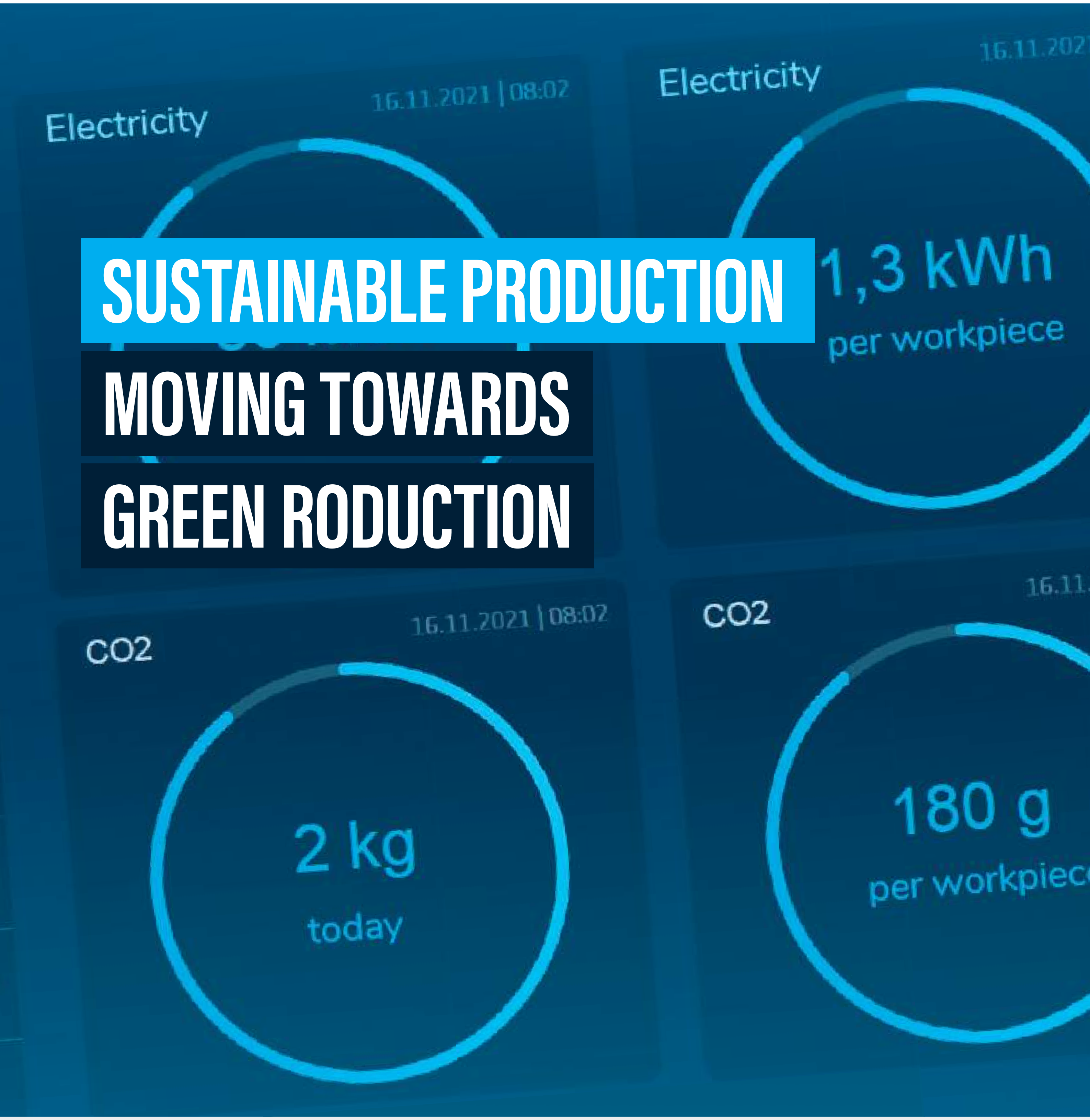
EMAG White Paper
Sustainable production



SUSTAINABLE PRODUCTION
MOVING TOWARDS
GREEN RODUCTION

Focusing on climate protection targets and energy efficiency

EMAG

TABLE OF CONTENTS

INTRODUCTION

SCRUTINIZING A MACHINE'S ENERGY CONSUMPTION

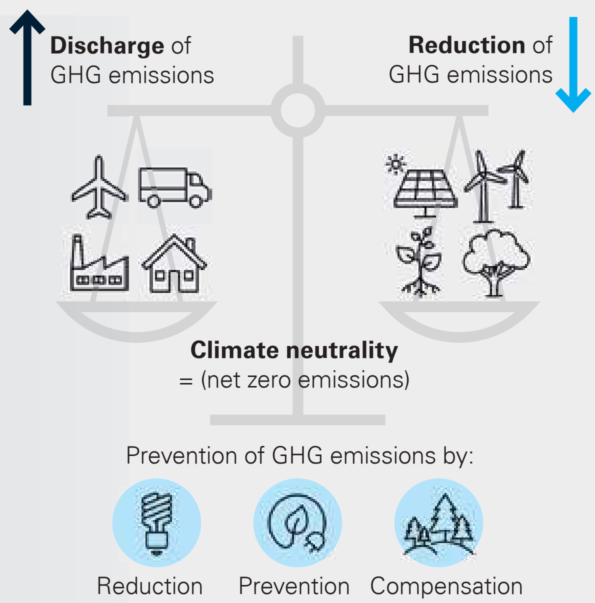
What is the energy consumption of a classic turning machine compared to a car or a single-family house? The figures clearly show that it all depends on which periods we consider.

