

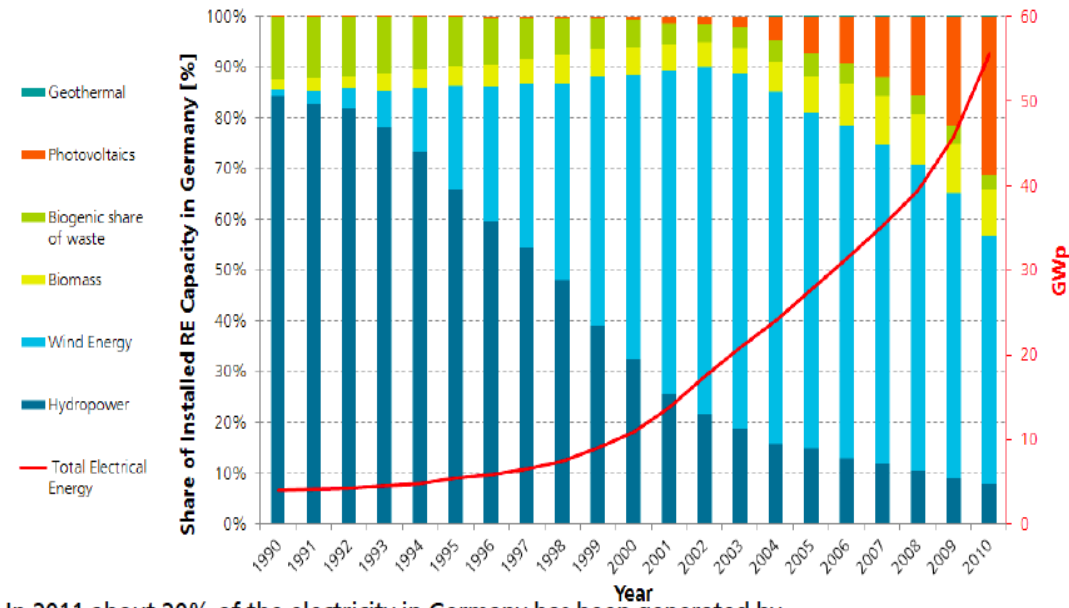
Strategic Outlook for Photovoltaics

Stuart Wenham
CTO, Suntech
Director of PV Centre at UNSW

27th November, 2012

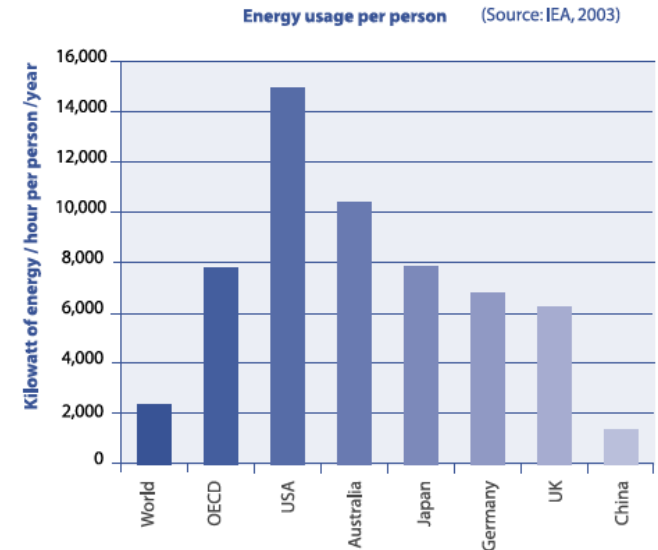
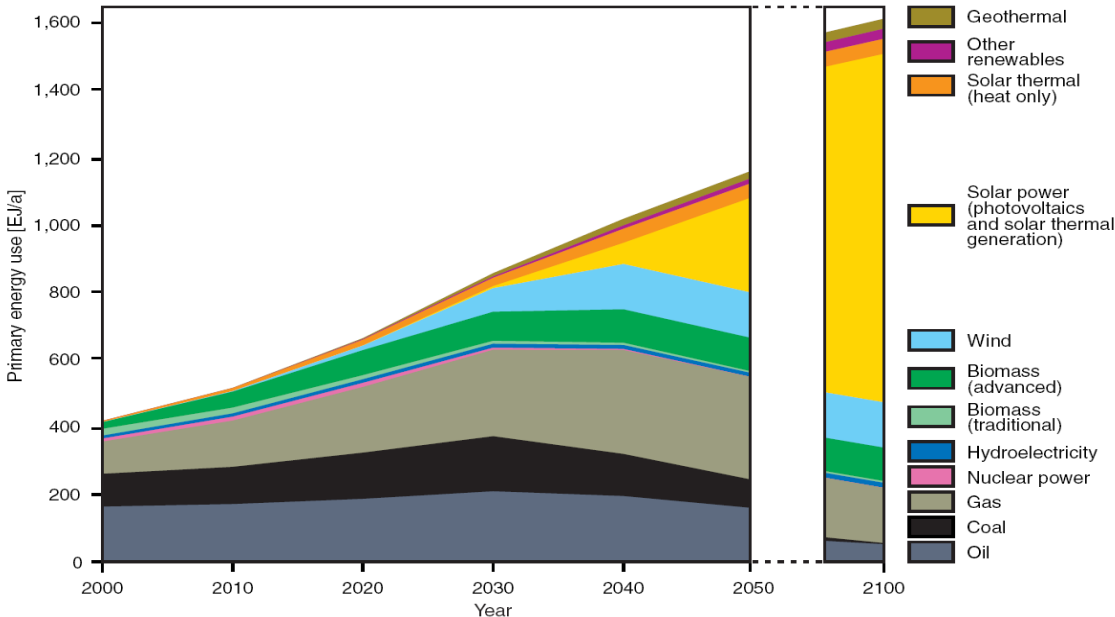
Current & Future Energy Sources

- Grid Parity being reached by RE sources
- Value of complementary nature of RE sources being better understood
