</td>
<td>100%. To be completed by FY18</td>
<td>Overachieved in FY19, 100% above end target</td>
<td></td>
</tr>
<tr>
<td>PDO Indicator 4: Direct project beneficiaries (Number of people, % of whom are female)</td>
<td>50,000 people (50% female) To be completed by FY18</td>
<td>62,632 people (50% female). Overachieved in FY19, 25% above the end target</td>
<td></td>
</tr>
<tr>
<td>Proxy Indicator: Generation N-1 criterion met (Yes/No)</td>
<td>To be completed by FY18</td>
<td>Fully achieved in FY19</td>
<td></td>
</tr>
<tr>
<td>B: Increased efficiency of electricity supply in the state power utilities</td>
<td>PDO Indicator 3: Projected lifetime fuel savings (MJ) Baseline: zero</td>
<td>124 million MJ projected lifetime fuel savings</td>
<td>915 million MJ projected lifetime fuel savings. Overachieved in FY19, 638% above the end target. Substantially attributable to the project</td>
</tr>
<tr>
<td>IR Indicator 1.3: Commissioning of efficient streetlights (Percentage)</td>
<td>100% To be completed by FY18</td>
<td>Overachieved in FY19, 642% above end target</td>
<td></td>
</tr>
<tr>
<td>PDO Indicator 4: Direct Project beneficiaries (% of whom are female)</td>
<td>50,000 individuals, 50% female</td>
<td>Fully achieved in FY19</td>
<td></td>
</tr>
</tbody>
</table>
## Outcome

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outcome Indicator</th>
<th>Target Value*</th>
<th>Actual Value at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>C: Strengthened planning capability of the National Government and state power utilities and strengthened technical capability of the state power utilities</td>
<td>PDO Indicator 5: Sustainability reform program agreed with each state power utility (Percentage)</td>
<td>100% To be completed by FY18</td>
<td>100%. Fully achieved in FY19 and fully attributed to the project</td>
</tr>
<tr>
<td></td>
<td>IR Indicator 2.1: Energy sector master plans completed and accepted</td>
<td>To be completed by FY18</td>
<td>Fully achieved in FY19</td>
</tr>
<tr>
<td></td>
<td>IR Indicator 2.2: Energy sector information system in place</td>
<td>To be completed by FY18</td>
<td>Fully achieved in FY19</td>
</tr>
<tr>
<td></td>
<td>IR Indicator 2.3: Improved planning capacity of the state power utilities and National Government</td>
<td>To be completed by FY18. However, there is an inherent measurement challenge.</td>
<td>Fully achieved in FY19 and likely to be sustainable</td>
</tr>
<tr>
<td></td>
<td>IR Indicator 1.4: Improved technical capacity in the state utilities for operation and maintenance</td>
<td>To be completed by FY18. However, there is an inherent measurement challenge.</td>
<td>Fully achieved in FY19 and likely to be sustainable</td>
</tr>
</tbody>
</table>

*Note: a. Although the target date was not updated at restructuring, it was updated in the Implementation Status and Results Report (ISRs). b. The achievement counts the fuel savings from a wind farm whose interconnection was enabled by the project but was funded by the ADB.
### Table 4. Outcomes in Each State

<table>
<thead>
<tr>
<th></th>
<th><strong>Outcome A</strong>: Increased available generation capacity in the state power utilities, resulting in increased reserve margin of generation</th>
<th><strong>Outcome B</strong>: Increased efficiency of electricity supply in the state power utilities</th>
<th><strong>Outcome C</strong>: Strengthened planning capability of the national government and state power utilities; and strengthened technical capability of the State power utilities.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chuuk</strong> (CPUC)</td>
<td>200 kW of solar PVs installed Generation N-1 criterion met</td>
<td>New solar PVs and streetlights have reduced diesel fuel consumption.</td>
<td>State Energy Master Plan was developed and adopted.</td>
</tr>
<tr>
<td><strong>Yap</strong> (YSPSC)</td>
<td>1,600 kW of diesel generators installed Generation N-1 criterion met</td>
<td>New diesel generation enhances system operation and enables further RE integration.</td>
<td>State Energy Master Plan was developed and adopted.</td>
</tr>
<tr>
<td><strong>Pohnpei</strong> (PUC)</td>
<td>2,000 kW of diesel generators installed Generation N-1 criterion met</td>
<td>New configuration of the generators and streetlights has reduced diesel fuel consumption.</td>
<td>State Energy Master Plan was developed and adopted.</td>
</tr>
<tr>
<td><strong>Kosrae</strong> (KUA)</td>
<td>600 kW of diesel generator installed Generation N-1 criterion met</td>
<td>New generator and streetlights have reduced diesel fuel consumption.</td>
<td>State Energy Master Plan was developed and adopted.</td>
</tr>
</tbody>
</table>

### Justification of Overall Efficacy Rating

34. Based on the overachievement of key targets for Outcome A, the expected overachievement of the key target for Outcome B, and the expected achievement of key targets for Outcome C, the efficacy is considered High.

### C. EFFICIENCY

#### Economic and Financial Analysis

**Analyses at Appraisal**

35. An economic cost-benefit analysis was conducted for the four investment subcomponents of Component 1, representing 76 percent of the component’s cost and 49 percent of the total project cost. The proposed priority capital expenditure (CAPEX) investments for the FSM’s power system were projected to create significant economic benefits by making the system substantially more available and economic and by reducing fuel imports and the FSM’s vulnerability to volatile fuel price and supply risks. The benefits are by far the most evident in the case of PUC, where the new firm capacity provided by the project was essential in helping solve a power supply crisis on Pohnpei island resulting from the failure of all four of the previously operational prime diesel gensets. The four states’ new power generation capacity and EE measures under the proposed project were calculated to provide an estimated economic internal rate of return (EIRR) of 25 percent and economic net present value (ENPV) of $5.03 million (1.5 percent...
of the FSM’s GDP in 2012). A sensitivity analysis showed that the EIRR remained above the cutoff threshold of 12 percent and the ENPV remained positive in a variety of adverse modeled scenarios (adverse changes to investment CAPEX, fuel cost, value of lost load [VoLL], discount rate, and so on).

36. Distribution analyses of the ENPV showed that consumers were expected to be the largest beneficiaries due to avoided tariff increases and reduced tariff fluctuations because of the reduced fuel imports and improved available generation capacity. Protection from economic shocks through stabilized power tariffs was expected to improve the ability of households, including those headed by women, to redirect household budget to other basic household needs, such as food and bus fares for school children.

37. Financial analysis was conducted for Component 1 to determine the financial viability and sustainability of the proposed investments. The proposed investments were projected to have a significant positive impact on the financial position of each of the four utilities through the reduction of operating costs due to increased efficiency. Proposed CAPEX under Component 1 was estimated to generate a financial net present value (FNPV) of $5.16 million and a financial internal rate of return (FIRR) of 25.8 percent.

38. No least cost plan or even a feasibility study regarding the proposed investments was available at the appraisal stage. It was akin to an emergency operation due to the dire situation at PUC subsequent to the terminal failure of three of its four prime diesel gensets. In addition, involvement of other donors was highly uncertain at the time. The ADB was discussing a complementary project but did not have a solid commitment at the time. The EU was in discussion about rehabilitation of hydropower on Pohnpei Island. Nevertheless, a sophisticated economic analysis was conducted with the aid of a counterfactual, and many data gaps were filled by best available means from comparable projects and other relevant literature. The small size and relative simplicity of the FSM utility systems provided confidence in the reasonableness of assumptions and the suitability of the proposed investments in the absence of sophisticated tailored studies.

Updated Analyses

39. An updated analysis is provided in Annex 4. The updated analysis benefited from updated aggregate operational data (including fuel usage and fuel efficiency of generation on a monthly basis) from two of the four utilities, including PUC which is by far the biggest. In addition, tailored analyses were available, including ‘Pohnpei Energy Assessment’ analyzing PUC operations in 2017, and the FSM Energy Master Plans were completed in 2018. Clarity was also available related to the complementary ADB and EU investments and assistance. Where specific updated data were not available, input assumptions generally followed those in the analyses at appraisal (including for the counterfactual). VoLL was increased from $1 per kWh to a more realistic value of $10 per kWh, and updated assumptions were included for social cost of carbon based on updated World Bank guidance ($30 per ton, with an avoided diesel emission factor of 0.65 tCO₂eq/MWh). A discount rate of 12 percent was assumed throughout, consistent with the base case discount rate used in the analyses at appraisal.

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10 $1 per kWh, which came from a Nepal case, was used at the appraisal since no data was available for the Pacific. The University of Technology Sydney estimated the VOLL value for the Pacific in 2019.
40. As was the case with the analyses at appraisal, the updated results are substantially attributable to the value of the fuel savings achieved by the four utilities (over an assumed 10-year operating life) associated with the investment components of the project. However, the methodology used at completion uses updated operational data reflective of the utility systems as a whole and includes some savings not directly attributable to the project as these cannot be extracted from the data provided by the utilities. It is also argued in this ICR that this is an appropriate approach for these tiny systems that should be considered on a holistic basis. The estimated value of the improvement in reliability (SAIDI) is also significant for PUC which was in the throes of a power supply crisis immediately before the implementation of the project. The updated ENPV is estimated at $5.93 million, with a corresponding estimated EIRR of 28.8 percent. The updated FNPV is estimated at $5.34 million, with a corresponding estimated FIRR of 27.5 percent.

Table 5. Estimates at Appraisal and Completion

<table>
<thead>
<tr>
<th></th>
<th>At Appraisal(^{11})</th>
<th>At Completion(^{12})</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENPV</td>
<td>$5.03 million</td>
<td>$5.93 million</td>
</tr>
<tr>
<td>EIRR</td>
<td>25.5%</td>
<td>28.8%</td>
</tr>
<tr>
<td>FNPV</td>
<td>$5.16 million</td>
<td>$5.34 million</td>
</tr>
<tr>
<td>FIRR</td>
<td>25.8%</td>
<td>27.5%</td>
</tr>
</tbody>
</table>

Assessment of Efficiency and Rating

41. The project provided a cost-effective solution to increasing the available generating capacity and reliability and improving the efficiency of electricity supply for the four utilities, as well as improving system planning capacities at the national and utility levels. The design of the project contributed to increased execution efficiency, including by focusing on a few key activities that were fully implemented. Some delays in implementation led to the need for a 14-month extension to complete some of the activities; however, this additional time was also used to apply cost savings from Component 2 to procure other additional equipment requested by the utilities. The extreme remoteness of the locations was a specific challenge in recruiting qualified personnel to remain in situ during project implementation. Given the high economic efficiency and the substantial implementation efficiency, the overall efficiency is considered to be higher than would be expected for similar operations in Pacific Island countries (PICs) and can therefore be rated High.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

42. The relevance of the PDOs is rated High, the overall efficacy is rated High, and efficiency is rated High, resulting in an overall outcome rating of Highly Satisfactory summarized as follows:

- **Relevance.** The PDOs were consistent with the priorities of the country and with the World Bank’s strategies of intervention in the FSM. The PDOs remained unchanged and highly relevant during project implementation. The proposed rating is High.

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\(^{11}\) The analysis covered 49 percent of the total estimated Project cost of $14.4 million at appraisal.

\(^{12}\) The analysis covered 68.4 percent of the total estimated Project cost of $12.57 million at completion.
• **Efficacy.** The ‘increased generation capacity’ outcome target resulting in increased reserve margin of generation has been overachieved, the ‘expected lifetime fuel saving’ outcome target is on track to be overachieved, and the planning and capacity outcomes are on target to be fully achieved. A High rating is considered appropriate.

