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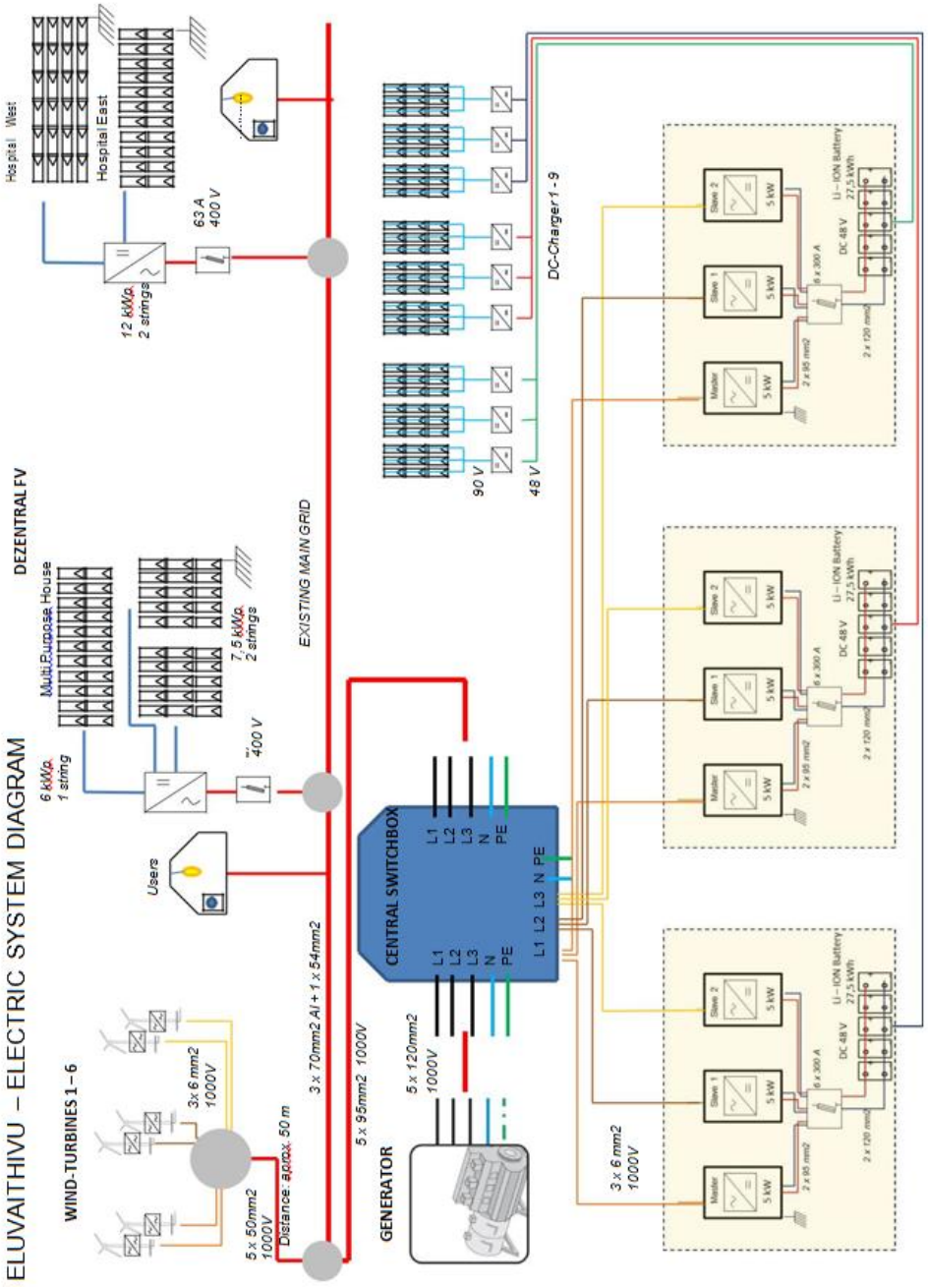

