OPTIMAL
POWER SOLUTIONS

Hybrid Power Systems combined with Intelligent A.I.

Company Brief

- Regional offices in the East coast & West coast USA, Australia, London, India, Malaysia and Indonesia
- Current deployments: Over 15 years of commercial experience, 2400 installations in 35+ countries with systems for enterprise, public safety as well as military.
- Voted by Navigant Research as Top Three Global Micro-Grid Companies
- Services:
  - End to end solution (for customers from 25 Kw to 5 Mw is sweet spot)
  - Procurement
  - Deployment
  - Analytics
  - Support

What is a Micro Grid?

A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. This means a microgrid can connect and disconnect from the grid to enable it to operate in both

Grid - connected

or

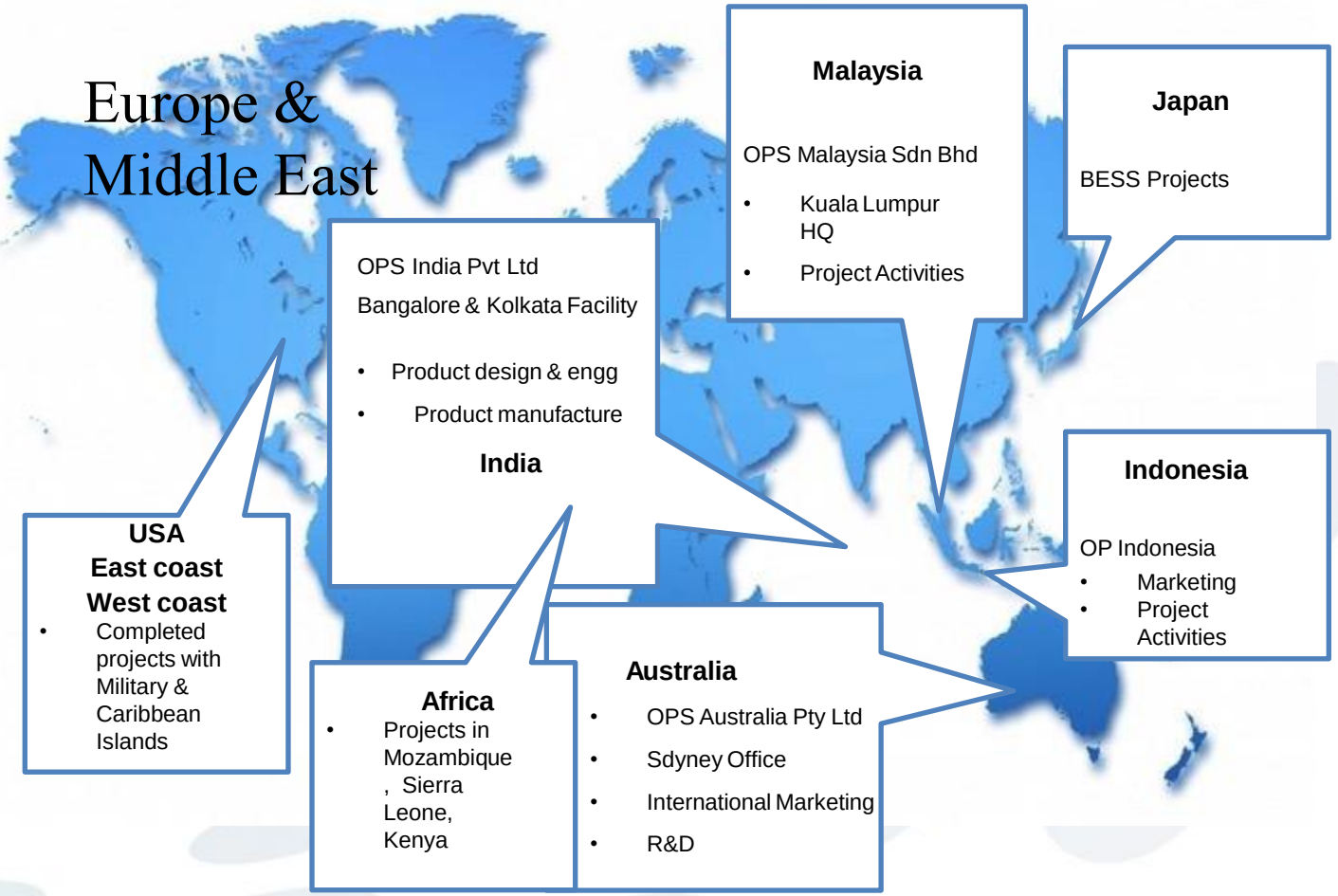
Island - mode

(Stable and Un-reliable Grid Mode).

U.S. DEPARTMENT OF ENERGY

Commercial Footprint highlights

- **Global presence collocated with customer deployments**
- **Commercial Customer footprint in all continents**



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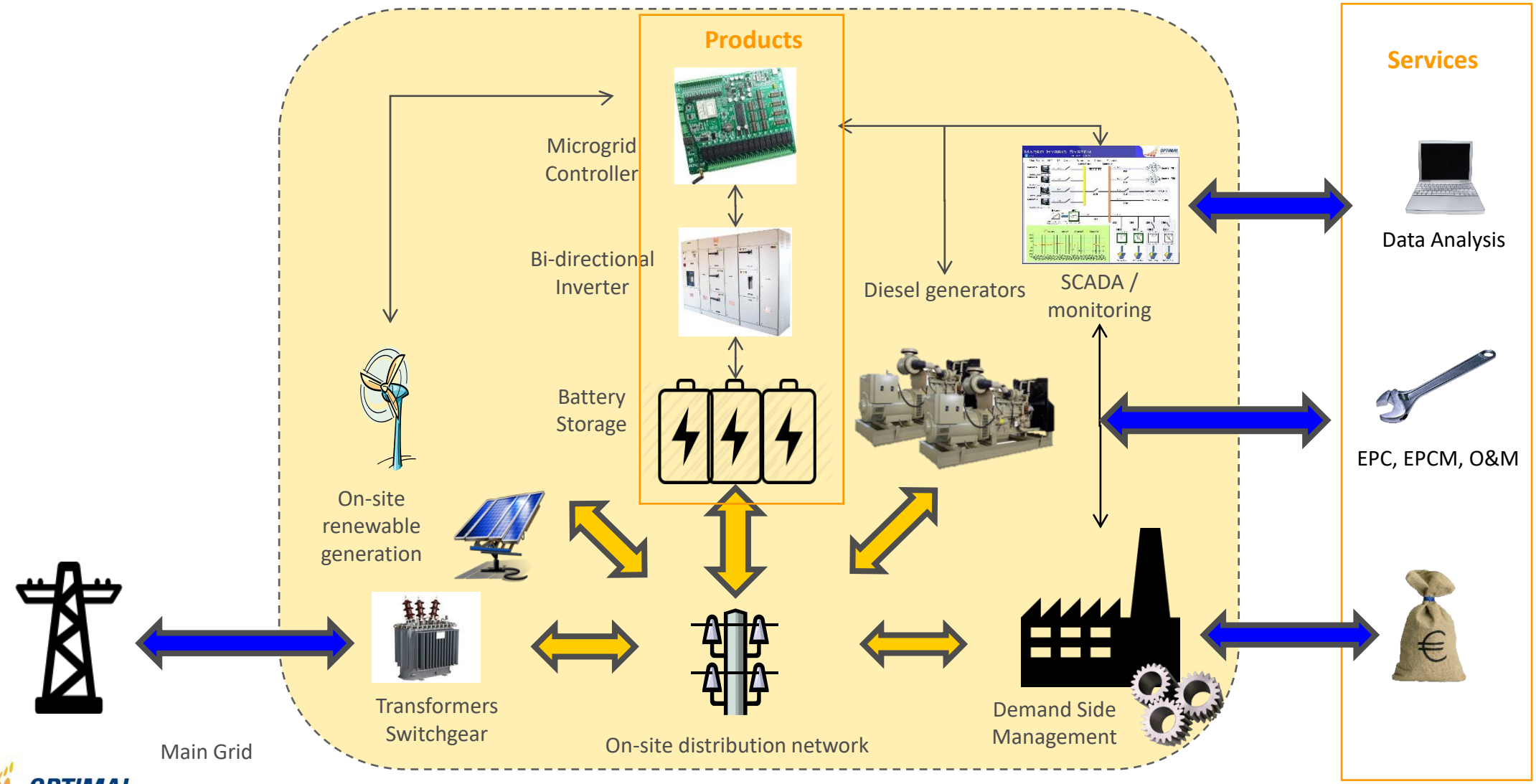
You can tell a lot about us by the company we keep…….

