

back to its former ingredients – water and air; it would be manufactured in combination with other materials to impart surface-hardness, fire-resistance and durability. It would come in infinitely long lengths, in blocks, or in sheets. It could be stiff, flexible, insulated, or as transparent as glass (think of polycarbonate skylights).

Special carbon fibres extruded throughout the polymer could confer remarkable tensile strength and electrical conductivity. Surrounding this scaffold, a matrix of carbohydrates would fill the gaps and provide electrical/heat resistance. For cutting edges, carbon would be sprayed on as diamond – the hardest substance known. Or for sliding edges, carbon could be manufactured as graphite. What does all this mean in terms of actual products?

Whole sides of buildings could be extruded in one continuous process, with windows seamlessly integrated. Car, aeroplane and ship bodies could adopt the same approach and the same materials. The interwoven carbon fibres have a wealth of potential uses: they could conduct electricity to power points, wheels or propellers; they could help turn all walls and roofs into solar panels; they could be attached to a network of LEDs to provide ever-changing colour and appearance. Imagine a house where all or most of the wall-area is translucent – a huge window where the

transparency is alterable by a rheostat switch. Or a house where the inside resembles the rippling waves of a coral beach, and the outside walls appear to be a dappled forest, leaves trembling in the wind.

In other words, we could end up living INSIDE a computer screen saver! Most things we would see and touch would be artificial – a construct or a mirage. Does this prospect delight or revolt the reader?

Even in the early years of the twenty first century, I see the signs of a back-to-nature backlash in public attitudes. Many people who have spent their whole lives in a conurbation yearn for the simplicity, the complexity, the cleanliness, the *rationality* of a “natural” environment. Their affection for “untouched” areas of land would have been peculiar – even unthinkable – only 100 years ago, but is now starting to grow into a deeper, almost religious veneration. The painful discovery that humans can survive on this planet only by courtesy of Nature’s goodwill, will induce an even greater reverence for the tree-clad hillsides that surround us.

Thus it would be premature to conclude that foresters will become redundant as a profession. There will continue to be a need for someone to protect and care for those forests. But wood production may not be part of the job description....

NZ pine plantation forestry - at a turning point?

John Roper*

Introduction

For the first time since plantation establishment started over 100 years ago, there has been a net decrease in plantation area in New Zealand. Ministry of Agriculture and Forestry figures indicate that there was a net decrease of 1,000 ha in the area of New Zealand’s plantation forest in 2005. Only 32,000 ha of the 39,000 harvested were restocked and new planting was only 6,000 ha.

Forestry is in the midst of dynamic land use changes in some parts of the country. In the Central North Island, the traditional heartland of New Zealand’s plantation resource, some young and mid-rotation radiata pine is being physically pulled out of the ground ‘roots-and-all’, placed in windrows, and the land converted as quickly as possible into dairy pasture. Two major forestry companies (CHH and Kiwi Forests) have announced an initiative to sell the freehold of at least 35,000 ha of such land in this region for this very purpose. In the South Island, the Selwyn Plantation Board, in local government ownership, has sold its plains forests, most likely for conversion back to farmland and lifestyle blocks, preferring instead to focus on hill country for its plantations.

Underpinning all this change is the fact that alternative land uses are offering better prices for land and higher returns than pine plantations. These changes are the ‘free market working’ – the response of a market economy

to economic drivers of the time – and current economic conditions certainly don’t show plantation returns in a very positive light.

However forestry is a long-term business, and it could be argued that how we have fared over the last rotation or two (say 25 to 50 years) should be taken into account by the market – not just the short-term view. Or has this in fact already happened? That the returns have been judged, and found to be seriously wanting by investors? Is this a harbinger of a fundamental change in attitude regarding long-term ‘feel-good’ forest investments by NZ investors, who have helped bankroll a substantial increase in the forest estate?

Complicating the issue are other non-timber values and non-market factors or externalities such as improved water quality and carbon sinks associated with forests, that may not be present with other land uses. Forests are also talked about as potential sources of bioenergy, with the advantage that they can be greenhouse gas neutral, recycling atmospheric CO₂. All these potential ‘markets’ are interrelated in the pine plantation investment/disinvestment scene we have today.

