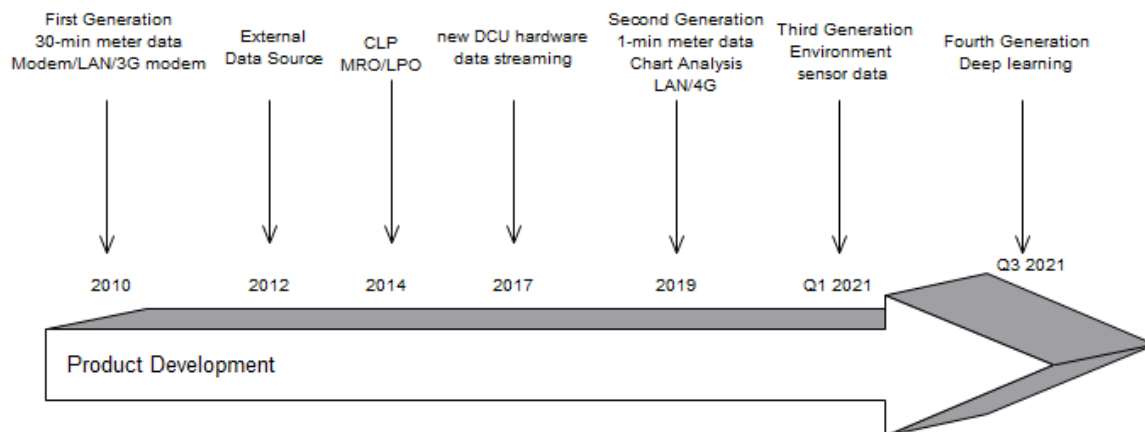


# Energy Management System



## 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 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 data in a site (or sensor in coming phase) 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. 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 quality, TVOC (ppb) and eCO<sub>2</sub> (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.

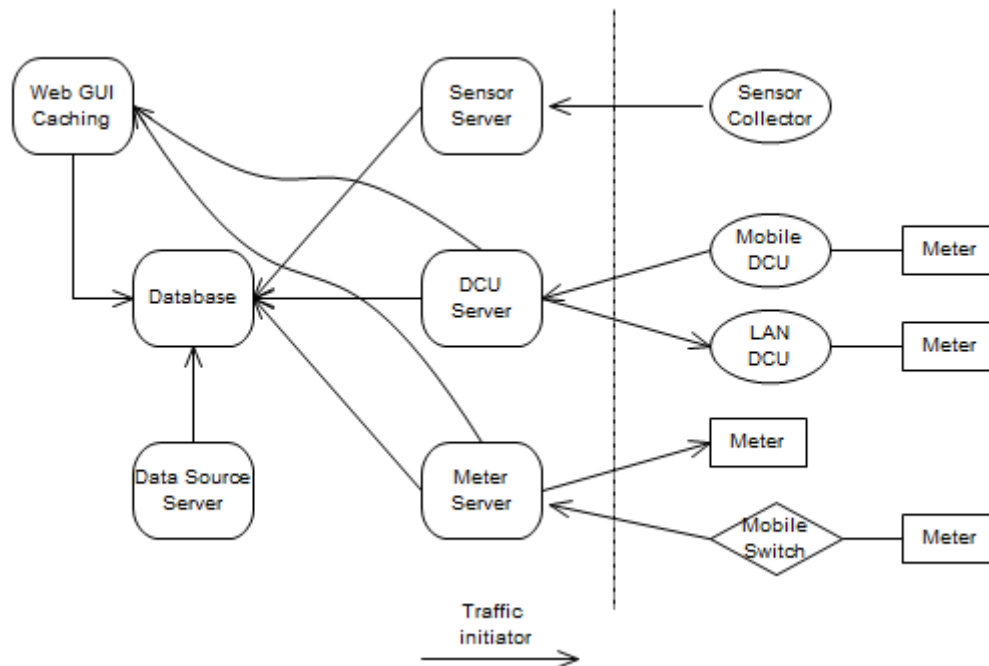
After these kinds of data are collected, deep learning no matter supervised or unsupervised can be further carried out. Of course, edge computing is to be used in future to better manage the whole eco-system but it is out of scope of this system.

