Food, Fuel and Famine

Mike Malloy

In memoriam

This essay is dedicated to the memory of the late Professor John Tong, clinical psychologist, university teacher and infantryman in the British Army during World War ii, who respected and enjoyed trees and who believed that quality tree farming was possible in New Zealand

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Introductory

Alongside all the research and rhetoric about the increasing levels of carbon in the atmosphere, a quiet revolution has been going on in the world of transport. Powering cars and trucks up to the present has been the explosive burning of fuels drawn from cheap petroleum oil. Coming into view is a quiet new form of power – electricity. Not the kind we see every day on power poles. It's a new kind, based on within-vehicle generation by fuel cells. And its preferred fuel is a liquid, portable and safer than gasoline: the hydrogen-rich methanol. Its most effective vehicle host is the fuel cell vehicle (FCV). In internal combustion vehicles (ICEs), the exhaust systems of explosive power emit carbon in the form of CO2 and expel it into the atmosphere. That's how climate warming develops. Similar systems within FCVs emit hydrogen in the form of dribbles of water – the stuff that leaves, grasses and animals need to survive – and no carbon. There's only one major snag. At present, FCVs run on methanol, and methanol from sustainable biomass is, and is likely to remain, more expensive than gasoline. (In contrast, methanol from natural gas, another fossil fuel, is comparable with gasoline for cost.) There is one possible advantage accruing to New Zealand. It has an opportunity to take a leading role in the revolution. Current evidence suggests that NZ may have a global advantage in the conditions attaching to its rural land and its capacity to yield the raw material needed for methanol production. Two of these conditions are hillslope and erosion. A study by Derose et al. found:

a) Annual herbage accumulation decreases with increasing slope angle from the bottom to the top of hillslopes.
b) Pasture recovery is slow on landslide scars, taking 40 years to reach about 74% of uneroded levels. Herbage accumulation is permanently reduced on soils with low soil water-holding capacity.
c) Declines in mean annual herbage accumulation are greatest on slopes steeper than 28 degrees (28*). These declines amount to between 1 and 3% per decade for the first 100 years after forest clearance, but are expected to decrease over longer time periods.

(5)

The inference is clear: steep land is more stable and productive in forest than it is in pasture. As a nation, we ignored selective clearing to our cost. The scientific evidence is indicative: when fossil fuels no longer supply a reliable and cheap fuel for transport purposes, farmers can step into the breach for raw material by converting their steep, relatively unproductive grassland into energy tree plantations, assuming, of course, that the market place provides an adequate return for wood. The world is running out of cheap oil. NZ is not (yet) running out of cheap land. People like living on flats, just as they like working land that is flat or gently sloping. They mostly by-pass steep land: just the kind that suits trees, their leaves and repetitive harvesting. The human dislike of steep country has been highlighted by the wholesale destruction of native forests that have in the past protected soils on steep country. The result: the steady erosion of valuable topsoil, often resting unsteadily on rock. By reversing forest removal, we can exploit the extraordinary capacity of leaves to absorb solar energy and convert it into portable, energy-rich hydrogen via methanol. If needed, the carbon content of wood and leaves can be handled conveniently at the processing plant and then sequestered. The same processes enable us to use tree roots on steep land as stable stores of carbon outside the atmosphere.

Cheap oil has made the modern world, and its people, what they are. Its problem is that, like natural gas, it is a wasting asset, used by a global population that is growing at a geometric progression. The gravy train must run out of steam soon – certainly before this century reaches the 50 year mark. Well before that happens, we need a replacement to take over the role of cheap oil. We can do the replacement act of oil, but we can't replicate its cheap aspect. Cheap oil is free oil. It merely needs extraction to enable it to be refined into fuel. Bound oil is quite different. It is found in sands and shale. To use it, we must extract it from its embedding material. It is much more expensive to convert into a fuel, but favoured by the oil companies as the replacement for free oil.

Plantation forests yielding methanol can stabilise our hill country, yield wood and leaves that are energy-rich, and support repetitive cropping of successive generations of tree growth through coppicing. The processing of wood, leaves, natural methane hydrates and water weeds into methanol is an immature technology, ripe for extensive development through research. So is plantation management on steep country. Such research normally leads to decreasing the price of the finished product.

Methanol is a basic product of trees or natural gas. Trees can be cropped. Natural gas can't. Methanol can be used as a laboratory solvent, as a component in a process yielding biodiesel, and, directly and indirectly, in the production of:

A. Chemicals – Formaldehyde
   Methyl-tert-butyl ether
   Acetic acid
   Chloromethanes
   Methylamines
   Methylamines
   Methyl methacrylate
   Dimethyl terephthalate
   Butanediol
   Ethanol
   Hydrogen
   Carbon monoxide
   Biochemicals

B. Products - Adhesives for particle boards, plywood & wood panels
   Paints
   Resins
   Silicones
   Antifreeze
   Plastics
   Foam as insulation in refrigerators, doors, dashboards & fenders
   Gasoline
   Gasoline additives

Explosives
Textiles
Windshield washer fluid
Aerosol spray propellant
Polymers
Direct methanol fuel cells

(26)

Globally, methanol is produced at the annual rate of about 40.6 million tonnes. Between 2008 and 2013, demand is expected to grow at the rate of some 7.8% per annum. Methanol can be blended with LPG for home heating and cooking, and as a diesel replacement. It can be used directly as a fuel in ICEs and in FCVs, thus displaying remarkable versatility. It can also be used as an ICE fuel in blends with gasoline. In ICEs, it has only half the energy content of gasoline. In FCVs, it has about the same energy power. When produced from sustainable biomass, it is the key to an evolving economy. The revolution opens up a vista of fame and fortune for the entrepreneur, the inventor, the bold and the ingenious. It also gives Parliament the opportunity to lay claim to a leadership role in economics – something in which it is markedly deficient at present.

Problem

On any map of the world, New Zealand sits alone – remote, small and sparsely peopled. When oil runs down to the point of its disappearance being measurable, where can New Zealanders look for a replacement fuel? To the oil companies? Their ability to find and exploit a sustainable replacement feedstock is highly unlikely. Compared with the wealth, population, land mass and pulling power of countries in the northern hemisphere, we will not rate a glance as consumers of a diminishing resource or any other resource that can be exploited as easily. What, then, should we be doing about it? How large groups of people react to stress suggests that nationalism will get a rebirth. Every state is likely to seek its own favoured solution based on resource and population statistics. Long term rather than short term solutions are likely to acquire popularity. "Sustainable feedstock" is likely to be judged an important attribute of any alternative fuel. New Zealand's national interest points to a secure "do it yourself" (DIY) solution based on close cooperation between people and government as the preferred scenario, especially during the transition period.

Petroleum oil is both a lubricant and a source of energy. Wood is also a source of energy, as it has been since man abandoned forest life. An FAO prediction of total world wood consumption for 2010 forecast 5069 million m3, of which some 47%, or 2395 million m3 would comprise fuelwood. Among developing countries (where most people live) fuelwood makes up 20-40% of total energy consumption and up to 90% of domestic energy supplies. A different picture emerges for developed countries. Fuelwood supplies some 1 to 15 % of total energy requirements and is far more likely to end up as waste in rubbish dumps. As a corollary, natural forests have a much better chance of survival in developed countries (where plantation wood is vastly more productive than native forest wood could ever be) than they do in developing countries.

From 1975 to 1995, wood provided about 5% of New Zealand's energy needs. (18) Thus, developed countries are far more vulnerable to economic collapse through oil depletion than are developing countries. However, developing countries are more vulnerable to famine than are developed countries when transport and food supplies suffer significant cost increases.

What is the government position? Like most other governments throughout the world, it does nothing. This is not because it knows nothing about the coming crisis. Its own SOE, Scion, has published a full report on the adoption of a New Zealand strategy for handling the crisis. (13) Moreover, the NZ government maintains a close working relationship with the governing bodies of its nearest neighbour, Australia. The Department of Primary Industries

for the State of Victoria has issued a paper on “Plantations for Energy”. On transport fuels the paper says:

Currently, the biomass-based transport fuels most commonly used are bio-diesel and ethanol. These fuels are mainly sourced from plants with a suitable starch and sugar content, such as sugarcane, potato, corn and grains. These are commonly known as “first generation” biofuels. “Second generation” biofuels promise a more advanced and efficient production of liquid biofuels and include the extraction of energy-producing sugars from cellulose. Cellulose is found in high concentrations in woody tissue, which includes forestry and agricultural residues. Current research aims to make this form of biofuel available for use in the community and has significant potential to address climate change issues, declining oil supplies and a solution to the current concerns regarding the use of food crops as energy.

