Submission to the Senate inquiry on Fuel and Energy

With particular regard to paragraph "g" of the terms of reference.

"The role of alternative fuels."

Submitted by Danny Stewart

CONTENTS

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INTRODUCTION AND SUMMARY

My name is Danny Stewart. I am a medical practitioner and I have a Masters degree in Engineering. Two years ago I was invalided out of my medical work. To occupy my time I took an interest in Alternative Energy and found that before long I seemed to be as well informed as many of the media experts. I suspected that the previous government did not have a focus on this topic and as a result made several decisions that were rushed or lobby driven. I now believe that observation was incorrect and that the problem was that the government did not have an advisory body well informed about all aspects concerning Alternative Energy.

This submission is to encourage the government to create such an office or body, and perhaps an inquiry devoted solely to the topic of alternative energy.

We are facing an energy revolution we will have to navigate the many innovations and understand their consequences.

"*The heat is on*" is the title a 2006 publication by the CSIRO which looks to the future without considering the many novel energy processes which are here or on their way.

I submit to the government that we need a study which involves assessment of the alternative energy schemes here and on the way. Further I suggest the Government establish a Commission, an Office or Department of Alternative Energy to continue this study and advise the government and the Australian public so we can enter the energy revolution intelligently and knowledgeably.

Attached is an addendum "*An overview of Alternative Energy*" that catalogues the many optional sources ofenergy. Its purpose is to demonstrate the size and diversity of the alternative energy industry and the complexity of the task ahead. Most of the innovations described below have been tested and found to be successful; many are already used either here or overseas.

While researching this I have found a very prominent ally in the person of the American ex-president, Mr Bill Clinton who puts the case more eloquently than I can. He describes the alternative energy as a potential trillion dollar business. He compares the fossil fuel industry as being highly centralised with the oil companies in charge from oil exploration right through to petrol going into the customer's tank. By comparison the alternative energy industry is fragmented, diverse and divergent and unable to unite itself. Because of this, it is very unlikely that the fossil energy industry will move into the alternative energy industry. Any government that takes the responsibility of overseeing this industry and steering it to the future as a cohesive development will reap the rewards.

The analogy is in the world of sports, made up as it is of hundreds of sports each struggling separately to make its way. But when these sports are centralised and united as they are by the Olympics, they suddenly develop a power and a purpose which would otherwise be impossible.

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THE SUBMISSION

This submission recommends that the Government recognises the energy revolution as the change from fossil fuel energy to alternative energy.

The submission recommends that the Government takes appropriate steps to oversee and manage the revolution in Australia.

The appropriate steps would be to create a Commission, an Office or a Department charged with informing the Government and the people of Australia of the developments and

directions of the Energy Revolution and advising on research grants, start up grants, tax reliefs and other such encouragements as may be deemed beneficial to the industry.

The submission recognises the disparate nature of the alternate energy industry and the importance of integration and coherence of planning and development at a national level.

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ADDENDUM – AN OVERVIEW OF ALTERNATIVE ENERGY

ALTERNATIVE ENERGY

INTRODUCTION

THE TRILLION DOLLAR INDUSTRY

The manufacture of wind turbines is a good example of a potential alternative energy industry. Wind turbines are in high demand Order books are full everywhere. Current manufacturers cannot keep up with demand. There is little competition. The potential profit is much higher that in car manufacture.

Electricity production costs about $1500 - $2000 per kilowatt in set up costs using wind turbines.

The potential size of the industry for Australia is calculated very approximately as follows.

The total electricity consumption for Australia is 200 billion kilowatts

If 20% is powered by wind turbine, the setup cost will be $70,000,000

If we make our own turbines and export the same amount, that is a $140,000,000 dollar industry for 20 % of our electricity consumption.

If the calculations are similar for 100 % of our electrical production, using other technologies, it could be a $700,000,000 - $1,400,000,000 industry depending on the export level.

The option is to import all alternative energy devices. That will add at least 4% annually to the trade deficit.

As a proportion of GDP my calculations are substantially lower than Mr Clintons.

Either way there is no doubt that Australia can take charge of its alternative energy industry and stand to make very substantial gains, or not do so and make equally large losses.

