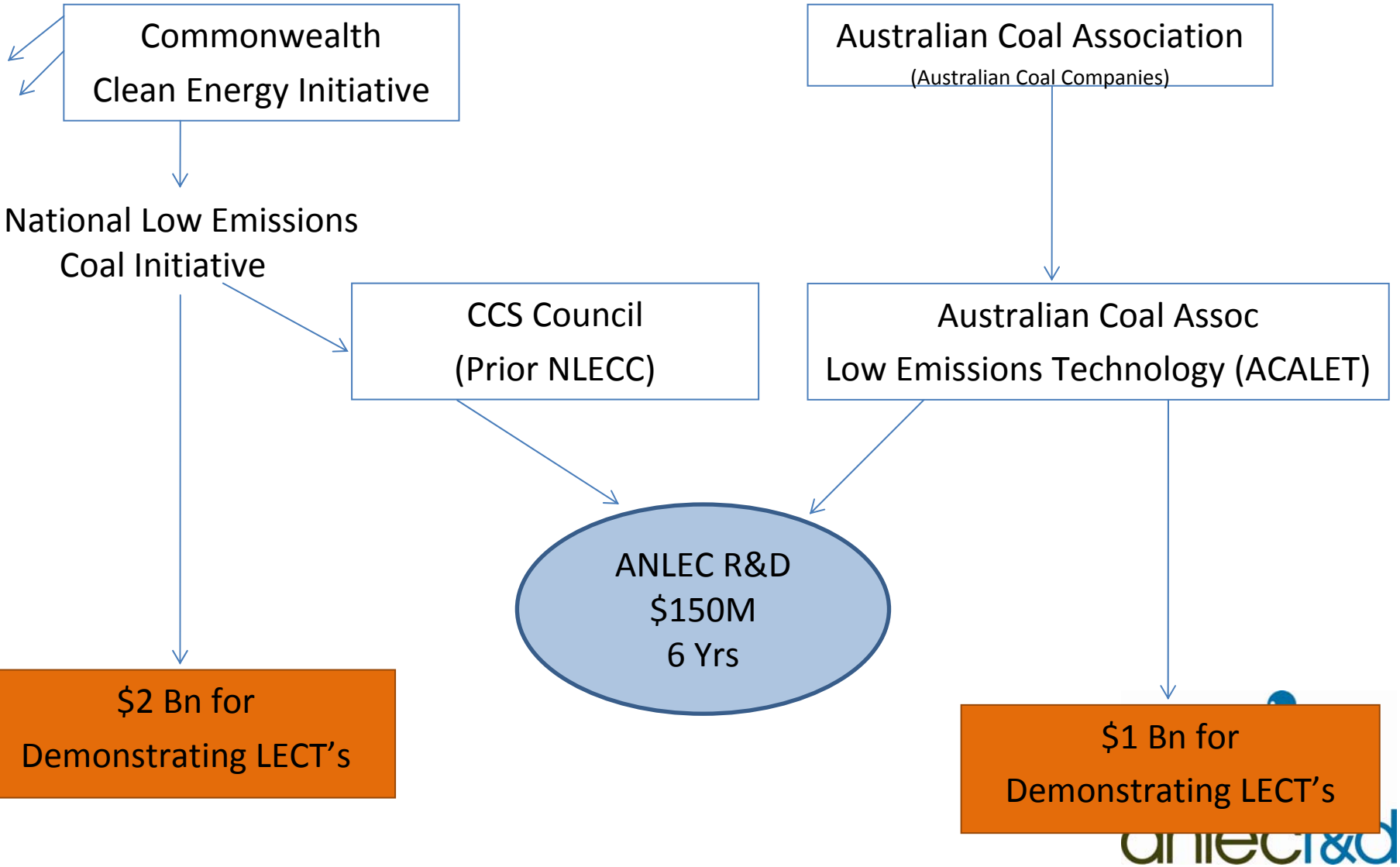
Australian National Low Emissions Coal R&D

