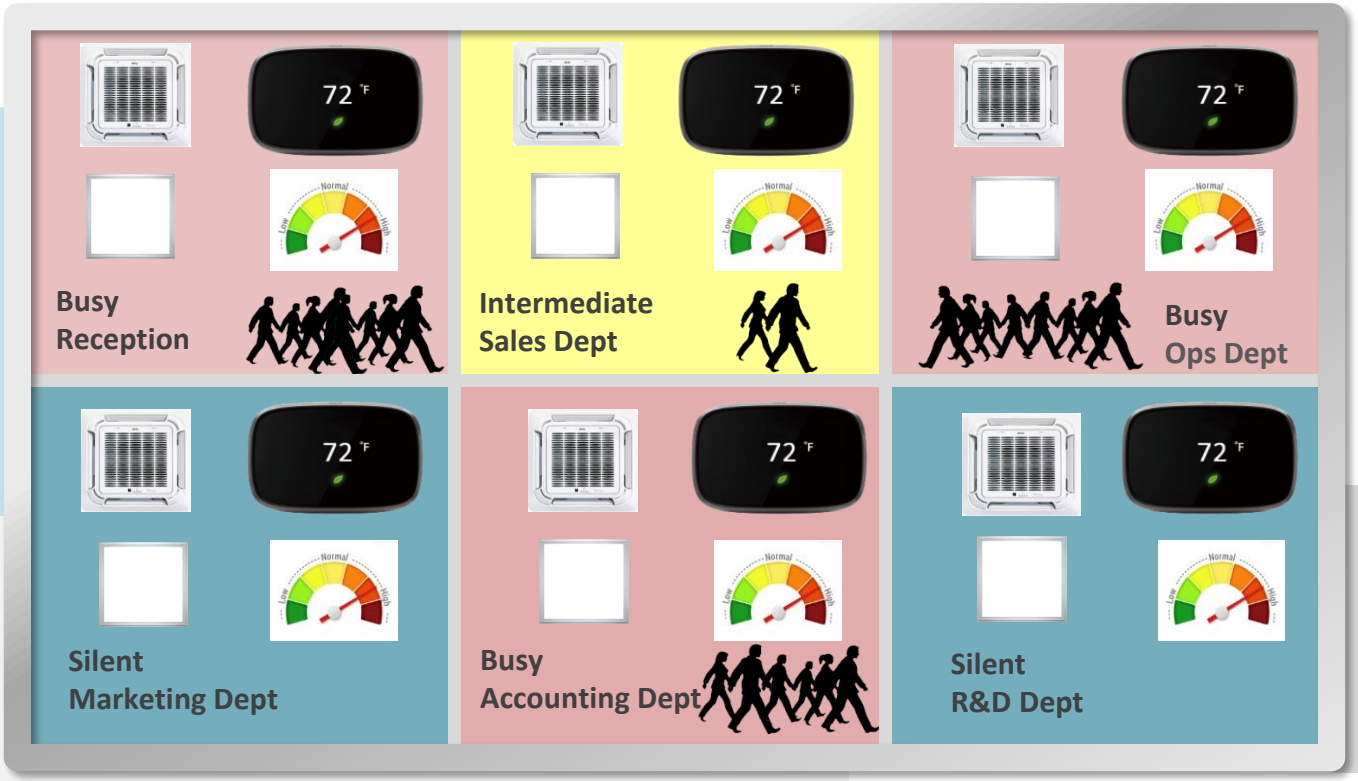
Lumani

The Best Control is No Control

Lumani Pte Ltd
April 2019

The Past– Typical Inefficient Use of HVAC & Light Energy in Commercial Properties:

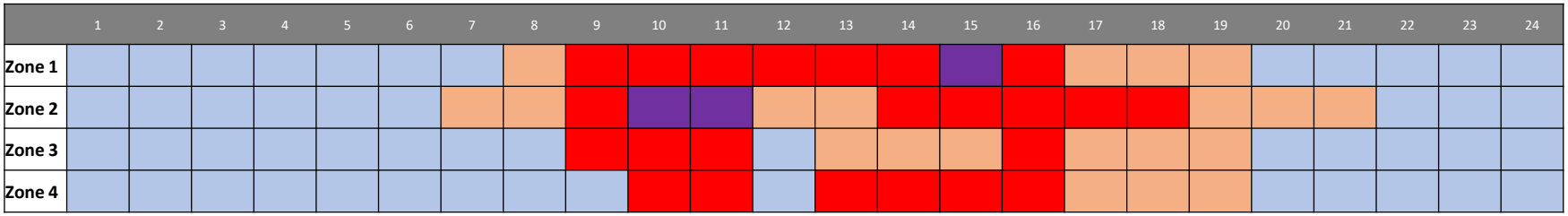


Zero Activity Zones
Where unnecessary wastage can be saved

Low Activity Zones
Where 6-10% HVAC energy can be saved

High Activity Zones
Where the energy consumption is necessary

The Present– Other Innovative Solutions Do by So-Called AI Machine Learning

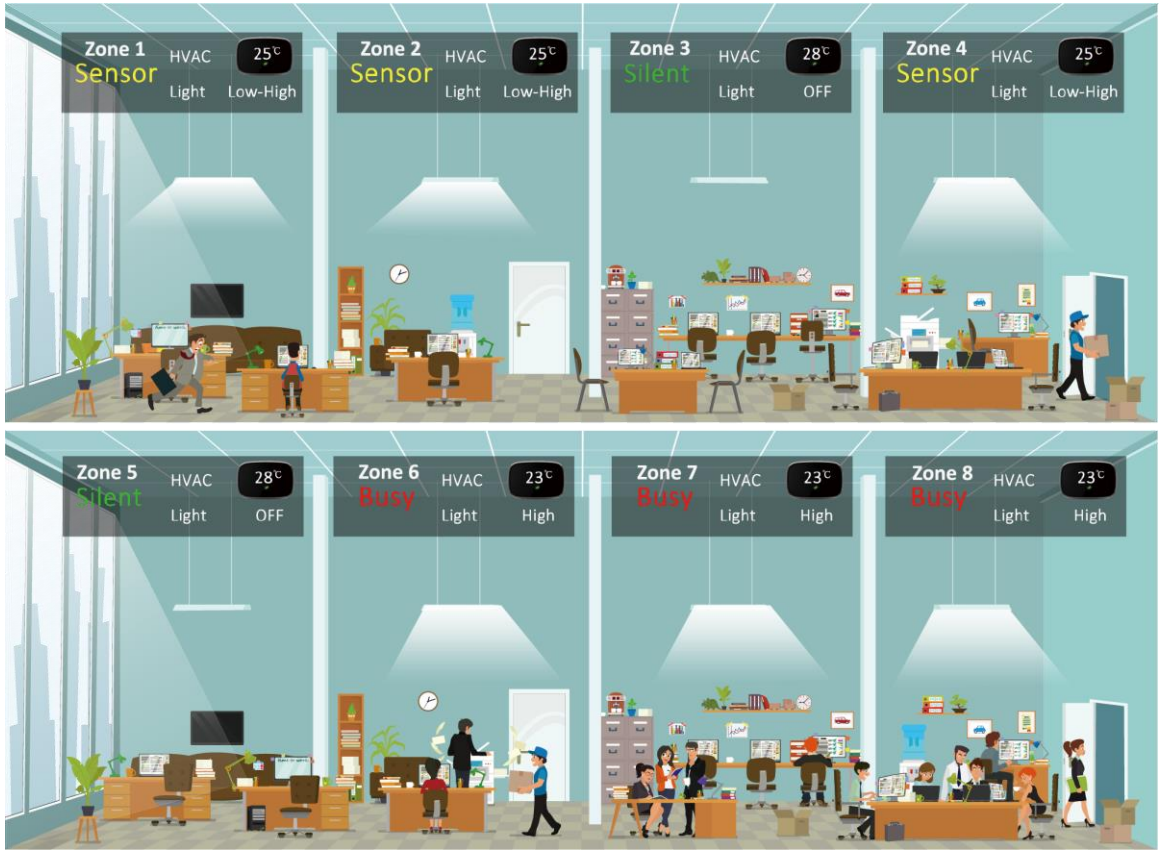


Predicted Schedule by Machine Learning

There are many chances that you can save energy by turning down or off the lights and HVAC when there's no one in that specific zone. The most common way to do that is as follows:

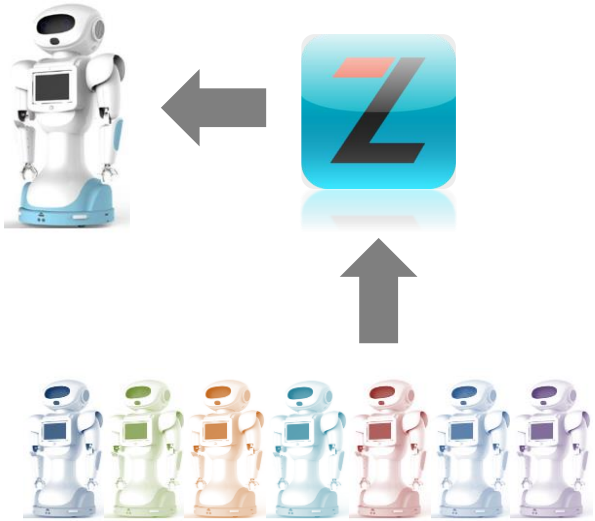
1. Using sensor to learn patterns
2. Generating the schedules to cope with the patterns
3. Results: **IMPRACTICAL** and **INACCURATE**

The Future– DISRUPTING the Conventional Models by Real-Time Autonomous Control of Lighting and HVAC



TECHNOLOGY IS BECOMING INVISIBLE

The LumaZones System Picks the Most Suitable Virtual Robot (The Best Scene Play) for the Detected Condition

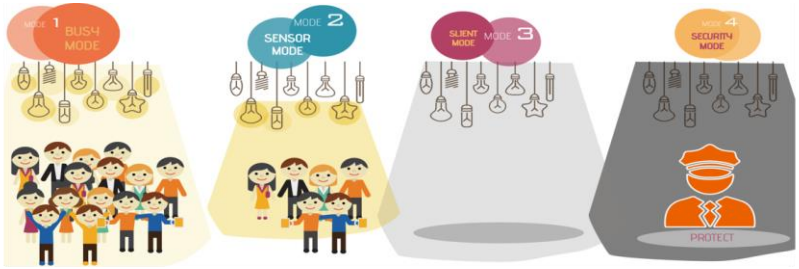


The LumaZones Invisible Robot Butler Troop (Advanced Scenes)

Patented Innovative Solution

US Patent No.: US 9,538,626 B1

LumaZones Automatic Switch Mode (LASM)
The Adaptive Zone Operation



Busy Mode
Light Level 100%
Air-con 24°C

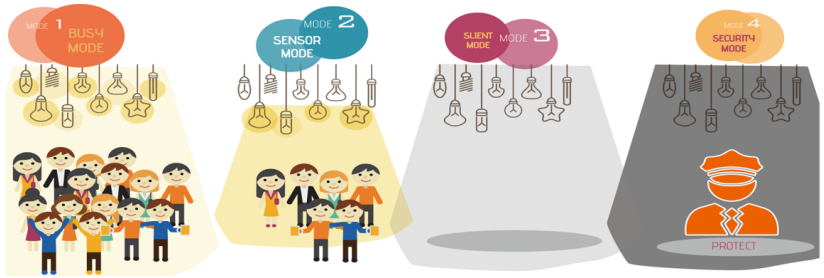
Sensor Mode
Light Level 20-100%
Air-con 26°C

Silent Mode
Light OFF
Air-con OFF or 28°C

Security Mode
Light OFF
Alarm ON, Lights ON and push messages to phones when intruded

Scene A

Scene B



Busy Mode
Light Level 80%
Air-con 25°C

Sensor Mode
Light Level 40-80%
Air-con 27°C

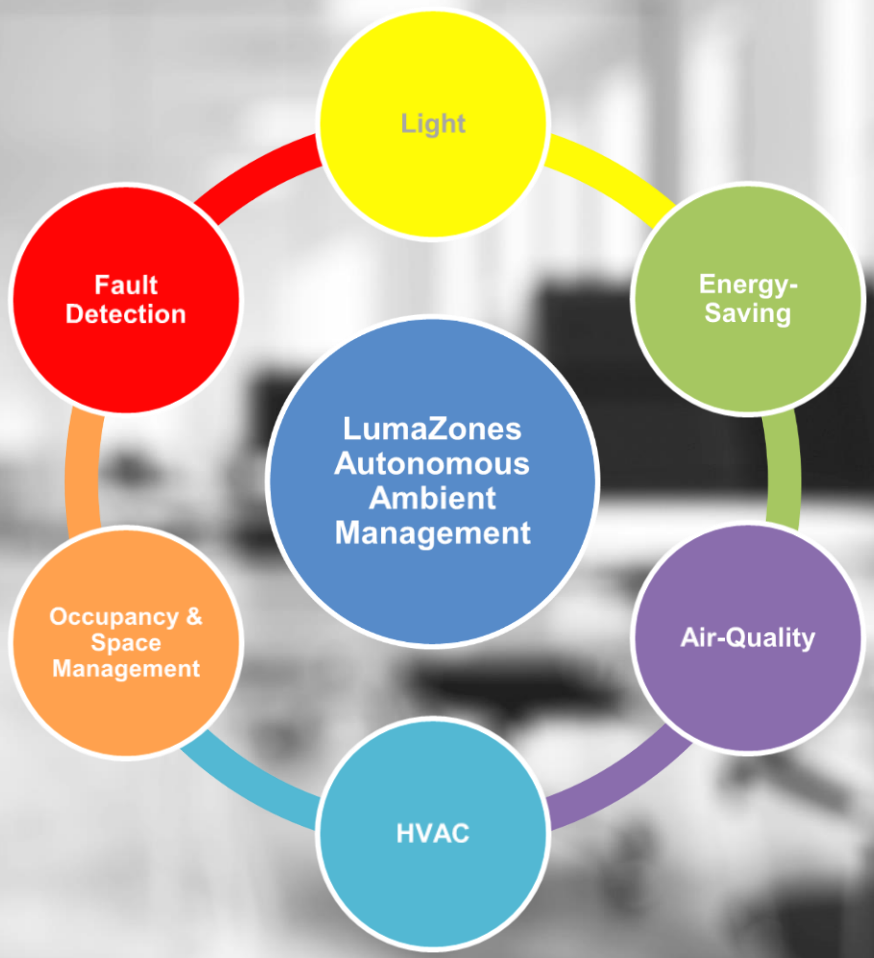
Silent Mode
Light OFF
Air-con 28°C

Security Mode
Light OFF
Alarm ON, Lights ON and push messages to phones when intruded

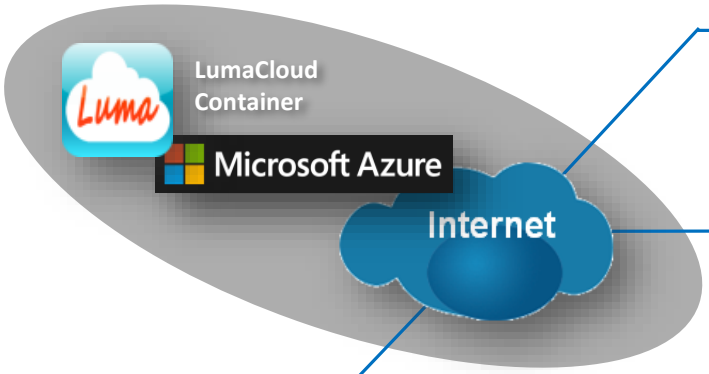
We Offer Experiences, Not Products.

