

***Renewable energy options for
Australia***

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GREENHOUSE

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ROAM Consulting

- Specialists in detailed modelling of electricity systems
- Forecast demand, electricity price, transmission congestion, CO₂ emissions, etc.
- Assess impacts of new policies
 - Renewable Energy Target
 - Carbon Pollution Reduction Scheme
- Provide consulting services to:
 - Generators (coal, gas, wind etc.)
 - Large electricity purchasers (mines, smelters, retailers etc.)
 - Transmission providers
 - Government (Department of Climate Change etc)

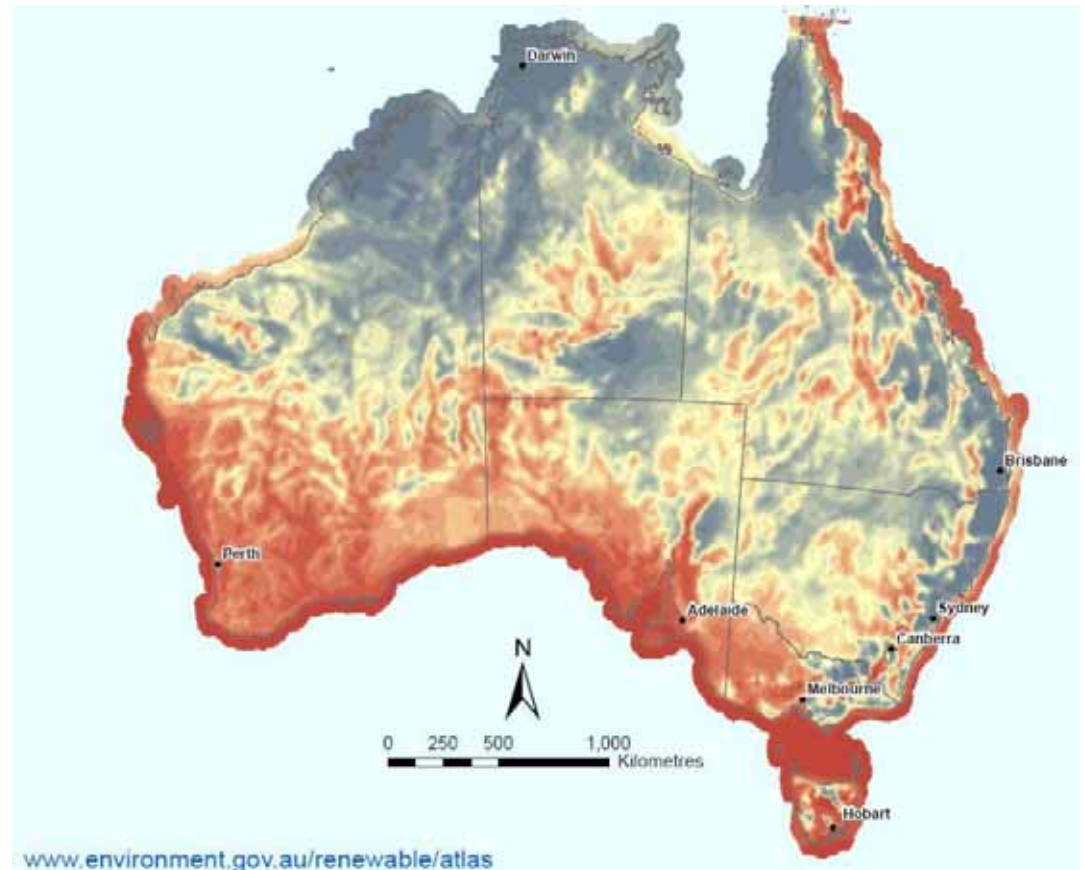
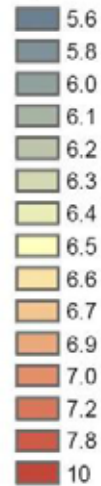
Renewable Energy Target (RET)

- Federal target of 20% by 2020
 - Is it achievable?
 - Which technologies?
 - Can we maintain electricity reliability?
 - What changes will be required?

