



SHIFTING THE LIMITS

THE RELEVANCE OF SHORT AND LONG-TERM STORAGE SOLUTIONS FOR REALISING 24 HOURS OF SUN

Vision for 24 hours of sun

“24 hours of sun” is the Fronius vision for the energy revolution. This represents the future of energy supply over the coming decades from the perspective of Fronius.

The challenge when it comes to renewable energies lies in making electricity available at the required location at different times of the day and year. To this end, two fundamental approaches to this problem are illustrated. On the one hand, attempts are made to match electricity consumption to generation and vice-versa, to implement energy management. As things stand, it makes sense to consider a mixture of energies including solar energy, wind energy, water power and other forms of energy. On the other hand, excess energy is stored and this stored supply is utilised when no power is being generated. This is assuming that a mixture of different storage technologies is also being used here. The following document sets out the relevance of short and long-term storage solutions in realising 24 hours of sun.

The short-term storage solution as the first step

Part of the vision of 24 hours of sun involves using solar power even during the evening and at night. Power is not only required during the solar hours, but generally 24 hours a day, i.e. round the clock. In order to enable this, a short-term storage solution that allows excess energy to be transferred from day to night is required. One solution for saving the electrical energy over short periods of time uses batteries that have been charged with excess solar power during the day. This store of power is then available to the household at night.

The benefit of the short-term storage of solar power

The short-term storage of power has many attractive aspects. It enables a significant increase in self-consumption with the transfer of energy from the daylight hours into the evening and night time. The reason for this is that the excess power is not fed into the grid during the day but instead remains within the household. A high level of self-consumption helps to reduce electricity bills – something that is becoming increasingly attractive given the constant increases in energy costs. Indeed, in many countries self-consumption of the power generated privately is a requirement. Several countries already have similar regulations limiting the maximum amount of power that is fed in to a certain value. Temporary storage of the excess energy is necessary to avoid having to isolate the system when this threshold is exceeded.

Furthermore, even a small short-term storage solution will help to smooth out the peaks that result from the generation of solar power, or to balance them by shifting the time at which load peaks occur within the household. This takes the strain off the grid, supports the integration of photovoltaics into the grid and hence increases the density of photovoltaic systems. Last but not least, even a short-term storage solution can continue to supply energy to the household in the event of a power cut, thereby increasing the autonomy of the household. Consumers such as the heating system, fridge or computer then simply continue to run, even if the grid is not supplying any power.

Integrating the short-term storage solution into the system

In an ideal solution, the battery can be connected directly to the photovoltaic inverter, which has a DC input for connecting a battery. By connecting the battery to the DC side of the system, a high total efficiency is achieved. This is possible as there are no multiple conversions of direct and alternating current (with corresponding losses), as is the case with AC-connected solutions. The inverter is then the device that controls the various energy flows – between the solar modules, battery, network and consumers – and ensures optimal energy management. With integrated outputs to manage peaks and modern communication methods, such as WLAN, intelligent load management based on the current energy situation in the household is a simple matter.



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All of the above mentioned advantages of a short-term storage solution can be exploited in the ideal manner using the Fronius hybrid inverter. It has a separate DC input for a battery, allowing this to be connected directly to the inverter. With the emergency power function, integrated energy management and WLAN interface, the Fronius hybrid inverter is equipped for all possible challenges. Its market launch is scheduled for 2014.

The long-term storage solution as the next step

The short-term storage solution creates a balance between day and night. Now it is a matter of attaining a balance between periods with high levels of insolation (summer) and those with less (winter). This is vital to be able to achieve 24 hours of sun, 365 days a year. At central European latitudes, insolation in winter is up to 85 percent less than in summer. In terms of storage capacity and loss-free long-term storage, this is a challenging task for storage technology. In practical terms, a solution cannot be achieved with batteries – the use of hydrogen as a storage medium is ideal in this situation.

How does it work?

If excess power is present in summer, this is fed to the electrolyser in the Fronius Energycell. The electrolyser breaks down water (H₂O) into its component parts of hydrogen (H₂) and oxygen (O₂). Hydrogen is stored under pressure in a gaseous state in steel cylinders. The size of the tank determines the amount of energy that can be saved for the winter during the summer months. In winter, the stored hydrogen is converted back to electricity using the Fronius Energycell's fuel cell function. These conversion processes in the Fronius Energycell also produce waste heat that can be used to provide hot water and heating back-up.

