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Inside

The New Zealand Institute of Agricultural & Horticultural Science Inc

John Lancashire
President

Biofuels Conference

This issue of AgScience contains the proceedings of the excellent conference on "Biofuels - the Future or a Folly?" organised by the Canterbury Section and held at Lincoln in August. The criticism of the previous government's policy on biofuels by the Parliamentary Commissioner for the Environment, Dr Jan Wright, and the decision of the new government to remove the mandatory small proportion of biofuels to be included in our petrol and diesel supplies, does NOT, however, reduce the importance of developing alternative sources of energy such as biofuels. This is emphasised by recent appointments by US President-elect Barack Obama, who has selected Nobel Prize-winning physicist Steven Chu to head their Department of Energy. Chu has a background in researching renewable energy, including solar power; the use of biotechnology to develop better biofuel plants and microbes and, not least, managing a large $134 million programme to improve biofuels.

With New Zealand's strong background in plant-based production systems and plant breeding and a growing skill base in biotechnology, New Zealand is ideally placed to make a significant contribution to these new US initiatives. Although this is a very fast-moving area, our conference stands as an excellent statement on the "state of the art" and should be required reading by government, researchers and policy-makers in New Zealand.

MINISTERIAL MEETINGS

Jon Hickford, Sonia Whiteman and I met with the Hon David Carter, the new Minister of Agriculture, in December. This was a productive meeting and the Minister suggested we write to him and Dr Wayne Mapp (the new Minister for Research, Science & Technology) on our serious concerns about the size of the science bureaucracy and the effectiveness and efficiency of the funding system. He also suggested we write to the Prime Minister with our suggestions for suitable candidates for the new position of chief science adviser to the government. Future meetings are planned with Dr Mapp and other new science spokespeople with opposition parties.

NEW FRST ADVISORY GROUP

Murray Bain, chief executive of the Foundation for Research and Technology, has responded to widespread concerns in the science community about many aspects of the funding system, by setting up a new advisory committee to help FRST create a simplified and more acceptable funding system. Stephen Goldson (AgResearch), a Fellow of the Institute, has been seconded part-time to FRST for six months to advise on what needs to be done. At the same time I have been invited to join an *ad hoc* commentator group chaired by Murray Bain, which (among others) includes Professor Carolyn Burns of Otago University, Professor Jacqueline Rowarth of Massey University and former President of the Institute, and Stephen Goldson. It is encouraging that three members from the National Science Panel are included in the group. We held our first meeting in December and I hope a much improved funding system will result. Also involved in all of the various phases is Dr Prue Williams, the newly appointed Chief Science adviser at FRST and formerly of Crop and Food Research. All of this, in my opinion, represents a very significant development with considerable potential to meet many of the concerns expressed by the science community over many years. If there are any particular issues that members would like raised, please let me know as soon as possible.

ELECTION RESULT

After nine years we may see some novel initiatives in science from the new government. There were some encouraging signs in the National Party manifesto, including concerns about the size of the science bureaucracy, the appointment of a science adviser to government – to "place science at the heart of government" – and replacement funding for the now discontinued "Fast Forward" scheme. Of course, given the state of the country's finances it is clear there will be constraints on new spending. Your Institute will continue to monitor policy developments and will run a political forum on the current state of the science system at our annual conference at Lincoln in July.

ROYAL SOCIETY

I chaired a lively meeting of the constituent organisations in November prior to the awards evening and the full RSNZ Council meeting. Several motions were passed and the full minutes of the meeting have been circulated to all the organisations. Main issues related to whether groups were obtaining "value for money" from membership of the Royal Society; a desire to see the Society take a stronger line with government on the concerns of the science community; and some disquiet about the concept for the proposed new science building for the Society on the Thorndon site.

ACKNOWLEDGEMENT

I would like to thank all Institute members who sent messages of sympathy on the sudden tragic death of my wife Sue in December. I will endeavour to respond to every one individually, but if you do not hear from me, please take this as a very sincere personal thank you.

John Lancashire
President

Biofuels – the Future or a Folly?
All references and footnotes included in the papers published in this issue of AgScience can be found in the full version on our website www.agscience.org.nz

Cover: Model hight-rate algal pond trials [NIWA/A2B], Bromley. DJ Painter

By Bob Edlin, editor of AgScience

Climate Inquiry

The new National-led Government moved on several fronts, including climate change and biofuels policy, in a rushed Parliamentary session between the general election and the Christmas-New Year holiday.

The Speech from the Throne, outlining the Government's priorities, mentioned the establishment of a special committee to review the emissions trading scheme, New Zealand's Kyoto Protocol obligations, balancing emission reductions with economic growth, seeking international recognition of New Zealand's livestock-dominated emissions profile and ensuring that emission reductions in this country are matched by other countries.

The push for recognition "of New Zealand's unique agricultural-emissions-profile" would be buttressed by increased public investment in research and development to reduce greenhouse gas emissions from livestock.

The 11-member special select committee on the emissions trading scheme will be chaired by United Future leader Peter Dunne. Prime Minister John Key expects it will report back to Parliament by March and that any amending legislation will have been passed by September.

An NZPA report on 9 December noted that under the several terms of reference, the committee will not relitigate the science that blames humans for global warming.

This was contrary to draft terms of reference, released when National signed up ACT as a support partner in post-election negotiations. Those terms did include an examination of the scientific claims underpinning climate change theory.

ACT questions whether human-induced climate change is real and wants to scrap the Clark government's emissions trading scheme. Mr Key simply wants to dilute it.

The draft terms of reference led to boisterous interrogation of the Government in Parliament.

Opposition leader Phil Goff asked Mr Key if the confidence and supply agreement with ACT implied he was suspicious of climate change and not even sure it was a problem, or was he a firm believer in climate change and always had been?

Mr Key affirmed he did believe human-induced climate change was occurring, and that his Government would take "a balanced approach" to reducing New Zealand's greenhouse gas emissions.

Mr Goff then drew attention to four contradictory positions that – according to the *New Zealand Herald* – the Government had held on emissions trading in the previous six weeks. Which of these was the Government's actual position?

"The Government's position is that we will have a high-level select committee, chaired by the Hon Peter Dunne, review the climate change legislation that is in place. It is the Government's view that it should be passed by 30 September 2009," Mr Key said.

Mr Goff shifted tack: "What confidence can the country have in the Prime Minister's claim that he is committed to combating climate change and that he is committed to the Kyoto Protocol, when every action that he has taken since the election has moved New Zealand in the opposite direction – suspending the emissions trading scheme, repealing biofuel obligations, opening up the expansion of thermal generation, and scrapping energy conservation measures such as insulating older homes?"

Mr Key said Mr Goff could rest assured the Government would be taking a balanced approach when it comes to climate change – balancing our environmental responsibilities with our economic opportunities.

He also had a knife to twist – "for all of the rhetoric of the last nine years, it will not be lost on the member that when his Government was in office emissions rose faster in New Zealand than they did in America under George W. Bush."

Mr Goff then inquired why the Government had pulled the rug out from under the $10 million investment of BioDiesel Oils (NZ) Ltd in research and development, which had the impact of slowing New Zealand's achievement of self-sufficiency in transport fuel, and increasing Kyoto Protocol costs. Was it, as former National Party president Sue Wood had suggested, because of pressure on the Government from vested interests in the oil industry?

Not so, Mr Key insisted. His Government was committed to ensuring that biofuels play a part in our future, "but I should point out…that the Parliamentary Commissioner for the Environment herself indicated that biofuels, unless one can be sure that they are from a sustainable source, should not be included. Rather than mandating that we take on biofuels from a source that we cannot be sure is sustainable, we are going to build up a proper supply, and it will be used in the future."

The passage of several bills under urgency, including the measure to rescind the biofuels quota, also came under question.

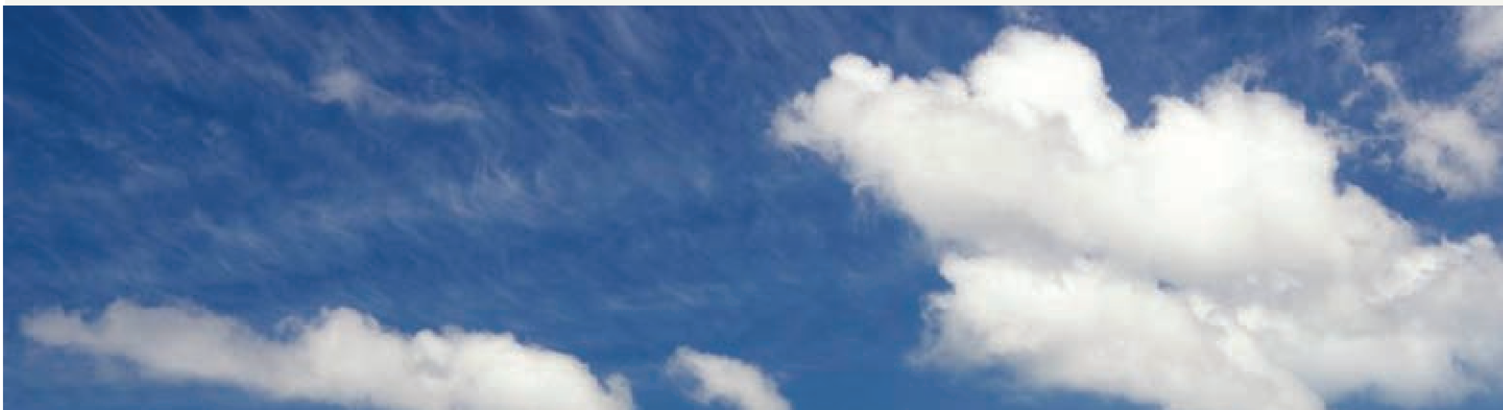
Labour's Michael Cullen asked if it was Government policy that no bill would be referred to a select committee if it was National Party policy for the general election 2008.

Gerry Brownleee, leader of the House, gave a succinct answer: No.

So – Dr Cullen followed up – how does the Minister reconcile that answer with the fact that "last week the only reason he gave for bills not being referred to select committees was that they were in the National Party's election policy?"

Because – Mr Brownlee replied – "the Government has decided in the very short time prior to the very, very long Christmas break that it wanted to advance some legislation that it felt was important for the economy."

