



Concentrating Solar Thermal

— *an opportunity for Australia*

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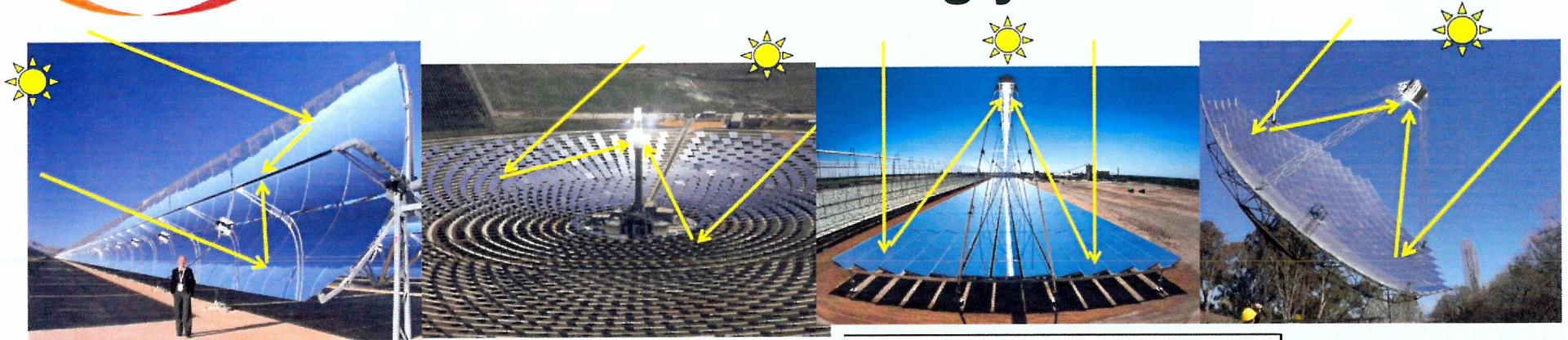
<http://www.itpau.com.au/>

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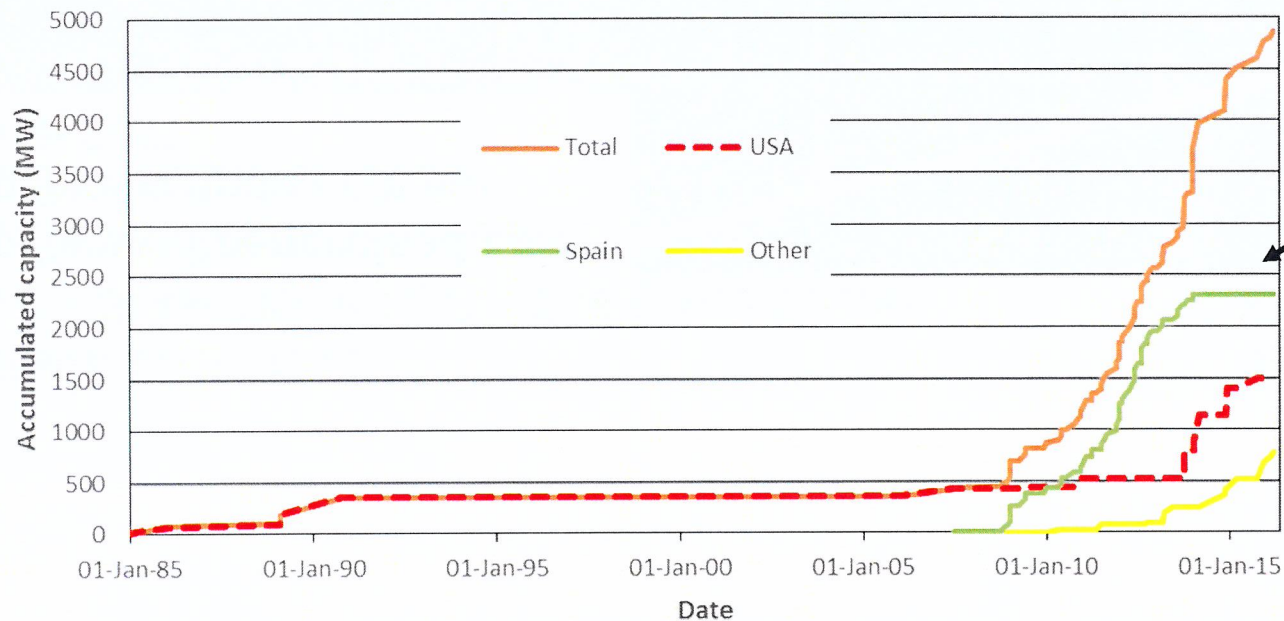




