Automatic Meter Reading
Practical Guidance Note

Who is this for?

This EAUC Guidance Note is provided to help energy managers and other facilities staff make the best use of their Automatic Meter Reading (AMR) data. This should help you identify problems with energy consumption but also identify opportunities for improvement. This is intended as a simple starter guide for those with little or no experience with AMR.

What does it cover?

AMR allows the automatic collection of data from energy and water meters. As well as being able to retrieve the raw data from the meter, many AMR systems will also provide graphical and numerical interfaces to allow you to analyse the information.

For most colleges some level of AMR should be available as a matter of course from your utility supplier. This might be titled as Simple AMR. It is merely a matter of knowing how to access this. Enhanced or Intelligent AMR systems are also available depending on how much detail you need and how you want this data to be presented. This will often require some level of additional investment.

How is this going to help me?

Knowing how to make the best of your AMR can greatly enhance your understanding of how energy is used in your college. There are clear benefits in that it will allow you to identify problems as and when they develop, indeed it will often be by far the easiest way that some problems (e.g. control time set points) can be picked up.

Beyond this AMR can give you a much firmer footing around which to base your proposals for energy saving, some of which you might want to include in a **Carbon Management Plan** and other Greenhouse

Mabbett & Associates Ltd, Corporate and Registered Office:
Mabbett House, 11 Sandyford Place, Glasgow, U.K. G3 7NB
Registered in Scotland No: SC 163378
Info@mabbett.eu www.mabbett.eu

Gas Reporting Tools. AMR can provide a much greater degree of rigour and confidence when selecting projects for inclusion, it can give you details on what equipment is actually consuming rather than having to make estimates. This is obviously a preference when you are considering making an investment.

This guide will help you use your AMR data to maximum effect.

How can I get started?

AMR brings information on your energy consumption to you in real time; often this will provide multiple individual meters for each part of your building. You may even have very large items of equipment with their own sub-meter (e.g. chillers, large air handling units, etc.)

This is great but having a clear idea about how you can present and analyse this data is equally important. This is where Simple AMR systems and more complex Intelligent AMR systems diverge.

With the Simple systems as might be expected you may simply have a less complex metering arrangement but also with Simple AMR systems you will be expected to do more of the analysis and presentation of the data. This can work well with the right circumstances - i.e. if you are happy to work with a limited number of meters and confident enough to handle the data. It is worth remembering that even if you are not familiar or confident with some of the analysis types suggested in this guide, you will be able to pick these up if you allow yourself some time to practice using them in your building. Simple AMR may be more time intensive but will also be cheaper – some level of user portal may well be provided by your utility company.

Intelligent AMR systems, if they are set up the right way and match the user's requirements, will do more of the analysis for you. You will be able to open up the AMR system and a lot of the key information that you would otherwise have to draw out through your own analysis will be presented automatically. Again this can prove a good fit in the right circumstances and may be a better option for very complex buildings, but there will be a price involved.

Before considering what you want to do with the data, the first step is to identify what level of AMR is available in your building. At the very least a half hourly AMR meter should be available for the main electrical meter in your college. It may be the case that more electrical meters and even a fossil fuel AMR has been fitted by your utility provider or other parties in the past few years, AMR being now much more widely applied than was previously the case.

We will consider half hourly data in more detail in the next section but if you do have more than one meter you will want to establish exactly what each sub-meter is actually serving. This is not always as straightforward as it sounds. Gas meters should be relatively easy to trace but establishing which electrical user matches which meter can be more difficult.

If you are lucky a Single Line Diagram (see below) may be available to show the meter locations. If the distribution boards are well labelled you should be able to deduce which user falls under each meter. If not you may need to compare the meter profiles over time to be sure about how the arrangement is set up.

Mabbett & Associates Ltd, Corporate and Registered Office:
Mabbett House, 11 Sandyford Place, Glasgow, U.K. G3 7NB
Registered in Scotland No: SC 163378
Info@mabbett.eu www.mabbett.eu

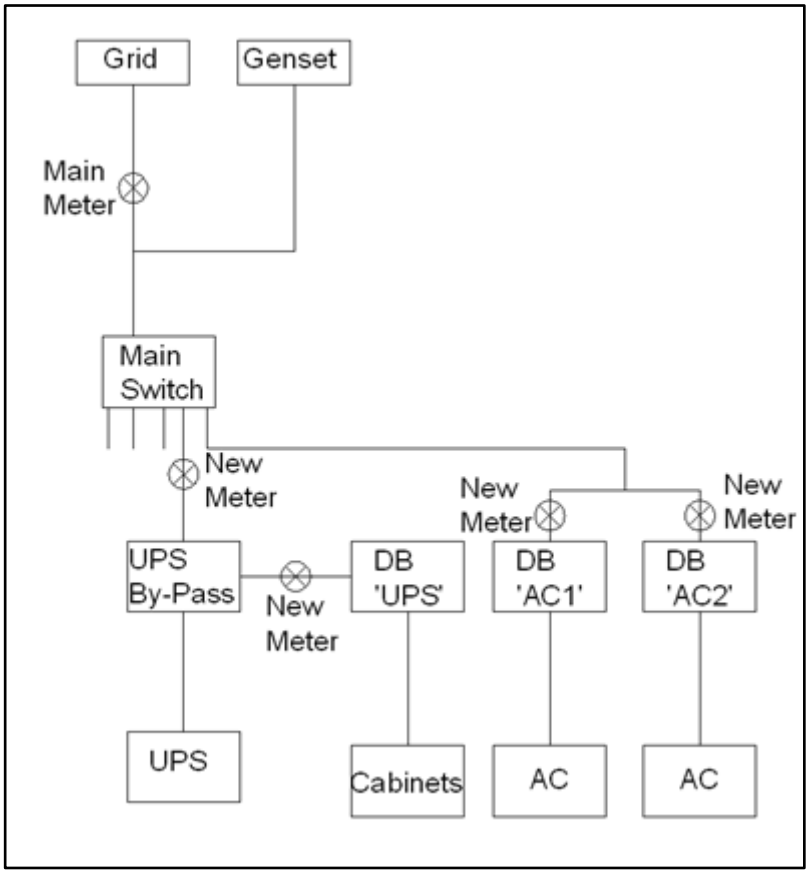


Figure 1 Example Single Line Diagram Showing Meter Positions

It could be the case that you are thinking about applying more detailed metering. It is worth noting that you can quickly have more meters than you can sensibly use the data from. Think about what you will actually do with the metered information before purchasing.

