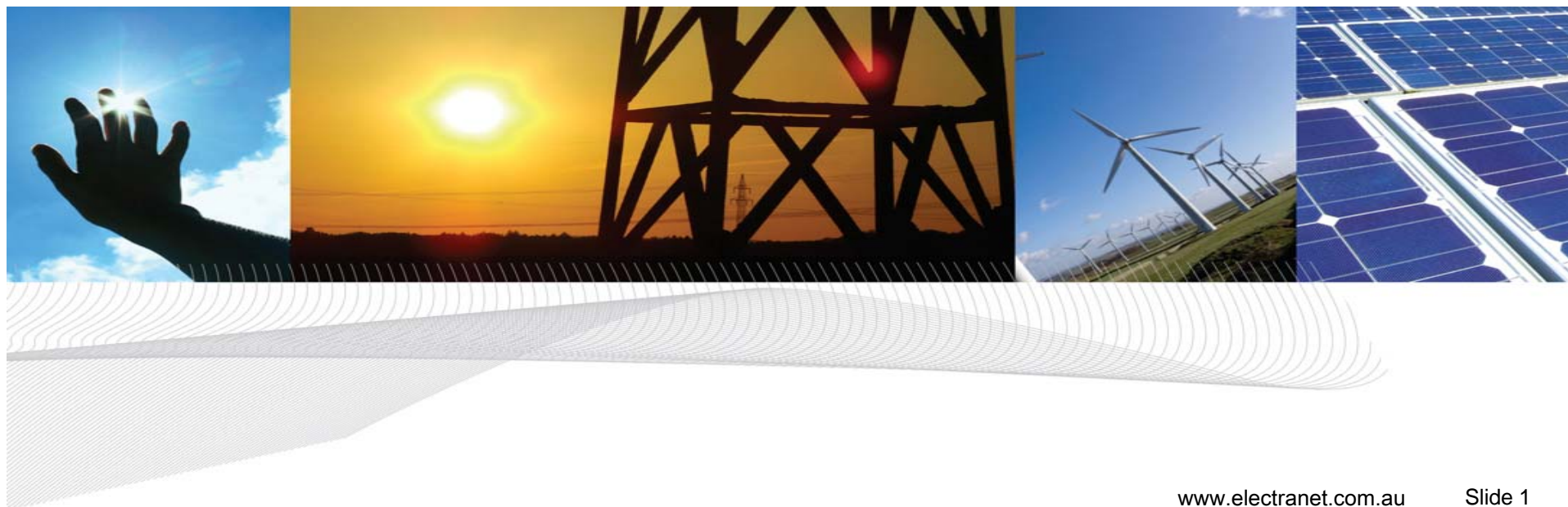


Renewable Energy – Transmission is part of the Solution

Presentation to RenewablesSA Board

2 December 2009



Presentation Outline

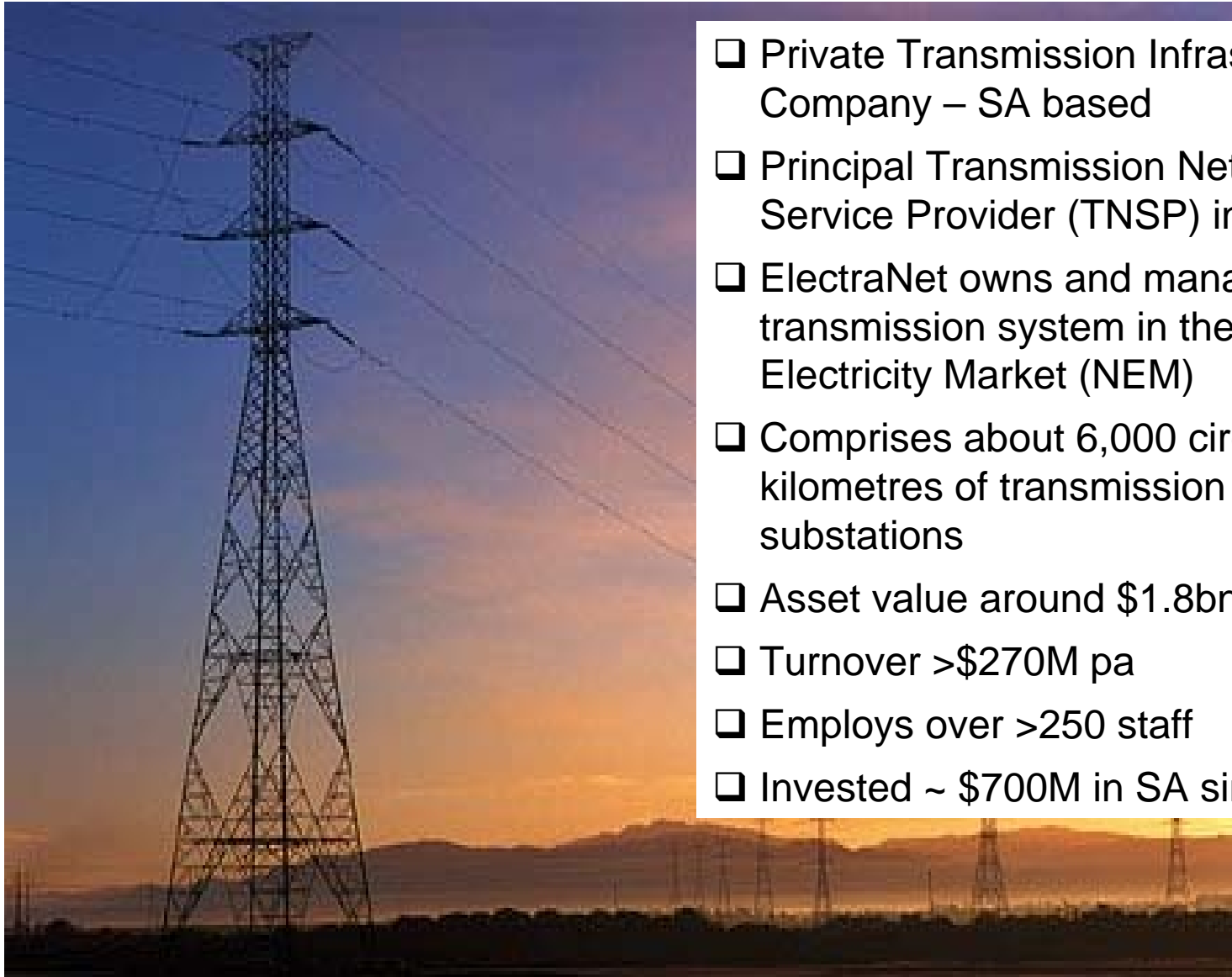
- ❑ Background – ElectraNet and NEM
- ❑ Integrated Energy Policy
- ❑ Context and outlook for electricity
- ❑ Transmission Issues and Solutions
- ❑ Renewable Technology Outlook
- ❑ Green Grid initiative perspective
- ❑ Scale Efficient Network Extensions (SENEs)
- ❑ Concluding messages

Background

ElectraNet and the National Electricity Market (NEM)

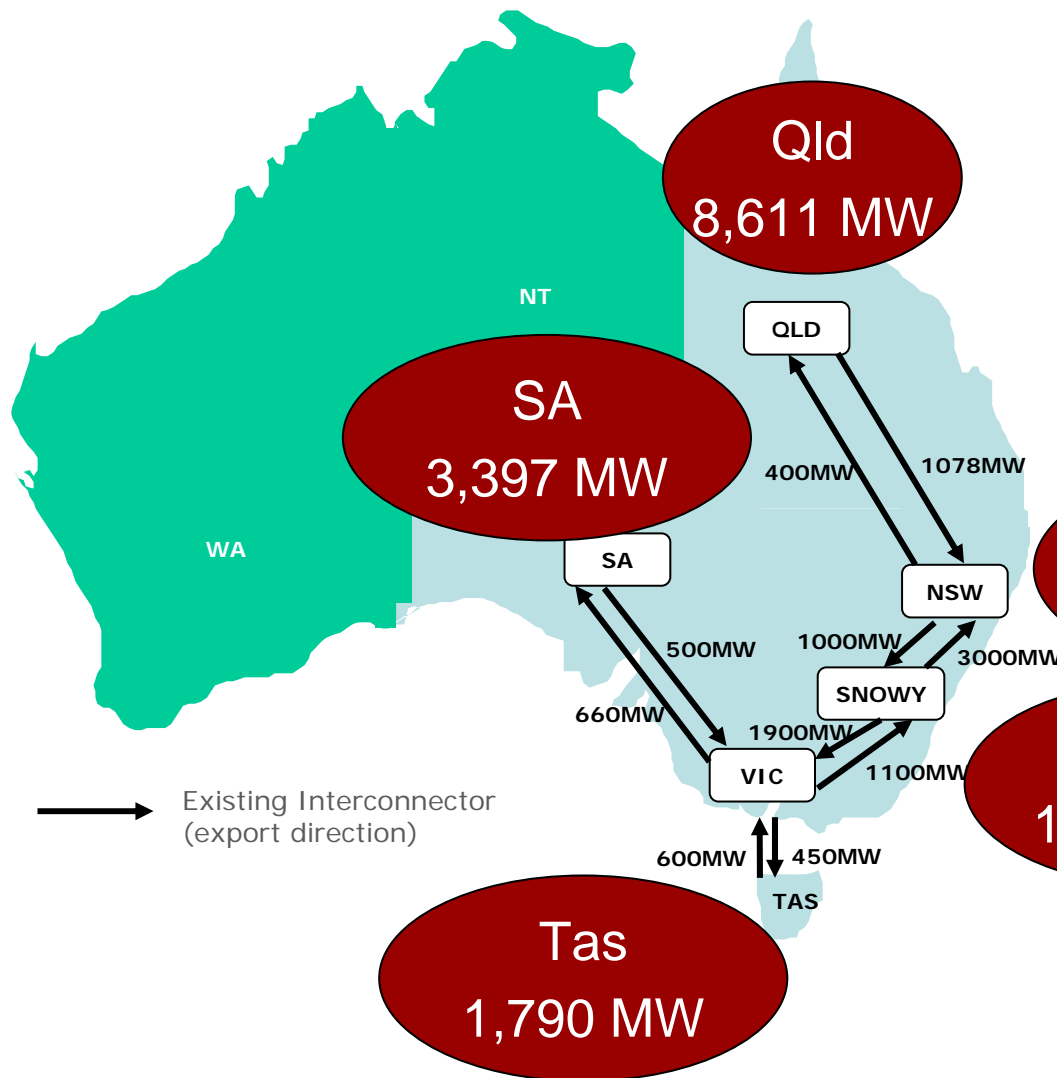


About ElectraNet



- ❑ Private Transmission Infrastructure Company – SA based
- ❑ Principal Transmission Network Service Provider (TNSP) in SA
- ❑ ElectraNet owns and manages the SA transmission system in the National Electricity Market (NEM)
- ❑ Comprises about 6,000 circuit kilometres of transmission line and 79 substations
- ❑ Asset value around \$1.8bn
- ❑ Turnover >\$270M pa
- ❑ Employs over >250 staff
- ❑ Invested ~ \$700M in SA since 2000