Concentrating Solar Power growing strongly



Global CST capacity



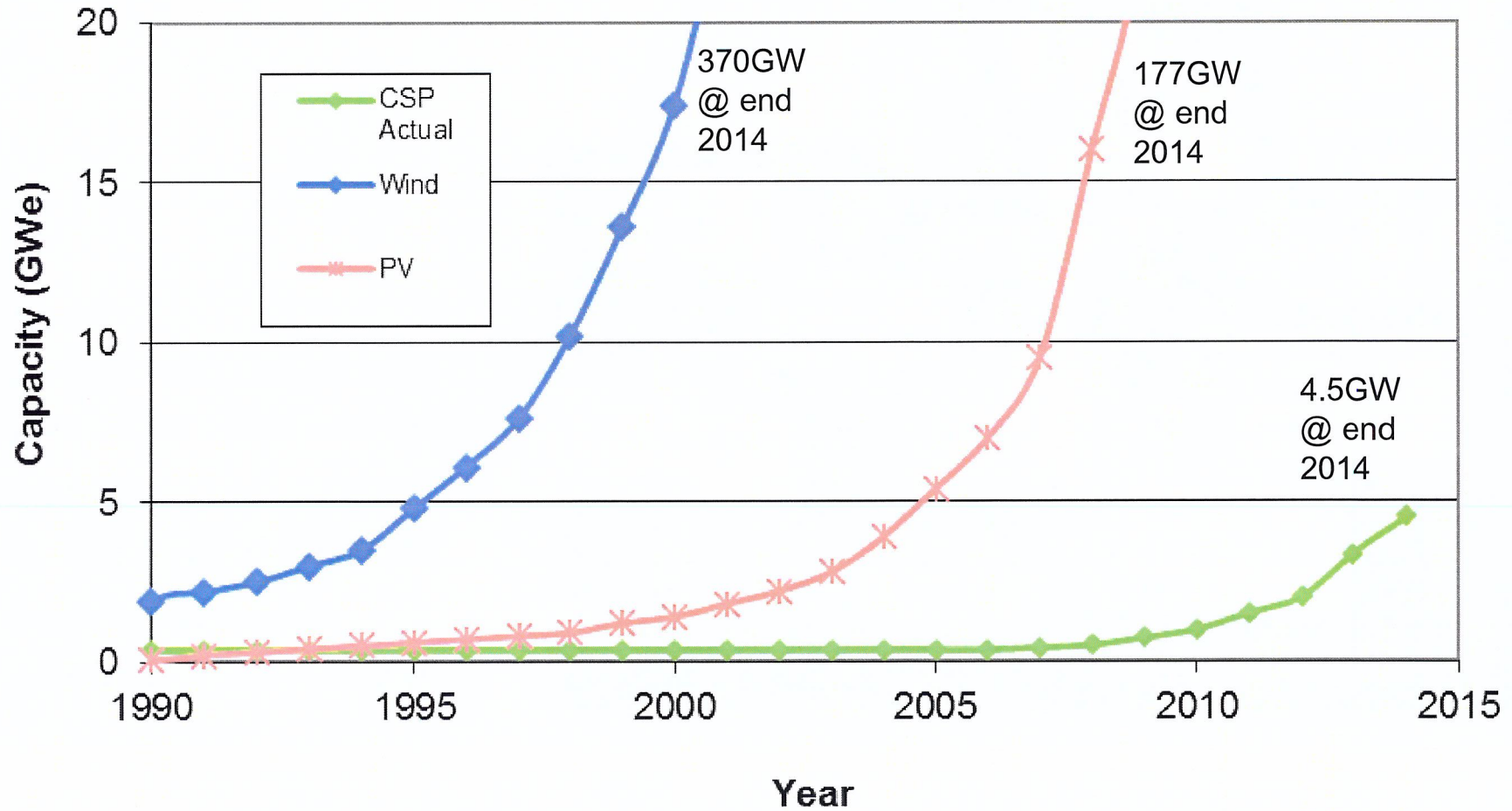
Spain stopped post the GFC

USA off and on again

Others (South Africa, Chile MENA, India, China), increasingly significant



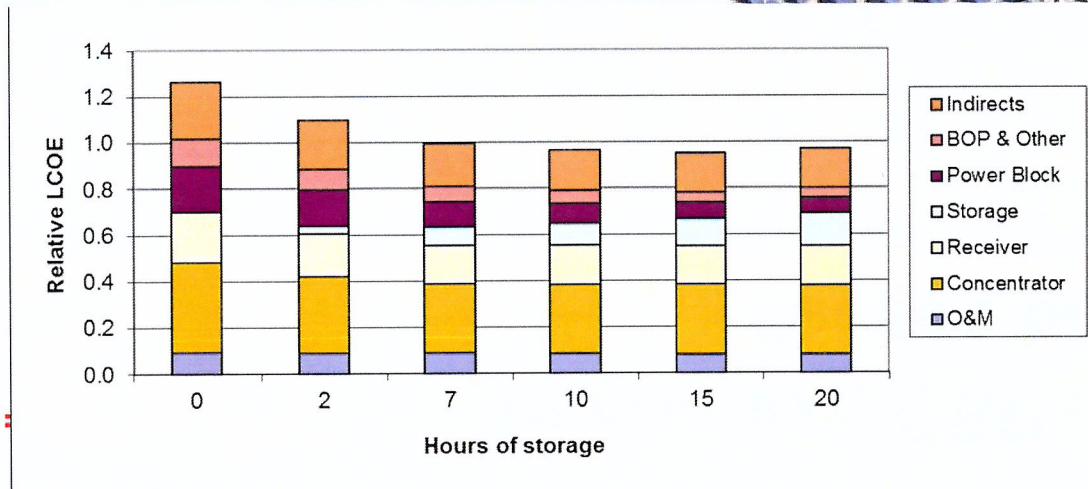
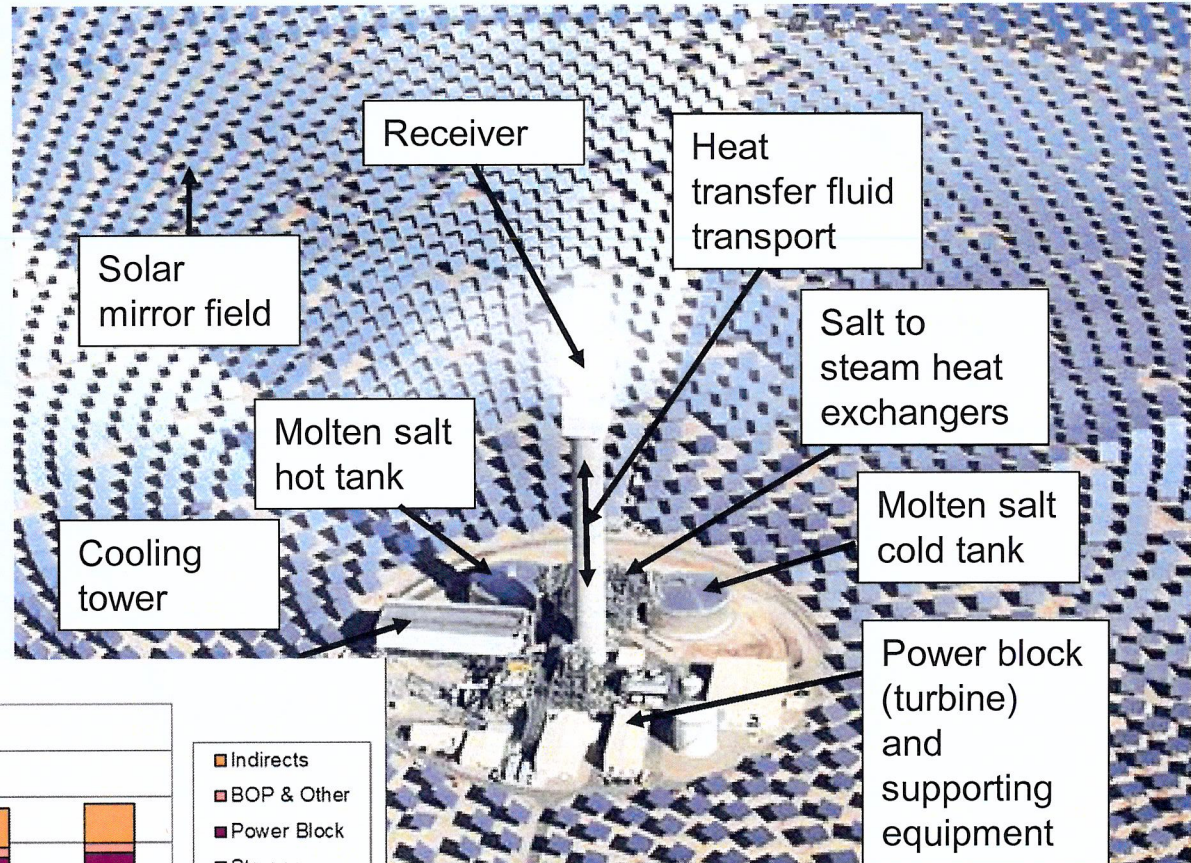
In context, CSP deployment is 1 decade behind PV





Proven Thermal Energy Storage is CSP's big competitive advantage

- * Two tank molten salt is proven / standard
- * A Higher temp makes it cheaper
- * Salt tanks have electrical heaters as ultimate back up.



- * Thermal storage is “integrated” – improves output, little or no extra cost, lowers LCOE!



