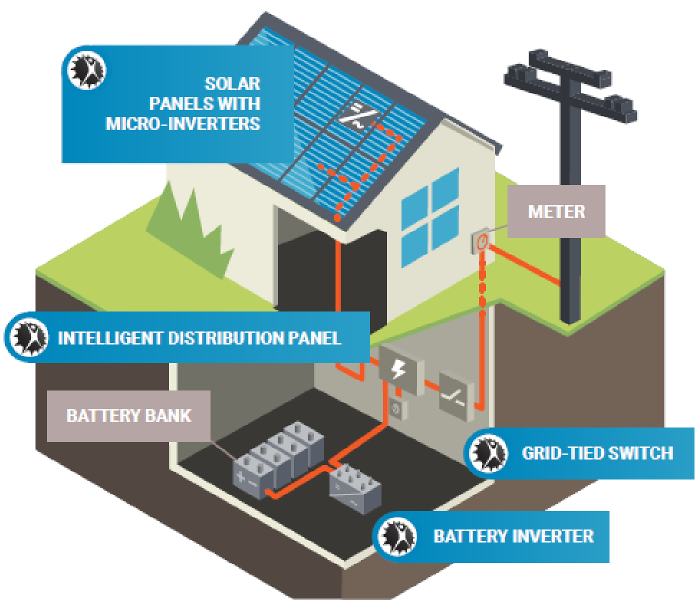
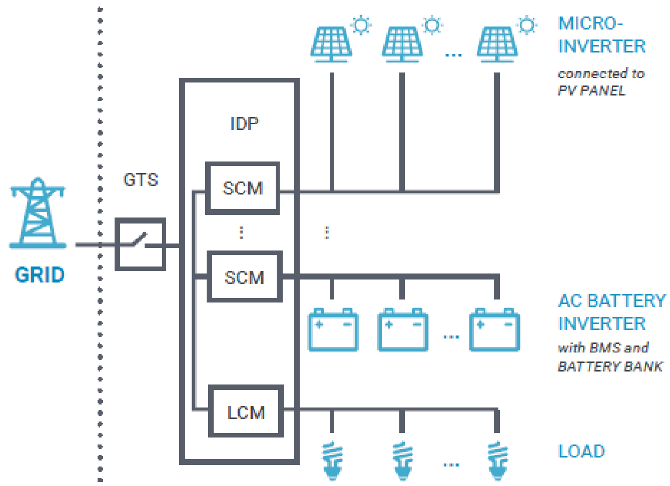
Self Forming Nanogrid Brief

Enabling the next generation of AC systems

Self-forming nano grid (SFnG)



SFnG system architecture



Solantro has demonstrated a working 10kw Self-Forming nanoGrid (SFnG) suitable for residential or small commercial applications. The all-AC SFnG can operate either in grid tied and off-grid modes and seamlessly switch between modes. The SFnG can form from the utility grid or self form from its own batteries for off-grid applications.

The SFnG is inherently scaleable and arbitrary numbers of energy sources, storage devices, and loads can be connected to the SFnG in a plug and play manner. The SFnG can provide consumer side services such as back-up power, cost reduction, peak demand limiting. The SFnG can also provide utility support services such as demand response, time shifting, reactive power and transient smoothing.