First of all, we must state that to be able to compare emissions from fuel with those from electricity, we use what is known as the CO_2 emissions factor. This is recalculated every year for Germany and provides an average value for emissions (grams per kilowatt hour) produced by generating electricity. In 2020, it was 366 g/kWh (see table). We can then place the CO_2 emissions from electricity and fuel side by side.

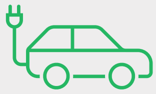
Energy costs
CO_2 emissions factor
In an hour
In a year

KEYWORD "CLIMATE NEUTRALITY"

A company is regarded as climate-neutral if its processes, products, and services do not increase the volume of CO_2 in the atmosphere – in other words, it has achieved a balance between emissions and their absorption from the atmosphere. This absorption process is achieved using so-called "sinks," for example, by growing trees and bogs.



1

Single-family house	VL 2	VLC 800	EV	Car
Living space 155 m^2 Heating and hot water from air-source heat pump	4000 h/year, equivalent to 10 8-hour shifts per week	4000 h/year, equivalent to 10 8-hour shifts per week	20,000 km/year, values per hour at a constant 120 km/h, average consumption 19.3 kWh/100 km	20,000 km/year, values per hour at a constant 120 km/h, average consumption 6 l/100 km
37 cents/kWh	37 cents/kWh	37 cents/kWh	37 cents/kWh	€1.75/l
366 g/kWh	366 g/kWh	366 g/kWh	366 g/kWh	140 g/km
0.9 kWh	4 kWh	15 kWh	23 kWh	7 l
0.3 kg CO_2	**1.5 kg CO_2**	**5.5 kg CO_2**	**8.5 kg CO_2**	**16.8 kg CO_2**
7,690 kWh	16,000 kWh	60,000 kWh	3,860 kWh	1,240 l
€2,846	€5,920	€22,200	€1,429	€2,179
2.8 tonnes CO_2	**5.9 tonnes CO_2**	**22.0 tonnes CO_2**	**1.4 tonnes CO_2**	**2.8 tonnes CO_2**

On the basis of "usage per hour," emissions from EVs and normal combustion engines are significantly higher than the emissions from turning machines. However, cars are not in use around the clock – in contrast to many machines. As a result, the annual consumption of a large machine operated on a two-shift basis will exceed the emissions from cars and single-family houses by some considerable distance. One interesting detail is that the single-family house used for the comparison is heated sustainably using an air-source heat pump.

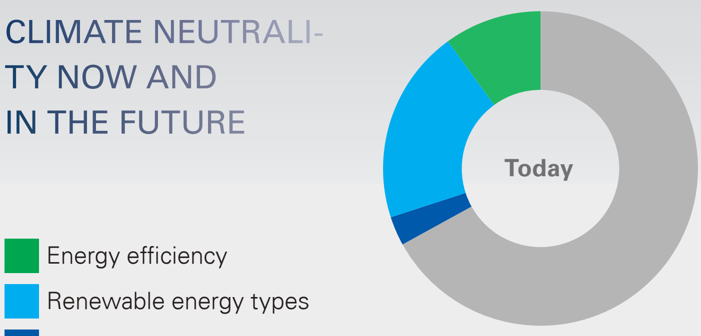
REDUCING EMISSIONS

WHAT DOES "CLIMATE NEUTRALITY" MEAN FOR COMPANIES?

We are familiar with the main objective of the Paris Climate Agreement – the signatory countries wanted to limit global warming to significantly below 2 degrees Celsius this century. But what does this mean for companies?

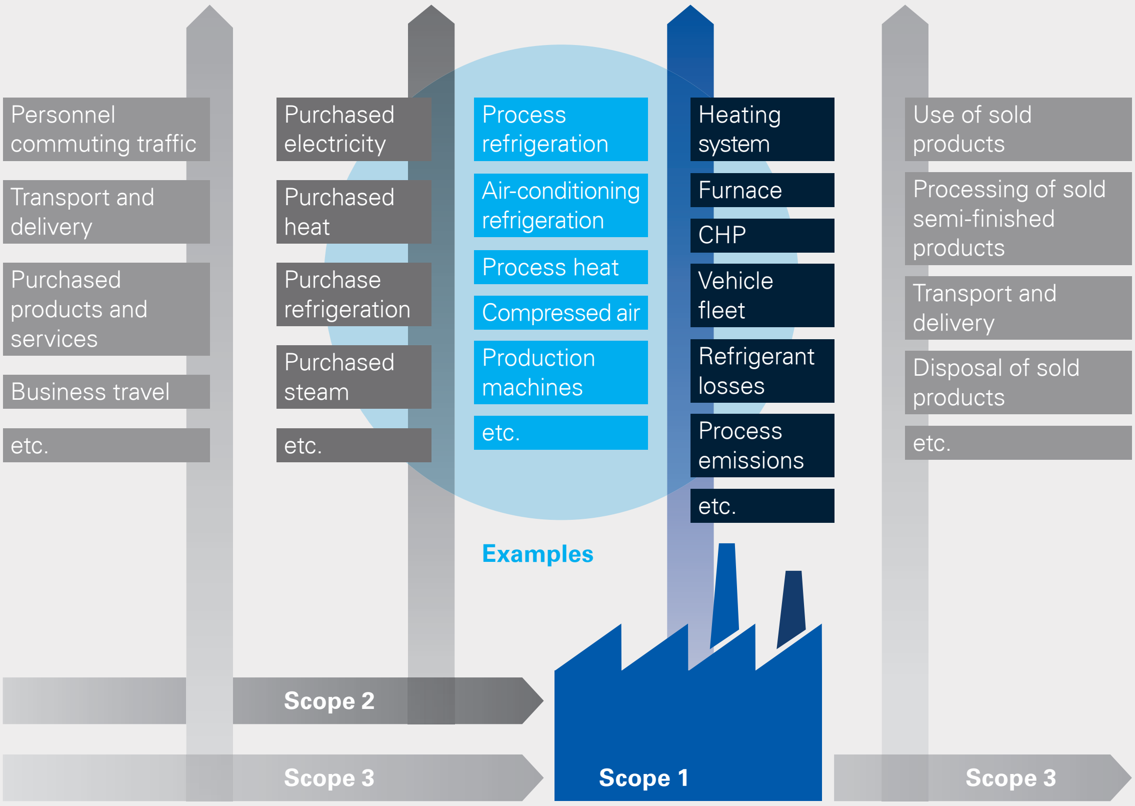
Various national laws play a role in this. The German government, for example, plans to reduce greenhouse gas emissions by 55% compared to 1990 levels in its "Climate Action Plan 2050". This general requirement has resulted in a range of national laws for its implementation. For example, the "CO2 Price" – which will be increased in stages to €55/tonne by 2025 – in turn will lead to compensation action by lots of companies with the overall objective of greater energy efficiency and reduced emissions. In addition, there is increased regulatory pressure imposed by the mandatory requirement to prepare a sustainability report or the active requirement by major customers to record environmental data and projects in databases.