ELUVAITHIVU – ELECTRIC SYSTEM DIAGRAM
DEZENTRAL FV
Multi Purpose House
6 kWp
1 string
7,5 kWp
2 strings
400 V
EXISTING MAIN GRID
Users
Hospital West
Hospital East
12 kWp
2 strings
63 A
400 V
DC-Charger 1 - 9
90 V
48 V
CENTRAL SWITCHBOX
L1
L2
L3
N
PE
L1 L2 L3 N PE
WIND-TURBINES 1 – 6
3x 6 mm2
1000V
5 x 50mm2
1000V
Distance: aprox. 50 m
3 x 70mm2 Al + 1 x 54mm2
5 x 95mm2 1000V
5 x 120mm2
1000V
GENERATOR
3 x 6 mm2
1000V
Li – ION Battery
27,5 kWh
DC 48 V
6 x 300 A
2 x 95 mm2
2 x 120 mm2
Master
Slave 1
Slave 2
5 kW

Input Summary

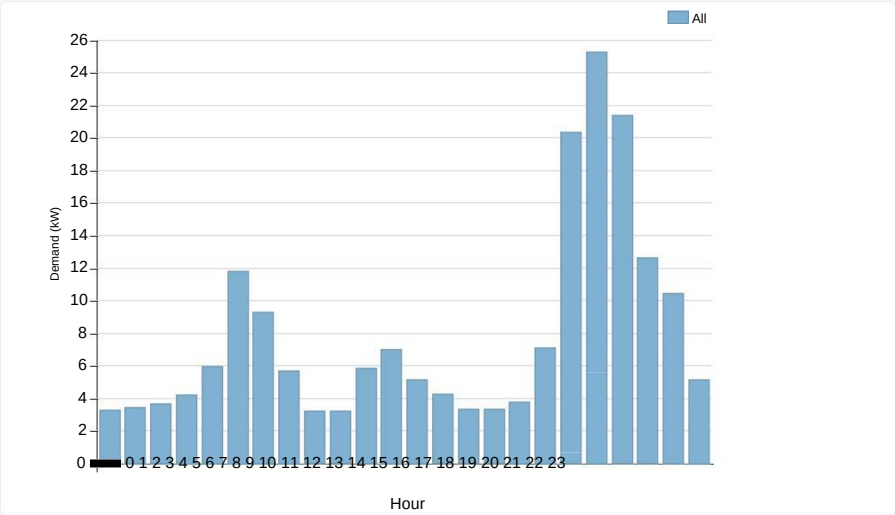
Project title	Eluvathivu
Author	
Notes	

Project Location

Location	Unnamed Road, Sri Lanka
Latitude	9 degrees 41.33 minutes North
Longitude	79 degrees 48.72 minutes East
Time zone	Asia/Colombo

Load: Electric1

Data source	Synthetic
Daily noise	10%
Hourly noise	20%
Scaled annual average	189.215 kWh/d
Scaled peak load	40.9879 kW
Load factor	0.1923



Microgrid Controller: HOMER Cycle Charging

Quantity	Capital	Replacement	O&M
1	$0.00	$0.00	$0.00

Minimization strategy	Economic
Setpoint state of charge	80
Allow multiple generators to operate simultaneously	Yes
Allow systems with generator capacity less than peak load	Yes
Allow diesel off operation	Yes

Microgrid Controller: HOMER Load Following

Quantity	Capital	Replacement	O&M
1	$0.00	$0.00	$0.00

Minimization strategy	Economic
Allow multiple generators to operate simultaneously	Yes
Allow systems with generator capacity less than peak load	Yes
Allow diesel off operation	Yes

PV:AC West

Size	Capital	Replacement	O&M
1.00	$1,800.00	$1,800.00	$30.00

Sizes to consider	11.5
Lifetime	25 yr
Derating factor	90%
Tracking system	No Tracking
Slope	20.000 deg
Azimuth	90.000 deg
Ground reflectance	0.0%