Wind

- Least expensive form of new renewable generation
- Great resources in Australia

Metres per Second



Wind

Limitations of wind:

- Intermittent
- Expensive compared with coal and gas
 - Not likely to be incentivised by the CPRS alone
 - Renewable target will be main driver of emissions reduction in electricity , not emissions trading
- Located in weak parts of grid
 - Transmission problems
- Penetration beyond 20% is likely to be problematic and expensive






Assessment:

- Likely to be the major contributor to the renewable target
- Enough wind projects proposed to meet renewable target alone!
 - 20% wind is fine, as long as it is evenly distributed around the grid



Biomass

- Burn bio-product to produce electricity
- Focus on waste biomass
 - Some forms compete with food sources and more valuable land uses

Types of Biomass	
	Wood fuel
	Rubbish
	Alcohol fuels
	Crops
	Landfill gas

Sugar Cane Bagasse

= fibrous remainder after sugar cane is crushed

Advantages

- Mature technology
 - Thermal boilers
- Uses existing waste biomass
- Schedulable!
- Immediately cost effective under the RET and CPRS

Limitations

- Mill owner may not have interest/experience
- Storage/transport issues for full time production



Sugar Cane Bagasse

- Could produce 1/10th of RET in QLD from bagasse alone

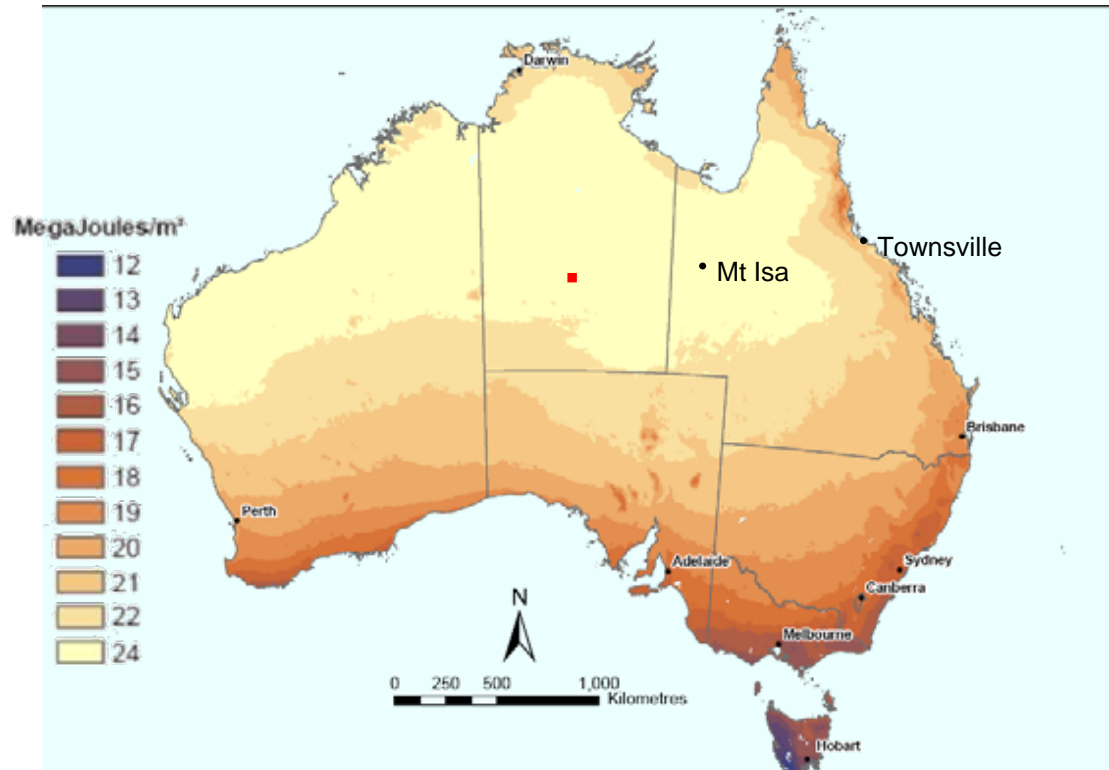
Assessment:

- Waste biomass will be a very important contributor to the RET, especially for maintaining system reliability
- We will need to support its entry into the market



Solar Power

- Australia has world class solar resources
 - Especially north QLD, NT and north WA
 - Difference is significant
 - Sites in the north will make twice the revenues of southern sites!



