

COAL INDUSTRY ADVISORY BOARD



INTERNATIONAL ENERGY AGENCY



# Case Studies in Sustainable Development in the Coal Industry

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## **INTERNATIONAL ENERGY AGENCY**

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- to operate a permanent information system on the international oil market;
- to improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- to assist in the integration of environmental and energy policies.

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### **COAL INDUSTRY ADVISORY BOARD**

The Coal Industry Advisory Board (CIAB) is a group of high-level executives from coal-related industrial enterprises, established by the International Energy Agency (IEA) in July 1979 to provide advice to the IEA on a wide range of issues relating to coal. The CIAB currently has 40 members from 15 countries, contributing valuable experience in the fields of coal production, electricity generation and other aspects of coal use, trading and transportation.



## FOREWORD BY THE EXECUTIVE DIRECTOR OF THE IEA

The effort to achieve sustainable development is already having a profound effect on businesses where board-level decisions must be responsive to environmental considerations and social well-being, as well as economic viability. Thus, decision making in companies with a long-term vision is now more complex and embraces a broad range of goals.

In 2005, G8 leaders agreed in their Gleneagles Plan of Action to act with resolve and urgency on climate change, clean energy and sustainable development. This initiative by the world's largest nations should be viewed not as a threat by the coal industry, but rather as an opportunity to demonstrate its commitment for a sustainable energy future. Without such a plan for coal, there can be no credible solution to the challenges we face.

This collection of case studies, prepared by the IEA's Coal Industry Advisory Board, is a welcome illustration of the practical steps being taken by corporations around the world towards achieving sustainable development. They demonstrate a serious resolve to improve the environmental performance of coal and will assist others, in developed and developing countries, to understand how the principles of sustainable development can be applied in practice.

I am pleased to publish this report, under my authority as Executive Director, as part of the IEA's role to promote discussion between industry and governments on implementation of the sustainable development concept. The views and recommendations expressed do not necessarily reflect the views or policies of the IEA or of the IEA member countries.

**Claude Mandil**  
Executive Director



## FOREWORD BY THE CHAIR OF THE CIAB

In 2006/07, the UN Commission for Sustainable Development will be focusing upon energy and climate change. Within the coal mining industry today, sustainable development is widely recognised as a key business driver. As a result, the entire mining industry, through the International Council on Mining and Metals (ICMM), has adopted sustainable development principles to help guide the way it conducts its business. Issues the industry must confront in seeking sustainable outcomes range from minimising the environmental footprint at mining sites to helping customers address emissions from the uses of our products.

The Coal Industry Advisory Board (CIAB) last surveyed its members about sustainable development in 2003. Much progress has been made in the intervening three years, so it is only appropriate to take another snapshot to show how far we have come. The diverse case studies in this volume represent significant achievements made by CIAB members - not only in the many projects undertaken to improve the sustainability of our mining operations, but also in building into the way we work sound practices that maximise our contribution to society's transition to sustainable development.

The result is increasing openness within our industry, a willingness to proactively tackle environmental issues, and active engagement with the local communities near our operations. I hope you will find these examples of leading industry practice informative.

**Preston Chiaro**

Chairman of the IEA CIAB





# TABLE OF CONTENTS

<b>FOREWORD BY THE EXECUTIVE DIRECTOR OF THE IEA.....</b>	<b>5</b>
<b>FOREWORD BY THE CHAIR OF THE CIAB.....</b>	<b>7</b>
<b>TABLE OF CONTENTS .....</b>	<b>9</b>
<b>ILLUSTRATIONS .....</b>	<b>11</b>
<b>PREFACE .....</b>	<b>13</b>
<b>INTRODUCTION.....</b>	<b>15</b>
• Aim of this Report.....	15
• Principles Underlying the Case Studies.....	16
<b>ISSUES FOR THE COAL INDUSTRY .....</b>	<b>19</b>
• Acceptance of Sustainable Development Principles .....	19
• Balancing the Objectives of Sustainable Development .....	19
• The Role of Technology .....	20
• Differing Regional Views .....	20
• Co-operation and Collaboration along the Value Chain .....	20
• Collaboration and Co-operation with Non-industry Partners and Participation in Non-business Activities .....	20
• Integrating Sustainable Development Principles into Practice .....	21
• Government Policies and Regulations.....	22
<b>CASE STUDIES: PEOPLE .....</b>	<b>23</b>
• Engaging Employees in a Sustainable Development Culture .....	23
• Human Resource Systems.....	24
• Health and Safety.....	25
<b>CASE STUDIES: VALUE CHAIN .....</b>	<b>27</b>
• Working with Customers on Improved Products and Practices.....	27
• Working with Suppliers to Achieve Sustainable Development.....	29
<b>CASE STUDIES: ENVIRONMENTAL IMPACTS.....</b>	<b>31</b>
• Managing Waste.....	31
• Tackling Greenhouse Gas Emissions from Coal-fired Power Generation .....	33
• Reducing Methane Emissions from Coal Mining .....	39
• Coal-to-liquids for Low-emission Transport Fuels.....	42
• Site Rehabilitation and Sustainable Land Use.....	43

<b>CASE STUDIES: RESOURCE STEWARDSHIP .....</b>	<b>47</b>
● Looking for Resource Efficiencies .....	47
● Water Management .....	49
● Using Fuels Efficiently .....	51
● Harnessing Synergies.....	55
● Biodiversity.....	57
● Sustainable Development of the Lignite-to-electricity Supply Chain.....	62
<b>CASE STUDIES: COMMUNITIES.....</b>	<b>67</b>
● Mechanisms for Community Engagement.....	67
● Community Activism.....	73
● Community Engagement in Practice.....	75
● Local Infrastructure Enhancement.....	78
● Community Health.....	82
● Education .....	84
● Human Rights .....	84
<b>CASE STUDIES: MANAGEMENT PROCESSES AND SYSTEMS .....</b>	<b>87</b>
● Business Cases for Sustainable Development.....	87
● Sustainable Development Reporting.....	91
<b>APPENDIX - SUSTAINABLE DEVELOPMENT PRINCIPLES AND STRATEGIES .....</b>	<b>93</b>
● Principles.....	93
● Strategies.....	93

# ILLUSTRATIONS

Figure 1	Dragline at Hail Creek Mine .....	23
Figure 2	Environmental specialist at Hail Creek Mine checks data at the environmental dam .....	24
Figure 3	Environmental dam and rehabilitation area at Rio Tinto's Kestrel Mine in Queensland, Australia .....	25
Figure 4	J-Power's Matsuura thermal power station, Nagasaki prefecture .....	32
Figure 5	Bio-Solid - granulised biomass .....	32
Figure 6	Exploration drilling .....	33
Figure 7	Genesee 3 power station .....	36
Figure 8	Site rehabilitation at New Wallsend No. 2 Colliery .....	43
Figure 9	Filling and stabilisation of the former box-cut, completed in 2004 .....	43
Figure 10	Re-establishment of Maryland Creek .....	44
Figure 11	Former coal washery reject emplacement area .....	44
Figure 12	One of the four silos at Salmisaari underground coal store viewed from below .....	45
Figure 13	Helsinki Energy's unique underground coal storage facility at Salmisaari power station .....	45
Figure 14	502 megalitre dam to store surplus mine water - part of the Bobadeen Irrigation Scheme .....	46
Figure 15	Haul truck .....	49
Figure 16	Matimba power station .....	50
Figure 17	Finned-tube condensers above forced-draught fans, Matimba .....	50
Figure 18	Kendal power station .....	50
Figure 19	Tube-bundle heat exchangers in the cooling tower, Kendal power station .....	50
Figure 20	Exposed steam turbine blades .....	52
Figure 21	Turbine hall, Connah's Quay, UK .....	52
Figure 22	View of coal-fired power station stockpile Kingsnorth, UK .....	53
Figure 23	Real data from plant showing effect of GNOCIS Plus on NOx emissions .....	54
Figure 24	E.ON UK Combustion Test Facility .....	54
Figure 25	Coal-fired power station at Manjung, Malaysia .....	54
Figure 26	Rapid growing crops as a source of carbon-neutral fuels for co-firing with coal .....	55
Figure 27	Environmental dam with rehabilitation in background at Rio Tinto's Coal and Allied Mount Thorley / Warkworth Operation, Australia .....	56
Figure 28	Water testing with CHPP in background at Rio Tinto's Mount Thorley / Warkworth Operation, Australia .....	56
Figure 29	Settling tanks at Rio Tinto's Coal and Allied Hunter Valley Operations, Australia .....	56
Figure 30	Bird flappers on power lines .....	57
Figure 31	Mount Owen, Hunter Valley, Australia .....	58
Figure 32	Biodiversity offset strategy and conservation programme .....	59

Figure 33	Management and maintenance of the New Forest.....	59
Figure 34	Artificial nesting and roosting boxes.....	60
Figure 35	Wildflowers and ringing of sand martins at Kingsnorth power station, UK.....	61
Figure 36	Ratcliffe power station, UK.....	62
Figure 37	Lignite-fired power plant with optimised plant technology (BoA) at Niederaussem.....	63
Figure 38	Recultivation in the Rhenish mining area: following consolidation of seal and subgrade.....	63
Figure 39	Recultivation in the Rhenish mining area: substrate placement by spreader....	64
Figure 40	Relocation of the Inde River: new river meadows in summer 2004.....	64
Figure 41	Flora is “conquering” the new Inde bed... ..	65
Figure 42	...and so is fauna.....	65
Figure 43	Livestock grazing on pastures at the Powell River Project Research and Education Center in Virginia, USA .....	68
Figure 44	Powell River Project educator Jon Rockett provides natural resource management instruction to student visitors at the Research and Education Center.....	68
Figure 45	Virginia Tech students, working with Dr. A. O. Abaye, collect and identify samples of vegetation growing on the reclaimed mine areas of the Powell River Project Research and Education Center.....	69
Figure 46	Conservation Volunteers Australia, River Paramedics .....	72
Figure 47	Hunter Economic Development Corporation’s Hunter Export Centre.....	73
Figure 48	Francis Greenway High School Opportunity Plus for students.....	73
Figure 49	Melanie Webber, BMA Goonyella Riverside Mine engineer, mentoring students from Moranbah State Primary School, Queensland, Australia .....	74
Figure 50	Moranbah Miners Junior Rugby League teams being coached by Mark Anderson, employee at BMA Peak Downs Mine, Queensland, Australia .....	74
Figure 51	National Trust Team Challenge .....	75
Figure 52	Electrification in South Africa, 3.2 million homes electrified since 1991 .....	76
Figure 53	Black economic empowerment through the <i>Commercial Farmer Settlement Project</i> .....	78
Figure 54	Kingaroy Shire Chief Executive Ron Turner goes over the plans for the new Heritage Precinct with the Information Centre's Sue Duncan .....	79
Figure 55	Programme participant and Year 10 student, Caragh Galway, now works part-time at the Clermont Pharmacy following her voluntary work placement..	80
Figure 56	General Manager Peter Dowling discusses the <i>Taking the Lead</i> project with Business Development Officer Janice Moriaty, Kestrel Mine Community Development Fund.....	80
Figure 57	Regional General Manager John Standish-White with traditional healers from neighbouring communities at a Family Khulumiminsana “chat show”, showing support for the Goedehoop and Bank Collieries' HIV/AIDS campaign.....	83
Figure 58	loveLife Centre, basket ball court supported by Landau Colliery.....	83
Figure 59	Fields of action and projects of the German cement industry <i>Initiative for Sustainable Development</i> .....	90

## PREFACE

The CIAB's work programme on sustainable development and its implications for coal began in 2000. Under this programme, two earlier papers were published:

- *Coal and Sustainable Development*: published in July 2002, a CIAB position paper prepared for the World Summit on Sustainable Development and
- *Coal and Sustainable Development - Attitudes and Activity*: published in 2003, the results of a 2002 survey of CIAB Members on attitudes to sustainable development and a compilation of practical activities being undertaken to improve the performance of coal-related industries.

This third paper is a timely update of sustainable development case studies by coal producers and users.

Widely held attitudes to coal's use have evolved greatly in the past five years - from those that largely dismissed a role for coal in sustainable development to a wider appreciation of coal's continuing role in providing a foundation for energy security and in meeting growing world energy demand, but only if accompanied by improved environmental performance.

The diversity of the case studies illustrates the complex and challenging nature of sustainable development. Most relate to the top priority identified in the 2002 survey: that of taking action to reduce the environmental impacts of coal production and use. The case studies indicate that coal producers and users are more ready to engage the community and other stakeholders and there is evidence of increased collaboration along the coal chain.

The case studies illustrate a continuation of the evolutionary process identified in 2003. This starts with a narrow internal focus on economic priorities and environmental compliance and then broadens to include local environmental issues and the community. Activity in its most complex and challenging stage focuses on global issues; provides for wide stakeholder engagement and integrates social, economic and environmental considerations in decision making. Almost all of the case studies presented in this report are in the second and third stages of this evolutionary process, indicating in general a more holistic approach than previously.

However, only a minority of case studies and significantly those with the widest collaboration, the longest time horizons and most demanding programmes, relate to low carbon emission technologies for electricity generation from coal. Greater effort in developing and commercialising these technologies will be essential to address coal's greatest challenge. This will require strong leadership from governments and great commitment from industry.

**David Cain**

*(David Cain convened the group of CIAB Associates that prepared the 2002 and 2003 reports on sustainable development activities.)*



# INTRODUCTION

## Aim of this Report

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Sustainable development is a broad concept covering the way in which human activities impact on economic development, the environment and social well-being. It is generally accepted that both governments and industry should promote development that is sustainable in all three dimensions, but practical application of the concept is complex because its objective assessment is elusive. While the concept can be readily and widely accepted in general terms, a consensus viewpoint on the value of individual actions is more difficult to achieve because of the absence of criteria permitting objective assessment of their “sustainable” qualities.

The IEA Coal Industry Advisory Board (CIAB) has asked its Members to contribute case studies on sustainable development activities to:

- Provide evidence of the progress toward sustainable development being made by the coal-producing and -using industries, in light of the commitment made at the UN World Summit on Sustainable Development in Johannesburg 2002.<sup>1</sup>
- Increase understanding of sustainable development best practices to assist others pursuing similar goals.
- Provide a library of examples of sustainable development activities in the coal-producing and -using industries, which illustrate the meaning of the concept in the commercial world.<sup>2</sup>

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1. See, for example, *Sustainable Entrepreneurship - The way forward for the coal industry*, World Coal Institute, December 2001 and the CIAB statement *Coal and Sustainable Development - Achieving balance in priorities*, published in July 2002 for the Johannesburg conference. In the WCI report, prepared for the United Nations Environment Programme, ten key principles and objectives were set out by its member companies in relation to sustainable development. In addition, seven key areas of improvement for 2012 were identified:

- Increase the understanding of the principles of sustainable development within the industry and among local mining communities.
- Build strong leadership within the industry to help implement the principles of sustainable development world-wide and foster greater co-operation with multi-stakeholders.
- Improve the health and safety performance of coal mining, especially in developing countries.
- Reduce the environmental impacts of coal production and use, especially in developing countries.
- Further the development and deployment of cleaner coal technologies and carbon capture and sequestration technologies world-wide.
- Improve the collection, collation and distribution of information regarding environmental, health and safety impacts - with enhanced transparency and recognition of exemplary performance.
- Demonstrate the effectiveness of voluntary agreements in achieving progress on sustainable development in order to enhance their credibility.

2. Building on the survey reported in *Coal and Sustainable Development - Attitudes and Activity*, International Energy Agency CIAB, October 2003. The survey itself is reported in *A Survey of CIAB Members on Coal and Sustainable Development, Volumes 1 & 2*, CIAB, October 2002.



## Principles Underlying the Case Studies

Table 1 lists the principles selected by the CIAB to best represent the key elements in the coal industry's journey to sustainable development. These principles are broadly based on the Bellagio Principles<sup>3</sup> and have been endorsed in the electricity industry through the World Business Council on Sustainable Development.<sup>4</sup>

**Table 1. Sustainable development principles<sup>4</sup>**

Principle	Objective
<b>Aspect 1: Establishing a vision of Sustainable Development and clear goals</b>	
Guiding vision and goals	Develop a clear vision of sustainable development and define the objectives that define that vision.
<b>Aspect 2: The content of any assessment and the need to merge a sense of the overall system with the practical focus on current priority issues</b>	
Holistic perspective	Adopt a holistic and integrated view of the role and impacts of utility operations.
Precautionary approach*	Adopt a precautionary attitude and modify electricity utility operations where possible, consistent with scientific/technical understanding, to prevent serious or irreversible environmental degradation.
Essential elements	Consider the essential elements of economic development, environmental quality and social equity in utility operations.
Adequate scope	Adopt a time horizon long enough to capture both human and ecosystem time-scales, where possible, and deal with a large enough space to capture local and long-distance impacts.
Practical focus	Develop practically oriented strategies, make use of standardised procedures and measurements, and target a limited number of activities.
<b>Aspect 3: Key issues of the process of assessment</b>	
Openness	Apply transparency in operations, including measurement and interactions with government and the public.
Effective communication	Report on activities and progress, and disseminate information in an appropriate manner.
Participation	Adopt a participatory approach to operations and evaluations.
<b>Aspect 4: Necessity for establishing a continuing capacity for assessment</b>	
Ongoing assessment	Continually assess progress towards objectives, and re-evaluate strategies in the light of these evaluations.
Institutional capacity	Contribute to greater understanding and capacity of sustainable development and the role of electricity utilities.
Efficiency*	Initiate processes to measure and improve efficiency.

\* Added to the original Bellagio Principles.

3. *Assessing Sustainable Development: principles in practice*, The International Institute for Sustainable Development, 1997.

4. *Sustainability in the Electricity Utility Sector*, World Business Council on Sustainable Development, July 2002. A further explanation of these principles can be found in the Appendix.

**Table 2. Index of case studies**

Case Study 1	Hail Creek, Contributing to Sustainable Development through Pro-active Recruitment and Extensive Induction, Australia (Rio Tinto Coal Australia) .....	23
Case Study 2	Making Decisions: an Analysis of Indigenous Community Decision Making in the Context of Major Project Development, Australia (Rio Tinto Coal Australia / Comalco / Rio Tinto Services) .....	24
Case Study 3	Farm Safety, Australia (Anglo Coal Australia) .....	25
Case Study 4	Energy Efficiency through Demand-side Management, South Africa (Eskom).....	27
Case Study 5	Power Station Ash and Flue Gas Desulphurisation Residue By-products as Construction Material, USA (CONSOL Energy) .....	29
Case Study 6	Utilisation of Coal Combustion By-products in Europe (ECOBA) .....	29
Case Study 7	J-Power's Biomass Co-firing Project at Matsuura, Japan (Electric Power Development Company).....	31
Case Study 8	Using Fly Ash and Bottom Ash, Japan (Japan Fly Ash Association) .....	32
Case Study 9	Industry-government Co-operation on the Use of Coal in China .....	33
Case Study 10	COAL21: an Australian Partnership for Low-emission Electricity from Coal .....	34
Case Study 11	FutureGen, USA.....	35
Case Study 12	Genesee 3: the Greenest Coal Plant in Canada (EPCOR & TransAlta) .....	36
Case Study 13	EPRI CoalFleet of the Future Study, USA .....	37
Case Study 14	Supporting Development of Low-emission Technologies, Australia (Xstrata Coal)...	38
Case Study 15	Thermal Efficiency Improvement Project at Huangtai Coal-fired Power Plant, China (Kyushu Electric Power).....	39
Case Study 16	Illawarra Coal Mine Gas Utilisation. Australia (BHP Billiton).....	39
Case Study 17	Methane Capture and Utilisation, German Creek, Australia (Anglo Coal) .....	40
Case Study 18	Coal-bed Methane Horizontal Drilling Demonstration with CO <sub>2</sub> Storage (CONSOL Energy) .....	41
Case Study 19	Monash Energy Coal-to-liquids and Carbon Capture and Storage Project, Australia (Anglo Coal) .....	42
Case Study 20	New Wallsend No. 2 Colliery Decommissioning and Mine Closure Project, Australia (Xstrata Coal) .....	43
Case Study 21	Sustainable Energy Operations in the Urban Environment: Underground Coal Storage, Salmisaari, Finland (Helsinki Energy).....	45
Case Study 22	Bobadeen Irrigation Scheme, Australia (Ulan Coal Mines) .....	46
Case Study 23	Achieving More Efficient Energy Production through District Heating and Cooling, Finland (Helsinki Energy) .....	47
Case Study 24	Trial of Diesohol in Mobile Mining Equipment, Australia (BHP Billiton).....	48
Case Study 25	Reducing Water Consumption in Power Generation, South Africa (Eskom).....	49

Case Study 26	Coal-fired Power Station Steam Turbine Upgrade to Provide Efficiency Improvement and Reduced Emissions, UK (E.ON UK) .....	51
Case Study 27	Development and Use of Tools for Performance Improvements to Reduce Costs and CO <sub>2</sub> Emissions in Electricity Generation (E.ON UK) .....	52
Case Study 28	Optimisation of Power Plant Operation and Evaluating Carbon-neutral Fuels using E.ON UK's Combustion Test Facility, UK .....	54
Case Study 29	Integrated Water Management at Rio Tinto's Coal & Allied Operations, Australia ..	55
Case Study 30	Working with Partners towards Sustainability, South Africa (Eskom) .....	57
Case Study 31	Mount Owen Biodiversity Offset Strategy, Australia (Xstrata Coal) .....	58
Case Study 32	Development of Biodiversity Action Plans for Land Owned or Managed by E.ON UK .....	60
Case Study 33	Sustainable Development in a Vertically-integrated Utility, Germany (RWE Power AG) .....	62
Case Study 34	The Powell River Project: University/Coal Industry Co-operation for Sustainable Development, USA (Virginia Polytechnic Institute and State University) .....	67
Case Study 35	Improving the Sustainability of Coal-fired Power Generation, the Genesee Public Advisory Committee and the Genesee Synergy Group, Canada (EPCOR) ...	69
Case Study 36	Coal & Allied Community Trust, Australia (Rio Tinto) .....	71
Case Study 37	BMA Community Partnerships Program, Australia (BHP Billiton) .....	73
Case Study 38	Energy in the Community, UK (E.ON UK) .....	75
Case Study 39	Community Volunteerism at Kennecott Energy, USA .....	75
Case Study 40	Electrification in South Africa (Eskom) .....	76
Case Study 41	Black Economic Empowerment in Commercial Farming, South Africa (Xstrata Coal) .....	77
Case Study 42	Rio Tinto's Investments in Community Development Projects, Australia .....	78
Case Study 43	BHP Billiton's Community Development Programme at Rietspruit, South Africa ..	81
Case Study 44	BHP Billiton Matched Giving Programme .....	81
Case Study 45	Anglo Coal's HIV/AIDS Initiatives in South Africa .....	82
Case Study 46	Xstrata's Schools Development Programme, South Africa .....	84
Case Study 47	Human Rights and Ethics in Colombia (Anglo Coal) .....	84
Case Study 48	Sustainability Opportunity and Threats Analysis, Water Management at BMA, Australia (BHP Billiton) .....	87
Case Study 49	Fatal Risk Control Protocols (BHP Billiton) .....	88
Case Study 50	Sustainable Development, A Joint Initiative of the German Cement Industry and Trade Unions .....	89
Case Study 51	Sustainability Reporting, South Africa (Eskom) .....	91

## ISSUES FOR THE COAL INDUSTRY

The case studies presented in this report support the findings of earlier work on sustainable development by the CIAB: there is a strong awareness of the importance of applying sustainable development principles in the coal industry to maximise business opportunities and to comply with government policies and regulations. Concrete actions are being taken in a wide variety of ways by many companies; the case studies detailed here are examples of just some of the myriad of activities that are being undertaken by CIAB Members. They have been selected to demonstrate not only the substantial strides that have been taken by the sector as a whole, but also to highlight innovative practices being undertaken by individual companies.

Specific issues, related to the application of sustainable development principles to particular cases, are discussed in the following chapters. There are a number of headline issues that arise. These are discussed in this chapter.

