

A photograph of a house with a red-tiled roof. Several blue solar PV panels are mounted on the roof. The house has white walls and a chimney. The sky is blue with some light clouds.

# Solar PV Online Energy Monitoring Cloud Solution

Solar PV, Import&Export Bidirectional, Online Energy Monitoring, 4G Cloud based.

Ver. Date: July,6th 2023

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District, Shanghai, China



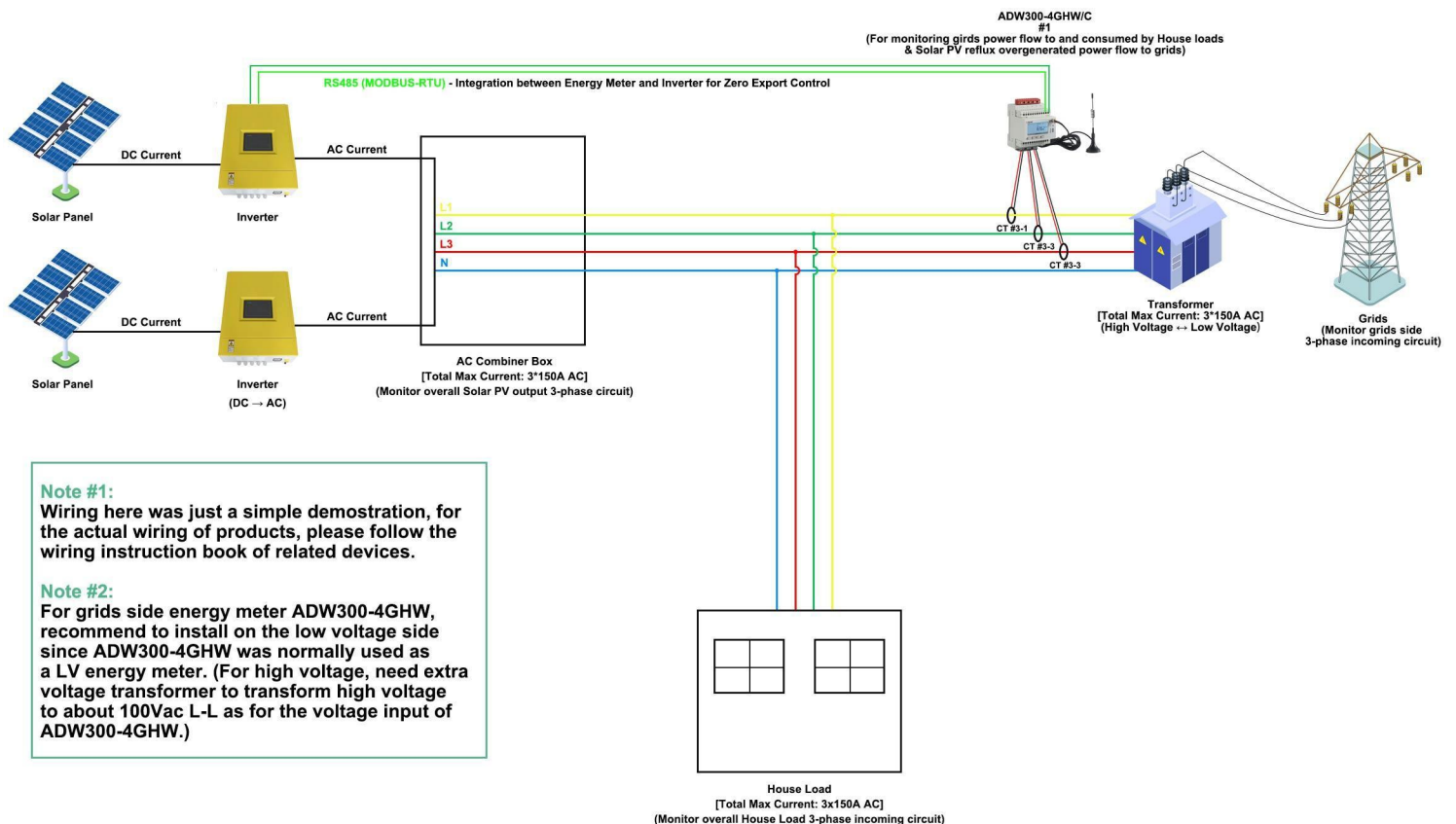
## 1.Scenario Preset

- (1) The scenario is based on a small on-grid Solar PV system without DC energy storage.
- (2) In order to establish a complete monitoring system, we need to install a smart wireless 3-phase energy meter with bidirectional metering function on Grids Side [Need to monitor the grids' overall 3-phase incoming circuit so that we can monitor the total power consumption supplied from grids to house loads and also monitor the over-generated reflux energy from Solar PV to grids or power transformer.]
- (3) The reason why to choose wireless energy meter was because it could directly send data to Acrel IoT Energy Monitoring System without using a extra IoT Gateway. For separate installation, this will be more economic.
- (4) Suppose grids sides incomming circuits is with rated current of 150A AC and rated voltage of 230Vac L-N&400Vac L-N.

