VeraSol℠

Product Comparison Plots

January 1, 2024 - December 31, 2024

Version 2.0

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The box plots below show performance of products that have been tested through the VeraSol program within the past year. Companies can use these plots to compare or benchmark their test results and understand how their products perform in relation to other recently tested products.

The box of a boxplot (Figure 1) starts in the first quartile (25%) and ends in the third (75%). Hence, the box represents the central 50% of the data, with a line inside that represents the median. On each end of the box there is a line drawn to the furthest data without counting boxplot outliers. Values that fall above or below the end of the whiskers are called outliers. An outlier is more extreme than the expected variation.

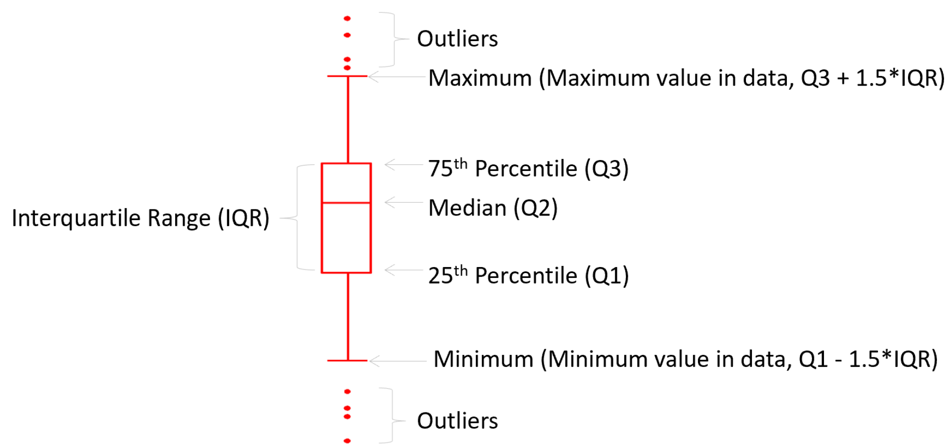

Figure 1. Box plot anatomy

The sample size showing the number of products evaluated for each metric is displayed at the top of each plot (n = XX). In cases where fewer than three products would be displayed in each category, their results have been excluded to preserve confidentiality.

The following example shows how to compare the results for a product with the benchmark data provided in this document. Result metrics can be found in the Results Summary section (Figure 2) of the VeraSol IEC TS 62257-9-5 Test Report. The average measured value can be compared to the benchmarking data.

Parameter tested	Unit / Appliance	Setting	Rating	Average measured value	Average percent deviation	Coefficient of variation	Comments
Lighting service							
Luminous flux [lm]	Integrated light	high	*50*	49	-2.0	0.01	
Luminous efficacy* [lm/W]	Integrated light	high	*125*	125	0.0	0.00	
* Luminous efficacy is calculated by dividing luminous flux by the power consumption from the appliance tests or assessment of DC ports. This calculation is not defined in IEC 62257-9-5 and is therefore not an ISO/IEC 17025 accredited test result.							
Color rendering index	Integrated light	high	*85*	80	-5.9	0.03	
Correlated color temperature [K]	Integrated light	high	*5700*	5560	-2.5	0.00	

Figure 2. Results Summary sample

The example metric (lumen efficacy) has an average measured value of 125 lm/W. This value can then be compared to the box plot for the benchmark data. For example, the measured value (125 lm/W) is shown as a red x in the example plot (Figure 3). The result is below the median value, meaning that more than half of products tested during this time performed better in relation to this metric.

