

Energizing Remote Areas in the Philippines: Solar-Hybrid Solutions



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Philippine Solar Power Alliance

- ***Founded in 2010;***
- ***Not-for-Profit Industry Association;***
- ***Membership : Manufacturer of Components; Project Developers and System Integrators for Rooftops; EPC Contractors;***
- ***Annual Solar Conference – SOLAR SUMMIT***
- ***Yearly Exhibition and Trade Shows;***
- ***Quarterly Product Orientation and Skills Training on Design & Installation;***
- ***Dialogue Partner of Government;***
- ***Voice of the Solar Stakeholders;***





Overview : Philippine Power Industry

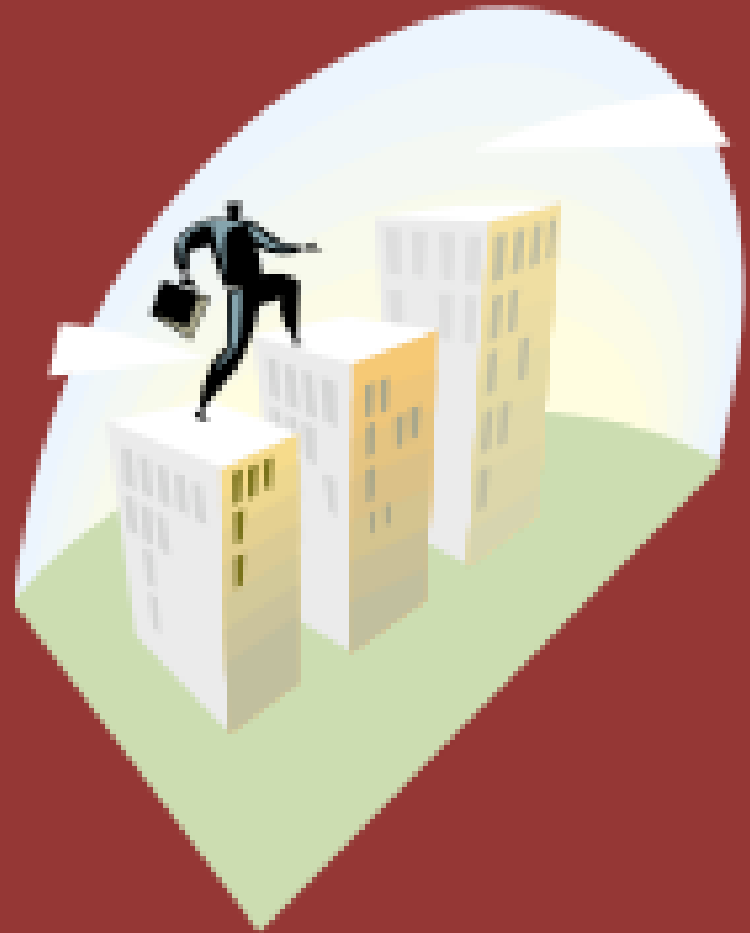


- 7,100 Islands;
- 16Gw Load with Metro Manila consuming 60%;
- Served by Almost 200 utility service entities; about 20 are privately owned;
- National Grid Corporation provides the Luzon to Visayas backbone; Mindanao not yet connected;
- 44 islands are off-grid but served by island grids;
- Power is produced by private generating facilities.

IN SHORT, PHILIPPINES IS LARGELY PRIVATIZED!

Philippines Is Growing & Moving Fast..

- **Philippine Population**
2012 : 92 million
2050 : 153 million
- **Gross Domestic Product**
2012- 2020 : 8.4 percent average
2020-2030 : 7.3 percent average
- **Energy Consumption**
in kg of oil equivalent per year
2003 : 1,524 kg,oe
2011 : 1,778 kg,oe



Growth Challenges : Planet in Peril

- Like the rest of the globe, the rise in temperature has been observed in the Philippines with a recorded increase of 0.68 degrees Celsius from 1951 to 2000, or an average increase of 0.01 degrees Celsius.
- According to WRI, 34% rise in energy use for period 1993-2010 caused 30% increase in emissions



