Energy Consumption and Saving

Revision History

Date	Version	Description
August 2024	V1.0	First release

In smart wireless Bluetooth lighting systems, energy consumption statistics is a crucial function that aids users in understanding the energy usage of lighting devices, enabling them to make more informed decisions for energy management.

In koolmesh,energy consumption statistics can be achieved through the following methods:Shelly energy metering,D4i data collecting and Koolmesh calculation method.And the default priority is:Shelly>D4i>Koolmesh.

Next, let's analyze and explain the details from different situations

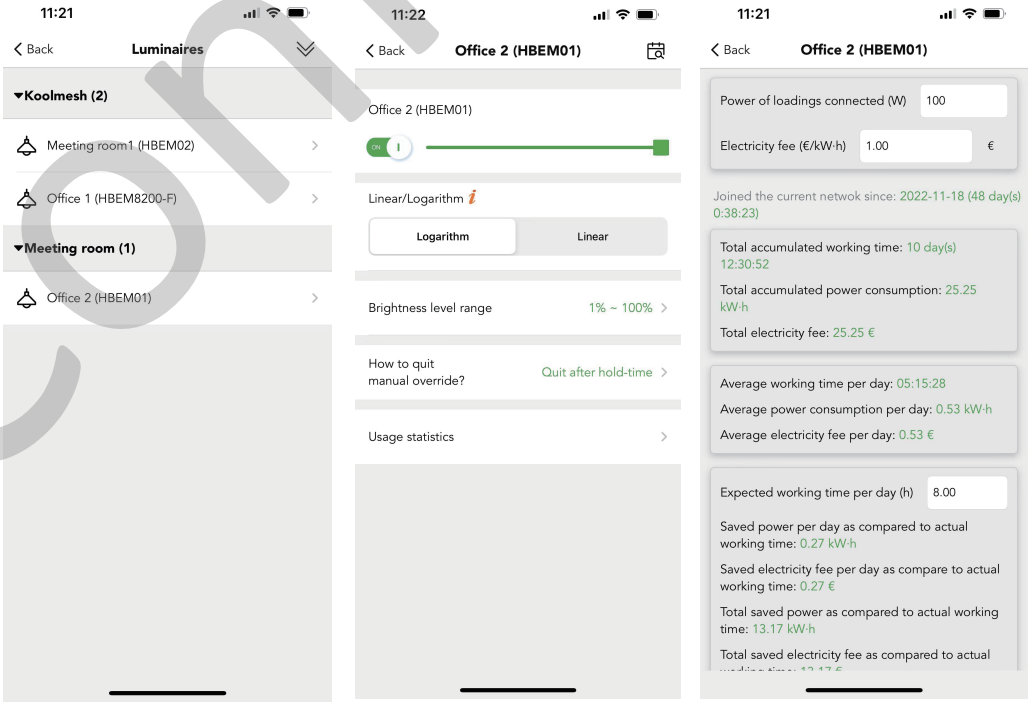
1.Without shelly or D4i

If there is neither shelly nor D4i connected to a network, then the energy consumption statistics method is as follows.

1.1 Single luminaire

Single luminaire → gateway needless → checking corresponding consumption data via Koolmesh app.

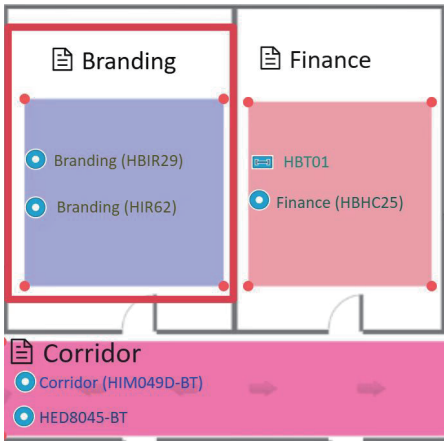
Take Office 2 (HBEM01) as example, users can check the usage statistics via clicking luminaires section.



There are three data need to be filled in

- Power of loading connected(W): please fill in the luminaire's power. Take power as 100W as an example.
  If Bluetooth node connects with one luminaire, then it should be 1*100=100W
  If Bluetooth node connects with four luminaires, then it should be 4*100=400W
  If Bluetooth node connects without luminaires, then it should be 0*100=0W

Case study: there is a zone named "Branding", there are 2 motion sensors mounted,which are HBIR29,HIR62
Sensor HBIR29 connected with 1 pcs 45W LED panels
Sensor HIR62 connected with 2 pcs 20W LED panels



Then the power of loading connected(W) should be as following
Sensor HBIR29 1*45=45W
Sensor HIR62 2*20=40W

- Electricity fee ($/kw·h) : please fill in electricity fee unit , users can choose the correct unit.
  (€/￥/ $ /£/ SEK / CHF/ PLZ / DKK/ CZK/AED is available),this value will work on the network level, which means as long as users change one of device, all the devices in the network will change accordingly.

※ If users change the electricity fee unit from $ to €, the system does not calculate the currency rate, all the data remains the same, only units are changed.

- Expected working time per day(h): please fill in the planning working time
  Koolmesh does not calculate the real time power consumption, when users check the usage statistics in the app, then the system will inquire corresponding data accordingly (total accumulated working time). The system calculate the time as following method.

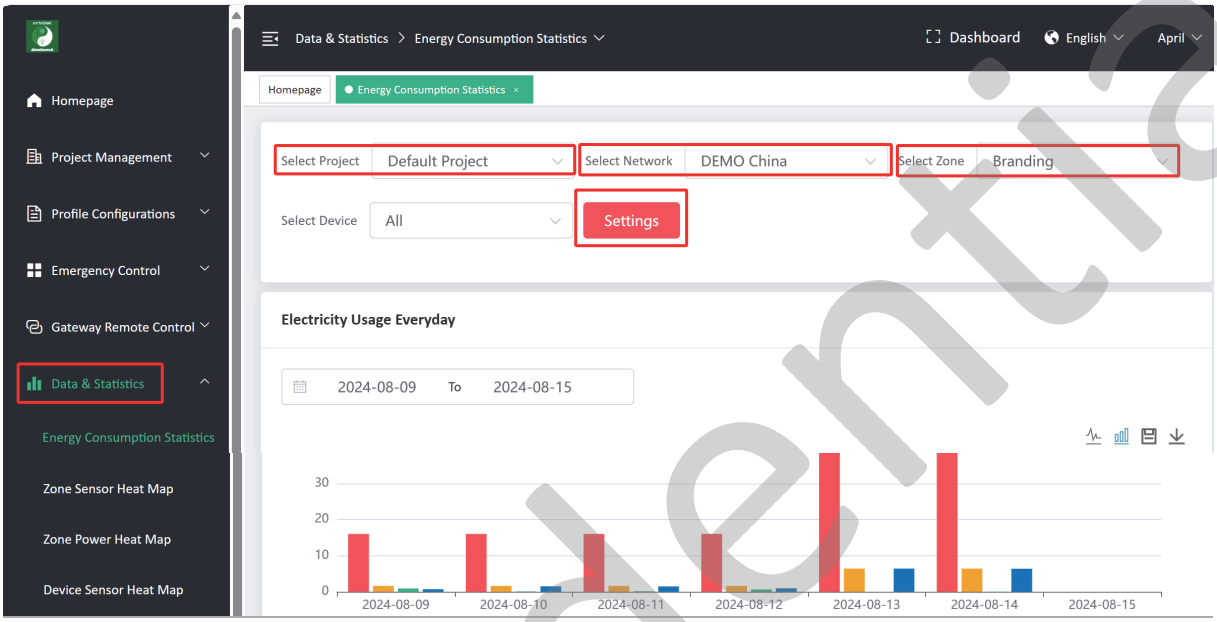
Example: luminaire A is turned on for 4 hours, in the first hour, it's 100% brightness, in the second hour, it is 50% brightness, in the third hour it's 25% brightness, in the last hour it's 10% brightness.
Then the total light on time we record is not "4 hours".
The total luminaire on time = 100%*1 +50%*1 + 25%*1 + 10%*1 = 1.85 hours.

