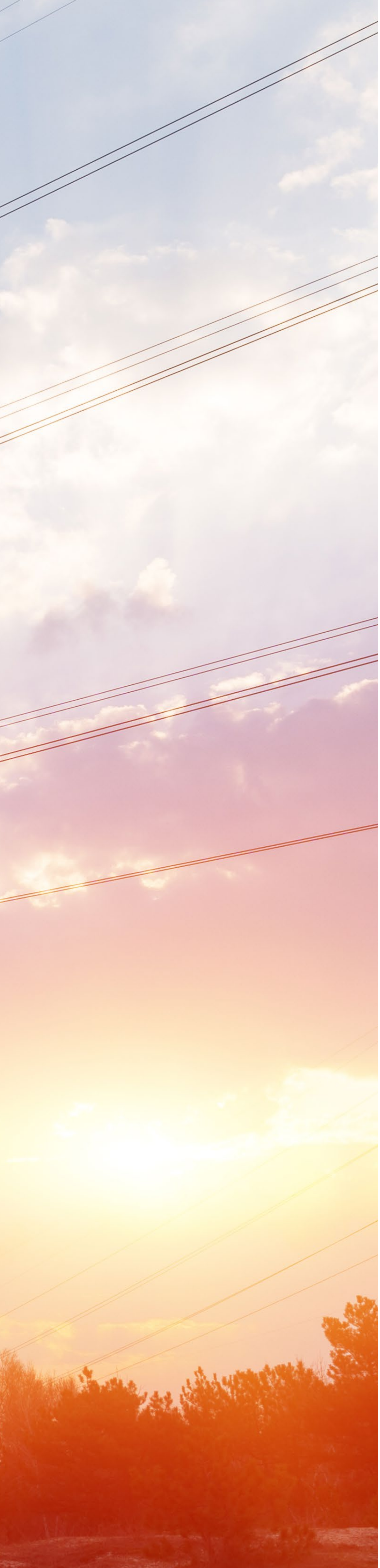

A complex challenge feed-in management and peak shaving

Words: Vivian Bullinger, Solar-Log GmbH

As renewable energy sources become more prevalent, the traditional electricity grid model has shifted. Historically, power flowed from a few large centralised plants to consumers in a one-way system. Now, consumers can also be producers who both use and contribute electricity. This shift introduces complexity for grid operators managing stability, requiring feed-in management to ensure a smooth, stable grid. Through central control centres and energy management systems (EMS), the grid can adapt to this new dynamic, allowing for both efficient renewable energy integration and techniques like peak shaving to manage demand and support grid stability.

Before the use of renewable energy sources, the electricity grid was a one-way street in many countries. It consisted of a few large centralised power plants whose energy flowed to many individual consumers. Today, consumers have become so-called prosumers, or producers and consumers, who both purchase and feed in electricity.

The associated increase in generation plants has made one of the core tasks of grid operators, maintaining grid stability, more complex.

Feed-in management is required to ensure that the interaction between decentralised prosumers functions smoothly and grid stability is maintained. This means that the

Figure 1: Feed-in management means the controllability of decentralised generation plants. There can be different levels of control, as can be seen in the picture, e.g. a reduction to 30% or even 0%.

many small generators can be controlled by a central control centre.

In addition to this, peak shaving plays an important role. As the name suggests, it is used to shave or avoid peak loads and thus support grid stability.

Energy management systems (EMS) support the implementation of both feed-in management and peak shaving. With the help of the EMS, the effective regulation of producers, consumers and storage facilities is made possible, thus relieving the grid and facilitating the integration of renewable energies.

Simple feed-in management: limited feed-in (x %)

There are often various regulations and requirements for feed-in management. These differ in their complexity and usually depend on the size of the system. As a rule, this means that the larger the PV system, the more complex the requirements that the system must fulfil. With the help of energy management systems, such as the energy manager from Solar-Log, a wide variety of requirements can usually be implemented with one system and adapted if necessary.

Simple feed-in management with x % control means that the system automatically regulates itself to x % of the system output. This measure ensures that too much electricity does not flow into the grid in the event of an energy surplus, resulting in an overload. This regulation can be implemented in very different ways.

Everything is possible, from direct x-% specification via control devices from the grid operator to independent regulation to x-% at the grid connection point, taking into account production and local consumption. The latter has the charm that it covers the local demand for energy in the best possible way with the locally produced energy and thus relieves the grid not only in terms of feed-in, but also in terms of consumption.

