Submission: **TIMBER INDUSTRY STRATEGY, VICTORIA.**

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BACKGROUND:
In an era of rapid global warming and peaking oil and natural gas production, forestry should be at the forefront of any campaign to roll back our carbon footprint whilst at the same time maintaining or increasing economic productivity and environmental improvement. This submission argues:

(1) a case for establishing a "Victorian Forest Service", a public body charged with the responsibility of establishing "New Forests Victoria".

This need is urgent in the face of global warming, rural destabilisation and environmental impoverishment.

(2) Intensive reafforestation of suitable land in Victoria to meet future industrial round-wood requirements in a planned expansion of forest industries.

The objective is to systematically substitute the use of oil, petrol, resins, steel, aluminium plastics and concrete through establishing "Forest Industries Victoria". This public body will given the objective of removing our dependency on oil by 2030 whilst at the same time expanding productivity and standards of living for Victorians as well as providing a sustainable raw material supply for rural industries in Victoria.

(1) NEW FORESTS VICTORIA:
The word "forest" is of French origin (*foret*). It replaced the Celtic equivalent *frith* following the invasion of England by William the Conqueror. In fact reference to the New Forest of Southern England dates from 1079 when William established the Royal "Nova Forestas". Much of the land had been degraded and the soil denuded following the Stone Age and then Bronze Age when vast areas were cleared. Much of the land could only support heath. Relic oak forests were used in the sixteenth century by the Royal Navy and were replaced by oak plantations. The Great War resulted in a focus on faster growing softwoods as a strategic raw material resource in the event of another war. Today (after almost1000 years), 95 % of the New Forest is still owned by the crown. And softwood plantations are now being managed back to the "old growth" oak forests.

The New Forest is rich in history, flora and fauna. It preserves ancient history and cultural heritage and provides a refuge for wild life in what is a very densely populated area of England. The New Forest covers a wide range of habitats including a range of heath lands, bogs and wetland as well as deciduous woodland and provides a sanctuary for a number of very rare British plants and animals. In fact it provides a home for some

indigenous British species that now no longer exist outside the New Forest. The New Forest has been designated a Site of Special Scientific Interest.

Global warming has brought about acute public interest and concern in relation to future impacts on the environment; the economic consequences of global warming; the numerous technical issues associated with climate change including fire, water and pollution and policy formulation and implementation. Environmental issues include biodiversity, the conservation of ecosystems, endangered species, fire, urbanisation and the impacts of global deforestation. Economic issues relate to maintaining industrial productivity and lifestyles in the face of rising oil prices, the costs of resource conservation for future generations, the costs of implementing continuous environmental improvement and life cycle analysis (LCA) and the consequences of reducing our carbon footprint.

Ecosystems change with time. The landscape that we may be familiar with today in Australia may have been completely different 100 years ago and different again 300 years before then. This rapid change reflects human interaction. The current natural distribution of species of both plants and animals since the last ice-age has seen a massive migration, evolution and adaptation of species occurring as a result of climate change and the movement, isolation and joining of land masses. Trees represent climax vegetation and as a structural species within an ecosystem are relatively robust from extinction. However, in nature, natural disasters arise. Flooding, hurricanes and fire can clear areas that then progress through a cycle of colonisation by opportunistic plants, replacement by shrubs that might provide shelter for tree species and eventually a steady state of old growth forest that remains almost static until disaster strikes again. Human intervention (within the context of ecosystem sustainability) has to be considered akin to a natural disaster, except where there is the unnatural disaster of urban development that imposes soil removal, concrete, tarmac and supermarkets on the landscape. Urban sprawl imposes real limits on the extent to which natural ecosystems may regenerate and recover when left to their own devices. However, many natural ecosystems have also disappeared without human intervention because of climate change. Over the centuries, variations in water table may create difficulties for an “original native species” to regenerate. Or the climate over several hundreds of years may just favour an alternative more competitive species. In other words there is no such thing as an original native species, because the landscape is continually evolving and changing in response to environmental and biological forces.