Over the past century countries became rich by have the good fortune to own resources. In the alternative energy revolution good fortune will go to those who manage their energy industry judiciously. Liassez-faire will not be rewarded, quite the reverse, it will be penalised. We will be penalised and our children will be penalised.

ALTERNATIVE ENERGY

PART 1

WIND POWER

Wind has long been used as a source of energy. Traditional windmills were used mainly by millers to grind wheat into flour. They have also been used to pump water for farming use. The other significant use was sailing ships. That was good as far as energy use was concerned. (Unfortunately the great hardwood forests of Europe were destroyed to build the ships and the deforestation continues today.) These uses have largely disappeared and now we have large windmills that generate electricity.

The principle of using wind energy is straightforward. It involves using a propeller to drive an electric generator. The propeller will convert 60% of the wind energy to power. The wind energy increases with the wind speed squared, that is double the speed and get 4 times the power, triple the speed and get 9 times the power. The turbines are better sited in areas where

the wind is constant.

Wind turbines have become commercial and the design has improved mostly with the efficiency of larger machines.

The use of wind power has grow dramatically all over the world but more so in Europe. Germany leads producing 21 thousand megawatts, Spain 15, America 14 and India 7. One megawatt will supply between 250 - 1,000 households. Affluent households need more electricity. Ireland and Australia both produce about 800 megawatts. Australia is not leading the world, not by a long shot. New Zealand produces over 300 megawatts. Spain and Germany appear to be on the way to beating their targets. America seems to be starting to move ahead with the impetus coming from the individual states. India has become of the worlds largest wind turbine manufacturers. China has increased its 2020 target from 20 to 30 thousand megawatts and even talks of an eventual output of 250 thousand megawatts. Mexico, Brazil, France and Canada are very committed to a substantial use of wind power, as are many other countries. On a world scale about one third of our electricity comes from renewable sources, hydroelectric being the most established. On current trends, renewable source could rise above 50% by 2020.

Terminology. The terminology is not confusing. A “wind farm” is a collection of wind turbines. A “vertical wind turbine” uses updrafts. These may work in high rise area to power buildings using the power of the air rising between skyscrapers. The quoted power output may be confusing. It may be the maximum output that the turbine is a capable of, or the hourly output or the annual output at the maximum or the annual output reduced by a factor

of usually to 20 – 40% to account for the variability of the wind. A 1 mega Watt, 9000 megaWatt and 3000 megaWatt may be all the same .

Small windmills may be used to power individual houses. They are seen in rural Australia powering small water pumps where no other form of power is available.

Potential The use of wind generation is increasing and may provide 20% of our world power in the future. Given that over 30% of the world's power comes from alternative energy sources, the addition of wind power can bring it to over 50% on a world basis. Australia doesn't match these figures which suggest the urgent need for more relevant energy planning.

WIND TURBINES.

Problems The argument against wind turbines is wind variability. For instance, on very hot days people will use air-conditioners and the air-conditioners will use electricity, but on hot days the wind tends to be minimal. In practice windy places tend to be windy places all the time or nearly all the time and the supply is more or less 90% constant.

The other concerns are the noise and the fact that they can kill birds. These are not seen as major problems given a good planning system that allows migratory routes to be avoided and rare species to be respected.

There have been some statements about the number of wind turbines required in Australia with the inference that they would cover every inch of coast, whereas somewhere around 7 % of the coast would be adequate, with turbines in a single line. If they were banked up in 4 or 5 rows, the use would around 1% or less. These figures are not accurate the data 3 or 4 years old and turbines have become bigger and more efficient.

There is an argument that the turbine has to have a reserve generator in case the wind

drops and so does not reduce emissions. But the missing bit of the argument is that the reserve generator is only on for about 10% of the time, so overall 90% of emissions are saved. The saving is estimated about half a tone per megawatt hour.

. The wind turbine will run on average at about one third of its maximum output and will have down time due to insufficient wind of about 10%. A fossil fuel generator will have similar downtime and usually runs at about 20% of its potential over its lifetime

Land use Though wind turbines do use some land, they do allow most normal activities to continue around them. They may be spread over a considerable area, roughly 1 square kilometre per 5 megawatts base load equivalent. Care does have to be taken with aircraft and in particular, aircraft use for agricultural jobs such as spraying crops.

