PVopti – tool for calculation the self-consumption of buildings based on hourly values

If a building has a certain amount of thermal flexibility, the run time of the heat pump can be limited to daytime hours, only. This increases the self-consumption of on-site PV electricity production. Also, an electrical storage increases the self-consumption and allows some flexibiliy. In order to make these interactions “designable”, an easy to use tool to calculate the self-consumption is missing. The development of such a tool is part of the Swiss national project in the scope of the IEA EBC Annex 67.

As part of subtask B of IEA EBC Annex 67, a methodology has been developed by the University of Applied Sciences Northwest Switzerland, Institute Energy in Buildings which allows the calculation of electricity self-consumption which requires a very limited set of information about the building. Based on this methodology, an hourly-based tool called «Enerflex» was developed. With this tool, variations in self-consumption can be rated in the (early) design phase with reasonable accuracy and cost.

On January 1st, 2017 the Swiss building label Minergie launched new set of requirements. These are based on an hourly energy balance and a different weighting of on-site generated electricity for self-consumption and electricity fed to the grid. Minergie attempts to be the first label to take grid interaction into account as a design parameter for buildings. Minergie and the Swiss cantons mandated the development of a publicly available “self-consumption-tool” for practical application – “PVopti”. This tool is a toned-down version of «Enerflex» geared to be used as part of the Minergie certification process. PVopti is an easy-to-use and freely available tool which can be used for most building types (www.minergie.ch). The tool respects common heating systems, the main energy demands and on-site electricity generation by photovoltaics and combined heat and power. Electricity storage can be included as well as demand side management. The distribution of annual or monthly to hourly values is as follows:

- Load profiles according to the Swiss guidline SIA 2024 are used to distribute annula values on hours (profiles for presence of persons, devices and artificial lighting). For artificial lighting, a criterion for daylight is added. If the horizontal global radiation exceeds 200 W/m^2, artificial lighting is off. This shifts the artificial lighting demand towards evening hours and wintertime to a large degree.
- The distribution of heating and cooling demand depends on the ambient temperature. Taking the thermal mass of the building into account, the moving average of the last 24 h is used. The heating limit is 12 °C referring to the moving average and 16 °C for the cooling. The cause for the low cooling limit are climate stations with low temperatures. If the cooling limit is 21 °C climate stations with low temperatures won’t reach the moving average of 21 °C. In this case, cooling cannot be taken into account.
- Ventilation, General HVAC equipment and domestic hot water have constant loads for every hour in the year.
- The distribution of PV-yield and the yield of a thermal collector depend on the hourly radiation values from the site climate data.

For the purpose of the IEA EBC Annex 67, PVopti was extended to allow for bespoke climate data. Due to this extension the tool can be used all over the world. The tool’s language can be chosen from English, German, French and Italian. Available descriptions of how to use the tool are copies of the Minergie descriptions (de, fr, it). The CISBAT conference paper tells a little about the background of the tool (doi.org/10.1016/j.egypro.2017.07.394).

We would like to thank Minergie that we can use PVopti as the basis for the IEA EBC Annex 67 version.

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