ENERGY
THAT
CHANGES

SMA SMART HOME

The System Solution for more Independence

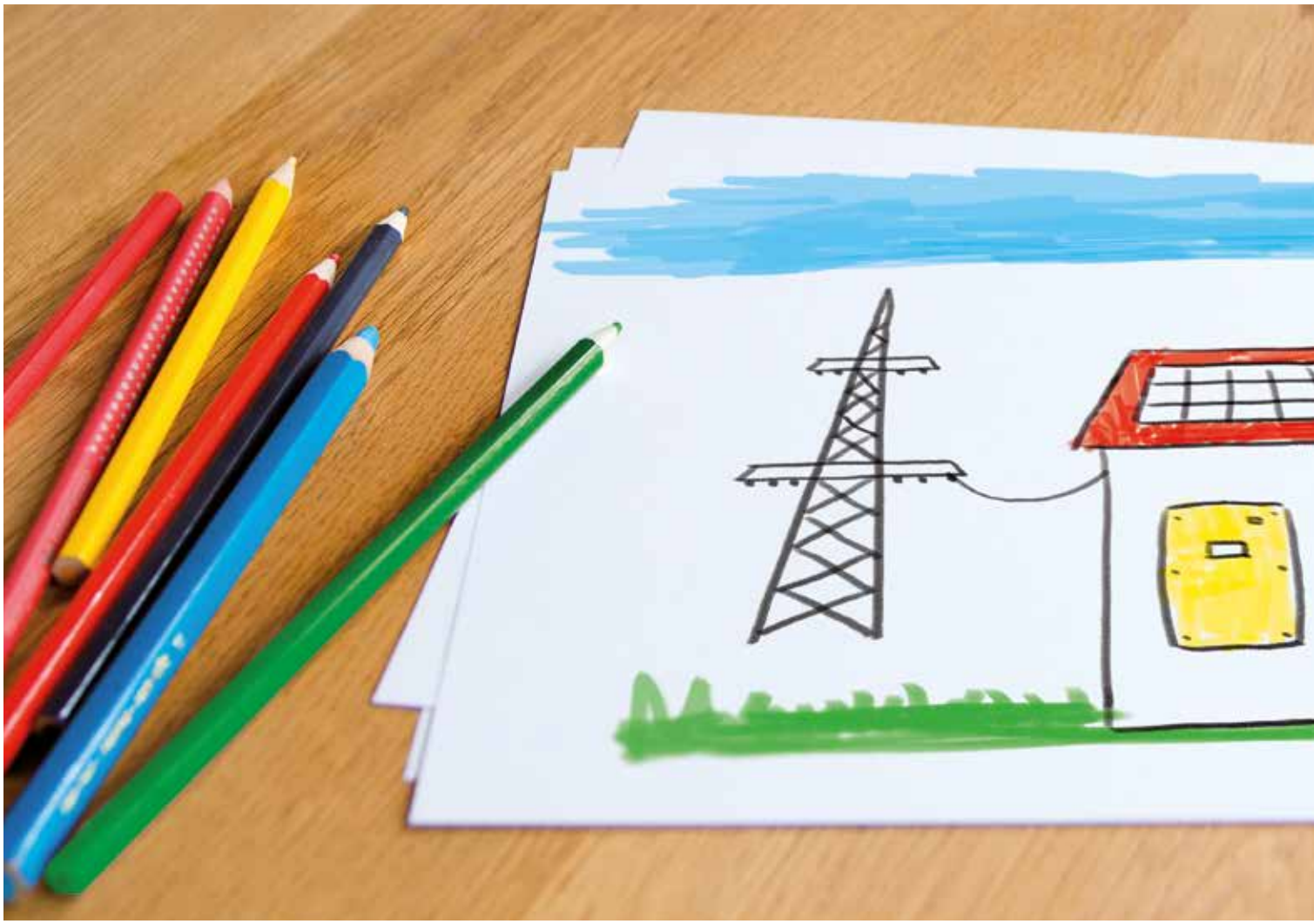
JOIN THE CLEAN ENERGY TRANSITION

Energy management from SMA

It is an unprecedented success story – in only a few short years renewable energy sources have become an affordable and reliable clean electricity supply. PV systems alone produce several billion kilowatt hours of CO_2-neutral electric current every year, and in many countries the cost of generating PV power is already lower than household electricity prices.

Yet the issue of grid parity raises new questions: What can help PV system owners to consume more of the power they generate? How can solar power make the utility grid more reliable? In short, what is the most optimal and profitable way to use solar power? The key answer to these questions lies in the self-consumption of solar power, which has become a major factor. Any reasonable increase in the rate of self-consumption requires the use of intelligent energy management systems that optimize power generation and consumption in an easy and automated way. Fortunately, the trend towards networked home appliances that are easier than ever to use, as well as the development of storage technologies that offer higher performance at a lower cost are arriving at just the right time.

Besides offering great financial benefits, improved energy efficiency and greater independence from rising electricity rates, a Smart Home also provides PV system owners with more convenience and a completely transparent energy budget. This transparency also facilitates the more conscientious use of energy and helps to reduce total energy consumption. To ensure the success of the energy transition, even utility grids will soon intelligently combine loads, renewable power sources and storage systems. This smart grid will be able to harness synergies with the same level of supply reliability as a conventional utility grid. Thus the ideal basis for a smart grid lies in generating electricity locally and using energy intelligently. On the following pages, we will introduce you to the most important building blocks of the Smart Home. Now anyone can begin to shape their own personal energy transition.



