



# Crystalline Silicon on Glass

## The Next Generation

An ASI funded project with UNSW

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Managing Director, Suntech R&D Australia Pty Ltd

- Introduction
- Short History of CSG
- Key Cost Drivers
- Recent Progress
- Next Steps

# Suntech – a global company

with an Australian heart

## Suntech Power Australia Pty Ltd

12 staff incl 4 PV engineers

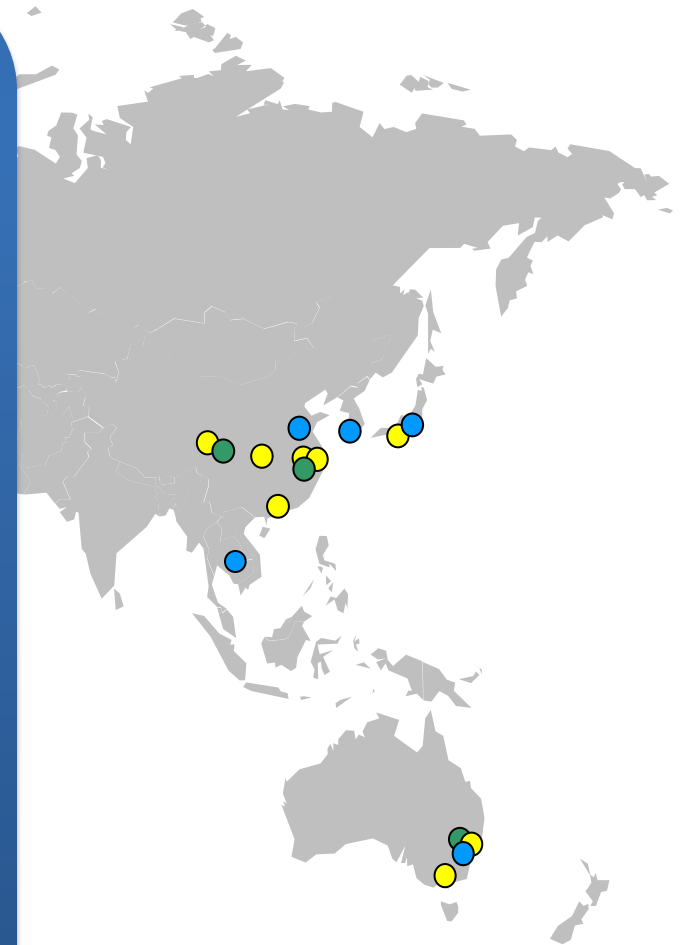
## Suntech R&D Australia Pty Ltd

20 staff engaged in research & development

## UNSW and VSASF , Swinburne

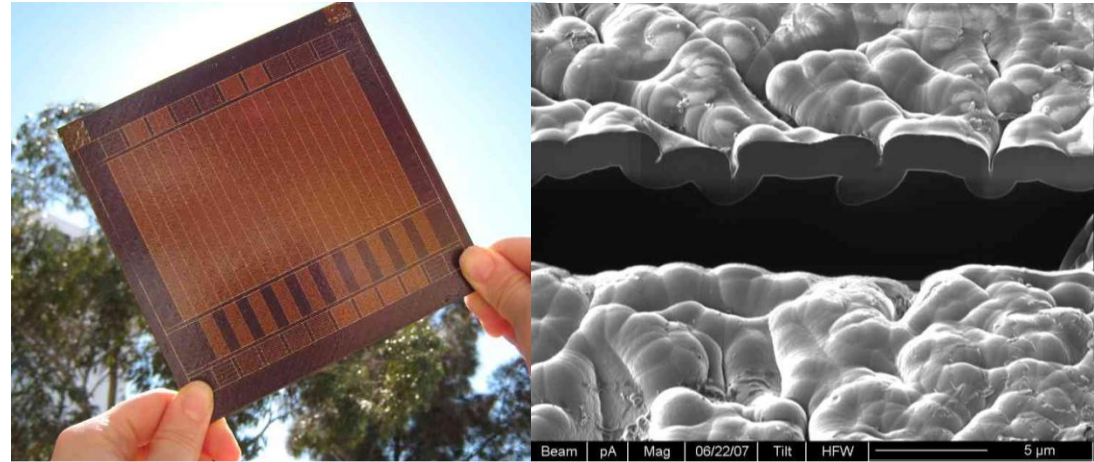
cash and in-kind contribution to projects  
with ASI, ARC, Vict Govt.

