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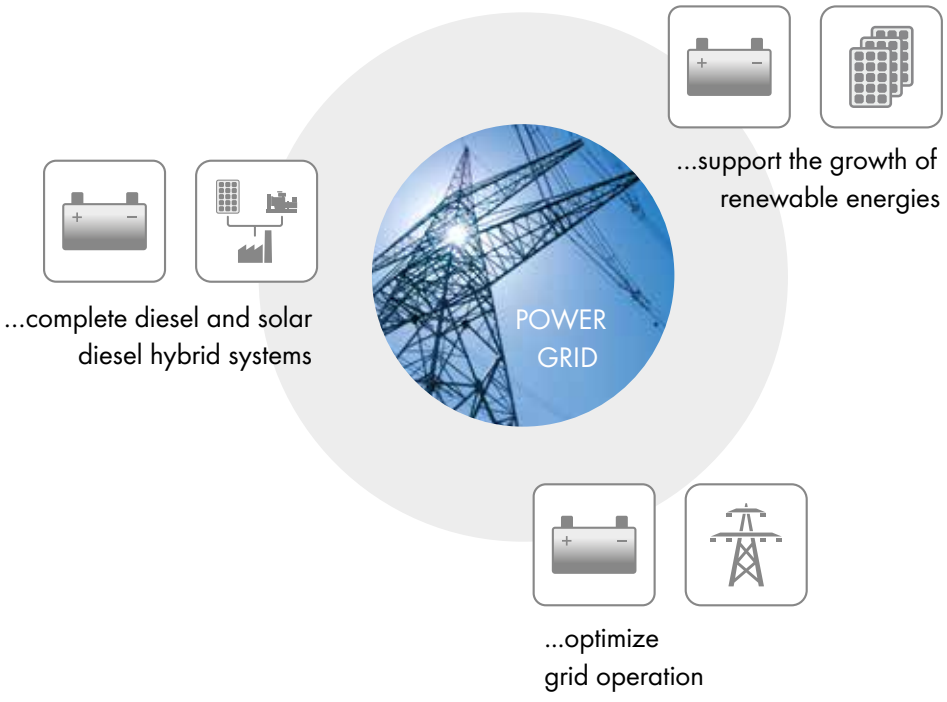
ENERGY THAT CHANGES

PV AND STORAGE: SOLUTIONS WITH POTENTIAL

Energy on demand with the Sunny Central Storage

Large-scale storages...



...support the growth of
renewable energies

...complete diesel and solar
diesel hybrid systems

...optimize
grid operation

LARGE ENERGY STORAGES

Stable grids through integration of storage systems

Whenever we turn on the lights we take it for granted that there will be enough energy available at that moment. Before energy can be transported throughout the grid, it must first be generated. Therefore, flexibility is needed to match energy generation with energy demand in order to balance the supply of energy with consumption of energy. The most comprehensive example of such flexibility can be found in energy storage systems.

However, direct storage of electrical energy is viewed as a difficult process. One solution is to change the energy into another form and then store it. There are many ways of doing this: mechanically in the form of pumped-storage power plants, using thermal or chemical processes such as rechargeable or high-temperature batteries or through chemical storage in the form of hydrogen.

Transformation of energy production – increased demands put on the grid

Centralized supply structures are becoming more and more decentralized. In terms of power plant scheduling and grid feed-in, various factors are being given more attention: higher energy demand, load fluctuations, forecast errors and power plant outages. Another component is the growing number of renewable energy sources with highly fluctuating feed-in behavior. All of these factors have led to an increase in the requirements grid management has to meet an overall grid infrastructure. Intelligent demand side management (DSM) is becoming more important.

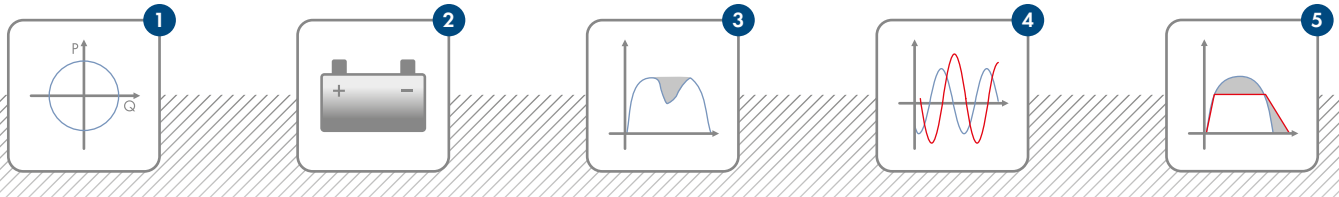
The increase in volatile feed-in has resulted in a growing demand for fast and variable load balancing. In the future this can be achieved through more accurate forecasting of energy production or the integration of energy storage systems.
Storage capacities can help meet power plant and grid operator needs while preventing grid stability problems. This applies when feeding power into local grids as well as large amounts of renewable energy into continental utility grids.