• **Efficiency.** As shown by an updated economic assessment at completion, the project provided a cost-effective solution to increasing the available generating capacity and reliability and improving the efficiency of electricity supply, as quantitatively estimated for the investment components. The project was designed to facilitate efficient implementation in a challenging environment, and it was fully implemented. A 14-month extension was needed to complete some activities and to reallocate cost savings from Component 2 to procure other equipment requested by the utilities. Efficiency is proposed to be rated High.

• Overall, the project outcome is rated Highly Satisfactory, reflecting very good performance in achieving the objectives.

### E. OTHER OUTCOMES AND IMPACTS

#### Gender

43. An outcome indicator (number of beneficiaries) was disaggregated by gender. This was fully achieved. More specific gender impacts were not intended at appraisal. However, other outcome indicators related to reliable and efficient electricity were overachieved. Women and children would benefit from more reliable electricity supply and eventually from more affordable and sustainable tariffs, which sustain basic education, health activities, the efficient handling of household tasks, and small-scale income-generating activities that help families.

#### Mobilizing Private Sector Financing

44. The successful structuring and implementation of the project helped create an enabling environment to promote private sector ownership and management of generation in the solar PV sector. As a separate initiative, a solar PV project in Pohnpei, structured as an independent power producer, has been accepted by PUC.

#### Poverty Reduction and Shared Prosperity

45. A long-term objective of the project is to secure affordable tariffs that will contribute to poverty reduction. The Energy Master Plans indicate plausible pathways to achieving this long-term objective. In addition, the project’s economic analysis conducted at appraisal included a distribution analysis showing that consumers were expected to be the largest beneficiaries due to avoided tariff increases and reduced tariff fluctuations because of the reduced fuel imports and improved available generation capacity. Protection from economic shocks through stabilized power tariffs was expected to improve the ability of households, including those headed by women, to redirect household budget to other basic household needs.
III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

46. **Lessons learned and reflected in the project design.** The project design benefited from the World Bank’s experience in designing and implementing projects in other PICs, as summarized in the following paragraphs; however, implementation was still delayed due to the inadequate staffing of the implementing entity during much of the implementation period.

- **Government and state ownership.** A project with multiple direct stakeholders requires a high level of ownership by all parties. This ownership needs to be secured throughout project preparation and implementation through the direct participation of all beneficiaries. In the case of the ESDP, there was a strong commitment and ownership of the proposed operation not only by the National Government but also by the four state governments and their respective utilities. The project was prepared in close coordination with all relevant institutions.

- **Targeted and flexible assistance.** The project responded to the National Government and states’ priorities regarding the critical need to improve the performance of power utilities in the short term and to diversify their energy matrix in the long term to reduce reliance on expensive petroleum products. Specifically, the new project gensets are already more fuel efficient and will reduce reliance on imported fuels in the near term. The project also responded to the need to identify, plan, and prepare sound energy sector investments for public sector and potential private sector participation in the sector. Project components were designed to address short- and long-term needs in a targeted and flexible manner, including investments to address the most critical needs of the utilities, technical assistance for strengthening energy sector planning, and the building of managerial and technical capacity. The utilities took the initiative in specifying additional equipment and services when cost savings materialized during project implementation.

- **Strengthening relationship with the client.** A well-designed and well-executed project that included a technical assistance component offered the opportunity to conduct a continuous policy dialogue and strengthen the relationship between the Government and development partners. The project helped build trust and paved the way for a sustained and larger collaboration by creating an enabling environment for further support to the country’s energy sector. A larger follow-on IDA financed project (SEDAP) is currently under implementation, having already secured the World Bank’s Board approval.

- **Aligning project design with implementation capacity.** Given the limited capacity of the implementing entity, the project was designed to be instrumental in broadening and strengthening implementation capacity by funding the staffing of key operational and technical positions in support of the implementing agency. In addition, project activities were packaged to reduce the number of transactions as much as possible.
Specific measures were taken to address and mitigate slow implementation. Slow implementation of energy sector projects in some PICs has been attributed to poor project design. The design of this project took into account World Bank good practices: (a) a limited and modest set of initial objectives to create momentum; (b) a deliberately lean program, with only three core development components closely tied to existing policy commitments; and (c) close attention to implementation arrangements, including the project’s readiness to implement these arrangements from day one. The simplicity of the design did minimize but did not remove all obstacles to slow implementation with many delays experienced throughout implementation.

47. **IDA allocation.** The project was initially prepared as an IDA17 deliverable with an estimated grant allocation equivalent to $10 million. Three components were scoped out on that basis (Component 1: $7.5 million, Component 2: $1.5 million, Component 3: $1 million). At the Concept Review meeting (February 2014), the discussion included planning to potentially deliver this project under IDA16 utilizing the FSM’s entire allocation (SDR 9.4 million, then equivalent to $13.9 million). It was agreed that the additional funds should contribute to (a) financing of detailed design of priority projects identified under Component 2 and other additional studies that could be relevant for the sector and (b) an investment provision under Component 1 for each state to finance such priority projects taking into account political economy dimensions when splitting allocations between the four states. The funding envelope was increased to the equivalent of $14 million. The estimated component costs were increased (Component 1: $9.27 million, Component 2: $3.4 million, Component 3: $1.5 million).

**B. KEY FACTORS DURING IMPLEMENTATION**

48. **Coordination and management.** The Energy Division in the NDRD implemented the project. It had only one staff member, the Assistant Secretary, who was the project coordinator and focal point. There was no full-time project manager during the life of the project, despite this being a requirement (a failing that is being addressed for the SEDAP). The project financed three part-time specialists located outside of the country (an energy technical specialist, a procurement adviser, and a safeguards adviser) and two full-time officers (a financial officer and an implementation support officer) to strengthen the division’s technical capacity. The staffing of the Energy Division did not meet the practical needs agreed during project preparation and reflected in the design of the project. This placed an unnecessary burden on the Assistant Secretary and NDRD and negatively affected the coordination with the utilities, particularly in the early part of project implementation. The state power utilities served as members of the Project Steering Committee to ensure complementarities and coordination among the four states and the National Government and to provide guidance, technical inputs, and data/information to the consultants hired under the project. The Energy Division served as the chair of the Steering Committee.

49. **Fiduciary arrangements.** The fiduciary arrangements were strengthened by the formation of a Centralized Implementation Unit (CIU) within the Department of Finance and Administration (DOFA) in early 2018. The CIU provides a centralized service for all functions required for all World Bank financed projects, such as financial management (FM), procurement, and safeguards. Dedicated FM personnel were hired initially with procurement and safeguards coming onboard during 2018. However, as the project had already hired procurement and safeguard specialists to provide intermittent support, there

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13 This position was not filled for the entire project implementation period.
was limited use of these CIU specialists until the latter part of the project. The PIU faced serious procurement capacity constraints throughout the project, which led to delays in the hiring of advisers and subsequently delayed the implementation of the various works, goods, and services financed by the project. The early engagement of the procurement expertise in-country may have helped minimize some of these delays. It should be noted that the ESDP was the first World Bank-financed project in the FSM, and therefore World Bank processes and procedures, including procurement, were new to the project team and government counterparts.

50. **U.S dollar appreciation during implementation.** The U.S. dollar strengthened relative to the SDR during implementation, resulting in the IDA allocation in SDR becoming less valuable in USD (reducing from $14.4 million at approval to $12.57 million at closing).

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

#### A. QUALITY OF MONITORING AND EVALUATION (M&E)

**M&E Design**

51. The M&E design was reasonably appropriate for the project. Although there was no Theory of Change diagram in the original PAD (as it was not required at the time), Annex 1 of the PAD had a well elaborated Results Framework, with outcome and measurable intermediate indicators with baseline targets and arrangements for results monitoring. The original wording of the Output Indicator 1 (increased generation capacity) is actually an output, and this was corrected in the ICR to refer to the increased reserve margin of generation. An estimated reliability improvement (SAIDI of PUC) was sampled at the ICR stage and hence was not included in the M&E design or monitored during implementation. Although PDO Outcome 3 (related to planning and capacity building) was split into two suboutcomes for ease of analysis in this ICR, there was no need to reinterpret or reprofile the original indicators.

52. Except as noted earlier, the indicators are generally adequate to measure the results chain. However, it is challenging to accurately measure the effectiveness of the technical assistance components, particularly when these benefits will become evident only in the future (assuming they materialize). This is a problem common to technical assistance interventions. Also, the rationale for calculating the projected lifetime fuel savings was not made clear in the PAD or other available documentation. This reflects the perception that the fuel savings were methodologically difficult to assess ex ante.

**M&E Implementation**

53. The required M&E data were simple to collect and generally coincided with obvious milestones, such as the completion of installation of key equipment. One exception is data on fuel savings, but the relevant indicator is the projected lifetime fuel savings to be realized over an extended period of operation. Regarding the technical assistance components, the relevant outputs were easy to measure but were difficult to determine as noted earlier. Although target dates were not specifically updated at extension, they were reflected in subsequent ISRs and the relevant activities were clearly on track for successful completion.
M&E Utilization

54. All ISRs updated the status of the progress toward the outcome targets. The first restructuring was also based on M&E data. This provided stakeholders with a timely picture of the progress of the project on the ground.

Justification of Overall Rating of Quality of M&E

55. The M&E system, as designed and implemented, was generally sufficient to assess the achievement of the objectives and test the links in the results chain. A ‘Substantial’ rating is considered appropriate.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

56. **Environmental and social compliance.** The project was classified as Category B and triggered the following safeguards: Environmental Assessment (OP/BP 4.01), Natural Habitats (OP/BP 4.04), Forests (OP/BP 4.36), Physical Cultural Resources (OP/BP 4.11), Involuntary Resettlement (OP/BP 4.12), and Safety of Dams (OP/BP 4.37). For the known investments in Component 1, an Environmental Management Plan (EMP) was prepared. The expected impacts from equipment installation were relatively minor and readily mitigated. For master planning in Component 2, an Environmental and Social Management Framework (ESMF) (incorporating a high-level social assessment) was prepared. Component 2 did not involve investments in new infrastructure. A Resettlement Policy Framework (RPF) was included in the ESMF to establish the principles to be included in master plans. The project funded a safeguard adviser to assist in the implementation and monitoring of the EMP and ESMF. The project together with the EMP, ESMF, and RPF was discussed in public consultations, and the documents were disclosed before appraisal. Overall compliance with applicable safeguard policies is considered Satisfactory.

57. **Financial management.** Financial reporting in the FSM is centralized in the CIU of DOFA. A financial officer (stationed in the CIU) was funded by the project to maintain project accounts. Regular FM reviews were conducted by the World Bank to ensure that the FM arrangements for the IDA grant were adequate for the successful achievement of PDOs. FM was rated ‘Satisfactory’ throughout project implementation.

58. **Procurement.** The principal risks identified by the procurement capacity assessment were (a) lack of procurement and technical capacity; (b) low participation by bidders and lack of local market capacity; and (c) delay in implementation due to procurement complexity and lack of proper cost estimate, planning, and contract supervision. Several mitigating measures were proposed, including (a) setup of a project implementation team in NDRD’s Energy Division to oversee project implementation; (b) hiring of a qualified procurement adviser and technical consultants to assist with the preparation of technical specifications, bidding documents, bid evaluation, and contract supervision; (c) development of a contract packaging strategy to attract participation from international bidders; and (d) use of a design, supply, and installation approach to address the lack of local installation capacity and logistical constraints. Nevertheless, the PIU faced serious procurement capacity constraints throughout the project, which led to delays in the hiring of advisers (and the full-time project manager was never hired) and subsequently delayed the implementation of the various works, goods, and services financed by the project. A full-time
project manager in-country and the engagement of the CIU procurement specialist on arrival in-country may have minimized some of these delays.

