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Grid Readiness for Smart Renewable Energy Transitions in Pacific Islands

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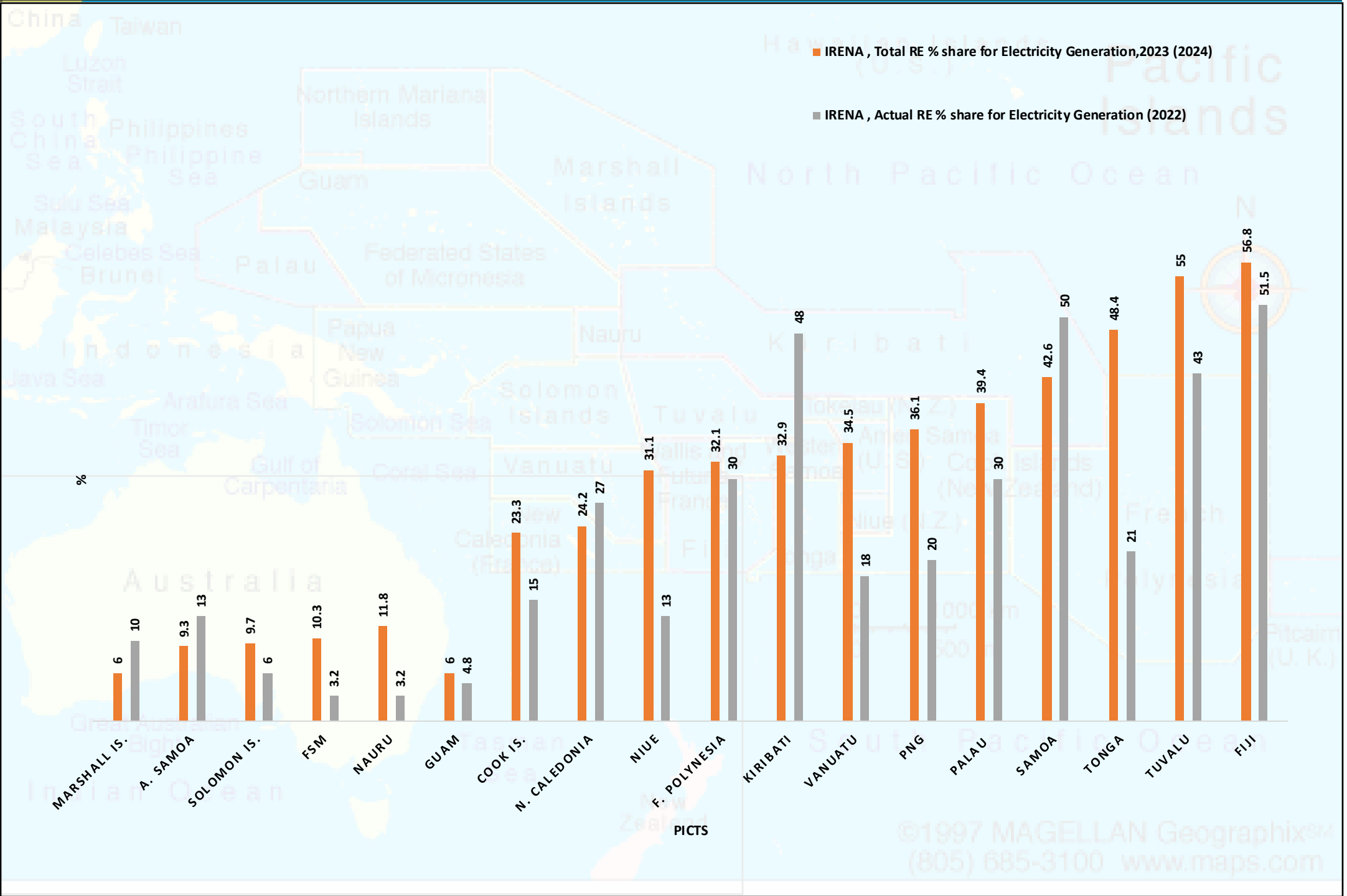

