

How Australia Can Add and Capture Value in a Global Solar Industry

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East Solar Conference
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Summary



- Industry snapshot
- Strengths: cutting-edge, industry-relevant collaborative research and niche applications
- Enablers
- Opportunities

Global solar technology directions



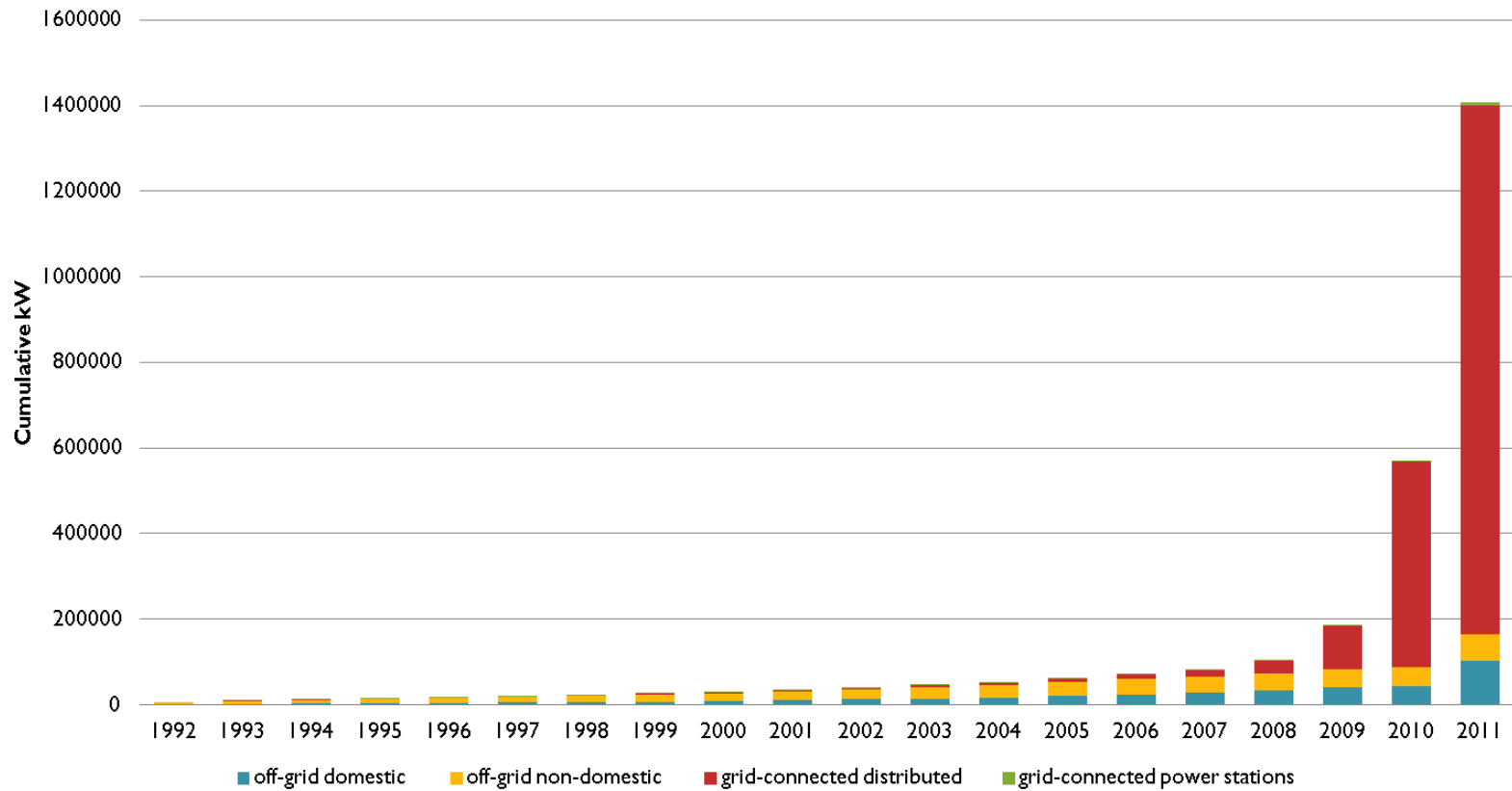
Solar PV 70GW deployed globally

- Australian R&D critical part of global supply chain
- Local costs a major driver with PV device now <\$1pW
- Technology – efficiency is key to lower installed costs
- Business models and distributed generation regulation and policy settings critical factors

