



Alinement

PV-Ketenoptimalisatie via integrale productie van
wafer-cel-module

24 maart 2011



The Project

World first integrated (wafer), cell and module facility

with

Module efficiency > 20%

with

Low manufacturing cost

resulting in

Higher kWh output per sqm

leading to

Grid parity at introduction



Options cost reduction

Costs PV still needs to be lower to compete with grid

Options to reduce costs:

- Economy of scale
- Higher efficiencies
- Lower material costs (thinner wafers)
- Optimising production
- Increasing yield (reducing breakage)



Alinement's approach

- Thin wafers i.e. $< 150 \mu$
- Other type of ingot/wafer
- Other way of cell processing
- Other way of solar module production
- Other way of wafer slicing

all in order to reduce material costs (thinner wafers), to reduce breakage during transport (no expensive packaging costs) and in production (no stringing and tabbing), to increase efficiency (processing and type of wafer) and to reduce encapsulation losses

Market positioning

Alinement efficiency range

Top 10 efficiencies*: mono-crystalline cells and modules

| RANK | COMPANY | MONOCRYSTALLINE CELL EFFICIENCY |
|------|-------------|---------------------------------|
| 1 | Sunpower | 22.0% |
| 2 | Sanyo | 20.2% |
| 3 | Sharp | 17.5% |
| 4 | Motech | 17.5% |
| 5 | Delsolar | 17.3% |
| 6 | E-Ton Solar | 17.2% |
| 7 | Solarfun | 17.2% |
| 8 | Gintech | 17.1% |
| 9 | JA Solar | 17.0% |
| 10 | Sunways | 17.0% |

| RANK | COMPANY | BEST MODULE EFFICIENCY |
|------|-------------------|------------------------|
| 1 | Sunpower | 19.3% |
| 2 | Sanyo | 17.7% |
| 3 | Trina Solar | 16.0% |
| 4 | Photowatt | 15.0% |
| 5 | Solarwatt | 14.7% |
| 6 | Solon | 14.6% |
| 7 | Tynsolar | 14.5% |
| 8 | Kyocera | 14.5% |
| 9 | CEEG Shanghai SST | 14.5% |
| 10 | Evergreen Solar | 14.5% |

A

Labor cost for Alinement today are in line with First Tier Chinese producers

Labor cost , USD/hr



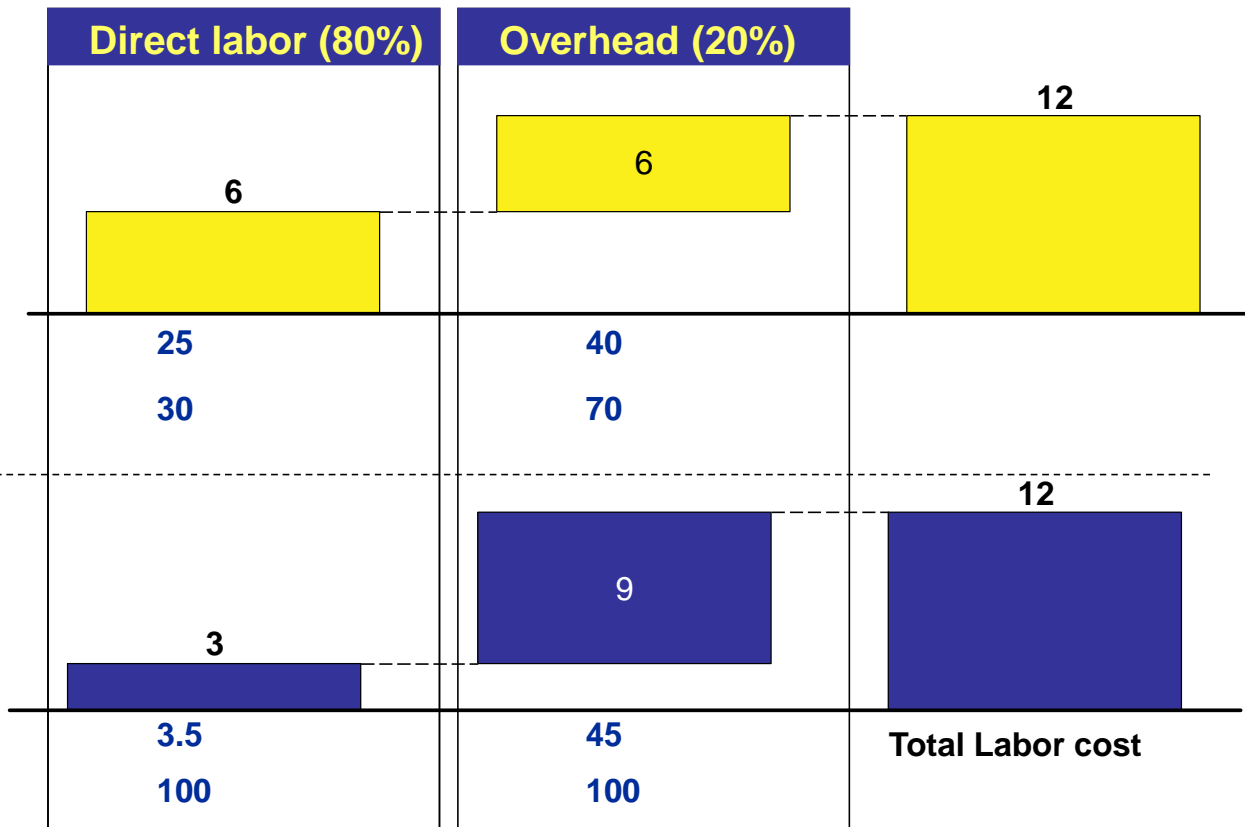
Labor rates (USD/hr)

