Lighting Kwang Ahn Bridge by Renewable Energy Sources

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Kwang Ahan Bridge located in Pusan City, South Korea, under illumination supplied by grid power

Input Study

- Load
  - Number of LED lamps: 1184
  - Rated Power of each LED lamp: 10 W
  - Total Lighting Load 1184*10W=11840W
- Solar Resources
  - Peak Sun Hours: 4
- Wind Resources
  - Average Wind Speed: 6.2 m/s

Renewable Sources

- Wind Turbine: 100KW
- PV: 50KW
- Converter: 50KW

Primary Load Inputs

File Edit Help

Choose a load type (AC or DC), enter 24 hourly values in the load table, and enter a scaled annual average. Each of the 24 values in the load table is the average electric demand for a single hour of the day. HOMER replicates this profile throughout the year unless you define different load profiles for different months or day types. For calculations, HOMER uses scaled data: baseline data scaled up or down to the scaled annual average value.

Hold the pointer over an element or click Help for more information.

Label: Primary Load 1

Load type: (•) AC ( ) DC

Data source: (•) Enter daily profile(s) ( ) Import time series data file

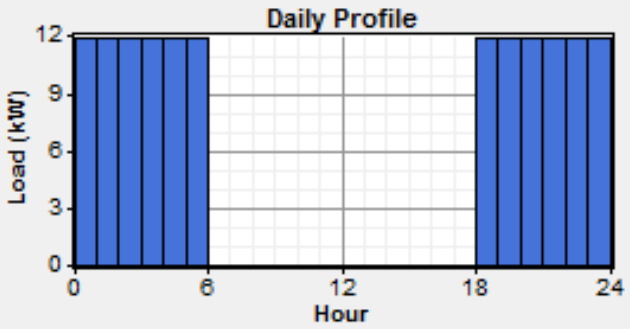
Import File...

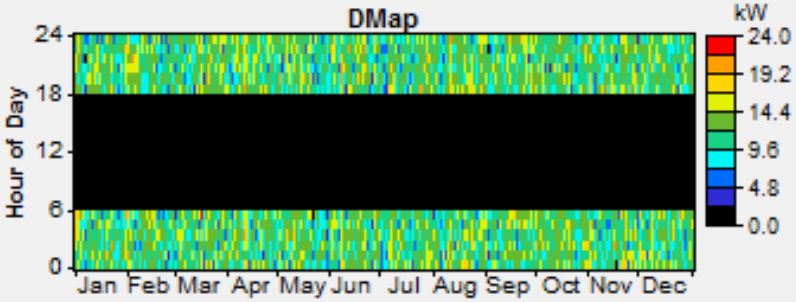
Baseline data

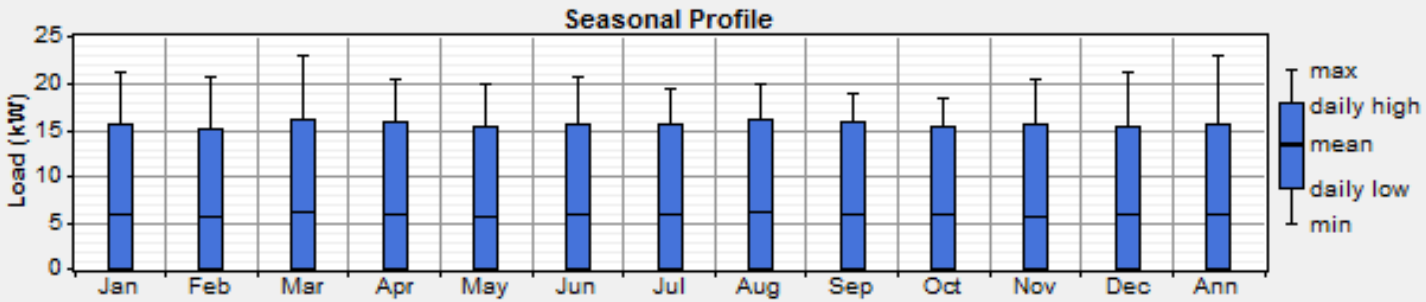
Month: January

Day type: Weekday

Hour	Load (kW)
00:00 - 01:00	11.840
01:00 - 02:00	11.840
02:00 - 03:00	11.840
03:00 - 04:00	11.840
04:00 - 05:00	11.840
05:00 - 06:00	11.840
06:00 - 07:00	0.000
07:00 - 08:00	0.000
08:00 - 09:00	0.000
09:00 - 10:00	0.000
10:00 - 11:00	0.000
11:00 - 12:00	0.000







Random variability

Day-to-day: 15 %

Time-step-to-time-step: 20 %

Scaled annual average (kWh/d): 141 {..}

	Baseline	Scaled
Average (kWh/d)	141	141
Average (kW)	5.88	5.87
Peak (kW)	22.8	22.8
Load factor	0.257	0.257

Efficiency Inputs...

Plot... Export...