PV:AC East

Size	Capital	Replacement	O&M
1.00	$1,800.00	$1,800.00	$30.00

Sizes to consider	13.5
Lifetime	25 yr
Derating factor	90%
Tracking system	No Tracking
Slope	20.000 deg
Azimuth	-90.000 deg
Ground reflectance	0.0%

PV:DC West

Size	Capital	Replacement	O&M
1.00	$1,800.00	$1,800.00	$30.00

Sizes to consider	9.75
Lifetime	25 yr
Derating factor	90%
Tracking system	No Tracking
Slope	20.000 deg
Azimuth	90.000 deg
Ground reflectance	0.0%

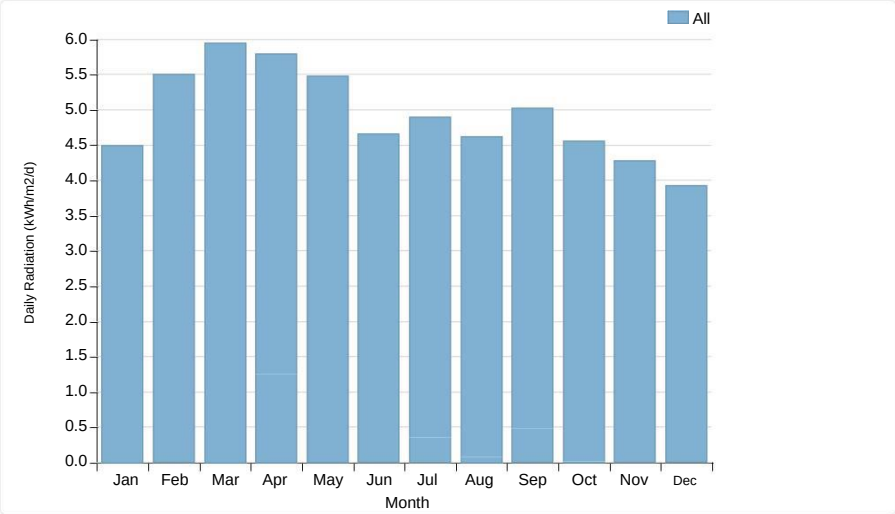
PV:DC East

Size	Capital	Replacement	O&M
1.00	$1,800.00	$1,800.00	$30.00

Size	Capital	Replacement	O&M
Sizes to consider		10.5	
Lifetime		25 yr	
Derating factor		90%	
Tracking system		No Tracking	
Slope		20.000 deg	
Azimuth		-90.000 deg	
Ground reflectance		0.0%	

Solar Resource

Scaled annual average	4.90 kWh/m2/d



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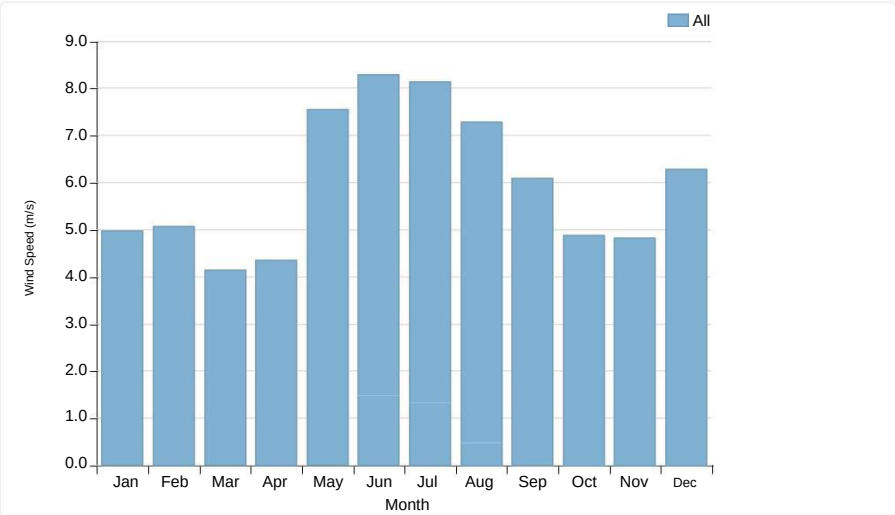
Wind Turbine:Windspot 3.5

