



Aiming high in vertical farming.

With efficient ventilation, drive,
and smart automation solutions.

ebmpapst

engineering a better life

Our portfolio of perfect growing conditions *from a single source.*



Optimum air supply and distribution for every system size



Efficient cooling for rooms and technology



Moisture regulation and nutrient supply as required



Complete oversight through networked applications and clear monitoring



Technologies and system solutions for control and automated processes



From supplying growing cities to responding to climate change – *vertical farming is the future.*

Create perfect growing conditions for plants and insects with the comprehensive product portfolio from ebm-papst. Intelligently controlled and automated – from cultivation to delivery.

Hand in hand *for a rich harvest.*

Compared to conventional agriculture, vertical farming has plenty of advantages. Yields, in particular, are many times higher, as systems offer perfect climatic conditions and can be operated all year round. On the other hand, huge amounts of energy are used, primarily for lighting and ventilation. It's high time to take a more economical approach: with precisely tailored system solutions and products from ebm-papst.

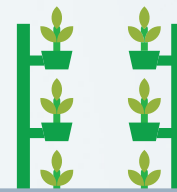
Wherever air needs to be moved in the most efficient and intelligent way, we are a sought-after engineering partner – and have been for

decades. Our wide range of fans, pumps and drives is up to any challenge. Thanks to our many years of experience, we can also develop specific customer solutions for special requirements.

All our products are robust and work reliably over the long term, even under the most adverse conditions. We also design and deliver sophisticated software and hardware solutions that make vertical farming as sustainable, economical and productive as possible – in every shape and dimension.

Traditional farming vs. vertical farming

Vertical farming has clear advantages over traditional farming, especially the avoidance of pesticides.



Land use		4–8 ha*		0.4 ha
Growing process		70 days		21 days
Plants per m ²		18		25–300
Vegetation period		Seasonal		365 days
Location		Outdoors		Everywhere
Handling after harvest		Extensive		Minimal
Proportion of sown plants that are harvested		50%		90%
Pesticides		4.19 million t		0

Water consumption is also significantly lower, as can be seen here using lettuce as an example.

Water use		250 l		1 l
Yield per m ² /year		3.9 kg		80–120 kg

*Depending on plant species

Up to any challenge.

Constant water circulation for hydroponics

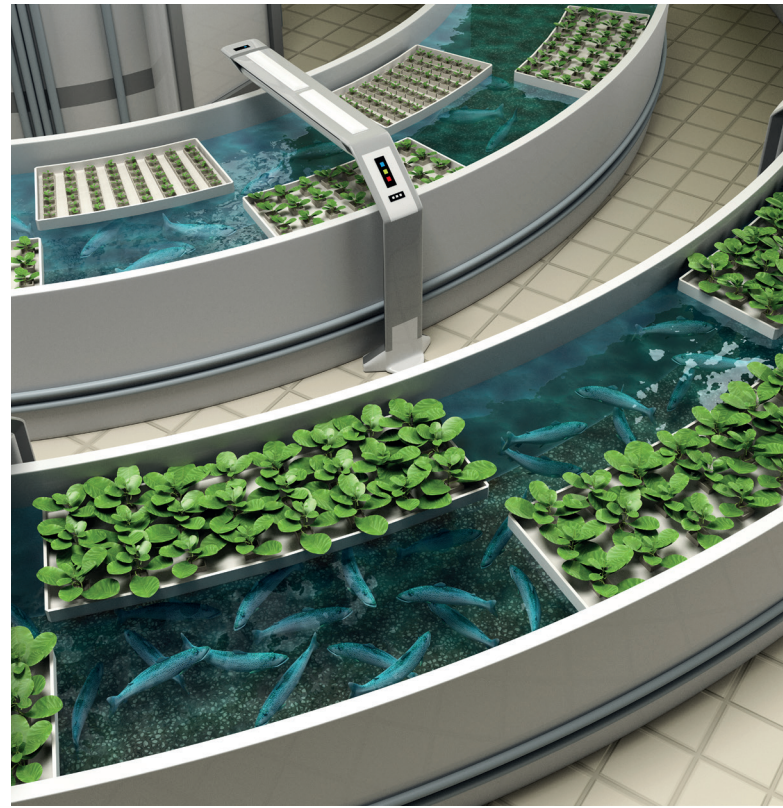
Roots that are constantly suspended in a nutrient solution must be intensively supplied with oxygen. At the same time, the plants require irrigation from above. We can provide you with the corresponding automation systems.