Optimal adopts a holistic “Systems Approach”



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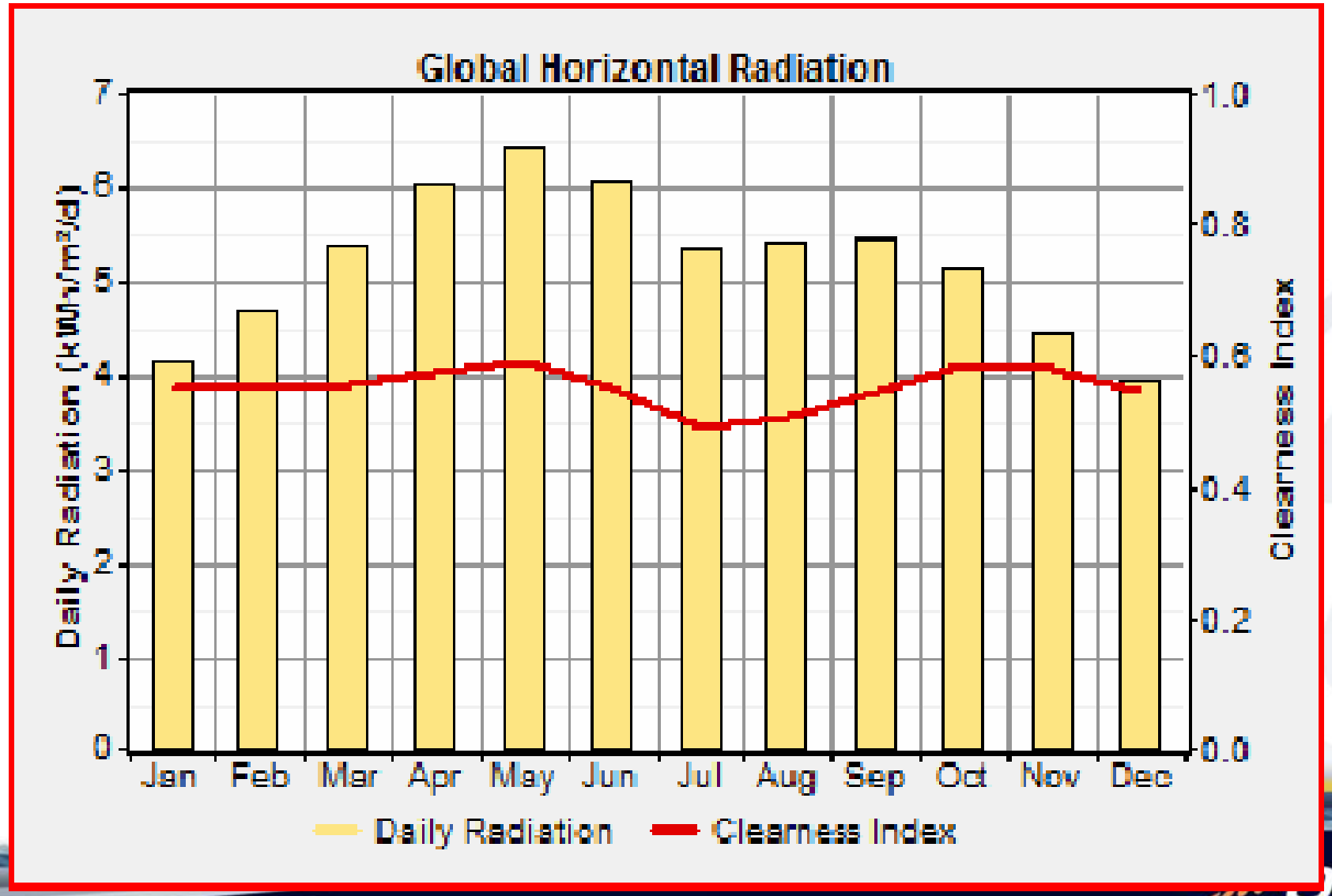
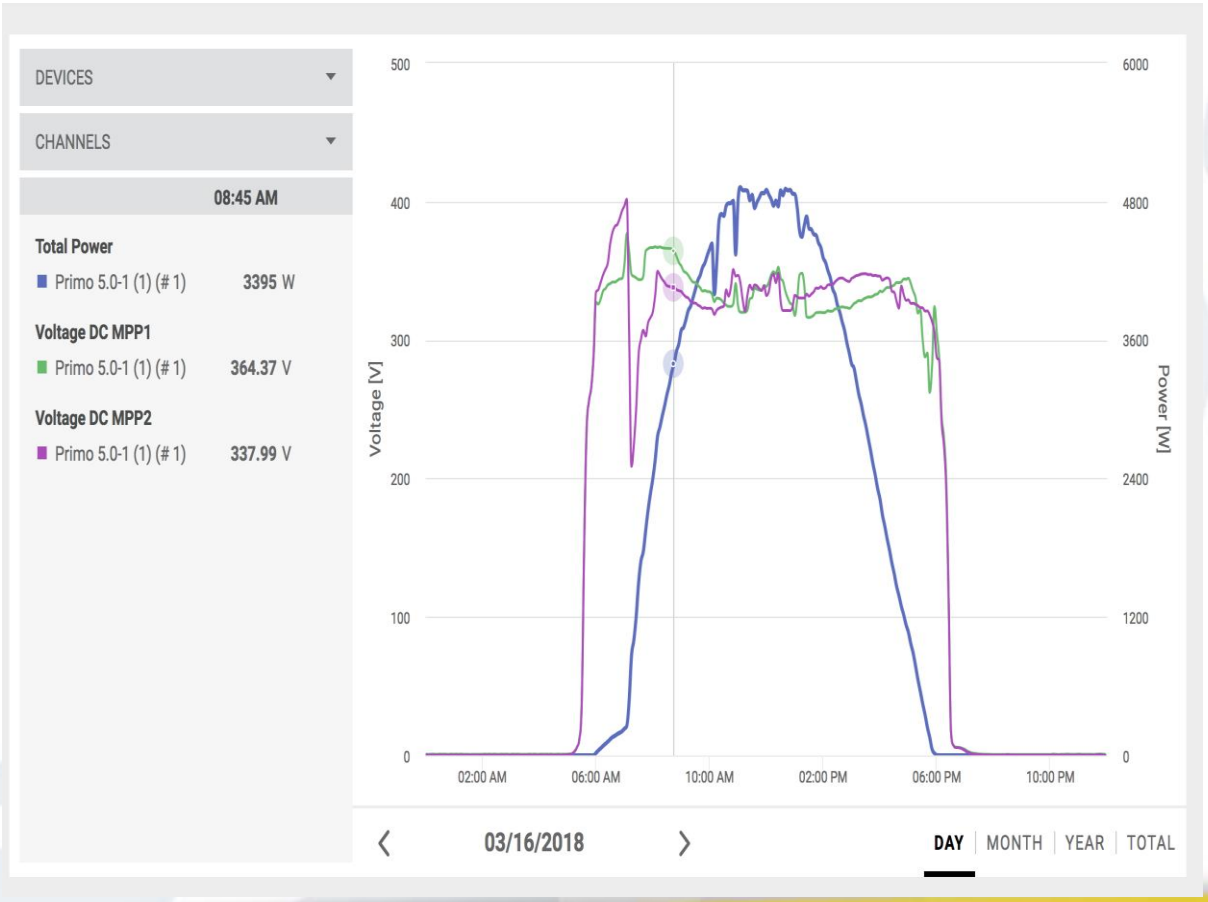
Typical Solar Radiation Profile at Oman similar pattern as Saudi Arabia



