



# energy-efficient drives

Answers for industry.

**SIEMENS**



Building costs: -7.5 %



Vehicle fleet costs: -20 %



IT costs: -25 %

#### Facts that speak for themselves:

- In industrial plants, drives account for just under 70 % of the electrical energy requirement
- By installing inverters and high-efficiency motors, 43 TWh of energy could be saved in the European Union alone – this equates to electricity costs of at least 3 billion euros or the energy generated by 19 fossil-fuel-fired power plant units



+



= Energy costs: -50%

## The most effective way of saving costs: Energy-efficient drive technology

Electric drives represent almost two thirds of the total industrial power demand. First, the bad news: As energy prices rise, this cost factor will have an increasingly negative impact on production costs. Now the good news: Almost every company can tap into an enormous energy saving potential. The reason for this is that up to 70% energy saving is possible using energy-efficient drives, especially in areas requiring a large amount of energy. So take the first step – with energy-efficient drive technology from Siemens.

Energy-efficient drive systems can assist companies in a number of ways. They help to reduce production costs, improve the return on investment, and lower CO<sub>2</sub> emissions. On a sustained basis and over the entire life cycle of the plant.

Particularly in energy-intensive sectors, using mechanically controlled pumps, fans and compressors or drives in continuous operation, switching to energy-saving systems has direct benefits. The investment will be recouped in a very short time. Within just a few short months for some applications.

One aspect worth remembering when choosing the right drive technology: Over the entire operating life of your equipment, not the procurement price, but the operating costs make the difference.

So this is what you should look at first, which is where we can help you. As one of the world's leading suppliers of drive systems, we can offer you a particularly extensive portfolio of energy-efficient drive technology – from individual products to expert advice and tools to special services that will help you to discover the full saving potential of your plant. Start thinking about energy efficiency now – you won't regret it.

# Where can the greatest savings potential be found?

In drive technology, operating costs are comparatively high in relation to the procurement costs. To illustrate: Operation accounts for 97% of the life cycle costs of a motor, of which the energy costs are usually by far the highest cost factor. Enormous potential for saving is just waiting to be harnessed.

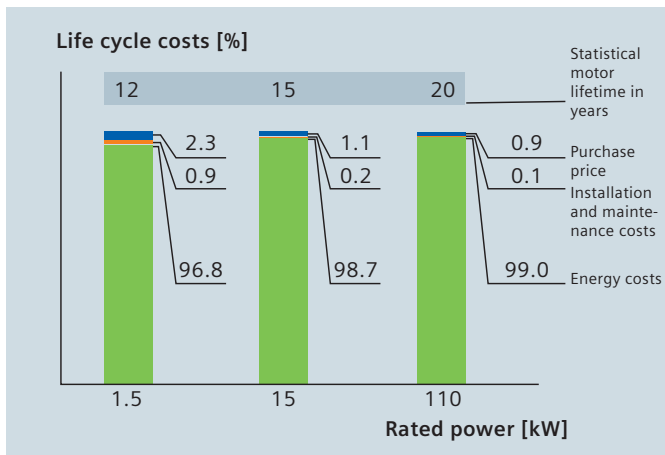
## Life cycle versus procurement costs

Despite high life cycle costs, it is usually the procurement price that tips the decision in favor of a particular drive technology. A fact that frequently works against energy-efficient drive technology; after all, the investment costs are higher. But it makes greater business sense to consider the entire life cycle balance of drives. Compare and contrast conventional technology with energy-saving systems and one thing will soon become clear: The high initial outlay for energy-efficient drives is usually recovered within a few months and sometimes operating costs are dramatically cut. Not only with respect to the energy costs but also in other areas like maintenance.

