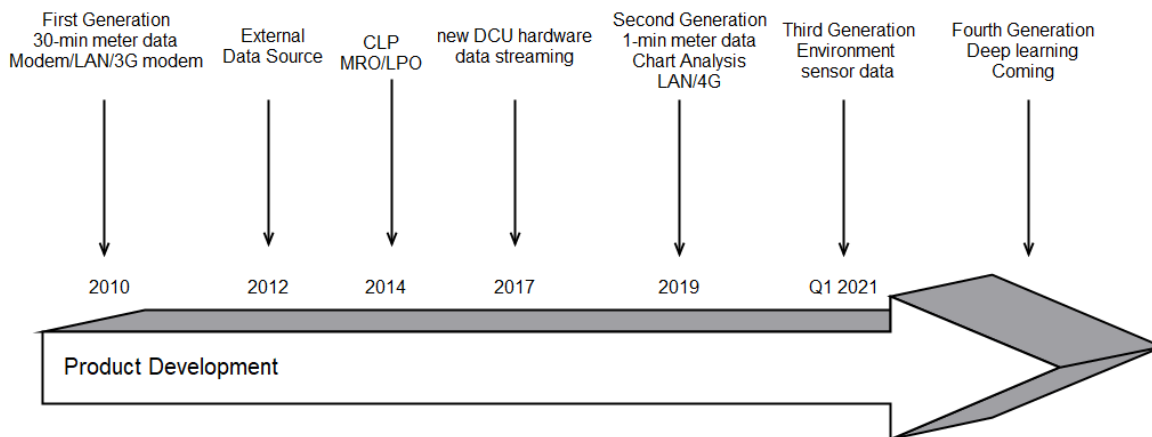


Energy Management System



Introduction

Energy Management System is to collect metering and environmental data from different sources through different means and to provide different levels of analysis using Web interface. The first generation was deployed in 2010 after working on several projects on meter reading for utility such as China Light & Power. Its preliminary version was installed in 2005 on 5 buildings in Tin Shui Wai of Hong Kong while it was used as case study for CLP AMR (Auto-Meter Reading) project on non-commercial sector's meter reading and billing.



The first generation was deployed for large property management company in Hong Kong on commercial buildings with shopping mall and second phase of CLP AMR project. While it served for 2 different kinds of industry, utility mainly for billing and commercial sector for data analysis, the system was designed in modular structure supporting different plug-in libraries. As shown in the above timeline, external data source incorporated metering data from external data sources in commercial sector and the system acted as central database filtering in important data for further data analysis. MRO (billing) and LPO (meter online service) of CLP were specific modules for utility. Category of device was introduced in commercial sector to depict what part of power consumption it belongs to, e.g. lighting, air-flow, lift etc. Each category of devices can be formulated as metering group for performance analysis. In addition, meters under same site can be formulated as billing group for bill calculation in commercial sector. Meanwhile, incomer was used to group meters under same trunk to find out load distribution. A very simple chart was provided in the first generation on either power consumption or demand.

DCU (Data Concentrator Unit) is one of components in this system and it is responsible for collecting metering and environmental data in a site to upload to the system. A separate document is available for this product because it can operate independently with the system as in its deployment in the government offices since 2010.

The second generation provides real time data collection over LAN or 4G mobile network. Unlike previous generation, it collects data immediately after DCU gets metering data instead of scheduling read. Thus, dial-up modem support is dropped though the components in two generations can be working together without issue. Furthermore, more data analysis based on either pie or line charts is introduced. These include load distribution, multiple fields of single meter and single field of multiple meters.

Energy Management System



On-line data in the transaction database is kept up to 3 years while earlier data is moved to historical database. The Web GUI allows data export across these two databases transparently. In addition, intra-day (depending on how frequent DCU collects data), minimum interval data across system (common data interval across the system e.g. 15-minute), daily and monthly data are provided. For charting analysis, only minimum interval data and daily are supported.

Without using DCU, the system can retrieve data directly over LAN (or 4G modem through special module) from Elster meter. Same kinds of metering data are processed. This model would be deployed for CEM (Companhia de Electricidade de Macau) soon.

The third generation is being developed to incorporate environmental data such as temperature, humidity, in-door air quality, TVOC (ppb) and eCO₂ (ppm) which is collected from another type of DCU using Raspberry Pi IoT (Internet of Thing). Thus, power consumption and these kinds of environment information can be studied. Since it is non-invasive installation, the measurement provides casual study.

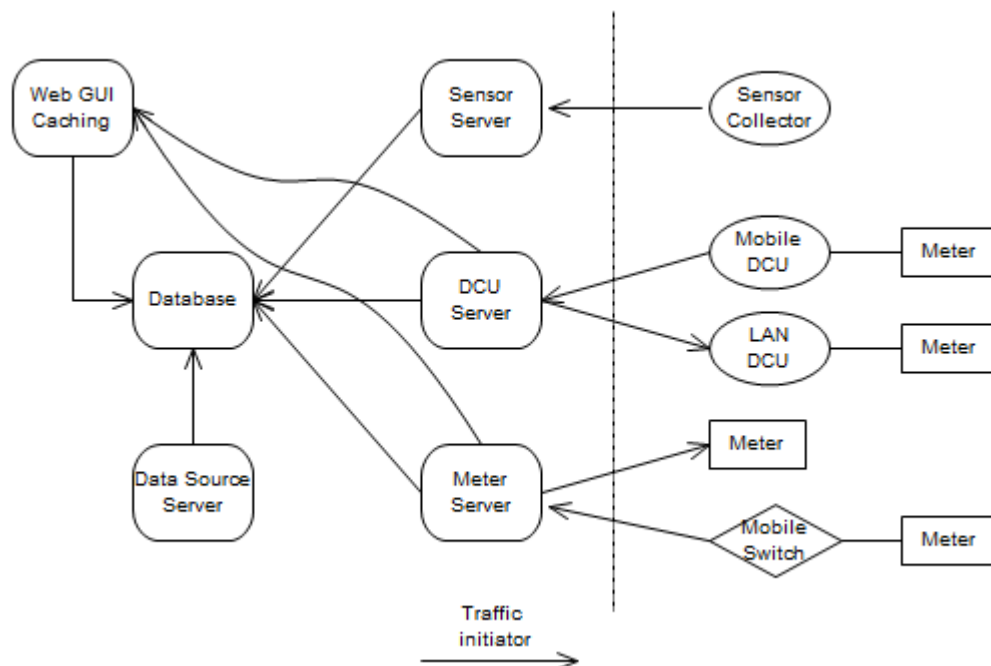
After these kinds of data are collected, deep learning no matter supervised or unsupervised can be further carried out. Of course, edge computing is to be used in future to better manage the whole eco-system but it is out of scope of this system.

Energy Management System



Features of the system

Data Collection



As shown in the above diagram, there are 3 ways to collect metering data, through DCU Server and Meter Server, Data Source Server for external system. Apart from updating data to database, it works together with caching server living within Web GUI. It provides updated status and information so that the user can get it instantly. It is achieved through standard Web Socket interface that data can be populated on the browser.

While multiple number of units of DCU Server or Meter Server are running in parallel for load sharing, the management job is processed in caching server. This scalability with minimum effort of system upgrade can lower the initial investment. Each DCU Server or Meter Server is operating in either one of modes, waiting for connection or making connection upon request from caching server. A small piece of communication module (mobile switch) is required in dynamic IP address meter in order that the system identifies the connection is valid one. In the first generation, some units of DCU was deployed in 2.5G mobile network where an intelligent mobile modem communicated with the server to authenticate with each other before actual data communication was made. These various kinds of connection method facilitate the deployment in different environments.

Since Elster meter provides historical data (load profile and instrumentation) stored inside the meter, the system collects and categories data before storage. Besides storing snapshot data from DCU instantly, the system requests the whole day data during its day end processing to recover those lost due to communication interruption. Data time is very important, and it serves one key parts in the data so the time synchronization between DCU server and DCU in site is performed once a week. Besides, modbus meter type is also supported through DCU while the system makes use of the data collected to provide historical data.