### Acceptance of Sustainable Development Principles

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The survey undertaken by the CIAB in 2003<sup>2</sup> revealed a substantial increase in awareness of the importance of sustainable development since 2000, with a clear majority of respondents seeing sustainable development principles aligning with their commercial objectives.<sup>5</sup> In 2003, reducing emissions from coal use was seen as a key priority. Generally speaking, although not a survey of attitudes, the case studies in this report reveal that whilst environmental issues have remained key, the adoption of a broad set of sustainable development principles is even more widespread in the coal industry than in 2003.

As in 2003, the range of activities suggests an evolutionary process - one that commences with a sole internal focus on economic priorities for the business, and then broadens to include local environmental issues and the community. Leading companies are increasingly undertaking activities that impact favourably on global issues, which recognise and share responsibility for the social and environmental impacts of producing and using their products, and which better engage stakeholders.

### Balancing the Objectives of Sustainable Development

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Particularly important when assessing coal-related activities is the balance between each of the three objectives of sustainable development: economic development, environmental quality and social equity. Due

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5. Responses indicated that sustainable development was an important element in decision-making, with 83% of responses reporting it was “very important” and a further 14% that it was “somewhat important”; 90% of responses indicated that it was more important or much more important in 2003 than in 2000, and 86% indicated that commercial advantage could be gained by applying the principles of sustainable development.

to differing priorities and circumstances at any given time, trade-offs and a balancing of objectives often need to be made. So whilst coal clearly makes an important and continuing contribution to the economic and social objectives of sustainable development, there is a recognition that environmental enhancement remains a key issue. Faster and more dramatic improvement in environmental performance in coal use is technically, and often economically, feasible now and should continue to be a high priority of industry and government to enhance coal's contribution to the environmental objective of sustainable development.

## **The Role of Technology**

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Improved performance in coal use is achievable through the application of technologies, especially in the areas of efficiency improvement, health and safety, and environmental performance. The case studies show that coal-producing companies recognise that investments in new technologies along the value chain are key; the future of their activities rests on the continuing use of coal in power generation and in steel making, in turn depending on compliance with tightening environmental standards. Indeed, technology development and technology transfer along the whole coal chain are seen as essential activities to protect the future of coal - to ensure growing markets for coal producers through the availability of competitively-priced coal for electricity generation, steel making and general industry.

## **Differing Regional Views**

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The role of coal in the energy mix varies greatly between countries depending on the relative cost and availability of different fuels, the stage of a nation's economic development, and the actual power generation technologies in use. The weighting given to sustainable development objectives, in government policy and by the private sector, varies accordingly. Where coal is not viewed as a strategically important fuel, perhaps because of the competitive availability of other fuels, governments may adopt measures on environmental grounds that would reduce the role of coal in the energy mix. Governments relying on the low-cost and supply security benefits of coal, because of the absence of competitive fuels, are more inclined to adopt policies ensuring the sustainable use of coal. Private sustainable development activities are more likely to be initiated in such a policy environment.

## **Co-operation and Collaboration along the Value Chain**

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The industries in the coal chain, together with consumers that depend on the numerous products coal use provides, are interdependent but rarely vertically integrated. The complexity of commercial relationships is increased greatly by the international and highly competitive nature of coal trade, electricity generation and metals production. In this respect, product stewardship - that is, the acceptance of some responsibility by producers and users of coal for the performance standards of others in the coal chain - is an essential component of the successful application of sustainable development principles. Collaboration in research and demonstration projects and technology transfer are important components of product stewardship that enhance performance along the value chain.

## **Collaboration and Co-operation with Non-industry Partners and Participation in Non-business Activities**

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Many of the case studies show the value of collaboration with research bodies, such as universities, for the development of new technologies. Apart from this conventional form of collaboration, many of the case

studies also highlight co-operation and dialogue with communities, conservation and environmental groups. In some cases this might be directly related to a company's operations, but may also be incidental to its core activities (for example, the management of land owned by, but not used by a company). Other activities are also undertaken, such as outreach to schools and community groups simply to inform interested parties about the activities of the company and the industry. These activities are not without cost; the case studies show the need for employee training and, in some cases, the use of specialist personnel.

## Integrating Sustainable Development Principles into Practice

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There is no single, quantitative indicator for sustainable development used by governments in the way that, for example, GDP growth and employment rate are critically-important and well-understood performance indicators of macro-economic management. Instead, a range of indicators is used and integration of the goals in the public sector often appears to take place at the political level. When sustainable development is evaluated, qualifying terms such as “balancing goals” and “trade-offs between goals” are commonplace.<sup>6</sup> Similarly, and not surprisingly, companies must keep in mind bottom-line profitability and return on shareholders' funds, while seeking cost-effective ways of integrating environmental and social goals into their organisations.

Both private companies and governments could probably do more to base their decisions and report their activities on a broader basis than just the financial bottom line. At an international level, this vision drives initiatives such as the Global Reporting Initiative<sup>7</sup> for corporate and government reporting, and the Equator Principles<sup>8</sup> for development project financing. At a national level, some firms now report on a triple-bottom-line basis, and socially- or ethically-responsible investment guidelines are now used in the financial services industry.

The case studies show that many companies consider the application of sustainable development principles to be a key issue for board-room consideration and seek to disseminate sustainable development principles throughout their organisations. By the time issues reach board-room level, environmental and social goals have been taken into account and harmonised with economic goals. This is possible for larger companies, anticipating the evolution of public policy and societal goals. They do so to ensure their commercial survival in the longer-term. But this may not always be an option for smaller companies or for companies under greater commercial pressure, for whom short-term survival is the principal goal.

Many of the case studies illustrate corporate “good citizenship” and the socially-responsible manner in which modern companies go about their activities. In developing countries, some companies are actively assisting national governments in achieving their development goals over and above the substantial economic contribution they make through taxation, employment, investment and other benefits linked to traditional business activity. Distinguishing the application of sustainable development principles from normal modern corporate behaviour is not always obvious because governments and the public have come to expect socially-responsible behaviour at a corporate level.

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6. The distinction made here is between “weak” and “strong” sustainability - see *Toward a Sustainable Energy Future*, OECD/IEA, Paris 2001, page 21. Importantly, it is unreasonable to expect the private sector to act in advance of the example set by governments, which habitually give priority to economic performance when the latter is under threat. For example, when oil prices began strengthening in 2004, and on several occasions since, governments have called on OPEC to increase production because of anticipated weakening economic growth. The equality of sustainable development goals is not a settled issue in practice.

7. [www.globalreporting.org](http://www.globalreporting.org)

8. [www.equator-principles.com](http://www.equator-principles.com)

## **Government Policies and Regulations**

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Governments directly and indirectly influence the extent and choice of sustainable development activities taken up by the coal industry. For example, electricity market liberalisation has expanded opportunities for companies to exploit opportunities to sell excess power to the grid and so reduce prices.

Government policy towards the coal industry has an overall influence on the application of sustainable development principles. Sustainable development is necessarily a long-term and ongoing goal. Many of the issues for the coal industry - cost-effective achievement of environmental standards, technology research and development, technology transfer, collaboration along the value chain, for example - are also issues that governments can approach positively, in consultation with the industry, to achieve a long-term role for coal in sustainable development.



## CASE STUDIES: PEOPLE

To be effective on a day-to-day basis, sustainable development principles must be embedded in the organisation's culture. The starting point is typically the acceptance of sustainable development principles at board-room level as corporate goals, and informing the workforce, investors and others of that commitment. Relevant employees need to be engaged as a first step in the practical application of sustainable development principles, followed by the gradual extension of training in sustainable methods of working to the workforce as a whole. To begin, communication with employees is likely to be one-way. Over time, feedback and the full development of two-way communication are important goals. To be successful, business benefits must be demonstrated. Case studies in this section illustrate aspects of this process, including the special case of indigenous people and communities.

### Engaging Employees in a Sustainable Development Culture

#### **Case Study 1. Hail Creek, contributing to sustainable development through pro-active recruitment and extensive induction, Australia (Rio Tinto Coal Australia)**

*The construction and subsequent operation of Rio Tinto Coal Australia's new Hail Creek Mine provided an opportunity to assemble a team of employees from scratch. While its core management and services team was in place for the construction period, during 2003, ninety-six operating positions were filled. Approximately 40% of applicants were sourced from existing Rio Tinto operations and the mining industry, and about 60% were employed locally. The focus of the recruitment campaign was to secure new employees who demonstrated the desired personal qualities, regardless of experience, and demonstrated they understood the company's commitment to sustainable development and safety.*



**Figure 1. Dragline at Hail Creek Mine**

The vision was to create an open-cut coking coal mine at Hail Creek that would become recognised as one of Australia's premier operations employing world-class technical and operational standards, and a highly-skilled, well-led and committed workforce. The recruitment process and the new-starter induction programme were critical components in the development of a culture focused on sustainable development, safety, teamwork and productivity.



Securing employees from the local community was identified as a means of contributing to the operation's sustainability. An intensive local campaign was conducted, enlisting the support of local authorities and organisations to facilitate applications and distribute application forms. A strategic media campaign was conducted, with advertising in local suburban newspapers and the distribution of 2 500 application forms from Hail Creek's Mackay office.

**Figure 2. Environmental specialist at Hail Creek Mine checks data at the environmental dam**

All new employees undertook a three-week induction programme designed to ensure they understood the culture and values of the operation. The induction programme covered:

- Sustainable development information including business context, cultural awareness training, community relations and environmental standards. This included sessions on sustainable development from the perspective of the National Parks Service and a local grazier.
- Detailed understanding of the business and its operating philosophy.
- Safety induction and overview.
- Aboriginal and cultural awareness training.
- Leadership and team membership training.
- Information on human resources systems, policies and procedures.
- Workplace and company orientation.



## Human Resource Systems

### **Case Study 2. Making decisions: an analysis of indigenous community decision making in the context of major project development, Australia (Rio Tinto Coal Australia / Comalco / Rio Tinto Services)**

*Better understanding the impact of proposed mining developments on indigenous communities is critical to the development of improved engagement and negotiation strategies and the delivery of effective agreements. An enhanced knowledge of social, economic and environmental impacts will assist in gaining land access and delivering beneficial outcomes for communities - both critical to the industry's future sustainability. This case study illustrates a co-operative effort by companies facing a similar challenge to objectively assess ways of improving relations with indigenous communities.*

A collaborative research project is being conducted to analyse cross-cultural negotiations between indigenous peoples and companies. Case studies that trace the agreement-making process in a Queensland mining context will provide the basis for an analysis of how decisions are implemented in cross-cultural development contexts. The project will:

- Investigate how indigenous communities make decisions about major projects. What are the main governance issues that communities face in dealing with major projects?
- Make recommendations to proponents and government about effective engagement with indigenous communities in relation to major projects.

- Suggest culturally-appropriate models for indigenous community engagement in negotiations and decision making with government and industry about major projects.

The project is expected to deliver valuable information on how indigenous communities face the challenge of development and interact with large corporations, for example, when participating in agreement-making processes, EIS submissions, etc. These findings may be used to assist in providing support to indigenous communities prior to their participation in the development process and assist companies engaged with indigenous communities. Key issues are to:

- Determine key objectives and translate these objectives into business deliverables.
- Identify communities to participate in the research programme.

Government, industry and James Cook University have formed a partnership to fund the study to be undertaken by the Native Title Studies Centre at James Cook University, an independent entity.

The study will be undertaken over a three-year period, as follows:

- Focus on communities affected by proposed mining development in particular areas/regions.
- Identify communities and their component organisations, together with the decision-making processes followed within the organisations and by the community at large.
- Identify a small number of decision-making case studies and follow the response and engagement techniques used over a two-year period.
- Identify the issues about which a community must make a decision and the processes employed to reach that decision.
- Evaluate the effectiveness of decision-making, using governance criteria.
- Provide recommendations about building capacity for governance.

The total project cost is expected to be AUD 150 000 (cash and in-kind support) per year for three years, funded by Rio Tinto.



**Figure 3. Environmental dam and rehabilitation area at Rio Tinto's Kestrel Mine in Queensland, Australia**

## Health and Safety

### **Case Study 3. Farm safety, Australia (Anglo Coal Australia)**

*Anglo Coal Australia's usual approach with rural properties that overlap active mining leases is to offer to buy out the owners at fair market value. This policy has been adopted because it gives clearer legal outcomes and assists property owners and the ongoing mining operation to develop their separate business interests. Much of the acquired land is leased back under licence to the original owners, or to other local share farmers, to keep the buffer zone*

*around operating mines in productive use. In 2004, Anglo Coal began a project to develop a Safety, Health and Environmental Management Plan for all of the company's agricultural properties in response to the realisation that safety standards applied to the rural activities on the company's land holdings were not up to the standards of the company's mining operations. Licensees who have been involved in the programme have expressed their strong support for the introduction of property safety plans. The programme is making a distinct difference to farming safety, contributing to sustainable agriculture, and at the same time is building stronger relationships between Anglo Coal and the company's rural neighbours.*

Sound safety, health and environmental practices on the company's rural properties are being achieved by:

- The development and maintenance of *Safety, Health and Environmental Management Plans* for each property to align with Anglo Coal's own standards, whilst ensuring that they address legislative requirements and are consistent with duty-of-care principles.
- Development and implementation of training for all licensees, contractors and employees working on Anglo Coal's rural properties.
- Ensuring property management planning is consistent with Anglo Coal's environmental standards.

Each rural property management plan is aligned with the *Safety, Health and Environmental Management Plan* of the adjacent mine site to ensure that they are compatible and that the physical, human and technical interfaces between the mining and farming operations are identified and managed appropriately.

The first phase of the programme, in 2004, involved initial training to provide licensees with an introduction to safety from both a mining and rural workplace point of view. Training included ensuring that workplace health and safety requirements for both mine site and the rural workplace were current for contract staff. In addition, specialist qualifications, such as Agricultural Chemical Handling Certification, were renewed. Licensees were encouraged to undertake simple risk assessment prior to undertaking both routine and new tasks and often commented on the positive changes they had made to routine tasks by following the risk assessment process.

Safety, health and environmental issues were introduced to property inspections and to the agendas of meetings held between the company and its rural property licensees. A rural safety audit checklist has been introduced, which is utilised during inspections by Anglo Coal staff and by licensees when undertaking tasks.

All new and renewed agricultural licences contain clauses introduced specifically to emphasise the need to operate rural properties safely; a requirement to develop individual property safety plans has also been included in all 2005 licences.

## CASE STUDIES: VALUE CHAIN

Business risks and opportunities arising from the application of sustainable development principles extend beyond single enterprises. The coal industry is highly competitive and increasingly international, but with little vertical integration. Sustainable development activities need to take into account, and ideally be undertaken in co-operation with, customers and suppliers along the value chain from coal production to coal use. Like-minded businesses might be expected to prefer dealing with each other, giving rise to a market incentive for competing companies to adopt a similar approach to sustainable development, and to support each other in improving performance. Product stewardship and co-operation along the value chain encourage a full life-cycle approach to the impact assessment of coal production and consumption.

### Working with Customers on Improved Products and Practices

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#### Case Study 4. Energy efficiency through demand-side management, South Africa (Eskom)

*Sustained economic growth in South Africa could result in peak electricity demand growing by about 4% per year, in a high growth scenario, according to Eskom's Integrated Strategic Electricity Plan. By 2007, peak-period demand could exceed Eskom's electricity supply capacity, and, by 2010, additional base-load capacity could be required. Reliable electricity supply is essential for the South African economy to grow. Eskom is addressing this challenge by expanding supply options, returning to service and upgrading three mothballed power stations, and supporting the Demand Side Management programme. The latter is illustrated by two case studies - the Alexandra compact fluorescent lighting rollout and energy saving by the Pick 'n Pay supermarket chain.*

Eskom is implementing demand-side management in South Africa in collaboration with the Department of Minerals and Energy and the National Electricity Regulator. The strategy comprises two elements to reduce electricity demand in peak morning and evening periods - shifting load to off-peak periods, and reducing overall electricity consumption by installing energy efficient equipment and optimising the efficiency of industrial processes. The programme began in 1991 with research, pilot studies and time-of-use tariffs. A national electricity-saving effort was officially initiated in the last quarter of 2002. Benefits include:

- Reduced electricity demand during peak periods, delaying new capital investment in electricity supply.
- Lower electricity costs for customers, encouraging economic activity and raising productivity.
- Reduced emissions and water consumption at power stations.
- Helping to address the affordability of electricity for low-income consumers.

The programme has three principal themes:

- Residential, commercial and industrial programmes designed to transform South African electricity supply into an energy-efficient industry.
- Public education to increase awareness about energy efficiency.
- Schools programme to highlight the benefits and importance of using electricity efficiently, through providing participating institutions with resources packs, including teacher, learner and electricity audit guides.

In 2004, total savings during peak periods of 197 MW were recorded by Eskom and reported to the national regulator under Eskom's demand-side management programme - a major improvement from the 101 MW achieved in 2003, and exceeding the 152 MW annual savings target by approximately 30%. The 197 MW was made up of 114 MW from energy efficiency measures and 83 MW from load management. Because South Africa's electricity supplies are largely generated from coal-fired power stations, every 1 kWh saved through energy efficiency measures avoids an emission of about 1 kg of carbon dioxide and reduces water consumption at power stations by about 1.2 litres.

### ***Compact fluorescent lighting rollout in Alexandra***

The Alexandra Township forms part of the City of Johannesburg and consists of both formal and informal residences that have access to essential services. The energy efficiency rollout project focused on approximately 50 000 houses, including both one- and two-bedroom houses with between four to six occupants. The project aimed at replacing 150 000 incandescent lamps with compact fluorescent lamps as part of a pilot phase.

To encourage community participation and empowerment, unemployed people in Alexandra were engaged as project staff. These recruits were trained in compact fluorescent lighting and its advantages over incandescent lamps, safety issues, data gathering forms, and procedures on visiting households.

A number of challenges were experienced in the rollout of the project, which were recorded to form a basis for future rollouts, including:

- Unavailability of household data.
- Limited supervisory skills of local resources.
- Logistics relating to the collection and distribution of fluorescent lamps during working hours.
- Unavailability of households during normal working hours.
- Light output - Eskom had assumed 60 Watt incandescent bulbs as a basis for specifying 11 Watt “warm-white” fluorescent lamps, but about half the households were using 100 Watt incandescent lamps.
- Facility for exchange of lamps.

### ***Pick 'n Pay supermarket***

With its countrywide chain of supermarkets, Pick 'n Pay realised that it could enjoy substantial electricity savings by converting its lighting, heating and air conditioning systems to energy efficient ones. The company has installed energy-efficient lighting in all new stores and is currently retrofitting 97 established outlets, which should save approximately ZAR 1.5 million annually in reduced energy bills. The capital costs of the project should be recouped in just over two years.



## Working with Suppliers to Achieve Sustainable Development

### Case Study 5. Power station ash and flue gas desulphurisation residue by-products as construction material, USA (CONSOL Energy)

*Sulphur and fly ash emissions from coal-fired power stations can now be reduced to acceptable levels by commercially-available capture technologies. Economic recycling of the residue materials is a further contribution to the sustainable use of coal in power generation. In 1997, CONSOL Energy commenced development of a beneficial use for these by-products in a joint venture with SynAggs LLC, aided by funding from the US Department of Energy and other co-sponsors. CONSOL developed a synthetic aggregate from a mixture of flue gas desulphurisation sludge and pulverised coal fly ash, which can be used in road paving applications and for the manufacture of concrete blocks. A new company, Universal Aggregates LLC, has been formed to commercialise and market the technology. CONSOL's approach illustrates several important lessons for the commercial application of sustainable development principles: it is a "zero-waste" approach; it reduces the need for costly land disposal of wastes; it creates a business opportunity, providing jobs and economic stimulus to regional support industries; it provides a compatible technology in support of flue gas scrubbing at coal-fired power stations, itself a sound technology for improving air quality and public health.*

The technology has been demonstrated in both bench-scale and pilot-plant tests. It is capable of producing manufactured aggregates from a variety of coal combustion by-products, including pulverised coal fly ash, fluidised bed combustion ash, and those generated from wet and dry flue gas desulphurisation (FGD).

Universal Aggregates LLC signed a Co-operative Agreement with the Department of Energy (DOE), through the *Power Plant Improvement Initiative*, to demonstrate the technology on a commercial scale. Universal Aggregates built and operates the aggregate manufacturing plant in Virginia using spray-dryer ash from the Birchwood Power Station. Previously, the power station had to pay the costs of disposing more than 100 000 tons of ash in a local land-fill each year, but Universal Aggregates' newly-built, recycling plant saves Birchwood operators land-fill costs by converting some of the waste into raw material for concrete block manufacturing. Across the USA, a greater proportion of the estimated 28 million tons of FGD waste could be converted into building materials, rather than sending this waste to land-fills.

US Secretary of Energy Samuel Bodman has commented, "By seeking alternative uses for these waste materials, we are showing how innovation is the key to environmental stewardship. Materials that once were discarded are now going into construction projects, not land-fills." Universal Aggregates is currently in negotiations with several electricity generation companies that have expressed a strong interest in the technology.

### Case Study 6. Utilisation of coal combustion by-products in Europe (ECOBA)

*The list of uses for coal combustion products continues to expand: land-fill, agricultural applications, mine and quarry reclamation, road construction, cement replacement/enhancement in concrete, gypsum products, and other construction applications. In most of these cases, coal combustion by-products replace naturally occurring resources and offer environmental benefits by avoiding the need to quarry or mine these resources, and by reducing energy demand, as well as emissions, that would otherwise result from the manufacturing processes of the products replaced. ECOBA, the European Association for Use of the By-Products of Coal-Fired Power-Stations eV, was founded in March 1990 to address matters related to the use of construction raw materials from coal. Membership covers twelve countries across Europe. ECOBA seeks to ensure beneficial use of by-products from coal-fired electricity generating plants through product and environmental research. ECOBA ensures the highest standards of use are maintained and further developed, and has been particularly active in the development of European standards.*

Fly ash captured by electrostatic or mechanical precipitation of dust-like particles from power station flue gas accounts for the largest proportion of by-products from coal combustion. Other important by-products

include bottom ash, gypsum from flue gas desulphurisation, and boiler slag. In the European Union, almost 50% of the fly ash and bottom ash produced by coal-fired power stations is used in the construction industry, while 71% of the gypsum and all the boiler slag are used.

Coal combustion by-products are used in a wide range of applications in the building and construction industry, for example as an additive in concrete manufacture, as a cement replacement material, and as an aggregate or binder in road construction. They are also used as mineral fillers and as fertilisers. The by-products meet national and European building materials standards and regulations.

Coal combustion by-products can significantly enhance the performance of products. When fly ash is added to concrete, for example, the spherical particles act like ball bearings in the mix, improving the workability and flow characteristics of concrete and the grading curve of the concrete mixture. These features reduce water requirements. Fly ash reacts with calcium hydroxide from the cement hydration to form stable hydrates of calcium silicate and calcium aluminate. The resulting concrete is not only stronger and more durable, but also less permeable and more resistant to chemical attack, such as from chlorides and sulphates. Fly ash use can also reduce crack formation in concrete by lowering hydration heat.

## CASE STUDIES: ENVIRONMENTAL IMPACTS

Responding positively to the environmental impacts of coal production and use involves several considerations that will determine the priorities selected by a company. These will include, for example, the expectations of key stakeholders, life-cycle benefits and impacts, detailed technical understanding of environmental impacts, costs and benefits of alternative courses of action open. The strategy adopted will vary from company to company, and will depend on the particular circumstances faced. In general, a company will need to develop a strategic plan to address key environmental impacts based on product stewardship and a life-cycle approach.

### Managing Waste

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#### **Case Study 7. J-Power's biomass co-firing project at Matsuura, Japan (Electric Power Development Company)**

*As one of the largest coal users in Japan, J-Power has recognised the importance of reducing environmental impacts from its business activities and set its corporate philosophy as follows: “We aim to ensure constant supplies of energy to contribute to the sustainable development of Japan and the rest of the world”. Like other companies, J-Power is developing technology to reduce emissions of greenhouse gases and waste from its coal-fired plants. In this respect, J-Power is using biomass fuel in conventional, pulverised coal-fired boilers. J-Power considers the Matsuura co-firing project to be a strategic approach to strengthen the competitive position of coal-fired power plant, despite the high cost of the fuel and the barriers to its use imposed by Japanese legislation governing power stations.*

Matsuura power station has two 1 000 MW boilers using ultra-super critical technology and state-of-the-art air/water pollution control. The plant consumes about two million tonnes of coal each year. Up to 1% of the coal can be substituted by biomass fuel - in this case, made from bio-sludge produced from sewage treatment.

