

# Biofuels and the Low Carbon Fuel Standard In California

Global Bio-Energy Partnership  
GHG reporting methodology meeting

Washington, DC  
October 9 2007

**Alex Farrell**

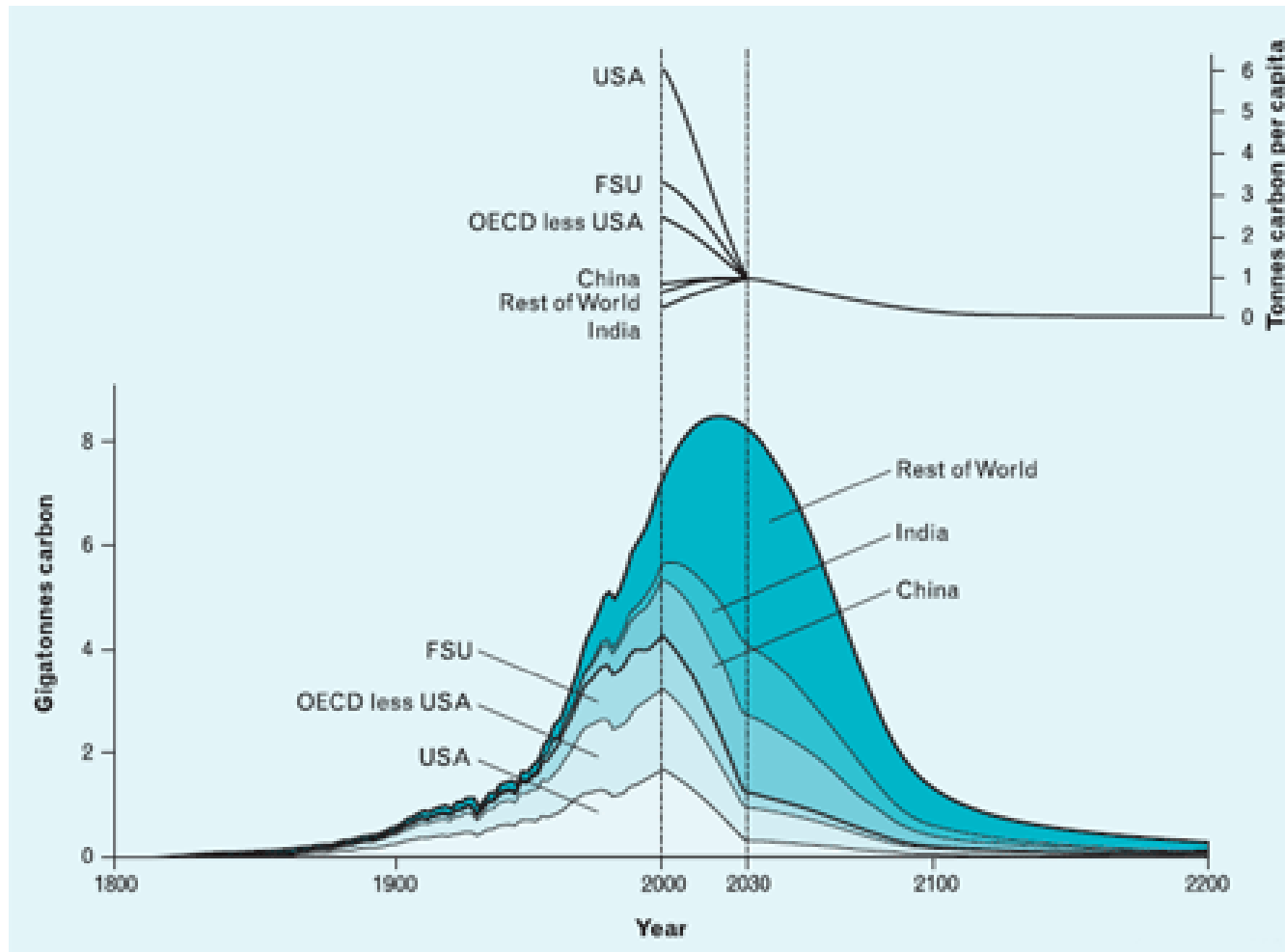
Energy and Resources Group, UC Berkeley

Director, Transportation Sustainability Research Center

aef@berkeley.edu



# Climate stabilization requires efficiency, ambitious targets and technological innovation

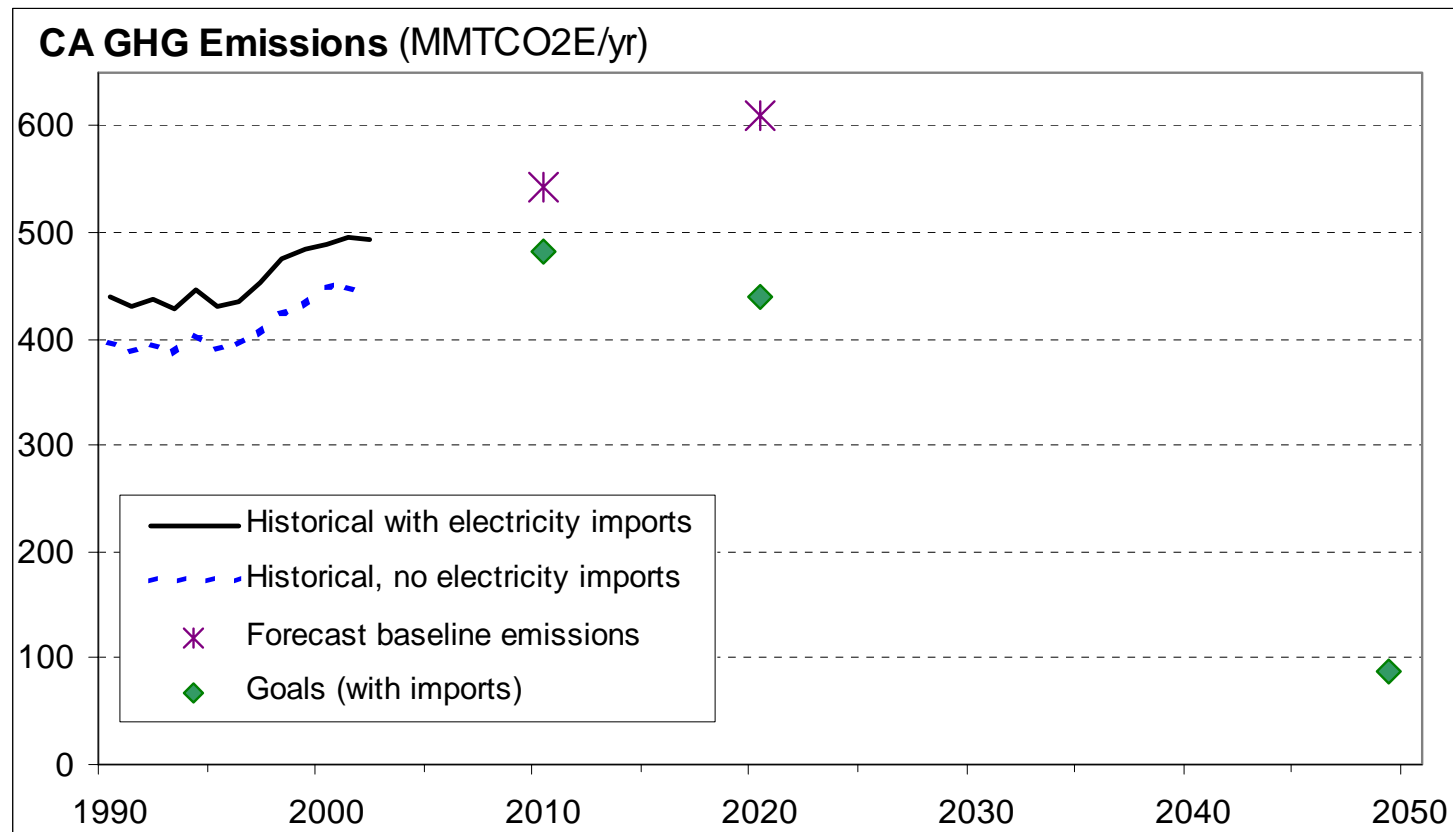


The LCFS is only a start – it will require a 10% *intensity* reduction by 2020

450 ppm example of “contraction and convergence” per the Global Commons Initiative

Source: [www.cru.uea.ac.uk/tiempo/newswatch/comment060704.htm](http://www.cru.uea.ac.uk/tiempo/newswatch/comment060704.htm)

Therefore, California has set ambitious targets and has designed policies to foster innovation



- Executive Order S-3-05 GHG emission reduction targets
  - 2010: maintain 2000 levels (~10% reduction from baseline)
  - 2020: return to 1990 levels (~25% reduction from baseline) → **AB32**
  - 2050: attain 80% below 1990 levels → **Climate Stabilization**

# Climate change strategy has three overarching goals

- 1. Deploy near-term technologies to cut emissions by ~25% by 2020**
- 2. Stimulate innovation & investment in new technologies needed to meet 2050 stabilization targets**
- 3. Contribute to related objectives**
  - Economic growth
  - Air quality
  - Affordable energy prices
  - Diversity of energy sources
  - etc.

