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Solar Thermal Energy Storage

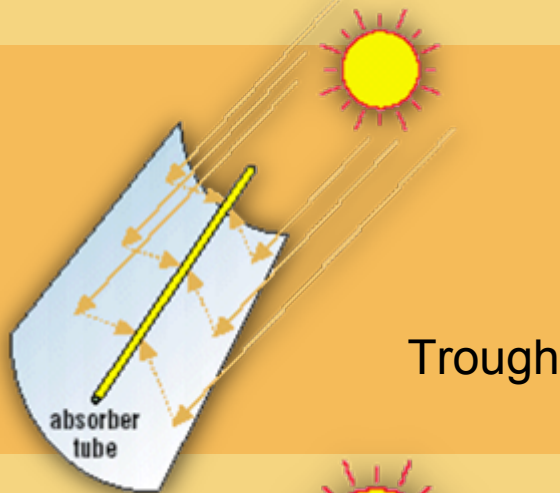
Jim Smitham, Tania Ritchie, Robbie McNaughton
11 November 2009



Collecting Solar Energy - Solar collector types

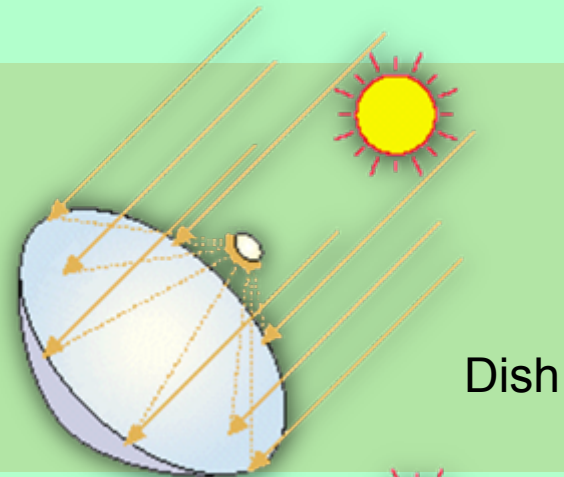
Continuous

Linear focus



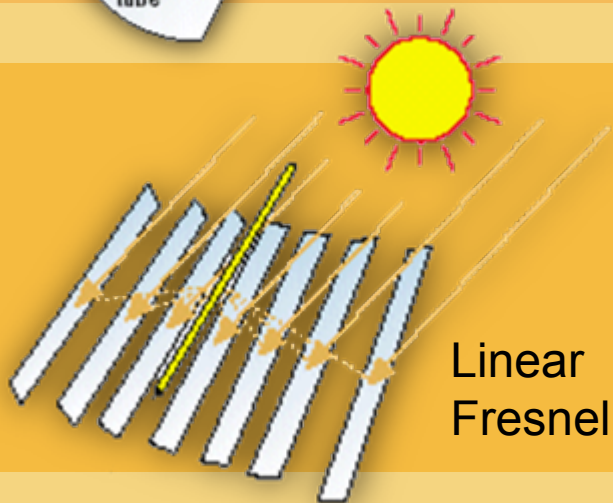
Trough

Point focus

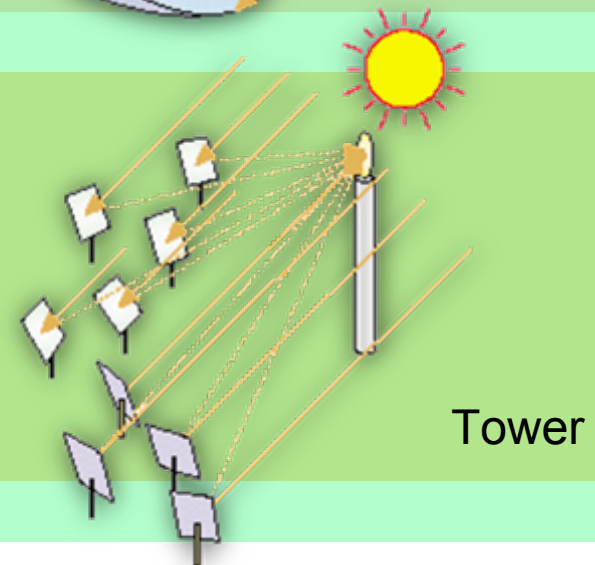


Dish

