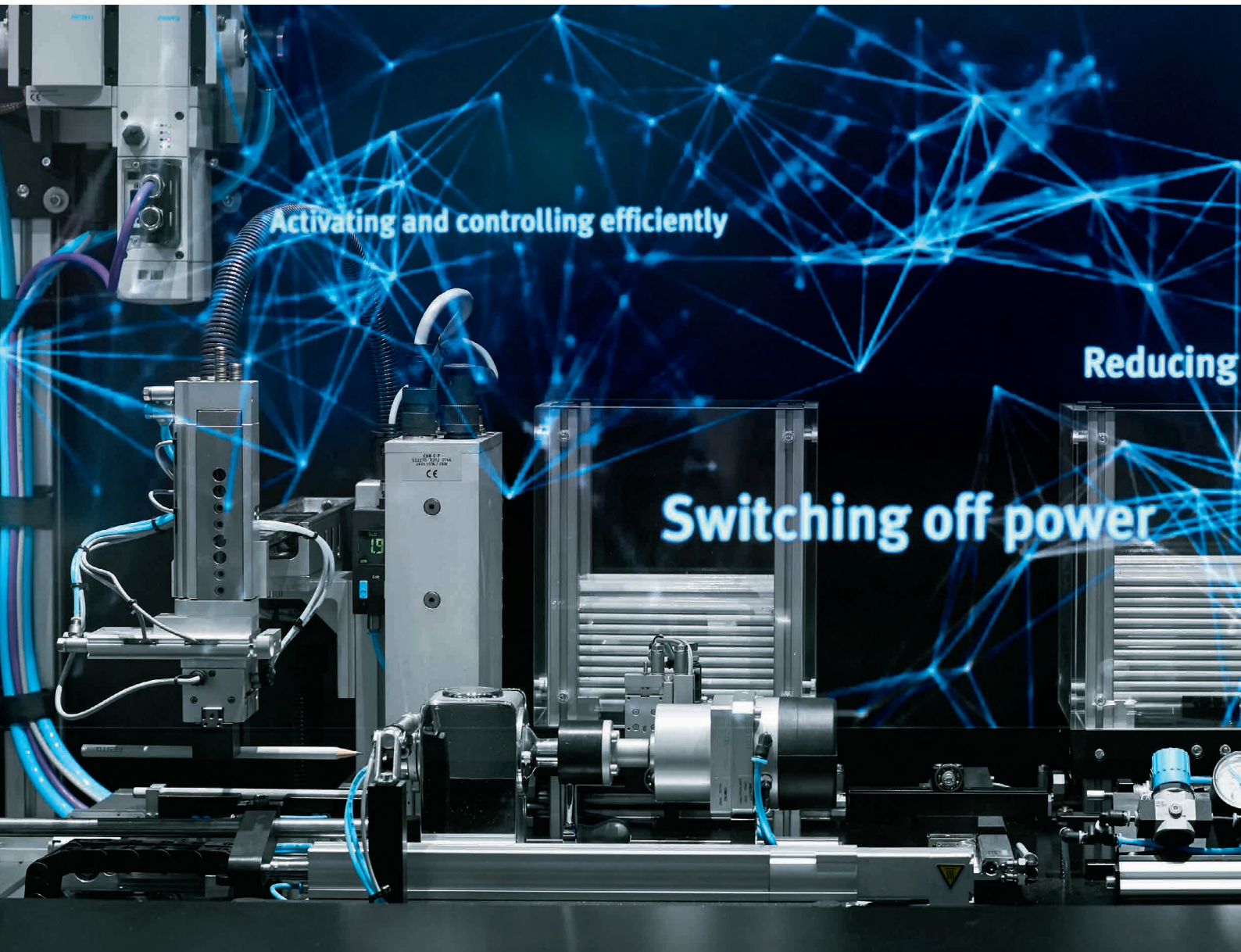


Energy efficiency@Festo

FESTO





Hands-on energy efficiency

Experience energy efficiency with our interactive displays and exhibits with products from Festo that can be touched and tried out. We make energy efficiency come alive.

Intelligent design, energy-efficient products and solutions, sustained service and well-founded industrial training are all integrated. This is what energy efficiency means at Festo. Come and pay us a visit.



We are energy saving innovations.
We are sustainability in production.
We are the catalyst for your efficiency.

→ **WE ARE THE ENGINEERS
OF PRODUCTIVITY.**



Energy efficiency in focus

We are the catalyst for your efficiency. With us, you can rely on technical experts and efficient technologies that will ensure your machines and systems consume fewer resources and less energy. This reduces your CO₂ emissions as well as your operating costs. And it leads to increases – in the sustainability of your production processes and your company's productivity.

Intelligent design

- Intelligent and innovative selection software for designing systems correctly.
- Choose smaller components, avoid the accumulation of safety factors.



Products and solutions

- Festo offers products and solutions that use energy more efficiently. You can realise significant potential savings right now.
- From high-performance, simple pneumatic systems to precise, highly dynamic automation technology.



Focus

Energy
efficiency



Industrial training

- Take advantage of the expertise of our sales engineers and energy efficiency consultants.
- Benefit from Festo Didactic's close links to industry and its training portfolio.



Services

- Festo Energy Saving Services: the service package to make the best possible use of potential savings.
- From compressed air audits to the implementation of energy-saving solutions, our specialists support you with tailor-made services.



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An eye to the future

Challenges of the 21st century

Ecological footprint

If we continue to live as we do now, we will need nearly 3 Earths to support our lifestyle in the year 2050.[2]

3x 

10,000,000,000

Growing world population

It is estimated that by 2050 the Earth's population will have reached between 9 and 10 billion people.[2]

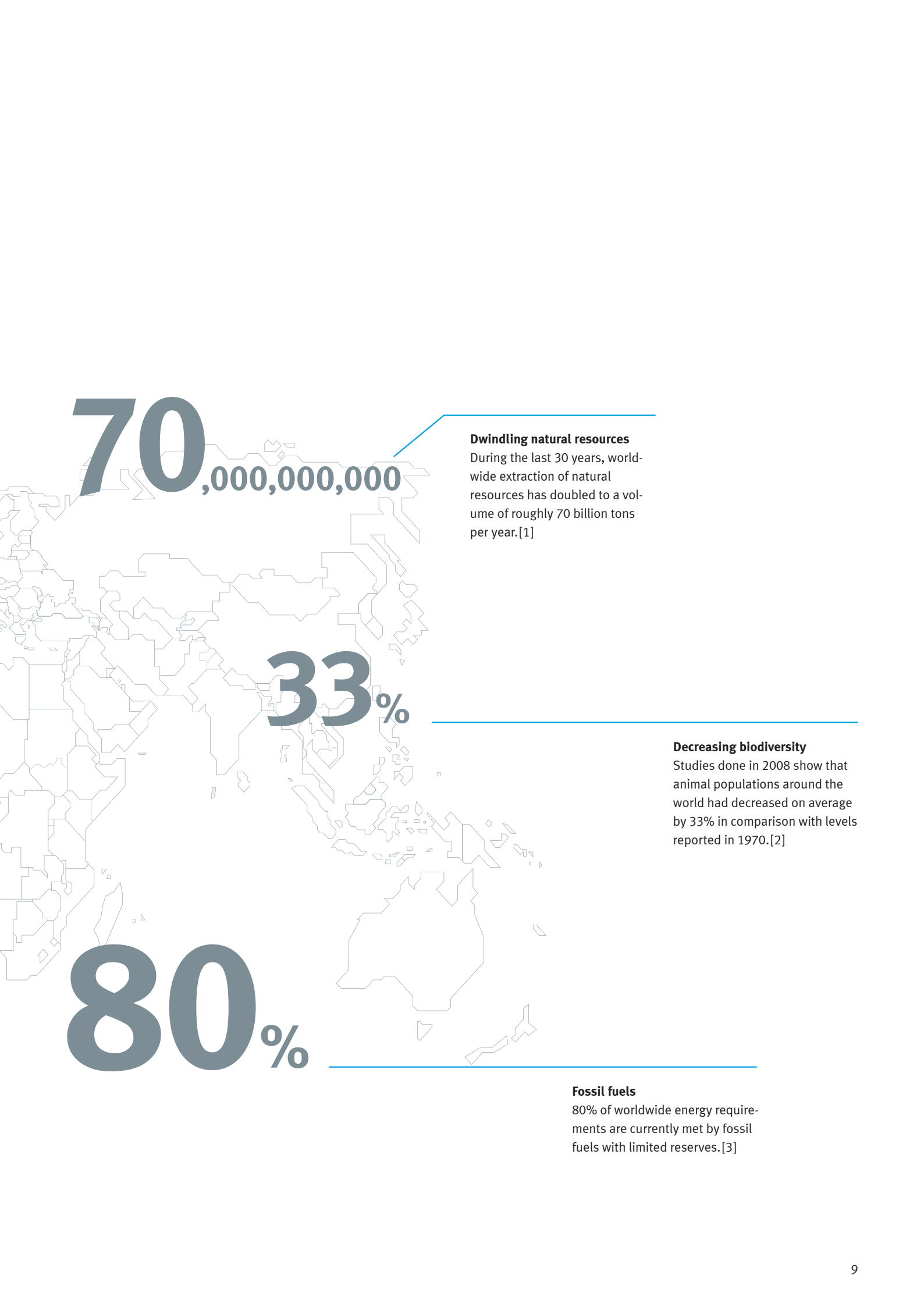
4°

Climate change

The temperature of the Earth's atmosphere is four degrees higher than it was before the onset of industrialisation.[4]

Sources

- [1] German Federal Environmental Agency, <http://www.umweltbundesamt.de/>, 2012.
- [2] Living Planet Report of the WWF, 2012.
- [3] The future of energy, an initiative of the German Federal Ministry of Education and Research, 2013.
- [4] Report issued by the World Bank, Turn down the heat: climate extremes, regional impacts, and the case for resilience, 2012.

A faint, light gray outline map of the world serves as the background for the infographic. The map shows the continents and major landmasses.

70,000,000,000

Dwindling natural resources

During the last 30 years, world-wide extraction of natural resources has doubled to a volume of roughly 70 billion tons per year.[1]

33%

Decreasing biodiversity

Studies done in 2008 show that animal populations around the world had decreased on average by 33% in comparison with levels reported in 1970.[2]

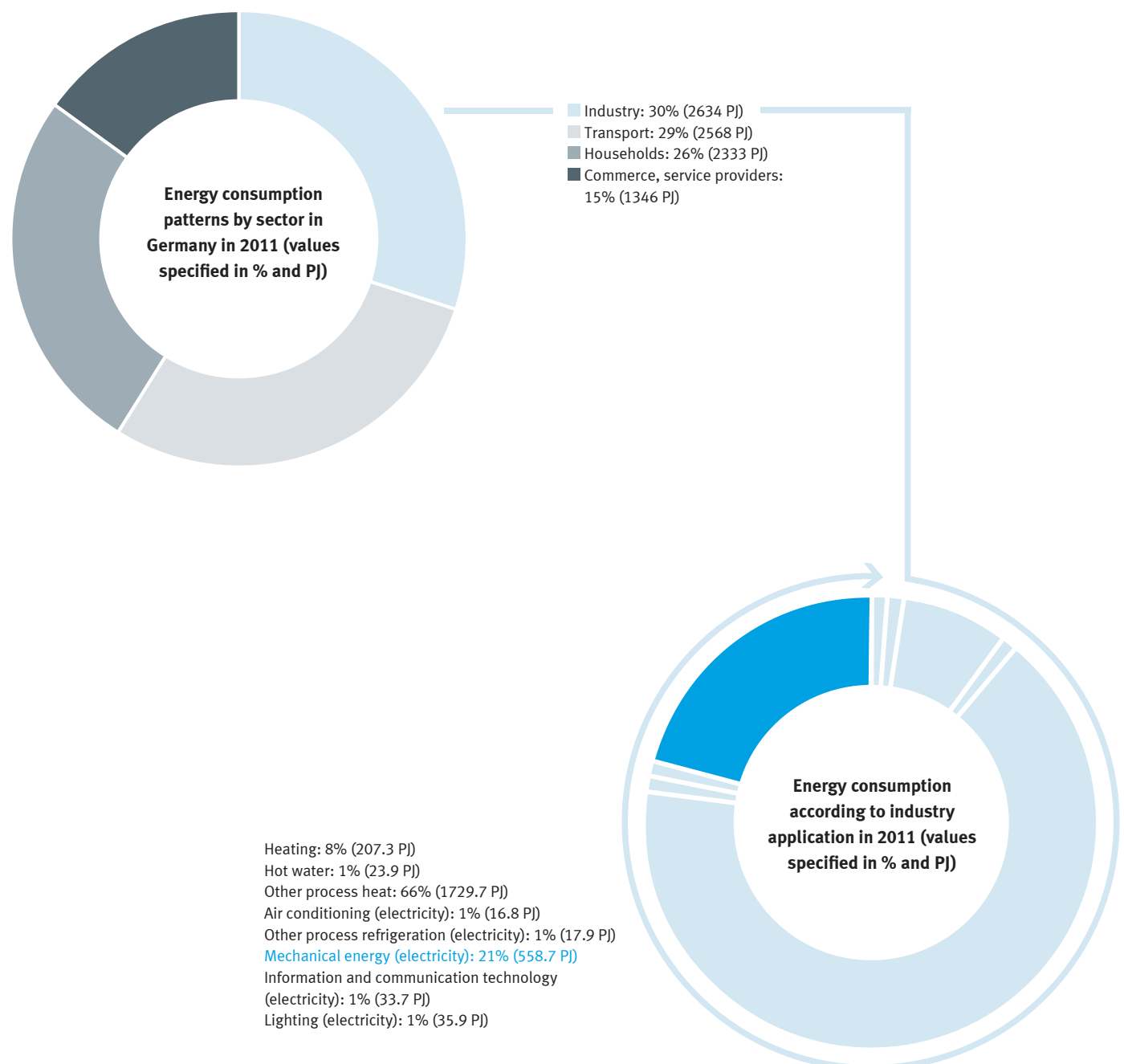
80%

Fossil fuels

80% of worldwide energy requirements are currently met by fossil fuels with limited reserves.[3]

Current facts: energy consumption patterns in Germany

How much energy is currently being consumed in Germany and how is consumption distributed? How much of this consumption is generated by industrial applications which are relevant for Festo? The two graphics below provide an overview and reveal that in the industrial sector too, significant energy saving potential can be exploited.