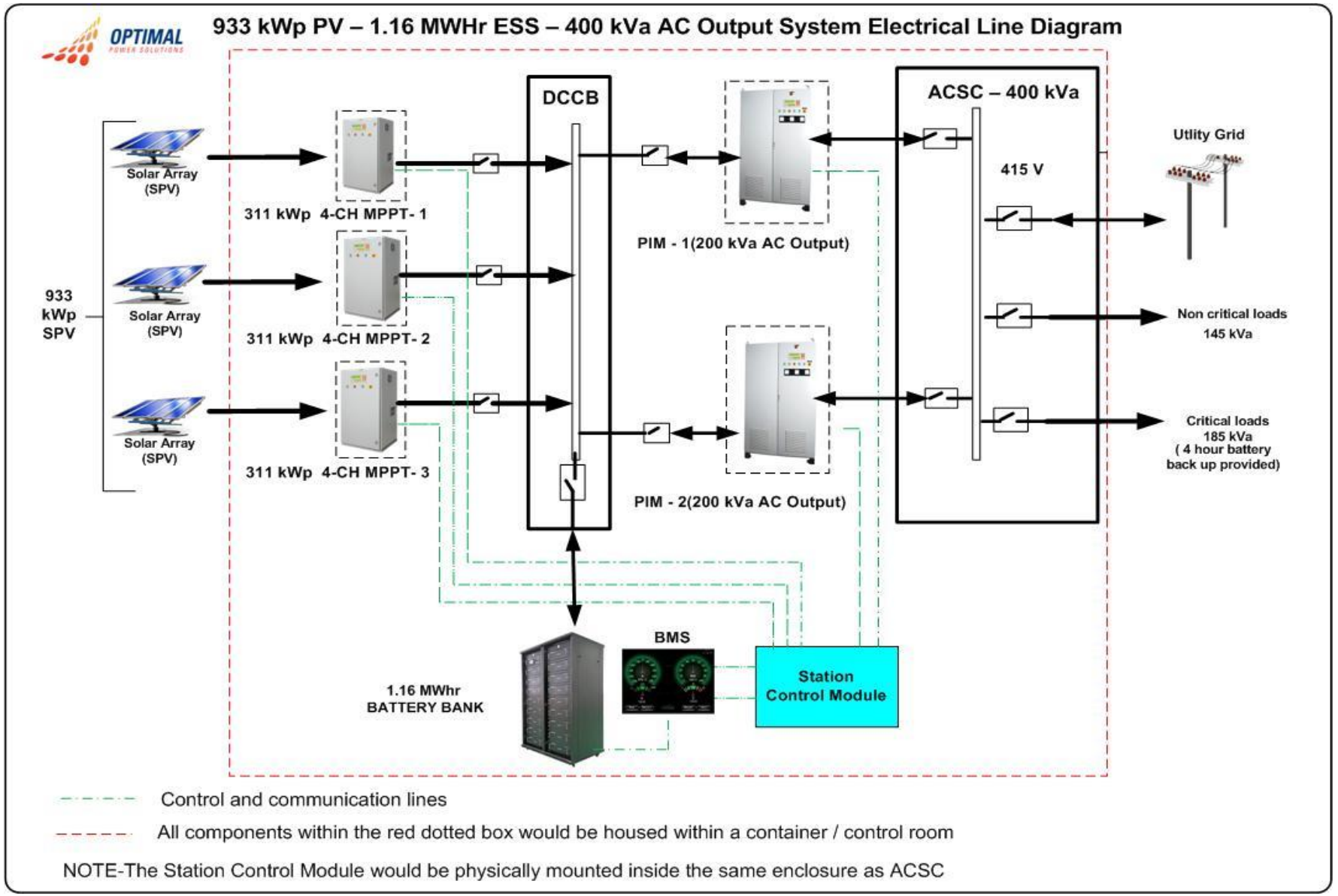
Offer of Crinkle Frame Design or Standard N-S system



Crinkle Frames

Improved PV Output

Typical 933 kWp System SLD



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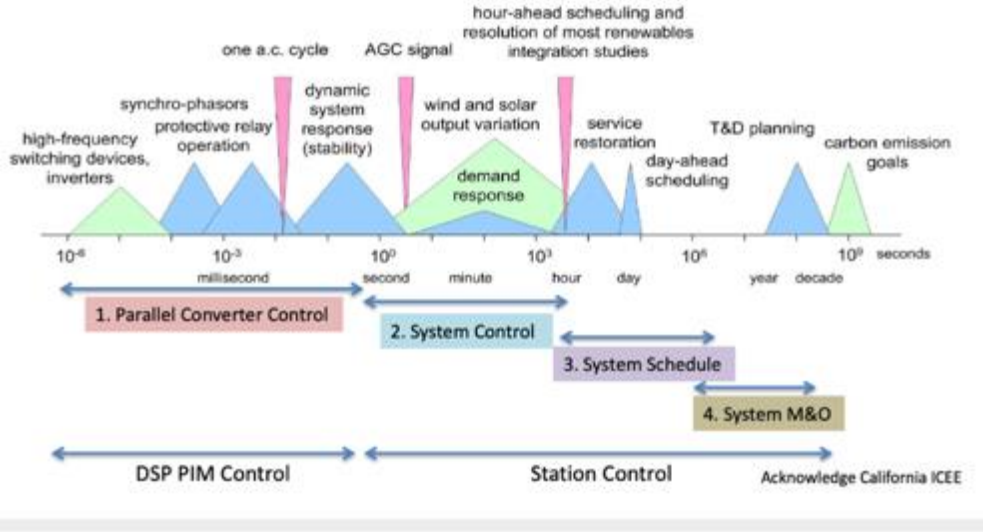
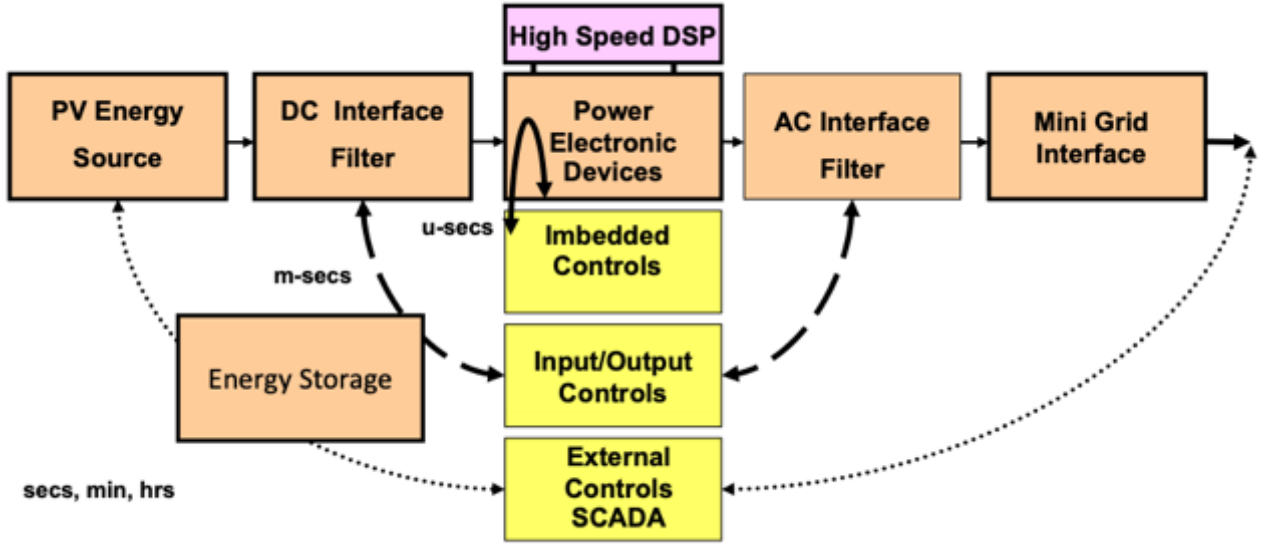
ELECTRIC GRID OPERATION COMPLEXITIES





