

Energy Power Systems Australia

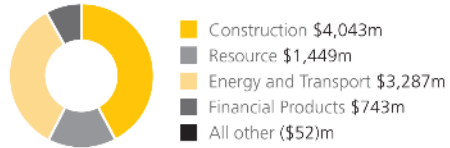
Introduction to Cat® Hybrid Microgrid

Presenter – Ronald Hall, Segment Manager – Hybrid Microgrid Systems



CATERPILLAR

SALES REVENUE Q1 2016 BY SEGMENT



\$9,461 BILLION

Total consolidated sales and revenues



Full-time employment

101,400 GLOBAL EMPLOYEES

**COLLABORATION
AND INNOVATION
ARE KEY FOR
CATERPILLAR**

28,000+
suppliers worldwide.

3M+
units of Cat® product at
work around the world.

\$2,165M
spent on R&D in 2015.

190
completed new
product programs.



175 authorised Cat®
dealers serving
in over **180** countries
worldwide
GLOBAL COVERAGE, LOCAL SUPPORT.

EPSA ENERGY POWER SYSTEMS AUSTRALIA

EPSA is the exclusive Cat® Power Systems dealer for Australia, Papua New Guinea and the Solomon Islands. Being backed by the Cat® Dealer network means that you are never far away from a local servicing dealer.



- RENEWABLE & HYBRID SYSTEMS
- DIESEL, GAS & GENERATORS
- TEMPERATURE CONTROL
- STAND-ALONE ENGINES
- COMPRESSED AIR
- UNINTERRUPTIBLE & CRITICAL POWER

**Energy Power
Systems**



Why Hybrid Microgrid?

Diesel / Gas Generator

- Low CAPEX
- High OPEX
- Moderate Stability
- High Reliability
- High CO₂ emissions

