Introducing a 1.2GW metallization line utilizing a novel screen-printing approach with a throughput of 13500 wafer per hour

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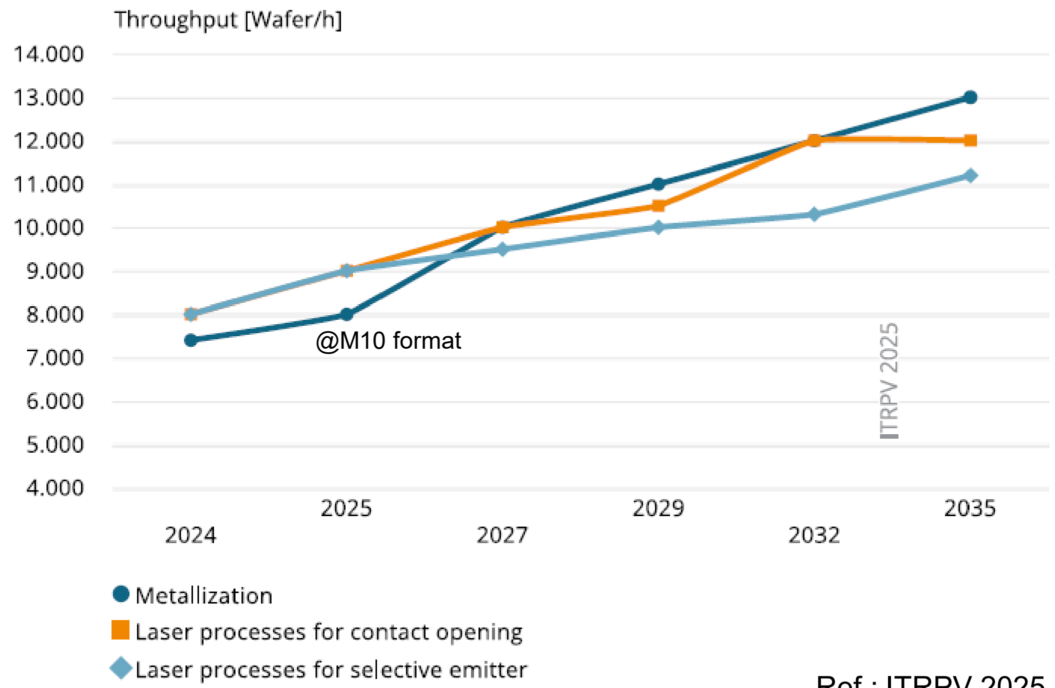
Solar cell metallization - Production tool throughput rates: State of the Art and Outlook



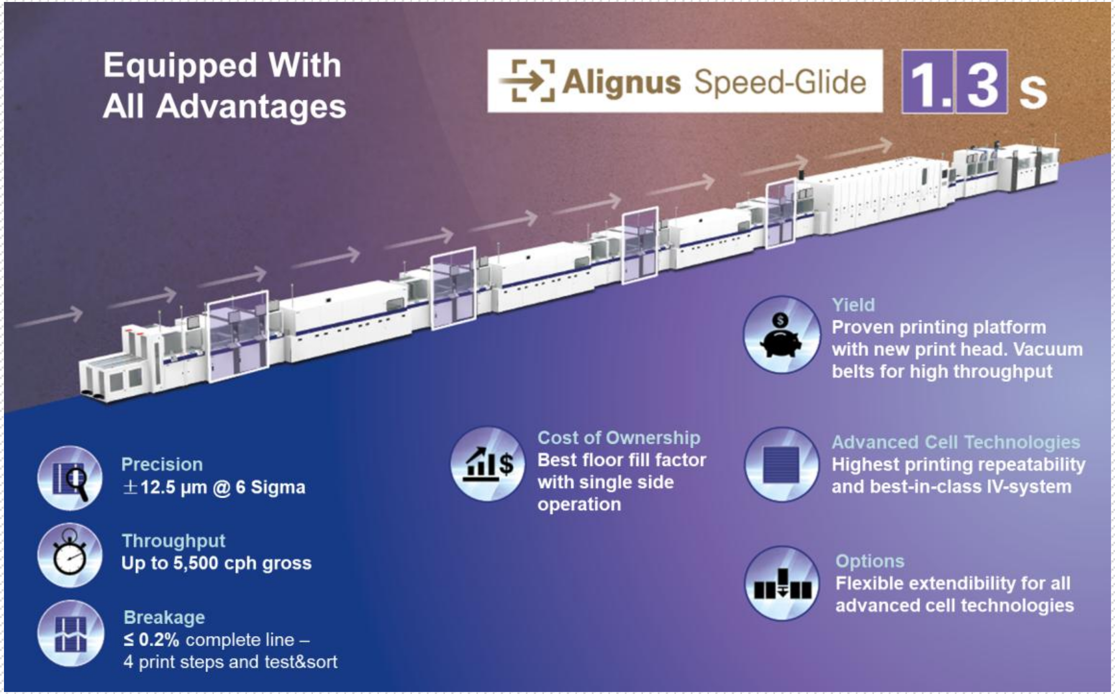
Ref.: ITRPV 2025

Is this throughput an accurate reflection of today´s reality in mass production?