NZ is well placed to adopt and manage second generation biofuels. Where will we get our replacement feedstock? The primary answer has to be the surface of our land. Our history, culture and population numbers support a strategy based on land and biomass. What kind of fuel? A study of options suggests some principles that should be used to guide the new fuels of choice. To educated inhabitants of the South Pacific, the principles will look like simple common sense. To most inhabitants of the Northern Hemisphere they may look like a mixture of common sense and heresy. (The culture of most such inhabitants is heavily impregnated with a belief in mining, regardless of whether or not it is sustainable.) Given world beliefs, the proposed Fundamental Principles of Adaptation (FPA) to oil depletion in NZ are proposed as follows:

a) Biomass fits NZ skills and population numbers and distribution;
b) Plantation forests are part of NZ national experience;
c) Recent overseas research (particularly on the high methane content of grass and leaves) points to full tree conversion into energy as the preferred management tool (20);
d) Economic efficiency points to multi-goal plantations (such as the short term growth of trees for large scale woody production and, long term, of trees for naturally strong, durable, and cheap timber for house framing) as the strategy of choice;
e) Plantation methods should target soils vulnerable to degradation and well designed tree mixtures, able to provide their own shelter against strong winds in high country, as the preferred plantation pattern;
f) Plantation design should include provision for easy logging and permanent conservation of ridge soil, possibly by native tree species (e.g. beech), thus constituting a reserve dedicated to permanent ridge soil protection;
g) Land dedicated to energy use must not diminish food production (13) subject to export demand not dropping severely;

h) The technology used for biomass conversion should be capable of processing a wide range of raw materials possessing a strong hydrogen component;
i) The base goal of a biomass takeover of petroleum oil (now, or near completion of the mining process) should be to produce the greatest possible amount of energy for transport purposes from land displaying the least possible disturbance of food production, thus maintaining export trade;
j) Automotive manufacturers should be informed as soon as practicable of New Zealand's policy on the production of substitutionary transport fuels and the implications of new fuels for vehicle power systems;
k) New Zealand's preferred fuel should be based on established technology at the time of initial transition.
l) Fast growing, water-based plants offer attractive sources of biomass, particularly when growth rates can be stimulated by urban sewage, but because of limited wetland areas available for the purpose, their contribution to energy must be supplementary to that of plantation forests on erosion prone (EP) land.

Evidence supporting FPA points to the selection of methanol rather than the government-touted ethanol as a preferred, basic fuel for transport purposes. Its second stage process (catalytic conversion of gas to liquid fuel) enables the collateral input of both wood gas and methane from hydrates for liquefaction processing. This is important to a country with large, dangerous marine deposits of methane hydrates, vulnerable to atmospheric discharge through global warming. In NZ, they currently have only 2*C of oceanic security. Some weather forecasts indicate a rise of 3*C this century. The use of methane hydrates for energy production, although not sustainable, is warranted because of the vulnerability of hydrates to melting and release of methane (about 17 times as powerful as CO2 as a greenhouse gas) as global warming continues with the use of oil-based fuels. This point constitutes a strong argument in favour of a rapid rather than a delayed shift to biomass energy.

Large scale woody production suggests a careful look at pines, poplars, redwoods, eucalypts and cypress trees for the short rotation production of wood and leaves as raw material for conversion into liquid fuel. (A recent paper [20] reports an experiment showing that leaves and grasses are rich in methane, thus for the first time opening the door to 100% use of tree material as input for liquid fuel production.) The choice of species should make use of natural coppice growth to speed regrowth following felling, in order to maintain and extend the existing store of carbon in roots, and to fit climate and site soil conditions. The Scion report on bioenergy options for plantation trees (3.4 million hectares of steep EP country) gives site locations and a pointer to a possible mode of organisation. (13)

For long rotation timber purposes, different selection criteria should apply. Such trees could be planted with short rotation trees in something like a chequer-board pattern to

create a growing environment conducive to the provision of shelter in young trees and of logging methods appropriate to varying periods of growth. (It was mainly the omission to supply shelter that brought about the failure of the tung oil plantations near Kaikohe during the 1930s. Strong winds on ridges can constitute a growth problem on steep country.) Possible candidates for long term use include:

a) tallowwood (Eucalyptus microcorys – air dry density [ADD] about 990 kg/m3),
b) blackbutt (E. pilularis – ADD about 900 kg/m3) and
c) yellow stringybark (E. muellerana – ADD about 870 kg/m3) . (2)

The evidence for NZ grown tallowwood will be given later. All three species have been tried for plantation growth on the writer's farm in Lower North Auckland and found satisfactory for growth and form.

NZ houses present a special long term problem. At present, their framing is (or ought to be) treated Pinus radiata. Its ADD ranges from 450 to 580 kg/m3 (2). Pine is now the dominant plantation species. Its wood (nearly all sapwood) is subject to water-based rot and needs treatment to prevent the onset of premature decay. (Treatment can only penetrate the sapwood.) Large pressure cylinders are used for treatment and require significant amounts of energy for impregnation. Post oil, the cost of energy for treatment and transportation of timber will be greater than is possible for fuels drawn from cheap oil because of the need for intervening, expensive processing of the raw material. If framing is produced from plantation-grown eucalypts of relatively high density, thus not leaving their dwellings vulnerable to framing decay, two advantages will accrue:

a) Absence of treatment will lower cost;
b) The greater strength of high density timber gives builders the option of using smaller timber sizes or wider spaces or both.

Something like a 30 year term should be used for the growth of framing timber and a 3 to 10 year term for energy. The raw material for energy could include urban waste wood (e.g., Christchurch earthquake waste), dedicated plantation wood, mill residues, old tyres, urban tree droppings and prunings, and long grass clippings. Sewage disposal systems could provide extremely rapid growth sites for fast growing water plants. Biomass of different types could supply a source of income for local bodies. Off-site production of designed nail-free framing could be used to avoid the need for difficult on-site nailing of framework.

Of the three eucalypt species suggested for house framing purposes, only two are needed for plantation growth. The preferred species are tallowwood and blackbutt for long term plantation growth. The reason for two species is to build in plantation insurance against unknown risk. If only one species is grown, it is relatively

vulnerable to unpredictable hazards. Two species halves the risk while still retaining major economic advantages associated with scale. By this stratagem, some of the disadvantages associated with the choice of a single species (Pinus radiata – notable for the scale of growth of sapwood) in New Zealand's forest monoculture can be avoided.

Technical

A biomass scenario for the production of transport fuels is essentially sustainable because its growth processes absorb carbon from the atmosphere while its processing stage will either return it or enable convenient sequestration. The longer the period of storage and the greater the volume extracted, the more atmospheric carbon is reduced. This point has implications for plantation management. Short rotation plantations leave stumps at harvest. If cropping for follow-on crops can be done via coppice regrowth, the root system for the preceding crop maintains its growth and its store of carbon. If practicable, we should ensure that the store of carbon grows continuously as successive energy crops are harvested. Globally, a shift to biomass fuels enables man to manipulate the amount of carbon in the atmosphere and so influence temperature and climate, not to mention political debate.

The processing of wood to yield alcohol goes back to 1648. It became the mainstay of Hitler's armed forces in World War ii. According to a report of the Methanol Institute (Washington, D.C.) published in 2006, methanol's commercial use "has focused primarily on its value as a building block for thousands of consumer products from plastics and paints to construction materials and windshield washer fluid." (26) When used in internal combustion engines it carries half the energy supplied by gasoline. When used in FCVs, it matches gasoline for energy because of the greater energy efficiency of FCVs. (Only 17 to 20 % of the energy in gasoline is used to move a vehicle, whereas 75 to 86% of the electricity delivered to an electric vehicle goes into motion. {21}) The Institute reports that a 50 kw.fuel system for a vehicle will cost about US$2500, thus being comparable to the cost of internal combustion engines (ICEs).

Currently, the main operational advantage of methanol over gasoline is its safety record. The Institute writes: "Methanol is one of the safest and most environmentally sound fuels available. In the United States there are over 180,000 vehicle fires each year in which gasoline is the first material to ignite. According to the Environmental Protection Agency, a switch to methanol could reduce the incidence of these fires by 90%, saving 720 lives, preventing nearly 3900 serious injuries, and reducing property losses by millions of dollars." (26) Any NZ government interested in the health and employment of its citizens would accord top priority to switching from gasoline in

ICE vehicles to methanol in FCVs by regulating imports and domestic economics to render a full DIY system sustainable, efficient and obligatory. The result (if achieved in the near future) would be a marked improvement in our trade balance, improved adaptation to our environment, a significant improvement to life and health, a significant reduction in unemployment and smooth passage to an oil-free world.

In the German city of Freiberg, Saxony, Choren Industries has established an operational plant designed to convert waste wood into liquid fuel. It has established a marketing arrangement with a firm in Beijing. Its basic technology involves the gasification of solid matter and the conversion of the resultant gas into liquid fuel. The company appears to be interested in licensing it technological knowhow. At this time, any dealings with the firm would first require an assessment of the nature and quality of its fuel products. As this is the first firm to attempt the large scale commercial adoption of gasification and liquefaction technology, a study of its operations could be of assistance for engineering purposes.

Elsewhere in the world, methanol is processed from natural gas. This technology is used in NZ. Methanex New Zealand Ltd., a Canadian-owned company, has its executive office in Auckland and its processing plants in Taranaki. Its products are largely exported. At present, it is not interested in expanding its raw material input to include biomass.

In the course of converting petroleum oil into petrol fuel, refineries have been established world-wide, including NZ. They do a lot more than simply refine the raw material. They also add further components to aid the efficiency of the combustion process. Whether additives may be needed to convert factory methanol into something the motorist will need remains to be fully tested.

