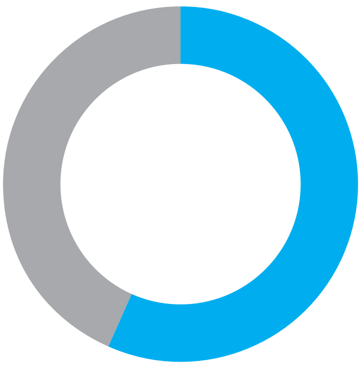
Grid integration assessment:
Viti Levu, Fiji

International Renewable Energy Agency

POWER GENERATION MIX (2017)



- Diesel **100 MW**
- Hydropower **130 MW**

- Higher consumption for diesel

GRID INTEGRATION ASSESSMENT

IRENA studies on the Viti Levu power system assessed:

- **Solar resource potential at island-level**
- **Potential levels for incorporating solar PV (both distributed and utility-scale) into a stable local island system**

The studies provided:

- **Technical analysis**
- **Policy guidance in relation to Fiji's climate NDC**

RECOMMENDED GRID UPGRADES

- Grid reinforcement
- Fault ride through of PV systems
- Curtailment and grid code
- Corrective measures

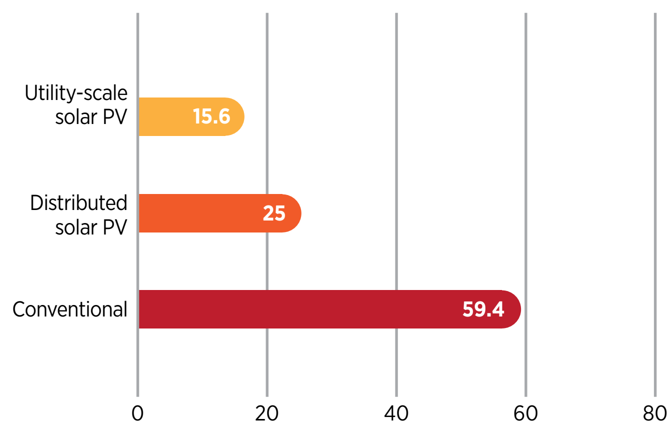
IMPACT

Achievable generation mix

- Diesel **100 MW**
- Hydropower **130 MW**
- Distributed solar PV **100 MW**
- Utility-scale solar PV **25 MW**

- **40 MW** of roof-top distributed PV
- **25 MW** of utility-scale PV

Achievable shares (%) at 160 MW peak demand



Summary of findings

from IRENA's Grid Integration Assessment for **Viti Levu, Fiji**

POWER SYSTEM CONDITIONS (2017)

The power system on Viti Levu is characterised by peak demand of **160 MW** and valley demand of 63 MW, with projected annual growth of 3%, according to Energy Fiji Limited (EFL). The island has **29 substations**, with power being distributed through radial 11 kV and 415/240-volt feeders. Additionally, there is around 10 MW of wind power generation.

THE STUDY

Through this grid assessment for island of Viti Levu, the International Renewable Energy Agency (IRENA) aims to assist Fiji in achieving formulated objectives. The study provides technical analysis and addresses the policy changes required to facilitate solar PV deployment on the island, supporting the implementation of Fiji's nationally determined contribution (NDC) to meet climate goals under the Paris Agreement.

Power system model:
The power system model of Viti Levu was developed using Power System Simulator for Engineering (PSS/E)® to conduct steady-state and dynamic simulations and was and later converted to Digsilent PowerFactory®. Simulated generation dispatch scenarios included those expected to cause severe challenges in the system due to high PV penetration and low synchronous generation. The inherent variability of solar PV and the practice of load shedding was also included in the study. EFL provided the data used to develop the model.

SIMULATION STUDIES

Feeder level:
Studies were initially conducted at feeder level, without any upgrade or extension. They included:

- **instantaneous power flow analysis;**
- **sequential power flow analysis; and**
- **short-circuit analysis.**

These were conducted on representative feeders of four zones categorised as industrial, commercial and residential, and chosen in agreement with EFL, to assess the impact of rooftop DPV for high, low and zero demand snapshots.

System level:
The feeder-level analysis was followed by system-level analyses including:

- **N-1 contingency analysis;**
- **transient stability study;**
- **frequency stability study; and**
- **voltage stability study.**

These analyses simulated three-phase faults and the trip of a major generation plant at transmission system level at high PV/low demand and high PV/high demand scenarios.

RECOMMENDATIONS

The study recommended the following for Viti Levu:

- Consider **40 MW of roof-top distributed PV and 25 MW of utility-scale PV** as the conservative upper bounds for a first stage of PV deployment in Viti Levu, Fiji.
- Upgrade **voltage compensation** methods of on-load tap changers.
- Implement **fault ride-through** according to Australian grid code.
- Implement **dynamic frequency limits** in PV inverters.
- Consider curtailment of utility-scale PV in critical scenarios.
- Use operational measures to achieve **voltage regulation**.
- Adapt **reserve requirements** for PV deployment.
- Adjust the **ramp rate requirements** of conventional generation to accommodate PV inclusion.

GRID DEVELOPMENT OPPORTUNITIES

- Initially, **25 MW** of PV could be deployed in the system at **utility scale**.
- **10–40 MW** of distributed PV could also be installed, depending on technical requirements.
- The total PV share could reach **65 MW** if the grid code were modified.

kV = kilovolt	GW = gigawatt	PV = photovoltaic
MW = megawatt	GWh = gigawatt hours	DPV = distributed PV

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Based on a grid assessment study (IRENA, 2019) carried out at the request of Fiji.