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THE U.S. LOW-CARBON FUEL LEGISLATION AS GLOBAL WARMING SOLUTION

DR. SONIA YEH
Institute of Transportation Studies,
University of California, Davis

SESSION 2
POLICIES & REGULATIONS: ISSUES INFLUENCING THE OILS & FATS DYNAMICS

The U.S. Low-Carbon Fuel Legislation as Global Warming Solution

Dr. Sonia Yeh
Institute of Transportation Studies
University of California, Davis

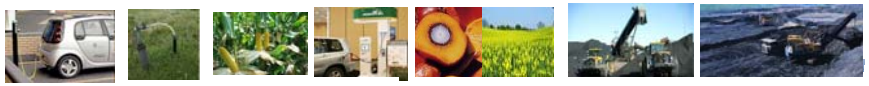
Email: slyeh@ucdavis.edu

Abstract

On January 18, 2007, California's Low Carbon Fuel Standard (LCFS) was announced through Executive Order S-1-07. The LCFS creates a state-wide goal of reducing the carbon intensity of California's transportation fuel by 10% by 2020 compared to the baseline year and applies to all fuel providers, including refiners, blenders, producers and importers. LCFS-participating transportation fuels include gasoline, diesel, ethanol, biodiesel, compressed national gas (CNG), liquefied petroleum gas (LPG), propane, electricity, and hydrogen. The average fuel carbon intensity ("AFCI") of the fuel is the well-to-wheel (WTW) greenhouse gas (GHG) emissions on a CO2 equivalent basis (gCO2e) per unit of energy (MJ). This reduction target is reachable but challenging, and many analytical, technical, and policy issues need to be examined in further detail and carefully addressed to ensure successful implementation of the LCFS. Among these, top priority issues are the quantification and certification of global greenhouse gas emission reductions, as well as the development of better methods to study lifecycle emission factors, land use changes, climate impacts of emissions, treatment of market-mediated effects, and standards to ensure sustainability. Setting sustainability standards or creating a roadmap for establishing sustainability standards to complement the LCFS requires a durable policy framework that is flexible and robust to future uncertainties. The sustainability guidelines must also be clear, simple, and practical so industry can follow while simultaneously stimulating technological innovations. Equally challenging is the need to better understand the impacts of biofuel and other bioenergy production within a global market in which biomass feedstocks serve multiple critical uses, over which no individual nation has direct control. Stimulating innovative production methods that improve current practices and adhere to sustainability standards will be important for the continuing development of the bioenergy sector in the U.S. and elsewhere. California's LCFS proceedings have been watched closely both nationally and internationally, e.g., the Northeast states, Canada, and the European Commission, and the standard will likely be adopted by other countries.

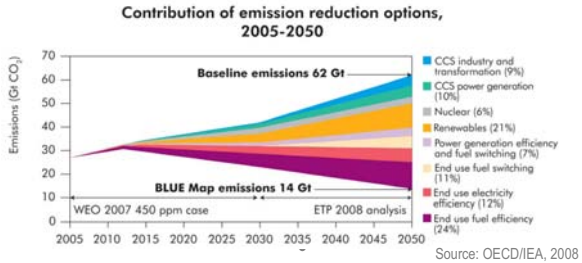
Outline

1. **Introduction**
2. **Theory and Principles**
3. **Design Issues**
   - *Measurement, Tracking, and Reporting*
   - *Shuffling and Leakage*
4. **Analytical Issues**
   - *Measurement of Indirect Land Use Change*
   - *Measurement of Sustainability*
5. **The Future of LCFS**



1. Introduction

- To reduce impacts of climate change, we need to:
  1) **Deploy existing and near term technologies** to start lowering greenhouse gas (GHG) emissions within the next decade;
  2) Over the next decade, **develop and deploy new technologies** that can support prosperous and sustainable livelihoods with GHG emissions about an order of magnitude lower than today's;
  3) **Adapt to unavoidable climatic change**, and;
  4) To the maximum extent feasible, **contribute to other important goals** such as increasing energy security, lowering air pollution, enhancing biodiversity and ecosystem health, promoting rural economic development and sustainability goals.