※ We can also check the single luminaire's corresponding consumption data via the gateway,please refer to the Whole project/network/zone part.

1.2 Whole project/network/zone

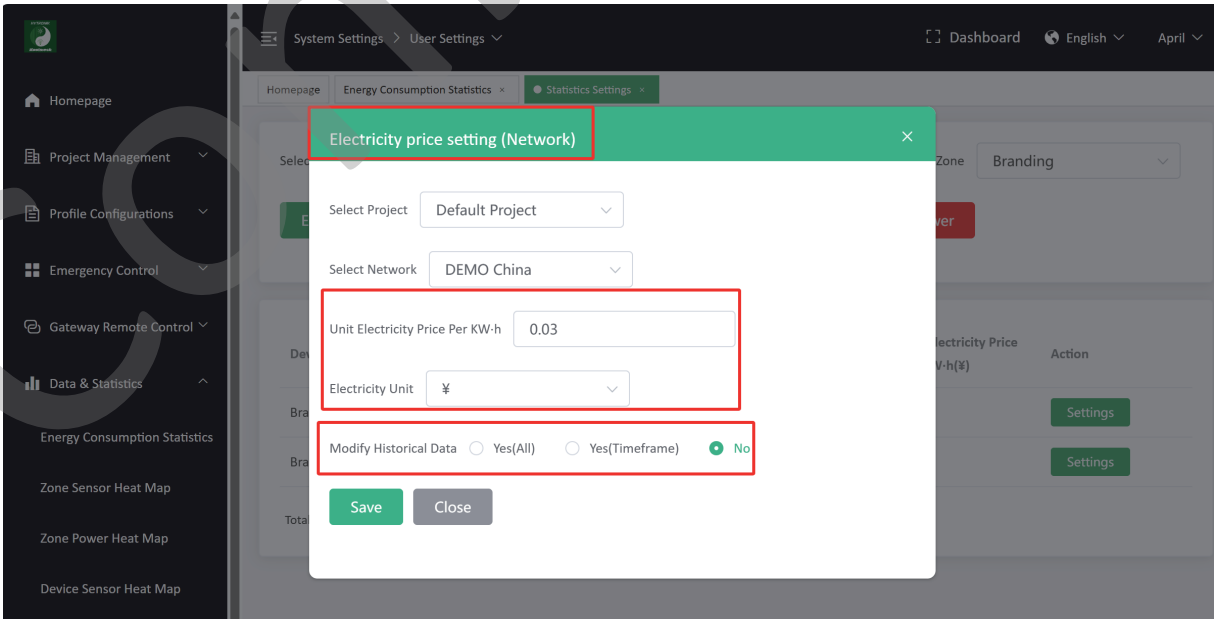
Whole project / network/zone → gateway needed → checking all the consumption data via Koolmesh web platform.Users can check statistics via https://www.iot.koolmesh.com/ by clicking on Data & Statistics, take below project,network and zone as example .

Project: Default project Network: Demo China Zone:Branding



There are three data need to be filled in by clicking “Settings”

- Electricity fee ($/kw·h) : please fill in electricity fee unit by clicking “Electricity price settings” , users can choose the correct unit. (€/￥/ $ /£/ SEK / CHF/ PLZ / DKK/ CZK/AED is available)This value will work on the network level.