Harm Birds are killed by wind turbines, and more so if the turbines are constructed on migratory routes. In comparison one bird is killed by a car per year for every 5 - 6 people and about twice as many by collision with glass. Turbines are killing birds at the rate of between one per turbine to one per thirty turbines. Other forms of electricity generation pose a threat to bird life. The problem is real but currently not considered prohibitive. If the turbines are place about 2 kilometres offshore, no birds are killed. There is a possibility that the noise from the turbines may be transmitted under the sea and effect marine life especially whales. More research is needed.

Wild life Bats seem to be vulnerable to shore and off shore turbines but this area needs research as does the effect on marine life.

Humans There are three problems for humans. People working on the machines can and do fall off. Ice may form on the propellers and fall off as may parts of a damaged machine. The rotor needs to be lubricated so there is oil in the machine. If it overheats this may cause a fir. Because of the height the fires cannot be accessed easily and may have to be left to burn out. One fire is said to have caused a significant forest fire in Australia.

Opportunity Australia is not only lagging behind in the number of turbines, but we are missing the opportunity to manufacture turbines, a lucrative up and coming business, with little competition. Australia could build wind turbines

Opportunity. There is a possibility that sailing ships may make a comeback in the face of rising fuel costs and the desire for low emissions. Merchant shipping produces 4% of the worlds carbon dioxide output. (Twice as much as aircraft,) Australia could research and develop a new breed of sailing ships.

ALTERNATIVE ENERGY

PART 2

SOLAR POWER

The sun produces enough energy to power the world 6000 times over. Wind can do it twenty times over.

Terminology The term “Solar power” is associated with solar panels. There are two sorts of solar panels, one that heats water and ones that produce electricity and often the term is used indiscriminately. These are very limited uses of solar power.

Solar energy or solar power can be harnessed very significantly by house and building design and construction. “Solar efficiency” is sometimes used in this regard.

A “solar furnace” is a device that uses an array of mirrors to concentrate the suns heat. The concentrated heat may then be used to boil water for a steam turbine that generates electricity.

Potential Australia has more sunlight than most countries in the world. We can use all the different methods of harnessing solar energy. We have the intellectual base to research and develop new methods and devices. We could probably half the energy costs of most homes. We could ensure all new buildings are designed to use solar energy.

Problems The knowledge required to make significant use of solar energy is at our fingertips. The problem is the desire and support of the government to make the commercial environment secure and comfortable for the investors and consumers. Germany got off to a much better start than we did but we are improving.

Problems. Building regulations do not require energy efficiency.

Problems. Individuals may have the desire but need assistance to improve their properties.

Problems. Poorly designed grant schemes will be abused.

Opportunity Australia could reduce its overall energy consumption by 10 - 15 % in as many years by sensible legislation. That would reduce our greenhouse emissions by the same amount. If done well it could mean a similar level of saving in the household budget.

Difficulties. The greatest difficulty is managing the changes that need to be made. Solar panels are still expensive and not very efficient. They’re getting cheaper and more efficient and should continue to do so. There is the danger of profiteering if these improvements are not passed on to the customers. Lower production costs should be passed on to the customer.

Higher efficiency should allow the customer to sell more electricity to the suppliers, with an aim of zero cost to domestic consumers. Building design and construction will need to be guided through a period of change.

ALTERNATIVE ENERGY

PART 3

POWER FROM THE SEA

Power can be harnessed from the sea in four main ways. Energy can be taken from the tide moving in and out, the waves moving up and down, bodies of water moving through narrow channels and the difference in temperature between surface and deep water. Water power can be used for desalination with no need for additional power.

Tidal power

This means the power of the body of water that moves either up and down or in and out with the tide. There are a variety of devices which capture tidal power. They work 24 hours a day compared with solar powers limitations to daylight and clear sky. They are constant compared with the variability of wind power. They do have an output which reaches a maximum at half tide and a minimum at high and low tide. Depending on the particulars of

the site, a constant output can be engineered into the device.

