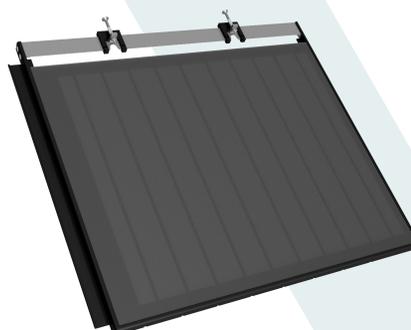


SOLAR & ELECTRIC MOBILITY
INNOVATIONS



paXos

TABLE OF CONTENTS

Foreword	5
Solar	6
Solar Plain Tile Light-Hybrid.....	6
Solar Beaver Tail Light-Hybrid	8
Solar Roof Tile Mild-Hybrid	10
Solar Roof Tile Accessories	12
Solar Facade Element	14
Solar Water Element	16
Solar Agricultural Element Foundation System	18
Solar Traffic Route Element.....	20
Junction Box PV.....	22
Electric Mobility	24
High Performance Charging System	24
Wheel Hub Motor Axial Suspended.....	28
Charging Pole Small	30
Charging Pole Tall.....	32
Charging Pole Top-Roof	34
Mounting System	36
Foundation System Shear-Compression-Bending Plate	36
Company	38
Services	39
Consulting	39
Think Tank.....	39
Engineering	40
Project Management	40
Training.....	41
HR Consulting.....	41
Journey Description	42
Notes	43
Imprint	46

FOREWORD

Dear Reader,

The world today is full of challenges.

Climate change demands significant reduction of CO₂ emissions. High population pressure demands the best utilization of land for food and energy production. Finite resources (fossil fuels / clean air to breath / land) demand careful usage of these resources.

paXos innovates and develops solutions to overcome these challenges. We are a “think tank” focusing on cleantech: sustainable energy production, practicability of e-mobility and the best utilization of resources and land.

Our motivation is to create the best future for mankind. Our easy-to-use scalable solutions with their proven business cases have the potential to reach many end users.

In this brochure you will find an extract of cleantech solutions - some of them will shortly go into high volume production and others are ideas waiting to unfold.

We are looking for you - dear investor, production partner, sales partner and end user to move with us from concept to production.

Together we can make the world a better place.

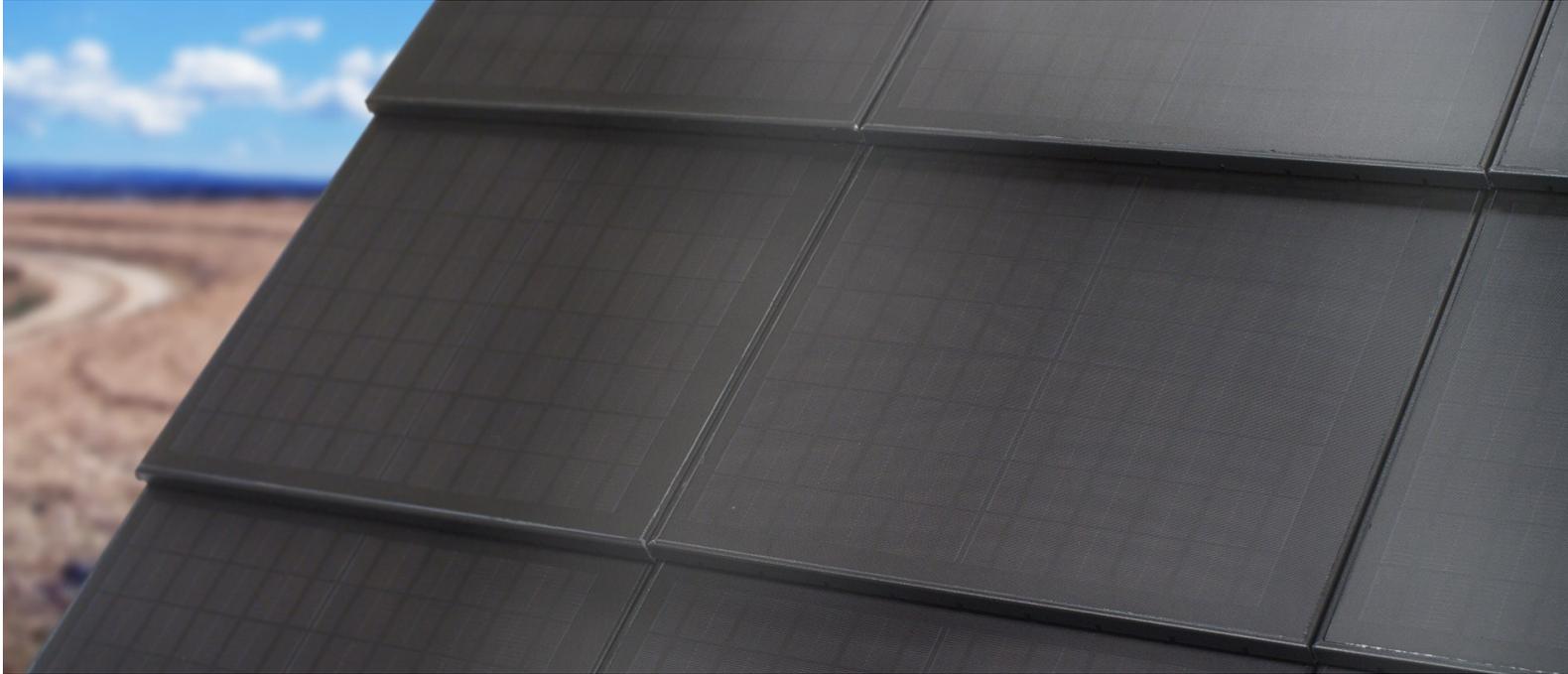
The paXos associates



From left to right:

- › Karsten Birkholz
- › Janina Kaergel
- › Peter Hakenberg
- › Stefan Puczynski
- › Guido Schumacher

SOLAR PLAIN TILE LIGHT-HYBRID



With the Solar Plain Tile developed by paXos, it is possible to use photovoltaics and solar thermal energy in combination with an attractive, inconspicuous appearance.

The direct covering of the roof with Solar Plain Tiles eliminates the need for double covering - the required substructure is identical to a roof surface covered with conventional plain tiles.

REASONS FOR THE DEVELOPMENT

The visually flawless integration into a wide variety of roof surfaces is only possible to a limited extent with conventional solar modules. The Solar Plain Tile offers the look of the asphalt roof shingles mainly used in the U.S., but in combination with the benefits of PV and solar thermal energy. Different color variants of the Solar Plain Tile offer a large number of possibilities to inconspicuously integrate the tiles into the roof surface.



- › Appearance resembles conventional roof shingles
- › Hybrid system for electrical and thermal energy generation
- › Integrated rear ventilation for high performance and durability
- › Optimal use of the entire roof surface for energy generation, partial roofing is also possible

SOLUTION

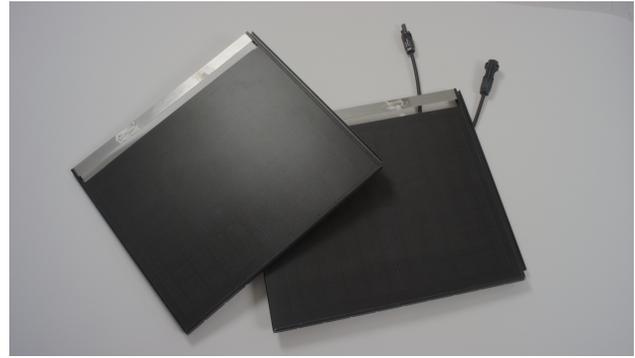
An individual design of the roof is possible due to the small product dimensions compared to conventional PV modules. Thus, the entire roof or only optimal areas (shading, orientation) can be covered.

The PV module is a so-called glass-glass module, which has an extremely high resistance to external loads (storm / hail). Compared to other glass-glass modules, the two glass panes are hermetically sealed with a butyl edge bonding. This prevents moisture from affecting the cells, which would lead to steadily increasing performance losses.

The design is rounded off by an aluminum frame in which the glass package is enclosed. The frame is cathodic dip coated and powder coated and thus offers excellent protection even against salt water. In addition, the slightly overlapping frame protects the corners and edges of the glass package.

PROMISES

- › **Performance:** Due to back venting, we can promise high performance of electrical and thermal energy over a period of 50 years.
- › **Mechanics:** We have our products certified by institutes in terms of hail impact, storm suction and walkability of the roof.
- › **Quality and Durability:** Due to the glass-glass construction, the roof remains water-tight for 200 years.
- › **Installation:** Our modules are easy to lay, connect and exchange.
- › **Environment:** Our focus lies on the sustainability of our products. We increase the useful life and offer very good recyclability.



ADVANTAGES

The addition of a water drainage channel on the side ensures minimal overlap. Slots in the front cover provide rear ventilation of the plain tile and thus the use of thermal energy. In addition, infiltrated water can run off due to the wind pressure.

The mounting of the Solar Plain Tile is done by a spring steel on the aluminum frame, which also acts as a conductor of the potential equalization. This allows quick installation as well as removal of individual tiles.

TECHNICAL DATA

Parameter	SPT-LH*	
Color	Black, Blue, Terracotta	
Dimensions (L x W x H) [mm]	330 x 362.5 x 12	
Clearance Dimensions [mm]	270 x 362.5	
Junction Box	67 x 75 x 15.7 IP67	
Cable	4mm ² , 0.47m	
Connector	PV4-S	
Mass	1.9kg	
Wafer	Monocrystalline, PERC	
Open-Circuit Voltage	5.3	V
Short Circuit Current	3.5	A
Nominal Voltage (U _{mpp})	4.5	V
Nominal Current (I _{mpp})	3.3	A
Rated Output (P _{mpp})	14.5	W
Power Density	145	W/m ²

* Specifications for black design

SOLAR BEAVER TAIL LIGHT-HYBRID



For a classic roofing in the style of the beaver tail, the Solar Beaver Tail Light-Hybrid is developed. As a building-integrated photovoltaic module, it has the same appearance as plain tiles.

This means that European buildings with listed structures can be stylishly used for energy production.

IDEA

The widespread use of plain tiles in some European countries (e.g. Poland) has led to a high demand for this product. Since there are increasing requirements for the protection of monuments on classic roofs, a major part of the development is based on the inconspicuous integration into the roof surface.

This also includes the implementation of different color shades and multiple designs.



- › Building-integrated, monocrystalline photovoltaic module (BiPV) with different colors
- › Light-hybrid system for electrical and thermal energy generation
- › Different roofing possible (crown and double roofing)
- › Roofing of historic and listed buildings
- › Easy installation and removal of a single SBT-LH from the compound

FEATURES

Historic and listed buildings can be covered with SBT-LH during roof renovation. In addition, several designs and colors are provided to easily implement regional differences. Further product advantages lie in the simple laying and installation of the SBT-LH, which can be detached individually from the composite.

For an efficient dual use of the surface (PV and solar thermal), there is an integrated rear ventilation, which allows cooling of the solar cells. This significantly increases the service life of the entire system.

In contrast to a mild-hybrid system, the overall height of this hybrid system is lower. In this case, the degree of heat utilization is lower in favor of an aesthetic, uniform appearance, why it is called a light-hybrid system.

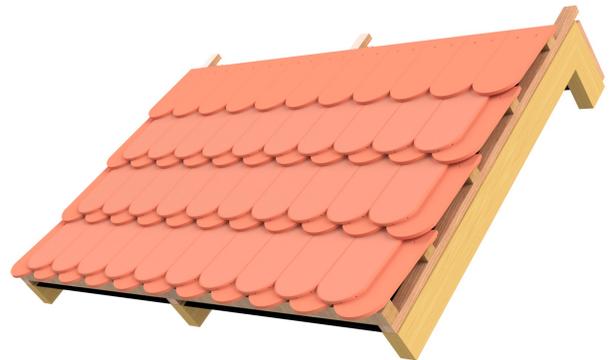
PROMISES

- › **Performance:** Due to back venting, we can promise high performance of electrical and thermal energy over a period of 50 years.
- › **Mechanics:** We ensure high hail and storm suction resistance as well as walkability of the roof.
- › **Quality and Durability:** Due to the glass-glass construction method, the roof remains watertight for 200 years and has a long-term performance with over 50 years.
- › **Installation:** The dimensions of the SBT-LH are identical to the classic 380 x 180mm beaver tail tile. This makes the module easy to install, connect and replace.
- › **Environment:** Our focus lies on the sustainability of our products. We increase the useful life and offer very good recyclability.

- › **Additional Benefits:** Mounting aids facilitate access to the roof surface and increased fire protection via black switchability.

TYPES OF ROOFING

The roofing of the SBT-LH can be done as a classic double roofing or as a crown roofing. The latter offers the advantage of significantly lower system costs at the same power density.



TECHNICAL DATA

Parameter	SBT-LH*	
Color	Black, Terracotta	
Dimensions (L x W x H) [mm]	380 x 180 x 12	
Junction Box	IP67 incl. Bypass diode	
Cable	4mm ² , 0.47m	
Mass	1.0kg	
Wafer	Monocrystalline, PERC	
Rated Output (P _{mpp})	4.2	W
Power Density	80	W/m ²

* Specifications for terracotta design

SOLAR ROOF TILE MILD-HYBRID



A stylish integration of the energy revolution into our everyday life, combined with a high-power density and an improved concept in partial shadowing can be found in the Solar Roof Tile Mild-Hybrid.