Help Cancel OK

Wind Turbine Inputs

File Edit Help

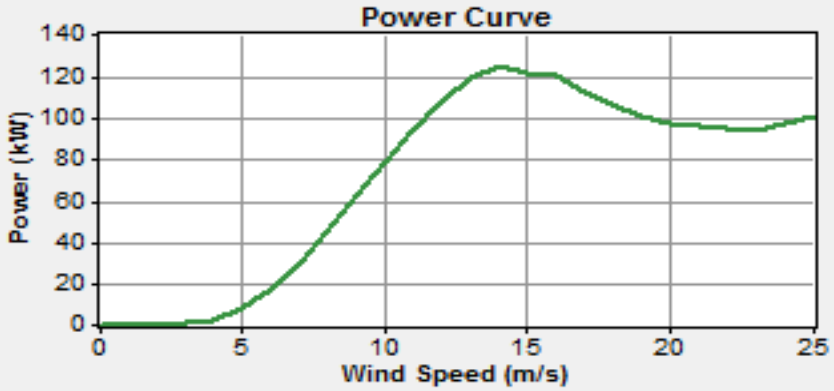
Choose a wind turbine type and enter at least one quantity and capital cost value in the Costs table. Include the cost of the tower, controller, wiring, installation, and labor. As it searches for the optimal system, HOMER considers each quantity in the Sizes to Consider table.

Hold the pointer over an element or click Help for more information.

Turbine type: Fuhrl?der 100 | Details... | New... | Delete

Turbine properties

Abbreviation: FL100 (used for column headings)
Rated power: 100 kW AC
Manufacturer: Fuhrl?der AG
Website: www.fuhrlaender.de

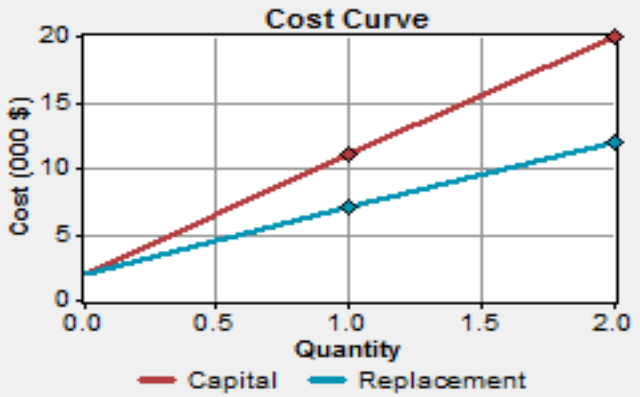


Costs

Quantity	Capital ($)	Replacement ($)	O&M ($/yr)
1	11000	7000	200
2	20000	12000	375
	{..}	{..}	{..}

Sizes to consider

Quantity
0
1
2



Other

Lifetime (yrs): 15 {..}
Hub height (m): 50 {..}

Help | Cancel | OK

PV Inputs

File Edit Help

Enter at least one size and capital cost value in the Costs table. Include all costs associated with the PV (photovoltaic) system, including modules, mounting hardware, and installation. As it searches for the optimal system, HOMER considers each PV array capacity in the Sizes to Consider table.

Note that by default, HOMER sets the slope value equal to the latitude from the Solar Resource Inputs window.

Hold the pointer over an element or click Help for more information.

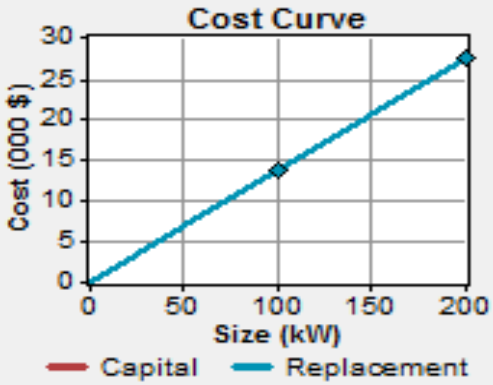
Costs

Size (kW)	Capital ($)	Replacement ($)	O&M ($/yr)
50.000	6900	6900	0

{..} {..} {..}

Sizes to consider

Size (kW)
0.000
100.000
200.000



Properties

Output current AC DC

Lifetime (years) 20 {..}

Derating factor (%) 80 {..}

Slope (degrees) 35.4333 {..}

Azimuth (degrees W of S) 0 {..}

Ground reflectance (%) 20 {..}

Advanced

Tracking system No Tracking

Consider effect of temperature

Temperature coeff. of power (%/°C) -0.5 {..}

Nominal operating cell temp. (°C) 47 {..}

Efficiency at std. test conditions (%) 13 {..}

Help Cancel OK

PV Inputs

File Edit Help

Enter at least one size and capital cost value in the Costs table. Include all costs associated with the PV (photovoltaic) system, including modules, mounting hardware, and installation. As it searches for the optimal system, HOMER considers each PV array capacity in the Sizes to Consider table.

Note that by default, HOMER sets the slope value equal to the latitude from the Solar Resource Inputs window.

Hold the pointer over an element or click Help for more information.

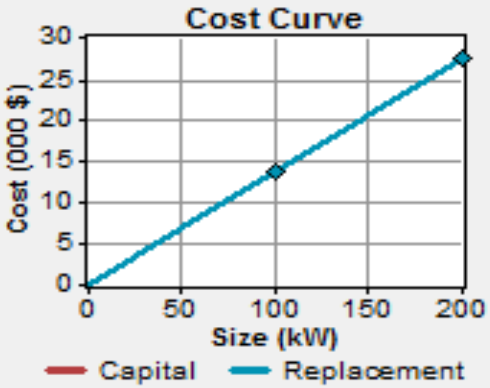
Costs

Size (kW)	Capital ($)	Replacement ($)	O&M ($/yr)
50.000	6900	6900	0

{..} {..} {..}

Sizes to consider

Size (kW)
0.000
100.000
200.000



Properties

Output current ○ AC ◉ DC

Lifetime (years) 20 {..}

Derating factor (%) 80 {..}

Slope (degrees) 35.4333 {..}

Azimuth (degrees W of S) 0 {..}

Ground reflectance (%) 20 {..}

Advanced

Tracking system No Tracking

☐ Consider effect of temperature

Temperature coeff. of power (%/°C) -0.5 {..}

Nominal operating cell temp. (°C) 47 {..}

Efficiency at std. test conditions (%) 13 {..}

Help Cancel OK

Battery Inputs

File Edit Help

Choose a battery type and enter at least one quantity and capital cost value in the Costs table. Include all costs associated with the battery bank, such as mounting hardware, installation, and labor. As it searches for the optimal system, HOMER considers each quantity in the Sizes to Consider table.