A considerable amount of work has gone into experimentations with blends of petrol using the alcohols as additives. Volkswagen (VW) began a series of tests of 45 vehicles in 1975 using gasoline and 15% methanol. Olah et al. (26) report that minimal modifications were made to existing engines. VW found that the blend worked efficiently with minor problems. The methanol acted as an octane booster enabling the blend to deliver more power than could pure gasoline. VW also tested 5 vehicles running on pure methanol. They found that the lower volatility of methanol led to cold start problems but that problem could be solved by adding small quantities of butane or pentane. All in all, comparatively minor experimental work in NZ, coupled with minor vehicle adjustments made by manufacturers, would see biomass-based fuels (methanol and diesel) provide sustainable replacement fuels that would not damage world climate and would assist in stabilising high country soils – without significant loss of food! Olah et al. discuss a decision by Bank of America to convert most of its vehicle fleet to methanol fuel in 1980. More than 200 vehicles so fuelled accumulated over 30 million km. on the roads. The Bank concluded that, compared

with gasoline powered cars, the use of neat methanol was cheaper, increased the engine's lifespan, and greatly decreased exhaust pollutants.

A voluntary shift to methanol before the run-down of oil compels such a step enables ICE vehicles to use methanol immediately, enables trees to grow in timely fashion, stimulates research and brings up the issue of tree species. Wood quality for short term (e.g. 3 to 10 years) energy production does not impact on the selection of tree species. Long term growth for timber framing does. The writer's family company has a farm west of Warkworth. A trial was undertaken in 1980. The forest literature accorded high marks for strength and durability to Eucalyptus microcorys, yielding tallowwood. Would the same properties be found in material grown in NZ? The climate and soils were obviously different. To find out, one tree planted in 1980 near the railway line was felled in May, 2009 and milled on site. The resultant timber was stored in an air drying unit for over a year. A tested sample revealed a density of 889.55 at a moisture content of 12.4%. Bootle (2) quotes an ADD of about 900 for Australian grown tallowwood. A New Zealand density figure of 890 for a plantation tree only 29 years in the ground strongly supports the conclusion that there is no significant density difference between NZ and Australian grown trees of the E. microcorys species.

What is tallowwood? New Zealanders do not know it, but they are familiar with its uses. Walk down any street in any town in NZ and look upward. The poles you will see are there to support cross-arms, which support wires. Wires are heavy and must withstand strong winds from time to time. Their supporting cross-arms must be very strong. Chances are high that the cross-arm you see will be made from tallowwood.

For short term species, growth rate seems the obvious determinate for selection. For the lower North Island, three species have been found to be suitable: Pinus radiata, Eucalyptus fastigata and Sequoia sempervirens. (25) Selection criteria were health, siting and productivity. They did not include reproduction by coppice. That might exclude P. radiata for short term use. Some research may be needed to refine preferences for liquid energy. For other parts of NZ, other species should be added to the list for short term selection. One genus that may require exclusion is Syncarpia (Turpentines). Current evidence suggests that it is fire retardant and will not burn except in hot fires in mixture with more flammable woods. (30) Another genus requiring care in selection is Salix. It may not adjust well to EP sites.

The energy content of wood has not been adequately tested in relation to species. Among people interested in farming trees for energy, the common view is that species differences do not matter. This seems contrary to common sense. Hardwoods may contain double the number of cells in equivalent volumes of material. Cellulose is a carbohydrate forming the main constituent of plant cell walls. It seems to be the key to the organic production of methane, or CH4. This suggests that, by doubling wood

density, nature has doubled the quantity of wood gas produced. Horgan (18) holds a similar view. He writes: "While on a mass basis, wood energy content is not affected by density, density does matter when comparisons are made on a volume basis. Basic densities of commonly encountered NZ tree species can vary almost twofold from little more than 300 kg/m3 to over 600 kg/m3. The heat content/volume will also vary similarly." The issue needs careful testing for the purposes of fuel energy derived from the gasification and liquefaction of wood.

Of critical importance to management is the lack of research. All commentators are at one on this issue. At this time, one problem remains unsolved ahead of all others. For a forest resource to base transport fuels, what is the best possible use of scarce land? At the beginning of a programme to build up a sustainable, biomass resource we need to know which species produce the most energy when converted into liquid fuel. As a bonus, we want to know which species can do the job in the shortest time. Alternative technologies (with particular reference to Ghana and the Third World) were discussed in a report to the American Society of Agricultural Engineers. The officer responsible for the report discussed good practice in evaluating options. They were:

a) Search for tree, bush or plant species that might be higher energy collectors than the common lumber and pulp wood varieties;
b) Follow a new strategy in the breeding and development of conventional field crops in order to maximise energy production;
c) Manage mixed farming methods to yield (in Ghana) food, fodder, energy, fibre and lumber production. (1)

In many ways, NZ is strongly resistant to change. So far, it has not experienced the kind of bully-boy tactics that have damaged Australia and the US in adapting to oil run-down. Inertia has been the enemy of adaptation. Inertia has characterised the attitude of the Labour and National parties to the development of new fuels. Not, however, the Maori party. Mrs. Tureana Turia, one of its leaders, has displayed a keen interest in, and an extensive knowledge of, renewable fuels. Among the population at large, indifference is the keynote attitude. Oil has become a part of the common culture – a bit like the stone culture of Gothic cathedrals in the 12th century – just part of the scenery. Oil and its derivatives have crept into our language unnoticed. Words and expressions like car, automobile, lorry, tin lizzy, gin palace, beach bomb, petrol head and gas guzzler all owe their adoption to oil and its derivatives. They are part of our common mental furniture.

When oil companies plan counter-attacks on renewable fuels, they start with a huge cultural advantage. They can simply use common mental furniture to distract attention away from uncomfortable adaptation to environmental change and towards comfortable reliance on the status quo. An example of this phenomenon recently emerged in Auckland. Mayor Len

Brown has suggested a railway train link through the CBD, including a subterranean line through lower Queen Street – just a few feet above the high water mark of the adjoining Waitemata Harbour. He has totally ignored the possibility of rising sea levels drowning the tunnel. Such a rise has been predicted for low lying land this century. Climate warming melts Antarctic ice and lifts ocean levels. And no one has noticed! Fortunately for Aucklanders, the Government vetoed the project for financial reasons. Thus, Auckland commuters will not have to swim out of the Britomart Place tunnel at high tide later this century, thanks to an accident of Government penny pinching.

For many years the NZ economy has stuttered along, displaying minor annual gains. Its prop, oil, has been the focus of attention by oil-wealthy and large industrial states. NZ has watched management of oil from the sidelines. If biofuels dominate the economic skyline, NZ could be in a very different position. It has certain natural advantages in an energy world dominated by biofuels. It has a large area of land suitable for biomass growth, a population accustomed to an agricultural base for the economy, lots of expertise in food production, distribution and sales, plenty of marine expertise, an adequate base for research, development and sales of biofuels, and a well-tuned social conscience, all critical to leadership of a world needing a new deal in mobile energy.

For the individual, the introduction of a new fuel has some exciting possibilities. It opens the door to innovation, new knowledge and new enterprise. Such opportunities do not open up in a vacuum. They are tender flowers, nurtured in quantity only in broadly favourable environments. This is where forest biomass comes into its own. As a novel feedstock for an essential commodity, its potential demand (when translated into transport fuel) is on the global scale. For the individual aspiring to fame and fortune, the opportunity for innovation is opened up by a new fuel. For him (or her), knowledge is power, innovation is its key, and global interest in relevant technology represents potential reinforcement on a huge scale. For the politician, new energy also opens up the need and the opportunity to introduce protective measures for intellectual property and trading rights.

Political

Digging up petroleum oil and refining it is one approach to the supply of transport fuels. Growing biomass and converting solid raw material into liquids is another. The two techniques are like chalk and cheese. A world-wide shift from one to another necessarily requires a culture shift of epic proportions. Who wants it? Answer, almost nobody. Who needs it? Answer, we all do. Why? The answer has several parts:

1. Nothing on earth will stop humans from extracting oil to feed their insatiable demand for mobility and industrial products until oil supplies are exhausted.
2. Oil has developed into a fundamental prop for transport, food production, its distribution, the world economy and as a component of a huge variety of manufactured products.
3. Without oil, the world population could not reach the predicted 9 billion this century. (16)
4. Without oil, famine (actual or threatened) would have prevented population growth, mainly during the 20th century, of at least 3.6 billion people.
5. Oil represents the sun's historic contribution to life by the storage of solar energy in organic matter under the surface of planet earth for millions of years.
6. Solar storage of energy in organic matter is currently effected by leaves at low temperatures but nobody has worked out how leaves do it.
7. Man's only long-term hope of reducing the role of famine in controlling its population overhang of some 4 billion (based on existing knowledge) is to manage the solar role in developing organic matter to supply the energy needs of humans in a new way.
8. Current knowledge indicates that famine control is mainly limited to land management.
9. Land management of energy crops and their processing will inevitably increase the cost of mobile energy.
10. The longer land management of mobile energy is delayed, the greater will be the role of famine in controlling population.