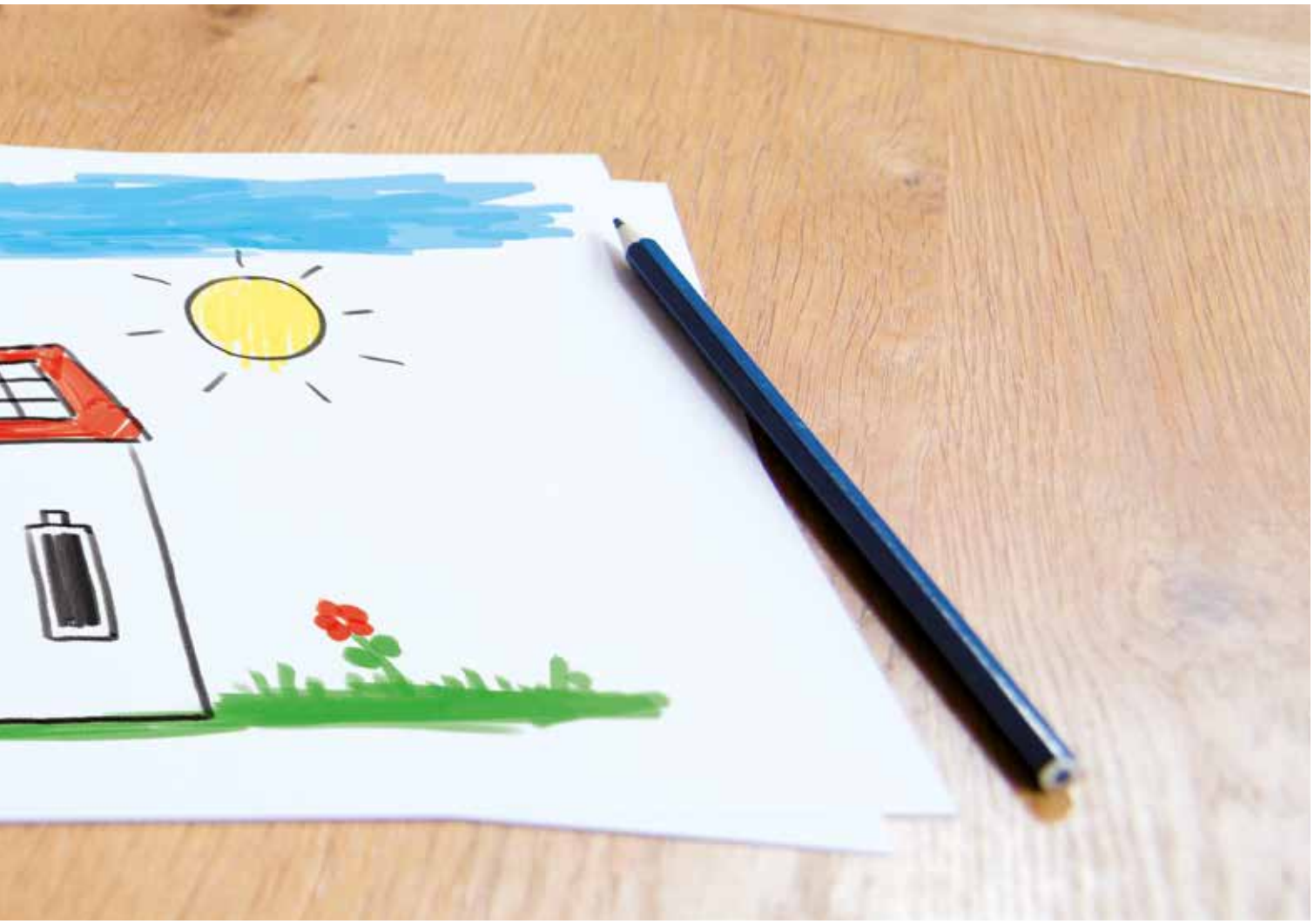
SUPPLYING INSTEAD OF JUST GENERATING

From inverters with 99% efficiency to intelligent energy management

A greater focus on optimizing solar energy use has led to higher system requirements. Naturally, highly efficient inverters remain of key importance. However, they can no longer do the job alone. Instead, they must become an integral part of an intelligent, renewable energy supply.

SMA has accepted this challenge and is the first manufacturer to offer a comprehensive system solution for the energy-efficient Smart Home: the SMA Flexible Storage System encompasses an intelligent and intuitive Sunny Home Manager, the Sunny Island battery inverter with Speedwire data module, the Sunny Remote Control, and a battery. Optional is a high-efficiency PV inverter. The system offers maximum flexibility in terms of storage, battery type as well as battery capacity and can also be integrated into existing installations. As a further alternative, SMA is developing the SMA Integrated Storage System – a fully integrated and easy to install PV storage solution of maximum economic efficiency. The core component of this system is the Sunny Boy Smart Energy, the first wall-mounted large volume PV inverter with integrated battery storage which offers incredible possibilities with its optimally dimensioned lithium-ion battery.

To ensure that all product and system solutions for home energy management meet the highest quality standards, SMA works with leading manufacturers in the fields of storage technology, smart metering, home appliances, electric mobility, heating, air conditioning and ventilation systems.



