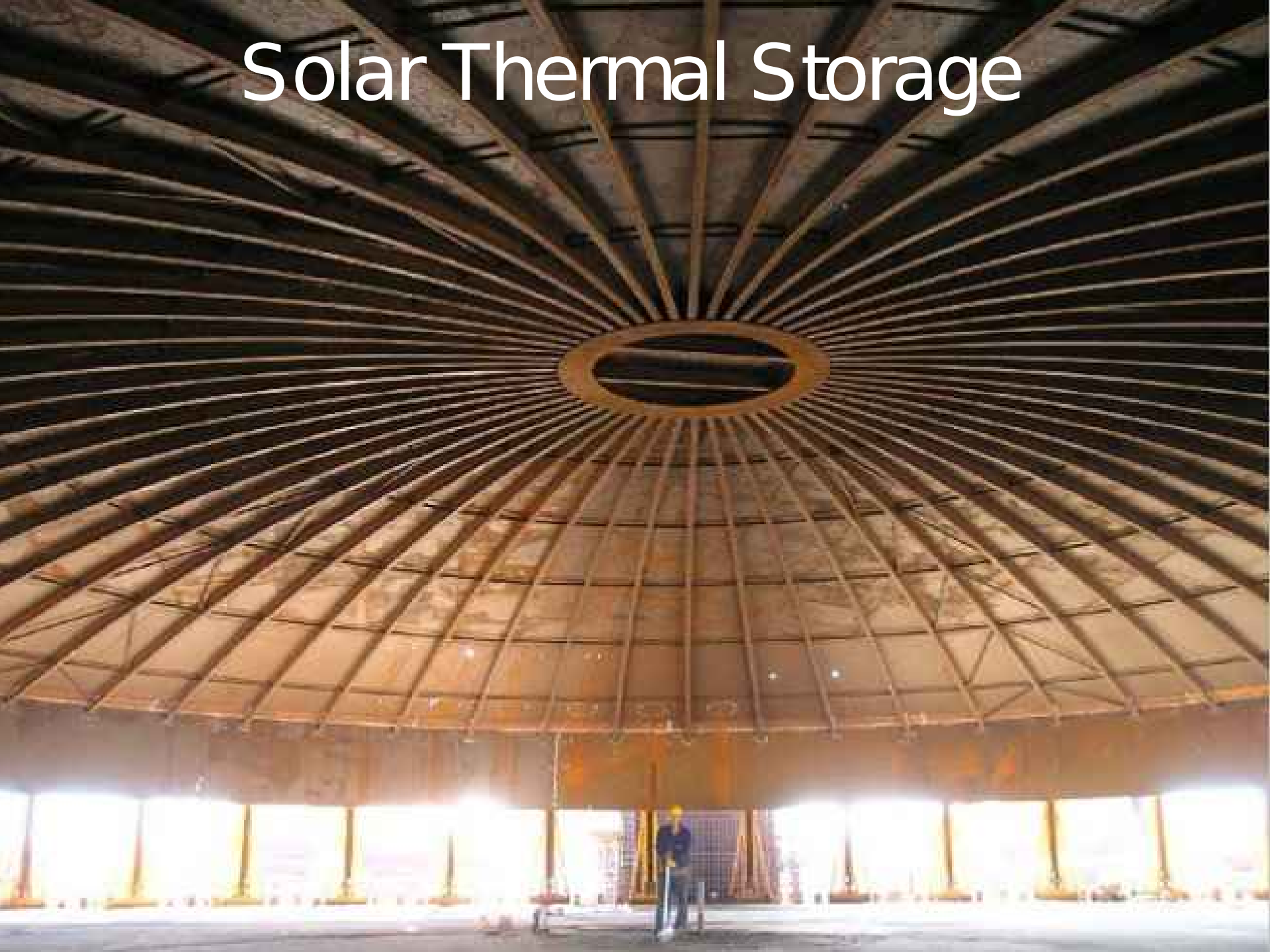
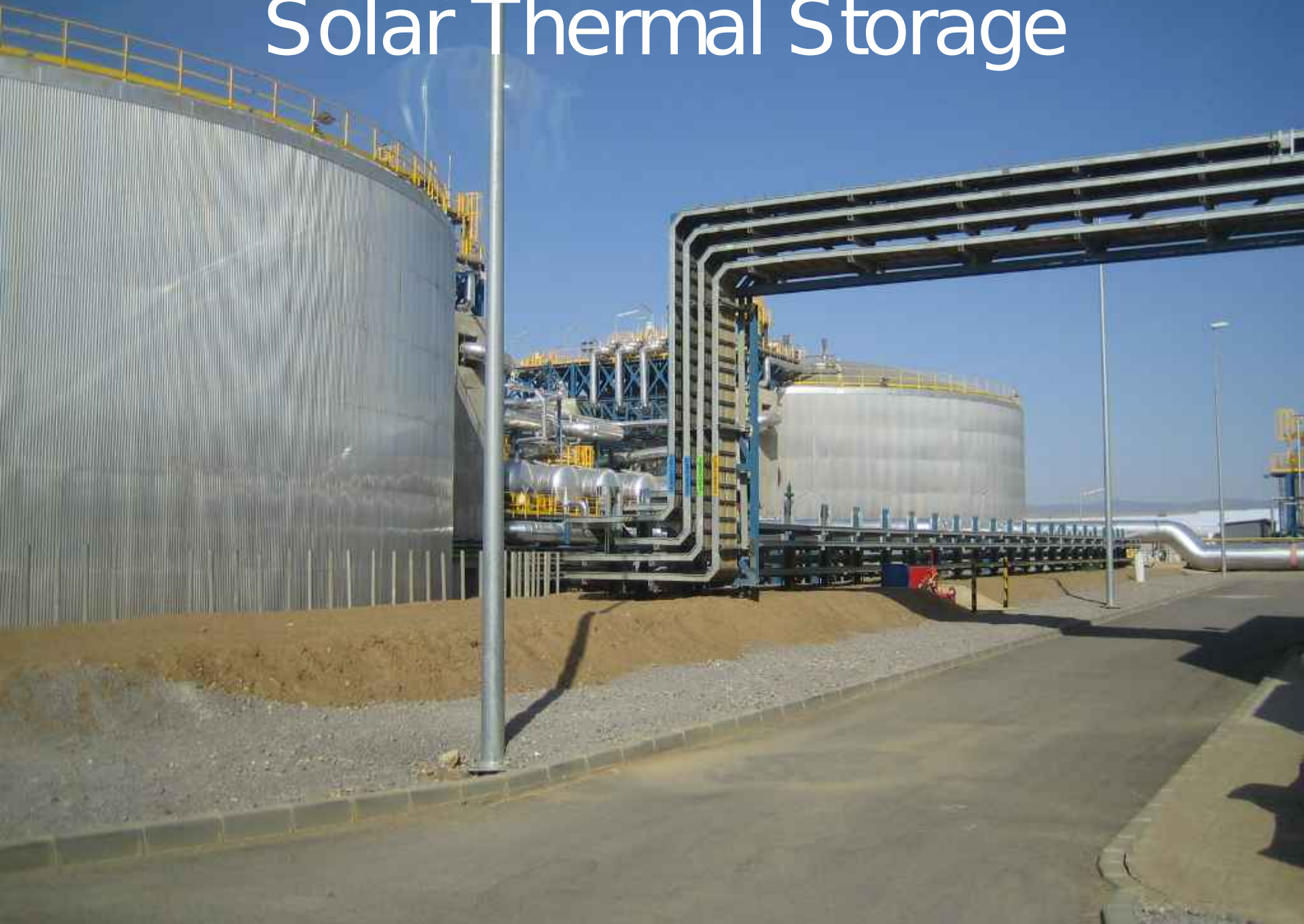


Solar Thermal Storage



Solar Thermal Storage

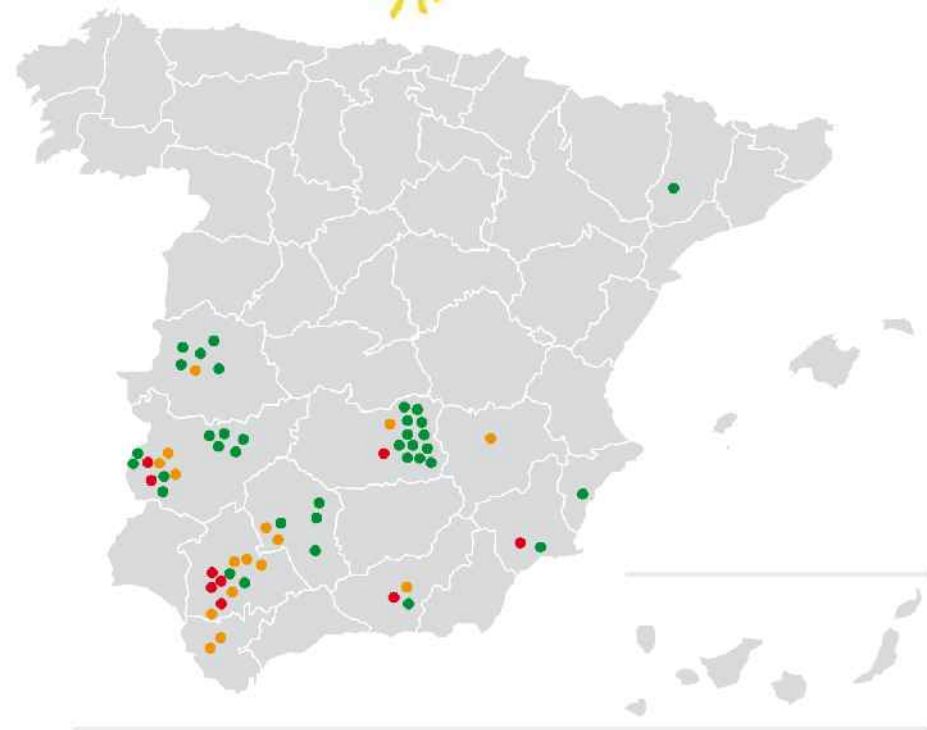


What's happening in Spain?