Politicians have known these simple facts for decades. Herein lies the critical problem. Its indicative solution runs counter to everything they stand for. They are short term people. By unspoken consensus, leaders of all stripes and systems throughout the great part of the world's land area have side-stepped the issue. One stratagem has been to cloud the problem by masking its language. It sounds less ominous to talk about the feedback to humans from the disappearance of mining mobile energy rather than to examine mining itself. The term "climate change" does not sound threatening. When it comes to mining, New Zealand is part of an informal, international political club. I wrote to two NZ leaders about oil depletion. One recipient of a letter was the Labour PM at the time, Helen Clark. Another recipient was the National leader, John Key. He received two letters – one as Leader of the Opposition and the other as PM. The letters did not result in a single reply. There can be only two possible interpretations of Ministerial silence. They either cannot produce a solution of the problem or they believe that the electorate will not swallow the needed medicine. Presumably their Parliamentary colleagues feel the same way, judging from their silence on the issue.

The story of petroleum oil illustrates an aspect of human behaviour that receives little publicity. Man is clever at interacting with his environment to satisfy appetitive and mobility drives where his actions produce immediate and positive results. He is not clever at, and probably not interested in, protecting the ability of his descendants to do the same thing. The NZ Herald of the 5th May 2011 reports a decision of the federal and South Australian governments to release the Woomera Rocket Range for mining. The area contains vast storehouses of gold, copper, iron ore and uranium. It is bigger than England. According to State premier, Mike Rann, "we are talking about thousands of jobs for more than 100 years, and it is a resource that is valued at more than A $1.4 trillion." With the demise of the Cold War, who could resist such a move? The Herald couldn't. Clearly, the immediacy and magnitude of the rewards make Rann's move a predictable election winner. How will the mining be powered? By fossil fuels as usual, stupid!

Mike Rann is playing to Australian strength by pitching his political appeal to mining. John Key could do the same in NZ by leading a move to plant 3.4 million hectares of EP country in sustainable energy crops. He does not. Clearly, Australia and NZ are very different countries, of different areas and composition, and of very different geological ages. Their environments offer different economic opportunities. History suggests that, in the modern world and in the light of mining culture still playing a dominant role in Australian and American politics, the political influence of the miner exceeds that of the forester. But where does the scientist stand in the influence stakes? And what should be the role of politicians?

Since man emerged from the forest, sex drives and food needs have been in chronic conflict. Peter Goodchild (11) describes the issue thus: "At some point in the early years of the 21st century, there will be a clash of two giant forces: overpopulation and oil depletion." The

world will look to its leaders to guide nations in their approach to this conflict. There is nothing new about the fundamentals of the conflict. Man has always attempted to lift population numbers beyond the limits imposed by food availability. In good years, the war appeared to have been won. In bad years, food crops failed and famine ruled. Its victories showed up in death statistics. Commonly, famines lasted for 6 to 10 years. Some were accompanied by pestilence of varying types. Some triggered war. Some degenerated into cannibalism. Available records cover the Eurasion land mass, stretch to the west of England and Ireland and date back to some 1000 years B.C. The most severe famine in England occurred in the reign of Ethelred the Unready and lasted from 1005 to 1016. According to contemporary chronicles, half the population perished. Some 3 years after the Conquest, in 1069, northern peasants, being no longer able to secure dogs and horses to appease hunger, sold themselves into slavery in order to be fed by masters.

In 1314, heavy rain spoiled the harvest. Edward ii was scarcely able to feed his household. The dead lined the roadsides. Dogs, horses, cats and even babies were eaten. When a new criminal was thrown into gaol, he was torn to pieces by other starving inmates and eaten. In France, between 987 and 1059, 48 famines devastated the peasantry, all triggered by climatic disasters. In Ireland, due to potato crop failures, famine struck between 1844 and 1850 and caused the population to drop from 8.3 million to 6.6 million through death and emigration. Russian famines occurred in 1891, 1906 and 1911. That of 1911 affected over 1/3rd of the Empire in Europe (30 million people) and reduced some 8 million to starvation. In China, famine broke out in 1846 – 1849 and accounted for 45 million deaths. A later one in 1906 – 1910 accounted for 10 million deaths.

Historically, famine deaths represent nature's way of maintaining a tolerable balance between the forces of procreation and environmental support. They reveal no results of varying leadership skills. Their place in history is no longer regarded as of practical importance, due to the long economic rein of petroleum oil. In most of the world, decisions are taken in reliance on the opinions of economic "experts". If this attitude continues, the world faces a monumental disaster. Leaders and led, politicians and electors, will all be on the endangered list when oil runs out. M. K. Hubbert's (19) predicted date for the complete extinction of oil deposits was 2075. Church (4) predicts a crunch date of 2040. Oil's lifetime seems to be contracting. The contraction is probably related to unpredicted demand associated with population growth. Church wrote:.

"Eating Oil" was the title of a book which was published in 1978 following the first oil crisis in 1973. The aim of the book was to investigate the extent to which food supply in industrialised countries relied upon fossil fuels. In the summer of 2000 the degree of dependence on oil in the UK food system was demonstrated once again when protestors blockaded oil refineries and fuel distribution depots. The fuel crises disrupted the distribution of food and industry leaders warned that their stores would be out of food within days. The lessons of 1973 have not been heeded. Today the food system is even more reliant on cheap,

crude oil. Virtually all of the processes in the modern food system are now dependent upon this finite resource, which is nearing its depletion phase. Moreover,…… the food system is lengthening its supply chains and increasing emissions to the point where it is a significant contributor to global warming.

The danger inherent in using oil-based fuel to subsidise food supply and distribution is developed further by Jay Tomcz. Writing in the Energy Bulletin of December 2005 he says:

Our current industrialized food system is not sustainable due to its over dependence on non-renewable fossil fuel energy and its degradation of the natural systems on which it depends for its existence. If action to change these aspects of the food system is not taken, convening resource depletion and degradation will cause the food system to collapse. Our food system is the result of the "green revolution" which created greatly increased crop yields by using large amounts of fossil fuel energy in the form of synthetic nitrogen fertilizers, petroleum based agrochemicals, diesel powered machinery, refrigeration, irrigation and an oil dependent distribution system. This system destroys biodiversity, contributes to global climate change, and degrades soil and water quality." (33)

In this picture, the role of national leaders (autocratic or democratic) changes dramatically. Up to this point, they have had no responsibility for maintaining stability between the population and crop forces. Oil depletion changes all that. Such depletion constitutes a change in the global environment that has been brought about by humans. It arose from the use of petroleum oil on a scale comparable to the global conversion of natural forests into pasture land. Its exhaustion can be partially made good by the afforestation of EP land in NZ at least, and by the installation there of a processing plant or plants. If action is taken rapidly, there will be a short period of competition between biomass- and oil-based fuels. Government can regulate such competition during the takeover phase to ensure survival of a NZ growing and processing enterprise essential for food protection, both for domestic consumption and in our global trade. It can do more. It can and should stimulate investment in farm woodlots and processing plant(s) and participate in their financing.

The opportunity and responsibility facing the NZ government are without world precedence. They are based on the work of scientists and not upon precedent relied on by lawyers, civil servants and politicians. It is evidence based rather than judiciary based. The need to act on changing the resource base of transport fuels has both its negative and its positive aspects. Action is relatively simple. It involves an extension of plantation forest methods well bedded down in NZ, the implementation, extension and refinement of the Sustainable Land Management Hill Country Erosion Programme already adopted by Government to improve water and soil management, the use of distribution methods established for oil-based fuels, and the construction of a processing plant or plants along lines familiar to engineers. This amounts to a commercial programme, needed to work large scale, from a standing start. State initiative and protection of a novel kind will thus constitute an essential component. Political ideology will be irrelevant. Multi-disciplinary expertise will be essential. While

population and economic pressures have shortened the expected time period for the needed change-over from a terminal date of 2075 to 2040, the effective date of commercial crisis is still about 2030, thus leaving a very short but (possibly) achievable period of adaptation, given immediate and urgent action.

In contrast, government inaction will leave NZ at the mercy of oil companies' trading policy driven by a declining resource base. Current evidence points to transport fuels being supplied by the companies for as long as possible from their present resource base – extended if possible by the mining of bound oil. The same attitude seems to apply to the manufacture of methanol from natural gas. If the oil and methanol companies seem intent, long term, on commercial suicide, that is their prerogative. It is not, however, a recipe for responsible government because it will lead, inevitably, to famine deaths this century of unprecedented proportions. Of the two contrasting courses of action open to the NZ government, never in history have the issues been so stark. They boil down to a choice between courageous action leading to long term economic survival, compared with self-serving inaction, so allowing famine on a global scale to reinstate its rule.

As a nation, NZ faces a situation where prompt, broad-based action can be expected to lead to world rewards in terms of employment, capital returns, government initiative and world status. On the other hand, failure to act will leave the country facing fierce pressure to admit starving migrants while dealing with a moribund economy and a horrific public debt. It is no consolation to learn that the US, parts of the EU and the UK may be in an even worse position.