## 2.Devices Deployment Plan

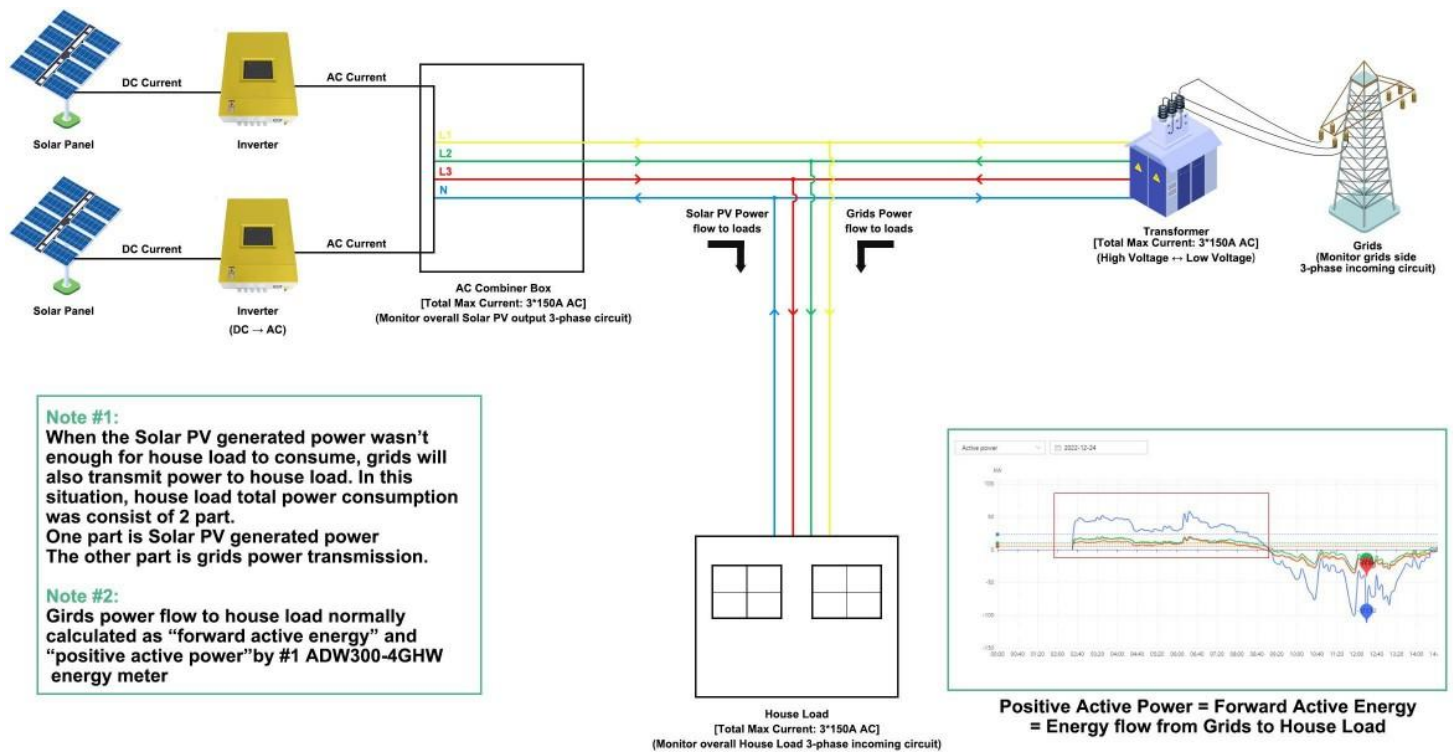
### Grids Side - Grids' Overall 3-phase Incoming Circuit:

7. 1\* ADW300-4GHW/C Wireless 4G Energy Meter
8. 3\* AKH-0.66/K K-φ24 150/5 Split-core Current Transformer



**7. Calculation Logic - When the Solar PV Generated Power < House Load Consumed Power**

- (1) When the solar PV generated power wasn't enough for house loads to consume. Grids will also distribute power to house load for consuming. So, in this situation, the house load total power consumption was consisted of 2 parts, solar PV generated power and grids distribution power.
- (2) Grids power flow to house load for consuming was normally calculated as "forward active energy, EPI" and "positive active power, +kw" by #1 ADW300-4GHW energy meter.



Calculation box logic (When Solar PV not Enough)

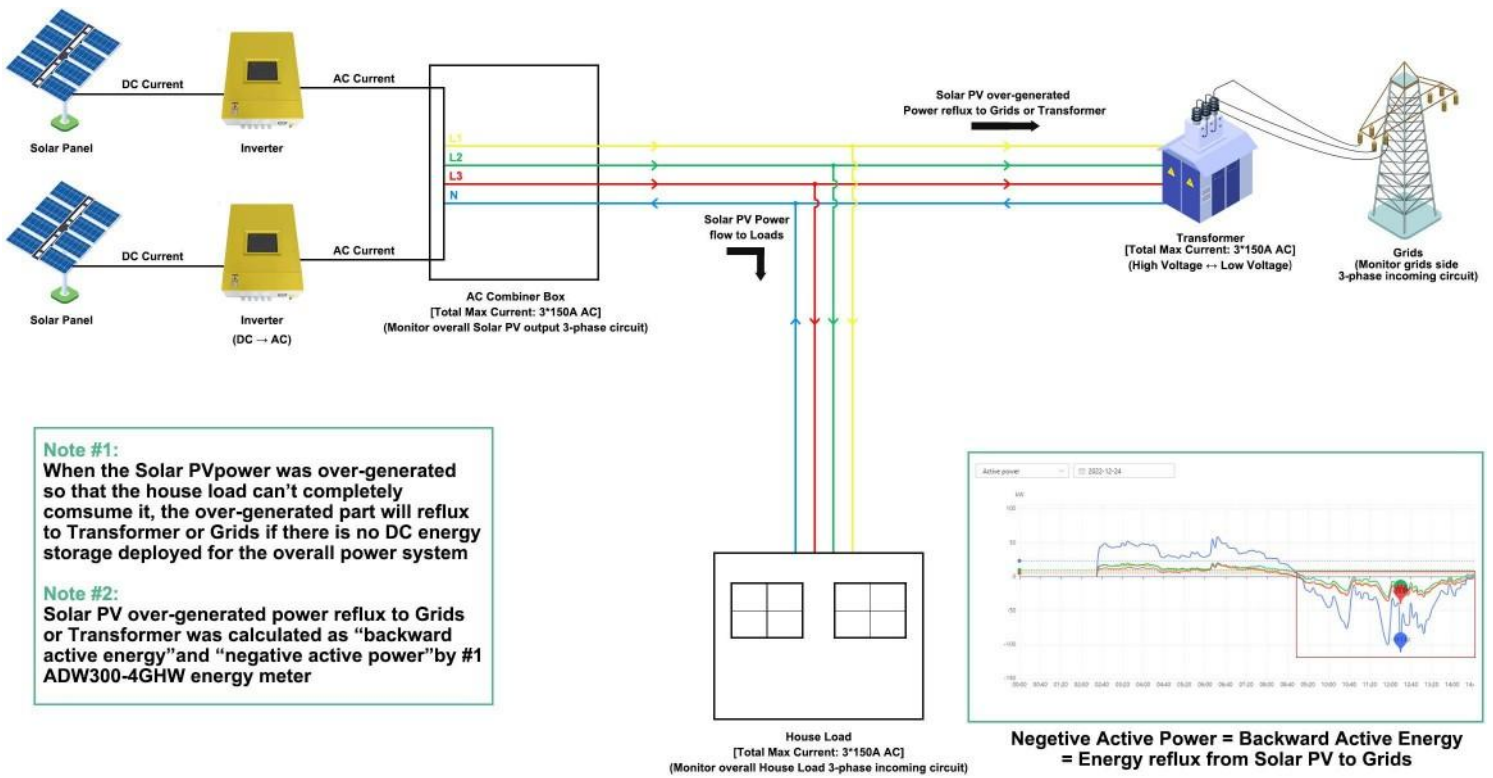


Diagram of "Forward Active Energy, EPI"

**7. Calculation Logic - When the Solar PV Generated Power > House Load Consumed Power**

(1) When the solar PV generated power was larger than house loads power consumption. The part of over-generated solar PV power will reflux to power transformer or grids. In this situation, solar PV power generation will be distributed to 2 part, to house loads and to power transformer or grids.

