

*Vision:* Coal is accepted as a secure, competitive and environmentally sustainable energy resource contributing to New Zealand's prosperity

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## Genesis Energy take 50% stake in CRL Energy

### Boost for low-emission thermal future



*Genesis Energy Chief Executive Murray Jackson, foreground, and Coal Association Chairman Chris Baker sign the shareholders agreement on the purchase of a 50% stake in CRL Energy.*

On 21 July 2008, Genesis Energy purchased a 50 percent stake in CRL Energy, New Zealand's leading research company of low-emission coal technologies.

All parties see the transaction as a significant boost for research and development of low-emission coal technologies in New Zealand; these technologies which include high efficiency coal gasification, carbon capture and storage, and hydrogen manufacture, will provide New Zealand with the option to make sustainable, low-emission power and vehicle fuel from the country's vast coal reserves.

CRL Energy Chairman Alan Broome said that Genesis Energy's investment was a vote of confidence in the organisation led by Chief Executive Rob Whitney, and reflected the world-class calibre of its researchers and research programme.

"The involvement of Genesis Energy means we can advance our coal research programmes

along the pathway to eventual commercial application.

"New Zealand, through CRL Energy, has the opportunity to make a significant contribution to international research into the advanced coal and hydrogen technologies required to combat global climate change," says Mr Broome.

Genesis Energy has purchased the 50 percent shareholding in CRL Energy from the National Institute of Water & Atmospheric Research.

Genesis Energy Chief Executive Murray Jackson said the investment in CRL Energy is part of his company's commitment to developing sustainable energy solutions for tomorrow.

"As the largest thermal generator of electricity in the country, we need to be able to address the effects our operations have on the environment. That's why we are investing in CRL Energy - to promote the development of new thermal power technologies with fewer emissions and greater efficiency.

"We are looking at opportunities to work with CRL Energy to scale up this technology so it can be used with carbon capture and storage in future low-emission power generation from thermal sources," says Mr Jackson.

Chris Baker, Executive Chairman of the Coal Association of New Zealand, which is the other 50 percent shareholder of CRL Energy, welcomed Genesis Energy's investment.

"Genesis Energy's decision to invest is recognition of the long term potential for New Zealand's coal resources to provide a sustainable, low-emissions energy source."

On sale of the shares, NIWA Chief Executive Officer John Morgan commented that NIWA's two-year involvement with CRL Energy has forged strong links between the two research institutes. "NIWA and CRL Energy have a combined expertise right across New Zealand's energy resource portfolio and will continue to work together closely though our collaboration in the National Centre for Climate and Energy Solutions, and the 'EnergyScape' future energy pathways research for the Foundation for Research Science and Technology," says Mr Morgan.

# Locking in carbon is key

*By Chris Baker, Chariman of the Coal Association*

Carbon capture and storage (CCS) is widely acknowledged as a vital measure to reduce global carbon emissions and one that can be commercially feasible in the near term.

Over the next 30 years the world faces a significant challenge. Carbon dioxide emissions from energy use are set to continue to rise, while over the same period there is a need to reduce atmospheric greenhouse gas levels.

The ongoing significance of coal and other fossil fuels as a global energy source underscores the key role for CCS technologies in addressing global emissions.

The Coal Association of New Zealand recognises that carbon emissions from thermal fuels need to be addressed as the world moves to a lower carbon future.

## CCS in a mix of measures

The Intergovernmental Panel on Climate Change (IPCC), International Energy Agency (IEA), and Lord Stern have each identified CCS as having the potential to be a key abatement measure in slowing climate change.

While renewables and energy efficiency will assist in reducing CO<sub>2</sub> emissions, they are unlikely to provide sufficient reductions to meet global emissions reduction targets.

Rather, a portfolio of responses, in combination, is required to combat emissions: energy efficiency, renewables, CCS and other technologies.

The IPCC estimated including CCS as part of a mitigation portfolio has the potential to contribute over half of the cumulative global mitigation effort while reducing costs by 30% or more.

## Energy demand

Today the world relies on fossil fuels for 80% of its energy. That figure is expected to rise slightly to 81% by 2030 without significant technology breakthroughs.

In developing countries, access to energy, in particular electricity, drives economic growth and improvements in living standards. Rapid economic growth in China and India is underpinned by the use of coal for electricity generation and in manufacturing.