Lumani Experience:

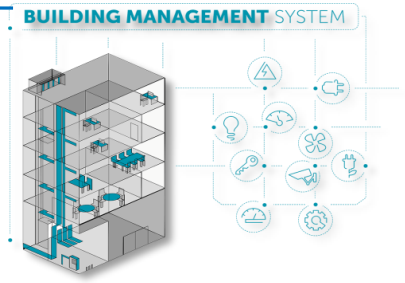
Connection as usual as daylight we see. Intelligence as natural as the air we breathe.



LumaZones Autonomous Lighting and HVAC Control

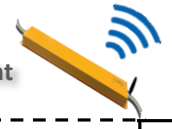


Gateway
Zigbee Wireless



BMS Dashboard

Mobile APP



Emergency Light

Lighting Control

VRV, VRF, Split Air-Con

Occupancy
Sensor

Wi-Fi
Thermostat/
Modbus over
Zigbee AHU
Controller

The Smart Meter
Sends the Energy
Data back to the
Cloud

Daylight
Harvesting

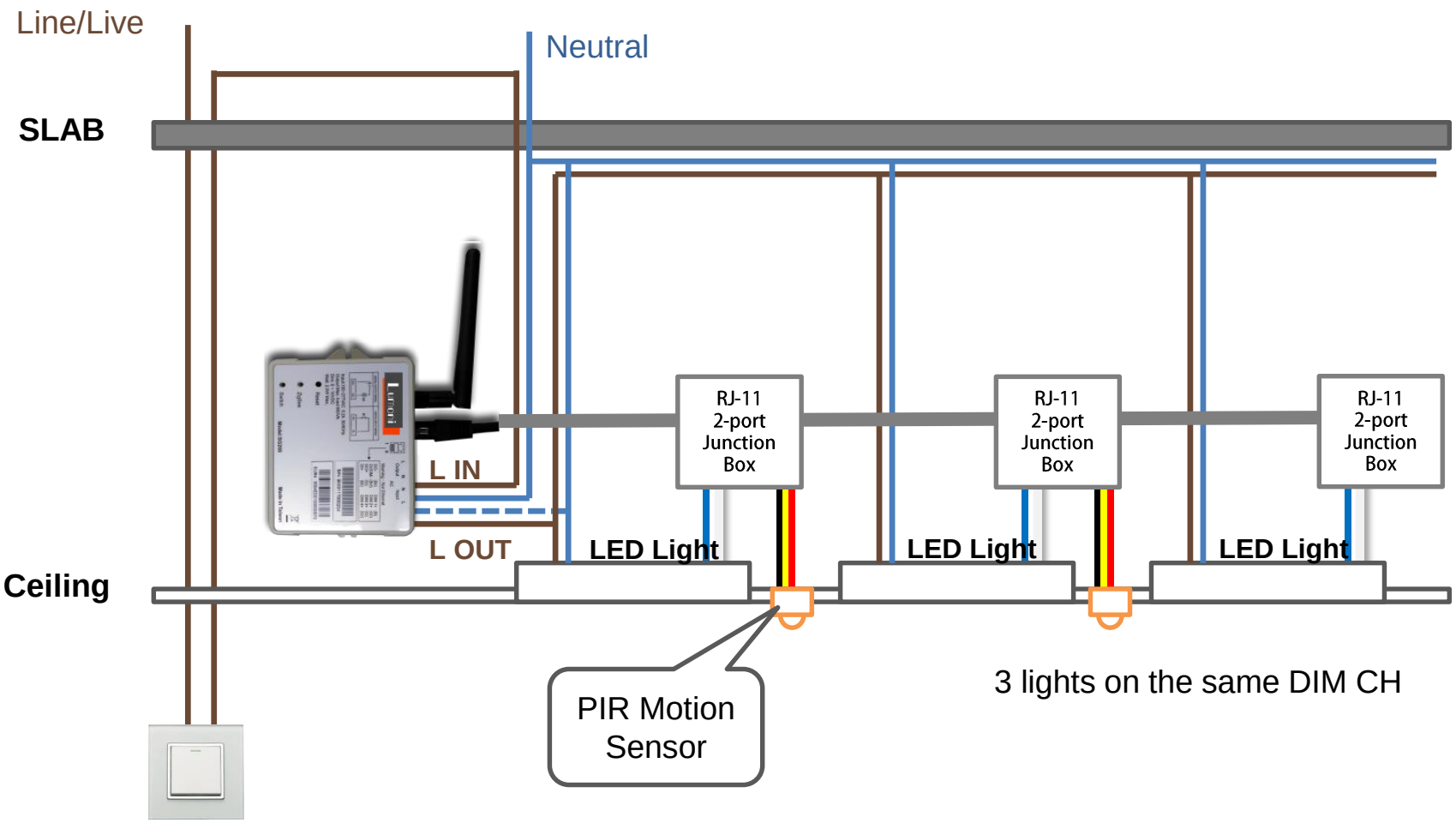
Indoor Air
Quality
Sensor

Original Wall
Switch can
override the
control any time

Zigbee
T&H Sensor

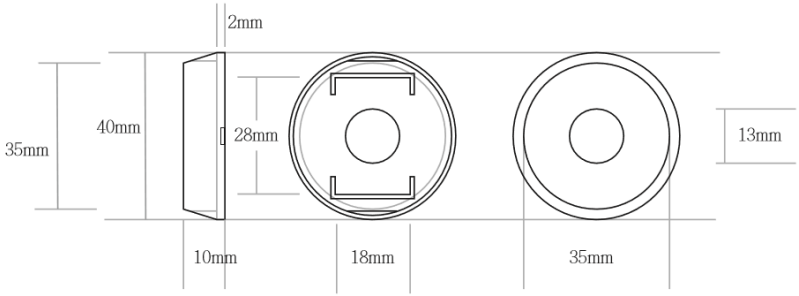
Wi-Fi to IR Control

Power and Signal Lines for One SG200 Lighting Control Box

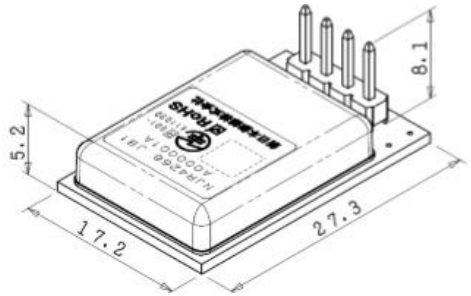


Next Gen Motion Sensors

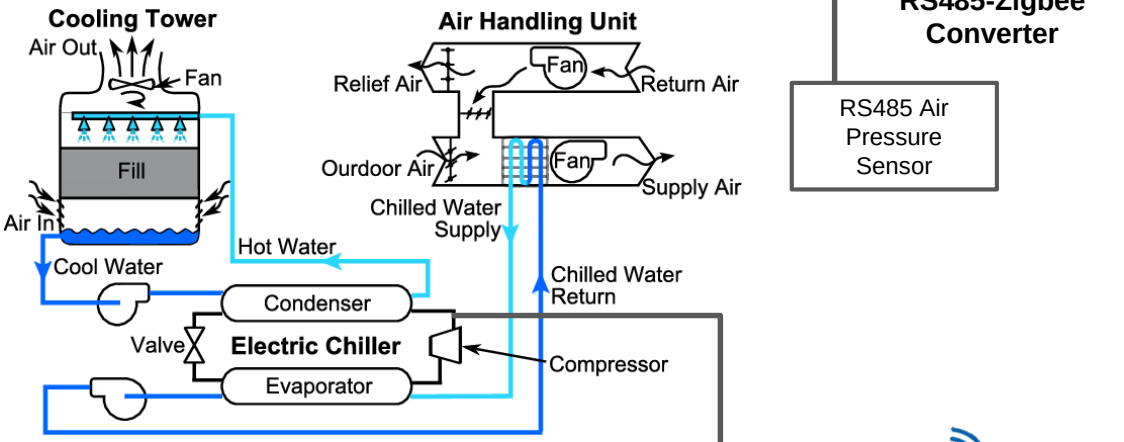
- **Low Profile PIR Sensors**
  - –Aesthetic Desig
  - –Low Profile



- **24GHz RF Motion Sensors**
  - –High Sensitivity
  - –Invisible– Hiding behind the ceiling
  - –Long Range– up to 13m



Empowering the Edge Computing— What Devices Do We Need for HVAC?



RS485-Zigbee Converter

High Performance Edge Computing Gateway

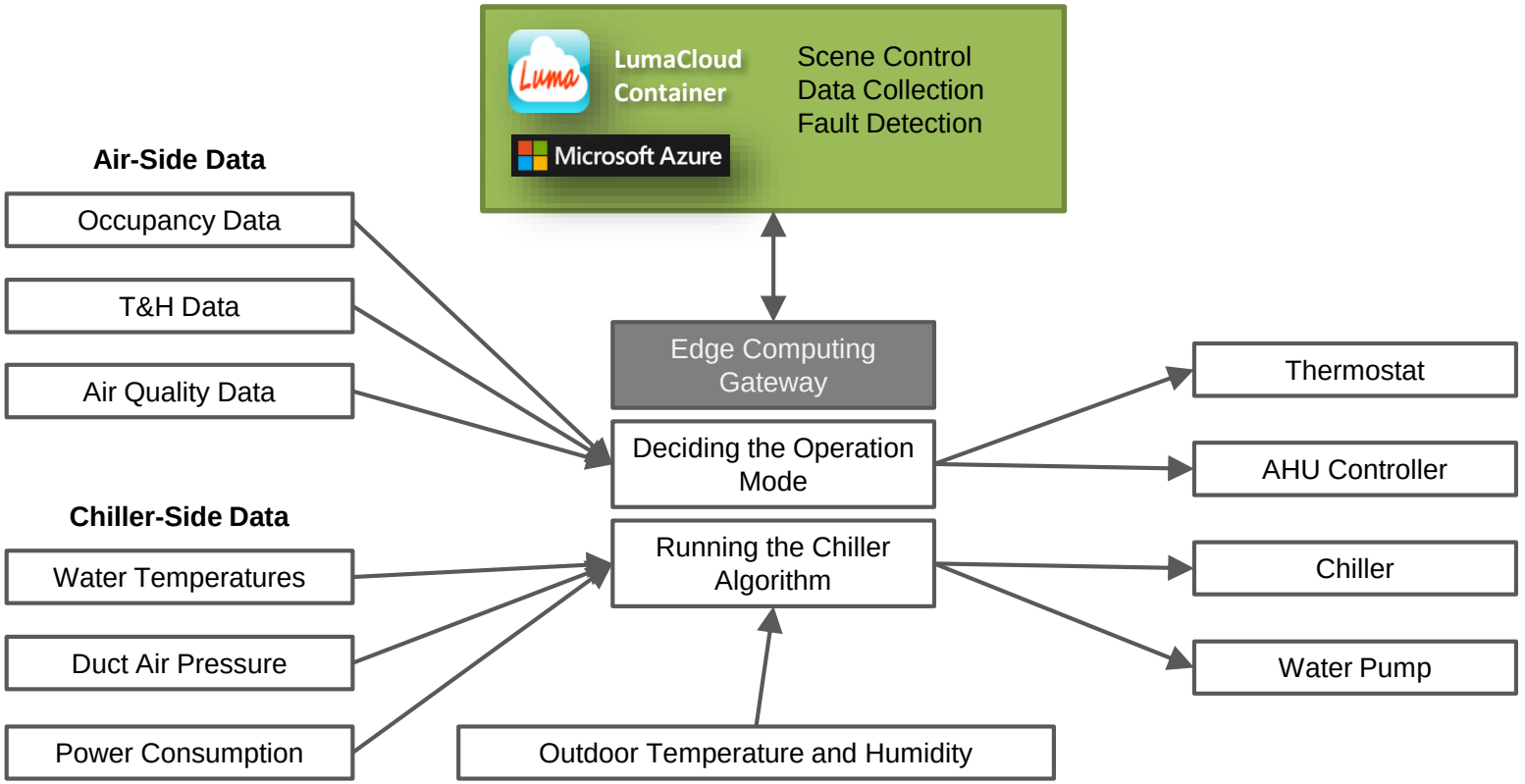
Lighting Control with Motion Sensor

RS485-Zigbee Converter

CO_2 Sensor

Zigbee Temperature & Humidity Sensor

Occupancy-Based Load Balance Chiller Control



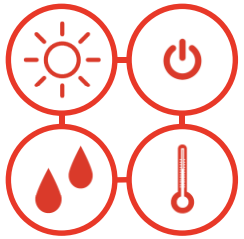
LumaZones @Office, Store, &School

Applications

It Is beyond Office from Now on

Lumani

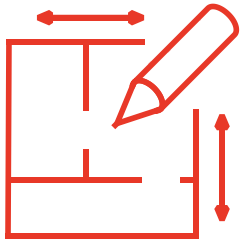
Autonomous Operation makes your office smart and convenient. Unmanned operation reduces the labor on equipment management, and even the emergency light reports its fault. Lumani truly increases the overall productivity of your company.



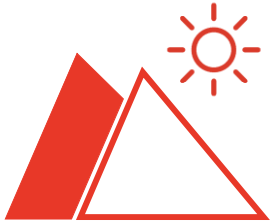
Space Management

We are not just saving the energy. Utilizing precious space efficiently in the building can produce even more value than energy itself. Our sensor networks provides various data including occupancy, temperature, lux, air-quality to help you understand your property unprecedently

Total Ambient Control makes your office sleek and comfortable. It gives you the best quality of light by managing the lux and CCT on occupancy and daylight. It also ensures the temperature, humidity, and air quality to be the best to human health.

