

APEC 2013

Power and Energy Management at Remote Cell Sites

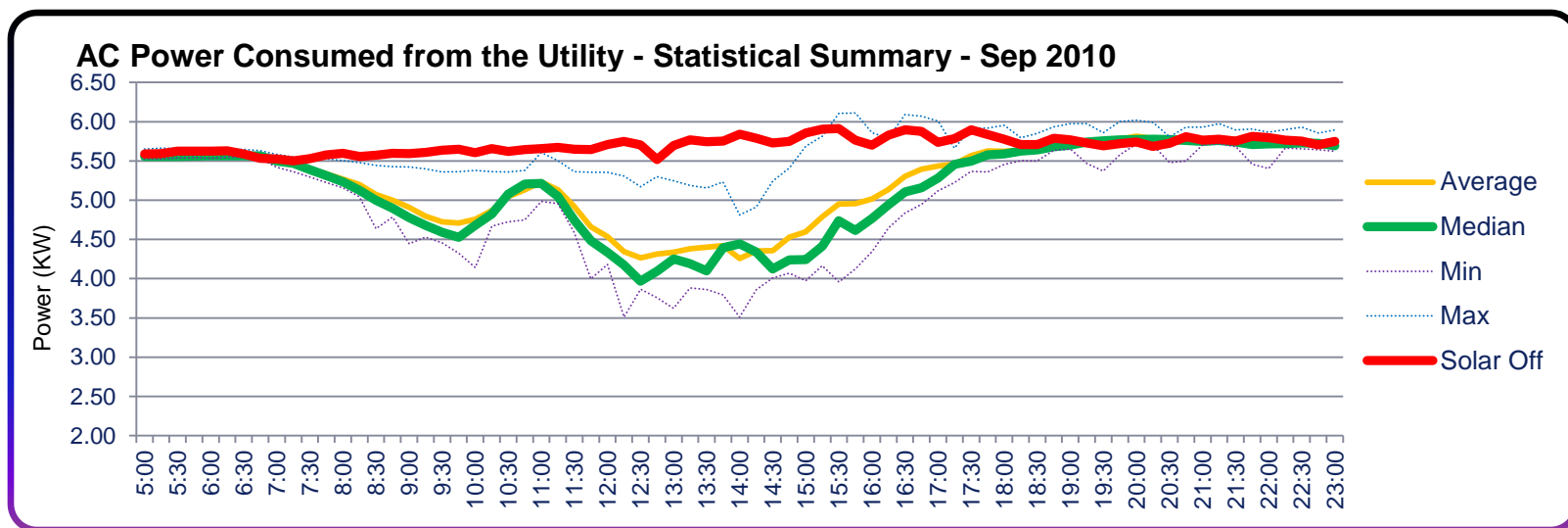
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Why the Energy Distinction?

- We pay for energy used, maybe peak power, but it is energy we consume!
- So the industry forward path is to conserve energy and enable “multiple energy sources”.



- Remote applies to: On-Grid, Bad-Grid and Off-Grid



Utility Rates and Consumption

Year	Factor	2009	2010	2011	Delta
Terabyte throughput	million	67.87	78.65	88.59	12.64%
Electricity (kWhr)	billion	10.27	10.24	10.00	-2.34%
kWhr / Terabyte	million	151.7	130.3	112.8	-13.4%