PICTs

Sector Context

Renewable Energy Trends- Pacific Islands

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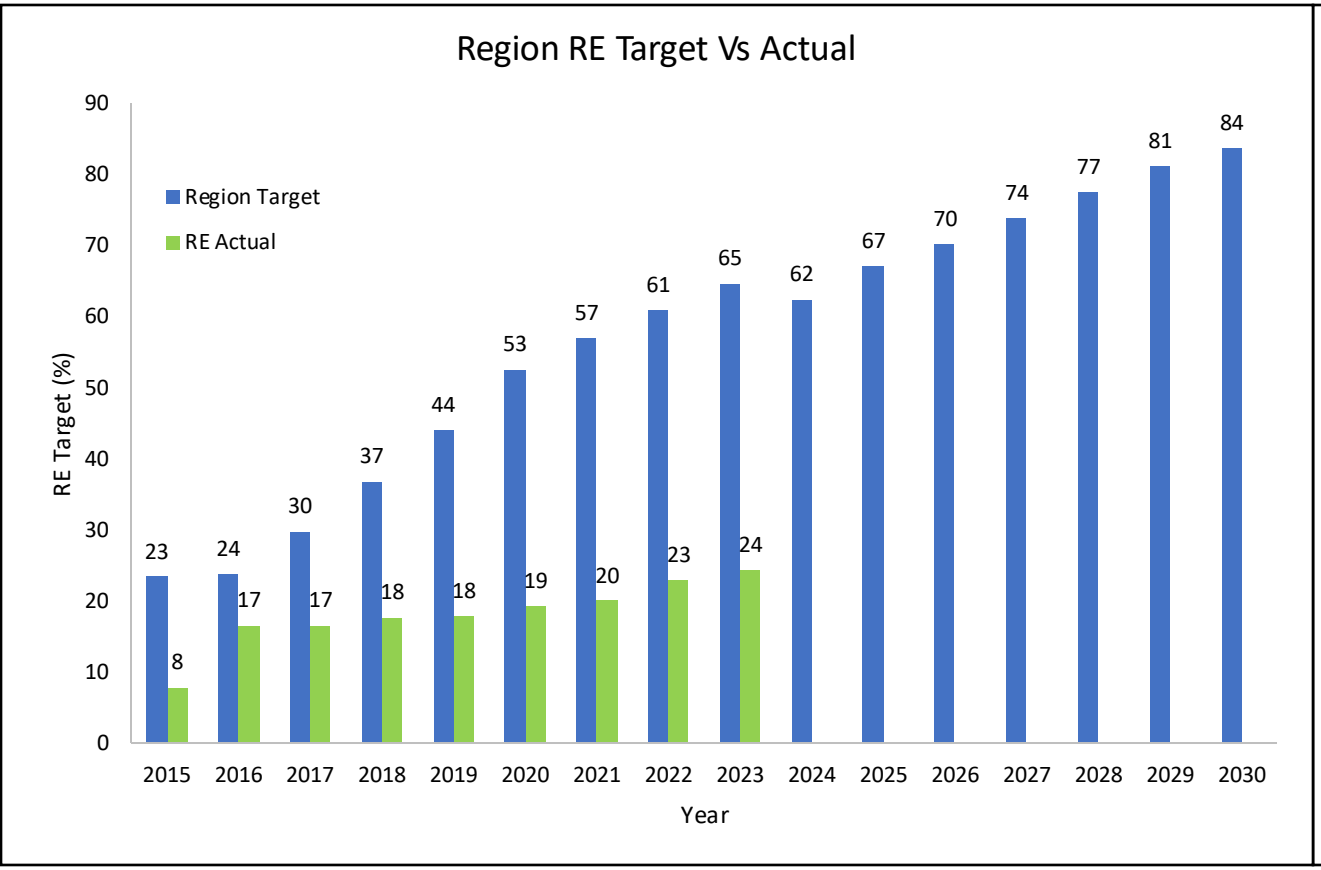
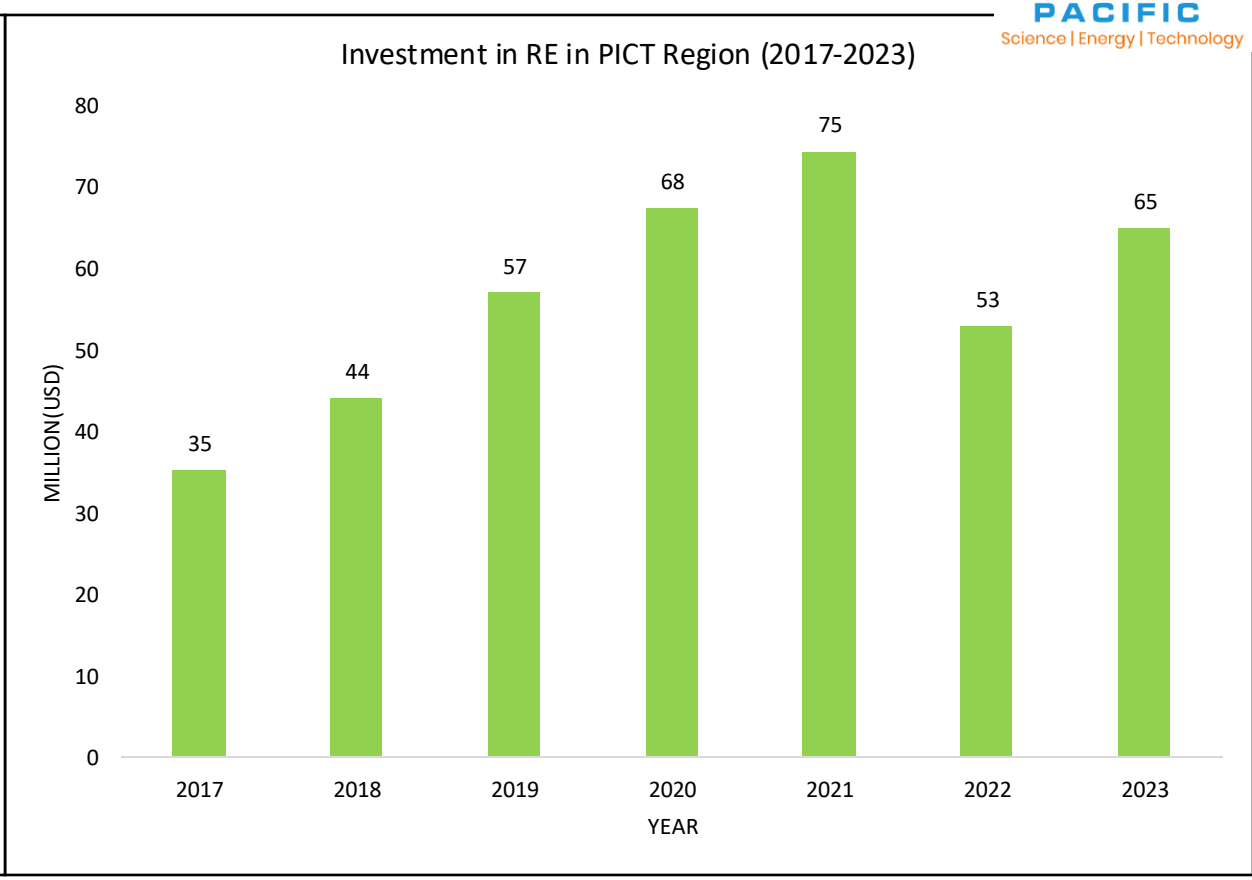
SDG Target 7.2: RE as a Percentage of Total Energy (Electricity)





