Grid Readiness for
Smart Renewable Energy Transitions in Pacific Islands

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Introduction

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Energy's Role in Development

Energy is essential for economic and societal progress.

Increasing Energy Demand

Population growth and industrial expansion drive energy needs.

Climate Change Impacts

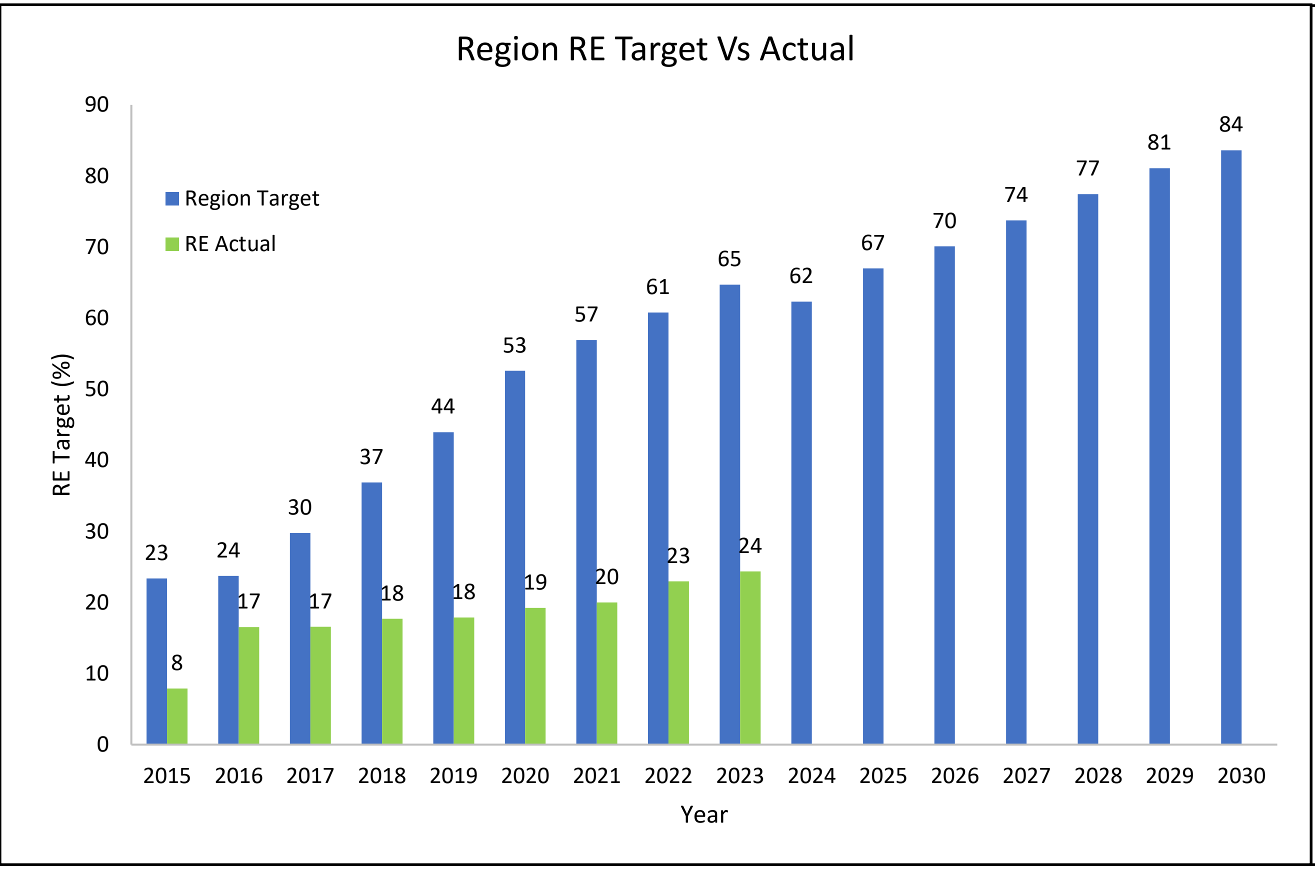
Fossil fuel use leads to global warming and rising sea levels.