Hold the pointer over an element or click Help for more information.

Battery type: Surrette 6CS25P | Details... | New... | Delete

Battery properties

Manufacturer: Rolls/Surrette
Website: www.rollsbattery.com

Nominal voltage: 6 V
Nominal capacity: 1,156 Ah (6.94 kWh)
Lifetime throughput: 9,645 kWh

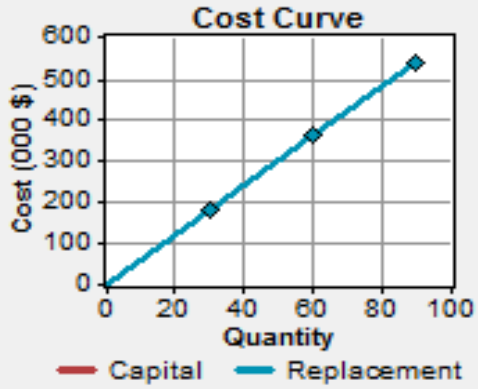
Costs

Quantity	Capital ($)	Replacement ($)	O&M ($/yr)
1	6000	6000	50.00

{..} {..} {..}

Sizes to consider

Batteries
0
30
60
90

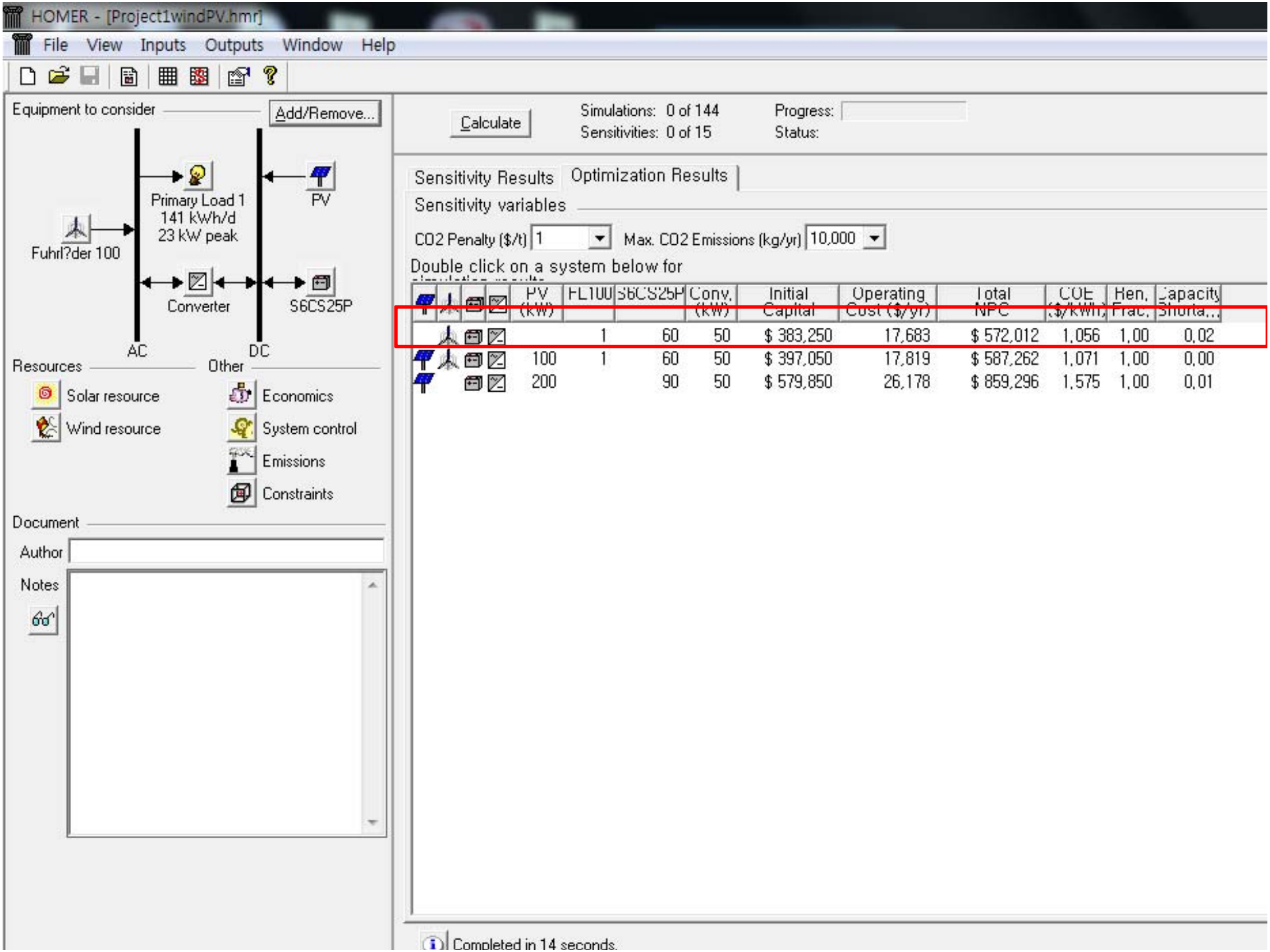


Advanced

Batteries per string: 1 (6 V bus)