A theoretical issue confronting the world is caught up in the expression "climate change". Concern about the aetiology of climate change has obscured the practical issue of oil replacement. Chemists have not been routinely consulted on climate matters. If they had been, someone is likely to have pointed out a simple remedy. If the burning of oil-derivatives stores climate-changing carbon in the atmosphere, why not burn hydrogen and pour water into the ocean? After all, hydrogen is as plentiful as carbon on planet earth, burns readily and converts into harmless water. It makes up a major part of the greenhouse gas methane (CH4) but in the liquid methanol becomes a harmless fuel which, when burnt, yields potentially valuable water. Automobile emissions could then change role from enemy to helper.

While New Zealand's politicians remain in the "do nothing"camp, this is not entirely true in historic and administrative terms. Scion reports on "Bioenergy options for New Zealand" were published in 2007 and 2008. The 2007 report related to planting medium- to long-rotation forests on marginal land. It predicted that "to meet the country's total heat demand, an estate of 700,000 hectares would be required. To meet the liquid fuels demand a further 2.5 to 2.8 million ha. would be needed." It is expected that the report was written about 2005 because the first year's plantings in 2007 were expected to comprise:

a) 70,000 ha of short rotation forests;
b) 20,000 ha/year of medium rotation forests;
c) 80,000 ha/year of pine forest or equivalent.

In 2010, plantings were expected to comprise:

a) 30,000 ha/year in medium rotation forest;
b) 100,000 ha/year in pine forest or equivalent.

In 2020, forest plantings were expected to amount to 130,000 ha. The annual area was expected to reduce to 100,000 in 2030. Production from biofuels was expected from short rotation forests in 2010 and from short and medium rotation forests in 2020. By 2030, biofuels were expected to meet a significant proportion of demand. By 2040, domestic supply was expected to meet 100% of demand for liquid fuels and heat. (13)

Scion is a state-owned enterprise. Its signposts for successful adaptation to a new, DIY energy world were well displayed. Successive governments have simply ignored the signals. Through its East Coast Forestry Project Grant scheme of June, 2007, the Ministry of Agriculture and Forestry makes cash grants to farmers who address erosion on steep land by planting radiata pine, Douglas fir or poplars but the scheme has a 50 year tree life. Through its SLM Hill Country Erosion Programme of October 2010, MAF targets erosion-prone land especially in Northland, Gisborne, Hawkes bay, Greater Wellington, Manawatu-Wanganui and Taranaki but has no implications of wood being used for energy purposes and excludes planting before 2012. Its focus is entirely on soil erosion and flooding. The failure of successive governments to act on energy leaves NZ exposed to an energy poor, declining economy – at the least. The deadline for NZ to achieve a workable, JIT, takeover of King Oil's dominion is when oil is no longer affordable for essential transport and agricultural productive purposes. With a herculean effort, it may be possible for NZ to meet the deadline, subject only to updating of the tree species and the quantitative annual planting components of the Scion programme, to a survivable extent. The Parliamentary elections in 2011 give electors and candidates the opportunity to take a fresh look at Scion's DIY signposts. It will be interesting to see how the energy/economic penny lands.

Where NZ politicians fail badly is in assessing their own self-interest. They concentrate on money when examining indifferent economic performance. Money does not prop up economic activity. Energy does. By boldly addressing the real-life oil issue, politicians would achieve an important place in history for imaginative steps taken akin to the mana now attaching to the name Winston Churchill – an erstwhile news reporter, who made a nuisance of himself during the Boer War and who accurately predicted the menace of Nazi ideology and the steps needed by Britain to protect itself against invasion.

In the section on "Globalization" below, reference is made to the transitional period between the run-down of oil and the commencement of a sustainable replacement. One

conclusion is that the role of the nation state will, if anything, become more important globally. In NZ, this will be of critical importance during the transitional phase. Shifting rapidly from an oil-dependent regime to a biomass-dependent regime will be conditional upon fuel prices being comparable with each other. This issue will inevitably require state intervention – hopefully, for a brief period. Long term, there is no reason to expect that normal market forces will prevail and enable farm-produced transport fuels to achieve the same status in public estimation as does milk. Managing such a takeover is without precedent in world history. To succeed, politicians would be wise to locate expertise wherever it may be found and to follow expert advice carefully. In NZ we are fortunate in having Fonterra's experience to draw on. A collateral issue that should be addressed is that of the need for strong, durable and cheap framing timber for houses in the post-oil world.

American influence

Two nation states are of particular interest to New Zealanders – the U.S.A. and Australia. Like them, we have coastlines to the Pacific Ocean and speak English – more or less. The US is ranked 6th in the world for GDP per capita in 2010 (US$47,016) and 10th for public debt as a proportion of GDP (58.9%). Wikipedia records total public debt (including intragovernmental holdings) in March 2011 at US$14.26 trillion or 96.3% of GDP, ranked 12th highest against other nations. In 1980 a committee of the National Academy of Sciences chaired by economist Thomas Schelling wrote to its parent body on the social and political consequences of global warming. He focused on physical and social scientific uncertainties on what warming would mean. In particular, he emphasized the huge scale of those uncertainties as regards both their physical dimensions and their cost. Unsurprisingly, he strongly recommended more research. He thought that we had time to deal with the problem, which boiled down to a change in the distribution of climate zones on Earth. The time period for appropriate research was supposedly sufficient for adequate research. It would probably lead to a rise in the cost of fossil fuel and a decrease in usage. In this, Schelling was mostly wrong. Over the next 3 decades, fuel price increased but fossil fuel use rose dramatically, and global warming accelerated.

Within the US, a war of words erupted from about 1980 until the mid-nineties. In the one corner were the physicists, solidly behind human responsibility for global warming. In the other were a number of doubt merchants, mostly economists with a strong American belief in the power and the right of private interests to extract oil and supply energy to the world. Respected Academy members like Jastrow, Seitz, Singer, Nierenberg and (later) Michaels made up a denial group that set to work to create something like a new Cold War aimed at bringing about a do-nothing Congress. Battle took place within the Academy, at public meetings and in leading American newspapers. It was summed up in an American publication as follows:

This divergence between the state of the science and how it was presented in the major media helped make it easy for our government to do nothing about global warming. Gus Speth had thought in 1988 that there was real momentum toward taking action. By the mid-1990s, that policy momentum had not just fizzled out; it had evaporated. In July 1997, three months before the Kyoto Protocol was finalized, U.S. senators Robert Byrd and Charles Hagel introduced a resolution blocking its adoption. Byrd-Hagel passed the Senate by a vote of 97-

0. Scientifically, global warming was an established fact. Politically, global warming was dead. *(27)*

The significance of this outcome of an American cold war over science was not confined to America. In 1994, IPCC began to put together a position paper on climate change. Benjamin Santer of the Lawrence Livermore National Laboratory undertook to find a group of lead authors. Their task would be to complete an agreed version of Chapter 8 of a publication devoted to the detection of climate changes and the attribution of causes. Santer put forward a draft of Chapter 8 to a meeting organized by IPCC in November 1995. Among those present were representatives from Saudi Arabia and Kuwait. According to a New York Times reporter, the oil-rich states made common cause with American industry lobbyists to try to weaken the conclusions of the draft. That meant a diminution in the human capacity to adapt to change. Among those present at the meeting was a representative of NZ and a lone Kenyan who suggested that there was no need for a Chapter 8. Presumably, the NZ government was fully briefed on the IPCC meeting in 1995. Presumably, it knew all about representations made by the chairman of a fossil fuel industry group, the Global Climate Coalition, and by automobile industry representatives. Why were the public not informed of the outcome of the meeting and of the pressure exerted by commercial lobbyists? Why were special interest organisations such as Federated Farmers and the NZ Institute of Forestry not brought into discussion?

The role of oil in supplying the essential base energy for 20th century economies is well known. Its role in enabling the greatest population increase of any century over the last 8000 years (3.6 billion people) is less well known. So are predictions of the deaths of equivalent numbers of people when oil disappears. It appears that government inaction in NZ has been influenced by inaction of the US government justified by propaganda on the part of American lobbyists acting for interested industrial groups, including oil companies.

On the basis of American experience, allegations of democratic strength do not stand up. Against the power of the dollar and the human weakness for short term reinforcement, US legislators had no defence. So what about Australia?