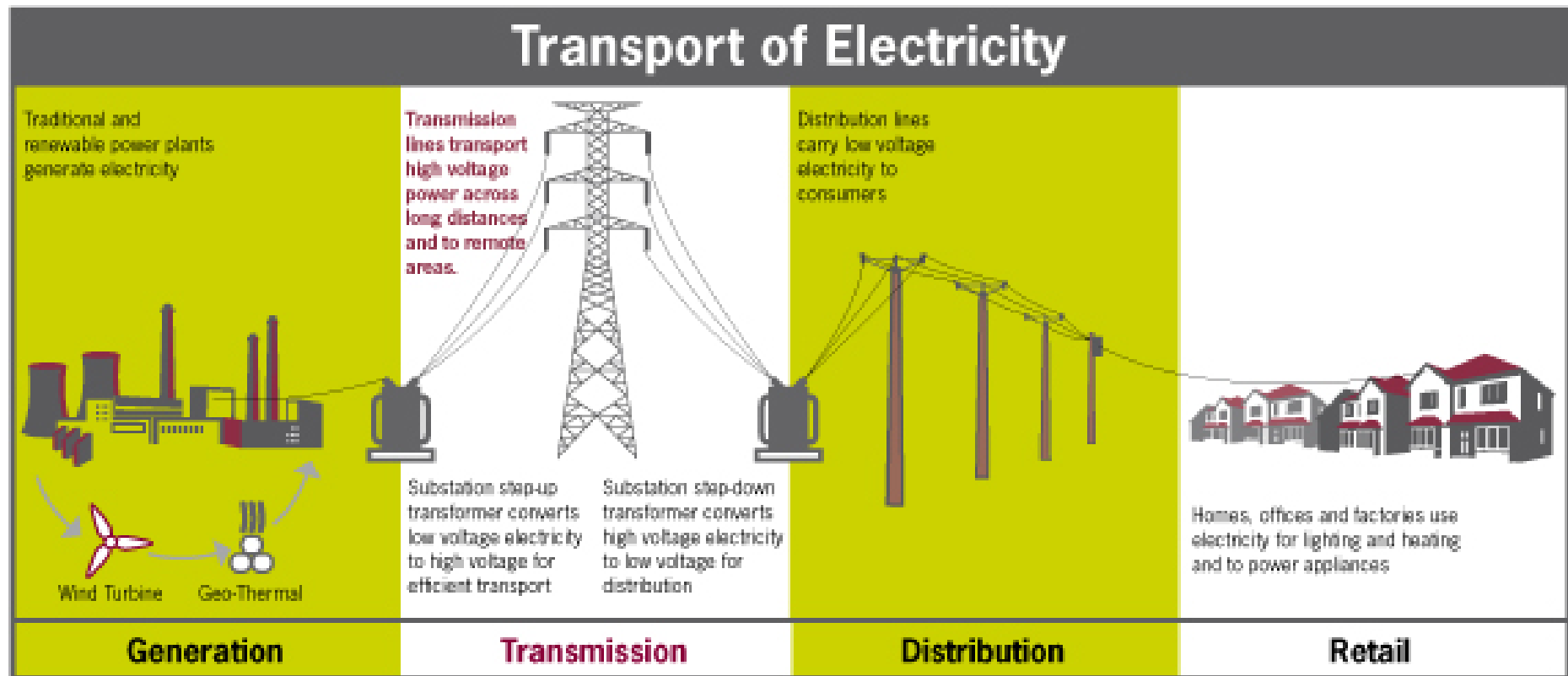
National Electricity Market (NEM) Grid



National Electricity Market is made up of five regions joined by transmission interconnectors

Total Demand: 35,679 MW

NEM Market Components



Network Service Provider (NSP)

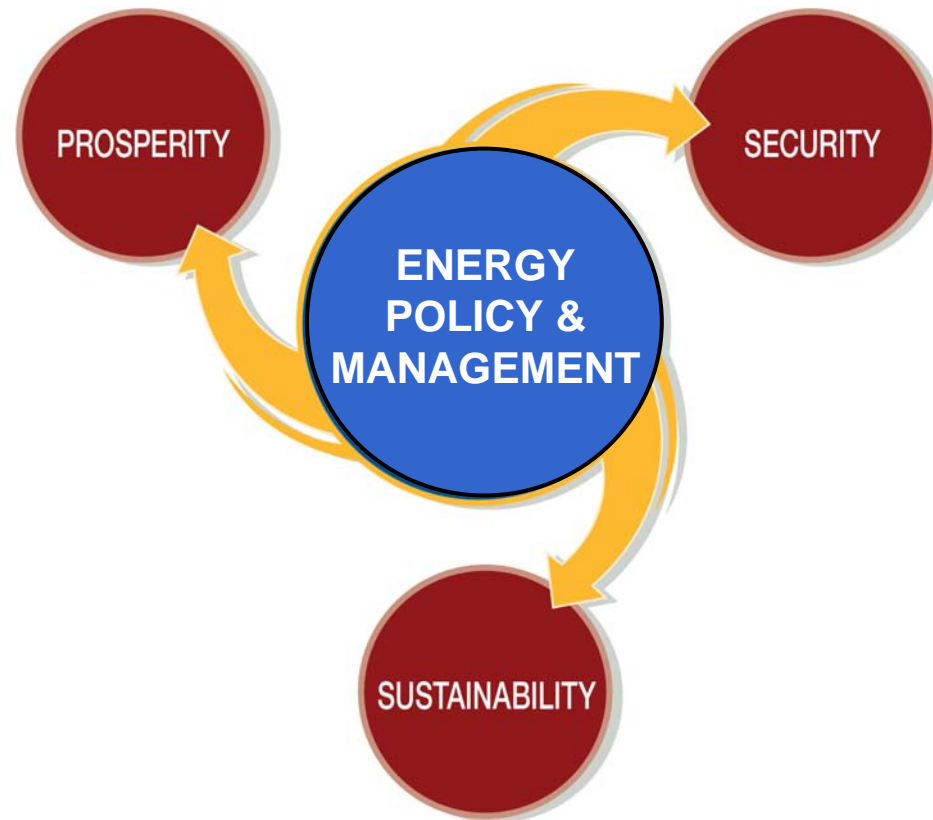
- ❑ Network Companies are common carriers of generators' and/or retailers' energy on a non-discriminatory basis, but are NOT responsible for:
 - The generation of electricity
 - The trading or setting of Spot Price for electricity
 - The operation of the National Electricity Market

- ❑ Networks provide:
 - Least cost transport for generators
 - Reliable and secure power delivery for customers
 - Access to competitive market for participants

