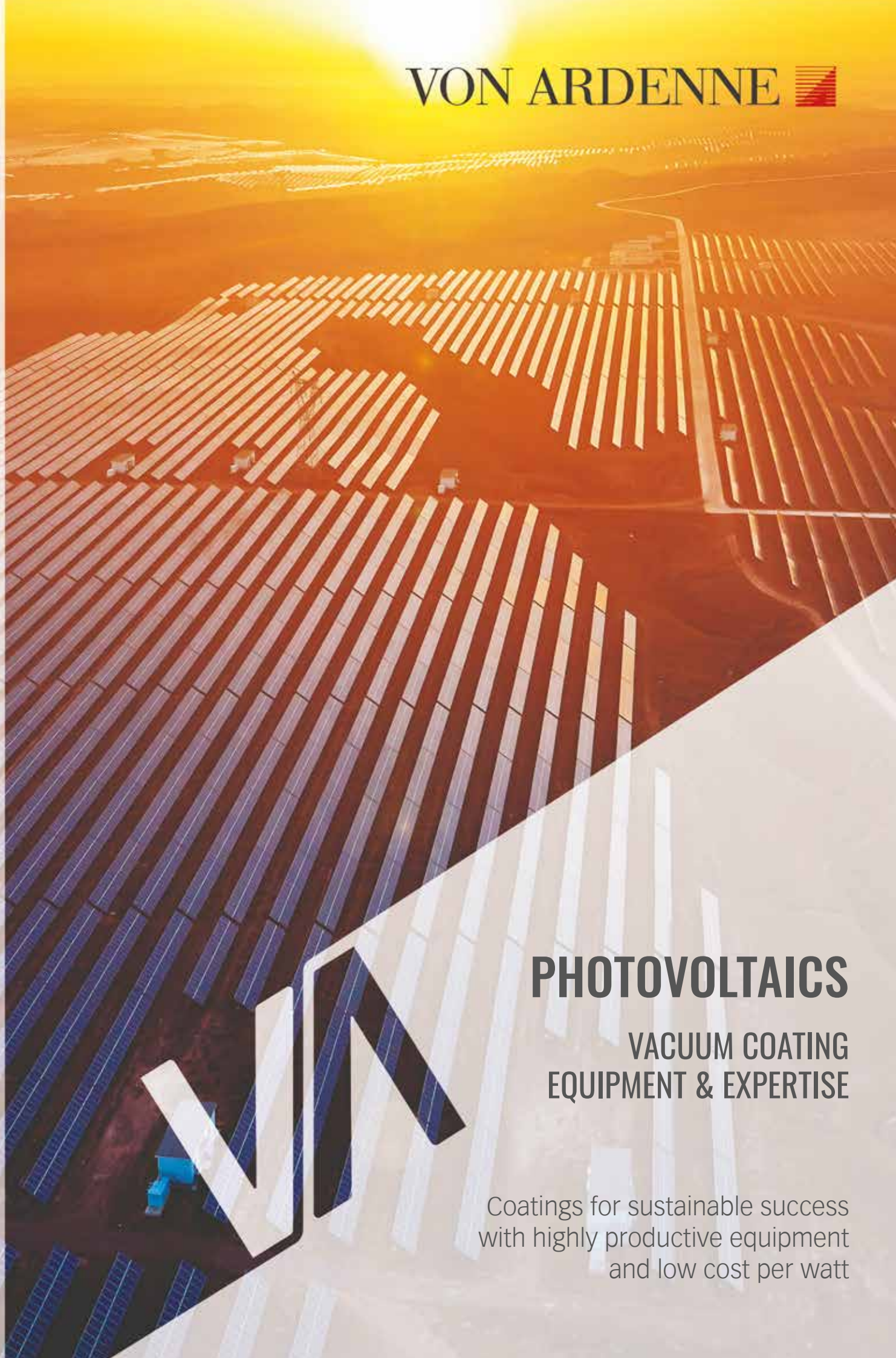
VON ARDENNE



PHOTOVOLTAICS

VACUUM COATING EQUIPMENT & EXPERTISE

Coatings for sustainable success
with highly productive equipment
and low cost per watt

COATINGS FOR SUSTAINABLE SUCCESS

WITH HIGHLY PRODUCTIVE EQUIPMENT

Electricity is a prerequisite for prosperity and progress. And electrical energy from renewable sources such as photovoltaics has become an essential building block in the energy mix. According to all forecasts, photovoltaics will be expanded to a much greater extent in the coming years.

