PETRA SYSTEMS

SMART CITY SOLUTIONS

PETRA SYSTEMS

BUDGET NEUTRAL SMART CITY TECHNOLOGY INNOVATION

PETRA SYSTEMS

Petra Systems helps cities, campuses, and businesses achieve their energy savings and renewable power generation objectives by retrofitting existing city streetlights to generate power, save money and become the foundation for Smart City data and communications networks.

Ramp up energy savings and renewable energy production while simultaneously reducing municipal energy consumption, helping to enable more sustainable, carbon-neutral cities.

Increase safety by providing data and communications networks that can support security operations.

Strengthen municipal resilience by creating energy independent networks that can maintain power through extreme weather events and grid disruptions.

Enable a wide range of additional valuable services that the city can provide to improve the quality of life for its citizens and businesses, including: Wi-Fi networks, Electric Vehicle (EV) Charging stations, and many others.

THE TECHNOLOGY BEHIND THE WORLD'S LARGEST AND MOST ADVANCED DISTRIBUTED SOLAR INSTALLATIONS

With over 200,000 systems installed worldwide, Petra Systems, Inc. is the world leader in distributed power generation technologies that deliver intelligent, efficient, and remotely managed networks for Smart City infrastructure.

Petra's Smart City Solution™ (SCS) converts a city's existing streetlights into a network of intelligent pole mounted devices that can include distributed solar power plants, city wide smart lighting and sensor and communication infrastructure. This intelligent streetlight network can be leveraged as the backbone for Smart City applications and services, improving citizen safety and security while simultaneously yielding strong project economics and maximizing project value.

By combining the energy savings of an LED retrofit with the revenue generation of solar power production, Petra delivers budget neutral programs with strong project economics, allowing cities to transform their streetlights into one of their most valuable Smart City assets.

PETRA SMART CITY SOLUTIONS

Transforming Streetlights Into One of Your Community's Most Valuable Smart City Assets

Petra SCS transforms streetlights from simple roadway lighting into revenue generating assets that extend the value of LED retrofit projects and establish a robust and cost optimized data and communications network. By combining the cost savings of LED retrofits with solar energy revenue production, the SCS allows cities to self-fund additional technologies including surveillance, public and private Wi-Fi, EV charging stations, emergency response support, grid performance monitoring, as well as others, while still reducing overall expenses.

Strengthens Sustainability

Petra SCS increases distributed renewable energy production and improves municipal energy efficiency - supporting your community's sustainability.

- Produces 10 megawatts (MW) of renewable power for every 50,000 poles installed, - enough to power 1,800 homes and eliminate 21 million pounds of carbon emissions a year, the equivalent of offsetting 2,300 vehicles annually.
- Reduces municipal street lighting costs by as much as 70% using smart light controllers comprised of smart transceivers that control individual streetlights.

Increases Resilience

- Allows your community operate a grid-independent communications network, a critical asset for responding to severe events such as earthquakes and severe weather.
- Delivers a robust and resilient communications and lighting network that can remain active during grid disruptions and disturbances.
- Establishes a distributed data sensor and communications network for enhanced security and extended Smart City services.
- Provides safety and security departments access to real-time information from sites throughout the city to enhance the quality and speed of their response.
- Enables valuable smart city devices such as cameras, sensors and other metering and communication devices that can be customized to meet your specific needs.

Transforms communities, campuses, and businesses with advanced and valuable add-on services

With its integrated technology platform approach, Petra SCS gives cities an array of options to improve quality of life enabling:

- Distributed public and private Wi-Fi networks
- Electric Vehicle (EV) charging
- Highly distributed crowdsourcing communications networks
- Security and sensor networks for security and traffic monitoring
- Citizen reporting (potholes, bulb outages, graffiti, and others)
- Intelligent parking

SCS SMART LIGHTING SOLUTION

PETRA SYSTEMS

The SCS Smart Lighting Solution is composed of a high-efficiency LED luminaire coupled with a Smart Lighting Controller.

In addition to providing traditional dusk-dawn sensing photo controls, SCS Smart Lighting Solutions enable the management of streetlights from a centralized location and the ability to customize streetlight behaviors at the individual pole level or across subset groupings of poles across the lighting network.

The SCS Smart Lighting Controller unit supports PLC and Wi-Fi communication back to the Network Communicator through the Mesh Wi-Fi network. Petra's IntelliView® Lighting Module provides full access to system data for management and control.