Effects of Changing Environment

More Severe Typhoon, Greater than 150kmh winds



\$4.38m damage by Typhoon Sendong
Billions on rehab for Typhoon Yolanda

Effects of Changing Environment

Loss of Properties and Lives

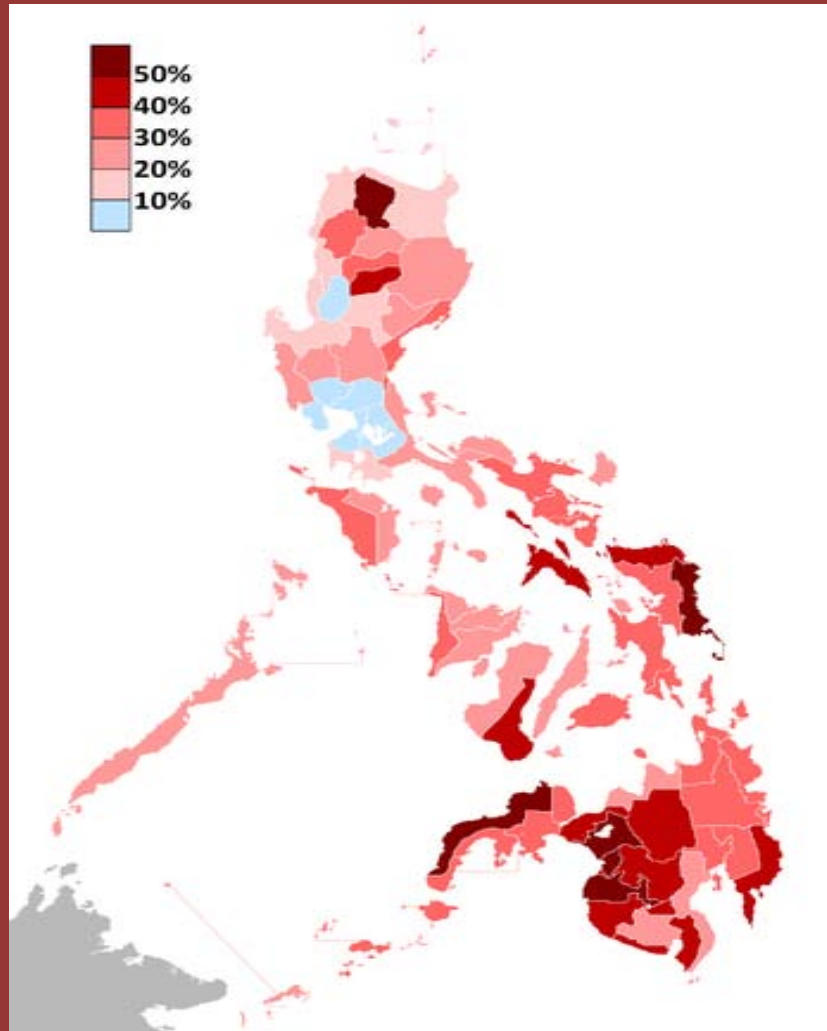


Growth Challenges : Pervasive Poverty

- Slow Trickling Effect of Philippine Growth as 27.9 percent of the population live below poverty line.
- Though this figure is much lower compared to 33 percent in 2009, improvement in poverty incidence is slow and uneven.
- Rapid Population has caused poverty to persist.



Growth Challenges : Uneven Development



Growth is highly concentrated in few areas in the Philippines.

