



# Factory Planning for a start up technology Based on selected criteria for Oerlikon Solar's PV technology

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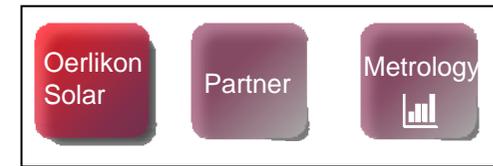
# Agenda

1. Oerlikon Solar's mission & business
2. Factory planning: Development of energy and CDA consumption over time
3. Conclusion & outlook
4. How to trim LCA for the industry?

Oerlikon Solar's mission is to make solar power economically viable.



Oerlikon provides end-to-end (E2E) production solutions...



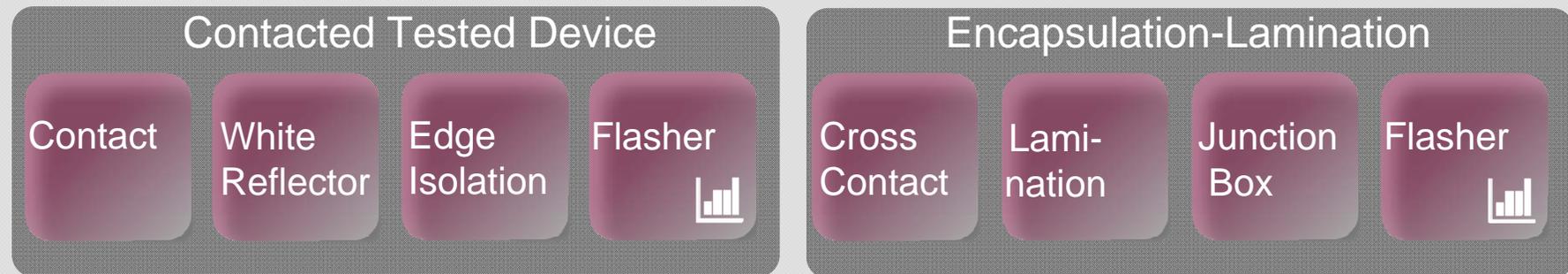
Front-End



Line Automation



Back-End



...and all critical components for module production...

Laser Scribes (LSS)  
Define Cells

PECVD (KAI)  
Deposit PV Material

LPCVD (TCO)  
Deposit contacts



**LSS1200**

Laser Scribing Solutions for the Industrial Production  
of Large-Area Thin-Film Solar Modules



**KAI1200**

Amorphous and Micromorph® High-Performance Layers  
for Large-Area Thin-Film Silicon Solar Modules



**TCO1200**

Transparent Conductive Oxide High-Performance Layers  
for Large-Area Thin-Film Solar Modules