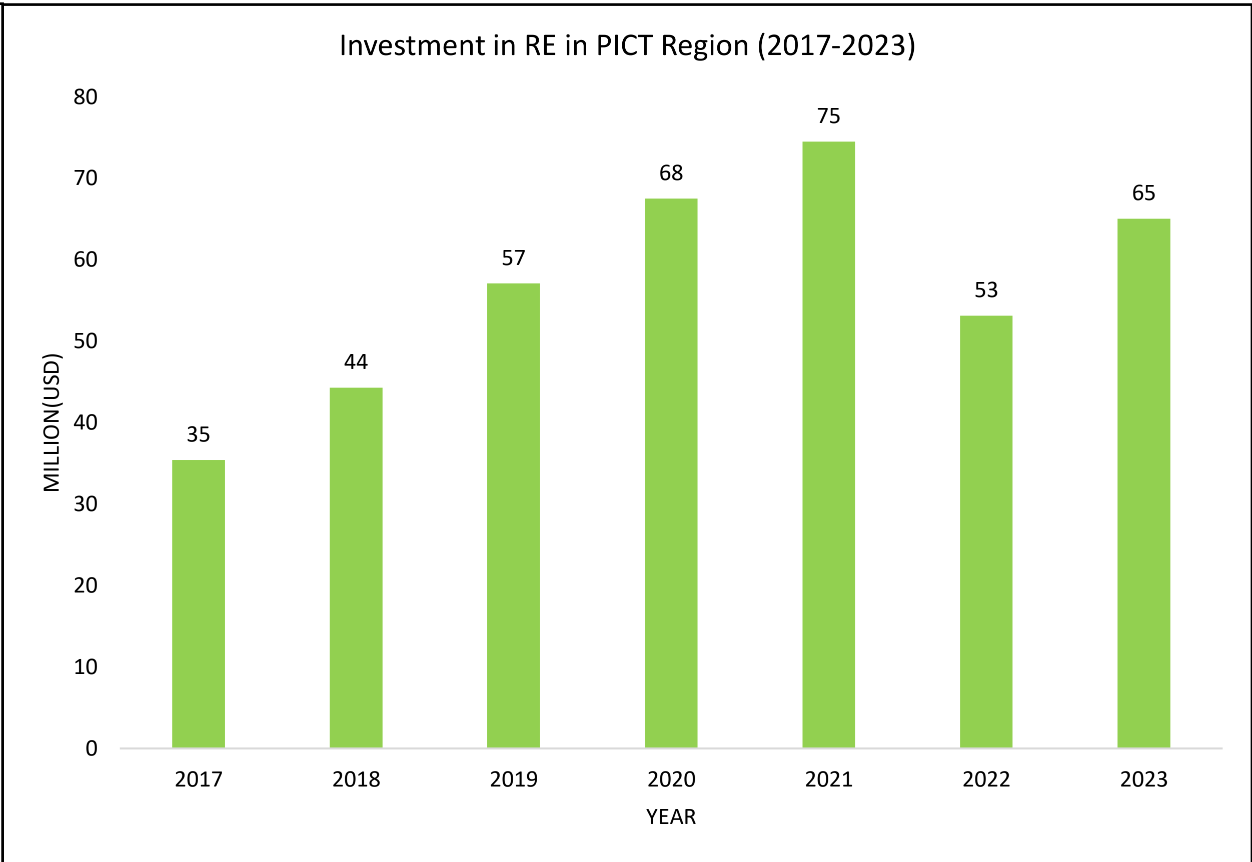
PICTs' Vulnerability

Despite low emissions, PICTs face severe climate change effects.