Fresnel



Linear
Fresnel



Tower

CSP development hotspots

Spain

81 MW operational
839 MW under construction
Total 14,230 MW underway

USA

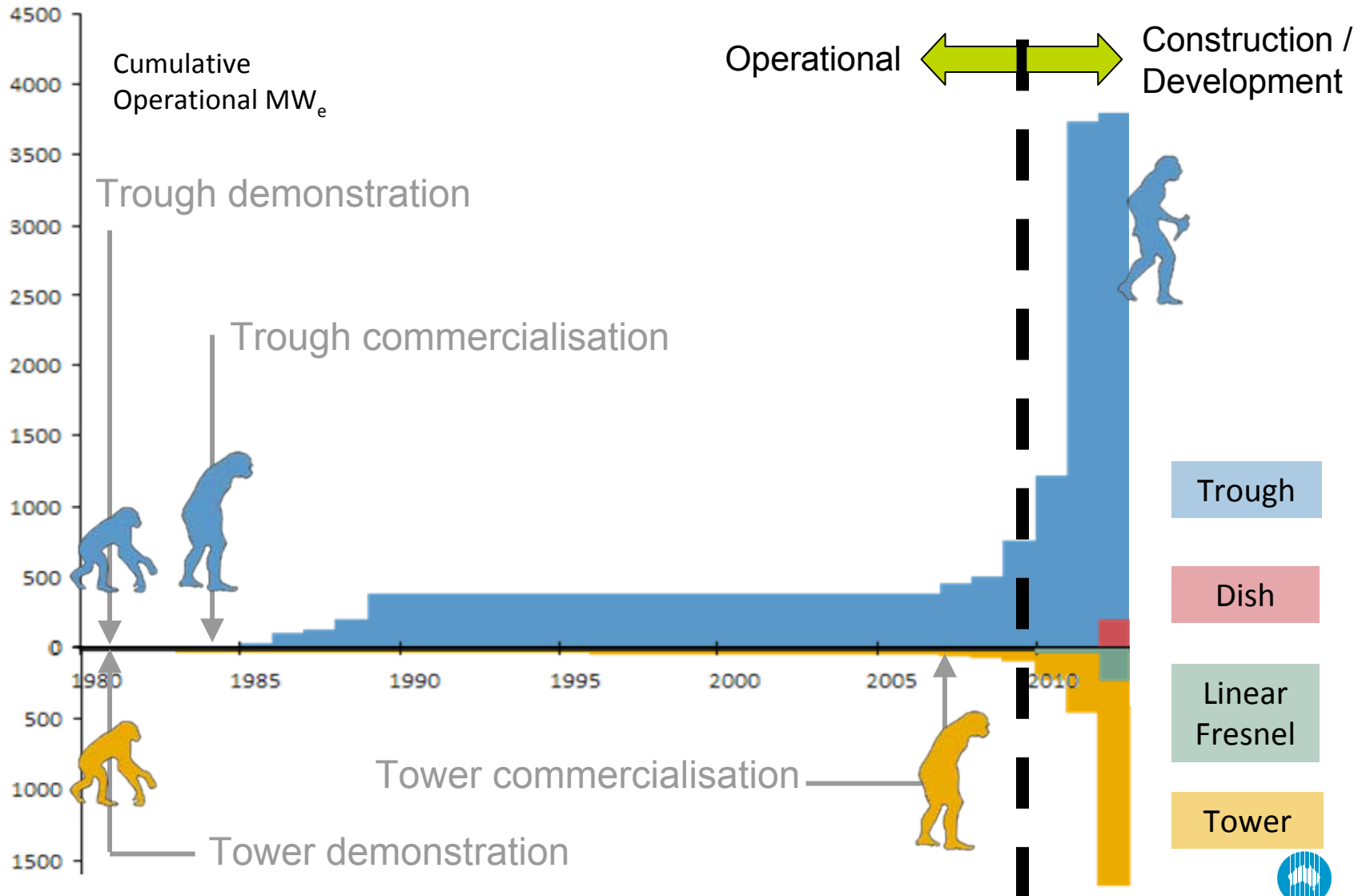
429 MW operational
200 MW under construction
Total 6,735 MW underway

Australia

<10 MW_e operational
<50 MW_e under construction
Total ≈ 200 MW_e underway

Averaged solar irradiation 1990-2004. Ecole des Mines de Paris / Armines 2006.