- **Balancing power across multiple input sources is not trivial. Needs to be managed on Milli, Micro, Pico seconds Realtime for shaping. We have excelled at this.**

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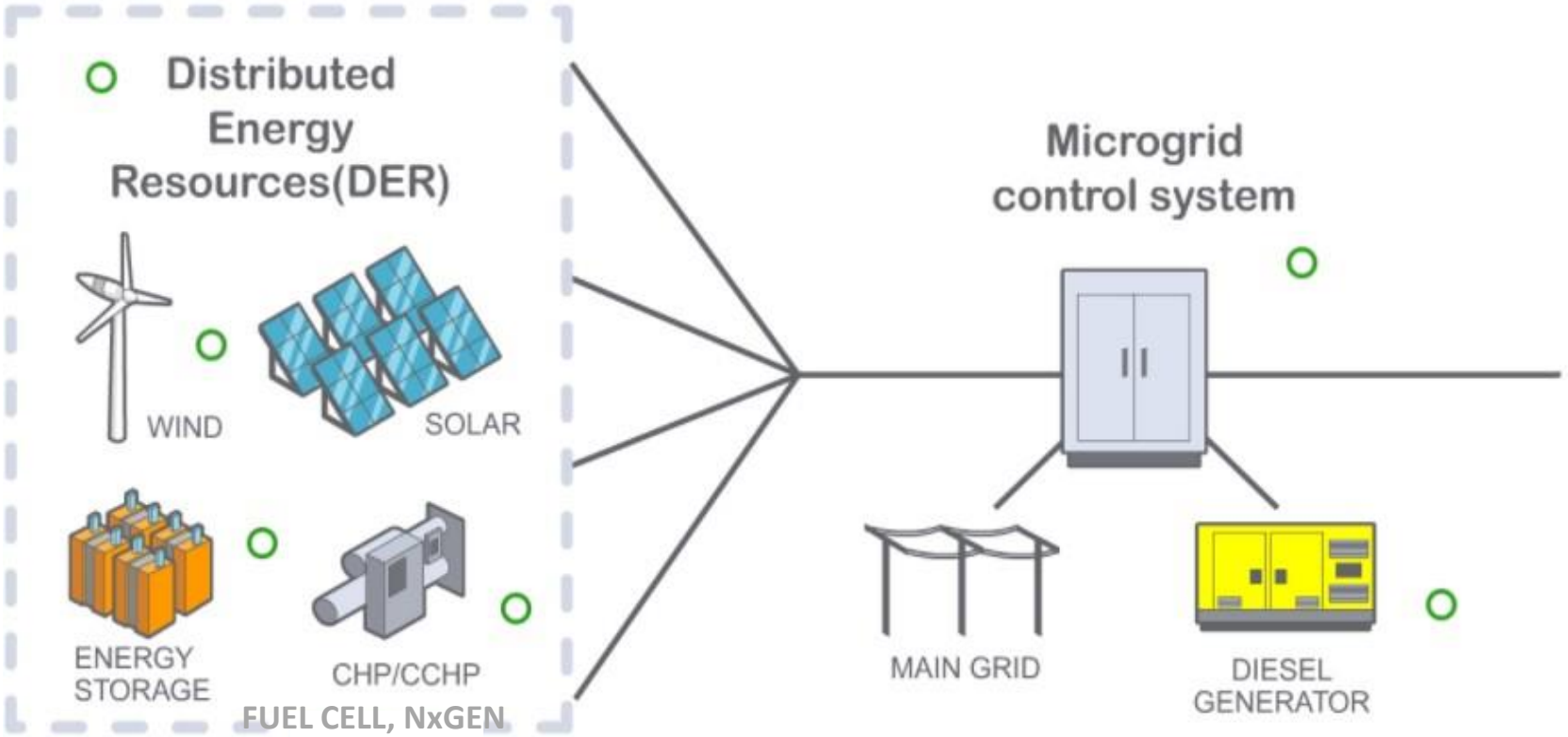
Distributed Energy Resources (DERs)

Carry sustainability attributes



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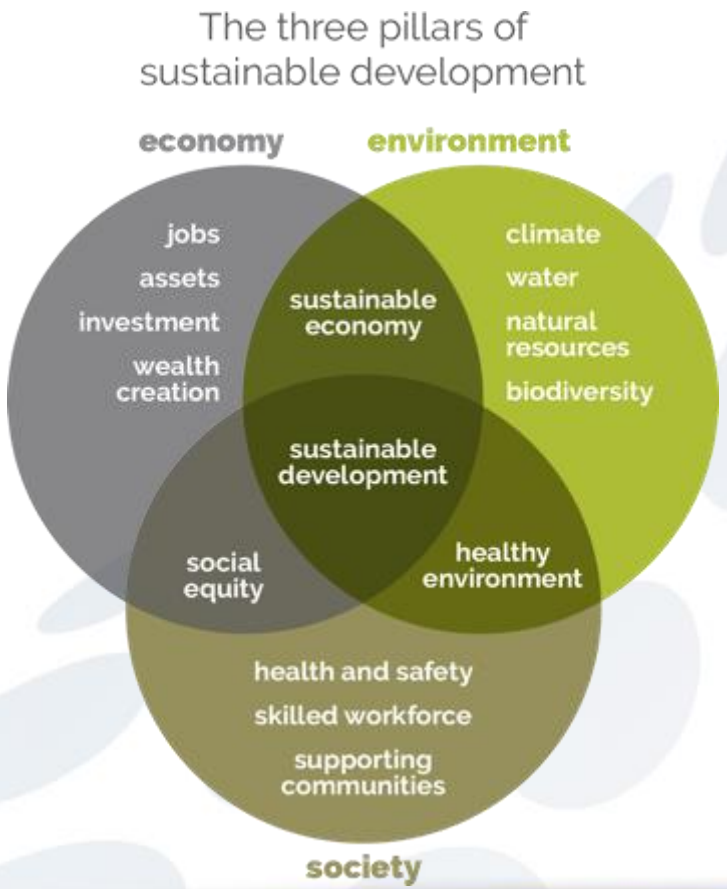
Sustainability has many definitions