Minimum battery life (yr): 4 {..}

Help Cancel OK


HOMER - [Project1windPV.hmr]
File View Inputs Outputs Window Help
Equipment to consider
Add/Remove...
Primary Load 1
141 kWh/d
23 kW peak
PV
Fuhrl?der 100
Converter
S6CS25P
AC
DC
Resources
Other
Solar resource
Wind resource
Economics
System control
Emissions
Constraints
Document
Author
Notes
Calculate
Simulations: 0 of 144
Sensitivities: 0 of 15
Progress:
Status:
Sensitivity Results
Optimization Results
Sensitivity variables
CO2 Penalty ($/t) 1
Max. CO2 Emissions (kg/yr) 10,000
Double click on a system below for
PV (kW)
FL1UU
S6CS25P
Conv. (kW)
Initial Capital
Operating Cost ($/yr)
Total NPC
COE ($/kWh)
Ren. Frac.
Capacity Shorta...
1 60 50 $ 383,250 17,683 $ 572,012 1,056 1,00 0,02
100 1 60 50 $ 397,050 17,819 $ 587,262 1,071 1,00 0,00
200 90 50 $ 579,850 26,178 $ 859,296 1,575 1,00 0,01
Completed in 14 seconds.

System Report - Project1

Sensitivity case

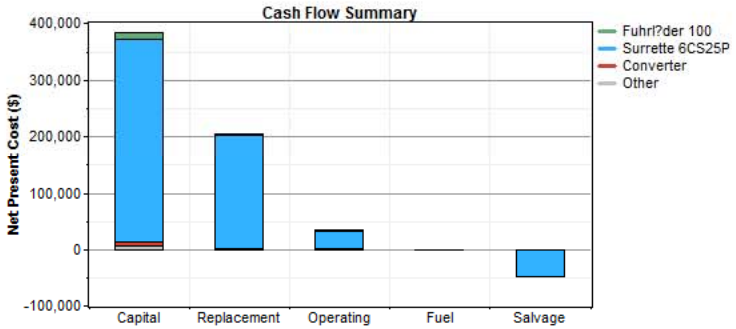
CO2 Emissions Penalty: 2 $/t
Maximum CO2 Emissions: 30,000 kg/yr

System architecture

Wind turbine 1 Fuhrl□nder 100	
Battery	60 Surrette 6CS25P
Inverter	50 kW
Rectifier	50 kW

Cost summary

Total net present cost	$ 572,012
Levelized cost of energy	$ 1.056/kWh
Operating cost	$ 17,683/yr



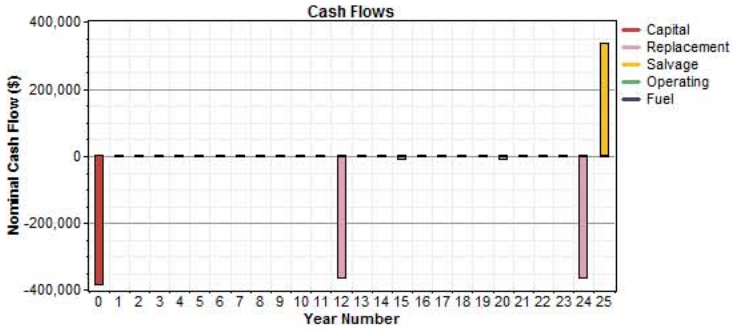
Net Present Costs

Component	Capital	Replacement	O&M	Fuel	Salvage	Total
	($)	($)	($)	($)	($)	($)
Fuhrl□nder 100	11,000	2,207	2,135	0	-341	15,001
Surrette 6CS25P	360,000	199,733	32,024	0	-48,186	543,571
Converter	6,250	1,341	534	0	-684	7,440
Other	6,000	0	0	0	0	6,000
System	383,250	203,280	34,693	0	-49,211	572,012

Annualized Costs

Component	Capital	Replacement	O&M	Fuel	Salvage	Total
	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)
Fuhrl□nder 100	1,030	207	200	0	-32	1,405
Surrette 6CS25P	33,724	18,711	3,000	0	-4,514	50,921
Converter	585	126	50	0	-64	697
Other	562	0	0	0	0	562
System	35,902	19,043	3,250	0	-4,610	53,585

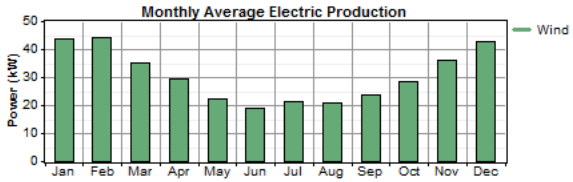
Surrette 6CS25P	33,724	18,711	3,000	0	-4,514	50,921
Converter	585	126	50	0	-64	697
Other	562	0	0	0	0	562
System	35,902	19,043	3,250	0	-4,610	53,585



Electrical

Component	Production (kWh/yr)	Fraction
Wind turbine	268,724	100%
Total	268,724	100%

Wind Power Alone works



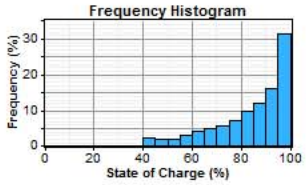
Load	Consumption (kWh/yr)	Fraction
AC primary load	50,746	100%
Total	50,746	100%