CSP <2GW deployed globally

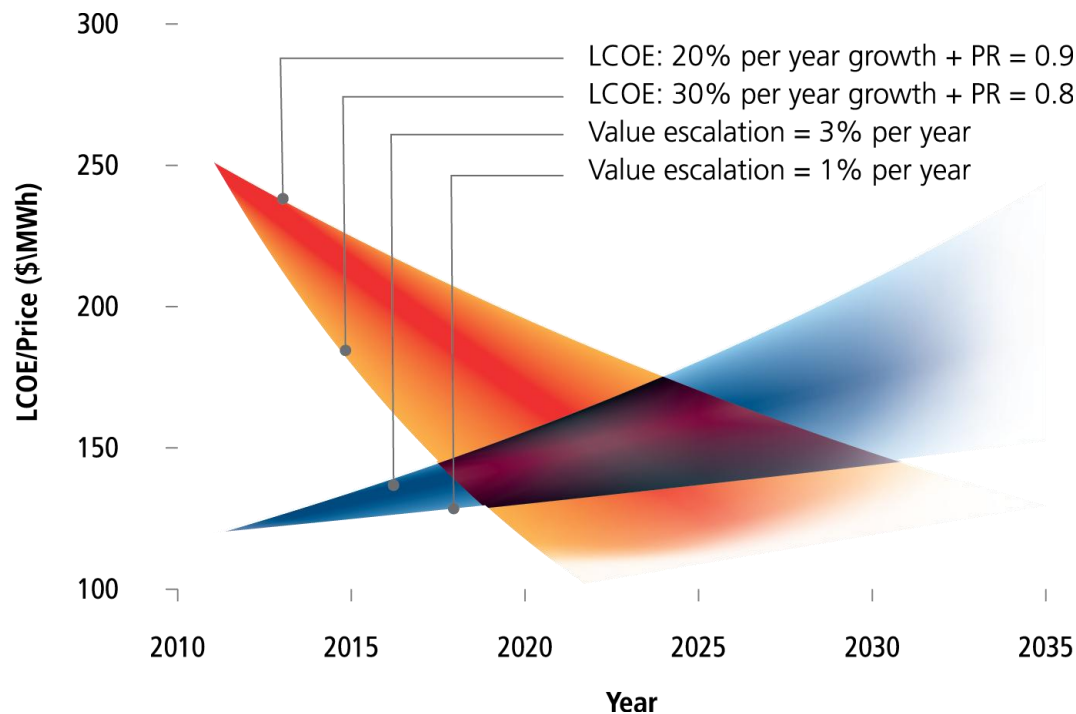
- RD&D of high temperature point focus (towers / dishes) technology critical to driving costs down to commercial viability
- Integrating cost effective storage and appropriate settings to reward dispatchability are key investment drivers
- Australian end of grid and off-grid applications already economic – focus now on R&D, demonstrating prospective technology and lowering perceived operational risk
- Business models will emerge through demonstration of prospective technology and increased investor confidence

Australian PV market



The CSP commercial equation

Indicative baseline LCOE: \$252 per MWh for a typical 64MW_e trough CSP plant vs. potential earnings of \$120 per MWh in today's grid connected markets.



A vision for a strong CSP future for Australia

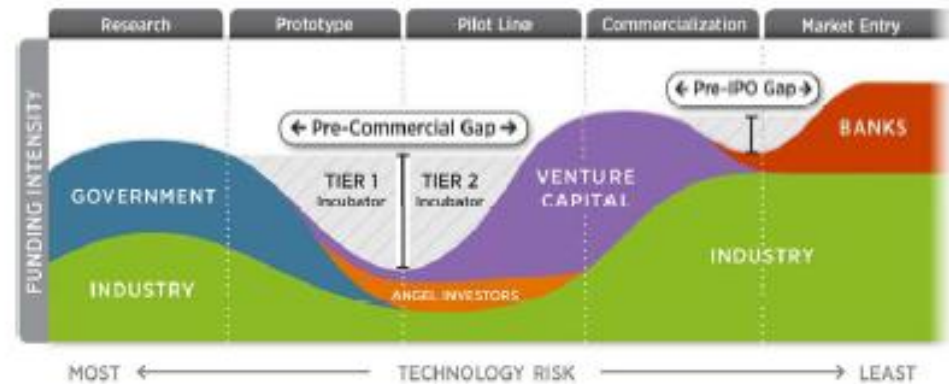


Cumulitive capacity	Timing	Fraction of national demand	Notes
100s GW	2050 +		Significant source of export income via solar derived fuels and or HVDC links to Asia
100 GW	2050	30–50%	CSP provides between 30–50% of Australia’s electricity in a mature 100% clean energy scenario
10 GW	2030	5–10%	CSP provides significant contributions in all market segments. Established Australian Supply chain
2 GW	2020	1%	First fullt commercial projects in the most prospective market segments
0.3 GW	2013	0.2%	First assisted demonstration systems at various scales