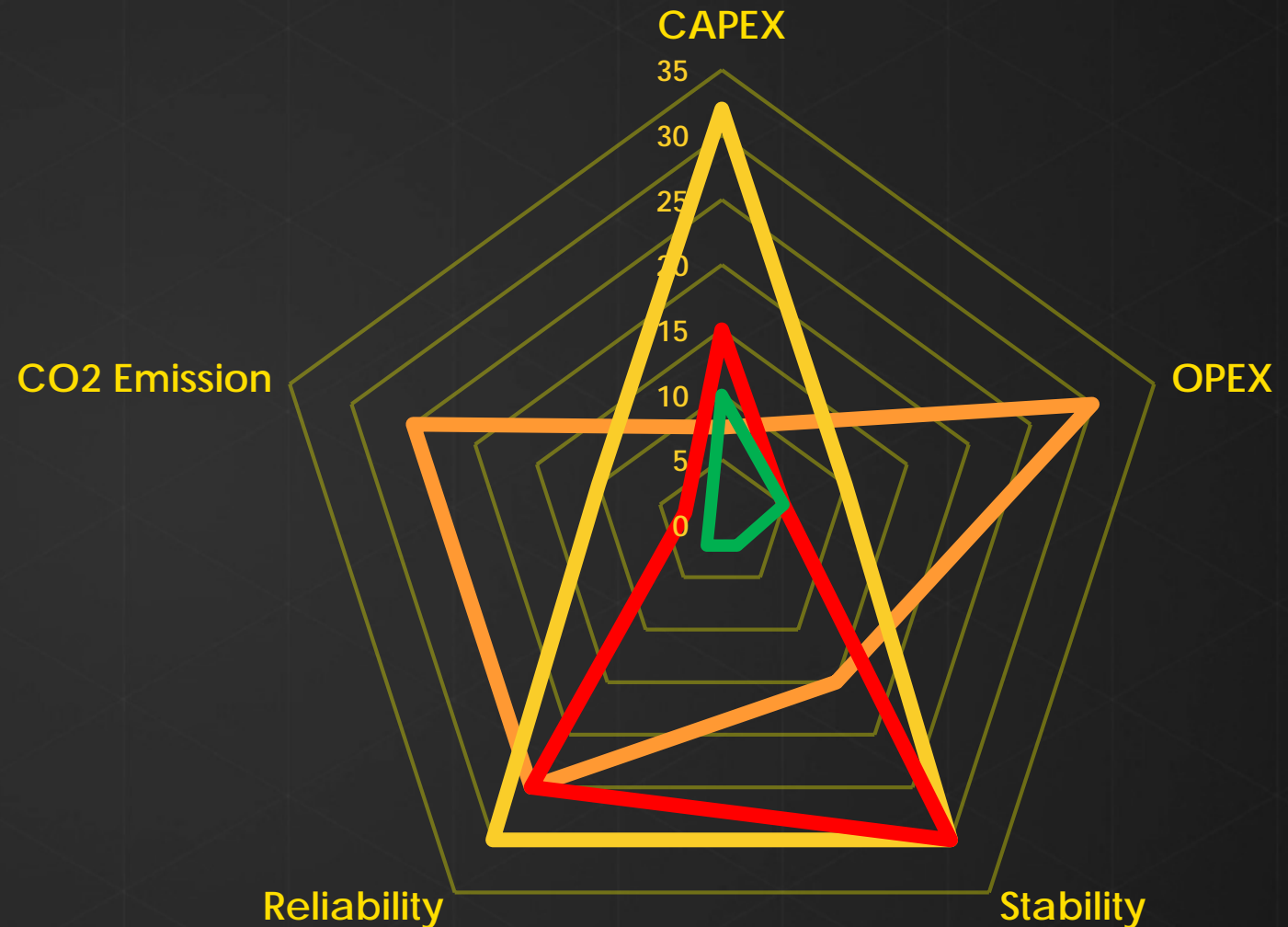
Solar PV

- Low CAPEX
- Low OPEX
- Unstable
- Low Reliability
- No CO₂ emissions

Battery Storage

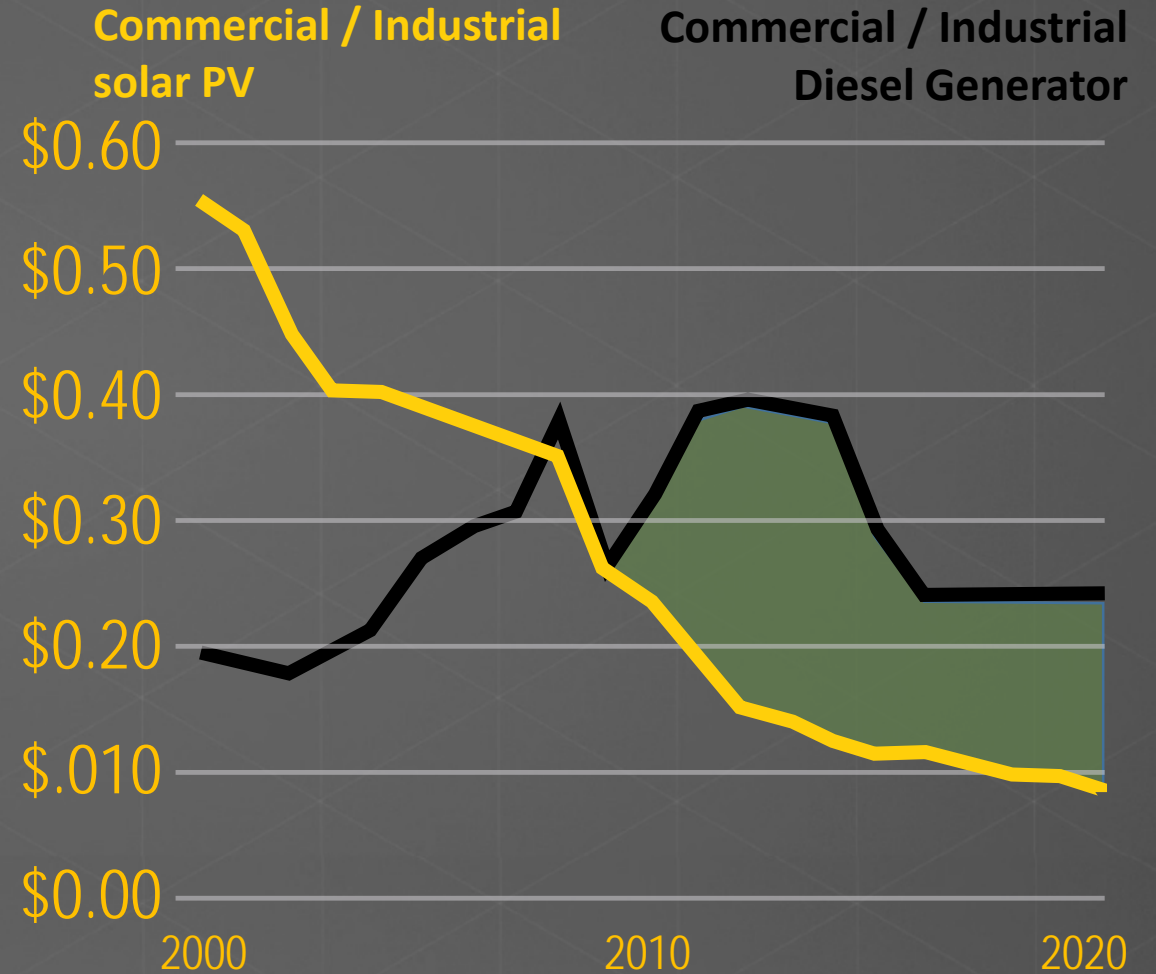
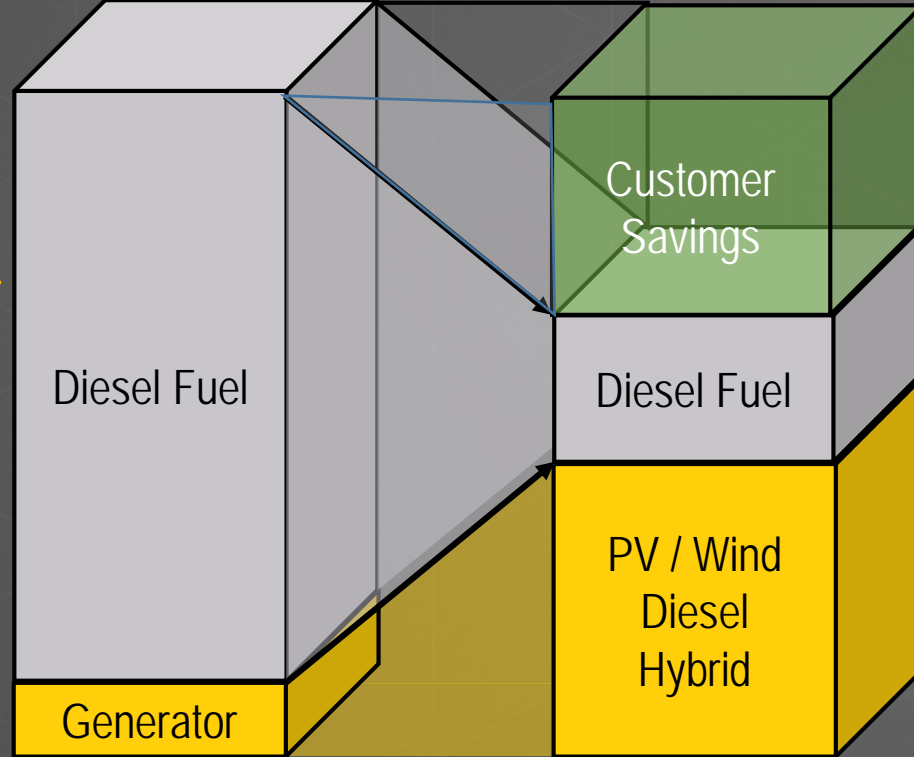
- High CAPEX
- Low OPEX
- High Stability
- High Reliability
- Low CO₂ emissions

