



New generation coal technology

Presentation to

2008 Gasification Technologies Conference

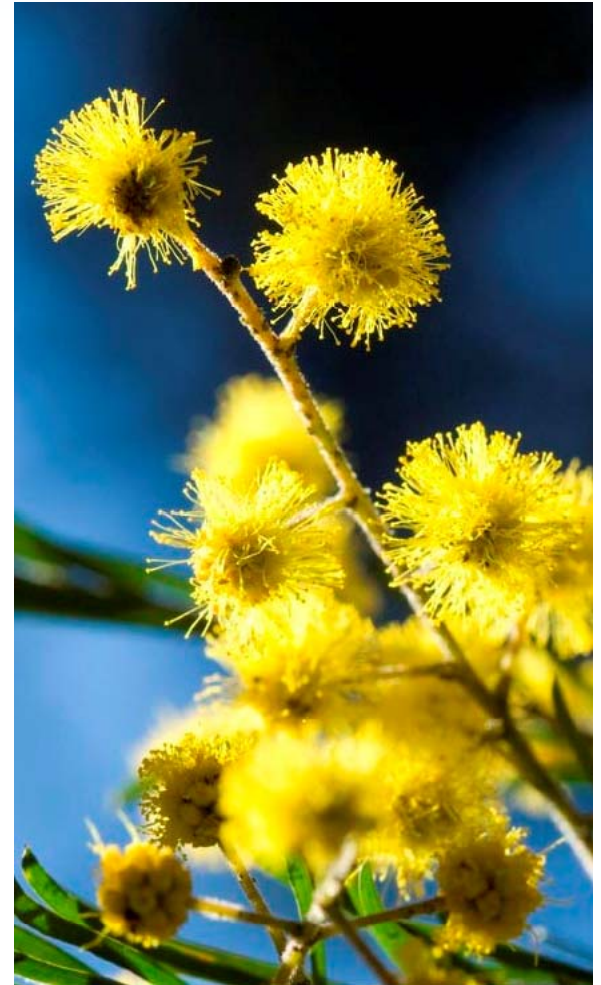
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6 October 2008



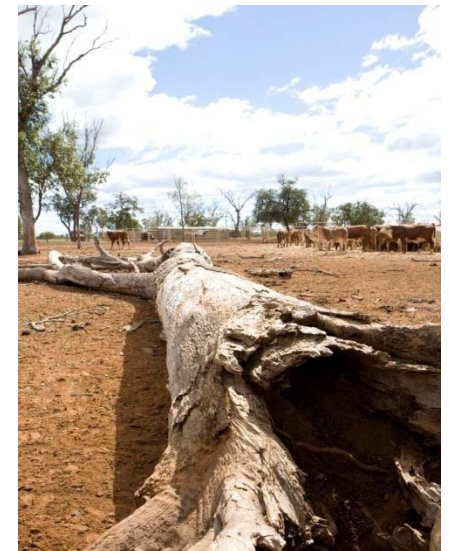
Presentation outline

1. The Australian context
2. ZeroGen Project
3. Stage One
4. Stage Two
5. Challenges to deployment
6. Summary



The Australian context

- 80,000 million tonnes of black and brown coal reserves*
- Australia's coal industry worth \$A24.5 billion (2005-06) in exports and supports 130,000 jobs*
- 80% of Australia's coal is exported*, world's largest exporter
- Approximately 84% of power from coal*
- High GHG emissions per capita
- Deregulated electricity market
- National emissions trading scheme for introduction in 2010
- No onshore OEMs for major components
- High electricity-dependent value adding industries



*Australian Coal Association

Low-emission coal technology

Drivers

- Contribute to global efforts aimed at mitigating climate change by making deep cuts in greenhouse emissions, in particular from coal-based power generation
- Preserve Australia's coal industry
- Start the journey towards a hydrogen economy
- Develop specialist skills and expertise in the technology that are in global demand
- Generate flow-on, value-added investments and jobs in Queensland and Australia
- Reduction in CO₂ emissions compared to traditional coal and gas fired power generation

Areas of focus

- Plant control
- Plant availability/reliability
- Capital cost
- Cost of electricity
- Water usage
- Efficiency