Dr Noel Simento

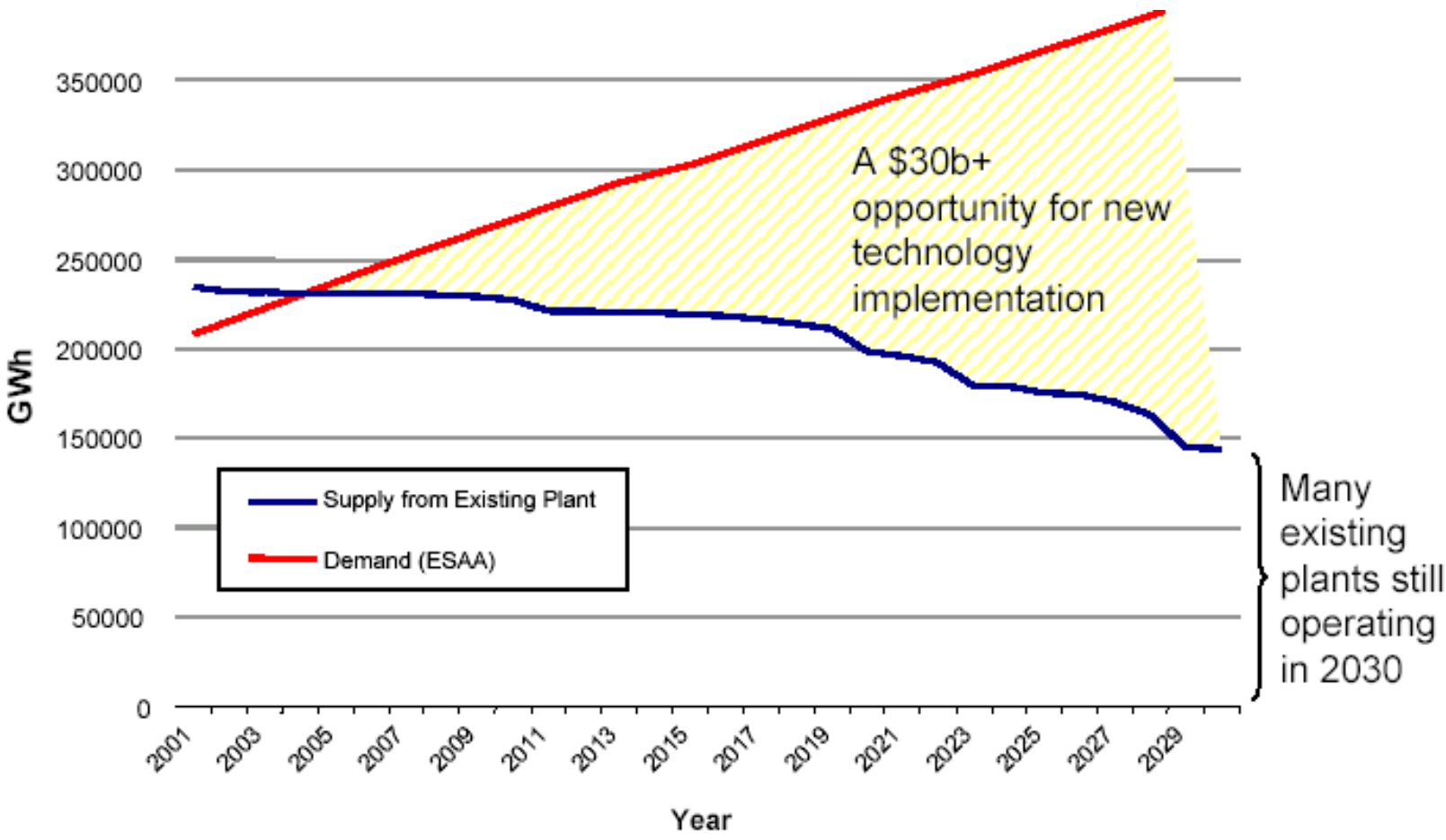
Australia- Japan Coal Technology Workshop March 2011

