gridComm In Jakarta Smart Street Lightings

1.0 Overview

Indonesian cities typically have sub-optimal street lighting systems, with illegal connections, limited metering coverage, and poor service standards. Cities commonly use inefficient mercury and sodium lamps rather than modern lamp technologies.

Only a few cities including Yogyakarta and Makassar have implemented full metering and are switching to more efficient technologies such as LEDs. This shows that 50-80% of a city's street lighting electricity bill can be saved by optimizing the system.

The national utility, PLN, recovers the cost of electricity used for street lighting and currently bills cities on a 'lump sum' basis which tends to overestimate consumption. Many cities are unable to further increase their tax receipts for providing street lighting to inhabitants and are now facing budgetary shortfalls as a result (bills issued by PLN already or will soon exceed the tax receipts).

Due to the slow pace of installing metering in Indonesian cities and the current billing practices, cities have very little incentive to install more energy-efficient street lighting. As such, the Indonesia government has launched a Smart Street Light Initiative (SSLI) in 2014 under the NAMA (Nationally Appropriate Mitigation Actions) framework established to tackle the above issues.

1.1. SSLI NAMA Objectives

In 2011, about 3068 GWh or 2.3 million tons of CO2 resulted from public street lighting's power consumption. Up to 40% of CO2 emission reductions can be achieved with more efficient lighting technologies and management.

Hence, the SSLI NAMA objectives are obviously to:

a) Increase the energy efficiency of street lighting by substituting conventional street lighting systems with more efficient street lighting technologies in Indonesian cities and urban areas.
b) Reduce energy consumption on the supply side, thus leading to a reduction in greenhouse gas (GHG) emissions resulting in a more efficient, stabile and less carbon intensive energy system.
c) Achieve 400,000 tCO2e emission reduction by 2020; considering the current average lifetime (10 years) of LED street lighting technologies, the SSLI NAMA would achieve up to approx. 1,400,000 tCO2e in 2024.

The emission reduction targets can be achieved via implementing several measures such as replacing the traditional mercury or sodium vapor street light bulbs with the more efficient LED lights, implementing smart street light control systems, installing metering systems and improving cable quality and construction workmanships etc.

Besides the core objectives, the SSLI will also bring about other co-benefits such as:

- reduced GHG emissions
- promotion of energy efficient technologies
- energy security of supply (reduced electricity load)
- electrification (by freeing up existing and new capacity)
- phase out of electricity subsidies
- job creation in value-added installation and maintenance
- improved public lighting and living quality
- improved night-time safety in cities
- leverage of public and private investment

2.0 PT. SIKLON ENERGI NUSANTARA Selects gridComm As Partner

PT. SIKLON ENERGI NUSANTARA (Siklon), an ISO 9001 & ISO 14001 company, is Indonesia's first truly LED street light manufacturer with advance manufacturing capability producing high quality LED products. gridComm collaborates with Siklon to conduct test trials in Jakarta in early 2015 as required for bidding the first SSLI tender of 50Ku of street lights. gridComm enables Siklon with a suite of end-to-end Power-Line-Communications-based (PLC) smart street light solution comprising the web-based management software, the concentrator and the individual smart light controller/digital power supply while Siklon integrates and deploys the solution into their LED street lights. The tender attracted interests from several companies amongst some internationally renowned brand names. Eventually, Siklon along with gridComm's solution emerged as one of the very few companies to win the tender with the highest reliability and lowest cost. Over the next few years, 250Ku of traditional street lights in Jakarta will be fully replaced. Companies that offered RF instead of PLC technologies for this tender were all disqualified due to reliability issues. The success in Jakarta has boosted SIklon's confidence advancing into other major cities beating the competition hands-down.

