Australian Solar Institute

Solar Energy : the technologies, market and R&D

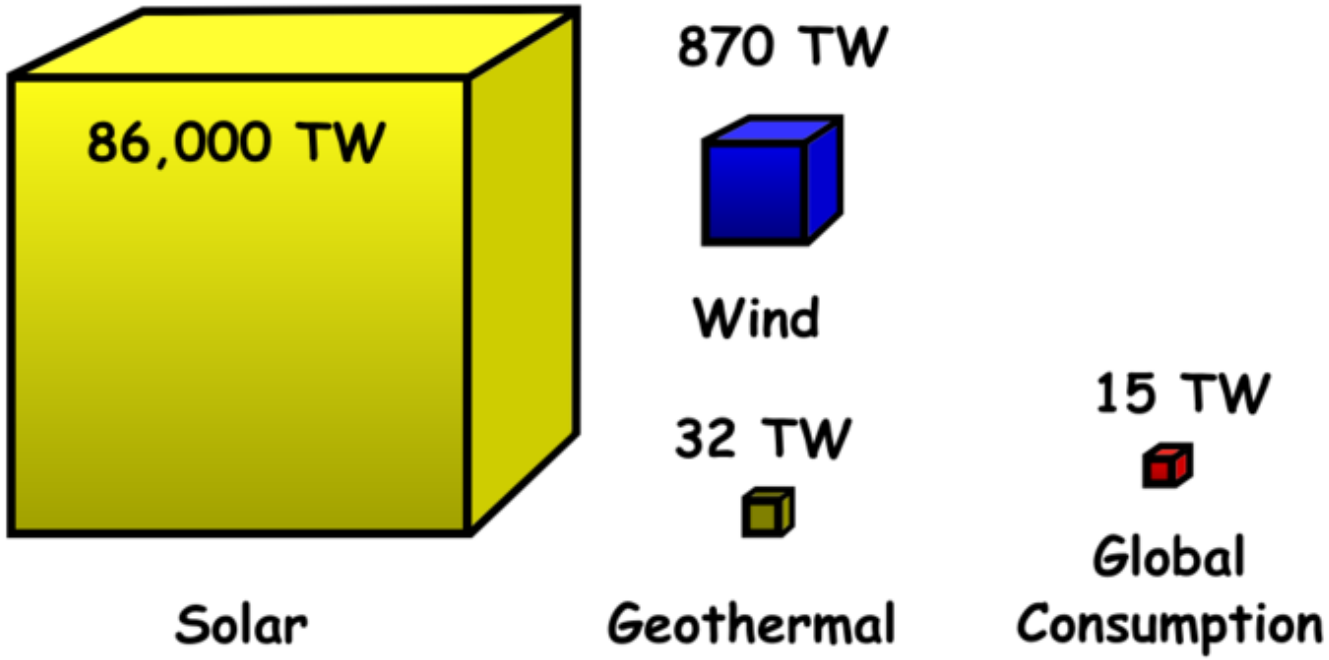
Climate Spectator Webinar

Mark Twidell

Tuesday 20th September 2011

The technologies

Solar Energy – The world is not short!



AUSTRALIAN SOLAR INSTITUTE

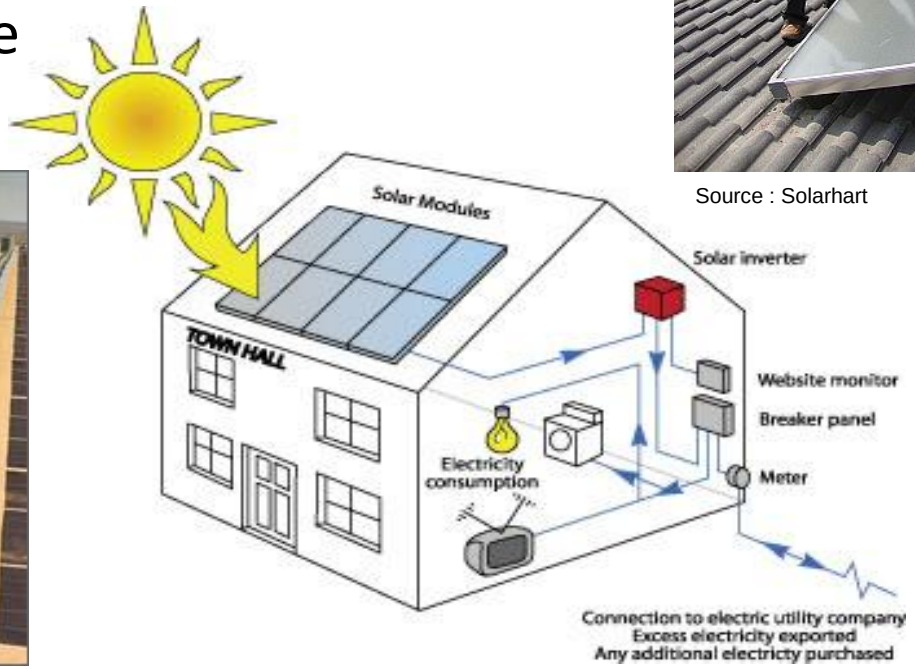
Solar Energy – Direct from the Sun

Main technologies today

- Solar Thermal – Hot Water
- Solar Photovoltaic – Electricity with no moving parts
- Concentrated Solar (Thermal) Power –to drive a turbine cycle

Source : Solarhart

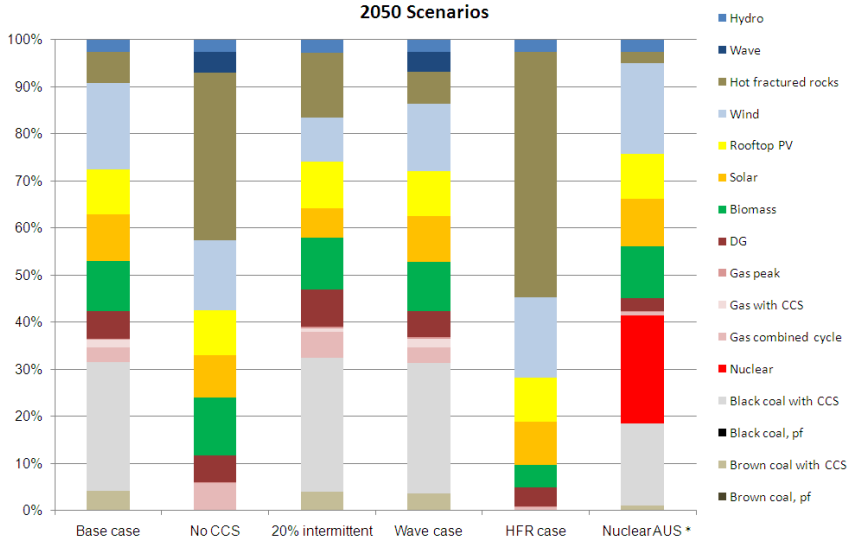
Source : http://thegreenasia.com/blog/?p=69



