

A Study of Employment Opportunities from Biofuel Production in APEC Economies – Preliminary Findings and Results to Date Phase I-III

APEC Biofuels Task Force Meeting Golden, CO



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INTRODUCTION – TERMS OF REFERENCE



Intro – Terms of Reference

The Terms of Reference for this project included:

- A Summary of the increment of Biofuel production that has occurred or is anticipated, in the farm and biofuels sectors across a range of APEC economies.
- An estimate of the additional employment that could be expected for men and women in APEC economies in the farm and Biofuels sectors.
- A synthesis of the aggregate result of potential Biofuels employment on GDP, balance of payments and trade.
- An identification of social, economic, educational and institutional barriers that might prevent women from participating equally in employment opportunities.
- A description of the models used to estimate the employment effects, including assessing quality of data inputs and the models' strengths and deficiencies.
- Sufficient analytic detail to help build capacity of policy makers.



The Five (5) Phases of the Project

The project was to be carried out in five (5) Phases:

1. Project scoping and review of existing information
2. Information collection
3. Information review
4. Draft Report
5. Final Report



Phase I and Phase II



Phase 1: a) Project Scoping

To keep the project manageable within the given timeframe, and within budget, the project team has focused on the following dimensions as the scope of the project:

- Calculating employment in ethanol and bio-diesel processing plants that are in operation or currently anticipated within APEC economies.
- Calculating employment in the farm sector, to provide feedstock inputs to the above-identified ethanol and biodiesel processing plants.
- Synthesizing available estimates of the “multiplier effects” from economic activity associated with Biofuels production.
- Synthesizing available estimates of the “opportunity costs” of Biofuels production associated with any employment losses in the oil production and refining sectors within APEC economies.

Phase 1: b) Review of Existing Information and Phase II: Information Collection



Key information sources, outside the project team, that we have used so far include:

- APEC (NREL), The Future of Liquid Biofuels for APEC Economies, 2008
- Cunha and Scaramucci, An Input-Output Model with Mixed Technologies, (Brazil)
- South African government, An Investigation into the Feasibility of Establishing a Biofuels Industry in the Republic of south Africa, 2006
- USDA, Economic Impacts and Value-added Benefits of Biofuel in the USA, 2002
- Santa Rosa (Florida) Economic Development Council, an Evaluation of Biodiesel Production Feasibility in Santa Rosa County, 2005
- U. of Minn., Opportunities and Issues Surrounding Ethanol as a Renewable Energy Source
- Dr. Joy Clancy, University of Twente, Netherlands – Biofuels and Gender issues
- Prof. David Swenson, U. of Iowa – Biofuels Modelling
- Dr. Hosain Shapouri, USDA – National perspectives on the Biofuels industry in the USA

The existing knowledge and databases of project team were also referenced.

APEC Current Ethanol Production (Estimates)



APEC Economy	Primary Feedstock – Ethanol (in order of importance)	Current Production – Ethanol Amount (ML)	Current Production – Ethanol Year/Estimated	# of Current Operating Processing Plants -Ethanol
Australia	sorghum, wheat, sugar cane	83.60	2006/07	4
Brunei Darussalam	n/a	0.00	2007E	0
Canada	Cereals (corn77% and wheat)	931.00	2008E *****	16
Chile	n/a	0.00		0
China	Corn	1593.00	2008E *****	8
Hong Kong, China	n/a	0.00		0
Indonesia	Sugar cane molasses	140.00	2007	???
Japan	Sugar cane molasses	0.03	2008	???
Korea	n/a	0.00		0
Malaysia	n/a	0.00		0
Mexico	n/a	0.00		0
New Zealand	Whey (a by-product of dairy indust.)	5.00		1
Papua, New Guinea	n/a (but cassava upcoming)	0.00		0 (1 under const.)
Peru	n/a (but sugar cane upcoming)	0.00		0 (2 under const.)
The Philippines	n/a	0.00		0
Russia	n/a	0.00		0
Singapore	n/a	0.00		0
Chinese Taipei	n/a	0.00	E ****	0 (2 planned)
Thailand	Cane molasses (8 of 9 plants)	192.80	2007	9 (9 under const.)
United States	corn	35741.00	2008E *****	135
Viet Nam	n/a	0.00	2007E *	2
APEC Total		38686.43		

APEC Current Biodiesel Production (Estimates)