We are focusing on environmental sustainability here

Source: https://sdgs.un.org/goals



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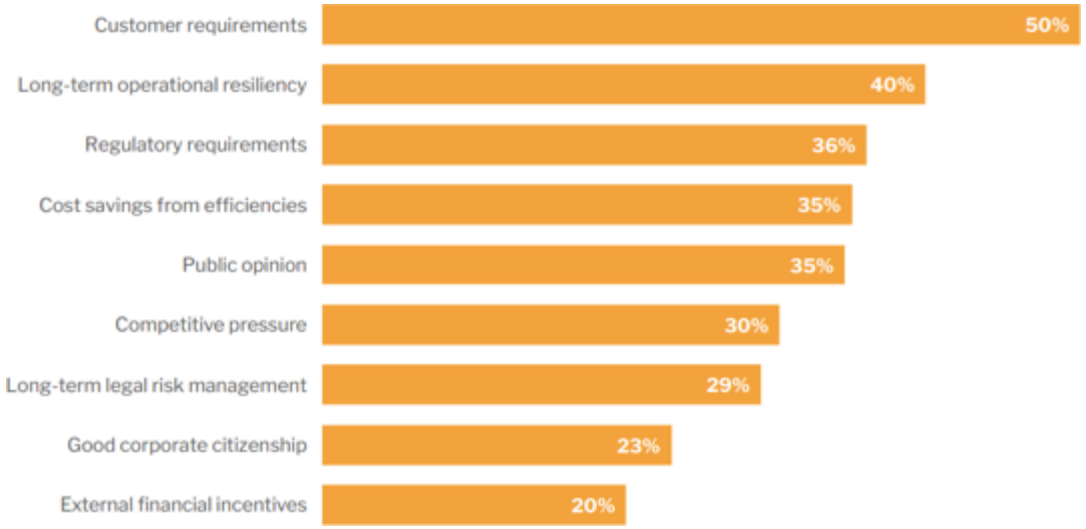
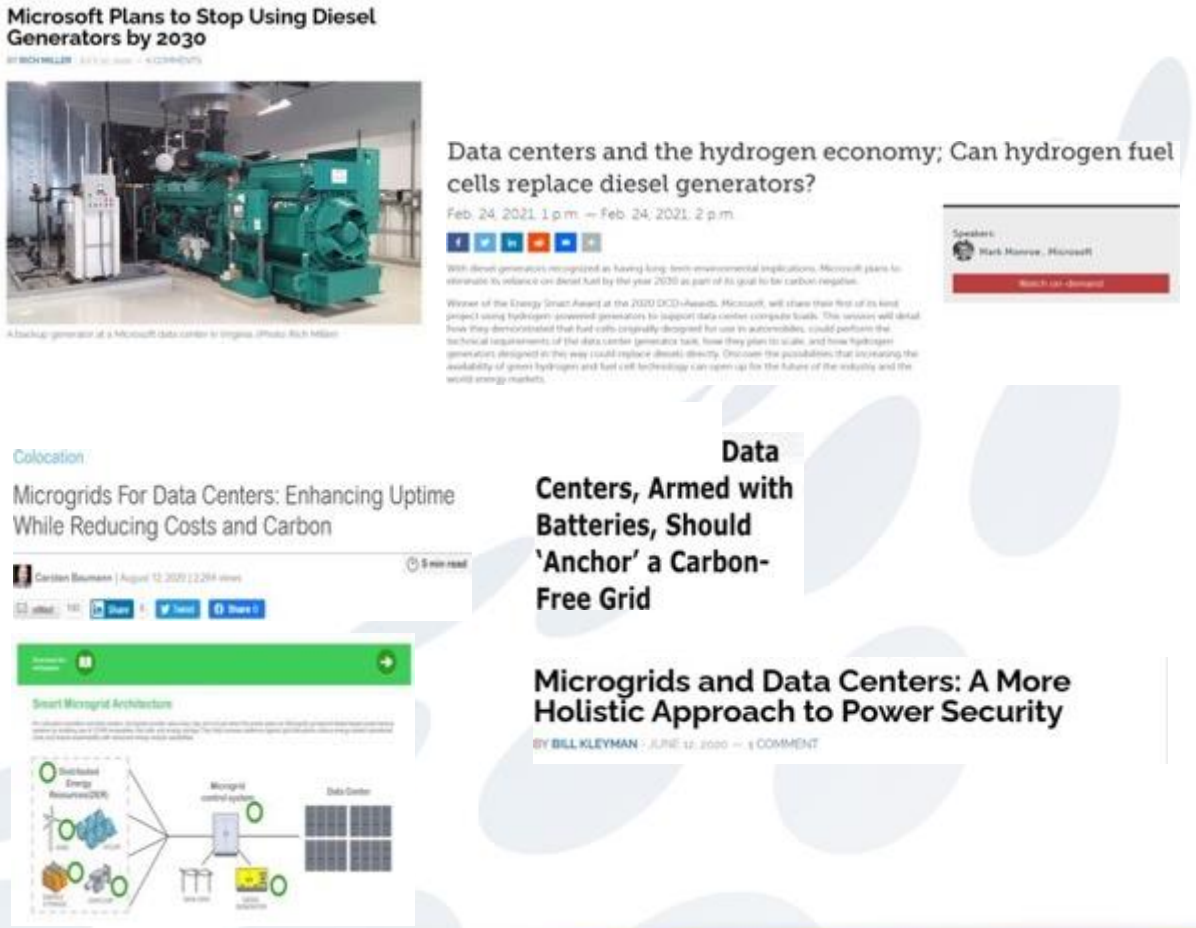
Sustainability is not a “nice to have” It is now a “must have” Microsoft to STOP using Diesel Generators by 2030



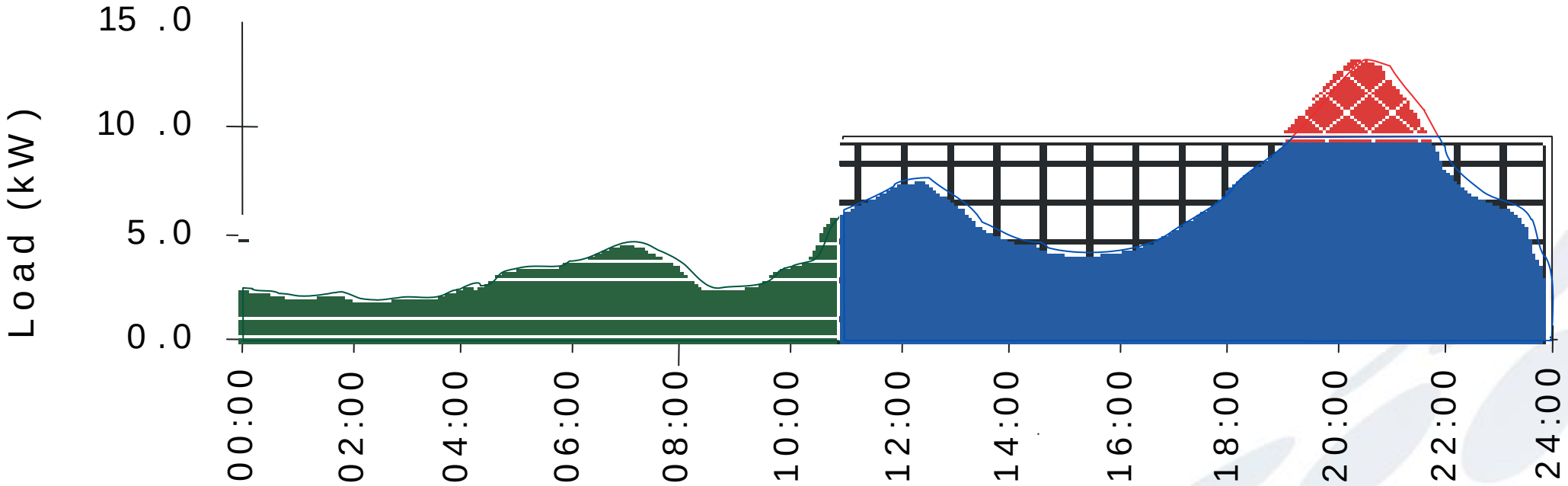
Source: 451 Research custom survey Nov. 2020



Main Benefits of Hybrid Power Systems

- Reliable 24-hour grid quality power
- Reduced generator run time – used only when required
- Fully automatic operation with remote access - seamless transitions amongst various energy sources
- Reduced fuel consumption - Diesel Gen always runs at optimum performance Load and auto-balances
- Reduced Generator maintenance and site visits.
- Renewable resources are prioritised directly to the site loads followed by storage in Battery Banks
- Futuristic Pollution Solution like NEVER before

