

CSP- Market Prospects in Australia

Mark Twidell, Executive Director
Intersolar Europe
14 June 2012



Summary



- About ASI and CSP portfolio
- Policy framework- market drivers
- Aust. CSP pipeline
- Market segments and location
- The market
- Challenges
- The commercial equation

About ASI



- Australian Government initiative for R&D into solar PV and CSP technologies.
- Newcastle, Australia HQ
- ASI-funded solar R&D projects in research institutions and companies around Australia and internationally, supporting 150+ Australian researchers
- c\$255m portfolio of projects leveraged by c\$90m of Australian Govt. funding
- Australian Government's \$1.5b Solar Flagships Program – sharing learnings
- International engagement – USASEC; Fraunhofer Institute MoU; DLR MoU; strategic engagement with Asia

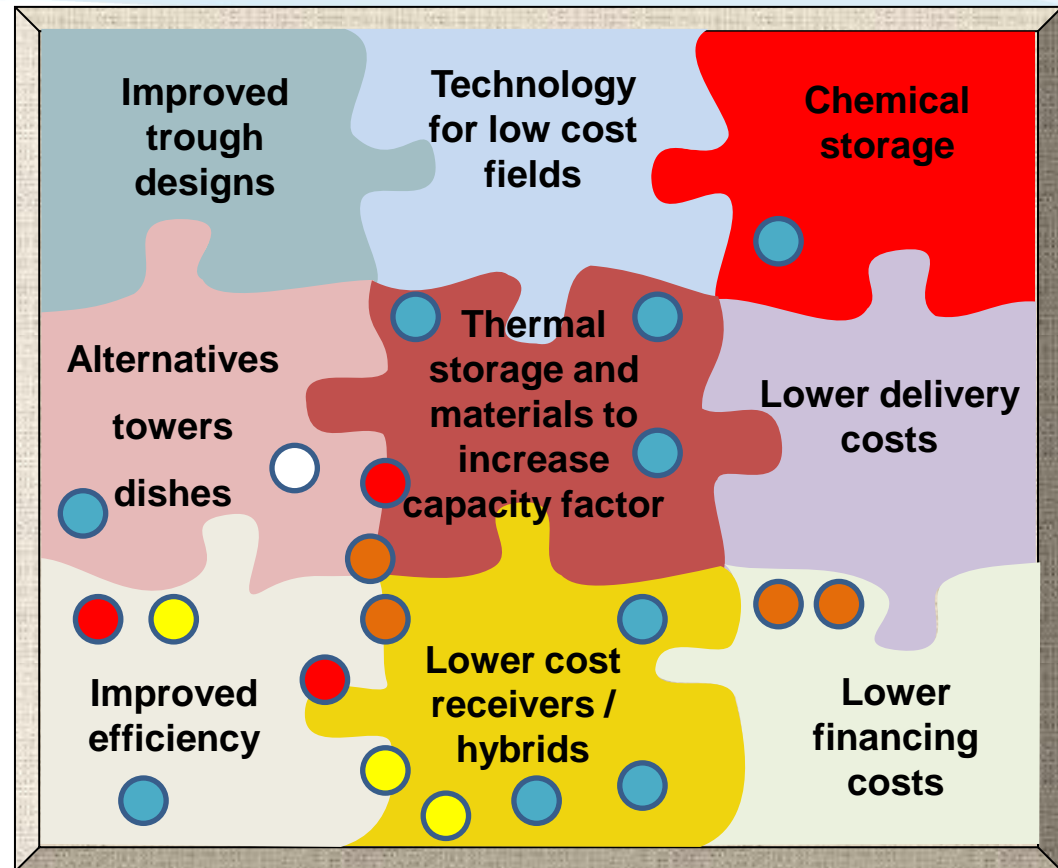


CSP R&D Portfolio mapping

ASI cA\$41m leveraging cA\$114m



- Foundation Projects
- Round 1
- Round 2
- Round 3
- USASEC
- Aust.-Germany



Full details on ASI website – R&D Projects

Case study: CSIRO Solar Thermal Research Hub



- Largest of its kind - Brayton receiver solar air turbine system, which doesn't require 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
- A\$5m from ASI



Case study: High-efficiency multi-junction solar cells on low-cost, large-area silicon substrates



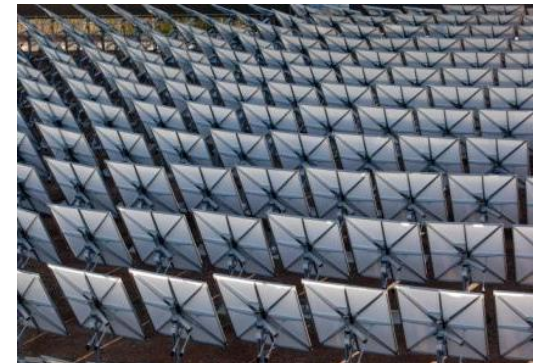
- Solar Systems Pty Ltd (lead), Translucent Inc., IQE Plc., Emcore Corporation, Boeing Spectrolab Inc
- A\$2m ASI funding for A\$5.2m project
- The key differentiator of this project is the development of a new 'Virtual Germanium-on-Silicon' substrate where a thin layer of Ge is deposited on a Silicon wafer. This will significantly reduce the cost and potentially improve the efficiency of the multiple-junction cells used in CPV applications.
- Once commercialised the technology would be available for large utility scale concentrating photovoltaic power plants.



