Optimized energy efficiency and cost effectiveness

effiDRIVE® energy-saving concepts
Going the energy-efficient way with effiDRIVE®

Dwindling resources and rising energy costs prompt all companies worldwide to analyze and evaluate the degree of energy efficiency of their systems as well as the amount of follow-up costs involved. They find that the energy costs of systems that have not been optimized with respect to their energy consumption can constitute up to 90% of the follow-up costs.

effiDRIVE® energy-saving concept for energy-efficient application solutions

SEW-EURODRIVE offers a comprehensive energy-saving concept to enable customers to tap all available energy saving potentials. It consists of:

1. Modular energy efficiency system
2. Energy consulting
3. Energy-efficient solutions

The energy-saving concept ensures a comprehensive review and consistent implementation of all energy-saving factors coming into consideration.

The basis of the concept is the modular energy efficiency system. It is made up of drive components that are highly efficient on their own. However, it is the clever combination of these individual components that achieves the best possible result for any application: Permanently low energy expenses.

This is why SEW-EURODRIVE also offers energy consulting, based on comprehensive experience with all drive technology components and close contact with our customers.
Reducing energy costs with effiDRIVE®

1. Modular energy efficiency system

2. Energy consulting

3. Energy-efficient solutions
Modular energy efficiency system

Energy-efficient components on their own, but even more impressive energy savers in a team.

The effiDRIVE® energy-saving concept is also based on the tried-and-tested modular system from SEW-EURODRIVE. It draws on a wide range of products with technically mature and energy-optimized components, such as:

- the new modular DR motor system
- MOVIGEAR® mechatronic drive system
- the drive and frequency inverters MOVIDRIVE® and MOVITRAC® or
- the MOVIAxis® multi-axis servo inverter

Just one individual drive component with optimized energy efficiency may be sufficient to achieve a positive energy balance. But it is only the combination of motor, gear unit, frequency inverter and controller that turns the individual energy-efficient drive components into real energy-saving solutions.
- The optimized components of SEW-EURODRIVE, i.e. motor, gear unit, inverter and controller, significantly reduce energy consumption.
- This is possible by taking into account the specific requirements of the application already when developing the individual components.
- A well-conceived interplay of individual components ensures optimum energy saving effects.
Energy consulting is the key service in the energy-saving concept of SEW-EURODRIVE. Only customer-specific consulting can determine the individual requirements of industries and applications and provide ideally suited energy-saving solutions. This applies both to planned and to existing systems.

**Consulting services in detail:**

1. Identifying and assessing the potentials for saving energy
   - Collecting application-specific customer data
   - Consulting on normative and legal requirements
   - Identifying energy-saving potentials
   - Prioritizing measures (package of measures)

2. Developing an optimization concept
   - Detailed analysis and determining the exact saving potentials
   - Defining the necessary investment
   - Calculating the profitability
   - Documenting the consultation results (optimization concept)

3. Verifying the energy-saving solution in addition to the technical implementation of the measures
   - Checking the result by verifying the predicted saving potentials (performance review)
   - Suggesting additional measures for improvement, if necessary
Energy-saving calculator: the new software tool

The energy-saving calculator is a software tool that helps you to determine the energy-saving potentials that are created by using energy-efficient motors. It is available on the Internet free of charge.

– Quick and user-friendly
– You can compare the energy consumption of standard motors (IE1 = Standard Efficiency) with that of energy-efficient motors (IE2 = High Efficiency, IE3 = Premium Efficiency) with one mouse click and calculate the respective amortization times for the investment.

– The calculation log can be downloaded in PDF.

www.sew-energy-saving.com
Within the effiDRIVE® concept, the energy-efficient solutions constitute the measurable result for the customer.

The optimum energy-saving solution depends on the customer-specific application and can only be determined on the basis of individual consulting and a detailed analysis of the system. We focus on the overall system, and our goal is to optimize the output power ($P_{\text{out}}$) and the power losses ($P_{\text{loss}}$) by using the right drive technology while taking existing processes into account (see energy-saving checklist). Measures derived from this approach guarantee a customized energy-saving solution tailored specifically to the individual application.

In close cooperation with the customer, the SEW-EURODRIVE consultants develop a tailor-made solution. They can rely on a wealth of experience with already implemented and proven package solutions. Key factors for the ideal customer solution are the amortization time and the overall costs of the system components.
The energy-saving checklist ensures a comprehensive review and consistent implementation of all energy-saving factors coming into consideration.

