



# Concentrating Solar Thermal

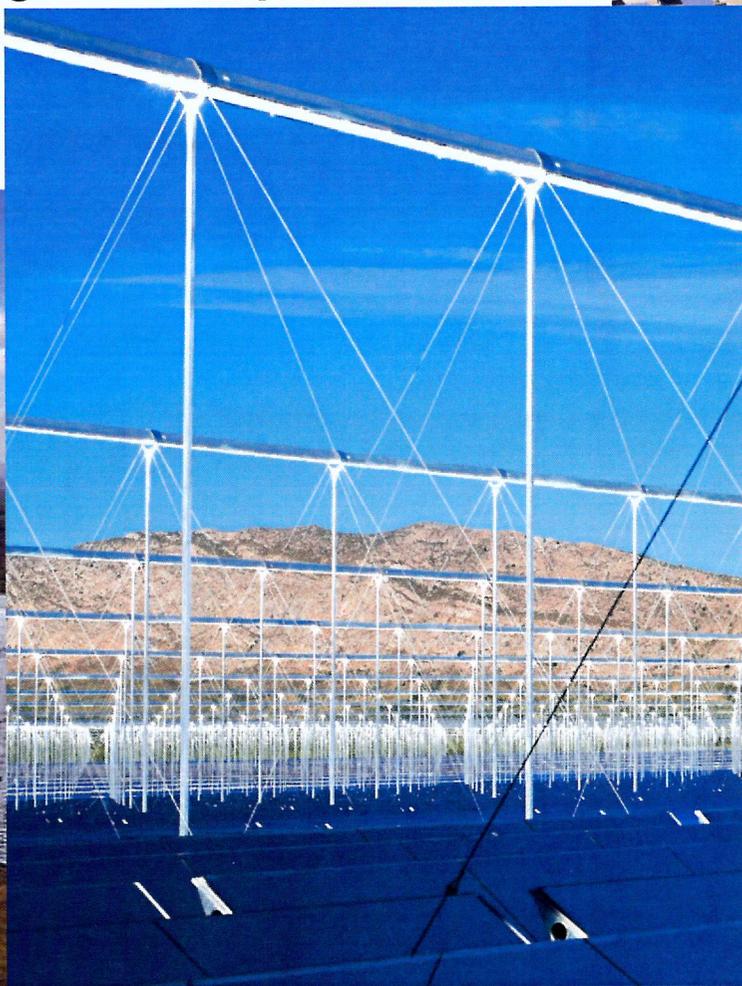
— *an opportunity for Australia*

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<http://www.itpenergised.com/>