Andasol 3 a Typical Spanish 50MW_e trough plant

- * 7.5hrs molten sa storage
- * High efficiency customised turbine
- * 18 months from ground breaking to on grid



Gemasolar, Seville

- * First commercial tower plus salt
- * Operating since October 2011
- * 19.9MWe turbine
- * 15 hours storage, 75% capacity factor
- * Achieved 36 days non stop generation Oct 2013



Novatech's PE 2 plant in Spain



- * Operating since 2012
- * 28 rows of linear Fresnel collectors, conventional steam turbine equipment and generator
- * Solar Field 302,000 m²
- * Power Capacity 30 MW_e
- * Most successful utility scale LFR plant so far

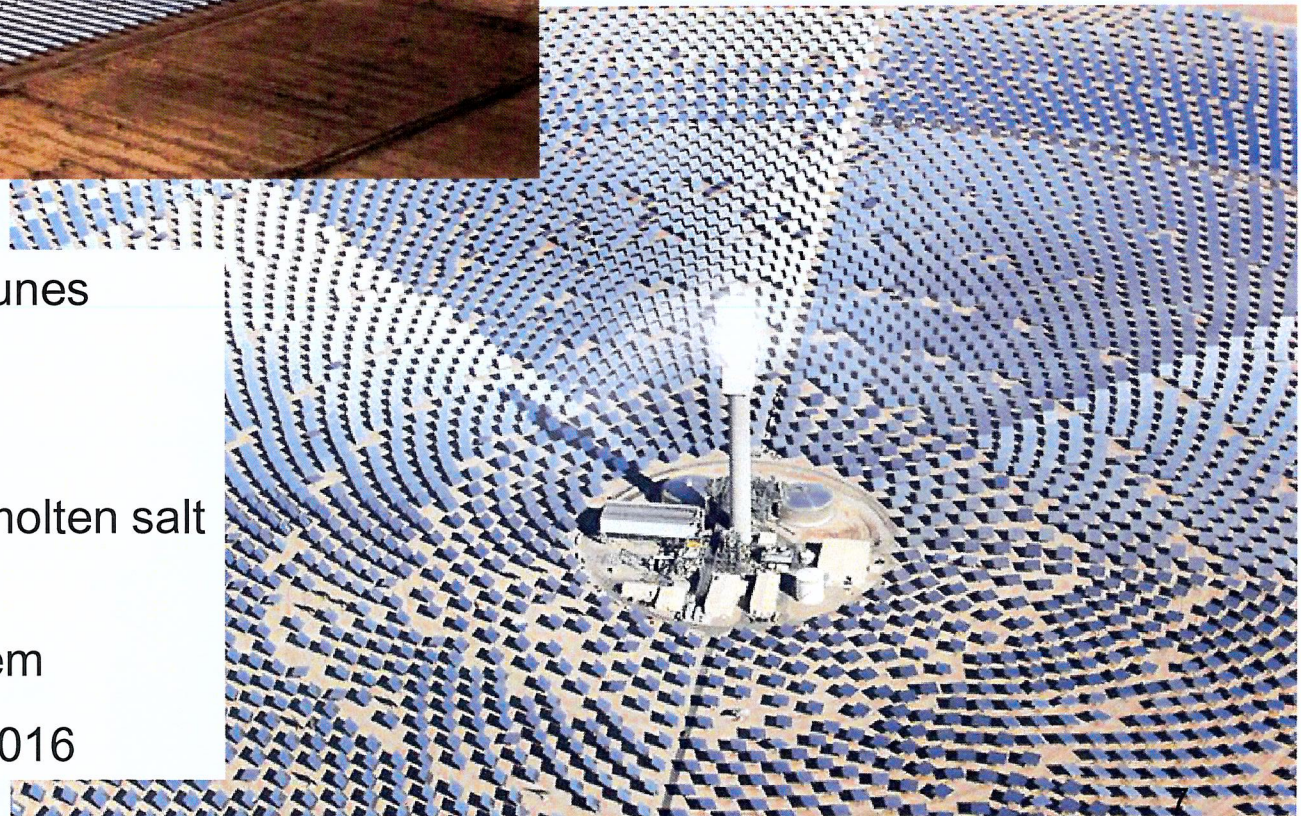


Abengoa's Solana plant, Arizona

- * Trough concentrators
- * 280 MW_e trough plant with six hours of thermal storage.
- * Operation since October 2013

SolarReserve's Crescent Dunes plant, Nevada

- * Tower and heliostats
- * 110MW_e with 10 hours molten salt energy storage
- * Biggest ever tower system
- * Operational from early 2016