PHILIPPINES

Regions and Provinces



ENERGY ACCESS

Connections/Population

POTENTIAL
17.484 Million / 88 Million

WITH ACCESS
13.442 Million / 68 Million

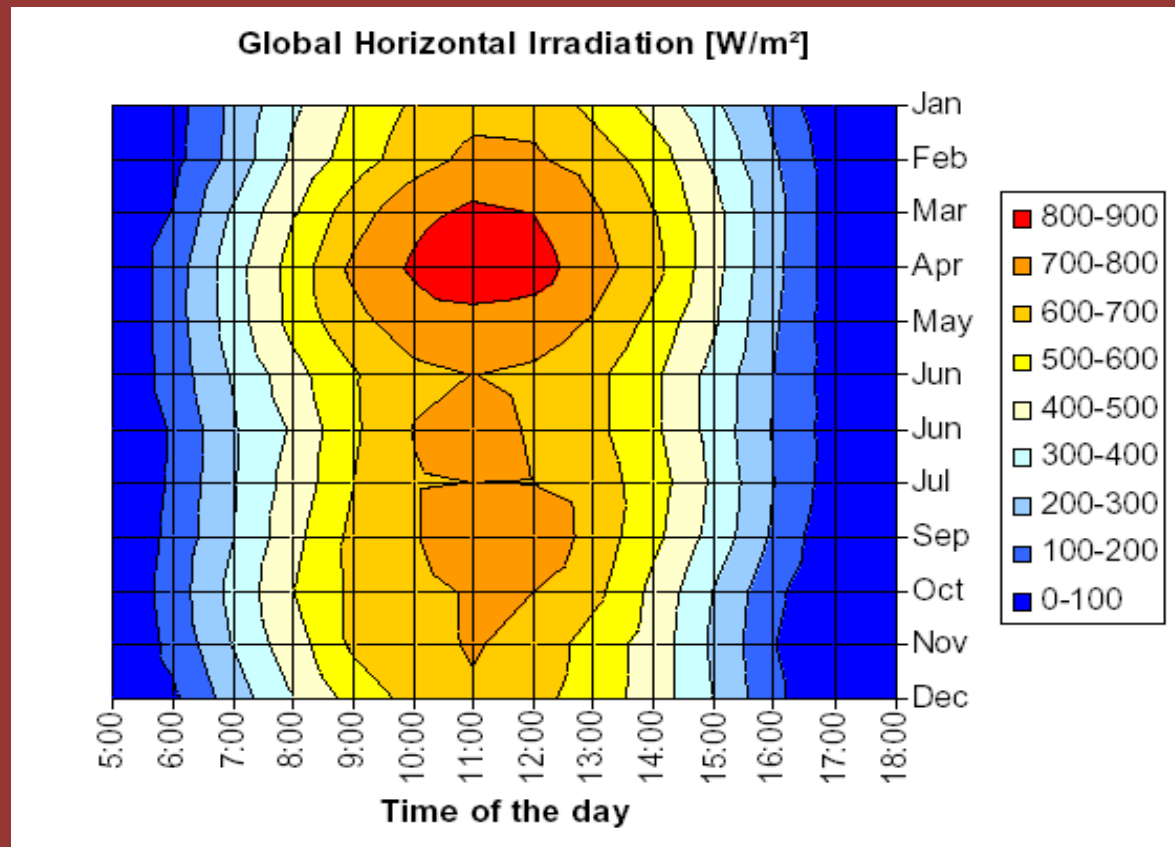
W/OUT ACCESS
4.042 Million / 20 Million

Philippines : Adapting New Ways

- Renewable Energy offers electricity access in unserved areas that address poverty and climate change objectives.
- RE Law provides way forward for Philippines.
- Solar energy proves to be the technology of choice.



Solar As Technology of Choice...



Solar Is At Parity...

MISAMIS ORIENTAL II ELECTRIC COOPERATIVE							
Year	Solar PV Annual Yield (kWh)	BFO Tariff Rate (P/kwh)	Avoided Annual Payment	Solar PV Tariff Rate (p/kwh)	Solar PV Cost	Annual Net Savings	Net Cumulative Savings
1	9,203,346.00	12.222	112,483,357.85	9.50	87,431,787.00	25,051,570.85	25,051,570.85
2	9,157,329.27	12.589	115,278,569.29	9.50	86,994,628.07	28,283,941.23	53,335,512.07
3	9,111,542.62	12.966	118,143,241.74	9.79	89,156,444.57	28,986,797.17	82,322,309.24
4	9,065,984.91	13.355	121,079,101.30	9.79	88,710,662.35	32,368,438.95	114,690,748.19
5	9,020,654.99	13.756	124,087,916.96	9.79	88,344,235.64	35,743,681.32	150,434,429.51
6	8,975,551.71	14.169	127,171,501.70	9.79	87,902,514.46	39,268,987.24	189,703,416.75
7	8,930,673.95	14.594	130,331,713.52	9.80	87,541,649.87	42,790,063.65	232,493,480.40
8	8,886,020.58	15.032	133,570,456.60	9.80	87,103,941.62	46,466,514.98	278,959,995.38
9	8,841,590.48	15.482	136,889,682.44	9.81	86,748,621.28	50,141,061.16	329,101,056.54
10	8,797,382.53	15.947	140,291,391.05	9.81	86,314,878.17	53,976,512.88	383,077,569.42
11	8,753,395.61	16.425	143,777,632.12	9.82	85,965,085.15	57,812,546.97	440,890,116.39
12	8,709,628.64	16.918	147,350,506.28	9.82	85,535,259.72	61,815,246.56	502,705,362.95
13	8,666,080.49	17.426	151,012,166.36	9.83	85,190,977.98	65,821,188.37	568,526,551.32
14	8,622,750.09	17.948	154,764,818.69	9.83	84,765,023.09	69,999,795.60	638,526,346.92
15	8,579,636.34	18.487	158,610,724.44	9.84	84,426,237.56	74,184,486.88	712,710,833.80
16	8,536,738.16	19.041	162,552,200.94	9.84	84,004,106.37	78,548,094.57	791,258,928.36
17	8,494,054.47	19.613	166,591,623.13	9.85	83,670,802.89	82,920,820.24	874,179,748.60
18	8,451,584.20	20.201	170,731,424.97	9.85	83,252,448.88	87,478,976.09	961,658,724.69
19	8,409,326.27	20.807	174,974,100.88	9.86	82,924,614.25	92,049,486.63	1,053,708,211.33
20	8,367,279.64	21.431	179,322,207.29	9.86	82,509,991.17	96,812,216.11	1,150,520,427.44

