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## Lighting Global Quality Test Method Results: SunBell 2.0 Y

**To: Olivier Butstraen**  
**Bright Products**  
**Hoffsveien 17a, 0275 Oslo, Norway**  
**sam@bright-products.co**

**From: Lighting Global Quality Assurance Team**

We recently received Lighting Global Quality Test Method results for the SunBell 2.0 Y. The tests were completed at Shenzhen Academy of Metrology and Quality Inspection in Shenzhen, Guangdong, China, and include performance, quality, and attribute measurements. Intertek personnel procured the 7 samples that were tested, which arrived at the test laboratory on 11 December 2017. The sampling report can be provided upon request. This letter is a summary of the results detailed in the test report, number WT175200641. Tests were conducted to verify the product's performance after the manufacturer made upgrades to improve the product's full-battery run time. Additional test results for the original QTM testing of the Sun Bell 2.0 are detailed in test report number WT175200173 from SMQ.

Overall, your product meets the Lighting Global Quality Standards.<sup>1</sup>

The Lighting Global *Quality Standards*, which are required for basic program participation, include:

- Truth in Advertising and Warranty: Accurate consumer-facing labeling and basic 1-year warranty
- Lumen Maintenance: Average lumen output after 2000 hours of use  $\geq$  85% initial output or average lumen output after 1000 hours of use  $\geq$  95% initial output
- Quality: Pass basic durability 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

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<sup>1</sup> A description of Lighting Global Quality Assurance framework with links to detailed documents is available here: <http://www.lightingglobal.org/quality-assurance-program/>

- Battery Durability: Average battery storage capacity loss  $\leq 25\%$  after storage under adverse conditions and no more than one unit of the six tested may have a capacity loss greater than 35%
- Performance Reporting: 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. 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.

SUNBELL 2.0 Y Results Summary				
	Aspect	Requirement	Results	Notes / Suggested Compliance Actions
Quality Standards	Truth in Advertising	Accurate	OK	OK
	Performance Reporting	Accurately report light output, solar run time and include a mobile phone charging statement	OK	OK
	Warranty	1 year	OK	OK
	Lumen Maintenance	L85 or greater at 2000 hours, or L95 or greater at 1000 hours	OK	Results referenced from report number WT175200173 from SMQ.
	Quality Check	Functionality, wiring, soldering	OK	OK
	Battery Durability	25% or less capacity loss, no more than one greater than 35% capacity loss	OK	Results referenced from report number WT175200173 from SMQ.
	Drop Test Durability	Functionality, Safety	OK	
	Switch, Connector, and Strain Relief Durability	Functionality, Safety	OK	