Quantity	Capital	Replacement	O&M
1	$18,000.00	$18,000.00	$180.00

Wind Resource

Scaled annual average	6.00



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Generator:50kW Genset

Size	Capital	Replacement	O&M
1.00	$500.00	$500.00	$0.03

Sizes to consider	0,30
Lifetime	15,000 hrs
Min. load ratio	25%
Heat recovery ratio	0%
Fuel used	Diesel
Fuel curve intercept	0.0330 L/hr/kW
Fuel curve slope	0.2730 L/hr/kW

Fuel: Diesel

Price	$ 1.00/L
Lower heating value	43.2 MJ/kg
Density	820.00 kg/m3
Carbon content	88.0%
Sulfur content	0.4%

Battery:Li-Ion 27.5 kWh

Quantity	Capital	Replacement	O&M
1	$48,160.00	$38,528.00	$190.00

Quantities to consider	3

Converter

Size	Capital	Replacement	O&M
100.00	$61,760.00	$0.00	$500.00

Sizes to consider	0,100 kW
Lifetime	25 yr
Inverter can parallel with AC generator	Yes

Economics

Annual real interest rate	3%
Project lifetime	25 yr
Capacity shortage penalty	$0/kWh
System fixed capital cost	0
System fixed O&M cost	0

System control

Timestep length in minutes	60
Multi-Year enabled	No
Allow systems with multiple generators	Yes
Allow systems with multiple wind turbine types	No
Battery autonomy threshold	2
Maximum renewable penetration threshold	55

Warn about renewable penetration	Yes

Optimizer

Maximum simulations	10000
System design precision	0.01
NPC precision	0.01
Minimum spacing	0
Focus factor	50
Optimize category winners	Yes
Use base case	Yes

Emissions

Carbon dioxide penalty	$ 0/t
Carbon monoxide penalty	$ 0/t
Unburned hydrocarbons penalty	$ 0/t
Particulate matter penalty	$ 0/t
Sulfur dioxide penalty	$ 0/t
Nitrogen oxides penalty	$ 0/t

Constraints

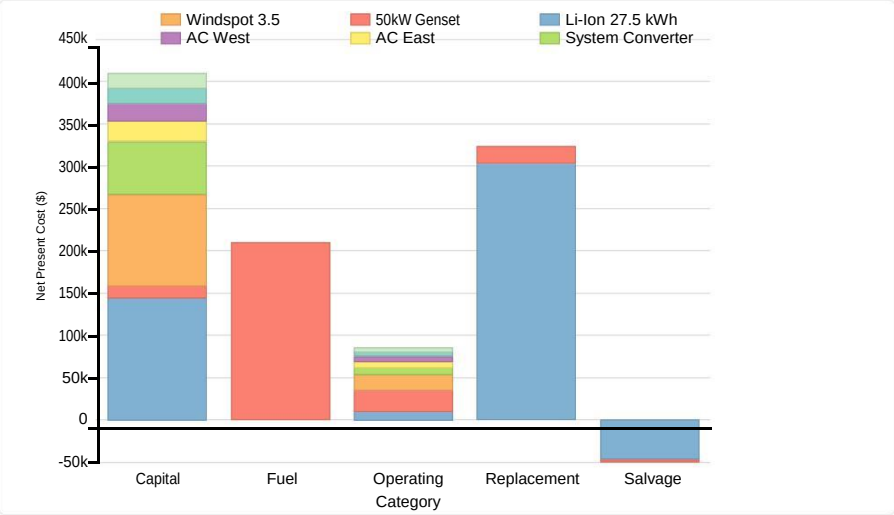
Maximum annual capacity shortage	0
Minimum renewable fraction	0
Operating reserve as percentage of hourly load	10
Operating reserve as percentage of peak load	0
Operating reserve as percentage of solar power output	25
Operating reserve as percentage of wind power output	50

