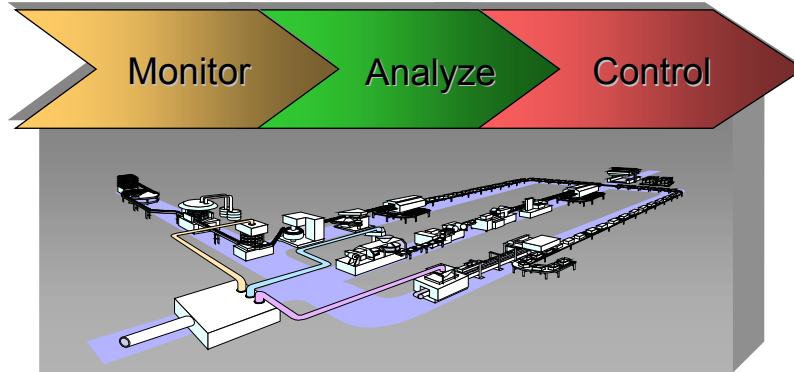


Rockwell Automation’s Users Realize Quick Return on Energy Solution “ROE” Investments

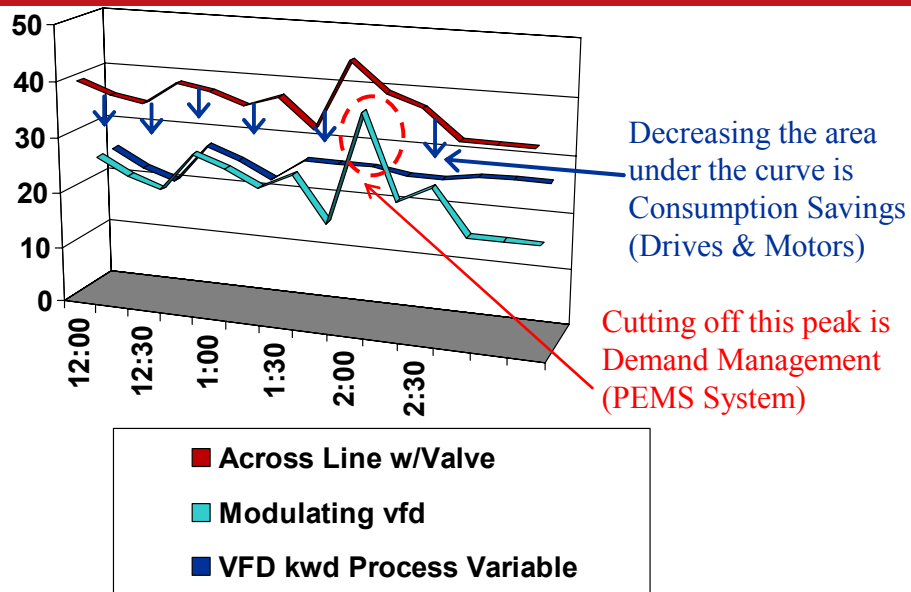
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Rockwell Automation Energy Solutions



Rockwell Automation integrates a broad scope of solutions to *manage and optimize energy* across the industrial enterprise.

Consumption Management + Demand Management = Maximum Value to Rockwell Customers



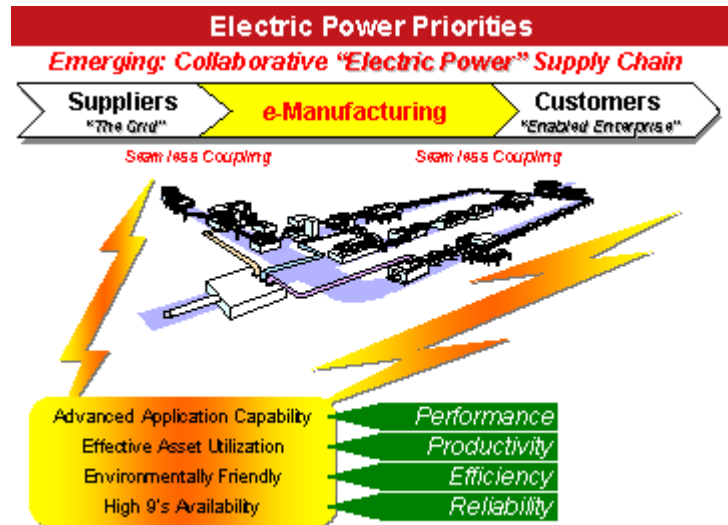
Introduction

Rockwell Automation is a \$4.3 billion business with 64 manufacturing locations, 620 sales and support offices, 5,600 distributors and agents, and 23,000 employees. Rockwell Automation's products and services fall into three categories: Power Conversion and Control, Control Platforms and Components, and Software and Services. Thirty-nine percent of the company's revenues, or \$1.7 billion, come from products that manage and control electric power delivery to motors or convert electric power into mechanical or rotational movement via motors and gears, the muscle that moves manufacturing.

