Energy management initiatives have taken on a greater sense of urgency than at any time in the past. Rising and fluctuating energy costs, stricter environmental regulations, energy supply constraints in some regions and corporate sustainability programs are some of the drivers of this change. The industrial sector, especially energy-intensive industry, faces significant challenges in managing energy use strategically.

While the opportunities for energy efficiency improvements are many, it requires an ‘integrated system’ approach to unlock the full potential of energy savings. The use of an open, collaborative architecture that links process and energy monitoring systems, supported by expertise from energy management specialists, will go a long way towards helping industry optimize productivity and profitability, while at the same time meet energy efficiency goals.
Background

This white paper was commissioned by Schneider Electric with the objective of considering the need for effective energy management, the key challenges facing energy-intensive industries in reaching desired energy efficiencies and approaches to overcoming those challenges.

The white paper was written by analysts of the Industrial Automation Practice at Frost & Sullivan.

Founded in 1961, Frost & Sullivan, the Growth Partnership Company, partners with clients to accelerate their growth. The company's TEAM (Technical, Econometric, Application & Market) Research, Growth Consulting and Growth Team Membership empower clients to create a growth focused culture that generates, evaluates and implements effective growth strategies. Frost & Sullivan employs close to 50 years of experience in partnering with Global 1000 companies, emerging businesses and the investment community from more than 40 offices on six continents. The Industrial Automation & Process Control Practice of Frost & Sullivan monitors and tracks markets and technologies in MES, PLC, DCS, SCADA, HMI, asset management and optimization, simulation, robotics, motors, drives, fluid power and other process and manufacturing systems.

For further information on Industrial automation markets and technologies, visit http://www.industrialautomation.frost.com

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, with leadership positions in public utilities and infrastructure, industry and OEMs, non-residential buildings, data centres and networks, and residential applications. Focused on making energy safe, reliable, efficient and clean, the Company's more than 110,000 employees achieved sales of €19.6 billion in 2010 through an active commitment to helping individuals and organisations "Make the most of their energy™".

www.schneider-electric.com

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The Energy Management Mandate

As businesses strive to find fresh ways of building competitive advantage, meeting customer expectations, attracting the right skill sets and improving profit margins, a new challenge is also being added - the challenge of managing energy use strategically. This is not a new area of focus, but the sense of urgency and importance around it is certainly recent. As the collection of energy consumption data becomes more sophisticated – across sectors and across nations – there has clearly been a shift away from ambiguous rhetoric to finding actionable ways of improving energy management. This is the result of several key drivers.

**Drivers for Energy Management**

- **Rising Energy Costs**
- **Energy Supply Constraints in some Regions**
- **Corporate Sustainability Initiatives**
- **Shaping Corporate Image in Public Perception**
- **Variability in Energy Costs**
- **Technological Advances**
- **Surging Demand for Industrial Output**
- **Stricter Environmental Regulations**

*Source: Frost & Sullivan*
Energy Management for Industry

The industrial sector is critical to addressing the challenge of climate change as it accounts for close to 40 percent of global carbon dioxide (CO₂) emissions. Worldwide industrial energy consumption (electricity, coal, natural gas, renewables, liquids and other petroleum) is expected to grow from 174.5 quadrillion Btu in 2005 to 261.7 quadrillion Btu in 2035. While in 2009, as a result of the global financial crisis, delivered energy consumption in the industrial sector dropped lower than that in other end-use sectors combined, this position is expected to be reversed by 2016 and the gap to widen even more thereafter.

Over the period 2005 to 2035, electricity use is expected to see the most significant growth amongst fuel sources used by industry.

Energy-intensive industries (the major ones being mining, metals and minerals (MMM), chemicals and pulp & paper) consume about half of the energy used in the industrial sector. For these industries, energy accounts for a significant portion of operating costs (for example, energy is around 60 percent of the chemical industry's operating costs, 15 percent of the iron and steel industry's production costs and between 20 to 40 percent of the cement industry's production costs).

This makes energy management for industry more than just a buzzword. In fact, the surge in electricity prices in most regions globally has brought energy management clearly to the top of the agenda for industry. (For example, the EU-27 saw average electricity prices for industrial consumers rise from 0.0672 €/kWh in 2005 to 0.0918 €/kWh in 2010.)

2 Energy intensity is energy consumed per unit of output.
4 Eurostat
Aggravating the problem is volatility of electricity prices in some markets.

For example, the electricity price for large industrial consumers in the UK was 35 percent higher in Jan 09-Jun 09 compared to the same period the previous year\(^5\).