For those investors involved in commercial plantation forestry there are currently two main economic drivers for staying in the business or exiting from it. The first is the markets for their produce (mainly, but not exclusively logs) giving a worthwhile return on investment. The second is the markets for the land on which the forest is growing and the potential for conversion to other land uses. This paper mainly examines the first driver.

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Current plantation profitability

Return to shareholders

Most analyses of forest profitability are forward looking (i.e. they are some sort of forecast of future earnings), often given as part of an investment prospectus for plantation forests. Yet there is scant published analysis of posterior profitability of forests harvested to date. Since we are currently harvesting around 20 million m³ of plantation logs per annum this seems a rather curious oversight.

One entity capable of analysis is the Nuhaka Fund. Listed in 1974, it has grown a crop of radiata pine on around 2000 ha on the east coast of the North Island and has subsequently returned all revenues to shareholders by selling logs, land and forestry rights, with the final payments being made in 2005. In all there were 1,772,988 units issued at various times and at various prices from 1974 to 1994 and, using the data presented in Table 1, it is possible to calculate the average gross pre-tax return achieved on the units' issue price.

On the face of it, Table 1 indicates not a bad return, with on average \$1.48 per unit being invested for a final return of \$8.22 pre-tax. (The only units that fared really badly were those issued at the time of the log price spike 'boom' in 1994 at \$14, being issued at around the perceived 'fair value' at the time.) But what was the real rate of return? To do this requires that the timing differences between costs and revenues be taken into account. IRR (Internal Rate of Return) analysis of Nuhaka indicates a rate of return of 7.9% pre tax (or 7.6% after tax paid by the entity). The RBNZ CPI indicator series (see www.rbnz.govt.nz/statistics) over the years 1974 to 2005 represents a compound average annual

Table 1: Nuhaka Fund costs and returns to unitholders.

Unit Issues			
Year	Issue Price	Units Issued	Value
1974	\$1.00	871,182	\$871,182
1980	\$1.00	379,318	\$379,318
1980	\$1.20	139,100	\$166,920
1989	\$2.00	347,388	\$694,776
1994	\$14.00	36,000	\$504,000
Total		1,772,988	\$2,616,196
Average Cost	\$1.48		
Distributions to unitholders			
Date	Amount per Unit	Gross Dist.	Tax Deducted
08/12/2000	\$0.20	\$354,598	-
20/07/2001	\$0.35	\$620,546	\$77,318
20/12/2002	\$1.15	\$2,038,936	-
23/06/2003	\$0.91	\$1,613,419	\$4,704
08/12/2003	\$0.11	\$195,029	\$25,753
18/06/2004	\$0.63	\$1,116,982	\$165,546
17/12/2004	\$3.50	\$6,205,458	\$784,741
04/03/2005	\$0.78	\$1,374,420	-
04/03/2005	\$0.59	\$1,053,154	-
Total Return	\$8.22	\$14,572,543	

inflation rate of 7.2%. So the pre-tax Nuhaka returns were not much ahead of the inflation rate for that same period.

More detailed analysis suggests that the real rate of return, after adjusting for inflation and differences in timing of the various expenses and revenues, was 1% pre tax. This is vastly different to the discount rates traditionally applied to forest investment analysis and projected in the various prospectuses floated over the last decade or three. It represents a somewhat sobering reality check on the high expectations placed on the sector over the previous decades.

Personal experience

I was a shareholder in a small plantation harvested in 2004. A contractor clearfelled a small block of untended 27 year old radiata pine (planted in 1977) using a bulldozer and logging arch, with the actual stand being very similar in silvicultural history and age at clearfelling to the Kaingaroa forest plantation being felled some 50 years previously. Here was an opportunity to compare 'apples with apples' as far as possible – two plantations being harvested 50 years apart at a similar age using similar ground-based harvesting technology, both with a similar 'minimum tending' silvicultural history planted using genetically unimproved radiata pine seed. How would the residual 'run-of-bush' stumpages compare when adjusted for the change in the real value of money over time?