(2) Solar PV over-generated power which reflux to power transformer or grids was normally calculated as "backward active energy, EPE" and "negative active power, -kw" by #1 ADW300-4GHW energy meter.



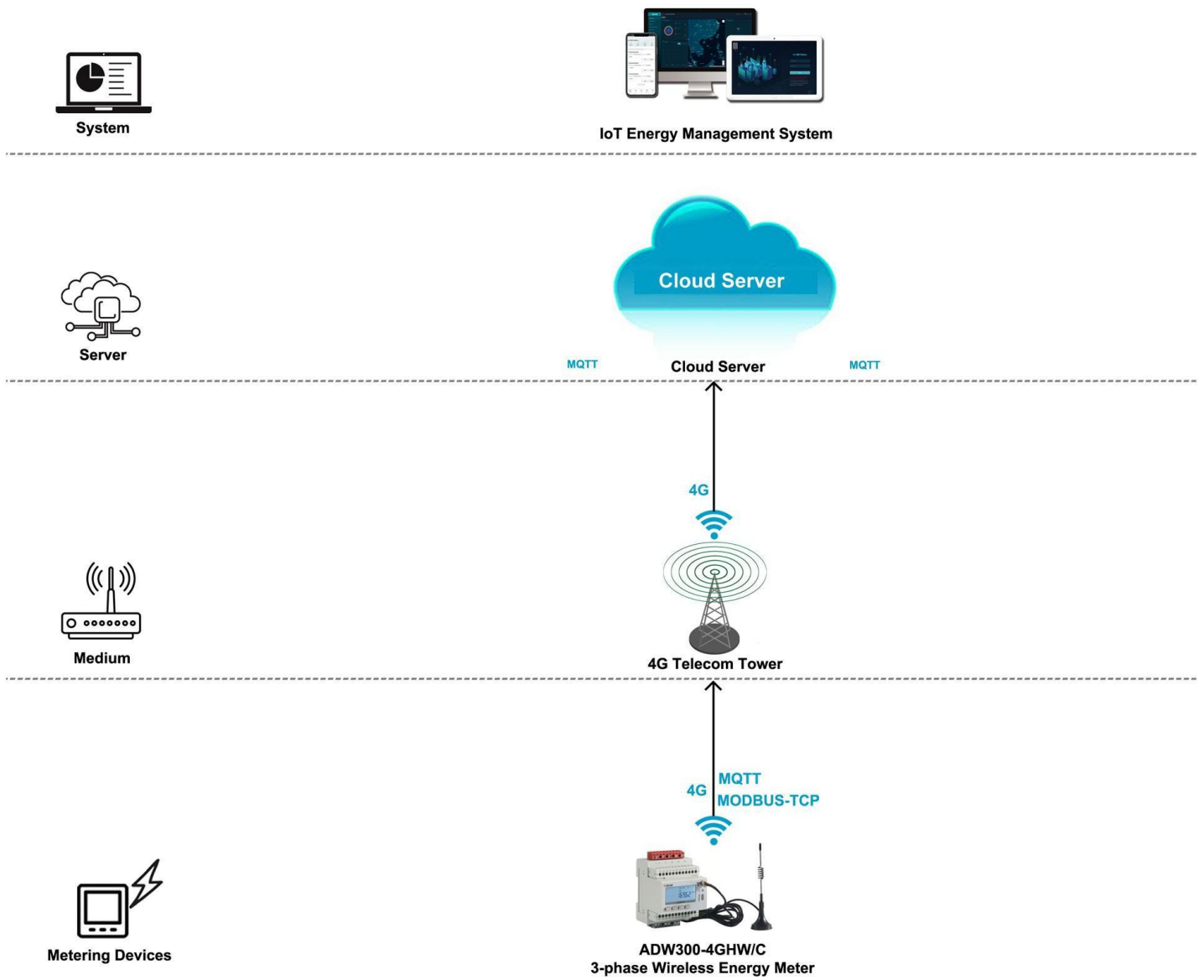
**Calculation Logic (Solar PV Over-generated)**



**Diagram of "Backward Active Energy, EPE"**

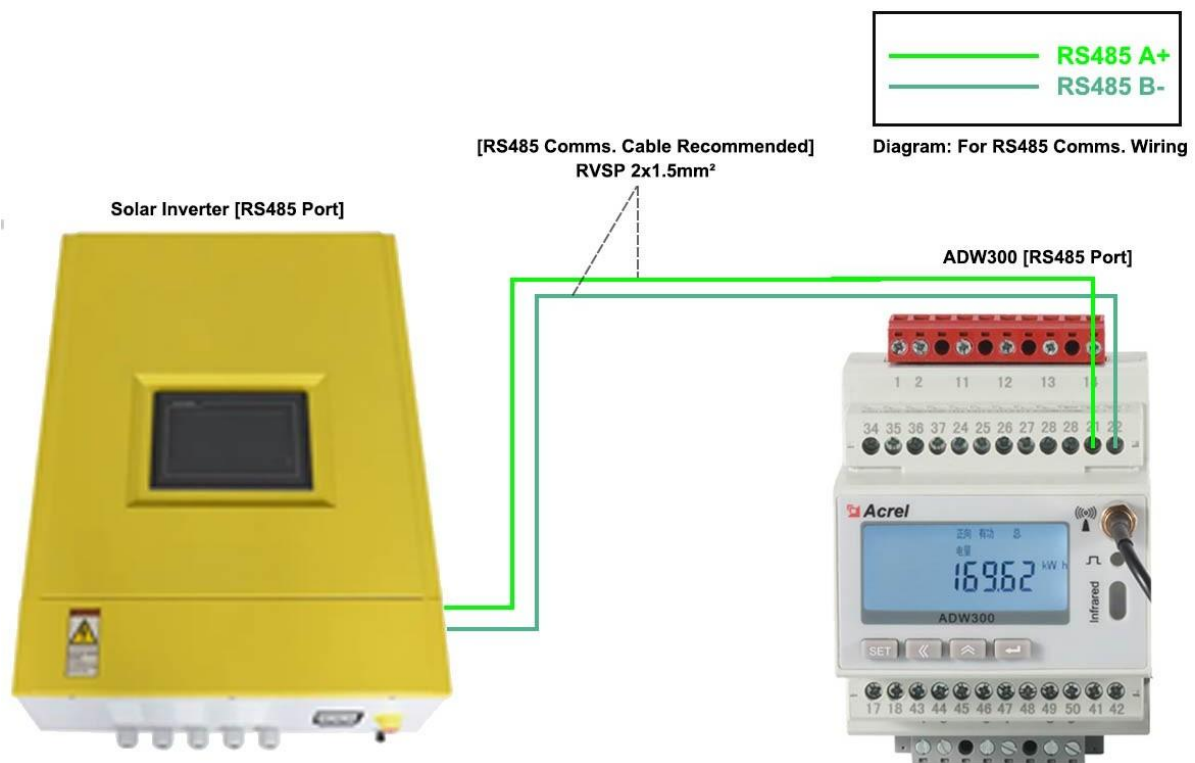
## 8. Communication Structure&Logic - To IoT System

