Schneider Electric
Professional Services
White Paper

Five Global Trends Shaping the Future of Energy

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At a time of such uncertainty in global energy markets, we felt it opportune to highlight five global trends which are set to shape the future of energy, from our viewpoint as a leading global energy management company.

The following five trends provide useful information and guidance to consider as you try to navigate your way through the decision-making process related to energy demand, supply, and sustainability:

About Schneider Electric

As a global specialist in energy management, with operations in more than 100 countries, Schneider Electric offers integrated solutions across multiple market segments, including leadership positions in Utilities & Infrastructure, Industries & Machines Manufacturers, Non-residential Building, Data Centres & Networks and in Residential. Focused on making energy safe, reliable, efficient, productive and green, the Group's 140,000 plus employees achieved sales of 24 billion euros (31.5 billion US dollars) in 2012, through an active commitment to help individuals and organisations make the most of their energy.

Schneider Electric Professional Services Strategic Focus

Schneider Electric's Professional Services division addresses clients' diverse energy and sustainability management needs with tailored services and solutions. The energy experts within the Professional Services division provide integrated solutions around the Energy Management Life Cycle, Schneider Electric's guided, strategic approach to comprehensive energy management.

For further information

If you would like to discuss our range of services, please contact us on enquiries@ems.schneider-electric.com

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Global energy demand will continue to grow in the coming decades...

...just not in developed countries

A number of recent research reports from the likes of the US Energy Information Administration (EIA) and the International Energy Agency (IEA), as well as 'big oil' companies such as Exxon Mobil and BP, have served to highlight a common theme running through the world of energy: a distinct dichotomy in global energy consumption has emerged and is set to continue in the coming years.

For although global energy demand is set to grow by a third over the next two decades, demand from developed nations is set to remain relatively flat. In other words, global demand growth will be entirely generated by developing nations.

This is not to suggest that developed countries are going to see deteriorating economic conditions, and hence lower energy demand; they are expected to see slow but consistent economic growth going forward.

It will instead be that greater energy efficiency from technological development will keep demand in check, created by diverse factors ranging from more efficient natural gas-fired power plants to improving fuel standards for vehicles. Essentially, the focus on energy efficiency and lower energy intensity will offset the impact of increased economic activity in developed nations.

Another key influence on energy demand going forward is population growth. The rapid increase in global energy demand over the coming decades seems inevitable when you consider the world's population is expected to rise by 25% from 2010 to 2040 to surpass 9 billion. And the theme of increasing energy consumption from developing nations is only affirmed by the expectation that three-quarters of the global population will reside in Asia Pacific and Africa by 2040.

Higher energy consumption will not only be as a result of a rising global population, but also due to the increasing availability of electric power on a global scale. Currently, 1.3 billion people in the world do not have access to electricity, with leading emerging markets such as India lacking basic electricity access for a quarter of its population. As these nations steadily grow and mature, infrastructure will be built out, and access will accordingly rise.

Industrial demand is another sector that will drive energy use in developing nations; it is projected to account for 70% of global industrial demand by 2040. An countertrend is already underway in developed nations, where lesser manufacturing activity and higher energy efficiency means lower energy consumption from this sector.

Not only do we see a dichotomy between trends in developed and developing nations over the coming decades, but we see divergences in these developing countries themselves as their economies mature and their demographics change.

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For example, according to Exxon Mobil, industrial demand for energy in India is expected to triple between now and 2040. Meanwhile, industrial demand in China is expected to peak in 2025 and then subsequently decline by 20% to 2040 as it transitions to a developed nation, with more of an emphasis on energy efficiency.

While much remains unknown for the global economy and changing energy landscape over the coming decades, increasing energy efficiency in the developed world is set to be as strong a trend as any, perhaps only overshadowed by the theme of growing energy demand in developing nations.

What does it mean to you?

Staying abreast of these market developments is a must, because such developments can drive long-term strategic decisions. From new plant sites to input-fuel choices to demand-side management, understanding how and where energy markets are evolving and what it means for prices can help you make competitive strategic decisions. And as global demand increases in developing nations, the focus will shift towards the emerging markets, where a mix of liberalisation and regulation will prove difficult to navigate successfully.

