# Solar and Storage

## Policy Paper – April 2016

EUROBAT
ASSOCIATION OF EUROPEAN AUTOMOTIVE AND INDUSTRIAL BATTERY MANUFACTURERS

ehpa
european
heat pump association

SolarPower Europe

## KEY MESSAGES

Energy storage solutions acts as a bridging technology between the electricity, heating and cooling as well as transport sectors.

1. **System benefits:** Storage technologies allow for the best use of zero marginal cost solar electricity when it is available. Hence storage can help the overall energy system to be more cost-effective.

2. **Consumers benefits:** Solar and storage are mutually reinforcing. The fast cost decrease of solar systems means that more consumers will be able to invest in storage capacities. This in turn will increase the ratio of self-consumption and brings concrete economic benefits to the consumers. Storage solutions also unlock demand side flexibility which help safely operate our grids.

3. In order to unlock the synergies between solar and storage, the following regulatory adjustments are needed:

   - **Provide a common EU legal definition of storage**

   Storage is currently not defined at the EU level, which hampers the creation of a real European market for storage. A commonly agreed legal definition is therefore needed in order to clarify its position with regard to the unbundling regime and specify the ownership structure of a storage facility.

   - **Create an appropriate framework for self-consumption**

   Any barrier to self-consumption (such as specific additional taxes or levies) will hamper the further development of decentralized storage. An appropriate and cost-efficient framework for renewable self-consumption should therefore be developed in the upcoming new Renewable Energy Directive.

   - **Ensure that all dimensions of storage are properly valued**

   Electricity markets should better remunerate flexible assets and reflect scarcity. In parallel, energy policies should ensure that services provided by storage and solar to DSOs and TSOs are properly recognized and valorised.

   - **Develop a holistic strategy for the electricity, heating and cooling and transport sectors**

   The implementation of the Heating and Cooling Strategy in particular should identify which elements require a regulatory prolongation in the building and product-related European legislation. Bridging electricity and thermal grids via the storage of surplus electricity in the form of heat (in heat pump, hybrid heat pumps or thermal storage) should also be emphasized, as the thermal storage potential is already widely available and require little extra effort to be used. The upcoming communication on decarbonisation of transport should also highlight the role that solar and storage can play in supporting e-mobility (BEV, all classes of hybrid vehicles and FCEV).

- **Promote R&D to unlock all technology options**

The SET Plan should support a system perspective promoting the integration of storage solutions, solar technologies and controls into buildings, communities and industrial processes to further reduce their costs and accompany them down their learning curves.

- **Temporary market introduction programs can help reduce cost**

Energy storage technologies offer great potential for creating high-tech R&D and production jobs in Europe. Introduction of temporary market programmes with a digressive design can help in accelerating cost reduction for energy storage. For example, the KFW program in Germany has helped to create a strong battery-storage market in Europe.

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## Make the system cost-effective by using power when it is cheap

In 15 years from now, almost half of our power in Europe will be generated by renewables[1]. ENTSO-E forecasts that by 2025 already, 22 Member States will have a renewable electricity capacity penetration higher than 50%[2].

Solar is expected to play a major role in this shift of our power mix: by 2020, it could cover up to 8% of the European power demand, while this is expected to rise to 15% by 2030[3]. Combined with the further increase of wind generation, it will also require a much more flexible system in order to make the best use of zero-marginal costs renewable sources when they are available.

The figure 1 below illustrates how the introduction of solar power in different European countries reduces the need for residual electricity generation during the day (the so-called "residual load"), whilst power demand will still be high on the evening. New forms of flexibility will therefore be needed in order to ensure a better use of electricity when power is cheap and to release the pressure on the grid during the evening peak.

Among the different flexibility options, storage allows to respond quickly to balancing needs by absorbing the excess solar generation at peak times and to release it during periods of lower production. By making the best use of cheap renewable electricity when it is available, storage can **make the energy system more cost-effective**. By adapting to demand and limiting the possibility of peak pricing, storage will also have a **balancing effect on prices** throughout the day.