- US DoE study – RE mix provides reliability of supply



In 2011 about 20% of the electricity in Germany has been generated by renewable energy (RE) sources according to BDEW

Data: BMU, BDEW Graph: PSE AG 2012



Evolution in PV Applications

1970-1995

- Stand-alone Systems
 - Remote locations
 - Deserts & marine

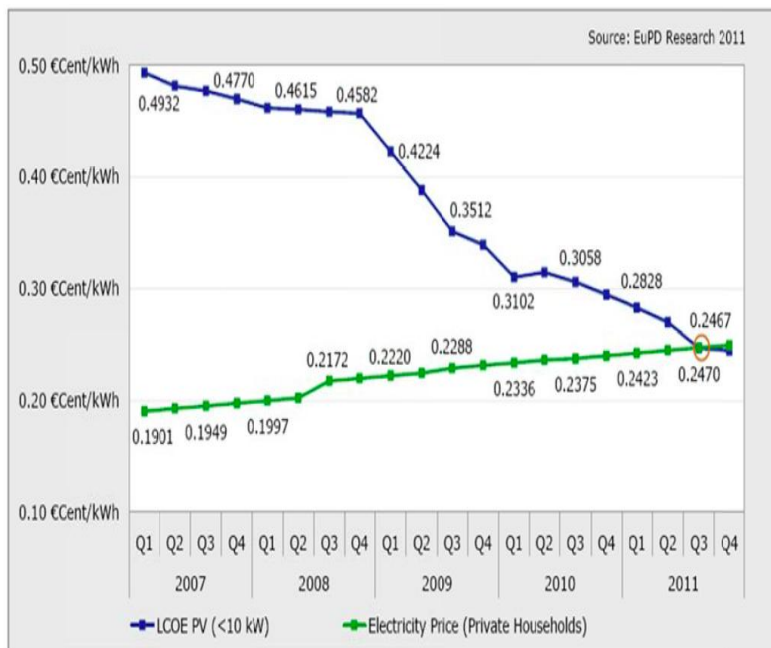
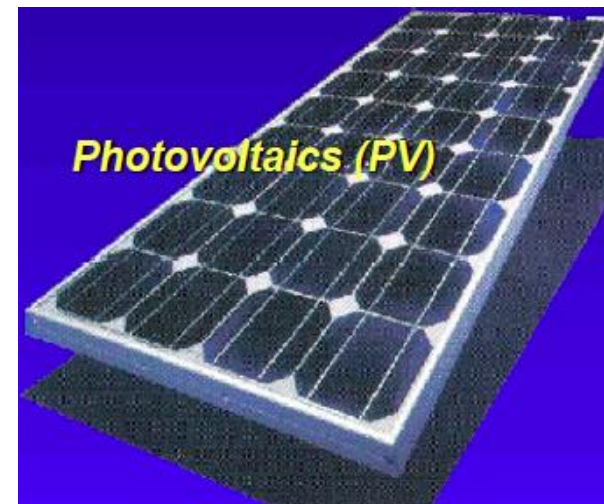
1995 – present – future

