



MEYER BURGER

Manufacturing Execution System in a High Performance Pilot Cell Production

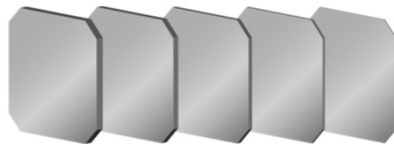
Marcel Leonhardt, Frank Allenstein, Heiko Mehlich, Ina Kutscher, Michael Mrosko

HJT Technology

A

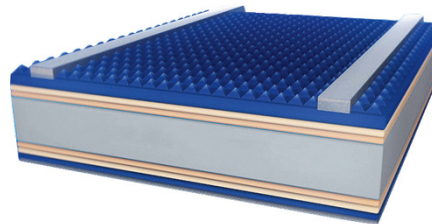
Wafer

180 μm 160 μm 140 μm 120 μm 100 μm



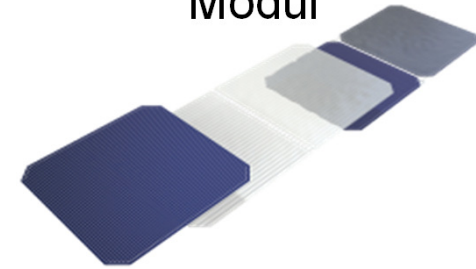
B

Cell



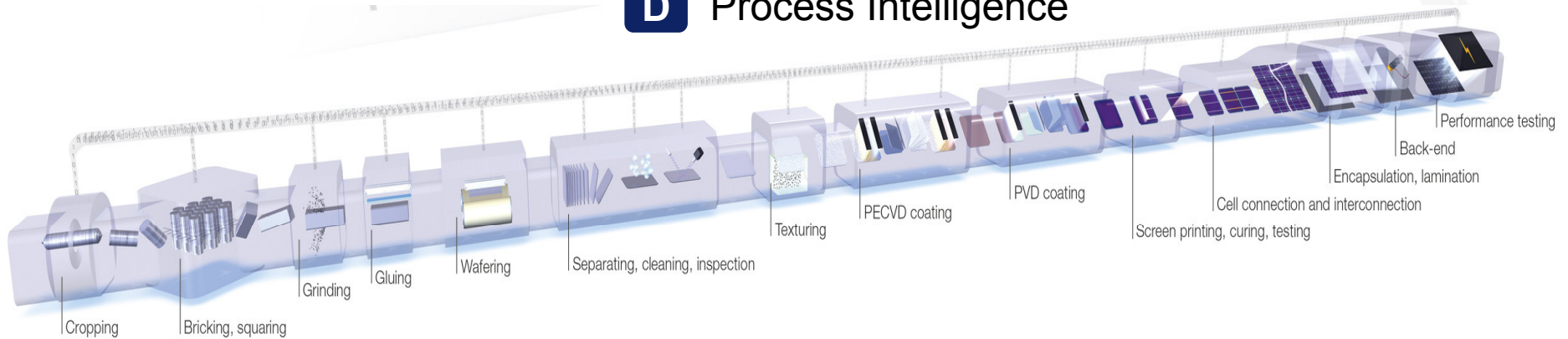
C

Modul

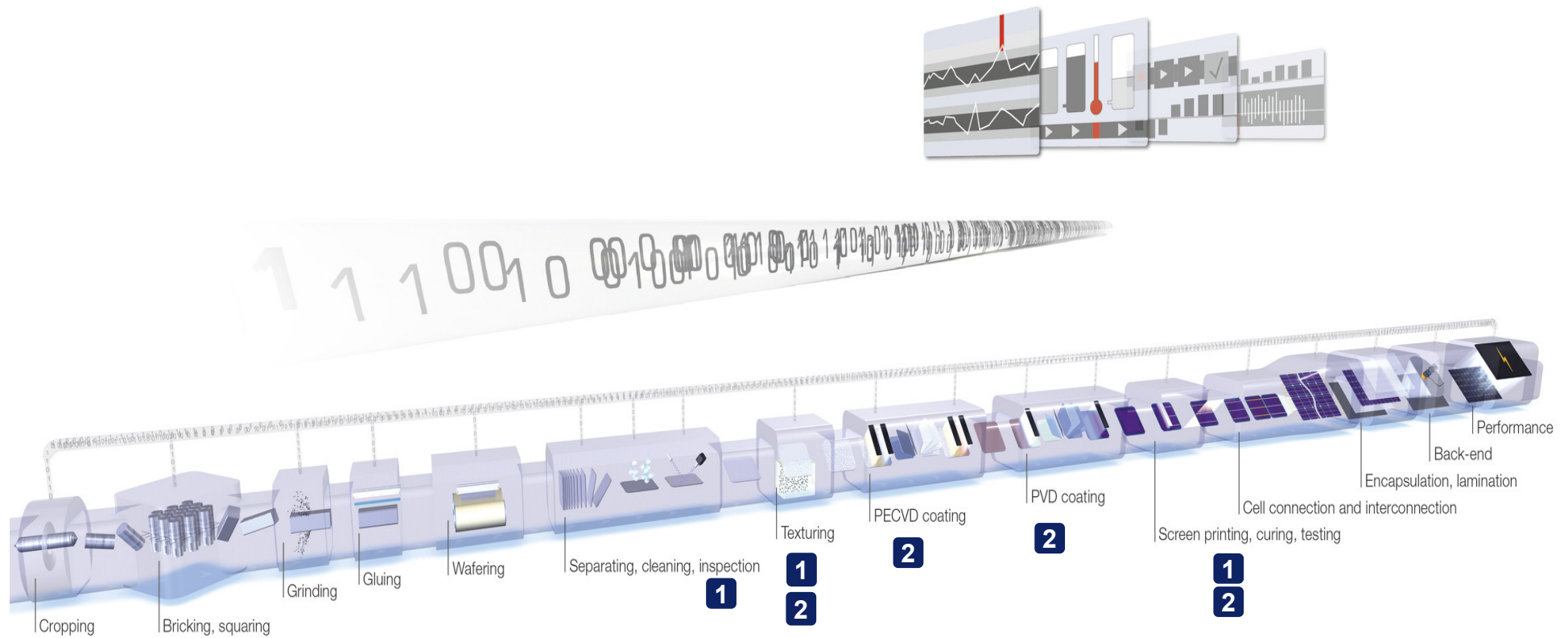


D

Process Intelligence



the perfect combination MES + Metrology

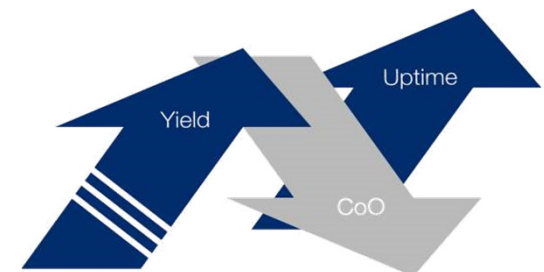


1

Inline Metrology

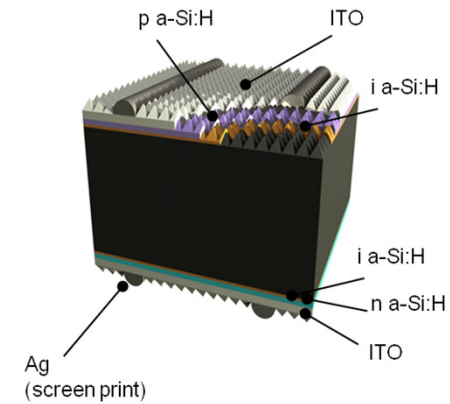
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Offline Metrology

