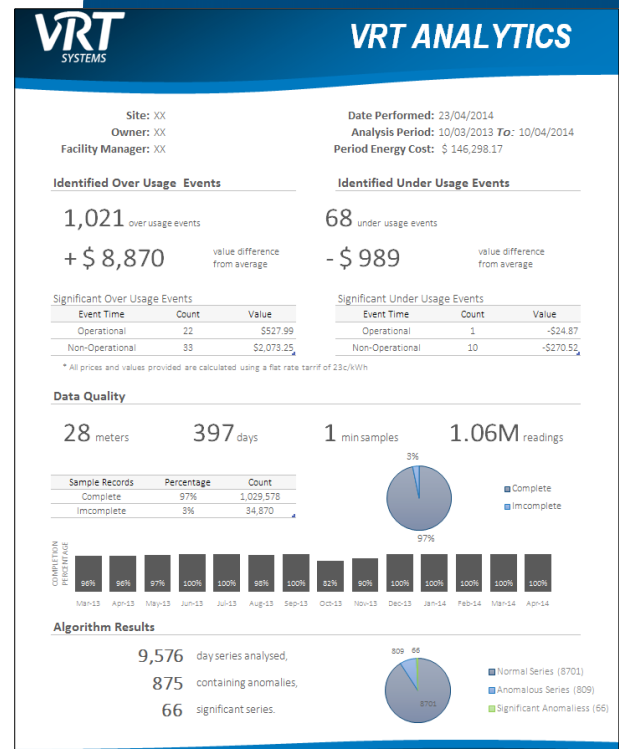# VRT ANALYTICS

*If you have an Energy Management System (EMS) it's probably fair to say that you have no shortage of data – the real question is how do you turn that data into actionable information?*



## The Problem

Energy audits are often one of the first steps that organisations take when embarking on an energy efficiency program. Energy audits are performed to varying levels of detail (ASHRAE defines levels 1 to 3) with varying expectations of the extent and accuracy of predicted savings. Even cursory investigations are able to yield significant savings, but the law of diminishing returns can apply, with and ever greater levels of analysis often only identifying smaller savings opportunities, or simply confirming confidence levels of predictions.

Organisations that already have an energy management system (EMS) with sub-metering usually find that they have access to vast quantities of data. While the EMS package may provide a dizzying array of charts, trends, heat maps, calendar views, dials and dashboards, in practice it soon becomes apparent that a similar investment of investigative effort is required to identify opportunities for savings. The process followed (aggregate and compare consumption data, identify anomalous consumption patterns, locate and quantify opportunities for improvement) is similar to that applied during an audit, but while the tools may be better, there is vastly more data and the process needs to be repeated on an ongoing basis to preserve the savings.

## The VRT Analytics Solution

VRT Analytics is an automated anomaly detection tool designed to -

1. Support the audit process with a "rapid return" analysis of energy data to uncover opportunities that may not be discoverable cost-effectively by traditional (manual) methods – ideal for use by consultants to deliver greater value to their clients.

2. Enhance the effectiveness of an EMS, by decoupling the discovery of savings opportunities from the need for a significant ongoing investment in time to analyse data – ideal for use by overloaded facility/energy managers.

At the heart of VRT Analytics is a learning engine purpose-designed for analysing energy data. It analyses for data quality and compensates for missing data. It can analyse operational and non-operational times (or different types of activity days) separately and produces characteristic curves for each of your circuits to illustrate circuit behaviours under these different conditions. It looks for changes in the time of consumption, the magnitude of consumption, and the overall signature of the consumption pattern, and *can detect changes in consumption behaviour that would normally be lost in the noise*.

This is a product that has been years in the making, with a vision of providing clients with a more in depth understanding of their energy consumption and to give them the ability to identify areas where simple action can be taken to reduce consumption.