Verizon 2011 Sustainability Report

@0.10 USD / kWhr, we estimate Verizon's Annual Utility Bill at 1B USD

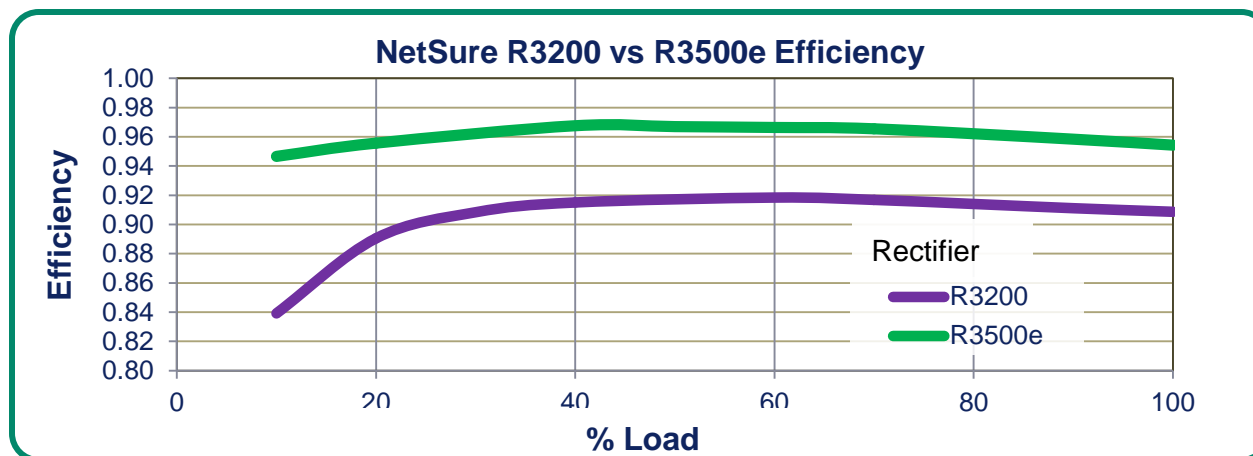
Much of the technology sector has relied upon Moore's Law, 30% annual reductions, but Energy Costs will not follow Moore's Law.

So is a shift of emphasis coming? The need to manage energy costs.



1st Response - Efficiency

■ Migration to High Efficiency Power



■ Case: 2 2000A DAS Installation at a large theme park - 70% Load and a low utility rate of 0.07 USD/ kWhr.

- NetSure R3200 at 0.9168 efficiency – 98878.48 USD per year.