[White Paper]

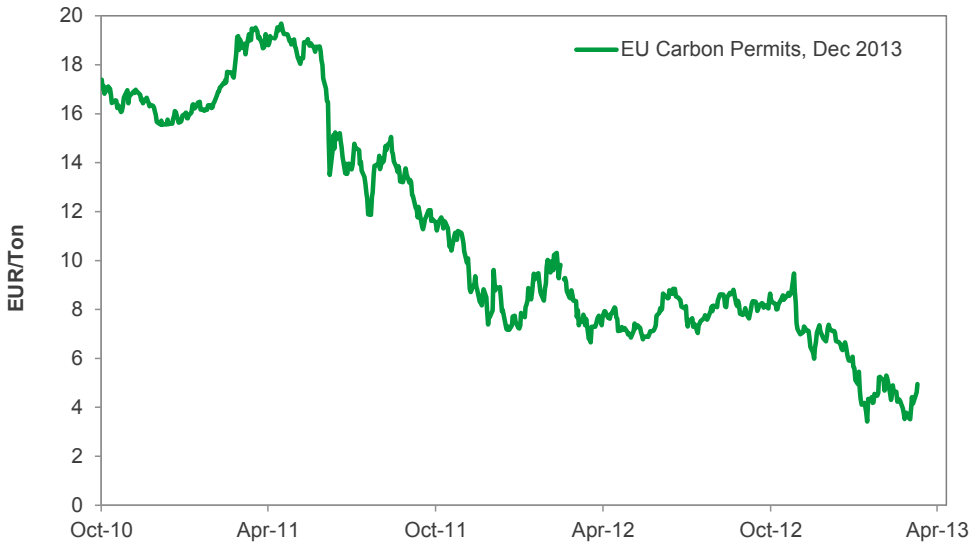
Harsh lessons for the European carbon market should benefit new emissions schemes

The experience of the European Union Emissions Trading Scheme (EU ETS) is somewhat similar to 'first born syndrome', where a first child is raised differently to subsequent children, as parents learn how to more effectively raise a child.

This scenario is playing out in global carbon markets, with the EU ETS acting as the first born. What hasn't worked for the EU ETS will ultimately be cast aside by developers of future schemes, while greater focus will be placed on what has been more successful.

The EU ETS has lived through an unprecedented time in the global economy, which has seen it presented with all manner of unexpected challenges and obstacles. The EU ETS has been taught some harsh lessons in recent years, and it is these lessons which should be of the greatest benefit to those new markets that are being planned.

While the first phase of the EU ETS was launched as a test phase in 2005 as part of a 'cap and trade' approach to lowering the emissions of the 27 member countries of the EU, prices fell to virtually zero as the phase finished at the end of 2007. The second phase was somewhat more successful until prices tumbled in the latter years due to a combination of an over-issuance of permits and a global recession, which served to drive down demand.



But the EU ETS looks a roaring success when compared to its United Nations counterpart. While European permits have fallen considerably, UN permits have become virtually worthless over the past year as oversupply has plagued the scheme; something we should be wary of with new schemes. There are also additional challenges to conquer, such as balancing political influence. After all, the EU ETS has seen some member states negotiate overly generous permit allocations, creating inequality in the scheme and exacerbating the situation of oversupply. Meanwhile, some countries such as the UK have taken steps to try to

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account for the scheme's shortcomings, introducing a carbon floor price to ensure polluters pay a minimum amount of money for the emissions they produce.

So where are these new emissions markets? California is leading the charge in the US, as it has established a cap-and-trade programme, which was finalised in October of 2011. The programme began at the beginning of 2013, with the power generation sector the first required participants, while other sectors are expected to fall under compliance over the next five years. The goal of the programme is to reduce GHG emissions to 1990 levels by 2020, Carbon credits have been actively trading since August 2011.

China has also started a pilot carbon programme at the beginning of this year, encompassing seven locations - two provinces and five major cities - approved by the National Development and Reform Commission (NDRC) in October 2011. As the world's largest emitter of CO2, the programmes are targeting emissions reductions from the power generation and manufacturing sectors, with an underlying goal of breaking the country's reliance on coal.