Typical System Operation



Diesel off-line, battery and renewables operating through inverter

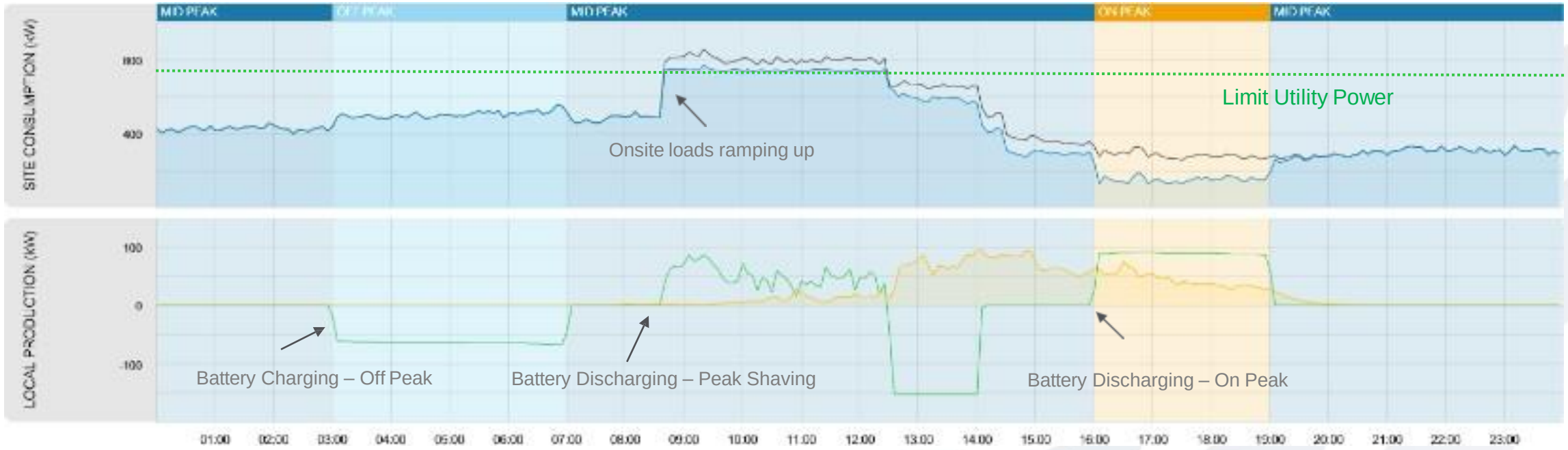
Diesel supplying load

Inverter charging batteries with excess diesel power

Inverter and diesel supplying peak loads in parallel

Demand charge reductions leading to cost savings

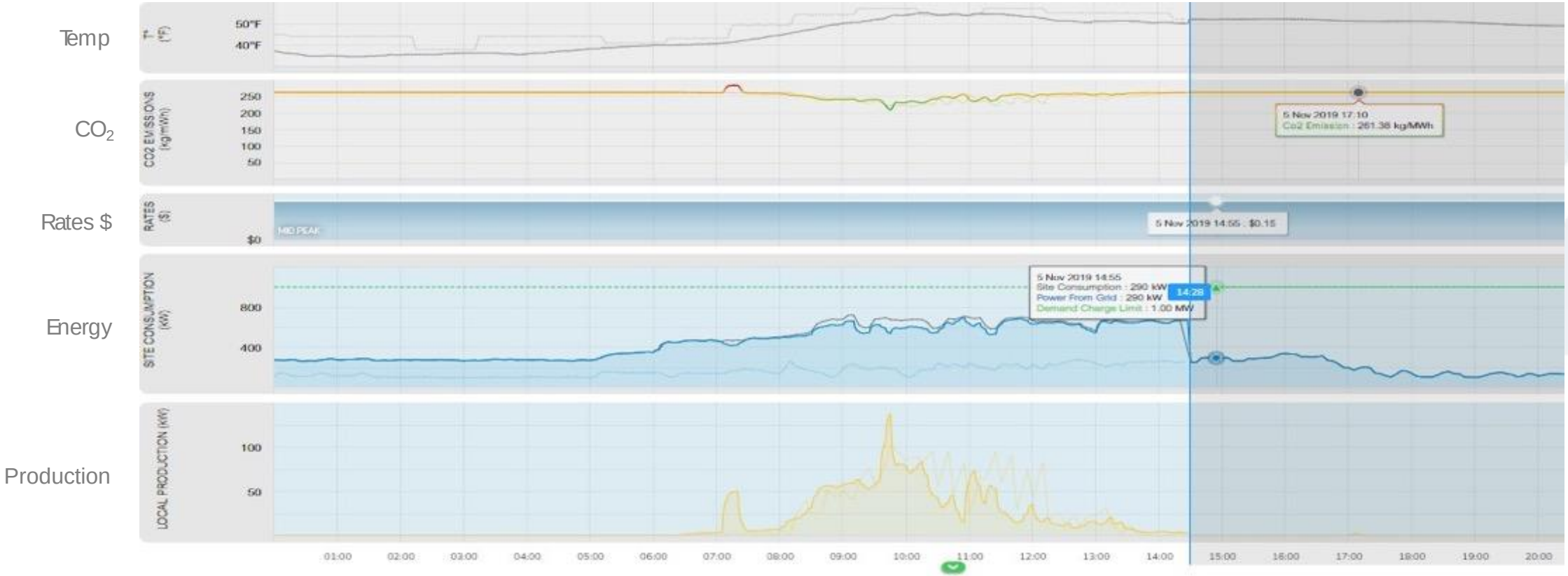
Peak shaving



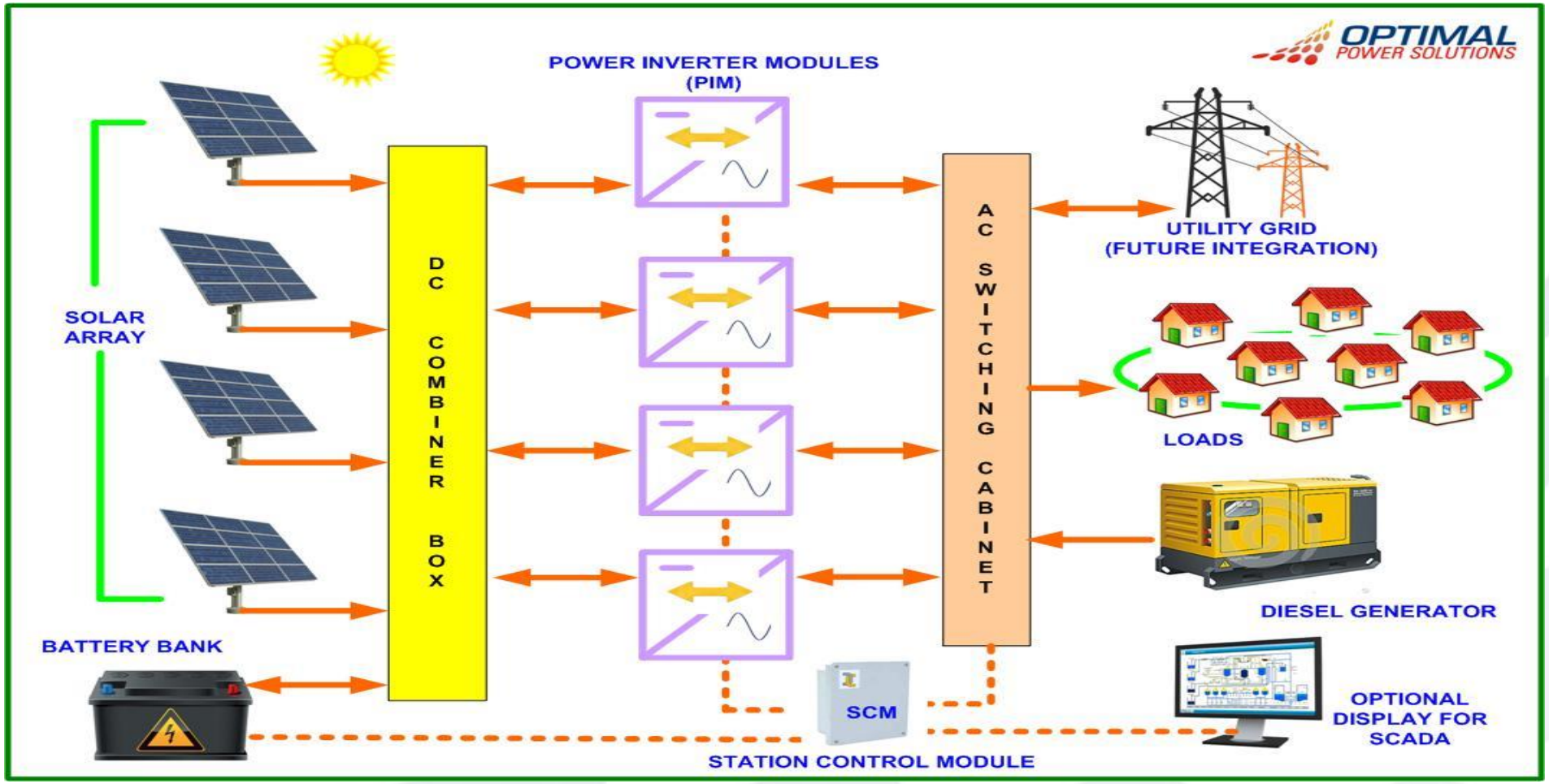
Example - Energy Optimization: economic dispatch of DERs, balance energy forecast, tariff structures and operating conditions

Example – Demand Charge Reduction: peak shaving by optimizing local DERs, DR program participation

Microgrid controller need to consider actuals and forecasts



Typical Mini Grid System



A microgrid enabled use case – Morotai Island, Indonesia Client: PT PLN Persero

- Off-grid solar hybrid system
- Largest solar power plant currently in Indonesia
- A spokesperson from PT PLN Persero said in a press statement that the System will reduce the island's fuel consumption by 800 litres per day and save approximately Indonesian Rupiah 2.5 billion per year.