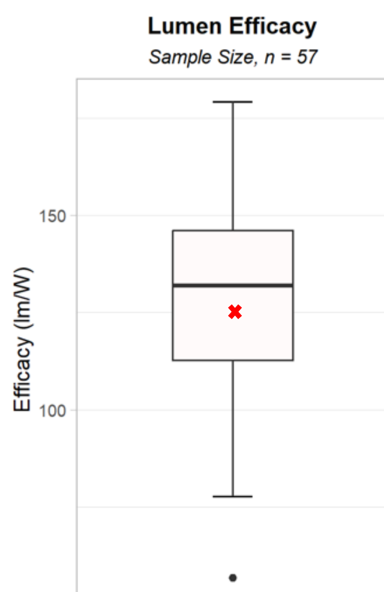

Figure 3. Example plot

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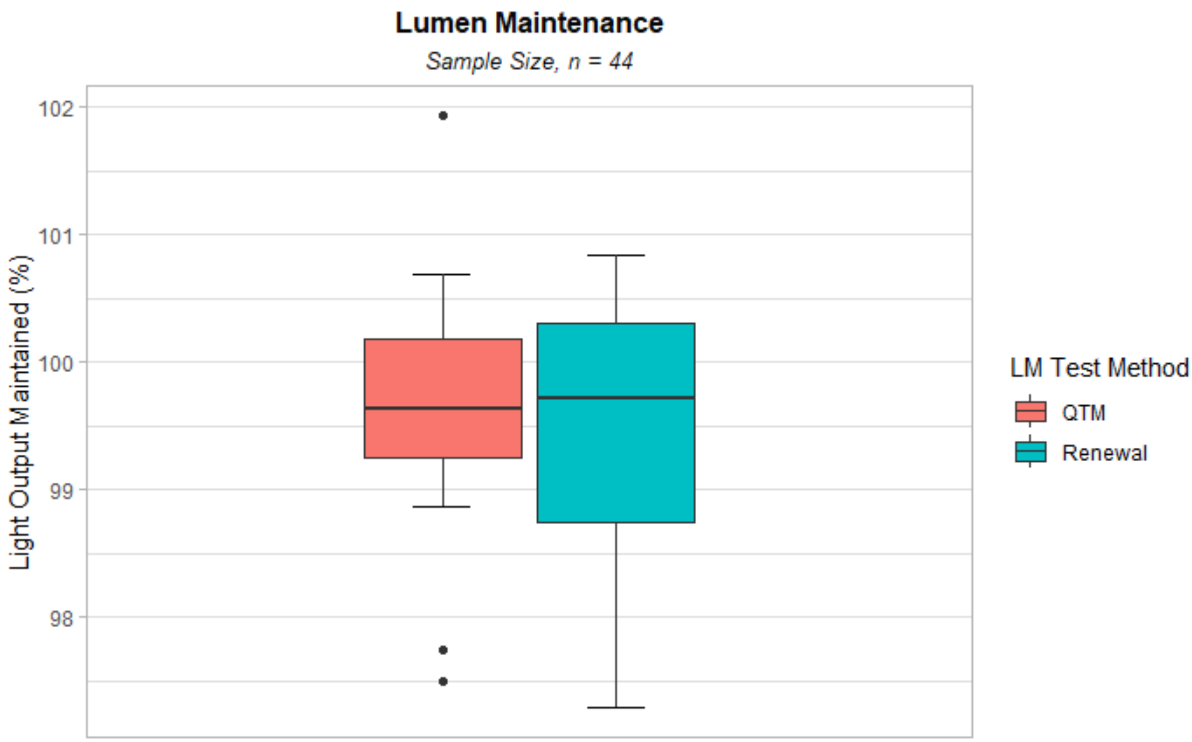
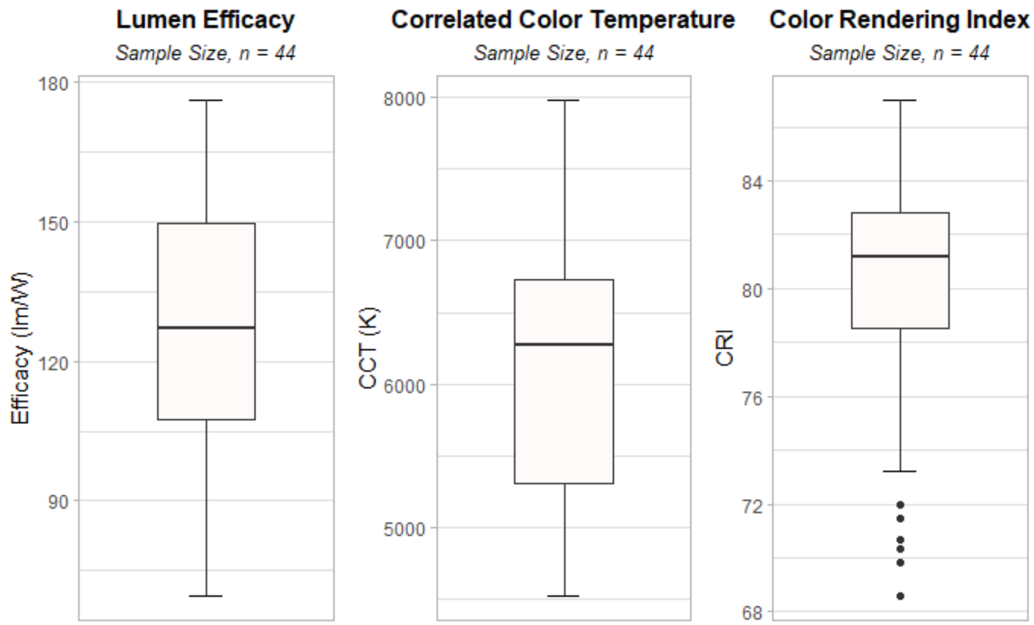