Half hourly data

In its very simplest form AMR data will be presented to you as half hourly (or other comparable time interval) data. This measures the energy passing through the meter in each half hourly period. That provides 48 measurements in each day, plenty of information for most applications.

However, in its basic format the data can appear quite daunting. This is presented as a spreadsheet with 48 columns and 365 rows (if we are talking about a year), so 17,520 entries (see sample sheet below). In its basic form it is quite difficult to make sense of this information however half hourly data once you know a few simple ways to look at it can be very easily interpreted.

Mabbett & Associates Ltd, Corporate and Registered Office:
Mabbett House, 11 Sandyford Place, Glasgow, U.K. G3 7NB
Registered in Scotland No: SC 163378
Info@mabbett.eu www.mabbett.eu

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1			00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	0
8	Wed	07/04/2010	6.6	7	7.8	6.2	6.4	7	7.8	7.4	7.2	9.4	12.2	7	11.8	6.8	9.6	9.4	9.8	
9	Thu	08/04/2010	7	6.8	6.4	6.2	6	7.2	7.8	5.8	7.2	9.2	12.8	5.6	10.6	5.6	10	8.8	8.8	
10	Fri	09/04/2010	6.2	7.6	6.2	5.6	7	7.2	6.6	6.8	7	9	12.2	6.2	9.8	6	10	6.2	8.6	
11	Sat	10/04/2010	6.2	7	6	5.8	5.8	7.4	6.6	6.6	6.6	6.6	6.6	6.4	5.4	5	6.4	5.6	5.8	
12	Sun	11/04/2010	5.4	6	5.8	6	6	6	6.8	6.4	5.8	6.8	6.4	6	5.4	5.4	10	8.2	5.6	
13	Mon	12/04/2010	5.4	5.8	6.8	6.4	4.6	6.4	7	6.4	7	9	18	14	13.8	7.8	6.4	11.2	7.8	
14	Tue	13/04/2010	6.2	5	5	5.8	5.8	6	5.4	6.8	6.4	7.8	11.2	5	10.2	6.2	9	14.6	7.2	
15	Wed	14/04/2010	5.6	7.2	7.4	6	6	7.4	6.4	7.2	7.2	10.8	14.4	11.2	17	12.6	18.4	26.2	19.8	
16	Thu	15/04/2010	7	7	6	5.8	7.2	6.8	7.2	6.2	7.4	11	17	12.4	19.4	13.6	16.8	20.2	21	
17	Fri	16/04/2010	6.2	5.6	5.4	7	6.8	6.8	6.4	6	7.4	12.6	18.4	12.8	19.8	15	17.6	15.4	17.2	
18	Sat	17/04/2010	5.4	6.4	5.6	5.4	7.2	6.6	5.8	6.6	6	6.6	6.8	6	4.6	5.8	6.6	4	5.4	
19	Sun	18/04/2010	6.4	7.4	5.8	6.2	6.4	6.6	7.2	7.4	6.2	5.6	7	5.8	5.8	5.8	9.6	6.4	6.8	
20	Mon	19/04/2010	241	242.4	239.8	240.8	240	200.4	6.8	6.8	6.8	9.6	19.4	15.4	13.4	8	31.2	39.8	38.4	
21	Tue	20/04/2010	235.6	239	238.6	238.8	236.6	199.4	7.6	7.2	7.2	10	18.8	15.6	11.8	9.4	35.6	32.6	50.2	
22	Wed	21/04/2010	213	210.6	212.8	213.2	219.8	184.8	8	6.6	7	10	19.6	15.2	11.6	9.6	37.2	32.2	45.2	
23	Thu	22/04/2010	173.2	181.6	182.2	182.6	182.2	159.2	7	6.4	6.2	8.2	17.2	18.6	12.2	7.4	36.8	35.4	38.4	
24	Fri	23/04/2010	199.2	196.2	211.2	209.6	206.2	177	5.4	6.6	6	7.8	17.6	17	9.6	7.8	29.4	28.6	36.8	
25	Sat	24/04/2010	6.2	5.2	5	6	6.4	5.8	5.6	5.8	6	5.8	5	5.4	5.4	4.6	5.2	4	4	
26	Sun	25/04/2010	5	6.6	4.6	4.4	5.4	4.8	6.2	5.4	4.8	5	6.2	4.2	4.8	3.8	8.8	6.8	4.2	
27	Mon	26/04/2010	224	221.8	224.2	227.2	222.4	182.8	5.8	5.6	6.6	8.2	17.6	17	21	7.6	32.8	32.4	36	
28	Tue	27/04/2010	145.2	146.6	148	146.2	144	135	6.4	5	5.6	8	16.6	7	9.6	4.8	34.4	31.2	36.8	
29	Wed	28/04/2010	120.6	129	127.4	135.6	135.2	124	5	5	5.8	7.4	16.6	8.6	8	5.6	28.8	40.6	49.4	
30	Thu	29/04/2010	87.4	79.8	89.6	85	93.4	80.8	5.4	5.4	6	7.8	16.8	6.4	9	6.2	35.8	34.6	40.4	
31	Fri	30/04/2010	95	103.2	114.2	113.6	115.6	101.6	5.6	5.2	5.8	7.4	17	4.8	8.6	7.2	29.4	23.6	43.2	
32	Sat	01/05/2010	6	6	6.6	6.2	6	7	7	6.2	6.6	6.8	5.2	5.6	5	3.8	4.6	4.8	4.4	
33	Sun	02/05/2010	6.4	7	7.4	6.4	7.8	7.4	7	7.8	7.8	7	6	6.8	6.2	6.4	9.8	7	6	
34	Mon	03/05/2010	8.4	7.4	8.2	8.2	9	8.2	9.2	9.2	9	10.2	19.8	19.4	16.2	9	8	11.8	9.8	
35	Tue	04/05/2010	218.8	217.2	217.2	215	214.4	187.6	8.4	6.8	7.2	10.4	12	6	10.8	8	36	32.2	35	

