January 2017

VAT on battery storage integrated with domestic solar PV

Evidence submitted on behalf of the Solar Trade Association

Summary

The market for domestic battery storage with solar photovoltaics (PV) is set to grow in 2017 and beyond. There is currently a lack of clarity over whether batteries attract VAT at 5% or 20% when installed at the same time as, or retrofitted to, a PV system. There is an understanding among industry representatives that batteries attract 5% VAT when installed at the same time as PV.

Following a meeting with HMRC the Solar Trade Association (STA) agreed to provide evidence to justify why battery storage should attract reduced rate VAT at 5% where installed alongside a PV system, including cabling, control panel and AC/DC inverters. Specifically HMRC asked for evidence on how battery storage systems connect to and interact with PV systems and the grid.

The STA request that HMRC clarify their view on how VAT applies to battery storage units when installed with new PV and when retrofitted. This clarity is essential for sector confidence, as without it well-managed companies looking to safeguard their tax affairs may be put at a competitive disadvantage to those willing to take risks on uncertainty. Alternatively, companies may be incentivised to sell at an incorrect rate and be put at risk during a VAT inspection.

***Ask 1*: The STA asks HMRC to consider the evidence provided below, and as a matter of urgency to issue a notice giving clarity on how VAT applies to battery storage connected to a PV system. Without this clarity there are commercial risks facing installers and risks to fair competition.**

In addition the STA hopes to provide evidence to justify why battery storage should attract reduced rate VAT whether installed at the same time as, or retrofitted to a PV system. Storage integrates with the PV system to provide an ancillary service in either case, enhancing the energy-saving benefit by reducing grid-related electricity losses. This briefing note is intended as a starting point for this discussion.

***Ask 2*: The STA seeks to engage HMRC to explore the possibility of a 5% VAT rate for all battery storage, whether installed at the same time as a PV system or retrofitted to an existing PV system. This would be a longer process, and before engaging on this we first wish for HMRC to issue a notice on the current situation, as per Ask 1.**

Solar PV and reduced rate VAT

The UK justifies its application of reduced-rate VAT to energy-saving materials under Categories 10 and 10a of Annex III to VAT Directive 2006/112/EC, amended by Directive 2009/47/EC. This states that reduced VAT can be applied to goods and services which are utilised in the '*provision, construction, renovation and alteration as part of a social policy,'* and also to the '*renovation and repairing of private dwellings, excluding materials which account for a significant part of the value of the service supplied*.'

Solar Trade Association Greencoat House, Francis Street, London, SW1P 1DH
t: +44(0)203 637 2945 e: enquiries@solar-trade.org.uk w: www.solar-trade.org.uk
@thesolartrade

According to VAT Notice 708/6 solar panels meet the above requirements. On-site consumption reduces electricity imports from the grid, thereby reducing transmission and distribution network losses and saving energy. In the context of PV, 'solar panels' refers to: *'all systems that are installed in, or on the site of, a building and that are… photovoltaic (PV) panels with cabling, control panel and AC/DC inverter.'* The latter elements refer to products that attract reduced rate VAT when installed as part of a PV system. In addition, the Notice has this to say about the 'installation of energy-saving *materials with ancillary services:'*

> *'The installation of just energy-saving materials with ancillary supplies is reduced rated. An ancillary supply is a supply of goods or services that is a better means of enjoying the principal supply, for example, installing loft insulation but having to cut a new loft hatch in the ceiling and making good to access the loft. Clearly, the cutting of the loft hatch and making good is, in itself, a simple construction supply, but as the services have been carried out solely in support of the loft insulation, they become ancillary.'*

We believe this suggests that reduced rate VAT can be applied to products that provide an ancillary service to energy-saving materials.

To inform their position, HMRC have asked whether storage can justifiably be treated as part of a PV system. Specifically questions were raised on how storage interacts with PV, connects with inverters and interacts with the grid to discern whether it functions as an integral part of the system.

