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Solar Energy System Design (SESD) Calculation Model

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In this article we provide a brief description of the calculation model of the Solar Energy System Design (SESD) tool.

SESD input data includes the following:

- System monthly energy consumption (E KWh/month)
- Solar irradiance of the site (H W/m².year)
- Maximum power of the solar panel (P_{max} Watt)
- Area of the solar panel (a m²)

SESD input data also includes energy losses coefficients, these are:

- L_{inv} = Inverter losses (6% to 15 %)
- L_{temp} = Temperature losses (5% to 15%)
- L_{dc} = DC cables losses (1 to 3 %)
- L_{ac} = AC cables losses (1 to 3 %)
- L_{shad} = Shadings 0 % to 40%
- L_{irrad} = Losses weak irradiation 3% to 7%
- L_{weath} = Losses due to dust, snow... (2% to 5%)
- L_{other} = Other Losses

SESD calculates the basic design parameters of a solar energy system including:

- **Performance ratio (R)**

$$R = (1 - L_{inv}) (1 - L_{temp}) (1 - L_{dc}) (1 - L_{ac}) (1 - L_{shad}) (1 - L_{irrad}) (1 - L_{weath}) (1 - L_{other})$$

- **Annual energy yield (E_{tot} KWh/year)**

$$E_{tot} = 12 \times E$$

- **Solar panel energy yield (Y KWh/m²)**

$$Y = 10^{-3} \times P_{max} / a$$

- **No. of solar panels (N)**

$$N = E_{tot} / (P_{max} \times H \times R)$$

- **Total area of the solar panels (A m²)**

$$A = a \times N$$

- **Maximum DC power of the solar energy system (KW_{dc} KW).**

$$KW_{dc} = N \times P_{max}$$

The above calculating model has been implemented as an Excel Worksheet for desktop-application as well as an online web-based application. You can Download and Run SESD Excel Worksheet on your computer or Run SESD Online on your Internet browser.

E = Monthly energy consumption (kWh/month)	528	kWh/month	Input Data
H = Solar irradiance at the site (kWh/m ² .year)	1900	kWh/m ² .year	
P_{max} = Maximum DC power of the PV solar panel (Watt)	450	Watt	
a = Solar panel area (m ²)	2.00	m ²	
R = Performance ratio	0.87		Output Data
E_{tot} = Annual energy yield (kWh/year)	6,336	KWh/year	
Y = Solar panel yield (KW/m ²)	0.23	KW/m ²	
N = No. of solar panels	10	Panel	
A = Total solar panels area (m ²)	20	m ²	
KW_{dc} = Maximum DC power of the solar energy system (KW)	4.50	KWdc	
Losses details (depend of site, technology, and sizing of the system)			
L_{inv} = Inverter losses (6% to 15 %)	3%		Input Data
L_{temp} = Température losses (5% to 15%)	3%		
L_{dc} = DC cables losses (1 to 3 %)	2%		
L_{ac} = AC cables losses (1 to 3 %)	2%		
L_{shad} = Shadings 0 % to 40%	0%		
L_{irrad} = Losses weak irradiation 3% to 7%	1%		
L_{weath} = Losses due to dust, snow... (2% to 5%)	3%		
L_{other} = Other Losses	0%		