- Rooftop Systems
 - Currently dominating
- Utility Scale Systems
 - Spain, USA
 - particularly in deserts
- Stand-alone Systems
 - Developing Countries

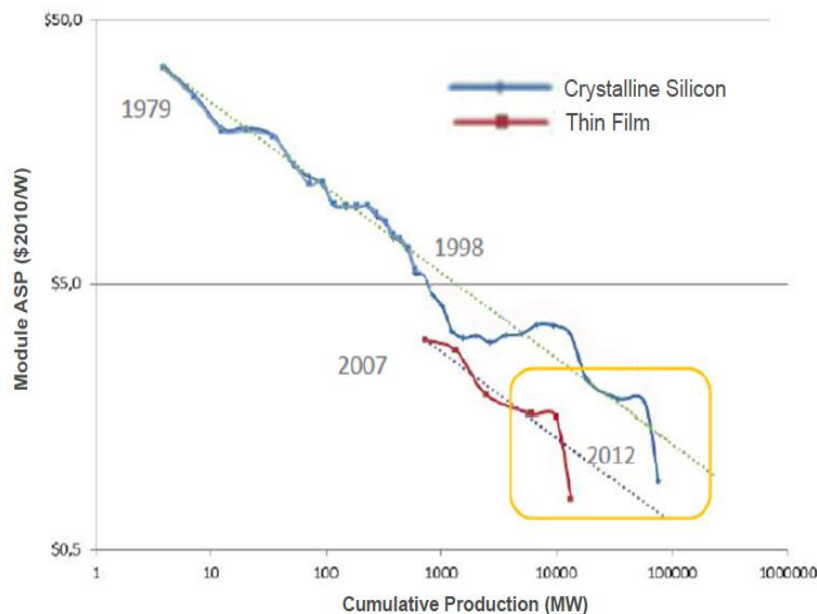


80% PV Module Price Reduction in 4 Years

- PV prices no longer limiting market growth
- Red-tape, approvals, electricity supply agreements & BOS costs are primary limits
- Example of roof-top systems (module costs US\$0.75 /Wp) :
 - US system costs >US\$4 /Wp
 - Many countries still without grid-interconnection policies



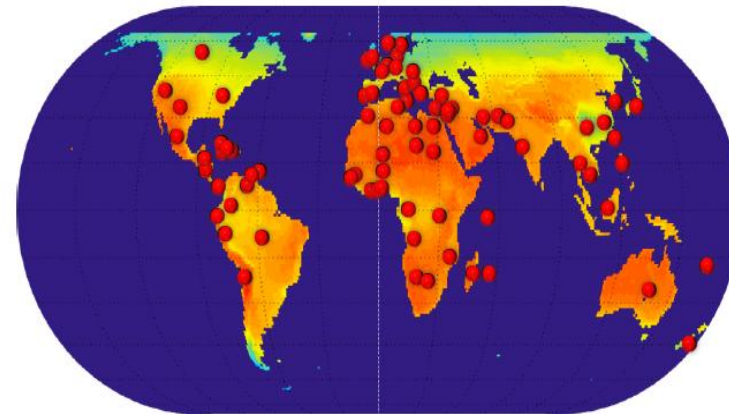
Recent Times: Accelerated Learning, New Synergies



