Today's Agenda

- ✓Introductions
- ✓Bagley-Keene Review
- ✓Advisory Panel Guidelines
- ✓LCFS Overview and Updates
- ✓Draft Workplan and 2011 Agenda
- ❑Expert Workgroup Summaries
- ❑Method 2A/2B Review and Update
- ❑Next Steps

Summary of Expert Workgroup Recommendations

Advisory Panel
February 16, 2011

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Outline

- Overview of current CARB LUC analysis
- Revised Purdue analysis
- Expert Workgroup and Independent Reviewer recommendations
- Timeline for revising LUC carbon intensity values
- Potential effect on LUC carbon intensity
- Implications for compliance with LCFS targets

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Understanding ARB's Current LUC Estimate

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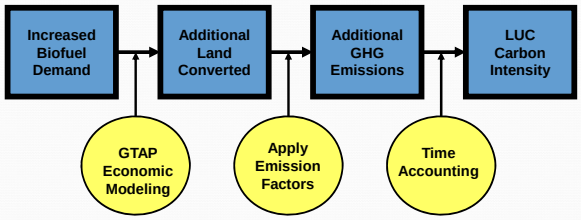
GTAP+ external



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GTAP Model Version

- Uses an economic baseline for the year 2001
- Is "static" and responds to a "shock" by re-establishing economic equilibrium
- Estimates amounts of forest and pasture converted to cropland for 18 world regions

Example used in following slides: 13.25 billion gallon increase in corn ethanol production in U.S.

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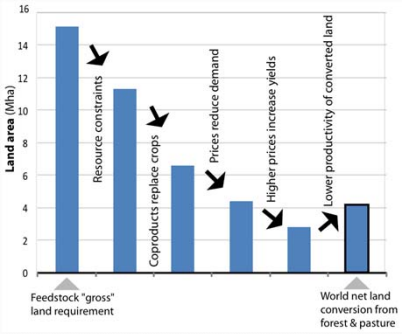
Key Responses Modeled within GTAP



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GTAP Modeling Results

- Conversion of ~4 million hectares worldwide
- Location of the land use change
  - United States: 40%
  - Brazil: 7%
  - Canada: 11%
  - Europe: 11%
- Type of land use change
  - Pasture to cropland: 78%
  - Forest to cropland: 22%

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Applying Emission Factors

- Assume the release of:
  - 100% of above ground carbon
  - 25% of below ground carbon
- Account for the "forgone sequestration" potential of forests converted to cropland
- Approximate "worldwide average" values
  - Forest to crops: 700 $MgCO_2e/Ha$
  - Pasture to crops: 110 $MgCO_2e/Ha$

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Time Accounting Background

- **Apply emissions factors to pasture and forest conversion estimates to estimate LUC emissions (MMT CO2)**
- **Determine whether/how to account for time at which these emissions occur**
  - **Allocated over 20, 30, 40, or 100 years of biofuel production?**
  - **Should near-term emissions be counted as more damaging than later emissions?**

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ARB Time Accounting

- **simple 30-year averaging approach**
- **LUC emissions divided by 30 years of biofuel production**
- **Consistent with U.S. EPA (30 year) and EU (20 year)**
- **Example: 13.25 billion gal increase in corn ethanol**

Foregone Sequestration (30 years)	~40 MMT CO_2e
Forest Conversion Emissions	~570 MMT CO_2e
Pasture Conversion Emissions	~360 MMT CO_2e
Total LUC Emissions	**970 MMT CO_2e (9.7×10^{14} gCO_2e)**
Total Fuel Production (30 years)	400 billion gallons
Total Energy Content of Fuel	3.2×10^{13} MJ
LUC Carbon Intensity	**30 gCO_2e/MJ**

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Revisions to Purdue Corn Ethanol Analysis

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Revised Purdue Corn Ethanol Analysis

- Released in July, 2010
- Commissioned by Argonne National Lab
- Included results from three distinct modeling approaches for estimating LUC
  - Group 1 uses 2001 economic baseline (same as for CARB LUC analysis)
  - Group 2 updates baseline to 2006
  - Group 3 uses 2006 baseline, attempts to account for yield and demand growth after 2006

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Changes to Purdue Analysis

- Added cropland pasture land category in U.S. and Brazil
- Updated treatment of co-products and energy sector supply and demand elasticities
- Modified structure of livestock sector
- Revised forest emission factors and yields on cropland
- Provided an econometric estimate of yield response to higher prices

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Comparison of ARB and Revised Purdue LUC Results

	CARB	Revised Purdue Analysis		
		Group 1	Group 2	Group 3
LUC (million hectare)	3.9	3.0	2.0	1.7
• Percent Forest	22	25	33	33
• Percent in US	40	34	24	24
Carbon Intensity (g/MJ)	30	21	18	15

