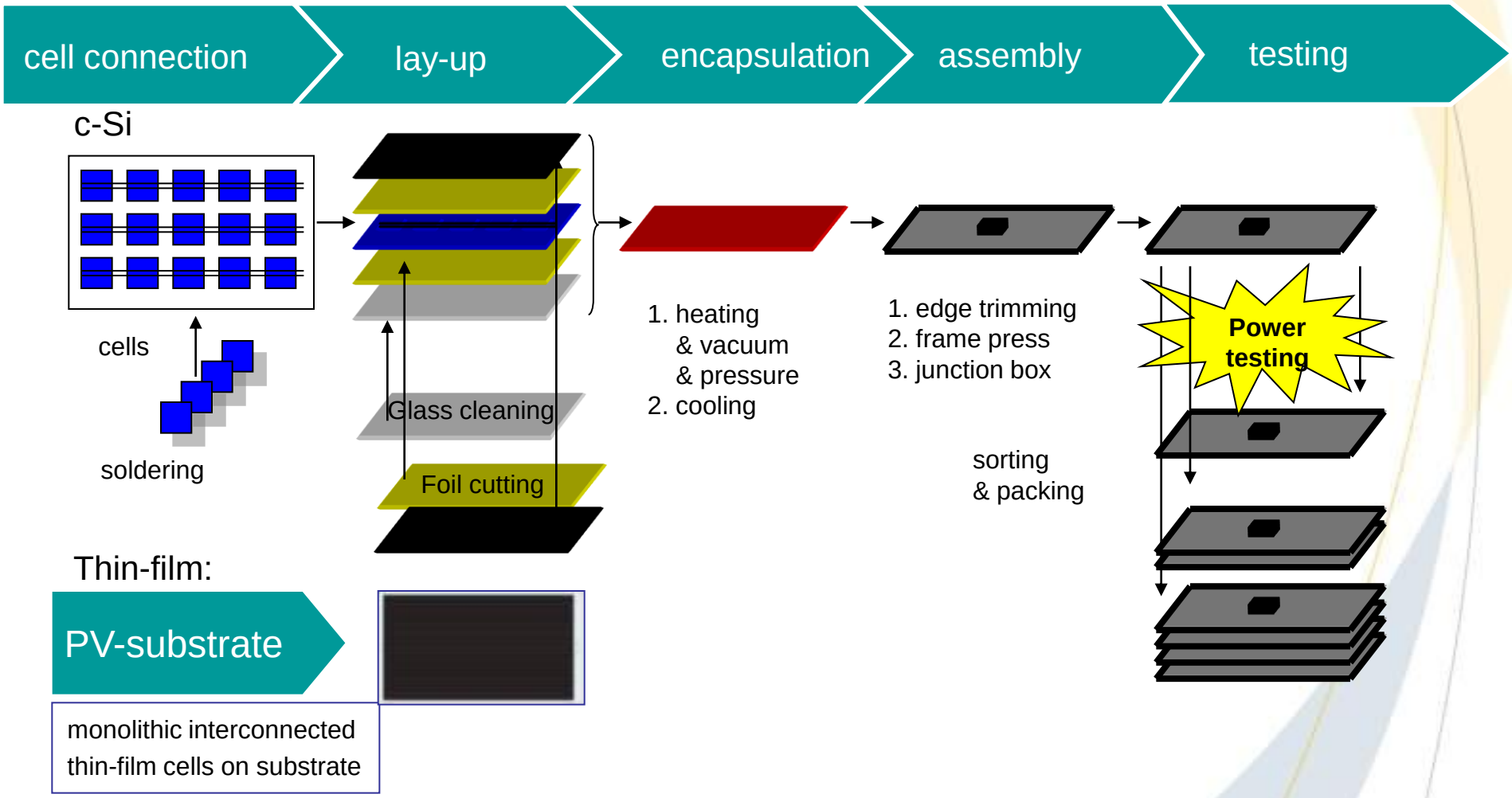
Manufacturing Equipment

From Single Machines
to Integrated High Performance Systems

Marcel Blanchet Senior Engineer Technology
3S Swiss Solar Systems

Production Processes



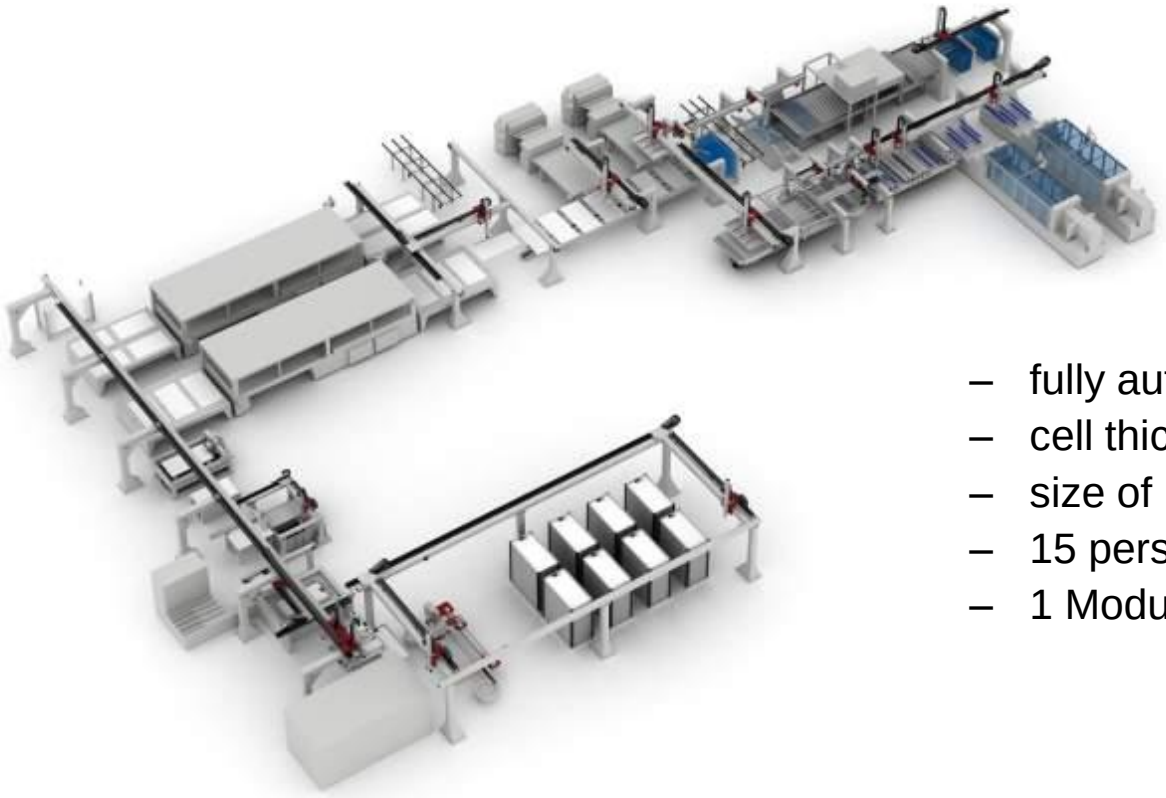
Manual Production Line (2000)

cell connection → lay-up → **encapsulation** → finishing → testing

- most handling is manual
- cell thickness 300um
- size of production lines mostly 10-15MW/year with approx. 20 pers/shift
- 1 Module every 20 minutes

Fully Automated System (today)

cell connection → lay-up → encapsulation → finishing → testing



- fully automated
- cell thickness 160um
- size of production lines >100MWp
- 15 pers/shift for 200MWp
- 1 Module every 32 seconds

Cell Interconnection

Challenges:

- handling of fragile cells and matrices
- soldering process determines electrical output of the module
- different coefficient of expansion of ribbons and silicon
- micro cracks