# 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 cost. Each DU Server or Meter Server is operating in either one 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 make deployment to 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 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.

# 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**

admin | [Logout](#)

**BMS Data Source Management**

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

Show: 5 entries

Source id	Building	Type	Info	Password	Additional Info	Last Process
1	GB	File	c:\wiredata\	--	yyMMdd.txt,0	2016-02-19
7	GB	PC-DCU	--	--	--	2016-05-24
10	TEST	File	c:\testdata\	--	yyyyMMdd.csv,0	2019-09-18
12	NONEXIST	File	c:\test\testing\	yyyyMMdd.txt,1	--	2020-04-13
13	GB	Database	192.168.2.26,1433,dmpidb,dbuser	--	bmslogdata,Mnemonic,Timestamp,value,0,0,c:\wired	2020-05-11

Showing 1 to 5 of 5 entries

**Create BMS Data Source**

Building: GB

Source Type: File

Source Info: [ ]

Source Password: File, TFTP (filter list) D

Additional Info: [ ]

Module: clpdcdecoder

Max. History (days): 4

Schedule Time: HH:mm,HH:mm

User Email List: email,email

[No](#) [Yes](#)

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.

## Automatic Meter Management System v2.1

admin | [Logout](#)

**Meter Register Data**

Device: [ ]

Connection Object: [ ]

Search: 10066552 | Register

Show: 3 entries

Deviceid
10066552
12068942
4017161

Showing 1 to 3 of 3 entries

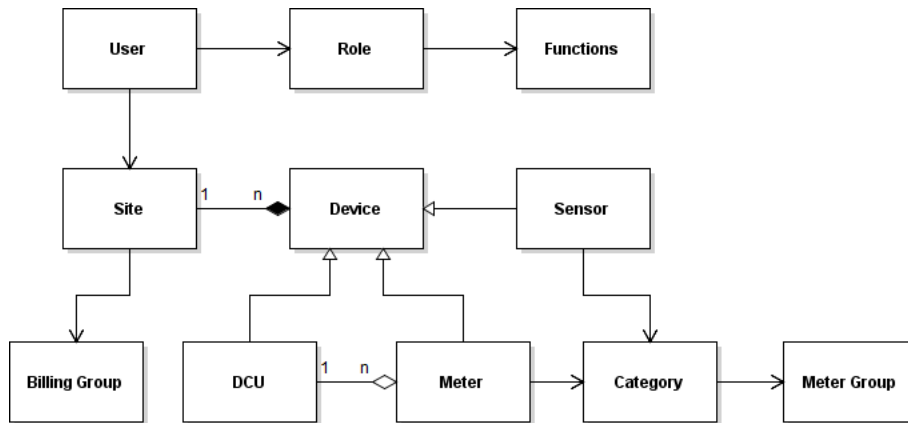
[No](#) [Yes](#)

# 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.

### Automatic Meter Management System v2.1

admin [Logout](#)

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

**Elster Device Management**

Site: GB    Choose file: No file chosen    Upload    Display

DeviceId	ConnObject	ConnDevice	Device Type	EndPt	Module	DataStream	Schedule
0000001	A220	gbtestdca	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	gbtestdca	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	--	stddcdecoder	active	Y
gbdemodcu	PC DCU	--	PCDCU	COM3:	pp3dcdecoder	inactive	N
gbtestdca	Sampe DCU	--	Elster NetDCU	192.168.2.13,3288	advdcdecoder	inactive	Y

Edit Device Configuration for Device: gbdcu0002

Device: gbdcu0002  
 Comm Type: Direct LAN  
 Comm Param: Not applicable  
 EndPointId:   
 Schedule: HH:mm,HH:mm or nn  
 Sync Time Day: 17  
 Device Sync Day: 3  
 Module: stddcdecoder  
 Streaming support:  No  Yes  
 DS Name:

Showing 1 to 14 of 14 entries    Previous    1    Next

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



## Automatic Meter Management System v2.1

admin [Logout](#)

Account Management  
System Management  
Site Management  
[Meter Data Import](#)  
[Group Definition](#)  
[Data Report](#)  
[User Profile](#)

### BMS Device Management

Building: GB  No file chosen

Show  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. 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.

