Energy Power Systems Australia

Introduction to Cat® Hybrid Microgrid

Presenter – Ronald Hall, Segment Manager – Hybrid Microgrid Systems
Why Hybrid Microgrid?

Diesel / Gas Generator
• Low CAPEX
• High OPEX
• Moderate Stability
• High Reliability
• High CO₂ emissions

Solar PV
• Low CAPEX
• Low OPEX
• Unstable
• Low Reliability
• No CO₂ emissions

Battery Storage
• High CAPEX
• Low OPEX
• High Stability
• High Reliability
• Low CO₂ emissions
Economic logic

Off Grid Hybrid Economic Justification

- Customer Savings
- Diesel Fuel
- PV / Wind Diesel Hybrid
- Generator

Generators only
- Lower CAPEX
- Higher OPEX

Hybrid
- Higher CAPEX
- Lower OPEX

Customer 10-Year Spend $

- Commercial / Industrial solar PV
- Commercial / Industrial Diesel Generator

$0.60 $0.50 $0.40 $0.30 $0.20 $0.10 $0.00

2000 2010 2020
Cat® PV Module

Features

The Cat PV module has a dark Monolithic look that is a feature coveted by developers worldwide. It is made from toughened glass and has a frameless design that helps with cleaning and avoids dirt buildup at the module edge.

- Cadmium Telluride CdTe (thin film)
- Durable and recyclable frameless glass-glass laminate
- Low embodied energy and carbon
- 25-year Linear Power Output (Guaranteed)
- Robust against shading in landscape orientation (perpendicular to cells)
- High energy yield in real operating conditions
- Low temperature coefficient (-0.29% /°C to -0.34%)
- 60 x 120 cm, 11kg
SOLAR INVERTER

Built-in Wi-Fi for fast commissioning, advanced communications and smart inverter grid support functions, commercial installations are up and running faster and simpler than ever.

- SMA is the leading Solar inverter brand on the market
- Online monitoring platform called sunny portal
- Will be branded Cat® (2017)
- Sizes range from 4kw up to utility scale 1.5MW
- Q on Demand 27/7 active KVAR absorption
- 10 year warranty
MMC Controller (s/m/l)

- Comes in Small, Medium, Large
- PC Based controller optimised over 11 years
- Fully designed by Cat® to operate with Cat® Microgrid equipment
- Open protocol Comms can communicate with almost anything
- Configured by Cat® engineers and acceptance tested to site configurations in factory
- Scaled platform for small to large installations
- Integrates all energy sources
- Optimizes production of energy
CAT
BI-DIRECTIONAL INVERTER

• Non linear droop control
• Rated at 250kw (continuous)
• Based on the D7e Hybrid tractor inverter (mines compliant)
• Frequency and voltage control  
  (4 Quadrant power quality control)
• Can be paralleled for larger sites (unlimited)
• 10 minute / 125% overload capacity
• Capable of 256% short duration overload <3sec
Caterpillar Patented Non-linear Droop

- Transient assist during initial speed drop is crucial for the recovery of genset during motor start
- Nonlinear droop maximizes ESS early contribution while maintaining grid stability
- Overall lower freq. deviation and less load drop outs
CAT® ENERGY STORAGE
(LARGE SCALE)

Energy Storage Modules are Designed to accommodate combinations of:

- Transient Support
- Master Control
- Ultra Capacitors
- Bi-Directional Inverters
- Time Shift
- Generators
- Batteries
- Flywheels
Typical Microgrid Operation: Daily Load & Generation Profiles

<table>
<thead>
<tr>
<th>Site Load (kW)</th>
<th>Solar PV Output (kW)</th>
<th>Diesel Generator Output (kW)</th>
<th>Generator Shut-off with MMC</th>
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<tbody>
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</tbody>
</table>

Time of Day
0:00 - 6:00
6:00 - 12:00
12:00 - 18:00
18:00 - 24:00
Typical Microgrid Operation: Daily Load & Generation Profiles

- **Extra Solar PV Output**
- **Extended Generator Shut-off Period**
- **Time-Shifting with Energy Storage**

**Time of Day**

- 0:00
- 6:00
- 12:00
- 18:00
- 24:00

**Power (kW)**

- 0
- 75
- 150
- 225
- 300
- 375
- 450
- 525

- 12:00:00
- 6:00
- 18:00
- 24:00
Typical Microgrid Operation: Grid stability testing

520KW load step on 500KW Genset

1.5 MW load step on 750KW ESS + 500KW Genset
THE CAT® / EPSA DIFFERENCE

EPSA is only Australian fully integrated service provider of hybrid systems.

We offer purpose built products, project services, finance and warranty that's backed by a global brand.
Case study
Tucson Proving Grounds Microgrid
Case study
Tucson Proving Grounds Microgrid.

The situation
Off-Grid facility Operated on 3 x C15 Generators since 1990
(~950KL fuel p.a.)

The solution
Added 500kW PV and Energy Storage made up of:
- Energy Storage Ultra-capacitor 250kW/30 sec
- Lithium Ion Battery 250kW/10 min

The result
Reduces Genset Operation 25% and Fuel Consumption 33%
Improves power quality
Data Trending Availability
Genset off operation ~7 hrs
Energy storage picking up transient loads and PV instability
Remote Monitoring Interface

Lorem ipsum dolor sit amet.

User Interface
• Key data shown on summary screen
• Multiple screens for detailed live data
• Charting and trending of historical data
• Available for all Cat Microgrids and Mobile Hybrids
Remote Monitoring Interface

- Individual PV Inverter Monitoring
~18.5% Single Axis Tracker energy capture advantage on 30 day average
Image Gallery

**Top Left**
Ariel shot showing the fixed tilt and Single Axis Trackers.

**Top Right**
Single axis trackers and the SMA STP25000-30.

**Bottom Left**
500KW Gsm, Ultracapacitors and LiIon batteries.

**Bottom Right**
Ariel shot showing the fixed tilt and Single Axis Trackers.
Image Gallery

**Top Left**
Array 2/3

**Top Right**
Array 1

**Bottom**
EPSA Adelaide 1.5MW project.