

California's Low-Carbon Fuel Standard

Daniel Sperling
Sonia Yeh

Institute of Transportation Studies
University of California, Davis

TRB Annual Meeting
Washington, DC
January 11, 2010

UCDAVIS UNIVERSITY OF CALIFORNIA

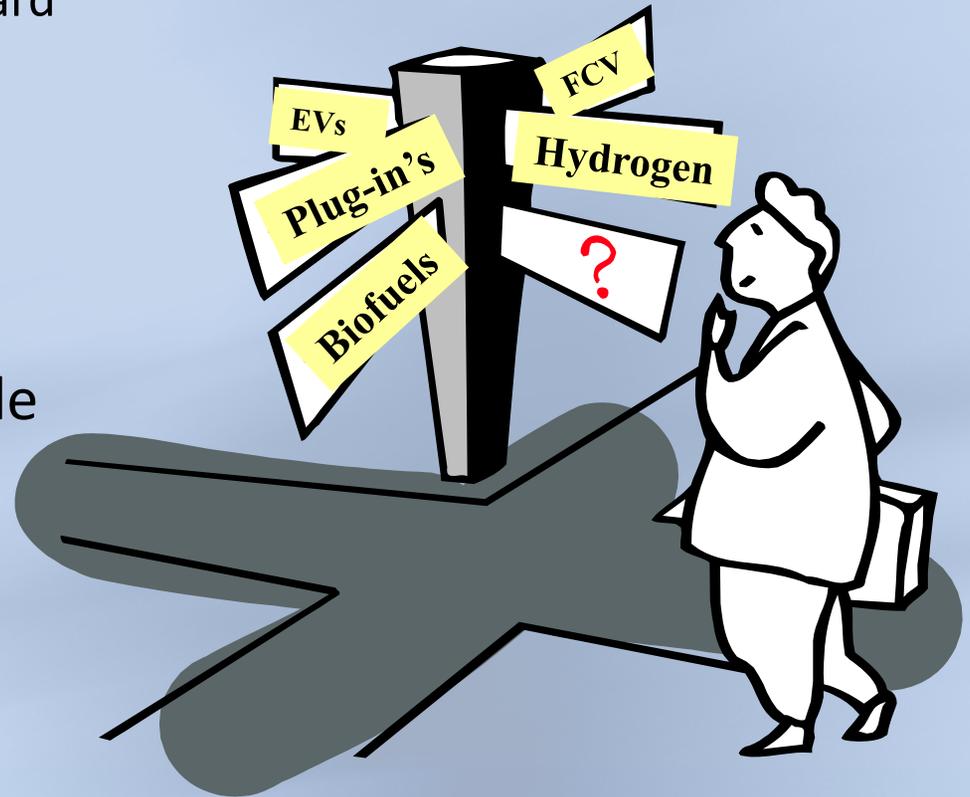
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Fuel *du jour* Phenomenon

- 30 years ago – Synfuels (oil shale, coal)
- 25 years ago – Methanol
- 18 years ago – Electricity (Battery EVs)
- 8 years ago – Hydrogen (Fuel cells)
- 4 years ago – Ethanol
- Today – Electricity (Plug-in hybrid vehicles)
- *What's next?*