Account Management  
System Management  
Site Management  
[Meter Data Import](#)  
[Group Definition](#)  
[Data Report](#)  
[User Profile](#)

### Billing Group Management

Site: 3PP

Bill Group: 2PP\_DCU\_check

Show  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  Next

# Energy Management System



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

### Meter Group Management

Category: Airside Create Meter Group Display Meter Group under owner

Meter Group: 3PP-airside

Show: 1 entries

Update Virtual Meter Configuration

Meter Group	3PP-airside
Device	101000171
Device Type	Elster
Scale factor	1.00
Management Info	1

Device	Scale factor	Device Type	Mgmt Info
101000064		Elster	1
101000069		Elster	1
101000153		Elster	1
101000171		Elster	1
101000172		Elster	1
101000173	1.00	Elster	1
101000178	1.00	Elster	1
101000180	1.00	Elster	1
3PP_3.LV.02.031.KWH	1.00	BMS	1
3PP_3.LV.02.036.KWH	1.00	BMS	1
3PP_3.LV.02.038.KWH	1.00	BMS	1
3PP_3.LV.22.100.KWH	1.00	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

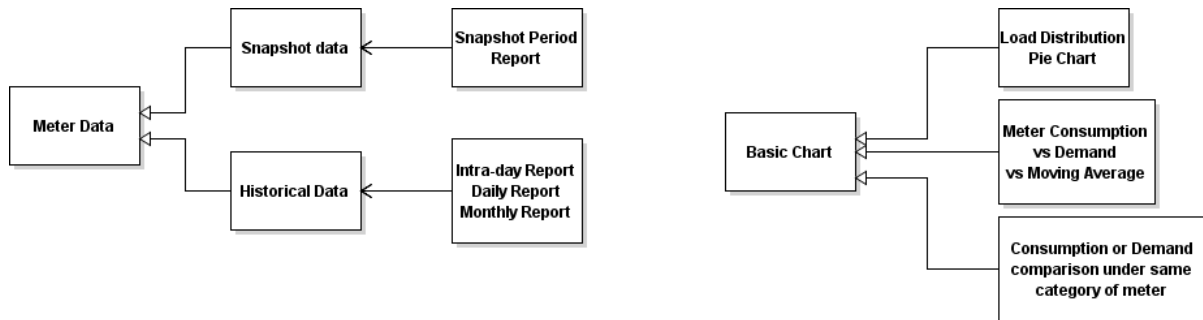
Area	Usage	Start time	Description	End time	On peak start	On peak end	On peak Demand Rate 1	On peak energy rate 2	Off peak Energy Rate	On peak Energy grade factor	On peak Energy grade	Fuel factor	
CLP	Industrial Customer	2010-01-01	Bulk Tariff	2010-12-31	9	21	61.90						
CLP	Industrial Customer	2011-01-01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

# 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"/> 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) / G/F 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

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.



# Energy Management System



## Automatic Meter Management System v2.1

admin [Logout](#)

Account Management  
System Management  
Site Management  
[Meter Data Import](#)  
Group Definition  
Data Report  
User Profile

### Meter Data Report

Site: GB Data Type: Elster LP Category: All

Start Date:  End Date:

Elster Field: importkw totalkva importkwh q14kvah

Period for export: Intra-day

000001	01352818
03352520	05052572
05052592	
10066572	
12068942	
35074953	
4017161	
6099776	
6099779	

The data is displayed as follows.