- **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**

Current Approaches to Energy Planning in the PICTs

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- Based on static reports
- Don't allow stakeholders to update or test new scenarios
- Based on analysis that lacks transparency
- May not be technology agnostic

Successful transition from fossil fuels to diversified renewable sources will require careful planning and detailed assessment

5th PRETMM Ministerial Resolution for Paper E8:

… to develop and use enhanced and tailored energy planning frameworks and capacity expansion tools for net zero outcomes, with a focus on future demand assessments,

… transitioning fossil fuel dependent sectors,

…meeting 100% renewable targets,

… securing island grids with high variable renewable penetrations,

…jurisdictional planning"

Recommendations

21. This meeting is invited to:

i) **endorse** the collaborative efforts by UNSW, USP, SPC, PPA and other partners to jointly undertake regional studies that build upon the existing work of partners including IRENA and the World Bank to assess the renewable energy potential of the PICTs to meet future energy demand including the provision of universal energy access, electrification of key energy uses sectors currently reliant on imported fossil fuels including road transport, and the potential for renewable hydrogen and hydrogen derivatives to supply energy uses that can't be electrified.

ii) **support** the development and use of enhanced planning frameworks and capacity expansion tools tailored for PICT countries given their unique challenges and opportunities in energy transition, and particularly including the ability to plan 100% renewables electricity sectors and growing cross sector linkages such as the electrification of road transport, household and commercial energy use, and Power2X options.

iii) **adopt** improved tools for ensuring the security and resilience of island grids with high variable renewable penetrations and appropriately facilitate more distributed microgrids as well as solar home systems for remote communities.

iv) **Strengthen** the regional capabilities of SPC/PCREEE and PPA to support energy transition efforts across the region, building on existing efforts and including data provision and tools to assist jurisdictions in planning and execution of net zero strategies.

Utility Board Directors Workshop- 2025

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Grid Readiness – Consolidated Themes

1. Grid Strengthening & Renewable Integration
2. Infrastructure Investment & Maintenance
3. Financing, Tariffs & Regulatory Frameworks
4. Human Capacity & Talent Retention
5. Risks & External Vulnerabilities

Grid Assessment- A New Approach

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- 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.**
- Considers Other Enabling Environment.

