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Battery Selection for Different Microgrids



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Topics

- Key considerations to plan a microgrid system
- Microgrids case studies:
 - EarthSpark/Zero Base in Haiti
 - GENSA/Hemeva in Colombia
- Key considerations to select a battery type for a microgrid.
- Typical charging behavior of a solar-diesel hybrid system.

Haiti Microgrid: EarthSpark International/ZeroBase

Town-sized, Solar-diesel hybrid grid is the first of its kind in Haiti. Smart grid serves residential and commercial customers, including agricultural processing facilities. 430 households and businesses. Town of Les Anglais

System components:

- Hybrid system: 90KW solar panel
- Inverter/chargers: Princeton Power Systems
- 400kwh battery capacity (152 Trojan VRLA 12V 200AH).
- Battery bank Voltage: 480V
- Emergency generator
- Grid: Medium-voltage line for future increase in consumption
- Funds: USAID Powering Agriculture Grant. The \$1.1 million in grant funding will enable EarthSpark to expand the Microgrid and assist agribusinesses with upgrading to efficient electric mills to modernize local processing for rice, sorghum, coffee, and corn.
- Installed: 15 May 2015



Breadfruit crops



Haiti, Microgrid: EarthSpark International/ZeroBase

Prepayment system by SparkMeter. It enables customers to know the status of their use and recharge their account with prepaid credits from a local energy seller.



2012- first pre-pay Microgrid the grid enabled the **14 pioneer customers** to light their homes, charge their phones and listen to music for an average US\$1.50/month

In October 2013, EarthSpark expanded grid coverage to a total of **54 customers** including a school and several local businesses. New smart meter.

April 26, 2015, EarthSpark expanded service to **430 households** and businesses, which represent most of Les Anglais downtown area



Haiti, Microgrid: EarthSpark International/ZeroBase



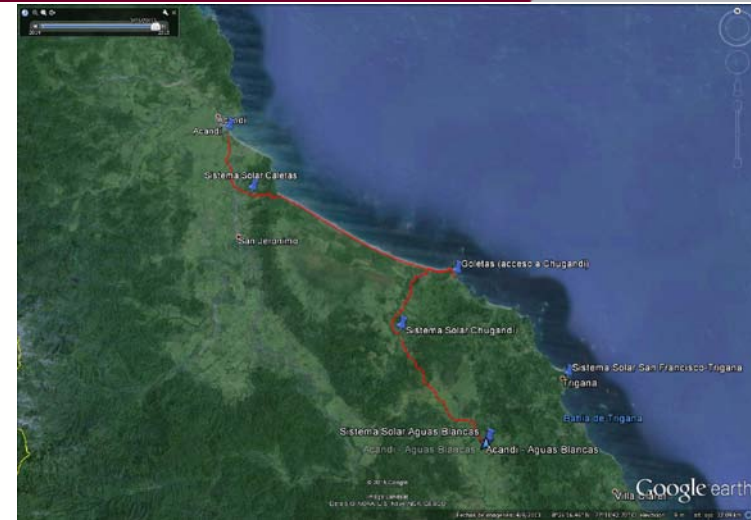
Colombia, 4 Microgrids: GENSA/Hemeva

The 4 microgrids were funded by the government to increase the coverage and satisfy the demand of energy in the “not interconnected areas”.

The users had access to electricity, powered by diesel, only for 4 hours before the hybrid systems were installed.

Location: Acanci, towns: San Francisco-Triganá (293 households), Chugandí (40 households), Caleta (45 households), Aguas Blancas (28 households).

Each households has a meter and pay a monthly invoice to the existent utility company.



Colombia, 4 Microgrids: GENSA/Hemeva

Systems configurations:

	San Francisco	Chugandi	Caletas	Aguas Blancas
Estimated Consumption	818kwh/day	99Kwh/d	99kwh/d	45Kwh/day
Solar Pv	126 Kwp (60% of the demand)	21Kwp (80% of the demand)	21Kwp (80% of the demand)	15Kwp (100% of the demand)
Battery bank	12 banks of 48V 2015AH (IND29-4V)	4 banks of 48V 2015AH (IND29-4V)	4 banks of 48V 2015AH (IND29-4V)	4 banks of 48V 2015AH (IND29-4V)
Inverter/charger	SMA Sunny Island	SMA Sunny Island	SMA Sunny Island	SMA Sunny Island



Colombia, 4 Microgrids: GENSA/Hemeva



Colombia, 4 Microgrids: GENSA/Hemeva



Key considerations to plan a Microgrid system

The following steps need to be taken into account to plan a microgrid in order to ensure the sustainability of the project.