# Thin film solar cell basics

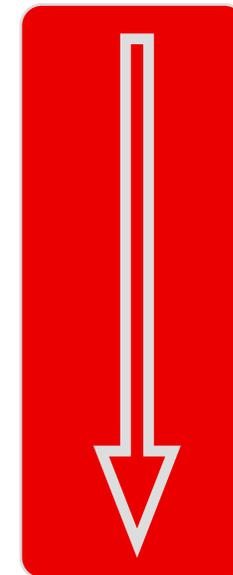
## Thin Film Solar Modules



## Cell Structure



## Manufacturing



Technology	Stabilized efficiencies	
amorph	7.0%	90 Wp
micromorph	9.3%	125 Wp

# Factory planning

The driving force for PV development is to reach Grid Parity

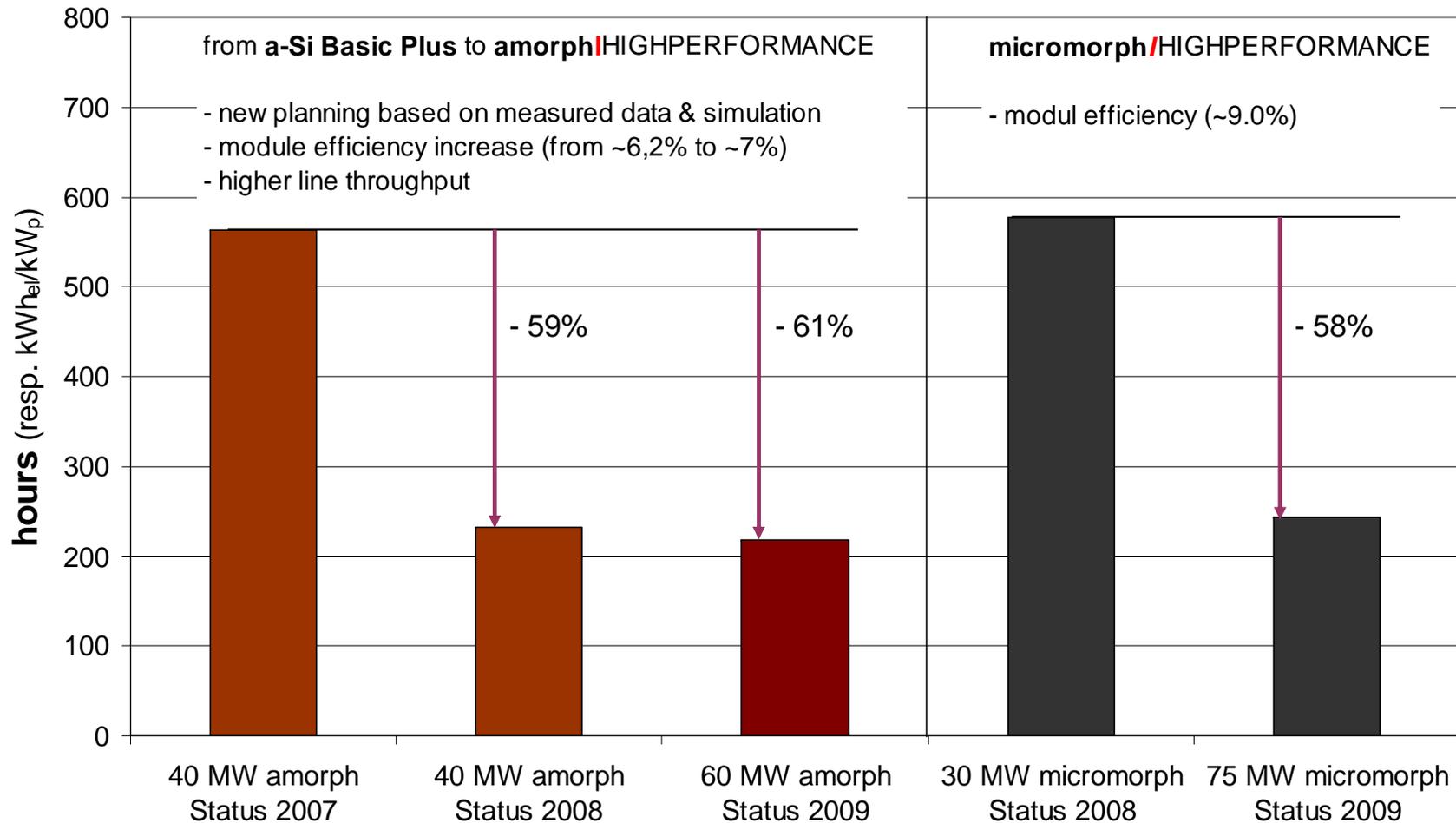
$$\frac{\$}{W_p} = \frac{\text{Total Cost}}{\text{Throughput} \times \text{Power}}$$

Implications for Oerlikon Solar	Oerlikon Solar's approaches	Effect on the LCA
Reduce total costs	<ul style="list-style-type: none"> <li>▪ <b>Simplify production</b> e.g. eliminate equipments &amp; process steps</li> <li>▪ <b>Simplify equipments</b> e.g. save materials, eliminate or combine process steps</li> <li>▪ <b>Optimize factory planning</b> e.g. harmonize requirements, apply economies of scale</li> </ul>	<ul style="list-style-type: none"> <li>▪ Lower media requirements &amp; consumption</li> </ul>
Increase throughput	<ul style="list-style-type: none"> <li>▪ Increase cycle time</li> </ul>	<ul style="list-style-type: none"> <li>▪ Higher total consumption but</li> <li>▪ Lower consumption/module</li> </ul>
Increase modul efficiency	<ul style="list-style-type: none"> <li>▪ Investment into R&amp;D</li> <li>▪ R&amp;D roadmap</li> </ul>	<ul style="list-style-type: none"> <li>▪ Higher output over the lifetime of the module</li> </ul>

