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## **NOVEL CONCEPTS OF INDICATORS FOR PERFORMANCE VERIFICATION OF STAND-ALONE PV HYBRID ENERGY SERVICE**

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The aim of monitoring stand-alone PV hybrid systems has changed during the years. Initially, monitoring was designed to validate the correct technical operation of the system and its components. For small power plants monitoring can represent an important fraction of the operational costs. Nowadays, almost all components of stand-alone PV hybrid systems are reliable and their performance is well known. The interest of system monitoring within large-scale electrification programs is to assure a good quality of service to the end-user. This issue has two main challenges that at this moment are to be tackled: first, the verification of the quality of service offered and the determination of the factors that causes adverse effects on the service quality (as for example abuse of the system by the user) with a standardised verification concepts based on adequate performance indicators and second, an optimisation of costs for implementation of these concepts. Additionally, standardisation on international level is a major objective in order to create global acceptance of energy service with stand-alone PV hybrid systems.

As consequence we have developed and applied several concepts for verification of quality of service that we propose for discussion as inputs for international standardisation. In this paper the following aspects will be developed:

### **1. Adapted indicators from the viewpoint of the operator of the energy service**

In general we base our proposal for system verification on the fact that there has to be a skilled responsible for operation of the hybrid system. Depending on the organisational scheme (depending on the local legal framework) we have to adapt the verification concept to the different actors, so that each one gets the indicators that are important to do HIS job:

- User
- Owner of the system
- Responsible for O&M, energy operator
- Reglamentation entity that establishes the service quality standards in regional or national framework and verifies the service that is offered by the energy operator

### **2. Technical, social and economical indicators for quality of service verification.**

The indicators proposed will give the energy operator a quick overview on the system status and the user behaviour with special emphasis on prevention of failures and cost intensive system operation, what means special attention to battery state as weakest component in a life-cycle analysis. On the other hand the perception of the user as well as the service interruptions are monitored. Like this the compliance with the contract can be verified. Main indicators are:

- Historical battery index – indicates days with full battery in the last 30 days
- Performance Ratio
- Energy load ratio – indicates user consumption compared with energy contracted
- User satisfaction
- Total time of service interruption

### **3. Integrated data-analysis with the software GIFA.**

The software GIFA (Gestión de Instalaciones Fotovoltaicas Autónomas) is conceived as a tool for energy operators of stand-alone PV hybrid systems to do a standardized analysis of it's installations by means of the basic indicators mentioned, among others. The monitoring analysis is based on IEC 61724. Additionally GIFA serves as data-base for a numerous installation park managed from one service point.