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WEBINAR SERIES

International Renewable Energy Agency

Grid Stability with High Share of Renewables - Transforming Small Island Power Systems

Presenter:

- Gayathri Nair, Grid Integration team

TUESDAY, 18 FEBRUARY 2020 • 10:00 – 10:30 CET

Grid Integration – What we do?

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Assist Member States and stakeholders in addressing key questions on integration of Renewable Energy/Variable Renewable Energy:

- Technical constraints in the power system for integrating VRE
- The enablers and advanced technologies
- Hosting capacity of the existing power system
- Resource diversity
- Pathway to 100% renewable power system
- Improving power system resilience

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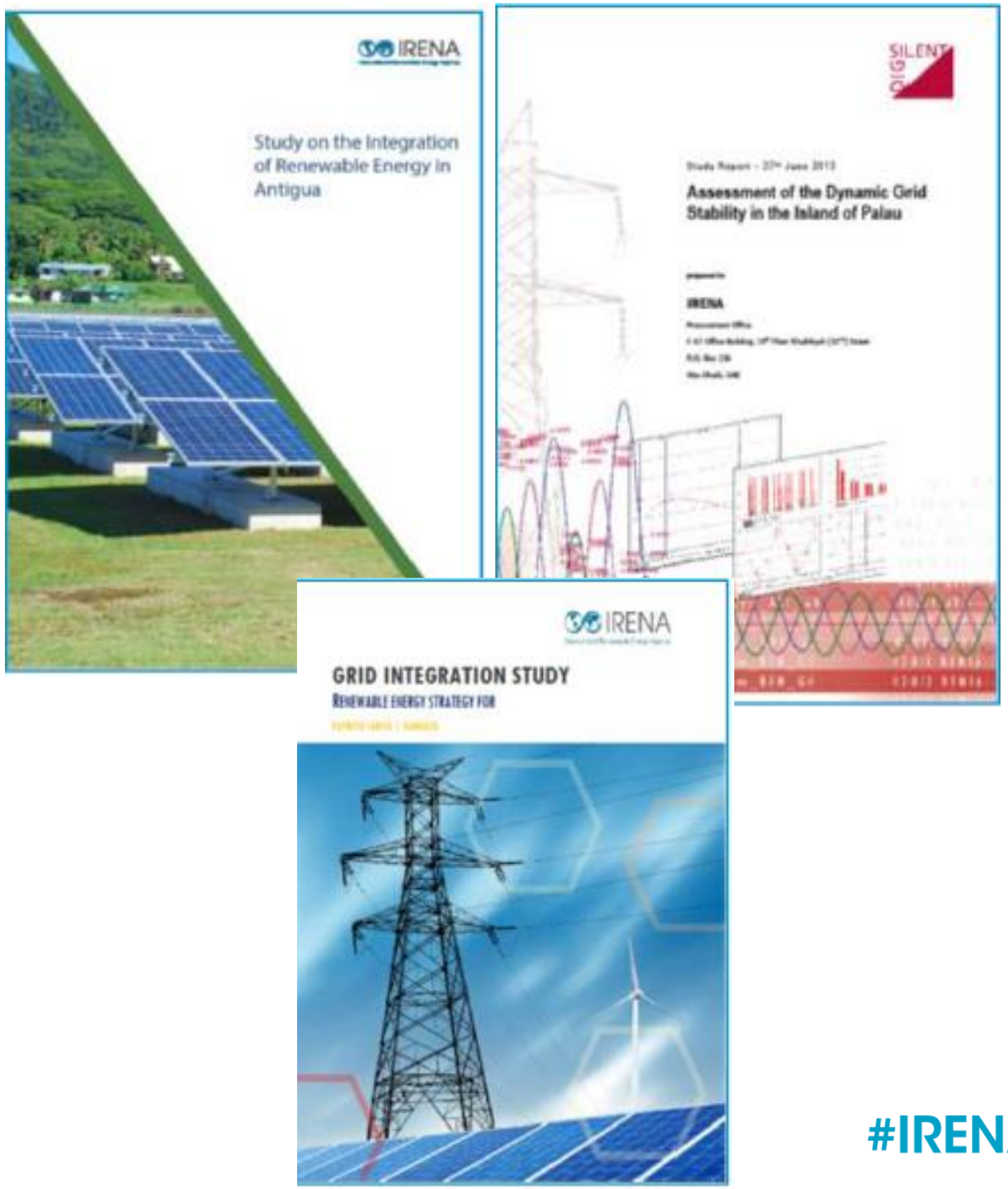
Grid studies to date