The issue today, however, is that climate change may be so rapid that we may lose the intricacies of many of our ecosystems, the interdependencies of plants and animals that may have taken thousands and millions of years to evolve. Key elements may become lost, so that the ecosystem becomes impoverished. Such loss of biodiversity is a tragedy for future generations. *New Forests Victoria* has as its principle objective, the practical maintenance of regional biodiversity. The managed maintenance of ecosystems that exist currently or existed within recorded history. Whilst “management of the ecosystem” may once again be seen as undesirable from a purist’s perspective, the objectives of *New*

Forests Victoria is to maintain biodiversity and where destroyed, recreate as far as practicable an idea of what the living ecosystem may have looked like to our ancestors.

The traditional practice of forestry dates back several millennia and has undergone parallel evolution in different civilisations. Written forest laws in the UK date back to the Romans, where severe penalties were imposed on individuals who failed to abide by these laws. The forest laws developed by King Canute in Winchester in 1016 also reflected a concern for forests and their conservation. King Canute is most famous for forbidding the sea to rise. The world is awaiting similar leadership or a similar conviction that can limit the rising sea levels due to global warming! The training of professional foresters throughout the centuries and in different civilisations has for the most part tended to reflect the need to manage forests for future generations whilst at the same time meeting the objectives of the custodians and rights of the general public.

In summary "*New Forests Victoria*" takes its model from the New Forest. The New Forest has been managed intensively for almost 1000 years and has for the greater part enjoyed sustainable forest management that continues to improve the wealth of plant species, biodiversity as well as the health of the landscape for this generation and future generations. It has a rich history of documented management. Biodiversity has been maintained, not just the forest species but examples of plants and animals from all the different ecosystems that have existed in the area for more than a thousand years. Some of these "original" habitats such as the heath lands are man made from activities of the Bronze age and have arisen as a result of the soil becoming impoverished. None-the-less, the maintenance of such habitats is seen as a legitimate objective because wild life has adapted to these man-made circumstances and formed a unique ecosystem in its own right. The forest has also become a refuge for endangered indigenous species, a living heritage.

The Forests whilst established by William the Conqueror for maintaining deer for hunting also retained "commoners" or the general publics rights of access for specific uses. Public rights included access, gathering fire-wood, bracken collection, cutting peat, digging clay and grazing of ponies and cattle on heath land and grazing of pigs during the harvest when acorns are abundant. These rights play an important role in the management of the various ecosystems. They incorporate many quaint customs in their management and execution that are still applied today. In more primeval times foraging wild pigs would have performed the same role currently performed by domestic pigs in ensuring that a small percentage of acorns were accidentally pushed into soil to provide natural regeneration of oak forests.

Public right of access underlines an important principle that the forests exist for public good. In an era where 95 % of Australians live within an urban environment, this principle becomes even more important for future generations.

Exotic species have been introduced at different times to meet specific policy objectives of the custodians of the New Forest. Many ecological purists may not see this as a

sympathetic activity. However, as with man made ecosystems, the introduction of exotics has an historical significance in human development and thinking and a scientific interest that should to an extent be preserved for future generations. Tree farming for industrial timber supply also represents an important or legitimate rural industry especially within the current context of global warming as a means of carbon sequestration, a sustainable option for the substitution of oil derivatives and a means of maintaining economic productivity in a world where rising prices for oil will inevitably exact a toll on human welfare. However, a primary objective of "*New Forest Victoria"* is to nurture indigenous biodiversity and reproduce ecosystems that eventually reflect the whole range of natural ecosystems that are indigenous to the area.

The long-term goal of "*New Forests Victoria*" is for selected areas of land located close to heavily populated areas of Australia to be purchased and managed to become the old growth forests typical of the area in which they are located. Specific objectives include:

- Providing a systematic process for maintaining the long-term genetic diversity of plants and animals for future generations.
- Establishing areas of scientific interest.
- Preserving historical land-marks and artefacts and cultural traditions.
- Providing general public access to living forest.

The New Forest has thousands of preserved historical sites where significant events are recorded for posterityrity. Such artefacts of human history enrich the visitor's experience, particularly in an era where diversity in virtually all human activity is being challenged. "*New Forests Victoria"* will similarly respect the spirit and spirits of past generations so that future generations can reflect on the human condition and at the same time make provision for future generations.

Whilst the goal is to provide New Forests for all major population centres, initially one site should be selected, potentially in Victoria. The actual site will be determined to a greater extent by the quality of land available. The site needs to be fertile. Forest establishment is difficult on poor or impoverished soils. Climatic conditions also need to be stable. Whilst it is tempting to try and do something for the very large drought prone areas in Australia, this would defeat the primary objective of "New Forests", that is, to secure biodiversity. Maintenance of biodiversity is a first step in a goal to identify plants and ecosystems that may help reverse the impact of drought on vegetation cover in many parts of Australia. The area selected also needs to be located close to a large population centre with suitable infrastructure to facilitate rapid public access and enjoyment.

