

# BASF's CypoSol™ metallization inks for newly developed Laser Transfer Printing (LTP) technology

## 2<sup>nd</sup> Workshop on Metallization for Crystalline Silicon Solar Cells

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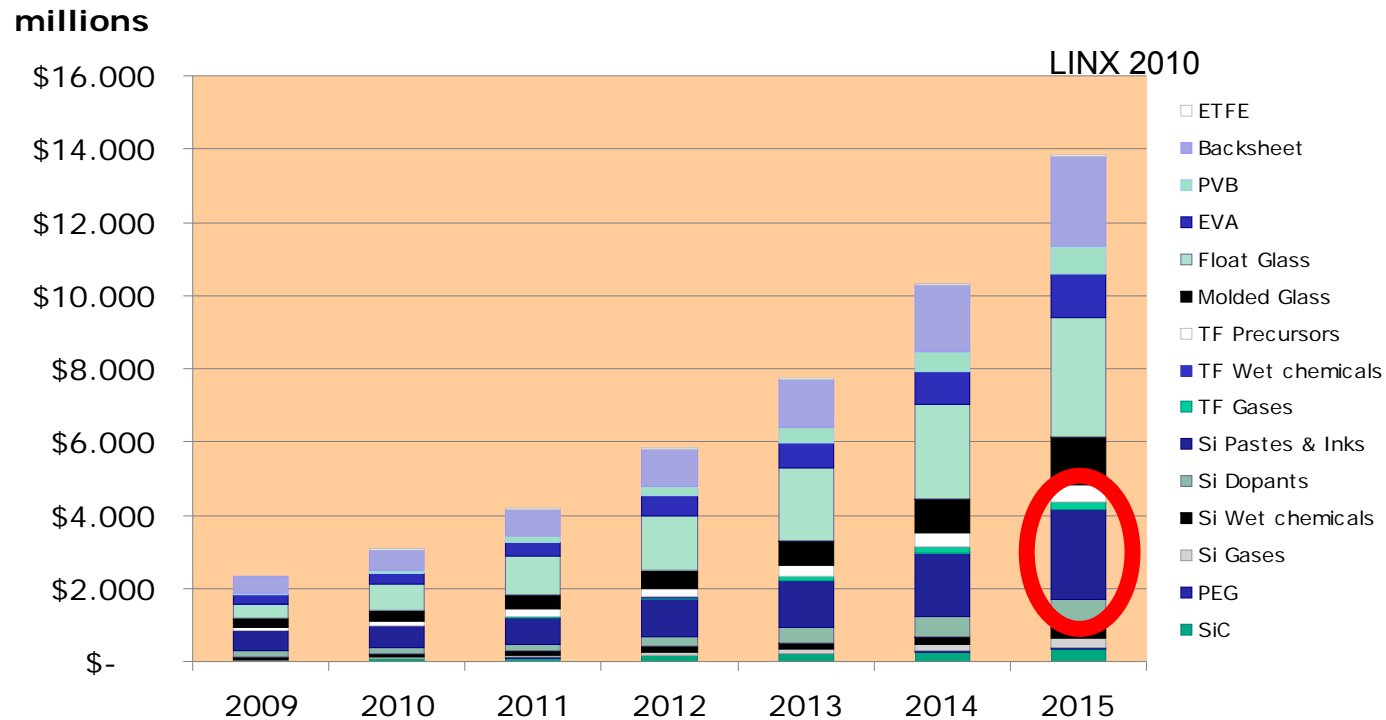
4) Gebr. Schmid GmbH+Co., Freudenstadt