## Automatic Meter Management System v2.1

admin [Logout](#)

Account Management  
System Management  
Site Management  
[Meter Data Import](#)  
Group Definition  
Data Report  
User Profile

### Meter Data Report

Site: GB Data Type: Elster Inst Category: All

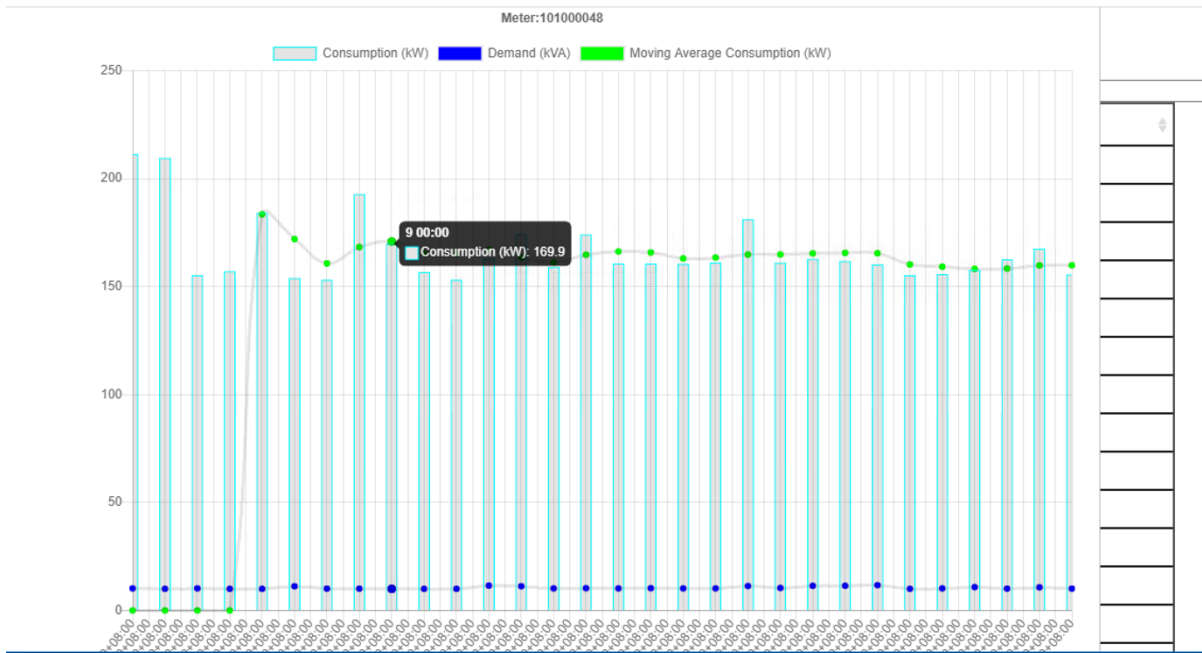
Plot Consumption-demand Chart

Show ▼ 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



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 of data from individual meter. This is available in both bill group and meter group reports.

# Energy Management System



### Billing Group Report

Start Date: 07/10/2020

Field: importkw

Total		
101000213	101000272	101000277
1908181.89	3003361.02	2709123.7

Show 2 entries

Time	101000272
2020-10-07 00:00	953984
2020-10-08 00:00	954197

Showing 1 to 2 of 2 entries

### Data Distribution

Field:3

- 101000213
- 101000272
- 101000273
- 101000275
- 101000276
- 101000277

Search:

101000276	101000277	CG_airside
275115.18	1121649.00	6984744.30
275178.13	1121967.18	6986453.69

Previous 1 Next

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

Account Management System Management Site Management Meter 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