The key technical data of the Fronius Energycell:

- / Total efficiency including utilisation of waste heat: > 80%.
- / Waste heat level: up to 80°C.
- / By utilising the waste heat from the energy cell, over 2/3 of the annual hot water requirement of a four-person household can be met.
- / In principle, the heat sources of your choice can be used to cover the remainder of the hot water requirement and/or for heating energy. Given the presence of the all-year power storage solution, the use of an electrically-powered heat pump makes sense.

If we take the data from an energy-efficient four-person household in Central Europe as our starting point, approximately 10 kWh of short-term storage (battery) and 1,200 kWh of long-term storage (hydrogen tank) are required for a fully autonomous configuration. The hydrogen tank can be constructed in the form of four bundles comprising twelve 50 litre steel cylinders at a pressure of approx. 200 bar. This storage medium represents state-of-the-art technology and has been harnessed in industrial applications for decades.

Combining the two storage technologies enables important synergies to be pooled. Short-term energy storage takes advantage of the good electrical efficiency offered by batteries, as well as their ability to provide peak power. Storing comparatively high levels of concentrated energy over extended periods of time before delivering this energy in the form of electricity and heat is a particular strength of hydrogen.

With an installation heading towards complete autonomy, energy management becomes even more important. In addition to the electricity balance, it is also necessary to manage the overall heat balance (hot water and heating). Special systems, such as those from the Basle-based Sauter organisation, are used for this complex task. For this purpose, both the Fronius Energycell and the other components of the overall system provide open interfaces for integration of system data. This allows the integration of energy management systems and also of home automation systems that support these standards.

Conclusion

This approach provides year-round power and heating autonomy, on your own property, thanks to decentralised photovoltaics. The Fronius hybrid inverter allows customers to start out with traditional grid connected photovoltaics, expand these with a short-term storage solution and then achieve full autonomy with the aid of a Fronius Energycell.

Characters (with spaces): 6,932

Words: 1,333



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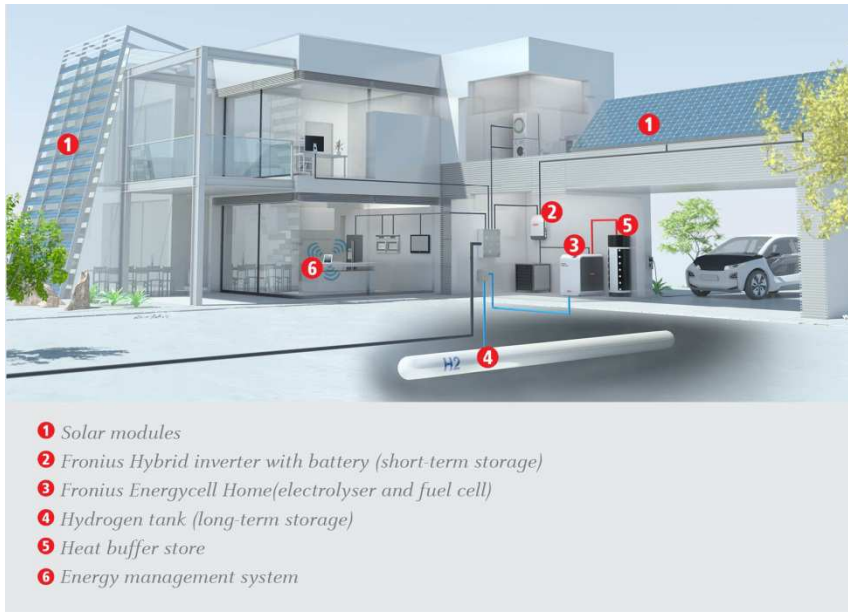
The Fronius vision of 24 hours of sun.



The Fronius hybrid inverter increases self-consumption and is the first step towards 24 hours of sun.



As a long-term storage solution, the Fronius Energycell allows you to take the final step towards energy autonomy.



- ❶ Solar modules
- ❷ Fronius Hybrid inverter with battery (short-term storage)
- ❸ Fronius Energycell Home (electrolyser and fuel cell)
- ❹ Hydrogen tank (long-term storage)
- ❺ Heat buffer store
- ❻ Energy management system

The Fronius house of the future.

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About Fronius International GmbH

Fronius International GmbH is an Austrian company with headquarters in Pettenbach and other sites in Wels, Thalheim, Steinhaus and Sattledt. With 3,239 employees worldwide, the company is active in the fields of battery charging systems, welding technology and solar electronics. Around 93% of its products are exported through 19 international Fronius subsidiaries and sales partners/representatives in over 60 countries. With its innovative products and services and 864 active patents, Fronius is a global technology leader.

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