C. BANK PERFORMANCE

Quality at Entry

59. The project was the World Bank’s first energy intervention and first intervention in the FSM, and it was fully consistent with national priorities. The objectives were realistic, and the design was relatively simple despite the complex institutional context. As an IDA financed project, it was necessary to spread the investments in an equitable way between the four FSM utilities. The technical design of the project was sound, and there were clear and immediate investments to be urgently addressed by the project. A detailed economic and financial analysis was prepared to justify the proposed investment. Strong buy-in was achieved from the FSM Government and the four utilities. Generally, adequate procurement, financing, budgeting, and FM mechanisms were put in place. Particular attention was given to the procurement arrangements given the weak capacity of the counterparts. Key risks were correctly assessed in the PAD, which was of high quality, and suitable mitigation measures were identified in key areas.

Quality of Supervision

60. The project launch was slow, in part due to the time taken to add additional personnel into the PIU to help with the arrangements. However, the project progressed substantially by the time of the midterm review (MTR) (June 2017). All the key objectives were overachieved or achieved, and the project almost fully disbursed. A remaining amount of $550,000 will be used by the FSM Government for another project in its World Bank portfolio. The recipient has pointed out some deficiencies in the World Bank performance during implementation, as noted in its ICR (attached as Annex 5). These related mainly to the World Bank handling of the procurement of some goods and consulting services. World Bank relations with the recipient and the utilities were otherwise positive and cooperative, and a new and larger IDA project (SEDAP) is now under implementation in the FSM. Overall, it can be concluded that the World Bank proactively identified and resolved threats to the achievement of relevant development outcomes and was diligent in preparing relevant progress reports and conducting supervision missions.

Justification of Overall Rating of Bank Performance

61. The overall rating is considered ‘Satisfactory’ despite minor shortcomings in quality of supervision.

D. RISK TO DEVELOPMENT OUTCOME

62. The unwillingness to impose cost-reflective tariffs may hurt operational performance and efficiency in the near to medium term, particularly at PUC. However, raising tariffs also poses a dilemma. A substantial tariff increases for KUA had to be scaled back because of the specter of falling demand hurting utility revenue. In the case of YSPSC, the Government pays roughly twice the tariff of other customer classes to keep the utility afloat, and YSPSC is also experiencing falling demand. The electric utility tariffs are already very expensive and marginally affordable to households in this low- and middle-
income country (with overall GDP of $3,188 per capita for 2017), and an economic downturn could jeopardize the fragile progress already made toward stabilizing the financial condition of the utilities.

63. High-speed containerized mobile diesel gensets are not designed for long-term prime power needs and will need to be replaced relatively quickly. The follow-on SEDAP will provide 7.5 MW of medium-speed diesel generation for PUC that will ensure reliable long-term operation provided the diesel gensets are operated properly.

64. There continues to be a substantial risk to long-term development outcomes in terms of the ability of all the utilities to provide universal, affordable, reliable, and cleanly generated electric power to serve the FSM population. The follow-on SEDAP will contribute to the sustainability path of the utilities by providing scaled-up support ($30 million IDA), and other substantial donor programs are also under way and planned. On a positive note, the ongoing revolution in cost reduction of solar PV and battery storage should greatly benefit the FSM and its utilities in the future.

V. LESSONS AND RECOMMENDATIONS

65. A targeted holistic package of support can be very beneficial in small island contexts. The Project Concept Note identified a number of issues in the power sector in the FSM (which seem to be common to small and low-income island states) including high cost of import fuels, high losses, inefficiency, lack of maintenance, and significant lack of technical and management capacity. The project set out to provide support for purchase of critical equipment linked to improving efficiency of electricity supply, capacity support for key institutions, and support with Energy Master Plans.

66. A CIU shows promise in consolidating scarce government capacity for handling cross-cutting functions such as procurement, FM, and safeguards for the implementation of World Bank-financed projects. A CIU was set up during project implementation and has worked effectively to assist with a variety of administrative procedures including FM and procurement. This can avoid duplication of such arrangements within several separate PIUs and can build permanent expertise and capacity after individual PIUs have disbanded. The centralized approach also enables in-country expertise that increases the knowledge of country systems and contexts and provides a standardized approach to many aspects of implementation. By maintaining its role as a support unit, it does not usurp the authority of line departments to implement sector projects.

67. A fully resourced PIU and clarity of roles, responsibilities, and accountabilities between the CIU, PIU/implementing agencies, the state governments, and the utilities are required. These lessons have been considered for the new project. Sufficient resources need to be available at the Energy Division of the NDRD to assist with project implementation and coordination; otherwise, there will be delays. Memorandums of Understanding have been introduced under the new project that provide clarity on roles, responsibilities, accountabilities, and relevant human resource needs. Owner’s engineers are also being funded and engaged at the state level to ensure real-time technical support to the utilities.

68. DSM and EE can become elements of an effective energy sustainability strategy. The Energy Master Plans did marginally address these issues. Given relatively high tariffs, demand-side EE and DSM can be a very cost-effective approach to improve reliability and efficiency.
69. **Lessons and recommendations were also identified in the recipient’s ICR (Annex 5).** In particular, lessons and recommendations were provided related to instituting of proper maintenance procedures, the com mingling of investment components with different timescales for implementation, the continuity of project implementation structures, and capacity building for local engineers and technicians.
## ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

### A. RESULTS INDICATORS

#### A.1 PDO Indicators

**Objective/Outcome:** Increase the available generation capacity and efficiency of electricity supply in utilities

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation Capacity of Conventional Generation constructed under the project</td>
<td>Megawatt</td>
<td>0.00</td>
<td>4.70</td>
<td>6.20</td>
<td>30-Sep-2019</td>
</tr>
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<td></td>
<td></td>
<td>14-Apr-2014</td>
<td>31-May-2018</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments (achievements against targets):**
The indicator is over achieved. See additional information in Table 2 and 3.
### Renewable Energy (other than hydropower) constructed

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation Capacity of Renewable Energy constructed-Solar</td>
<td>Megawatt</td>
<td>0.00</td>
<td>0.20</td>
<td>0.40</td>
<td></td>
</tr>
</tbody>
</table>

**Comments (achievements against targets):**
The indicator is over achieved. See additional information in Table 2 and 3.
<table>
<thead>
<tr>
<th>Direct project beneficiaries</th>
<th>Number</th>
<th>0.00</th>
<th>50000.00</th>
<th>62632.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>14-Apr-2014</td>
<td>31-May-2018</td>
<td>30-Sep-2019</td>
</tr>
<tr>
<td>Female beneficiaries</td>
<td>Percentage</td>
<td>0.00</td>
<td>50.00</td>
<td>50.00</td>
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<tr>
<td></td>
<td></td>
<td>26-Apr-2018</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments (achievements against targets):
The indicator is over achieved. See additional information in Table 2 and 3.

**Objective/Outcome:** Strengthen planning and technical capacities of national government and utilities

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainability reform program agreed with each state power utility - implementation progress</td>
<td>Percentage</td>
<td>0.00</td>
<td>100.00</td>
<td>100.00</td>
<td>30-Sep-2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14-Apr-2014</td>
<td>31-May-2018</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments (achievements against targets):
The indicator is fully achieved. See additional information in Table 2 and 3.
A.2 Intermediate Results Indicators

Component: Increasing available generation capacity and efficiency of electricity supply in the state power utilities

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioning of conventional energy generation equipment</td>
<td>Percentage</td>
<td>0.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14-Apr-2014</td>
<td></td>
<td>31-May-2018</td>
<td>30-Sep-2019</td>
</tr>
</tbody>
</table>

Comments (achievements against targets):
The indicator is fully achieved. The generation capacity at completion reached 132% the size of the original target. See additional information in Table 2 and 3.

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioning of solar generation equipment</td>
<td>Percentage</td>
<td>0.00</td>
<td>100.00</td>
<td></td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14-Apr-2014</td>
<td></td>
<td>31-May-2018</td>
<td>30-Sep-2019</td>
</tr>
</tbody>
</table>

Comments (achievements against targets):
The indicator is fully achieved. The generation capacity at completion reached 200% the size of the original target. See additional information in Table 2 and 3.
<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioning of efficient streetlights</td>
<td>Percentage</td>
<td>0.00</td>
<td>100.00</td>
<td></td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30-Sep-2019</td>
</tr>
<tr>
<td>Comments (achievements against targets):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The indicator is fully achieved. The number of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>efficient streetlights at completion reached 742%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of the original target. See additional information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in Table 2 and 3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Component: National and state energy planning**

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy sector master plans completed and accepted</td>
<td>Yes/No</td>
<td>N</td>
<td>Y</td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14-Apr-2014</td>
<td>31-May-2018</td>
<td></td>
<td>30-Sep-2019</td>
</tr>
</tbody>
</table>

**Comments (achievements against targets):**

The indicator is fully achieved. See additional information in Table 2 and 3.
<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy sector information system in place - implementation progress</td>
<td>Percentage</td>
<td>0.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14-Apr-2014</td>
<td>31-May-2018</td>
<td></td>
<td>30-Sep-2019</td>
</tr>
</tbody>
</table>

**Comments (achievements against targets):**
The indicator is fully achieved. See additional information in Table 2 and 3.

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved planning capacity of the state power utilities and national government</td>
<td>Yes/No</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14-Apr-2014</td>
<td>31-May-2018</td>
<td></td>
<td>30-Sep-2019</td>
</tr>
</tbody>
</table>

**Comments (achievements against targets):**
The indicator is fully achieved. See additional information in Table 2 and 3.

**Component: Technical assistance and project management**

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
</table>
### Improved technical capacity in the state utilities for operations and maintenance

<table>
<thead>
<tr>
<th>Indicator Name</th>
<th>Unit of Measure</th>
<th>Baseline</th>
<th>Original Target</th>
<th>Formally Revised Target</th>
<th>Actual Achieved at Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation specialists in place</td>
<td>Yes/No</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>30-Sep-2019</td>
</tr>
</tbody>
</table>

#### Comments (achievements against targets):
The indicator is fully achieved. See additional information in Table 2 and 3.
### 1. Generation capacity of conventional generation constructed under the project - resulting in increased reserve margin of generation

- **Target:** 4.7 MW
- **Actual:** 6.2 MW

### 2. Generation capacity of renewable energy (solar PV) constructed under the project - resulting in increased reserve margin of generation

- **Target:** 0.2 MW
- **Actual:** 0.4 MW

### 3. Projected lifetime fuel savings (MJ)

- **Target:** 124 million
- **Expected Actual:** 915 million

### 4. Direct project beneficiaries and % of whom are female

- **Target:** 50,000 and 50% female
- **Actual:** 62,632 and 50% female

### 1. Commissioning of conventional energy generation equipment

- **Target:** 100%
- **Actual:** 100%

### 2. Commissioning of solar generation equipment

- **Target:** 100%
- **Actual:** 100%

### 3. Commissioning of efficient streetlights

- **Target:** 368
- **Actual:** 2,733

### 1. Acquisition and installation of new gensets for PUC, KUA, and YSPSC

### 2. Acquisition and installation of other equipment such as capacitor banks, digital fuel meters, and prepaid meters for YSPSC