Is such an increase in throughput over the next 10 years achievable?

Progress industrial throughput for metallization lines

Early 2010s ~5500 cells / hour



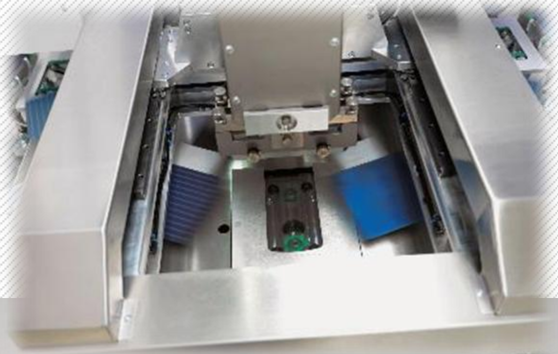
Progress industrial throughput for metallization lines

Several innovations, e.g. parallelization of cell alignment

Early 2010s ~5500 cells / hour

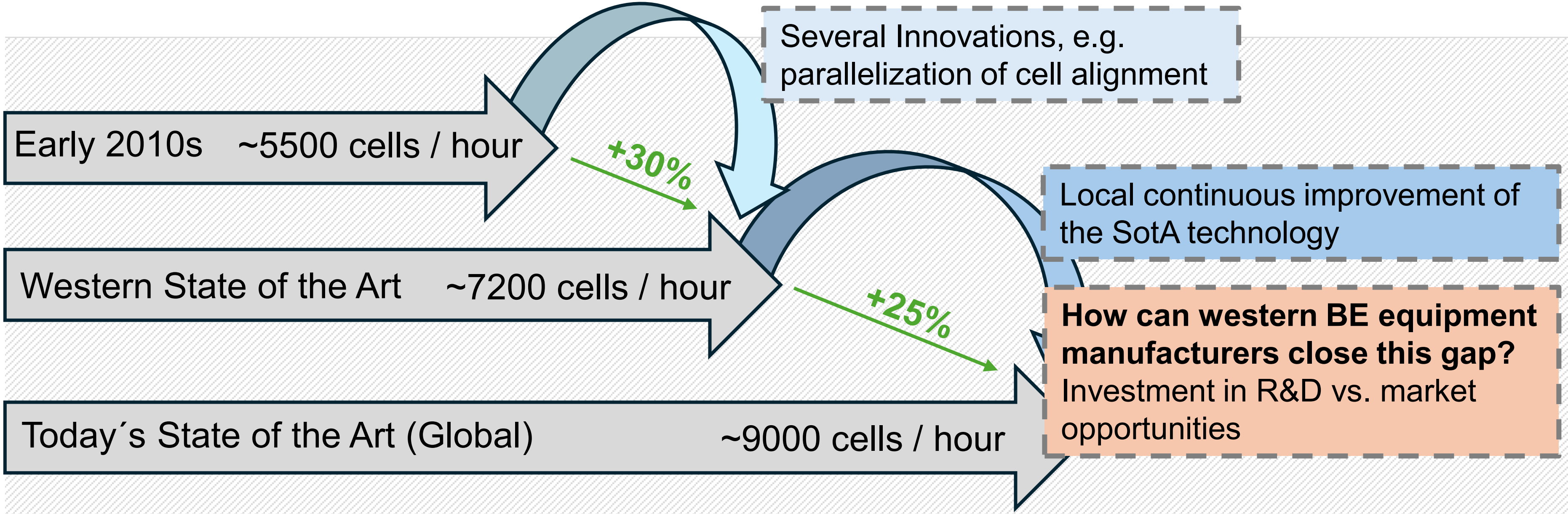
+30%

Western State of the Art ~7200 cells / hour



AIRON Metallization line

Progress industrial throughput for metallization lines



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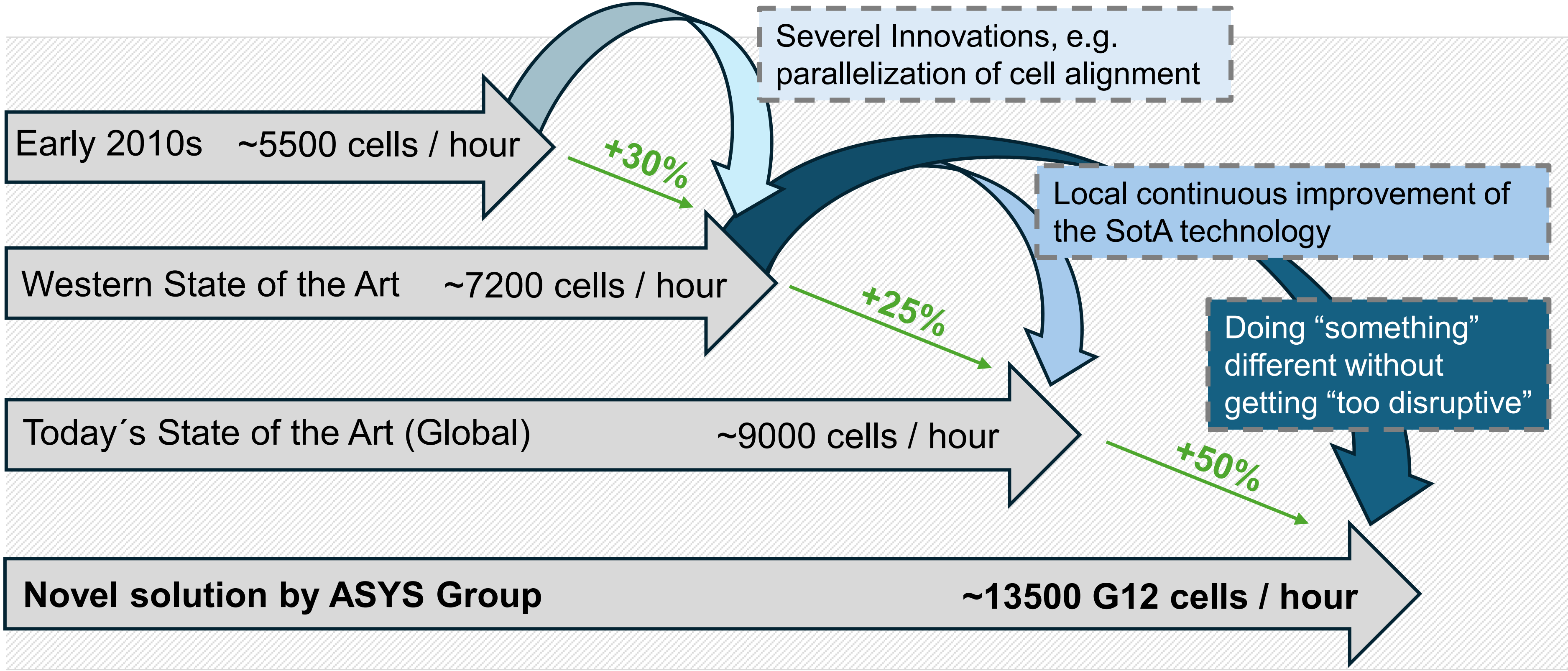
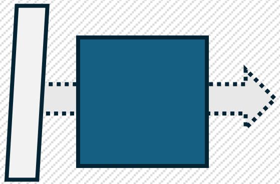


Coming back to an old idea: Matrix-based screen printing

State of the Art:
Single cell screen printing

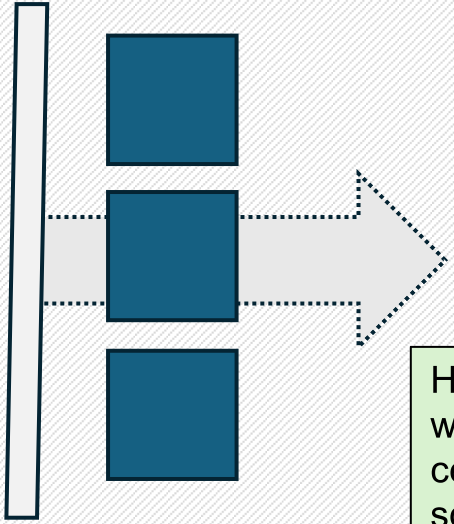


One full-sized cell per squeegee stroke

Cycle time
~0.8s SotA Equipment
~1.0s Western Equipment
(TP dual lane: ~7200cells/h)

→ Print speed ~600+ mm/s
→ Flooding speed ~1000+ mm/s

Natural evolution:
Matrix-based screen printing



Higher throughput w/o increasing speed of cell movements and squeegee

Three full-sized cells per squeegee stroke

Coming back to an old idea: Matrix-based screen printing

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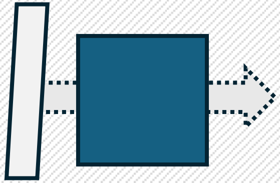
Single cell screen printing



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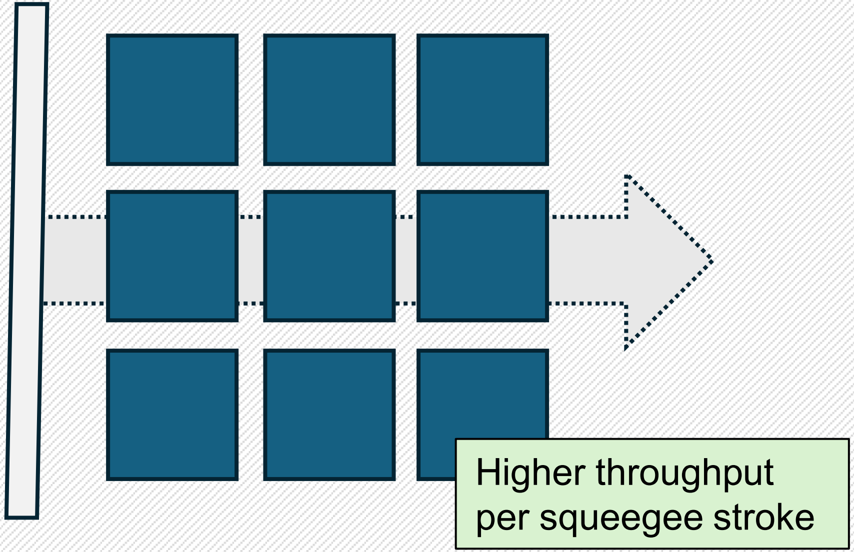
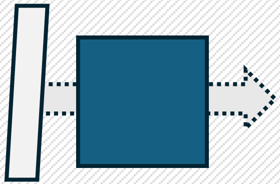