- NetSure R3500e at 0.9655 efficiency – 93361.31 USD per year.
- Annual Savings – 5571.11 USD per year

- Ripple > Turn off idle power equipment (ECO Mode)



2nd Response – Reduce Losses

- **Cooling**
 - Temperature hardened (& smaller) equipment – eliminate HVACs.
 - Ripple: OEMs addressing heat loss and efficiencies.
 - Mixed cooling solutions.
 - The weak link is batteries and the industry is responding.





On-Grid versus Bad-Grid

A look at India (2009)

- Average Daily Outage: 6.1 hours
- Power Quality: Poor

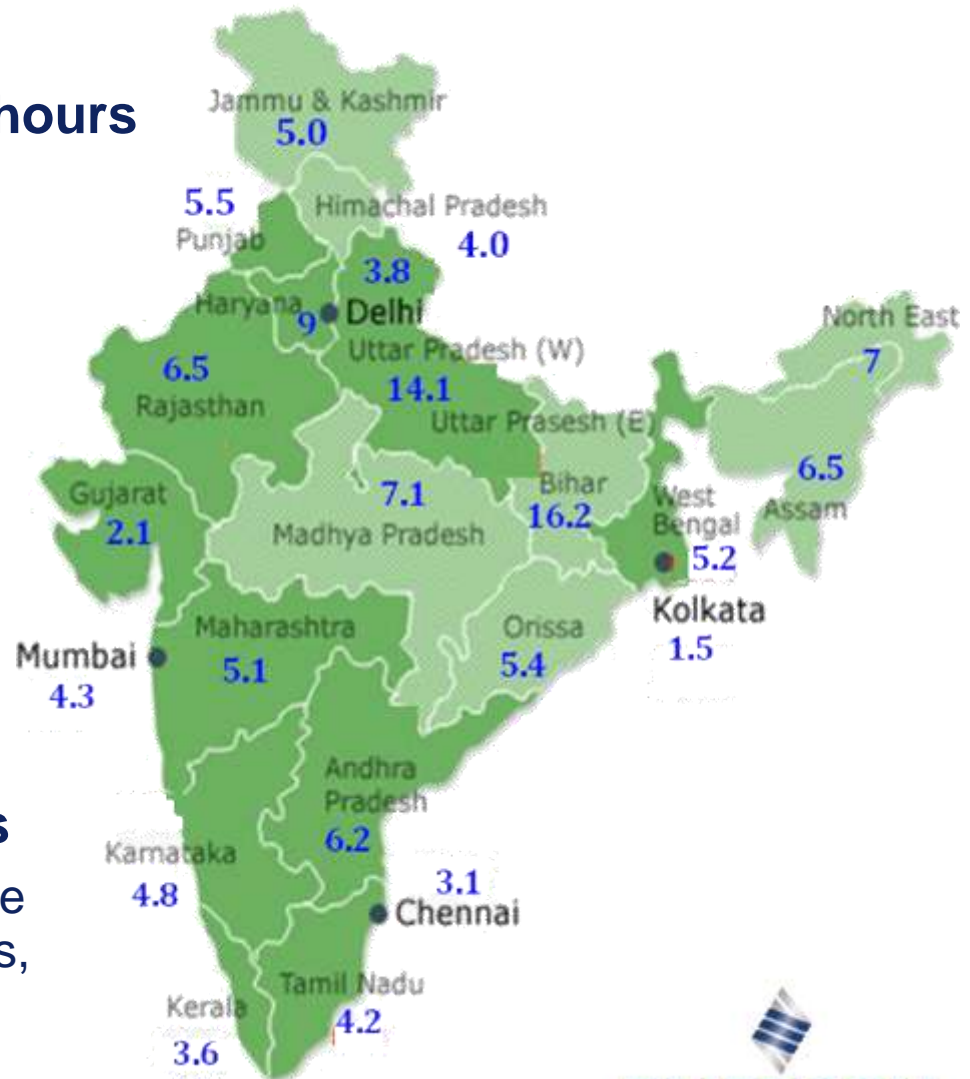
Though a grid provides a source of cheap power, it cannot be relied upon.