Manufacturers are more tightly coupling their manufacturing with the supply chain. This seamless combination of automation, information and operation technologies enables scalable solutions that create positive investment returns. Factory-floor information enriches all enterprise layers, enabling relevant, timely decision making that creates uptime – essentially adding capacity without adding costly assets.

But only having an information-enabled plant is not enough. These factory-floor brains need muscle and blood, motors and electric power, to implement e-manufacturing. Maintaining a reliable electric power source and enabling the factory to manage energy use efficiently must also be integral parts of effective e-manufacturing. Rockwell Automation approaches manufacturers with this systemic approach, keeping systems fully operational, increasing capacity, reducing costs and the need for additional assets.

This white paper will explore the topics of industrial energy management, focusing on energy as a strategic business issue, how all plant assets must contribute to higher revenues and lower costs, and identifying targets for energy efficiency programs. It will also focus on Rockwell Automation energy solutions, such as Industrial Power & Energy Management Solutions (PEMS), optimizing motor system efficiency, manufacturing power solution packages, and technology partnerships with the U.S. government. Finally, it



Effective power management, energy management, and energy optimization is not an option, it is a strategic business imperative.

will conclude with Rockwell Automation demonstrating their position as a single source of energy solutions and support, backed up by case studies.

Knowledge is Power: Industrial Energy Management

A flat economy puts tremendous pressure on manufacturers worldwide to aggressively find ways to lower variable costs. Simultaneously, headlines around the world increasingly point to a renewed focus on the need for energy efficiency. Focusing on energy consumption is ideal, as this is sensitive to sharply increased energy prices and regional energy shortages. Industrial energy users are being pressured by regulators, market conditions and their own initiatives to lower energy expenses while maintaining productivity. This seemingly contradictory mandate is causing havoc in board rooms around the globe.

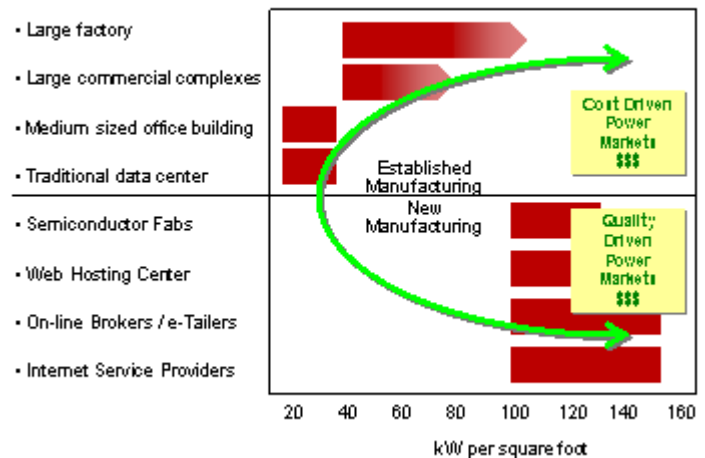
A key component of energy costs is of course electricity. In the United States, manufacturers spend over \$33 billion per year on electricity. Motor systems in particular consume 63 percent of all electricity in the U.S. industrial sector. Electricity costs are rising rapidly, as witnessed by California's energy crisis and the doubling of wholesale power prices in the past three years.

Industry Categories	Net Electric Demand* (GWh/Year)	Motor System Energy as % of Total Electricity
Manufacturing	917,834	59%
Process Industries	590,956	71%
Metal Production	152,740	30%
Non-metals Fabrication	106,107	47%
Metals Fabrication	68,031	37%
Non-manufacturing	167,563	82%
Agricultural Production	32,970	41%
Mining	44,027	90%
Oil and Gas Extraction	33,038	90%
Water Supply, Sewage, Irrigation	57,528	95%
Total All Industrial	1,085,397	62.6%

More than 13.5 million electric motors of one horsepower or greater use 63 percent of the industry's electricity when converting electricity into mechanical energy in U.S. industrial process operations. (Source: U.S. Industrial Motor Systems Market Opportunities Assessment," Dec. 1998, by DOE)

One prediction is certain: all energy use will rise. Over the next two decades, the Department of Energy (DOE) forecasts increases in industrial natural gas and petroleum use 31 and 25 percent, respectively. As far as electricity is concerned, power density, or kilowatts of energy used per square foot, is increasing not only in traditional-economy applications such as large factories, commercial complexes, and data centers, but also in new-economy applications such as e-manufacturing processes, Web hosting centers, Internet Service Providers, and on-line brokerages. Also, the migration of mechanical applications towards electrical systems and the growing use of information technology equipment on the plant floor are both increasing demand and driving power density higher. Combine these forecasts with the current reality that power costs already exceed labor costs in some industries, and the conclusion is that Energy-optimizing is a necessity for all manufacturers' long term survival.

Power Density Is Increasing - Diverging Markets



Initiatives are under way by both the U.S. government and the utility industry to encourage reduced energy consumption while efforts are ongoing to plan and build new power generation capacity to resolve the instability and choke points found in the nation's power grid. In fact, the DOE has projected a need for 1,300 new power plants by the year 2020, averaging 300 megawatts in size. However, this does not address the short-term supply problems, which can only be solved if manufacturers implement various energy-efficiency measures in-house to both reduce consumption and lessen demands on the grid, while simultaneously reducing their costs.