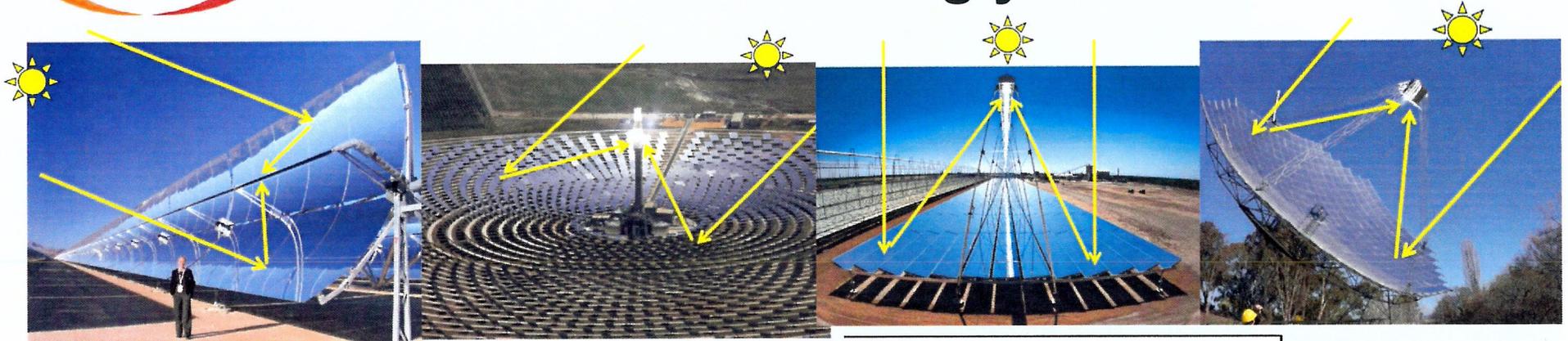
<http://www.itpau.com.au/>

March 2017

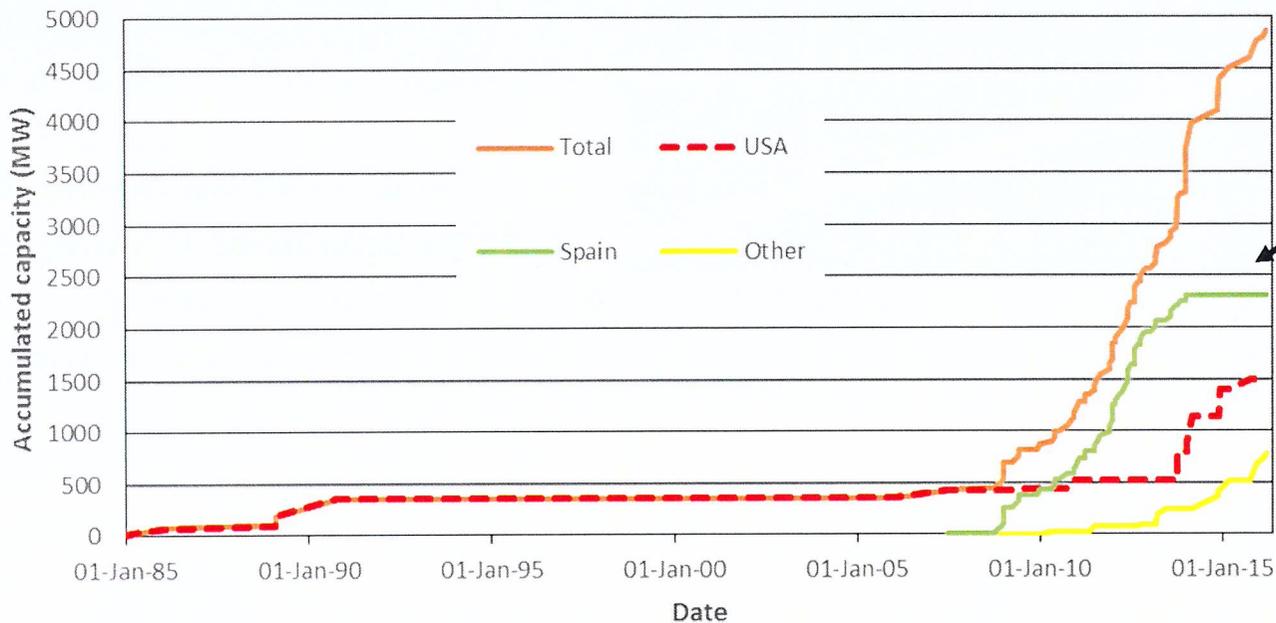




# Concentrating Solar Power growing strongly



Global CST capacity



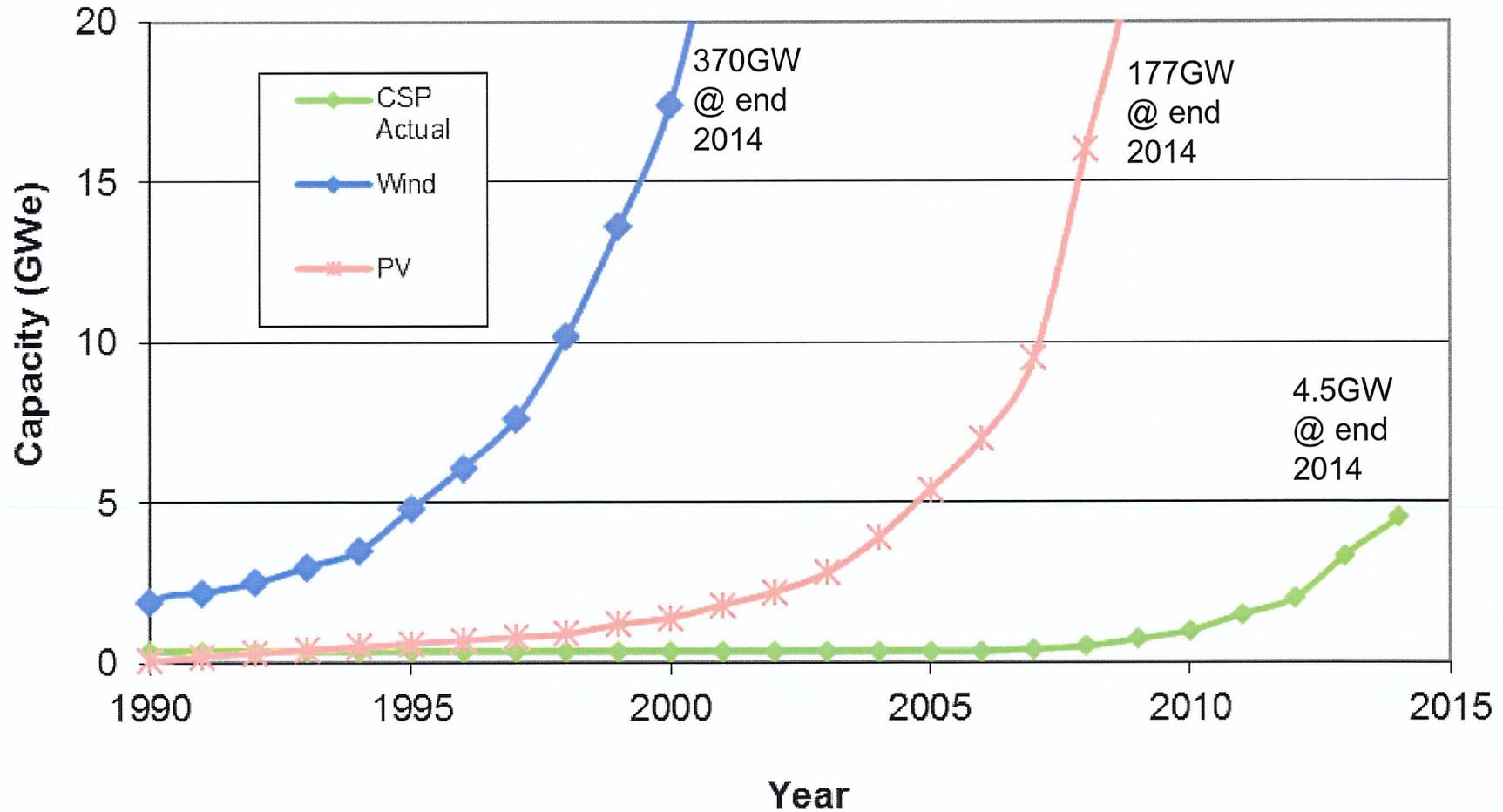
Spain stopped post the GFC

USA off and on again