In developed countries, coal-fired power stations continue to be built. In Germany, coal plants are being constructed which have the potential to reduce carbon emissions by up to 30% compared with a standard lignite-fired plant. However, the most significant advances in reducing carbon emissions from coal will require some form of CCS.

## CCS economics

The recent McKinsey Report, "Carbon Capture & Storage: Assessing the Economics" found that by 2030, CCS costs for new coal power installations in Europe could fall to "around €30-45 per tonne of CO<sub>2</sub> abated, which is in line with expected carbon prices in that period".

In effect, by 2030 CCS could pay for itself, without government subsidy, in new European power plants.

McKinsey has estimated that by 2030, CCS has the potential to provide around 20% of the total European abatement potential.

In addition to that, CCS for coal power generation could provide greater energy security by reducing Europe's dependency on imported natural gas and improve the environmental impact of new energy forms such as electric cars and hydrogen, which could be produced with CCS-based electricity.

There are, of course, hurdles to overcome to introduce CCS on a substantial scale. McKinsey assesses that early demonstration projects are likely to cost €60-90 per tonne of CO<sub>2</sub> abated. Storage and investor risk are key uncertainties.

## Promising progress

We do know that commercial applications of CCS are feasible within the decade and could be widely deployed with a favourable policy environment.

Progress on CCS is highly promising: "Complete CCS systems can be assembled from existing technologies that are mature or economically feasible under specific conditions," says the 2005 IPCC Special Report on CCS.

Significant progress is being made in proving the commercial feasibility of CCS in projects such as the pilot scale demonstration of permanent storage of carbon underground in Victoria, Australia and commercial-scale trials of carbon capture by Sargas, Norway to remove 95% of CO<sub>2</sub> from a coal-fired power station.

There is widespread scientific and intergovernmental support for CCS as one of a combination of solutions to reduce emissions from organisations including the IPCC, UN Framework Convention on Climate Change, Kyoto Protocol, IEA and the European Commission.

The world's largest emitter, China, is rapidly developing its own clean energy technology and would have the rest of the developing world as a potential market.

The modern coal industry has successfully developed technological solutions for the near-elimination of particulate and sulphur emissions - these are now commonplace in modern coal-fired power stations. The challenge is now to progress technologies to a stage where coal can be used as a near-zero emissions energy source.

## CCS in New Zealand

The Coal Association has been instrumental in establishing an industry and Government partnership to explore and assess CCS solutions for this country. Among the partnership's activities has been to join the Australian CCS research organisation, the Co-operative Research Centre for Greenhouse Gas Technologies (CO2CRC).

The pilot scale demonstration of permanent storage of carbon underground in Victoria, Australia is a CO2CRC project and is a major advance in the science of carbon sequestration.

The Coal Association, through CRL Energy, is also involved in research into the potential for New Zealand's hydrogen future, including developing the advanced technologies for hydrogen manufacture from coal.

Any country serious about climate change must include CCS technologies in its suite of abatement technologies alongside renewables.

New Zealand, given its large lignite resource and reliance on increasingly expensive imported fuel sources, has more incentive to do so than most.

## ETS passes with a six vote margin

The controversial emissions trading scheme (ETS) legislation passed with a 63-57 vote after its third reading in Parliament on 10 September. Despite passing, many commentators are grumbling that the bill has been rushed as an election year stunt and for appearances. During a committee debate on 2 September, Dr Nick Smith, National's opposition spokesman for climate change, claimed that it was unlikely that any Members of Parliament would have read all the 785 amendments to the Bill and they should be returned to the Select Committee for further public consultation. "The process over this bill is awful. It will result in serious mistakes, and that will cost New Zealanders dearly in terms of both jobs and costs. New Zealand deserves a whole lot better than to have this shabby process." Opinion on the bill is polarised with neither side particularly happy. Green Party co-leader Jeanette Fitzsimons who supported the Bill said that while the passing of the ETS was a step in the right direction, it was time to make some big strides. At the third reading of the bill, Fitzsimons said it was important for New Zealanders to recognise that the emissions trading scheme had not fixed climate change. "We need to adopt real targets within New Zealand. We must also work in international forums to get the United States and the larger developing countries to sign up to an international agreement on climate change."

However, during the Parliamentary debate, National MP for Invercargill, Eric Roy said "the Intergovernmental Panel on Climate Change is like some international nudist club, with every nation a member, and the only country taking its clothes off is New Zealand." He went on to say that the ETS Bill would leave New Zealand seriously 'exposed'.