Php9.50 = USD0.21/Solar
 Php12.20 – USD0.28/Diesel

Economic Benefits of Solar

	MORESCO II GRID	KEGI	SOLAR PV SYSTEM
System Size (MW)		10.00	7.00
Electricity Sold (kwh)	88,977,689.85	34,310,000.00	9,448,758.00
Price (Php/kwh)	6.3420	12.2220	9.5000
Cost (Php)	564,296,509.03	419,337,055.00	89,763,201.00
Blended Rate (P/kwh)		7.9784	6.6452
Tariff Impact (P/kwh)		1.6364	0.3032

* Source : NEA, December 31 2012, with 5% increase

** Source : NEA, System rate

USD0.03/kwh consumer impact for diesel fuel use
USD0.006/kwh impact for solar

Cost : Driver to Solar Energy Installation

Php/kwh Ranges from \$0.36 to \$3.93

OTHER AREAS	Energy Sales MWh	TCGR P/kWh
PALUAN	825	19.2945
BALABAC	301	29.2546
ARACELI	389	22.9406
AGUTAYA	168	46.5526
LINAPACAN	172	43.6128
CULION	6,030	24.9044
BUSUANGA	9,672	16.1644
CAGAYANCILLO	121	63.3223
CUYO	4,403	18.7851
SAN VICENTE	1,508	19.8284
TAYTAY	1,588	18.9215
ROXAS	5,598	16.3834
EL NIDO	3,217	17.8108

MINI GRIDS	Energy Sales MWh	TCGR P/kWh
MASBATE PRES	1,148	100.084
BURIAS MINI-GRID	71	133.827
MASBATE MINI-GRID	233	28.4029
MINABEL MINI-GRID	23	120.087
MACONACON MINI-GRID	59	78.4213
ALMAGRO MINI-GRID	116	91.4786
STO NINO MINI-GRID	147	68.2097
CATBALOGAN MINI-GRID	22	171.273
PANAY MINI-GRID	71	81.1472
BOHOL I MINI-GRID	340	27.7784
BOHOL II MINI-GRID	94	73.0979

Resolution 21 : Cash Incentives in Off-Grid (\$0.11/kwh to \$1.89/kwh Addition to \$0.2@/kwh)

(b) "Cash Incentive of RE Developer for Missionary Electrification" shall refer to the cash generation-based incentive per kilowatt hour generated, equivalent to fifty percent (50%) of the universal charge for power needed to service missionary areas where the RE Developer operates the same, to be chargeable against the UC-ME.

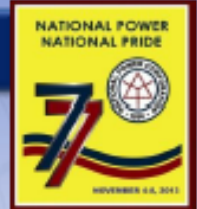
(c) "Missionary Electrification Subsidy" or "ME Subsidy" shall refer to the subsidy funded from the UC-ME and the funds sourced by NPC SPUG from appropriations from Congress, the utilization of private capital, multilateral aids or grants, Official Development Assistance (ODA) Funds and others, expressed in Peso per Kilowatt-hour, whose ultimate beneficiaries are end-users in missionary electrification areas. It shall be calculated as the difference between an NPP-TCGR or NPC SPUG TCGR, and the applicable Subsidized/Approved Generation Rate, NPC SPUG shall petition the ERC for the setting and approval of the ME Subsidy in accordance with Article V of these Guidelines.

Barrier to Solar Energy Installation

Limited Experience on Medium Scale Solar System in Remote Areas

- Implement RE Law Provisions
- Minimum Percentage Sourcing from Renewable Energy; 6.5Mw/year or 65Mw for 10 years; Renewable Portfolio Standards Being Finalized.
- Reduction of Subsidy to Missionary Areas; About 6 percent cut annually; Priority Areas are Islands with Expensive Transport and Hauling Cost;
- Demonstration of Solar-Diesel Hybrid Technology.

