Green Power for Mobile Base Stations





Dialog Experience

Priyantha Meegasdeniya
Dialog Axiata PLC

Agenda

- About Dialog Axiata PLC .
- Back ground / Key Drivers for Green Power .
  - Grid Power Quality .
  - Operational Costs .
  - Cost of Fuel .
- Preferred Alternatives .
- Renewable Energy Potential in Sri Lanka.
  - Wind Energy .
  - Solar Energy .
- Green Power at Dialog Axiata PLC.
  - VISION
  - Dream RE Site for Dialog Axiata PLC.
  - Implemented Configurations.
  - Implementation Process.
  - Financials.
- Case Study .
  - Randenigala (Solar + Wind + DG Hybrid).
  - Meegaswewa(Solar + DG Hybrid).
- Key Challenges .
- Vendors .

About Dialog Axiata PLC

Dialog Axiata PLC

- A subsidiary of Axiata Group Berhad .
- Multi-sensory connectivity services.
  - Mobile (Core)
  - Fixed line
  - Broadband
  - Television
- Largest mobile network in Sri Lanka .
  - Subscriber Market Share – 45%
  - Revenue Market Share –55%
- Over 7 million customers.
- Over 76% of land area covered.
- Over 95% of population covered.
- Over 2000 2G and 1000 3G Base Stations.

Back Ground / Key Drivers for Green Power at Dialog Axiata PLC

Key drivers of green power

Economic

High Opex of Full Time DG.

Increasing fuel price.

Decreasing call tariff.

High Capex to get grid power for off grid sites.

Zero (minimum) Opex for RE.

Decreasing Wind & Solar Capex.

Corporate

Reach for off grid areas.

Most environment friendly operator.

Environmental compliances.

Network quality.

Sustainability

Environment

Minimum CO2 & other emissions

Reduce noise

No discharge of burnt lubricants & air filters etc

Save 30-40 grown trees on average per site. (Way leaves)

Society

Connectivity for remote areas

No disputes with community regarding construction of new power lines.

Minimize damages due to lightning & surges

Cleaner environment

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Grid Power Quality

- 24 Hrs electricity supply.
- Electricity accessibility for 80% of the population
- Government aims to achieve complete electrification (through grid & off grid schemes) by 2012

- No grid connectivity for most of the areas in North & East
- Extra high Capex to connect grid power for mountain top sites
- Around 30 # of off-grid sites (100+ in 2008)
- 50-100 remote sites with low voltage

- Longer duration to develop infrastructure to connect off-grid sites.
- Objection for way leaves from the public.

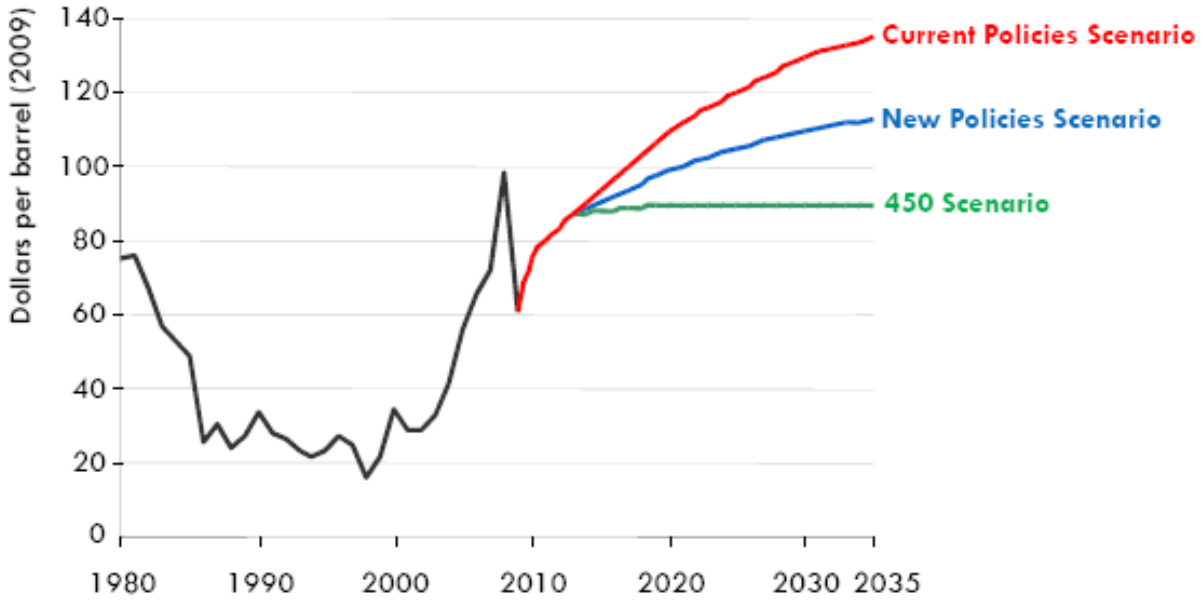
Operational Cost For Fulltime Generator site

DESCRIPTION	COST	REMARK
Fuel Cost	1335	Per month
Service Cost	158	Per month
Operator Cost	157	Per month
Over haul Cost distributed	122	Per month
New Generator Cost distributed	280	Per month
TOTAL COST (USD)	**2052**	**Per Month**

Assumptions:

- Generator capacity is 11.5 KVA & operated at 75% load.
- Manual Distance to site 500m
- 1 USD = Rs.114.94

Fuel Costs

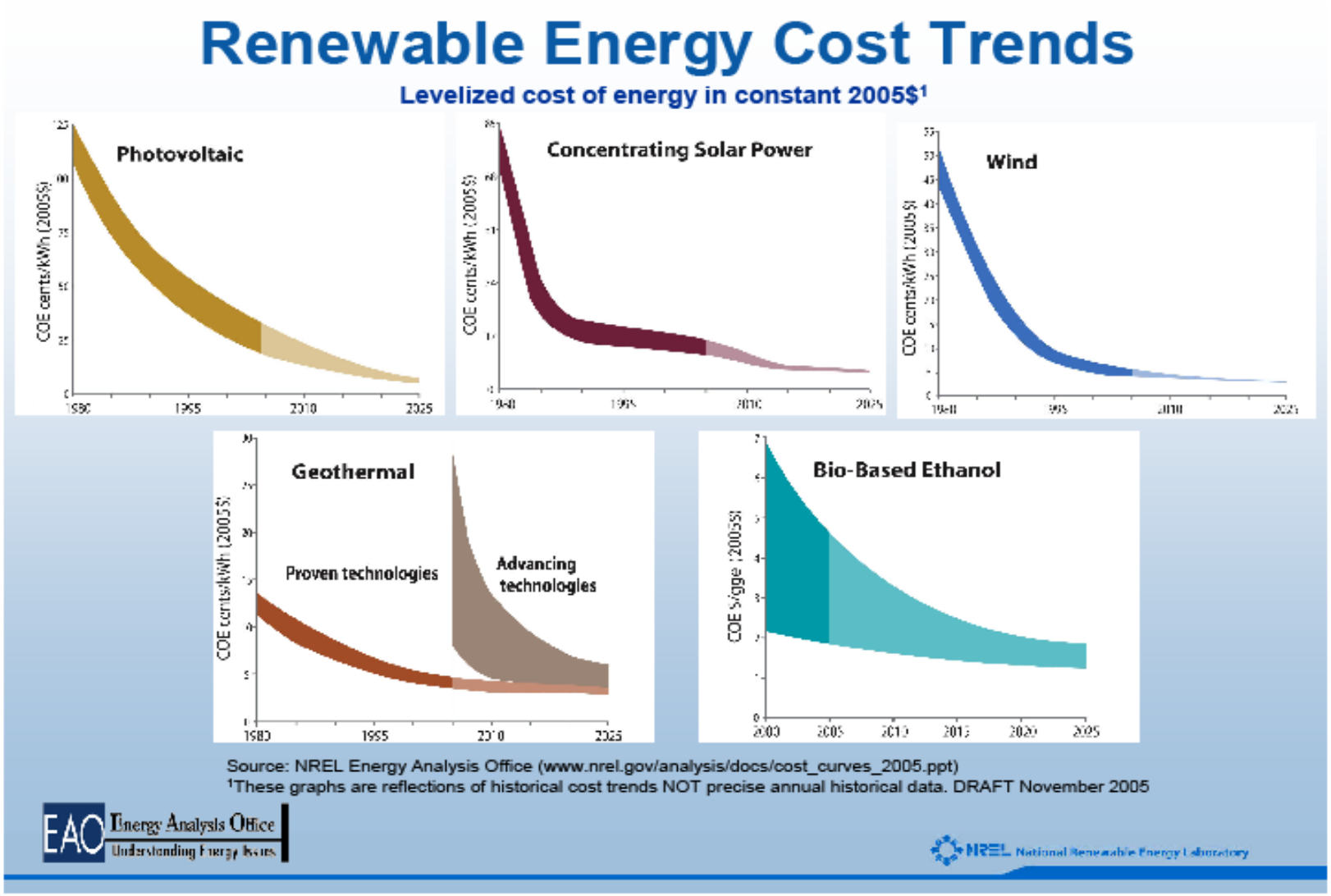


The age of cheap oil is over, though policy action could bring lower international prices than would otherwise be the case

Source – IEA WEO 2010

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RE Cost Trends



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Preferred Alternatives

Criteria



Renewables

- Solar
- Wind
- Biomass
- Pico-Hydro
- Geothermal
- Tidal
- Fuel Cells ??

Resource Availability (On site)

- Solar
- Wind
- Biomass
- Fuel Cell

ROI < 3 Yrs

- Solar
- Wind
- Biomass ??

