THE GAIA VILLAGE PROJECT:

A proof-of-concept Action Plan* to mitigate Peak Oil, Global Warming, Resource Depletion and Environmental Destruction

(*In the context of residential Queensland)

Second draft - February 2008
(please destroy first draft)

THE GAIA VILLAGE PROJECT: A proof-of-concept Action Plan to mitigate Peak Oil, Global Warming, Resource Depletion and Environmental Destruction

Draft copy - February 2008

AIMS:

The purpose of this paper is to advocate a multidisciplinary project in Queensland which will prove we can achieve a carbon neutral, minimal waste, petroleum independent, high quality lifestyle using existing and imminently available technology, ***without*** resorting to nuclear power (which is expensive, fraught with intractable long term problems and more to the point has a long lag time to development of at least 15 years). The subsequent expectation is that the principles and practices of sustainability derived from this project will then be spread nationwide (with modifications to suit local conditions).

However, even if the whole of Australia was to emulate this project and become carbon neutral and petroleum independent, it will have a negligible impact on a global scale. The ultimate aim will therefore be to export this proof of concept project (with the accompanying Australian expertise and consultancy services) as a comprehensive sustainable package to China, India and other large countries, and in the process jump start a new economic engine for Australia while globally reducing carbon emissions, reducing waste, reducing petroleum dependency and reducing the risk of international conflicts over diminishing resources (especially oil).

We can do well by doing good.

Al Gore stated that there will be no single magic silver bullet to solve all our problems - it will be more like silver "buckshot". Here then, is an outline of some buckshot.

BACKGROUND & RATIONALE:

The observed effects of Global Warming to date have been far worse than the worst case scenarios predicted twenty years ago. There are already positive feedback mechanisms accelerating the melting of glaciers (particularly in Greenland) and we now see ice-free water at the North Pole in summer. It is almost certain the true consequences of Global Warming twenty years from now will be far worse than the worst case scenarios predicted today - predictions which have been watered down by interfering bureaucrats for political reasons (as stated in many publications by James Hansen, senior NASA scientist and leading climate change authority).

The good news is that Australians have finally removed the obstructive, denialist and deceitful Howard regime and it does appear the Rudd government will move forward on these matters. The target of a 60% greenhouse gas (GHG) reduction by mid century (compared to year 2000 emissions) has been pledged, however growing evidence indicates our GHG reductions must be far more drastic to avoid a global temperature rise above 2 degrees Centigrade which may, by many scientific assessments, be the critical "tipping" point.

Talk is one thing, however ***we need action now***. But what specific action can we take? This paper will answer that question in the residential context of Queensland.

Global warming is undoubtedly the greatest threat to human civilisation today - however we have now also passed the point of global Peak Oil production - which

makes the latter issue a more immediate concern. The fact of the matter is that we cannot deal with each of the threats of Global warming, Peak Oil, Resource Depletion, Environmental destruction and Overpopulation in isolation - they must be tackled together in a holistic fashion to ensure the solution for one problem does not exacerbate another. One example is the manufacture of non-conventional oil from tar sands or oil shale - which will result in up to three times more carbon emissions compared to burning conventional oil - as well as consume valuable natural gas and fresh water resources. Colin Campbell, the eminent petroleum geophysicist, after evaluating this scheme declared, "*gentlemen, we have now discovered a way to turn gold into lead*". Another example is the idea of harvesting ocean methane hydrate deposits ("clathrates") for fuel - which would also disastrously worsen Global warming.

Oil exceeded US$100 per barrel for the first time in history on 3 January 2008. There is no doubt whatsoever we have seen the last of cheap petroleum - and fluffing about with market mechanisms, competition issues and perverse subsidies misses the point completely. The cost of petroleum will escalate at an increasing pace when we inevitably and irreversibly tumble down the curve of oil depletion and there is nothing whatsoever we can do about it.

The economic consequences of "business as usual" will be disastrous for societies which are heavily fossil fuel dependent, such as Australia. We can, however, mitigate these disastrous effects with sensible and courageous planning, however there are considerable obstacles to be overcome. These include public ignorance, political denial/obstructionism/venality, as well as downright resistance/hostility from certain industries - particularly certain fossil fuel dealers. On the other hand, public awareness and willingness to act is rising. Furthermore, many industry leaders and venture capitalists are straining at the leash to bankroll sustainability initiatives - if only clear and favourable policies could be promptly legislated by government. For example, the feed-in tariff to households for providing renewable energy to the grid which were pioneered by Japan and Germany should be adopted by Australia ***now***.

When the cost of petroleum goes up another fivefold (and in due course this ***will*** inevitably occur), but if we are able to reduce our petroleum requirement to one fifth of our current use (by efficiency measures and by use of other energy sources) then the total cost to us will be neutral - and the impact of Peak Oil on us will be negligible. Indeed we must all focus on the goal of ultimately becoming a fully fossil fuel free society.

There are obvious compelling reasons why we ***must*** wean ourselves off petroleum dependency ***now***. Firstly, to mitigate global warming - which requires moving away from petroleum based transport. Secondly, because economic collapse and societal turmoil & hardship will inevitably ensue from petroleum depletion if we continue business as usual. This is analogous to the horrendous withdrawal symptoms (and even death) visited upon a drug addict if he is suddenly deprived of his heroin. Thirdly and less well publicised - but just as important - are the worldwide human rights abuses, exploitation, warfare, murder of innocents and consequent backlash against us (so called "terrorism") which directly result from our acquisition of petroleum from foreign sources. This is analogous to the crimes (including murder) committed by a drug addict in order to feed his habit. I have elaborated on this further in appendix 2. Clearly, there are moral and health dimensions to these issues.

We need to formulate a methadone program for ourselves if we are to avoid the shock of going cold turkey.

WHERE TO FROM HERE?

The threats of Peak Oil, Global warming, Resource Depletion and Environmental Destruction have arisen because of the way we live. It therefore stands to reason **we must change the way we live**. If we do not adapt our lifestyles to become sustainable in a systematic, structured and orderly manner, Nature will do so for us in an abrupt, painful and even lethal manner, whether we like it or not. This is the simple reality.

Suburban sprawl is completely unviable. James Kunstler, author of "*The geography of nowhere*", stated that **the entire suburban project is the greatest mis allocation of resources in the history of the world.** Indeed, all new suburban projects should be completely and permanently banned right now. Suburbia is a destructive, wasteful and foolish paradigm which is extremely costly to maintain and is totally predicated on the old model of cheap and easily available petroleum. That day is past.

Large population, high density cities - fed by distant vast agricultural hinterlands - may no longer be viable either, as they are heavily dependent on cheap oil for long distance transportation of goods in and of waste out (not to mention oil to power all agricultural machinery & crop dusting planes & irrigation pumps, oil to manufacture pesticides & herbicides and increasingly costly natural gas to manufacture nitrate fertilisers). One possible way to salvage large cities would be to electrify all land transportation, particularly long distance rail, using baseload renewable energy *which is not water hungry* (unlike thirsty nuclear energy). One such source in Australia may be the Innaminka "hot rocks". Another other possible source may be large scale solar thermal electricity as advocated by Dr. David Mills (who seems to have solved the problem of baseload provision). The lead article in the January 2008 edition of *Scientific American* outlined a large scale photovotaic plan (which incorporated energy storage methods enabling baseload provision) which could provide 69% of all US electricity by 2050 without even addressing energy efficiency issues. Australia has even greater solar energy availability than America and less than one tenth the population.

Large scale solar schemes will not however address the problem of the major fossil fuel inputs required for industrial scale agriculture. Thus, the viability of large cities in the absence of cheap petroleum may still be in serious doubt.

A number of Peak Oil aware individuals have taken personal steps to protect themselves from the future turmoil. For example, Adrienne Langman, in an ABC Radio National interview broadcast in September 2007, described how she and her husband moved to a rural property near Coffs Harbour to become self sufficient in food, water and renewable energy. This strategy may be possible for a few Australians who possess the necessary resources, skill and initiative, however we need solutions which can be offered to *all* Australians. Furthermore a post Peak Oil society suffering from hyperinflation and food shortages would give rise to wandering bands of hungry desperate people who would invade and consume the Langmans' crops and livestock in the blink of an eye. There would be no way for the Langmans to protect themselves from being raided in the long term, even if they armed themselves with rifles, kept round the clock watches and electrified their fences - a soul destroying, paranoid and mean spirited way to live (but a mentality not unfamiliar to many mean spirited corporate types who already live in gated communities in America). In addition, growing food is in fact a difficult and tricky skill which is not easily learned and many who attempt it will fail to feed themselves adequately. The individualistic notion of going off grid and planting one's own food is

therefore quite unrealistic.

If not suburbs or mega cities or individual fenced compounds, how should we organise our lives in this brave new world?

