Implications of Findings of APEC Biofuels Task Force for GHG Impact Analysis Needs

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Biofuels development and use depends on several key factors:

- Biofuel Economics (cost of ethanol vs. petrol and biodiesel vs. diesel)
- Biofuel Trade Opportunities (created by production cost differentials
- Biofuel Infrastructure (cost and time to build biofuel filling station network)
- Fuel-Flexible Vehicles (practical path of uptake into the automobile market)
- Biofuel Resources (current and potential availability of biofuel feedstocks)

Biofuel Economics and Trade

- Biofuels from a variety of feedstocks are cost effective at current oil prices, and the options are expanding.
- Cost differentials for biofuels produced from different crops in different places mean significant opportunities for biofuels trade.
- Performance-based biofuel standards can encourage international trade.
- Case studies of biofuels from different crops and places can identify which opportunities contribute to environmental sustainability

Cost of Biofuel in Brazil

- Various studies indicate that Brazil can produce ethanol from sugarcane for an overall cost between $US0.20 per liter and US$0.30 per liter.
- This would make Brazilian ethanol competitive with gasoline at crude oil prices of $28 to $50 per barrel.
- GREET indicates life cycle carbon emissions 60% lower than gasoline

Cost of Biofuel in USA

- Ethanol from corn can be produced for US$0.30-0.37 per liter, including:
  - 21 cents feedstock cost at $88 per ton (or 32 cents if corn costs 50% more),
  - 3 cents capital plant cost assuming 5% cost of capital and 20-year lifetime,
  - 12 cents operation and maintenance (O&M) and labor costs, and
  - 6 cent credit for Dried Distillers Grains and Solubles (DDGS) as co-product (or 10 cents if corn prices are 50% higher).
- Competes with crude at $50-68/barrel
- CO2 emissions 20-30% less than gasoline

Cost of Biofuel in Malaysia

- Biodiesel from palm oil can be produced for about US$0.38 per liter:
  - 26 cents in feedstock cost,
  - 6 cents in capital plant cost, and
  - 6 cents for labor and O&M, with a
  - <0.5 cent credit for glycerine co-product.
- Competes with $42/barrel crude.
- Similar cost picture in Indonesia.
- Life cycle carbon emissions unclear, unfavorable if rain forests affected.

Cost of Biofuel in Indonesia

- Indonesia can produce biodiesel from jatropha for around US$0.48 per liter:
  - 37 cents for feedstock
  - 7 cents for capital plant cost assuming 10% cost of capital,10-year plant life.
  - 4 cents in labor and operating costs
  - No credits for byproducts
- Competes with crude at $58/barrel
- Biodiesel from palm oil is cheaper.
- CO2 emissions for biodiesel from jatropha presumably lower than for conventional diesel since unproductive land would be vegetated, but study needed.

Strategic Interest to United States of Biofuels Trade in the Asia Pacific

- Biofuels can make more oil available for export from region (examples: Malaysia and perhaps Indonesia again)
- Trading partners and allies can diversify transport sectors away from reliance on oil, reducing dependency on Middle East (Examples: Japan, Korea, Chinese Taipei)
- Substantial resources are being devoted to biofuels development, with real economic and strategic potential at today's oil prices.
- But life-cycle CO_2 emissions of biodiesel from palm appear potentially unfavorable.

Long-Term Trends Will Expand Worldwide Biofuel Potential

- The gradual depletion of easily recoverable oil reserves is causing an upward trend in real, inflation-adjusted oil prices.
- Growing concerns over global warming may yield a clear market value for carbon.
- RD&D is rapidly bringing down the cost of abundant lignocellulosic feedstocks like farm and forest residues and grasses that have much lower carbon emissions than the current generation of biofuel crops.

Costs of Ethanol from n^th^ of a Kind Lignocellulosic Production Plant

- A US study indicates the cost of producing ethanol from corn stover could decline to about $0.24/ liter:
  - 9 cents feedstock cost at $30 per ton,
  - 9 cents capital plant cost assuming 10% cost of capital and 20-year lifetime,
  - 9 cents O&M and labor costs, and
  - 3 cent credit for electricity co-product.
- This would compete with $30 crude!