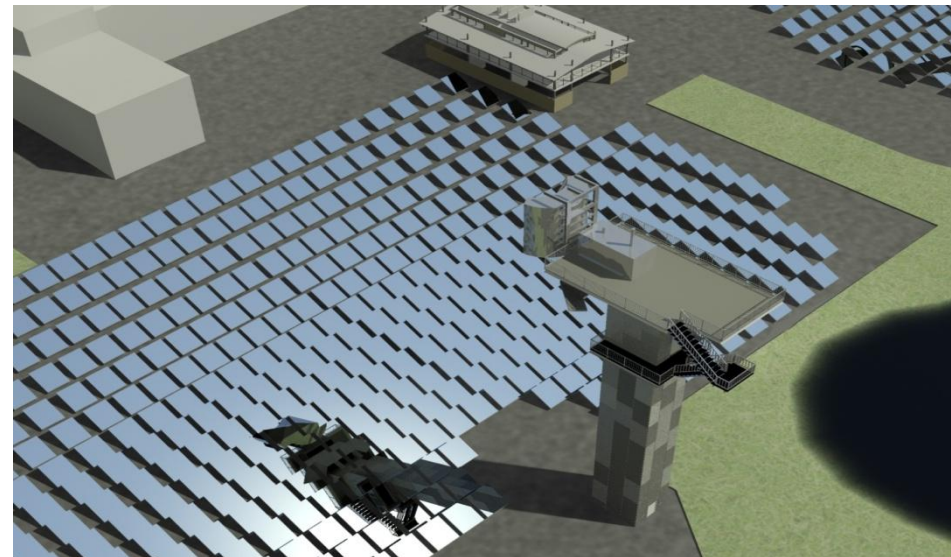
New CSP technology requires demonstration to improve bankability

- **R&D Pilot Phase (c\$5m)**
400kW - prove basic operation
- **Phase 1 Demonstration (\$10m)**
1MW - prove yield
- **Phase 2 Pre Commercial Demonstration (\$30m)**
4-5MW - prove reliability & revenue stream
- **Phase 3 Early Commercial Operation (\$200m)** 50MW - prove financial return

Capital Finance Key Barrier



Source : US DoE 2011



Prize – Competitively priced solar electricity with hybrid / storage integration to provide firm supply

Progress across the full set of costs is required to increase commercial viability and deployment

LCOE Drivers

Finance
Channel
Margins

Other
Hardware,
Civils, Install ,
Land, O&M

Solar Device

Local costs

70-80% of
employment in
these areas

Global costs

Technology
IP key value

Area required for a
6.5MW PV Power
Plant at 10% and
20% efficiency

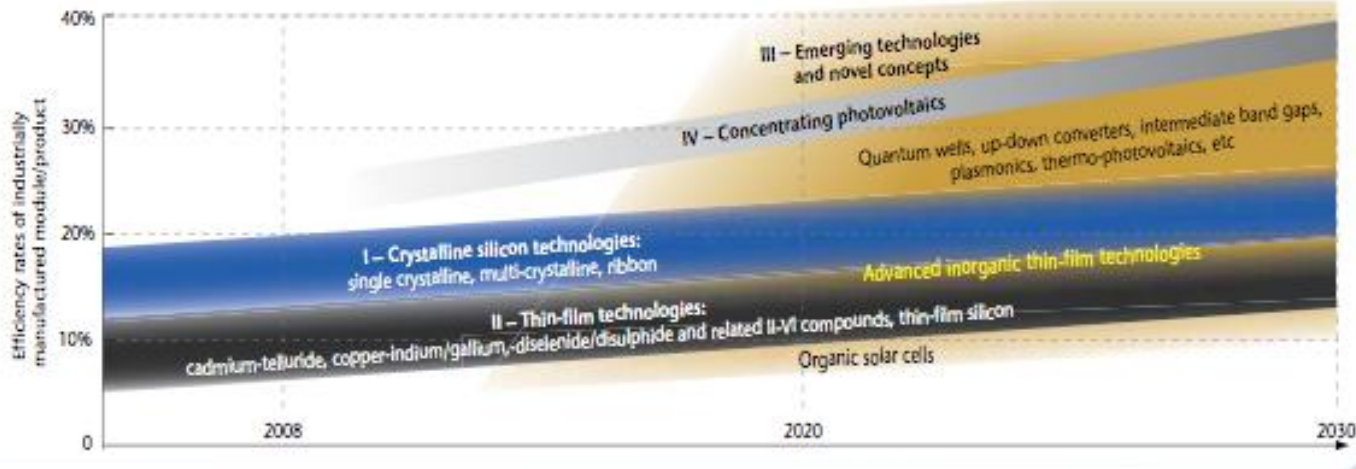
Source : Sunpower Corporation.