**Energy-saving checklist**

<table>
<thead>
<tr>
<th>Optimizing the power output</th>
<th>Reducing the power losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Reducing the output speed (control)</td>
<td>✓ Increasing the gear unit and motor efficiency</td>
</tr>
<tr>
<td>✓ Reducing the load torque</td>
<td>✓ Improving the inverter efficiency</td>
</tr>
<tr>
<td>– Using rigid transmission elements</td>
<td>✓ Energy-efficient design of options/functions (e.g. brake)</td>
</tr>
<tr>
<td>– Using counterweights</td>
<td>✓ Using regenerative energy</td>
</tr>
<tr>
<td>– Minimizing friction in the process</td>
<td>– Direct use of energy in other axes</td>
</tr>
<tr>
<td>✓ Energy-saving mode (automatic switch-off, stand-by)</td>
<td>– Regenerative braking</td>
</tr>
<tr>
<td></td>
<td>– Energy storage</td>
</tr>
<tr>
<td></td>
<td>✓ Dimensioning in line with demand</td>
</tr>
</tbody>
</table>

\[ P_{in} = P_{out} + P_{loss} \]

Energy is saved by reducing \( P_{out} \) (output) and / or \( P_{loss} \) (losses)!
The production cycle in the beverage industry is characterized by a wide range of extremely varied tasks, such as palletizing, cask or bottle conveying in dry, wet, or hygienic areas. The drive technology for these tasks is exposed to special ambient conditions, such as heat, moisture, cleaning agents, etc. The mechatronic MOVIGEAR® drive system meets these specific requirements and contributes to an optimum energy balance due to the improved overall efficiency of the system.

### Energy-saving properties of the mechatronic MOVIGEAR® drive system

| ✔ Use of a drive system with high overall efficiency | – Highest motor efficiency due to permanent-field synchronous motor. Already now, the motor efficiency complies with the planned efficiency class IE4 (Super Premium Efficiency) of the international standard IEC 60034-T30. |
| ✔ Energy-efficient selection of options | – Use of an efficiency-optimized parallel-shaft helical gear unit |
| ✔ Dimensioning in line with demand | – Increased efficiency due to new electronic components and adjusted control modes |
| ✔ | – When using the dynamic deceleration function DynaStop®, no energy is needed to release the mechanical brake. Based on the motor output, this saves up to 5 % of power. |
| ✔ | – High overload capability allows for dimensioning in line with demand – lower installed system power with higher overall efficiency |
The mechatronic drive system MOVIGEAR® combines motor, gear unit and electronics in one product. With optimized interfaces between the inverter, motor and gear unit, minimized friction and current losses, and intelligent control modes, this system provides a higher overall efficiency level than any previously achieved, between 10% and 25% above that of conventional drive solutions. Here, too, system manufacturers at this stage achieve an efficiency that surpasses efficiency class IE3 (Premium Efficiency), reducing their energy costs by up to 50% on average. Special properties of the mechatronic MOVIGEAR® drive system for implementation in the food and beverage industry:

– Smooth surface design, prevents accumulation of dirt and simplifies cleaning
– Fully enclosed system, uses the principle of surface cooling, no additional fans or blowers required, no dirt is sucked in, germs and bacteria cannot be distributed by air swirls
– Meets hygienic design requirements

### Comparison of

<table>
<thead>
<tr>
<th></th>
<th>Standard variant</th>
<th>effiDRIVE® solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Components</td>
<td>105 helical-worm gearmotors with standard motors and standard frequency inverters in the control cabinet</td>
<td>Mechatronic drive system MOVIGEAR® SNI with 105 MOVIGEAR® drive units</td>
</tr>
<tr>
<td>Investment</td>
<td>94 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Energy costs/year*</td>
<td>€ 44,150</td>
<td>€ 34,500</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>128 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Amortization time</td>
<td></td>
<td>1.3 years</td>
</tr>
<tr>
<td>CO₂ reduction/year</td>
<td></td>
<td>65 t</td>
</tr>
</tbody>
</table>

*The effiDRIVE® solution with MOVIGEAR® saves a total of € 35,700 after only 5 years of operation.