The SCS Smart Lighting Solution leverages the data and communications network deployed as part of the Smart City Solution to deliver further energy savings and streamline the maintenance and operations of streetlights.

The Smart Lighting Controller mounts on streetlights using a standard compliant five or seven pin twist-lock.

Features and Benefits of SCS Smart Lighting:

- Direct energy savings (60-80%)
- Prolonged life of the lamp
- On/Off/Dimming with on-demand or scheduled controls
- Revenue grade metering
- Health and status diagnostics
- Alert based on lamp outage, energy consumption and other indicators
- Remote system configuration
- Ability to pinpoint outages across the network
- Improved asset maintenance planning and management

Specification	Description
Luminary Specifications	
Technology	High efficiency Light Emitting Diode (LED)
LED Power Range	24W to 600W
HPS Replacement Range	40W to 1500W
Light Distribution	Type 1, Type 2, Type 3
Luminous flux	2,400 to 24,000 Lm
Color Temperature	4000K
Life in hours	>100,000
Electrical Specifications	
Operating Voltage	100-277Vac
Operating Frequency	50/60Hz
Mechanical Specifications	
Operating Temperature	-40ºC to 65ºC
Enclosure	NEMA4
Connector Type	5 or 7-pin twist-lock per ANSI 136.41
Features	
Communication	PLC, Wi-Fi
Wi-Fi Access Point	802.11b/g/n (2.4GHz)
Diagnostics and Fault Monitoring	Lamp Burn-outs, Lamp Cycling, Ballast Failure, Over/ Under Voltage, Abnormal Power Consumption, Communication Failure, Operating Hours, Ambient Light and Temperature
Power Metering	Current, Voltage, Frequency, Power Factor, Power Consumption, and Energy Consumption
Remote Control and Scheduling	User configurable (On/Off/Dim schedules programmed on a Daily/Monthly/Yearly or special event basis) or locally controlled using local time, astronomical time or photo sensor
GPS	Optional
Compliance	ANSI C62, UL 773, FCC Part 15, CE
Revenue Grade Metering	ANSI 12.1/12.20
Standard Warranty	10 Years Limited (SLC) Manufacturer Pass Through (LED)

SCS SMART SOLAR POWER GENERATOR

The SCS Smart Solar Power Generator is a high-efficiency solar power generator composed of a PV solar panel, a SunWave Microinverter and fully integrated custom racking and cabling for pole mounting.

The SCS Smart Solar Power Generator supports PLC or ZigBee mesh communications back to the Network Communicator. The IntelliView® Energy Module enables full access to system data for management and control.

Electrical Specifications

DC Input Power*	260-340W
AC Output Power	240W (continuous)
AC Output Voltage**	120/230/240V
AC Output Frequency	50/60Hz
Current THD	3%
Power Factor	0.99
CEC SEM Efficiency	96%

Mechanical Specifications

Operating Temperature	-40ºC to 65ºC
Weight*	76-87lbs. (34.5-40kg)
Enclosure	NEMA4
Wind Speed/Snow Load	Up to 170mph/Up to 50PSF
Tilt Angle	30º fixed
Mounting Options	Wood, metal, fiberglass and aluminum poles

Features

PV Solar Module	60-Cell framed/frameless
Communication	PLC, ZigBee
Compliance	UL1741, IEEE1547, FCC Class B, CE, G83, G59
Revenue Grade Metering	ANSI 12.1/12.20
Standard Warranty	10 Years Limited (SunWave) manufacturer pass through (PV solar module)

* Based on PV solar module type
** Based on the inverter configuration

SCS Smart Solar Power Generator System Advantages:

- The safest solar power solution
- No high voltage DC
- Automatic panel level shut-off
- Fast and flexible deployment
- Highly scalable and easily upgradable system

High-Performance

- Optimized panel level energy harvest enabling the highest levels of performance in all environments and conditions