PieGRAF

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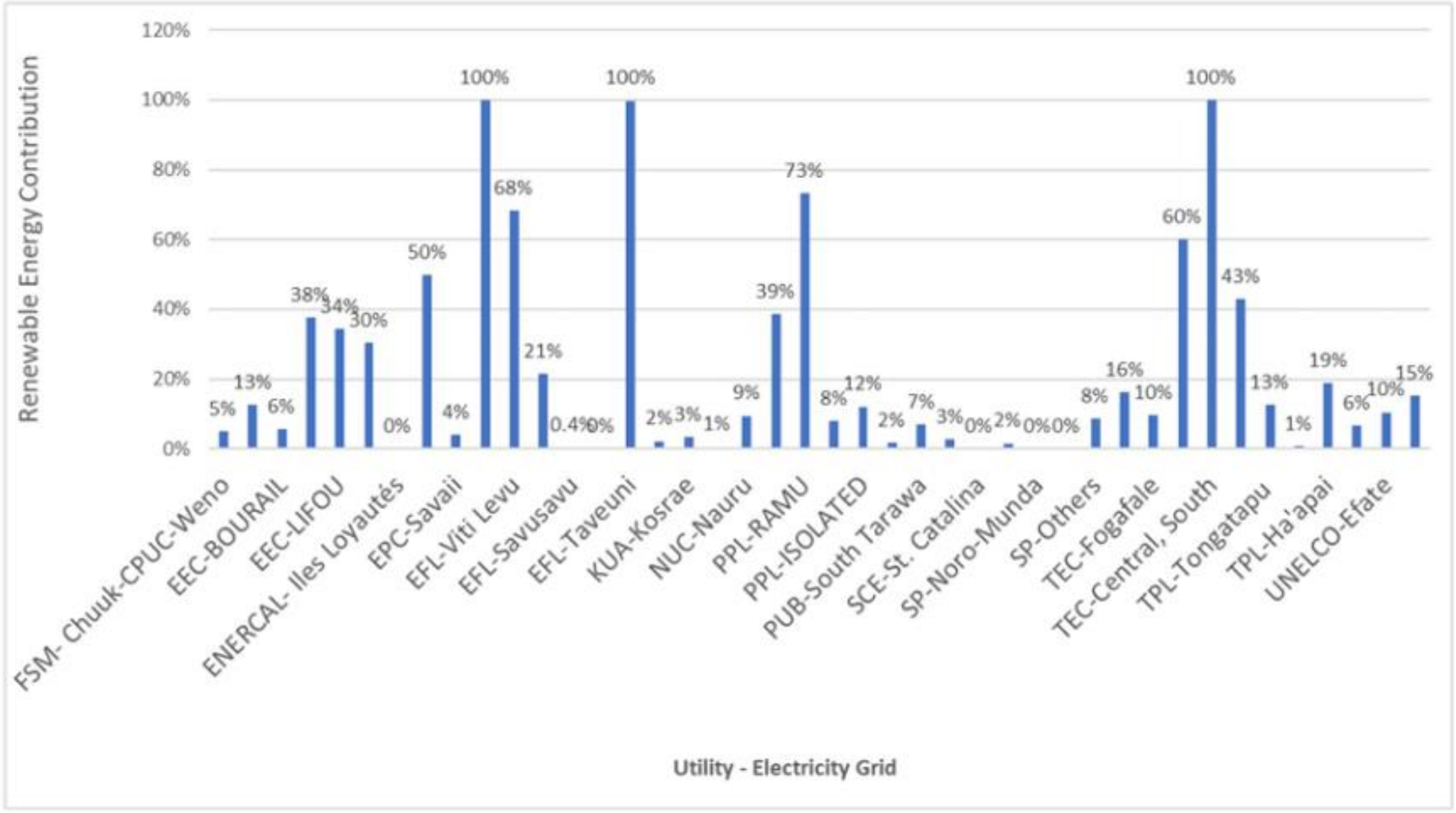
- A Grid Readiness Assessment Framework (GRAF) can be utilized to evaluate how organized the electricity grid is to integrate new technologies, adapt to emerging demands and support energy transitions.
- The biggest drawback of existing frameworks is that it does not capture the Pacific realties and thus its application is not embedded in decision making.

Pacific islands electricity Grid Assessment Framework (PieGRAF)

- Tailored for the PICTs.
- The PieGRAF moves beyond current **ad-hoc** fixes by providing a structured approach for RE integration and grid planning