So there we have it.



Biofuels – the Future or a Folly?

BIOFUELS – WHAT ARE THEY?

We use 'fuel' to mean a transportable source of energy, particularly those which are liquid, but not excluding solids such as wood and coal or gases such as hydrogen or compressed natural gas. 'Biofuels' are derived from biological material. Crude oil (petroleum) is a fossil biofuel, most of it produced aeons ago by marine organisms subjected to intense heat and pressure in suitable geological environments. In post-peak-oil days the pressure is on to produce renewable biofuels, especially for transport uses. Nothing has yet been found to quite match the convenience, compact density and high energy content of fossil-oil-derived liquid fuels.

Electrical energy is a wonderful vehicle mover, with many advantages. Once on-board generation (fuel cells) or compact, high-power, high-storage batteries are improved, electric vehicles will suit New Zealand's hydro-rich, wind-rich, wave and tide-rich environment. But at least until then, we will need biofuel to supplement dwindling and increasingly costly fossil oil fuels. Photosynthesis in our low-population-density, land-rich country, like high water for hydro, strong winds and strong tidal currents, should not be ignored.

Several decades ago, after the 1970s 'oil shocks', my then colleague, George Davies, spoke of the four useful 'F's derived from 'Fotosynthesis': Food; Fibre; Fuel and 'Farmaceuticals'. Biofuels in New Zealand should be produced in harmony with the other three 'F's, not in harmful competition with them.

CAUGHT BETWEEN GENERATIONS

New Zealand now is caught between the old and the new biofuels. So-called 'first generation' biofuels often have low values of energy ratio (useful vehicle energy out: total production and distribution energy in) and unwanted side effects (such as displacing food crops from limited arable land). 'Second generation' biofuels promise to overcome these disadvantages, but very few are yet market-ready.

Some of the old biofuels are very old indeed. Well before internal combustion and compression ignition engines appeared in the late 19th century, both animal and vegetal oils – whale oil and tallow; castor, linseed and peanut oils – were used for lighting. Alcohols have been used since ancient times for beverages, at least as far back as the Babylonians and Sumerians. Yeast fermentation is one of the oldest chemical technologies.

Unidentified Maori group pouring whale oil. (Circa 1900)

In 1895, Rudolf Diesel ran his first engine on peanut oil. He showed it at the World Exhibition in Paris in 1900 and said in 1912: "The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in the course of time as important as the petroleum and coal tar products of the present time." In 1908, Henry Ford designed his Model T Ford to run on a gasoline/ethanol blend, calling it "the fuel of the future" to a New York Times reporter in 1925: "The fuel of the future is going to come from fruit like that sumach out by the road, or from apples, weeds, sawdust — almost anything." he said. "There is fuel in every bit of vegetable matter that can be fermented. There's enough alcohol in one year's yield of an acre of potatoes to drive the machinery necessary to cultivate the fields for a hundred years." Modern analysis might reduce Henry's numerical estimate somewhat, but the principle remains valid.

Rudolf Diesel

Fermentation of sugar from crops like sugar cane continues to supply bioethanol, notably meeting up to about half of Brazil's transport fuel needs. Use of cellulosic material from crops like maize ("corn" in the USA) is fraught with more pitfalls and debate. Energy ratios are sufficiently close to unity (as much out as is put in, with most of the latter from fossil oil) to provide more fuel for argument than for transport, and competition for arable land has contributed to global increases in prices of grain for food. Ligno-cellulosic sources are something of a 'holy grail' for bioethanol advocates. Successful pre-processing and co-products could mean that purpose-grown crops, like switchgrass or specific willow species on non-food-crop land, and forest wood wastes become preferred sources of biomass.

Most biofuels from animal sources (tallow, whale oil, lipo-suctioned human body fat) are more costly to produce, and more valuable or more protected than those from vegetable sources. There are too many vegetable oil sources to list. Rapeseed (rapa, colza – all Brassica napus var. oleifera) oil or CANOLA (CANadian Oil, Low Acid) has become the preferred feedstock, particularly in Europe, and particularly for conversion to biodiesel by base-catalysed transesterification, producing monoalkyl esters. 'Biodiesel' is a biofuel with recognised specifications that is miscible with diesel or can run alone in compression-ignition engines.

Babassu palm (Orbignya martiana, Orbignya oleifera) and jatropha (Jatropha curcas/curcus, Barbados nut, physic nut) most often have been quoted in recent years as promising new sources of vegetal oil, but sunflower, coconut, soya bean and other oils are also mentioned. Babassu oil is controversial because deforestation is occurring to provide plantation culture. And while jatropha can

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This is a summary and review paper following the Biofuels Forum: Biofuels – the Future or a Folly? Review organised by NZIAHS Canterbury Section and held at Lincoln University on 27 August 2008

grow on very poor land (eg in India, Africa and South America), it is a poisonous shrub and a 'declared plant' (not a prohibited import, but sale or distribution might be illegal) in Western Australia. Agronomic history tells us that plants which can grow on poor land often turn into 'crops' which grow even better on good, arable land! What is already happening with babassu could also happen with jatropha. "Brazil and Indonesia were jointly responsible for two-thirds of the global net loss in forest from 2000 to 2005." Part of this was due to rapid development of biofuel crops.

THE STATE-OF-PLAY IN NEW ZEALAND

Bioethanol from whey, a waste product of the dairy industry, is produced by the Fonterra Cooperative Group and marketed as 10% blends with both 95 octane petrol ('Gull Force 10') and 91 octane petrol ('Gull Regular Plus') by Gull Petroleum. This is the only sustainable, energy-efficient, commercially attractive and sourced-in-New Zealand option of significant volume in place in this country. Several firms for some time have been producing biodiesel from waste cooking oil, or from tallow. Waste cooking oil is a very small resource compared to total diesel use and will never be a resource of significant volume. Tallow is available in much greater quantities and several firms (eg Biodiesel Oils; EcoDiesel) had been planning to increase production to meet the previous Government's Sales Obligation (see Policy Environment 2008, below) of about 75 million litres a year, to be blended with diesel by 2012. But tallow is a valuable commodity for other purposes, including export for use as a constituent of soap and food products. During Environment Canterbury's tallow/biodiesel bus trial, the price of tallow increased from $570 a tonne at the start in September 2006 to a peak of $1,300 and $1,000 in October 2008.

Biodiesel from rapeseed oil is being developed commercially by Biodiesel New Zealand, a subsidiary of the state-owned enterprise, Solid Energy New Zealand. There has been both support from potential growers and criticism from science commentators, farmer groups and others (including myself) of this option. Despite some poor crop results in the first season, the website of Biodiesel New Zealand advises of "plans to increase its production to 70 million litres of biodiesel a year, or around 2% of the country's total diesel use and more than half of the Government's 2012 target for biofuels use." (But see Policy Environment 2008, below). In its *Horticulture and Arable Monitoring Report for 2007*, the Ministry of Agriculture and Fisheries summarised:

> "The potential for the biofuel industry to expand into New Zealand is causing both optimism and concern in the arable industry. On the one hand, global biofuel demand is raising all crop prices globally. Even where a crop is not directly related (for example, vegetable seeds), the bargaining power for New Zealand is increased as European farmers find cereals or oilseeds easier to grow than vegetables for seed production, thus increasing the opportunity for New Zealand vegetable seed exports. However, for those farmers and industry involved in the production of specialist brassica seeds, the prospect of canola production in New Zealand is seen as a threat to their industry. Separation distances must be maintained between canola and brassica crops, which may cross-pollinate; otherwise, seed of sufficient purity is not produced. If large areas of canola crops are grown, this will severely reduce the potential area available for brassica seed crop production. For some farmers, particularly those who run less-intensive mixed livestock and crop systems, the prospect of growing canola as a new spring crop option is very attractive in an environment where there are few profitable options."

POLICY ENVIRONMENT 2008

The most relevant current policy before the 2008 election was the 'Biofuels Sales Obligation'. In April 2008, the Parliamentary Commissioner for the Environment recommended to a Parliamentary select committee that the relevant Bill should not be enacted. However, in spite of a minority view in opposition (attached to the select committee report) from National Party members of the committee, it was enshrined in legislation effective October 2008. The Biofuel Sales Obligation would have obliged firms (such as the major oil companies) which import petrol or diesel, or obtain them from New Zealand manufacturers, to have biofuel make up a percentage of the energy content of the combined petrol and diesel sold by them. The requirement started at 0.5% and would have increased to 2.5% by 2012. Only biodiesel and bioethanol were specifically included as 'obligation fuels' for climate change greenhouse gas calculations. The newly elected National-led Government repealed the relevant legislation in December last year.

Climate change policies are also relevant to biofuels use. The most relevant is the Emissions Trading Scheme (subject to a select committee review after the change of government in November last year). Included by amendment in September 2008 in the Climate Change Response Act 2002 No. 40, the ETS requires the 'liquid fossil fuels' business sector to monitor emissions of greenhouse gases from 1 January 2011. The first annual report is due in March 2012. All businesses which supply more than 50,000 litres annually must self-assess emissions in carbon dioxide equivalent and surrender emission units ('carbon credits') annually to the government. An emission unit is equivalent to one tonne of

carbon dioxide (or its equivalent in other greenhouse gases) that would otherwise have been emitted into the atmosphere. Units, effectively, are tradable allowances for greenhouse gas emissions. As a country with targets under the Kyoto Protocol, New Zealand must hold sufficient emission units to match its actual emissions during the first commitment period of the Protocol, 2008-2012.

The central government allocated emission units by tender rounds in 2003 and 2004 to qualifying projects which would reduce equivalent carbon dioxide emissions by a minimum of 10,000 tonnes annually in the first Kyoto Protocol commitment period. That minimum would need 750,000 litres of diesel or 875,000 litres of petrol to be removed annually from emitting by a project, compared to business as usual. Nearly 10 million emission units were allocated in the two rounds but nearly all were for small hydro, wind power, landfill gas or geothermal projects. There was just one biofuel project: 20,000 units for "manufacture and sale of wood pellets". Separately, emission units have also been awarded to forestry projects through the Permanent Forest Sink Initiative. Under present policy, only carbon sequestered by 'forest species' (trees capable of reaching five metres in height at maturity in the place they are growing) is eligible to be considered for allocation of emissions units.