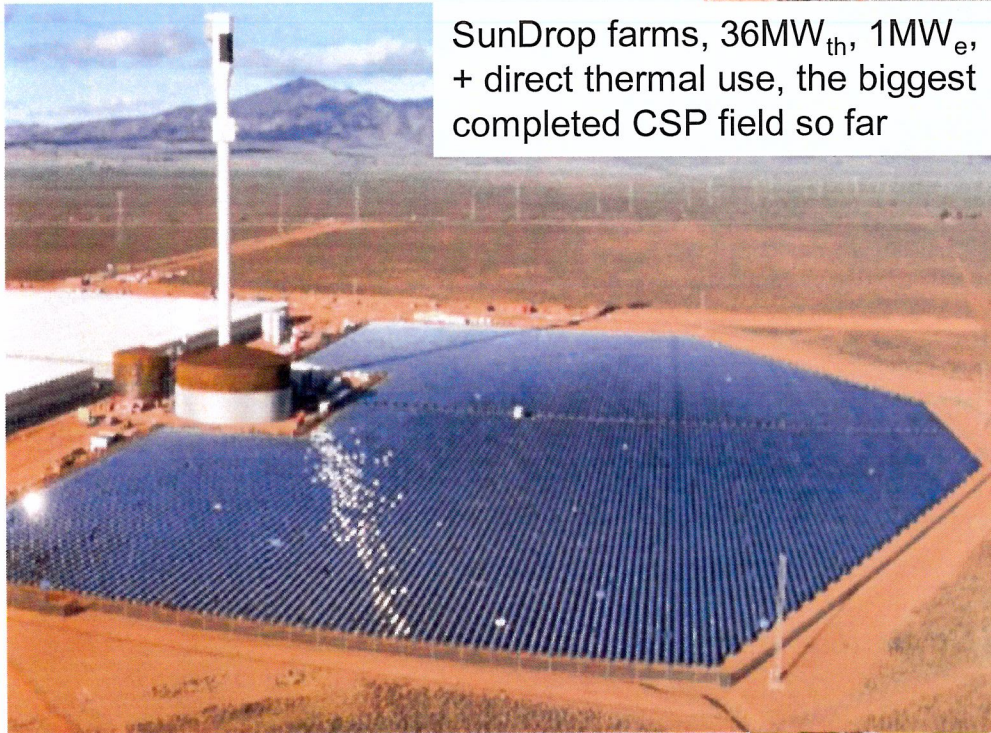


Australia still taking baby steps

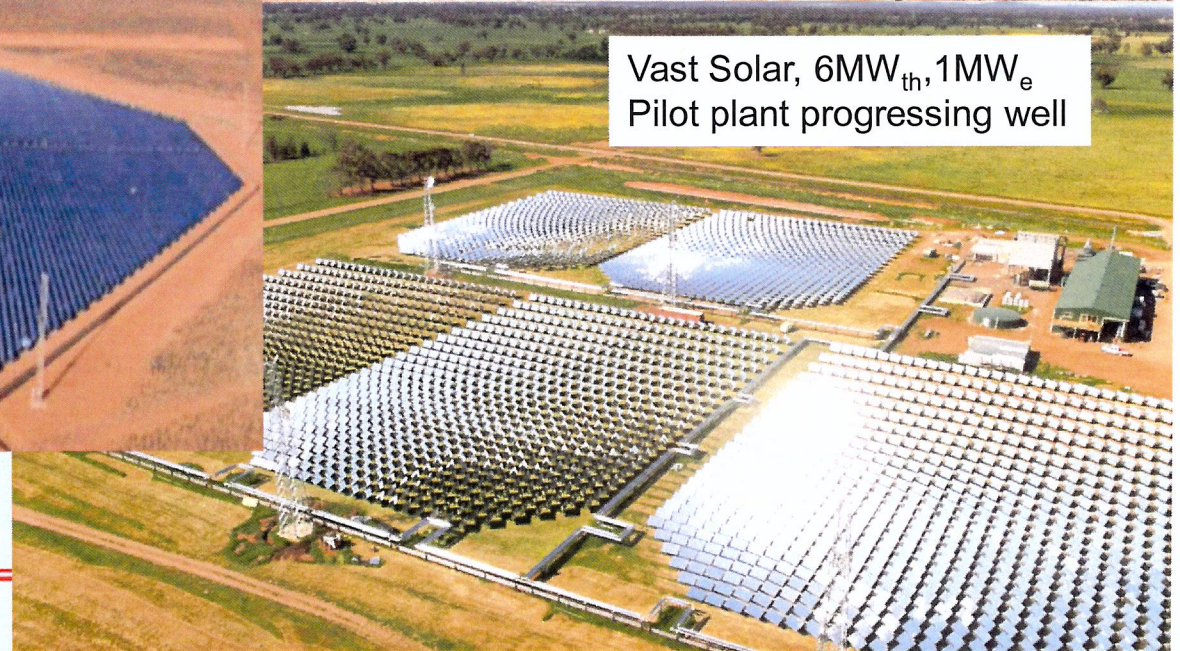
Kogan Creek Solar Boost.
130MW_{th} AREVA LFR
solar field 75% complete
but project stalled!!!