NPC-SPUG RE Development Plan in the Off-Grids



NPC Compliance Strategies

- ❖ Pilot test the installation of Solar-Diesel Hybrid in Masbate and in Limasawa, Leyte to increase operating hours from 8 to 24 hours
- ❖ Prioritize and adopt solar-diesel hybrid in areas with less than 24 hours service and/or in areas where fuel is difficult and expensive to deliver:
 - With Increased Operating Hours
 - Siasi (from 20 to 24 hours)
 - Pilar (from 18 to 24 hours)
 - West Simunul (from 10 to 16 hours)
 - San Vicente (from 16 to 24 hours)
 - Balabac (from 8 to 16 hours)
 - San Jose (from 12 to 20 hours)
 - Biri (from 12 to 20 hours)
 - Corcuera (from 12 to 16 hours)
 - Balimbing (from 10 to 16 hours)
 - Agutaya (from 8 to 16 hours)
 - Rizal (from 8 to 16 hours)
 - Concepcion (from 8 to 16 hours)
 - Capul (from 8 to 16 hours)
 - Maripipi (from 12 to 20 hours)

Solar Hybrid Demo in Limasawa, Leyte

OBJECTIVES

- Provide 24x7 power to the island
- Reduce production costs and overheads in delivering fuel to the island
- Adopt Solar PV system integrated with existing diesel gensets in the island

ISLAND STATISTICS

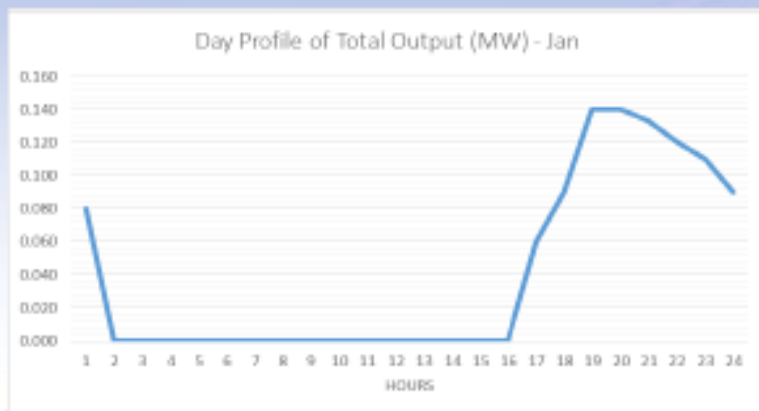
I. Power Supply

- NPC Gensets
- Installed Capacity: 326 kW
- Dependable Capacity: 320 kW
- Peak Demand: 160 kW
- Current Daily Operating Hours – 8 hours
- Distributor – South Leyte Electric Cooperative (SOLECO)

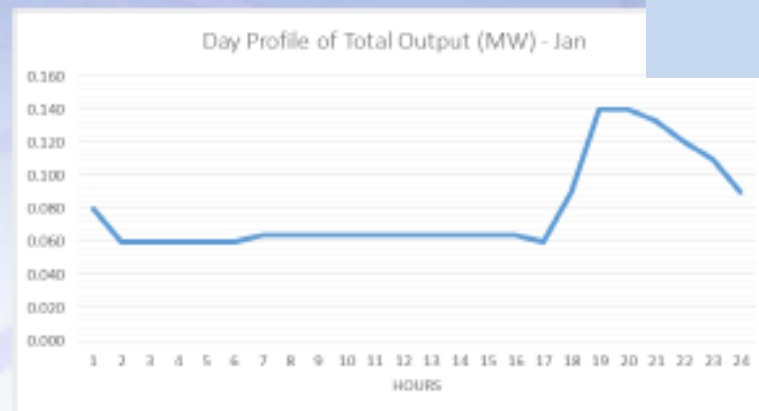
II. Customers

- Number of Household Beneficiaries – 1,106 (as of 2012)