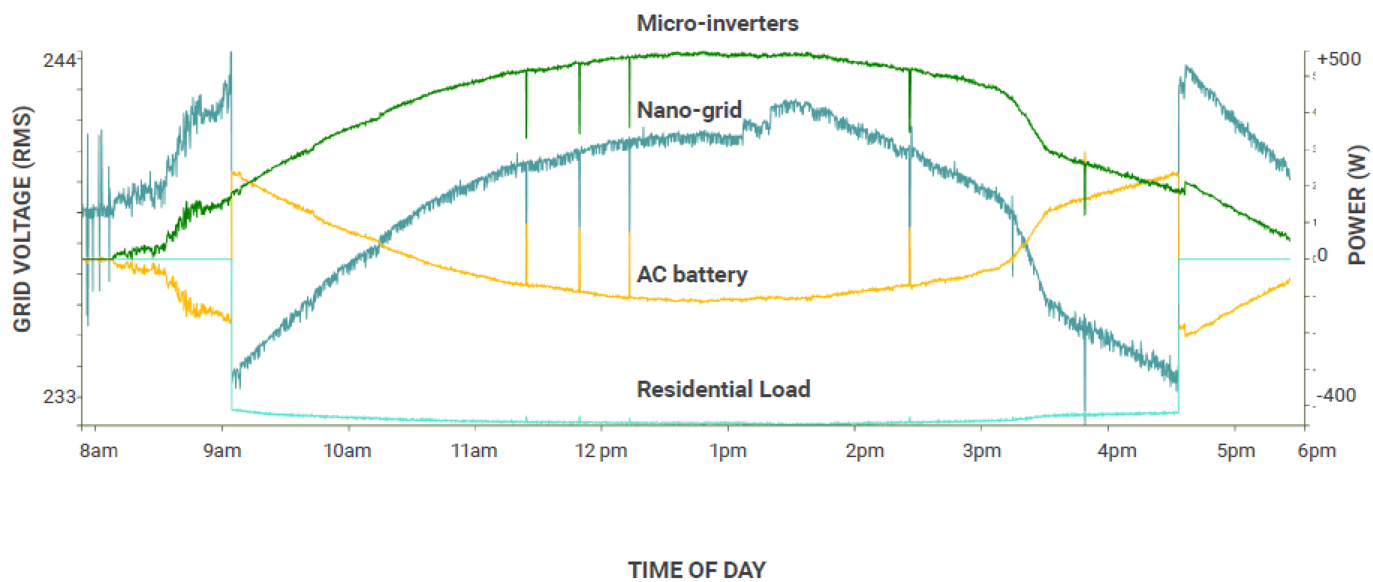
Field trials at Solantro and the University of Ottawa's Sun Lab confirmed for reliable generation, storage, and electrical performance.

The SFnG is entirely AC. Storage connects to the SFnG through a bidirectional battery inverter and PV generation through micro-inverters, eliminating DC cabling and enabling arbitrary panel and battery configurations.

This 'Plug and Play' system can be assembled like Lego blocks, reducing the need for expensive installation and maintenance.

Solantro's innovation brings a reliable, cost effective, safe energy solution to the global community, and will transform our energy generation and use for a more sustainable future.

SFnG daytime operation



Description for daytime operation

The graph above shows nanogrid behavior over a 12hour period from approximately 6 AM to 6 PM. Grid voltage is shown in blue and measured on the left-hand axis. Battery, load and PV powers are shown in yellow, red and green and measured on the right-hand axis. The nanogrid consisted of two battery inverters and 4 PV inverters.

Before 8 AM the PV inverters are off-line and PV power is zero. The grid load is also zero and the batteries are idle and neither charging or discharging. In this completely unloaded condition the batteries oscillate between charge and discharge and the grid voltage also oscillates with an amplitude of about 8V. Since there is nothing connected to the grid this is acceptable. At 8 AM the PV inverters being to wake up and connect to the grid. The grid voltage rises and the batteries begin to charge.

At about 9 AM a 400W load connects, the grid voltage drops and the batteries switch to discharge. PV power continues to increase until about 1:00 PM. The batteries begin to charge at about 10:30 AM and then switch to discharge again at about 3:30. By about 4:45 the grid voltage has dropped to below the load's disconnect threshold and the load disconnects. The grid voltage again rises and the batteries begin to charge. The grid was manually shut down at 5:30 PM.

Grid Control based on Resistive Droop

- Nano grid voltage, VGRID, decreases "droops" with increasing load
- Generators respond to VGRID changes
- VGRID > 240V signals storage to charge
- VGRID < 240V signals storage to discharge
- PV reduces output power when VGRID > VMAX1
- Loads start / stop based on VGRID
- Storage stabilizes grid against load and PV variation

Major components

- PV Micro-inverter (PVI) – 320W, panel mounted,
- Battery Inverter (BI) – 1kW,
- Split Phase Generator –generates 120V from 240V
- Intelligent Distribution Panel
- Grid Tie Switch – connect/reconnect of nano grid to utility grid + sensing
- Commercial (3.4kW) LiFeP batteries
- Panels :300W