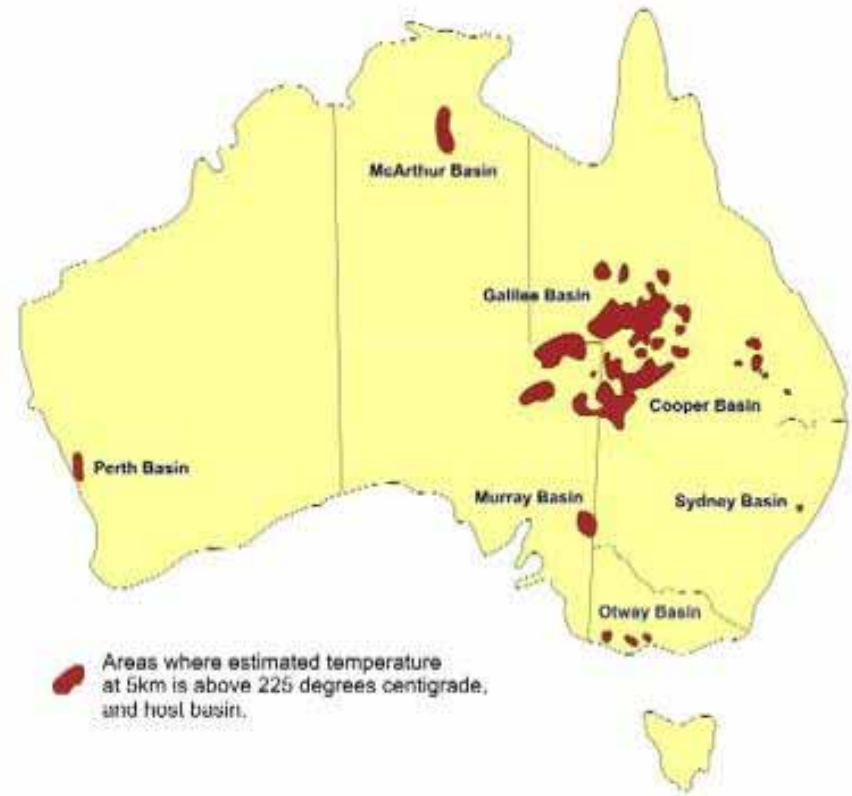
Solar technologies

- Solar thermal
 - Underrated technology
 - Existing technology
 - Incremental cost reductions expected
 - Heat storage provides schedulability!
- Assessment
 - Could contribute to RET, if we provide pilot funding
 - Likely to be very important post-2020 regardless



Geothermal

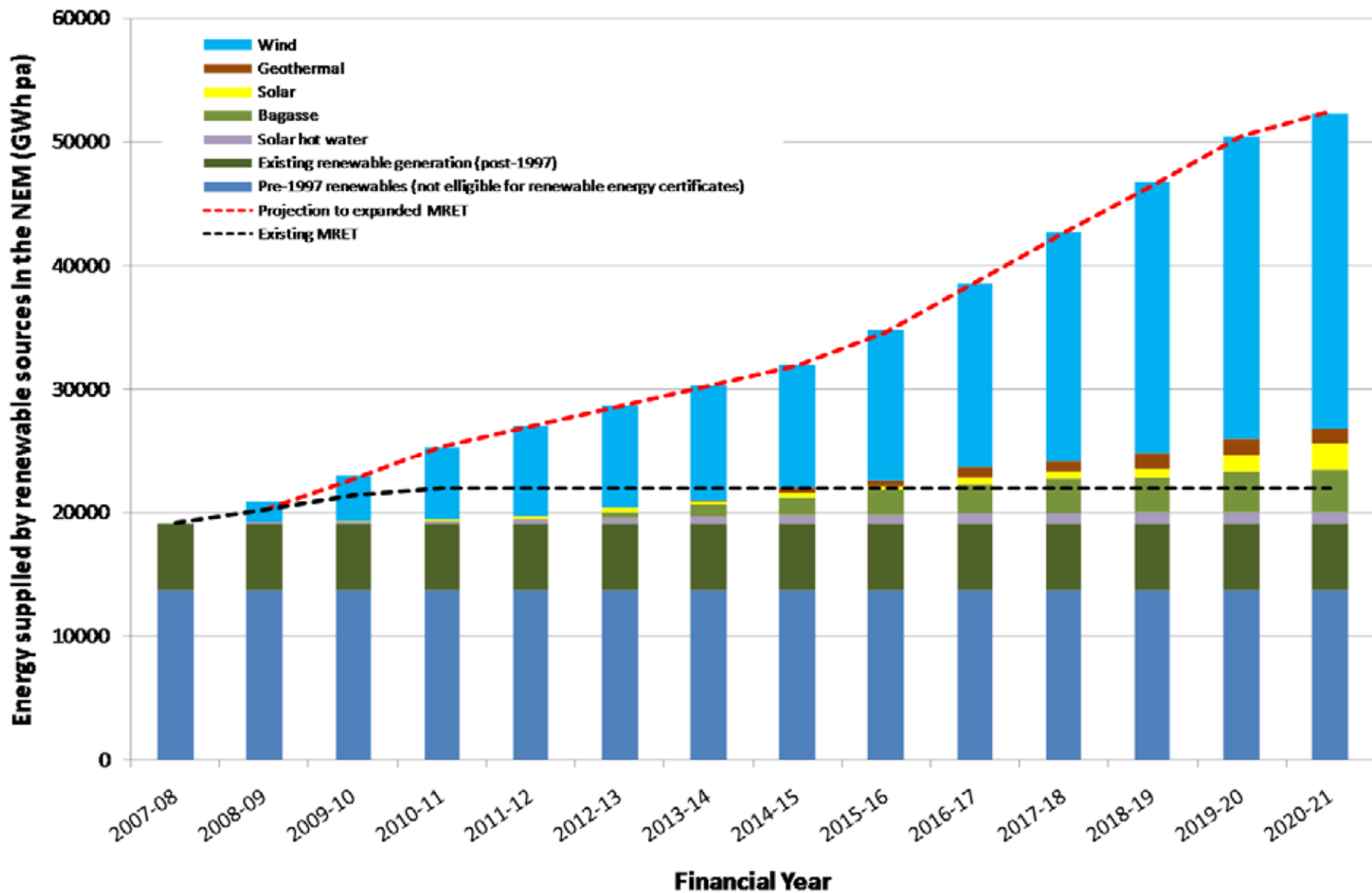
- Large potential
- Schedulable!
- Currently at early pilot stage
 - Potentially very large technical barriers
 - Will take time to develop this technology to commercial scale
 - Significant contributor beyond 2020?