The project achieves three goals: reduction of carbon dioxide emissions, reduction of waste from the plant, and compliance with the *Special Measures Law Concerning the Use of New Energy by Electric Utilities*, which came into effect in 2002. This law mandates 12.2 TWh of electricity derived from renewable energy by 2010, or approximately 1.35% of total, nationwide electricity output.

Granules of dried biomass material, called “Bio-Solid”, are used as fuel. Bio-Solid is produced by frying bio-sludge with waste bio-oil. The caloric value of Bio-Solid is roughly equal to that of coal, about 24 000 kJ/kg. J-Power purchases Bio-Solid fuel from a sewage treatment plant in Fukuoka, some 100 km from the Matsuura power station.





**Figure 4. J-Power's Matsuura thermal power station, Nagasaki prefecture**

During 2004-05, J-Power conducted demonstration tests to explore how biomass co-firing affects operation of the plant and the possibility of commercial operation of the process. At present, the maximum rate of co-fired Bio-Solid is 1% (heat equivalent), and 1 200 tonnes are being consumed each year. Consumption in a future commercial plant is planned to be considerably greater. Issues being investigated include burning characteristics, flue gas quality, waste water quality, ash quality,

and impacts on boiler and other facilities after long-term operation. From 2006, commercial operation is expected to start.

**Figure 5. Bio-Solid: granulated biomass**

As well as technical verification, J-Power is currently investigating expanding Bio-Solid fuel procurement. Bio-Solid is an expensive fuel because sources are widely distributed and shipping costs are high. In the case of the Matsuura co-firing project, shipping cost is the dominant element of the total cost, being dozens of dollars per metric tonne. Diversifying the type of biomass fuel used, for example to include wood chip or municipal solid waste, could expand the potential of biomass energy in Japan.



The cost of bio-fuel is high because Japanese power stations operate under the *Electric Utility Law* and not the *Waste Management Law*. In principle, waste material is banned from use in commercial power generation. To overcome this barrier, biomass fuel must be traded as “valuable materials” for which prices are correspondingly higher. Power generators are obliged to purchase waste instead of being recognised as performing a valuable service by disposing of waste.

### **Case Study 8. Using fly ash and bottom ash, Japan (Japan Fly Ash Association)**

*Coal-fired power stations produce two principal forms of ash - fly ash and bottom ash. Both are readily captured in modern power stations. Coal ash has been used as an additive in concrete since the 1950s, but production of cement and concrete in Japan is decreasing. Government legislation and the work of the Japan Fly Ash Association have encouraged research on coal ash, and other uses for coal ash have been developed or expanded to contribute to the continuing sustainability of coal use. Many economic and environmentally-acceptable means of using the material have been developed that use the sometimes unique physical and chemical qualities of coal ash.*

Coal ash, produced by burning pulverised coal, is of two types - fly ash, which is captured from power station flue emissions, and bottom ash, which is ash recovered from the bottom of the boiler and crushed. Fly ash and bottom ash have similar chemical properties but different physical qualities making them suitable for a wide range of uses. Japan has thirty-eight, coal-fired power stations and additional power stations are under construction or in planning. In a coal-fired power station with a capacity of 1 000 MW, about two million

of coal is consumed and about 230 000 tonnes of coal ash is produced each year. In Japan, the production of coal ash is expected to increase from 6.9 million tonnes in 2002 to about 10 million tonnes by 2010.

Since 1955, coal ash has been used as an additive for concrete, but further research has resulted in its use in dams, where very high reliability is required. Today, fly ash is used in large quantities for major construction projects such as dams, foundations for bridges and power plants (including nuclear power plants), as well as in building materials, road bases, fertilisers, and soil stabilisation works. In Japan, the *Promotion of Recyclable Resources Law* defined coal ash as a by-product and promoted the development of technologies for its use. Coal ash possesses some unique physical and chemical properties not found in other materials, including: long-term strength; low rate of drying shrinkage after curing, reducing the risk of cracking; good workability; heat, chemical and water resistance; low heat generation due to hydration; and, capacity to prevent alkali-aggregate reactions.

In 2002, about five million tonnes of coal ash were used. Most was used in cement making as a clay substitute, which accounted for 3.64 million tonnes. The remainder was used as building materials, as an additive to concrete and cement, road-making, soil improvement, agriculture and fish-breeding, and many other applications, including water treatment, backfill, and as a desulphurising agent.

The Japan Fly Ash Association is working to improve the quality of coal ash and to establish a reliable supply of the material, to expand research on utilisation technologies and use, and to contribute to environmental benefits through the recycling of coal ash.

## Tackling Greenhouse Gas Emissions from Coal-fired Power Generation

### Case Study 9. Industry-government co-operation on the use of coal in China

*Individual companies can take the initiative in promoting sustainable development, as these case studies illustrate; but, in some areas, governments must take the lead, supported by industry expertise. For example, how China and India use coal in the future will be possibly the single most significant influence determining the success of global climate policies.*



**Figure 6. Exploration drilling**

China's hard coal consumption grew by 55% between 2000 and 2004 to 1.9 billion tonnes. With 500 coal-fired units planned to come on-line over the next ten years, the surge in China's coal production, use and trade is set to continue.

The Australian coal industry is actively promoting the sustainable use of coal in China by agreeing to form an Australian Coal Mine Safety task-force to exchange expertise with the Chinese State Administration of Work Safety. The first meeting of the industry task force with Chinese representatives was held in August 2005.

In the words of the Hon Ian Macfarlane MP, Minister for Industry, Tourism and Resources, announcing the establishment of the task force "... Australia can offer more than just raw materials to fuel China's growth and development ... our nations can trade ideas and expertise as much as we can goods and services."

## Case Study 10. COAL21: an Australian partnership for low-emission electricity from coal

*Coal fuels over 80% of Australia's electricity generation and is valued by the government and many stakeholders as a competitive source of energy and the nation's leading export. Co-operation between the industry and a wide group of stakeholders in COAL21 is a constructive way of ensuring the future of coal, both domestically and in export markets, by working towards enhancing coal's environmental performance. COAL21 is a partnership between coal producers, unions, electricity generators, research institutions, and the Federal and State Governments. It was the initiative of the Australian Coal Association and its members, responding proactively to the need to reduce emission of greenhouse gases from coal use. The case study illustrates how a public-private partnership approach can help the transition from established practices and technologies to a sustainable future in which coal retains its dominant role in the world energy economy.*

The objectives of COAL21 are to:

- Create a national plan to scope, develop, demonstrate and implement near-zero emissions, coal-based electricity generation that will achieve major reductions in greenhouse gas emissions over time and maintain Australia's low-cost electricity advantage.
- Facilitate the demonstration, commercialisation and early uptake of technologies identified in the plan.
- Promote relevant Australian research, development and demonstration activities and provide a mechanism for effective interaction and integration with other international zero-emission coal initiatives.

Following twelve months of consultation among the participants and other interest groups, in March 2004, COAL21 released a *National Plan of Action* for reducing greenhouse gas emissions from the use of coal in electricity generation and, in 2005, a report on progress.<sup>9</sup>

The COAL21 Action Plan reviews current and emerging technologies for reducing emissions from coal-fired generation and identifies those that are particularly promising for Australia by achieving near zero-emissions, increasing energy efficiency and facilitating hydrogen production. The plan recommends actions and government policies necessary to accelerate commercialisation and adoption of these technologies in Australia. The plan quantifies the abatement of greenhouse gas emissions achievable through the deployment of the key technologies over coming decades.

Geological storage of carbon dioxide is pivotal because it has the potential to deliver deep cuts in emissions. Reducing the cost of capturing carbon dioxide from power generation is the key research challenge to enable commercial application. The extent and rate of potential abatement of emissions from coal-based generation will depend on how actively technological advances are pursued. The COAL21 Action Plan separates the period to 2030 into two phases:

- To 2015, the main focus should be on developing priority technologies to the stage that they are commercially deployable by Australian industry; commercially-viable opportunities to reduce greenhouse emissions, such as ash/methane use and plant retrofits, should be taken; and any new base-load, coal-fired capacity should be the most efficient and competitive available.
- From 2015, the newly-commercialised, priority technologies should be deployed, particularly carbon dioxide capture and storage; "sequestration-ready" technologies, such as IGCC and oxy-fuel combustion, should be preferred for new capacity.

COAL21 calls for a significantly greater commitment on the part of industry and government than in the past. Government-supported investment in demonstration-scale plants and a focus on areas of technology development where Australia has emerging expertise are recommended.

9. [www.coal21.com.au](http://www.coal21.com.au)

## Case Study 11. FutureGen, USA

*In addition to carbon dioxide, it is now believed to be technically possible to limit all emissions from coal-based power generation to near zero. However, before this technology can be deployed economically, it needs to be proven at a large scale. Using available technology and technology under development, an industry alliance with the US government is planning to build a zero-emissions, coal-based power plant, known as FutureGen. FutureGen is a billion dollar, ten-year demonstration project in the USA to create the world's first coal-based, near zero-emission electricity and hydrogen plant with carbon capture and storage. FutureGen is a Presidential initiative supported by a consortium of nine of the largest electric utilities and coal companies in Australia, China, the UK and the USA. The project demonstrates a practical and proactive response to climate concerns by the US government and coal users and producers, based on the precautionary principle. The FutureGen Alliance demonstrates the sustainable development principles of openness and participation by creating a partnership to take forward mutually important work that is, by its nature, longer-term without any prospect of direct commercial return.*

The Alliance currently consists of American Electric Power, Anglo Coal, BHP Billiton, CONSOL, Kennecott Energy Company (Rio Tinto), Peabody Energy, Foundation Coal, Southern Company and the China Huaneng Group. A number of other coal production and coal-using electricity generation companies throughout the world are considering membership and the US government is actively seeking the collaborative participation of a number of other nations. The key goals of the companies for FutureGen are to:

- Develop commercially-competitive and affordable coal-based electricity and hydrogen production systems that have near-zero emissions.
- Develop large-scale carbon dioxide sequestration technologies, which are technically and economically viable and publicly acceptable.
- Provide a large-scale research platform for the development and commercialisation of advanced technology.
- Provide opportunity for stakeholder involvement and education.

FutureGen will be a nominal 275 MW prototype plant that produces both electricity and hydrogen and sequesters at least 90% of carbon dioxide emissions from the plant. The size of the plant is driven by the need for commercially-relevant data, including the requirement for producing one million tonnes per year of carbon dioxide, to adequately validate the integrated operation of the gasification plant and the receiving geological formation.

FutureGen is an important component of the US climate change policy response, and, because of its large scale and comprehensive nature, is a project of global importance. Government funding is now confirmed and the companies are finalising commercial and contractual details of their participation with the US Department of Energy.

The project is a unique and important opportunity for stakeholder engagement in a full-scale integration of carbon capture and storage with coal-fired electricity generation. Significant challenges include:

- Defining a viable project scope. The diverse range of key participants involved, the scale of the project, and the number of technologies involved, bring many different objectives to the project.
- Delivering results in a meaningful time-frame.

FutureGen is open to other governments and companies, and to international collaboration. As other relevant projects proceed, this collaboration will be important in providing wider confirmation of the technologies essential for the economic use of coal in an environmentally sustainable manner.



## Case Study 12. Genesee 3: the greenest coal plant in Canada (EPCOR & TransAlta)

**Figure 7. Genesee 3 power station**

*The most advanced, coal-fired facility in Canada was commissioned on 1 March, 2005. It features the first use of supercritical technology in the country, and an enhanced technology suite which - combined with an industry-leading commitment to reduce and offset greenhouse gases - could bring greenhouse gas emissions down to the level of a natural gas combined-cycle plant. The facility is Genesee 3, co-owned by EPCOR and TransAlta, operated by EPCOR, and located 70 km southwest of Edmonton, Alberta, Canada. This case study*



*illustrates how, in a competitive electricity market, companies will invest in advanced coal technology when this is in their own commercial interests. Whilst some provinces have chosen to postpone deregulation of their electricity markets and to discourage further investment in coal-fired power, Genesee 3 has improved the outlook for coal-fired generation in Canada and across the continent. At a time when coal is viewed with increasing scepticism, EPCOR and TransAlta have delivered a project regarded as an environmentally-responsible option by regulators, investors, stakeholders and the public.*

Backed by a rapidly expanding economy, Alberta's peak electricity demand has risen 5% per year since 1999, and now exceeds 9 200 MW. Nearly 60% of peak demand is served by base-load, coal-fired generation, with gas supplying most of the remaining load. Alberta lacks the geology required for major hydropower development, has no history of nuclear power, and has limited interconnections to other jurisdictions. Most new generation has been natural-gas fired, with some renewables. But fuel prices, supply uncertainty and reliability make these unsuitable options for base-load power.

By 2000, industrial and population growth had significantly increased Alberta's demand for electricity. Genesee 1 and 2, completed in 1989 and 1994, were among the first coal-fired generating plants in Canada to achieve ISO certification for their environmental management systems. Owned and operated by EPCOR, G1 and G2 deliver 762 MW of base-load power to Alberta's electricity grid. To help meet the demand for power, EPCOR proposed a third unit at Genesee.

When Genesee 3 was proposed, no new coal facilities had been approved in Western Canada for twenty years. EPCOR and TransAlta had to demonstrate that coal had a future as an environmentally-responsible fuel choice. Genesee 3 posed significant business risks, being the first base-load generator built in a newly deregulated power market, and amidst heightened environmental concerns.

The CAD 695 million project was completed on-time in 36 months and on-budget. At 450 MW, Genesee 3 is the largest generation unit ever added to Alberta's power grid, supplying enough power for a city of 350 000. Public consultation and an environmental impact assessment were completed in June 2001, and the application for the development was filed with the Alberta Energy and Utilities Board in July 2001. The approval from the regulator was received in December 2001, after a six-day public hearing. Advance meetings with neighbours, environmental groups and stakeholders throughout 2001 ensured that many issues were addressed prior to the hearing.

Genesee 3 is the most advanced coal-fired power plant ever built in Canada, being the first to use supercritical technology. The supercritical process, which features higher boiler temperatures and pressures, and a high-efficiency turbine, delivers an 18% improvement in fuel efficiency. Because less fuel is used to produce the same amount of power, carbon dioxide emissions per MW are 18% lower than at an average, coal-fired plant.

EPCOR and TransAlta have committed to offset Genesee 3's carbon dioxide emissions down to the level of a natural gas combined-cycle plant - a further 52% reduction - beginning in 2005. This commitment is the first of its kind in Canada, and is a condition of the approval for the plant.

A CAD 90 million investment in clean air technologies cuts nitrogen oxide emissions by one half, and stops 99.9% of particulates from reaching the atmosphere. It also cuts sulphur dioxide emissions significantly below the provincial emission limit.

The Canadian Electricity Association consistently ranks EPCOR's plants - and the Genesee Generating Station - as national leaders for availability and operating reliability. EPCOR President and Chief Executive Officer, Don Lowry has tied the company's sustainability directly to an ability to lead, and consistently raise the bar on performance. *"Every power plant we build must be better than the last ... this will give us the advantage we need to stay competitive and outperform others."* Upon approval in December 2001, Alberta regulators called Genesee 3 *"the most technologically-advanced, coal-fired power plant in Canada"*.

### Case Study 13. EPRI CoalFleet of the future study, USA

*The EPRI CoalFleet study is a good example of collaboration at work across the industry. It seeks to address environmental concerns through group action to lower the costs of advanced technologies. The study showcases the principles of openness and transparency and adopts the precautionary approach in creating low-cost, environmentally-friendly alternatives for the future. CoalFleet has over forty participants representing nearly half of the US coal-fired power generation fleet, as well as suppliers, engineering firms, non-US participants and the Department of Energy. CIAB members include E.ON AG, E.ON UK and AEP.*

The Electric Power Research Institute (EPRI) is an independent, US-based, non-profit organisation for energy and environmental research of public interest and benefit. EPRI's members are responsible for over 90% of the electricity generated in the United States and international participation accounts for nearly 15% of EPRI's total research and development programme. EPRI's integrity is based on its ability to provide clear, credible and independently verifiable scientific and technical research. Its environmental research is regularly submitted to peer review and third-party scientific committees to assure it meets best scientific practice.

The EPRI CoalFleet study responds to an interest among US utilities in plant designs that have the flexibility to allow carbon dioxide capture and storage systems to be installed in the future. This has led to an increased interest in integrated coal-gasification combined-cycle (IGCC) plants, which are possibly more adaptable to retrofitting a carbon capture and storage system. Among recent announcements, AEP has stated its intention to build a 600 MW IGCC plant in the next decade, Cinergy has announced similar plans, and the US Department of Energy has selected two IGCC projects to fund in the Second Round of its *Clean Coal Power Initiative* - Southern Energy Company/Orlando Utilities' 280 MW air-blown KBR IGCC, and Excelsior's 530 MW oxygen-blown E-Gas IGCC. Although none of the new plants that have been announced include carbon capture and storage in their initial designs, utilities would consider a staged approach in which carbon capture and storage is delayed until financial or legislative conditions allow its deployment.

The key focus in the medium term will be reducing IGCC capital and electricity production costs to near that of new pulverised-coal plants. EPRI's CoalFleet study will have a key role to play in assisting the implementation of new IGCC plants. The goals of the study are to:

- Ensure that coal remains a strategic fuel option in electricity generation portfolios, providing price stability and security.
- Work with plant owners to support/accelerate early deployment of three to five commercial advanced coal plants in four to eight years, with consideration for carbon dioxide capture adaptability.
- Speed availability of competitive, next-generation coal plants in 2015-2020, with carbon dioxide capture adaptability and viable sequestration options, to meet government and industry roadmap goals.

- Take advantage of today's “window of opportunity” to enable the cost-effective and timely transition to clean coal technology.

As part of this exercise, EPRI will:

- Build an industry-driven collaborative partnership, led by major coal generation owners intending to build advanced coal plants, and focus on accelerating the deployment of new commercial plants.
- Involve other key stakeholders in industry and government in a supporting role to ensure commercial viability of advanced coal plants.
- Address barriers to commercialisation and regulatory/public acceptance through incentives and permitting.
- Support the development of standard plant design guidelines to reduce technology, performance and financial risks.
- Accelerate and augment research, development and demonstration for advanced coal technology and carbon dioxide capture and sequestration

The EPRI CoalFleet study will undertake the following work:

- Assess the need for early deployment incentives, the impacts of plant design on permitting, and the communication needs to promote regulatory and financial community awareness that would support permitting and early deployment of advanced coal plants.
- Develop design guidelines to assure that required plant capabilities are met and to minimise design, permitting, and construction times, costs and risks through “reference-plant” designs. The CoalFleet programme will address several types of advanced coal plants including IGCC, and other efficient, near-zero emission combustion systems.
- Accelerate and augment research, development and demonstration by complementing existing government programmes with industry-led projects to support early plant deployments and to hasten commercialisation of next-generation designs.

### **Case Study 14. Supporting development of low-emission technologies, Australia (Xstrata Coal)**

*Xstrata Coal has joined a number of Australian energy producers, clean coal technology researchers from Australia and Japan and a major Japanese power engineering company in a project to help position Australia - and the State of Queensland in particular - at the forefront of emission reduction technology development. The project at CS Energy's Callide A power station is investigating the development of oxy-fuel technology for a first-of-a-kind demonstration power plant, which would also capture and store the carbon dioxide produced.*

Oxy-fuel combustion has the potential to significantly lower the cost of capturing carbon dioxide from conventional coal-fired power stations. Pure oxygen, rather than air, is fed to a modified conventional boiler and a proportion of the flue gases is recycled through the combustion chamber, significantly raising the concentration of carbon dioxide. The low concentration of carbon dioxide in the flue gases of conventional power stations is the major barrier to carbon dioxide capture, because it is very expensive to separate and process.

Oxy-fuel combustion is one of the priority technologies identified in the COAL 21 *Plan of Action for Australia* (see Case Study 10) as being of most relevance to Australia because of its potential as a retrofit option for Australia's existing fleet of coal-fired power stations. Xstrata Coal is also an active participant in the COAL 21 programme.

Oxy-fuel technology is one of several technologies that could contribute to the sustainable use of coal: it could prove to be a lower-cost and lower-risk technology option for achieving near-zero emissions from coal-

based electricity generation; it has the potential to be retrofitted to standard, pulverised coal-fired boilers; and, it could be applied to new coal-fired plant with significant reductions in the capital and operating cost of flue gas cleaning equipment, such as that used to reduce oxides of nitrogen.

### **Case Study 15. Thermal efficiency improvement project at Huangtai coal-fired power plant, China (Kyushu Electric Power)**

*Transferring modern coal-fired power technology to countries such as China and India, where coal use is growing rapidly, could have major regional and global environmental benefits as well as contributing to economic growth and social well-being in those countries. Kyushu Electric Power of Japan, has agreements with eight electric power companies in seven countries to exchange management and technical information as of 2000, and to respond to energy and environmental problems. Under one of these agreements, Kyushu responded to a request from Shandong Electric Power to improve the thermal efficiency of Shandong's existing thermal power plants in China. The two companies selected Huangtai Thermal Power Plant No. 7 for improvement, and work completed in 2000 improved the efficiency of the plant by 4.4%age points resulting in an annual fuel saving of 90 000 tonnes of coal and reduced carbon dioxide emissions of 210 000 tonnes.*

Shandong Electric Power supplies about 89 million customers (1997) in a service area of 156 000 square kilometres. The company generates nearly 90 TWh and employs 61 000 people. Huangtai Plant No. 7 is located in a suburb of Jinan City and began service in November 1987. It generates 1.9 TWh annually, using locally-mined coal. By 1998, the plant's thermal efficiency had decreased by about 4.5%age points from its original value. Based on performance tests, Kyushu Electric Power identified a number of causes. Boiler-related causes included decreased heat transfer due to accumulated ash on the heating surfaces. Turbine-related causes included losses due to ageing of the high pressure and low pressure turbines.

In 2000, Shandong and Kyushu agreed on actions to improve the efficiency of Unit No. 7 at the plant and the work was completed by October 2000. Performance tests showed that the thermal efficiency of this 300 MW unit was improved from 33.17% to 37.57% as a result of the actions taken. This resulted in the reduction of about 90 000 tonnes annually of coal use and a reduction in carbon dioxide emissions of about 210 000 tonnes.

The work undertaken by Kyushu is also expected to reduce emissions of sulphur and nitrogen oxides, and so moderate the impact of acid rain on Japanese territory. Reduction in carbon dioxide emissions is of global significance. The transfer of power generation technologies to China should contribute to improving the thermal efficiency of other plants, and to improving energy supply and economic development in China. The experience gained through the project is expected to enhance Kyushu's capability and know-how, and to help Kyushu's related companies to develop future projects and to grasp other business opportunities outside Japan.

## **Reducing Methane Emissions from Coal Mining**

### **Case Study 16. Illawarra coal mine gas utilisation, Australia (BHP Billiton)**

*As well as a potential safety hazard, coal mine methane is a potent greenhouse gas with twenty-three times the global warming potential of carbon dioxide if released to the atmosphere, and almost three times that of carbon dioxide if flared (burnt off).<sup>10</sup> It is also a potentially valuable energy source, either for supply to a gas*

10. When methane is simply released to the atmosphere, its contribution to global warming is 23 times that of an equivalent mass of carbon dioxide (eight times by volume). If, instead, it is flared, the methane is converted into carbon dioxide (and water) at the rate of 2.75 tonnes of carbon dioxide per tonne of methane gas.



*distribution grid, if the quantities recovered are sufficient, or for on-site electricity generation. Using coal bed methane demonstrates how the application of sustainable development principles can simultaneously achieve commercial and environmental goals.*

BHP Billiton owns and operates several underground coal mines in the central coastal Illawarra region of New South Wales, Australia. Two of them - West Cliff and Appin collieries - are “gassy” mines containing in-seam concentrations of methane that would pose an unacceptable safety risk to mineworkers, and need to be reduced to acceptable levels by drainage operations in advance of mining.

BHP Billiton's Illawarra operations presented an opportunity to meet a number of sustainability objectives. While the primary motivation for draining the methane from the West Cliff/Appin mine seams was to improve safety, there was potential for using the gas in on-site power generation to enhance the commercial sustainability of the mining operation and reduce greenhouse gas emissions.