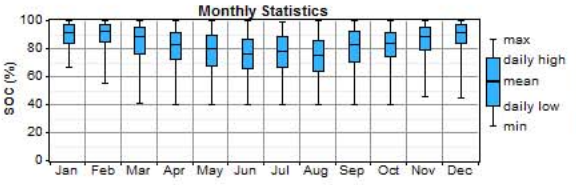
Quantity	Value	Units
Excess electricity	204,508	kWh/yr
Unmet load	719	kWh/yr
Capacity shortage	853	kWh/yr
Renewable fraction	1.000	

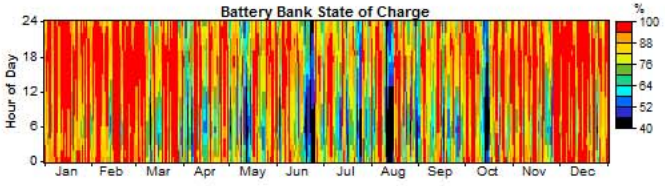
AC Wind Turbine: Fuhrl□nder 100

Variable	Value	Units
Total rated capacity	100	kW
Mean output	30.7	kW
Capacity factor	30.7	%

Quantity	Value	Units
Energy in	29,517	kWh/yr
Energy out	23,618	kWh/yr
Storage depletion	5.48	kWh/yr
Losses	5,893	kWh/yr
Annual throughput	26,406	kWh/yr
Expected life	12.0	yr



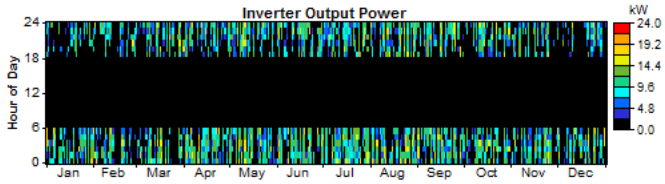


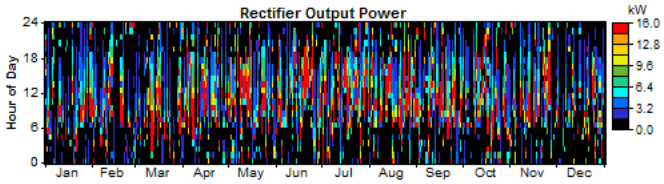


Converter

Quantity	Inverter	Rectifier	Units
Capacity	50.0	50.0	kW
Mean output	2.4	3.4	kW
Minimum output	0.0	0.0	kW
Maximum output	21.6	14.8	kW
Capacity factor	4.9	6.7	%

Quantity	Inverter	Rectifier	Units
Hours of operation	2,349	6,200	hrs/yr
Energy in	23,618	34,726	kWh/yr
Energy out	21,257	29,517	kWh/yr
Losses	2,362	5,209	kWh/yr





Emissions

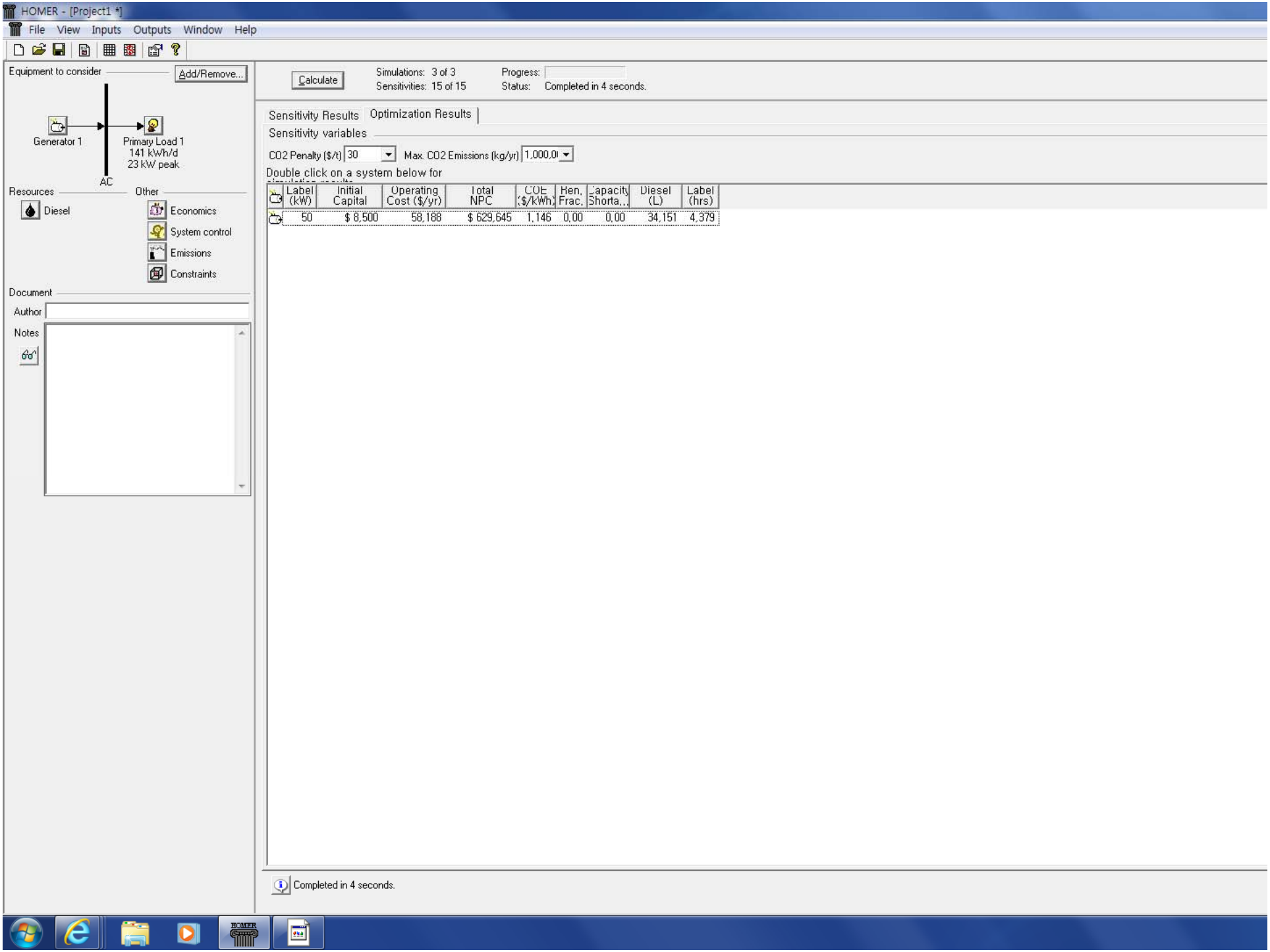
Pollutant	Emissions (kg/yr)
Carbon dioxide	0
Carbon monoxide	0
Unburned hydocarbons	0
Particulate matter	0
Sulfur dioxide	0
Nitrogen oxides	0