anlecr&d

ANLEC R&D - Commenced Activities March 2010

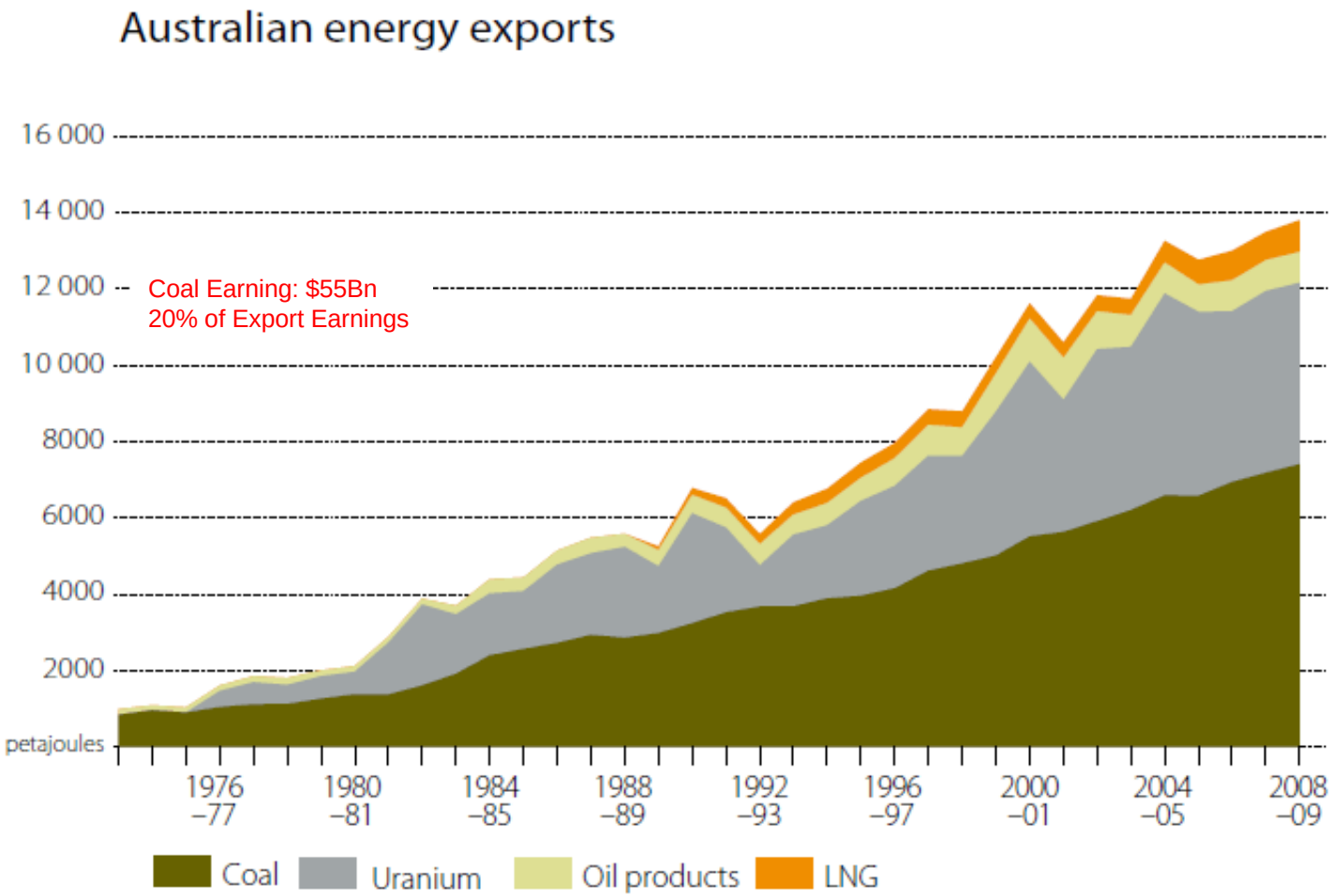


Australian Electricity Supply & Demand



anlecr&d

Low Emissions from Coal to Support Australian Markets



Source: ABARE

anlecr&d

Relative Costs

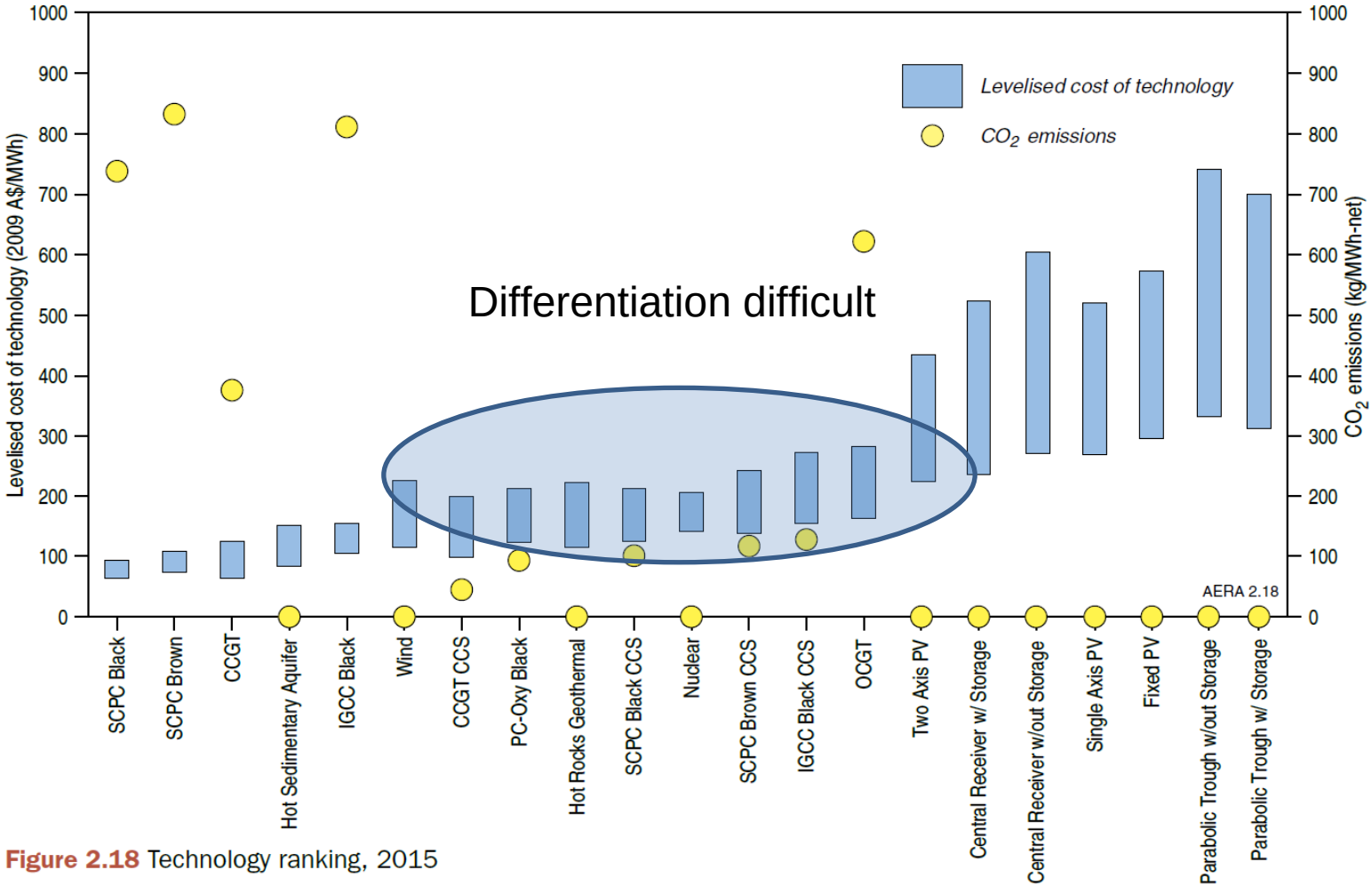


Figure 2.18 Technology ranking, 2015

Source: EPRI technology status data, 2010

anlecr&d

Prospective Demonstration CCS Projects

Project	Technology	Partners	Details
Callide Oxy-fuel Project	Oxy-fuel	CS Energy, IHI, JPower, Mitsui, Schlumberger, Xstrata	www.callideoxyfuel.com
Wandoan Power/CTSCo	IGCC+CCS	Stanwell Corporation, GE Energy,Xstrata	www.wandoanpower.com.au
CarbonNet CO_2 Hub	CO_2 Storage	Department of Primary Industry, Victoria, HRL, TruEnergy, Loy Yang Power, Schlumberger, MHI, Southern Company	
South West Collie Hub	CO_2 Storage	Dept of Mines and Petroleum, WA, Griffin Energy, Verve Energy, BHP Billiton Worsley Alumina, Wesfarmers Premier Coal, Perdaman Chemicals and Fertilisers, and Alcoa Australia	http://www.dmp.wa.gov.au/9525.aspx
Delta PCC	PCC+CCS	Delta Electricity, NSW	
ZeroGen*	IGCC+CCS	Zerogen Pty, MHI and others	http://www.zerogen.com.au/

*Project undergoing significant change

anlecr&d

ANLEC R&D Objectives

- The near term risk reduction and technology developments necessary for successful demonstration of LECT in Australia.
- Support for and investigation of issues affecting the performance of the early demonstration projects.
- The delivery of independently validated, data and knowledge to assist key stakeholders understand benefits and assess the real risks associated with the deployment of CCS in Australia.