### effiDRIVE® solution with MOVIGEAR®

**Up to 50% energy-saving potential**

The mechatronic drive system MOVIGEAR® combines motor, gear unit and electronics in one product. With optimized interfaces between the inverter, motor and gear unit, minimized friction and current losses, and intelligent control modes, this system provides a higher overall efficiency level than any previously achieved, between 10% and 25% above that of conventional drive solutions. Here, too, system manufacturers at this stage achieve an efficiency that surpasses efficiency class IE3 (Premium Efficiency), reducing their energy costs by up to 50% on average. Special properties of the mechatronic MOVIGEAR® drive system for implementation in the food and beverage industry:

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– Meets hygienic design requirements

*The calculation is based on 3,500 hours of operation/year x 0.10 €/kWh x system power*
In “traditional baggage handling”, conveyor belts, collection conveyors, vertical translators, lifts, circular storage units and sorting lines ensure smooth and fast transportation of the baggage items. In addition to flexible, space-saving and intelligent drive technology, the energy-saving aspect has come to the fore especially in the field of airport technology due to the long operating periods of the motors. The energy consumption in horizontal conveyor applications can be significantly reduced by using energy-efficient motors in combination with efficiency-optimized gear units.

**Energy-saving properties of helical-bevel gear units and energy-efficient DRE motors (IE2)**

- **Increased motor efficiency**
  
  In view of existing and foreseeable national and international legislation and regulations, the new DR motors have been designed as a modular energy saving system. The energy-efficient motors DRE and DRP even surpass the efficiency requirements of the international standard IEC 60034-T30. They are labeled IE2 (High Efficiency) and IE3 (Premium Efficiency). Using these highly efficient motors in combination with helical-bevel gear units creates an energy-efficient overall solution.

- **Increased gear unit efficiency**
  
  Replacing helical-worm gear units with efficiency-optimized helical-bevel gear units results in an increased efficiency of up to 30 % depending on gear unit size and reduction ratio.
Using energy-efficient motors of the DRE series allows for a significantly improved energy balance. SEW-EURODRIVE is the first company worldwide that has implemented die-cast copper technology in an industrial high-volume production. Result: highly efficient energy saving motors. All this comes at a surprisingly economic price, which enables amortization within one or two years.

In baggage handling, the replacement of helical-worm gear units with efficiency-optimized helical-bevel gear units in combination with the highly efficient energy-saving motors and the resulting increase in motor efficiency can save up to 10% of energy.

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### Comparison of Components for a project with 100 drive units each

<table>
<thead>
<tr>
<th></th>
<th>Standard variant</th>
<th>effiDRIVE® solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Components for a project with 100 drive units each</td>
<td>Helical-worm gear unit with standard motor SA57 DV100 L4</td>
<td>Helical-bevel gear unit with energy-efficient DRE motor KA37 DRE100 L4</td>
</tr>
<tr>
<td>Investment</td>
<td>77 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Energy costs/year*</td>
<td>€ 71,750</td>
<td>€ 65,560</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>110 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Amortization time</td>
<td>approx. 2.2 years</td>
<td></td>
</tr>
<tr>
<td>CO₂ reduction/year</td>
<td>40 t</td>
<td></td>
</tr>
</tbody>
</table>

*The effiDRIVE® solution with helical-bevel gear units and energy-efficient motors saves a total of € 17,300 after only 5 years of operation.*

The calculation is based on 3,500 hours of operation/year x 0.10 €/kWh x system power.

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### effiDRIVE® solution with helical-bevel gear units and energy-efficient DRE motors

**Up to 10% energy-saving potential**

Using energy-efficient motors of the DRE series allows for a significantly improved energy balance. SEW-EURODRIVE is the first company worldwide that has implemented die-cast copper technology in an industrial high-volume production. Result: highly efficient energy saving motors. All this comes at a surprisingly economic price, which enables amortization within one or two years.

In baggage handling, the replacement of helical-worm gear units with efficiency-optimized helical-bevel gear units in combination with the highly efficient energy-saving motors and the resulting increase in motor efficiency can save up to 10% of energy.
The energy-saving potential of so-called ancillary components, such as the fresh air supply of a factory building, should not be underestimated. The system analyzed in this example supplies fresh air to a building. It consists of 24 ventilation units installed on the roofs of the factory buildings, each comprising 4 interconnected individual fans. The fans are driven by pole-changing motors without gear units directly via belts. This means that even if the drives are optimally dimensioned and tuned, one operating point is always in the partial load range, which causes a poor efficiency level. In addition, only two operating points are possible with the existing setup.