Source: OECD/IEA, 2008

Strategies to Reduce Transportation GHG Emissions

- **Energy intensity reduction**
  - Increasing the efficiency of transportation technologies through improvement in vehicle technology or by adopting smaller, more efficient vehicles.
- **Fuel switching**
  - Increasing the share of vehicles using low-GHG fuels such as compressed natural gas, low-GHG ethanol, hydrogen, or electricity.
- **Lowering the global warming intensity (GWI) (on a life-cycle basis) of transportation fuels**
  1) making the fuel production process more efficient or reducing upstream emissions;
  2) blending lower-GWI fuel, such as ethanol or bio-diesel, into the fuel mix (e.g., E10 or B20); or
  3) producing fuel from low-GWI feedstock, such as ethanol from cellulosic materials instead of corn, or hydrogen from renewable energy sources such as biomass gasification or electrolysis using wind or solar power.
- **Demand reduction or travel mode change**.
  1) reducing the reliance on personal vehicles, increasing use of more efficient modes of transportation such as mass transit and rail,
  2) better land use policies that reduce transportation demand (such as smart growth policies that encourage high-density housing and mixed-use residential, retail, and business communities) and
  3) improve system efficiency (as by reducing congestion).

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★ **Low Carbon Fuel Standard (LCFS)**

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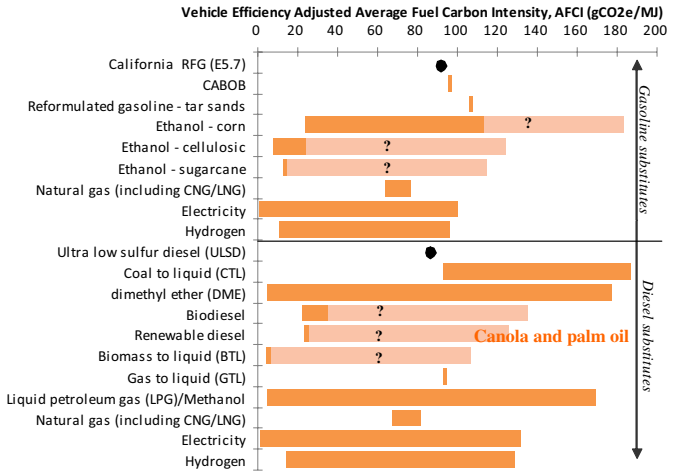
2. Principles of California's LCFS

- State-wide goal of reducing the carbon intensity (on a lifecycle basis) of California's transportation fuel by 10% by 2020
- Create durable framework for orchestrating near and long term transition to low-carbon alternative fuels
  - Send consistent signals to industry and consumers to reduce GHGs
- Stimulate technological innovation
- Use performance standard, with tightening over time
- Government does not pick winners (or losers!)
  - Provides industry with flexibility
- Use lifecycle approach
- Consistency/compatibility between US, and international efforts, including the EU[1], UK[2], Canada[3] and others in the future.

[1] EU's Proposal to modify *Fuel Quality* Directive (COM(2007)18) introduces obligation to report and reduce lifecycle GHG emissions from road transport fuels so as to reduce greenhouse gas emissions. [2] (Renewable Transportation Fuel Obligation (RTFO) [3] British Columbia and Ontario signed a Memorandum of Understanding (MOU) with California on May 31, 2007 to commit themselves to adopt California's LCFS.

Carbon Intensity Ratings for Transportation Fuel Pathways



Numbers are preliminary. Light bars represent uncertainties in GHG emissions associated with indirect land use change. Source: (CEC 2007; CARB 2008b).

3. Design Issues: *Measurement, Tracking, and Reporting*

- Reporting requirement for LCFS transportation fuels (biofuels)*
  - Batch number
  - Fuel type
  - Fuel Quantity
  - Feedstock type
  - Feedstock origin
  - Processing characteristics
  - Fuel carbon intensity
  - Accuracy level
  - Sustainability information

* Preliminary. Source: CARB (2008)

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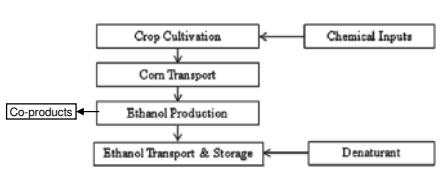
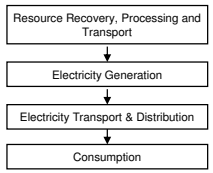
- Default versus option-in
  - Assign a lifecycle GHG default value to all fuel paths
  - Fuel suppliers who beat the default value get extra credit, but must provide documentation



