



Economy-Wide Impacts of Biofuels from Forestry

Presentation to
Bioenergy Association of
New Zealand

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Outline

1. General equilibrium approach
2. Biofuel from new purpose grown forest
3. Biofuels from existing forest
4. Further research



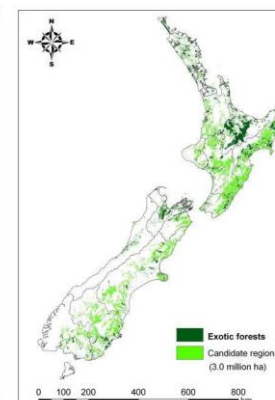
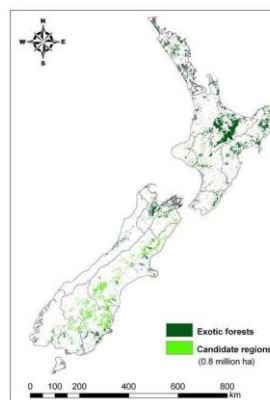
What is a General Equilibrium Model?

- Economic behaviour described by mathematical equations
household spending decisions
world demand for NZ exports
choice of fuels and factor inputs by industry
 - Wider ambit than traditional cost-benefit analysis
 - Economy divided into numerous industries (53)
 - Track flow-on effects from one industry to another; eg
energy prices -> industry costs -> competitiveness -> exports->
labour demand -> household spending -> other industries
 - Designed for "what if"? scenarios, not forecasting
 - Able to accommodate government policies
(tax, welfare, spending on infrastructure, user pays, subsidies)
- ...and external shocks (oil price rises, protectionism, some aspects of global warming)



Biofuel from Forestry to 2050

Purposely Grown Forest: 0.8m ha and 3m ha



Baseline Costs of Production

Capex	Enzymes to Ethanol			Gas + FT to Biodiesel		
	\$/litre	\$/MJ	\$/Peq	\$/litre	\$/MJ	\$/Peq
	0.620	0.0288	0.925	0.390	0.0115	
Feedstock						
Grow	0.410	0.0191	0.612	0.610	0.0179	
Road	0.040	0.0019	0.060	0.050	0.0015	
Log	0.270	0.0126	0.403	0.400	0.0118	
Transport	0.110	0.0051	0.164	0.170	0.0050	
Comminution	0.030	0.0014	0.045	0.040	0.0012	
Handling	0.010	0.0005	0.015	0.010	0.0003	
Enzymes	0.150	0.0070	0.224	0.000	0.0000	
Electricity	0.130	0.0060	0.194	0.130	0.0038	
Chemicals	0.030	0.0014	0.045	0.030	0.0009	
Fixed costs						
Salary/Wages	0.070	0.0033	0.104	0.060	0.0018	
Admin	0.020	0.0009	0.030	0.020	0.0006	

GE Modelling

Economy-wide effects of using the nation's resources to produce biofuels instead of producing other goods and services that are exported in exchange for imported oil.



All scenarios assume:

- No change in the total usage of labour
- No change in the total usage of capital
- No change in balance of payments

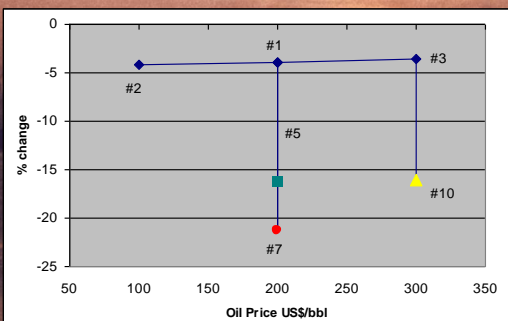
Hence economy-wide effects are entirely attributable to changes in:

- Productive efficiency
- Allocative efficiency
- Terms of trade

Effect on CO₂ Emissions

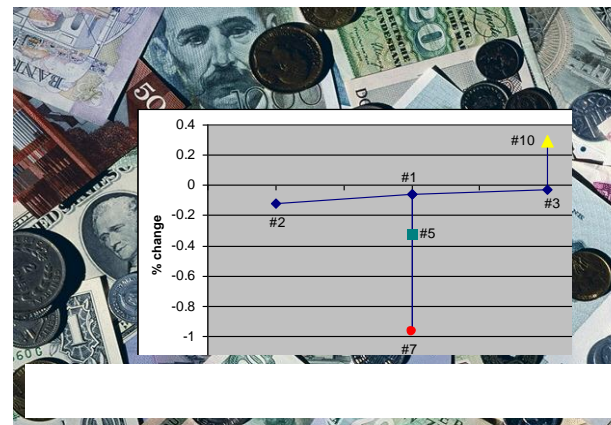
Scenarios

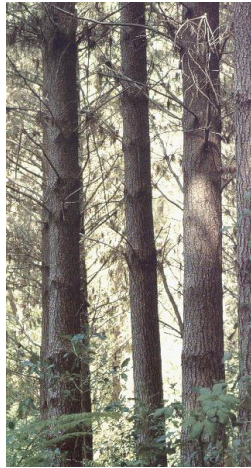
0.8m ha: (1) oil US\$200 (2) oil US\$100 (3) oil US\$300
 3.5m ha: (5) oil US\$200 (7) = (5) more agr land conversion
 (10) = (5) with oil US\$300, higher CO₂ price, lower costs 35%



Effect on RGNDI

...could be positive or negative



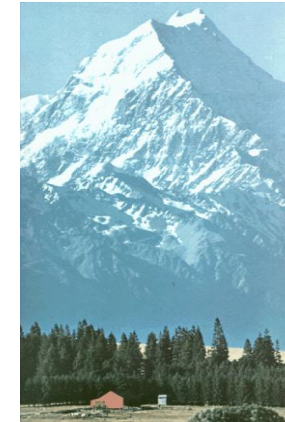


Why?