Case Study – A PICT Utility Grid



Development of PieGRAF

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Piloting

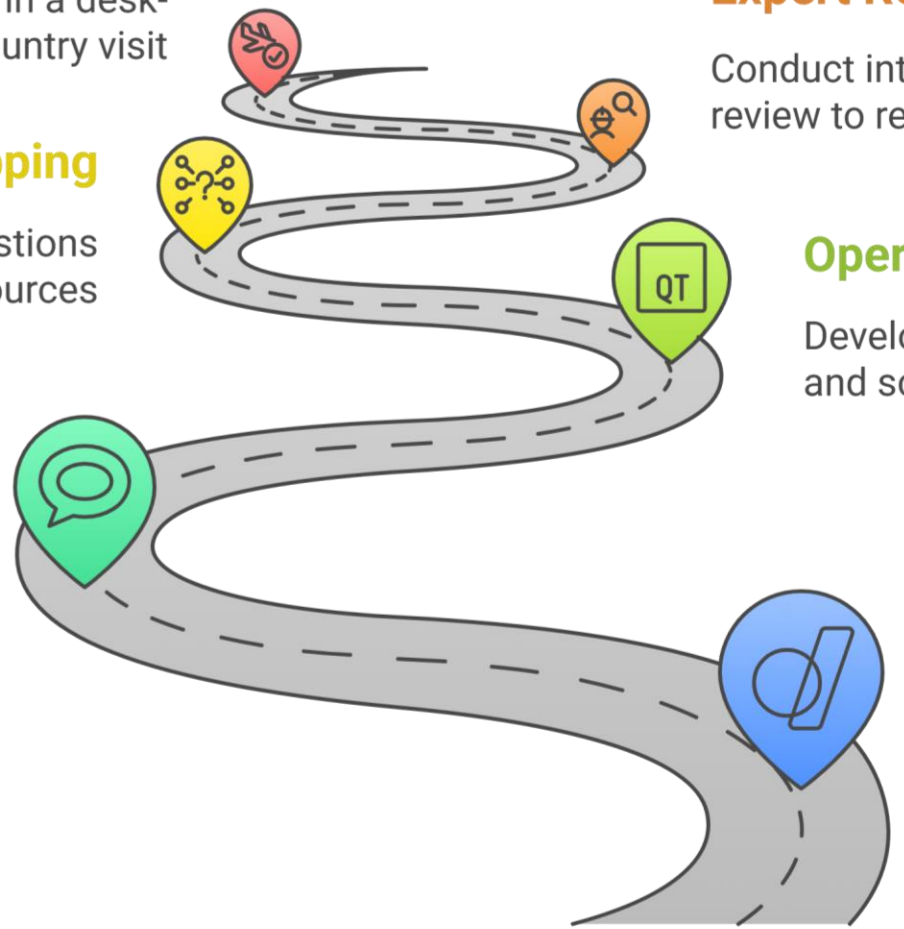
Trial questions in a desk-study and country visit

Analytic Mapping

Compile candidate questions from various sources

Contextualization

Check domain completeness and relevance through stakeholder interviews



Expert Review

Conduct internal technical review to refine questions

Operationalization

Develop assessable questions and scoring rubrics

Conceptual Scaffolding

Define high-level readiness domains through literature review

Development of PieGRAF

- 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.
  - A. Legislative, Regulatory and Policy Frameworks
  - **B. Institutional Arrangements and Stakeholder Engagement**
  - C. Power Sector Planning and M&E Frameworks
  - D. Grid Infrastructure and Network Architecture
  - E. System Control and Operations
  - F. Renewable Energy Resources and Land Availability
  - G. Smart Grid, Enabling Technologies and Sector Coupling
  - **H. Economics and Financial Mechanisms**
  - **I. Capacity, Training and Workforce Readiness**

PieGRAF Criteria and Rationale

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A. Legislative Frameworks

Robust policies provide direction and investor confidence.

Coordinated priorities avoid duplication and ensure cohesive planning.

B. Institutional Arrangements/ Stakeholder Engagement

C. Power Sector Planning

Integrated planning prioritizes projects and selects technologies.

PieGRAF Criteria and Rationale

Reliable grid infrastructure is vital for renewable energy integration.

D. Grid Infrastructure

E. System Controls/Operations

Modern control systems enhance grid stability.

Accurate data enables informed investment decisions.

F. Renewable Resources/Land

PieGRAF Criteria and Rationale

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G. Smart Grid Technologies

Improves grid flexibility and aids decarbonization.

Strong financial structures determine project implementation.

H. Financial Mechanisms

I. Workforce Readiness

A skilled workforce sustains operations and improvement.

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.