APEC Economy	Primary Feedstock – Biodiesel (in order of importance)	Current Production – Biodiesel Amount (ML)	Current Production – Biodiesel Year/Estimated	# of Current Operating Processing Plants - Biodiesel
Australia	animal fats, used cooking oil, canola	117.00	2007E *	9 (maybe some offline)
Brunei Darussalam	n/a	0100		0
Canada	animal fats, used cooking oil, canola	105.00	2007E *	4
Chile	n/a	0.00		0
China	Used cooking oil, acid oil	117.00	2007E *	7 ***
Hong Kong, China	Used cooking oil, animal fats	4.30	2008 *	1
Indonesia	Palm oil	1550.00	2007	???
Japan	Used cooking oil	3.00	2006	???
Korea	Imported soybean oil (80%)	50.00	2006	15
Malaysia	Palm oil	217.00	2007E *	5
Mexico	animal fats, used cooking oil	15.00	2006	6 ***
New Zealand	Tallow (a by-product of meat industry)	20.00	2007 E ***	3
Papua, New Guinea	Palm oil, coconut oil (much smaller)	7.00	2007E *****	2 *****
Peru	Palm oil (jatropha under consideration)	127.00	2008	1
The Philippines	Coconut oil	257.00	2007	7
Russia	n/a	0.00		0
Singapore	Palm oil, soya oil, used cooking oil	35.00	2007E *	5 (with more coming soon)
Chinese Taipei	Used cooking oil, soybean	3.80	2007	5 (with 1 under const.)
Thailand	Palm oil	58.00	2007	9
United States	Soybean oil	2225.00	2008E *****	165
Viet Nam	animal fats, used cooking oil	0.00	2007E ***	0 ***

An aerial photograph of a long, straight road that stretches from the foreground into the distance, vanishing at the horizon. The road is flanked by fields and is set against a bright blue sky filled with large, white, fluffy clouds. The overall scene is bright and open, suggesting a path forward or a journey.

Phase III

Phase III: Information Review – Types of Models



1. **Input-Output (I/O) Analysis**

- Calculates the direct and indirect impacts on employment
- Very data-intensive
- Difficult to apply to a particular sector or generalize from a specific facility

2. **Social Accounting Matrix (SAM)**

- Modifies I/O to cover a given geographic region over a 1-year timeframe
- Charts “cash flows” within a regional economy, and then works backwards to calculate impact of a given sector or facility

3. **Spatially Explicit Equilibrium Model**

- An equilibrium model that assesses impacts on food supply from biofuel production

4. **Hybrids**

- Combining models in order to integrate results from different sources and calculations
- Combining models so as to create “larger picture” assessments (e.g. throughout APEC region rather than merely economy-specific)

Case Studies – 1. Brazil Ethanol From Sugarcane



- Ethanol production has been a high priority for Brazil, with 2006 output of 18 billion litres, equivalent to 25-30% of automobile fuel. Almost 4 billion litres were exported.
- Processing plants remain capital-intensive and highly mechanized, limiting direct job numbers (approx. 50 workers per typical 200M litres/yr plant).
- However, feedstock growing and harvesting is labour-intensive and this contributes to job-creation – about 300,000 sugarcane workers.
- Data from this case study provides reference points, to calculate feedstock requirements for supplying a processing plant, and therefore implied employment on the necessary land area.
- However, the general literature suggests numerous employment challenges remain in sugarcane harvesting, including:
 - Relatively low wages
 - Difficult working conditions, with limited opportunity for gender equality
 - Vulnerability to displacement from mechanization of farms, as Brazilian economy accumulates capital.



2. South Africa – Impact on Economy

- The South African National Biofuels Task Force developed an I/O model to investigate the feasibility of establishing a Biofuels industry, and calculating the employment impacts.
- The industry could be based on sugar cane and maize (corn) for ethanol, and soybean for bio-diesel.
- The processing plant total employment (including indirect) implied for E5 and B2 in S.A. would be only 4500. Moreover, the oil refining sector would lose from 200 to 1,800 jobs.
- The agriculture sector, however, would create 30,000 new jobs.
- Moreover the total effort would add up to 0.4% to GDP, and 0.6% to the growth rate.
- There would be a 1% reduction in foreign expenditures, to improve the balance of payments.



Phase IV – Draft Report





Phase IV – Building an APEC Employment Model

- The project team is currently constructing an employment model for biofuels that will give quantitative projections of the employment opportunities across all APEC economies.
- The model is based on the individual biofuel plant. This gives employment in processing.
- From the case studies data, the implicit feedstock quantity can be quantified, based on the size of plant and type of feedstock.
- The implicit agriculture sector employment can then be calculated, based on the level of mechanization of the economy.
- The employment implications can also be double-checked, by comparing:
 - the implied wage levels X number of workers on the one hand; to
 - the total value of the output of the plant, less a capital investment return factor, on the other.
- The project team is assuming:
 - oil prices remain above approx. \$50/barrel, making biofuels competitive;
 - any biofuel production can be absorbed domestically, or that any exports come from capital-intensive, mechanized, agriculture and processing plants sectors; and,
 - that APEC oil exporters can still retain their markets.

Some Possible Emerging Results



- The direct employment opportunities for biofuels processing plants is limited. The technology is well-known but capital-intensive. Increasing the scale of operations does not proportionally increase number of jobs.
- The employment opportunities in the agriculture sector can be substantial in emerging and developing economies. However, there are substantial challenges in terms of work quality and gender equality.
- Increasing mechanization, as an economy accumulates capital in the agriculture sector, limits or actually reduces these job numbers.
- A promising set of employment opportunities lies in an economy developing a Knowledge-Based Economy (KBE) agriculture sector.
- Biofuels can be seen as providing high-quality, highly-skilled jobs in a high-wage agriculture sector. Direct employment would be low, but there would be strong economic multipliers that would allow development of ancillary goods and services, such as machinery and equipment.
- Gender equality would also be more feasible, in a general context of higher education levels.