Energy Management System



For external data source, it generally supports file and database type. File should be in tab delimited format. A mapping file is used for database access to map the end point and field to the system used device name. The corresponding decoder should be set up.

Automatic Meter Management System v2.1

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BMS Data Source Management

Building: GB | [Create](#) | [Display](#)

Show entries

Source id	Building	Type	Info	Password	Additional Info
1	GB	File	c:\swiredata\	--	yyMMdd.txt,0
7	GB	PC-DCU	--	--	--
10	TEST	File	c:\testdata\	--	yyyyMMdd.csv,0
12	NONEXIST	File	c:\test\testing\	yyyyMMdd.txt,1	--
13	GB	Database	192.168.2.26,1433,dmpidb,dbuser	--	bmslogdata,Mnemonic,Timestamp,value,0,0,c:\swire

Showing 1 to 5 of 5 entries

Create BMS Data Source

Building: GB

Source Type: File

Source Info: File,FTP (filter list) D

Source Password: File,FTP (filter list) D

Additional Info:

Module: clpdcdecoder

Max. History (days): 4

Schedule Time: HH:mm,HH:mm

User Email List: email,email

1 | [Next](#)

For direct meter data request through Meter Server, the corresponding metering protocol is running on top of mobile network. The checksum being used in the protocol and retry mechanism in the server can ensure the data accuracy. Some meter protocol includes sequence number to further guard against error. Meter request schedule can be specified by either set of fixed schedule or period such as 15-minute.

The system also supports adhoc mode in Meter Server and that means the user can make request through Web GUI to request data immediately. This was used in the first generation by CLP to check the billing information (power consumption) for immediate needs.

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Meter Register Data

Device: | [Register](#)

Connection Object:

Search:

Show entries

Deviceid
10066552
12068942
4017161

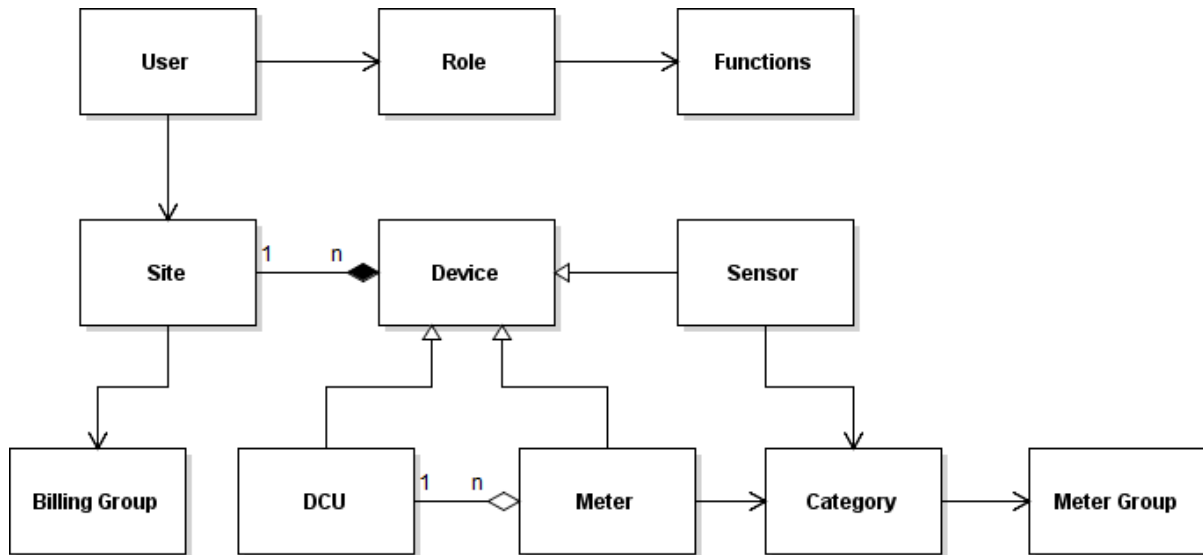
Showing 1 to 3 of 3 entries

Energy Management System



Central Management

User in the system is assigned the role which maps to a set of functions. Only allowed functions can be found in the Web GUI. Every request is to be verified again to prevent user from accessing the function. Data permission in terms of site is configured for the user. Thus, the user can only access data from the sites. In addition, the system reserves field for special permission. It was used by CLP in the first generation to control additional data permission such as writing back data to database for adhoc request or remotely turning on or off meter.



Device information can be uploaded through tab delimited file or using Web GUI.

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Elster Device Management

Site: GB
Choose file No file chosen
Upload
Display

Show entries

DeviceId	ConnObject	ConnDevice	Device Type	EndP	Module	DataStream	Schedule
0000001	A220	gbtstdcu	Elster A220	--	elstermeterdecoder	N	--
01352818	A1350	gbdcu0002	Elster A1350	192.16	elstermeterdecoder	Y	--
03352520	AS1440	gbdcu0002	Elster AS1440	192.16	elstermeterdecoder	Y	--
05052572	A120	--	Elster A120	--	elstermeterdecoder	N	--
05052592	A140	--	Elster A140	--	elstermeterdecoder	N	--
10066572	AS230	gbtstdcu	Elster AS230	--	elstermeterdecoder	N	--
12068942	A1700+	gbdcu0002	Elster A1700	192.16	elstermeterdecoder	Y	--
35074953	AS220	gbdcu0002	Elster AS220	192.168.2.12.2332	Chiller	active	elstermeterdecoder
4017161	A1700	gbdcu0002	Elster A1700	192.168.2.12.2332	Airside	active	elstermeterdecoder
6099776	A1120	gbdcu0002	Elster A1120	192.168.2.12.2332	CT	active	elstermeterdecoder
6099779	A1140	gbdcu0002	Elster A1140	192.168.2.12.2332	CT	active	elstermeterdecoder
gbdcu0002	BBB DCU	--	Elster NetDCU	--	Undefined	active	stddcudecoder
gbdemodcu	PC DCU	--	PCDCU	COM3:	RS485 or RS232	Undefined	inactive
gbtstdcu	Sampe DCU	--	Elster NetDCU	192.168.2.13.3288	Undefined	inactive	advdcudecoder

Showing 1 to 14 of 14 entries

Previous 1 Next

Edit Device Configuration

Device	gbdcu0002
Comm Type	Direct LAN
Comm Param	Not applicable
EndPointId	
Schedule	HH:mm,HH:mm or nm
Sync Time Day	17
Device Sync Day	3
Module	stddcudecoder
Streaming support	<input type="radio"/> No <input checked="" type="radio"/> Yes
DS Name	

No Yes

Similarly, device information from external data source can also be configured through file upload. In general, the module would create the basic information automatically from the filtering file or the data file through file-based mechanism.

Energy Management System



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BMS Device Management

Building: GB | Choose file: No file chosen | Upload | Display | Export

Show: 20 entries | Search: _____

Pointname	Building	Source	Category	Transformer	Location	Serving area	Description
GB_3.CW.RF.CT1.KWH	GB	7	Airside				--
GB_3.CW.RF.CT2.KWH	GB	7	L&P				--
GB_3.CW.RF.CT3.KWH	GB	7	Undefined				--
GB_3.CW.RF.CT4.KWH	GB	7	Undefined				--
GB_3.CW.RF.CT5.KWH	GB	7	SWP				Test
GB_3.CW.RF.CT6.KWH	GB	7	Undefined				--
GB_3.CW.RF.P01.KWH	GB	7	Undefined				--
GB_3.CW.RF.P02.KWH	GB	7	Undefined				--
GB_3.CW.RF.P03.KWH	GB	7	Undefined				--
GB_3.CW.RF.P04.KWH	GB	7	Undefined	--	--	--	--
GB_3.CW.RF.P05.KWH	GB	7	Undefined	--	--	--	--
GB_3.CW.RF.P06.KWH	GB	7	Undefined	--	--	--	--
GB_3.CW.RF.P06.NKW	GB	7	Undefined	--	--	--	--
GB_3.CW.RF.P07.KWH	GB	7	Undefined	--	--	--	--
GB_3.CW.RF.P08.KWH	GB	7	Undefined	--	--	--	--
GB_3.CW.RF.P09.KWH	GB	7	Undefined	--	--	--	--

Edit BMS

Pointname: GB_3.CW.RF.CT3.KW

Building: GB

Category: Ten

Transformer: _____

Location: _____

Serving Area: _____

Description: _____

There are 3 kinds of meter grouping, incomer, billing group and meter group. The first two limit the meter under same site whereas meter group is based on category of the meter but bounded by user's site permission. The user can choose the option to share meter group with others. Incomer describes the relationship of meters in physical world. Billing group is mainly for bill calculation while meter group is generally for data analysis.