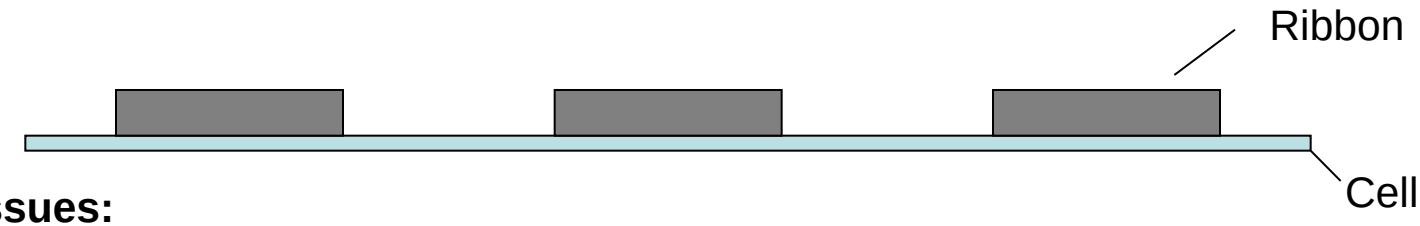
Cell Interconnection 2

Soldering technologies used:

- contact soldering
- inductive soldering
- infrared soldering
- halogen soldering
- laser soldering
- hot air soldering

Future trends:

- current increasing due to better and larger cells
- thinner cells
- larger cross-section of ribbon to reduce losses
- back-contact technologies to avoid shading



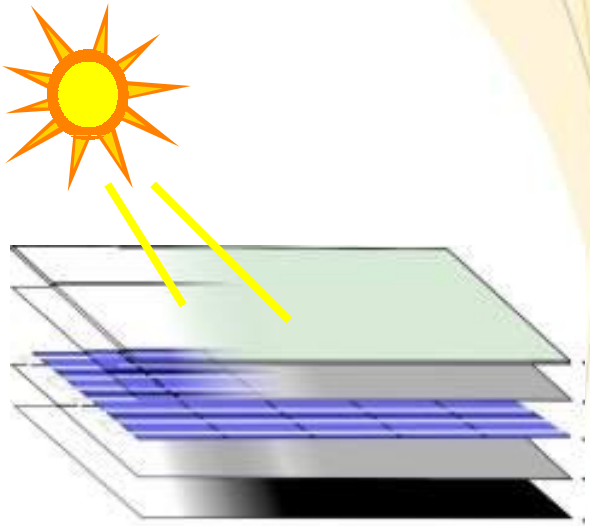
Key issues:

- there is no contact free soldering (if the soldering process is contact free, the ribbon have to be hold down by a mechanical way)
- soft-touch soldering system has proven best process control, with lowest breaking rate and highest yield

Encapsulation Materials

Solar module concepts

c-Si		Thin-film	
Solar glass	Solar glass	Superstrate/cell	Solar glass
Encapsulation	Encapsulation	Encapsulation	Encapsulation
Cells	Cells	Back glass	Cell/substrate
Encapsulation	Encapsulation		
Backsheet	Float glass		