LCA for corn ethanol



LCA for electricity

3. Design Issues: *Shuffling and Leakage*

- Regulated parties or markets shift (or rationalize) their existing production and sales so that improvements appear on paper to have been made, when in reality no significant change has occurred.
- Regulators must account for rationalization in their rule making
- This problem may correct itself or eventually goes away when more states and nations adopt the same regulatory standards and requirements.
- A much more difficult issue to address is the potential of shuffling outside of the biofuel industry and into, for example, the food and chemical sector.
- The issue is directly relevant to the discussion of indirect land use change and sustainability standard

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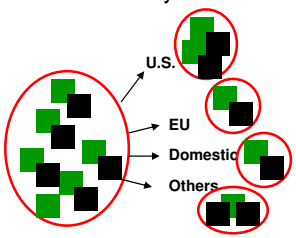

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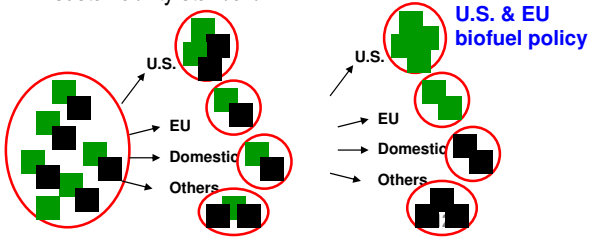

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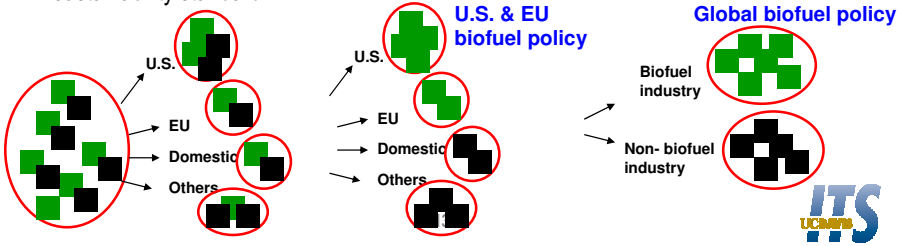


4. Analytical Issues:
Measurement of Indirect Land Use Change (iLUC)

- Recent studies suggest that the iLUC issue can not be ignored

Source of Fuel*	Making Feed-stock	Refining Fuel	Vehicle Operation (Burning Fuel)	Net Land Use Effects: Feedstock Uptake from Atmosphere (GREET)	Net Land Use Effects: Land Use Change	Total GHGs*	% Change in Net GHGs vs. Gasoline
Gasoline	+4	+15	+72	0	–	+92	–
Corn Ethanol (GREET)	+24	+40	+71	-62	–	+74 +135 without feedstock credit	-20% +47% without feedstock credit
Corn Ethanol + Land Use Change	+24	+40	+71	-62	+104	+177	+93%
Biomass Ethanol (GREET)	+10	+9	+71	-62	–	+27	-70%
Biomass Ethanol + Land Use Change	+10	+9	+71	-62	+111	+138	+50%

Searchinger (2008)

Table 2.1: Illustrative GHG savings and payback times for biofuel feedstock causing land change[13]

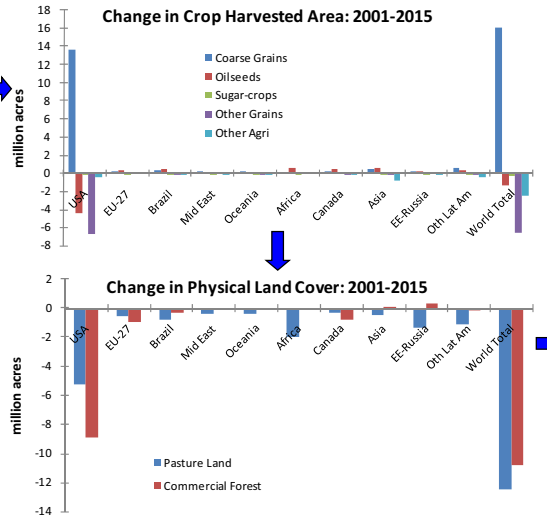
Fuel chain	Assumed country of origin	GHG saving excluding the impacts of land-use change (%)	Carbon payback (years): Grassland	Carbon payback (years): Forest
Palm to biodiesel	Malaysia	46%	0 – 11	18 – 38
Soya to biodiesel	USA	33%	14 – 96	179 – 481
Sugarcane to bioethanol	Brazil	71%	3 – 10	15 – 39
Wheat to bioethanol	UK	28%	20 – 34	80 – 140

The Gallagher report (2008)

Estimating the Effect of iLUC based on Global Economic Models

- Example: Hertel *"Implications of U.S Biofuels Production for Global Land Use"* *

U.S. Corn ethanol, 1.75 to 15 bgy, 2001-2015



x CO_2e emission factor by land type

CO_2e_{ILUC}

* http://www.arb.ca.gov/fuels/lcfs/063008purdue.pdf

Why Current Laws and Regulations are Insufficient in Addressing Sustainability Issues?