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Billing Group Management

Site: 3PP | Create Trunkline | Display Trunkline

Bill Group: 2PP_DCU_check

Show: 20 entries | Search: _____

Device	Real Device	Description	Management Info
101000235	Yes	L01 / Cargo Lift 26 & 27	101000001
101000251	Yes	3 / Incomer 3	101000001
101000286	Yes	P50 / FAF/ EAF (LG1)	101000001
101000353	Yes	P153 / Cold & Hot Water Bosster Pumps (PPA)	101000001
101000521	Yes	SN30476 / Incomer 17	101000001
101000522	Yes	SN30475 / Incomer 18	101000001
101000540	Yes	029 / Gen L&P L28-36	101000001
101000552	Yes	P09 / L2 A/C Plant Room	101000001
101000558	Yes	P162 / PAU & EAF (PPA)	101000001
101000564	Yes	020 / A/C Equipment /L38 AFT Equipment	101000001
101000595	Yes	A06 /	101000001
101000597	Yes	P93 / Essential Equipment	101000001

Showing 1 to 12 of 12 entries | Previous | 1 | Next

Energy Management System



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Meter Group Management

Category: Airside

Meter Group: 3PP-airside

Show ▼ entries

Device
101000064
101000069
101000153
101000171
101000172
101000173
101000178
101000180
3PP_3_LV.02.031.KWH
3PP_3_LV.02.036.KWH
3PP_3_LV.02.038.KWH
3PP_3_LV.22.100.KWH

Update Virtual Meter Configuration

Meter Group: 3PP-airside

Device: 101000171

Device Type: Elster

Scale factor: 1.00

Management Info: 1

Search:

Device Type	Mgmt Info
Elster	1
Elster	1
Elster	1
Elster	1
Elster	1
Elster	1
Elster	1
Elster	1
BMS	1
BMS	1
BMS	1
BMS	1

A scaling factor is introduced in each meter within category group and it is used to calculate the result for single virtual meter. Billing group requires both bill parameters and billing rules. Coming with the system is a general rule in 4 categories being used in Hong Kong. The bill parameters are specified in period basis and it is managed by the user.

Demand On-Peak Rate 1	0
Demand On-Peak Rate 2	0
Demand Off-Peak Rate	0
Demand On-Peak Grade	0
Demand Short Fall Rate	0
Demand Short Fall Grade	0
Energy On-Peak Rate 1	0
Energy On-Peak Rate 2	0
Energy Off-Peak Rate	0
Energy On-Peak Grade Factor	0
Energy On-Peak Grade	0
Fuel Factor	0
<input type="button" value="Create Bill"/>	

Edit bill parameter

Bill Area	CLP
Bill Usage	Industrial Customer
Start Time	2011-01-01
Bill Description	Bulk Tariff
End Time	
On peak Start hour	9
On peak End hour	21
Demand On-Peak Rate 1	61.90
Demand On-Peak Rate 2	59.10
Demand Off-Peak Rate	24.20
Demand On-Peak Grade	650
Demand Short Fall Rate	0.00
Demand Short Fall Grade	0
Energy On-Peak Rate 1	0.63
Energy On-Peak Rate 2	0.62
Energy Off-Peak Rate	0.56
Energy On-Peak Grade Factor	0
Energy On-Peak Grade	200000
Fuel Factor	0.14

Show ▼ entries

Area	Usage	Start time	Description	End time	On peak start	On peak end	On peak Demand Rate 1	On peak Energy rate 2	Off peak Energy Rate	On peak Energy grade factor	On peak Energy grade	Fuel factor	
CLP	Industrial Customer	2010-01-01	Bulk Tariff	2010-12-31	9	21	61.90		0.56	0	200000	0.12	
CLP	Industrial Customer	2011-01-01	Bulk Tariff	--	9	21	61.90		0.56	0	200000	0.14	
CLP	Large Power Consumption Customer	2010-01-01	Large Power Tariff	2010-12-31	9	21	108.80		0.39	200	200	0.12	
CLP	Large Power Consumption Customer	2011-01-01	Large Power Tariff	--	9	21	108.80		0.39	200	200	0.14	
CLP	High voltage Demand Customer	2010-01-01	High voltage super demand rider	2010-12-31	9	21	100.40		0.37	200	200	0.12	
CLP	High voltage Demand Customer	2011-01-01	High Voltage Super Demand Rider	--	9	21	100.40		0.37	200	200	0.14	
CLP	General Customer	2011-01-01	General Service Tariff	--	0	0	0.00	0.00	0.89	0.88	0.00	5000	0.14

Showing 1 to 7 of 7 entries

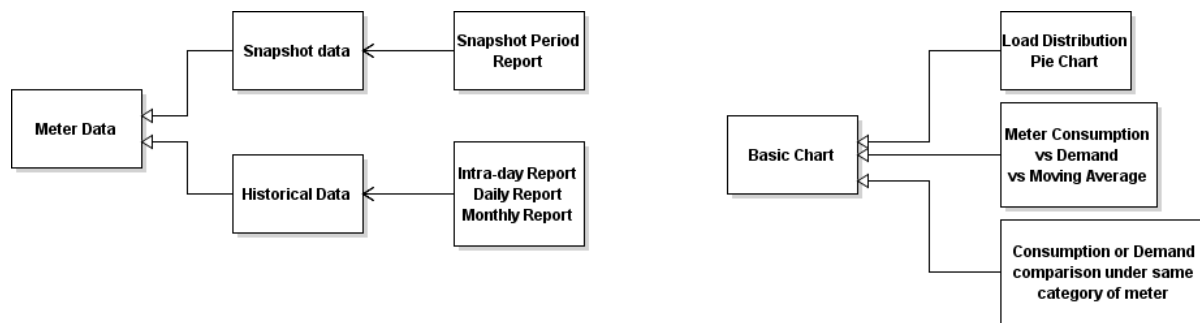
Copyright by Green Bird Technology Limited, 2020

Energy Management System



Report

There are 3 kinds of meter data for Elster meter in the system, snapshot data and historical data (load profile and instrumentation). Snapshot data comes from the polling mechanism in either DCU or system whereas historical data is stored in the meter itself. The minimum period attained by DCU and system is 1-minute and 15-minute respectively. This is based on two factors, data time associated with the historical data in Elster meter and the time required to get historical data in DCU (details in DCU product specification). Snapshot data (real time data in Web GUI) is populated together with instrumentation data to give system-wise periodic data.



Snapshot data is presented with reference to DCU which connects to meter. Besides displaying and exporting data in 4 kinds, intra-day (per DCU polling period), periodic (system wide period), daily and monthly), the system provides facility through Web Socket to give real time update data. Thus, when the data is retrieved from DCU, the information in the Web page is automatically updated immediately.