## *How it Works*

The tried and tested analysis process we have developed consists of three stages:

1. Data Quality Analysis
2. Load Curve Characterisation
3. Anomaly Detection

## Data Quality analysis

To ensure that analysis is conducted on a firm basis, a pre-analysis of data quality is performed to gauge completeness of the record (in terms of overall good samples) and proportion of complete full-day series.

This is used by later load curve characterisation and anomaly detection passes to adapt the methods applied depending on data confidence levels, to avoid incorrect assumptions being drawn. This approach allows for more flexibility in the acceptable minimum data quality while ensuing the validity of the overall analysis output.
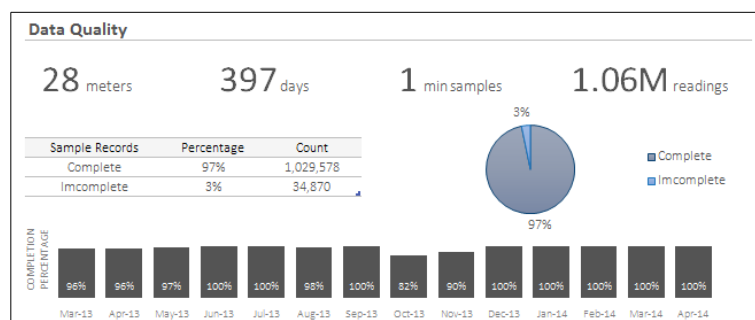


## Load Curve Characterisation

The next stage of the analysis focuses on collating consumption curves on a circuit-by-circuit basis for both operational and non-operational times. This data is not only used for the subsequent anomaly detection, but produces a series of characteristic "signature" curves for each circuit that are useful in illustrating typical usage patterns, and the variability of this usage through the day (the mean curve is accompanied by a deviation indicator to show times of the day when usage is most variable).