PILOT PROJECT: SOLAR-DIESEL HYBRID FOR LIMASAWA



TODAY'S LOAD PROFILE



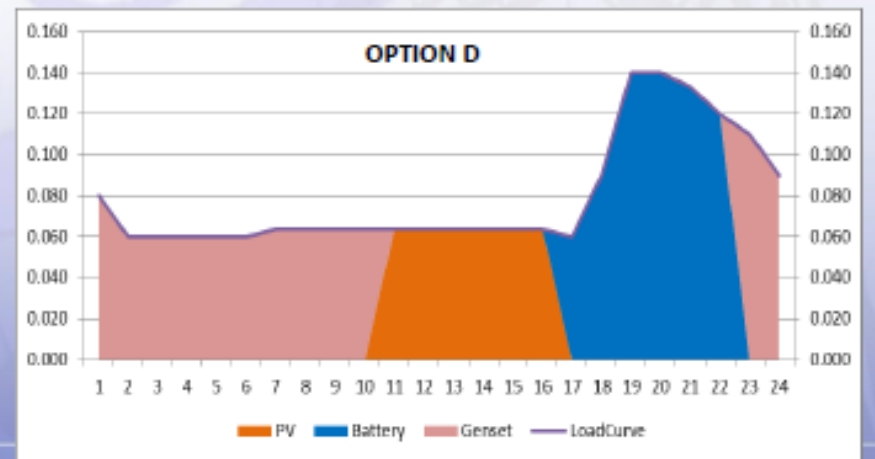
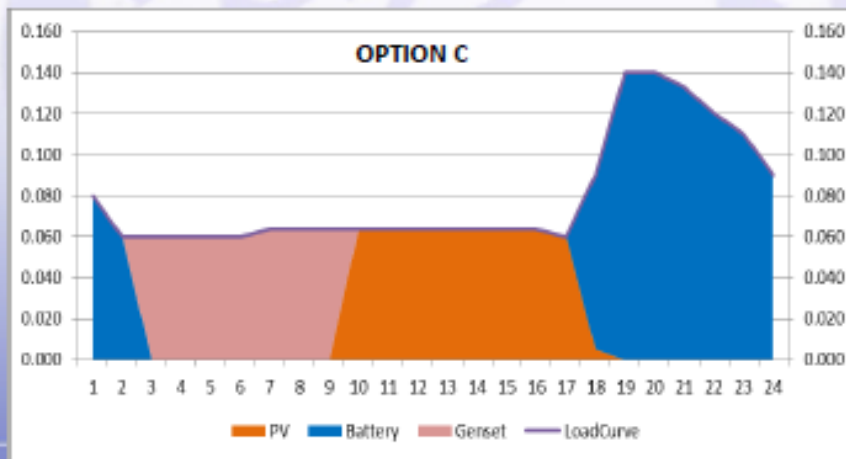
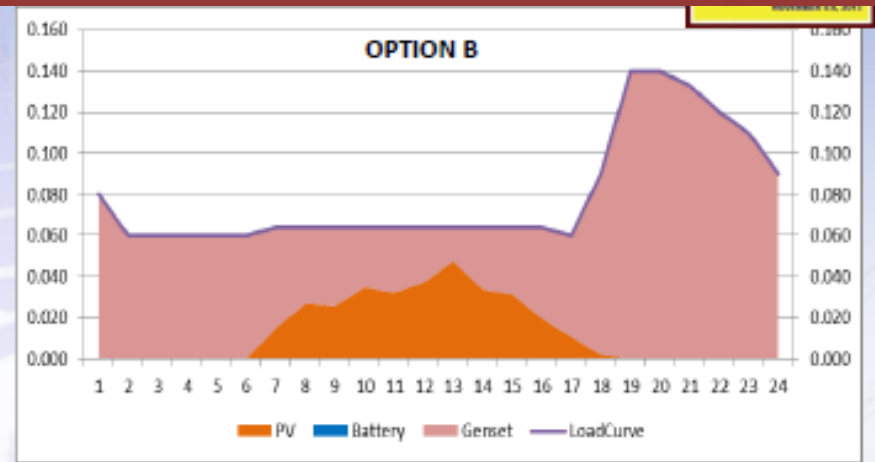
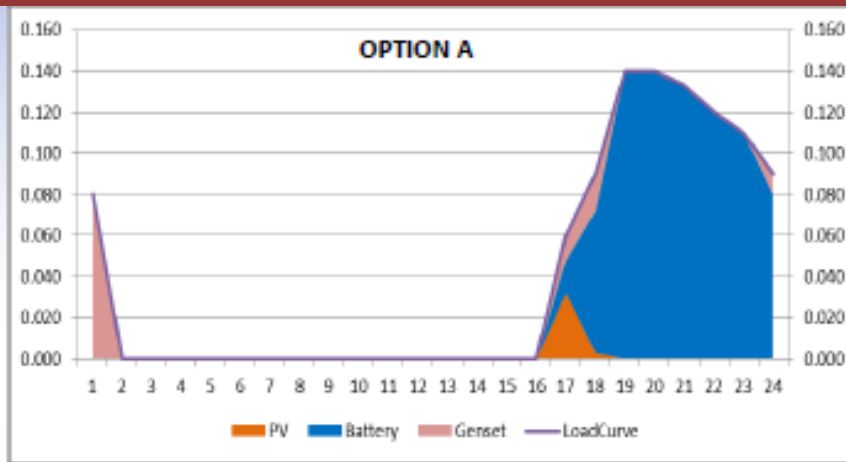
TARGET 24x7 LOAD PROFILE