Federated Farmers President, Don Nicolson, is also unhappy, "This has all been rushed through Parliament for short-term political gain rather than any sound economic or environmental reasons that will benefit New Zealand or the globe. The reality is it will cost New Zealand significant real money and is unlikely to achieve the global outcomes sought. For some politicians the passing of this bill is seen as a clever political public relations stunt."

The Greenhouse Policy Coalition points out it is hard to imagine how long a scheme would last in New Zealand if businesses and consumers here face increases in fuel and energy at an international price of \$40-50 a tonne of CO<sub>2</sub>, while Australia may cap its ETS price at A\$20 a tonne. Also, Australians will not be burdened with any increase in transport fuel costs until at least 2013 because they will be offset by matching reductions in fuel excise tax and the Australian Government (unlike the New Zealand Government) has promised to recycle every cent of revenue collected from its ETS.

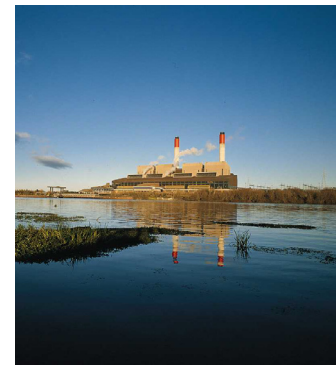
Chris Baker, Chairman of the Coal Association, says the hastily prepared legislation passed by a small majority is not a good basis for durable climate change policy that will help create investment certainty. "A bill that will have such major impacts on New Zealand society for decades needs more time to develop better consensus. In particular, the pace and extent to which the Bill imposes costs throughout the New Zealand economy will reduce our competitiveness against most other countries, without creating any benefit for the global environment. At any time, let alone in these times of great uncertainty in terms of the global economy and future climate change agreements, that is a strategy with no upside."

### Impacts on Coal Users

Of the amendments to the bill, the main impacts on trade-exposed energy users will be the slower phase out rate for free allocation and the much reduced emissions threshold for free allocation. There is provision for some purchasers of coal to take the risks of "opting in" to the ETS (rather than the emissions payment being included in their supplier's coal price). An MED led cross-government group is working on developing regulations for CO<sub>2</sub> Capture and Storage and is working closely with the NZ CCS strategy (in which the Coal Association is taking a lead role).

The direct CO<sub>2</sub> price impacts (from a market price of \$30 per tonne CO<sub>2</sub>) will still be from the start date of January 2010 (2011 for transport fuels):

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## Treasury report acknowledges thermal ban will increase costs

*The New Zealand Business Roundtable released a Treasury report (prepared in February and obtained under the Official Information Act) that acknowledges the proposed ban on new baseload thermal power will impose unnecessary costs. The report comments on interventions over and above that needed with a market mechanism like an ETS (such as the thermal ban and the biofuels obligation): "Layering duplicative regulatory measures on top of the economy wide price measure increases costs" and "The majority of sector-specific measures are rendered redundant by the adoption of the ETS."*

*In spite of the proposed ban, the absence of legal definitions of baseload and peaking power supply is behind Genesis Energy's application for resource consent for a new gas-fired power station at Rodney, north of Auckland. It could be meeting electricity demand in the Auckland area within five years.*

## ETS passes with six vote margin

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- about \$60 per tonne of sub-bituminous coal (\$42 per tonne lignite) or \$3 per gigajoule;
- about 8c per litre for diesel; and
- about 1.7c per kWh electricity.

For coal users and producers in particular, the other amendment affecting most of them is the extra costs from inclusion of fugitive methane emissions from coal mining, against advice that this will be difficult to measure and would be inequitable.

“Fugitive” methane emissions from coal mining are currently estimated for the National Greenhouse Gas Inventory by MED using average international factors because there is a vast range of coal geology conditions in New Zealand and no generalisations can be made on current limited information. IRD and Treasury officials accepted the measurement difficulties and recommended coal seam gas (CSG) not be included in the ETS coverage (except where it was to be extracted for utilisation).

Also importantly from a legal view, the coal producer does not always own the CSG so liability for emissions should fall on the owner. In detailed submissions, Solid Energy concluded that “it is neither feasible nor cost effective to levy a charge on fugitive emissions of methane from coal mining operations in the NZ context... Crown Minerals is of the view that methane falls within the petroleum minerals regime. The proposed levy on

fugitive gas emissions therefore represents a charge against one party based on an asset owned by another party. Worse, the present law prevents the owner of the coal licence mitigating his exposure to the tax by employing well-proven and commercially viable methane drainage/electricity generation technologies. A precondition to the introduction of any charge on underground emissions must be the resolution of this statutory confusion and mismatch.”

