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Lighting Global Internal Screening Test Method Results: SOLAR WHAT?!

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From: Lighting Global Quality Assurance Team

We recently received Lighting Global Initial Screening Method (LG-ISM) results for the Solar What?!. The tests were completed at the Schatz Energy Research Center in Arcata, California, and include performance, quality, and attribute measurements. This letter is a summary of the results detailed in the test report, number SERC19002ISM. The three samples arrived at the test lab on 18 August 2019. The sampling report can be provided upon request.

The results indicate that it is likely that your product would not meet **the Lighting Global Pico-PV Quality Standards**.[1] The reasons the product would likely not meet the standards include issues identified during testing related to truth in advertising, ports, performance reporting, warranty, screw terminals, and water ingress protection. Additional testing according to the Quality Test Method (QTM) procedures described in IEC Technical Specification 62257-9-5 is needed to make an official determination regarding the status of the product in relation to the Lighting Global Quality Standards.

The Lighting Global Pico-PV Quality Standards, which are required for basic program participation, include:

- Truth in Advertising, Performance Reporting and Warranty: Accurate consumer-facing labeling and basic 1-year warranty
- Lumen Maintenance: Average lumen output after 2000 hours of use ≥ 90% initial output or average lumen output after 1000 hours of use ≥ 95% initial output
- Quality: Pass basic durability, safety, and quality checks
- Ingress Protection: Physical ingress protection of IP 2x or greater (IP 3x for separate solar modules and IP 5x for permanently mounted outdoor products)
- Water Protection: Protection from permanent outdoor exposure for outdoor products, frequent rain for portable products with integrated solar modules, and occasional rain for other portable products
- Battery Protection: Protection by an appropriate charge controller that prolongs battery life and protects the safety of the user

- Battery Durability: Average battery storage capacity loss ≤ 25% after storage under adverse conditions and no more than one unit of the units tested may have a capacity loss greater than 35%
- Performance Reporting Requirements: Accurately report the product's light output and solar run time performance for its brightest setting, and if applicable, include a statement regarding the impact of mobile phone charging and/or radio use on the lighting run time

We are providing these test results to you confidentially as a service to your organization so that you can use them to further improve your product. Page 9 contains a list of next steps that will help you to address these issues. Lighting Global does not plan to release the name of your product in conjunction with these results, although we may choose to publish results or derivative analyses in a way that does not reveal the identity of the product. The following is a summary of the test results, drawing from the official test reports that are attached to this letter.

SOLAR WHAT?! Results Summary				
	Aspect	**Requirement**	**Results**	**Notes / Suggested Compliance Actions**
Quality Standards	Truth in Advertising	Accurate	The full-battery run time for the SW2001 on its high setting is rated 6 h on the product's website but measured 4.9 h (-18%) The full-battery run time for the SW2001 on its low setting is rated 96 h on the product's website but measured 53 h (-45%)	Correct the ratings on the website / packaging or change the design of the system to match the ratings.
	Ports	Ports must be accurately advertised and meet voltage requirements	The USB Port did not meet the truth-in-advertising or functionality requirements.	Improve the regulation of the 5 V port. See Required Steps for Compliance section for details.
	Performance Reporting Requirements	Report light output and solar run time, and include a mobile phone charging statement	The performance reporting for the product could not be evaluated because packaging was not provided.	Provide product packaging for evaluation.
	Warranty	1 year	The warranty could not be evaluated because no warranty information was provided.	Provide a detailed warranty in a consumer-facing location
	Lumen Maintenance	L95 or greater at 500 hours	OK	OK
	Quality Check	Functionality, wiring, soldering, cables	OK	OK
	Circuit and Overload Protection	Sufficient overcurrent and overload protection	OK	OK
	Wiring and Connector Safety	Manufacturer declares wires are appropriately sized	OK, with note	Products undergoing QTM testing are required to submit a Lighting Global Off-Grid Product Testing Declaration Form