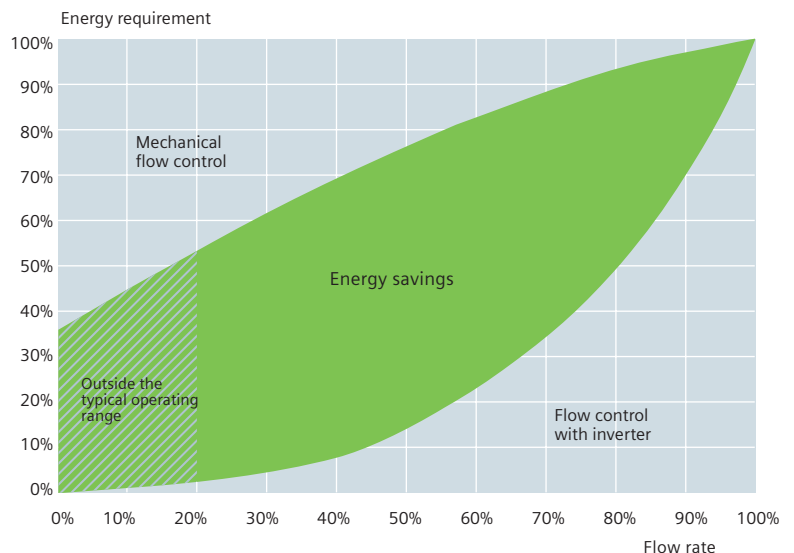
## Buy new or upgrade?

There are savings potential to be realized in almost every business. The decision on whether to introduce a completely new concept or upgrade your existing equipment must be made on a case-by-case basis. With new systems, it is relatively easy to calculate how quickly the additional costs for energy-efficient drive technology will be recovered. When considering an upgrade, it is important to look at the application. The more energy-intensive the application or the longer a drive operates at partial load, the faster an energy-efficient system will pay off.

We also have the tools and services to help you find the right energy-saving measures. Whatever you want us to do, whether it be to calculate the payback period of the additional cost for a high-efficiency motor or to perform an energy analysis of your entire plant. We offer you solutions for every type of industrial plant.



Users can effectively save energy using energy-saving motors



# Savings ripe for the picking: Pumps, fans, and compressors

The biggest potentials for saving are offered by pumps, fans, and compressors that are still operated with mechanical throttles and valves. Converting to variable-speed drives can produce considerable economic benefits.

## **Changing the speed rather than mechanically controlling the flow**

Mechanical control methods have many hidden disadvantages. For example, the motor runs continuously at the speed required for the maximum delivery rate, which is rarely needed in practice. Additionally, the throttles and valves lose energy and cause high temperatures and vibration levels which can have a negative impact on the drive and production operation.

Variable-speed drives with inverters offer a more economic alternative for a number of reasons. They can be controlled much more quickly and precisely. By adapting the flow rate directly to actual requirements, no more energy is wasted and savings of up to 60% – in extreme cases even up to 70% – can be achieved, especially in energy-intensive applications.

## **Reducing costs, improving processes**

Compared with mechanical controllers, variable-speed drives reduce not only energy costs, but also maintenance and service costs. They also improve process quality and raise productivity. Current spikes during motor start-up and heavy torque surges are a thing of the past – as are pressure waves in pipe systems, cavitation and vibration, which cause lasting damage to plants. Smooth starting and coasting down is gentle on the mechanics and prolongs the lifetime of the entire drive train considerably.

In addition to the energy saving achieved by closed-loop speed control, our products also offer additional energy-saving functionality, for example, automatic motor shutdown in certain operating conditions. Inverters, such as our MICROMASTER and SINAMICS families, can be added to existing motors at any time. For best results, we recommend that the entire drive system is optimized, taking into account all of its components.





## Up to 50% more efficient: Drives that generate braking energy

Whether you are looking at hoisting applications, centrifuges or conveyor belts – inverters with regenerative feedback will cut your energy requirement considerably in all applications where large loads have to be frequently decelerated.

### Driving down high costs

In conventional drive systems, the braking energy generated is lost. Inverters with regenerative feedback capability from the SINAMICS family and the SIMATIC ET 200 inverter modules feed the braking energy of the motor back into the line supply instead of burning it up in brake resistors.

In hoisting applications for example, energy savings of up to 50% can be achieved by implementing intelligent infeed technology. There are other beneficial

side effects when using efficient infeed technology: For example, components such as line reactors and braking resistors can be dispensed with. Not only this, the current drawn can be reduced by approx. 20%. The space required for the drive system is also correspondingly lower and the amount of heat generated is reduced. Regenerative feedback into the line supply is possible either centrally (using the electrical cabinet) or in a distributed fashion (high degree of protection – stand-alone solution).

# Will it pay off?

## Your energy checklist

You can find out for yourself whether introducing energy-efficient drive systems will pay for itself. Just take a little time to analyze your systems using the following checklist. The more points apply, the higher is your potential for savings:

### Look at your primary processes

- Do they still use mechanical flow control?
- Do your motors run uninterrupted for long periods?
- Do you have many drives that run in partial load operation?
- Do you run processes where large loads are frequently decelerated?