The focus will be on two factors: higher productivity and increasing the efficiency of converting sunlight into electricity. At the same time, this increase in productivity and efficiencies must be accompanied by resource-conserving use of the necessary materials.

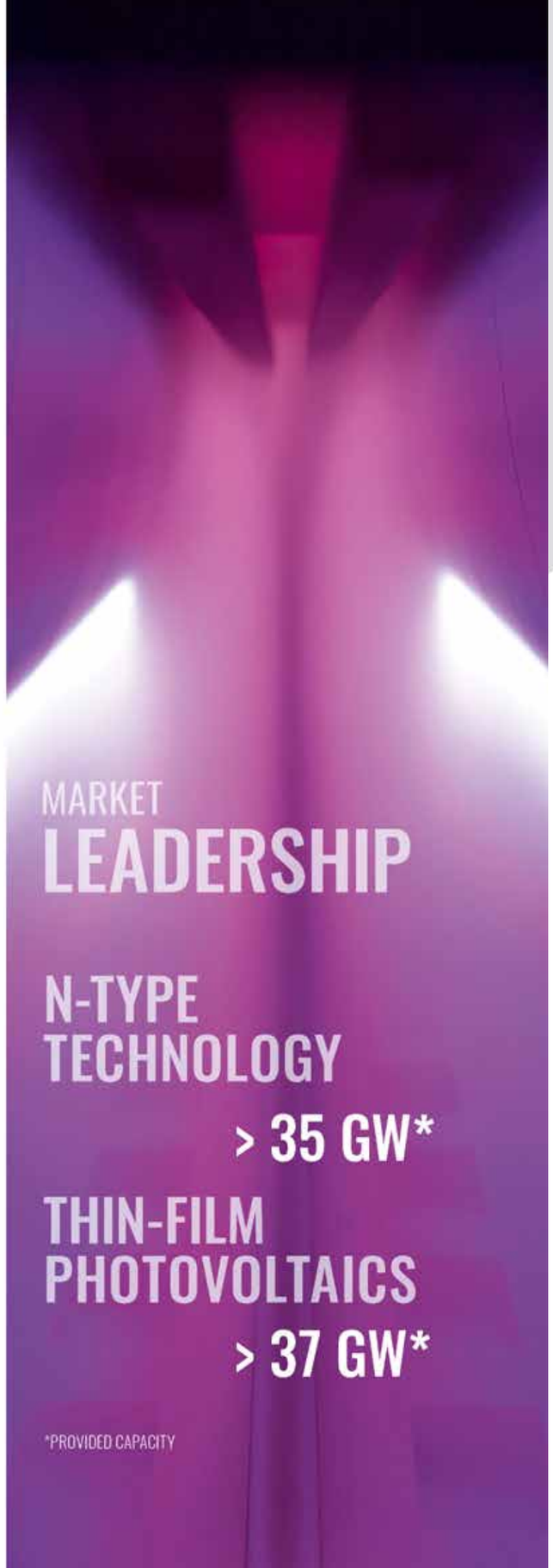
Contribution to the expansion of photovoltaics

Our contribution is highly productive vacuum coating equipment, which our customers use to manufacture solar cells or solar modules. The systems are tailored to their requirements and are suitable for different materials and formats. And they are scalable, meaning that processes from research and pilot production can be transferred to larger plants for mass production.

Major international manufacturers of crystalline and thin-film solar modules use our equipment for their production. They benefit from our experience and expertise as market leader.

We work closely with our customers to develop the next generation of modules that will be even more efficient.