Ultra-fine spray in aeroponics

This is where nutrient solutions are nebulized with the help of atomizers and the free-hanging roots are moistened by them. Together with AgriConnect (see page 12), sensors for measuring humidity and water components help to control the pumps used for this according to demand, thereby increasing efficiency.

Aquaponics – the perfect combination of two worlds

Oxygen supplied is also used for breeding fish, with the animals' excrement serving as fertilizer for the plants. Our sensors and automation systems keep the cycle running and create the best climates for both plant and fish stock.



All-round technology for insect farming

From animal feed and protein sources to ingredients in pharmaceutical and cosmetic products, the industrial processing of insects is a rapidly growing market. We supply the technology for optimal breeding conditions along with drives and automation solutions for economical processes from feeding to shipping.

In demand everywhere. *In use around the clock.*

LED cooling

- + Avoidance of 'hot spots'
- + Reliable and cost-effective operation

Sensors and controls

- + Climate, lighting and equipment
- + Air, soil and nutrients

Automation

- + Automated product handling
- + Conveyor belts
- + Access control systems

Driverless transport systems





Central air supply

- + Great energy saving potential
- + Enhanced air performance
- + Considerable noise reduction
- + Operation with constant air flow

Digital services

- + Central monitoring
- + Control and automation of processes
- + Integration of external solutions

Air distribution

- + Optimum air intake and circulation
- + Demand-based air supply to plants
- + Temperature regulation
- + Resilient fans

Many strengths. to your advantage.

Powerful, space-saving axial fans and axial compact fans

Our axial fans are real space-saving marvels, moving large air flows and operating extremely reliably even at high back pressures. A comprehensive range of accessories enables further modifications to be made, such as guard grills.

Technical values:

Voltage: 5–110 VDC, 11–480 VAC

Air volume: 1 to 65,000 m³/h

Area of application: up to 1,500 Pa



Robust over the long term

Our fan solutions offer maximum operational reliability even in harsh ambient conditions and are extremely durable. They withstand temperature changes, high humidity, and UV lighting and are therefore ideally suited for indoor farming. We can say this with confidence because we subject each of our solutions to the following voluntary, extremely demanding tests:

- Shock and vibration test
- Corrosion test
- Highly accelerated life test (HALT)
- Temperature change rain test
- EMC test



Unbeatably quiet

To keep noise emissions during cooling, air supply and distribution as low as possible, we continuously improve the flow properties of our products. We also ensure that all components interact quietly.



Powerful centrifugal fans

Our centrifugal fans perform particularly well against high back pressures. They are available with forward or backward-curved blades and in a scroll housing or as freewheel fans as appropriate. Versions with external rotor motor in the impeller not only cool the motor perfectly, but are also very compact.

Technical values:

Voltage: 6–72, 110 VDC, 85–480 VAC

Air volume: 1 to 30,000 m³/h

Area of application: up to 5,200 Pa



Regulated and networked as required

Aerodynamically optimized and equipped with DC or GreenTech EC motors, our fans achieve excellent levels of efficiency. Intelligent controls and sensors regulate their output as required, which saves energy and resources. Various interfaces also enable comprehensive networking,

for example for economical automation with AgriConnect (see page 12).



Future-proof and sustainable

Taking responsibility for people and the environment is an integral part of our corporate philosophy. That is why we develop products designed for maximum environmental compatibility and produce them using processes that preserve resources. Our EC motor magnets with no rare earths are a great example of this.

The right drive *for every goal.*

Many different work processes in vertical farming increase the complexity of goods handling. However, the efficient automation of **logistics processes** offers great potential for savings. Decentralized drive solutions, for example, reduce costs for transport or handling systems.

When it comes to **automation**, outstanding control characteristics and precise positioning are also important in vertical farming. This is because reliable, compact and highly dynamic drive systems that

can withstand extreme stresses are required for opening and closing barriers, gates, and windows.

System solutions play a crucial role here and flexible, reliable drive systems with a high degree of networking are indispensable. Based on its many years of experience, ebm-papst offers a modular set of **drive system solutions** consisting of a motor, transmission and electronics; in the area of transmissions, both as planetary and angular gearboxes.



We have powerful motor and transmission engineering ready for every requirement. *Whatever fits best in terms of application, output torque and installation space is used.*



Brushless ECI 63.20 K4 internal rotor motors with Eta Crown angular gearbox

Internal rotor motors in the ECI series offer output powers of up to 750 watts. These brushless DC motors form the heart of the drive solution in a modular system. They develop their full potential in combination with angular gearboxes and feature impressive and innovative crown gearhead technology. This guarantees you operational reliability in the long run.