Encapsulation materials

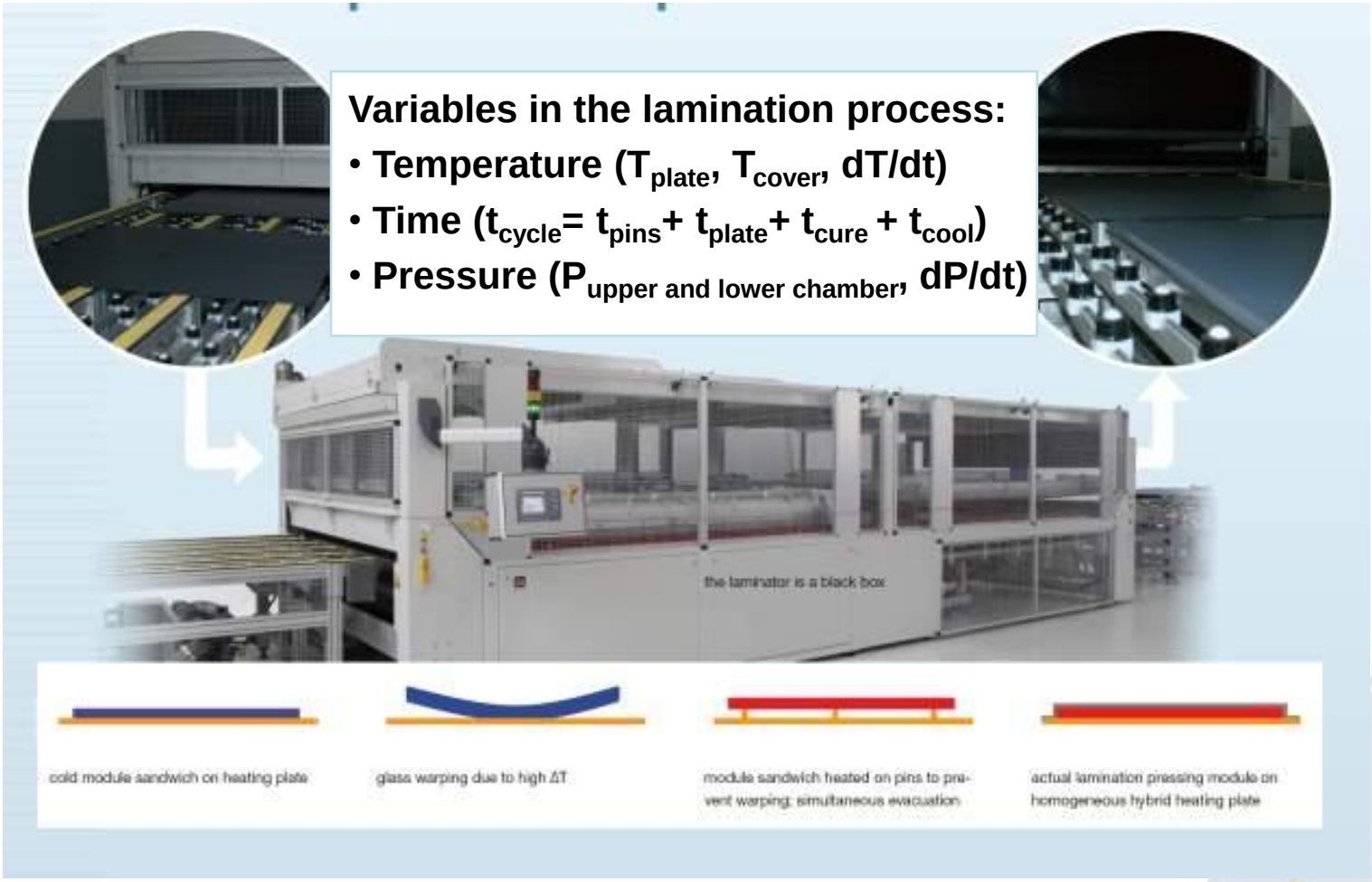
EVA most common for c-si modules

Other materials used: PVB, TPU, cast resin

Autoclave used for PVB processes
Picture: With permission of Kuraray

Encapsulation Process

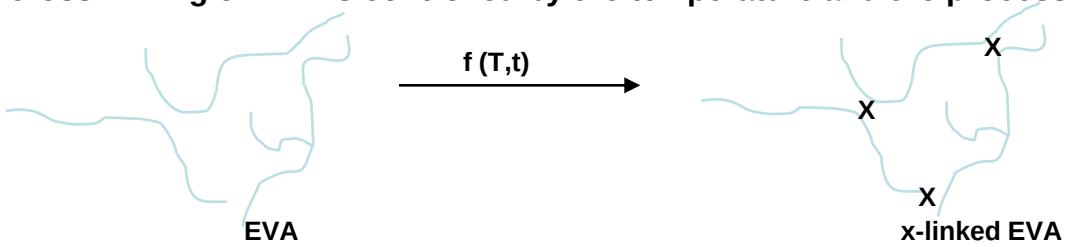
The laminator is a black box, but its process defines the lifetime of the product