Figure 1 - Siklon REVOLED Street Light

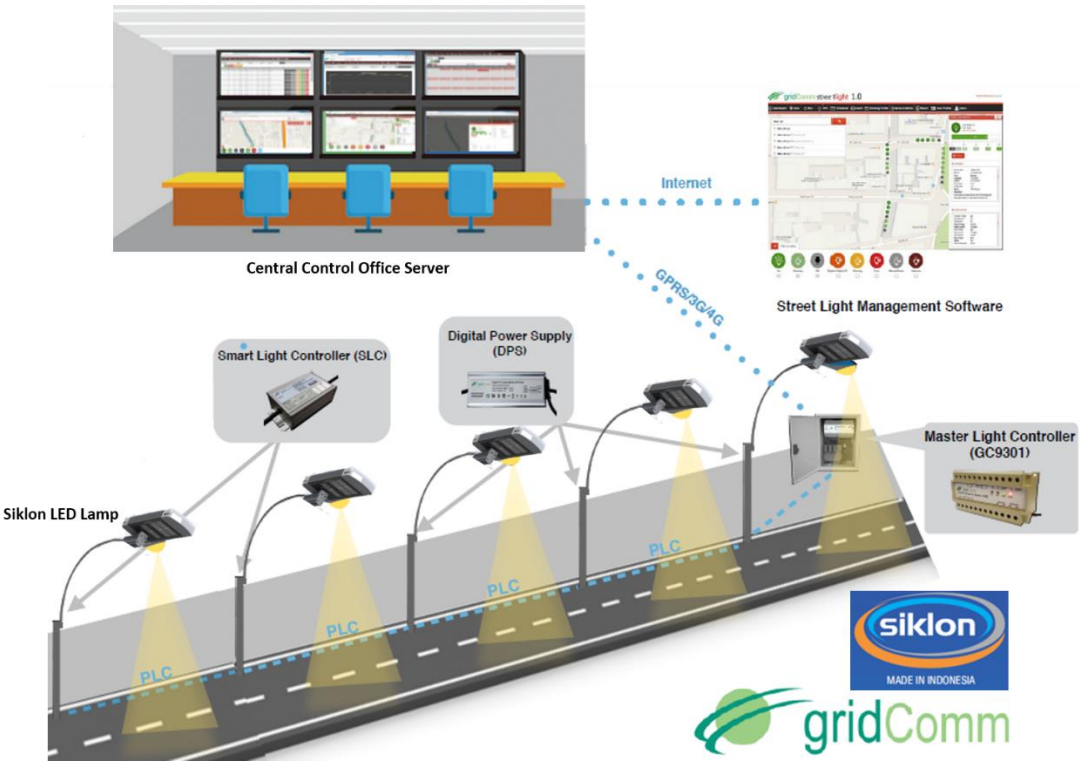

Figure 2 – gridComm-Siklon Smart Street Light System

3.0 Core Technology Superiority

gridComm solution makes use of the existing power lines to perform communications with the street lights. This has the advantage of avoiding to lay dedicated communication cables which could be costly and inconvenient. Besides, the fact that communications take place in power lines, there will not be external interferences from wireless signals which could cause the street light control to be unreliable.

gridComm's patented Digital Power Supply is able to support a wide AC input range from 90V to 300V. Implemented with a programmable MCU, it is adaptive to different types of load with lesser components and simpler circuit design delivering huge cost-saving advantage and longer life span.

3.1 gridComm PLC versus competitions

gridComm's PLC-based smart street light solution is the preferred choice for Jakarta because the underlying PLC technology utilizes gridComm's flagship OFDMA (Orthogonal Frequency Division Multiple Access modulation technique) PLC transceiver chip, GC2200, that scans and selects the best frequencies in noisy environments providing both flexibility and opportunity for full redundancy. The GC2200 is ideal for use in noisy environments where it is effective in tackling signal variations that are commonly present in power line applications due to signal attenuation, impulsive noise, and changes in line impedance. GC2200 automatically configures and self-adapts to the varying conditions on power lines, resulting in extremely reliable and robust communications in a Low-Voltage power network. The GC2200 has 18 independent channels capable of operating with up to 54 carrier frequencies over a wide frequency range of 5 KHz to 500 KHz. This is in stark contrast to other PLC technologies such as FSK and other OFDM modulation schemes.

While FSK largely operates on a single fixed frequency which can be easily interfered with impulse noise, hence providing less reliability. OFDM, such as the G3 and PRIME standard, which is better than FSK due to its capability to switch between frequencies, however requires a minimum number (overhead) of carrier frequencies to work within the operable band of frequencies. Therefore, robustness becomes an issue for these OFDM standards in very noisy environments where minimum number of carrier frequencies cannot be easily obtained. This is where the GC2200's OFDMA technology truly shines, scaling from 1 to 54 carrier frequencies with additional flexibility available through redundancy settings.