Tide varies in different parts of the world. Basically what happens is the moon goes round the earth and as it does so its gravity pulls a bulge of ocean waters behind it. When waters rise and are pulled through narrow straits the rise may be higher. Where there are large areas of water that is relatively shallow the rise may be less. Also over a lunar month the pull will get weaker and stronger. Again the device can be designed to eliminate any effect of this variation.

Tidal rise and fall.

There are devices which rely on the rise and fall of the tide but these are more limited. There is one in France which has been in commission for more than 40 years producing about 70 megawatts.

The incoming tide fills an inlet and the water is released again at low tide through a turbine that generates electricity. This requires large sluice gates and water barrages constructed across a suitable inlet. The output is therefore intermittent, although ways have been found to even out the output. For example there may be two inlets and one may empty into the other and then in turn into the low tide. The inlet may be pumped higher than the high tide to give a higher head of pressure at low tide. The head equals the sum of the tide and the pumped head.

The construction of such a plant is on a very large scale and it requires a very suitable local topography and geography. There are about 24 different projects planned or even more advanced around the world and some of these will be built.

The cost will be high for the original construction. It would be very durable. So projects of this kind would be undertaken by government bodies rather than private industry.

Flow through a narrow channel.

The vast majority of applications rely on the flow of water rather than the rise and fall. The strength of the flow will vary according to the local hydrology and geography. The attractiveness of a site will depend on other local resources and local population. In Australia we have to look at the Torres Strait and the Bass Strait. We can also look at smaller plants in other areas. Sydney harbour for example would have a rush of water through the Heads, which make it ideal except that putting a sea turbine in the water at the Heads would be a massive engineering challenge.

The turbine or generator is much the same as a wind generator size for size it will produce 800 times more power, if the wind and water speeds are the same.

Generators of this sort have already been built and connected to the grid using 1 megawatt generators. One Australian firm, named '*Tidal Energy'* is making turbines for Australia and for export.

England, Ireland, Canada, Norway, Vietnam and America all have working generators. Technical innovation has made these turbines considerably more efficient and increased the power output by a factor of 3 or 4. I am referring to the shrouded turbine which is a technique whereby the flow of water of concentrated and effectively turns the turbine faster. The water is the same as a wind turbine and has an efficiency of about 60% and if the water speed is doubled the output increases by 4, trebled then by 9 and quadrupled, then increased by 16, that is to say the output is related to the square of the water speed. The shroud allows that increase in output by 3 to 4 times.

They do not harm wildlife and as they are partially or totally submerged they do not interfere with the scenery. They are expensive to install and so are best suited to remote locations

where there is no easier solution, although an inlet near a centre of population could provide a solution that requires no land.

The cost is based on repaying the initial cost and have been quoted around of 10 cents per kilowatt which is commercially viable. It is about 25% higher than other possible sources, but the conditions such as remote locations, islands not on the grid may negate the difference along with the fact that the supply is constant and reliable.

Ocean thermal energy conversion (otec)

With a reservoir of heat and a reservoir of cold, a gas can be cooled in the cold reservoir and then taken it to the hot reservoir. When the gas heats up it will also expand and that expansion can be used as a source of power. That is the essence of a heat engine. If a gas is selected that liquefies at a temperature between those of the hot and cold reservoir, then when that gas is cold it will be a liquid and when hot, a gas. The change in temperature will see a much greater expansion.

In order to run a heat engines there has to be a difference of around 20oC between the hot and cold reservoir.

Sea water has a surface temperature which reflects local conditions and goes up to 27oC in tropical regions. The water does not tend to get any warmer because at that temperature loss of heat from evaporation matches the heat from the sun and air.

In deep water the temperature goes down to around 5oC and that is the same all over the world. Deep water may be 1 kilometre down.

Anywhere where the surface water is 20oC or over and deep water is available then the conditions are right for a heat engine. Water is pumped from the deep water and a suitable

liquid is cooled to 5oC by the cool water and warmed by the surface water. The suitable liquid boils and expands and gives out energy.

This system is a refrigerator in reverse and so refrigerator liquids are ideal for the job and easily available.