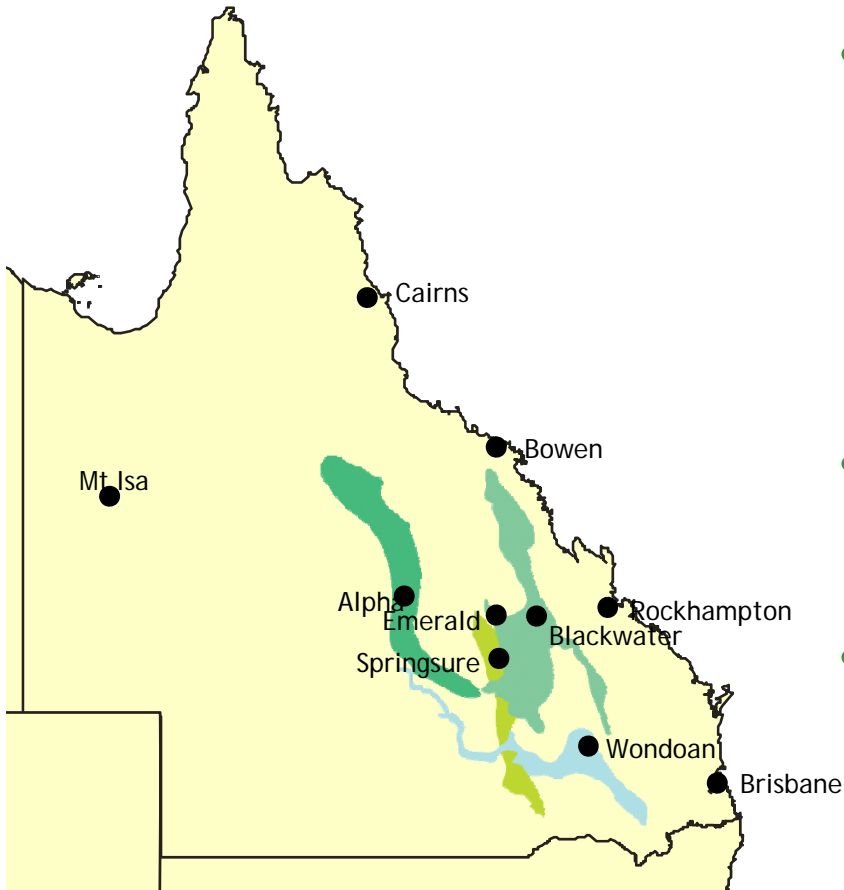


ZeroGen Project

ZeroGen Project



- **Location:** Queensland, Australia
- **Current structure:** owned by Queensland Government
- **Technology approach:** IGCC with CCS



- **Timeline:**
Stage One - 120MW gross in 2012
Stage Two - 450MW+ gross in 2017

Stage One learnings to accelerate commercial-scale development
- **Substantial industry support:**
Australian Coal Association (ACA); Shell
- **Substantial NGO support:**
WWF Australia; CFMEU; AgForce Queensland; Climate Institute

ZeroGen's mission



- Demonstrate new technology, low emissions coal fired power generation
- Deploy low-emission coal-fired power generation plants at commercial-scale
- Commercialise ZeroGen on a global scale

Accelerating commercial-scale deployment



- Request by ACA for ZeroGen to “steepen risk curve” to achieve commercial-scale deployment of IGCC with CCS before 2020
- Stage One knowledge and learnings generated to date transferable to development of ZeroGen commercial-scale plant
- Selection of gas turbine technology to minimise risks of deployment at full commercial-scale
- Stage One: R&D focus; Stage Two: commercial focus

Project participants



A photograph of a field of tall, golden-brown grasses swaying in the wind against a clear blue sky. The grasses are in the foreground and middle ground, creating a sense of movement and depth. The sky is a uniform, light blue color, occupying the upper half of the frame. The overall mood is serene and natural.

Stage One

Overview - study and test work

- 120MW gross plant (6F turbine with Shell gasifier) - located near Rockhampton, Central Queensland, Australia
- 75% of CO₂ emissions captured with partial sequestration approximately 140 miles from IGCC plant
- Learnings and knowledge “de-risk” technology to reduce costs and accelerate commercial-scale deployment
- Feasibility study underway - due for completion Q4 2009
- Environmental approvals underway
- Capital formation process & partnerships
- Extensive and successful stakeholder engagement



CCS program overview

- ✓ Determine whether CO₂ can safely be injected into low permeable rocks
- ? Determine site of adequate storage volume for project
- ? Determine expected injection rates and volumes per well
- ? Monitor and predict behavior and fate of CO₂ in storage
- ? Investigate potential for both supercritical and gas phase storage



