

# Household Comprehensive IoT Energy Management Solution

Grids prepaid monitoring&billing&control, Solar PV monitoring&billing, PCS&BMS  
discharge&charge monitoring, IoT based, Cloud based

Ver. Date: May, 7th 2024

Acrel Co., Ltd.

No.253 Yulv Road, Jiading  
District, Shanghai, China





## 1. Scenario Preset

(1) This solution request a IoT based cloud monitoring for 8000 residential houses power system with solar PV and energy storage system [BMS&PCS] so that we could realize online&remote monitoring&billing&control for all 8000 houses centralizedly via IoT system.

(2) For each house, there are 2 monitoring points:

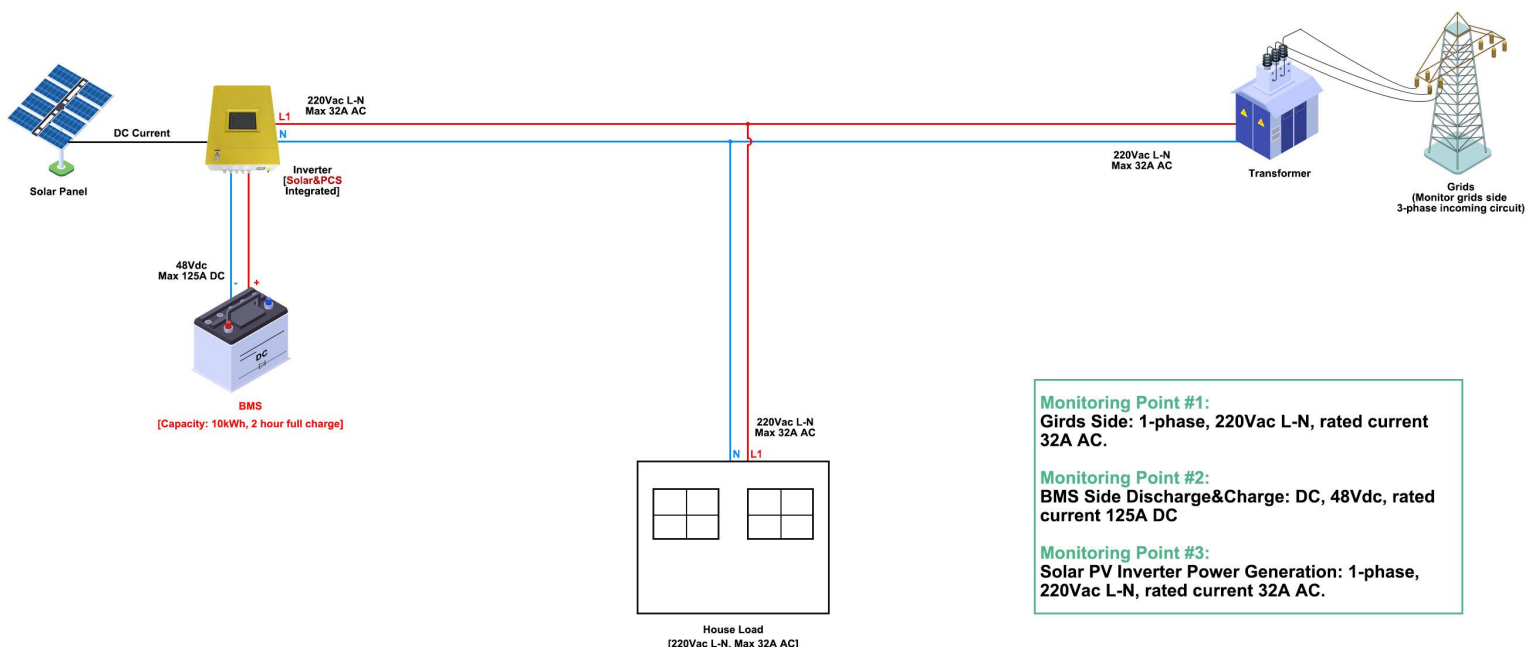
Grids side monitoring [For monitoring grids import to loads and solar PV export to grids]

Rated Current: Max 32A AC; Rated Voltage: 220Vac L-N, Type: 1-phase Circuit

② Solar PV&BMS overall export energy side monitoring [Solar PV&BMS overall export energy will flow to both household loads and grids]

Rated Current: Max 32A AC; Rated Voltage: 220Vac L-N, Type: 1-phase Circuit

(3) For the places that we gonna install IoT gateway, it's covered by stable 4G signal.



### (1) Scenario Preset

## 2. Devices Deployment Plan A - Stable Plan [Take 1 House for example]

### House#1 - Overall Communications #1-1:

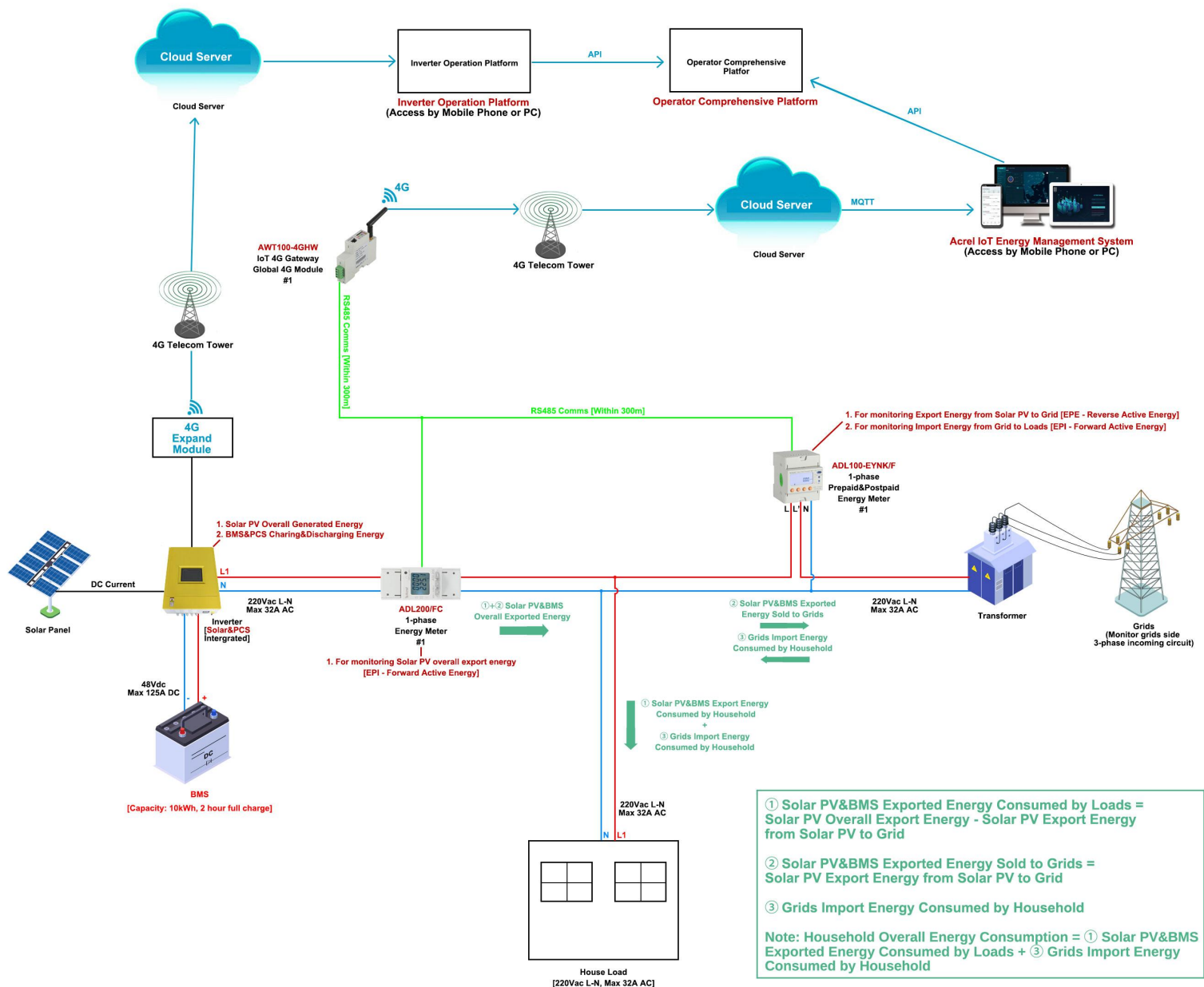
- 1\* AWT100-4GHW 4G IoT Gateway [For communicate with ADL100-EYNK/F and ADL200/C energy meter and further interact with upstream Acrel IoT Energy Management&Billing System]
- 1\* AWT100-POW Power Module [paired with AWT100-4GHW for 85~265Vac power supply input]

### House#1 - Grids Side #1-1:

- 1\* ADL100-EYNK 1-phase Prepaid&Postpaid Energy Meter [For monitoring&control the import energy of house's loads sourced from grids, and also monitoring&control the export energy from Solar PV&BMS to grid]