**effiDRIVE® energy-saving solutions for fresh air supply taking supply air for buildings as an example**

<table>
<thead>
<tr>
<th>Energy-saving properties of controlled energy-efficient DRE motors (IE2) and MOVITRAC® B frequency inverters</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Process and speed adjustment: Reduction of the output speed</td>
</tr>
<tr>
<td>✔ Increased motor efficiency</td>
</tr>
</tbody>
</table>

The process can be adjusted to the actual demand through stepless speed and torque control for more energy efficiency and reduced power consumption.

- In comparison with standard motors, the energy-efficient motors DRE (IE2 = High Efficiency) and DRP (IE3 = Premium Efficiency) from the new modular DR motor system reduce power losses by up to 40%, which significantly increases the motor efficiency.
- In the partial load range: Thanks to the MOVITRAC® B energy saving function and the resulting dynamic adaptation of the magnetization current, the motor can be operated with optimum efficiency at any operating point.
After the modification of the fresh air supply system, the highly efficient DRE motors (IE2) in combination with the MOVITRAC® B frequency inverter reduce the overall energy consumption by more than 16%. This corresponds to an annual energy cost saving of € 95,000. In this application, the already energy-efficient DRE motors are operated with optimum efficiency even in the partial load range thanks to the energy-saving function of the MOVITRAC® B frequency inverter. This means the motor runs with optimum efficiency at each operating point on the fan characteristic curve. Complete retrofitting with the new drive technology will already pay off after 2.7 years. This calculation does not even include the energy saved by continuous adaptation of the process and thus the speed to the actual demand.

### Table: Comparison

<table>
<thead>
<tr>
<th>Components for a project with 96 building fans each</th>
<th>Pole-changing asynchronous motors and fan adjustment</th>
<th>Controlled energy-efficient motors DRE180 M4 and MOVITRAC® B frequency inverter with energy-saving function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>0 % (existing)</td>
<td>100 %</td>
</tr>
<tr>
<td>Energy costs/year*</td>
<td>€ 675,000</td>
<td>€ 580,000</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>116 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Amortization time</td>
<td></td>
<td>approx. 2.7 years</td>
</tr>
<tr>
<td>CO₂ reduction/year</td>
<td></td>
<td>720 t</td>
</tr>
</tbody>
</table>

The effiDRIVE® solution with energy-efficient motors and MOVITRAC® B frequency inverters saves a total of € 218,500 after only 5 years of operation.

* The calculation is based on 7,200 hours of operation/year x 0.084 €/kWh x power per load

### effiDRIVE® solution with energy-efficient motors and MOVITRAC® B frequency inverters

**More than 16 % energy-saving potential**

The calculation is based on 7,200 hours of operation/year x 0.084 €/kWh x power per load.
In intralogistics, storage and retrieval units are used to deposit and retrieve a variety of loads quickly and safely. The SRU stores potential energy by depositing the transported load in the storage rack. It is basically a huge energy storage system. In a conventional design, a braking resistor converts the energy released when the vertical drive descends and the horizontal drive decelerates to heat. This is wasteful from an energetic point of view. Even more so as suitable technical means are available to efficiently re-use the released energy, i.e. to “recycle” it.

**EffiDRIVE® energy-saving solutions for intralogistics taking a storage and retrieval unit as an example**

<table>
<thead>
<tr>
<th>Energy-saving properties of MOVIDRIVE® MOVI-PLC® motion control</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Direct usage of regenerative energy in other axes</td>
</tr>
<tr>
<td>– To recycle released energy, the two MOVIDRIVE® inverters, which control the horizontal and vertical axes, share their DC links. Electric energy released by one axis can be directly re-used by the other axis.</td>
</tr>
<tr>
<td>– The higher-level controller MOVI-PLC® provides intelligent control functions for the horizontal and vertical axes. The total time is kept short, while the horizontal and vertical drives are operated with optimum efficiency within the time frame.</td>
</tr>
</tbody>
</table>
Comparison of Standard variant effiDRIVE® solution

<table>
<thead>
<tr>
<th>Project components</th>
<th>Conventional control: Released energy is dissipated via a braking resistor</th>
<th>Intelligent DC link coupling with MOVIDRIVE® inverters and MOVI-PLC® motion control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy costs/year*</td>
<td>€ 7,200</td>
<td>€ 5,750</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>125 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Amortization time</td>
<td>Immediately</td>
<td></td>
</tr>
<tr>
<td>CO₂ reduction/year</td>
<td>10 t</td>
<td></td>
</tr>
</tbody>
</table>

The effiDRIVE® solution with MOVIDRIVE® inverters and MOVI-PLC® motion control saves a total of € 7,250 after only 5 years of operation.