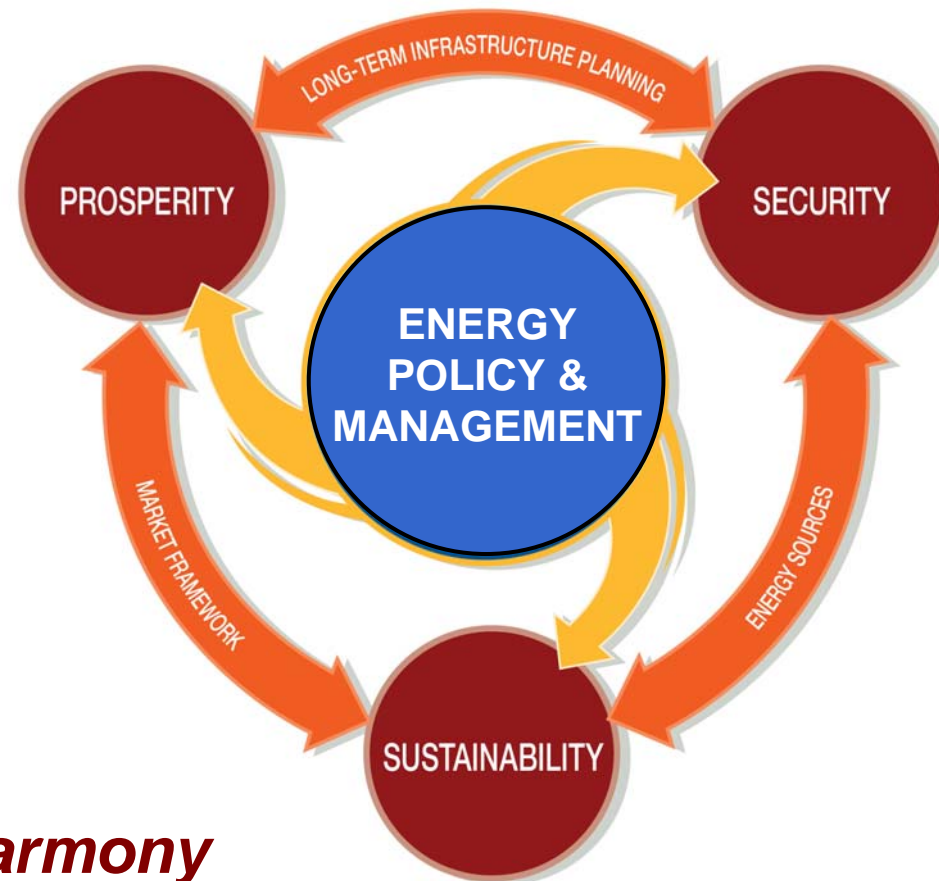
Integrated Energy Policy



Integrated Energy Policy – The Drivers

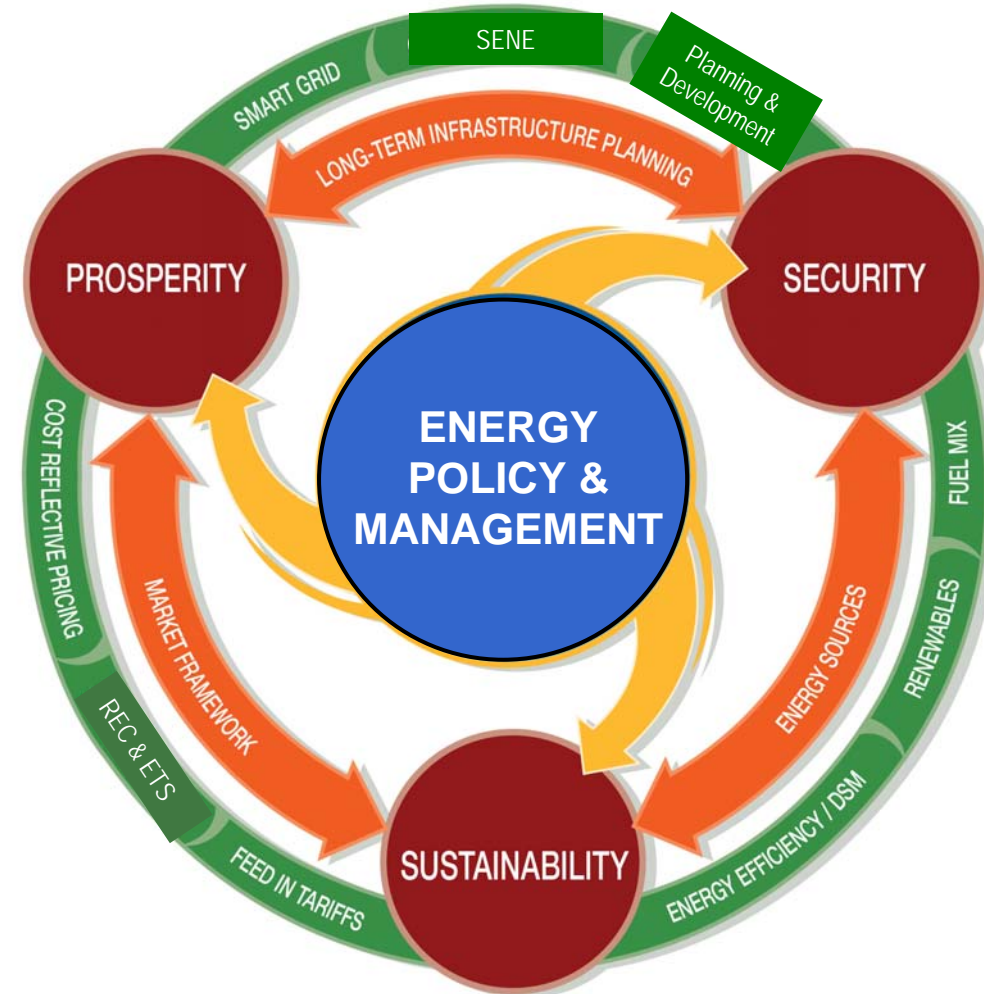


Integrated Energy Policy – The Connectors



The Connectors
Keep the Drivers in Harmony

Integrated Energy Policy – The Elements



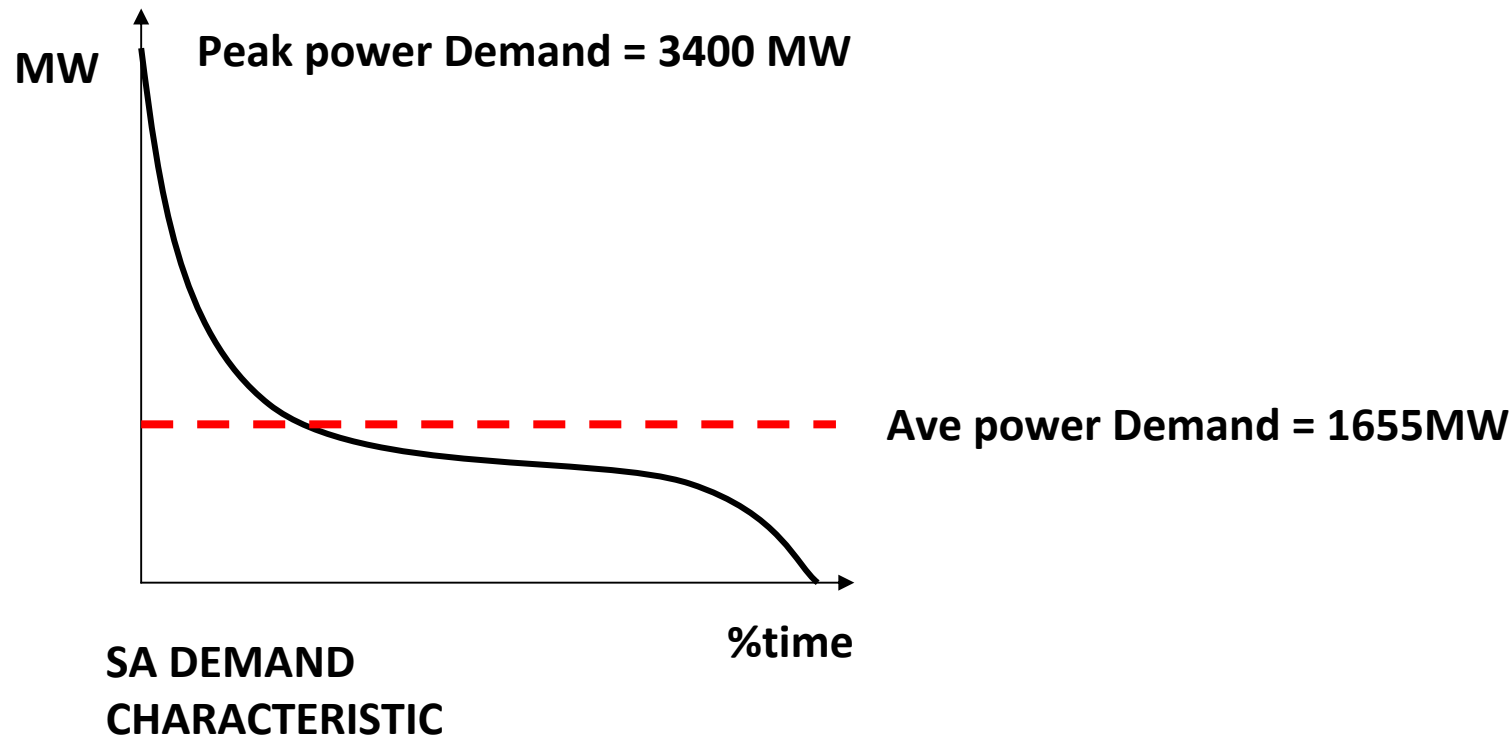
The integration is the key.

Any change in one element affects outcomes in other quadrants

Context and Outlook



SA Load Duration Curve



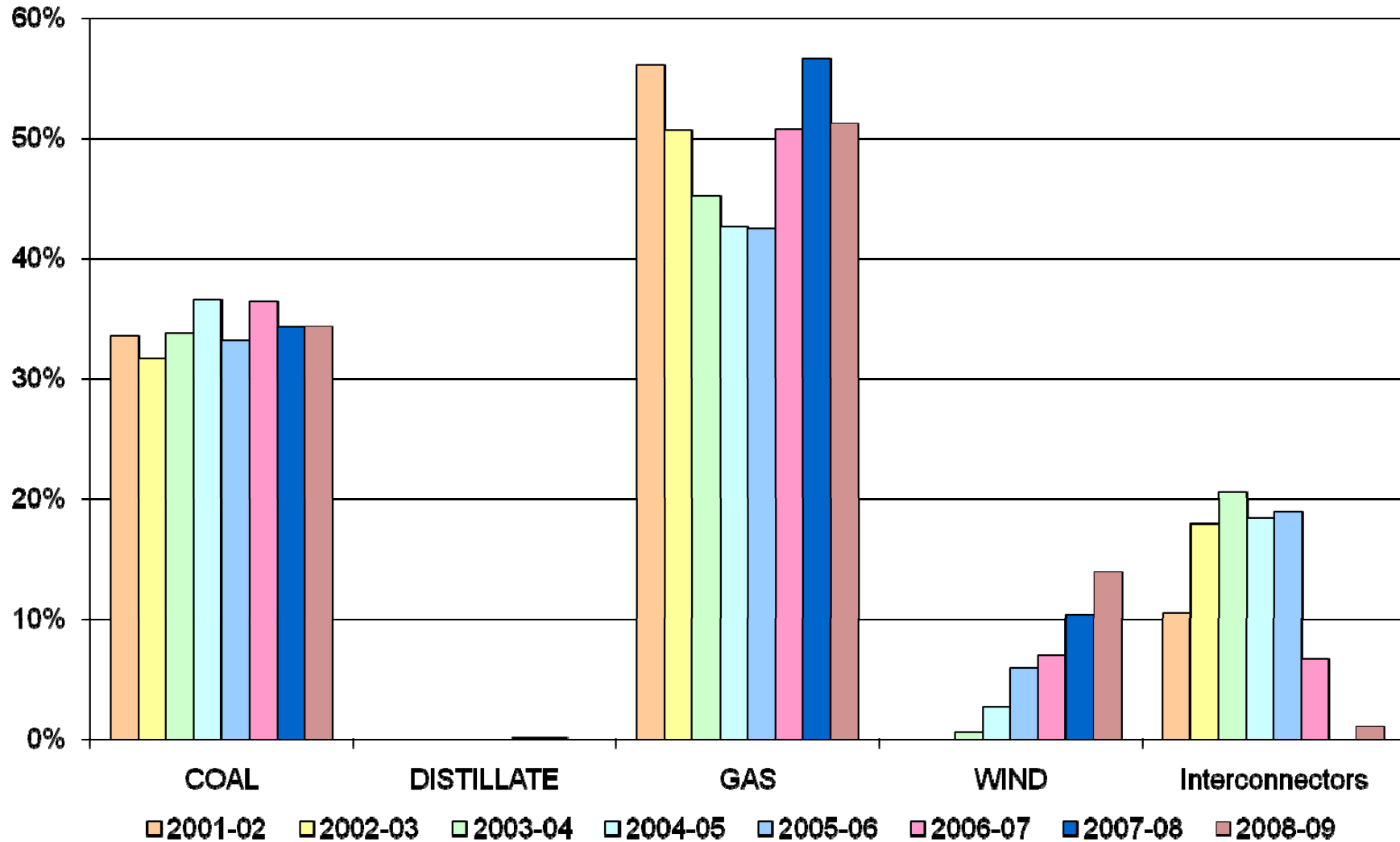
SA Energy Demand = 14,500GWhr = Area under Load Duration Curve

This means average Power Demand = 1655MW

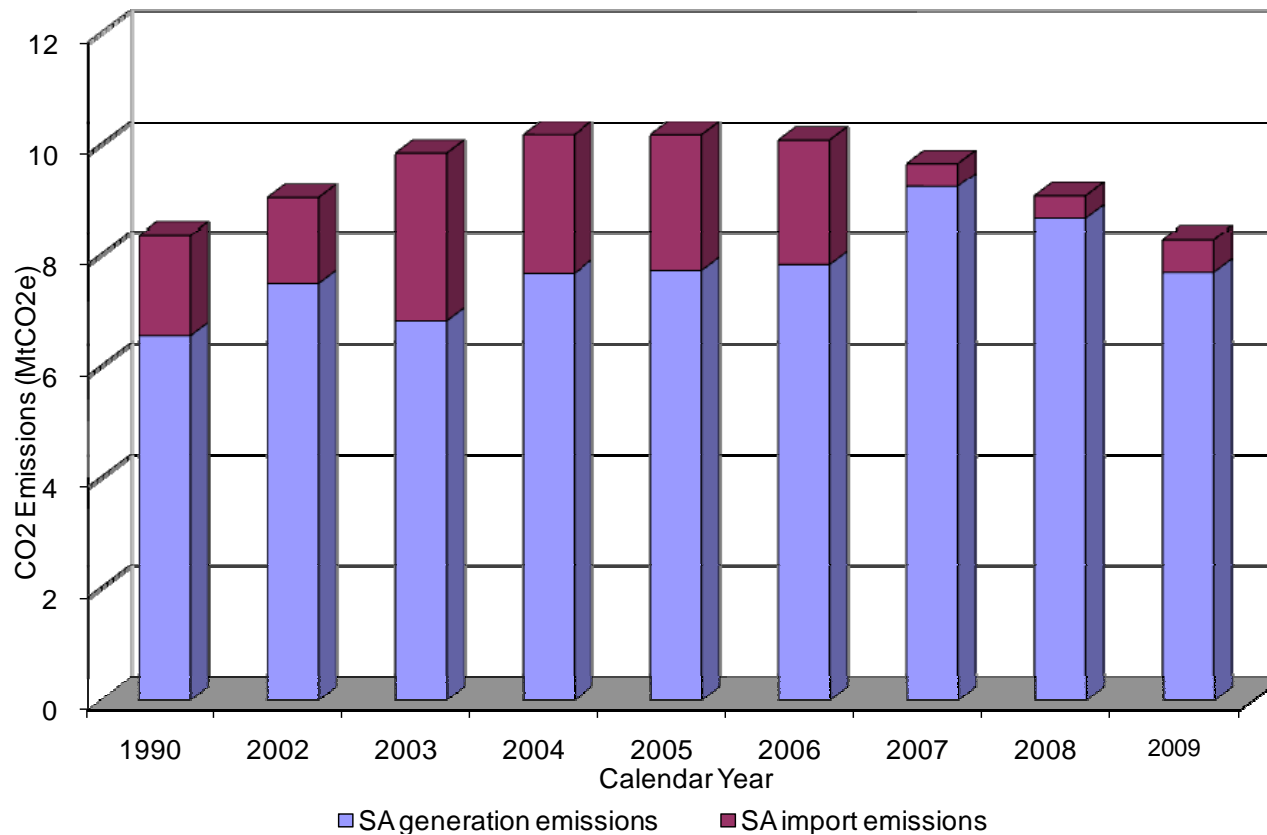
Load Factor = $1655/3400 = 48\%$ (worst in the world)

The load factor has been deteriorating which will increase the average price per kWh, other things being equal