In some regions, industrial energy consumers also have to contend with a further level of uncertainty; potential supply limitations.

Beyond these supply-demand and price factors, stricter regulatory compliance obligations with regard to environmental sustainability are prompting industry to proactively launch energy management initiatives. This can take the form of holistic energy consumption reductions or specific actions to comply with energy efficiency standards. As an example, in Canada, the regulation of most 1 – to 200-horsepower motors (introduced in 1997) has led to savings of 9.5 petajoules annually in the industrial sector by the year 2010.

**Challenges in achieving energy management goals**

The obvious difficulty in the industrial sector is the complexity of processes and outputs in industrial operations that make accurately measuring, verifying and tracking energy use a formidable task in itself. But there are more important and persistent barriers:

Unfortunately, for most industrial firms, energy has not been top-of-mind historically. Perhaps, this low mind-share was the result of the lower energy price levels of the past. Perhaps, it is the result of conflicting priorities. Or perhaps, the lack of senior management

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\(^5\) Eurostat
buy-in or support. In some instances, even with the right level of senior management sponsorship, energy management goals are hard to achieve because some companies have not managed to break away from a silo approach to operations. This prevents a holistic approach from being taken. In other instances, regulatory uncertainty (especially around carbon pricing) can be a disincentive.

Whatever the reasons, the low priority given to energy management is obvious from the fact that very few organizations have specialist professionals who are responsible for and dedicated full-time to energy management.

The priority given to energy also varies from region to region. Local conditions, energy shortages and compliance requirements create a greater sense of urgency in some regions than in others. In addition, the drivers for energy management tend to vary based on the industry vertical. In some verticals, energy costs are a focus because they help reduce opex (e.g. the water and wastewater industry). In some verticals, the driver for energy management is primarily productivity and compliance (e.g. the mining industry).

What all of this means is that while production and its sub-processes have over time evolved in their nature and scope, managing the energy used for these processes now has to play ‘catch up’. This task is made more difficult by the significant shortage of skilled personnel (internal and from third-parties) who can monitor, manage and optimize energy use effectively. Added to that, the paucity of robust case studies that accurately represent cost and savings in energy efficiency improvement projects weakens the impetus for new initiatives.

**Identifying Opportunities for Energy Efficiency Improvements**

Typically, motor-driven applications account for around 60 percent of total industrial energy consumption. Since energy accounts for most of the operating cost of motors in industrial applications, energy efficient methods of running motors (with soft starts and variable...}

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6 Only a miniscule proportion of these personnel have the word ‘energy’ in their job title.

7 Mining and petrochemical industries have traditionally not been very proactive in energy management (except for the aluminium sector, which has a much higher cost of energy as a proportion of total opex).
speed drives) can make a significant difference to total energy consumption and operating costs. Even the simple act of choosing the correct rating for each application will ensure that there are fewer instances of oversized motors resulting in lower efficiency and power factor.

Human factors play a key role in energy management as well. For example, operators who are not sensitive to the energy impact of conveyors left running with no load can significantly impact energy consumption.

Looking at energy use in the context of time is also a useful avenue for savings. That is how high-cost non-essential processes can be shifted to off-peak times to take advantage of dynamic pricing arrangements with energy utilities. Similarly, location-driven opportunities (within a processing area, plant or across sites) can be identified and pursued; for example, where surplus stock is held, or where waste heat is excessive.

However, effective energy management in the industrial environment is better achieved through an ‘integrated system’ approach, rather than by following a ‘component based’ approach. That is why optimizing process control (which works as an integrated system on site and across sites) is being seen as a more significant energy efficiency improvement opportunity than most other options. As the chart indicates, ‘process control’ had the second highest savings amongst identified opportunities through the Australian Energy Efficiency Opportunities (EEO) program.

With the focus on optimizing control systems for energy efficiency gains, companies are then able to assess and reduce energy cost per unit produced rather than total energy used. To do this, industrial companies need the right set of tools in the form of collaborative systems and the right level of expert advice.

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8 Department of Resources, Energy and Tourism, Australia (as of November 2010)
Schneider Electric’s Energy Management Solutions

Schneider Electric offers such a collaborative system that allows industrial companies to meet their automation needs and at the same time optimize the energy consumed in the production process to achieve their sustainability targets.

Through Schneider Electric’s suite of tools and services, industrial companies now have the ability to operate with an integrated architecture for both process management and energy management.