	Nombre	Localidad	Potencia MW	Fase
OPERATIVAS	PS10	San Lucar la Mayor	11	Fase 1
	ANDASOL 1	Alcañes	50	Fase 1
	PS20	San Lucar la Mayor	20	Fase 1
	PUERTOLLANO IBERSOL	Puertollano	50	Fase 1
	PUERTO HERRADU 1	Castejuna	1,4	Fase 1
	LA BARRA	Alvarado	50	Fase 1
	ANDASOL 2	Alcañes	50	Fase 1
	EXTRESOL 1	Torre de San Miguel Sesmero	50	Fase 1
	SOLNOVA 1	San Lucar la Mayor	50	Fase 1
	SOLNOVA 3	San Lucar la Mayor	50	Fase 1
CONSTRUCCION AVANZADA	ANDASOL - 3	Alcañes	50	Fase 1
	PL. TERMOELECTRICA DE MAJADAS	Majadas	50	Fase 1
	PL. TERMOELECTRICA DE PALMA DEL RIO II	Palma del Rio	50	Fase 1
	PL. TERMOELECTRICA DE PALMA DEL RIO I	Palma del Rio	50	Fase 1
	CENTRAL SOLAR TERMOELECTRICAL FLORIDA	Alvarado	50	Fase 1
	CENTRAL SOLAR TERMOELECTRICAL DEHERVA	La Herminilla	50	Fase 1
	MANCHASOL-1	Alcañes de San Juan	50	Fase 2
	PLANTA TERMOELECTRICA EXTRESOL-2	Torre de San Miguel Sesmero	50	Fase 2
	CTS SOLAR THEA	Puertos de Andubia	17	Fase 2
	SOLNOVA 4	San Lucar la Mayor	50	Fase 2
	HELIOENERGY 1	Esja	50	Fase 2
	HELIOENERGY 2	Esja	50	Fase 2
	LEBRIJA 1	Lebrija	50	Fase 2
	TERMO SOL 60	San Juan del Valle	50	Fase 3
	ARCOSOL 60	San Juan del Valle	50	Fase 3
PL. TERMOELECTRICA 590KW CASAS DE LOS PINOS	Villanueva	1	Fase 3	
PREASIGNADAS	PL. SOLAR TERMOELECTRICA	Espejo	50	Fase 1
	C. TERMOELECTRICA "LA AFRICANA"	Puertos Palmira	50	Fase 1
	PL. TERMOELECTRICA DE CONSOL ORELLANA	Orellana	50	Fase 1
	PUERTO HERRADU 2	Puerto Errado	30	Fase 1
	HELIOS I	Puerto López	50	Fase 1
	HELIOS II	Puerto López	50	Fase 1
	C. SOLAR TERMOELECTRICA "ASTE-1A"	Alcañes de San Juan	50	Fase 2
	C. SOLAR TERMOELECTRICA "ASTE-1B"	Alcañes de San Juan	50	Fase 2
	SOLADOR I	El Carpio	50	Fase 2
	SOLADOR 2	El Carpio	50	Fase 2
	PL. TERMOELECTRICA DE MORON	Marón de la Frontera	50	Fase 2
	MANCHASOL-2	Alcañes	50	Fase 3
	PL. TERMOELECTRICA DE OLIVENZA 1	Olivenza	50	Fase 3
	PL. TERMOELECTRICA EXTRESOL - 3	Torre de San Miguel Sesmero	50	Fase 3
	C. SOLAR TERMOELECTRICA "ASTEXOL -2"	Castor	50	Fase 3
	SOLABEN 1	Logroño	50	Fase 3
	SOLABEN 2	Logroño	50	Fase 3
	SOLABEN 3	Logroño	50	Fase 3
	TERMOELECTRICA 1	Navastillar de Pela	50	Fase 4
	TERMOELECTRICA 2	Navastillar de Pela	50	Fase 4
	TERMOELECTRICA BORGES, S.L.	Agüero, Alcañes	22	Fase 4
	EXTREVASOL 1	Villanueva de la Serena	50	Fase 4
	SOLABEN 6	Logroño	50	Fase 4
	C. SOLAR TERMOELECTRICA CACERES	Calasas	50	Fase 4
	CASABLANCA	Taibubas	50	Fase 4
C. SOLAR TERMOELECTRICA EN ESTAN VILLEMA	Alcañes	50	Fase 4	
PL. TERMOELECTRICA 8MW PUERTOLLANO	Puertollano	8	Fase 4	
PL. TERMOELECTRICA 10MW PUERTOLLANO	Puertollano	10	Fase 4	
PL. TERMOELECTRICA 10MW PUERTOLLANO	Puertollano	10	Fase 4	
PL. TERMOELECTRICA 10MW PUERTOLLANO	Puertollano	10	Fase 4	
PL. TERMOELECTRICA 10MW PUERTOLLANO	Puertollano	10	Fase 4	
PL. TERMOELECTRICA 10MW PUERTOLLANO	Puertollano	10	Fase 4	
ARENALAS	Marón de la Frontera	50	Fase 4	

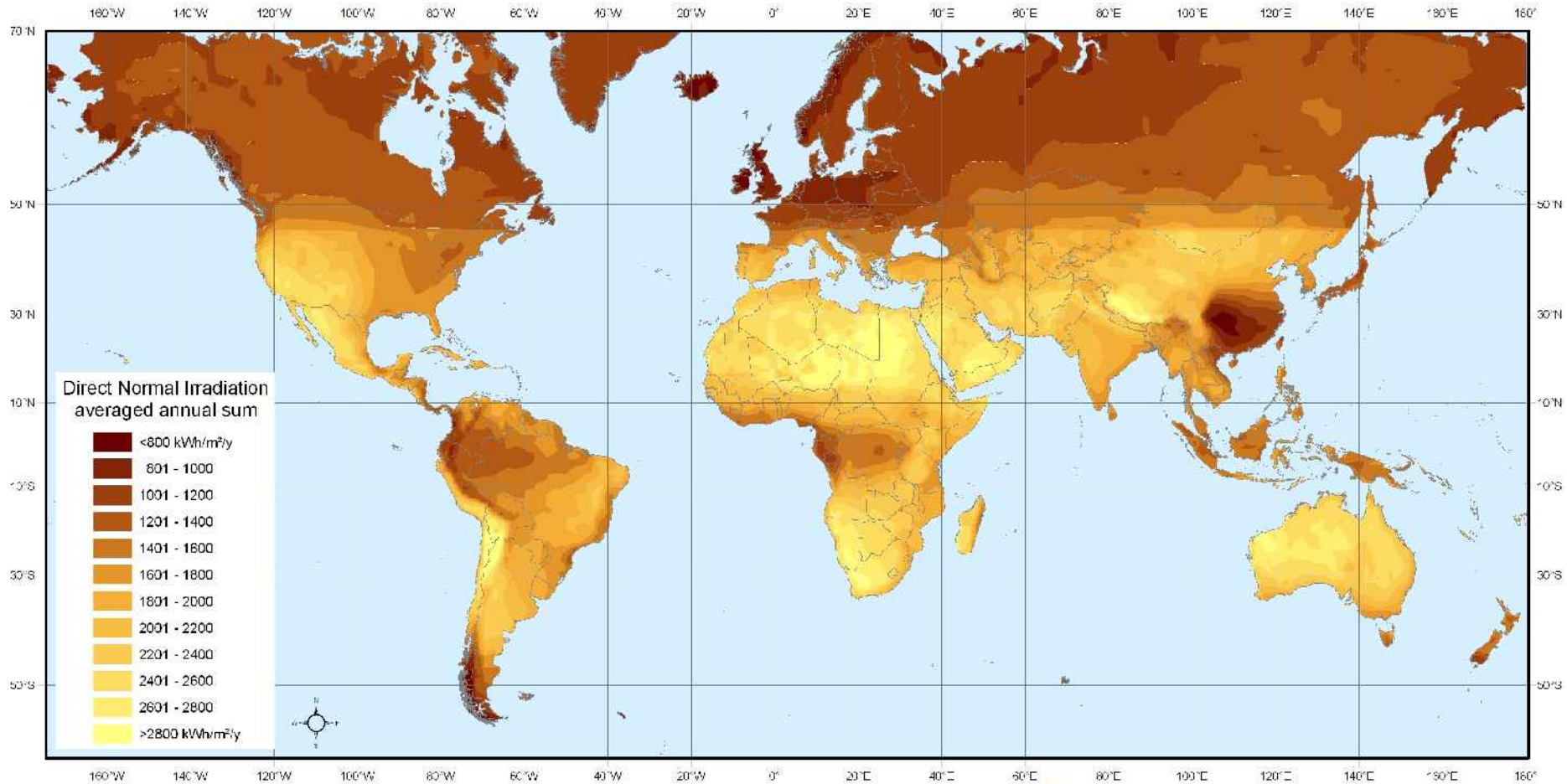
Total de Plantas 60


LOCALIZACIÓN DE CENTRALES TERMOSOLARES EN ESPAÑA




● Operativas ● Construcción avanzada ● Preasignadas

Direct Normal Irradiation (DNI)



Data based on  SSE 6.0 dataset for a 22-year period (July 1983 - June 2005)
(<http://eosweb.larc.nasa.gov/sse/>)

Map created and map layout by  2008
(<http://www.dlr.de>)