South Australian Energy Consumption by Source

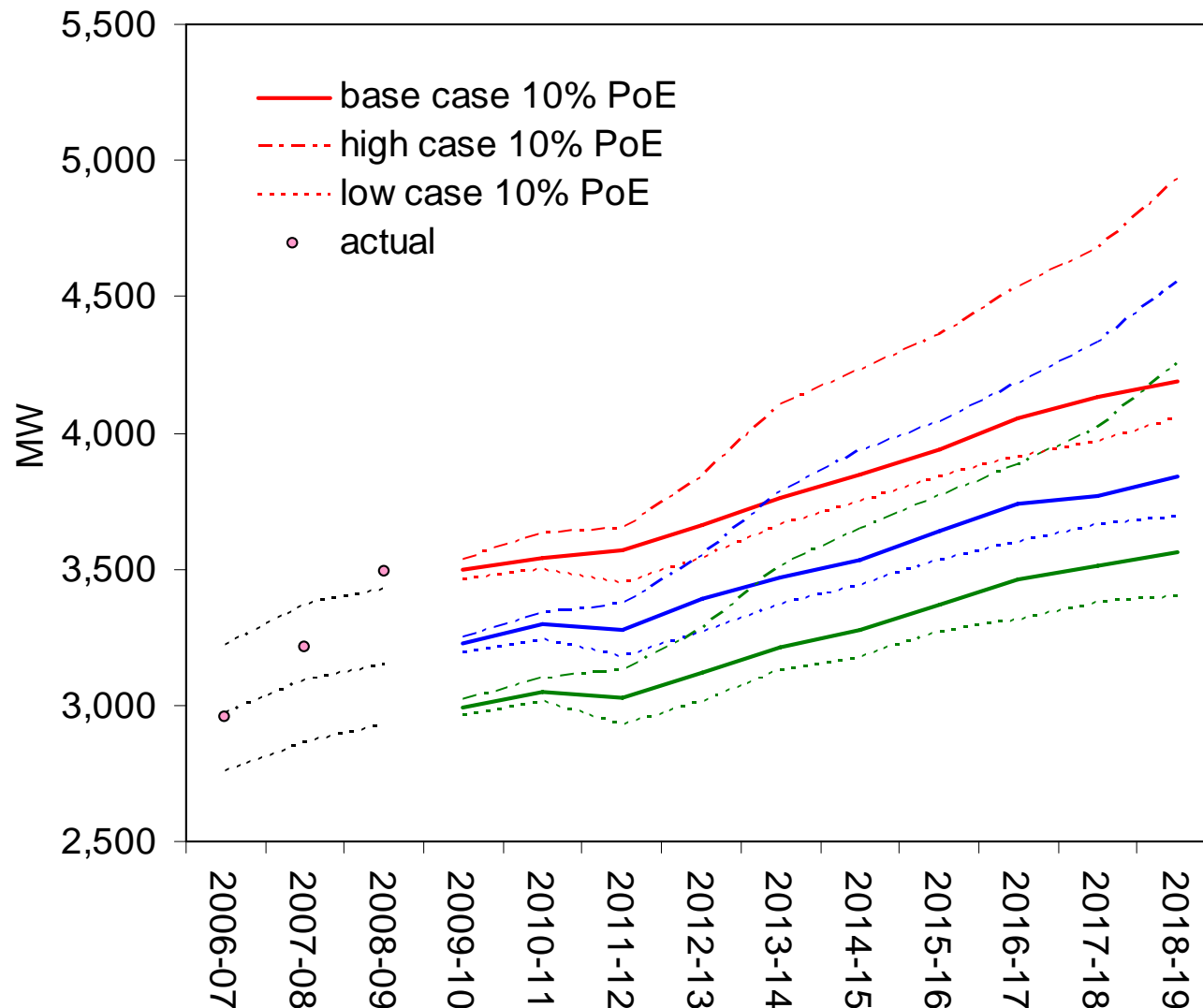


South Australian Emission Levels



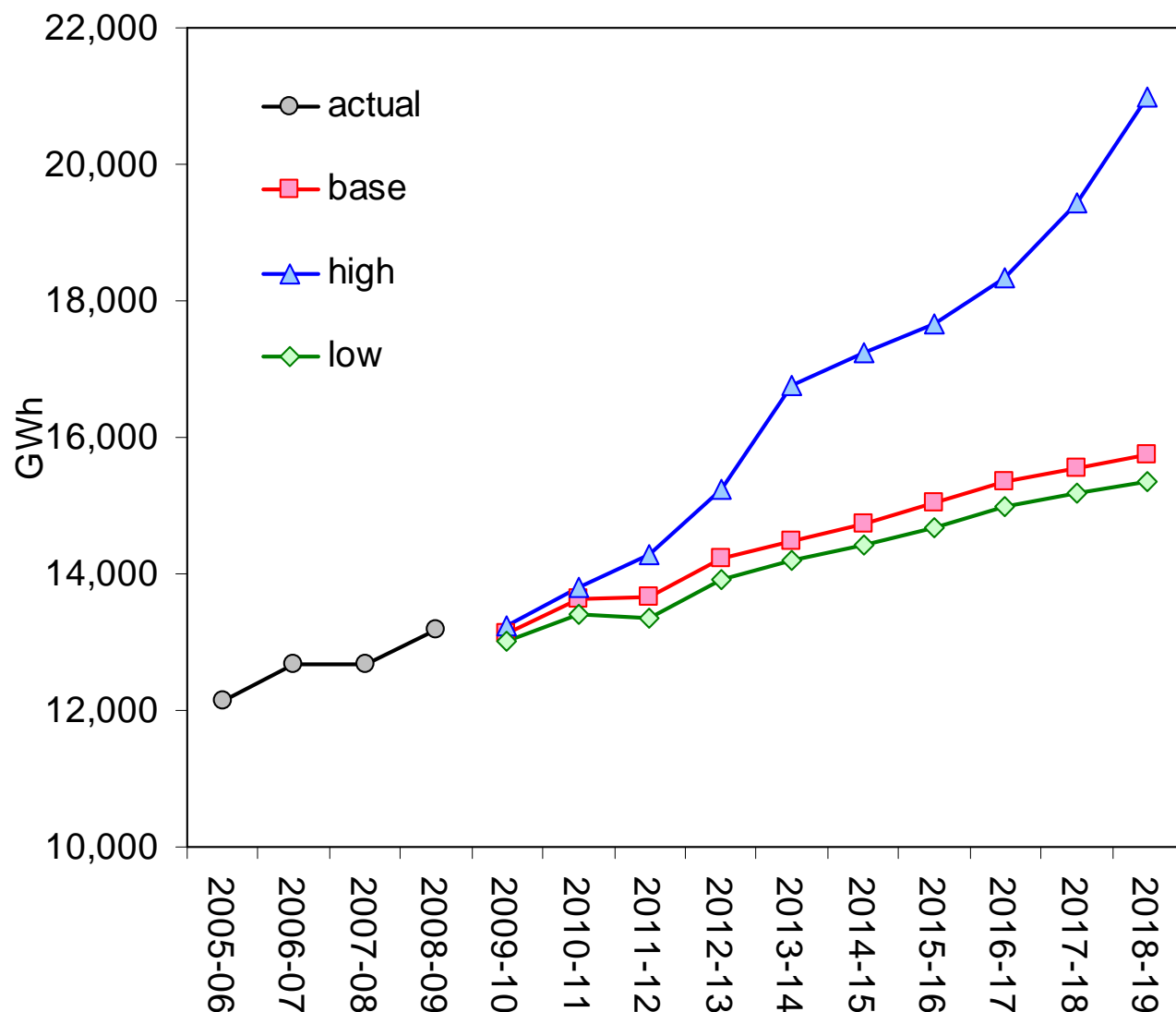
South Australian electricity emissions are down nearly 20% on 2004/05 peak

South Australian Summer MD forecasts – 10%, 50% & 90% PoE



- 2009-10 10% PoE: 3,500 MW
- 75 MW (2.2%) increase on the 2008-09 10% PoE level
- revised down by 30 MW from the 2008 view
- forecast average growth of 2% to 2018-19
- high case includes Olympic Dam expansion and new pulp mill

South Australian Customer Sales Forecasts



- 2008-09 growth expected to come in at 4% (mainly pumping & Prominent Hill)
- Sales expected to fall 0.3% in 2009-10, reflecting slowing GSP growth
- Residential sales -3.6%
Business -0.2%
Pumping -29%
Other +20%
- Growth to 18-19 expected to average 1.8%
High case ave 4.8%
Low case ave 1.5%

Transmission Issues and Solutions



Current Capacity and Energy Status

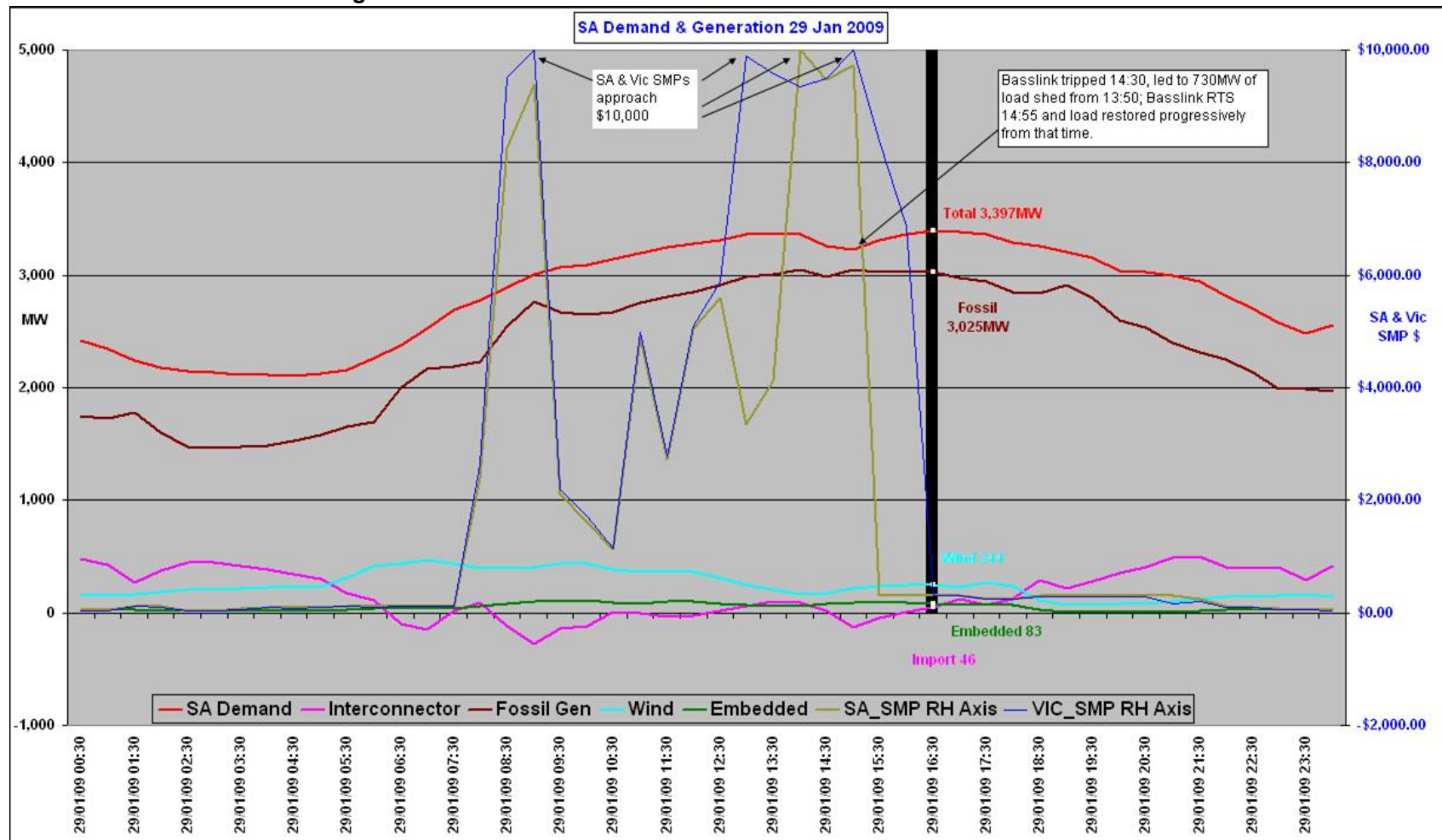
- ❑ SA has sufficient nameplate fossil fuel generation to meet forecast peak demand for the next 2-3 years
- ❑ Taking into account all installed generation and its associated capacity factors (fossil fuel and renewable) there is theoretically approximately 30,800 GWhrs of **energy** available vs 14,500 GWhrs consumed (i.e. more than enough energy!)
- ❑ Problem is that the renewable resources are intermittent

29 January 2009:

16:30 - SA Record Demand 3,397MW

DATE	SA Demand	Interconnector	Fossil Generation	Wind	Embedded *	SA_SMP	VIC_SMP
29/01/09 16:30	3,397	46	3,025	244	83	\$300.00	\$308.77

* Note: Embedded generation includes windfarms at Canunda & Starfish Hill.

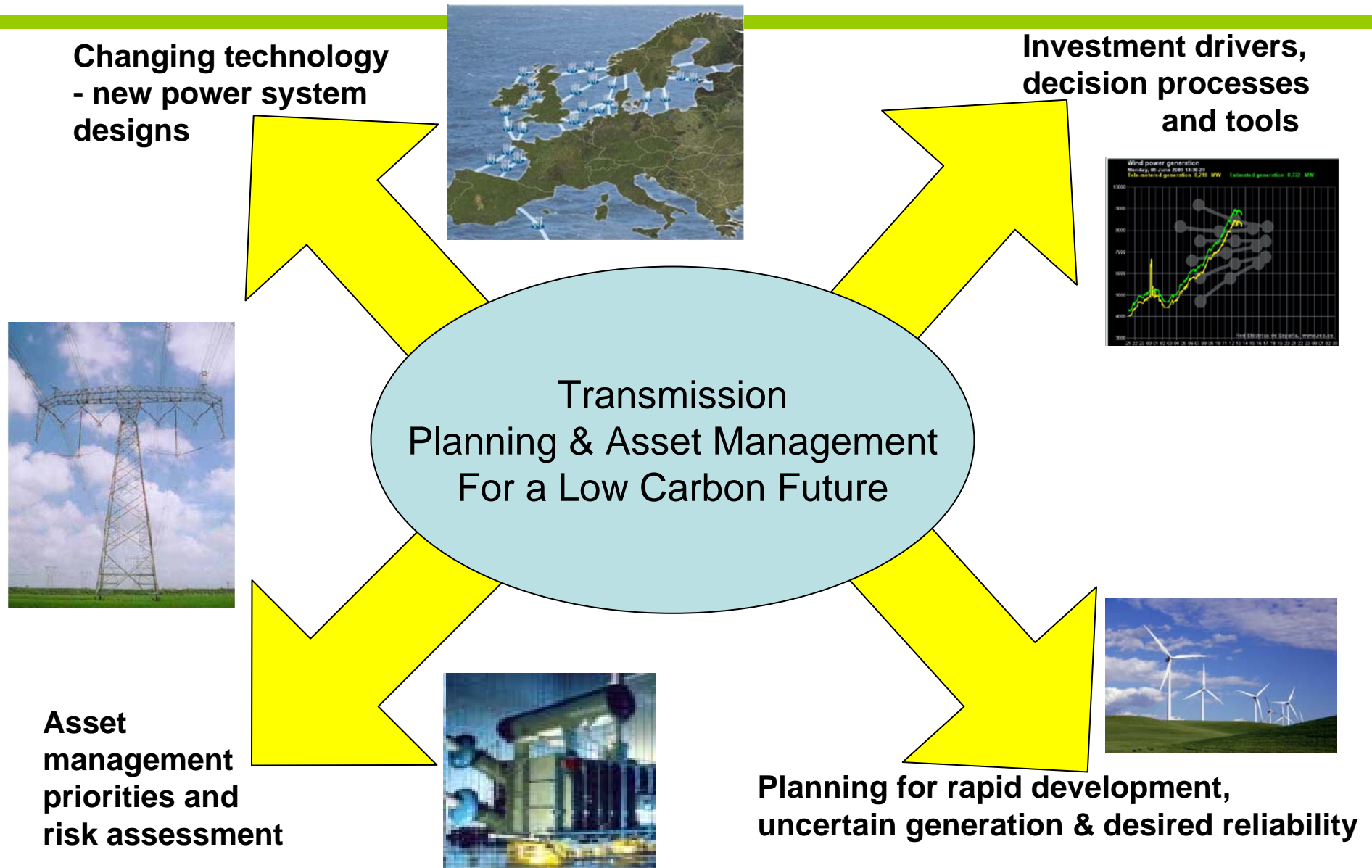


□ NEMMCo commenced customer load interruption in Vic at 12:40 to maintain system security.