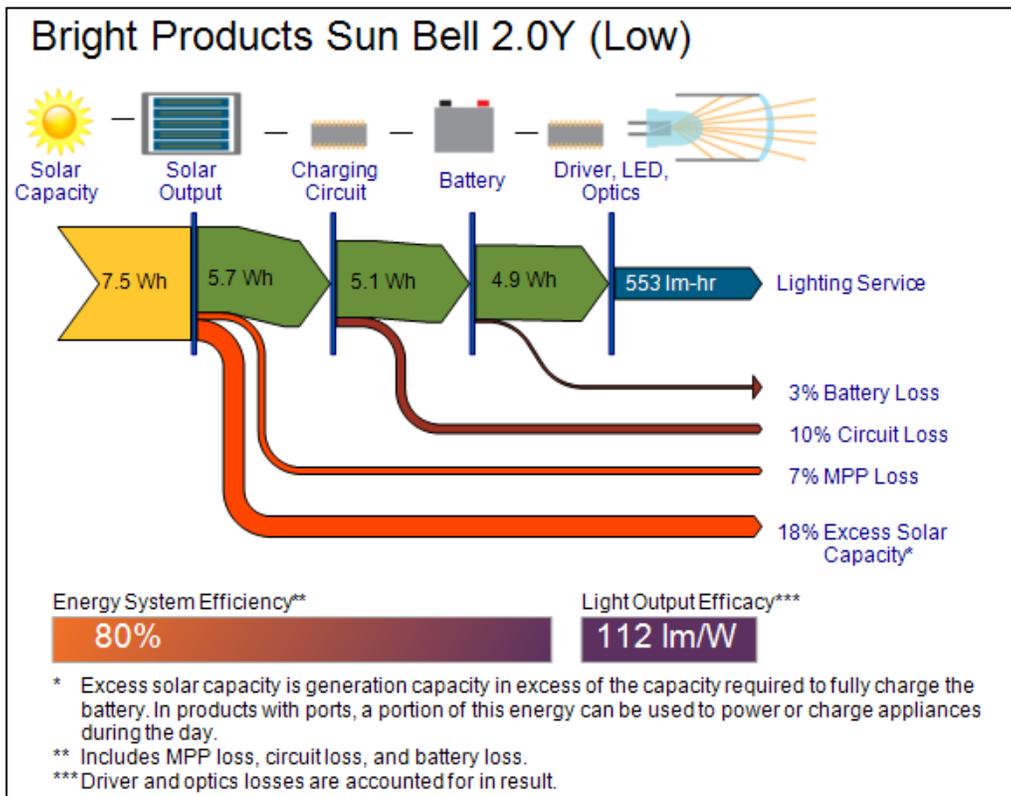
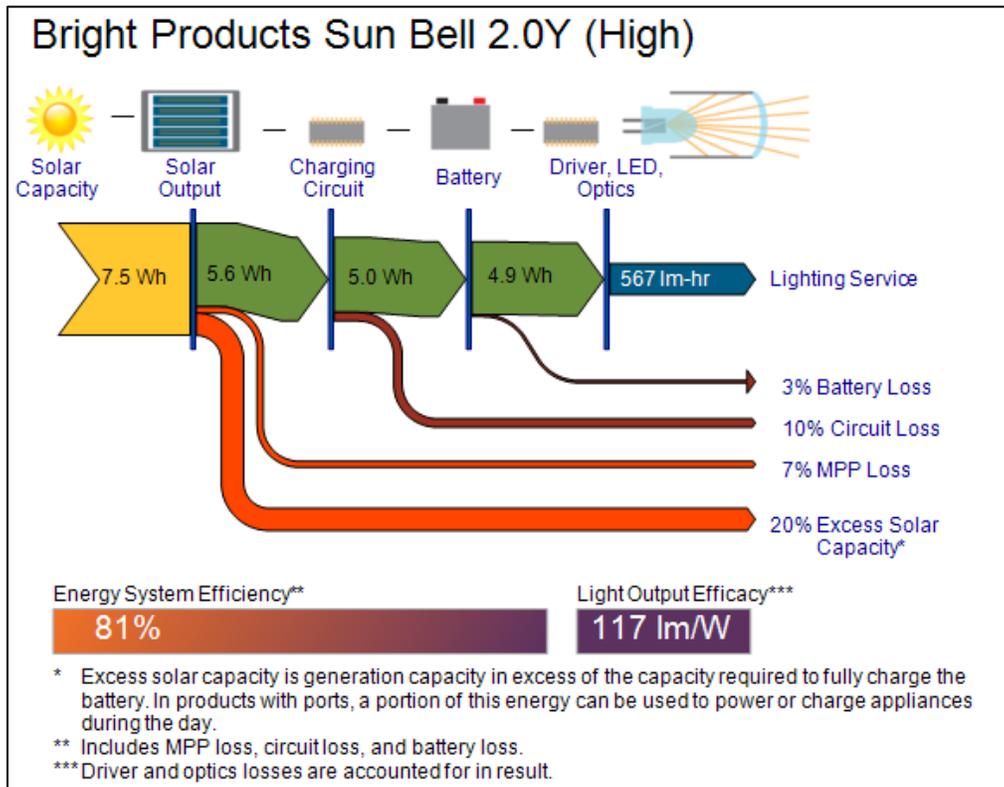
	Water Exposure Protection	Lighting Unit: Frequent Rain or Equivalent Solar Module: Permanent Outdoor Exposure or Equivalent	OK		Results referenced from report number WT175200173 from SMQ.
	Physical Ingress Protection	Lighting Unit: IP 2x Solar Module: IP 3x	OK		
	Battery Protection	Protect battery and user	OK		
Performance Results	Setting		High	Low	The product's results are close to or exceed all its consumer-facing ratings.
	Brightness	Luminous flux (lm)	90	6.2	
	Run Time	Solar run time (h)	6.3	89	
		Full-battery run time (h)	6.3	89	

#### System Efficiency:

The diagrams below show how system-level efficiencies combine to result in the service provided by the SunBell 2.0 Y. In the diagram, the first (left-most) arrow indicates the maximum solar energy available to the product assuming a 5 kWh/m<sup>2</sup>/day solar resource and the product's measured PV module power. The product is able to only use a portion of the total available solar energy because the PV module does not operate at its maximum power point (MPP) at all times and, in some cases, because the battery capacity limits the amount of solar energy that can be captured. For products with ports, a portion of the unused solar energy could be captured by using appliances or charging mobile devices during the day; in some products, daytime use can also reduce the MPP loss.