- Sites without power: 30%

Primary Source: Generators

Ripple: Shared Power Centers

Multiple Carriers sharing the same energy infrastructure – generators, rectifiers, batteries, et cetera.



And the trend?



... annual deployments of off-grid power supplies, using renewable or alternate energy sources, for remote mobile base states will grow from fewer than 13,000 worldwide in 2012 to more than 84,000 in 2020. In all, more than 390,000 such base stations will be deployed from 2012 through 2020.

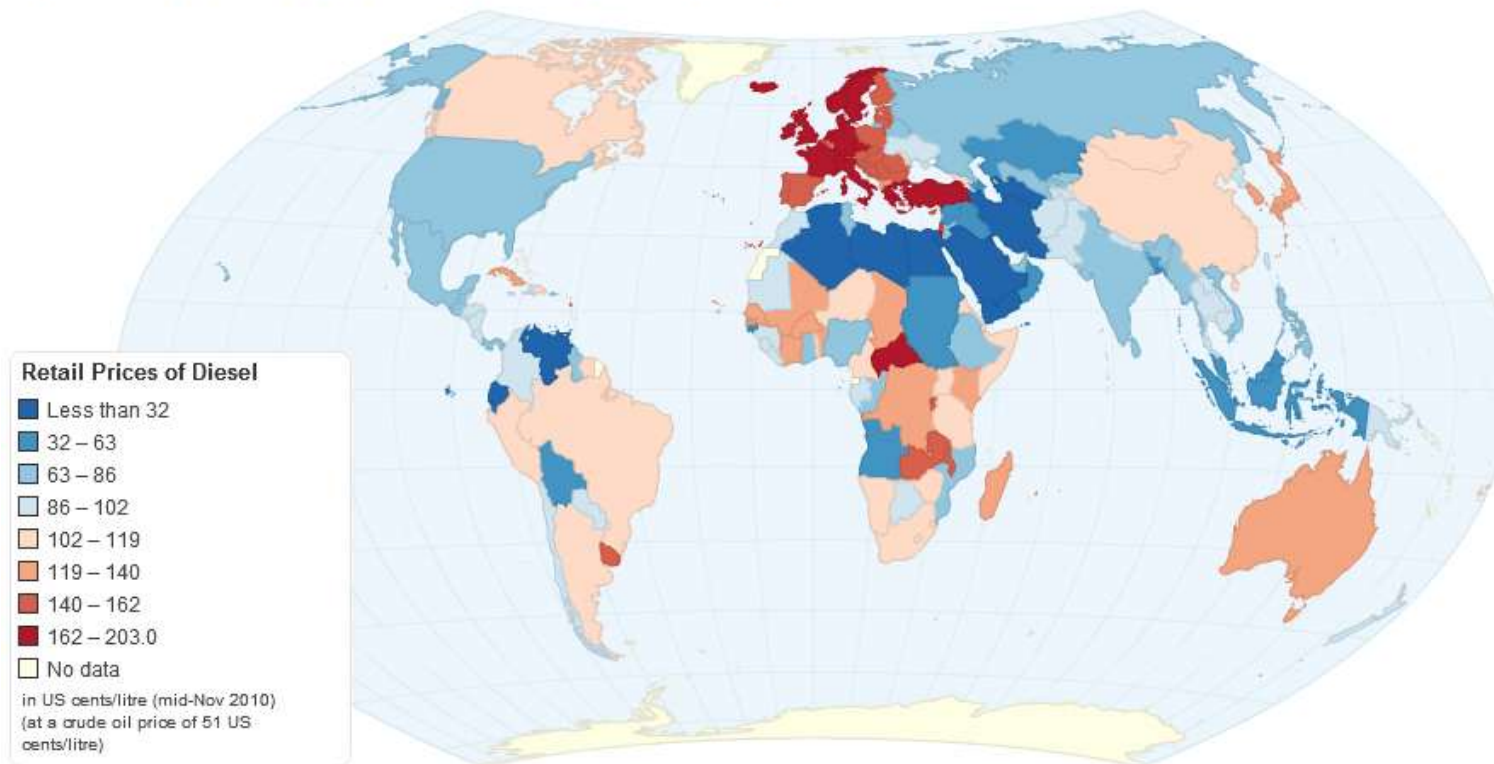
Pike Research Report “Off-Grid Power for Mobile Base Stations”