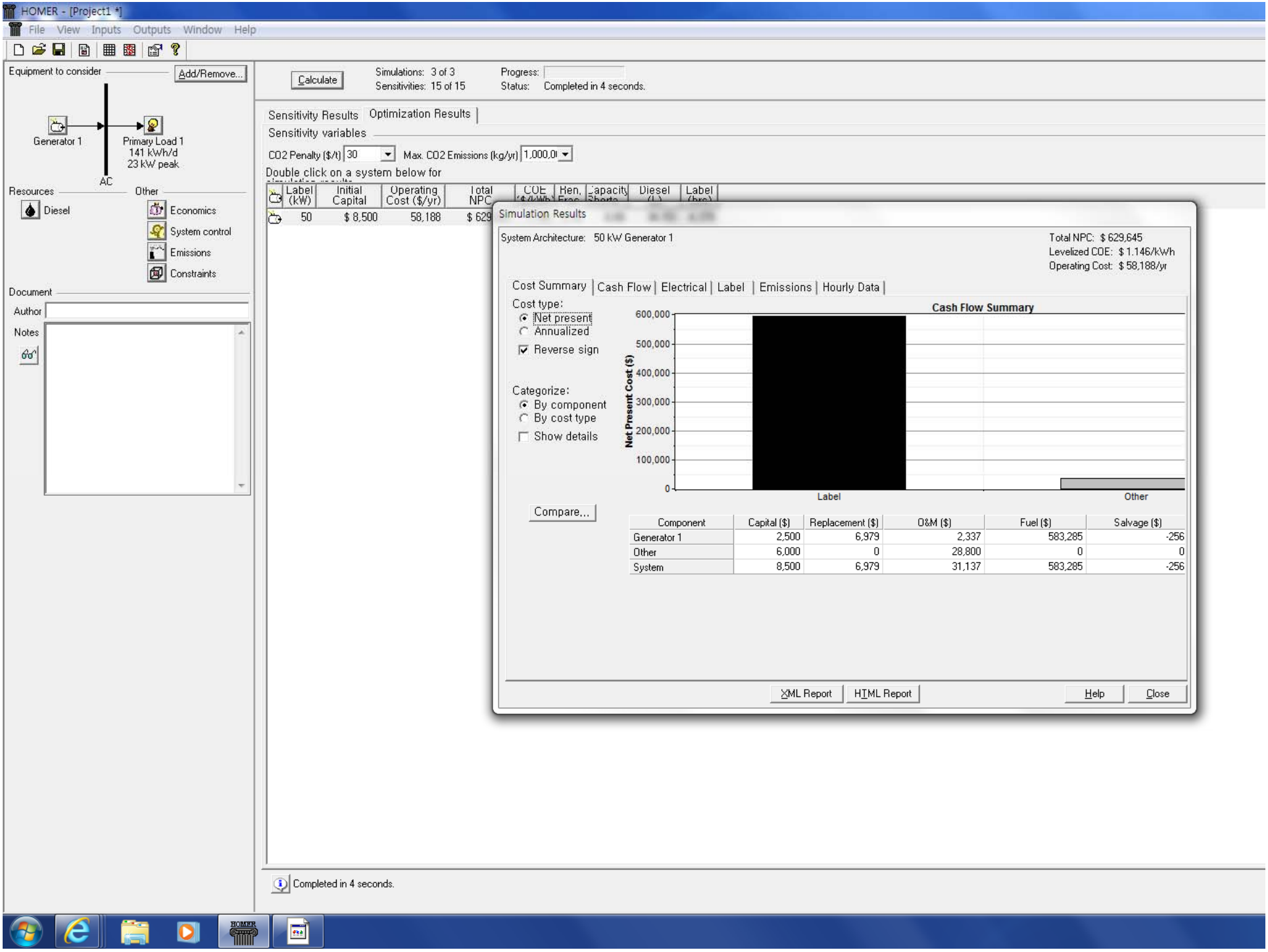
Optimization

- Wind Turbine 100KW
- Installation of 50KW at either side of the bridge.

