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Different balancing methods for Net Zero Energy Buildings - Impact of time steps, grid interaction and weighting factors

Monika Hall[a,*], Achim Geissler[a]

[a]*University of Applied Sciences and Arts of Northwestern Switzerland, Institute Energy in Building, St. Jakob-Strasse 84, 4132 Muttenz, Switzerland*

Abstract

Adding large photovoltaic systems to buildings is becoming more and more popular. To date, the self-consumption/grid interaction is not typically part of the energy balance. The choice of symmetric or asymmetric primary energy factors has an impact on the balance. The primary energy factor for import from the grid depends on the chosen type of the power mix in the grid. If this factor is higher/lower than the primary energy factor of the on-site PV-system, a larger/smaller PV system than when using symmetrical factors is required in order to fulfil the NZEB balance.

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Keywords: self-consumption; autarky; grid interaction; energy balance; primary energy; net zeo energy buildung

1. Introduction

The energy balancing of buildings is usually based on aggregated annual values. If the annual PV-yield is as high as the total annual energy demand, the building is called a Net Zero Energy Building (NZEB) [1]. With this approach, the time shift of PV-yield and energy demand is not considered in the energy balance. Fig. 1 shows the annual balance

* Corresponding author. Tel.: +41-61-467-4561
E-mail address: monika.hall@fhnw.ch

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for the autarky and self-consumption rates based on evaluation at different time step resolutions for a small apartment building (monitored values: 15 min). The annual PV-yield is higher than the annual demand. With a monthly or daily time step, the lack of winter PV-yield cannot be compensated with the summer yield. For evaluation at time steps shorter than a daily range, the mismatch of day and night is taken into account. The time steps of 1 min and 1 sec are extrapolated based on [2], [3]. In general, one can summarize the data given in Fig. 1 with "the shorter the time step, the lower the autarky and self-consumption rate". Therefore, it is paramount to know the time step resolution for autarky or self-consumption rates.

Annual and detailed monthly values for two time step resolutions are shown in Fig. 2. It can be seen that the implied autarky rate of the aggregated monthly values is twice as high as the autarky rate found for the 15-min balance. This clearly shows the high impact of the different time steps on the energy balance.

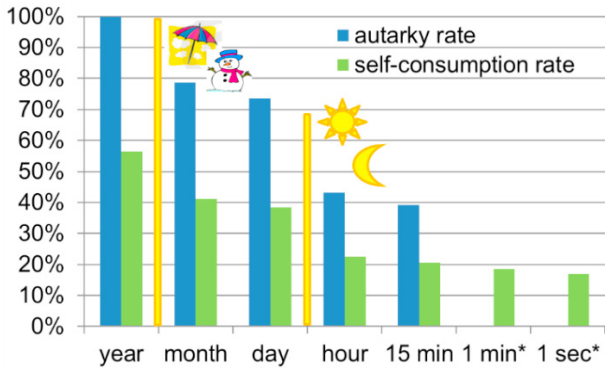

Fig. 1: Annual balance of measured data based on different time steps (building description: [4], 20 kWp, ground source heat pump, mechanical ventilation with heat recovery, Minergie-P, three apartments, without electric vehicle, time span 05/2013-04/2014).

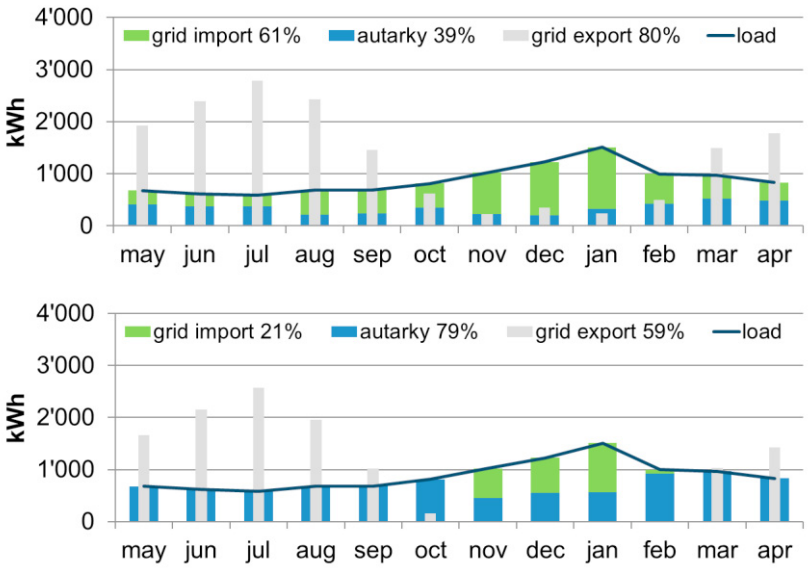

Fig. 2: Annual and monthly values for autarky, grid import and grid export based on 15- min values (top) and aggregated monthly values (bottom), time span 05/2013-04/2014.

Presently, the energy balance is based on aggregated annual values and energy carriers are weighted with primary energy factors or the Swiss national weighting factors. The factors are basically the ratio between primary energy and end-use energy at the gate of the building. This concerns delivered energy from an off-site source like e.g. electricity