- Equipment with high productivity
  due to short cycle times & high availability
- Unique scalability
  of equipment & technologies
- Our customers are leading
  due to low cost per watt



BUILDING-INTEGRATED PHOTOVOLTAICS

Turning buildings into generators with functional layers for integrated solar cells

With integrated photovoltaics, the building envelope performs two functions: Protecting the building and generating electricity. However, the design freedom for architects should not be lost in the process. For this reason, the requirements for the cell and the front glass of the solar module are extremely high.

We offer vacuum coating systems that enable you to meet these requirements. Our systems ensure your production process, both for cell production and for glass coating. With extremely precise layer distribution of our deposition processes, even the highest demands on aesthetics can be met. In addition, you can also produce chromatic layers according to your specifications. The optical result is reproducible at any time with our equipment.

- Aesthetic surfaces
  due to extremely high layer thickness homogeneity
- Lower material costs
  due to high target utilization
- High reproducibility
  of the different layers

THIN-FILM PHOTOVOLTAICS

Efficient equipment for thin-film PV to make the most of the sun

As a thin-film solar module manufacturer, you need coating equipment you can rely on and that keeps pace with your growth.

VON ARDENNE offers you proven PVD coating equipment, key components and technological know-how for all production stages of thin-film photovoltaics. Our laboratory and pilot systems use the same key components as our production equipment for the industry. Thus, you can test your applications under laboratory conditions. And you will save time when you want to scale up your products.

What makes our offer unique for you? We provide solutions for complex thin-film PV products.

- Reliable & highly productive equipment:
  proven in industrial use
- Systems keep pace with your requirements
  through upgrades & high scalability
- Lowest cost of ownership
  and costs per Watt

IBC SOLAR CELLS

Seed layers for the metallization of IBC solar cells: cost effective & in high quality

The world's most powerful PV modules today are made from IBC solar cells. IBC stands for interdigitated back contact. And the name indicates the special feature of these cells: their electrodes are located on the back.

This eliminates the otherwise visible metallic strips on the front, which has advantages for the efficiency and aesthetics of the cells.

We offer you suitable equipment so that you can produce the required thin films with PVD technologies cost-effectively and in high quality. Different materials like TCO (ITO, AZO), titanium, copper and aluminum can be deposited with one system.

- Deposition of different materials
  in one coating system
- High target utilization
  and best coating homogeneity on the market
- Special carrier design
  for shunt-free coating

TOPCON SOLAR CELLS

High-efficiency TOPCon solar cells by coating without back etching

N-type TOPCon solar cells offer numerous advantages over PERC solar cells, such as lower degradation and higher efficiency.

We have further developed the sputtering technologies that have proven themselves in VON ARDENNE systems for the mass production of heterojunction solar cells. As a result, we can also offer coating systems with a capacity of up to 1.3 gigawatts for customers in the TOPCon market.

The sputtering process allows the single-sided, full-surface coating of the solar cell rear side with tunnel oxide and a doped amorphous silicon layer in a highly productive inline process. The result is a significantly higher yield than with conventional PECVD and LPCVD processes.

Furthermore, with PVD, we can deposit the front- and rear-side SiNx layer in a single system. The combination of the two process steps - TOPCon and SiNx deposited with PVD - leads to a silane- and phosphine-free production.

- Highest cell efficiencies
  with high productivity
- Entire TOPCon layer stack in one step:
  silicon oxide & amorphous silicon
- Higher safety: silane- and phosphine-free production
  through PVD process without toxic or flammable gases

HETEROJUNCTION SOLAR CELLS

Double-sided coating with TCO in one process

Heterojunction solar cells (HJT) combine the advantages of thin-film and silicon photovoltaics. With excellent electrical and optical properties in a very lean process flow, our customers achieve the highest efficiencies in the gigawatt production of bifacial solar cells.

We offer you sputtering equipment for the mass production of conductive oxide (TCO) layers for HJT silicon solar cells. You will benefit from our experience of having installed equipment with a capacity of over 70 gigawatts worldwide. Optimized processes and field experience ensure the best price-performance ratio on the market.