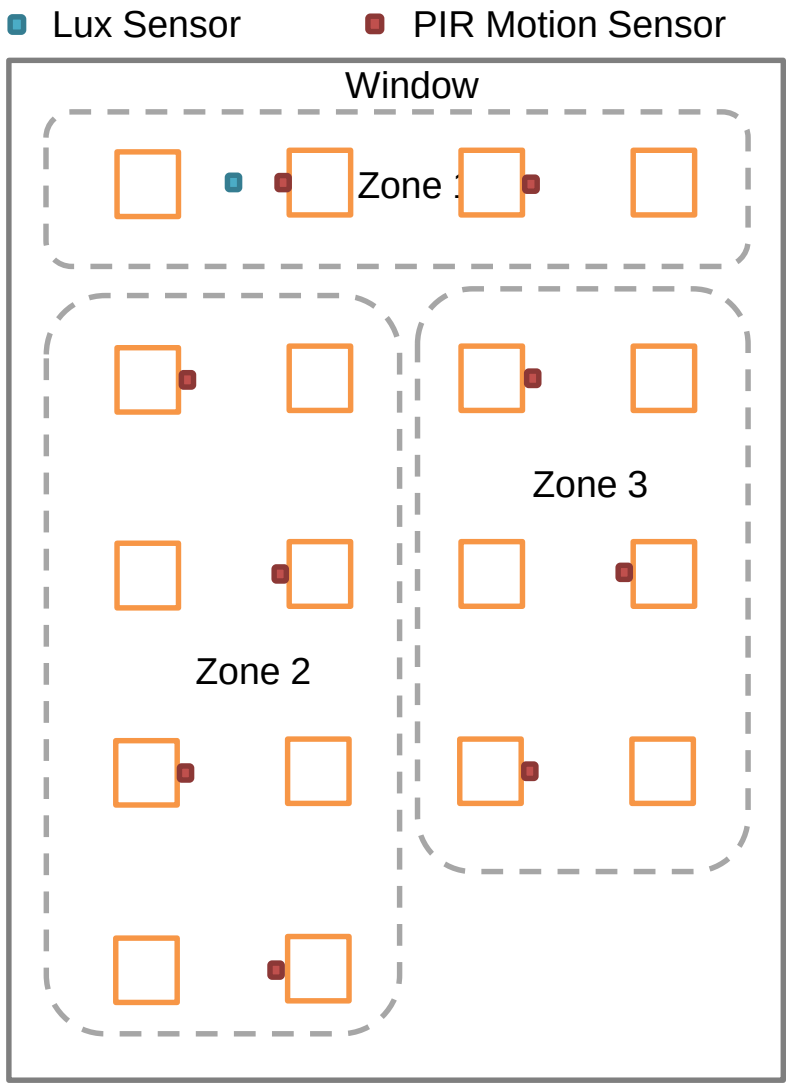


Advanced Scene Control makes your office the fanciest and smartest. All parameters of the autonomous system (light, HVAC, and door) can be scened, and controlled by specific logic, schedule, or shortcut button manually. The capability of the system is totally beyond your imagination



Open Office System Setting Example

- **1 SG600R2 Gateway can connects up to 15 SG200 controllers**
- **Planning zones by functionality and moving path**
- **One zone may comprise from 4 to 8 60x60 panels, 30x120 panels, or double 4ft-tube fittings**
- **Zone 1**
  - 4 panels in line for window side placement
  - 1 LS001 lux sensor
  - 1 SG200 controller with 1 ch dim
  - 2 CA002S motion sensors
- **Zone 2**
  - 8 panels
  - 1 SG200 controller with 1 ch dim
  - 4 CA002S motion sensors
- **Zone 3**
  - 6 panels
  - 1 SG200 controller with 1 ch dim
  - 3 CA002S motion sensors



Conference Room

Advanced Scene Setting for lighting, HVAC

Fully autonomous for lights and HVAC, no human control needed

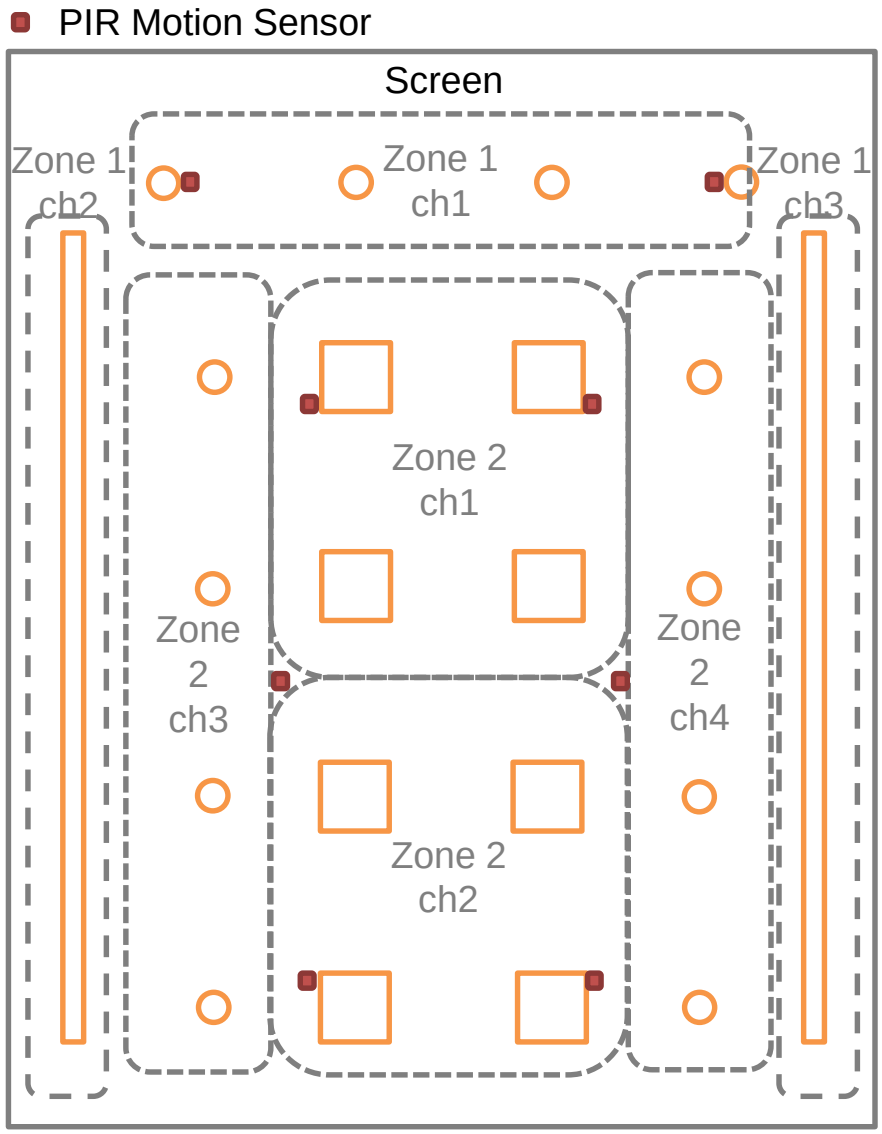
Data Mining
Usage history and ambient data on the cloud

Can also be integrated with Meeting Management or BMS through LumaZones API

Air Quality Monitoring (CO_2, TVoC) for small space

Conference Room Setting Example

- **1 SG600R2 Gateway can connects up to 15 SG200 controllers**
- **One zone with 4 dimming channels by feasible scenes and functionality**
- **One zone may comprise from 4 to 8 60x60 panels, 30x120 panels, down light, cove light, or double 4ft-tube fittings**
- **Zone 1 with 3 dimming channels**
  - 4 down lights; 2 cove lights
  - 1 SG200 controller with 3 ch dim
  - 2 CA002S motion sensors
- **Zone 2 with 4 dimming channels**
  - 8 down lights; 8 panels
  - 1 SG200 controller with 4 ch dim
  - 6 CA002S motion sensors



Corridor

Energy saving and also occupant safety with programmable dimming speed and standby level

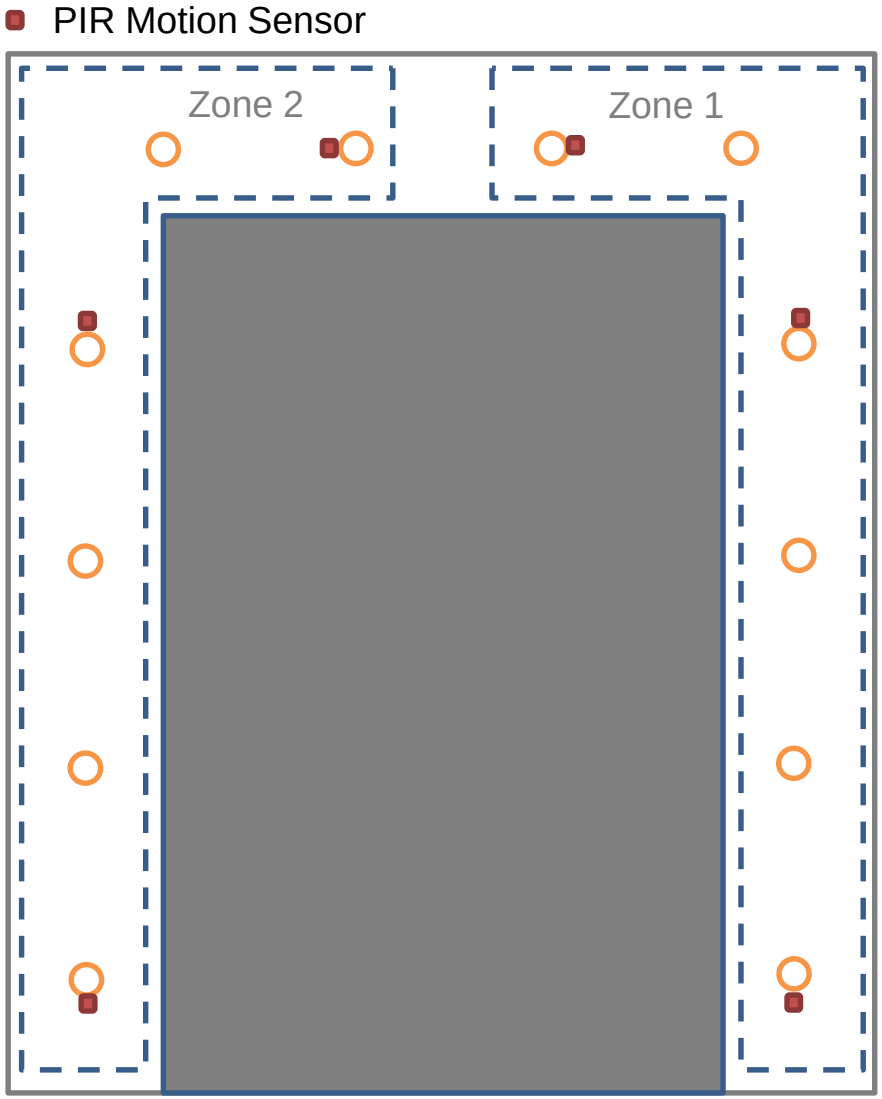
Fully autonomous for lights, no human control needed

Can also be integrated BMS through LumaZones API

Optimized user comfort and energy saving by Advanced Scene Setting

Corridor Setting Examples

- **1 SG600R2 Gateway can connects up to 15 SG200 controllers**
- **One zone with 1 dimming channel**
- **One zone may comprise from 4 to 8 60x60 panels, 30x120 panels, down light, cove light, or double 4ft-tube fittings**
- **Zone 1 with 1 dimming channel**
  - 6 down lights
  - 1 SG200 controller with 1 ch dim
  - 3 CA002S motion sensors
- **Zone 2 with 1 dimming channel**
  - 6 down lights
  - 1 SG200 controller with 1 ch dim
  - 3 CA002S motion sensors



Private Office

Advanced Scene Setting for lighting and HVAC

Adjustable by voice control

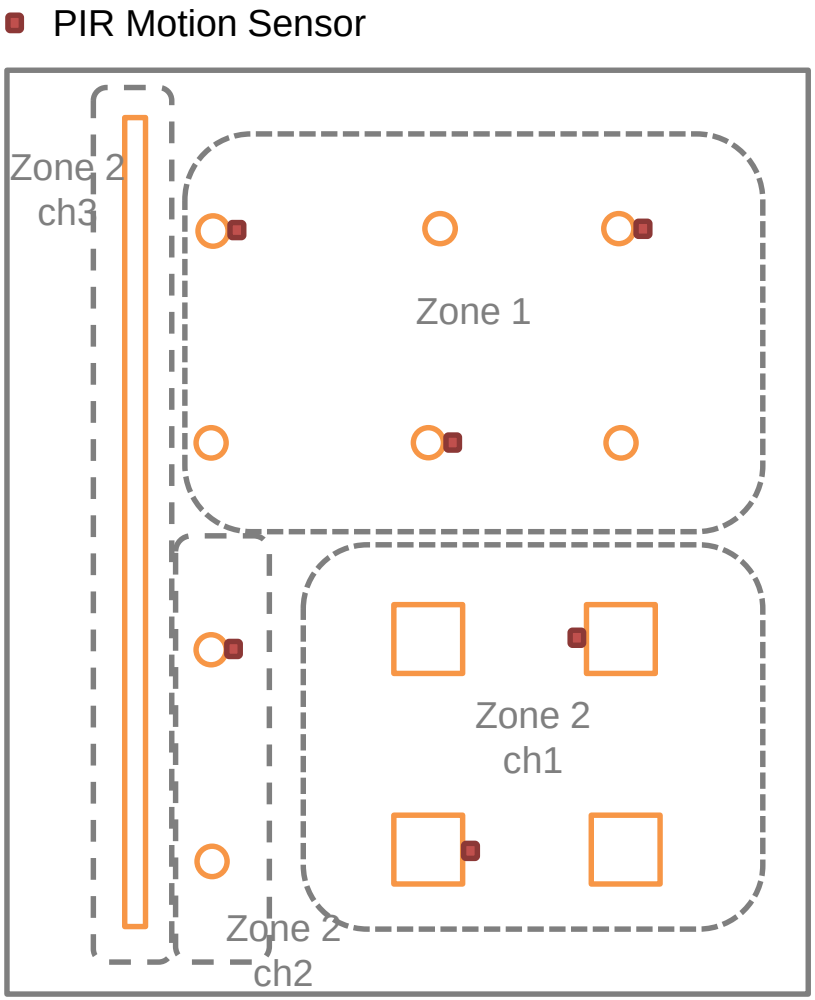
Fully autonomous for light and HVAC, no human control needed

Can also be integrated with BMS through LumaZones API

Air Quality Monitoring (CO_2, TVoC) for small space

Private Office Setting Example

- **1 SG600R2 Gateway can connects up to 15 SG200 controllers**
- **One zone with 1-3 dimming channels by feasible scenes and functionality**
- **One zone may comprise from 4 to 8 60x60 panels, 30x120 panels, down light, cove light, or double 4ft-tube fittings**
- **Zone 1 with 1 dimming channels**
  - 6 down lights
  - 1 SG200 controller with 1 ch dim
  - 3 CA002S motion sensors
- **Zone 2 with 3 dimming channels**
  - 2 down lights; 4 panels; 1 cove
  - 1 SG200 controller with 3 ch dim
  - 3 CA002S motion sensors
- **If there's split air-con or VRV/VRF**
  - SG211 IR controller