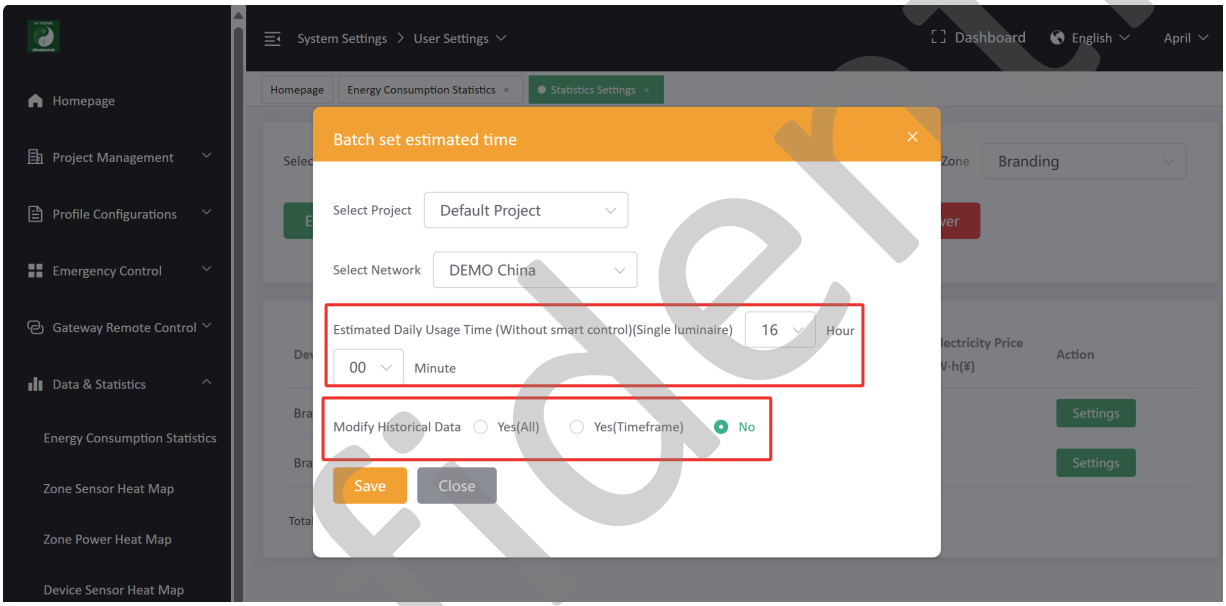


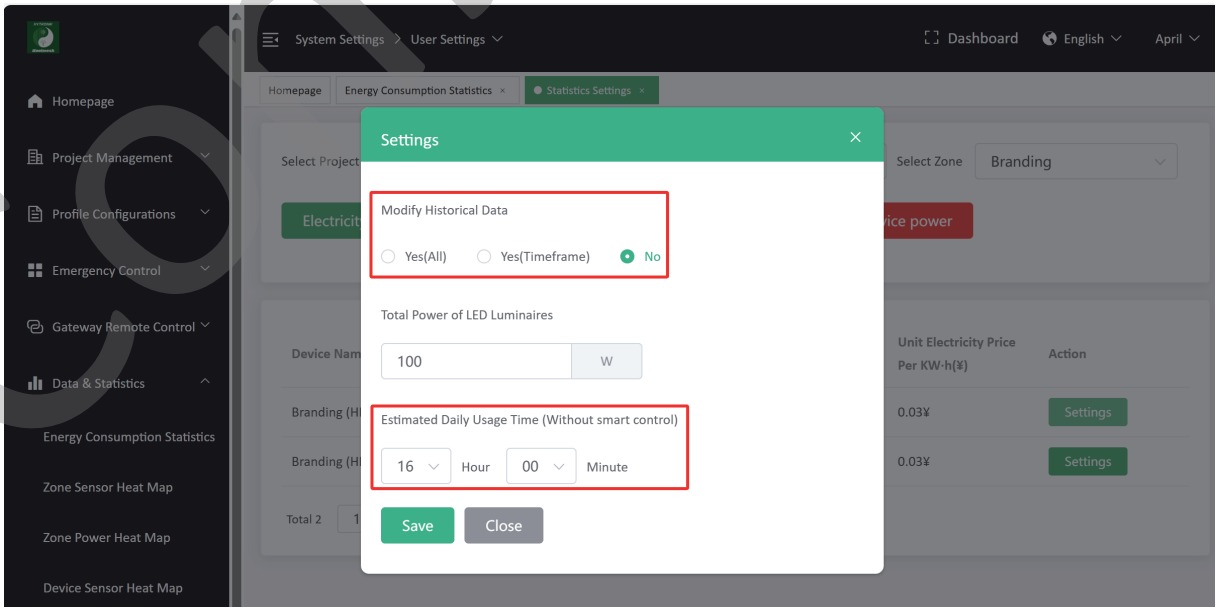
※ If users change the electricity fee unit from $ to €, the system does not calculate the currency rate, all the data remains the same, only units are changed.

System can only calculate all the data by only one electricity fee.

Example 1: If users fill in the electricity fee as $2 in May, then the system will calculate all the data based on $2. Somehow the electricity fee increases to $2.5 in October and change it to $2.5 accordingly, then system will calculate all the data based on $2.5, but historical will remain $2. However, user also can choose to change the historical data or not.

- Expected working time per day(h): please fill in the planning working time by clicking "Batch set estimated time" or "Settings" of single luminaire, users also can choose whether to change the historical data or not.





System calculate the time as following method.

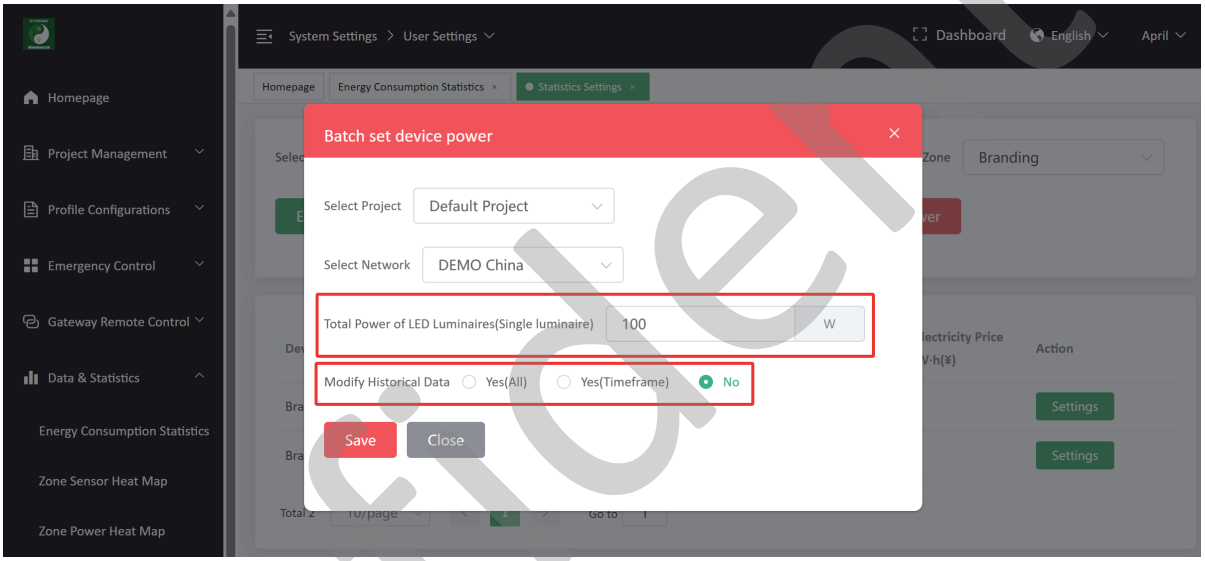
Example: luminaire A is turned on for 4 hours, in the first hour, it's 100% brightness, in the second hour, it is 50% brightness, in the third hour it's 25% brightness, in the last hour it's 10% brightness.
Then the total light on time we record is not "4 hours".
The total luminaire on time = 100%*1 +50%*1 + 25%*1 + 10%*1 = 1.85 hours.