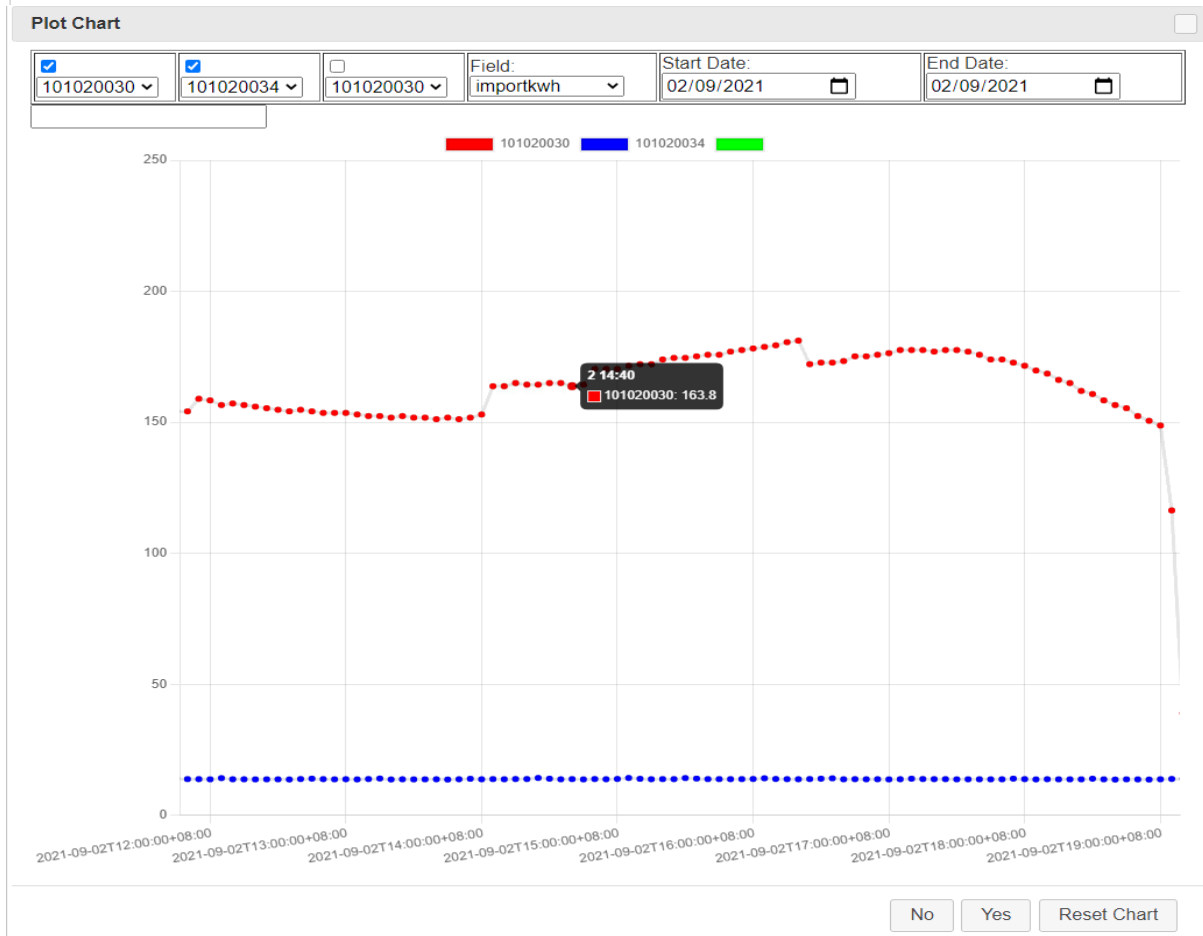
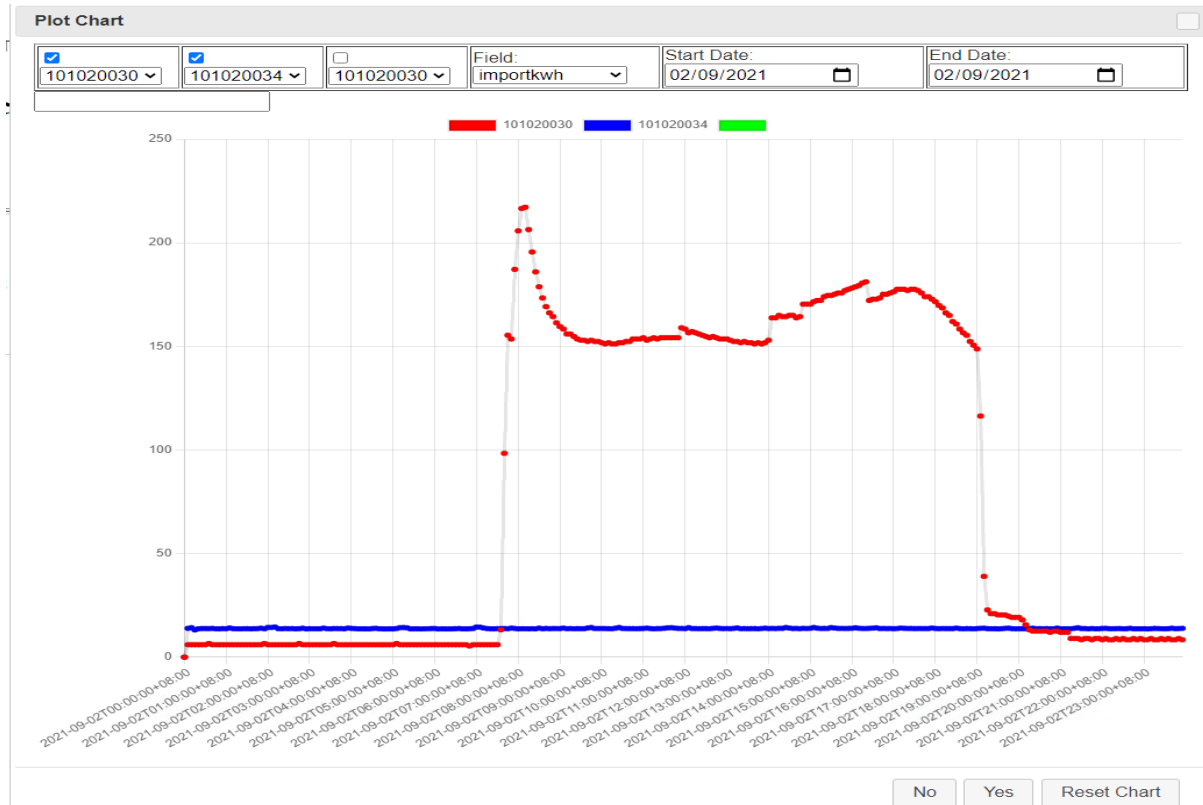
Real Time Data																
Account Management System Management Site Management Meter Data Import Group Definition Data Report User Profile																
DCU: 101090042 Search Snapshot Query Streaming DCU																
Show <input type="text" value=""/> entries Search: <input type="text"/>																
101090042																
meterid	description	dcu time	meter time	kWH	Watt	kVA	L1i	L2i	L3i	L1v	L2v	L3v	L1pf	L2pf	L3pf	Last update
101000479	32-52 (S-23) / GF Essential Public Lighting & Power	2020-11-18 13:15:00	2020-11-18 13:09:55	324090.468200	3.400	3.400	5.3	4.6	5.3	224.4	227.1	226.8	1.000	1.000	1.000	2020-11-18 13:10:42
101000480	32-52 (S-109) / MTR Tunnel D Essential Lighting & Power and Fan	2020-11-18 13:20:00	2020-11-18 13:15:05	244282.906100	2.800	2.900	7.3	2.6	2.6	223.3	226.0	225.9	1.000	-32.767	-32.767	2020-11-18 13:15:53

Showing 1 to 2 of 2 entries Previous 1 Next

Start streaming Stop streaming

In addition, snapshot data can also be plotted using one of the configured fields. “Zoom in” is provided to look at details.

Energy Management System



Energy Management System



Meter data is displayed or exported with reference to the site. The data type includes Elster load profile, instrumentation and external data presented as BMS. 4 kinds of periodic data can be specified, system wise specific period (term as intra-day), hourly, daily and monthly. “Intra-day” applies to all reports except real time data report whose data comes from polling period of DCU.