Opportunities are available: grab them!

There are lots of opportunities for increasing energy efficiency in your production processes – they only need to be exploited! Take the time to search for possible approaches – it pays off. Take advantage of the following typical opportunities:



Building new systems

In particular within the context of new projects, considerable efficiency potential can be easily exploited through the use of conceptual solutions.



Renovating and modernising existing systems

The renovation and modernisation of existing systems also offer good opportunities to increase those systems' energy efficiency.



Introduction of an energy management system in accordance with ISO 50001

If the goal is to embed energy efficiency throughout the entire company, this can be consistently pursued by introducing an EnMS in accordance with ISO 50001.

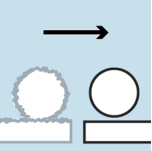
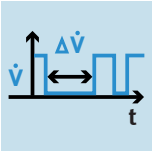
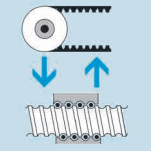
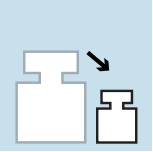
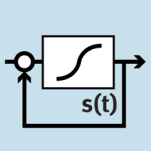
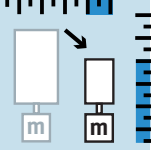
Note

There are many other ways to increase energy efficiency!

12 ways to save energy!

12 different measures and ways to successfully save energy In the opinion of our experts, these measures promote quick and simple implementation of suitable optimisation measures, for example as described in VDMA standard sheet 24581 (Pneumatic fluid power - Application notes for the optimization of the energy efficiency of pneumatic systems). The following examples show best-case scenarios of how much you can save with the help of each measure.

Our tip: Ask for advice from the experts at Festo who are highly knowledgeable with regard to energy efficiency and have mastered the implementation of this integrated approach.

 Reduce friction • Use low-friction components → Mini-slide DGSL	-15%	 Use air-saving circuits • Handling vacuum with monitored switch-off → use OVEN	-60%
 Choose the right components • Motor with holding brake for long standstills	-14%	 Reduce weight • Optimum technology mix • Electric handling unit with pneumatic Z-axis	-18%
 Efficient open- and closed-loop control • Adapt positioning profiles • Optimise the controller → Festo FCT	-10%	 Correct sizing • Ideal size • Use the next smaller size for pneumatic drives → Festo Engineering Tools	-35%

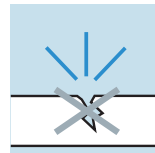
From products ...



Reduce the pressure level

- With a pressure regulator
- Return stroke with reduced pressure 6 → 3 bar
→ MS series, VABF

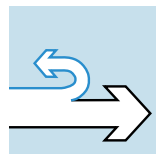
-22%



Reduce leakages

- Routine leakage detection, condition monitoring
→ Energy Saving Services

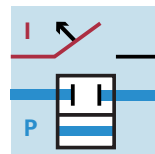
-20%



Recover energy

- Save braking energy in the coupled intermediate circuits
→ Multi-axis controller CMMD

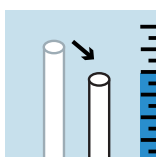
-10%



Switch off power

- Leakages reduced by up to 10%
- In this case for the entire compressed air system

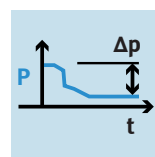
-10%



Reduce tubing lengths

- Decentralised valve terminal
- Optimised tubing layout
→ Pipe and tubing cutter ZRS

-25%



Reduce pressure loss

- Ideal tubing diameters, less resistance
- Reduced network pressure 8 → 7 bar
→ MS series size combinations

-6%

... to systems

Functional chains of pneumatic systems

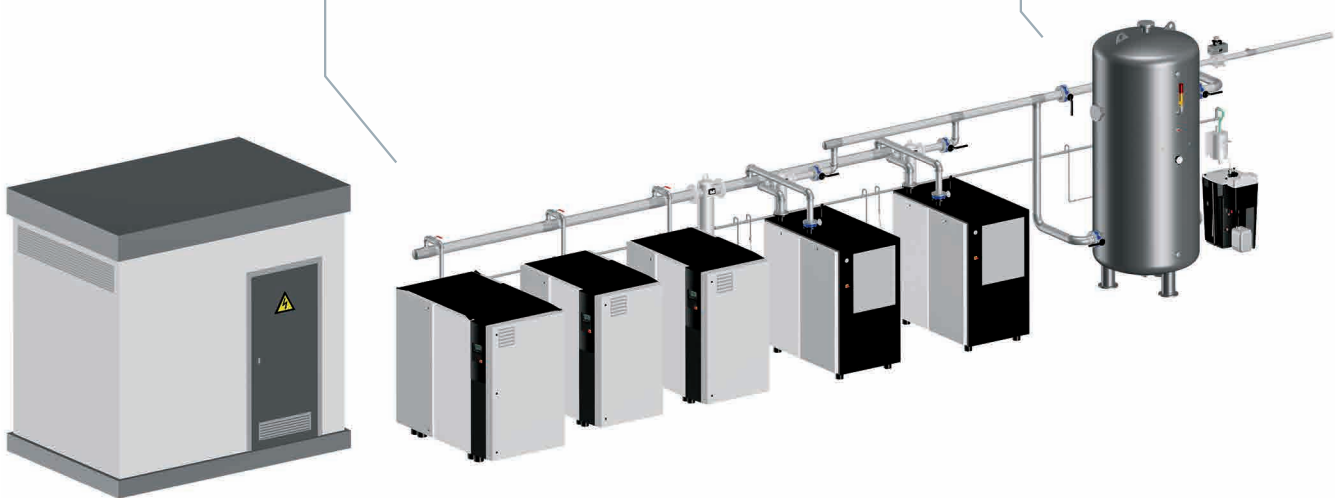
High energy prices, rising cost pressure and a growing awareness of climate protection have turned energy efficiency into a key business task. Pneumatic systems, too, offer attractive potential savings in this respect. The key to success lies in taking a comprehensive look at pneumatic systems.

Compressed air generation

Energy-efficient use of compressed air begins with its generation: the selection of the right compressors, their sizing and their controlled and coordinated interaction are decisive factors for energy consumption and energy costs per cubic metre of compressed air.

Air preparation

The quality of the compressed air used has a definite impact on service life and flawless operation of pneumatic components. Compressor oil, water or particles wash out the life-time lubrication and lead to increased wear and damage to seals. Compressed air consumption and costs skyrocket as a result.

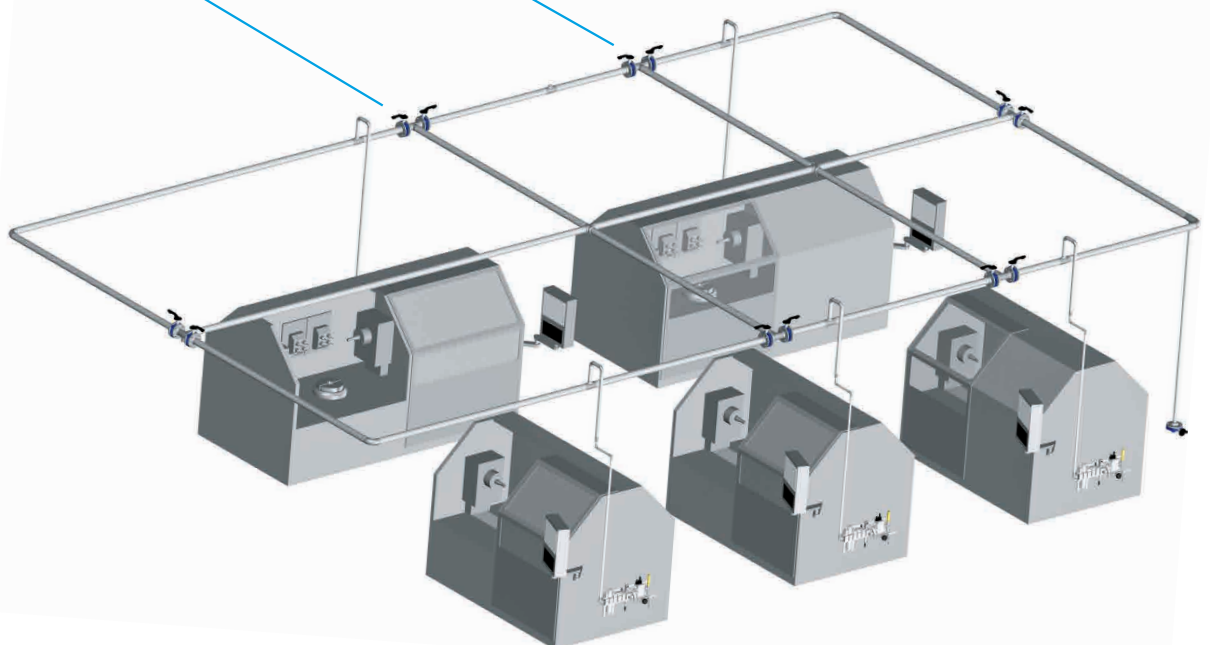


Compressed air distribution

Compressed air systems are subject to continuous change, as, for example, production systems are converted or expanded, the amount of air is increased or lines are added. This results in networks which are not optimally laid out and installed, in some cases with significant pressure losses.

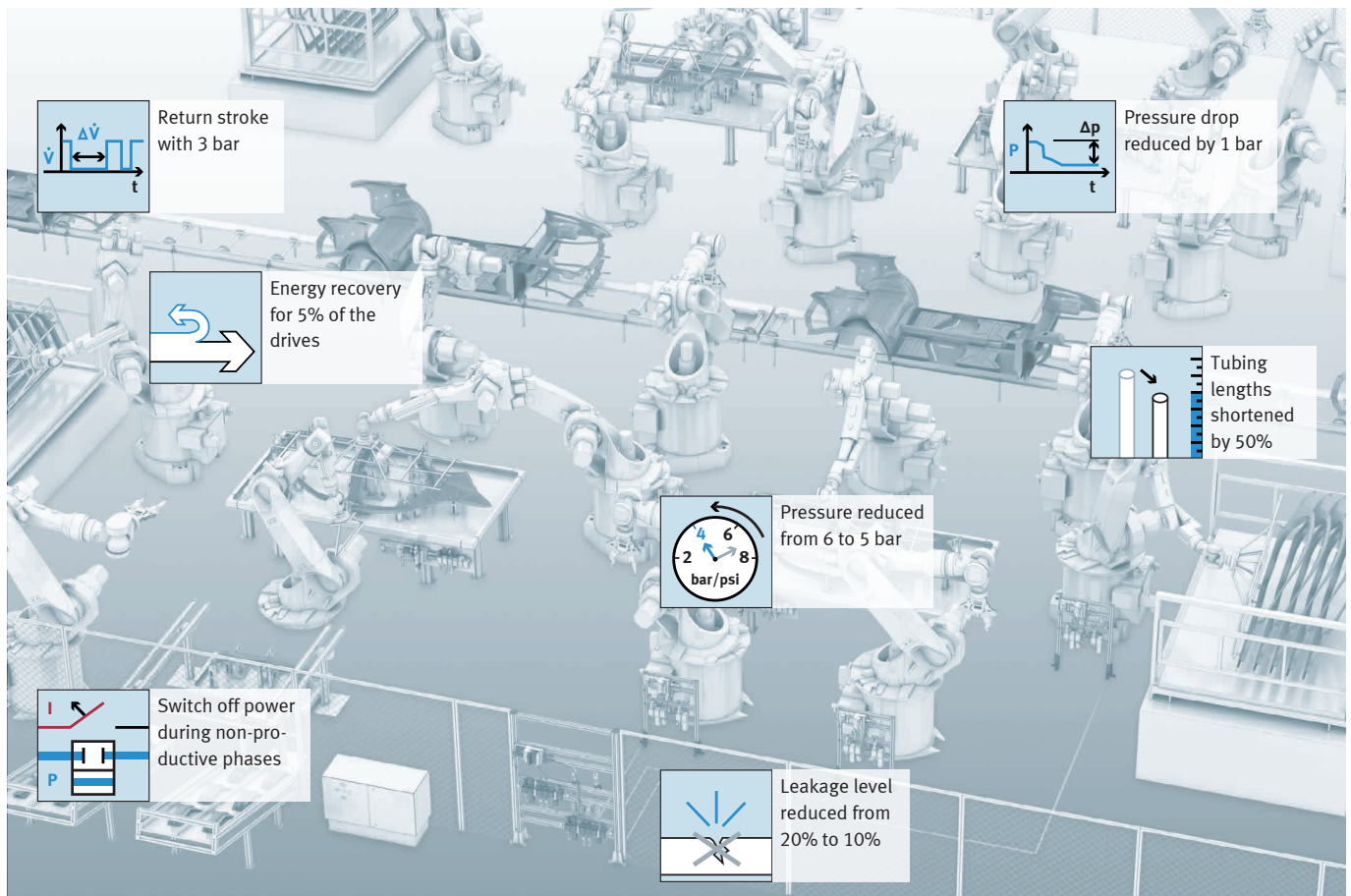
Compressed air applications

There are numerous opportunities for saving energy when using compressed air applications. Detailed information can be found from page 18 onwards.