Wireless RF technology (specifically the low-power Zigbee and Bluetooth which are meant for creating Personal Area Networks) can also be found in some small scale street light trial deployments. However, RF suffers from inherent limitations in outdoor applications. It is not as robust as PLC because it is susceptible to many types of interference including wireless signals from a dense city with similar frequency. Weather and obstructions such as metal, trees or walls can also disrupt RF communications, causing them to become unreliable. Imagine when the communication signals of a particular street light node on the street are being interfered, the communications for the downstream street light nodes will be impeded and put out of control. Besides these "natural" interferences, RF is also easily susceptible to hackers since RF signals are

accessible over the air. A hacker could easily use a jammer device with strong enough output power to jam the signals with the same operating frequencies. This will not happen in PLC as physical access to the power cable is needed.

3.2 Digital Power Supply

gridComm's patented Digital Power Supply (DPS) integrates PLC and metering functions all within one unit. It is probably the only integrated Digital Power Supply in the world. It is ideal for Smart Street Light control, transforming traditional street lighting into energy-aware, remotely managed monitored networks. The DPS employs a 32-bit MCU to replace the control feedback compensation loop in the traditional power supply. This has the advantage of doing without the failure-prone electrolytic capacitor in the circuit design, hence saving large amount of discrete components and boosting longer life-span. Besides, due to its programmable nature, the DPS is adaptive to different types of loads with simpler circuit design and lower cost. In particular, it adaptive nature enables it to learn and compensate for any DC voltage variations in LED luminaire preventing the lamp from flickering due to aging. The end result is higher accuracy and performance with capabilities for multiple phase control, non-linear control and load current and failure predictions. Therefore, gridComm DPS can be used to drive LED, Sodium Vapor and Metal Halide lamps.

In summary, gridComm Street Light Solution delivers the following key benefits for Indonesia:

- Less energy usage by using automatic lighting schedules, hence reducing the carbon footprint
- Savings in operating and maintenance costs
- Efficient remote monitoring system, thus doing away with using surveillance vehicles to check for faulty lights
- Flexibility in mixing different lamp types and technologies
- Scalability and extendibility to support other applications such as traffic, weather, and motion monitoring
- Display of street light locations on a map for real-time control and monitoring.

4.0 GUI Controls and Monitors

The Jakarta street light authority makes use of the following features in the Street Light Management Software to control and manage the street lights:

4.1 Dashboard

A dashboard showing the street lights on a map with various icons representing the different status of the lights. This gives the user a bird's eye view of what is happening on the streets. For example, an icon in dark green represents the light is fully lit, an icon in light green

represents it is dimmed, an icon in black represents it is off and an icon in red represents an error condition has happened etc.

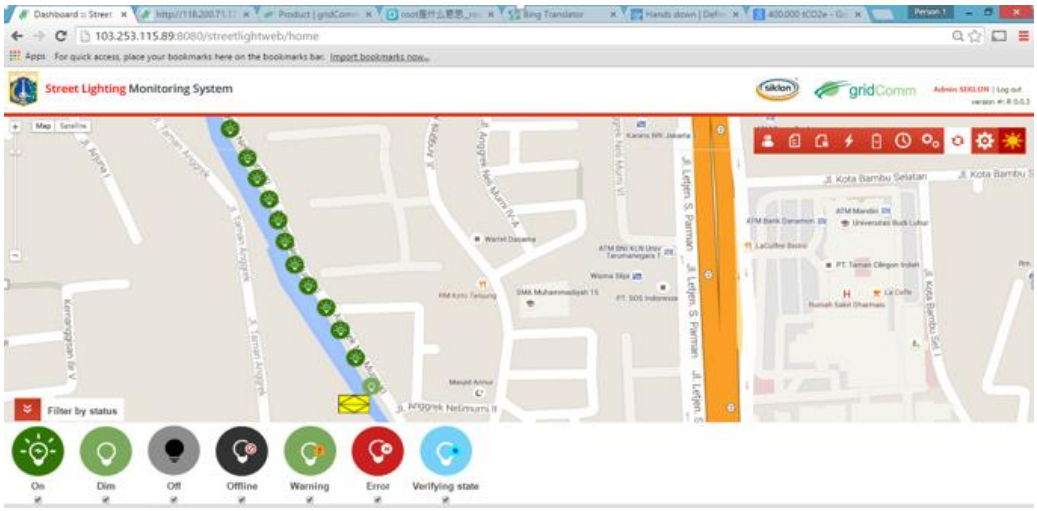

Figure 3 – Dashboard Showing Street Light Icon Graphical Representations

4.2 Manual control of individual DPS

While the dimming strategy generally brings on electrical saving during wee hours, there are occasions where full lighting level is desired for specific sites and reasons. For example, a New Year Count Down party at a particular site would require full lighting level late at night. The manual control of individual DPS gives the authority full flexibility and control over the selected lights. Clicking on the street light icon will bring up a control manual whereby different dimming levels can be set manually. The control manual also shows other information such as the lamp ID, its GIS information, lamp type, brand and model as well as the various electrical data such as input/output voltage, current, power, power factor and temperature.