Grid of the Future



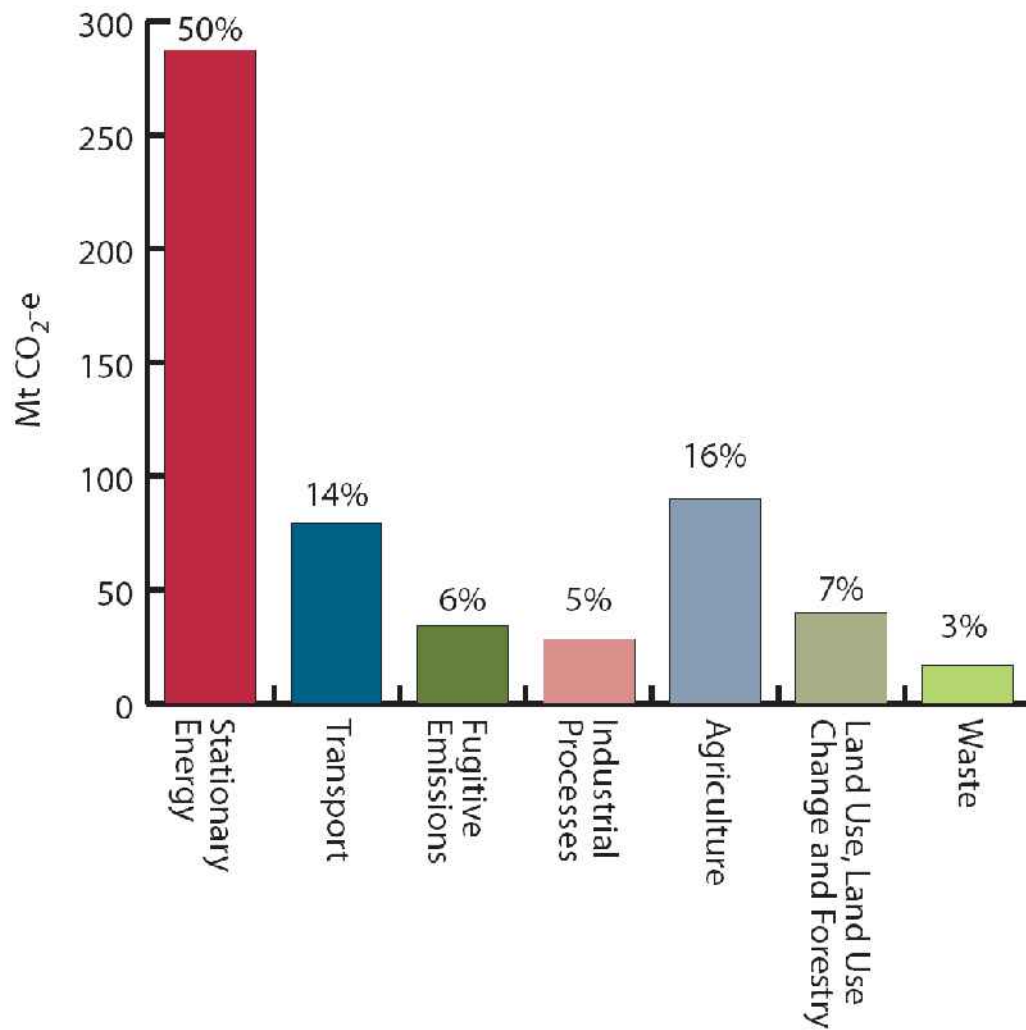
Wind

+

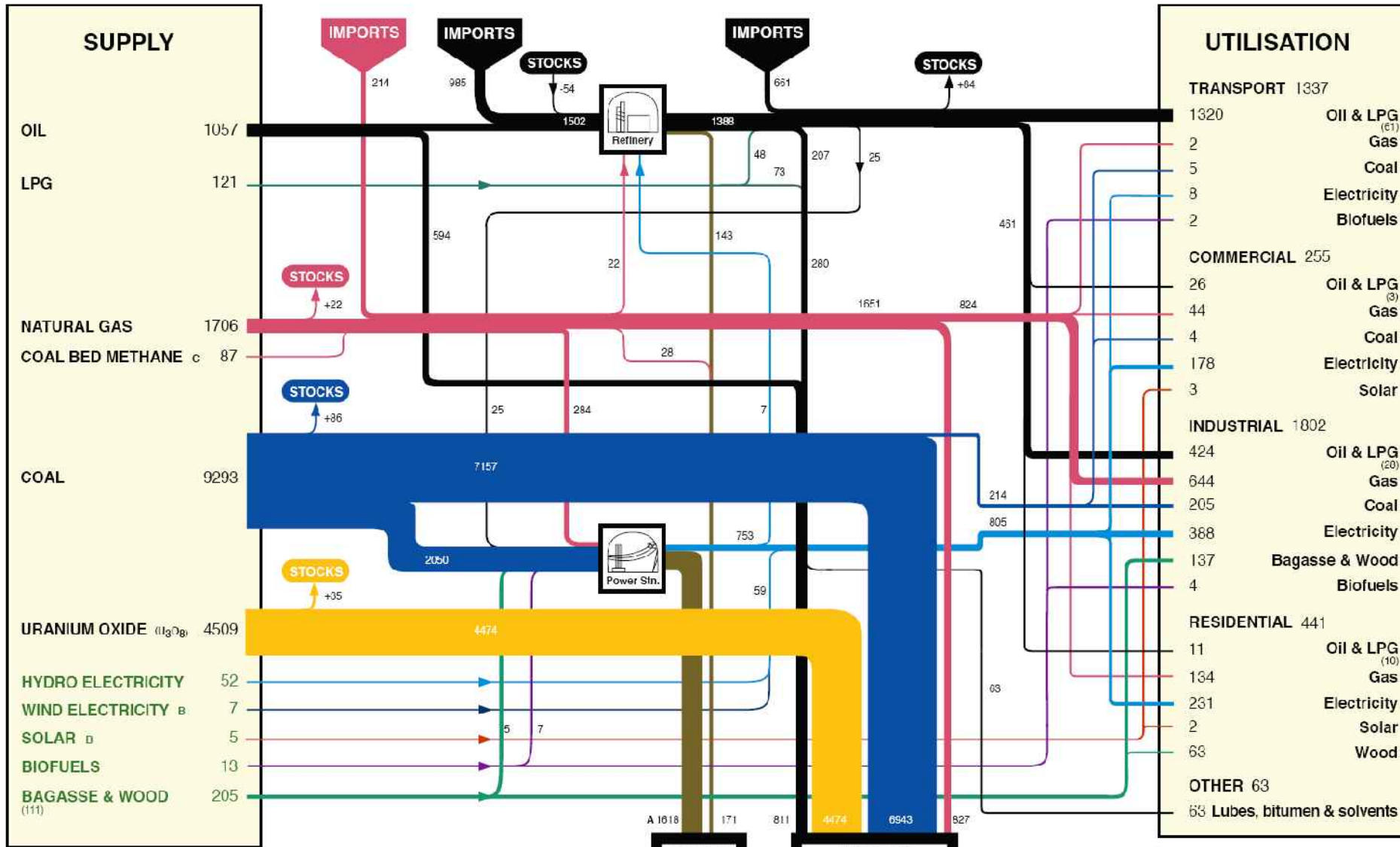


Solar Thermal with Storage

Australian emissions 2006



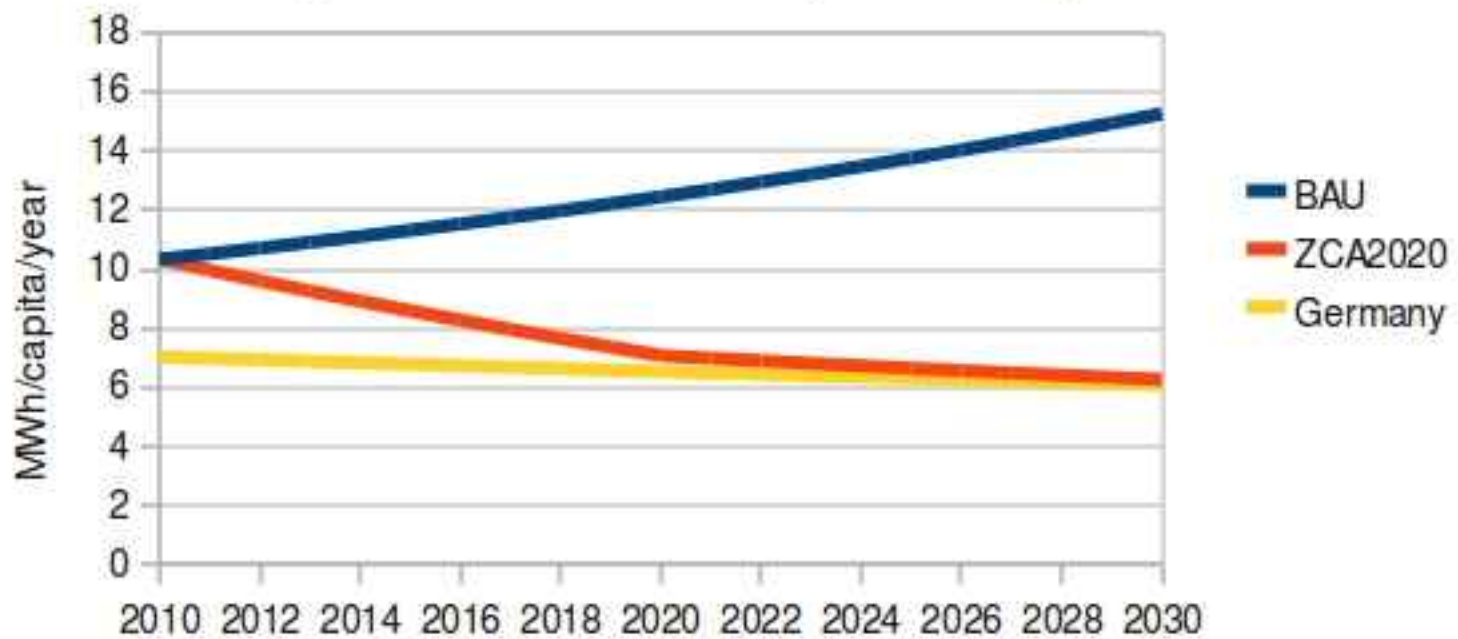
AUSTRALIAN ENERGY FLOWS 2006-07 (Petajoules)