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Renewable Energy Potential in Sri Lanka

Wind Energy Potential in Sril Lanka

Wind Energy Potential in Sri Lanka

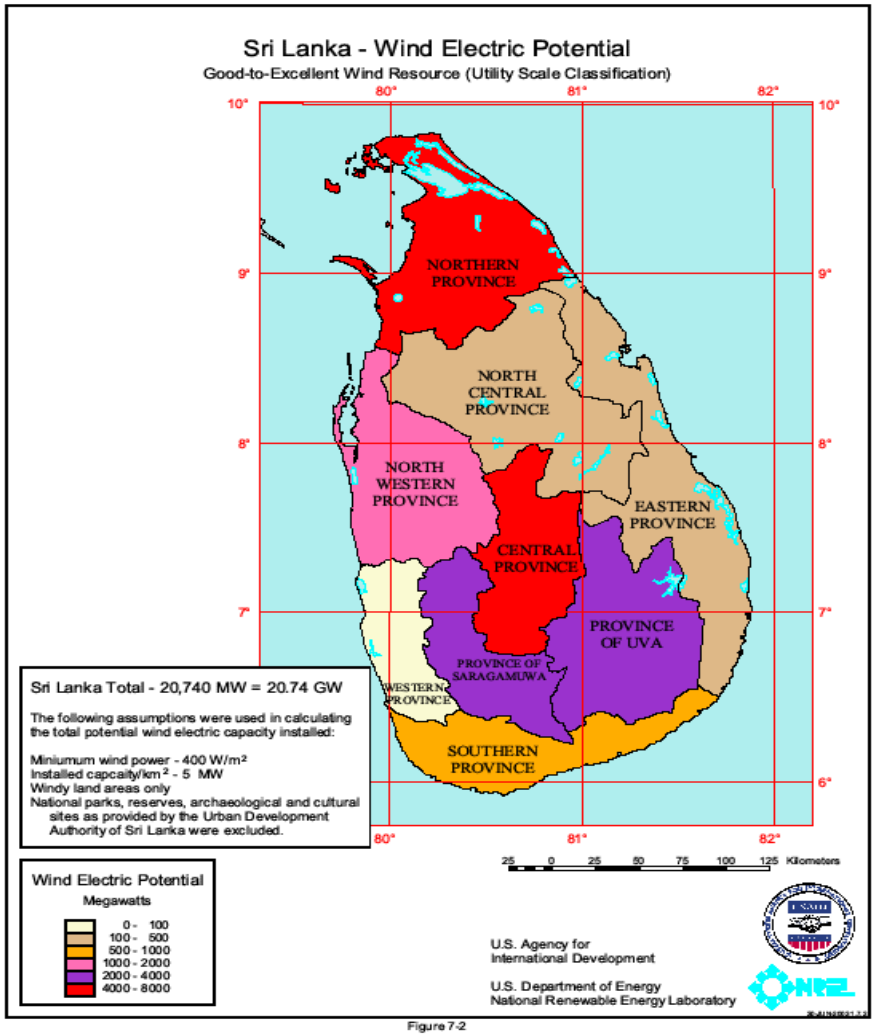


Figure 7-2

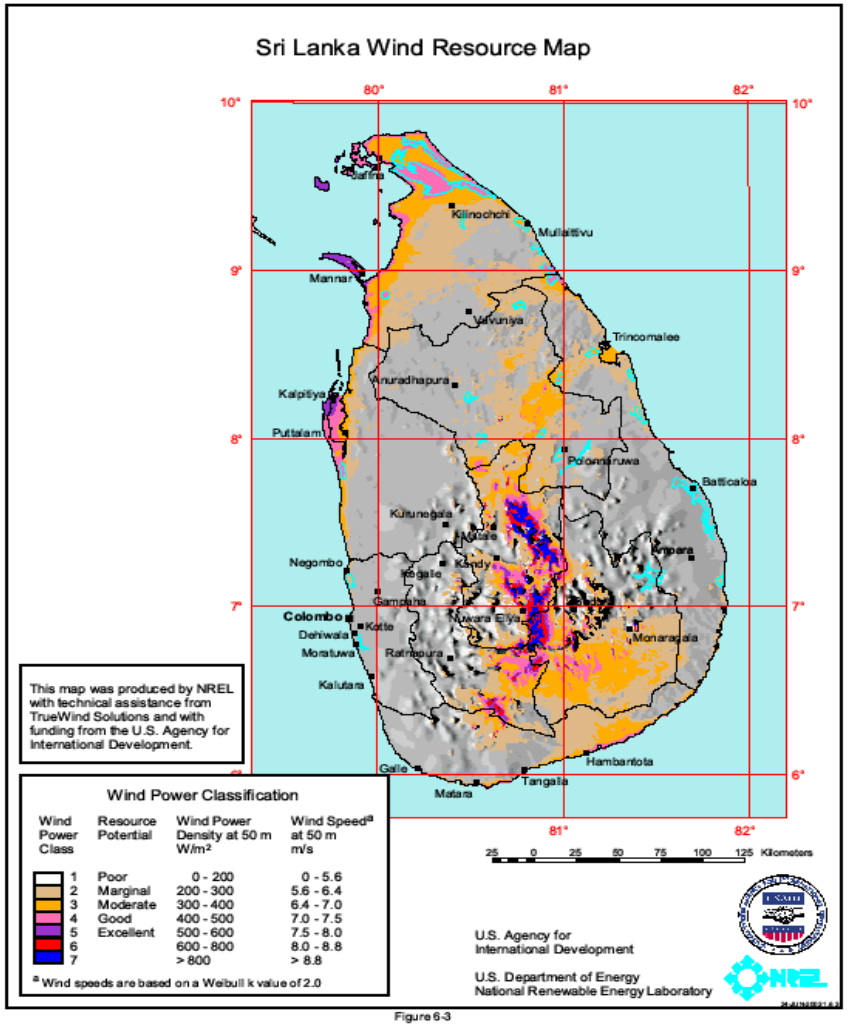
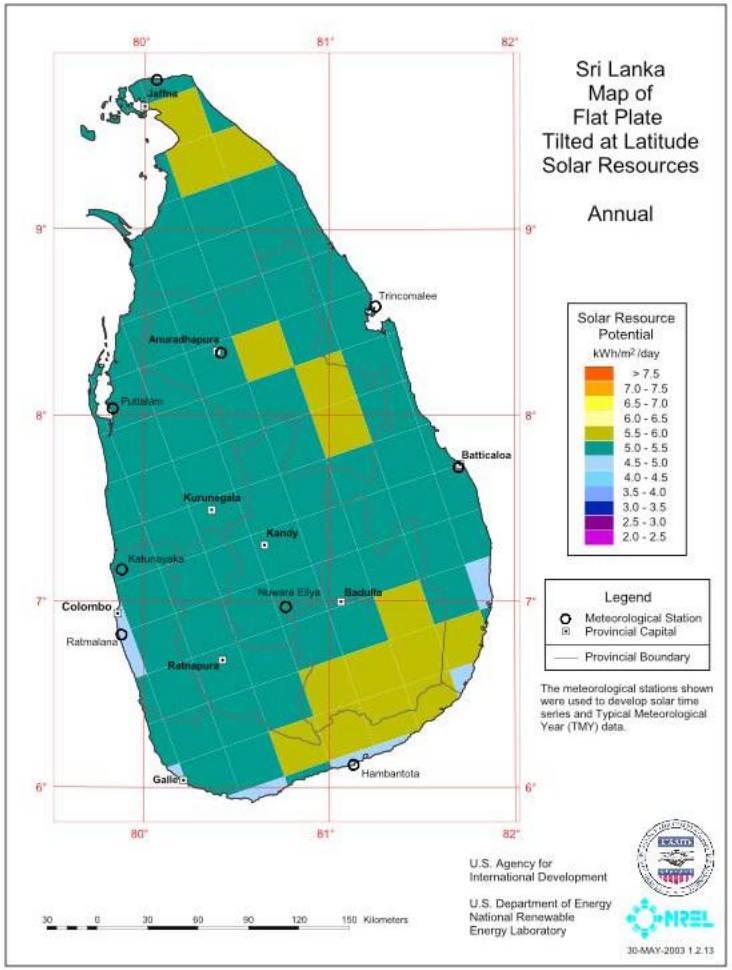
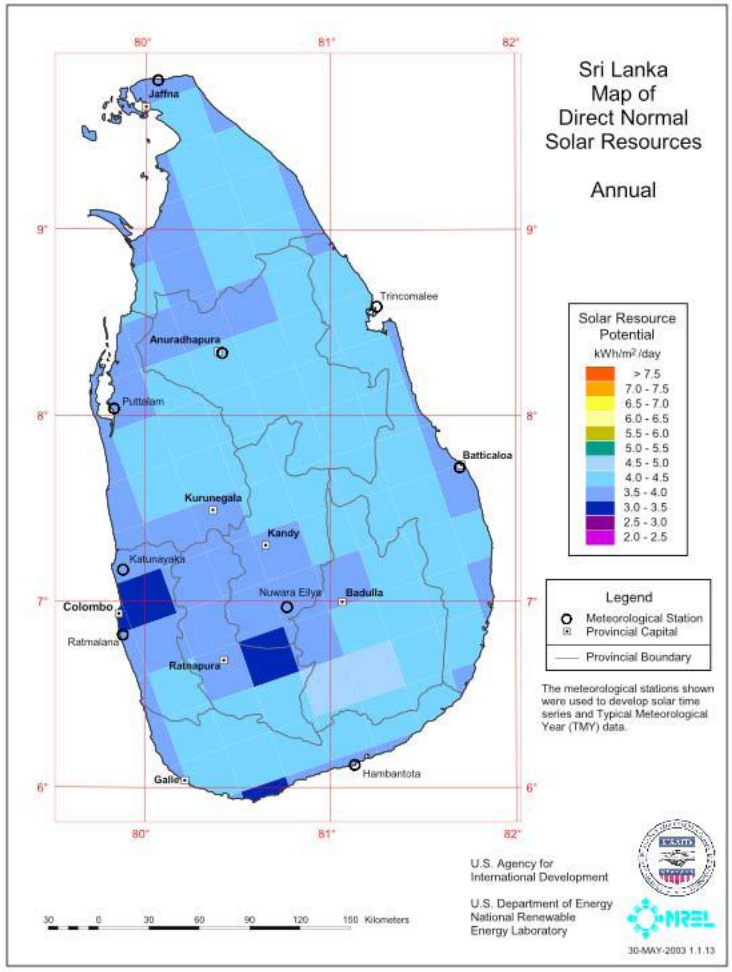