Retail Store

Advanced Smart Scene Setting for lighting, HVAC optimizes the power consumption under different conditions

Fully autonomous for lights and HVAC, no human control needed

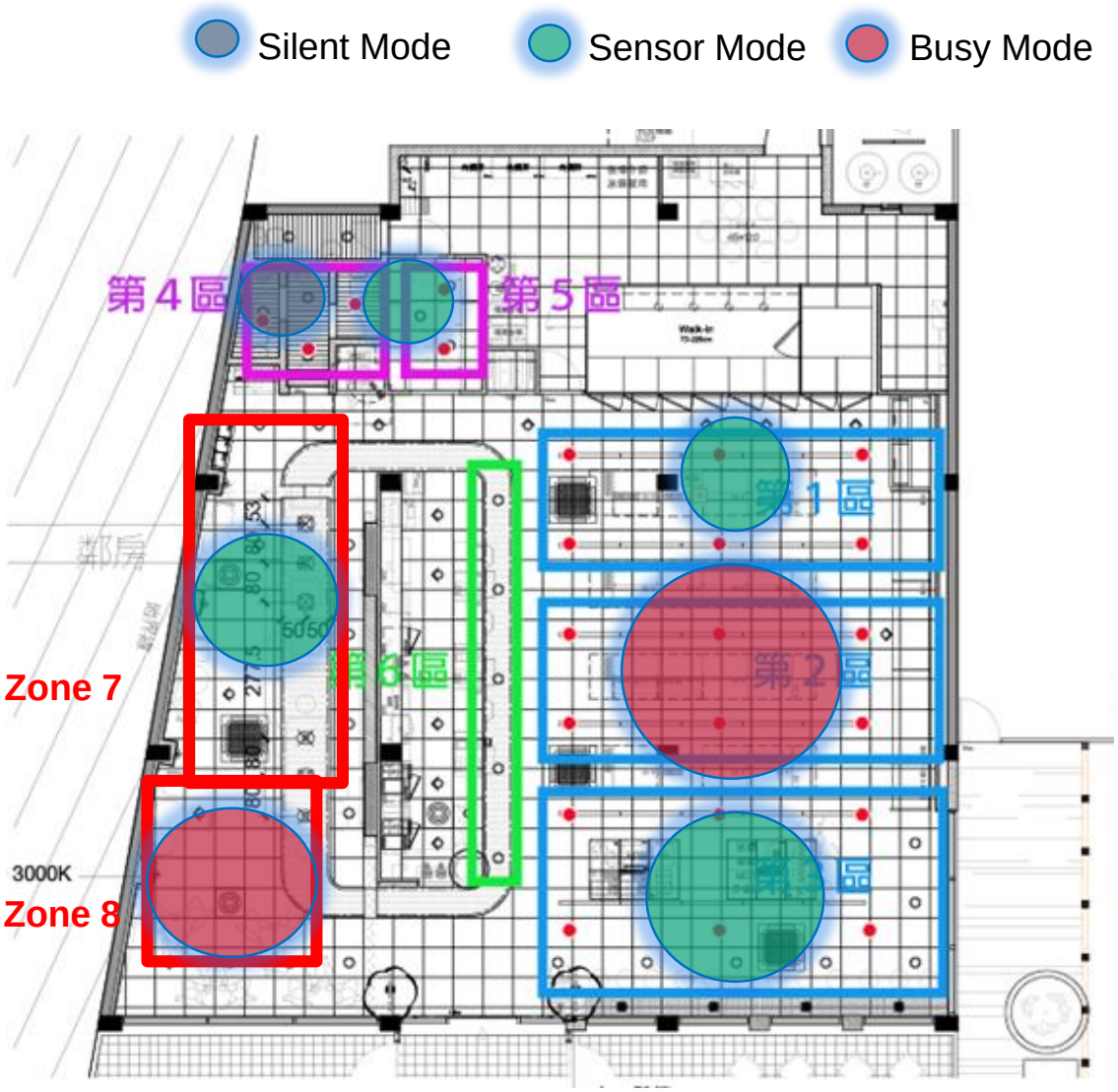
Data Mining customer flow and ambient data on the cloud to improve sales

Can also be integrated BMS through LumaZones API for Chiller control

Air Quality Monitoring (CO_2, TVoC) for ventilation system

Example: Activity Heat Map for Convenient Store

- Zone 1-3:
  - –You may understand which row of shelf are the favorite to the customers
  - –You may charge higher shelf fee for products on the “hot shelves”
  - –Putting more zones can get more detailed behavior of the customers
- Zone 4 Toilet:
  - –When the activity reach the preset number, the system can inform the staffs to clean the toilet to keep it from being smelly
- Zone 5 Customer Delivery Pickup
  - –You get a quick view for how many pickup happening there
- Zone 7-8 Sitting Area
  - –Can compare the level with the shopping area and revenue to assess the effect of the sitting area



School

Advanced Scene Setting for lighting, HVAC

Fully autonomous for lights and HVAC, no human control needed

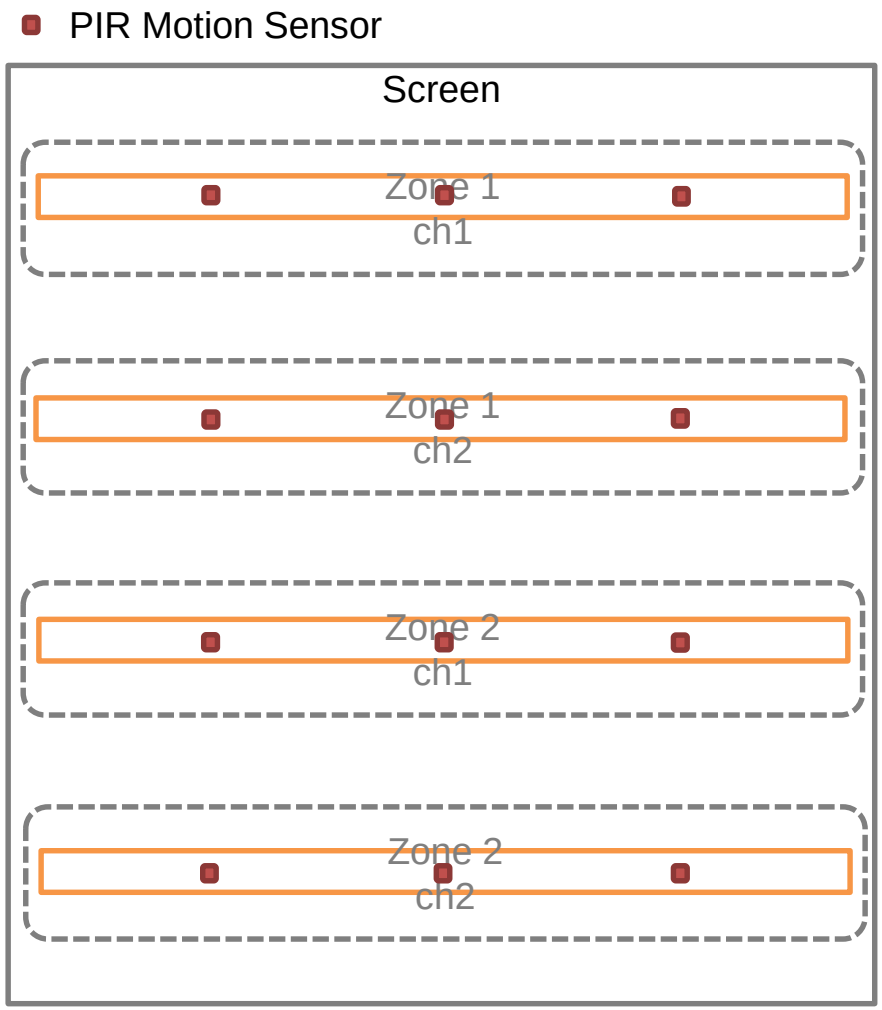
Data Mining
Usage history and ambient data on the cloud

Can also be integrated with curriculum management or BMS through LumaZones API

Air Quality Monitoring (CO_2, TVoC) for small space

Class Room Setting Example

- **1 SG600R2 Gateway can connects up to 15 SG200 controllers**
- **One zone with 2 dimming channels by feasible scenes and functionality**
- **One zone may comprise from 4 to 8 60x60 panels, 30x120 panels, down light, cove light, or double 4ft-tube fittings**
- **Zone 1 with 2 dimming channels**
  - 8 double 4ft-T8 dimming LED
  - 1 SG200 controller with 2 ch dim
  - 6 CA002S motion sensors
- **Zone 2 with 2 dimming channels**
  - 8 down lights; 8 panels
  - 1 SG200 controller with 2 ch dim
  - 6 CA002S motion sensors
- **If there's split air-con or VRV/VRF**
  - SG211 IR controller



Coming Soon–
Emergency Light Networks

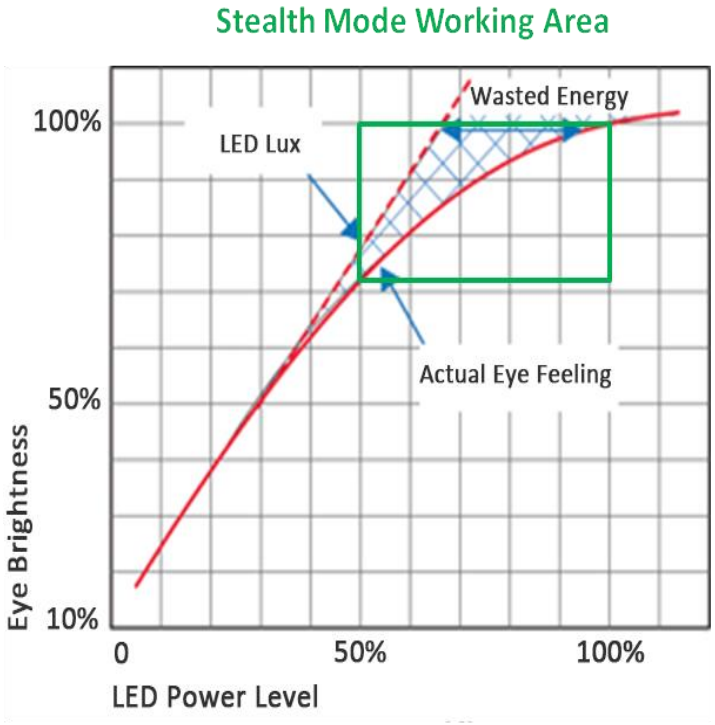
Low Cost– Co-exist with regular lighting networks through Zigbee wireless
Productivity– No need to test the emergency light one by one manually
Convenient– Browse and check your lights and their history on the internet
Fast and Reliable– LumaCloud on MS Azure sends out push message and email for immediate fault warning
Aesthetic– Using the original lighting fixtures

LumaZones Advanced

Features

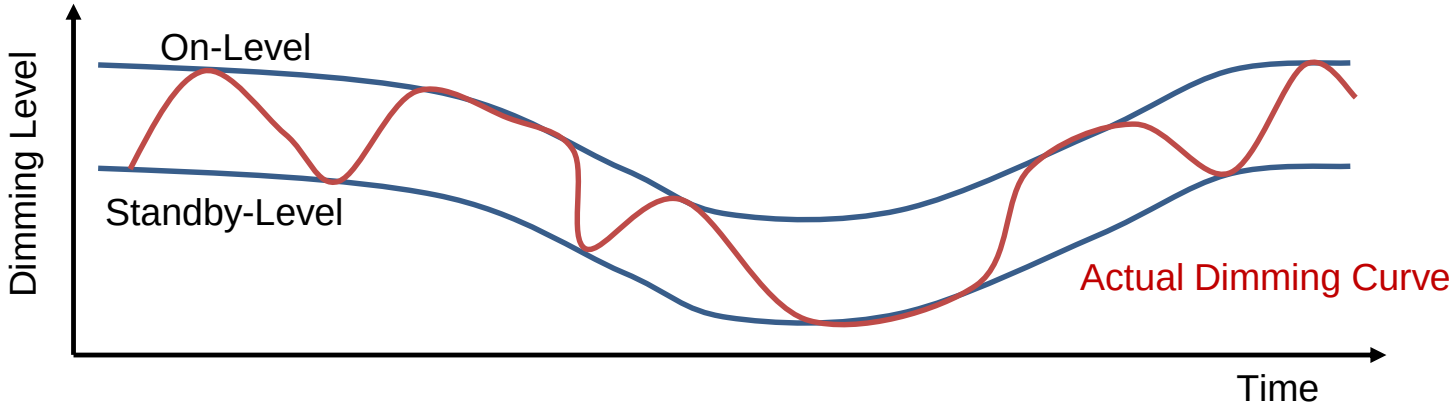
Saving Energy in Stealth Mode

- WE MAY DIM THE LIGHT for all occasions to save energy
- It saves 35% of energy when there's average 8 hours of highly occupied period a day
- Good for the offices, shops, or restaurants where light level changes shouldn't be seen
- Exploiting the non-linear area of Eye-to-power curve to save energy
- Set the dimming speed to the lowest (1 min) so the user can't tell the level fluctuation while saving the energy

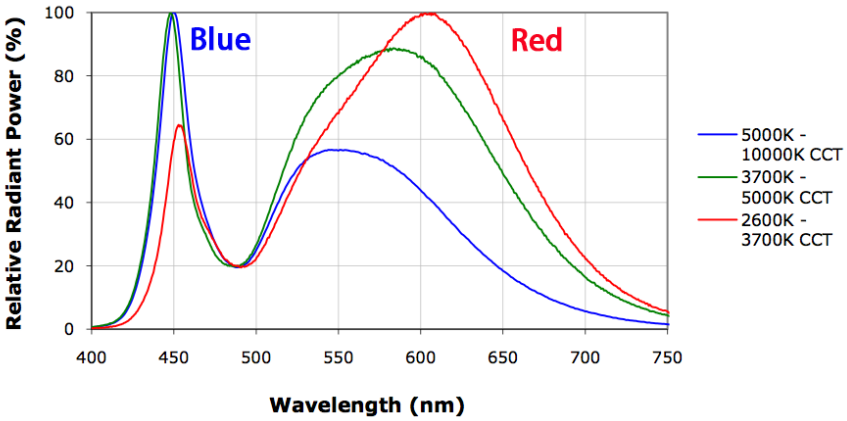


Day Light Harvesting

- It is blended in LASM perfectly to co-work with our occupancy sensors for ultimate energy-saving efficiency
- Sudden change of the ambient brightness doesn't have instant effect on LumaZones
  - **–No continuous disturbances**
  - **–The mode changes at very low dimming speed periodically by statistical data**