Evolution of CSP

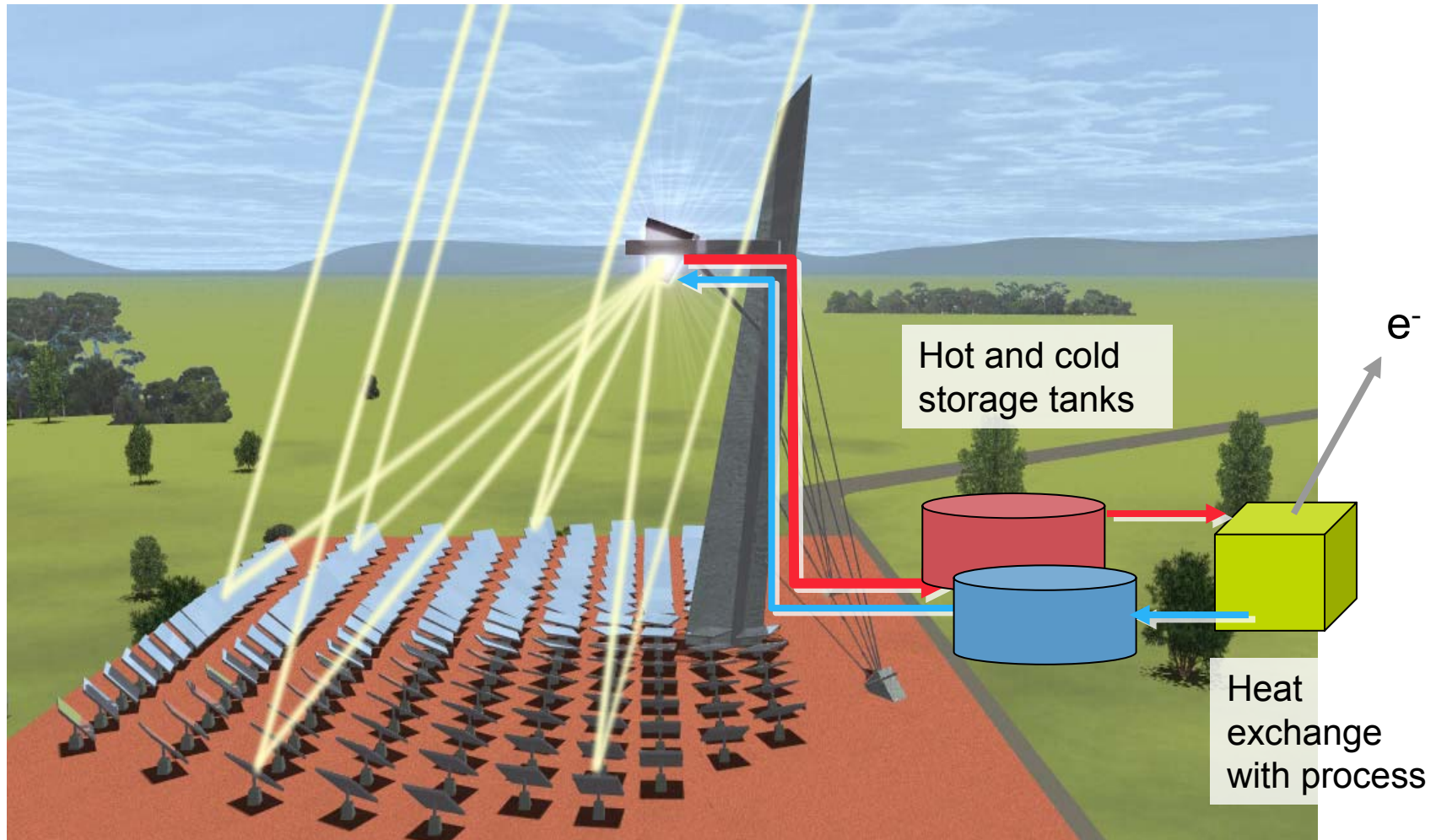


Storing Thermal Energy

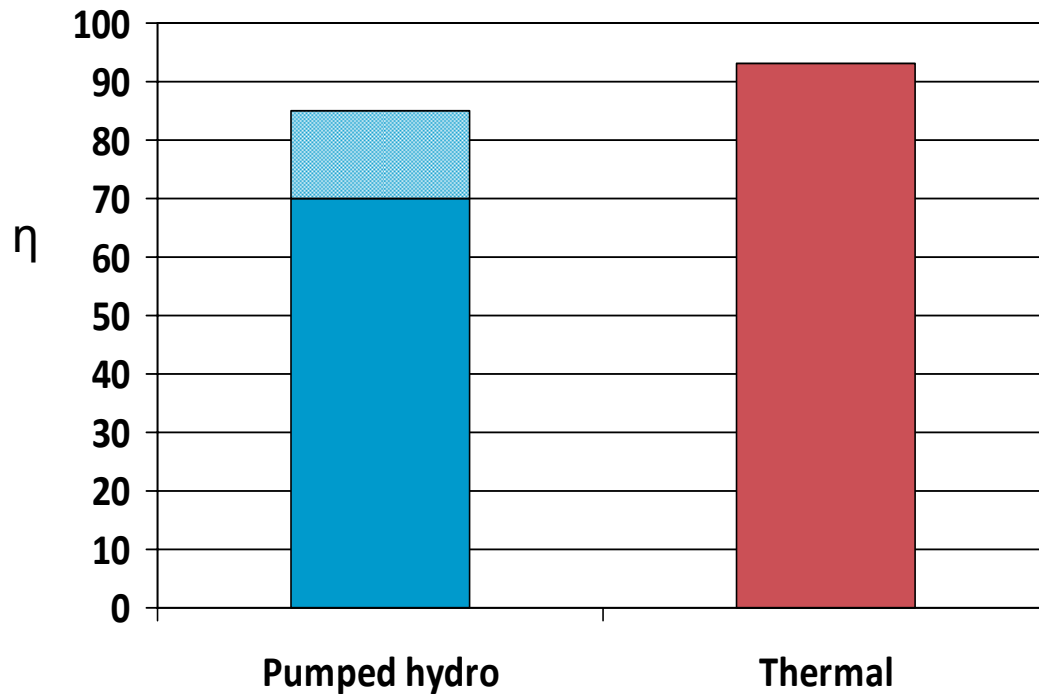