In addition to electrical energy, the hybrid system also generates thermal energy that can be used for heating or hot water preparation. The building-integrated photovoltaic system sits inconspicuously on the roof, eliminating the need for double roofing.

SALE TO MEYER BURGER

We are very proud to announce that Meyer Burger has acquired the rights to our Solar Roof Tile Mild-Hybrid and is now taking care of industrialization and sales.

For further questions and information, please contact the Meyer Burger sales team directly:

tiles-germany@meyerburger.com



- › Building-integrated, monocrystalline photovoltaic module (BiPV)
- › Hybrid system for electrical and thermal energy generation
- › Optimal utilization of the entire roof surface for energy generation
- › Roofing of listed buildings
- › Integrated rear venting for high performance and durability

REASONS FOR DEVELOPMENT

The space available for solar energy is currently mostly limited to rural regions or suburbs, where large PV modules can be installed or mounted without shading. In large cities, the problem is crystallizing that there are increasingly jagged roof surfaces that cannot be developed with PV modules.

SOLUTION

The Solar Roof Tile Mild-Hybrid is a building-integrated photovoltaic system that has the appearance of a conventional roof.

In addition, the entire roof can be used to generate energy, as the system is small-sized and can be customized. Shading is minimized by intelligent interconnection and protection, which increases the overall yield.

PROMISES

- › **Performance:** Due to back venting, we can promise high performance of electrical and thermal energy over a period of 50 years.
- › **Mechanics:** We have certified our products against hail, storm suction and walkability of the roof.
- › **Quality and Durability:** Due to the glass-glass construction method, the roof remains watertight for 200 years and has a long-term performance with over 50 years.
- › **Installation:** Our modules are easy to lay, connect and exchange.
- › **Environment:** Our focus lies on the sustainability of our products. We increase the useful life and offer very good recyclability.
- › **Additional Benefits:** Matching complementary system available (p. 12), in case of snow and dew on the roof surface, the mod-

ules can be thawed, mounting aids facilitate access to the roof surface and increased fire protection via black switchability.



Figure: Cool air warms up as it passes through

ADVANTAGES

There is direct access to all major components via sliding glass packs. This makes it easy to replace any module while the roof is covered.

Thermal degradation no longer takes place due to cooling of the glass package. In addition, the heat at the ridge can be made usable via a heat pump.

TECHNICAL DATA

Parameter	SRT-MH Planum*	
Color	Black, Blue, Terracotta	
Dimensions (L x W x H) [mm]	468 x 331.5 x 30.8	
Clearance Dimensions [mm]	340 x 300 x 30.8	
Junction Box	67 x 75 x 15.7 IP67	
Cable	4mm ² , 0.47m	
Connector	PV4-S	
Mass	2.5kg	
Wafer	Monocrystalline, PERC	
Open-Circuit Voltage	5.3	V
Short Circuit Current	3.5	A
Nominal Voltage (U _{mpp})	4.5	V
Nominal Current (I _{mpp})	3.3	A
Rated Output (P _{mpp})	14.5	W
Power Density	145	W/m ²

* Specifications for black design

SOLAR ROOF TILE ACCESSORIES



In addition to the development of the hybrid modules, we also offer the complementary accessories that can be used for complete roofing.

COMPLEMENTARY SYSTEM

Suitable complementary systems to the SRT-MH are available. Neutral traditional flat roof tiles with standard dimensions of 420 x 330 mm can be used, whose dimensions are identical to the SRT-MH.

- › **Ideal addition to the SRT-MH**
- › **Similar appearance**
- › **No need to cover the entire roof surface**

In the visible area of the roof surface, no differences are apparent in this respect. The visual difference is reduced to a minimum. All roof systems offer the same connections, so that installation can take place immediately.



- › Complementary systems are available
- › Similar appearance to the SRT-MH
- › Wave profile to get a classic roof optic
- › Compatible roof steps to get easy on the roof
- › Snow guard modules provide receptacles for snow guard tubes

WAVE PROFILE



The desired design of the roof can be transformed into a classic roof with the wave profile. In this case, the modules are further apart and are connected by the aesthetic wave. The wave profile is designed in such a way that shading only occurs when the sun is very flat.



ROOF STEPS

Formed roof steps and snow guard modules complete the accessories. The roof steps are installed in place of solar roof tiles and provide a secure foothold for chimney sweeps, etc. For simple installation purposes, the integrated installation step is usually sufficient.

- › **Sheet metal package with roof steps**
- › **Optimal solution for chimney sweeps**
- › **Easy integration in the roof**



SNOW GUARD MODULES

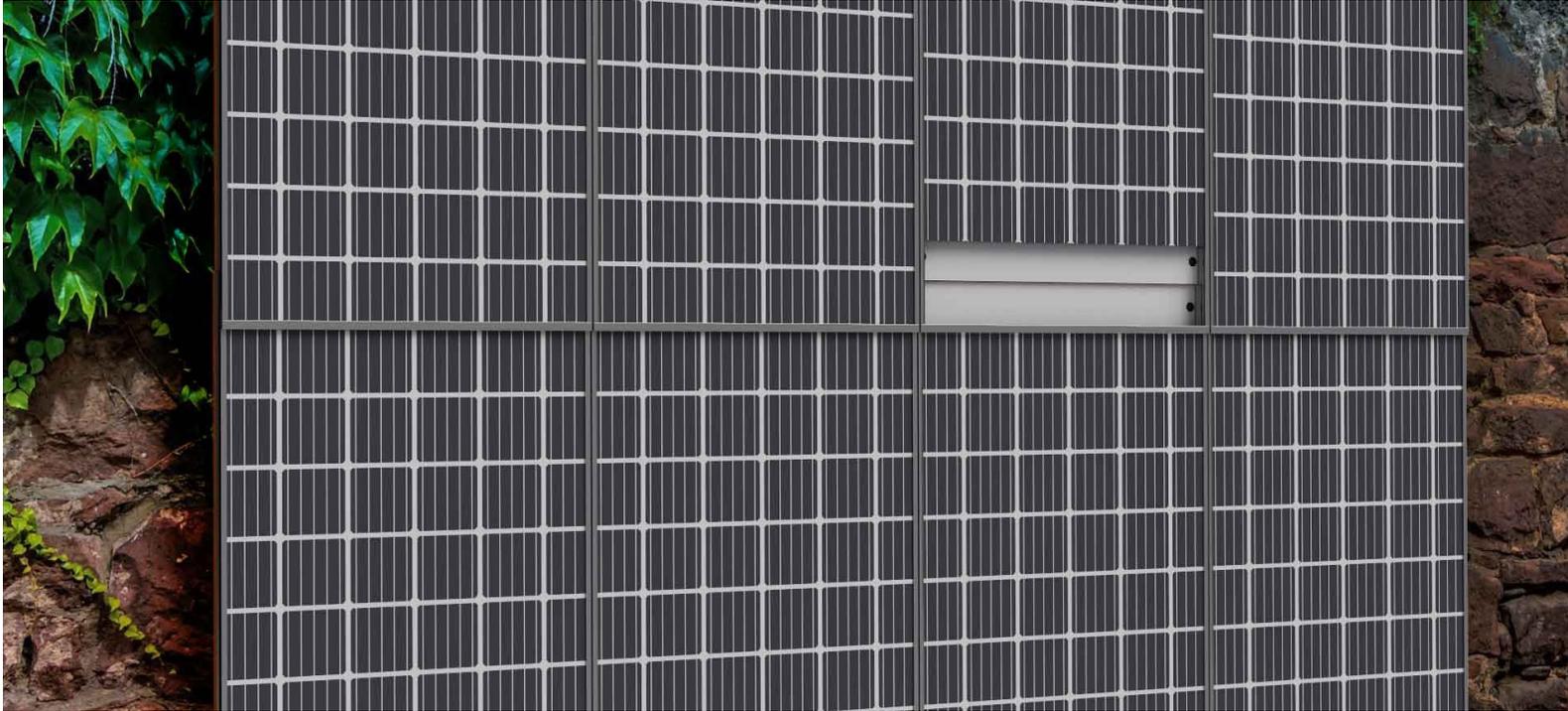
For snowy regions, we offer snow guard modules that provide receptacles for snow guard tubes. In connection with the defrost function of the SRT-MH, slipping of so-called roof avalanches can be reliably prevented.

EXPLANATION: ROOF TILES

There are two different main types of roof tiles that are mostly common: Concrete and clay roof tiles. The clay roof tile is made of, as the name says, clay and is fired at high temperatures. Because of the raw material, there can be color changes within the product.

On the other hand, there is the concrete roof tile, which is made of concrete. Several color grades can be added to the concrete. Made with the extrusion moulding technology, the product is cheaper than a clay roof tile.

SOLAR FACADE ELEMENT



With the universal Solar Facade Element, it is possible to easily open entire exterior facades for photovoltaic panels. The type of solar panel is irrelevant for the Solar Facade Element. The system can be directly integrated into steel and concrete skeleton buildings. The minimal sloping position allows the facade elements to be covered vertically, creating a visually uniform exterior surface.

ADVANTAGES

In addition to the universal mounting and the possibility of using PV panels from different manufacturers, the facade element itself already enables cooling of the PV panels. The integrated air duct provides an air flow that protects the solar cells from degradation.



- › Universal mounting for external facades (BiPV)
- › Integration of any PV panels
- › Cooling of solar cells through rear ventilation
- › Removal of individual facade elements from the compound
- › Easy detachment of a PV panel for better maintenance

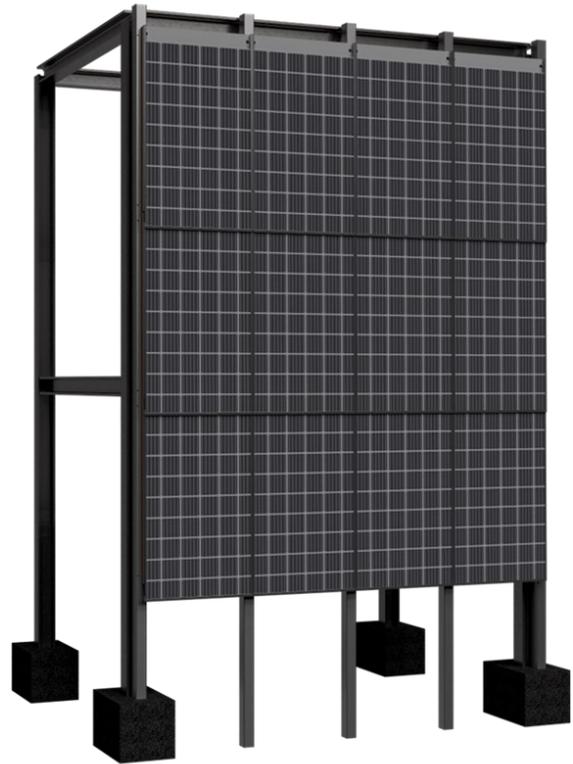
- › Easy mounting of the facade element
- › Thermal insulation can be integrated
- › Rear ventilation can be realized in the module

Towards the building side, the thermal insulation is taken over by insulation material and a thermal insulation board, so that no heat loss occurs due to the air flow. In addition, the facade will be kept warm during winter and cold during summer.

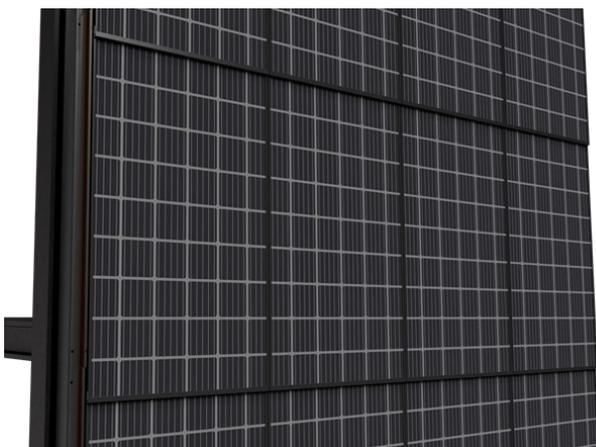
INSTALLATION

The mounting on the facade is first done via screws, which are fixed at the upper edge. After the sliding PV panel has been pushed up, the two lower screws are accessible and can be screwed in place. The inside is overall uniform and straight. Via a front panel, the PV panel can be pulled out of the profile separately during disassembly.