Energy is a Strategic Business Issue

Energy is a strategic business issue for all manufacturers. Internally, committees are developing corporate energy strategies and examining historical energy usage to reduce demand and negotiate favorable contracts with electricity suppliers. Manufacturers are considering multiple supply sources, on-site generation, and alternate energy procurement agreements. While efforts are underway to meet future energy needs, both traditional and new-economy manufacturers still have to run their operations profitably today.

Manufacturer's have many business drivers for taking energy management initiatives, such as reducing energy dollars spent per unit of production, optimizing the cost of producing each individual product while increasing the overall value of the assets used in the plant. Reducing the cost of collecting energy data is also a key driver, as this is most cost-effective when auto-

Manufacturer's Drivers for Energy Management

- Reduce energy cost per unit of production
- Reduce cost of collecting energy data
- Establish electrical capacity plan
- Prevent unplanned production shutdowns
- Prevent premature equipment failure
- Establish predictive & preventive maintenance
- Manage the energy procurement process
- Prepare to buy deregulated, curtailable power
- Monitor CO₂ baseline and plan for reductions

ated. Manufacturers are also driven to establish an electrical capacity plan to determine if their electrical infrastructure can support increases in production to avoid unplanned production shutdowns. Another driving force to avoid unplanned shutdowns is to reduce premature equipment failure, which also allows manufacturers to establish pro-active predictive and preventative maintenance programs. Finally, manufacturers are driven to manage their energy procurement process, especially when

purchasing in a competitive environment where rates can be time of day dependent, as well as monitoring energy by-products such as carbon dioxide.

Assets Must Contribute To Revenues

In all industries, shareholders and financial analysts are driving manufacturers to improve bottom-line performance by operating more efficiently. Metrics, including return on net assets (RONA), are increasingly scrutinized. To remain successful, manufacturers must invest in power optimization tools and expertise to manage these unpredictable costs. Most importantly, these investments need to be made with the assurance of a quick return on investment.

Energy needs vary by industry and manufacturing process. In industries that are more cost-driven, such as metals, paper or chemical processing, energy is viewed as a key and significantly large cost variable. In industries that are more reliability-driven, such as semiconductor and pharmaceutical, energy is viewed as a quality-process variable, requiring reliability-driven energy for acceptable product output. Getting reliable energy may require conditioning incoming utility power to eliminate process poor power quality and the resulting equipment deterioration.

Whatever the primary driver for manufacturers' concerns about energy, they're getting help from the manufacturers and suppliers of components that previously may have been perceived as modest solutions to energy consumption problems. More than ever, power optimization tools, such as software, variable frequency drives, energy-efficient motors and gears, motor controllers, power monitoring equipment, and energy management support services, are having an immediate, measurable impact on a company's bottom line.

More than ever, power optimization tools, such as software, variable frequency drives, energy-efficient motors and gears, motor controllers, power monitoring equipment, and energy management support services, are having an immediate, measurable impact on a company's bottom line.

Automation suppliers can help manufacturers manage and minimize energy consumption with a suite of products, solutions, and services focused on maintaining or exceeding current productivity levels while providing a quick return on the capital investment. For example, many energy optimization goals are only geared toward energy conservation, or simply using less energy without regard to the effect on manufacturing output. Automation suppliers must be focused on solutions that use less energy to result in an equal or greater amount of manufacturing output.

In this context, automation suppliers have an opportunity to offer products and services that have measurable return on investments (ROI), which are justifiable capital improvements for manufacturers. The challenge for automation suppliers is to provide manufacturers with metrics on their products and services to determine ROI. This is the only way manufacturers can justify retrofitting what is not broken. Capital investments for facility improvements are hard to come by. Manufacturers want to make energy investments that create proven, long-term savings. More than ever, an assurance of this return is driving capital spending.

These investments vary from one manufacturer to another. There's no one-size-fits-all solution. That's why automation suppliers listening to the manufacturer is the first and most critical step to integrating energy-optimizing solutions. Reducing energy costs and improving the bottom line is a logical process, starting with an assessment of current energy consumption. Energy experts should first perform energy audits on facilities to help identify savings opportunities.

Identifying Targets for Energy Efficiency Programs

A key question facing manufacturers is how energy efficiency and utilization can be monitored and managed. The answer is by focusing on data collec-

tion and analysis, correlating energy usage with production requirements, and managing the effects of weather and other external variables. Manufacturers can then effectively control energy costs and economically justify energy management programs.

When manufacturers have the right energy and system data, they're in a better position to negotiate lower energy rates. They also benefit from improved electrical system operation, faster identification of power system problems, reduced power demand charges, reduced costly downtime and startups due to unexpected blackouts, and minimized costly equipment damage.