The NDRC hopes to expand the scheme to a national scale by 2015, but many potential hurdles remain – perhaps none as challenging as for the regulated power market, which limits the ability for power generators to pass on the increased costs of lower-emission resources or efficiency investments onto consumers.

A third and final example is Australia, which has for a long time planned to link to the EU ETS in 2015. The scheme was officially approved in late 2011, but has been brought into question recently given the turmoil seen in the EU ETS market. Regardless, Australia is set to aggressively target emissions reductions from the power generation and transportation sectors, particularly as coal is a large component of generation in the country. This will also help them to achieve their Kyoto Protocol commitments for the second commitment period of the protocol, which begins this year.

Even though the EU ETS scheme may be viewed as much less of a success as initially hoped, it may by the end of the decade still achieve its goal of lowering emissions by 21% from 2005 levels, albeit inadvertently due to challenging economic conditions. The biggest legacy of the scheme, however, may be its self-sacrificing nature. For without the shortcomings of this pioneering and ambitious scheme, other global schemes would likely not be in a stronger position to succeed.

What does it mean to you?

As governments and other organisations trudge up the learning curve of how to successfully reduce emissions, it is a safe bet that those requirements will be passed on to industrial users. Calculating and tracking a company's global carbon footprint is one of the first steps in creating a Sustainability strategy, though it is no easy step. Throw into the mix the varying schemes in different countries or regions and you have a recipe for confusion. Be sure to understand which countries may bring the most immediate requirements, and how those requirements will impact not just individual plants, but your overall carbon footprint and long-term corporate sustainability strategy.

[White Paper]

Why the US oil shale revolution is a big deal...except for the consumer

In 2005 the US was importing 60% of its oil needs. US oil production had been in structural decline since the late 1980s, leaving the country not only highly reliant upon supplies from neighbours Canada and Mexico, but also from countries such as Venezuela, Nigeria, Russia, and Saudi Arabia.

But the US has experienced a remarkable turnaround in its energy fortunes in the past few years. Hydraulic fracturing and onshore shale plays have turned the domestic natural gas market on its head, and now a similar scenario is underway in the domestic oil market.

The most recent statistics are startling. US crude production grew 14.6% in 2012, achieving the highest year-on-year increase since 1995. The start of 2013 has seen production break above seven million barrels per day to reach a 20-year high. Even more remarkably, exponential growth is being seen from just a few shale plays, with a number more yet to reveal their full potential.

Of the shale plays currently ramping up, production is surpassing even the most bullish of expectations. The original US shale play is the Bakken shale in North Dakota, which saw production increase 58% in 2012 versus the prior year to average 769,000 barrels per day. Meanwhile, the ramp-up of output in the Permian and Western Gulf Basins has led oil production for the state of Texas to double in the last three years, reversing a downward trend which had been in place for the past 23 years.

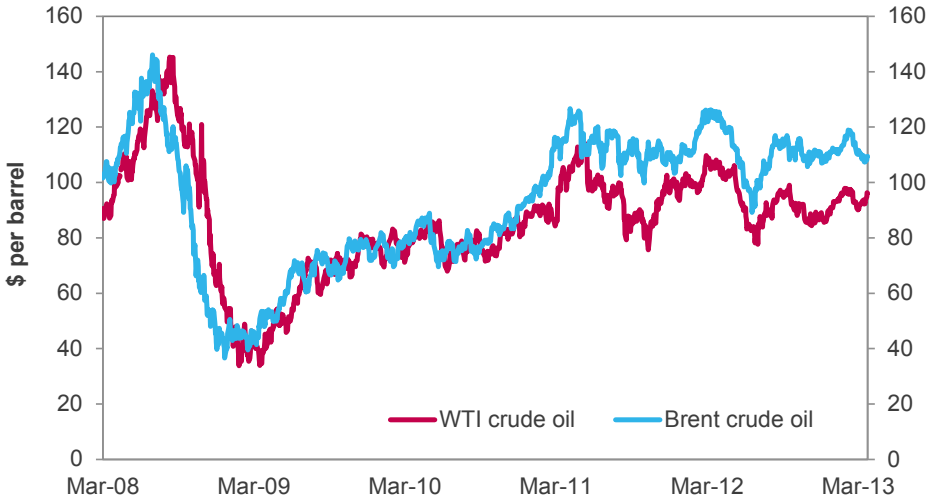
According to the International Energy Agency (IEA), this trend of increasing domestic output is only set to continue. The agency predicts imports will drop to about four million barrels per day in a decade from the current average of 10 million barrels per day. This drop will not only be due to increasing production in the US, but also due to higher fuel-efficiency standards for vehicles.