R&D budget for Australian operations  
>5M AUD/annum between 2010 and 2012



# Crystalline Silicon on Glass The Next Generation

Technology Developed in Australia



Targets reduced cost;  
low silicon use, no silver, large format, vertical integration ,  
Film of silicon on glass, crystallised and patterned  
Record 10.4% efficiency (2007) using only 2um silicon  
>10 international patents issued during development

# Crystalline Silicon on Glass The Next Generation

Manufacturing Development in Germany



Manufacturing, 2007-2009

1.4m<sup>2</sup> panels with efficiencies 7-8%

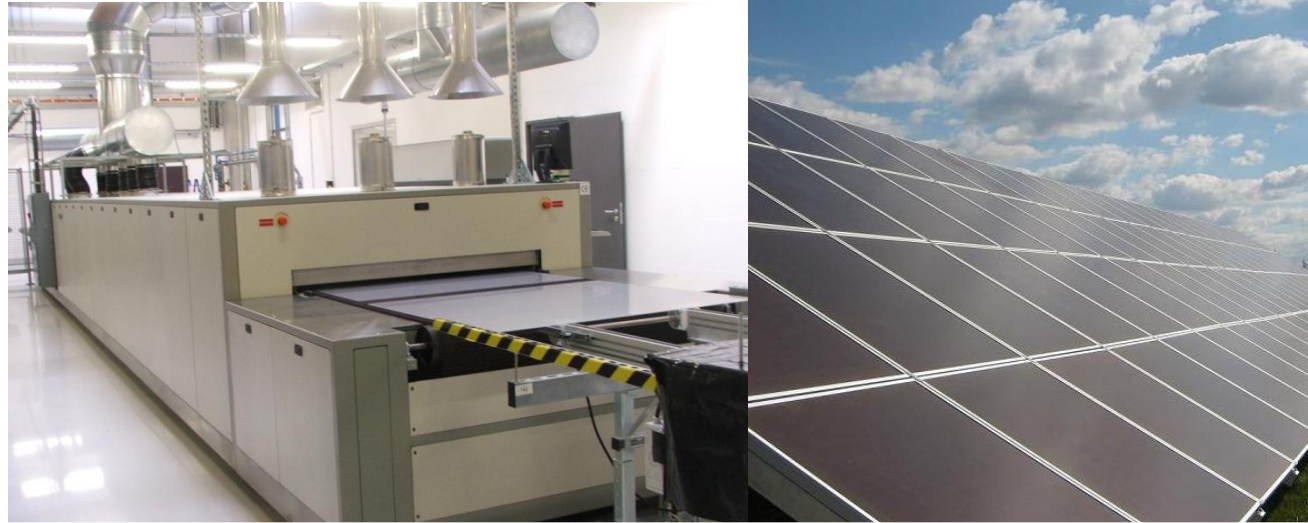
>100,000 modules produced, >7 MW fielded

2008 Manufacturing Cost 2.00-2.50 €/Wp

2008/9 drop in module prices = strategic changes

# Crystalline Silicon on Glass The Next Generation

## Key Cost Drivers



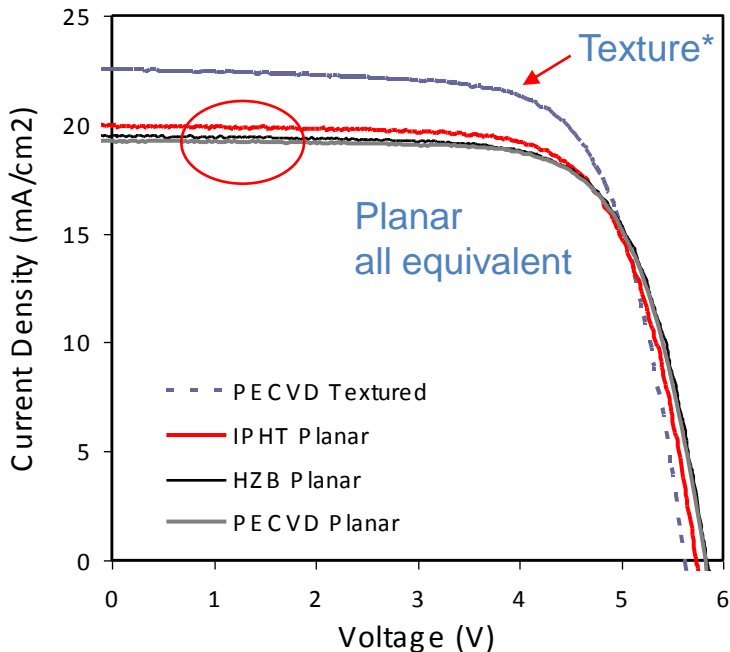
Alternate Substrate  
Alternate Deposition Process  
Higher Efficiencies