Andasol 1 & 2, Spain: 1,020 MWh, 7.5 full load hours, 31,000 tonnes molten salt

Transfer and storage of thermal energy



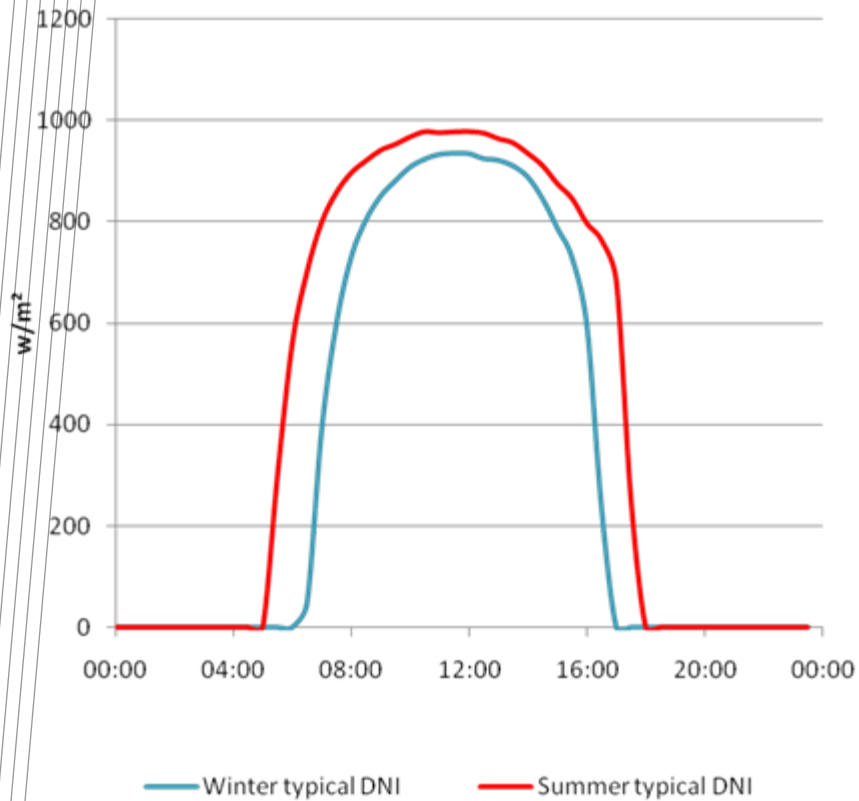