- Solicited input regarding comparison of results from:
  - Expert Workgroup
  - Independent Reviewers
  - Stakeholders

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Expert Workgroup and Independent Reviewer Recommendations

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LCFS Expert Workgroup

- Convened at Board's direction to improve indirect effects analysis
- Met eight times during 2010
- Nine subgroups met independently and formulated recommendations, including those pertaining to recent Purdue LUC analyses
- Subgroups each prepared final reports detailing recommendations

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Conclusions: Use of GTAP Model

- GTAP is an appropriate model to use to determine LUC emissions for a change in biofuel production
- ARB should:
  - Continue to improve GTAP's capacity
  - Continue to compare GTAP with other economic modeling approaches
  - Re-examine its conclusion that it must use only models which are publically available

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Some Near-Term Subgroup Recommendations

- Adopt the "Group 2" model version and most changes in revised Purdue modeling
  - Develop a more comprehensive, spatially explicit set of carbon stocks and emission factors
  - Re-evaluate distiller's grains co-product credit
- Adopt a consistent set of model inputs for all biofuel pathways
- Gain a better understanding of changes in food consumption predicted by the new model version
- Continue to update/improve the land pools considered as accessible in GTAP

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Longer-Term Recommendations

- The subgroups also made many longer-term recommendations
- These can be accessed in the subgroup reports at http://www.arb.ca.gov/fuels/lcfs/workgroups/ewg/expertworkgroup.htm

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Independent Reviewers

- Contracted Steve Berry (Yale University) and John Reilly (MIT) to review revised Purdue analysis
- Both made many recommendations similar to those of the Expert Workgroup
- However, both believe that Armington trade assumptions used in GTAP are unrealistic
- Steve Berry strongly argues for
  - lower response of yields to price
  - not including credit for reduced consumption of food

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Preliminary Review by ARB Staff

- Agree with many near-term recommendations made by EWG
- Further analysis needed in near-term:
  - Price-yield elasticity value
  - Armington Trade elasticity values
- Indirect Effects of Other Fuels
  - Finalizing contract to develop a research plan quantifying the potential market effects of conventional fuels
  - Recommendations from the Indirect Effects subgroup will be considered

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Timetable for Revised LUC Analysis

- Winter, 2011: Solicit assistance for LUC modeling using GTAP, finalize proposed near term revisions to LUC analysis
- Spring, 2011: Complete revised LUC analyses for corn and sugarcane ethanol, soy biodiesel
- Summer, 2011: Conduct public workshops on revised LUC analyses
- Summer or Fall, 2011: Present revised LUC values to the Board

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Potential Effect on LUC Carbon Intensity

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Effect on LUC Carbon Intensity

- Many recommendations from EWG will decrease LUC estimate
- A few recommendations may counter-balance this trend:
  - Assuming a lower response of yields to price
  - Eliminating or reducing the credit allotted for reduced food/feed consumption
  - Re-evaluating the yields on newly converted land as estimated by the Terrestrial Ecosystem Model
  - Updating the land pools in GTAP

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Effect on LUC Carbon Intensity

- Adopting the "Group 2" model version in its entirety decreases the corn ethanol LUC CI by ~ 40%
- Reducing the price-yield elasticity may increase the LUC CI by ~ 40% (based on Group 1 model results)
- Reducing or eliminating credit for reduced food consumption may significantly increase LUC estimate

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Impact on LCFS if LUC Values Decrease

- Changes to the Gasoline Compliance Schedule
  - If the corn ethanol LUC CI is reduced
    - The baseline CI for CaRFG decreases
    - The compliance schedule targets shift down
    - A greater deficit is generated for a given volume of CARBOB used, thereby requiring a greater number of credits to be generated
- The compliance schedule for diesel is based on 100 percent ULSD as the reference and does not change

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Impact on LCFS if LUC Values Decrease

- Does a reduction in LUC CI for corn ethanol make compliance with the targets easier?
- The answer depends on the:
  - type of alternative fuel used to achieve compliance
  - level of corn ethanol use
  - change in LUC CI for other biofuels

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Impact on LCFS if LUC Values Decrease

- Ease of compliance with 10 percent corn ethanol does not change
- Easier to comply with greater than 10 percent corn ethanol
- Achieving compliance with sugarcane ethanol may be easier or harder
- Reducing the LUC CI value for soy biodiesel and renewable diesel will make compliance easier

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Impact on LCFS if LUC Values Decrease

- Therefore, it is most likely that compliance will be easier
- However, unless very high levels of first generation biofuels are used, achieving compliance will eventually require use of less carbon intensive fuels
- But… large amounts of credits may be banked in early years which could delay the transition to less carbon intensive fuels

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