Renewable Energy Trends- Pacific Islands

SDG Target 7.2: RE as a Percentage of Total Energy (Electricity)





- **Pacific Islands countries have set quite aggressive targets to reduce their carbon emissions.**
- **Heavy reliance on fossil fuels, which make up to one-third of their total import costs.**
- **RE uptake in the Pacific Island Countries and Territories (PICTs) has been far less than required to meet their national energy sector objectives.**
- **Considerable investments in RE in Pacific Islands over the past two decades**

Introduction

- Need for PICTs to transition their grids from fossil fuel dependence to RE systems that are inclusive and aligned with a sustainable energy goals.
- The modernization and expansion of electricity grids are key to achieving energy transitions (ESCAP, 2025).
- **For a successful transition to occur, it essential to obtain the current status of the grid in terms of how prepared the grid is for RE uptake and transition.**

Introduction

- A Grid Readiness Assessment Framework (GRAF) can be utilized to evaluate how organized the electricity grid is to integrate new technologies, adapt to emerging demands and support energy transitions.
- The biggest drawback of existing frameworks is that it does not capture the Pacific realties and thus its application is not embedded in decision making.
- The present work therefore, proposes a new Pacific islands electricity Grid Assessment Framework (PieGRAF) that is tailored for the PICTs.
- The PieGRAF moves beyond current **ad-hoc** fixes by providing a structured approach for RE integration and grid planning.

Development of PieGRAF

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- The development of PieGRAF is centred around enablers that will accelerate RE transition in PICTs.
- The PieGRAF consists a total of 63 questions which are organized into 9 criteria.
- There are criteria that are important in context of PICTs. These are;
  - institutional arrangements and stakeholder engagement
  - Grid and infrastructure readiness
  - economics and financial mechanisms
  - capacity, training and workforce readiness.

Assessment Criteria

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Criterion	Rationale and Focus
A. Legislative, Regulatory and Policy Frameworks	A robust legislative and policy environment gives long-term direction and investor confidence for RE transition. The criterion captures the enabling conditions such as statutory clarity, grid codes, IPP frameworks, and regulatory authority.
B. Institutional Arrangements and Stakeholder Engagement	Coordinated and aligned priorities among stakeholders are critical to avoid duplication of effort and ensure cohesive planning. The criterion emphasizes governance mechanisms, energy sector working groups, validation of energy roadmaps and data-sharing agreements that create a unified vision. This ensures that RE projects are culturally appropriate and socially accepted.
C. Power Sector Planning and Monitoring and Evaluation (M&E) Frameworks	Integrated planning determines which projects are prioritized, which technologies are selected, and how investment decisions are sequenced. The criterion focuses on planning tools, forecasting capabilities, and systematic monitoring frameworks that ensures RE targets are technically sound and cost-effective.

Assessment Criteria (contd.)

Criterion	Rationale and Focus
D. Grid Infrastructure and Network Architecture	Reliable and resilient grid infrastructure is vital for RE integration. The criterion captures generation capacity, transmission, and distribution capacity, grid flexibility, inertia, and proper asset management. These play a critical role in determining whether high RE penetration can be supported.
E. System Controls and Operations	Modern control systems, automation, and real-time monitoring enhance grid stability. This criterion concentrates on reliable dispatch of both conventional and renewable resources, protocols for curtailment, voltage and frequency control, and fault response standards.
F. Renewable Energy Resources and Land Availability	Accurate data on different renewable sources and clear land acquisition processes enable bankable projects and informed investment decisions. The criterion captures information on resource data and its validity, resource mapping, feasibility studies, and the sensitive issue of land acquisition in PICTs.

Assessment Criteria (contd.)

Criterion	Rationale and Focus
G. Smart Grid, Enabling Technologies and Sector Coupling	Grid enabling technologies Improves grid flexibility and sector coupling aids in further decarbonization efforts. The criterion focuses on energy storage systems, demand response, EV integration, smart meters, smart appliance and energy efficiency.
H. Economics and Financial Mechanisms	Strong financial structures and market mechanisms determine whether technically feasible projects are implemented. This criterion captures tariffs, investment modalities, risk mitigation, and access to donor or global climate finance.
I. Capacity, Training and Workforce Readiness	A skilled local workforce is essential for sustaining operations, maintenance, and continuous improvement after project commissioning. This criterion focuses on capacity planning, technical expertise, gender equity, and structured training or mentorship programs.