More importantly, solar combined with storage acts as a **bridging technology** between the electricity, heating and cooling as well as transport sectors. Besides the rapidly developing battery storage capacity, the electrification of the transport sector and the use of electricity for heat purposes allow for an integrated approach of the energy system.

[1] Staff working document accompanying the Communication of the Commission concerning the Paris protocol (COM(2015)81 final).
[2] ENTSO-E, "2015: Scenario Outlook and adequacy Forecast", June 2015.
[3] SolarPower Europe "Global Market Outlook for Solar Power 2015- 2019", 2015.

*Figure 1 – The evolution of the residual peak load in Germany, Italy and the UK (2011, 2020 and 2030)*


source: EPIA, 2012

## Storage and solar are mutually reinforcing

The combined evolution of solar and storage provides new opportunities for European consumers and businesses, whilst potentially offering a variety of services to grid operators.

- **Empowering consumers**

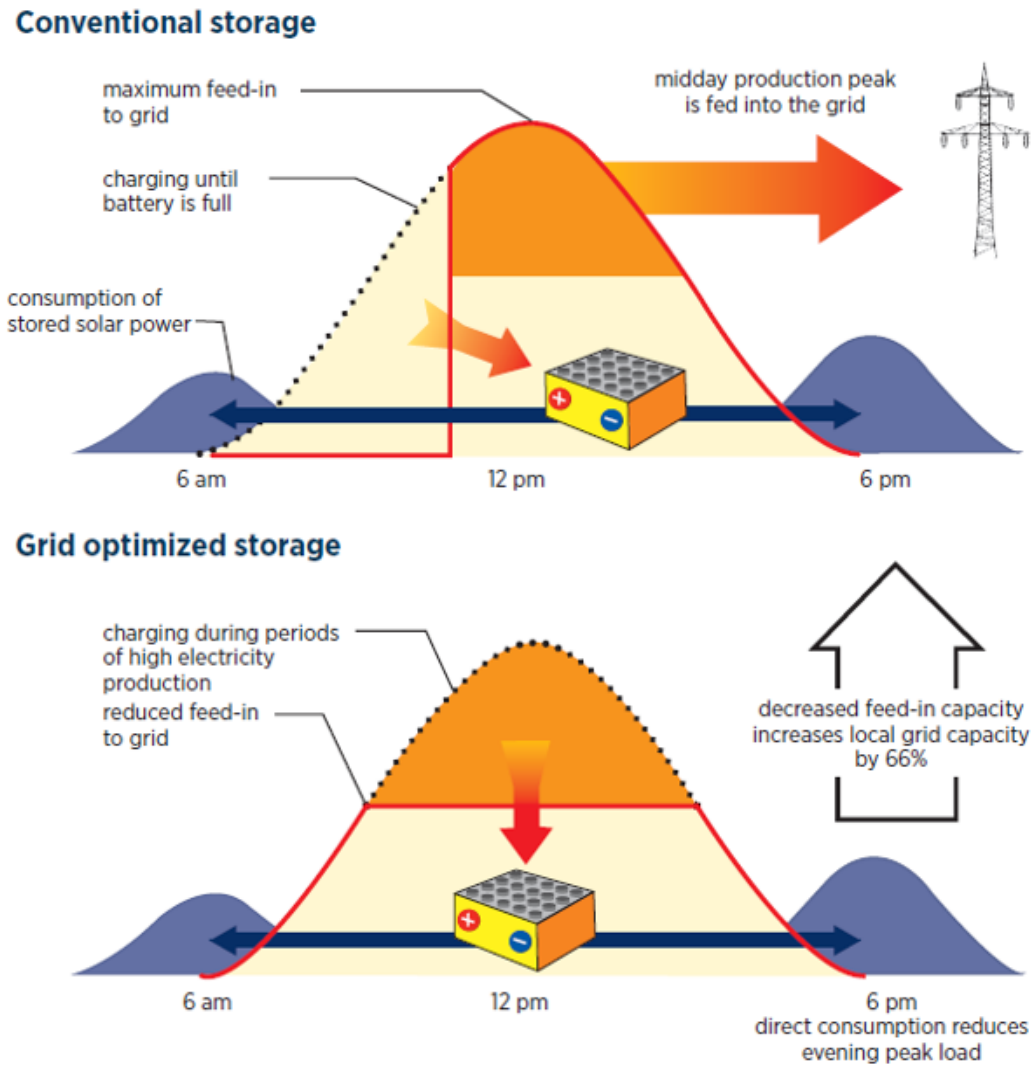
At a time when retail electricity prices tend to rise, storage combined with solar appears as a new way of controlling energy bills. Germany – where a market introduction program for storage is in place - is already experiencing such a trend as the share of households installing grid-connected PV-plus-battery systems represents now 12% of the PV system owners[4].