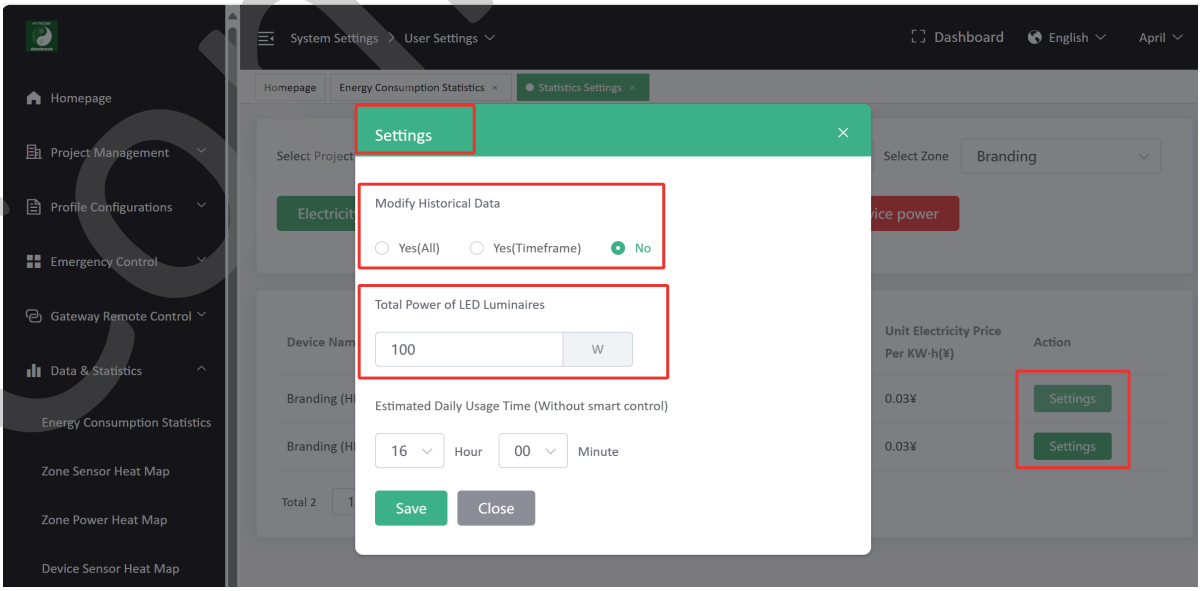
- Power of loading connected(W): please fill in the luminaire 's power by clicking "Batch set device power" or "Settings" of single luminaire. Take power as 100W as an example.

  If Bluetooth node connects with one luminaire, then it should be 1*100=100W

  If Bluetooth node connects with four luminaires, then it should be 4*100=400W

  If Bluetooth node connects without luminaire, then it should be 0*100=0W

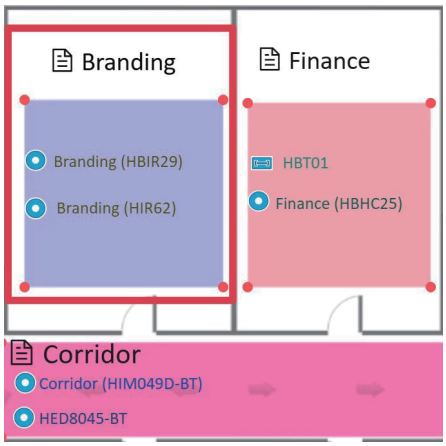




Case study: there is a zone named “Branding”, there are 2 motion sensors mounted,which are HBIR29,HIR62

Sensor HBIR29 connected with 1 pcs 45W LED panels

Sensor HIR62 connected with 2 pcs 20W LED panels



Then the power of loading connected(W) should be as following

Sensor HBIR29 1*45=45W

Sensor HIR62 2*20=40W

All the charts Koolmesh provided in the web platform only a rough comparison with and without using Koolmesh solution, all the statistics are calculated based on what users filled in, not the real-time data.

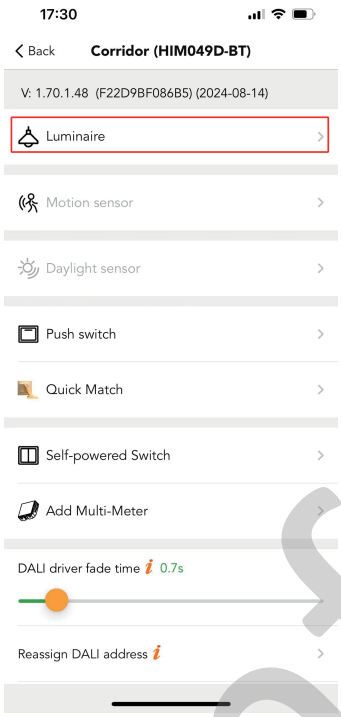
2.Without shelly,but with D4i

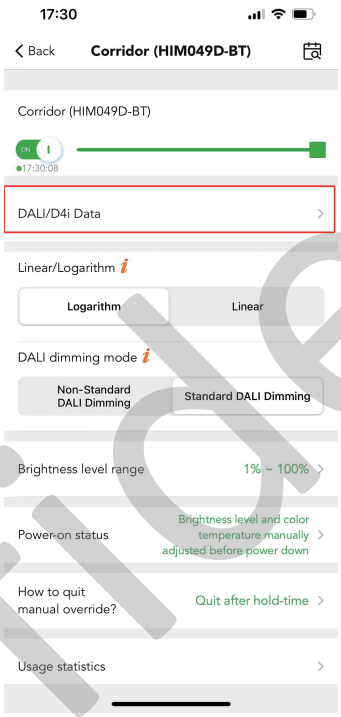
According to the default priority of the system, if some devices in a zone are connected to D4i drivers,then the energy consumption statistics of these devices are based on D4i, but the energy consumption of other devices is calculated based on the wattage entered by the users.

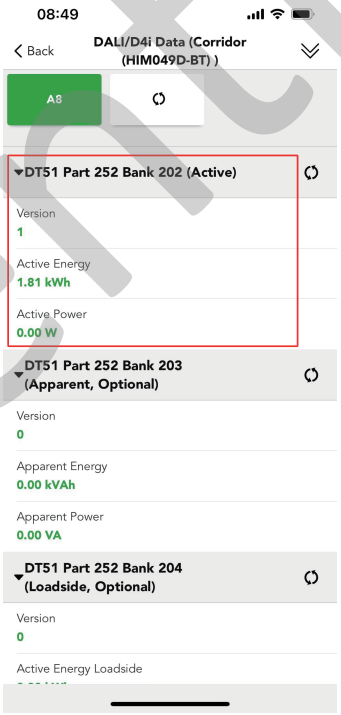
2.1 Single luminaire

Single luminaire (connected with a D4i driver)→ gateway needless → checking corresponding consumption data via Koolmesh app.

Take HIM049D-BT as example, users can check the usage statistics via clicking luminaires-D4i data section.