Figure 2 Screenshot Showing Part of a Half Hourly Data Spreadsheet

One of the first things we can do is make this array of numbers more colourful and hence more intuitive. If we highlight all the numbers on the sheet and use the conditional formatting option, choose the colour scales and specifically the Red/Yellow/Green colour scale.

Very large entries (intense energy consumption) will appear as bright red and with green the opposite will also be true. You will find that you can now view the spreadsheet on a very large scale using the zoom function (you will not even be able to read the numbers) but that you will be able to discern patterns as days and weeks progress though the year. You will see the typical equipment start up times and you will quickly be able to see where exceptions to these typical patterns occur.

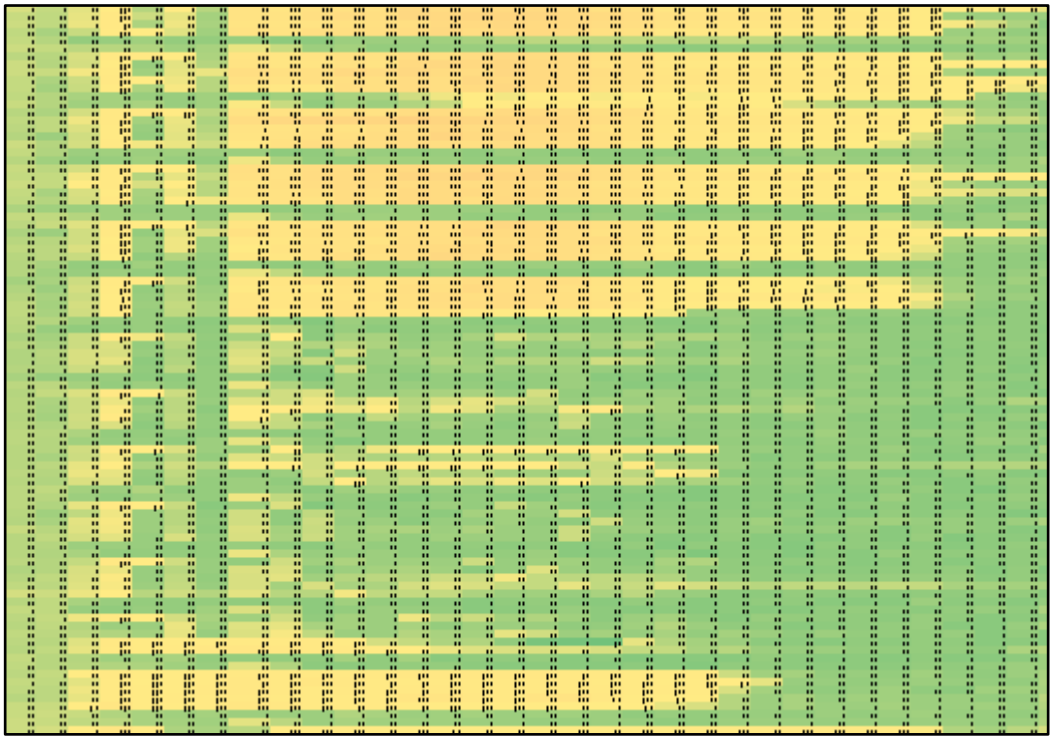


Figure 3 Section from a Half Hourly Plot in Colour Scale

This can allow you to quickly pick up the patterns of consumption through the year.

You will also want to look at the numbers in more detail too, using the AVERAGE, MINIMUM and MAXIMUM functions at the base of the column for each half hourly period for an entire year can provide an interesting snap shot of what typically happens in each day and how far this varies through the year.