SMA SMART HOME

Step by step towards an independent electricity supply

Analysis, Forecasts and Information

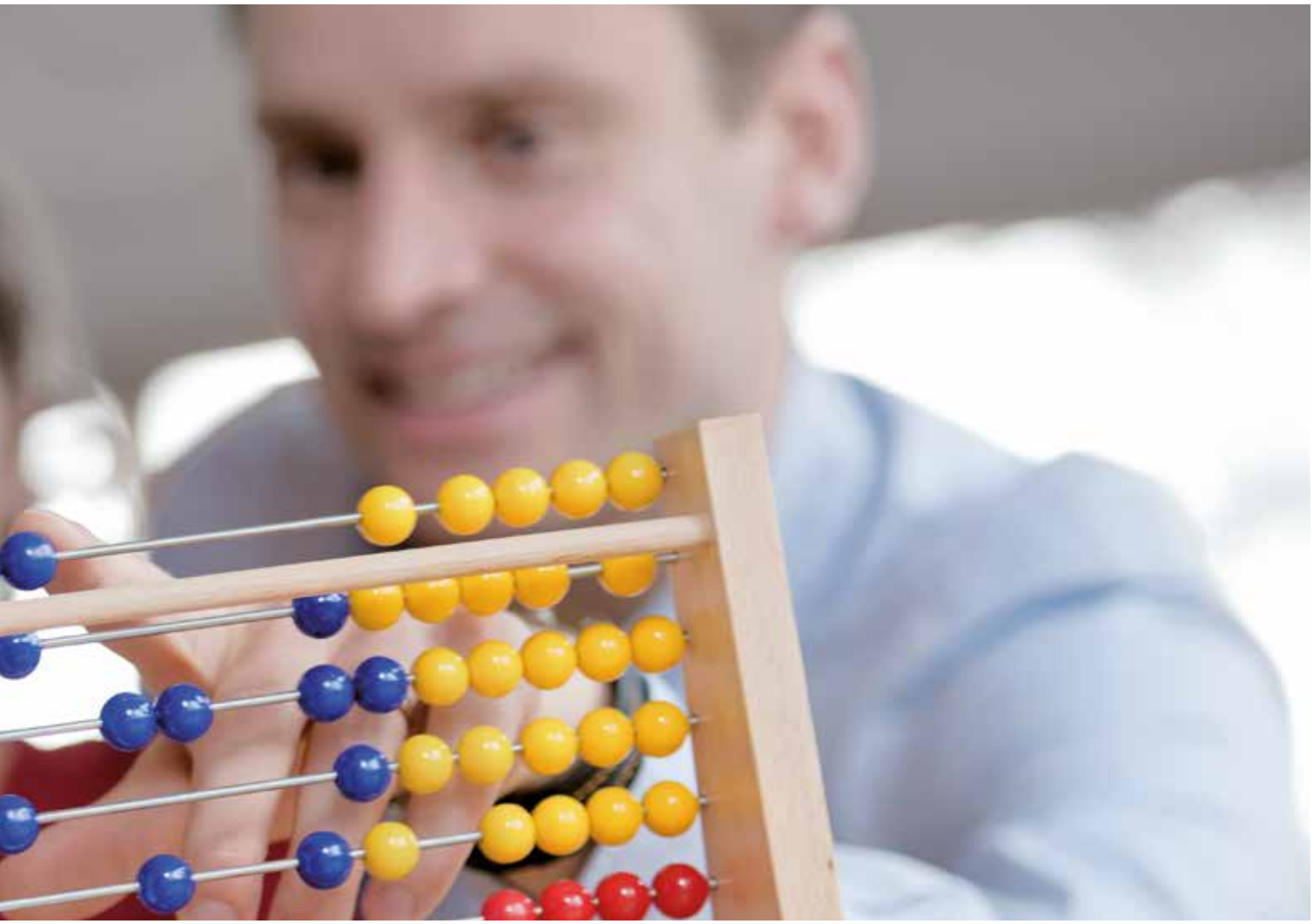
Like the smart grid of the future, the SMA Smart Home combines a wide range of electric loads, power sources and batteries into an intelligent and fully automated system. In addition to providing an intuitive user interface, the key feature of this system is the continuous communication between the individual components and the central energy manager. This supplies valuable information such as: How much solar power will be available at a specific time? When and for how long do larger loads need power? How full is the battery or thermal energy storage system and what is the present charging or discharging power? Last but not least, how much electric current is being generated, consumed and supplied to or drawn from the utility grid at any given time? To answer these questions, the energy manager not only analyzes the energy meter data but is also connected to the other components. Another important feature is the clear display and analysis of all energy data.

Automatic Load Management

Washing, drying, heating: Almost every household has some appliances that are independent of fixed operating time. Washing machines are a good example. An automatic controller makes it easy to change the turn-on time for these kinds of devices without causing any inconvenience for the user. This allows to consume a greater portion of the cheaper solar power directly, which reduces the quantity of externally supplied power at the same time. Moreover, the option to make use of variable energy prices further reduces home electricity costs. Excellent candidates for time-delayed operation are large programmable appliances as well as heat pumps and heating elements for hot-water tanks. Integrating the heat supply into the electric load management system creates major synergies since thermal energy storage systems are already available in many homes. These systems are significantly cheaper than batteries and generally have enough capacity to store large amounts of solar electricity as usable heat.

Intermediate Energy Storage

Maximum flexibility: An electric storage system allows to accumulate solar energy for later use, boosting self-consumption rates and independence from rising electricity prices. Additionally, while the cost of fossil



energy carriers continues to rise, there is a clear downward trend in the price of batteries. Even small storage systems reduce grid load by limiting the maximum feed-in capacity, thus avoiding power loss due to throttling. Larger storage systems provide homes with greater protection from grid failures and make them less dependent on external power sources. With the integration of electric vehicles into the household energy concept, yet another storage option becomes available. Other conceivable options are applications that work with the utility grid – the provision of system services in virtual power plants, for example.

Advantages at a Glance:

» 100 percent environmentally friendly energy supply through the use of self-generated solar power without grid losses

» More independence without compromised comfort or energy supply security

» Cost saving through the self-consumption of cheap solar power in ones own household

» All optimizations are carried out automatically taking the wishes of the consumer into account

» Economization potentials are made visible through complete transparency via the electricity energy budget

» Prepared for the future by taking into account variable electricity prices and the upcoming smart grid business models

SUNNY HOME MANAGER

Basic solution for smart energy management

With the Sunny Home Manager, SMA is the first manufacturer to offer a central energy management solution that not only provides intelligent planning for automatic load control but also allows for the integration of power storage systems. It is currently the only system on the market that refers to local weather forecasts to predict PV power generation. Another unique feature of the Sunny Home Manager is its ability to consider time-of-use electricity rates providing comprehensive load management for the first time ever. Therefore, the device is able to adjust power consumption in the house in line with both the current power of the PV system and the respective prices of power from the utility grid. The Sunny Home Manager connects to loads via SMA radio-controlled sockets but is also ready to support future communication standards for smart home applications. It can therefore control all compatible household devices as well as heating, air conditioning and ventilation systems, integrating them into the energy management system.