(2) FOREST INDUSTRIES VICTORIA

The second initiative relates to establishing a public body charged with the responsibility of removing our dependency on oil and other non-renewable resources by 2030 through the rapid expansion of plantation forests and development of a vertically and horizontally

integrated forest industry. This initiative also requires an integration and expansion of research, education and training to this end.

The utilization or mining of non-renewable fossil fuels predominantly for energy has had a number of consequences. These include:

- Unprecedented economic growth and wealth generation and an exponential growth in consumption.

However, we are told that we are:

- Squandering valuable natural resources for low value uses such as energy.

- Artificially pricing manufactured synthetic commodities because no account is taken of raw material replacement cost. In other words there is no future opportunity value being taken into account.

- Failing to recognize the potential resource needs of future generations.

We are also being told that expansion in consumerism is resulting in

- The pollution of land, soil, water and waterways and the accumulation of waste in landfills.

- An expansion of urbanization and the depopulation and breakdown of infrastructure in rural areas.

- The release of sequestered CO_2 and the accumulation of CO_2 and other gases such as methane in the atmosphere.

However, the dire projections made in the 1960's that fossil fuels would become exhausted by the turn of the century failed to materialize. Three factors mitigated against this pending disaster. The first was the discovery of more reserves of oil and gas. The second was the ability to mine resources economically at greater depths and the third an unparalleled technological revolution in processing technology, material science, product development, manufacturing and communication that increased productivity beyond any projections or dreams that could be envisaged at the time.

An example of this productivity is given by Drucker (1992) who argues that there has been an uncoupling of the raw material economy from the industrial economy and an uncoupling of the industrial economy from labour. He states that for Japan from between 1965 and 1985 that industrial production increased two and a half times whilst raw material and energy consumption barely changed. The labour content of industrial production in 1985 required only two fifths of the labour that it did in 1973. For example the cost of labour for today's car is about 8% of the total manufacturing cost.

In recent years productivity has continued to improve at unprecedented rates. Drucker argues that this is arising primarily because of an uncoupling of the real economy of goods and services from the money economy. Thus industrial production has tended to concentrate where-ever there are economies of location. This might be associated with the cost of labour, the clustering of complementary services, raw material location, water, energy, ease of transportation, legal requirements, levels of education and training, a whole host of factors that influence productivity and the costs of production. How many times have you been contacted for a telephone interview survey of your consuming habits from India?

There have been glitches in this unprecedented growth. The most noticeable impacts have been those associated with oil crises where for various reasons there have been artificial increases in the costs of oil. In the 1974 oil crisis, the world economy battened down with a consumer led drop in commodity consumption. The result was disastrous. It was a very difficult time for everyone and continued for several years. In NZ there were car-less days unless you registered your car as a truck. To do this you had to blend 5 or 10% ethanol with your petrol. The rationale was to try and reduce petrol consumption. Many New Zealanders registered their cars as trucks, simply because of the difficulty society had in functioning even for one day without a car when everything is built around mobility.

The NZ government responded to the oil crisis by directing research into evaluating options for alterative fuels for example ethanol from wood. There was rapid growth in research into wind power, hydro-dams, ethanol from natural gas and thermal ground water etc. A number of "Think Big" projects were implemented by the Muldoon government. These projects were heavily criticized a decade later when the economy started to boom under economic rationalism and user pays or more precisely user pays twice. However, more recently these project have started to be commended for imagination, foresight and daring.

Other "oil crises" have arisen since the mid seventies. We are experiencing one right now where petrol prices fluctuate daily. For the man and woman in the street, the world economy appears to be delicately balanced and vulnerable to the political manipulation of oil supply. People feel nervous. Oil is a finite resource. Fluctuating oil prices have an immediate market reaction. Unfortunately rises in the price of oil are inevitable. The unknown is how quickly will oil prices rise? And what impact will this have on our economy, the way we live, our standard of living?