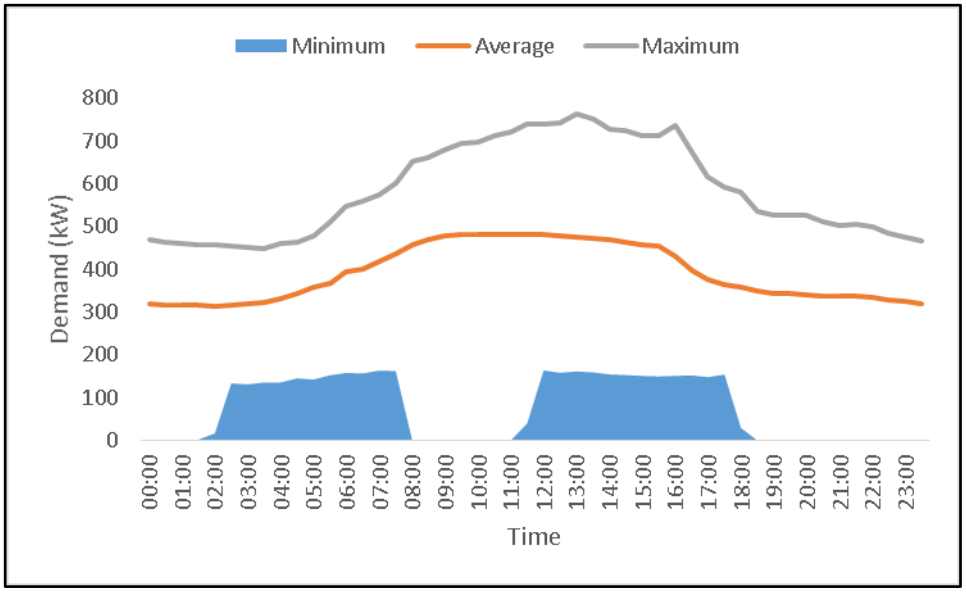


Figure 4 MAX, MIN, AVERAGE PLOT

We can even pick out specific days (for example holiday periods) for comparison to see what is happening when the building is out of use as compared to in use.

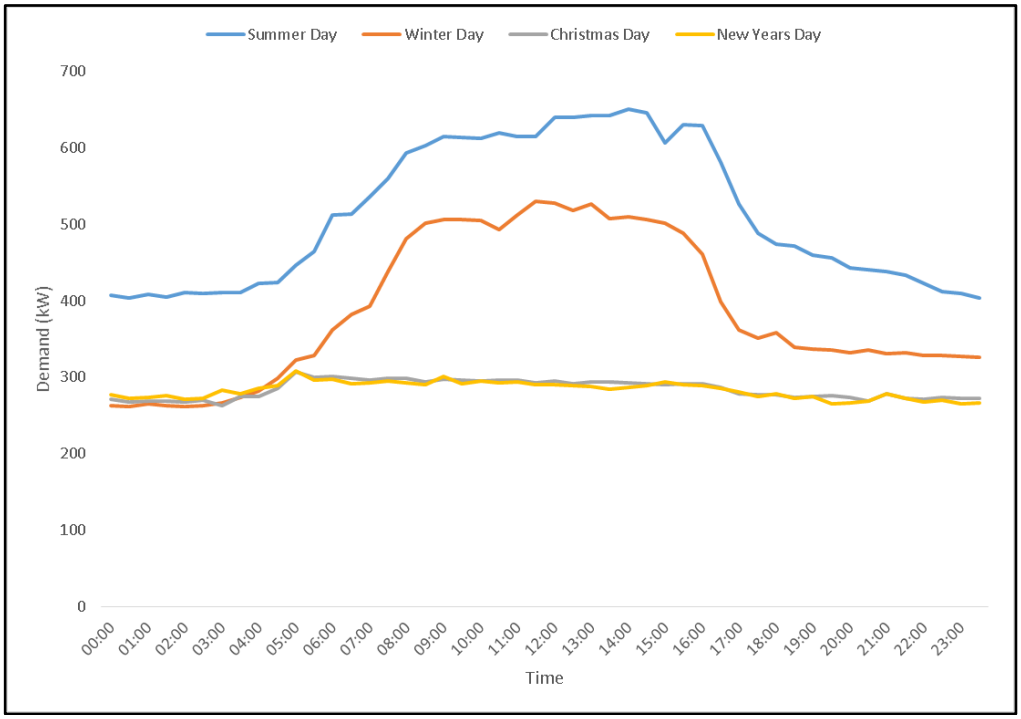


Figure 5 Holiday vs Typical Day Plot

Full weeks can be plotted if we are interested in changes over particular time periods:

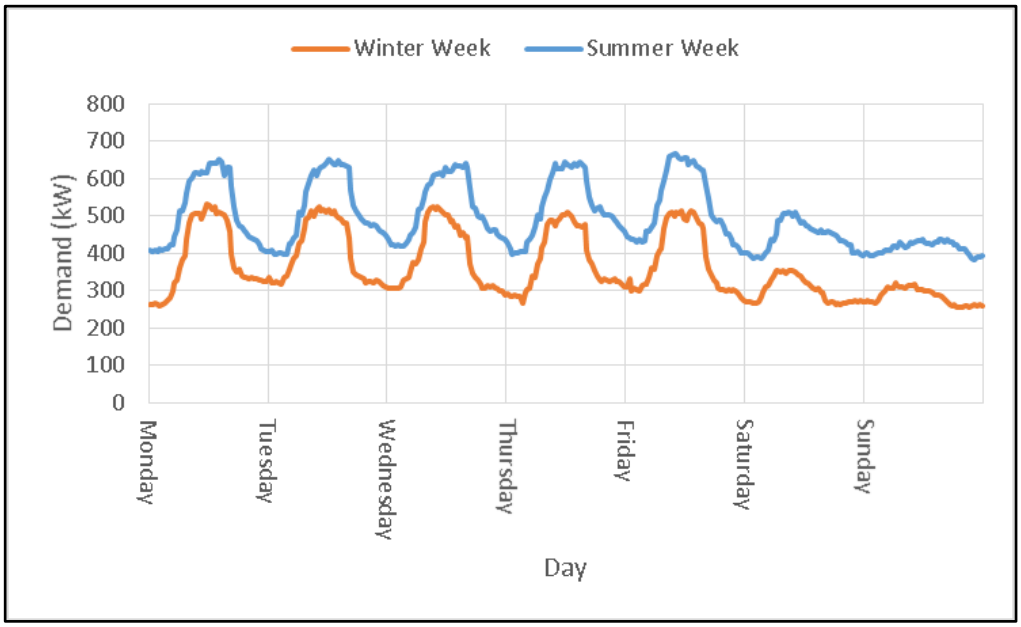


Figure 6 Working Week Plot

All of these time plots are useful but there are other ways to look at the data. If you are interested in how often the energy use is above or below a certain level, a demand exceedance plot can prove useful:

