Ethanol as a bio-fuel from woody biomass – a future opportunity ?

Apart from a brief respite in the price of oil in recent months, the price has generally been escalating. There is reason to believe that peak oil production has been reached, and that in general the price will continue to escalate. Both economic and environmental factors are driving the world-wide search for alternatives to fossil fuels, and biofuels are one promising option.

Ethanol – a petrol alternative

Ethanol stands out ahead of most other options as an alternative to petrol. It is a good candidate for an alternative fuel for New Zealand's motor vehicles. Most of our cars could run on a petrol-ethanol blend. Initially, only a small proportion, say 5% to 10%, of the mix would be ethanol, but as time went on, vehicle engines could be adapted or even replaced to run on increasing concentrations of ethanol until petrol was largely phased out.

The wastes from New Zealand's vast forestry resources and from agricultural crops such as corn could be used to make bio-ethanol. Ethanol is widely used as a car fuel in Brazil, where it is made from sugar in sugar cane plantations. Brazil is making huge savings by producing locally made ethanol and imports a decreasing amount of expensive oil.

Cars are being manufactured called FFV's or flexible fuel vehicles. These can run on either petrol or a fuel mix containing 85% ethanol called E85. By producing its own ethanol as fuel, Brazil has strengthened its economy by reducing the trade deficit, and also by increasing the productivity of agriculture, the secondary industries that follow, as well as creating many jobs for its own people.

Manufacturing ethanol

The process of making ethanol from plants is pretty much the same as that for making whisky - fermenting of plant sugars to make alcohol. Consequently those plants in which the sugars are freely available, such as sugar cane, sugar beet and grains such as corn, will always have the advantage over other materials such as wood, straw and most other plant residues. The production of ethanol from plant sugars would require a change in our established pattern of agriculture in NZ. This may happen, but then there would be competition for the land between producing food and producing energy for vehicles.

Lignocellulosic materials, such as woody biomass, require an extra energy step requiring an enzyme or chemical process to break down the lignin and cellulose material to sugar. Naturally, this is more expensive, and is called second generation ethanol production. The technology for making ethanol from wood is a work in progress with new discoveries being made constantly. As the price of oil continues to rise, it is not a question of if, but when ethanol produced from wood will become economic. Although this would cost more than producing ethanol from sugar-containing plants, it would not disrupt our existing pattern of agriculture.

Processing waste wood

Since the amount of waste in commercial forests in New Zealand is particularly great at harvesting time, this would be the best time to collect and process the waste timber to manufacture ethanol. It may also be possible to do this at the time of a production thinning at mid-rotation for a crop of pine, if the trees are growing on an easy topography. This could all be accomplished by having a wood chipper on site during harvest time, which fills up a truck with wood chips from the waste timber, and this truck would transport the chips to the ethanol-producing plant. It has been estimated that the amount of timber wasted in a rotation of pine can be as high as 35%, which could be put to better use as ethanol.

The Bigger Picture

In New Zealand, a bio-fuel industry manufacturing ethanol (also bio-diesel) has the potential to make our primary industries more efficient and profitable. It could create new secondary industries with the processing of fuel, create thousands of jobs in the primary and secondary industries, and make our economy more robust. It would definitely make us considerably less vulnerable to international political upheavals and violent storms overseas (Gulf of Mexico etc) , which undermine our dependency on oil producing countries for our vehicular fuels.

There is much discussion going on about climate change being caused by greenhouse gases, particularly carbon dioxide, released by burning fossil fuels. Carbon that was locked into hydrocarbons (oil & gas) many millions of years ago, has been released into the atmosphere as CO_2 and this may be contributing to global warming. Bio-fuels such as ethanol and bio-diesel, however, recycle the carbon between plants which absorb CO_2 during photosynthesis and vehicles which produce it. As such, bio-fuels like ethanol are carbon-neutral.

Article by Rick Swan (Forest Grower and Private Teacher).