Round trip efficiency



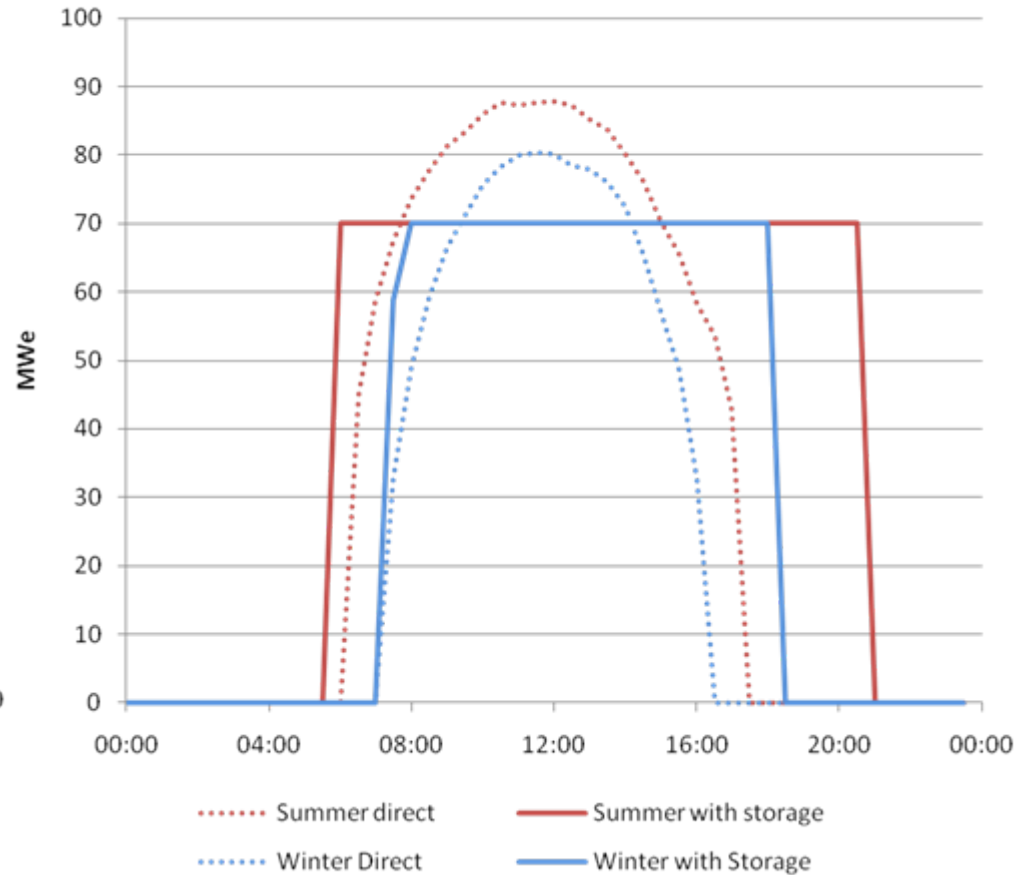
Source: electricitystorage.org (hydro);
NREL/Sci.Am. (thermal)