Gasification technology selection



- Outcomes from gasification technology selection process - technology choices to meet Australian/ZeroGen objective
 - Membrane wall gasifier preferable to refractory wall gasifier
 - Dry feed gasifier preferable to slurry feed gasifier
 - Reference plant(s) of appropriate size
 - Scalability from demonstration to commercial size
- Shell Coal Gasification Process (SCGP) selected for Demonstration Plant (Stage One) feasibility study

Learnings from Stage One design studies



- Implications for demonstration plant design
 - Membrane wall gasifier selection confirmed
 - Dry feed gasifier selection confirmed
 - Ability to demonstrate integration of technology blocks is critical (integration has not been achieved for IGCC with CCS)
 - Ability to respond to deregulated electricity market load changes
 - Ability to use highly shifted syngas in high availability gas turbine
- Implications for commercial plant design
 - Improvements in syngas quenching - is an area of interest
 - Recycling of dry fly ash to extinction appears to have advantages over other fly ash handling approaches
 - Air blown vs oxygen blown question remains open

Stage Two



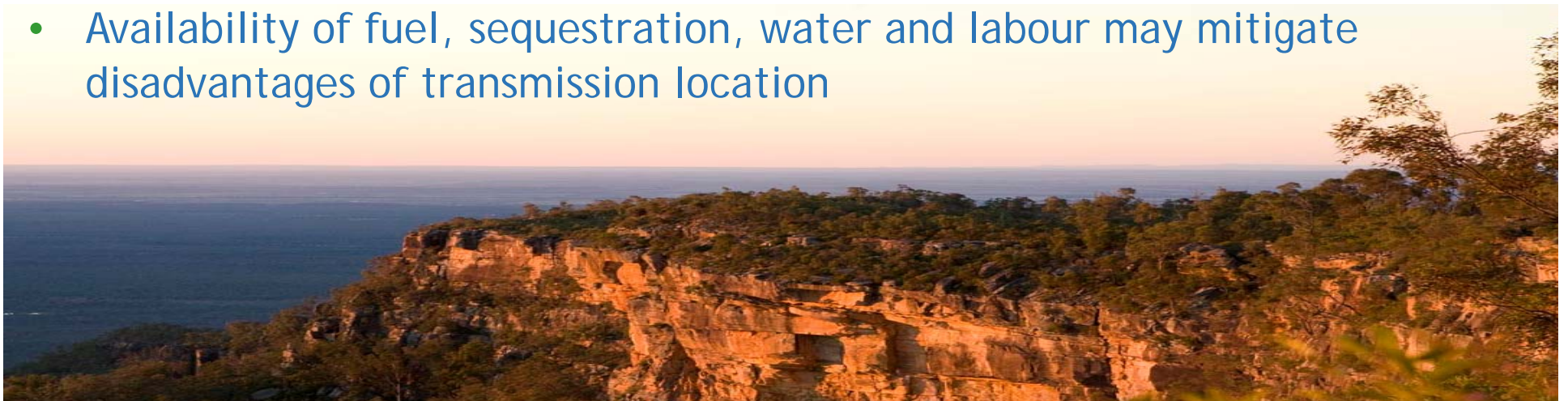
Stage Two



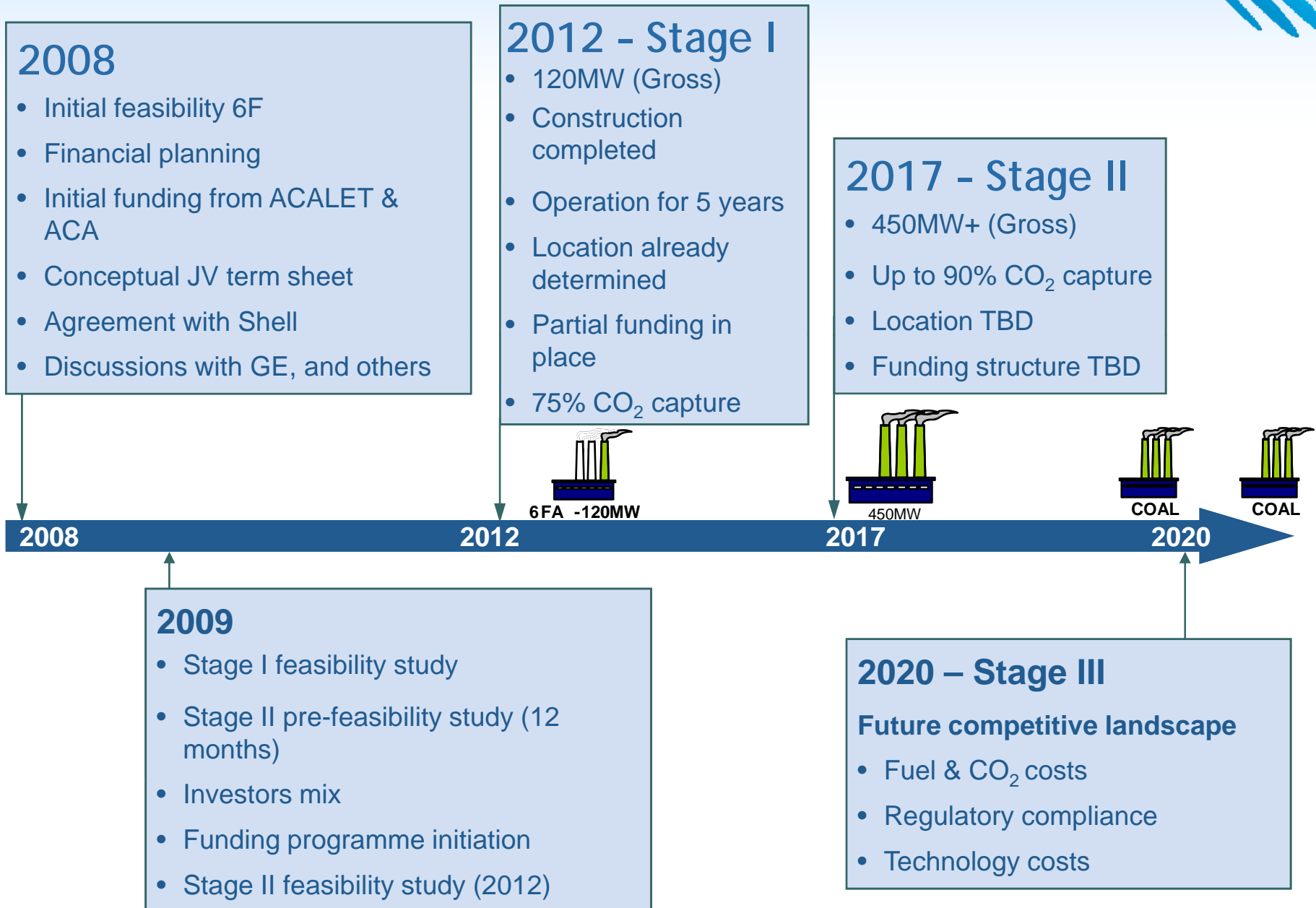
- World's first commercial-scale IGCC + CCS power plant by 2017
- ZeroGen considering earlier deployment of a commercial-scale plant
- 450MW+ gross plant
- Capture up to 90% of CO₂ emissions
- Developed concurrently with Stage One - transfer of knowledge and learnings to "de-risk" construction and operation in commercial-scale
- Plant location and geosequestration at Queensland site - to be determined in pre-feasibility study


Optimal plant location - factors

- Access to adequate transmission network