If the methane emission factors currently used by MED were used as default ETS factors, this would mean that the direct extra cost for bituminous coal from underground mines such as Terrace, Spring Creek and the future Pike River would be \$10.60 per tonne (assuming a market price of \$30 per tonne of CO<sub>2</sub> equivalent). The similar cost for sub-bituminous coal from underground mines like Huntly East would be \$7.60 per tonne and for all surface mined coals \$0.50 per tonne. If this had been applied to the approximate 19,000 tonnes of fugitive methane emissions calculated for 2006, the same market price would be equivalent to extra direct costs of \$12M. (This can be compared with the potential direct liability of \$200M for 6.8M tonnes of CO<sub>2</sub> emissions from coal combustion in New Zealand in 2006.)

However, it is known that some underground mines contain negligible methane so producers would have to gather the data to demonstrate specific emission factors for their coal mines where this is practical.

## Improvement in projected emissions implies lower deficit

The latest annual greenhouse gas inventory report showed New Zealand’s emissions rose less than 1% between 2005 and 2006, compared with the previous year’s increase of 3%. This is one of the factors leading to the improvement in New Zealand’s projected balance of Kyoto Protocol units during the first commitment period (2008–2012). The balance of units is a projection of what actual emissions will be reported in national greenhouse inventory submissions over the commitment period and government transfers of Kyoto emissions units. The projections report is known as the net position report and is compiled using the best available information at the time of projection.

As at May 2008, the net position is projected to be a deficit of 21.7M units during the first commitment period. This comprises 14.7M tonnes excess emissions over the period and 7M tonnes of assigned amount units already promised to successful tenders in the Projects to Reduce Emissions programme. The 2008 update compares with a projected deficit reported in May 2007 of 45.5M units. The 2008 net position report includes all government decisions as at 15 April 2008, including the modelled effects of new policies: the NZ ETS, the NZ Energy Strategy and the NZ Energy Efficiency and Conservation Strategy. Kyoto Protocol compliance

over the first commitment period will not be finalised until 2015.

After the figures were released, the National Party accused the Government of “political manipulation” of the figures. The Government’s projected deficit of 21.7M tonnes was claimed to equate to \$481M at current carbon prices (although there is a wide range of potential prices for the 2008-2012 period). This is a sharp revision downwards from the previous estimate of 45.5M tonnes, which would create a liability of just over \$1 billion.

National suggested the figures were manipulated to suit the government agenda in explaining its “backward flip” on the ETS (the delayed introduction for transport fuels and delayed assistance phase out for industry and agriculture). The Climate Change Minister replied Treasury updates the figure every month to take account of movements such as the exchange rate or the international price of carbon. He added that New Zealand’s preparation of Kyoto estimates is “probably the most transparent in the world.” National responded that if the figures are to have credibility, they should be managed independently and released in the same way as the household labour force survey, inflation and other critical economic data.

## Straterra: Launch of new minerals industry organisation

The formation of a new sector representative organisation, Straterra was announced in September. Based in Wellington, Straterra's mandate will be to advocate for the natural resource and energy sectors, including minerals, coal and aggregates.

Representation in this sector has historically been fragmented and not adequately resourced. This has resulted in mixed messages to local and central government and reduced effectiveness in influencing policy across the common interests that the current industry organisations share.

Straterra is a well resourced incorporated entity that will address issues that are currently in the domain of the NZ Minerals Industry Association (NZMIA), Aggregates and Quarrying Association (AQA), Coal Association of New Zealand and Minerals West Coast. Membership is open to corporate organisations and individuals with an interest in the minerals and energy sectors.

The minerals sector, including petroleum, generates more than \$4b per annum in New Zealand, with contribution to exports of around \$2b. Straterra believes that the sector can deliver much more in economic and social terms over the medium term providing the investment and regulatory regime is competitive with other similar countries and

that the industry continues to set standards that earn it a social license to operate. Straterra will work for greater recognition of the importance of the sector and form partnerships with local and national agencies to resolve issues which constrain investment and development in this sector.