Australian influence

Australian politics is supposedly based on democratic principles. On climate change, however, let's examine the record of Senator Warwick Parer from Queensland. Democratic government principles flew out the door when he was appointed by John Howard to act as Minister for Resources and Energy in 1996. At the time, he was chairman of Queensland Coal Mine Management, a position from which he then resigned. Parer has been described as "an untiring defender of the fossil-fuel industries and the coal industry in particular." In the 1970s he became CEO of Utah Mining, one of the largest coal producers in Australia. In 1978 he was appointed chair of the Australian Coal Exporters industry body. Until 1997 he gave speeches lauding coal as "the corner-stone of economic growth in the Asian region well into the next century" and praising "clean coal". He abolished the Energy Research and Development Corporation and made it clear that Government would refuse to take any measures to reduce emissions that would, in his view, affect economic growth and employment. (15)

It has been suggested that the fact that Howard appointed as Minister of Resources and Energy a man who rejected greenhouse science, defended coal interests and had a large investment in the coal industry, was symbolic of his approach to climate change. In the nineties the government asked ABARE (Australian Bureau of Agricultural and Resource Economics) to provide an estimate of the costs of cutting emissions. The Bureau's results were captured in a number of publications, two of which were carried around the world in the briefcases of Ministers and public servants. In 1997 131 professional economists, including 16 professors of economics, issued a statement declaring that the Bureau's conclusions overstated the costs of abatement measures and underestimated benefits. Critics pointed out that the Bureau model failed to allow for technological change, overstated the likelihood of jobs going offshore, and presented estimates in a grossly misleading way. (15)

In 1997, Parer revealed details of the funding of the Bureau's research to the Senate. A number of organisations each paid A$50,000 per annum for the privilege of sitting on the steering committee. They included:

1. Australian Coal Association
2. Australian Aluminium Council

3. BHP
4. CRA
5. Business Council of Australia
6. Electricity Supply Association of Australia
7. Exxon
8. Mobil
9. Texaco

All these organisations had strong interests in oil-based energy and in the business status quo. Three of them (Exxon, Mobil and Texaco) are transnational oil companies. Two of them (Exxon and Mobil) are among the world's biggest industrial corporations. (8) By their constitutions, all three must act in the interests of their shareholders rather than in the interests of Australia. Ethical and inter-disciplinary conflict became apparent to Professor Alan Powell of Monash University, who had been asked by the Bureau to provide independent advice. On 16 July 1997 he resigned from his advisory position, citing private sector funding as posing major risks for the integrity and efficacy with which modelling work can be done. He wrote that the problem was made severe when "government seeks to use results from a semi-secret proprietary model as a basis for justifying its policy position." The funding arrangements of the steering committee were investigated by the Australian Ombudsman late in 1997. He found that by limiting membership of the committee to organisations willing to pay A$50,000 for the privilege, the Bureau had failed to protect itself from allegations of undue influence by vested interests. (15)

Overall, the handling of climate change issues in both the US and Australia has been a disaster. Governments of two of the world's leading democracies have made a similar mistake. They have sought to mix specialists in physics and economics together and produce a cake by "agreement". They failed, as they were bound to do. Oil and water really don't mix. Apart from that issue, there is another and more fundamental problem.

Climate change is only one side of an intellectual coin. The other side is the run-down of oil, a far more practical issue, and one which might have helped to solve the physicist-economist dilemma. The academic squabbles given media and commercial publicity do not open up alternatives for examination. If oil disappears, human ingenuity may well find another way of solving the energy problem, and even a sustainable one. Biomass is one option not handled by the physicist/economist wrangle. It has many aspects not even touched on in the political arenas to date. The version tried out by George Bush (using food to yield liquid energy) is about as stupid as it is possible to imagine. Biomass, however, has a vast number of possible applications to the energy problem. Only some of them have negative consequences such as the diminution of the global food supply.

Globalisation

The tragedy of the American and Australian events is that they tend to put an end to the exploration and exploitation of well-founded biomass sources of raw material for the production of sustainable liquid fuel. They have done mage to enterprise and exploration. They may be responsible for a failure to carry out critical research and investment and cost the human species some billions of famine deaths. The people responsible for such a disaster must go down in history as the most prominent examples of the failure of leadership in the 21st century.

Within the universe of discourse that is climate change, NZ is not a player. If anything, it is an observer from the sidelines. Politically, it is merely an ill-informed observer. As a sovereign state, with a low population density and large areas of both fertile hill country and low country that are suitable and effective for food production, NZ could contribute substantially to the cause and effect side of adaptation to climate change. It knows where to look for land that sits neatly within the basic FPA principles. It knows that the critical area is some 3.4 million hectares. That has already been identified. It has legislators possessing some familiarity with the principles (if not the practice) of sustainable resources. Its forestry consultants know a great deal about forest management as a tool to assist in the creation and management of forest biomass as a source of energy for transport purposes. It has a reasonable supply of competent forest scientists. Given this head start, the inability of government to try for world leadership in the adaptation and new economic stakes looks like inexcusable negligence. The interest of forestry consultants in the Emissions Trading Scheme does nothing for any professional claims to respect for professional integrity that their Institute may seek. All told, advocates of democracy (other than those in Germany (of all places!) have nothing to boast about when the oil saga becomes history.

The mining industry started well in its claim to respectability. It did relatively little damage in its extraction processes. By confining attention to cheap oil, it built up a huge clientele and a huge population of dependent users. Now it faces oblivion as it advances towards extinction of the resource. That it resolutely refuses to bow to its own extinction can mean only one thing. The industry is determined to continue with oil until it has exhausted the global resource of bound oil. Free oil has traditionally been the only mined source of feedstock for mobile fuels. It has been accessible on land and beneath seas. It has been simple to mine.

Bound oil has been found in Canada (the Athabasca tar sands), the US (the Colorada oil shales), Venezuela and elsewhere. Bound oil necessarily involves environmental damage in

extraction and industrial work in freeing oil from its earthen containers. Additional mining, environmental and processing costs mean that it can only be sold at a relatively high price. It can no longer be regarded as “cheap”.

The same comments apply to methane hydrates. They will be difficult to mine and unsustainable. The only excuse for their extraction is the danger posed by non-extraction. Given steady global warming brought about by the use of petroleum oil, the 2*C of safety left for oceanic stability, when coupled with the large scientific ignorance of hydrates, looks like a highly dangerous margin of security for human survival. The spontaneous release of methane to the atmosphere is likely to increase global warming at a much higher rate and commence feedback warming at a catastrophic and irreversible level. The threat is such that it compels attention being given to the early mining of hydrates and their liquefaction for fuel as a preventative measure. Here, however, we meet a snag.

Methane hydrates constitute a gas (methane) trapped in ice water. The ice may exist beneath land or beneath lake, river or sea. At this time, nobody has succeeded in mining the hydrates commercially. In NZ, a very large deposit of hydrates exists along the Hikurangi margin, stretching from Gisborne down the eastern flank of the North Island to the vicinity of Cook Strait. If a method of extracting the hydrates could be devised, they could be brought ashore and then melted to yield natural gas, or methane, needing only catalytic liquefaction to produce methanol. The legal problem is that the Crown, by law, owns all hydrocarbons found in land, whether or not the land is covered by water. Further, “all petroleum, gold, silver, and uranium existing in its natural condition in land….shall be the property of the Crown”. (Crown Minerals Act 1991, sec. 10.) Under the same Act, “petroleum” means any natural occurring hydrocarbon (other than coal) whether in a gaseous, liquid or solid state or any natural occurring mixture of one or more hydrocarbons (other than coal) whether in a gaseous, liquid or solid state.” (Section 2) The Minister of Energy has power to issue Minerals Programmes “to establish policies, procedures and provisions to be applied in respect of the management of any Crown owned mineral that is likely to be the subject of an application for a permit … and in particular, policies, procedures and provisions which provide for –

(a) The efficient allocation of rights in respect of Crown owned minerals; and
(b) The obtaining by the Crown of a fair financial return from its minerals.”

(Section 12)

In the light of these provisions, the Minister has a duty to exercise his powers to protect the interests of the people of NZ. Those same people are vitally interested in securing access to cheap energy. Methane hydrates are potentially a major source of energy. The higher the Minister raises the financial return bar, the greater will be the cost of energy to the same population, including in particular the cost of transport fuel. In effect, the Minister of Energy has the power to increase taxation at any time and at his whim. The absurdity of this situation has not yet dawned on Government.

The ability of Parliament to tie Government in knots is seen in the Climate Change Response Act, 2002. The purpose of that Act is to enable NZ to meet its international obligations under the UN Framework Convention on Climate Change made at New York on the 9th May 1992 and the Kyoto Protocol thereto made on the 11th December 1997. The ultimate objective of the Convention was to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." (Article 2). The authors were referring to burning petrol in ICE vehicles, with consequential release of CO2. The reverse side of the burning coin is the fact that deposits of petroleum oil in or on planet Earth are finite in amount. The available scientific evidence suggests that depletion is expected by mid-century, but run-down to the point of unaffordable prices will occur by 2028-2030. It never occurred to the UN negotiators to fund research to pinpoint substitutes and to find a way to establish programmes for replacement. They simply turned to the one symbol system they understood (regulations) and drafted a wish list. It constituted a fundamental error. Substitutes like biomass do exist. They take time to sort out and to implement. The UN could not stomach this effort, and chose to attempt their tried and tested tool - regulation. A pity. At issue were the lives of some 3.6 billion people – the population bulge brought about by global efforts to climb aboard the petrol gravy train. Finding a recipe for hydrogen and fuel cells to replace carbon and ICEs would not have been difficult when brooding about hydrocarbons and their use in new and less harmful recipes.

For its part, NZ has not succumbed to the blandishments of oil companies with bottomless purses. It simply turned to the "wisdom" of the UN and adopted a one-sided view of the energy coin. It ignored the practical side of the coin: the issue of sustainable energy. It followed the UN's trip into fantasy. Its Government ignored the reality that trucks cart food. They need fuel to make that happen. Fuel is the central issue of the NZ economy, because that is where we are vulnerable to the ploys of the oil companies. The irrelevance of words in place of knowhow will come to attention when the insupportable global population starts to die off in large numbers in about 20 years' time. The lunacy of a UN rump and of the NZ Parliament will then become apparent.