- (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) ADW300-4GHW/C Wireless 4G 3-phase Energy Meter has a built-in 4G communication module which allow it to directly send data to local 4G telecom tower through 4G signal based on MQTT and MODBUS-TCP protocol without using a extra 4G IoT Gateway.
- (3) Each ADW300-4GHW/C has a 4G card tray for installing the 4G sim card which could be bought from your local 4G service provider.
- (4) ADW300-4GHW/C also have a RS485 communication normally used for devices adjustment with Acrel ADW300 adjustment software.



### (3) Communication Structure&Logic - To Solar Inverter

- ADW300-4GHW energy meter also has a RS485 port [MODBUS-RTU protocol] which could be connected to Solar PV Inverter so that inverter could get the reading from ADW300 based on MODBUS-RTU protocol.
- Once the inverter get a reading of "backward active power [minus value]", the invert could automatically lower its power generation rates so that the over all Solar PV generated power won't be more than house load consumption. Thus Solar PV side won't have export to grids side and eventually realize zero export.







Note:

- 7.** Solar PV inverter get reading of bidirectional active power of grids side from ADW300 based on RS485 [MODBUS-RTU]
- 8.** Once inverter get the reading of backward active power [export], inverter will lower its power generation rates so that no more Solar PV over-generated power flow to grids side. [no more export power]
- 9.** All the generation power control logic was decided by inverter, energy meter ADW300 only provide the reading of bidirectional active power. So the integration between ADW300 and inverter based on RS485 interface [MODBUS-RTU] protocol for get the reading of bidirectional active power must be done and inverter side must have this type of control logic. [When inverter get the reading of backward active power, it will lower its power generate rate ]

**(4) Overall Model Selection&Quotation**

- This Quotation doesn't include freight charge. To gain a complete quotation, please refer the actual quantity that you want to request for the actual order, once we receiving it. We will issue a Official Proforma Invoice with Acrel Stamps on it for later procedure.

<b>System Software</b>					
Name	Description	System Price	Remark (Choose Host Service or Buy-out Service after 3-month Free Trial of <b>Cloud IoT System</b> )		
 <b>Acrel Cloud IoT Energy Management System</b>	1.System support all the meters across the country whose data has been sent to cloud server through <b>4G,WIFI or Ethernet</b> . 2.Remote meter reading and data collection. 3.Provide <b>IoT APP for mobile phone</b> side and <b>IoT WEB</b> for PC side. 4.Generate energy data report of daily, monthly and annually period with year-on-yeay and period-on-period energy analysis. 5.Provide various alarm function to ensure a stable operation of the system and protect your property. 6.Offer 3-month free trial of system with full technical support as for a test phase or pilot project.	\$0 (recommended in pilot project)	3-month Free Trail (Users don't need to rent a cloud server))		
		\$xx/Year (For 1 Points) (Price for Host Service Only, recommended in pilot project)	\$xx to buy Hosting Service for 1 monitoring points connected to the system 1 year (Users don't need to rent a cloud server)		
		\$xxxx/Permanent (Limitless Points) (Price for Buy-out Service Only, recommended in late project)	1-time charging of \$xxxx for Buy-out Service of permanent use (A cloud server need to be rent by users)		
<b>Cloud Server</b>					
Name	Description	Server Renting Price (For Reference Only)	Remark		
 Cloud Server	1.Cloud Server could be rent on the cloud server provider like Amazon Cloud. 2.Users of <b>Cloud IoT Energy Management System</b> only need to rent cloud server when they choose <b>buy-out</b> service of our <b>Cloud IoT System</b> . And if they are using <b>hosting service</b> or <b>3-month free trial</b> of our Cloud IoT System, we will use our own cloud server which has been rent on Amazon so that users don't need to rent a cloud server. 3.The quotation of Cloud Server is only a reference price that we have rent on Amazon Cloud.	According to Specs of Rented Cloud Server	Below cloud server specs could support 1000-2000 monitoings points connected to the system (Server: 8 core 16G Operation System: windows server 2016)		
<b>4G Wireless Energy Meter</b>					
Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	3-phase 4G Wireless Energy Meter <b>ADW300-4GHWC</b>	<b>Communication:</b> 4G Wireless Communication (with 4G SIM card)&RS485 (MODBUS-RTU) <b>Rated Voltage:</b> 3x380~456VAc L-L or 3x660VAc L-L (45~65Hz) <b>Rated Current:</b> 3x1(6)A AC (via CTs) <b>Auxiliary Power Supply:</b> 85~265VAc	1 pcs	/	/
<b>Paired Split-core CT</b>					
Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Split-core Current Transformer <b>AKH-0.66/K K-φ24 150/5</b>	<b>Current Ratio:</b> 150/5A AC <b>Aperture:</b> φ24mm (diameter) <b>Accuracy:</b> Class 1.0 <b>Application:</b> Paired with ADW300-4GHWC for current input	3 pcs	/	/

## (1) Acrel IoT Energy Monitoring System (Partail Introduction)

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

- Access through WEB on your computer.