- Deposition of TCO
  on one or both sides
  for up to 1.3 gigawatts per system
- Can be combined with metallic layers
  as seed layer for galvanically applied fine line contacts
- High target utilization
  and best layer homogeneity on the market

PEROVSKITE TANDEM SOLAR CELLS

Establishing pilot production for tandem cells with joint process development

Do you want to push the technical limits of a solar cell? Would you like to set up a pilot production for perovskite tandem solar cells? Realize the next generation of solar cells with scalable vacuum coating equipment.

VON ARDENNE will support your scientists and process engineers in finding the processes for perovskite absorber deposition as well as ETL, HTL and recombination layers.

Benefit from our expertise in photovoltaics through hundreds of installed systems in more than 20 years. VON ARDENNE provides you with thermal evaporation and sputtering processes. They will put you in a position where you can realize your cell production on a mega and gigawatt scale and in a reliable and repeatable way.

Alternatively, we can combine PVD technology with other processes such as Vapor Transport Deposition (VTD), spin coating or slot die coating.

- Experienced partner for
  scalable process development
  from single wafer processes to megawatt to gigawatt
- ... with highest possible cell efficiency
  of over 30 percent
- ... at competitive costs
  per watt peak

HISS

HIGHLY FLEXIBLE & SCALABLE INLINE SYSTEMS

for horizontal substrate transport

The HISS is a modular coating system for the horizontal coating of substrates. It is the perfect choice if you are looking for highly flexible production equipment with a small or medium throughput equipped with proven technology.

Thanks to its modular design, the HISS can be configured according to your needs. We offer various basic configurations of the system such as the single-ended version for a smaller production scale.

The system offers a high process flexibility for sputter processes and evaporation processes as well as various pre- and post-treatment methods.

The flexible and dynamic design of the system with standardized modules enables custom-made configurations. That means that the system can be adapted to new processes or requirements. Therefore, our customers are able to act very dynamically and can adapt to the evolution of their product.

Double-sided or single-sided coating
to suit your substrate & process requirements

High flexibility
in process technology and equipment configuration

Ideal for R&D up to series production
through easily scalable processes

HISS|300

- Focus on research and development of new coating systems or improvement of existing ones
- Testing of different process technologies with low space requirements
- Scalability to small series and production due to platform approach

HISS|600

- Focus on developing new or improving existing coating systems
- Possibility of testing in small series and, if required, 24/7 production
- Scalability to larger system concepts due to platform approach

APPLICATIONS


ADVANCED PANEL-LEVEL PACKAGING


RADAR ANTENNAS


METALLIC BIPOLAR PLATES


PRINTED CIRCUIT BOARDS


IBC SOLAR CELLS


TOPCON SOLAR CELLS


HETEROJUNCTION SOLAR CELLS


PEROVSKITE TANDEM SOLAR CELLS


POWER ELECTRONICS

TECHNICAL DATA

Subject to change without notice due to technical improvement.

Substrates
Glass, polymers, metals, silicon wafers

Coating area
HISS|300: up to 300 mm x 300 mm, 900 mm x 300 mm on request
HISS|600: up to 1000 mm x 600 mm

Deposition arrangement
Double-sided or single-sided

Substrate temperature
RT … 250°C

Deposition technology
Magnetron sputtering, linear evaporation, pre- and post-treatment

Transport type
Carrier or glass transport

Loading & unloading
Optional automation by robot

System control
Siemens SPS and WinCC

GC120VCR

PROVEN COATING SYSTEM FOR DISPLAYS

With high productivity

With the GC120VCR, we offer you a reliable system for the deposition of thin metal and oxide layer systems on flat glass or substrates made of other materials.

The substrates are guided vertically through the system in a carrier. After coating, the carrier is transported back to the start by a return system. This saves you time and manpower.

VON ARDENNE is a leader in developing and manufacturing of large-area coating lines. Therefore, we were able to incorporate our extensive knowledge and experience with PVD technologies into this platform. The reliability of the system has been proven and confirmed in the display industry.

- High productivity
  due to scalability, modular design & short cycle times
- Small footprint
  due to vertical chamber orientation
- Low defect rates
  due to vertical orientation

APPLICATIONS

AUTOMOTIVE DISPLAYS

DISPLAYS FOR CONSUMER ELECTRONICS

THIN-FILM PHOTOVOLTAICS

SMART GLASS

TECHNICAL DATA

Subject to change without notice
due to technical improvement.

