

SOLAR

Leading-edge process technology
for the PV industry

Solar technology

Semiconductor technology

Microsystems technology

Medical technology

Circuit board technology



RE-THINK! THINK RENA!

While our reserves of fossil fuels continue to deplete, photovoltaics is developing from a niche application to a global alternative to conventional energy sources. For RENA this represents both the motivation and the social responsibility to build state of the art systems for solar cell production and thus make a contribution towards new environmentally-friendly technologies.

LARGEST INSTALLED BASE

PROCESS GUARANTEE

BEST COST OF OWNERSHIP

INCREASED YIELD

HIGHEST QUALITY

THE WET PROCESSING COMPANY

WET PROCESS – COMPLETE SOLUTIONS FOR INLINE AND BATCH PROCESSING

Silicon technology forms the basis for over 80 per cent of all PV systems. Pure silicon is recovered from quartz in a number of melting and purification steps. The liquid silicon is cast in blocks or drawn to form silicon monocrystals. These are then sawn into wafers of ≤ 0.2 mm thickness. The wafers are pre-cleaned, automatically separated and fed into horizontal cleaning, and dried. In cell production the wafer goes through a number of process steps from saw damage etching and texturing to doping, edge isolation and metallisation, up to the final measurement of the efficiency.

From process development to manufacturing of equipment and final acceptance - RENA products cover the full range of wet processing for the solar industry, including handling, transport and measurement solutions. Driven by extensive research and development RENA improves the wet processing steps for solar wafer and solar cell production. This engagement for higher yields by increasing the efficiency and reducing the demand of raw material enables RENA to provide a new generation of process solutions.



RENA!

OPTIMISED SYSTEMS FOR CHALLENGING REQUIREMENTS IN THE PV MARKET

- LARGEST INSTALLED BASE
- PROCESS GUARANTEE
- ONLINE PROCESS CONTROL
- SINGLE SIDE PROCESSING

WAFER



The RENA Wafer Cluster includes all handling, cleaning, characterisation and data transfer steps necessary in state of the art wafer production after sawing.

Features and benefits

- Throughput up to 8.000 wafers/h
- Effective pre-cleaning with special showerhead
- Gentle separation under water
- Simple basket and wafer handling

FRONT END



RENA offers all wet process tools and corresponding automation solutions for the Front End Cell production. You can choose between a single tool, a tool with automated loading and unloading system or one of our Cell Cluster solutions with optimised process and mechanical sequences. The RENA process expertise further ensures reliable mass production and provides advanced solutions for high efficiency concepts.

Features and benefits

- Inline, batch and automation solutions from a single source
- Harmonised loading and unloading systems
- Technology leadership
 - Process guarantee
 - Low cost of ownership
 - Advanced process solutions
 - High process integration



BACK END



The InCellPlate plating tool is the centre of our metallisation family. In combination with our liquid jet guided laser system SelectDop LCP RENA offers Cluster solutions to increase the efficiency of standard cell types.

Features and benefits

- Single side processing
- No backside protection necessary
- Functional and process guarantee
- Efficiency increase guarantee

THIN FILM



Innovative wet process tools for wet processes in all three thin film technologies - this is our philosophy. All RENA solutions are developed to offer our customer low cost of ownership values.

Features and benefits

- Efficient consumption
- Low total cost of ownership
- Innovative solutions
- Process integration