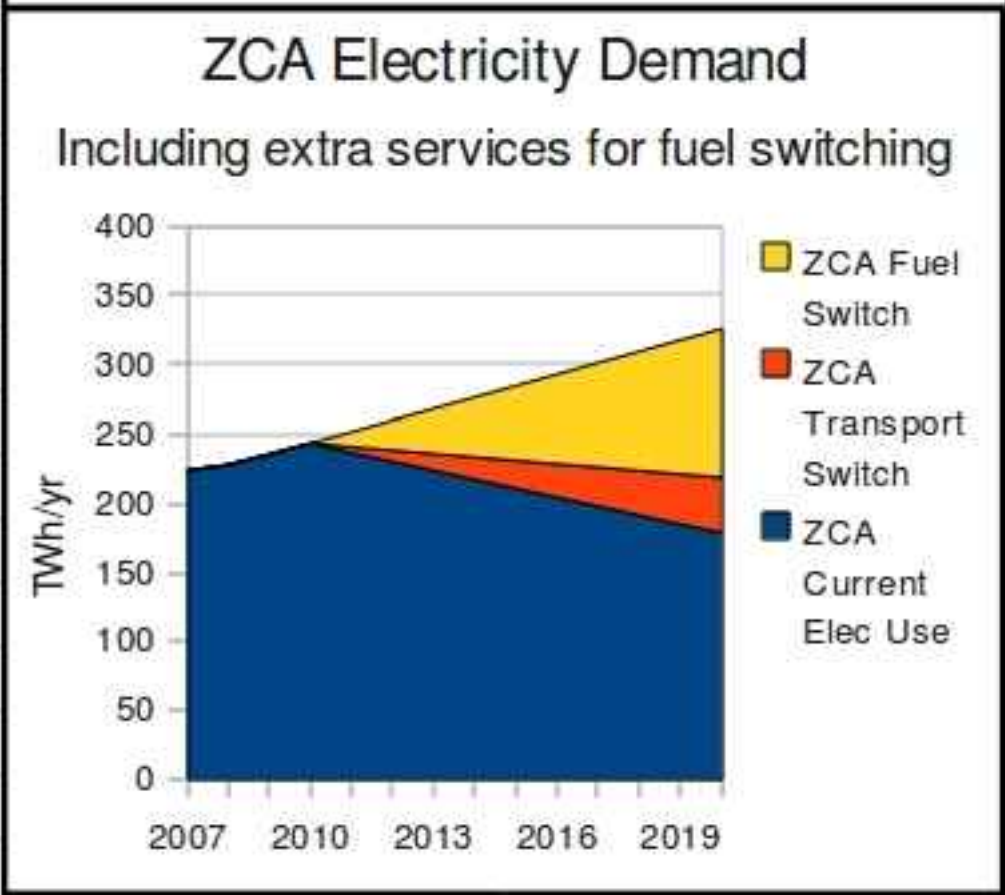


Australian Government
Office of the Renewable Energy Regulator
Geoscience Australia

NOTE:
 A Includes transmission losses
 B ORER estimates
 C Geoscience Australia estimate
 • Numbers rounded to nearest PJ
 • Source: ABAHL Australian Energy Statistics' Energy Update 2008.

Per Capita Electricity consumption Existing electrical services only - excluding fuel switch



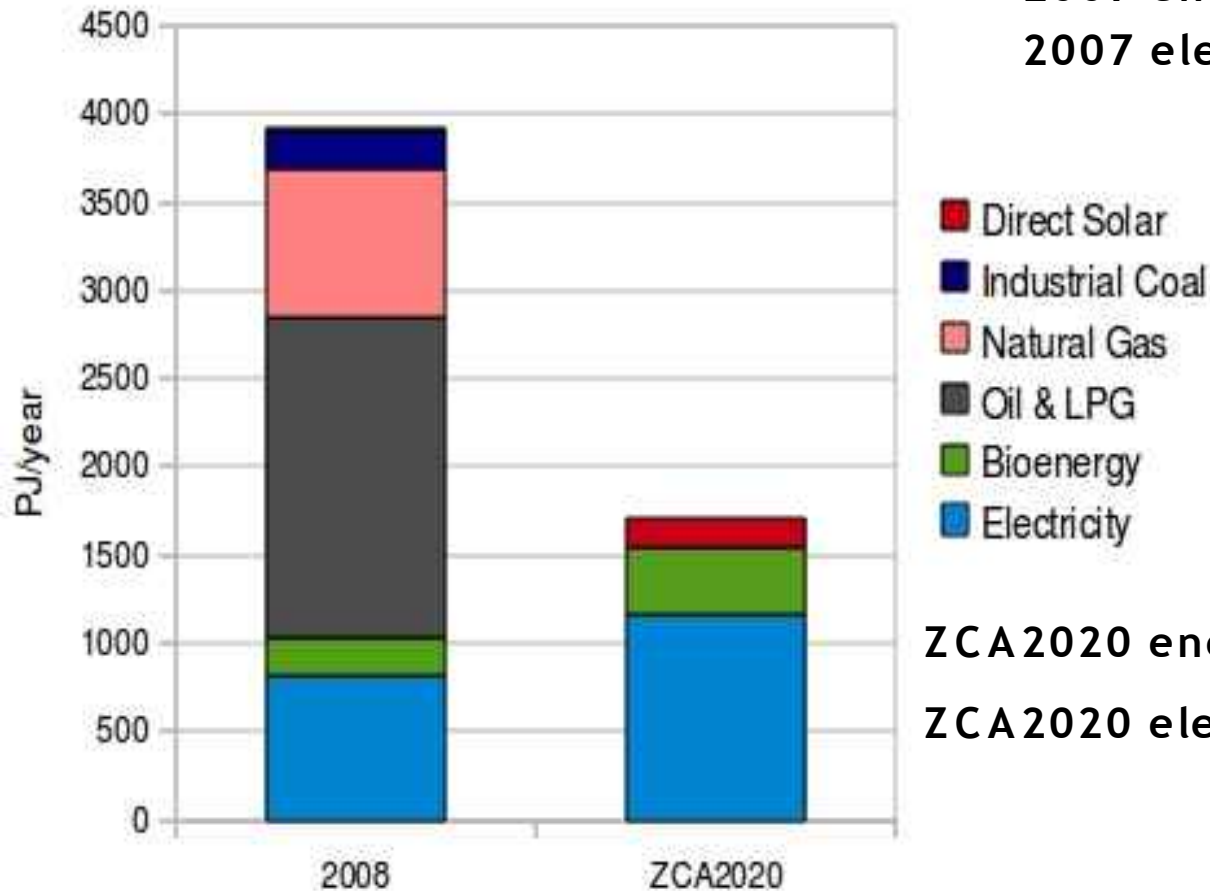


Electricity and Energy Demand

Australian End-Use Energy
Present and ZCA2020

2007 energy demand = 3,915PJ

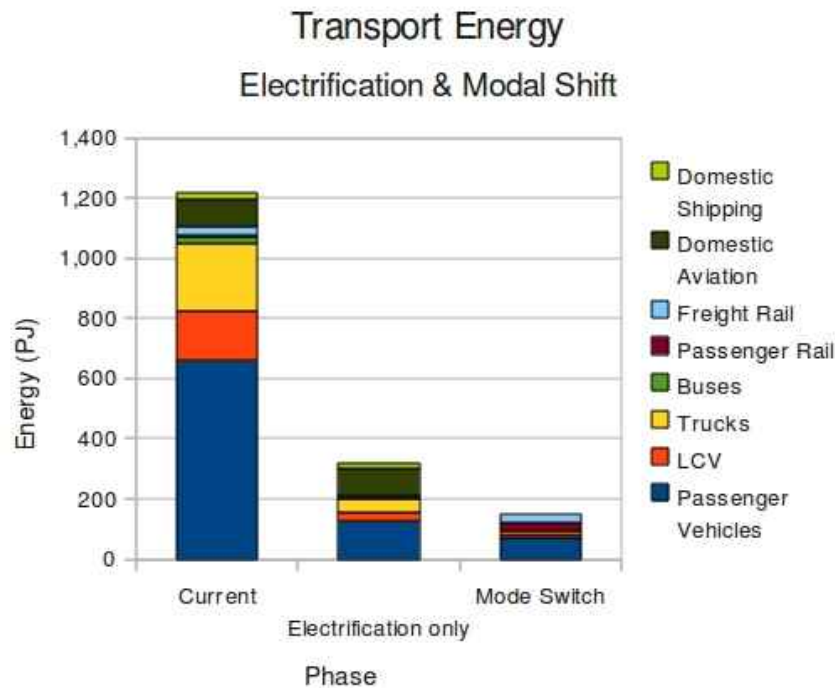
2007 electricity demand = 822PJ



ZCA2020 energy demand = 1,708PJ

ZCA2020 electricity demand = 1,165PJ

Electrifying transport



Electrifying vehicle fleet: 5:1 efficiency gain, biofuels reserved for heavy machinery, range extension on electric vehicles and other vehicles that can't be electrified.

Modal shift: Large shift to freight rail. Electric trains and trams, 50% of urban passenger-kilometres, 25% of non-urban by public transport



How Easy is Energy Efficiency in Transport??

The Nissan Patrol uses more energy to move 5 people around the city than a Siemens tram uses to move 190 people



Nissan Patrol
Capacity 5
17 litres per 100km



Siemens Combino tram
Capacity 190
16 litres per 100km (Oil Energy Equiv)

100% renewable Stationary Energy



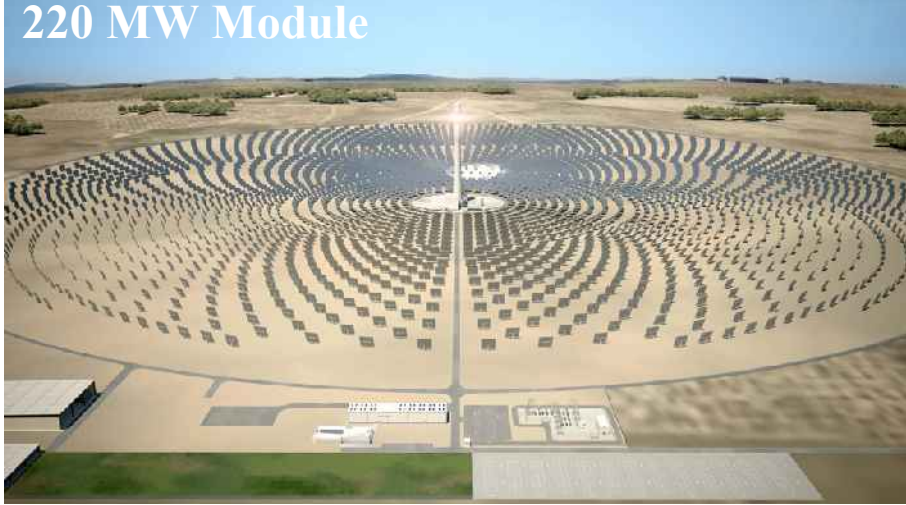
Australia's Renewable Energy Grid 2020



© 2010 MapData Sciences Pty Ltd, PSMA
© 2010 Europa Technologies
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2010 Cnes/Spot Image

Zero Carbon Australia Solar Thermal Power

220 MW Module



3500 MW Solar Region



- To Supply 60% of Australia's energy
- Each module generates **220MW**
- Ability to **store energy** and dispatch as needed, day or night
- A plant or **Solar Region** will be made up of 19 modules and will have a capacity of **3,500MW**
- There will be 12 plants distributed across Australia