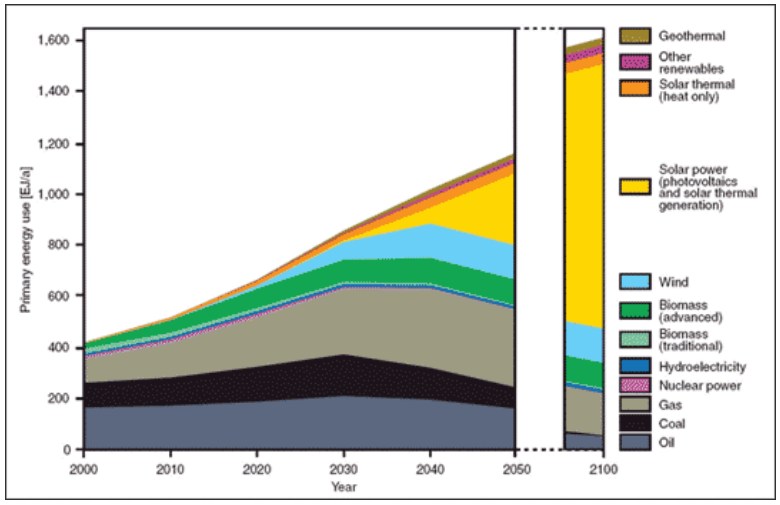
SOURCE : http://www.givemesolar.com/solarpv.html

AUSTRALIAN SOLAR INSTITUTE

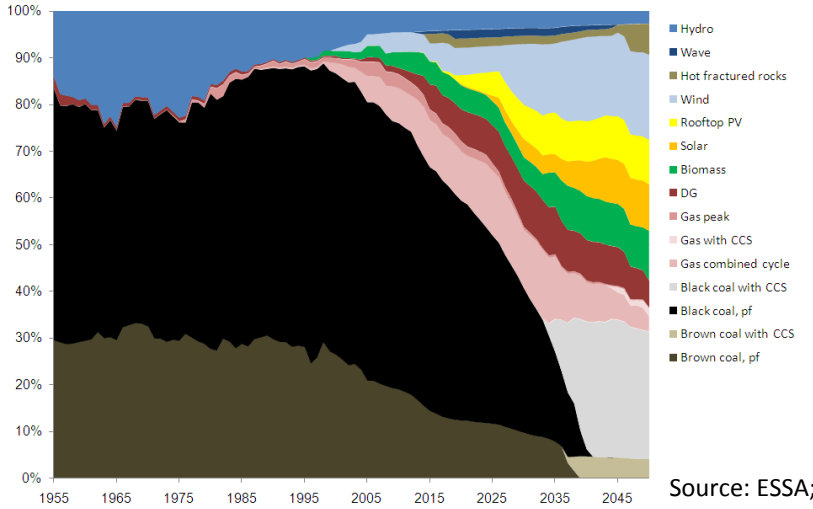
Various forecasts project continued solar growth – typically 20-25% of supply by 2050



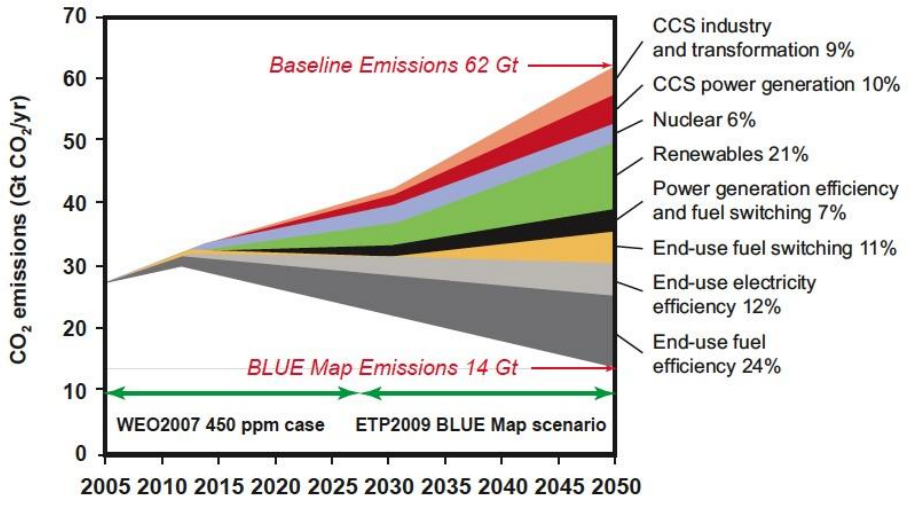
Source: CSIRO ESM Feb 2011



German Advisory Council on Global Change (WBGU)



Source: ESSA; CSIRO ESM Mar 2011

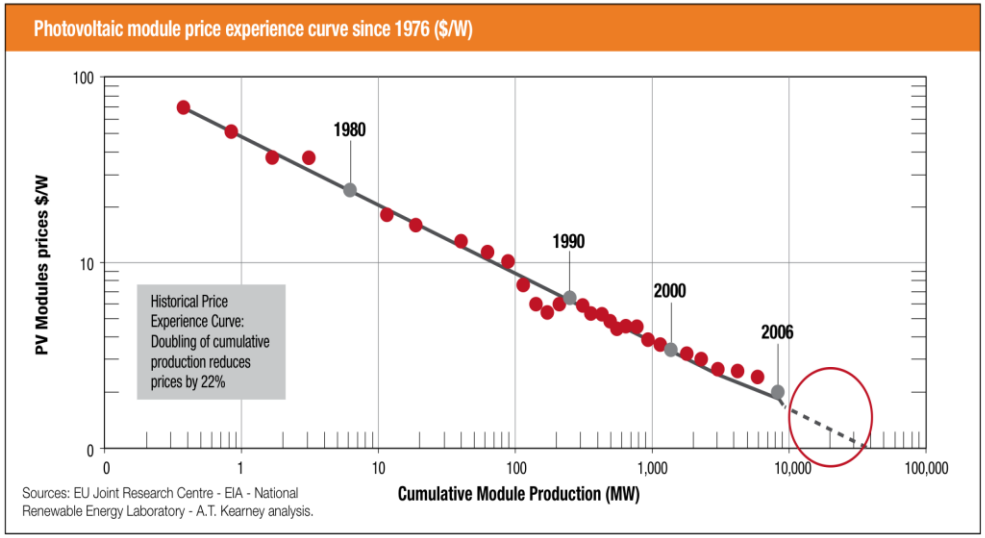


Source: IEA

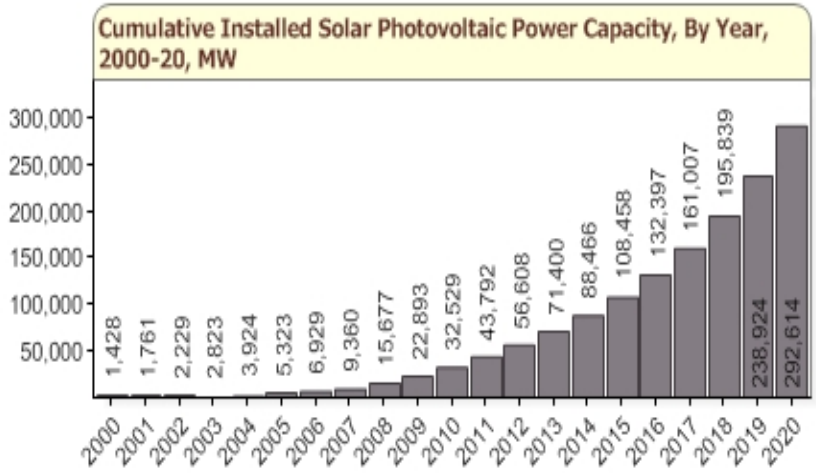
The market

The world PV market has grown 1000 fold in the last 30 years with prices falling 90%