Scores in PieGRAF

The weighted score is calculated using equation 1.

$$WS_i = n_i \times W_i \quad \text{equation 1}$$

Where WS_i is the weighted score of criteria i, n_i is the raw average score of criteria i and W_i is the weighting of criteria i. The weighted average (WA) is then calculated using equation 2.

$$WA = \frac{\sum n_i \times W_i}{\sum W_i} \quad \text{equation 2}$$

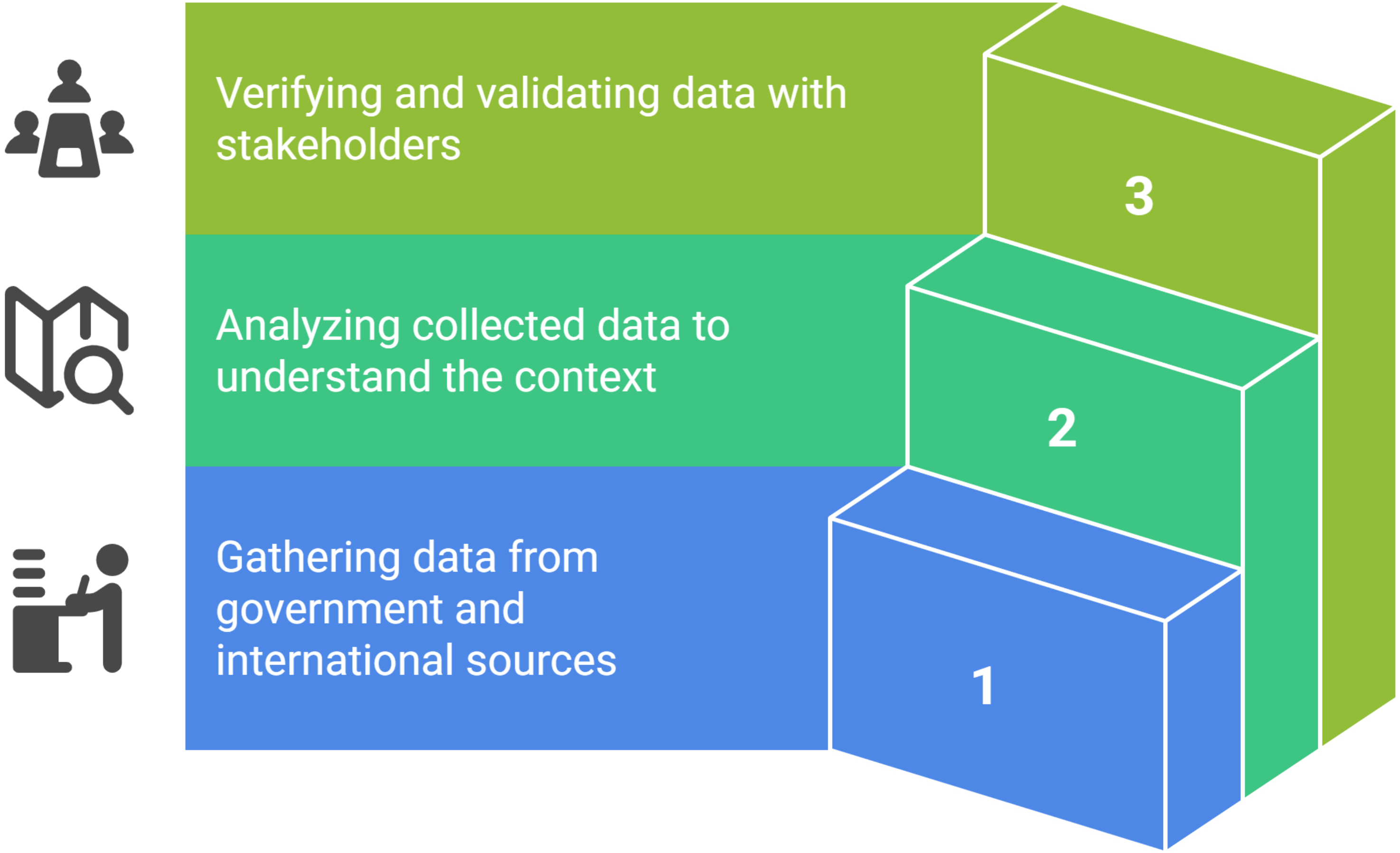
Case Study – Pohnpei Grid

- Pohnpei is one of the 4 states in FSM.
- Based on the 2021 Census projection, the Pohnpei State has a population of 36,896, accounting for 35.2% of the national total (DoRD, 2023).
- The electricity distribution grid on Pohnpei's consists of three feeders with the following lengths:
  - Kolonia feeder: approximately 9.5 km,
  - Western feeder: approximately 57.9 km,
  - Eastern feeder: approximately 42.5 km (PPA, 2010, DoRD, 2024).
- The main grid system is managed by the Pohnpei Utilities Corporation (PUC), which is responsible for power generation, transmission and distribution across the state.

Case Study – Pohnpei Grid

- As of 2025, Pohnpei has a total installed capacity of 22 MW and a peak demand of 7.4 MW; however, the total available capacity stands at 11.15 MW.
- The contribution of RE towards Pohnpei's energy mix is very little. Approximately 97% of the state's electricity is generated from fossil fuels and a mere 3% is from RE sources.
- This dependency exposes the state to international fuel price volatility, high operational costs, and environmental concerns, reinforcing the urgent need to accelerate the transition to RE sources.