- If cost(MJ of energy from PGF biofuels) > cost(MJ of energy from imported oil) => loss in national productive efficiency; lower GDP.
- However, under high oil prices the economy benefits from an increase in the terms of trade.
- The production and use of PGF biofuels reduces CO₂ emissions.
 - ⇒ reduces NZ liability to purchase offshore emission units
 - ⇒ raises RGNDI.
- Increasing the efficiency of PGF biofuels production raises RGNDI as lower productive efficiency loss.

More Results

- Results sensitive to oil price and carbon price, but not sensitive to world agricultural food prices.
- Economic impacts of PGF ethanol and PGF biodiesel very similar.
- 3.5m ha scenario: loss of 0.6m ha in agricultural land (small amounts moving out of dairy farming and horticulture)
- If more land converts from agriculture (sheep and beef) to PGF - refer Motu analysis - the opportunity cost of PGF biofuels rises significantly, making a net welfare gain less likely.
- 3.5 m ha scenario: 28% of output from re-directing forest harvest out of lower value uses - chipping and pulp - into biofuels.



Existing Forest Instead of New Forest



Cheaper production cost: 12%-19% compared to purpose grown forest.
Also, no loss of agricultural land.

Scenarios

Alternative Wood Use (million m³)

	2006		2020		
	BAU	BAU	Biofuels		
			(i)	(ii)	(iii)
Log exports	5.0	10.7	10.7	10.7	
Timber & wood exports	4.5	6.7	6.7	1.7	1.7
Pulp & paper exports	2.5	3.8			
Domestic use	8.0	12.1	12.1	12.1	12.1
Biofuels			8.2	13.2	27.9
Total demand	20.0	33.3	37.7	37.7	41.7
Potential supply			30 to 57		

(i) 8.2 million m³, for 51.5 PJ of ethanol or biodiesel, \$50/m³

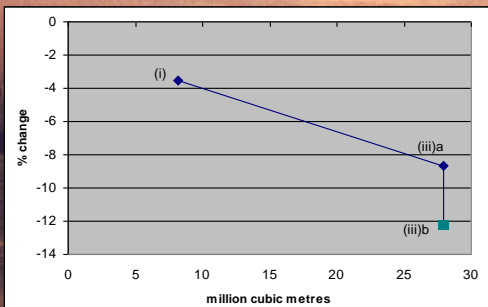
(ii) 13.2 million m³, for 83.3 PJ \$65/m³

(iii) 27.9 million m³, for 174.3 PJ \$85/m³

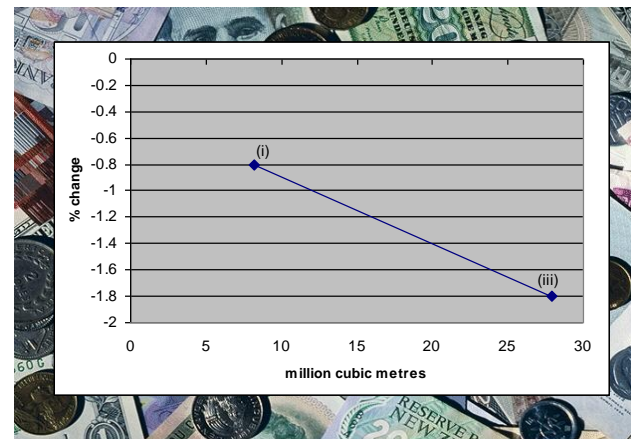
Effect on CO₂ Emissions

Scenarios

- (i) 8.2 million m³, 24.9 PJ of ethanol
- (ii) 27.8 million m³, (a) 84.3 PJ of ethanol or (b) 90.3 PJ of biodiesel



Effect on RGNDI



Why?

Save \$650m in emission permits (Scenario iii). But:

- ethanol costs 8.1c/MJ to produce,
- wholesale petrol price is 3.4c/MJ (in 2020; about 50% above current),

The difference x 84 PJ => total cost excess of \$3.9 billion.

So economic cost of biofuels v importing petrol is 6x CO₂ savings.



Net economic gain would likely require:

- Opportunity cost of trees closer to zero (analogy to loss of agricultural land in PGF scenarios).
- Even with NZ\$100/tonne CO₂ need oil price > NZ\$150/bbl.



Future Research?



Land substitution between scrub, agriculture and forestry



Economic Drivers:
National income break-even points wrt:

- oil price,
- carbon charge,
- production costs,
- value of agricultural and forestry products.