### What secondary processes and building installations do you have?

- Is your factory equipped with air extraction and ventilation?
- Do you operate pumps that run permanently or frequently with a partial load?
- Are you familiar with all your auxiliary processes (conveyor belts, etc.)?
- Is it possible to shut down your auxiliary processes at the weekend?

### What about your electricity bill?

- Do you want to reduce the energy costs of your plant?
- Have you ever considered a holistic system analysis of your drives, which looks at everything from the energy management to the pipe lagging?
- Are you paying for reactive power?



#### Our energy-saving portfolio at a glance:

- A comprehensive range of energy-efficient motors in almost every performance class, with up to 40% lower power losses than standard motors
- The most comprehensive range of inverters available on the market, which, depending on the application, can result in electricity savings of up to 70%
- Regenerative feedback inverters with innovative infeed technology, which feed any braking energy generated back into the line supply and in the case of hoisting applications, for example, save up to 50% energy
- The SinaSave software tool, which calculates the total saving and payback period of high-efficiency motors or inverters
- A comprehensive service package for optimizing the power consumption of drive systems, called EOD, which will help you to identify inefficient electrical drives in your plant and implement the necessary improvements
- The Power Management System with SIMATIC PCS 7 powerrate and SIMATIC WinCC powerrate add-ons, block libraries for SIMATIC PCS 7 and SIMATIC WinCC and the SENTRON PAC3200 and SENTRON PAC4200 multi-function measuring devices for optimized energy usage where energy savings of up to 20% can be achieved



# More efficient all round: Siemens products and services

So what does the energy balance of your plant look like? What did the energy checklist on the previous page tell you? Have you already discovered potential for savings in your systems? Then there's no time to lose. We will assist you with all aspects of optimizing the energy consumption of your drive systems and actively support you in implementing improvements.

As your expert partner, we can offer you a comprehensive package for energy-efficient drive systems – from a single source. From the analysis of your plant to configuration and implementation of new systems to maintenance and service of those systems. Anywhere in the world. Our technical spectrum, which meets all international standards and specifications, is one of the most comprehensive on the market.

Beyond the field of drive technology, we can also offer you Totally Integration Automation and Totally Integrated Power, integrated solutions for your industrial automation and power distribution.

## **Totally Integrated Automation**

This product and system spectrum will give you integrated automation in all sectors, from goods-in to goods-out, from the field to the production level and through to the enterprise resources planning level.

Totally Integrated Automation is a platform on which all drive and automation components intermesh perfectly.

The benefits for you: reduced integration costs and transparency of your automation, in teleservice, commissioning, or operation/process decisions; reduced complexity in industrial plants and tangible cost savings throughout the life cycle.

## **Totally Integrated Power**

With Totally Integrated Power, we can offer integrated solutions for power distribution in functional and industrial buildings – from the medium voltage level to the power socket. Totally Integrated Power embraces not only harmonized products and systems for power distribution, but also efficient motors, motor starters, and inverters. Products and services are complemented further by software modules for communication or for integrating the power distribution systems into the building automation and power management systems. Thus our energy concept draws together all components of power distribution to form an integrated whole that will give you not only reliable but above all profitable power distribution.

# Unlock the real potential: with SinaSave

Our software tool SinaSave, which you can download free of charge from the Internet, will tell you precisely what potential for savings there are in your application and how fast an investment in an energy-efficient motor or an inverter will pay for itself.

You can spend all day philosophizing about possible savings, but our software tool will deliver the facts. Based on the key data of your system, SinaSave calculates potential savings for your specific application. The payback period is then derived from the total monthly savings of your application and the procurement and installation costs of your motor or inverter. Often it is just a few months.

## How SinaSave works

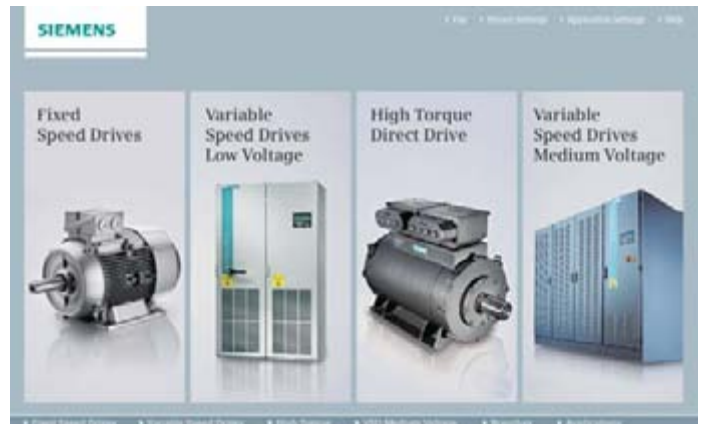
SinaSave has been designed to select an energy-efficient motor in on-line operation or an inverter for variable-speed and therefore energy-saving operation.