Lumen maintenance is the fraction of total light output remaining after a given number of hours of continuous use. For market entry testing (using the QTM or AVM methods), the lumen maintenance over 2000 hours is either measured directly or estimated using temperature measurements and data from LM-80 reports for the LED. For renewal testing, the lumen maintenance over 500 hours is measured. Results from these two different assessments are presented in the plot above.

A higher lumen maintenance indicates that the product maintains its original brightness more fully during long-term use than other products tested. A lower lumen maintenance indicates that brightness of the product's light output degraded more during long-term use than other products tested.

Consider reading Tech Notes Issue 2: LED Lumen Depreciation and Lifetime and Issue 1: Thermal Management for LEDs via https://verasol.org/publications/led-lumen-depreciation-and-lifetime and https://verasol.org/publications/thermal-management-leds.



Lumen efficacy is the total light output divided by the power consumed by the system.

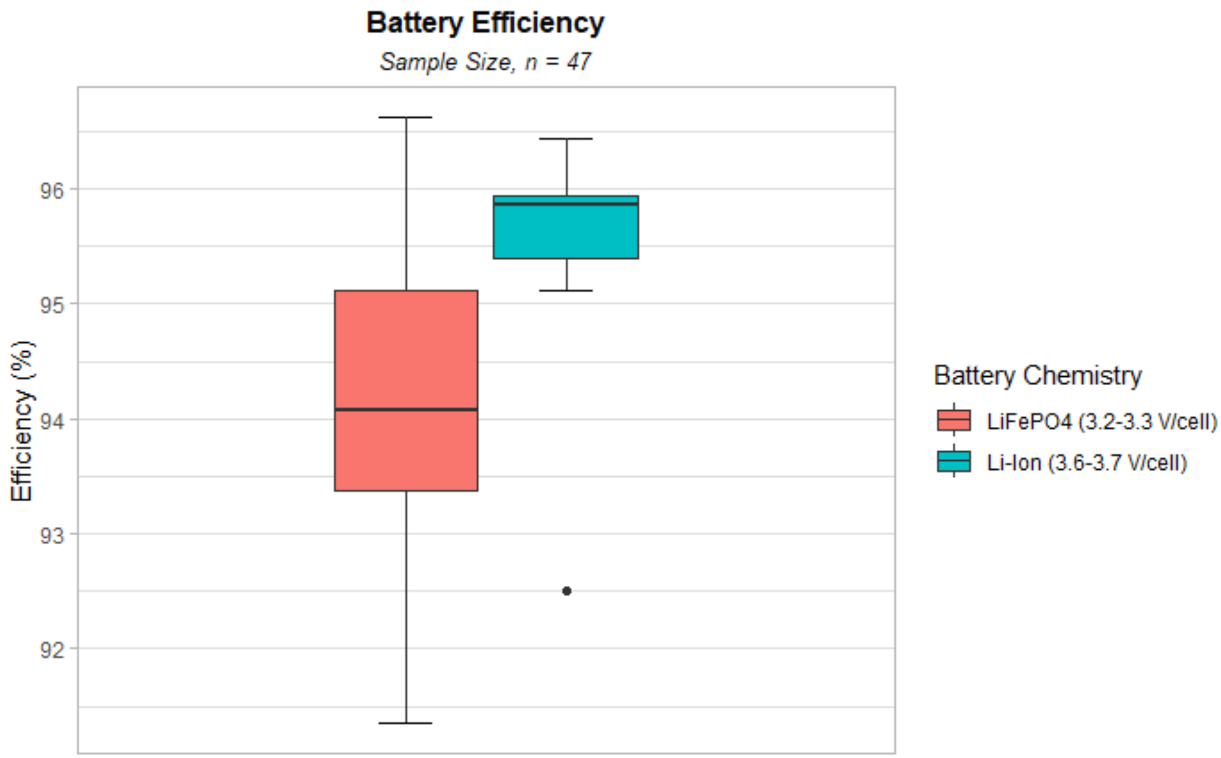
A higher lumen efficacy indicates that the product's LED and driver require less power to provide light compared to other products tested. A lower lumen efficacy indicates that the product's LED and driver require more power to provide light.