5) Aurentum GmbH, Mainz

6) ISC Konstanz



## Total Materials Market (w/o Si)



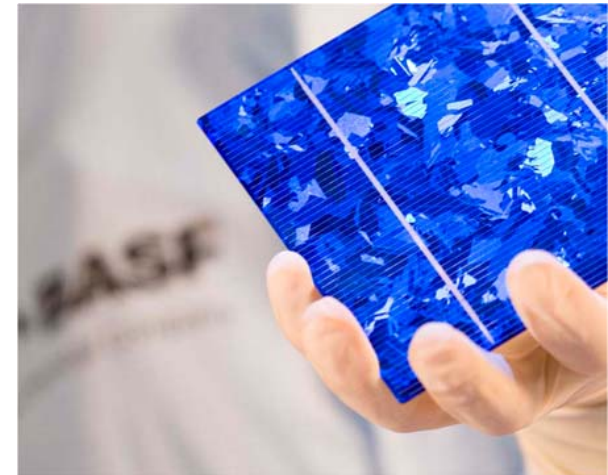
- Strong market growth – CAGR (2009-2015):  $30 \pm 5\%$
- Metallization approx. **20 % of BOM** – total market size (pastes & inks) > 2 bn USD in 2015



**Huge potential to reduce costs for cell metallization**

## New metallization technologies require

- Reduced breakage
- Processing of thinner wafers to reduce costs of Si ( $< 140\mu\text{m}$ )
- Higher machine uptime
- Reduced variable costs (pastes, consumables e.g. screens, etc.)



### ***New metallization technologies have to be***

- ... contact-free
- ... digital
- ... robust and reliable
- ... compact and affordable and have to
- ... provide high-throughput

### **LTP – Laser Transfer Printing**

## Our strategy

- BASF – supplier of lead-free and leaded CypoSol™ metallization pastes and inks in photovoltaic's
- CypoSol™ paste products for use in screen printing application - CypoSol™ inks designed for LTP technology
- BASF and aurentum co-developed LTP technology for use in photovoltaic application
- Schmid – reliable engineering partner in photovoltaic's and manufacturer of LTP Printer (under License)
- Market entry and commercialization of CypoSol™ pastes/inks and LTP Printer in 2010

## **New CypoSol™/LTP system solution**

## CypoSol™ paste/ink Production facility in Ludwigshafen

- Paste und ink production capabilities ramped up in Ludwigshafen / Germany
- Production in Ludwigshafen covers complete CypoSol™ products
  - CypoSol™ L inks
  - CypoSol™ S pastes
- Large production capacity to ensure a global CypoSol™ product roll-out



### **BASF SE**

Sales 2009: 50,6 bn EUR

EBIT 2009: 6,5 bn EUR

Site Ludwigshafen:

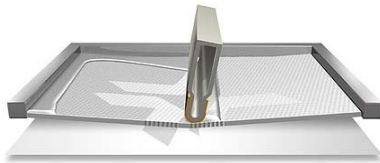
10 sqkm

> 32.000 Employees



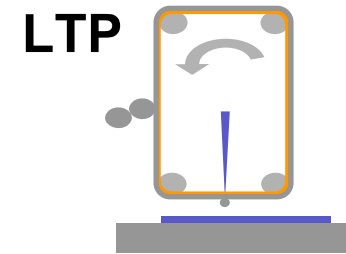
## CypoSol™ product portfolio (currently launched)

### Screen printing



### CypoSol™ S

- CypoSol™ S 51-10 silver paste
- CypoSol™ S 51-105 fine line silver
- CypoSol™ S 55-10 Al paste
- CypoSol™ S 59-10 Ag/Al paste



