

IEooc_Methods1_Exercise1: Defining and locating indicators in a system definition

Goal: Establish a system definition to allocate quantitative information that is given as text. Define and calculate indicators base on the system definition.

Problem setting

The following problem deals with energy flows of different forms (sunlight, electricity) in a photovoltaics installation.

Assume that the following information is given in the technical manual of the PV park, which is available on the homepage of the operator of the installation:

“The solar park is built with PV modules of an average conversion efficiency of 17%. It is equipped with DC/AC converters with a loss rate of 2%, resulting in an overall conversion efficiency of 16.7%. With additional grid and transformer losses of 8% the system efficiency is 15.3%.”

A report on the PV plant in the local newspaper, which is based on the information supplied by the operator, gives the following information:

“With an overall conversion efficiency of 16.7%, solar park A clearly outperforms the other parks in the region. Electricity consumers rejoice as the system efficiency of the renewable energy grid is now more than 15%.”

Clearly, the cited section of the newspaper article contains less quantitative info than the technical report. Information was lost when simplifying the description. In particular, the exact meaning of ‘overall conversion efficiency’ and ‘system efficiency’ remains unclear, as no definitions are provided (which cannot be expected from a newspaper article). The technical report cited above does not provide definitions either, but from the flow of the text and the numbers provided it becomes clear that the ‘overall conversion efficiency’ must be the ratio of electricity supplied to the grid and the incoming sunlight. It can be calculated as $(1-0.02) * 0.17$. This understanding of the meaning of the indicator gets lost in the transition to the newspaper article.

By providing explicit definitions of the efficiency indicators and using them consistently ambiguities can be removed. To formalize the knowledge provided in the technical report an explicit system definition shall be used to define and quantify indicators for this case:

Task

Draw a system describing the situation, define the system variables, define and calculate the efficiency indicators from the text above, and find more descriptive names for the different efficiencies!