3x3 cell matrix per squeegee stroke

Single cell screen printing vs. Matrix based screen printing



State of the Art: Single cell screen printing
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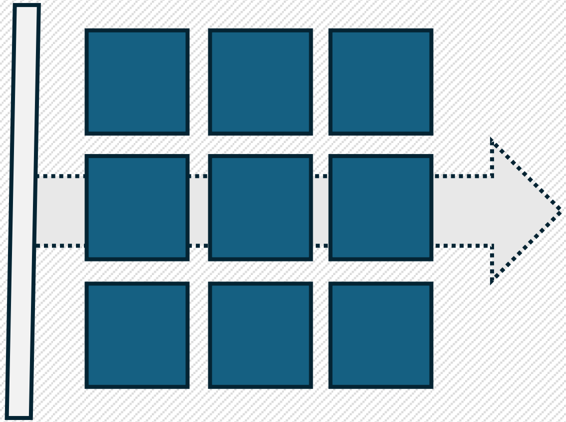


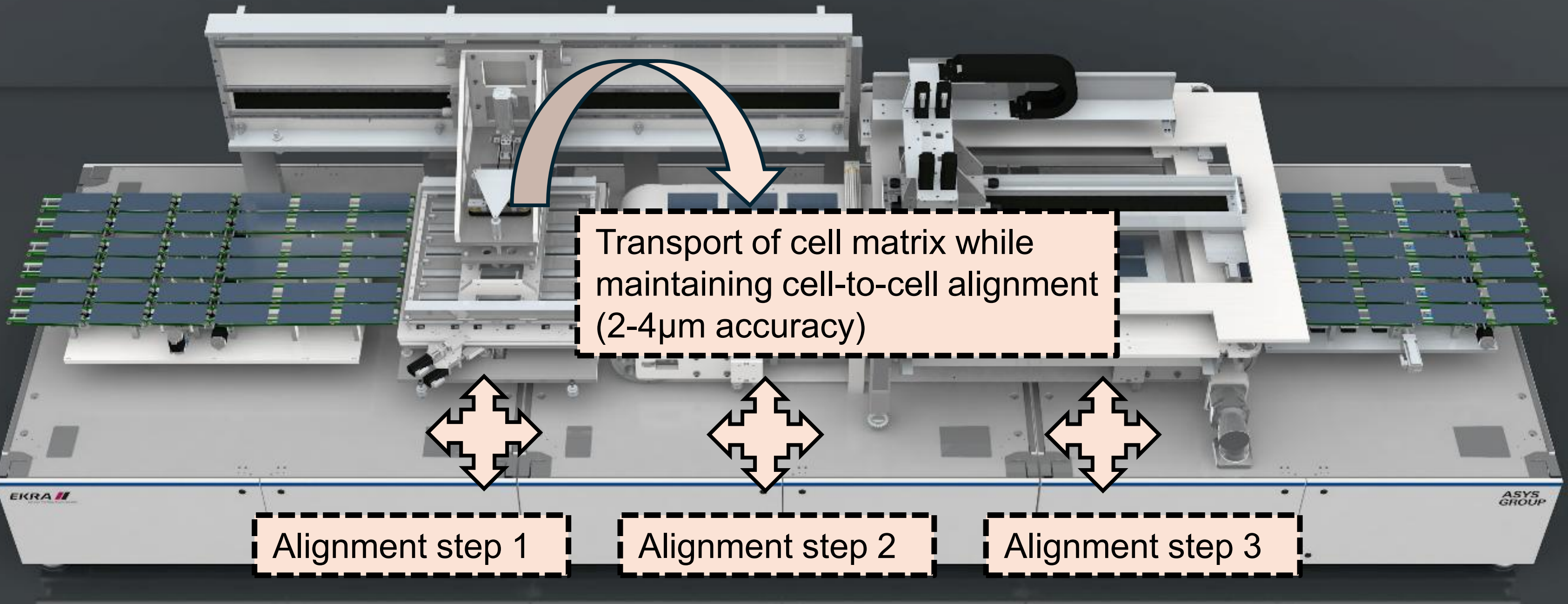
Matrix-based screen printing
~4.8s per 9 cell matrix (@G12 format)
~0.53s cycle time
(TP dual lane: 13500 G12 cells/h) **+87%**