Energy-savings from domestic battery storage

Battery storage is installed as part of a domestic PV system in order to charge from electricity generated by the PV at times when it exceeds the household's electricity demand, and discharge to supply the household demand when this exceeds PV generation. In this way the on-site consumption of electricity generated by a PV system is maximised, increasing from around 20-40% without storage to 65-80% (or higher) with a storage unit. Because self-consumption of PV-generated electricity reduces transmission losses (saving energy), the addition of a battery unit which increases the level of self-consumption and reduces exports to the grid also saves energy. As such we suggest that the battery provides an ancillary service to the PV system, in accordance with the provision in VAT Notice 708/6, by improving the means of enjoying the principle supply. This effect is the same whether a battery is installed during the installation of the PV system or retrofitted later.

How batteries are connected

DC batteries connect directly into the PV system and usually use the same inverter. In some cases a separate hybrid inverter is used (containing a charge controller, e.g. SolarEdge's Store Edge). AC units connect to the AC mains in the home and will require their own inverters. Schematic diagrams of each are shown at the bottom of this document. While there are small differences in technical specification and functionality between AC and DC batteries, some of which are identified below, the principle function of each is the same where integrated with PV.

Most batteries on the market today are separate from the inverters, however in an increasing number of designs the inverters are integrated into the battery casing, both for AC (e.g. Enphase) and DC (e.g. Tesla) systems, further embedding storage into the system.

Solar Trade Association Greencoat House, Francis Street, London, SW1P 1DH
t: +44(0)203 637 2945 e: enquiries@solar-trade.org.uk w: www.solar-trade.org.uk
@thesolartrade

January 2017

How batteries of different types interact with the grid

The primary purpose of all grid-connected battery systems installed in conjunction with PV is to reduce import from and export to the grid. This is because the economic benefit from installing a battery alongside PV is maximised through the minimisation of imports from the grid (at the retail electricity price) and maximisation of on-site consumption of PV-generated electricity (at zero marginal cost). As such, most battery systems are configured to charge only from excess PV generation. Some batteries are configured never to import from or export to the grid, the result being that the PV system with storage will only ever export to the grid the maximum power that the PV system can generate (when the electricity demand of the property is being met and the battery is fully charged for later use). To date the vast majority of batteries installed have followed this model, enabling installers to install a 'plug-and-play' battery in confidence that the battery will operate in an economically sensible way.

That said, it is possible to configure batteries to interact with the grid; more likely for AC-coupled units than for DC-coupled. In some cases a battery could be used to charge with low cost night-time electricity to power the household during peak times if a customer is billed on time-of-use tariffs through their supplier (for example, Green Energy UK's recently launched TIDE tariff, which has a 20p/kWh differential). These tariffs are offered by suppliers as a result of the system benefits from consuming power during times of low demand. In addition, more innovative companies are exploring the potential for batteries to provide balancing services to electricity network operators in the form of frequency response. Domestic batteries could be commanded to charge or discharge in small increments in response to network signals. Aggregated across a fleet of batteries this will make flexible capacity available to network operators, reducing the need for network upgrades and expensive 'peaking' thermal generation. Finally, some AC-coupled batteries require small amounts of imports from the grid to maintain battery health, e.g. conditioning charges in winter or to run battery management systems.

Battery owners will be able to increase the return on their investment via these business models. However, given that this briefing relates only to storage where integrated with solar PV, the benefit should be seen as additional; small relative to the primary benefit. Configuring a battery to charge at night using low cost electricity reduces the available capacity of the battery to charge from the PV at zero marginal cost. Therefore, while some savings will be possible, it is not economically sensible to prioritise arbitrage in time-of-use retail tariffs over on-site consumption from PV. Further, the returns available from providing services to the grid through aggregation models are by nature incremental, particularly where the battery is integrated with PV, for the same reason given above. As such, the primary driver for installing a battery is to integrate with PV to maximise on-site consumption.