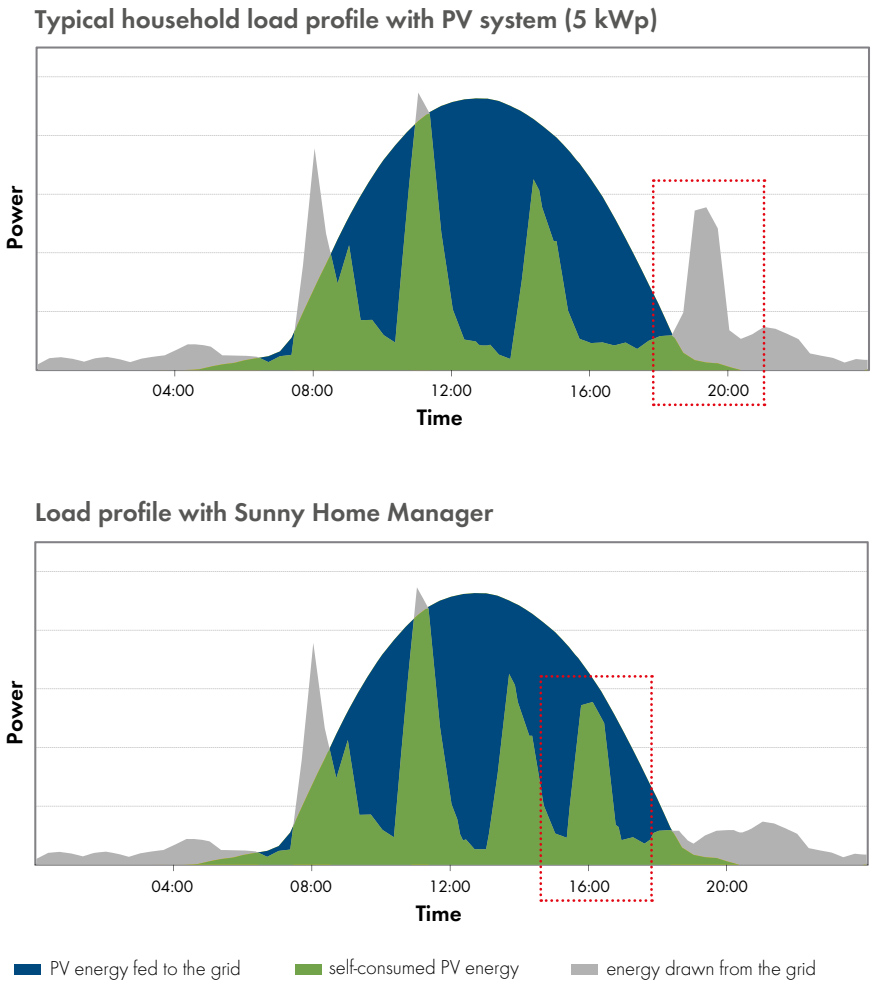
Simple

Using the Sunny Home Manager via an Internet browser is easy as child's play. Accessible via PC or smartphone, whether at home or on the move. Users benefit from a range of convenient automatic functions and preset evaluation charts. Installation is equally straightforward: Once the data link to the energy meter has been established, Internet access is all that is required as the connection to the Sunny Portal is made automatically. The SMA radio-controlled sockets used to control appliances also function as repeaters, ensuring a reliable connection to the network.

Precise

The Sunny Home Manager analyzes data from up to three energy meters and uses that data to precisely record all relevant energy flows. Offering both analog and digital meter interfaces, it is able to process energy flow data with accuracy down to the second, which is crucial for effective load control. An additional feature are the SMA radio-controlled sockets with integrated measurement function that determines the exact electricity demand of connected loads as load profiles, which helps improve planning accuracy.

Products are available either separately or as a package.



The Sunny Home Manager is able to shift the activation of electrical loads which greatly increases the rate of self-consumption. If time-of-use electricity tariffs are available, shifting activation also reduces grid electricity costs.

Comprehensive

The Sunny Home Manager continuously receives local and system-specific PV output forecasts, takes into account time-of-use electricity prices and provides standard access to the Sunny Portal, which contains a variety of evaluation and analysis options. Battery banks can be integrated into the intelligent energy management system with the SMA Flexible Storage System. The upcoming SMA Integrated Storage System, on the other hand, already includes a battery. Furthermore, the Sunny Home Manger ensures that the grid feed-in is limited to a specified percentage of the nominal generator power. In addition to automatically controlling loads, the device also provides visual recommendations regarding the best operating times for electric appliances.

Advantages at a Glance:

- Approx. 45 percent less electricity from utility companies*
- Self-consumption boosted from 30 to an average of 45 percent*
- Capable of automatically starting appliances at the perfect time (based on user specifications)
- Transparency for all household energy flows and a live display of power values
- Free online monitoring of the PV system via Sunny Portal (basic function)
- Greater planning reliability and independence from costs related to future developments in the energy market

* All figures are based on an annual PV generation of 5,000 kWh, annual power consumption corresponding to PV generation and a natural rate of self-consumption of 30 percent.

SMA SMART HOME
with SMA Flexible Storage System

(1) **Sunny Boy 5000TL**
The PV inverter converts the direct current produced by PV modules into alternating current. The electricity is then primarily used by the loads in the household, only excess power is fed into the utility grid.

(2) **Sunny Home Manager**
As the central energy manager, this device analyzes a wide range of input parameters and then uses an intelligent planning algorithm to harmonize power generation and consumption schedules.

(3) **Sunny Portal**
The Sunny Portal is used to operate and configure the Sunny Home Manager. These functions are available via any Internet browser and can be accessed using a PC or smartphone. The live display of all power and energy values provides further incentives to save on power consumption.

(4) **Sunny Island 6.0H**
In combination with the batteries, this system facilitates the temporary storage of solar power and also offers an uninterruptible, grid-quality power supply.

(5) **Energy meter**
Up to three energy meters can be connected to the Sunny Home Manager via D0 interfaces. Once connected, the device monitors all relevant energy flows in the home with the digital interfaces providing particularly high precision timing.

(6) **SMA Energy Meter**
The SMA Energy Meter transmits electrical measured values regarding PV generation, purchased electricity and grid feed-in via Speedwire to other central system components.

(7) **Uncontrolled loads**
Many appliances like stoves, televisions and computers are not controlled by the Sunny Home Manager. However, the Sunny Home Manager memorizes the typical load profile of the building and takes it into account during automatic controllable load management planning.