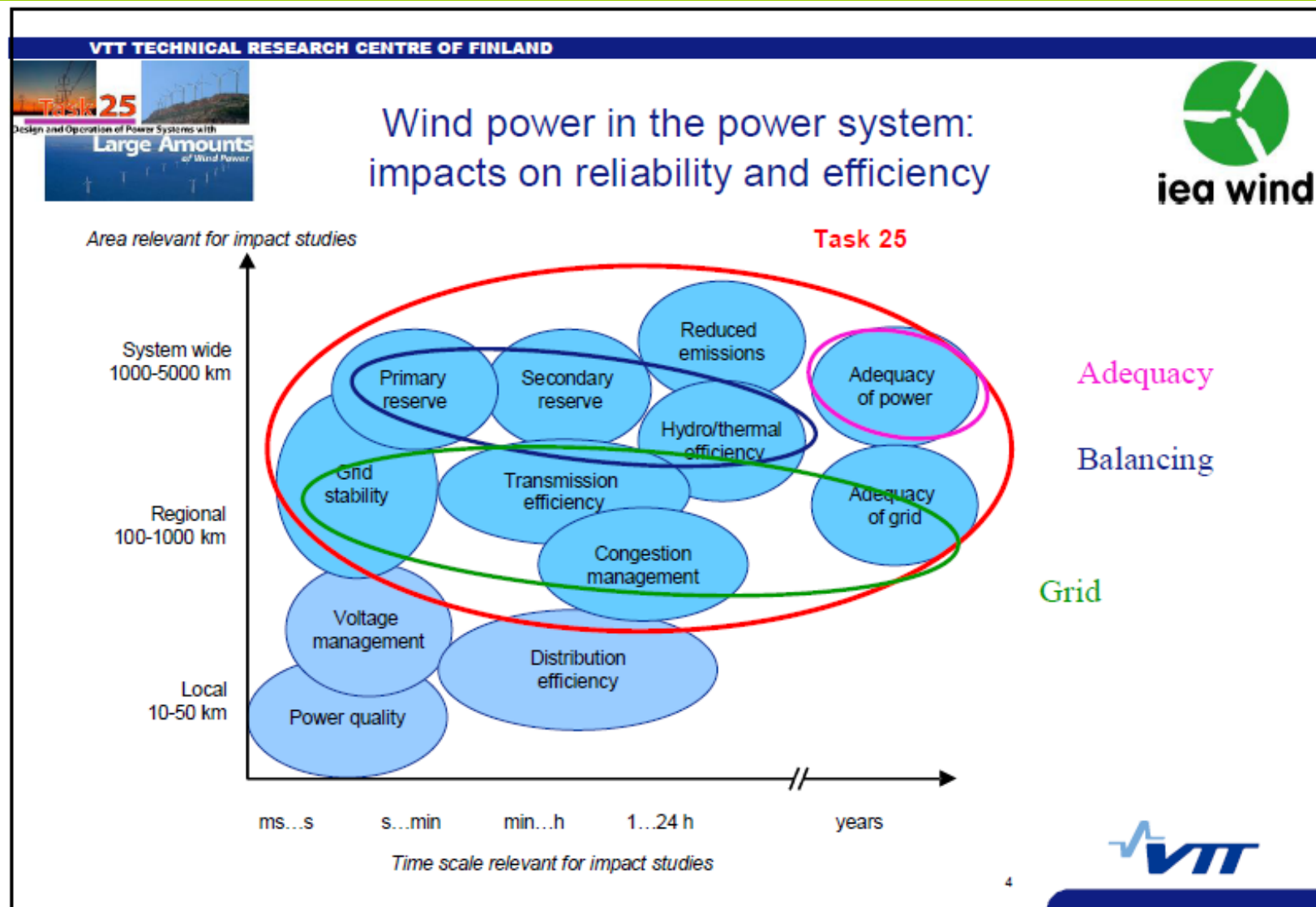
Transmission Network Reality

- ❑ SA transmission network has thermal capacity to connect approximately 2300MW of wind generation (other limits currently under investigation)
- ❑ Beyond that, there needs to be one or more of the following ...
 - Additional demand in SA
 - Increased interconnector capacity to other markets
 - Energy storage capacity