Tideland : Made in Sydney 1983 – 5W



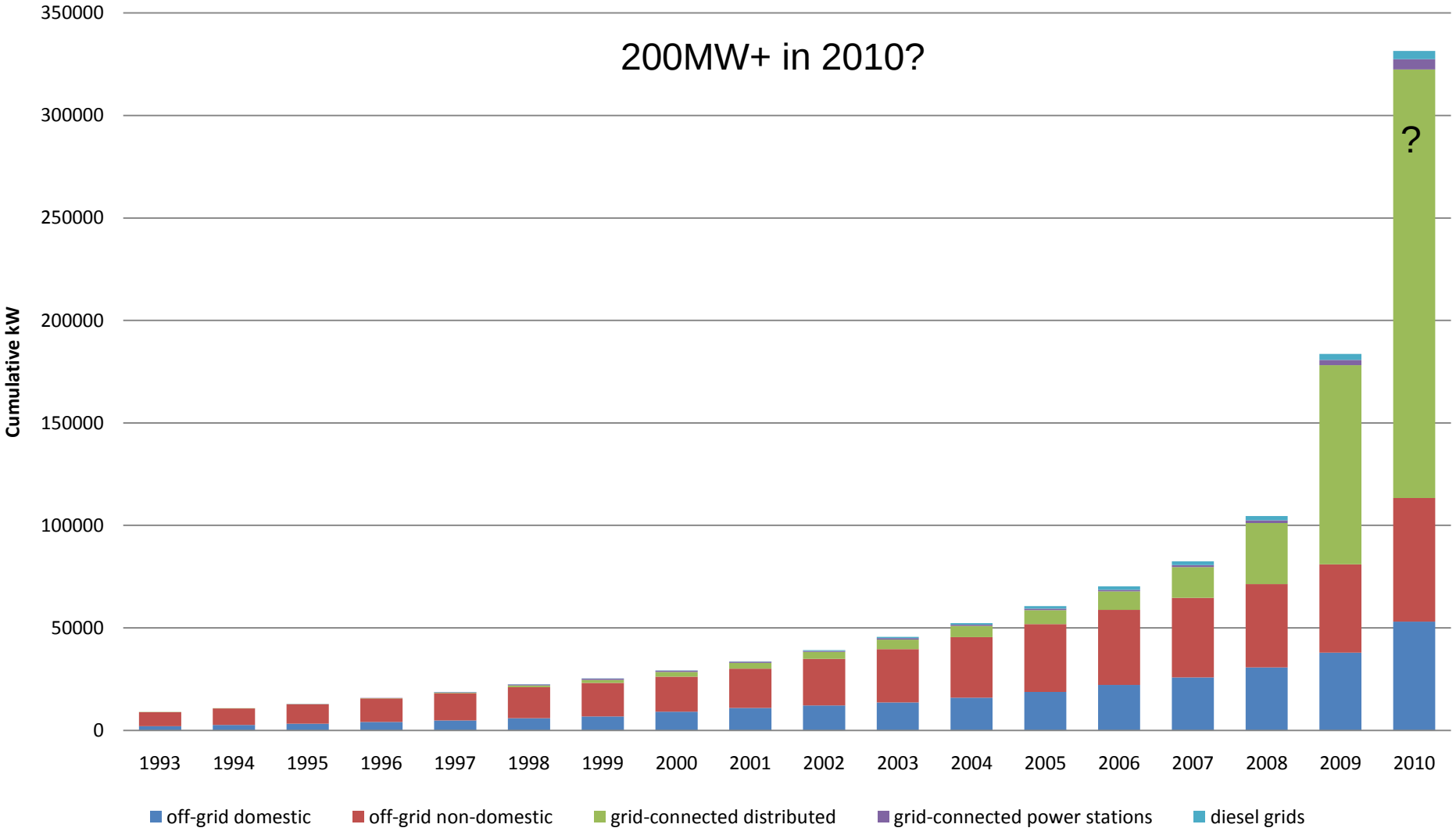
Technological progress will enable further substantial PV cost reductions, while fossil fuel-based electricity prices are expected to continue their long-term increase.



Silex Solar : Made in Sydney 2011 – 260W

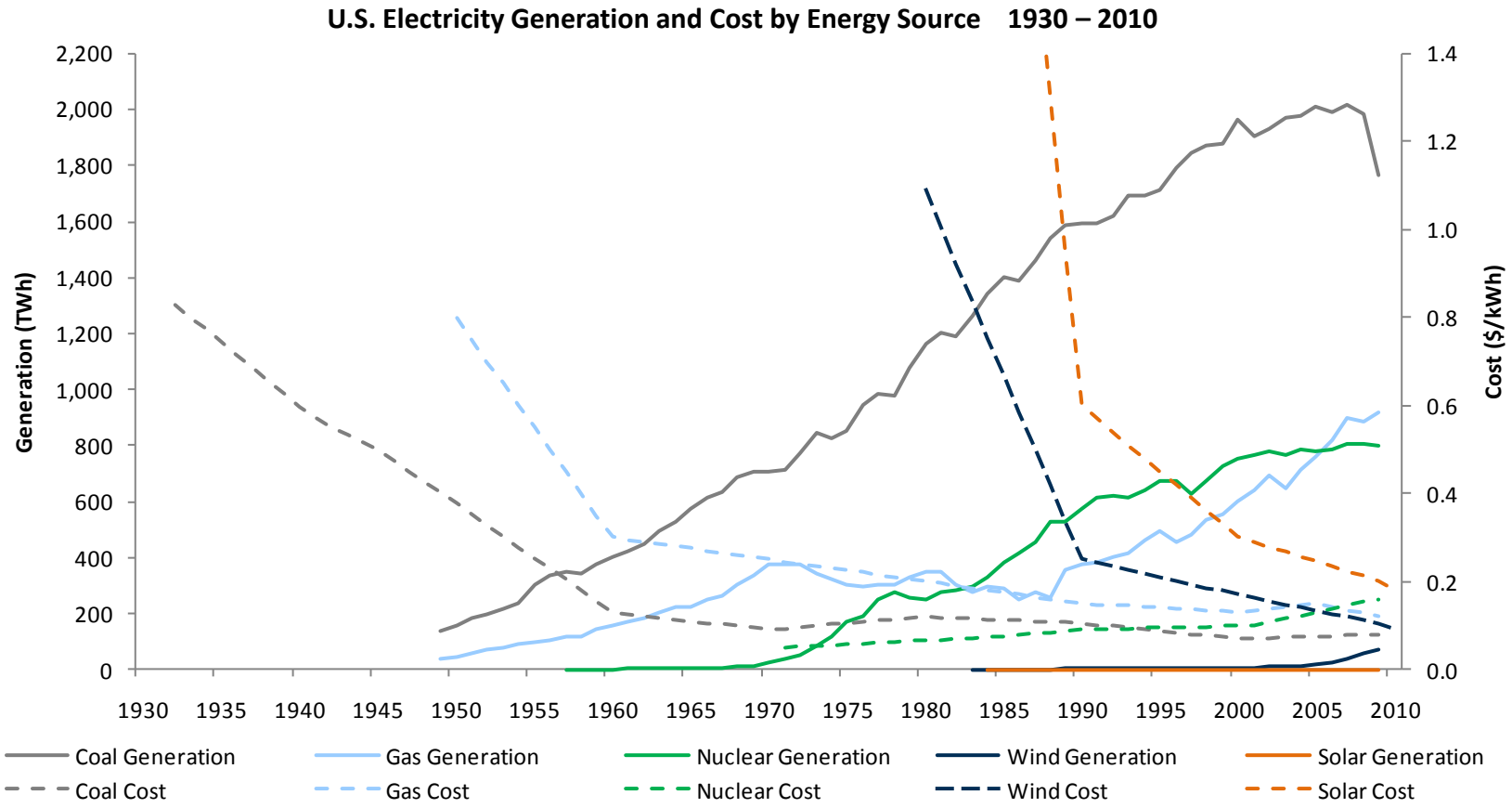
Australian PV Market

(APVA, 2010 and projections)