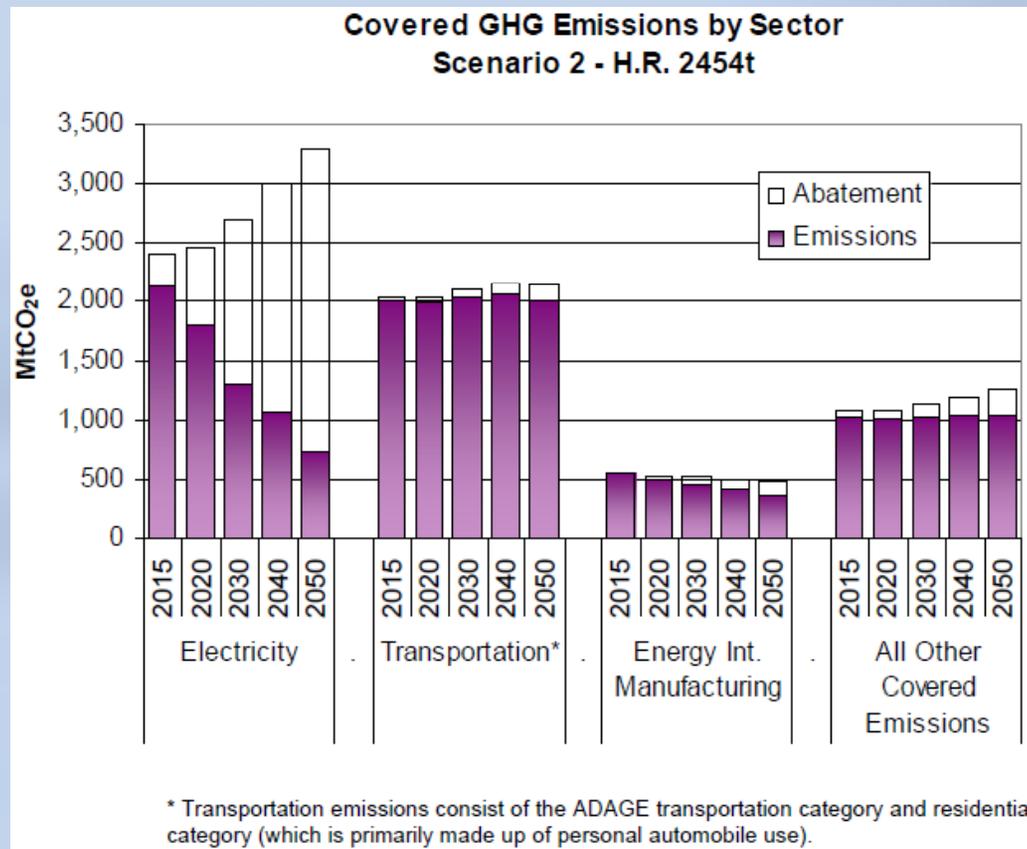
Many Possible Policy Approaches and Many Possible Low Carbon Fuels

- Volumetric mandates
 - e.g. US Renewable Fuel Standard
- Fuel subsidies
 - eg, corn ethanol and biodiesel
- Carbon taxes or cap and trade
- Low carbon fuel standard



Cap & Trade (and Carbon Taxes) Aren't Enough for Reducing Transport Emissions

- US EPA analysis of Waxman-Markey Bill and other analyses of previously proposed cap-and-trade programs suggest that only a very tiny fraction of emission reduction (<5%) will come from the transport sector



Source: EPA Analysis of H.R. 2454 – Appendix (June 2009)

Cap & Trade (and Carbon Taxes) Aren't Enough for Reducing Transport Emissions – Cont'd

- EPA estimates that cap-and-trade (Waxman-Markey) will raise gasoline price by \$0.13 in 2015, \$0.25 in 2030, and \$0.69 in 2050
 - Not enough for inducing significant change in consumer behaviors (VMT and vehicle/fuel purchases) or low-GHG vehicle/fuel production
- Cap & trade and taxes are in theory more “economically efficient,” but are far less effective at introducing new fuels
 - Need prices of \$10-30/gallon to elicit same volume of low-carbon fuels as the LCFS (Hollander et al, 2008)
 - Producers just pass on the extra fuel cost to consumers
 - Too indirect to overcome resistance by fuel suppliers and consumers
- More effective and direct policy is needed to gain large reductions in oil use and GHG emissions

What is LCFS

- **Performance based:** GHG intensity target for transport fuels

$$AFCI(\text{gCO}_2\text{-eq/MJ}) = \frac{\sum_i^n E_i \times CI_i}{\sum_i^n E_i \times EER_i}$$