Energy efficiency in pneumatic applications

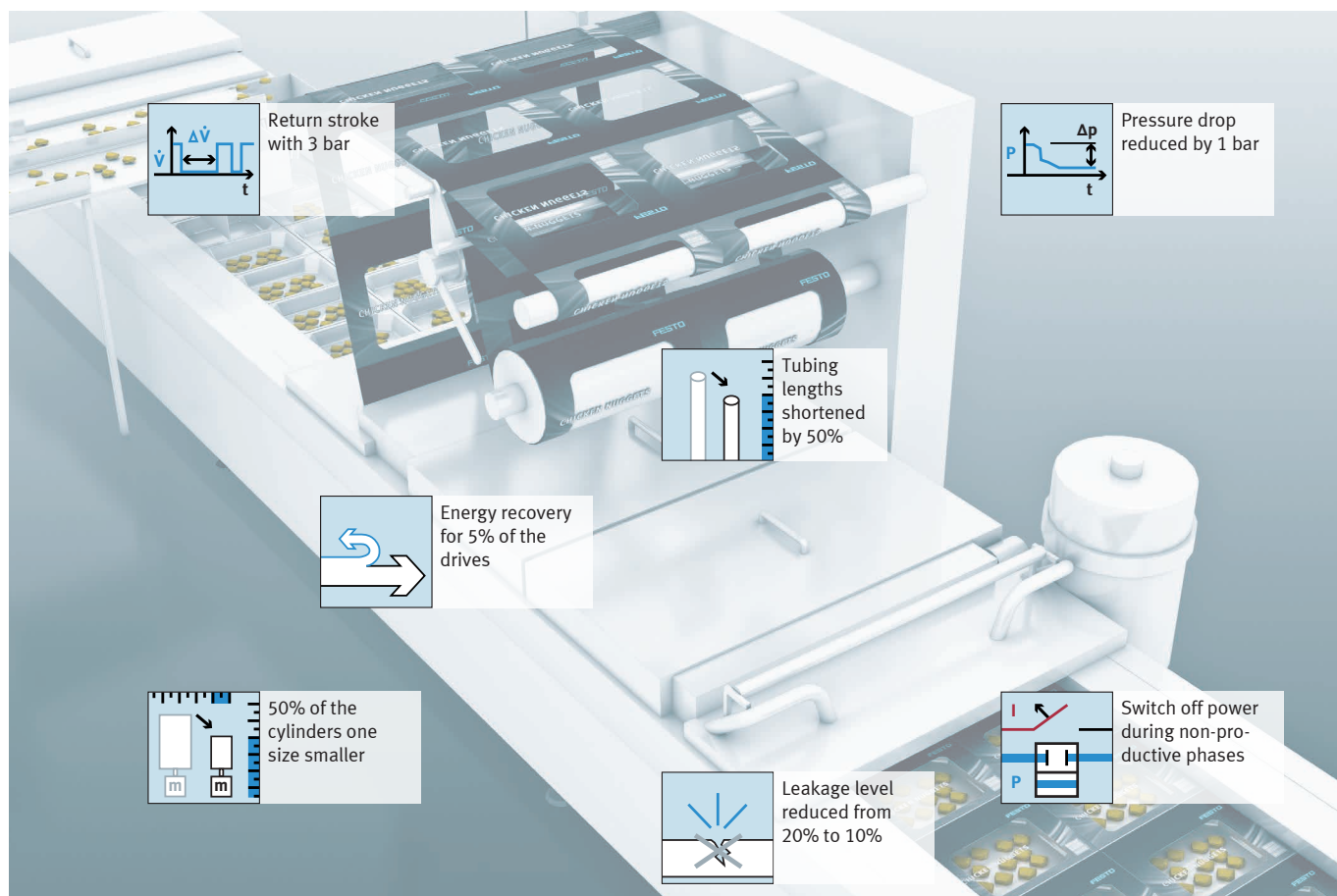
... in the automotive and Tier 1 supplier industry – body shop



Energy and cost savings,
and CO₂ reduction

-53%
-€3000
-13 tons CO₂

... in the food industry – forming, filling and sealing



Energy and cost savings,
and CO₂ reduction

-46%
-€2600
-11 tons CO₂

The payoff

How can Festo help you to optimise your application?

Select the application which is most similar to yours. We have calculated the potential savings per measure per year as a %, in euros and in CO₂ emissions and entered the resulting values in the appropriate column.

General conditions:

250 working days per year
16 hours per day
6 bar operating pressure

Annual savings

> €1000

€500 to €1000

€100 to €500

< €100

Energy efficiency measure	Description	Working parameters
		Number of cylinders [pcs.] Cylinder diameter [mm] Stroke [mm] Distance from cylinder to valve [m] Cycle rate [s]
 Reduce pressure	From 6 to 5 bar	
 Correct sizing	50% of the cylinders one size smaller	
 Reduce tubing lengths	Tubing volume cut in half (tubing 50% shorter)	
 Reduce pressure losses	With an optimised compressed air network, pressure can be reduced at the compressor by 1 bar	
 Reduce leakages	Reduce leakages from 20% to 10%	
 Recover energy	Energy recovery for 5% of the pneumatic drives	
 Switch off power	Switch off for 3rd shift (20% leakage)	
 Use air-saving circuit	50% of the drives with return stroke at 3 bar	

Annual savings

Sample applications with potential savings

Automotive: parts handling		Automotive: clamping		Automotive: engine parts machining	Food: forming, filling, sealing			Small parts assembly: feeding and joining parts		Electronics: through-hole technology (THT)	
60	30	100	100	5	4	2	2	10	10	100	100
63	40	63	50	32	16	100	80	16	25	16	25
80	40	100	100	800	150	220	150	10	20	10	10
7		4		2	6			4		4	
30		15		60	6			1		5	
15% €880 3.71 tons CO ₂		15% €4,131 17.44 tons CO ₂		14% €46 0.20 tons CO ₂	14% €825 3.48 tons CO ₂			16% €712 3.01 tons CO ₂		16% €1,425 6.02 tons CO ₂	
8% €472 1.99 tons CO ₂		10% €2,824 11.92 tons CO ₂		14% €46 0.20 tons CO ₂	13% €721 3.05 tons CO ₂			2% €97 0.41 tons CO ₂		2% €194 0.82 tons CO ₂	
17% €974 4.11 tons CO ₂		11% €3,035 12.82 tons CO ₂		1% €4 0.02 tons CO ₂	4% €228 0.96 tons CO ₂			32% €1,439 6.08 tons CO ₂		32,% €2,878 12.15 tons CO ₂	
6% €350 1.48 tons CO ₂		6% €1,674 7.07 tons CO ₂		6% €19 0.08 tons CO ₂	6% €342 1.44 tons CO ₂			6% €270 1.14 tons CO ₂		6% €541 2.28 tons CO ₂	
12% €714 3.01 tons CO ₂		12% €3,413 14.41 tons CO ₂		12% €39 0.17 tons CO ₂	12% €697 2.94 tons CO ₂			12% €551 2.33 tons CO ₂		12% €1,102 4.66 tons CO ₂	
3% €166 0.70 tons CO ₂		3% €805 3.40 tons CO ₂		3% €9 0.04 tons CO ₂	3% €163 0.69 tons CO ₂			3% €127 0.53 tons CO ₂		3% €253 1.07 tons CO ₂	
8% €482 2.03 tons CO ₂		8% €2,304 9.73 tons CO ₂		8% €27 0.11 tons CO ₂	8% €470 1.99 tons CO ₂			8% €372 1.57 tons CO ₂		8% €744 3.14 tons CO ₂	
14% €800 3.38 tons CO ₂		13% €3,733 15.76 tons CO ₂		13% €41 0.17 tons CO ₂	13% €754 3.18 tons CO ₂			14% €649 2.74 tons CO ₂		14% €1,298 5.48 tons CO ₂	

Pneumatic drives – tips

There are numerous options for saving energy consumed by pneumatic drives. These are always advantageous where sustained holding force is required. The application's features also play an important role in selecting a pneumatic solution. The following should be taken into consideration:

General



- Design safety functions correctly – accumulation reduces economic efficiency.



- Keep tubing lengths as short as possible – the shorter they are the less energy is lost.



- Misalignment causes stress on the seals and bearings. Leakage and wear can be minimised by flexibly coupling the drive and the load.



- Reduce moving masses as much as possible.

Pneumatic drives



- Reduce air consumption – if possible, use single-acting cylinders.
- Size pneumatic cylinders correctly. Oversized cylinders consume more compressed air than necessary.



- Use cylinders with round piston rods in preference to those with oval and rectangular piston shapes as they always have relatively high leakage rates.
- Drive-guide combinations provide ideal operating characteristics, while going easy on the seals. This helps to avoid high leakage rates.
- Suitable hard scrapers on the piston rod reduce wear in dusty environments.



- Use reduced pressure for non-productive strokes.

Working it out for you: correct sizing

Correct sizing of pneumatic drives reduces compressed air consumption by up to 40%.

In our example, the software tools determine that a DSCB in size 32 instead of a DSBC 40 is just as adequate. This cuts procurement costs and, more importantly, it reduces compressed air consumption by 35% during operation.

Correct sizing of pneumatic drives

Software tools are used in order to select the right system components for the application with minimal effort. The components used are thus only as large as they really need to be for the application. Oversizing is avoided. Unnecessary energy consumption due to excessive potential force can be prevented. Reduction to the next smaller size decreases energy consumption by roughly 35%.



- A diameter of 40 mm has been used thus far.
- The diameter is reduced to 32 mm because the application can still be operated with a smaller cylinder without any problem.

→ Air consumption is reduced by 35%.



In many cases the next smaller drive can be used.



-35%

Other possible applications

This also applies to electric systems. Design of the overall system (motor, gear unit, axis) and avoidance of accumulated safety factors when considering individual components.

Pneumatic drives – products

Lightweight materials, continuous improvement of reliable seal concepts and the development of hermetically sealed drive systems: these are three decisive factors for low energy consumption during operation. Festo's portfolio includes a broad range of pneumatic drives that have precisely these attributes.

In particular the numerous guided drive combinations deserve special mention, as they help customers avoid misalignment and thus potential leaks as well.

50% savings thanks to size reduction: semi-rotary drive with piston DRRD

The improved design ensures a very high load capacity and an extremely high mass moment of inertia. Smaller drives can thus often be used.

Calculated value

- Air consumption, DRRD-50-180 at 6 bar operating pressure: 1.7 l/min
- Air consumption, DRRD-40-180 at 6 bar operating pressure: 0.8 l/min

→ Consumption reduction: roughly 53%

Benefits

- High precision and load capacity thanks to innovative bearing technology
- Simple layout and concept provide good availability and very short delivery times
- New function variants for a great variety of customer applications





Compact cylinder ADNP

Especially lightweight cylinder due to polymer end cap

- Dia.: 20 ... 50 mm
- Stroke: 5 ... 80 mm



Linear drive DGO

Leakage-free thanks to magnetic power transmission without mechanical connections

- Dia.: 12 ... 40 mm
- Strokes of up to 4000 mm



Linear drive DGC

Rodless cylinder with patented sealing band reduces leakages.

- Dia.: 8 ... 63 mm
- Strokes of up to 8500 mm



Mini slide DGSL

The sturdy and precise guide reduces leakages due to wear.

- Dia.: 4 ... 25 mm
- Stroke: 10 ... 200 mm



Valves and valve terminals – tips

In the field of pneumatics, valves function as switching and control components. The drives connected to them can only be operated efficiently if the valves are correctly sized and actuated.



- Combine valve sizes correctly on the valve terminal.



- Keep the number of connections/fittings as low as possible: valves on manifold blocks, or in general on valve terminals, reduce potential leak-ages.



- Use valves whose solenoids are actuated with reduced holding current.



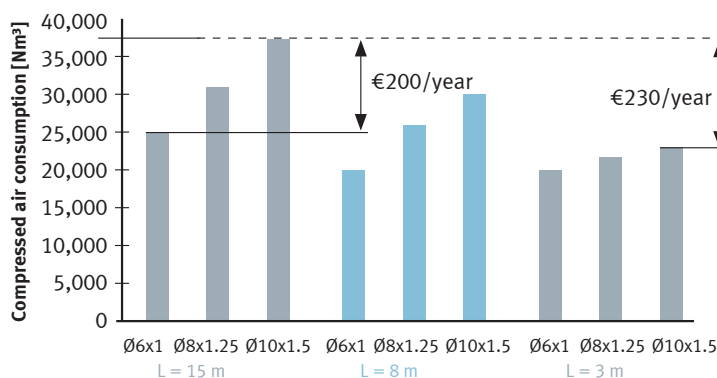
- Give preference to decentralised installations: less compressed air consumption thanks to reduced tubing lengths. See graphic below.