Illawarra Coal, working in partnership with Energy Developments Limited (EDL), achieved these objectives through the establishment in 1995 of the Appin Tower Power Project. The project consists of ninety-four gas engines operated by EDL, each of which is capable of generating 1 MW of electrical power from coal bed methane, primarily from the Appin and West Cliff mines. The electricity generated is supplied to the local electricity distributor, Integral Energy and is sufficient to power up to 60 000 homes.

The project abates greenhouse gas emissions in two ways - by avoiding the venting or flaring of methane, and by displacing or forestalling more carbon dioxide-intensive (mainly coal-based) electricity generation elsewhere in the New South Wales power grid. The combined effect is a reduction in emissions of about 2.5 million tonnes of carbon dioxide a year, which makes it one of the most significant greenhouse gas abatement projects in Australia. The project has an important place in BHP Billiton's commitment to the Australian Greenhouse Challenge programme, which is a co-operative effort by Australian industry and governments to reduce greenhouse gas emissions through voluntary action.

### **Case Study 17. Methane capture and utilisation, German Creek, Australia (Anglo Coal)**

*Deeper coal seams, particularly those consisting of hard coking coal, generally contain significant quantities of methane, part of which is released into the mine ventilation system and the atmosphere when the coal is mined. It is this fugitive methane that constitutes the main greenhouse impact of black coal mining. It represented approximately 75% of Anglo Coal's greenhouse emissions in 2004, a proportion reasonably representative of the whole Australian black coal industry. The Australian mining industry has long practiced methane drainage in gassy underground mines as a safety management procedure - primarily by drilling drainage holes into the coal to reduce its methane content ahead of mining. Like other coal mining companies, Anglo Coal is developing methane drainage as a greenhouse gas reduction technique and combining it with methane utilisation initiatives to minimise fugitive emissions and maximise the use of an otherwise waste product.*

Anglo Coal's methane strategy has three major activities: improved methane capture, pipeline development, and mine site utilisation.

#### **Improved methane capture**

Anglo Coal has extended methane capture with the development and uptake of “surface to in-seam” drilling techniques that enable the coal seams to be drained of methane from the surface, well in advance of mining. With scope for pre-drainage periods of many years, this technique improves the recovery and cost efficiency of methane capture. The technology has been used for many years at the company's Dawson mine, where much of the technology was developed, and its use has now been extended to Anglo's other coking coal mines at German Creek and Moranbah North.

### **Pipeline development for methane sales**

Access to a gas pipeline has the potential to generate revenue from mine methane, thereby underpinning investment in methane drainage and further reducing fugitive emissions. The early development of methane drainage at Dawson gained impetus from access to the nearby Gladstone gas pipeline, and for several years Anglo has been active in fostering the development of pipeline access for its other coking coal mines at Moranbah North and German Creek. One pipeline has been constructed providing a market outlet for methane drained by surface to in-seam methods at Moranbah North mine.

### **Mine-site methane utilisation**

In the absence of access to a gas pipeline, some form of gas-utilising, mine-site project is required to provide a use for mine methane. Dawson mine has the benefit of an adjacent ammonium nitrate plant as well as a pipeline to provide an outlet for methane, but Anglo's German Creek mine has had neither pipeline access nor any form of on-site methane utilisation. Consequently Anglo has entered into agreements with Energy Developments Limited for the development of a gas-fired power project at German Creek to utilise the drainage methane associated with underground mining operations.

The 32 MW project, consisting of sixteen reciprocating engines each with 2 MW output, is supported by a Commonwealth Government grant and is expected to begin operation in early 2006. The greenhouse gas mitigation effect of the power project at full capacity is 1.1 million tonnes of carbon dioxide equivalent per year, including the effect of displacing the emissions from alternative fuels that would otherwise be used to generate the equivalent amount of electricity. That amount of mitigation is equivalent to planting 1.6 million trees or taking 250 000 cars off the roads.

### **Case Study 18. Coal-bed methane horizontal drilling demonstration with CO<sub>2</sub> storage (CONSOL Energy)**

*Energy-related activities are responsible for more than 80% of US greenhouse gas emissions, and most of these emissions are carbon dioxide. Carbon capture and storage offers an approach to redirect carbon dioxide emissions into sinks such as geological formations, oceans, soils and vegetation, contributing to stabilisation of carbon dioxide levels in the future. Coal seams are attractive sinks because of their abundance and proximity to electricity-generation facilities. CONSOL is demonstrating the application of a coal-bed methane (CBM) production technology known as horizontal drilling to degasify coal seams and to use the gas production holes to store carbon dioxide. Recovering marketable methane provides a value-added stream, potentially reducing the cost of capturing and storing carbon dioxide. Research is needed to evaluate the storage capacity, stability, commercial feasibility and overall economics of this technology.*

With support from the United States Department of Energy (USDOE) National Energy Technology Laboratory (NETL), CONSOL is undertaking a seven-year programme to construct and operate a coal bed storage site composed of a series of horizontally drilled wells that originate at the surface and extend through two overlying coal seams. Once completed, all the wells will first drain CBM from the upper (mineable) and lower (unmineable) coal seams. After draining 50-60% of the CBM reservoir, centrally-located wells in the lower coal seam will be converted from CBM drainage wells to carbon dioxide injection ports. Injecting carbon dioxide should enhance methane production, while storing carbon dioxide in the unmineable seam. Carbon dioxide will be measured and injected into the lower coal seam while CBM continues to drain from both seams. Additional monitoring wells will be used to further examine horizontal and vertical migration of carbon dioxide.

Directional drilling of horizontal wells promises to be a more productive and much lower-cost alternative to the more conventional, vertical-frac wells for CBM production. In particular, horizontal drilling is likely to be effective in most coal seams, regardless of geological environment, while wells stimulated by hydraulic fracturing require a favourable geology to be effective.

A unique feature of this work is that CBM is being drained simultaneously from a mineable coal seam overlying the unmineable seam. By removing CBM from the mineable seam, methane that would otherwise have been vented to the atmosphere during mining is being captured and used. Thus, the technology provides the dual greenhouse-gas-reduction benefits of storing carbon dioxide in the unmineable seams and avoiding methane emissions, a potent greenhouse gas, from the mineable coal.

The horizontal technique involves drilling vertical production wells through the targeted coal seams, then a number of guided boreholes that deviate from the vertical wells, extending up to 915 metres horizontally in the coal seam. This allows CBM production and carbon dioxide storage over a large area from relatively few sites. In full commercial application, vertical drilling could require up to thirteen wells, while horizontal drilling would require only six wells. Reducing the number of wells will reduce the initial cost and land area affected by drilling operations.

## Coal-to-liquids for Low-emission Transport Fuels

### Case Study 19. Monash energy coal-to-liquids and carbon capture and storage project, Australia (Anglo Coal)

*Anglo Coal's subsidiary Monash Energy has plans to convert brown coal mined in Australia's Latrobe Valley to ultra-clean diesel fuel. The process achieves low emissions to the atmosphere by separating a concentrated stream of carbon dioxide for transport by pipeline to injection wells for secure storage deep underground in geological formations. The development of sustainable, low-emission technologies is vital to maintaining the status of the Latrobe Valley as the premier base load supplier in Australia's National Electricity Market. For this reason the State and Federal Governments are making available funds for new technology demonstration projects, providing a potential pathway for the Monash Energy project to reach commercial development by initially bringing advanced coal drying and gasification technologies into operation.*

The Monash Energy vision involves: a brown coal mine; a coal drying and gasification plant; a synthesis gas-based, hydrogen production plant; a fuel synthesis plant for converting gas to liquids; and, an integrated waste heat and off-gas power plant.

The gas-to-liquids facility widens the scope for achieving a sustainable return from the resource, which is otherwise wholly dependent upon opportunities in power production. The plant is planned to produce more than 60 000 barrels a day of liquids - mainly ultra-clean diesel. It will also be suited to the production of low-cost hydrogen and, in the future, when the technical challenges associated with a hydrogen economy have been overcome, the Latrobe Valley could become a source of zero-emission transport fuels.

The Monash Energy project, currently in pre-feasibility, is also acting as a catalyst for the development of local carbon capture and storage infrastructure. With the assistance of an Australian Federal Government grant Monash Energy is working with the Cooperative Research Centre for Greenhouse Gas Technologies, to investigate the technical and commercial potential of the adjacent offshore section of the Gippsland Basin as a site for the storage of carbon dioxide from the Latrobe Valley. Earlier study results were highly encouraging and the current study appears to be confirming the status of the Gippsland Basin as a world-class carbon dioxide source-sink match.

The project with the Cooperative Research Centre for Greenhouse Gas Technologies includes a community engagement component to ensure the public has the necessary confidence in the technologies, and appreciates the conceptual link between a carbon-constrained future and the requirement for implementation of carbon capture and storage. Monash Energy is also supporting State and Federal Government efforts to establish a carbon capture and storage regulatory regime to give the public confidence that the implications of transporting, injecting and storing carbon dioxide have been fully evaluated and that the process is safe and secure.

## Site Rehabilitation and Sustainable Land Use

### Case Study 20. New Wallsend No. 2 Colliery decommissioning and mine closure project, Australia (Xstrata Coal)

*This case study illustrates the responsibility taken by the current owner of an Australian mine that commenced operations more than 140 years ago and how the principles of sustainable development have been applied during rehabilitation of the site.*

Mining operations within the Newcastle local government area ended in December 2002 with the closure of the New Wallsend No. 2 Colliery. Xstrata Coal implemented a mine decommissioning programme to provide a positive, environmental legacy for future generations.

#### Figure 8. Site rehabilitation at New Wallsend No. 2 Colliery

The decommissioning strategy was developed in consultation with three State Government departments and two local councils as well as local residents. Key objectives were to:

- provide for public safety,
- minimise environmental impact and liability,
- prevent access to disused underground workings,
- minimise the potential impact from decommissioning activities, and
- return land affected by mining to a condition suitable for a range of sustainable land uses.

The AUD 8 million project was undertaken over two and a half years, during which time a number of technical challenges were faced, notably landform stability and the remediation of contaminated land. Key features of the project included the sealing of current and former entries to the mine, filling of a former box cut, re-establishment of Maryland Creek, reshaping and revegetating former coal reject emplacement areas, sealing shafts that were previously filled; remediation of contaminated land, demolition of buildings and revegetation to native bushland and open grassland.



#### Figure 9. Filling and stabilisation of the former box-cut, completed in 2004



Before...



...After



The remediation of the box cut involved the emplacement of more than 300 000 cubic metres of material, which was excavated from the re-establishment of Maryland Creek. The aim of the project was to fill the former void and stabilise a land slip that occurred when the box cut was originally mined. To provide for further stability, a series of subsoil drains were incorporated into the fill material to prevent the build up of any groundwater seepage. The area has been seeded with native tree species to return this area to native bushland.

The re-establishment of a 500 metre section of Maryland Creek, which was previously piped through the site, was completed in late 2004. As part of the construction of the creek line, a flood plain was established with a meandering, low-flow channel incised through its centre. The design of the creek considered the nature of the channel upstream and included the construction of a similar pool and riffle sequence. Establishment of the riparian vegetation zone also took into the consideration the type of vegetation present upstream as well as what had been identified in the local area.

**Figure 10. Re-establishment of Maryland Creek**



Significant reshaping works were undertaken as part of the rehabilitation of the coal washery reject emplacement area. As the mining operation used voids left from previous open cut coal mining operations, there was limited opportunity for progressive rehabilitation, which meant that a large area requiring rehabilitation remained following mine closure.

**Figure 11. Former coal washery reject emplacement area**



June 2003...



...March 2005

Once all decommissioning activities are complete, a land use strategy will be put in place. The site is close to employment areas and by incorporating remnant bushland on the urban fringe, there are also opportunities for biodiversity conservation.

### Conclusion

Through this decommissioning project, Xstrata Coal is able to share key learning and technical information on mine closure with a range of stakeholders. The lessons for the industry include:

- in all cases, mine closure plans should be developed well in advance of actual closure so that the full scope of issues can be identified, engineering solutions developed and adequate provisions accrued;
- consideration to mine closure should be given throughout all stages of a mining operation (e.g. from the pre-feasibility phase onwards) and any opportunities for progressive rehabilitation should be identified and implemented;
- the implications for decommissioning and restored landform should be considered when designing and constructing mine infrastructure (e.g. tailings dams, emplacement areas, creek diversions); and,
- assessments should be undertaken to determine the potential for contamination on site; any potentially hazardous substances used (e.g. diesel) should be properly stored and contained; and, buffer lands should be well-managed to minimise illegal dumping and so reduce the potential for contamination.

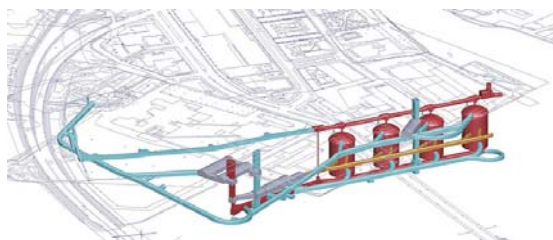
### Case Study 21. Sustainable energy operations in the urban environment: underground coal storage, Salmisaari, Finland (Helsinki Energy)

**Figure 12. One of the four silos at Salmisaari underground coal store viewed from below**

*Helsinki Energy's underground coal storage facility, excavated in the bedrock of Salmisaari, is a good example of blending energy production in to the urban environment. The fully automated underground store, using vertical rock silo technology, is the first of its kind in the world. The store was commissioned in 2004.*

Four vertical silos have been excavated in granite bedrock, each 40 metres in diameter and 65 metres high. The silos can store up to 250 000 tonnes of coal, about half the annual requirement of the Salmisaari power plant. The lowest parts of the facility are 120 metres below sea level.

The storage facility is a significant investment for Helsinki Energy and Helsinki City, the total cost of EUR 61 million being met jointly. The project was undertaken because power production is necessary in the Helsinki city centre. The plant has freed valuable building space, removed coal stockpiles from the landscape, and reduced dust and noise that occasionally resulted from moving crushed coal.



**Figure 13. Helsinki Energy's unique underground coal storage facility at Salmisaari power station**

- The storage space for coal
- A district cooling plant
- The space for maintenance vehicles
- The space required for excavation

## Case Study 22. Bobadeen irrigation scheme, Australia (Ulan Coal Mines)

*The Bobadeen Irrigation Scheme is an innovative means of disposing of surplus mine water generated by Xstrata Coal's Ulan coal mine, located in the western coalfields of New South Wales (NSW).*

Ulan implemented the Bobadeen Irrigation Scheme in response to government and community concerns about the discharge of mine water into the Goulburn River, a major tributary of the Hunter River.

After an extensive evaluation of water management and disposal options, concurrent with a two-year consultation programme with the local community and relevant government agencies, Ulan commissioned the Scheme at a project cost of AUD 7 million.

Saline mine water is pumped from Ulan mine to a 502 megalitre storage dam, located 6 km to the north. It is then pumped to five, centre-pivot irrigators, which apply the water to 242 hectares of pastures planted with vigorously growing perennials. Controlled grazing of the area by beef cattle keeps the pastures at an optimum height to maximize water uptake.

### The challenges

The Bobadeen Irrigation Scheme straddles the Great Dividing Range which presented some unique, environmental challenges. Ulan Coal Mines Ltd had to ensure that the Scheme met the salinity targets set out in both the *Hunter* and *Central West Catchment Blueprints*. These “blueprints” are a NSW Government initiative, setting salt load and electrical conductivity targets for river catchments in New South Wales; they are linked to the *National Action Plan for Salinity and Water Quality*.

Ulan has developed a ground-breaking programme to offset the residual salinity load arising from the irrigation scheme and thus ensure there is no net increase in salinity load in the Macquarie and Hunter catchment areas. This initiative leads the way, in terms of applying the theory of land management to offset the impacts of a development.



**Figure 14. 502 megalitre dam to store surplus mine water, part of the Bobadeen Irrigation Scheme**

Ulan is working closely with government agencies on the salinity-offset programme to model changes in soil water dynamics following the proposed changes to pasture management in the offset areas. The latter includes the controlled grazing of perennial pastures to manipulate the uptake of soil water, and also fencing out areas of native vegetation to encourage regrowth.

The Scheme has the potential to allow Ulan not only to meet its environmental obligations, but also be a leader in land management research and innovation. Indeed, the NSW Environment Protection Authority has nominated the Ulan irrigation scheme as a *Federal Pilot Programme* in green offset policy development.



## CASE STUDIES: RESOURCE STEWARDSHIP

Resource stewardship refers to the practices that ensure natural resources are used and managed in line with the principles of sustainable development. It demands an understanding of the contributions made by land, water, air and biological resources to the economy and to society at large. These case studies provide examples of resource stewardship in practice.

### Looking for Resource Efficiencies

#### **Case Study 23. Achieving more efficient energy production through district heating and cooling, Finland (Helsinki Energy)**

*Combined heat and power generation and district heating have been the basis of Helsinki Energy's energy production for more than fifty years. In the Finnish market, these technologies are an energy efficient, economic and environmentally-friendly means of producing heat and electricity, and a long-standing application of the sustainable development principles. Provided there is a market for both heat and power simultaneously, thermal efficiency of commercial operations can exceed 90%, compared with 35% to 55% in power plants that cannot market the heat produced during power generation; fuel costs can be 50% lower than separate power generation. Coal is an important fuel for these plants because it is relatively low-cost, easy to transport and store, and supply is reliable, all important factors in maintaining economic heat supply. Using combined heat and power / district heating reduces emissions of carbon dioxide, sulphur and nitrogen oxides, and particulates. District cooling has been developed to use heat energy out of the heating season; by distributing chilled water, the noise and visual impact of conventional air-conditioning units are avoided, whilst making sustainable use of the available energy.*

Over the last fifty years, district heating has replaced individual home heating in Helsinki. Today, Helsinki Energy's power plants generate about 85% of their electricity and about 90% of their heat by co-generation and, since 1990, the city's emissions of particulates have been reduced by 84%, sulphur dioxide emissions by 72%, nitrogen oxides by 60%, and carbon dioxide by 27%.

The main fuels used by Helsinki Energy are natural gas and hard coal. In 2004, 51% of the company's electricity was generated by natural gas, 25% by coal, 17% by nuclear power, and 7% by renewable sources, principally hydro. In the same year, 52% of the district heating was produced by natural gas and 46% by coal. In the larger towns, especially in the northern latitudes, coal is favoured to safeguard heat supply.

Helsinki Energy produces district cooling in summer by absorption chillers driven by the condensing heat obtained from power generation, which would be used for heating in winter. Cooling required in winter can be produced using sea-water and heat exchangers. The absorption technology has a technical service life of



about 50 years and the distribution network about 200 years – sustainable, long-term investments that cut primary energy needs and reduce peak loads by avoiding the use of many individual air conditioning units in buildings.

Production of district cooling began in 1998, in co-operation with the European Union. Since 2000, district cooling facilities have expanded in the Helsinki business district and by 2010, the total connection capacity of buildings with district cooling is expected to exceed 100 MW, rising to 200 MW in 2020. District cooling water is centrally supplied from the coal-fired Salmisaari plant and further cooling plant capacity is under construction beneath Katri Vala Park, where the heat energy of warm, treated waste water will be used as a heat source for both district heating and cooling.

### **Case Study 24. Trial of diesohol in mobile mining equipment, Australia (BHP Billiton)**

*BHP Billiton Mitsubishi Alliance (BMA) operates seven large, mainly open-cut coal mines in Queensland, Australia. BMA's greenhouse gas emissions are increasing in total and per tonne of coal produced, mainly because of increasing energy use (electricity and diesel fuel) resulting from increased earth-moving activity. The amount of material moved during open-cut mining is a function of pit depth and scale of production, both of which are rising as BMA expands production from mature mines. BMA consumes more than 250 million litres of diesel fuel a year, which equates to 670 000 tonnes of carbon dioxide or nearly 20% of the company's annual greenhouse emissions. The proposed trial of the use of diesohol in mobile mining equipment is motivated mainly by BMA's desire to explore options for ameliorating the steady rise in emissions which would otherwise result from the company's future diesel consumption.*

Diesohol is an emulsion of diesel and ethanol that can be used in normal diesel-powered machines, with or without the need for major engine modification, depending on the proportion of ethanol in the fuel mix. Provided the ethanol is produced from renewable sources of biomass, the carbon dioxide released during its combustion is offset by that removed from the atmosphere by the next crop of feedstock.

The diesohol being trialled by BMA contains 15% ethanol produced as a by-product of sugar production in the central coastal region of Queensland. The ethanol is azeotropic (it contains 5% water) and requires less processing and associated transportation than the anhydrous type (<1% water) usually used in ethanol fuel blends. This maximises the life-cycle emissions abatement potential of the fuel, which BMA estimates to be in excess of 10% compared to straight diesel. Other potential benefits from the use of diesohol include:

- reductions in emissions of engine smoke and other pollutants (nitrous oxides, carbon monoxide, hydrocarbons and particulate matter),
- lessening BMA's exposure to oil price-driven increases in production costs, and
- supporting diversification of the local sugar industry.

BMA's proposed trial will seek to verify these benefits, as well as to identify any potential downsides, such as detrimental effects from diesohol on engine performance or durability. Initially, diesohol will be compared with low sulphur (<50 ppm) diesel fuel in an engine laboratory, using a dynamometer to simulate a range of engine load conditions. Key performance indicators such as power and rate of fuel consumption will be recorded. Specialised emissions testing equipment will measure exhaust output of carbon dioxide, carbon monoxide, oxides of nitrogen, and hydrocarbons.

If the laboratory tests are successful, diesohol will be used in a major piece of mining equipment, such as a haul truck, at one of BMA's mines to demonstrate the logistics of diesohol supply and handling, and to identify any potential safety or operations management issues associated with the fuel. The effects of diesohol, if any, on engine components such as fuel injectors and pistons would also be evaluated during this longer-term (3-6 month) field trial.



**Figure 15. Haul truck**

## Water Management

### Case Study 25. Reducing water consumption in power generation, South Africa (Eskom)

*Like other major power generators, Eskom is a large consumer of fresh water, accounting for approximately 1.5% of South Africa's total water consumption annually. Eskom power stations run constantly, supplying in excess of 95% of South Africa's electrical energy and more than half of the electricity used on the African continent. Without water, supplying this electricity would be impossible, but water is also a scarce resource and water quality is an important environmental issue. Eskom has helped conserve water by reducing the volume needed for a given level of power generation. The quantity of energy produced between 1993 and 2004 has increased by 43%, but water consumption has increased by only 27%. Access to water and water availability remain key factors in ensuring the sustainability of development in southern Africa. The efforts by Eskom to minimise water use are an integral part of the company's commitment to sustainable development.*

Eskom is committed and determined to support the drive to improve the management of South Africa's scarce water resources. In 2004, Eskom used 277.6 million cubic metres of water for electricity generation, mainly at its coal-fired power stations. It is expected that Eskom's water consumption will increase over the next ten years due to increased electricity demand.

Management strategies are formalised in Eskom's *Environmental Management Policy* and its *Water Management Policy*. Annual targets for water used, per unit of electricity sent out, are set for each power station and are linked to the Eskom Sustainability Index, introduced in 1996 to ensure long-term sustainability of Eskom's business in the technical, financial, social and environmental arenas. The specific water use indicator (litres/kWh) forms part of the index, and is included in the performance contracts of all those who have an impact on Eskom's water use. Water use is benchmarked against historical as well as theoretical water consumption for each particular type of plant.

Eskom has, over the last two decades, introduced a number of innovative technologies to save water. These include dry cooling, desalination, investment in water infrastructure, and metering and monitoring. As a result, water consumption has fallen from approximately 2.85 litres per kWh in 1980 to 1.26 in 2004.

#### **Dry cooling technology**

In a conventional, wet-cooled power station about 85% of the total quantity of water supplied to the power station evaporates through the cooling towers. Dry-cooling avoids this loss but has an economic cost, because dry-cooled stations are less efficient than wet-cooled ones, and capital and operating costs are higher.

Matimba Power Station, near Ellisras in the Northern Province, is the largest, direct dry-cooled station in the world, producing more than 4 000 MW. It uses a closed-circuit cooling technology similar to the radiator and fan system used in motor vehicles. Water consumption is about 0.1 litres per kWh of electricity sent out, compared with about 1.9 litres on average for wet-cooled stations. The choice of dry-cooled technology for Matimba was largely influenced by the scarcity of water in the area.