Number of workers required versus Chinese producers(%)

Chinese producers

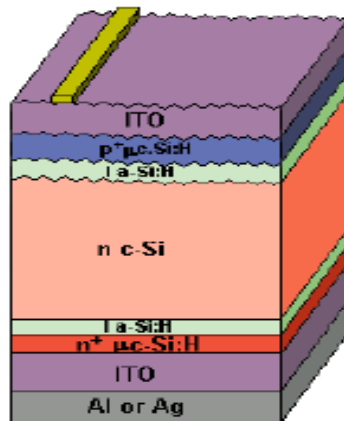
Labor rates (USD/hr)

Number of workers required versus Chinese producers(%)



Source: Alinement, BCG, press search

Cell technology (Provider Roth & Rau)



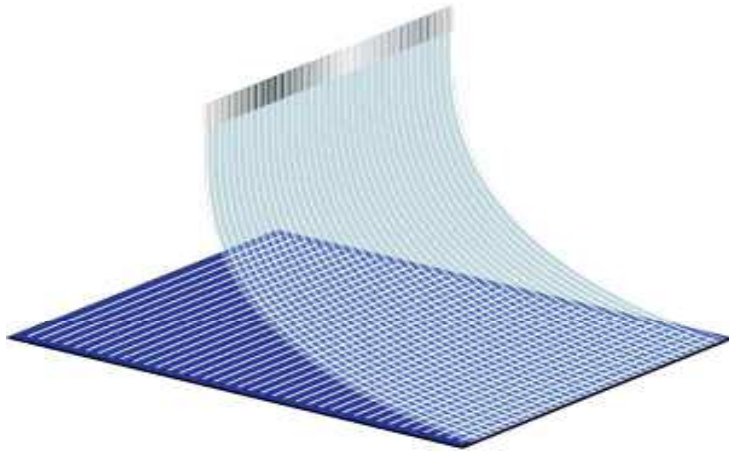
Cross-section
Hetero Junction
Structure

- N-type mono Si-wafer
- Alkaline texturing
- Hetero junction concept
- PECVD a-Si
- PVD TCO/metal layers
- Single print step
- Low temperature process

