



Reducing greenhouse gas emissions arising from the use of coal in electricity generation: A plan of action for Australia.

OVERVIEW

An overview of the COAL21 National Action Plan launched in March 2004.

WHY FOCUS ON COAL?

"The need to stabilise greenhouse gas concentrations in the atmosphere at levels that would prevent adverse impacts on the climate is now a widely accepted imperative. The problem is global in scale and solutions will be decades in the making. Meeting the challenge will require major changes in the way we produce and use energy.

Fossil fuels, including coal, oil and natural gas have driven economic and social advancement since the industrial revolution. They are also the major source of greenhouse gases that scientists believe may trigger climate change. But meeting the needs of an increasingly energy hungry world – one in which more than two billion people still have no access to electricity – will require continued and growing use of these fuels for the foreseeable future. Renewable forms of energy may prove to be the long-term solution, but will only account for a relatively modest albeit growing proportion of the energy mix for many decades.

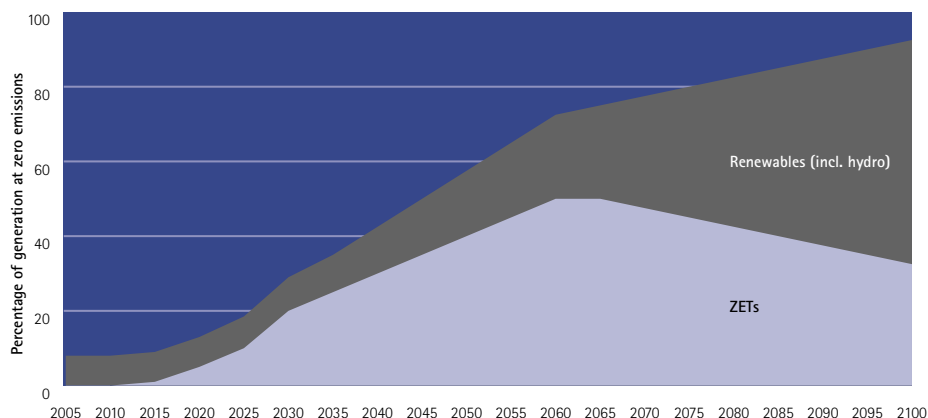
Part of the solution must therefore be to minimise emissions from our use of fossil fuels during the long transition to more sustainable energy systems that will surely emerge during the course of the 21st Century. Technology holds the key, and a global RD&D effort is now gearing up in response. A number of emerging technologies hold great promise that these emissions can indeed be reduced and in some cases virtually eliminated."

Tim Besley, COAL21 Chair

COAL21

COAL21 is a unique collaborative program aimed at identifying the role Australia should play in contributing to the development of these technologies and understanding how they might be deployed as an integral part of our national greenhouse response.

The COAL21 National Action Plan focuses on the use of coal in electricity generation. Coal accounts for around 85 per cent of the nation's electricity demand, underpins the competitiveness of Australia's electricity supply and the stability of the electricity grid. Technological change will be needed to ensure that the many economic and social benefits we derive from the use of our most abundant fossil energy resource can be better balanced with the need to protect the environment.



Hypothetical role of near zero emissions technologies (ZETs) for coal in the transition to a low or zero emissions electricity generation mix

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EXECUTIVE SUMMARY

COAL21 has examined the options for reducing greenhouse gas emissions arising from the use of coal in electricity generation in Australia. While a number of options are identified in the COAL21 National Action Plan, its primary focus is on breakthrough technologies, including those with the potential to deliver major reductions or even near zero emissions.

A number of promising technologies have been identified as being of particular relevance to Australia (see table on page 4). Each of these technologies met one or more of three basic assessment criteria. These included the potential of each technology to facilitate near zero emissions, increase coal-use efficiency and facilitate hydrogen production.

The range of technologies associated with carbon dioxide (CO₂) capture and geological storage (also known as geosequestration) are identified as the key to achieving deep cuts or even near zero emissions in coal-based electricity generation. Other technologies that meet one or more of the criteria include Integrated Gasification Combined Cycle (IGCC), Oxy-fuel Combustion, Lignite Dewatering and Drying and Ultra Clean Coal (UCC). Ultrasupercritical Pulverised Fuel (PF) technology meets the criterion of increased coal-use efficiency, but has not been included in the Action Plan because it is unlikely that Australia could play a meaningful role in its further development.

Each of the priority technologies is at a different stage of development and all require further RD&D before they are likely to be available for commercial deployment. Depending on progress in each case, most could be at least technically mature enough for commercial deployment to commence after 2015. The Plan outlines actions that should be pursued in Australia to accelerate the development of each of the technologies. These actions are divided into two broad phases: an RD&D phase out to around 2015 and a subsequent deployment phase.