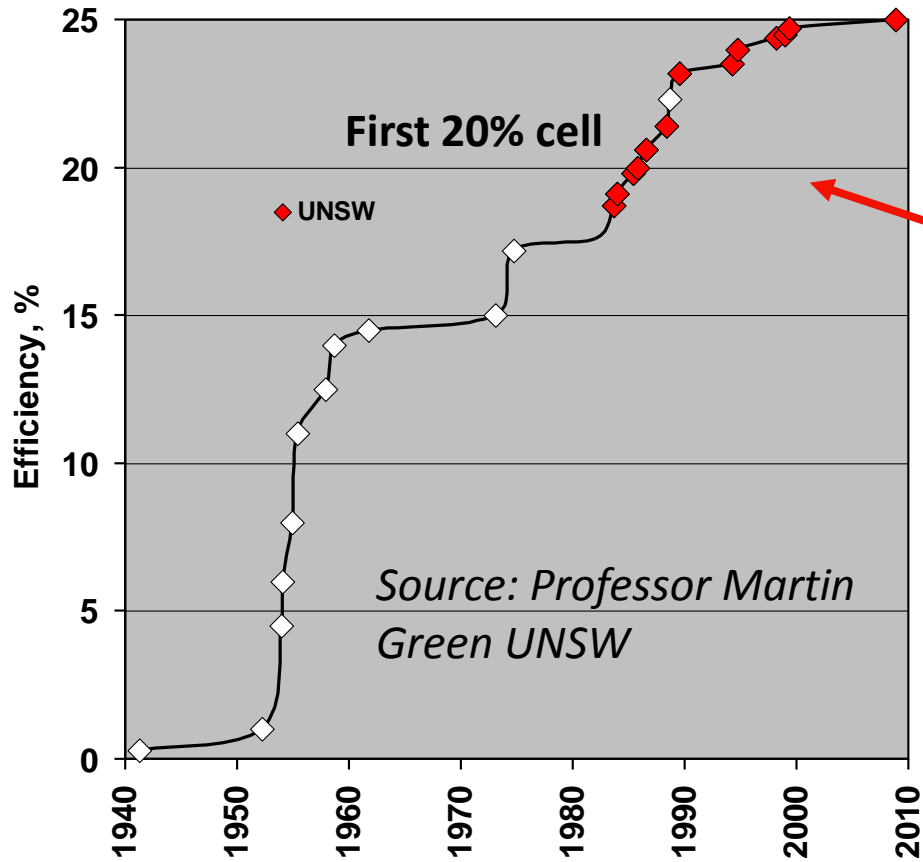
Current high level strategic technology roadmaps

- Today's technology will continue to evolve, lowering costs and increasing efficiency
- New technology emerging that will accelerate trends