OTEC gives you electricity. OTEC can also give you drinking water.

Where the deep water source is near a population centre the cold water can be pumped into the local buildings to cool them (OTEC would be used in the tropics or sub tropics). Cooling buildings in the heat demands as much energy as heating buildings in cold climates.

OTEC is suitable for the top half of Australia. The continental shelf mostly ends close enough to the land to be available, and the surface temperatures are right. The plant can be built on land or off shore.

OTEC allows you to do with less electricity, it will produce clean green electricity and stabilises the fresh water supply.

It comes at a reasonable price. Cheaper than a coal or oil power station to build and needs no fuel, that is without the large diameter pipe that has to go a kilometre down to get the cold water. That is the most expensive part of the process.

OTEC can produce electricity at or below the price of other systems.

There are OTEC plants in India and Hawaii. They have opened up a few more opportunities that may not have been expected.

Deep waters do not contain much marine life but do contain a large amount of nutrients and so the waste from the OTEC plant enriches local fishing.

Water in the deep water contains a small amount of nearly every known element. The amounts are so small that is not commercial to tap this source, but if the deep water is brought to the surface as part of an electricity generating operation, then extracting the

minerals becomes a realistic proposition.

OTEC needs large capital investment and it need research and development. Most of all it needs to be guaranteed not to be over taxed, or to have to compete with subsidised power suppliers. The government would have to get this one right. We would benefit. Our children would benefit. The planet would benefit. The process has been tried and tested. We need a government strategy that will allow OTEC to be tried, or at least have informed public debate.

CETO

CETO is the name of a process of that uses sea power to desalinate sea water.

The government has helped the Carnegie organisation to produce their prototype and are producing electricity and clean water. The process is environmentally friendly with no emissions and no fuel bills.

The process is like an enormous syringe. The plunger is attached to a weight on the sea bed, and the barrel of the syringe is attached to a floating balloon or buoy. As the waves come in they lift the balloon up and down and the syringe fills with water as it goes up and the water is pushed out when it goes down. The water that is pushed out goes ashore to push a turbine, which makes electricity. The water can also be pushed through a special membrane which is a sort of filter, but is special because it filters out the salt, and so produces pure drinking water.

Carnegie claims that about 300 acres would be sufficient to supply Adelaide, Melbourne and Perth (all southern mainland cities, they say) with all the water they need.

Other contenders

There are a number of other schemes to get power from the ocean. It is not possible to

predict which will be the most successful.

The Palmaris Wave Energy Converter is the first off-shore wave machine to be connected to the grid.

Oceanlinx has their Oscillating Water Column which has been built at Port Kembla and successfully tested. It has been selected by the Cornwall project in England as one of three wave power providers expected to eventually provide as much as 15% of the grid requirements.

ALTERNATIVE ENERGY

PART 4

GEOTHERMAL ENERGY

"Geothermal energy" can be the name applied to three slightly different sources of energy. One is at the surface, ready to use and the other are deep down and drilling is required. Geothermal energy is energy which comes from rock in the ground. They give out energy in the form of heat because they contain radioactive potassium, thorium and uranium. The level of radioactivity is low and not usually harmful. In these rocks the temperature may be anything from 150^{o}C to around 400^{o}C.

Mostly this rock is at a depth of 1 to 5 kilometres and it is the heat in this rock which generally considered as "geothermal energy".

Occasionally the effects of this phenomenon are seen at the surface in the form of natural springs. Hot springs are the result of geothermal energy, but the term "geothermal energy" is generally applied to the heat from rocks deep underground. It is not wrong to use the same

term for ground effect and the deep effect, but it may cause confusion.

Access to deep heat requires drilling. Hot springs energy can be tapped without drilling so the cost of using the geothermal energy is higher or lower depending on what you are talking about. It is important to be clear. We can use the term geothermal energy for hot rocks deep below the surface and hot spring energy for surface geothermal energy to avoid confusion. With water passed over these rocks the heat can be brought to the surface and used to drive turbines which drive generators to create electricity. (Hot springs can be similarly used to produce electricity but the potential is not so great).