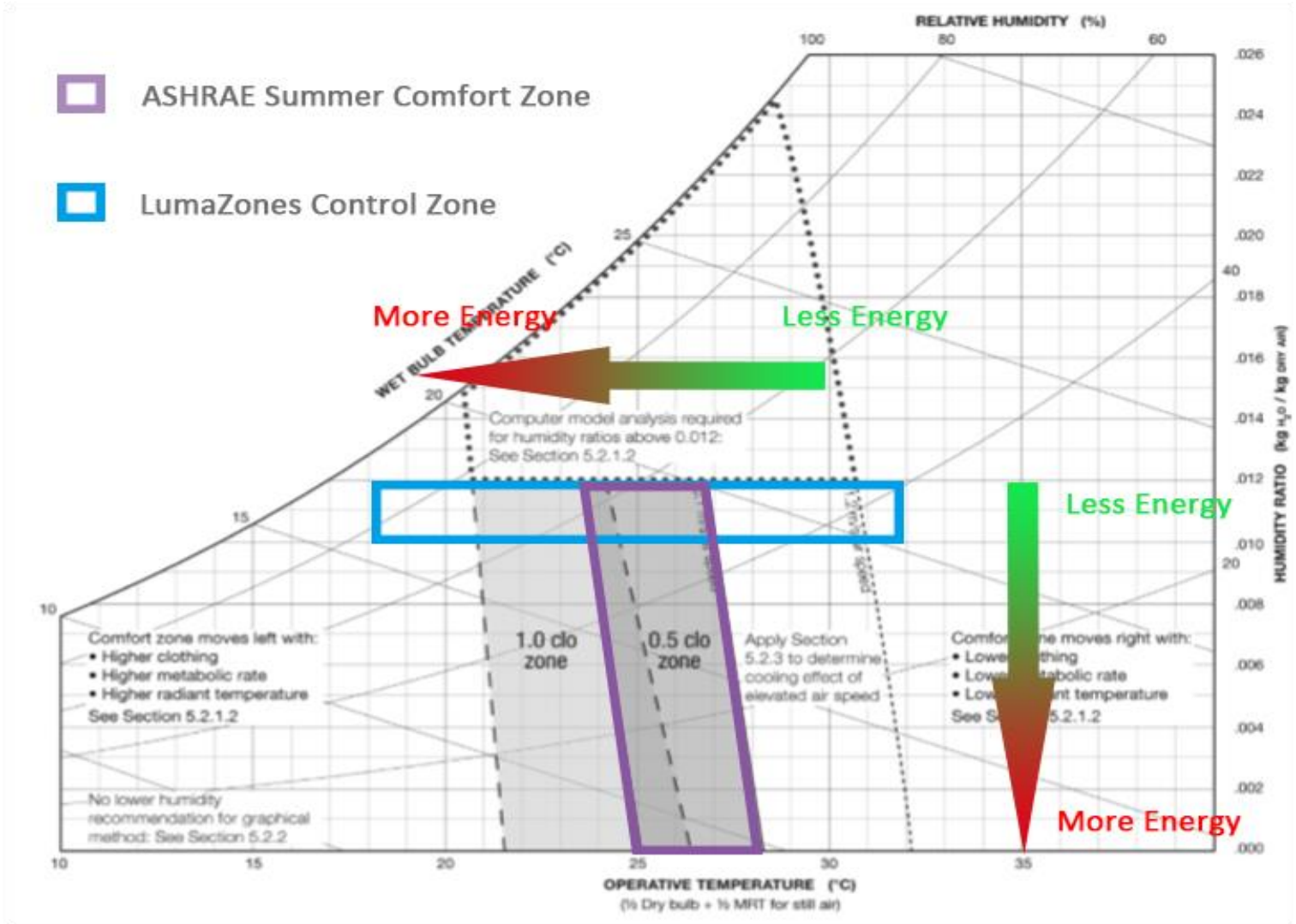


Energy-Saving, Health, and Productivity

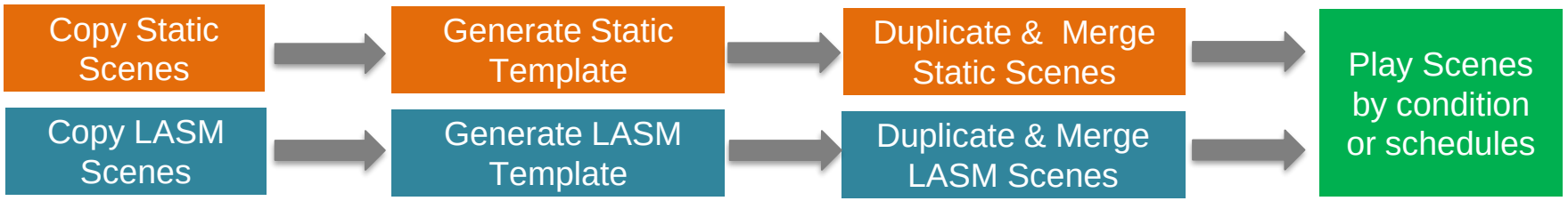


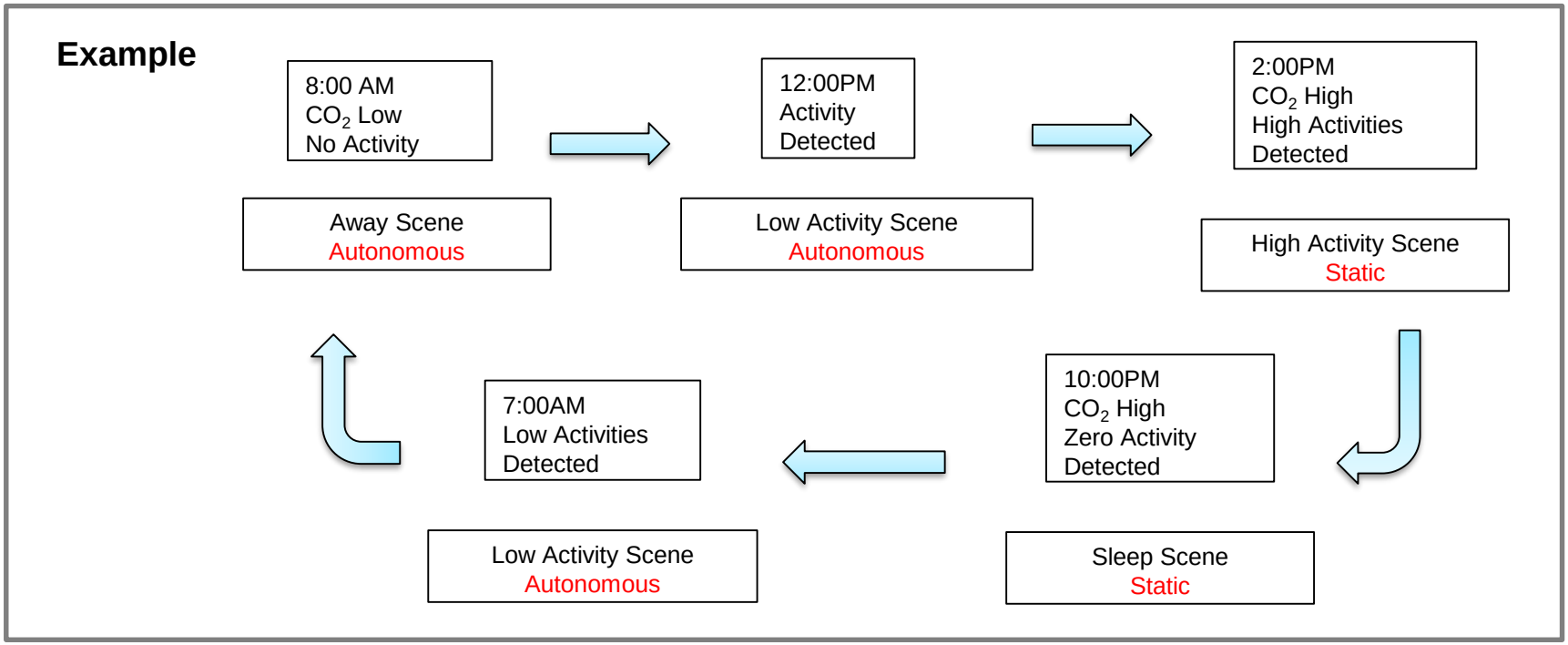
- CCT schedulable while doing LASM
- Our intelligent LED lighting control provides the staffs an energy boost for maximal productivity and mood with bio-active blue light in the morning
- At dusk or night, after a day of hard work, the over exposure to the bio-active blue light could be harmful to human body. It causes insomnia, sleep disorder, and other chronicle diseases
- Our system emulates the spectrum of the sunset by low CCT light for your body to prepare for the upcoming rest at night

Comfort and Energy Saving for HVAC



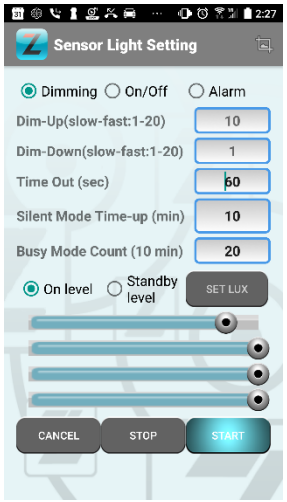
LumaScene– Not only for Lighting but also for HVAC and Other Things





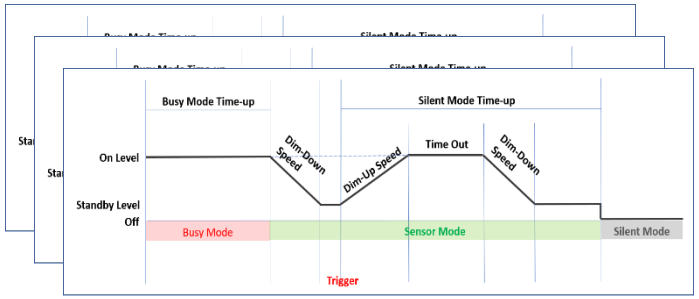
Using LASM Scene Template to Create Dynamic and Flexible Scenarios

