

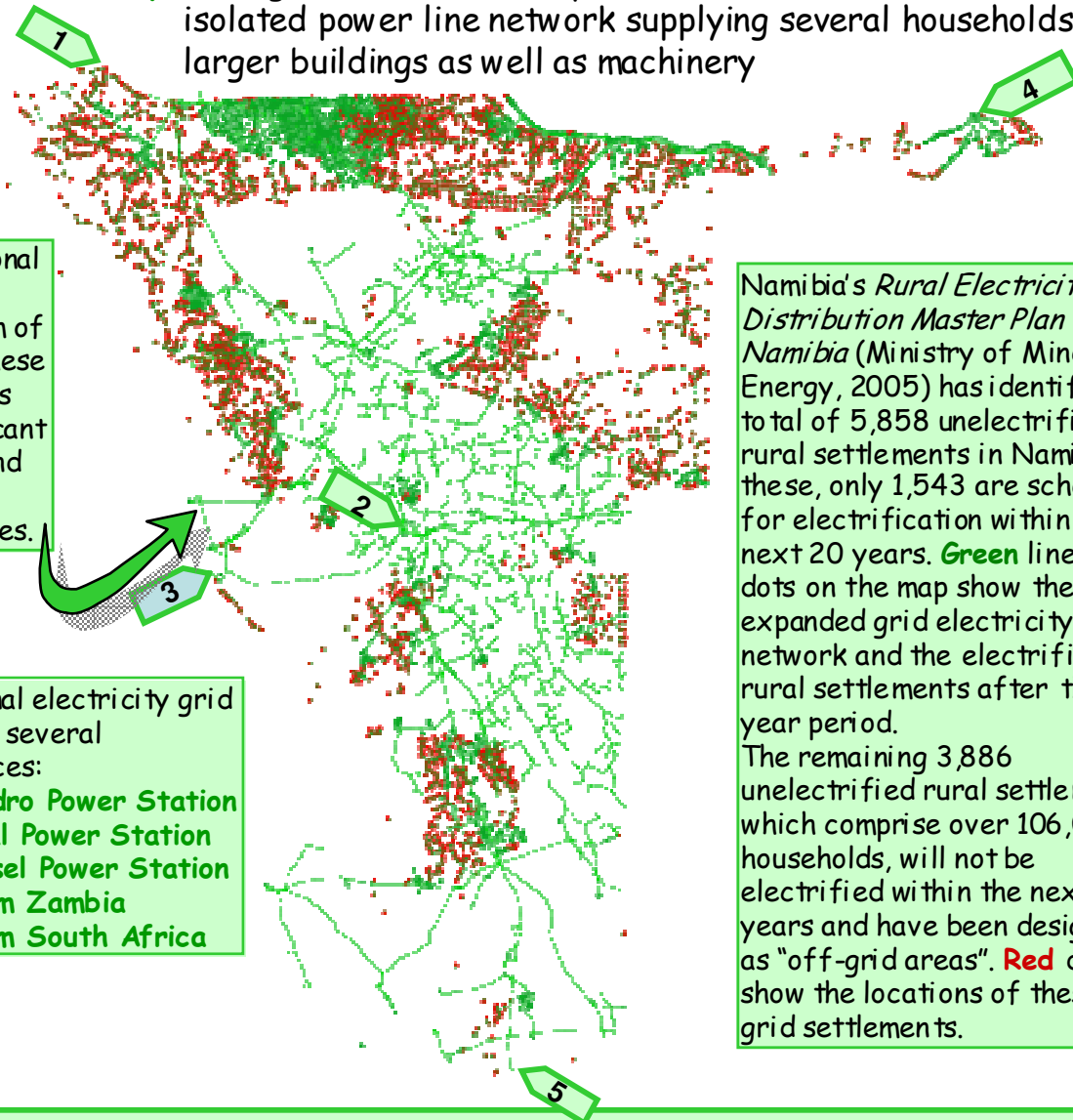
Electrification with Grid, Off-grid & Mini-grid



Electricity is regarded as a most versatile and flexible form of energy. However, in Namibia less than 70% of urban and 13% of rural households have access to electricity.

There are three different ways for households to get access to electricity:

1. **National Electricity Grid:** an extensive network of power lines connected to large power stations
2. **Off-grid Electricity:** through power sources such as diesel or solar supplying an individual or small cluster of households
3. **Mini-grid Electricity:** through a decentralised power station connected to a small isolated power line network supplying several households and larger buildings as well as machinery



Namibia's national grid comprises over 16,000 km of power lines. These long power lines require significant maintenance and result in electricity losses.