- › **Insertion between the vertical beams of the steel or concrete skeleton structure and fastening to them. Additional use of spacers between the beams and the SFE-MH.**



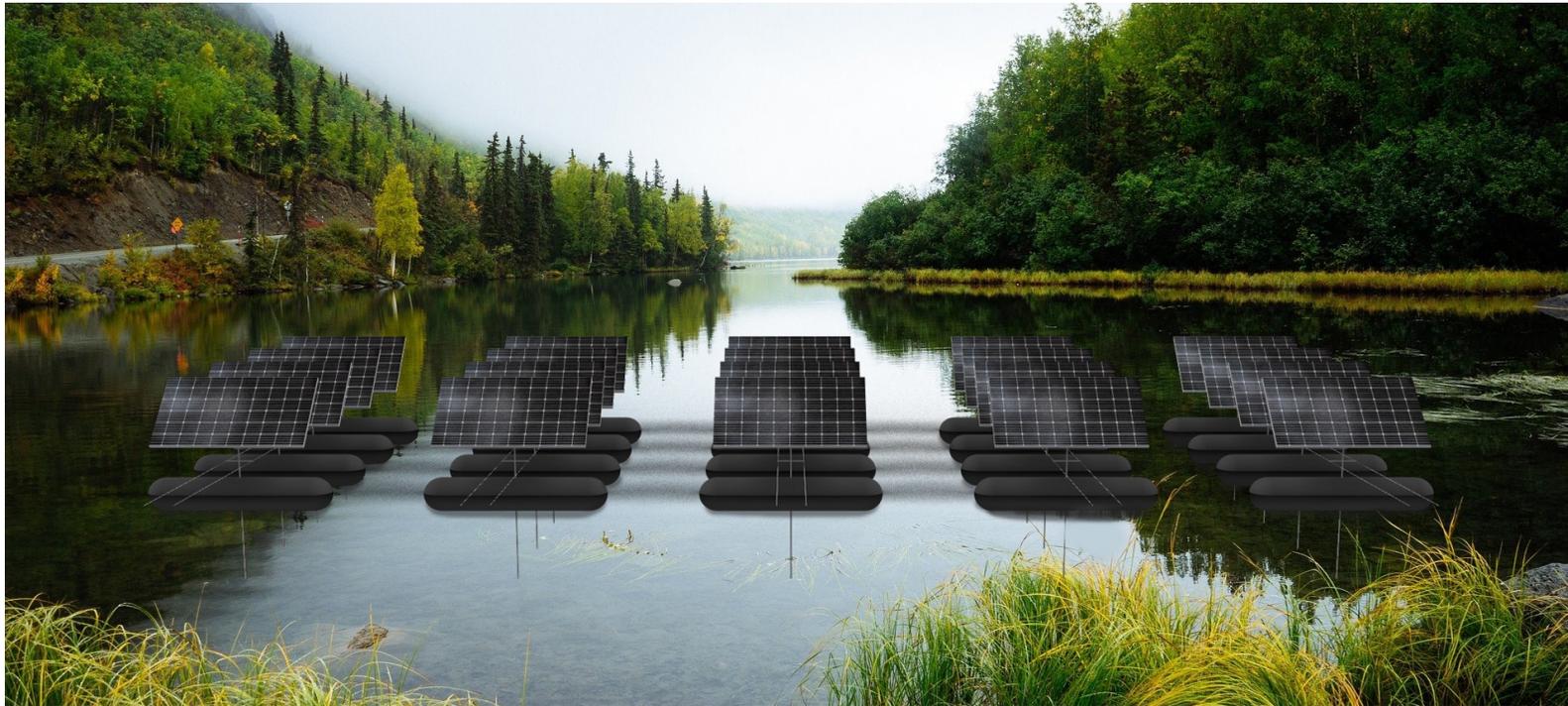
The PV module can be pulled out of the SFE-MH individually. To achieve this, the panel is pushed upwards and the two lower retaining screws are loosened. This allows the SFE-MH to be angled slightly and allows access to the front panel.



TECHNICAL DATA

Parameter	SFE-MH
Color and Power	Depending on panel
Housing Material	Aluminium
Housing Coating	Powder coating (all RAL colors possible)
Dimensions (L x W x H) [mm]	1700 x 1000 x 105
Connector	PV4-S
Mass	115.1kg
Variants	<ol style="list-style-type: none"> 1. Basic: only panel and static holder 2. With extra building insulation 3. With extra cable canals and interior wall cladding

SOLAR WATER ELEMENT

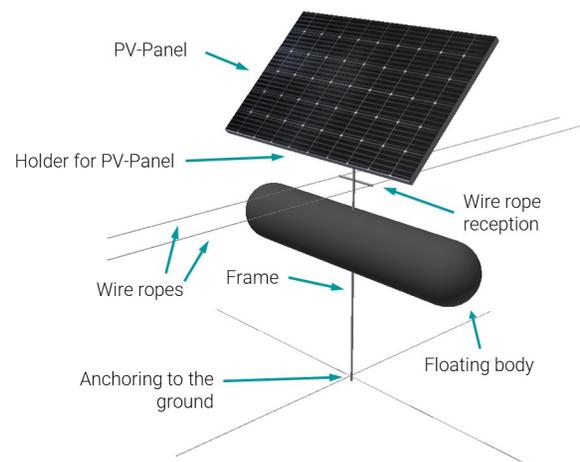


Water surfaces lend themselves to the use of photovoltaics due to their mostly unshaded location. Photovoltaic modules installed on water have a higher energy yield than comparable modules on land due to the reflection of the water and the solar radiation. At the same time, the water has a cooling effect, which also increases output.

Challenges exist in the active tracking of the solar modules and the mounting of the entire system in the landscape.

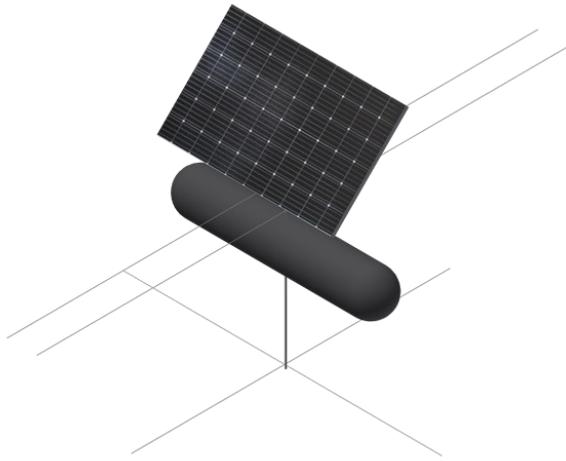
GENERAL FUNCTIONALITY

The PV panel is located on a frame equipped with a scalable float. On the frame are receptacles for wire ropes, through which the system can be controlled in rows. A node on the ground provides translational fixation in two directions.

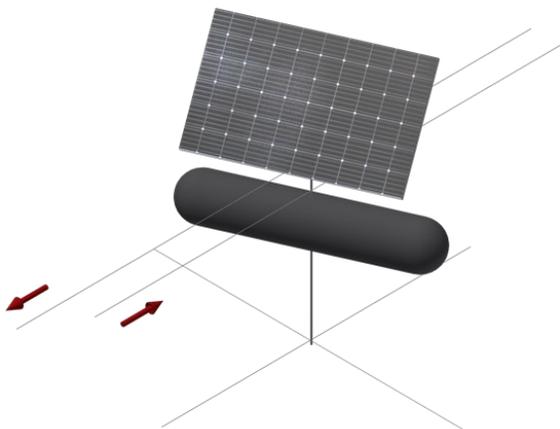


- › Universal mounting for PV panels on the water
- › Reflection of light, hardly any shading and cooling by the water increase energy output
- › Floating body provides buoyancy
- › Rotation and displacement are done by steel cables
- › Low motor power required as the whole system floats

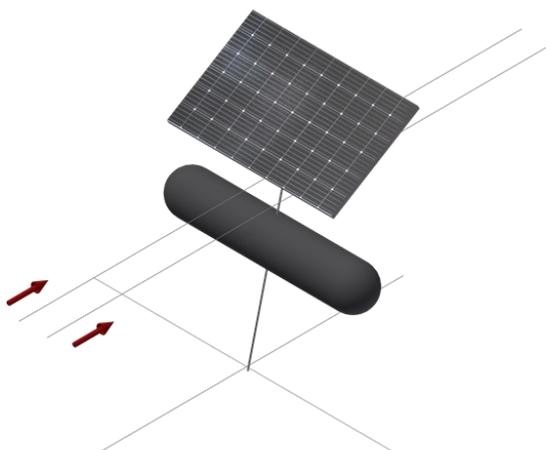
CONTROL



Initial State: The anchoring in the ground prevents floating away, the float provides sufficient buoyancy. The wire ropes connect and hold the entire system together.



Rotation around azimuth: The wire ropes are pulled in opposite directions so that the PV panel can be optimally directed according to the course of the sun.



Rotation in elevation direction: When rotating around the abscissa, the wire ropes are pulled simultaneously. This allows the PV panel to always be positioned perpendicular to the sun. The motor power is only low in both cases, since the entire system floats. It is a 2-axis tracking system.

EXPLANATION: AZIMUTH

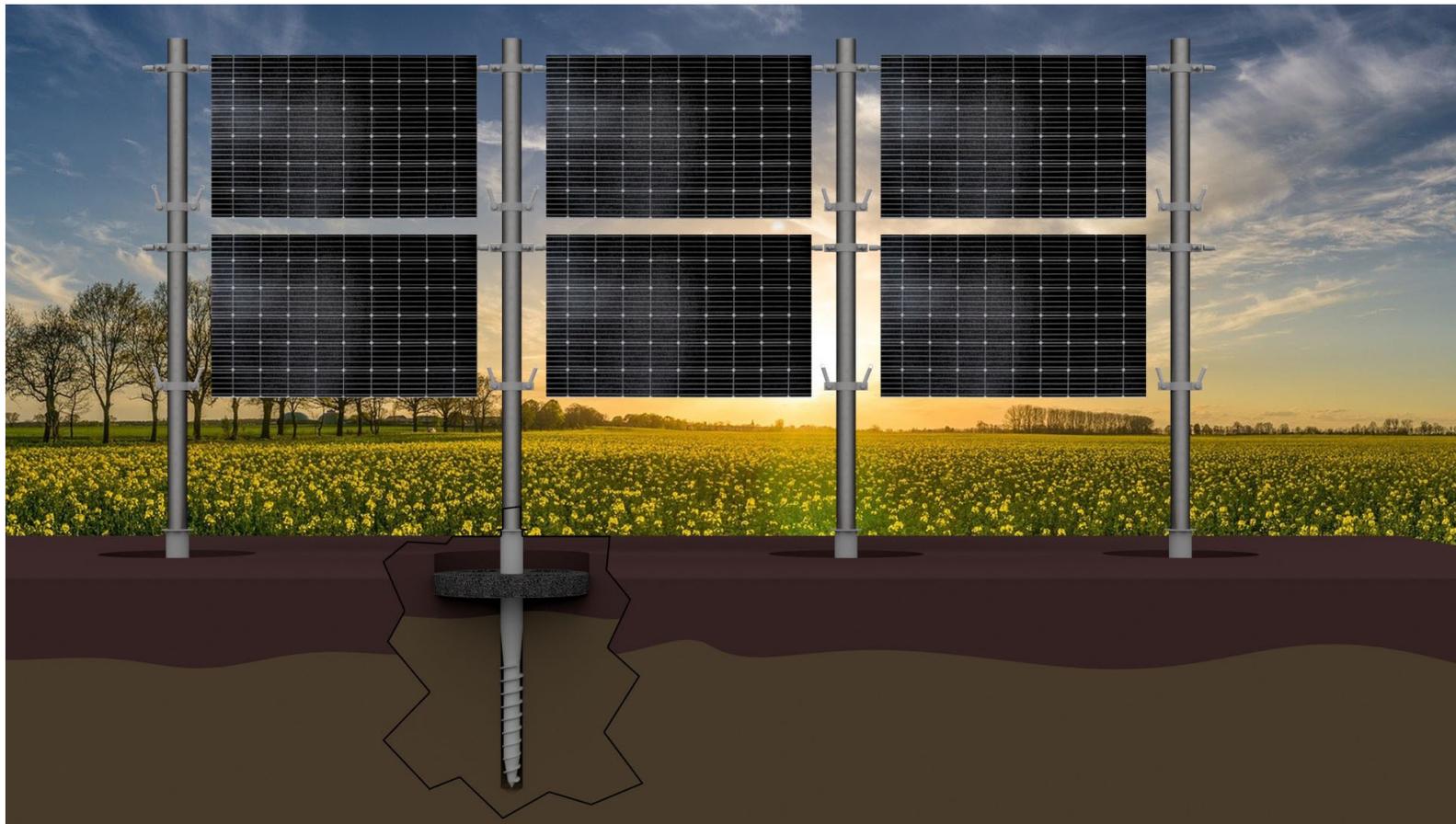
The azimuth is the angle between the south vector as a reference vector and the actual direction of the photovoltaic system in the horizontal plane.

In the northern hemisphere the azimuth angle corresponds to the directions 180° north, 270° east, 0° south and 90° west. In the southern hemisphere, the azimuth angle corresponds to 0° north, 90° east, 180° south and 270° west.

TECHNICAL DATA

Parameter	SWE-VG
Color and Power	Depending on panel
Housing Material	Aluminium
Housing Coating	Powder coating (all RAL colors possible)
Floating Body	Plastic blow mold
Drive Type	Electric motor
Control Type	2-axis system
Dimensions (L x W x H) [mm]	1850 x 1000 x 105

SOLAR AGRICULTURAL ELEMENT FOUNDATION SYSTEM



Agricultural systems allow farmers to make double use of arable land and increase land efficiency. The development of bifacial modules makes vertical installation in an east-west arrangement economically attractive to cover own needs with electricity generation as well as to protect semi-shaded crops from excessive solar radiation. In particular, vertical construction of Agri-PV promotes the need of foundation systems.