Any targets for energy efficiency programs should incorporate motors, since they consume 63 percent of all electricity in the U.S. industrial sector. To prove the potential savings, the DOE sponsored a study in the late 1990s that looked for ways to save energy costs in industrial applications with high motor system content. That study showed that implementing efficiency measures yielded an expected total energy cost savings of 14.8 percent across all industries.

Potential Energy Savings from Industrial Motor System Efficiency Measures by SIC

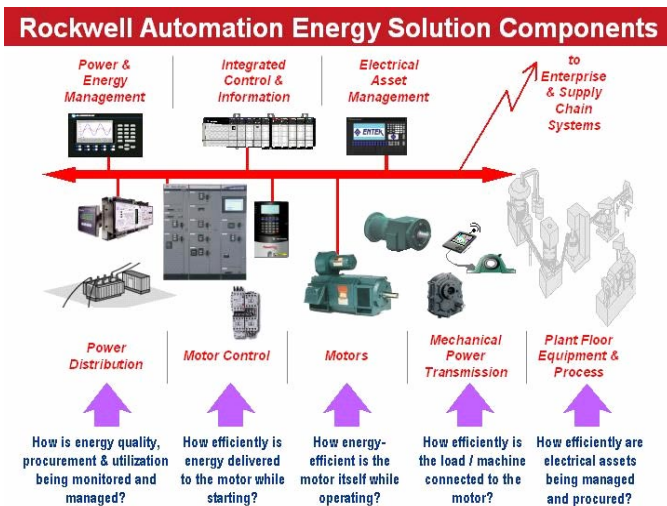
SIC	Industry Category	Estimated Savings (GWh/Year)							All Systems	As % of Total Energy
		Fan System	Pump System	Compressed Air Systems	Other Proc. Systems	Motor Upgrade	Motor Downsizing	Replace vs. Rewind		
20	Food and Kindred Products	157	1,250	494	517	1,376	585	295	4,674	12.4%
21	Tobacco Products									
22	Textile Mill Products	170	593	408	166	743	305	121	2,506	15.0%
23	Apparel & Other Textile Products	1	0	68	15	47	22	8	162	13.9%
24	Lumber and Wood Products	153	243	324	341	432	336	184	2,013	8.8%
25	Furniture and Fixtures	87	5	78	33	173	68	26	471	12.7%
26	Paper and Allied Products	1,082	6,293	773	881	3,197	845	870	13,942	14.0%
27	Printing and Publishing	52	17	74	90	305	153	39	731	12.3%
28	Chemicals and Allied Products	942	7,556	6,813	994	4,219	1,409	1,255	23,188	16.1%
29	Petroleum and Coal Products	271	6,159	1,352	169	1,736	459	453	10,599	20.4%
30	Rubber and Misc. Plastics Products	113	1,851	813	411	1,498	435	303	5,424	14.8%
31	Leather and Leather Products	27	0	0	0	22	6	3	58	11.8%
32	Stone, Clay and Glass Products	31	18	96	20	117	45	14	343	15.4%
33	Primary Metal Industries	738	1,537	2,150	1,085	3,199	983	749	10,441	11.9%
34	Fabricated Metal Products	34	181	303	80	298	195	46	1,137	15.6%
35	Industrial Machinery and Equipment	28	195	200	94	368	208	44	1,138	15.4%
36	Electronic and Other Electric Equipment	18	1,554	513	43	609	222	93	3,053	23.1%
37	Transportation Equipment	353	1,109	941	242	1,195	340	235	4,415	14.9%
38	Instruments and Related Products	71	119	123	78	263	169	39	862	13.3%
39	Misc. Manufacturing Industries									
	<i>All Industry Groups</i>	4,330	28,681	15,524	5,259	19,799	6,786	4,778	85,157	14.8%

Numbers printed in blue show SIC/system types with greatest potential for systems savings

Rockwell Automation Energy Solutions

Helping to manage and minimize energy consumption is an opportunity that automation suppliers such as Rockwell Automation have responded to with a suite of solutions. This suite of electric power solutions spans from the motor and gearing, to controls, and to broad facility-wide energy management. Optimizing individual energy consumption is not optimal in an overall system sense. However, optimizing the integration of these solutions will give manufacturers the lowest total motor system energy cost.

Rockwell Automation energy solutions range from control products on the plant floor to facility-wide energy management control. Along with energy auditing services, they offer manufacturers a variety of calculators used to estimate energy savings before making capital investments to reduce power consumption. By matching and integrating energy-saving components, the result is that the parts can become greater than the whole. Combining energy-efficiency components creates a multiplier effect, providing greater energy savings than by addressing isolated components. Optimizing the integration of these solutions will give the manufacturer the lowest total motor system energy cost. Done correctly, manufacturers can save 30 percent or more of their total energy cost.



Industrial Power & Energy Management Solutions (PEMS)

The Rockwell Automation Power and Energy Management Solutions (PEMS) business uses data analysis as a first step to help manufacturers integrate turnkey systems that are custom-configured to meet particular needs. Since a first-hand understanding of a customer's process is critical, PEMS energy experts conduct energy audits to determine the best energy savings plan. The process includes preliminary data gathering, such as assessing utility bills, energy tariffs and facility drawings. Auditors conduct plant walk-throughs to visually inspect the facility, listing major loads and document key measurements as appropriate. After reviewing gathered data, auditors calculate options, review results and formulate recommendations. The for-

matted report includes an executive summary, facility description, energy bill analysis, energy conservation opportunities (ECOs), and an action plan.