The x-% control or the limitation of the x % feed-in to the grid can be implemented via an EMS. The fixed or dynamic power limits now prescribed in many countries can also be flexibly implemented for different threshold values with an energy manager. This means that different requirements, 70% regulation, 50% or 60% regulation for storage support, 0% regulation as required in Spain, for example, can be met.

In practice, a bidirectional measuring device is usually installed for this purpose, which records the energy flows at the grid connection point and transmits this information to the energy management system (EMS). A controller responsible for the EMS analyses this information and regulates the energy flow from the local PV system, for example.

However, it is also possible that the grid operator sends a control specification via its control devices and regulates the system to this value.

Interconnected control for PV power plants

The larger the PV system, the more complex the implementation of feed-in control usually becomes. Particularly in PV power plants

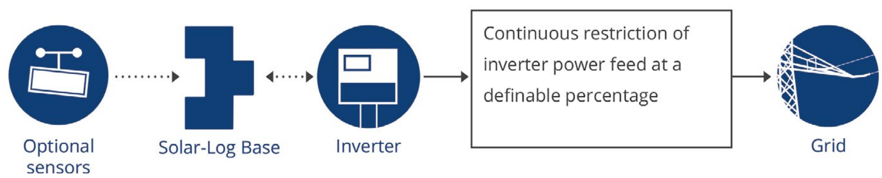

Figure 2: Set-up of a limited feed-in control (x %)