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

Populating PieGRAF

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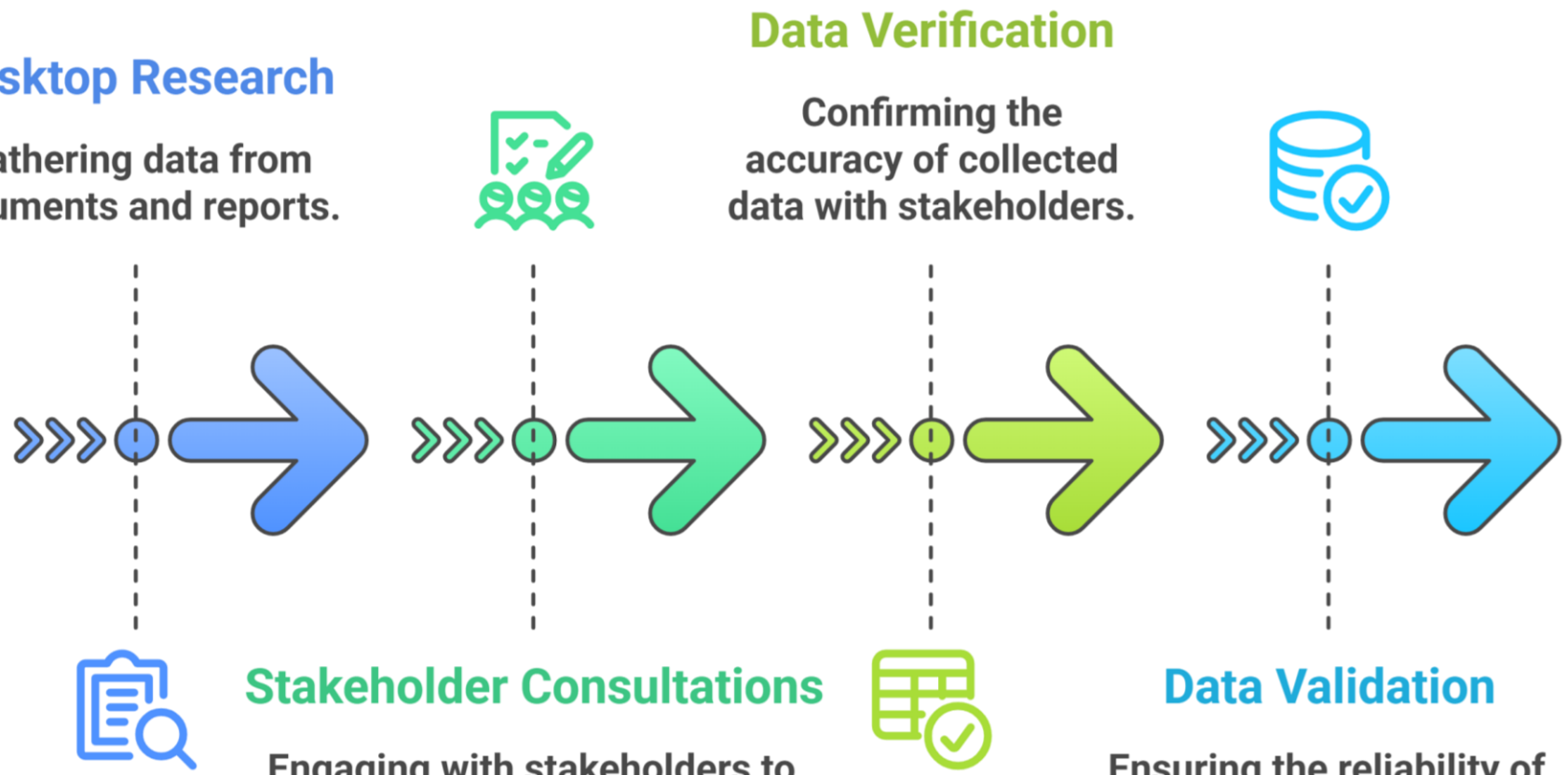