If energy is generated or stored directly where it is needed, then costly grid infrastructure investments, transmission losses and complicated grid congestion management can be avoided.

PLANNING FOR THE ENERGY SUPPLY OF THE FUTURE

The transformation in energy generation calls for complete ancillary services

Currently the majority of ancillary services are provided through conventional power plants and pumped-storage plants. These services include intelligent functions that go beyond energy transmission and distribution and ensure secure grid operation. The increasing share of renewable energy production has created a decrease in the availability of conventional power plants to provide these ancillary services. This can be compensated once grid-connected storage systems are used. Storage systems enable the provision of high-quality energy at any time and serve to balance the fluctuations caused by the rapid rise in renewable energy use. The same storage system can also be used for other purposes such as an uninterruptible power supply or for trading electricity purchased at an affordable rate. As fluctuating generators become more adjustable and controllable, the number of con-



ANCILLARY SERVICES

1. Four quadrant operation
Full four quadrant operation allows for all combinations of active and reactive power.

2. Battery Control
A reliable controller ensures the continuous monitoring and the control of the battery under all circumstances.

3. Renewable firming
Batteries provide backup power to tighten the output of the PV system and ensure a continuous power supply.

4. Reactive power control
Reactive power supply can be controlled via different methods to meet any grid requirement.

5. Peak-shaving and -shifting
Peaks in power production can be shaved, stored in batteries and delivered when needed.

6. Ramp rate control
Buffering of output changes of intermittent renewable energy sources.

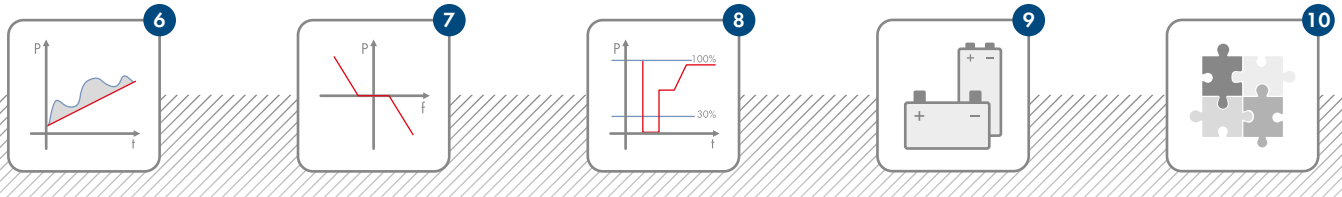
7. Active power management
Frequency-dependent control of active power to support the grid.