→ Print speed ~400 mm/s **-33%**
→ Flooding speed ~600 mm/s **-40%**

Introducing ASYS / EKRA novel XH6 printing solution

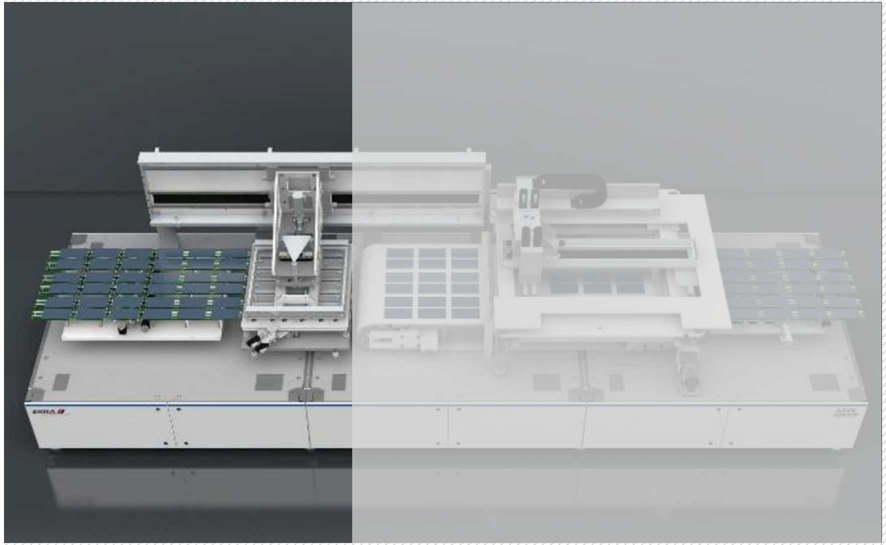
Patented parallel alignment procedure

Patented vacuum in vacuum transport



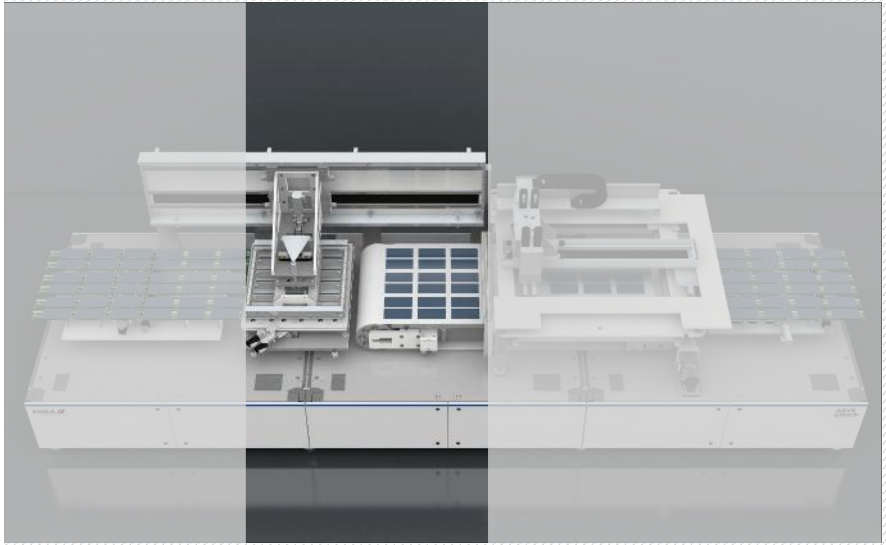
Live impression from the XH6 printing solution

Loading and cell alignment



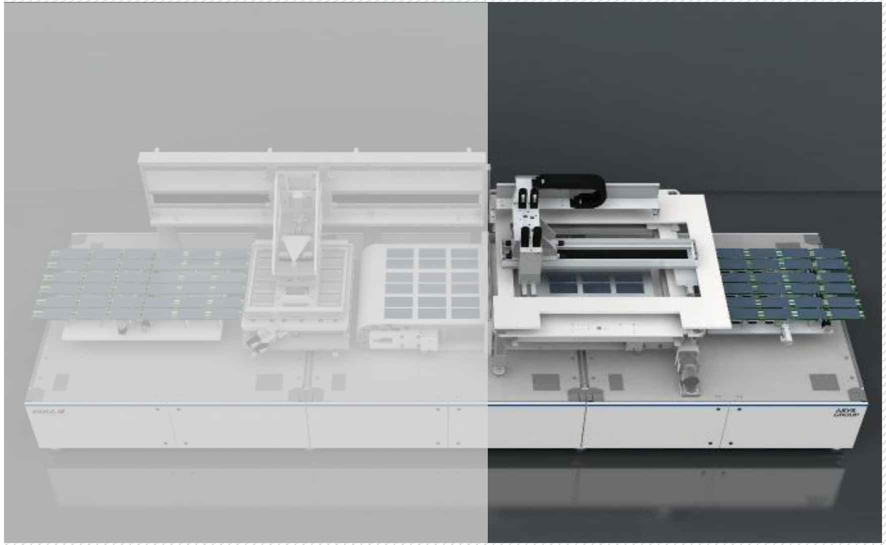
Live impression from the XH6 printing solution

cell matrix
transport



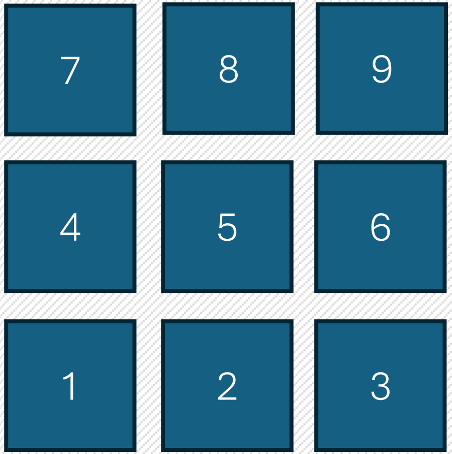
Live impression from the XH6 printing solution

matrix screen
printing



Printing Results – Homogeneity of printing across the cell matrix

Cell Average (12measurements per cell on full cell batch)
Finger width w_f = 31.2µm ± 2.9µm (± 9.1%)
Finger height h_f = 9.75µm ± 1.4µm (± 14.8%)