When connected directly to the line supply, you can calculate the cost-saving and payback period of our energy-saving motors class EFF1 (IE2) or NEMA Premium based on three comparison cases: compared to EFF2 (IE1) or EPAct motors, individually selected and known motors, or compared with known motors within a complete plant or system assessment.

In inverter operation, SinaSave looks at all the necessary system-specific parameters as well as values required for the process: for example, the flow rate of pumps, the density of the medium and the efficiency of the pumps, fans, and compressors of the entire system. Other basic data the program draws on are the number of working days and shifts as well as the delivery profile determining the energy-saving effect over the day and the year. Based on plant-specific data, the program derives a suitable drive system, calculates the price of a suitable inverter and derives the energy requirement of the variable-speed drive system as compared with all potential alternative concepts.

In addition to high-efficiency motors (IE2), SinaSave also includes low-voltage and medium-voltage inverters that are predestined for pump and fan applications. Further, the motor side has been supplemented by mechanical system analyses. High-torque motors have also been newly integrated into SinaSave. User-friendly functions, such as the automatic update function, an up-to-date currency table and improved export functions – such as sending pdf e-mail from SinaSave – round off the contents of the energy-saving tool.

For further information about our services, please go to:  
[www.siemens.com/energy-saving](http://www.siemens.com/energy-saving)



# A powerful energy-saving module within our energy optimization service (EOS).

In addition to determining the saving potential of individual applications, we also help you optimize the energy consumption of the entire plant with our energy optimization service (EOS). The EOD service package included in EOS focuses on drive systems in which the energy optimization will pay back the investment in no longer than two years. This offers targeted cuts in energy costs without a high initial outlay.

**To achieve maximum cost-benefit effectiveness, EOD uses a three-step optimization concept:**

## **Step 1: Estimate of potential**

Based on motor lists and operating times, we estimate the theoretical energy-saving potential and prepare a specific quotation for an energy analysis of your entire drive systems performed on your site.

## **Step 2: Energy management analysis**

In this in-situ analysis, we identify electric drives that are inefficient in technical and economic terms and determine the precise energy cost saving. We then work out a specific optimization concept by means of cost-benefit analyses, taking your technical requirements into account.

## **Step 3: Technical implementation**

In the last step, we take care of the technical and organizational implementation of the optimization measures based on result-dependent contracts.

## **Comprehensive energy optimization**

EOD is an important module in our comprehensive energy optimization service (EOS). As part of EOS, we examine not only drives but also all relevant energy processes and forms of energy in the plant for potential savings. With EOS, companies can usually cut energy costs by at least 10%.

You can obtain information about our services in the Internet at: [www.siemens.com/simain](http://www.siemens.com/simain)



# A whole range for energy efficiency: a run-down of our products



## Energy-saving motors

We can offer you high-efficiency aluminum and cast-iron motors to address the widest range of applications and for all international markets. When compared to standard motors, these motors have up to 40% lower power losses. Our portfolio includes everything: for voltages from 230 V to 13.2 kV, for power ratings from 0.12 kW up to 100 MW as well as the corresponding international versions with efficiency classes IE1 and IE2 according to IEC 60034-30 – and for the North American market in compliance with EPM and NEMA Premium. Our motors up to 690 V are available both for line supply operation as well as inverter operation and are perfectly matched to our SINAMICS inverters as well as SIRIUS motor starters.

The new international efficiency standard IEC 60034-30 also applies to explosion-protected motors. Loher GmbH – a Siemens daughter company – has specifically designed, among other things, a new series of flameproof encapsulated motors (type of protection Ex d) with the high IE2 efficiency classification. These high-efficiency Ex d motors in IE2 cover a range of power ratings from 0.75 to 375 kW, are available as 2-, 4- and 6-pole versions and for 50- and 60-Hz operation.