Case study: Validation of performance modelling for 1.2MWth solar array with high temperature receiver and integrated thermal storage



- Vast Solar Pty Ltd (lead), Twynam Agricultural Group, The University of NSW, RMIT University
- A\$0.4m ASi funding for A\$1.3m project
- This project seeks to validate performance modelling of Vast's 'high efficiency/low cost components for solar thermal central receiver power plants with integrated thermal energy storage' at pilot scale by extending an existing testing and demonstration facility in Jemalong, western NSW.
- Modularised concept will provide tangible demonstration of the technology to Series B investors



Clean Energy Future Package



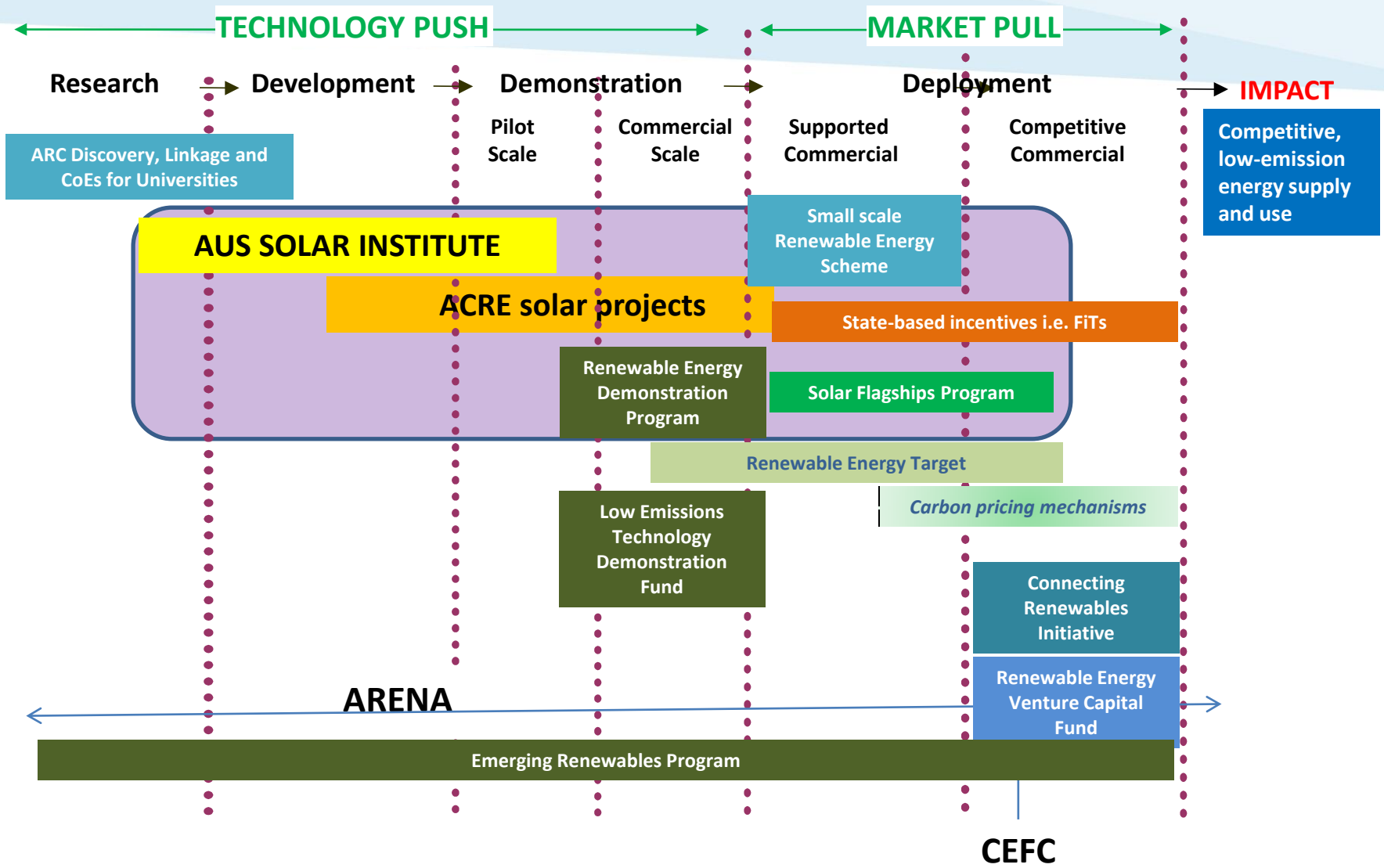
- Carbon price commences July 1, 2012
 - Broad-based, national coverage
 - Fixed price period to June 30, 2014 (A\$23 per tonne, rising at 2.5% p.a. in real terms)
 - Emissions trading scheme from July 1, 2015
 - Link to international carbon markets
- Industry and household transitional assistance
- New governance structure
- Complementary measures
 - Renewable energy
 - Energy efficiency

Clean Energy Future Package



- ARENA
 - \$3.2 billion investment to promote R&D, demonstration, commercialisation and deployment of renewable energy projects
- CEFC
 - \$10 billion for investment in commercialisation and deployment of **renewable energy**, energy efficiency and low-pollution technologies, and **manufacturing businesses providing input into these sectors**
 - Debt and equity financing to commence lending 1 July 2013