Solution Scoring



Economic logic

Off Grid Hybrid Economic Justification



Cat® PV Module Features

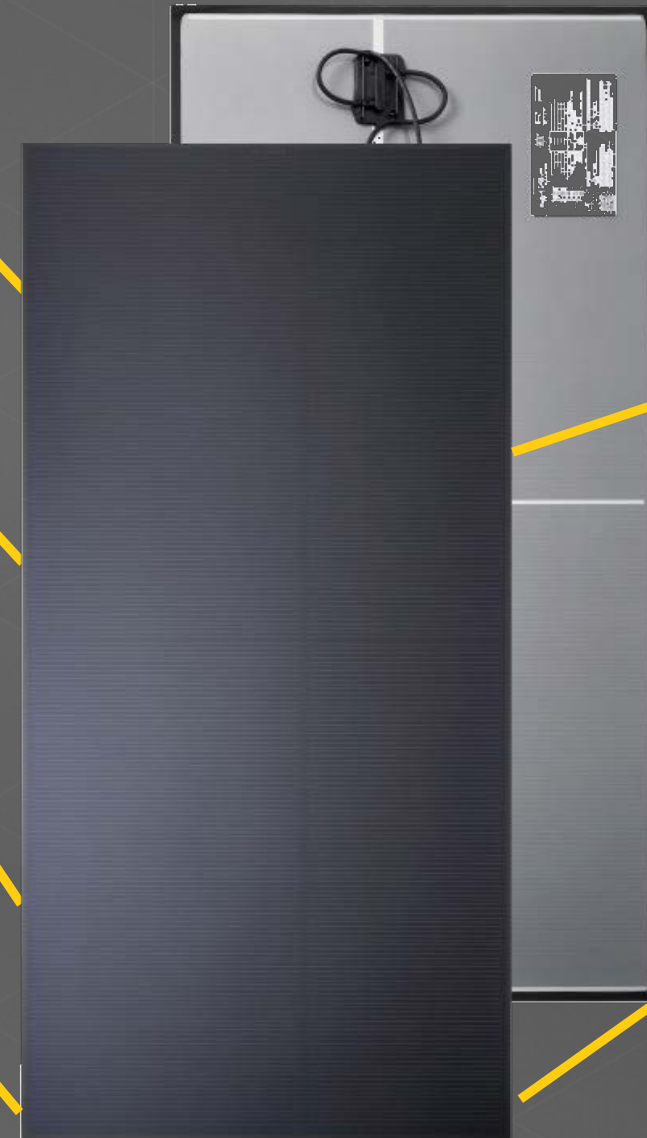
The Cat PV module has a dark Monolithic look that is a feature coveted by developers worldwide. It is made from toughened glass and has a frameless design that helps with cleaning and avoids dirt buildup at the module edge.

Cadmium Telluride CdTe (thin film)

Durable and recyclable frameless glass-glass laminate

Low embodied energy and carbon

60 x 120 cm, 11kg



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%)