If we are to survive and thrive, we must do so in medium sized, medium-rise communities and villages fed by local agricultural produce. This will facilitate efficient land use, reduce the distance between food production and consumption, and will enable division of duties between residents to ease the burdens of production and maintenance, while also allowing for beneficial healthy social engagement, interdependency, mutual support and community solidarity. This will therefore also be an antidote to the urban alienation so prevalent in our current lifestyles. These villages will be self sufficient in energy and water. Such communities will thus impose little demand on existing energy and water grids and in fact may export such resources to the greater grid much of the time.

The village model is not a hypothetical one. Human beings have in fact lived in medium sized groups for much of history.

Cuba offers us a salutary example. America imposed a continuous trade embargo on Cuba more than 40 years ago, ever since Castro seized power. Cuba had been propped up by the Soviet Union and was receiving many subsidised imports, petroleum being especially important. When the USSR collapsed in 1990, oil imports to Cuba were cut by more than 50% and food imports by more than 80%. They faced the real prospect of widespread starvation at the time (as did in fact occur in North Korea when the Koreans did not manage their affairs well). However the Cubans managed to move from highly mechanised agriculture to organic farming and urban gardens in a fairly orderly fashion. They used cars less and walked, bicycled and rode buses more. Cuban citizens now continue to enjoy universal healthcare with higher literacy levels, better life expectancy and lower infant mortality than the USA.

Many political and corporate "authorities" advocate centrally controlled big "solutions" such as nuclear energy, hydrogen based transportation or carbon capture and sequestration - which are all severely flawed in concept and realisation. We must examine what their motivations may be. Some are obviously promoting their own industry and are entirely self serving in the pursuit of their future personal profits - boosted by huge tax payer funded subsidies. The amount of money these industrialists make is proportional to the amount of energy they sell, hence they focus entirely on the energy supply side of the equation and encourage wasteful comsumer practices. Many consumers have been misled by this paradigm of "needing" a large energy supply, without appreciating how dramatically energy efficiency can reduce our consumption without affecting our quality of life.

Many economic flat earthers and globalisation ideologues often have no grasp of scientific realities. For example, the late Julian Simon, former Professor of Economics at the University of Maryland and famous resource optimist, said that we did not need to worry about copper depletion because we could always make copper from other metals(!!). Such profound ignorance reflects the calibre of advice offered to the American government - which is comprised of even denser people such as Bush junior.

Having said that, it can be appreciated why some countries may perceive nuclear energy to be essential for their particular situation. The eminent scientist James Lovelock of "Gaia" fame advocates more nuclear energy for Britain, a country with considerable winter heating requirements and a paucity of solar energy. These issues however do not apply to sunny warm Queensland where well insulated houses do not require significant winter heating apart from a handful of towns such as Stanthorpe.

What I propose is a movement from the ground up which can then be adopted around the world. This is in contrast to the top down approach - which is how our current profligate lifestyle was created by industry and colluding government. Two powerful examples of decentralisation come to mind. Barely thirty years ago, the prevailing computer paradigm was that of extremely expensive room-sized main frame computers which would be sold to just a small handful of entities (such as government intelligence organisations). No one then foresaw the rise of the personal computer and the massive worldwide economic opportunities created as a result. The Internet similarly originated as a means to decentralising information networks, rendering them more robust against attack. This evolved into the Worldwide Web, giving rise to billion dollar companies such as Google and was nothing less than an information revolution.

In a sane world, the process of decentralisation - of placing energy, water and food resources within the control of communities - will become acceptable and indeed highly desirable because it literally places power in the hands of the people - a potent and literal manifestation of democratic empowerment if ever there was one.

THE GAIA VILLAGE: A PROOF OF CONCEPT PROJECT

This proposal should be established as a *commercial* enterprise in the first instance - with the intention of fully recuperating the outlay (from the sale of utilities, residences, vehicles and sustainable enterprises) and ultimately creating or popularising a whole host of profit making products and services based on sustainable technologies and practices, which can be sold onwards as a comprehensive package (or in individual parts) and thus be exported to other states and other countries.

Certainly there will be glitches, difficulties, problems and obstacles to be overcome. This is unavoidable in any pioneer project - the whole purpose of which is to sort out these issues. The **final product will be a carbon neutral, self contained & self sufficient, minimal waste, high technology community which is immune to the impact of petroleum scarcity**.

This project will require multidisciplinary input from experts in many fields. In my process of organising talks on sustainability these past few years, I have been fortunate to make contact with many such knowledgeable, talented, capable and well meaning people with proven track records (please see appendix 1) and have learned much along the way. I am certain that shortly after writing this paper, much of the cutting edge technology I describe will become commercially available or may even be superseded by better options, given the rapid pace of progress.

For want of a better name, perhaps I can suggest the provisional title of "***The Gaia Village Project***".

A HOLISTIC PACKAGE EXTENDING FAR BEYOND ENERGY AND WATER ISSUES ALONE:

Many so-called "eco-villages" have sprouted up around the world, so what is so special about this project? Take for instance the "*Christie Walk*" eco-village in metropolitan Adelaide, a mixture of cottages and apartments where 27 families live on a half acre footprint. This community project has adopted excellent energy conservation and efficiency measures. In one study, the metered electricity power consumption during peak hour of 0.4kW per dwelling was just *one tenth* the peak usage of a standard Adelaide residence. They have also instituted efficient water

management systems.

The Gaia Village Project will however address far more than merely energy and water conservation and efficiency. The aim will be near total self sufficiency in all aspects of energy, water, food production, waste processing and recycling - on the way to become completely independent of fossil fuels - yet maintain a high quality lifestyle with many added social benefits.

BRIDGING TECHNOLOGY:

This pioneer project may allow some initial concessions to fossil fuels, for example the use of the hybrid electric/petrol or electric/diesel plug-in car. This will merely be a bridge to the goal of vehicles eventually being completely powered by renewable energy.

Neither can we begrudge Australians the essential gas barbeque on the balcony. It is likely that fossil fuel based pesticides and herbicides for agriculture will be necessary for the forseeable future.

THE PHILOSOPHIES OF RELIABILITY, EFFICIENCY AND USER FRIENDLY CONVENIENCE:

On the **supply side of the energy equation**, the emphasis will be on rock solid reliability, simplicity and low maintenance - if necessary at the expense of some efficiency. For example, with regard to residential solar electricity supply: cheaper, hail proof and idiot proof fixed flat photovoltaic panels (up to 15% efficient) will be preferable to more expensive solar tracking parabolic mirrors driving Stirling engines (up to 30% efficient) which could be blown off the roof in a gale. Much better to have a less efficient energy supply which works one hundred percent of the time than a more efficient energy supply which could break down half the time and require experts to be called in for maintenance. Similarly, we may find in time that non-directional vertical wind turbines are more reliable, robust and require less maintenance than directional "propeller" type turbines despite the latter being more efficient.

Using this philosophy, I predict a far more dependable electricity supply will be achieved compared to our existing coal-fired metropolitan electric grid, with its boringly predictable rolling blackouts every stormy summer.

On the **demand side of the energy equation**, the emphasis will be on ease of use, "plug-in and forget" technology. Ruthless efficiency will be adopted here, but will be built into the system and will not be user dependent - energy efficiency should not require conscious effort by the user, otherwise we are bound to fail. The resident will move from an existing old technology, energy wasteful household to a new technology, energy efficient Village household seamlessly and effortlessly. He/she will experience electricity savings of >90% without noticing any inconvenience whatsoever. The appliances will do all the work of energy conservation for the user, who will not need to go about frantically switching off devices throughout the house every few hours. Some examples:

Corridor lights: in many of today's buildings (especially offices), corridor lights are kept on all the time, day and night. However, corridor lights are only required when there are actually people walking down the corridors. Furthermore, electric lights will not be necessary in the daytime if natural sunshine is delivered to deep indoor locations.

Here is the solution: ambient daylight should be ducted indoors by one of the many systems already available eg "solar tubes" fed by light collecting lenses on the

rooftop. Artificial corridor lighting will be governed by the interaction of two sensors: when daylight declines (overcast day or nightfall) the corridor light sensor will activate a movement sensor. The movement sensor will then activate instantaneous LED lighting (no warm up time compared to fluorescent lights) if any movement along the corridor is detected and will turn the lights off 3 minutes after all movement has ceased.

A similar system may be useful for underground car park illumination.

Room lights: We all tend to leave lights on after leaving a room and the bulbs continue to burn for hours on end needlessly. A movement sensor for the bedroom is not suitable - for instance if one is motionless reading a book in bed it will be inconvenient if the lights suddenly go off. The solution here will be to use an infrared sensor which detects body heat rather than movement. Hence once a person leaves a room and no body heat is detected, the sensor will automatically turn the lights off 3 minutes later. The system will enable us to override the sensor and turn the lights off manually - eg. when one has finished reading one's book and wants to sleep.
Hence rather than "on" or "off" modes, the light switch modes will be:
"*conditional on*" ie. lights on only if body heat detected in room and automatically off 3 minutes after no body heat detected - and lights will automatically come on again if a person reenters the room.
The other mode will be "*unconditional off*".