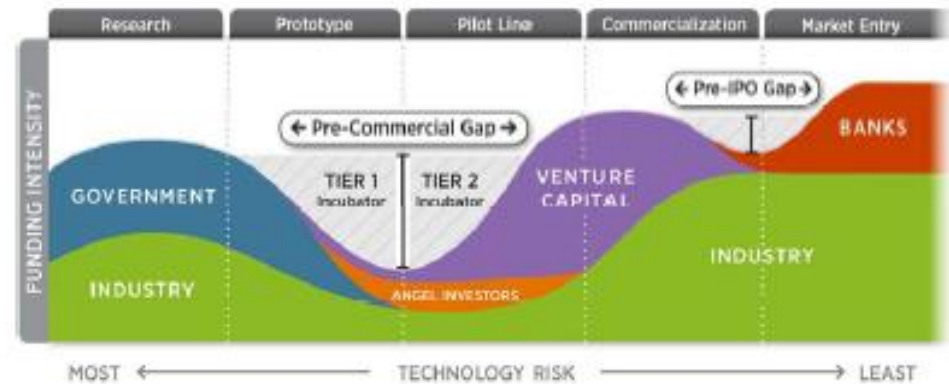
Policy framework- market drivers



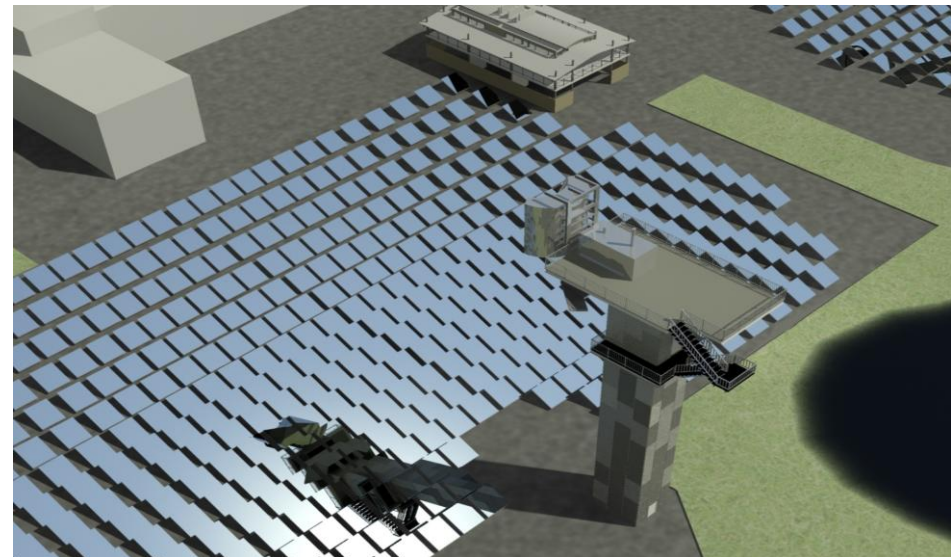
New technology requires demonstration to gain bankable capital market support – e.g. CSP Tower