CLIMATE NEUTRALITY NOW AND IN THE FUTURE



Balanced climate neutrality – **short term**!

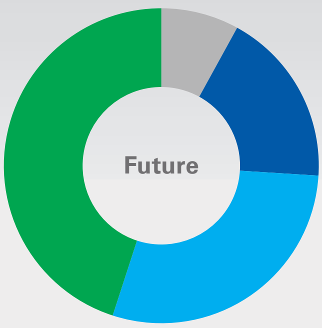
GREENHOUSE GAS EMISSIONS, FOR EXAMPLE CO_2, N_2O, AND CH_4



Source: ETA-Solutions

Under the internationally accepted standard of the **"Greenhouse Gas Protocol" (GHGP)**, the activities of companies are divided into three categories (scopes). Only Scope 1 (direct emissions) and Scope 2 (indirect emissions) are currently included in the GHGP on a mandatory basis. Scope 3 contains various upstream and downstream emissions.

The emissions balance is currently improved mainly by CO2 compensation (gray) and the use of renewable energy types (light blue). This ultimately results in balanced climate neutrality.
In the long term, the aim will be to prevent or reduce emissions to a greater extent. The significance of compensation will be reduced and the focus will be on energy improvements (green).



Climate neutrality by reducing emissions – **long term**!

MANUFACTURING PROCESS

WHAT EMISSIONS DOES A MACHINE TOOL GENERATE?

The scope division presented in the previous section can also be applied to EMAG machine tools. The main focus in this respect is on electricity consumption.

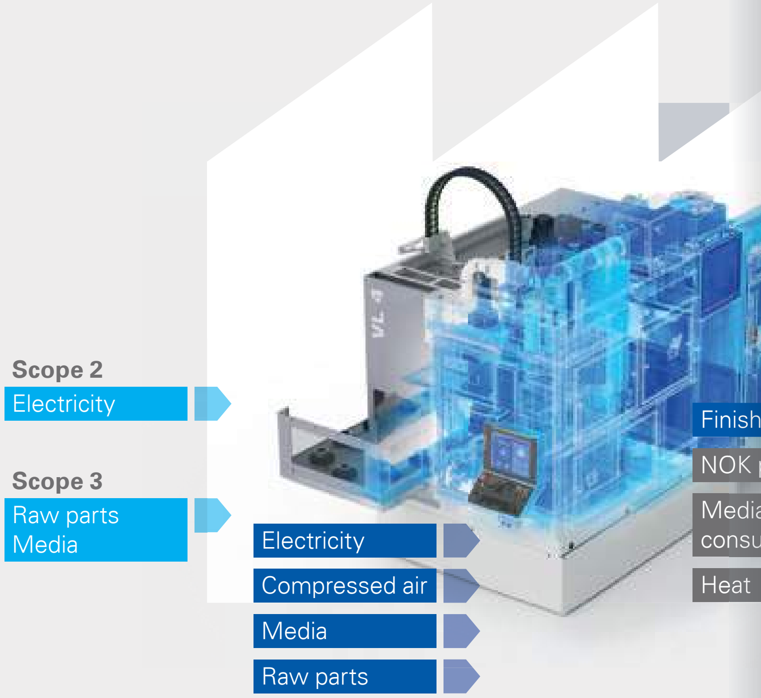
Direct emissions (Scope 1) do not generally occur at all on an EMAG machine. The main component of Scope 2 (indirect emissions) is the electricity used. All the other factors (from the waste and media to raw parts) are covered by Scope 3.

Productivity and emissions

There is generally a relationship between productivity and climate neutrality: If you produce more parts in a shorter time, emissions fall because the machine requires one shift less for the production run, for example. And that means: less electricity, compressed air, media, and so on are required.

By the way, this equation may be different for other production machines. For example, annealing furnaces often do not have a flame to burn flue gases, which are direct emissions covered by Scope 1.