Results from PieGRAF

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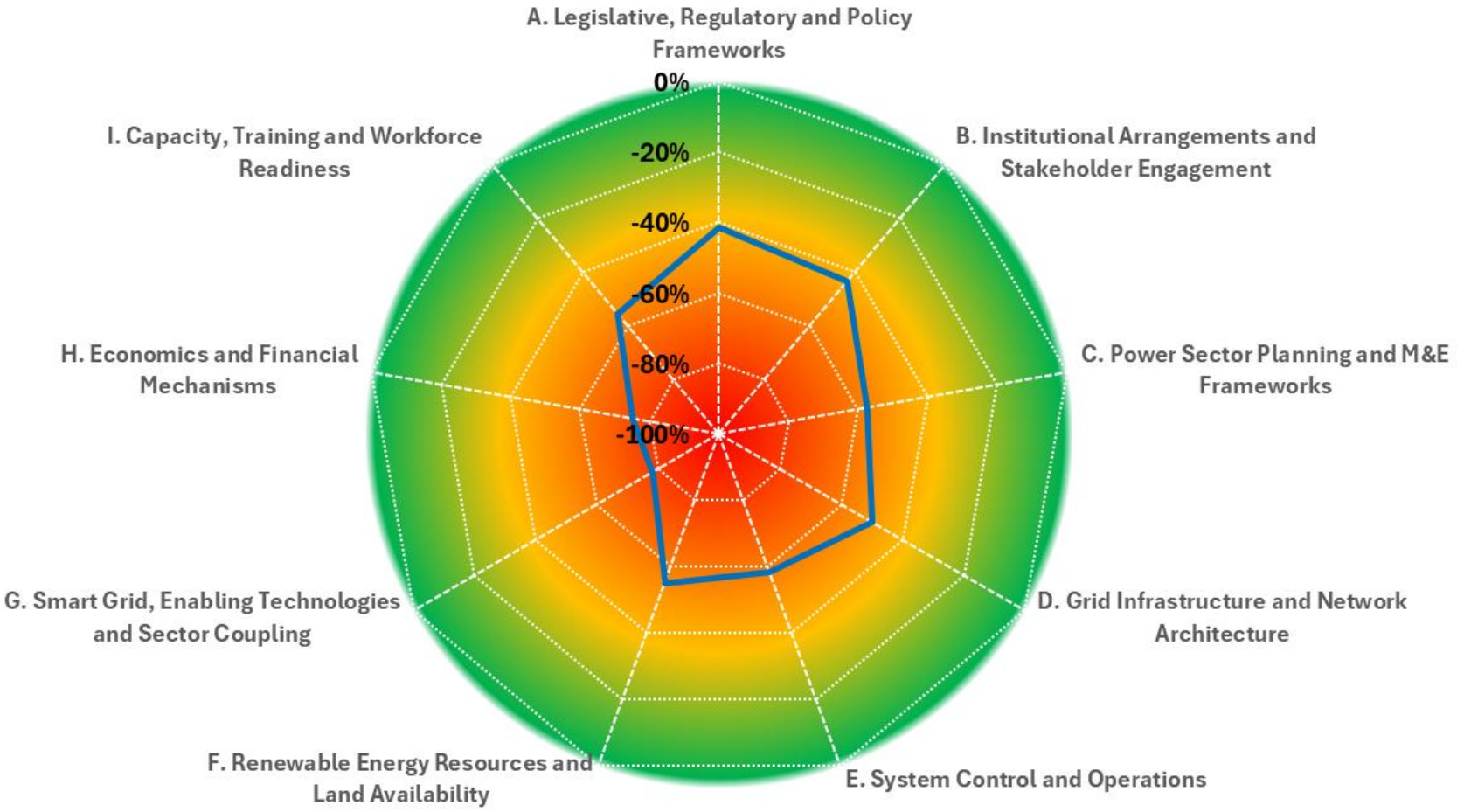
Table 1 *Weighted criteria scores in PieGRAF*

Categories	Average Score	Weighting	Weighted Score
A. Legislative, Regulatory and Policy Frameworks	2.33	10.0	23.33
B. Institutional Arrangements and Stakeholder Engagement	2.25	10.0	22.50
C. Power Sector Planning and M&E Frameworks	1.70	15.0	25.50
D. Grid Infrastructure and Network Architecture	2.00	20.0	40.00
E. System Control and Operations	1.67	10.0	16.67
F. Renewable Energy Resources and Land Availability	1.80	10.0	18.00
G. Smart Grid, Enabling Technologies and Sector Coupling	0.88	5.0	4.38
H. Economics and Financial Mechanisms	1.00	10.0	10.00
I. Capacity, Training and Workforce Readiness	1.78	10.0	17.78

The weighted average is 1.76. The grid has significant gaps and is far from being adequately prepared to support RE uptake. This low score reflects deficiencies across critical technical, operational, and institutional dimensions, highlighting an urgent need for targeted upgrades.

Results from PieGRAF



Gaps identified in PieGRAF of the 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.

The least and the most developed criteria are Smart Grid, Enabling Technologies and Sector Coupling (-78.13%), and Legislative, Regulatory and Policy Frameworks (-41.67%) respectively.

Recommendations for the Grid

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Strengthen Regulatory Frameworks