Controlled loads
Electrical appliances that do not have specific turn-on times can be remotely activated by the Sunny Home Manager and hence included in the intelligent load management system.

(8) **Washing machine**

(9) **Clothes dryer**

(10) **Heat pump**
A heat pump using regular tap water year round generates up to four kilowatts of heat from one kilowatt-hour of electric current, which can be easily stored in hot water.

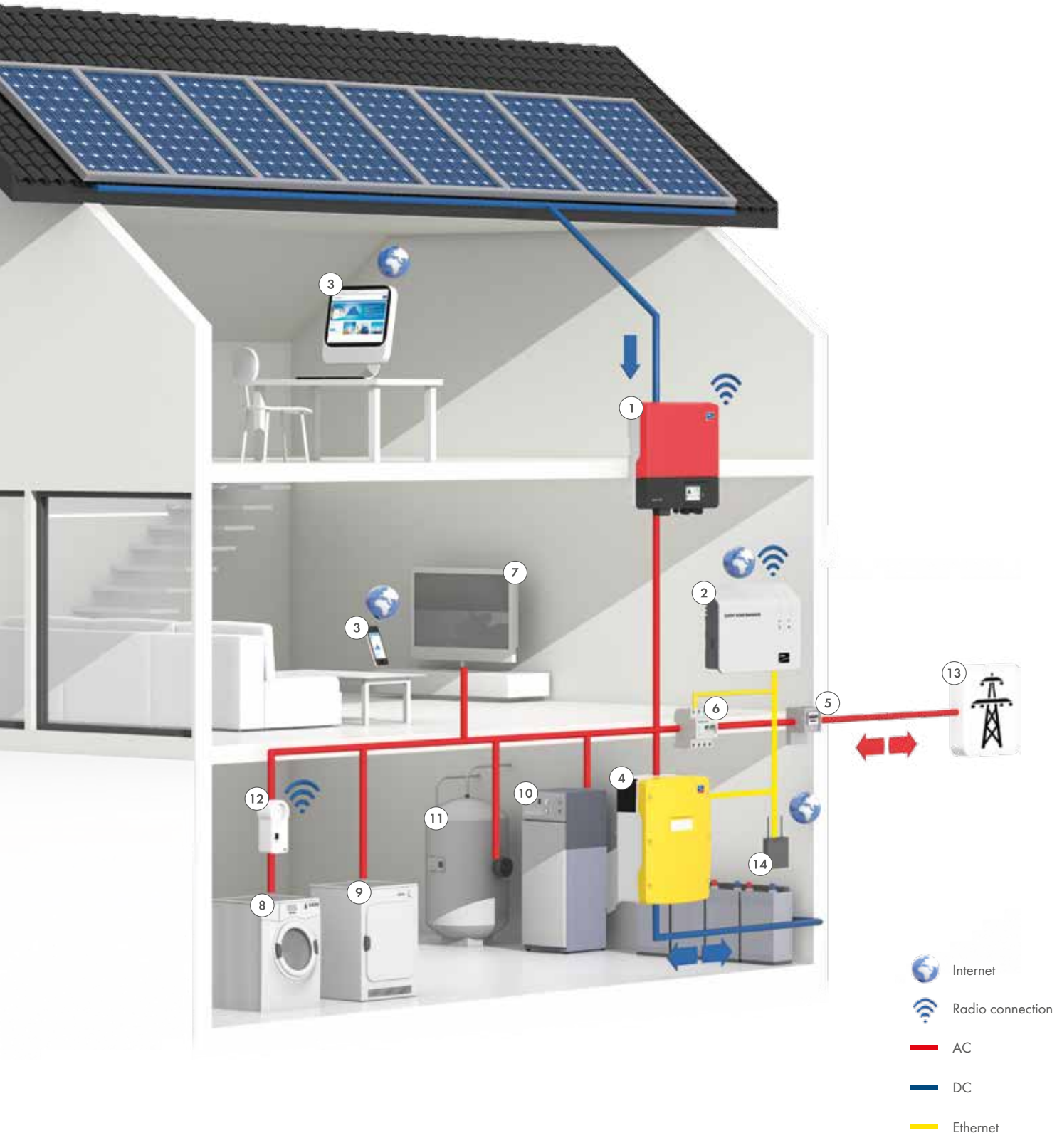
(11) **Thermal energy storage with SMA Smart Heater***

(12) **SMA *Bluetooth*® radio-controlled socket**
Loads that can be operated at various times and have no control interface can be activated at the optimal time by the Sunny Home Manager via an SMA radio-controlled socket. The socket also features an integrated measurement function that records the exact energy consumption of the connected device to improve planning accuracy.

(13) **Utility grid**
The load on the utility grid is reduced through self-consumption because the household consumes less power from the grid and at the same time feeds less PV power into it.

(14) **Router**

* Availability slated for fourth quarter 2013


3
1
3
7
2
13
6
5
4
12
10
11
14
8
9
Internet
Radio connection
AC
DC
Ethernet

SMA FLEXIBLE STORAGE SYSTEM

The versatile solution for new and retrofit PV systems

Storage systems are used around the world – but for different reasons: They provide additional energy supply security and greater self-sufficiency, and can also make PV systems more economical by increasing the rate of self-consumption. The requirements on batteries are therefore equally diverse.
A relatively large battery capacity is needed to bridge prolonged grid failures but has a significant impact on the economic viability of the system. If independence is a priority, then at least a medium-sized battery is required. However, an additional energy source is needed during periods of low solar irradiation. If system costs are the main concern, then a small battery is recommended. These three criteria carry different weight and depend on specific needs and external factors such as the current feed-in tariff, compensation cap and grid electricity price. With the SMA Flexible Storage System, SMA offers you the right system solution for all of these requirements. Components of the storage system include the Sunny Island battery inverter with the Speedwire data module, the Sunny Remote Control, and the Sunny Home Manager. In addition, they can be combined with an SMA PV inverter, SMA radio-controlled sockets as well as an individual number of battery storage systems.

