International feed-in management solutions

Feed-in management is a crucial aspect of managing energy. It refers to the control and optimisation of the feed-in of renewable energies such as wind and solar into the electricity grid. It now plays a central role in the integration of renewable energies into electricity grids worldwide. In some countries, it is firmly established and has been proving its worth for several years. Other countries are following suit and are adopting some of the regulations and technology that have already been tried and tested.

First steps towards standardised regulations within the EU

To date, there are no standardised regulations for the European Union and its member states with regard to feed-in management. In the EU, this is regulated by the Renewable Energy Directive (RED II) and the regulation on the internal electricity market. The aim of RED II is to increase the share of renewable energies in the electricity, heating, and transport sectors by 2030. The directive sets a binding target of at least 32% renewable energy in the Union's gross final consumption. For the EU, the focus is on creating an integrated European electricity market to ensure grid stability across national borders.

Member states currently have national implementation strategies, but these are highly harmonised. Countries such as Germany, Austria, Spain, and Denmark already have advanced systems for the feed-in and management of renewable energies. These systems show parallels in their technical implementation, which we will look at in more detail here.

Complex implementation in Germany

In Germany, feed-in management has been implemented for some time, with different levels depending on the size of the system. The Renewable Energy Sources Act (EEG) stipulates that grid operators are obliged to prioritise the purchase of electricity from renewable energy sources and feed it into the grid. However, grid bottlenecks can occur that make feed-in management necessary. In such cases, grid operators can throttle the feed-in of system operators. The operators receive compensation for this.

The main current challenges are the integration of ever increasing amounts of renewable energy and the avoidance of curtailment. Smart grids and storage technologies are playing an increasingly important role in ensuring grid stability and managing feed-in efficiently.

In order to stabilise the electricity grid even on critical days, there will be new requirements for grid stability in the medium term in all countries that provide larger capacities of decentralised energy generation (Source Solar-Log GmbH, Germany).

Specific regulations in Austria

In Austria, feed-in management is organised similarly to Germany, but with some specific regulations. The Electricity Industry and Organisation Act (ElWOG) plays a central role here. Grid operators are obliged to prioritise renewable energies. Systems can be curtailed in the event of grid bottlenecks, although the compensation regulations are also clearly defined.

Austria is strongly committed to the expansion of decentralised energy generation plants and the use of storage technologies. There are various funding programmes aimed at improving grid stability and optimising the feed-in of renewable energies.

Stringent expansion in Switzerland

In Switzerland, feed-in management is regulated by the Energy Act and the Electricity Supply Act. Switzerland is pursuing the goal of a sustainable and secure energy supply with a high proportion of renewable energies. Grid operators are obliged to purchase renewable energies and ensure grid stability.

Particular challenges arise due to the geographical conditions and the strong dependence on hydropower. The expansion of photovoltaics and wind energy places additional demands on feed-in management. Smart grids and flexible consumption controls are becoming increasingly important to optimise the load on the grid.

Practical example in Switzerland

K.R. Pfiffner AG, a Swiss machine manufacturer with high energy consumption, has decided in favour of a photovoltaic system to significantly reduce its ecological footprint. This step improves sustainability, reduces dependence on fossil fuels, and strengthens energy resilience.

The specific aim of this project was to make over 60% of K.R. Pfiffner AG's solar power production available for production. The PV system was installed on a roof area of over 4,000 m² and comprises 1,100 kWp.

The main objective of the project is to use more than 60% of the solar power generated for production purposes. This in turn leads to a remarkable reduction in electricity costs and a significant reduction in CO_2 emissions of 69 tonnes per year for the next 25 years. The remaining approximately 40% is marketed directly in accordance with Swiss regulations and is thus fed into the public electricity grid.

The feed-in control is implemented by the Swiss company BKW Energie AG using telecontrol technology. BKW supplies