Diesel Generator Only Case

- Gen1-200KW
- C02 Emission 89,931 kg/yr


HOMER - [Project1 *]
File View Inputs Outputs Window Help
Equipment to consider
Add/Remove...
Generator 1
Primary Load 1
141 kWh/d
23 kW peak
AC
Resources
Diesel
Other
Economics
System control
Emissions
Constraints
Document
Author
Notes
Calculate
Simulations: 3 of 3
Sensitivities: 15 of 15
Progress:
Status: Completed in 4 seconds.
Sensitivity Results
Optimization Results
Sensitivity variables
CO2 Penalty ($/t) 30
Max. CO2 Emissions (kg/yr) 1,000,0
Double click on a system below for
Label (kW)
Initial Capital
Operating Cost ($/yr)
Total NPC
COE ($/kWh)
Ren. Frac.
Capacity Shorta...
Diesel (L)
Label (hrs)
50 $ 8,500 58,188 $ 629,645 1.146 0.00 0.00 34,151 4,379
Completed in 4 seconds.


HOMER - [Project1 *]
File View Inputs Outputs Window Help
Equipment to consider
Add/Remove...
Generator 1
Primary Load 1
141 kWh/d
23 kW peak
AC
Resources
Diesel
Other
Economics
System control
Emissions
Constraints
Document
Author
Notes
Calculate
Simulations: 3 of 3
Sensitivities: 15 of 15
Progress:
Status: Completed in 4 seconds.
Sensitivity Results
Optimization Results
Sensitivity variables
CO2 Penalty ($/t) 30
Max. CO2 Emissions (kg/yr) 1,000,0
Double click on a system below for
Label (kW)
Initial Capital
Operating Cost ($/yr)
Total NPC
50
$ 8,500
58,188
$ 629
Simulation Results
System Architecture: 50 kW Generator 1
Total NPC: $ 629,645
Levelized COE: $ 1.146/kWh
Operating Cost: $ 58,188/yr
Cost Summary
Cash Flow
Electrical
Label
Emissions
Hourly Data
Cost type:
Net present
Annualized
Reverse sign
Categorize:
By component
By cost type
Show details
Compare...
Cash Flow Summary
Net Present Cost ($)
600,000
500,000
400,000
300,000
200,000
100,000
0
Label
Other
Component
Capital ($)
Replacement ($)
O&M ($)
Fuel ($)
Salvage ($)
Generator 1
2,500
6,979
2,337
583,285
-256
Other
6,000
0
28,800
0
0
System
8,500
6,979
31,137
583,285
-256
XML Report
HTML Report
Help
Close
Completed in 4 seconds.

Simulation Results

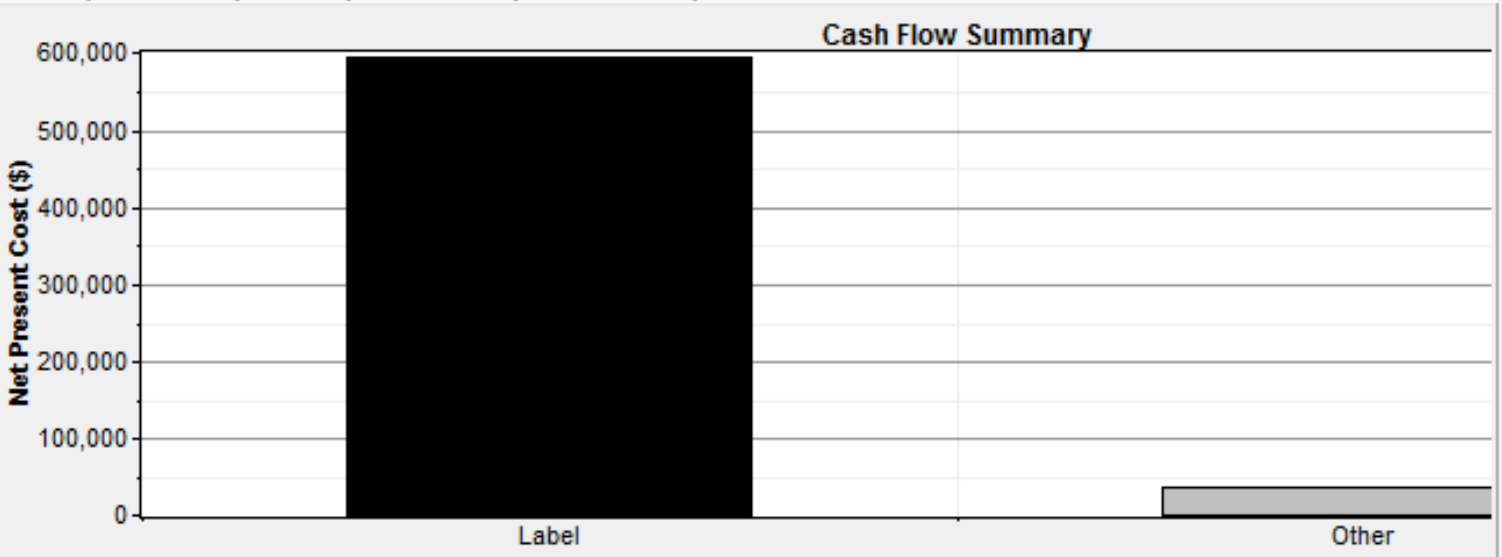
System Architecture: 50 kW Generator 1

Total NPC: $ 629,645
Levelized COE: $ 1.146/kWh
Operating Cost: $ 58,188/yr

Cost Summary | Cash Flow | Electrical | Label | Emissions | Hourly Data

Cost type:
- (•) Net present
- ( ) Annualized
- [x] Reverse sign

Categorize:
- (•) By component
- ( ) By cost type
- [ ] Show details



Compare...