The first question therefore is how can we maintain the current level of exponential growth in productivity in an economy that is based on finite resources that one day will become in short supply. The answer is not obvious. Either we can't or we have to uncouple our consumable society from its total dependence on non-renewable resources. Can't isn't really an option that our politicians or the man and woman in our urbanized over populated consumable society can cope with. All of the dire projections of the 1960's and the Club of Rome in the 1970's have been remodeled and are being re-extrapolated to occur in 2050.

So our best scientific minds and politicians need to find a substitute to uncouple the dependency on oil. If we take a scientific approach and try to list the ideal technological attributes of a raw material that can potentially substitute for oil, what are the ideal attributes? The raw material should be:

- renewable, sustainable and recyclable;
- environmentally friendly,
- non-toxic,
- and not just benign to the environment but ideally improve the environment;
- use low energy in its production and remanufacturing, (low embodied energy)
- capable of stream-line automated production and have a relatively low social cost.
- and in the context of global warming, sequester carbon.

It is enormously difficult in fact almost impossible to try and identify raw materials with such outstanding attributes. Our politicians have one answer: **"Nuclear power"**. So in essence we maintain the status quo, but substitute the energy component of oil exploitation with nuclear energy. This is a partial solution. But when we check the attributes of nuclear power against our ideal list of attributes, it falls short. It's not renewable, sustainable or recyclable. It's hardly environmentally friendly or non-toxic and it is unlikely to enhance the environment.

Our science community is suggesting liquefying CO_2 and pumping it onto the sea-bed. This is innovative. However, when one compares the costs of manufacturing one tonne of liquid CO_2 versus one tonne of wood which is a fraction of the costs of liquid CO_2 and the long term, environmental improvement, employment and utility that can be provided from wood I know what I would be doing.

The debate on environmental impacts resulting from growing consumption of energy and raw materials on one side and emission of solid, liquid and atmospheric waste on the other side is now centre stage throughout the world; issues such as global warming, ozone degradation in the stratosphere, depletion of natural resources, acidification of water and soil, human and eco-toxicity, etc., have engaged scientists and environmentalists all over the world to develop new methods towards environmental impact assessment. One of the methods developed for this purpose is the Life Cycle Assessment of products or simply LCA.

Life Cycle Analysis measures the inputs or consumption of renewable and non-renewable materials and energy and the impact of design and manufacturing technology and the use of products and their end of life, i.e. recycling, burning or landfill. The objective is to optimize the sustainable management of natural resources which includes the minimal

consumption of materials (renewable or non-renewable) and the protection/conservation of the environment. So the technical measures serving to achieve the goal of sustainability are:

- Energy saving,
- Improved use of materials,
- Reuse and recycling,
- Emission control,

One cannot fault the logic of Life Cycle Analysis, but at the end of the day the process is an accounting process and is only as good as the data fed into the model. It's not questioning potential impacts on health, rural employment and support of rural infrastructure and social issues. At the end of the day Life Cycle Analysis tends to support incremental improvements associated with raw material use and the ensuing environmental consequences. However, when Life-Cycle Analysis is used to rank human activity, forestry and the forest industries tend to come out at the top of the list as good commendable human activities, that are desirable, where-as urban development comes out close to the bottom of the list. Clearly a very sensible tool, particularly when applied to continuous environmental improvement. Clearly we should be embracing the principles of ISO 14000.

However, there are other attributes that need to be considered in addition to LCA analysis. Raw material production should ideally be based in rural often remote areas where there is a desperate need to maintain infrastructure and employment. Ideally production of the raw material should alleviate environmental problems; provide solutions to very serious soil degradation, salinity problems, water quality issues; foster community development; provide rural industries and employment, provide better infrastructure, improve health and welfare, in other words real and tangible impacts for the rural poor, alleviation of greenhouse and global warming, and ideally achieve some measure of carbon sequestration.

Is it possible to disconnect economic growth from dependency on fossil fuels? In an article by Louise Williams published in the Age on June 17th 2007, the answer would appear to be a qualified yes. In this article the Swedish Government in 2006 announced a National Goal "To end oil dependency by 2020". The article identifies Sweden's per capita emission of carbon in tonnes per annum. We see that the average for Sweden is 5; the city of Vaxjo which is a little smaller than Ballarat is 3.5 whereas Australia and the US are in the high 20's.The article goes on to identify the steps taken in Vaxjo starting in 1996 (when oil prices were $20 / barrel) to achieve this end:

- Terminate the use of coal
- Provide substitutes for petrol (These include the substitution of biogas or E85, a blend of 85 per cent renewable ethanol for petrol.
- Require drivers to pay an extra tax of 80 cents per litre of petrol

- Establish a city power plant based on wood waste
- Focus on public transport
- Focus on cutting edge clean technologies.