Options	Capital Inv (\$M USD)	Annual Fuel Usage (K Litres)	Annual Fuel Savings (K Litres)	Annual Fuel Savings (%)	Annual Energy (MWh)
1: Today's Load Solar, Storage, Limited Diesel	1.3	23.4	84.5	78%	324
2: Target 24x7 Load Solar, No Storage, Diesel	0.4	175.8	(67.8)	(63%)	695
3: Target 24x7 Load Solar, Storage, Limited Diesel	1.9	57.1	50.9	47%	695
4: Target 24x7 Load Solar, Limited Storage, Diesel	1.2	113.0	(5.0)	(-5%)	695

Assumptions:

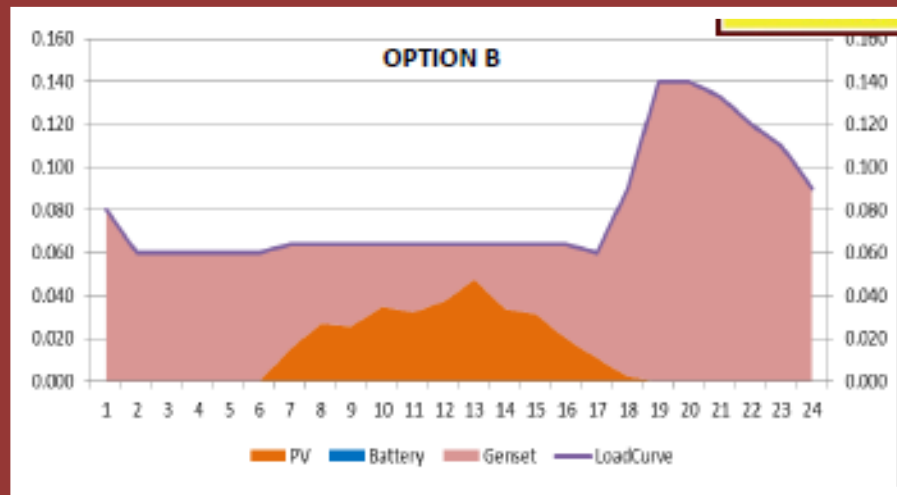
1. Current Diesel Consumption at 108 K Litres per year for 318MWh of annual net generation (based on MOR file)
2. Capital Inv costs are indicative only and assume ready availability of requisite land and use available gensets.
3. Solar PV plant O&M costs, transmission lines, not included in investment
4. Current Gensets can work with SunEdison Fuel Optimizer controller. Fuel Savings estimates are preliminary and vary by load.

Generation Options for Limasawa

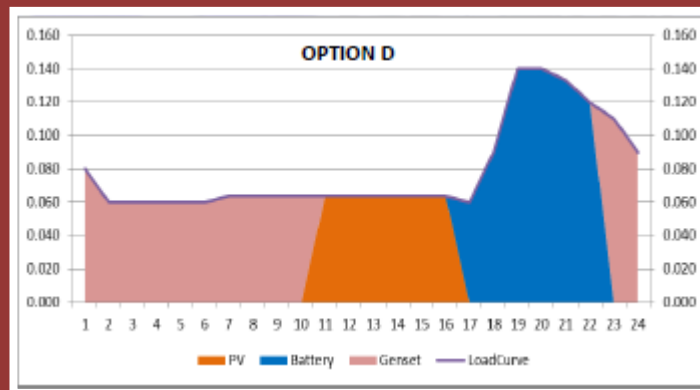


Components : 320kw

- Solar Modules : IBC PolySol 255watt
- Inverter : SMA Tripower & Sunny Island
- Batteries : Hoppecke