← Total GHG emission

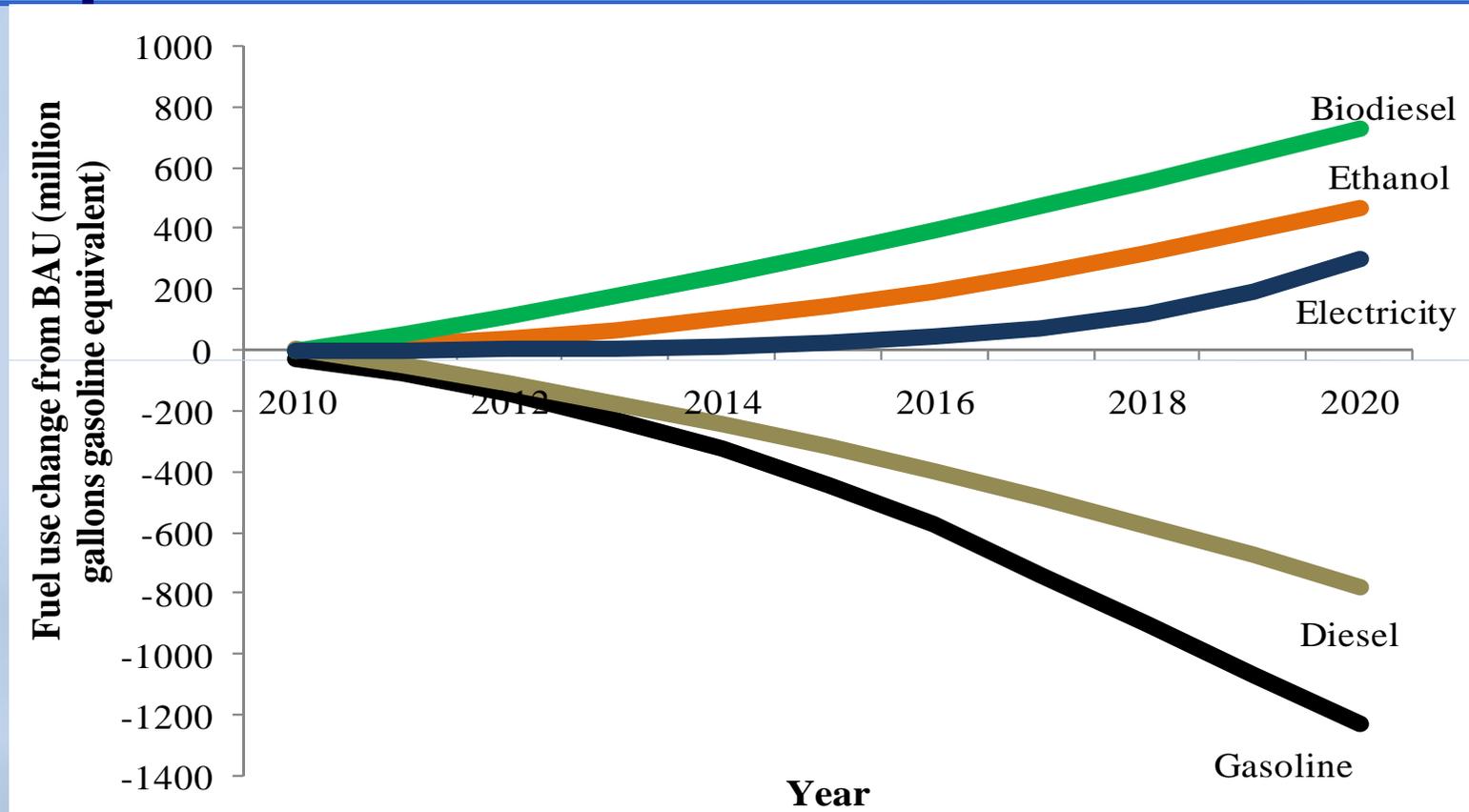
← Total transportation fuels produced/displaced

- **Lifecycle measurement** for “carbon intensity”
- **Regulated parties are transport energy suppliers** (oil providers, plus others who want to earn credits, such as biofuel, electricity, NG and H₂ providers)
- **Harnesses market forces:** Allows trading of credits among fuel suppliers, which stimulates investment and continuing innovation in low-carbon fuels