Abundant Lignocellulosic Resource

- A small but significant percentage of oil use could potentially be displaced by biofuels produced from conventional agricultural crops, dependinging on factors such as available land, crop yields, production costs, climate, and automobile use.
- A larger percentage of crude oil use could be displaced if biofuels were supplied as well from cellulosic feedstocks like crop residues, forest residues and new crops designed for biofuel production or grown on marginal or degraded land.

Biofuel Resources in ASEAN Region from Agricultural Residues

- Mitsubishi Research Institute Paper, Tokyo International Biofuels Conference 2007

Economy	Ethanol Million Liters	Ethanol Million Tons	Gasoline Million Tons
Indonesia	55,995	44.2	27.7
Malaysia	16,157	12.8	8.0
Philippines	21,617	17.1	10.7
Thailand	13,968	11.0	6.9
Viet Nam	11,138	8.8	5.5

Potential Oil Displacement from Biofuel Resources in APEC-ASEAN: Ethanol from Agricultural Residues as Share of Petroleum Demand

Ethanol Potential from Agricultural Residues as Share of

Economy	Petroleum Demand 2002	Petroleum Demand 2030	Transport Oil Demand 2002	Transport Oil Demand 2030
Indonesia	59%	25%	117%	40%
Malaysia	40%	16%	60%	21%
Philippines	78%	28%	119%	36%
Thailand	22%	7%	37%	11%
Viet Nam	65%	12%	117%	21%

Additional Estimates of Ethanol Resource Potential Evaluated by the APEC Biofuels Task Force

Economy	Ethanol Million Liters	Ethanol Million Tons	Gasoline Million Tons
Australia	9,804	7.7	4.9
Canada	4,194	3.3	2.1
Thailand	54,831	43.3	27.2
USA	352,565	278.3	174.7

Potential Oil Displacement by Ethanol Resources in APEC: Ethanol from Various Sources as Percentage of Petroleum Demand

Ethanol Potential from Available Resources as Share of

Economy	Petroleum Demand 2002	Petroleum Demand 2030	Transport Oil Demand 2002	Transport Oil Demand 2030
Australia	14%	9%	18%	11%
Canada	3%	2%	4%	3%
Thailand	87%	28%	145%	43%
USA	23%	16%	29%	19%

Example: Biofuel Resources Beyond Food Crops in Thailand

Summary of Biofuel Potential In Thailand by Type of Resource	Annual Harvest (million tons)	Fuel Yield (liters fuel per ton of feedstock)	Biofuel Production Potential (billion liters)
Agricultural Residues	53.7	300	16.1
Animal Waste	3.2	300	1.0
Wood Supplies	48.8	300	14.6
New Wood Plantations	59.2	300	17.8
Municipal Solid Waste	5.6	300	1.7
Biomass Saving	12.3	300	3.7
Total	182.8	300	54.8

Climate Change Benefits: Biofuels from Conventional Agriculture

- For ethanol produced from corn and sugar cane, energy output is substantially greater than fossil energy input, so that net life cycle carbon emissions are lower than for transport fuels derived from crude oil.
- Energy and carbon balances for biofuels from conventional crops should improve over time as sustainable crop yields increase and as processes for converting crops to biofuels become more efficient.
- Life cycle carbon emissions for biodiesel from palm depend on where the palm is planted and need to be better understood.

Climate Change Benefits: Biofuel from Farm and Forest Residues

- For biofuels produced from lignocellulosic feedstocks, positive energy balances and carbon-equivalent emissions reductions are several times greater than for biofuels made from food crops, so lignocellulosic feedstocks represent the greatest long-term opportunity for biofuels to contribute to energy and environmental security.
- Since a large share of potential biofuel resources are lignocellulosic, achievable reductions in crude oil dependency and greenhouse emissions may be substantial.