Victoria University of Wellington
Institute of Policy Studies Working Paper 2008/01

Commercial forestry and LULUCF for a "carbon neutral New Zealand": the "Leaky Bucket"

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This note

1. shows that commercial forestry can very easily secure carbon neutral New Zealand by 2022 (and sooner in combination with other likely measures).
2. proposes a "leaky bucket" framework for the post-2012 LULUCF* regime to secure the most benefit for 'N.Z. Inc.' from expanded commercial forestry and other land use improvements
3. discusses the geopolitical merits of a LULUCF regime focused on Biosphere Carbon Stock Management (BCSM) a strategy advanced in my editorial essay in Climatic Change of that title, forthcoming in print in April and available electronically since 29.x.2007 at http://www.springerlink.com/content/rt798740226381q8/fulltext.pdf

This note has its origin in a series of round table discussions on the topic of Climate policy conducted under the auspices of the Institute of Policy Studies of the Victoria University of Wellington in the winter of 2007, under 'Chatham House Rules. This version of the paper has been edited to delete references to other participants, in accordance with those Rules.

P.R. 1.ii.08

*Land Use, Land nUse Change and Forestry, an acronym in use since the 2000 IPCC Special Report on that topic.

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It has been shown http://ips.ac.nz/publications/publications/show/205 that carbon removals through biosphere carbon stock management (BCSM) is (if implemented successfully – by no means a foregone conclusion) a more effective mitigation strategy than emissions reductions. This note aims for a policy framework and post-2012 regime that takes advantage of the potential of BCSM

1 Commercial forestry as a tool for carbon management

Regeneration of slow growing natural bush refills a reservoir and then ceases to provide a carbon benefit. Thus the government's permanent forest initiative, while it may confer many side benefits, can provide only a temporary, medium term, contribution to climate change mitigation. This is *per contra* on-going commercial forestry, which, as mature stands are felled and replanted, acts as a continuing sink.

However, new commercial forestry, on previously unforested plantation lands, provides first a new and potentially very large reservoir as new stands are established each year, so as to yield an on-going supply of timber after the earliest-planted stand is harvested and replanted. Then, from the first harvest of the earliest stand, it provides an on-going sink. The sink comprises two parts: (A) harvested wood products that stock carbon directly and also indirectly through (a) leaving other forest [possibly bio-diverse tropical forest] standing within the context of overall global market demand for harvested wood products and (b) – under shifting relative prices in a carbon constrained world and maybe also under non-market policies to stimulate (e.g.) "more wooden houses" – substituting for C-intensive steel, concrete and aluminium and (B) bio-energy uses of currently wasted forest arisings, that result in fossil fuels being left underground.

A variety of models provided to me by New Zealand forestry experts suggest that ~8 tonnes C per Ha per year (~30 t CO_2 p.a. per Ha) is a fairly conservative number for total absorption over a 20 year rotation by commercial *pinus radiata* forestry. Not all the 3mHa of land described in the Royal Society study as 'earning less than $350/Ha-yr, not too steep, not too high, and not in tiny lots' may be suitable for *radiata*, but neither need all the commercial forestry driven by New Zealand policy be located in New Zealand – indeed it should not be, given the need to involve developing countries in land use improvement schemes if climate change mitigation is to be successful globally.

Carbon neutral NZ by 2022 at the latest

For arithmetic convenience (and to avoid Kyoto commitment period 1 issues) assume that there is zero growth for four years from establishment and that there follows 16 years of 10 tonnes C per Ha per year (37 t. CO_2) absorption before harvest. Then, if 150,000 Ha is converted to commercial plantations annually for 20 years, starting in 2011, to create a 3 m.Ha normal forest harvested from 2030 onwards (and to easily swamp the 'echo effect' that has been raised as a matter of concern in relation to the reduction/cessation of planting of Kyoto forests over the last 10 years) then the reservoir effect is as follows:

	Area established (m. Ha)	Area capturing CO_2 (m. Ha)	net C captured in year (m.Tonnes)	Cumulative C captured (m.Tonnes)	
2011	0.15	0	0	0	
2012	0.30	0	0	0	
2013	0.45	0	0	0	
2014	0.60	0	0	0	
2015	0.75	0.15	1.5	1.5	
2016	0.90	0.30	3.0	4.5	
2017	1.05	0.45	4.5	9.0	
2018	1.20	0.60	6.0	15.0	
2019	1.35	0.75	7.5	22.5	
2020	1.50	0.90	9.0	31.5	
2021	1.65	1.05	10.5	42.0	
2022	**1.80**	**1.20**	**12.0**	**54.0**	**[12mt C = 44mt CO_2**
2023	1.95	1.35	13.5	67.5	**~ = annual NZ emissions]**
2024	2.10	1.50	15.0	82.5	
2025	2.25	1.65	16.5	99.0	
2026	2.40	1.80-	18.0	117.0	
2027	2.55	1.95	19.5	136.5	
2028	2.70	2.10	21.0	157.5	
2029	2.85	2.25	22.5	180.0	
2030	3.00	2.40	24.0	204.0	= 898 m.t CO_2 (cf. B.A.U. NZ
2031	3.00	2.40	0	204.0	emissions = ~ 42mtp.a. 2011
2032	3.00	2.40	0	204.0	- 2030 = 840 m. t CO2)
2033	3.00	2.40	0	204.0	