SCOPE 1 / 2 / 3 CLASSIFICATION OF MACHINE TOOLS

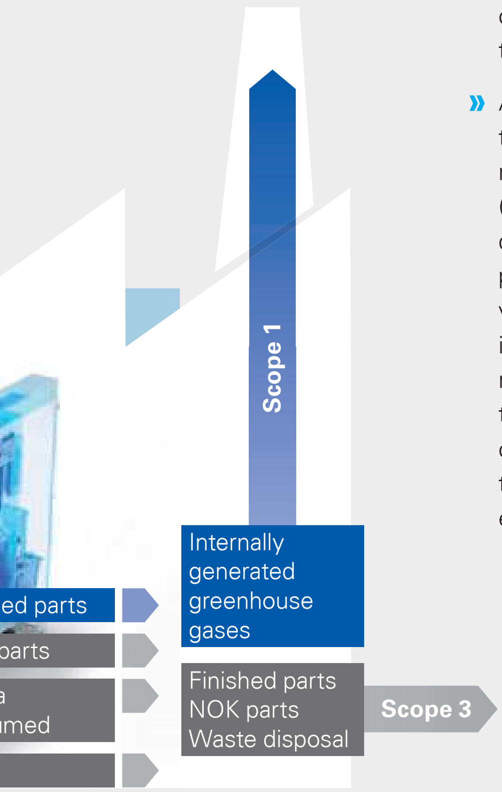


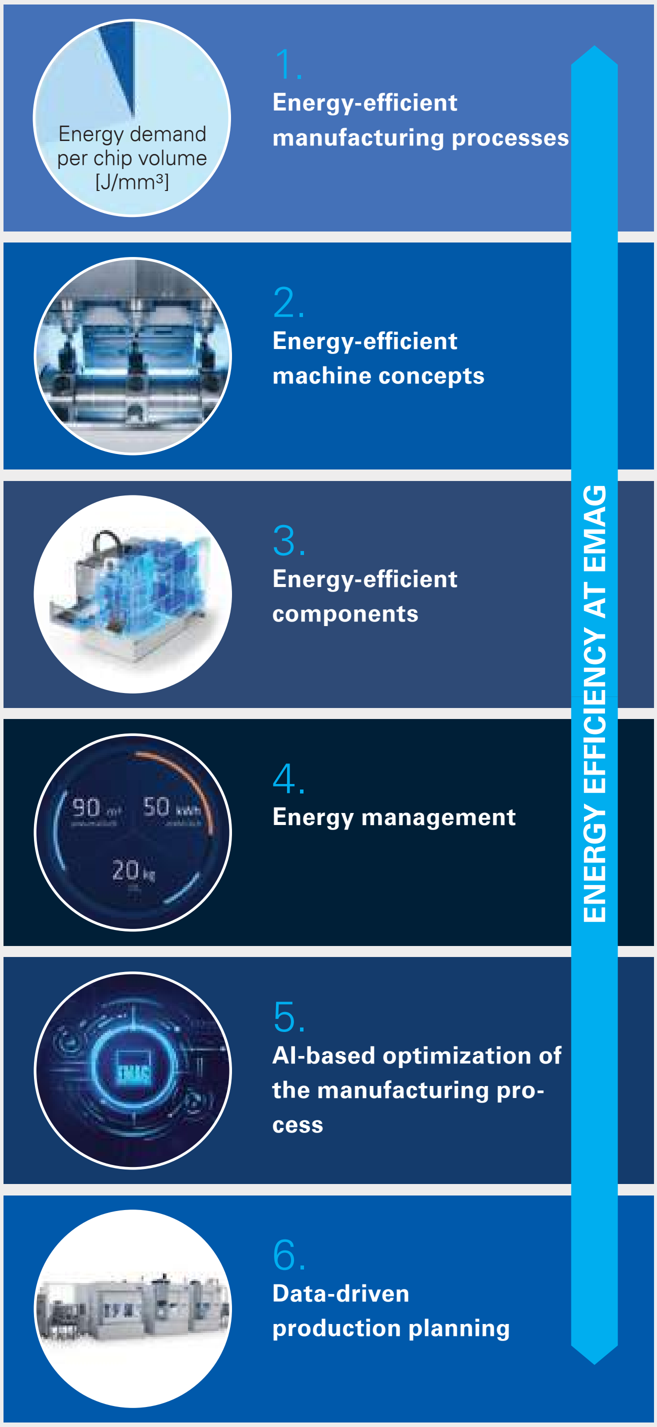
3

ENERGY EFFICIENCY AT EMAG AT A GLANCE

If you save energy, ultimately, you will also reduce emissions from your production. There are six factors which play a role in this for EMAG machines.

- The biggest influence is the selection of the production process (1). For example, it makes a major difference as to whether a part is cast and then turned or whether it is milled "from a single piece."
- The development of a machine concept (2) also affects energy efficiency. For example, simple automation delivers reduced electricity consumption. The same applies to economical motors or precision control strategies (3).
- Energy management can help to reduce consumption during waiting times, for example. When specific components are shut down, this saves electricity (4).
- AI-based optimization of the manufacturing process more important than ever. (5): Data delivers improved quality (less waste) and improves availability. Data-driven production planning (6) improves the manufacturing sequence so that throughput times are reduced (and the machines can, therefore, be switched off earlier).



