# How relevant is VaR for energy markets?

*Despite its many limitations, Value-at-Risk is still the most commonly used risk profile measuring tool in the energy industry. This business briefing paper discusses why the energy industry's love affair with VaR could be dangerous. Subsequent business briefings will look at the alternatives.*

## Overview

Energy organisations require risk metrics that provide well informed decision-making to enable them to apply appropriate hedges, absorb market volatilities and price shocks and optimise their operations to improve profitability.

In practice, risk management for many organisations is typically limited to calculating a Value-at-Risk (VaR) metric – and often this is the simplest form of VaR, called Delta or Analytic VaR. Given the industry's increasing focus on the measurement and reporting of risk as well as the increased regulatory oversight in which energy organisations now have to operate, this approach needs to be reassessed with respect to the alternatives that are available.

It is not unusual to attend talks at energy risk management conferences and to see presentations on the advantages and disadvantages of the various different VaR metrics (Delta, Historical, Monte Carlo, etc).

But why? Why do many energy market participants even bother with VaR when, if you look at their typical portfolios, and the assumptions underlying the VaR metric, none of them are fully satisfied, and some not even remotely satisfied.

If the focus of senior management meetings is typically on the current and forecasted gross margin, earnings, cashflow, or profits, then these should form the basis of the 'at risk' measure, and not just value at risk.

## What does VaR actually measure?

What characteristics make the application of VaR different in financial and energy trading markets? How meaningful is VaR really as a risk metric to present to senior management in energy organisations?

Firstly, what is VaR? We define VaR to be the measure of the level of loss of value which would not be expected to be exceeded with a chosen probability, over a chosen time period. For example, a VaR of $4 million over two days at 95% means that we would not expect our loss on the

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portfolio, over a two day period, to exceed $4 million more than 5% of the time, or once in every twenty independent two day periods.

VaR is the standard risk management tool used in the financial markets and seems to have been taken up as the standard risk quantification measure in energy markets. In *Energy Risk's* 2009 Risk Management Survey, some 85% of respondents (who consisted mainly of risk managers, traders and senior executives at energy producers and energy trading firms) said they use simple VAR metrics. This dropped to around 30–50% of respondents who said they calculate earnings-at-risk. In essence, VAR is supposed to provide quantification of the primary risks that an organisation faces, and is often the only risk profile information that is given to senior management, shareholders, regulators and credit ratings agencies.

Unfortunately, often it seems to be a "goal" in itself to produce a VaR number to present the risk profile of an energy organisation when it should actually be applied as one of many tools to measure risk.

When an energy company's senior management meet, it is rarely to discuss the current 'market value' of the company's physical assets and financial contracts that are linked to the physical assets, such as off-take agreements, or long-term supply contracts. If this is the case then what value is there in a metric that looks at where this value could potentially be in 1 day, or 10 days time?

If the objective for senior management is to minimise variability of the firm's earnings through time and to determine which risks are worth taking and which are not, then VaR actually gives very little information about these requirements.

## What differentiates energy from financial trading markets?

VaR is a concept that has been borrowed directly from financial markets where it has been used in its current form since the late 1980's. For many financial institutions, trading is generally characterised by operating in financial markets (foreign exchange, interest rates, indexes, equity prices, etc.) and by standardised contracts, liquid instruments and short-term trading horizons. However, there are large differences between the evolution of financial time series' and their energy equivalents (power, gas, and oil), and also between the typical banking portfolio and energy company portfolio.

Historically, financial institutions have typically operated in foreign exchange, interest rate, stock index, and individual stock markets. The price evolution of these time series is very different from gas and power price evolution, which is characterised by high levels of seasonality, mean reversion in prices and discontinuities, or jumps, in prices (power prices in the US, for example, can jump from $70 per megawatt hour (MWh) to $1,000/MWh and back again in a few hours). If models developed to describe the stochastic evolution of financial price series'

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are applied directly to power and gas prices then users should at least be aware of the limitations of the modelling approach being used – and also on the likely limitations on the risk outputs.

In addition, energy organisations typically have a mixture of financial contracts and a diverse range of physical assets in their portfolios such as thermal, hydro power plants, gas storage facilities and pipelines. The financial contracts often "back-to-back" physical assets, for instance a tolling agreement that sells the power produced by a particular station or a virtual storage contract that mirrors a physical storage facility. This makes the financial contracts traded by energy organisations more complex in that they tend to be more illiquid than those traded by financial institutions, are typically very specific to one counterparty, and embed a lot of constraints and flexibilities.

Aside from credit issues, financial institutions are typically exposed almost exclusively to market risks such as the risks posed by fluctuating exchange rates and indexes etc. However, energy organisations are also exposed to a range of non-financial risks in addition to market risks. Such risks include volumetric, rainfall and temperature risks, which do not fit into a typical VaR framework.

Such fundamental differences make it difficult to apply VaR to energy trading markets and consequently make risk exposure reporting less meaningful.