And the continuing sink effect, after the normal forest has been established, from 2030 on, is an annual harvest of 24 m tones C = ~ 48 m.t. dry biomass, say 24 m t. timber for HWP + 24m.t. x 16GJ/t = ~ 400PJ.for bioenergy from collected forestry wastes (= ~ half NZ demand for primary energy). This yields carbon neutral NZ for 2011 – 2030 (or, on a year by year basis, by ~ 2022 – earlier still if other mitigation policies are successful).

Note that short rotation energy crops (e.g. *salix* proposed by RSNZ) can likely achieve carbon neutrality sooner, but this involves

(i) dispensing with the high value co-produced HWP fraction of the product and
(ii) large scale investment in bio-energy conversion plant at an early date, possibly before mature technology has been developed.

2. <u>A post 2012 forestry (and LULUCF) regime</u>

Most carbon removals systems, including forestry options, involve land use improvement with a large margin of error in determining how much CO_2 equivalent has been removed, e.g. both A (a) and (b) above (harvested wood products and new plantation avoidance of deforestation). However, B (carbon emissions reductions through fossil fuel displaced) is measured accurately by default since the benefit (national, and energy sector) is measured

in terms of reduced fossil emissions (though this may not so easily be sheeted home to the biofuel supplier). Similarly, with the current vogue for biochar soil amendment, how much biochar goes into the soil can be measured, but the CO_2 equivalent benefit from claimed methane and nitrous oxide emissions reductions, and from increased soil organic matter and crop yield, are less easily determined.

Although carbon removals is a very powerful tool for greenhouse gas mitigation, albeit hard to measure, an emissions cap generates a need for rigorous accounting. This was the root cause of the difficulty in negotiating land use change offsets in Kyoto (Arts 3.3 and 3.4) leading to complex rules and high transactions costs. Hence there have been only two Land Use Change projects under the CDM, neither forestry. Effectively Kyoto provides a small but perfectly formed teaspoon that is not much use for baling CO_2 out of the good ship Earth's Atmosphere: if the ship is sinking, a leaky bucket is much more useful. So for the atmosphere and posterity, as well as for NZ Inc., the aim must be to drive policy-desirable BCSM projects with minimal transactions cost, eliminating the 'additionality' aspect which, as has been noted, is an incentive for collusive dishonesty.

If conducted sustainably, any carbon using project or activity is necessarily more costly than if done without regard to environmental impact – most obviously burning fossil fuel while disposing of CO_2 to atmosphere. Thus 'sustainable best practice' should be the criterion for financial additionality while environmental additionality should be defined through a schedule of qualifying activities (both of these subject to review and upgrading in the light of ongoing technological advance). The implication here is that moves to take all LULUCF activities out of the emissions cap accountancy and shift them to a new 'leaky bucket' regime, should be welcomed, though this does not at present seem a likely direction for international negotiations. Short of that, the NZ negotiating aim would be to limit and/or prevent the inclusion of further LULUCF activities within the post 2012 cap.

The alternative approach is to establish targets for excluded activities (and/or excluded aspects of included activities) and to negotiate realistic policies and measures for their achievement (e.g. portfolio standards as a condition of emissions permit issue – see below) with the targets then treated as an easement (subject maybe to some discount factor) of emissions reductions commitments, and with the related negotiation of future assigned amounts taking as their context the negotiations on policies and measures. Such negotiations, conducted between experts in a truth-seeking atmosphere could follow the model proposed by Nobel Laureate Thomas C Schelling in his 1992 Presidential Address to the American Economists Association, building on the experience of post WW2 negotiations over Marshall Aid dispersals (one of a number of suggestions for implementing the UNFCCC, in his Address, that were lamentably forgotten by the Conference of Parties when it first met in 1995).

Achievement of such targets can then be driven by imposing conditionality on the issue of permits to firms at the point of policy obligation, effectively a renewable portfolio standard (or, more specifically, a carbon removals portfolio standard). Of course, necessary activity for meeting the conditions can be contracted out by such obligated firms. But if the permits are traded, responsibility does not transfer to the purchaser of the permit.