Influence of Temperature

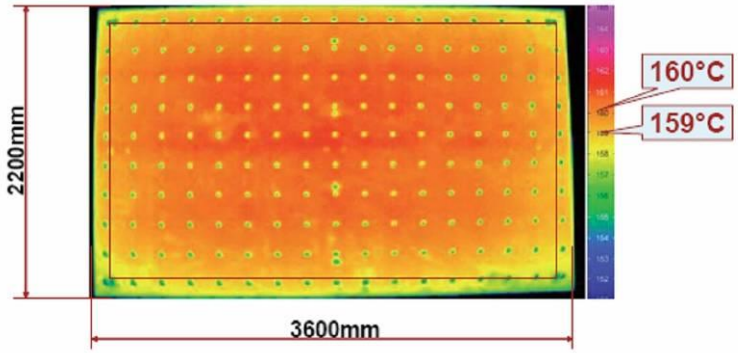
Schematic representation of a) a crystalline silicon and b) a thin film technology based PV module

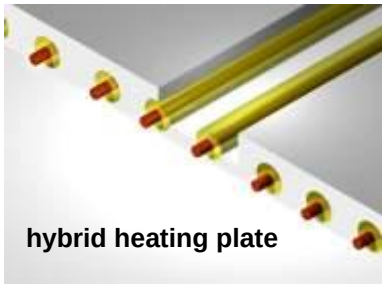
Chemical cross-linking of EVA is controlled by the temperature and the processing time



Homogeneous cross-linking of EVA over the complete module area demands a homogenous heating plate and results in highest quality of the module

A homogeneous temperature profile over the entire process area will be obtained by using a hybrid heating plate





Encapsulation Equipment

Solutions to increase throughput

Enlargement of lamination surface

- larger laminators
- multi opening laminators

Reduction of cycle time

- new encapsulate material
- multi chamber machines (process splitting)

Stacklaminator "Incapcell 5x43-24

Modular concept of multi chamber equipment

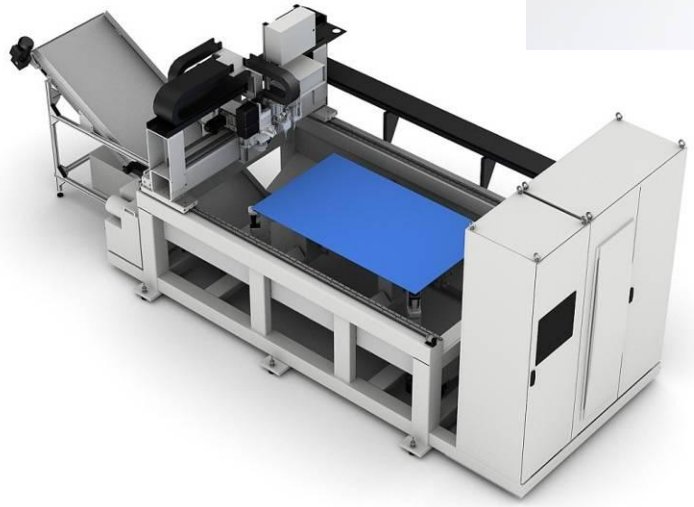
Edge Trimming Equipment

Manual Trimming

+ independent of laminate shape
- high tool costs (blades)
- high labour costs in 24/7
- risk of injury

Automatic Trimming

+ low cost of ownership
+ high efficiency in production
+ high cutting speed (6ft / sec)
- necessity to define laminate shape

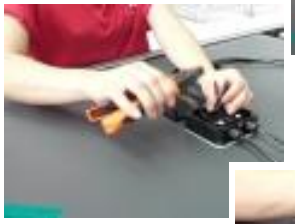


Setting J-Box

In general, the first attempt is to automate human handling by robots

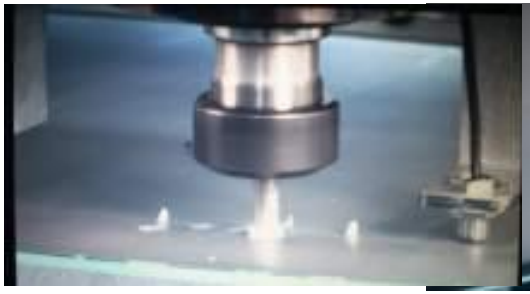
Manual placement of J-Box

Manual guiding of the back contacts through the encapsulate and back foil before the lamination step