System Report

System architecture

PV	AC West	12	kW
PV #2	AC East	14	kW
PV #3	DC West	10	kW
PV #4	DC East	11	kW
Wind Turbine	Windspot 3.5	6	
Generator	50kW Genset	30	kW
Storage	Li-Ion 27.5 kWh	3	strings
Converter	System Converter	100	kW
Dispatch Strategy	HOMER Cycle Charging		

Cost summary



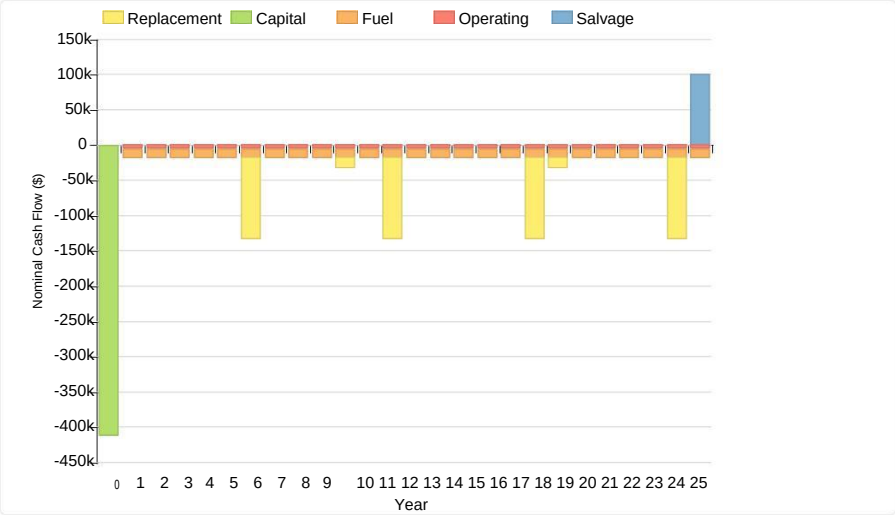
Cost Summary

Total net present cost	981215	$
Levelized cost of energy	0.813	$/kWh

Net Present Costs

Component	Capital	Replacement	O&M	Fuel	Salvage	Total
AC West	20,700	0	6,027	0	0	26,727
AC East	24,300	0	7,076	0	0	31,376
DC West	17,550	0	5,110	0	0	22,660
DC East	18,900	0	5,503	0	0	24,403
Windspot 3.5	108,000	0	18,869	0	0	126,869
50kW Genset	15,000	20,015	25,001	209,273	-2,526	266,764
HOMER Cycle Charging	0	0	0	0	0	0
Li-Ion 27.5 kWh	144,480	303,818	9,958	0	-46,336	411,921
System Converter	61,760	0	8,735	0	0	70,495
System	410,690	323,833	86,280	209,273	-48,861	981,215

Component	Capital		Replacement		O&M	Fuel	Salvage	Total
AC West		1,185		0	345	0	0	1,530
AC East		1,391		0	405	0	0	1,796
DC West		1,005		0	293	0	0	1,297
DC East		1,082		0	315	0	0	1,397
Windspot 3.5		6,182		0	1,080	0	0	7,262
50kW Genset		859		1,146	1,431	11,978	-145	15,269
HOMER Cycle Charging		0		0	0	0	0	0
Li-Ion 27.5 kWh		8,270		17,390	570	0	-2,652	23,578
System Converter		3,535		0	500	0	0	4,035
System		23,507		18,536	4,939	11,978	-2,797	56,163