Implications of Price Reduction

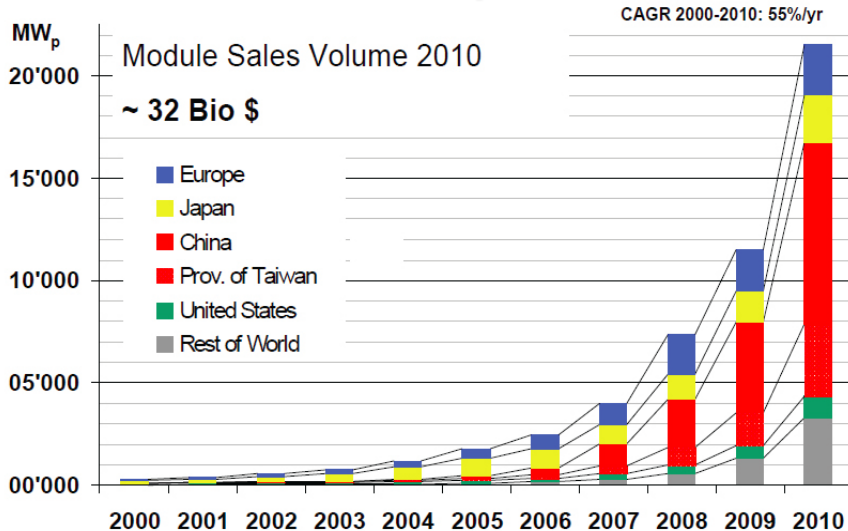
- Grid parity in >100 countries
- Reduced importance on subsidies & FITs
- Fastest growing industry world-wide for its size