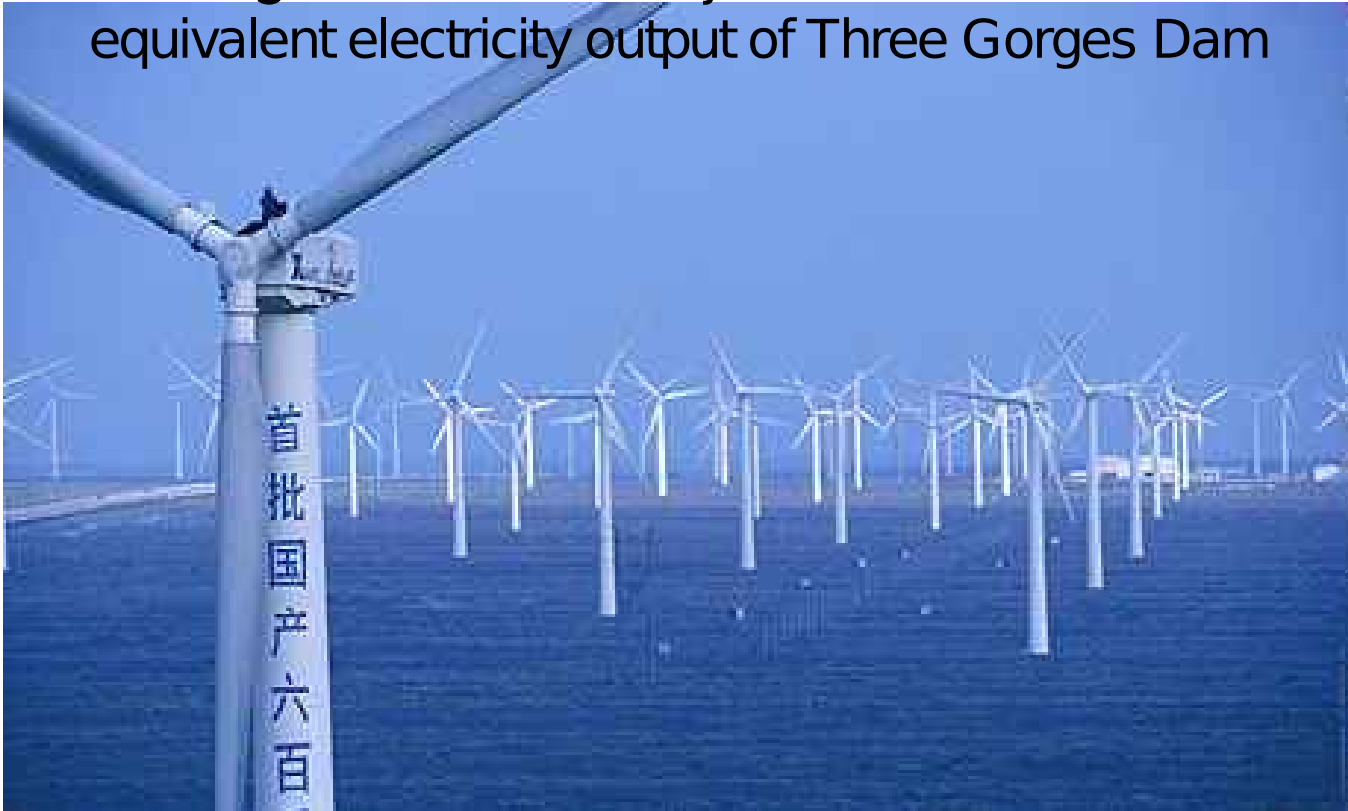
Wind Power



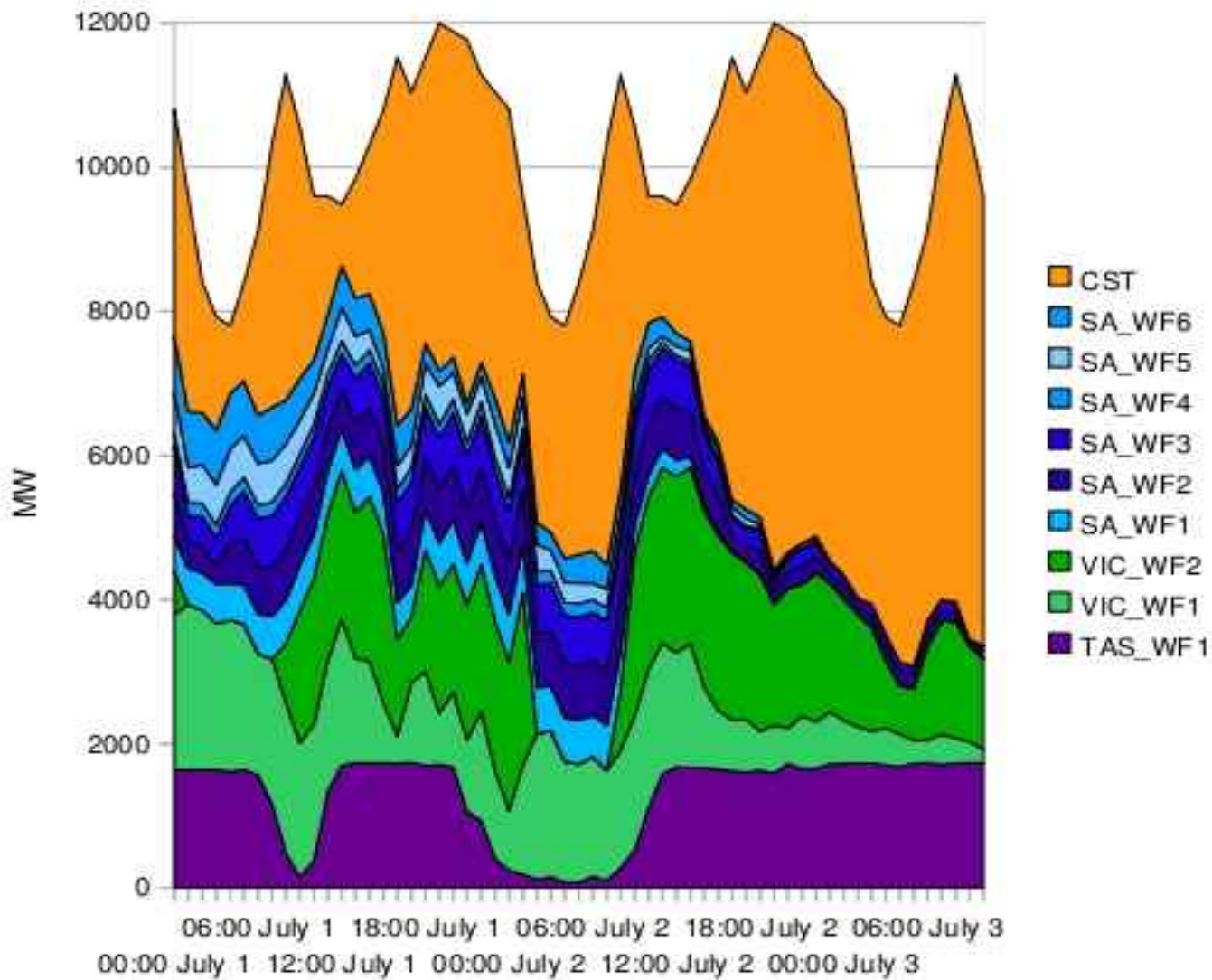
- To Supply 40% of Australia's Energy
- Low-cost, technologically mature, first dispatch
- 8,000 turbines
- 24 geographically diverse regions

China : 150,000 MW wind by 2020

'Three Gorges of Wind' Project , under construction now, equivalent electricity output of Three Gorges Dam