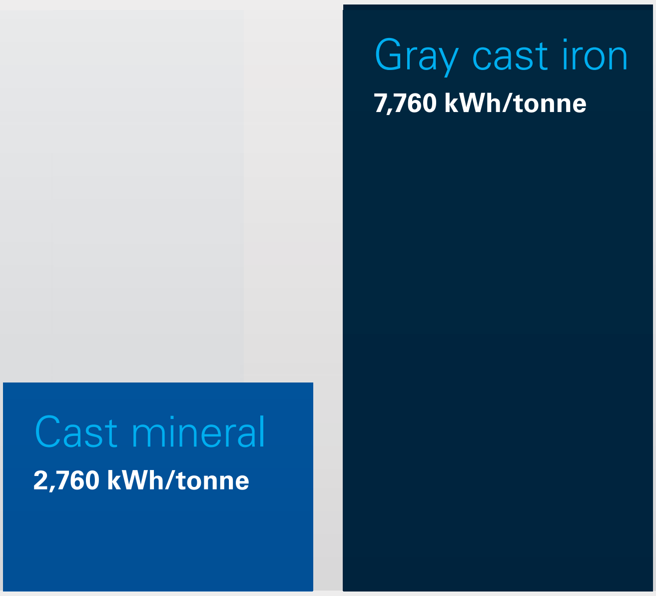


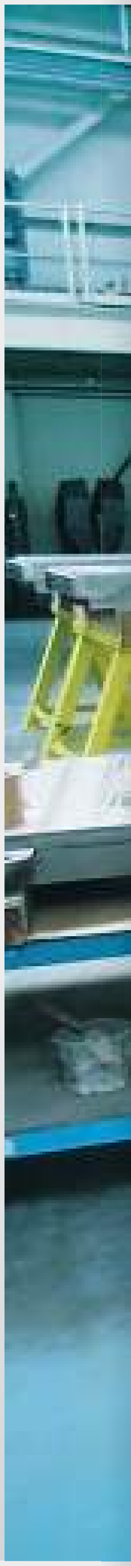
MINERALIT

SUSTAINABILITY IN MACHINE PRODUCTION

Examples from EMAG production show how energy-efficient production processes affect resource and energy consumption. Even the use of cast mineral makes a major difference.

The classical way of producing a machine body is to use gray cast iron. To do this, steel is smelted and cast in a mold – a process which requires high temperatures and a large amount of energy. As an alternative, EMAG uses MINERALIT®. This cast mineral is produced in a cold process, which results in energy savings of around 75% compared to gray cast iron. It also delivers other benefits. The machine has 10 times higher damping, which in turn extends tool service lives and reduces noise.





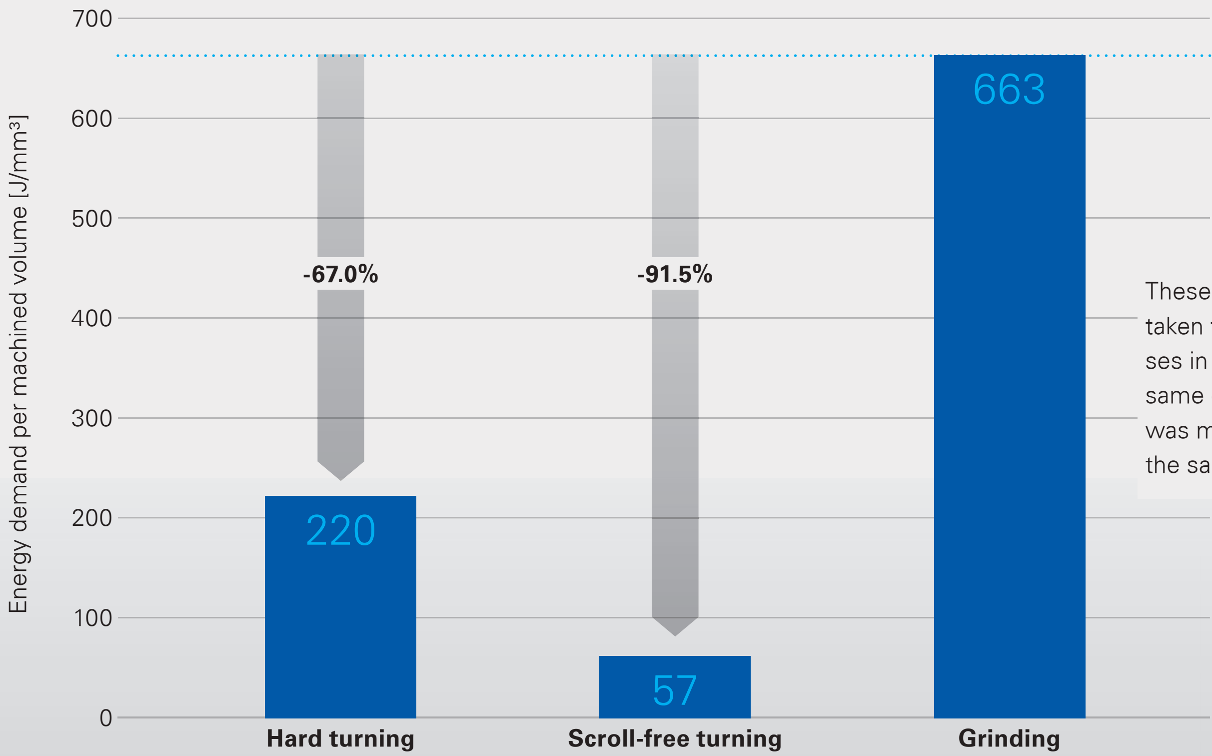
4

» Body of an EMAG machine made of MINERALIT®.

TOOL PROCESSES AND MACHINE CONCEPT

SAME RESULT – DIFFERENT CONSUMPTION

The choice of tool processes and machine concept has a major effect on the energy consumption of a production process.