In fact, the IEA projects total US liquids production (includes crude and natural gas liquids) will surpass that of Saudi Arabia by 2020 to reach 11.1 million barrels per day. This will mean that the world's largest fuel consumer will become the world's largest producer.

Given this domestic backdrop, there is a presumption that growing domestic production will lead to lower fuel costs in the US, as has been the case with natural gas. Unfortunately, this is unlikely to be the case. Whereas natural gas is priced domestically given the lack of ability to export, gasoline and diesel prices are much more dictated by the input price of crude oil, which is driven to a large part by global, not domestic, fundamentals.

If the global dynamics reflected the dynamics of the US domestic market, this presumption might hold true. The reality is that demand in developed countries such as the US is currently declining, and is set to flat-line over the coming years and decades due to increasing efficiencies and declining energy intensity as the economy shows less of a focus on manufacturing. Meanwhile, global oil demand growth is set to rise at a rapid clip, driven on by emerging market demand. So while the US will see distinct benefits from rising

domestic production in the form of greater energy independence, benefits at the pump seem a much less likely scenario.



What does it mean to you?

Global oil markets will still dictate the prices, even as production of oil from shale grows in the US. The challenge of understanding global crude markets fundamentals combined with global crude products markets fundamentals is immense. Throw in the influence of complicated geopolitics, and the challenge of keeping up with and understanding how crude and product prices will evolve, becomes time and cost-prohibitive for companies whose core business is not forecasting energy markets. The common presumption that the US shale oil boom should reduce gasoline and diesel prices in the US is a great example of how counterintuitive these markets can be without in-depth research to drive conclusions and actions.

[White Paper]

Global natural gas – how price divergences are bringing the world together

It is almost incredulous to consider that US natural gas prices were seven times higher in the summer of 2008 than they were in the spring of 2012. A lot has happened in recent years, but there is only one main reason for such a sea change in the dynamics of the US natural gas market – shale.

After achieving a high of $13.60/MMbtu in the summer of 2008, prices experienced a cataclysmic fall for the rest of the year as the global recession took hold. But even as other commodities such as oil started to rebound from their lows in 2009 as demand - and hence a sense of balance - returned to these markets, US natural gas prices were unable to halt the bleeding.

This was because the market fundamentals for US natural gas had been turned on their head, as domestic production continued to ramp up even as prices fell, causing a massive supply glut. The game-changer was shale, as emerging unconventional plays required much lower breakeven prices than those seen by their conventional counterparts. This was largely due to increased efficiencies involved such as horizontal drilling combined with hydraulic fracturing.

The supply glut was then further exacerbated by the emergence of oil-bearing shale plays in the past few years. Despite focus on the much more profitable commodity of oil, associated natural gas was still produced in sizeable volume, and essentially produced for free because oil was the primary focus.

US domestic production has relentlessly ramped up in recent years, and remains near record levels. Given this backdrop of cheap and abundant supply, it is no surprise that US natural gas prices have averaged below $4/MMbtu since the beginning of 2009.

On the other side of the world, just as stark a shift in market dynamics can be seen in Asian natural gas prices, but in an opposing manner to that of the US.

Prior to the Fukushima Daiichi nuclear disaster of March 2011, Japan relied upon nuclear reactors to meet 30% of its electricity needs. However, in the aftermath of the tragedy the country took all 54 nuclear reactors offline. This left a gaping hole in Japan's energy requirements, and one which natural gas was immediately relied upon to help fill.

Just a glance at the chart on the page below highlights the divergence in Japanese prices from their global counterparts due to the immediate demand response following the Fukushima disaster, with prices accordingly propelled higher. Although the first few nuclear reactors are starting to return to service, increased reliance on natural gas will be an ongoing trend for the foreseeable future.