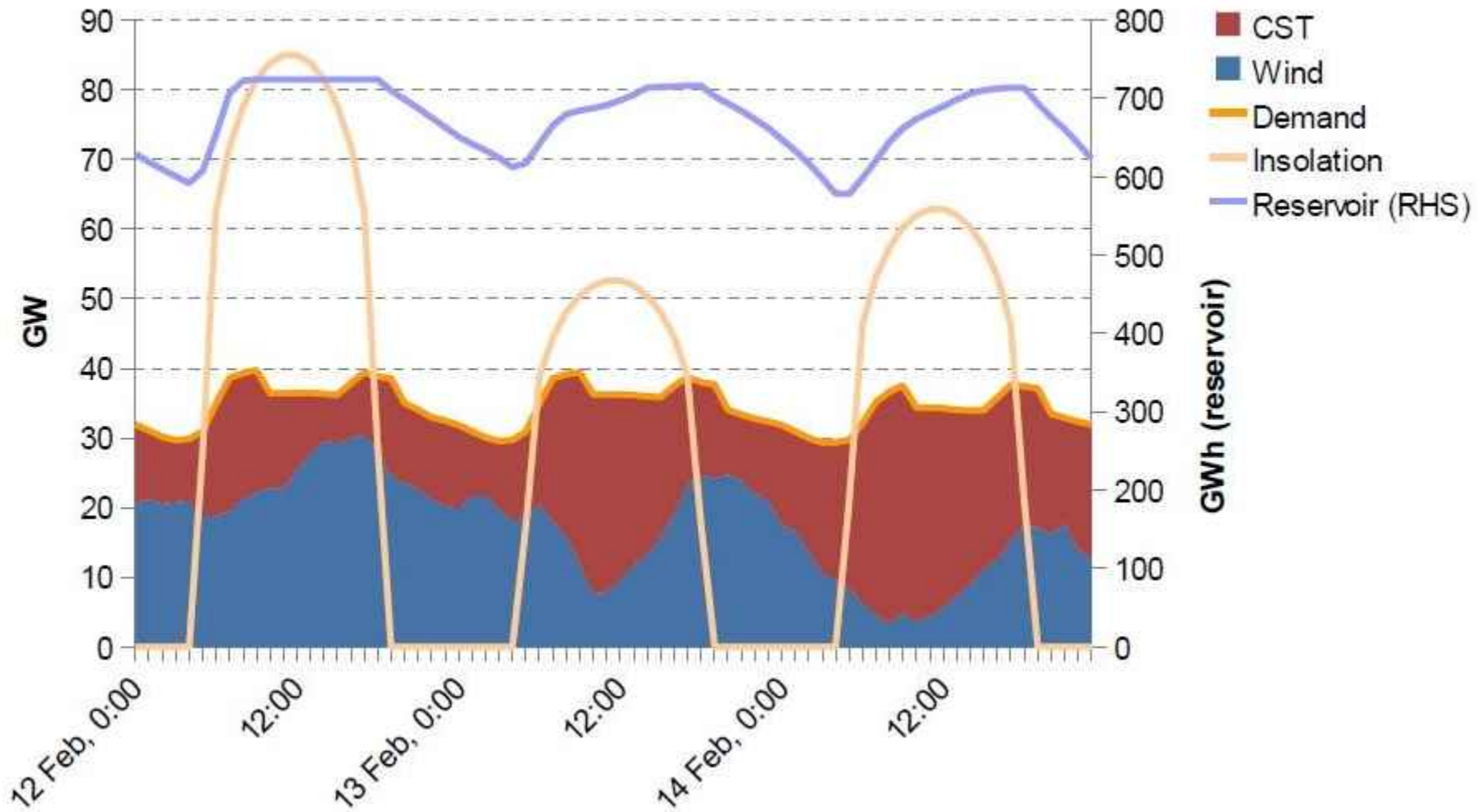


Wind & CST meeting demand

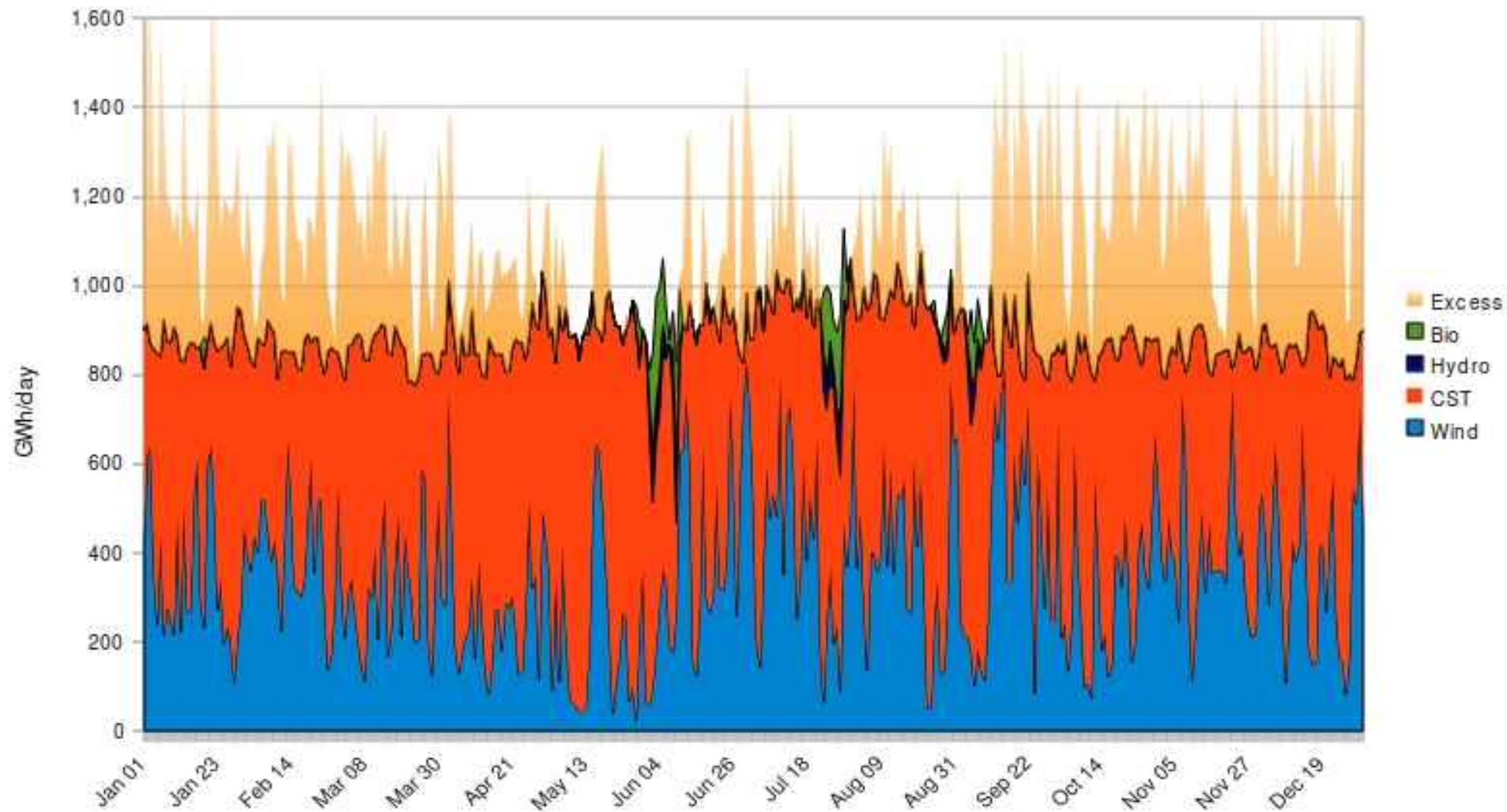


How does the thermal storage work over a few days?

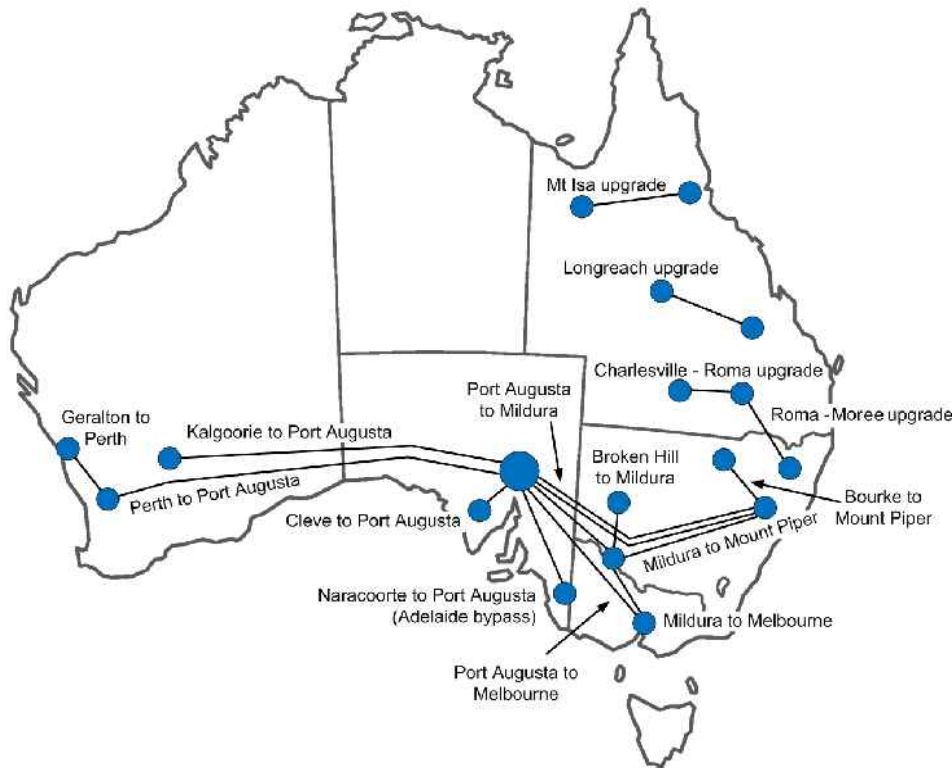
Hourly dispatch - February 2009



ZCA2020 Grid Model 2008 Daily Data



The National Grid



SKM Review of ZCA2020 transmission

“The review finds that the transmission scenario proposed is technically feasible in terms of capacity and reliability. In addition, the proposed transmission uses mature technology with proven capability around the world.”

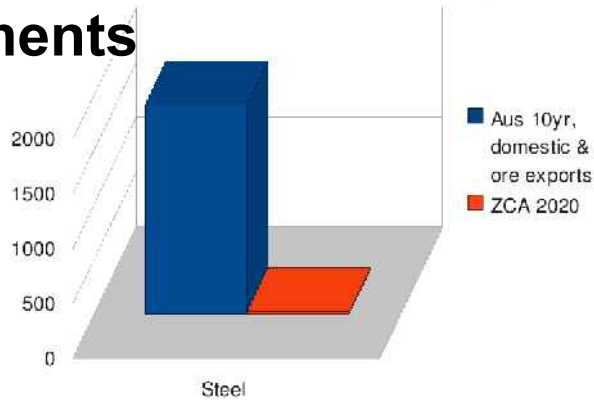
	Line name	Type	Length	Power	Total Cost	
			km	MW	AUD\$M	
Solar Plug-Ins	Camarvon to Geraldton	HVAC	499	6000	\$3,610	
	Kalgoorlie to Perth	HVAC	560	6000	\$3,895	
	Broken Hill to Mildura	HVDC	262	4000	\$1,936	
	Bourke to Mount Piper	HVDC	567	4000	\$2,292	
	Dubbo to Mt Piper Direct	HVAC	249	3000	\$1,220	
	Moree to Armidale	HVAC	364	6000	\$2,980	
	Prairie Plug-in	HVAC	296	6000	\$2,660	
	Longreach Plug-in (direct)	HVDC	654	4000	\$2,395	
Wind Plug-Ins	Charleville to Roma	HVDC	311	4000	\$1,993	
	Albany Plug-in	HVAC	430	3000	\$1,643	
	Esperance Plug-in	HVAC	363	3000	\$1,487	
	Geraldton to Perth	HVDC	440	4000	\$2,144	
	Bunbury Plug-in	HVAC	10	3000	\$662	
	Cleve to Port Augusta	HVDC	201	8000	\$3,729	
	Ceduna Plug-in	HVAC	327	3000	\$1,403	
	Yongala Plug-in	HVAC	125	3000	\$930	
	Port Lincoln Plug-in	HVAC	121	3000	\$921	
	Cape Jaffa Plug-in	HVAC	54	3000	\$765	
	Streaky Bay Plug-in	HVAC	269	3000	\$1,267	
	Port Fairy Plug-in	HVAC	61	3000	\$780	
	Ballarat Plug-in	HVAC	79	3000	\$823	
	Mt Gellibrand Plug-in	HVAC	56	3000	\$769	
Wonthaggi Plug-in	HVAC	96	3000	\$862		
Grid Upgrades	Crookwell Plug-in	HVAC	86	3000	\$839	
	Dubbo-Orange-Mt Piper	HVAC	93	3000	\$854	
	Waicha Plug-in	HVAC	35	3000	\$719	
	Cooma Plug-in	HVAC	122	3000	\$923	
	Silverton to Mildura	HVAC	287	3000	\$1,310	
	Stanthorpe Plug-in	HVAC	98	3000	\$867	
	Atherton Plug-in	HVAC	62	3000	\$783	
	Collinsville Plug-in	HVAC	18	3000	\$680	
	Georgetown Plug-in	HVAC	272	3000	\$1,274	
	Subtotal, plug-ins					\$49,416
	Grid Upgrades	Roma to Moree	HVDC	417	4000	\$2,117
		Port Augusta to Mount Piper	HVDC	1169	8000	\$5,994
		Mildura to Mount Piper	HVDC	708	4000	\$2,458
Mildura to Melbourne		HVDC	544	8000	\$4,533	
Port Augusta to Mildura		HVDC	461	4000	\$2,169	
Port Augusta to Melbourne		HVDC	886	4000	\$2,666	
Port Augusta to Naracoorte		HVDC	560	4000	\$2,285	
Naracoorte to Portland		HVAC	216	6000	\$2,286	
Subtotal, grid strengthening & upgrades					\$28,879	
InterGrid	Mt Isa upgrade	HVDC	847	4000	\$2,620	
	Perth to Port Augusta	HVDC	2146	4000	\$4,140	
	Kalgoorlie to Port Augusta	HVDC	1586	4000	\$3,485	
	SWIS-NWIS Connection	HVAC	561	6000	\$3,900	
Subtotal, national grid interconnections					\$14,145	
TOTAL for ZCA2020 Grid					\$92,440	