California LCFS Program

- Adopted April 2009, took effect Jan 2010
- Applies to on-road transport fuels
 - Excludes air and maritime (where California has limited authority)
- Separate targets for gasoline and diesel (10% reduction for each)
 - Allows trading between these two targets
- Default measurements and opt-in procedure for each activity in energy chain
 - Encourages further innovation and investment in low-carbon practices
- Refinements still in progress
 - Rules on “sustainability”
 - Lifecycle calculations for additional energy paths

One California LCFS Scenario of Alt Fuel Use Compared to the Baseline



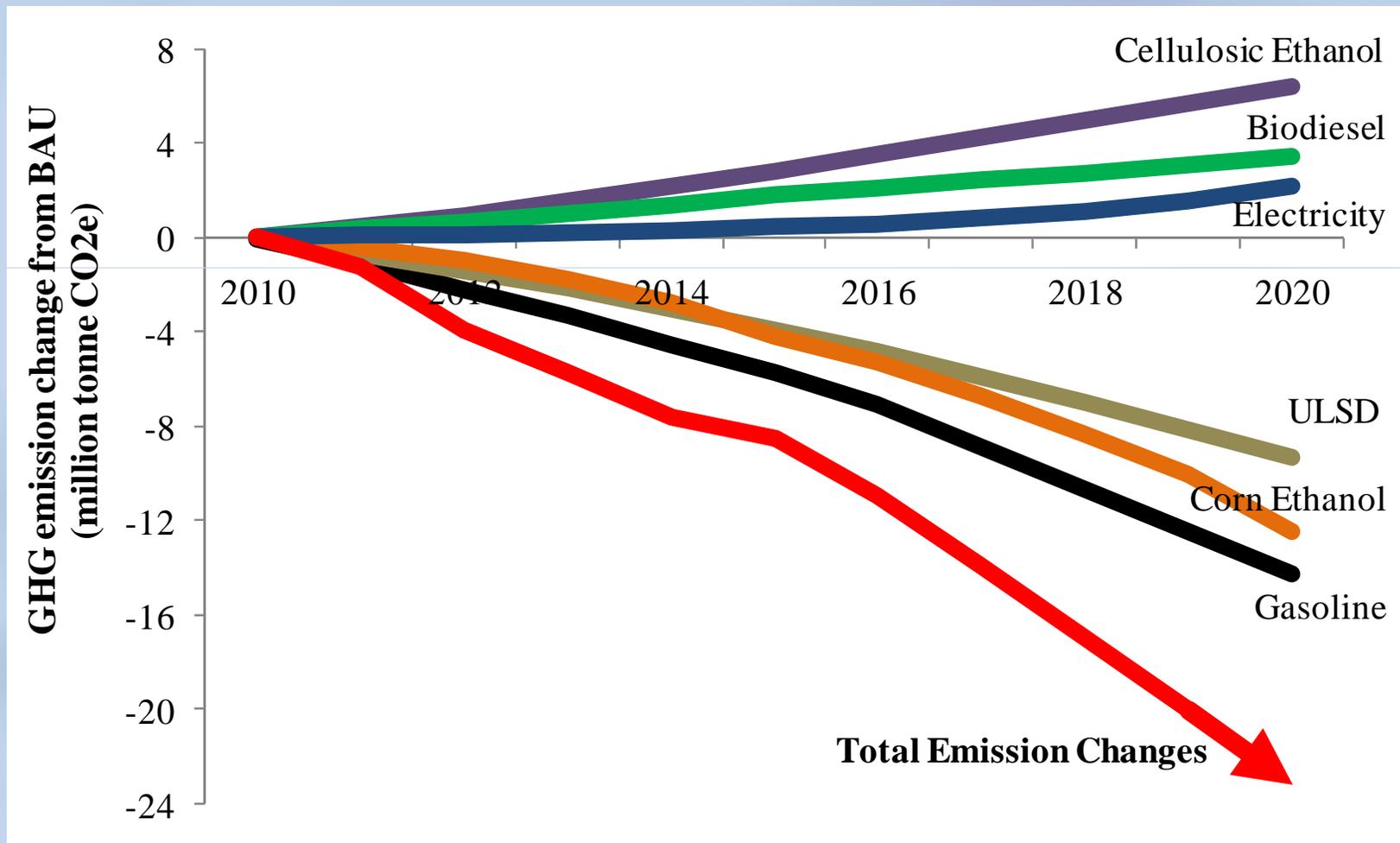
Biofuels (2020)