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

- Access through APP on your mobile phone

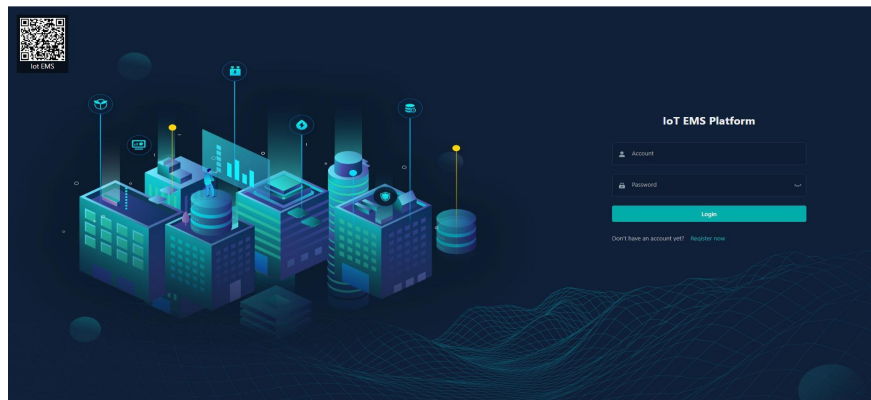
Download Link: <https://play.google.com/store/apps/details?id=com.acrel.iotems>

### 7. WEB Access (Computer):

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

Test Account Name: acrel

Test Account Password: 123456

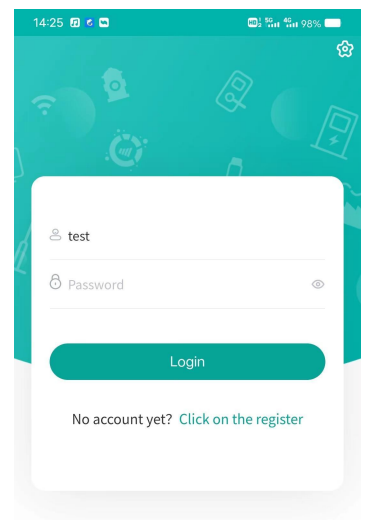
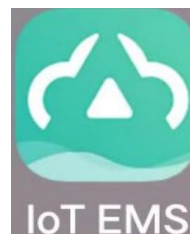


### 8. APP Access (Mobile):

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

Test Account Name: acrel

Test Account Password: 123456



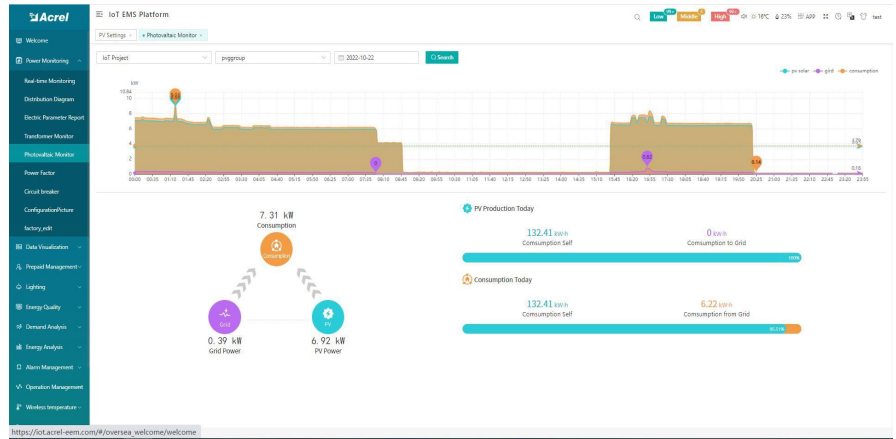


## (1) Acrel IoT Energy Monitoring System (Partail Introduction)

Main Function of WEB side System:

- Solar PV Monitoring (2) Devices List (3) History Curve (4) Electricity Parameters Report (5) Energy Consumption Report (Daily, Monthly, Yearly) (6) User Report

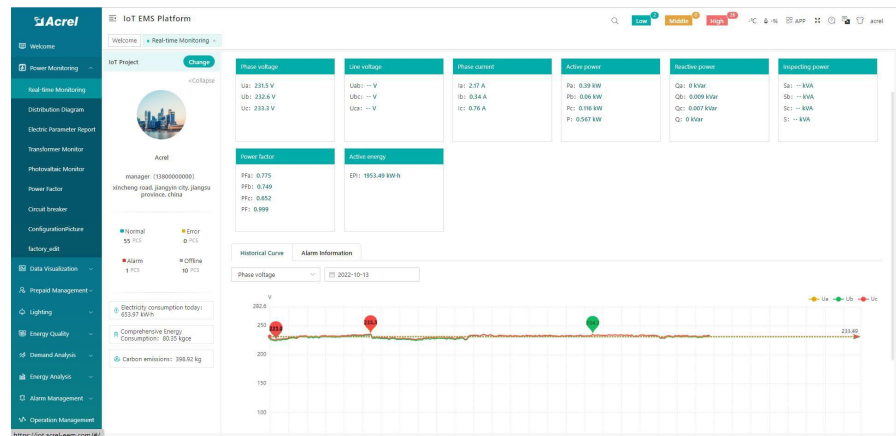
**7. Solar PV Monitoring:** Overview of overall loads' power consumption, Solar PV total power generation, energy supplied by grids that consumed by loads, over-generated Solar PV power flux to grids or power transformer.



**8. 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.

Gateway ID	Meter Address	Meter Type	Status
70100001001	70100001	ADZ400LS	Normal
70100001002	70100002	ADZ400LS	Normal
70100001003	70100003	ADZ400LS	Normal
70100001004	70100004	ADZ400LS	Normal
70100001005	70100005	ADZ400LS	Normal
70100001006	70100006	ADZ400LS	Normal
70100001007	70100007	ADZ400LS	Normal
70100001008	70100008	ADZ400LS	Normal
70100001009	70100009	ADZ400LS	Normal
70100001010	70100010	ADZ400LS	Normal

**9. History Curve:** Showing the daily history data curve of all the data that could be collected and uploaded by energy meter or other basic metering devices.

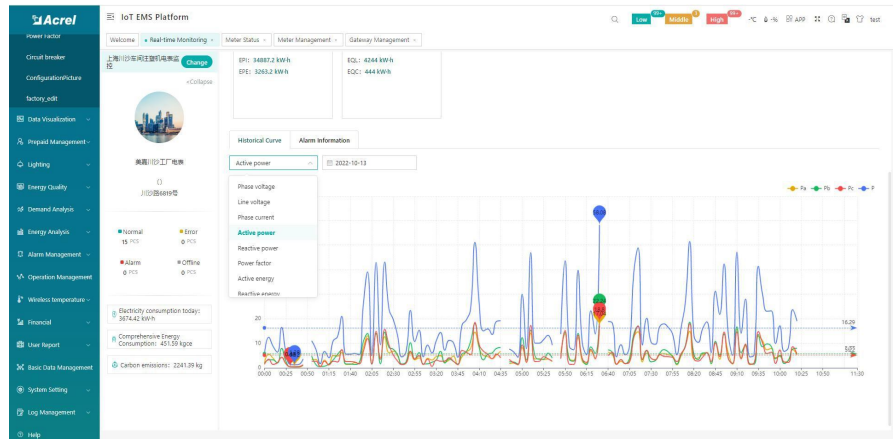


## 1. Acrel IoT Energy Monitoring System (Partail Introduction)

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



**5. Electricity Parameters Report:** All the electricity parameters that could be collected by certain energy meter will showed as a report here.