Implementation

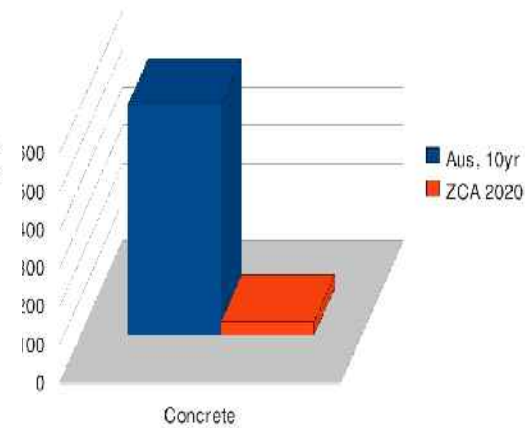
Manufacturing Ramp-up

Resource Requirements

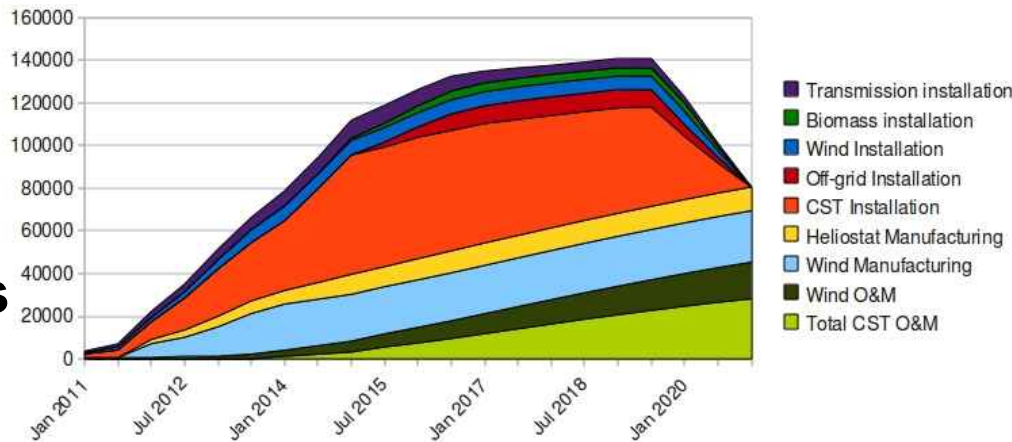
CST + Wind Steel requirements
Million tonnes, including ore exports