For more information, you may like to check out the following website links :

(1) Sites for ethanol based on woody biomass :

NZ Crown Institutes work on forestry-based NZ cellulosic ethanol :

http://xtramsn.co.nz/businessandmoney/0,,13273-6846487,00.html

Dutch PhD student makes GE yeast which will convert xylose into ethanol :

http://www.terradaily.com/reports/Producing_Bio_Ethanol_From_Agricultural_Waste_A_Step_Closer.html

Straw and Wood Chips in Line as Energy Sources :

http://today.reuters.com/news/articlenews.aspx?type=reutersEdge&storyID=2007-01-08T123610Z_01_N02280536_RTRUKOC_0_US-ENERGY-FUTURE-BIOFUELS.xml&pageNumber=0&imageid=&cap=&sz=13&WTModLoc=NewsArt-C1-ArticlePage3

Cellulosic Ethanol Plant to be built in New York State :

http://www.planetark.org/dailynewsstory.cfm/newsid/39605/story.htm

Making Ethanol from Woody Biomass More Economically :

http://www.technologyreview.com/NanoTech/17799/

Methanol and Ethanol and other useful by-products from wood :

http://www.insights.co.nz/products_processes_wc.aspx

Cellulosic Ethanol Prototype Plant to start up in the USA in 2007 :

http://www.ethanolproducer.com/article.jsp?article_id=2229

Article from NZ Forest Owners Association about producing ethanol from Forests :

http://www.nzfoa.org.nz/layout/set/print/forestry_bulletin/summer_2004/biofuels_need_a_leg_up

Bio-ethanol as a transport fuel produced from "sugary" plants, woody biomass and also whey, by the Ministry of Agriculture and Fisheries, NZ :

http://www.maf.govt.nz/mafnet/publications/rmupdate/rm10/rm-update-june-2002-04.htm

Article on producing ethanol from Forests from ScienCentral :

http://www.sciencentral.com/articles/view.php3?type=article&article_id=218392828

Energy Bulletin Report about a breakthrough in manufacturing Ethanol from Wood :

http://www.energybulletin.net/4291.html

Renewable Energy Access report about a breakthrough in manufacturing Ethanol from Wood :

http://www.renewableenergyaccess.com/rea/news/story?id=22228

Australian experience in how the difficulties in producing Ethanol from wood have been overcome :

http://www.turboweb.net.au/~nrrdb/privateforestry/eth_tim.htm

(2) Other ethanol and bio-fuel links :

The Royal Society of NZ has produced a report entitled "2020 Energy Opportunities". It was written by the Royal Society Panel on Sustainable Energy, and it goes into the points

that I have touched on in this webpage in much more detail. I recommend that you read it, if you have found this page of value. Download the PDF Files :
"2020 : Energy Opportunities Book 1 - Overview" and "2020 : Energy Opportunities Book II - Appendices" from this webpage :

http://www.rsnz.org/advisory/energy/ .

The current state in the evolution of cars running on renewable energy resources :

http://www.ens-newswire.com/ens/jan2007/2007-01-08-01.asp

Video : Bio-Fuels : Think Outside the Barrel by venture capitalist Vinod Khosla. Please note that this is about ethanol as a fuel when it is produced from sugar-containing plants, not woody biomass :

http://video.google.com/videoplay?docid=-5702888891289509l3

The Centre for Energy Research, Massey University, New Zealand :

http://ite.massey.ac.nz/researchandconsultancy/EnergyResearchWebsite/home.htm

Ethanol Fuel Cell Technology - a report from NZ's Industrial Research Ltd :

http://www.irl.cri.nz/newsandevents/innovate/Innovate59/ethanol-fuel-for-the-future.aspx

The following website shows that it is technically feasible to make your own fuel. You will need to get legal advice for the location where you would wish to do this. See your lawyer first before committing any money towards this :

http://www.dogwoodenergy.com/

Don's Auto-Pages on Alternate Fuels :

http://www.donsautopages.co.nz/alternatefuelslinks.htm

(3) Peak Oil and Climate Change :

Some of the problems and dangers and probems that lie ahead, even if we make a shift to bio-fuels may be found on the website that follows. There is a wealth of information here, and it is certainly a wake-up call for us all. Although it may paint a gloomy scenario in places, I must emphasise that the technology of the internet provides a synergistic means of finding solutions. This synergy will yield good results if it connects people whose minds and hearts are in the right space. I personally see bio-energy for fuels as an interim solution. Whatever the future holds, we have some huge challenges ahead of us, which can be solved of we work on it collectively. The website below is produced by Robert Atack, a Kapiti-based Energy Researcher :

http://www.oilcrash.com/index.htm

NZ Links about climate change :

http://www.eia.doe.gov/oiaf/1605/ggccebro/chapter1.html

http://www.climatechange.govt.nz/about/

http://www.landcareresearch.co.nz/research/greenhouse/climate_change.asp#temp