- Use reversible operation: pressure regulators upstream of the valves allow exhaust air to escape from the cylinder without resistance. It doesn't have to be exhausted by the regulator.
- Create different pressure zones in valve terminals in order to save energy.
- Use modern proportional valves with pilot control based on piezo valve technology to control pressure levels and flow rates. This reduces energy consumption considerably.



**Annual compressed air consumption [Nm³]
for 10 clamping cylinders, 1500 cycles per day**



The graph shows the influence of different tubing lengths and tubing diameters on compressed air consumption. This sample calculation is based on 10 clamping cylinders in automotive production at 1500 cycles a day.

Working it out for you: reduced pressure during the return stroke

In many applications, full force is only required in one direction. Pressure can be cut in half for the return stroke without causing any problems. This is especially easy to achieve if valve terminals with vertical-stacking regulators are used. Compressed air consumption can be reduced by more than 20%.

Adjust the pressure level to meet the requirement

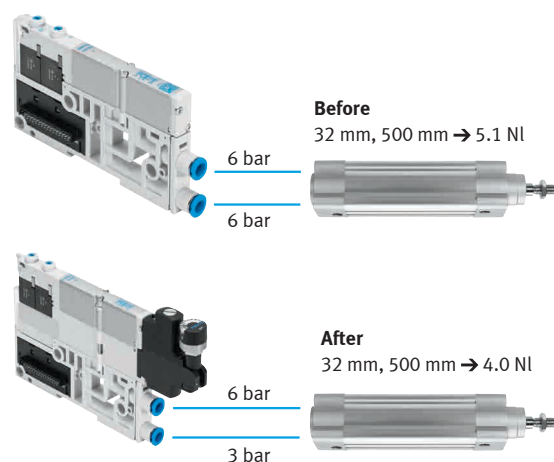
If valve terminals with vertical-stacking regulators are used, the pressure level can be easily adjusted to the application's actual requirements. This makes, for example, a return stroke with reduced pressure easy to implement.



- Air consumption of a standard cylinder DSBC 32-500 during normal operation at 6 bar: approx. 5.1 NI
- Air consumption of a standard cylinder DSBC 32-500 when advancing at 6 bar and with pressure reduced to 3 bar during the return stroke: approx. 4.0 NI

→ All in all, air consumption is reduced by 22%.

-22%



Valves and valve terminals – products

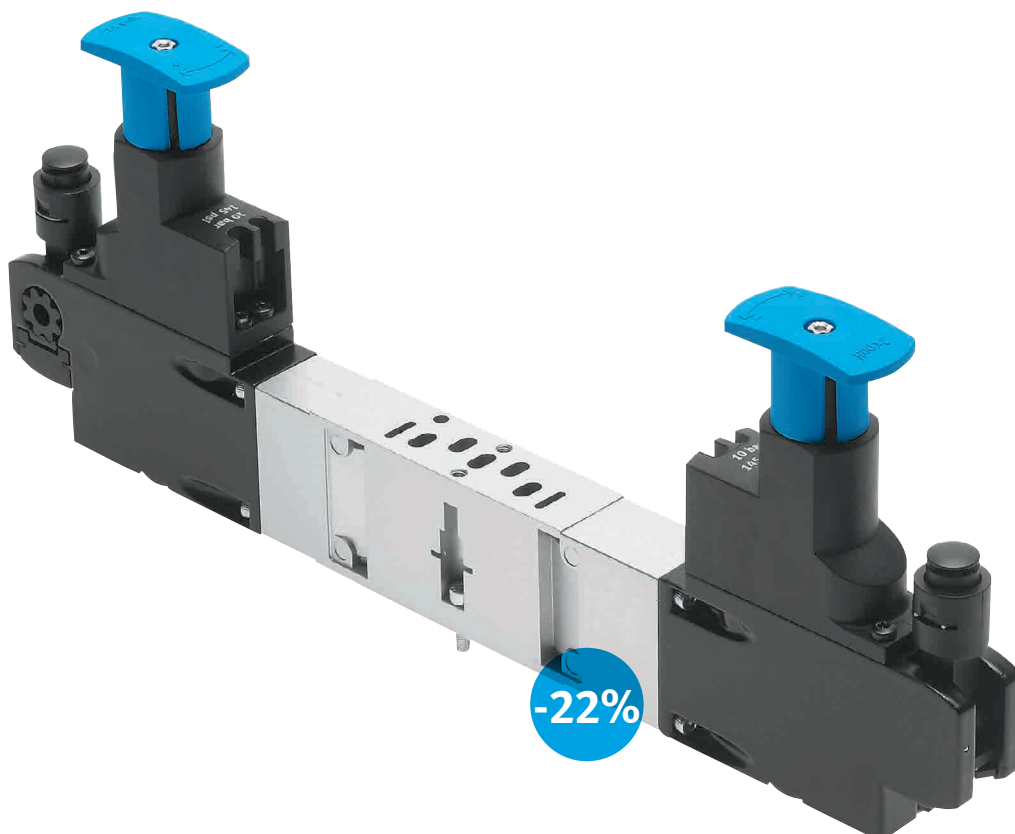
Nowadays a great variety of valve functions are performed using valve terminals. This saves time and effort during installation – and it is important for the prevention of leakages in pneumatic circuits. Valve terminal systems tested for leaks, solenoid coils with electronically reduced holding current, the creation of pressure zones and integrated pressure regulators: valve terminals with these features reduce energy costs in the long term.

Vertical stacking for more energy efficiency, e.g. with the valve VABF-S3-2-R4C2-C-10

In the case of valves and valve terminals, energy efficiency measures such as a return stroke with reduced pressure can be elegantly and easily realised through vertical stacking. The required pressure regulator plates are easy to install.

Benefits

- Quick and simple installation – even for retrofitting
- Operating pressure can be optimally adjusted to the application
- Various regulator types are available

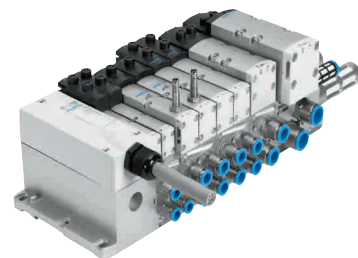




ISO valve terminal VTSA

Unique worldwide – 5 valve sizes on a single valve terminal

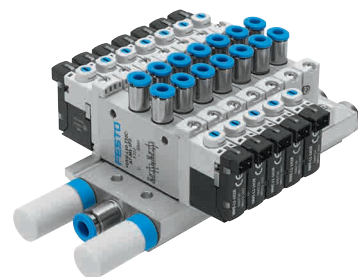
- Very high flow rates – up to 4500 l/min
- Reverse operation of valves and pressure regulators
- Simple implementation of pressure zones
- Diagnostic concept
- Vertical stacking



Valve and valve terminal series VG

The best individual valve in its class

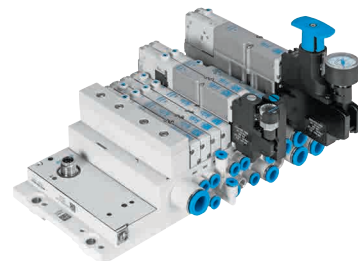
- Compact with high flow rate
- Expandable into a valve terminal with individual connection
- Easy installation
- Wide range of variants
- Numerous pressure zones are possible and can be easily implemented



Valve terminal MPA

Maximum function integration on a single platform

- Compact and space-optimised for high performance directly at the drive
- Highly variable: up to 64 valve positions/ 128 solenoid coils
- Vertical valve stacking: manual pressure regulator, pressure shut-off plate



Gripping and vacuum – tips

Of course the extensive product range from Festo also includes perfectly matched mechanical and vacuum grippers for the front unit. In some cases this results in massive energy-saving potential.

Gripping



- The gripper must be correctly sized. Oversized grippers consume more compressed air than necessary.



- Use shortest possible tubing lengths, i.e. position the valve as close as possible to the gripper.
- Please note that dead volume in the tubing frequently accounts for a large percentage of overall consumption, especially where gripping with small volumes is involved!



- Use pneumatic grippers in moving applications. They are lighter than electric grippers, and they reduce weight and save energy as a result.
- Use pneumatic grippers for long holding times. With pneumatic grippers, gripping force is available for as long as needed – without any additional energy consumption. Electric grippers are controlled and require additional holding current.

Vacuum



Install the vacuum generator as close as possible to the application.

Vacuum suction nozzles are the ideal solution for this purpose.

- Avoid long tubing lines between the vacuum generator and the suction gripper.



- Powerful vacuum or high suction rate? Select the right suction nozzles for the application in question.

- Short evacuation times reduce air consumption at the vacuum generator.



- Vacuum generators with air-saving circuit are capable of saving large amounts of compressed air in many cases.



- Check exhaust air silencers in vacuum generators for contamination on a regular basis!

Working it out for you: air-saving circuits in vacuum applications

Constant vacuum pressure is not absolutely necessary for reliable holding of objects. Continuous air consumption can be avoided by using an air-saving circuit, especially in the case of smooth surfaces. Savings amount to roughly 60% of previously required volumes of compressed air.

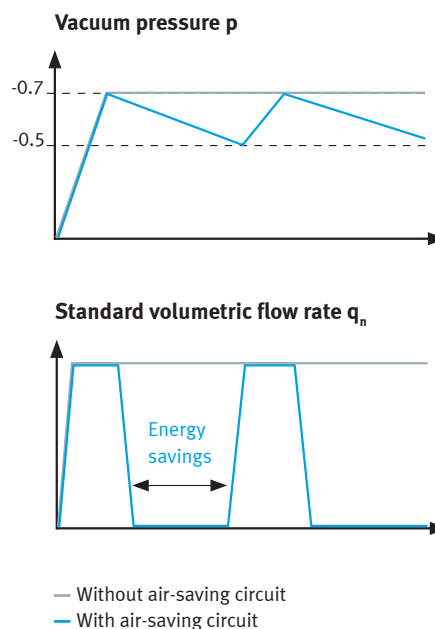
Switch off vacuum generation intermittently

The vacuum suction nozzle OVEM with integrated air-saving circuit monitors vacuum pressure. When the predefined level is reached, the vacuum generator is switched off until the specified vacuum pressure value is once again exceeded.



- The compressed air supply is shut down by a solenoid valve, and vacuum pressure is monitored by a sensor.
- The air-saving circuit is especially efficient in the case of smooth surfaces, and reduces air consumption by up to 60%.

-60%



Gripping and vacuum – products

Space-optimised, lightweight components for gripping and vacuum applications provide great potential for increasing energy efficiency at the front end.

Intelligent vacuum monitoring – vacuum generator OVEM

Intelligent vacuum monitoring only generates vacuum when it is actually needed, and reduces energy consumption significantly.

Benefits

- Compact design
- Integrated vacuum monitoring with air-saving circuit
- High-performance suction and air-jet functions with optimised vacuum generator nozzles and power module
- Condition monitoring with OVEM increases process reliability and prevents machine downtime because it monitors evacuation and ejection times during every cycle and automatically generates error messages.





Parallel grippers HGPD

Sturdy, powerful and lightweight

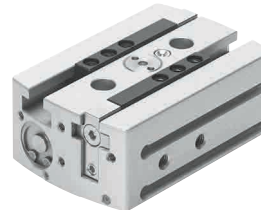
- Sealed gripper (IP65) for harsh environments
- No need for additional sealing air
- Easy to clean



Parallel grippers HGPL

Sturdy, high-precision long-stroke gripper

- Two opposing pistons move the gripper jaws directly without loss of force
- A single gripper type for internal and external gripping
- 4 sizes: 14 ... 63 mm
- Total gripping force: 130 ... 2800 N



Vacuum generator VN

Minimal space required

- Lightweight technopolymer housing
- Can be used directly in the work space
- Electrical and pneumatic actuation
- Max. vacuum: 93%



Compressed air preparation and energy monitoring – tips

Energy-efficient pneumatic applications can only be achieved with suitable compressed air quality in accordance with ISO 8573-1:2010. It is therefore crucial to take certain parameters into consideration.

The following questions need to be clarified when designing a decentralised compressed air preparation system:

What is the maximum required flow rate?

Connection size?

Do all consuming devices need the same compressed air quality?

What is the quality of the compressed air supplied by the compressor?



- Whenever possible, switch off the air supply during machine standstills, at the end of shifts, during breaks etc.



- When higher pressure levels are required at specific points within the network, use pressure boosters instead of increasing pressure throughout the entire system.



- Carefully check the need for filters, because every filter stage reduces the flow rate and increases the pressure drop. Follow the motto: “as much as necessary, as little as possible”.
- Timely replacement of filter elements in service units prevents unnecessary flow resistance.
- Use a multiple distributor instead of a series of T-branches. The pressure drop is greater with in-line T-connectors than with a multiple distributor.



- Decentralised compressed air preparation directly at the system reduces the risk of components being contaminated. Moisture, contamination and oil have a negative effect on seals and wash the initial lubrication out of the components.
- Tubing material which is suited to the environment prevents chemical, physical and microbial damage.
- Use only suitable tools when cutting tubing to length.
- Fittings with modern sealing rings and support functions ensure leak-proof, reusable connections.
- Monitor all air consumption. Countermeasures are only possible if you know how much compressed air is used.

Working it out for you: air supply switched off during standstills

World's first: the energy efficiency module E2M. The module is used to save energy in production systems that automate processes which are powered by compressed air. E2M provides active, intelligent control of the compressed air supply by shutting it off during system standstills and restarting it for production. Losses due to leakages are therefore limited. The module reads out relevant measured values from the machine's controller such as pressure and flow rate via a bus system. This makes it possible to monitor the system in a specific, targeted way.