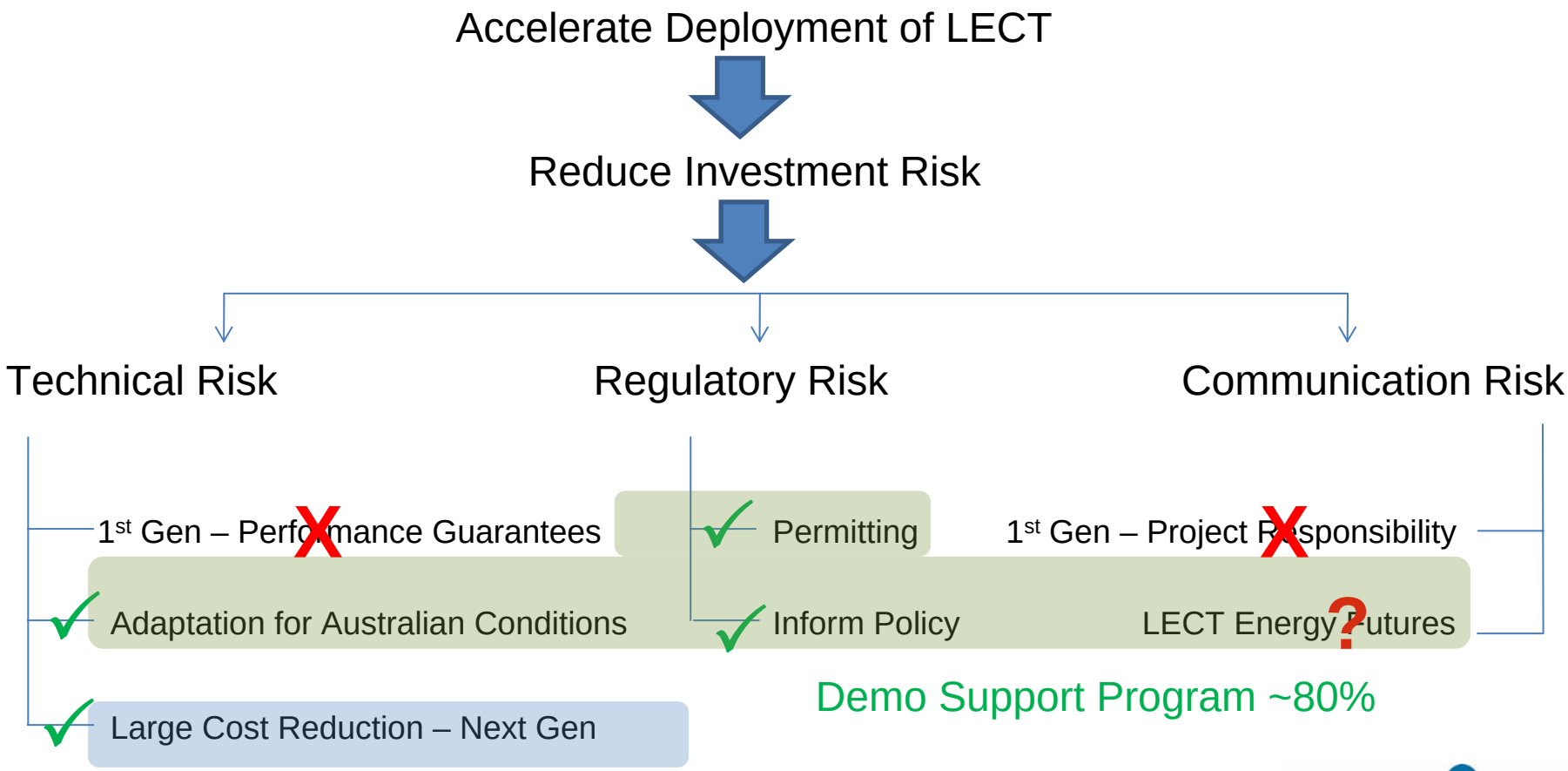
anlecr&d

Areas of Coal to Power Interest

- ✓ Advanced Brown Coal Technologies
- ✓ Carbon Dioxide Transport and Storage
- ✓ Integrated Gasification Combined Cycle (IGCC)
- ✓ Oxy-Fuel Combustion
- ✓ Post Combustion Capture (PCC) of CO_2
- ✓ Techno-Economic Analyses for Low Emissions Energy from Coal