Cell efficiency > 20 %



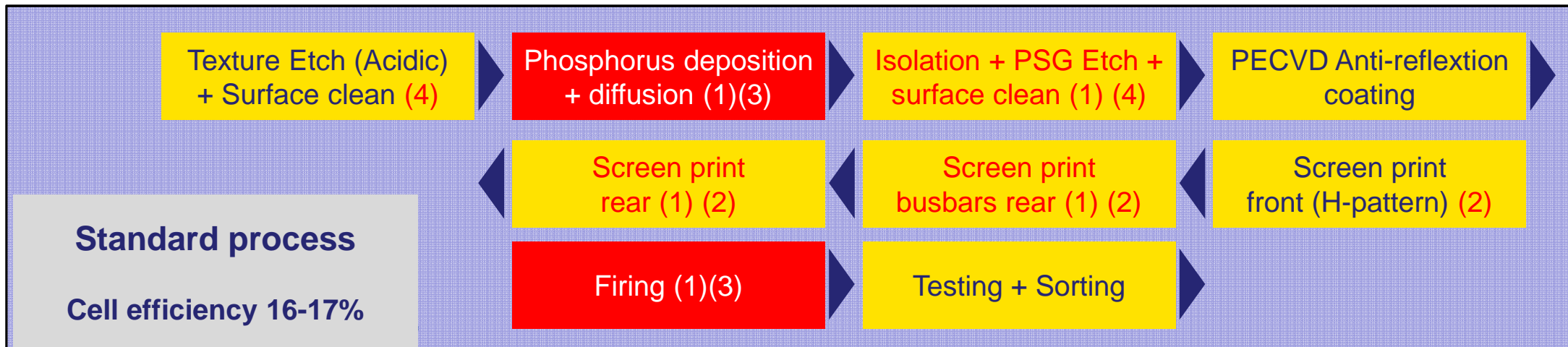
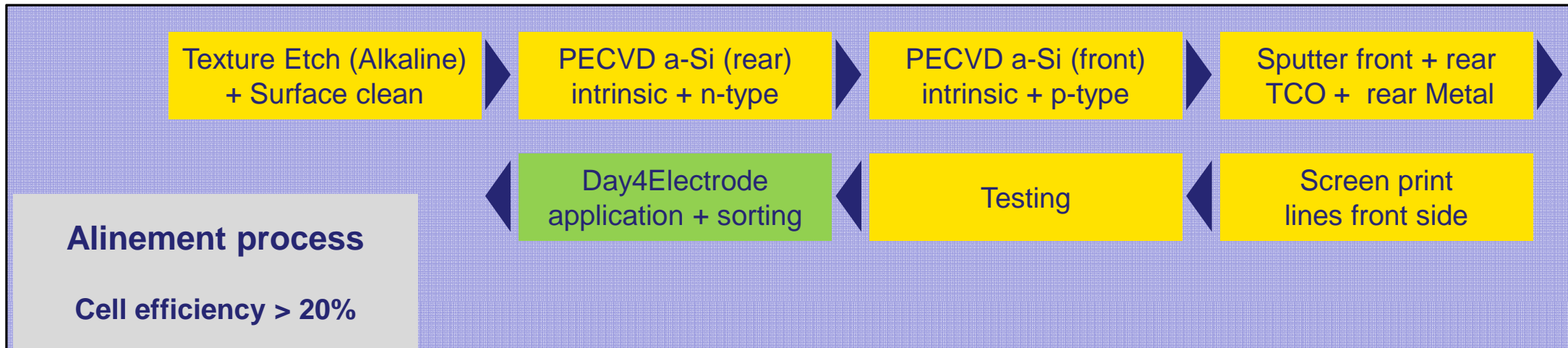
Module technology (Provider Day4Energy)