### 3. Acquisition and installation of grid-connected PV generators and upgrading of the public street lighting for CPUC

### 4. Program to improve technical performance of the utilities, including capacity building and O&M plans
## Objective/Outcome 2: Strengthen the planning and technical capacities of the National Government and the state power utilities in the energy sector

| Outcome Indicators | 1. Sustainability reform program agreed with each utility  
(Target: 100%. Actual: 100%) |
|-------------------|-----------------------------|
| **Intermediate Results Indicators** | 1. Energy sector master plans completed and accepted  
(Target: Yes. Actual: Yes)  
2. Energy sector information system in place  
(Target: 100%. Actual 100%)  
3. Improved planning capacity of the state power utilities and National Government  
(Target: Yes. Actual: Yes) |
| **Key Outputs by Component** (linked to the achievement of the Objective/Outcome 2) | 1. Preparation of Energy Master Plans for each of the FSM states  
2. Development of a national energy sector master plan which will build on the state energy plans  
3. Carrying out activities to build capacity of the Energy Division and the AMU for sector data collection, utility benchmarking, and policy dialogue including utilities reform |
## A. TASK TEAM MEMBERS

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preparation</strong></td>
<td></td>
</tr>
<tr>
<td>Roberto Gabriel Aiello</td>
<td>Task Team Leader</td>
</tr>
<tr>
<td>Jinan Shi</td>
<td>Procurement Specialist</td>
</tr>
<tr>
<td>Stephen Paul Hartung</td>
<td>Financial Management Specialist</td>
</tr>
<tr>
<td>Beverley Ann McLean</td>
<td>Social Specialist</td>
</tr>
<tr>
<td>Penelope Ruth Ferguson</td>
<td>Social Specialist</td>
</tr>
<tr>
<td>Natsuko Toba</td>
<td>Senior Economist</td>
</tr>
<tr>
<td><strong>Supervision/ICR</strong></td>
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</tr>
<tr>
<td>Leopold Sedogo, Takayuki Doi</td>
<td>Task Team Leader(s)</td>
</tr>
<tr>
<td>Dominic Reyes Aumentado, Zhentu Liu</td>
<td>Procurement Specialist(s)</td>
</tr>
<tr>
<td>Maria Liennefer Rey Penaroyo</td>
<td>Financial Management Specialist</td>
</tr>
<tr>
<td>Kim Dagmar Baverstock</td>
<td>Team Member</td>
</tr>
<tr>
<td>Penelope Ruth Ferguson</td>
<td>Environmental Specialist</td>
</tr>
<tr>
<td>Ross James Butler</td>
<td>Social Specialist</td>
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<tr>
<td>Audrey Marie Crochemar</td>
<td>Team Member</td>
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<tr>
<td>Vilija Kostelnickiene</td>
<td>Senior Operations Officer</td>
</tr>
<tr>
<td>Alan David Lee</td>
<td>Energy Specialist</td>
</tr>
<tr>
<td>Maria Ayuso Olmedo</td>
<td>Team Member</td>
</tr>
<tr>
<td>Qingyuan Wang</td>
<td>Team Member</td>
</tr>
<tr>
<td>Paul Dolan</td>
<td>ICR Main Contributor</td>
</tr>
</tbody>
</table>
### B. STAFF TIME AND COST

<table>
<thead>
<tr>
<th>Stage of Project Cycle</th>
<th>Staff Time and Cost</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>No. of staff weeks</td>
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<tr>
<td><strong>Preparation</strong></td>
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<tr>
<td>FY14</td>
<td>29.637</td>
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<tr>
<td>FY15</td>
<td>1.350</td>
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<td><strong>Total</strong></td>
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<tr>
<td><strong>Supervision/ICR</strong></td>
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<tr>
<td>FY15</td>
<td>4.625</td>
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<td>FY16</td>
<td>7.644</td>
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<tr>
<td>FY17</td>
<td>15.144</td>
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<tr>
<td>FY18</td>
<td>14.793</td>
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<tr>
<td>FY19</td>
<td>9.121</td>
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<tr>
<td>FY20</td>
<td>7.994</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>59.32</td>
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### ANNEX 3. PROJECT COST BY COMPONENT

<table>
<thead>
<tr>
<th>Components</th>
<th>Amount at Approval ($, millions)</th>
<th>Actual at Project Closing ($, millions)</th>
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</thead>
<tbody>
<tr>
<td>Increasing available generation capacity and efficiency of electricity supply in the state power utilities</td>
<td>9.27</td>
<td>9.19</td>
</tr>
<tr>
<td>National and state energy planning</td>
<td>3.40</td>
<td>1.48</td>
</tr>
<tr>
<td>Technical assistance and project management</td>
<td>1.50</td>
<td>1.90</td>
</tr>
<tr>
<td>Contingency allowance</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14.40</strong></td>
<td><strong>12.57</strong>*</td>
</tr>
</tbody>
</table>

*The total number of $12.57 million is not identical to the number of $12.48 million in the datasheet (page 2) because the system had not captured the last disbursement of about $0.1 million when the ICR was prepared.*
ANNEX 4. EFFICIENCY ANALYSIS

ASSESSMENT AT APPRAISAL

Economic Analysis at Appraisal

1. An economic cost-benefit analysis was conducted for the four investment subcomponents of Component 1, representing 76 percent of the component’s cost and 49 percent of the total project cost. The proposed priority CAPEX investments for the FSM’s power system were projected to create significant economic benefits by making the system substantially more available and economic and by reducing fuel imports and the FSM’s vulnerability to volatile fuel price and supply risks. The benefits are by far the most evident in the case of PUC, where the new firm capacity provided by the project was essential in helping solve a power supply crisis on Pohnpei island resulting from the terminal failure of all four of the previously operational prime diesel gensets (three of them had failed by the time of project approval). The four states’ new power generation capacity and EE measures under the proposed project were calculated to provide an estimated EIRR of 25 percent and ENPV of $5.03 million (1.5 percent of the FSM’s GDP in 2012). A sensitivity analysis showed that the EIRR remained above the cutoff threshold of 12 percent and the ENPV remained positive in a variety of adverse modeled scenarios (adverse changes to investment CAPEX, fuel cost, VoLL, discount rate, and so on).

2. Distribution analyses of the ENPV showed that consumers were expected to be the largest beneficiaries due to avoided tariff increases and reduced tariff fluctuations because of the reduced fuel imports and improved available generation capacity. Protection from economic shocks through stabilized power tariffs was expected to improve the ability of households, including those headed by women, to redirect household budget to other basic household needs, such as food and bus fares for school children.

3. No least-cost plan or even a feasibility study regarding the proposed investments was available at the appraisal stage. It was akin to an emergency operation due to the dire situation at PUC subsequent to the terminal failure of three of its four prime diesel gensets. In addition, involvement of other donors was highly uncertain at the time. The ADB was discussing a complementary project but did not have a solid commitment at the time. The EU was in discussion about the rehabilitation of hydropower on Pohnpei Island. Nevertheless, a sophisticated economic analysis was conducted with the aid of a counterfactual, and the many data gaps were filled by best available means from comparable projects and other relevant literature. The small size and relative simplicity of the FSM utility systems provided confidence in the reasonableness of assumptions and the suitability of the proposed investments in the absence of sophisticated tailored studies.

Financial Analysis at Appraisal

4. A financial analysis was conducted on Component 1 to determine the financial viability and sustainability of the proposed investments. The proposed priority CAPEX investments were expected to have a significant positive impact on the financial position of each of the four utilities through the reduction of operating costs due to increased efficiency. Proposed CAPEX under Component 1 was projected to generate an FNPV of $5.16 million and an FIRR of 25.8 percent. Further details were provided in annex 7 of the PAD.
5. PUC suffered from a substantial energy crisis since 2011, when a series of unplanned genset failures of the existing medium-speed 2.5 MW Daihatsu generators—which had individually operated in the region for 100,000 hours—left the main island of Pohnpei with insufficient generating capacity, widespread outages, and rotational load shedding. By the end of 2014, three of the four Daihatsu generators were out of service, and during 2015, the remaining engine also experienced a major crankshaft failure that rendered it inoperable. In the absence of funding or spare parts inventory to refurbish the aging Daihatsu gensets (which were anyhow considered to be at the end of their design lives), there was a need for an urgent donor response to procure a new generation plant to respond to these failures. Three 2 MW (nameplate) high-speed containerized mobile Caterpillar diesel gensets were urgently purchased (single sourced) in 2014 with the aid of funding under the U.S. Compact and were installed in January 2015. These were second-hand at the time of purchase but were available for quick installation to help resolve the power crisis at that time (2 MW is the manufacturer maximum rating—the prime power rating is 1.65 MW).

6. This project financed the purchase of two additional 2 MW (nameplate) Caterpillar gensets of the same specification as the other three new gensets (as requested by PUC since they were still short of capacity). The gensets were procured during an emergency condition and were single sourced. The addition of the five Caterpillar gensets (three funded by the U.S. Compact in 2014 and two funded by the project) restored the nominal generating capacity that was previously provided by the Daihatsu gensets. The choice to use containerized mobile generators was the most expeditious way and likely the only practicable way to restore power to the island in the short term (absent donor or government funding to refurbish the existing Daihatsu diesel gensets, which were anyhow considered to have been at the end of their design lives), and the actions taken by PUC to get an effective outcome should be commended.

7. In addition to providing two new essential new diesel gensets, the project funded a major refurbishment of Genset No. 3 (one of the three Caterpillar gensets that were installed in 2014) that had suffered a catastrophic bottom end failure at approximately 14,000 hours of operation, likely caused by a lack of timely funding to purchase spare parts. This additional work was not planned at the appraisal stage, as the catastrophic damage had not yet occurred. This shows the benefit of the flexibility that was built into the design and implementation of this project. Also, 760 efficient LED lights were procured and installed in Pohnpei under the project (none were originally planned).

8. It is also noteworthy that the blackouts that were occurring during the emergency had a big impact on the utility, including deteriorated relations with some customers, billing disputes, and overall loss of confidence in the utility, and they were also a threat to the island’s economy. It is estimated that the PUC SAIDI was reduced from approximately 8,600 minutes per year to approximately 4,000 minutes per year resulting from implementing the measures indicated earlier.

9. The original economic and financial analyses for this project used a key assumption that the fuel efficiency of PUC’s power system would increase from 12.1 kWh/gal to 15 kWh/gal, corresponding to a 24 percent improvement. The updated information provided by PUC shows that the fuel efficiency was 11.48 kWh/gal in FY14 and improved to 14.45 kWh/gal in FY19 (ending September 2019), which
corresponded to a 25.8 percent improvement. On this basis, the fuel cost saving for FY19 was calculated as $1.43 million. This is very substantial when compared to the relevant direct project investment cost for PUC of $3.37 million (inclusive of $0.72 million for overhaul spare parts).

**Chuuk State - CPUC**

10. The original economic and financial analysis assumed an improvement of fuel efficiency by 7 percent (from 14.75 kWh/gal to 15.8 kWh/gal) due to the provision of fuel injection for existing diesel gensets. (PAD, annex 7, paragraph 21). This was expected to result in an annual fuel saving of $225,419 at a fuel price of $4.50 per gallon. However, fuel injection for CPUC was not installed as part of the project. The addition of 400 kW of solar PV (twice the originally planned addition of 200 kW) will have a positive impact on the efficiency of the power system. As the PV system has just been installed, operational data are not yet available, but a rough estimate can be made by extrapolating from the performance of the existing PV installations in Chuuk. Solar grid-connected systems are already operating at the Chuuk International Airport and Chuuk State High School that provided 1.8 percent of total power generation during FY18—this equates to an avoided cost of fuel of $70,922. If this result is used to conservatively project the performance of the 400 kW of new solar PV, the resultant fuel saving from the solar PV component of the project should be about $110,000 annually at the FY18 average fuel cost of $3.33 per gallon (400 kW of solar PV was added under the project, twice the projected level of 200 kW). Recent informal communication with staff at CPUC indicated that an annual saving of $150,000 can be expected from the solar PV facility based on preliminary operational results. Also, 668 efficient LED streetlights were procured and installed in Chuuk (including on Tonoas Island as well as Weno Island) under the project (300 more than originally planned). This is expected to result in savings of approximately $24,000 per year.