PROBLEM

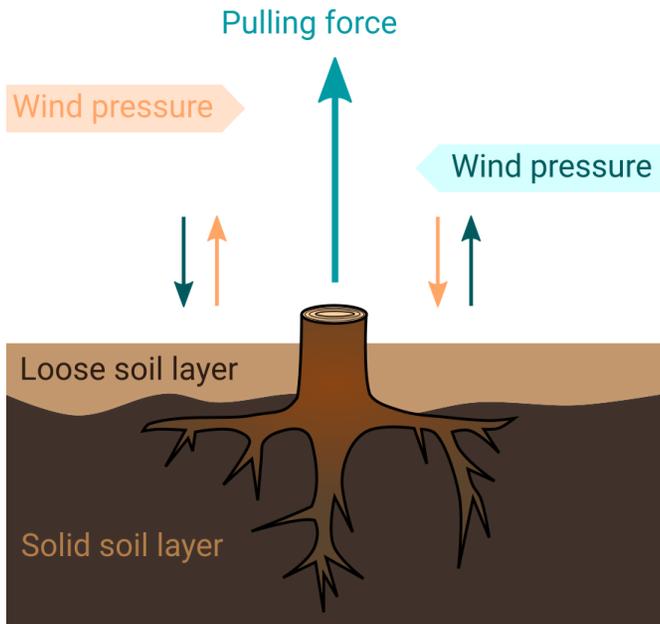
High wind loads that occur on open areas must be absorbed by the foundation and dissipated into the soil. This requires a high material input of concrete in conventional foundations. In addition to the increased ma-



- › Universal mounting system especially for PV panels on agricultural land
- › Foundation system for secure mounting according to nature's tree root principle
- › High bending moment absorption (higher fences possible)
- › Rapid installation and immediate loading possible
- › Easy to dismantle and reusable - no surface sealing

material and installation costs, the ecological disadvantages such as soil sealing as well as the CO₂ footprint are also challenges that need to be solved.

SOLUTION



For the attachment of a fence post, the tree root principle is imitated. Central taproots absorb high tensile forces and surface roots absorb the bending and shear forces. The paXos foundation system is the combination of an earth screw, which absorbs the tensile forces, and a rigid concrete slab just below the turf, which absorbs the bending and shear forces.



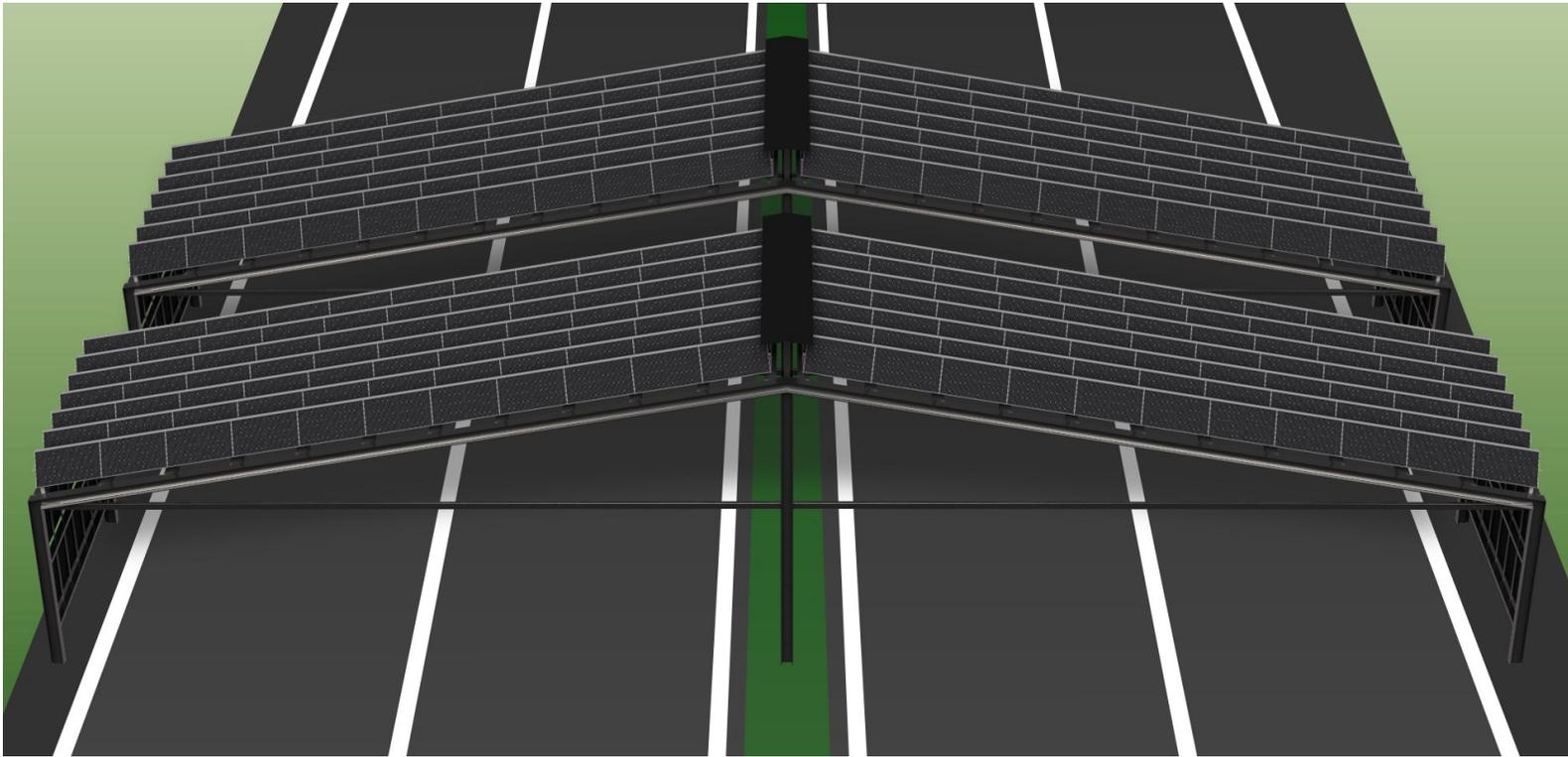
ADVANTAGES

The foundation system from paXos enables cost-effective, quick installation with proven machines and techniques as well as immediate loading. Due to the derived tree root principle, higher bending moments can be introduced, which allows the construction of higher PV fences. In contrast to conventional systems, significantly less material is required, which is also easy to dismantle, so that areas are not permanently sealed and the environment is protected.

TECHNICAL DATA

Parameter	SAE-MS
Color and Power	Depending on panel
Pole Material	Stainless steel
Earth Screw Sleeve Material	Stainless steel
Compression Plate Material	Reinforced concrete
Dimensions (L x W x H) [mm]	1800 x 960 x 3500
Mass	200kg
Variants	Variable height possible 1. One panel in height 2. Two panels above each other

SOLAR TRAFFIC ROUTE ELEMENT



The Solar Traffic Route Element makes built-up and sealed traffic areas usable. Highways, freeways, etc. have great potential for multiple use. In addition, the road is protected from environmental influences and noise emissions are reduced.

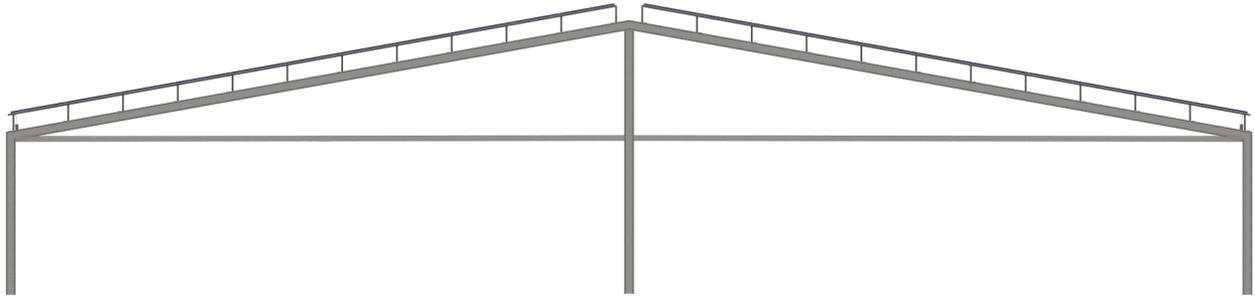
- › **No shading on highways**
- › **High potential for photovoltaics**
- › **Heat protection in summer**



SOLUTION

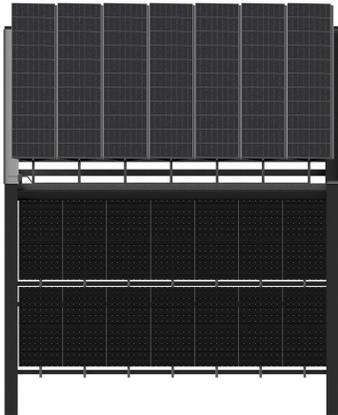
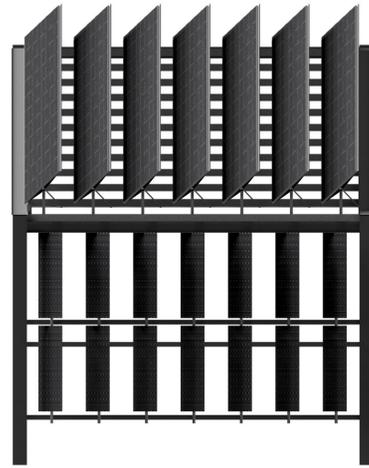
A skeletal steel beam structure provides mounts for photovoltaic modules that can be attached overhead and laterally. All modules are rotatably mounted and can be tilted for emergencies. The construction is based on cost-effective standard components and can be individually adapted to the road size.

- › Universal support for PV panels over traffic areas
- › Multiple use of highways, roads, etc.
- › Simple skeleton construction
- › Inclination of PV modules possible
- › Lightning smoke extraction provides increased fire protection



ADVANTAGES

Due to the inclination of the modules, the system enables rapid smoke extraction in the event of a fire without the need for an elaborate additional construction. In addition, simple escape routes can be integrated in the lateral area. In case of heavy snowfall, the construction can also be relieved by inclining the modules.



EXPLANATION: TUNNEL

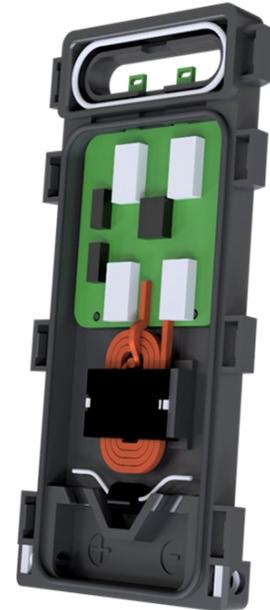
Tunnels are traffic route elements that are built above-ground or underground. In Germany, above-ground enclosures with a minimum length of 80m are called tunnels as well.

Tunnel structures with a length of less than 80m are called underpasses. Every tunnel has to meet special safety requirements in terms of fire and escape routes.

TECHNICAL DATA

Parameter	STE
Color and Power	Depending on panel
Construction Material	Mild steel / concrete
Dimensions (L x W x H) [mm]	Variable depending on width of lanes
Mass	200kg
Variants	Variable width possible Up to 4 driving lanes each direction

JUNCTION BOX PV



In order to be able to use photovoltaic modules even more specifically and efficiently, we have developed our own junction box in a flat design for BiPV. The junction box is particularly suitable for small-format systems, as it offers performance optimization at module level. In this way, PV modules with different inclinations and orientations can be interconnected in one string, offering freedom in module alignment.

ADVANTAGES

The power optimization on module level includes a MPP tracking, which keeps each pho-

- › Flat junction box
- › Suitable for small format photovoltaic systems
- › Interconnection of PV modules with different orientations and inclinations
- › Power optimization at module level
- › Safety shutdown reduces critical voltage to the short circuit voltage of the module

tovoltaic module in the range of the highest power. This leads to the maximum power output of the string.

The junction box offers the possibility of a safety shutdown at module level, which reduces the dangerous voltage in case of fire to the open-circuit voltage of each module. Since the DC main power lines are de-energized, there is no longer any danger to firefighters.