- **Antigua and Barbuda**
    - Island of Antigua (2015)
- **Cook Islands**
    - Island of Aitutaki (2015)
- **Samoa (independent state)**
    - Island of Upolu (2014, 2016)
- **Palau**
    - Island of Palau (2013)
- **Vanuatu**
    - Island of Espiritu Santo (2018)
- **Fiji**
    - Island of Viti Levu (2019)
- **Dominican Republic**
    - National power grid (2019)
- **Tonga**
    - Nine islands (ongoing)
- **Mozambique**
    - Two asynchronous systems (ongoing)



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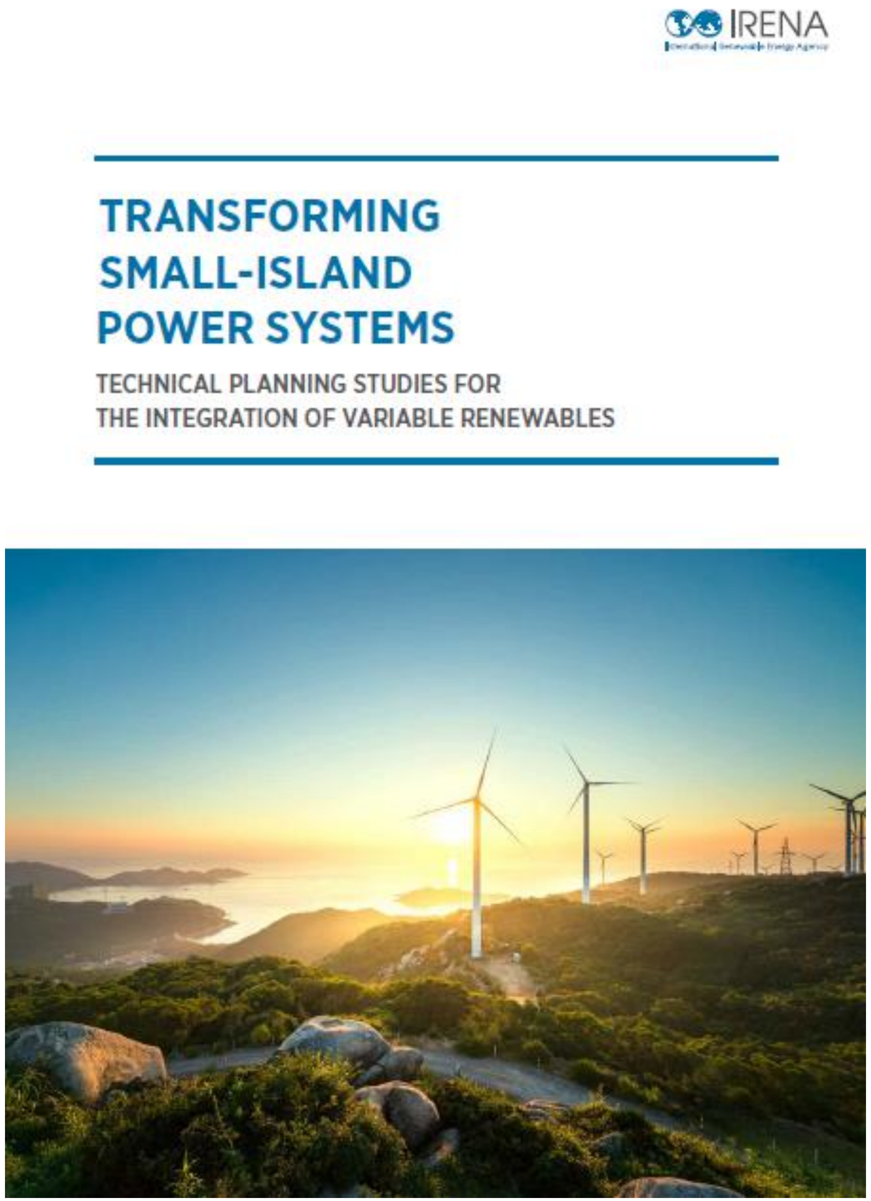
Grid Integration – Transforming Small-Island Power Systems