These figures are taken from processes in which the same component was machined with the same objective.

Different processes can be used as alternatives for certain components to carry out the same work – in other words, the required end result, such as high surface quality, can be achieved in different ways. The energy requirement per machined volume differs widely, however. For example, a great deal of energy is required for grinding, including for the grinding spindles, oil and air lubrication systems and cutting fluid treatment.

5

ENERGY-EFFICIENT MACHINE CONCEPTS

CONCEPT

"Chaku-Chaku"

- Single-technology machine
- Minimal automation
- Manual loading

CONCEPT

Shuttle machining

- Two spindles, one tool carrier
- Loading takes place at the same time as machining
- Reduction in down times

CONCEPT

Twin / Duo

- Two spindles, one/two tool carriers in one machine
- Minimal peripherals – one controller and one main unit

CONCEPT

Multiple technology

- Multiple technologies combined in one machine
- Minimal peripheral equipment
- Less workpiece handling

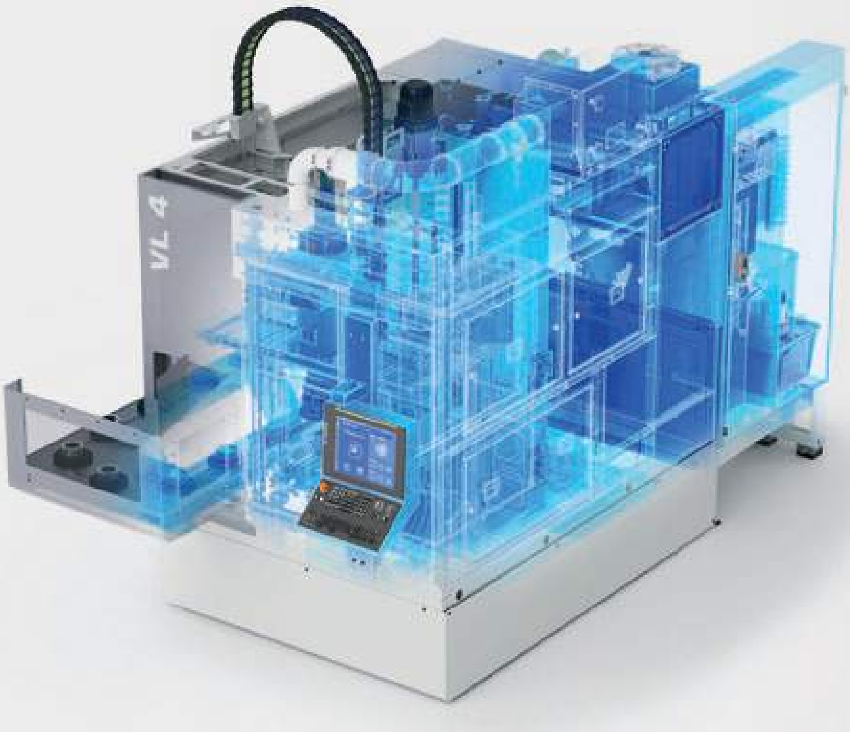
SIMPLIFICATION | **PARALLELIZATION**

The selection of the machine concept has a similar effect – the level of potential automation has a major effect on energy consumption. In simple terms, every additional time the workpiece has to be handled requires additional energy. On the other hand, machines that can easily be integrated into the production process reduce energy consumption. This can be achieved, for example, through integrated parts storage areas and easy loading and unloading processes. The same applies to shuttle machining: If parts are loaded at the same time as the machining takes place, idle times are reduced. For example, with duo machines, two machines share the peripheral equipment used for cooling; therefore, a duo machine consumes less energy than two single machines.
If multiple production processes are combined on a single machine, the cost of handling is reduced. It also means that less peripheral equipment is required.

COMPONENTS

ENERGY CONSUMPTIONI NSIDE THE MACHINE

How much electrical power is used in a machine, and where? The energy flow table shows this quite clearly – and also highlights potential savings.



Energy flow of a turning machine

1,660 WDrive system

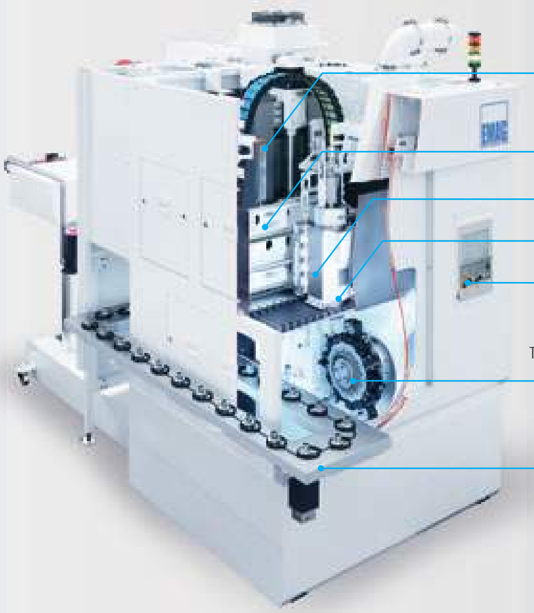
1,576 W	**Cooling system**
915 W	Compressor
500 W	Machine cooling pump
161 W	Control cabinet
487 W	**Hydraulics**
430 W	Hydraulic pump
57 W	Blower
	Cutting fluid
1,248 W	Cutting fluid pump
82 W	Chip conveyoer
99 W	Extraction
674 W	Others

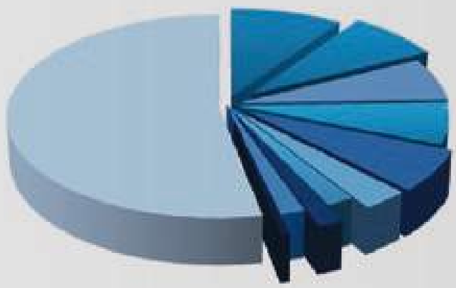
Source: ETA-Fabrik / PTW TU Darmstadt; all figures in W

Overall, these table always have a similar pattern – regardless of the size of the machine. The majority of the energy is used by the auxiliary units used for cooling, hydraulics and lubrication. The energy requirement of the drive system generally accounts for only around one-third of the total consumption. When major improvements are being considered, the focus is always on this area.