Enhance regulatory independence and grid codes

Develop Power Sector Planning

Invest in grid studies and planning tools

Implement System Control

Enable real-time monitoring and control

Integrate Smart Grid Technologies

Incorporate advanced grid technologies

Enhance Capacity Building

Prioritize training and workforce readiness

Enhance Institutional Arrangements

Improve coordination and data sharing

Modernize Grid

Improve grid infrastructure, flexibility and reliability

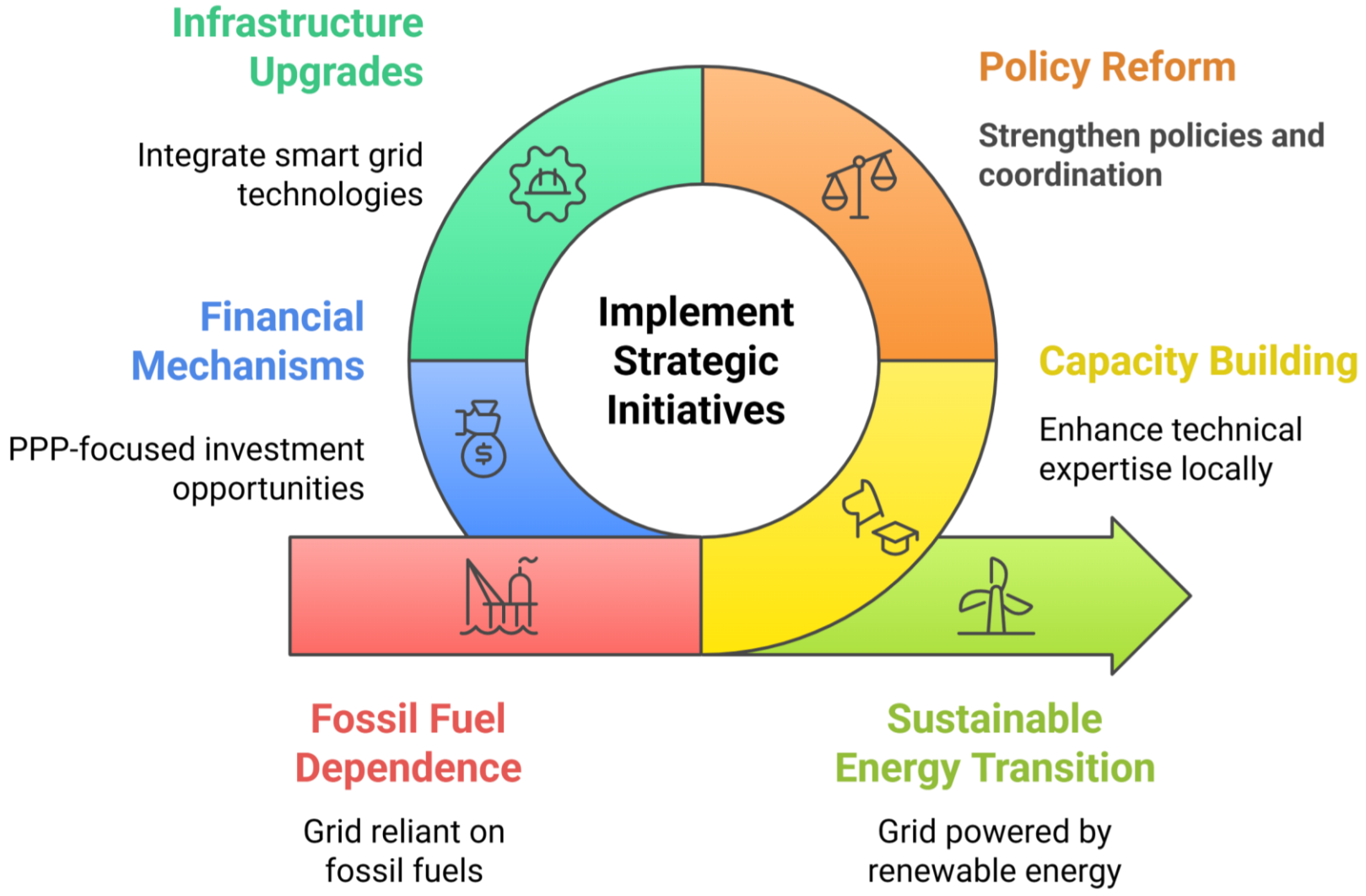
Assess Renewable Resources

Conduct resource assessments and feasibility studies

Develop Financial Mechanisms

Create financial tools and risk mitigation strategies

Conclusions



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Questions?

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Kom Kmal Mesulang

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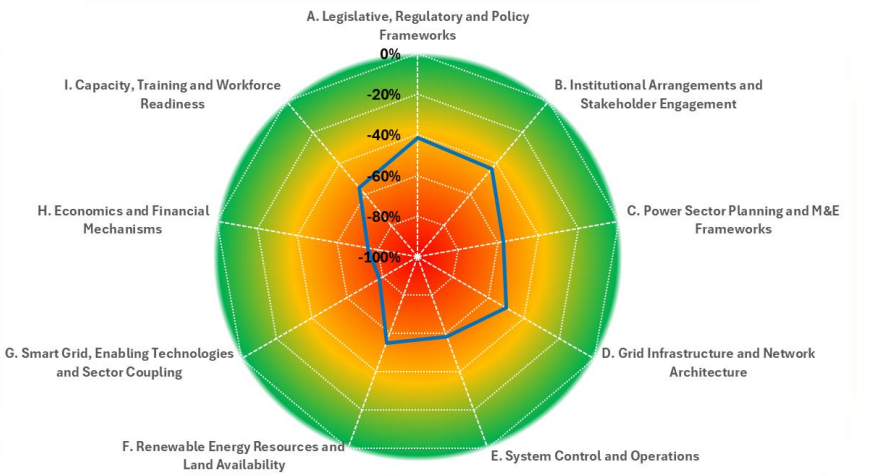

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