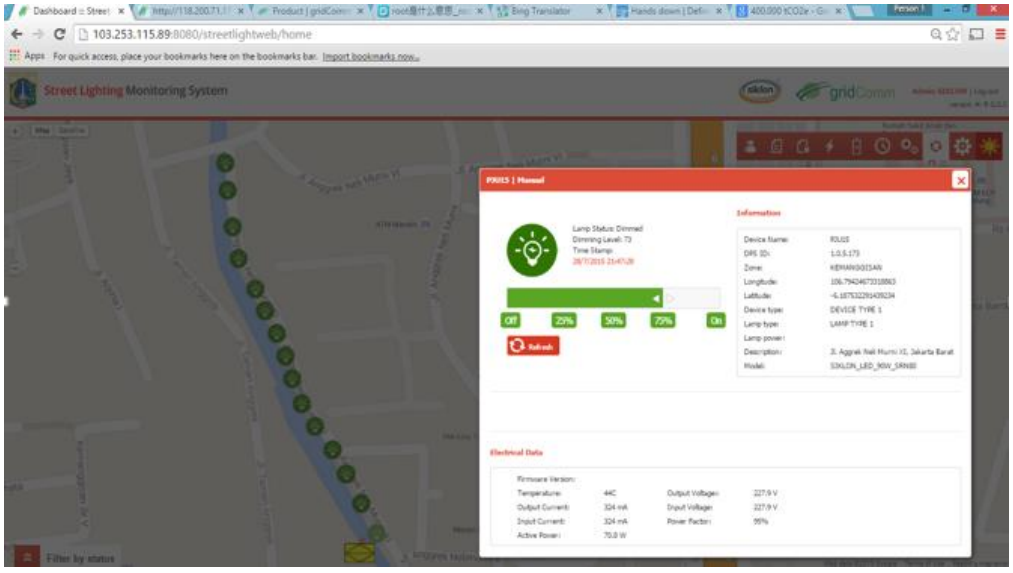

Figure 4 – Manual Control to Turn ON/OFF/Dim Street Light

4.3 DPS Listing

For a quick tabular view of DPS, the user is able to click the DPS tab for a list of status and information for each DPS.

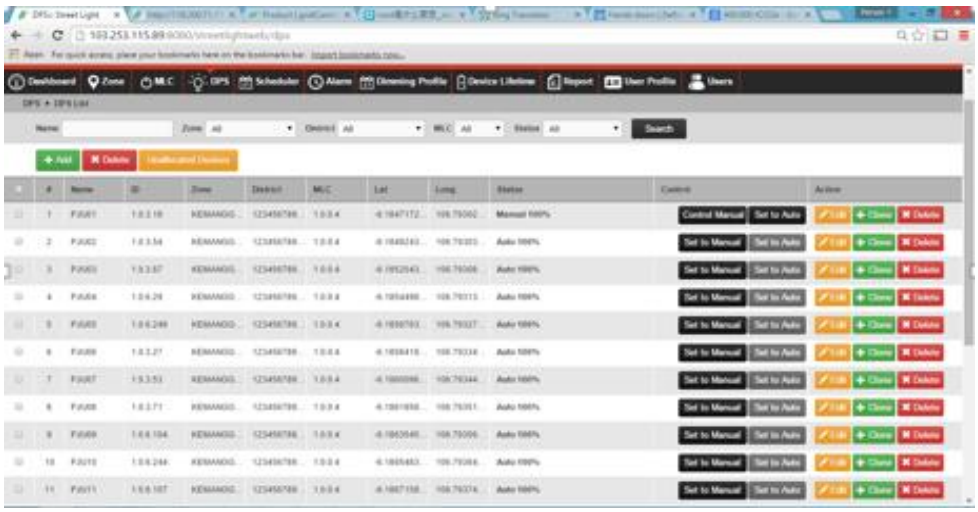

Figure 5 – Tabular Representations and Control of Street Lights

4.4 Dimming Profile

The user is able to create a dimming profile comprising of different dimming points and priority including sunrise/sunset timing. He/she can create as many dimming points as necessary.