### House#1 - Solar PV Overall Export Side #1-1:

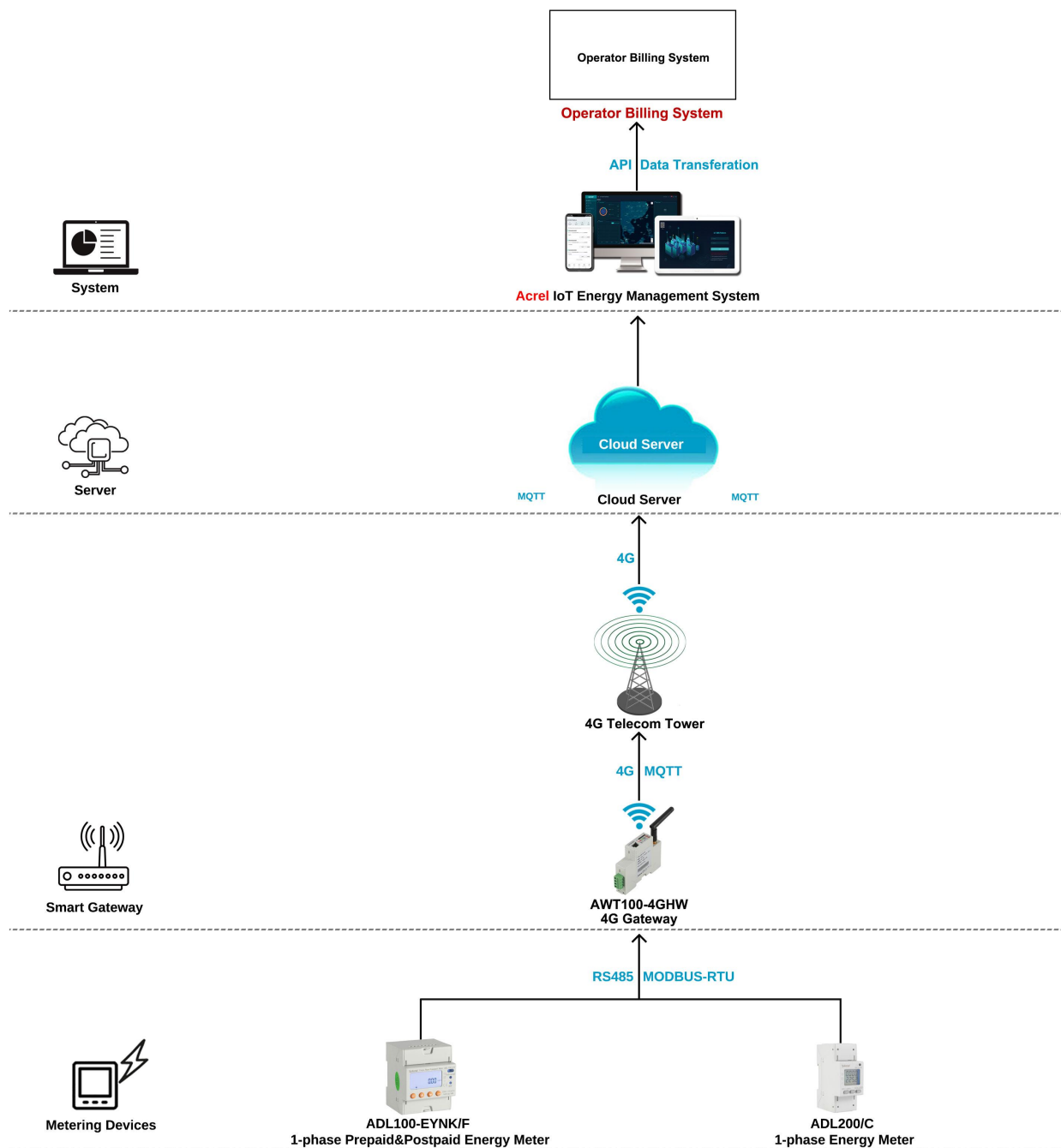
- 1\* ADL200/C 1-phase Energy Meter [For monitoring overall energy output of Solar PV&BMS/PCS]



(1) Device Deployment Plan

### 3. Communication Structure&Logic - Plan A - Stable Plan [Both Acrel Hardware&Software]

- (1) 4G Communication could be served as one of the final data upstream methods by sending the data to cloud server deployed in Internet so that Acrel IoT System could be interact with these data collected by bottom metering devices like Energy Meter
- (2) Between AWT100-4GHW and ADL100-EYNK energy meter & ADL200 energy meter we are using RS485 Comms. within 300m [via RS485 Port & MODBUS-RTU protocol].
- (3) Between AWT100-4GHW IoT 4G Gateway and Acrel IoT Energy Management System, we are using 4G Communications based on MQTT protocol.
- (4) Between Acrel IoT EMS system and 3rd party system, we could use API for energy data transference.





#### 4. Hardware Devices Overview - [Energy Meter]

##### Model 1: ADL100-EYNK/F 1-phase Prepaid& Postpaid Energy Meter

- Communicaiton: RS485[MODBUS-RTU]
- Monitoring: Up to 1 circuits [AC Metering]
- Control Mode: Prepaid&Postpaid Control Model
- Multi-tariff/TOU Function [optional]: 4 tariff rates and etc.
- Rated Voltage: 220~264Vac L-N
- Rated Current: 10(60)A AC
- Certificate&Standard: CE



##### Model 2: ADL200 1-phase AC DIN-rail Energy Meter

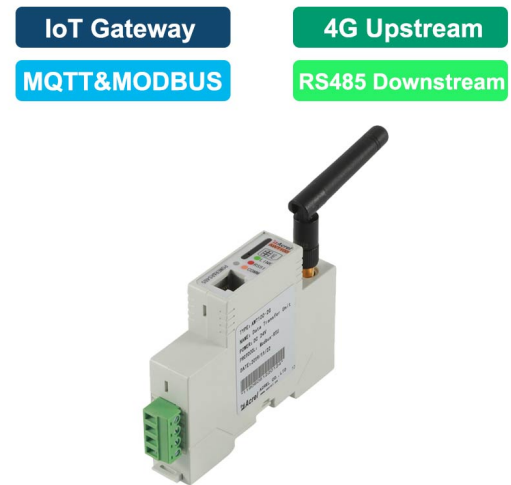
- Monitoring: Up 1 circuits 1-phase [AC Metering]
- Rated Voltage: 220~264Vac L-N
- Rated Current: 10(80)A AC (via direct connect)
- Wired Comms: RS485 Interface, MODBUS-RTU Protocol
- Certificate&Standard: CE; CE-MID;



#### 4. Hardware Devices Overview - [IoT Gateway]

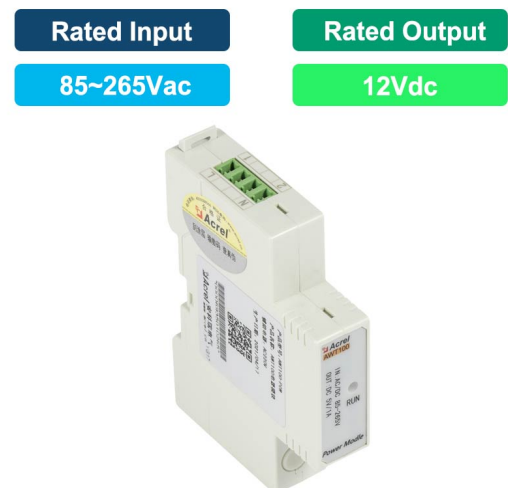
##### Model 1: AWT100-4GHW IoT 4G Smart Gateway

- Upstream Comms.: 4G [MQTT, MODBUS Protocol]
- Downstream Comms.: RS485 [MODBUS-RTU Protocol]
- Support: Up to 25 Downstream Devices via RS485.
- Auxiliary Power Supply: 85~265Vac [via AWT100-POW]
- Certificate&Standard: CE; CE-RED; IEC



##### Model 2: AWT100-POW Power Supply Module

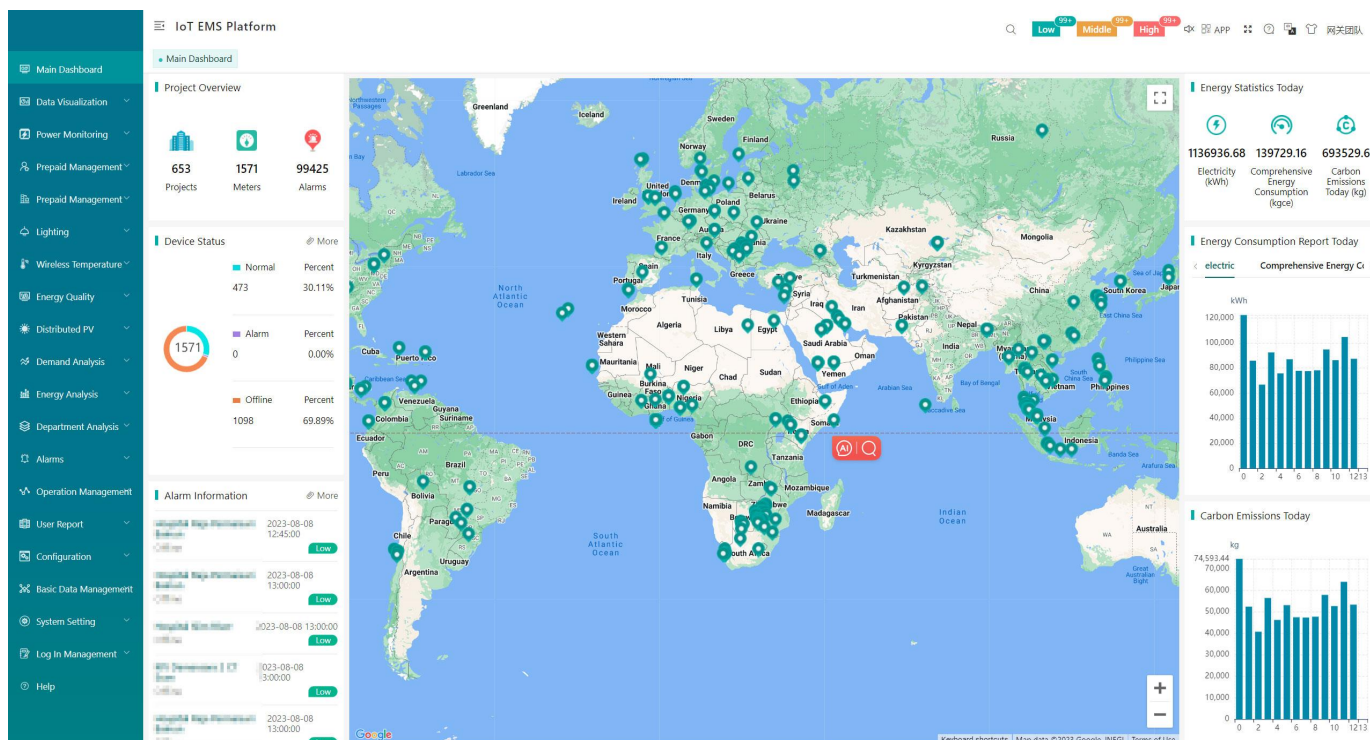
- Input: 85~265Vac
- Output: 12Vdc
- Application: Paired with AWT100-4GHW for 85~265Vac Power Supply Input [via PIN L & PIN N]
- Certificate&Standard: CE