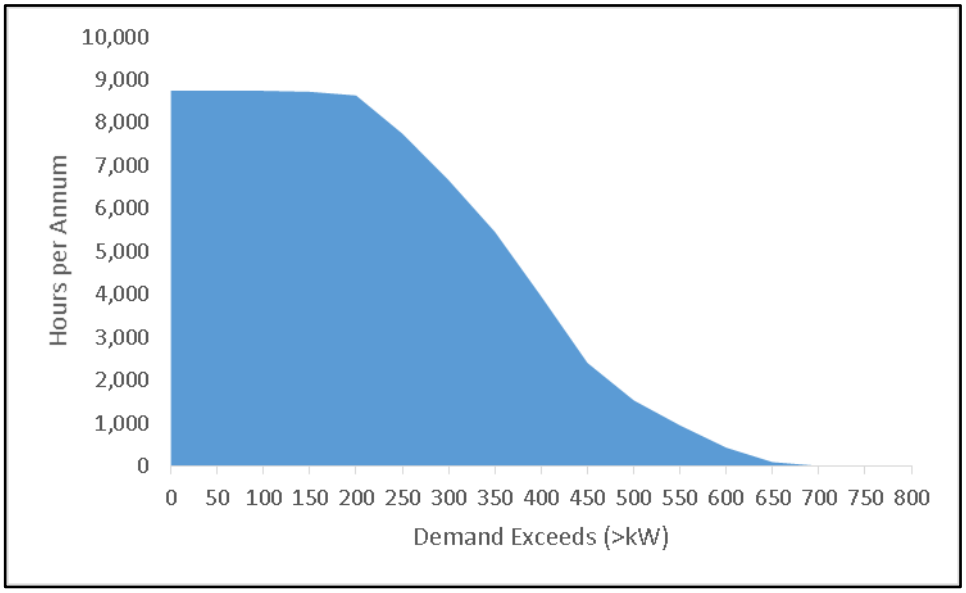


Figure 7 Demand Exceedance Plot

Also some of the analysis that you might do with monthly data is able to be done in much more detail for example degree day analysis can be performed on daily entries rather than monthly providing a much better indication of how well a heating system performs.

Before and After

One of the most useful features of AMR is that it allows you to compare specific time periods on the same meter, sometimes you will have a clear reason for doing so – it could be that you have installed some new energy saving equipment and you want to quantify how much difference this has actually made. It could be that you think a problem has occurred on a particular week or day.

AMR gives you the opportunity to look into these points in more detail. In the example below a switch off campaign has been initiated and the building user wanted to identify how much difference this has had actually made to the overnight consumption.

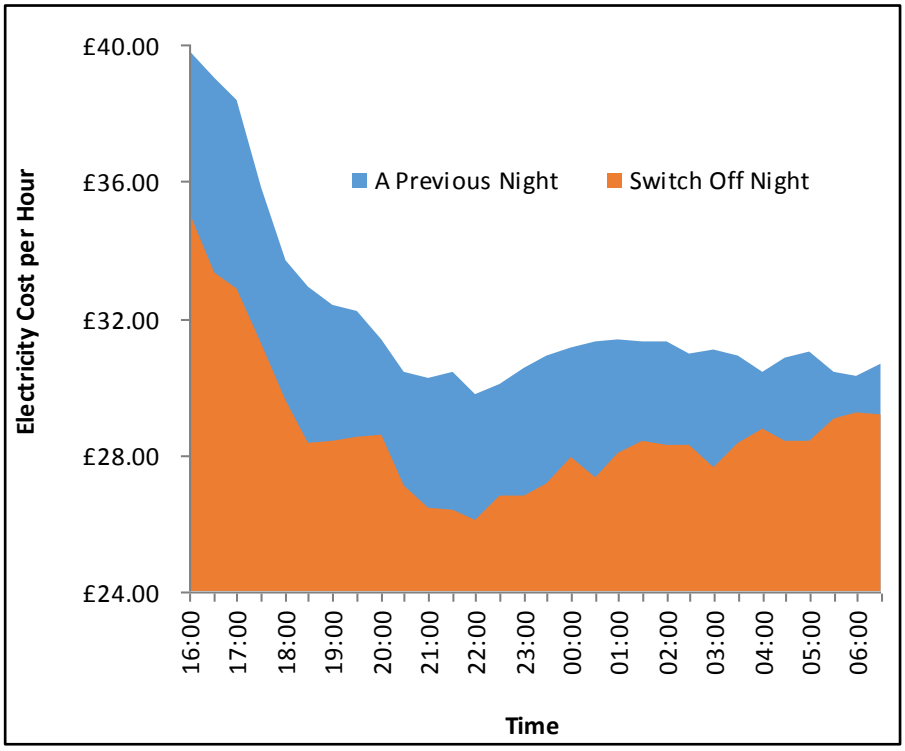


Figure 8 Night Time Switch off Campaign

In another example (this time from an Intelligent AMR System) the time period considered is the switch off in a factory environment over the Christmas period in the first year no coordinated switch off was conducted, in the second much more effort was made to make sure kit was off or well controlled through the Christmas period.