	Battery Protection	Protect battery and user Provide safety documentation	OK, with note	Products undergoing QTM testing are required to submit battery safety documentation.
	Battery Durability	25% or less capacity loss, no more than one greater than 35% capacity loss	OK	OK
	PV Overvoltage Protection	Sufficient protection from PV voltage when battery removed	OK	OK
	Miswiring Protection	Product design sufficiently protects from misconnections	OK	OK
	Drop Test Durability	Functionality, safety	OK	OK
	Switch, Connector, and Strain Relief Durability	Functionality, safety	OK	OK
	Screw Terminal	Adequate tools, materials, and instructions provided, and safety	Adequate instructions are not provided for non-plug and play connections	Provide additional instruction for the non-plug and play connections in a consumer-facing location.
	Water Exposure Protection	SW2001:Occasional rain or equivalent	The product does not meet IPX1 and does not have an adequate warning label for ingress protection.	Improve the level of water protection. See Required Steps for Compliance section for details.
		PV module: Permanent outdoor exposure or equivalent	OK	OK
		SW001: Occasional rain or equivalent	The torch does not meet IPX1 and does not have an adequate warning label for ingress protection.	Improve the level of water protection. See Required Steps for Compliance section for details.
	Physical Ingress Protection	SW2001 and SW1001: IP 2x	OK, with note	The SW2001 met IP3X and the SW1001 met IP4X
		PV module: IP3x	OK	OK

Product Comparison

The box plots below show how the Solar What ?! performs compared to other products that have been tested through the Lighting Global program within the past year for the following metrics:.

Lighting

- lumen maintenance – fraction of total light output remaining after 2000 hours of continuous use
- lumen efficacy – total light output divided by the power consumed by the system
- correlated color temperature – measure of the color appearance of the light; low values are considered warmer and higher values cooler
- color rendering index – measure of the light's ability to reveal colors on illuminated surfaces