### CypoSol™ L

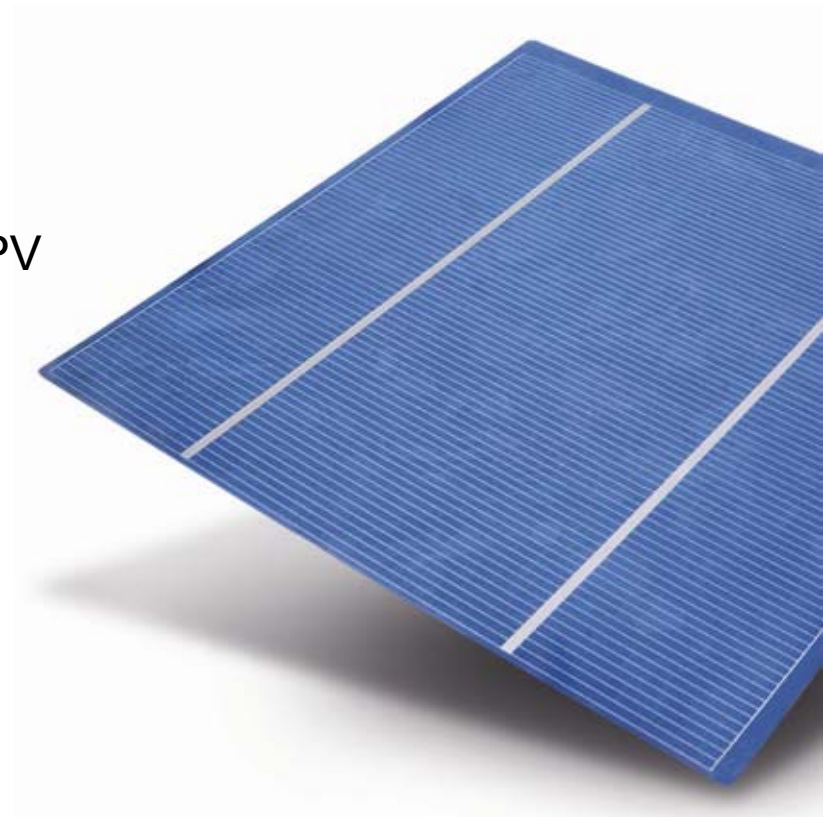
- CypoSol™ L 61-10 silver ink (aq)
- CypoSol™ L 65-10 Al ink
- CypoSol™ L 65-20 Al ink (aq)\*
- CypoSol™ L 69-10 Ag/Al ink