**Kosrae State - KUA**

11. The new 600 kW (nameplate) high-speed Caterpillar diesel genset for KUA has just been installed (September/October 2019) and no operational data are yet available. The original analysis projected that a new 1,200 KW diesel generator would have a fuel efficiency of 15.8 kW/gal compared to 14.85 kW/gal for the existing generators, and the estimated annual savings would be $224,272 at the then prevailing price of $4.50 per gallon (PAD, annex 7, paragraph 18). Following JICA’s demand forecast for Kosrae and discussions with KUA and the PIU in late 2017, it was agreed to purchase three 600 kW gensets: the first one to be procured through the project and the other two by JICA once the JICA grant is approved. Since the project installed a genset of only half the originally estimated size and the new high-speed genset is less efficient than originally expected, the projected level of fuel saving cannot be realized. Also, 70 efficient LED lights and 85 LED solar lights were procured and installed in Kosrae under the project (none were originally planned). This is expected to result in savings of approximately $7,500 per year.

**Yap State - YSPSC**

12. In the case of YSPSC, the original analysis relied on the key assumption that the fuel efficiency of the YSPSC power system was projected to increase from 13.9 kWh/gal to 16 kWh/gal as a new 1.5 MW genset would replace two smaller gensets installed in 1978 (to be retired). This was projected to result in an FNPV of $526,000 and FIRR of 19.91 percent. Based on a fuel price of $4.50/gal, the estimated annual savings were projected to be $128,000.
13. The new project genset is a high-speed 1.6 MW Caterpillar 3516, which has a lower fuel efficiency than was contemplated in the original economic analysis. At the same time that the project genset was installed, two additional gensets (combined 2,400 kW) and a 725 kW wind farm also became operational, and recently installed solar PV capacity also came on line. The aggregate effect of these developments was that the RE production on the Yap main grid increased from zero in FY15 to 20.2 percent of the total energy produced in FY19 (ending September 30, 2019). This contributed to a large drop in the overall fuel consumption, from 818,100 gallons in FY15 to 663,989 gallons in FY19, resulting in an overall fuel cost saving of $592,000 for FY19 or over four times the original projection. Third, 750 efficient LED lights were procured and installed in Yap under the project (none were originally planned).

14. Since YSPSC’s RE capacity additions were not financed by the project, the project attribution for the fuel savings is less obvious than for CPUC where the RE addition was financed and provided as part of the project. This does not negate the fact that the project has contributed to YSPSC’s positive efficiency trajectory by enabling the hybrid system operation. The solar and wind plants were occasionally curtailed due to system constraints, and high-speed diesel generation (with its excellent load ramping characteristics) is an effective solution to this problem. The follow-on SEDAP will directly build on this progress by providing an additional 830 kW of high-speed diesel capacity to complement a further increase in RE. It is indicated in the SEDAP PAD (in its annex 2) that the result of implementing this future diesel component will be measured by the volume of RE output, which mirrors the basic thesis presented in this subsection.

UPDATED ESTIMATES

15. As was the case with the analyses at appraisal, the updated results are substantially attributable to the value of the fuel savings achieved by the four utilities (over an assumed 10-year operating life) associated with the investment components of the project. However, the methodology used at completion uses updated operational data reflective of the utility systems as a whole and includes some savings not directly attributable to the project as these cannot be extracted from the data provided by the utilities. It is also argued in this ICR that this is an appropriate approach for these tiny systems that should be considered on a holistic basis. The estimated value of the improvement in reliability (SAIDI) is also significant for PUC, which was in the throes of a power supply crisis immediately before the implementation of the project. A realistic value for VoLL of $10 per kWh was used for the estimation. The updated ENPV is estimated at $5.94 million, with a corresponding estimated EIRR of 28.8 percent. The updated FNPV is estimated at $5.34 million, with a corresponding estimated FIRR of 27.5 percent.

16. It is important to look at the broader positive impact of this project that was well implemented under difficult circumstances and has paved the way for another larger IDA operation (SEDAP) that will definitively address the fuel efficiency and long-term reliability deficits at PUC.

17. An external study ‘Pohnpei Energy Assessment’ commissioned by the project in 2017 did not find fault with the decision to procure the containerized mobile high-speed gensets for PUC, and the project was in any event constrained by a previous PUC decision in 2014 to purchase three of the same gensets under the U.S. Compact.
FEDERATED STATES OF MICRONESIA (FSM)

P148560: Energy Sector Development Project
(Grant No. H9570-FM)

RECIPIENT’s IMPLEMENTATION COMPLETION REPORT
1. INTRODUCTION

1. On 29 May 2014 the World Bank (WB) approved the Energy Sector Development Project (ESDP). The ESDP was financed through a grant from the International Development Association (IDA) of SDR 9.4 million (US$ 14.4 million equivalent at the time). The Project became effective on 15 October 2014 and the original closing date was July 31, 2018. The ESDP aimed to increase the available generation capacity and efficiency of electricity supply in the state power utilities, and to strengthen the planning and technical capacities of the National Government and the state power utilities in the energy sector.

2. A mid-term review (MTR) of the ESDP project took place June 8-9, 2017 in Yap, which inter alia suggested a project extension. Following a request from the Government of the Federated States of Micronesia on November 22, 2017 for an extension of the project, the World Bank granted, at the end of July 2018, a formal extension of the project up to end of September 2019.

3. The ESDP Financing Agreement stipulates that the Recipient shall prepare Project Reports in accordance with the provisions of Section 4.08 of the General Conditions and as set forth in the Project Implementation Manual (PIM). The PIM stipulates that an Implementation Completion Report shall be furnished to the World Bank not later than six months after the Closing Date and that the Implementing Agency is responsible for preparing this report.

4. The Implementation Completion and Results Report Guidelines by the WB’s OPCS Department from August 2006, last updated on: 10/05/2011, spell out (under 1.2) that the borrower is responsible for preparing and submitting to the Bank its own completion report and also what the completion report/summary should include. This Report has been elaborated to respond to those requirements14.

2. ASSESSMENT OF THE PROJECT

2.1 Objective

5. The Development Objective (PDO) was to increase the available generation capacity and efficiency of electricity supply in the state power utilities, and to strengthen the planning and technical capacities of the National Government and the state power utilities in the energy sector. The PDO Results Indicators were (i) Generation capacity of conventional generation constructed under the project (megawatts [MWs]); (ii) Generation capacity of renewable energy constructed under the project (MW); (iii) Projected lifetime fuel savings (megajoules [MJ]); (iv) Direct project beneficiaries (number of beneficiaries); and (v) Sustainability reform program agreed with each state power utility.

6. The objectives of the project were well aligned with GoFSM’s objectives at the time of original appraisal. The Strategic Development Plan (SDP) for FSM, which provided a roadmap for the country’s social and economic development over 20 years (2004–2023) had energy as an integral component. The National Energy Policy (NEP), which was adopted in 2012, was developed based on four primary components: Policy and Planning, Conventional Energy (fossil fuel), Energy Efficiency and Conservation,

and Renewable Energy. NEP aims to secure a safe, reliable and affordable supply of conventional energy, to increase the share of renewable energy with the aim of reaching 30 percent of energy supply by 2020.

7. In the context of the current objectives, the Energy Master Plan (MP) financed under this project, was adopted by the Government in April 2018. The MP sets out a technically feasible, financeable, and implementable pathway for each state to provide a reliable and environmentally sustainable electricity service to all residents. The plan’s target is providing electricity access to more than 80 percent of FSM households by 2020 and to almost every household by 2023. The plan seeks to achieve the FSM’s objectives to deploy RE, decrease diesel consumption, and reduce greenhouse gas (GHG) emissions.

8. The Direct Project Beneficiaries included electricity consumers (residential, commercial, industrial and government) in FSM who would benefit from an improved and more efficient and reliable electricity supply, and eventually from more affordable and sustainable tariffs. Direct project beneficiaries were estimated at 50,000 (50% of whom were female). Women and children would particularly benefit from improved electricity services because electricity is critical for completing basic education and health activities, the efficient handling of household tasks, and small-scale income-generating activities that help families. Policy and decision makers, as well as planners and managers of the utilities in the four states and the National Government, would also benefit from strengthened energy planning capacity at the state and national levels, and from recommended actions for the development and long-term sustainability of the country’s electricity sector.

2.2 Project Design

9. Project Preparation. This project was prepared over a relatively short time frame, the main reason for this shorter than usual preparation time frame was a “preparation standstill period” for projects in other Sectors, which opened up for the first World Bank energy project in FSM.

10. The design of a new project in a new country relies on strong technical expertise that can ensure timely integration of Country and World Bank requirements to secure timely implementation. The design of this project had: (i) a limited and modest set of objectives; (ii) a lean program, with only three core development components closely tied to existing policy commitments; and (iii) a readiness to adjust implementation arrangements. Through this design choice, the development outcome of component 1 and 2 were achieved and even exceeded.

11. The original PAD mentioned that project design had benefitted from the Bank’s experience in designing and implementing projects in other PICs. The key lessons learned mentioned in the original PAD were:

- **Government and state ownership.** The Project Steering Committee arrangement did secure a strong commitment and ownership of the proposed operation by the National Government and the four state governments through the Energy Working Groups and the state utilities.

- **Targeted and flexible assistance.** Project components were designed to address the critical need to improve the performance of power utilities in the short term and to diversify their energy matrix in the long term in order to reduce reliance on expensive petroleum products.
The project did allow for targeted and flexible investments to timely address the most critical needs of the utilities. The project also responded to the need to identify, plan, and prepare sound energy sector investments for public sector and potential private sector participation in the sector.

- **Strengthening relationship with the client.** The project did indeed pave the way for larger collaboration with the World Bank for further support to the country’s energy sector.

- **Align project design with implementation capacity.** The experience of the implementation of the project’s component 1 and 2 has highlighted the importance of establishing an experienced, knowledgeable team to assist with project implementation and the need for adequate training to counterpart staff from the project onset. As the ESDP Project was the first-ever World Bank-financed project in FSM, the World Bank procurement procedures and rules were new to FSM. Component 1 was initially delayed, which is partially attributed to lack of this procurement knowledge. There were some important delays in setting up an adequate FSM team responsible for the implementation of component 1 especially.

- **Specific measures should be taken to address and mitigate slow implementation.** The design of the project has allowed for attention to implementation arrangements although there has not always been universal agreement on the arrangements.

12. Overall the project was well prepared, given the limited time for preparation and the complexity of its undertakings in a new project for a new country. Preparation of component 1 was comprehensive and solid, which ultimately was proven by the timely implementation of this component. Component 2 was also timely implemented.

13. **Risks.** The overall project risk was rated as Substantial at appraisal. Several risk factors were assessed, and mitigation measures were considered. Here are the main ones:

   (a) **FSM’s limited technical capacity in the energy sector/Weak project implementation capacity, including safeguards, procurement, financial management and supervision.** The following mitigation measures were proposed:

      (i) Under Component 3, the project would finance a project implementation support officer, a technical specialist, a financial officer (working on FM issues with DoFA), a procurement advisor and a safeguard advisor for timely and efficient project implementation, monitoring and supervision, in particular to comply with Bank requirements.