- Feasibility study based on economics, physical infrastructure and community objectives: population density, ability to pay for energy, etc.
- Governmental support to set up a utility/concession.
- Load-demand management
- Planning typical load demand growth
- Energy efficiency
- Payment method
- Community participation
- Clear organization scheme to operate and maintain the system
- Find Partners to operate the system, to install the system, etc.

Key considerations to select a battery type for Microgrids

An analysis of the economics of the project, the batteries' technical characteristics, the existent infrastructure and the logistics.

- Capital budget.
- Life of the battery and other features such as ability to perform at partial state of charge
- Maintenance level: minimize maintenance when local staff are not trained electricians mainly when you are working with High-Voltage systems.
- Space limitation: using a container for the batteries vs building a house for them
- Transportation issues to remote areas: how to transport heavy batteries?

Batteries improve the reliability of Microgrids; reduce fuel consumption, cost of fuel transportation and maintenance cost of diesel generators.

Key considerations to select a battery type for Microgrids

	Space limitation	Maintenance	Transportation	Life of the battery in RE systems (IEC 61427)	Partial state of charge (PSOC) applications	Initial Cost
Monoblock GEL/ Reliant AGM	Good fit for Container's solution	No requires maintenance	Lighter weight	3-5 years	NA	Medium
Premium Line - Flooded	Mostly used in a built infrastructure or a well ventilated container	Requires watering	Lighter weight	8-9 years	With Smart Carbon for PSOC	Medium
Industrial Line - Flooded	Mostly used in a built infrastructure	Requires watering	Heavy weight	17 years	With Smart Carbon for PSOC	High



A Focus on Innovation

Key Innovations in batteries for Renewable Energy & Backup Power

AGM
Reliant™ Line
with C-Max Technology™



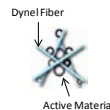
- Trojan's Reliant™ Line of U.S.-made Absorbed Glass Mat batteries are the only *true* deep-cycle AGM battery on the market today. Reliant is engineered with an advanced technology feature set that provides **outstanding sustained performance and total energy output**.

Flooded
Premium Line & Industrial Line
with Smart Carbon™



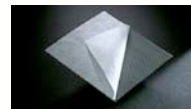
- Trojan's renewable energy Industrial and Premium with Smart Carbon™ Technology batteries are optimized for maximum cycle life when operating in partial states of charge for extended periods of time. Smart Carbon helps to **increase the life of the batteries over 15% under PSOC conditions**.

Alpha Plus® Paste



- Proprietary, high-density paste formulation engineered to deliver outstanding battery performance. **Sustained battery performance over a longer period of time**.

Maxguard® Separator



- Creates a more robust battery with **increased protection against failures** caused by separator degradation.