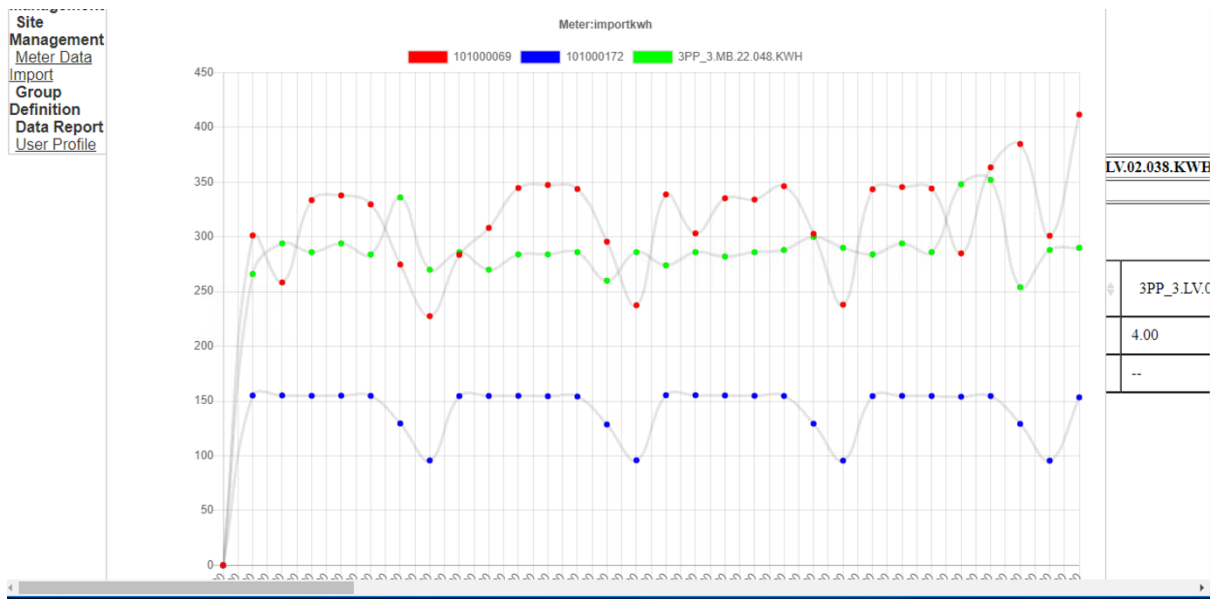
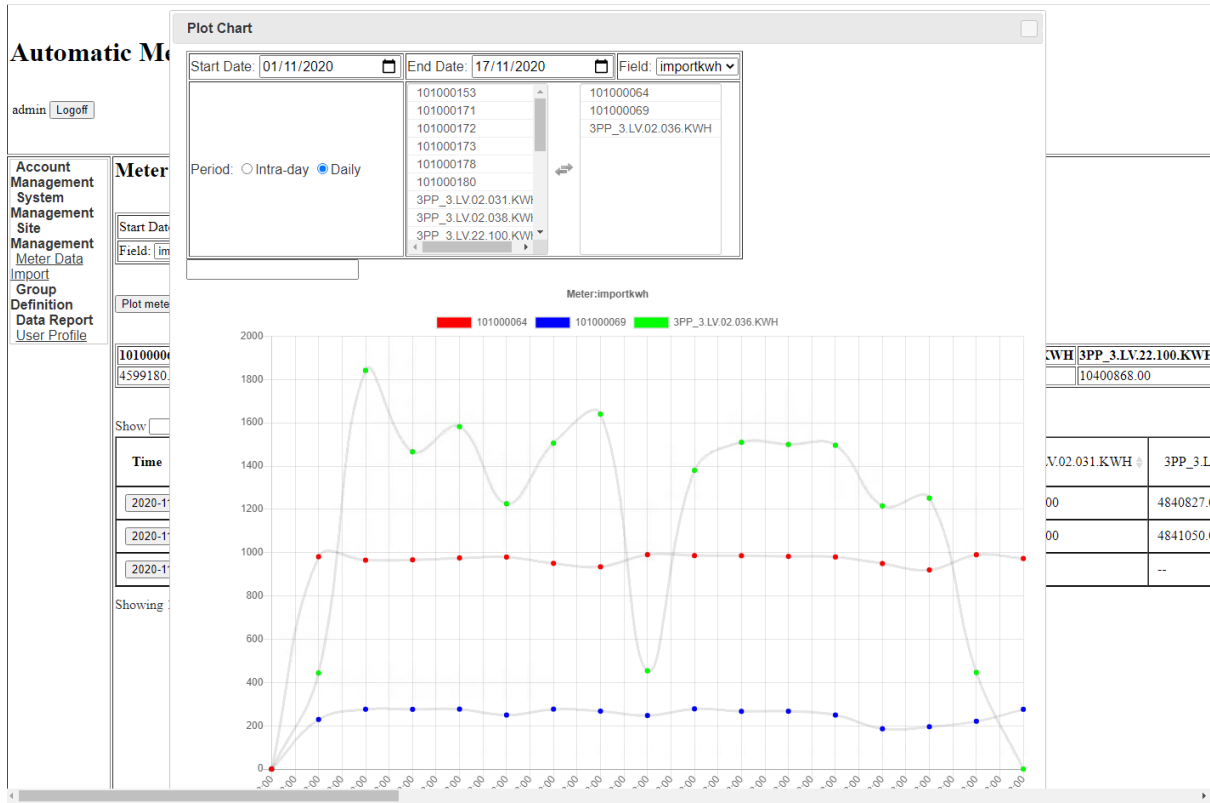
Show 2 entries