New Zealand has significant unrealised potential in base and precious metals, coal, industrial minerals and oil and gas. In addition, aggregates play a major role in growing infrastructure investment. The minerals sector should be enjoying greater benefits and contributing more to the national economy at this stage of the commodity cycle.

"We are bringing together the minerals, aggregate and coal sectors so that we can advocate our common interests professionally and effectively" said John Dow, Chairman of Straterra.

"Our CEO Dr Ian Parton has brought a wealth of experience and professionalism to Straterra and we look forward to helping our sector make an increasingly significant contribution to the New Zealand economy."

More information can be obtained by visiting the website [www.straterra.co.nz](http://www.straterra.co.nz) along with a membership application form.

## Coal Seam Gas exploration operations underway

In early August L&M Petroleum (LMP) announced that it had entered into a contract with Washingtons Drilling and Exploration Limited to use its Rig #8 to drill the first three coal seam gas (CSG) wells to be drilled in the Company's 2008 CSG exploration program.

All necessary land access consents for the three drill sites have now been secured and construction of the drill sites is underway. The first well to be drilled will be Goodwin-1, located in the eastern portion of petroleum exploration permit (PEP) 38226 (Waiuu Basin of Western Southland) adjacent to the proven Ohai coalfield. The Goodwin-1 well drilling and coring operation is projected to take a week to reach the base of the Beaumont coals at approximately 250m underground.

The Goodwin-1 well will be followed immediately by Mt Linton-1, also in the Waiuu Basin, and Wairaki-1, located in the adjacent PEP 38238 (Blackmount). All three wells will be air drilled to the top of the Beaumont coals and then cored through the entire coal section. The cores will then

undergo analysis to determine the coal's properties, gas content and gas desorption.

LMP also announced that it had entered into a contract with Southern Geophysical Services to acquire 17.2 kms of new two-dimensional seismic data within the Waiuu Basin. The seismic acquisition program is also expected to start next week (weather permitting) and will be run in parallel with the well drilling operations. The new seismic data is being acquired over the western end of the proven Ohai coalfield area and will be used to confirm the location of subsequent CSG wells to be drilled. Once the seismic data has been processed and interpreted, the necessary drill site access permits will be obtained and site construction undertaken.

The Company's initial analysis indicates its onshore Western Southland Basin permits may hold up to 300PJ of CSG potential resources. And with an exploration fund of \$11m, LMP plans to drill up to another five wells in 2008 to help confirm the extent of the coal seam gas potential resources contained within its Southland permits.

## Coming Events

19-23 Oct 2008, 12th Australian coal preparation conference: *cleaning coal to secure our future*, Darling Harbour, NSW. Contact: Australian Coal Preparation Society, Tel: +61 02 4926 4870, Email: [acpsnational@acps.com.au](mailto:acpsnational@acps.com.au), Internet: [www.acps.com.au](http://www.acps.com.au)

19- 21 Oct 2008, 28th Coaltrans' World Coal Conference, Prague. Internet: [www.coaltrans.com/prague](http://www.coaltrans.com/prague)

20-22 Oct 2008, 17th International Symposium on Mine Planning and Equipment Selection 2008 and China International Mine Planning and Equipment Selection Exhibition, Contact: Mr Guangjun Qiu Tel: +86-10-85110095, Email: [qiu@mc-cppit.com](mailto:qiu@mc-cppit.com), Internet: [www.mpesbeijing.com](http://www.mpesbeijing.com).

21-23 Oct 2008, Power-Gen Asia 2008 Conference, Kuala Lumpur. Contact: Samantha Malcolm, PennWell Corporation, UK, Tel: +44 1992 656 619, Email: [attendingpga@pennwell.com](mailto:attendingpga@pennwell.com), Internet: [www.powergenasia.com](http://www.powergenasia.com).