Brushless external rotor motors VDC 49.15 K4 with PerformaxPlus planetary gear

External rotor motors in the VD/VDC series are the method of choice if high requirements are placed on synchronous operation and compact dimensions. Not only do they score points for durability, they also offer you excellent control characteristics and, in combination with our PerformaxPlus planetary gear, enable you to create a wide range of innovative automation applications.



Optimal networking and automation. With AgriConnect.

The digital services of our subsidiary ebm-papst neo can help you monitor, control and optimize your growing in real time. We create new freedom of production control, whether you are testing your irrigation system settings on site with our app or receiving automated up-to-date information via your cell phone while traveling. You can react immediately in all cases.

In the process, we help you digitize all necessary and meaningful data through our sensors and hubs. Whatever the issue, from the status of technical equipment to monitoring air and water quality, we make the information work for you. Our experienced team will

be happy to help you define and implement the best and most effective solution possible. Our proprietary cloud applications give you exactly the information and control you need to perfect your production.

Here's how it works:

AgriConnect Controll	Control types	Climate	Web-enabled thermostat	
		Lighting	- Pulse width modulation (PWM) - 0 - 10 V - 4 - 20 mA - Modbus - BACnet - SNAP	- DALI - KNX - LON - Works - Other
			Equipment	- Counters - Valves - Dampers
	Sensor types	Soil Composite materials Hydroponic Aeroponic	- pH - Dissolved oxygen pressure - Infrared temperature - Vapor-pressure deficit (VPD) - Photosynthetically active radiation (PAR)	- Light level setting (Lux) - Carbon dioxide - Volatile organic compounds (VOC) - Particulate matter (PM _{2.5} & PM ₁₀)
		Earth or composite materials	- Temperature - Moisture - Electrical conductivity (EC)	
		Hydroponic or aeroponic	- Salinity - Electrical conductivity (EC)	





GreenIntelligence.

Making Engineers Happy.