Printing speed = 400mm/s, Flooding speed = 600mm/s
Screen opening w_s= 25µm

Cell ID 1:
Avg. finger width w_f ±2.8%
Avg. finger height h_f ±0.4%

Cell ID 2:
Avg. finger width w_f ±1.3%
Avg. finger height h_f ±5.9%

Cell ID 3:
Avg. finger width w_f ±6.3%
Avg. finger height h_f ±0.8%

Cell ID 4:
Avg. finger width w_f ±6.2%
Avg. finger height h_f ±4.1%

Cell ID 5:
Avg. finger width w_f ±5.7%
Avg. finger height h_f ±8.0%

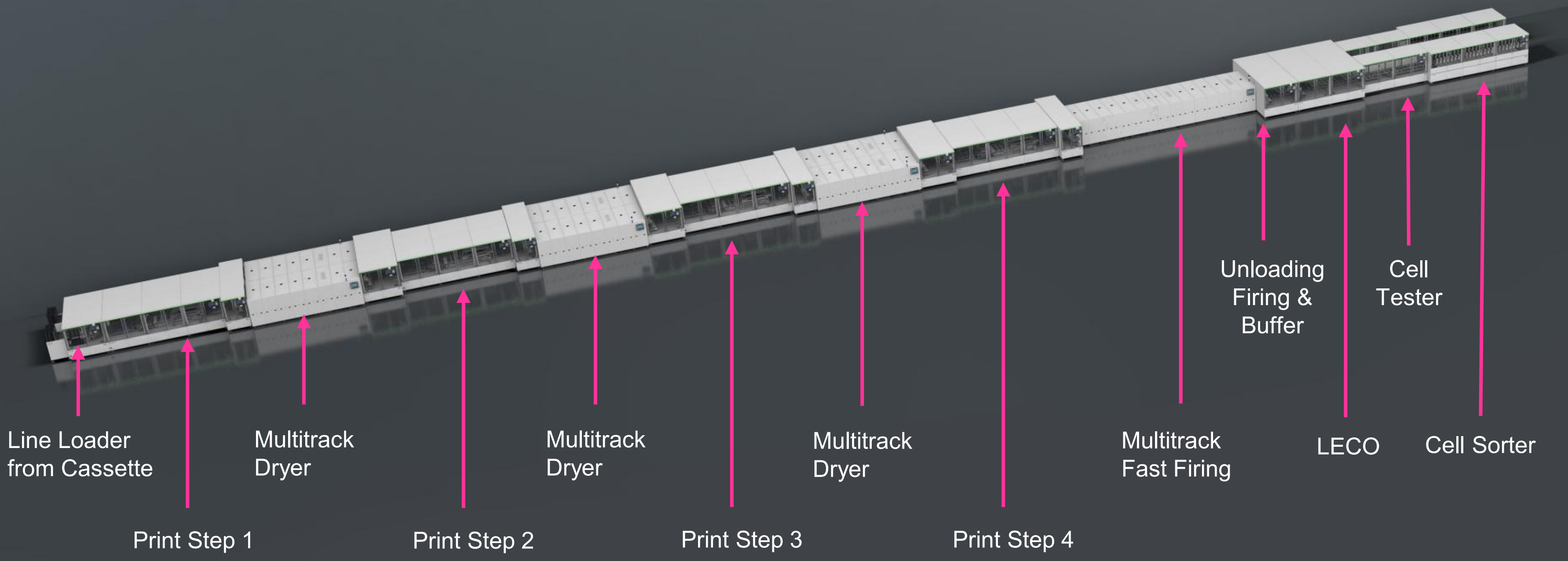
Cell ID 6:
Avg. finger width w_f ±4.5%
Avg. finger height h_f ±4.0%