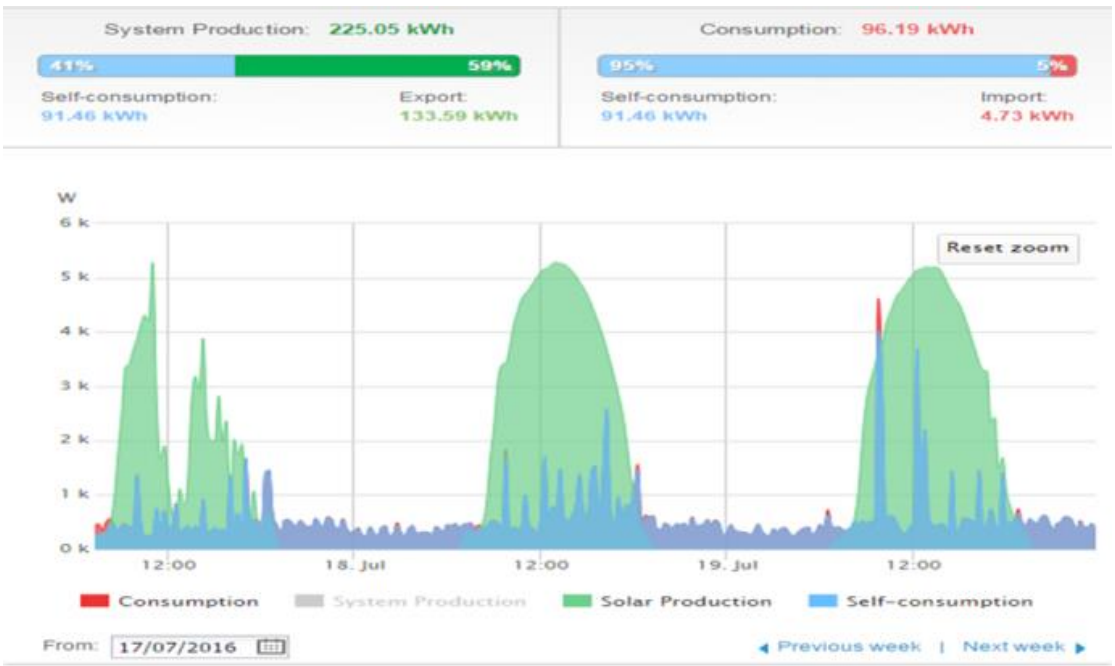
Battery type	Where connected	Interaction with grid (import/export)
DC-connected	Battery connects into PV inverter	• Unlikely to be able to import from the grid unless the inverter also acts as an AC-to-DC converter (rather than DC-to-AC), which is rare. • Charging from the grid to a DC battery is commonly not permitted under the Feed-in Tariff, as power imported from the grid would run back through the generation meter on discharge. • Normally configured not to export to the grid to maximize on-site consumption from PV.
AC-connected	Battery	• Capable of importing from the grid as the inverters are

Solar Trade Association Greencoat House, Francis Street, London, SW1P 1DH
t: +44(0)203 637 2945 e: enquiries@solar-trade.org.uk w: www.solar-trade.org.uk
@thesolartrade

	connects to AC consumer unit and needs its own combined inverter / battery charger (AC-to-DC)	separate to the PV inverters, but primarily configured not to for economic reasons where integrated with PV. • Sometimes import small amounts in the form of conditioning charges during winter to maintain battery health or to run battery management systems. • Normally configured not to export to the grid to maximize on-site consumption from PV.