SOLAR WAFER PROCESSING

SYSTEMS FOR THE COMPLETE CLEANING CHAIN AFTER SAWING

- ENVIRONMENTALLY FRIENDLY CLEANING
- BEST COST OF OWNERSHIP
- MES INTEGRATION

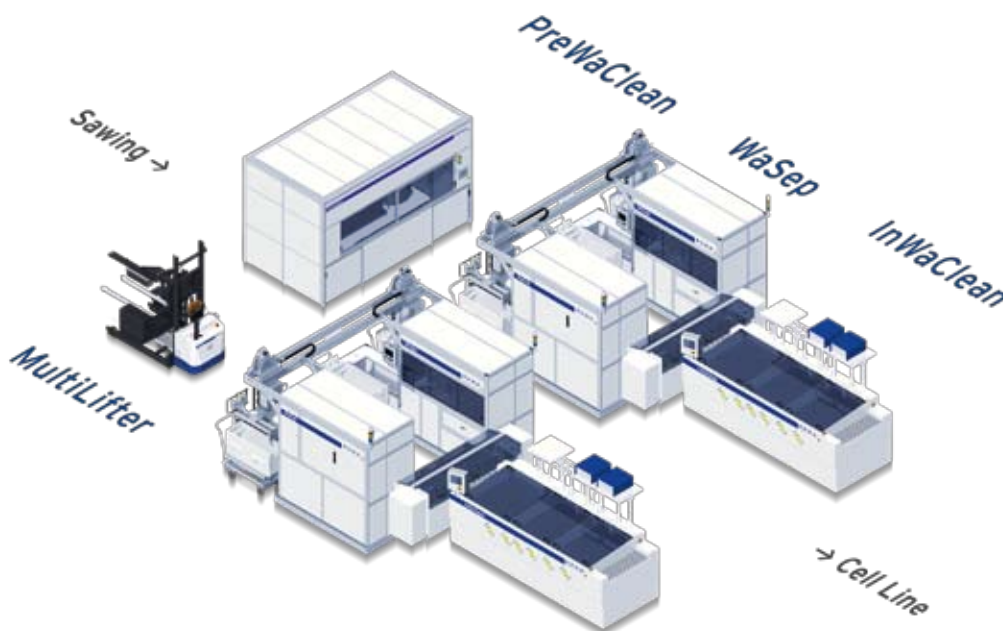


Product Process

Transfer

MultiLifter

The RENA MultiLifter is designed for loading a silicon brick into the wire saw and unloading the sawn brick into the wafer basket of a PreWaClean transportation tank.



Features and benefits

- Optimised handling between saw and pre-cleaning process
- Universally compatible with common wire saw types
- Easy and safe direct transfer from wire saw into the wafer basket
- Integrated wet storage of the sawn bricks
- Convenient and smooth brick handling with electric drive and hydraulic lifting
- For bricks with up to 1.080mm length

WAFER CLUSTER

Due to technology partnerships and longtime experience RENA was able to optimise the handling and process sequence for the complete process chain after sawing.

Features and benefits

- Throughput up to 8.000 wafers/h
- Simple handling tool
- Effective pre-cleaning with special showerhead
- Gentle separation under water
- Automated loading of inline cleaning systems
- Higher production yield through reduced breakage rate
- Reduced operator costs



Product Process

Pre-Cleaning

PreWaClean

The highest cleaning efficiency per time and area can be achieved with the wafer still glued to the saw carrier. RENA optimised the function to get an effective and homogeneous wafer pre-cleaning.

Features and benefits

- Best cleaning results
- Minimised water consumption
- Removal of slurry and silicon residues from a sawing process
- Removal of silicon residues from a diamond wire sawing process
- High throughput with excellent water management
- Special showerhead

Separation

WaSep

The latest generation of the RENA WaSep series ensures a reliable and smooth wafer separation.

Features and benefits

- Direct separation out of the RENA PreWaClean wafer basket, time saving and gentle process
- Gentle wet ribbon separation
- Integrated breakage management and automatic removal of broken wafers
- Throughput matches with RENA InWaClean

Cleaning & Drying

InWaClean

The process systems in the InWaClean series with integrated drying remove saw residues from individual wafers in a physical/chemical process sequence.

Features and benefits

- Horizontal cleaning line with high throughput based on multi-lane processing
- Main cleaning with water and ultrasonics
- Low breakage rate due to new transport system
- Reliable, reproducible process results
- Environmentally friendly cleaning chemistry and lowest consumption
- Cleaning process without etching
- Best wafer conditions for texturing
- RENA AirChannelDryer leaves no water marks

SOLAR CELL PROCESSING FRONT END INLINE

OPTIMISED SYSTEMS FOR CHALLENGING REQUIREMENTS IN THE PV MARKET

- LARGEST INSTALLED BASE
- ONLINE PROCESS CONTROL
- SINGLE SIDE PROCESSING
- PROCESS GUARANTEE

Product Process

Saw Damage Etching & Texturing

InTex

Removal of the damage caused by the sawing process. Improvement of the light absorption due to the generation of a textured surface.