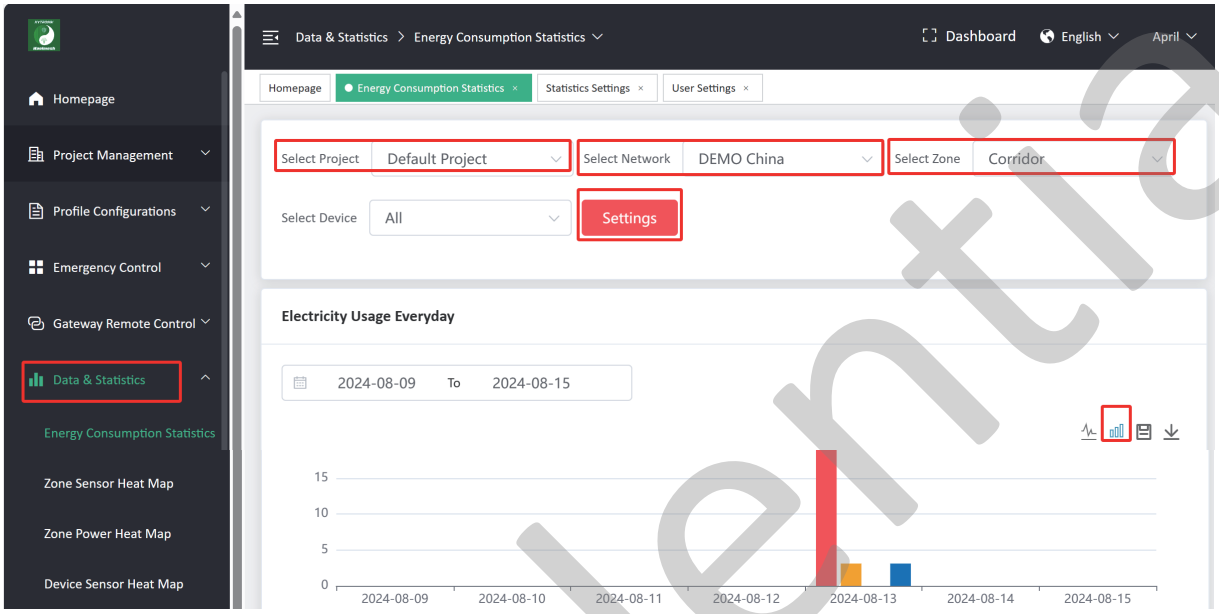




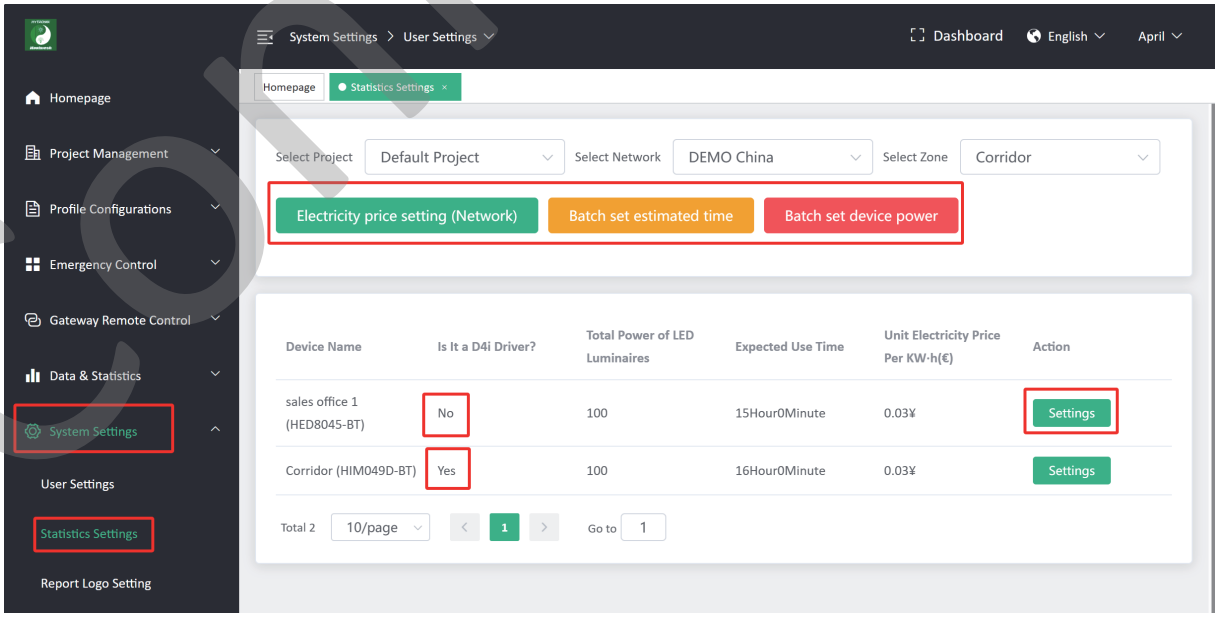
2.2 Whole project/network/zone

Whole project / network/zone → gateway needed → checking all the consumption data via Koolmesh web platform.Users can check statistics via https://www.iot.koolmesh.com/ by clicking on Data & Statistics, take below project,network and zone as example .

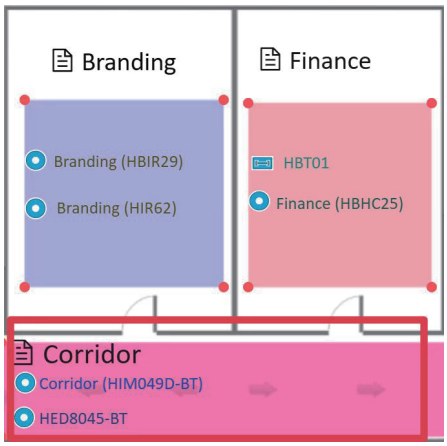
Project: Default project Network: Demo China Zone:Corridor



In this zone, the energy consumption of the device connected to the D4i driver can be read directly in the corresponding D4i data of the app, and the data will be automatically uploaded through the gateway, so the relevant parameters of the device do not need to be filled in the web. However, for devices not connected to D4i, there are three data need to be filled in by clicking “Settings” ,which are the same as part1 “Without shelly or D4i”



Case study: there is a zone named “Corridor”,there is a HED8045-BT and a motion sensor HIM049D-BT mounted,-
Sensor HIM049D-BT :connected with a D4i driver,connected with 1 pcs 20W LED panel
HED8045-BT :connected with 2 pcs 20W LED panels
As HIM049D-BT is connected with a D4i driver,the D4i data will upload to the web through the gateway,so there’s no need to fill in the data.And the energy consumption of HIM049D-BT can be read directly in the corresponding D4i data on the app.But HED8045-BT is not connected to a D4i driver,so in order to get accurate energy consumption data on the web side,there are three data need to be filled in by clicking “Settings” ,which are the same as part1 “Without shelly or D4i”.And the energy consumption of HED8045-BT is calculated as follows.



The power of HED8045-BT is:2*20=40W
Time:These two panels turned on for 4 hours, in the first hour, it’s 100% brightness, in the second hour, it is 50% brightness, in the third hour it’s 25% brightness, in the last hour it’s 10% brightness. Then the total light on time we record is not “4 hours”.
The total luminary on time = 100%*1 +50%*1 + 25%*1 + 10%*1 = 1.85 hours.

Energy consumption=Power*Time,so the energy consumption of HED8045-BT is:40*1.85=74wh.