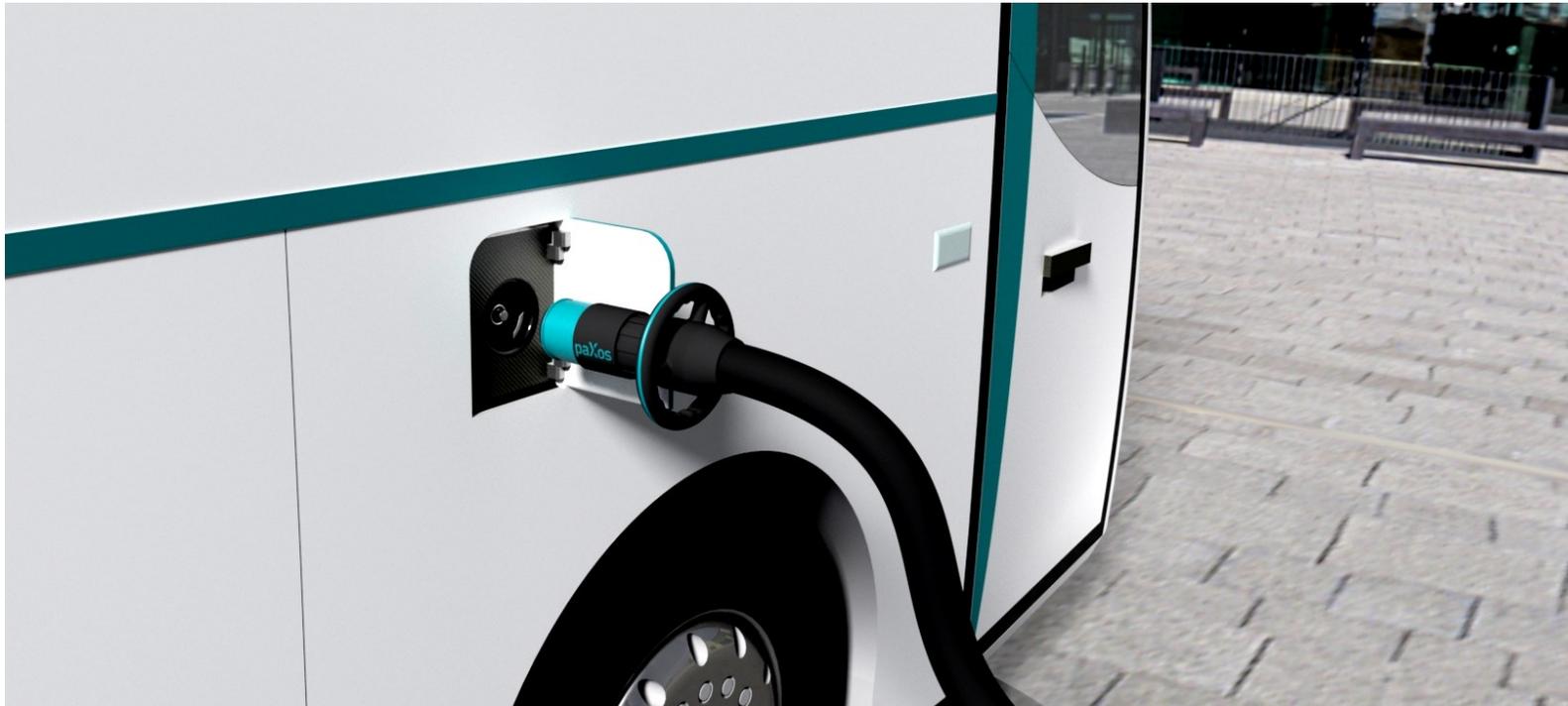
TECHNICAL DATA

Parameter	Junction Box PV
Material	ASA
Dimensions (L x W x H) [mm]	67 x 75 x 15.7
Water Resistance	IP67
Cable	4mm ² , 0.47m
Connector	Sunclix
Mass	0.3kg

DON'T
WANT
TO
MISS
ANY
NEWS
IN
THE
FUTURE?



➤ HIGH PERFORMANCE CHARGING SYSTEM (HPCS)



With a reliable high-performance charging system, the electrification of cars, commercial vehicles, ships and even aircraft is possible. To achieve broad acceptance, a short charging time (idle time) is necessary, especially in the area of commercial vehicles, as this is the only way to ensure economic efficiency. A high level of energy transmission between the power grid and the consumer is particularly crucial for this.

CHARGING PLUG COOL-LOAD MEGAWATT

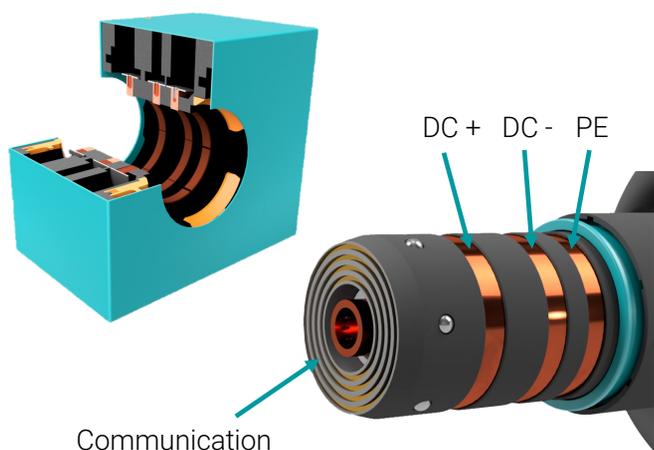
In the future, the classic plug connection consisting of "pin & socket" will be one of the limiting factors within the charging infrastructure. With the charging plug "Cool-Load Megawatt", which has ring-shaped contact surfaces, the charging power can be adapted to future requirements simply by scaling the connector diameter. In this way, outputs of up to 12MW are possible.



- › High Performance Charging System for heavy duty vehicles
- › Charging power can be increased to 12MW
- › Radial connection between plug and socket increases contact surface
- › Direct cooling of the plug and rinsing of the power cables in the charging cable

ADVANTAGES

1. Large contact area and small transmission distance



2. High contact pressure

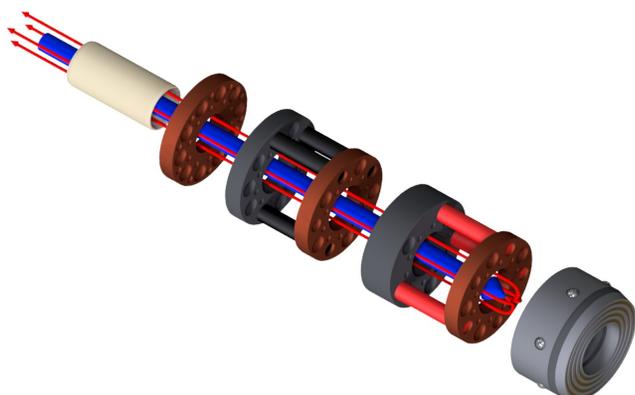
The contact between plug and socket is made automatically. As a result, the insertion forces are low and the contact pressure during contacting is very high.

3. Grinding of contact surfaces

During the contacting process, the contact jaws close on the socket side and grind over the contact surfaces of the charging plug. This ensures that the surfaces always remain clean and the contact resistance is low.

4. Cooling of contacts and cable

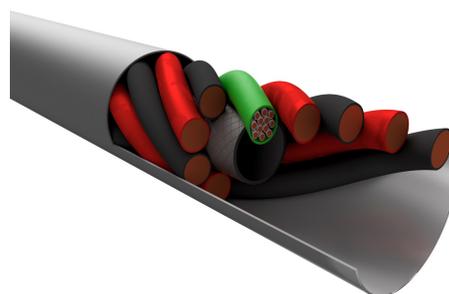
The contact rings are located on a high-performance ceramic, through which the cooling fluid flows. This results in a very large heat transfer surface.



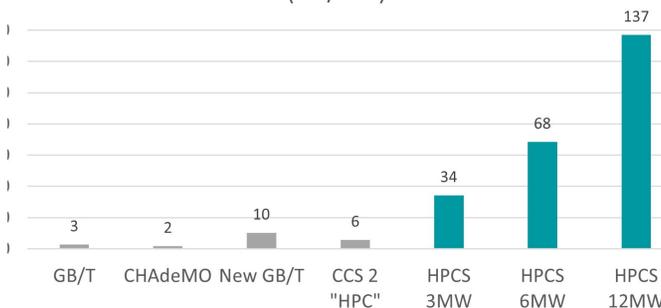
CHARGING CABLE

The division of the power cables into several small individual ones and the stranding of these individual wires results in a high flexibility of the charging cable.

In the center of the cable is the supply line for the coolant, which flows back between the individual, insulated cores. This provides excellent cooling and high flexibility of the cable.



RANGE PER MINUTE CHARGING TIME (km/min)

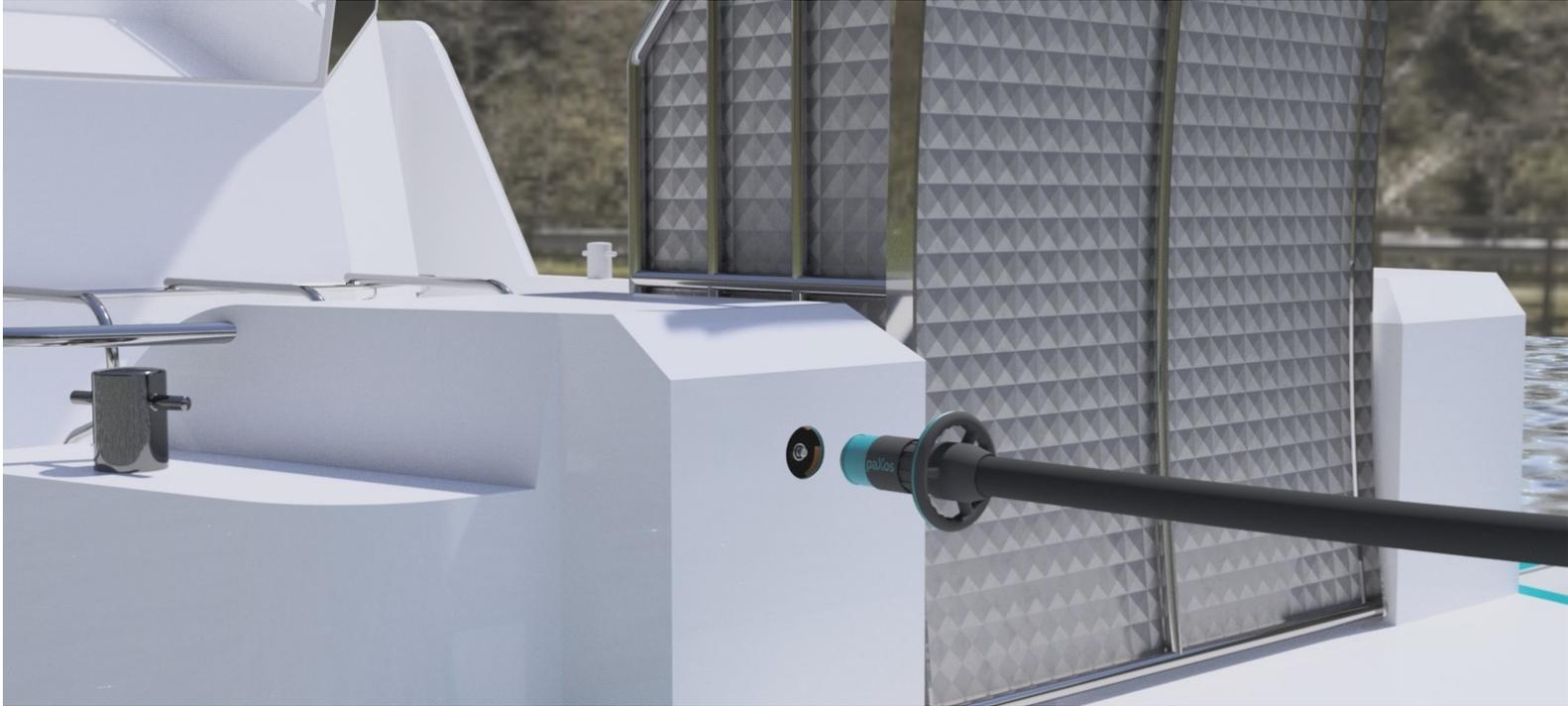


* For an e-truck with an average consumption of 167kWh/100km

TECHNICAL DATA

Parameter	HLS 3 - 12MW
Power	3 - 12MW (dc 100 %)
Nominal Voltage	1500V
Nominal Current	2000 - 8000A
Contact Area	2200 - 11000mm ²
Surface Pressure	> 100N with mechanical connection system
Insertion Force	~ 0N
Handling	Orientationless contacting
Cooling	Direct contact cooling

HPCS APPLICATION AREAS



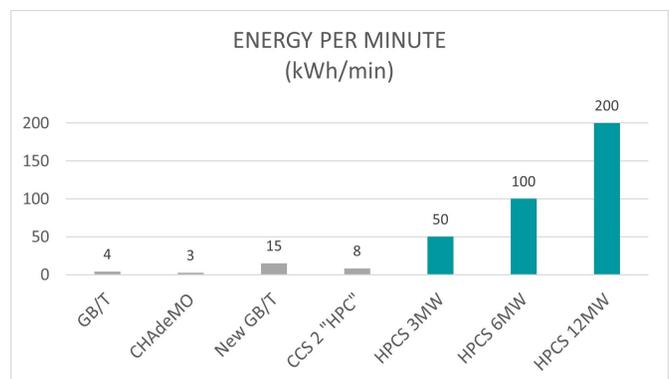
COMMERCIAL VEHICLES

Particularly in the commercial vehicle sector, charging systems that can transfer high amounts of energy in the shortest possible time are required. The aim is to supply the vehicle with the amount of energy needed until the next prescribed break during the legally prescribed driving breaks. This means that there are no additional breaks that lead to higher costs for the carriers and in this way negatively influence their acceptance of e-mobility. To achieve this goal, it must be possible to transfer an energy quantity of approx. 600kWh in 45 minutes.