2012 Status: PV Solar at Grid Parity

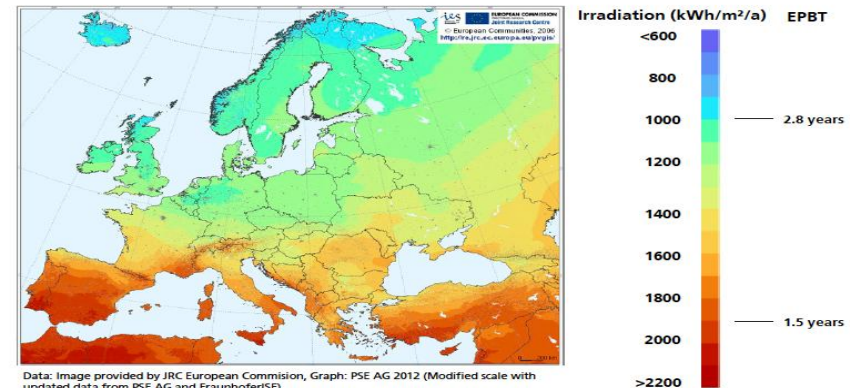


Now
2012
102
countries
have
reached
grid parity

Annual PV Factory Production

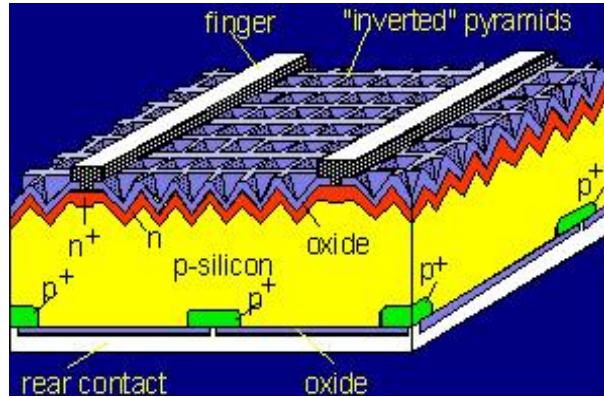
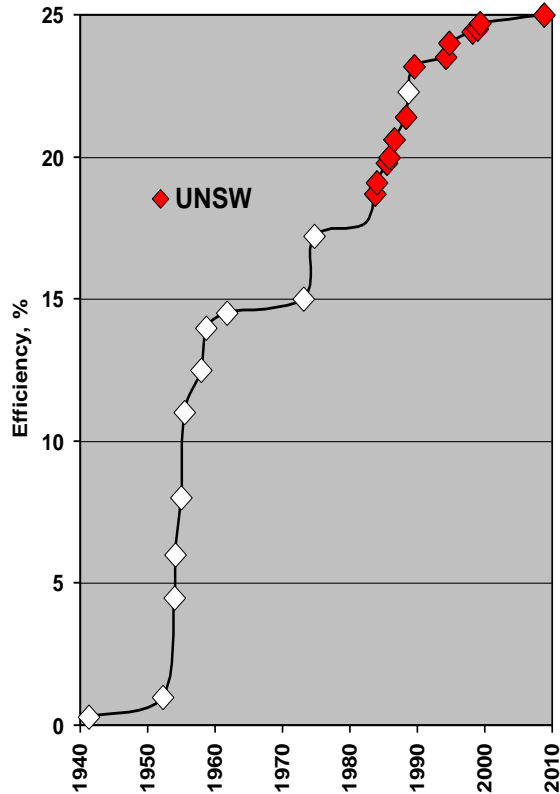


Energy Pay-Back Time of Multicrystalline Silicon PV Systems - Geographical Comparison



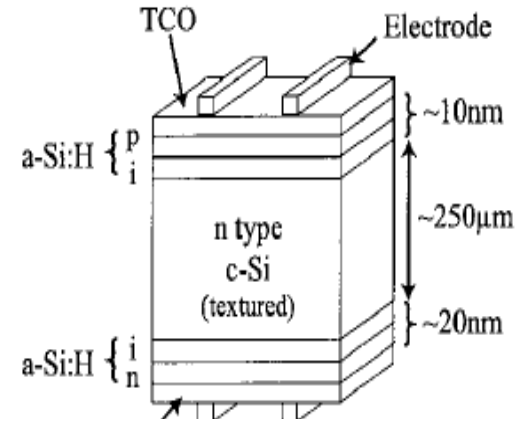
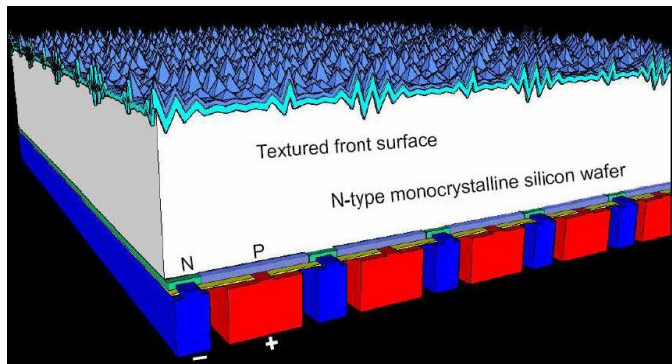
Leading Technologies

- Stanford University gave rise to the SunPower technology
- The UNSW gave rise to the Suntech Pluto technology



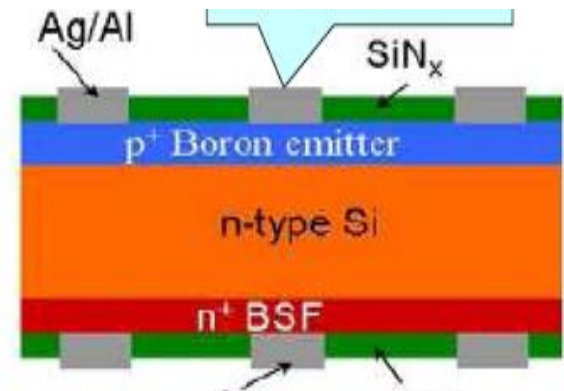
UNSW – 25% PERL cell (world-record)