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



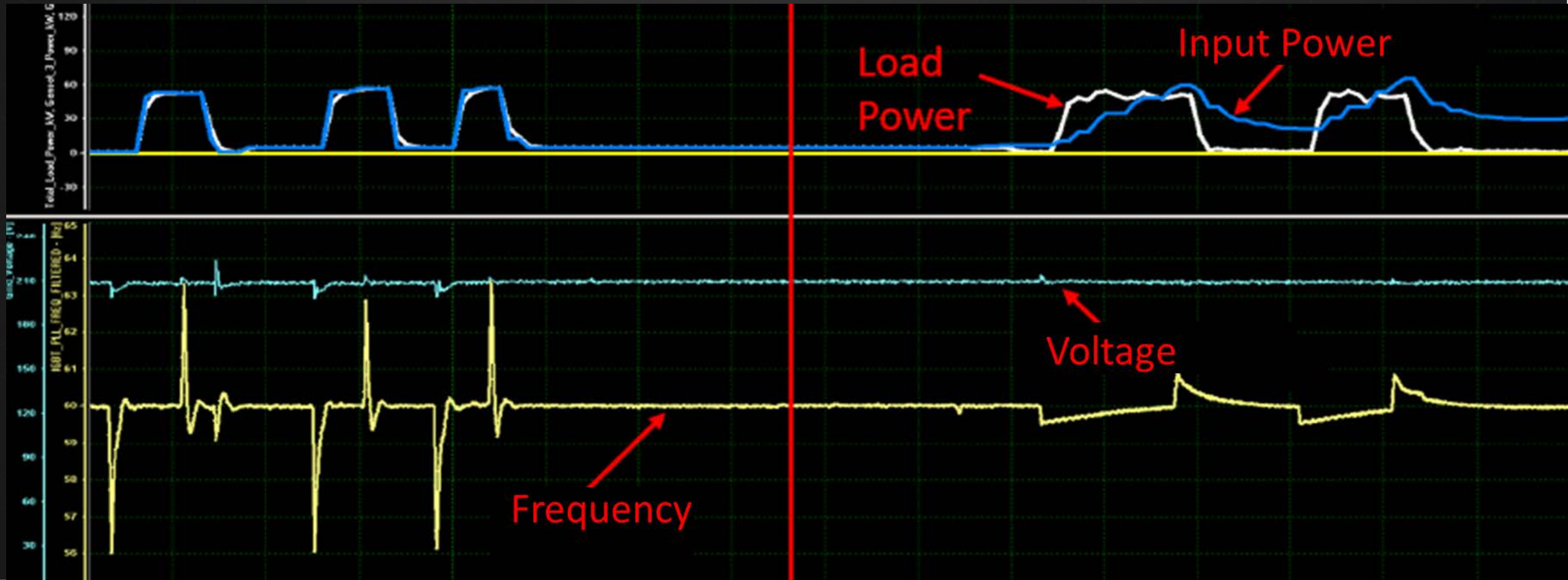
CAT BI-DIRECTIONAL INVERTER

- 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



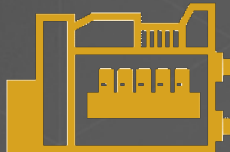
Ultra
Capacitors



Bi-Directional
Inverters