Features and benefits

- Technological leadership
- Process start up by RENA
- Proven process performance
- Homogeneous textured surface
- Best process yield
- Small footprint
- Optimised total cost of ownership
- Surface texture tunable to optimise reflection and defect etching
- Patented process

Polishing

InPolish

Single side inline polishing using a polishing etch. The process generates smooth surfaces for high-efficiency concepts.

Features and benefits

- Enables processing schemes for rear-side passivated cells
- Inline single side process
- Smooth back surface in a single process step
- No masking of the front side required
- Easy automation integration and combination with other RENA inline tools
- Suitable for both multi- and monocrystalline cells
- Technological leadership
- Process start up by RENA
- Etch depth and polishing grade tunable to the cell requirements

Doping

InDop

Phosphoric acid is applied to the wafer surface before inline diffusion. The RENA soft roller system generates thin and homogeneous layers.

Features and benefits

- Ideal line integration with RENA InTex systems
- Doping process adapted to the texturing
- In combination with InOxSideEB, same performance like POCl_3
- Double side coating
- Low cost of ownership
- Formation of a thin PSG layer
- Excellent process homogeneity
- Stable process control
- Online monitoring



Product Process

Oxide Etching & Junction Isolation

InOx | InOxSide

In addition to the PSG removal in the InOx the InOxSide performs also the junction isolation. During the junction isolation process the front side is kept dry.

Features and benefits

- PSG removal and junction isolation in one single tool
- Ideal process and work flow integration
- Junction isolation performed by rear side emitter removal
 - Enables processing schemes for rear-side passivated cells
 - Patented process
- Cell efficiency increase
- Technological leadership
 - Process start up by RENA
 - Best process yield
 - Outstanding process performance

Oxide Etching & Junction Isolation and Etch Back

InOx EB | InOxSide EB

The EB series with an additional emitter etch back step offers an extra boost in blue response.

Features and benefits

- PSG removal, junction isolation and emitter etch back in one single tool
 - Optimised footprint
 - Ideal process and work flow integration
- Technological leadership
 - Integration with the RENA InDop raises the performance of inline diffusion to the level of POCl_3
 - Process start up by RENA
 - Low total cost of ownership
 - Stable and reproducible processing

Single Side Oxide Etching

InSiOx

Thermal SiO_2 removal from one cell side with an Inline single side process. The oxide layer on the other side remains undamaged.

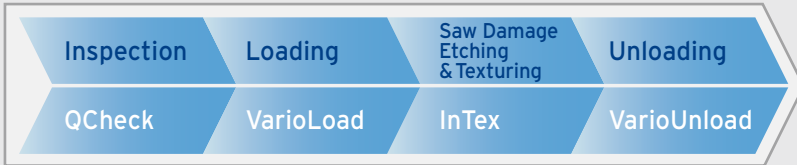
Features and benefits

- Enables processing schemes for rear-side passivated cells
- Inline single side process:
 - No oxide etching on upper side
 - No masking required
 - Easy automation integration
- Technological leadership
 - RENA owned process
 - Process start up by RENA
 - Suitable also for drilled wafers



CELL CLUSTER MULTI TEXTURING

All around wet texturing in the RENA InTex - tunable process, harmonised loading and unloading systems including a characterisation system.

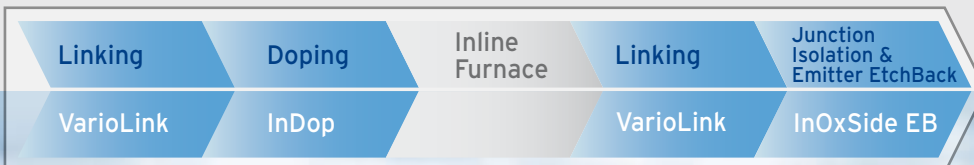


Features and benefits

- Perfect automation integration
- Defined mechanical and data handshakes
- Optimised footprint
- Ideal workflow integration
- Optimal wafer tracking
- Technological leadership
- Process guarantee
- Tunable texturing
- Process start up by RENA
- Low total cost of ownership
- Continuous transport of wafers, no pick and place

CELL CLUSTER DIFFUSION

Process integration of inline doper InDop, a diffusion furnace and InOxSide EB with emitter etch back to achieve $POCl_3$ performance. Full automation integration with two VarioLink tools, for InDop loading with flip station and buffer, for linking the InOxSide EB with buffer.