Of course, if LED technology progresses to the extent that energy consumed by the LED lights is even less than that consumed by the infrared sensors, the above considerations will not apply.

Appliances on standby: If we know a household will be empty in the daytime when everyone is at work or school, standby appliances can automatically be turned off by a timer during that period. The standby mode can be automatically turned on at the anticipated time the earliest person returns home. This is probably something we should be doing right now.

METHODOLOGY:

The Gaia Village Project team leader (preferably an environmental or agricultural scientist *and* economist with a background similar to, say, Professor John Quiggin) will be assisted by a business manager/accountant. They will invite tenders and quotes from Queensland based entrepreneurs for the various projects. Tenders will not necessarily go to the lowest bidder but to the best value quote as determined by a list of sustainability criteria formulated by the Project Team and made public. The team leader will seek quotes from architects and planners (a good candidate would be a visionary designer with a background similar to, say, Dr. Elizabeth Farrelly), builders, solar energy and renewable electricity engineers, water and plumbing experts, drainage and waste processing engineers, agricultural scientists, farming consultants and various engineers (eg. recycling experts, refrigeration experts, automobile electrical engineers etc).

It must be emphasized that the business manager/accountant will be an adviser, assistant and facilitator to the team and not a primary decision maker. Final decisions must always be made by the team leader in consultation with other scientists and engineers based on big picture long term sustainable considerations.

Capitalism and market forces are useful tools when judiciously employed, however the economic flat earthers who assert that the unregulated free market will solve all our problems - people who know the price of everything but the value of nothing - are utterly deluded[1]. Adam Smith himself advocated that free market

forces must be tempered by socially just policies, to which we should add today that free market forces must also be tempered by environmentally protective policies.

The business manager will play an important role in negotiating tax exemptions from local, state and federal government for most if not all the pioneer subprojects (and the entire Project as a whole). For example, the land should be exempt from rates charges when under development, being a university research project in the service of the public good. As another example, property purchasers should be exempt from stamp duty in recognition of the inconvenience/teething problems which may be encountered due to the adoption of new technologies as well as the initial higher cost of subsidising local produce - in essence, for the privilege of being "guinea pigs". Indeed, the UK government has already legislated across the board that any new British homes reaching level six sustainability is exempt from stamp duty.

Residents will sign a pledge to purchase all food produced from local Village agriculture for, say, five years - the strongest possible incentive for residents to encourage the Village farmers to lift their game. Only if local staples prove quantitatively insufficient should external sourcing will be allowed (items not produced in the Village may be exempt eg chocolates, coffee, exotic spices etc). Obviously local Village food produced in 2008/9 will not be price competitive with industrially cultivated food generated by relatively cheap petroleum, thus we must ensure the economic protection of the Village produce during startup. However, a few years hence when the price of oil escalates, the situation will be very different and we can let market forces rule.

There will be no need for a marketing manager in the first instance as the number of dwellings will be limited and promotion can be achieved by word of mouth.

We should expect and perhaps even require that all those participating in the Project should buy into and live in the community. This will ensure that they have a vested interest in guaranteeing its success and especially in ensuring that their own particular project will be successful. For example, the designer/builder of the energy efficient fridge should live on-site and be available to fix any malfunctions of the residents' fridges. The same may hold true for the automobile electrical engineer and other pioneer entrepreneurs.

Ultimately all new eco-villages in future will have their own trained service personell-in-residence to maintain the community infrastructure.

I predict that outside the Project participants, there will be no shortage of Peak Oil aware people in the general public who would dearly love to buy into this Village Project, realising it is the best way to protect themselves against a dire future which is occurring much sooner than anticipated.

After final establishment of this proof of concept Village, we must lobby State and Federal governments to mandate that ***all*** new residential developments be established on these principles. The economic opportunities for these pioneer entrepreneurs (and other sustainable technology developers) will then become limitless. Multitudes of jobs will be created across the country as these fledgling companies expand, companies which may well become transnational in scope.

The final step to achieve a fully fossil fuel free society will be the retrofitting, refurbishment (or if not possible, redevelopment) of pre-existing habitations to conform to the principles of sustainability. **We must redevelop our sprawling suburbs into ecovillages and in the process free up wasted land to grow food locally.**

SPECIFIC ISSUES:

LAND and LOCATION:

If we anticipate most project participants will come from Brisbane, it will be practical to choose a land site no more than, say, 35km from the Brisbane city centre (and close to a train station).

The Ripley Valley (south of Ipswich) residential development - the largest in Australia's history - is commencing now. Developers anticipate a population of more than 100,000 (ie. the size of Toowoomba) - which will place unrealistic demands on the already overstretched water and electricity grids of Ipswich and Brisbane - unless they can become fully self sufficient in energy and water supplies (ie. along the lines of this Gaia Village Project) - which will be extremely unlikely.

We should also remember that at it's most economic, fresh water consumption by Brisbane city is about 400 megalitres per day, 30 megalitres of which is required to cool Swanbank Power station and 90 megalitres of which is required to cool Tarong Power station - high quality water (which exceeds drinking quality) which is literally lost as steam. Coal fired electricity is very thirsty for fresh water, a fact not appreciated by many people.

Development of the Ripley Valley based on the obsolete suburban model will be disastrous and will render it a white elephant in just a few years when petroleum becomes unaffordable. Unfortunately this development is a beast which seems to have gained unstoppable momentum. It appears unlikely we will be able to incorporate the Gaia Village Project in part or in whole into the Ripley Valley plan and we will have to consider another location.

Considerations of land area, soil quality, drainage, water sourcing etc. must be made.

SIZE and LAYOUT:

The team will determine the size of the land and size of the population for the Village predicated on the funds available. Funding should be sought primarily from State and Federal government however the private sector may also play a role. As income will be derived from sale of habitats and enterprises, additional bank loans may be sought to fund construction and infrastructure development. It may even be possible to fund the development of a small town. Layout will be determined by a planner/designer with a view to establish people friendly public spaces - especially a central market place for the sale of local produce and for social interaction. This central space may include alfresco bookshop cafes, a stage for live music performance, a podium for public speaking and debates for residents to voice their concerns and an area for art displays.

ELECTRICAL ENERGY SUPPLY and HABITAT CONFIGURATION:

The way we harvest and utilise electrical energy - and our energy efficiency measures - are intimately bound with the way our habitats should be configured. Such issues must be discussed together.

It is a no brainer that the primary source of electrical energy for the Gaia Village must be solar energy.

Solar energy is a grossly neglected and tremendously abundant resource in Queensland, the so-called Sunshine State. For instance, the Bavarian town of Freiburg, (where solar energy has taken off in a big way and almost every rooftop has a solar panel) receives solar energy insolation of about 3kWH per square metre per day, whereas Brisbane receives about 5kWH per square metre per day (averaged

over a year) and yet there is hardly a solar panel to be seen in Brisbane roofs.

Some definitions and numbers will be useful for those who may not be familiar. Energy is the capacity to do work, often described in Calories or Joules, however the electrical units we generally use are Watt hours (Wh) or Kilowatt hours (kWh). Power is the *rate* at which energy is delivered (or consumed) and the electrical units we generally use are Watts or Kilowatts.

Power = Energy/Time and **Energy (Wh) = Power (W) x Time(h).**

A air conditioner with a power rating of 1500W (or 1.5kW) will consume over *one* hour the quantity of energy of 1500 x 1 = 1500Wh or 1.5 kWh. A fan which with a power rating of 60W will consume over *24* hours the quantity of energy of 60 x 24 = 1,440Wh or 1.44 kWh. Thus running an air conditioner for *1* hour consumes *more* energy than running a fan for *24* hours.

Clearly air conditioning is a profligate waste of energy. Furthermore air conditioning does *not* provide superior comfort to the natural ventilation of a well designed habitat (augmented by fans if necessary), is less healthy and requires more maintenance. There will be no air conditioning in the eco-village residences. Neither will there be electrical hot air clothes driers - which are completely unnecessary and energy wasteful.

It is well proven that **present households**, using existing off-the-shelf technology, can massively reduce their energy consumption without sacrificing quality of life, and therefore **can be 100% powered by the Queensland sun**. For example, Wendy Miller (manager of the Queensland Sustainable Energy Industry Development Group or QSEIDG) and her family live in a renovated 1970's home which is both energy efficient (uses less than 4kWh per day) and is powered by solar roof panels (net *exporter* to the grid). In contrast, the current average Australian household consumes around 32kWh per day, largely representing waste heat generation from inefficient appliances, often neglectfully left on unnecessarily for excessive periods.