11-12 Nov 2008, McCloskey US Coal Imports and Exports Conference 2008, Portsmouth, Virginia. Contact: [claire.lewis@mccloskeycoal.com](mailto:claire.lewis@mccloskeycoal.com), Tel: +44 (0) 1730 265095, Internet: [www.mccloskeycoal.com/conferences](http://www.mccloskeycoal.com/conferences)

16-20 Nov 2008, 9th international conference on greenhouse gas control technologies, Washington, DC. Contact: John Gale, IEA GHG R&D Programme, UK, Tel: +44 1242 680753, Email: [john@ieaghg.org](mailto:john@ieaghg.org), Internet: [mit.edu/ghgt9](http://mit.edu/ghgt9)

3-5 Dec 2008, McCloskey India Coal Conference 2008, New Delhi. Contact: [claire.lewis@mccloskeycoal.com](mailto:claire.lewis@mccloskeycoal.com), Tel: +44 (0) 1730 265095. Internet: [www.mccloskeycoal.com/conferences](http://www.mccloskeycoal.com/conferences)

## West Coast and Southland mine drainage workshop

In July, the research consortium of scientists from CRL Energy, Canterbury University, Landcare Research and Otago University presented another successful workshop on their FRST-funded research programme into the environmental consequences of mine development on aquatic systems. The research programme is expected to take six years; currently the research group is at the start of year five.

The workshop examined the ongoing development of a framework to assist data collection, interpretation and decision making by mining companies, regulatory agencies and other parties with regard to mine development proposals. The framework provides a set of standard guidelines so that regulators and industry can have greater certainty in environmental outcomes arising from mining activities.

The framework also provides guidelines on how to sustain and improve the surrounding environment when new and existing mineral deposits are being developed – setting the benchmark for good mining practices. The framework does not establish ‘acceptable’ and ‘unacceptable’ water quality criteria because these are likely to be different at different sites and because there are social, economic and cultural factors that may also influence decision-making. Instead the framework provides a robust scientific basis to determine the level of impact on aquatic systems.

The research programme involves detailed research into mine drainage and rock geochemistry, ecological impact on aquatic systems, as well as management and rehabilitation, and is overseen by a Governance Panel with representatives from mining companies, industry organisations, regional councils and Department of Conservation. The researchers report to the Governance Panel on a six-monthly basis.

### Prediction of water quality impacts

Prediction of mine drainage chemistry and downstream water quality at proposed mine sites requires information on the target commodity, region, and geological formation. Acid-forming potential and trace element content of rocks to be disturbed by mining are often the key environmental considerations for both coal and gold mines. An assessment of this requires sample collection and acid base accounting analysis. More detailed information on mine drainage chemistry and trace element content can be had using XRF analysis and a variety of long-term-leaching simulation tests.

Once mine drainage chemistry is predicted, site specific hydro-geological information and background water quality information is used to predict downstream water quality. Hydrological data, background water quality and predicted mine drainage chemistry is integrated using a reactive transport approach rather than a simple dilution model.

Arsenic is the main environmental issue associated with hard-rock gold mines, and acidity is almost invariably controlled by surrounding rocks to pH 7-8. Typical gold mine ore contains about 2000 times as much arsenic (as arsenopyrite) as gold. The gold and arsenic are closely interlinked in the ore rocks, so that all gold-extraction techniques affect the arsenopyrite as well. The arsenopyrite will dissolve in water during all mining and processing activity and removal of arsenic from mine water before discharge is often necessary.

### Predictions of ecological impacts

A healthy stream ecosystem usually includes a range of species of plants and animals which feed, prey and depend on each other in a number of ways. At the base of most stream foodwebs are plants (primarily algae) and terrestrial matter (e.g. leaves and wood) that are then decomposed by bacteria and fungi and eaten by a range of invertebrates (e.g. insects). These invertebrates are the main food for fish and crayfish. Mining discharges can directly and indirectly affect all components of a stream foodweb.

The most severe conditions are usually associated with acid-forming geology. These geological conditions have the potential to produce acidic waters, high in toxic metals (e.g. Fe, Al, Ni, Zn). They may also create metal hydroxide precipitates in streams and create highly turbid waters.

Severe impacts might mean only a few species of acid tolerant algae and invertebrates surviving in a stream and all fish dying. Gold mining is more likely to create sediment and turbidity issues and possibly release metals such as As, Sb & Hg. These metals can be toxic to many animals.

### Management and remediation systems

Mine waste management can be a cost-effective means to minimise impact. Mine waste management goals are to; prevent or reduce the amount of water entering the mined area, reduce the contact of water and/or oxygen with acid-forming materials, and neutralise or reduce the level of contaminants present in any water runoff. To achieve these goals, factors influencing mine drainage at each site are evaluated, particularly background water quality, the volume, composition of mine waste material, and the position of the overburden and waste rock relative to surface and ground water. Appropriate site-specific management options are then applied to reduce the volume of mine drainage or minimise acidity and trace elements concentrations.