Features and benefits

- Perfect automation integration
- Defined mechanical and data handshakes
- Optimised footprint
- Technological leadership
- Process integration of the RENA InDop and InOxSide EB raises the performance of inline diffusion to the level of $POCl_3$
- Process start up by RENA
- Low total cost of ownership
- Boost in blue response

SOLAR CELL PROCESSING FRONT END INLINE

NEW INLINE PLATFORM

Features and benefits

- Solid roller transport system
- Easy maintenance access
- Open gear system
- Modular setup
- Plug and process solution
- Intelligent process control
- Easy process transfer tool to tool
- Harmonised loading and unloading systems
- Advanced data logging



SOLAR CELL PROCESSING FRONT END BATCH

TECHNOLOGY LEADERSHIP
BASED ON DEVELOPMENTS WHICH
SET NEW STANDARDS

- PROCESS GUARANTEE
- LOW BREAKAGE RATES
- HIGH THROUGHPUT
- MAXIMUM FLEXIBILITY

Product Process

Saw Damage Etching

BatchEtch

Removal of the mechanical saw damage from as-cut wafers

Features and benefits

- Process guarantee
- Low breakage rate due to advanced handling and transport systems
- Small footprint and improved process homogeneity due to tank-in-tank design
- Special tank: carrier arrangement to prevent wafers from floating
- Integrated pre-scrubbing of exhaust-air
- Integrated etch rate determination
- Low breakage rate

Texturing

BatchTex

Chemical texturing of the wafer surface to increase light absorption and improve the efficiency of the cells.

Features and benefits

- Process guarantee
- Homogeneous texturing
- IPA free texturing with monoTEX
- monoTEX guarantees a process time < 20 min
- Low chemical consumption
- Pre-Clean guarantees a monoTEX bath lifetime of > 30 runs
- Control of pyramid size
- Small footprint and improved process homogeneity due to tank-in-tank design
- Texturing and metal cleaning area separated by a shutter
- Special tank: carrier arrangement to prevent wafers from floating
- Integrated pre-scrubbing of exhaust-air optional
- Integrated etch rate determination
- Low breakage rate

Cleaning & HF/O₃

BatchClean

Efficient metal and particle cleaning based on the HF/O₃ process. Best surface preparation before thermal and coating processes.

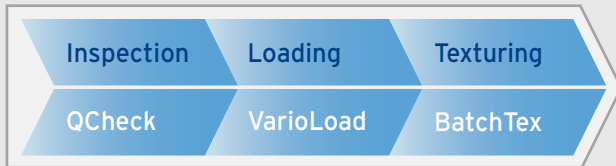
Features and benefits

- Process guarantee
- Worldwide lowest metal surface concentrations
- All-in-one solution using HF/O₃
- Improved adhesion of downstream AR layer
- Process without post-rinsing
- Use of ozone in liquid and as gaseous oxidation step possible
- Bleed and feed function
- Low breakage rate



CELL CLUSTER MONO TEXTURING

monoTEX based IPA free texturing with process guarantee, complemented by a characterisation system for the incoming wafers, a matching loading system and a chemical supply system is our plug and play Cluster solution.



Features and benefits

- Perfect automation integration
 - Defined mechanical and data handshakes
 - Optimised footprint
 - Ideal workflow integration
- Technological leadership
 - Process guarantee
 - Process start up by RENA
 - Low total cost of ownership
 - Stable and reproducible processing

Product Process

Oxide Etching

BatchOx

The main process sequence consists of HF etching, rinsing and drying. The alternative is the all-in-one solution HF/O₃ processing.

Special Applications

e.g. BatchTex SP

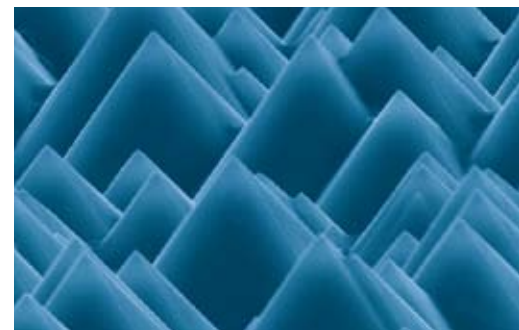
Customised solutions

Features and benefits

- All-in-one solution using HF/O₃
- Improved adhesion of downstream AR layer
- Process without post-rinsing
- Use of ozone in liquid and as gaseous oxidation step possible
- Reduced footprint
- Bleed and feed function
- Low breakage rate