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	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	0.00	4.63	0.03	1.25	0.00	--	

Showing 1 to 2 of 2 entries

Up to 3 units of meter under same meter group can be plotted in same chart for visual analysis.

# Energy Management System



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.

# Energy Management System



## Automatic Meter Management System v2.1

admin [Logoff](#)

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

### Meter Register Data

Device	<input type="text"/>
Connection Object	<input type="text"/>
Search	<input type="text"/>

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  Next

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

A few summary data reports are available in the system, daily and monthly report on the quantity of data collected. DCU log message can also be found in the system.

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

### DCU Status Log Report

#### Invalid Parameter

Start Date:  End Date:  Site:  DCU:

Show  entries Search:

Device	Module	Type	Code	Description	Time
101090040	gbarmdcu	Info	0	New day	2020-11-17 00:00:00
101090040	gbarmdcu	Info	0	Historical data preparation is started	2020-11-17 00:00:00
101090040	gbarmdcu	Info	0	New day SysCik=2020-11-17 00:00:04 RTCCik=2020-11-16 23:58:58	2020-11-17 00:00:04
101090040	gbarmdcu	Info	0	DCU temperature:42.76	2020-11-17 00:00:45
101090040	gbarmdcu	Info	0	DCU case 1 open:1	2020-11-17 00:00:45
101090040	gbarmdcu	Info	0	DCU case 2 open:1	2020-11-17 00:00:45
101090040	gbarmdcu	Info	0	Backup battery voltage:1.7297	2020-11-17 00:00:45
101090040	gbarmdcu	Info	0	Historical data request is complete	2020-11-17 00:19:40
101090040	gbarmdcu	Info	0	DCU temperature:43.07	2020-11-17 01:00:52
101090040	gbarmdcu	Info	0	DCU case 1 open:1	2020-11-17 01:00:52
101090040	gbarmdcu	Info	0	DCU case 2 open:1	2020-11-17 01:00:52
101090040	gbarmdcu	Info	0	Pack file process is invoked	2020-11-17 02:00:06
101090040	gbarmdcu	Info	0	Data packing started	2020-11-17 02:00:06
101090040	gbarmdcu	Info	0	Working on file date:20201116	2020-11-17 02:00:06
101090040	gbarmdcu	Info	0	Log file 20201116 was packed	2020-11-17 02:00:06
101090040	gbarmdcu	Info	0	DCU temperature:43.13	2020-11-17 02:00:58
101090040	gbarmdcu	Info	0	DCU case 1 open:1	2020-11-17 02:00:58
101090040	gbarmdcu	Info	0	DCU case 2 open:1	2020-11-17 02:00:58
101090040	gbarmdcu	Info	0	Complete one set of pack files:20201116	2020-11-17 02:10:31

System audit report can also be displayed and exported.

# 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