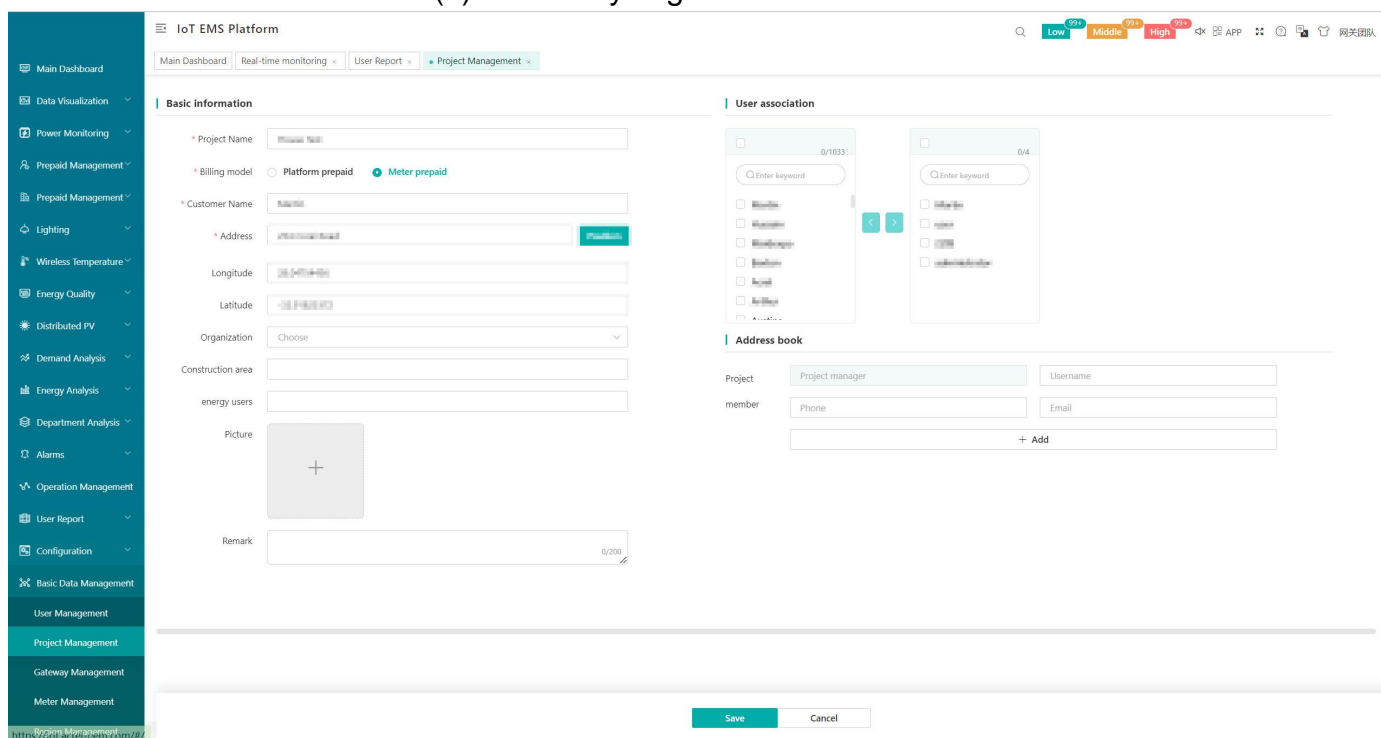


## 5. GIS Analyzing

- (1) Customer side could manage all the project room/buildings position all over the country.
- (2) Customer side could manage all devices that connected to Acrel Cloud Prepaid&Postpaid System to know where these devices are located & which room/building was monitored by this devices.
- (3) Customer side could receive all kinds of alarm including devices off-line alarm for example for checking the working status of the devices in countrywide project.