- 1.9 million E-85 flex-fuel vehicles
- 2.8 B gallons etoh (E10=1.9B gallons)
- 0.65 B gallons biodiesel
- ~10% of national RFS requirement

Electricity (2020)

- 1.7 million PHEVs and 49,000 BEVs
- 3950 GWh/yr
- ~ 1% of 2008 CA electricity demand

GHG Reduction with California LCFS Scenario



The figure includes emissions from the preliminary assessment of indirect land use change

LCFS is Spreading

- EU moving toward an LCFS; its “Fuel Quality Directive” is very similar to California LCFS (amended Dec 2008)
- 11 northeastern and mid-Atlantic states signed a MOU in January 2009 committing to cooperate in developing a regional LCFS
- Early version of Waxman-Markey climate bill contained an LCFS
 - **0% target until 2022:** Would operate in parallel to RFS until 2022
 - If fully implemented, RFS would reduce GHG intensity by 4.6%
 - In 2023, LCFS and RFS rolled together, with 5% GHG-intensity reduction target
 - In 2030, target would increase to 10%

Key Challenges of an Expanded LCFS

- 1) Indirect land use change
- 2) Leakage and shuffling
- 3) Energy security
- 4) Environmental and social sustainability

Challenge 1. Indirect Land Use Change

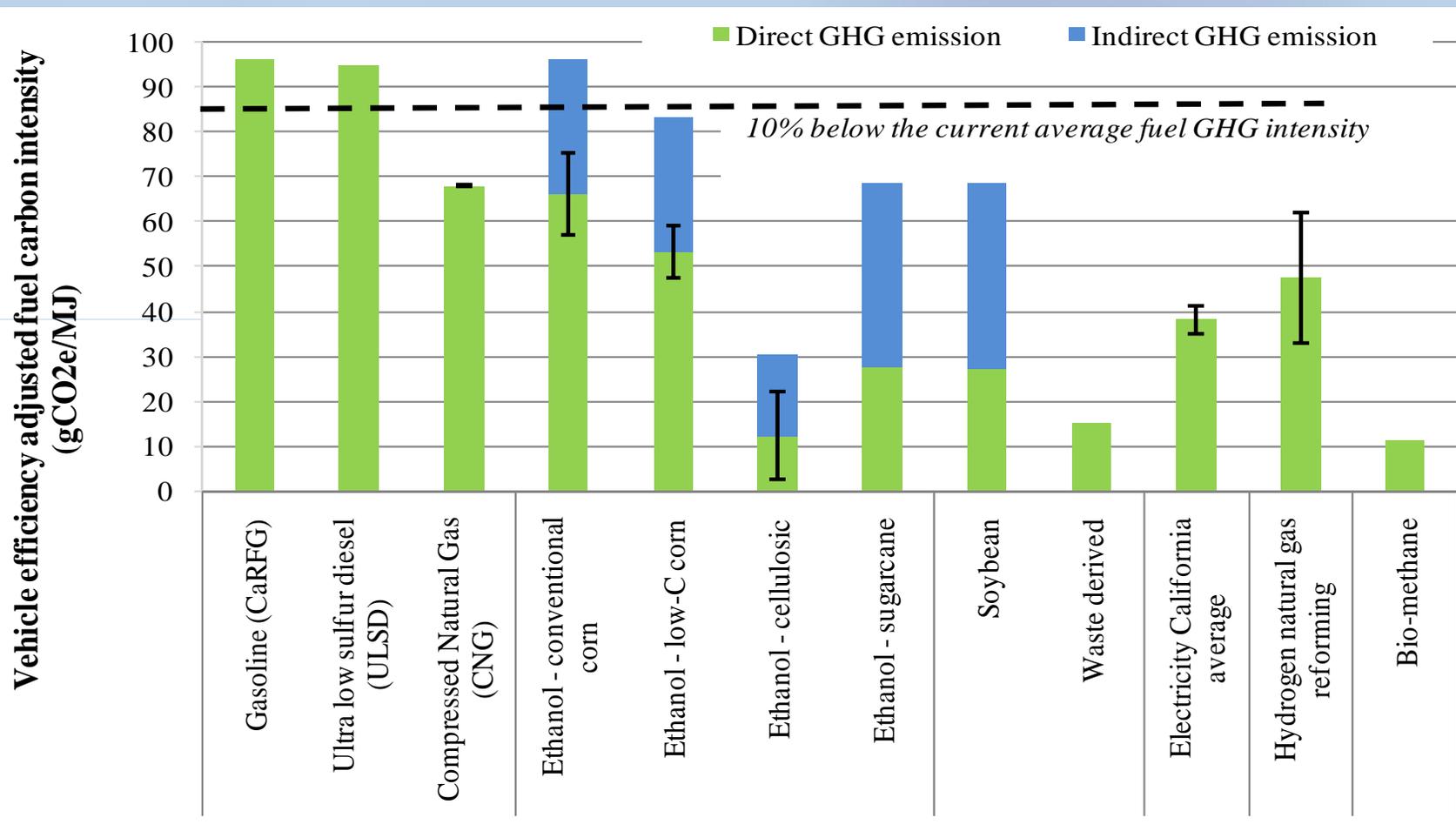
- When lands with rich soil and biomass carbon deposits are initially converted to agricultural production, a large amount of carbon is emitted.
- Massive consumption of biofuels in the U.S. leads to expansion of cultivated land area in and outside of the US (to replace diverted ag production)
 - These iLUC effects cannot be directly observed or easily measured

How to handle this scientific uncertainty?? If we ignore it, we are assigning a value of zero, which we know is incorrect.