# To ensure innovation across the economy, a sectoral approach is needed

- **Multiple market imperfections create the need for complements to economy-wide policies**
  - Inadequate R&D; High private discount rates; Market power; Network effects; Infrastructure requirements; Differences in fuel-on-fuel competition, Poor applicability of carbon capture and sequestration
- **Can be added to economy-wide cap and trade**
- **Example: Implications of a \$25/ton CO<sub>2</sub> price**
  - Nuclear + renewable electricity \$0.01/MWh
  - Integrated gasification combined cycle with carbon capture and storage (IGCC+CCS) \$02.50/MWh
  - Natural gas combined cycle (NGCC) \$12.50/MWh
  - Pulverized coal (PC) \$20.00/MWh
  
  - Gasoline \$0.22/gallon
  - Corn ethanol \$0.11 to \$0.23/gallon

# California has developed a comprehensive, sectoral strategy to cut GHG emissions

- **Overall goals**

- Executive Order S-3-05 (2005)
- Global Warming Solutions Act 2006 (AB 32)
- Energy Action Plan (CEC and CPUC)
- Bioenergy Action Plan (CARB, CEC, CPUC, etc.)

- **Energy research portfolio**

- **Buildings and appliances**

- Energy efficiency standards (CEC)

- **Electricity other large sources**

- Carbon Adder (CPUC)
- Renewable portfolio standard for electricity (SB 107)
- GHG performance standard (CPUC and SB1368)
- GHG emissions cap (CPUC)
- Energy efficiency targets for utility companies (AB 2021)

- **Transportation**

- Vehicle GHG performance standard (AB 1493, CARB)
- Low Carbon Fuel Standard (LCFS Executive Order S-1-07, CARB, CEC, and others)
- Reduce vehicle usage

- **Other policies**



# Main provisions of AB32

- **GOAL Reduce CA GHG levels to 1990 levels by 2020**
- **CARB lead agency / CPUC involvement**
- **2012 cap on stationary sources**
  - Covers all GHGs and most emitting stationary sources
  - Market-based mechanisms recommended (preferred?)
- **Numerous regulatory programs under development**
  - Energy efficiency standards, port and truckstop electrification, afforestation, manure management etc.
- **Early action plans**
  - Low Carbon Fuel Standard (LCFS), etc.
- **Environmental justice considerations**
- **Governor can delay the deadline**

## AB32 Timeline (selected)

- **Jan 07** - Form advisory committees and lay out schedule actions
- **Jan-May 2007** – Agencies conduct initial workshops and analyses
- **June 2007** – University of California Berkeley/Davis study of LCFS  
[www.its.berkeley.edu/sustainabilitycenter](http://www.its.berkeley.edu/sustainabilitycenter)
- **July 2007** – CARB starts regulatory proceedings on early actions, public workshops and notice and comment process
- **July 2008** – CARB adopts mandatory reporting regulations
- **Jan 2009** – CARB adopts plan for achieving 2020 targets and completes regulatory proceedings for early actions (including LCFS)
- **Jan 2010** – Early action regulations take effect (including LCFS)
- **Jan 1, 2012** – All GHG regulations are legally enforceable



## LCFS basics

- **Carbon intensity must be measured on a lifecycle basis**
  - Average Fuel Carbon Intensity (AFCI) measured in gCO<sub>2</sub>e/MJ
  - AFCI must decline by at least 10% by 2020
- **Stimulate technological innovation**
  - Use performance standard, with tightening over time
  - Measures desired outcome (GHGs), not a proxy (renewable)
  - Different fuels (electricity, biofuels, fossil, etc.) compete with one another, so government does not pick winners (or losers!)
- **Compliance by manufacturers or importers of fuels (mostly oil refiners)**
- **Additional to vehicle performance standards**
- **Overcompliance creates credits that can be traded in a market or banked for later use**
- **Default and opt-in approach** (Thanks to the U.K.)

# Compliance through default and opt-in approach

- **Compliance is possible with many competing technologies:**
  - Lowering the carbon intensity of current fuels – e.g. refinery efficiency
  - Using new, low-carbon fuels – biofuels, electricity, hydrogen, etc.
  - Buying credits (or offsets)
- **Default: all fuel inputs are assigned a carbon intensity**
  - Fuel inputs must be categorized
  - Highest value in common use is the default value
  - Encourages opt-in and focuses management attention
- **Opt-in: certified data allow lower carbon intensity values**
  - Requires protocol development and data collection
  - Certifiers are needed
  - Tends to encourage innovation
- **Default example:**
  - Gasoline: conventional oil, heavy oil, tar sands, coal
  - Diesel: conventional oil, heavy oil, tar sands, coal
  - Ethanol: U.S. corn, Brazilian sugar, U.S. switchgrass