SHIPPING & AVIATION

The maritime and aviation sectors are becoming increasingly electrified. However, there is currently still a lack of sufficiently mechanically protected systems that meet the increased requirements for contact reliability due to, for example, strong waves or storms as well as

increased air pollution due to salts or dust. In addition, very high amounts of energy are required in these areas, which can only be realized with current systems through long charging times or the use of multiple charging systems.



- › Charging power up to 12MW possible
- › Protection of contact surfaces against salt water due to overpressure
- › Secure locking between charging plug and socket ensures reliable charging process

PAXOS AND RWTH AACHEN TEST SUCCESSFUL NEW 5MW HIGH-POWER CHARGING PLUG FOR E-MOBILITY

Supported by:



on the basis of a decision
by the German Bundestag

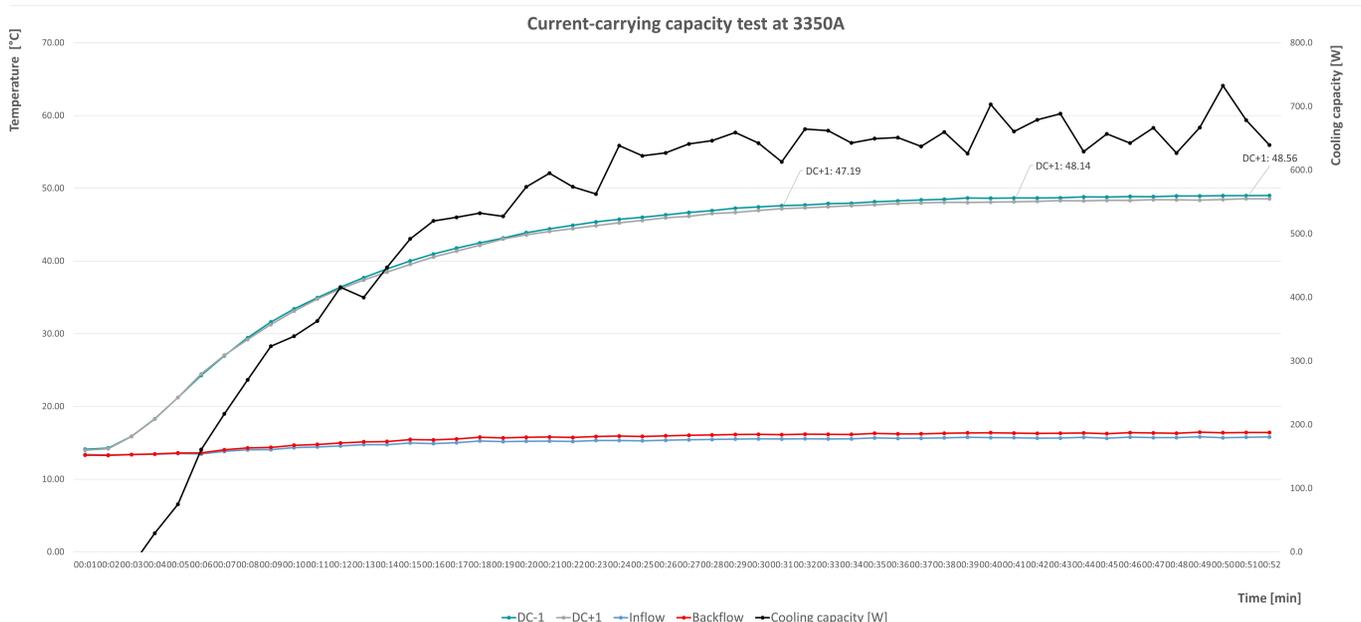
In initial current-carrying capacity tests (proof of concept), carried out with the support of the Institute for Power Generation and Storage Systems (PGS) at RWTH Aachen University, a current of 3350A could be sent via the radially contacted charging plug for a duty cycle of 50 min. During the entire duty cycle, taking into account the nominal voltage, a transmission of more than 4MWh would have been possible. The liquid-cooled contacts of the connector exhibited stable temperatures of less than 50°C during the test.

The analysis of the measurement results underlines the advantages of the radial connector design. Thanks to the innovative cooling in the charging plug, a cooling capacity of 700W was achieved. Due to the large contact area and the high contact pressure, only extremely low losses of approximately 100W occurred at the transition between plug and

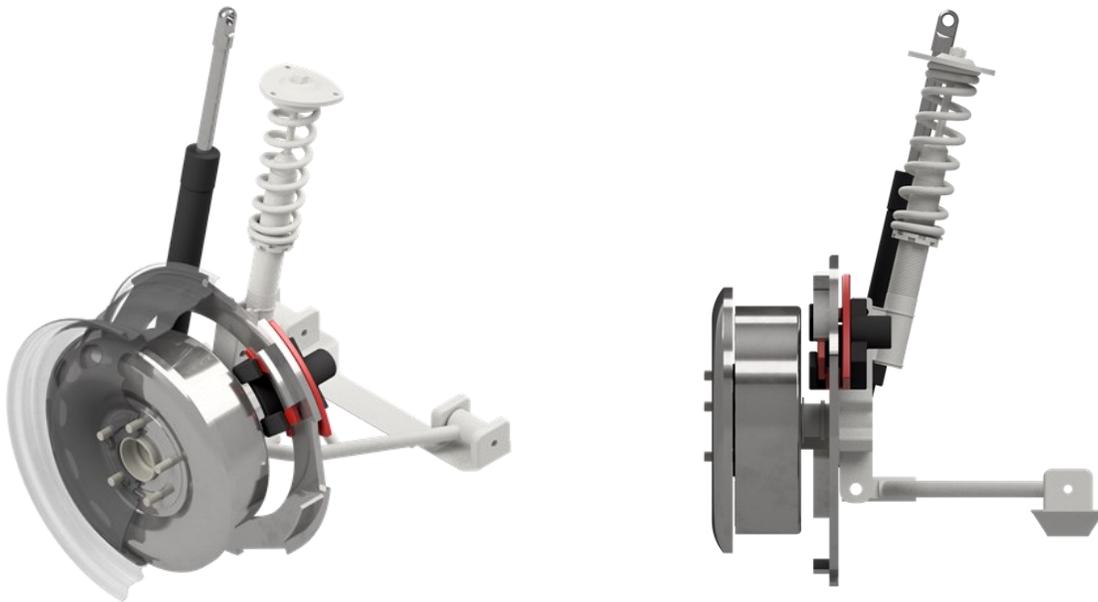
socket. This corresponds to only 9% of the total power loss of the prototype setup. And in relation to the transmission power of 5MW, the losses of the overall system even amount to only 0.02%.

PROJECT IDEAL

In the IDEAL project (Innovative DC Technology for the Sustainable Integration of Modern Charging Infrastructure for Electromobility), new types of DC-based charging solutions for electromobility are being researched. In addition to paXos and RWTH Aachen University, the companies elxon GmbH and Siemens AG Technology Research in Energy and Electronics are involved in the joint research project. The project is supported by the German Federal Ministry for Economic Affairs and Climate Action.



WHEEL HUB MOTOR AXIAL SUSPENDED

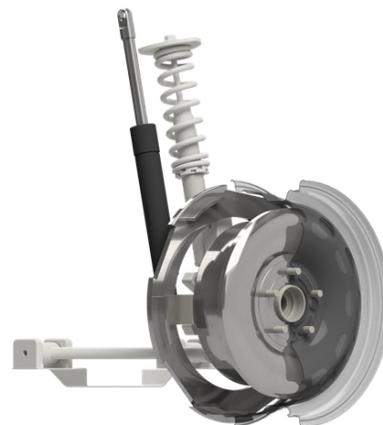


Wheel hub motors and near-wheel drives have not yet become established in the automotive sector. The reasons for this range from increased tire-sprung masses, which lead to a loss of comfort, to increased production costs.

From a driving dynamics and safety perspective, it is worth considering wheel hub drives. They lead to better driving performance and more precise control in critical situations - and in this way support the driver.

REASONS FOR THE DEVELOPMENT

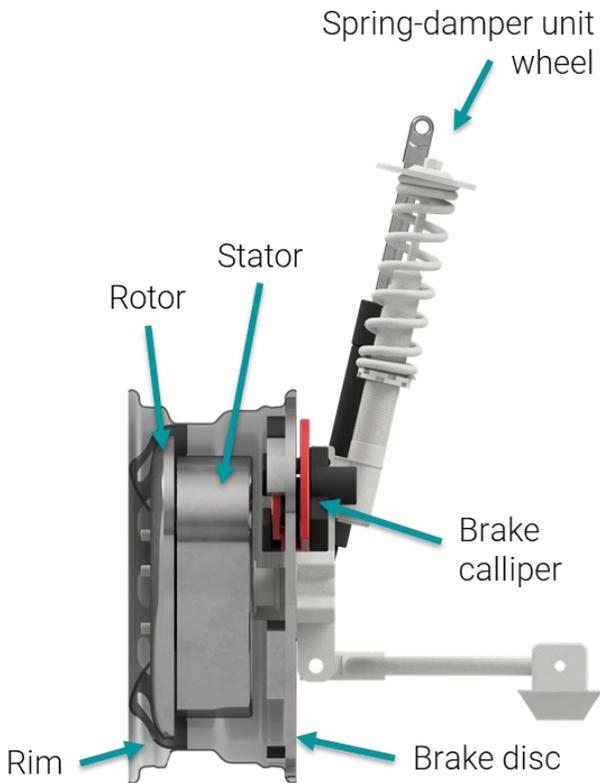
paXos has set itself the goal of thinking sustainably - also for drives in vehicles. We are developing a state-of-the-art machine that creates space inside the car. The engine, clutch and transmission are reduced to a single unit that is inconspicuously integrated into the installation space of the rim. A patented axially



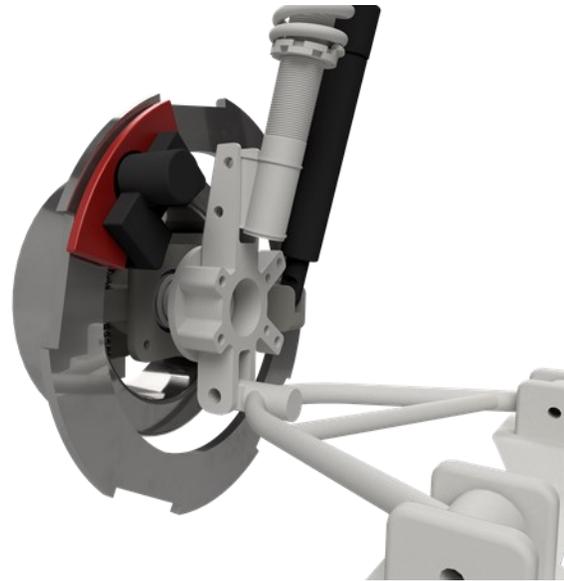
- › Axially arranged, switched reluctance machine
- › High efficiency in the partial load range
- › Reduction of tire-sprung masses due to suspension of the stator
- › No use of rare earths required
- › Cost-effective production possible

arranged switched reluctance machine is used, which uses the reluctance force to set the rotor in motion.

SETUP



The separate suspension of the stator leads to advantages in terms of driving dynamics, since the stator is no longer tire-sprung. In addition, depending on the voltage level of the battery, only a DC / DC conversion is necessary.



SPECIFICATIONS

- › **Novel design as axially switched reluctance machine (GRM)**
- › **Inconspicuously integrated in rim**
- › **Simplified design, low-cost production**
- › **External brake disc**
- › **Reduction of tire-sprung masses thanks to separate spring-damper unit for stator**
- › **McPherson / multi-link**

FEATURES

Unlike other electric motors, a switched reluctance machine does not require rare earths. Since both the stator and rotor have no permanent magnets, they have lower losses and a lower weight, compared to PMSM.