So whilst petrol is still readily available to the public, carbon emissions in Sweden are heavily taxed. In the face of these restrictions, "Sweden has clawed its way back to being one of the top 5 economies in the world". "Vaxjo is half way to achieving a fossil free future with no sacrifice in life style, comfort or economic growth".

The production of waste biomass by production forestry and the forest industries is enormous. A production forest leaves substantial percentages of the tree behind, essentially the waste is uneconomic to harvest. The waste biomass is heaped up into piles and burnt to waste or left scattered as an unsightly mess to decay and convert into CO_2 and methane over the period of forest re-establishment.

During the primary conversion process substantial quantities of wood waste are generated. Bark may make up 15% of a log. Bark contains very valuable products such as tannins. Sawdust, docked ends of timber, defects and shavings are generated during the sawmilling process. Whilst substantial progress has been made in utilizing waste for energy production and in some instances co-generation, wood waste is still a major untapped resource. The situation is more chronic in the construction industry and furniture sector. These industries actually have to pay for waste disposal in land-fill at something like $40 / tonne.

Conventional Fast Pyrolysis or charcoal manufacture comprises a process that provides:

high rates of heat transfer,
short residence times,
intermediate reaction temperatures (450-650^{o}C).

We can used the basic chemical reactions of the process to calculate the release of gases for example CO_2 during oil production:

$2C_6H_9O_4 \rightarrow 2C_6H_7O_3 + 2H_2O$ (net eq. for bio-oil production from wood)
$4C_6H_9O_4 \rightarrow 16CO + 8CH_4 + 2H_2$ (net eq. for gasification reactions)
$2CO + 2H_2O \rightarrow 2CO_2 + 2H_2$ (secondary gasification reactions)
$6C_6H_9O_4 \rightarrow 2C_6H_7O_3 + 14CO + 8CH_4 + 4H_2 + 2CO_2$

These equations serve to quantify the efficiency of these processes. Total gases given off during fast pyrolysis are as follows:

Gases total: 7-24%
The gases comprise

-CO_2:	4.2-7.7%
-CO:	2.5-13%
-CH_4:	0.1-1.6%
Char (basically carbon):	5-16%
Bio-oil:	71-77%

Other gases include, ethane, propane and hydrogen.

Most conventional fast pyrolysis processes report maximum bio-oil yields of around 60%.

Slow Pyrolysis
Involves low rates of heat transfer, long residence times and low-intermediate reaction temperatures (350-500^{o}C). Basically the reactions are the same as for fast pyrolysis except that condensation reactions are far more prevalent resulting in high char yields and increased water formation.

Yields include:

Charcoal:	20-50%
Gases total	20-30%
CO_2:	8-12%
CO:	6-9%
Bio-oil	20-40%

An alternative technology under development at the University of Melbourneinvolves the production of furfural alcohol using pyrolysis.

Pyrolysis Process for Furfural Production
The process involves catalysed low temperature fast pyrolysis (250-350^{o}C). Yields include a residue, primarily cellulose. Importantly there is no charcoal.

Cellulose	65-75%
Gas emissions are low:	7-12%
CO_2:	2-3%
CO:	0.2-0.7%
Bio-oil :	18-27%
Furfural:	7-11.6%
Water:	3-5%

Source: David Butt, University of Melbourne

So the low temperature pilot pyrolysis plant based at Creswick can produce about 12% furfural alcohol and leave a solid residue of cellulose. Potentially the cellulose should be converted into ethanol at much faster rates than traditional wood waste because the lignin component has been substantially removed. This aspect has never been evaluated. However, in the traditional ethanol production process from wood waste the presence of

lignin is problematical because it protects cellulose from acid hydrolysis, thus making the process of cellulose hydrolysis an expensive and time consuming operation. Nevertheless the production of ethanol from wood waste is reported to be economically feasible in South America when the price of oil reaches a threshold of greater than $43 / barrel.

There is also a lignin waste utilization problem associated with traditional wood ethanol production processes. Both these problems have been overcome through the low temperature pyrolysis process.