Further relevant policies or strategies are contained in the New Zealand Energy Strategy to 2050 (issued 2007), the New Zealand Transport Strategy 2008 and the New Zealand Energy Efficiency and Conservation Strategy (issued 2007).

RESEARCH ENVIRONMENT

A spurt of biofuels research activity in New Zealand followed the 1970s 'oil price shocks', much of it funded by two long-since-defunct agencies, the Liquid Fuels Trust Board and the New Zealand Energy Research and Development Committee. When fossil oil prices fell, laboratory work stopped, pilot plants closed, reports went on to shelves to gather dust and business as usual resumed for two or three decades. Most central government funding now is committed through the Foundation for Research, Science and Technology (FRST). From 2008 a 'Low Carbon Energy Technologies (LCET)' scheme specifically targets research related to the scale-up and demonstration of existing research on second-generation biofuels, other low-carbon liquid biofuels and low-carbon energy technologies. Other biofuels research is funded by FRST in the 'Infrastructure and Resources' and 'Optimising Physical Resource Use and Infrastructure' portfolios. The main FRST 2008 research round allocated 9% ($40 million) of all contestable funding to biofuels research. Many of the crown research institutes and universities have current biofuels research funded by FRST.

Much recent near-market research and development has been funded by both onshore and offshore commercial enterprises. But the nature of these entrepreneurial activities often makes it difficult to obtain information and distinguish real research progress from public relations hype aimed at potential investors. Many dedicated, and sometimes genuinely innovative, individuals and small companies are also pursuing their own 'solutions' to New Zealand's medium-term transport fuel problems. Much of this work is necessarily self-financed, as some kind of track record is usually required before funding agencies or commercial investors will take an interest.

INTERNATIONAL INITIATIVES

There has been an unfortunate and premature over-enthusiasm for biofuels development, particularly in USA and Europe, in advance of the availability of appropriate and sustainable 'second generation' feedstocks and technologies. Politicians have jumped on bandwagons before properly understanding what their horses are eating and what music the band is playing. The result has been ill-conceived support schemes and the need to re-visit incentives and regulations. There is now serious interest in second-generation biofuels development by multi-country blocks (like the European Union), national governments and large corporations.

In the USA the Energy Independence and Security Act of 2007 requires fuel producers to use at least 136 gigalitres (10^9) of biofuel annually by 2022. This represents about five times previously required levels. In Europe, 2.6% of the energy content of all the fuels used in road transport is already from biofuels. The target set by the 2004 EU directive on biofuels is 5.75% by 2010. Both production increases and increased imports will be necessary, in spite of the misgivings and problems now in focus.

In Australia, the biofuels industry supplies less than 0.5% of transport fuel. Biodiesel and ethanol are made from canola oil,

Model high-rate algal pond trials [NIWA/A2B], Bromley

DJ Painter

cotton seed oil, wastes and co-products of food production such as C-molasses, waste starch (from flour milling), and tallow. The major Federal policy set by the previous administration in 2005 was a 350 megalitre-a-year target by 2010. The previous administration had resisted having obligatory biofuels, but there had been support grants for biodiesel and bioethanol production and a remission of excise scheme. The post-2007 Federal Government is still developing biofuels policy.

The aviation industry has constraints and problems additional to those faced by land-based transport. They not only need a convenient, compact-density and high-energy fuel, as for other transport, but one of low flammability, which does not freeze or otherwise thicken at high altitude, is not hygroscopic, meets emission standards and can be made available all around the world to tight specifications. From 2006, for the first time, fuels became the largest component of American airlines' operating costs. A Commercial Aviation Alternative Fuel Initiative (CAAFI) was set up by industry authorities and associations in October 2006. An indication of their short-term and medium-term intentions can be gleaned from a recent statement by CAAFI's Executive Director:

> "CAAFI is currently refining roadmaps...(for)... environmentally friendly (ie with emissions sequestration) coal/biomass to liquid (CBTL) synthetic blends produced by the Fischer Tropsch process, as well as hastening the potential of environmentally friendly HRJ fuels (derived from plants such as jatropha) and biofuels from algae and other feedstocks."

Air New Zealand is a partner with Boeing Corporation and Rolls Royce in a proposed demonstration flight of a Boeing 747-400 "in the second half of 2008" which will use Bio-jet fuel incorporating "second-generation methodologies relative to sustainable feedstock source selection and fuel processing." Virgin Atlantic, Boeing, GE Aviation and Imperium Renewables had already flown a demonstration flight in February 2008 which used a small amount of babassu and coconut oil-derived jet fuel in a blend. Air New Zealand, Virgin Atlantic and Boeing Corporation are also 'Platinum Members' (along with UOP-Honeywell and USA legal advice firm Wilson Sonsini Goodrich & Rosati) of the Algal Biomass Association.

THE 2008 NZIAHS BIOFUELS FORUM: CONTENT

Five papers were presented at the Biofuels Forum organised by the NZIAHS Canterbury Section at Lincoln University on 27 August 2008. The written versions of those papers (edited for space reasons) are published in this issue.

Steve Wratten's paper notes some of the problems of first-generation biofuels and how they might occur in New Zealand. He outlines a six-year programme of research starting up now, funded by FRST and supported by Chevron NZ, Biodiesel NZ/Solid Energy, Ngai Tahu and others. This programme has worthy aims for novel and more sustainable production of biodiesel, with economic and ecological advantages.

"In 2008, we are facing new energy crises relating to global warming, 'peak oil', rapid increases in world population and individual wealth of some sectors of society and exceptional increases in oil prices, impacting on food costs," Professor Wratten notes. He wonders if "people in the richer nations should consider going on an 'energy diet'." In the context of transport fuels, this is not a matter of choice – it is an inevitable consequence of our present state and the physical limits of rates of change.

The paper by Jan Wright (co-author Caren Schroder) reviews her April 2008 decision, as Parliamentary Commissioner for the Environment, to recommend "to a select committee of Parliament that the Biofuel Bill not proceed to become legislation." Her opposition was based on evidence that the Bill was likely to fail in its two aims: to "reduce our net carbon dioxide emissions and increase the security of energy supply, particularly for transport." Amendments which became part of the 'biofuels obligation' and 'emissions trading scheme' legislation (but see Policy Environment 2008, above) would have overcome some of Dr Wright's objections. A valid concern remains "about the practicality of implementing and enforcing sustainability standards, particularly overseas". Another valid concern is the "looming gap between supply and demand", which needs to be urgently addressed on both sides of the gap. Biofuels are part of future transport fuel supply, in particular, but Dr Wright also points out that they are a relatively small part of the overall energy system and need to be considered alongside other significant aspects, such as electricity and a plentiful supply of wood in New Zealand.

The third paper primarily focused on first-generation biofuel was by David Geary, describing progress with implementation of commercial production of biodiesel from rapeseed. Biodiesel NZ and parent Solid Energy NZ must have examined both the technical and commercial aspects of this venture before committing to the substantial development costs. It nevertheless remains first generation in both feedstock and technology, with some of the well-documented defects that implies. "Globally, oilseed rape is ranked as the third most important edible oil crop after soybean and palm." The difference between on-farm production cost and farm-gate value is a major driver of what farmers grow and "for some farmers, particularly those who run less-intensive mixed livestock and crop systems, the prospect of growing canola as a new spring crop option is very attractive in an environment where there are few profitable options".

Mr Geary's paper records Solid Energy's "commitment to help New Zealand's transition to sustainable and renewable energy sources." The Climate Change Response Act 2002 No. 4026 included fuel derived from "rotational oilseed crops grown not more than 12 months in any 24-month period on the same land or as otherwise specified in the Order in Council" as obligation fuel. Notwithstanding the problems (see The State-of-Play in New Zealand, above), biodiesel from rapeseed and tallow are the only home-grown biofuels which will be available in significant quantities for blending with diesel in the next few years.

The two remaining forum papers consider second-generation options from wood feedstocks. Jim Watson makes clear his view "that energy can only be considered truly renewable if it is produced by effectively harnessing the power of natural resources or if it results from converting replenishable biomass into gases or biofuels, without threatening the food supply or harming the environment." For transport biofuels: "We can do it poorly, with short-run approaches which have no potential to scale and produce

an adverse environmental impact; or we can do it properly – with long-term solutions that can meet our biofuel and environmental needs." "None of the 'food/feed crop' based biofuels (corn or sugar based) or biodiesel sources (soy, vegetable oils) comes close" to the economic and environmental targets Dr Watson considers we must meet. Bioethanol from lignocellulosic material is the option that he and colleagues have chosen to pursue; it requires pre-treatment and hydrolysis prior to fermentation, so reducing the economic and energy costs of these processes is crucial. If the processes can preserve valuable lignin and hemicelluloses as by-products, so much the better. His paper does not discuss the possible use of coppicing shrub willow (eg crosses from Salix viminalis) on marginal land as a purpose-grown feedstock, but colleagues of Dr Watson have done that in other publications. In addition to information on process technology and more general comments on biofuel development in New Zealand, the paper has some cogent comments on the difficulties of funding near-market research and development in New Zealand.

The paper by Piers Maclaren sings the praises of forest wood not just as a natural solar panel, but as a storage battery to boot. "Trees accumulate and retain the energy in sunlight for decades, or until the energy is required for use." And they can do this without competing with agriculture for land. Mr Maclaren explains 'forest' and 'stand' differences in terms of carbon balance and explains that "a steady-state forest may supply greenhouse-neutral fuels continuously and indefinitely." So while wood as a biofuel is as old as humankind, it has a future as a feedstock for second-generation biofuels, including those for transport. The paper provides a balanced view of alternative uses of forest wood, including waste wood, and briefly mentions a few of the technologies available for converting wood to liquid biofuels.

A recent National Science Foundation (USA) report points out that lignocellulosic biomass can now be produced in the US at costs that are about US$15 per barrel of oil energy equivalent lower than the price of crude oil. Enough could be sustainably produced on American agriculture and forestry land to equal the energy content of 60% of the current USA fossil oil consumption. "The key bottleneck for lignocellulosic-derived biofuels is the lack of technology for the efficient conversion of biomass into liquid fuels." A recent report from Scion in New Zealand suggests that bioethanol from plantation feedstock is not yet cost-competitive, but could be by 2020. It would take about 2.7 million hectares (34% of the available low- to medium-quality grazing land) to produce the foreseen 2040 total transport fuel need (excluding air and sea transport).