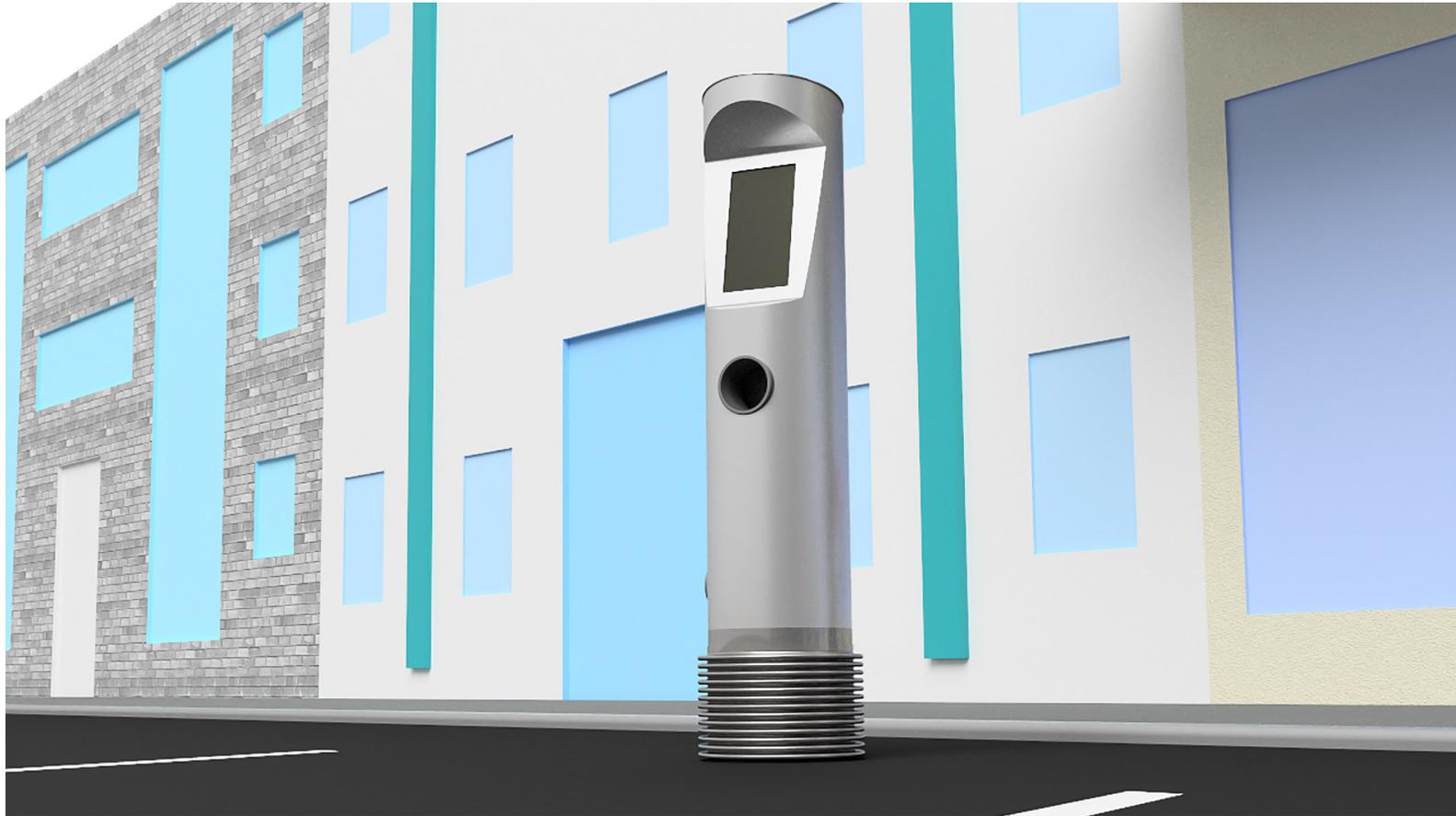
EXPLANATION: RELUCTANCE FORCE

The reluctance force is based on the change of the magnetic resistance so that it is always minimal. A Switched Reluctance Machine (SRM) generates a changing magnetic field via windings in the stator. The rotor moves in such a way that the magnetic resistance is minimized.

TECHNICAL DATA

Parameter	WHM paXos
Power	50kW
Weight	35kg
Rim Size	17inch
Suspension	McPherson, multi-link Separate spring-damper unit for stator
Brakes	Outside brake disc

CHARGING POLE SMALL



The expansion of the charging infrastructure is progressing worldwide and is placing ever new demands on charging points.

As the number of charging points increases, so does the risk of accidents due to crashes or parking bumps between vehicles and charging points. In such a case, the charging points are often replaced to ensure continued safety.

REASONS FOR THE DEVELOPMENT

The fact that this process is resource- and labor-intensive lowers the profitability for the providers of corresponding systems. In addition, damage occurs due to environmental influences and vandalism, which negatively affects customer loyalty.



- › Clean, slim and round design made of stainless steel
- › Robust against parking bumps due to patented predetermined bending point
- › Cables and plugs directly accessible from outside
- › Electrically sensitive parts independent of the ground
- › Compatibility with fast charging systems

ADVANTAGES

The small charging pole from paXos has a clean, functional design made of stainless steel that accommodates all the essential elements in the charging pole.

The large touchscreen enables easy operation, and individual operating systems can be easily integrated. Cables and plugs are directly accessible from the outside. Classic charging plugs or the paXos Cool-Load Megawatt can be used.

- › **Large touch screen**
- › **Safe accommodation of all essential elements in the charging pole**
- › **Electrically sensitive parts independent of the floor**
- › **Predetermined bending points at the bottom of the housing**
- › **Built-in parts accessible via top plate**

FEATURES

The round design in stainless steel makes it possible to minimize damage from parking bumps and vandalism. The cable and plug are released after successful authentication (RFID or cell phone call), and the charging connection to the vehicle can then be established.

For maintenance, the internal components can be accessed via the maintenance plate in the head, so that repairs can be carried out quickly.

EXTRACTABILITY

For the inconspicuous integration of charging points in city centers, the retractable version of the small charging pole can be used. This is equipped with an automatic lowering of the head unit for aesthetics and additional protection against vandalism.



- › **Touchscreen accessible after verification and extension for proper operation**
- › **Use with classic charging plugs**
- › **Robust housing**
- › **Maintenance access of the complete head unit**

TECHNICAL DATA

Parameter	Charging Pole Small
Power	Depending on charging system
Dimensions (Diameter x H) [mm]	300 x 1200
Access Protection	Via RFID/cell phone
Cooling	Direct contact cooling possible

CHARGING POLE TALL



The expansion of high-performance charging infrastructure is progressing worldwide and is essential for reliable and resilient electromobility. Increasing the number of charging points as well as securing them in the event of a crash represent challenges that must be implemented promptly.

- › Round design in stainless steel
- › Charging unit securely housed in lid
- › Charging cable and display remain locked until authentication
- › Predetermined bending point at floor level in the event of a crash
- › Maintenance access for quick and easy inspection

REASONS FOR THE DEVELOPMENT

The charging stations currently on the market have the disadvantages that the charging cables are not integrated and are exposed to weather conditions during charging. In addition, significant weather events such as flooding pose the risk of permanent damage to the charging point.



Figure: Maintenance flap

- › **No charging cable integrated**
- › **Installation parts difficult to reach**
- › **Cooling of the charging pole problematic**
- › **No predetermined bending points on the housing**
- › **Poor protection against vandalism**

ADVANTAGES

In the case of the large charging station, the cable and plug are locked in a column. After successful verification, they are released. The stainless steel column is strongly secured against vandalism and protected against scuffing, scratching or being stepped on.



Figure: Direct access to the sensitive parts

All electrically sensitive parts are located above a height of 1 m above street level, so that they are secured in the event of a crash. A predetermined bending point at ground level ensures that the loading point is not damaged.

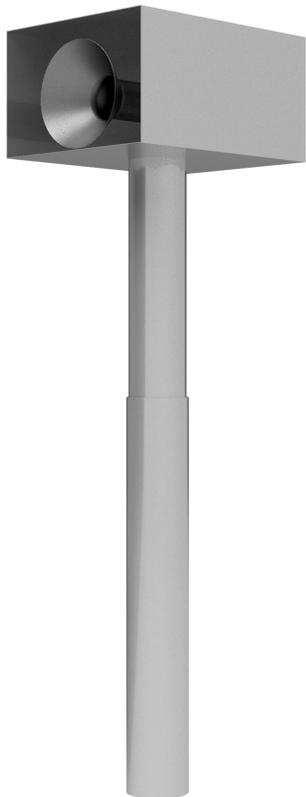
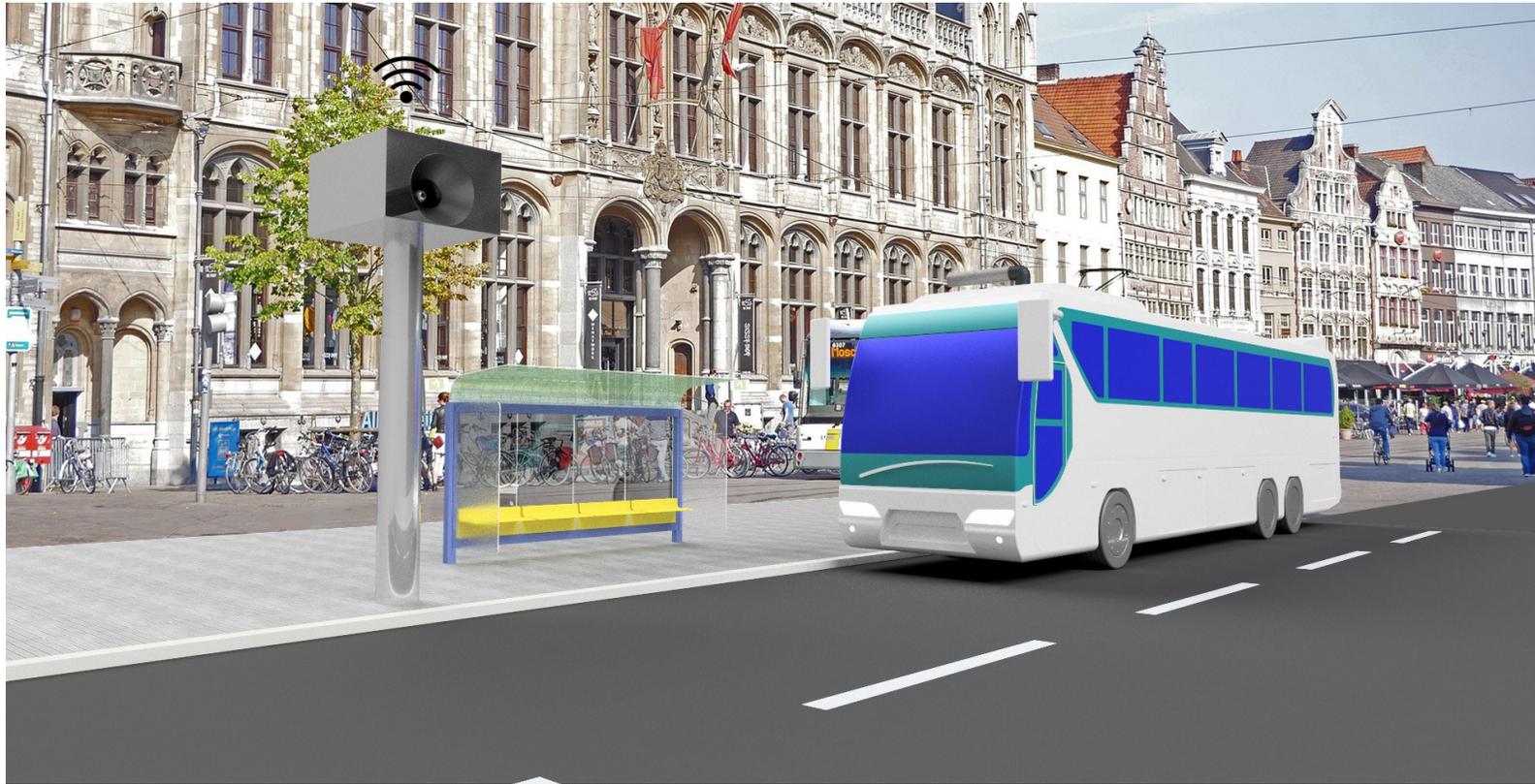
MAINTENANCE

The maintenance flap makes it easy to reach the installed parts and to replace them if necessary. The working height is ergonomically designed. Despite the easy opening for service work, the charging pole remains closed in the event of an accident and offers protection from the weather during operation.

TECHNICAL DATA

Parameter	Charging Pole Tall
Power	> 4500kW (dc 100%) 350kW (CCS)
Nominal Voltage	1500V
Nominal Current	3000A
Dimensions (Diameter x H) [mm]	300 x 2500
Access Protection	Via RFID
Cooling	Direct contact cooling possible

CHARGING POLE TOP-ROOF



The electrification of commercial vehicles will increase sharply in the coming years. For this reason, the course must be set today to provide suitable technical solutions. Special requirements must be taken into account with regard to the necessary expansion of the charging infrastructure.

- › Customizable charging station for commercial vehicle sector
- › Automated charging process
- › Direction-independent charging of the vehicle (front right or left)
- › Safe accommodation of all essential elements in the charging pole
- › Safety of the commercial vehicle against swaying of the body due to loading and unloading or wind load

REASONS FOR THE DEVELOPMENT

The charging solutions currently available on the market have the disadvantage that heavy-duty vehicles cannot be charged reliably and safely. The dimensions of the charging cables and plugs continue to increase due to the higher charging capacities, so that manual operation will no longer be possible in the future.