Highlights

- **the expected challenges** associated with Variable renewable energy (VRE) integration in Small Island Developing States (SIDs);
- **the VRE integration planning** required to overcome technical challenges,
- **the technical studies needed** to analyse and quantify such challenges, and how to carry out these studies;
- **the solutions required to overcome** VRE integration challenges.

https://www.irena.org/publications/2019/Jan/Transforming-small-island-power-systems

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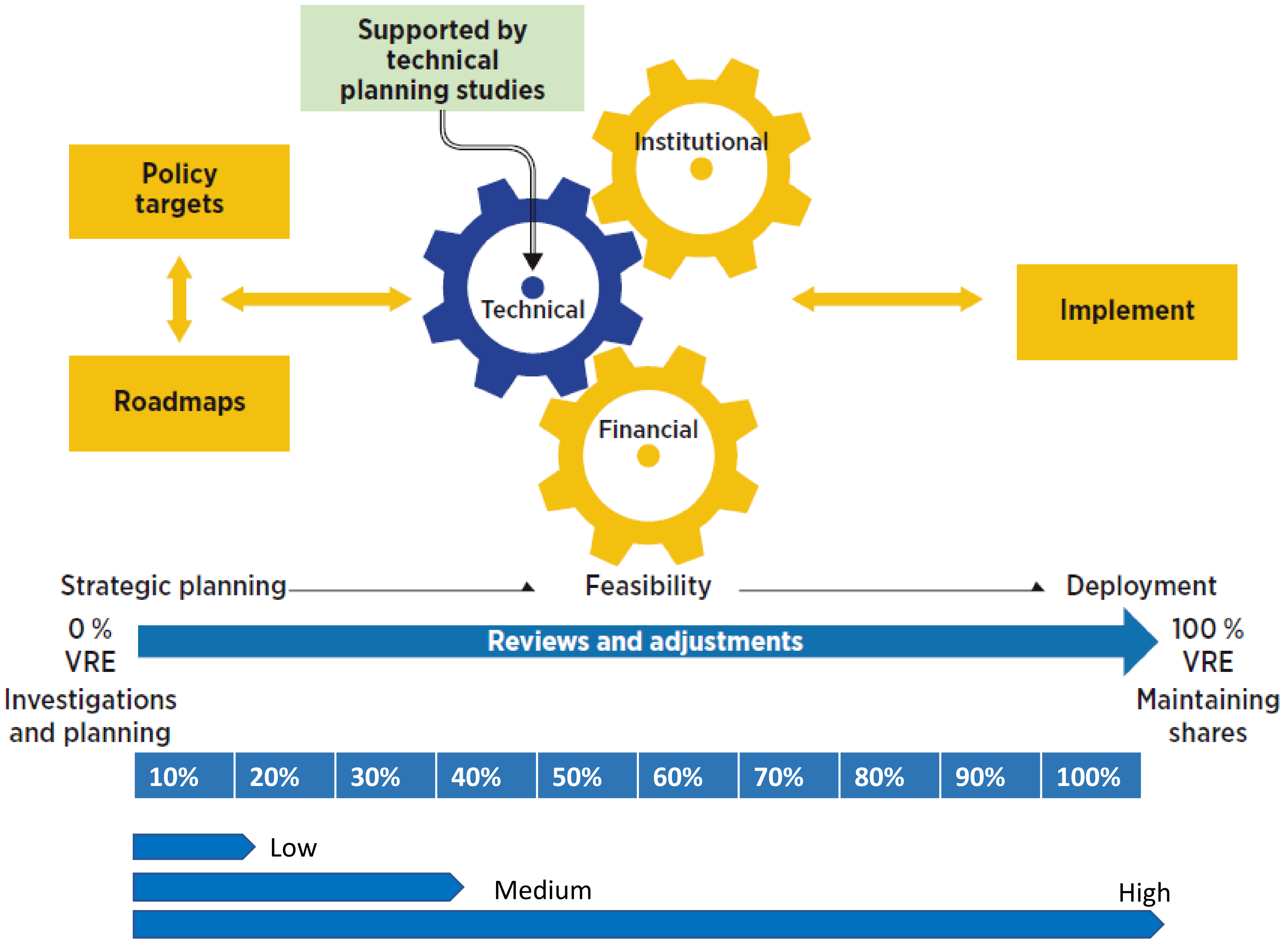
Transformation of the SIDS power systems-The strategy