Time	PActive1	PActive2	PActive3	PActive4	QActive1	QActive2	QActive3	QActive4	PFActive1	PFActive2	PFActive3	PFActive4	PF	EPActive
0 11:04	9	8.82	28.86	-5.4	-5.12	-7.2	22.86	10.82	11.46	36.96	--	--	--	134325
10 10:02	8.82	8.84	27.48	-7.6	-6.18	-7.02	21	13.26	10.86	35.22	--	--	--	134327
24 8:4	8.46	8.46	26.76	-8.34	-5.82	-6.84	21	12.9	10.26	34.02	--	--	--	134329
38 10:14	8.76	8.76	27.66	-7.74	-6.06	-7.02	20.82	13.2	10.86	34.02	--	--	--	134331
76 5:4	8.64	8.34	26.52	-8.28	-6.06	-6.6	20.94	12.6	10.56	34.02	--	--	--	134333
114 10:36	9.18	8.64	28.2	-7.44	-6.42	-6.9	20.76	13.3	11.22	31.1	35.82	--	--	134335
38 9:3	8.82	8.34	27.06	-6.46	-6.12	-6.84	21.42	13.08	10.74	30.84	--	--	--	134337
56 10:38	8.76	8.58	27.12	-6.54	-6.12	-6.9	21.06	13.32	10.68	31.04	35.04	--	--	134339
48 8:18	8.84	8.52	27.34	-7.2	-6.18	-6.9	20.58	12.9	10.82	30.84	34.8	--	--	134341
24 9:8	9.54	9.3	28.44	-6.34	-6.12	-6.12	20.82	12.72	11.4	31.64	36.78	--	--	134343
46 9:78	8.58	8.4	26.76	-6.46	-6.06	-6.9	21.42	12.96	10.56	34.8	34.8	--	--	134345
26 13:56	11.4	11.82	36.78	3.36	-4.8	-6.36	14.52	15.48	12.36	13.44	41.28	--	--	134347
24 8:66	8.4	8.52	26.58	-6.52	-5.94	-7.02	21.48	12.9	10.84	34.26	--	--	--	134349
64 9:42	8.38	8.34	26.04	-6.28	-5.88	-6.96	21.32	12.84	10.14	30.84	33.54	--	--	134351
86 9:36	8.16	8.28	25.8	-6.28	-5.82	-6.96	21.06	12.66	10.8	33.3	--	--	--	134353
14 10:02	8.22	8.22	26.46	-6.28	-5.88	-6.84	21	12.96	10.68	33.72	--	--	--	134355
68 8:66	8.38	8.16	26.1	-6.34	-5.84	-6.96	21.24	12.78	10.68	33.66	--	--	--	134357
22 10:92	8.38	8.34	27.54	-4.64	-5.94	-7.08	17.46	13.8	10.26	35.04	--	--	--	134359

**(4) Electricity Parameters Report:** Report on platform could be exported in "Excel" format to your computer for a brief storage when accessing the IoT EMS WEB platform.

Acquisition time	Ua(V)	Ub(V)	Uc(V)	Ia(A)	Ib(A)	Ic(A)	Pa(W)	Pq(W)	Pp(W)	Qa(kVar)	Qb(kVar)	Qc(kVar)	PFa	PFb	PFc	PF	EP(kWh)			
2 00:00	225.6	225.9	227.4	--	--	--	64.96	45.93	9.11	9.4	8.82	28.96	-9.54	-6.12	-7.2	22.86	10.82	11.46	36.96	
3 00:05	225.6	225.4	227.3	--	--	--	58.92	47.94	49.08	10.02	8.82	8.64	27.48	-7.8	-6.18	-7.02	21	13.26	10.86	35.22
4 00:10	224.2	224.2	225.8	--	--	--	37.72	45.96	48.24	9.84	8.46	8.46	26.76	-8.34	-5.82	-6.84	21	12.9	10.26	34.02
5 00:15	225.9	224.2	225.9	--	--	--	59.16	47.92	49.98	10.14	8.76	8.76	27.66	-7.74	-6.06	-7.02	20.82	13.2	10.86	34.02
6 00:20	225.4	225.6	227.1	--	--	--	56.1	47.04	47.76	9.54	8.64	8.34	26.52	-8.28	-6.06	-6.6	20.94	12.6	10.56	34.02
7 00:25	224.6	224.7	226.3	--	--	--	60.12	50.1	49.14	10.38	9.18	8.64	28.2	-7.44	-6.42	-6.9	20.76	13.3	11.22	31.1
8 00:30	225.3	225.7	227.3	--	--	--	58.08	47.7	47.58	9.9	8.82	8.34	27.06	-8.46	-6.12	-6.84	21.42	12.96	10.74	30.84
11 00:45	225.7	225.9	225.6	--	--	--	56.32	50.28	51.24	9.6	9.54	9.3	26.44	-8.34	-6.12	-6.12	20.82	12.72	11.4	31.64
12 00:50	225.8	227	226.6	--	--	--	59.04	47.16	48.36	10.38	8.76	8.58	27.72	-8.04	-6.12	-6.9	21.06	13.32	10.68	31.04
10 00:50	225.8	226.2	227.7	--	--	--	57.18	48.3	48.48	9.78	8.94	8.82	27.24	-7.5	-6.18	-6.9	20.58	12.9	10.92	30.84
14 01:00	225.5	225.8	230	--	--	--	56.52	45.12	48.24	9.66	8.4	8.52	26.58	-8.32	-5.94	-7.02	21.48	12.9	10.32	31.04
15 01:05	227.7	228	229.2	--	--	--	55.32	44.7	47.64	9.42	8.38	8.34	26.04	-8.28	-5.88	-6.96	21.12	12.54	10.14	30.84
16 01:10	230	230.2	231.8	--	--	--	54.54	43.68	46.86	9.36	8.16	8.28	25.8	-8.28	-5.82	-6.96	21.06	12.48	10.2	30.8
17 01:15	230.3	231.1	232.5	--	--	--	56.52	43.86	46.14	10.02	8.22	8.22	26.46	-8.28	-5.88	-6.84	21	12.96	10.68	33.72
19 01:20	230.5	231.2	232.8	--	--	--	55.56	44.28	46.08	9.66	8.28	8.16	26.1	-8.34	-5.94	-6.96	21.24	12.78	10.2	30.68
19 01:25	230.8	231.2	232.7	--	--	--	60	44.4	47.22	10.92	8.28	8.34	27.54	-4.44	-5.94	-7.08	17.46	13.8	10.26	35.04
20 01:30	231.4	231.2	233.1	--	--	--	53.28	43.14	46.32	9.24	8.16	8.34	25.74	-8.1	-5.64	-6.78	20.52	12.3	9.96	30.74
21 01:35	229.8	229.8	231.3	--	--	--	53.16	43.8	46.8	9.66	8.16	8.28	25.5	-8.16	-5.7	-6.9	20.76	12.18	9.96	30.8
22 01:40	230.6	230.5	232.3	--	--	--	51.9	42.9	45.96	9.18	8.16	8.46	25.8	-7.56	-5.82	-6.82	19.56	11.94	9.9	30.68
23 01:45	229.8	229.5	231.1	--	--	--	51.36	42.6	45.06	8.7	7.92	7.92	24.84	-7.92	-5.64	-6.72	20.28	11.76	9.72	30.38
24 01:50	230.1	229.6	231.9	--	--	--	58.32	50.88	51.6	12.24	10.56	10.32	33.12	6.4	3.54	-6.6	19.14	12.24	10.68	30.96
25 01:55	230.1	230.2	232	--	--	--	52.86	49.8	49.26	10.38	10.08	9.12	29.68	6.3	3.34	6.9	19.54	12.12	11.46	31.4
26 02:00	229.2	228.8	230.5	--	--	--	53.58	48.12	46.86	10.44	9.24	8.28	27.96	6.36	3.88	6.84	19.08	12.24	10.98	31.02
27 02:05	231	230.7	232.8	--	--	--	53.16	47.58	47.1	10.38	9.18	7.86	27.54	6.54	6	6.6	19.14	12.24	10.68	30.36
28 02:10	230.7	230.4	232.6	--	--	--	52.32	46.68	43.68	10.26	8.94	7.8	27	6.3	3.88	6.42	18.6	12.06	10.74	30.94