- **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

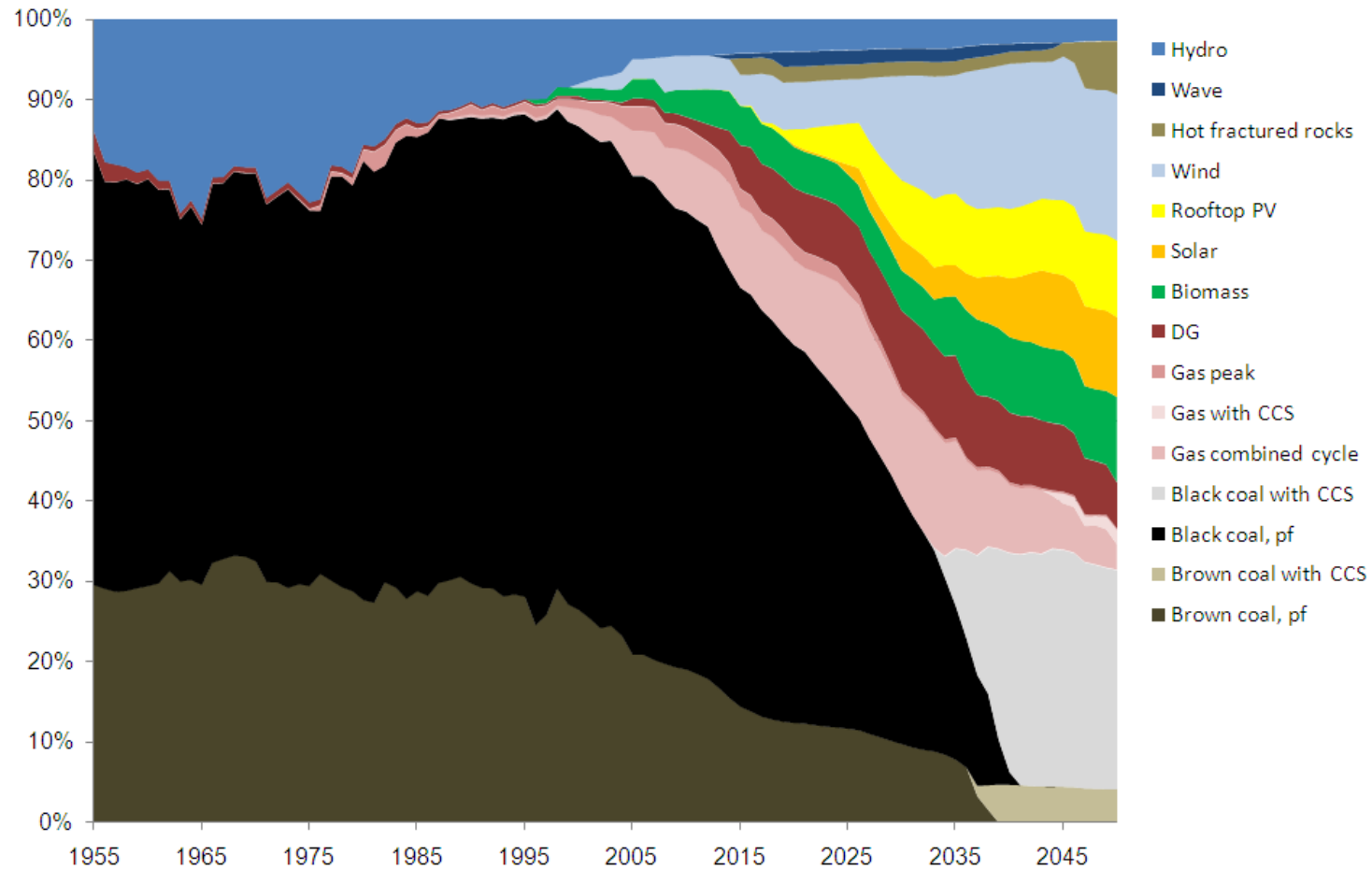


Source : US DoE 2011



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

Future of solar in Australia- 20-25% by 2050

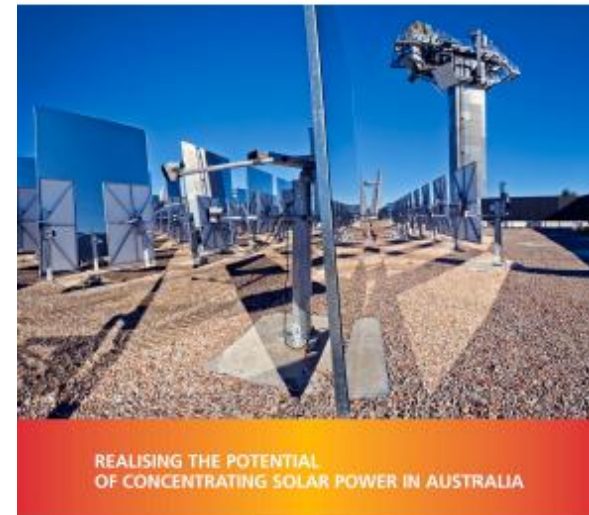


Source: ESSA; CSIRO ESM Mar 2011

Acknowledgement



Information in this presentation is drawn from a report commissioned by ASI and prepared by IT Power (Dr Keith Lovegrove et al): **Realising the Potential of CSP in Australia, May 2012**



Available on ASI website

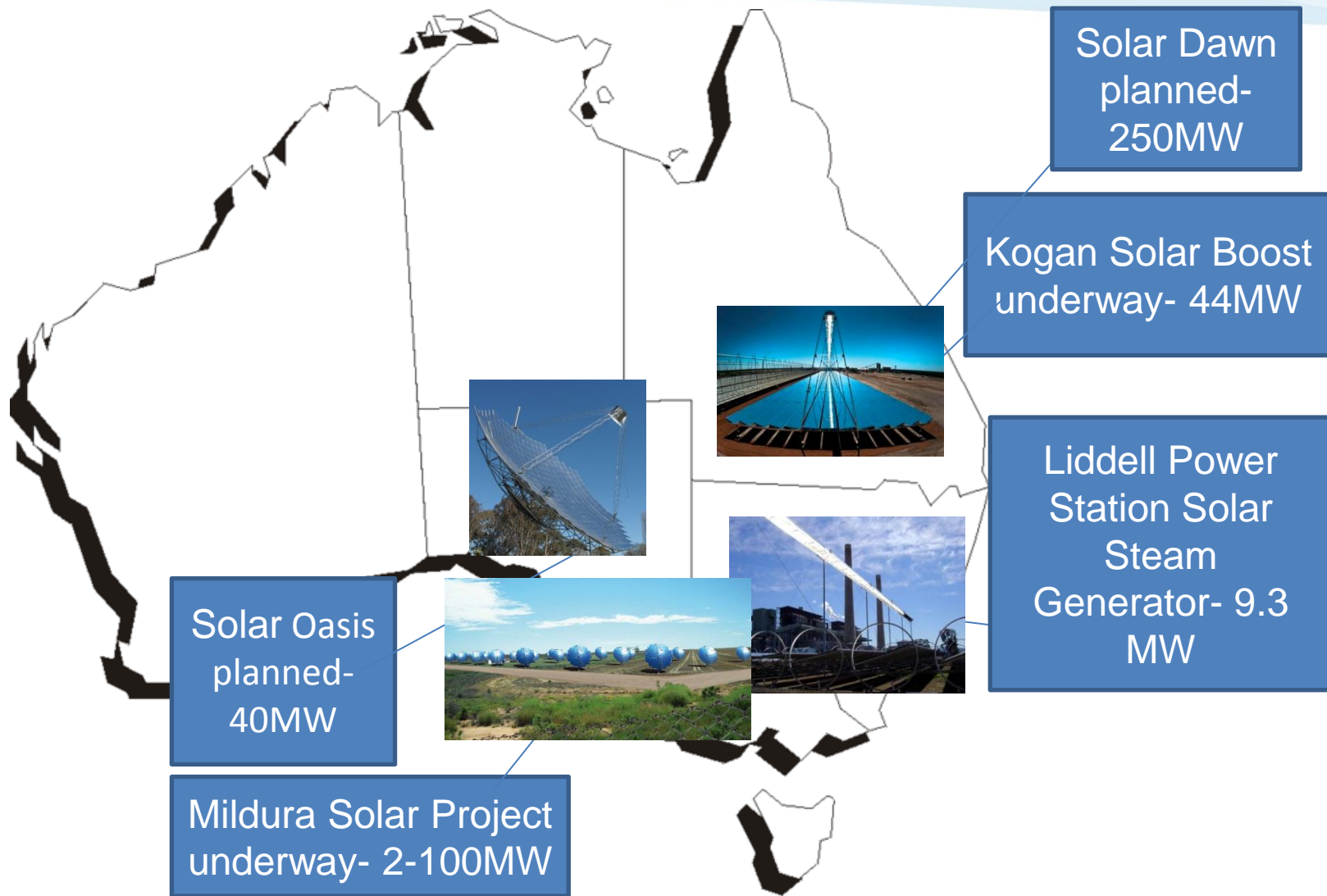
<http://www.australiansolarinstitute.com.au/reports/.aspx>