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Meter Data Report

Site: GB
Data Type: Elster LP
Category: All
Search

Start Date: dd/mm/yyyy

End Date: dd/mm/yyyy

Elster Field: q14kvah

Period for export: Intra-day

Select All

0000001

03352520

05052592

10066572

12068942

35074953

4017161

6099776

6099779

Deselect All

01352818

05052572

Display
Export

The data is displayed as follows.

Automatic Meter Management System v2.1

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Meter Data Report

Site: GB
Data Type: Elster Inst
Category: All
Search

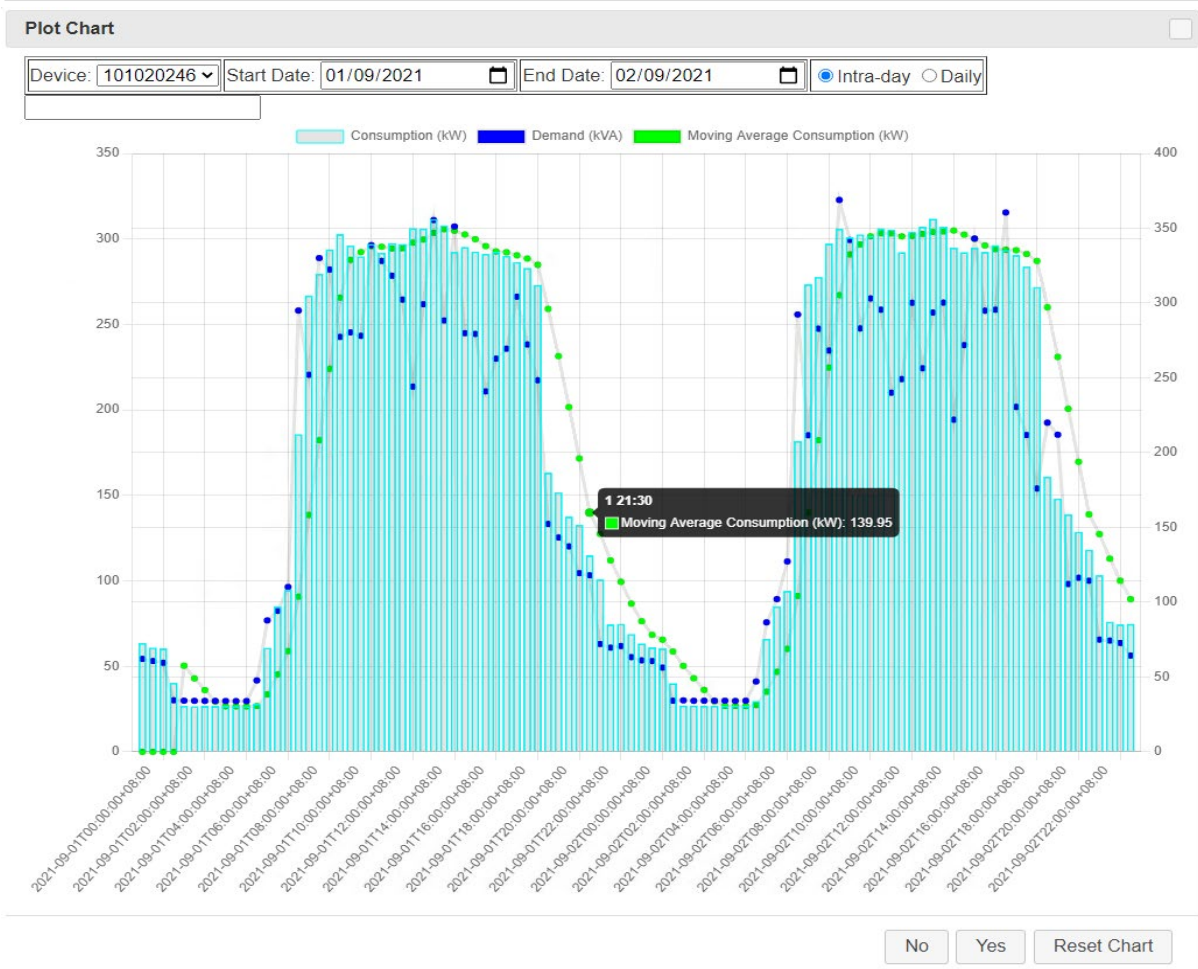
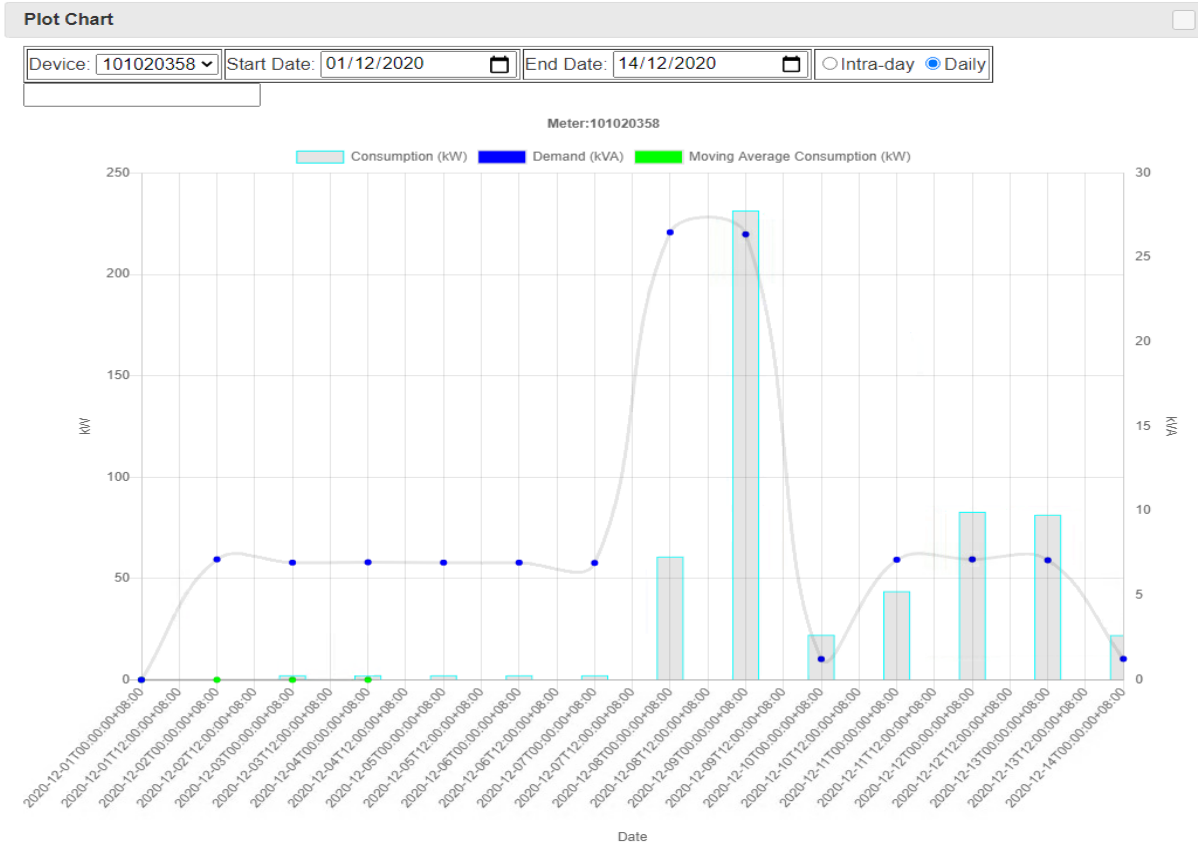
Plot Consumption-demand Chart