Waihi Waste Water Treatment IAF Plant

DJ PAINTER


Christchurch Waste Water Treatment Plant Ponds, Bromley

DJ PAINTER

THE 2008 NZIAHS BIOFUELS FORUM: MISSING INFORMATION

The most significant second-generation feedstock not covered in the forum papers was microalgae. This was surprising for several reasons: microalgae are phenomenal biomass producers; they are both the oldest (fossil oil) and among the most truly second generation (not competing with food production, sustainable) biofuel feedstocks; they have been internationally recognised as a major player in future biofuel production; and there has been quite a lot of publicity in New Zealand about algal biofuel. Because this paper is intended to be an even-handed review, and because I have been an advocate of 'algae to oil' for several years, it is appropriate that I should simply quote from a recent, reputable, joint European/USA report:

> "The technical potential of micro-algae for greenhouse gas abatement has been recognised for many years, given their ability to use carbon dioxide and the possibility of their achieving higher productivities than land-based crops. Biofuel production from these marine resources, whether use of biomass or the potential of some species to produce high levels of oil, is now an increasing discussion topic. There are multiple claims in this sector but the use of micro-algae as an energy production system is likely to have to be combined with waste water treatment and co-production of high value products for an economic process to be achieved.
>
> "These current biofuel discussions illustrate two issues. First, the potential broad utility of these organisms that are capable of multiple products, ranging from energy, chemicals and materials to applications in carbon sequestration and wastewater remediation. Second, the need for a robust evidence base of factual information to validate decisions for the strategic development of algae and to counter those claims made on a solely speculative basis to support commercial investment."

The UK Carbon Trust, funded by the British Government, announced on 23 October 2008 an 'Algae Biofuels Challenge' with £20-30 million of funding, to carry out research and development into open-pond algae selection, growth and harvesting.

New Zealand can claim to be among world leaders in some aspects of algae biofuel developments, both in scientific and commercial aspects. Research groups in NIWA, Cawthron Institute, Landcare Research the University of Canterbury and Massey University are studying algal biomass, including for biofuels. Two commercial firms are claiming major breakthroughs in relevant technology. Aquaflow Bionomic

announced on 11 September 2008 that it had "produced the first samples of green-crude from its proprietary processes" which, in essence, "has the same origins as traditional oil reserves". Aquaflow had previously been more concerned with converting the oil fraction of algae harvested from Marlborough municipal wastewater ponds into biodiesel. They announced on 30 October 2008 that they had signed a Memorandum of Understanding with USA company UOP (Honeywell) to use "existing UOP processes to produce renewable fuel" and to "develop a carbon dioxide sequestration storage model for Aquaflow's algal oil production facilities." Solvent Rescue in Christchurch and Rayner Engineering in Invercargill (together Solray Energy) revealed on 18 September 2008 that they had completed a patented "super-critical water reactor" under development since 2003. Students and colleagues under the direction of Dr Chris Bathurst, of Solvent Rescue, had identified algae as a likely biofuel feedstock in 2002 and produced biodiesel from algae at the Christchurch Wastewater Treatment Plant in 2003.

Other second-generation technologies were either mentioned only in passing or in discussion at the forum. The largest research grant in the August 2008 FRST Low Carbon Energy Technologies funding was of $12 million to Lanzatech to develop a second-generation "low-carbon petrol" biofuel from industrial flue gas waste. Six projects in the August 2008 FRST Infrastructure and Resources investment round were also related to biofuel feedstocks and technologies not covered at the forum.

PROMISING BIOFUEL OPTIONS FOR NEW ZEALAND 2009-2013

To have promise for implementation in New Zealand in the next few years, biofuels should satisfy at least these criteria:

- Fuel properties allowing blends which meet appropriate standards with current fossil oil transport fuels and allow immediate use in the current vehicle fleet.
- Feedstock availability sufficient to provide fuel in commercially significant quantities.
- Sustainability, at least satisfying principles related to greenhouse gas reduction, not competing with food crops and not reducing biodiversity or conservation values.
- Commercial viability.
- Appropriate life-cycle-assessed energy performance.

A second tier is of 'desirable' criteria:

- New Zealand feedstock and technology rights.
- Clean technology of high New Zealand content.
- Secondary benefits, such as waste product use or environmental clean-up.
- Useful and valuable co-products or by-products, or being itself a co-product or by-product of an economically and environmentally valuable product.
- Intellectual property, technology or product export potential.
- Contributing to progress towards living within transport energy 'flows' (not mining 'stocks').
- Contributing positively (at least potentially) to the overall New Zealand energy system.

A small number of single feedstock and technology combinations has been subjected recently to different life-cycle assessment procedures, and a small number of different feedstock and technology combinations subjected to a single life-cycle assessment procedure. But (to my knowledge) no single life-cycle assessment procedure has been applied to a reasonably large number of feedstock and technology options in New Zealand. (A comprehensive 'well-to-wheels' energy and greenhouse gas emission study was carried out in Europe in 2003 and updated in 2006.) For that reason, and because it would be a pity to end a review of this nature without picking a few winners, the rest of this section must be understood to be my opinions, unsupported by the kind of analyses I would like to have seen performed.

Bioethanol as a by-product of the dairy industry already meets most criteria in the first set above, some in the second set, and is promising insofar as production can readily be expanded. For diesel, and for alternatives to dairy bioethanol for petrol, it is easier to identify which options are NOT promising than those which ARE. Comment has already been made above about the defects of waste cooking oil, tallow and rapeseed as feedstocks for biodiesel production. Coal gasification and liquid fuels synthesis by the Fischer-Tropsch process would be likely to fail the sustainability (greenhouse gas reduction) and energy performance criteria. Any biofuel option involving hydrogen as the transportable fuel immediately fails the very first criterion.

Bioethanol from cane sugar imported from Brazil does not meet many of the 'desirable' criteria involving New Zealand benefits. It seems likely to meet most of the first set of criteria, although there will probably be argument about how well it meets the sustainability principles. It promises to be valuable for petrol blends early in the 2009-2013 quintade, particularly if whey bioethanol production falls short of demand. In spite of the supply and sustainability defects already referred to, biodiesel from tallow, palm oil and jatropha could well play a similar role for diesel blends. It will be interesting to see how sustainability criteria are applied to imported supplies.

Towards the end of the quintade, I see promise in algae feedstock with super-critical water reaction technology and associated wastewater cleanup providing oil for whichever transport fuel users place most value on this combination's particular advantages – quite possibly aviation jet fuel users. With similar timing, forest waste or purpose-grown wood feedstocks should start providing multiple co-products, including transport biofuel, via one of the routes now in active development.

So are biofuels the future, or a folly? They are no folly, although some unwise policies have been put in place, with undesirable outcomes in the past and present, and some foolish claims are still being made. The positive view is of some very promising second-generation options and the advanced state of development of some of them in New Zealand. "Biofuels are neither good nor bad. They have an important transitional role in New Zealand's transport fuel future."

ACKNOWLEDGEMENTS

The NZIAHS Canterbury Section Committee and Biofuels Forum organisers invited me to chair the Forum. Subsequently, they requested this summary paper and review. NZIAHS Secretariat and AgScience Journal staff gave me a free hand and much assistance. Three colleagues knowledgeable about biofuels kindly reviewed the draft article.

Biofuel Opportunities

I start from my base, BioJoule Limited, a New Zealand renewable energy company that grew out of the work of a number of Genesis staff beginning back in 2002 looking at the transport fuel opportunity. The focus was woody biomass as a feedstock. There was Neil Domigan, a very capable business manager, and two senior scientists, Richard Forster and Sean Simpson. They saw the coming energy market and saw the opportunities in renewable fuels and in displacing petrochemicals. Today, these are individuals with their own companies – Ecodiesel and Lanzatech.

When BioJoule was a cash-strapped idea within Genesis looking for nourishing capital we did what all startups do. We went to the government. We did the rounds with all the brokerages and venture capital funds. We received no support. The major business issues were the perceived risk that Government would not put in place mandatory biofuel obligations to underpin a local industry, the focus of EECA on biodiesel, and ministries which viewed bioethanol from lignocellulosics as an uneconomic proposition. We then went to Australia and almost relocated to Brisbane, and went to the United States.

We got lucky. We also talked to a number of Singaporean investment funds. We meet Pure Power and initiated a conversation. But Pure Power was the only investor to see that our technology and business potential was more than biofuels because of two other product streams, natural lignin and xylose. This is key to the economic production of biofuels from lignocellulosics. They bought BioJoule and today Pure Power is a renewable company with corporate offices based in Singapore and technology development based in Auckland.

So what is lignocellulosic biomass? It is Cellulose, lignin and hemicelluloses. Cellulose is the largest constituent component of trees and plants and is the most abundant naturally occurring polymer in the world. It is the fibre extracted from trees and used to make paper, as well as many specialty fibres, chemicals and foodstuffs. Lignocellulosic biomass refers to plant material where the cellulose is bound up in a matrix of lignin and hemicelluloses which together form the biomass of all woody species.

The bioethanol industry began in Brazil where excess sugar from the sugar cane industry was simply fermented into ethanol. The United States followed using corn as a feedstock to produce ethanol. Corn ethanol is produced from grain starch of the corn cob. Starch, like cellulose, is a polysaccharide made of glucose units. Fermentable sugars are only released from starch following digestion with enzymes called amylases. Unlike cellulose found in wood, starch in corn grain is not wrapped up with lignin and hemicelluloses. Therefore, starch is much easier to extract from the corn grain as compared to cellulose extracted from wood.

With lignocellulosic feedstocks, cellulose must first be separated from the lignin and hemicellulose and then enzymes called cellulases can be used to break down cellulose to fermentable sugars. Cellulases are more costly to produce than the amylases which are used to digest starch. Also, the activity of cellulase enzymes is much lower than amylase enzymes. As a result, the amount of enzyme required to digest cellulose is much higher than that required for starch.