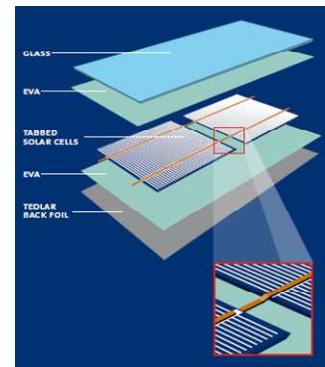
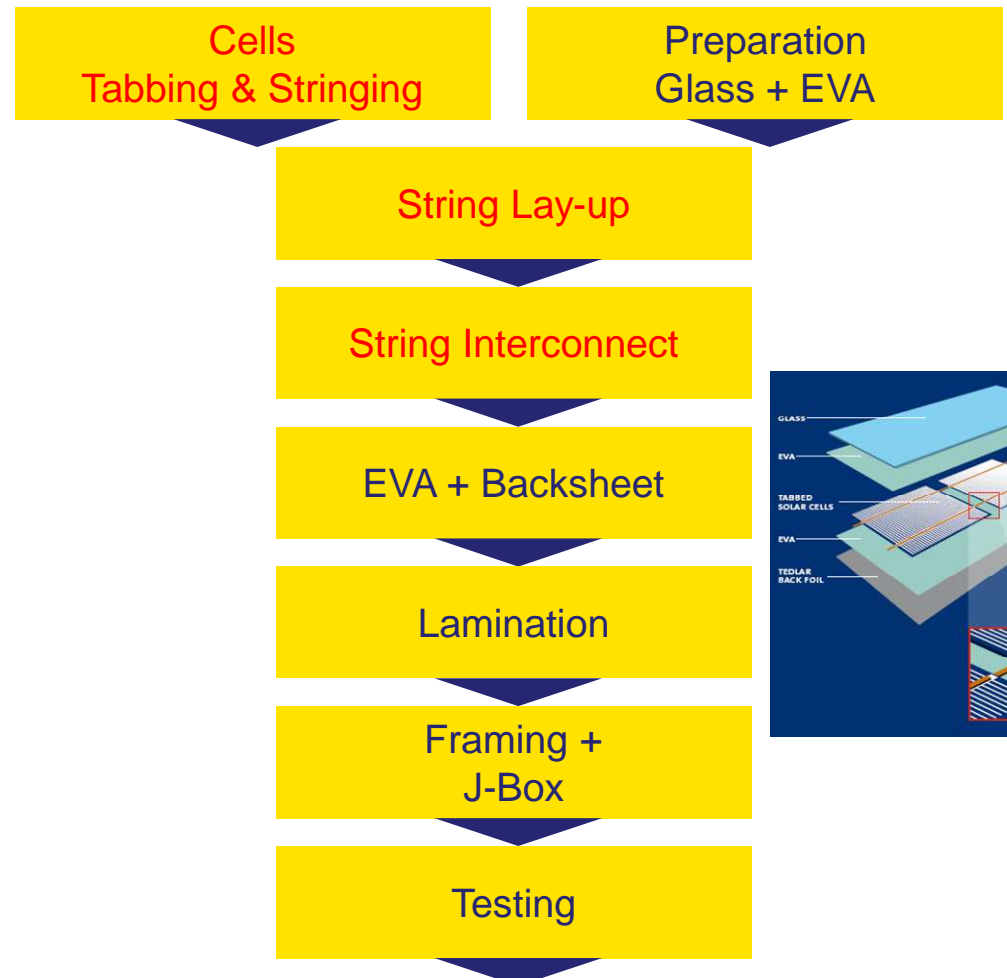
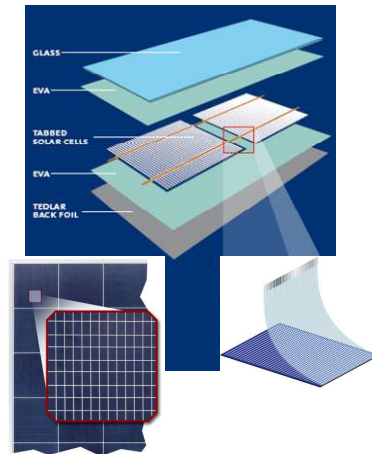
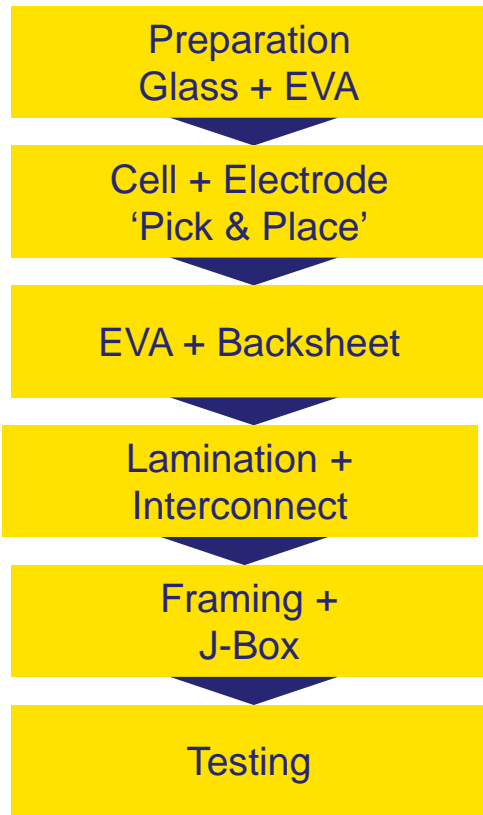
- Low temperature process
- No tabbing/stringing
- Automatic lay-up
- Highly automated
- Low series resistance
- Less encapsulation losses
- Low temperature coefficient