Highly Reliable

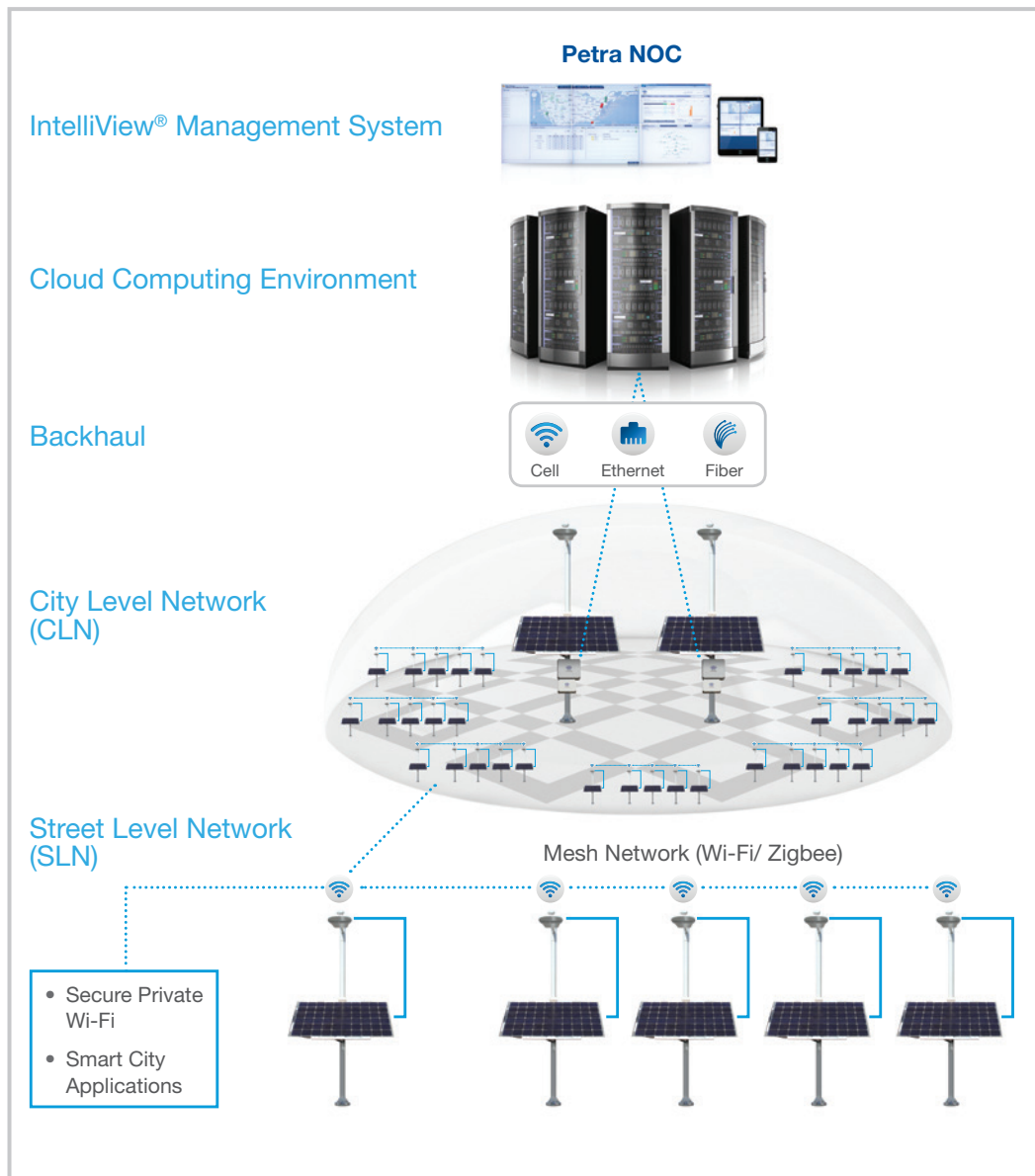- Distributed and resilient solar power plant design eliminates single point of system failure

Granular Network Management

- Panel/pole level visibility, diagnostics, reporting and control

SCS SMART MESH NETWORK

Petra's Smart Mesh Network (SMN) consists of an intelligent, self healing mesh network and cloud-based management system that provides monitoring, control and data analytics for SCS network services.

The SMN is compatible with multiple communication protocols to support community, government or public safety entities. With an open architecture and flexible communication interface, the SMN solution allows for simple and flexible integration with existing municipal systems creating a uniform Smart City platform.