- Wide range of current laws and regulations already address:
  - Air quality
  - Water quality
  - Multi-media exposure
  - Forest management
  - Local environment impacts
- However, these policies are inadequate in the following sense:
  - Not designed to reduce GHG impacts
  - Inadequate to address indirect, market-mediated effects at macro levels
  - Inadequate to address some issues only associated with large-scale implementation

Basic Principles of Sustainability

- Energy feedstock should be produced in a sustainable manner that will promote the long-term welfare the environment, human society, and economic growth;

1. Achieve sustainable GHG reductions
2. Avoid large-scale environmental degradation
3. Do not threaten food supply and food price stability
4. Lead to continuous technology innovation that improves energy efficiency, reduces energy use, and minimizes environmental footprint.

List of Sustainability Issues being Considered for CA's LCFS

Environmental Components	Social and Economic Components
Greenhouse gas emissions	Environmental justice
Air quality	Income distribution
Water use	Working conditions/worker rights
Water quality	Child labor
Land use protections (like those in federal Energy Act)	Land rights (displacement of indigenous people)
Soil erosion	Labor rights
Genetically modified organisms	Food prices and food security
Biodiversity	

http://biomass.ucdavis.edu/materials/forums%20and%20workshops/f2008/10.2_%20Bob%20Fletcher.pdf

4. Analytical Issues: *Measurement of Sustainability (example: land use impacts)*

Activities
- terracing of croplands, removal of terraces
- restoration of eroded fields
- changes in the groundwater table (in contrast to water extraction)
- ploughing, removal of weed vegetation
- conservation of patches of wild vegetation
- others

Total land area disturbed (m^2/MJ or m^2/MJ/yr)

Midpoint impacts
- surface area needed for crops
- changes in organic carbon content of soil
- release of greenhouse gases from the soil to the air due to changes in groundwater table
- carbon sequestration
- release nutrients and acidifying substances from the soil to the groundwater
- salinization due to irrigation in combination of evaporation of soil water
- others

GHG calculations gCO2e/MJ/yr

Environmental impact assessment

Life support impacts
- soil erosion
- soil fertility loss
- disturbance of nutrients cycling
- disturbance of hydrology
- others

Damage impacts
- habitat loss
- impacts on biodiversity (existence value)
- impacts on biodiversity (production value)
- others

Haes (2006)

Key Design Elements of Sustainability Criteria

- Sustainability standard must be robust to future uncertainties such as unexpected research findings of adverse environmental outcome.
- Treat all bio-based products equally. This can avoid creating incentives for practices such as leakage and shuffling.
- Work with state, national and international regulating parties to encourage broad and consistent enforceable rules are (or in the process of being) adopted.

Small vs. Large scale?

- Issue: a single farm is in compliance with regulations and meets sustainability criteria, but what about the aggregate effect of 100 farms in the same area?
- Possible Solution:
  - Reporting and careful monitoring will help track the problem over time and provide data needed to analyze policy options to reduce impacts.
    - Identifying opportunities and providing incentives for improvements in best practices and technologies
  - Sector specific sustainability certification/management, each addresses sector-specific environmental, ecological, and social impacts:
    - Forestry
    - Fisheries
    - Agriculture
    - Mining activities

Conclusions

- The LCFS is an integral part of the overall strategy to combat global warming
  - Performance-based standard awards low-GWI fuels with higher credits
  - The default-and opt-in option provides flexibility and encourage innovation to reduce GHG emissions
- Developing a proper policy design that provide adequately incentives for alternative fuels
- Implementation of LCFS faces many challenges
  - indirect land use change
  - Sustainability standard
- LCFS policy might be introduced in a evolutionary way -- transforming EU mandate/directive into LCFS, and converting state LCFS's into a federal LCFS.