

## variable-renewable-energy-process

Collection of tools to process and interact with variable renewable energy data

### Photovoltaic

1. Solar energy output

$$E = A * r * GHI * \mu$$

where,

$E$  = Energy (Wh)

$A$  = Total solar panel area (m<sup>2</sup>)

$r$  = Solar panel efficiency (default value = 0.159) [1]

$GHI$  = Global Horizontal Irradiation (Wh / m<sup>2</sup>)

$\mu$  = Coefficient for losses (range between 0.5 and 0.9, default value = 0.9)

2. Solar power output

$$P = E / \Delta t$$

where,

$P$  = Solar panel power output (W)

$E$  = Energy (Wh)

$\Delta t$  = Time step (hour)

3. Solar per unit output

$$\begin{aligned} cf &= P / \bar{P} \\ &= \frac{A * r * GHI * \mu}{\Delta t * \bar{P}} \end{aligned}$$

where,

$cf$  = Capacity factor (p.u.)

$P$  = Solar panel power output (W)

$\bar{P}$  = Maximum power output of the installed solar panel (Wp)

$A$  = Total solar panel area (m<sup>2</sup>)

$r$  = Solar panel efficiency (default value = 0.159) [1]

$GHI$  = Global Horizontal Irradiation (Wh / m<sup>2</sup>)

$\mu$  = Coefficient for losses (range between 0.5 and 0.9, default value = 0.9)

$\Delta t$  = Time step (hour)

### Typical Value

Symbol	Value	Unit	Note
$A$	1.63350	m <sup>2</sup>	[1]
$r$	0.159	-	[1]
$\mu$	0.90	-	-
$\bar{P}$	260	W	[1]