Remediation of mine drainage may be required even with good waste rock management. Remediation can be accomplished by either active or passive treatment systems, or a combination of both. Active systems typically require continuous dosing with chemicals, consume power and require regular operation and maintenance, but they are very reliable. Passive systems rely on natural physical, geochemical and biological processes but can fail if not carefully selected and designed. Site parameters to consider when selecting active and passive treatments include chemistry, flow rate, available land area, availability of power, and type of mine site.

Highly toxic arsenic is mobile throughout a range of pH conditions. Arsenic removal can be carried out by a number of processes, conventional techniques include oxidation, coagulation-precipitation, adsorption, ion exchange, membrane/reverse osmosis and biological processes. The choice of treatment depends on economics, availability of chemicals or adsorptive media and concentration of arsenic.

Publications on this research as well as a booklet on the July workshop can be found on the CRL Energy website at: [http://www.crl.co.nz/research/mine\\_drainage.asp](http://www.crl.co.nz/research/mine_drainage.asp)

## EnergyScape examines future driving: biofuels, hydrogen fuel cells and electric cars

The EnergyScape team from CRL Energy, Scion, IRL, GNS Science and NIWA has been examining the technology and the resources that New Zealand has available to create energy and provide fuel for the cars of the future.

The scientists, who presented their research so far at a conference in Wellington on 16 July, say that it is important for New Zealand and the rest of the world to have alternative technologies available so that we are not so reliant on petrol, diesel and oil. Especially as these fuels have to be imported, their prices do not remain stable, and they could eventually run out.

Dr Peter Hall from Scion discussed ways to make biofuels from biomass to run existing combustion engines. He said that existing residues, such as tallow, fruit rejects, straw, dairy effluent etc., would only ever provide a very small percentage of demand, that these are widely distributed and could only be small scale operations. He proposed that purpose grown forests, probably pine or another fast growing species, are the best bet for generating large amounts of biofuel, and that New Zealand currently had some three million hectares available for such a process. He said that if current trends in oil barrel prices continue prices could get to \$185 a barrel by 2015, if that happens, large-scale forest biomass to liquid fuels could compete directly with fossil fuel even if no improvements in existing technology occurred.

Dr Tony Clemens, research manager at CRL Energy discussed the potential role of hydrogen in New Zealand's future energy mix. He says that using 'fluidised bed coal gasification' it is possible to make hydrogen from coal and biomass such as wood waste. "We can do this without making any carbon dioxide emissions by capturing and storing left-over carbon dioxide from both coal and biomass."

The hydrogen can be used to run cars which have hydrogen fuel cells. Several large car manufacturers, such as Honda, Toyota, BMW, Ford and GM are already making hydrogen-powered cars, however, it is likely to be a decade or more before we have them here as New Zealand doesn't yet have a hydrogen infrastructure (hydrogen stations instead of/as well as petrol stations). Many countries have already installed hydrogen stations and introduced hydrogen powered public transport buses. An increasing number of private vehicles are running

on hydrogen. Dr Clemens discussed how such an infrastructure could be rolled out in New Zealand, beginning with a 'hydrogen highway' from Wellington to Auckland. Hydrogen powered vehicles are an attractive option for many reasons, not least of which is they have no emissions except for some water vapour. He also pointed out that the hydrogen fuel cell vehicles being made by the auto-manufacturers are already able to match the performance of conventional vehicles in terms of range, refueling times and meeting customer expectations and to exceed them in terms of reduced emissions and efficiency. Neither of the alternative vehicle technologies – biofuelled vehicles or battery electric vehicles are able to do so.

Many car manufacturers are also making electric cars which you can plug in to a normal power outlet to recharge your car overnight, or combined fuel and electric vehicles. These might also be a good option for New Zealand car drivers and the Government hopes to have 5% of the vehicle fleet as electric vehicles by 2020, assuming we can generate enough electricity to meet both business as usual needs and an increased demand to run our vehicle fleet. Hyundai have just announced this September that they will be producing a retrofitted electric vehicle, the Getz, these should be available from November this year. A spokesman for Hyundai warned that while acceleration would be the same as a combustion vehicle, the maximum speed is about 120km/hour with a maximum range from a single charge of about 120km, they would, however, be ideal for urban driving. Fully recharging takes about 9 hours from a normal power outlet, the vehicle is expected to have a price tag of about \$35,000.

