

## **SELF AUTONOMY – THE HOLY GRAIL OF SOLAR STREETLIGHTS**

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**INTRODUCTION:** Solar street lighting is a wireless solution with the potential to be the global technology of choice for all the outdoor lighting requirements. One of the key requirements in these streetlights is the need for autonomy or light functionality on cloudy days. The most prevalent solution which also comes with inherent limitations is based on lead acid batteries. We will review the fallacy with existing systems and provide a solution based on lithium ion battery technology.

**AUTONOMY:** Solar panels generate electricity based on the intensity of sunlight. On cloudy days the output of solar panel power generation drops to less than 50% levels depending on the type of cloud cover.

The lead acid external battery based streetlight solutions have high losses due to

- a. Long cables required to connect the solar panel and the battery
- b. Low efficiency (70 to 75% typical) PWM based charge controllers used in these systems

The above results in negligible charging of battery on cloudy days. The conventional wisdom has been to double or triple the battery size to enable proper backup/autonomy for one to two continuous days of cloudy weather. This is just a band aid and creates other issues like:

- a. Increased cost of battery, installation and maintenance
- b. The battery is fully discharged after one or two days of cloudy weather. Post this scenario the battery gets partial charging on a daily basis (unless the solar panel is so large that it can charge the battery completely in a day). This is detrimental and leads to a reduction in the lifetime of the lead acid battery.

**SOLUTION:** The proper solution to provide autonomy is by reducing the system losses by minimizing the wire and charge controller losses. This allows the right battery sizing which avoids partial charging (to maintain reliability) while enabling 'self autonomy'.

Picture 1 below is a battery inbuilt into the luminary thus reducing cable lengths with a high efficiency (>90%) charge controller.

Picture1: Solar streetlight with inbuilt lithium ion battery and charge controller

Lithium Ion battery is a key piece of technology to enable Self Autonomy for the following reasons:

- a. The high energy density of Lithium ion cells helps reduce the size of the battery pack which can then be integrated into the luminary thereby minimizing cable lengths

- b. Battery management system (BMS) for lithium ion can be made >90% efficient with the use of state of the art electronics

Below is a comparison depicting the lead acid and the lithium ion based solutions.

**SUNWAY:** Picture 2 below shows 0.5Amp current being pumped into the battery from a 35W solar panel on a cloudy day with our Sunway LI3 model. This is about 30% of the typical current (1.5amp) from this panel seen on a sunny day.



Picture2: Sunway charging on a cloudy day

Another key feature required to create self autonomy is automatic dimming. The Sunway LI3 has a 3 stage dimming with the third level at about 40% light intensity of the peak and providing 10hours of backup while consuming about 30% of the battery capacity.

Table1 below shows UL certification for >9hours of runtime with only 40% of battery charged as seen on a typical cloudy day with our Sunway platform. This essentially results in what is known as 'self autonomy' providing runtime on any cloudy day rather than one or two days seen with the conventional solutions. This is achieved without having to oversize the battery or solar panel which ensures that the maximum lifetime out of the battery by avoiding the partial charging scenario.



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	off)			
	c. Load cut- off voltage	>11V	11.60 V	
	d. Over charge cut- off	<17.4V	16.74 V	
	e. No load current	<10mA	4.59 mA	
6	<b>Other features</b> Duty Cycle-Full charge of battery on sunny day	3hr/3hr/6hr for dusk to dawn	3hr/3hr/10.6hr	Refer table below for results
	Autonomy-40% charged battery under cloudy condition	6Hrs	>9hrs	30.7Wh is the 40% of battery capacity

Table1: UL test report on Sunway LI3

**CONCLUSION:** Self autonomy in solar streetlights is the key for its widespread acceptance as the first choice for any outdoor lighting. The fallacy with the conventional lead acid based systems has led to many issues on solar streetlights. The concept of Self Autonomy with lithium ion technology with dimming and smart efficient electronics is the proper solution to provide runtime on cloudy days while maintaining the battery lifetime. Sukam with its partner Intelizon has for the first time introduced the Sunway platform providing a reliable wireless outdoor lighting solution and enhancing its reputation as a world class innovator.