Substrates
Glass

Coating area
Up to 1280 mm x 1650 mm

Deposition arrangement
Double-sided, pulsed DC, AC or bipolar

Substrate temperature
RT / 200°C / 400°C

Deposition technology
Magnetron sputtering, linear evaporation
pre-and post-treatment

Transport type
Inline, carrier-based

Loading & unloading
Optional automation by robot

System control
Siemens SPS and WinCC

PIA|NOVA

PROVEN COATING SYSTEM

For solar applications

If you are looking for a highly productive and flexible production system combined with proven technology and design, the PIA|nova® is our answer.

The PIA|nova® is a horizontal glass coating system based on a modular platform. With this system, VON ARDENNE offers you standard, yet flexible, manufacturing equipment for depositing thin films using physical vapor deposition (PVD) technology.

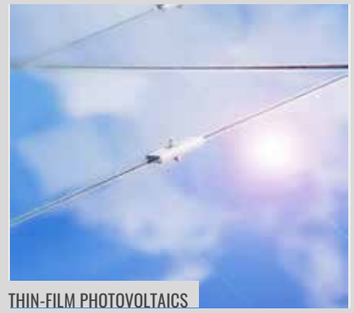
We have incorporated our vast process know-how into this platform, gained from hundreds of industry-proven glass and photovoltaic coating systems.

Tried and tested
in in the industry for many years

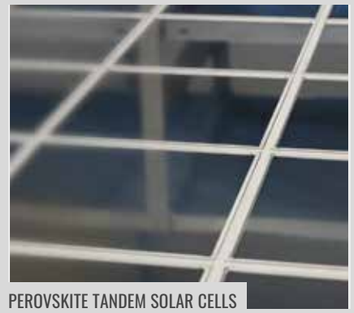
Reliable
due to extensive process know-how

Flexible
through modular design

APPLICATIONS



THIN-FILM PHOTOVOLTAICS



PEROVSKITE TANDEM SOLAR CELLS

TECHNICAL DATA

Subject to change without notice due to technical improvement.

Substrates
Glass

Coating area
Up to 1650 mm x 1400 mm

Deposition arrangement
Sputter down, DC, pulsed DC, AC

Substrate temperature range
RT / 200°C / 400°C

Deposition technology
Magnetron sputtering, planar or rotatable targets (single or dual)

Transport type
Inline

System dimensions (L x W x H)
Customized x 9 m x 2.8 m

System control
PLC, Siemens S7

XEA|NOVA L

HIGHLY PRODUCTIVE & HIGHLY PROFITABLE

Double-sided coating on large areas

If you are looking for a highly productive and flexible production system combined with proven technology and design, the XEA|nova L is the perfect choice.

The inline coating system is based on our patented coating technology for large substrate areas. The system is wide and can therefore process many substrates simultaneously. Therefore, it is particularly suitable for applications with high productivity at very low costs. With the XEA|nova L, you can coat silicon wafers or other small substrates. It is also suitable for very thin substrates.

Thanks to its modular design, the XEA|nova L can be equipped with rotatable magnetrons for the sputter deposition of high performance TCO layers or various other materials such as metals and metal oxides. It can also be adapted for other deposition technologies Substrates can also be pre-treated in the system by cleaning or etching, either under vacuum or before entering the vacuum.

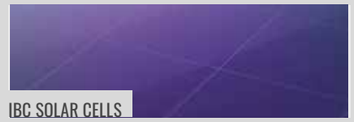
Exceptionally productive
due to large width

Easily adaptable to new processes & requirements
due to flexible & modular design

Low downtime
due to quick and easy maintenance

APPLICATIONS


METALLIC BIPOLAR PLATES


IBC SOLAR CELLS


BUILDING-INTEGRATED PV


TOPCON SOLAR CELLS


HETEROJUNCTION SOLAR CELLS


PEROVSKITE TANDEM SOLAR CELLS

TECHNICAL DATA

Subject to change without notice
due to technical improvement.