CRL Energy energy analyst elected to NZGA board



*Cito Gazo.*

*CRL Energy's Energy Engineer Research Analyst, Cito Gazo, has been elected to the board of the New Zealand Geothermal Association (NZGA) in a ballot held on 12 September. He will take up the position following the association's AGM on 12 November.*

*Other successful candidates elected to the NZGA board were:*

*Spence McClintock (MRP)  
Marcel Manders (MB Century)  
Paul Quinlivan (SKM)  
Claude Bannwarth (PB Power)*

### Coal Association AGM

*This year's Coal Association Annual General Meeting will be held on 20 November at the Copthorne Hotel Commodore in Christchurch.*

*A programme of events will be circulated to interested parties soon.*

*For any enquiries regarding the AGM please contact:*

*Dr Trevor Matheson*

*Coal Association Secretary*

*Ph (04) 570 3700*

*E-mail: t.matheson@crl.co.nz*

# Coal Association of New Zealand Inc.

## Directors

C Baker	<i>Chairman</i>
Saunders	Unsworth
A Broome	Independent
D Elder	Solid Energy
B Francis	Francis Mining
A Melhuish	Genesis Energy
G Perkins	Birchfield Coal Mines
R Pullein	NZ Steel
N Shewan	G L Bowron
C Van Oosterom	Fonterra

## Officers

Secretary	T W Matheson
Treasurer	R McGregor

## Coal Producer Members

Birchfield Coal Mines Ltd  
Burkes Creek Mining  
Canterbury Coal Company  
Cascade Coal Pty Ltd  
Francis Mining Co. Ltd  
Glencol Energy Ltd  
Harliwich Carrying Co  
Heaphy Mining  
Kai Point Coal Co. Ltd  
MacDougall Mining  
McLaughlin Mining  
Menzies Mining Company  
New Creek Mining  
New Vale Coal Co. Ltd  
O'Reilly's Opencast Ltd  
ROA Mining Co. Ltd  
Rogers Mining Ltd  
Solid Energy NZ Ltd  
Victory Lime 2000 Ltd  
Waituna Coal Mine

## Associate Members

A W Taylor Industrial Coal Ltd  
Alliance Group Ltd  
Bionutral Laboratories Corporation

Coal Distributors (Auckland) Ltd  
Coal Marketing Services  
Coal Power Ltd  
DLA Phillips Fox  
Doug Hood Contractors  
Energy for Industry  
(formerly Meridian Solutions)  
G L Bowron Ltd  
Genesis Energy  
Golden Bay Cement  
Heinz-Wattie Ltd  
Huntly Retail Distribution Centre  
Kenroll Industrial Coal Ltd  
Kingett Mitchell  
L&M Coal Ltd  
Lincoln University  
Lion Breweries South  
Lyttelton Port Company Ltd  
Mangapapa B2 Incorporation  
McDonald's Lime Ltd  
Meritec (Worley Consultants)  
Metso Minerals (New Zealand) Ltd  
Ministry of Economic Development  
Montgomery Watson Ltd  
National Institute of Water and  
Atmospheric Research (NIWA)  
NZ Coal Processors Ltd  
NZ Steel Ltd  
Pike River Coal Ltd  
Port of Greymouth  
SGS NZ Ltd  
Shipherd Nurseries  
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South Port NZ Ltd  
Southtile Ltd  
Summit Wool Spinners  
TNL Group Ltd  
University of Canterbury  
Vector Ltd  
Websters Hydrated Lime Company

## Associate Membership

Did you know that you can join the Coal Association, even if you are not a coal producer, by becoming an Associate Member?

### Why should you join?

The Coal Association needs the support of Associate Members more than ever, so that New Zealanders can retain access to the plentiful and economic fuel coal. Your support is vital, as the Association attempts to reduce the impact of economic measures, designed to help meet New Zealand's Kyoto Protocol obligations. As an Associate Member, you can keep up to date with happenings in the energy industry by reading the Coal Newsletter, which is sent out twice yearly, and the Annual Review, which every Associate Member receives with an invitation to the Annual General Meeting.

### Other benefits of Associate Membership are:

- opportunities to participate in Coal Association activities;
- opportunities to make your voice heard through Coal Assn initiatives;
- free access to information held by CRL Energy Ltd;
- free short consultations with CRL Energy staff; and
- free updates of recently published coal information.

### What does it cost?

An annual fee of \$350 +GST.

### How do I join?

Ring CRL Energy 04 570 3715 for the details.



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