What started the UN slide into irrelevance was the UN Framework Convention on Climate Change adopted in New York on the 9th May 1992. It was accepted by 40 nation states plus the European Economic Community. Using 2008 statistics, the combined population of the states amounted to a mere 9.7% of the global population. The geographic areas not represented by signatories comprised the islands of the Caribbean, Central America, South America, Africa, the oil-producing countries of the Middle East, and the whole of Asia except Eastern Russia and Japan. Their lack of interest in the convention had no influence on New Zealand legislators. The fact that oil-based energy propped up the global economy, and its implications for survival, by-passed their deliberations. Bluntly, we in NZ get the legislators we deserve. We are uninterested in what props up our economy, nor in its disappearance. The result is that we inhabit a country with a vulnerable economy, a proneness to natural

disasters, and huge economic potential in the post-oil era which we ignore. It is not pleasant to reflect that we get the legislators we deserve.

Where should we be going? We have seen that the oil to transport fuels scenario (A) will simply die from over use. It does have an obvious alternative: wood to fuel cells (B). Scenario A has market support. Scenario (B) does not - yet. Scenario A is the fossil fuel way, unsustainable and powered by explosion. Scenario B is quiet, sustainable and powered by leaf capture of solar energy and electricity. Vehicles using it do not send carbon into the atmosphere. Unwanted carbon during processing can be absorbed by existing and newly planted forests or sequestered into earth storage from the processing plant. Obviously, scenario B is the pathway of choice, but when should it be adopted? The do-nothing politicians would opt for scenario A. Before we enthuse at their wisdom, some recent research deserves mention. A team of American researchers, all geologists or climate scientists, visited Spitsbergen, a large island in Norway's Svalbard archipelago, Arctic Ocean, in 2007. There they were joined by other scientists from England, Norway and the Netherlands. They were interested in the Paleocene Eocene Thermal Maximum (PETM) period, which lasted as a unique period for a few thousand years some 56 million years ago, and was accompanied by planetary fever. Over its existence, temperatures rose some 5*C, forcing plants and animals to migrate, adapt or die. What caused PETM was a massive injection of heat-trapping greenhouse gases akin to the emissions from vehicles today. The scientists intended to drill through rock beneath an eroded plateau for samples of sediment lifted from beneath the sea by tectonic forces. They struck it lucky. They ran across a geologist employed by a mining company who, years previously, had kept earth samples of drilled material removed from the target area and stored in 1.5 metre boxes. It was exactly what the researchers needed.

From traces of organic material they were able to build up a picture of global warming during what had traditionally been regarded as the most significant period of warming in the earth's "history". In comparing 3 separate samples of temperature warming from the Cretaceous, PETM and modern periods, they found that rates of warming varied markedly. (See Table 1.)

Table 1

Warm Climate Periods

Period	Cretaceous	PETM	Modern
Duration	145.5 to 65.5 million years before present (myBP)	56 my BP	18^{th} to 21^{st} centuries

Warming period	145.5 to 140.2 myBP = 5.3 my	20,000 y	1750 onwards
Warming rate	0.000025*C/100 y	0.025*C/100 y	1 to 4*C/100 y
	(Key: *C = degrees Celsius)		(23 and others)

From Table 1 it is clear that, as the warming periods decrease over time from millions to thousands to hundreds of years, the warming rates increase. This has a significant effect on adaptation of life forms: the more rapid the rate, the more dangerous it is to successful adaptation. The Cretaceous was a period when the seas were populated with marine reptiles, ammonites and rudists. The land was populated by dinosaurs. During the same period, new groups of mammals and birds as well as flowering plants appeared. Wikipedia reports: "The Cretaceous ended with one of the largest mass extinctions in Earth history, the K-T extinction, when many species, including non-avian dinosaurs, pterosaurs, and large marine reptiles, disappeared." PETM was harsh on life forms. Some perished; others, by genetic modification, became smaller. The speed of change was significant for adaptation: the faster, the harder. While the Cretaceous changes took place over millions of years, PETM lasted for thousands of years and modern is expected to last for decades, possibly rising to hundreds of years. Surviving living creatures adapted easily to Cretaceous warming, but had difficulty during PETM. Some seafloor life became extinct but most life on land either adapted or migrated. The expected life responses to the relatively rapid modern warming are the poleward movement of many species; habitat loss; coral bleaching; and extinctions. Overall, it appears that differences in capacity to adapt among species, including learning capacity, play an important role in determining which species survive and which species do not in any period of warming, whether induced by nature or by man. (23)

Modern threats associated with warming are clearly more serious than those associated with earlier climatic changes. The inference is that persistence with fossil fuels for motive power may be a form of suicide for the human species. Changing from oil-to-ICE power to wood-to-fuel cell power becomes not just something forced on us by mobility; it becomes an issue of human survival. The keynote to survival has just changed. The sooner we start producing sustainable fuel, the sooner we provide an impetus and the environment needed to improve its technology and to address the thorny issue of rising transport and food costs. This issue may well become the key to famine's success in reducing human numbers to a very few billions, starting this century.

An immediate switch to scenario B above has 2 key problems:

a) It involves a switch to high cost rather than low cost fuel;
b) It allows no time for the creation of dedicated tree crops for feedstock.

Both problems could be handled in NZ by government subsidy and immediate small scale production based on a) waste wood, old tyres, and water weeds as feedstocks, and b) a pilot plant for processing, possibly at Auckland.

Any broad-based switch to high cost fuels must be accompanied by basic economic changes and by a host of other changes that cannot be accurately predicted. There is a price demanded by the environment for shifting primary allegiance from unsustainable economics to sustainable survival: the deaths of impoverished oil-to-food consumers. Among the obvious mechanisms must be the direct costs of travel and transport. They must rise. Of the indirect costs, the most certain increase attaches to food prices throughout the world. This could well have a negative effect on NZ exports. On the other hand, NZ may be able to develop an export business in energy. Countries such as Indonesia, committed to deforestation, may continue to treat forests as mining areas and drift into extreme poverty. Others, able and willing to convert to plantation forests dedicated to energy, are likely to prosper. In any case, voluntary, large scale movements of people are likely to diminish, with consequential damage to tourism and conventions. Effective gatherings of people for political purposes are likely to decrease in number. Famine will reappear, but on an unknown scale, depending on how effectively the world handles depletion of oil. On the global political scene, globalization is likely to decline in importance and national political issues to rise. The UN may develop a role similar to that of the pre-war League of Nations. Its handling of the ETS issue, including its logic on distinguishing between developed and developing states, is unlikely to assist in the development of international mana.

All in all, until nation states develop their own positions on sustainable energy in an oil-free world, globalisation must take a back seat in economics.

Organisation

NZ is a country with a relatively small population – comparable with the population of Sydney (4 million odd). As a nation, it can act with reasonable competence but requires care in handling tasks needing scale for effectiveness. In tackling the transition from dependence on a single mineral (oil) to dependence of various forms of biomass, its first priority must be the public welfare. In this area, we have some historical experience to guide us – most of it negative.

New Zealand's record of preserving the national interest in corporate affairs is appalling. Domestic companies have fallen like ninepins to takeover raids. Our shareholders are suckers for any offer that looks good in purely dollar terms. On the other hand, our record with co-operatives is fairly good. Dairy farmers have shown that in Fonterra they possess a powerful, reliable tool in handling sales in an international context. If farmers on EP country elect to establish energy and quality timber plantations on that land, they would make up a common interest group that could form an effective co-operative. Appropriate regulatory legislation already exists in the form of the Co-operative Forestry Companies Act 1978. Enabling legislation that can be adapted for the partial use of farm land for woodlots exists in the form of the Forestry Rights Registration Act 1983.

One of the activities of an endangered soil co-operative is likely to be the establishment of a company to process biomass into liquid fuel. A descriptive name for such a company is Forest Fuels Limited. That name is available for such a project. Foundation shareholders could include investment funds held by special interest groups such as that formed to handle government compensation for the loss of West Coast forests and some Maori trusts. Government should be included to ensure that the public interest is represented. Given a strong foundation of funds committed to national interests, public participation in a minority position (including, in particular, fuel distributors) should be encouraged. The primary group of shareholders, however, must be the grower co-operative.

In essence, the energy problem confronting NZ involves the whole population. We are all dependent for survival on food and shelter, and both are dependent upon an efficient transport service. With a shift of the source of transport fuel from mining to growing, we confront a vitally important change in the conditions of supply of raw material. From a world-wide, heterogeneous collection of unknown miners, we move to a well- known group

of local landowners. This shift demands a carefully negotiated arrangement between the people's representatives (government) and landowners' representatives (initially, Federated Farmers). The first and most difficult part of the fuel transition is to put up the money to get tree crops established on the target land. Only the Government can do that - quickly. Initial funding should be regarded as a bridging loan. Eventually, returns from the sale of fuel should be used to repay the loan, and only then should net returns be used for shareholder dividends.

Loan conditions are a matter of careful negotiation in a setting of emergency lacking precedent. From the perspective of taxpayers, they are all vitally interested in the takeover. There is no reason, however, why they should lose money put up for vital bridging. Money repaid could be calculated on its value at the time of repayment by the use of the Consumers' Price Index and the loan reduced in magnitude accordingly. Thus, the taxpayer gets two returns: his capital in full and access to fuel, transport and commerce without break. In due course, the same kind of arrangement could be used to get Forest Fuels Limited under way.