Batteries can increase the percentage of self-consumed electricity from 30% without storage to around 70%, optimising efficiency and reducing the amount of additional power needed from the grid. Besides, prosumers can use arbitrage to inject the surplus electricity into the grid when prices are higher, improving the business case for wind or PV home systems. Batteries can also provide backup power through the entirety of a power outage period, working as uninterruptable power supply unit (UPS). This service is particularly useful in areas with weak low voltage grids.

IRENA[5] forecasts that batteries will for instance be fully competitive with other technologies by 2020. In the US, the Rocky Mountain Institute[6] predicts that grid-connected PV will be competitive by 2020 and that grid connected **PV system-plus-battery** will follow within the next decade. In other words, the fast cost decrease of solar systems is freeing up money that can be invested in storage capacities which in turn increase the ratio of self-consumption. In addition, market introduction programs like in Germany can help in accelerating cost reduction for storage to get competitive. This combination will allow for a smarter management of the different energy flows within the building and create a capacity to interact with the grid. The figure 2 below illustrates how a combination of solar and batteries can shave peaks of injection by storing the surplus of solar electricity during midday.

[4] IRENA (2015), « Renewables and Electricity Storage: A technology Roadmap for REmap 2030 ».
[5] IRENA (2015). « Battery Storage for Renewables: Market Status and Technology Outlook ».
[6] Rocky Mountain Institute (2015), « The Economics of load defection ».

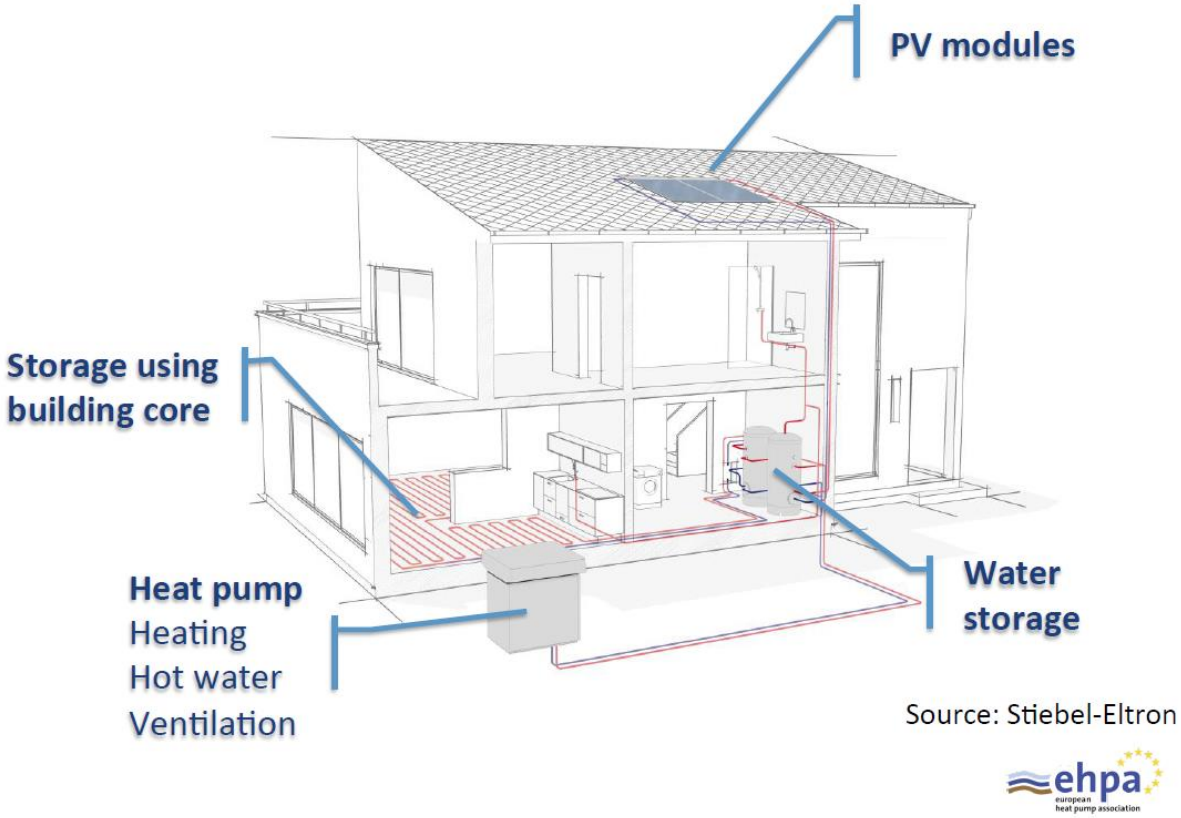
*Figure 2 – Battery storage shaving peaks while increasing self-consumption*