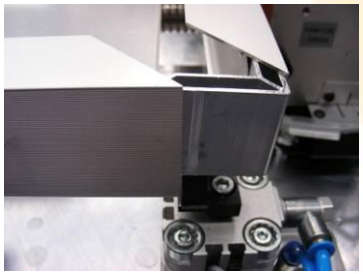
However, new definition of individual production and handling steps leads to new approaches

Fully automated, fast, reliable and reproducible procedure to implement the J-Box

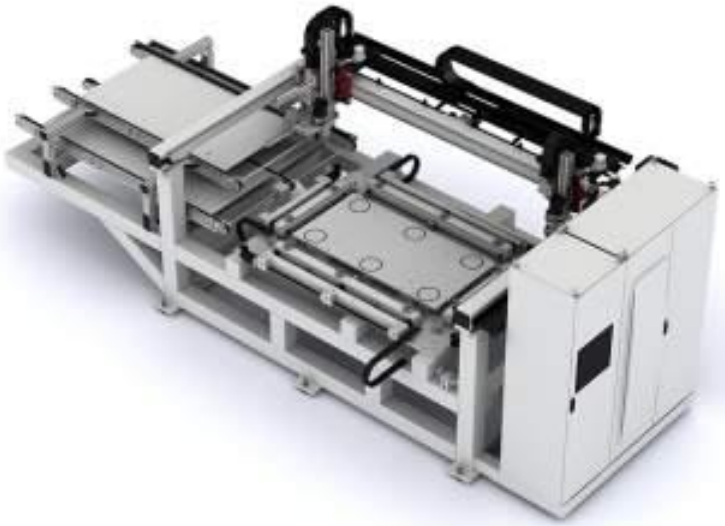


Framing Equipment

- manual work required
- inaccuracy of corner position
- personnel intensive
- manual rework necessary
- increased automation enhances quality



manual equipment
using two operators



fully automated equipment

Testing Equipment

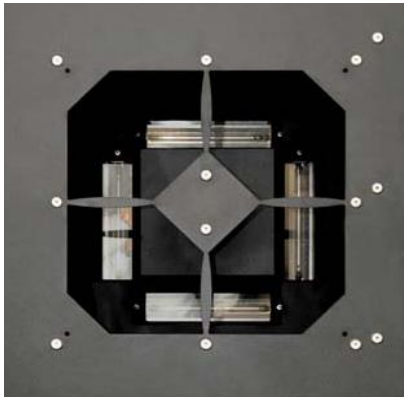
Flatbed testers continuous or pulsed

+ footprint 8’ x 12’
- poor homogeneity
- poor spectral match
- high power consumption (cont)

- class C-B-A
- spectral match -> class C
- uniformity on the target plane -> class B
- pulse stability -> class A