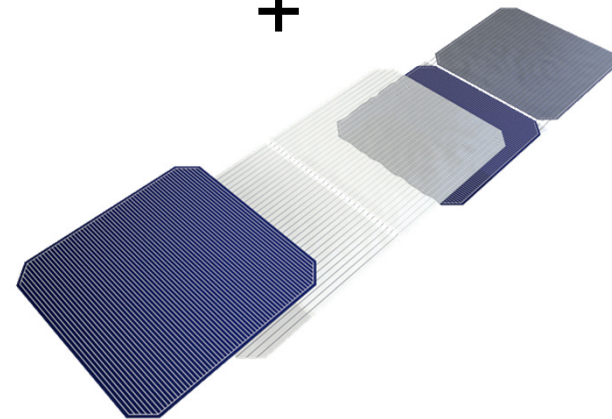


Outline

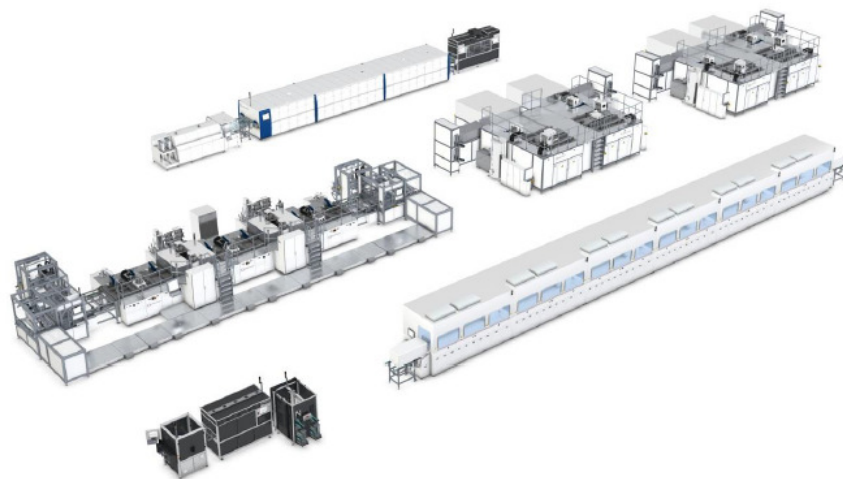
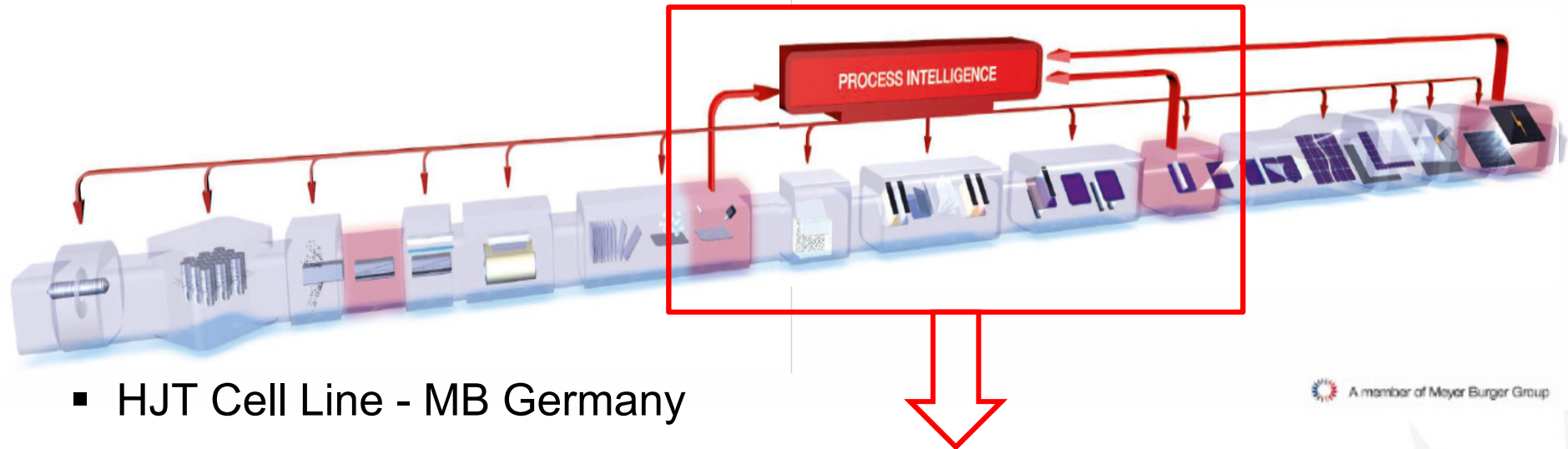
- Heterojunction Cell Pilot Line
- MES
- Metrology
- User Storys
- Summary