Features and benefits

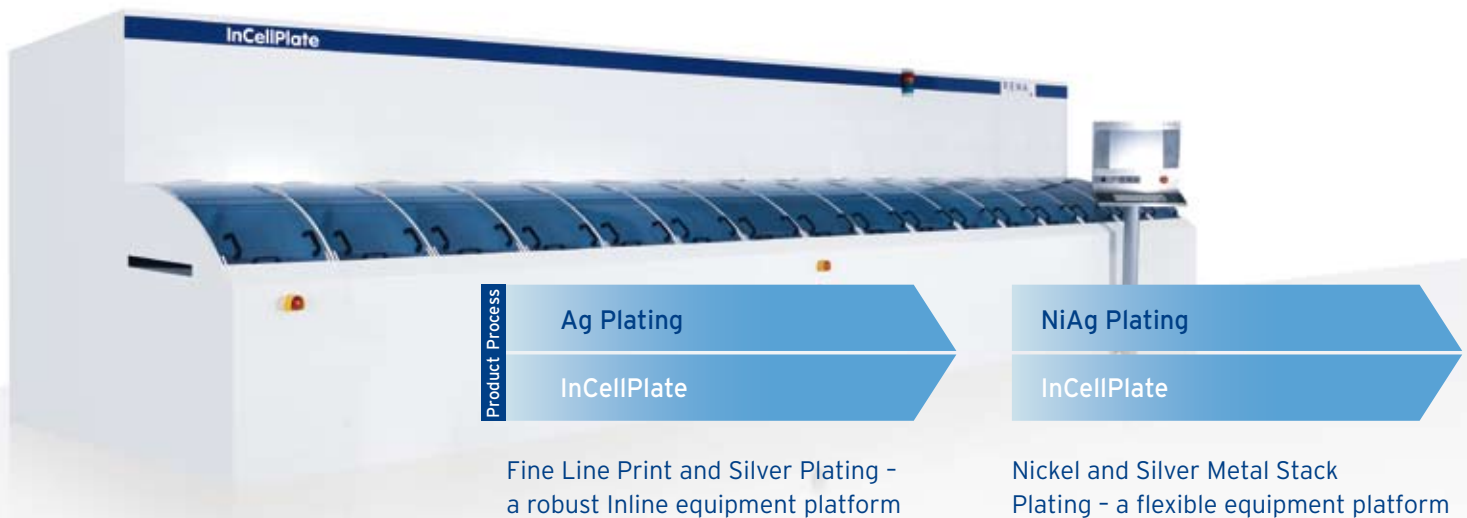
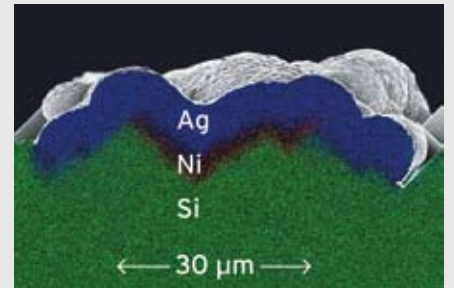
- Process and media part according customer experience
- Bleed and feed function
- Process sections separated by shutters
- Small footprint and improved process homogeneity due to tank-in-tank design
- Special tank: carrier arrangement to prevent wafers from floating and adhesion
- Special carrier transfer system and tank arrangement to prevent wafers from sticking together
- Integrated pre-scrubbing of exhaust-air
- Integrated etch rate determination
- Savings on heating energy
- Low breakage rate
- Comprehensive recipe management system



SOLAR CELL PROCESSING BACK END

HIGH PERFORMANCE METALLISATION SOLUTIONS

- LEADING PLATING KNOW-HOW
- VARIOUS EQUIPMENT PLATFORMS
- CUSTOMISED PROCESS SOLUTIONS



Product Process

Ag Plating

InCellPlate

Fine Line Print and Silver Plating -
a robust Inline equipment platform

Features and benefits

- Ag plating
- High conductive metal layer
- Single side plating process
- Inline plating principle
- Plating on printed contacts
- For standard solar cells
- Dry back contacts for potential or light bias plating
- Patented
- Up to 0.5% efficiency increase - depending on Fine Line Print Process