3.Without D4i,but with shelly

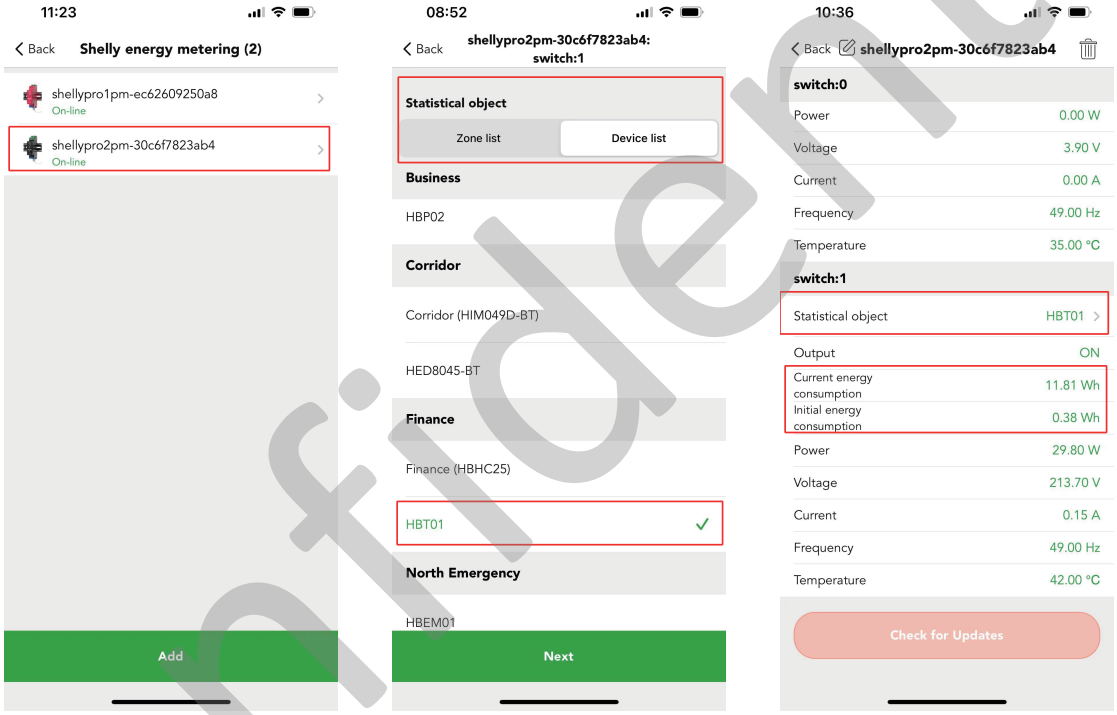
If there is no D4i driver but a shelly connected to a luminaire,then the energy consumption of this luminaire is according to shelly,which can be seen on app.But the energy consumption of other devices is calculated based on the wattage entered by the user.

If the shelly is connected to the zone,then the energy consumption of this zone is according to shelly.But the actual power consumption of a single device is calculated according to the wattage entered by the user， and multiplied by the power consumption time uploaded by the gateway, to obtain the power consumption of the device, and then calculated according to the proportion of the entire zone.

3.1 Single luminaire

Single luminaire (connected with a shelly)→ gateway needless → checking corresponding consumption data via Koolmesh app.

Take HBT01 as example, users can check the usage statistics via clicking shelly energy metering section.

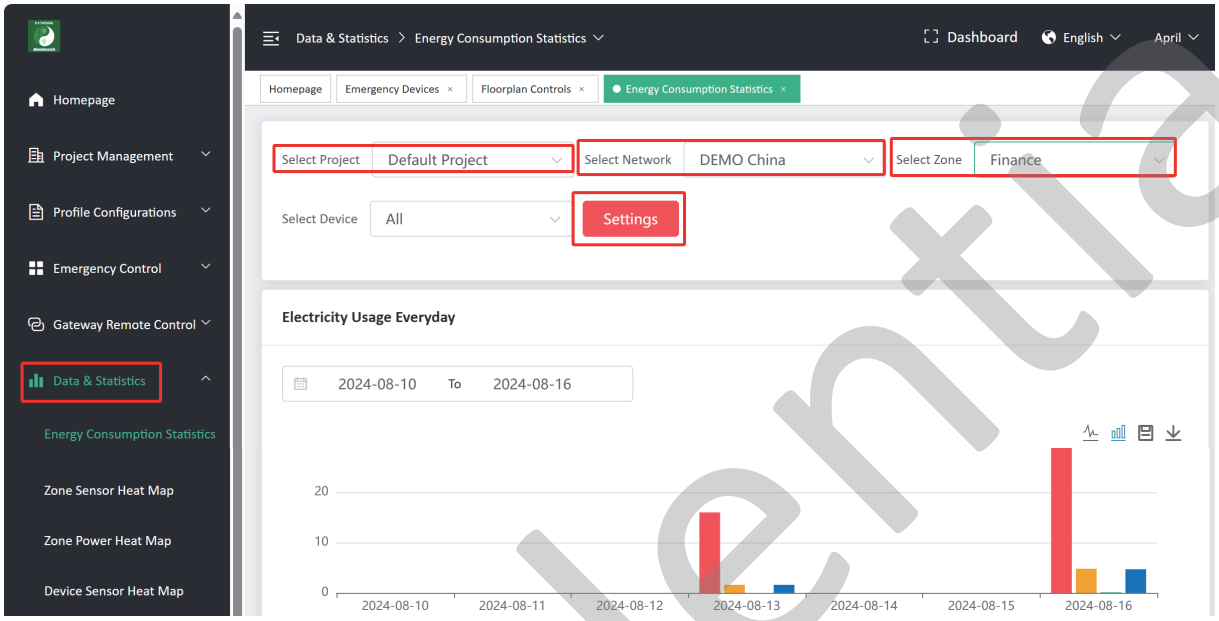


On the app, we can see two readings, which are the “Current energy consumption” data and the “Initial energy consumption” data. Subtract the “Initial energy consumption” data from the “Current energy consumption” data to obtain the energy consumption for the corresponding time period.So the energy consumption of HBT01 is:11.81wh-0.38wh=11.43wh.