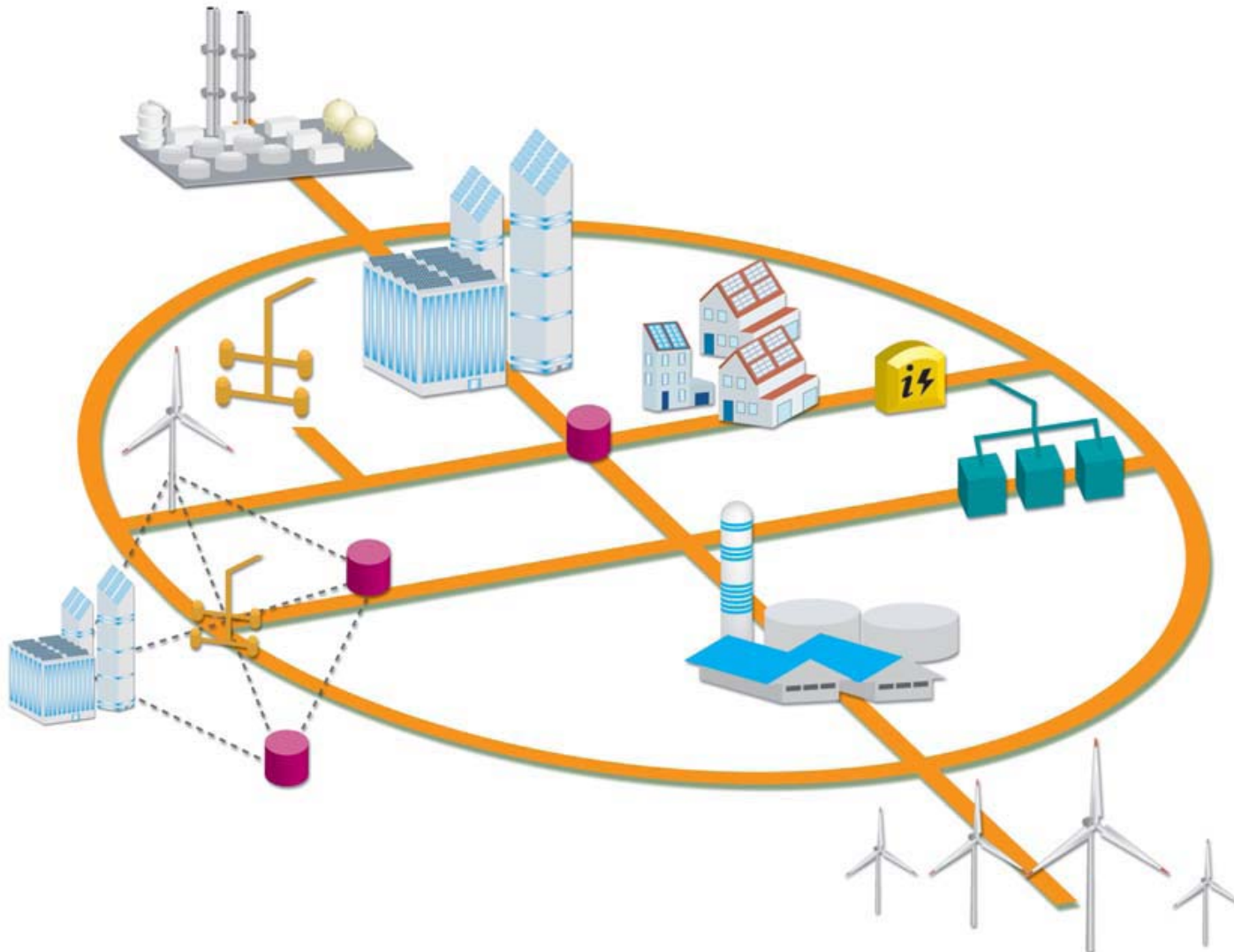
Transmission Issues



Security: Large Scale Integration of Wind

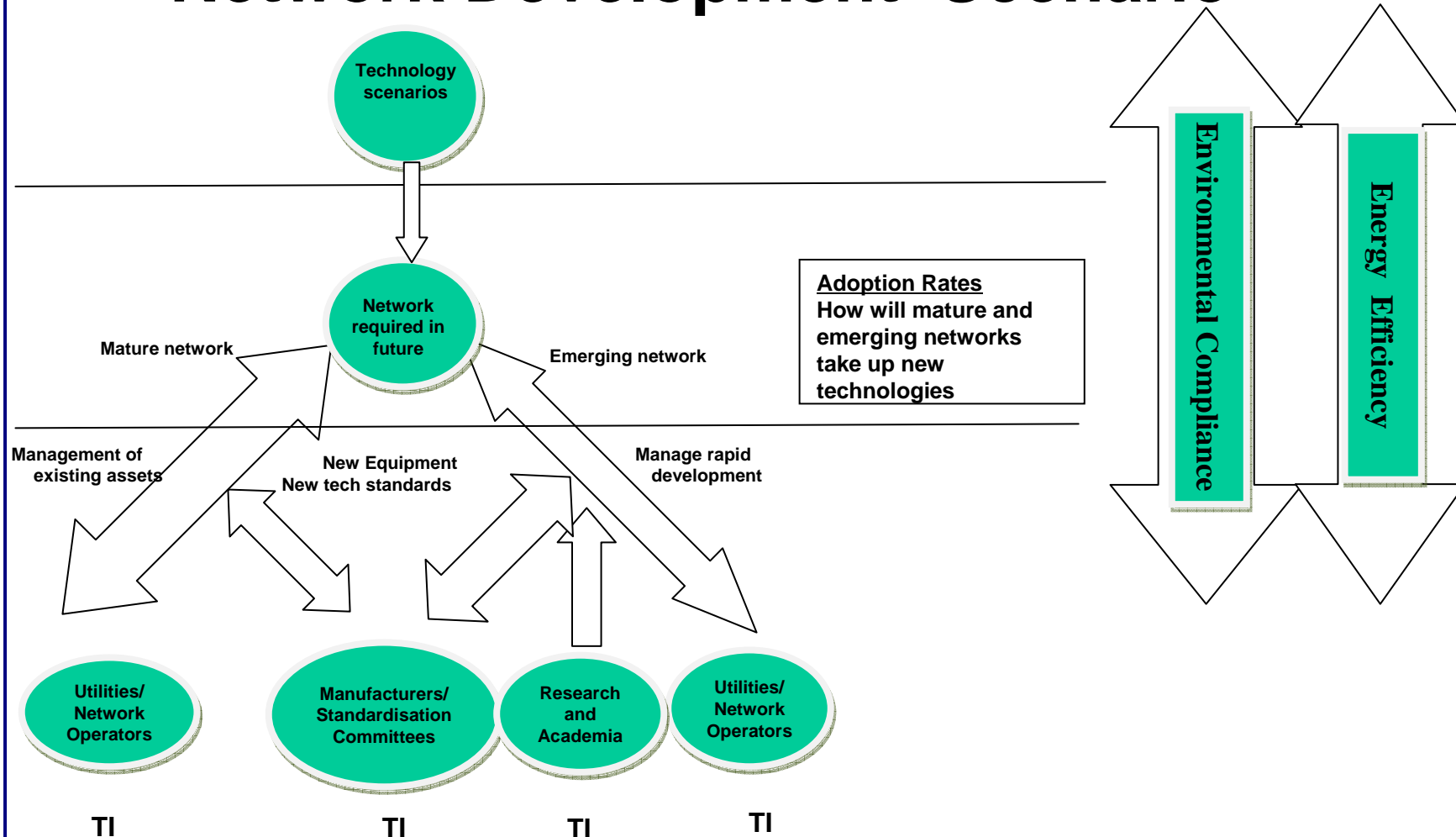


The Network of the Future



The Network of the Future

Network Development Scenario



Renewable Technology Outlook

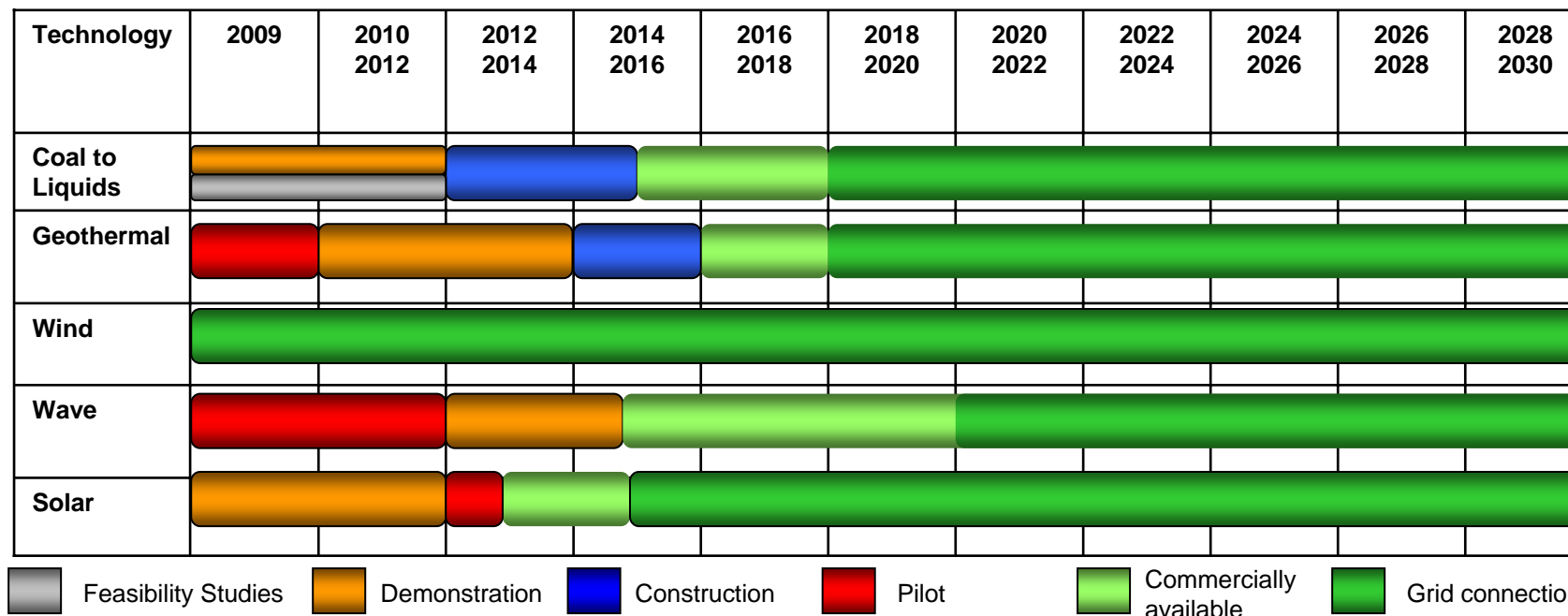


Renewable Energy Outlook for SA

- ❑ Co-operative PIRSA/ RESIC, SACOME and ElectraNet process during October/ November 2009 has resulted in two draft Information Papers...
 - Future Electricity Demand for South Australia's Resources Industry prepared by RESIC and SACOME
 - Future Electricity Infrastructure Requirements of South Australia's Resources Industry prepared by ElectraNet
- ❑ Papers explore the potential for renewable and mineral resource development in SA in period 2010 to 2030 and the resulting implications for electricity infrastructure
- ❑ Comments on the papers are welcome (copies of ElectraNet paper are available)

Renewable and Emergent Technology in SA

An optimistic view of timelines...



Coal to Liquids: Considered an emergent technology. The timeline combines multiple sources of the Coal to Liquids technology. Although some are currently available, most sources are in the study and demonstration phases throughout 2009. Some construction work will be required prior to grid connection being realised with expected completion around 2015. Grid connection is shown to commence as of 2018. Data based on Green Grid Initiative flyer and Justyn Peters' presentation.

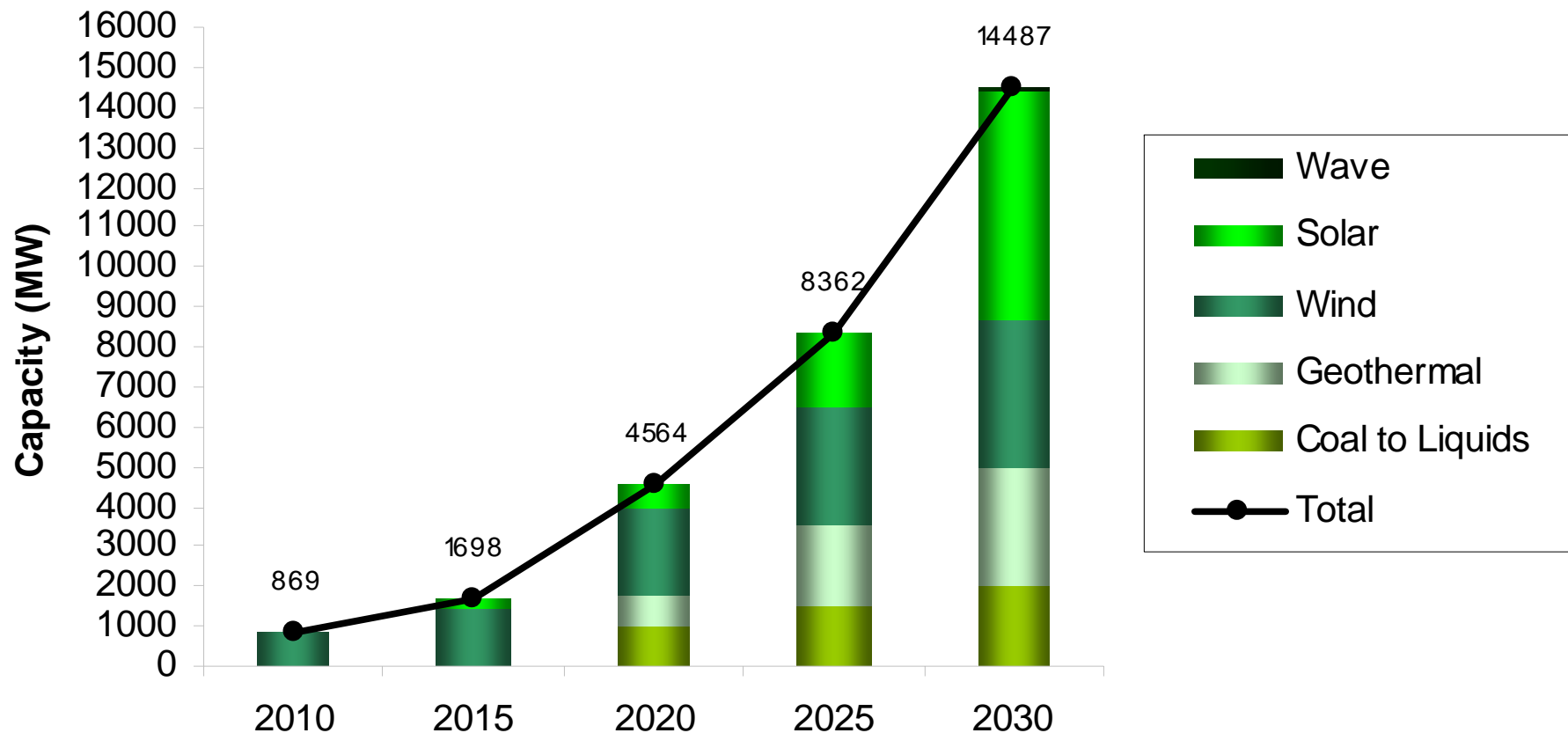
Geothermal: Grid connection is shown to commence in 2018 based on Section 2.3 of MMA memo regarding AGEA report; construction time frame is shown between 2014-2016 to allow for the establishment of required infrastructure (however the timing of this requires review as it would need to assume that the construction commences prior to completion of the demonstration phase – construction of a major transmission line requires 5 years minimum, the construction period represented is only two-years).

Wave: The NIEIR Future Prospects for Renewable Energy in SA Report indicates that this technology is unlikely to become a significant renewable energy source until post 2020.

Solar: The timeline combines both solar thermal and solar photovoltaic technologies. A project is currently underway in Whyalla which aims to produce 0.5MW by 2010.

Renewable and Emergent Technology in SA

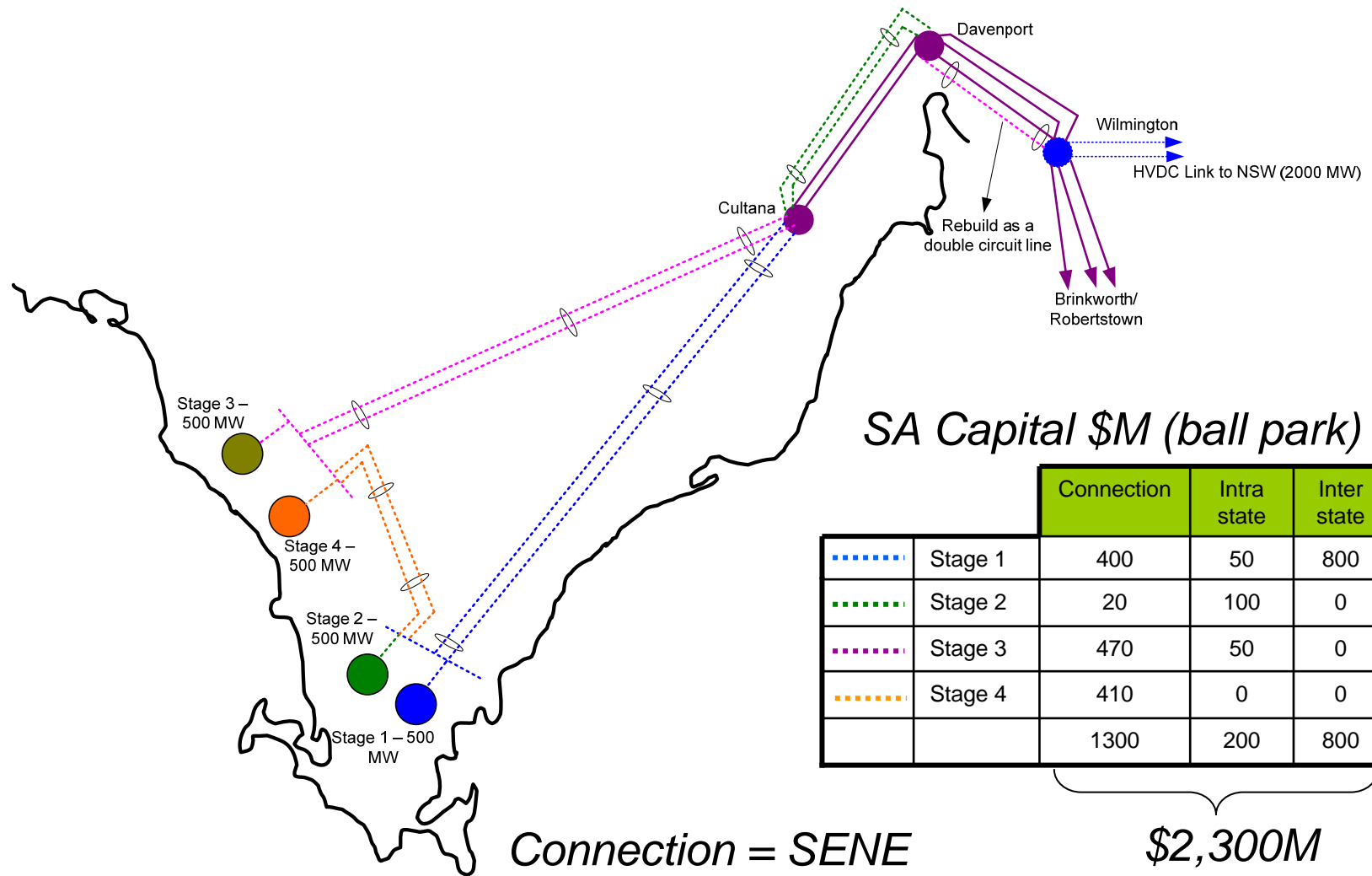
An optimistic view of forecast capacity...