PREPARED BY IT POWER (AUSTRALIA) PTY LTD
FOR THE AUSTRALIAN SOLAR INSTITUTE
MAY 2012



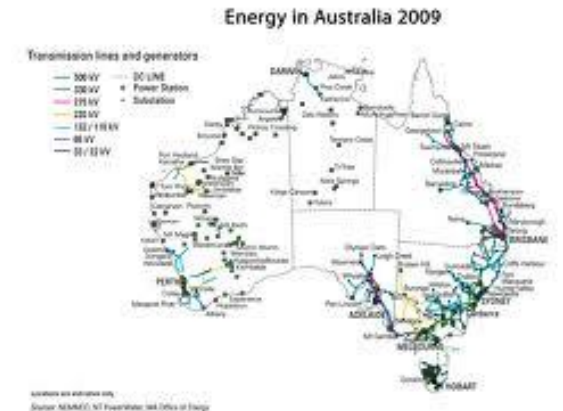
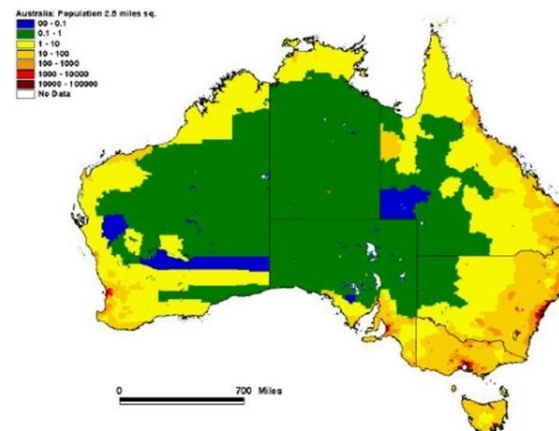
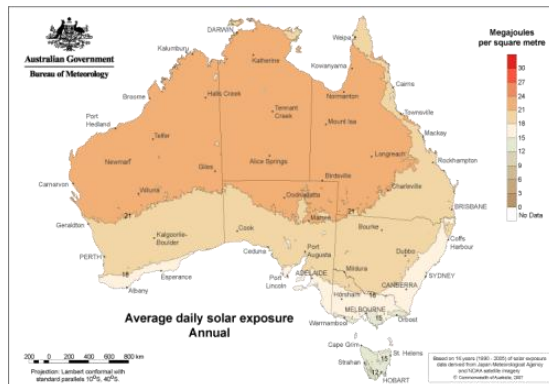
For further information contact IT Power (Australia) Pty Ltd
ph: 61-2 6257 3511
email: itpau@itpau.com.au
web: www.itpau.com.au
© Australian Solar Institute May 2012
www.australiansolarinstitute.com.au
ISBN: 978-0-9873356-1-6 (paperback)
978-0-9873356-2-3 (online)