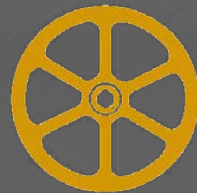
Time Shift



Generators



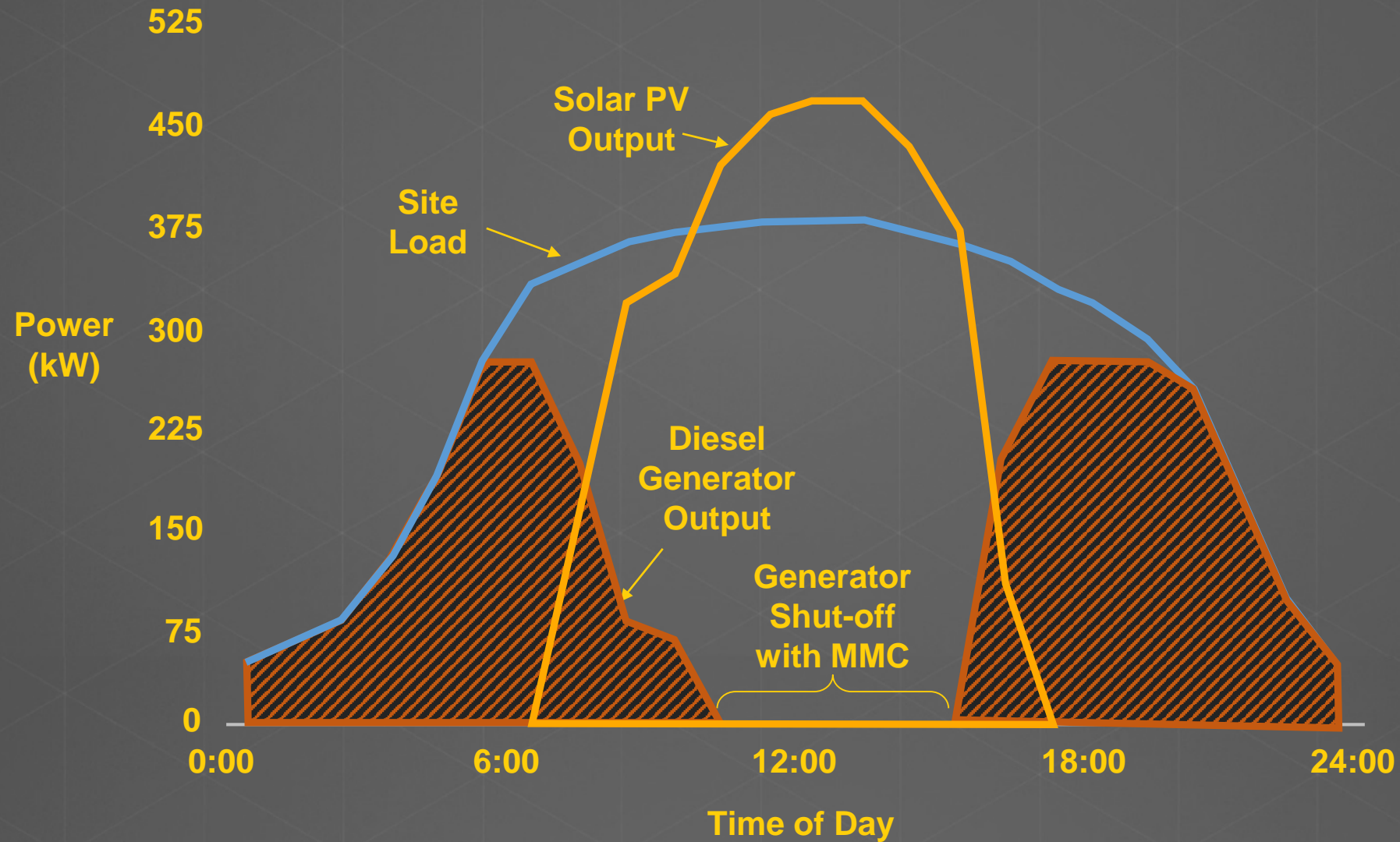
Batteries



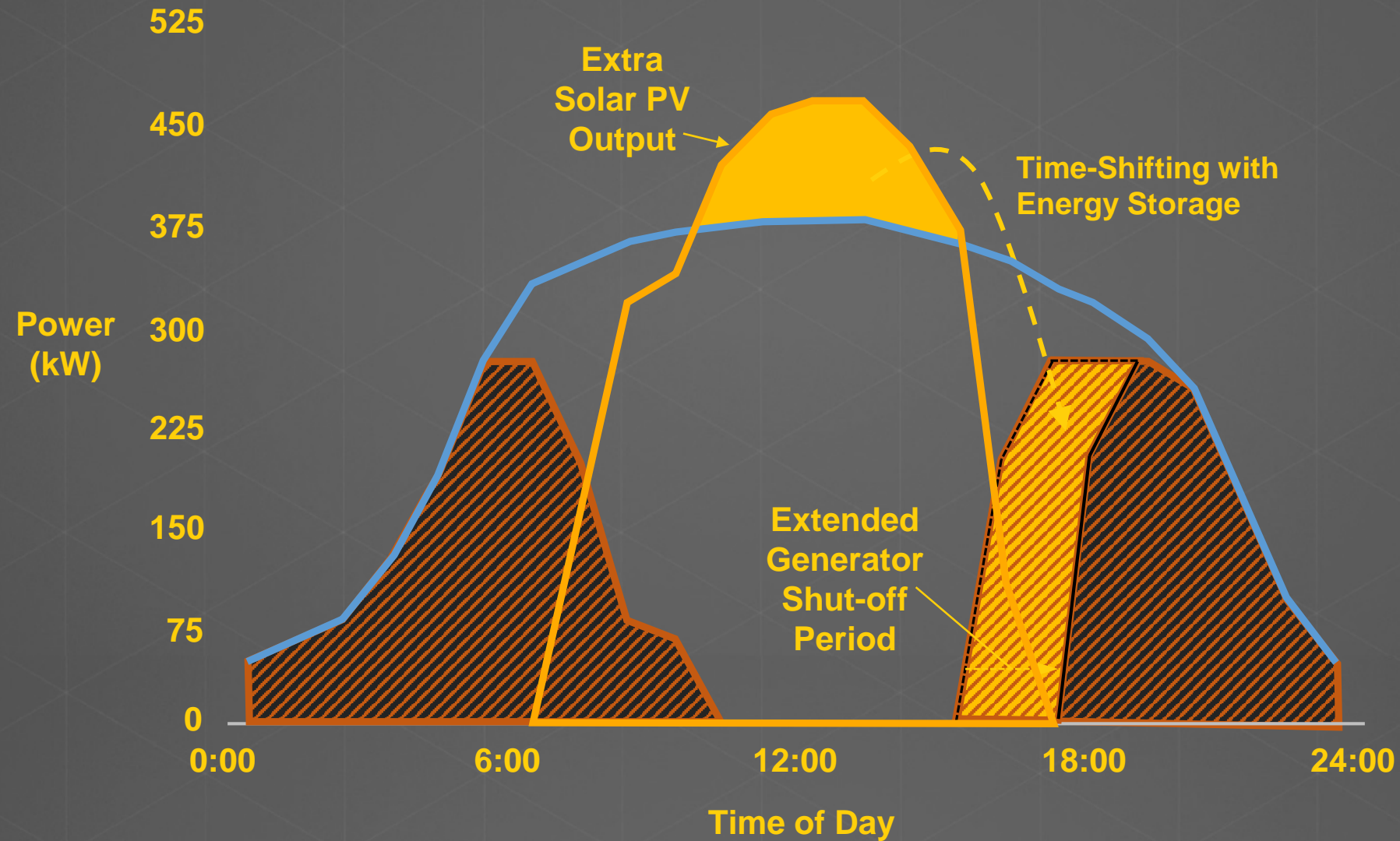
Flywheels



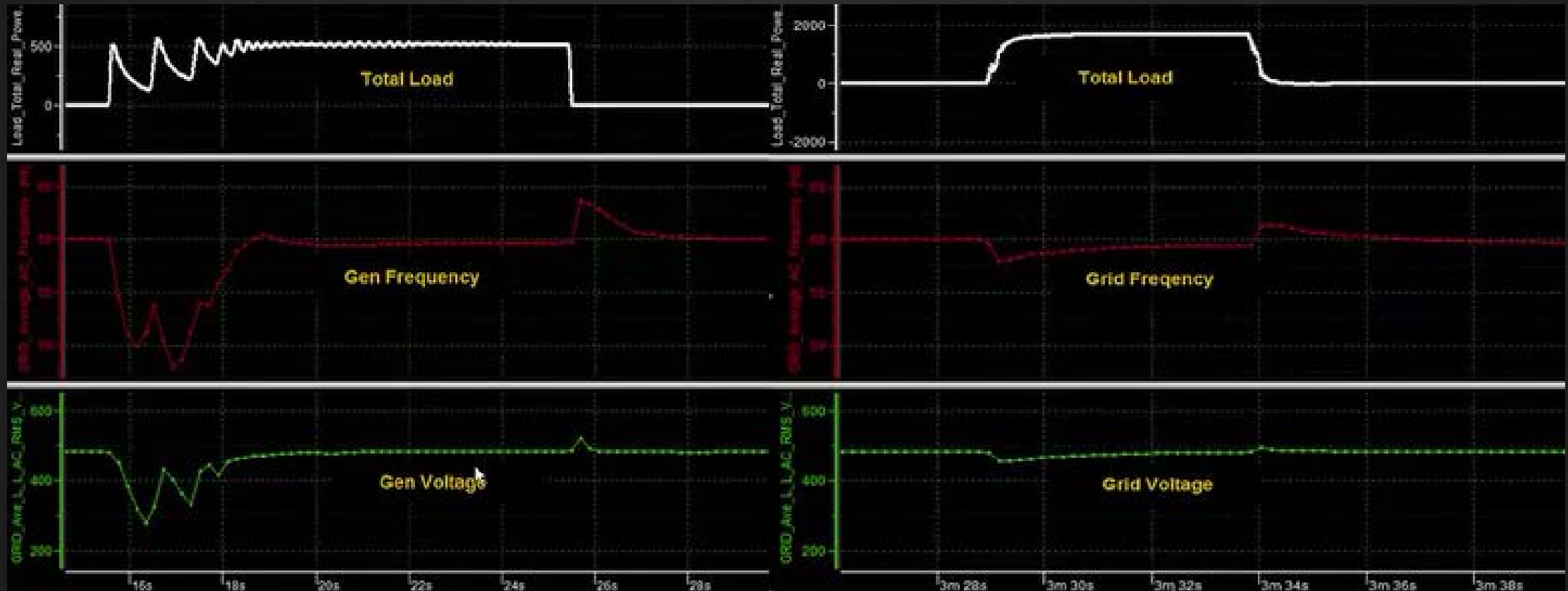
Typical Microgrid Operation: Daily Load & Generation Profiles