*The calculation is based on energy consumption/single cycle x 880 single cycles/day x 350 days/year x 0.10 €/kWh

The tried and tested package solution “Intelligent DC link coupling for storage and retrieval units” reduces the energy consumption by up to 25 % at maximum utilization of the unit and its dynamic properties.

Within the framework of the effiDRIVE® energy-saving concept, an already installed system was analyzed and improved with regard to energy efficiency and life cycle costs. The state-of-the-art optimization measures energetically coupled the horizontal and vertical axes via the DC link of the already installed MOVIDRIVE® inverters. This means the regenerative energy released by one axis can be directly used by the other. The decentralized MOVI-PLC® controller provides energy-optimized control for both axes while keeping the maximum number of double cycles. The overall energy consumption of this system was reduced by € 1,450 per year, at minimal investment costs and slightly higher costs for installation.

effiDRIVE® solution with MOVIDRIVE® inverters and MOVI-PLC® motion control

Up to 25 % energy-saving potential

The tried and tested package solution “Intelligent DC link coupling for storage and retrieval units” reduces the energy consumption by up to 25 % at maximum utilization of the unit and its dynamic properties. Within the framework of the effiDRIVE® energy-saving concept, an already installed system was analyzed and improved with regard to energy efficiency and life cycle costs. The state-of-the-art optimization measures energetically coupled the horizontal and vertical axes via the DC link of the already installed MOVIDRIVE® inverters. This means the regenerative energy released by one axis can be directly used by the other. The decentralized MOVI-PLC® controller provides energy-optimized control for both axes while keeping the maximum number of double cycles. The overall energy consumption of this system was reduced by € 1,450 per year, at minimal investment costs and slightly higher costs for installation.
The energy analysis of an existing or planned system not only takes energy efficiency into account, but also the applicable normative and legal framework.

During project planning, the SEW energy consultants check for compliance with standards and regulations that apply over the entire service life of the drives as part of the effiDRIVE® energy-saving concept.

SEW-EURODRIVE actively participated in shaping the new IEC standard in order to harmonize the many different existing energy efficiency standards for asynchronous motors all over the world. The new part 30 of the AC motor directive IEC 60034 defines the energy efficiency classes IE1 to IE3. The efficiency class “Ultra Premium Efficiency” (IE4) is described in the appendix to part 30. The abbreviation IE stands for “International Efficiency”. The numbers were reversed in comparison to the previous EFF classes to open the designation to higher levels:

### Definition of uniform energy efficiency classes

<table>
<thead>
<tr>
<th>Efficiency Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE1: Standard Efficiency</td>
<td>EFF3: Motors without any particular efficiency requirements</td>
</tr>
<tr>
<td>IE2: High Efficiency</td>
<td>EFF2: Motors with improved efficiency</td>
</tr>
<tr>
<td>IE3: Premium Efficiency</td>
<td>EFF1: Motors with increased efficiency</td>
</tr>
<tr>
<td>IE4: Ultra Premium Efficiency</td>
<td></td>
</tr>
</tbody>
</table>

### New measuring method

The efficiency classes of IEC 60034 part 30 are based on the new method for determining the efficiency of AC motors according to IEC 60034-2.1. Additional losses are measured and not represented by a fixed factor of 0.5%.
In the European Union, the EuP Directive 2005/32/EC will be implemented as of June 16, 2011. The implementing regulations for the EU directive are based on the two new parts of IEC 60034 (measurement methods 2.1 and efficiency classes 30).

In a first step, 2-, 4- and 6-pole AC motors in the power range 0.75 – 375 kW must at least achieve level IE2.

As of January 1, 2015, motors in the power range 0.75 – 375 kW must either meet IE3 requirements, or they can be operated as IE2 motors on a frequency inverter.

As of January 1, 2017, this provision will apply to all motors with a power rating of 0.75 kW and higher.

For an overview of international provisions, go to www.sew-energy-saving.com on the Internet.
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