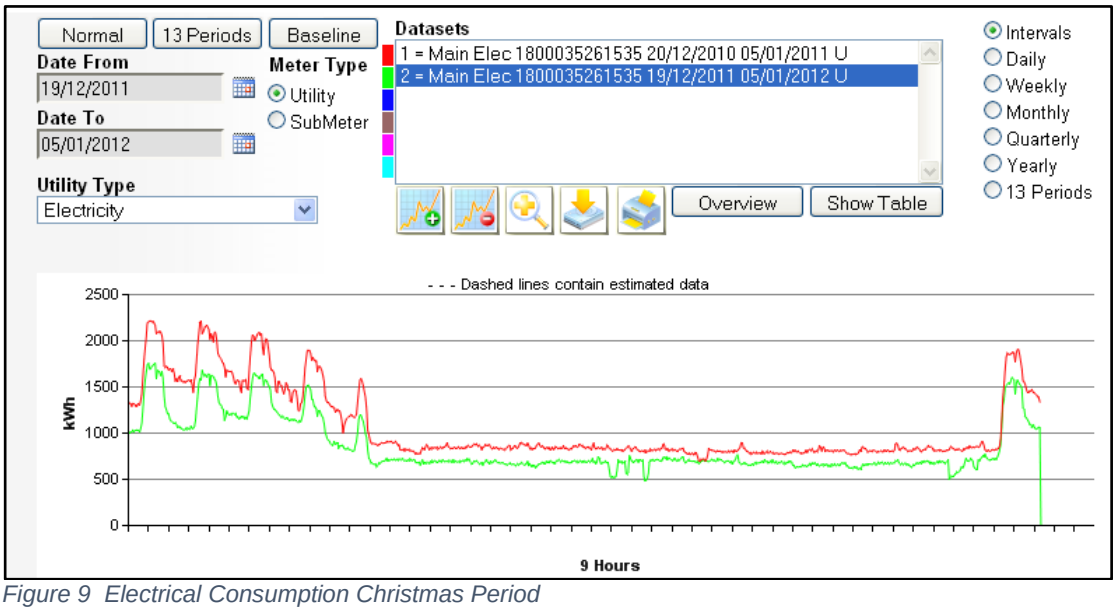


Figure 9 Electrical Consumption Christmas Period

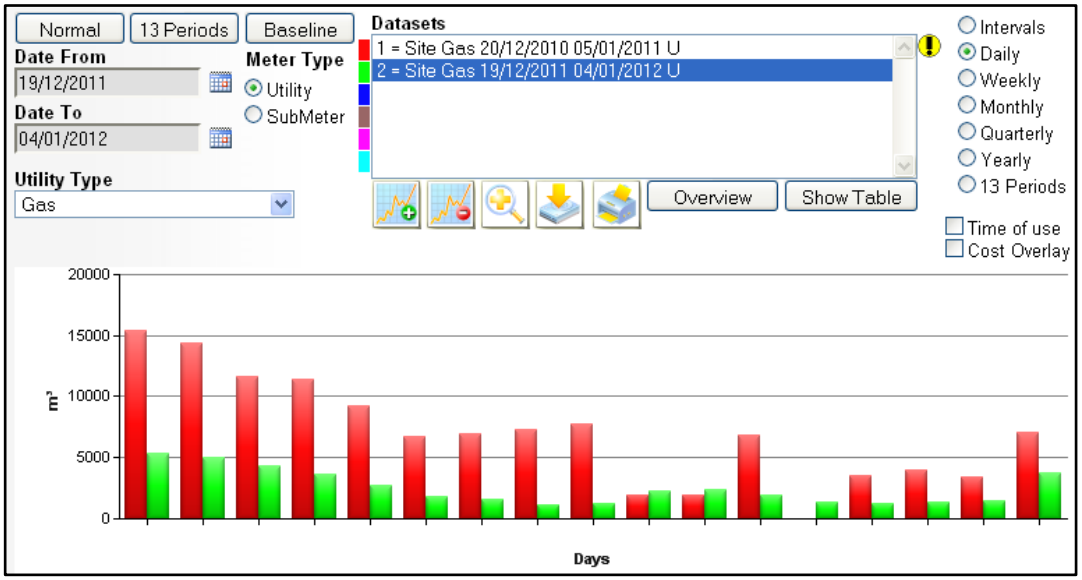


Figure 10 Gas Consumption Christmas Period

In other instances AMR can quickly identify problems that would be difficult to predict by other methods; the plot below shows steadily increasing consumption in an IT Server Suite. This wasn't suspected by anyone until the metering was reviewed in detail.