Typical Microgrid Operation: Daily Load & Generation Profiles



Typical Microgrid Operation: Grid stability testing



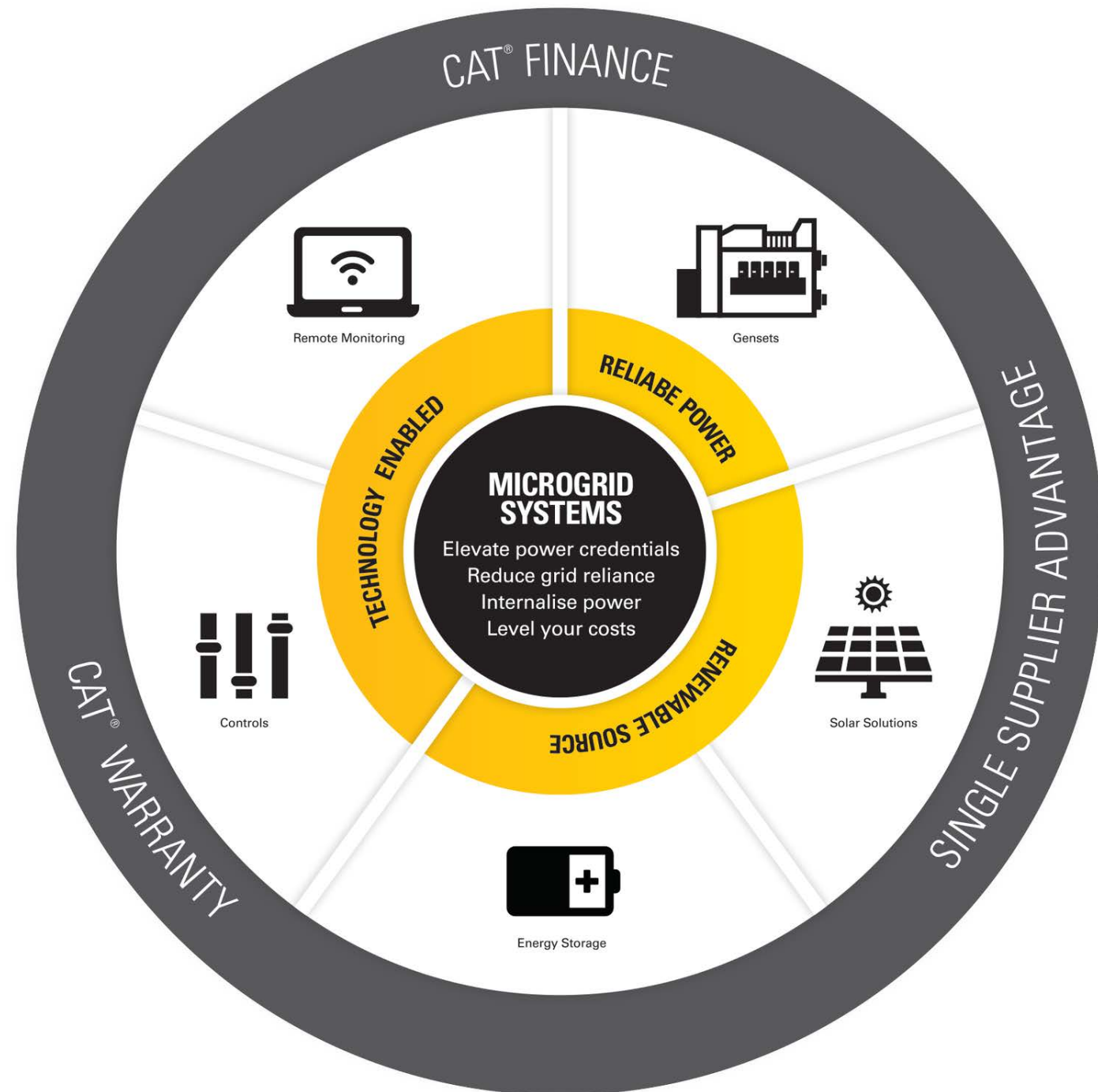
520KW load step on 500KW Genset

1.5 MW load step on 750KW ESS +
500KW Genset

THE CAT® / EPSA DIFFERENCE

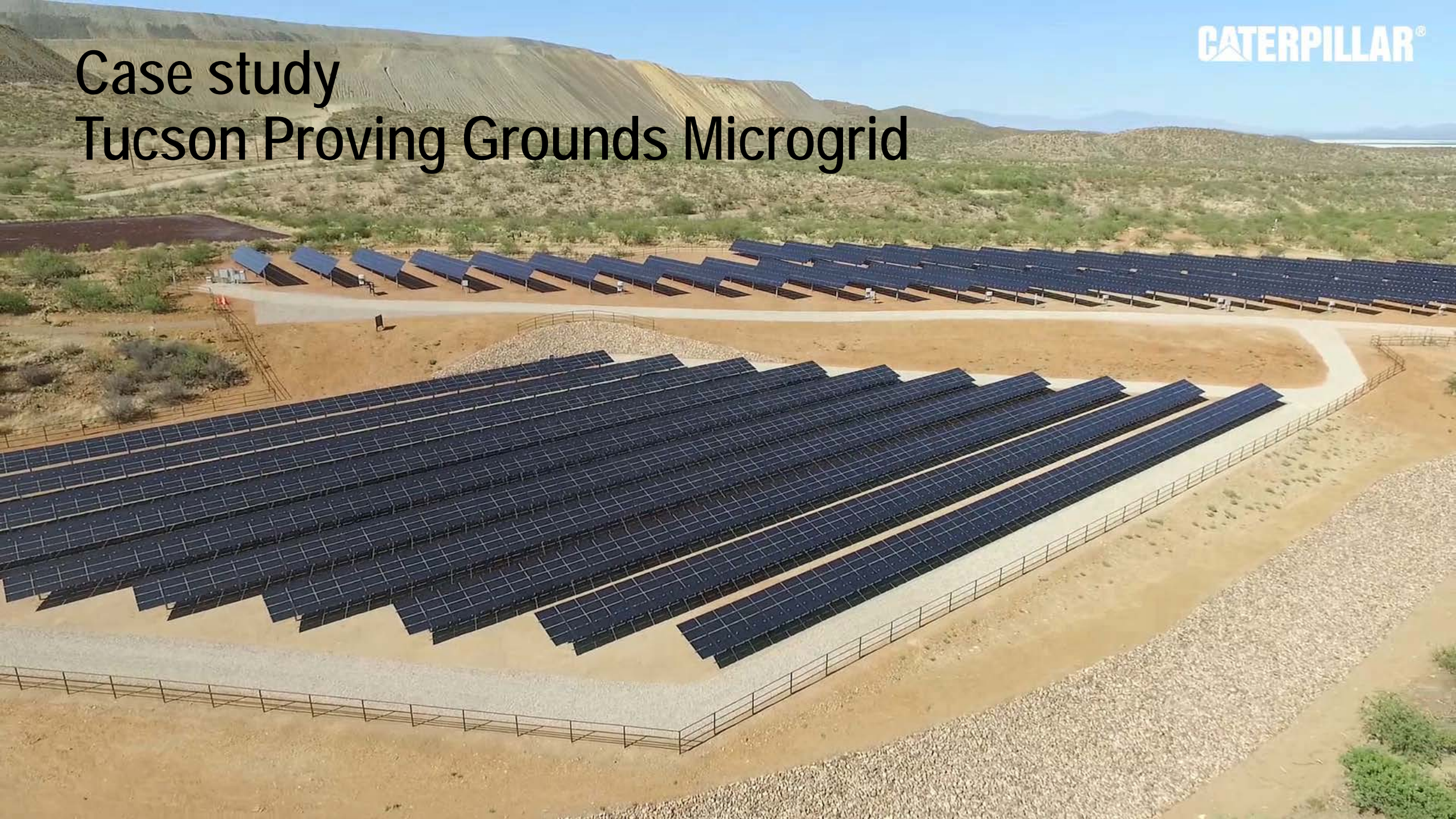
EPSA is only Australian fully integrated service provider of hybrid systems.

We offer purpose built products, project services, finance and warranty that's backed by a global brand.



Case study Tucson Proving Grounds Microgrid

CATERPILLAR®



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



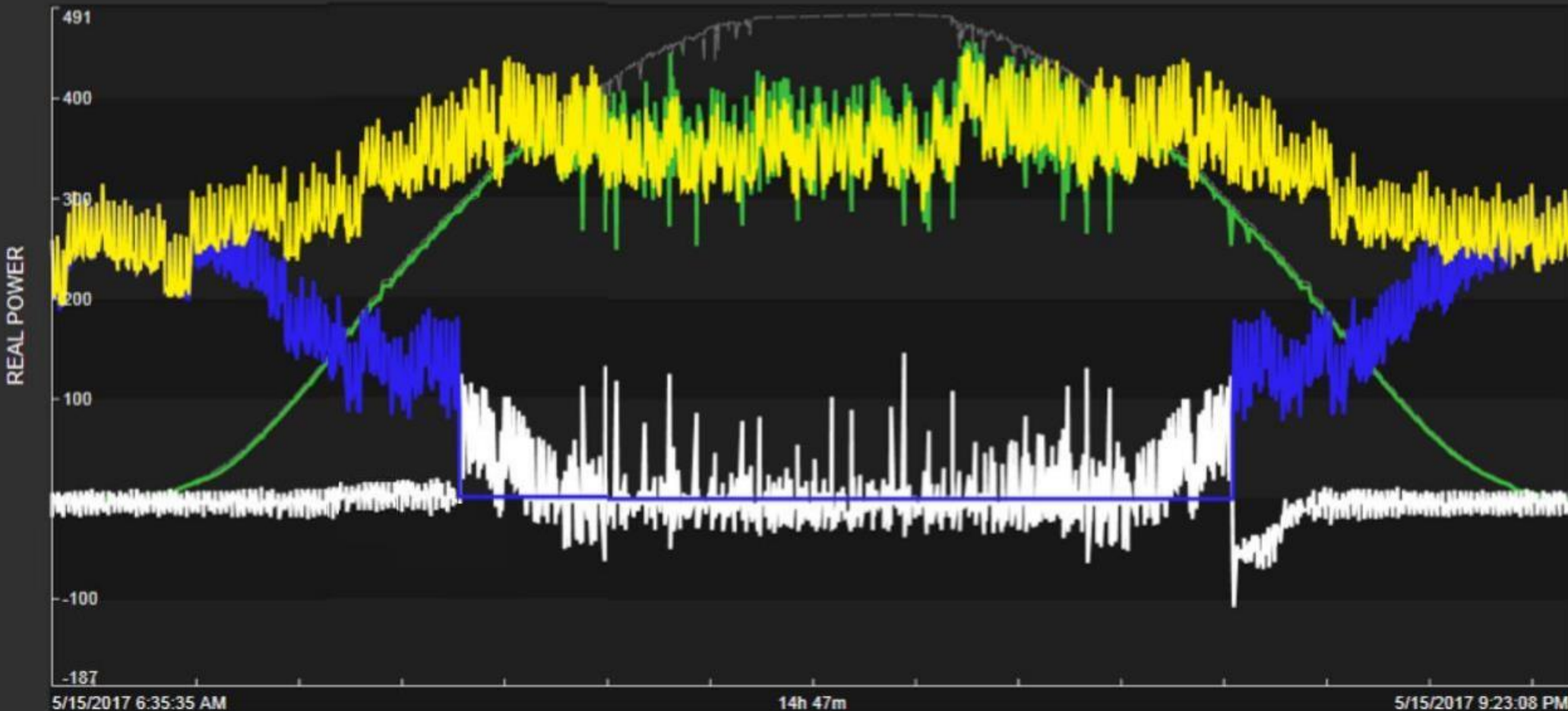
Data Trending Availability
Genset off operation ~7 hrs
Energy storage picking up transient loads and PV instability