Module efficiency > 20 %

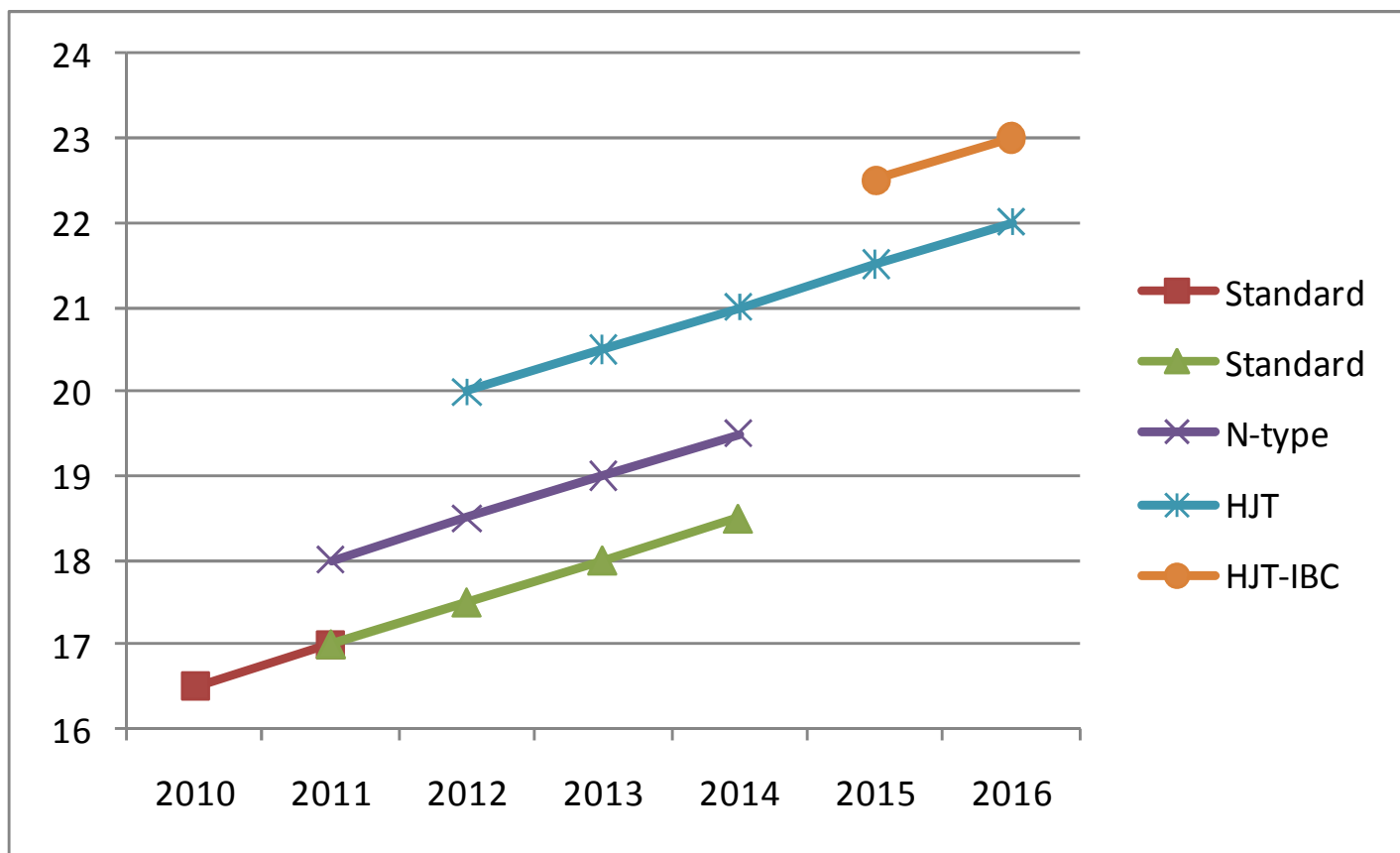
Cell Processing (Alinement vs Standard)



Module manufacturing (Alinement vs Standard)



Technology Roadmap



The Project time-line

- Phase 1 Cell & Modules 80 – 100 MWp in 2012
- Phase 2 Cells & Modules 500 MWp in 2013 - 2014
- Phase 3 Integration wafers* 2014

** slicing only*





Low manufacturing cost

- Cell manufacturing concept with less process steps and higher throughput.
- Low headcount due to new manufacturing concept.
- Low consumption of expensive materials (e.g. silver).
- Low energy consumption due to low temperature cell processing.
- Integrated cell-module manufacturing reducing handling costs and logistics.
- High automation within module manufacturing.
- Very low waste disposal costs.