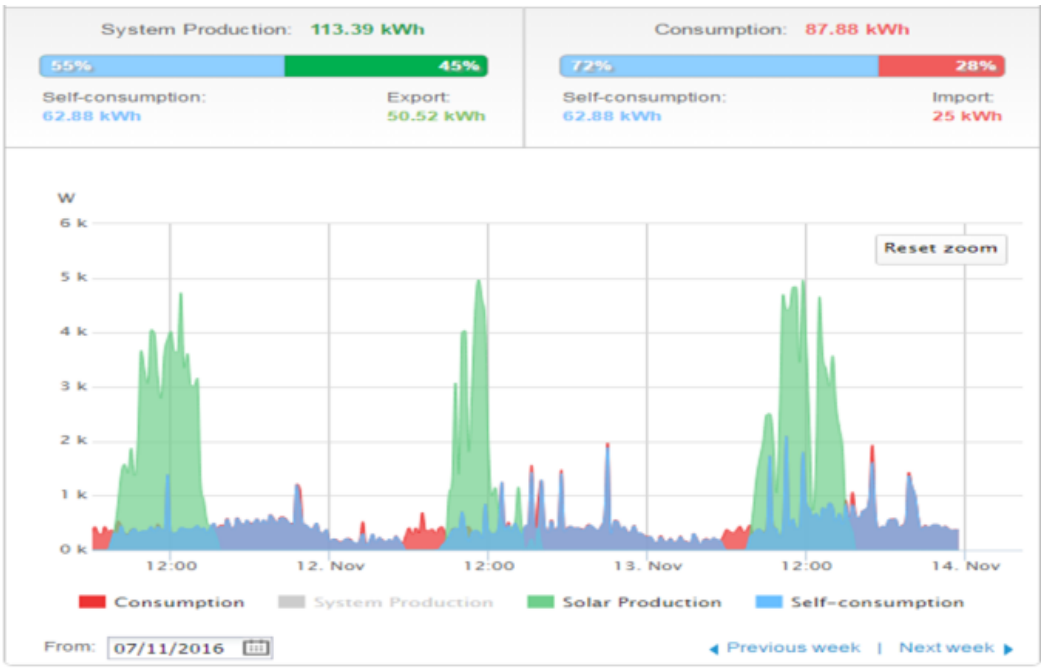
Performance of a PV and storage system

The two following graphs show real performance data of a typical domestic PV and storage system over three days during July and November respectively. Red represents the user's electricity demand met by imports from the grid, green represents PV generation, and blue represents demand that has been met by PV generation either directly or time-shifted via the battery. In summer the PV has generated 225kWh of electricity. 41% of this is (91.5kWh) is consumed on-site (directly or time-shifted via the battery), with the remaining 59% exported. The 41% of on-site consumption is enough to satisfy 95% of the user's household electricity demand (96kWh), with the remaining 5% imported from the grid. The battery has not been charged from electricity imported from the grid or discharged to the grid.



In the example from winter, shown below, the PV has generated 113.4kWh, roughly half the amount in the example above. 55% of this (62.9kWh) is consumed on-site (directly or time-shifted via the battery), with the remaining 45% exported. The 55% of on-site consumption is enough to satisfy 72% of the user's household electricity demand (87.9kWh), with the remaining 28% imported from the grid. The battery has not been charged from electricity imported from the grid or discharged to the grid.

Solar Trade Association Greencoat House, Francis Street, London, SW1P 1DH
t: +44(0)203 637 2945 e: enquiries@solar-trade.org.uk w: www.solar-trade.org.uk
@thesolartrade



Conclusion and asks

Where batteries are integrated with PV they are configured to work as part of the system, alongside cabling, control panel and AC/DC inverter, principally charging from the PV and enhancing the energy-saving benefit of the PV system. This effect is the same whether the battery is installed at the same time or retrofitted to the system. The broadly-held industry view is that batteries attract 5% VAT when installed at the same time as PV. There is less clarity on how VAT applies to batteries retrofitted to PV systems.

***Ask 1*: The STA asks HMRC to consider the evidence provided, and as a matter of urgency to issue a notice giving clarity on how VAT currently applies to battery storage connected to a PV system. Without this clarity there are commercial risks facing installers and a risk to fair competition.**