The typical usage signatures can quickly provide valuable insights into the consumption patterns at a facility. Depending on the site, the operational and non-operational periods may be considered separately e.g. an office building may be only operational Monday to Friday. The definition of these usage periods can be either performed algorithmically using maximum power demand calculations or manually (by calendar or operating schedule) if they are known. The system also includes the flexibility of defining separate usage periods facility wide or on a meter-by-meter basis if parts of your site operate on independent schedules.
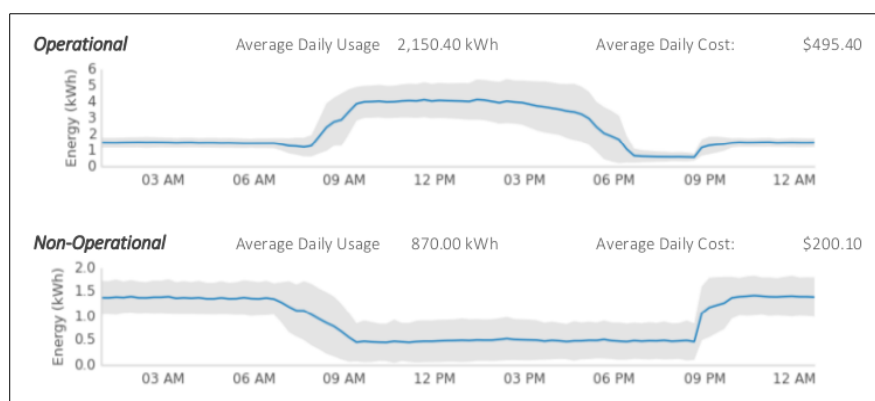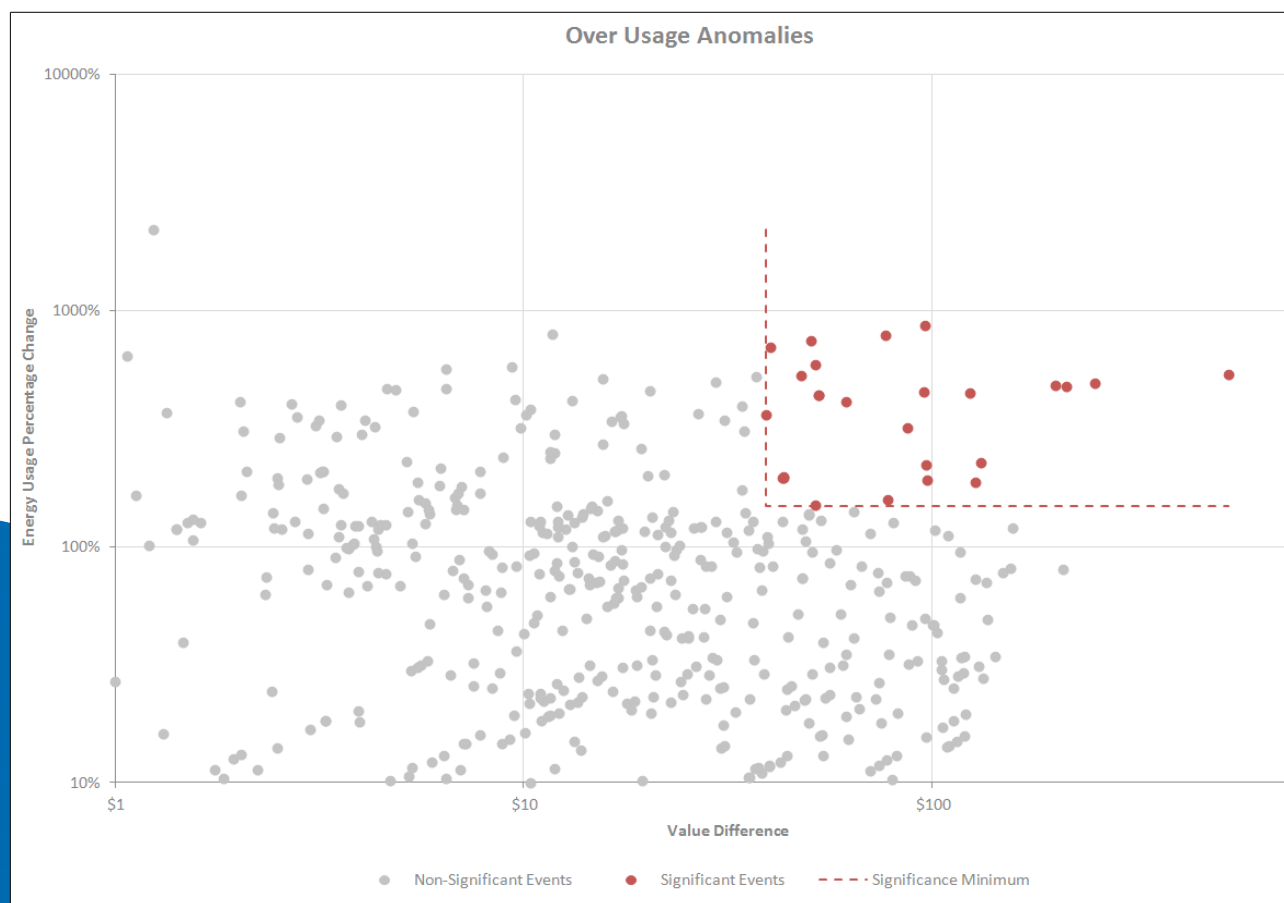
# Anomaly detection