Source: Bundesverband Solarwirtschaft 2014

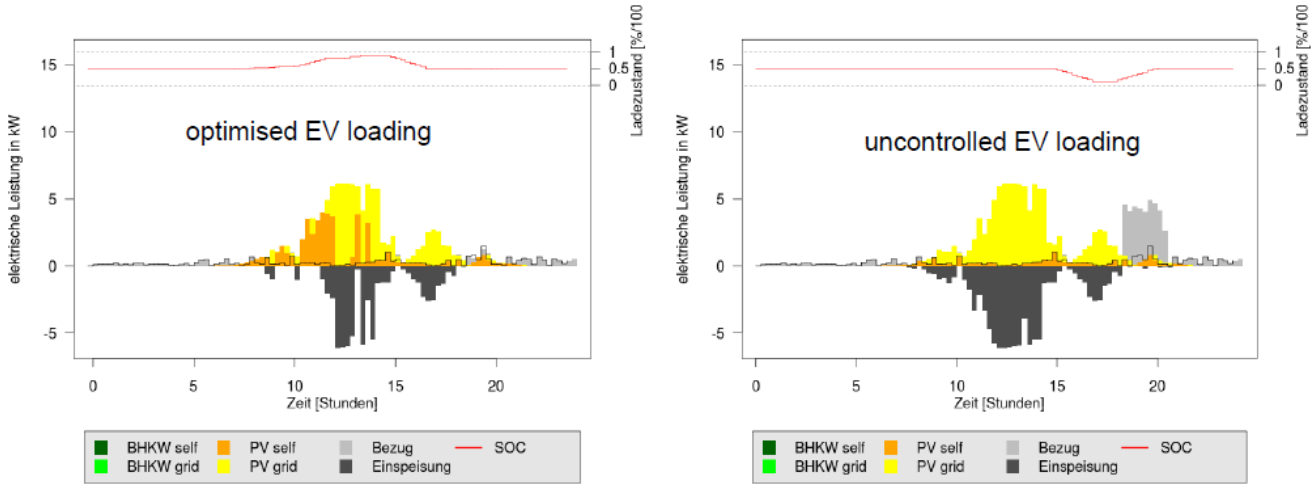
Given that **heating and cooling needs** represents the larger share of energy consumption in the building sector, heat pumps or large refrigeration equipment (mainly in commercial buildings) can also play a key role in absorbing the midday excess of solar power. There are currently 7,5 million heat pumps in Europe representing an overall share of around 6% of all boilers installed. Besides heating, reversible heat pumps can also use solar electricity to provide the cooling need without creating additional stress for the grid. In doing so, hot water is produced as a by-product of the cooling operation and will be provided to the end- user at virtually no extra cost. Assuming an updated design, storage tanks and the building envelope can indeed store excess electricity and provide the necessary heating and cooling services from a few hours to a few days (figure 3 below).