T2 Technology™



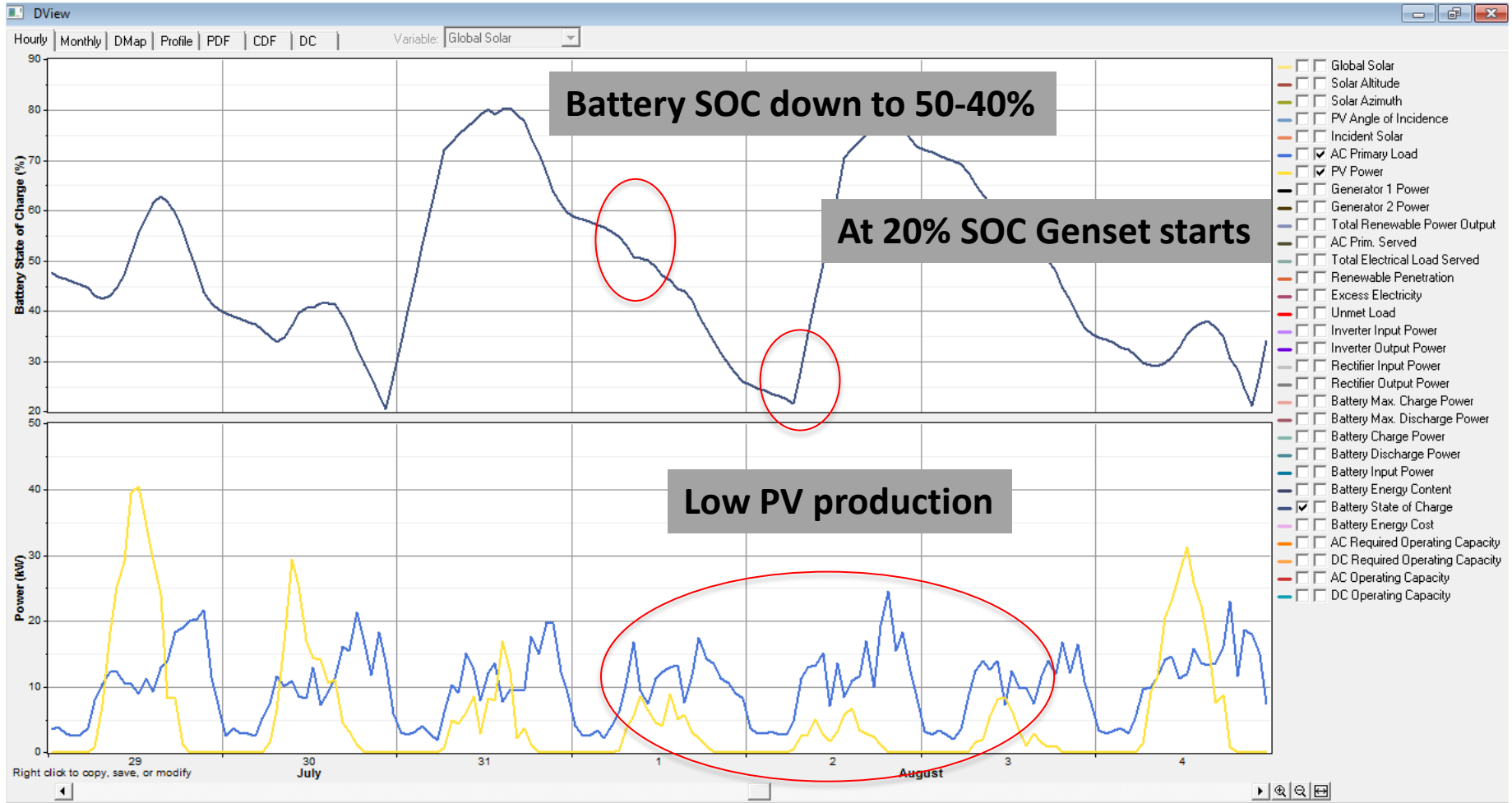
- T2 metal agent delivers maximum operating performance with more sustained capacity and **higher total accumulated ampere-hours**.

