

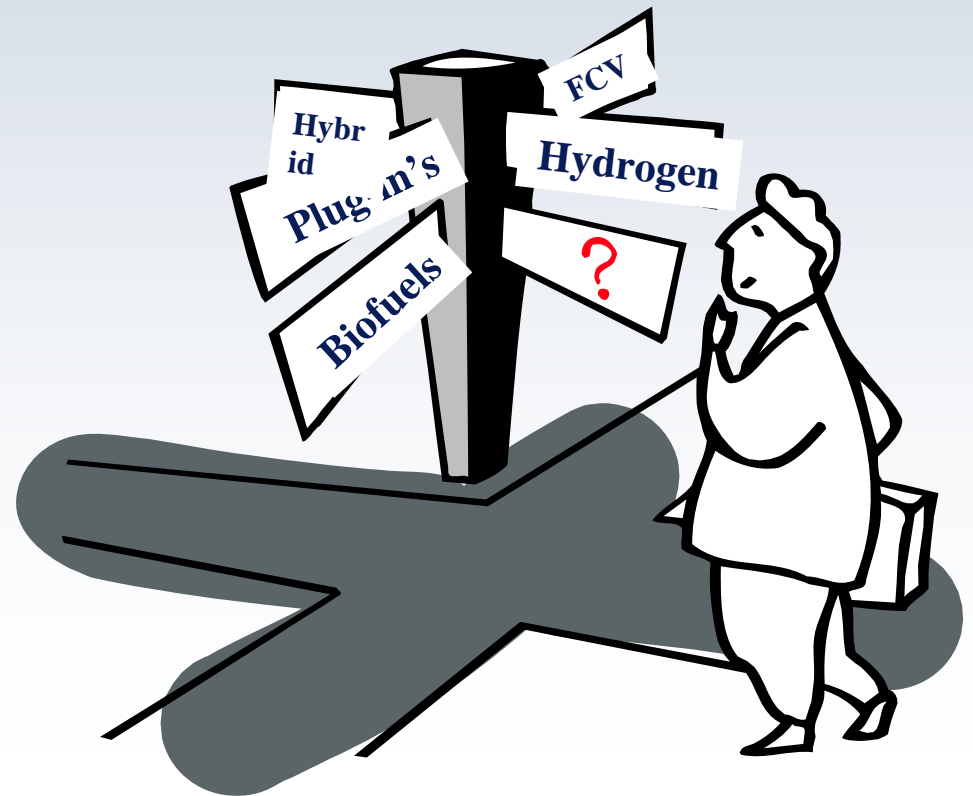
Biofuels and the LCFS

Daniel Sperling

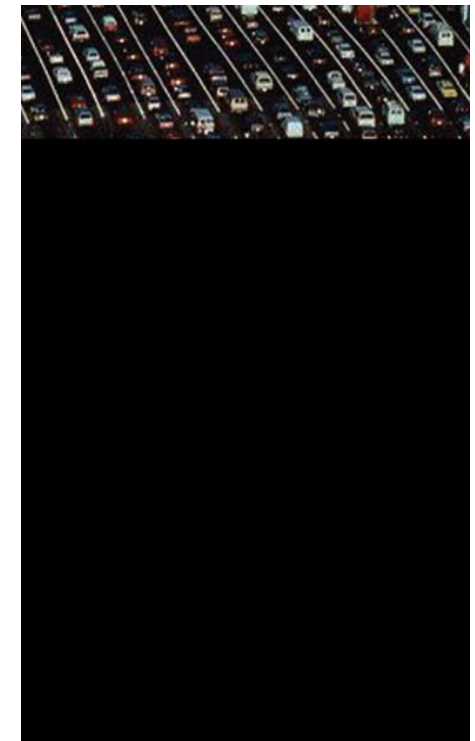
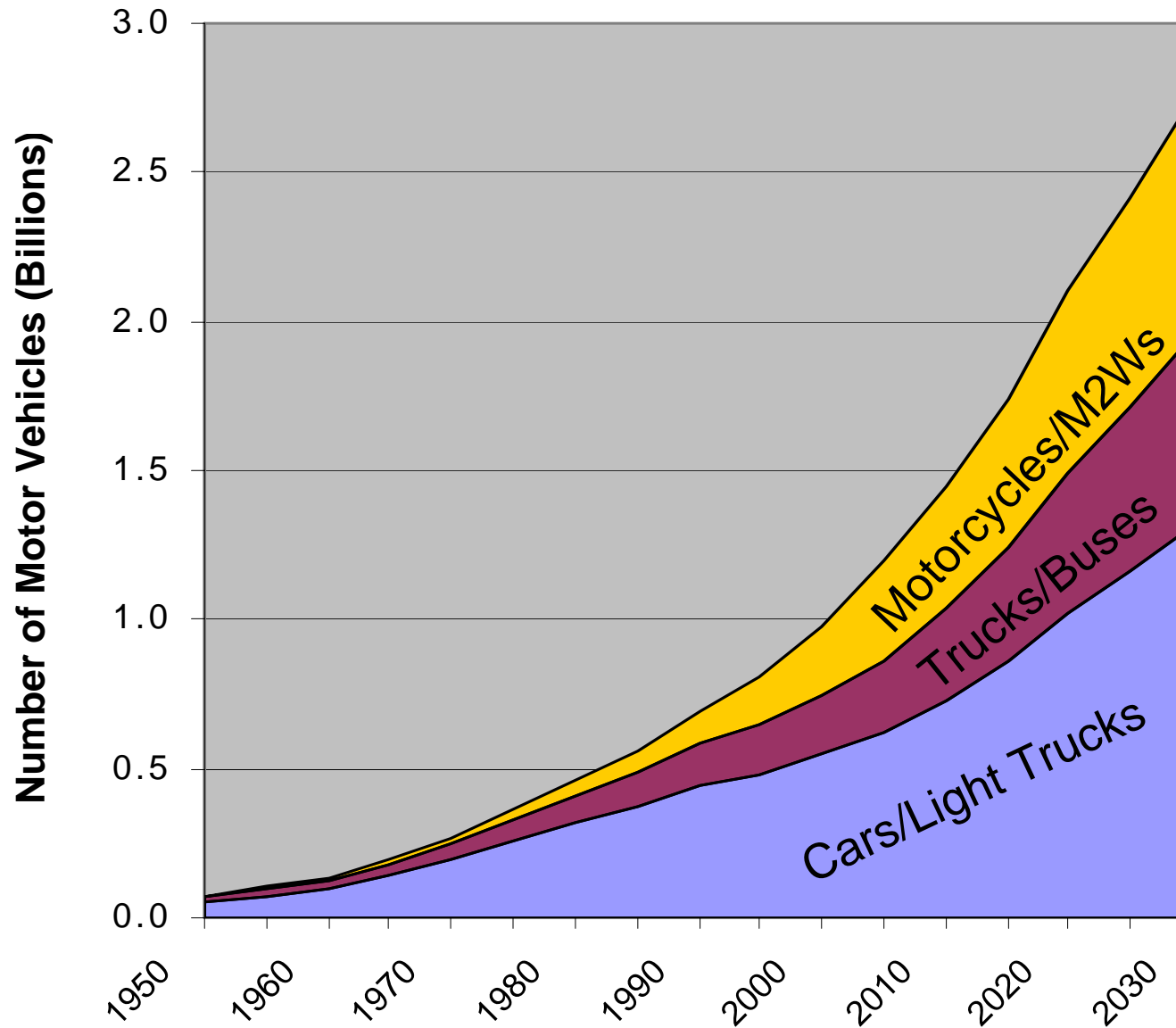
University of California, Davis & California Air Resources Board