Flash testers continuous or pulsed

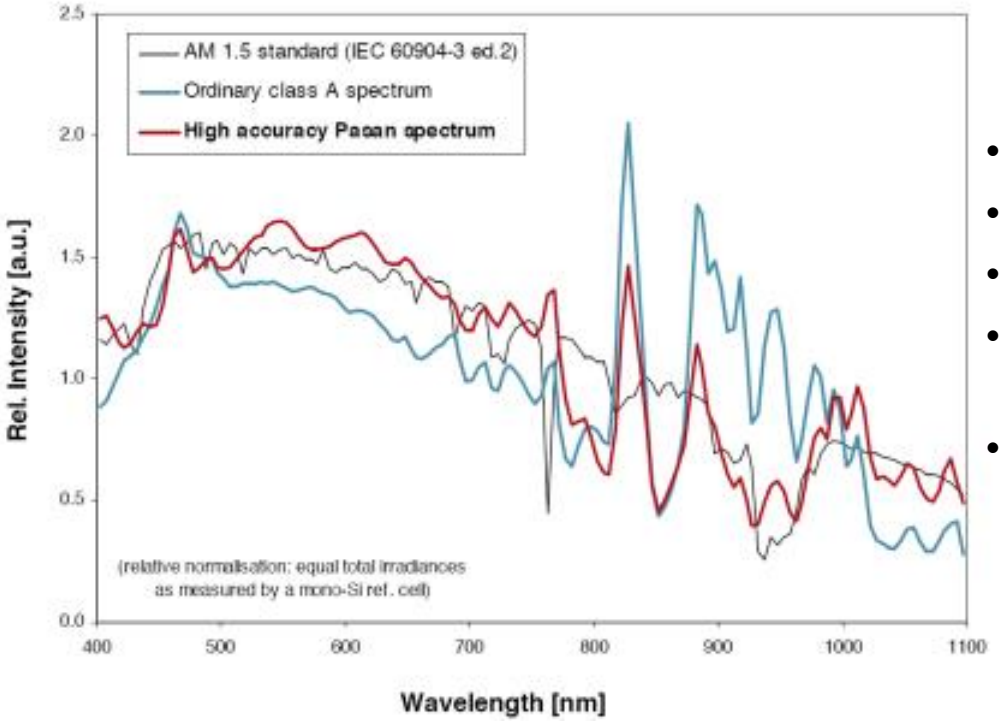
- footprint 11’ x 21’ (tunnel)
- footprint 11’ x 11’ (tower)
+ very accurate
+ low power consumption



PASAN HighLIGHT

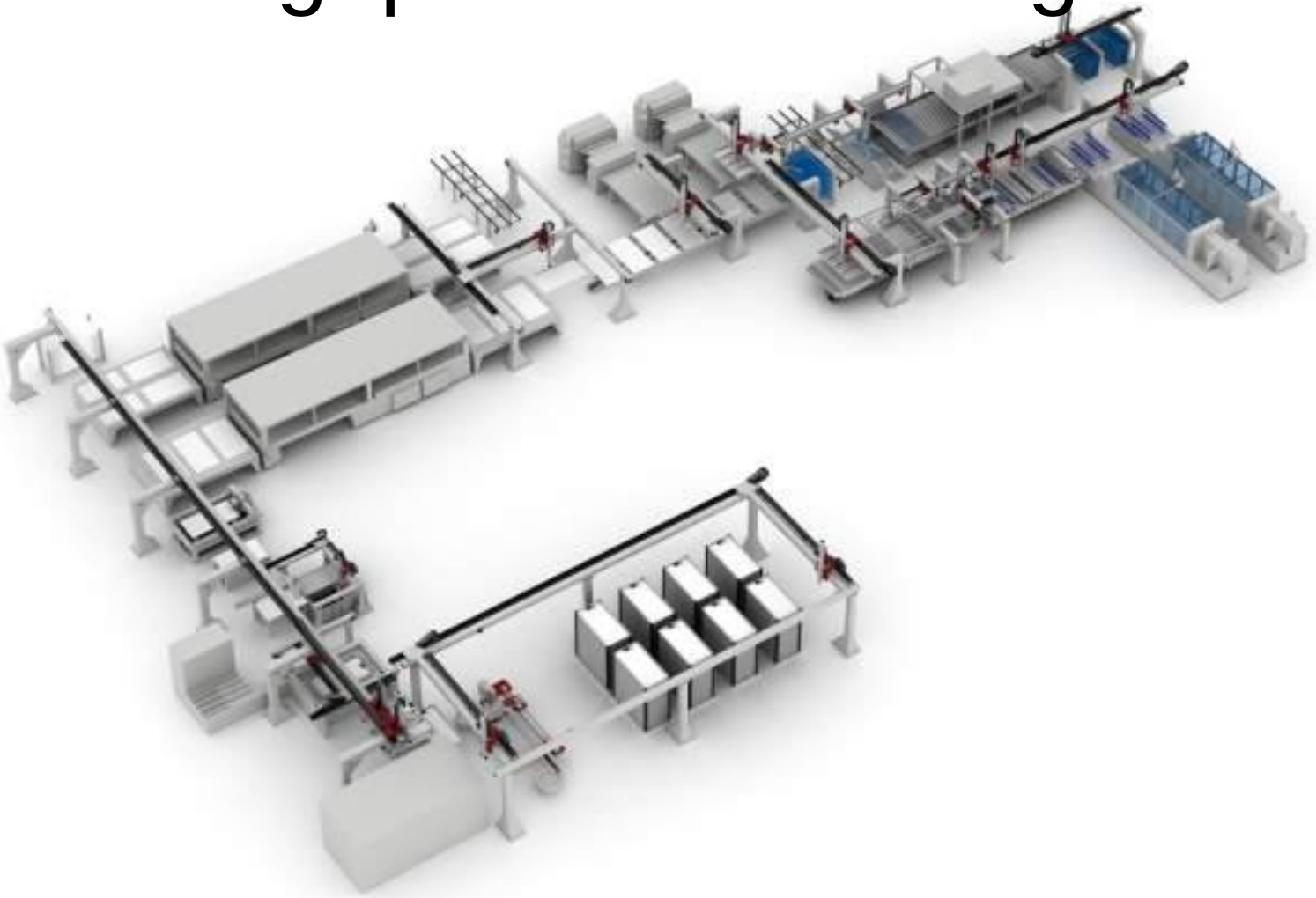
- class AA-AA-AA
- spectral match +/- 12.5%
- non uniformity on the target plane <1%
- pulse instability <1%