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VRE Integration and why we need grid assessment

System Specific Challenges

- Limited primary resource
- Uncertainty in demand growth
- Small size of the system
- Compliance with environmental constraints

VRE Challenges

- Non-synchronous- affects frequency and voltage response and control
- Location constrained- needs more transmission capacity
- Uncertainty- needs more flexibility
- Variability-affects firm capacity and therefore needs more flexibility and

Technical studies for VRE Integration in the different planning time frames

Expansion Planning: long/mid-term

Load and Generation Balancing studies

- Generation adequacy
- Sizing of operating reserves
- Generation scheduling

Operational Planning: short term

Network Studies

- Static network analysis
  - Load flow
  - Static security
  - Short-circuit studies
- System stability analysis
  - Transient Frequency and Voltage
- Special network analysis
  - Defence plans
  - Grid connection studies

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Solutions for better integration of VRE-Infrastructure investments and Operational Measures

- Diversification of VRE installations
- Flexible generating units
- Energy storage systems
- Grid Reinforcements
- Distribution automation and smart grid technologies
- Interconnection with neighboring countries

- Demand response programs
- Enhanced generation dispatch and control
- Enhanced defense plans
- Automatic power controller and network monitoring
- Short term VRE forecast

Grid Integration – Grid study for the Island of Viti Levu, Fiji

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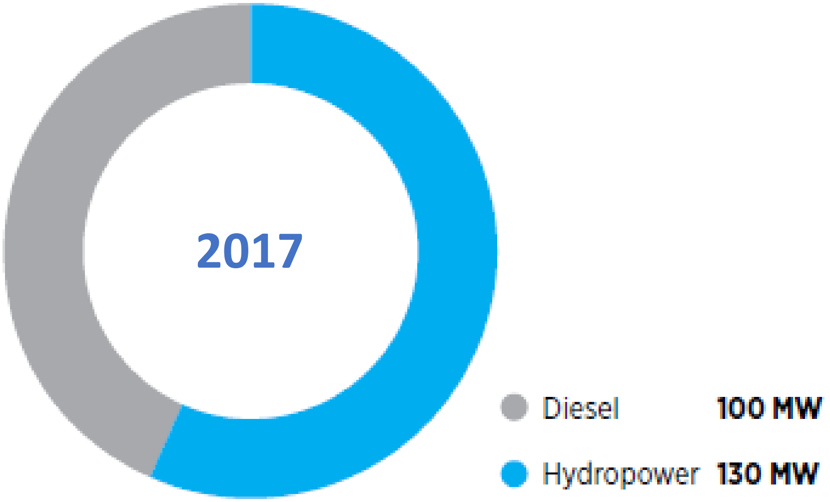
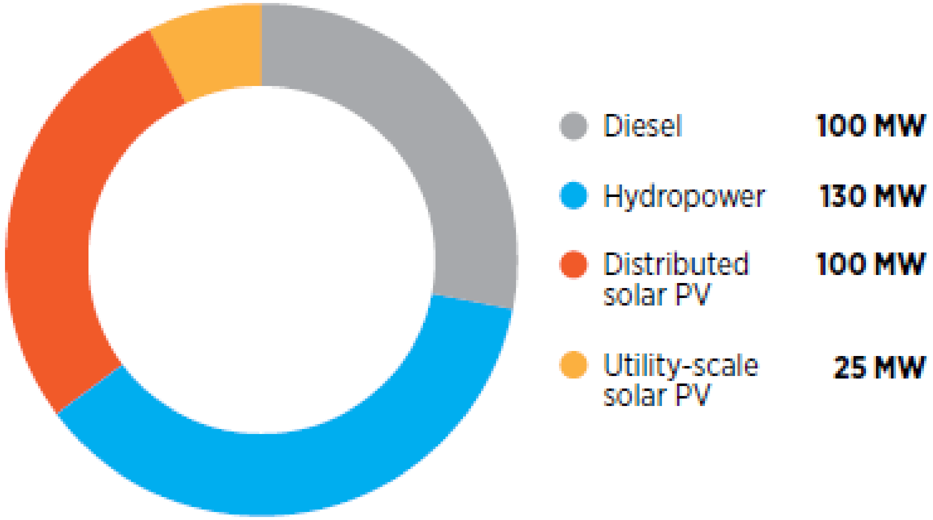
Power Generation Mix