PV technology status and prospects



Australian technology and research capability is world leading



Australian alumni now leaders in a global industry

UNSW Tech Transfer

Trina, Solarfun CTO

Suntech/ Sunergy/ JA Solar/
Sunrise Global

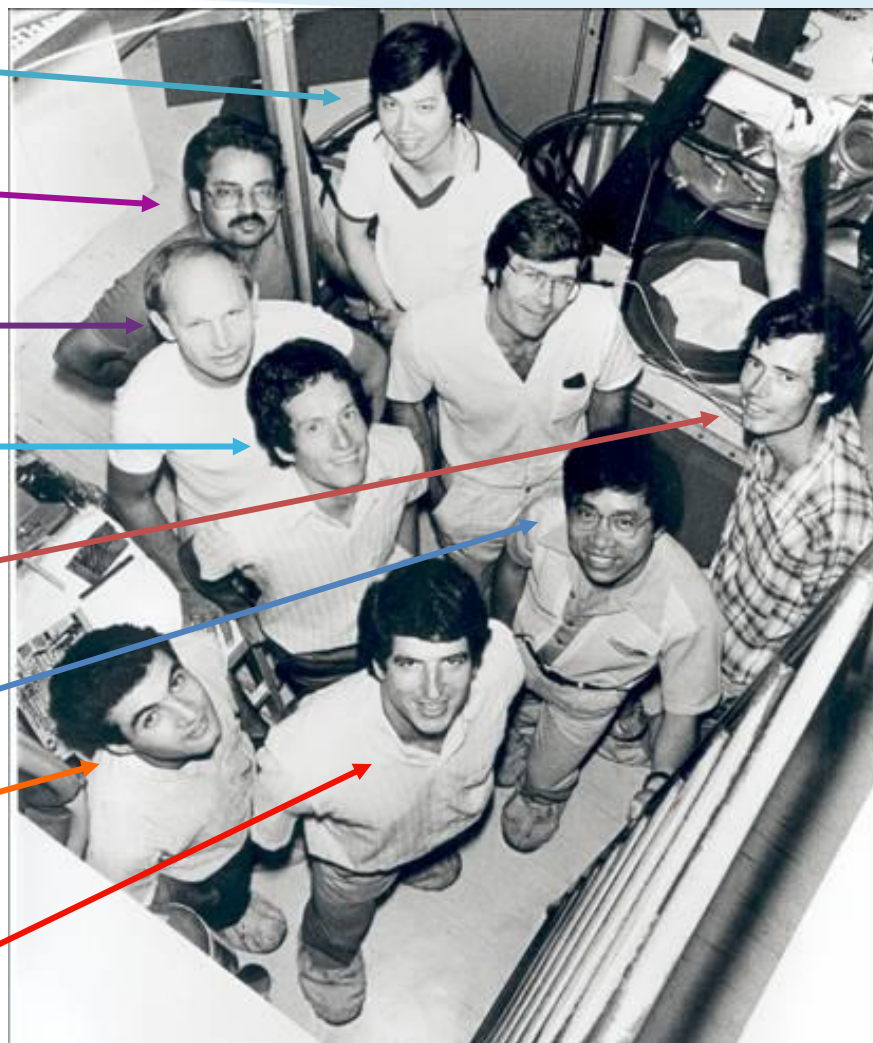
ANU CoE

UNSW PV CoE/
Suntech CTO

China Sunergy CTO

CSG Solar CEO

UNSW PV Centre of
Excellence (PV CoE)



Our comparative advantage- technology innovation



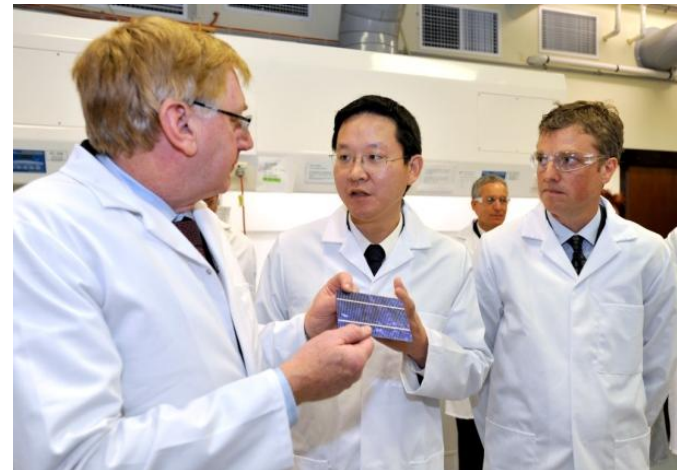
"University of New South Wales' collaboration with Suntech exemplifies how research institutions around the world can commercialise innovative technologies"
Scientia Professor Martin Green, ARC Photovoltaics Centre of Excellence, UNSW



Case study: Industry ready n-type silicon solar cells led by ANU



- \$3.3m ASI funding for \$10.3m project combining existing fast and inexpensive methods used to make today's standard p-type silicon solar cells, with the latest advances in higher efficiency n-type silicon cells. 3 parts:
 - Developing 20% efficient n-type cells with Trina Solar
 - Improving standard p-type cell to 19% with Trina Solar
 - In collaboration with UNSW, developing industry-ready n-type cells with >22% efficiency



Case study: Lowest LCOE: Australian pilot of rooftop CST and CPV-T micro-concentrator systems



- Chromasun Pty Ltd, Australian National University, Echuca Hospital, Little Creatures Brewing Pty Ltd, Ergon Energy, Coolgaia Pty Ltd, University of Southern Queensland, Munters, Futuris Group of Companies
- \$3.5m ASI funding for \$9.3m project.
- Aims to establish an Australian pilot manufacturing capability for the Chromasun Micro-Concentrator (MCT) concentrating solar thermal product.
- Pilot deployment at in Echuca Hospital (Vic), Little Creatures Brewery (WA), University of Southern Queensland and at the Australian National University.



Niche applications

“ We can't do it all ourselves so we have got partnerships with people around the world including universities, governments, and commercial operations overseas. So bringing that technology to Australia and combining it with our steel products to deliver something to the market”