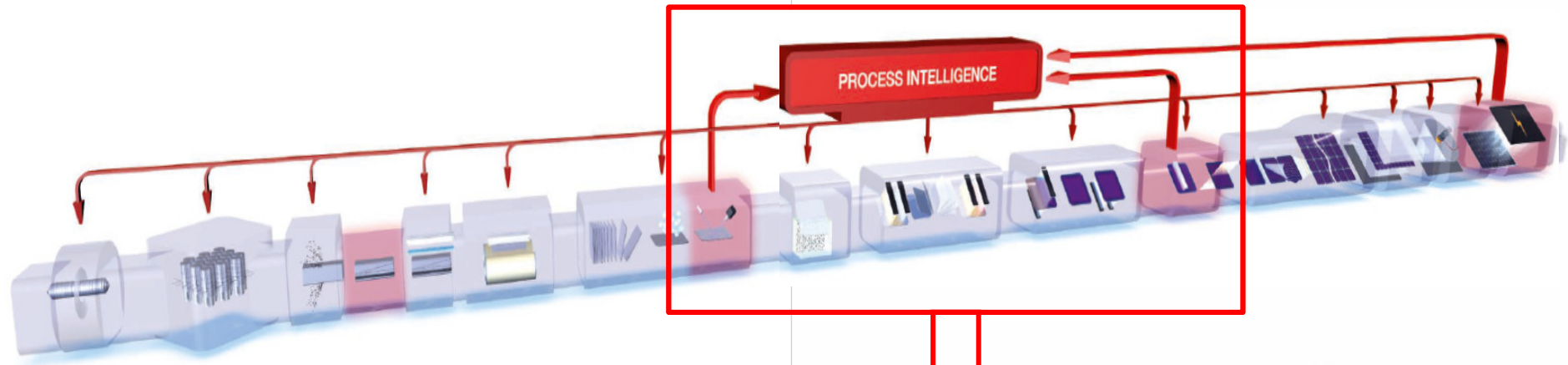
+



HJT Technology – Cell Pilot Line

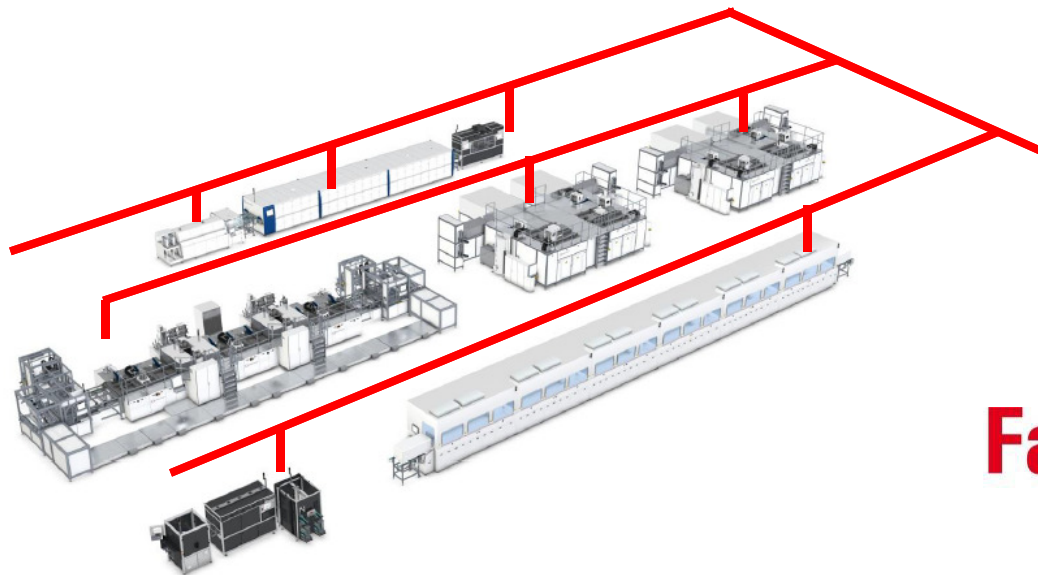


HJT Technology – Manufacturing Execution System



- HJT Cell Line - MB Germany

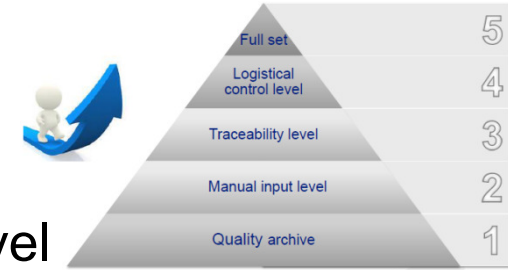
 A member of Meyer Burger Group



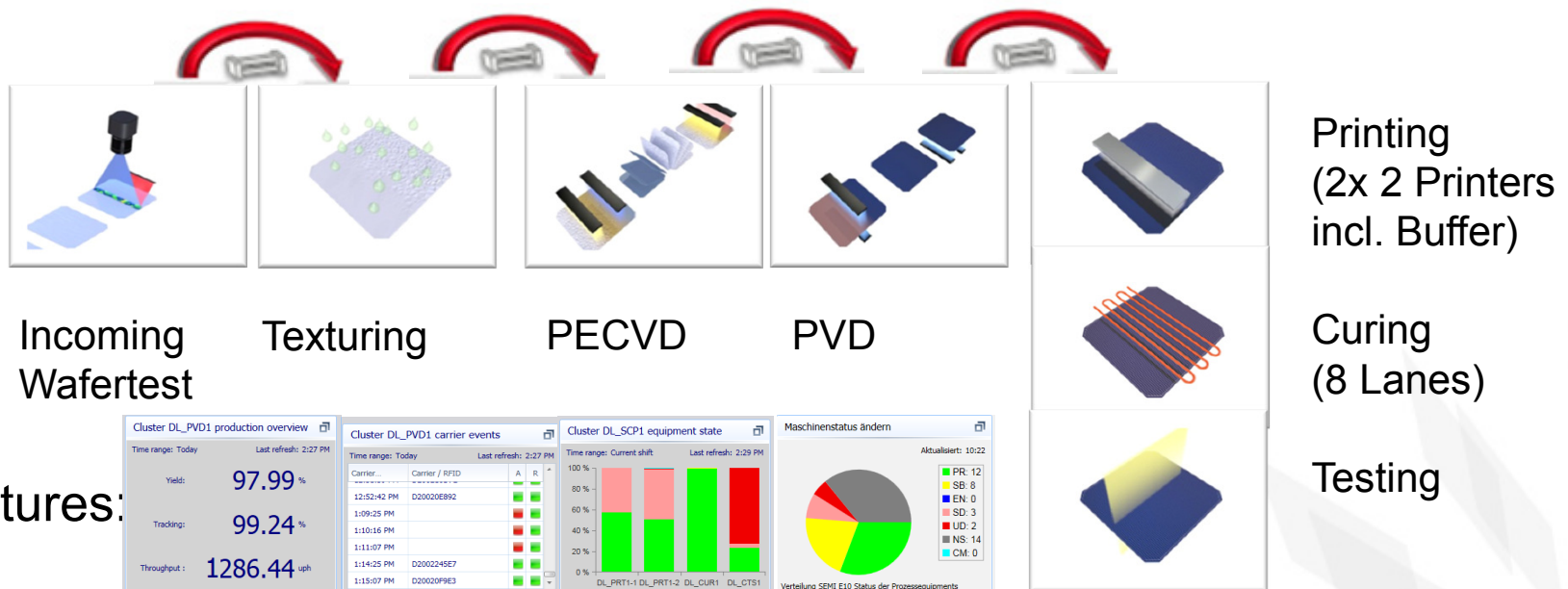
Visualize,
Control &
Report

FabEagle[®] MES

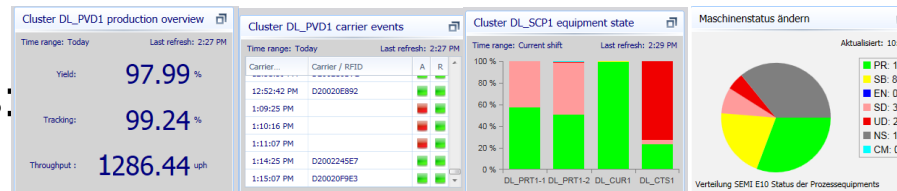
HJT Technology – MES



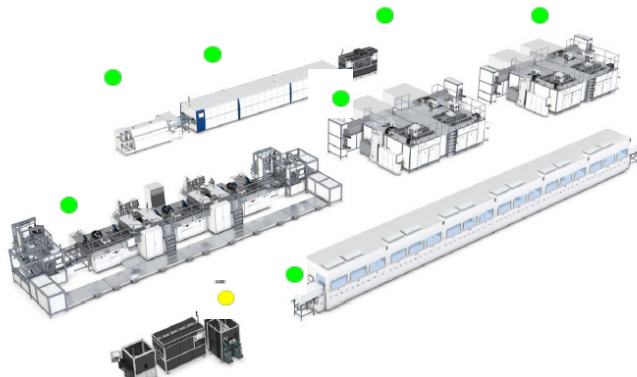
- System Setup: Functionality up to logistical control level
- Cell Pilot Line – Virtual Wafer Tracking → Carrier based with RFID



■ Features:



Backend



Production control & monitoring