Figure 6-3

Solar Energy Potential in Srilanks

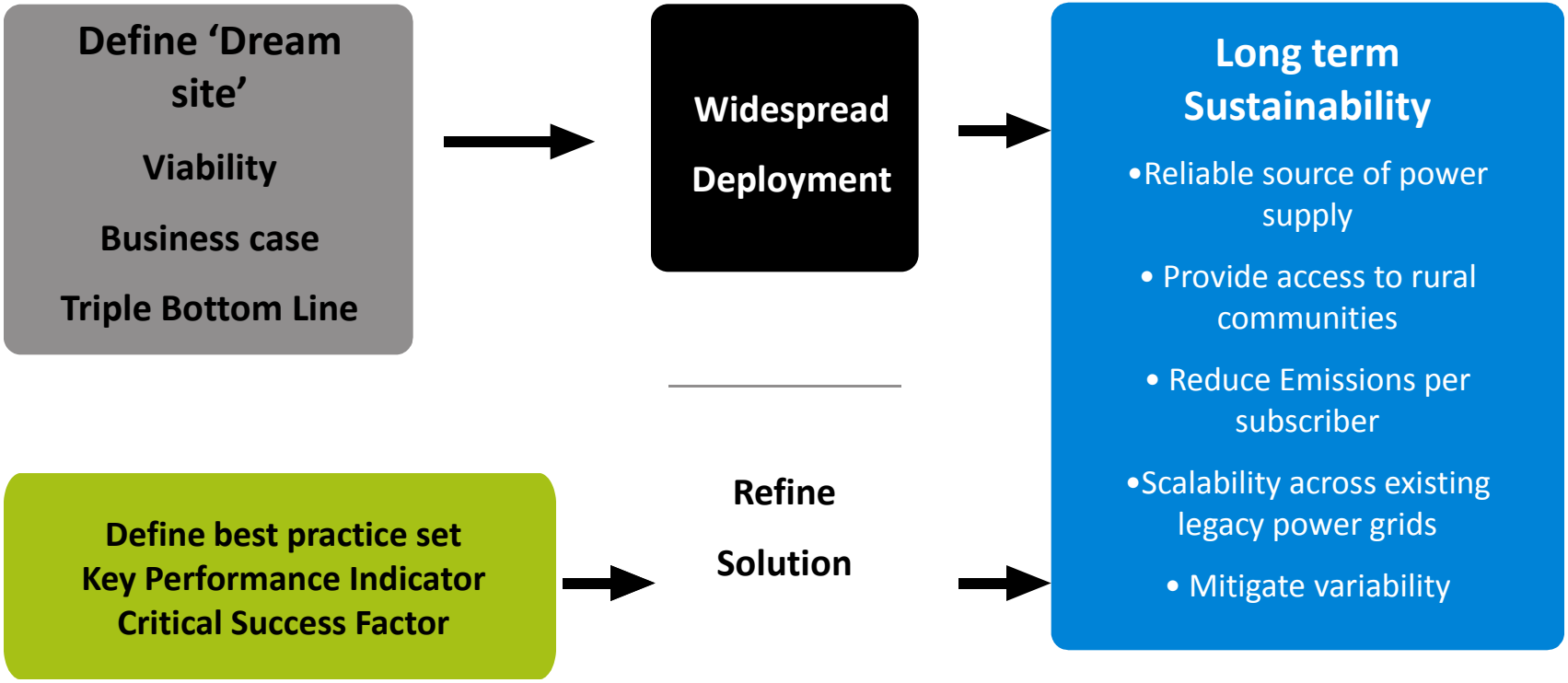




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Green Power at Dialog Axiata PLC

Dialog Green Power Vision

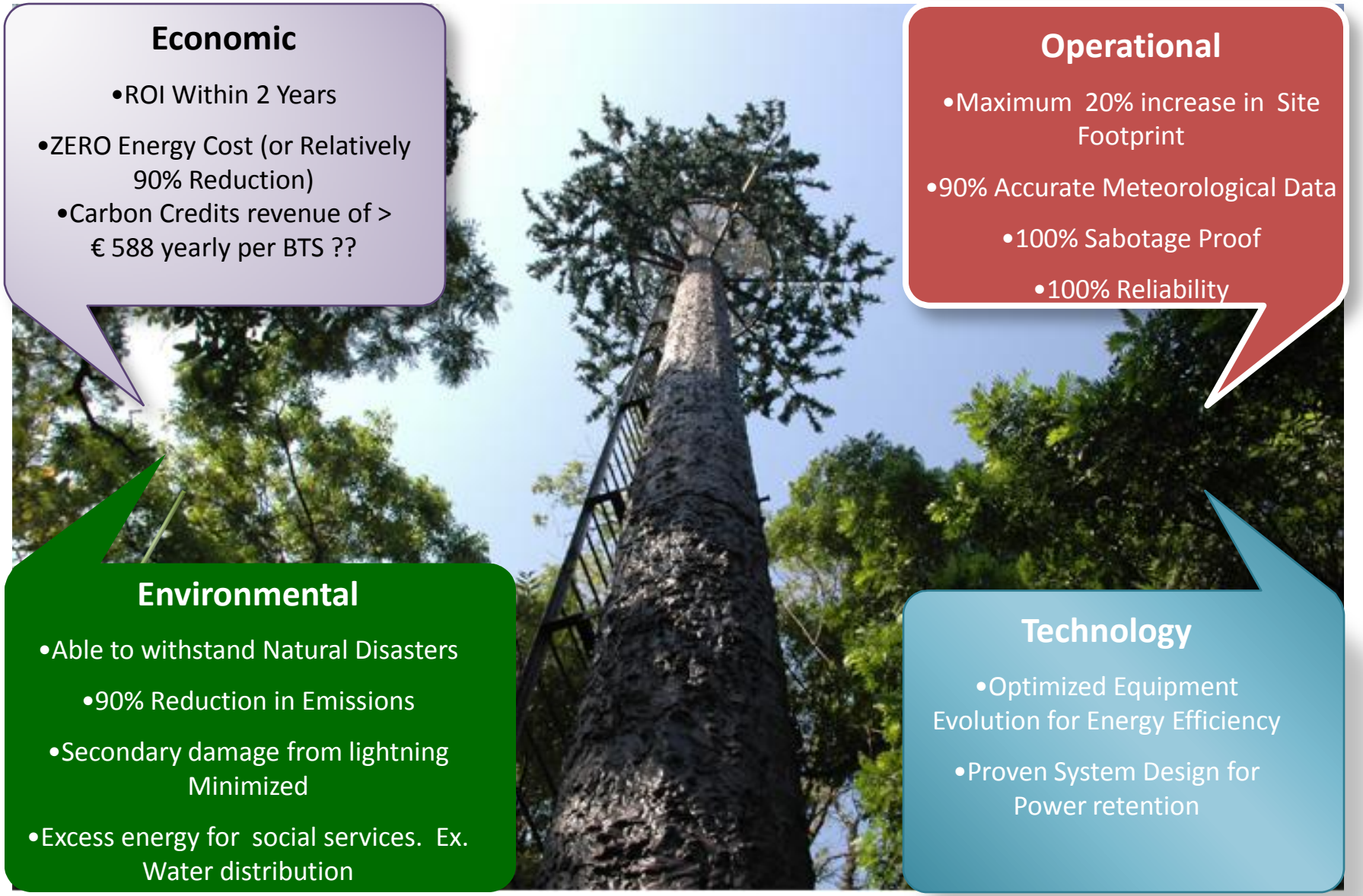


- Derive best possible results from project to meet dream RE site expectations
- Look at scalability of trial to move towards a green network
- Work with the Clean Development mechanism towards a carbon neutral position in the market
- Set measureable KPI's to achieve acceptable emissions per subscriber

Drive public policy locally on green energy for a cleaner planet

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Dream ‘RE’ for Dialog Telekom Axiata PLC



Economic

- ROI Within 2 Years
- ZERO Energy Cost (or Relatively 90% Reduction)
- Carbon Credits revenue of > € 588 yearly per BTS ??