### 3. Acrel IoT Energy Monitoring System (Partail Introduction)

Main Function of WEB side System:

- (1) Solar PV Monitoring (2) Devices List (3) History Curve (4) Electricity Parameters Report (5) Energy Consumption Report (Daily, Monthly, Yearly) (6) User Report

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

Energy Node	00:00		01:00		02:00		03:00		04:00	
	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)
...	0.00	0.32	0.00	0.32	0.00	0.32	0.00	0.32	0.00	0.32
...	0.00	31.20	0.00	19.20	0.00	36.00	0.00	15.20	0.00	23.40
...	0.00	46.40	0.00	30.40	0.00	44.00	0.00	28.00	0.00	39.20
...	0.00	8.80	0.00	5.60	0.00	9.60	0.00	9.60	0.00	9.60
...	0.00	12.00	0.00	13.20	0.00	12.00	0.00	11.20	0.00	11.20
...	0.00	39.20	0.00	39.20	0.00	40.80	0.00	32.80	0.00	47.20
...	0.00	32.80	0.00	32.80	0.00	33.60	0.00	32.80	0.00	32.80
...	0.00	29.60	0.00	29.60	0.00	29.60	0.00	29.60	0.00	29.60
...	0.00	30.40	0.00	30.40	0.00	30.40	0.00	30.40	0.00	29.60
...	0.00	24.80	0.00	21.60	0.00	20.80	0.00	21.60	0.00	20.80
...	0.00	40.80	0.00	40.80	0.00	40.80	0.00	40.80	0.00	40.80
...	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
...	0.00	42.40	0.00	36.40	0.00	47.20	0.00	47.20	0.00	46.40

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

Energy Node	01:00	02:00	03:00	04:00	05:00	06:00
...	0.00	0.32	0.00	0.32	0.00	0.30
...	19.20	36.00	15.20	22.40	32.00	20.40
...	30.40	44.80	28.00	39.20	40.00	40.80
...	9.60	9.60	9.60	9.60	9.60	9.60
...	11.20	12.00	11.20	11.20	12.00	12.00
...	39.20	40.80	32.80	47.20	40.00	49.20
...	32.80	33.60	32.80	32.80	32.80	32.80
...	29.60	29.60	29.60	29.60	29.60	29.60
...	21.60	20.80	21.60	20.80	21.60	20.80
...	40.80	40.80	40.80	40.80	40.80	40.80
...	0.00	0.00	0.00	0.00	0.00	0.00
...	26.40	47.20	46.40	45.60	47.20	33.60
Total	387.52	348.32	401.92	356.32	389.92	387.50

(5) 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.

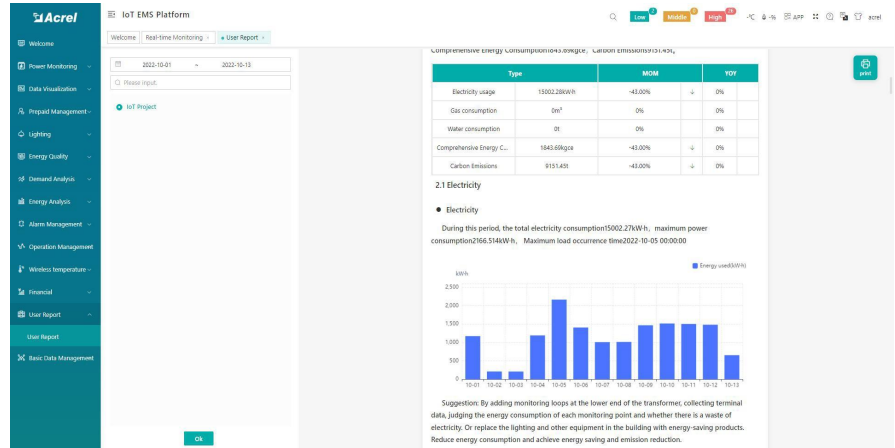
Energy Node	01		02		03		04		05		06	
	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)	Cost(Y)	Consumption(Wh)
...	0.00	2.76	0.00	2.62	0.00	2.81	0.00	2.17	0.00	1.72	0.00	1.72
...	0.00	2.76	0.00	2.62	0.00	2.81	0.00	2.17	0.00	1.72	0.00	1.72
Total	0.00	2.76	0.00	2.62	0.00	2.81	0.00	2.17	0.00	1.72	0.00	1.72