Stanford – 24% Rear Contact



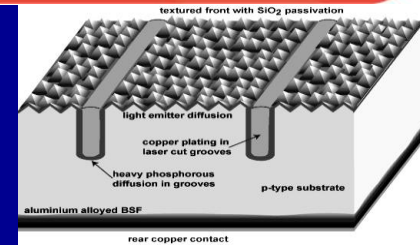
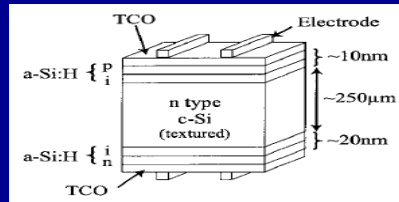
Sanyo – 23% HIT cell

ISE – 23.9% PERL



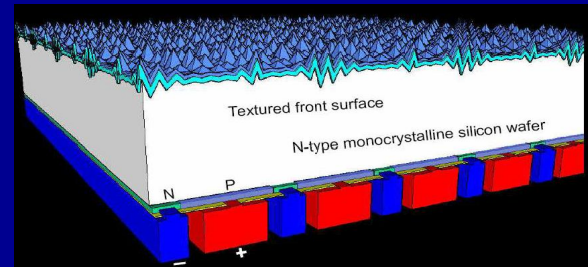
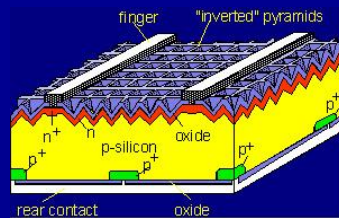
Commercialisation of High Efficiency, Low Cost Technology

- Buried Contact Solar Cells (Australian)

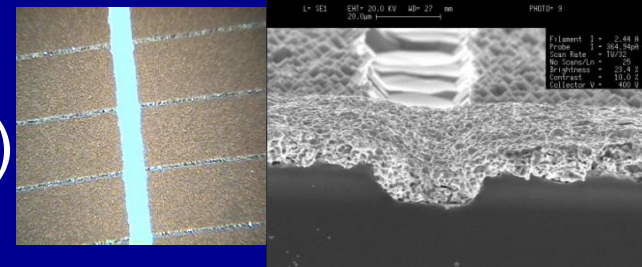


- HIT cell (Japan)

- Rear Point Contact Cell (USA)



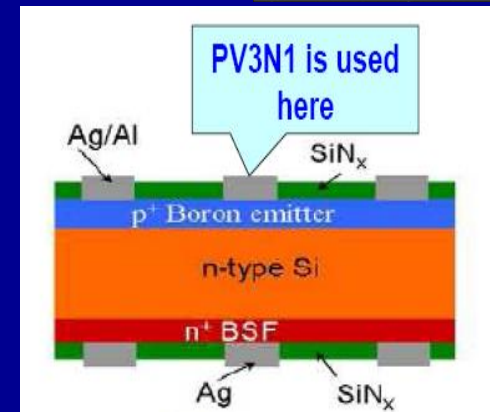
- Pluto (Australia)



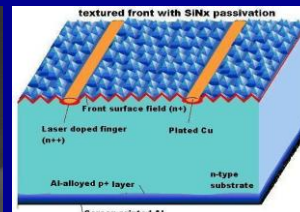
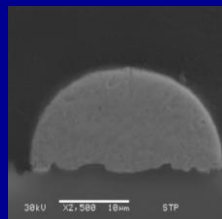
- Semiconductor Finger Cells (Australia)

- Yingli Panda technology (Netherlands)

- Laser Doping (Australia)



- Innovalight (USA)





China's Dominance in Manufacturing

2007	MW	2008	MW	2009	MW	2010	MW	2011	MW
	389		582		1100		1573		2096
	363		504		704		1400		1721
	336		494		595		1300		1711
	207		473		586		1100		1695
	200		300		525		1000		1623



BUSINESS

Chinese Solar Companies Thrive on Manufacturing Innovations

Suntech Power's CTO argues that the secret to China's success is not cheap labor but advanced equipment for making solar cells.