6

RETROFIT: WHAT POTENTIAL SAVINGS CAN BE MADE?





46.9% compared to previous machines

9.6%	Cooling unit improvement
8.0%	Hydraulics (for example, variable speed pump units)
6.9%	Drive unit cooling with through hole technology
6.6%	Reduction of barrier air, pneumatic system pressure
6.6%	Standby circuits
3.2%	IE3 motors
1.9%	Low-loss geared motors
1.8%	Frequency-controlled auxiliary drive units
1.7%	Cycle-controlled blow-air valves, fan-type nozzles
0.6%	Low wattage valves
53.1%	Remaining machine consumption

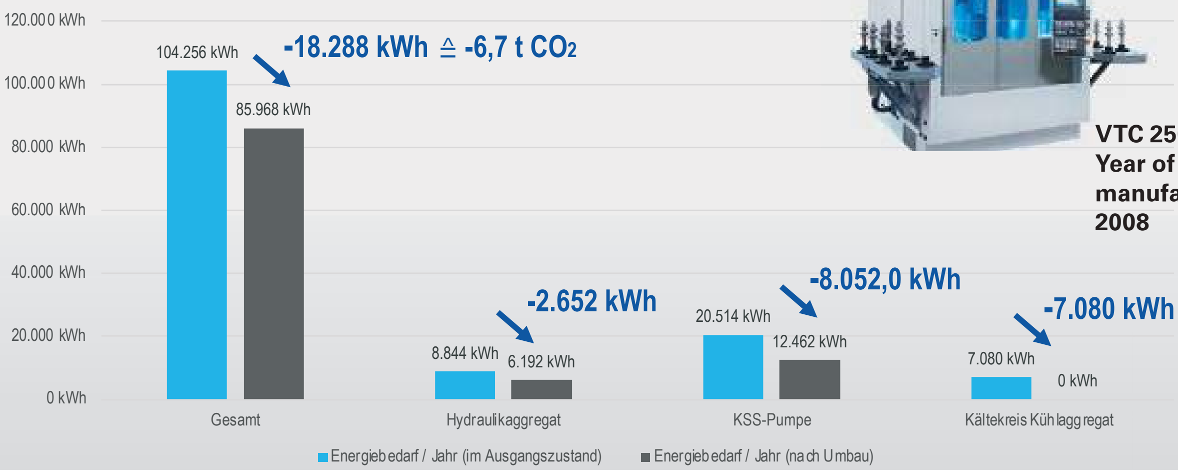
Focusing on energy consumption, EMAG continues to develop its machines with the very latest technologies used in the mass production process**.** It is also possible to achieve large potential savings by retrofitting. Consumption can be reduced by around 10% simply by improving the cooling units.

SUCCESS STORY

REDUCING CO_2 CONSUMPTION IN A FLASH

The energy efficiency of older machines does not just have to be accepted as a given. Simple retrofit work can reduce consumption enormously.

VTC 250
Year of manufacture 2008



This example focuses on a VTC 250 shaft turning machine dating from 2008 – in good condition with no leaks or similar defects. The energy flow diagram highlights three areas in which the machine is no longer state of the art, namely the hydraulic unit, cutting fluid pump and cooling unit. All three units were replaced. As a result, the user saves around 18,000 kWh per annum or around 6.7 tonnes of CO_2. This is more than the consumption of two single-family houses per year.

One interesting feature of this is that the new units were installed at the customer's site and the work only took one and a half days. The cost of the work was amortized in around 2.5 years, including state grants.

7

ETA-FABRIK IN DARMSTADT: CONSIDERING THE PRODUCTION PROCESS AS A WHOLE

The ETA-Fabrik is a research project of the Technical University of Darmstadt, involving various industrial partners and companies from the construction and technical building equipment industries. The figure shows a demo process chain with the various production steps, which are coordinated and closely networked with the production building.

In addition to improving the individual components, the aim here is to achieve synergism and a holistic view. For example, using the waste heat from the machine tools to heat the cleaning machine or even entire office buildings. By the way, the ETA-Fabrik also offers advanced training courses for interested companies.

EMAG ENERGY MANAGEMENT

COMPENSATING FOR STARTING AFTER BREAKS AND FROM COLD

1 **Body temperature**
2 **Spindle temperature**
3 **Workpiece geometry measurement point**
4 **Turret temperature**

A very normal process for many – machines undergo a warm-up process before starting production. This uses relatively large quantities of energy – with zero output.

The warm-up actually requires around 90% of the energy used in the production process, making it a great waste of energy, which is often unavoidable if you wish to start production without generating waste. And this is where EMAG comes into play: The aim of our current research work is to make warm-up phases superfluous and compensate for thermal properties. Various measurement results (together with their timings) are evaluated using machine learning. The ultimate aim is to achieve the required production quality without warm-up and heat holding programs.

