

## RENEWABLE ENERGY MINI-GRIDS

### WHAT ARE RENEWABLE MINI GRIDS?

Renewable mini-grids (RE mini-grids) are defined as one or more local electricity generation units mainly from renewable energy sources that provide access to reliable and affordable electricity in remote locations. The generation sources include solar photovoltaic (PV) and wind with battery storage, biomass, micro and mini hydro plants, and hybrid systems. With low or zero fuel costs, RE mini-grids are cost-effective and reduce carbon footprints. They can function independently without being connected to the national grid. RE mini-grids have also played an important role in rural electrification, especially where grid extension was not a viable option.

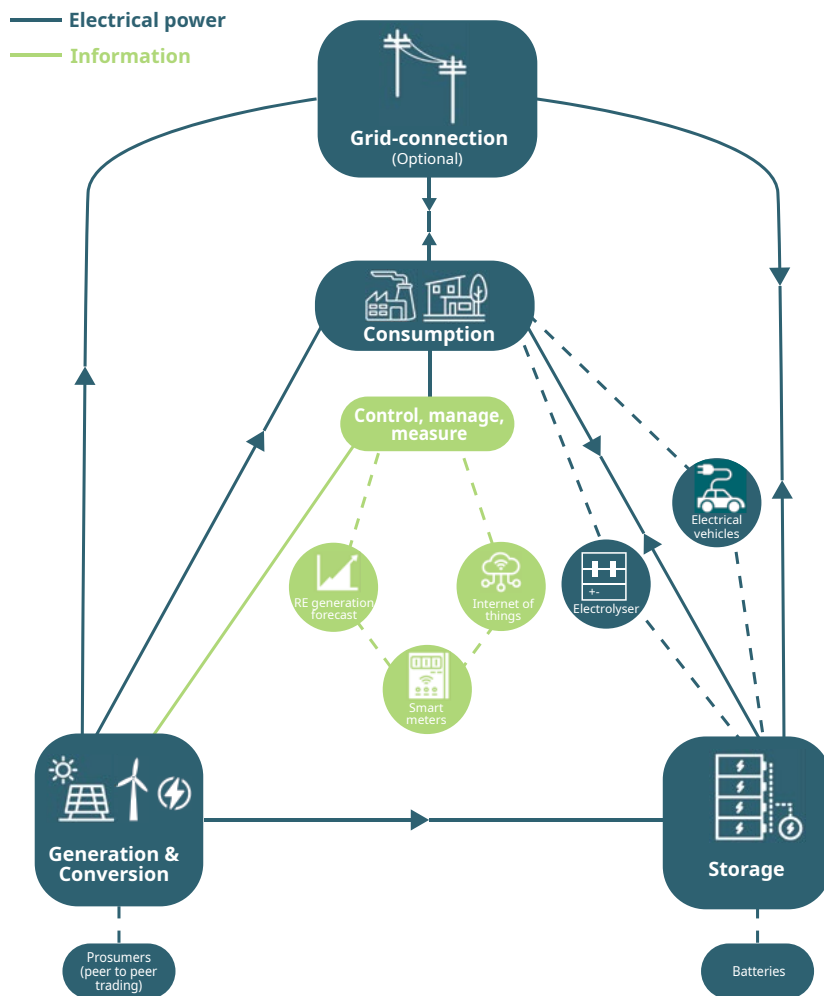


Figure 1: Renewable mini-grids for the future

### A CLOSER LOOK AT RE MINI-GRIDS

The core functionalities for a renewable mini-grid are power generation, energy storage, conversion, consumption, and control, management and measure (CMM). Typically, RE mini-grids have a capacity of not more than 15 MW.

*RE mini-grids allow consumers to climb the energy access ladder.*

### KEY FACTS

Switching from conventional mini-grids to solar mini-grids will potentially save up to **470 MILLION METRIC TONS** of global carbon emissions annually, which is **equivalent to Brazil's annual carbon emissions**.