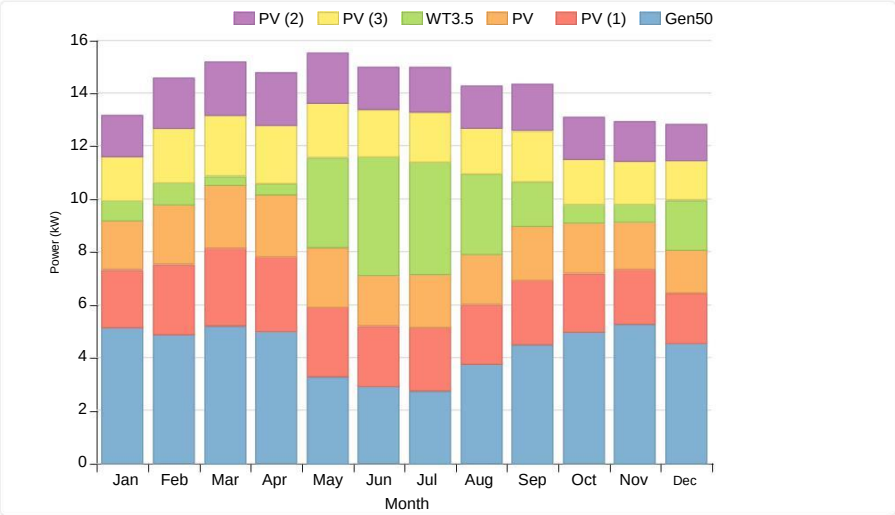
Electrical

Quantity	Value	Units
Excess electricity	52071	kWh/yr
Unmet load	3	kWh/yr
Capacity shortage	9	kWh/yr
Renewable percent	45	%

Component	Production(kWh/yr)	Percent (%)
PV	17,661	14
PV	20,985	17
PV	14,973	12
PV	16,321	13
Generator	38,111	31
Wind Turbine	16,492	13
Total	124,543	100

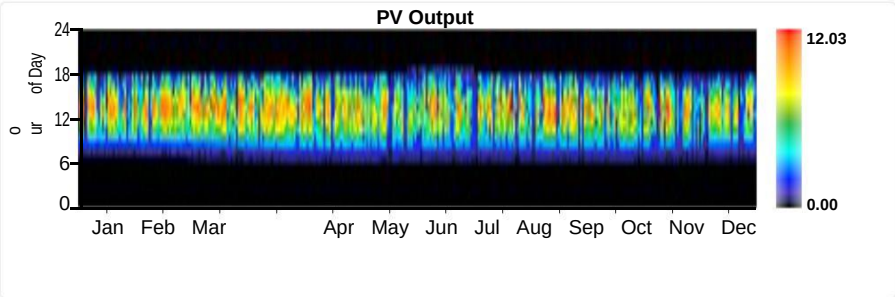
Load	Consumption(kWh/yr)	Percent (%)
AC primary load	69,061	100
DC primary load	0	0

T t l Load	Consumption(kWh/yr)	69,061	Percent (%)	100



PV:AC West

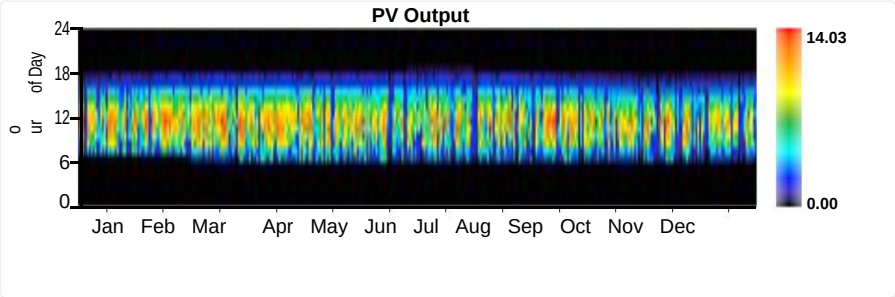
Quantity	Value	Units
Rated capacity	12	kW
Mean output	2	kW
Mean output	48.39	kWh/d
Capacity factor	17.53	%
Total production	17661	kWh/yr
Minimum output	0.00	kW
Maximum output	12.03	kW
PV penetration	25.57	%
Hours of operation	4358	hrs/yr
Levelized cost	0.087	$/kWh