May 12, 2009

***Thanks to Mike Scheible
and ARB for many of the
slides.***

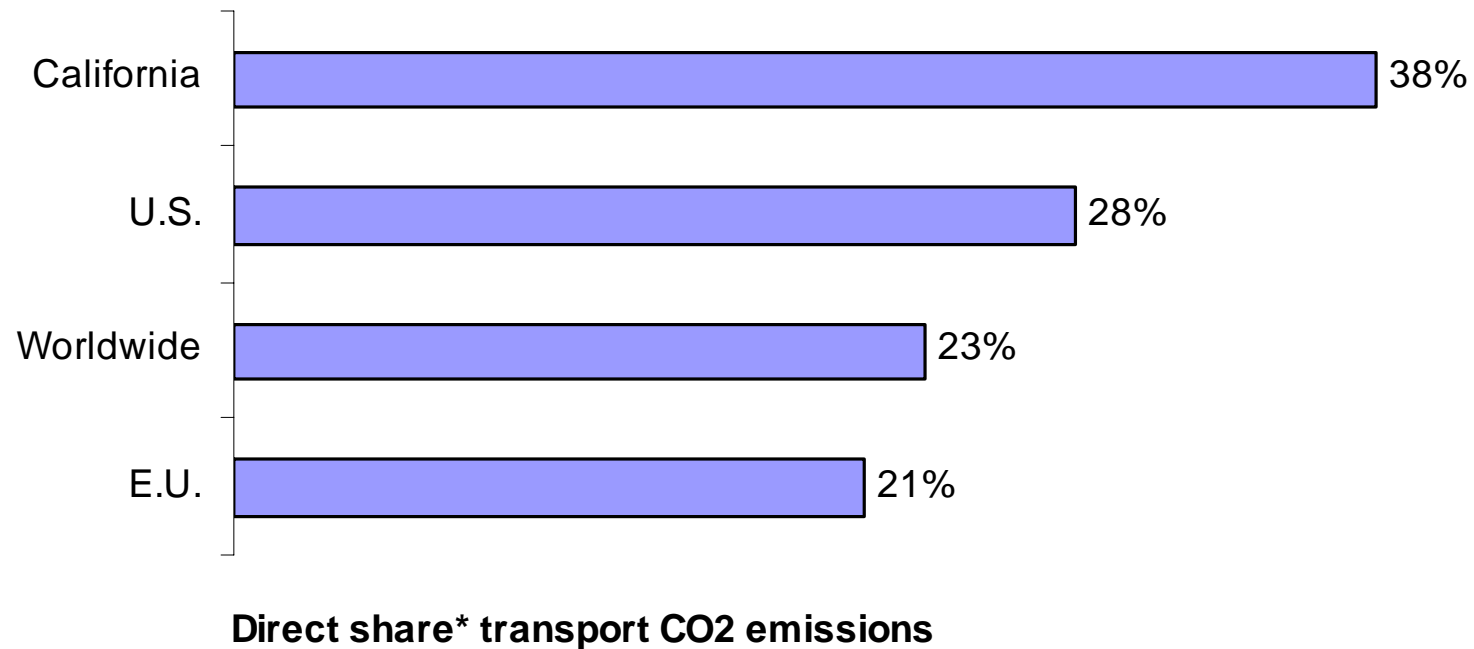


Global Vehicle Ownership (and oil use) Is Soaring



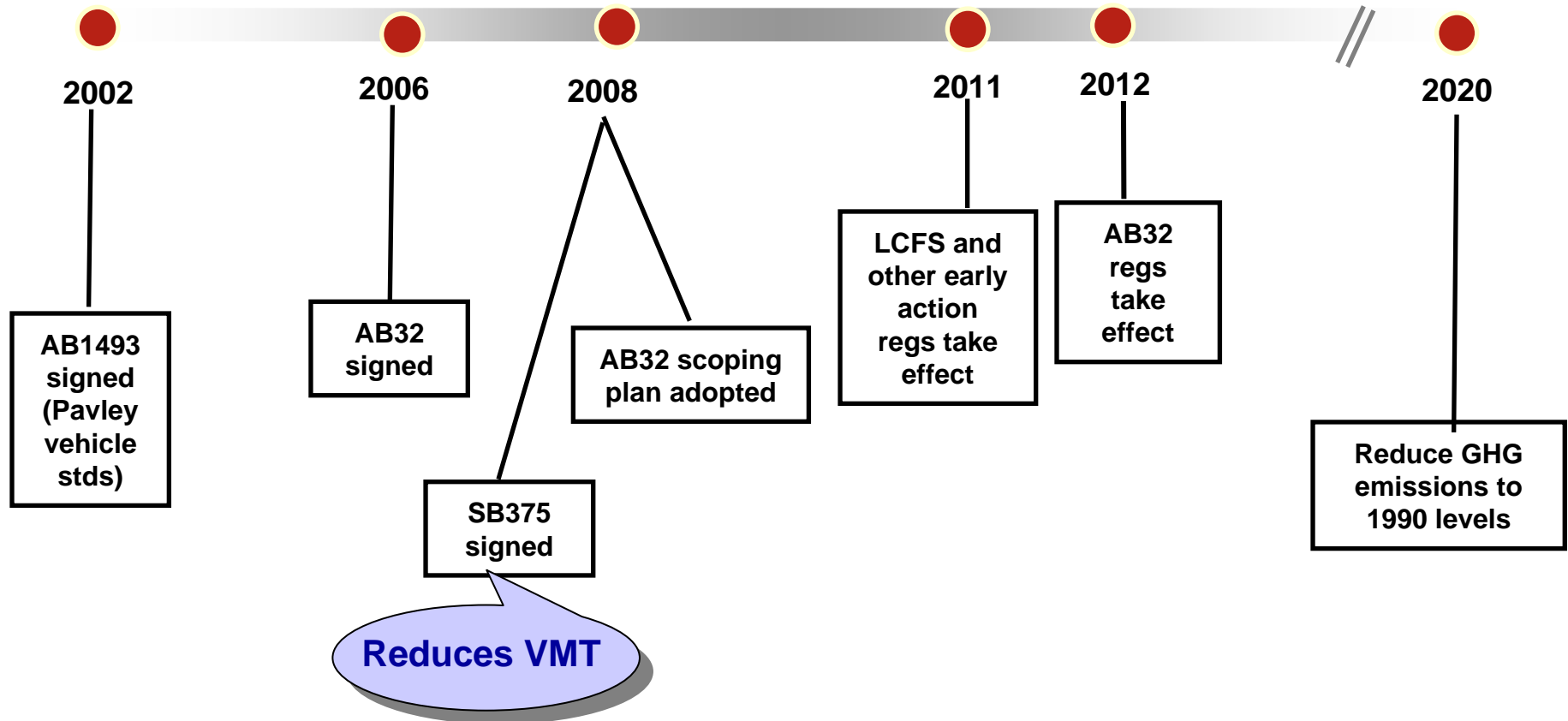
Sperling and Gordon
(2009), based on
DOE, JAMA, other