Capital costs and LRMCs of new renewable technologies

Type	Capacity	\$/kW Treasury	\$/kW ACIL Tasman	\$/kW ROAM	Long Run Marginal Cost
Wind	100 MW	\$2,134	\$2,400	\$2,200	\$100 /MWh
Sugar cane bagasse	70 MW	\$2,598	\$2,200	\$2,200	\$70 /MWh
Parabolic trough	200 MW	\$4,176	\$5,000	\$4,500	\$200 /MWh

- Wind is likely to be the major contributor to the 2020 target



Transmission

- Australia has the longest grid in the world
- Each line has limitations on how much power it can carry
 - Voltage limits
 - Stability limits
 - Thermal limits
- Many limits vary constantly, depending on system conditions
 - A very complex system
 - Important to model accurately



Wind farms annual shortfalls to total available energy

	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21
Wind Farms NSW - CAN	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%
Wind Farms NSW – NCEN	0%	0%	0%	0%	0%	0%	0%	1%	0%	1%	1%	2%	2%
Wind Farms NSW - NNS	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	1%	1%
Wind Farms QLD - CQ	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wind Farms QLD - NQ	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wind Farms QLD - SEQ	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
Wind Farms QLD - SWQ	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wind Farms SA - ADE	0%	0%	1%	1%	5%	6%	7%	10%	13%	16%	16%	18%	18%
Wind Farms SA - NSA	1%	3%	6%	14%	29%	31%	30%	40%	50%	54%	53%	53%	60%
Wind Farms SA - SESA	0%	0%	0%	4%	9%	10%	10%	20%	31%	34%	34%	55%	60%
Wind Farms TAS - TAS	0%	0%	0%	0%	0%	0%	0%	1%	0%	1%	0%	0%	0%
Wind Farms VIC - CVIC	0%	0%	0%	0%	1%	1%	2%	3%	3%	5%	5%	5%	6%
Wind Farms VIC – CVIC	0%	0%	0%	0%	0%	0%	3%	7%	6%	10%	9%	9%	9%
Wind Farms VIC - LV	0%	0%	0%	0%	0%	0%	1%	1%	1%	2%	3%	4%	4%

Inter-regional transmission limitations prevent export of wind power

Percentage of time wind exceeds demand

	SA	NSW	VIC
2007	0.00%	0.00%	0.00%
2008	0.00%	0.00%	0.00%
2009	0.17%	0.00%	0.00%
2010	0.30%	0.00%	0.00%
2011	2.68%	0.00%	0.00%
2012	2.52%	0.00%	0.00%
2013	2.55%	0.00%	0.00%
2014	2.68%	0.00%	0.00%
2015	5.55%	0.00%	0.00%
2016	10.57%	0.00%	0.00%
2017	12.25%	0.00%	0.00%
2018	11.82%	0.00%	0.00%
2019	15.87%	0.00%	0.00%
2020	23.72%	0.00%	0.00%

- Huge amounts of wind proposed for SA
- Inter-regional transmission is insufficient

Summary

- Australia has substantial renewable resources
 - We can certainly implement 20% by 2020 and maintain system reliability
- Initial investment is likely to be largely in:
 - Wind
 - Waste biomass
 - Perhaps solar thermal (with pilot funding)
- Emissions trading alone is not enough; also need:
 - RET
 - Address information and non-economic barriers
- Transmission augmentation is likely to be required in some areas
 - Although the grid copes remarkably well if renewable projects are distributed
 - Transmission limitation information to renewable investors is very important