Finally, the European natural gas market has continued to see prices moving broadly in sympathy with oil, as a good deal of Europe's natural gas contracts are still tied to oil-indexed pricing. So while US prices continued to be suppressed by increasing supply in

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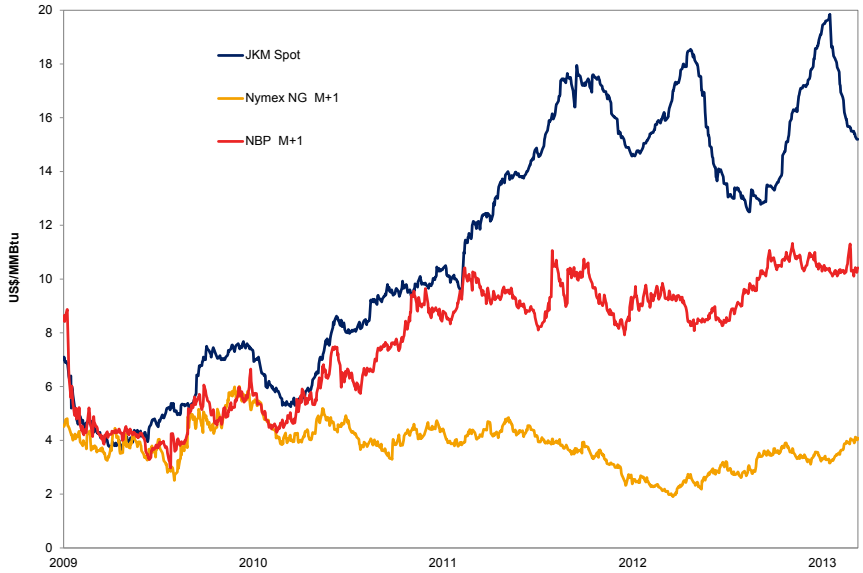

2009, European natural gas prices rose in tandem with oil. We are starting to see a material shift in this purchasing behaviour, however, as an increasing number of buyers are making purchases on liberalised hubs, which are dictated by gas-specific fundamentals (though still influenced by oil price movements).

Given the backdrop of falling supply from the North Sea, an increasing reliance on imports, and elevated oil prices, UK and European natural gas prices have remained far more elevated in recent times than the weaker demand-side fundamentals would lead us to expect.

Despite the fact that Asia, the US, and Europe are seeing distinctly different pricing environments given their contrasting regional fundamentals, it is these price divergences which are accelerating the natural gas market to become more global. And these markets are set to be inextricably more closely linked in the coming years due to the expansion of the global LNG market.

The US is set to have an increasing impact on the global market in coming years, as LNG exports will be a viable option from the US by 2016. Arguably the largest interest in long-term contracts with potential US LNG exporters has come from Japan, as the country seeks long-term stability and diversification in its energy flows.

The UK, and ergo European prices, meanwhile, will likely not only benefit from having a new prospective supplier, but also from having additional supply available in the global market. Ultimately, the development of LNG exports will help to lower the cost of natural gas on a global scale, though could push domestic prices higher for newer exporting nations such as the US.

What does it mean to you?

As the global LNG market grows in the coming years, price environments can shift dramatically, contract structures may change, and new opportunities may arise. Indeed, the increasingly interdepending natural gas markets will introduce new complexities to natural gas markets everywhere. Thinking several years ahead of the curve as to how the global arbitrage may bring global prices and markets together may prevent missed opportunities for end-users.