Setup for One Zone



LASM Scene Template

System Default and User-Defined Scene Templates

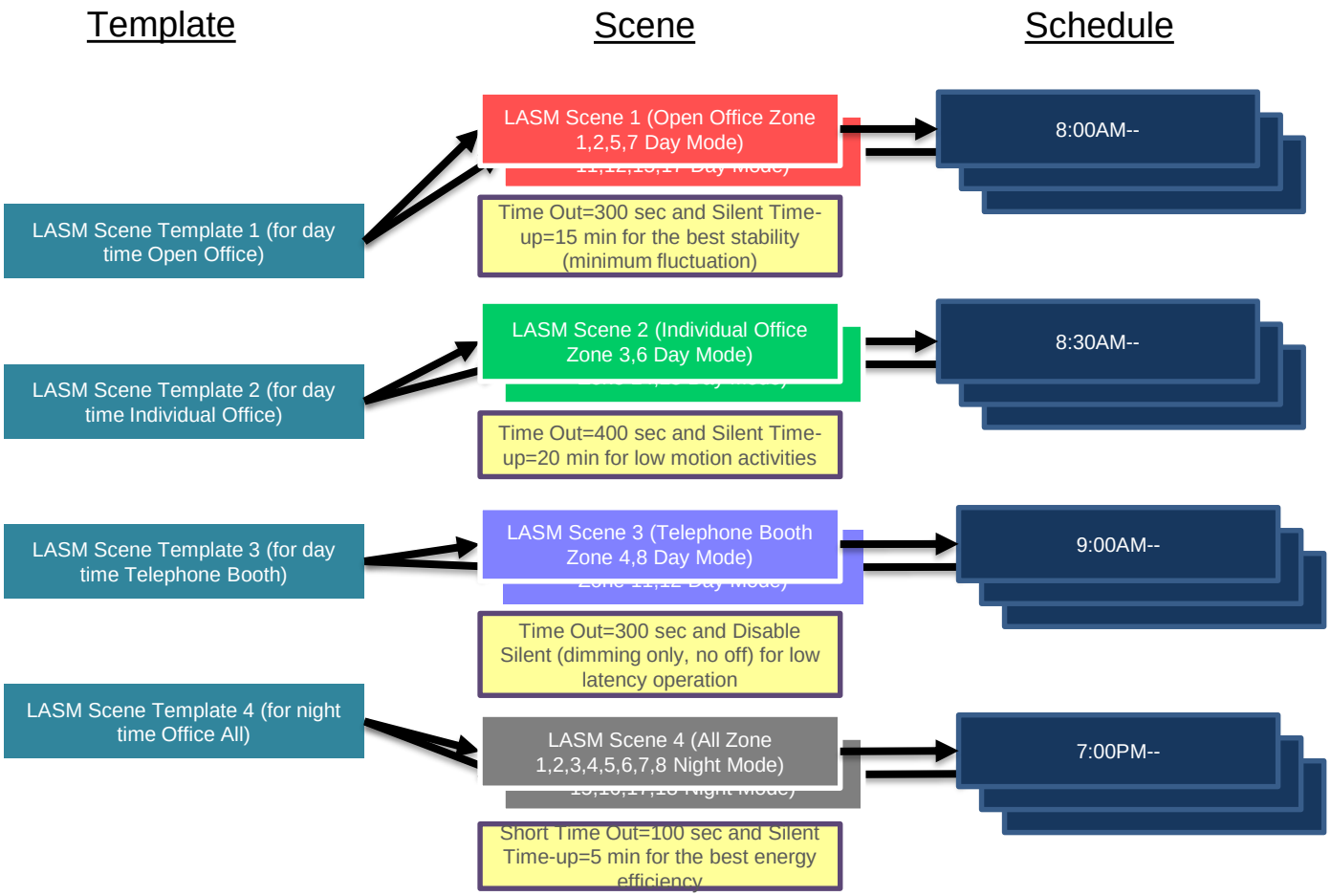


LASM Scene Template 3

LASM Scene Template 2

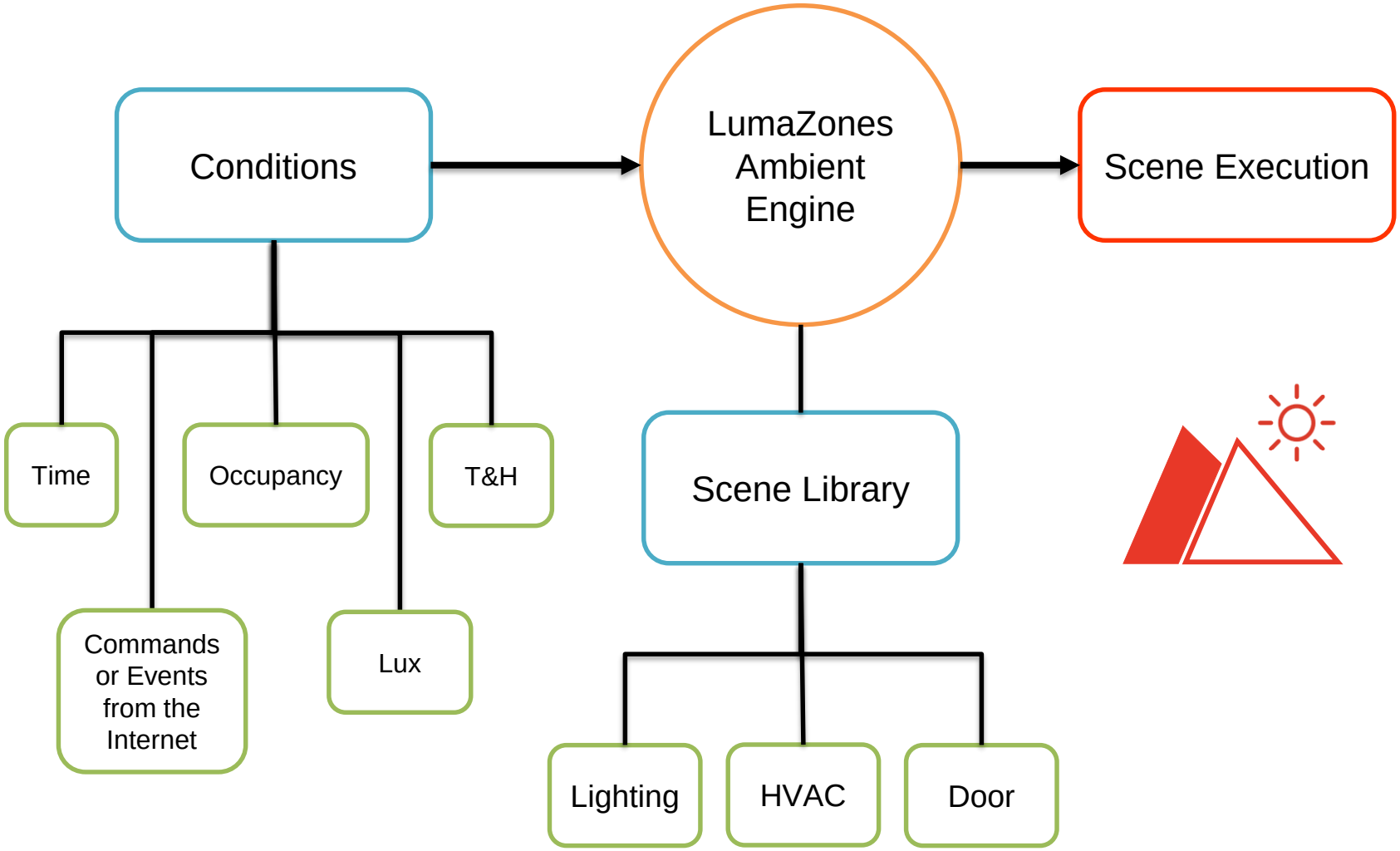
LASM Scene Template 1

Using Templates to Generate Scheduled LASM Scenes



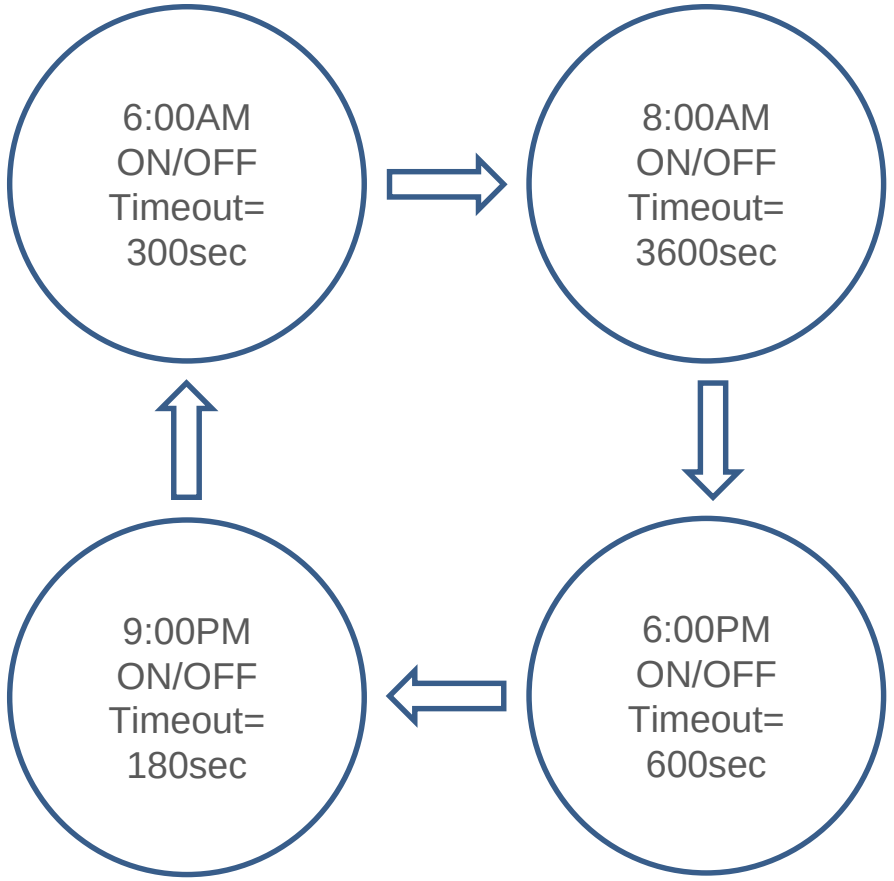
- Assign the Zones to apply to the templates to make scenes
- Assign the scenes and times to execute
- Scenes can be further merged

LumaScene– All Things Are Scene-able



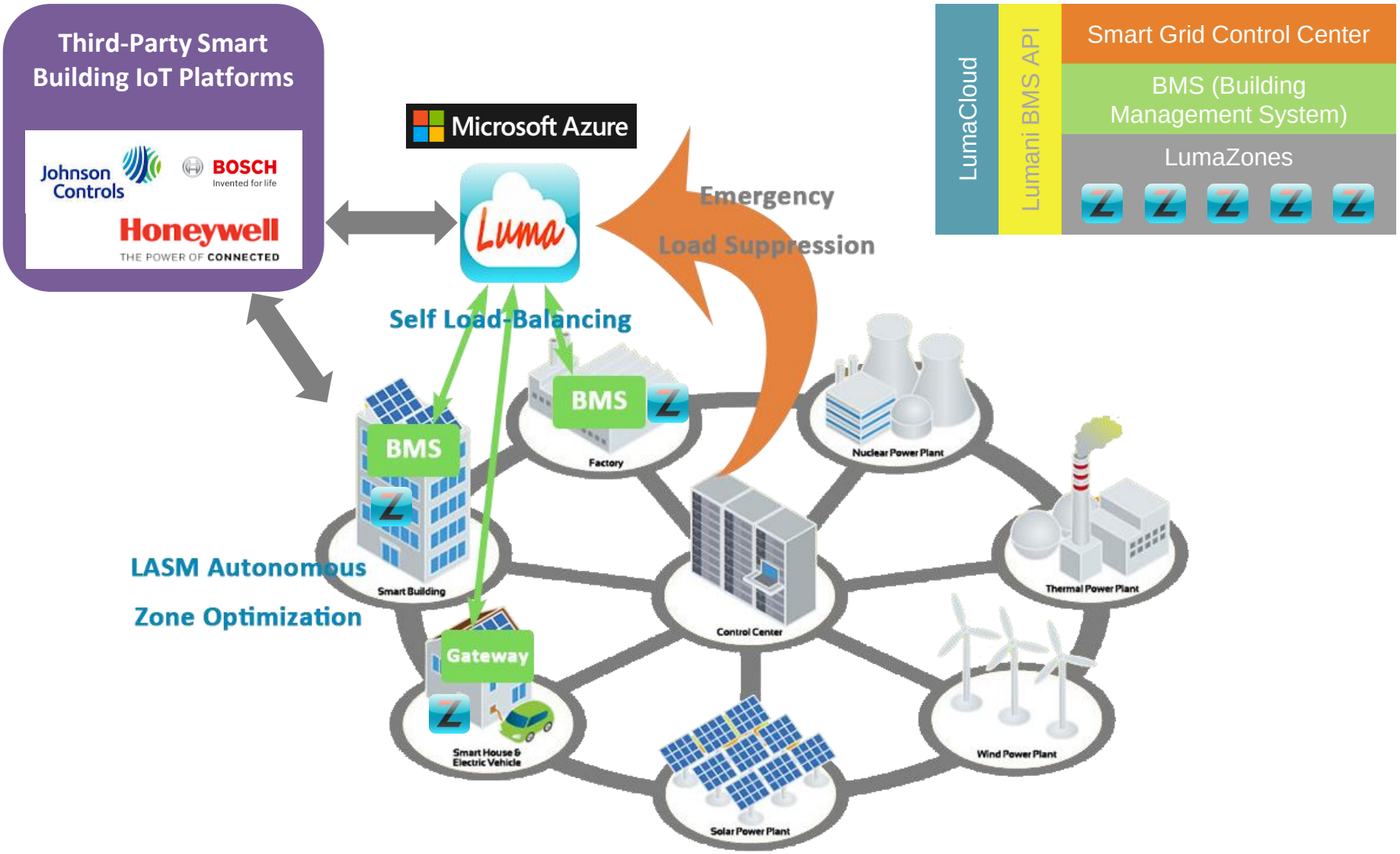
LumaScene Application– Adaptive Sensor Light Control

- **The control can be**
  - –ON/OFF
  - –Dimming
    - ✓ Upper and lower levels
  - –Dimming Speed
  - –Timeout
  - –Lux Compensation Parameters
  - –Temperature set points of Air-Con



Tremendous Scalability– from Room to Grid

It is totally integratable with 3rd party platform through API



Business Model

LumaZones™ Platform

- Energy Savings in Air-Con & Lighting Solution
- Bundled sales of Hardware , App, and Cloud Service

IBTaaS (Intelligent Building Technologies as a Service)

- Through the Partnership with IBTaaS Companies to Finance for the Clients

ESCO

- Through the Partnership with Energy Service Companies to Finance for the Clients

LumaCloud Subscription Service

- Autonomous control
- Reports
  - Occupancy, Energy Consumption, Temperature, Humidity etc.

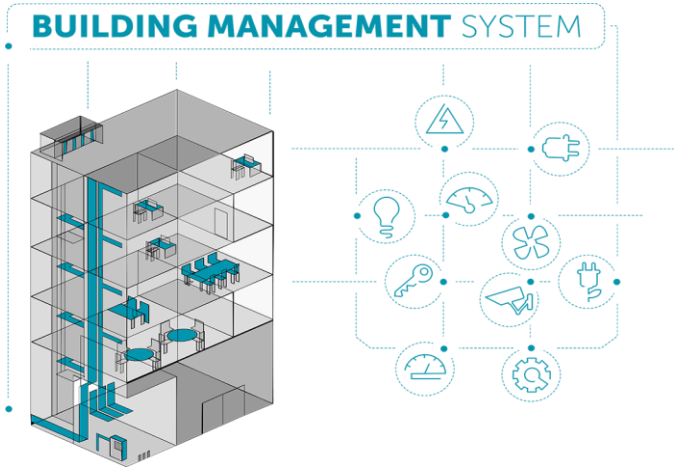
Customization, Licensing, Royalty Fee

- Open IoT Platform for More Applications
- API's for Clients to Utilize Lumani's Data and Infrastructures
- Security Access, In-Door Air Quality etc.

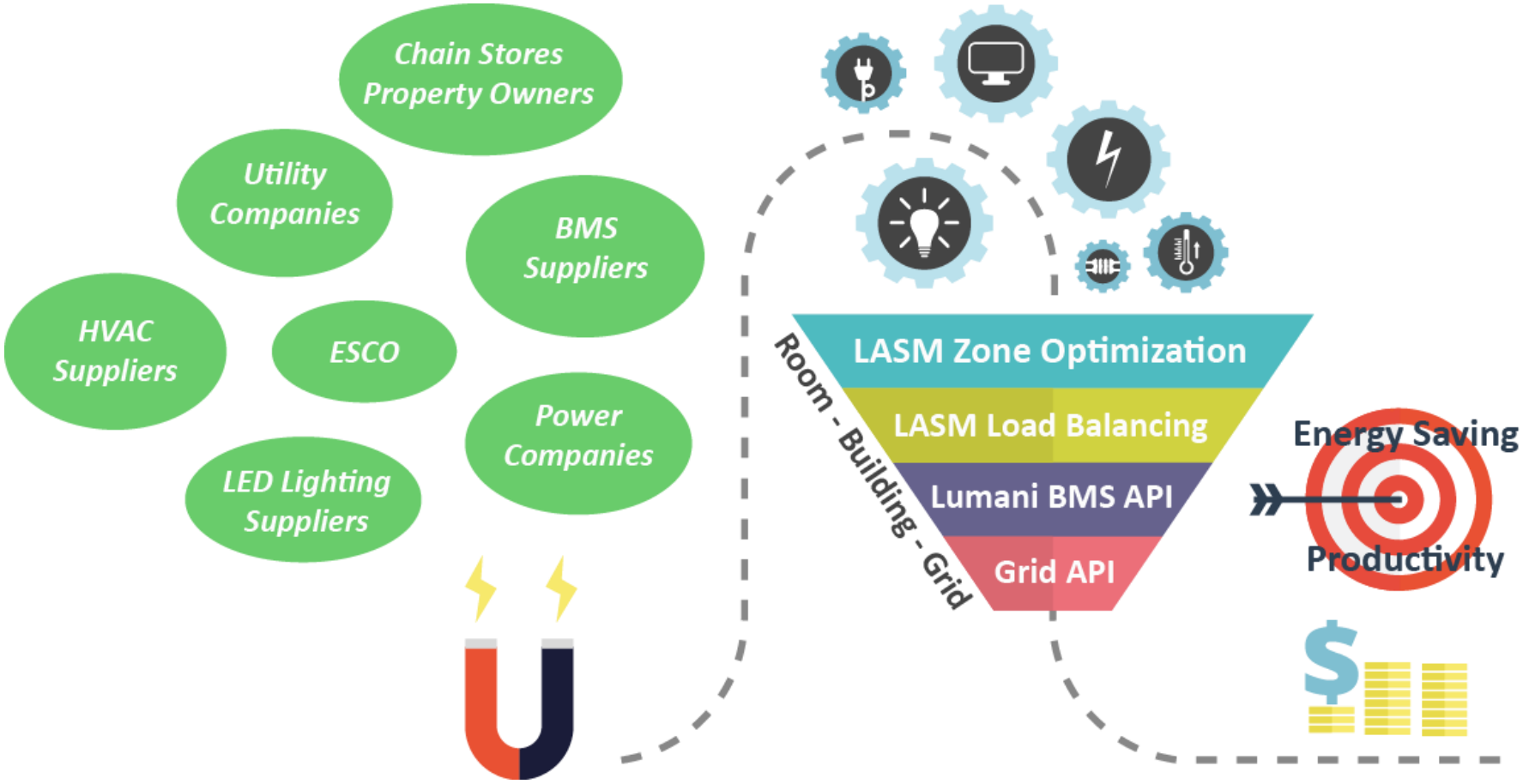
LumaCloud

Lumani BMS API

- Power Consumption
- Occupancy Level
- Temperature
- Humidity
- Air Quality
- LASM Management