COAL21 assessed the levels of emissions abatement that could possibly be achieved by 2030 through the deployment of advanced technologies, in particular CO₂ capture and storage. This assessment was based on scenarios modelled for COAL21 by the Co-operative Research Centre for Coal in Sustainable Development (CCSD). Provided that the assumptions underlying the model were met, an average emissions intensity target for coal-based generation of 650 kilograms of CO₂ per megawatt hour (currently 1017) or less could be at least theoretically achievable by 2030. This would result in total annual emissions from coal being lower than they are today despite an assumed 35 per cent increase in total coal-based generating capacity. Achieving this would require the equivalent of around 20 per cent of coal-based generation to be at zero emissions by 2030 through CO₂ capture and storage.

It is unlikely that any technology combination that includes CO₂ capture and storage will be competitive with conventional coal-based PF generation. While costs are certain to fall significantly over time, there is considerable uncertainty about both the cost of abatement and the impact on generation costs. This uncertainty applies to both the current and future costs associated with deploying the key technologies in Australia. A range of estimates have been presented in the literature, but considerable work is needed to further consolidate these and place them in an Australian context.

This uncertainty has precluded any robust identification of realistic, quantitative cost targets until more definitive technical and economic assessments are completed. However, two general cost targets can be endorsed. The first is that options for abating coal-related emissions must be competitive with other options in the Australian generation market. The second is that any impact on the cost of generation must be consistent with the need to maintain an internationally competitive electricity supply.

International collaboration will be essential if Australia is to play a role in the development of the key technologies. Australian RD&D activities must complement rather than replicate overseas programs wherever possible. While a full assessment of existing RD&D was beyond the scope of COAL21, a number of criteria that can be used to assess domestic RD&D programs in this context have been identified.

Governments have an important role to play in supporting and facilitating RD&D, particularly for first of a kind demonstrations of key technologies. Support during the RD&D phase will need to be carefully targeted and encompass both policy and various forms of direct and indirect assistance. Public/private partnerships will also be important during this phase, particularly for pilot and demonstration-scale facilities.

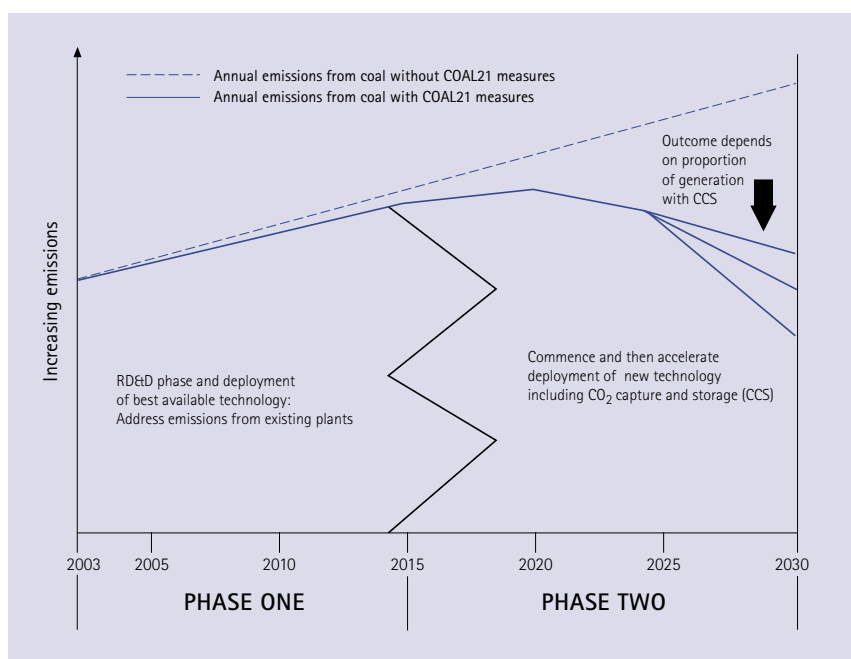
Education and communication will be essential to increase community awareness and understanding of the key technologies and the issues surrounding energy and climate change.