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Cost of Diesel - Operation

Worldwide Retail Prices of Diesel (US cents per litre)

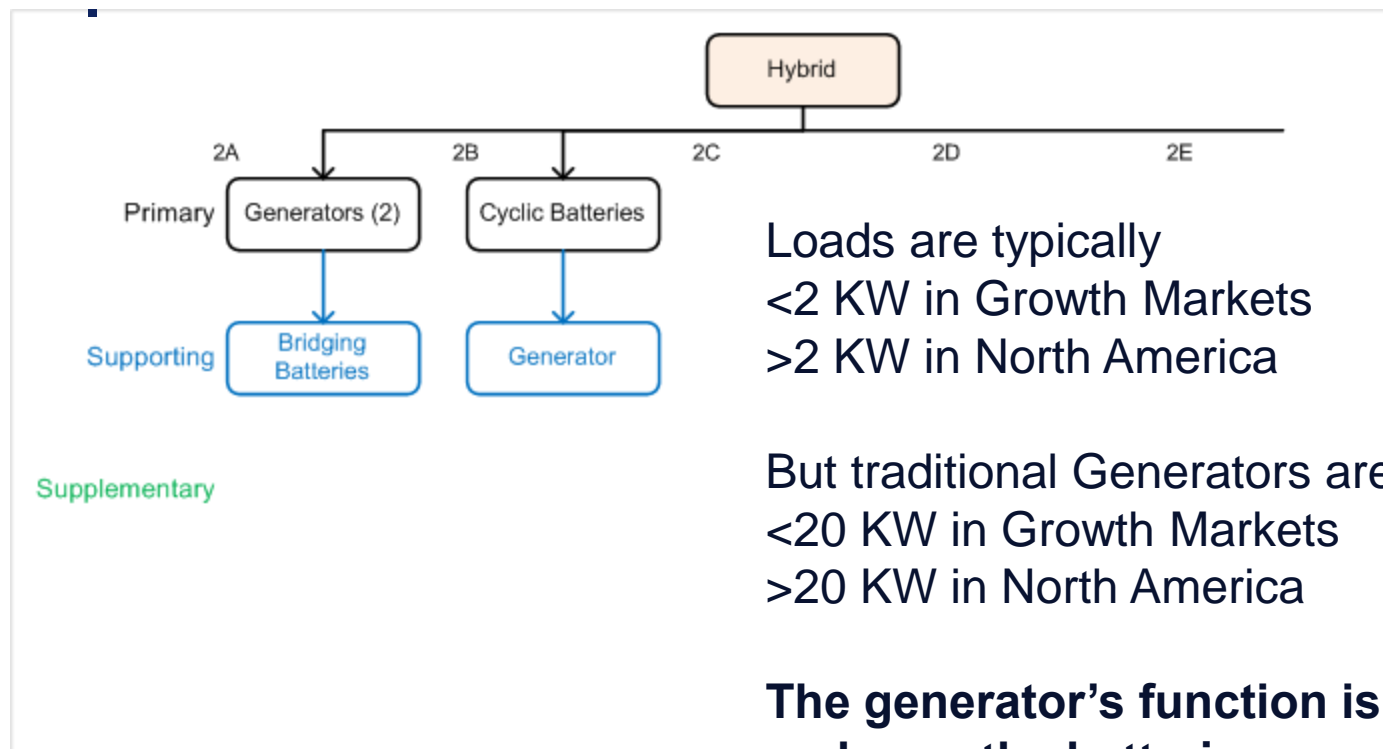


- But what is a **typical operating** cost of a Diesel Generator?
 - From 0.50 USD / kWhr in Urban Growth Regions to over 1.00 in Rural Regions.



3rd Response – Reduce Fuel

Changes roles – Batteries are the Primary Energy Source



Loads are typically
<2 KW in Growth Markets
>2 KW in North America

But traditional Generators are oversized
<20 KW in Growth Markets
>20 KW in North America

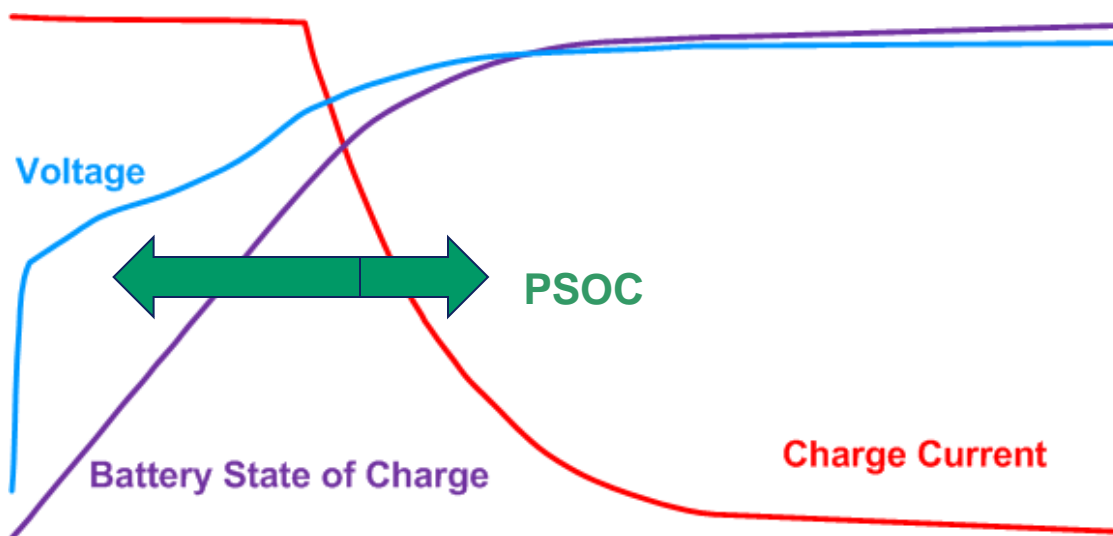
The generator's function is to recharge the batteries.