SunDrop farms, 36MW_{th}, 1MW_e,
+ direct thermal use, the biggest
completed CSP field so far

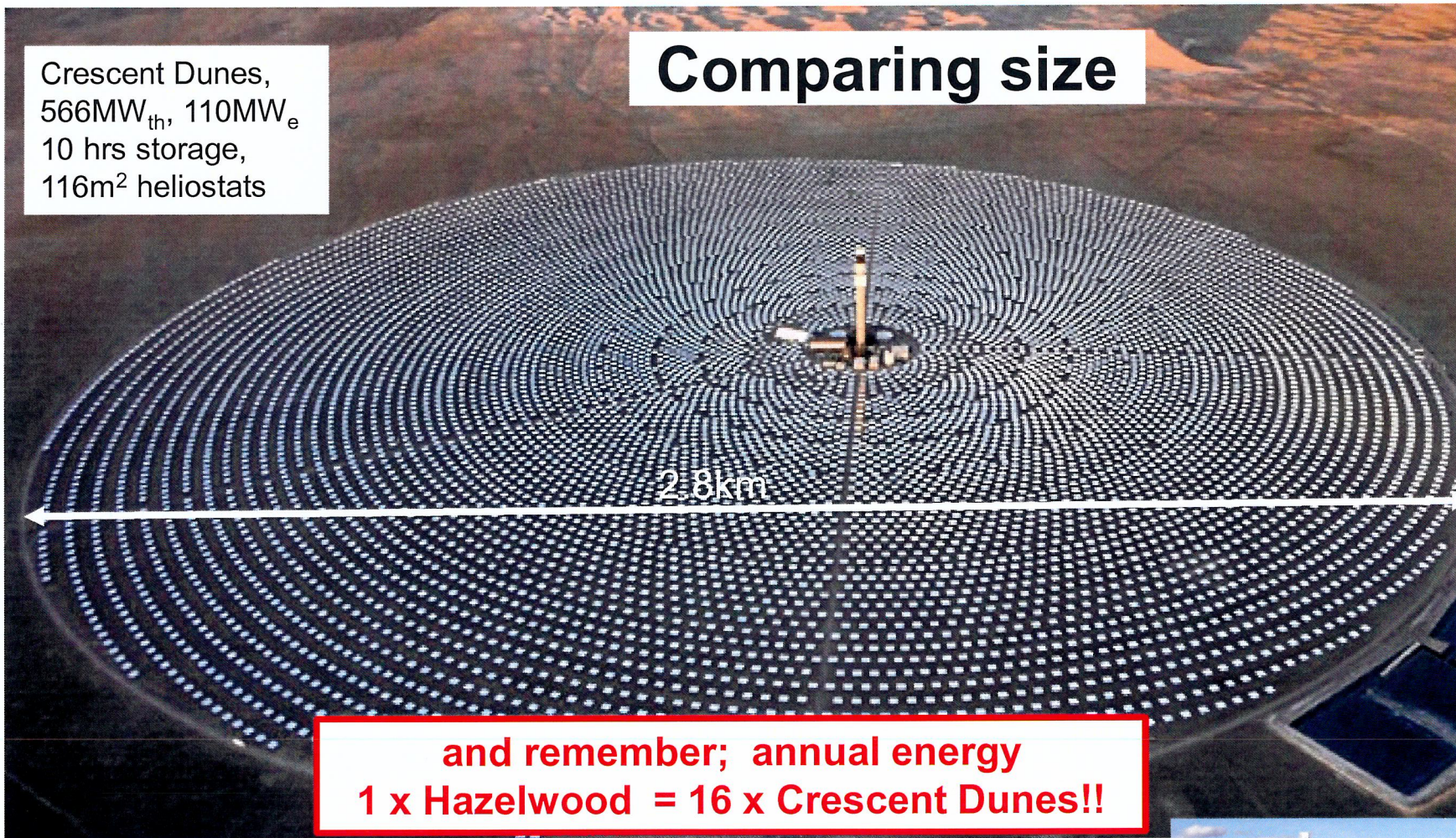


Vast Solar, 6MW_{th}, 1MW_e
Pilot plant progressing well



Comparing size

Crescent Dunes,
566MW_{th}, 110MW_e
10 hrs storage,
116m² heliostats



**and remember; annual energy
1 x Hazelwood = 16 x Crescent Dunes!!**

Vast Solar, Jemalong
6MW_{th}, 1MW_e
1/2 hr storage



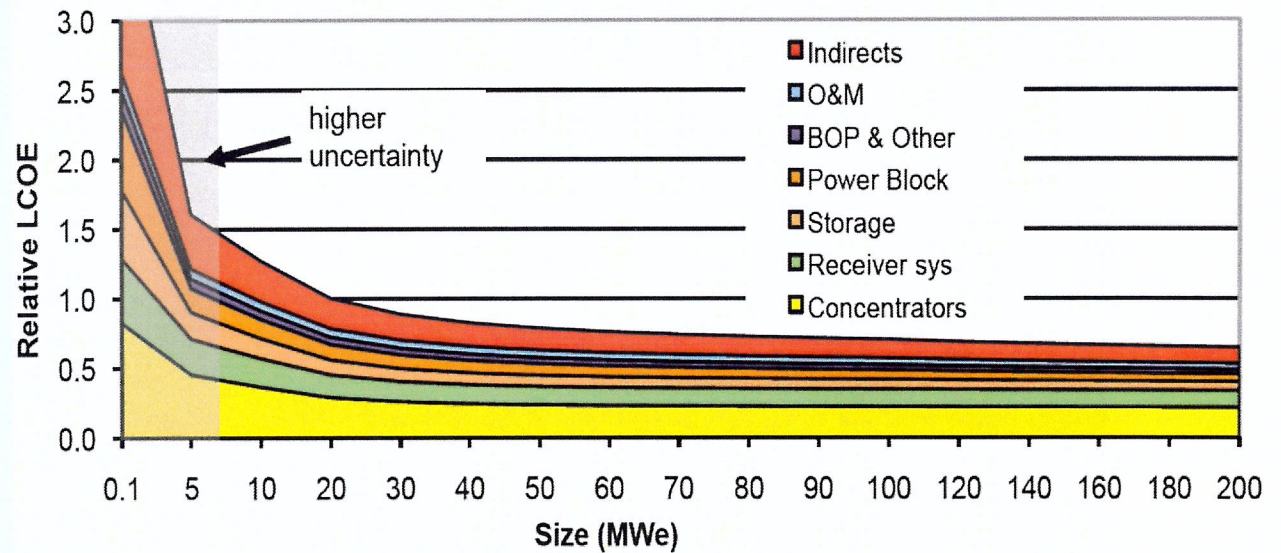
SunDrop farms,