Site location

Avantis industry park, cross-border Heerlen (NL), Aachen (DE)

Reasons for selection:

- In EU, sustainable PV market
- Availability of highly skilled personnel (NL-DE-BE)
- Reliable and competitive energy supply
- Excellent infra structure



Alinement

Integrale productie van wafer-cel-module

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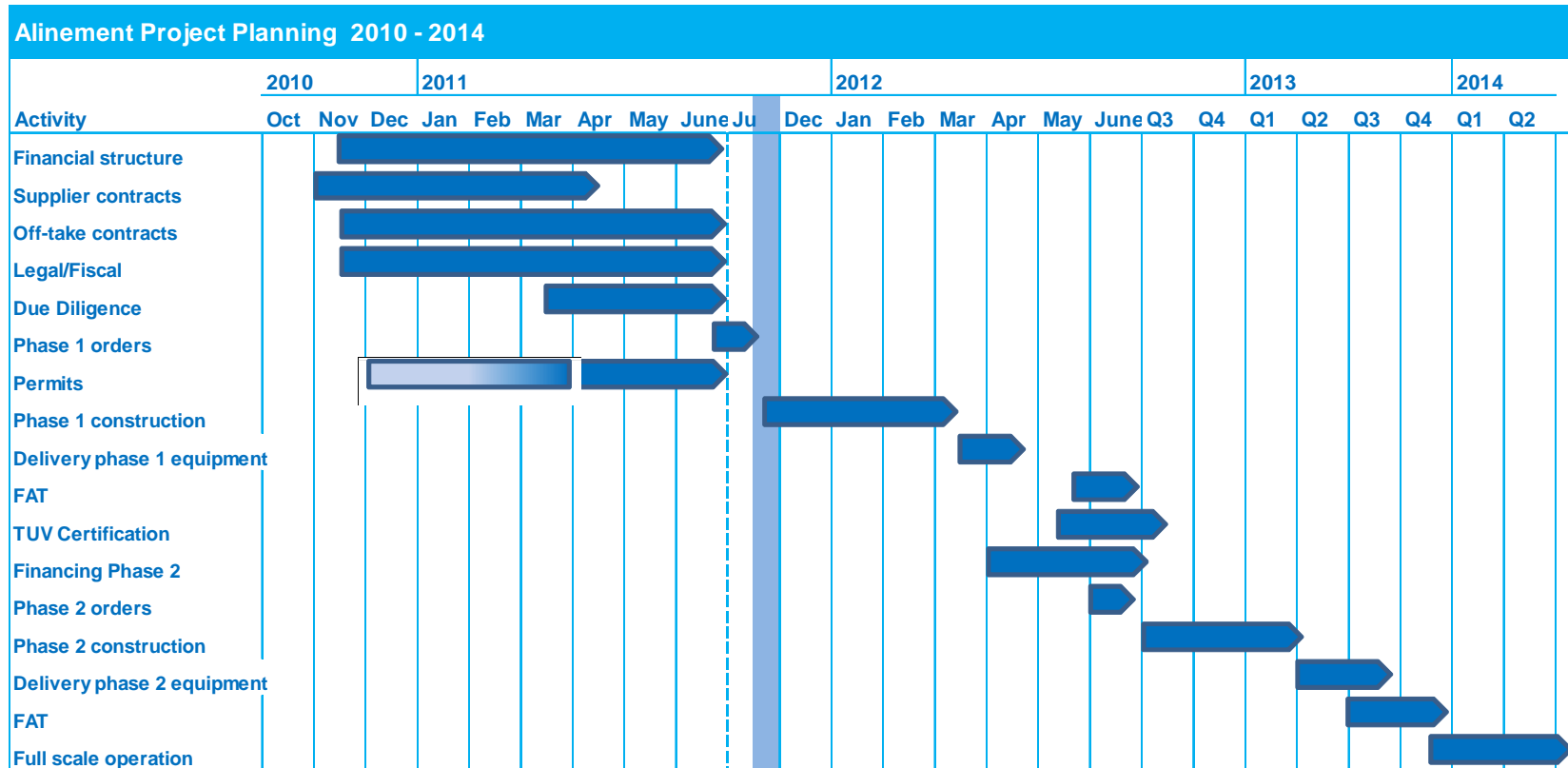
Attachments