 realtime monitoring and instant messaging
 (SEMI E10, Yield, Throughput, ...)

HJT Technology – MES

- Features:

- Online SPC

Rule violations announced by instant messaging
(e-mail, logbook, entries)

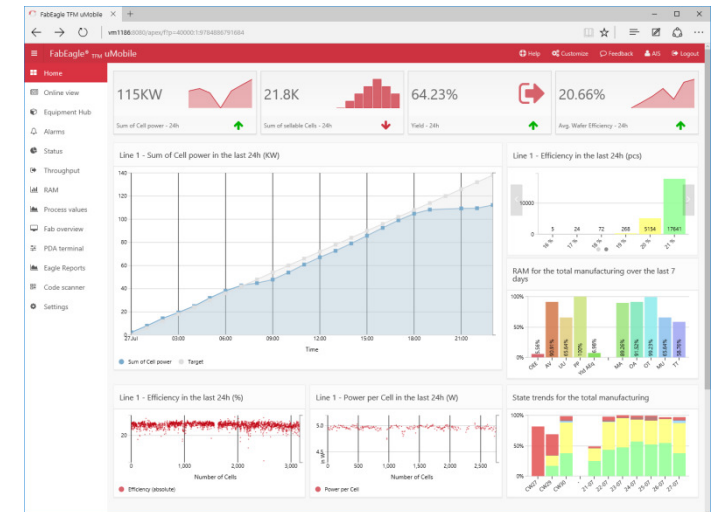
- Scheduled Reporting

Using your predefined report filters the system creates an report and sends e.g: scheduled e-mails

- Web Dashboards

HTML5/CSS3 based with responsive design for
e.g. PC, Smartphone and Tablet and all operation systems

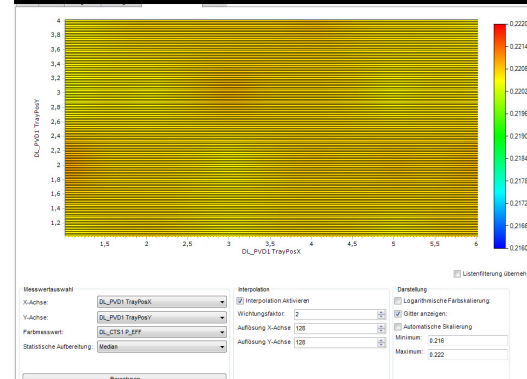
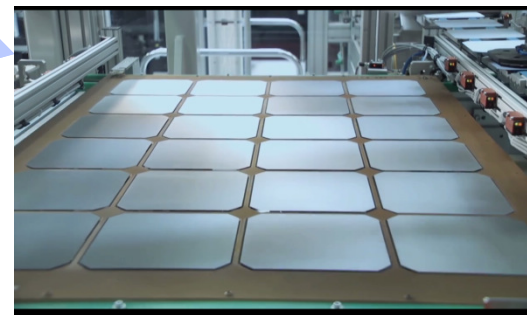
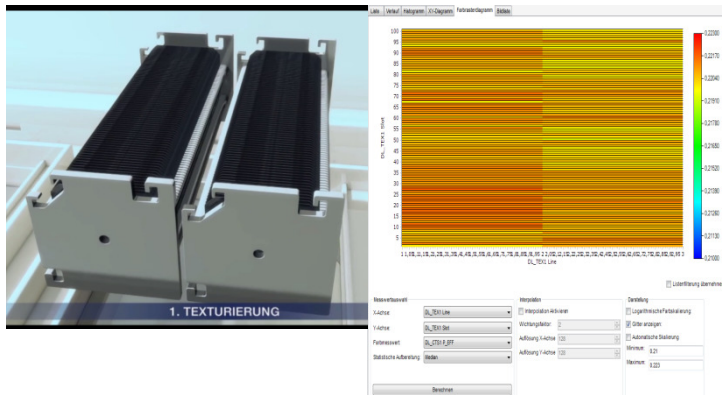
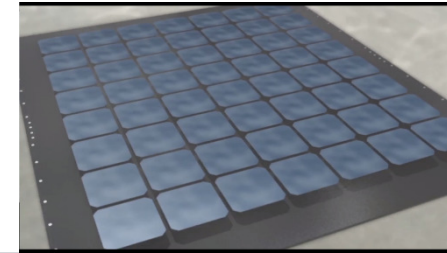
- Tracking based reports