3.2 Whole project/network/zone

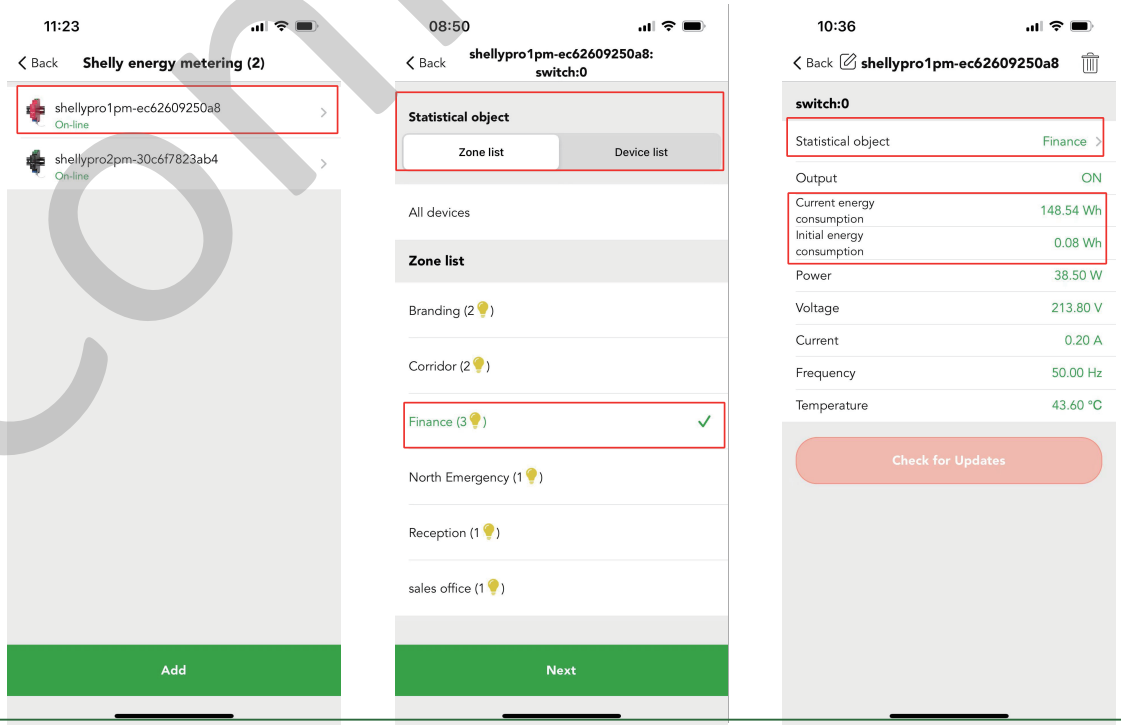
Whole project / network/zone → gateway needed → checking all the consumption data via Koolmesh web platform.Users can check statistics via https://www.iot.koolmesh.com/ by clicking on Data & Statistics, take below project,network and zone as example .

Project: Default project Network: Demo China Zone:Finance

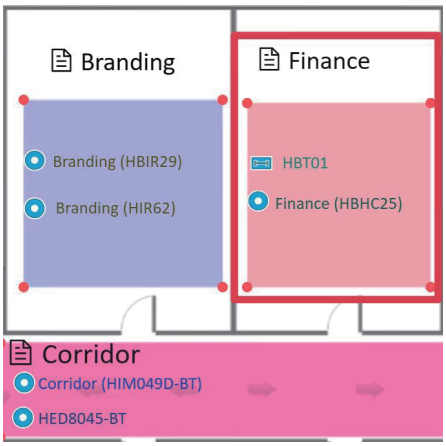


If a shelly is connected to the whole zone,then the energy consumption of this zone is according to shelly(see figure below).But the actual power consumption of a single device is calculated according to the wattage entered by the user,and multiplied by the actual power consumption time uploaded by the gateway, to obtain the power consumption of the device, and then calculated according to the proportion of the entire zone.

There are also three data need to be filled in by clicking “Settings” ,which are the same as part1 “Without shelly or D4i”.Otherwise, the energy consumption of a single device cannot be accurately calculated on the web.



Case study:In zone Finance,there are 2 motion sensors mounted,which are HBT01and HBHC25.The whole zone is connected with a shelly energy metering.After a period of time, the energy consumption data of shelly is： 65.5wh.



Sensor HBT01 is connected with 1pcs 45W LED panel
Sensor HBHC25 connected with 2 pcs 20W LED panels

Actual working time（calculated according to 100% brightness）:
Sensor HBT01:1 hour
Sensor HBHC25:0.5hour

So the the energy consumption statistics in this zone is 65.5wh, and the single luminaire is calculated as follows.

Sensor HBT01:65.5*45/65=45.35wh
Sensor HBHC25:65.5*20/65=20.15wh

You can also check out the table below.

Node	Power(w)	Actual working hours(h)	Energy consumption(wh)	Energy consumption according to shelly(wh)
Sensor HBT01	45	1	45	45.35
Sensor HBHC25	40	0.5	20	20.15
Power: Entered by users Actual working hours:Real-time statistics from the gateway Energy consumption=Power*Actual working hours Energy consumption according to shelly=Shelly data*Energy consumption/The sum of the energy consumption of all devices under this shelly statistic				

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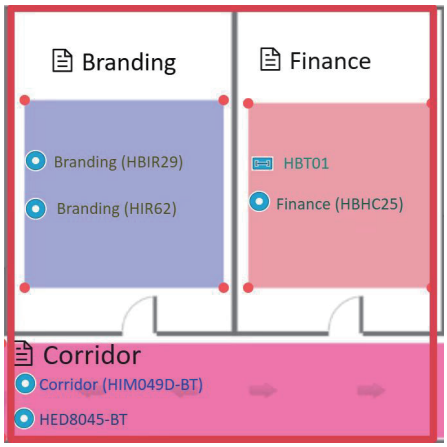
Website: https://www.koolmesh.com/

4.With both D4i and shelly

If a shelly is connected to the entire network(Let's call it shelly1), and some zones of the network are connected to another shelly(shelly2) ,and some devices are connected to D4i drivers, then the energy consumption of the entire network is based on shelly1, and the energy consumption of the zones which are connected to shelly2 is based on shelly2.We recommend that the user take the reading of the shelly2, and of course we will also present all the shelly connected to the device in the list for the user to choose from.The other single device in the network is calculated based on the actual wattage input by the user,and multiplied by the power consumption time uploaded by the gateway, to obtain the power consumption of the device, and then calculated according to the proportion of the entire zone.

4.1 Single luminaire



Case study:
There is a network which includes three zones:Branding,Finance,Corridor. And it is connected with shelly1,zone Finance is connected with shelly2,and Corridor(HIM049-BT) is connected with a D4i driver.Then the energy consumption of the whole network is according to shelly1, the energy consumption of zone Finance is according to shelly2 , and the other single device in the network is calculated based on the actual wattage input by the user,and multiplied by the power consumption time uploaded by the gateway, to obtain the power consumption of the device, and then calculated according to the proportion of the entire zone.

There are two ways to calulate single luminaire's energy consumption,and there will be some small differences between them,please see the table below for details.
Energy readings for shelly1:171wh
Energy readings for shelly2:40.5wh

Way1:all single luminaires use the data from shelly1,based on the proportion of the energy consumption of each single device to the total energy consumption of all devices.
e.g.Sensor HBIR29's energy consumption according to shelly1 is caculated as:171*45/170=45.26wh.
The same goes for the rest.