BlueScope Steel on
ABC Illawarra

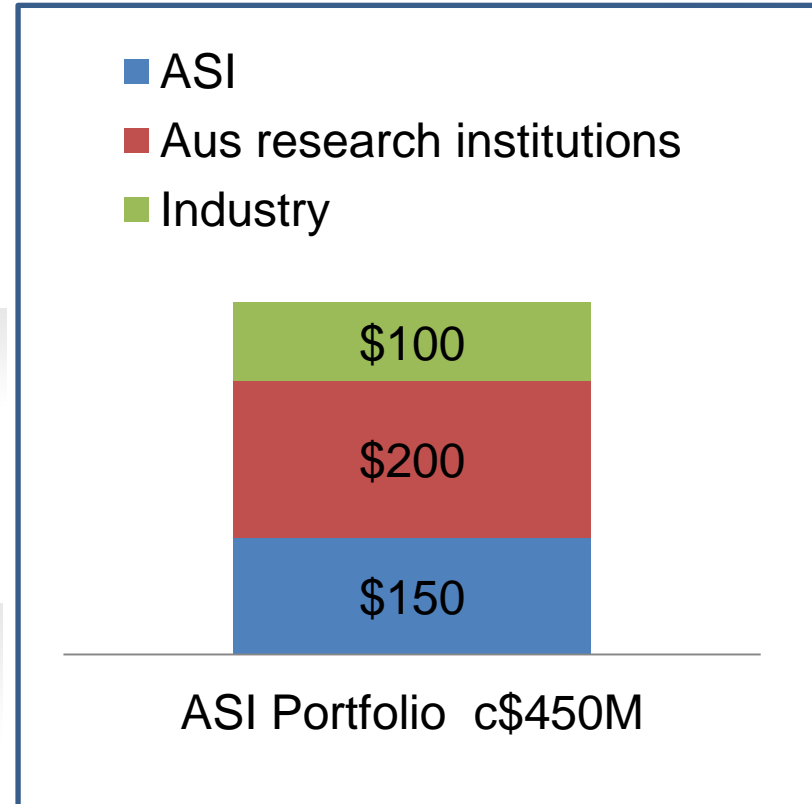


Case study: Expanding the value proposition for Building Integrated Photovoltaics



- Bluescope Steel Ltd, Germany's Fraunhofer Institute for Solar Energy Systems (ISE), The Sustainable Buildings Research Centre at The University of Wollongong
- \$0.5m ASl funding for \$1.6m project
- Develop a systematic approach and methodology to optimise the design configuration and sizing of building integrated photovoltaic thermal (BIPV-T) systems to suit installation on Australian buildings.
- Outcome will be a decision support framework and tool for Australian conditions that could lead to manufacturing and widespread deployment of thin-film solar cells integrated into Australian buildings.

ASI portfolio on track to be c\$450m by end 2012 leveraged by \$150m Australian government funding



International Engagement

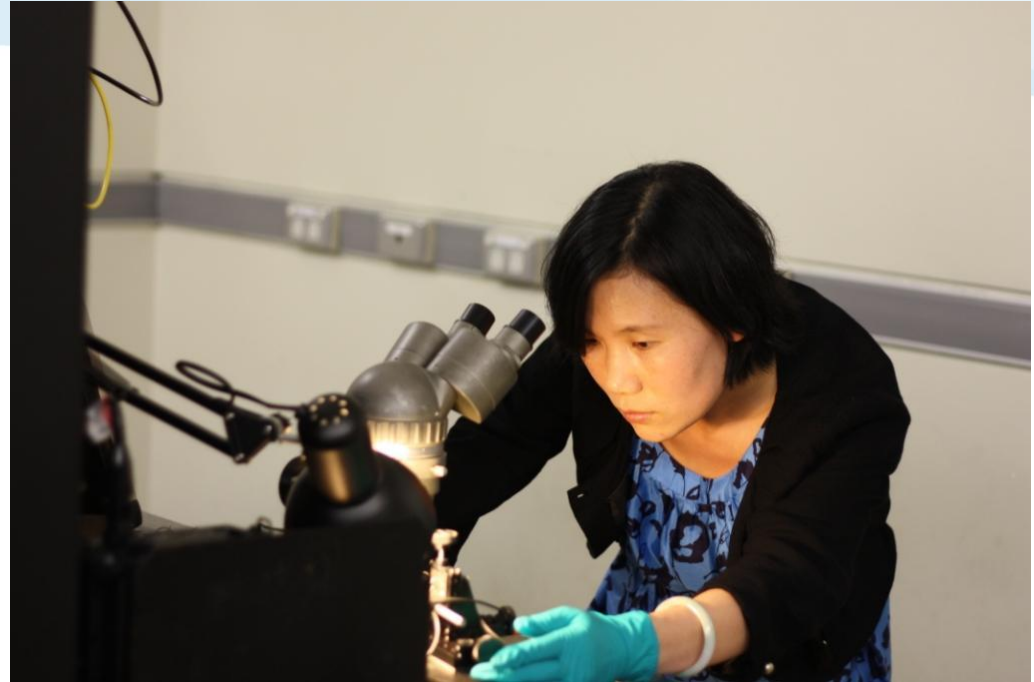


- US – Australia Solar Energy Collaboration achievements since November 2010 announcement:
 - 7 Foundation Projects contracted
 - 3 Research Exchanges
 - Current Open Funding Round: range of Australian and U.S. industry and research organisations
- Australia-Germany Collaborative Solar R&D Program, created pursuant to MoUs with Fraunhofer Institute and DLR:
 - 5 projects contracted
- Through funded projects and other facilitation, supporting deep R&D partnerships between Australian researchers and global solar companies