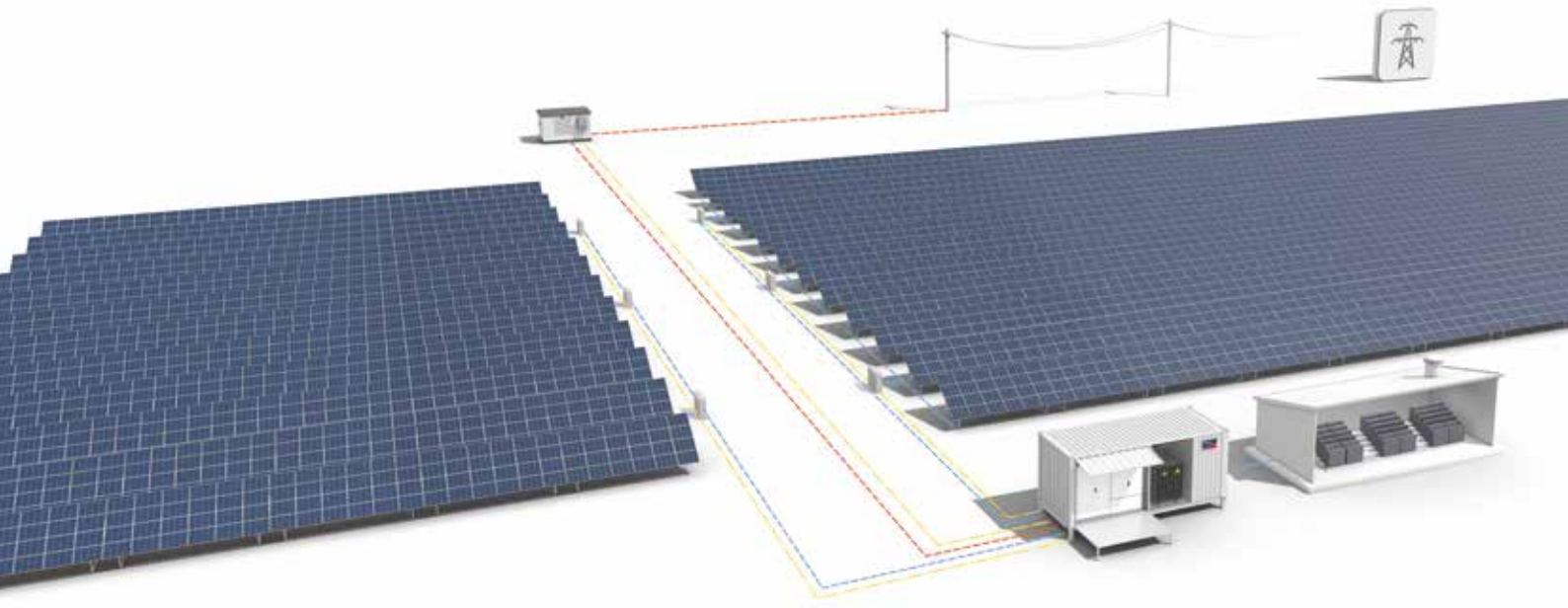
8. Fault ride through (FRT)
Compliance with local FRT requirements.

9. Tested and compatible
A wide DC voltage range and an advanced controller allows the use of li-ion-, lead-acid-, flow- and high-temperature batteries.

10. Modular & scalable
SMA inverters are modular and blocks can be replicated easily in existing control structures.

ventional “must run” units can be significantly reduced. Future grid requirements will be met and supply reliability will be guaranteed at all times. Ancillary services include frequency-dependent control of active power feed-in, voltage stability, blackstart capability after a grid failure and grid congestion management. It’s these services that provide renewable energy with the same grid-stabilizing characteristics as conventional power plants.





INTELLIGENT STORAGE INTEGRATION

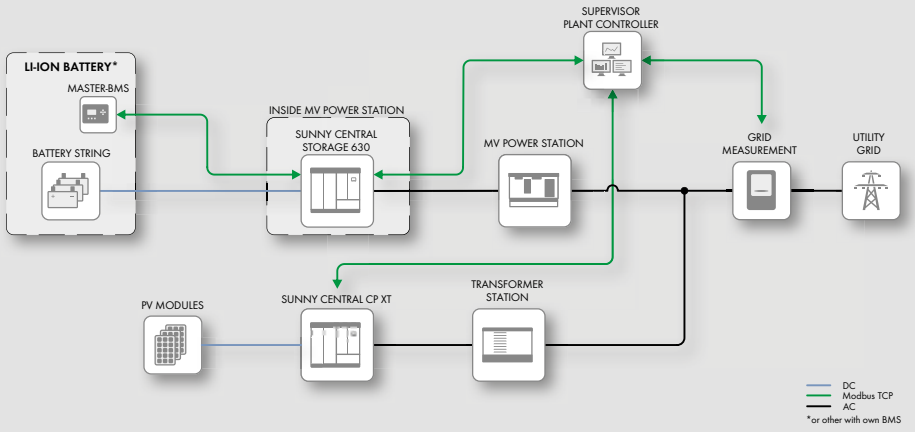
Large-scale storage concept offers compatibility with key battery technologies

As an energy management company, SMA develops innovative technologies for future energy supply structures and connects both photovoltaic systems and large-scale storage systems to the public grid.