For Retrofitting

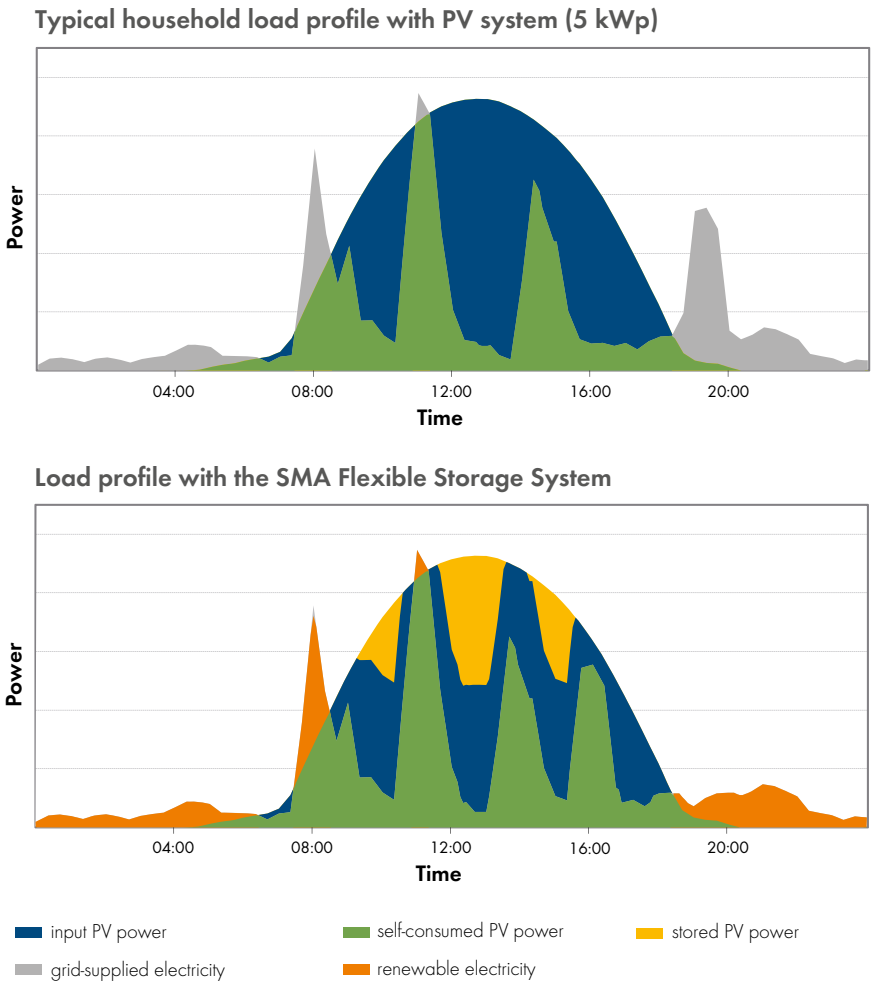
The SMA Flexible Storage System can be added as an upgrade to almost any PV system. In this way, all advantages of the intelligent energy management system are available.

Flexible

Storage power, battery capacity and battery type are chosen by the customer. The SMA Flexible Storage System can work with almost any lead acid or lithium-ion battery from major manufacturers such as LG Chem, Sony, Samsung, SAFT, Dispatch Energy, Akasol and Leclanché.

Reliable

If the utility grid fails, the backup power supply* guarantees a secure electricity supply. The inverter technology used in this system has an extremely high overload capacity ensuring that critical loads can be operated reliably. In the field of lithium-ion technology, SMA works closely with major manufacturers who offer proven safety concepts



Thanks to its largely scalable battery, the SMA Flexible Storage System can store large amounts of solar energy for greatly increased independence. The battery inverter has an extremely high overload capacity and can supply almost all power needed during grid failures.*

for batteries. And thanks to a special data link between the battery and the inverter, the system can ensure optimal battery management and component interplay.

* Retrofitting availability slated for third quarter 2013

Advantages at a Glance:

» Approx. 57 percent less electricity from utility companies**

» Self-consumption boosted from 30 to an average of 65 percent**

» Use of solar power possible 24 hours a day

» All PV power generated annually is used, even when the power feed-in is limited to 70 percent or less of nominal generator power

» Can be used to upgrade almost any existing PV system

» Maximum flexibility in terms of storage, battery type and battery capacity

» Future-oriented with Smart Grid compatibility

** All figures are based on an annual PV generation of 5,000 kWh, annual power consumption corresponding to PV generation, an actual battery capacity of 5 kWh and the use of the Sunny Home Manager.

SMA SMART HOME
with SMA Integrated Storage System

(1) **Sunny Boy 3600/5000 Smart Energy**
The Sunny Boy 3600/5000 Smart Energy can store around 2 kWh of solar energy. It thus increases self-consumption rates while limiting the feed-in power.

(2) **Sunny Home Manager**
As the central energy manager, this device analyzes a wide range of input parameters and uses an intelligent planning algorithm to harmonize power generation and consumption schedules.

(3) **Sunny Portal**
The Sunny Portal is used to operate and configure the Sunny Home Manager. These functions are available via any Internet browser and can be accessed using a PC or smartphone. The live display of all power and energy values provides further incentive to save on power consumption.

(4) **Energy meter**
Up to three energy meters can be connected to the Sunny Home Manager via D0 interfaces. Once connected, the device monitors all relevant energy flows in the home with the digital interfaces providing particularly high precision timing.

(5) **SMA Energy Meter**
The SMA Energy Meter transmits electrical measured values regarding PV generation, purchased electricity and grid feed-in via Speedwire to other central system components.

(6) **Uncontrolled loads**
Many appliances like stoves, televisions and computers are not controlled by the Sunny Home Manager. However, the Sunny Home Manager memorizes the typical load profile of the building and takes it into account during automatic controllable load management planning.

Controlled loads
Electrical appliances that do not have specific turn-on times can be remotely activated by the Sunny Home Manager and hence included in the intelligent load management system.