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



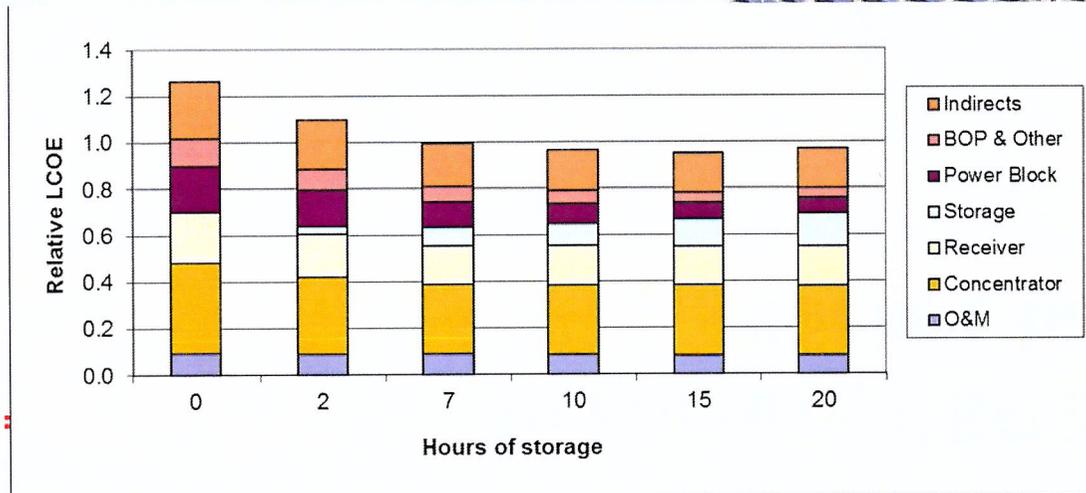
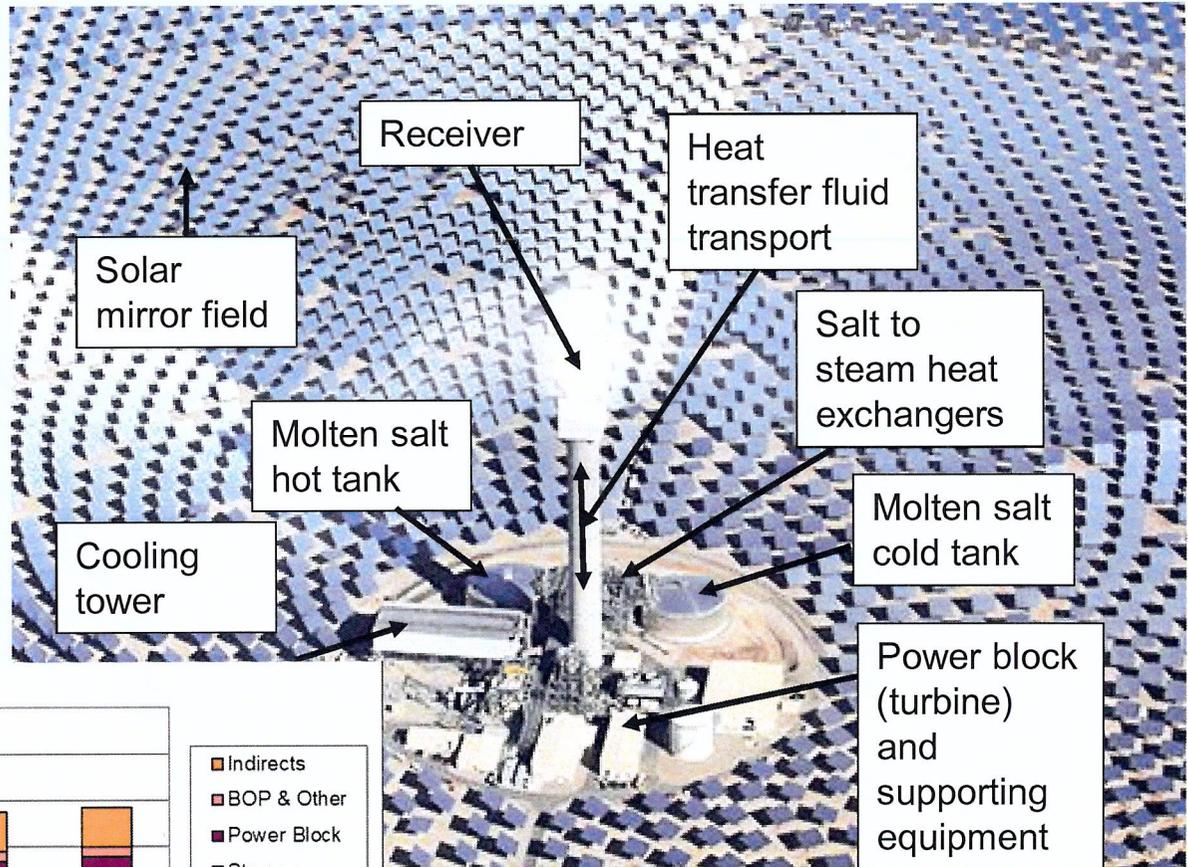
# In context, CSP deployment is 1 decade behind PV





# 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<sub>e</sub> trough plant

- \* 7.5hrs molten salt 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 m<sup>2</sup>
- \* Power Capacity            30 MW<sub>e</sub>
- \* Most successful utility scale LFR plant so far



## Abengoa's Solana plant, Arizona

- \* Trough concentrators
- \* 280 MW<sub>e</sub> trough plant with six hours of thermal storage.
- \* Operation since October 2013