Achievable generation mix



Technical studies conducted

Feeder level:

- Instantaneous and sequential power flow analysis
- Short-circuit analysis.

System level:

- N-1 contingency analysis;
- Transient stability study;
- Frequency stability study; and
- Voltage stability study.

Recommendations

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

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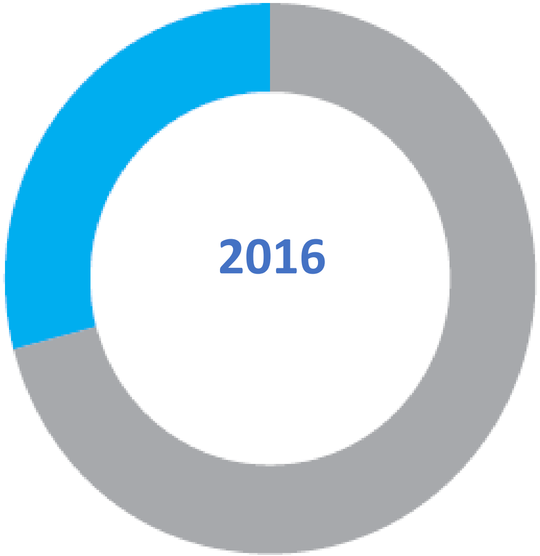
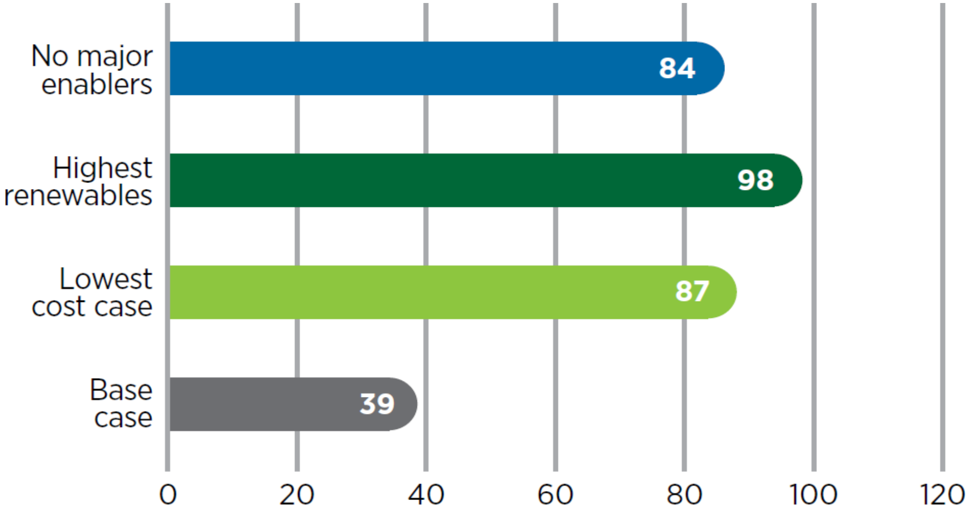
Grid Integration – Grid study for the Island of Espiritu Santo, Vanuatu