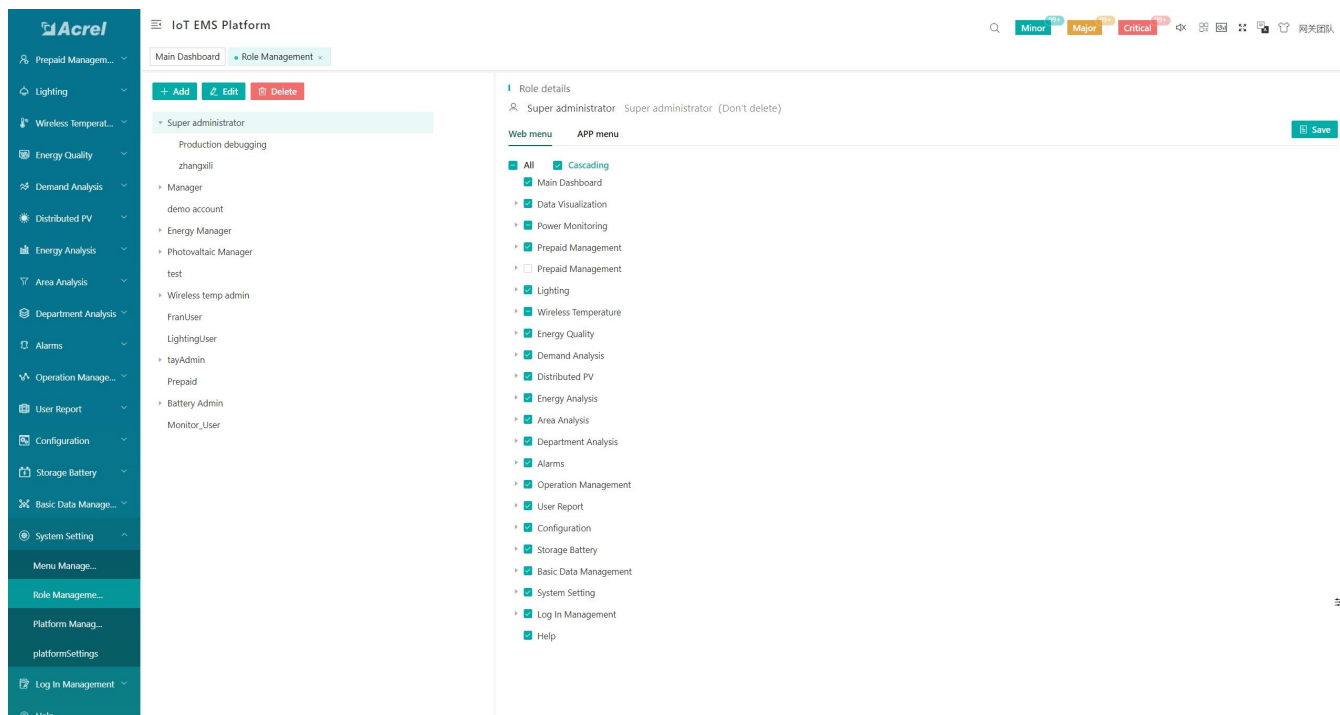
(1) GIS Analysing and Command Interface



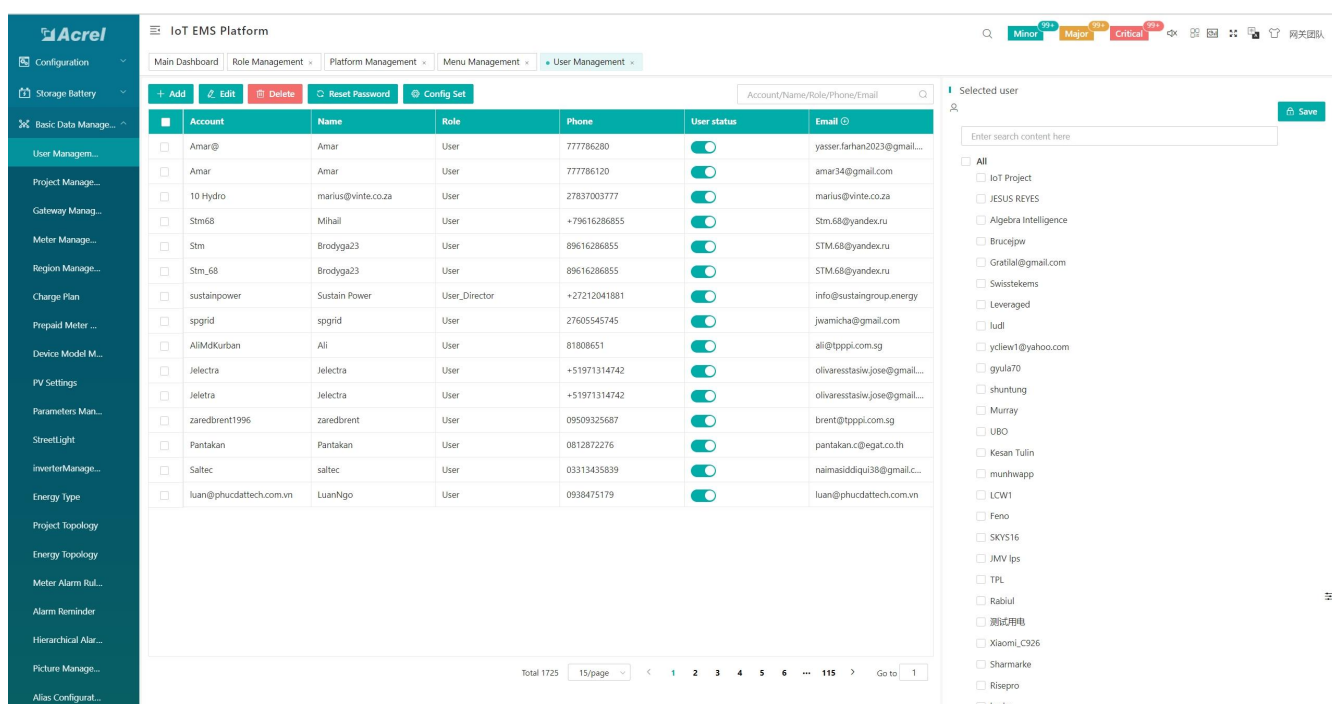
(2) Write in Project/Building Logistic Location Information

## 6. Role setting and Sub account creation

- (1) Operator could set the system permission level of each role [administrator, end power user for example]
- (2) Sub Account Creation: Administrator could create sub account for their end power user and allow them to only check the energy and billing data of their own house. Also, could ban the permission of end power user for changing everything.



(1) Role and Permission setting

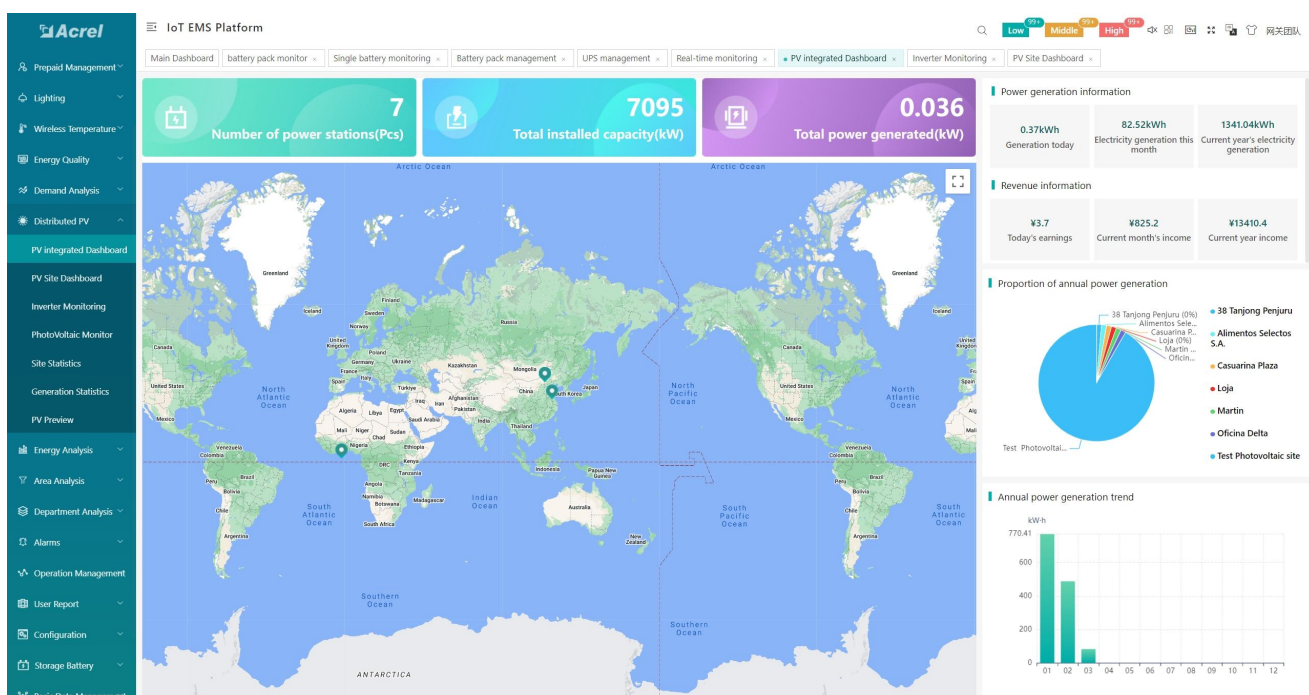


(2) Sub account creation and management

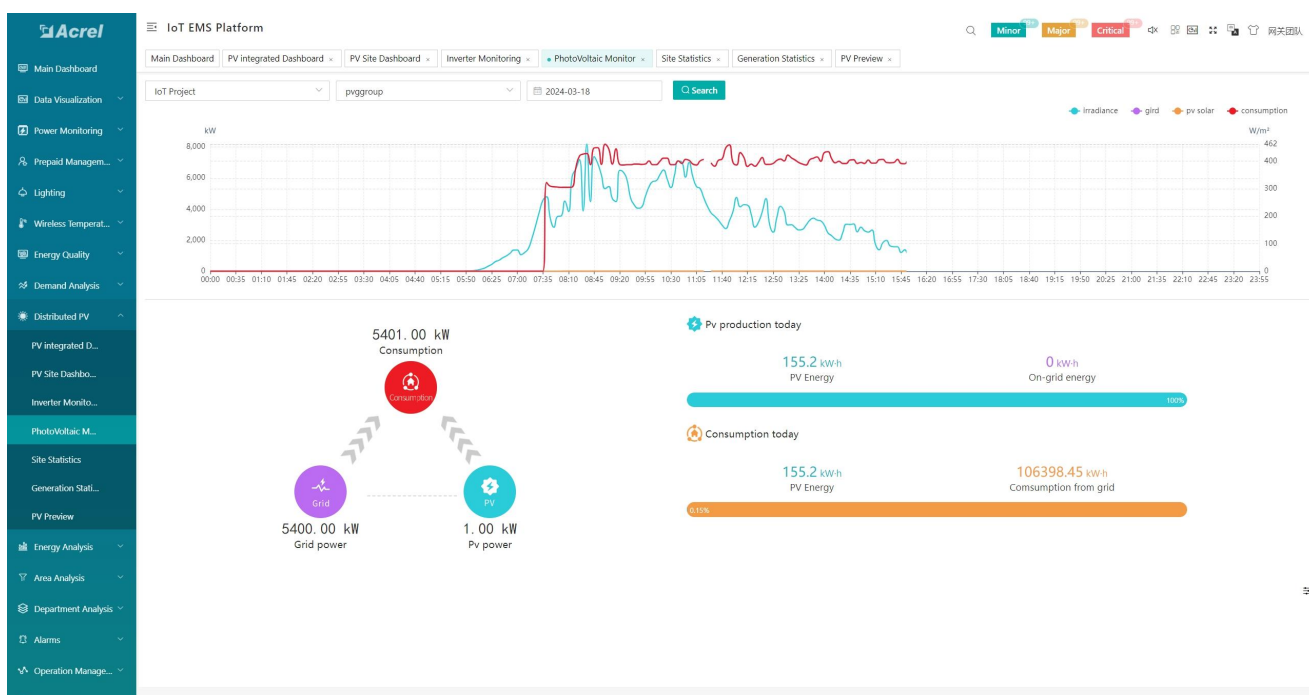


## 7. Solar PV Monitoring Part

- (1) Solar PV project overview: For checking the overall power generation, benefit and etc of Solar PV deployed all over the country. [Solar Power Generation data will be collected by Solar Inverter and further issued to AWT100-4GHW gateway for a further 4G upstreaming]
- (2) Solar PV monitoring: For checking the solar power generation, house loads overall power consumption sourced from both Solar PV/BMS and Grids, house loads partial power consumption sourced from Grids.