Node	Power(w)	Actual working hours(h)	Energy consumption(wh)	Energy consumption according to shelly1(wh)
Sensor HBIR29	45	1	45	45.26
Sensor HIR62	40	0.5	20	20.12
HIM049D-BT	45	1	45	45.26
HED8045-BT	40	0.5	20	20.12
Sensor HBT01	20	1	20	20.12
Sensor HBHC25	40	0.5	20	20.12
Power: Entered by users				
Actual working hours:Real-time statistics from the gateway				
Energy consumption=Power*Actual working hours				
Energy consumption according to shelly=Shelly data*Energy consumption/The sum of the energy consumption of all devices under this shelly statistic				

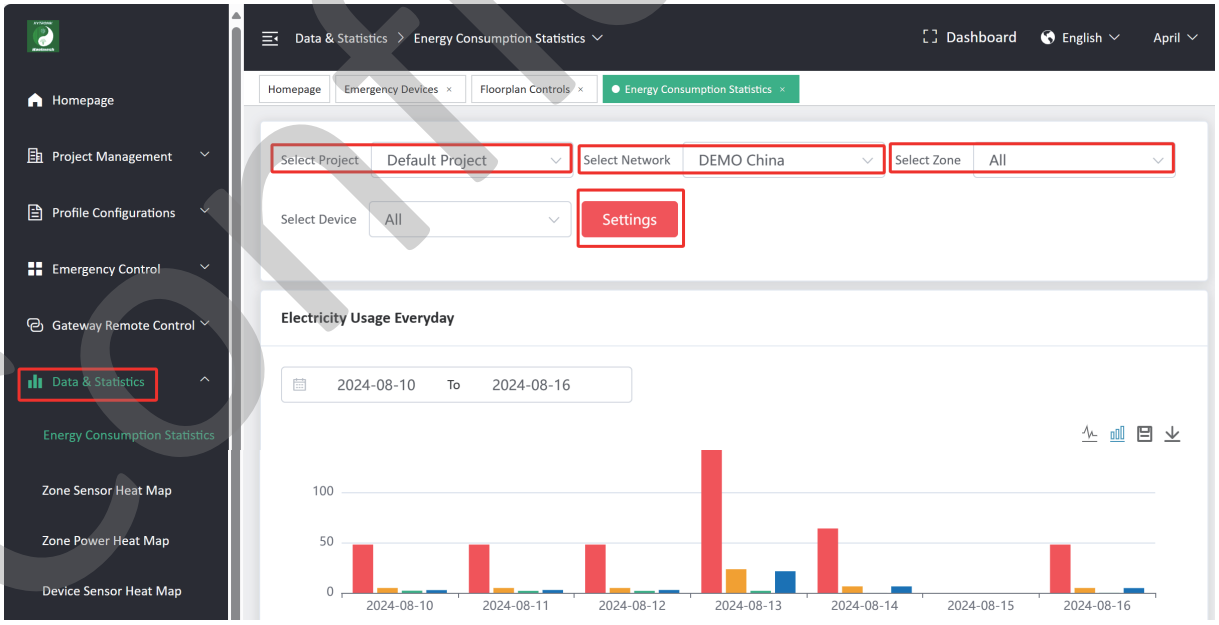
Way2:devices in zone Finance use the data from shelly2,the othes use the data from shelly1(the calculation method is the same as way1)

Node	Power(w)	Actual working hours(h)	Energy consumption(wh)	Energy consumption according to shelly1(wh)
Sensor HBIR29	45	1	45	45.26
Sensor HIR62	40	0.5	20	20.12
HIM049D-BT	45	1	45	45.26
HED8045-BT	40	0.5	20	20.12
Node	Power(w)	Actual working hours(h)	Energy consumption(wh)	Energy consumption according to shelly2(wh)
Sensor HBT01	20	1	20	20.25
Sensor HBHC25	40	0.5	20	20.25
Power: Entered by users Actual working hours:Real-time statistics from the gateway Energy consumption=Power*Actual working hours Energy consumption according to shelly=Shelly data*Energy consumption/The sum of the energy consumption of all devices under this shelly statistic				

4.2 Whole project/network

Whole project / network → gateway needed → checking all the consumption data via Koolmesh web platform.Users can check statistics via https://www.iot.koolmesh.com/ by clicking on Data & Statistics, take below project and network as example .

Project: Default project Network: Demo China



If a shelly is connected to the whole network,then the energy consumption of this network is according to shelly. There are also three data need to be filled in by clicking “Settings” ,which are the same as part1 “Without shelly or D4i”.Otherwise, the energy consumption of a single device cannot be accurately calculated on the web side.

Shelly instructions:

Currently, the following shelly models are compatible with koolmesh. When installing shelly, users should choose according to factors such as the size, installation method, and load size of the shelly. For more information about shelly, please click the link to view.

picture	name	Output current	Number of output ports	Installation	link
	Shelly Plus 1PM	16A	1	Small, can be built into the wire box	https://kb.shelly.cloud/knowledge-base/shelly-plus-1pm
	Shelly Plus 2PM	16A	2	Small, can be built into the wire box	https://kb.shelly.cloud/knowledge-base/shelly-plus-2pm
	Shelly Pro 1PM V1	16A	2	DIN rail mountable	https://kb.shelly.cloud/knowledge-base/shelly-pro-1pm-v1
	Shelly Pro Dual Cover PM	16A	4	DIN rail mountable	https://kb.shelly.cloud/knowledge-base/shelly-pro-dual-cover-pm
	Shelly Pro 2pm V1	16A	2	DIN rail mountable	https://kb.shelly.cloud/knowledge-base/shelly-pro-2pm-v1
	Shelly Pro 3EM	16A	1	DIN rail mountable	https://kb.shelly.cloud/knowledge-base/shelly-pro-3em
	Shelly Pro 4pm V2	16A	4	DIN rail mountable	https://kb.shelly.cloud/knowledge-base/shelly-pro-4pm-v2
	Shelly PM Mini Gen3	16A	2	Small, can be built into the wire box	https://kb.shelly.cloud/knowledge-base/shelly-pm-mini-gen3
	Shelly Pro Dimmer 1PM	16A	1	DIN rail mountable	https://kb.shelly.cloud/knowledge-base/shelly-pro-dimmer-1pm
	Shelly Pro Dimmer 2PM	16A	2	DIN rail mountable	ttps://kb.shelly.cloud/knowledge-base/shelly-pro-dimmer-2pm
	Shelly Pro EM-50	50A	2	DIN rail mountable	https://kb.shelly.cloud/knowledge-base/shelly-pro-em-50#ShellyProEM-