Transportation Plays Large Role in Climate Change

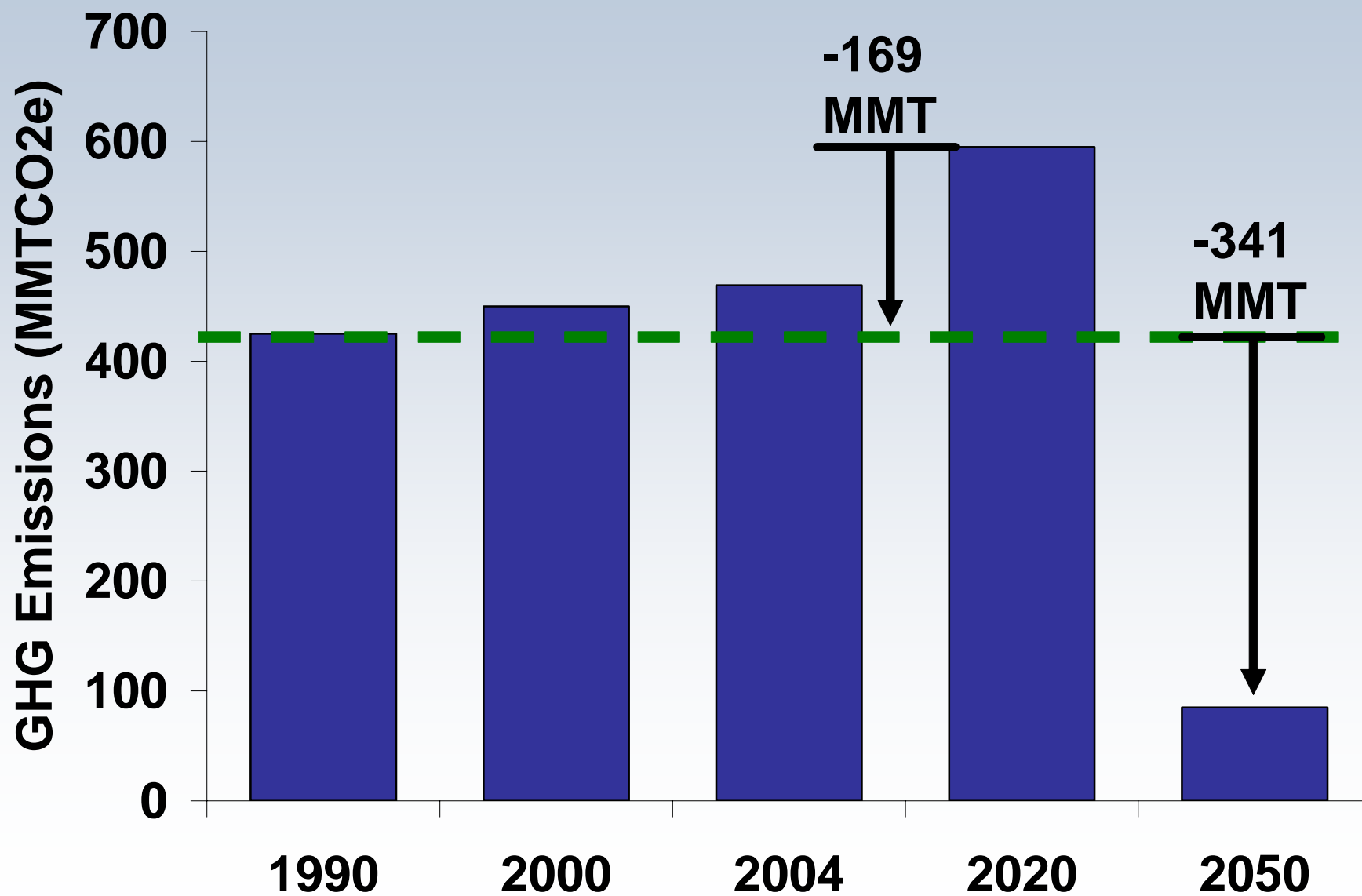


Globally, greenhouse gas emissions have been rising more rapidly in transport than any other sector – up 120% between 1970 and 2004

California GHG Policy Timeline



Large GHG Reductions Required

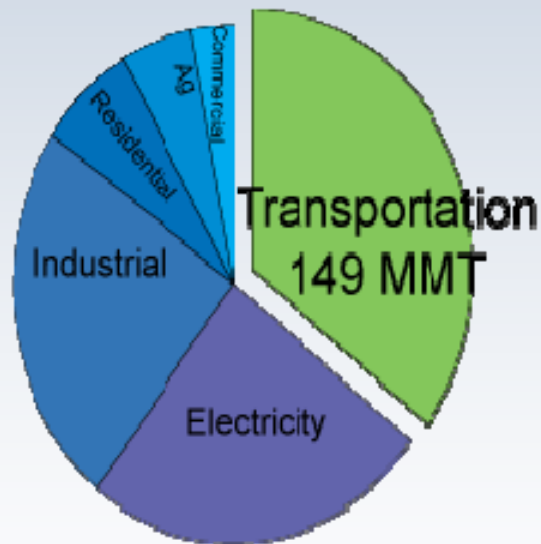


The California Model

- Model and leader, not island
- Stimulate innovation in technology, behavior, institutions
- Economy-wide approach, mix of short and long term strategies
- Target specific GHG reductions with broad array of rules and incentives