Eliminating the flow of supply air in compressed air systems at standstill

At weekends and during breaks, if the machine is at a standstill air supply to the system is shut down automatically, but working pressure (P2) is maintained. Pressure losses due to leakages are reported. The system is started up manually when required. This reduces compressed air consumption by up to 20%.



- Assembly system with 20% leakage
- Daily utilisation: approx. 10 hours production and 14 hours standby
- System consumption per day without E2M: 1242 cubic Nm
- System consumption per day with E2M: 970 cubic Nm

→ Savings: 20%



-20%

Compressed air preparation and energy monitoring – products

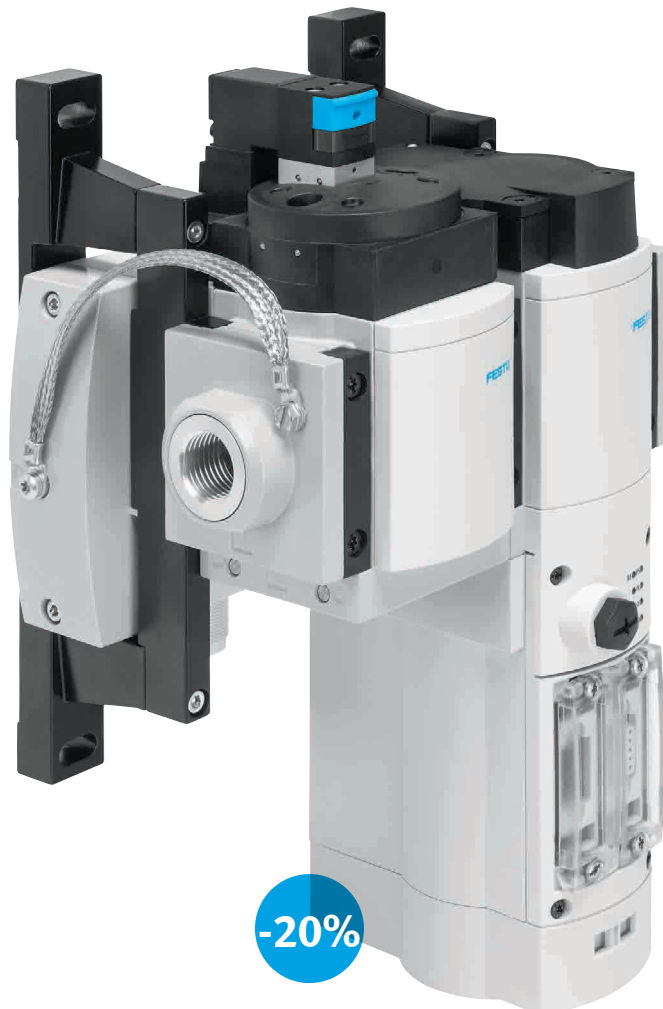
Optimally sized intelligent service units provide just the right amount of clean compressed air, and also monitor the system's consumption levels. Using the right components for distributing the compressed air can save a great deal of money.

Energy saving made easier than ever – energy efficiency module MSE6-E2M

The MSE6-E2M automates energy savings in compressed air systems. Reduces leakages to zero during non-production times, which it reliably detects by means of the integrated monitoring function.

Benefits

- Zero compressed air consumption in standby
- Checks the system for leaks
- Ensures maintenance in the event of leaks
- Monitors relevant process data





Air flow analyser

Autonomous measuring system with data logger for recording flow rate and pressure directly at the system

- Easy to install
- Software for evaluating and documenting data
- Measuring range: 30 ... 3000 NI/min



Service units – MS series

4 sizes

- Port sizes: 1/8" ... 2"
- Flow: max. 22,000 NI/min
- Intelligent combination of sizes permits high flow rates with low pressure drops



Flow sensors SFE3/SFET, SFAB and SFAM

Ideal for monitoring energy costs and testing air lines for leaks. Easy detection thanks to the displays.

- Flow rate measuring range SFE3: 0.05 ... 50 l/min
- Flow rate measuring range transmitter SFET: 0.05 ... 10 l/min
- Flow rate measuring range SFAB: 10 ... 1000 l/min
- Flow rate measuring range SFAM: 1000 ... 15,000 l/min



Pressure regulator LR /LRMA

- Easy to retrofit pressure regulator
- Flow rate: 22 ... 127 l/min
- Push-in fitting for tubing ODs of 4 ... 8 mm



Gain time – with Festo engineering tools for pneumatic solutions

Festo's customers have easy access to a networked, digital customer information system for everything from product selection, design and ordering to outstanding after-sales support. The electronic catalogue with integrated engineering tools and the online shop are perfectly set up for a wide range of requirements – and they take energy efficiency requirements into special consideration.

Pneumatic drives

Perfect simulations replace expensive actual tests because in particular during the design phase, an important cornerstone is laid for energy efficiency. The sizing software for pneumatic drives (GSED) simulates and calculates specific applications and suggests suitable products. Whenever the parameters are changed, all other values are updated automatically by this expert system. Product information such as CAD data, accessories and documentation is also available.

Valves and valve terminals

You can create your individual solution quickly and easily with our configurators for valves and valve terminals. Different pressure zones and valve-specific supply pressures, for example with the help of vertical-stacking regulators, can be implemented with only minimal effort.

Grippers

Reliable gripping and the energy-efficient use of grippers depend on correct calculation. The gripper selection tool from Festo calculates the best possible gripping solution based on weight, direction of motion, distances and the workpiece to be gripped. It immediately displays which parallel, radial, angle or 3-point gripper and in which size is best for the application – with maximised productivity and greatest possible energy efficiency.

Vacuum

Which suction gripper on which surface for which motion? Don't experiment – calculate! The vacuum selection program helps you select the right suction cups, tubing and venturi nozzles. It also calculates the distribution of the forces acting on the individual suction cups, as well as evacuation time.



Pneumatic drives – tools

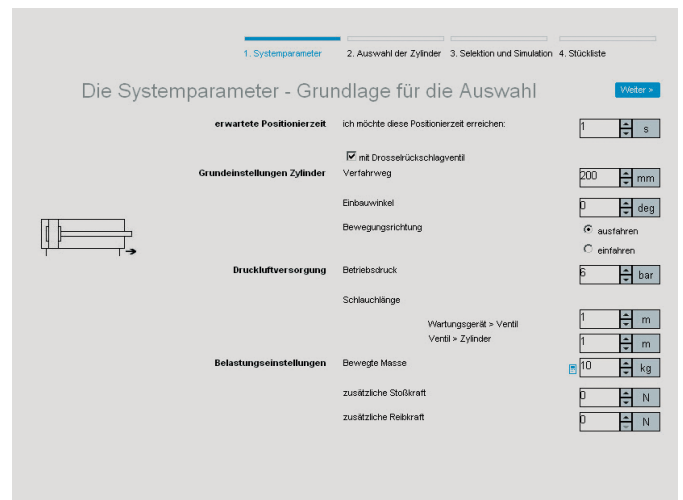
Dimensioning pneumatic drives with sizing software from Festo

Perfect simulations replace expensive actual tests. The Festo sizing software is expert at supporting you during the selection, configuration and sizing of the entire pneumatic control chain. If one parameter is changed, the program automatically updates all others. When configuring pneumatic control chains, the program ensures that all system components are of the right size.

Start the program, enter application data, calculate, select: done

Example with double-acting cylinder

- Expected positioning time
- Travel
- Mounting angle
- Direction of motion
- Operating pressure
- Tubing length
- Moving load
- Sensing via additional impact/frictional force



The screenshot displays the 'Die Systemparameter - Grundlage für die Auswahl' (The System Parameters - Basis for Selection) window in the Festo sizing software. The interface is organized into a grid with various input fields and checkboxes. A small diagram of a double-acting cylinder is visible on the left side of the window.

Parameter Group	Parameter	Value	Unit
erwartete Positionierzeit	ich möchte diese Positionierzeit erreichen:	1	s
	Verfahrenweg	200	mm
Grundeinstellungen Zylinder	Einbauwinkel	0	deg
	Bewegungsrichtung	☒ ausfahren ☐ einfahren	
Druckluftversorgung	Betriebsdruck	6	bar
	Schlauchlänge	1	m
Belastungseinstellungen	Wartungsgerät > Ventil	1	m
	Ventil > Zylinder	10	kg
	Bewegte Masse	0	N
	zusätzliche Stößkraft	0	N

Electric automation infrastructure

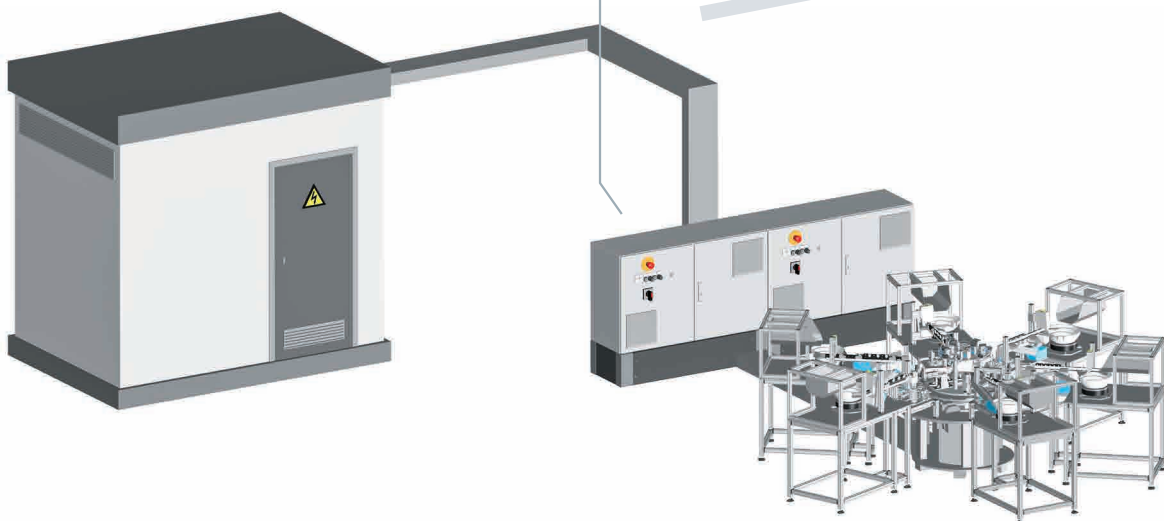
High energy prices, rising cost pressure and a growing awareness of climate protection have turned energy efficiency into a key business task. Pneumatic systems, too, offer attractive potential savings in this respect. The key to success lies in taking a comprehensive look at electric systems.

Energy supply and distribution

Electrical energy is usually supplied by an external power utility. On-site power generation is the exception. Energy is distributed within buildings via electrical cables. This usually results in minor losses.

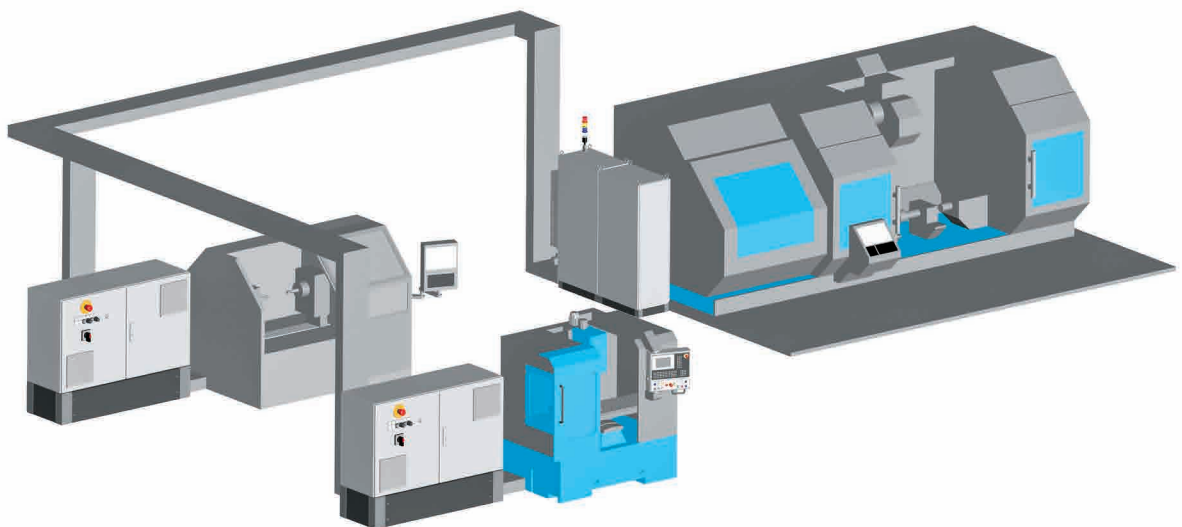
Preparing energy

In addition to distribution, electrical energy also has to be prepared for the various consuming devices. Depending on the application and the drive systems, different voltage levels and types are required which can be generated decentrally in, for example, control cabinets.