PEMS engineers use Rockwell's Activity-Based Costing (ABC) tool as a means to measure manufacturing line and building area energy usage. This helps manufacturers more accurately determine production cost or occupancy charges than traditional "square foot" billing. Other PEMS offerings include:

Rockwell Automation's PEMS Offerings

- **Data Analysis**
- **Energy Audits**
- **Load Profiling**
- **Demand Management**
- **Power Control**
- **Power Quality**

Load Profiling (LP) – This measures the electrical consumption over a period of time, creating a pictorial graph that allows users to purchase power "intelligently" in a competitive power industry. This step enables better demand management.

Demand Management – By controlling electrical loads, manufacturers can save money by avoiding demand penalties or participating in utility curtailment programs.

Power Control – Users can reduce cost through co-generation or ensure continuing operations with emergency backup by integrating energy monitoring with on-site power generation.

Power Quality – To identify or prevent unplanned shutdowns or equipment damage, PEMS engineers can work with manufacturers to monitor and optimize the quality of electrical power.

Steel bar producer Republic Technologies International (RTI) based in Canton, Ohio, spent \$2.7 million per month on electric power, a significant share of its operating expenses. The company worked with Rockwell Automation to integrate a demand-management system that inhibits or sheds electric furnace loads to control power demand. The system regulates plant electrical consumption to pre-set limits, calculating projections every five seconds at the plant mains and three main furnaces.

The demand management algorithm is highly accurate, permitting the system to delay shedding furnaces as long as possible and reducing electric power costs, avoiding both demand-limit rate increases and curtailment clause enforcement. RTI recovered its total installed cost of \$300,000 in less than six months, saving in excess of \$800,000 in annual substation manpower costs and reduced monthly demand charges.

RTI saves in excess of \$800,000 annually.

Upper-tier automation suppliers are increasingly positioning themselves as full-service providers to the manufacturing customer base that they serve. Many of these suppliers, including Rockwell Automation, are forging this new market position in spite of a legacy perception as a product-oriented company. Rockwell Automation has a long-standing reputation for providing a complete portfolio of industrial products, offering virtually a “one-stop-shop” for motors, variable speed drives, mechanical power transmission, smart motor controllers, and electro-mechanical products. In most cases, these products are combined to form manufacturing power solutions.

Optimizing Motor System Efficiency

Since motor systems consume nearly 63 percent of industrial energy, auditing them is the most logical starting point to find ways to conserve energy and reduce costs. The savings potential can be determined by the following factors:

How efficiently is energy delivered to the motor while starting?

Starting a motor using direct line power increases stress on the mechanical system. Belts slip and squeal, chains jump, and high pressure develops in pipes and ducts. Using smart motor control products with “soft starts” and “soft stops” reduces mechanical stress on systems and lengthens their productive lives, helping to reduce the overall long-term cost of equipment ownership (LTCO). Additional energy-saving features of smart motor controllers minimize energy consumption on unloaded or lightly loaded motors.

Motor System Savings Potential

- **How efficiently is energy delivered to the motor while starting?**
- **How energy efficient is the motor itself while operating?**
- **How efficiently is the load/machine connected to the motor?**

Centrifugal loads, such as pumps (which account for nearly 20 percent of the world’s electrical energy demand) and fans, offer the greatest energy savings potential when applications require less than 100 percent flow or pressure conditions. Very few applications require 100 percent pump and fan flow continuously, but many motors are started at full speed and remain running at full, fixed speed while in use.

Centrifugal systems often have peak and off-peak needs that can be met with a variable frequency drive. Integrating drives in a municipal water distribution system, for example, enables users to control flow by reducing or increasing motor speed rather than by opening or closing a valve to meet varying peak and off-peak water needs. Variable frequency drives help

eliminate valves, increase pump seal life, decrease power surge during start-up, and contribute to more flexible operation.

The previous modulating valve system ran 42,729 kW per month at a cost of more than \$4,500, compared to the new AC drive-controlled operation running 25,400 kW per month at a cost of less than \$2,700

Moulton Niguel Water District in Laguna Niguel, Calif., worked with Rockwell Automation to address this situation. In its old system, Moulton Niguel engineers used two 60 hp motors running at full speed and regulated flow with modulating valves, similar to creating a dam within the water pipes. This method used excessive electrical energy and added stress to the motors and system's pipes.

Rockwell Automation worked with the water district to install Allen-Bradley AC drives to regulate motor speed and, in turn, water flow. With AC drives controlling motor speed to meet demand, the water district saw improved performance and lowered electrical consumption. The previous modulating valve system ran 42,729 kW per month at a cost of more than \$4,500, compared to the new AC drive-controlled operation running 25,400 kW per month at a cost of less than \$2,700. The result was an electrical savings of 60 percent without added stress to the motors.