In order to compare residual stumpages obtained by our 'small forest owner' (net return per m³ of harvest to grower) it is necessary to deduct the direct harvesting and road transport costs of getting to markets. In-forest roading may or may not be included in the costs for harvesting. As roading cost is very variable (and high in my woodlot example being sited on clay soils) depending as it does on terrain, soil type, and the amount harvested, I have excluded this cost to get an accurate comparison of 'true stumpage' compared to a relatively flat pumice plateau site with cheap roading.

Our 2004 average nett stumpage revenues ranged from \$16.33 to \$18.73/m³ depending on how sales commissions are treated.

The original State sale agreement from Kaingaroa to Tasman in 1955 was a large sale of roughly 1.7 million m³ of logs per year (60 million cubic feet per year). It set a stumpage value of 3d/cubic foot for all radiata pine regardless of quality (sawlog or pulpwood) (see Kirkland & Berg 1997 for details). The Reserve Bank of NZ CPI-based inflation calculator gives 3d per cubic foot (x 35.3 cuft/m³) = 106 pence or £0.44375 (= 106/240d) per cubic metre in 1955 (pre decimal currency when in 1967 £1 became \$2 so £0.44375 = \$0.89c/m³) as being equivalent to \$17.42/m³ in 2004.

When \$17.42/m³ (3d per cubic foot in 1955) is compared to the derived average stumpage obtained by myself in 2004, averaged over all logs for a similar crop, it is roughly the same! This can be taken as somewhat of a good news/bad news story. The good news is that stumpages, taken on a per hectare basis, at least seem to have kept pace with inflation, but only if using the original heavily subsidised

Tasman sale as a benchmark! The bad news is that there has been no discernable 'real' price growth from this extremely low concessionary stumpage base set by the government of the day. Note that higher prices were achieved by my domestic sawlogs in 2004 in particular, when compared to 1955. Also, the export log market was in the process of continuing decline during harvesting, leading to very low average returns at the time. An approximate breakdown of nett stumpage for my block is given in Table 2.

Table 2: Contribution of Log Grades to Total Stumpage for small block harvested in 2004.

Log Grade	Unpruned Domestic S Grade Sawlogs & Roundwood	Export J, K and K-Industrial Grades	Domestic Pulpwood
Nett Stumpage \$/m ³	30-45	0-20	0
Percent of total Harvest Volume %	50	25	25
Contribution to Total Stumpage	85%	15%	Nil

Who pays the forest growing costs?

Profitable returns from plantation growing have been increasingly restricted to the basal sawlog part of the tree. This is unlike the original Tasman agreement, which priced all logs the same. (Of course today, even higher prices are achieved by pruned sawlogs, compared to unpruned structural logs, but not without major silvicultural inputs early in the rotation.)

Overall, I believe this trend over the succeeding 50 years is an unhealthy development for plantation growers. It means that only a proportion of the total harvested crop (i.e. that going to solidwood users such as sawlogs, both domestically and overseas export markets, roundwood (poles & posts) and peelers for plywood or LVL) carries the growing costs for every log produced from the forest. This in effect subsidises the supply for pulp & paper and MDF industries dependent on the same forest resource, meaning they can pay less than the growing cost, and still be assured of adequate supply.

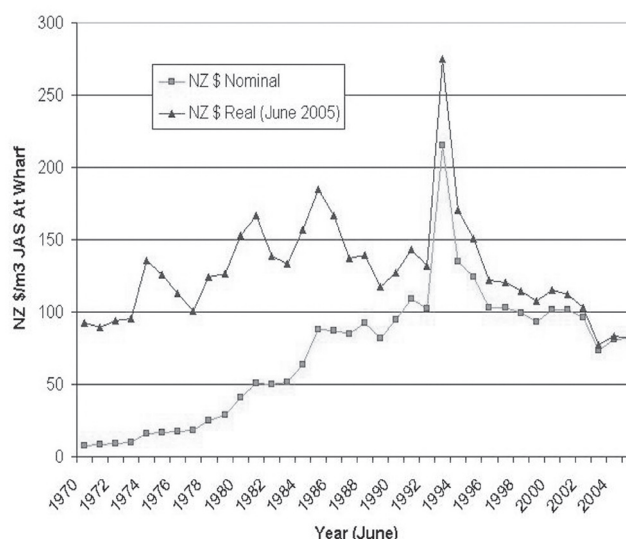
Log export returns

Reliance on lower regions of the stem yielding a positive stumpage means that plantation growers are in a more vulnerable position and are susceptible to downturns in the profitable parts of their forestry business.