Case study

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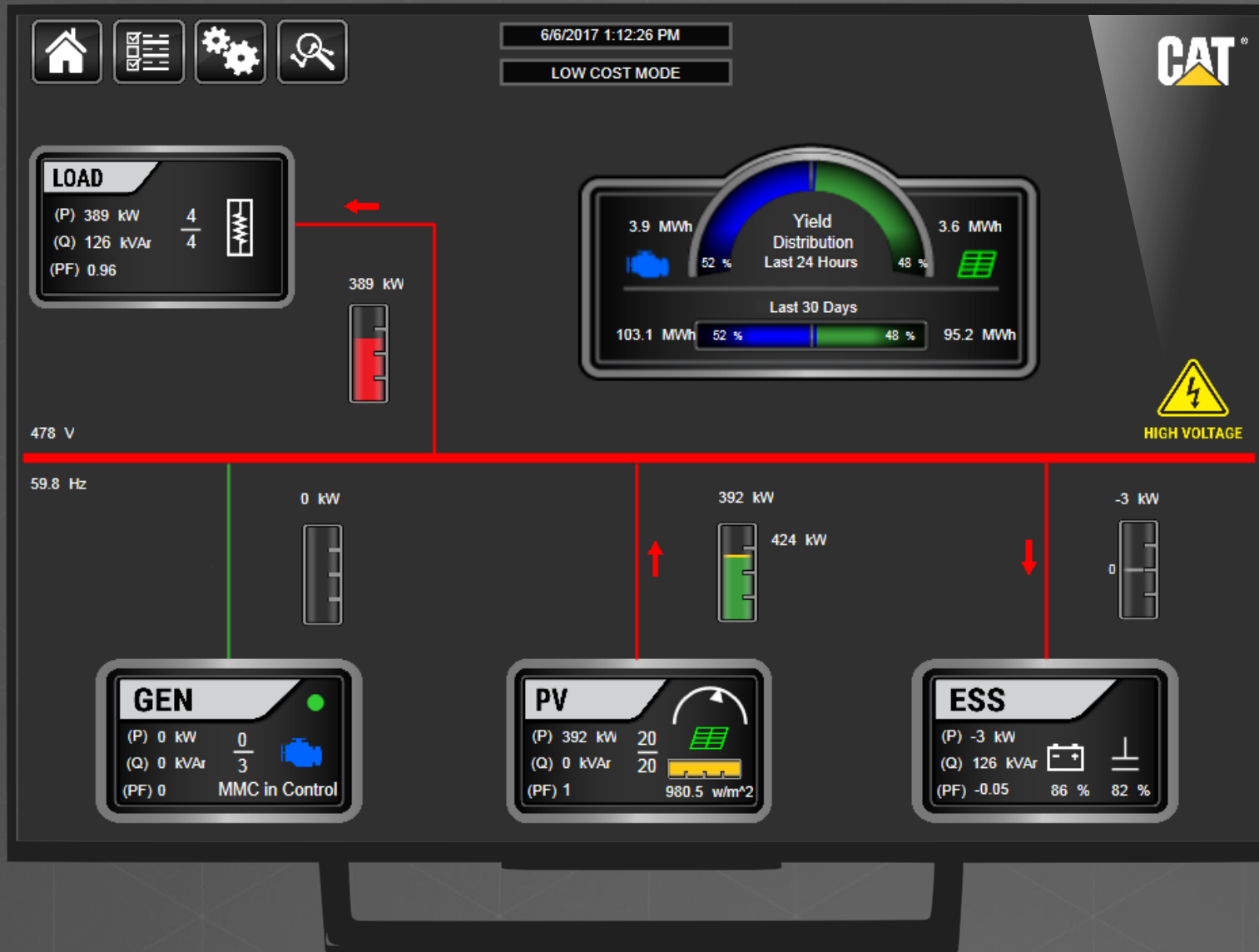