Cell ID 7:
Avg. finger width w_f ±2.0%
Avg. finger height h_f ±3.1%

Cell ID 8:
Avg. finger width w_f ±5.1%
Avg. finger height h_f ±2.5%

Cell ID 9:
Avg. finger width w_f ±1.2%
Avg. finger height h_f ±1.4%

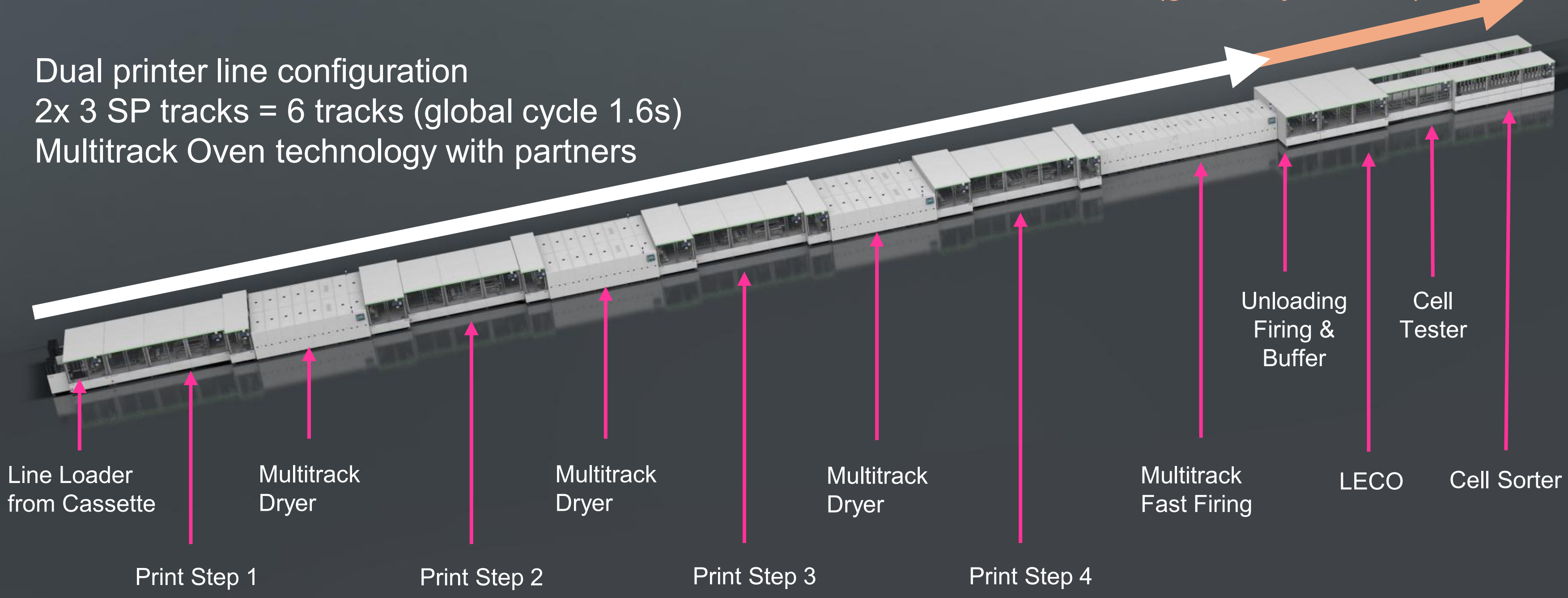
1.2 GW of production capacity of G12 TOPCon per metallization line



1.2 GW of production capacity of G12 TOPCon per metallization line

Conventional LECO/IV/Sorter
2x Dual lane → 4 tracks (global cycle 1.1s)

Dual printer line configuration
2x 3 SP tracks = 6 tracks (global cycle 1.6s)
Multitrack Oven technology with partners



Reference vs. ASYS solution: ASYS Advantages

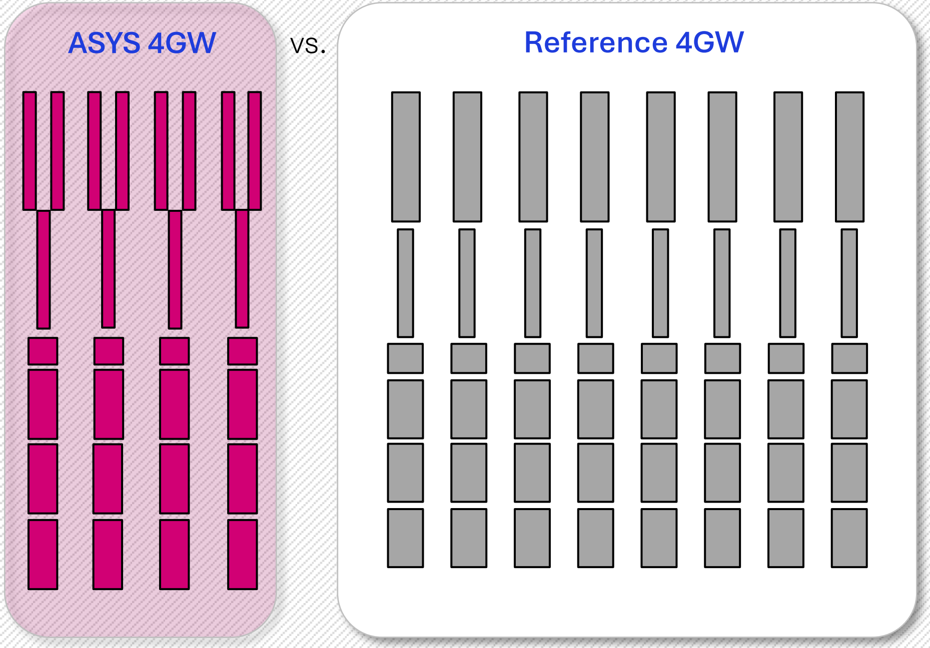
Contribution to OPEX calculation (e.g. 4GW scenario)