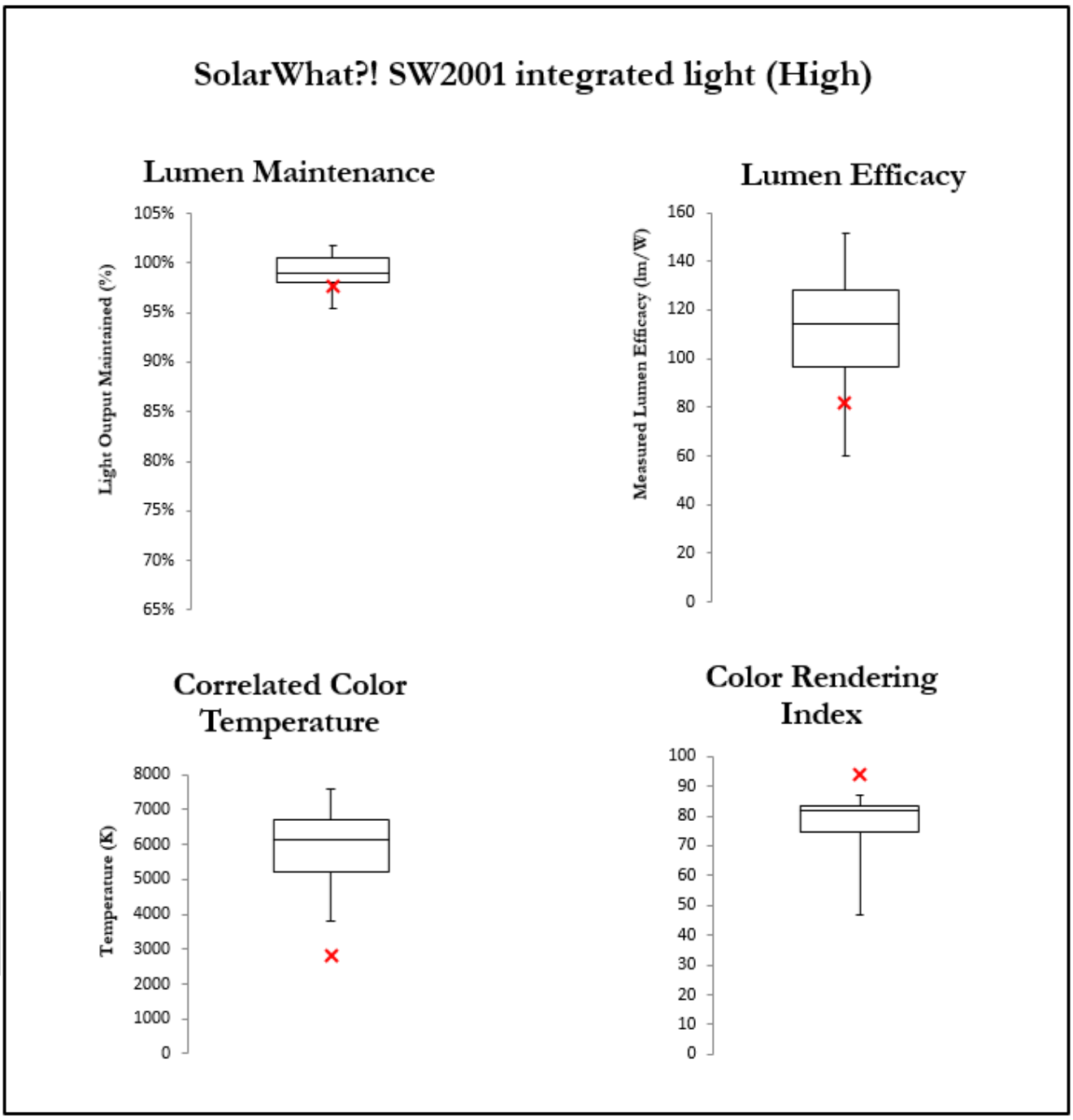
Battery

- battery efficiency – fraction of the energy delivered to the battery during charging that is recovered during use
- battery capacity loss – fraction of the battery capacity irreversibly lost due to degradation of the battery after a simulated six-month storage period