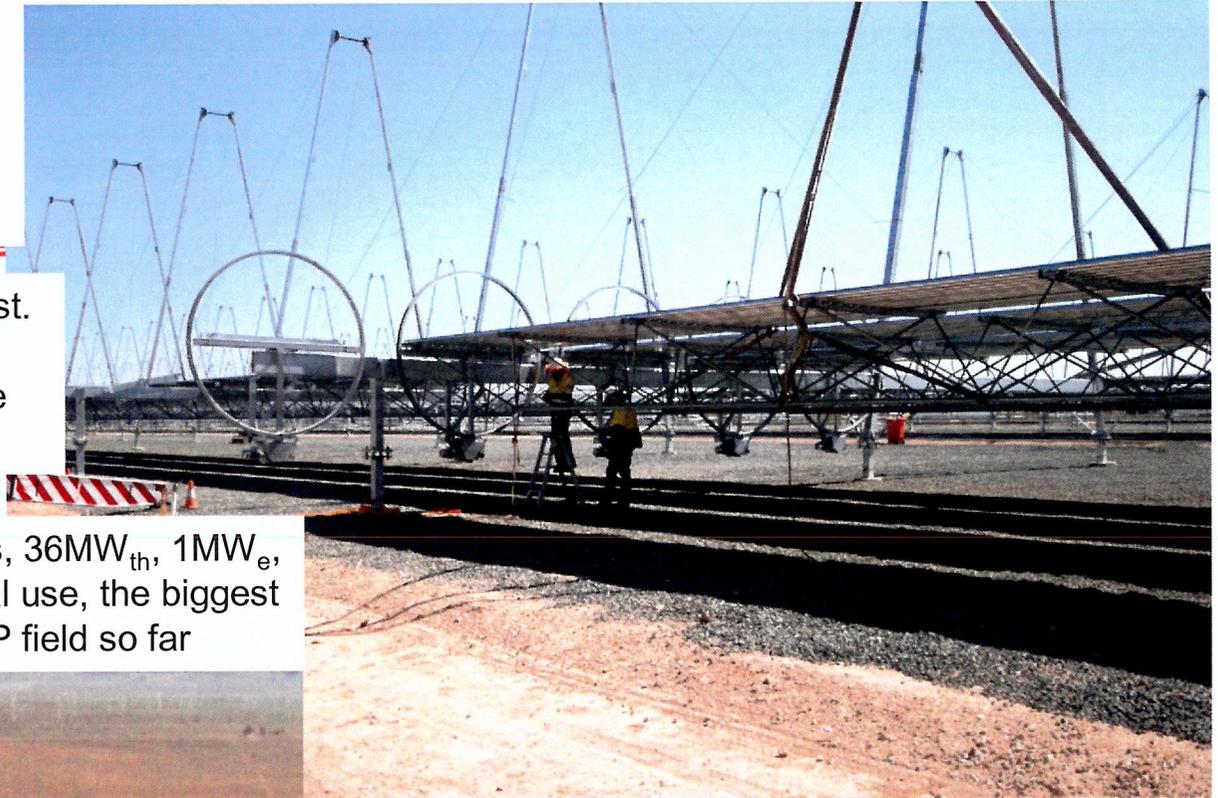
## SolarReserve's Crescent Dunes plant, Nevada

- \* Tower and heliostats
- \* 110MW<sub>e</sub> with 10 hours molten salt energy storage
- \* Biggest ever tower system
- \* Operational from early 2016