Component	Capital ($)	Replacement ($)	O&M ($)	Fuel ($)	Salvage ($)
Generator 1	2,500	6,979	2,337	583,285	-256
Other	6,000	0	28,800	0	0
System	8,500	6,979	31,137	583,285	-256

XML Report | HTML Report | Help | Close

HOMER - [Project1 *]

File View Inputs Outputs Window Help

Equipment to consider — Add/Remove...

Generator 1 — Primary Load 1 (141 kWh/d, 23 kW peak) — AC

Resources: Diesel

Other: Economics, System control, Emissions, Constraints

Document

Author

Notes

Calculate

Sensitivity Res

Sensitivity vari

CO2 Penalty ($/t)

Double click on

Label	(kW)	C
	50	

C:₩Users₩user₩AppData₩Local₩Temp₩Project

System Report - Project1

파일(F) 편집(E) 보기(V) 즐겨찾기(A) 도구(T) 도움말(H)

System Report - Project1

Sensitivity case

CO2 Emissions Penalty: 30 $/t

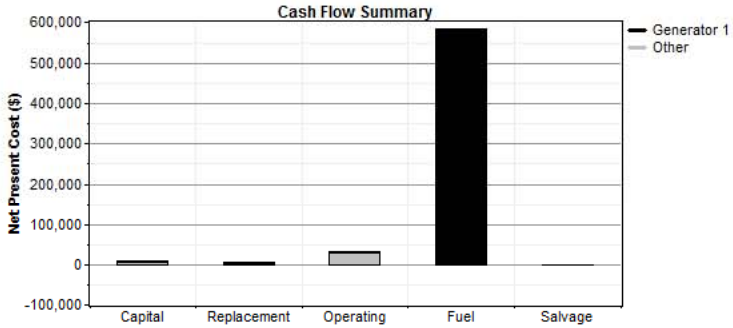
Maximum CO2 Emissions: 1,000,000 kg/yr

System architecture

Generator 1 50 kW

Cost summary

Total net present cost	$ 629,645
Levelized cost of energy	$ 1.146/kWh
Operating cost	$ 58,188/yr

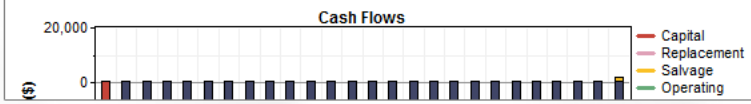


Net Present Costs

Component	Capital ($)	Replacement ($)	O&M ($)	Fuel ($)	Salvage ($)	Total ($)
Generator 1	2,500	6,979	2,337	583,285	-256	594,845
Other	6,000	0	28,800	0	0	34,800
System	8,500	6,979	31,137	583,285	-256	629,645

Annualized Costs

Component	Capital ($/yr)	Replacement ($/yr)	O&M ($/yr)	Fuel ($/yr)	Salvage ($/yr)	Total ($/yr)
Generator 1	234	654	219	54,641	-24	55,724
Other	562	0	2,698	0	0	3,260
System	796	654	2,917	54,641	-24	58,984



Completed in 4 seconds.

HOMER - [Project1 *]

File View Inputs Outputs Window Help

Equipment to consider — Add/Remove...

Generator 1

Primary Load 1
141 kWh/d
23 kW peak

AC

Resources — Other

Diesel

Economics
System control
Emissions
Constraints

Document

Author

Notes

Calculate

Sensitivity Res
Sensitivity vari
CO2 Penalty ($/t)
Double click on

Label	(kW)
	50

C:₩Users₩user₩AppData₩Local₩Temp₩Project

System Report - Project1

파일(F) 편집(E) 보기(V) 즐겨찾기(A) 도구(T) 도움말(H)

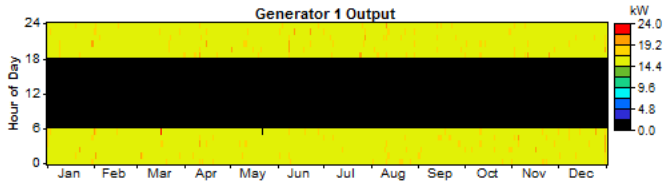
Quantity	Value	Units
Excess electricity	15,075	kWh/yr
Unmet load	0.00	kWh/yr
Capacity shortage	0.00	kWh/yr
Renewable fraction	0.000	

Generator 1

Quantity	Value	Units
Hours of operation	4,379	hr/yr
Number of starts	366	starts/yr
Operational life	3.43	yr
Capacity factor	15.2	%
Fixed generation cost	6.93	$/hr
Marginal generation cost	0.420	$/kWhyr

Quantity	Value	Units
Electrical production	66,540	kWh/yr
Mean electrical output	15.2	kW
Min. electrical output	15.0	kW
Max. electrical output	22.8	kW

Quantity	Value	Units
Fuel consumption	34,151	L/yr
Specific fuel consumption	0.513	L/kWh
Fuel energy input	336,045	kWh/yr
Mean electrical efficiency	19.8	%



Emissions

Pollutant	Emissions (kg/yr)
Carbon dioxide	89,931
Carbon monoxide	222
Unburned hydocarbons	24.6
Particulate matter	16.7
Sulfur dioxide	181
Nitrogen oxides	1,981

CO2 Emission

Completed in 4 seconds.

Conclusions

- Kwang Ahn Bridges can be illuminated at night by using 100KW wind turbine power.