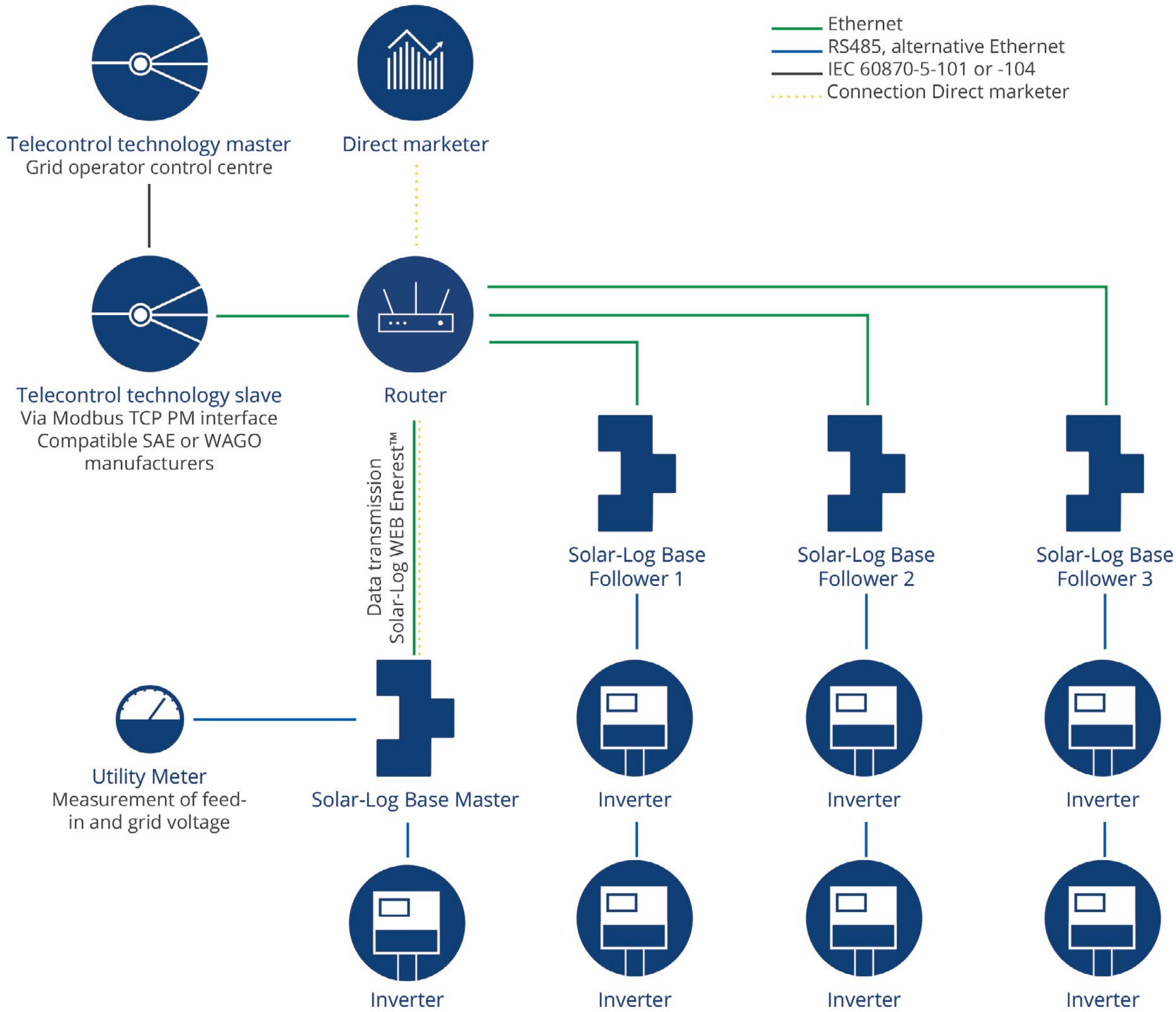

Figure 3: Connected control for feed-in management for PV power plants

where many inverters come together, the demands on the controllability and thus on the energy management system used to implement the specifications increase.

In order to reliably implement feed-in management for systems of this size, several energy management devices are linked together via an Ethernet network. This networking enables the control signals from the grid operators to be exchanged smoothly.

With Solar-Log, for example, such complex architectures can be realised using the network control principle. Here, the signals from the grid operator are received at the master EMS and distributed to the connected inverters via the slave EMS. For this system architecture, the master can be coupled with up to nine slaves in the network.
By networking the individual EMS, complex requirements with several system parts and feed-in points and many different inverter manufacturers can be realised.

By using the interconnected control system and the corresponding licence, it is also possible to split up the system for direct marketing. This means the direct sale of the electricity generated via a direct marketer on the electricity exchange. By using slave devices, the system is divided into different areas. A separate direct marketer can then be selected for each area. Any reduction commands from the direct marketers are also prioritised with the commands from the energy suppliers and documented accordingly.

Load peak management, or peak shaving

One area of energy management that is becoming increasingly important with the ongoing expansion of renewable energies is peak shaving.

Most companies have a very high demand for electricity due to a large number of consumers with machines, heat pumps and vehicle fleet. This means that the base load, which they permanently draw from the grid, is very high. If this base load is then supplemented by so-called consumption or load peaks, e.g. when a larger machine is temporarily required, a higher capacity of energy must be continuously available at all times.

Vivian Bullinger

This capacity must be provided in the energy grid infrastructure, which is usually very cost-intensive. The efficient handling of peak loads is therefore not only important to ensure the stability of the power grid, but also to avoid overloading and optimise energy costs.

There are various options for capping or avoiding these load peaks. One option is the intelligent use of PV energy together with battery storage systems, which are coordinated by an energy management system. The energy management system, e.g. from Solar-Log, caps the peak loads, or peak shaving, by effectively controlling the PV system and the battery storage. It therefore ensures that the additional electricity required for peak loads is not drawn from the power grid, but that the energy is taken directly from the battery storage system.

Peak shaving combined with e-mobility

Peak shaving and e-mobility are two areas that can be combined to improve grid stability and manage demand more effectively during peak times.

The EMS already ensures that the PV system is used in conjunction with an appropriate battery storage system to reduce the connected load at the grid connection point and thus avoid peak loads. Electric vehicles can also be integrated into this intelligent charging management system and controlled in this way. This means that they are preferably charged at times of low load. This distributes the additional energy demand from electromobility more efficiently, which in turn avoids peak loads.

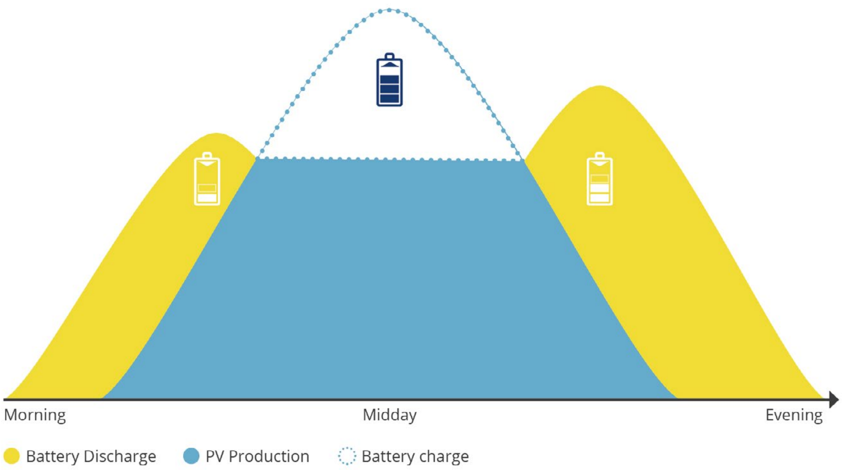

Figure 4: With peak shaving and load management, the PV system can be used in conjunction with a qualified commercial storage system to reduce the connected load at the grid connection point and continue to use sustainable energy for e-mobility

A perfect team for more growth

The interaction between feed-in management and the energy management system is crucial for the efficient utilisation of renewable energy. Feed-in management regulates the feed-in to the electricity grid by optimising the production of renewable sources. At the same time, an energy management system offers a wide range of options that can be highly customised to control consumption in line with demand.