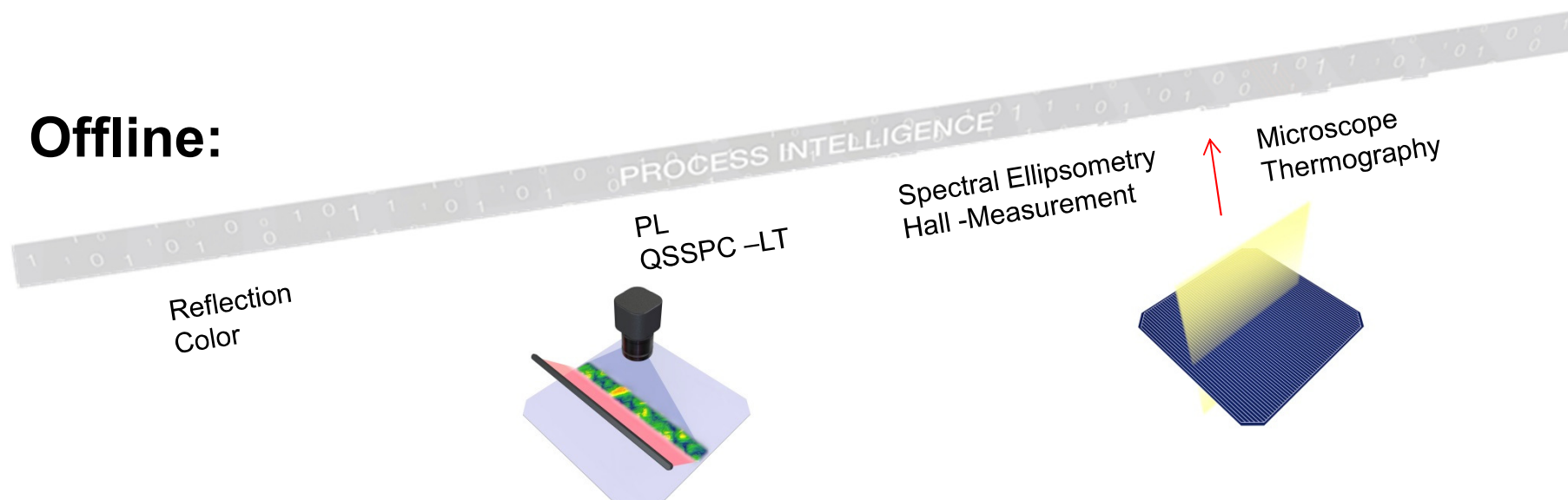
HJT Technology – MES

Tracking based reporting → Traymaps/Heatmaps

- Usage of the tracking information of wafers or cells to plot electrical results or parameters by its processing position
- e.g.: Tray PECVD (3 trays) →
- e.g.: Tray PVD
- e.g.: Texturing

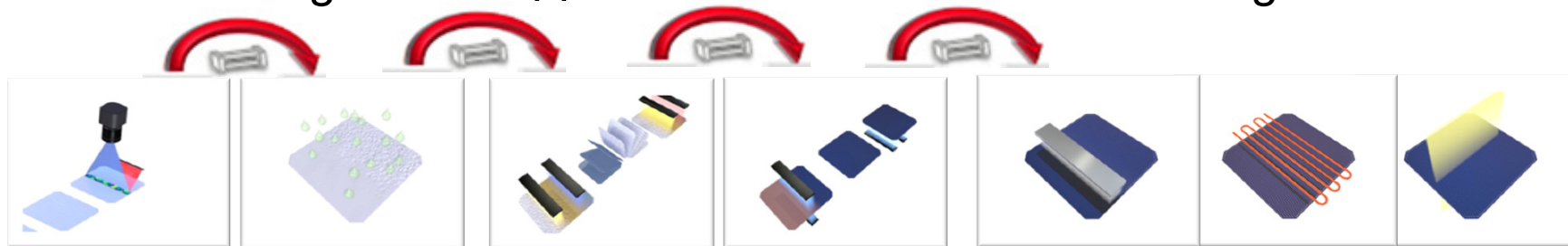


Inline:



Example 1– Tracking & Cell-Efficiency

- Challenges and Opportunities of virtual wafertracking



IWT

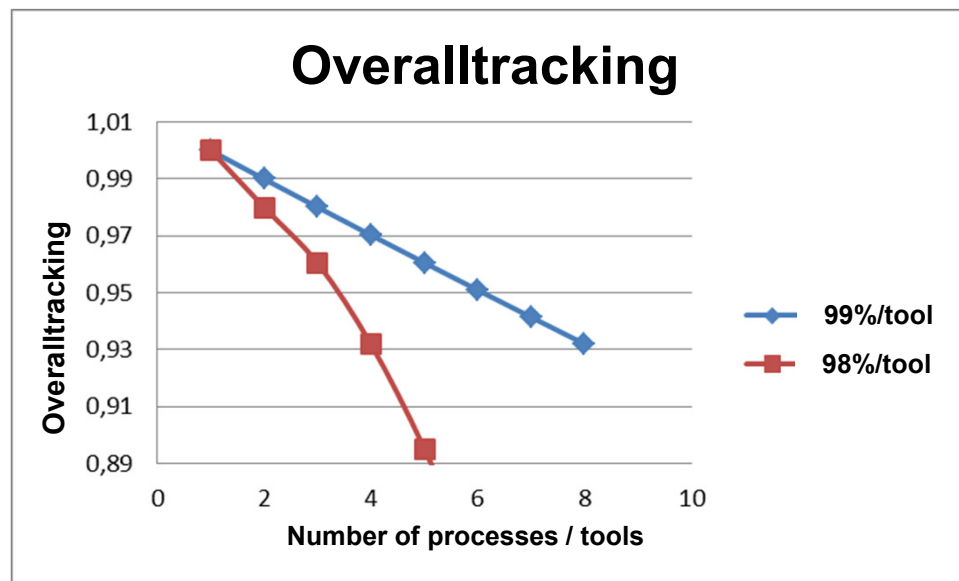
Texturing

PECVD

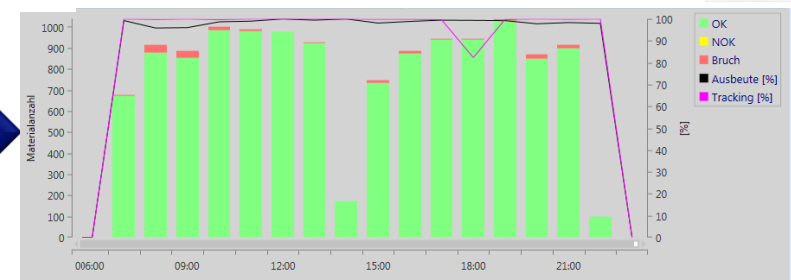
PVD

Backend

- In each tool its possible to loose the tracking of cells



- establish 98,5% tracking for each tool



- establish >90% for Line

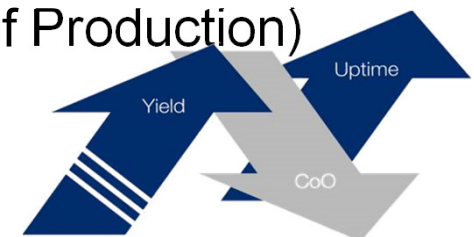
Example 1– Tracking & Cell-Efficiency

- Usage of the opportunities of the MES system (e.g.: the cockpit)



| | |
|-------------------------------------|-----------------------|
| Cluster_DL_PVD1 production overview | |
| Time range: Today | Last refresh: 2:27 PM |
| Yield: | 97.99 % |
| Tracking: | 99.24 % |
| Throughput: | 1286.44 uph |