Controversial because first effort to assign carbon value to land use changes (what about beef and agriculture??)

Corn ethanol interests are opposed to iLUC because it makes corn ethanol less attractive.

Magnitude of ILUC (Preliminary CARB Estimates)



Error bars represent range of direct lifecycle emissions using different technologies, feedstocks, and energy sources. Uncertainty of iLUC emissions are not shown, but are much larger than uncertainties of direct emissions.

Challenge 2. Leakage and Shuffling

- Concern: Regulated parties export high-carbon fuels to non-LCFS countries
 - Canada exports gasoline from oil sands to China
 - Iowa sends high-carbon ethanol to Canada
 - Thus, no net benefit?

Questions for discussion:

- How likely are these concerns to occur? What are the magnitude of the impacts?
- What if carbon policies implemented in EU and Canada?
- What else can be done to reduce leakage?
- Is concern for leakage and shuffling a legitimate reason for doing nothing?

Challenge 3. Energy Security

- LCFS responds to climate goals (by reducing GHGs), but more mixed effect on energy security
 - Encourages use of alt fuels and thus increases energy security
 - But also discourages production of fuels from oil sands, heavy oil, oil shale, and coal
- How to adjust LCFS to be responsive to energy security?
 - Reduce target
 - Other?

Note 1: LCFS does not ban oil sands (which is ~15% higher GHGs than gasoline from oil).

Note 2: LCFS encourages more efficient production of oil sands, and use of lower carbon process energy (nuclear energy? CCS?)