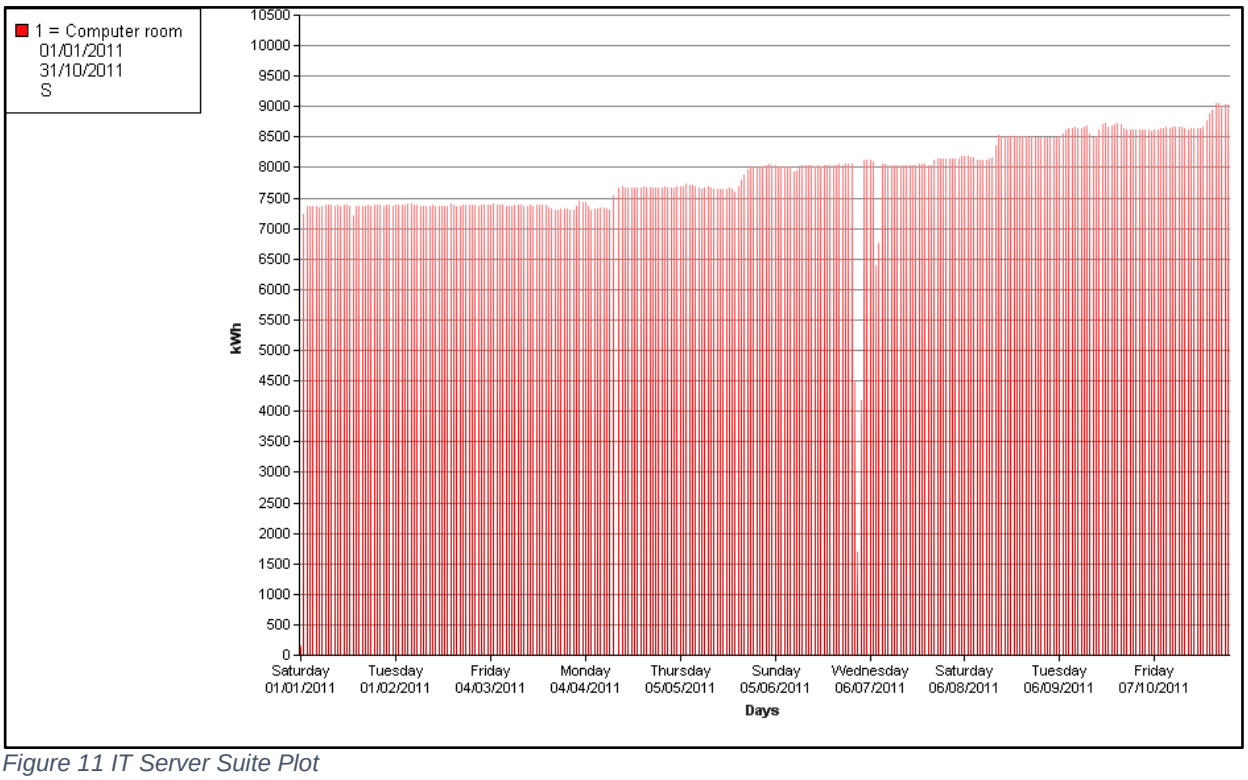
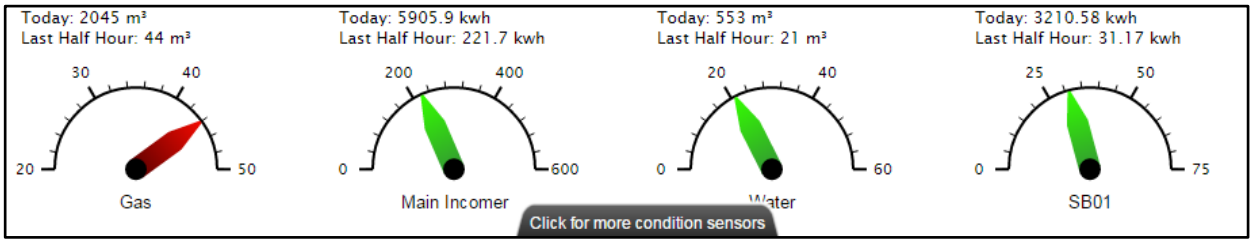


Figure 11 IT Server Suite Plot

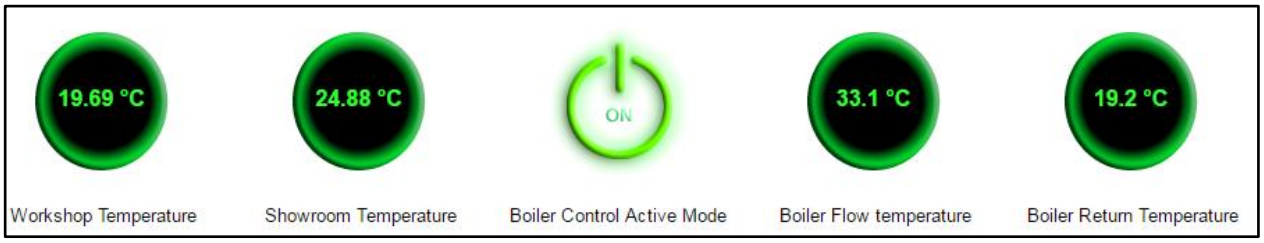
Intelligent AMR

Intelligent AMR might be a good option if you have limited time to analyse the data yourself. It will come at a cost however.

Intelligent AMR can make the types of analysis noted above very easy to perform but it can also provide some of the key information for your site in a customised form. For example many AMR systems feature a dashboard type feature:



This often also includes other key information about your building - for example BMS information such as internal and external space temperatures, or the operation of specific equipment



Intelligent AMR can also quickly allow you to quickly prepare time period analysis or comparisons between specific meters without a great deal of input from the user. This can include benchmark type analyses (e.g. degree day or comparison with other buildings in the estate or best practice guidance).

Some Intelligent AMR systems can also help you to identify problems. This can be presented as alarms when consumptions for specific meters fall out with expected limits or league tables showing the poorest performing meters or buildings in a specific time period.