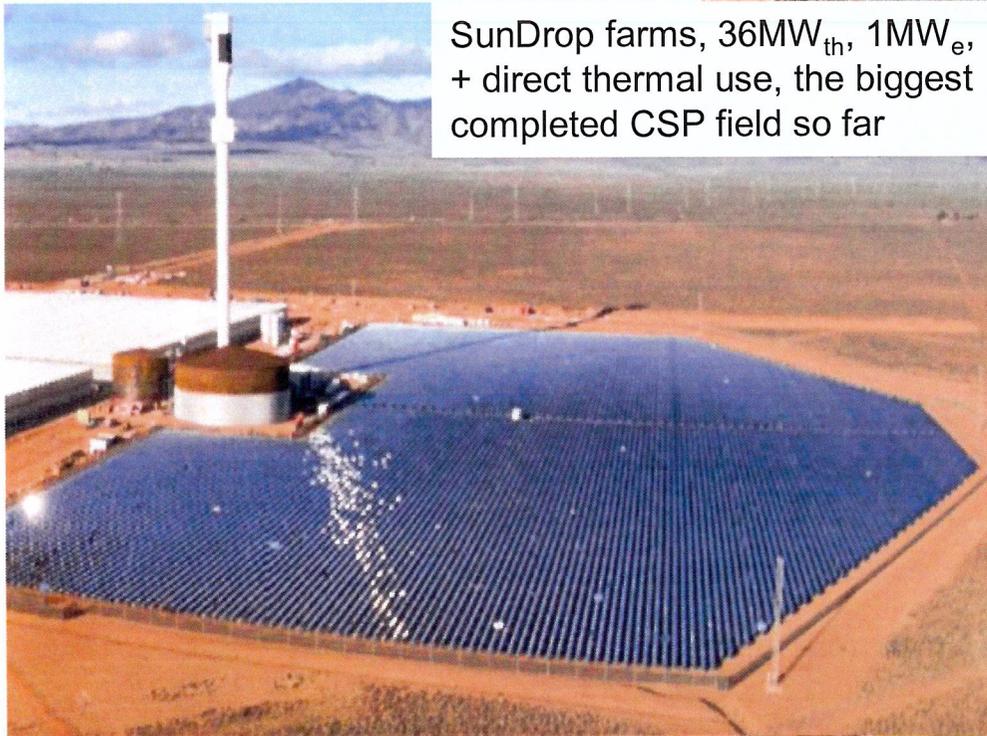


# Australia still taking baby steps

Kogan Creek Solar Boost.  
130MW<sub>th</sub> AREVA LFR  
solar field 75% complete  
but project stalled!!!



SunDrop farms, 36MW<sub>th</sub>, 1MW<sub>e</sub>,  
+ direct thermal use, the biggest  
completed CSP field so far