The use of lignocellulosic biomass for fuels, chemicals and other bioproducts is now the subject of intense interest and awareness. Driven by increasing food price pressures, environmental concerns, high oil prices, and the instability/uncertainty of petroleum reserves, the production of bioethanol from lignocellulose is receiving increasing attention from governments, industries and academics throughout North America and Europe.

Technology is rapidly advancing for the use of cellulose from crop biomass, perennial grasses, woody perennials and forest products in the production of bioethanol. Two technology platforms are needed for converting lignocellulosic feedstocks into fuel:

- Pretreatment processes that can either (a) destroy lignin and hemicelluloses leaving cellulose intact, or (b) unwrap and separate the cellulose from lignin and hemicelluloses while retaining natural lignin and hemicelluloses for further processing; and
- Enzyme hydrolysis of cellulose into sugars for further fermentation into ethanol.

In general, lignocellulosic feedstocks for bioethanol production can be divided into six main groups:

- Crop residues (sugar cane bagasse, corn stover, wheat straw, rice straw, rice hulls, barley straw, sweet sorghum bagasse, olive stones and pulp).
- Hardwood (willow, aspen, poplar, maple, Salix, Eucalyptus, mesquite) or woody biomass with "hardwood-like" properties (e.g. oil palm waste).
- Softwood (pine, spruce, fir).
- Cellulose wastes (newsprint, waste office paper, recycled paper sludge).
- Grass-alfalfa hay, switchgrass, miscanthus, reed canary grass and coastal Bermuda grass.
- Municipal solid wastes.

A range of technologies have been developed to chemically or mechanically modify these feedstocks to initiate release of cellulose and hemicellulose from woody biomass. The problem is that most technologies to date destroy much of the lignin and hemicelluloses to liberate the cellulose.

The technologies that transform cellulosic feedstock into sugars are analogous to those used in the production of ethanol from grain. Enzymatic hydrolysis releases sugars like glucose from cellulose-rich pulp. These sugars are then fermented to produce bioethanol or other products.

The hemicellulose part of the woody biomass can also be broken down into sugars. These hemicellulose sugars, such as xylose, cannot be fermented by the yeasts which are usually used to make bioethanol. A current challenge for the industry is the development of appropriate technology to ferment hemicellulose sugars like xylose.

Our approach is to separate sequentially lignin, hemicellulose and cellulose. Each of these components then forms a product stream and this can be marketed as valuable products in its own right.

Pulp produced from the Pure Power pretreatment process is virtually depleted of lignin, devoid of hemicellulose sugars and is very clean. This is important because the gentle but thorough wash of the biomass removes inhibitors that otherwise could prevent cellulase enzymes and the yeast fermentation

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He thanks Ross Prestidge, Tony Lough and Clare Elton for their many discussions and reviews of this paper.

from BioJoule to Pure Power

from working efficiently. The presence of degraded lignin and hemicelluloses in cellulose pulp, as occurs with highly acidic or alkaline pretreatment process, consumes and inhibits the effectiveness of costly cellulase enzymes.

New-generation cellulases are being developed by several companies and cellulase enzyme production is an increasingly competitive field with Novozyme and Genencor the current major market suppliers. Following are recent highlights in improving cellulase technology:

- Iogen was the first company to apply enzymatic digestion to woody biomass to demonstrate the production of ethanol from lignocellulosic feedstocks.
- Verenium, formed from the merger of Celunol (microorganism technology for xylose fermentation) with Diversa (cellulases isolated from the termite gut), has a large cellulase development platform.
- Novozyme is expanding joint venture activities with China Resources Alcohol Corporation, Broin, ICM and Greenfield Ethanol to produce new cellulases.
- Genencor has recently signed a joint venture with DuPont and has many collaborators including Mascoma, Tembec and PureVision.
- Dyadic International is developing cellulase enzymes from a proprietary fungus with collaborative agreements with Abengoa and Royal Nedalco.

Process technology used for bioethanol production from starch (corn grain) is considered mature and is not likely to see a marked reduction in production costs. The cellulose-to-ethanol conversion is more costly, and processing technologies are still under development in order to make its price competitive with starch-based ethanol conversion.

Behind cellulose, lignin is the second most abundant polymer found in nature. Its phenolic sub-unit structure makes it suitable for incorporation into a multitude of bioproducts, including adhesives, plastics, glues, paints, resins and perhaps even carbon fibre. Lignin is also a polyol which means it has many hydroxyl subgroups which makes it easy to react with many chemical agents.

Natural lignin produced by the Pure Power process represents a renewable and sustainable alternative chemical feedstock for the plastics and resins industries, which currently rely on petroleum-derived feedstocks. These markets, after the oil-to-transport fuel supply market, are the major consumers of petroleum. The chemical nature of lignin and its low toxicity, combined with many additional properties, make it an ideal renewable feedstock substitute for fossil fuel-derived chemical feedstocks. Unlike synthetic polymers, lignin is biodegradable in nature, and yet is known to be one of the most durable biopolymers.

Many industrial chemical feedstocks potentially can be displaced by lignin. This fact clearly demonstrates the value of high-grade lignin as a bio-based chemical in a variety of polymeric systems.

Natural lignin could displace phenol currently supplied for adhesive resin production by the petrochemical industry. Phenolic resins are the primary adhesives in the wood industry for the manufacture of particleboard, oriented strand board, hardboard, plywood and engineered wood products such as laminate. In the friction product industry, phenolic resins are used as the bonding agent to manufacture brake blocks and pads, brake linings, and clutch facings. Phenolic resins give friction products excellent heat resistance and thermostability as well as good friction characteristics such as wear, fade, and noise reduction. In conjunction with mineral wool or fibreglass, phenolic resins are also used in the manufacture of insulation products (roofing, walls, pipes).

Natural lignin can be used in place of bisphenol A in the manufacture of epoxy resins. Epoxy resins, like phenolic resin, are liquid or solid resins which cure to form hard, insoluble, chemical-resistant plastics. Epoxy resins are also known for their adhesion performance and heat resistance properties. There are hundreds of ways to modify epoxy resins, such as by adding fillers, flexibilizers, viscosity reducers, colorants, thickeners, accelerators and adhesion promoters. As a result many formulations tailored to the requirements of end users can be achieved. These modifications are made to reduce costs, to improve performance, and to improve processing convenience.

Lignin with multiple hydroxyl functional groups available for organic reactions is also capable of being used as a polyol. More than 75% of the polyols globally produced are used in the manufacturing of polyurethane resins. Polyols provide the backbone structure of the polyurethane resin and may be polyether, polyester, polyolefin or vegetable oil-based, the first two being the most widely used.

Carbon fibre is currently manufactured from two feedstocks, polyacrylonitrile (PAN) and pitch. Carbon fiber production is limited because of extremely expensive feedstock. It is of major interest as syringyl (S-) lignin of hardwoods and oil palm may be a substitute feedstock for carbon fibre production.

So how big is the biofuels opportunity? It dependents on how you view the markets, continued dependence on fossil fuels and the future. First-generation biofuels have been driven largely by corn, sugar and soy feedstocks, and we are accustomed to viewing the industry as a one-product industry. Wood as a feedstock is different. It has three major constituents; cellulose which can be used to make ethanol, as well as lignin and hemicelluloses. Second-generation technologies using lignocellulosic feedstocks have the additional potential

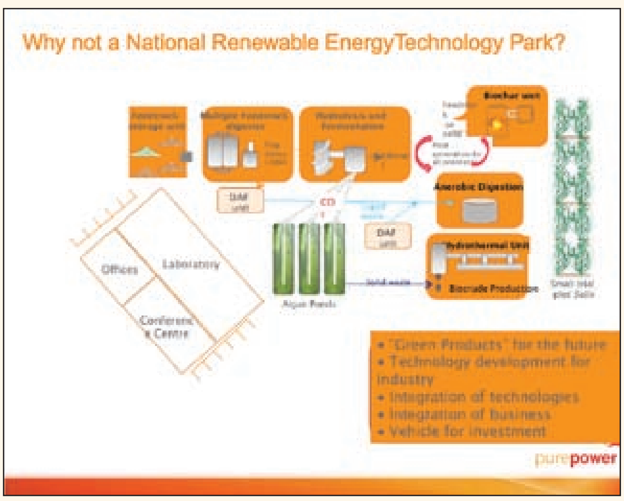
of using the right-processing technology to produce lignin and hemicellulose to address another two multi-billion-dollar markets – opportunities largely ignored in the rush to find replacements for fossil fuels used in the transport and electricity generation industries. We now know that many petrochemical feedstocks can potentially be replaced by lignochemical feedstocks. The demand for petrochemicals is growing about 2% or 3% above world GDP as people in developing nations seek to acquire the consumer products that we all currently enjoy and depend on. They are an essential but largely invisible part of fabric of everyday life in cars, houses, fittings, furniture, appliances and packaging.

The industry's average growth rate of 5% to 6% is about triple the expected growth rate for energy. And 99% of the industry's feedstocks come from oil and natural gas. Woody biomass is also a source of wood sugars which have a high commercial potential as food sweeteners. In fact when viewed like this, the value of each of these non-biofuel products exceeds that of the biofuel product.

New Zealand today is at a crossroads, with a static GDP and gradually slipping down the OECD rankings. The Government speaks of the need for economic transformation. We ask what are the opportunities for such significant changes in our country.

Agricultural activities account for 53% of total exports, indicating our continued dependence on good soils, abundant rain and our skills within the primary industries. This is an ideal platform from which to grow an energy farming industry, an opportunity to leverage our advantages and to grow a new land-based industry. This is a realistic means of achieving our goal of transforming our economy.

By perhaps replacing forestry or drystock farming on our more suitable marginal land, we can see on the horizon the possibility of creating new agricultural income streams as well as reducing what we spend on importing oil. We have the agricultural and technology skills, but are we prepared to seize the opportunity? Biofuels and its associated opportunities have to be an economic opportunity we must use if we are to transform economically our nation.



In April last year, I recommended to a Parliamentary select committee that the Biofuel Bill not proceed to become legislation. Biofuels are generally regarded as a renewable form of energy and so this recommendation by a Parliamentary Commissioner for the Environment was unexpected. It was not a decision I took lightly, but it is where the analysis took me.