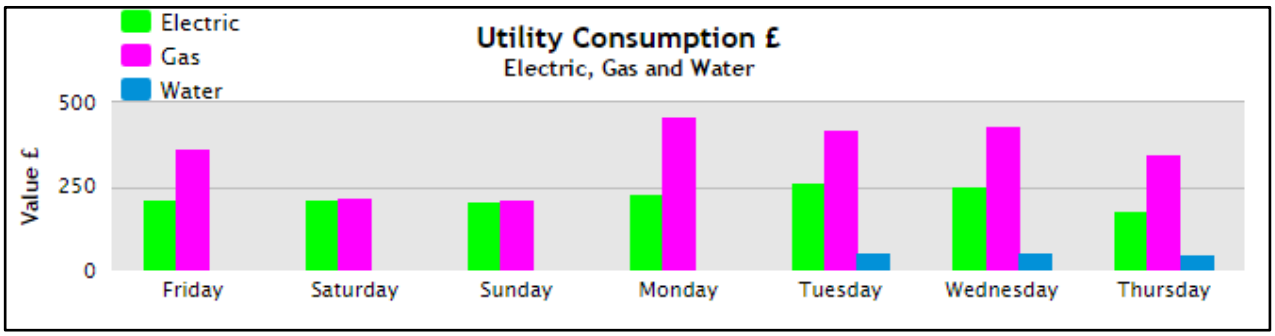


Figure 12 Intelligent AMR Presentation of Weekly Data as Cost Information

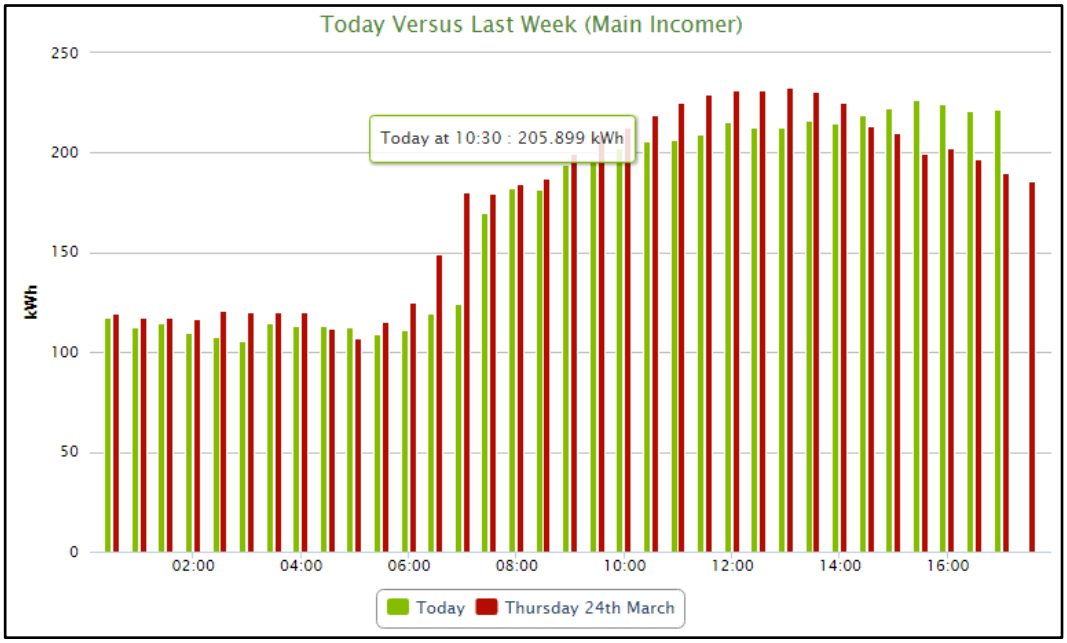


Figure 13 Intelligent AMR – Comparison of Half Hourly Consumptions between Two Similar Days

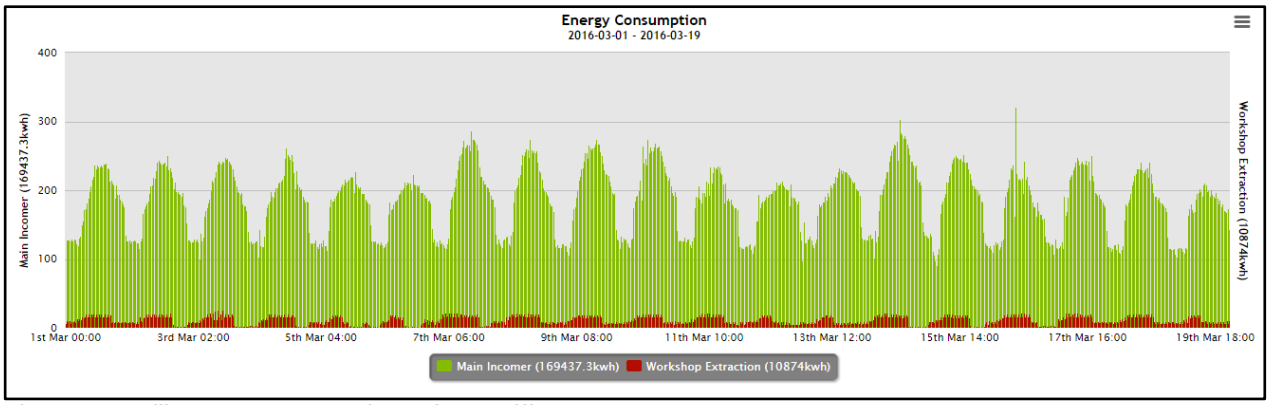


Figure 14 Intelligent AMR Comparison of Two Different Meters

Name	Utility Type	Units	Est. Value
1st Floor Admin Support	Electric	61.47 kwh	£6.76
2nd Floor Call Centre	Electric	147.76 kwh	£16.25
Gas	Gas	2045 m³	£347.65
Main Incomer	Electric	5905.9 kwh	£5905.9
SB01	Electric	3241.75 kwh	£356.59
SB02	Electric	2003 kwh	£220.33
Water	Water	559 m³	£50.31
Workshop Extraction	Electric	498 kwh	£54.78
Total:			£6958.58

Figure 15 Intelligent AMR – Snapshot of Key Information for Week

Other useful links

- Metering technology overview (CTV027) - Carbon Trust

Summary and Top 5 Tips for Colleges

At least some of the tips above should be relevant to you, but what you find most useful will depend on your own experience, the size of building you manage and the state of your existing metering system.

The following might be the best places to start:

- Familiarise yourself with your on building's metering arrangement
- Make sure that existing metering information is accessible and makes sense (AMR can often fail or become inaccurate)
- Experiment with some of the suggested forms of half hourly data analysis for your building
- Look at how you might use data for an energy saving project or to identify a suspected problem
- If you think it would be of benefit, engage with some of the suppliers of intelligent AMR to see what can be offered

Mabbett & Associates Ltd, Corporate and Registered Office:
Mabbett House, 11 Sandyford Place, Glasgow, U.K. G3 7NB
Registered in Scotland No: SC 163378
Info@mabbett.eu www.mabbett.eu