PV:AC East

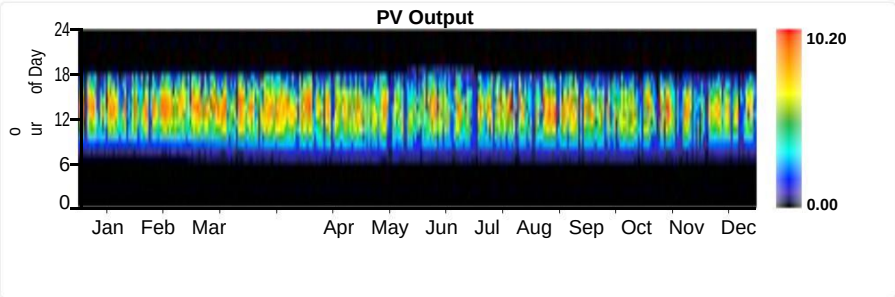
Quantity	Value	Units
Rated capacity	14	kW
Mean output	2	kW
Mean output	57.49	kWh/d
Capacity factor	17.74	%
Total production	20985	kWh/yr
Minimum output	0.00	kW
Maximum output	14.03	kW
PV penetration	30.38	%

Quantity	Value	Units
Hours of operation	4358	hrs/yr
Levelized cost	0.086	$/kWh



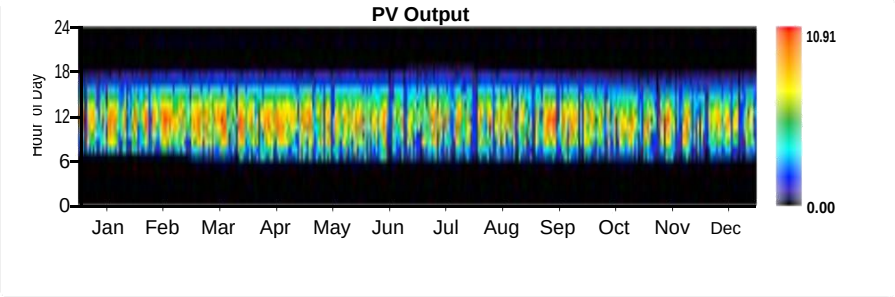
PV:DC West

Quantity	Value	Units
Rated capacity	10	kW
Mean output	2	kW
Mean output	41.02	kWh/d
Capacity factor	17.53	%
Total production	14973	kWh/yr
Minimum output	0.00	kW
Maximum output	10.20	kW
PV penetration	21.68	%
Hours of operation	4358	hrs/yr
Levelized cost	0.087	$/kWh



PV:DC East

Quantity	Value	Units
Rated capacity	11	kW
Mean output	2	kW
Mean output	44.72	kWh/d
Capacity factor	17.74	%
Total production	16321	kWh/yr
Minimum output	0.00	kW
Maximum output	10.91	kW
PV penetration	23.63	%
Hours of operation	4358	hrs/yr
Levelized cost	0.086	$/kWh

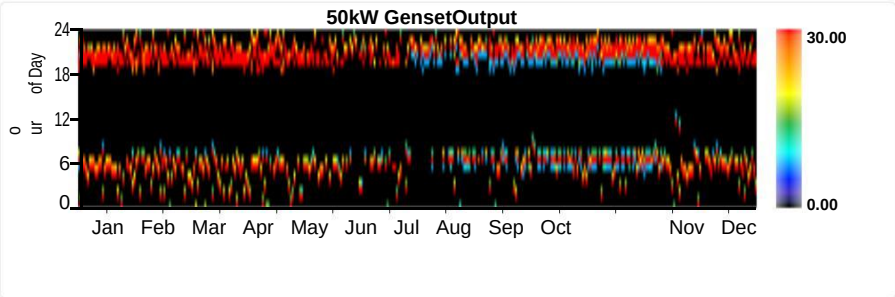


Wind Turbine:Windspot 3.5

Quantity	Value	Units
Total rated capacity	18	kW
Mean output	2	kW
Capacity factor	10.46	%
Total production	16492	kWh/yr
Minimum output	0.00	kW
Maximum output	22.53	kW
Wind penetration	23.88	%
Hours of operation	8760	hrs/yr
Levelized cost	0.440	$/kWh