      (ii) Capacity building and training would be provided in Bank procurement and FM.

      (iii) The Bank would provide close supervision of the implementation of environmental and social safeguards.

      (iv) A simple project design with a limited number of contracts would facilitate its implementation.
(b) **FSM’s lack of experience in implementing World Bank projects/Lack of technical capacity at the national and state levels to implement the project and maintain the assets created.**

The following mitigation measures were proposed: A technical specialist would be hired under the project to support the National Government and the four states in ensuring quality and timely delivery of studies and investments. In addition, under Component 1, technical and capacity building support would be provided to the state utilities to strengthen their capacity for the management and maintenance of utility equipment.

The risk for capacity (a and b) was assessed as High. This original design of the project was not completely implemented, as the technical team was only in place a couple of years after project initiation. Thus, basically the risk materialised, however, the technical team managed to speed up the implementation to avoid any cost increases under the originally planned budget. Then the Bank inexplicably curtailed the Team 9 months before the end of the project. This likely caused both cost increases and loss of opportunities. Perhaps the Bank had expected that the Consultants that were being hired under the new World Bank financed SEDAP project would assist the ESDP project, although this was not included in their ToRs.

(c) **The need to coordinate among the National Government plus the four state utilities/Lack of commitment to the project objectives by the National Government or the states, and lack of leadership by the project implementation agency (the Energy Division of the Department of Resources and Development).** This risk was assessed as Modest, and a number of mitigation measures were proposed, including: Implementation arrangements to include close coordination and consultations among all relevant parties through the AMU, the states’ energy sector working groups, and the project steering committee. The Bank would conduct regular reviews of the implementing entities’ procurement and financial management practices. All contract award information would be published on the FSM government website. FM and procurement specialists would provide training in Bank procedures. The Bank would provide intensive implementation support, especially during the initial stages of project implementation, and would initiate appropriate action in the event of any irregularities. Although the promised Bank training and implementation support in the end was rather limited, this risk did not materialize as project stakeholders including National Government, states and power utilities, etc were strongly supportive of the project.

### 2.3 Implementation

14. **The implementation** of the project faced challenges during the project’s initial lifetime. At the onset of project implementation, the responsible project management unit (PIU) for the project situated at the NDRD was set up with a significant delay, due to a slower than expected hiring process by the NDRD. This initial delay of the PIU establishment consequently had an impact on the implementation schedules of all other activities supported by the IDA grant in components 1-3. However, after the PIU was adequately staffed the project picked up pace and in the main caught up with the original time schedule.

15. The implementation of Component 2, the Energy Master Plan Component also experienced delays, initially caused by the late set up of the NDRD PIU, but then due to slower than anticipated
procurement execution, and the drawn out process of discussing several draft Reports and presentations with the widely spread stakeholders. Nevertheless, component 2 was substantially completed by March 2018 and the Energy Master Plan was presented at an FSM Energy Sector Partners’ Conference on Finance and Investment on 19 April 2018 in Honolulu, Hawaii. In retrospect and comparing with International experiences this is a remarkably quick process for elaborating a National Energy Master Plan.

16. The significant project savings realized under component 2 were discussed during the Project Mid Term Review in 2017 and resulted in the introduction of a number of new activities.

17. Monitoring and Evaluation (M&E). The M&E design was appropriate for the project. This includes relevant outcome and measurable intermediate indicators with baseline targets. Quality data was collected by NDRD and the Utilities throughout project implementation.


19. Fiduciary Financial management and procurement aspects of the project have continuously been reviewed by the World Bank specialists. Overall, the objective of the financial management reviews has been to ensure that the FM arrangements for the IDA Grant were adequate for the successful achievement of project development objectives. The reviews covered: (1) review of the project’s financial management system through (a) discussions with Central Implementation Unit (CIU), (b) inspection of selected expenditures from WAs for eligibility, adequacy of supporting documents and compliance with policies and procedures; (2) review of financial reports and books of account; (3) review of compliance with the financial covenants under the Financing Agreement and; (4) follow up on FM issues raised in the previous review. Issues arising from the latest reviews include: (i) delays in the completion of Withdrawal Applications (WAs), and (ii) the balance on encumbrances for travel advances.

2.4 Operational Experience

20. The infrastructure financed by component 1 has in the main been well operated and maintained. The new diesel generators in Pohnpei went through a few technical issues after the commissioning in July 2016. This raised concerns about whether these particular new engines were compatible with the FSM environment and operation patterns. An assessment of the Pohnpei Energy sector was conducted under the project to identify the main issues that were impeding the sector development, PUC’s thermal power plant and operational performances. The study made several recommendations, but did not find any particular problems with the PUC new gensets.

21. The elaboration of Energy Master Plans under Component 2 also included three Feasibility Studies and Tender Documents. These studies assessed the feasibility of integrating additional solar PV capacity (i) into Pohnpei’s main grid, recommending an additional 18.3MW of solar PV capacity and (ii) into Weno’s main grid, recommending an additional 12MW of solar PV capacity. A third study assessed the feasibility of installing a mini-grid on Udot, recommending that Udot consumers be provided with electricity access via a combination of a mini-grid and stand-alone solar systems. A 3 MW solar PV Plant is already under way in Pohnpei under a private PPA. The next World Bank energy project in FSM “SEDAP” includes a solar PV Plant on Weno and a hybrid grid on Udot.
22. The project’s component 2 and 3 significantly strengthened institutional capacity in the state utilities and in government agencies through multiple technical assistances, which had all been duly implemented by project closing.

23. The success of the project, and component 2, the Energy Master Plan led to further investments by the World Bank and other Donors (e.g. ADB) into the FSM energy sector.

3. ASSESSMENT OF THE OUTCOME

3.1 Original Components

Component 1: Increasing available generation capacity and efficiency of electricity supply in the state power utilities (IDA US$9.27 million).

(a) Carrying out a program of activities designed to increase available generation capacity and efficiency of electricity supply in the State Power Utilities, such program to include:

(i) Acquisition and installation of new gensets for the Pohnpei Utilities Corporation, Kosrae Utility Authority and Yap State Public Service Corporation;

(ii) Acquisition and installation of equipment such as capacitor banks, temperature compensated digital fuel meters and prepaid meters for the Yap State Public Service Corporation.

(iii) (A) Acquisition and installation of grid connected photovoltaic generators; and (B) upgrading of the public street lighting system to a more efficient system, all for the Chuuk Public Utility Corporation.

(b) Carrying out of a program of activities designed to improve the technical performance of the State Power Utilities, such program to include capacity building activities, and the development and implementation of operations and maintenance plans

Component 2: National and state energy planning (IDA US$3.40 million).

(a) Preparation of energy master plans for each of the FSM States, including: (i) identifying and prioritizing infrastructure investments in the energy sector; and (ii) undertaking feasibility studies, and environmental and social impact assessments for the priority investments.

(b) Development of a national energy sector master plan which will build upon the energy master plans developed under Component 2(a).

Component 3: Technical assistance and project management (IDA US$1.50 million).

(a) Carrying out a program of activities designed to build the capacity of the Energy Division and the Association of Micronesian Utilities (AMU) for: (i) (1) sector data collection, statistics, and the development of an information management system, (2) utility benchmarking and
(3) implementing the national energy policy; and (ii) broadening dialogue on matters affecting the energy sector, including developing a utilities reform program to improve sustainability of their operations.

(b) Carrying out a program of activities designed to enhance the capacity of the Energy Division for overall Project coordination, management and monitoring.

3.2 Modified Components

24. The original project components were not “revised”. However, some activities (in component 1 especially) were modified, without change in objectives, taking into account revised priorities and other Donor financed projects. In addition, important cost savings under component 2 allowed some added activities. The modifications included:

25. **Acquisition and installation of capacitor banks and prepaid meters for YSPSC were not proceeded with.** Instead, YSPSC identified the urgent need to rehabilitate the Yap substation, which was a critical power facility for YSPSC. Incidents emanating from this part of the electrical infrastructure had serious consequences for power reliability and quality and impacted the whole island of Yap i.e. 2,000 customers and among them, the Yap hospital, the international airport, the government buildings and all business and residential customers. The Yap Substation was in urgent need of rehabilitation. The step-up transformer, manufactured in 1989, was in poor condition and the existing switchgear had experienced numerous operational issues and the protection system had numerous selectivity issues. The World Bank agreed to the rehabilitation, which involved three major components

(a) Replace an old step-up 5 MW transformer with a new 5MW transformer. Estimated costs $100,000

(b) Install new containerized switchgear of 8 HV circuit breakers. The choice of container installation was made based on previous unsatisfactory experience with contractor installation in situ. Estimated costs $500,000

(c) Finally, after the above, install new underground MV cables to connect them. Estimated costs $60,000

26. In 2016, an agreement was reached with the World Bank to add two activities for KUA, Kosrae:

- New 500 kVA Pad Mounted Distribution Transformer. Estimated costs $60,000
- Efficient street lighting in Kosrae. Estimated costs $250,000.

27. During the Mid Term Review in June 2017, an agreement was reached on how to use the USD 1.12 million in the PAD for Assistance O&M.

- Bucket trucks for Pohnpei. Estimated cost $175,000\(^\text{15}\)

\(^{15}\) It was later agreed to include a bucket truck for KUA, Kosrae, as well (estimated cost $175,000).
28. During the World Bank Mission to Micronesia and Guam October 16-20, 2017, a number of new activities were discussed. It was agreed that the project would submit a justification to the World Bank for a No Objection. In November 2017 the ESDP Project formally submitted a detailed “justification” and the ESDP Project subsequently received a No Objection from the World Bank for the following ‘new’ activities:

**Chuuk**

- Efficient LED Street lighting Tonoas, Estimated costs $150,000
- Cash power meters Tonoas, Estimated costs $90,000
- Govt buildings’ Efficient Lighting, Estimated costs $150,000
- PV Plant system, add. 100 kWp, Estimated costs $330,

**Pohnpei**

- Top end maintenance of Cat 4-5, Estimated costs $300,000
- SCADA/ thermal coupling, Estimated costs $150,000
- Distribution transformers, Estimated costs $100,000
- Efficient LED Street lighting, Estimated costs $250,000

**Kosrae**

- Efficient LED Street lighting, Estimated costs $50,000
- Distribution transformers, Estimated costs $75,000
- Cash power meters, Estimated costs $25,000
- SCADA, Estimated costs $100,000

**Yap**

- Efficient LED Street lighting, Estimated costs $260,000

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16 It was later agreed that the EE projects would not be eligible as they were not covered by the ESDP PDO.
17 This procurement was delayed for various reasons until the middle of 2019 and the estimated cost was revised to $630,000.
18 It was subsequently agreed with the World Bank to move the PUC SCADA component to the new SEDAP.
19 It was subsequently agreed with the World Bank to move the PUC SCADA component to the new SEDAP.
• Reclosers, Estimated costs $105,000

29. The Pohnpei Energy Assessment was an assessment of Pohnpei Energy sector conducted to identify the main issues that were impeding the sector development, PUC’s thermal power plant and operational performances. The study recommended a number of initiatives and it was agreed to finance under the ESDP Project:

• Rehabilitation of the PUC genset #3. Estimated cost $414,000
• PUC: Protection/control review. Estimated cost 50,000

30. After discussions with the World Bank, it was decided to finance a follow up activity to the FSM Energy Sector Partners’ Conference on Finance and Investment/FSM Energy Master Plan presentation in Hawaii in April 2018:

• Preparation of funding strategy and identification of preparatory work to implement the FSM National and State Energy Master Plans. Estimated cost $131,394.