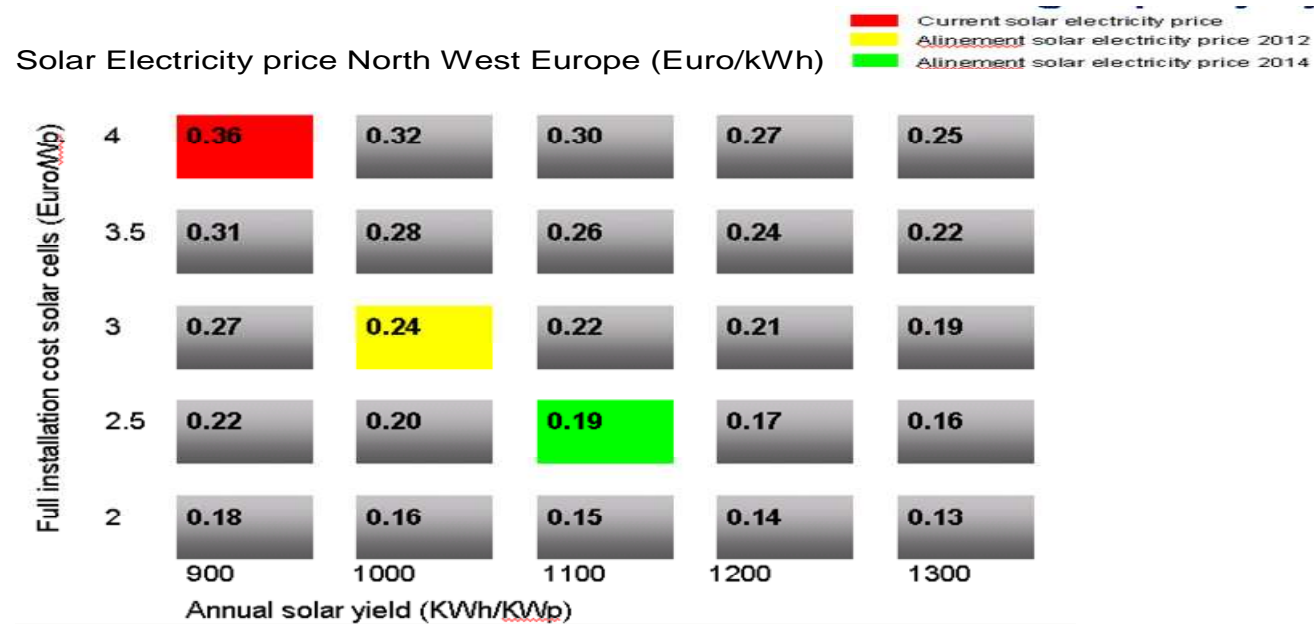
Founders

- Gosse Boxhoorn: CEO at The Silicon Mine (“TSM”) and founder of Solland Solar;
- Jan Willem Hendriks: CCO at The Silicon Mine (“TSM”) and founder of Solland Solar;
- Jac Hanssen: CEO at Alinement and former Site Manager at Solland Solar;
- Henk Koerselman: CTO at Alinement and former COO at Solland Solar;
- Geert Seelen: Procurement at Alinement and former procurement at Solland Solar;
- Pieter van Ameiden: Former senior engineer at Shell Solar and Solland Solar
- Hans Haarlem: former senior vice-president new business at DELTA NV
- Ruud Broere: CFO at Alinement and former interim CFO at Solland Solar
- Informal investors