(1) Solar PV Project Overview



(2) Solar Site Monitoring Overview

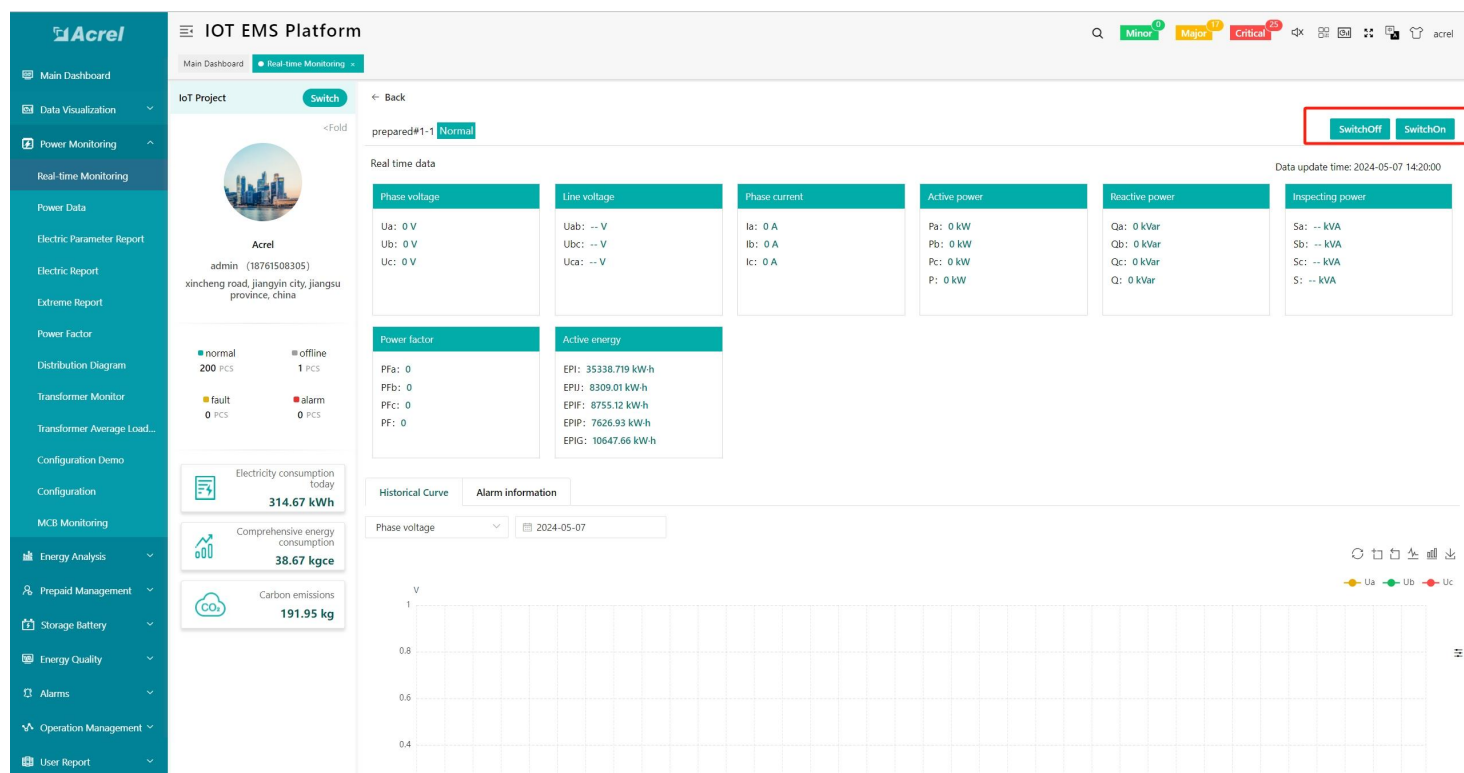
## 8. Remote Circuit On/Off Control Logic

For remote switch on/off control of circuit's CB (circuit breaker), basic control logic was as below [pic 6.1]:

- (1) Administrator use Acrel Cloud IoT Energy Management System to issue Switch On/Off command down to AWT100-4GHW IoT gateway.
- (2) AWT100-4GHW gateway receive the control command via 4G communication. And further issue this control command to downstream ADL100-EYNK energy meter.
- (3) ADL100-EYNK/F energy meter has built-in **magnetic holding relay**. Once the energy meter receive the "switch on" or "switch off" control command, this will trigger its magnetic holding relay to switch on or switch off the connected circuit respectively.



(1) Illustration of Remote Control Logic

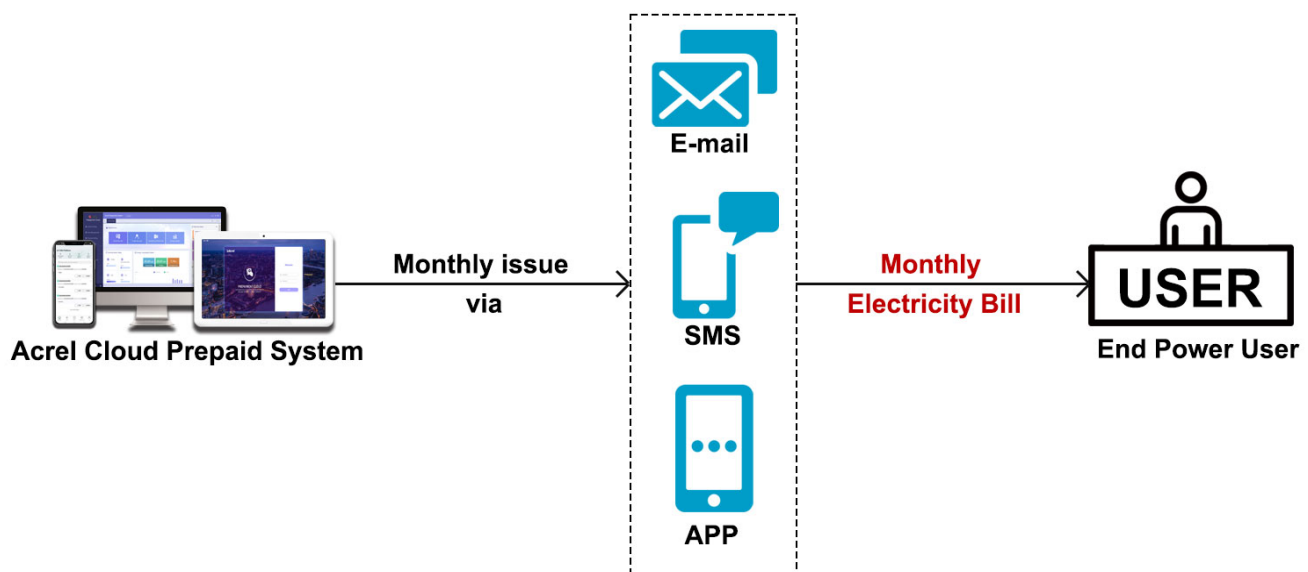


- (2) Administrator use Acrel Cloud Prepaid&Postpaid System to issue "Control Command"

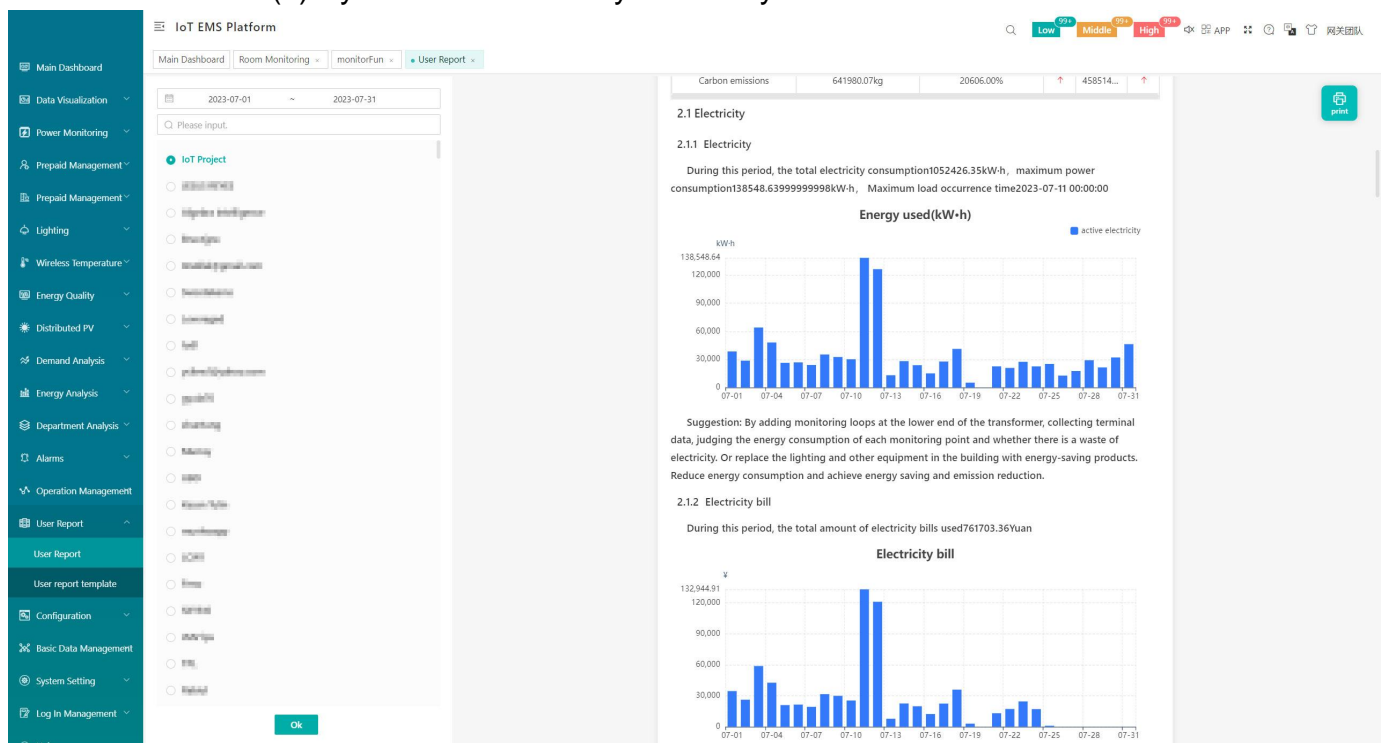


## 9. Auto-generated & Auto-issuing Customizable User Report and Electricity Bill

- (1) A comprehensive user report&bill could be automatically generated issued down to end power user via E-mail, SMS, APP, etc.
  - (2) Monthly electricity bills will be based on flat rates or step rates accordingly.
  - (3) End power user could also check their energy consumption or electricity bills on their Prepaid& Postpaid APP.
  - (4) Customizable User Report was possible according to the customer request.
- Noted: Utility side could customize the format of monthly electricity bill&energy report.