System Topology:	Macro-Hybrid System (MHS)
Rated Total Power:	3MW
Solar Total Power:	600kWp
Solar Module Type:	Poly c-Si

Inverter Technology:	PIM + GEC
Inverter Capacity:	3 x GEC-250 (250 kVA) 2 x PIM-300 (300 kVA)
System Control:	SCADA + Onboard DSP
Monitoring System:	SCADA + OPS Coms

Wind Turbines:	n/a
Diesel Details:	1.750 MW peak (7 gensets)

Storage Type:	Lead Acid Battery
Storage Capacity:	2.7MWh

A microgrid enabled use case – Ajman, UAE
Hybrid Off-Grid System

Cost-effective renewable energy for industrial facilities

Advanced microgrid control platform incorporating advanced energy storage

Technical Details:

System Topology:	Hybrid off-grid system
Rated Generation Capacity:	1.4 MW peak
Solar Total Power:	305 kWp
Solar Module Type:	Mono c-Si
Gensets:	Dual
Diesel Details:	2 x 500 kVA

Inverter Technology:	Parallel Power System with MPPT
Inverter Capacity:	2 x PIM-200 (400 kVA total)
System Control:	Prescient U10 Microgrid Control Platform
Monitoring System:	Prescient U10 SCADA Solution
Storage Type:	Lithium Ion Battery
Storage Capacity:	614 kWh, 414.4VDC

- An advanced lithium-ion energy storage system with parallel power processing system and modular microgrid control platform
- Ensures power reliability and quality while delivering a strong financial outcome

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THANK YOU

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APPENDIX:

REMOTE ACCESS AND DIESEL LOAD BALANCING DEEP DIVE

Principle behind Optimal Loading of Diesel Generators

1. This Curve shows the Fuel Consumption of a Diesel Generator with respect to changing Load conditions

2. There are 3 Load Conditions which are shown in the Curve, namely: L, O and H

3. Point 'O' indicates that Generator is running at Optimal Loading and the Fuel Consumption is LOWEST

4. Point 'L' indicates Generator operating below the 'Optimal Load-O' and 'H' indicates that it is running above the 'Optimal Load-O' .

5. In both conditions of either 'L' or 'H', the Fuel consumed for 1 Unit of Energy generated is higher than 'O' i.e. Fo <Fh < Fl