NiAg Plating

InCellPlate

Nickel and Silver Metal Stack
Plating - a flexible equipment platform

Features and benefits

- Ni, Ag plating
- High conductive metal layer
- Single side plating processes
- Inline plating principle
- Fast plating on Silicon and Seed Layers (NiSi)
- For front and back contacts
- Dry back and wet front contact for potential or light bias plating
- Patented
- Up to 0.5% efficiency increase - depending on patterning quality

METALLISATION CLUSTER Ag

Fine line screen print and InCellPlate inline Ag plating are the two process steps of the Metallisation Cluster Ag.

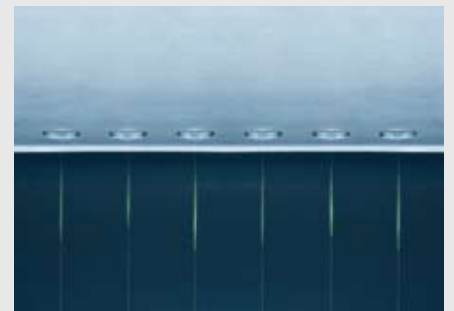
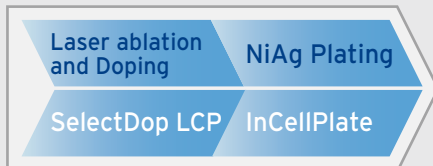


Features and benefits

- Technological leadership
- Process guarantee
- Process integration of fine line print and plating
- Process start up by RENA
- Low total cost of ownership
- Efficiency increase up to 0.5%

METALLISATION CLUSTER HIGH EFFICIENCY

Simultaneous SiNx ablation and phosphorous doping by a liquid jet guided laser in the SelectDop LCP - followed by a plating process on the RENA InCellPlate are the two steps of the RENA Selective Emitter technology.



Features and benefits

- Perfect automation integration
- Defined mechanical and data handshakes
- Optimised footprint
- Ideal workflow integration
- Technological leadership
- Process integration of laser processing and plating
- Process guarantee
- Process start up by RENA
- Low total cost of ownership
- Efficiency increase up to 1% or more



THIN FILM TECHNOLOGY

OPTIMISED INLINE PRODUCTION PROCESSES ON GLASS AND FOIL SUBSTRATES

TECHNOLOGY FOR:

- CIS/CIGS
- CdTe
- a-Si:H/ μ -Si



Product Process

Substrate Cleaning

PVGlassClean | PVFlexxClean

Optimised cleaning processes on glass and flexible substrates

Features and benefits

- Standard and customer-specific substrate sizes up to 3.300 mm
- Inline system
- Anti-UV-light equipment design
- Substrate breakage rate < 0.01%
- „No special tool philosophy“ for maintenance
- Automatic height adjustment for different substrate thicknesses

Etching

PVGlassEtch | PVFlexxEtch

Etching processes on glass and flexible substrates for TCO and absorber etching

Features and benefits

- High uniform etching process technology
- Standard and customer-specific substrate sizes up to 3.300 mm in width
- Inline system / Roll-to-roll technology
- Integrated automatic process control systems
- Process support by experienced process engineers from RENA