### (1) System issue Monthly Electricity Bills to End Power User



### (2) Customized Monthly Electricity Bills

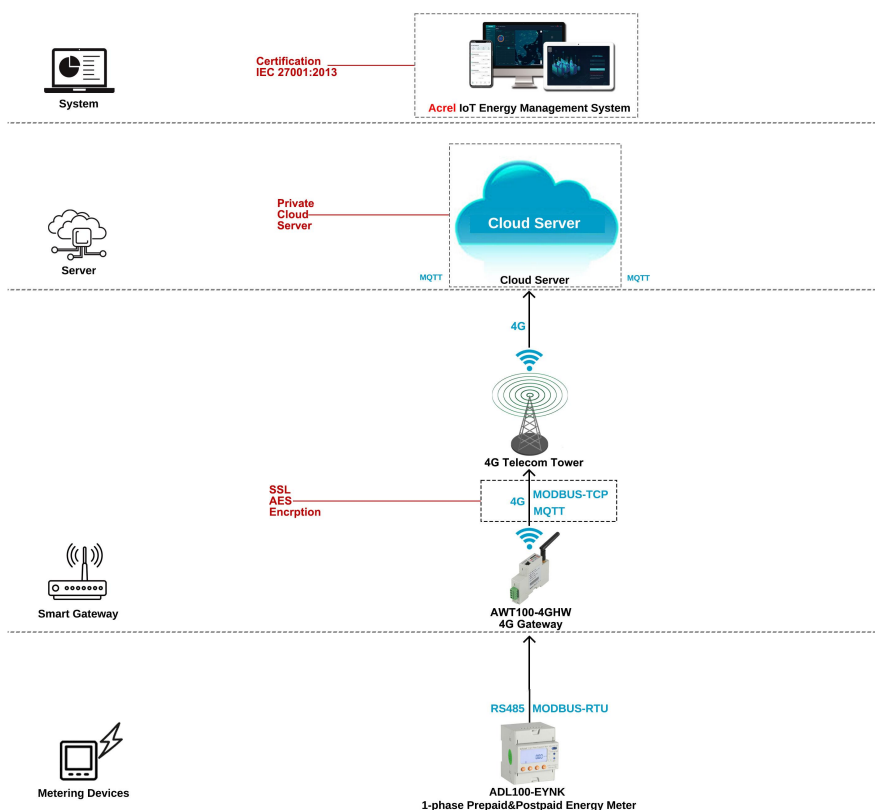


## 11. System Platform Security

- (1) Acrel Cloud Prepaid&Postpaid System got a IEC 27001:2013 certification for approving the system security level on information security management of design, development of electrical meters and etc.
- (2) For safety of data transmission between Acrel AWT100 IoT Smart Gateway and Acrel Cloud Prepaid&Postpaid System. Normally use the AES, SSL or other types of data encryption methods.
- (3) Cloud Server recommend to use private cloud server for safe and stable data storage.
- (4) For other information about data security, kindly contact Acrel Software Department for more information.



(1) IEC 27001:2013 Certification



(2) Data Transmission Encryption



## 12. Acrel IoT Energy Management System General Introduction

Acrel IoT Energy Monitoring System could be access in 2 different ways:

(1) Access through WEB on your computer.

Access port: <https://iot.acrel-eem.com/>

(2) Access through APP on your mobile phone

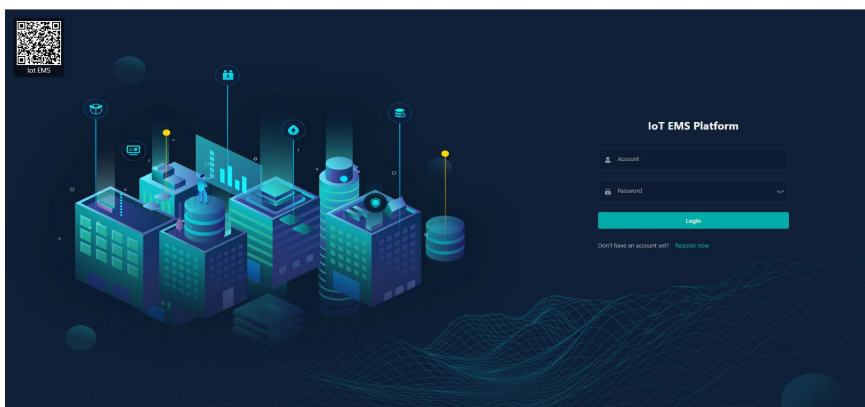
Download Link: <https://play.google.com/store/apps/details?id=com.acrel.iotems>

(1) WEB Accesss (Computer):

Access Port: <https://iot.acrel-eem.com/>

Test Account Name: acrel

Test Account Password: 123456

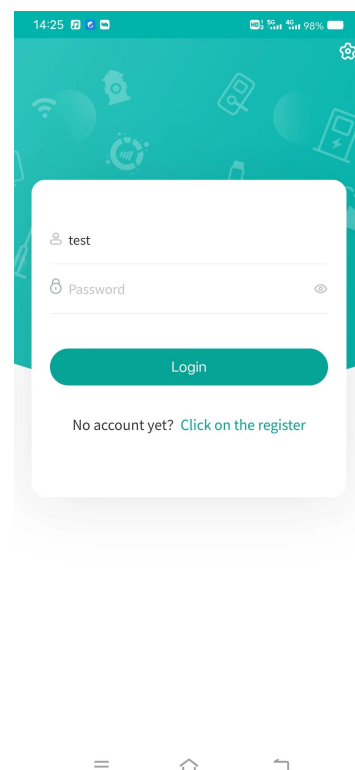
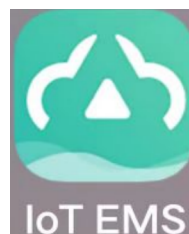


(2) APP Accesss (Mobile):

Download Link: <https://play.google.com/store/apps/details?id=com.acrel.iotems>

Test Account Name: acrel

Test Account Password: 123456

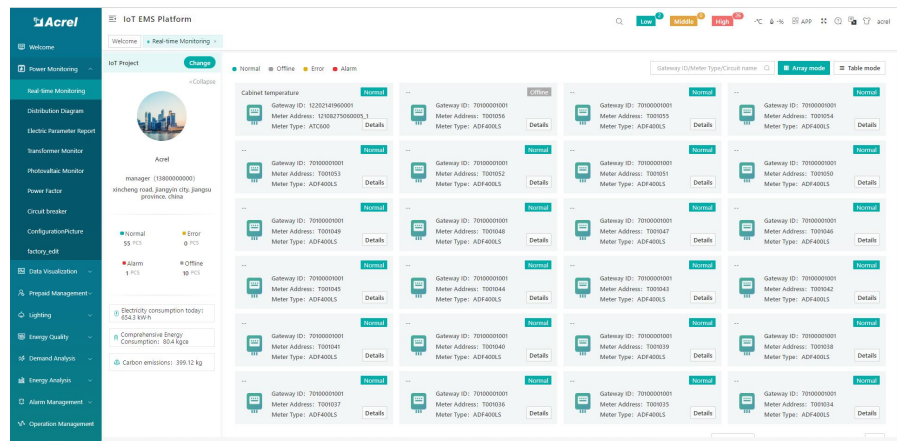


## 12. Acrel IoT Energy Management System General Introduction

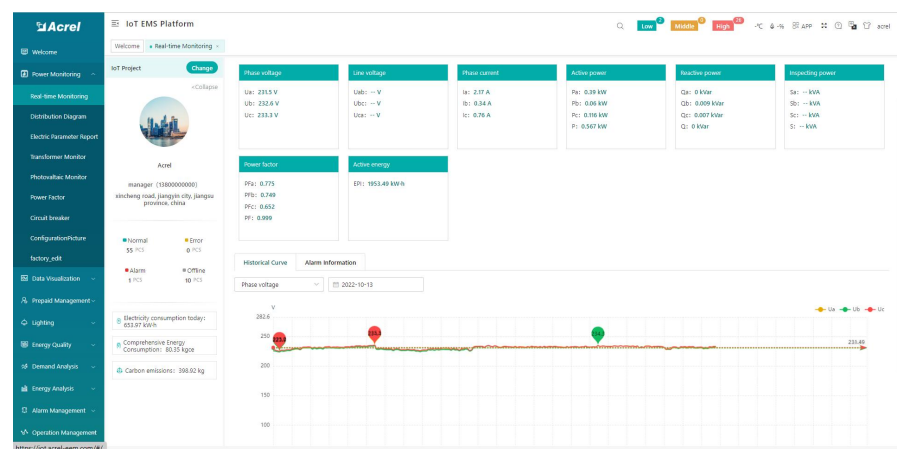
Main Function of WEB side System:

(1) Devices List (2) History Curve (3) Electricity Parameters Report (4) Energy Consumption Report (Daily, Monthly, Yearly) (5) User Report

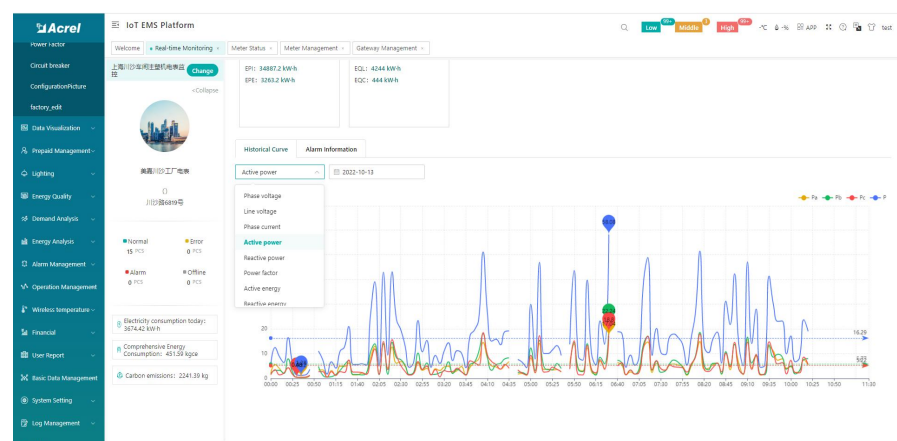
(1) Devices List: Showing the overall devices connected to Acrel System and were bond to certain project. SN code, Online-Offline status, devices model and other necessary information will be shown here.