Historical and full market context shows both the challenge and opportunity

- Historic perspective demonstrates relative nascence of solar technologies
- Economies of scale and technological progress have dramatically reduced the cost of clean energy over the past few decades, particularly wind and solar
- Wind and solar energy expected to reach parity with traditional sources over next decade
- Scale-up expected to be accompanied by significant cost declines over next decade



Sources: EIA, MIT, American Energy Independence; NREL; Cooper; Hudson estimates.

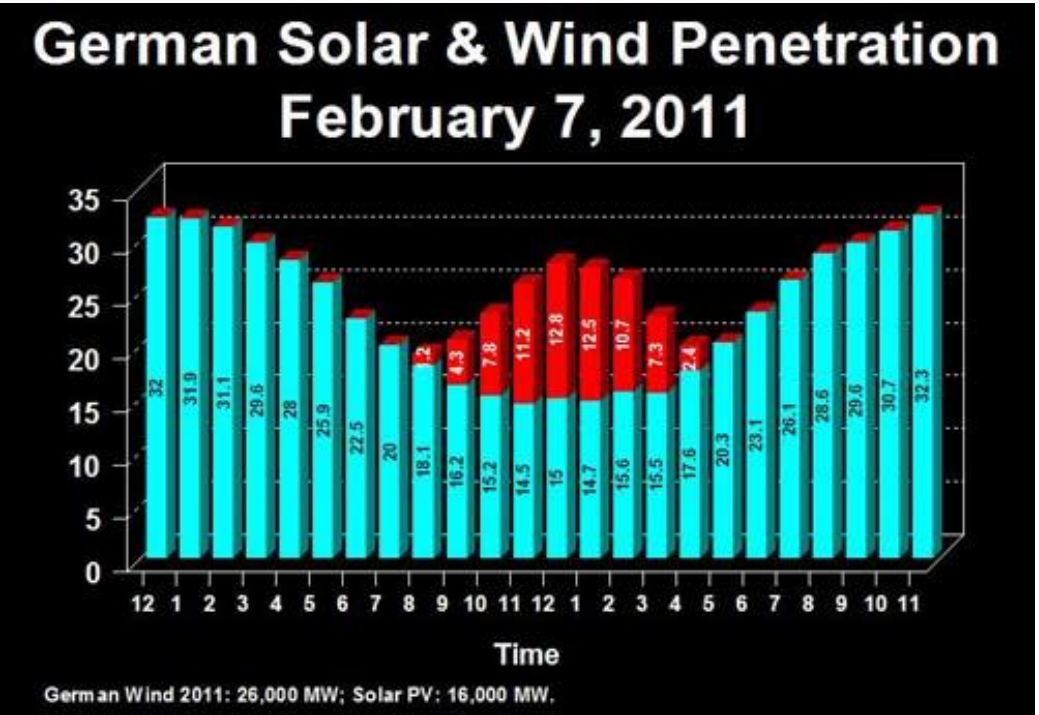
Slide used with permission from Paul Ho of Hudson Clean Energy