**Figure 16. Matimba power station**



**Figure 17. Finned-tube condensers above forced-draught fans, Matimba**

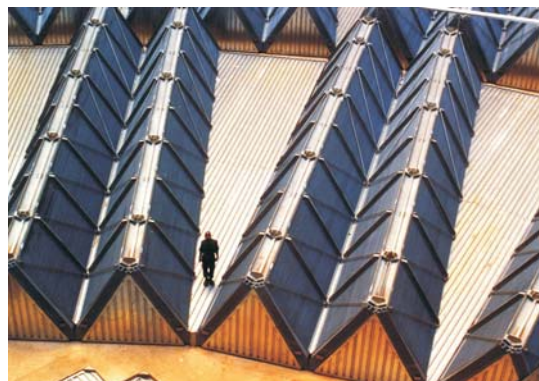


**Figure 18. Kendal power station**



**Figure 19. Tube-bundle heat exchangers in the cooling tower, Kendal power station**

Kendal Power Station near Witbank in the Mpumalanga Province, is the largest, indirect dry-cooled power station in the world, with a water consumption of about 0.08 litres per kWh of electricity sent out. Indirect dry-cooling entails the cooling of the water through indirect contact with air in a cooling tower. Virtually no water is lost in the transfer of the waste heat.



## Desalination

Where power station design permits, Eskom has endorsed a policy of zero liquid effluent discharge at its wet-cooled stations. Water is cascaded from good to poor quality uses until all pollutants are finally captured in the ash dams and the maximum mass of salts are removed in the smallest possible volume of water.

Desalination plants operate at the Lethabo and Tutuka power plants allowing polluted mine-water from the tied collieries to be re-used at the power stations.

Tutuka Power Station, near Standerton in Mpumalanga, is a wet-cooled station using a dry ashing system, where moistened ash is conveyed to the ash dump on overland conveyors. Blow-down water, from the concentrated cooling water system, is used for ash conditioning. When the power station operates at a low load factor, the amount of ash generated is normally insufficient to contain the blow-down water required to balance the salinity of the incoming Vaal River water. A desalination plant was therefore built in 1985 to treat excess blow-down water. This was later extended in 1998/99 to include the treatment of mine water from the adjacent New Denmark colliery for re-use at the power station. The power station is now better able to control the salt load and water volumes to match the effluent sink available on the dry ash dump - reducing the amount of water sent to the ash dump and reducing the risk of water discharges to the Vaal River at both the power station and the adjacent colliery.

## Water infrastructure

Eskom has contributed to the development of an extensive network of pipelines and dams, working with the Department of Water Affairs and Forestry, especially on the Mpumalanga Highveld. Currently, Eskom is the major contributor to a pipeline linking Vaal Dam to the water supply system on the Mpumalanga Highveld which will provide water security to the area for the next twenty years.

## Water metering and monitoring

Water supplied to the power stations is measured at the boundary of the power station terrace. Eskom and the Department of Water Affairs and Forestry have upgraded metering to a level of accuracy of 0.5%. Water meter readings are taken at least once per month, and water/salt balances carried out using the readings to verify performance and identify potential problems. At the power stations, inspections are carried out during every shift and any leaks are recorded and reported for repair as part of formal reporting systems and maintenance procedures. Major leaks in raw water pipelines are rapidly indicated by the remote supervisory control system that senses the reduced water levels in the raw water reservoirs at the power stations. Regular pipeline inspections are carried out to identify minor leaks, and all leaks are recorded in mandatory inspection schedules.

## Using Fuels Efficiently

### **Case Study 26. Coal-fired power station steam turbine upgrade to provide efficiency improvement and reduced emissions, UK (E.ON UK)**

*Deregulation of electricity markets throughout the world, growth in power demand and ever more demanding environmental emission limits have resulted in the need for modernisation, upgrading and life extension of existing generator steam turbine systems in ageing fleets of generation plant. By upgrading two of its turbine units, E.ON UK has demonstrated a practical and cost-effective way of improving turbine efficiency and operational reliability with quantifiable economic and environmental benefits.*

The initiative aims to significantly improve the performance of the steam turbines of Units 2 and 4 at E.ON UK's Ratcliffe power station, near Nottingham, UK by the replacement of their high pressure turbine rotors.



The expected performance gain for each of these retrofits is an efficiency improvement of 0.59%. The benefits of the upgrade can be realised in two ways:

- the power generator may choose to operate at the same output as before the retrofit but with reduced fuel consumption, or
- the power output may be increased.

When the former option is adopted, an annual coal saving of 52 000 tonnes is possible along with avoided CO<sub>2</sub> emissions of 127 000 tonnes per year.



**Figure 20. Exposed steam turbine blades**

Baseline performance data were collected for Ratcliffe's Units 2 and 4 steam turbines so that the cost/benefits of performing the retrofit could be examined and evaluated. Significant progress in steam turbine technology has been made by the suppliers in the areas of steam path, frame architecture, component design and material development. An invitation to tender for the retrofit was circulated and the bids appraised. The selected supplier then carried out the retrofit and the unit was then retested to ensure that the expected benefits had been achieved. Unit 4 was retrofitted during 2005 and Unit 2 is scheduled for retrofitting in 2006.

Lessons learnt from the case study suggest that the retrofitting of a steam turbine should always be preceded by an impact assessment exercise to consider how the upgraded device will affect the overall plant. This impact assessment ensures that the generator and boiler will be able to handle the improvement that will result from the higher efficiency steam turbine. E.ON UK undertook such a survey to ensure that the retrofit was executed smoothly and the maximum benefits and flexibility of operation will be realised.

### **Case Study 27. Development and use of tools for performance improvements to reduce costs and CO<sub>2</sub> emissions in electricity generation (E.ON UK)**

**Figure 21. Turbine hall, Connah's Quay, UK**

*Energy companies operate in a highly-regulated sector, at least in terms of the environmental legislation and regulations with which they must comply. To remain competitive and profitable, utilities must ensure that fossil-fuelled electricity generation is as environmentally benign as possible. Companies must balance cost-minimisation alongside strict compliance with environmental regulations. Achieving this balance is at the core of the sustainable development concept. Key issues are ensuring that all environmental regulatory requirements are met; adapting to, and being able to take advantage of, changes in coal supply quality and cost; improving operational flexibility, plant responsiveness and availability; and, preparing for the implementation of CO<sub>2</sub> abatement technologies by*



*tracking development of new technologies and promoting the development of appropriate technical and commercial expertise, both in-house and in collaboration with others. Developing CO<sub>2</sub>-related technologies is one of the few, realistic routes that allow companies, such as E.ON UK, to respond to technical development and governmental decisions concerning the control of greenhouse gases. Although development activities are not predictable, E.ON UK experience has shown that a cost/benefit assessment of what is proposed is always necessary to help avoid technically-poor returns on investment. In this case study, quantifiable plant performance improvements have been made as a result of the development and use of the tools described, demonstrating the role of research and development when adopting sustainable development principles.*

E.ON UK has developed a range of tools that can contribute to performance improvements, cost benefits and emission reductions in electricity generation.

**GNOCIS™ Plus** is one of the lowest-cost options for achieving sustained reductions in emissions. The system is a real-time, neural-network based, boiler optimisation system which delivers reduced NO<sub>x</sub> and CO<sub>2</sub> emissions and lower fuel costs in coal-fired boilers. It is estimated that installing GNOCIS™ Plus can result in NO<sub>x</sub> reductions of 10-15% for a plant which is already typically well-operated. A range of coals may be burned and the system will adapt to optimise settings. Users can specify constraints on certain variables to ensure that accurate control settings are always maintained. Spin-off benefits include a consistent quality of low-carbon fly ash that should ensure ash always meets specification for sale. The system has a short payback period and a low-cost rollout for similar units.

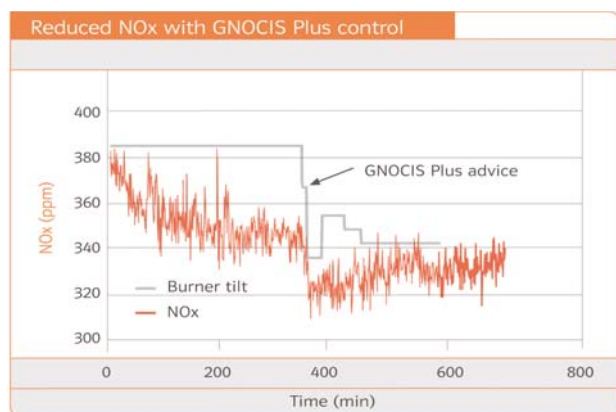
**PROATES** is a flexible thermodynamic modelling tool for “what-if” and “on-line” analysis of efficiency and power output improvement options in all designs of coal-, gas-, oil- and renewable-fuelled plants. It is capable of quantifying the impact of operational changes on efficiency and emissions. These include analysing boiler, turbine and cooling water changes for improved efficiency and output, and assessing the effect of fuel changes on thermodynamic performance. Other benefits include tracking long-term thermal efficiency trends through on-line data analysis, and evaluating gas-turbine topping cycles and re-powering options for increased output. The design of new combined heat and power and combined-cycle gas-turbine plants may be optimised, and investigations into the viability of alternative fuels such as Orimulsion®, poultry litter and industrial off-gases are possible.

**VISTA** is a powerful, cost and performance analysis software tool that can assess fuel switching and blending options. It is used to develop optimum fuel purchasing strategies for coal-fired plants through the evaluation and analysis of current supplies and alternative options, including costs of fuel purchase and transport, plant maintenance, and auxiliary power requirements. Utilising VISTA can provide financially-sound and informed decisions about the total impact of fuel switching and blending in pulverised coal power stations. The product was developed by Black and Veatch in association with the Electric Power Research Institute (EPRI); and E.ON UK Power Technology is the VISTA agent for the UK, Europe and Africa.



**Figure 22. View of coal-fired power station stockpile Kingsnorth, UK**





**Figure 23. Real data from plant showing effect of GNOCIS Plus on NOx emissions**

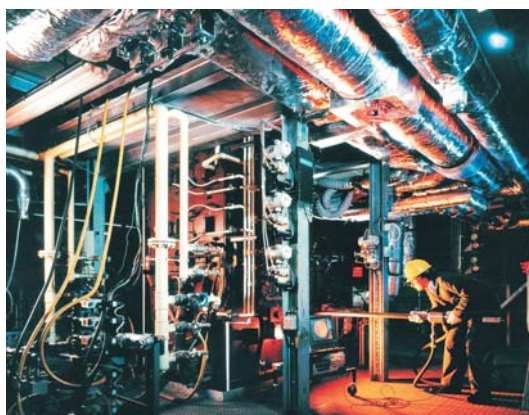
A computer model is constructed, based on the plant's specifications, data, and design drawings, using pre-configured modules within the package. One of VISTA's features is the ability to calibrate the model from plant-specific performance data. Fuel specification data from the current coal supply, potential alternative fuels and blends are then added. VISTA undertakes comparative analysis of all relevant costs,

including any predicted de-rates. Outputs from the model include the total cost of the fuel scenarios assessed, and changes in emissions, fuel-burn rates, availability and boiler efficiency.

### **Case Study 28. Optimisation of power plant operation and evaluating carbon-neutral fuels using E.ON UK's Combustion Test Facility, UK**

**Figure 24. E.ON UK Combustion Test Facility**

*Applying sustainable development principles may involve substantial expenditure by companies. E.ON UK's combustion test facility was built in the early 1990s to demonstrate a number of technologies that could enhance the sustainable development aims of E.ON, one of which is the safe combustion of biomass and biomass/coal blends. The plant has been evaluated technically through comparison with full-scale boiler plant, and economically through the value of test results to the company and collaborators. The plant is expected to continue operating to provide a range of support services for the growing use of carbon-neutral fuels that are important in the context of sustainable development. The combustion test facility is a scaled-down version of a modern, fossil-fired boiler; it provides realistic data, is quick and relatively cheap to operate, and does not interfere with full-size boiler plant operations.*



**Figure 25. Coal-fired power station at Manjung, Malaysia**

E.ON UK's Combustion Test Facility was designed to address a wide range of combustion-related scenarios. For example, it is able to realistically replicate the high combustion intensity, near-burner zone necessary for low-NOx system studies, but it can also handle the investigation of low-temperature flue gas treatment technologies. It can burn coal, liquid fuels, natural gas and other fuel gases, in a manner closely resembling that of a full-scale

boiler, and produce flue gas compositions and temperatures comparable to those of a commercial plant. Multiple extraction ports, located throughout the facility, allow the extraction of gaseous and solid samples as required.

Many other features were incorporated, such as the ability to study fuel quality effects on the combustion process and emissions; to investigate the slagging, fouling and corrosion propensities of different fuels; to develop high-efficiency, liquid-fuel atomisers; to evaluate combustion additives; to study trace metal emissions; to provide “fitness-for-purpose” checks; and, to provide data for mathematical models.

### **Figure 26. Rapid growing crops as a source of carbon-neutral fuels for co-firing with coal**

The test facility has also been used for the evaluation of carbon-neutral fuels, such as cereal co-product, palm oil expeller, olive cake and others, both as neat fuels and also co-fired with coal. The implication and impact on all aspects of the use of such alternative fuels has been demonstrated using the test facility.

Partnerships are formed, on a project-by-project basis, where generic information is shared by all of the project partners. In cases where proprietary information is being developed, no alliances are formed.



## **Harnessing Synergies**

### **Case Study 29. Integrated water management at Rio Tinto's Coal & Allied Operations, Australia**

*Coal & Allied is one of the major coal producers in the Hunter Valley region of New South Wales, employing approximately 1 500 people in three operations: Hunter Valley Operations, Mount Thorley and Warkworth. In addition to mining, the region is an important centre for dairying, wine, horse-breeding and tourism. All depend on the Hunter River for water. Mining uses water for processing and increases the salinity of the surface water run-off. The company has developed an integrated approach to water management which, in 2003-04, reduced fresh water use by 58% at the Hunter Valley Operations, and by 40% at the combined Mount Thorley/Warkworth mines. Coal production has increased by around 10% and fresh water intake has decreased by almost 50%, freeing some 785 Ml of good quality water for other users. By helping to maintain water availability and discharge quality in the longer-term, the company also helps ensure mining can continue to develop in the region. Salinity has not increased because of the greater re-use of water, but is closely monitored. Discharge credits will not be sold until the impact of the system on salinity is well understood.*

Coal & Allied's open-cut mines are managed as an integrated business by Rio Tinto Coal Australia. Some of the mines are “wet” and must store excess water, while others are “dry” and need to import water. By reducing its fresh water intake and managing the salinity of its discharges, Coal & Allied saves money in licence fees and construction costs of storage facilities, frees up land otherwise set aside for water, and frees up good quality water for other users. The Rio Tinto group aims to reduce, by 10%, the fresh water required per tonne of coal produced between 2003 and 2008, but Coal & Allied sought a 25% reduction in 2004, 30% in 2005 and up to 40% in 2008. All surface and sub-surface water is managed to minimise



impacts on the environment and neighbours, and to limit interference to mining production, through:

- emphasising control of water quality and quantity at source;
- segregating waters of different quality, where practicable;
- giving priority to recycling lower quality water;
- ongoing maintenance and review of the system; and,
- discharging water to the environment in accordance with statutes and regulations.



**Figure 27. Environmental dam with rehabilitation in background at Rio Tinto's Coal and Allied Mount Thorley Warkworth Operation, Australia**

The integrated water management system began in a piecemeal way, as each operation focused on localised studies and engineering solutions for individual pit problems. Commencing in 2002, the linking of operations with pipelines meant that the water needs of one operation could be met by water availability at another. By early 2005, most piping and storage reservoirs were in place, and a water balance model developed for all three operations.

Development of the integrated system required capital and operating costs for works within each of the operations to be accounted for transparently. The benefits accruing to each, separate operation had to be sufficiently attractive to offset any expenditure in favour of other operations in the group. Also important were the co-operation and the agreement of the Joint Venture Partners. Regulators assisted by agreeing to combine the approvals processes with environmental impact assessments already underway. Because the programme was focused on internal improvements, there was little external interest from a regulatory viewpoint, apart from ensuring that ownership of the water management structures was clearly defined so that in the event of an incident and non-compliance with discharge licences, the responsible party could be identified and prosecuted. Other water users in the Hunter Valley will benefit from the improved water availability.

**Figure 28. Water testing with CHPP in background at Rio Tinto's Mount Thorley Warkworth Operation, Australia**



**Figure 29. Settling tanks at Rio Tinto's Coal and Allied Hunter Valley Operations, Australia**

## Biodiversity

### Case Study 30. Working with partners towards sustainability, South Africa (Eskom)

*Eskom, a South African electricity utility, is increasingly moving towards developing long-term partnerships and sustainable environmental programmes with non-governmental organisations and community groups to promote sustainable projects in the environment, and among rural and urban communities. Partnerships with non-governmental organisations are a method of empowering organisations and communities, and must be of benefit to both Eskom and its partner to be effective. Partnerships focus on achieving common goals through innovative methods and ensuring the optimal utilisation of all resources.*

Formal partnerships have been established with the Endangered Wildlife Trust, the Wildlife and Environment Society of South Africa, BirdLife South Africa, the Middelpunt Wetland Trust, and the Ekangala Grassland Trust. There are also numerous relationships between non-governmental organisations and Eskom that have the potential to develop into partnerships, should common goals be identified.

The partnership with the Endangered Wildlife Trust focuses on minimising avian interactions with electricity infrastructure and was initiated in 1996. The partnership, which was initiated to minimise biologically-significant impacts in the region, also aims to educate stakeholders on the way birds interact with electrical infrastructure and how this should be managed safely. The partnership offers strategic guidance to Eskom through the identification of biodiversity risks and opportunities, and offers practical support in the management of impacts throughout the region.

Through the partnership, significant progress has been made in the development and testing of devices aimed at reducing bird collisions and electrocutions. The bird flapper, a disk designed for attachment to power lines under live-line conditions to improve the visibility of the line, has been further refined and initial results show significant reductions in bird mortalities. The partnership has developed an internationally-recognised centre of excellence, focusing on improving the quality of supply of electricity and reducing the impact on biodiversity in southern Africa, and has offered its support internationally.



**Figure 30. Bird flappers on power lines**

The activities of the partnership have resulted in financial savings for Eskom, and contribute to ensuring that impacts of infrastructure on biodiversity in the region are sustainable. A total of 605 field investigations of wildlife mortality have been performed since August 1996 by volunteers from the Endangered Wildlife Trust and Eskom staff members, helping to build capacity within Eskom. In most cases, investigations conducted led to recommendations on preventative action. In situations where there was low biological significance or low impact on electricity supply, no action was taken. In such cases, the incident is closed or the landowner or field investigator monitors the situation.

The Eskom Energy and Sustainability Programme (a partnership between Eskom and the Wildlife and Environment Society of South Africa) is aimed at exposing learners and educators to a broad range of energy issues through undertaking energy-related projects. These projects contribute to the sustainability of rural schools in southern Africa, reducing energy costs and improving the quality of life through food provision and job creation. This, in turn, has social and financial impacts on the community, ensuring a better life for all in areas where HIV AIDS is pandemic, and young children are forced through circumstance to be breadwinners and leaders in households.

In 2002, the partnership won second prize in the Youth category of the Energy Globes Awards. The Energy Globes are awarded annually for environmentally-sustainable projects in the categories Earth, Fire, Water, Air and Youth. The submission from Eskom's Energy and Sustainability Programme was short-listed from 997 entries submitted from 95 countries. The award gives international recognition to the partnership.

Eskom, BirdLife South Africa and the Middelpunt Wetland Trust have formed a partnership to manage the area around the proposed Braamhoek Pumped Storage site on the KwaZulu-Natal/Free State Border in the Drakensburg region of South Africa. This partnership aims to optimise ecological conditions around the site, home to many rare and endangered species, and monitor impacts during the construction and operation of the project. The partnership has resources dedicated to the management of the site and will ensure that biodiversity issues are continually addressed and that the ecological condition is improved.

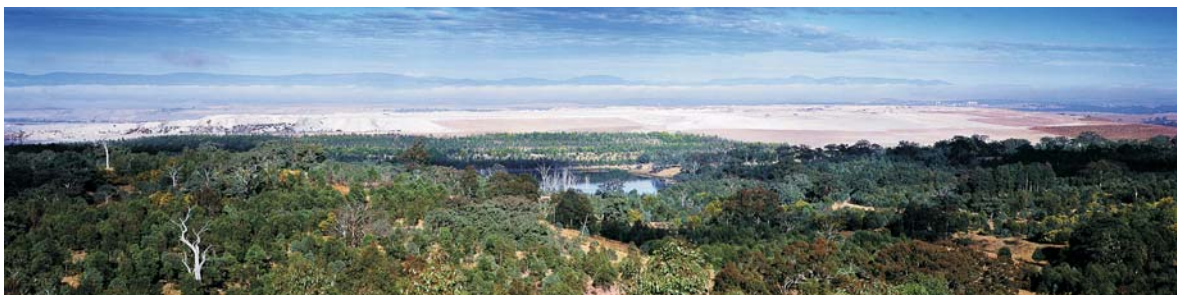
The Ekangala Grassland Trust is an inter-provincial initiative that aims to ensure the sustainable utilisation of the threatened, high-altitude, moist grassland biome of KwaZulu-Natal, Mpumalanga and the Free State. The area represents one of the largest contiguous pieces of relatively untransformed grassland in southern Africa. It hosts high levels of biodiversity and endemism, delivers numerous important ecosystem services, but is not well represented in any network of formally protected areas and is under constant threat of transformation through unsustainable land-use practices. The grassland area is important to Eskom as a water catchment - a large amount of Eskom's water resources originates in the grasslands of the Ekangala project area. The Ekangala Grassland Project has been established as a platform for facilitating co-operation between all relevant stakeholders and to enable priority projects to be implemented jointly. The focus on community-based projects ensures the co-operation of civil society in the sustainable utilisation of the area.

### Case Study 31. Mt Owen Biodiversity Offset Strategy, Australia (Xstrata Coal)

*The original consent for the Mt Owen mine permitted disturbance of 240 hectares of the Ravensworth State Forest, a highly significant remnant on a local and regional scale. Through its original consent, Mt Owen has enhanced the biodiversity value of the state forest, and a new forest, established by the mine owner, by excluding threatening processes such as grazing, firewood removal and recreational activities. Since 2004, the Mt Owen Biodiversity Offset Strategy has established a like-for-like habitat to compensate for the loss of habitat resulting from mining. The strategy underpinned the successful application to expand mining within the project area. Implementation of the strategy, through mine rehabilitation, restoration research, and flora and fauna management, will result in a significantly larger conservation area of increased biodiversity value than existed prior to mining. Security arrangements will ensure that conservation areas are protected and managed to enhance their ecological values in the long-term.*

Mt Owen, in the Australian Hunter Valley coalfield, is an open-cut coal mine owned and managed by Hunter Valley Coal Corporation Pty Limited, a wholly-owned subsidiary of Xstrata Coal. Theiss operates the mine.

**Figure 31. Mount Owen, Hunter Valley, Australia**





Associated with gaining approval to extend the mine in December 2004, was an extensive biodiversity offset strategy and conservation programme. Combined with the life-of-mine rehabilitation programme, it will deliver approximately 1 800 hectares of native woodland and a new forest area, five times larger than the original woodland. This will provide an expanded conservation area, with additional benefits for biodiversity.



**Figure 32. Biodiversity offset strategy and conservation programme**

Since 1995, 145 bird species, 24 non-flying mammals, 18 bat species, 20 reptiles and 15 amphibian species have been recorded in the Ravensworth State Forest and adjacent land. Eighteen threatened fauna species, listed on the NSW *Threatened Species Conservation Act 1995*, have been recorded, including the green and golden bell frog, squirrel glider, spotted tailed quoll, and a number of bat and woodland bird species.

The remnant area of the forest, that will not be

disturbed by mining, contains an area of the Hunter Lowlands Redgum Forest, an endangered ecological community listed under the *Threatened Species Conservation Act*.