# A Low-Carbon Fuel Standard for California

August 2007

## Project Directors

Alexander E. Farrell, UC Berkeley  
[www.its.berkeley.edu/sustainabilitycenter](http://www.its.berkeley.edu/sustainabilitycenter)

Daniel Sperling, UC Davis  
[www.its.ucdavis.edu](http://www.its.ucdavis.edu)

## Contributors

S.M. Arons, A.R. Brandt, M.A. Delucchi, A. Eggert, A.E. Farrell,  
B.K. Haya, J. Hughes, B.M. Jenkins, A.D. Jones, D.M. Kammen,  
S.R. Kaffka, C.R. Knittel, D.M. Lemoine, E.W. Martin,  
M.W. Melaina, J.M. Ogden, R.J. Plevin, D. Sperling,  
B.T. Turner, R.B. Williams, C. Yang

## Several LCFS compliance scenarios are feasible for California with moderate biofuel use

Scenario name	Volume in 2020 (million GGE/yr) *
Business as Usual (BAU)	Gasoline: 15,300 (of which ~900 are ethanol) Diesel: 850
Existing Vehicles and Advanced Biofuels	Low-GHG ethanol: 957 Low-GHG diesel: 709 <i>Today's pilot plants</i>
Biofuel Intensive	Mid-GHG ethanol: 3,293 Mid-GHG diesel: 423 <i>Today's average practices</i>
Multiple Vehicles and Fuels	Low-GHG ethanol: 1,262 Low-GHG diesel: 171 <i>Today's best practices</i> CNG: 289 Electricity: 69 Hydrogen: 59

\* GGE = gallons of gasoline equivalent

# Regulatory implementation requires a new approach to Life Cycle Analysis

- **Plant-specific analysis is required**
  - May be proprietary and thus must be protected by government
  - Mechanisms for certifying data are needed
  - Results must be self-documenting
- **Key assumptions** (e.g. forecast information) **must be agreed-upon by all users**, else the model produces any answer you want
- **Uncertainties** must be calculated and evaluated.
- **Factors that cannot be represented in a LCA need to be added** – market responses such as land use change
- Must be **usable** by regulated entities, **resistant** to fraud, and easy to **verify**.

# Key implementation issues and questions

- **Basis of competition**

<b>Electricity</b>	<b>Oil</b>	<b>Biofuels</b>
Rate-of-return regulation	Competitive	Subsidized/Protected
All emissions capped	Intensity target	Ignored unless LCFS
Local/Regional	Global	Global
"Ratepayer subsidies"	"Capital at risk"	"Mandated volumes"

- **Including "upstream" emissions for oil production**
- **Rationalization (aka "leakage")**
- **LCA methods and compliance tools**
- **Compliance schedule and time for innovation/investment**
- **Complementary regulations and government actions**
- **Availability of offsets, interactions with cap and trade**
- **Land use change**

# What does the LCFS mean to biofuel producers?

- **Accept default or obtain certified information** that allows for a lower, more accurate opt-in value.
- Value for product will be reflected in **prices** that the regulated entities (e.g. refiners) have will pay
- **Incentives to lower GHG emissions** (efficiency, fuel switching, process changes, etc.)
- **Incentives to use waste and residue feedstocks** that require little or no inputs because these have low GHG emissions and so obtain a high price.
- **Feedstock production on newly-cleared land is likely to have a low price** (due to high GHG emissions, direct and indirect)

# The LCFS may become a complement to (or replacement for) biofuel mandates

- **United Kingdom:** Renewable Transportation Fuel Obligation (like a RFS) requires GHG monitoring in 2008
- **California:** LCFS regulations to be in effect 2010
- **Consideration by other states and provinces:** AZ, BC, CT, DE, MD, MA, MN, NH, NJ, NY, ON, OR, NM, RI, VT, WA...
- **Federal regulations:** Proposed CAFE + LCFS rule in Nov 2007
- **Federal bills:** Sanders-Boxer, Feinstein, Inslee, Boucher
- **European Union:** monitoring in 2009, reductions in 2011
- **Global Bio-Energy Partnership:** Oct 9-10 meeting on GHG emission monitoring



# Thank you

- Anand Gopal
- Andy Jones
- Dan Kammen
- Eva Markiewicz
- Mike O'Hare
- Rich Plevin
- Deepak Rajagopal
- Julia Thompson
- Brian Turner

This research was made possible through support from the Climate Decision Making Center. This Center has been created through a cooperative agreement between the National Science Foundation (SES-034578) and Carnegie Mellon University. <http://cdmc.epp.cmu.edu/>

Additional funding provided by the the National Science Foundation's Graduate Research Fellowship Program and the Energy Foundation