Show 1 entries

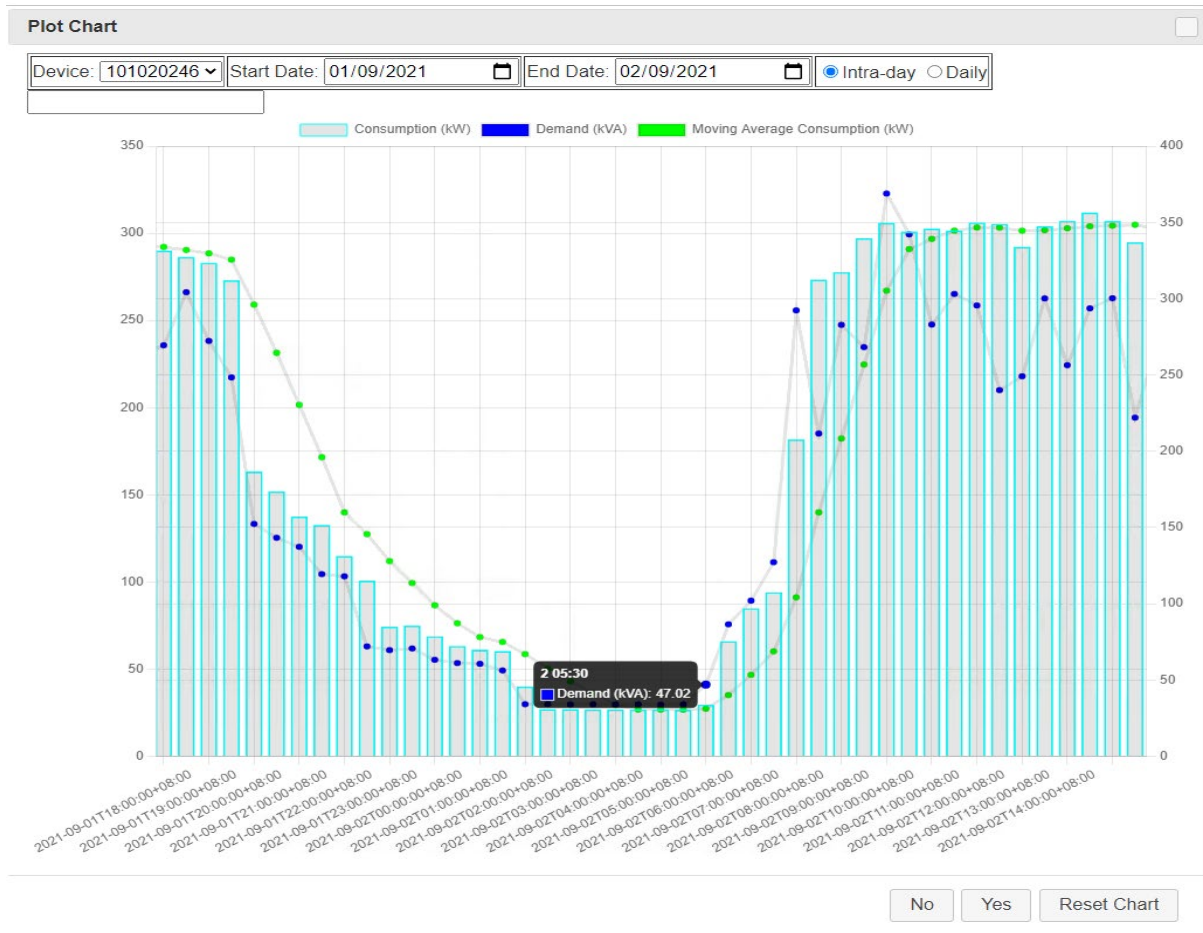
Time	Device	importkwh	totalVA
2020-11-17 00:00	03352520	0000000.0	0.000
2020-11-17 00:00	6099779	2.919026	0
2020-11-17 00:30	03352520	0000000.0	0.000
2020-11-17 00:30	6099779	2.919026	0
2020-11-17 01:00	03352520	0000000.0	0.000
2020-11-17 01:00	6099779	2.919026	0
2020-11-17 01:30	03352520	0000000.0	0.000
2020-11-17 01:30	6099779	2.919026	0
2020-11-17 02:00	03352520	0000000.0	0.000
2020-11-17 02:00	6099779	2.919026	0
2020-11-17 02:30	03352520	0000000.0	0.000
2020-11-17 02:30	6099779	2.919026	0
2020-11-17 03:00	03352520	0000000.0	0.000
2020-11-17 03:00	6099779	2.919026	0
2020-11-17 03:30	03352520	0000000.0	0.000
2020-11-17 03:30	6099779	2.919026	0

Consumption, moving average of consumption and demand can be plotted per device so that the user can find out the trend of the power usage before detail analysis is to be carried out.

Energy Management System



Energy Management System



Billing Group meter report is to depict the contribution of individual meter to overall consumption under the same group.

Billing Group Report

Account Management System Management Site Management Meter Data Import Group Definition Data Report User Profile

Start Date: 07/10/2020 End Date: 08/10/2020 Billing Group: CG_airside

Field: importkw Bill Usage: Industrial Customer Data Type: Intraday Daily

Display Export Calculate

Total values in this period

101000213	101000272	101000273	101000275	101000276	101000277	CG_airside
1908181.89	3003361.02	2709123.76	3556621.83	550293.30	2243616.18	13971197.99

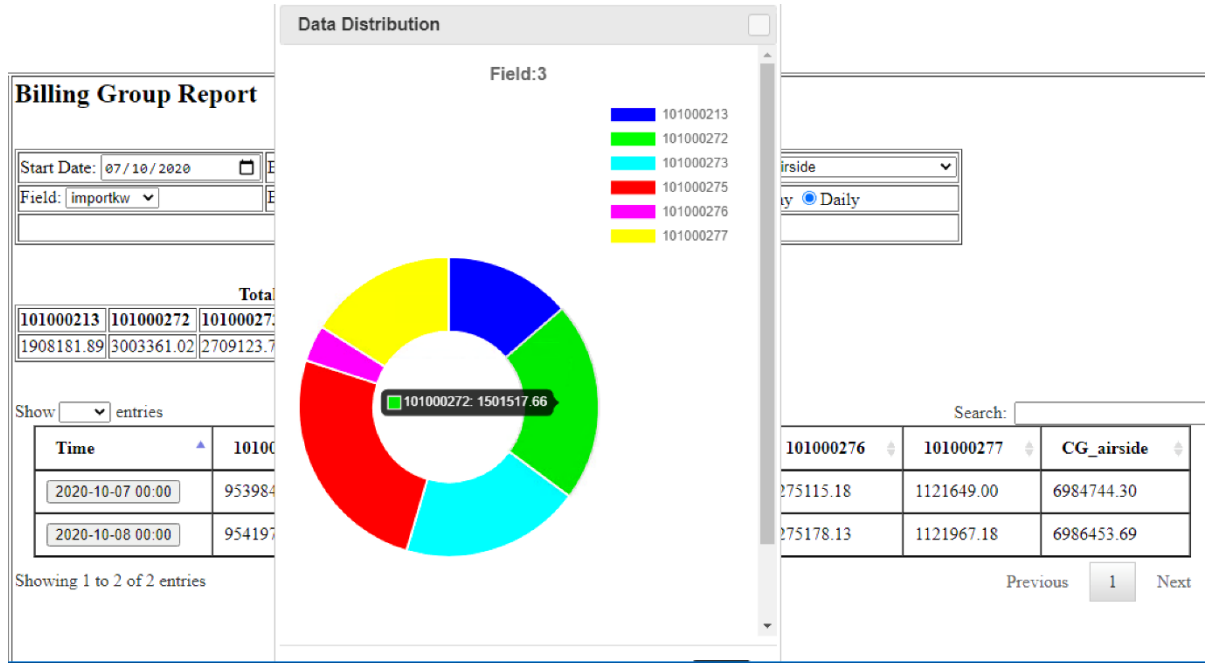
Show entries Search:

Time	101000213	101000272	101000273	101000275	101000276	101000277	CG_airside
2020-10-07 00:00	953984.48	1501517.66	1354403.87	1778074.11	275115.18	1121649.00	6984744.30
2020-10-08 00:00	954197.42	1501843.36	1354719.89	1778547.71	275178.13	1121967.18	6986453.69

Showing 1 to 2 of 2 entries Previous 1 Next

Load distribution pie chart can be plotted at particular instant or entire period of data from individual meter. This is available in both bill group and meter group reports.