The **correlated color temperature** (CCT) is the measure of the color appearance of the light; higher values are considered cooler and low values are considered warmer.

A higher CCT indicates that the light produced by the product is cooler (more blue) compared to other products tested. A lower CCT indicates that the light produced by your product is warmer (more red). Research regarding CCT and eye safety indicates that very bright lights with high CCT can increase the risk of hazard to the human eye. See Eco-Design Notes Issue 5: LED Lights and Eye Safety Part II: Blue light hazards via https://verasol.org/publications/led-lights-eye-safety-ii-blue-light-hazards. Some market studies indicate that many consumers prefer products with lower CCT values (i.e. warmer light).

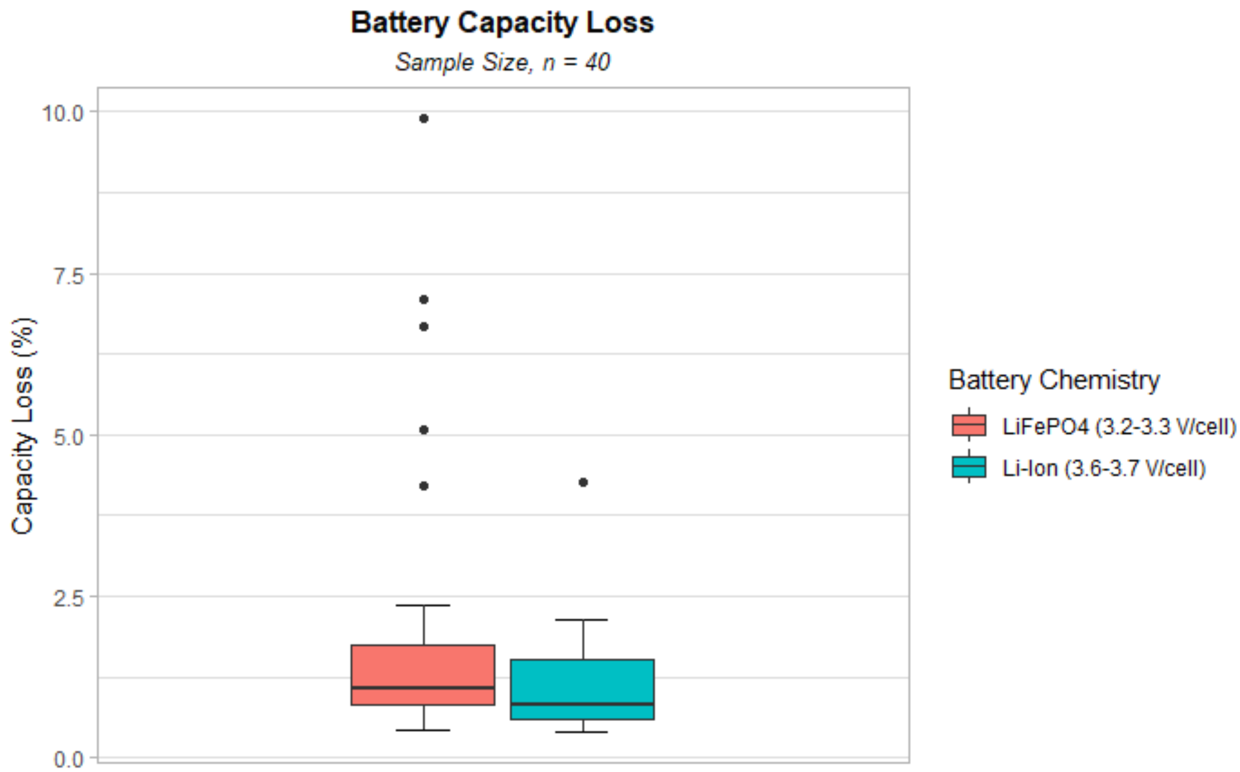
The **color rendering index** (CRI) is the measure of the light's ability to reveal colors on illuminated surfaces.