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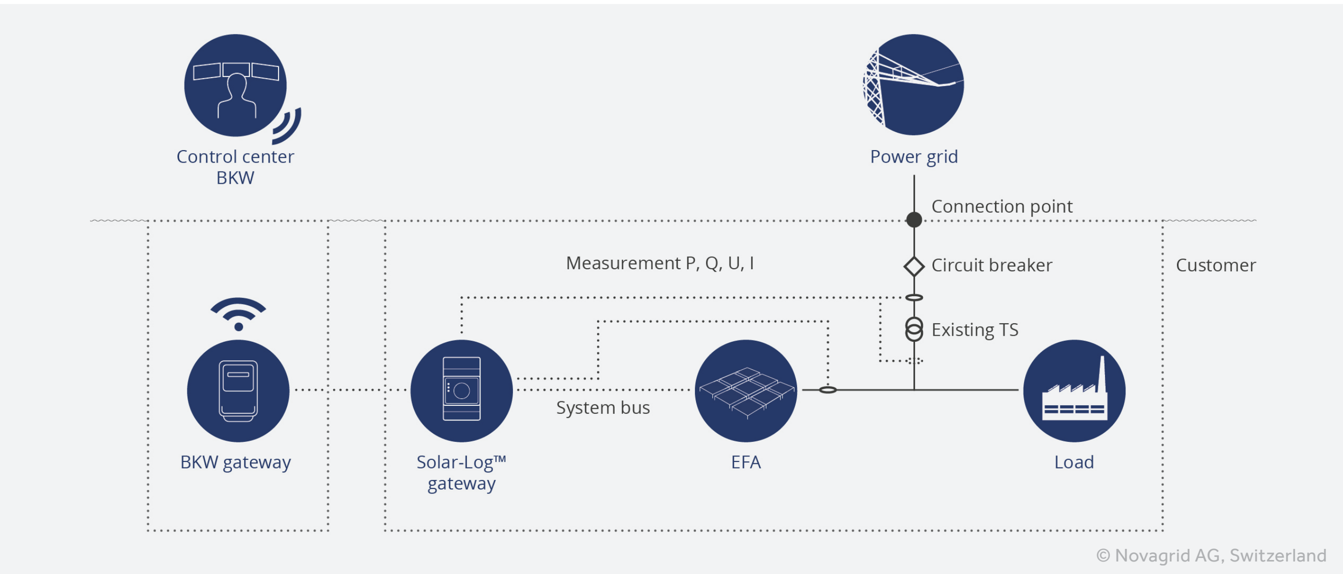
a gateway that controls the system by command and actively reads values from the Solar-Log controller and transmits them to the control centre.

The gateway communicates with the BKW control centre via IEC protocol and transmits commands and data to the EZA controller via Modbus TCP. The active power of the PV system is controlled by the control centre by command, whereas the reactive power is controlled by Q/U control. Here, the EZA controller measures the voltage and converts voltage changes into inverter commands based on a predefined curve.

Global trends and challenges

The trend towards digitalisation and automation of feed-in management can be observed worldwide. Smart grids, real time data analyses and advanced storage technologies are key components in overcoming the challenges. Climate change and the need to reduce CO_2 emissions are



Implementation scheme of the Swiss Energy Act for systems over 500 kWp driving this development. International cooperation and the exchange of best practices are essential to achieve global energy goals.

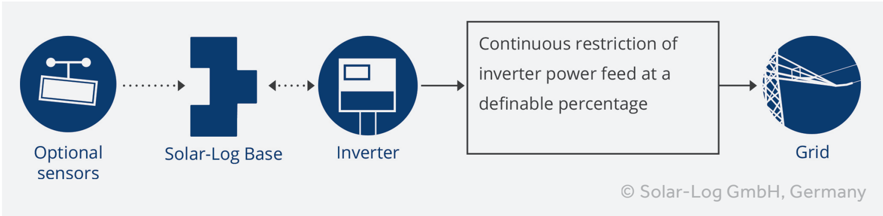
Technical solutions from the basics to complex requirements

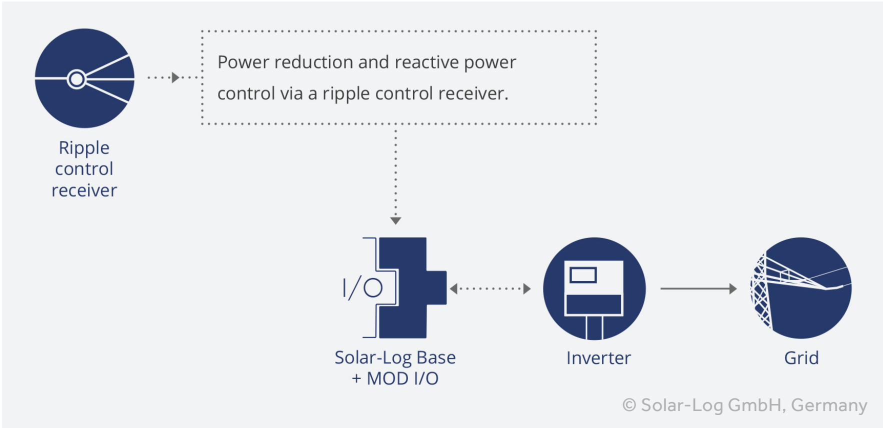
A central function is the limitation of feed-in to the grid. Fixed or dynamic power limits are now prescribed in many countries. This limit can be set flexibly for different threshold values. This means that different requirements of 70%, 50% or 60% regulation with storage support can be met.