Australia has knowledge of the underground temperature all over the country. Australia is a mining country and knowledge of temperature in mines and potential mining sites exists from one end of the country to the other.

There is hot rock all over the country.

Geothermal energy is brought to the surface by sending down cold water and pumping it up again when it is hot. The water gets from the down pipe to the up pipe by travelling through the cracks in the rock. Sometimes the rock is naturally cracked. If not, then the cold water pumped onto the hot rock boils and the steam forces the rock to crack. Rock has a grain or a natural direction in which it will tend to crack. In Australia, unlike the rest of the world the rock has a horizontal grain and tends to crack horizontally. That makes it easier to circulate the water. So Australia is particularly suited to developing and using geothermal energy.

The water circulates in superheated form. That means it is under high pressure and does not boil, even at well above normal boiling point.

When the hot water reaches the surface it goes through a heat exchanger. The liquid heated in the exchanger is used to drive an electric generator.

There is enough hot rock in Australia to energise the world forever. The supply is inexhaustible.

It is clean with no emissions and needs no fuel. The water can be circulated in a closed system so that the small amount of radiation is contained within the system.

This form of alternative energy has been well tested without problems and at a competitive price. However well it has performed overseas, it can do better here. This is the potential backbone of Australian energy.

There are different techniques of converting the heat to energy. Steam can be used directly from the hot rocks, superheated water can be use, or hot water can be used and the heat transferred to another liquid which then boils to drive the turbines.

Water can be sourced from underground or pumped underground from the surface.

The cost of the power is the cost of drilling plus the cost of the electricity generator.

The cost of drilling is fixed but the cost of the generator will depend on the output required and so a large plant can supply a city and a small plant can supply a village and the cost to the customer should be about the same. That makes it ideal for Australia.

Geothermal energy is constant and always on tap which unlike wind or sea energy.

In Kenya some 25% of power comes from geothermal sources.

Iceland has 25% of its electrical supply and nearly 90% of it’s heating from geothermal sources. It expects to be independent of fossil fuels in the future.

The Philippines develop about one seventh of its electricity from geothermal sources.

It has to be said that the terminology does not distinguish between surface and deep heat sources and most of these established sources are surface.

The most interesting development in Australia comes under the title of hot dry rock, which distinguishes from both surface rocks and rocks which contain water.

These hot dry rocks are found all over Australia but the area of interest has been south of Muswellbrook in the Hunter Valley. Hot rocks ($90^{o}C$) have been found at a depth of less than 2 kilometres (the deepest drillings for oil are up to 11 kilometres in America and 20 kilometres rumoured in Russia) and the studies suggested another body of hot rock ($270^{o}C$) at 5 kilometres. The Cooper basin also has major resource.

The nature of the geological structure in Australia makes the engineering for tapping these resources easier than in other countries, and therefore cheaper.

Once a site has been drilled, it expected to be productive for 30 years, during which time it would slowly cool down. It would then take 20 years for that site to recover and be ready for use again.

The three areas that have proven commercial hot dry rock thermal sources are south west Australia, the Cooper basin and the Hunter Valley. There is more than enough potential to replace coal or oil fired power stations with cheaper and cleaner electricity supply. The steam turbine units from the coal fired stations could be used in the geothermal power stations, reducing their setup cost.

The electricity supply is constant and uninterrupted.

The cost of electricity is comparable to other production methods.

Four large plants would supply all Australian electricity needs.

Domestic electricity could be supplied free or at a nominal cost.

ALTERNATIVE ENERGY

PART 5

ELECTRICITY

Electricity is not an alternative form of energy but maybe produced by alternative clean and emission-free processes. The energy may be used as a fixed or mobile power source.

Both sources may be used to power electric vehicles.

ELECTRIC VEHICLES

Electric vehicles are already familiar.

They are efficient, produce no emissions and very little noise and have few moving parts and so require little maintenance and have a long life.

They already accept such vehicles as electric trains trams, trolley buses, golf carts and

internal transport in airports, large shopping or industrial complexes and as motorised wheelchairs for the elderly and disabled.

There are two areas of development which will affect the use of electric vehicles, namely batteries and fuel cells.