5. This confirms that Generators would consume LOWEST Quantity of Diesel, if it can be "managed to run" at Point 'O'

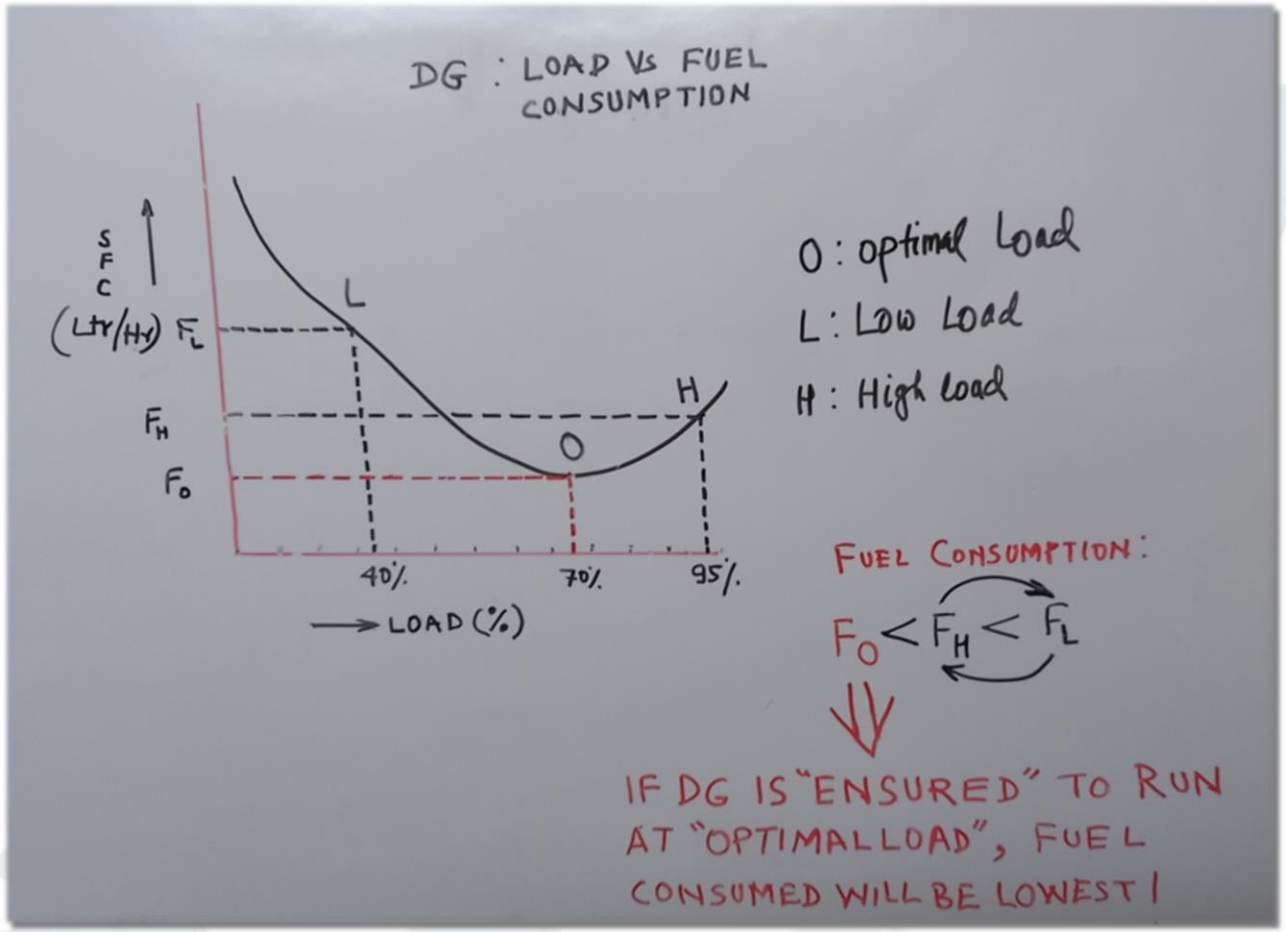

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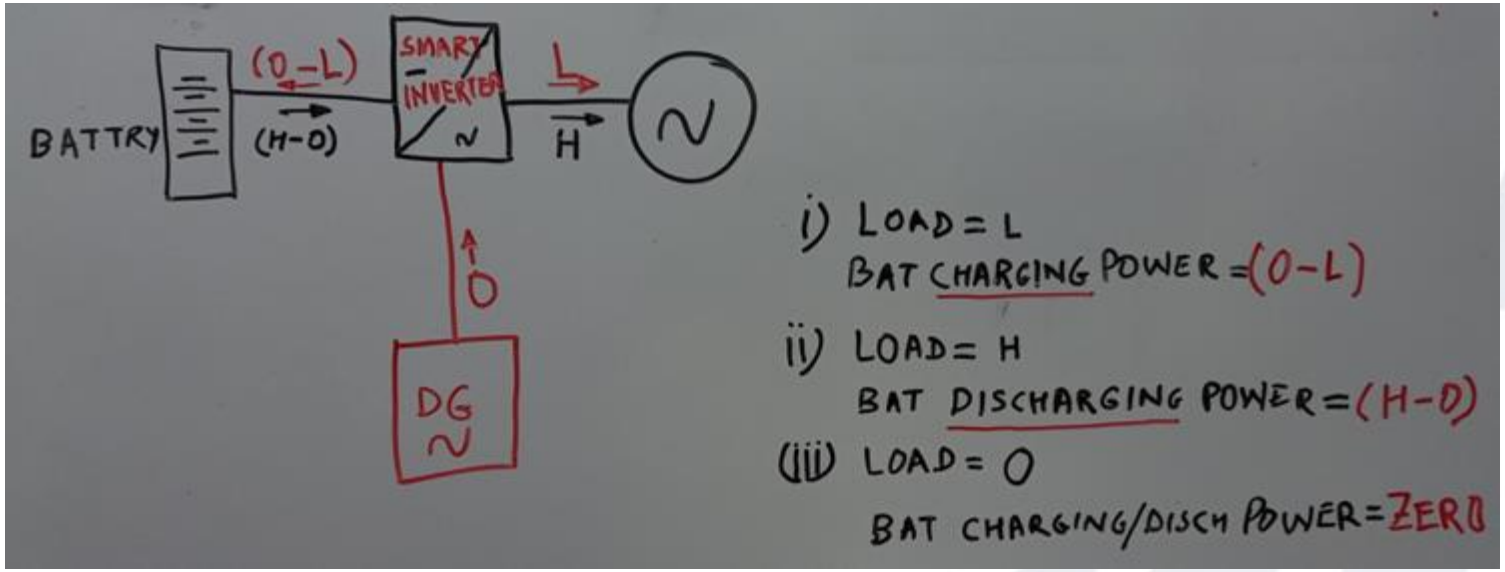
Illustration of Load Balancing on Diesel Gen

This Hybrid System illustrates the "Energy Management" by the SMART Inverter which ensures that Generator always gets the Load 'O'i.e. it would Always run at Optimal Load.



1. Condition L :
Actual Load is lower than the 'Optimal Load-O.

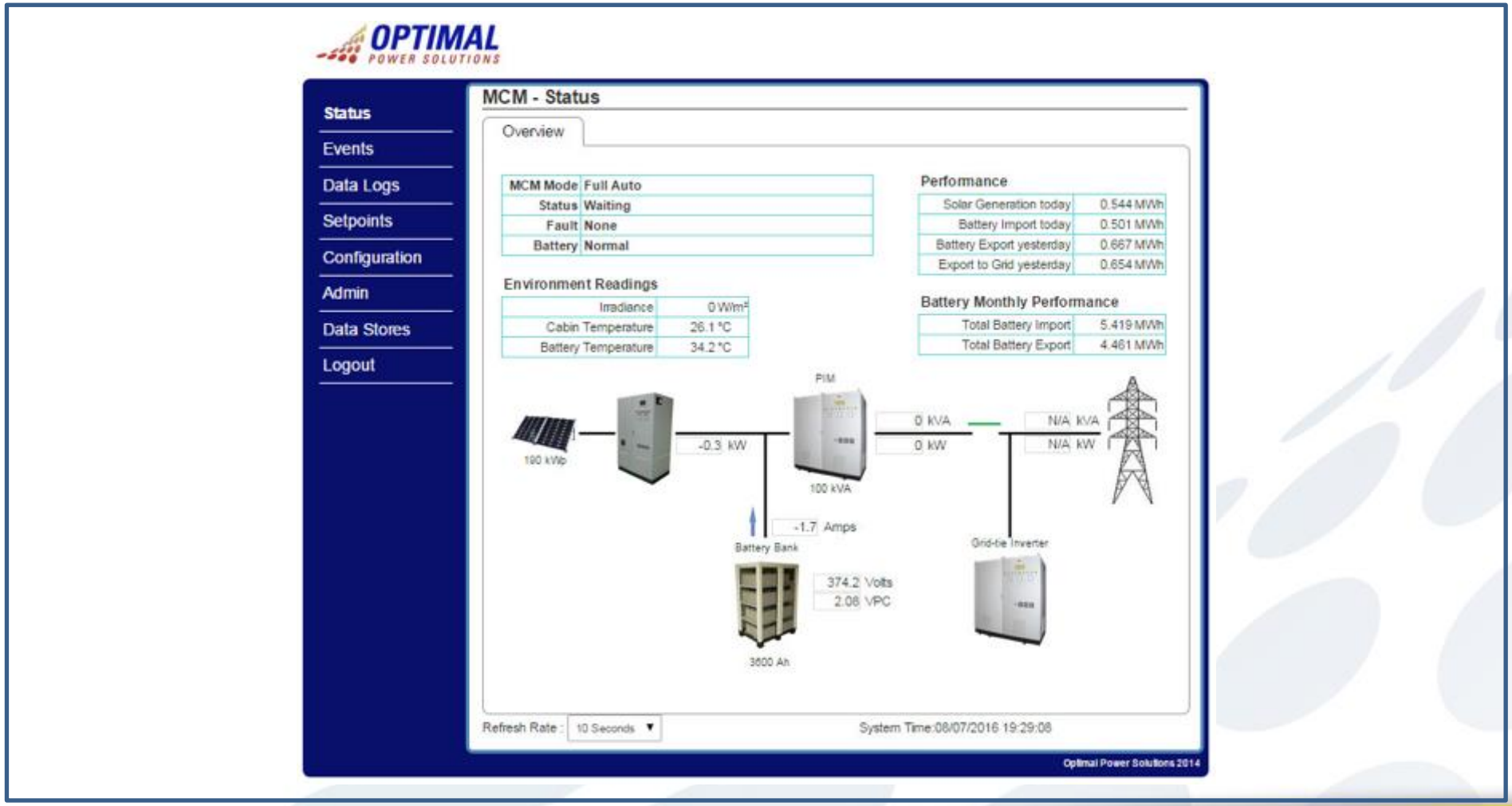
In this situation , the Energy Storage Bank (Battery) will be drawing a current which will be equivalent to Power (O-L) so that Total Load (Actual Load + Charging Load of Battery) on the Generator, adds up to 'O'.

2. Condition H:
Load is higher than the 'Optimal Load-O. In this situation , the Energy Storage Bank (Battery) will be supplying a current which will be equivalent to Power (H-O) so that Total Load (Actual Load - Charging Load of Battery) on the Generator adds up to 'O', again.

3. Condition 'O':
In this situation the Load is equal to Optimal Load 'O'. Hence, the Battery will neither be drawing NOR supplying any current.

The generator will be running under Optimal Load 'O'.

A.I. based Application Sample



Unreliable Grids Strategies

We Offer a unique PV – ESS solution

- UPS System - no break in power
- Voltage Conditioning with an efficient true on-line topology
- Integrated MPPT solar charge regulator
- “No break Transfer” to battery and renewable energy power in the event of grid failure
- Can export excess solar power to the utility.
- PLS (Peak Load Shaving) feature available
- PLS feature allows for operation of battery under controlled battery discharge rates leading to extended battery life

Part 3. Micro Grid / Mini Grid & ESS

We Offer unique solutions for Micro/ Mini grids & ESS

- Efficient and Reliable - no break in power
- Can form a Mini Grid in Self & Source tracking modes
- Can connect in parallel – provides for flexibility in expansion.
- Available Solar is used on priority
- Can Start / Stop DG remotely
- Optimisation of fuel consumption to achieve least LCOE.
- Provides for demand side management
- Best suited for ESS applications like Load levelling, peak load shaving, demand charge reduction, back up supply etc

OPS Comms System Features

The system overview page displays a simplified graphical representation of the system as a whole.

Trend Graphs Information will allow previously downloaded data logs to be viewed on a historical basis

Set point Editor Information

System set points can be viewed and modified from this page

Event Log Information

Displays all actions and faults related with the operation of the system

Data Logs Information

Displays selected historic data from the systems

PIM based applications – Our Sample installations

Powering of remote radars, Mini Grids, ESS etc