Testing - the Ultimate Step to Win or Loose $



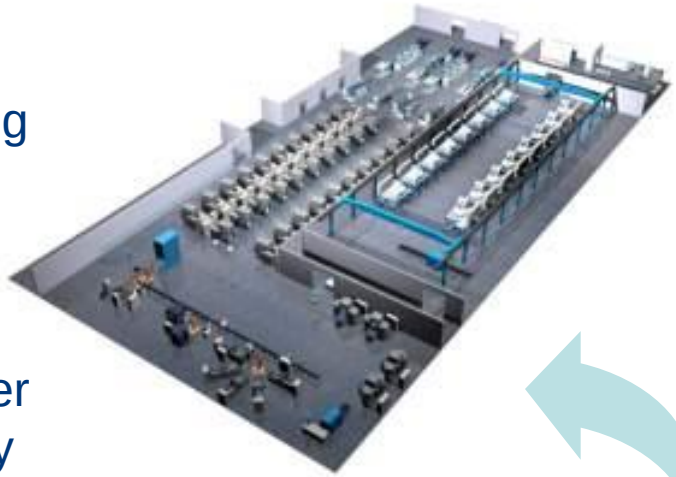
- module testing as final quality control
- spectral match is key
- defines module output (Wp, and hence $)
- in automated lines integrated with sorting and packaging
- integrated high pot and continuity test

Modularity helps to Increase Throughput with Growing Demand



Who we are?

World leading company for production of equipment and processes for manufacturing of wafers, solar cells and solar modules



Optimized processes along the entire value chain to lower kW/h costs of solar electricity

Experts in design and development of innovative building integrated solar systems

Merger of 3S and Meyer Burger, a unique Technology Group is formed

- over 50 years of Swiss machine building excellence
- staff with over 20 years of PV expertise
- all key processes from wafering to the module production are in house
- global service infrastructure
- market capitalization of 1.2 bCHF (approx. 1.15 bUSD)
- 900 staff around the globe to serve our costumers

MEYER BURGER
TECHNOLOGIES

How to contact us

www.3-s.com

www.meyerburger.com

Together. Under the sun.

Disclaimer

- Certain statements made in this presentation may constitute “forward-looking statements” within the meaning of the U.S. federal securities law. Forward-looking information is subject to various known and unknown risks and uncertainties. These include statements concerning our expectations and other statements that are not historical facts. The Company believes any such statements are based on reasonable assumptions and reflect the judgement of Meyer Burger Technology AG management based on factors currently known by it. No assurance can be given that these forward-looking statements will prove accurate and correct, or that anticipated, projected future results will be achieved.