Thermal Storage Technology

Solar Resource

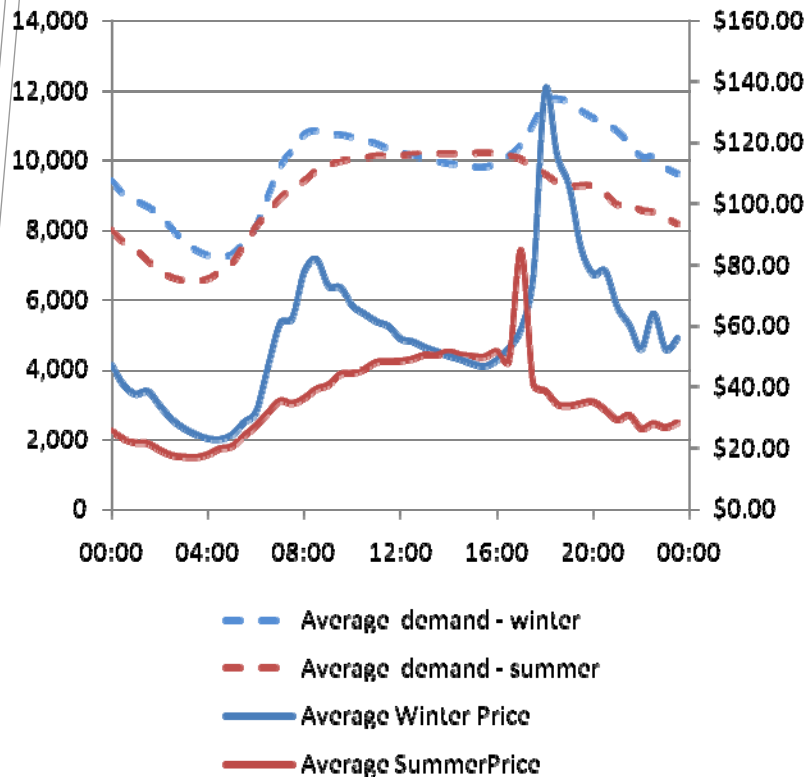


Electricity Production

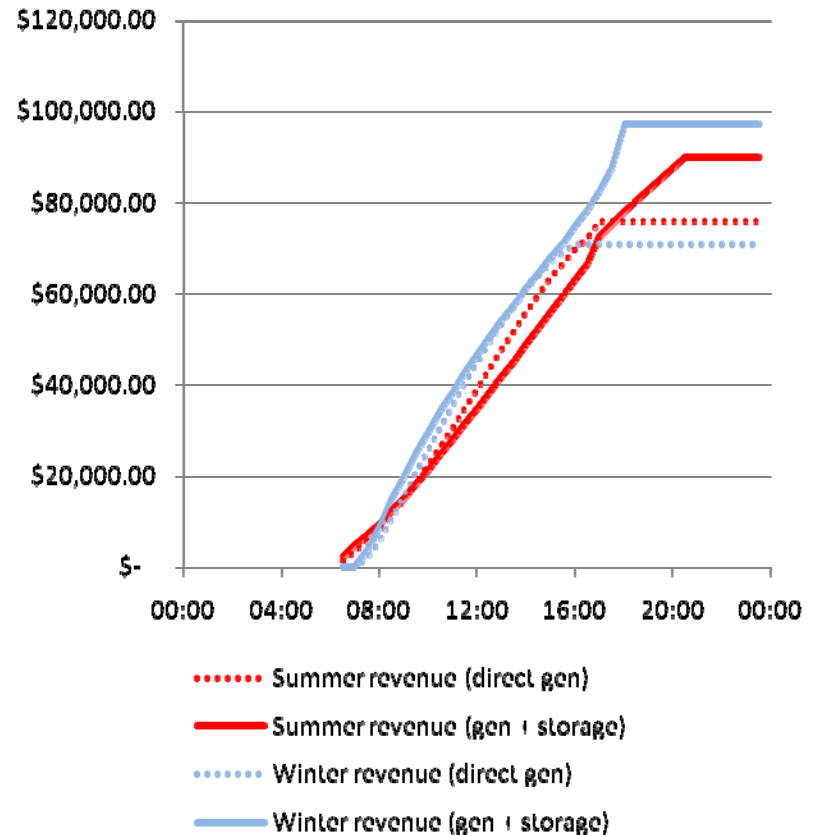


Thermal Storage Economics

NSW Average demand and pricing 2007-8



Cumulative 24 hr revenue



Storage R&D

<p>Red = commercialised</p> <p>Blue = development</p>	Sensible heat (solid, liquid or gas)	Latent heat (phase change)	Thermo-chemical storage
Medium temperature 200-400°C	<p>Oil</p> <p>Molten nitrate salt</p> <p>Oil/concrete</p>	Nitrate salts	
High temperature 400-600°C	Molten nitrate salt		
Very high temperature > 600°C	<p>Solid graphite</p> <p>High-T salts</p> <p>Ceramic particles</p>		<p>H₂O splitting</p> <p>NH₄ splitting</p> <p>Fossil reforming</p>

CSIRO Energy Transformed Flagship

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Thank you

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