To offset the impacts of mining through part of the state forest, the mine owner established, between 1995 and 1997, a new 430 hectare area of woodland (known as the “New Forest”) which adjoins the remnant Ravensworth State Forest. The New Forest, originally open pastureland with isolated mature trees, was planted with native tree and shrub species indigenous to the forest and surrounding area. Growth rates and survival of the trees have been encouraging and the reforestation programme has established key species that provide habitat for fauna and encouraged the movement of native fauna into the area. In December 2003, the New Forest was transferred to Forests NSW for incorporation into the forest reserve system. Mt Owen Mine retains responsibility for management and maintenance of the New Forest in accordance with its development consent.

**Figure 33. Management and maintenance of the New Forest**

In addition to the establishment of this extensive offset area, management of the mining process to date has involved best practice rehabilitation of mined areas to woodland, ongoing research into rehabilitation and reforestation techniques, and a comprehensive flora and fauna management and monitoring programme, undertaken in accordance with a *Plan of Management for Revegetation and Wildlife Management*. The implementation of the plan is overseen by the Mt Owen Flora and Fauna Advisory Committee, comprised of representatives from the NSW Department of Environment and Conservation, Forests NSW, the NSW Department of Primary Industries, and the Hunter Environment Lobby.



In early 2004, Hunter Valley Coal Corporation submitted a development application and supporting environmental impact statement to the Department of Infrastructure, Planning and Natural Resources for modifications to existing approved mining operations. A commission of inquiry considered the application

between June and August 2004. The application was approved in December 2004, subject to stringent conditions to minimise impacts on the environment and surrounding community.

The approval permitted extension to the currently approved mining area at Mt Owen to provide for a further 21 years of mining, which necessitates the disturbance of an additional 35 hectares of the Ravensworth State Forest and 59 hectares of open woodland outside of the forest.

It was recognised early in the project planning stage that substantial offsets would need to be established to compensate for the loss of habitat. A comprehensive *Biodiversity Offset Strategy* has been developed in consultation with the government and the Mt Owen Flora and Fauna Advisory Committee. The strategy is consistent with the NSW Government's *Green Offsets for Sustainable Development* (April, 2002).

The strategy compensates for the disturbance of vegetation within the project area through the conservation of 415 hectares in offset areas adjoining the Ravensworth State Forest and the New Forest. The proposal includes the conservation of 100 hectares of the Central Hunter Spotted Gum / Grey Box / Ironbark Woodland Community. The offsets provide immediate protection for a slightly greater area of woodland than the 94 hectares that will be mined.

Where accessible, open pastureland within the offset areas will be actively planted or direct seeded with native tree and shrub species indigenous to the forest and surrounding area. Measures will also be implemented to encourage natural regeneration, for example, fencing and exclusion of livestock. Following the completion of the reforestation programme, the Hunter Valley Coal Corporation proposes to secure the long-term conservation of these offset areas through a combination of measures available under its operating consent.

### Figure 34. Artificial nesting and roosting boxes

In addition to the establishment of the offset areas, existing flora and fauna management measures will be maintained for the life of the project, including:

- Installation of additional artificial nesting and roosting boxes to complement approximately 300 installed to date.
- Spreading of tree debris from areas to be mined, such as logs and tree crowns, in revegetated and rehabilitated areas to provide a surface mulch and seed source.
- Exclusion of domestic stock within rehabilitation and conservation areas and an ongoing programme of feral animal and weed control.
- Construction of aquatic habitats in dams and channels.
- Restriction of tree clearing during the breeding seasons of key species.
- Conducting surveys prior to clearing to identify habitat tree species.



### Case Study 32. Development of biodiversity action plans for land owned or managed by E.ON UK

*Companies often own extensive areas of land not immediately required for core activities. E.ON UK's approach, explained here, illustrates how the company has made a positive contribution to the UK Biodiversity Action Plan by actively managing sites to encourage biodiversity. A number of sustainable development principles are demonstrated, notably the value of collaboration with non-industry partners (stakeholders from*

communities local to land owned or managed by E.ON UK, including tenant farmers and other businesses). In this instance, biodiversity issues were given further consideration within a management plan for the company's land. The case study shows that:

- A company with significant landholdings can manage its land sensitively and encourage biodiversity.
- Encouraging biodiversity does not have to be a costly process, for example, cutting the grass at certain times and reducing chemical use has greatly enhanced the value of grasslands.
- There is a need to engage in early communication with various key stakeholders, including staff with land management responsibilities, tenant farmers, biodiversity officers and local conservation groups.

The *UK Biodiversity Action Plan* was launched in 1994. The plan encouraged businesses and their employees to take action to conserve priority habitats and species. The company had a long running involvement with nature conservation, but there was no previous overall biodiversity strategy in operation.

Individual biodiversity action plans have been researched and developed by E.ON UK since 2001 and resulted in the production and adoption of site plans for Kingsnorth and Ironbridge power stations in 2003 and 2004, respectively. A company-wide Biodiversity Champion was appointed in 2004, to assist with the development of a corporate biodiversity policy and further site plans. Specifically, to:

- Assess, monitor and review the biodiversity assets on power station sites.
- Educate staff and contractors across the business in the importance of protecting biodiversity.
- Identify priority species for the land in line with local plans and the *UK Biodiversity Action Plan*.
- Achieve mutual benefits by working in partnership with local communities, local government, non-governmental organisations and other organisations.

At Kingsnorth Power Station work completed includes the installation of around 20 bird and bat boxes, active monitoring of up to 1 500 birds each year by ringers, in addition to the creation of ponds around the nature study centre.

Employees on power station sites with land management and conservation responsibilities have been overseeing the development of nature trails. Representatives of Ironbridge and Kingsnorth power stations have formed strong links with local schools and colleges, wildlife trusts and other conservation groups through their enthusiastic promotion of environmental education at the nature trails.



**Figure 35. Wildflowers and ringing of sand martins at Kingsnorth power station, UK**

E.ON is developing a site biodiversity action plan for Ratcliffe Power Station in 2005, and will focus on covering all sites larger than 50 hectares in 2006. Objectives and targets for biodiversity are to become an integrated part of E.ON's environmental management system, certified to ISO 14001.

During the process described, partnerships were formed with various organisations, including the Environment Agency, Forestry Authority, English Nature and the Countryside Council for Wales. The company liaised with non-governmental and other organisations at a local, national and regional level. Representatives from the local Wildlife Trusts, amateur naturalists' societies and local Biodiversity Officers, and the Royal Society for the Protection of Birds were key sources of support. Also, employees were encouraged to become involved in the management of biodiversity in E.ON UK, such that many local biodiversity projects have been carried out to improve and manage wildlife areas.





**Figure 36. Ratcliffe power station, UK**

## **Sustainable Development of the Lignite-to-electricity Supply Chain**

### **Case Study 33. Sustainable development in a vertically-integrated utility, Germany (RWE Power AG)**

*RWE Power views sustainability and climate protection as an integral part of its corporate philosophy. Application of the sustainable development principles is illustrated in all the company's operations, from coal mining and land restoration, to coal-fired power generation and waste disposal. Its activities are supported by a research programme to ensure new investment, particularly in power generation, cost-effectively improves environmental performance at all stages of the company's vertically integrated activities. RWE Power is actively involved in the development and practical application of climate-friendly power plant technologies, and energy efficiency is systematically addressed in meeting its own power requirements, for example at the company's opencast mines. RWE's overarching objective is to successively renew its ageing power generation plants with new plants, since this makes the greatest contribution to improving the efficiency of resource use and climate protection. Several projects are underway or in the final planning stages, and RWE's research programme positions the company to make further, cost-effective improvements to the environmental performance of power generation in the longer-term. Landscape rehabilitation complies with German law and permits the continued mining of coal in Germany while ensuring mined areas have an ongoing, sustainable use.*

#### **Power generation**

The lignite-fired power station at Niederaussem, which has been on stream since 2003, can generate the same amount of power as older, lignite-based systems, but emits up to 3 million tonnes of carbon dioxide less every year. RWE Power is also developing new hard coal-fired power plants. With partners from science and industry, the company is participating in a study commissioned by the State of North-Rhine Westphalia on a reference power plant that could achieve an efficiency of 46% compared with the worldwide average of 30%.

Because of its relatively high moisture content, lignite pre-drying can significantly improve the environmental performance of lignite-based power generation. A trial system for fluidised-bed drying with internal waste heat utilisation has been built at RWE Power's Frechen factory. By 2007, a full-scale prototype is to be erected at Niederaussem. Using this technology, each kWh of electricity could be produced with some 10% less coal, emitting correspondingly less carbon dioxide.

A request for approval for the construction of a new lignite-fired power station with optimised plant engineering was submitted in May 2004. The plant will have two units, each capable of producing 1 050 MW net output with an efficiency of more than 43%, and is expected to cost EUR 2.1 billion. Depending on the approval procedure and construction time, the new power plant could go on stream in 2010.

At the Weisweiler plant, two 190 MW topping gas turbines are being installed upstream of the existing 600 MW lignite units. Output is expected to increase by 12.5% and efficiency for the entire plant from 36% to 40%. The cost will be about EUR 150 million and the plant is expected to be commissioned in 2006.

Using solid recovered fuels from treated industrial and household waste can reduce hard coal requirements by up to 10%. Recovered solid fuels are co-combusted in the Gersteinwerk plant at Werne and in the Westfalen power plant, Hamm. The ConTherm plant also carbonises special upgraded waste and uses the resulting process gas and coke to fire the power plant.

Other projects include the new efficiency-enhancing flue gas desulphurisation system being built by RWE Power for the STEAG plant at Voerde, and the application of new burner technology at the Neurath power plant. The latter prevents the fouling of the heating surfaces and so maintains heat transfer in the boiler at a constantly high level, even when the ash content of the coal feed changes.

**Figure 37. Lignite-fired power plant with optimised plant technology (BoA) at Niederaussem**

#### *Power generation research programme*

RWE Power is taking part in several research projects on power generation that embrace the sustainable development principles. These include:

- **COMTES 700** has the objective of a 700°C power plant. A component-testing plant is being built in Scholven to develop materials that withstand such extreme temperature. Developing new materials is an important step toward the next generation power plant operating at a higher temperature and hence higher efficiency.
- **COORETEC** is the CO<sub>2</sub> reduction technologies programme of Germany's Federal Economics Ministry to implement low-emission and zero-CO<sub>2</sub> fossil-fired power plants. Studies are currently planned on the combustion of coal with oxygen and on coal gasification, each with CO<sub>2</sub> capture. The OXYCOAL project has already been launched at the technical university RWTH Aachen.
- In the **Sixth EU Framework Programme**, RWE Power is involved in three development projects to capture carbon dioxide produced from power generation.



**Figure 38. Recultivation in the Rhenish mining area: following consolidation of seal and subgrade**

#### *Landscape rehabilitation*

Post-mining rehabilitation is mandatory under German mining law to restore a cultivated landscape, typical of the region, that can be used on a sustainable basis. In the Rhenish area, many former lignite mines have been recultivated over the last eighty years. During this period, more than 10 100 hectares of new arable land, some 7 650 hectares of forest and 800 hectares of lakes and humid biotopes have been created. Current projects include the following:

- **Ash landfill in the former Benzlerath opencast mine** aims at creating favourable conditions for the development of an ecologically stable landscape of great diversity on the former opencast mine terrain. Rehabilitation will meet the requirements of forestry and recreational use, as well as those of biotope and species protection.





- **Protection of the wetlands in the north of the Garzweiler opencast mine** responds to public discussion in the early 1980s on the ecological compatibility of the Garzweiler I and II opencast mines, Rhineland. The matter at issue was, in particular, to protect wetlands and moors which might have been damaged as a result of mine dewatering. RWE Power identified this problem at an early stage and co-operated with the authorities to find a sustainable solution. Groundwater levels have been maintained since 1987 by infiltrating and discharging treated mine water between the mine and the wetlands, and was stipulated in the *Garzweiler II Lignite Mining Plan*. To protect the wetlands and to secure water supplies, some 53 million cubic metres of water are discharged and infiltrated each year through a 120 km long pipe network. Most of the water comes from dewatering wells at the Garzweiler mine and is treated in the Jüchen and Wanlo waterworks before being pumped to the infiltration and discharge points. The annual amount of water infiltrated will rise to 100 million cubic metres in 2030, when the mine will have reached its maximum depth. From 2030, groundwater lowering and water requirements will decline and water from the Rhine River will complement mine water. Throughout mining operations and in the longer-term, stable and natural groundwater conditions in the north of the Garzweiler mines are being maintained.
- **Relocation of a five kilometre stretch of the Inde river** between Inden-Lamersdorf and Jülich-Kirchberg will permit lignite mining at the Inden mine to continue. The relocated river will wind through a wide, virtually natural meadow and flood large sections of the meadows during the year in a manner identical to the original river, permitting meadow forest species typical of river environments to develop. Some 400 000 deciduous trees and shrubs have been planted. Over time, the young Inde meadows will evolve into a closed and rich ecosystem, and new and intact habitats and recreation areas will develop.
- **Application of groundwater models** developed by RWE Power has helped reduce mine dewatering from some 1 200 million cubic metres in the 1980s to about 600 million cubic metres today, securing mine operations and conserving groundwater resources. Mine dewatering is necessary to ensure safe coal extraction, but groundwater lowering and depressurisation in individual aquifers must be kept as low as possible to conserve the resource. The effects of dewatering can be predicted using groundwater flow models developed by RWE Power. The models can allow for very specific mine operations and the water balance in wetlands. Application of the groundwater models allows major water management issues to be clarified and the withdrawal and infiltration of water to be optimised, helping to minimise sump water quantities that affect mining, and protecting the groundwater environment.

**Figure 39. Recultivation in the Rhenish mining area: substrate placement by spreader**



**Figure 40. Relocation of the Inde River: new river meadows in summer 2004**



**Figure 41. Flora is  
“conquering” the new  
Inde bed...**



**Figure 42. ...and so is  
fauna**



## CASE STUDIES: COMMUNITIES

Participation in non-business activities in the wider community applies the sustainable development principles of openness and communication, while also providing an opportunity to explain the company's role in the community and helping define a wider vision for the company's activities by encouraging feedback from the general public. Discussions with the wider community can contribute to an understanding of the sustainable development aspirations of neighbouring communities and help define company priorities for key communities that are defensible and informed. In the first instance, this could directly assist the company achieve its corporate goals by defining areas where relations with the community might be unduly sensitive, but could also lead to companies making a valued contribution to the achievement of local communities' own sustainable development aspirations.

### Mechanisms for Community Engagement

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#### **Case Study 34. The Powell River Project: university/coal industry co-operation for sustainable development, USA (Virginia Polytechnic Institute and State University)**

*The Powell River Project is a co-operative programme of Virginia Polytechnic Institute Virginia Tech and the coal industry that conducts research and education programmes to advance mine restoration practice. Programme goals are to enhance restoration of mined lands and to benefit communities and businesses in south-western Virginia and adjacent areas of the central Appalachian coalfield. Funding is provided by industry, the university and the state. A Board of Directors establishes priorities and aids in the generation of funds, a staff solicits research proposals and disseminates research results, and university personnel conduct sponsored activities. A variety of factors indicate programme success, including advances in both industry environmental protection practices and regulatory standards. The success of Virginia Tech's Powell River Project shows the potential for industry/university co-operation to develop and aid implementation of mine restoration practices so as to aid sustainable development of coal-mining areas.*

Land use patterns and economic activity in south-western Virginia, and central Appalachia, are strongly influenced by its mountainous terrain. Extensive and rich deposits of high energy, low sulphur coal, suitable for both metallurgical and steam generation uses, have made coal mining a major industry. The terrain also creates challenges for the region's coal industry due to its effect on both mining operations and environmental protection practices. Within this region, the most intensive uses of land occur in narrow valleys adjacent to rivers and streams, and transportation corridors. This landscape makes it costly to extend public infrastructure, is not conducive to agriculture, and hinders location by manufacturing facilities. Coal resource depletion and coal industry mechanisation are causing major declines in coal mine employment.

Lack of public infrastructure accentuates industrial-recruitment difficulties and has a negative effect on local living conditions. Many communities lack access to public water and sewers.

**Figure 43. Livestock grazing on pastures at the Powell River Project Research and Education Center in Virginia, USA**

The project was founded in 1980 to address coal mine restoration concerns. Initial funding was provided by a major owner of coal-bearing lands, the Penn Virginia Corporation. The company came to Virginia Tech with concerns about the large acreages of lands under its ownership affected by surface coal mining; in particular, about the potential effects of a new US mining law - the *Surface Mining Control and Reclamation Act of 1977* - on mining firms that operated on its property. Mountainous terrain would make compliance more costly in Appalachia than in other US mining areas. Given that Penn Virginia's primary source of income was coal mining royalties, company personnel were concerned that restoration practices should allow coal mining to continue profitably, while satisfying the new legal standards. A related concern was that mine restoration practices should render the land suitable for economically-viable, post-mining uses, so that the company's lands could remain an economic asset after mining was complete. In 1980, company personnel approached Virginia Tech for assistance in developing the scientific knowledge and reclamation practices that would address these concerns. In addition to funding support, the company offered an area of land in Virginia's coalfield for experimentation and education purposes. Initial activities addressed soil reconstruction, forestry, cattle, and horticulture on reclaimed mine areas. In the mid-1980s, other companies were invited to participate. The programme continues today as a co-operative activity of the university with multiple mining firms and disseminates publicly all its research findings.



Today, coal industry involvement remains essential to the Powell River Project programme in several ways:

- A Board of Directors establishes priorities and includes representatives of Virginia Tech, educational organisations located within the Project's service region, and coal-related businesses.
- Financial sponsorship from Penn Virginia Resource Partners, Alpha Natural Resources, Red River Coal, Arch Reclamation Services, and Norfolk Southern.
- At its research and education centre, on lands owned by Penn Virginia Resource Partners, research projects are commonly conducted in partnership with mining firms who are also involved in implementing research results to improve mine restoration practice.

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**Figure 44. Powell River Project educator Jon Rockett provides natural resource management instruction to student visitors at the Research and Education Center**

Powell River Project research has focused on developing practical, cost-effective solutions to natural resource problems in central Appalachian coal mining areas. Topics addressed include: mine reclamation and environmental protection practices at coal mining operations; use of



reclaimed lands for forests, agriculture, and homes; and, managing water and timber resources. Current research also addresses coal combustion product utilisation on reclaimed mine areas. Educational programmes disseminate the results of completed research, with the goal of putting research results into practice.

Advances in coal mining environmental protection technologies create numerous public benefits, including: support for the coal industry's role as a regional economic force and major employer; reclamation of lands that can serve as economic assets; and, improved environmental quality. A key factor leading to technology utilisation has been the emphasis on developing technologies to improve the industry's ability to protect the environment while achieving cost-effective regulatory compliance.

Coal mining and reclamation are highly-regulated activities. To be effective, progress in technology must often be accompanied by changes in regulations or regulatory agency policy. Several regulatory agencies have worked closely with the project in modifying their approaches to accommodate research results, for example, on the use of coal fly ash as a soil amendment during reclamation, on reforestation practices, and on the restoration of abandoned coal mines as a beneficial adjunct to active operations.

**Figure 45. Virginia Tech students, working with Dr. A. O. Abaye, collect and identify samples of vegetation growing on the reclaimed mine areas of the Powell River Project Research and Education Center**



The success of the Powell River Project illustrates many of the sustainable development principles, including:

- Openness - All information generated by Powell River Project research is made available to the coal industry and public.
- Tangible Impacts and Accomplishments - The documented success of Powell River Project in identifying problems of local concern, and in generating information useful to clientele dealing with those problems, has been essential to the retention of both its financial and political support. Industry participation in the Board of Directors has helped maintain a practical and applied focus.
- Research/Education Linkage - An essential component of the project is a strong linkage between research and outreach education. Powell River Project staff work with researchers to disseminate research results appropriately, through publications, technical workshops, and field tours.
- Local Presence and Involvement - Participation in the community ranges from coal industry assistance to educational programmes in local schools.
- Partnerships - The coal industry's contributions to, and involvement in, the Powell River Project has been essential to the programme's 25 year survival and its record of success. Working closely with regulatory agencies helps to assure that technology-development research is targeted towards objectives that have a real potential to be put into practice. Most research is co-sponsored by other organisations that have similar interests, extending the project's influence despite its limited funding base.

### **Case Study 35. Improving the sustainability of coal-fired power generation: the Genesee Public Advisory Committee and the Genesee Synergy Group, Canada (EPCOR)**

*In order to ensure that coal continues to have an important role in the future, EPCOR recognised that it must work with the community where its operations are located. That community includes local landowners, local*

*regulators and local businesses operating in the area. These are very diverse groups with very diverse interests, but are key enablers in allowing EPCOR to conduct its business in the area. The Genesee Public Advisory Committee illustrates how working with the community can be achieved through a formal organisation, and the Genesee Synergy Group has improved co-ordination of development in the region.*

The Genesee Power Project Advisory Committee was established on 18 September, 1981, to bring EPCOR and its mining partner together with the surrounding farming community, the provincial government and local regulators. At the time, area farmers were concerned about getting fair prices for the land needed to support the Genesee coal mine and mine-mouth generating station. These concerns, along with those raised by government, environmentalists and competing power companies, caused EPCOR's plans for Genesee to be delayed several times. Through the continuous efforts of EPCOR staff, along with proper stakeholder alignment through the Genesee Power Project Advisory Committee (GPPAC), EPCOR received approval to construct the power plant and mine. The support of local area residents was instrumental. They were the main group considered by the regulators for the necessary approvals. Ongoing consultation was key in this process and was the basis for building a long-term relationship of trust and respect between EPCOR and the local community. GPPAC gave them a collective voice in how their homesteads and land would be managed while under EPCOR's management, recognising it would not last forever. Ultimately, this allowed the sustainable development of a coal field that otherwise might never have been possible.

Now called GPAC, the Genesee Public Advisory Committee has an advisory role on issues and projects related to the Genesee Power Project. This includes matters resulting from the operations of the power plant and the adjacent coal mine, operated by Luscar Ltd. Over the years, it has become an essential link to area residents by providing a forum for considering community ideas and initiatives. Many of these initiatives, such as reclamation, land use planning, water well policies, road closures and relocation, wildlife management, community investment, and environmental policies, have proven to be successful for both EPCOR and the community.

GPAC has four scheduled meetings each year and calls special meetings whenever the need arises. The committee addresses a wide variety of matters important to the community, including land reclamation/management, plant expansion, government updates, pasturing, cropping, wildlife studies, and funding of youth development programmes. Local residents are encouraged to contact GPAC members with concerns, comments and ideas regarding Genesee Power Project activities that affect the community.

Staff have become a part of the community through support for, and participation in, various local and Leduc County events. GPAC activities and upcoming events are annually reported in a magazine called *The Coal Arch Chronicle*.

In the course of the stakeholder consultation for the Genesee Phase 3 Project in 2001, the opportunity arose to improve the manner in which EPCOR and other resource developers in the Genesee area, such as oil and gas companies, co-ordinated their activities. EPCOR established the Genesee Synergy Group (GSG), to facilitate the orderly development of energy resources and to assist in co-ordinated planning activities in the Genesee area.

The GSG has two scheduled meeting per year and calls special meeting when the need arises. The goal of the group is: *“Co-operation among resource industry, government, and local residents, working together to provide resource and community development in an efficient and environmentally-responsible manner.”* Specifically, the group focuses on clearly identified needs, such as:

- Efficient, environmentally-responsible, safe and orderly, long-term development of resources in the Genesee area.
- Minimisation of land use conflicts and the need for formal regulatory hearings over co-resource development.
- Understanding and addressing the interests of all stakeholders in the group.

The GSG provides a forum for EPCOR and its mining partner Luscar Ltd. to share its plans for the area and, conversely, to gain an understanding of the plans of other resource developers and businesses in the area. Each meeting has an open session in which the companies or any individual attending can provide an update, from their own perspective, on latest developments. Meetings typically include topics of interest to all attendees, and have ranged from use of water resources to emergency response planning. Each meeting is followed by a short tour of a member's facility in the area.