Additional energy losses occur due to inefficiencies in the circuitry and battery storage. Energy that is discharged from the battery is converted to light. That conversion is referred to as a light output efficacy. It accounts for losses in the driver circuit, the LED chip efficiency, and losses in light from any diffusers or optics that are present.

The bottom row of values in the diagram provides the product's estimated energy system efficiency and light output efficacy (in units of lumens per watt).



## Product Comparison

The box plots below show how the SunBell 2.0 Y on the High setting performs compared to other pico-solar products that have been tested through the Lighting Global program within the past year. The plots highlight notable metrics:

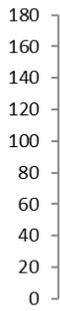
- lumen efficacy – total light output divided by the power consumed by the system
- lighting service – product of the solar run time and light output, in units of lumen-hours/day, with a daily solar resource of 5 kWh/m<sup>2</sup>
- battery efficiency – fraction of the energy delivered to the battery 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
- 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
- lumen maintenance – fraction of total light output remaining after 2000 hours of continuous use
- 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

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 SunBell 2.0 Y's performance.

# Bright Products Sun Bell 2.0Y (High)

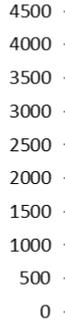
### Lumen Efficacy

Measured Lumen Efficacy (lm/W)



### Lighting Service

Service (lm-h/day)



### Battery Capacity Loss

Capacity Loss (%)



### Solar Operation Efficiency

Efficiency (%)



### Charging Efficiency

Efficiency (%)



### Battery Efficiency

Efficiency (%)



### Lumen Maintenance

Light Output Maintained (%)



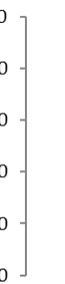
### Correlated Color Temperature

Temperature (K)



### Color Rendering Index

Index



### Product Strengths

- The product is well constructed, and the workmanship is good.
- The housing appears to be sturdy.
- The lumen maintenance of the SunBell 2.0 Y is notably high compared to other products that have been tested through the Lighting Global program within the past year. A higher lumen maintenance indicates that your product maintains its original brightness more fully during long-term use than other products tested.
- The solar operation efficiency of the product name is notably high compared to other products that have been tested through the Lighting Global program within the past year. A higher solar operation efficiency indicates that your product is more effectively utilizing its solar module compared to other products tested.
- The battery efficiency of the product name is notably high compared to other products that have been tested through the Lighting Global program within the past year. A higher battery efficacy indicates that less 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.

### Next Steps

- Because your product meets the Quality Standards, it is immediately eligible to use a Lighting Global Standardized Specifications Sheet. There is a draft specifications sheet included in this package of results and feedback. Please coordinate with Lighting Global personnel to fill in any missing information and finalize the specifications sheet and verification letter if you wish to participate in the program.
- Your company may also be eligible to receive additional Business Development Services from Lighting Africa, Lighting Asia and Lighting Pacific if you become a Lighting Global Associate. Please coordinate with Leo Blyth at [bds@lightingglobal.org](mailto:bds@lightingglobal.org) for matters related to accessing Lighting Global Business Development Services. He can help inform you about the next steps and put you in contact with Lighting Africa, Lighting Asia, or Lighting Pacific personnel to coordinate the process of becoming an Associate with those programs. Note that your firm would need to meet additional requirements and pass a World Bank Group due diligence check to qualify for Associate status.
- Your company may make ongoing, incremental changes to your product. You should alert us when these occur. If the changes to performance are small (e.g., making a small update to the Standardized Specifications Sheet), no further testing will be required to maintain your status with the program. Large changes (generally, greater than 10% differences) may require targeted re-testing to maintain your status.
- After two years, renewal testing will be required. In general, if no changes have been made to the product, Associate Renewal testing, which involves a sample size of  $n = 2$  for each test and an abbreviated (500 hour) lumen maintenance test, may be used. If a limited number of changes have been made to the product, renewal may be based on a custom test plan involving  $n = 2$  testing for parameters that are unaffected by the changes and  $n = 6$  testing for parameters that are affected by the changes. If a number of changes have been made, full QTM retesting at a sample size of  $n = 6$  for all tests may be required. Lighting Global has the sole discretion to determine the type of test that must be used to renew the status of the product. While renewal testing typically takes less than 2 months, we recommend contacting Lighting Global at least 4 months in advance of the product's expiration to allow time for product sampling, shipping, testing and reporting.

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](http://www.lightingglobal.org/resources/?fwp_resource_type=technical-notes)

And

[http://www.lightingglobal.org/resources/?fwp\\_resource\\_type=eco-design-notes](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*