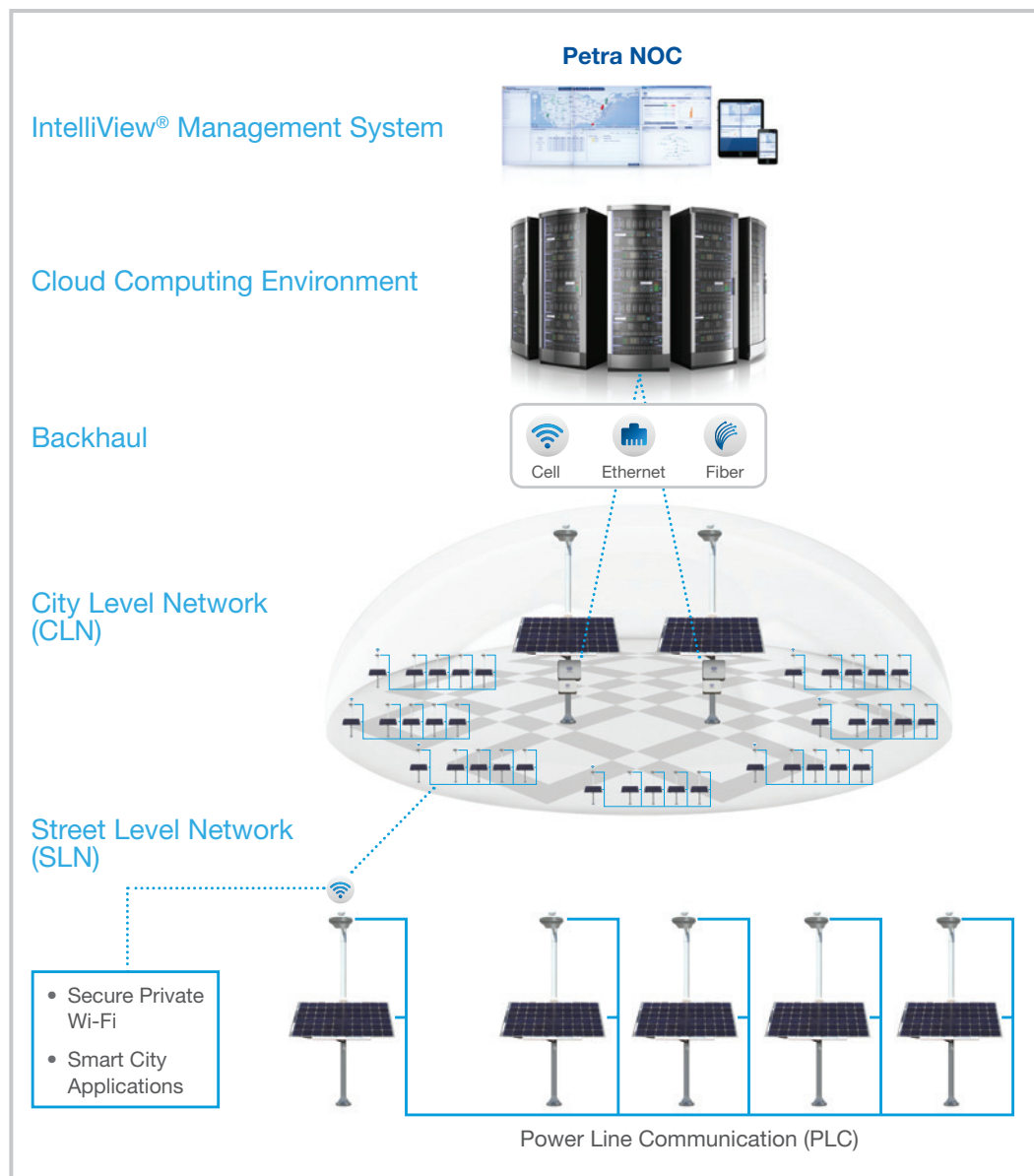## Pole to Pole Mesh Communication Architecture

IntelliView® Management System

Cloud Computing Environment

Backhaul

City Level Network (CLN)

Street Level Network (SLN)

Petra NOC

Cell   Ethernet   Fiber

Mesh Network (Wi-Fi/ Zigbee)

- Secure Private Wi-Fi
- Smart City Applications

SCS SMART MESH NETWORK

The Smart Mesh Network is composed of:

- Multiple Street Level Networks (SLN) that provide connectivity for end devices (SunWave Microinverter, Smart Lighting Controller, other client devices) through a PLC, ZigBee and/or Wi-Fi mesh network.

- An array of Network Communicators (gateways) that provide redundant connectivity between the City Level Network and the Cloud Computing Environment through a cellular or wired (fiber/copper Ethernet) backhaul.

- A City Level Network (CLN) consisting of Wi-Fi mesh points (Smart Mesh Router) that provide city-wide network access.