Blue Sky Vision:
Adding Unprecedented Value of Service to Multiple Energy Verticals



The Benefit of Being Smart and Green

- Cutting-edge technologies raise the value of the property
- It saves up to 30% of the energy consumed by lighting and HVAC
- It brings all the benefits for your property as green building
- Reduces the work load of checking the status of light, HVAC, and other devices
- Web-based dash board provides the real-time status of the utility, energy, occupancy, temperature, and humidity

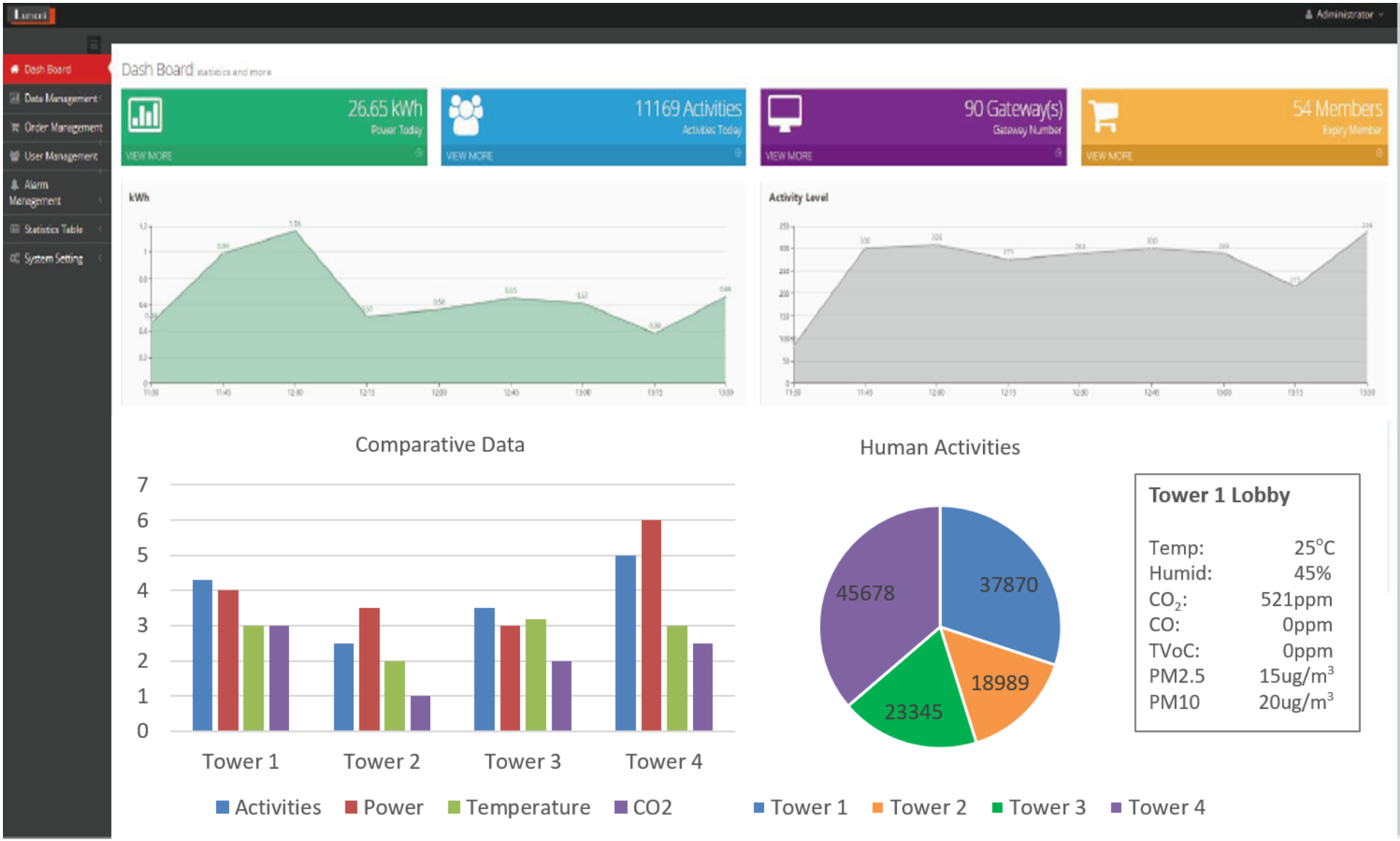
	Difference vs. Non-Green Average
Market Value	8.4%
NOI	28.8%
Operating Expense	-17.6%

Source: Utilizing Commercial Real Estate Owner and Investor Data to Analyze the Financial Performance of Energy Efficient, High-Performance Office Buildings, May 2017, U.S. Department of Energy

Productivity is the Key–
The 3-30-300 Rule

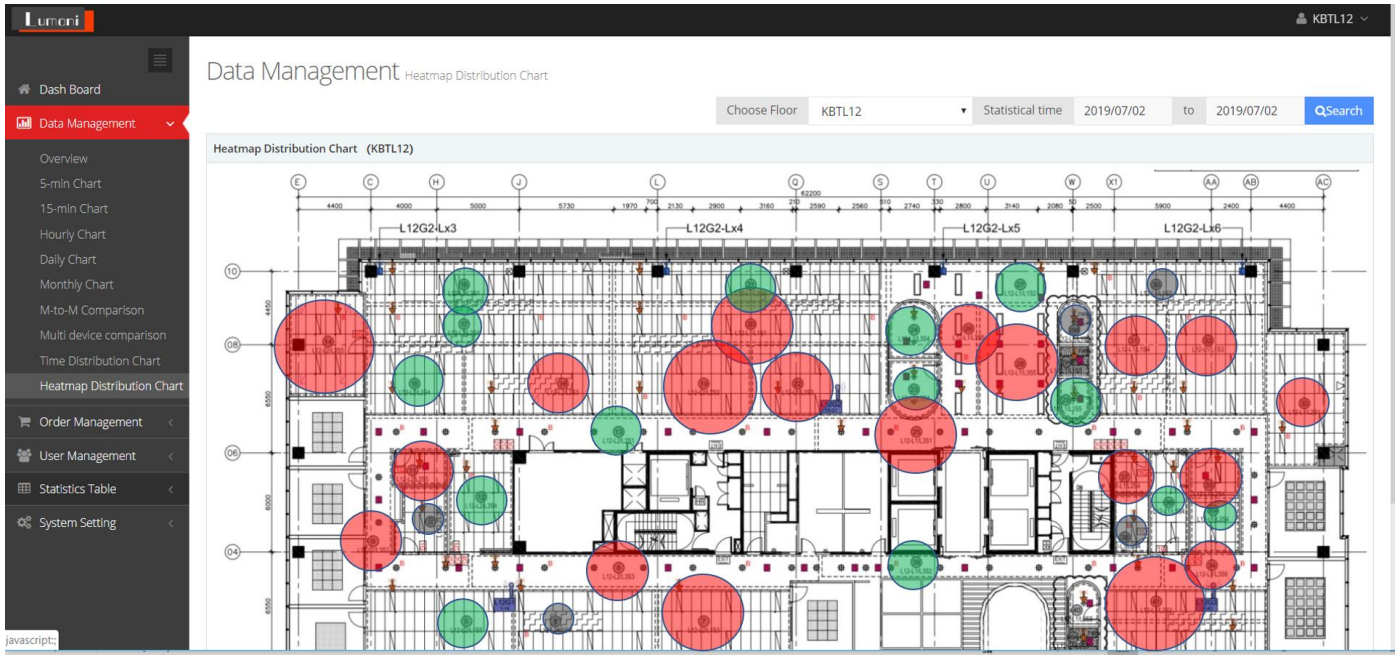
- **Organizations typically spend approximately**
  $3 per square foot per year for utilities, $30 for rent and $300 for payroll
- **Greatest financial savings from greening a workplace may not be in energy but in productivity.**
  A 2% energy efficiency improvement would result in savings of $.06 per square foot but a 2% improvement in productivity would result in $6 per square foot through increased employee performance

Holistic Energy and Ambient Monitoring



Dashboard and Heatmap

- Fathoming the whole property by big data
- Though they are autonomous, all the lights can be set and controlled on the dashboard
- Operating modes are shown, “Busy”, “Sensor”, and “Silent” by different colors, red, green, and grey
- The size of the circle indicates the accumulated occupancy level during a period of time
- Click the circle, you may see the activity count and light status



Tractions & Global Partners

LIGHT FIXTURE MANUFACTURERS

QSSI SINCE 1985 LIGHTING & ELECTRICAL PRODUCTS MANUFACTURERS

Energyled

東亞照明

chiMay Chimay Technology Co., Ltd.

KLD KLAASEN LIGHTING DESIGN — Future proofing our world — LDoT Lighting Design of Things™ by Klaasen Lighting Design

CLIENTS

7-ELEVEN

SINGAPORE POLYTECHNIC

ALEXANDRIA

C.P. GROUP

SLEB SMART HUB

Super Low Energy Building

中華大學 CHUNG HUA UNIVERSITY

CHANNEL PARTNERS

SOCIAL ENERGY PARTNERS

OTTO solutions

有限会社 エース電気工事社

Industrial One Driven by innovation

株式会社アクティブ沖縄

TECHNOLOGY PARTNERS

Microsoft Azure

BILLION

BOSCH Invented for life

HUAWEI

Johnson Controls

Awards

APAC CIO Outlook TOP 25 SMART CITY SOLUTION PROVIDERS - 2017

POWER ACE 2018 — 1st Runner Up

Outperforming the Competitions in Many Aspects

	Lumani ($)	Enlighted ($$$)	Competition Smart Lighting Control ($$$)	Competition Energy Saving Solution ($$)
Remote Access	√	√	NRE	√
Multi-site Management	√	NRE	NRE	√
Remote Control/Wall Switch	NA/Original Wall Switch	Proprietary	Proprietary	x
Scene Control	Dynamic Play for Lighting & HVAC	√	√	x
Automatic Operation by	Activity Level with LASM & Dynamic Scene Play	Schedule by Occupancy Analytics	Schedule by Occupancy Analytics	Schedule by Occupancy Analytics
Sensor Light	Programmable Multi-Mode	Programmable 2-Level	2-Level	2-Level
Schedule On/Off & Dimming	Any Scene	√	√	√
Automatic Operation Mode	Four-Mode *LASM	Schedule Learning	Schedule Learning	Schedule Learning
Occupancy Data Collection	On Cloud, may be fetched through API	√	√	√
Security Functions	Embedded Alarm, Link to door & other systems	x	x	x
Door Access Control	Embedded	x	x	x
Meter/Energy Management	Embedded	Embedded	Plug-in	Embedded
Air-con Automation	IR Control, Centralized Chiller, BMS	BMS Control	BMS Control	BMS Control
BMS Connectivity	Embedded API	√	√	√
Indoor Environment Quality (IEQ)	Light & Air	x	x	x

- LASM: LumaZones Automatic Switch Mode
- NRE: Non-Recurring Engineering (One Time Cost)

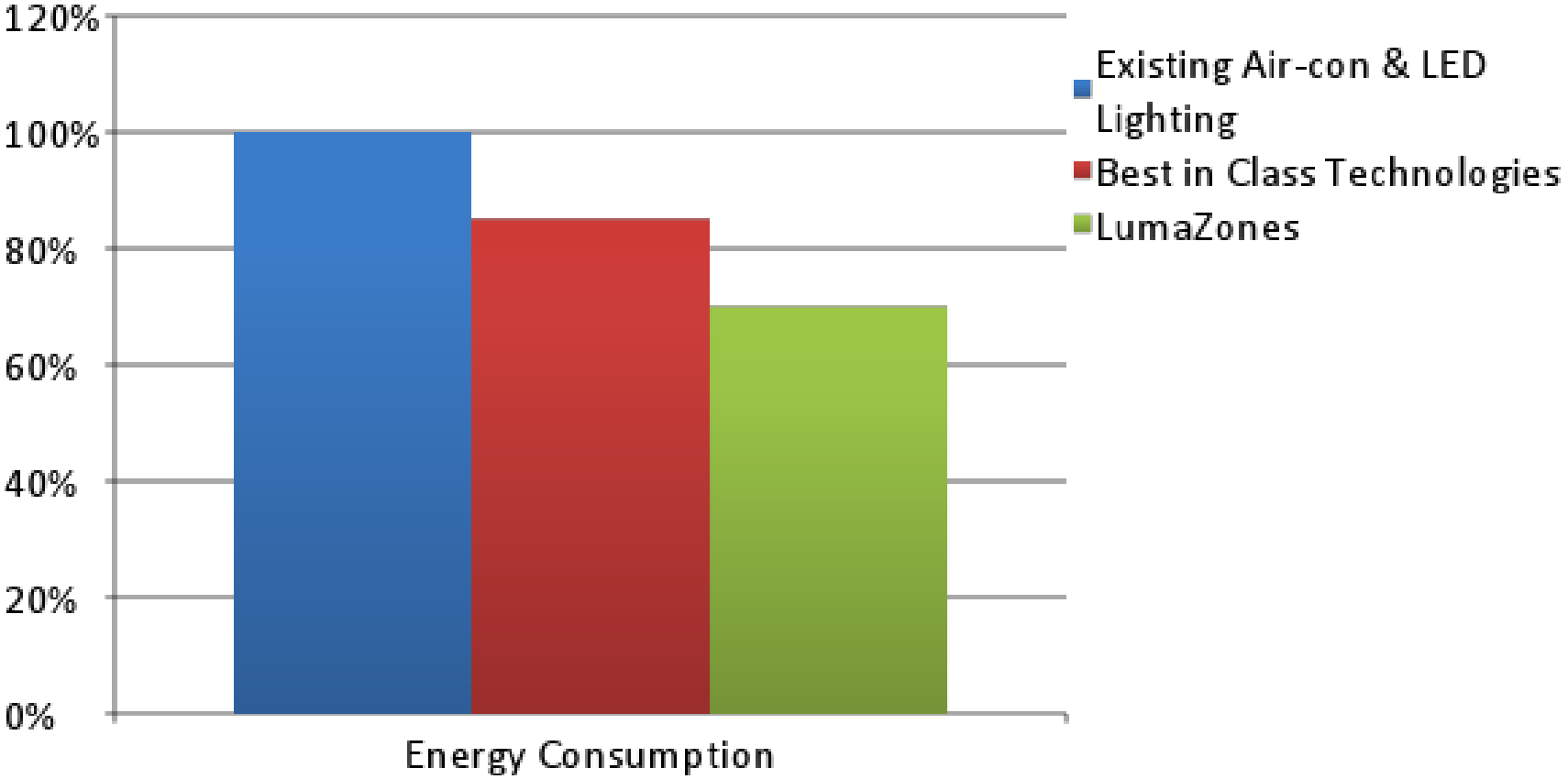
Lumani

Thank You!