*Figure 3 – Typical combination of heat pumps and PV in a residential building*



Finally, another example of an optimization strategy is the **smart charging and discharging of electric vehicles**. In the figure 4 below we can see how the battery of electric vehicles can be operated in order to make the best use of solar electricity.

*Figure 4 – Electrical load and power generation for a summer day in Germany, signle house with PV (7 kWp) with optimized operation (left) vs. uncontrolled loading (right); maximal loading capacity EV 3.7 kW*




Source: DLR, Thomas Pregger, Diego Luca de Tena, Carsten Hoyer-Klick

The same example can be extended to hydrogen refueling stations or Power-to-Gas plants producing hydrogen through water electrolysis when electricity prices are cheap when helping balancing the electrical grid.

- **Supporting the management of the energy system**

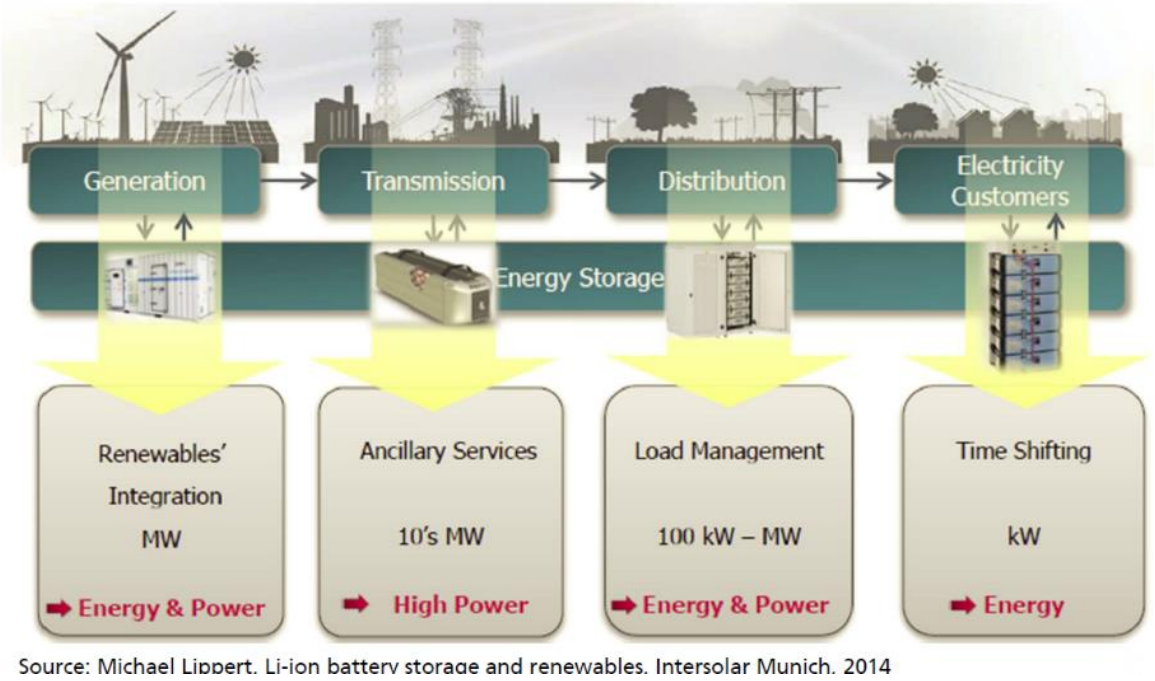
While storage combined with solar will empower consumers, it can also act as a service provider for the grid at all voltage levels, as described in the figure 5 below:

- Storage can **facilitate renewable integration**: daily storage in particular is well-suited for PV peak generation. This is because it is guaranteed that PV generation (in a large region) is available every day with a perfectly predictable peak that always occurs around midday. As the peak demand in Europe occurs in the evening hours the time shift between peak PV generation and the peak demand never exceeds eight hours.