(2) History Curve: Showing the daily history data curve of all the data that could be collected and upload by energy meter or other basic metering devices.



(2) History Curve: By selecting the items of "data" and "electricity parameter", platform can show the history curve of different data and date.

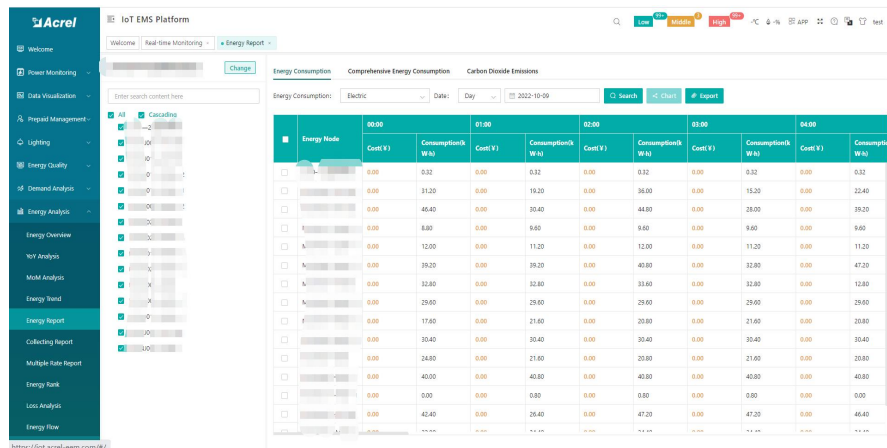


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Main Function of WEB side System:

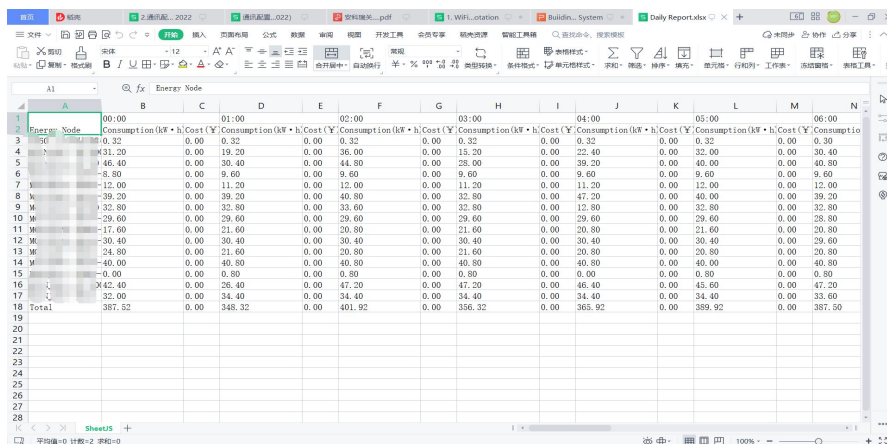
(1) Devices List (2) History Curve (3) Electricity Parameters Report (4) Energy Consumption Report (Daily, Monthly, Yearly) (5) User Report

(4) Energy Report (Daily): This Interface show the daily energy consumption report (calculated by forward active energy)



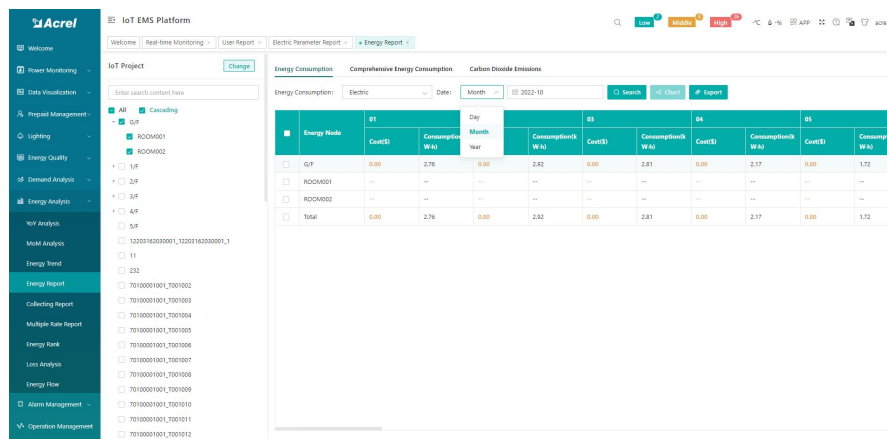
Energy Node	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)
00:00	0.00	0.32	0.00	0.32	0.00	0.32	0.00	0.32	0.00	0.32
01:00	0.00	31.20	0.00	19.20	0.00	36.00	0.00	36.00	0.00	36.00
02:00	0.00	46.40	0.00	30.40	0.00	48.00	0.00	28.00	0.00	39.20
03:00	0.00	8.80	0.00	9.60	0.00	9.60	0.00	9.60	0.00	9.60
04:00	0.00	12.00	0.00	11.20	0.00	12.00	0.00	11.20	0.00	11.20
05:00	0.00	39.20	0.00	39.20	0.00	40.80	0.00	32.80	0.00	47.20
06:00	0.00	32.80	0.00	32.80	0.00	33.60	0.00	32.80	0.00	32.80
07:00	0.00	29.60	0.00	29.60	0.00	29.60	0.00	29.60	0.00	29.60
08:00	0.00	17.60	0.00	21.60	0.00	20.80	0.00	21.60	0.00	20.80
09:00	0.00	30.40	0.00	30.40	0.00	30.40	0.00	30.40	0.00	30.40
10:00	0.00	24.80	0.00	21.60	0.00	20.80	0.00	21.60	0.00	20.80
11:00	0.00	40.00	0.00	40.80	0.00	40.80	0.00	40.80	0.00	40.80
12:00	0.00	0.00	0.00	0.80	0.00	0.80	0.00	0.80	0.00	0.80
13:00	0.00	42.40	0.00	26.40	0.00	47.20	0.00	47.20	0.00	46.40
Total	0.00	387.52	0.00	348.32	0.00	401.92	0.00	356.32	0.00	365.92

(4) Energy Report (Daily): This daily energy report could be also export to computer in "Excel" format



Energy Node	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)
00:00	0.00	0.32	0.00	0.32	0.00	0.32	0.00	0.32	0.00	0.32
01:00	0.00	31.20	0.00	19.20	0.00	36.00	0.00	36.00	0.00	36.00
02:00	0.00	46.40	0.00	30.40	0.00	48.00	0.00	28.00	0.00	39.20
03:00	0.00	8.80	0.00	9.60	0.00	9.60	0.00	9.60	0.00	9.60
04:00	0.00	12.00	0.00	11.20	0.00	12.00	0.00	11.20	0.00	11.20
05:00	0.00	39.20	0.00	39.20	0.00	40.80	0.00	32.80	0.00	47.20
06:00	0.00	32.80	0.00	32.80	0.00	33.60	0.00	32.80	0.00	32.80
07:00	0.00	29.60	0.00	29.60	0.00	29.60	0.00	29.60	0.00	29.60
08:00	0.00	17.60	0.00	21.60	0.00	20.80	0.00	21.60	0.00	20.80
09:00	0.00	30.40	0.00	30.40	0.00	30.40	0.00	30.40	0.00	30.40
10:00	0.00	24.80	0.00	21.60	0.00	20.80	0.00	21.60	0.00	20.80
11:00	0.00	40.00	0.00	40.80	0.00	40.80	0.00	40.80	0.00	40.80
12:00	0.00	0.00	0.00	0.80	0.00	0.80	0.00	0.80	0.00	0.80
13:00	0.00	42.40	0.00	26.40	0.00	47.20	0.00	47.20	0.00	46.40
14:00	0.00	32.00	0.00	34.40	0.00	34.40	0.00	34.40	0.00	33.60
Total	0.00	387.52	0.00	348.32	0.00	401.92	0.00	356.32	0.00	365.92

(4) Energy Report (Monthly& Yearly): Same as daily energy report, monthly and yearly energy report could be also checked on platform and exported in "Excel" format.