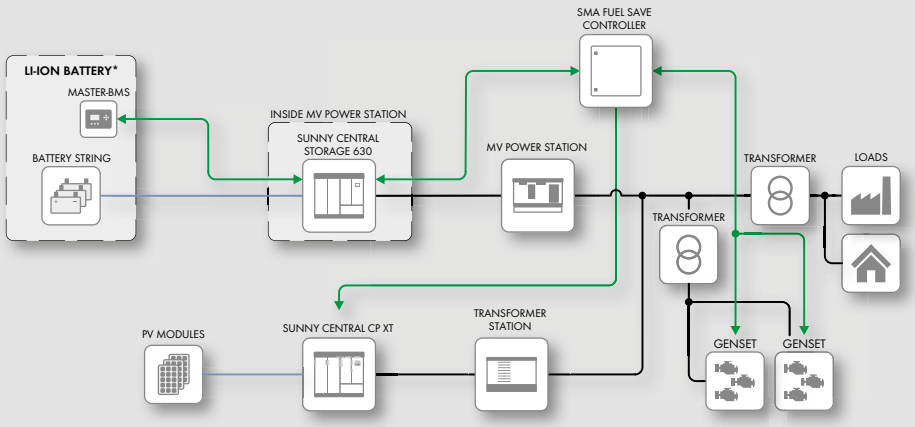
In addition to our existing smart home storage solutions designed to increase self consumption in private homes and our hybrid systems used to supply energy off grid, SMA now offers a large-scale storage concept. This solution intelligently integrates megawatt-class energy storage systems, both with or without a solar system, into the grid.

Customers benefit from our 30 plus years of experience in system technology for off-grid hybrid energy supply systems and megawatt-class PV power plants. SMA experts understand local grid requirements and offer advice on issues regarding PV component technology and system design.
The large-scale storage concept is compatible with key battery technologies, including lithium-ion, lead-acid, high-temperature and flow batteries.

PV
AND STORAGE



PV DIESEL HYBRID
AND STORAGE



SUNNY CENTRAL STORAGE

Turnkey storage solution with energy on demand

The SMA large-scale storage concept consists of the following components:

- Sunny Central Storage battery inverter, with transformer and medium-voltage switch gear integrated into a container station
- PV inverter from the field-proven Sunny Central CP XT series, including transformer station
- Power Plant Controller acts as the smart interface for the PV battery system
- Battery storage system with optimally adjusted power and capacity

The Sunny Central Storage is based on the successful Sunny Central CP XT platform. That means it features the same level of efficiency, a robust design for use in extreme ambient conditions, and a wide operating temperature range of -40 °C to 62 °C.

Two Sunny Central Storage battery inverters can be used in parallel operation. Their integration into a container creates a turnkey solution for large-scale energy storage.

PERFORMANCE

Intelligent battery inverter for storage integration:

- Frequency-dependent control of active power
- Voltage control
- Blackstart capability after a grid failure
- Grid congestion management

ENERGY STORAGE ON THE RISE

Integrating large-scale energy storage systems – SMA invests in research projects

Hybrid Test Bench, Niestetal, Germany:
An in-house 2.4-MW test plant is currently being built on-site at SMA in Niestetal, Germany to test new system technologies and certify new products for megawatt-class hybrid and storage systems.
Also being built on-site are traditional off-grid systems with diesel and PV arrays as well as hybrid grids equipped with the SMA Fuel Save Solution to increase the share of PV power in diesel-operated grids.
This test plant allows simulation of certain grid phenomena that result from the interaction of various power generation units. All SMA products will be tested under real-life conditions.

Energy Storage Management Research & Testing Site, Tucson, U.S.:
At the University of Arizona in Tucson in the U.S., SMA has developed a 500-kilowatt battery inverter which, in combination with a 200-kWh lithium-ion battery, is capable of balancing fluctuations in solar power generation. The 1.6 MW PV system installed there, in cooperation with the SOLON Corporation and Tucson Electric Power (TEP), is used to research a wide array of storage technologies and test various options for energy storage.

"M5BAT," Aachen, Germany:
The world's first modular, large-scale battery storage system with a capacity of 6.25 MW is being built in Aachen, Germany. The Modular Multi-Megawatt Multi-Technology Medium Voltage Battery Storage (M5BAT) project is a collaboration between SMA, the E.ON Energy Research Center at RWTH Aachen University, the German power supply company E.ON and battery manufacturers Exide and Beta Motion. The project will focus on the following areas: integrating renewable energy sources, testing the decentralized supply of control power to stabilize grid operation, and facilitating electricity trading at competitive prices.

We will be pleased to advise you
Do you have any questions or need individual consulting? Contact us.

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