Challenge 4. “Sustainability” of Fuels

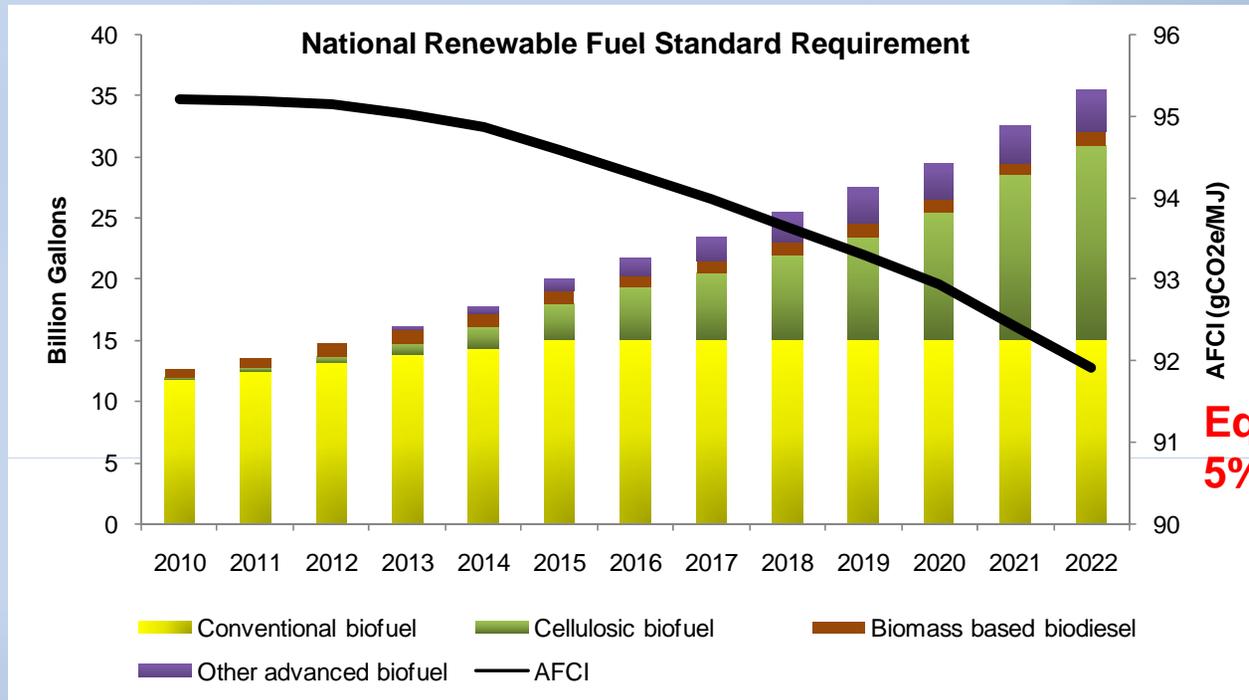
Many environmental and social impacts:

- **Food vs fuel:** increased demand for **SOME** biofuels puts pressure on food prices
- **Water:** many fuel processes use large amounts of water
- **Encourages use of land including forests and “degraded lands”?**
 - Encourages deforestation, harms indigenous people (in Asia, Brazil)

Many (especially the EU, NGOs, and industry groups) are working on “sustainability standards”



Integration with National RFS?



Equivalent to LCFS target of 5% reduction by 2022

- Phase out RFS and replace with LCFS (as proposed in early Waxman-Markey bill), but do it sooner than 2023
- Convert assigned GHG requirements for each RFS fuel category into LCFS format

Variations from California LCFS That Are Possible

- Different targets?
- Include other fuels (jet fuel, maritime, home heating oil, etc)?
- How to handle electricity whose carbon footprint varies greatly across the US?
- How to integrate with cap and trade and RFS?

Summary

- LCFS appears to be most effective policy for orchestrating transition to low carbon fuels
 - Includes all fuels and fuel neutral
 - Performance standard
 - Relies on market forces
 - Durable framework for reducing long-term GHG emissions for transport
- Transforming US RFS into a federal LCFS would provide additional flexibility and incentives for innovation
- Need to address key challenges: indirect land use change, leakage, energy security and “sustainability”.

Thank You