For EPCOR, ongoing consultation has helped gain the support of the community, regulators and other resource developers in the Genesee area. Specific achievements have included:

- The relocation of the Genesee community hall.
- The relocation of Secondary Highway 770.
- The development of a water well replacement programme.
- Land reclamation practices that have gained EPCOR a strong reputation with the Alberta Government.
- Significantly improved noise management for both mine and power station equipment.
- Apprenticeships and improved qualification opportunities for area residents seeking to work at the station.
- Wildlife management programmes for deer and migratory birds.
- Wetlands research programmes.
- Live root transfer methods for native plant reclamation.
- Development of a community recreation site for day picnics and family fishing.
- Scheduled removal of oil and gas facilities in order to optimise EPCOR's coal mining.

### **Case Study 36. Coal & Allied Community Trust, Australia (Rio Tinto)**

*In the Hunter Valley, New South Wales, the history of coal mining is paralleled by the history of unionism; relationships between the workforce and management have, at times, been extremely corrosive. In the late 1990s, after prolonged disputes, the community acknowledged the need to change work practices, but resented some of the impacts of coal industry modernisation, such as rationalising operations, reducing the workforce and employing more contractors. The legacy for the industry of these necessary changes was an isolated workforce and a damaged reputation in the local community. Coal & Allied realised that long-term business success is based on a competent, engaged workforce and an ability to recruit well from within the local community. The company's reputation underpins its ability to meet these requirements, and so Coal & Allied sought to repair the damage caused after a decade of dispute. The case study highlights the challenges inherent in implementing programmes designed to build capacity in the community, including the need for an adequate scope, a practical focus, willing participation and effective communication. Independent review is important to ensure planning is properly focused on the sustainable development of all corporate activities.*

In 2000, Coal & Allied established the Coal & Allied Community Trust:

*“To assist the community to build a strong, sustainable future for the Upper Hunter focusing on community leadership, attraction of new business, industry diversification or growth, improving workforce skills and vocational education, the promotion of environmental awareness and programmes that will improve the quality of the Upper Hunter environment.”*

Selected projects were expected to promote/develop capabilities within the Upper Hunter; be sustainable, practical and properly managed; and be clear in their aims with identifiable outcomes and deliverables. Outcomes desirable to the company were also considered in evaluating projects, including to:

- Enable strategic interaction within the community and its opinion-leaders in a manner that would enhance the reputation of the company.



- Develop a positive relationship between the community and company.
- Obtain support from host communities that can grow with the company and share some of the success.
- Dilute community reliance on the mining industry.
- Demonstrate to government, non-governmental organisations and industry analysts the company's commitment to social responsibility.
- Involve and engender pride among employees.
- Gain access to land and sanction to operate.

#### **Figure 46. Conservation Volunteers Australia, River Paramedics**

Six trustees were appointed, three from the company and three from the community, and AUD 3 million provided for an initial, three-year period. Following a review of the programme in 2005, the company committed a further AUD 3 million for a further three years. Three recent projects illustrate local initiatives receiving support from the Trust:

- **The Upper Hunter Learning Co-operative** provides a video conferencing facility in Muswellbrook, linked to the Distance Education Centre at Dubbo, to give access to secondary school courses not supported at the local high schools. The Trust has funded the capital costs of the facility and its administrator. By providing a “virtual” classroom, the facility enables children to study academically-challenging subjects that may not otherwise be available and that will prepare them for the mining jobs of the future. The State Government is particularly interested in this new education delivery model and is actively engaged in the project, and will most likely continue the programme.
- **The Australian Stock Horse Society**, based in Scone, is establishing an export market for stock horses in countries such as China and the USA. The goal is to establish a sustainable industry for Hunter Valley breeders and create employment opportunities based on these emerging export markets. The project complements the work of a State Government funded project officer. The Community Trust has part-funded research to identify and prioritise target export markets and establish an Australian Stock Horse Society breeders network. Further funding has been provided to develop a database to support improved communication of export opportunities, develop promotional material, enhance the Society's web presence and allow participation in trade missions to target market areas.
- **The River Paramedics** three-year partnership between Conservation Volunteers Australia, the Coal and Allied Community Trust, and local project partners, including the local Catchment Management Authority, Landcare, local councils, schools and scouts, has been established to:
  - rehabilitate the Hunter River and its tributaries through priority environmental projects;
  - increase the community's awareness of environmental issues affecting the catchment;
  - provide opportunities for and co-ordination of community involvement in safe, managed activities, thereby increasing the capacity of the community; and,
  - provide land-holders with a managed labour resource.



To date, the project has planted 44 634 trees and shrubs, revegetated 229 974 square metres, weeded 9 330 square metres and used 1 899 volunteer days to control erosion, improve water quality, reduce salinity and enhance habitats. These efforts have been publicised widely and community support has been impressive.

### Figure 47. Hunter Economic Development Corporation's Hunter Export Centre

Experience to date suggests that the key requirements for success are a commitment to long-term partnership and the active engagement of senior management with the Trust, such that the company can assist the community in developing projects that meet the requirements of the Trust's funding application process. Rio Tinto's Queensland coal operations also operate Community Trusts and these are covered in Case Study 42.



Figure 48. Francis Greenway High School Opportunity Plus for students



## Community Activism

### Case Study 37. BMA Community Partnerships Program, Australia (BHP Billiton)

*BHP Billiton Mitsubishi Alliance (BMA) has a major presence in the central regional communities of Queensland, Australia where it operates seven large mines and the Hay Point Coal Terminal. Several towns in the region were purpose-built to accommodate coal mine workers and their families, while other towns rely, for a large part of their employment and commercial activity, on the coal mining industry and, therefore, on BMA. BMA makes a very considerable economic contribution to these communities in the form of jobs and wages, investment, and the sourcing of goods and services from local suppliers. The company recognises that the social dimension of sustainability involves more than this. BMA tries to be genuinely engaged in the communities in which it operates - to understand and be responsive to their needs, and to enhance their ability to shape their own futures. BMA also would like the communities to understand the company's perspectives on sustainability and to share its key sustainability goals. The company's Community Partnerships Program is an important means for achieving this goal.*

In early 2002, BMA undertook a comprehensive review of its existing community support programmes. Over several months, interviews were conducted with employees, Queensland and local government officials, local community groups, welfare organisations and education providers. The review also included extensive research of the community programmes of other leading Australian companies.

**Figure 49. Melanie Webber, BMA Goonyella Riverside Mine engineer, mentoring students from Moranbah State Primary School, Queensland, Australia**

The aim of the review was to identify community needs and those areas where BMA, working with expert groups and local providers, could make a genuine difference - key areas included adult and child literacy, access to training in information technology and to vocational studies.



The outcome of the review was a doubling of the company's financial commitment to community support activities and a major redesign of the means through which this support would be delivered, managed and monitored. The new programme - the BMA Community Partnerships Program - retained a "local-engagement" model, in that participation in approved projects continued to be through BMA's operating sites, but was better co-ordinated than the earlier approach, and better targeted at community needs.

The programme encompasses a diverse range of activities under six broad headings - youth support, business and skills training, community welfare, sport and recreation, arts and entertainment, and the environment. It promotes partnerships in these areas with local and State governments, training and welfare providers and communities groups.

From its inception, progress reviews have been undertaken. The first of these - a comprehensive stakeholder survey - was held after the first year of operation. It found overwhelming support for the programme, but also recommended improvements, which were incorporated into the programme's second and third rounds of annual funding approvals.

During 2004/05 BMA commissioned a social impact assessment of the programme by the University of Queensland's Sustainable Minerals Institute. Projects were found to have clear goals and target populations, and the programme's emphasis on partnering with established organisations was noted as its key strength. The main recommendation made for improving the programme was to devote more resources to building the capacity of the local programme managers. Among other recommendations, the programme would also benefit from greater involvement by senior mine management in projects and the involvement of external expertise in the selection of projects. These findings will be used to guide further development of the programme.



**Figure 50. Moranbah Miners Junior Rugby League teams being coached by Mark Anderson, employee at BMA Peak Downs Mine, Queensland, Australia**



## Community Engagement in Practice

### Case Study 38. Energy in the community, UK (E.ON UK)

*Community activities incur some cost. This case study shows the need for a specialist manager to oversee the activity, as well as the commitment of employee time to activities that do not directly benefit the company. Despite the cost, E.ON UK considers that these activities can replace “cheque-book charity” and benefit the company by improving staff retention and contributing to employee development.*

Under the supervision of an Employee Involvement Manager, appointed in 2003, E.ON UK undertakes several, community-based activities, including:

- Offering matched funding to recognise employees' fundraising efforts or time spent volunteering.
- Working with Education Business Partnerships, allowing employees to volunteer during work time in local schools, helping with maths and reading, or mentoring pupils.
- Working with Business in the Community (BITC) and the UK National Trust, providing volunteers to undertake team-based community activities.
- Working with Business in the Community to assist homeless people to find employment.

The Energy in the Community programme has been set the target of increasing the number of employees taking part to 15% and 27% of E.ON UK employees in 2005 and 2006, respectively. Participation has grown from 49 volunteers at the start of 2003 to over 1 200 volunteers in 2004 - or 8.2% of E.ON UK employees. Participation is encouraged by desk-drop literature, road shows at the company's sites and articles in newsletters and newspapers.

#### Figure 51. National Trust Team Challenge

Volunteering has been at the line manager's approval and is used by individual managers as a motivation and development tool. Over the years, thirty-three team challenges have taken place with more scheduled. During 2004 alone, 206 volunteers went out to help in local schools and 579 matched-funding claims were processed, benefiting 237 different charities. During 2005, the main area for development was the ONE (Offering New Expertise) business expertise programme, designed to allow employees to use their business skills in the local community.



### Case Study 39. Community volunteerism at Kennecott Energy, USA

*Kennecott Energy Company employees live in seven different communities near the company's five mine sites. Since the company was formed in 1993, volunteer activities have developed on an ad hoc basis without any formal, company initiative, but Kennecott employee voluntary participation has been strong and varied. The company has decided to formalise voluntary employee activities as part of its commitment to supporting the communities in which it operates.*

In 2005, Kennecott Energy Company developed a *Five-Year Community Plan* that outlines the roles of each mine site in adopting a specific community and then in spearheading volunteer activities, and any necessary donations, within that community. Each mine site was surveyed to determine the existing level of

volunteerism. By June 2005, two of the five mines reported and demonstrated a high level of community participation from mine employees. When all the surveys are completed, the *Five-Year Community Plan* will be amended to foster the employees' ongoing volunteer efforts and to provide continuity and sustainability for volunteerism into the future.

Prior approval for this effort was obtained by the company's vice-presidents of operations and their respective mine managers. Kennecott recognised that the success of this effort would depend on ongoing, high-level support. Early concerns were raised that community volunteerism efforts would fall on the shoulders of the company's Human Resources department. In an effort to avoid any conflict, Kennecott stressed the importance of involving a broad spectrum of employees such that employees from every sector of the business are encouraged to participate in the community volunteer efforts.

### Case Study 40. Electrification in South Africa (Eskom)

*One of the key issues for sustainable development is giving the majority of people access to the essential services needed to improve their quality of life. These services include improved health services, clean water, adequate food and modern energy. Electricity generated from coal plays a key role in delivering all of these services, because it is low-cost and reliable. It underpins the economic and social development of many countries, as well as providing the support infrastructure for such development to occur. For any nation or region to move forward and become competitive in the global market, providing reliable and affordable electricity is crucial, and coal has a proven track record in meeting these requirements. The provision of electricity leads to job creation and a rise in disposable income. Electrification of schools and homes is likely to lead to better education and improved productivity. The supply of electricity can lead to a decrease in the harvesting of firewood, helping to safeguard biodiversity, and a decrease in respiratory diseases due to the reduction of smoke from biomass burning. The relative efficiency of using electricity will reduce the overall emission of ambient air pollutants and lead to an improved quality of life.*

The level of electrification in South Africa has risen from 36% in 1994 to 71% at the end of 2004; the number of rural households electrified countrywide has risen from 12% in 1994 to 51% in 2004. Eskom electrified an annual average of 300 000 households from 1994 onwards and at the end of 1999 had met and exceeded its target of electrifying 1 750 000 homes. From the beginning of the electrification programme in 1991, up to the end of March 2005, 3.2 million homes had been electrified at a cost of approximately ZAR 9.4 billion.

**Figure 52. Electrification in South Africa, 3.2 million homes electrified since 1991**

Achieving this impressive result has fallen largely on Eskom as the organisation responsible for implementing the government's electrification policy. In addition to conventional project management, which required over 200 individual electrification projects to be planned, designed and executed each year, Eskom also had to consider wider sustainability issues such as affordability, billing procedures, and the rising cost per connection as more rural electrification took place. A comprehensive programme into how to overcome these difficulties was undertaken, including more comprehensive community interaction programmes and the development of a pre-payment meter.



The effective implementation of the electrification programme was made possible by the commitment and participation of a number of bodies, including government departments, businesses, academic institutions and other non-governmental organisations, co-ordinated by Eskom.

Eskom has reduced the cost per connection from ZAR 4 500 in 1991 to around ZAR 2 800 in 2000 by innovative ideas and the implementation of cost-effective and appropriate technologies for rural electrification. Capital cost per connection increased in 2003 to just over ZAR 3 000, and in 2004, to just over ZAR 4 000, primarily because of connections in deep rural areas, where there is no existing electricity infrastructure and housing densities are low.

Some of Eskom's technical innovations were the development of a series of structures and cable types that were readily available and allowed for easy construction at lower cost. This permitted the development of a range of “building blocks” which could be used to design and construct electrification projects, as in a production line. It was also necessary to define the parameters by which networks were designed and to ensure that these matched the load demanded by the inhabitants. Measures were also devised to assess designs and determine if they were on target, or needed rework. It was estimated that these measures reduced the cost per connection by approximately 20%.

Some of the lessons from Eskom's experience in providing low-cost, reliable electricity include:

- Electrification programmes require strong, government intervention at early stages of development, especially when the overall energy economy is far from saturated and the government wants to improve the socio-economic development of the country.
- Electrification should not be evaluated only in terms of financial cost-effectiveness, but also by considering access to electricity, socio-economic development and progress towards improved quality of life.
- Attempts should be made to use optimal technological and operational solutions in any electrification programme, as this will help to reduce costs.
- Cost recovery of electrification programmes should be strongly linked to affordability for users.
- Realising the full benefits of electrification may be slow, and ways to maximise benefits over both the shorter and longer terms should be found.
- Modelling is a useful tool to develop options to manage load distribution and ensure optimal potential for electrification.
- Demand-side management can assist with the realisation of benefits, but should be linked to affordability, as the cost of implementation can be a barrier, as can physical access to the suggested measures.
- Projects need to be undertaken in a holistic manner.
- It is not possible to separate planning and project management. Defined targets and a technology plan are required, but continual re-planning is inevitable as well.
- A centralised approach is required for planning.
- Customer knowledge is essential.
- Standardised designs must be based on proven pilots and provide building blocks that allow the matching of tariffs and technology to customer requirements.
- Tariffs and revenue collection methods are critical and must reflect technology options and cultural preferences.
- Non-grid electricity supply options need to be integrated in a controlled manner.

#### **Case Study 41. Black economic empowerment in commercial farming, South Africa (Xstrata Coal)**

*Xstrata Coal's Commercial Farmer Settlement Project is a further illustration of how sustainable economic activity, at a local level, is encouraged by coal companies, particularly in developing countries. The ensuing*

*benefits of a healthy economy and a socially-stable nation help investors and communities alike. This case study illustrates a strong commitment to achieve the social goals of sustainable development, alongside the policy goals of the Government of South Africa, by creating opportunities for Historically-Disadvantaged South Africans to enter the mainstream economy.*

New farmers are given training and then enter into a long-term lease agreement with Xstrata Coal South Africa to farm Xstrata land for their own purposes. The minimum economic size of each farm is about 770 hectares, with a maize crop yielding 5.2 tonnes per hectare and a potential turnover of between ZAR 3.2 million to ZAR 4.2 million per annum, depending on maize prices. A comprehensive and intensive training and development programme assists the farmers, with a focus on the practical aspects of commercial farming, and on-the-job application of best farming practices.

The four farms within the project should generate a combined turnover of up to ZAR 12.8 million each year. This will create the potential for twenty to thirty permanent jobs, as well as eighty to one hundred seasonal employment opportunities.

**Figure 53. Black economic empowerment through the Commercial Farmer Settlement Project**



## Local Infrastructure Enhancement

### Case Study 42. Rio Tinto's investments in community development projects, Australia

*Australian coal producer Rio Tinto Coal Australia Pty Ltd actively engages in community development projects in the areas in which it operates in New South Wales, via the Coal and Allied Community Trust (Case Study 36), and in Queensland at its Tarong, Blair Athol, Kestrel and Hail Creek operations. Rio Tinto Coal Australia's community development projects aim to meet the challenges facing the communities in which they operate, by stimulating opportunities for employment and training, providing young people with skills to enhance their long-term employment prospects and supporting business initiatives that achieve these goals.*

As a member of the Rio Tinto Group, Rio Tinto Coal Australia adheres to the group's *Business with Communities Partnerships Program*. The funds made available from Tarong Mine, Blair Athol Mine, Kestrel Mine and Hail Creek Mine are administered by local boards, comprised of company and community representatives. Applications for funding are invited from eligible businesses, educational establishments and community organisations. Rio Tinto Coal Australia's *Community Needs Assessment* process identifies the priorities of each local community, a process that includes personal interviews with a broad, cross-section of community members.



The Tarong Mine Community Development Fund was established in 1999 following a survey of community leaders. The survey sought views from people in local government, health and social services, youth affairs, business, rural affairs, religion, environmental groups, and State politics. It revealed some of the major challenges facing the community: reducing unemployment, diversifying industry, attracting new business and developing a skilled labour force.

Community proposals are assessed by a Fund Board comprising community members and senior management from Tarong Mine. The Fund's goals are to meet the challenges facing the community by stimulating opportunities for employment and training, providing young people with the skills that will enhance their long-term employment prospects, and supporting business initiatives that align with these goals.

**Table 3. Examples of projects that have received funding from Tarong Mine**

Projects	Outcomes
Tarong Mine School Work Placement Program	Provided on-the-job training for 130 high school students
Nanango Visitor Information Centre	28 volunteer workers trained to staff the information centre
Tarong Business Program, Stage 2	Assisted local enterprises gain AUD 15 million in new business
Farmers' Market	Assists local producers in developing new markets
South Burnett Regional Tourism Website	Giving 300 local businesses a presence on the Internet
Tarong Mine Apprentice/Traineeship Scheme	Created five new jobs and paid half the salaries of employees in 2000/01
South Burnett Enterprise Centre	Incubates local business start-ups

The Kestrel Mine Community Development Fund and the Blair Athol Mine Community Development Fund have operated along this model since 2003.



**Figure 54. Kingaroy Shire Chief Executive Ron Turner goes over the plans for the new Heritage Precinct with the information centre's Sue Duncan**

This model has recently been extended with the creation, in late 2005, of the Hail Creek Mine Community Development Fund which will follow a similar model as that successfully demonstrated at Rio Tinto's other coal operations.

**Figure 55. Programme participant and Year 10 student, Caragh Galway, now works part-time at the Clermont Pharmacy following her voluntary work placement**



**Table 4. Projects that have received funding from Kestrel Mine**

Projects	Outcomes
Young Farmers Tour (in partnership with Agforce)	Assisted 14 young farmers attend a pre-conference technical tour, before attending National Grains Week
Ecoman workshop (Emerald State High School)	18 students participated in three-day, business simulation exercise
Opti-Minds Challenge workshop (Emerald State High School)	90 students attended one-day, problem-solving, decision-making workshop
Central Highlands Tourist Organisation Tourism Manager	Full-time Tourism Manager employed to promote tourism in Emerald and Peak Downs Shires
Biz-e Centre and Biz-e week (Capella State High School)	Operation of centre as interface between students and local business community (24 students undertook school based traineeships and apprenticeships)
Central Highlands Science Centre	Over 500 students visited the centre in 2005. The Centre promotes development of scientific skills and possible career path in science and technology
Central Highlands Development Corporation Conference Centre Feasibility Study	Consultant employed to examine viability and need of conference centre in Central Highlands



**Figure 56. General Manager Peter Dowling discusses the *Taking the Lead* project with Business Development Officer Janice Moriarty, Kestrel Mine Community Development Fund**

### **Case Study 43. BHP Billiton's community development programme at Rietspruit, South Africa**

*Ensuring a sustainable future for mining communities, following the cessation of mining operations, is an essential element of sustainable development programmes at multi-national coal mining companies. During twenty-four years of mine operations, the town of Rietspruit developed into a lively community, with extensive housing and recreational facilities provided by the company. In May 2002, the mine closed and the community, located south of Witbank, South Africa, has been working with the mining company to ensure that the people of Rietspruit have a sustainable future following the closure. Continuous consultation between stakeholders and BHP Billiton's Rietspruit Mine Services has been an integral part of downsizing and the eventual closure of mining operations at Rietspruit. By establishing formal communication structures to keep employees abreast of developments and an information centre to provide advice and counselling, the company has ensured that the community has a voice in framing plans for its future.*

BHP Billiton aimed to create sustainable, economic and alternative employment opportunities for the remaining mine employees at Rietspruit, and for the community as a whole, following cessation of mining operations in May 2002. New community structures have been created to identify and manage sustainable job creation and local economic development activities. The company assisted employees' transition from their previous jobs at the mine by replacing contractors with former employees, actively placing affected employees at other BHP Billiton operations in South Africa, and by creating a climate where employees could choose to leave the company to start their own businesses or pursue other interests.

In the first phase of the programme, stakeholder groups were identified and steps taken to gain their support. Within a short period of time, twelve groups were identified throughout the community and a transitional community forum established. An Executive was elected and the Rietspruit Community Development Forum institutionalised. The forum was designed to allow community leaders to consult with the various stakeholders in the village. It does not hold any operational responsibility, but acts as a steering body, although it is responsible for distributing any excess funds to beneficiaries.

The second phase focused on creating a final representative forum that would encourage self-sufficiency in the supply of goods and services within Rietspruit by creating service-related jobs, for example through municipal services being performed mainly by local residents, and by establishing new businesses with links extending outside Rietspruit.

A special company was formed to manage a social fund through which employees could buy their houses at below market price and without incurring any income tax liability - with monies raised from house sales used for the creation of new, sustainable employment opportunities. To this end, a Development Corporation was formed to manage the community's investment portfolio of job-creating businesses and to generate revenue to cover the costs of other community infrastructure projects.

A Community Trust and Village Bank were formed to allow participation by community members in the investment decisions that would create jobs. The ongoing supply of basic services, such as electricity, water sanitation and the upkeep of roads and open spaces, has been handed over to the local council with arrangements in place to source some of the municipal services from people within the town.

### **Case Study 44. BHP Billiton Matched Giving Programme**

*Matched giving is a means through which the employees of BHP Billiton may influence the company's programme of charitable donations and other forms of giving. Under the programme, employees' contributions to eligible, not-for-profit, community organisations are matched by the company, up to individual ceilings. Employees may donate money, or volunteer time and effort to fund raising and other activities, for which the ceilings are higher.*

Beginning in 2002, the *Matched Giving Programme* has been adopted at BHP Billiton sites in Australia, the United Kingdom, South Africa, and Canada. The programme is evolving and is reviewed every year against its goals, which are to:

- create a unique programme that would operate successfully at any of BHP Billiton's sites around the world;
- encourage employees to actively engage in their communities;
- enable employees to influence some of the company's community investment funding; and,
- use BHP Billiton's matching contributions to strengthen local communities.

Of the eligible activities under the programme, volunteering has been consistently the most popular form of giving, with community services, education, sports, and health attracting most employees' efforts and donations.

## Community Health

### Case Study 45. Anglo Coal's HIV/AIDS initiatives in South Africa

*HIV/AIDS is having a major impact on public health in South Africa and poses a significant threat to labour productivity and sustainable economic development. Anglo Coal recognised the potential impact of HIV and AIDS some ten years ago and has progressively implemented interventions in both the workplace and in neighbouring communities. Initial efforts were focused on awareness, education and prevention; these have developed to include concrete steps to minimise the impact of HIV and AIDS, and to improve the care of those affected. This case study illustrates the willingness and capacity of a major coal company to act in an area conventionally considered as the role of government. Although, first and foremost, an issue concerning social well-being, HIV/AIDS calls for a wider vision of the company's objectives than might be expected since it could affect the long-term operations of the company.*

In August 2002, Anglo Coal South Africa introduced an anti-retroviral therapy (ART) programme for employees with HIV or AIDS, thus becoming the first South African mining company to administer ART to HIV-infected employees progressing to AIDS. The programme is consistent with the requirements and treatment protocols of the World Health Organisation (WHO).