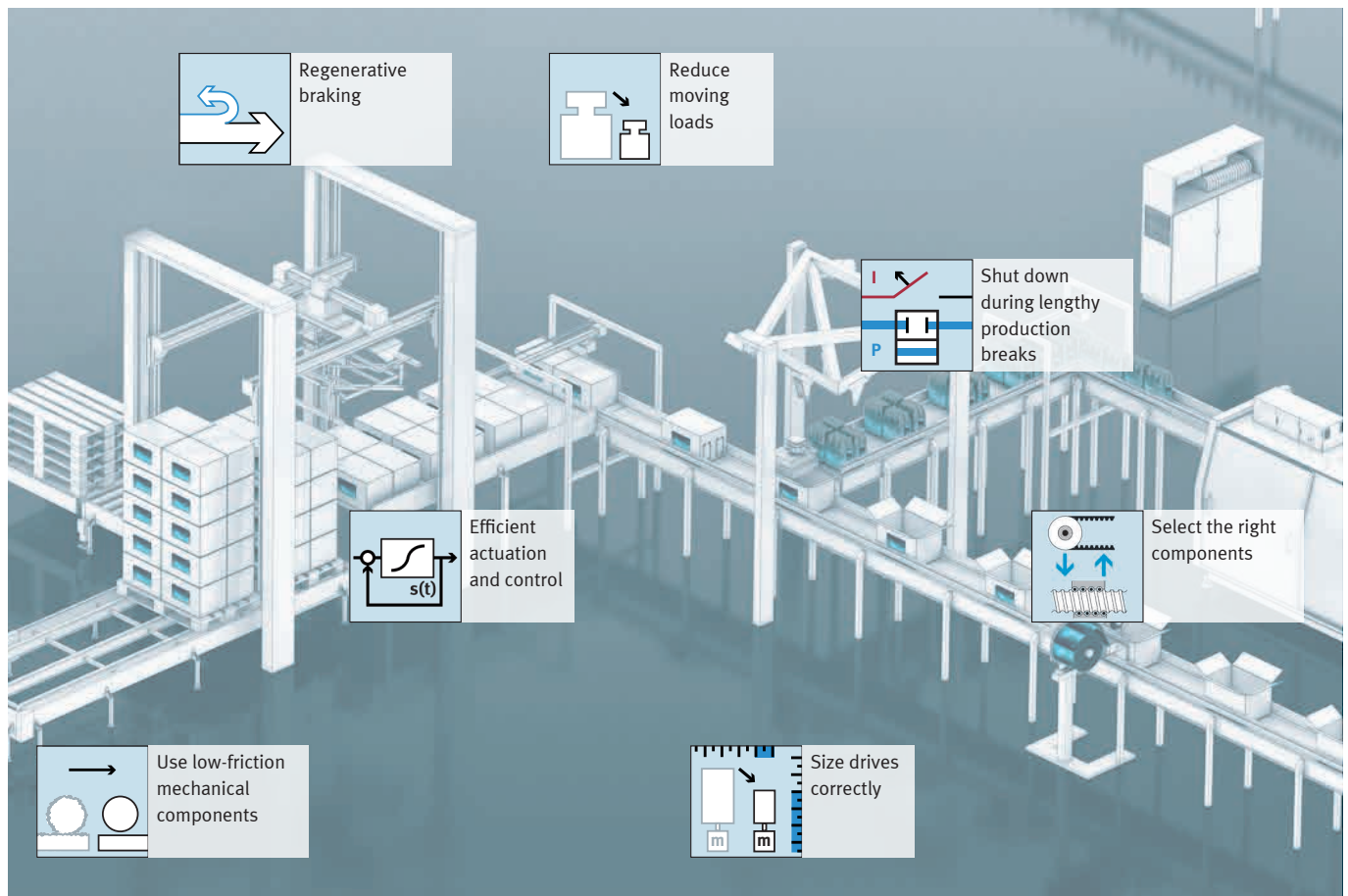
Application

The range of applications is very diverse. However, most systems consist of three main components: a servo controller or a control unit regulates or controls the system. An electric actuator, usually a rotary or linear electric motor, converts the electrical energy into mechanical drive power. The third component, the mechanical system, converts this into the required motion.



Energy efficiency in electric applications

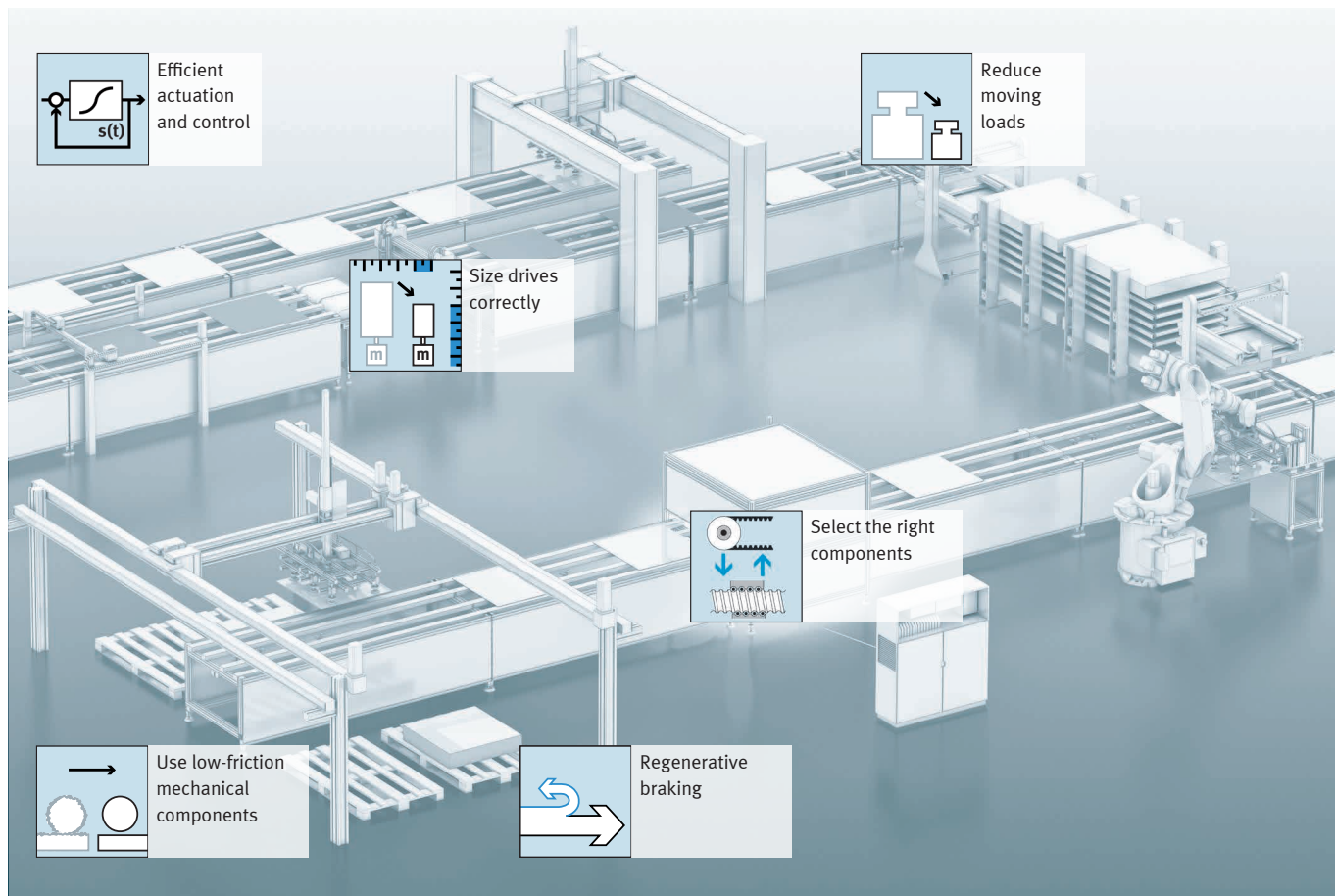
... in the packaging industry



Energy and cost savings,
and CO₂ reduction

-42%
-€643
-3 tons CO₂

... in the solar and flat-panel industry



Energy and cost savings,
and CO₂ reduction

-35%
-€570
-2.7 tons CO₂

Electric drives and axes – tips

Where electric drives are concerned, there is plenty of scope for selecting a suitable solution. Here too, it pays off to consider the efficiency of the overall system and to reduce energy consumption wherever possible. Below are several tips on how this can be achieved:



- Reducing the moving load has a direct effect on energy consumption.
- In the case of vertical applications with large loads, it may be helpful to use gravity compensation (e.g. a pneumatic spring).



- Service drives and axes regularly in order to reduce frictional loss.
- Low friction components minimise unnecessary losses.
- Eliminate any unnecessary gear units if possible.



- Adapt the drive technology to the task: use spindle drives for high forces, or toothed belt and direct linear drives for high dynamic response.
- Use holding brakes for long holding times.
- Designing the drive train as a whole avoids the accumulation of safety factors.



- Rigid mounting of the axis and the motor reduces vibration and thus unnecessary control effort as well.

Working it out for you: reduced moving loads

Where electric drives are used, moving loads play a significant role with regard to energy consumption. The payload is often only a small part of the moving load because cable chains, guides, workpiece carriers and motors also have to be moved. Reducing the moving loads can significantly influence energy consumption.

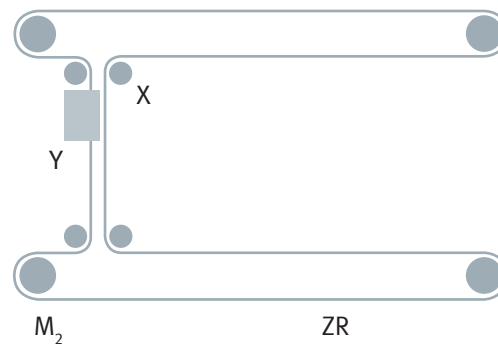
Keep the moving load as low as possible

The 3D gantry EXCH, in contrast to conventional gantries, is equipped with two stationary motors for motion in the X and Y directions. This greatly reduces the moving load and leads to considerable gains in efficiency and performance.



- 3D handling task realised using of a 2D gantry with stationary motors in comparison with a conventional 3D gantry
- The moving load can be significantly reduced.

→ Energy consumption is reduced by 20%



-20%

Electric axes and motors – products

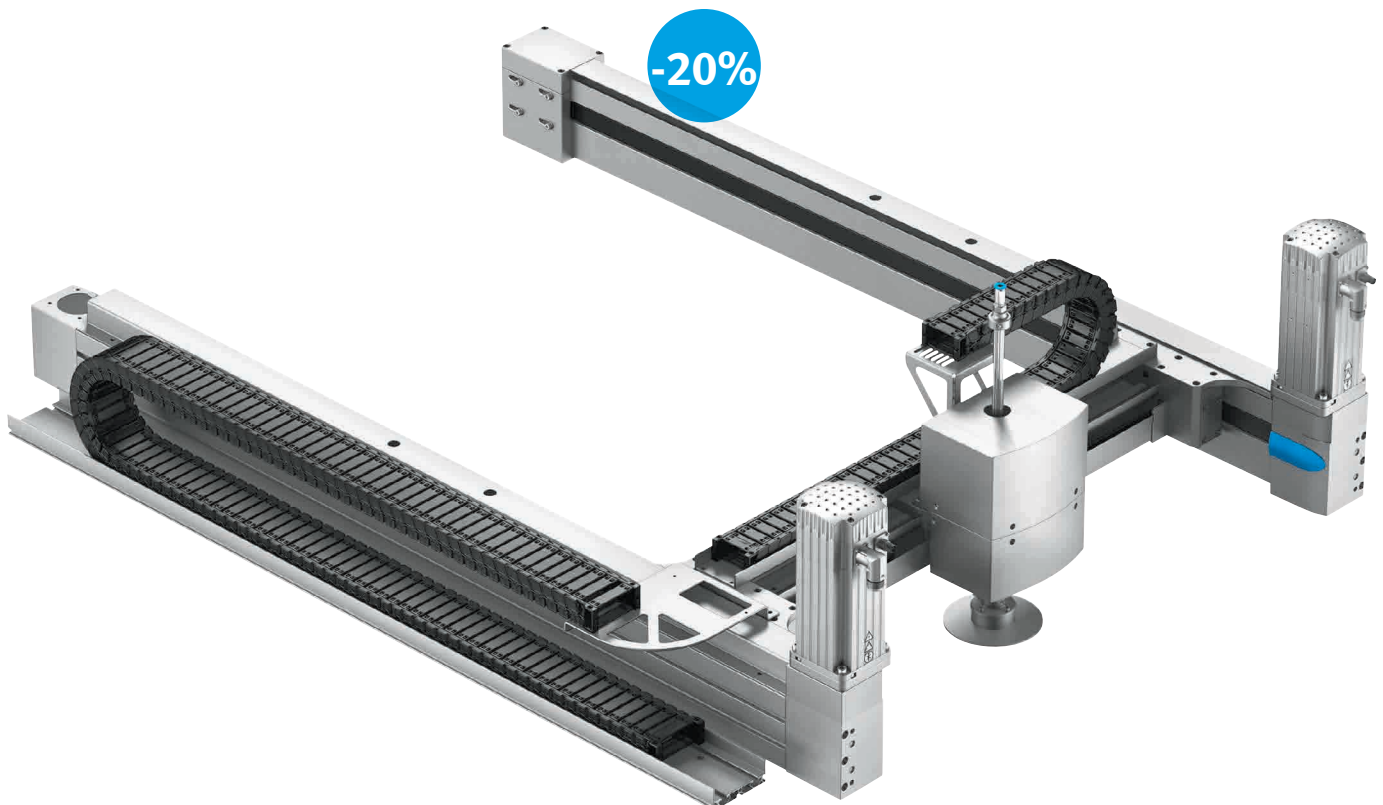
Energy efficiency is always part of the package with electric cylinders and drives from Festo as they are perfectly matched to the motors and controllers and are never under- or oversized thanks to the sizing software.