 - Energy efficiency stds, Renewables Portfolio Standard, LCFS, etc
- Overlay cap-and-trade program (and offsets) to create price signal for carbon and to equilibrate costs across sectors (and gain additional reductions)

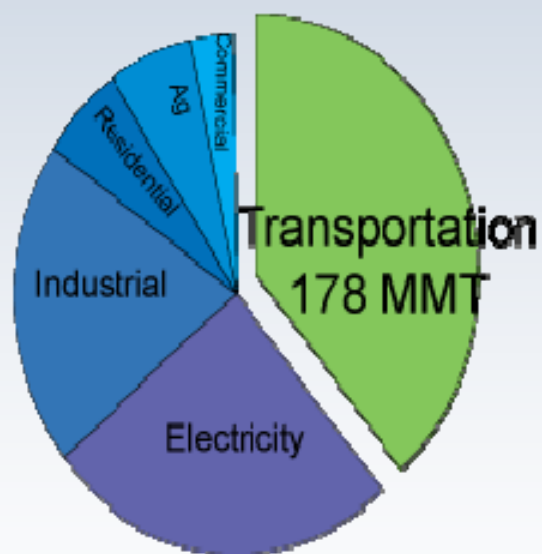
Transportation Emissions Increasing

1990



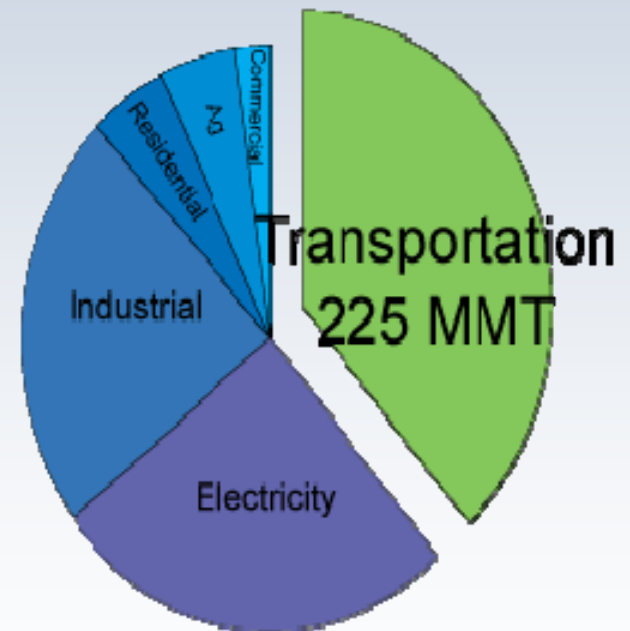
~425 MMT

2004



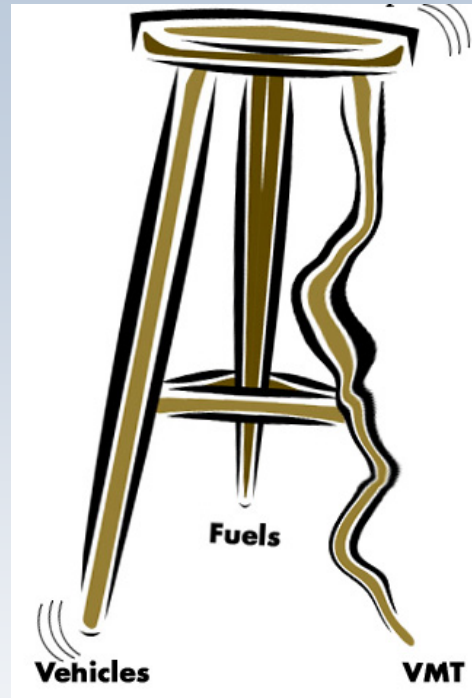
~469 MMT

2020



~595 MMT

Transforming Transportation



- Transforming vehicles (*“easiest”*)
- Transforming fuels (*hard*)
- Transforming mobility (*hardest*)