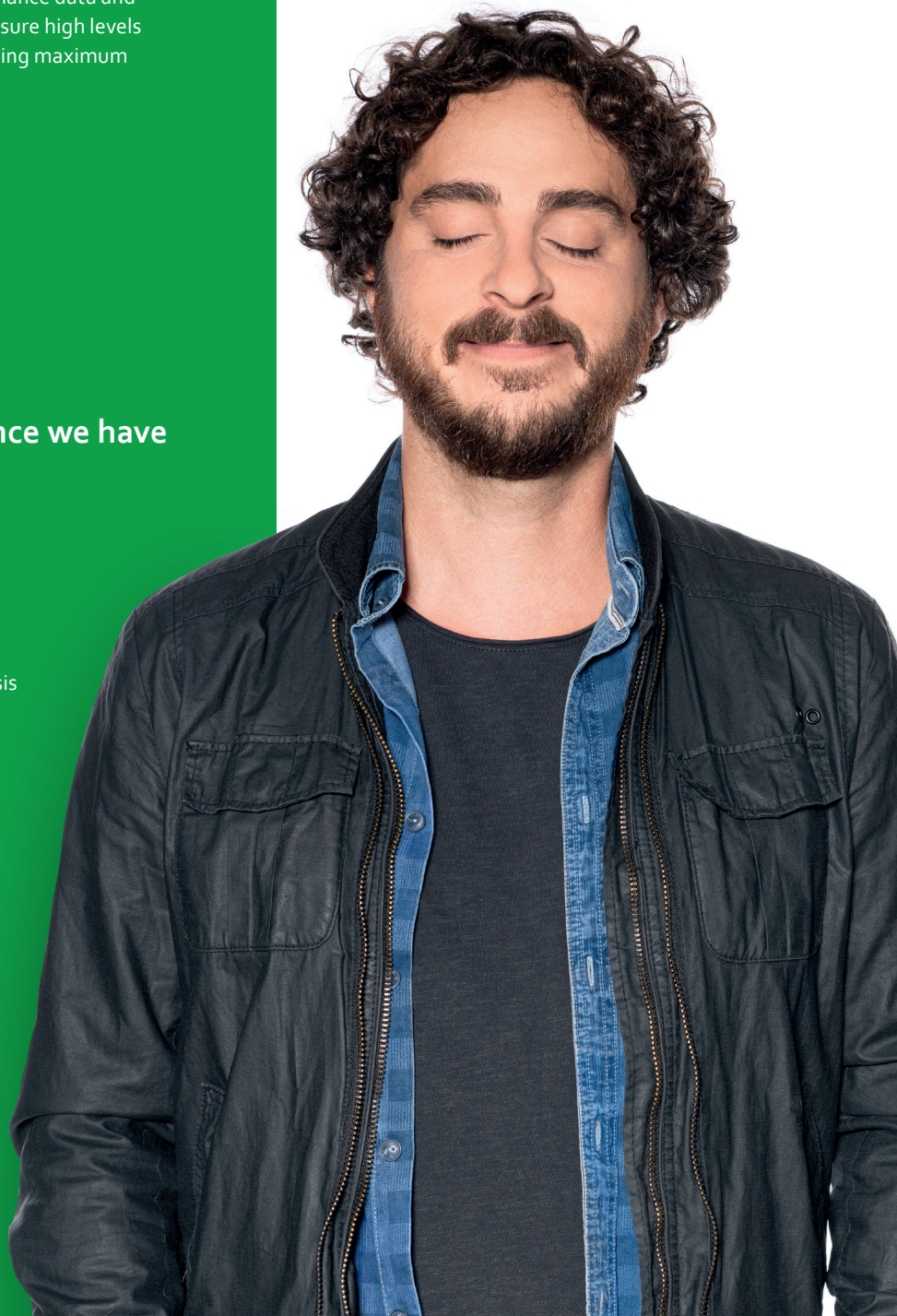


Why do our customers look so happy? Because when it comes to digitalization and sustainability, we provide them with a clear competitive edge with GreenIntelligence. The intelligent control and networking of fans and drives makes applications more powerful and efficient. Together with a long product life and highly efficient EC technology, we achieve lasting reductions in energy costs and emissions.

For industrial ventilation technology, solutions are in demand that ensure top performance and operational reliability in every situation. GreenIntelligence gives you robust fan solutions with intelligent networking capabilities that provide reliable performance data and extensive control and monitoring functions. They ensure high levels of efficiency and system availability while guaranteeing maximum data security.

Here's how much GreenIntelligence we have *in our solutions for vertical farming*

- + Motor and ambient temperature monitoring
- + Precise adjustment of air flow and operating point
- + Control and monitoring via MODBUS RTU and/or PWM / analog (0-10V)
- + Fan as a sensor
- + Automatic status monitoring and resonance analysis
- + Warning and possible shutdown in the event of continuous imbalance



ebm-papst. Engineering a better life.

Who we are.

With over 20,000 different products, ebm-papst offers the right solution for just about any challenge. As the logical next stage in the development of our highly-efficient GreenTech EC technology, we believe that industrial digitization offers the greatest future prospects for our customers. With GreenIntelligence, we already represent intelligently interconnected complete solutions that are unrivaled worldwide.

Because we are always committed to making each of our innovative hardware and software solutions more powerful, compact, efficient and sustainable than its predecessor, we have evolved over the years into the global technology leader for ventilation and drive technology.

What drives us.

But our consistent pursuit of efficiency and progress has even deeper roots. After all, there is something that excites us even more than our market position. It is the deep awareness that, with our solutions for vertical farming we are making the lives of many people around the globe more pleasant, safer and thus better. Therefore, the central driving force in all our thoughts and actions is Engineering a better life. It is the reason why it is worthwhile for us to get up every day and do our best.

More about this under ebmpapst.com/betterlife

ebmpapst

engineering a better life

What you get out of it.

- 1. Technological edge.**
With our EC technology and GreenIntelligence, we combine the highest energy efficiency with the advantages of IoT and digital networking.
- 2. Our sustainable approach.**
We take our responsibility seriously with energy-saving products, environmentally-friendly processes and through social engagement.
- 3. System expertise.**
As experts in advanced motor technology, electronics and aerodynamics, we provide perfect system solutions from a single source.
- 4. The ebm-papst spirit of invention.**
Over 800 engineers and technicians will develop a solution that precisely fits your needs.
- 5. Personal proximity to you.**
Thanks to numerous sales locations worldwide.
- 6. Our standard of quality.**
Our quality management is uncompromising, at every step and in every process.

Pablo improves the performance of his ventilation systems, even when they are already in operation.

GreenIntelligence helps us turn our commitment to Engineering a better life into reality.

What exactly does this mean? Watch the video now:



And what are you planning?

Let us find out together how we can support you as effectively as possible.

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Technical data and variants:
ebmpapst.com/verticalfarming

www.ebmpapst.com

ebmpapst

engineering a better life

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