- A secure Cloud Computing Environment, Network Operations Center (NOC) and suite of remote mobile and desktop applications to access the IntelliView Management System, providing command and control of the entire asset base and delivers real-time analytics and data visualization through an advanced graphical user interface (GUI).

Pole to Pole Power Line Communication Architecture

Petra NOC

IntelliView® Management System

Cloud Computing Environment

Backhaul

Cell   Ethernet   Fiber

City Level Network (CLN)

Street Level Network (SLN)

- Secure Private Wi-Fi
- Smart City Applications

Power Line Communication (PLC)

NETWORK COMMUNICATOR

The Network Communicator sits at the center of Petra's SCS Smart Mesh Network by providing mesh network, access point, and gateway functionality, enabling connectivity to remote, distributed assets including the SunWave Microinverter and the Smart Lighting Controller Systems.

Key Features

- Enables monitoring and reporting of critical data
- Aggregates reports of operational status to the operations center
- Provides health status and diagnostics data
- Flexible LAN interface including mesh networks (Zigbee, Wi-Fi), and PLC
- Flexible WAN interface (Cellular, Ethernet, Wi-Fi)
- Secure communications

* Shown with optional battery backup

Electrical Specifications	
Operating Voltage	100-277Vac
Operating Frequency	50/60Hz
Power Consumption (Max.)	7W (58W with PoE+ option)

Mechanical Specifications	
Operating Temperature	-40ºC to 65ºC
Weight	10lbs (4.5kg)
Enclosure	NEMA4
Mounting Options	Wood, Metal and Concrete Poles, Wall Mount

Features	
Communication	Wi-Fi, Ethernet, Cellular, PLC, ZigBee
Management	Local Web Interface, Remote Access
Remote Power Cycle	Standard
System Watchdog	Standard
Extended Storage	Optional
GPS	Optional
Power Over Ethernet	Optional
Compliance	UL/IEC 60950, CSA 2.2, FCC Class B, PTCRB, CE
Standard Warranty	10 Years Limited

Data Communication Options	
PLC	
Standard	Proprietary, PRIME capable, G3-PLC capable
Range	Up to 20 devices on same circuit
Wi-Fi	
Standard	802.11s Mesh and 802.11b/g/n (2.4GHz)
Mesh Type	Self-forming, self-healing mesh network
Range	1000' line of sight
Cellular	
3G/4G	LTE: 700, 850, 1700, 1900 HSPA+: 800, 850, 1700, 1900 UMTS: 850, 1900 GSM, GPRS, EDGE: 800, 900, 1800, 1900
Zigbee	
Standard	ZigbeePRO
Mesh Type	Self-forming, self-healing mesh network
Range	1000' line of sight
Ethernet	
Ports	2 RJ-45
Standard	IEEE 802.3, 10/100Base-T
Power Over Ethernet (PoE)	IEEE 802.3af Type 2 (optional)

SCS ASSET MANAGEMENT PLATFORM

Petra's SCS Asset Management Platform (AMP) provides for real time monitoring and management of the entire network. Leveraging IntelliView®, AMP places data for all network assets in the hands of the customer in a simplified and intuitive manner.

AMP provides for continuous performance monitoring of the entire network and distills the critical data points in a useful manner to empower the user to quickly and effectively manage and report high-impact issues across the installation. In addition, AMP measures and meters performance of both the luminary and the solar generator, pinpoints issues, and enables role- based alerting and reporting.

The SCS Asset Management Platform is available as a hosted software system or as a managed service, allowing customers the flexibility to determine and achieve the highest value and the lowest total cost of ownership across their O&M operations.

AMP's modular design creates a platform for additional data-analytic modules, coupling critical network management with smart city applications.

AMP leverages Petra's IntelliView® platform and is composed of the following solution modules:

- **IntelliView Communication Module (CM)**
- **IntelliView Energy Module (EM)**
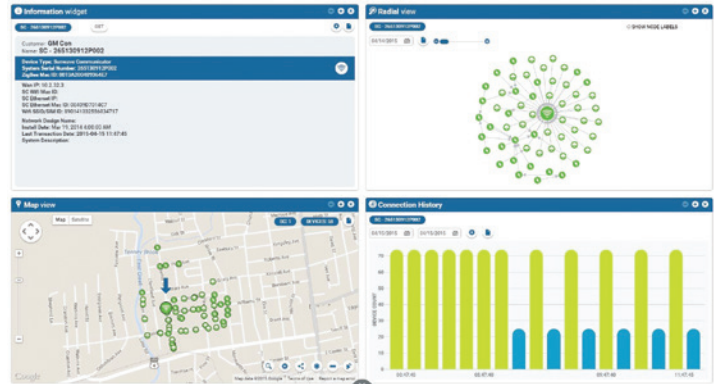- **IntelliView Lighting Module (LM)**