The benchmark 'Japan A' grade radiata pine log has been traded for over 30 years, and long-term price series are available extending over a rotation in length or more.

The trend in real prices was positive from the early 1970s up until the price spike of 1994. A Grade export log returns for most of this period 1970 to 2002 exceeded those available for similar unpruned logs sold to domestic sawmills. However, since the 'export price spike' of 1993, the trend in both nominal and real returns has been declining (Fig. 1). This has now reached the point that domestic sawlog prices for structural grade logs exceed the A Grade export returns.

Fig 1: Japan A Grade nominal and real at-wharf prices 1970 to 2005 (Source D.A Neilson).



The dominant log export market for NZ since 1993 is Korea, which takes lower value K (and KI or K Industrial) grades. These have also shown price drops over the last 10 years.

But the decline in returns for export logs fail to give a realistic view of the worsening situation facing the forest owner. The forest owner in effect receives a 'residual value' return as stumpage after all harvesting, roading, cartage and wharf costs are deducted. Although such logging, cartage and wharfage costs have been the subject of intensive cost reduction efforts, and open to competitive pricing, the forest owner has borne the full impact of these export log price drops. For even well located forests, close to wharf and on easy terrain, the costs of getting logs to wharf are seldom less than \$25 per tonne (roughly 1 m³ of log). For forests on steeper terrain, with hauler harvesting, and located further from the wharf, these costs can quickly double to at least \$50/t. Once costs of this magnitude are deducted from the at-wharf prices, the residual stumpage has been heavily reduced for all grades, to the point where it is not worth harvesting in some cases.

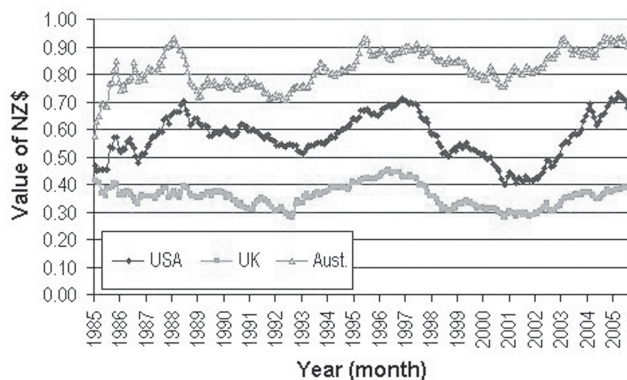
Another feature which works to the disadvantage of the pine forest grower, is that export logs are predominantly scaled according to the Japanese Agricultural Standard (JAS), and this system almost always leads to a lower JAS volume paid for 'at wharf' than when the same truckload of logs is measured in tonnes. All costs of reaching the wharf (logging & cartage) are denominated in tonnes, but the final

scaling formula frequently means that the final payment in JAS cubic metres is for around 90% of this (i.e. around 0.9 JAS cubic metre per tonne). It is worth noting that all export log price statistics are given in JAS volume.

Exchange rates

Exchange rates have been a huge factor in determining export log returns, with the most important being the US\$. This is the currency in which almost all sales for logs (and many sales of lumber and other forest products) are conducted, including those to the Asian markets. The NZ\$ has had a greater volatility against the US\$ than other NZ trading partners (see Fig. 2).

Fig. 2: Comparative NZ\$ exchange rates to other currencies.



Quite clearly, there are huge changes when the base currency of the log trade (the \$US) fluctuates so widely against our own. Over the last 5 years, this volatility has been extreme, with the NZ\$ going from a low of US\$0.40c to a high of over \$0.70c. On the basis of US\$100 received, this equates to a NZ return of less than \$140 to around \$250. These are massive changes, and their causes are far beyond this paper. But it is the NZ forest owner that has to live with them.