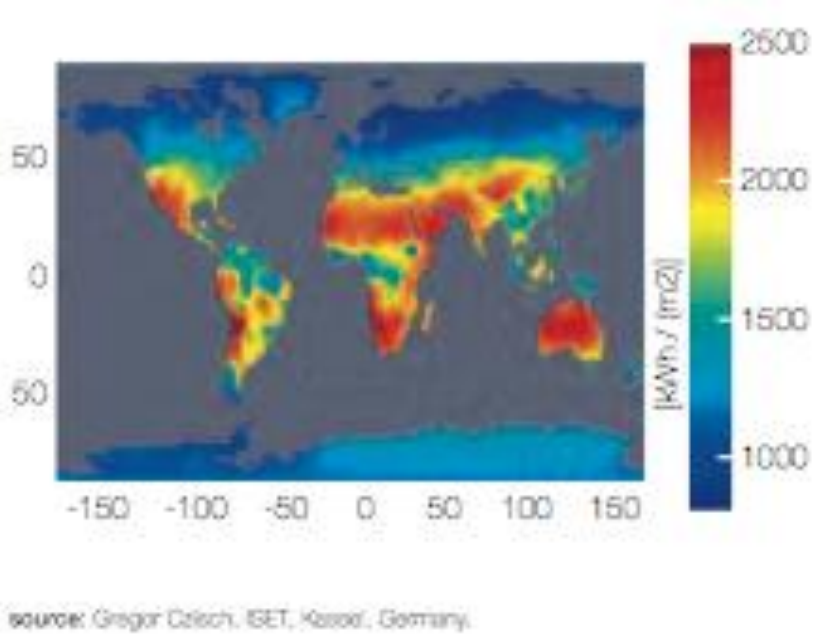
HUDSON CLEAN ENERGY

Solar starting to make a material contribution to energy markets

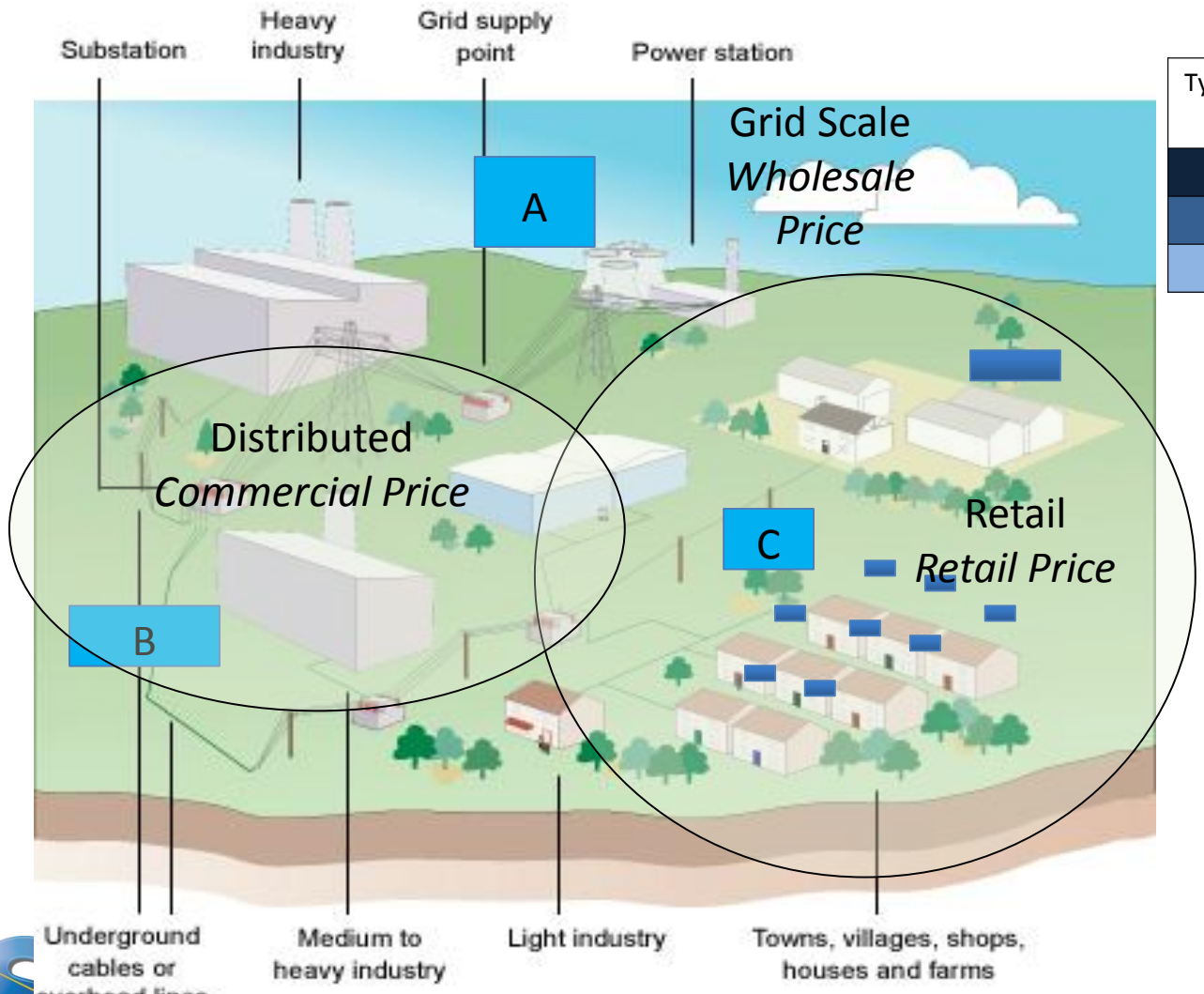
- Germany >2% of annual electricity in 2010 (at a cost)
- A snapshot - 13% of German electricity came from PV at noon on Feb 7 2011 (midwinter)

Source : http://www.allianceforrenewableenergy.org





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

Sources of Value

$/MWHr NEM Pool
Time of Day

$/MWHr RET/Carbon

Distributed Value
Retail Price

AUSTRALIAN SOLAR INSTITUTE

Australian R&D

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

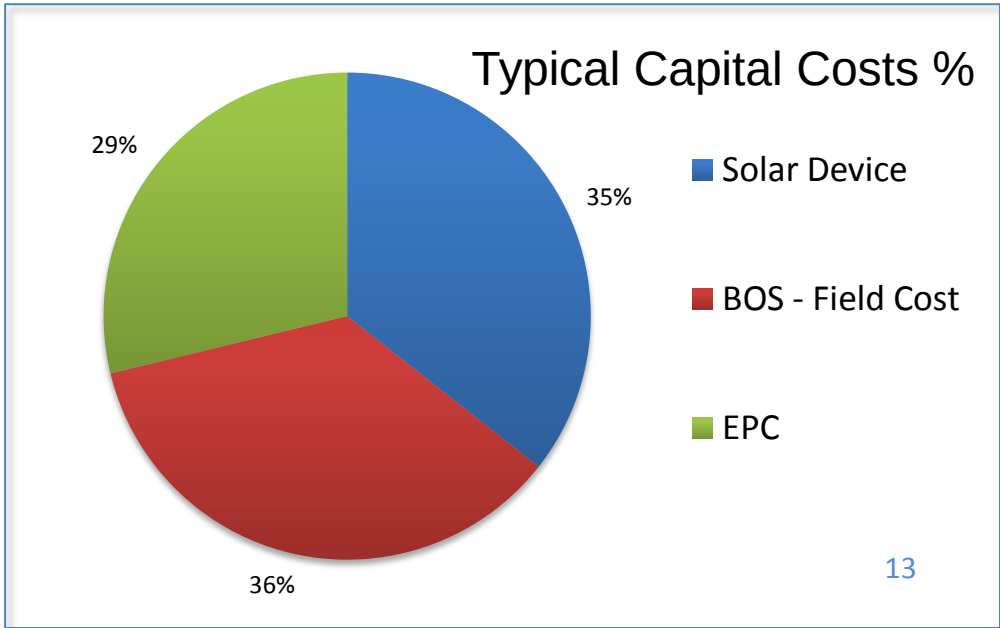
$a → Finance Channel Margins

$b → Other Hardware, Civils, Install , Land, O&M

$c → Solar Device

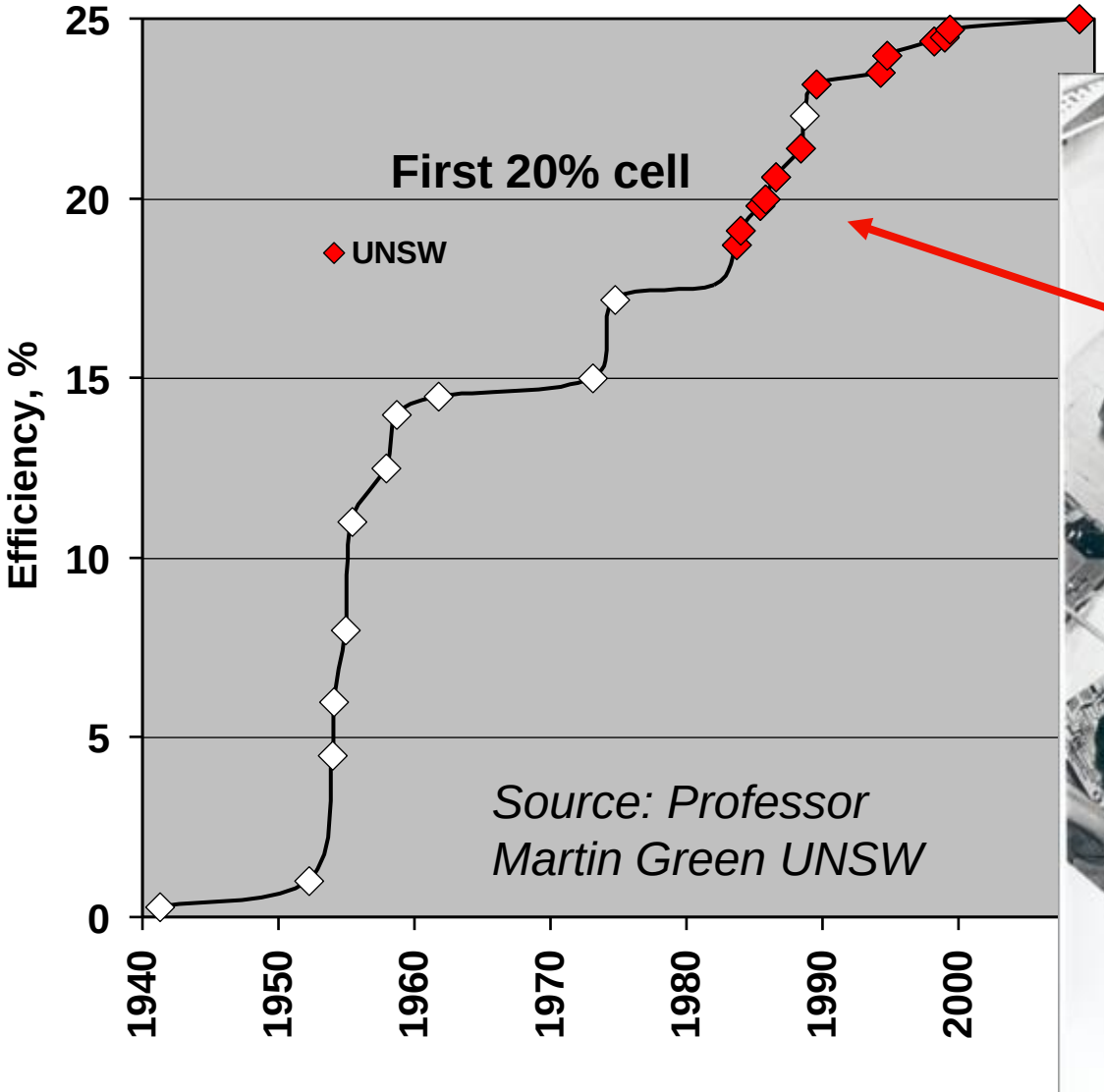
$$\sum \frac{(\$a+\$b+\$c)}{MWHrs} = \$/MWHr\ (LCOE)$$