Capacity building- drawing international leaders to Australia

Over 1/3 of ASI projects have international researchers working on them in Australia

At least 30 international early-career researchers working in Australia on ASI projects



Fellow, Dr Xiaojing Hao at UNSW

** Based on May 2012 ASI survey with 64% response rate*

Solar succession plan – supporting the next generation of researchers



Beyond technology projects: enabling research



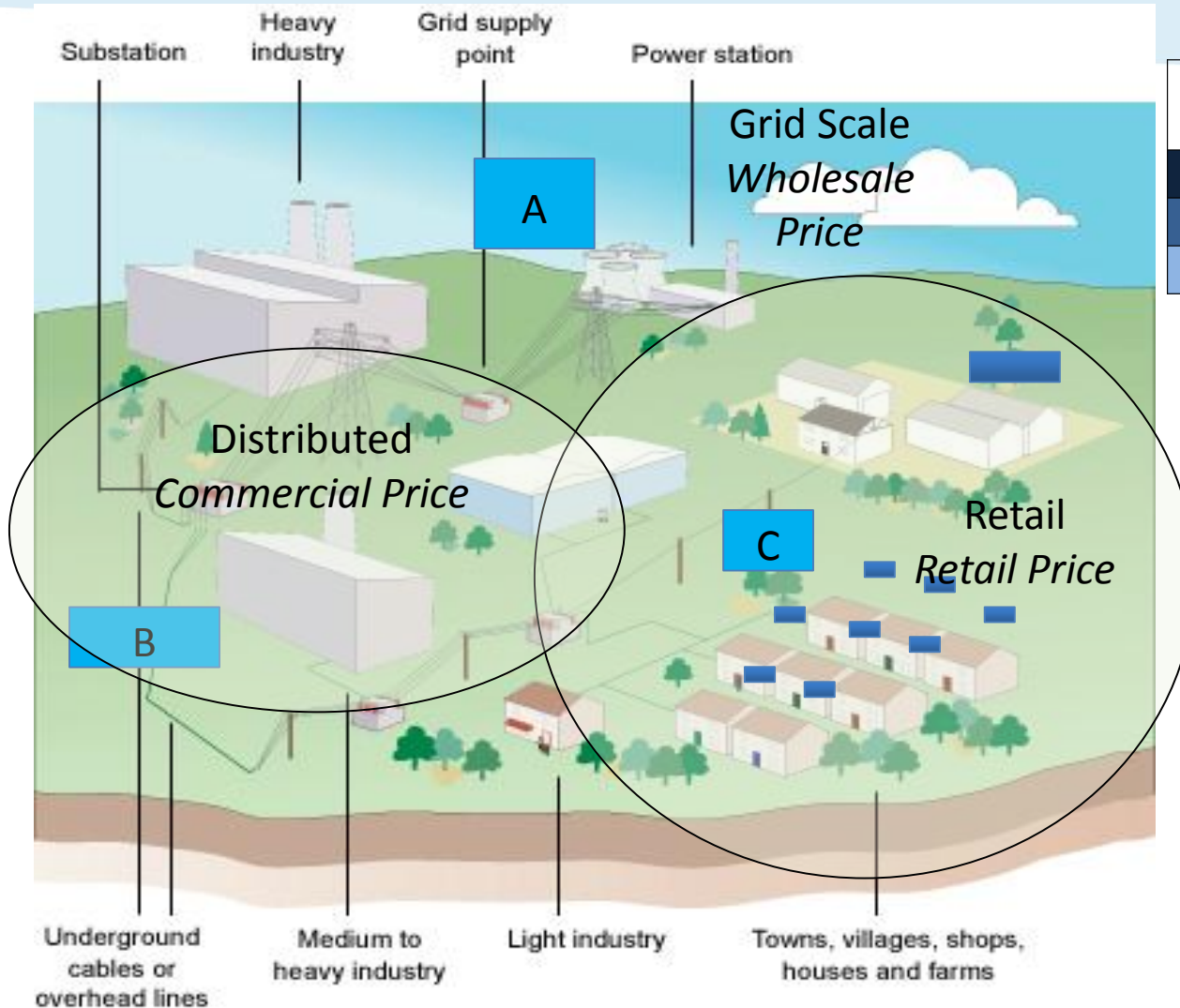
- Active program of commissioned, enabling research to supplement technically-oriented R&D project portfolio:
 - Strategic Plan for PV in Australia
 - IEA PVPS and SolarPACES activity
 - Optimal funding models for solar RD&D
 - Review of solar energy forecasting requirements and proposed approach to development of an ASEFS
 - Review of Potential for CSP in Australia
 - Solar load optimisation in diesel mini-grids
 - Solar generation Australian market modelling
 - Forecasting and Characterising Grid Connected Solar Energy and Developing Synergies with Wind
 - Characterising the Effect of High Penetration Solar Intermittency on Australian Electricity Networks
 - Integrated Solar Radiation Data Sources over Australia
 - Capture and dissemination of one minute solar data