The Bill was intended to require fuel companies to ensure a certain percentage of their sales are biofuels. The biofuels must be mixed in with conventional fuels – ethanol into petrol; biodiesel into diesel. The establishment of an obligation follows similar legislation in Europe – the European Union's biofuel directive and the United Kingdom's biofuel obligation.

The Bill aimed to reduce our net carbon dioxide emissions and increase the security of energy supply, particularly for transport. The potential effectiveness of the Bill hence should have been judged by its ability to achieve those two aims.

With regard to reducing net carbon dioxide emissions, the original version of the New Zealand Bill allowed any bioethanol or biodiesel to qualify as "biofuel", regardless of its source. But not all biofuels achieve a significant net greenhouse gas reduction.

Lifecycle assessments show that the lifetime CO^2 emissions of biofuels vary greatly by feedstock, production method and country of origin. For instance, bioethanol from American corn is a very poor performer – total CO^2 emissions are close to those of diesel. But biofuels made from wastes like whey, manure, and recycled plant oil can emit up to 80% less carbon dioxide than fossil fuels. This emphasises the need for a life-cycle CO^2 reduction standard.

As to increasing energy security, the Bill guarded against supply failure by allowing the importation of biofuels.

It is now well-known that large-scale plantations of biofuel crops have incentivised the felling of carbon-absorbing rain forests and driven up food prices. Developing a system that allows the import of biofuels while avoiding the harmful environmental and social impacts felt in developing countries will generate high compliance costs.

Further, the importation of biofuels is inconsistent with the "clean green" branding of New Zealand. If our lightly populated country with a workforce skilled in plant growth and processing cannot grow and produce its own biofuels, which country can?

At the time of writing, the Local Government and Environment Committee had reported back to Parliament with a range of suggested amendments to the Biofuel Bill. One amendment would lower the obligatory percentage by 2012 from 3.4% to 2.5%.

By Dr Jan Wright and Caren Schroder
Dr Wright is Parliamentary Commissioner for the Environment

Biofuels Some Big Questions

More significantly, it was proposed that three sustainability principles be added to the Bill. First, biofuels must achieve a net CO^2 reduction of at least 35%; second, they must not use land of high value for food production; and third, they must not reduce indigenous biodiversity.

A further amendment signalled that by-products of food production such as whey and tallow, oilseed crops grown on a rotational basis, and ethanol from sugarcane are all considered acceptable feedstocks because they are considered to be in accord with the three sustainability principles.

I remained concerned about the practicality of implementing and enforcing sustainability standards, particularly overseas. In a former role as chair of Land Transport New Zealand, I became very aware that we are able to confidently import vehicles into New Zealand because the overseas manufacturers have a rigorous documented regime around the standards to which vehicles are manufactured. No such regime of credible certification exists for biofuels.

The issue of second-order effects would be a challenge for implementing the sustainability standards. For instance, while Brazilian sugar cane does not directly displace food crops, other crops and pasture may shift further north as they are displaced by sugar cane.

Biofuels illustrate the need to critically examine the "renewable/non-renewable" energy paradigm that has influenced much thinking about energy since the 1960s. The underlying concept is that of living within flows rather than depleting stocks. Biofuels indeed trap the flow of solar energy, but there is more to be considered in assessing the environmental footprint of an energy source – net greenhouse gas emissions, and effects on soil fertility, biodiversity, and landscape.

It is useful to step back from focusing on biofuels and think about the problems that biofuels are intended to solve.

The fundamental problem is a looming gap between supply and demand. I have spent much of my working life researching how this gap can be closed in part by reducing demand as well as increasing supply.

The amended 2012 target for the biofuel obligation is 2.5% of petrol and diesel. To put this in perspective, it is only slightly larger than the growth in petrol and diesel consumption between 2006 and 2007. The scope for demand reduction, whether through improved efficiency or behaviour change, is not trivial.

With regard to energy supply, two challenges stand out, both with a strong connection to climate change. One is transport energy; the other is electricity, particularly peak electricity which is generated by burning coal and gas.

Hybrid plug-in cars, which can run on both electricity and liquid fuel, are one way in which these two supply challenges might be connected in the next decade. Putting it simplistically, we could run cars on electricity in summer and on liquid fuel in winter. With real-time electricity pricing incentivising switching between the two forms of energy, the batteries in hybrid cars could become part of the national electricity storage system, effectively acting as tiny hydro lakes.

We do not think of firewood as a biofuel. But it is. And the decline in heating homes with wood, the trend toward central heating, and the increasing use of heat pumps must increase peak power demand in winter.

What is the best use for this most plentiful of biofuels? Should we use wood in efficient burners to heat our homes, particularly those that are old and draughty? Or should we burn wood in power stations to generate electricity to run heat pumps? Or should we bank on being able to convert wood to ethanol? Or maybe all three?

Conversion of agricultural by-products like whey, tallow and manure to biofuels will certainly add greatly to our understanding of biofuel technologies, but these feedstocks are small. There is a strong case for waiting for the second generation of biofuels – like wood to ethanol – before we get serious about them. In contrast, we should not delay getting serious about curbing growth in our consumption of transport energy.

Review

The Emerging Oilseed Rape Industry in

The word rape, applied to oilseed crops, is derived from the Latin word rapum, meaning turnip. Around the globe turnip rapes, and the similar but more common swede rapes, are grown for their seed and as forage. Rape exists both as annual and biennial plants. The height varies from 50-250cm. The seed is small, with a diameter of 2mm, and contains up to 40% oil.

Rapeseed crops have been cultivated throughout much of the world for at least 4,000 years, but not on a commercial scale until the 13th century in Europe. At that time its primary use was as a lamp oil but before then the oils had been used in soaps and other purposes. Typically, the more common use of oilseed crops in recent times has been in oil production, both culinary and as a fuel.

In the United Kingdom the oilseed rape crop was barely known until the 1970s. Today, it is considered the third most important crop, with around 400,000ha grown annually, (roughly an eighth of the area sown each year in wheat and barley). Most of this is autumn-sown and known as winter oilseed rape (WOSR). Europe grows some 4.5 million hectares annually, a quarter of the total global crop.

Oilseed rape globally is ranked as the third most important edible oil crop after soybean and palm. Today's varieties of oilseed rape have been bred to provide oil that is suitable for a variety of uses, including biodiesel, as a foodstuff and for industrial use.

In 1740 it was noted that the oilseed rape crop had a useful soil-improving role that aided the performance of crops planted subsequently. This attribute is still vital today and oilseed rape is a valued "break crop", one that helps improve the yield of the following cereal crops, particularly wheat. British research has shown that growers can expect an additional 30% grain yield from a first wheat crop. Despite this useful role, oilseed rape that is grown too regularly in the same field risks a serious disease build-up. For this reason oilseed rape is always grown as part of a farm rotation and rarely returns to the same paddock more often than once in five years.

By removing cereals from a farm's rotation, using break crops such as oilseed rape, growers break cereal disease cycles, particularly soil-borne diseases such as Take-all. Ideal results are achieved providing that volunteer cereals and grass weeds are effectively controlled during the break crop period. Growing oilseed rape also improves the physical soil structure as its strong rooting plants penetrate deeper than cereal roots. This leads to improved aeration and results in the soil becoming more open, one reason for improved performance in subsequent crops.

Oilseed rape, although a relatively easy crop to grow, requires some additional attention at certain stages in its growth. It can be established using conventional tillage, minimum-till or even direct drilling on most soils. Min-till and direct drilling allow growers to reduce costs, improve the speed and evenness of establishment and retain valuable soil moisture, leading to improved yield potential. These methods also have the potential to reduce the crop's overall carbon footprint and resultant oil.

Compared to cereals and some other break crops, oilseed rape leaves relatively high levels of soil nitrogen and nitrogen inputs are therefore generally lower than those for cereal and other break crops.

Grass weeds that in cereal crops are difficult and costly to control can be dealt with using alternative chemistry when they appear among oilseed rape. Broadleaf weeds are easily controlled, reducing the need for costly chemical programmes in following crops.

Oilseed rape seed typically contains 38-42% oil. The meal by-product left after oil extraction is about 42% crude protein and is attractive to the stock food industry as supplementary feed. The meal therefore makes an important contribution to the overall success of any biodiesel industry using oilseed rape as a feedstock.

There are two oil quality types, edible and industrial. Edible food-grade oil is most often encountered as an odourless frying oil low in unsaturated fats but is also an ingredient in many food products, especially where "healthy" oil is required. Double low (00) food grade types typically contain low levels of erucic acid (which humans have difficulty digesting) and glucosinolates (indigestible in livestock). These types are mainly used for human

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consumption, biodiesel production and in high-protein livestock meal.

While some edible types have industrial applications, industrial rapeseed oils are not edible, having been bred to produce high levels of compounds critical for some industrial processes. In these high erucic acid rapes (HEAR) the raw oil alone, with some engine adjustment, will run diesel engines. HEAR types have very soft seed coats, contain up to 50% oil content and are sometimes used to produce an alcohol which is added to waxy crude mineral oil to improve its flow. This type of rape is not currently grown in New Zealand.

The 1970s oil crisis encouraged the development of a small New Zealand oilseed rape industry but this lost momentum when oil prices dropped. At that time research was conducted on cultivar suitability and agronomic requirements and this information was further advanced in the mid-1980s when another attempt was made to develop an industry, this time in Southland. Although it was primarily aimed at the culinary market the Southland operation also included some biodiesel production. Other attempts have been made by small groups of growers looking to supply fuel for their own farms but – for several reasons – this industry faded by the early 1990s.

Biodiesel New Zealand is a Solid Energy business. The state owned enterprise established it in 2007 as part of its commitment to help New Zealand's transition to sustainable and renewable energy sources. In spring 2007, Biodiesel New Zealand started what it hopes will be a long-term and mutually beneficial relationship with the agricultural sector. Since then interest has been steadily growing with arable growers recognising the overall benefits to their total rotation.

To support the industry a research and development programme has been established to provide up-to-date information about agronomy and cultivar performance. Cultivar performance and management trials have been established in Southland, South Canterbury, Canterbury and the Manawatu. Biodiesel New Zealand has also established a partnership with the Foundation for Arable Research (FAR) to cooperatively evaluate the potential of biodiesel crops in New Zealand. FAR, an independent research and information provider to New Zealand's arable industry, began this programme in autumn 2008, aiming to develop a clear understanding of the benefits and value of oilseed rape, optimal management approaches and to ensure that international experience is applied in New Zealand in a sound scientific manner.