By precisely monitoring production and consumption, the system also enables prompt adjustment and controllability.

The seamless interaction of these subsystems, producers, consumers, electricity grids, energy suppliers, direct marketers, EMS, promotes grid stability, optimises energy efficiency and facilitates the integration of renewable resources into energy management.

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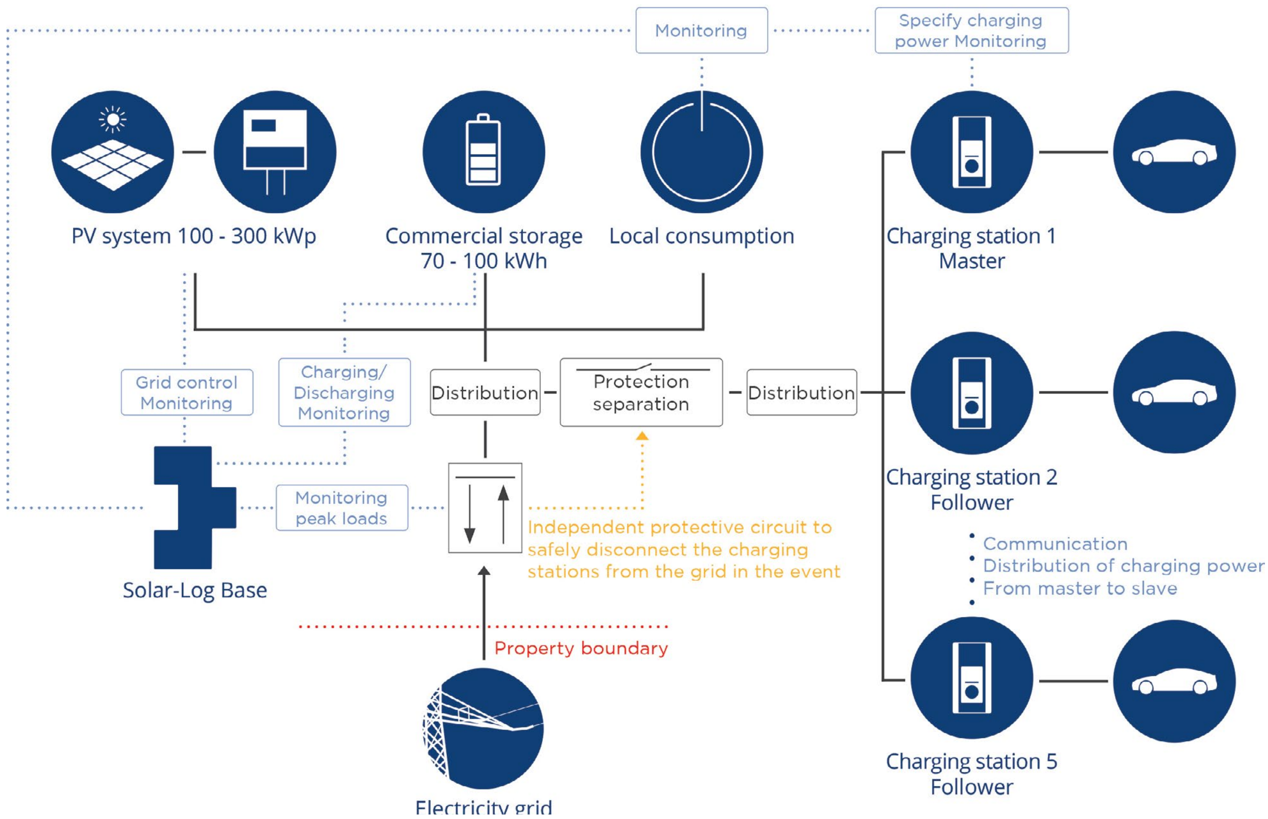

Figure 5: The diagram shows how a complex energy management system can be set up. The example covers the following tasks with one solution: implementing the requirements for avoiding peak loads; implementing the required feed-in regulations for the grid connection; and monitoring the total yields for the system