**- Acrel IoT Energy Monitoring System (Partail Introduction)**

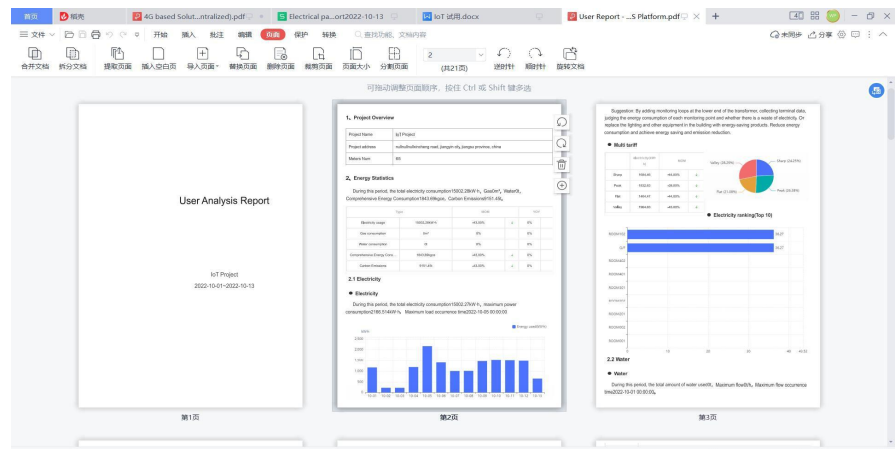
Main Function of WEB side System:

- Solar PV Monitoring (2) Devices List (3) History Curve (4) Electricity Parameters Report (5) Energy Consumption Report (Daily, Monthly, Yearly) (6) User Report

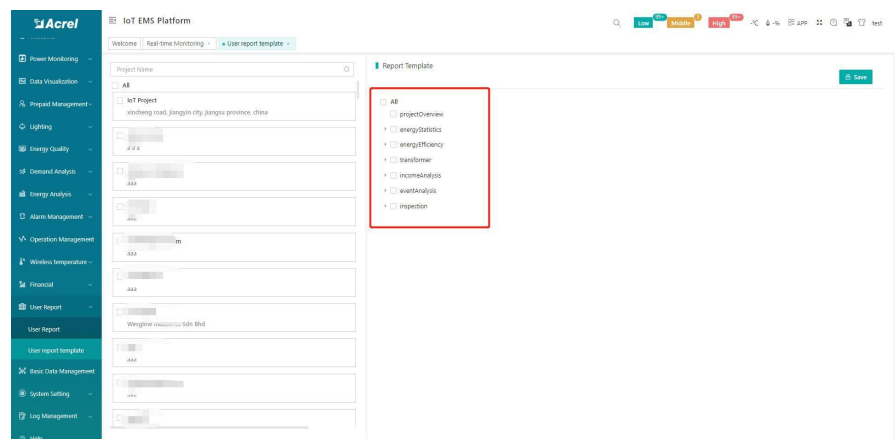
(6) User Report: A comprehensive user report including project overview, energy report, energy analysis and etc could be check on platform



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



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

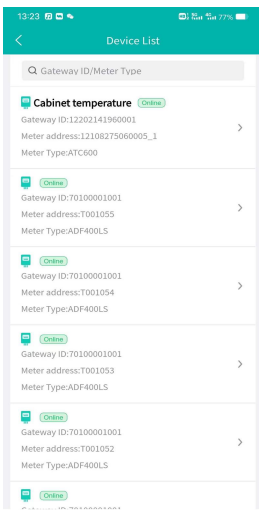


## 1. Acrel IoT Energy Monitoring System (Partail Introduction)

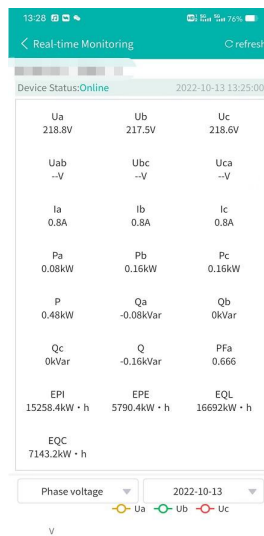
Main Function of APP side System:

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

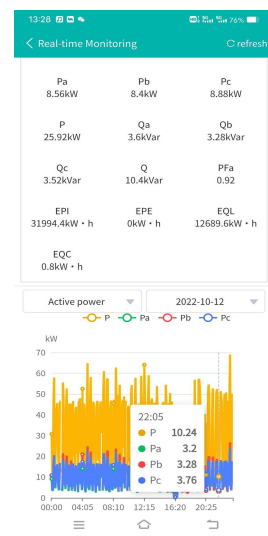
Noted: Since APP side and WEB side of Acrel IoT Energy Monitoring System share the same data, normally recommend our user to add the devices to their account using APP and check the data using WEB platform.



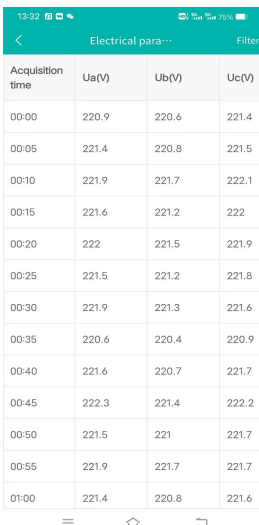
• Device List



(2) History Curve

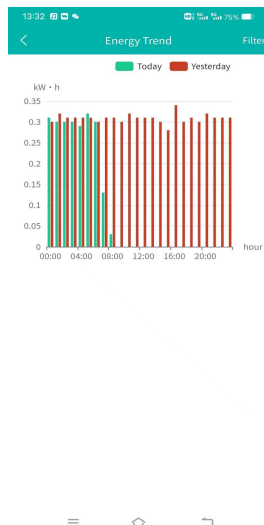


(2) History Curve



Acquisition time	Ua(V)	Ub(V)	Uc(V)
00:00	220.9	220.6	221.4
00:05	221.4	220.8	221.5
00:10	221.9	221.7	222.1
00:15	221.6	221.2	222
00:20	222	221.5	221.9
00:25	221.5	221.2	221.8
00:30	221.9	221.3	221.6
00:35	220.6	220.4	220.9
00:40	221.6	220.7	221.7
00:45	222.3	221.4	222.2
00:50	221.5	221	221.7
00:55	221.9	221.7	221.7
01:00	221.4	220.8	221.6

(3) Parameter Report



(4) Energy Trend



energy	comEnergy	CO2
Circuit name	17:00	
	Cost(¥)	Consumpti on(kW·h)
	0.00	0.80
	0.00	22.40
	0.00	38.40
	0.00	17.60
	0.00	18.40
Total	0.00	97.60

(5) Energy Report