Namibia's national electricity grid is supplied from several electricity sources:

1. Ruacana Hydro Power Station
2. Van Eck Coal Power Station
3. Paratus Diesel Power Station
4. Imports from Zambia
5. Imports from South Africa

Namibia's Rural Electricity Distribution Master Plan for Namibia (Ministry of Mines and Energy, 2005) has identified a total of 5,858 unelectrified rural settlements in Namibia. Of these, only 1,543 are scheduled for electrification within the next 20 years. Green lines and dots on the map show the expanded grid electricity network and the electrified rural settlements after this 20 year period. The remaining 3,886 unelectrified rural settlements, which comprise over 106,000 households, will not be electrified within the next 20 years and have been designated as "off-grid areas". Red dots show the locations of these off-grid settlements.

National Electricity Grid

The traditional model of electric power generation and delivery is based on the construction of large, centrally located power plants. Regardless of where power plants are located, their power must be brought from the plant to the users, and that's the purpose of the **electricity grid**.



The grid consists of two structures: the high-voltage transmission systems, which carry electricity from the power plants and transmit it over hundreds of kilometers to where it is needed, and the lower-voltage distribution systems, which draw electricity from the transmission lines and distribute it to individual customers. Grid electrification is very expensive due to the high cost of the infrastructure and its maintenance. It is thus not always an option, especially in large and sparsely populated countries with remote villages like Namibia.

Off-Grid

Off-grid refers to the electrification of individual or small clusters of households totally independent from an electricity grid. Common technologies used for off-grid electrification are solar, wind and diesel power generators. Solar Home Systems are a typical off-grid energy solution in rural Namibia, and many farms operate larger solar systems or diesel generators at the homestead.

Off-grid technologies are limited in their electricity supply, which is why they are often combined with other technologies for example:

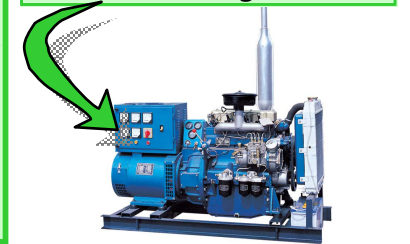
- A Solar Home System provides electricity for lighting, refrigeration and TV, while gas is used for cooking and water heating
- A diesel generator provides electricity, while gas is used for cooking and a solar water heater for heating water

Off-grid technologies offer a viable alternative to costly grid electrification, but require that households learn to manage their own electricity supply.



80 W (0.08 kW) Solar Home System

10 kW diesel generator



Mini-grids

There are electrical supply systems which are not connected with the national grid, but which generate their own electricity and supply an entire village. These systems are known as **mini-grids**.

Mini-grids vary in size:

- Tsumkwe village is supplied with 24 hours electricity from three large diesel generators
- Gam settlement is supplied with a few hours of electricity each day from one diesel generator
- Gobabeb Training and Research Station is supplied with 24 hours of electricity from solar energy, with diesel generators as back-up

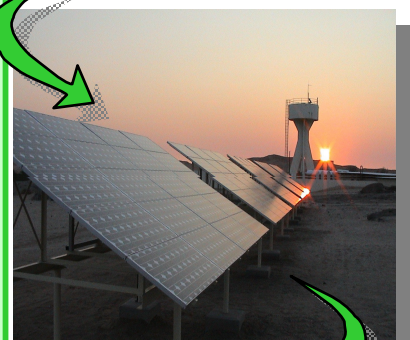
A mini-grid can be more cost-effective than a connection to the national grid, but this depends largely on the electricity supply source. Most mini-grids in Namibia use imported diesel fuel, which makes them very expensive to operate as the diesel prices increase.

A mini-grid's electricity is far more versatile than a single off-grid system and can cater for many electricity needs. Users are however required to use electricity efficiently. If a few users operate wasteful appliances, such as electric geysers, then electricity supply to the entire community can be negatively affected.



A 150 and 350 kW diesel generator at Tsumkwe

Gobabeb 26 kW solar



Hybrid mini-grid?

A hybrid mini-grid uses at least two different energy supply sources, such as a combination of solar and diesel. This reduces the dependence on any single energy source, ensures that peak electricity demand can still be met, and significantly reduces the operating cost.

Gobabeb is one of the largest solar hybrid mini-grids in Southern Africa with a solar installation of 26 kWp and two diesel generators of 50 kVA. The station continuously supplies between 30 and 70 residents.

Additional Information

http://www.dme.gov.za/energy/renew_hybrid.stm

http://www.enviro-energytech.com/Renewable_Energy_Primer.htm

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