# Crystalline Silicon on Glass The Next Generation

## Recent Progress (2010-2011)

Suntech, with UNSW and Eu partners

- Alternate Substrate – move to Soda Lime Glass
  - ✓ Eff increased from 2% to > 8% (but with CVD)
  - ? Need to develop low impact thermal processes
- Silicon Deposition – move to high rate process
  - ✓ e-beam evaporation
  - ✓ 20 fold increase in deposition rates over PECVD
  - ✓ Eff increased from 5% to > 8%, equivalent to untextured PECVD (but with oven crystallisation)
  - ? Need to develop textures + tools



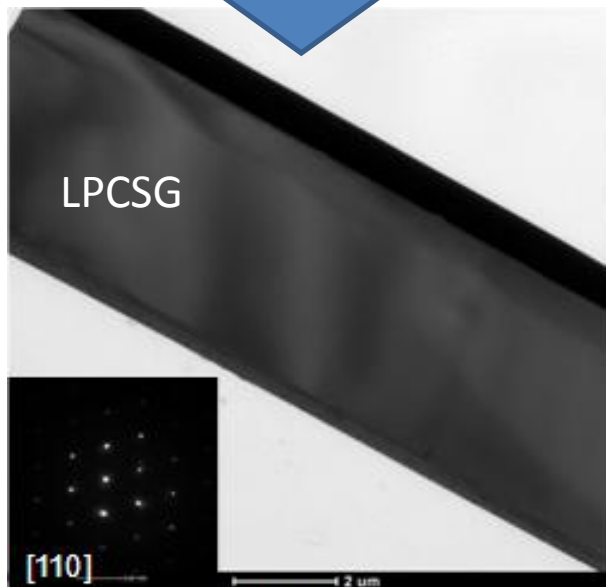
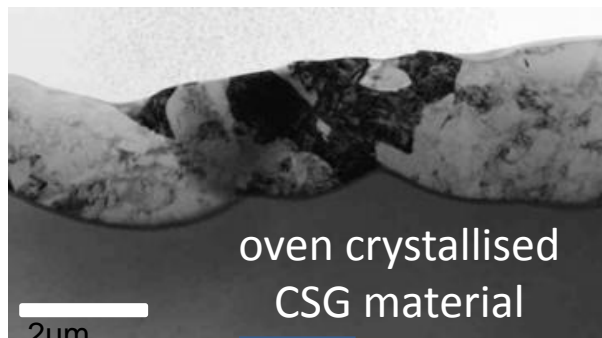
# Crystalline Silicon on Glass

## The Next Generation

Recent Progress (2010-2011)

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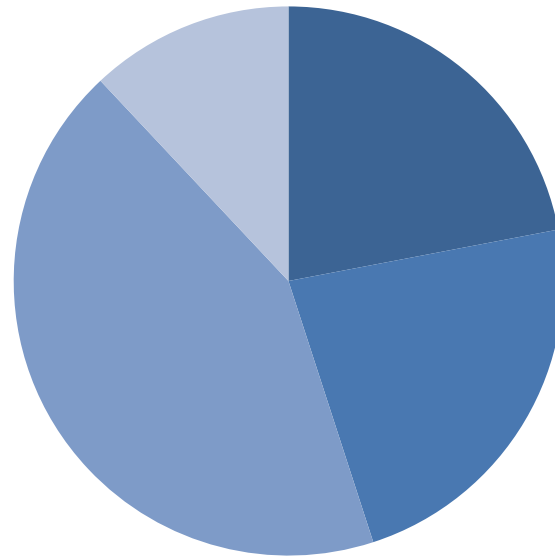
- Alternate thermal processing
  - Low Energy Payback
  - Compatible with SodaLime Glass
  - ✓ Liquid Phase Crystallisation
  - ? New Device technology
- Efficiency – breakthrough 500mV ceiling
  - ✓ Initial improvements already achieved with e-beam and LPCSG.
  - ? Target 13-15% to be cost effective



(Bright field)

# Crystalline Silicon on Glass The Next Generation

An ASI funded project 2012-2015



- ASI, 1.2M funding to UNSW
- UNSW - project manager
- SRDA - industry partner
- EU partners in kind

Total Project Value  
5.3 Million AUD

PM Dr Sergey Varlamov  
PI Dr Renate Egan

Advance the e-beam deposition of silicon  
Develop low impact thermal processes  
Develop compatible textures for light trapping  
Targets: CapEx of <\$1/Wp and  
COGS 50c/Wp at 12% and 60c/Wp at 15%



# Progress and Plans for the CSG Technology is made possible by contributions from....

- The team at UNSW, Martin Green and Sergey Varlamov
- The team at Pacific Solar Pty Ltd
- The team at CSG Solar AG and CSG Solar Pty Ltd
- The team at Suntech R&D Australia Pty Ltd



AND Project Funding from

- The Australian Research Council
- EU Framework 7
- The Australia Solar Institute