Bureau of Meteorology: One minute solar data



- Publicly accessible online system for the delivery of one minute solar data recorded at the Bureau of Meteorology ground solar network stations.
 - Historical data: Large archive of one minute solar data, up until early 2012, available on USB drive
 - Recent data: Both historical and recently processed data accessible via the Bureau's web site with user login ID and password
- Can easily synchronise data with other weather observations, as well as providing the capacity to derive statistics over time periods matched to the needs of the end application
- Visit: www.bom.gov.au/climate/data/oneminsolar/
- Online survey to help build understanding of data preferences

Solar has an opportunity across Australian electricity markets

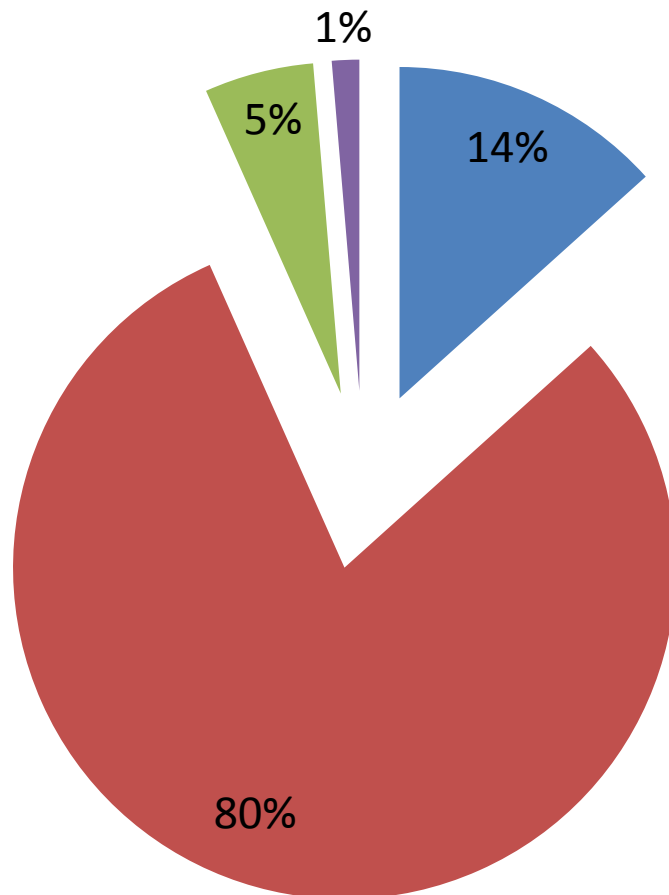


Type	MW Range	2030 Parity
A	>5MW	\$80-150
B	<5MW	\$130-220
C	1-100kW	\$220-400

Market segment CSP opportunities with grid being the constraint

15 GW

Market Potential with modest grid extension

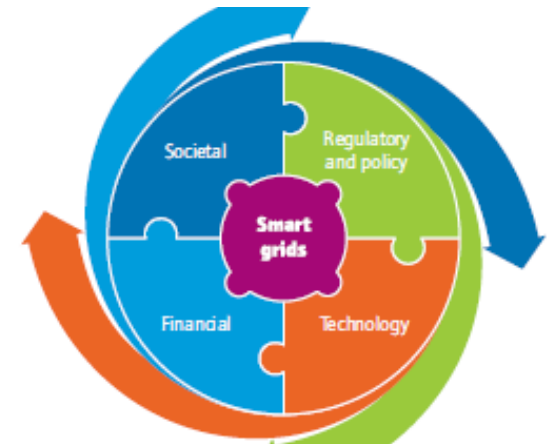


With major grid extension market potential is limited only by commercially viable demand

- Hybridisation of existing fossil fleet
- Stand - Alone Large Scale CSP Plants
- Grid Support (<20MW)
- Off Grid

Summary: industry trends and potential sources of value

- Wide and growing solar deployment
- Australian R&D critical, high-value part of global supply chain
- Technology – efficiency is key to lower installed costs
- Local costs now a major driver with PV device <\$1pW
- Enablers, business models and distributed generation regulation and policy settings critical factors





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