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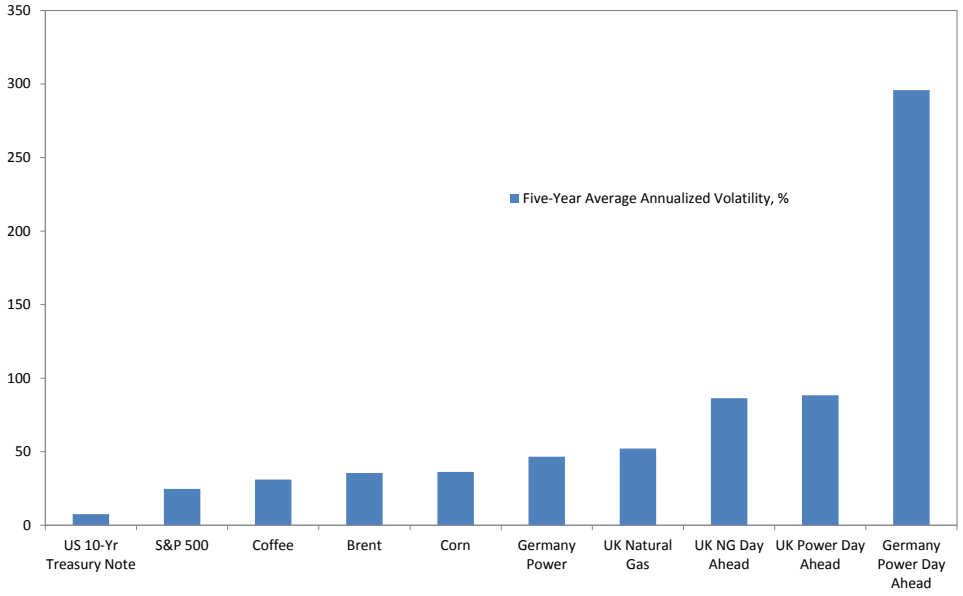
Power Price Volatility & the Changing Generation Mix

Energy prices have a long tradition of being more volatile than most other commodities or traded financial products. Near-term prices are more volatile than forward contracts, while day ahead electric power prices are among the most volatile of all energy prices. Indeed, day-ahead Germany power prices are more than three times more volatile than day-ahead UK gas prices.



When markets experience real-time supply shortfalls, inventories of a commodity are called upon to make up the difference. For example, in many natural gas markets around the world, winter consumption cannot be met by daily production and imports, so supplies are drawn from storage facilities to meet demand. This helps to stabilise prices by effectively eliminating the shortfall. The same philosophy can be applied for shorter-term, rather than seasonal, spikes in demand – inventories are a supply cushion and can mitigate some of the price volatility.

Unlike coal, natural gas, oil products, and many agricultural commodities, electric power cannot be stored in commercial quantities. This provides a distinct market differentiation for power relative to other commodities.

If supply is to meet the demand in a power market, generation (supply) capacity must be at least as great as the volume of demand at its peak. Given the extreme volatility exhibited in electricity consumption, generation capacity needs to be much greater than the average demand load across a year. This is much different to a market such as natural gas, where a supply cushion is provided by the ability to store gas for times of higher demand. Supply capacity for natural gas, excluding storage, can therefore fall short of peak demand.

This, in turn, means electricity grids need to manage the level of demand, which plays into how physical supply contracts can be structured for industrial and commercial users. Interruptible supply contracts may provide price advantages to industrial and commercial

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users that can reduce or even eliminate electricity consumption on short notice. This also creates additional regulatory involvement regarding supply and demand relative to other commodities; one form of additional regulation is that of the required capacity margin – a mandated cushion of generation capacity beyond the expected peak demand.

But perhaps most strikingly, this lack of storage capability creates extreme fluctuations in price, as real-time supply shortages are directly reflected in the market price. This price volatility can wreak havoc on a financial budget.

As demand for electric power grows, it becomes essential for generation capacity to increase. In 2010, the year for which the most recent data is available, world generation capacity had grown 23% in the preceding five years. Of these capacity additions, 34% were renewable sources of electric power (wind, solar, etc.).

A recent study by Schneider Electric Professional Services' Global Research & Analytics team analysed the positive relationship in power markets with higher proportions of the generation mix coming from renewables and the greater volatility in those markets. As renewable generation capacity and utilisation grows in global power markets, we are likely to see increasing volatility in electric power prices, with Germany – as a leader in renewable generation – providing an example now of how the future will look.

How we can help/What does it mean to you?

These market characteristics create risks and opportunities for end-users, which can be managed actively. By sourcing strategically, physical supply contracts can be chosen based on key factors such as pricing, contract terms, product structures, credit conditions, all of which can contribute to the ability to reduce the price risk and volatility. In markets where possible, employing a dynamic hedging strategy can also mitigate exposure to price spikes and help to ensure financial plans are met. Gathering stakeholders to put a strategy in place, guided by research and forecasts for market dynamics is key to managing the exposure to extremely volatile power prices.

For further information...

If you would like to discuss our range of services, please contact us on **enquiries@ems.schneider-electric.com**

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