Management Changes

- **All DC – Minimize conversions and inversion.**
 - Security station, tower lights, battery charger on generator, et cetera.
- **Relook at how efficiency is measured.** (Component vs System)
 - Efficiency is effectively measured by the consumption of fuel at site!
- **Operation Partial State of Charge.**
 - Balance: Battery Life vs Fuel Savings

Typical Battery Recharge





4th Response - Renewables

One site – Two Off-Grid Solutions

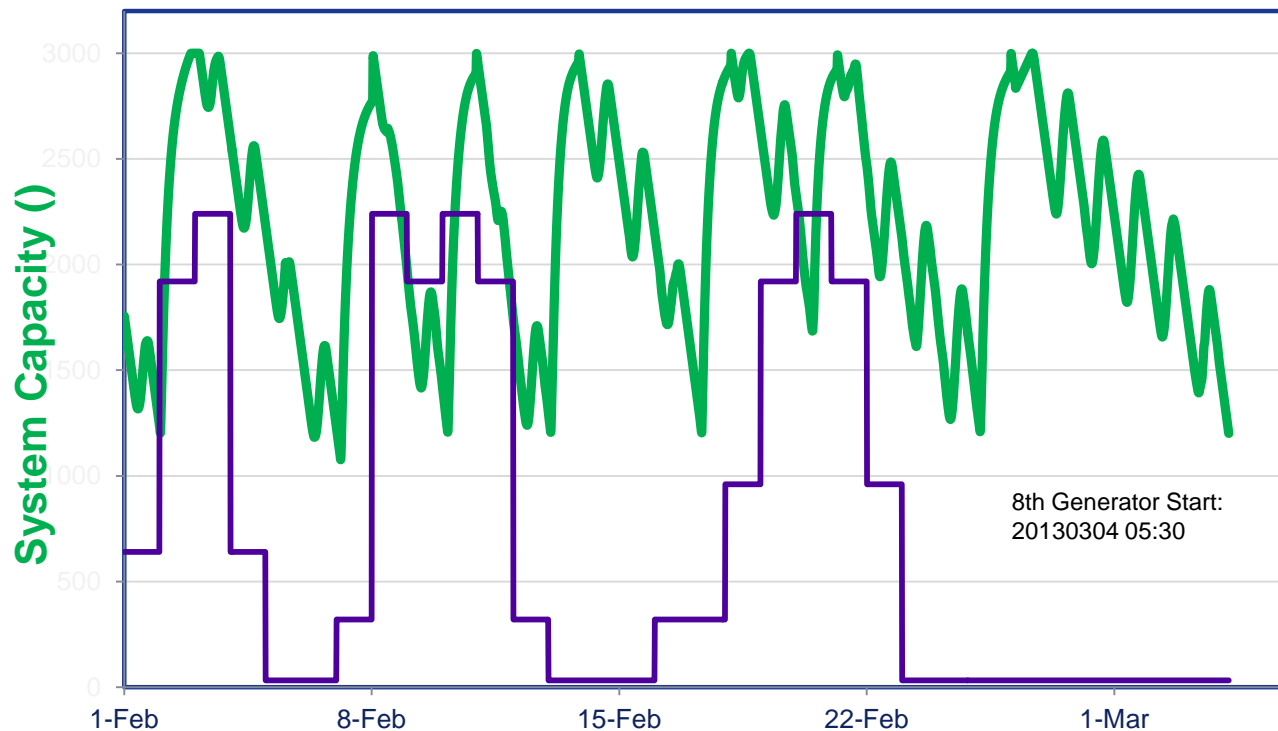
Primary:	Cyclic Battery	Generators (2) (Fuel)
Supporting:	Generator	Bridging Battery
Supplementary:	Solar	-----