LCFS Established by the Governor and Adopted by ARB

- **Governor Schwarzenegger established the LCFS in January 2007**
- **UC completed analysis demonstrating feasibility in the spring and summer of 2007**
- **ARB identified LCFS as AB 32 discrete early action measure in June 2007**
- **ARB adopted LCFS on April 23, 2007**



LCFS Plays Important Role in Reducing Transport GHG Emissions in California

- Vehicles (cars and trucks) **39 MM tons** (reduction from BAU by 2020)
 - Light-duty vehicle GHG stds (Pavley I and II)
 - ZEV mandate + ZEV incentives (“ZEV” = BEVs, PHEVs, FCVs)
 - Feebates?
 - Truck technology (Aerodynamic design of cabs, trailer skirts; hybridization of urban and short-haul trucks)
- **Fuels 16 MM tons** (reduction from BAU by 2020)
 - **Low Carbon Fuel Standard**
- VMT and goods movement **5-10 MM tons** (reduction from BAU by 2020)
 - VMT reduction via land use, transit, pricing (SB375)
 - Low-emission req'ts at ports, eco-driving, tire inflation, etc

Framework for LCFS

- **Creates durable framework for near and long term transition to low carbon fuels**
- **Encourages technology innovation**
- **Establishes a model for regional and national standards**
- **Sets stage for future reductions**
- **Complementary to vehicle and usage (VMT) policies**

LCFS Mechanics

- Applies to on-road transport fuels (but can generate credits from low-carbon fuels used in off-road vehicles)
- Separate targets for gasoline and diesel (10% reduction for each)
- Carbon intensity represents the GHG emissions per unit of energy (gCO₂-eq/MJ)
- Fuel producers achieve 10 percent reduction by 2020
- Reduction is gradual and weighted toward later compliance years

Who is Regulated?

- Providers of most petroleum and biofuels are 'regulated parties'
- Providers of fuels that meet 2020 levels must 'opt in' to earn credits:
 - Electricity
 - Hydrogen
 - Natural Gas

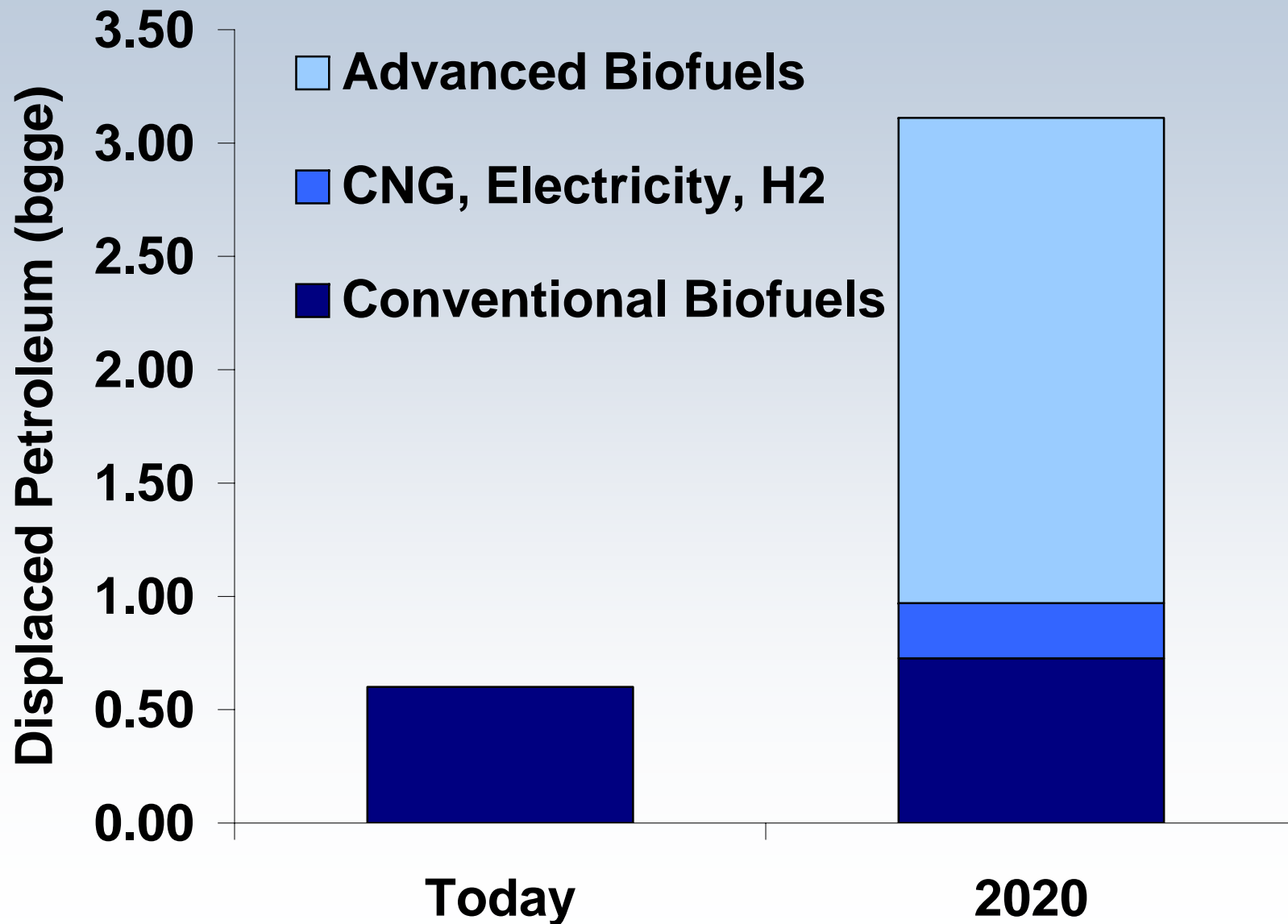
LCFS is Flexible and Harnesses Market Forces