Anomaly detection lies at the very core of the value that VRT Analytics delivers. It is the one feature that breaks the link between invested effort and results returned – it is pro-active and exception-based, and short-cuts the investigative effort usually required to explain "why" a difference exists between one time period and another. The algorithms we developed for this purpose are derived from those proven in other industries such as stock market analysis and medical diagnosis, adapted to perform anomalous event detection within energy consumption data.
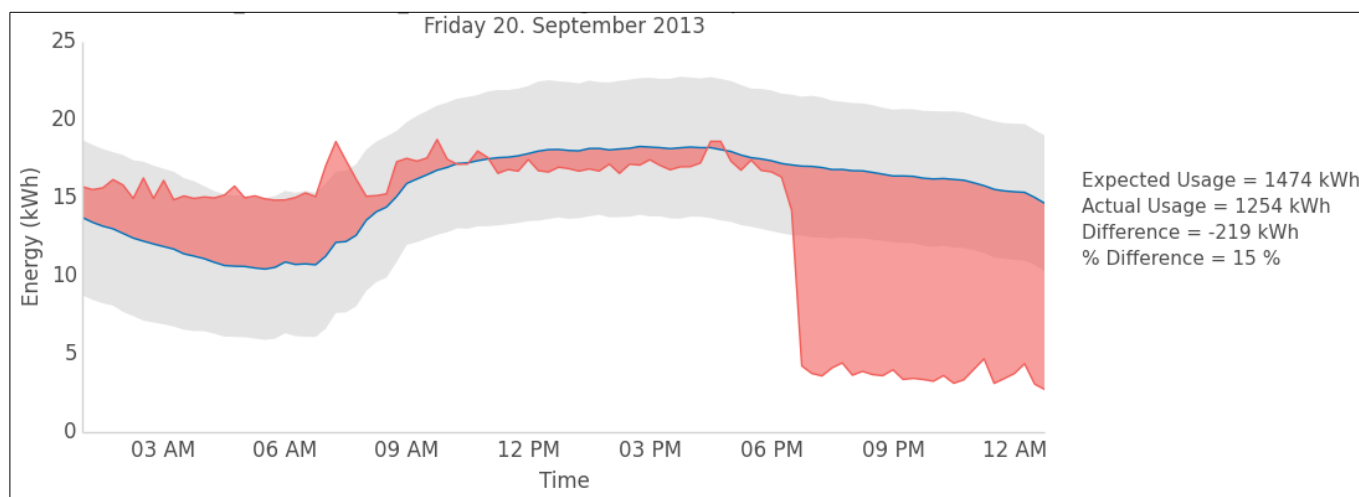
The algorithms apply a three-factor detection mechanism that is based on the same techniques used by humans scanning for anomalies by sight – differences in magnitude, changes in the time of use, and variances in the general shape of the curve. These anomalies can be qualified in terms of their duration, the magnitude of deviation from the mean, and the total amount of energy involved.

## *Results*

Each of the anomalies detected relates to a period of unusual activity, and the list is filtered to ensure you are presented with the most significant first. As well as a list view, the software prepares a scatter plot showing the anomalies in terms of their severity and cost, and uses this to focus the investigation on the highest impact, highest value events (below). This plot also provides a mechanism to drill-down to the actual anomalous load curve for each event.

While there might be a natural tendency to focus on over-use events (and implementing measures to avoid them), we find that often the most interesting anomalies are under-use events – under use because the normal pattern is over use. Whereas mitigation of an over-use event might generate savings a few times a year, a saving identified from an under-use anomaly can sometimes be repeated every other day of the year.

Friday 20. September 2013

Expected Usage = 1474 kWh
Actual Usage = 1254 kWh
Difference = -219 kWh
% Difference = 15 %

In one example detected by VRT Analytics, on a single Friday afternoon (the only day in the year this happened) someone turned off an air conditioner that (it was later found) normally runs 24 hours a day. If the air conditioning plant that was turned off that Friday could be switched off every afternoon, the resulting savings amount to approximately *$7,500 per year*.

## Features & Benefits

- Delivers benefits in both one-off (e.g. energy audit) scenarios and an ongoing basis (generating alerts for energy managers as the anomalies occur)

- Works with a range of EMS software packages (PecStar, RUMS, ION Enterprise), cloud-based energy reporting solutions (Switch Smart Hub, Envizi, Greensense, Lucid) or with data in CSV files or spreadsheets.

## SOLUTIONS ENGINEERED FROM EXPERIENCE

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