$$\frac{\$Lifetime\ Costs}{MWHrs\ Supplied} = \$/MWHr$$



AUSTRALIAN SOLAR INSTITUTE

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

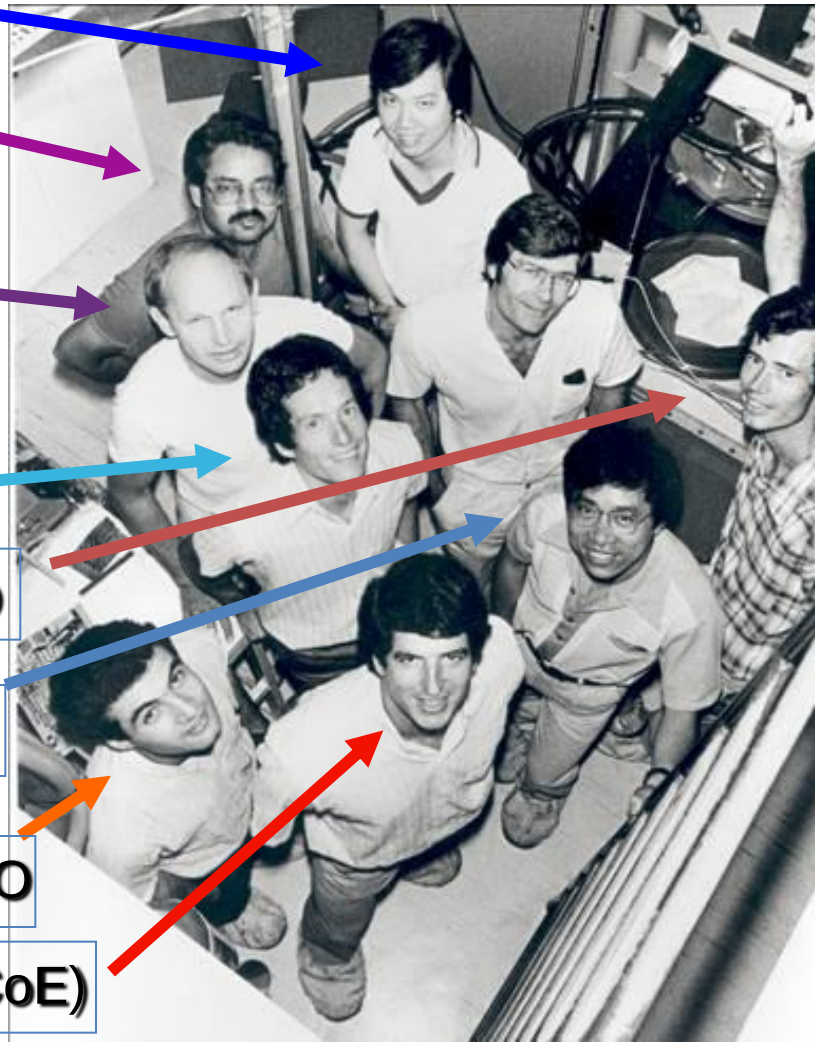
ANU CoE

UNSW PV CoE/ Suntech CTO

China Sunergy CTO

CSG Solar CEO

PV Centre of Excellence (PV CoE)



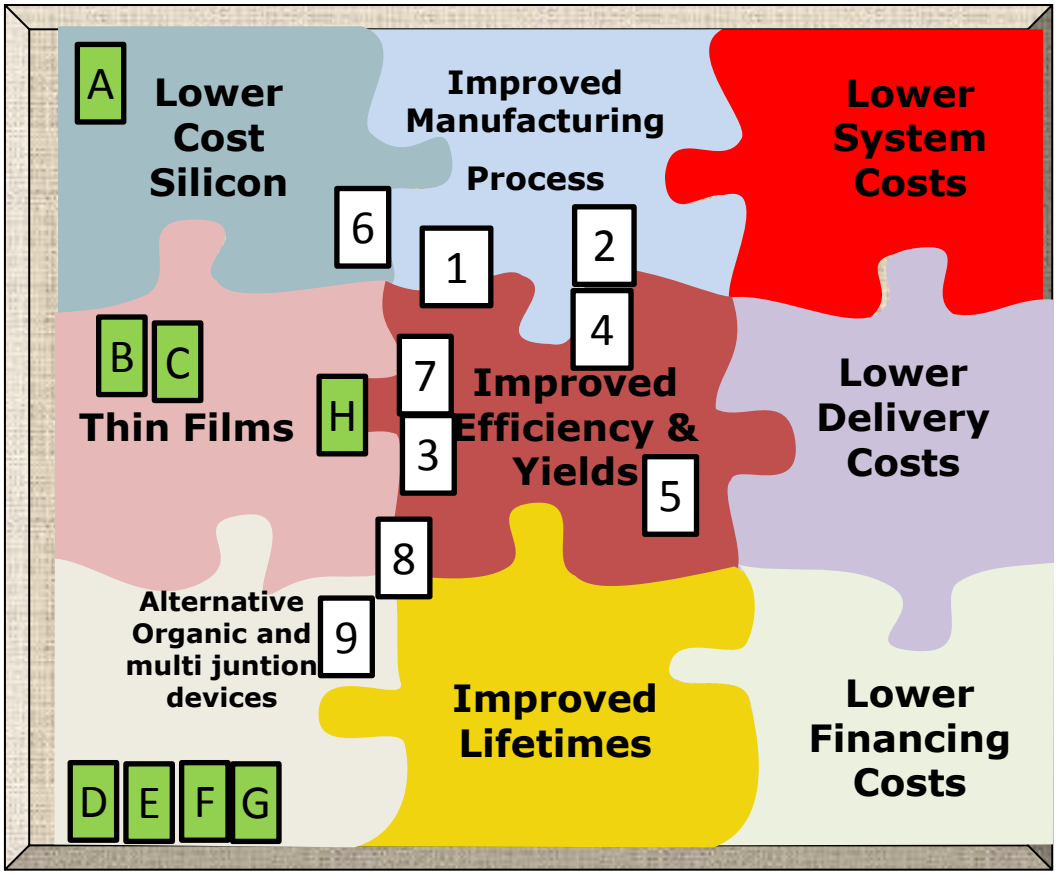
PV R&D Portfolio Mapping

$41m ASI leveraging c$155m

Today

Round 1

1. ANU Solar labs
2. UNSW SIRF
3. ANU Plasmonics
4. UNSW Core
5. UNSW Suntech
6. ANU SLIVER
7. BT Imaging Inline Inspection Tools
8. Sapphicon
9. UQ OPV