INTELLIVIEW®

Communication Module

The Dashboard for Network Monitoring and Management

The Communication Module (CM) is the foundation module of IntelliView. With the Communication Module, users have a dashboard view of all elements of the communications network. Alerts, performance summaries, and mesh networking diagnostics are provided for problem identification and resolution on an exception basis.

The Communication Module allows the user to configure the network, and ensure maximal system uptime. Component level monitoring provides for complete system monitoring at the node level, allowing for reporting or troubleshooting in an efficient manner.

The Communications Module dashboard delivers a visual tool composed of an interactive map of each individual SCS node, enabling users to intuitively visualize network connectivity, status, performance and alerts. This allows management-by-exception by displaying connection summaries, and presents the user with a graphical representation of the network topology to aid in the troubleshooting process.

IntelliView License Key Features

Remote management of:

- Smart Solar Power Generators
- Smart Lighting Solutions
- Smart Mesh Network

Reports on network and system health

Management dashboards

View historical data enabling:

- Troubleshooting analysis
- Trending
- Forecasting

Configurable alerts

Branding customization

User-level permissions

Hosting Services – Key Features

Secure web hosting

Data storage

Database backup

Secure updates and patches

INTELLIVIEW®

Energy Module

A centralized view of the Smart Solar Power Generator

The Energy Module (EM) enables a centralized view of a large, highly distributed install base of Smart Solar Power Generators. Network managers can perform remote monitoring, command and control and reporting of both panel level and total network energy generation across a highly distributed network.

The Energy Module features a dashboard view where energy generation can be correlated to geographic locations on a map view, and performance issues are identified and addressed in the alerts and performance summaries, simplifying the complexity of the network to streamline issue identification and correction.

Data analytics and command and control are made possible by management by exception, grouping, scheduling and setting up profiles for the systems deployed.
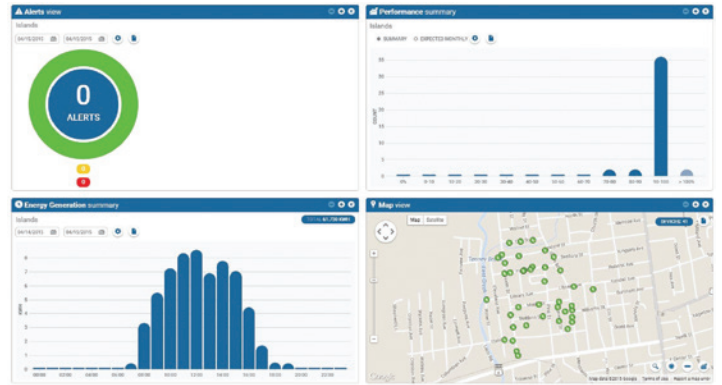

Lighting Module

Remote energy efficiency and conversation management for Smart Lighting Solutions

The Lighting Module (LM) enables users to control when streetlights are turned on, off or dimmed, and seamlessly coordinates with traditional dusk-dawn sensors. Lights can be managed individually or grouped, and commanded actions can be scheduled on periodic, one-time or an event basis.

Alerts such as bulb outages and day burners reduce the burden on call-centers and provide a streamlined management network to optimally schedule maintenance work based on priority and geographic locations.

Visibility to the network performance also enables pro-active scheduling of preventative maintenance to optimize labor assets.

With metering at both the luminary and the solar generator, the system can also be leveraged to report energy costs and energy production in real time to quantify savings and revenue generation from the system.