Green Grid Perspective

- ❑ ElectraNet has held a number of preliminary discussions with the consortium
- ❑ Planning workshop with Worley Parsons scheduled for early December
- ❑ Given other committed and likely wind farm developments, even first stage of Green Grid (500MW) may require additional interconnector capacity to be viable
- ❑ Increased interconnector capacity must pass Regulatory Investment Test (economic test) to be funded by electricity consumers
- ❑ Land and easement acquisition, planning approval, construction and commissioning for new lines takes around 5 years

Eyre Peninsula SENE (Green Grid)



Scale Efficient Network Extensions (SENE)

- ❑ AEMC proposed new SENE framework is intended to capture economies of scale
- ❑ Thus may provide the opportunity to connect clusters of generators to the transmission network that would not otherwise be economic
- ❑ However, timings and processes proposed by AEMC are unlikely to see first proposal approval until end of 2012 with two or more years construction period (2015 most likely)

Example of Scale Efficient Extensions

Option	Description	Normalised Cost per Connection
1	4 x 132 kV single circuits	1.0
2	2 x 132 kV double circuit lines	0.69
3	2 x 275 kV single circuits	0.68
4	1 x 275 kV double circuit line	0.5

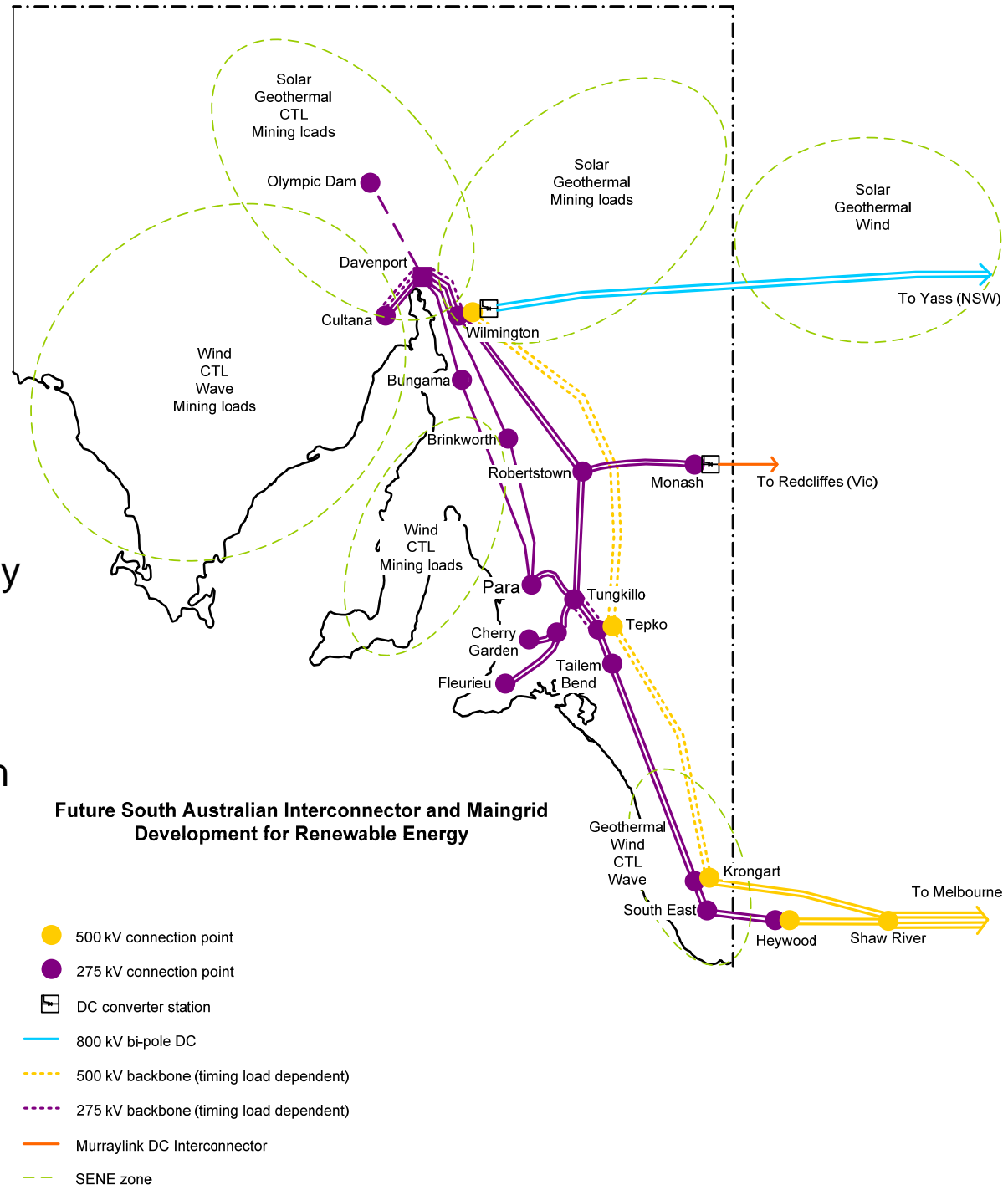
Assumptions:

- ❑ Each extension option caters for 4 wind farms of 125 MW capacity each
- ❑ Line length of each extension is 100 km
- ❑ Substation connections are meshed bus for 132 kV and 1.5 CB for 275 kV

Possible Future View at 2030

A conceptual view of what expanded network could look like in 2030 to maximise renewable energy developments in SA

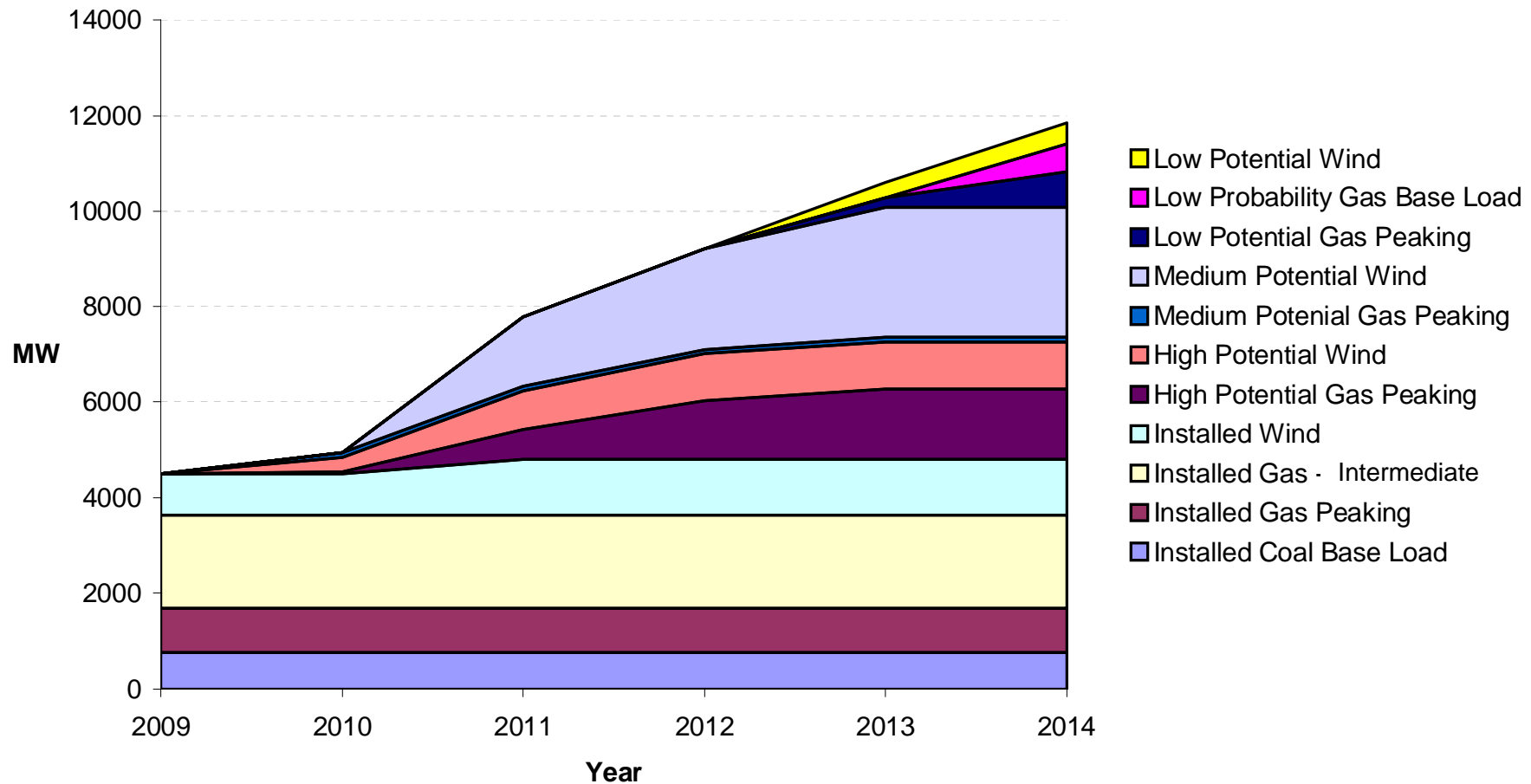
Note potential Scale Efficient Network Extension (SENE) zones



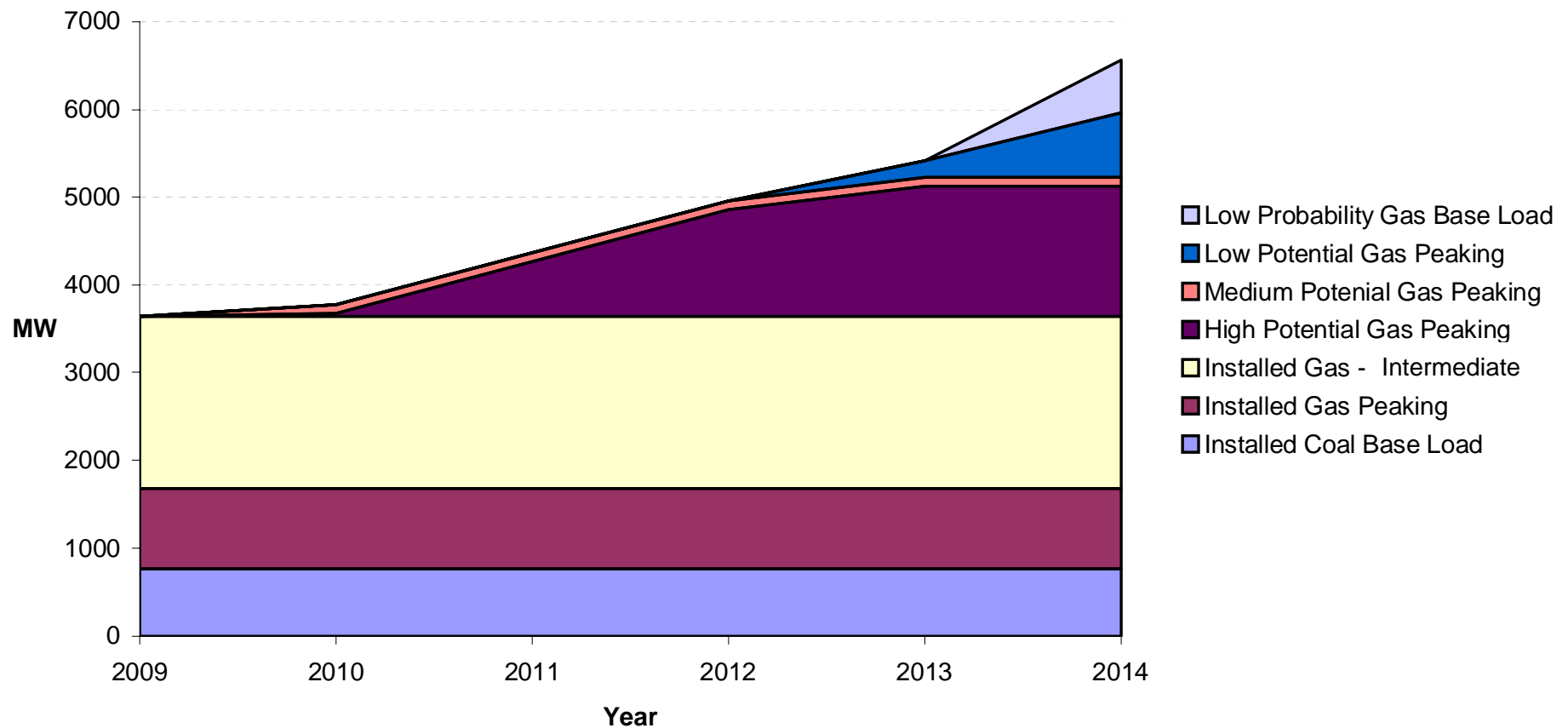
Concluding Messages

- ❑ ElectraNet is actively engaged in industry working groups and studies to support the development of renewable and other forms of energy options
- ❑ Additional interconnector capacity will be required in the medium term to facilitate the potential for generation development
- ❑ ElectraNet intends to commence a feasibility study to investigate the potential for additional interconnector capacity early in 2010