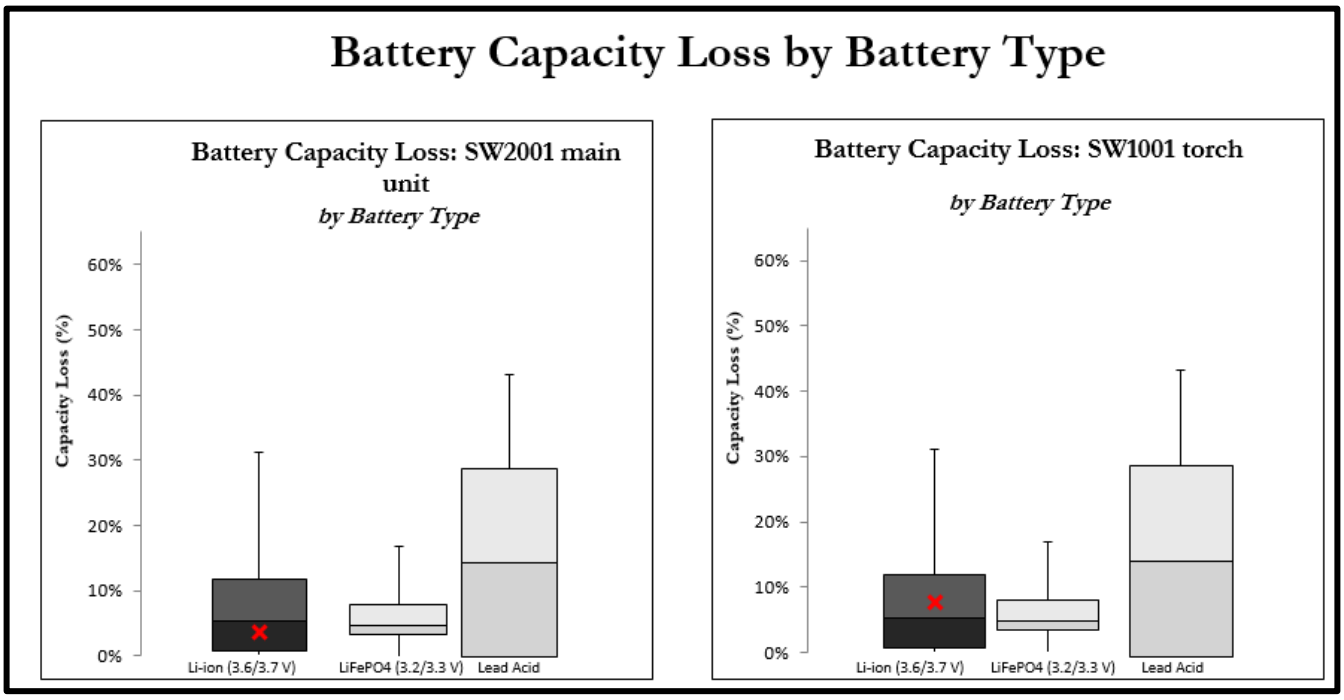
Ports and Charging

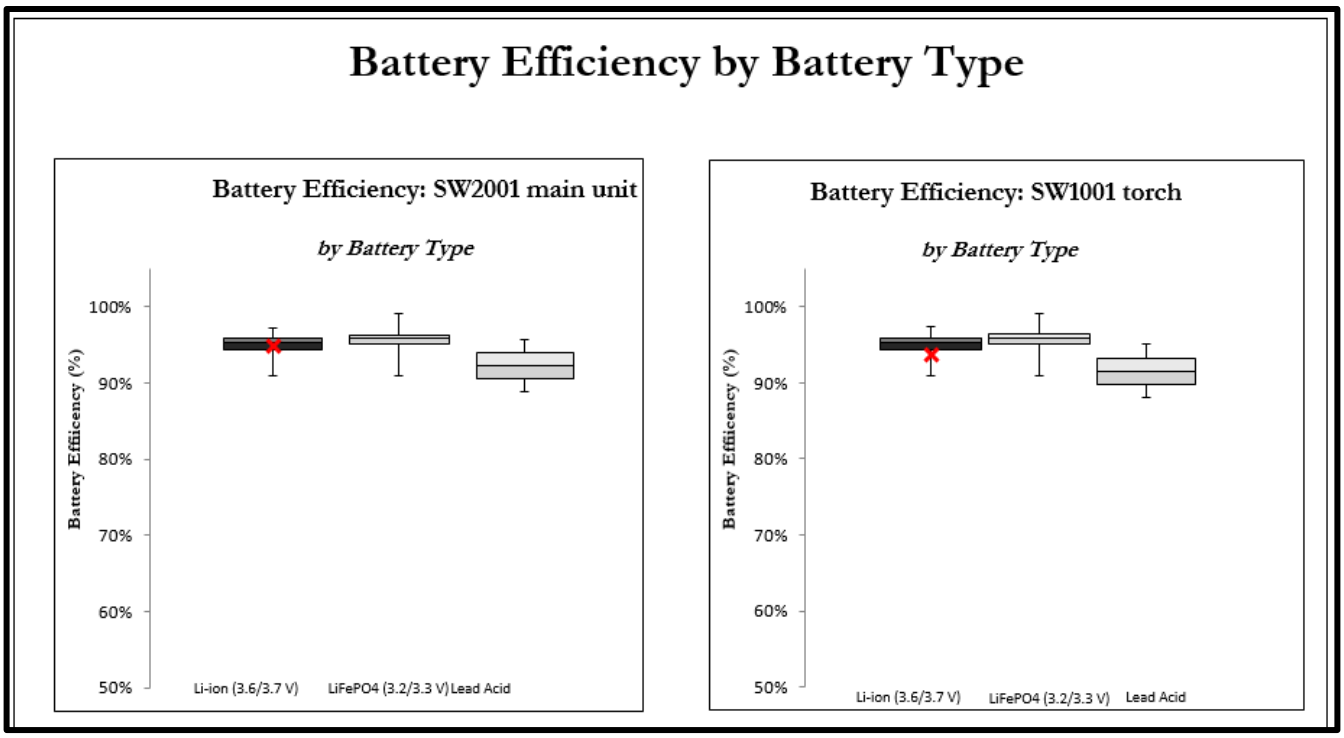
- ports efficiency – fraction of energy from the appliance port that is delivered to the appliance when powered on
- solar operation efficiency – ratio of the energy produced by the solar module during a typical day of solar charging to the energy that could be produced (i.e., if the module operated at the maximum power point at all times)
- charging efficiency – fraction of the energy input into the charging port that is delivered to the battery