For example, a dimming profile named “Weekdays” is created with the schedule in the table below.

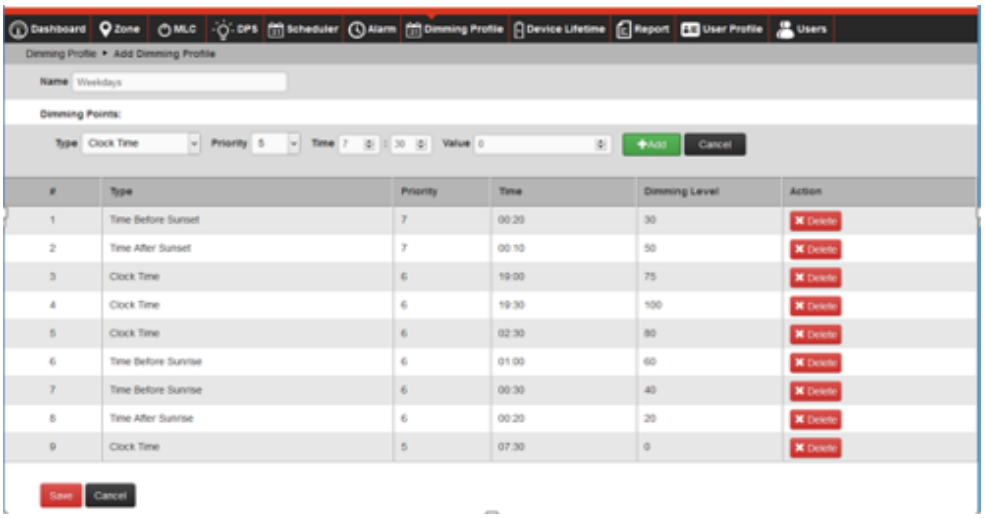

Figure 6 – Dimming Profiles

4.5 Dimming Schedule

A dimming schedule can be created by week, month or year.

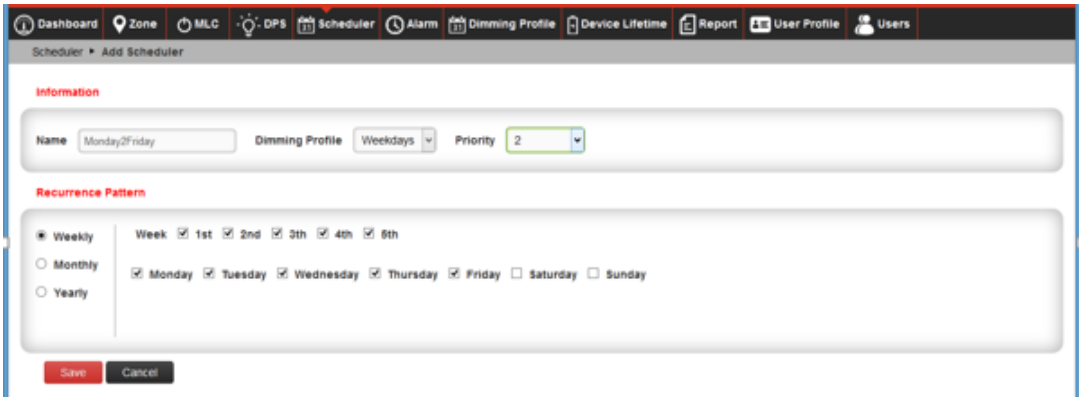

Figure 7 – Dimming Schedule

The dimming schedules can also be viewed on the calendar – weekday, weekend, holidays.