Energy Management System



The meter group report is focus on the meter under same category.

Account Management System Management Site Management Meter Data Import Group Definition Data Report User Profile

Meter Group Report

Start Date: 07/10/2020 End Date: 08/10/2020 Meter Group: 3PP-airside

Field: importkw Data Type: Intraday Daily

Plot meter data

101000064	101000069	101000153	101000171	101000172	101000173	101000178	101000180	3PP_3.LV.02.031.KWH	3PP_3.LV.02.036.KWH	3PP_3.LV.02.038.KWH
32.36	0.00	0.00	0.00	9.24	0.07	2.49	0.00	4.00	22.00	2.00

Show: 2 entries

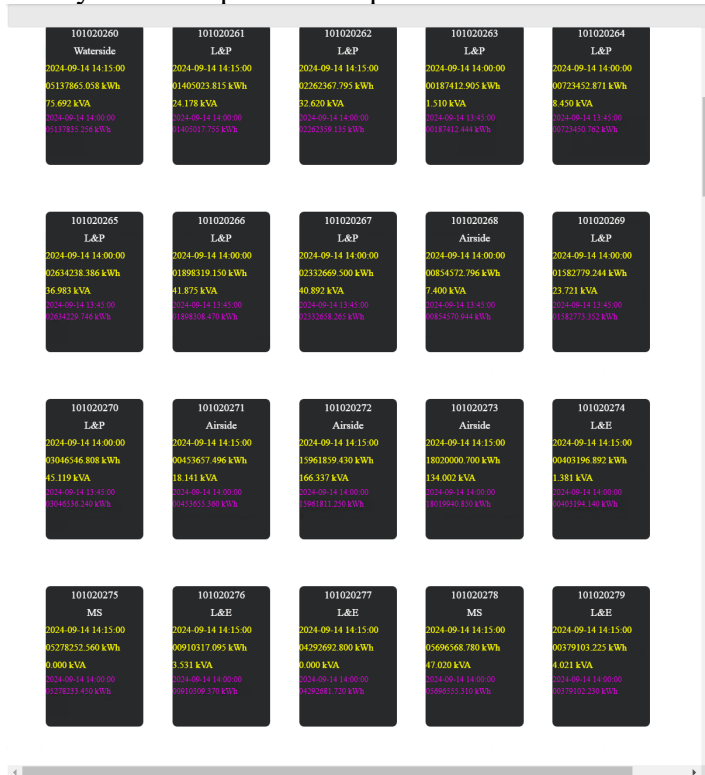
Time	101000064	101000069	101000153	101000171	101000172	101000173	101000178	101000180	3PP_3.LV.02.031.KWH	3PP_3.LV.02.036.KWH	3PP_3.LV.02.038.KWH
2020-10-07 00:00	16.14	0.00	0.00	0.00	4.61	0.03	1.24	0.00	4.00		
2020-10-08 00:00	16.22	0.00	0.00	0.00	4.63	0.03	1.25	0.00	--		

Showing 1 to 2 of 2 entries

Energy Management System



The system also provides a quick view on the latest metering data collected as follows.



For those meters managed by the system directly, a separate functional tab is introduced, and it occupies same menu item as real time data report.

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Meter Register Data

Show ▼ entries Search:

Deviceid	Connection Object	Device type	Comm type	End point	Site	Schedule
10066552	A1700-ZG	Elster A1700	Direct LAN	202.126.221.206.4001	ELSTER	0-30,8-30,14-30,19-00
12068942	A1700+	Elster A1700	Direct LAN	192.168.2.12.2332	GB	--
4017161	A1700	Elster A1700	Direct LAN	192.168.2.12.2332	GB	--

Showing 1 to 3 of 3 entries Previous 1 Next

Basically, meter information is queried through device identity or connection object (full description of the device). Data permission is applied to the search.

Energy Management System



In addition of meter data analysis, the system also introduces sensor data referring to environmental data such as UV index or eVOC. This is accomplished through sensor report.

Sensor Data Report

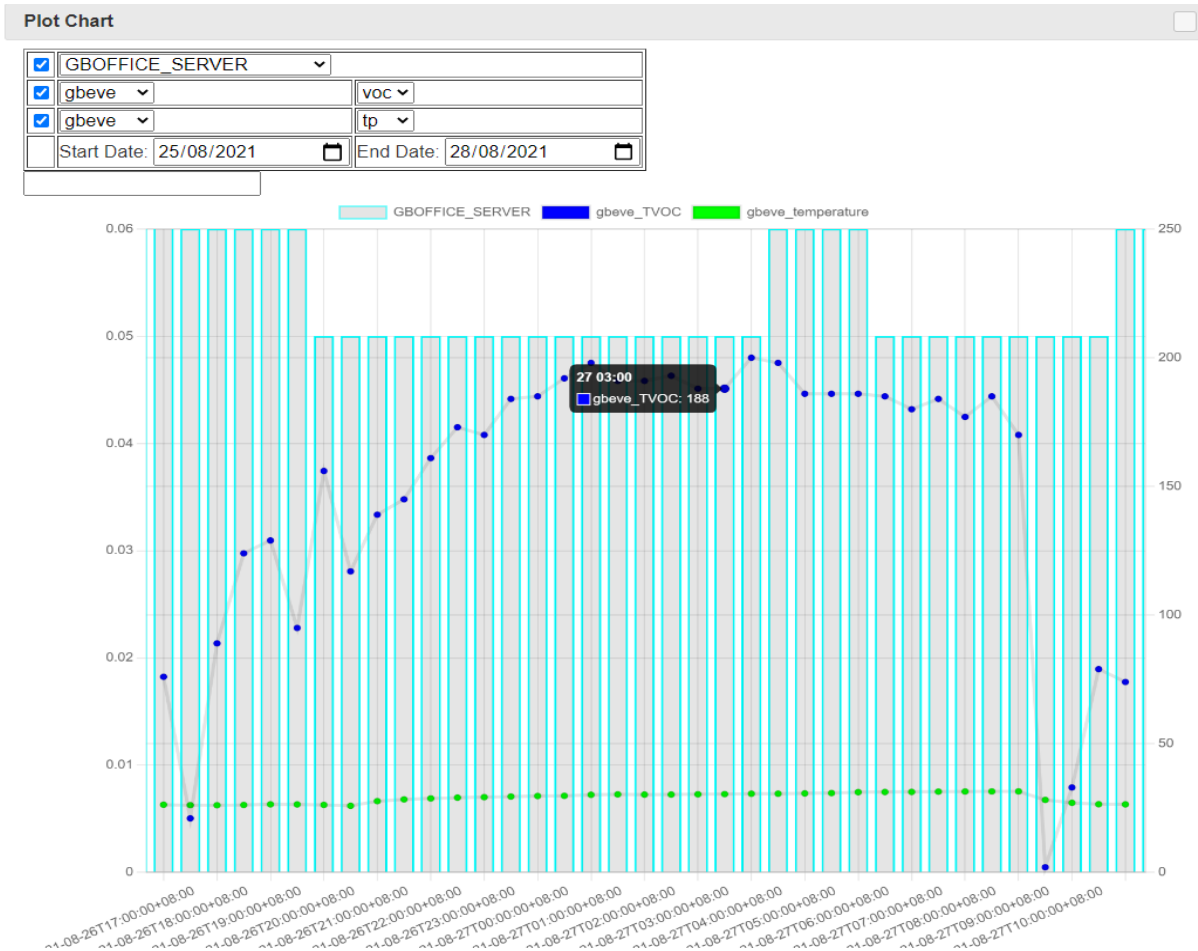
Site:

Show entries Search:

Sensor id	Description	Type	Support Fields	Site	Category	Status
jcpi3	Integrated Sensor	Socket Server	tp:-20:60,hm:5:95,iaq:0:1000,voc:0:60000,co2:400:60000	GBOFFICE	CE	active