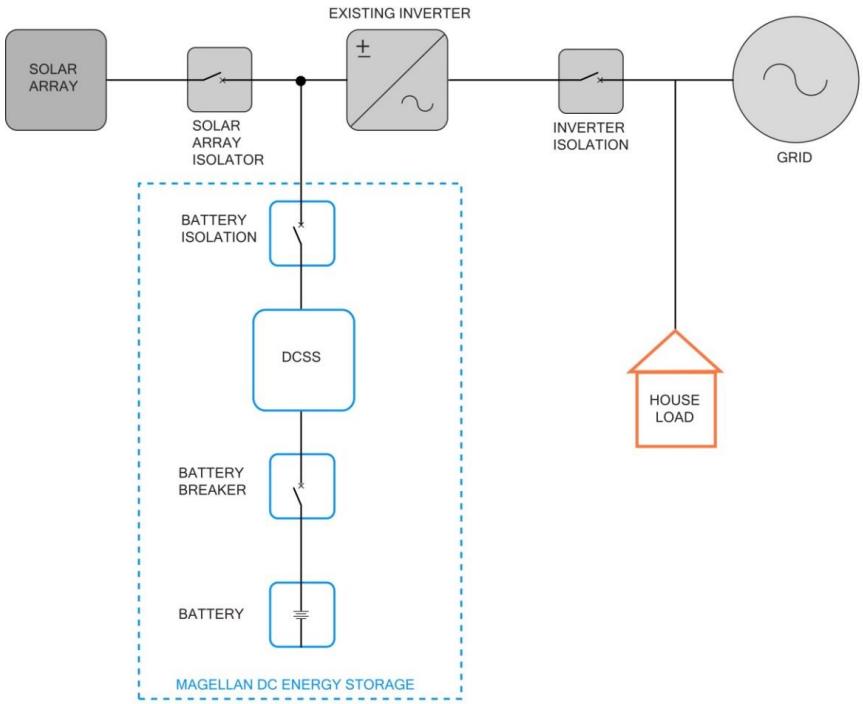
Additionally, the STA proposes that all batteries should attract 5% VAT when installed with PV, whether at the time of PV installation or retrofitted with a PV system. The basis for this is that the function of battery storage in conjunction with PV (enhancing the energy-saving benefit) is the same whether installed at the same time or retrofitted. We propose that this function fits the definition of an ancillary service above: '*a supply of goods or services that is a better means of enjoying the principal supply.'* Further, where sized appropriately, the product value of the storage element is less than that of the PV. This avoids the disqualification in category 10a to the VAT Directive of materials providing ancillary services that account for a more significant value than that of the principle supply. This will be further assured in future as the cost of domestic storage units are decreasing at a higher rate than those of PV, which is a relatively more mature technology.

***Ask 2*: The STA seeks to engage HMRC to explore the possibility of 5% VAT for all battery storage, installed at the same time as a PV system or retrofitted. This would be a longer process, and before engaging on this we first wish for HMRC to give notice on the current situation, as in Ask 1.**

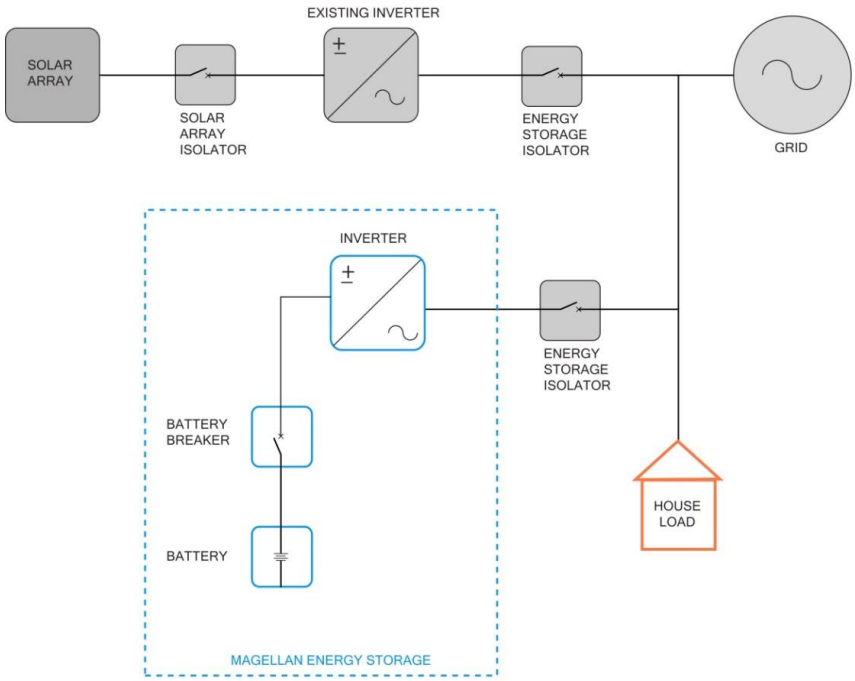
Solar Trade Association Greencoat House, Francis Street, London, SW1P 1DH
t: +44(0)203 637 2945 e: enquiries@solar-trade.org.uk w: www.solar-trade.org.uk
@thesolartrade

Annex: Schematic diagrams

DC-coupled battery storage integrated with PV:



AC-coupled battery storage integrated with PV:



Solar Trade Association Greencoat House, Francis Street, London, SW1P 1DH
t: +44(0)203 637 2945 e: enquiries@solar-trade.org.uk w: www.solar-trade.org.uk
@thesolartrade