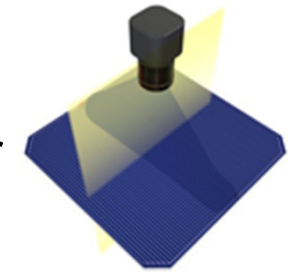
- Trend over the year:
 - Tracking ~90%
 - Improve GridTouch measured Efficiency (Median of Production)
 - Improve the Average Cell-Efficiency



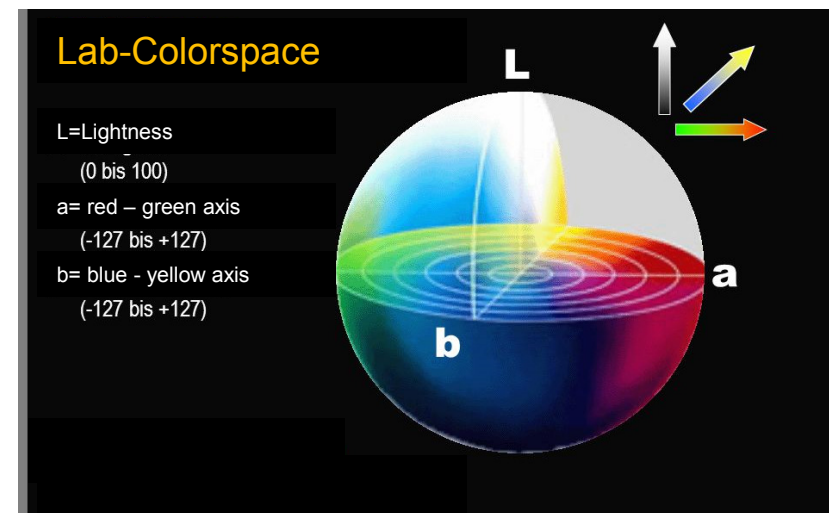
Example 2– Monitoring of PVD Magnetron Lifecycle

- Observation: Color measurement is high sensitive to PVD process
- Question: When is the end of lifetime of PVD targets without yield loss and maximum usage?

- Inline color measurement of cells in the Hennecke Celltester
 - Monitoring of cellcolor with L,a,b – Colorspace

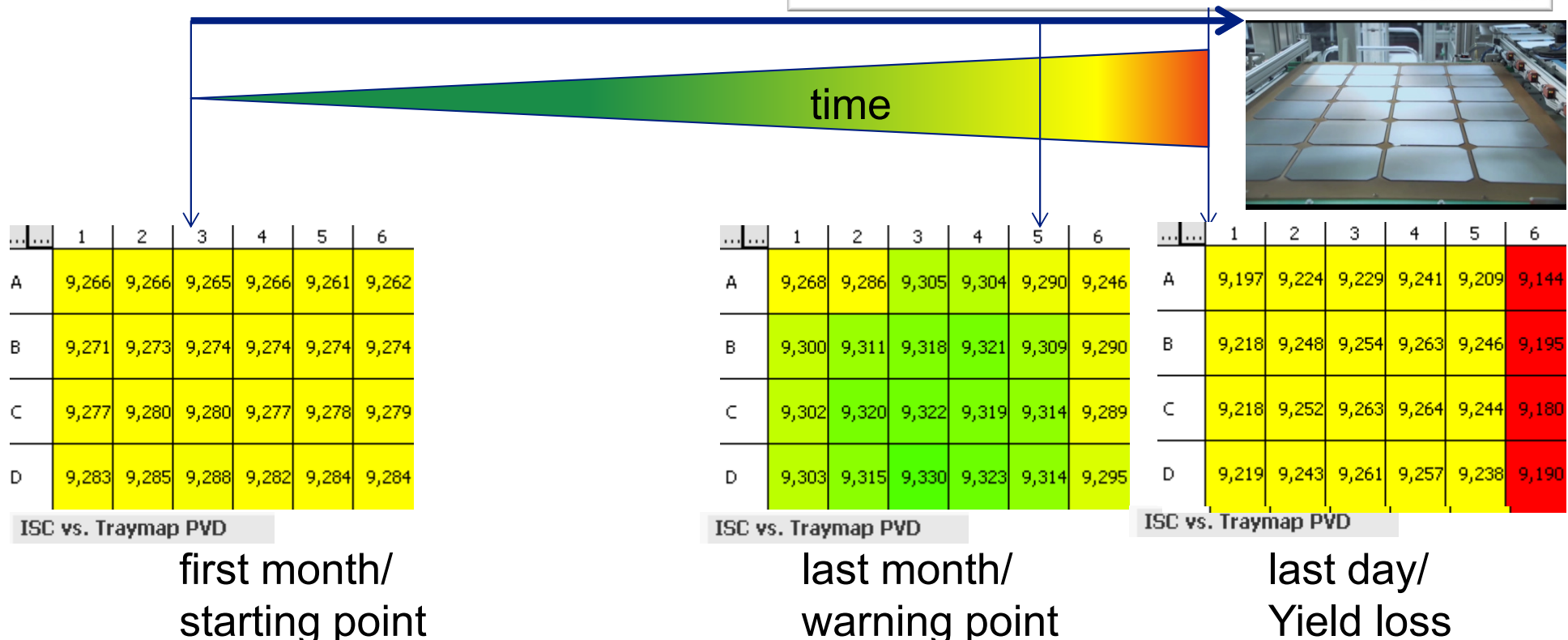
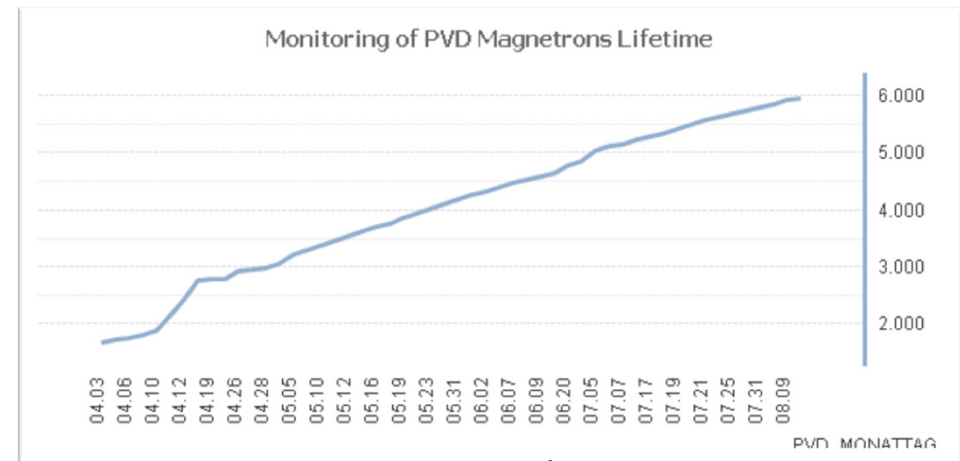