## Geared motors

For an improved energy balance, in the power range from 0.09 to 200 kW, we have a complete range of MOTOX geared motors for you. These can be used for applications in each and every sector. They distinguish themselves as a result of their extremely high nominal gear unit torques, a wide range of options and high efficiencies. Generally, helical, offset shaft and helical bevel gear units have efficiencies

of 98 % (1-stage), 96 % (2-stage) or 94 % (3-stage). From frame size 180 and higher, MOTOX geared motors have as standard efficiency class IE2. In addition to the energy costs, the operating costs are also important (life cycle costs). These can be optimized by precisely engineering the application. Optimization measures such as these include the mounting position, the gear ratio as well as the correct drive speed. More efficient drive solutions are obtained using the plug-on gear unit mounting type. When precisely engineered, these gear units operate with the ideal oil sump temperature and the lifetime of the lubricant, shaft seals and gearing is optimized.

## Inverters

For drive concepts that are fit for the future, we can offer you inverters to meet every requirement – with simple and standard tools for prompted commissioning. Intelligent Operator Panels (e.g. the IOP) significantly simplify operator control. The most extensive portfolio of inverters in the marketplace includes, for instance, the general-purpose MICROMASTER 420, MICROMASTER 440 with sensorless vector control for higher demands as well as MICROMASTER 430 with the energy-saving mode for pumps and fans. For complex plants and systems, we have our SIMATIC ET 200S FC and ET 200pro FC inverters. These are directly integrated into the distributed SIMATIC ET 200 automation system as modules.

Our SINAMICS drive family also provides the optimum inverter for every application. In the low-voltage range, these include e.g. SINAMICS G110 for low power ratings or SINAMICS G120 for a multitude of applications extending up into the medium power range. These are equipped with a whole raft of innovative functions



such as energy recovery and Safety Integrated. The SINAMICS G110D and SINAMICS G120D as single-axis drives up to 7.5 kW are available for distributed applications in a high degree of protection. On the other hand, SINAMICS G130 chassis units as well as SINAMICS G150 cabinet units have been specifically tailored for high-rating, single-motor drive applications, which do not require energy recovery. These applications include pump, fan and compressor drives up to 1500 kW.

In the medium-voltage range up to a power rating of 120 MW, we offer our SINAMICS GM150, SINAMICS GL150 and ROBICON Perfect Harmony. ROBICON Perfect Harmony is a transformer, power unit and closed-loop control in one drive unit that has a very high availability due to its innovative concept.

#### **Motor starters and soft starters**

Our communications-capable SIRIUS motor starters and soft starters are the right choice for switching, protecting and monitoring motors. Direct-on-line, reversing and soft starters cover the complete range – from the high number of switching operations to soft starting and stopping without mechanical or electrical peaks for pump and fan applications. From simple SIRIUS contactor combinations through pre-wired fuseless load feeders and soft starters up to motor starters for the distributed SIMATIC ET 200S and ET 200pro I/O. All of our motors and soft starters are especially space-saving, can be quickly installed and can be simply linked to the automation level via AS-Interface, PROFIBUS or PROFINET. Whether located centrally in the electrical cabinet or directly in the field – our motor starters are optionally equipped with intelligent monitoring functions, including



preventive maintenance and Safety Integrated functionality. With data – for instance maintenance data – you can eliminate failure times, with service data, you can minimize downtimes, and with the appropriate operating data, you have efficient energy management at your fingertips. With our motor starters and soft starters, you have a simple, practical and energy-saving solution for continuous operation and at a fixed speed.

#### **Power Management**

Power management systems help you improve the transparency of your energy requirements and energy quality and ensure the availability of the power distribution. With our innovative SENTRON PAC3200 and SENTRON PAC4200 multi-function measuring devices, which can be connected to the widest range of loads, you can continually measure electrical power values. The measurement results can be evaluated using the power management SIMATIC WinCC powerrate or SIMATIC PCS 7 powerrate add-ons. With the SIMATIC WinCC powerrate and SIMATIC PCS 7 powerrate add-ons – which are based on well-proven industrial technology – you can ensure that your power distribution and associated costs are transparent and monitored. Just the same as you are accustomed to with SIMATIC WinCC and PCS 7 when it comes to your technological processes. Thanks to the comprehensive and reliable functions, power data is continually acquired, archived, further processed, and assigned to the various loads. These devices also monitor the power peaks. All of these functions allow energy to be efficiently purchased and when all is said and done, they can reduce your power and operating costs by up to 20%.