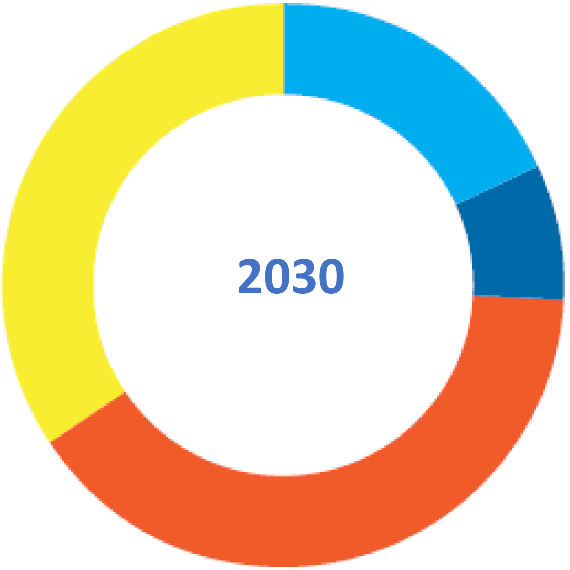
Dispatch at Peak Demand



Renewable Shares (%) Achievable By 2030



Achievable dispatch at peak demand



Technical studies conducted

- Frequency stability analysis
- Voltage stability
- Transient stability analysis
- Contingency analysis

Recommendations

- Installation of batteries/storage
- Diesel UPS
- Solar PV
- Hybrid control system

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Grid Integration – Grid study for Dominican Republic

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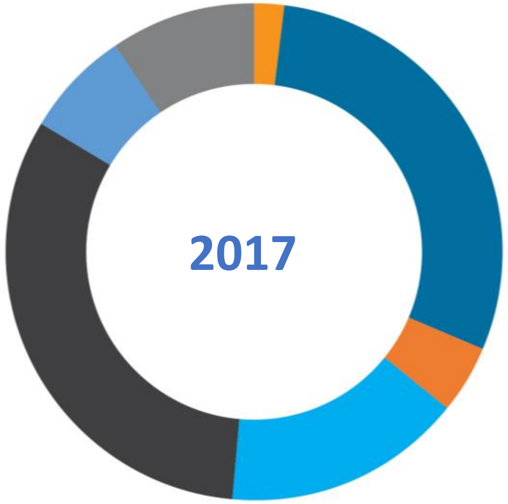
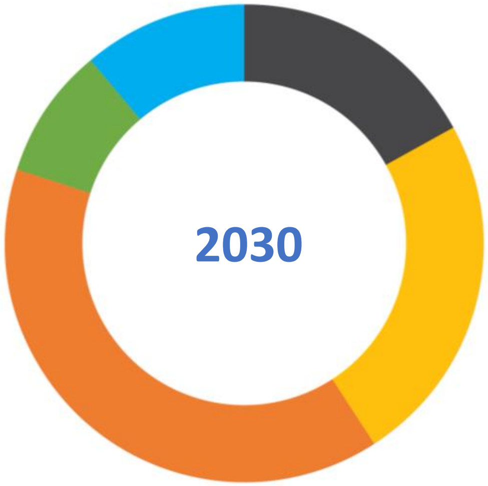


Combined cycle	29%
Wind power	5%
Hydropower	15%
ICE	32%
Gas turbine	7%
Steam turbine	9%
Solar Generation	2%



Coal	17%
Solar	24%
Wind	39%
Landfill	9%
Biomass	0%
Hydropower	11%
Fuel	0%
Gas	0%

Technical studies conducted

- 2020 (17% Renewable)
- 2025 (25% Renewable)
- 2030 (45% Renewable)

- Frequency stability analysis
- Voltage stability
- Transient stability analysis
- Contingency analysis

Snapshots considered for study

- Peak demand
- Mean demand
- Low demand

Recommendations

Wind ↑ 36% Gas ↓ 25%

Solar ↑ 24% Coal ↓ 15%

Fuel ↓ 26%

vs. 2018 base year

- Battery storage capacity
- Grid reinforcement
- Parallel transmission lines
- Corrective measures

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Questions & Answers

grid.integration@irena.org

Please use the ‘Questions’ feature on the webinar panel

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Next webinars

- TUESDAY, 3 March 2020 • 10:00 – 10:30 CET
  “Planning for the renewable future: improving use and development of long-term energy scenarios”

- TUESDAY, 17 March 2020 • 10:00 – 10:30 CET
  “Innovations for 100% renewable power: a systemic approach”

Thank you!

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