As a further living proof that all our essential mod cons can indisputably be powered completely by solar electricity, we can look to the example of those who live aboard sailboats. Real-life experience from live aboard yachties demonstrate that just 500W of solar panels placed flat under the Queensland sun (*without* periodic orientation to track the sun - which is unfeasible when swinging at anchor) and 800 amp hours (see section on Electrical Energy Storage below) worth of batteries are more than enough to run everything - a fridge/freezer, navigation equipment & radios, running or anchor lights, entertainment systems (including wide screen LCD TV), laptop computers, cabin lights as well as high drain (but briefly utilised) equipment such as a small front loading washing machine, microwave, vacuum cleaner and anchor winch. High drain items are best used only in the day however, when there is a surfeit of solar electricity available (although the anchor winch would cause minimal night time drain, being run for probably less than 5 minutes each time).

Some zealots can even reduce their household electricity use down to a miserly 0.8kWh per day despite running a fridge, microwave and washing machine! (Tom Chalko, *"The super low energy house"*, ReNew magazine, Oct-Dec 2007).

We have proof beyond proof, evidence beyond evidence that *all* domestic electrical needs can *easily* be met by the Queensland sun.

What principal criterion will determine the configuration of the Village habitats? I assert it will be the *amount of solar energy which can be harvested from the area of a standard sized rooftop on an overcast Queensland winter's day*. Fortunately there are few overcast winter's days in Queensland and it is the stormy

summer days which are more likely to be overcast - however due to the longer duration of the summer days, sunshine delivered on such overcast days should still be adequate.

As stated previously, the single level sprawling suburban dwelling with attached lawn is completely unsustainable and represents an excessive footprint on the ground. Placed end to end, these suburban plots quadruple our commuting distance to the city compared to 4 storey apartment dwellings. We must build multilevel habitats to reduce our footprint and free up surrounding land for local food production. But how high can we go? Would a ten storey building free up ten times as much land for growing food as ten single storey dwellings? The answer is no, and this is related to the energy requirement of each dwelling.

A 200W rated polycrystalline photovoltaic panel is about 1mx1.5m or 1.5m2 in area, hence 2000W or 2kW worth of panels will occupy 15m2 or only 10% the area of a 150m2 roof. 2kW of panels is more than enough to power all domestic electrical needs including an electric stove with convection oven *as well as an electric car*, given energy efficient devices (please also see the website for the "solar decathlon" competition in Washington DC in October 2007 where each house had to power an electric car with solar electricity).

A household solar hot water heating system will occupy even less rooftop area than the photovoltaic panels (about 9m2).

Thus in total, the energy needs of a modest sized dwelling can be met by less than 20% of the roof area, assuming optimum orientation of panels to the sun. However let us utilise a full 20% of roof area, adopting fixed mounted panels - to obviate the need for solar tracking which will add to the capital cost, complexity and maintenance - in keeping with the KISS principle.

Having demonstrated that the energy efficient single storey house requires only 1/5 of its roof area ("1/5 R") to meet all its energy requirements, it then stands to reason that a five storey building will have enough roof space to meet all the energy needs of all the dwellings under that roof. However a six storey building will require an extra area at ground level of "1/5 R" for the solar energy requirements of the sixth dwelling. An eight storey dwelling will require an additional "3/5 R" at ground level for the requirements of the three extra dwellings. A ten storey building would require an additional "R" at ground level for the five extra dwellings. Therefore a ten storey building would be better split into two separate five storey blocks, both with fully utilised roof spaces.

This simple concept is the reason why I believe that 4 or 5 storey apartment blocks will be the ideal habitat configuration.

This scenario is based on the assumption that the solar electricity will be harvested using current technology (up to 15% efficient) silicon crystalline photovoltaic cells, the rationale for which has been previously explained. If and when a more efficient (and equally robust) solar electricity system becomes available in future, or if we also utilise vertical surfaces for solar energy collection (eg. amorphous silicon coated windows - which look like tinted windows - have been used in the Ballarat University's Building and Construction training centre) then higher buildings will be feasible. However this may not necessarily be ideal. It is fair enough for 4 or 5 storey buildings to be constructed without lifts (the ground floor dwellings being reserved for those who have difficulty with stairs). Higher than 5 storeys however, many residents will expect lifts, with their additional construction and maintenance costs and significant energy consumption. Furthermore high rise towers are more likely to lead to dehumanising urban blight with less of a village atmosphere. For these additional reasons I believe 4 or 5 storey apartments without

lifts are the way to go.

In the absence of lifts, will there be a better way to move large items such as furniture in and out of units other than negotiating the stairwells? Many techniques adopted in the Village will be a matter of relearning old wisdom. Hence we may take our cue from the old warehouses of Amsterdam where the roof gables bear sturdy horizontal beams with pulleys, which enable heavy, bulky items to be rope hauled from barges floating on the canals to the upper levels of the warehouses, then swung inwards through large doors. The Village furniture removalists may adopt a similar system (using a transportable ground based winch) allowing even a grand piano to be lifted onto the balcony of the top apartment, then carried in via large sliding doors.

ELECTRICAL ENERGY STORAGE and BACKUP ELECTRICITY GENERATION:

To confuse things further, most boat electrical systems are based on 12 volts and battery capacity is quoted in "Ampere hours" or "Amp hours". As electrical power = current x voltage, one Ampere of current in a 12 volt system represents 1x12=12 watts of power, and one Amp hour (Ah) of energy in a 12 volt system represents 1x12x1=12 watt hours (Wh) of energy.

An 800Ah battery system theoretically contains 800x12 = 9600 Wh or 9.6 kWh of energy. In practice however, lead acid accumulators cannot be drained more than 30% from full capacity without being damaged, hence the available energy in a 800 Ah system would be 0.3 x 9.6kWh = 2.9kWh which would be sufficient to supply an energy efficient boat or house for one overcast day before needing recharging. Furthermore, these systems deteriorate after about 1500 charge/discharge cycles and must be replaced after about 4 years (although newer systems may last somewhat longer).

Fortunately, better energy storage systems are becoming available but have yet to reach economies of scale. The vanadium flow redox battery can be completely discharged without damage and has an operating life of more than 12,000 cycles (~33 years, assuming daily deep cycling). It can be expanded in size indefinitely to suit energy requirements (the energy is stored in the electrolyte) - perhaps one battery to supply a whole apartment block of 4 families rather than just one household[2]. It however has a rather poor energy density (about 30Wh/kg or 33kg/kWh). It was developed largely by University of NSW researchers, however as is the case of many Australian developed technologies (due to lack of financial support by Australian government) the commercial opportunities have been lost offshore. A cupboard sized redox battery can be imported from Canada and costs around A$30,000 however the cost will undoubtedly fall with economies of scale.

The zinc bromine battery, being developed by Murdoch University, has more than twice the energy density of the vanadium system but a lower operating life (>2000 cycles).

Whether vanadium redox or ZnBr systems, either will have far more energy availability than lead acid systems (a 10kWh rated system should have 10kWh available, not 3kWh as in the case of a 10kWh rated lead acid system).

Other energy storage options may be imminently available, but due to complexity or larger size, each energy storage unit might be better utilised to supply an entire block (or even several apartment blocks) rather than one per dwelling.

Some examples:

thermal storage: eg. phase change of molten salt, pressurised super heated water

chemical storage & thermal regeneration: eg. methane solar reforming or ammonia dissociation/recombination

mechanical storage: eg. compressed air systems

Most residential photovoltaic roof packages now commercially available in Australia are offered without on-site energy storage, the fluctuations being ironed out and night time electricity being supplied by voltage regulated grid connection.

For this Village project however, we should incorporate some form of energy storage for each home - but probably do not need to build in spare capacity exceeding one overcast day* due to the presence of backup renewable energy generators (see below) and partial grid connection.

Residences should be partially grid connected (a single high capacity cable connected to one transformer should be sufficient to supply the whole Village), to enable excess solar energy to be sold into the Brisbane grid on sunny days (which would be the vast majority of days in the year) and to enable the household batteries to be trickle charged from the grid and kept topped up, should backup Village generation be insufficient on overcast days.

The final goal is to be completely independent of the Brisbane grid (and hence coal independent) however. Therefore we must add a backup electrical generating system(s) based on renewable energy which can be utilised on overcast days. What sort of system or systems will these be?

Unless a high coastal land site is acquired, wind energy is unlikely to feature significantly. Even if in a favourable location, the wind will be intermittent (but may still have a role - see section later on water). Coastal Queensland is not as well endowed with wind compared to the Southern coast of Australia. Depending on geography and finances, wind energy may or may not be a feature of our project.

I believe a Village biomass electricity generator must be part of this project - which is integral to the agenda of zero waste. It has been said that "waste is just another resource in the wrong location". This is a motto worth adopting.