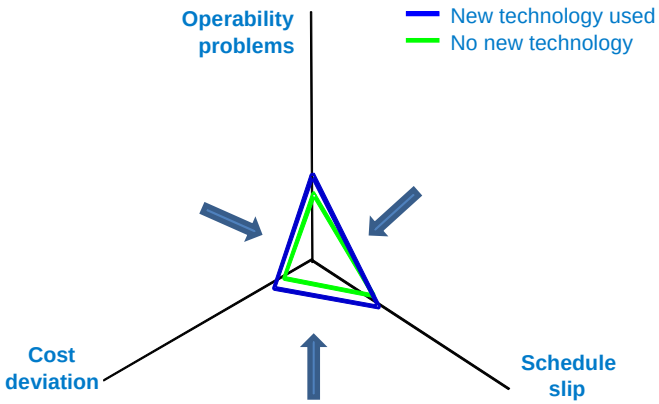
anlecr&d

ANLEC R&D Objectives



anlecr&d

Objectives - Surface



Reduce Project risk and increase likelihood of success

- Validation and Reporting of Performance
- Bi-products and Emissions
- Managing Variability - In-line coal analysis
- Dynamic Simulation
  - IGCC Plant + Pipeline + Well Field + NEM
- Flow sheet modelling
- Supplementary Fuel
- Community Engagement
- Water usage efficiency
- Options for low S coal
- Catalyst Optimisation
- Materials
- CO_2 System Optimisation
- CO_2 dispersion modelling

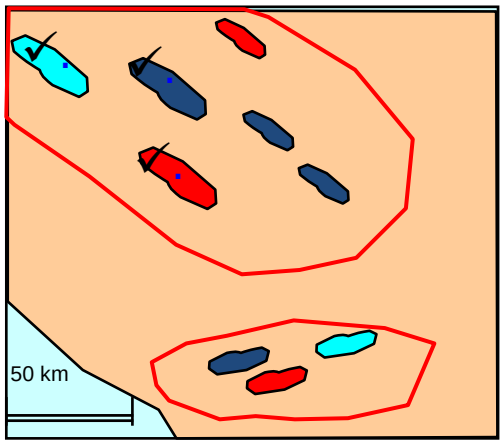
Important to integrate Knowledge Transfer and R&D into Demo program

anlecr&d

Objectives - Subsurface

Reduce Project risk, provide independently verified tools and procedures

Viable Options



- Storage Capacity Estimation
  - Measurement and estimation
  - Resource conflicts
  - A best practice "how to"
- Fate of CO2 in the Ground
  - Trapping mechanisms
  - Leakage studies
- Monitoring, Measurement & Verification
  - 'fit for purpose' and not 'over the top' MMV

Important to integrate Knowledge Transfer and R&D into Demo program

anlecr&d

Environmental Permitting

anlecr&d

Environmental impacts of amine based CO_2 PCC processes

Objective: Provide detailed assessment of the nature of degradation products from liquid absorbents for PCC

- Develop mass balance and life cycle analysis of candidate liquid absorbents when used in PCC
- Determine the fate of PCC emissions into the atmosphere
- Develop a protocol for evaluation of liquid absorbents for use in PCC
- Carry out analysis of legislative, regulatory and permitting requirements for the use of PCC in Australian power stations

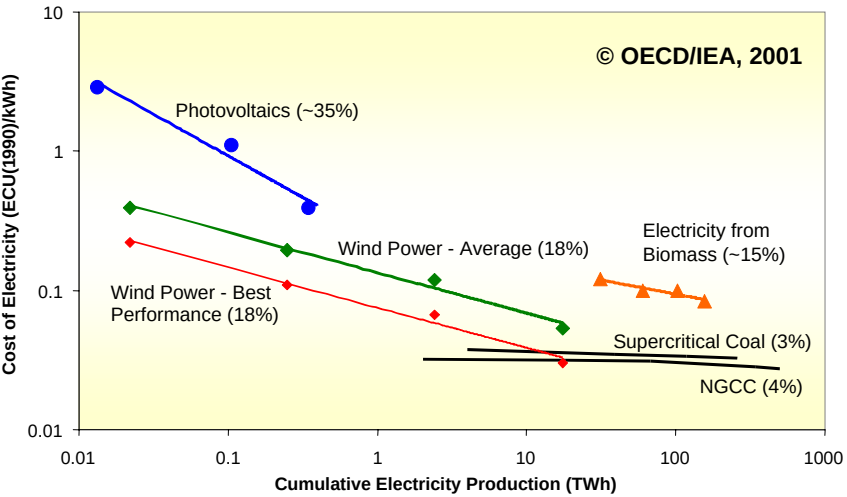
anlecr&d

Mitigation of resource conflicts for CO_2 storage

- **Objective: To identify the potential impacts of carbon storage on water, and other resources at each of the four flagship CCS sites**
- Provision of baseline information and analyses is a critical step in identification and mitigation of risk.
- Determines the extent of required site characterization, and input to the appropriate design of monitoring and verification of CO_2 storage
- Outcome of the study:
  - identification of all important conflicting resources for CO_2 storage
  - compilation of existing water level and water chemistry data and
  - a comprehensive monitoring program for detection of changes in groundwater levels and chemistry for each site.