BATTERIES

Currently batteries, lead acid batteries which are used in cars are heavy and give a limited range in electric vehicles of about 200 kilometres.

Lead acid batteries can be improved to be about a third lighter.

Nickel-zinc batteries can be made about half the weight and are already used in electric vehicles.

Lithium–ion batteries are cheaper and less toxic though they are technically more difficult to recharge.

The lithium-metal-polymer is a similar type of battery but it uses a paper-thin sheet of polymer between the metal plates instead of a liquid or paste electrode. These are lighter and equally reliable.

Other developments concern batteries which can be recharged rapidly which will increase the effective range.

Range should increase to 400 kilometres. Normal recharging would be overnight at low peak.

Recharging may be at service stations using rapid recharge or battery replacement.

It may be possible to recharge while travelling through an electric contact built into the road

Most new batteries can be recycled and designers want to reduce cost and toxicity.

The majority drivers do not travel more than 200 kilometres a day, and it is thought there

may already be a market for a vehicle with such a limited range, given the advantages of long life, low maintenance and costing about a quarter of a petrol vehicle.

Paris has introduced electric cars to its CBD which can be picked up and left anywhere in the CBD at the convenience of the user. It is aimed to have 4,000 electric vehicles available.

Such a scheme would work in other cities and in resort towns.

FUEL CELLS

Fuel cells are not batteries and not motors but fit somewhere in between. They use fuel and have exhaust. They do not make things move. They produce electricity.

The fuel goes through a catalyst usually platinum (which is very expensive) and has electrons separated which go round the circuit as electricity and come back to combine catalytically with the oxidant to form water (and carbon dioxide depending on the fuel used) as the exhaust waste from the process.

They may be fuelled with hydrogen or other fuels.

The hydrogen production may produce carbon dioxide.

Fuel cells are expensive to purchase, inefficient and heavy, but are emission-free (the emission is water).

Three fuel celled buses has had a successful three year trial in Perth.

Honda has released a fuel cell car in America, FCX Clarity. Holden/CSIRO and Mercedes Benz are working on cars with fuel cells (separately).

Monash University, (Professor Maria Forsythe,) have developed a polymer cathode that does not use platinum. This could make fuel cells 10 - 20 times cheaper. The polymer cathode is much more reliable than the platinum cathode.

The reasonable expectation is that long haul freight will be transferred from the roads to the railways which will be electrified. This will make roads much safer and freight haulage much cheaper.

For passenger vehicles electric cars will have increased range and easy recharging as batteries improve. It is hard to see the petrol car with its low efficiency as having a future, even in the hybrid form.

ALTERNATIVE ENERGY

PART 6

OIL FROM COAL

Historically oil was made from coal before oil wells were developed. Germany and Japan fought the last war using oil made from coal. Oil from coal fell out of favour because it was cheaper to drill for oil.

Australia made oil from coal during the war. But it did not continue after the war.

Coal contains oil. It can be extracted by several methods. The most efficient method seems to be the Low Temperature Conversion or Karrick method which is an improvement on the Fischer Tropsch method.

This method can be used be used to process different types of coal and it can also be used to process shale oil, lignite and importantly organ waste. Organic waste includes most domestic

waste and agricultural or forest debris. Domestic waste could supply 10 – 15% of oil required.

With the Low Temperature Conversion process one ton of coal is said to produce 0.75 ton of char (smokeless fuel) that will produce the same heat as 0.9 ton of coal without any smoke. It will also produce one barrel of oil that can be refined into fuel. It will release 3000 cubic feet ($95m^2$) of gas that is better than natural gas. A 1000 ton/ day coal power station would produce 100 megawatts of electricity and 200,000 litres of oil. The output can be varied. For example the gas can be processed into petrol.

In the 1930s the University of Utah trialled the Karrick process and compared it with previously used Bergius process. Karrick was twice as efficient. The petrol was as good as the tetraethyl lead petrol from drilled oil and gave up 20% more fuel economy.

Coal should be looked on not a fuel, but a chemical store. Having as large reserve of coal gives use the opportunity manufacture oil at well below world prices, should the oil crisis continue.

ALTERNATIVE ENERGY

PART 7

NUCLEAR ENERGY.