Methane produced from sewage can be siphoned off and burnt to generate electricity. Such energy plants are proven and are already functioning around the world - Portugal being one good example. This will have the added bonus of mitigating global warming as methane is about 20 times more potent a GHG as carbon dioxide. Furthermore, carbon dioxide emitted from the burning of biomass does not represent a net CO2 increase in the atmosphere.

A greater source of biomass energy will be waste plant, wood and paper products which instead of being discarded can be dry stored, and on overcast days can fuel the community biomass electricity generator connected to the Village grid to top up the household batteries.

There is a proliferation of biomass electricity generators in towns across Europe, particularly in Germany and Austria. They have elevated biomass utilisation to a fine art. They convert their wood waste to tiny pellets for burning - resulting in ultra efficient combustion and almost no ash residue.

Faced with the luxury of excess methane or wood on a day when the wood shed is filled to capacity - and if the day is sunny - excess biomass can still be disposed of in the biomass electricity generator and the electricity then fed into the Brisbane grid, thus reducing the coal fired electricity use of the Brisbanites and creating positive income for the Village.

(*If *all* backup systems fail, the household energy storage system will still allow a one day grace period to repair those backup systems, ensuring residents will not experience any interruption of supply.)

OTHER TYPES OF SOLAR ENERGY:

Solar electricity: The main reasons for choosing photovoltaic panels over other more efficient (but not necessarily better) forms of solar electricity generation were mentioned previously.

A few other methods are:

Solar thermal electricity: on a large scale, parabolic troughs reflect sunlight to heat water in tubes and power generators. On a smaller scale, parabolic dishes reflect sunlight onto bulbs which drive Stirling engines (which really should be called Stirling *generators*) to produce electricity

High efficiency photovoltaics: parabolic dishes concentrate sunlight onto high efficiency gallium arsenide photoelectric receptors to produce electricity.

These methods are more efficient (up to 30%) than silicon photovoltaic panels but tend to be ground based, thus occupying potential agricultural land. Their configurations are more complex and they are more costly on a small scale but become more economical on a large scale (when generating megawatts rather than kilowatts of power). Thus deserts may be the best locations for such schemes.

Placing solar panels on the roofs of buildings also eliminates long transmission distances and associated transmission losses.

Solar hot water heating: older technology systems had limited lifespans due to electrolytic corrosion. They were less efficient and needed roof mounted tanks. Newer evacuated tube systems are much more efficient, do not need roof mounted tanks and promise to have a much longer lifespan.

ENERGY EFFICIENT ELECTRICAL APPLIANCES:

The fridge/freezer will be the largest energy consumer and it is especially important to be ruthlessly efficient here. Taking our cue again from energy miserly marine appliances, we should adopt such technology for land based fridges and freezers. Some measures we should adopt are obvious such as using thicker insulation and changing the configuration to vertical opening freezer doors to prevent loss of cold air. The Danfoss company produces highly efficient compressors. An especially worthwhile but very simple system is the incorporation of a holding plate or "eutectic tank" in the freezer. The so-called eutectic mixture (usually either concentrated brine or propylene glycol) is a low freezing temperature liquid. In the daytime when solar electricity is abundant, the compressor is run to freeze the eutectic mixture. The compressor is turned off throughout the night but the freezer is still maintained under minus 15 degrees C because the eutectic tank "stores" the cold (this is reckoned to obviate energy storage equivalent to an extra high capacity lead acid battery). We can *easily* reduce daily electricity consumption for a family sized fridge/freezer to under 0.7kWh per day with good design.

Virtually all domestic lights will be "warm" (or "natural light") type light emitting diode (LED) lights which have a very long life of around 50,000 hours. These are becoming more energy efficient than the best compact fluorescent bulbs. Fluorescent bulbs are a less good option than LEDs. They pose a mercury hazard should they break, require a "warm up" time and many fluorescent bulbs cannot be variably dimmed.

There is no longer any need for energy hungry desktop computers. Notebook computers these days are fully featured and may use about 30W of power compared to a desktop computer using around 100W of power. Newer computers with high capacity solid state flash memories are now becoming available and will require even less energy (as they do not have a heat generating hard disk nor the need to run a fan to cool it).

LCD screens use two thirds less energy than the old cathode ray tube screens. The wide screen plasma TV is fast becoming the highest energy user in the household. Once again, recent advances in technology have enabled high definition LCD TVs to match plasma screens in quality (high contrast ratio, no significant motion blur etc) while using much less energy.

High drain but transient use appliances such as the front loading washing machine or the vacuum cleaner should be preferably used in the day when there is a surfeit of solar energy. It will be impractical to place such recommendations on use of the microwave oven or electric kettle however.

ENERGY EFFICIENT HABITAT DESIGN:

Climate control: Orientation of buildings, insulation, thermal mass incorporation etc. are all well known principles but poorly utilised in many current buildings due to a short term cost cutting mentality which represents false economy. The use of automatic extendable/retractable eaves (to control sunlight entering the dwelling) and automatic shutters (to control the natural flow of air) augmented by fans, will enable comfortable ambience to be achieved, the whole system being regulated by temperature sensors.

Daytime lighting: as mentioned before, natural daylight should be ducted into the deepest crevices indoors to avoid using electric lights in the day.

WATER:

As a result of the worst drought in more than 100 years in the year 2007, Queenslanders are now acutely aware of many water capture and conservation issues. Water is life.

We can anticipate future international conflicts - even wars - over water, for example between Ethiopia and Egypt over Nile allocations. Historically, settlements have always arisen near sources of fresh water which were usually rivers (although the Mayans had a unique underground supply of "Cenotes"). Australia, oft described as the driest inhabited continent, faces particular challenges. Some climate models predict a permanent El Nino effect as a result of global warming, which would ultimately render Eastern Australia as dry as the Atacama desert.

For our Gaia Village, the level of water security achieved will be proportional to the initial capital investment.

I assume in this scenario that well or bore water will be unavailable.

The lowest capital outlay will involve connection to the Brisbane water grid, however that will defeat the whole purpose of the project.

Sourcing water from a nearby lake, creek or river will be more expensive due to the treatment and energy costs (eg. membrane ultrafiltration) incurred, however it is possible such sources may dry up in the indefinite future.

The **ultimate level of water security** will be provided by locating the Village on the coast* in order to **source sea water** - which will of course never run out. This will also be the most capital and energy expensive option, requiring investment in a desalination plant and an additional source of renewable electricity to run it. Using renewable energy will represent a extra 30% availability of fresh water compared to using thirsty coal fired electricity (see comments on the Ripley Valley previously).

(*The Village and associated cultivated land should be located on land high enough to be unaffected by future sea level rises.)

It goes without saying that a system for recycling Village water will also be necessary. Reverse osmosis of recycled water derived from sewage uses only one

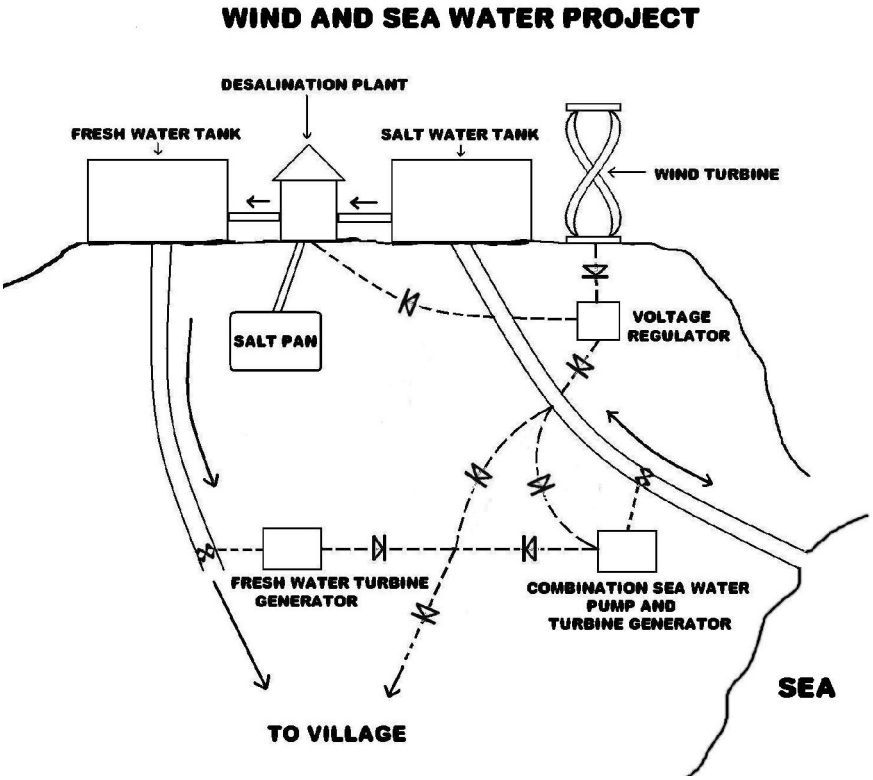
quarter the energy required to desalinate an equivalent volume from sea water. Recycled water can be processed to a quality far exceeding WHO health requirements (as proven and practised by the Public Utilities Board of Singapore).