June 2012 CSP pipeline > 1MW under development

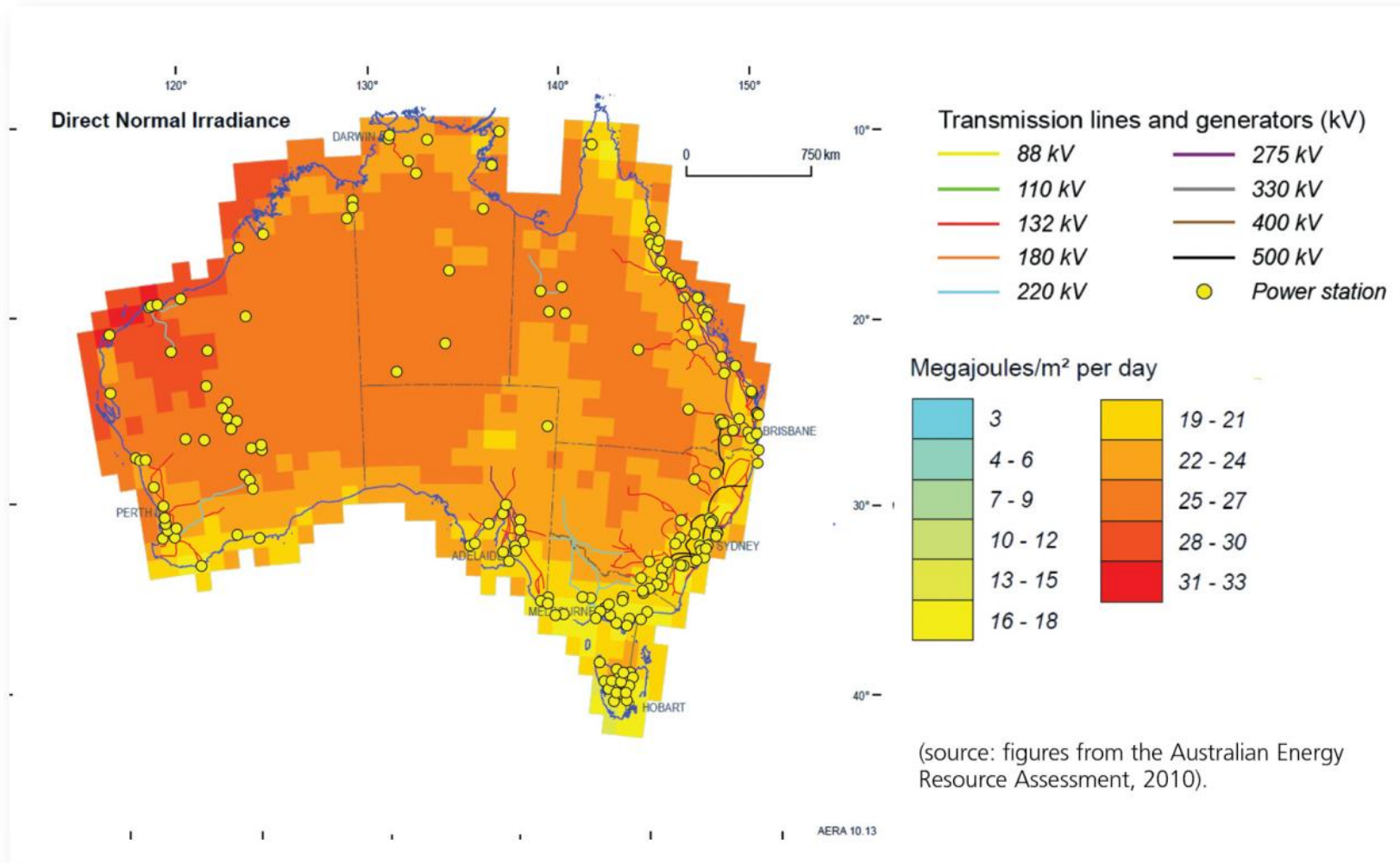


Solar resources, population, grid

- Optimal solar resources/area are often remote from population centres and the grid.
- Trade-off between value of electricity at point of consumption vs. lowest cost often at scale in remote locations.



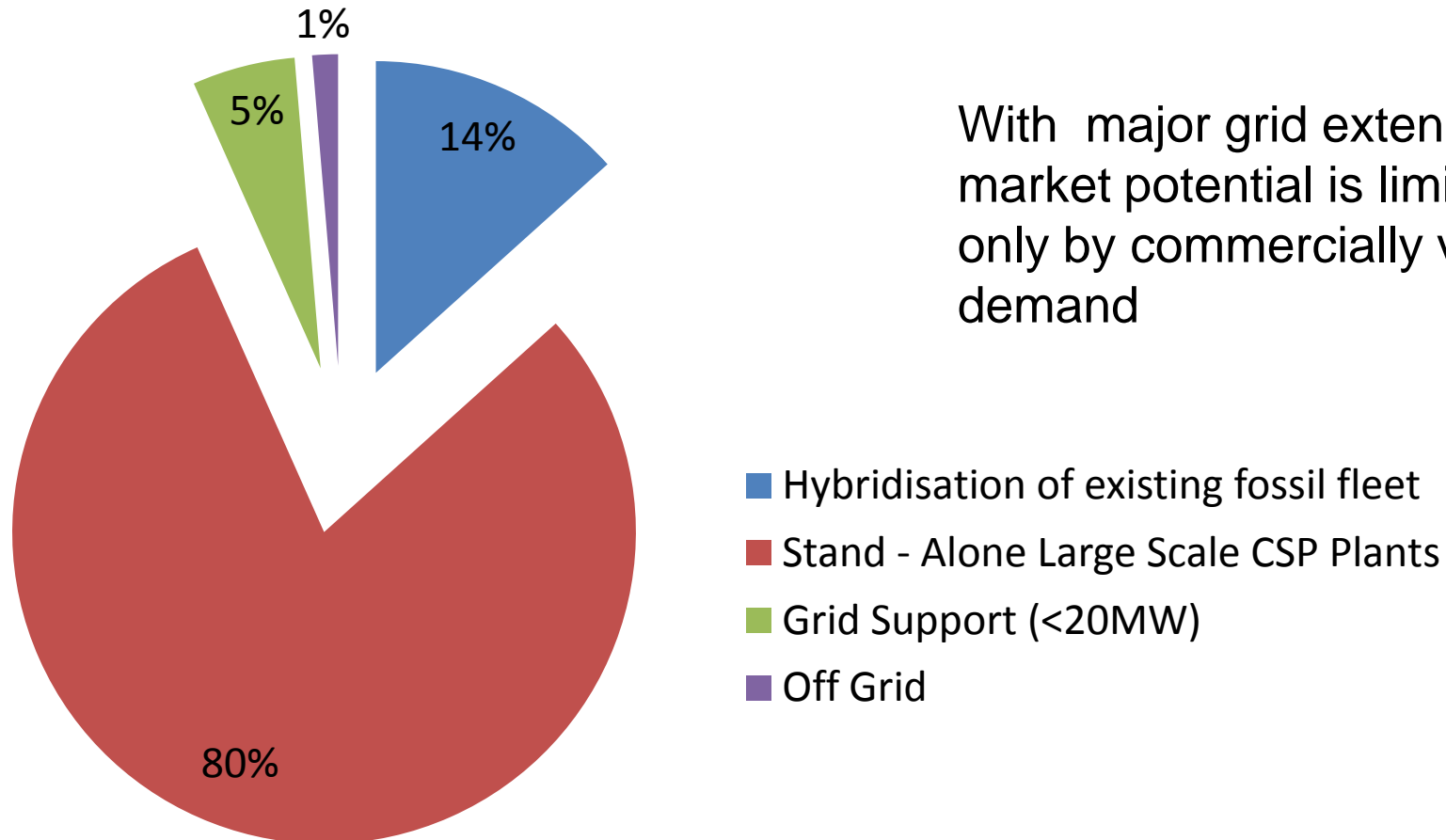
Grid and potential CSP location



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

Issues facing CSP market segments



Off-grid/ mini grid

- Reliable power at price competitive with diesel
- Hedge against future fuel price fluctuations and supply chain risks

But...