Populating PieGRAF



Results of Pohnpei Grid

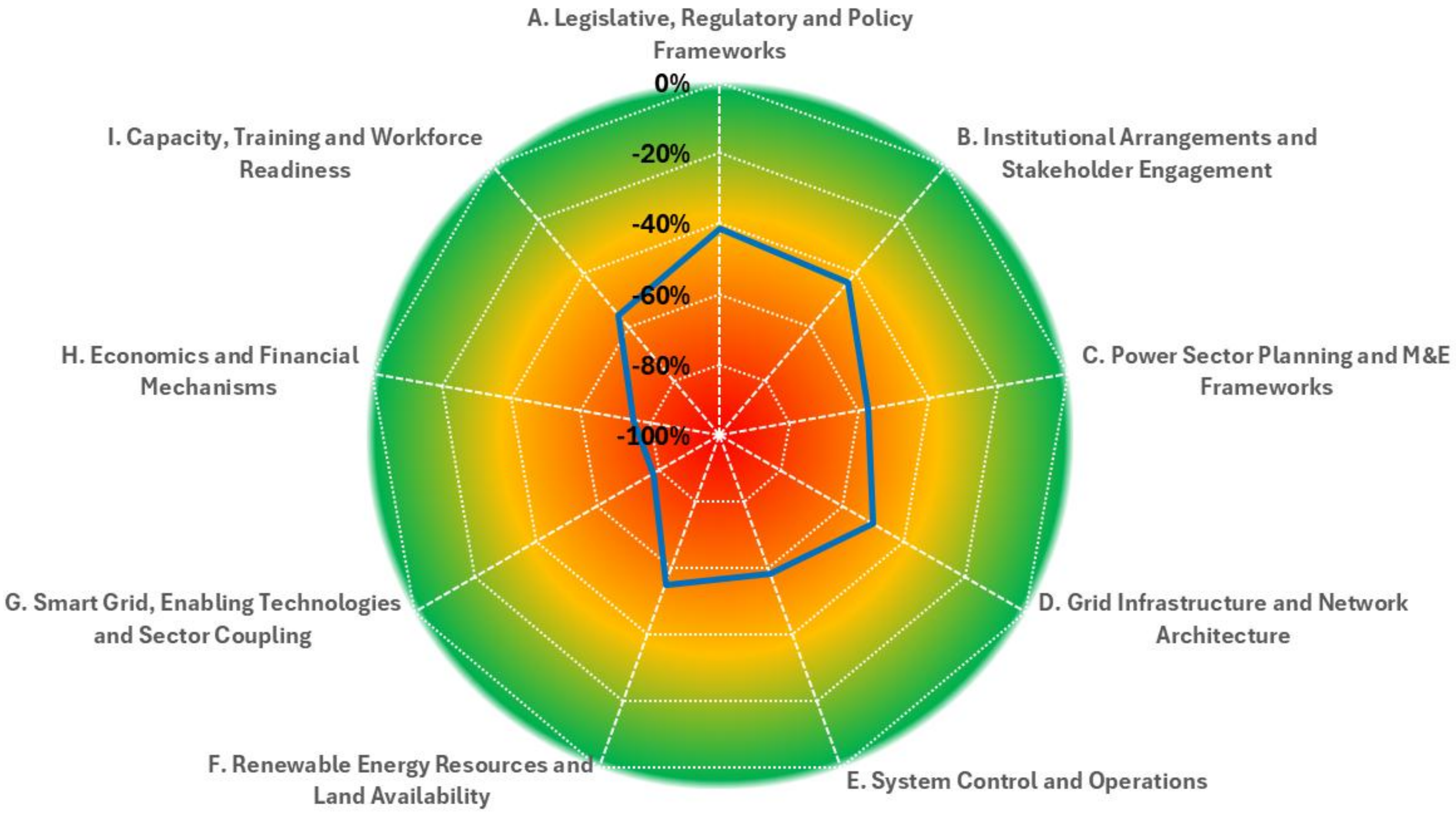


Figure 1 *Gaps identified in PieGRAF for Pohnpei grid*

A rating of 0% indicates the criterion is fully developed and does not require further interventions; where as -100% indicates that the criterion scored 0 and is not developed at all and requires substantial efforts to bring it up to par.

Recommendations for Pohnpei Grid

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Criteria	Key Recommendations
A. Legislative, Regulatory and Policy Frameworks	Strengthen regulatory independence, update grid codes, and clarify laws to enable private sector RE participation.
B. Institutional Arrangements and Stakeholder Engagement	Enhance coordination between agencies, formalize data sharing, engage communities, and maintain donor alignment.
C. Power Sector Planning and M&E Frameworks	Invest in grid studies, forecasting, and advanced planning tools and modelling (e.g., PyPSA, PowerFactory); align RE scenarios with national roadmap and institutionalize monitoring frameworks

Recommendations for Pohnpei Grid

Table 3 Key recommendations to get Pohnpei grid ready for RE uptake

Criteria	Key Recommendations
D. Grid Infrastructure and Network Architecture	Improve flexibility and inertia; prioritize preventive maintenance and plan upgrades for higher RE integration.
E. System Control and Operations	Implement SCADA/EMS/DMS, enhance voltage/frequency control, integrate forecasting, and establish curtailment protocols.
F. Renewable Energy Resources and Land Availability	Conduct high-quality resource assessments, feasibility studies, streamline land access, and promote rooftop PV