8

RECORDING ENERGY DATA

Users can keep an eye on the consumption data for their machines using the EMAG Energy Monitor – seamlessly integrated into an IoT platform. The information relating to electricity and compressed air can be visualized on the machine or opened remotely – even for a whole production line. The main point here is that it is possible to gain an insight between energy data and the status of the machine as well as forming characteristic values such as “energy consumption per shift,” “energy consumption per workpiece” and “energy consumption during unproductive times.” Unusual discrepancies can then be identified immediately.

GO LIVE!

VISIT EMAG ON THE WEB.

» EMAG.COM

emag.com contains presentations of all our machines, technologies, and applications.

» EMAG YOUTUBE

The EMAG YouTube channel shows manufacturing systems in action. Experts also explain lots of details and animations show the processes clearly.

» EMAG BLOG

In the EMAG BLOG, we report on general market and technology developments, among other things.

» SOCIAL MEDIA

We also have a presence on Facebook, Twitter, and Instagram – with the very latest information.

EMAG EUROPA

EMAG Salach GmbH
Austrasse 24
73084 Salach
Germany
Phone: +49 7162 17-0
E-mail: info@emag.com

EMAG Salach GmbH – Austria
Glaneckerweg 1
5400 Hallein
Austria
Phone: +43 6245 76023-0
E-mail: info@austria.emag.com

EMAG Salach GmbH – Sweden
Glasgatan 19B
73130 Köping
Sweden
Phone: +46 221 40305
E-mail: mkarlsson@emag.com

EMAG Salach GmbH – Hungary
Gerenda 10
1163 Budapest
Hungary
Phone: +36 30 9362-416
E-mail: lbujaki@emag.com

EMAG Salach GmbH – Czech Republic
Lávová 1628/8
104 00 Praha 10 – Uhříněves
Czech Republic
Phone: +420 731 476070
E-mail: mdelis@emag.com

EMAG Salach GmbH – Poland
Spółka z ograniczoną odpowiedzialnością
Oddział we Wrocławiu
ul. Krzycka 71A / 6
53-020 Wrocklaw
Poland
Phone. +48 728 389 989
E-mail: arak@emag.com

EMAG Salach GmbH – France
5 Avenue de l'Europe
18150 La Guerche sur l'Aubois
France
Phone: +33 02 48 7711-00
E-mail: info.france@emag.com

EMAG Salach GmbH – Spain
Pasaje Arrahona, n° 18
Polígono Industrial Santiga
08210 Barberà del Vallès (Barcelona)
Spain
Phone: +34 93 7195080
E-mail: info.spain@emag.com

EMAG Salach GmbH
Merkezi Almanya – Turkey
Istanbul Merkez Subesi
Sanayi Cad. No.: 44
Nish İstanbul Sitesi D Blok
D:155 34196 Yenibosna – Istanbul
Turkey
Phone: +90 532 694 54 44
E-mail: ckoc@emag.com

EMAG Milano S.r.l.
Via dei Mille 31
20098 San Giuliano Milanese (Mi)
Italy
Phone: +39 02 905942-1
E-mail: info.milano@emag.com

EMAG ASIA

EMAG (China) Machinery Co., Ltd.
Sino-German Advanced Manufacturing Technology
International Innovation park Building 2, No. 101,
Chen Men Jing Road, 215400 Taicang
Jiangsu, China
Phone: +86 512 5357-4098
E-mail: info.china@emag.com

EMAG (Chongqing)
Intelligent Technology Co., Ltd.
24-7 Fangzheng Allee
Beibei Stadtbezirk
400700 Chongqing, China
Phone: +86 23 6824 8000
E-mail: info.china@emag.com

TAKAMAZ EMAG Ltd.
1-8 Asahigaoka Hakusan-City
Ishikawa Japan, 924-0004
Japan
Phone: +81 76 274-1409
E-mail: info@takamaz.emag.com

EMAG INDIA Pvt. Ltd.
Technology Centre
No. 17/G/46-3, Industrial Suburb
2nd Stage, Yeshwantpur
Bengaluru – 560 022
India
Phone: +91 80 50050163
E-mail: info@india.emag.com

EMAG KOREA Ltd.
Rm204, Biz center, SKn Technopark
124 Sagimakgol-ro, Sangdaewon-dong
Jungwon-gu, Seongnam City
Gyeonggi-do, 462-721
South Korea
Phone: +82 31 776-4415
E-mail: info@korea.emag.com

EMAG Systems GmbH (Thailand)
Eastern Seaboard
848/14 M.3, Bowin, Sriracha
Chonburi 20230
Thailand
Phone: +66 (0) 38110485
E-mail: service.thailand@emag.com

EMAG AMERICA

EMAG L.L.C. USA
38800 Grand River Avenue
Farmington Hills, MI 48335
USA
Phone: +1 248 477-7440
E-mail: info@usa.emag.com

EMAG MEXICO
Maquinaria EMAG Mexico S de RL de CV
Av. Hercules 301 Nave 1
Poligono Empresarial Santa Rosa
76220 Santa Rosa Jauregui, Querétaro
Mexico
Phone: +52 442 291 1552
E-mail: info@mexico.emag.com

EMAG DO BRASIL
Edifício Neo Corporate Offices, CJ 1503
Rua Enxovia, 472
04711-030 São Paulo SP
Brazil
Phone: +55 11 38370145
E-mail: info@brasil.emag.com

EMAG
www.emag.com