SCS INTELLIGENT O&M SOLUTIONS
NETWORK OPERATIONS AND COMMISSIONING SERVICES

PETRA SYSTEMS
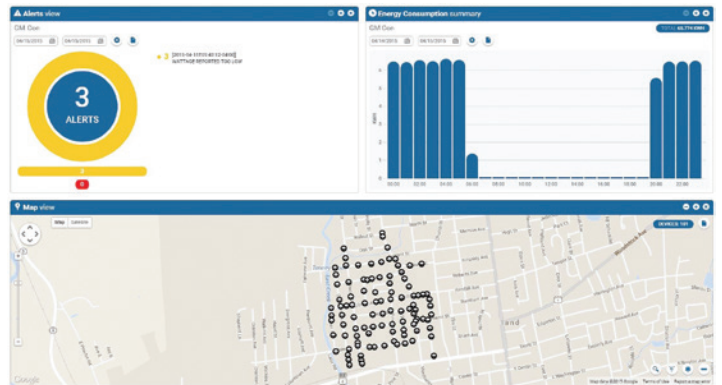
The Petra Network Operation Center (NOC) provides Operations and Commissioning Services for Smart City Solution installations. Petra's operations management solutions feature remote monitoring capabilities and advanced data analytics coupled with the highly skilled monitoring and management of Petra SCS Networks. This powerful combination allows owners and operators to continually optimize the performance of their assets by maximizing energy production and savings, minimizing downtime, and ensuring maximum return on investments.

Network Operations Center (NOC) Services

Petra's highly skilled Network Operations Center (NOC) team provides critical support and operations for Petra's Smart City Solutions, enabling optimal operations, remote troubleshooting and pinpointing of equipment issues, planning maintenance schedules, responding to alerts, dispatching maintenance crew, and generating detailed performance reports.

Petra NOC services allow customers to leverage the expertise of the specialized Petra Systems trained technical staff to efficiently manage, monitor and troubleshoot the system proactively, minimizing the impact of underperforming components and enabling rapid and cost effective resolution to any issues that may occur.

Network Operations Center Key Features:

- **Highly trained technical staff**
- **Remote monitoring**
- **Triaging:** NOC personnel will identify issues and route resolution requests to appropriate parties efficiently, thereby reducing resultant resolution time.
- **Troubleshooting:** NOC personnel will use all steps to understand nature of each identified issue and ultimately determine the root cause. Subsequent identification of problem resolution will be performed.
- **Reporting:** Monthly status report will be created and generated.
- **Configuration Management:** Petra Systems NOC personnel will maintain device and system configuration details, ensuring that all associated information is acquired and logged. This will be performed upon installation. The NOC personnel will update changes to the configuration as required.

Commissioning Services Center Key Features

- **Provisioning:** Installation information required to be entered into the Energy Management and Lighting Management Portal, in order to activate each end device and over-all system will be performed during provisioning.
- **Field Deployment Verification:** NOC personnel will verify that the designed system parameters are comparable to the actual installed data.

SCS INTELLIGENT O&M SOLUTIONS
NETWORK OPERATIONS AND COMMISSIONING SERVICES

Petra Systems offers a complete suite of maintenance services for Smart City Solutions that feature remote monitoring services and advanced data analytics coupled with highly skilled personnel to intelligently manage the installed assets.

Advanced Monitoring & Management

- Streamline operations with centralized intelligent monitoring and data warehousing.
- Set system alarms and alerts, categorize by severity, and assign to designated personnel.

Audit Energy Production / Savings and Generate Performance Reports

- Generate daily, weekly, monthly and annual energy production / savings reports of Solar and Lighting installation at the project level as well as for an aggregated portfolio of installations.
- Generate regular and in depth energy production / savings and performance reports of the installations at the module, system, or portfolio level.

Analyze & Optimize System Performance

- Track and analyze energy production data against benchmarks calculated with reputable models, guaranteed production and saving levels, and revenue targets.
- Analyze historical performance data, detect performance degradation, and diagnose underperformance issues.
- Diagnose and pinpoint cause and source of system component and equipment failures.
- Identify and correct developing problems early prior to equipment failure to eliminate system downtime and loss of revenue.

Scheduled Preventive Maintenance

- Preventative Maintenance:
  - Plan and execute regular maintenance schedules, document electrical system inspections and reporting
  - Service equipment based on OEMs and system warranty requirements
  - Plan and conduct panel cleaning and maintenance schedules based on performance data analytics
- Warranty Management:
  - Manage and administer warranty claims of all system components and equipment
- Spare Parts Management:
  - Store, issue, re-order, and re-stock spare parts

Manage Alerts & Perform Predictive and Corrective Maintenance

- Preventative Maintenance:
  - Predict performance degradation issues and failures based on historical operational data, component & equipment failure statistics, and site data to minimize economic losses due to outages
- Corrective Maintenance:
  - Perform repairs on a timely basis to minimize downtime
  - Respond rapidly to critical fault alerts and system downtime events

PETRA
SYSTEMS