Furfural provides the basis for a substantial value adding industry. Primary uses for furfural in the forest industries include its use as a resin and extender or direct substitute for phenol formaldehyde. Phenol formaldehyde, which is used as a binder in wood based panel products manufacture, is currently manufactured from oil. Therefore the industrial production of furfural has the effect of direct substitution of oil as well as a means of sequestering carbon dioxide. In fact chemically, furfural resin has the same base carbon, hydrogen, oxygen components as wood.

A second use for furfural comprises modifying the chemical structure of wood by cross-linking, rendering the wood unattractive to decay fungi. Furfuralisation is now one of the key research areas in Europe for the chemical modification of wood. It is being heralded as a potential substitute for copper-chrome-arsenic wood preservative.

Furfural is one of those chemicals that can provide the basis for a whole range of industrial processes. One of the most fascinating is its role as an extractant using a phenomenon known as conjugation. Furfural will hook onto molecules containing double bonds, but ignores molecules without double bonds. Conjugation can be used to:

- Remove aromatics from lubricating oils
- Remove aromatics from diesel fuels and
- Obtain unsaturated compounds from vegetable oils to make drying oils for paints and varnishes.

Even more fascinating is the role of furfural as a fungicide (Zeitsch, 2000). He reports that a 0.05% aqueous solution of furfural will kill the (wheat blight) fungus, *Tilletis foetus*, without dimishing germination. That it will destroy nematodes in soil that currently causes US$60 billion worth of damage in crops of potatoes, peanuts, soybean, tomatoes, tobacco, berries, citrus cotton and a number of other crops. And that furfural is effective as a nematocide when applied at 75 litres / hectare.

Furfural alcohol costs a lot less than other nematocides. It is reported to be non toxic to humans (oral LD 50 (dogs) is 2,300 mg/kg). It is harmless to the environment and non systemic, i.e. it is not taken up in plants and can be applied to plants until harvest (Zeitsch, 2000).

The new pyrolysis process should provide very cheap manufacturing of both furfural and

ethanol. So what are the benefits of ethanol-blended fuel. Firstly ethanol contains 35% oxygen. Adding oxygen to fuel results in more complete fuel combustion reducing harmful tailpipe emissions. Ethanol displaces the use of toxic petrol components such as benzene – a carcinogen known to cause leukaemia. The main pollutants of concern are ozone, PM10 and PM2.5. They have peak concentrations at or above the NEPM standards and no consistent downward trend (National Environmental Protection Council (NEPC). The benefits of using ethanol blending include less dependency on imported crude oil. It extends Australia's dwindling domestic supply of light crude petroleum used to produce transportation fuels. It provides an expanded market opportunity for the Forest Industries. It provides rural economic development and displaces dangerous components in petrol such as benzene.

Sydney University has researched the harmful effects of pollution. Exhaust pollution is associated with inflammatory lung diseases (asthma, bronchitis and alveolitis, cardio-vascular disease), risk for exercise-induced heart damage more limited blood flow and increased blood clotting, increased mucous production and airway hyper-responsiveness. One fifth of lung cancer deaths in the USA are associated with particulates associated with exhaust fumes from cars. Particulates cause accelerated tumour growth, premature death, significant risk of ovarian cancer, symptoms of anaemia, tiredness, headaches, fatigue and shortness of breath, low birth rate, some types of leukaemia (from exposure to benzene), loss in productivity (absenteeism from work and school), increased sensitivity to bacterial infection of airways, more severe common viral asthma, reduced mail fertility and adverse lung development in children. Twice as many people die in Sydney from air pollution than in road accidents (Amoako *et al.* 2003).

A second product under development at the University of Melbourne is a modified bark in which the water-soluble tannins have been fixed into the bark. Tannins are scavengers for any heavy metals. For example soluble copper will form copper tannate that is firmly fixed into the modified bark. Other heavy metals that are sequestered include lead, mercury uranium, gold, silver, chromium and many others. Heavy metals are toxic and therefore the bark substrate which has been turned into a nice friable product can be used in very large scale filtering of water or for soil remediation or removal of heavy metals from industrial processes. The modified bark can also be used for removing biological wastes from sewerage, blood from abattoirs, milk waste from dairy factories. These products can then be conditioned and recycled as valuable soil mulches in agriculture and horticulture. The product will also remove oil from sea-water. When the bark is placed in the sea over an oil spill, the oil coagulates in the bark creating a solid mass on which sea birds can walk. In theory it should be possible to physically recover the oil in this form. Any residual left in the sea will after about a week sink to the sea-bed as hard lumps of inert looking oil impregnated bark where presumably it can provide new homes for a variety of sea creatures.