Raise Your Profit and Save Our Planet

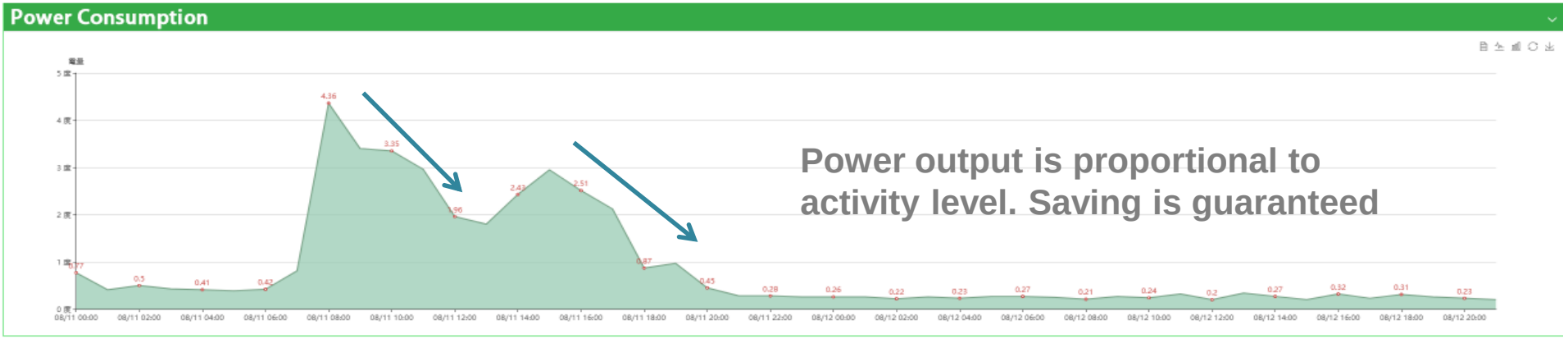
Backup Slides

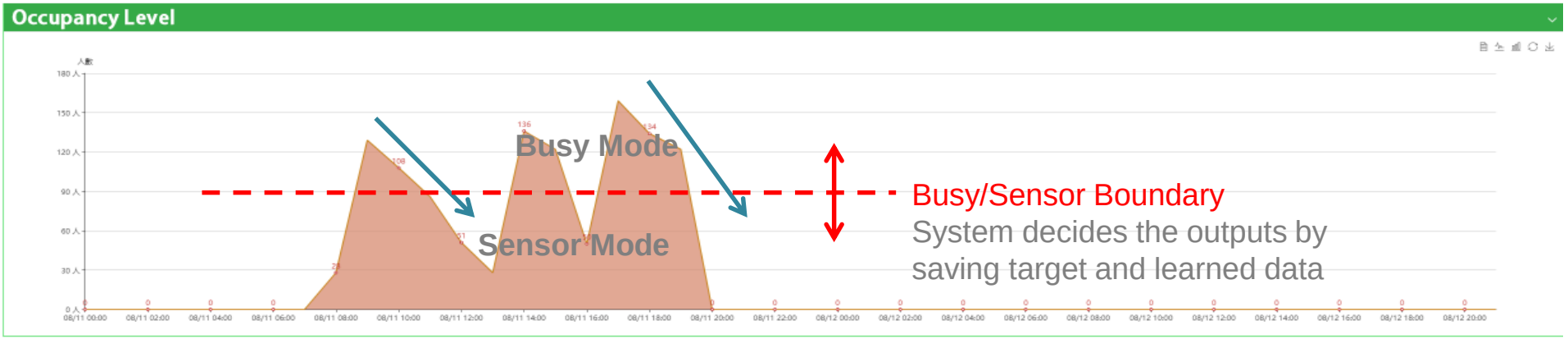
LumaZones™ vs Best in Class Technologies



20% - 30% additional energy savings from Existing Air-con & Light Energy Consumption by installing LumaZones™ .

Validation– How LumaZones Saves Energy





Pay Per Use System with Cloud Analytics based on Occupancy Level

Singapore Polytechnic partners Singapore based start-up, Lumani Pte Ltd to educate students on future trends in Smart Building IoT

Singapore, 12 September 2017 – In line with Singapore's push towards a Smart Nation, Singapore Polytechnic (SP) has collaborated with Lumani to feature smart facilities management solutions in the curriculum of the Diploma in Facilities Management (DFM).

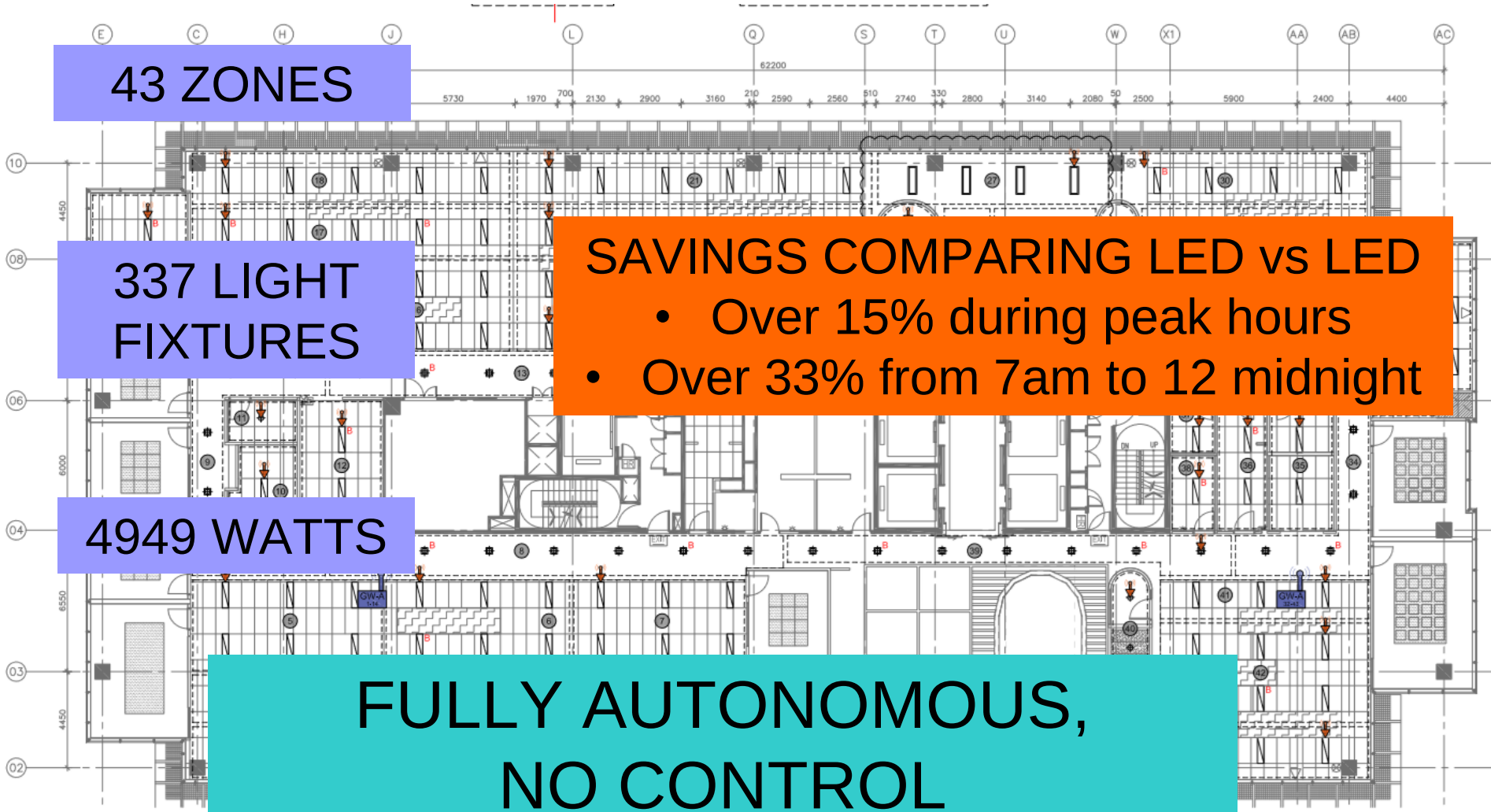
The polytechnic will work with Lumani to showcase its smart lighting solution - LumaZones™ in one of the Diploma in Facilities Management (DFM) labs under the SP School of Architecture & the Built Environment. The latest collaboration will expose Diploma in Facilities Management (DFM) students to the latest trends in Smart Building technology and be equipped with the skills and knowledge to handle it.

LumaZones™ is an open cloud based platform with the complete infrastructure for IoT applications. It is scalable, powerful, and easy to integrate with new devices and appliances. The patented automatic switch mode technology enables further energy savings in lighting and air-con without compromising occupants' comfort. Once installed, no human intervention is needed. It can also collect data that could be used for occupancy management.

"The close industry collaboration in the area of Smart Building technology will equip students with skills that are sought after by the industry. Students will also gain a greater appreciation of Singapore's Smart Nation direction as a result of the collaboration," said Mr Goh Siak Koon, Director, School of Architecture & the Built Environment.

Vinson Chua, co-founder and VP of Sales & Marketing at Lumani added, "We are very excited and honoured to be able to contribute to Singapore Polytechnic's vision in teaching students future trends and technology. As a Singapore based start-up, this is a great opportunity for us to give back to society through education."

Keppel Bay Tower Level 12 Floor Plan



43 ZONES

337 LIGHT FIXTURES

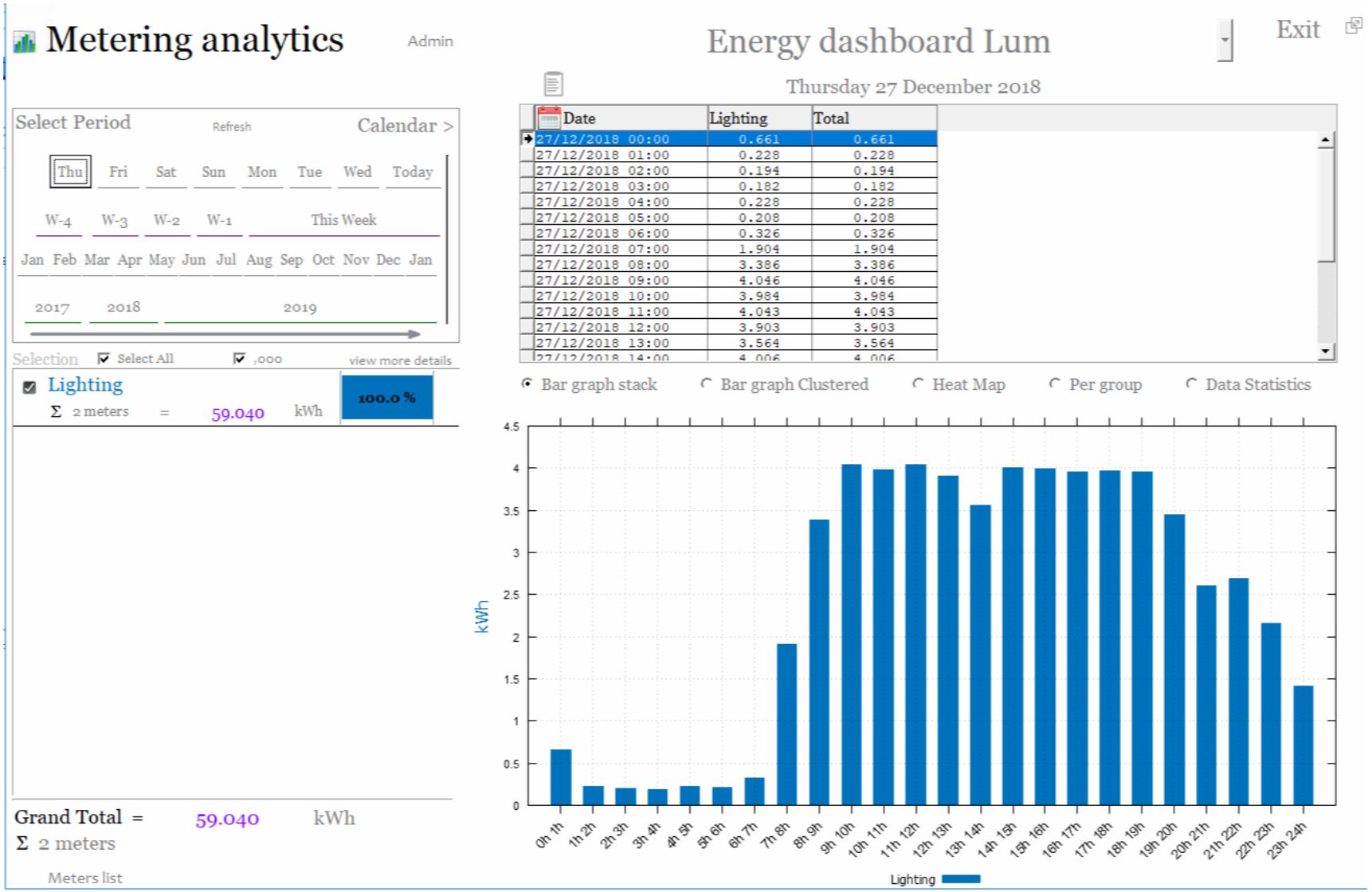
4949 WATTS

SAVINGS COMPARING LED vs LED

- Over 15% during peak hours
- Over 33% from 7am to 12 midnight

FULLY AUTONOMOUS, NO CONTROL

Keppel Bay Tower Level 12 Results by Hour



Keppel Bay Tower Level 12 Results by Day

Lumani

Metering analytics

Admin

Select Period | Refresh | Calendar >

Thu Fri Sat Sun Mon Tue Wed Today

W-4 W-3 W-2 W-1 This Week

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan

2017 2018 2019

Selection | Select All | view more details

Lighting

Σ 2 meters = 750.487 kWh 100.0 %

Grand Total = 750.487 kWh

Σ 2 meters

Meters list

Energy dashboard Lum

Exit

Monday 17 December 2018 > 18 Day(s) >Thursday 3 January 2019

Date	Lighting	Total
Mon 17/12/2018	59.311	59.311
Tue 18/12/2018	59.569	59.569
Wed 19/12/2018	63.348	63.348
Thu 20/12/2018	58.699	58.699
Fri 21/12/2018	60.538	60.538
[WE] Sat 22/12/2018	26.287	26.287
[WE] Sun 23/12/2018	14.149	14.149
Mon 24/12/2018	47.339	47.339
Tue 25/12/2018	8.390	8.390
Wed 26/12/2018	58.074	58.074
Thu 27/12/2018	59.040	59.040
Fri 28/12/2018	57.368	57.368
[WE] Sat 29/12/2018	24.623	24.623
[WE] Sun 30/12/2018	16.754	16.754
Mon 31/12/2018	42.424	42.424

Bar graph stack | Bar graph Clustered | Heat Map | Per group | Data Statistics