31. Although there was an agreement with the World Bank for procurement of spares for the gensets in Kosrae and Yap and ITQ’s had been issued and bids received, the evaluation highlighted a number of problems which made delivery before the end of September, i.e. by the Project End unfeasible. These procurements were:

• Yap, Top End Spare Parts for 1.6 MW Caterpillar diesel generator. Est cost $350,000
• Kosrae, Spare Parts for Caterpillar Genset C-27. Estimated cost $220,000

32. The World Bank and the FSM agreed to utilise the work done and experiences gained under the 400 kW Solar PV Project in Chuuk, inter alia from the Solar Basic Unit (SBU) and the multi functionality concept developed under ESDP, in comparing the general design concepts developed by Castalia and Entura for the Outer Islands and determine which design would be best suited to the Udot specifics. Thus, it was decided to include a procurement for:

• Review of Feasibility Study and Design Work for Udot. Estimated cost $65,000

3.3 Achievement of Project Development Objectives

33. The Development Objective (PDO) is to increase the available generation capacity and efficiency of electricity supply in the state power utilities, and to strengthen the planning and technical capacities of the National Government and the state power utilities in the energy sector. Thus, the PDO is threefold (i) to increase the available generation capacity and (ii) efficiency of electricity supply in the state power utilities, and (iii) to strengthen the planning and technical capacities of the National Government and the state power utilities in the energy sector.

34. The first (i) part of the PDO has been [over] achieved; the generation capacity constructed under the project has reached 132% of the original target.
35. The second (ii) part of the PDO has also been over achieved; 400 kW (twice the original target) of solar generation equipment has been commissioned and efficient street lighting has been steadily promoted. A total of 2,733 efficient street lights\(^{21}\) were procured under the project and is being continuously installed by the utilities. The original target was only 368 lights so instead of 100%, the project has achieved an impressive $2733/368= 742\%$.

36. The third (iii) part of the PDO is mainly supported by the implementation of the Master Plan, which was completed by March 2018. The Master Plan was presented at a Donors’ Conference, “FSM Energy Sector Partners’ Conference on Finance and Investment on 19 April 2018” at the Hilton Waikiki Beach Hotel in Honolulu, Hawaii. Following the Conference various updates of the Master Plans have become necessary and the current version is dated June 2018.

<table>
<thead>
<tr>
<th>Box 1: Example of improved enabling environment for private sector involvement in the FSM Energy Sector; Development of Private Solar PV to Produce Least-cost Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>The successful structuring and implementation of the ESDP project helped to create an enabling environment to promote private sector ownership and management of generation in the solar PV sector. The FSM National Government started encouraging foreign commercial fishing operators to commit foreign-direct investments in industries in FSM, beyond industries immediately related to the fishing industry itself (e.g. fish processing facilities). As a result of these efforts, FSM received a proposed PPA for 3 MW PV and 1 MW of storage to be installed in Pohnpei, which was accepted by PUC. By being able to make use of this solar power plant for power generation purposes, PUC will significantly reduce the operational costs of its thermal power generation.</td>
</tr>
</tbody>
</table>

37. **Efficiency.** While the power cuts that occurred during the various generation shortage crises had an impact on the country’s economic growth, those negative impacts would have been even larger without the project’s implementation. Overall the project has generated substantial economic and financial benefits. Efficiency is rated substantial.

38. **The risk to the development outcome** of the project is deemed an overall low. With regard to the generation and efficiency objective it is clear that the project has supported installation of the power generation facilities, infrastructure, and assets that will sustain their operation over the terms as agreed in the contractual agreements between the companies and the FSM. Efforts will be supported through various technical assistance measures in form of follow-on projects, financed by the World Bank and the ADB. In that sense the exploration, production, and usage of solar PV generation in FSM is now a core element in FSM’s energy and industrial sector.

39. **Achievement.** The Borrower rates the achievement of the PDOs overall as at least Satisfactory, based on high relevance of objectives, substantial relevance of design, satisfactory achievement of outcomes, and substantial efficiency.

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\(^{21}\) As per the initial planning, 368 efficient streetlights were procured in Chuuk. This was followed by a second procurement contract of 400 efficient streetlights in Kosrae. Finally, following the MTR, a third procurement contract was arranged for 1,965 efficient streetlights: (a) Chuuk: 300 LED lights; (b) Kosrae: 70 LED lights and 85 LED solar lights; (c) Pohnpei: 760 LED lights; and (d) Yap: 750 LED lights.
4. THE BORROWER’S PERFORMANCE

Government Performance

40. The government performance is assessed based on the performance by central government, stakeholders of the project, including mainly the NDRD but also the DOFA as borrower on behalf of the Federated States of Micronesia. While the NDRD also held an important role in the implementation of the project, the NDRD’s project implementation performance is assessed in the following section with regard to the day-to-day management of the project by the PIU/Division of Energy.

41. The Government’s commitment to the development objectives was overall strong during the preparation phase and also during most of the implementation phase. Further evidence that the Government remained committed to the project throughout the implementation phase is that at project closing, all activities in the main had been duly completed and the project outcomes were achieved with satisfactory results. The DOFA provided good support to the project, though sometimes with certain delays in taking action.

42. At the same time there were a number of areas for improvement. With regard to the NDRD, there was a significant delay of setting up the PIU. In addition, during the latter part of the project there was disagreements between NDRD and DOFA regarding who should be in charge of procurement and coordination of all project activities. Following advice from the World Bank, the DOFA was setting up a Central Implementing Unit, CIU inside DOFA to control the implementation of all World Bank funded projects in FSM. While there were several initiatives and interactions between the NDRD and DOFA, this issue was only [partly?] resolved after considerable delay.

43. Although after this delay, it was re-established that as per the ESDP Financing Agreement “The Recipient shall vest responsibility for overall implementation of the Project in the Department of Resources and Development.” However, by that time the NDRD had lost all the expatriate experts in the PIU and only the Assistant Secretary remained to run the project during the last 9 months.

Implementing Agencies Performance

44. The Energy Division in NDRD implemented the project. In addition, the State Utilities increasingly assumed implementation roles within their various subcomponents under component 1. While the FSM States have legally not been direct signees to the IDA grant (the various assets will be passed on to the States and the Utilities by NDRD and DOFA), the States played important roles in implementing the various subcomponents of the project.

45. The GoFSM implementing agency faced serious procurement capacity constraints throughout the project, which led to delays in the hiring of advisors and subsequently also delayed the implementation of the various, works, goods, and services financed by the project. The assistance indicated in the PAD from the Bank for financing of trainings and advisories for procurement to the implementing agencies never truly realised, thus the procurement functions in NDRD/DOFA and the Utilities improved only slowly over the years.
46. The delays that occurred in the setup of the PIU also had an impact on the timely submission of project monitoring reports and lack of capacity to prepare timely and complete progress supervision reports in early years. In addition, when the PIU situated at the Energy Division of NDRD basically ceased to exist in December 2018, coordination issues occurred and led to a suboptimal transition, which created further delays. Coordination issues between the NDRD and DOFA have affected the handling of contract approvals and payment requests.

47. Taking into account both the Government’s and the implementing agencies’ performances, the overall performance of the borrower is considered to have been Moderately Satisfactory.

5. THE PERFORMANCE OF THE BANK

Bank Performance during the Preparation

48. The quality at entry of the project is deemed satisfactory, mainly given by (i) the adequacy of appraising the country context, (ii) background studies and analysis of the energy sector, and (iii) alignment of the project and its development objectives with the objectives of the GoFSM at the time of preparation.

49. The design of components 1 and 2 with a strong focus on the critical need to improve the performance of power utilities in the short term and to diversify their energy matrix in the long term in order to reduce reliance on expensive petroleum products, led to a timely implementation and achievement of project outcomes.

50. At the same time, the design of Component 1: Acquisition and installation of new gensets for the Pohnpei Utilities Corporation and the problems with acknowledging FSM’s declaration of a National Emergency for these gensets, in retrospect was proven wrong and the original misconception led to important delays of this sub-component, which could have been avoided by a more careful attention to the circumstances surrounding this subcomponent. However, given the smaller size of this subcomponent and taking into account that the ultimate outcomes of this Component were substantially achieved by project closing, the Borrower thinks the overall quality at entry can be considered satisfactory.

Bank Performance during the Supervision

51. The quality of supervision is judged less than satisfactory mainly due to certain shortcomings in supervision relating to procurement and forced curtailment of the PIU Experts’ contract.

52. **Procurement.** The project interaction with the Bank on ESDP Procurement Processes has consumed an inordinate amount of time for the ESDP Team, the main problems being un-predictability and inconsistency during the processes, resulting in additional work and long delays.

53. Although the project used the prescribed templates, there have been numerous requests for changes or modifications of these and for some submissions using these templates, the project was given instructions from the World Bank which were contradictory to these templates. The large Pohnpei generator contract is a works type contract, but the project was asked to change the contract for the smaller and simpler Yap and Kosrae Genset procurements to using a “supply and install” type of contract.
In the case of Yap that required re-doing certain processes. Requested modifications of the Shopping ITQs include e.g. adding Shopping ITQ pre-qualification processes, not allowing alternative bids and requiring three currencies. Other requested changes to the PIM specified Templates also included not allowing point systems in CQS evaluations.

54. The Master Plan procurement was a Quality and Cost Based Selection process (QCBS), which requires No Objections from the Bank at certain steps. The Master Plan required several re-submissions, and in some instances new issues were found with each new submission. Take the Evaluation of Expressions of Interests as an example; as some Bank procurement staff prefer to use the “point system” to evaluate the EOI and others prefer the “pass and fail” criteria, the project obtained a prior approval to use the point system. After receipt of the EOIs and preparing the evaluation, the project was requested to change the evaluation report from the point system to the pass fail system.

55. A consistent problem has been the long time required to obtain a No Objection to procurement processes, e.g. the NO request with the format finally approved by the Bank for the evaluations of the EOI for the Master Plan took 34 days, the actual Master Plan submission took 37 days, the Yap Substation request took 40 days and the relatively simple request for a NO to the Evaluation Report for the FSM Energy Advisor took 24 days.

56. **Forced Curtailment of the PIU Experts’ Contracts.** The World Bank ESDP Mid-Term Review Mission in June 2017 assessed the overall progress toward achievement of PDO and the implementation progress as satisfactory. This rating was based on very good progress in most of the contracts, although some contracts were delayed and 120% achievement of the Indicator on the new Generation Capacity.

57. However, during the Mid-Term Review, the World Bank surprisingly raised the institutional arrangements under ESDP and questioned their suitability for the country and the sector. The Bank team also presented a few models of implementation arrangement from other projects with what they saw as associated benefits and challenges if they were applied to the FSM case. However, the MTR Aide Memoire concluded that, even though the current institutional arrangement could be improved, given the status of implementation and performances to date, any change of the current structure was likely to negatively impact implementation rather than providing more benefit.

58. Nevertheless, in December 2018, the Bank forced through curtailing of the contracts for the project implementation support officer and the procurement advisor and in April 2019, the Contract for the energy technical specialist, leaving the NDRD Assistant Secretary and ESDP Project Coordinator without any dedicated technical support for the last 9-6 months of the project. In addition, this astonishing action resulted in FSM not being able to keep a Project Covenant: The Recipient shall maintain, throughout the Project implementation period, the Energy Division with resources, staffing and mandate satisfactory to the Association and with responsibility for implementation of the Project. To this end, the Recipient shall hire, and thereafter maintain, a project implementation support officer, an energy technical specialist, a procurement advisor and a safeguards advisor, all with qualifications, terms of reference and experience satisfactory to the Association.