- All fuels eligible
- Regulated parties can meet carbon intensity standard by selling fuels or buying credits from other low-carbon fuel suppliers
- Buying and selling of credits creates a market for low-carbon fuels and encourages innovation

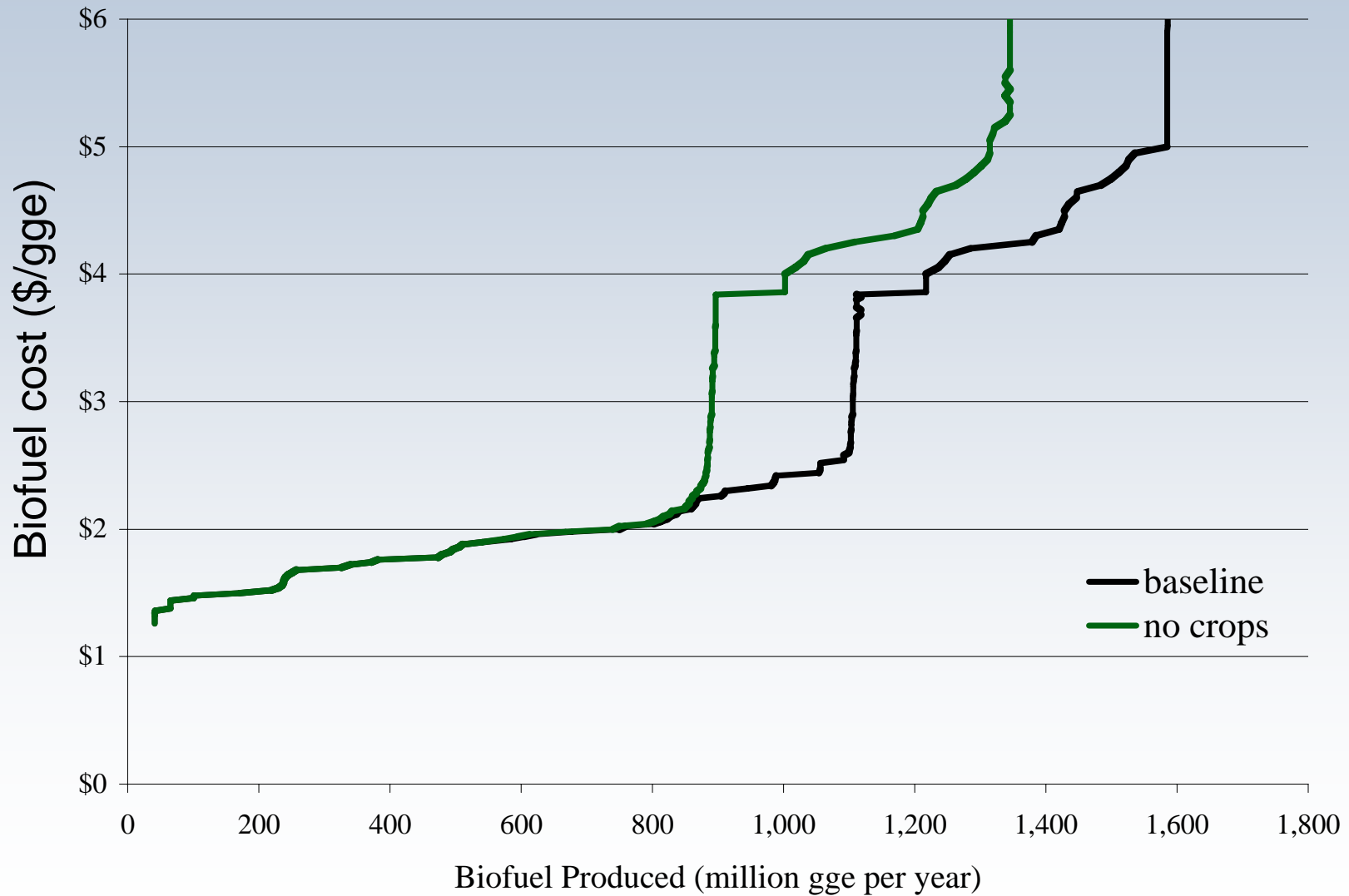
Net Effect of LCFS on Fuel Supply

- Increases use of:
 - Low carbon corn and sugarcane ethanol
 - Cellulosic biofuels
 - Renewable diesel and biodiesel
 - Electricity, hydrogen, natural gas
- Decreases use of:
 - Petroleum
 - High carbon biofuels
- Stimulates efficient energy production and use of low-carbon energy inputs