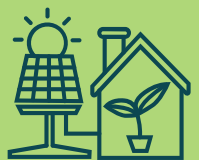


A global market with an installed capacity of **4.16 gigawatts (GW)** of off-grid renewable energy mini-grids, **predominantly powered by bioenergy** linked to industrial mini-grids.

**HYDROPOWER MINI-GRIDS** in particular have recently increased their deployment in the community and industry sectors [1].



**SOLAR PV MINI-GRID** installations are commonly used for commercial, community, and agricultural purposes [1].



**98%**

In Tanzania, smart meter data showed that the **reliability of renewable mini-grids was 98%**, while the reliability of the national grid was just 47%.

**TABLE 1: TYPES OF GRIDS**

Type	PICO	Solar Home Systems	Mini-Grids	National Grids
Capacity	1-11 Wp	10-250 Wp	< 15 Wp	> 15 MW
Scale	Small home appliances and devices such as calculators, toys, cameras, cell phones and tablets	Standalone systems for residences	Decentralized systems for a localized group of customers isolated from the grid, involving one or more small-scale electricity generation units (solar PV, fuel cells, micro hydro, wind, storage devices such as flywheels and batteries)	Interconnected network that provides electricity to multiple customers over large distances
Market	Remote communities	Isolated users/ institutions, remote communities	Isolated users/ institutions, remote Communities, rural towns	Regional and urban areas

**TABLE 2: CLASSIFICATION OF RE MINI-GRID TYPES AS PER THE OFF-TAKER**

Type 1	Type 2	Type 3
<b>Size</b> 1-10 MW	<b>Size</b> 100 kW-1 MW	<b>Size</b> < 100 kW
<b>Off-taker</b> State utility Anchor client Local community	<b>Off-taker</b> Anchor client Local community	<b>Off-taker</b> Local community
<b>Comments</b> Small IPP More predictable revenue system Post-payment Captive supply license Often connected to the grid	<b>Comments</b> Micro concessions or micro IPPs Part of the licensing & tariff regime	<b>Comments</b> No standard business models May be exempt from the licensing & tariff regime

**Advantages of scaling up RE mini-grids**

Further deployment of renewable mini grids is driven by a mix of benefits provided: energy access, energy cost savings (including fuel savings), improved service quality and supply independence, reduced carbon dioxide (CO<sub>2</sub>) emissions and pollution, and fulfilment of renewable energy targets.

**FINANCIAL FACTS**

Renewable mini-grids are becoming economically viable and are an attractive cost-competitive option to conventional generators. The levelized cost of electricity (LCOE) of renewable mini-grids ranges from \$0.39 per kilowatt-hour (kWh) to 0.75 \$/kWh, with prospects of decreasing to 0.20 \$/kWh by 2035, in comparison with small gasoline and diesel generators (0.35 \$/kWh to 0.70\$/kWh) [2].

**EMERGING TRENDS**

Low-voltage direct current (LDVC) mini-grids and appliances are essential and are having an upward trend. The characteristics of renewable mini-grids (DC power generation, limited system, size and user profiles) also enable the introduction of "new" means of distributing energy to the end user to make its consumption more efficient and cost-effective.

**REFERENCES**

- IRENA. 'Quality infrastructure for smart mini-grids' (2020) [Online]. Available: [https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Dec/IRENA\\_Smart\\_mini-grids\\_outlook\\_2020.pdf](https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Dec/IRENA_Smart_mini-grids_outlook_2020.pdf)
- IRENA. 'Renewable mini-grids' (2019) [Online]. Available: [https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA\\_Renewable\\_mini-grids\\_2019.pdf?la=en&hash=CFE9676B470A96F7A974CB619889F5810A06043E](https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_Renewable_mini-grids_2019.pdf?la=en&hash=CFE9676B470A96F7A974CB619889F5810A06043E)

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**Supported by:**


Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

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