Operational

- Maximum 20% increase in Site Footprint
- 90% Accurate Meteorological Data
- 100% Sabotage Proof
- 100% Reliability

Environmental

- Able to withstand Natural Disasters
- 90% Reduction in Emissions
- Secondary damage from lightning Minimized
- Excess energy for social services. Ex. Water distribution

Technology

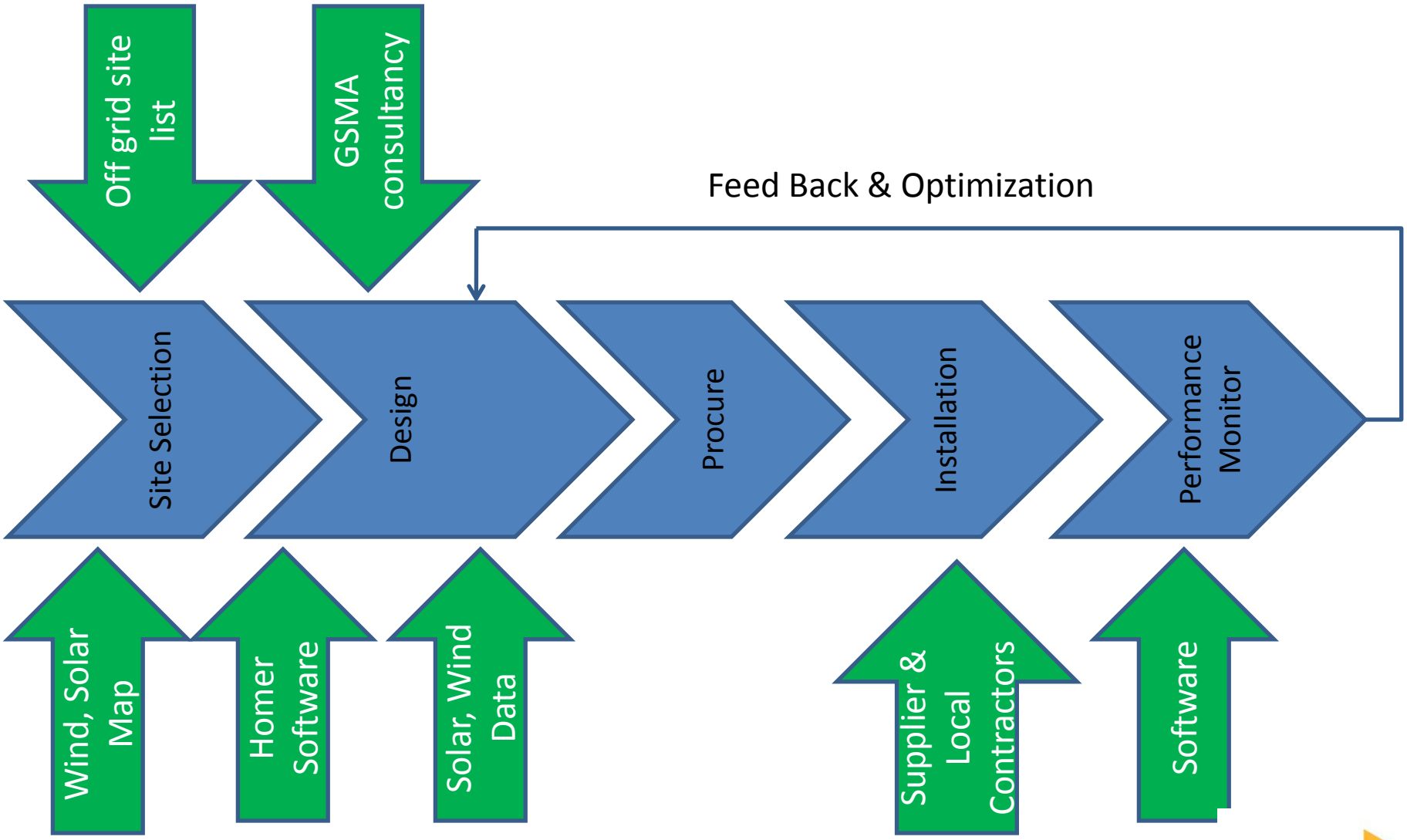
- Optimized Equipment Evolution for Energy Efficiency
- Proven System Design for Power retention

Implemented configurations for Green Power Solutions at Dialog Axiata

Solar+ Generator + Battery	Already Implemented	Welimowapothana , Meegaswewa, Amithirigala
Solar +Wind+ Generator + Battery	Already implemented	Randenigala, Dekethipothana, Theppanawa
Solar +Wind + Generator +Battery + Grid power sharing.	Already implemented	Weerawila (Decommissioned)
Solar +Grid+ Battery (for low voltage sites)	To be installed	

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RE – Implementation Process



Configurations

Site	Solar	Wind	Battery	Generator	Controller & Integration
Randenigala	6 kW	3kW	2800 Ah	11.5 kVA	Power Oasis
Weerawila	2 kW	1kW	1200 Ah	11.5kVA	Power Oasis
Dekethipothana	5.2kW	1kW	1000Ah	11.5kVA	Huawei
Welimowapothana	6kW	N/A	1000Ah	10kVA	Power Oasis
Meegaswewa	6kW	N/A	1000Ah	10kVA	BP Solar
Theppanawa	2kW	1kW	1200Ah	8kVA	Power Oasis
Amithirigala	4kW	N/A	800Ah	13kVA	Eltek

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RE – Financials

Site	Investment / USD	Fulltime Gen Operation Cost / Month / USD	Expected Payback
Randenigala		22,668.75	3 year 2months
Weerawila			8 Years
Dekethipothana		24,083.00	
Welimowapothana		24,083.00	2 years 7 months
Meegaswewa		23,569.00	3 years
Theppanawa		16,996.00	2.5 years (with full PV configuration of 6kW)
Amithirigala		21,200.00	2.5 Years

CASE STUDY 1 – Solar+Wind+DG

Randenigala – Hybrid Solution

Randenigala (Remote Mountain)



- Implemented in 2008 .
- Consultancy from GSMA.
- Integration & Commissioned by Power Oasis.
- Free Cooling Box installed to minimize the load .
- Load 20-25 A dc

Generator Only (Previous)

No commercial power. Full time on gen

Capex: USD 8.7K

Opex Cost for full time gen: USD23K per year

Hybrid solution

Solar+ Wind + Generator

Capex : USD86K

Technical details :

3 kW Southwest Wind power turbine. Tower head mounted.

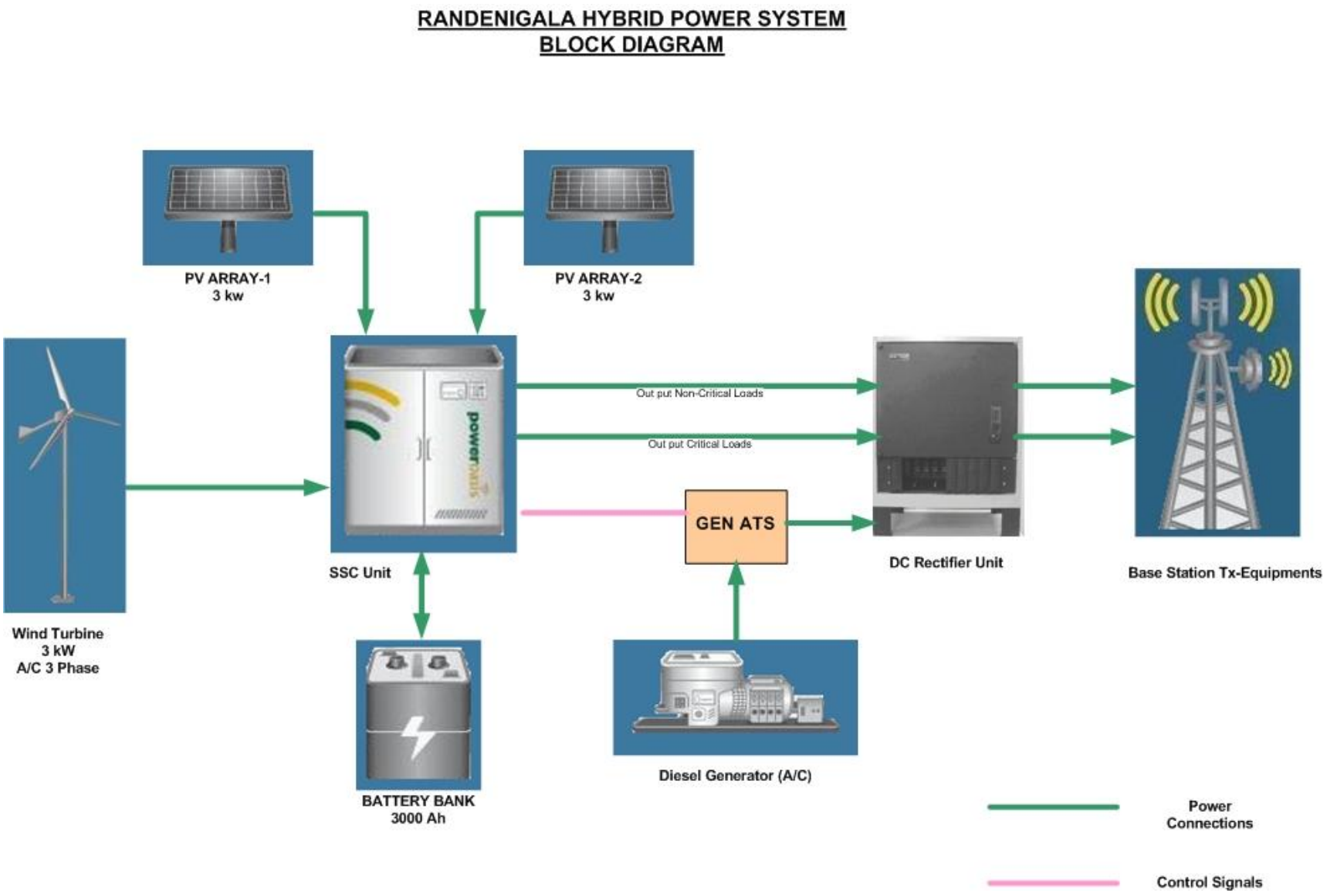
6 kW BP solar PV array.