anlecr&d

COST REDUCTION



anlecr&d

Low cost hybrid capture technology development

Objective: Test the cost reduction potential of a hybrid process (adsorption + solvent scrubbing)

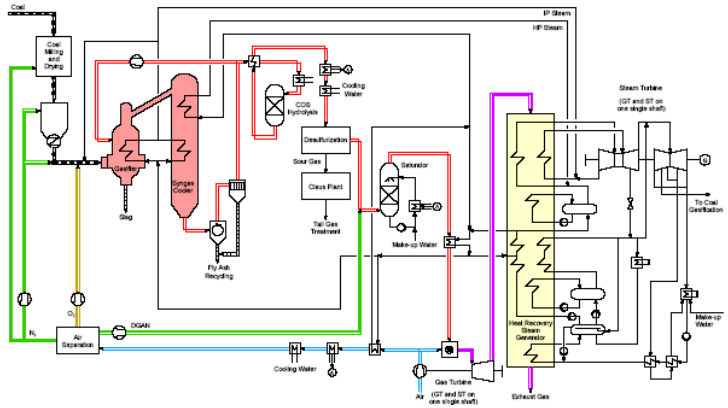
- Will investigate the use of low energy adsorption for initial enrichment
- Removal of contaminants can be integrated into the adsorption process to prevent downstream issues with solvent scrubbing
- The effect of operating variables such as enrichment on power requirements of both stages is unknown
- Examination of hybrid capture processes is still in its infancy

anlecr&d

Precipitating Systems for Solvent CO2 Capture

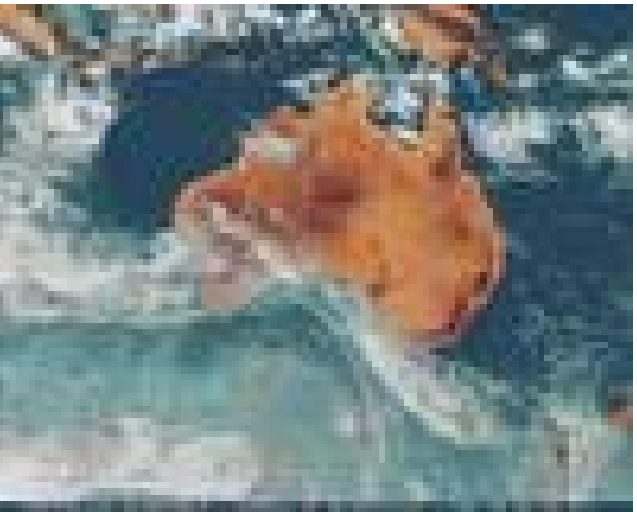
Objective: Uses super saturation conditions to re-examine effectiveness of CO_2 capture with carbonate solvents

- Preliminary assessment suggests there would be many benefits thermodynamically if the system were allowed to form a precipitate
- Potential 25% reduction in energy requirement available
- Degradation effects of NOx and SOx to be determined



anlecr&d

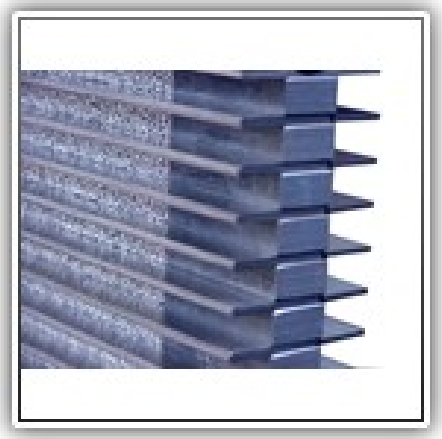
ADAPTATION for AUSTRALIA



anlecr&d

Metal foam heat exchange for dry cooling

- **Objective: Tests for “step-reduction” opportunities for water demand reduction to the IGCC process**
- Addresses alternative to finned-tubes with a class of porous materials called metal foams
- Initial with forced air systems, but metal foams also potentially open the way for dry natural draft cooling towers
- Air heat exchangers will be a reality in the IGCC configurations and requires examination for improved efficiency



anlecr&d

IGCC Solids disposal and utilisation

Objective: To understand the important issues that may impact on solid by-product utilisation or disposal