Substrates
Silicon wafers (M2, M4, M6, M10, G12, triple-cut-formats), metals

Coating area on carrier
≈ 1.5 m x 2.3 m, e.g. (9 x 12) for M6-wafers

Deposition arrangement
Double-sided or single-sided

Deposition technology
Magnetron sputtering,
alternative technologies upon request
(e.g. linear evaporation, Ion etching)

Transport type
carrier-transport

Loading & unloading
Automated substrate loading & unloading
Automated carrier return system

System control
Siemens SPS and WinCC

GIGA|NOVA

EXTREMELY PRODUCTIVE & HIGHLY PROFITABLE

Wafer coating on extremely large areas

If you are looking for highly productive coating systems for solar cell production with an annual capacity of up to 1.3 gigawatts, the GIGA|nova horizontal wafer coating system is the perfect choice. There is no comparable carrier-based system on the market with a higher throughput.

The inline coating system is based on our patented coating technology for large substrate areas. The system is very wide and can therefore process many substrates simultaneously. It is therefore particularly suitable for applications with high productivity at very low costs and is suitable for single- as well as double-sided wafer coating.

Thanks to its modular design, the GIGA|nova can be equipped with magnetrons with rotating targets for single-sided sputter deposition or with linear evaporators for thermal evaporation.

The GIGA|nova benefits from the experience we have gained in delivering more than 300 coating systems for high-volume production to companies in the photovoltaic industry.

Low cost of ownership
through extremely high productivity

Easily adaptable to new processes & requirements
due to flexible & modular design

High uptime
due to quick & easy maintenance

GIGA|nova SCX

- With the GIGA|nova SCX, you can coat silicon wafers on one side
- For TOPCon or IBC TOPCon: tunnel oxides and n- or p-doped silicon
- For IBC: metal layers
- For tandem perovskites (2T): ETL, HTL, absorber, TCO or recombination layers

GIGA|nova DCX

- With the GIGA|nova DCX, you can coat silicon wafers on both sides
- For HJT: transparent conductive oxide layers
- For TOPCon: front and rear site SiN_x layers
- For double-sided TOPCon: tunnel oxides and n- or p-doped silicon

APPLICATIONS

IBC SOLAR CELLS

TOPCON SOLAR CELLS

HETEROJUNCTION SOLAR CELLS

PEROVSKITE TANDEM SOLAR CELLS

TECHNICAL DATA

Subject to change without notice due to technical improvement.

Substrates
Silicon wafers, glass

Coating area
GIGA|nova SCX: up to 2700 mm x 3100 mm
GIGA|nova DCX: up to 2800 mm x 3600 mm

Deposition arrangement
Single sided (from up to bottom)

Substrate temperature
RT … 250°C

Deposition technology
Magnetron-sputtering, other technologies on request (e.g. linear evaporation, ion etching)

Transport type
Single-sided, carrier-based

Loading & unloading
Optional automation

System control
Siemens PLC and WinCC

XENIA

HIGHLY PRODUCTIVE AT LOWEST COSTS OF OWNERSHIP

Large-area vacuum coating on glass

If you are looking for highly productive and flexible production equipment combined with proven technology and design, then the XENIA is the perfect choice.

The XENIA is an inline coating system based on our proprietary large-area coating technology. As the coater is very wide and can therefore process many substrates at the same time, it is especially suited for high productivity applications at very low costs. It is suited for large-area glass substrates.

The XENIA benefits from our experience gained from delivering more than 300 coating systems to the photovoltaics industry.