(7) **Washing machine**

(8) **Clothes dryer**

(9) **Heat pump**
A heat pump using regular tap water year round generates up to four kilowatts of heat from one kilowatt-hour of electric current, which can be easily stored in hot water.

(10) **Thermal energy storage with SMA Smart Heater***

(11) **Micro-CHP plant**
Combined heat and power plants can make better use of fuel energy by generating both heat and electric current at the same time. Since heat is easily stored, CHP plants can be used as a controllable source of power generation in the Smart Home.

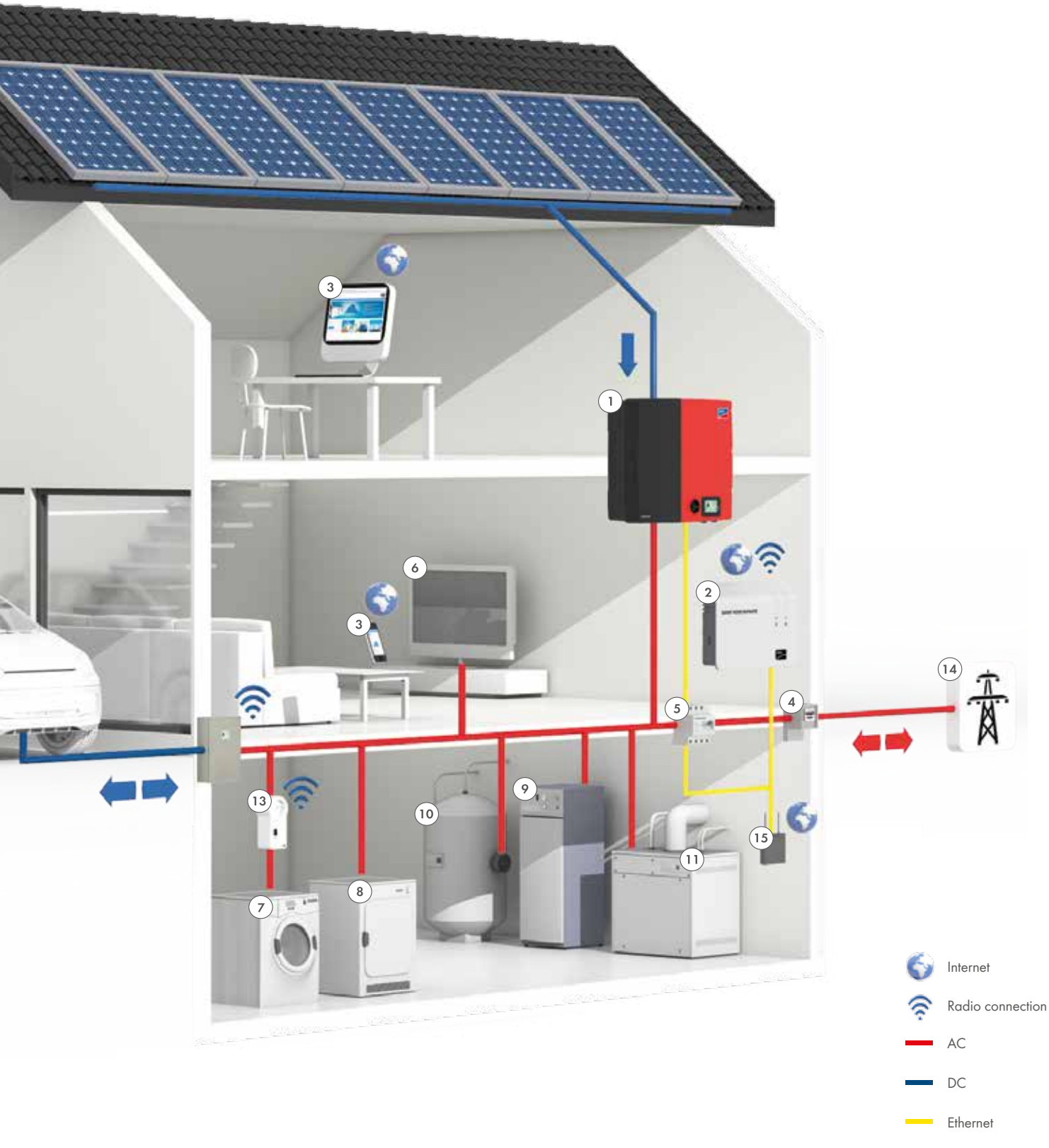
(12) **Electric car**
An electric car battery is more than just another electric load – when combined with the right inverter, it can also be used for additional power storage in the Smart Home.

(13) **SMA *Bluetooth*® radio-controlled socket**
Loads that can be operated at various times and have no control interface can be activated at the optimal time by the Sunny Home Manager via an SMA radio-controlled socket. The socket also features an integrated measurement function that records the exact energy consumption of the connected device to improve planning accuracy.

(14) **Utility grid**
The load on the utility grid is reduced through self-consumption because the household consumes less power from the grid and at the same time feeds less PV power into it.

