ANLEC R&D

Low Emissions Coal Research and Development in Australia
Background

Australia
- Population – 21.5 M
- GDP (PPP) – $ 0.82 T
- Generating Capacity – 47GW
- Coal % Generation – 84%
- Coal mined – 435 M st
- Coal exports – 287 M st
- Coal % total exports – 19%

USA
- Population – 310 M
- GDP (PPP) - $14.26 T
- Generating Capacity - 1,100GW
- Coal % Generation – 48.5%
- Coal Mined – 1.1 B st
- Coal exports - 59 M st
- Coal % Exports – 0.4%

Source: ABARE, EIA, CIA world handbook, www.census.gov
Context – Kaya Identity

Derived by Japanese energy economist Yoichi Kaya as a formula for calculating human-based CO2 emissions:

\[ F = P \times \frac{GDP}{P} \times \frac{E}{GDP} \times \frac{F}{E} \]

where

– \( F \) is global CO2 emissions from human sources,
– \( P \) is global population,
– \( GDP \) is world GDP and \( \frac{GDP}{P} \) is global per-capita GDP,
– \( E \) is global primary energy consumption and \( \frac{E}{GDP} \) is the energy intensity of world GDP,
– and \( \frac{F}{E} \) is the carbon intensity of energy.
Options available

1. Decrease population (P)
2. Decrease standard of living (GDP/P)
3. Decrease energy intensity (E/GDP), e.g., via higher efficiency processes
4. Decrease carbon intensity (F/E), e.g., low CO2 emission power sources
Constraints

\[ F = P \times \left( \frac{GDP}{P} \right) \times \left( \frac{E}{GDP} \right) \times \left( \frac{F}{E} \right) \]

Options to decrease emissions by 70% from 2010 levels by 2050

- \[ 0.3 = 0.74 \times 0.74 \times 0.74 \times 0.74 \]
- \[ 0.3 = 1.5 \times 0.58 \times 0.58 \times 0.58 \] (1%/yr population growth)
- \[ 0.3 = 1.5 \times 2.2 \times 0.3 \times 0.3 \] (2%/yr GDP/P growth)
- \[ 0.3 = 1.5 \times 2.2 \times 0.8 \times 0.11 \] (20% efficiency improvement)

Even greater reductions likely required in developed world

Even greater reductions likely required from stationary energy

This will require a fundamental transformation of the Energy system – effectively a new industrial revolution
Low Emissions Coal R&D

- Meaningful action on climate change will require near zero emissions from the stationary power sector mid century
- In the absence of unified global action it is unlikely that any country will unilaterally impose a sufficiently high CO2 price to incentivise near term commercial LECT deployment
- To date global policy frameworks developed to enable demonstration projects have not adequately addressed the economic penalties associated with LECT or sufficiently addressed the allocation of investment risk
- The commercial value chain is poorly understood and it is difficult to appropriately allocate risk and reward between the different components of the project

Reducing uncertainty is critical to successful near term demonstration
Reducing costs is critical to ultimate deployment
National Low Emissions Coal Council

- Develop and implement a national low emissions coal strategy
- National strategy will cover the research and development, accelerated demonstration and early commercial deployment
- Demonstration at commercial scale from 2015 and available for commercial deployment by 2020

ANLEC R&D

- Implement a national program for low emission coal research and development to address research priorities identified in the NLECC strategy
- Applied R&D to help reduce project risk, provide independently validated cost and performance data, and identify research priorities to accelerate deployment
- Focus on R&D to assist 2015 to 2020 demonstration projects
- $75M funding from Commonwealth and $75M from ACALET
- Funding Agreements signed in March 2010
**‘STRATEGY DIAMOND’ FRAMEWORK**

**How will we Create Value?**
- Inform decisions
- Provide options
- Reduce Risk enabling faster technology cycles

**How will we win?**
- Unique assets?
- Unique capabilities?
- Other?

**Where will we be active?**
- Core technologies?
- Timeframe?

**How will we get there?**
- Funding models?
- Engagement model?
- Review Process?
- Partnerships?
- International?

**What will be our speed and sequence of moves?**
- Spending Profile?
- Project Sequence?

**How will we be active?**
- Core technologies?
- Timeframe?

- Funding models?
- Engagement model?
- Review Process?
- Partnerships?
- International?

Source: Hambrick & Fredrickson, “Are you sure you have a strategy?” modified for R&D application
Economic Logic

• Export Coal Industry
  – Enable coals contribution to greenhouse abatement
• Commonwealth / State Governments
  – Build a portfolio of low carbon power options
• Power Industry
  – Maintain coal option
• Demonstration project proponent
  – Maximise chance of project success

Common driver – successful early demonstrations
Arenas

• Coal to Power
• Demonstrations in the 2015 to 2020 timeframe

Focus on first generation – success is critical
Differentiators

• Adapt and apply for Australian conditions
• Build on world class subsurface expertise
• Accelerate knowledge transfer between R&D and demonstration

ANLEC R&D focus

Australia will remain a power generation “technology taker”
Vehicles

• Embedded demonstration technology managers
• Independent science leaders
• Flagship driven project selection process
• Proof of concept funding for alternative and enabling technologies
• Technology based review process
• International collaboration
• Best researcher for the job
Increased application focus as flagship feedback becomes available
Funding becomes more targeted as flagship projects develop
Research Programs

1. Economics, Modelling & Reviews
2. Alternatives / Fundamentals
3. Brown coal R&D
4. PCC
5. Oxyfiring
6. IGCC + CC
7. Geosequestration

Links to other organisations

Board / Chairman
MD / CEO
Research Manager
Early Projects

- Alternatives and Fundamentals
  - RFP - $40M in applications for $5M in funds

- PCC
  - Environmental Impacts of Amine based Post-Combustion Capture Processes

- IGCC
  - Dynamic Behaviour and Environmental Impacts of IGCC

- Oxy-Fuel
  - Gas quality impacts, assessment and control in oxy-fuel technology for CCS

- Geosequestration
  - Residual Trapping in Saline Aquifers

- Economics and Modelling
  - Policy Incentive Mechanisms

- Brown Coal
Facilitating applied R&D to enable successful near term LECT deployment

Integrate R&D and early mover “flagship” and demonstration projects to drive R&D program that:
- Produces data, knowledge and capability that reduces the risk of LECT of development and deployment
- Enables optimisation and adaption of LECT for Australian fuels, geology, environment and market

Integrated set of Strategic Actions to deliver Operating Model
1. Embedded flagship technology managers
2. Independent science leaders
3. Transparent flagship driven project selection process
4. Proof of concept funding for alternative and enabling technologies
5. Transparent project review process
6. International collaboration
7. Transparent process for selecting the best researcher for the job