3000AH Exide batteries.

Expecting <120 running hours per month on gen

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Randenigala Hybrid Power System Block Diagram



Randenigala - ROI

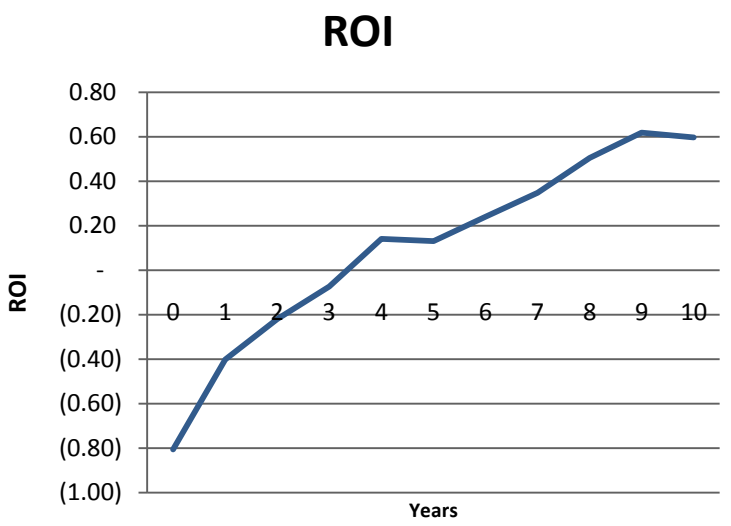
Year	0	1	2	3	4	5	6	7	8	9	10
Capex	81,385.00	0	0	0	-	25,958.49	0	0	-	0	41806.41256
opex		2340.91	2692.05	3095.85	3560.23	4094.26	4708.40	5414.66	6226.86	7160.89	8235.03
Financial cost		10,868.18	14,649.30	13,021.60	11,393.90	12,460.14	10,563.05	8,665.96	6,768.86	4,871.77	11,335.95
Total	**81,385.00**	**13,209.09**	**17,341.35**	**16,117.45**	**14,954.13**	**42,512.90**	**15,271.45**	**14,080.62**	**12,995.73**	**12,032.66**	**61,377.40**
NPV	**54,340.91**	**13,209.09**	**15,079.43**	**12,187.11**	**9,832.58**	**24,306.89**	**7,592.61**	**6,087.44**	**4,885.57**	**3,933.50**	**17,447.29**
Total cost (cumulative)	81,385.00	67,550.00	82,629.43	94,816.54	104,649.12	128,956.01	136,548.62	142,636.07	147,521.64	151,455.14	168,902.42

Saving	(65,588.00)	(27,092.60)	(18,197.72)	(6,971.39)	14,659.30	16,860.94	32,745.96	49,612.77	74,381.78	93,575.32	100,686.85
ROI	**(0.81)**	**(0.40)**	**(0.22)**	**(0.07)**	**0.14**	**0.13**	**0.24**	**0.35**	**0.50**	**0.62**	**0.60**