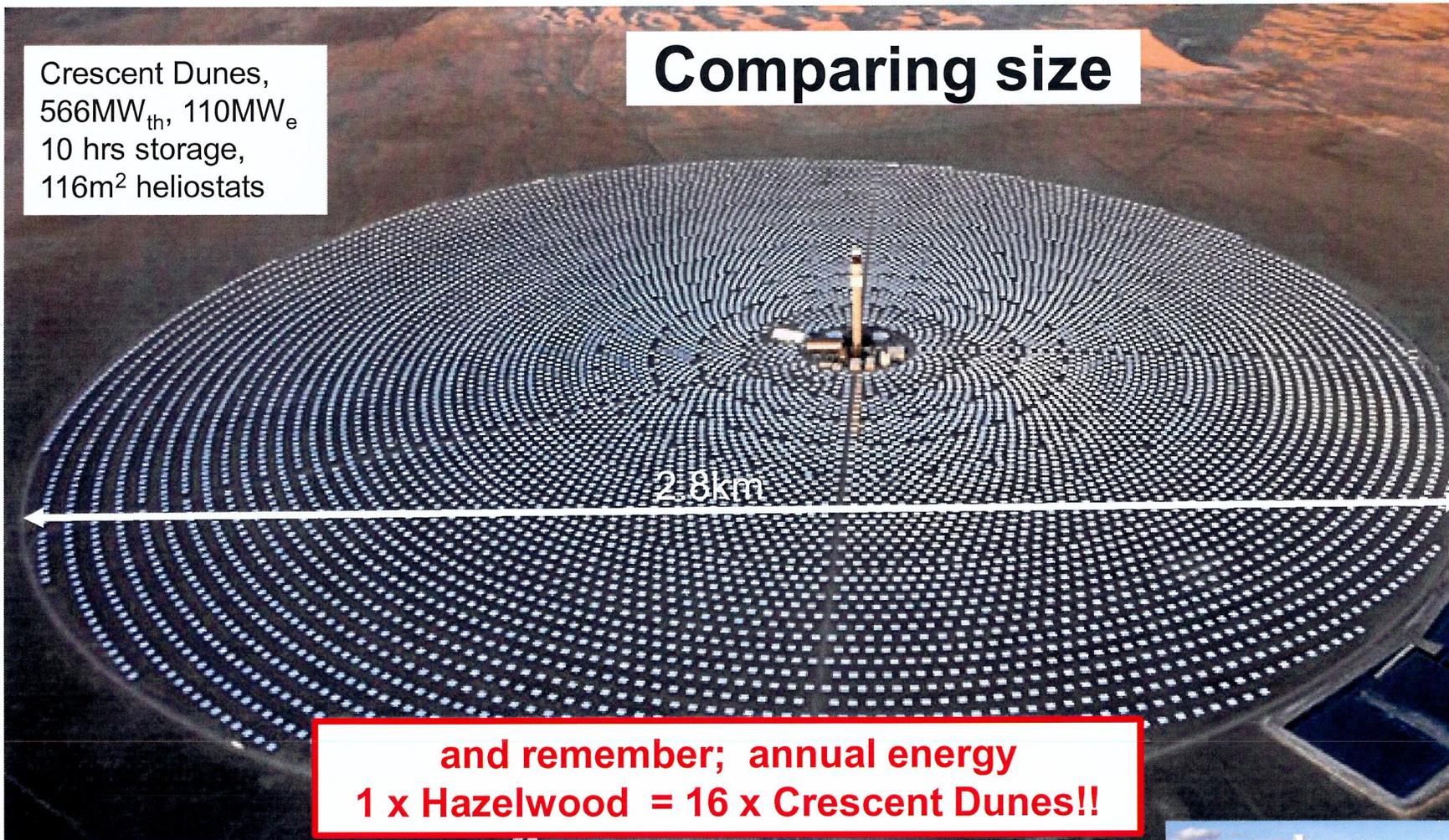


Vast Solar, 6MW<sub>th</sub>, 1MW<sub>e</sub>  
Pilot plant progressing well



# Comparing size

Crescent Dunes,  
566MW<sub>th</sub>, 110MW<sub>e</sub>  
10 hrs storage,  
116m<sup>2</sup> heliostats



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

Vast Solar, Jemalong  
6MW<sub>th</sub>, 1MW<sub>e</sub>  
1/2 hr storage



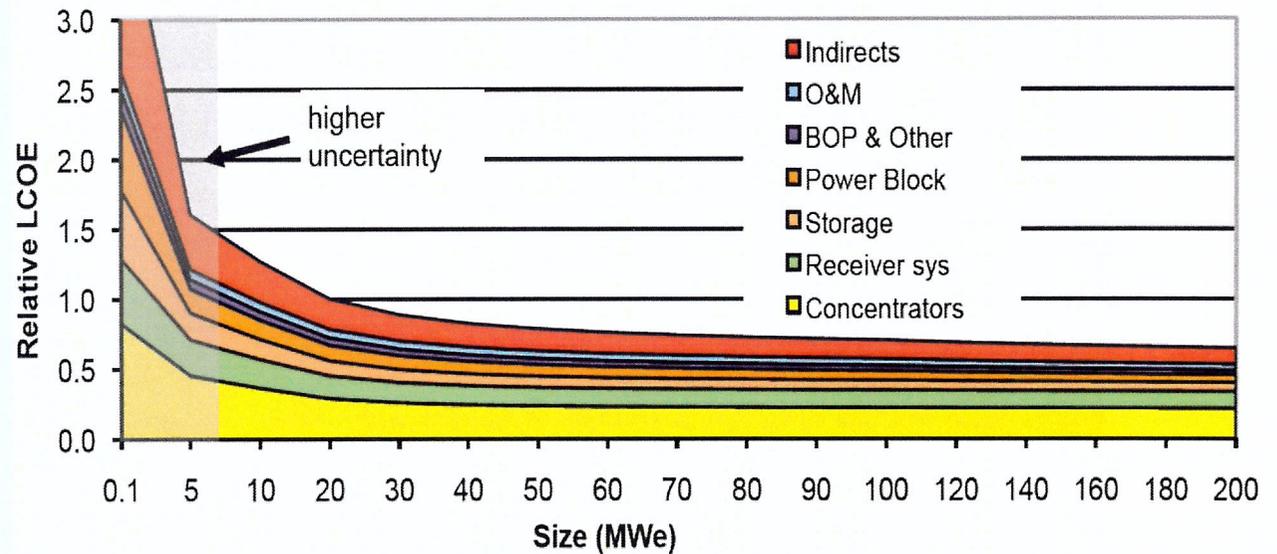
SunDrop farms,  
36MW<sub>th</sub>, 1MW<sub>e</sub>, +  
direct thermal use,  
2m<sup>2</sup> heliostats