- Expectations of high system availability and capacity factor
- Short time horizons on investment decisions
- Split/perverse incentives around diesel fuel excise rebates
- Requires demonstration at 1-10 MW scale in grid connected areas to build confidence

Issues facing CSP market segments



Stand-alone, grid connected plants

- Grid-stabilising, load-firming, zero-carbon generation
- Enables penetration of renewable energy sources to > 20%
- High correlation with daytime peak loads
- Load-following using thermal energy storage
- Co-fire to maximise reliability

But...

- Very large capital costs of individual projects
- Lack of transmission infrastructure at optimal solar locations
- Limited reward for benefit of avoided line loss and grid extension
- Lack of confidence with network service providers
- Hard to get long term PPAs

Issues facing CSP market segments



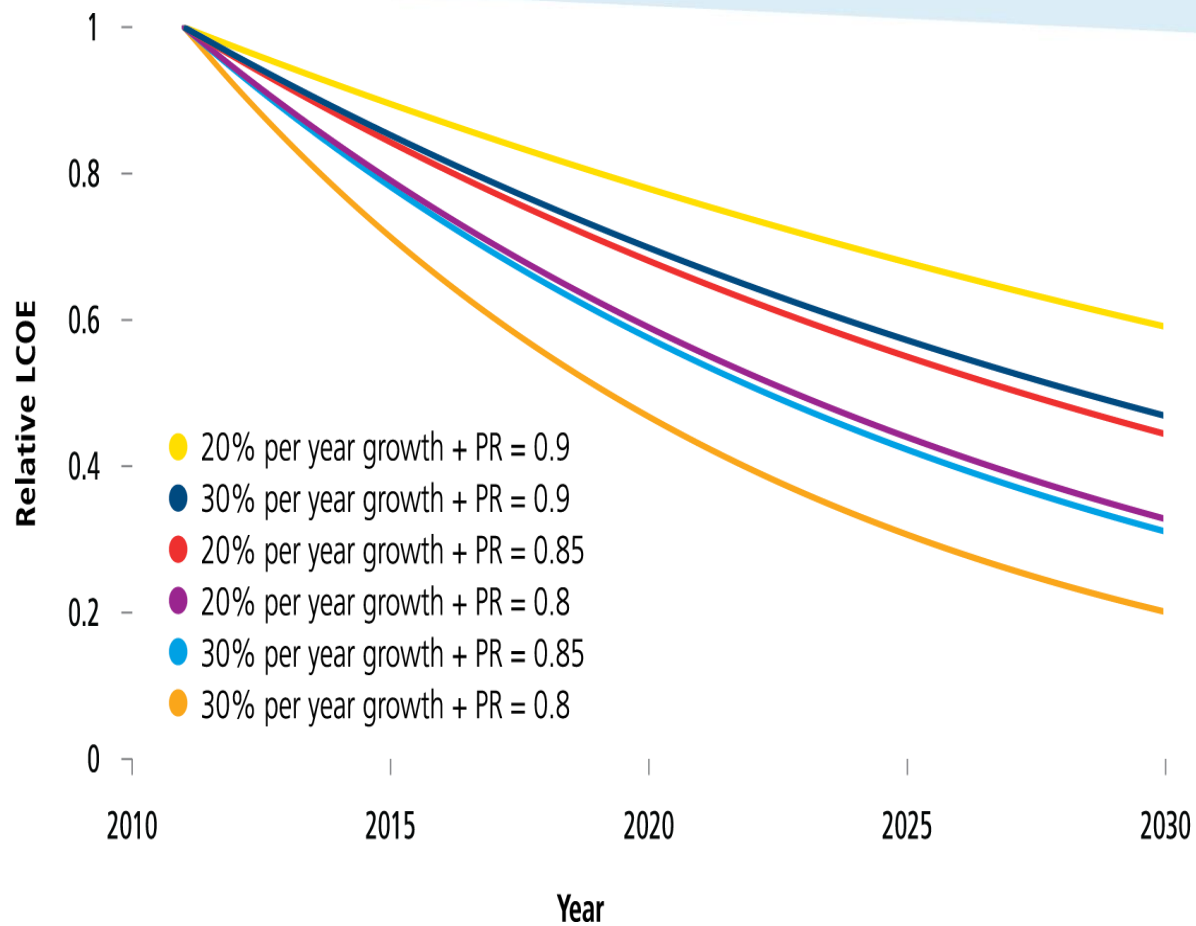
CSP add-ons to fossil-fired systems

- Lower emissions intensity for existing power plants
- Leverages existing infrastructure
- Prolong existing fleet lifetime
- High performance systems with lower project risk and capital cost.

But...