Round 2

A. UNSW Low-cost silicon
B. ANU Industry Ready N-Type Si Solar Cells
C. CSG Next Gen Si on Glass
D. UNSW Hot Carrier Cell
E. UNSW 40% Efficient PV Power Tower Receiver
F. UniMelb OPV
G. UNSW Quantum Dots
H. USyd Upconversion

Goal

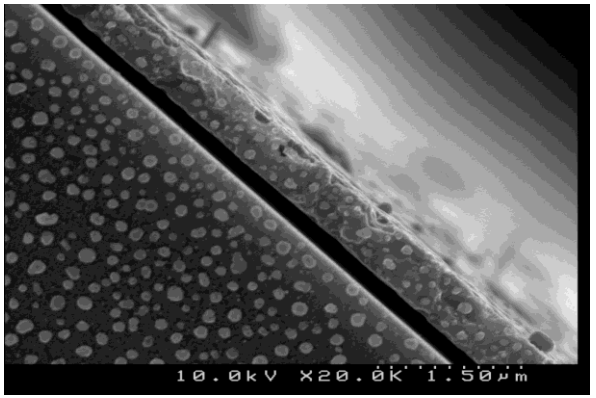
AUSTRALIAN SOLAR INSTITUTE

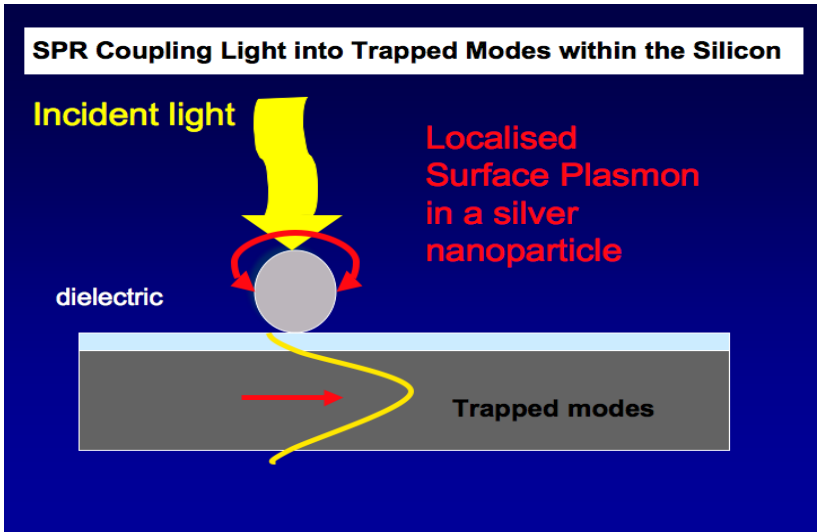
Plasmonics to Increase Light Capture for Greater Efficiency PV

- Silver nanostructures can help to trap light inside solar cells where it is converted to electricity

- Experimental devices produce 30% more electrical current than current thin-film silicon cells

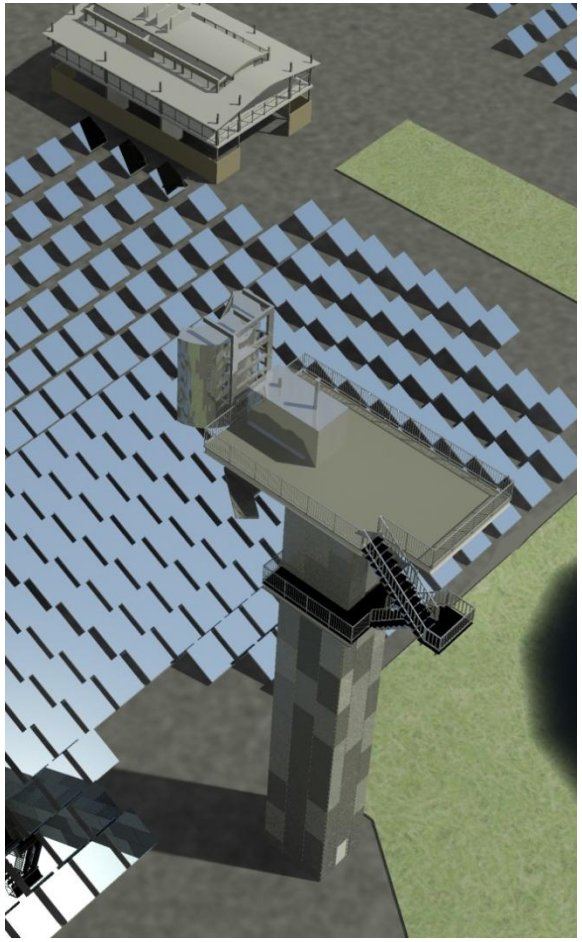
- **MIT Technology Review: 10 Emerging Technologies of 2010 rates Dr Kylie Catchpole's light-trapping solar cells work among the 10 technologies most likely to change the world**





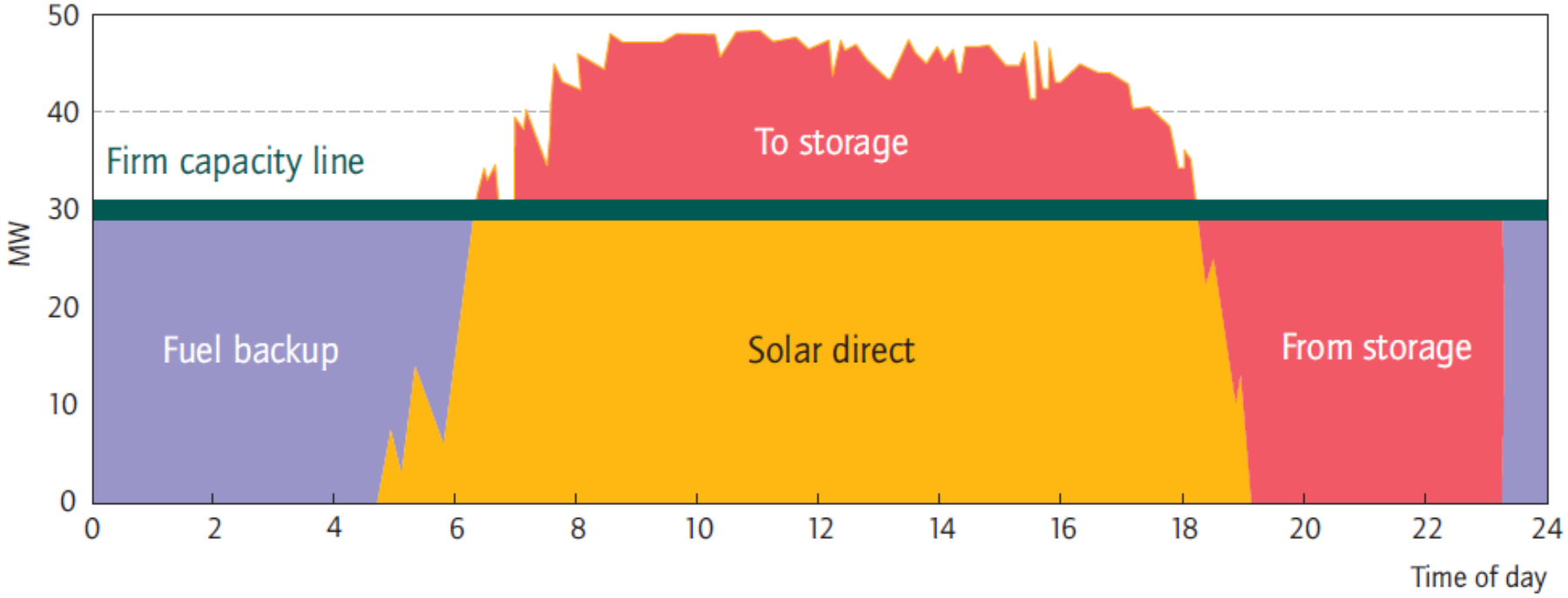
ASI also investing in Concentrated Solar Power – CSIRO Solar Thermal Research Hub