Nuclear energy or atomic energy is usually means energy created by radioactive uranium.

Nuclear energy can be produced using thorium instead of uranium.

Thorium is more plentiful and easier to mine than uranium.

A thorium reactor does not produce plutonium. It will burn plutonium.

Plutonium is the nuclear waste that is difficult to dispose of. It is essential to make atomic bombs.

There is nuclear waste from a thorium reactor that decays in 500 years and is easier to deal with than uranium waste which takes thousands of years to decay.

A thorium reactor is inherently safer than a uranium reactor because it cannot go out of

control.

Thorium reactors have been used in India and some have been in commission for 12 - 14 years. India has a large amount of thorium. India is expected to change to thorium when their uranium runs out.

Both uranium and thorium reactors are very expensive to commission and cheap to run.

FUSION REACTORS

Fusion reactors are very expensive and still experimental.

There is a European project called ITER (International Thermonuclear Experimental Reactor)

Japan is a partner in this project.

ALTERNATIVE ENERGY

PART 8

BIOFUEL

Biofuel describes any fuel derived from organic matter.

The term ‘agrofuel’ is sometimes used to describe fuel created from material grown on agricultural land.

‘Biodiesel’ is used to describe fuel created from material grown in non-agricultural land.

Unfortunately the terms are interchanged.

Ethanol is an agrofuel.

There is an argument against agrofuels because it can disturb the often delicate agricultural economy and drive land and food prices up and encourage forest clearance.

Ethanol is made from corn and canola.

Ethanol is a lower energy fuel than petrol (about 60% equivalent).

It is sold at a similar price to petrol, even though the producers have to pay about 23 cents less excise per litre and ethanol produces 40% less energy than petrol. E10 is sold at only 3 cent below the price of petrol, even though it is worth 6.9 cent less

The newer cellulose ethanol should be even cheaper.

Prices are driven by the market and not production costs

Ethanol sales are encouraged in Australia, America, China, India and South America.

Europe has reconsidered and is moving toward biodiesel.

Biodiesel can be made from any vegetable material.

Plants such as hemp (not the marijuana variety) or algae have been shown to be particularly suitable as they have a high yield and use land that is not otherwise viable.

Algae will grow in high saline soil.

According to American calculations an area about 100 kilometres square would supply Australia with all the diesel it needs from algae on saline soil.

Growth can be enriched with carbon dioxide.

ALTERNATIVE ENERGY

PART 9

HYDROGEN.

Hydrogen can combine with oxygen to form water. If hydrogen and oxygen are mixed and lit it will explode.

This explosion can be used to drive an engine. The exhaust is water.

Problems. Petrol has far more energy than hydrogen. Petrol comes in a liquid form that can be stored in a simple tank. Hydrogen has to be cooled to become a liquid because it is a gas at normal temperatures, and has to be stored in a pressure tank.

Petrol does not make a great hazard when cars crash, which is a bit of a surprise, but liquid hydrogen in a pressurised tank could be a serious hazard.

Hydrogen is expensive to produce.

Hydrogen may be made from oil. Carbon dioxide is emitted from the reaction.

Hydrogen may be produced by the electrolysis of water. This process consumes a large quantity of electricity.

ALTERNATIVE ENERGY

PART 10

CONCLUSION

The alternative energy industry is about to open up and the harvest will be rich. Those who reap the reward will be those who know exactly what they are doing. As a democracy, the people of Australia should be making the decisions, making the right decisions, and we and our children would be better off for it. To do so they need more knowledge than they have now.

The words used in nearly every branch of alternative energy have unclear meanings, or wrong meanings or misleading meanings.

It is often hard to distinguish between information from a disinterested expert and someone with a vested interest in some particular industry or part of it.

This submission has not covered energy security or economic implications. It has not enlarged on carbon dioxide emissions effects. It has been limited to a selection of innovations and is not comprehensive. The intention is to demonstrate the diversity, the expanse and the complexity of alternative energy and the need for integration, planning and management.

In conclusion I recommend coherent government driven action and feel confident that that will happen.

Disclaimer I have no financial or other material interest in anything mentioned above.

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