Discount rate **15%**

NPV **$17,4476**

Payback **3years and 2 months**



Randenigala



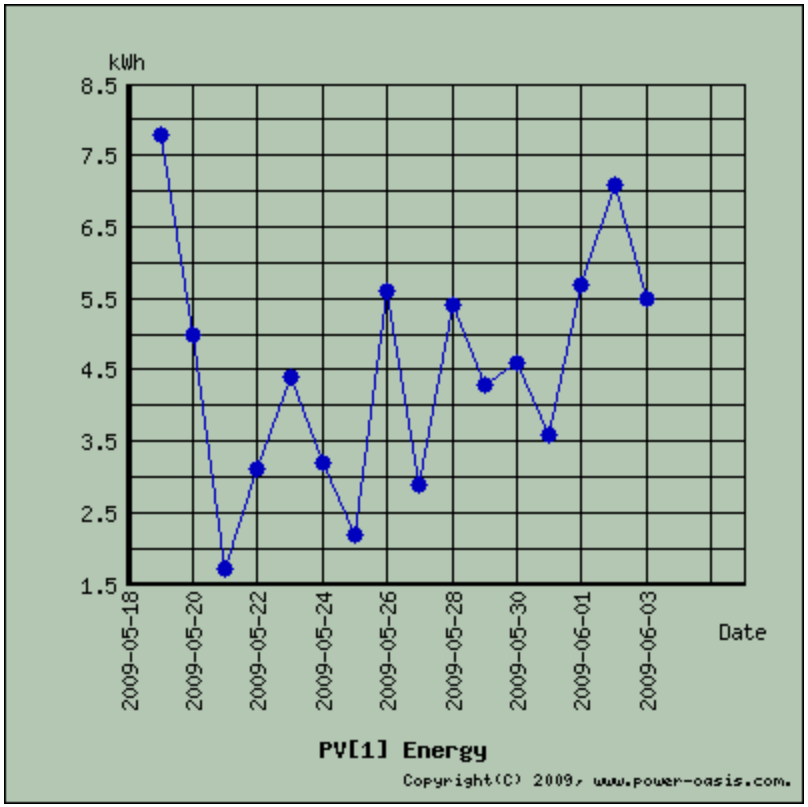


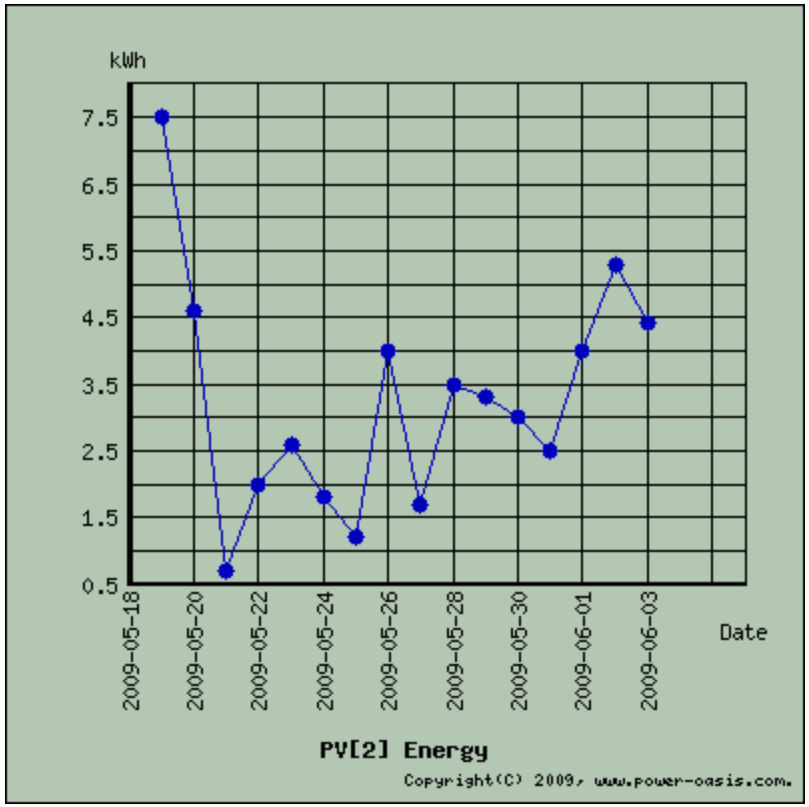




Randenigala Performance Data

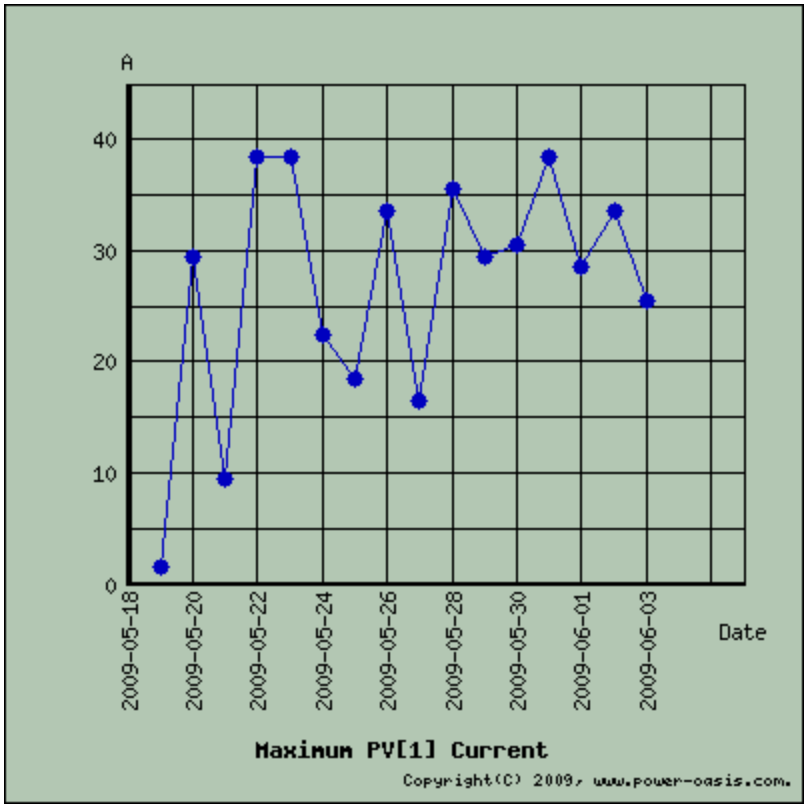
PV arrays power generations

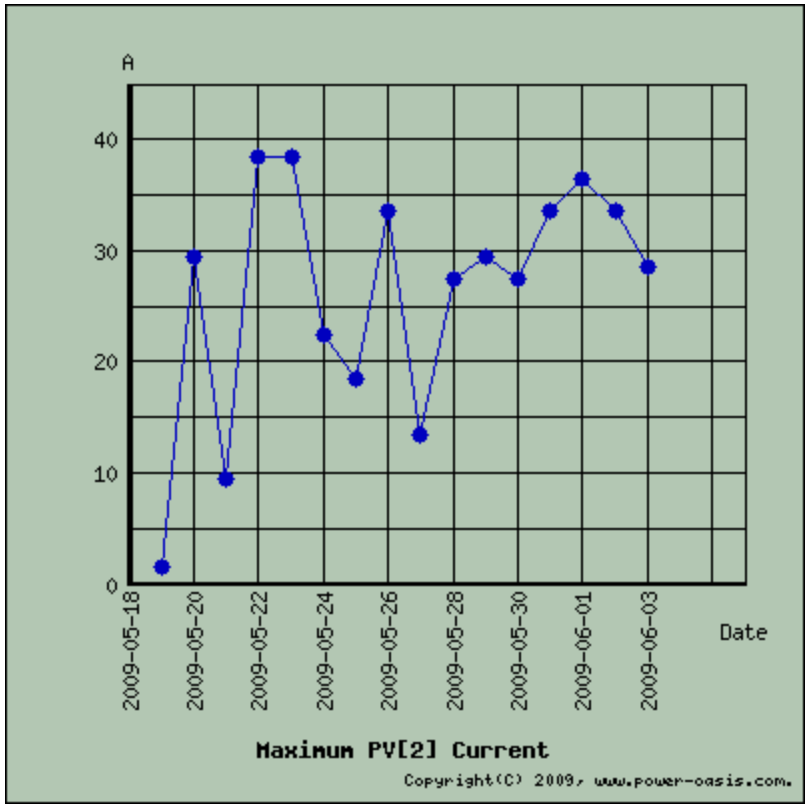




Randenigala Performance Data

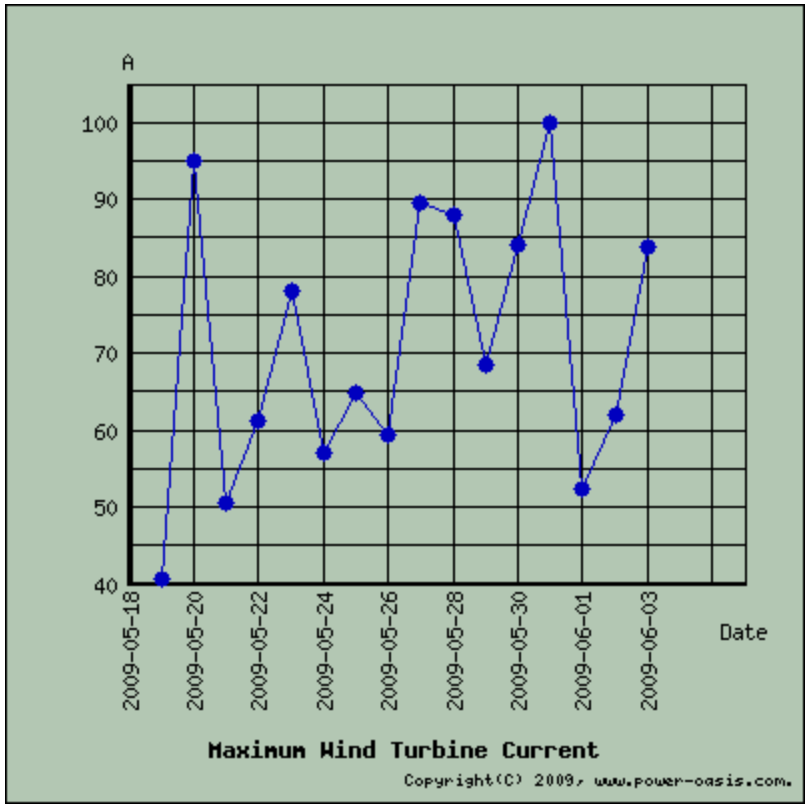
PV arrays currents

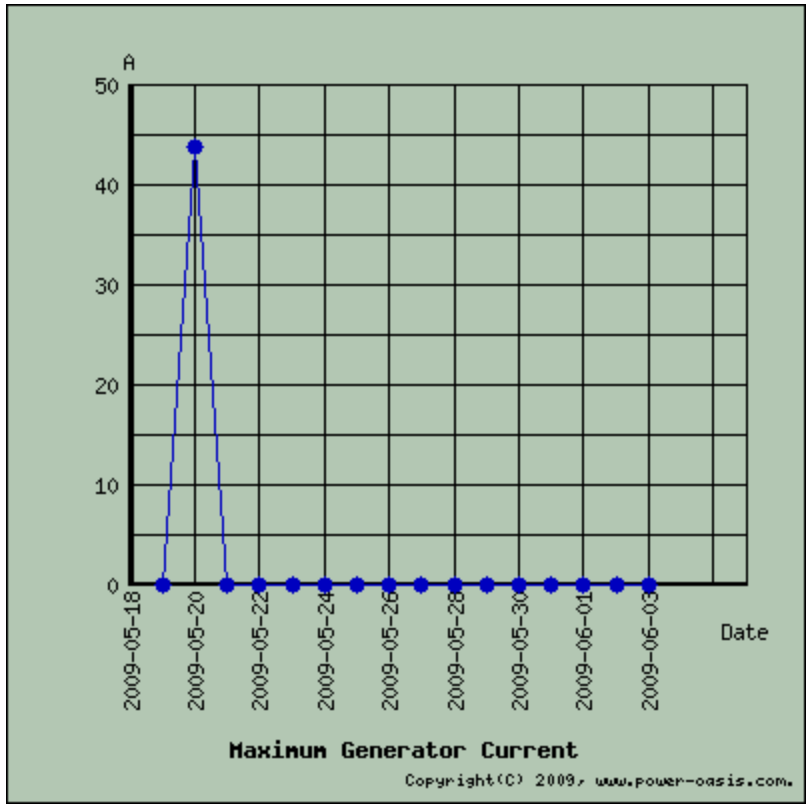




Randenigala Performance Data

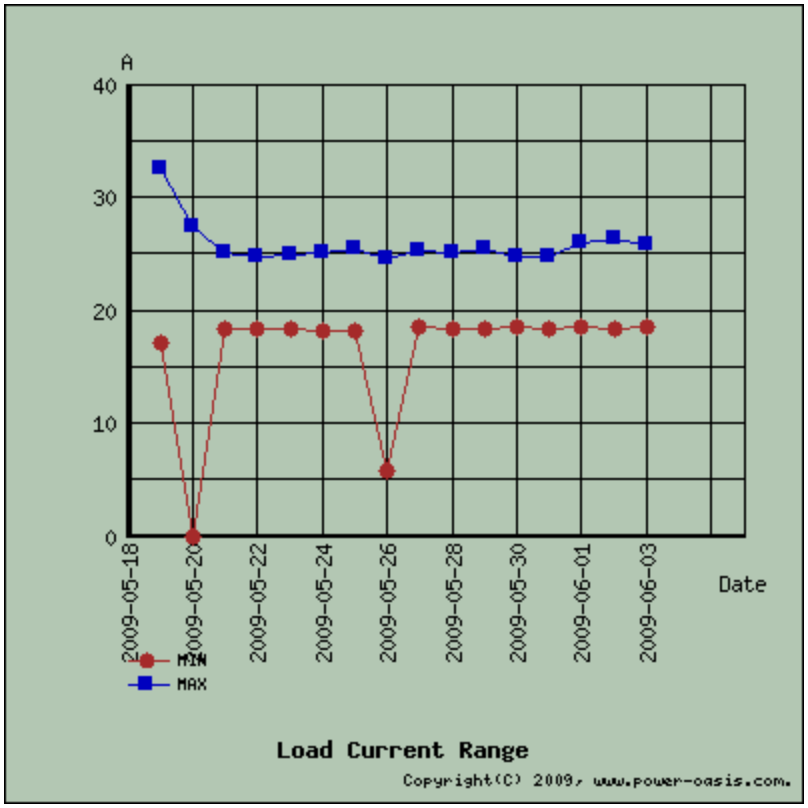
Wind turbine current & generator current