- In addition, storage can also provide **ancillary services at transmission level**. As an operating reserve it allows for a real-time reaction of the system. By complementing the variability of renewables, storage also increases the predictability of the power flow into the grid.

- At distribution level, **"prosumer" storage or storage at community level can provide support to the management of distribution grids** and could even be an effective alternative to measures for grid stabilization. These systems can provide storage service on an aggregated level both to the households as well as to grid operators and this leverage the value of the asset.

*Figure 5 – Types of services provided by storage combined with solar*




Source: Michael Lippert, Li-ion battery storage and renewables, Intersolar Munich, 2014

There is no single energy storage option to cover all requirements in all European regions. Applications, technological development and market evolution will define the share of centralized and decentralised storage solutions in the power system.

## A reinforced regulatory framework to unlock these solutions

The following regulatory adjustments should be introduced at the European level:

- **Provide a common EU legal definition of storage**

Storage is currently not defined at EU level, which hampers the creation of a real European market for storage. A commonly agreed legal definition is therefore needed in order to clarify its position with regard to the unbundling regime, specify the ownership structure and focus on regulatory aspects for the development of the storage facility.

An important aspect of the definition is the need to cover all known energy storage technologies and the need to be general enough to allow for the integration of unforeseen innovations. This includes improved system designs, future technologies but also specific services Energy Storage can provide, which will evolve over time.

- **Create an appropriate framework for self-consumption**

The economic benefits linked to a combination of storage technologies, building automation and solar at decentralized level are to a large extent based on the assumption that a high share of solar electricity can be self-consumed. Hence any barrier to self-consumption (such as additional taxation) will hinder the further development of storage.

The guidance on best practices for renewable self-consumption recently published by the European Commission could serve as a basis for developing an appropriate framework for self-consumption in the new Renewable Energy Directive.

- **Ensure that all dimensions of storage are properly valued**

This means that electricity markets should better remunerate flexible assets and therefore better reflect scarcity. In parallel, energy policies should ensure that services provided by storage and solar to the regulated actors (DSOs and TSOs) are better recognized and can be founded on sound business models.

- **Develop a holistic strategy for the electricity, heating and cooling and transport sectors**

In a power system dominated by variable renewable generation, an integrated view at these four sectors will be needed. This systematic integration should be stressed when implementing the Heating and Cooling strategy via the revision of the renewable energy and buildings Directives as well as related building and product-related European legislation.

Similarly, the upcoming communication on decarbonisation of transport should highlight the role that solar and storage can play in supporting e-mobility (BEV, all classes of hybrid vehicles and FCEV).

- **Promote R&D to unlock all technology options**

The fast decreasing cost curve observed in solar and in several storage technologies indicates that public efforts to support these technologies are justified. A specific focus is needed on systems integrating decentralised production with direct use on site, as such systems will meaningfully reduce the load on the grid. The development of building automation devices and standards also need to be supported. Research and demonstration programmes under the SET Plan should therefore be continued.

- **Temporary market introduction programs can help reduce cost**

Energy storage technologies offer great potential for creating high-tech R&D and production jobs in Europe. Introduction of temporary market programmes with a digressive design can help in accelerating cost reduction for energy storage. For example, the KFW program in Germany has helped to create a strong battery-storage market in Europe.

EUROBAT is association for the European manufacturers automotive, industrial and energy storage batteries. EUROBAT has 52 members from across the continent comprising more than 90% of the battery industry in Europe. The members and staff work with all stakeholders, such as battery users, governmental organisations and media, to develop new battery solutions in areas of hybrid and electro-mobility as well as grid flexibility and renewable energy storage.

EHPA is a Brussels based industry association which promotes awareness and proper deployment of heat pump technology in the European market place for residential, commercial and industrial applications. EHPA provides technical and economic input to European, national and local authorities in legislative, regulatory and energy efficiency matters. All activities are aimed at overcoming market barriers and dissemination of information in order to speed up market development of heat pumps for heating, cooling and hot water production.

SolarPower Europe, the new EPIA, is a member-led association representing organisations active along the whole value chain. Our aim is to shape the regulatory environment and enhance business opportunities for solar power in Europe.