## Cost of a CSP system

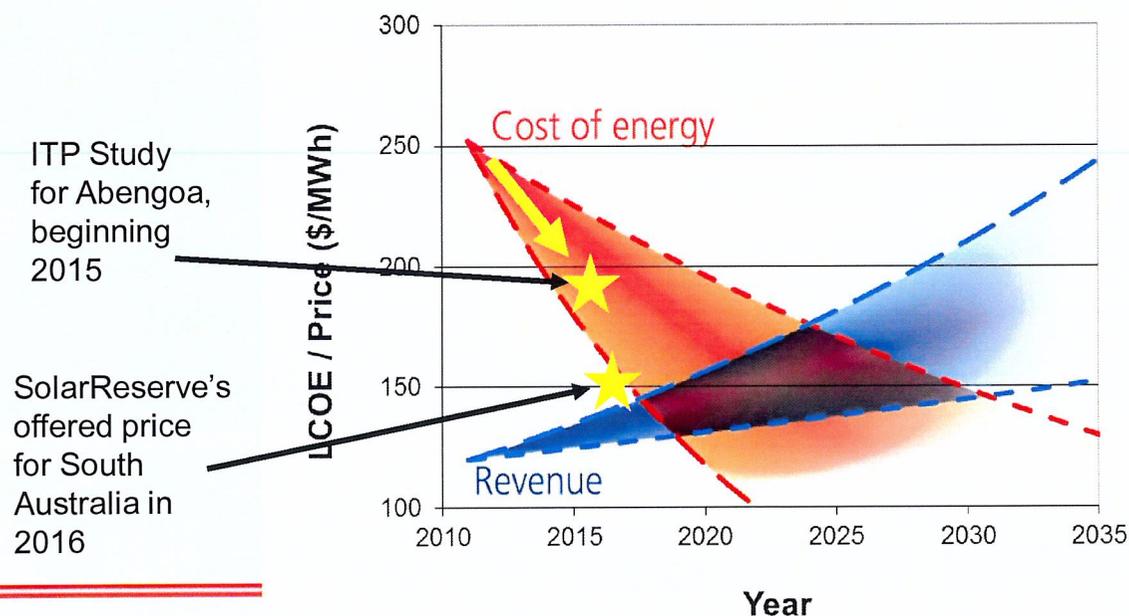
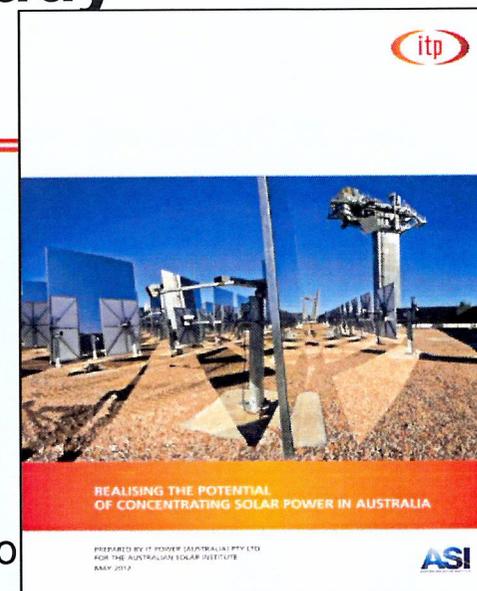
- ★ Once a developer has chosen a basic CSP technology set:
- ★ Installed cost (and hence average LCOE) depends on:
  - ★ Size of solar field
  - ★ Size of storage
  - ★ Size of power island
- ★ The cost dependency on size is non linear
- ★ 100MW – 200MW is a sweet spot





# 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



- - LCOE; 20%/yr, PR=0.9
- LCOE; 30%/yr, PR=0.8
- - Value esc = 1%/yr
- Value esc = 3%/yr

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/>

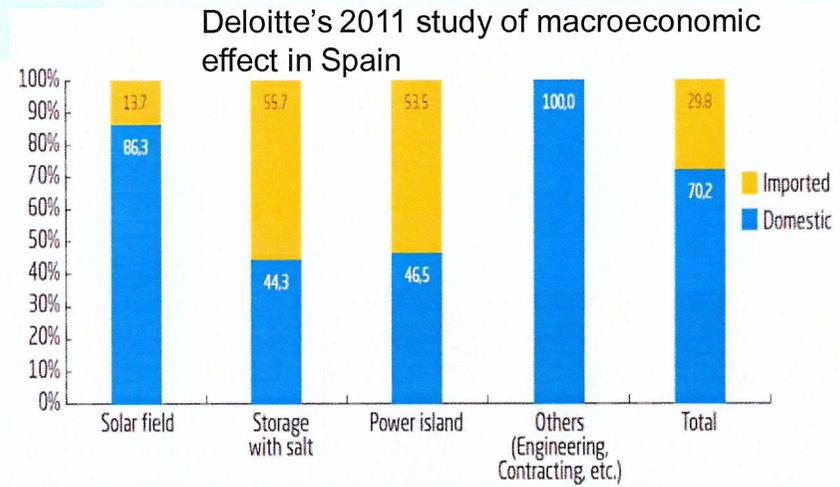


# CSP Value Proposition

- \* 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%
<b>Total extra for CSP with storage</b>	<b>50% - 150%</b>



- \* 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

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- \* 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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