

## EFFICIENCY MEASURES IN SOLAR ELECTRICAL PRODUCTION - A CONSISTENT TERMINOLOGY

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The term "efficiency" is very ambiguous in relation to Solar energy systems. The aim of this brief paper is to clarify the origin of the problem and to propose, if we may modestly do so, a consistent term at least good enough for comparisons.

What's so special about solar energy that makes the definition of efficiency more difficult than other domains where questions (on definition) are raised as well? The answer is that unlike other systems there are three different elements relevant to the definition of efficiency which can't be clarified simply in one note (like gross/net or HHV/LHV in power plant efficiency).

The first element relates to the fact that efficiency in a solar system depends on the condition of the sun, and accordingly will differ if we refer to peak, period and location.

The second element relates to the numerator of the efficiency ratio. Efficiency consist of a fraction for which the numerator is the energy collected by the system and for which the denominator is the potential available energy (not necessarily the useable one). The problem arises regarding the difference in the quality of the energy; for example, that of temperature, the sensible heat versus the latent heat, and other differences.

The third and most ambiguous element is the denominator which is the potential available energy, or more accurately, the definition of a common potential energy that make sense, and could be shared by the different systems of solar energy collection. It is common to find efficiency terms relating to the direct normal radiation in 2D tracking concentrating collectors, the direct normal radiation in collector surface for 1D tracking, and different global radiation portions for flat collectors pending their orientation and tracking.

This presentation is limited to solar systems producing electricity; similar terms could be used for thermal output.

We propose to use a yearly efficiency for a specific location. For the numerator the chosen quantity is the net electrical output for the year. For the denominator, we propose the "strange" term of the sum of the yearly direct normal radiation plus the yearly diffused radiation, as the potential available energy.

The paper presents different solar collector systems producing electricity and compares the other common terms for efficiency determination to the consistent one proposed hereby.