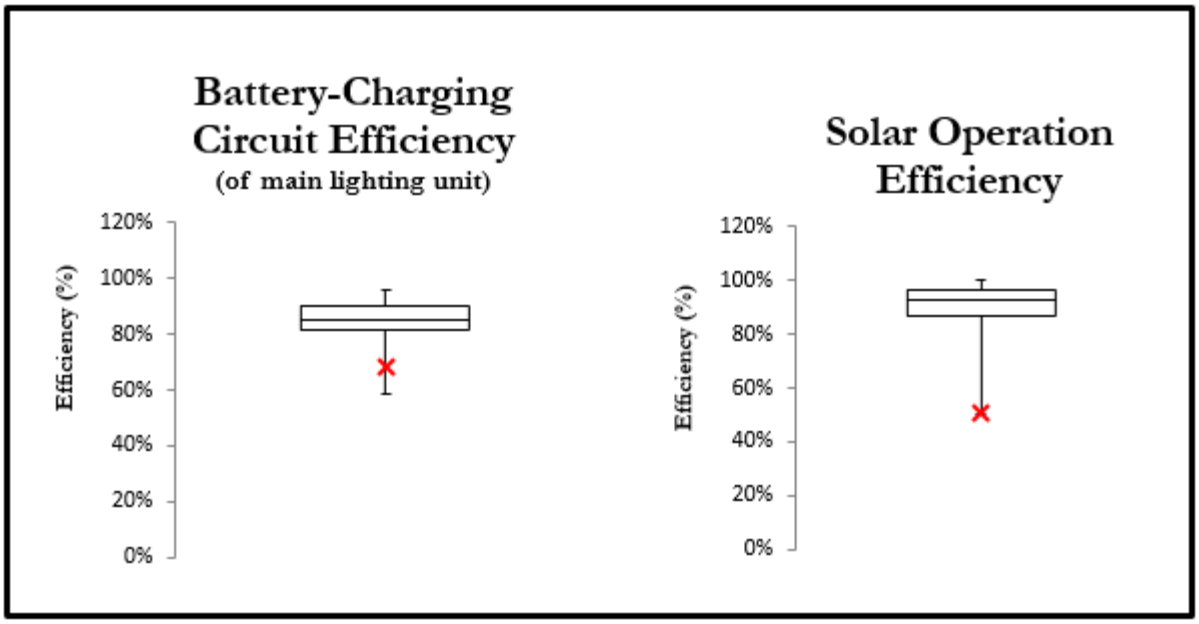
In each box plot, the center horizontal line represents the median value of the performance metric for products that have been tested within the past year. The box includes the values between the first and third quartiles (i.e., the middle 50%). The ends of the whiskers show the minimum and maximum values observed. The red X represents the Solar What?!'s performance.



- The lumen efficacy of the Solar What?! SW2001 is notably low compared to other products that have been tested through the Lighting Global program within the past year. A lower lumen efficacy indicates that your product's LED and driver require more power to provide light compared to other products tested. You may consider improving the energy efficiency of the main control unit and light bulbs. This could allow the product to provide a brighter light or longer run time using the existing solar module and battery.
- The correlated color temperature (CCT) of the Solar What?! SW2001 is notably low compared to other products that have been tested through the Lighting Global program within the past year. A lower CCT indicates that the light produced by your product is warmer (more red) compared to other products tested. Consumer preferences regarding light color vary, and there is no consensus on the ideal CCT value for off-grid solar lamps. Nonetheless, some market studies indicate that many consumers prefer products with lower CCT values (i.e. warmer light). 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 Lighting Global Eco-Design Notes Issue 5: LED Lights and Eye Safety Part II: Blue light hazards via www.lightingglobal.org/resources/?fwp_resource_type=eco-design-notes.
- The color rendering index (CRI) of the Solar What?! SW2001 is notably high compared to other products that have been tested through the Lighting Global program within the past year. A higher CRI indicates that your 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.







- The battery-charging circuit efficiency of the Solar What?! SW2001 is notably low compared to other products that have been tested through the Lighting Global program within the past year. 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.
- The solar operation efficiency of the Solar What?! is notably low compared to other products that have been tested through the Lighting Global program within the past year. A lower solar operation efficiency indicates that your product is less effectively utilizing its solar module compared to other products tested.