Generator:50kW Genset

Quantity	Value	Units
Hours of operation	1590	hrs/yr
Number of starts	707	starts/yr
Operational life	9	yr
Fixed generation cost	2.89	$/hr
Marginal generation cost	0.27	$/kWh
Electrical production	38111	kWh/yr
Mean electrical output	24	kW
Min. electrical output	8	kW
Max. electrical output	30	kW
Fuel consumption	11978	L/yr
Specific fuel consumption	0.31	L/kWh
Fuel energy input	117867	kWh/yr
Mean electrical efficiency	32	%



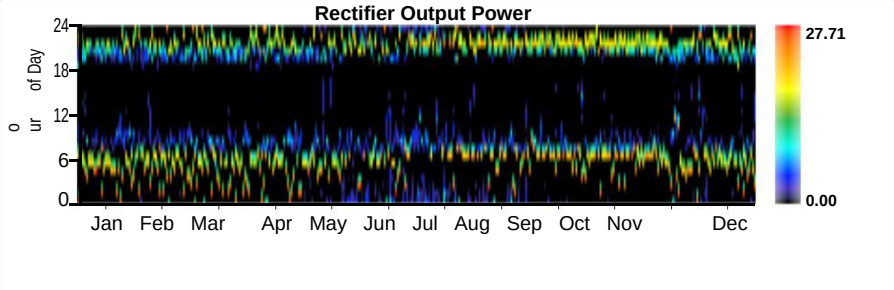
Battery:Li-Ion 27.5 kWh

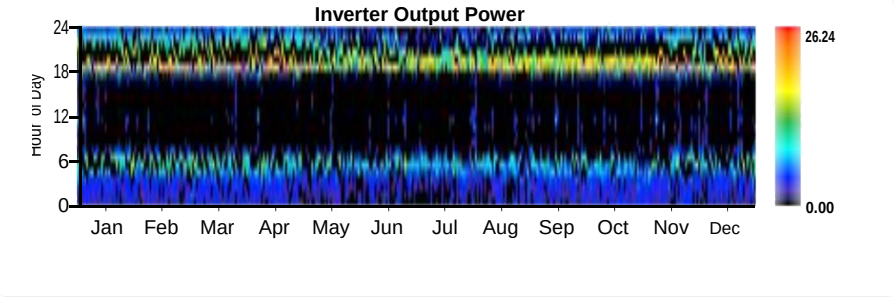
Quantity	Value
String size	1
Strings in parallel	3
Batteries	3
Bus voltage	48

Quantity	Value	Units
Nominal capacity	76	kWh
Usable nominal capacity	46	kWh
Autonomy	6	hr
Battery wear cost	0.065	$/kWh
Average energy cost	0.199	$/kWh
Energy in	26209	kWh/yr
Energy out	25193	kWh/yr
Storage depletion	34	kWh/yr
Losses	982	kWh/yr
Annual throughput	25713	kWh/yr

Converter

Quantity	Inverter	Rectifier	Units
Capacity	100	95	kW
Mean output	3	2	kW
Minimum output	0	0	kW
Maximum output	26	28	kW
Capacity factor	3	2	%
Hours of operation	3,975	2,058	hrs/yr
Energy in	26,310	21,591	kWh/yr
Energy out	24,994	20,512	kWh/yr
Losses	1,315	1,080	kWh/yr





Emissions

Pollutant	Emissions	Units
Carbon dioxide	31358	kg/yr
Carbon monoxide	196	kg/yr
Unburned hydrocarbons	9	kg/yr
Particulate matter	1	kg/yr
Sulfur dioxide	77	kg/yr
Nitrogen oxides	184	kg/yr