WEDNESDAY, JULY 6, 2011 | BY KEVIN BULLIS

[Audio »](#)

Five years ago only one of the 10 largest solar producers was based in China. Now five of the top five were based in China.

fast: all four doubled their production last year. It's widely believed that this is due to low labor costs, but Stuart Wenham, CTO of the largest solar manufacturer, Suntech Power, argues that the real causes are advances in manufacturing technology that have improved solar cells' performance and cut costs.

Suntech Sets World Record 20.3% Efficiency for Pluto Cell Technology

2 messages

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 To: E-SUNTECH <s.wenham@unsw.edu.au>

Mon, Mar 12, 2012 10:00 AM

WUXI, China, March 12, 2012 /PRNewswire-Asia/ -- Suntech Power Holdings Ltd. (NYSE: STP), the world's leading manufacturer of photovoltaic solar panels, today announced that its industry-leading Pluto multi-crystalline silicon PV module has achieved a new world record conversion efficiency of 20.3% (aperture area only) set by Sandia National Labs 15 years ago. The record efficiency was independently tested by Fraunhofer IZL.

Suntech Achieves World Record Efficiency for a Multi-Crystalline Module

August 19, 2009: 08:45 AM ET

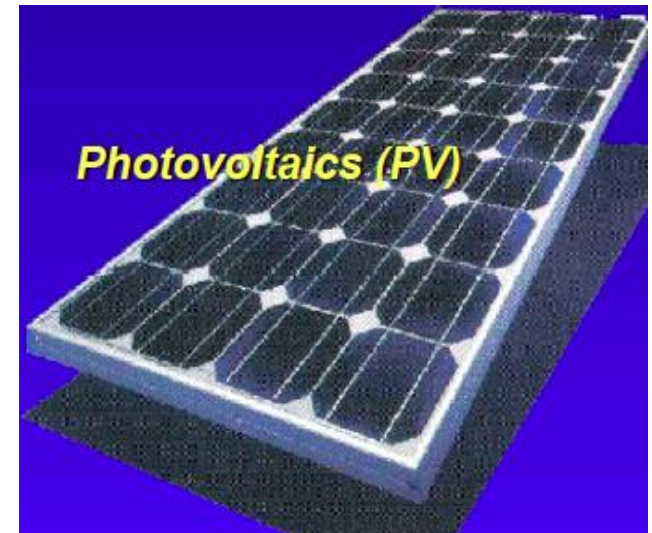
WUXI, China, Aug. 19 /PRNewswire-Asia/ -- Suntech Power Holdings Ltd. (NYSE: STP), the world's leading manufacturer of photovoltaic solar panels, today announced that it has achieved a new world record conversion efficiency of 20.3% (aperture area only) set by Sandia National Labs 15 years ago. The record efficiency was independently tested by Fraunhofer IZL.

PR Newswire

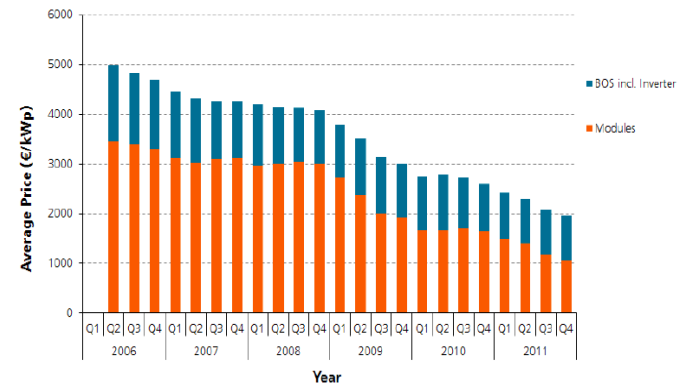
Trends in Module Design Present a Danger

9

1. Encapsulation costs now dominating. Typical per watt costs:
 - \$0.23 Wafer
 - \$0.13 cell conversion
 - \$0.34 encapsulation
2. Avoid cutting encapsulation costs for the harsh desert environment
3. Desert applications require:
 - higher temperature pottant
 - more durable backing sheet
 - avoid fast diffusing metals contacting silicon such as Cu
 - avoid thin semiconductor layers
4. Thorough testing for deserts needed