How energy-efficient is the motor during operation?

Motors are the heart of most industrial operations, and, in light of increased energy expenses, proper selection has never been more important. When replacing failed motors, installing motors in new applications, and retrofitting existing motors, users can improve facility performance, lower energy costs and take advantage of utility rebates with energy-efficient motors. To ensure maximum efficiency, Rockwell Automation developed the Reliance Electric XE motor in full compliance with the newly established NEMA Premium efficiency standard, the measure by which utilities pay rebates.

How efficiently is the load/machine connected to the motor?

Many motor applications, such as conveyors and mixers, require gear reduction to multiply torque and reduce speed. Picking the right gear type allows cost-efficient, higher-speed reductions. Long, near-continuous operations and/or areas with high energy costs are very good candidates for analysis. Proper installation of equipment and alignment of mechanical transmission equipment will reduce energy losses and extend equipment life.

Additional energy savings opportunities are possible by closely matching and optimizing the motor control, motor and mechanical power transmission

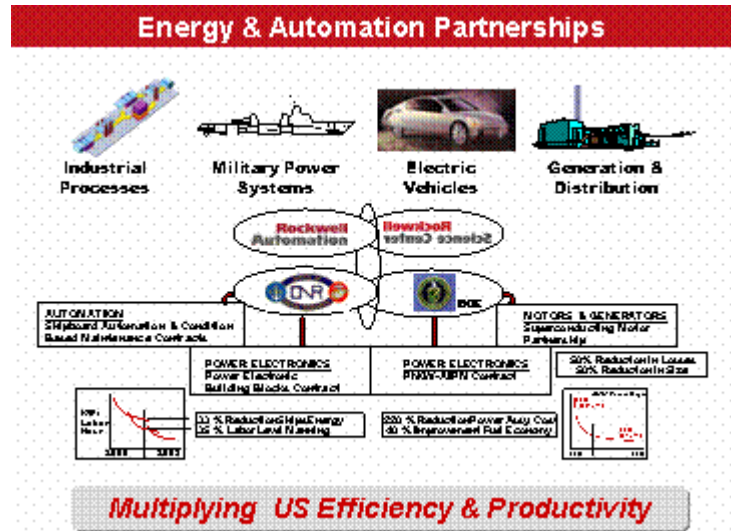
components as a system. Thorough evaluations by energy engineers help users find these opportunities.

Gearing For Energy Efficiency

Gearing is a common method of speed reduction and torque multiplication. Choices of gearing types can offer cost and efficiency alternatives from worm to helical. A gearmotor "consumes" a certain percentage of power when driving a given load. As losses due to friction from gear contact are reduced or minimized, efficiency improves. Tradeoffs must be made between the use of loss-efficient helical bevel gears over more cost-effective worm gears. Manufacturers addressing a wide range of applications and performance needs can leverage this for energy-efficient gearing solutions and advanced, integrated gear-motor packages.

Technology Partnerships with the U.S. Government

Rockwell Automation, through cost-sharing partnerships with the U.S. government, is helping to apply advanced technologies to reduce America's energy consumption. One area is partnering with the U.S. DOE Superconductivity Partnership Program to demonstrate high-horsepower superconducting motors. These motors will cut energy losses in half while reducing greenhouse gasses associated with power generation. A 1,000-hp, high-temperature superconducting motor, the largest of its kind in the world, is operating under full load in Rockwell Automation's Cleveland laboratories as a proof of concept. This research will contribute to the commercial success of superconductivity as a viable energy-saving solution. Another area is partnering with the U.S. DOE New Generation Vehicles Program, developing an efficient and cost-effective automotive power module to help U.S. automobile manufacturers reach the goal of an 80-mile-per-gallon, market-friendly family sedan. The automotive power module is being demonstrated to U.S. automobile manufacturers at Rockwell Automation's Advanced Technology Laboratory in Milwaukee. Engineers are developing power-saving technology from this module for use in distributed generation and commercial air-conditioning equipment to re-



duce energy usage. Finally, partnering with the office of Naval Research, Medium Power Building Block Program, to improve the energy efficiency of U.S. Navy ships by 33 percent, extending cruise range and lowering fuel costs with power electronic building blocks to control shipboard motors. The first power electronic building blocks were delivered to the Navy in 2000.

Conclusion: A Single Source of Energy Solutions and Support

In today’s dynamic, global, and highly competitive market environment, manufacturing efficiency and agility is not an option, it is a strategic mandate. Performance pressures on manufacturing companies today are greater than ever. They have to do more with less, and do it faster. Effective energy management and energy optimization solutions must be key elements of a manufacturer’s complete automation strategy. So how does Rockwell Automation match up against other automation suppliers who offer energy products and solutions? While no single vendor offers all capabilities needed to fulfill all the needs of manufacturing, Rockwell Automation is uniquely positioned to apply energy solutions across the entire industrial spectrum. Rockwell Automation is the only company that can provide a single source of energy solutions and support ranging from mechanical power transmission, electro-mechanical motor control, motors, and variable speed drives to the full spectrum of systems and services including architectural linkage, electrical asset management, and power & energy management.