## Limitations of VaR for energy market requirements

1. **VaR assumes a particular distribution of returns of the market variables.**
   In the majority of cases, that is a normal distribution assuming that the price variable follows Geometric Brownian Motion (GBM). However, energy market variables exhibit much more complex behaviour than can be approximated by GBM, principally, very strong mean reversion (e.g. gas and power prices), a high degree of seasonality (e.g. summer versus winter, business day versus non-business day or peak versus off-peak), and discontinuities in prices. These variables cannot be adequately incorporated into standard VaR calculations without a high degree of approximation.

2. **VaR is characterised by a time horizon which is typically only 1 or 5 days**.
   Most implementations of the VaR metric assume a very short time horizon, e.g. 1, 5, or 10 days. This assumption works well for trading portfolios that are characterised by standardised contracts, liquid instruments, and short term trading horizons, but is less applicable to energy organisations that have highly tailored 10-15 year tolling agreements or long term gas supply agreements in their portfolio.

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3. **VaR assumes that contracts can be fully liquidated at any time horizon**.
This is related to the previous point. Unlike financial trading deals which occur with a number of counterparties and can be unwound within a short time horizon, large energy trading deals often are linked to a single counterparty and contain very specific embedded optionality and constraints – often to reflect the operational constraints of a particular asset. Such complex contractual features make it difficult to unwind with other counterparties, making this assumption redundant for large sections of many portfolios.

4. **VaR characterises the potential future range of the mark-to-market value of the portfolio.**
A typical energy portfolio contains both physical assets as well as financial contracts. In order to represent the risks company wide then these assets should also be represented in the VaR metric. However, the valuation (mark-to-market) of a single power plant is a computationally intensive exercise, and so the revaluation, across many thousands of different forward scenarios needed for the VaR calculation becomes computationally intractable. Due to this limitation it is not an unusual scenario in energy organisations to leave physical assets, and complex contracts, out of the VaR metric altogether and so the calculation is only performed on the trading book – which could represent a small proportion of the total risk of the organization.

5. **VaR is driven by market (price) variables**
In standard VaR calculations market price is the only exposure considered. However, the risk profile for many energy companies is also driven by non-market variables such as demand, generation levels, temperature, wind, rainfall, etc. The risk profile of retail contracts is driven by the uncertainty in demand as well as price. Power and gas swing contracts, long term supply contracts, and gas storage also involve volumetric uncertainty in the exercise of the contracts – something which a standard VaR metric cannot take into account, and so will misrepresent the risk.

## So, why do people still rely on VaR?

Even with these key limitations discussed, VaR is still the most commonly used risk profile measuring tool in the energy industry. One reason for this is that VaR is the risk metric that comes as standard in the vast majority of ETRM systems, and is often already paid for when the ETRM system is purchased.

Secondly, and probably related to the first reason, is that the consultants, auditors, and system integrators that are often employed by companies to advise them on system requirements specification recommend VaR as a risk metric.

*Measurement of market (and credit) risk should start with determining where the risks to an organization originate from, and also what is a relevant risk - not just to use the default engine in your ETRM system.*

Lacima recently reviewed a "Request For Proposal" (RFP) for an ETRM system, where the company was being advised by one of the big four accounting companies on the system selection process. The risk management section of the RFP was dominated by questions around VaR, option pricing models, and with a whole section on different parameter estimation techniques required. Nowhere in the RFP did it address that the company was in fact a hydro electric generator whose biggest risk to its ability to service debt repayments or to pay dividends to its shareholders, was the capacity to generate power, and that this was heavily constrained by the uncertainty in rainfall and snow melt.

However, the single biggest justification for using VaR is that it is relatively easy to understand and communicate to senior management, shareholders and regulators. Just because people can understand what a number means, doesn't mean that it is useful, especially if the assumptions behind it are not satisfied.

## Conclusion

Any definition of risk exposure should encompass the firm as a whole and not just one part such as a trading book, which is often the sole focus of the reported VaR number. Measurement of market (and credit) risk should start with determining where the risks to an organization originate from, and also what is a relevant risk metric to report for the organization – not just to use the default engine in your ETRM system.

Having a comprehensive solution to the risk management issue will have a significant benefit to all energy market participants. Improved understanding of enterprise-wide risk leads to more informed decision-making, the ability to apply appropriate hedging strategies, absorb the market volatilities and shocks, and optimise decisions across all operations to ultimately increase profitability.

Returning to an earlier point, if the focus of senior management meetings is typically on the current and forecasted gross margin, earnings, cashflow, or profits, then these should form the basis of the 'at risk' measure, and not just value at risk. These cash flow based metrics will be the subject of a future business briefing paper.

## About Lacima

Lacima is a specialist provider of software and advisory services dedicated to valuation, optimisation and risk management for global energy markets. We help you to maximise your profit potential and make more informed decisions by providing tools that yield more accurate valuations, hedging analysis and risk exposure analysis for portfolios of financial contracts and physical assets.

Clients of our software and services include structuring, valuation and risk teams in vertically integrated energy companies, energy retailers, financial institutions and large energy consumers in Europe, North America and Australasia.

Our software solutions have been developed and implemented by peer-recognised experts in energy analytics, offering an unparalleled level of expertise and personalised support.

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