Average Price for PV Rooftop Systems in Germany (10kWp - 100kWp)



Suntech's State-of-the-art Testing Facilities

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- Suntech's test facilities the most extensive and advanced world-wide
- Please visit us in Wuxi to see our testing
- Suntech strongly recommends independent testing in Israel
 - Capital Nature's test site-Kibbutz Yotveta



Suntech Places Enormous Importance on Quality and Durability



Suntech National & International Technology Awards

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2007 World Technology Award for Energy (International Award)

Sponsored by the New York Stock Exchange and Time Magazine. Awarded for the successful development and commercialisation of the high efficiency Pluto technology

2008 Clunies Ross Award (National Award)

Suntech Chief Technology Officer Dr Stuart Wenham received the award for "contributions to solar cell development and commercialisation".

2009 IEEE PV Cherry Award (International Award)

For groundbreaking research on all PV-relevant materials and devices at the 34th IEEE Photovoltaic Specialists Conference in Philadelphia.

2010 UK Energy Institute Award for Technology (International Award)

Prestigious international award for Suntech's photovoltaic technology

2012 EuPD Top Brand PV for Germany, Italy, and France (International)

Suntech awarded the TOP Brand PV company for highest marks for brand recognition and recommendation in all three European key markets Germany, Italy and France.

2012 Australian Collaborative Innovation Award (National Award)

Awarded to Suntech and UNSW for the successful development and commercialisation of the Pluto technology

2012 PV Tech Most innovative Product of the Year (international Award)

PV Tech awarded Suntech's crystalline silicon solar panel as the most innovative solar product of 2011.

2012 MIT Technology Review Most Innovative Company (International Award)

Suntech has been named as one of the fifty most innovative companies worldwide by the Massachusetts Institute of Technology (MIT) Technology Review technology magazine.

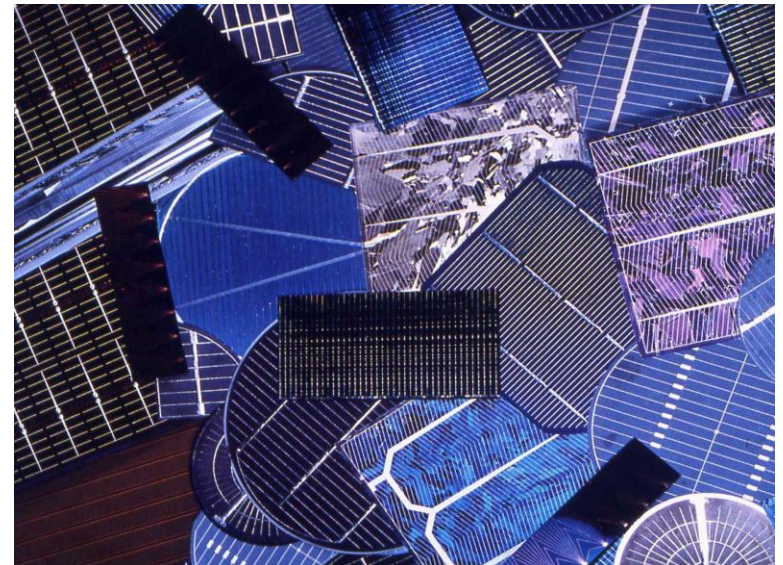
2012 Fast Company Ten Most Innovative Companies in China (National award)

For innovation in technology, ethonomics (ethical economics), leadership, and design. Fast Magazine is written for, by, and about the most progressive business leaders in the world .

CONCLUSIONS

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- PV costs will continue to fall, but cost-cutting may be a danger for desert applications
- A 15-20% premium is likely for highly durable pv modules for desert locations
- Efficiencies will continue to increase with new technologies
- Thin-films unproven in desert locations
- Silicon will strongly dominate for at least the next decade



Thank You

Experts Predict PV Trends for Next 10 Yrs

15

- Experts formulate the 2020 IPVTR
- Silicon to dominate for at least next 10 years



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Predicted Cost Reductions