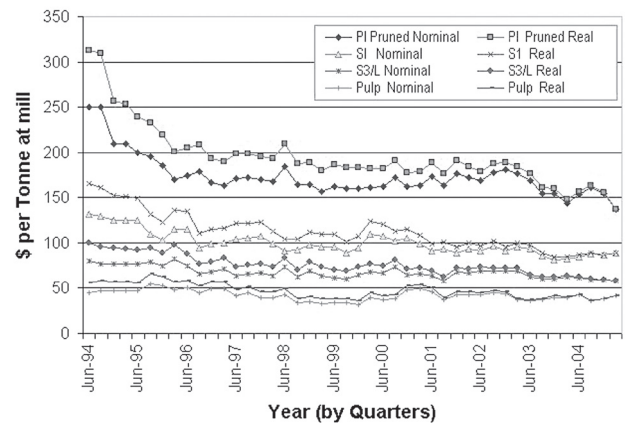
Additionally, forest profitability has been negatively affected by a rapid rise in ocean freight rates from below US\$20/m³, to US\$40-50/m³ in 2005 before falling back somewhat currently. At least here there is partial hedging against these rises since ocean freight rates are based on the \$US also.

Domestic log markets

The domestic log market has also faced nominal and real price reductions over the period of more than 10 years since the 1994 'price spike'. The domestic log market is largely driven by derived demand for the sawn lumber it produces, for both domestic and export sales. Like logs, almost all of the lumber exported to Asia and USA, is traded in US\$, and sawn lumber returns to these markets have been adversely affected by the strong NZ\$/US\$ exchange rate, high shipping costs, and competition in export markets from other producers. This in turn has impacted most heavily on the domestic pruned log market, being the log grade sawn to yield clear boards, solid lineal mouldings, and higher value cuttings grades predominantly exported to these markets.

This decline has continued into early 2006, with good quality pruned logs now trading in the \$120 to \$130/t range – well below the long-run averages shown in Fig. 3.

Fig. 3: Domestic log prices – nominal and real (\$/t at mill). Real values are in 2005 dollars.



There has also been a steady erosion of prices, in both nominal and real terms, for the other log grades sawn more for the domestic construction and remanufacturing industries. As with export, these declines have impacted most heavily on the forest owner, as the prices are almost invariably delivered to mill, and fixed direct costs of harvesting, roading, and transport reduce the residual stumpage available to the forest owner.

The outlook for pine plantations

In effect, the only major sector left covering the growing costs for the pine plantation industry, in the short-to-medium term, is solid-wood lumber. In this category, engineered wood products (EWP) such as LVL (laminated veneer lumber) have provided an advance in performance properties over traditional sawn lumber. Peeling technology, along with associated non-destructive ultrasonic stress-wave sorting of veneers by stiffness, allows recombination in LVL to achieve defined structural performance criteria. These performance criteria include stiffness, strength and stability, all of which are improved in LVL when compared to traditional sawn wood from the same species. Other advances have included wooden I-beams, utilising LVL flanges for the stressed top and bottom cords, with other EWPs such as plywood and OSB (oriented strand board) for the lower stressed area in the web. I-beams offer weight advantages over sawn wood, and can be engineered to provide greater depths allowing them to span greater distances as well.

Steady, if unspectacular returns for domestic sawlogs and peelers have been the sole bright spot in an overall dismal log market for forest growers over the last 10 years or so. However, a significant proportion of domestically processed lumber is in turn exported, and this return has also been adversely affected by cost movements in shipping, exchange rates and competitive supplies from other plantations outside NZ. Nowhere are margins safe, or markets available that cannot be reached by other suppliers.

The most optimistic outlook for pine plantations, to me, is that all sectors of the forest industry start to pay a realistic cost of growing, giving a viable long-term return to those who will have (and in the past have had) the courage to invest in a risky business for 30 years or more. Sure there will be innovations in some market segments which add value to the log resource, but this change must be profound and widespread in all segments of a very diverse industry. An analysis of trends in the last 50 years gives scant cause for unbridled optimism that this will happen without a revolution taking place in the minds and markets that have become dependent and piggybacked on a cheap fibre resource.