- Sale price of electricity from that location (dependant upon marginal loss factor - MLF range typically 0.9-1.2)
- Access to adequate CO₂ storage sites
- Access to coal resource
- Access to water resource
- Access to labour
- Availability of fuel, sequestration, water and labour may mitigate disadvantages of transmission location



Project timelines



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Challenges to deployment

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**Political legal and
regulatory**

Technology

**Community and
stakeholders**

**Financial,
commercial &
economic**

Technology integration challenges



- Process technology “blocks” have never been integrated together in an IGCC with CCS facility
- Key project driver is to have high plant availability early in Stage One project life
- Effective deployment of “process industries” technology in power production application to achieve required dynamic response for Australian national power grid demands is another key driver
- Lesson from previous non-capture IGCC projects is to pay careful attention to technology integration aspects as part of design and preparation for plant operation

Summary



- ZeroGen is accelerating the deployment of commercial-scale IGCC with CCS power plants
- Building confidence in the technology by confirming performance of reliability and availability of plant and equipment for power industry
- Confirming the real costs of developing IGCC with CCS
- Generating significant practical, contemporary and real experiences and knowledge
- Increasing the confidence of key stakeholders, investors, financiers, owners, operators, regulators, citizens and communities that technology is viable and safe

“There are risks and costs to a program of action, but they are far less than the long-range risks and costs of comfortable inaction”

- President John F. Kennedy





Thank you