(15) **Router**

* Availability slated for fourth quarter 2013


3
1
6
3
2
14
4
5
13
9
10
15
11
8
7
Internet
Radio connection
AC
DC
Ethernet

SMA INTEGRATED STORAGE SYSTEM

The turn-key solution for new PV systems

Easy to Use

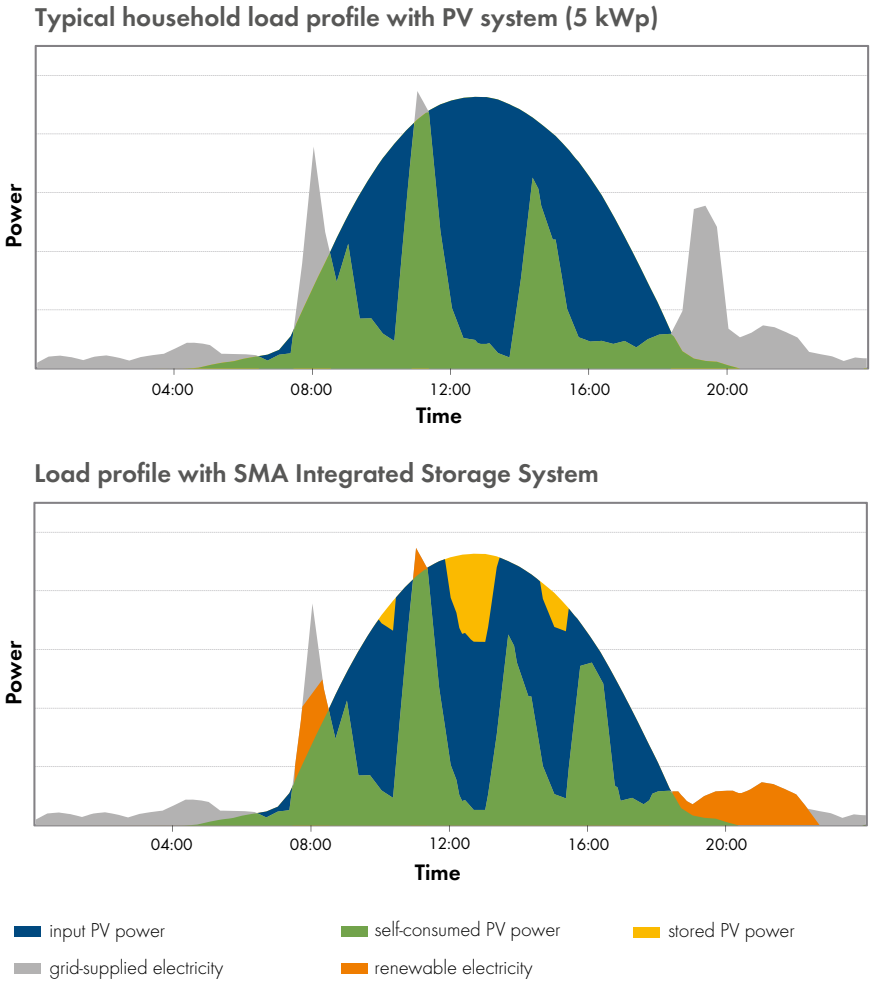
SMA has developed a unique concept with the Sunny Boy 3600/5000 Smart Energy. It is the first device to combine a high performance PV inverter and a storage system in a compact wall mountable enclosure. The Sunny Boy Smart Energy can unfold the full scope of its strengths when paired with the Sunny Home Manager, because the Sunny Boy Smart Energy is directly integrated into the intelligent energy management system and benefits from the predictive planning of the Sunny Home Manager. The results are clear to see: The SMA Integrated Storage System is as cost-effective as it is simple and is ideally suited to the demands of both standard home installations and the energy transition.

Efficient

The lithium-ion battery integrated in the Sunny Boy Smart Energy has an effective capacity of around two kilowatt-hours. This value is decisive in maximizing efficiency given that a large capacity battery can only be used to the fullest on high yield days, while a small battery increases self-consumption almost year round. For PV system owners, greater self-consumption means greater independence from rising electricity prices.

A further advantage of the system concept is the design of the battery to have a useful life of 10 years. In this way, around 90 percent of its storage capacity is used, significantly more compared to the 20-year design currently popular on the market. This leads to a considerably lower battery capacity and, as such, a lower initial investment. Due to battery prices sinking in the long-run, the total cost of ownership over a 20-year period also goes down thanks to the battery replacement concept, and the risk of failure is also considerably lower.

The device also enables the use of almost all available solar energy, even when feed-in is limited in accordance with article 6 of the Renewable Energy Sources Act (EEG). As a result, there is no need for a separate control system for feed-in management. The system can also be used for a variety of new applications, including the provision of highly profitable storage services in the smart grid of tomorrow.



The Sunny Boy Smart Energy's integrated battery increases self-consumption by storing energy during peak power generation.

Advantages at a Glance:

- Approx. 52 percent less electricity from utility companies*
- Self-consumption boosted from 30 to an average of 55 percent*
- Use of solar power possible 24 hours a day
- Nearly all PV power generated annually is used, even when the power feed-in is limited to 70 percent or less of nominal generator power
- Low-cost installation thanks to quick and easy wall mounting – comparable to a standard PV inverter
- Outstanding efficiency in power conversion and temporary storage of power
- Maximum reliability and dependability with specially developed lithium-ion cells from LG Chem with integrated battery management
- Future-oriented with smart grid compatibility

* All figures are based on an annual PV generation of 5,000 kWh, annual power consumption corresponding to PV generation, and the use of a Sunny Home Manager.

TECHNOLOGY FOR THE HOME OF TOMORROW

SMA Smart Home as a system component for the energy transition

Systems providing intelligent and automatic energy management in the home are key in comprehensive renewable energy supply, and they are becoming ever more important with the progression of the energy transition. These are the only systems that enable customers to reliably and inexpensively generate solar power and relieve the utility grid at the same time.

They can provide the photovoltaic market with properties found in power plants such as complete controllability and programmable power output through automatic load shifting, decentralized storage systems and the ability to gradually replace the "must-run units", (i.e., power plants that were previously needed to ensure grid stability). And this only scratches the surface of possible applications of intelligent energy management.

With an automatic response to variable prices for power from the grid, a continuous comparison of supply and demand for power will soon also be possible at grid level. Connecting several small installations into virtual power plants makes it possible to market large quantities of power directly or participate in smart markets providing services for energy and systems. Moreover, intelligent solutions will be the only way for electric mobility to be integrated into the energy supply system. The SMA Smart Home already offers the complete range of core functions for intelligent and convenient energy management as an end-to-end modular system that is prepared for the future. Today, it is possible to control common appliances around the home as easily as it will be to directly communicate with future generations of smart devices.

Heat pumps, thermal energy storage and even electric vehicles can also be integrated into the energy-efficient Smart Home; the transition is already happening. Simply put, the SMA Smart Home makes the technology of tomorrow available – today. PV system operators do contribute significantly to the energy transition while also conveniently supplying renewable energy to their own home, independent of the utility grid.

ENERGY
THAT
CHANGES

SMA

www.SMA.de/smarthome

Version: July 2013