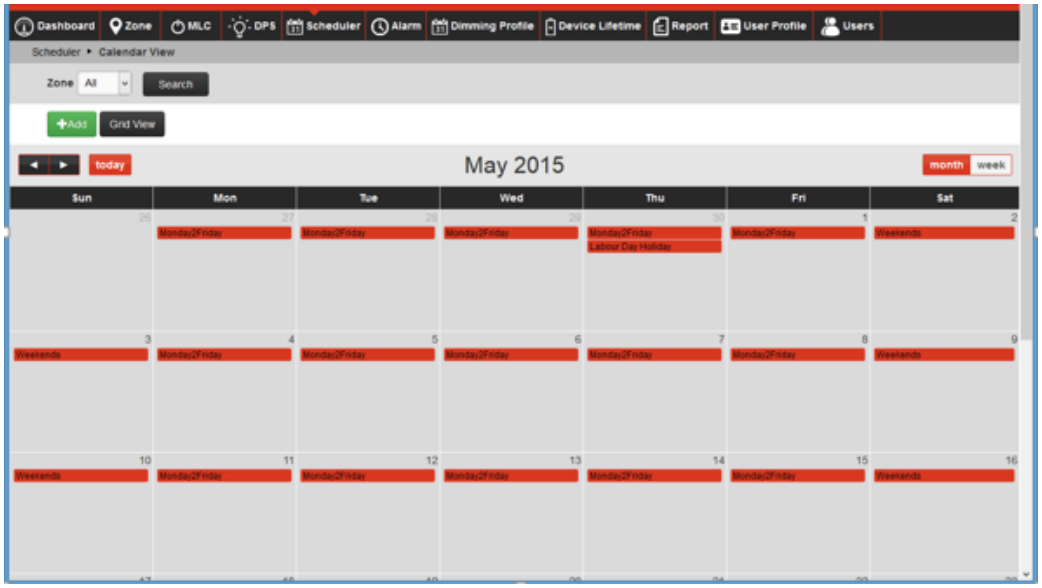

Figure 8 – Commissioning of Dimming Schedule on Calendar

4.6 Reports

In order to understand the amount energy savings generated as a result of implementing gridComm smart street light management system, the user could go to "Report" tab to read the data in table or chart view form. Besides energy report, the system is able to capture and tabulate alerts or failures due to the various conditions such as over temperature, over/under input voltage or current, over/under output voltage, over/under input power, open circuit and short circuit. Historical data of Burn Hours are also automatically recorded for each DPS so that preventive maintenance could be scheduled and carried out before the lights burnt out.

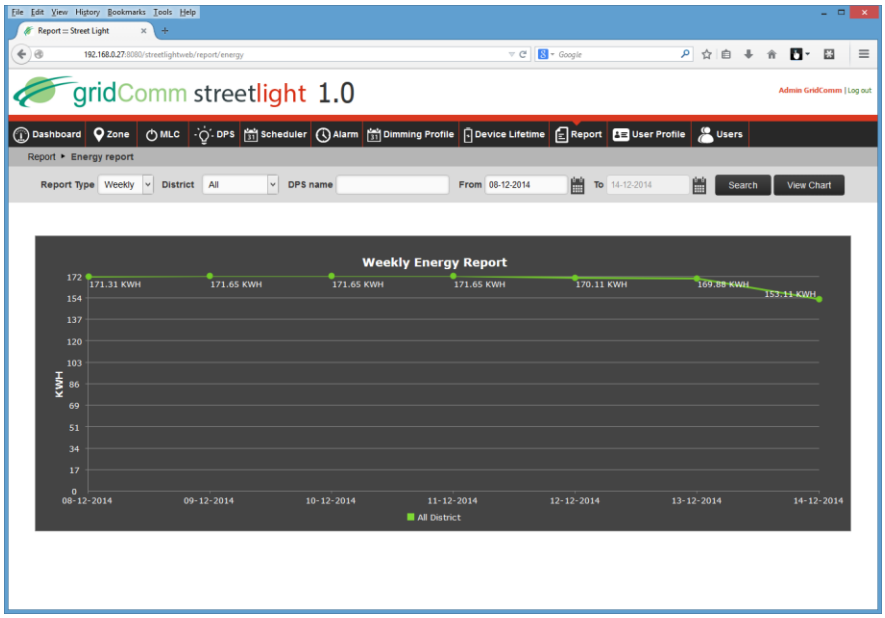

Figure 9 – Power Consumption Data

5.0 Conclusion

The smart street lighting system jointly brought upon by Siklon and gridComm has been in operation for months without any issue. Jakarta authority benefits immensely from the advantages brought upon by the system. Firstly, there is a huge fundamental energy savings by using Siklon LED lamps. Secondly, the street lights can now be automatically turned on and off without manual intervention based on sunset and sunrise timing or predetermined schedules. Thirdly, the staff are now able to monitor the streetlights at the convenience of a web browser. As a result, more time is saved for other tasks which would otherwise be used to roam around the streets to check for faulty lights. In addition, more energy can be saved by implementing dimming strategy while maintaining optimal lighting level late in the night. The success in Jakarta has attracted the attention of the other cities in Indonesia, which are now planning to roll out with Siklon and gridComm smart street lighting system.

Acknowledgement
Source of information : NAMA Indonesia