	Industrial Electrical Power				Systems & Services		
	Mechanical PT	E/M Motor Control	Variable Speed Drives	Motors	Architecture Linkage	Electrical Asset Mgmt	Power & Energy Mgmt
Rockwell Automation	█	█	█	█	█	█	█
GE		█	█	█		█	█
Emerson	█		█	█		█	█
Invensys	█		█	█		█	█
Siemens		█	█	█	█	█	█
ABB		█	█	█	█	█	█
Schneider		█	█	█	█		█
Eaton		█	█				█
Mitsubishi		█	█	█	█		

As a manufacturer of energy-efficient products and supplier of energy-saving solutions, Rockwell Automation is helping to lead the development of new energy-saving power technologies, such as semiconductor and switching technologies, to further reduce consumption. As these new technologies are implemented and new partnerships form in the United States and abroad, manufacturers will benefit from modern processes and facilities, distributed intelligence, smooth and precise motor control and distribution generation, all designed to reduce capital spending on energy costs and maximize asset productivity.

All of this has led to an evolving of the historical-based perceptions about Rockwell Automation, beginning to see them as a solutions company focused on meeting the business needs of manufacturers, which today universally include lower total cost of ownership (TCO), reduced time to market, and improved asset utilization.

Energy Solution Case Studies

These case study summaries demonstrate sound energy conservation management principles with real return on asset and lower total cost of ownership results.

CASE STUDY: AC DRIVE SOLUTIONS

In its Manchester, N.H., presence sensing business manufacturing facility, Rockwell Automation installed Allen-Bradley AC drives to lower air compressor frequency to 46 Hz, down from full-speed of 60 Hz, to maintain the required 90 p.s.i. This controlled decrease saved 15.2 KWH and, at a rate of \$0.09 per KWH and 8,760 hours of use per year, saved \$12,183 before any utility energy-savings rebate.

Manufacturer: Rockwell Automation
 Presence Sensing Business
Challenge: Improve energy efficiency in air compressors
Performance Impact of: AC drives
Result: Saved \$12,183 per year on utility bill

CASE STUDY: PEMS SOLUTIONS

In its Landerhaven, Ohio facility, Rockwell Automation needed to reduce electric power costs in a 470,000 square foot, all electric building that used about 40MW of electricity per year at a cost of \$3 million. They installed a PEMS (Power & Energy Management Solutions) Load Profiling & Cost Allocation System. The result was that the PEMS system provided energy data

Manufacturer: Rockwell Automation
Landerhaven, Ohio
Challenge: Reduce electric power costs in 470,000 sq.ft. building
Performance Impact of: PEMS
Result: Saved \$406,000 over three years on utility bill

that was used to renegotiate lower energy rates, leading to a three-year cost savings of \$406,000 from renegotiated rates alone. Other benefits included the ability to do power quality monitoring to pinpoint utility voltage problems, and the ability to do demand trending, which helps in limiting demand during peak hours.

CASE STUDY: MOTOR CONTROLLER SOLUTIONS

At the Elsinore Valley Water District in southern California, minor voltage imbalances were causing a 15 to 20 percent current unbalance. As a result, the incoming three-phase currents drawn by the motors were unbalanced. The frequent unbalances caused the pumps to shut down five to seven times a week. Each shutdown hindered the pumps’ ability to meet the 50,000 gallons of water needed in the district each day, and cost Elsinore nearly three hours of labor each time the pump controller needed to be manually re-set after shutdowns, pumps that were located on a remote site alongside a mountain.

Rockwell Automation worked with Elsinore to install an Allen-Bradley Motor Controller to control the district’s main 100-hp motor. This motor controller includes an automatic phase rebalancing feature that compensates

Manufacturer: Elsinore Valley, Calif.,
Municipal Water District
Challenge: Motor and pump shutdowns due to unbalanced power
Performance Impact of: Motor Controller
Result: Eliminated motor and pump shutdowns, 3 hours labor each, reduced current unbalance from 20 to 3 percent

for the negative voltage-unbalance effect by automatically adjusting the voltage output to balance the three-phase currents drawn by the motor. The controller eliminated all pump shut downs and reduced the current unbalance from an average of 20 percent to only three percent, helping extend motor life and support continuous operation. An additional benefit was the fact that the pump control feature reduced motor torque, protecting pipes and valves from sudden water surges and hammering, increasing Elsinore’s return on

assets and lowering their total cost of ownership.

CASE STUDY: AC DRIVE & SOFT STARTER SOLUTIONS

The city of Sandusky Water Department’s water lines were frequently breaking, causing recurrent disruptions in water service, road closures and an increased risk of system contamination. At the root of the problem was a 1940s vintage costly, inefficient and labor-intensive pump process requiring changing throughout the day to meet fluctuating water district needs. High-

service pump startups used excessive electricity, and pump changes created water hammer, a phenomenon where sudden pressure fluctuations can cause pipes to shake and possibly break.