Planning is well advanced for a large scale seed-processing and biodiesel manufacturing facility and infrastructure is being put in place to assist this emerging industry, including transport and storage logistics. To protect the existing lucrative vegetable seed production industry in New Zealand, the emerging oilseed rape industry is working closely with this group, putting in place practices to ensure the sustainability of both industries.

Several factors may impact the success of the oilseed rape industry. The New Zealand agricultural landscape has changed over the past 10 years with the expansion of dairy farming. Industry acceptance is another hurdle that needs to be overcome if there is to be a continuing increase in the area grown. However, by providing good support to growers and industry service providers, improving pre- and post-harvest management and by giving a commitment to the long-term sustainability of the industry, this should improve overall market acceptance.

Externally, there is concern about energy crops replacing food production, but the optimal use of oilseed rape is as a break crop which can improve following cereal yields. Ensuring the crop is only used in this way, on marginal land which is being developed or as part of a general pasture renewal programme will, over time, help to assuage those fears in New Zealand.

Biodiesel New Zealand wants the oilseed rape industry to grow and prosper for the benefit of the entire country, its customers and its suppliers. Sustainability is pivotal to the fuel's appeal and sustainability is central to the business. Every litre produced locally is one New Zealand no longer needs to import. Both sustainable and renewable oilseed rape is one piece to the overall puzzle of how to provide biofuels to secure and improve New Zealand's energy supply and reduce environmental impact along the way.

Review

Biofuels From Forestry

WHY USE WOOD?

For hundreds of thousands of years, humans have used the energy embodied in wood. It was one of the first fuels, yet it is still a critical part of the modern energy scene, even in New Zealand. Our renewable plantation forests contain a vast supply of wood that is currently not used for any purpose – and there is potential to greatly expand the area of our forest resource.

The important point to note is that biofuels from wood need not restrict food supply, as forestry and agriculture can be complementary, not competitive.

Wood is used mainly for low-grade heat, but the technology is being developed to convert it to other forms of energy, including liquid transport fuels.

WOOD VERSUS OTHER CROPS

All crops are natural solar panels. Rather than building a device of silicon and aluminium, with concomitant energy costs and greenhouse emissions, we can just plant a seed. In other words, a crop is a solar panel that constructs itself. But wood has a special quality: it is not just a solar panel but also a solar battery. Trees accumulate and retain the energy in sunlight for decades, or until the energy is required for use.

The harvesting age of a stand of trees is not determined by any biological law; it is more a question of an economic optimum – and even then, there is a "plateau of profitability" whereby it matters little if the date is delayed or brought forward by a few years. As an energy crop, a stand of trees can be harvested when it is 15 or 50 years: it can be held on standby for a lengthy period when the rain does not fall and the wind does not blow. Moreover, a tree will not just preserve its energy as might a heap of coal – it will use the waiting time to accumulate more.

When wood is the source of energy, it is not merely the year of harvest that is flexible: it is also the day or season. A processing plant with a feedstock of wood could theoretically operate for 365 days a year; harvesting can be continuous, and in any case piles of wood will not deteriorate significantly in several months. Contrast this to a grain crop or to fodder beet: there is a distinct harvest season, with a limited discretionary range; the material can be safely stored only at considerable cost; machinery such as trucks and processing equipment would be frantically busy for several months, but sit idle for the remainder of the year.

On the other hand, wood has one distinct disadvantage as a versatile energy source. The chemical composition of wood is mainly cellulose, hemicellulose and lignin. The latter (28% of the wood) is highly resistant to chemical and microbial attack. And the more tractable cellulose and hemicelluloses are a step removed from the starches and sugars that provide the ideal feedstock for, say, ethanol production. In other words, if there were sufficient areas of relatively cheap, suitable land, and if our preferred strategy for transport fuels was ethanol production, it would seem sensible to base that strategy on fodder or sugar beet, rather than wood.

CARBON IMPLICATIONS

Although well described in the literature, the carbon implications of biofuels and in particular forestry-based biofuels need reiterating. Biofuels are carbon neutral, in that they represent carbon that is extracted from the atmosphere in recent years by the process of photosynthesis. A return of this carbon to the atmosphere does not indicate a net gain in atmospheric carbon, provided that the terrestrial stocks of carbon are maintained at a constant level. This contrasts with emissions from fossil fuels – which although originally biological, were established over millions of years – that are extracted from beneath the ground (the "geosphere"). Movements of carbon from the geosphere result in a net gain to the atmosphere, unlike movements from the biosphere.

There is much confusion over the carbon implications of forestry, most of this arising from a failure to conceive the essential difference between a stand of trees and a forest. Whereas a stand of trees accumulates carbon during its life, and releases most of that carbon upon harvest, a forest does not necessarily do this. A forest consists of many stands of different ages, so that – in the extreme and idealised case of a so-called 'normal' forest – it can be carbon neutral, in that the loss of carbon from the harvested component is exactly compensated by the gain in carbon in all the other ages. The establishment of a forest on a non-forested site results in a gain in carbon stocks (because, quite simply, tall vegetation contains more carbon than short vegetation) but the maintenance of a forest may have no carbon gain or loss. Most importantly, a steady-state forest may supply greenhouse-neutral fuels continuously and indefinitely.

RESOURCE DESCRIPTION

New Zealand has almost 1.8 million hectares of plantation forest, comprising 89% radiata pine and 6% Douglas-fir. Despite common belief, ownership is not the sole prerogative of large multi-national companies – indeed perhaps some 45% is owned by small investors, including farm foresters.

By Piers Maclaren
Managing Director
Piers Maclaren Associates

A Forest Scientist's Perspective

Average productivity is about 25 m^3/ha/year of green wood. When dried, this equates to about 10.5 tonnes of biomass per hectare – a remarkably high figure, given that many of the sites were originally chosen because they were less productive than farmland. Of the annual harvest, some 1.8-1.9 million tonnes of residues are wasted and remain behind on landings and on cutovers. The material on landings could be especially valuable for two reasons: first, it has already been aggregated and transported to within easy reach of a truck; and second, because if allowed to remain *in situ* it is often a liability. Some three-quarters of the residues on landings (branches, foliage, offcuts, defective logs, etc) are wasted, and can catch fire or tumble down slopes into watercourses. These so-called "birds' nests" can harbour weeds and pests (possums).

CAN WOOD MEET OUR NEEDS?

Scion in Rotorua has estimated that a harvest figure of only 125,000 ha/yr would meet all New Zealand's needs for both heat and transport fuels. This figure is easily achievable, but it would require an expansion of our existing forest area to perhaps double the existing area – against the recent trend of deforestation and no new-land planting. Even if such large-scale afforestation were not required for carbon or bioenergy purposes, it would be essential merely for protection of vulnerable hillsides against erosion and to enhance water quality in sensitive catchments.

This is not the place to discuss the more general environmental case for widespread forestry plantings, but suffice to mention that past opposition to afforestation from certain quarters in the agricultural sector has often been based on the misconception that forestry is competitive with farming. The truth is that farming on some soils and some slopes has no future, given the spectacular levels of soil erosion or weed ingress. Moreover, on a farm scale it has long been known that a farmer can convert 20% or more of his land to trees without any loss in agricultural production – and indeed even with a surprising gain in output. This is because the worst parts of a farm generally produce the most problems (fence maintenance, stock loss, weed control, fertiliser inputs) but yield the lowest returns. By planting these in trees, a farmer can forget about those troublesome areas and concentrate time, energy, and money on to the better paddocks.

WOOD FOR HEATING

The most important use of the energy in wood is for low-grade heat. Some 38% of home heating in New Zealand derives from wood. In this respect, little has changed since our distant ancestors camped around a fire – except that modern combustion techniques demand highly engineered wood burners rather than open fires. These can be 85% efficient and emit up to 20 kW of heat – equivalent to twenty single-bar electric heaters. They have very low pollution levels, in terms of both smoke and ash. The smoke contains little sulphur and the ash can be used as a valuable garden fertiliser (note that in both respects, wood differs from coal).

But technology has progressed from the first wood burners. The concept of wood pellets is gaining ground, with four New Zealand manufacturers now supplying the fuel. Pellets are made from sawdust and shavings, compressed and glued using adhesives naturally present in the wood, and can be fed continuously from a hopper. As such, the system is convenient, easy to use, tidy, and being promoted by Solid Energy and the New Zealand Government in a pilot study for school boilers. If it is succeeds (and initial indications are favourable), wood pellets could be extended to replace coal in hospitals, hotels, dairy factories, cement works, meat works and food processing plants.

The wood processing industry is well situated to take advantage of the bioenergy that is available on site, and indeed it currently does this. The sector is already 66% self-sufficient in energy, some of which is used to heat kilns for drying wood, and some of which is used to generate electricity.

WOOD FOR LIQUID FUELS

'Energy' is a general term that disguises the huge differences between the types of energy that we require, or can produce. Low-grade heat is of little significance because all energy ends up in this form, and therefore should not be a limitation. Electricity is a high-grade form of energy, but it can be generated from a large number of sustainable sources (hydroelectric, geothermal, wind, photovoltaic, tidal, etc) and is not – with current technology – appropriate for direct use in trucks, bulldozers, or aeroplanes. The interesting and critical form of energy is for transport fuels. For this purpose, the energy must be in concentrated, lightweight, and transportable form.

Research is ongoing, in New Zealand and overseas, to investigate conversion of wood to liquid fuels. The best-developed and largest scale operation is the Choren BTL plant at Freiberg, Germany (www.choren.com/en). This uses a sophisticated gasification technique, with the resultant gases being converted to liquids via the Fischer-Tropsch process. An alternative approach is to ferment the cellulose to make ethanol, as advocated by Scion (but note the objections described earlier). Another is to use flash pyrolysis to make bio-oil and biochar – a product with many exciting agricultural uses. The forestry company Ernslaw One is importing an operational pyrolysis plant for pilot trials. Lastly, it is possible to liquefy wood using a combination of high temperatures and pressures – and research in this option is being advanced in Christchurch.