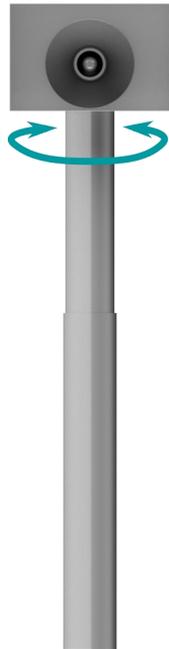
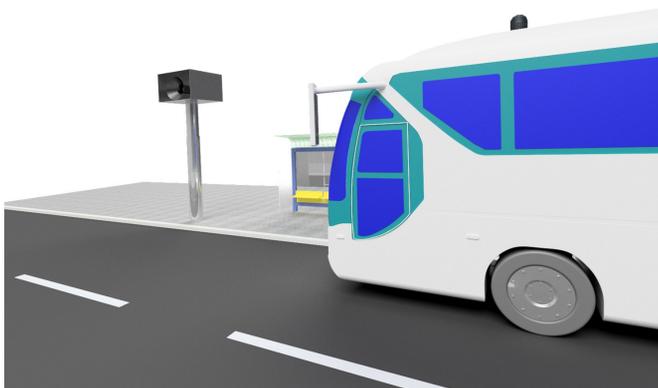


Figure: Adjustable charging unit

ADVANTAGES

- › **Automated charging process for use in commercial vehicles**
- › **Direction-independent charging of the vehicle (front right or left)**



- › **Increased safety in the event of a crash**
- › **Mechanical safety against unintentional driving off (also accident)**
- › **Safety of the commercial vehicle against swaying of the body due to loading and unloading or wind load**

FEATURES

The over-roof charging pole consists of a tubular stainless steel structure that protects against vandalism, with a flexible charging unit mounted on the upper end. This can be adjusted both in height and orientation. In this way, commercial vehicles can be charged largely independently of their standing position.

- › **Realization of fast charging systems possible**
- › **Contactless verification by mobile data systems (Vehicle-2-Infrastructure)**
- › **Safe accommodation of all essential elements in the charging pole**

EXPLANATION: V2I

Vehicle-to-Infrastructure is the wireless exchange of data between vehicles and the road infrastructure. V2I communication is wireless and bidirectional, the infrastructure provides the vehicle with various information.

TECHNICAL DATA

Parameter	Charging Pole Top-Roof
Power	Depending on charging system
Dimensions (Diameter x H) [mm]	300 x 3500
Access Protection	Via mobile data / Vehicle-2-Infrastructure (V2I)
Cooling	Direct contact cooling possible

FOUNDATION SYSTEM SHEAR-COMPRESSION-BENDING PLATE



Secure anchoring in the ground is essential in many applications. Factors such as soil conditions and occurring loads (e.g. due to wind) must be taken into account. In addition, safety factors must be included, so that a conservative design is usually used.

PROBLEM

To ensure such a secure anchorage, concrete foundations are poured. In addition to high costs for materials and labor, this also results in disadvantages from an ecological point of view. The concrete foundations remain in the ground after use or can only be removed with great effort - the ground is sealed.



- › High bending and compressive rigidities enable larger superstructures
- › Imitation of the pile root principle in combination with shear-compression-bending plate
- › Fast installation and immediate loading possible
- › Environmental protection due to residue-free deconstruction
- › Less material used than with conventional concrete foundations

SOLUTION

To ensure secure fastening in the ground, the taproot principle is imitated. The combination of a screw sleeve inserted into the ground and a rigid concrete slab underneath the final soil layer provides high bending and compressive rigidity. In this way, wind and weight loads from superstructures are reliably diverted.



Installation is carried out using tried-and-tested methods. The screw sleeve is a widely used product, so that inexpensive machines for screwing it in are already available. Excavation of the soil layer for insertion of the rigid slab is also simple and cost-effective.

Conventional mounting systems rely on the production of concrete on site or large machines for driving the posts into deep layers of soil. In comparison, the paXos foundation system eliminates the waiting time and multiple on-site operations that result from the setting time of poured concrete.

USE CASES

The foundation system developed by paXos is a sustainable anchoring solution for a wide range of applications:

- › **Large umbrellas**
- › **Traffic signs and lights**
- › **Masts (radio, antennas, floodlights)**
- › **Advertising boards**
- › **PV fences (see p. 18)**
- › **Foundations for containers and prefabricated buildings**
- › **Sound barriers**
- › **Wind turbines**

TECHNICAL DATA

Parameter	FS-SCBP
Earth Screw Sleeve Material	Stainless steel
Compression Plate Material	Reinforced concrete
Dimensions (D * H) [mm] 4 different sizes	(720 / 960 / 1200 / 1920) * 120
Weight [kg]: SCBP Screw	(90 / 140 / 185 / 418) 20

COMPANY

We look forward to the personal contact with you - be it as a future customer, employee or partner. Engineering services, project management and consulting are our passion, whether in small orders or large development projects. We are particularly strong in the cross-system challenges and can therefore handle projects holistically. We are looking forward to a sustainable and good cooperation in exciting projects.

We support you in your planning and questions in the areas of energy technology, automotive and industry. With our innovative in-house developments such as the solar roof tile or the charging plug, we are preparing for the future. Interdisciplinary execution of orders is our strength. The know-how flows in from all industries and areas to make your project successful.

PAXOS IS DIFFERENT

- › We are self-financed.
- › We are focused on sustainability.
- › We are a real team & act like one.
 - › We live flat hierarchies & can therefore act / decide quickly.
- › We are lean & dynamic.
 - › We are experts: tech-savvy, highly innovative & at the same time solid business people.



www.paXos.gmbh

HARD FACTS



Company:

- › founded in 2015
- › over 20 years of joint experience
- › self-financed
- › sustainable orientation
- › flat hierarchies / quick decisions
- › lean and dynamic

Key areas:

- › Engineering/Technical Services/Consulting
- › Project Management for small and large projects
- › Commercial Services and Consulting from one source

Excerpt of some customers:

CJ Automotive, Continental, Ford, Hoberg & Driesch, Knorr-Bremse, Magna, Meyer Burger, Porsche, ProGroup, RheinEnergie, Stadtwerke Iserlohn, Standard Profil, Webasto



www.paXos.solar

SERVICES

We develop state-of-the-art solutions for our customers at our site in Langenfeld (Rhld.) and offer not only consulting and services, but also product realizations up to prototypes.

With three key industries we bring a lot of expertise and know-how from a variety of projects. Synergies can be found not only in engineering, but also in cross-industry topics such as consulting, project management, training and human resources management.

- › **Analysis:** Problem Structuring, building process landscapes and maps, identification of possible weak points, planning of concrete measures
- › **Improvement:** Elaboration of concepts, support in decision making, monitoring, realization of individual solutions
- › **Control:** Final analysis to evaluate the solution, follow-up, lessons learnt

CONSULTING



With our excellent consulting, we provide you with individual solutions for your technical and economic problems. Based on your strengths, we develop tailor-made concepts for you that enable you to be even more successful. Whether by adding to your range of services or adapting to the specific customer - goal: a sustainable and profitable business.

- › **Definition:** Analysis of the specific situation (problem and scope), definition of the project outcome, creation of work plans
- › **Measurement:** Data collection, determination of the actual situation, definition of measurement criteria

THINK TANK



We not only advise, we have become an important player in the market in the field of innovation with a large number of patents, our own prototype workshop and testing facilities. In this brochure you will find many examples of how we set trends in innovations. We help you to identify precisely these trends for your company at an early stage and to implement them in appropriate products. Our focus is on the automotive and energy sectors, in particular renewable energies and electromobility.

ENGINEERING



Whether as support for your company on site or as a complete development project for you at our location - we offer you a wide range of cooperation options. If you need a component adaptation or a complex overall development - our team will be happy to convince you with its competence. We are also happy to represent your company in the development teams of large OEMs - we have the know-how that makes you successful.



We offer you a broad portfolio of engineering services from component / system support, CAD design and CAE calculation to resident engineering and electrics / electronics development through to testing.

- › **Concept creation:** Status analysis, package studies, strategy development, construction sketches
- › **Construction:** Data conversion and maintenance with CATIA V5, Inventor as well as

the databases Teamcenter and Vault, 3D-modelling according to specifications, 2D drawing derivation according to customer standard, component design and optimization

- › **Simulation & Calculation:** Durability and strength, acoustics, fluid mechanics CFD, 3D optimization with CAESSES Mantium Flow
- › **Prototyping:** Small parts from plastic and metal, own workshop with extensive tools and machines, rapid prototyping
- › **Test & Validation:** Define test conditions, test coordination and execution, preparation of measurement results and analyses

PROJECT MANAGEMENT



We offer you a comprehensive package in the area of project management from the first planning to commissioning and beyond. Everything from a single source, competent and reliable. With a wide range of project management know-how, a high level of motivation and experience from other industries, we react flexibly to situations and think sustainably.

Everything "new" in your company - new production facilities / products / processes / software etc. - is implemented through projects, which come to you as additional tasks. The implementation of projects, project management, is therefore one of the most important success factors for your company.

- › **Initialization:** Feasibility study, preparation of initialization, definition of project scope and objectives, (project) communication, approval procedures (BlmSchG)
- › **Planning:** Project definition, risk management, scheduling and coordination, budgeting, contract design and tracking, contract negotiations
- › **Execution:** Cost and performance control, determination of deviations (target-actual), report management, claim management
- › **Commissioning:** Progress tracking, critical path analysis, project control, construction and installation supervision, quality control

The paXos project management team is specialized in advising, accompanying and supporting you in your projects. Our employees have the following project management certifications: PMI / Prince2 / GPM IPMA. Together with you we realize your projects for a successful future of your company.

TRAINING



As a consulting company, we train almost all areas that are also offered as a range of services. From Engineering, CAx, PLM and Project Management to soft skill and office automation training: Let us convince you of our diverse offering!

- › **Technical Trainings**
- › **Project Management**
- › **MS Office**
- › **Soft Skills**

Our trainers and speakers have years of training and professional expertise and will be happy to develop individual training concepts tailored to your specific needs.

HR CONSULTING



Thanks to our years of experience in recruiting for our major clients and in developing successful employer brands, we can provide you with comprehensive support in establishing successful HR concepts, strategies and processes.

As employers, companies are more than ever exposed to constant competition for the best employees. An attractive overall HR concept is indispensable for successful recruitment and long-term loyalty to the company. The various HR topics are closely intertwined, so that they can only lead to the greatest possible success if they are combined.

JOURNEY DIRECTIONS



ARRIVAL BY CAR

Coming from the North

- › Take the A59, direction Cologne / Leverkusen
- › Leave the motorway at the exit 24 - Richrath and turn left at the traffic lights onto Berghausener Str.
- › Turn left at the next traffic lights onto Karl-Benz-Straße

Coming from the East, South and West

- › Take the A59, direction Düsseldorf
- › Leave the motorway at the exit 24 - Richrath and continue straight ahead at the traffic lights onto Karl-Benz-Straße

Further Route

- › Turn right at the first intersection and follow the road
- › The building is on the right hand side, parking spaces are on the right hand side behind the building

ARRIVAL BY PUBLIC TRANSPORT

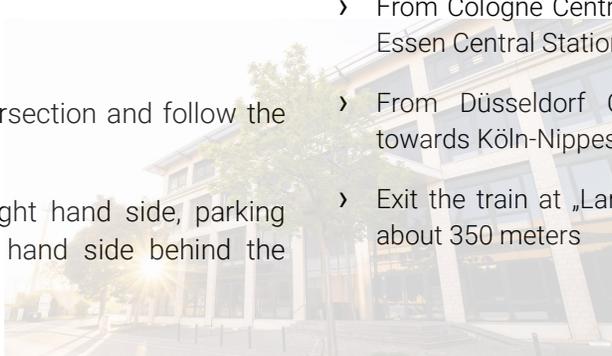
From the Airport

- › From Cologne/Bonn airport, take the S-Bahn (suburban train) lines 12, 13 or 19 to Cologne Central Station. Take the S6 in the direction of Essen Hbf.
- › From Düsseldorf airport, take the S-Bahn line 11 or the RE lines 1 or 5 to Düsseldorf Central Station. Take the S6, direction Köln-Nippes or Köln-Worringen.

- › Exit the train at „Langenfeld-Berghausen“ and walk about 350 meters

From the Main Station

- › From Cologne Central Station, take the S6 towards Essen Central Station
- › From Düsseldorf Central Station, take the S6 towards Köln-Nippes or Köln-Worringen
- › Exit the train at „Langenfeld-Berghausen“ and walk about 350 meters





IMPRINT

paXos Consulting & Engineering GmbH & Co. KG
Karl-Benz-Str. 9
D-40764 Langenfeld

REGISTER ENTRY

Entry in: Commercial Register
Register Number: HRA 24870
Register Court: District Court Düsseldorf

Represented by

paXos Management GmbH
Karl-Benz-Str. 9
D-40764 Langenfeld (Rhld.)

Entry in: Commercial Register
Register Number: HRB 82997
Register Court: District Court Düsseldorf

Professional Representation

Peter Hakenberg, Managing Director
Janina Kaergel, Managing Director
Karsten Birkholz, Authorized Representative
Guido Schumacher, Authorized Representative
Stefan Puczynski, Authorized Representative

CONTACT INFORMATION

Telephone: +49 (0) 2173 200 43 30
E-Mail: info@paXos.gmbh

VAT NUMBER

VAT identification number in accordance with
§27 a of the German VAT act: DE299685862

paXos

paXos Consulting & Engineering GmbH & Co. KG

-  Karl-Benz-Str. 9
D – 40764 Langenfeld (Rhld.)
-  +49 (0)2173 200 43 30
-  info@paXos.gmbh



www.paXos.gmbh



www.paXos.solar