Rockwell Automation worked with Sandusky to install AC drives to control pump motors and provide precise water pressure control, leading to significant energy savings. The AC drives decreased the need for time-consuming pump changes, reduced electrical costs by more than \$31,000 over 12 months, and lowered water main breaks by 76 percent, resulting in more reliable water service to residential, industrial and fire protection consumers. An additional benefit was the fact that reduced pump start-ups provide more constant water flow to satisfy demand, resulting in better water treatment, chemical dispersion and longer pump life, increasing Sandusky's return on assets and lowering their total cost of ownership.

CASE STUDY: PLC & SOFT STARTER SOLUTIONS

As the world's largest manufacturer of steel wire, the Belgian Bekaert Group has a long history of incorporating industrial automation tools. To prevent sudden changes of mass flow in its six main water pumps and pipes from causing surges that could damage seals, create water hammer, or implode pipes, the company worked with Rockwell Automation to optimize and protect pump control.

Each pump is now controlled and protected by its own Allen-Bradley soft starter connected to an Allen-Bradley PLC via remote I/O. The starter measures the actual load while starting and stopping, and evaluates it in relation to the centrifugal pump characteristics stored in the device. This intelligence allows the pumps to energize a signaling relay as soon as the drive reaches its design speed; avoid stalling while running up; automatically trip the motor as soon as the pump is stationary after a soft stop; and maintain the minimum current while starting and stopping. Bekaert engineers concluded that this safety measure is the best possible investment against a system failure. Additional benefits were reducing staffing from a full time operator to a tour of inspection every second day, minimizing training

Manufacturer: Sandusky, Ohio, Water Department

Challenge: Convert low-service raw water pump to a high-service pump

Performance Impact of: AC drive, improved efficiency motors, and soft starter

Result: 76 percent reduction of water main breaks, \$31,792 savings in electric power costs per year

Manufacturer: Bekaert Group - Belgium Steel Wire Producer

Challenge: Uninterrupted supply of water for annealing wire

Performance Impact of: PLC & soft starter
Result: Reduced staffing, less mechanical stress and damage to pumps and motors

requirements due to the ease of operation, and allowing the operators in a remote control room to monitor the system and alarms.

CASE STUDY: MEDIUM VOLTAGE DRIVE SOLUTIONS

With over \$25 million a year spent on electricity costs, Chevron's Richmond, California refinery engineers are always looking for ways to cut energy use. With capital spending limited, any upgrades must show a quick guaranteed return on investment.

Manufacturer: Chevron Refinery (in partnership with Planergy)
Challenge: Improve energy efficiency and process difficulties caused by vibration
Performance Impact of: Medium Voltage Drives
Result: 4.4 M kWh/yr, \$340,000 total energy savings per year with two drives, reduced vibration amplitudes, and no bearing or seal problems

Two pumps in the refinery's diesel hydro treater were known to be oversized. In some cases, they were operating at 40 percent below best-efficiency points, resulting in low hydraulic efficiency and excessive vibration. Chevron partnered with Rockwell Automation to install

Allen-Bradley medium voltage drives on the 2,250-hp primary feed pump and 700-hp product pump to reduce vibration and lower energy consumption. Pump #1 reduced vibration amplitudes from 0.3 ips to 0.12 ips, while pump #2 had vibration reduced by a factor of 3 at slower speeds. The drives permitted use of Chevron's existing standard motors, as opposed to replacing the standard motors with inverter-duty motors, which would have decreased Chevron's return on the drives investment. The result is annual savings of \$220,000 and \$120,000 on the 2,250-hp and 700-hp drives, respectively.

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Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/arcweb/Community/terms/indterms.htm

AI	Artificial Intelligence	EPM	Enterprise Production Management
ANSI	American National Standards Institute	ePS	E-Procurement Solutions
API	Application Program Interface	ERP	Enterprise Resource Planning
APS	Advanced Planning & Scheduling	HMI	Human Machine Interface
B2B	Business-to-Business	IT	Information Technology
B2C	Business-to-Consumer	LAN	Local Area Network
BPR	Business Process Reengineering	MIS	Management Information System
CAGR	Compound Annual Growth Rate	MRP	Materials Resource Planning
CAN	Controller Area Network	OLE	Object Linking & Embedding
CEMS	Continuous Emissions Monitoring System	OPC	OLE for Process Control
CMMS	Computerized Maintenance Management System	PAS	Process Automation System
CNC	Computer Numeric Control	PID	Proportional Integral Derivative
CPG	Consumer Packaged Goods	PIMS	Process Information Management System
CRM	Customer Relationship Management	PLC	Programmable Logic Controller
EAI	Enterprise Application Integration	ROI	Return on Investment
EAM	Enterprise Asset Management	SCE	Supply Chain Execution
EC	Electronic Commerce	SPC	Statistical Process Control
eFS	E-Fulfillment Solutions	TMS	Transportation Management System
eIS	E-Integration Solutions	WAH	Web Application Hosting
		WMS	Warehouse Management System

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