Typical charging behavior of solar diesel hybrid: Battery State of Charge

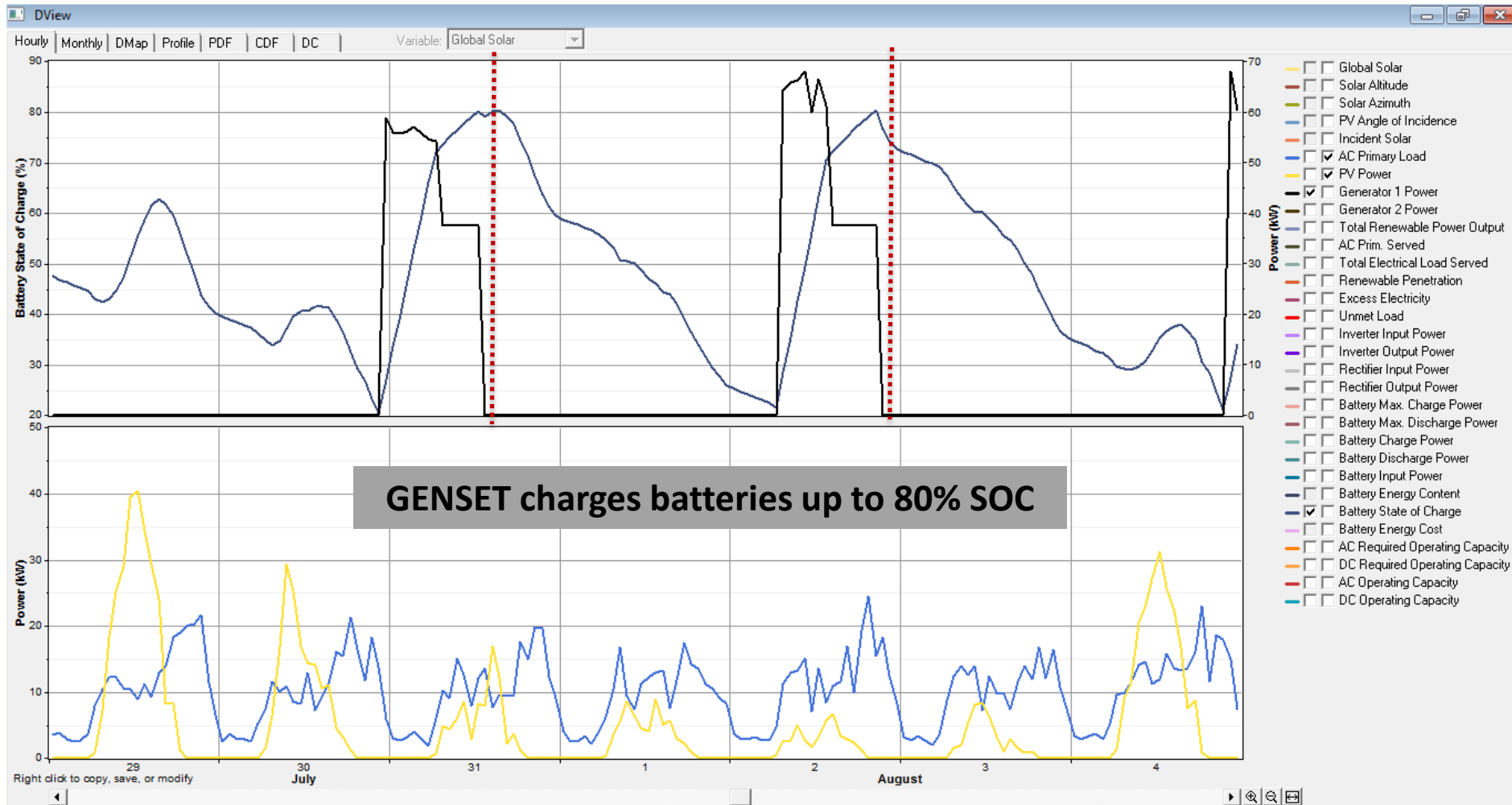
In the rainy season, May to September, batteries are mostly in PSOC



Primary Loads and PV Production vs Battery State of Charge



Primary Loads and PV Production vs Battery State of Charge and Diesel Generator



Conclusions

- Follow the best practices to plan a Microgrid.
- Select the battery technology that fits your project.
- Trojan batteries with Smart Carbon for Partial State of Charge deliver an increased performance in Renewable Energy applications.

Renewable Energy, Hybrid Systems & Backup Power



Markets

OFF-GRID REMOTE POWER

- ❖ Off-Grid Residential
- ❖ Solar Home Systems
- ❖ Rural Community Buildings
- ❖ Micro-Grids
- ❖ Solar Street Lighting

INDUSTRIAL MARKETS

- ❖ Telecom Networks
- ❖ Oil and Gas
- ❖ Communications
- ❖ Security
- ❖ Monitoring

GRID BACKUP

- ❖ Emergency Backup
- ❖ Inverter Backup



Product Families

2V 2V Batteries 4V 4V Batteries 6V 6V Batteries 12V 12V Batteries



INDUSTRIAL



PREMIUM



SIGNATURE



GEL



AGM

Headquartered in California with 4 USA manufacturing facilities in the USA & global distribution & offices

Sales presence in 120+ countries globally

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GEORGIA
UNITED KINGDOM
DUBAI
SOUTH AFRICA
HONG KONG

TROJAN BATTERY DISTRIBUTORS

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A.A. Battery
Battery Systems
Battery Systems
Factory Motor Parts
Camtec Energy LLC
Cosmoval Battery
MagCharge Battery
Northwest Battery
Safe-Start LLC
Storage Battery
Wardwide Battery Co. LLC

CARIBBEAN

Safe-Start LLC (B.L.)
Alternative Power Systems
Haiti
Valero Casey S.A.