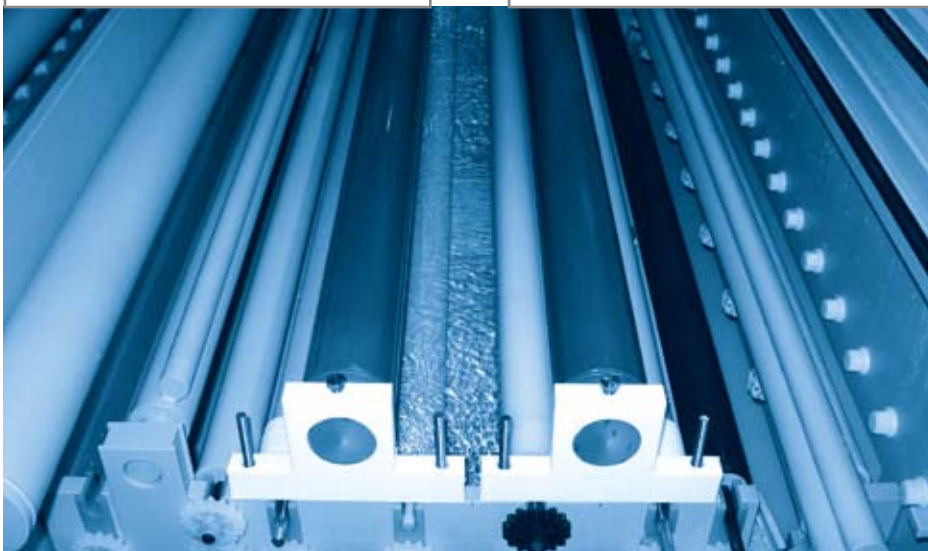
Plating

PVGlassPlate | PVFlexxPlate

Innovative deposition processes for homogeneous plating on flexible substrates

Features and benefits

- Inline plating system with patented plating cell technology
- High uniformity
- Low cost of ownership
- High chemical efficiency
- Touchless transportation





- MODULAR PROCESS SOLUTIONS
- HIGH THROUGHPUT
- LOWEST COST OF OWNERSHIP
- INLINE TECHNOLOGY

Product Process

Coating - Buffer / Absorber

PVGlassCoat | PVFlexxCoat

Patented chemical bath deposition for high efficient buffer layers and absorbers

Features and benefits

- Low cost of ownership
- Fully automatic inline system
- Single side deposition
- No backside contamination
- Total waste water treatment solution
- Automated dosing
- Homogeneous dosing CdS deposition

Coating - Activation

PVGlassCoat

Absorber activation by adjustable roller coating for glass substrates

Features and benefits

- Inline single side deposition
- Temperature control
- Adjustable roller pressure
- Measurement of the amount of deposited liquid
- Total safety solution
- Double housed system
- Waste water treatment for concentrated CdCl₂

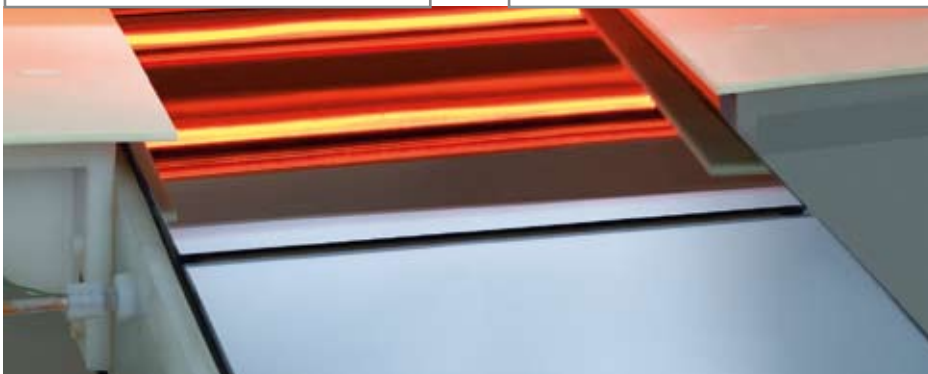
Edge Isolation

PVGlassIso

Mechanical edge grinding generates excellent longterm stability

Features and benefits

- Low cost of ownership
- Fully automatic inline solution
- One system for a cycle time down to 30 seconds
- Flexible for different glass substrate sizes



AUTOMATION SOLUTIONS

INTERFACE TO COST AND CAPACITY ADVANTAGES

- EASY INTEGRATION
- SMALL FOOTPRINT
- SCALABLE SYSTEMS
- MES INTEGRATION

Product Process

Loading

VarioLoad

As one of the main innovators in automation systems RENA offers a sensitive and fast handling solution for loading PV processing systems.

Linking

VarioLink

An automation solution to connect two inline PV processing systems.

Features and benefits

- All transfer combinations from carrier, stack or a single lane upstream process to a downstream multi-lane process
- Handling with minimum contact to the wafer
- Low breakage even for short cycle times
- High throughput thanks to continuous wafer transport
- Simple wafer format change
- Throughput even above 3600 wafers/h

Optional:

- Connection with MES
- Optimised adaption to quality system RENA QCheck



Features and benefits

- Modular construction - Upgrading and modification is possible any time - also onsite
- Direct connection of two PV processing system
- Uptime 98 %
- Low breakage rate < 0.05 %





Product Process

Unloading

VarioUnload

To allow a gentle, fast and safe unloading of PV processing systems, RENA offers innovative automation solutions.