CST + Wind Concrete requirements
Million tonnes



Total Installation Jobs for ZCA2020 electrical generation



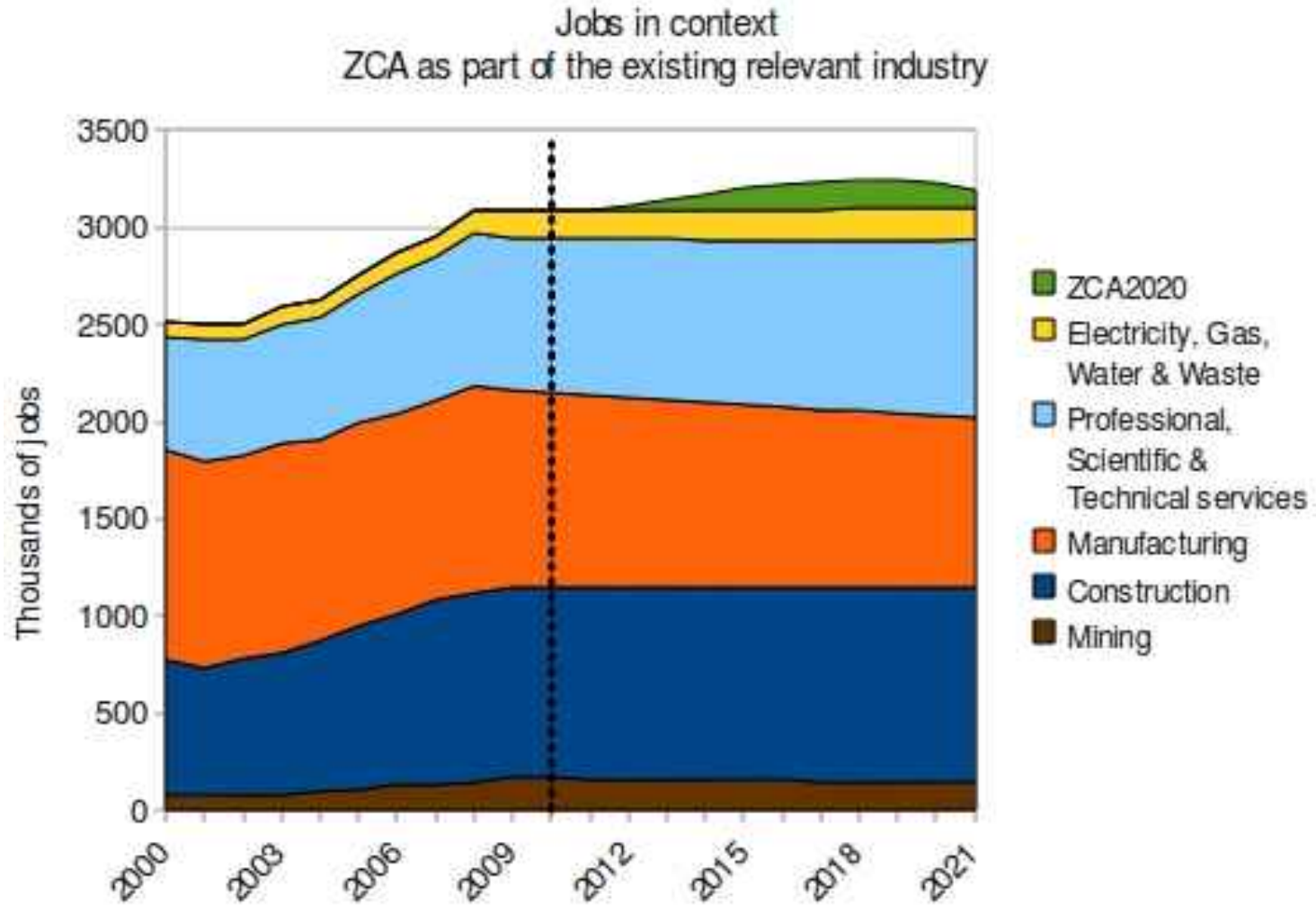
Labour Requirements

Enercon Viana Do Costelo Wind Turbine blade and tower factories Portugal

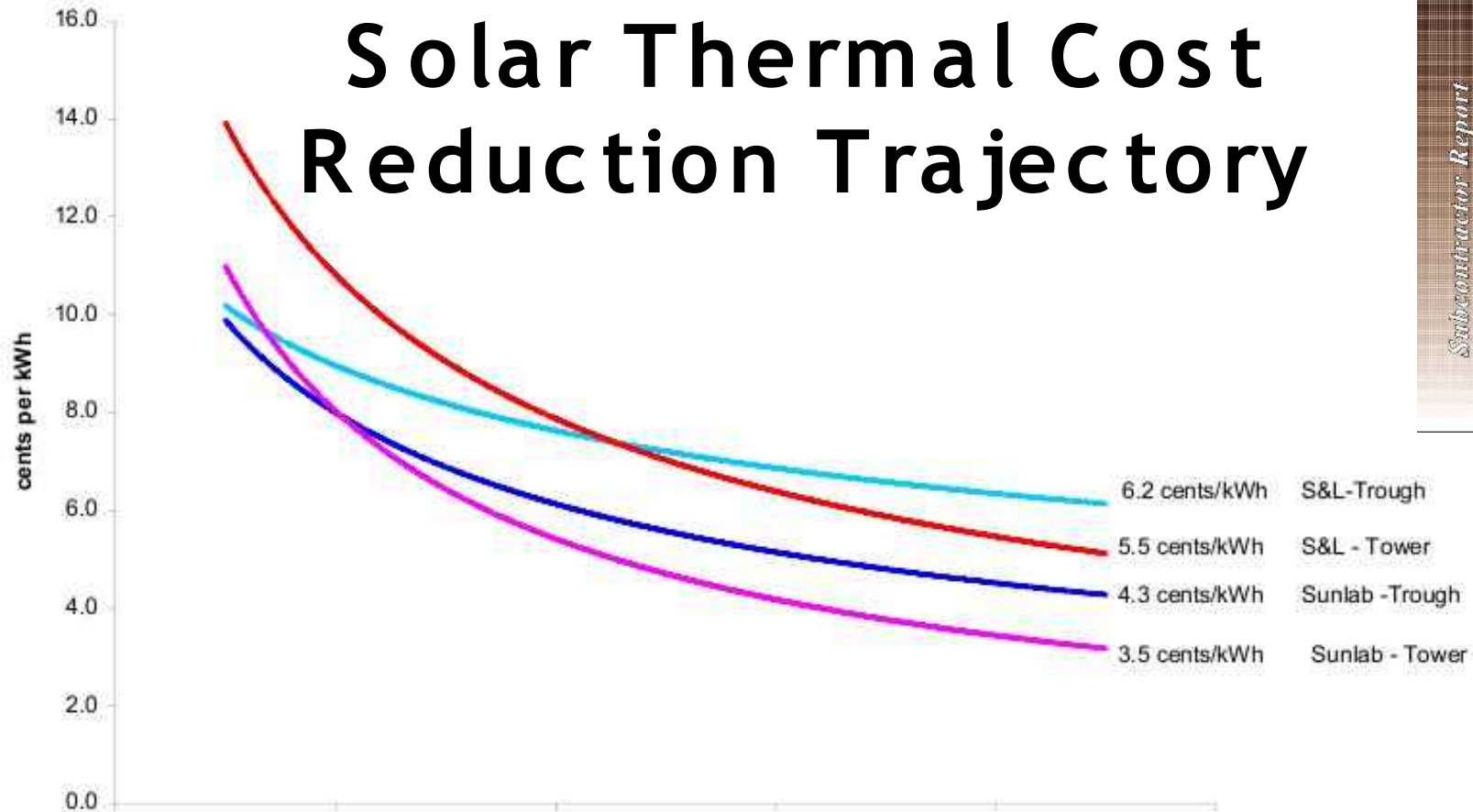
250 towers per year 600 Blades 400 Jobs



Achievability: Jobs In Context



Solar Thermal Cost Reduction Trajectory




October 2002 NREL/SP-500-34440

Subcontractor Report

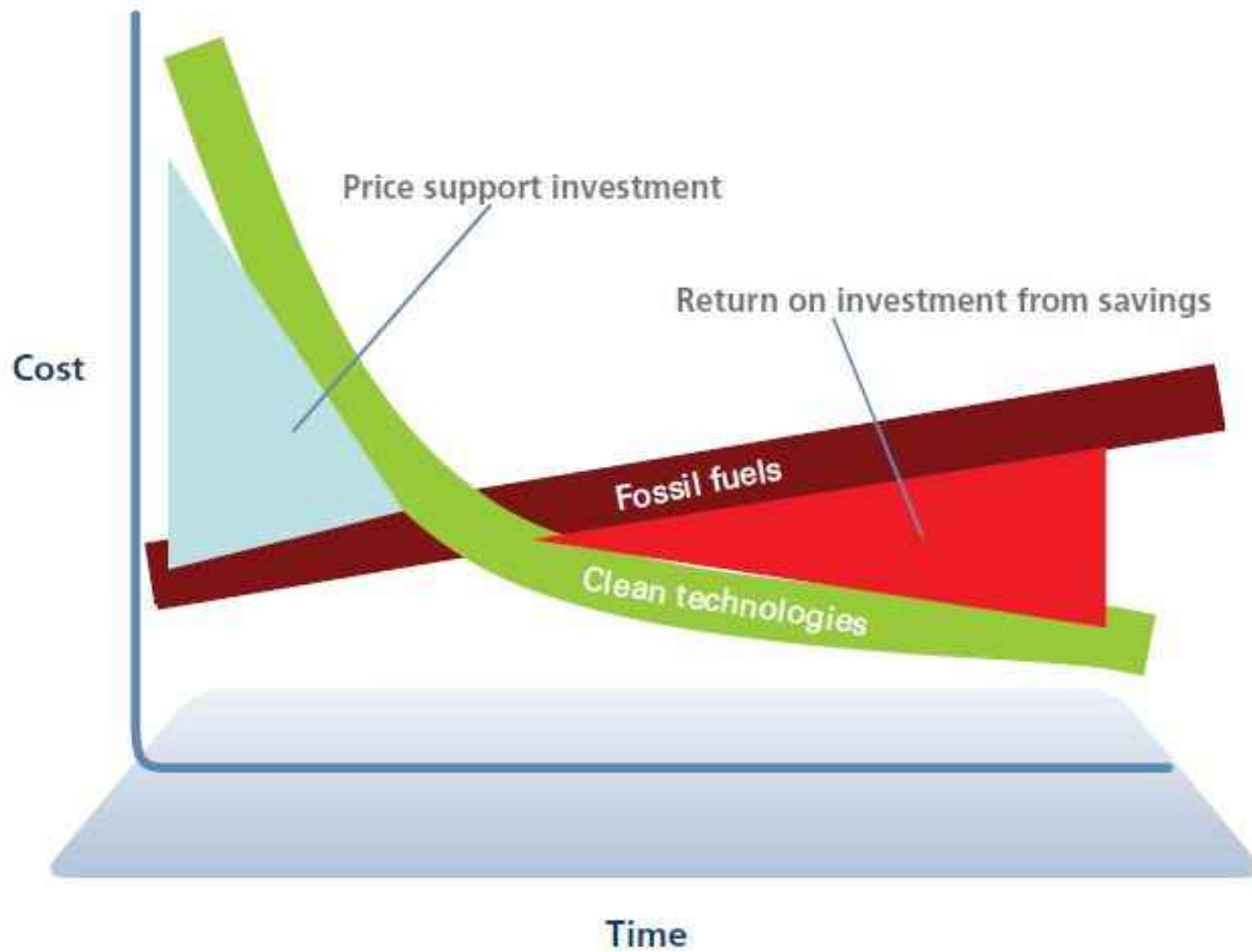
Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts

Sequent & Lund, LLC Consulting Group
Chicago, Illinois



NREL
National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, Colorado 80401-1500
www.nrel.gov

	S&L High-Cost Bound	Cumulative Deployment 2002–2020	SunLab Low-Cost Bound	Cumulative Deployment 2002–2020
Troughs	6.2 cents/kWh	2.8 GWe	4.3 cents/kWh	4.9 GWe
Towers	5.5 cents/kWh	2.6 GWe	3.5 cents/kWh	8.7 GWe



National Security

Food Security

Water Security

Energy Security

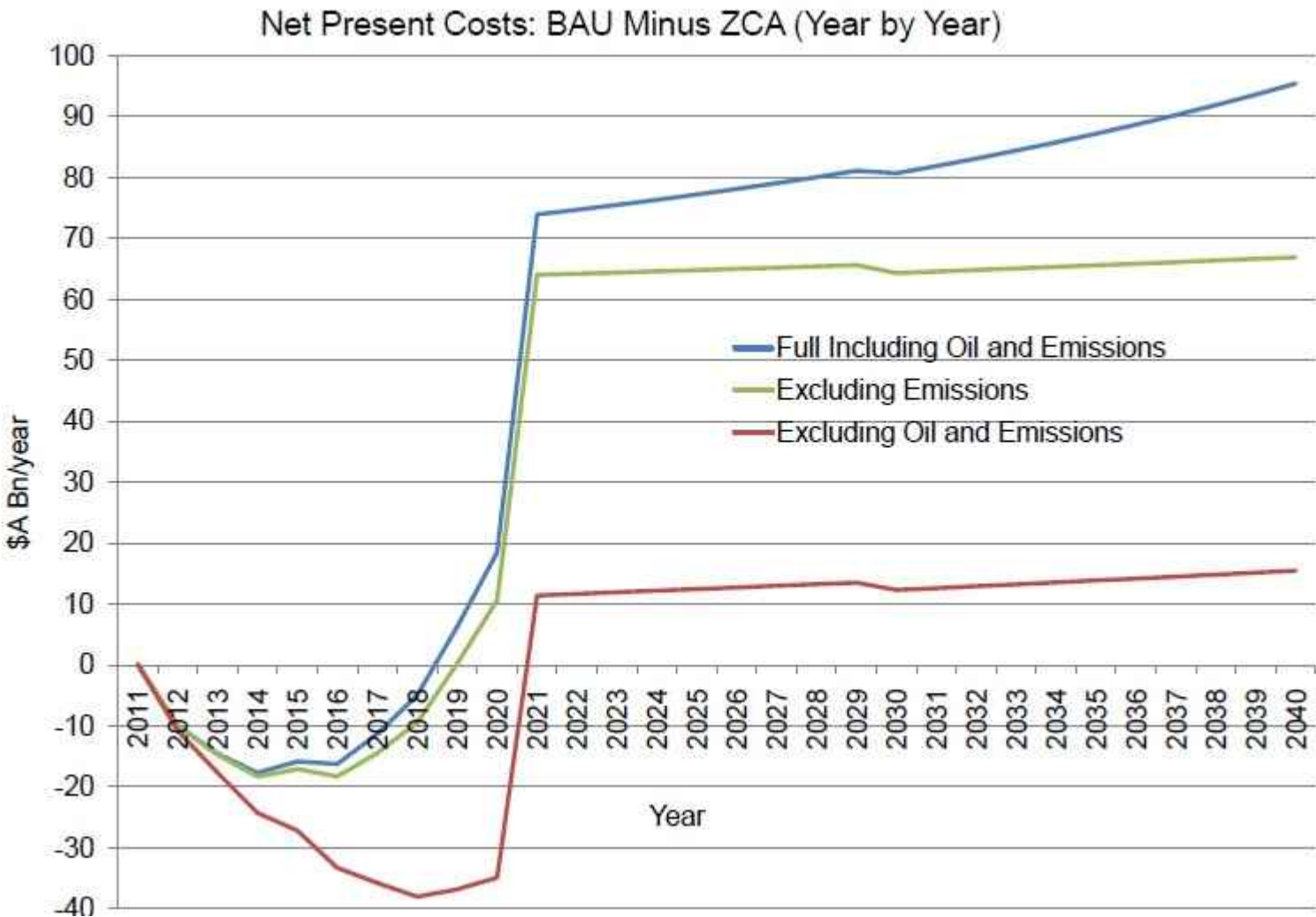
Regional Security



Safe Climate a Bargain at 3% of GDP

Component	AUD\$, Bn
CST	\$177
Backup Heaters	\$5
Bioenergy supply	\$6
Wind	\$72
Transmission	\$92
TOTAL	\$353
Off-grid CST + Backup	\$17
TOTAL + Offgrid	\$370

Economic Payback of this system relative to Business-As-Usual

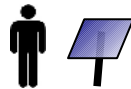


OUR CHOICE

1
mirror

OR

20 tons
of coal



GET INVOLVED!

- Join the 'Can Do' team
 - Radio
 - Media team
 - Zero Carbon Plan
- Donate

More information at

www.beyondzeroemissions.org