# Tried and tested: Energy efficiency successfully implemented



MICROMASTER inverter ensures cost-efficient diesel transportation at Shell



Inverters permit 66% energy savings in a flue-gas filter system at Siemens

## More efficient pump systems at Shell

Shell Deutschland Oil GmbH has a large tank depot at Kaiserwörthhafen for transshipment and storage of gasoline and diesel engine fuels and light oil. The products are supplied via pipelines and barges, stored, and shipped onward in tank cars. The main pumps for this diesel transportation were to be operated at the optimum operating point. The aim was to save the excess energy previously lost via mechanical shut-off and control valves.

The solution: SinaSave revealed that the use of inverters pays off within a short period of time. Inverters MICROMASTER 440 frequency inverters with a power of 132 kW were installed as well as 1LG4 motors for the redundant pump system. The payback period is approx. 14 months. The monthly energy costs are reduced by 3,000 euros.

Beneficial side effect of the new technology: The processes were improved and the piping networks were relieved of surges caused by on-line operation of the main pump. This resulted in additional savings for maintenance and gave a lasting boost to plant availability.

## Energy-saving ventilation at the Siemens motor plant

At the Siemens production plant in Bad Neustadt, a ventilation system with throttle control and a 20-year-old motor had been in use in the flue-gas filter system of the aluminum-smelting furnaces. First of all, the previously used electric motor with a nominal power of 45 kW was replaced with an energy-saving motor. This alone resulted in an energy saving of over two percent, i. e. 535 euros per year.

The motor was also equipped with a MICROMASTER 430 inverter, which now not only controlled the motor speed but also the air-flow rate. Previously, the air flow had been controlled via a mechanical throttle valve. Both previous system components – the motor, which ran at high power at a constant speed, and the throttle valve with its resistance and energy loss – consumed a disproportionate amount of energy. The result was therefore doubly beneficial: Replacement of the mechanical control with the MICROMASTER 430 yielded an energy saving of 66%.

This holistic approach included replacement of the entire drive system, which runs 24 hours a day, reduced the power costs from previously 24,000 euros to about 7,000 euros per year.



Variable-speed drives ensure profitable water supply in Madrid



Energy optimization resulted in a high saving potential at the ALRO Group

#### Reliable and profitable water supply in Madrid

About 1,000,000 people live in the southern district of Madrid and they want to be supplied with water throughout the summer dry season. To achieve precise but flexible management of the water reserves, the Picadas I und II and Plaza Castilla central drinking water pump stations were equipped with variable-speed drive systems.

Via the motor speed, the delivery rate of the pumps can now be optimally adapted to the fluctuating water demand. Variable-speed operation reduces mechanical wear throughout the pump station and makes a double-figure percentage saving in energy compared to mechanical control concepts. Because of the large delivery rates – the pumps of the Picadas stations often have to handle 3.5 m<sup>3</sup>/s – drive powers in the megawatt range are necessary. For this purpose, medium-voltage inverters are used, in this case SINAMICS GM150.

The existing motors, which were still in good condition, were retained and – by using the inverter – upgraded to a variable speed drive system. Motors with excessively poor efficiencies had been replaced. This replacement boosted the efficiency from 92 % to 97 %. The total payback period for the complete investment was only 2 years.

#### Energy optimization at the ALRO Group

The surface treatment of plastic components and metal products by powder coating and wet painting is ALRO's core activity. At its factory in Limburg, Belgium, the saving potential for reduction of the power requirement of pumps and ventilators for a painting system for automobile components was to be examined.

The first step was a stochastic analysis of the potential of all installed pumps and fans with a power of 5 KW or more. In the case of 12 drives, a saving potential with a payback period of less than 1,5 years was identified. The pumps and the fans were previously controlled using throttles and valves. This technology with its associated losses was to be replaced by MICROMASTER 430 inverters.

The analysis revealed a saving potential of 19,870 euros per year for the 12 drives. The payback period is less than 1.5 years. So, it was an easy decision for the management to implement the project.

## Links – your click to added value

### Tools

[www.siemens.com/sinasave](http://www.siemens.com/sinasave)

[www.siemens.com/sd-configurator](http://www.siemens.com/sd-configurator)

[www.siemens.com/motox-configurator](http://www.siemens.com/motox-configurator)

[www.siemens.com/energy-saving](http://www.siemens.com/energy-saving)

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Drive Technologies

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