59. The project closing date was extended by 14 months, bringing the implementation time frame to over four years under the leadership of two different World Bank task team leaders over the duration. Significant changes in team composition during the initial implementation period would have been one
of the causes for delays in the Bank’s responsiveness to implementation issues. In addition, delays on the implementation of the PUC gensets might also have been avoided had supervision been more intense and closer to the ground in the early years of implementation. In this regard, the Bank eventually made the right decision by having more frequent supervision missions.

60. It is acknowledged that with regard to component 1 and component 2 the Bank team facilitated a smooth implementation of those components. The various task teams also demonstrated proactivity and flexibility with regard to the important cost savings that arose under the project and adaptability with reference to component 2. Ultimately, all targets were met, and in some cases exceeded by project closure.

61. The Borrower deems the Bank’s performance at entry as satisfactory, but the quality of supervision is judged less than satisfactory mainly due to certain shortcomings relating to procurement and the forced curtailment of the PIU Experts’ contract.

6. PROPOSED ARRANGEMENTS FOR FUTURE OPERATIONS

62. The lessons from the ESDP Project include:

(a) The motivation for implementing power generation components are different from the motivation to maintain them. The experience, skills and inclination to design and implement new generation infrastructure is different to adequately maintain such infrastructure. The reasons for this are many and include lack of spare-parts inventory and asset management systems, proper cost accounting, recurrent budget planning, and allocations for regular maintenance. Project design should consider what can be done under the project to secure proper maintenance procedures.

(b) Project implementation planning must acknowledge different time frames needed for different types of project components. It is easier to complete large, compact, capital-intensive projects like diesel genset projects within a Utility power plant than to complete smaller dispersed PV plants on time. The latter by their very nature involve social issues and several different constituencies and are likely to take much longer. This needs to be kept in mind when comingling these types of components under the same project.

(c) Changing project implementation structures during project implementation should be avoided. The compression of the project activities and the inevitable associated shortcomings towards the end of the project may have been avoided, if the Bank Task Team had allowed the PIU experts to continue until the end of the project.

(d) Efforts should be made to improve the local resource base for participation at the project management level by having local engineers and technicians working with expatriate staff.

Proposed arrangement for future operations.
Annex 5-A: Project Cost

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component 1</td>
<td>US$ 9.1 million</td>
</tr>
<tr>
<td>Component 2</td>
<td>US$ 1.5 million</td>
</tr>
<tr>
<td>Component 3</td>
<td>US$ 1.3 million</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>US$ 11.9 million</strong></td>
</tr>
</tbody>
</table>

Expenditure by the National Government and States

- Kosrae: 11%
- Chuuk: 17%
- National: 19%
- Pohnpei: 32%
- Yap: 21%
## Annex 5-B: Meeting the Project Development Objective

<table>
<thead>
<tr>
<th>No</th>
<th>Indicator</th>
<th>Unit</th>
<th>Base</th>
<th>Target</th>
<th>Actual (end)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Generation capacity of conventional generation constructed under the project (MW).</td>
<td>MW</td>
<td>0</td>
<td>4.7</td>
<td>6.2</td>
</tr>
<tr>
<td>2</td>
<td>Generation capacity of renewable energy constructed under the project – Solar (MW).</td>
<td>MW</td>
<td>0</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>3</td>
<td>Fuel savings (MJ)</td>
<td>MJ</td>
<td>0</td>
<td>124 million</td>
<td>&gt;&gt;124 million</td>
</tr>
<tr>
<td>4</td>
<td>Direct project beneficiaries (% of whom are female).</td>
<td>#</td>
<td>0</td>
<td>50,000 (50% female)</td>
<td>62,632 (50% female)</td>
</tr>
<tr>
<td>5</td>
<td>Sustainability reform program agreed with each state power utility.</td>
<td>%</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
## Annex 5-C: Meeting Intermediate Results

<table>
<thead>
<tr>
<th>No.</th>
<th>Intermediate Results Indicator</th>
<th>Unit</th>
<th>Base</th>
<th>Target</th>
<th>Actual (end)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Component 1: Increasing available generation capacity and efficiency of electricity supply in the state power utilities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Commissioning of conventional energy generation equipment.</td>
<td>% Completed</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Commissioning of solar generation equipment.</td>
<td>% Completed</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>Commissioning of efficient street lights.</td>
<td>% Completed</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>4</td>
<td>Improved technical capacity in the state utilities for operations and maintenance</td>
<td>Y/N</td>
<td>0</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td><strong>Component 2: National and state energy planning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Energy sector master plans completed and accepted.</td>
<td>Y/N</td>
<td>0</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>2</td>
<td>Energy sector information system in place.</td>
<td>% Completed</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>Improved planning capacity of the state power utilities and national government.</td>
<td>Y/N</td>
<td>0</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td><strong>Component 3: Technical assistance and project management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Implementation specialists in place.</td>
<td>Y/N</td>
<td>0</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
ANNEX 6. FSM ENERGY MASTER PLAN SUMMARY OF RECOMMENDATIONS BY STATE (PREPARED UNDER THE PROJECT)

1. The FSM Energy Master Plan has been developed during the period of unprecedented technological change. The last few years have seen remarkable and disruptive improvements in RE technologies and battery storage. Further expected reductions in the costs of these technologies provide the FSM with an opportunity to combine achievement of its environmental targets while ensuring that electricity production remains affordable. At the same time, the FSM faces a substantial challenge of delivering electricity to people living on the outer islands. At present, there is a significant social and economic divide; people living on the four main islands enjoy almost universal access to the main electricity grids. By contrast, people on the outer islands and in outlying communities have almost no access to electricity. The master plan is designed to address this divide in a financially and socially sustainable way. The master plan will provide electricity access, at good-quality service standards, to more than 80 percent of FSM households by 2020 and almost every household by 2023. Access is defined as the practical ability of each household to be able to receive affordable electricity. The plan seeks to achieve the FSM’s RE, diesel reduction, and emissions reduction objectives.

Table 6.1. FSM National-level Outcomes of the Master Plan

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2020</th>
<th>2027</th>
<th>2037</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity access (%)</td>
<td>67</td>
<td>82</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>RE (%)</td>
<td>19</td>
<td>44</td>
<td>63</td>
<td>84</td>
</tr>
<tr>
<td>Diesel use (million gallons)</td>
<td>4.2</td>
<td>2.9</td>
<td>2.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Electricity CO₂ emissions (tons)</td>
<td>43,490</td>
<td>21,980</td>
<td>21,980</td>
<td>15,769</td>
</tr>
</tbody>
</table>

2. There is no consensus on affordable electricity. One of the recognized approaches is to measure affordability as the percentage share of the household expenditures. Based on experience with actual household expenditure patterns and results of willingness-to-pay surveys, certain thresholds are widely used by practitioners.

Table 6.2. Threshold of Affordability

<table>
<thead>
<tr>
<th></th>
<th>Measure of Ability to Pay</th>
<th>Threshold of Affordability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off-grid energy</td>
<td>Monthly bill as % of household income</td>
<td>20% of per capita household income</td>
</tr>
<tr>
<td>On-grid energy</td>
<td>Monthly bill as % of household income</td>
<td>5% of per capita household income</td>
</tr>
</tbody>
</table>

3. The master plan indicates that high-quality universal access electricity services can be provided at tariffs similar to those the utilities are currently charging in each state. As shown in figure 6.1, FSM tariffs are within the range of tariffs being charged by the electricity utilities in countries with a similar GDP per capita level.

**Pohnpei:**

(a) Three 2.5 MW medium-speed diesel gensets should be brought on line. This will allow for the aging Caterpillar C-18 units to be retired and the Vital independent power producer to be retired or released by 2021. The new units will increase fuel efficiency and reduce O&M costs compared to the existing units.

(b) A total of 3 MW of solar PV capacity should be developed at the Pohnlangas solar site.

(c) The 2.7 MW Lehnmesi hydropower scheme should be developed. This scheme incorporates storage to provide firmer capacity to the mix.

(d) Energy storage should be deployed at the Pohnpei power station, providing 1 MW of capacity and 1 MWh of storage to manage integration of the PV plants.

(e) The recommended investments in solar and storage will meet a large proportion of Pohnpei Proper’s demand in 2023, reducing the use of diesel and therefore the cost of electricity. However, diesel-off mode is not allowed—that is, at least one genset must run at all times.

*Source: Energy Master Plan.*
Chuuk:

(a) There should be a major overhaul of the existing diesel gensets No. 4 and No. 5.

(b) A total of 4 MW of solar PV capacity should be developed. This will help reduce the cost of energy by reducing the use of diesel. The feasibility study on integrating new solar PV into the grid on Weno will review possible locations for this and the other solar PV capacity recommended on Weno (figure 6.2) and the commercial arrangements that might be used.

(c) Energy storage should be deployed at the Weno power station, to provide 1 MW of capacity and 7 MWh of storage to manage integration of the PV plants and increased use of RE. The battery energy storage system can be used for spinning reserve, stability management, and additional security (n-2) 5, as well as load shifting.

(d) The recommended investments in solar and storage will meet a large proportion of Weno’s demand in 2023, reducing the use of diesel and therefore the cost of electricity (figure 6.2). However, the system is set to keep one genset running at all times; that is, there is no diesel-off mode in this period.

Figure 6.2. Weno Load Curve and Contribution of Generation Sources, 2023

Source: Energy Master Plan.

Kosrae:

(a) A total of 2 MW of PV should be developed at one or more solar sites. Some of the capacity could be deployed behind the meter in government or commercial buildings.

(b) Energy storage should be deployed at the Kosrae power station, providing 1.25 MW of capacity and 5 MWh of storage to manage integration of the PV plants and increased use of RE.
(c) The recommended investments in solar and storage will meet a large proportion of Kosrae’s demand in 2023, reducing the use of diesel and therefore the cost of electricity (3).

(d) Genset No. 4 should be retired in 2020.

**Figure 6.3. Kosrae Load Curve and Contribution of Generation Sources, 2023**

Source: Energy Master Plan.

**Yap:**

(a) A second 830 kW diesel generator should be added. This has been included at YSPSC’s request, to allow the power station operators to manage the run hours on smaller generators better and extend their lives. YSPSC reported that the existing 830 kW generator is currently being run hard in response to fluctuations in wind farm generation, and it is not expected to last more than five years. The second 830 kW will allow YSPSC to reduce the run hours on the existing generator so that it will not require replacement for at least 10 years. This may defer the need for a new 830 kW generator later in the master plan period.

(b) At least 2 MW of solar PV capacity should be developed at one or more sites. Some of the capacity could be deployed behind the meter in government or commercial buildings, but additional options such as ground-mounted and floating systems may also be needed.

(c) Energy storage should be deployed at the Yap power station, providing 0.5 MW of capacity and 3 MWh of storage to manage integration of the wind turbines and PV plants and increased use of RE.
(d) The recommended investments in solar and storage will meet a large proportion of Yap Proper’s demand in 2023, reducing the use of diesel and therefore the cost of electricity (Figure 6.4).

Figure 6.4. Yap Load Curve and Contribution of Generation Sources, 2023

Source: Energy Master Plan.
ANNEX 7. PHOTOS

New diesel generators in Pohnpei

New solar PV plants in Chuuk Airport parking area
New switch gears in Yap

New diesel generator in Kosrae