Greater dynamic response with reduced energy consumption: 2D gantry EXCH

Small design changes with an enormous effect: the moving load is significantly reduced thanks to the recirculating toothed belt and the stationary motors. Dynamic response and energy efficiency are thus increased.

Technical details

- Recirculating toothed belt and stationary motors
- Very high dynamic response: at least 30% higher performance than conventional gantry systems
- Flat design and low centre of gravity
- Integrated cable guide concept
- Configurable system solution





With EPCO you always get the right combination.

- Fully assembled, optimally matched
- 2 operating modes
 - Servo system: closed-loop operation with optional encoder
 - Cost-optimised: open-loop operation without encoder
- Possible motor positions
- Numerous mounting and attachment options
- Easy to clean thanks to CleanLook



Electric cylinders ESBF

Fast, precise, powerful:
free positioning with the ESBF.

- Maximum feed force: up to 17 kN
- Very precise
- Up to 1.35 m/s
- Non-rotating piston rod with plain bearing guide
- Optional: IP65
- High corrosion protection
- FDA-approved lubricating grease for the food and beverage industry



High-speed handling system EXPT

- Electromechanical parallel kinematic system in 4 sizes.
- Highly dynamic and accurate motion in 3D space.
- Easily implemented using standard components combined with extremely lightweight carbon fibre rods.
- The minimal weight of the system permits efficient use of drive energy.
 - Max. acceleration: 100 m/s²
 - Max. speed: 6 m/s
 - Repetition accuracy: ±0.1 mm
 - Load at max. dynamic response: 1 kg
 - Max. payload: 5 kg



Controllers – tips

The areas of open- and closed-loop electric control also offer various options for saving energy. These include efficient closed-loop control, energy recovery and shut-down during non-productive phases.



- Where several moving axes are used, couple the controllers' intermediate circuits in order to make more efficient use of recovered braking energy.



- Use efficient power supplies.
- Optimised controller settings prevent system vibration and unnecessary energy consumption.



- Wherever possible, reduce the controller's energy consumption during breaks and standby time, for example by switching it off.
- In the event of a lengthy production standstill, completely shut down the electric drives and the controller.

Working it out for you: energy recovery

In many applications electric drives not only have to accelerate loads, they have to actively decelerate them as well. This braking energy can be reused under certain circumstances, thus making it possible to save electrical energy.

Reuse energy by means of intermediate circuit coupling

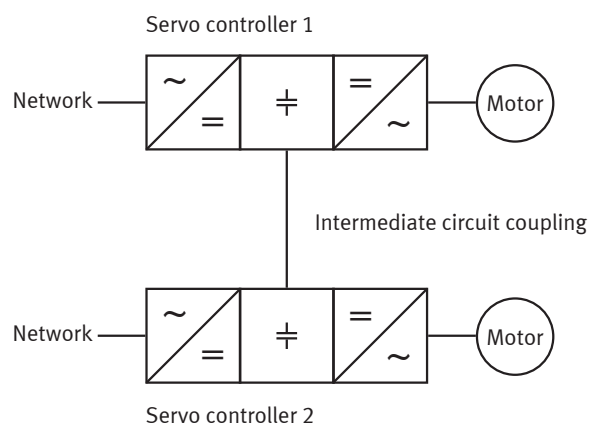
In applications in which the acceleration and deceleration phases of different drives take place simultaneously, intermediate circuit coupling can be used to recover braking energy.



- Handling task with 2 moving toothed belt axes without coupling the intermediate circuits in comparison with a system including coupling of the intermediate circuits

→ Energy consumption is reduced by 9%

-9%



Electric controllers – products

A broad-ranging portfolio of controllers for all types of applications and in different performance classes makes it easy to select the most suitable controller every time. In combination with drives and motors, the right energy-efficient package is thus always available.

Recovering braking energy: servo controller CMMP-AS

In the case of synchronised acceleration and deceleration, braking energy can be recovered through intermediate circuit coupling.

Technical details

- Extremely small dimensions
- Intermediate circuit coupling possible with several controllers
- Integrated EMC filters
- Automatic actuation for a holding brake integrated into the motor
- Can be expanded to include an STO function by adding a plug-in module





Motor controller CMMO-ST

Closed-loop servo controller as a position controller for stepper motors.



- Smooth running
- Monitored safe positions
- Minimal heat build-up
- Supports safe torque off (STO)
- For Performance Level e (PL e)
- 2 parameterisations
 - Integrated web server
 - Festo Configuration Tool FCT for up to 31 motion steps



Servo controller CMMS-ST

Stepper motor technology for closed-loop operation of single and multi-axis handling units with moving loads of up to 20 kg.



- Closed-loop servo system providing the highest degree of operational reliability and high dynamic response by using the best possible characteristic motor curve.
- Also available as an inexpensive open-loop system including stepper motors without encoder
- Outstanding value for money



Motor controller CMMS-AS

Highly flexible with multi-firmware for simple use of individually defined firmware versions with an integrated SD card.



- Primary voltage [VAC]: 100 ... 230
- Intermediate circuit voltage [VAC]: 320
- Motor current [A]: 4-phase



Gain time – with Festo engineering tools for electric solutions

A networked, digital customer information system is the key to energy-efficient electrical solutions. The electronic catalogue with integrated engineering tools and the online shop are optimally designed for a wide range of requirements – and they take energy efficiency requirements into special consideration.

Project engineering and design

Selection of electric drives

Positioning drives – create a suitable solution with just a few key data.

Which electromechanical linear drive best meets your needs?

Enter the data for your application, for example:

- Position values
- Payload
- Mounting position

The software will then recommend an optimised solution. Incorrect dimensioning and wasted energy are a thing of the past. Designing the drive mechanism, the gear unit and the motor as a whole prevents the accumulation of safety factors and eliminates the waste of primary energy due to oversized electric drive systems.

The screenshot displays the Festo engineering tool interface, which is divided into several sections for configuring and evaluating a linear drive system.

Systemparameter (Top Section):

- Auswahl, Konstruktion:** Options for 'Führung integriert' (Portalachse, Auslegerachse) and 'Ohne Führung' (Portalachse, Auslegerachse).
- Hinweis:** 'Auswahlfilter 1250 Systeme (Statisch)'. A note states: 'Die Achsen werden entweder als Portal- oder Auslegerachse betrieben. SCHNITTachsen sind Auslegerachsen mit erweiterten Montagemöglichkeiten.'
- Pflichteingabe (Einbaulage):** Radio buttons for 'Horizontal', 'Vertikal', and 'Beiebig'. A diagram shows a force vector F_g acting on a mass.
- Ergebnisse, Bereiche anhand von:** '1 Hub (Horizontal 0°)'.
- Achse:** Input fields for 'Maximal bewegte Masse' (10 kg), 'Hublänge' (500 mm), 'Wiederholgenauigkeit' (0,5 mm), and 'Zusätzliche externe Kraft' (0 N).
- Optionale Eingabe (Fahrprofil):** Radio buttons for 'Hublänge, ohne zeitliche Beschränkung', 'Detailliertes Fahrprofil', and 'Vertikaler Hub'. A 'Verfahrzeit + Pausenzeit' field is set to 60 s.
- Technologie Achsen:** Checkboxes for 'Lagerriemen' and 'Spindel'.

Ergebnisse (Bottom Section):

- Ergebnisse: Nr 5:** A list of different drive configurations (Portalachsen, Kugelumlauf, Rollen- oder Gleitführung, Verstärkte Ausführung, etc.) with a note: 'Dauerbetrieb: Diese Ergebnisse können von den Katalogangaben abweichen > 20 %'.
- Gewählter Antrieb:** Visual representations of the selected components: 'ESG-70-B5-10P-KF-GK' (Axis), 'EMMS-AS-55-S-Tx' (Motor), and 'CMMS-AS-C4-3A-G2' (Controller).
- Übersicht Leistungsdaten:** A table comparing required vs. possible performance.

Gefordert		Möglich mit Achse	
Hublänge	500,000 mm	500,000 mm	1000,000 mm
Wiederholgenauigkeit	±0,500 mm	±0,500 mm	±0,200 mm
Bewegte Masse	10 kg	10 kg	52 kg
Zusätzliche externe Kraft	0,0 N	0,0 N	1,226 s
Verfahrzeit + Pausenzeit	60 s	60 s	0,200 s

63 Ergebnisse: Optimale Baugrößen der Achsen

Nr	Achse	Größe	Führung	Motor	Getriebe	Achse	Motor	Führung	Verfahrzeit
3	Zahnriemen	70	Kugelumlauf	Servo AC	S:1	99 %	57 %	18 %	0,573
4	Kugelumlauftrieb	70	Kugelumlauf	Servo AC	---	97 %	69 %	31 %	1,036
5	Kugelumlauftrieb	70	Kugelumlauf	Servo AC	---	97 %	22 %	31 %	1,036
6	Zahnriemen	70	Kugelumlauf	Servo AC	3:1	99 %	57 %	18 %	0,501
7	Zahnriemen	70	Kugelumlauf	Servo AC	S:1	99 %	69 %	18 %	0,587
8	Zahnriemen	50	Kugelumlauf	Servo AC	S:1	99 %	85 %	35 %	0,782

Commissioning and operation

Two options – two great solutions: configuration via Web-Config and Parameters Cloud, or via FCT

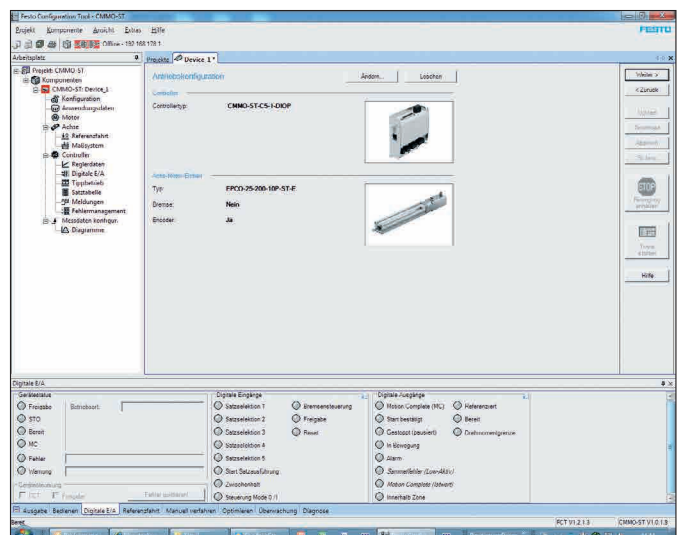
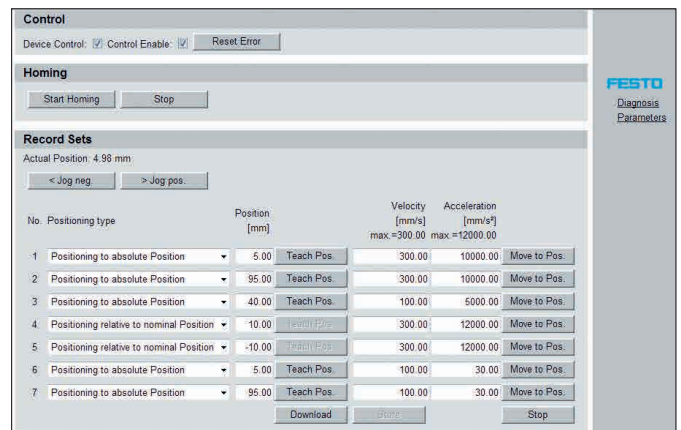
- Quick and easy via Web-Config and the parameter cloud on the server. Predefined, tested combinations are included in the catalogue with all of the necessary data. Motion to as many as 7 freely definable positions is possible and you'll be done in no time at all!
- Data from the parameters cloud! Controller-specific IP address for downloading data from the Festo parameter cloud via the Internet and the server.

Safe standard

Select motor, controller and axis with just a few clicks. Standard values are set by the software for the selected components including end position and homing values, as well as values for maximum acceleration and travel speed.

Parameterise and commission axis systems efficiently and safely with the Festo Configuration Tool FCT

All of the drives within a given system are represented in a clear-cut manner and can be managed and archived in a single project. Whether offline at your desk or online at the machine, FCT supports you with convenient configuration and assures maximum safety.



Note

The Festo Configuration Tool can be downloaded from the Support Portal.

→ www.festo.com/supportportal

Forward thinking, targeted action

High energy prices, rising cost pressures and a growing awareness of climate protection have turned energy efficiency into a key business task.

Energy Saving Services from Festo offer compressed air users a customised range of services for identifying and optimally exploiting potential compressed air savings – systematically and sustainably. You'll find our experts' enormous wealth of experience in automation technology and energy efficiency invaluable.

They analyse pneumatic systems from the point of compressed-air generation right on up to the applications in the plant. They show you how to avoid unnecessary compressed air consumption. And they help you implement the necessary measures and sustain the achieved savings in the long-run.