BB Site Energy Review

Off-Grid Southern California – February 2013



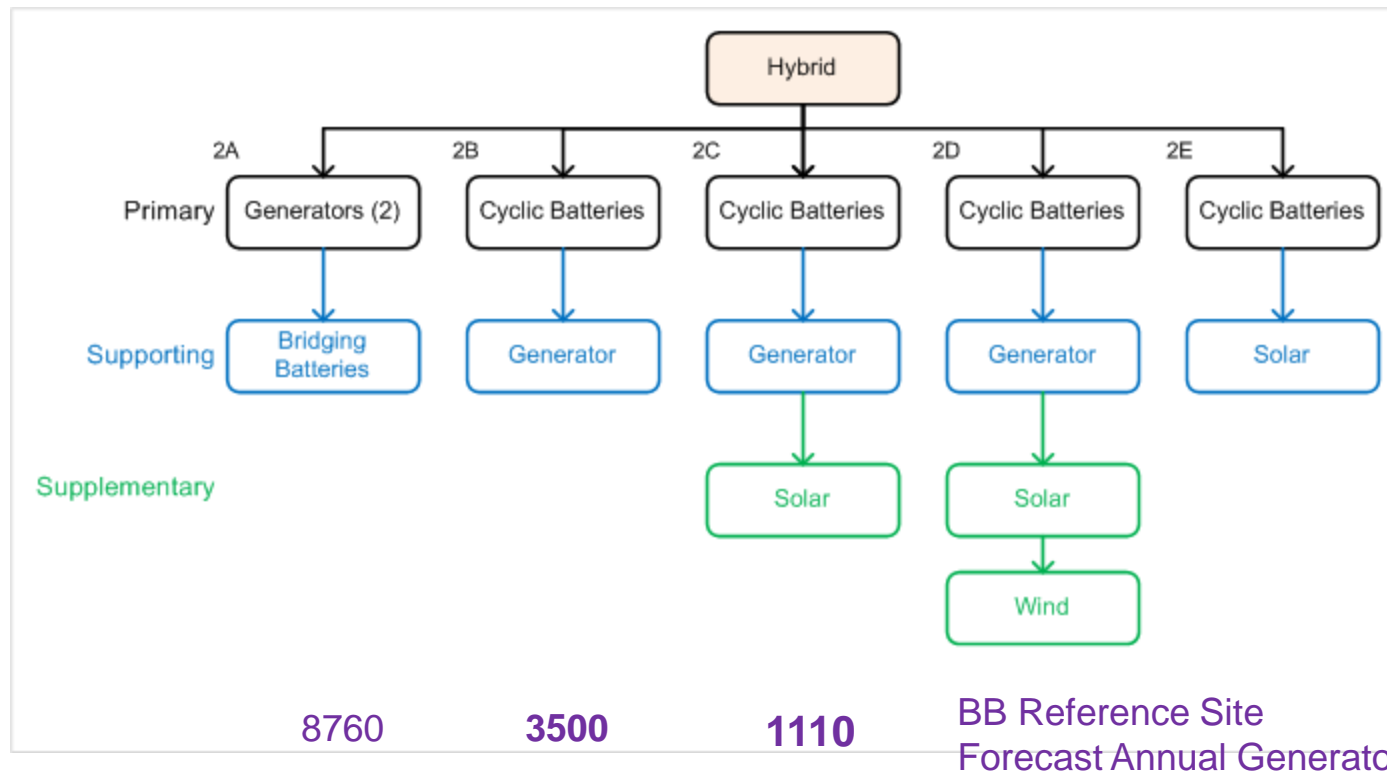
- ### Sky Summary
- Heavy Rain-Snow
 - Light Rain-Snow
 - Heavy Cloud
 - Light Cloud
 - Clear

February 2013



How real are the savings?

On-Grid, as a power unit, or Off-Grid, as a energy source, the application of multiple energy sources to reduce operating costs.





Management Changes

- **Good Energy Management now starts with site planning**
 - Clearances, landscaping and shade management
 - Use the solar array to shade and cool critical equipment
 - Neighbourhood acceptance

- **Ability and Willingness to Support Smart Grid “flexing”**
 - Some US Utilities today do ask and reward our carriers to disconnect from the grid, when the grid is under stress. **More to come?**

- **Coordination of Resources.**
 - Managing a hierarchy of energy sources.
 - Scheduling best-fit of resources.

- **Active Monitoring and Reporting of Energy**
 - Versus getting a monthly bill for fuel and electricity used.



Summary

- **Drive for efficiency and reduction of losses will continue, but the savings well is not infinite.**
- **Remote Systems will continue to roll-out, but a higher mix of sites will be ...**
 - Bad-Grid
 - Off-Grid (also “Near-Grid”)
- **Roll-out of renewable-alternate parts will grow.**
- **Moore’s Law does not apply to Energy Costs.**
 - Though most current procurement practices will hinder, we are seeing a transition >
- **Manage the energy & be responsible for system operating cost.**

Dialogue



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