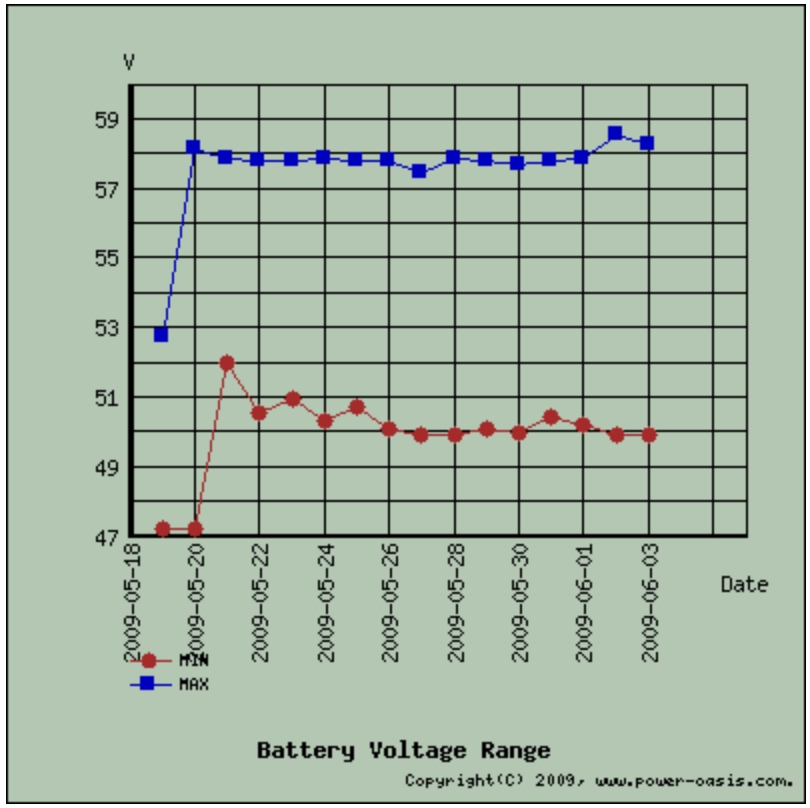




Randenigala Performance Data

Load current & battery voltage





CASE STUDY 2 – Solar Plus Gen

Meegaswewa – Hybrid Solution

Meegaswewa







Previous

Off grid site.
Fulltime DG

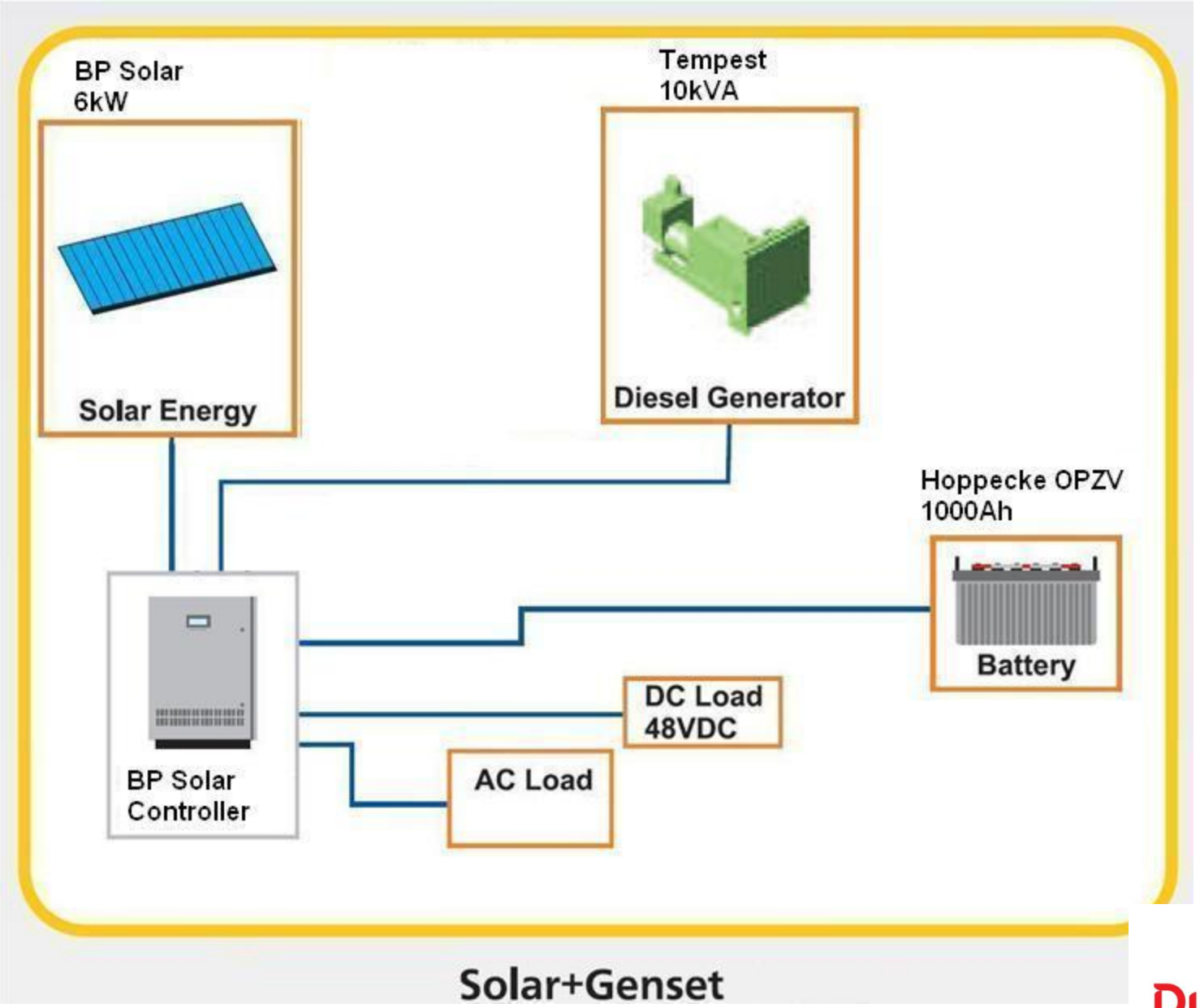
(Solar + Gen)
Capex : USD 19.4K

Technical details :
6 kW BP solar PV array
1000AH batteries
11.5 kVA Generator

Supplementary Technologies employed: Free Cooling Boxes

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Meegaswewa – Block Diagram

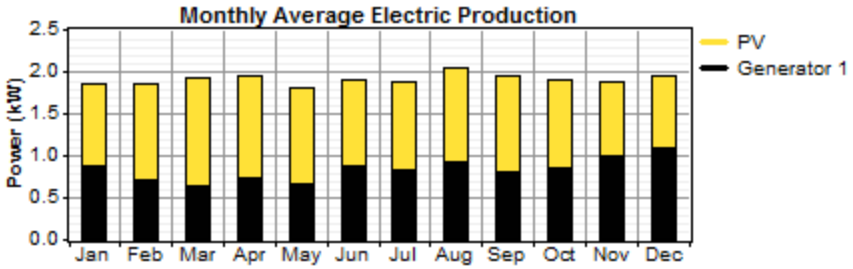


Meegaswewa – Homer Analysis

Electrical Data

Component	Production (kWh/yr)	Fraction
PV array	9,431	56%
Generator 1	7,332	44%
Total	16,763	100%

Quantity	Value	Units
Excess electricity	356	kWh/yr
Unmet load	0.00	kWh/yr
Capacity shortage	0.00	kWh/yr
Renewable fraction	0.563	



PV Data

Quantity	Value	Units
Rated capacity	6.00	kW
Mean output	1.08	kW
Mean output	25.8	kWh/d
Capacity factor	17.9	%
Total production	9,431	kWh/yr

Quantity	Value	Units
Minimum output	0.00	kW
Maximum output	5.87	kW
PV penetration	66.9	%
Hours of operation	4,418	hr/yr
Levelized cost	0.0755	$/kWh

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Meegaswewa – Homer Analysis

Generator Data

Quantity	Value	Units
Hours of operation	828	hr/yr
Number of starts	166	starts/yr
Operational life	18.1	yr
Capacity factor	8.37	%
Fixed generation cost	3.42	$/hr
Marginal generation cost	0.200	$/kW

Quantity	Value	Units
Electrical production	7,332	kWh/yr
Mean electrical output	8.86	kW
Min. electrical output	3.00	kW
Max. electrical output	9.41	kW