Radiata plantation forestry now occupies some 90% of New Zealand's plantation resource (the balance being Douglas fir, other softwoods, and largely short-rotation hardwoods). It seems unlikely that this percentage will be maintained. A move to more targeted silviculture with other species, aimed at fulfilling some of the specialist fibre needs in the most economic way, seems inevitable.

And for those who feel complacent that the much vaunted 'wall-of-wood' will still be there for us to utilise, then the cautionary tone of Goulding (2005) has not yet sunk in. A fundamental change in the way we value the wood from plantations is the best way to ensure we have a viable renewable resource for the next 50 years.

Emerging markets

Whilst the market for radiata softwood plantation logs for industrial wood products is dominant in determining plantation returns, there are a number of emerging markets for species and uses not traditionally important in the pine-dominated industry of today.

Hardwood plantations

The comparatively small short-rotation hardwood plantations in the Central North Island initially look more positive in terms of stumpage return for their fibre component than the typical pine plantation, at least on the better sites. Most fast grown species of pulp and fibre eucalypts (e.g. *Eucalyptus nitens*, *E. regnans* & *E. fastigata*) do not have significant value as sawlogs or peelers in the current market, especially when grown on relatively short rotations of under 20 years. Hence, their main value is as pulpwood, and grown for this, they seem to be able to generate a modest return on investment, given current costs and revenues. On the better sites, their growth rates are comparable to pine (around 20 m³/ha/yr), and rotations somewhat shorter. Prices for hardwood fibre logs are typically around \$50/t delivered at mill, or even slightly more. If estimates of harvesting cost (say \$20/t) and transport cost (say \$10 to \$15/t) are made, then this leaves a positive stumpage of between \$15 and \$20/m³ before in-forest roading costs.

Once again, this is comparable to the 3d/ft³ in 1955 (updated to 2005 dollar equivalent values), but it's on a relatively short rotation (say 15 years) compared to radiata pine rotations of say 25 to 30 years, so the compound rate

of return is potentially better.

There is a potential upside for older stands, with some of the biggest logs able to be peeled for hardwood veneer of superior stiffness with which to make LVL. If mixed with pine in LVL layup, there is the potential to increase the stiffness values over pure radiata LVL. This may offer some future diversification potential to the silvicultural regimes currently practised. But it is worthwhile noting that in the Bay of Plenty some of these plantations (along with pine), are being sold freehold and largely converted back to farmland once the eucalypt is harvested.

Other hardwood plantations in Northland have concentrated on Acacia species for pulp on a 7 to 10 year rotation. These too are being touted as successful, and offer a diversification away from the dominant radiata pine rotations. On slightly longer rotations (in the order of 15 years), there is also a potential to grow pruned sawlogs in the order of 50 to 60 cm diameter at breast height. This can be achieved in the case of *Acacia dealbata*, with diameter increments approaching 4 cm per annum. Work on the lumber properties of these fast grown species is potentially well justified.

A 'Hydrocarbon-to-Carbohydrate' economy?

If the 20th century were to be categorised from a resource viewpoint, it would have to be for the growth and dominance of the hydrocarbon economy. The developed world went a fair way to discovering and subsequently exploiting a substantial part of the fossil fuel reserves of coal, oil and natural gas accumulated over hundreds of millions of years. These reserves were for the most part relatively cheap to exploit and literally fuelled the revolutionary expansion of road, rail, sea and air transport which has characterised the 20th century. They also provided the energy and/or raw materials for much of the advanced metallurgical, concrete, synthetic fibre and plastics industries – the notable 20th century icons which have led to the urbanisation and agricultural production efficiencies in much of the developed world.

But the world of the 21st century looks somewhat different. There are no longer the seemingly limitless reserves of fossil fuels awaiting discovery, and even exploitation of those already discovered is argued to be having serious consequences for the planet's environment and climate. Something seems as if it has to change.... and change it undoubtedly will. The hydrocarbon age will probably not end because we exploit the very last of our fossil fuel reserves. As Sheik Yamani said in 1973 at the time of the first oil crisis 'The stone age didn't end because we ran out of stones.' But this begs the question of what might replace our hydrocarbon resources later in the 21st century.