Energy Node	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)	Cost (Y)	Consumption (Wh)
00:00	0.00	0.32	0.00	0.32	0.00	0.32	0.00	0.32	0.00	0.32
01:00	0.00	31.20	0.00	19.20	0.00	36.00	0.00	36.00	0.00	36.00
02:00	0.00	46.40	0.00	30.40	0.00	48.00	0.00	28.00	0.00	39.20
03:00	0.00	8.80	0.00	9.60	0.00	9.60	0.00	9.60	0.00	9.60
04:00	0.00	12.00	0.00	11.20	0.00	12.00	0.00	11.20	0.00	11.20
05:00	0.00	39.20	0.00	39.20	0.00	40.80	0.00	32.80	0.00	47.20
06:00	0.00	32.80	0.00	32.80	0.00	33.60	0.00	32.80	0.00	32.80
07:00	0.00	29.60	0.00	29.60	0.00	29.60	0.00	29.60	0.00	29.60
08:00	0.00	17.60	0.00	21.60	0.00	20.80	0.00	21.60	0.00	20.80
09:00	0.00	30.40	0.00	30.40	0.00	30.40	0.00	30.40	0.00	30.40
10:00	0.00	24.80	0.00	21.60	0.00	20.80	0.00	21.60	0.00	20.80
11:00	0.00	40.00	0.00	40.80	0.00	40.80	0.00	40.80	0.00	40.80
12:00	0.00	0.00	0.00	0.80	0.00	0.80	0.00	0.80	0.00	0.80
13:00	0.00	42.40	0.00	26.40	0.00	47.20	0.00	47.20	0.00	46.40
14:00	0.00	32.00	0.00	34.40	0.00	34.40	0.00	34.40	0.00	33.60
Total	0.00	387.52	0.00	348.32	0.00	401.92	0.00	356.32	0.00	365.92

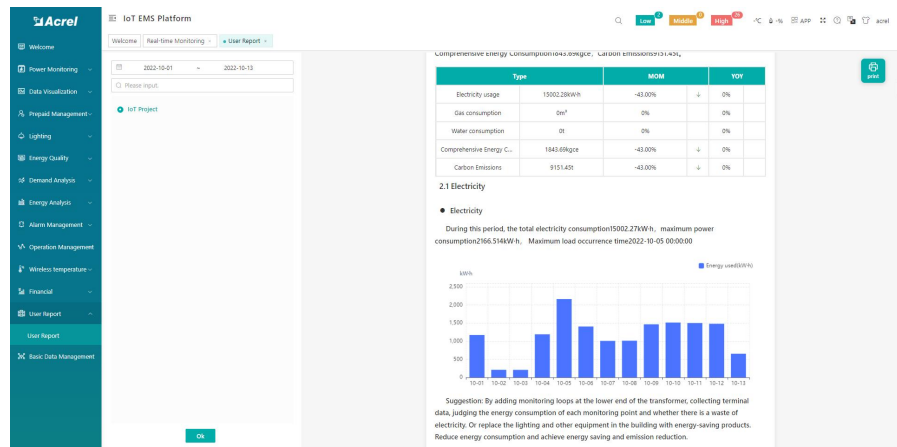


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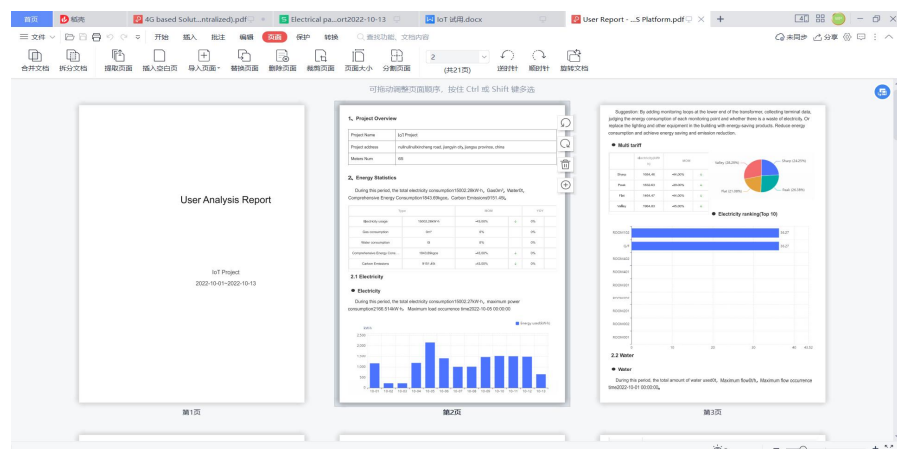
Main Function of WEB side System:

(1) Devices List (2) History Curve (3) Electricity Parameters Report (4) Energy Consumption Report (Daily, Monthly, Yearly) (5) User Report

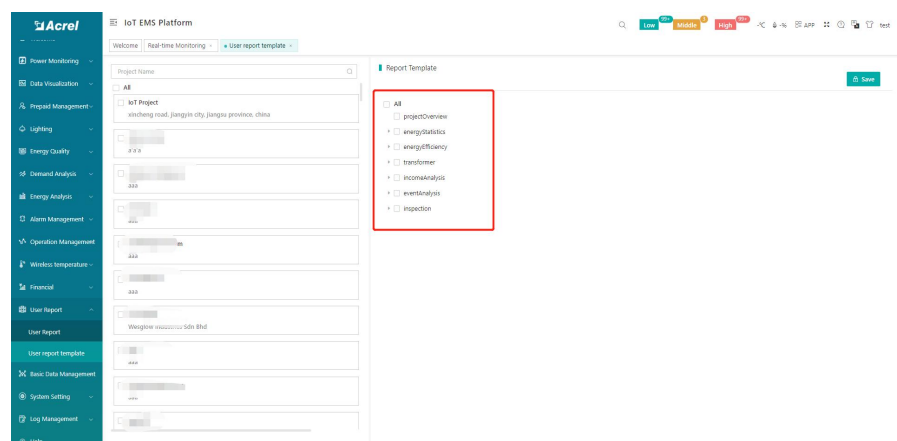
(5) User Report: A comprehensive user report including project overview, energy report, energy analysis and etc could be check on platform



(5) User Report: User report could be exported in "PDF" format into your PC for convenient check and storage.



(5) User Report: User report support template customization in buy-out service of Acrel IoT Energy Monitoring System.

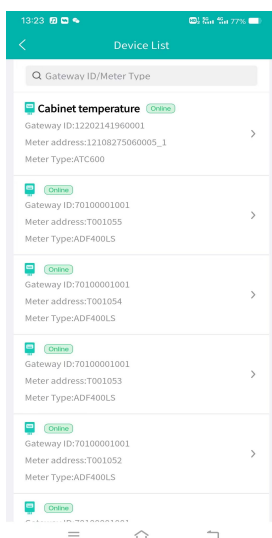


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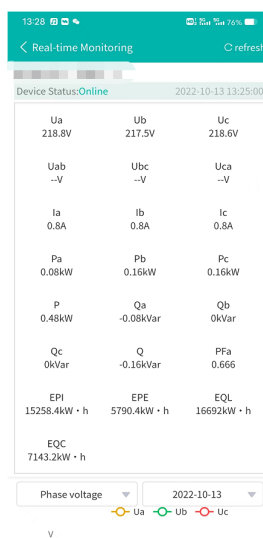
Main Function of APP side System:

(1) Devices List (2) History Curve (3) Electricity Parameters Report (4) Energy Trend (5) Energy Consumption Report (Daily, Monthly, Yearly)

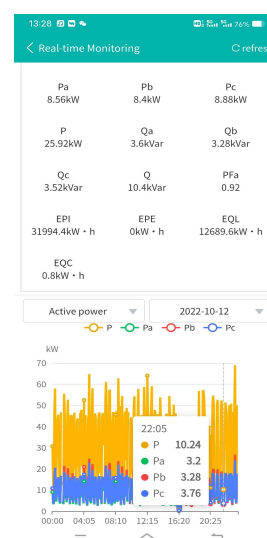
Noted: Since APP side and WEB side of Acrel IoT Energy Monitoring System share the same data, normally recommend our user to add the devices to their account using APP and check the data using WEB platform.



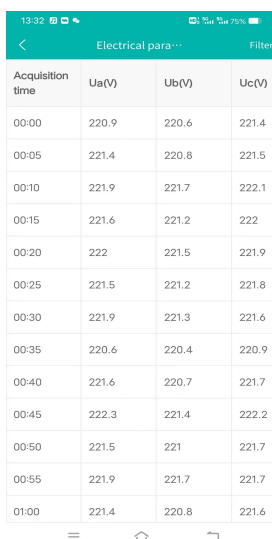
(1) Device List



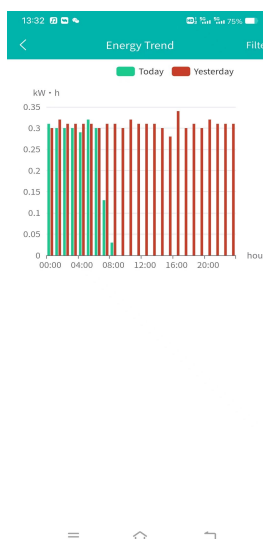
(2) History Curve



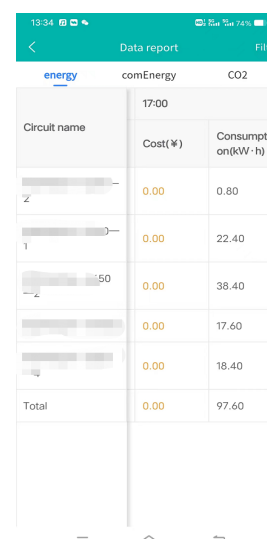
(2) History Curve



(3) Parameter Report



(4) Energy Trend



(5) Energy Report