A higher CRI indicates that the product's LED package is able to reveal colors better compared to other products tested; that is, colors more closely resemble their appearance under daylight or an incandescent lamp. A lower CRI indicates that the product's LED package does not render color as well as other products tested; that is, colors less closely resemble their appearance under daylight or an incandescent lamp.



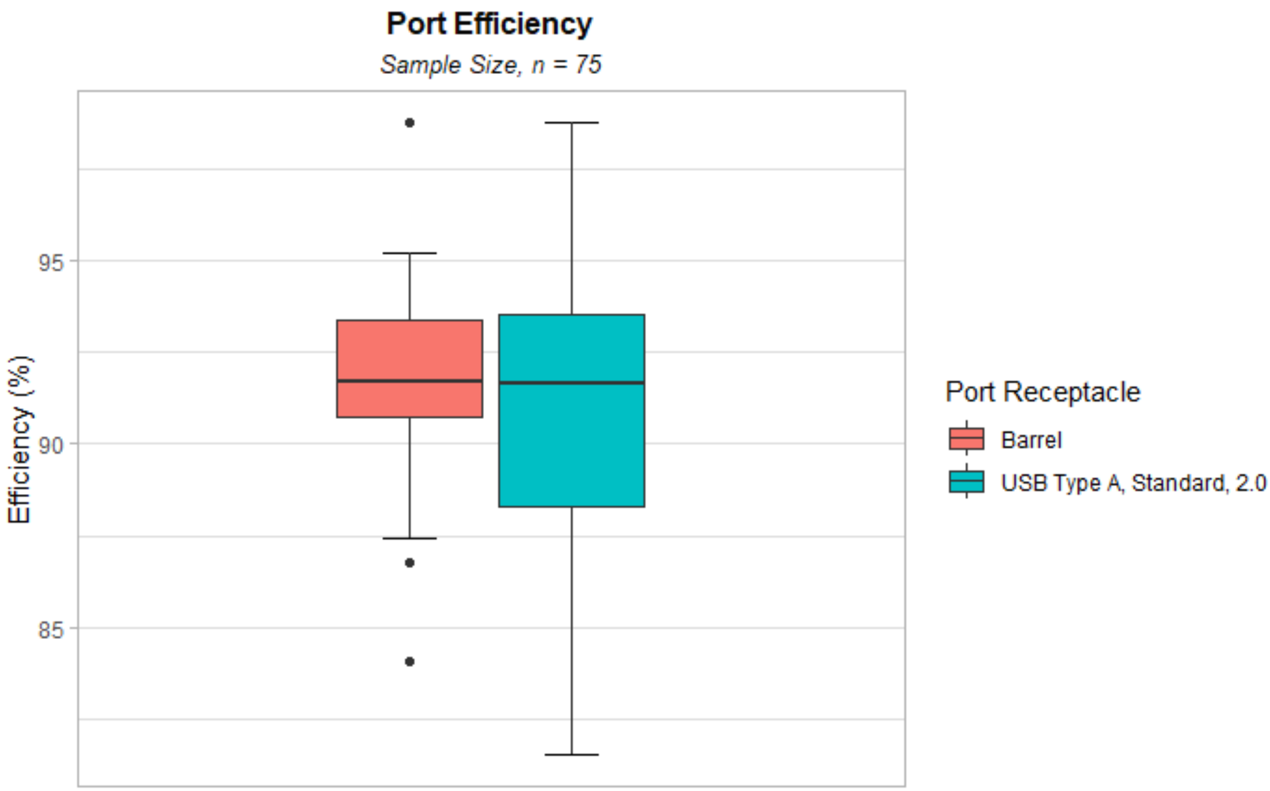
Battery efficiency is the fraction of the energy delivered to the battery during charging that is recovered during use.

A higher battery efficiency indicates that less energy is lost/wasted during charging and discharging of the product compared to other products tested. A lower battery efficiency indicates that more energy is lost/wasted during the process of energy entering and exiting your battery during charging and discharging of the product compared to other products tested.