Showing 1 to 1 of 1 entries Previous Next

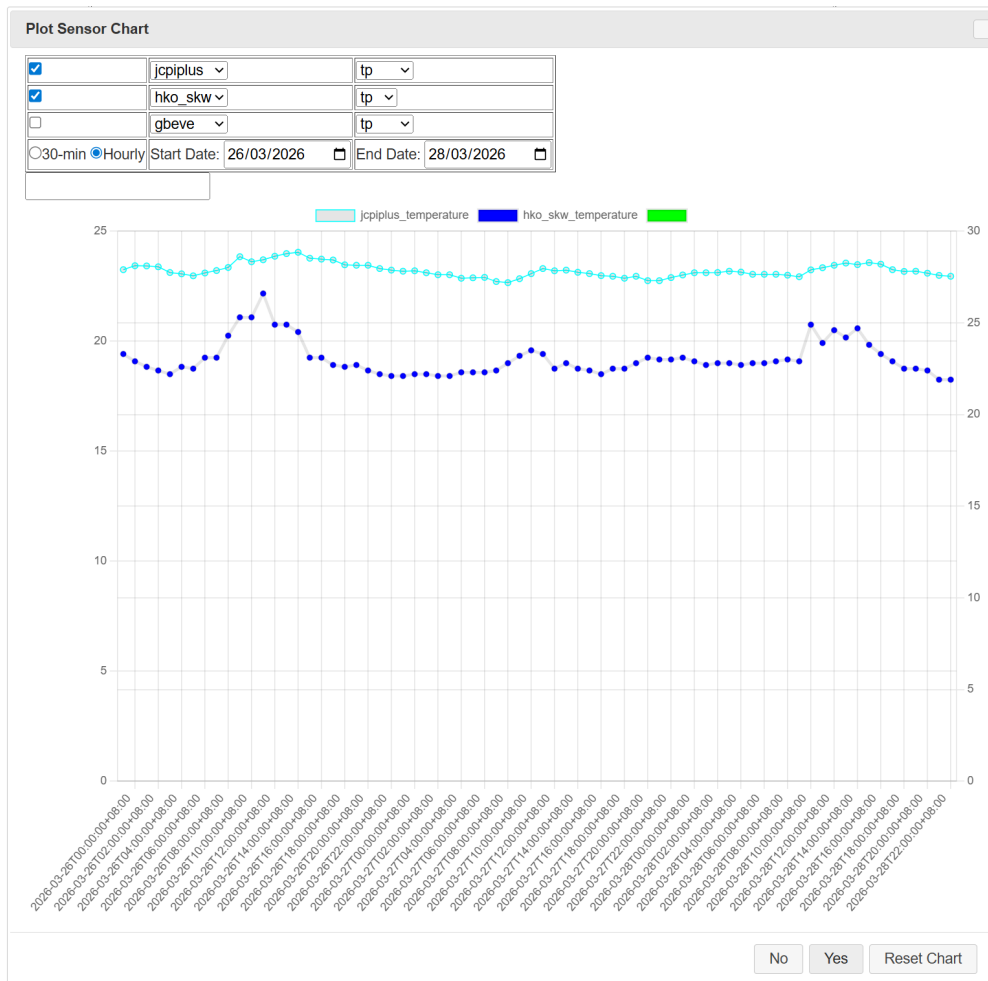
Each IoT is equipped with different kinds of sensor subject to what kinds of measurement to be taken. Just like meter type DCU, it stores data in flash and also publishes to the sensor server of the system. Each sensor is bounded by range of value as shown in the above diagram.



Energy Management System



In addition, different sensors can also be used for different studies such as the following chart comparing the external temperature and room temperature from the official and installed sensor respectively.



Energy Management System



A few summary data reports are available in the system, daily and monthly report on the quantity of data collected and specific report such as consumption and harmonic.

GB Office Energy Consumption	
1	GB Office Energy Consumption
2	Period From 2024-11-01 to 2024-12-01
3	
4	Trade Consumption (kWh)
5	Air side consumption 1,011.430
6	Water side consumption 718.130
7	Air conditioning 995.990
8	Total 2,725.550

A	B	C	D	E	F	G	H	I
Incomers		main_1				main_3		main
			1 of					
		03352520				35074953		6099
		L1	L2	L3		L1	L2	L3
		9.2	8.5	5.8		8.1	8.2	5.1
Max total harmonic distortion								
No of record with total harmonic distortion > 4%			4	4		1	3	4
No of record with total harmonic distortion > 5%			2	3		1	3	1
No of record with total harmonic distortion > 8%			1	1		0	1	1
Max. total harmonic distortion on 2022/01/01 recorded at 0								
Max. total harmonic distortion on 2022/01/02 recorded at 0		4.1		3.7				
Max. total harmonic distortion on 2022/01/03 recorded at 0							8.2	
Max. total harmonic distortion on 2022/01/04 recorded at 0						8.1	4.1	
Max. total harmonic distortion on 2022/01/05 recorded at 0						2022-01-04 21:06	2022-01-04 21:00:00	
Max. total harmonic distortion on 2022/01/06 recorded at 0								2.8
Max. total harmonic distortion on 2022/01/06 recorded at 0				8.5				2022
Max. total harmonic distortion on 2022/01/06 recorded at 0				2022-01-06 05:00:00				
Max. total harmonic distortion on 2022/01/08 recorded at 0							4.2	
Max. total harmonic distortion on 2022/01/09 recorded at 0								2022-01-08 19:00:00
Max. total harmonic distortion on 2022/01/10 recorded at 0								5.1
Max. total harmonic distortion on 2022/01/10 recorded at 0		5.2		3.6		5.1		2022-01-09 04:00:00
Max. total harmonic distortion on 2022/01/10 recorded at 0		2022-01-10 08:00:00		2022-01-10 16:00:00		2022-01-10 13:00:00		4.8
Max. total harmonic distortion on 2022/01/14 recorded at 0							3.5	
Max. total harmonic distortion on 2022/01/15 recorded at 0		9.2						2022-01-14 06:00:00
Max. total harmonic distortion on 2022/01/15 recorded at 0		2022-01-15 12:00:00						3.1
Max. total harmonic distortion on 2022/01/16 recorded at 0				5.1				4.8
Max. total harmonic distortion on 2022/01/16 recorded at 0				2022-01-16 11:00:00				2022
Max. total harmonic distortion on 2022/01/20 recorded at 0				4.2				
Max. total harmonic distortion on 2022/01/20 recorded at 0				2022-01-20 10:00:00		5.9		3.1
Max. total harmonic distortion on 2022/01/21 recorded at 0						2022-01-20 03:00:00		2022
Max. total harmonic distortion on 2022/01/21 recorded at 0					5.8		4.2	
Max. total harmonic distortion on 2022/01/21 recorded at 0					2022-01-21 18:00:00			
Max. total harmonic distortion on 2022/01/27 recorded at 0				3.1				2022-01-21 21:00:00
Max. total harmonic distortion on 2022/01/27 recorded at 0				2022-01-27 16:00:00				3.6
Max. total harmonic distortion on 2022/01/28 recorded at 0				6.9				2022-01-27 13:00:00

Energy Management System



Technical Information

System Requirements

- Up to 30 units of meter and less than 5 users
 - Intel i5 with 16 GB RAM, 256 GB storage holding all modules in one machine
 - MS SQL Express on Windows 10 Professional edition (note that up to 10 GB storage is allowed in MS SQL Express edition)
- Enterprise Usage
 - Intel XEON with at least 16 GB RAM, 1 TB storage with MSSQL Server on Windows or Linux and Tomcat Server for Web GUI
 - Intel i5 with 8 GB RAM, 128 GB storage for DCU Server and Meter Server on Windows 10 Professional or Linux (if the system requires to communicate with Elster UK Meter type directly, Windows machine is required)

Development environment

- Pure Java except the module to encapsulate the Elster meter encryption library using .NET framework C# which provides Web Service
- Spring framework, Mybatis and a set of open source libraries
- Apache Tiles, JQuery, Chart.js