 All actions to meet the cost down pressure go along with a better LCA of the module

# Reduction of electricity consumption over time

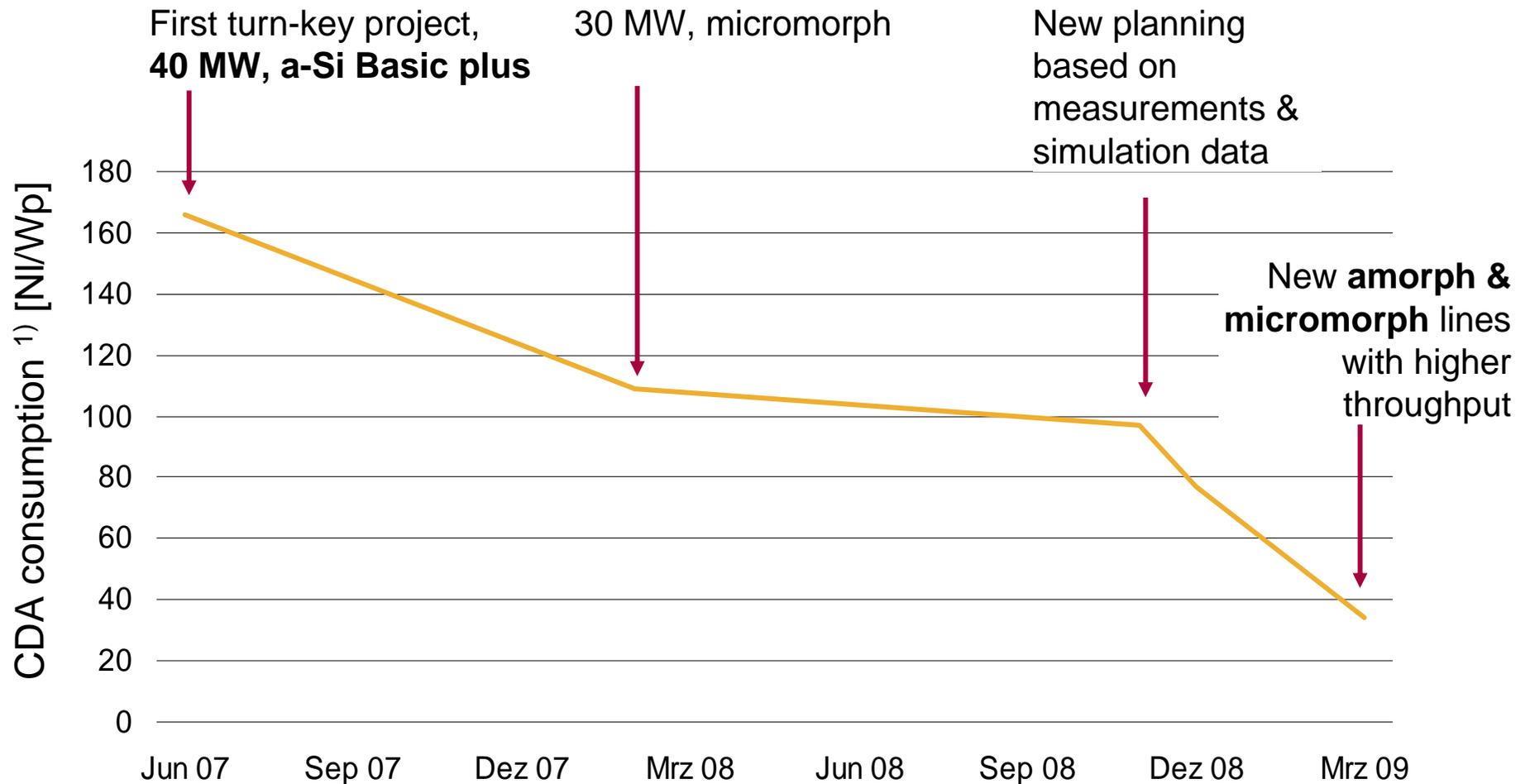
## Based on factory planning data for selected projects



Calculated for the electricity consumption of Oerlikon equipments. Factory requires app. 50% additional electricity, materials not included