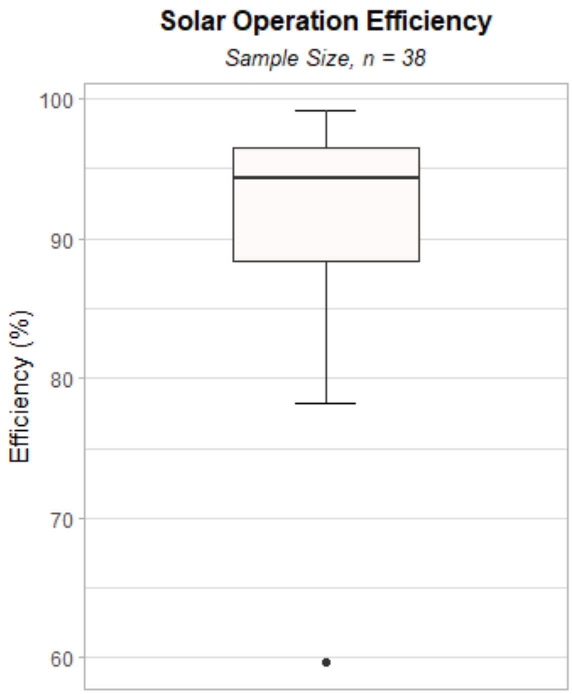
Battery capacity loss is the fraction of the battery capacity irreversibly lost due to degradation after a simulated six-month storage period.

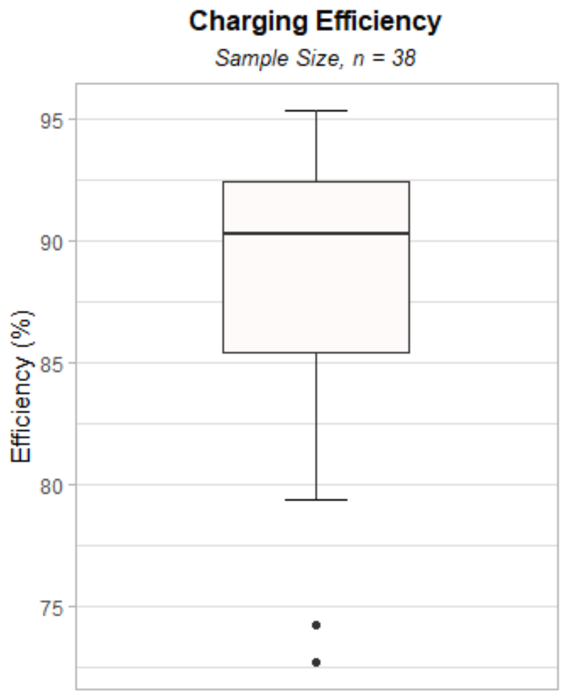
A higher battery capacity loss indicates that the product's battery degrades more during storage compared to other products tested. A lower battery capacity loss indicates that the product's battery degrades less during storage compared to other products tested.



Port efficiency is the fraction of energy from the appliance port that is delivered to the appliance when powered on.

The average port efficiency of the product's example use profile is presented in this plot. The comparative value can be found in Appendix B *Average battery-to-port efficiency for appliance combinations* of a VeraSol test report. A higher port efficiency indicates that less energy is lost/wasted when transferred from the product's battery to its USB port's output compared to other products tested. A lower port efficiency indicates that more energy is lost/wasted when transferred from the product's battery to its USB port's output compared to other products tested.





Solar operation efficiency is the ratio of the energy produced by the solar module during a typical day of solar charging to the energy that could be produced (i.e., if the module operated at the maximum power point at all times).

A higher solar operation efficiency indicates that your product is more effectively utilizing its solar module compared to other products tested. A lower solar operation efficiency indicates that your product is less effectively utilizing its solar module compared to other products tested.

Charging efficiency is the fraction of the energy input into the charging port that is delivered to the main unit's battery.

A higher charging efficiency indicates that the charging circuitry within the product, delivering energy from the generator to the battery, is more efficient than other products tested. A lower charging efficiency indicates that the charging circuitry within the product, delivering energy from the generator to the battery, is less efficient than other products tested.

About VeraSol

An evolution of Lighting Global Quality Assurance, the VeraSol program supports high-performing, durable off-grid products that expand access to modern energy services. VeraSol builds upon the strong foundation for quality assurance laid by the World Bank Group and expands its services to encompass off-grid appliances, productive use equipment, and component-based solar home systems. Like Lighting Global Quality Assurance, the VeraSol program is managed by CLASP in collaboration with the Schatz Energy Research Center at Humboldt State University. Foundational support is provided by the World Bank Group's Lighting Global program, UKaid, IKEA Foundation, Good Energies Foundation, and others.

Please visit VeraSol.org for more information.