Mischeck Kapambe has studied "Trends in wood use in housing in Victoria and its impact on carbon storage". The project has been supported jointly by the CRC Wood Innovations and the CRC for Greenhouse Accounting. The project investigates the effect of wood substitution in dwellings in Victoria, including the use of wood preservatives and the generation of wood waste during construction. Solid wood products used in

construction and furniture in Victoria, sequesters carbon for in excess of 120 years. The average house will store approximately 11 tonnes of CO_2. This represents very significant storage or sequestration of CO_2. Of greater significance is the low energy use in timber manufacturing (750 MJ/m^3). In comparison, concrete uses 4,800 MJ/m^3; steel uses 266,000 MJ/m^3 and aluminium uses 1,100,000 MJ/m^3. The carbon released during manufacture is also highly significant. In wood this represents 15kg/m^3, concrete 120 kg/m^3, steel 5,300kg/m^3 and aluminium 22,000 kg /m^3.

The potential for multi-storey timber construction has been recognized in a number of countries. The UK Timber Frame 2000 Project (TF2000) built a 6-storey timber frame platform construction. The building comprised 24 apartments and was framed up within 5 days and evaluated for a number of key issues, including, value engineering, differential movement, whole building lateral (racking) stiffness, disproportionate collapse, fire compartmentation, acoustics, fire issues, brickwork shielding and building documentation. The Minister of Forestry, New Zealand, has recognized the importance of such an initiative within the context of global warming; the potential for very rapid construction of high quality, high density, low cost construction; the potential for instant recycling of structures and opportunities for innovative design. New Zealand like Sweden is spear-heading the way forward in using the forest industries to reduce the carbon foot print, identifying the forest industries as centers for clean manufacture, recycling and energy production. The NZ Minister of Forestry announced that every government department uses timber in its construction.

CONCLUSIONS

World wide there is increasing recognition of the role of forestry and forest industries in rolling back global warming; providing a stable ecology for native vegetation and raw materials for new sustainable industries. A cringe faction will rigorously dispute the need for Government intervention in these industries. However, the lack of engagement by the forestry sector is pointing to a market failure of this sector in Victoria. Global warming and future uncertainty means that we can no longer afford to remain inactive or hide behind a blind belief that market forces will bail out the need for making responsible decisions for future generations.

The starting point is to establish a Victorian Ministry of Forestry with its own Minister and budget and brief to establish two Divisions “New Forests Victoria” and Forest Industries Victoria. The objective is to secure biodiversity in a band of Forests or green belt surrounding Melbourne; nurture a general public culture that appreciates forestry and the forest industries and the establishment of infrastructure (research, education and growing forests) that (as a minimum), achieves self sufficiency in forest products production in Victoria. In conclusion, in an era of global warming we have to maintain productivity in industrial manufacturing, but at the same time uncouple our dependence on oil and other non-renewable resources.

It is possible to achieve an uncoupling of our dependence on oil and at the same time maintain economic growth and development. However, initiatives such as those of Sweden will be limited by our capacity to grow forests on a scale needed to achieve such an objective. This paper argues that any wood utilisation represents a positive contribution to replacing oil consumption. However in addition there is the added value of carbon sequestration and a roll back of carbon emissions. Even newspaper that ends up as land fill represents a positive contribution to rolling back carbon emission, because research by the CRC for Carbon Accounting has demonstrated that the rate of decomposition of newspaper in landfill takes a long time. In the time it takes for a plantation forest to be rotated twice, there has been a maximum of only 3% conversion of a newspaper back into CO2. The development of policies in relation to global warming need to be thought through very carefully and based on fact rather than wishful thinking.

From a resource utilisation perspective forestry and the forest industries can substitute most of the needs obtained from oil. Edman, who pioneered the greening of Vaxjo states that economic argument is the strongest convincer… clean technology and energy solutions are the biggest emerging global sectors. “We can earn a lot of money and create a lot of jobs by being at the frontier”.

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