REAL POWER



Remote Monitoring Interface

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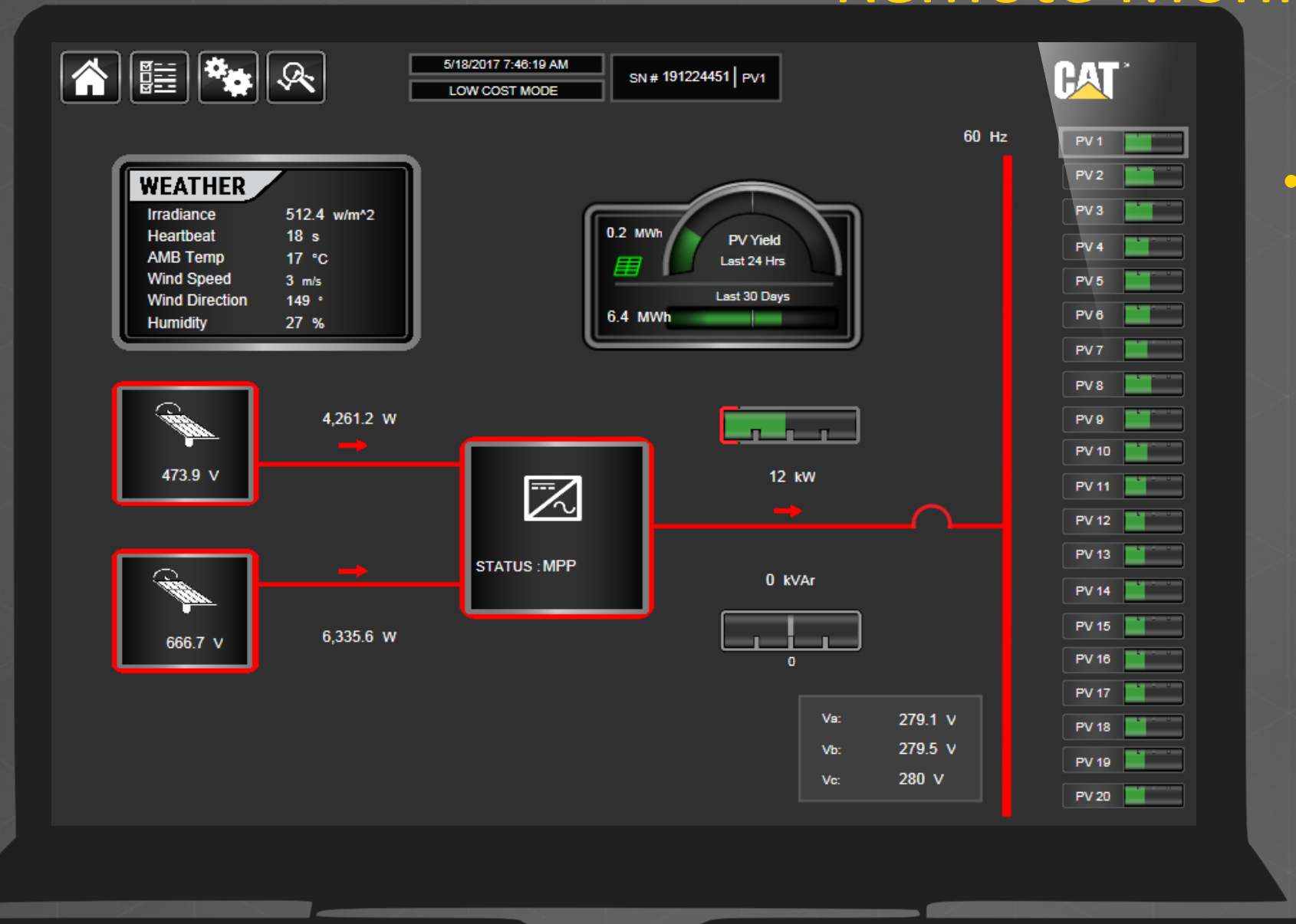
User Interface

- 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

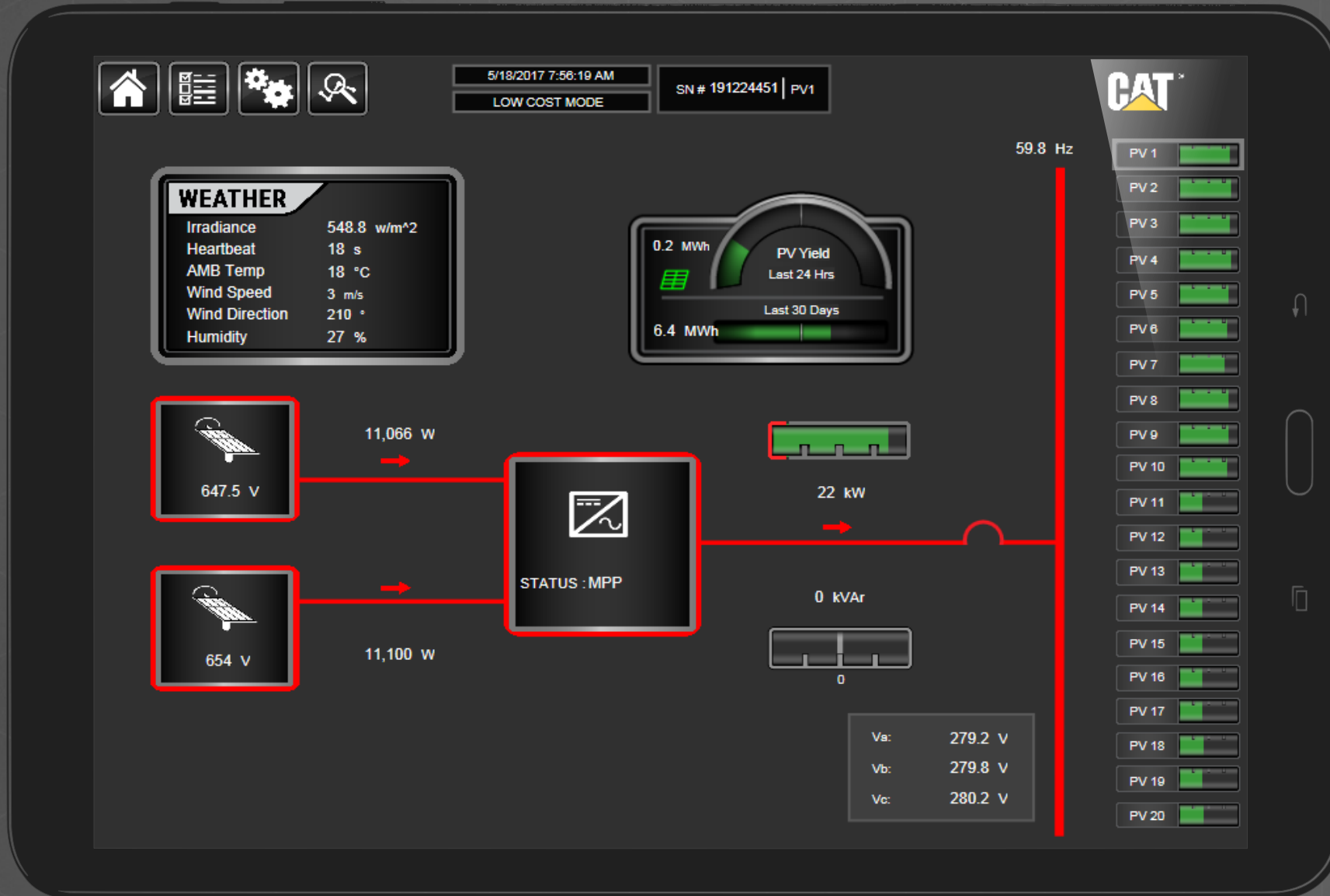
Remote Monitoring Interface

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- Individual PV Inverter Monitoring



Remote Monitoring Interface



~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 Li Ion 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.



**Energy Power
Systems**