Additional sourcing of water in the Village using roof fed rainwater tanks and storm water capture will opportunistically spare desalination & water recycling energy costs.

Residential conservation measures will be standard practice: dual flush toilets (perhaps even vacuum flush followed by high pressure water spray which will represent the ultimate in low water usage), low flow shower heads, triple plumbing (white, grey and black water systems) etc.

Thus the only requirement for "new" water (whether from seawater or rainfall) will be to compensate for evaporative losses which will largely be related to agriculture.

A coastal Village location with a nearby hill will give rise to a unique opportunity as shown in the diagram below:



In this scenario, windmills on the top of the hill pump seawater up to a storage tank which feeds a desalination system on demand, which then feeds fresh water into another storage tank. All flat surfaces here (whether on any tanks or the roof of the desalination plant) will also be used to collect rainwater, fed into a separate rainwater tank which can be delivered to the Village as needed.

The hilltop location means that water stored in the tanks represents potential energy which can be converted to electrical energy when piped downhill. Water and electricity supply to the Village can be adjusted according to their requirements at any particular time.

For example, on rainy windy days, the Village will lack solar electricity but

have plenty of fresh water. The wind turbines can directly generate electricity for the Village but can also pump up sea water up to the hilltop seawater tank. This seawater will *not* need to be desalinated at this time and can later be piped back into the sea after the wind dies down, in the process running the turbine in the sea water pipe and producing more electricity for the Village during that windless period. When *fresh* water is delivered to the Village from the hilltop fresh water tank, this can turn a turbine in the fresh water pipe producing electricity from another generator, again feeding the Village grid.

This wind power / water storage combination therefore represents a form of baseload renewable energy which will provide hydroelectricity on windless overcast days, in addition to the desalination function.

My understanding is that non-directional vertical wind turbines are less hazardous to birds (being more obviously visible than fast moving blades), can operate at much higher wind speeds, have less moving parts (and thus are less prone to breakdown and require less maintenance) and are quieter than standard directional wind turbines (most of the noise being generated by blade tip vortices). Noise should not be an issue anyway though, being located on the top of a hill away from the Village.

Water storage tank sizes will have to be calculated based on expected farming and residential requirements and may perhaps be the size of several Olympic swimming pools each (the rainwater tank will of course be smaller).

I fully expect that such a wind/water system will be the most expensive component of the Village project, but will be money well spent as a means of future proofing the community and ensuring indefinite water security. Skimping on water security is a false economy.

The obvious objection to this form of energy storage is that it is not energy efficient: the hydroelectricity generated by this system may represent perhaps only 15% of the original incident wind energy turning the windmills.

My reply to this objection is twofold. First, it is far better to store 15% of the energy of a strong breeze, than to have 100% of nothing at all if the project is not built. Secondly, it will not be an energy project alone but will be an energy/water project, fulfilling two purposes.

This system could even serve as a model to be used on a grand scale eg. a wind farm with massive water storage atop Mt Cotton to partially supply Brisbane with desalinated water and wind power with baseload hydroelectricity.

Water & Agriculture: Crop irrigation will represent the greatest water usage. Growing drought resistant plants and adopting efficient water management (eg the drip irrigation system invented by the Israelis) will be essential. Unprocessed rain water (and even grey water - for the phosphate tolerant plants) will be used in preference to desalinated water as the latter is energy costly. We need to rethink the sanity of growing rice and cotton in Australia.

HOUSEHOLD WASTE MANAGEMENT:

This routine will be the only lifestyle imposition placed upon Village residents, an exceedingly trivial imposition indeed.

It will be a requirement for all householders to separate their waste. Food scraps must be composted by each household (the compost bin can be located on an outside balcony - modern techniques can allow for an odourless process). Compost will then be collected by the waste/recycling worker and delivered to the Village

farmers. Paper, plastics, metallic items and electronic waste will be separated, then can be "exported" from the Village for later recycling (paper and cardboard can alternatively be burnt in the Village biomass electricity generator).

Householders will leave their waste for collection in biodegradable bags previously provided by the Village council and prelabelled with the householders' address. If it is later discovered that they are not separating their waste, the unsorted waste will then be delivered back to their doorstep, waste removal services will be suspended and they will receive community approbation until they do the right thing. Social compulsion in a small community is, I believe, far stronger and more effective than legislation, edicts or fines.

The task of household waste separation should be looked upon in a positive way. This physical ritual will give the residents a sense of engagement – a hands-on appreciation of their important role in "saving the planet".

SEWAGE PROCESSING:

Our linear system of using non-renewable fossil fuels to make fertilisers, which are poured on the land to grow crops, which are consumed by humans, then excreted as sewage, which may then be dumped directly into the sea (eg. Sydney used to pipe raw sewage directly into the sea) - is obviously unsustainable and is also damaging to the ocean ecosystem.

Natural fertility of the soil has been leached away and we are treating the soil as a hydroponic gravel bed.

We must recapture the lost nutrients and close the loop. The obvious measure here is to process the sewage in bioreactor tanks (from which we can also harvest methane for energy production) and the final detoxified sewage can be mixed with household compost and used as fertiliser. This system also requires that we stop pouring all manner of toxic chemicals, hormones and antibiotics down our toilets and sinks.

Raw sewage actually comprises 99.9% of water and this water component must be recycled as well.

FOOD PRODUCTION:

This is a field in which I claim particular ignorance and inexperience. We must glean the expertise of the ecologists, agricultural scientists and farmers on these matters. Many wise experts have spent decades and written volumes about these issues. Useful summaries include issue 14 (winter 2007) of *Pacific Ecologist magazine* which focuses on *food and agricultural security for the long emergency*. On the web, please refer to the ecologist Richard Heinberg's museletter #188, *"What Will We Eat as the Oil Runs Out?"*, a transcript of his lecture on November 22, 2007 which is also available as an MP3 podcast from the website of the Soil Association: http://www.soilassociation.org/web/sa/saweb.nsf/Resources/Podcast.htm

We need to address each of the steps in agriculture which now employ fossil fuels:

Agricultural machinery: We may have to consider electric tractors and harvesters. We may have to consider returning to the use of draft animals (oxen may be preferable as they eat straw compared to horses which eat grain and thus compete with humans for food). We know that growing crops for biodiesel to power all domestic vehicles is unethical and unworkable due to the vast amount of land required, however producing biodiesel only for farm machinery (which may use perhaps 15-20% of the farm land) may be worth consideration. Of course, if the *biodiesel from algae* projects currently being pursued around the world prove successful, the most

important machines we will need to run first will be the agricultural machines.
Fertilisers: use of detoxified human and animal waste and household compost. Possibly create a GM cereal which incorporates the nitrate fixing ability of legumes.
Pesticides and herbicides: GM technology here so far has proven a nightmare. We know that various animals including sheep have died after inadvertently eating BT cotton, a GM crop which expresses the insecticidal toxin of *Bacillus thuringiensis*. This approach for food crops is obviously unworkable. It may be possible to produce a GM crop which is selectively lethal to pest insects only (or interferes with their reproduction). However this should not be allowed on the market until after exhaustive multigenerational safety testing on mammals (and on "friendly" insect species) is completed. It appears that using fossil fuels for pesticide and herbicide production will be necessary for the foreseeable future.
Food transportation: as mentioned before, local agriculture will minimise transport requirements

As in other areas, we must also relearn the wisdom of the ages with regard to certain practices eg. crop rotation etc.

TRANSPORTATION:

Distances within the Village will be short and suitable for walking. Some may cycle occasionally. Those less physically able can use an electric tricycle. Shopping items can be transported in a wheelie trolley which can be converted to a bicycle/tricycle trailer.

National transportation solutions are beyond the scope of this paper. Development and certification of new car models cost billions of dollars and will not be addressed here. It is hoped that many residents will choose to commute by train to work, however it will be recognised that many Village residents will still need to use existing roads to commute outside the Village.

One Victorian company (Blade electric vehicles) converts the Hyundai Getz to a fully electric configuration with a range of 100km per charge at a cost of $1.30 based on the present price of coal-fired electricity. This is a 90% saving compared to the present petrol price and also represents a significant reduction in GHG emissions *despite* using coal-fired electricity. There will be *no* carbon emissions if renewable electricity is used.