Your advantages

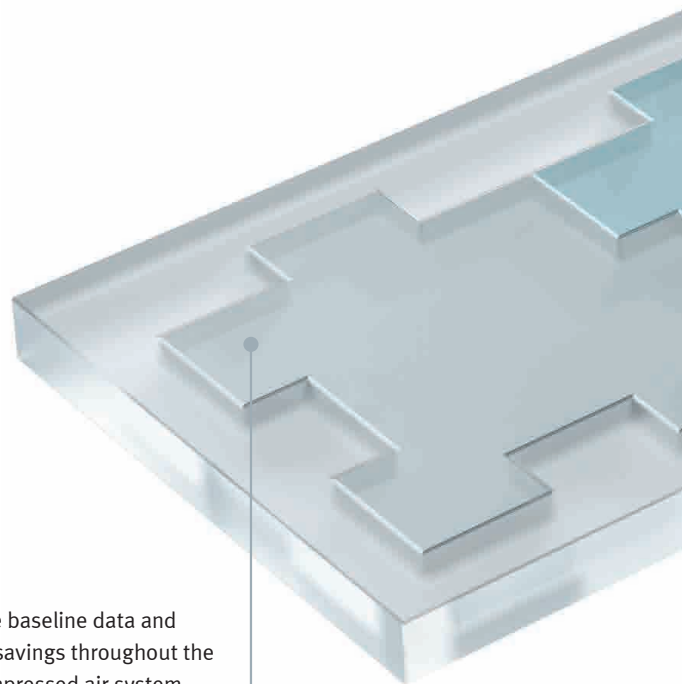
- Falling energy costs
 - More efficient compressed air generation
 - Reduced compressed air consumption
 - Avoidance of pressure drops
- Increased production capacity
 - Prevention of unplanned production downtime
 - A more stable production process
 - Avoidance of scrap thanks to uniform manufacturing quality
 - Maintenance of an optimised machine status

The result

Up to 60% cost savings with increased productivity
Practice shows that in most cases, attainable cost savings far exceed the costs of the services.
Experience reveals that the expenses are amortised within a few months after the measures have been implemented. Those who do more work with less energy also benefit from increased machine availability and process reliability, as well as lower operating costs.

Auditing

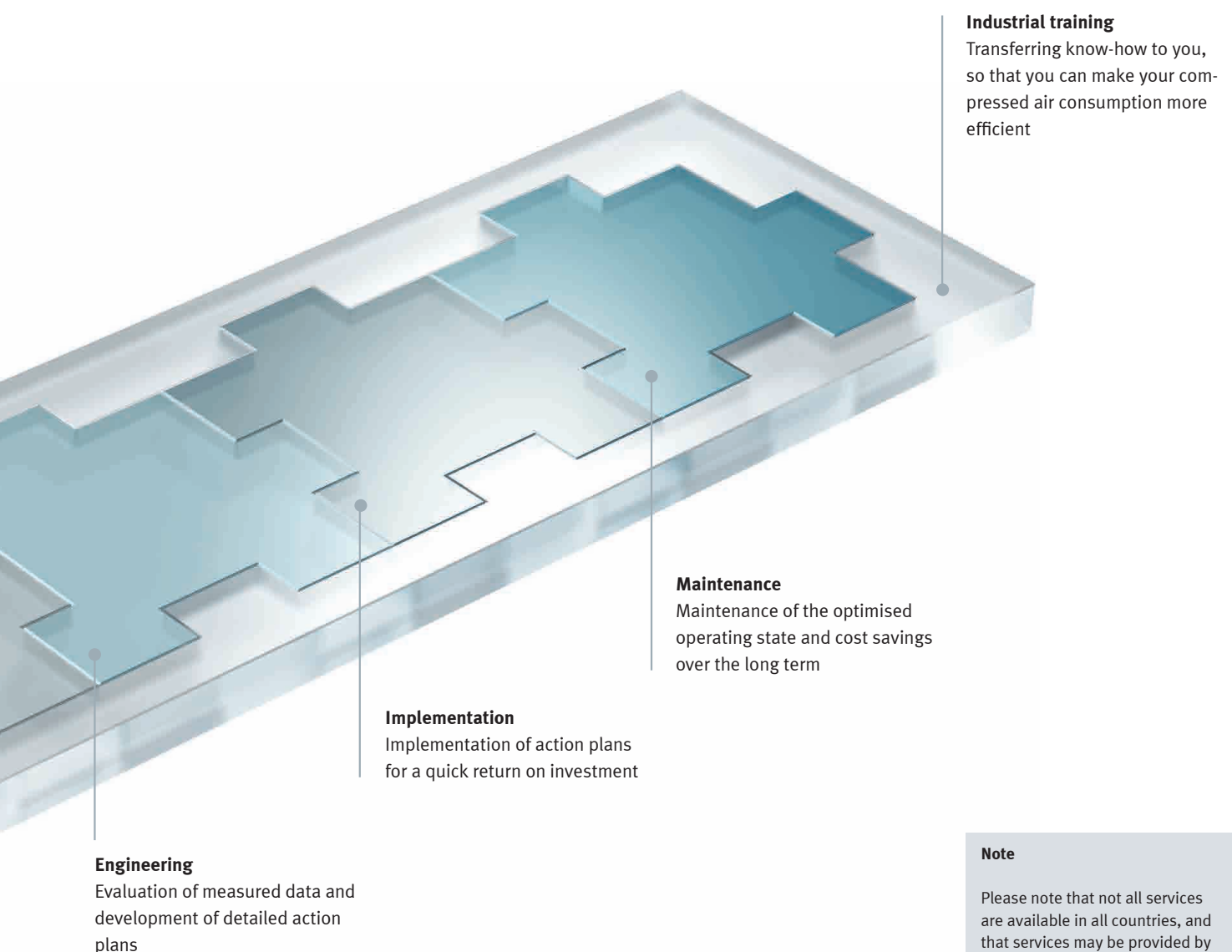
Determine baseline data and potential savings throughout the entire compressed air system



Energy efficiency as a service

Modular design to meet your exact requirements.

Our service offerings range from the recording and analysis of the status of compressors and machines, the development of action plans and professional maintenance of pneumatic components right up to maintenance of an optimised machine status. You define the objectives and we adapt the range of services to meet them. We have decades of experience in unique automation technology for each phase of the process. There's no doubt, it pays off in every respect.



Note

Please note that not all services are available in all countries, and that services may be provided by our local service partners. Ask your sales engineer.
→ www.festo.com/ess

Energy Saving Services in practice

Customer

Global food manufacturer

Measures

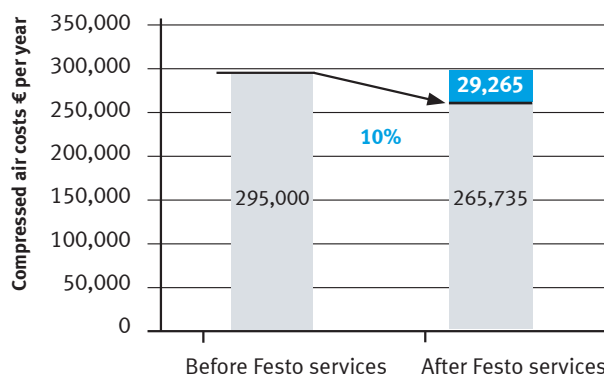
Leakage detection and elimination at the plant level

Initial situation

Plant size:	Approx. 50,000 sq. metres
Installed compressor power:	410 kW
Compressed air requirement:	40 m ³ /min
Production time:	8,000 hours per year
Control pressure:	6 bar
Compressed air consumption:	16,475,000 m ³ per year
Average price of compressed air:	€0.018 per m ³
Compressed air costs:	€295,000 per year

Results

Identified leaks:	296
Total compressed air loss:	1,625,815 m ³ per year
Leakage loss:	€29,265 per year
Reduction in annual CO ₂ emissions:	Roughly 160 tons
Total project costs (including replacement parts):	€31,000



Savings

Eliminating the leaks resulted in a 10% reduction in compressed air consumption.

Energy and cost savings, and CO₂ reduction

-10%
-€29,265
-160 tons CO₂

What our customers say

At Tate & Lyle, a global manufacturer of ingredients for food production, the experts from Festo have been able to fix leaks which were causing compressed air losses of 6000 litres per minute.

“We’re very satisfied with Festo and its Energy Saving Services. As a result, we were able to reduce compressed air consumption by about 8%.”

Remo Dubbeld,
Maintenance manager
Tate & Lyle, Netherlands

Tate & Lyle’s 30 production locations convert all kinds of raw materials into high-quality ingredients such as glucose syrup. The company faces high levels of global competitive pressure.

Consequently, Dutch maintenance manager Remo Dubbeld decided to test all the company’s compressed air systems. “We have our own energy saving programme, which has now been perfected thanks to Festo’s Energy Saving Services”, says Dubbeld.

Focus on leakage detection

“Festo checked our systems and discovered lots of leaks”, explains Dubbeld. “All in all we were losing 6000 litres per minute, which represents roughly 8% of our compressed air costs.”

Group-wide energy savings planned

This tremendous success in the Netherlands aroused interest at other Tate & Lyle locations.

“I told colleagues at other plants about Festo’s Energy Saving Services. We’re now planning to implement these measures in our other European plants as well”, says Dubbeld.

Customer

Tate & Lyle, Koog aan de Zaan, Netherlands, worldwide manufacturer of ingredients and solutions for the food and beverage industries and for other sectors



Leakage detection in the plant in Koog aan de Zaan. Detected leaks represent about 8% of total compressed air costs.

We make you more productive

Festo Didactic: because knowledge makes you more productive. With more than 40 years of experience and over 430 specialists, we offer skills development training, qualification and consulting services in roughly 80 countries around the globe. Festo Didactic is the world's leading supplier to technical educational institutions, as well as a provider of consulting and training services for industry. We've equipped more than 36,000 educational institutions with our hardware. Every year, more than 42,000 participants attend around 2,900 Festo Didactic seminars. And we're committed to promoting young talent too. That's why we've been a sponsor and partner to the international WorldSkills initiative – the world's largest vocational education and training platform – for more than 20 years.



Consulting and training services for industry

The Training and Consulting division offers:

- Skills development programmes
- Seminars and company-specific training in the areas of people, technology and organisation
- Process and organisational consultancy focusing on production and related areas



Resources for technical training facilities

We supply universities, schools and industrial companies with equipment for basic and further training in all areas of mechatronics, as well as factory and process automation:

- Technical laboratory equipment and learning systems
- Training factories
- Training sessions and train-the-trainer programmes
- Seminars
- E-learning



Festo – we never stop learning

As a learning company, we take our corporate responsibility for training and lifelong learning very seriously: 1.5% of our turnover is invested in training for our employees. And that means we're investing in your productivity too.

Industrial training

PN361 – Energy saving in pneumatic systems

Saving energy is becoming more and more vital. In factories and even small workshops, the intelligent use of energy sources and rightsizing and selection of components can save time and substantially cut cost and waste. Compressed air is a key energy source for industrial production and offers huge potential for cost-saving – from production to consumption. Savings begin by paying attention to the people working with compressed air. This course focuses on peoples' attention to costs and improves the areas of compressed air production, preparation and distribution, as well as on the design of pneumatic circuits. This course particularly meets the training needs of customers who have already benefited from the Festo Energy Saving Service.

Target groups

Operators, maintenance staff, engineering, designer, trainers

Contents

- Costs of compressed air with measurements
- Costs of leaks
- Compressed air consumption of various circuits
- The cost of oversizing and undersizing components
- Rightsizing for efficiency
- Energy efficient circuits
- Correcting the faults that cause efficiency waste

Outcomes

The participant:
understands the relationship between consumption and costs of energy sources
can apply efficiency measures in the preparation, distribution and consumption of compressed air
is able to correct faults that cause efficiency waste
can apply efficiency measures in pneumatic circuits
can select efficient components for various applications
is able to measure the air consumption of various pneumatic applications
can improve the lifetime of various pneumatic components

Note

Dates and other details are available at
→ www.festo-didactic.com

Together for more energy efficiency

Achieve more through cooperation: maximum possible energy efficiency can only be attained if the research efforts and the know-how of leading scientists, engineers, institutions and companies are combined as theory and practice go hand in hand in this respect.

This is the reason why Festo is actively involved in numerous research projects, initiatives and collaborations. See for yourself!



EMC2: Eco Manufactured Transportation Means from Clean and Competitive Factory

A research project of the European Community funded by the Seventh Framework Programme. The objective is to develop concepts for factories which are intended in particular to improve energy-intensive production processes in the automotive, aviation and railway industries.

→ www.emc2-factory.eu



The Green Carbody project: planning the efficient use of compressed air in the body shop

A research project of the German Federal Ministry of Education and Research (BMBF) targeted at "Research for future production". Energy requirements for pneumatic drive technology in the body shop need to be reduced by better coordination between energy suppliers and consumers.

→ www.greencarbody.de



EnEffAH: Energy efficiency in production in the field of drive and handling technology

A joint project within the framework of the German government's energy research programme. Development of methods, tools and products for energy-efficient automation, i.e. the right technology and efficient operation.

→ www.eneffah.de



ESIMA: Optimised resource efficiency in production through energy-autonomous sensors and interaction with mobile users

A joint project of the German Federal Ministry of Education and Research (BMBF) dealing with "Energy self-sufficient mobility – reliable, energy self-sufficient systems for mobile people". Hardware and software modules for simplifying interaction between people and machines in order to create transparency at any moment about machine statuses and the use of resources. This makes it easier to optimise production plants.

→ www.esima-projekt.de



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des Maschinen- und Anlagenbaus

Machines and systems manufacturing provides answers every day – with innovative, pivotal solutions and with the Blue Competence sustainability initiative.

FESTO



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You demand sustainable operations.
We are the catalyst for your efficiency.**

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OF PRODUCTIVITY.**

Saving energy is easier than ever before thanks to the MSE6-E2M which automates energy saving in compressed air systems. The intelligent service module monitors and regulates the compressed air supply in new and existing systems – fully automatically.

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Maximum productivity is a question of ambition

Do you share this attitude? We will be glad to help you achieve this goal – through our four outstanding qualities:

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