MEXICO

Soluciones en Baterías S. de RL de CV (Battery Mexico)
CENTRAL & SOUTH AMERICA
Brazil
Vielvito Sudo
Central and South America
Safe-Start LLC (B.L.)
Chile
Heros S.A.
Colombia
Alumbradores Caracas
Costa Rica
ASA Inversores Energéticos S.A.
Electra Cost of Costa Rica
Guatemala
Compania Comercial Línea S.A.
La Casa de las Baterías S.A.

Nicaragua

COM S.A.
Sociedad

Paraguay
Socima S.A.

Peru
CME Comercial S.A.
Vielvito SAC

Uruguay
Baterías Bateria

EUROPE
Cosco
Albania
C.I.A.K. d.d.s.
Austria
Bauer GmbH

Belgium
Emol
Baltic States
Gibtech

Bosnia & Herzegovina

C.I.A.K. d.d.s.
Bulgaria
Wart Sooling Ltd.

Croatia
Industrijske Solucije
E.L. Remedić SA

Cyprus
Pneon Engineers Ltd.

Czech Republic
Staver Elektro

Denmark
Danish Elektromotor A/S

Finland
Griftech

France
Acco Plus
BES Batteries Industrielle Services

Germany

BE Elektro D.O.O.
Industrie Batterie Service

Greece
Industrijske Solucije
E.L. Remedić SA

Hungary
Bauer Batterien Hungaria Kft.

Iceland
Dib

Ireland
Platinum Batteries (Europe) Ltd

Italy
BES Italia SRL

Luxembourg
Emol

Montenegro

BE Elektro D.O.O.
Netherlands
Emol

Ukraine
Acco-Group Petrol BV

Norway
Stavde Elektro-Mekanik AS

Portugal
DUSA

Romania
C.I.A.K. d.d.s.

Serbia
BE Elektro D.O.O.

Slovenia
C.I.A.K. d.d.s.

Switzerland

Bauer Batterien Schweiz AG
Turkey
Emol

Ukraine
Acco-Group Petrol BV

United Kingdom
Platinum Batteries (Europe) Ltd

MIDDLE EAST
Egypt
Hyplast International

Israel
Schneepp Batteries

Jordan
Hyplast International

Kuwait
Kansat Development and Trading Co.
Databank

Lebanon

Power Tech S.A.LL
United Arab Emirates
Safco

Vietnam
Acco-Group Petrol

AFRICA
North Africa
Hyplast International

South Africa
First National Battery Co. Ltd. (Gulf) (FNBP/FA)

West Africa
Emment Nigeria Ltd.

East Africa
Centre for Alternative Technologies

Botswana
Kansat Development and Trading Co.
Databank

RUSSIA

Moscow
Acco-Group Plus Ltd.

ASIA PACIFIC
Brunei
TNE Corp. Pte. Ltd. (Singapore)

Cambodia
Gateway Equipment Co. Ltd.

China
Dongguan EDA Technology Co. Ltd.

Hong Kong / Macau
Safe-Start Co. Ltd.

India
Manak Engineering Services
Makindia Systems Private Ltd.

FI 99 Indonesia

Japan
NESCO Corporation

Malaysia
VIE Malaysia Job Ltd

Nepal
Dasa Energy International Ltd.

Philippines
Karl Plus Manak Trading

South Korea
L&H General Machine Co. Ltd. (L&H-GM)

Singapore
TNE Corp. Pte. Ltd. (Singapore)

Taiwan
ACC International Ltd.
Thailand

Gateway Equipment Co. Ltd.
Vietnam
VIE (Vietnam) Co. Ltd.

AUSTRALIA / OCEANIA
Australia
Ako Battery Sales

New Zealand
Ako Battery Sales



Thank you for your attention!

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