One Forecast of LCFS Effect on Fuel Use

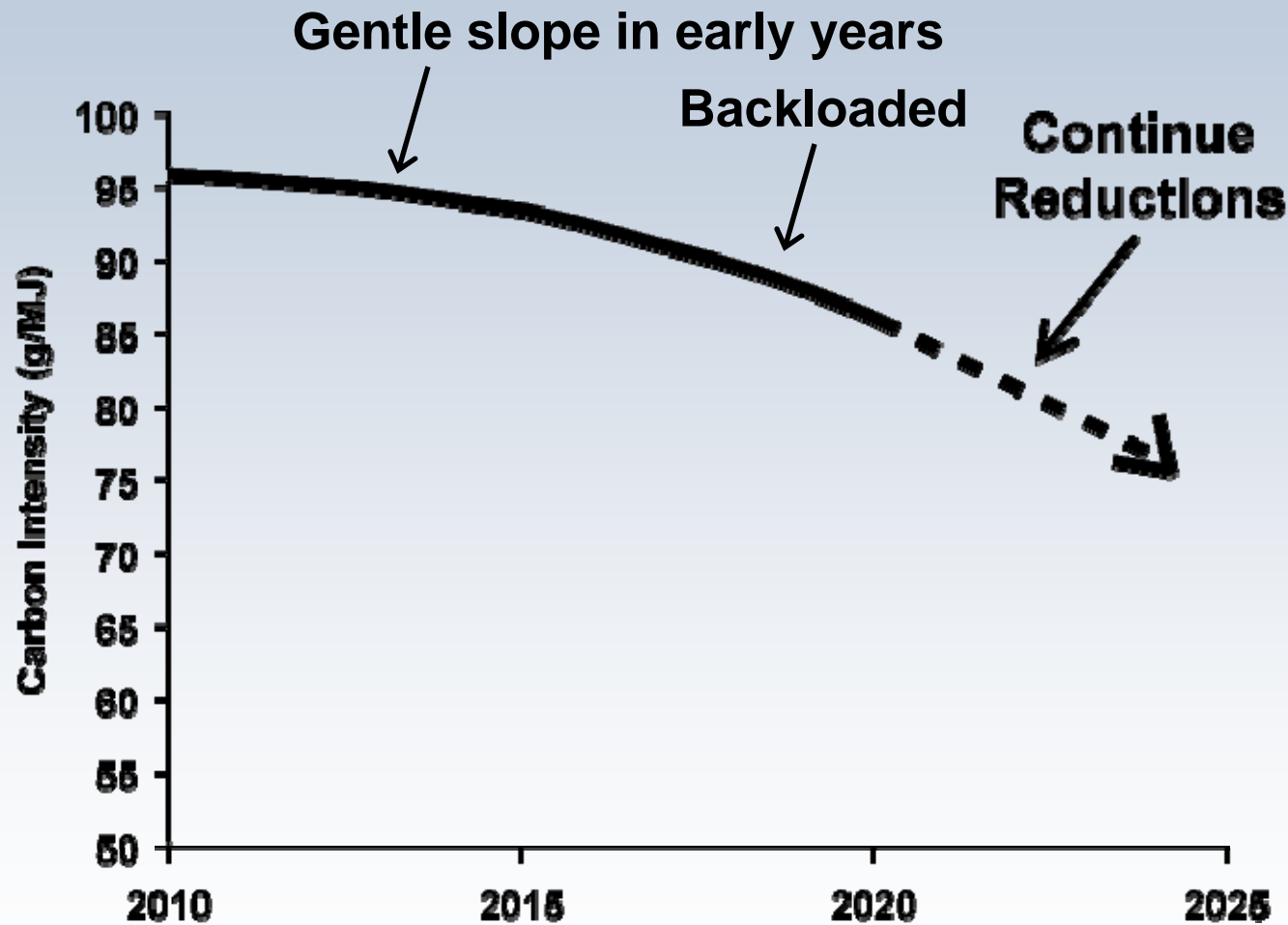


Biomass Supply, California