This is done through offerings on several levels:

- **Best-in-class power metering and monitoring solutions** that give users the visibility they need on electricity consumption in subsystems and on electrical flows to help improve efficiency.

- **Vijeo Citect SCADA** process control application that provides the site-wide process control and monitoring capability needed.

- **Historian**, the central data repository, which also has a ‘Process Analyst’ to enable viewing of trends and time-stamped alarm data on a single integrated display.

- **ION Enterprise power monitoring control application** that enables tracking real-time power conditions, analyzing power quality and reliability, and responding rapidly to events impacting power use.

- **Ampla MES** which draws from plant and business systems to deliver easy-to-understand, real-time intelligence for productivity analysis, data mining, querying and reporting. This way, the operations are linked seamlessly to business and financial KPIs through a single, open architecture.

- **Continuous improvement consulting services** that help make sure that the underlying architecture accurately reflects production and energy consumption patterns.

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9 Supervisory control and data acquisition
10 Manufacturing Execution System
For rapid and low-cost deployment in some verticals (cement and water facilities), the energy management solution comes in bundled best-in-class templates and standard configurations. For unique conditions and processes, a sophisticated, customizable production optimization system is designed.

These systems are scalable and can be easily integrated with existing automation architecture.

Of equal significance to the advanced tools is the expertise and support that consulting service teams at Schneider Electric bring to each unique energy management challenge. Through Schneider Electric's energy management solutions and support, awareness of discrepancies in energy consumption can help users minimize variability and waste. The
detailed view of how much energy is consumed (and how much energy is wasted), and at which processes, helps identify where the opportunities are for reducing variability or waste, what equipment or processes are underperforming, what types of operator behavior or operational procedures is significantly impacting energy use and what maintenance needs to be scheduled. Metrics such as Overall Equipment Effectiveness (OEE) and energy consumption per output unit can be viewed across time so that the impact of improvement initiatives can be assessed.

The approach that Schneider Electric uses to deliver this insight is two-pronged:

- Using PlantStruxure\(^\text{11}\) to automate active energy management into the process for real-time impact
- Using an Energy Management Information System (EMIS)\(^\text{12}\) to quantify energy waste in the process and identify continuous improvement projects

**Beyond Quick Fixes: The Value of a Roadmap**

While ‘low-hanging-fruit’ can bring immediate gains, Schneider Electric’s solutions and consulting services aim to take industrial companies further down the road to unlocking the full potential of energy efficiency gains.

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\(^\text{11}\) Schneider Electric’s collaborative system comprising I/Os, PLC, SCADA, Historian, MES

\(^\text{12}\) Schneider Electric’s solution for energy analysis, CO2 tracking, cost estimation, benchmarking, forecasting
The first step is EnergySTEP, Schneider Electric's energy audit methodology, which provides a comprehensive assessment and analysis of an industrial user’s current energy consumption, followed by the identification of specific energy improvement opportunities. The best approach to energy management for that operational environment is selected. This prepares the ground for effective root cause analysis, the fine tuning of underlying architecture, designing an energy management information system (EMIS) for comprehensive and real-time consumption visibility, and finally energy optimization systems at an enterprise-level.

Conclusion

Minimizing energy cost while still achieving overall production objectives is a formidable undertaking. Industry response has been uneven this far, and for the most part, ad hoc and incomplete. ‘Business-as-usual’ scenarios are no longer sustainable. While there have certainly been some sector-wide gains in energy intensity, this should not distract from the fact that even greater potential remains.

Industrial companies, seeking to unlock this potential, would do well to adopt an integrated system approach, leverage open, collaborative energy management solutions and work with specialists who understand energy management technologies and practices.¹³

¹³ The importance of working with solution providers who know best practice cannot be over-estimated. According to the International Energy Agency (IEA), if best available technologies and practices were deployed globally, industrial energy use could be reduced by 20 to 30 percent.
Reaping the Benefits: LY Steel leverages Schneider Electric’s Energy Management Solutions

1. The Company
LY Steel, major Chinese producer of sheet steel, with an annual output of 6.5 million tonnes.

2. The Challenge
High energy costs incurred in the production process. Lacked tools for visual analysis to manage and consolidate comprehensive energy data.

3. The Solution
Schneider Electric’s energy management solutions: Integrated and open SCADA and Historian solution designed by Schneider Electric’s energy management specialists.

4. The Benefits
A 50 percent improvement in energy efficiency and a 70 percent reduction in maintenance costs. Savings of 4 yuan (about 60 US cents) per tonne of steel, or US$3 million a year.

Source: Schneider Electric