Recommendations for Pohnpei Grid

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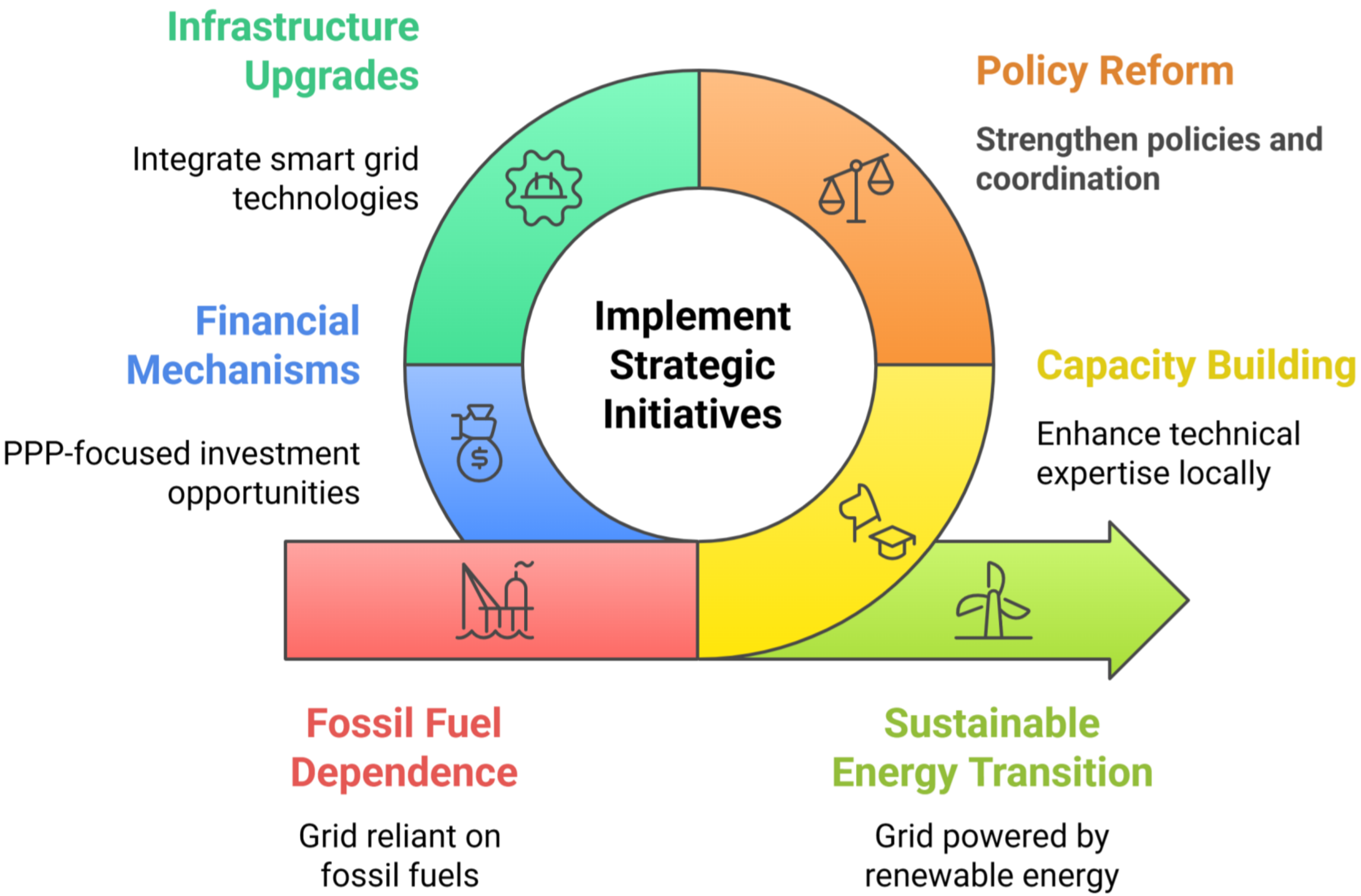
***Table 3** Key recommendations to get Pohnpei grid ready for RE uptake*

Criteria	Key Recommendations
G. Smart Grid, Enabling Technologies and Sector Coupling	Integrate energy storage, smart meters, grid-forming inverters; promote EV uptake, demand response, and energy efficiency.
H. Economics and Financial Mechanisms	Develop RE cost analysis tools, enable PPPs, reform tariffs, and leverage climate funds and diverse financing.
I. Capacity, Training and Workforce Readiness	Conduct training needs assessments, strengthen in-house expertise via mentorship and knowledge transfer, and align capacity plans with transition goals.

Conclusions



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Questions?

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