Reduced number of line operators:
~35-40%

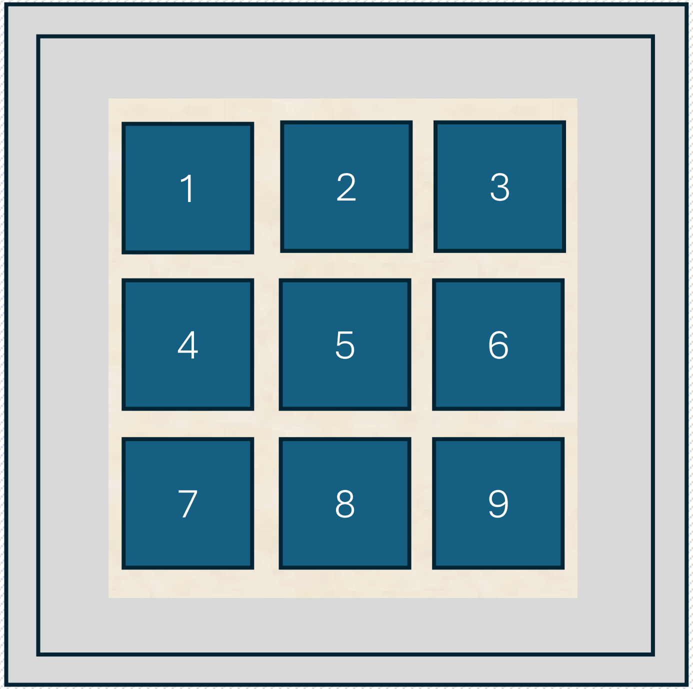
Reduced footprint:
~30-35%

Reduced operating power:
~45-50%

Reduced downtime for screen exchanges:
~70-75%



Matrix-based screen printing for solar cell metallization

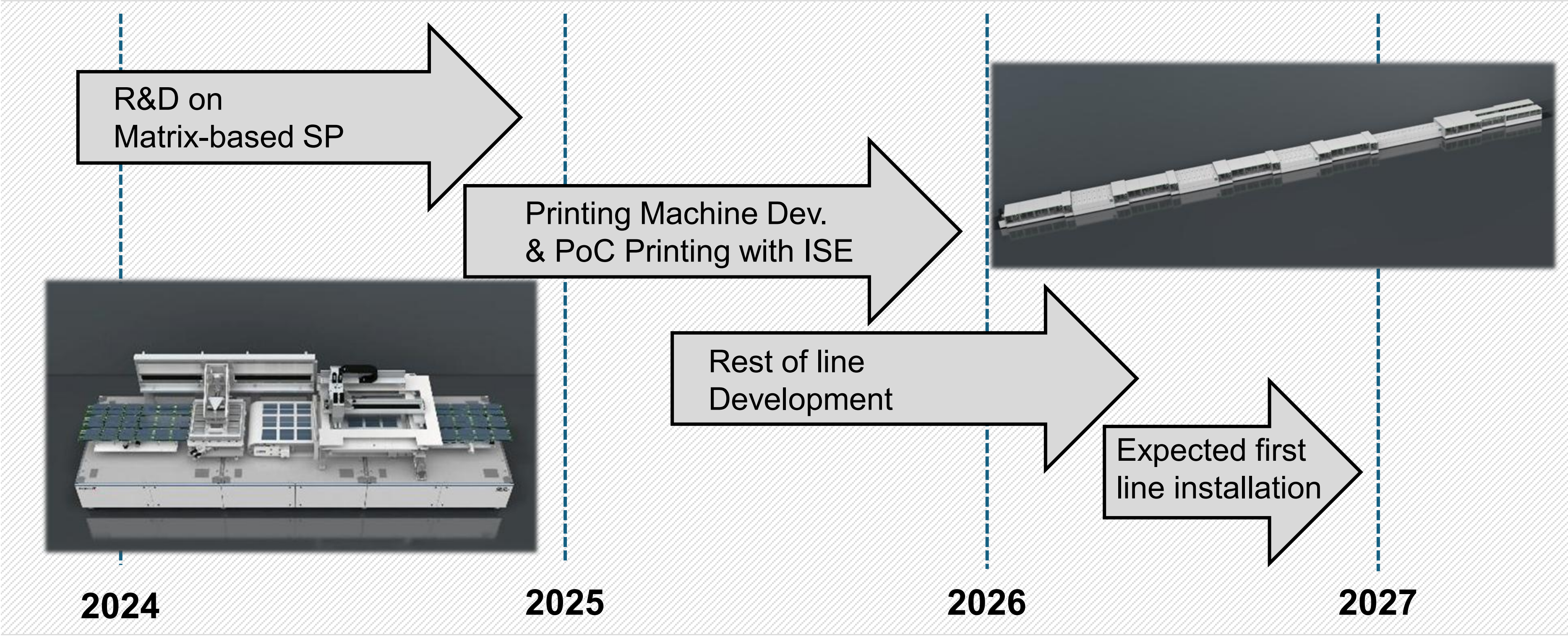


Who is able to manufacture large modern PV screens?

Requirements:

→ Stretching ultra-fine mesh at that size
→ Lamination of very thin PI foil at that size
→ Fine-line laser structuring of PI foil at that size

Summary & Outlook



Do you have any questions?

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