For a longer range, modified plug-in hybrid petrol or diesel electric cars based on existing models eg. the Toyota Prius can be an option. Adding extra batteries and enabling the car to be plugged into the grid will allow for, say, the first 40km of travel to be by electricity only, after which the petrol engine can kick in. Thus those commuting within a 20km radius may not need to use any petrol at all. Who will modify the vehicles to the plug-in configuration? This is already being done by handy individuals in isolated examples around the world. The Gaia Village project could enlist a qualified automobile electrical engineer who would liaise with the Toyota company to ensure safety and warranty issues are not compromised.

Due to embedded energy of manufacture, material costs, resource limitations and even environmental damage resulting from resource acquisition, it is recognised that hybrid cars are not long term solutions to achieve full sustainability - but they do represent a useful bridge to that ultimate goal.

Another limiting issue is the relatively short lifespan of rechargeable car batteries. One other option, perhaps ultimately the best one, may be the compressed air car. Manufacturers claim a surprisingly long range of 150km and a speed of 110km/h (a factory is planned for Melbourne). This form of energy storage should have far greater longevity than batteries.

Fuel cell cars, whether they use hydrogen, methane or methanol, are not feasible at this time as the fuel cell membranes last only a few months.

SOCIAL ISSUES:

The Village farmers will be held in high regard as providers of community sustenance. The waste collectors and sewage processors will be viewed as vital members of the community. Those who maintain the electrical and water systems will be considered indispensable. These networks of interdependency will foster mutual respect.

How can we avoid tribalism and the development of a small town mentality? Cultural isolation will not be a problem due to modern telecommunications, particularly the Internet. Free movement and migration between different ecovillages will be encouraged. Such transmigration may be driven by social forces or job opportunities.

The expectation is that each ecovillage will develop their own particular manufacturing skill or service capability enabling trade opportunities between settlements. Job losses in the coal industry will pale into insignificance compared to the proliferation of new jobs created in the sustainable industries.

TIMESCALE:

The sooner the better. Start now. There is no reason why the Gaia Village project cannot be built (and be up and running) within a year.

COST NEUTRALITY and SAVINGS:

One major obstacle to the uptake of sustainability measures is the short term economic mindset which dominates the thinking of most people. Upfront costs of dwellings with solar energy systems, energy efficient configuration & appliances and triple plumbing will certainly be greater than the costs current dwellings, however we have clearly shown that such measures will enable ongoing energy savings of around 90%. Therefore, given enough time there will be great net economic savings which will result in cost neutrality and even long term cost advantage compared to an old style standard dwelling - particularly in a world where the price of coal fired electricity will very soon increase to reflect the real damage that coal causes to our environment.

A similar argument applies to water issues.

Upfront costs will certainly fall dramatically with economies of scale if and when legislation is passed to ensure these measures are adopted nationwide.

PROBLEMS OF EMBEDDED ENERGY and ENERGY REQUIRED FOR CONSTRUCTION:

It will be extremely difficult to construct the pioneer ecovillages without the power of fossil fuels, which is why they should be constructed NOW when petroleum is still relatively affordable - rather than waste billions of dollars on highway and airport developments which will represent wasted investments in just a few years. This same argument applies to our need to urgently and exponentially increase our public transport (especially rail) capacity NOW.

INDUSTRIAL/MANUFACTURING SUSTAINABILITY:

This paper focuses only on residential sustainability issues. To become a fully fossil fuel free nation, it will be necessary to run all our industrial and manufacturing processes on renewable energy. New Zealand intends to derive 90% of all its electricity from renewable sources by 2025, however it has a small population and is

blessed with wind, hydro and geothermal resources. China hopes to achieve 100% renewable energy electricity by 2050, an amazingly ambitious but necessary goal. They are certainly aware of the looming energy shortages, particularly affecting petroleum.

Hopefully large scale baseload renewable power generation will soon be feasible from solar thermal, photovoltaic and/or hot rocks technology (although the economic advantage to Australia from the solar thermal project was lost to California when Dr. David Mills left Australia due to lack of support from the Howard government).

We need to convert our factories to run on renewable energy. Currently, it takes about 5 years of solar panel usage to "pay back" the fossil fuel energy costs & carbon emissions involved in its construction. In Freiburg however there already is a solar panel factory which itself is largely powered by solar panels, dramatically reducing such "payback" time. Ultimately we must aim for all manufacturing to become carbon neutral.

MODIFYING THIS PROJECT TO SUIT OTHER AUSTRALIAN LOCATIONS:

I propose that pioneer ecovillages of this nature be established near all State capital cities, each project to be tailored according to the particular circumstances and needs of that location eg. wind power will figure more strongly in southern coastal cities, perhaps utilising compressed air in nonporous underground chambers for energy storage. Each regional project will enlist the help of local universities, scientists and engineers.

CONCLUSION:

George Monbiot, the environmental journalist, wrote that if you talk about the *problems of* Global Warming, people call you a Saint, but if you talk about the *solutions to* Global Warming, people call you a Communist. Old categorisations based on political labels are misleading and worthless. A more useful and accurate categorisation is whether one's thoughts, beliefs and actions are based on outdated, ethnocentric, ideologically driven delusions or whether one's thoughts, beliefs and actions are based on facts, evidence, reason and fairness. *Are you a member of the delusional based community or the reality based community?* I trust the reader belongs to the latter.

Our present unsustainable and wasteful lifestyle did not simply occur by chance. It did not happen out of the blue. It was created by a rapacious system of unfettered capitalism driven by industrial greed and cheap petroleum, with the enthusiastic collusion of short sighted venal politicians. It was created with scant regard to the environmental ravages unleashed (whether local or foreign) or to the social injustices visited upon the exploited "resource" countries.

Sheikh Zaki Yamani, the Saudi Arabian oil minister, at the inaugural OPEC conference, was asked whether the world would always depend on fossil fuels. He replied that the Stone Age did not end because we ran out of stones.

Similarly we must consign fossil fuels to the dustbin of history. The hurdles are not technological but are related to poor public education, understanding and acceptance; to lack of political will at the highest levels and to obstructive maneuvering by certain sectors - particularly the coal industry. The tired old argument by John Howard and his erstwhile resource minister Ian MacFarlane (who I previously described as an impenetrably stupid coal company stooge) ran like this: *Australia has been blessed with several gazillion dollars worth of high grade coal.*

How can we not *avail ourselves of it? Should we just leave it in the ground?*

My answer is yes, absolutely, LEAVE IT IN THE GROUND. The same goes for uranium. Their argument is identical to that of the psychopathic drug dealer who has a huge stash of pure heroin - and their moral standards are equivalent.

We must refashion the way we live based on the principles of sound evidence, scientific reason and social justice - for our sake, for the sake of our brothers & sisters in other countries and for the sake of all future generations. In the process, we will also secure our long term economic future well beyond the resources boom and will raise the prestige of Australia in the eyes of the world after more than a decade of Howard government moral bankruptcy.

We face a global emergency and have no time to lose. Action is required immediately.

Dr. Geoffrey Chia
Cardiologist
Brisbane
February 2008

DECLARATION OF INTERESTS:
Apart from a few poorly performing Telstra shares, the author has no financial investments in or obligations to any corporations or companies whatsoever. His proposals are based on his best knowledge of evidence and facts at the time of writing.

DISCLAIMERS:
All errors of fact inadvertently mentioned in this paper are the responsibility of the author alone. Credit for all factual accuracy goes to my colleagues in *Doctors for a Sustainable Population* and the guest speakers and knowledgeable participants at the Brisbane *Sustainability and Social Justice* meetings.

END NOTES:

1. The ultimate icon of free market foolishness is imported bottled water. It is doubtful if there is any product more criminally wasteful of fossil fuels and more environmental destructive (when balanced against any purported benefit). Imported bottled water flown from halfway around the world is a product of the unfettered free market driven by misleading advertising, distorted values and gullible consumers. A manifestation of globalisation gone crazy.

2. For social reasons it may be preferable for each household to have its own separate energy storage system rather than, say, one storage system for five households. Shared systems may lead to diffusion of responsibility and a "tragedy of the commons", leading to excessive consumption by individual households. People should be responsible for their own energy use and face the consequences if they deplete their own household supply. Each household should also have an energy meter to display how they are doing.