\* under development

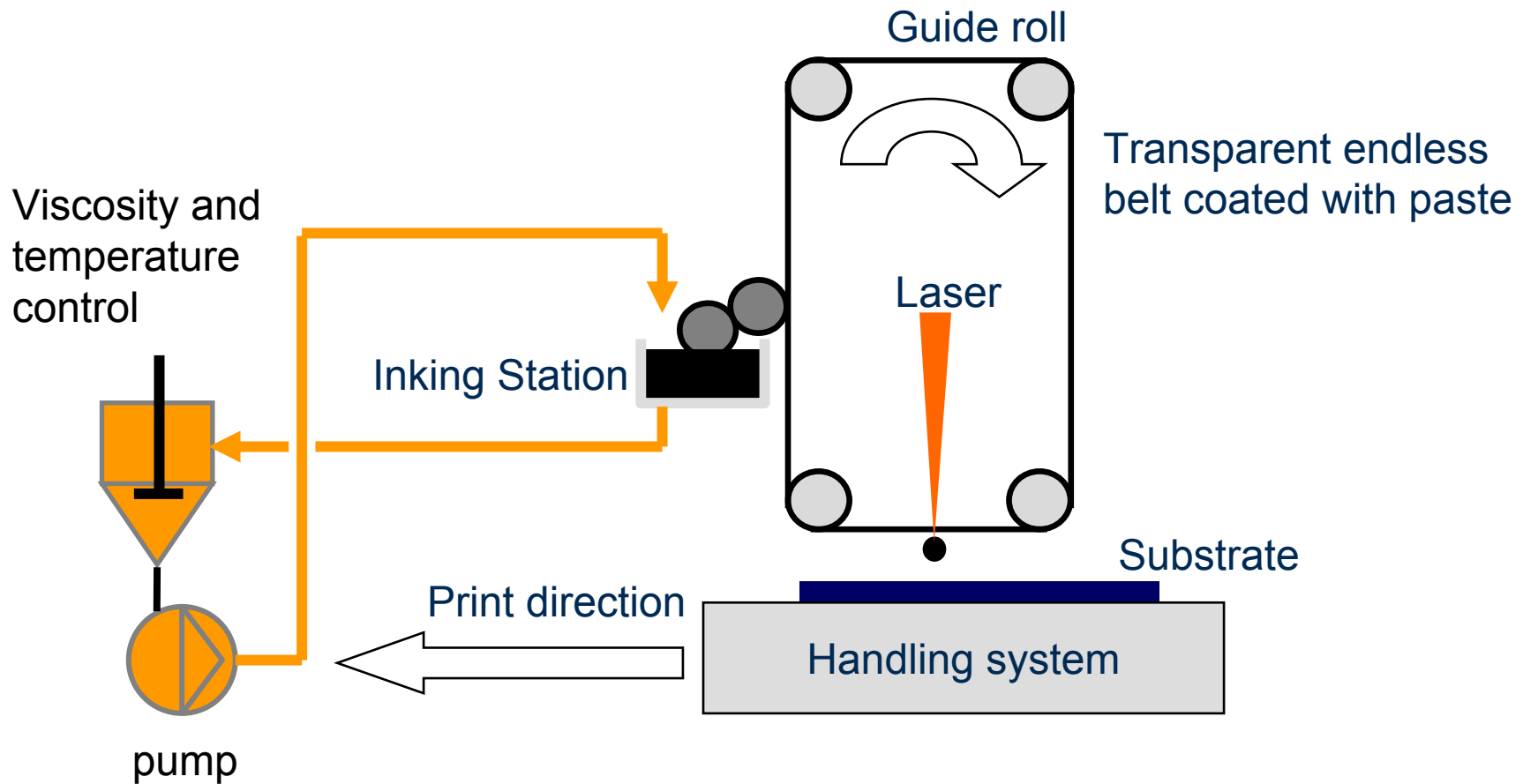
April 14<sup>th</sup>, 2010

## Laser Transfer Printer LTP Technical Data

- CypoSol™ metal based ink transferred by laser pulse
- CypoSol™ contains standard Silver/Aluminum powders - well proven in PV
- Print speed similar to screen printing
- Fully contact-free digital process
- Possible line width  $\leq 60 \mu\text{m}$
- Continuous process with continuous wafer transport