36MW_{th}, 1MW_e, +
direct thermal use,
2m² heliostats





Cost of a CSP system

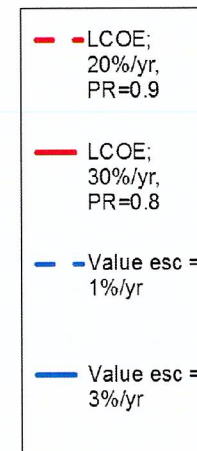
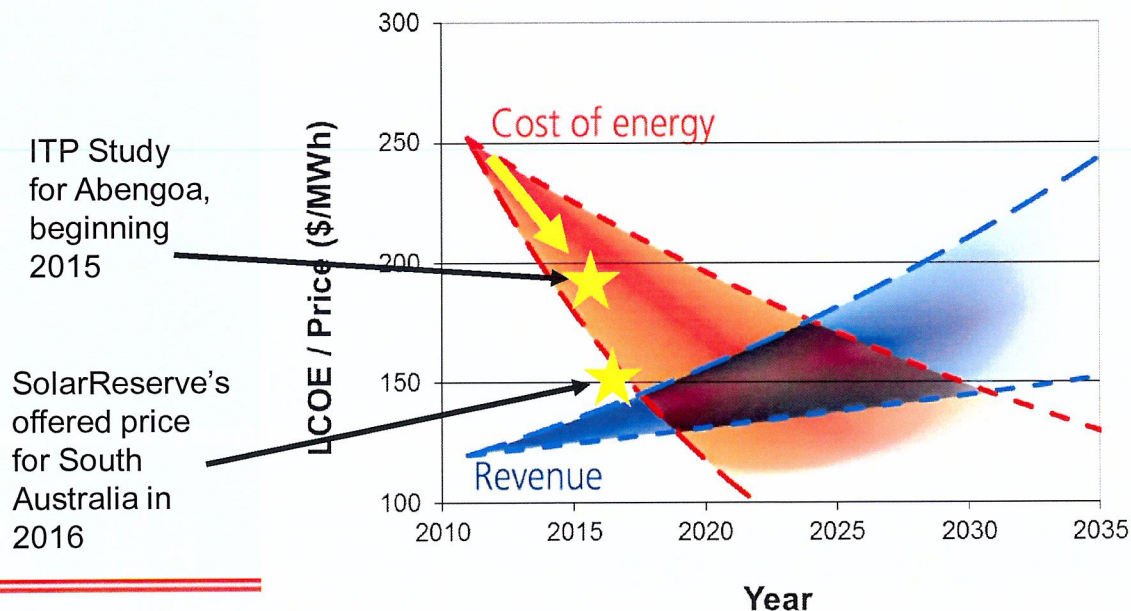
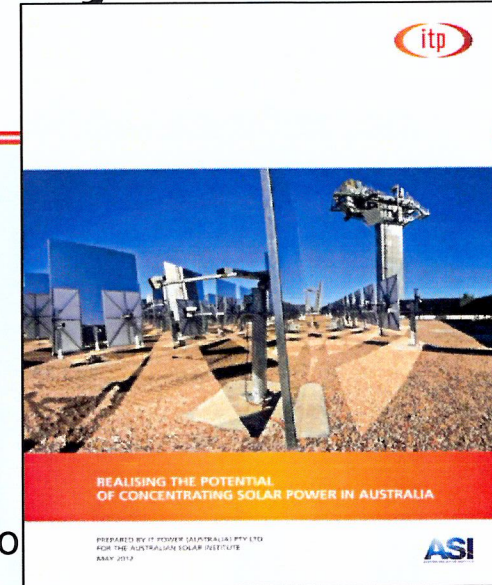
- ★ Once a developer has chosen a basic CSP technology set:
- ★ Installed cost (and hence average LCOE) depends on:
 - ★ Size of solar field
 - ★ Size of storage
 - ★ Size of power island
- ★ The cost dependency on size is non linear
- ★ 100MW – 200MW is a sweet spot