Inspection

QCheck

Measuring, checking, sorting - the RENA QCheck guarantees the quality-related classification of all wafers and cells.

Features and benefits

- All transfer combinations to carrier, stack or single lane downstream process step
- Available for wet and dry applications
- Optimised compatibility to all RENA tools
- Integrated systems, e.g. breakage discharge or wafer thickness measurements
- Throughput even above 3600 wafers/h

Features and benefits

- Modular design for individual configuration with measuring systems: Thickness, TTV, bow, resistivity, lifetime, surface inspection, topology and geometry, multicrystallinity and micro crack detection
- Arbitrary number of buffering classification stacks
- Throughput 3600 wafers/h



METROLOGY

PROCESS AND QUALITY CONTROL ECONOMICALLY INTEGRATED

- BATH ANALYSIS ONLINE/OFFLINE
- WAFER & CELL ANALYSIS
- ONLINE PROCESS CONTROL
- MES INTEGRATION

Product Process

Measuring & Classification

Bath analysis

Maximum quality standards in solar cell production are maintained by permanent control and analysis in all process steps and by simultaneous material flow monitoring.

Features and benefits

- Fully integrated bath analysis
- Etchrate control
- Reflectance control

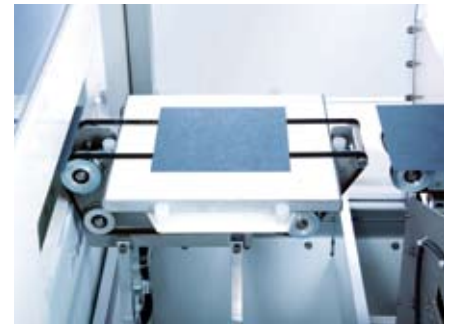
Measuring & Classification

Wafer control

Coordinated material flow and measurement solutions by RENA allow to control and monitor the process in terms of quality and efficiency.

Features and benefits

- Integrated wafer flow control and MES integration
- Inline wafer breakage detection
- Inline etch rate measurement allows direct process control
- Offline edge isolation tester, measurement of the isolation resistance



TECHNICAL SERVICE

JUST A PHONE CALL AWAY

- INSTALLATION SERVICE
- SERVICE CENTRES WORLDWIDE
- SPARE PARTS PACKAGES
- EXTENDED GUARANTEE

RENA talks quality! Our equipment is designed for durability and long production periods. But even the most capable technology can not avoid unexpected circumstances: a disruption in your production line. The RENA response is reliable and fast. Our 24-hour Technical Service is available worldwide, every day of the year.

We will take care of your situation right away, as well as contact any of our 110 worldwide service technicians. We will make sure you get all the help you need in order to solve the problem immediately.

TECHNICAL SERVICE
WORLDWIDE 24/7
Phone + 800 73624624

Modification and technical advice

In the course of the operating life of your RENA machine, the usage requirements can change. Running costs, especially with older machines, are often clearly higher. Modification and conversion concepts from our technical advisors extend the scope of application. Running costs can be reduced and the untapped potential of your machine unlocked.

Features and benefits

- Machine specific technical advice
- Modification of existing machines to new production requirements - also onsite
- Profitability analysis for modernisation measures

Spare Parts / - Packages

RENA Original Spare Parts are optimally designed to fit our equipment to the last detail and fulfil the highest quality requirements. Each individual part is crucial in achieving the highest level of efficiency with your RENA equipment.

To avoid taking the risk of a long break in production, we recommend one of our Original Spare Part Packages.



Warranty extension

The RENA Warranty + allows you to extend the standard guarantee of your equipment for a longer period of time. Your decision to invest in RENA equipment solutions remains therefore, safer for a much longer life cycle. The RENA Warranty + offers you a 2 year extended coverage on the initial standard guarantee of your product.



Features and benefits

- Extension of the original standard guarantee, up to 2 years
- Safer conditions on your investment
- Foreseeable costs

WORLDWIDE AT HOME

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CONTACT US TO FIND
A SOLUTION FOR
YOUR CHALLENGE!

-
- HEADQUARTERS
 - LOCATIONS
 - INSTALLED BASE
 - ▲ SERVICE CENTERS

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