Product Strengths

- The product is well constructed, and the workmanship is good.
- The Solar What?! maintains its luminous output over 500 hours of continuous use.
- The housing appears to be sturdy.

Required Steps for Compliance

- Properly rate the product's full-battery run time in all consumer-facing locations. The full-battery run time for the SW2001 on its high setting is rated 6 h on the product's website but measured 4.9 h (-18%). The full-battery run time for the SW2001 on its low setting is rated 96 h on the product's website but measured 53 h (-45%).
- Properly rate the current of the USB port. Currently the port is rated to deliver up to 5 A, but the measured maximum current was 0.36 A.
- Include a consumer-facing warranty of at least 1 year for all product components, including the product's battery. The warranty must include information regarding the terms of the warranty and how to access the warranty. Details of the warranty requirements are available here: http://www.lightingglobal.org/resource/performance-reporting-requirements/
- Improve the voltage regulation of the USB ports. These ports must meet the voltage requirements listed in footnote d of the Pico PV Quality Standards. The product does not meet the Standard for USB port functionality because its USB port voltage is outside the allowable thresholds. The Standards require that the USB port not fall below 4.5 V and never exceed 5.5 V under all test conditions, except the deep discharge protection voltage (USB voltages of 4.25 V are permitted when the product's battery has reached the deep discharge protection cutoff). The Solar What's USB port voltage falls below the proposed requirement; falling to 4.37 V. The current for the USB port is rated 0.5 A, but measured 0.36 and therefore does not meet the truth-in-advertising requirement for ports. Redesign the port regulation so that it functions within the allowable threshold at high battery voltages.
- Improve the level of water protection for the SW1001 and the SW2001. As portable separate products, the product must have water protection against occasional rain. This could be achieved using one of three options:
    - Meet IPX1 – vertical water drip. This could be done by adding gaskets, improving jack positioning, covering jacks, and/or reducing manufacturing tolerances.
    - Include an appropriate consumer-facing warning label to keep the product from water exposure. The warning label must explain **the degree of protection from water provided by the product** (e.g., "Designed for indoor use") AND **steps a consumer should take to prevent water exposure and to drain or dry the product** (e.g., "Protect the product from exposure to water. If the product gets wet, …")
    - OR include a technical level of water protection, such as a conformal coating and a proper water removal strategy.

- Report the product's light output and solar run time for the brightest setting and include a statement regarding the impact of mobile phone charging on lighting run time on the product packaging. Detailed guidelines are described in the Performance Reporting Requirements Policy here: http://www.lightingglobal.org/resource/performance-reporting-requirements/
- The product does not meet the requirements for screw terminals for the following reasons:
    - Adequate instructions for making the connections, a list of required tools, information regarding the type of battery and size of PV module to be used with the product, and adequate description for identifying wires to avoid incorrect connections were not provided in writing with the product. This information is provided in the on-line user manual, but must be available in writing in order to meet the requirements.
    - There are no evident physical barriers on the screw terminal block to prevent short-circuiting the PV leads. The Lighting Global Standards require short circuit protection for the leads from the battery to PV module.
    - There is no statement reporting that the terminals are for indoor use only provided in writing nor provided on the product's website.

Next Steps

- Because the ISM results indicate that the Solar What?! is unlikely meet the Quality Standards, we recommend that you take action to bring your product in line with the Quality Standards. The key points of failure for not meeting the Quality Standards are summarized above. Once these changes have been made, we suggest you coordinate with the Lighting Global Quality Assurance Team to submit the Solar What?! for testing according to the Quality Test Method (QTM) approach.

In addition, Lighting Global has produced a series of technical notes and eco design notes on off-grid lighting that you may find helpful going forward; they are available at:
http://www.lightingglobal.org/resources/?fwp_resource_type=technical-notes
and
http://www.lightingglobal.org/resources/?fwp_resource_type=eco-design-notes

We are always looking for feedback on the Lighting Global Quality Assurance process and framework. If you found these results helpful, please write to tell us how you plan to use them.

-Lighting Global Quality Assurance Team