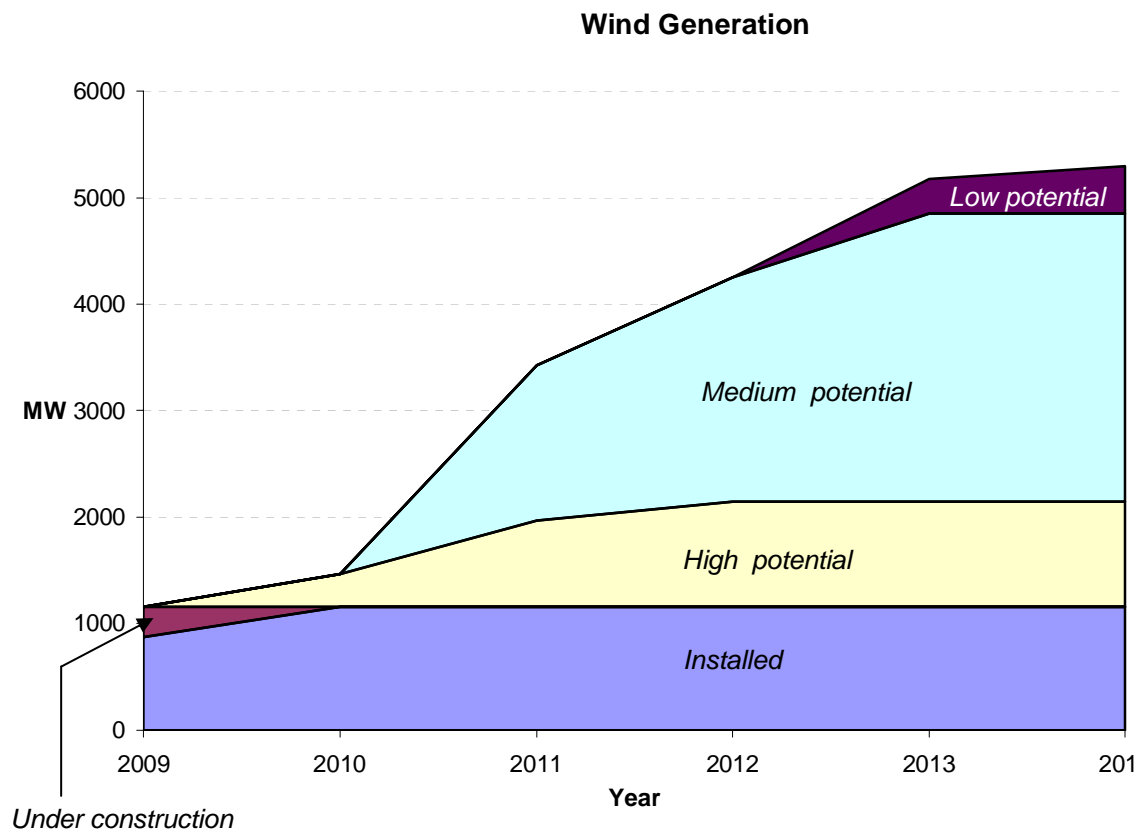
SA Generation Summary - Potential



SA Generation excluding Renewables - Potential



Wind Generation - Potential



- ❑ 9 connected Wind Farms in SA
- ❑ 2 connections under construction
- ❑ 20 known Short to Medium Term projects, including 6 wind farm connection applications currently being processed
- ❑ Circa 60 other long term wind projects identified (not included in this graph)

Outlook – Geothermal

- ❑ Has “base load” generation characteristics (i.e. potentially high capacity factor)
- ❑ Resources are generally remote from transmission network and load
- ❑ Predicted energy cost is relatively low compared to other renewable sources
- ❑ Earliest grid connected commercial production is probably approximately 10 years away
- ❑ AGEA Study shows significant “customer benefits” but negative “market benefits” and cannot therefore be funded via end use customers (TUOS)

Outlook – Wind

- ❑ Represents approximately 36% of RECs created
- ❑ Proven technology
- ❑ 869 MW of existing wind with another 289MW committed and another 800MW likely
- ❑ Capacity factor of about 32% in SA
- ❑ Output does not align well with SA peak demand – only 3% of capacity can be counted on at peak demand times
- ❑ Remote to load but to date locating close to transmission network
- ❑ Expanded connections through SENE possible

Existing Wind Generation in SA

Existing Wind Farms	Network	Region	Capacity (MW)
Mt Millar	ENet	Eyre	70
Cathedral Rocks	ENet	Eyre	66
Wattle Point	ENet	Mid North	90
Snowtown	ENet	Mid North	98
Brown Hill (Hallett)	ENet	Mid North	94.5
Hallett Hill	ENet	Mid North	72
Clements Gap	ENet	Mid North	58
Star Fish Hill	EU	Adelaide	34.5
Lake Bonney	ENet	South East	240
Canunda	EU	South East	46
Total			869

Committed and Likely Wind Generation

Committed Wind Farms	Network	Region	Capacity (MW)
North Brown Hill	ENet	Mid North	133
Waterloo	ENet	Mid North	117
Lake Bonney 2A	ENet	South East	39
Total			289

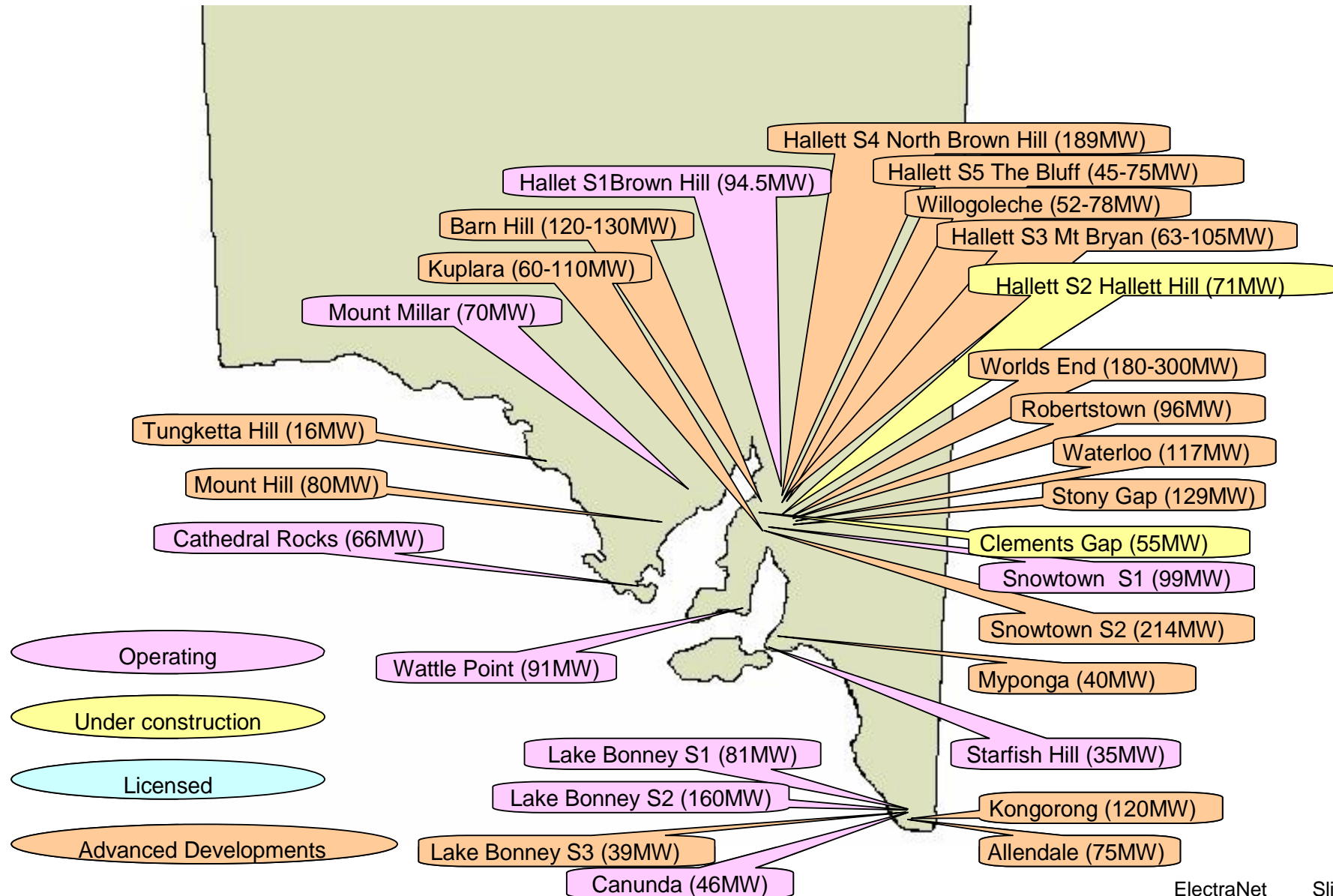
Within three years ...

Likely Wind Farms	Network	Region	Capacity (MW)
Eyre	ENet	Eyre	177
Mid North	ENet	Mid North	173
South East	ENet	South East	450
Total			800

Total = 1958 MW (existing, committed and likely)

Wind Projects Summary – mid 2009

(Since then, another 1100MW have made enquiries)



Outlook – Solar PV

- ❑ Represents approximately 4% of RECs created
- ❑ Well proven technology
- ❑ PV capacity factor of about 18%
- ❑ Good alignment of power output to SA summer but not to peak times
- ❑ Solar PV at residential/ light commercial end of market (i.e. embedded/ small unit scale)
- ❑ Solar PV is relatively expensive
- ❑ Australian household PV penetration of 0.2% vs >3% in some European countries and Japan
- ❑ Ultimate energy contribution probably less than 10%

Outlook – Solar Thermal

- ❑ Solar thermal provides possible larger scale energy source
- ❑ Good power output alignment to SA summer peak
- ❑ Technology has been proven overseas
- ❑ Commercial production could happen by 2015
- ❑ This technology is likely to go ahead

Outlook - Nuclear

- ❑ Current Generation III technology has efficient unit capacity of around $\approx 1000\text{MW}$
- ❑ Largest single generating unit in South Australia is 280MW and 750MW Australia-wide
- ❑ Unacceptable system security risk for large scale unit of that size in South Australia
- ❑ Generation IIIA and Generation IV technologies may be more efficiently sized at around 250-300MW
- ❑ Generation IIIA and Generation IV are in development and concept phases with timing expected around 2020 or later
- ❑ Deployment in Australia (excluding policy issues) would be unlikely prior to 2030

Energy Storage

- ❑ All current commercial renewable technologies except hydro are intermittent in production
- ❑ SA is a great candidate for energy storage given load factor
- ❑ Current energy storage technologies are expensive
- ❑ Energy storage could would provide opportunity for increased intermittent renewable generation
- ❑ May cause increased displacement of fossil generation
- ❑ Worth exploring further