Looking back at ITP's 2012 study of CSP for Australia

- * Around 15GW could be realistically installed in Australia without major grid extensions
- * Solar Flagships was a missed opportunity for CSP
- * Global capacity in CSP has increased 300% in last 4 years
- * Systems with thermal storage now dominate
- * Cost reduction is at best side of predictions; from \$252/MWh down to 150/MWh in 4 years



In 2012, a Nth of a kind trough plant 64MW no storage, in 2016 a 100MW tower plant with 10hours storage

<http://www.itpau.com.au/review-of-the-potential-for-concentrating-solar-power-in-australia-australian-solar-institute-asi/>

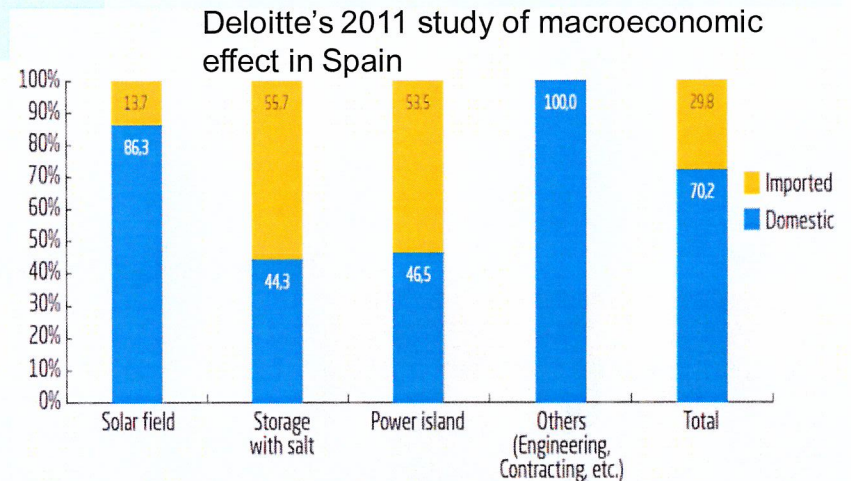


CSP Value Proposition

- * CSP Cost of energy (\$150/MWh) is 50% more than PV, 100% more than wind but...

Source of Value	Estimate relative value increase over intermittent renewable energy
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Time of Day benefit	5% – 100%
Ancillary services	0% – 10%
Network benefits	-10% – 100%
Societal / option value	10% – 20%
Total extra for CSP with storage	50% - 150%



- * Value propositions must be optimised on a case by case basis
- * Values change with geographical area, market rules and the other generating assets in place.



Conclusions

- * CST is growing strongly globally, about 1 decade behind PV.
 - * CST offers high value dispatchable renewable electricity generation.
 - * CST offers the developer country a bigger position in the value chain.
 - * Need to build utility scale CSP power systems to build experience and supply chain.
 - * We need all of:
 - * First utility scale systems by a globally experienced players
 - * Engagement between R&D institutions and global CST industry
 - * Nurture local content and start-ups
 - * Renewable Energy Policy (RET) should reward extra values with preferential tariffs
 - * eg x 2.5 for 4.30pm – 9.30pm or multiplier proportional to pool price
 - * Parallel zero emissions ancillaries market
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