- Reviews legislation and regulations relevant to handling, storage, utilisation, and disposal of IGCC by-products
- Laboratory-based program where existing samples will be assessed to identify issues that may impact on solid by-product utilisation or disposal
- Planning for demonstration relevant sample acquisition schedule if required

anlecr&d

Storage –OTWAY Stage 2

Objectives: To complete investigating residual saturation processes using the Huff-n-Puff (inject/soak/back-produce) CO2 injection testing method.

To demonstrate that injection in an unconfined aquifer is safe and can be monitored reliably, CO2 is residually trapped

Otway stage 2B/2C one of the few opportunities to get real data

- Reduce uncertainties in accessing potential storage sites thus expediting demonstration project development cycle
- Allow demonstration projects to perform exploration and appraisal programs
- Increase the overall body of knowledge of key issues facing CO2 injection in saline aquifers
- Understand injection effects in saline aquifers

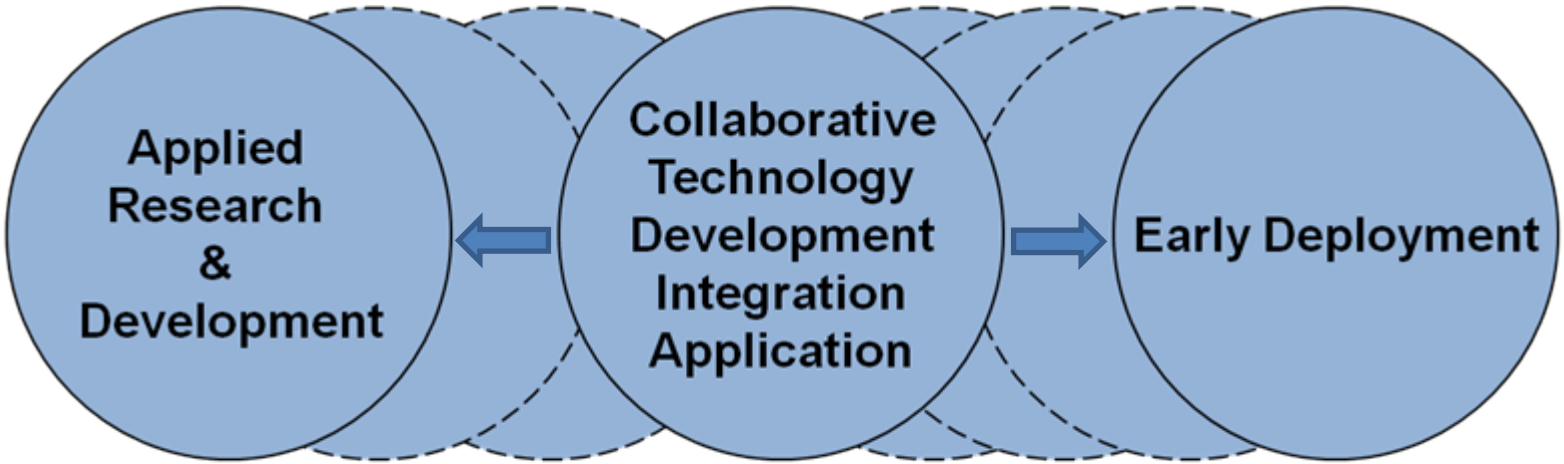
anlecr&d

Conclusions

- Very important for ANLEC R&D to execute a needs driven R&D program to assist demonstration projects
  - to link with national / international R&D programs
  - to engage Demos and Vendors
  - to use the best researcher for the task
- Building a flexible R&D program that can respond to changing circumstances

anlecr&d

ANLEC R&D Role



- Adapt and apply for Australian conditions
- Strong focus on advancing the near term deployment of CCS
- Strong support for an open transparent process for selecting needs-driven R&D, which supports first-of-a-kind demonstrations

anlecr&d

Thank you

Dr. Noel Simento
Acting Managing Director
PO Box 536, Civic Square, ACT 2608, Australia
T +61 2 6175 6400 | E noel.simento@anlecrd.com.au