APPENDIX 1:
Sustainability & Social Justice meetings 2006-2007:

Meetings 2006:

10 February: DVD presentations on ***Petroleum Depletion*** **and** ***Climate change*** (included interview with Sir David King, chief scientist of the UK) and discussion

27 March: Dr Paul Prociv, retired physician and university lecturer: ***The state of Aboriginal Health***

28 April: Dr. Richard Mochelle, university lecturer, architect, futurist, philosopher and ethicist: ***Holonic Rurban planning for post-petroleum sustainability***

10 May: Dr. Peter James, retired geologist, mathematician and author: ***Political correctness and its role as an intellectual contraceptive.***

14 June: Ms Rachel Nolan, Labor MP for Ipswich: ***The politics of sustainability***

12 July: Dr. Andrew Burke, infectious diseases dept of RBH: ***Experiences in Sudan working for Medecins Sans Frontieres for a year***

August: nil

13 September: Mr. Ricardo Johansson, investigative consultant & ex US Navy officer: ***Accountable Democracy***

11 October: Assoc Prof Terry Flew, Head of Postgraduate Studies,
Creative Industries Faculty, QUT: ***The Mass Media: bouquets and brickbats***

8 November: Mr. Ross Daniels, QUT lecturer and former international president of Amnesty International: ***Human Rights implications of Climate Change***

December: nil

Meetings 2007:

February 2007 meeting: ***Solar Power - The viable solution***
speaker: Bill Brazier, B.E; Grad.Dip.A.C; M.E. Cert. Management, F.I.E.Aust; CPEng, President of Queensland Branch of the Australia & New Zealand Solar Energy Society

March 2007 meeting: ***Democracy in India: past, present and future***
speaker: Professor Sarva-Daman Singh, BA (Hons), MA, PhD (London), PhD (Queensland), FRAS.

April 2007 meeting: ***Sustainability as a model for water management***
speaker: Professor Chris Moran who is the Director of the Centre for Water in the Minerals Industry, Sustainable Minerals Institute, University of Queensland.

May 2007 meeting: ***More Ecologically Sustainable Living – the autonomous house***
speaker: Mr. Chris Palmer, Director of ENVIROTECH TREATMENT SYSTEMS
Chris' background is that of a civil engineer with post-graduate qualifications in Environmental Engineering.

June 2007: ***Global warming myths & the promise of renewable energy***
discussion led by Dr. Ralph Cobcroft, physician and sustainability activist

July 2007 meeting: ***Reason, interests and ideology in the climate change debate***
speaker: Professor John Quiggin BA(Hons),BEc(Hons),MEc (ANU), PhD (UNE), is an Australian Research Council Federation Fellow in Economics and Political Science at the University of Queensland.

August 2007 meeting: ***Water supply in SE Queensland - How real is the water crisis?***
speaker: Professor Jurg Keller is Director of the Advanced Water Management Centre at the University of Queensland and Professor in the School of Engineering. He has also an Australian Professorial Fellowship from ARC (Australian Research Council).

September 2007 meeting: ***Agriculture in the post fossil fuel era***
speaker: Dr. Jane O'Sullivan, Agricultural Scientist, School of Land Crop and Food Sciences, The University of Queensland

October 2007 meeting: ***Dead as a dodo – How serious is the current biodiversity crisis?***
speaker: Dr Judit Szabo, Biologist & Postdoctoral Research Fellow at the Ecology Centre at the University of Queensland.

November 2007 meeting: ***Zero Carbon Emissons now! Lessons from the Solar Decathlon***
Speaker: Phil Little has over fifty years extensive experience in construction, residential design and social planning and has been a pioneer leader in "Triple Bottom Line" "Sustainable Design" of new Urban forms since 1990.

December 2007 meeting: ***Past Peak Oil - What is your action plan?***
Group discussion

Meetings 2008:

February 2008 meeting: ***Who's afraid of an aging demographic? The need to broaden Australia's population debate***
speaker: Dr. Jane O'Sullivan, Agricultural Scientist, School of Land Crop and Food Sciences, The University of Queensland

APPENDIX 2:

How Petroleum Addiction has led to morally bankrupt American foreign policy and has directly caused (and funded) terrorism

There are two major connections between petroleum addiction and terrorism.

The first connection is glaringly obvious to everyone in the world except to certain Americans and Australians (and to a lesser extent, British) - who willfully ignore or deny it, contrary to indisputable current and historical evidence.

It is the fact that America's petroleum addiction and sense of entitlement have led to despicable foreign interference and interventions which have corrupted or destroyed foreign governments and caused tremendous hardship, deprivation and death to the citizens of those foreign countries. This has now resulted in a terrorist backlash.

America has designated petroleum as a strategic commodity, meaning they will not hesitate to go to war to ensure their energy security. They are the most heavily petroleum dependent country in the world with 5% of the world's population consuming 25% of the petroleum. Their society will collapse without cheap petroleum, but they refuse to reduce their oil consumption (or sign up to the Kyoto protocol) because, as Bush senior said, "*the American way of life is not negotiable*".

It is a historical fact that in 1953, Kermit Roosevelt, grandson of Teddy Roosevelt and a CIA employee, used a few million dollars to depose the democratically elected Prime Minister Mohammad Mossadegh of Iran. He bribed the Iranian media to spread lies about Mossadegh and hired mobs of thugs to riot in the streets, destabilising society and enabling the Americans to install Shah Rehza Pahlavi to power, who served as an American puppet and was willing to sell cheap oil to the West.

There is strong evidence the CIA assassinated Jaime Roldos, the democratically elected leader of oil rich Ecuador in 1981 and strong evidence the CIA were behind the coup against democratically elected Hugo Chavez of Venezuela in 2002 (according to American lawyer Eva Golinger), however in the latter case, Chavez was reinstated in a counter coup as he clearly had the popular support of the people.

Mossadegh, Roldos and Chavez were all democratically elected leaders of oil rich countries who chose to stand up to Britain and America and to redress the unequal financial contracts imposed on their countries in order to better the lot of their own impoverished people.

There are a multitude of other examples of outrageous American foreign skullduggery, the most famous being the overthrow (and forced suicide) of democratically elected Chilean leader Salvador Allende on 11 September 1973 by the CIA, with the installation of American puppet and brutal right wing dictator Augusto Pinoche who went on to kill thousands of Chileans in the years to follow. This conspiracy was denied by America for many years until the freedom of information act thirty years later brought the truth to light.

It is therefore clear that the assertions by the Republican Neocons (which were parroted by John Howard) that they targeted Saddam Hussein because he was a brutal dictator or because they wanted to bring democracy to Iraq were barefaced lies.

If the US establishment truly wish to see democracy in the Middle East, why do they not insist that free and fair democratic elections be held in Saudi Arabia, which is ruled by a corrupt self serving monarchy who oppress women and practice public beheadings? It is because the Saudi Royal family sell cheap oil to America. The

pursuit of cheap oil is the single consistent factor of American Middle Eastern policy – not democracy and not human rights.

There was no excusing the 11 September 2001 World Trade Center attacks, which were horrific criminal atrocities. But what was the motive behind the attacks? The first precept in any engagement is to know yourself and to know your enemy. What do we know of the enemy, Al Qaeda? We know the mastermind was Saudi Arabian. We know that 15 of the 19 hijackers were Saudi Arabian. We know that there is a deep grassroots resentment in Saudi Arabia against America because of the perception that Americans have corrupted Saudi society and have used their country as a military base – infidels on "holy" soil. We know Al Qaeda wish to depose the Saudi Royal family and to establish a Fundamentalist state by any means possible (the Fundamentalists would probably win if free and fair elections were held – another reason for the Americans to resist democracy in Saudi Arabia).

The American administration are acutely aware of these issues and know they will face economic collapse if their supply of cheap Saudi oil is suddenly disrupted. How then to hedge their bets?

It was no coincidence that the country they *then* decided to invade happened to have the world's second largest oil reserves - a country with no weapons of mass destruction, was no threat to the rest of the world and had no connections to any terrorism whatsoever*.

In an unguarded moment of uncharacteristic honesty, erstwhile Australian defence minister Brendan Nelson in 2007 admitted that our involvement in Iraq was related to our energy security. This admission was followed by furious backpedaling and denialism by the coalition government to retreat to the previous platform of shameless deceit constructed by John Howard.

Alan Greenspan, erstwhile chairman of the American Federal Reserve Bank, stated bluntly in 2007 that the invasion of Iraq was clearly directly related to the seizure of their oil.

How else has petroleum dependency led to terrorism? Former CIA director R. James Woolsey outlined this second connection succinctly when speaking at the 2007 Aspen Ideas Festival (videoclip available on the web). The Saudis receive about US$160 billion worth of oil revenue per year, US$5 billion of which goes directly to the Wahabis, a fundamentalist Sunni sect with whom the Saudi Royals have an intimate political connection and to whom they owe an obligation (historically the Wahabis helped the Saudis sieze power on the Arabian peninsula). About 90% of worldwide Islamist Madrases are funded by the Wahabis who preach a particularly violent, intolerant and hateful doctrine. American oil money therefore directly funds terrorism. Woolsey thus said to his American audience: if you want to know who is the major funder of terrorism in the world, look in the mirror.

*Only *after* the Americans invaded Iraq did it become a hotbed of terrorism. There is international consensus among intelligence communities that the Iraqi invasion has been a potent motivator for the recruitment of terrorists - as stated by the US National Intelligence Council, London's International Institute for Strategic Studies, our own esteemed General Peter Cosgrove and our Federal Police Commissioner Mick Keelty.

The vicious cycle continues.