It seems a fair bet that we will have to rely on the energy emitted across the electromagnetic spectrum by the Sun, capturing solar heat, using the photovoltaic effect, and via photosynthesis of green plants to replace a substantial proportion of the energy currently derived from fossil fuels. Green plants in general, along with phytoplankton, share the remarkable photosynthetic reaction:



The carbohydrates so created are the basis for all the major food chains irrespective of whether the organism is vegetarian, omnivore, carnivore, or saprophyte. Moreover, the reaction is reversible and is utilised as such by both combustion and respiration processes. Historically, it has given rise to our fossil fuel reserves laid down under anaerobic conditions over millennia – but enough already said on that.

Whilst trees do not have the marvels of photosynthesis on their own, they do provide a convenient and perennial method of storage of the products thereof in terms of cellulose, hemicelluloses, and lignins comprising the typical woody fibre cell. These trees will likely be the feedstock of bioengineering processes and biochemical pathways as yet almost totally unknown to the current industry. They will become some of the replacement products for the liquid fuel and plastics industries that we currently depend upon from fossil fuel sources. However, it is likely that the plantations dedicated to these end-uses will optimise values other than those traditionally associated with solidwood products. Values such as dry matter productivity and yields of biochemical compounds not traditionally valued will likely become important silvicultural objectives.

Bio-energy today and in the future

A fairly recent phenomenon has been the concept of dedicated 'bio-energy' forest crops on a significant scale to replace the fossil fuel coal and oil based energy we have become so dependent on – in effect, to start to make the transition from the 'hydrocarbon-to-carbohydrate' economy. Of course, traditional 'bio-fuels' (including bark, sawdust and shavings) have always been used as a by-product of debarking, sawmilling, remanufacturing and pulping processes and as such have provided a significant input of high quality heat for power generation and drying processes in the industry.

However, with the 'stand-alone' operations running so far, such as the collection of fuelwood from old skid sites to replace natural gas at the CHH Kinleith pulp and paper mill, it again appears as if zero-cost residues already collected on a skid-site, form the basis of any business profitability. To be worthwhile, it seems they must be very close to the furnace (10 or 20 km) and have lost some of their moisture so the nett calorific value per tonne carted is enhanced. At Winstone Pulp International at Karioi, the forest manager has entered into a relationship with the the pulpmill and energy supplier, to harvest biomass from *Pinus contorta* and convert it to electricity and process heat economically. But once again, the advice from the forest manager is that there is precious little left over as a residual stumpage value, so returns are only considered marginal for an otherwise very low-value species.

Projections from UK scenarios (Royal Commission on Environmental Pollution 2004) of carbohydrate fuel wood economics give a range from £40 to £80 per oven-dry tonne delivered at plant. (These can be compared to current NZ at-mill log prices by assuming an exchange rate of NZ\$1 = UK£0.36 and around 400kg of oven dry wood per green

tonne, and equate to around NZ \$44 to \$89 per green tonne at mill). Thus the scenario encompasses the entire range of at-plant delivered wood costs in NZ, ranging from our near-zero stumpage wood-fibre industries, to a cost as high as putting a prime structural domestic NZ unpruned sawlog into the bio-energy process! The corollary is that at the higher price scenario, the only logs we couldn't economically put in to these processes currently for fuelwood would be pruned logs!

Such scenarios clearly imply a wide range of shadow energy prices, the implications of which can be only guessed at for the world economy longer-term, given the relatively profligate use of cheap fossil-derived fuel that underpins it currently. I accept the bio-energy industry has to start somewhere, and these starts have been made, but it doesn't promise to be a panacea to the lack of profitability currently facing our plantation owners, at least in the short-to-medium term. Once again in the case of bio-energy, as with pulp & paper and MDF currently, it's the forest grower who currently benefits only marginally with a contribution to the bottom line, and certainly is nowhere near recovering the full compounded wood growing costs over time.

The only way the potentially dedicated bio-energy plantations promise to be economic is if substantial real price increases for bio-energy based wood in a high cost energy environment is assumed. The Government's treatment of the forestry sector under its Kyoto policies to date hardly give cause for optimism either, but it is possible the final outcome may at least may offer some incentive to invest and reinvest in forestry. It will then be the foresters' challenge to grow forests and biomass in an economic way to meet these demands.

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