CONCLUSION

In attempting to achieve energy security and simultaneously to reduce the nation's carbon footprint, it may not be wise to look for "silver bullets": solutions may lie in a myriad of answers, rather than in any single technology. But if the problem is restricted to low-grade heat and transport fuels (as opposed to electricity generation) then forestry may well provide the nearest thing to just such a silver bullet. The technology of growing the trees and extracting the wood is proven. The technology of converting the wood to useful liquid fuel is being developed with no insurmountable hurdles in sight. The economic justification for biofuels-from-forestry has yet to be evaluated, but if the price of imported oil remains high or reaches even higher levels, this should also become favourable in due course.

By Professor Steve Wratten
Bio-Protection Research Centre
Lincoln University

Prospects for environmentally-sound biodiesel crops

Interest in biofuels has grown globally in the context of the world consuming 13.4 billion litres of oil daily, with the likelihood (according to 2008 expectations) of it increasing by 140 million litres a day, equivalent to 890,000 barrels a day @ 159 litres a barrel. A simple way of understanding this is that the daily water flow over the Niagara Falls is similar to daily world oil use. Further context is that the peak rate of annual discovery of oil reserves was 1964.

The New Zealand Government has a Biofuel Sales obligation which requires oil companies to meet a biofuels sales quota by 2012*. Biofuels must make up 3.4% of the energy content of all diesel and petrol sold in New Zealand, but probably the blend required will increase beyond 3.4%. The current supply of biodiesel feedstocks in New Zealand is limited, however, and the government requirement is likely to need a largely imported biofuels supply. That has led some commentators to suggest the government requirement should be modified or withdrawn. (See the article by Dr Jan Wright, page 12).

Biodiesel is a generic term for alkyl esters produced from biological fats and oils. It is usually produced using a mono-alcohol (methanol or ethanol) in a transesterification reaction catalysed by an alkali (sodium hydroxide or potassium hydroxide). While any fat or oil can be used in this process, the economics of production and the quality and quantity of the product are heavily dependent on the choice of feedstock. In the near future, tallow and used cooking oil will be the dominant feedstocks for commercial production in New Zealand. However, the volume of these is constrained below the potential demand for biodiesel and a need for alternative feedstocks has been recognised. The primary feedstock in the United States – soy – is unsuitable for cultivation in New Zealand. In Europe, most biodiesel is produced from rapeseed but cultivation is intensive, with a negative effect on the overall energy balance of the fuel, and with potential environmental costs. Importation of tropical oils such as palm oil also has disadvantages, including unsustainable cultivation practices and the financial, environmental and security costs of transport.

Biofuels have the potential to substitute for some "fossil" oil. The need for substitution is driven by rapidly increasing carbon dioxide concentrations in the atmosphere, caused by burning fossil fuels, with associated global warming which is suggested to cause a 0.5m rise in the sea level by the end of the century. Also, although predictions differ, "peak oil" is approaching. However, a high level of research, technology and policy development is required to make greater substitution a reality.

Current biofuels fall into three major groups: bioethanol, biodiesel and "biojoules" (representing heat from biomass such as wood).

Recent analyses worldwide have addressed the sustainability of the production of some biofuels, however, in terms of:

- Life-cycle analysis of energy inputs compared with outputs in the form of biofuel;
- The fact that some biofuel feedstocks are foods;
- The fact that some feedstocks require high-quality agricultural land;
- The fact that some feedstocks require high inputs of water, fertiliser and pesticides.

For example, publications by Zah *et al.* 2007, Pickett *et al.* 2008 and Scharlemann and Laurance 2008 indicate that some of the most important biofuels, such as those produced from corn (maize), sugarcane and soy perform poorly in many contexts. For example, "…multibillion-dollar subsidies for United States corn production appear to be a perverse incentive from a rational cost-benefit perspective…". (Sharlemann and Laurance 2008).

The New Zealand Government, through its Foundation for Science, Research and Technology (FRST), is investing in a wide portfolio of biofuel research, while overseas, investment is massive and increasing. For example, BP is investing US$500 million in biofuels research.

The Lincoln University Biodiesel Research Programme is funded for six years by FRST and is entitled: "Developing with Chevron New Zealand, novel, second-generation biodiesel feedstocks to improve New Zealand's economic and environmental performance". Chevron New Zealand and Chevron Ventures, San Francisco, are key partners in this work, along with Biodiesel New Zealand (part of Solid Energy New Zealand), Taharoa C Block Incorporation, near Hamilton, Ngai Tahu, Plant & Food Research, and others. This unique team aims to meet three objectives:

- Led by Dr Dick Martin of Plant & Food Research, this will demonstrate best practice management packages to ensure that oilseed rape and other selected oil and latex producing crops grow to their potential.
- Led by Professor Alison Stewart of the Bio-Protection Research Centre, this will investigate plant yield and quality enhancing microbial bio-inoculant technology already successful in pasture to increase per hectare oil harvest.
- Led by Professor Steve Wratten, of the Bio-Protection Research Centre, this will employ unique "ecological engineering" approaches to enable production of biodiesel feedstocks in a manner which enhances the ecological and environmental quality of farmland, rather than depleting it.

Oils will be analysed for their suitability for transesterification and biodiesel quality by Biodiesel New Zealand and Chevron Ventures Ltd. The involvement of under-used Maori land on both main New Zealand islands should provide the opportunity for new, sustainable uses for this land in the future.

Given the urgent need to address the criticisms of Scharlemann *et al.* (2008), Pickett *et al.* (2008) and Zah *et al.* (2007), this recent funding is timely and will open up the opportunity to address the challenges facing New Zealand's and global energy needs. However, current predictions of future global energy needs are based on the economic and political paradigm of continued economic growth. Current predictions are that the world economy will expand from US$54 trillion to US$400 trillion by 2030. As long ago as 1987, Bruntland questioned whether there should or will be *Limits to Growth*. That report was issued at a time of energy crises. Today we are facing new energy crises relating to global warming, "peak oil", rapid increases in world population and individual wealth of some sectors of society and exceptional increases in oil prices, impacting on food costs. New approaches and paradigms are sorely needed to address these issues and our biodiesel programme should help in some way. Perhaps it's a naive notion, but people in the richer nations should consider going on an "energy diet".

** This paper was written before the change of government and policy.*

John Key's Funding Assurances

15th September 2008

Dear Mr Key

The Council of The New Zealand Institute of Agricultural & Horticultural Science represents over 650 members covering all aspects of the primary sector and has 14 corporate sponsors including PGG Wrightson, DairyNZ, Ballance Agri-Nutrients, Federated Farmers, AGMARDT, AgResearch, Crop & Food Research, HortResearch, Horticulture New Zealand, Ravensdown Fertiliser, Catalyst R&D and Lincoln and Massey Universities.

We are writing in response to issues raised in the National Party's draft policy for Research, Science and Technology. We applaud, among many worthwhile innovations, the emphasis on improving the stability of science funding; the need to reform the overly bureaucratic funding system and the appointment of a senior science adviser (hopefully outside the formal bureaucracy) to the Prime Minister.

But we also need to voice the concerns of many of our members and others in the primary sector at the decision to abandon the Fast Forward scheme. We accept that you have made allowances for replacing potential funds from Fast Forward with a range of new initiatives, which we are sure will be very well received by researchers in the primary sector. However, as we understand it, the Fast Forward scheme did give a measure of stability to future funding, whereas your alternatives appear to be largely dependent on the annual budget round. Inevitably this gives a measure of uncertainty to funding, as there will be competing demands for resources and science will always have a problem in a "market" where health, education, crime prevention and other high profile areas will almost certainly receive priority. This is despite the fact that recent research, by Dr Grant Scobie and others at New Zealand Treasury, has shown that over a 30 year period public investment in long term agricultural research in New Zealand generated an annual return of 17%.

We would respectfully suggest that your funding proposals for Research, Science and Technology would be much improved if a way could be found to "ring fence" them outside the annual budget round. This would lift their value immensely because of the greater stability of funding which would result, and help improve an issue which has been of major concern to the science sector for many years.

Thank you for your attention.

John Lancashire
NZIAHS President

22nd September 2008

Dear Mr Lancashire

Thank you for your letter of 15 September regarding National's draft policy for Research, Science and Technology. As you know, this inadvertently found its way into the hands of the Government and then the media. Our final policy is due to be released shortly.

You were concerned about the stability of future agricultural and horticultural research, given that we plan to wind up the Fast Forward Fund and replace it with annual appropriations for primary sector and food research.

Let me assure you that the reason we are making changes in this area is to benefit primary sector research, not to limit it in any way. I believe that world-class agricultural and horticultural science, over many decades, has been one of the fundamental reasons behind the success of New Zealand's primary industries. These industries are – and will continue to be – the backbone of our economy. So I want to boost this science over the longer-term.

We believe the proposals in our draft policy are a better way of funding primary sector research, for all the reasons we outlined.

The fact that funding is dependent on the annual budget round should not give you any cause for concern. The government does not have capital funds set aside to guarantee a stream of operational funding for hospitals, schools, or other important areas of government expenditure.

I am also not convinced a capital fund would give any more certainty of funding, particularly over the next few years. At the moment, the other government funds, like the New Zealand Superannuation Fund, are losing considerable amounts of money. In the case of the Fast Forward Fund, that would be money that was lost to primary sector research. In addition, the Fast Forward Fund was due to run out, possibly in as few as 10 years.

I understand your concerns about stability in the science sector and I can assure you that National shares them. For example, one way we intend to improve the stability of the sector is to set up a secure, non-contestable funding allocation for CRIs. This will help to provide a stable employment environment in order to attract and retain quality staff.

NZ NATIONAL PARTY

Thankyou again for taking the time to write.

John Key
Leader of the Opposition
Leader of the National Party

Opinion

2009 NZIAHS CONVENTION

Tuesday 30th June &
Wednesday 1st July
Stewart Block,
Lincoln University, Canterbury

Tuesday 30th June
2.00pm-5.00pm
New initiatives to improve the New Zealand science system

5.00pm - 6.00pm
NZIAHS Annual General Meeting

6.00pm onwards
NZIAHS Annual Awards Dinner

Wednesday 1st July
9.00am to 3.00pm
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NOTE YOUR DIARY NOW
- more information to follow

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