- Tracking of
 - PVD-Target lifetime
 - Trayinformation
 - Cellposition
- Combination in MES System



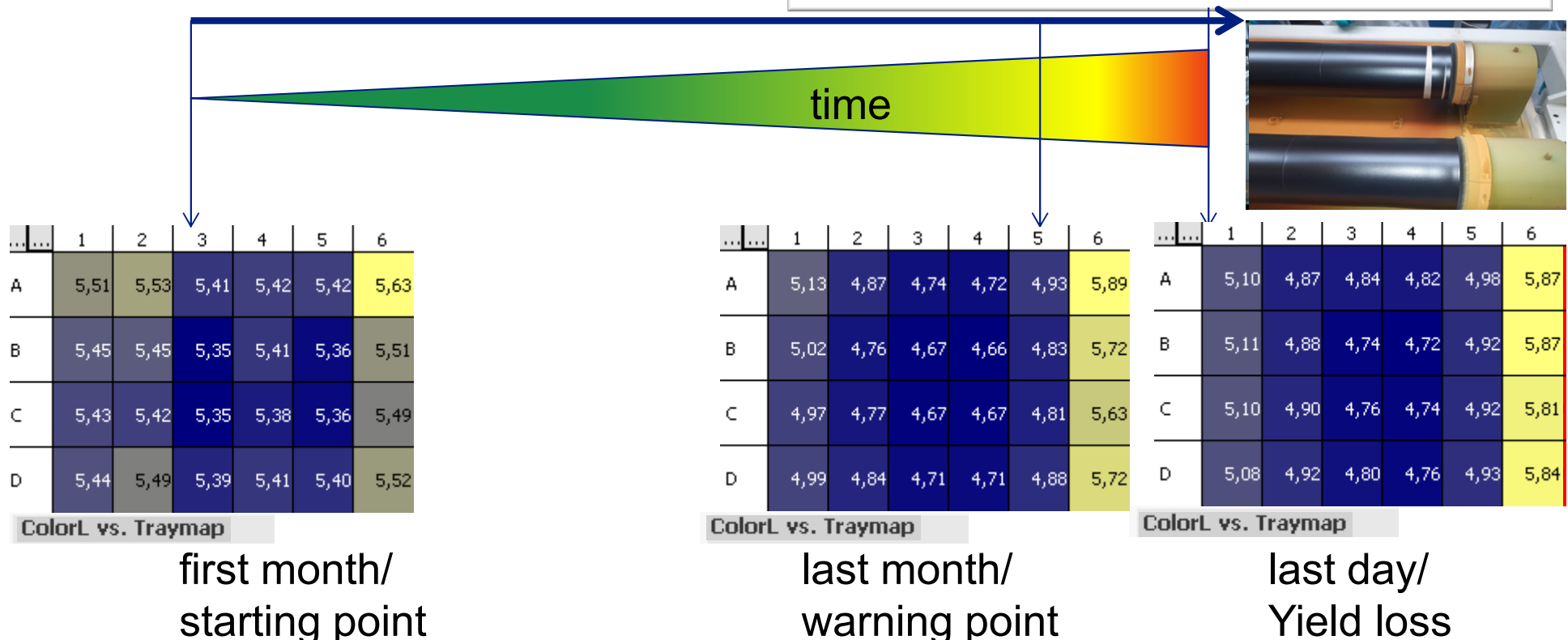
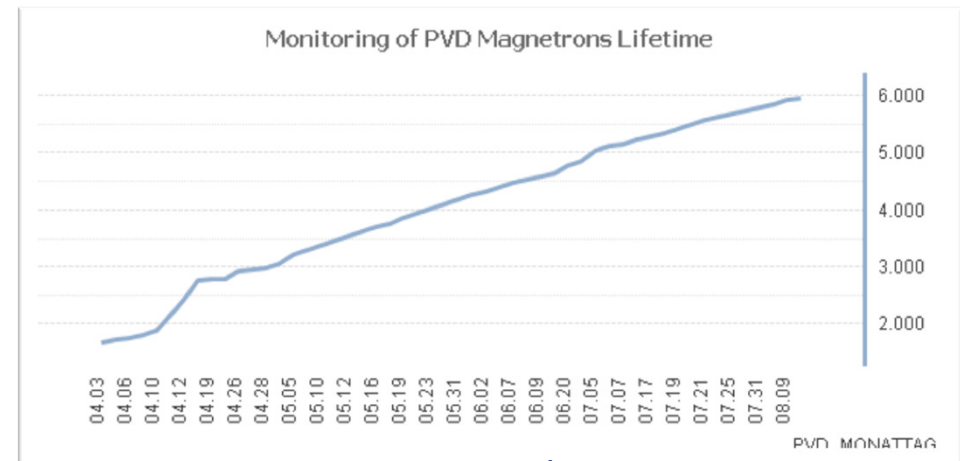
Example 2– Monitoring of PVD Magnetron Lifecycle

- Sputtered power applied to the target = value lifetime in [kWh]
- Mapping of CTS_Isc



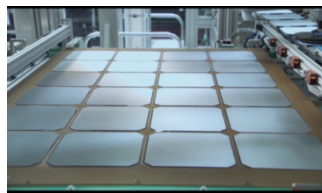
Example 2– Monitoring of PVD Magnetron Lifecycle

- Sputtered power applied to the target = value lifetime in [kWh]
- Mapping of **CTS_Isc** & **Color_L**