Exceptionally productive

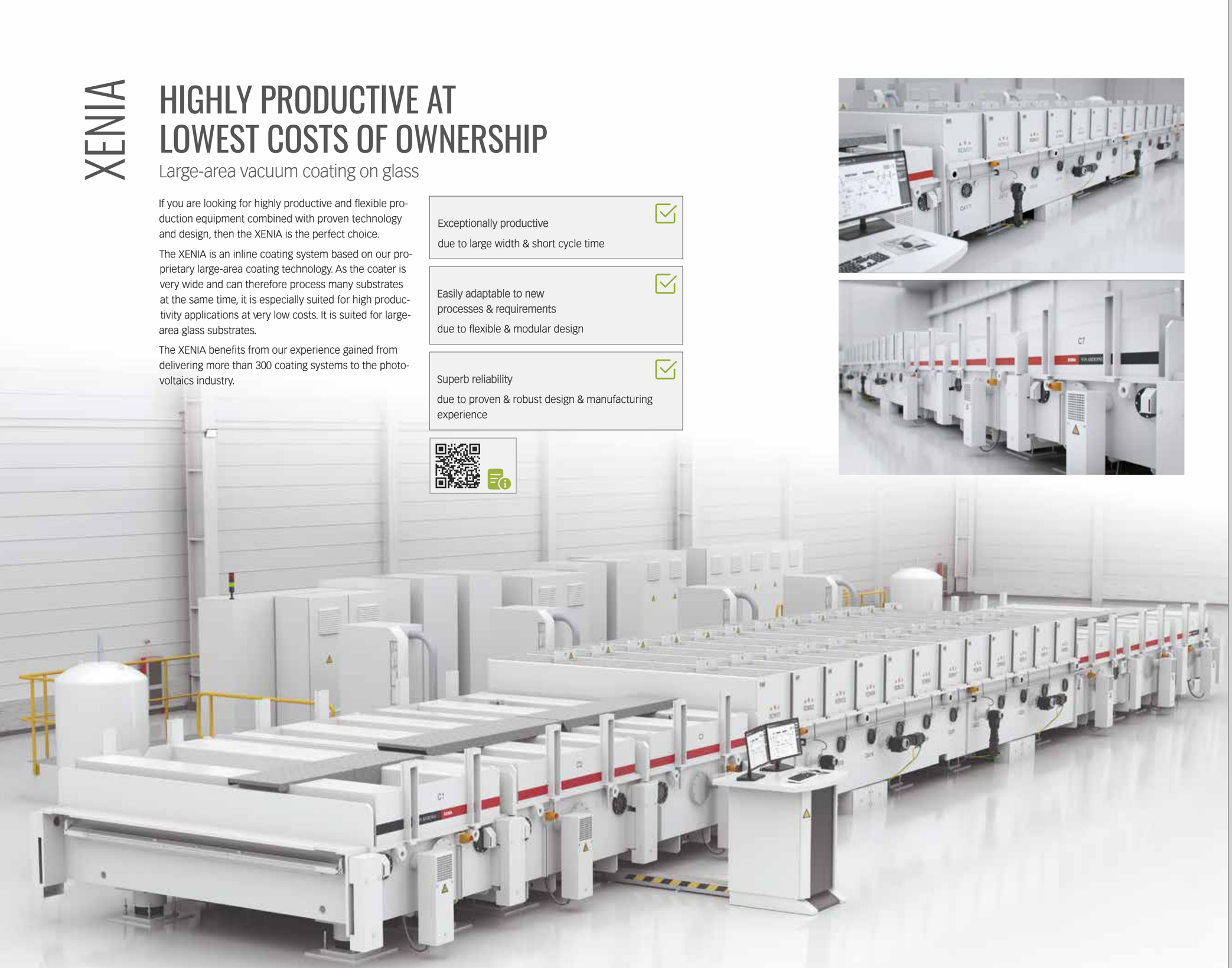
due to large width & short cycle time

Easily adaptable to new processes & requirements

due to flexible & modular design

Superb reliability

due to proven & robust design & manufacturing experience



APPLICATIONS

IBC SOLAR CELLS

THIN-FILM PHOTOVOLTAICS

PEROVSKITE TANDEM SOLAR CELLS

TECHNICAL DATA

Subject to change without notice due to technical improvement.