Project Time Line

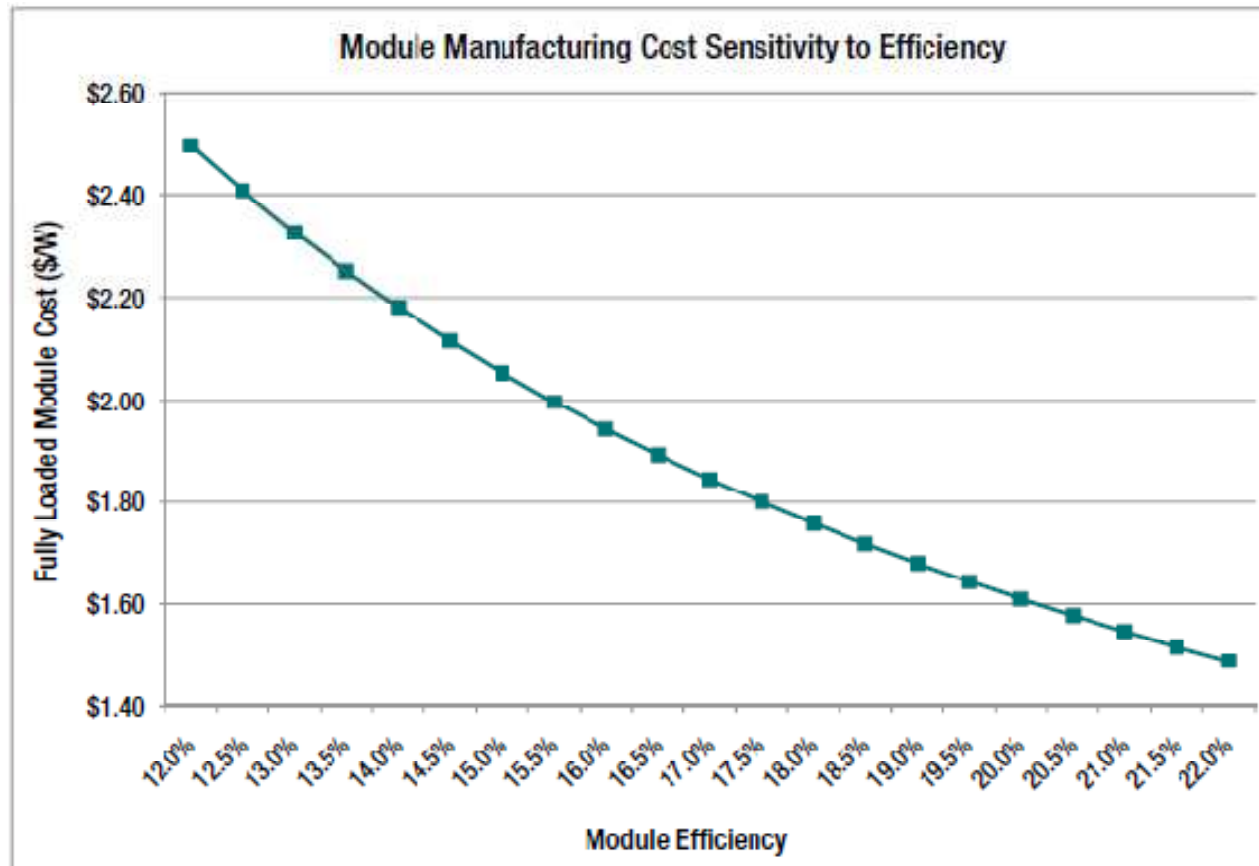


Grid parity without subsidies

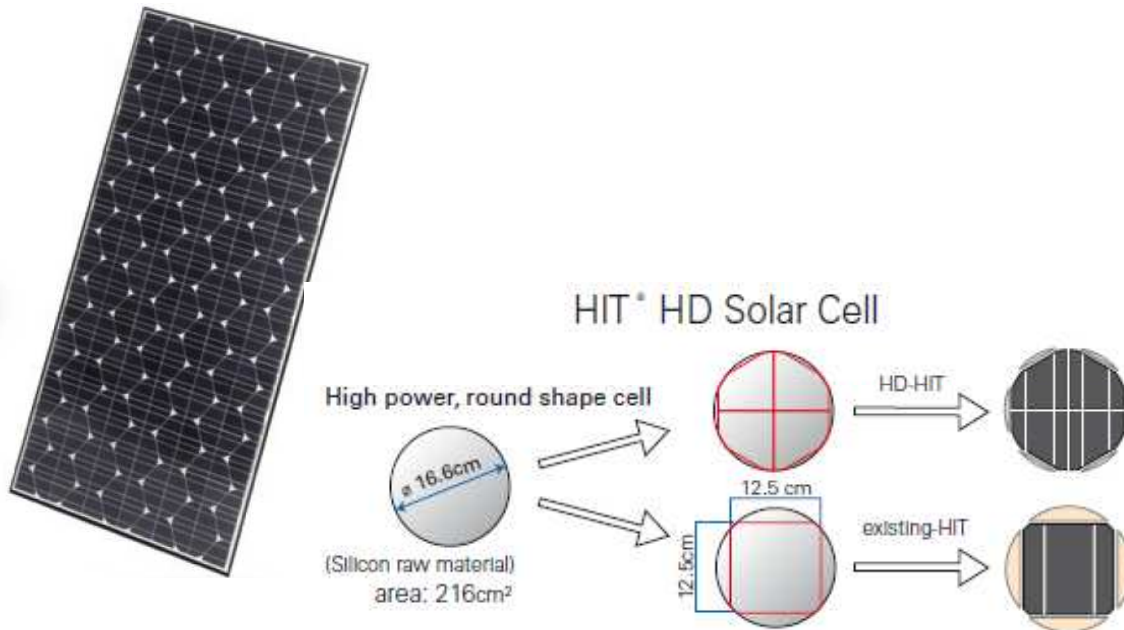


- Consumer electricity cost current PV systems: € 0.36/Wp.
- Consumer electricity cost present grid: € 0.23/Wp.
- Consumer electricity cost Alinement modules: € 0.24/Wp.

Cost Sensitivity to Efficiency



Competitor (Sanyo)



| Model | Cell Efficiency | Module Efficiency | Output / m ² |
|-------------|-----------------|-------------------|-------------------------|
| HIT-H250E01 | 20.8% | 18.0% | 180 W/m ² |
| HIT-H245E01 | 20.4% | 17.7% | 177 W/m ² |