In the case of included activities (such as, presumably, Kyoto Art 3.3 Forestation) the conditionality would be direct – so much plantation forest established per 1000 tons CO_2 equivalent emissions permits (in the case of stationary emitters) or so much percentage of biofuels in the product sales mix (in the case of transportation fuel sellers).

In the case of excluded activities, conditionality would be by way of a 'leaky bucket' currency of Carbon Removals Vouchers issued in respect of independently verified sustainable carbon management projects – say 3 vouchers for a house built with best practice utilization of wood-based materials or 2 vouchers per Ha for methane and nitrous oxide emissions reductions on land benefiting from biochar soil amendment (assuming the actual tonnage of carbon in the biochar is an included credit in the post 2012 emissions cap accountancy). The precise numbers of vouchers for different activities conducted in different local circumstances in different countries would be the subject of the Schelling style negotiations mentioned above.

One advantage in New Zealand of this conditionality approach is that it distances government from negotiations with land-owners – it would be a commercial contract between land-owners and firms at the point of policy obligation (wholesale fossil fuel sellers, meat processors, Fonterra, etc.) with such firms having the option of going to land-owners overseas if New Zealand land is too valuable in food production.

The upshot of this arrangement would be firms at the point of policy obligation seeking contracts with entrepreneurs able to supply verifiable carbon removals projects. Then the psychology is quite different from an emissions cap regime: instead of a punitive zero sum game, such an activity-oriented approach releases entrepreneurial energy to get ahead with securing market share and competitive edge with new, policy oriented, technologies. And carbon neutral New Zealand – and a carbon negative world – could become practical realities soon.

Geo-political aspects of carbon removals (Biosphere Carbon Stock Management)

The bull point is, I think, that BCSM offers a way to side-step the North South impasse. The prospect is of investment by energy suppliers, cement firms, etc., from the North (and from advanced developing countries also concerned about 'energy security') in supplies of bioenergy raw material from the South (mainly the South, because that's where the land is, and where the good growing conditions are found). Likely also investment in processing plant (bio-refineries at the most sophisticated extreme, charcoal burning for co-produced biochar and bio-oil at the most primitive) to turn the raw material into easily transported biofuels.

These investments, and subsequent sales/exports of biofuels, would provide both hard currency to drive export led growth at the country level and sustainable rural development projects on the ground, relieving energy poverty and providing stimulus to meet numerous Millennium Development Goals in consequence. The likely scale of activity can be measured by the IEA's estimate of $30 Trillion over 30 years needed energy sector investment – not all of that on primary energy supply, say $10 Tr. But still a lot of money spread over the 4 Billion Ha (2.4b.Ha FAO 'potential' arable land and 1.4 current arable land, plus some degraded ex-forest land, etc.) envisaged to be improved under BCSM. This is $2,500 per Ha without taking account of any value from carbon emissions offsets. This DFI is clearly additional to ODA.

Secondly (given sweeping global success with related policy implementation, by no means a foregone conclusion) there is prospect of a return to pre-industrial CO_2 levels before 2050 as a response to the threat of dangerously accelerating climate change (although BCSM may need to be supplemented with albedo modification if there is rapid acceleration). This is because carbon removals – getting carbon out of the atmosphere and stocking it somewhere safer – is far more effective than emissions reductions. Thus carbon removals can be treated by individual Parties as a response to their duty under Art 3.3 of the Convention, without need to proceed at the speed of the slowest ship in the convoy (as with action by the COP under Art 4.2(d)).

So individual importing Parties could negotiate Bilateral Bioenergy Partnerships with land rich but otherwise impoverished exporting Parties, under which investment flows and export markets would be conditional on the adoption of sustainable best practice by the host country, with project-based best practice Vouchers, confirmed, e.g. by Veritas, being evidential of additionality. If dangerous climate change is imminent, this low transaction cost 'leaky bucket' approach is needed to bale out the good ship earth's atmosphere. Eventually, maybe through co-ordination by the G8's GBEP, convergence on agreed best practice would lead to adoption by the COP to a second and complementary Protocol hanging from Art 3.3.

Best practice conditionality would be dynamic and progressively up-graded through research and experience, leading to the service of numerous MEA's – for instance more Vouchers could be issued for energy cropping of perennial grasses established on desert fringes than for projects that did not serve anti-desertification aims. And land use planning as part of the country to country negotiation, could serve bio-diversity aims through establishing conservation areas, migration trails, etc. A billion Ha of new commercial plantations to meet long term demands for timber, co-produced with bioenergy raw material, would serve REDD objectives. Co-production of food and energy would realize potential synergies based on the capital injections noted above, *per contra* current experience with 'energy security' driven biofuels produced without regard to sustainability (e.g. corn-stach based ethanol and Indonesian oil palms).