	Existing	B: 120KW DC Solar, No Storage		
	Limacawa DPP	Diesel + Solar w/o Storage		
	Limacawa DPP	Limacawa DPP	Solar	Total
Operating Hours	8	24	12	24
Gross Generation, kwh	320.623	579.535	115465	695.000
Oil	320.623	579.535		579.535
Solar			115465	115.465
Energy Sales, kwh	318.466			690.324
Net Utility Revenue	1.796.273			3.893.706
Less: Variable Costs	4.505.141	7.333.368		7.333.368
Fuel	4.505.141	7.333.368		7.333.368
Gross Generation Margin	(2.708.868)			(3.439.662)
Less: Fixed Costs	2.785.423	2.785.423	1.332.000	4.117.423
Depreciation	876.000	876.000	900.000	1.776.000
Plant	876,000	876,000	900,000	1,776,000
Other Operating Exp.	1.909.423	1.909.423	432.000	2.341.423
Total Direct	1.909.423	1.909.423	432.000	2.341.423
Plant	1,829,102	1,829,102	432,000	2,261,102
OM per Area	80,320	80,320		80,320
Net Generation Margin (Loss)	(5.494.291)			(7.557.085)
Production Cost, P/kWh	22.8928			16.5876
Subsidized Approved Generation Rate, P/kWh	5.6404			5.6404
Fuel Cost, P/kWh	14.1464			
Subsidy, P/kWh	(17.25239)			(10.94715)
Depreciation	5%			
USD --> PHP	45			



	Existing	D, 310KW DC Solar, 0.8MWh Storage		
		Limasawa DPP	Limasawa DPP	Solar
Operating Hours	8	12	12	24
Gross Generation, kwh	320,623	305,318	389,682	695,000
Oil	320,623	305,318		305,318
Solar			389,682	389,682
Energy Sales, kwh	318,466			690,324
Net Utility Revenue	1,796,273			3,893,706
Less: Variable Costs	4,505,141	4,713,712		4,713,712
Fuel	4,505,141	4,713,712		4,713,712
Gross Generation Margin	(2,708,868)			(820,006)
Less: Fixed Costs	2,785,423	2,785,423	4,869,000	7,654,423
Depreciation	876,000	876,000	2,700,000	3,576,000
Plant	876,000	876,000	2,700,000	3,576,000
Other Operating Exp.	1,909,423	1,909,423	2,169,000	4,078,423
Total Direct	1,909,423	1,909,423	2,169,000	4,078,423
Plant	1,829,102	1,829,102	2,169,000	3,998,102
OM per Area	80,320	80,320		80,320
Net Generation Margin (Loss)	(5,494,291)			(8,474,429)
Production Cost, P/kWh	22,8928			17,9164
Subsidized Approved Generation Rate, P/kV	5,6404			5,6404
Fuel Cost, P/kWh	14,1464			
Subsidy, P/kWh	(17,25239)			(12,27601)
Depreciation	5%			6.782319421
USD --> PHP	45			

Contracting Options



Diesel Gensets

- CapEx
- EPC
- O&M



PV System

- CapEx
- EPC
- O&M

RE Developer

PPA

NPC-SPUG

Bidding of the Solar-Diesel Project
No Cost to NPC
Power Purchase Agreement with Developer
RE is responsible for O&M

Off-Grid Areas Eligible for Incentives

200Mw

Island Grids - Luzon & Visayas Not Connected to Main Grid

- Batanes
- Mindoro Or
- Mindoro Occ
- Tablas
- Romblon
- Marinduque
- Masbate
- Catanduanes
- Ticao
- Bantayan
- Dinagat
- Camotes
- Siquijor

(13)

Island Grids - Mindanao Not Connected to Main Grid

- Basilan
- Sulu
- Tawi-Tawi
- Cagayan of Sulu

(4)

Off-Grid Locations Connected to Main Grid

- Kalinga
- Aurora
- Batangas
- Quezon
- Albay
- Camarines Sur
- Antique
- Iloilo
- Bohol
- Samar1
- Samar2
- Samar3
- Bohol1
- Bohol2
- Zamboanga
- Davao Norte
- Sultan Kudarat
- Davao Sur
- Surigao

(19)

Solar Energy Is Not A Fad in the Philippines..



9Mw Solar Farm in San Carlos
CONERGY : Developer
Inverters : SMA
Funder : Thomas Lloyd

2.5Mw of Solar Rooftop in the Phils...



3.8kw in LandBank

38kw in Makati Medical Center



40kw in Toyota Showroom



78kw International School



**5Mw Solar
Rooftop in
2014 is
possible...**

Solar Energy Made Sense



**Emergency Power for Clinics ...
Enabling Medics to Attend to
the Injured Victims.**

**Allowing Volunteers to
Perform Relief Operations
to Affected Families.**



Tips to Private Sector Participants

- **Philippine Off-Grid Areas Make Economic & Environmental Sense;**
- **Local Partners Make Project Development Easier;**
- **Participate in the Piloting of the Solar-Storage-Diesel Hybrid Technologies;**
- **Participate in Tender Process.**

THANK YOU FOR LISTENING..

**IT IS MORE SUN IN THE
PHILIPPINES!**

**CONTACT US...
PHSOLAR.ALLIANCE@GMAIL.COM**