- Largest-of-its-kind tubular receiver solar air turbine system, which doesn't require any cooling water
- Aiming to prove that a target of 10-14 cents/kWh is achievable in commercial CST deployments- required to compete with wind generation
- Systems approach focused on increasing the efficiency of CST systems options (higher temperatures at the receiver) and proving storage while at the same time reducing capital and operating costs



AUSTRALIAN SOLAR INSTITUTE

Large scale CSP proponents offer prize of firm supply through storage and hybrid application



Source: Geyer, 2007, *SolarPACES Annual Report*.

AUSTRALIAN SOLAR INSTITUTE

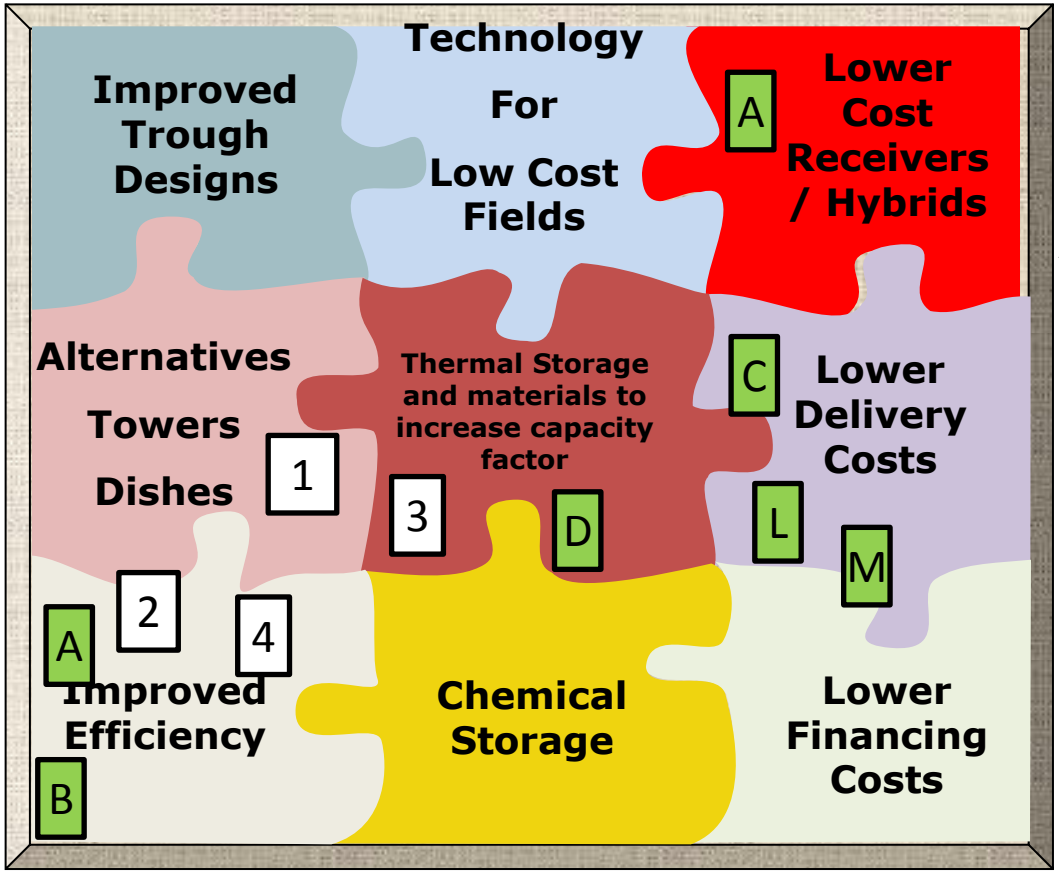
CSP R&D Portfolio Mapping

$24.7m ASI leveraging c$54mm

Today

Announced Round 1

1. CSIRO ANU Foundation
2. CSIRO Core Steam
3. CSIRO Core Storage
4. Uni Newcastle Thermionic Devices



Round 2

CST

A. CSIRO Air Turbines
B. CSIRO Thermodynamic Topping Cycles
C. ANU Roof Mounted Hybrid CST
D. Graphite Energy Storage

Enabling

L. CSIRO – Intermittency
M. UNSW – Forecasting

Goal

AUSTRALIAN SOLAR INSTITUTE

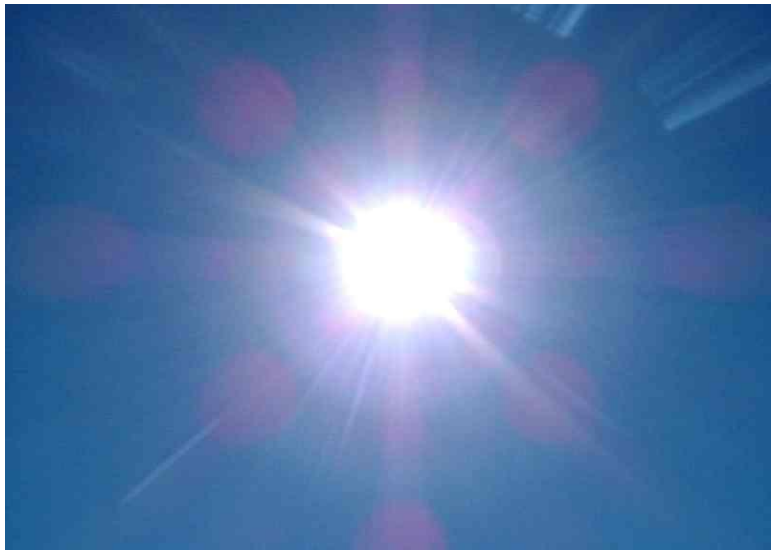
ASI also supporting the next generation of solar research leaders

Summary

- Solar is an emerging viable energy proposition driven by:
  - Falling costs and increased finance sector engagement;
  - Technology innovation pace picking up; and
  - Traditional energy costs rising.
- Australian deployment growth has been where traditional prices are highest – customer side of the retail meter – near term potential for diesel replacement to drive large scale solar learning curve

AUSTRALIAN SOLAR INSTITUTE

Contact



Australian Solar Institute

(61 2) 4960 6300

www.australiansolarinstitute.com.au

AUSTRALIAN SOLAR INSTITUTE