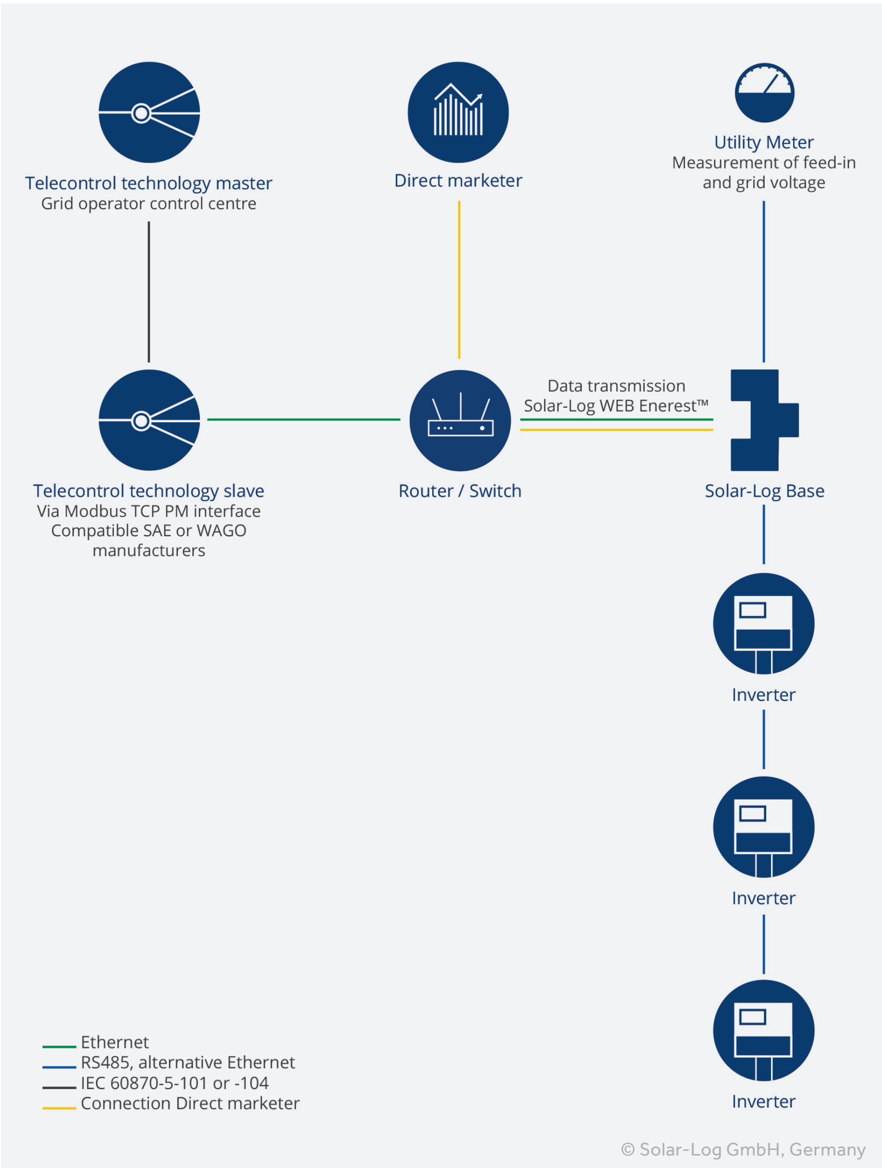
An energy controller, in this example the Solar-Log Base, is used for this purpose. Among other things, the controller is used here as a regulator with which the feed-in can be set to any value.

Simplified feed-in management

Simplified feed-in management means that it is possible to control the feed-in. In addition







to the controller, a ripple control receiver is usually required for implementation.

Complex feed-in management

The central point here is that a control centre receives feedback on the current production of the respective generation plant and can reduce, switch off and increase it again as required.

Such grid operator requirements can be implemented by having the telecontrol systems communicate directly with the controller via the TCP based Modbus protocol.

In this case, the commands and feedback messages are exchanged between the telecontrol technology and the controller via the protocol, i.e. without the potential fee and analogue interfaces.

Conclusion

Feed-in management is a complex and dynamic field that is crucial for the successful integration of renewable energies into power grids worldwide. Different countries and regions face specific challenges, but also utilise innovative approaches and technologies to ensure a sustainable and stable energy supply. Continuous further development and adaptation to local conditions are of central importance.

It is therefore imperative that the technical solutions are designed to be as flexible as possible. So that they can not only implement a specific solution, but also meet the diverse requirements of different countries and their priorities. In addition, the technical management of renewable energies harbours enormous potential for further expansion across national borders.

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