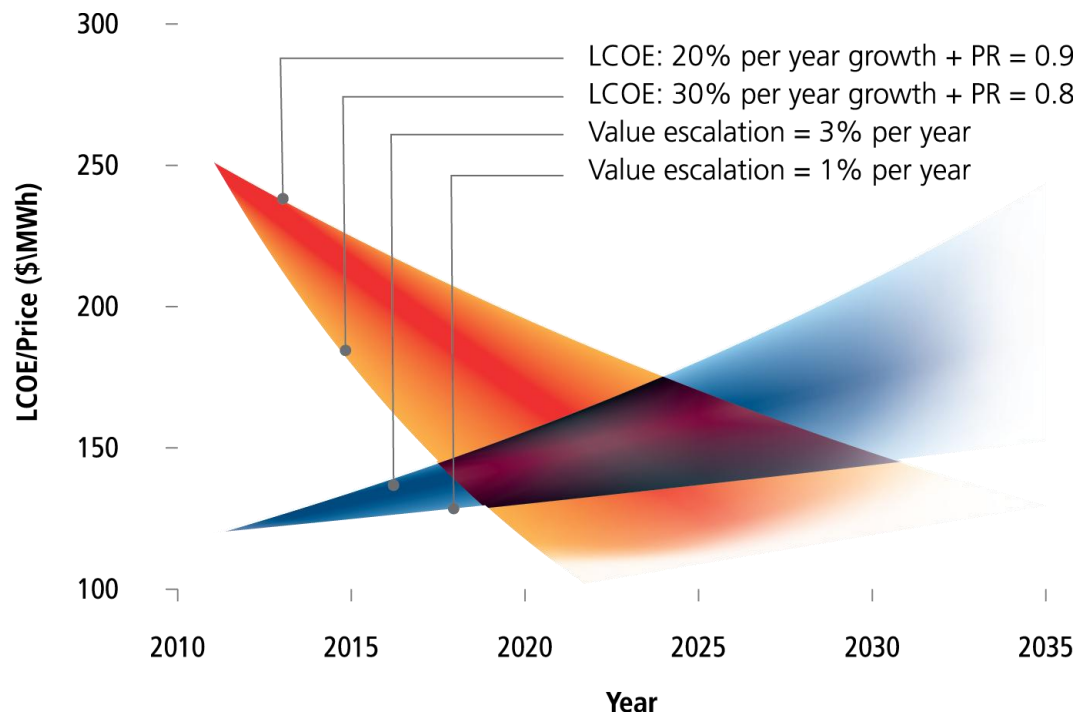
- Need to build confidence of existing generators re: CSP integration with core operations
- Split/perverse incentives, e.g. free carbon permits reducing pressure to lower emissions

Projected CSP cost reduction

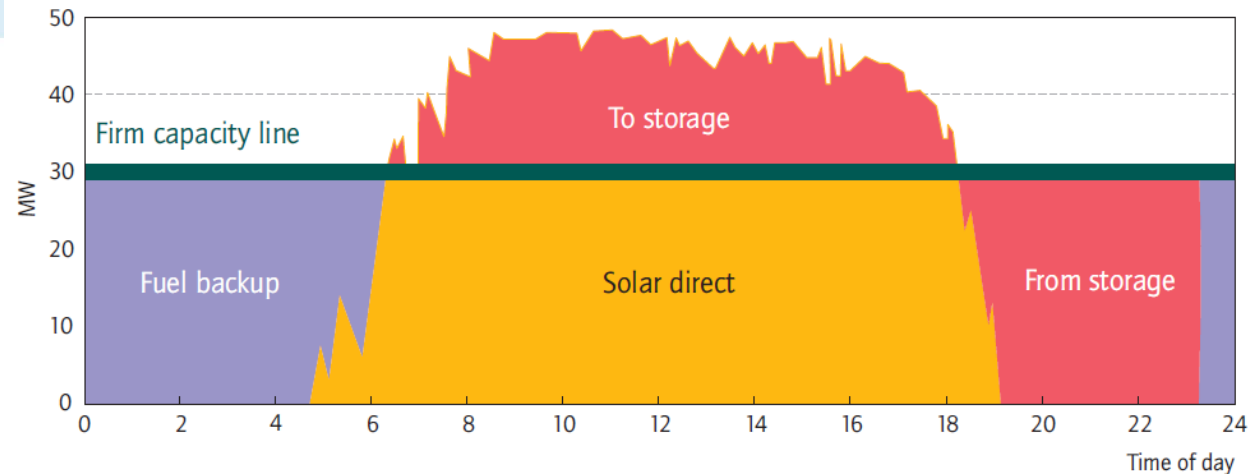


The commercial equation

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.



CSP Storage value key in Australia



Source: Geyer, 2007, SolarPACES Annual Report.

State	Market average price \$ / MWh	Immediate dispatch average sale price	Ratio immediate / market average sale price	Dispatch from storage average sale price \$ / MWh	Ratio Storage / market average
VIC	\$39.2	\$58.9	1.50	\$74.6	1.90
SA	\$49.5	\$89.7	1.81	\$136.9	2.77
QLD	\$36.9	\$50.0	1.35	\$77.2	2.09
NSW	\$41.3	\$54.7	1.32	\$80.7	1.95
WA	\$50.1	\$58.1	1.16	\$65.8	1.31
AVERAGE	\$43.4	\$62.3	1.43	\$87.0	2.01

A vision for a strong CSP future for Australia



Cumulative 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



Mark Twidell, Executive Director

Mark.twidell@australiansolarinstitute.com.au

+61 2 49606300

www.australiansolarinstitute.com.au