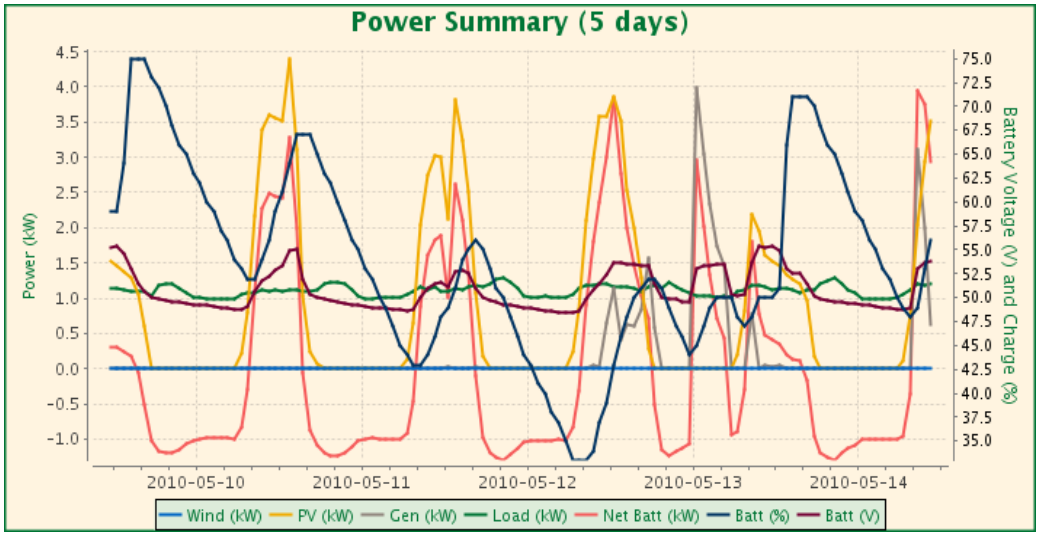
Battery Data

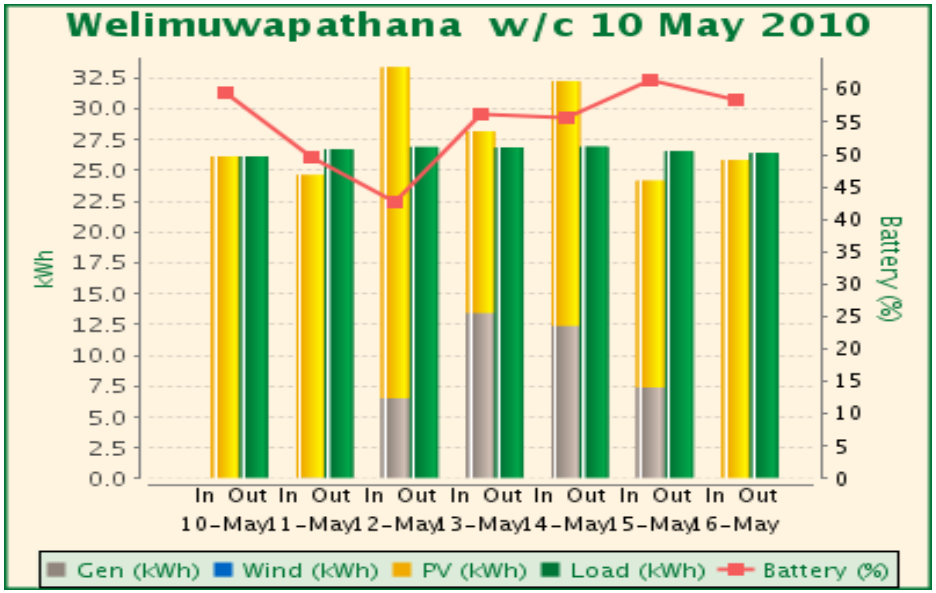
Quantity	Value	Units
Nominal capacity	48.0	kWh
Usable nominal capacity	33.6	kWh
Autonomy	20.9	hr
Lifetime throughput	82,512	kWh
Battery wear cost	0.131	$/kWh
Average energy cost	0.118	$/kWh

Quantity	Value	Units
Energy in	8,919	kWh/yr
Energy out	7,699	kWh/yr
Storage depletion	25.7	kWh/yr
Losses	1,195	kWh/yr
Annual throughput	8,302	kWh/yr
Expected life	9.94	yr

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Hourly Data (Sample)





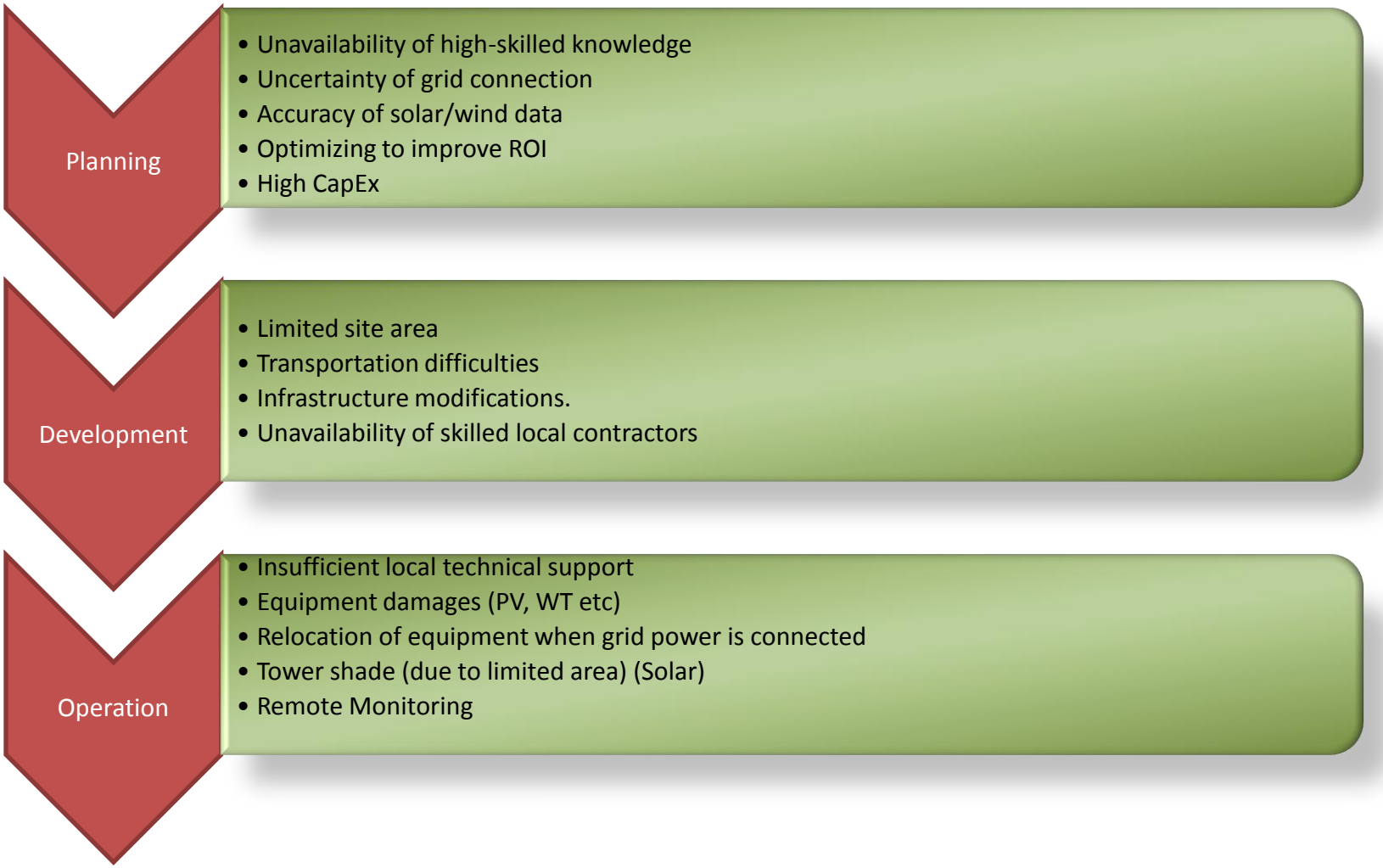
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Meegaswewa – Performance

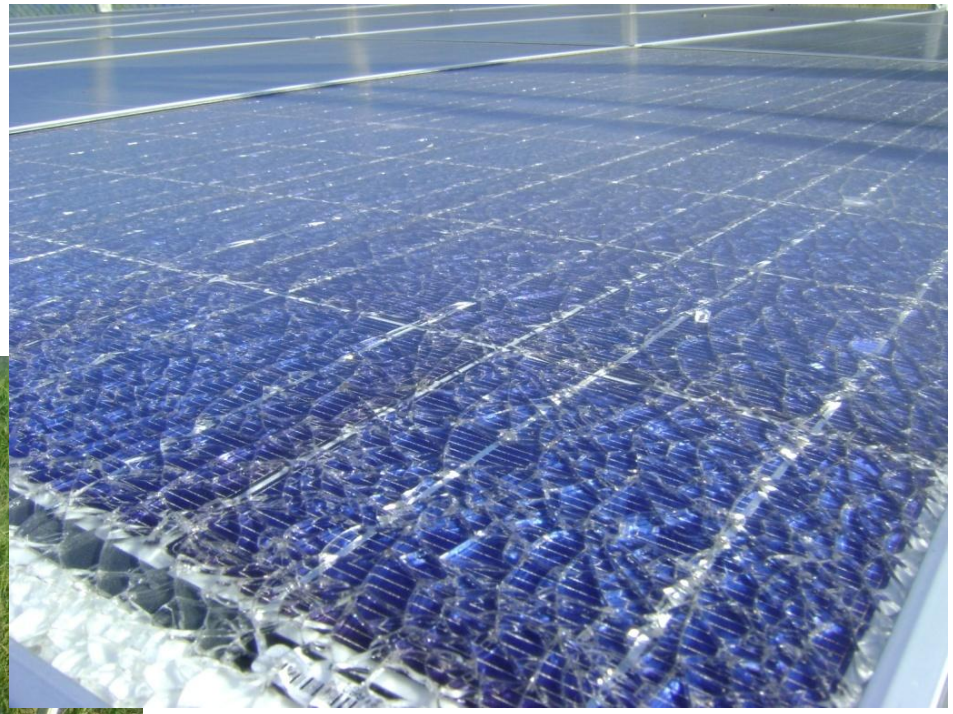
- Actual generator running hrs - 195 hrs/year (based on monthly average)
- Expected generator running hrs - 828 hrs/year
- Reduction in generator running hrs - 97%
- Actual OPEX (LKR) - 90,000.00
- Reduction in OPEX - 96%

Key Challenges

Challenges


Planning
• Unavailability of high-skilled knowledge
• Uncertainty of grid connection
• Accuracy of solar/wind data
• Optimizing to improve ROI
• High CapEx
Development
• Limited site area
• Transportation difficulties
• Infrastructure modifications.
• Unavailability of skilled local contractors
Operation
• Insufficient local technical support
• Equipment damages (PV, WT etc)
• Relocation of equipment when grid power is connected
• Tower shade (due to limited area) (Solar)
• Remote Monitoring

PV Panel Damages





Tower Shade



Transport & installations








Vendors

Vendors

- Hybrid controllers
- Wind Turbines
- PV panels
- Batteries
- Cooling systems
- Installations

poweroasis Energy, bp BP Solar , Eltek

Southwest, kestrel wind turbines Bergey, Proven

bp BP Solar

GNB , Sonnenchein, Hoppecke

STULTZ , Airsys, Glocool FCBs & Locally assembled cooling system

Tech assistance GSMA , Dialog & Local Contractors

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THANK YOU

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