# Reduction of CDA consumption over time

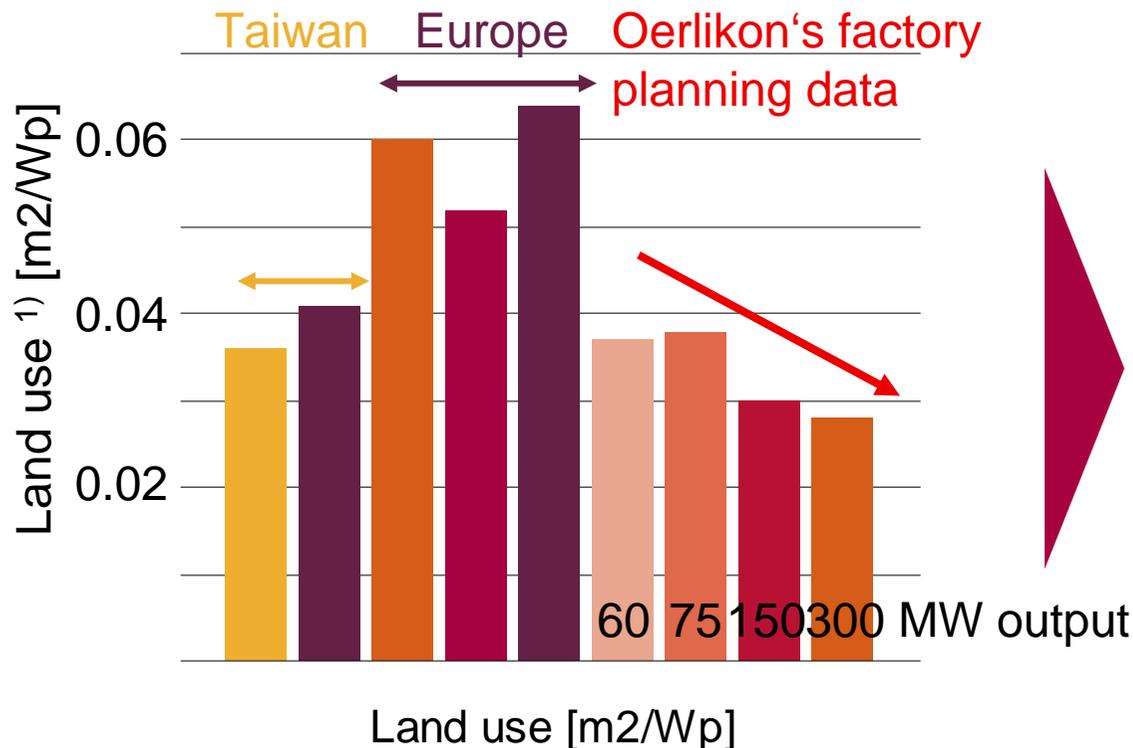
Based on factory planning data for selected projects



<sup>1)</sup> calculated for the CDA consumption of Oerlikon Solar's equipments.

# Land use for factories with comparable outputs

Based on selected projects and factory planning data



- In Taiwan, estates are small. So, customers must fit the factory onto a much smaller area
- Customers in Europe have higher land use compared to Taiwan
- Scaling effects are relatively small and only appear for bigger factories (60 MW to 300 MW)

1) calculated for the output of one year for the respective project

## Conclusion & outlook

### Significant improvements but still a long way to go

The factory planning for utilities such as electricity and CDA was given little attention in the beginning, the primary focus was to run the process. This led to an oversizing of cables, transformers and pipes (contribution to grey energy).

- **Electricity and CDA** could be reduced significantly by measuring the consumption under production conditions.
- Increase of throughput and module performance also contributed to the reduction per  $W_p$ .
- External restriction (e.g. small estates) and a clever factory planning probably contribute more to a better land use than scaling effects.



### Outlook:

- To achieve grid parity, Oerlikon has to continuously reduce its consumptions by simplifying processes & equipments.

## How to trim LCA for the industry?

- **Provide simple decision tools for engineers**  
How can I reduce the environmental impacts of my equipment/process?  
What materials have big impacts, which have less?
- **Do not spread LCA's with high uncertainty among society**  
It is difficult for society to assess uncertainty. A wrong message easily fixes in the common knowledge.
- **Maintain its excellent reputation**  
Take care that LCA's are not abused and loose their reputation.



Thank you