# LTP Principle



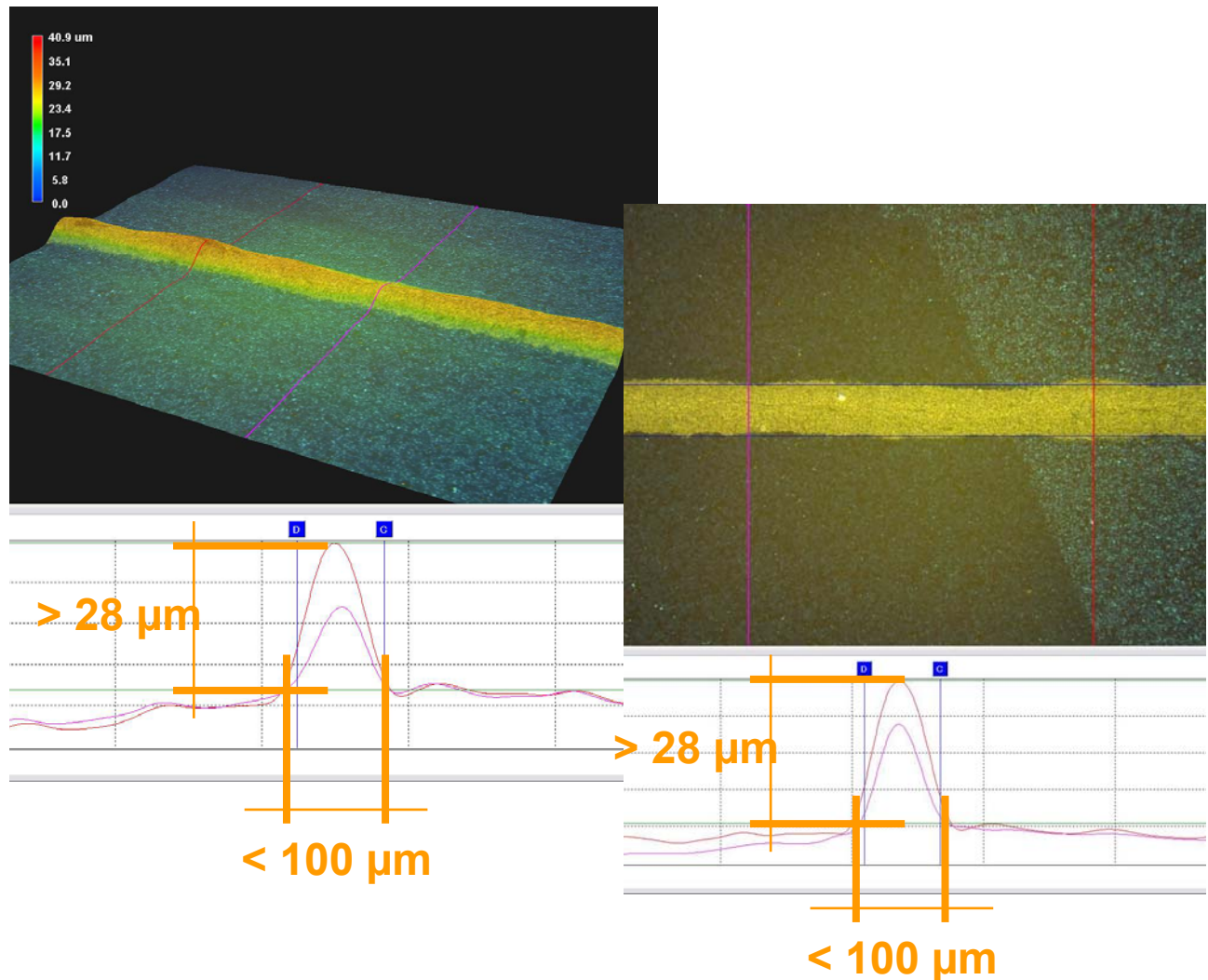


## LTP silver finger

- Homogeneous line height
- Multiple print possible
- Minimized line breaks

### Challenge

- Optimize line height over line length
- Min. shadowing – max. CE





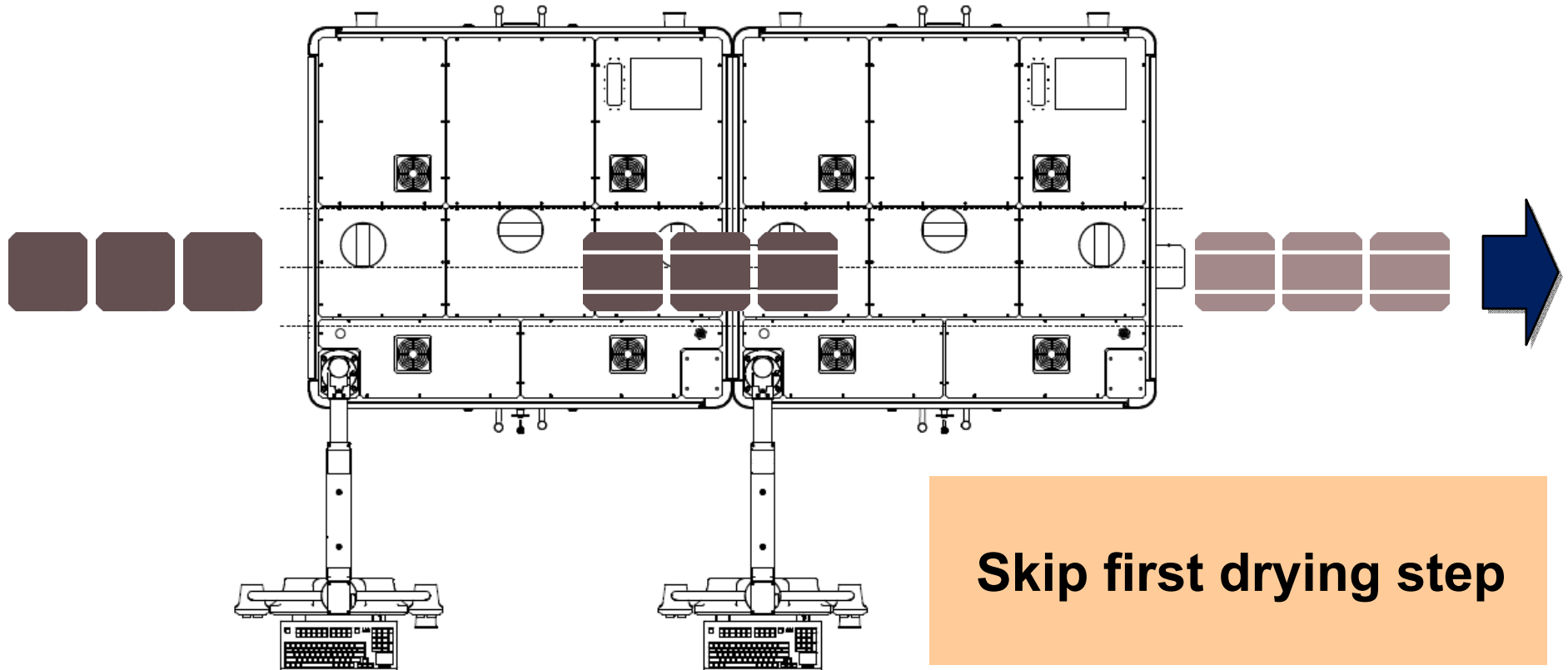


## Reduced equipment costs (“save one dryer”)

1<sup>st</sup> Printer prints  
backside Ag

2<sup>nd</sup> Printer prints wet in wet! No  
further drying

2<sup>nd</sup> Printer prints  
backside Al



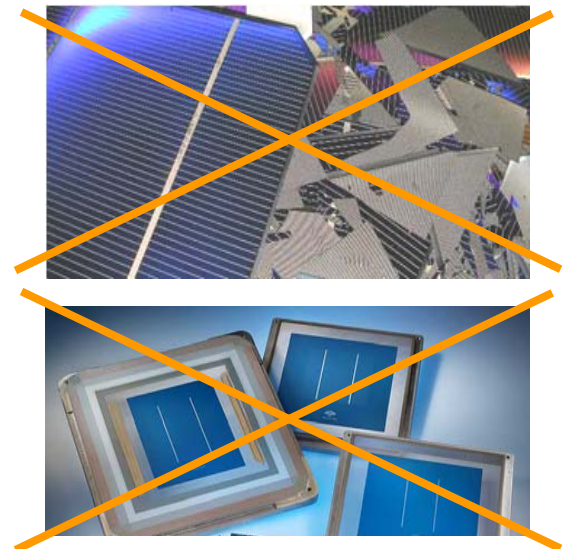
## CoO Calculation – LTP system (Ag front contact)

- Reduced process and paste losses
- No screen exchange
- Total

> 1,00 \$ct/W

### Upside potential

- + Higher machine uptime (no screen exchange)
- + Potential Si material savings (thickness < 180 $\mu$ m)
- + Improved process stability (e.g. screen degradation)
- + Reduced investments  
("save one dryer" / simple off-gas treatment)



## Customer benefits

- Less process and paste losses due to contact-free, full digital LTP technology
- Wafer handling with thickness  $< 180 \mu\text{m}$  possible
- Solvent-free, water-based inks with optimized processibility
- Higher machine uptime (e.g. no screen exchange) and improved process stability (e.g. no screen degradation)
- Simple, digital and robust process with high throughput

## LTP process evaluation together with Customers

- **LTP printer integrated in pilot production facility in Freudenstadt / Germany (TCS at Schmid GmbH)**
- **BASF and Schmid offer process evaluation tests**
  - Rear side processing with Al-ink according to customer design – ongoing
  - Front side processing with Ag-ink starting mid of 2010



Further information:

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