An implication of producing high quality specialty wood for house framing is that nailing will not be easy. It would be advantageous if it were not required. Attention is therefore drawn to nail-free construction methods. Houses in Auckland have been constructed in this way. So have the stave churches of Norway that have stood for a millennium. The practice of off-site fabrication of dwelling components lends itself to the engineering of framework members as building components needing only placement and glue for construction purposes.

The directorate of the company will need to be multi-skilled. It will need to establish company policy on a number of different issues, all of critical importance to the company and NZ. Some of these issues will be of importance to both the co-operative and the company. Others will be of importance mainly to the company. Some critical issues appear to be:

a) The delivery, timing and condition of raw material for processing;
b) The makeup of raw materials;
c) Research into, and the identification and procurement, of raw materials;
d) The drying of raw materials;
e) The scope of processing for energy use;
f) The refining of processed fuels;
g) The distribution of fuels in NZ;
h) The export of fuels surplus to New Zealand's requirements;
i) The relationship of the company to the government of the day;
j) Lobbying government on regulatory assistance;
k) Public relations.

Another activity of an endangered soil co-operative will be the sale of high quality, untreated lumber from long term woodlots. For this purpose, it seems unnecessary to establish a special purpose organisation unless merchants prove resistant to the use of high quality lumber. It is expected that the issue will not arise until some 30 years after planting. However, the scale of production of such lumber and its impact on the quality of buildings in NZ are expected to be such that the co-operative should be in a position to compete successfully in the market place with merchants favouring low grade lumber to their own commercial detriment.

In dealing with lumber, the co-operative will need to take careful note of government policy. At present, government is unwilling to protect specialty lumber against overseas competition, regardless of whether the competition emanates from legal or illegal logging of natural forests. That policy puts an intolerable handicap in the way of farm production, and reduces the capacity of farmers to make sensible and profitable use of their land. It thus acts against soil conservation in high country – an inconsistent and surprising policy for NZ governments.

The logical administrative and research centre for the proposed co-operative and processing company is at Auckland. The University of Auckland has the qualified staff to handle a variety of research needs. It makes sense to site a pilot plant in that city. A centre there is well placed to make use of freight movements by air, land and sea. The city has the resources to handle a variety of meetings and conferences in a variety of settings. A pilot plant there could serve as a test of efficient manufacturing and as an auxiliary plant when methods have been checked and perfected. Gisborne is the obvious site for a major production facility. It could be readily reached by land transport of raw forest material harvested from 40% of EP land in NZ. It is adjacent to the northern reaches of methane hydrates in the Hikurangi margin. If they can be mined economically for methane, it would be convenient to land the gas close to the plant and feed it directly into its liquefaction section.

Summation

For thousands of years, humans have dreamed of finding a way to escape the Rule of Famine. In the second half of the 20th century, they thought that they had found the secret. Stored solar energy in the form of petroleum oil was the elixir. For a few generations, the dream seemed to have come true. Population numbers climbed as never before. Invention blossomed as humans played with the new toy. The shape of civilisation and everyday technology changed. Famine seemed to have lost its grip. However, the real cost of fuel climbed steadily and remorselessly as population numbers bloomed and oil supplies remained steady. Predictions of oil depletion increased in volume and number. The predicted date for final exhaustion dropped from the 2070s to the 2040s. The Age of Oil seemed destined to last less than a century and to terminate in a painful, monster famine, wiping out billions of people. A defence screen could be attempted, but success is not assured. To their lasting shame, politicians simply looked the other way, and continue to do so. Even basic research has been by-passed.

We now live in the 21st century – crunch time. Generations have now grown up in a world where powered vehicles are just part of the environment. The gasoline and diesel that power them are of interest only when the tank runs down and demands replenishment. Vehicles are of passing interest, but only as units in traffic congestion and as parts of a brand and age class. Habituation has consigned both vehicles and fuel to the back room of consciousness and left no room for the handling of the run-down and disappearance of oil. That is not perceived as a disaster. Natural disasters are something to which humans must adapt. However, they relate to incidents such as plagues, fires, earthquakes, volcanic eruptions, tidal waves and floods. They do not cover man-made disasters. In other words, perception acts against survival in a world bereft of one of life's props.

A critical factor in addressing the problem of supplying a substitute for disappearing oil supplies is scale. NZ uses about 6750 million litres of petroleum products per annum. That requires a great deal of replacement. It wipes out most "good ideas" for substitutes. To be useful, any substitute must fit two limiting factors: available land and existing knowhow. Of these issues, the most difficult to deal with is land use.

A first class SOE report on a strategy to introduce a national programme of high country afforestation for energy purposes in 2007 has been ignored. Time has gone by with virtually

nothing to show for it. We now have a mere 19 years within which to carry out basic research and to implement something like the Scion programme. What is now needed is a crash course of planting trees on a best guess basis to the maximum extent possible and amend it as research findings come to hand. Parallel to these steps will be the raising of capital, the design and location of a processing plant or plants, and the construction of the plant or plants. When coupled with the need to convince Parliament of the need and urgency of the work, NZ faces a seemingly impossible task.

The conclusion is stark. No matter how effective intervention may be, it can only mitigate the disastrous effects of losing cheap oil as the mainstay of the economies of nation-states. Famine on an unprecedented scale will return. It will garner an enormous death toll. Its victims will, as always, be the world's poor. Where will famine reign supreme? There are a number of answers. The sizes of domestic food production and domestic population density will be the first determinants. Also relevant will be the capacity of leadership to handle public debt. Its magnitude will attract public scrutiny. Leaders who cannot display competence in its management under stress will fail to attract new loans. The cheapness of petroleum oil as a prop for national economies will never return because energy comes only from the sun, and its earth store can only be replenished through a very limited number of resources, including the management of forest leaves. Transport will necessarily be expensive because fuel will become a capital-intensive commodity. Only those states displaying marked efficiency will survive, let alone dominate world affairs.

To have any hope of surviving the run-down of oil unscathed, NZ should be in a position to process significant volumes of biomass fuels by 2030. If Hubbert's (19) prediction of oil run-down are not borne out by 2030, that year still retains its importance. The more NZ is able to produce DIY fuels by that time, the sooner it will be able to reduce carbon emissions from oil feedstocks. Nineteen years remains a fixed time constraint under any scenario. Within that period, an action plan for a New Zealand DIY scheme to yield transport fuels will need to be operating. Some of its critical components must be:

- Discussions between the Government and Federated Farmers will be needed to ensure that landowners are willing to plant EP land in short term and long term tree species and that Government is willing to fund such plantings at an agreed level;
- Government should establish a pilot plant capable of processing wood waste, used tyres and water weed sustainably into methanol for research and use;
- Nurseries and forestry consultants will need to be briefed and be able to handle biomass planting at updated Scion levels;
- A co-operative planters' company needs to be put in place;
- Loggers will require to be briefed in order to be able to handle harvesting in time;
- Water-based and land-based transport firms need to be briefed in advance of decisions on processing;

- The economics of land- versus water- based transport for processing and distribution need to be worked out;
- A site at Gisborne should be designated as the primary site for a production processing plant capable of converting wood and wastes into methanol;
- Local bodies will need to be briefed on the location of woodlot establishments, processing plants and transport traffic;
- Research into the engineering of mining methane hydrates in the Hikurangi margin for on-shore liquid fuel processing should be carried out;
- The design of processing plant(s) should be completed and approved by concerned local bodies;
- A processing company needs to be incorporated (say, Forest Fuels Limited, or FFL);
- FFL should be structured so that the majority of voting shares are held by the Grower Co-operative and processing plant(s) are owned by FFL;
- Extraneous capital for FFL will need to be found and under its Articles of Association attract dividends at the rate enjoyed by the holder of voting shares;
- The dominant position of the Grower Co-operative in FFL and the dividend rights attaching to extraneous shares should be entrenched by Act of Parliament;
- Processing plant(s) will need to be constructed in time for the initial takeover of biomass fuels;
- A public relations plan must be implemented to inform the public of relevant information on changing patterns of transport.

Explosive power represented man's habit of taking whatever he needed from his environment. If it was environment friendly, that happened solely by accident. Electric power from methanol is essentially environment friendly but capital intensive. Its corollary that the end price of motive power must increase has its counterpart – increased wealth in a changed economic structure. The increased costs of planting trees, managing steep sites, transporting raw materials, processing raw material and distributing and selling finished methanol represent:

a) Income in the hands of recipients,
b) New products in the market place,
c) New opportunities to develop the production of methanol-base products, including new products,
d) Safer motor vehicles through reduced risk of fire;
e) An expanded industrial base for NZ;
f) Potential for new industries in NZ;
g) A sustainable base for the creation of wealth;
h) An expanded tax base for Government.

Methanol is an alcohol. It is poisonous and can lead to blindness and death if ingested in quantity. For this reason, it is not a drug of potential addiction. It is worth noting that

working with, rather than against, the environment can lead to increased wealth and no clear risk of death arising from alcoholic excess.

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