Example 2– Monitoring of PVD Magnetron Lifecycle

- Result: combined monitoring of machine and substrate values

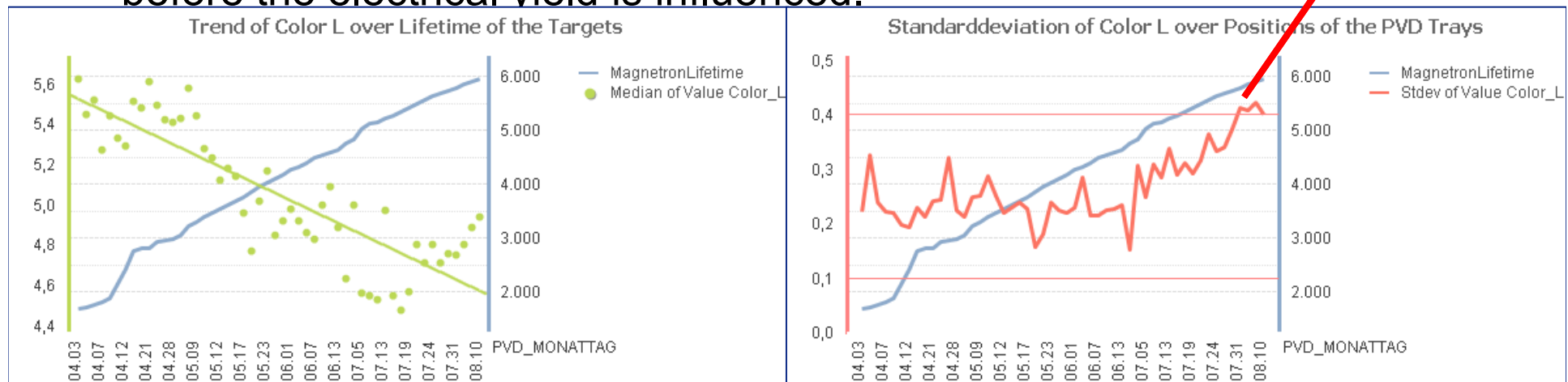


| | ... | 1 | 2 | 3 | 4 | 5 | 6 |
|---|-----|-------|-------|-------|-------|-------|-------|
| A | | 9,197 | 9,224 | 9,229 | 9,241 | 9,209 | 9,144 |
| B | | 9,218 | 9,248 | 9,254 | 9,263 | 9,246 | 9,195 |
| C | | 9,218 | 9,252 | 9,263 | 9,264 | 9,244 | 9,180 |
| D | | 9,219 | 9,243 | 9,261 | 9,257 | 9,238 | 9,190 |

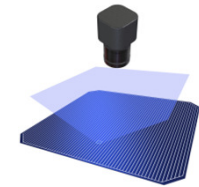
| | ... | 1 | 2 | 3 | 4 | 5 | 6 |
|---|-----|------|------|------|------|------|------|
| A | | 5,10 | 4,87 | 4,84 | 4,82 | 4,98 | 5,87 |
| B | | 5,11 | 4,88 | 4,74 | 4,72 | 4,92 | 5,87 |
| C | | 5,10 | 4,90 | 4,76 | 4,74 | 4,92 | 5,81 |
| D | | 5,08 | 4,92 | 4,80 | 4,76 | 4,93 | 5,84 |



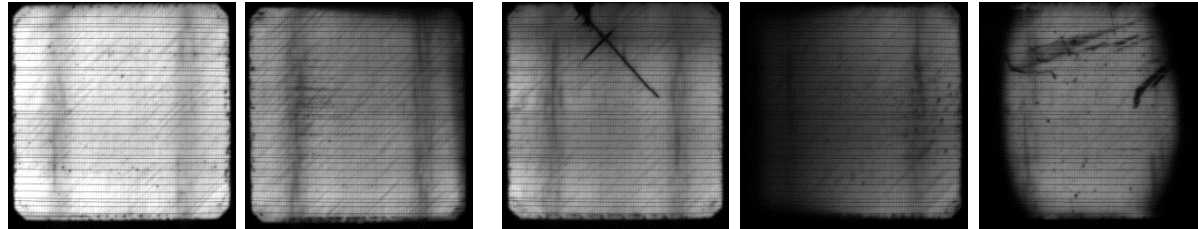
enables to use a inline measured value that reacts before the electrical yield is influenced.



Example 3– Monitoring of PECVD



- Observation: EL measurement shows characteristic signatures for certain problems



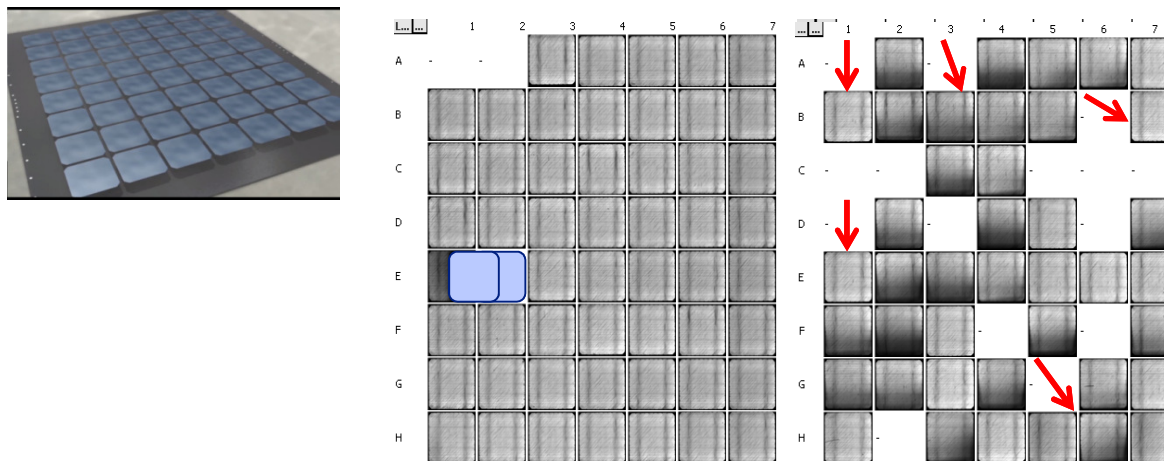
- Inline EL measurement of cells in the Hennecke Celltester
- Tracking of
 - Trayinformation PECVD
 - Cellposition
 - EL-Pictures
- Combination in MES System

Example 3– Monitoring of PECVD

- Result: combined monitoring of machine and substrate values



- Picturemapping of EL Images to get the Possibility to use the 2D Information of the EL-Picture



- Wafer loss on Automation Gripper
- Mispositioning of wafers with Automation (sensor and settingproblem)

Summary



- Improvement of Median and Average Efficiency with the Fabeagle MES
- Implementation of Cockpit Items and Usage of Instant Messaging for Yield improvement
- Generation of Traymaps based on tracking related Information
- Combination with Inline Metrology enables to monitor processes and equipment with the chance for yield improvement due to more sensitive control
- Automatically generated Picturemaps enable to use 2D information



MEYER BURGER

**«Your task is not to foresee the future,
but to enable it!»**

Antoine de Saint-Exupéry



**Meyer Burger Germany
An der Baumschule 6-8
09337 Hohenstein-Ernstthal
Germany**

Phone: +49 (0) 3723 671 - 3400

Fax: +49 (0) 3723 671 – 1000

Email: marcel.leonhardt@meyerburger.com

Thank you!