At the end of December 2005, 68% of Anglo Coal South Africa's employees had been voluntarily counselled and tested for HIV - a marked improvement on the 17% achieved in 2003. Of this group, 604 employees (13% of the tested population or 8% of the total workforce) tested positive. 87% of all HIV-positive employees have registered on the Anglo Coal South Africa *Disease Management Programme* and about half of these have started anti-retroviral therapy. For those individuals who test HIV-negative, the voluntary counselling and testing (VCT) programme gives added impetus to the call for precautionary behaviour to avoid HIV infection.

Anglo Coal South Africa's chief medical officer, Dr Jan Pienaar, has noted that: “*The benefits of the ART programme are emerging in both the absenteeism rate and in the prevalence of new cases of tuberculosis. For HIV-positive employees, a more than 50% reduction in absenteeism has been recorded after commencement with ART. Similarly, the number of new cases of compensable cardio-respiratory tuberculosis has declined significantly.*”

The HIV prevention programmes extend to neighbouring communities. The programmes are aimed at youths, high-risk groups such as migrant workers and sex workers, and expectant mothers. The programmes cover awareness, peer education and support, education on the need for behavioural modification, condom



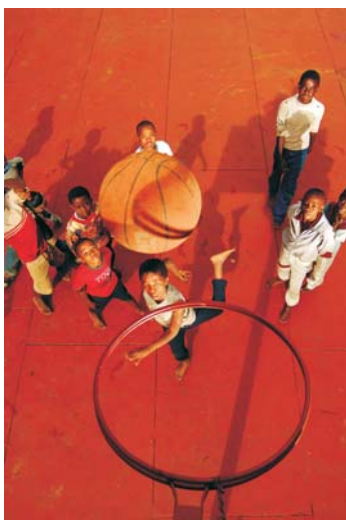
distribution, and prevention and treatment of sexually-transmitted infections. Increasing emphasis is being placed on encouraging voluntary counselling and testing, since this encourages early diagnosis and entry into the disease management programme for HIV-positive individuals.

**Figure 57. Regional General Manager John Standish-White with traditional healers from neighbouring communities at a Family Khulumiminsana “chat show”, showing support for the Goedehoop and Bank Collieries' HIV/AIDS campaign**



Specific activities include:

- Anglo Coal's partnership with loveLife is specifically focused on engaging the youth and young adults. The focus is on positive lifestyles and healthy attitudes towards sexuality. The partnership also focuses on upgrading government clinics so that usage is increased and they become more beneficial. Clinic upgrades undertaken in Witbank included those at Hlalanikahle, Sibonginsimbi, Beatty, Lynville, Tubelihle and Klipfontein.
- Anglo Coal's Home-based Care partnership with mineworker recruitment organisation TEBA Ltd provides assistance for ex-employees in rural areas. Employees at an advanced stage of illness are able to return home with an understanding that some form of assistance is available to them. The programme runs in Lesotho and the Eastern Cape.
- At Goedehoop colliery, approximately 96% of employees have reported for voluntary counselling and testing during 2005. Testing has been accompanied by ongoing educational activities - linked to induction programmes, awards and celebrations. The mine has begun serving vitamin-enriched porridge, the local staple food, in its canteens and distributing “thank-you” packs to workers reporting for counselling and testing. Since February 2002, more than 286 000 condoms and femidoms have been distributed in the surrounding community. Local sex workers have been recruited into the campaign to promote safe sex and now play an important role in distributing condoms and raising awareness along trucking routes. A total of 176 employees has enrolled on the HIV disease management programme, of whom 70 have started anti-retroviral therapy. The other 106 employees remain on the wellness programme designed to keep them from progressing to the next stage of the disease for as long as possible.



**Figure 58. loveLife Centre, basket ball court supported by Landau Colliery**



## Education

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### Case Study 46. Xstrata's schools development programme, South Africa

*Particularly in developing countries, some companies are actively assisting national governments in achieving their development goals, over and above the substantial economic contribution they make through taxation, employment and investment. Distinguishing the application of sustainable development principles from modern corporate behaviour is not always obvious, because governments and the public have come to expect socially-responsible behaviour at the corporate level. This case study illustrates the long-term vision of a company committing its resources to an immediate and focused activity, well outside its core activities. The three-year, joint Xstrata Coal / Xstrata Alloys programme is focused initially on improving the governance and management of the schools, before addressing the quality of primary and secondary school teaching.*

In contrast to the historic tendency of business to focus solely on short-term gain in curriculum development, the companies recognised the importance of the actual management and governance of the schools to ensure that they are being run professionally and with the best interests of the students' educational development in mind. The ZAR 3.8 million programme is helping twenty, historically-disadvantaged schools in Mpumalanga Province in South Africa improve the quality of their mathematics and science teaching, governance and school management.

A number of preparatory meetings were conducted between July and September 2003 to introduce the programme to senior representatives of the provincial and regional levels of the Mpumalanga Department of Education. In October 2003, Xstrata representatives held meetings with circuit-level officials and stakeholders from all the government-selected primary and secondary schools to encourage participation. The meetings were followed by school visits to discuss the programme with school staff.

In January and February 2004, a baseline study was conducted to determine the condition of infrastructure and the governance, management and curriculum practices in the schools. The study revealed the strengths and needs of each school and will serve as a benchmark to measure improvement. The results of the study were used to establish plans for each school.

Forty teachers have been registered to complete the *Mathematics Advanced Certificate* in Education course through the University of South Africa and further science teachers were registered in 2005.

## Human Rights

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### Case Study 47. Human rights and ethics in Colombia (Anglo Coal)

*Anglo Coal holds a one-third, non-managing stake in Cerrejón Coal. The operation has had to address legacy issues connected with past relocations and resettlements.*

Most of the obligations under relocation agreements have been addressed: only eight agreements from the relocation of the Tabaco community are now outstanding. The Guajira region, in which the operation is located, has seen significant levels of activity by armed groups, principally the FARC and para-military groups. In April 2004, a group of Wayuu Indians in Portete, close to Puerto Bolívar, was tragically massacred by para-military forces. Cerrejón immediately implemented a humanitarian aid programme. Hundreds of community members sought refuge at Puerto Bolívar, where they were given food aid. Cerrejón provided further logistical support to enable community members to return to Portete once the military had made the area safe.

Cerrejón bases its security policies on the *Voluntary Principles on Security and Human Rights*. It has also been working with the Inter-American Centre for Human Rights in Costa Rica, to provide human rights training to the military personnel deployed in the vicinity of the mine. During 2004, 328 people were trained, with training for a further 500 security personnel planned.

Towards the end of 2004, trade union leaders connected with Cerrejón's main union were subject to threats and intimidation. These coincided with bi-annual negotiations on pay and conditions. Relations between management and the trade union at Cerrejón have been good and constructive for more than a decade. Management and the trade union issued a joint statement, affirming their belief in fundamental labour rights and condemning intimidation; the company drew the threats to the attention of the Vice President of Colombia, with a view to ensuring that personal security issues were adequately addressed.



## CASE STUDIES: MANAGEMENT PROCESSES AND SYSTEMS

Integration of sustainable development into management processes and systems has several aspects. A company needs to consider the impact of government and community support for sustainable development on its current and future business activities. Benefits, as well as risks, are likely to be identified as experience is gained, and views exchanged with governments, communities, the workforce and the general public. Commitment to sustainable development principles is likely to commence with a general commitment at a high level, but gradually evolve to include the participation of key personnel in concrete projects and more widespread participation of the workforce as a whole. Both formal business plans and the dissemination of a sustainable development culture are necessary to ensure decisions, at all levels, take into account sustainable development principles. Consultation and reporting are essential aspects and should extend to community endorsement of the approach taken by a company. For coal producers, planning for mine closures and post-mining rehabilitation is an important issue, and, for producers and utilities alike, co-operation along the value chain is a key issue.

### Business Cases for Sustainable Development

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#### **Case Study 48. Sustainability opportunity and threats analysis: water management at BMA, Australia (BHP Billiton)**

*Aspects of water management by BHP Billiton Mitsubishi Alliance (BMA) were used to trial a new tool for identifying and evaluating site-level sustainable development issues in open cut and underground coal mining - the Sustainability Opportunity and Threats Analysis (SOTA), developed by Australia's Sustainable Minerals Institute. The institute was established in 2001 to co-ordinate minerals-related research in the University of Queensland, and to work with mining and minerals processing companies to develop an improved understanding of the meaning and application of sustainable development principles to the state's minerals industry. SOTA assists mine managers to identify the threats and the opportunities which could affect the future success of an operation, and its ability to contribute to sustainable development objectives. At its core is the novel application of risk management techniques, which have become standard procedure in the mining industry, to sustainable development issues in an attempt to blend the two themes into a single, operational tool.*

Access to reliable sources of waters is essential to coal mining. Even mines that do not wash their coal in preparation plants need significant quantities of water for dust management, drilling, human consumption and many other uses. Also, as a result of these activities, the transformation of clean water into dirty water must be carefully managed by the mine and presents many challenges.

Water management at BMA's Norwich Park mine was chosen to trial application of SOTA because of the multi-dimensional nature of the issues it presented. BMA manages water resources for its seven large mines, and supplies water to local communities, farmers and other mines through its extensive pipeline system. The range of water management issues arising, and the potential for conflict between priorities, presented a particularly appealing test subject for SOTA, with the whole range coming together at Norwich Park mine.

The SOTA process at Norwich Park involved a number of steps:

- Scoping the project and defining its boundaries, which in Norwich Park's case encompassed the mine, the nearby town of Dysart, the Binegang Weir/Dawson River, various farms and the section of BMA's water pipeline which connects them.
- Information gathering, including the identification of stakeholders and the compilation of a list of sustainable development-related "prompts" to guide the consideration of threats and opportunities.
- Risk identification and evaluation, using well-known techniques for assessing the likelihood and consequences of occurrences, but, in this case, applying these techniques to events with a sustainable development impact. Opportunities are also assessed to arrive at an overall risk rating for a particular outcome.
- Treatment of the risks, involving the identification of measures to control the major risks and enhance any benefits - that is, the main elements of a management strategy balancing financial, social and environmental objectives.

For Norwich Park mine, there were a number of lessons in the exercise, including the need to improve the measurement and balancing of fresh water flows through the system, opportunities for the mine to replace some raw water use with recycled water, and opportunities for the local community to use less water. More broadly, the Norwich Park trial was a valuable test of the SOTA tool and validated its usefulness. It also provided BMA with a new technique to apply at each of its sites as part of the company's efforts to improve the overall sustainability of its water management practices.

### **Case Study 49. Fatal Risk Control Protocols (BHP Billiton)**

*BHP Billiton introduced Fatal Risk Control Protocols in 2003 in response to a review of fatalities and significant incidents at company-managed operations over the previous ten years. The review identified nine key fatal risks, which required the development of sound practices to eliminate further fatalities and also accident situations with the potential for a fatal outcome. The protocols were developed by groups of employees from across the company, with extensive operational experience.*

The protocols establish minimum performance expectations and requirements in three areas - plant and equipment, procedures, and people. So far, protocols have been developed for nine activities:

- light vehicle operation
- surface mobile equipment operation
- underground mobile equipment operation
- underground ground control
- hazardous materials management
- molten materials management
- equipment safeguarding
- isolation of electrical, mechanical and hydraulic equipment
- working at heights

A tenth protocol, to cover the lifting of loads with cranes, will be developed following a further review of fatal risks.



All BHP Billiton managed operations are required to apply the protocols and self-assess compliance with them. Implementation across the company is monitored and assisted by the development of a self-assessment toolkit and a series of workshops for managers to review implementation and resolve outstanding issues.

Unfortunately, there is invariably a lag between changed practices and improved results. Whilst implementation of the protocols has brought benefits, such as instances of workers surviving accidents due to the insistence on minimum standards for light vehicles (e.g. rollover protection), it has not yet eliminated the occurrence of fatalities at BHP Billiton operations.

To assist the company's operations in determining where there is potential for significant incidents, a mix of lagging indicators and new, leading indicators are used to enable management to identify and mitigate potential hazards. Lagging indicators include historical data on accidents and incidents, HSEC Standards audit results and *Fatal Risk Control Protocol* audit results. Leading indicators include safety behaviour observation results and trends, newly-approved greenfield and brownfield projects and labour turnover rates; these are being considered as triggers to alert operations to any heightened risk potential.

### **Case Study 50. Sustainable development, a joint initiative of the German cement industry and trade unions**

*The cement sector is a major industrial consumer of coal and is the subject of one of six projects launched by the World Business Council for Sustainable Development (WBCSD). The cement industry itself is also taking part in several activities around the world to implement its vision of sustainable development. Global cement companies, such as HeidelbergCement, Holcim, and Lafarge, will make an important contribution toward this vision. HeidelbergCement is taking part in the forum "econsense" - a joint project of twenty-three, global companies from different industries which share a common vision of sustainable development and its integration into business strategies. This case study outlines the approach to sustainable development taken by employers' and employees' organisations of the German cement industry, who have signed a joint commitment to sustainable development.*

Employers' and employees' associations examined the entire added-value chain of cement-bonded building materials: raw materials extraction; cement manufacture, including the use of fuels and electricity; concrete production; construction and utilisation of buildings; and, concrete recycling. Within this framework, former contributions to sustainable development were described and future courses of actions identified. This inventory formed the starting point of the joint initiative, which encompassed:

- **Extraction of raw materials.** Around 1.6 tonnes of limestone and clay are required to produce one tonne of cement clinker, the burnt intermediate product. The industry has worked to minimise the impact of materials extraction and to rehabilitate land after use. Today, nature conservation has been implemented in around 54% of former quarrying areas. In order to preserve natural resources, the use of secondary raw materials has risen in recent years.
- **Emissions abatement and CO<sub>2</sub> reduction.** Substantial progress has been made in the reduction of dust and NO<sub>x</sub> emissions from cement plants. Fuel consumption has been reduced by about 60%, compared with levels in the 1950s. In addition, the German cement industry has undertaken a voluntary commitment to reduce its specific, energy-related carbon dioxide emissions by 28% between 1990 and 2008/12. Measures adopted include the replacement of burnt cement clinker by other materials, particularly granulated blast furnace slag, and the use of secondary fuels which increased from under 5% in 1987 to over 40% in 2004. The use of secondary fuels saves fossil energy (i.e. hard coal and lignite), and also means that suitable waste materials do not have to be burnt or land filled elsewhere. There is also potential for the cement industry to use the project-based instruments of the Kyoto Protocol.
- **Concrete recycling.** In concrete production, cement is mixed with gravel, sand and water; however, concrete rubble, left after buildings have been demolished, can be fully recycled as an alternative aggregate,

along with crushed bricks and other recovered construction materials. Today, about 70% of construction rubble in Germany is re-used with the support of the cement industry through the *German Initiative for the Recycling of Construction Materials*.

- **Saving energy resources in housing.** A major goal of sustainability is to meet housing needs. Among other aspects (e.g. construction costs, durability of buildings, noise and fire protection), the energy required for heating is of great concern. A combination of different measures enables the latest legal regulations on energy savings to be exceeded in concrete buildings. Because of their high, heat-storage capacity, concrete construction elements are eminently suited to solar power applications, which can be exploited with collector walls or by deploying solid absorbers and heat pumps.

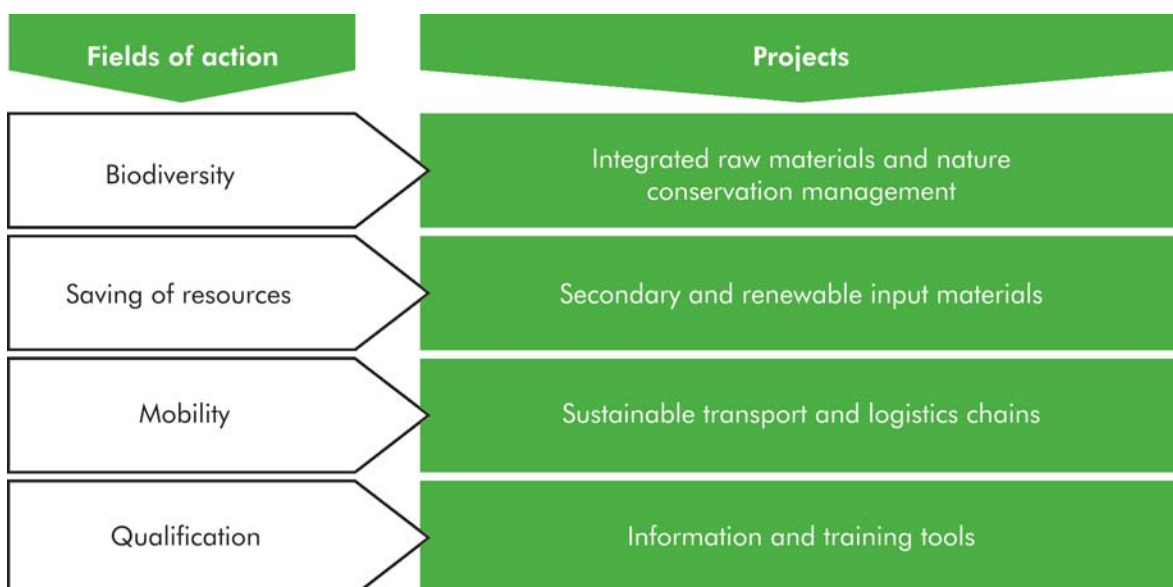
To guide future activities, employers' and employees' associations have decided to implement the *Initiative for Sustainability*, with four objectives to:

- Inform employees in the German cement industry about sustainable development.
- Implement the vision of sustainable development in companies and organisations.
- Realise pilot projects that provide impetus for sustainable development.
- Strengthen the dialogue with stakeholders outside the industry.

A joint working group co-ordinates activities, which have included a report on *Sustainability and the Cement Industry*. Dialogue with government, environmentalists and the scientific community is promoted by an advisory committee, and through events and workshops with external stakeholders. The advisory committee has about twenty members, including a number of well-known personalities from public life, representing the various interest groups relevant to sustainable development.

At its first event in November 2003, stakeholders discussed: the balance between raw materials extraction and nature conservation; the challenges to a sustainable industrial policy, including the different instruments for climate protection (e.g. voluntary agreements, eco taxes, emissions trading); and, the outlook for sustainable building. Members from different political parties and representatives of environmental associations were able to debate how political aims and industry-specific options should be reconciled.

**Figure 59. Fields of action and projects of the German cement industry Initiative for Sustainable Development**



Other stakeholder dialogues are focused on the fields of action and pilot projects illustrated in the diagram. Some examples include:

- A survey of the transport and logistics chains within the cement industry has been completed. On the basis of this survey, sustainable concepts to optimise the modal split of input and output transportation was developed.
- A pilot project, based on a cement plant in southern Germany, will develop and test indicators for measuring and evaluating biodiversity in quarries, and implementing a biodiversity action plan. Results will be evaluated for application to other production sites.
- Preparation of an information paper and regional conferences on training in sustainable development.

## Sustainable Development Reporting

### Case Study 51. Sustainability reporting, South Africa (Eskom)

*Companies are increasingly expected to broaden their accountability, beyond reporting their financial performance to shareholders, by demonstrating a sustainable performance to all stakeholders, such as regulators, the financial community, shareholders, customers, employees, non-governmental organisations and the general public. International sustainability reporting guidelines are available, such as the Global Reporting Initiative, and the UN's Global Compact, and encourage companies to report on sustainability. The interest in sustainability issues by the financial market has grown and led to the launch of sustainability indexes such as the FTSE4Good Index, Business in the Environment Index, the Johannesburg Securities Exchange Social Responsibility Index, and the Dow Jones Group Sustainability Index. This case study illustrates the way in which Eskom, one of the world's largest utilities, undertakes this task in South Africa.*

In South Africa, the revised *King Report on Corporate Governance* has emphasised directors' sustainability obligations, with an entire chapter devoted to “non-financial matters”, including social accounting, stakeholder engagement, ethics, environment, health, safety, societal transformation and black economic empowerment. The report places special emphasis on the importance of transparent and credible, non-financial reporting.

Eskom produced its first, separate environmental report in 1994, with high-level, sustainability-related information being provided also in annual financial reports. Eskom's annual reporting process, from 2001 onwards, was revised to produce one, integrated report covering sustainable development issues as well as annual financial information. This evolution was important, since integrated reporting on all aspects of performance was considered critical to demonstrate how sustainable development had been integrated into company practice. The report adheres, as far as possible and practical, to the *Global Reporting Initiative Guidelines* and the recommendations on non-financial reporting made in the revised *King Report*. The goal was to move towards an integrated approach for sustainability reporting, covering economic, environmental and social aspects. A more detailed version of the sustainability-related information contained in the annual report is published on the company's website. In maintaining its commitment to the principle of continual improvement, Eskom's 2005 Annual Report includes a GRI index.

In addition to compliance with relevant legislation, the focus of Eskom's reporting is on demonstrating good governance practices by way of material, relevant and clear disclosure to all stakeholders. An external audit firm is responsible for auditing and expressing an opinion on the performance reporting in the Directors' Report. This audit is not limited to financial performance data, but extends to reporting of non-financial performance, including the additional sustainability information in the internet version. Thus Eskom has

taken a fairly unique approach to sustainable development reporting, but one which is considered to be important in demonstrating full integration of sustainability into the business.

This approach to integrated sustainability reporting has enabled a single process to be employed for the collation, reporting, verification and auditing of all relevant performance information. Such an integrated sustainability report is better able to meet the needs of an organisation's many stakeholders, in terms of presenting information that is both relevant and material to them.

## APPENDIX

# SUSTAINABLE DEVELOPMENT PRINCIPLES AND STRATEGIES

This explanatory text is based on the approach taken by World Business Council on Sustainable Development (WBCSD) in its report, *Sustainability in the Electricity Utility Sector*.

### Principles

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The Bellagio Principles are intended to serve as guidelines for any sustainable development assessment process, including the choice and design of indicators, their interpretation and communication of the result. They are grouped into four aspects:

- The starting point of any assessment - **establishing a vision of sustainable development** and clear goals that provide a practical definition of that vision in terms that are meaningful for the decision-making unit in question.
- The **content** of any assessment and the need to merge a sense of the overall system with the practical focus on current priority issues.
- Key issues of the **process** of assessment.
- The necessity for establishing a **continuing capacity** for assessment.

The principles are intended for use in starting and improving assessment activities of community groups, non-governmental organisations, corporations, national governments and international institutions. They are inter-related and are intended to be applied as a complete set.

The World Business Council on Sustainable Development used the Bellagio Principles to identify key principles and objectives to inform the development of strategies and actions that are most meaningful for electric utilities in pursuing their sustainable development goals. Two additional principles were included.

### Strategies

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The case studies that the CIAB has compiled cover a range of environmental, social and economic strategies applied in the coal-producing and -using industries. The strategies outlined below, taken from the WBCSD report, encompass a range of actions and initiatives that, together, can move these industries closer to sustainable development objectives, consistent with principles based broadly on the Bellagio Principles.



Environmental	Social	Economic
Comply with environmental regulations	Expand access to electricity	Add to shareholder value
Implement environmental management systems	Provide reliable service	Deliver competitive return on assets/equity
Integrate environmental and social issues into planning and decision-making	Support key social programmes	Improve productivity and efficiency
Develop low pollution technologies and measures	Consult stakeholders and provide information	Apply transparent, fair and affordable prices
Develop GHG strategies	Support employment	Support R&D and training
Promote renewable energy development	Price power at affordable levels	Support business development
Promote energy and resource efficiency	Support ethical business practices	Procurement ( <i>i.e.</i> improve supply chain management)
Promote resource stewardship*	Promote health, safety and employee welfare	Liabilities and risk management
Undertake environmental education and training	Promote community engagement projects*	
Demonstrate environmental leadership	Integrate social issues into planning and decision-making*	
Sustainable development reporting		
Promote waste minimisation*		
Support key nature conservation programmes		

\* Added here to the WBCSD strategies.

The CIAB Members wish to thank Associates and others from their companies who contributed to the production of this report.

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9, rue de la Fédération  
75739 Paris Cedex 15

Printed in France by STEDI  
April 2006