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Editorial Open Access

On the Accumulated Capacity Factor of Integrated Energy Systems

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Editorial

The steady but slow transition from the era of aggressive renewable energypromotion policy to the era of cheap energy has made scientists and developers more carefulon energy planning, than few years ago. Focus now is given on extracting the maximum of energy – and not only electricity – locally generated. This developing concept has started being broad and dominating in the energy industry. The question is not only how much energy is it possible to be generated, but also what kind of energy and how can it be utilized efficiently. For instance the surplus of thermal load is – and should be more – exploitable. The number of Photovoltaic/Thermal (PV/T) installations is increasing [1]; thermal plants are transferring their waste heat to local communities for heating purposes [2]. Even in the wind energy industry, the manufactures' successful design paradigm is about to be changed to include the waste heat generated since more and more innovative systems appear ready to exploit such opportunities. Systems proposed are suggested by researchers to be included to the Wind Turbine initial design to transfer from the nacelle the excess heat produced, where the major part of mechanical – due to friction – losses takes place, to the foundation of the Wind Turbine (WT) and then to the nearest local community via a working fluid using the necessary piping [3]. Wind farm operators, proving that they are changing their perspective, are introducing huge batteries' systems to integrate fluctuating renewables [4]. All these trends are becoming more profound towards a Low(er) Carbon Economy. While district heating might be an apparent application, the agricultural and livestock sector can also benefit by those applications. Cooling (absorption cycle), greenhouse space-heating, even milk heating (during pasteurization) is just a few of the possible technical uses of the excess heat from the energy industry.

However, what is crucial in this new environment is to be able to "speak the same language". The advantages of such systems with the integration of multiple applications increasing the overall system efficiency are significant. But how much they are increasing the system's efficiency? How can we categorize – and evaluate – potential investments? How can we choose between one system or another? The need of the use of a new term equal to capacity factor will be necessary. So far the Capacity Factor (CF) of a plant was offering the factor which declared the percentage of the energy output of the investment compared to the theoretical one. It is given by the following equation:

$$CF = \frac{AEP}{8760 \cdot C_i} \cdot 100\% (1)$$

whereAEP is the electricity generated [MWh], *8760 h* are the total hours within a year (365 days • 24 hours), and Ci the installed capacity of the wind farm [MW]. Taking into account all the losses of a system, the exergetic capacity factor (ExCF) was being introduced as in [5,6].

$$ExCF = \frac{NetAEP}{8760 \cdot C_i} \cdot 100\%, (2)$$

where,*NetAEP* is the Net Energy [MWh]. However, attempting to incorporate in one factor, proposed to be called accumulated capacity factor (ACF) as discussed byXydis [7], all the changes of the new energy reality, what should be included in the formula is the energy saved from the extra uses of the plant each time. Therefore, in the hypothetical scenario that during the operation of the wind farm there is part of electricity that was foreseen to be cut – due to grid restrictions/curtailments – but now it is stored in a battery, assuming E1, and in the village close to the wind farm there is amount of energy saved, assuming E2, transferred via pipe system for heating purposes, the ACF should be given by the equation (3)

$$ACF = \frac{(NetAEP + E_1 + E_2)}{8760 \cdot C_i} \cdot 100\%, (3)$$

This way the investors, engineers, project planners, the local community will have common understanding on project development/ retrofitting issues. What's more interesting is that these factors can create a solid basis for evaluating not only one unit, but unique integrated systems – autonomous or not. The aim is and will always be to minimize the community costs for energy and extract the maximum output from energy systems.

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