COAL21 RECOMMENDATIONS

COAL21 participants recommend that Australian governments consider policies and programs that would, in partnership with industry and the research community:

- Support and facilitate assessment of the potential for CO₂ capture and geological storage in Australia through research, pilot scale projects and larger scale demonstrations.
- Support and facilitate a first of a kind black coal IGCC demonstration plant in Australia.
- Support and facilitate Australia's first brown coal IGCC plant.
- Support research into the potential of Oxy-fuel Combustion and other possible post-combustion CO₂ capture options, including the potential for retrofit to existing capacity.
- Support and facilitate the further development of technologies for lignite dewatering and drying.
- Support and facilitate the further development of Ultra Clean Coal.
- Encourage improvements in the efficiency of existing coal-based electricity generation where cost effective.
- Ensure that all new and replacement coal generating plants are the most efficient (i.e. delivering the lowest emissions intensity) available that is competitive in the generation market at the time of construction (sequestration-ready IGCC or Oxy-fuel plants should be preferred if and when these become competitive).
- Maximise cost-effective abatement of non-power station emissions, particularly coal seam methane where practical.
- Foster greater community awareness and understanding of the role clean coal technologies (CCTs) and near zero emission technologies (ZETs) in meeting Australia's energy needs and reducing greenhouse gas emissions.



COAL21 National Action Plan phases and impact of COAL21 measures on emissions

COAL21 PARTICIPANTS

Federal and State Governments

- Commonwealth Dept of Industry, Tourism & Resources
- Australian Greenhouse Office
- Dept of Natural Resources and Mines (Qld)
- Dept of Innovation & Information Economy (Qld)
- Dept of Mineral Resources (NSW)
- Dept of Primary Industries (Vic)
- Dept of Primary Industries and Resources (SA)

Coal industry

- Anglo Coal
- BHP Billiton
- Rio Tinto
- Xstrata Coal
- Australian Coal Association
- Australian Coal Association Research Program (ACARP)
- NSW Minerals Council
- Queensland Resources Council
- Victorian Minerals and Energy Council

Electricity industry

- CS Energy
- Delta Electricity
- Edison Mission Energy
- Hazelwood Power
- Loy Yang Power
- Stanwell Corporation
- Tarong Energy
- HRL
- Energy Supply Association of Australia

Research Organisations

- Centre for Fuels and Energy, Curtin Uni of Technology
- Cooperative Research Centre (CRC) for Clean Power from Lignite
- CRC for Coal in Sustainable Development
- CRC for Greenhouse Gas Technologies
- CSIRO
- UCC Energy

Priority technologies identified by COAL21

<i>Technology</i>	<i>Advantages</i>	<i>Developmental Status and Needs</i>
CO ₂ capture and geological storage	Key enabling technologies for achieving major reductions or near zero emissions for coal-based power generation.	CO ₂ capture is feasible but uneconomic with existing conventional power generation systems. More cost-effective capture systems are required and may result from work on conventional power station flue gas capture, oxygen fired combustion or gasification systems. CO ₂ injection and storage is site specific, but proven and commercial in enhanced oil recovery operations at a range of sites in North America, Africa and Europe. Now needs to be demonstrated at selected sites under Australian conditions with the research focus on the long-term reliability of storage, safety and environmental implications.
Integrated Gasification Combined Cycle (IGCC) for black and brown coal	Enabling technology for higher efficiency, product flexibility, lower cost CO ₂ capture and hydrogen production.	A commercial black coal technology proven in the US and Europe but not yet demonstrated in Australia. Requires a first Australian demonstration plant. Locally developed brown coal drying gasification (IDGCC) has been demonstrated at small scale but requires a step-up commercial plant.
Oxy-fuel Combustion (Oxygen-firing of conventional PF type systems)	Enabling technology for post-combustion CO ₂ capture from advanced pulverised fuel (PF) coal plants. Possible retrofit option for existing plants.	Potentially applicable to both new and existing conventional PF coal plants but still at the early development stage.
Lignite dewatering and drying	Enabling technology for higher efficiency in conventional wet brown coal (lignite) generation and for the use of brown coals in IGCC systems.	A number of different technologies being developed in Australia have shown promise but need further pilot and/or demonstration scale development.
Ultra Clean Coal (UCC)	Enabling technology for greater flexibility (e.g. enabling the use of coal as a gas turbine fuel in peaking and distributed applications) and higher coal-use efficiency.	Developed in Australia and trialled in Japan but requires a step-up pilot plant to be progressed. Work is also required to assess the practicality of oxygen firing to facilitate CO ₂ capture.

MORE INFORMATION

Detailed information is available in the COAL21 National Action Plan, including:

- The COAL21 process
- Reducing emissions from existing coal-based generating capacity and new generating capacity
- Options for reducing non-power station emissions
- Priority technologies
- Technology RD&D roadmaps
- Targets for emissions abatement
- Priority actions
- Australia's role in RD&D
- The role of Government and Industry
- Education and communication

The COAL21 National Action Plan can be downloaded from www.coal21.com.au