Substrates
Glass

Coating area
Up to 2000 mm x 2400 mm

Deposition arrangement
Single-sided, sputter down

Substrate temperature
RT / 200°C / 400°C

Deposition technology
Magnetron sputtering, planar or rotatable

Transport type
Inline

System dimensions (L x W x H)
Customized (min. 20 m) x 16.5 m x 3.5 m

System control
PLC, Siemens S7

FOSA MX

HIGHLY PRODUCTIVE ROLL-TO-ROLL COATING

With modular equipment

The FOSA MX is a web coating system with a modular design. It is ideal for high-volume production and can be configured with up to three separate coating chambers. Furthermore, it features an advanced maintenance concept.

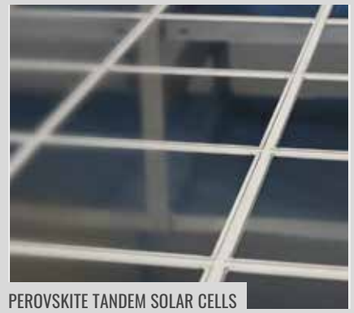
The FOSA MX is engineered for minimized downtime for complex layer stacks, such as anti-reflex and window films.

VON ARDENNE is a leading supplier of large-area coating systems that have been proven in the industry. Therefore, we were able to incorporate extensive technological knowledge and experience in handling film substrates into this platform.

- High flexibility
  through many configuration options
- Saves time & effort:
  coil exchange without evacuating process chamber
- Low downtime
  due to quick & easy maintenance

APPLICATIONS

LITHIUM-ION BATTERIES



PEROVSKITE TANDEM SOLAR CELLS

TECHNICAL DATA

Subject to change without notice
due to technical improvement.

Substrate material
PET

Good coating width
1.56 m

Web thickness
125 µm

Coating speed
Dry index matching ITO: 10 m/min
Cu metal mesh: 2.4 m/min

(values refer to FOSA MX 1600 D10)

OUR STRENGTHS

IN-HOUSE TECHNOLOGY & APPLICATION CENTER

- Sample coatings of customer applications
- Development of customized layer stacks
- Product & process verification and optimization
- Testing of new technologies and components

PROFESSIONAL SIMULATION SUPPORT

We offer professional simulation technology to ensure best process quality with regards to plasma, heat and cooling. Furthermore, our simulation tools help demonstrate, develop and improve layer properties and define or optimize processes, details and the performance of our systems.

GLOBAL PROJECT EXPERIENCE

VON ARDENNE equipment is used in over 50 countries.

We have established an installed base of hundreds of coating systems worldwide, ranging from small tools to equipment for large-area coating applications for several markets.

COMPREHENSIVE SERVICE PORTFOLIO

- VON ARDENNE service hubs around the world
- On-site service
- Remote access by our technology department
- Regular technical and technological trainings
- Spare & wear part warehouse close to customers
- Lifecycle extension of wear parts

CLOSE PARTNERSHIP

VON ARDENNE has a network of partners for even more profound R&D work and to identify future technologies. It consists of:

- Fraunhofer Institutes
- Institutes of the Helmholtz Association
- Universities
- Companies

UPGRADES & RETROFITS

As soon as your business is growing, your VON ARDENNE equipment will grow accordingly - thanks to its modular design and the upgrades we provide. We will also supply you with the necessary technology upgrades if you decide to change your applications.

Furthermore, when your equipment is ageing, we will retrofit your systems with new components, no matter if they are VON ARDENNE or third-party machines.

PRODUCT TOPICS
PRODUCT INDEX
COMPO-NENTS

vonardenne.com

WHO WE ARE & WHAT WE DO

VON ARDENNE develops and manufactures industrial equipment for vacuum coatings on materials such as glass, wafers, metal strip and polymer films. These coatings give the surfaces new functional properties and can be between one nanometer and a few micrometers thin, depending on the application.

Our customers use these materials to make high-quality products such as architectural glass, displays for smartphones and touchscreens, solar modules and heat protection window film for automotive glass.

We supply our customers with technologically sophisticated vacuum coating systems, extensive expertise and global service. The key components are developed and manufactured by VON ARDENNE itself.

Systems and components made by VON ARDENNE make a valuable contribution to protecting the environment. They are vital for manufacturing products which help to use less energy or to generate energy from renewable resources.

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SERVICE CONTACTS

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