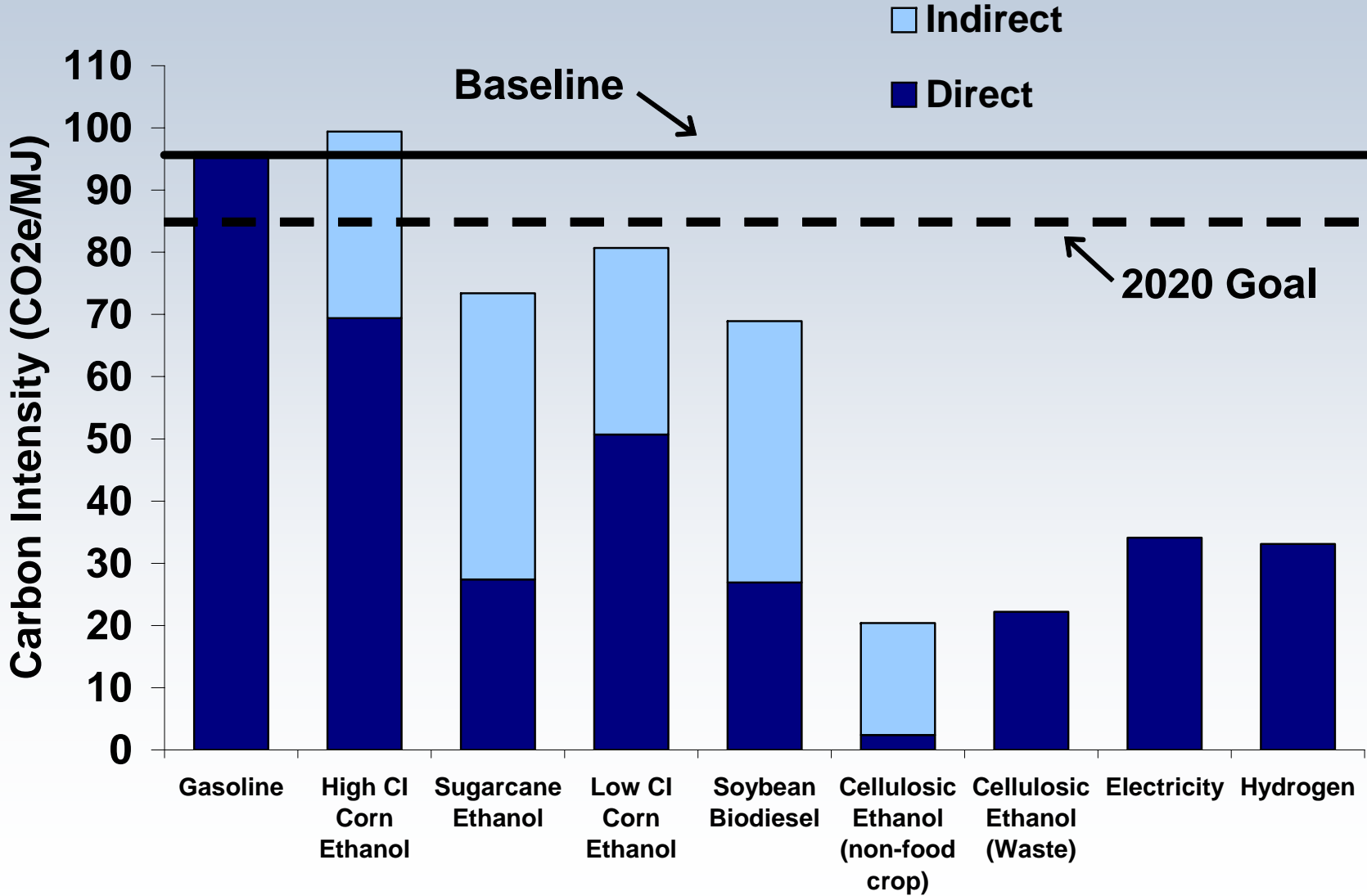


Source: Parker and Jenkins, 2009

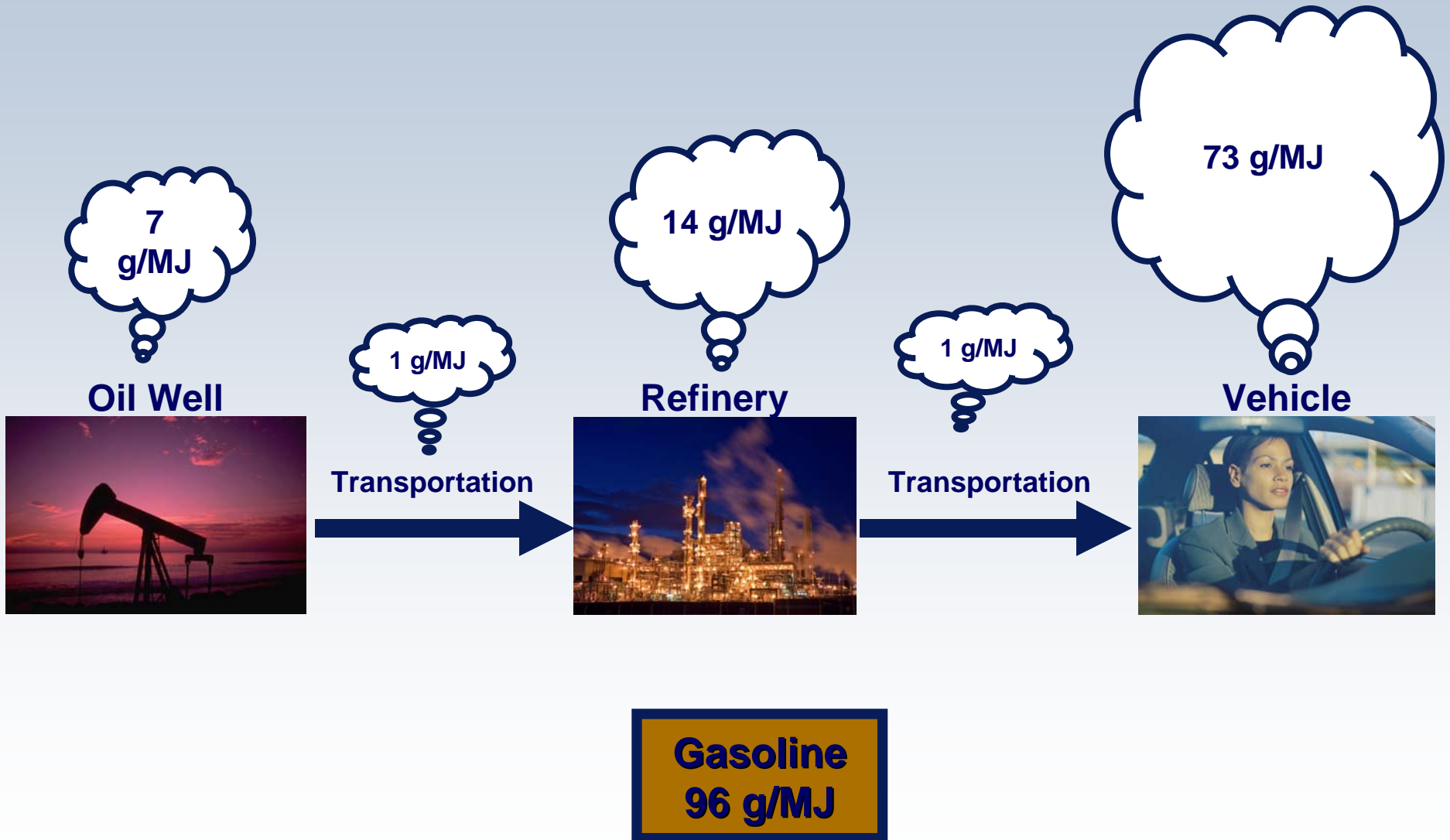
The LCFS Compliance Schedule



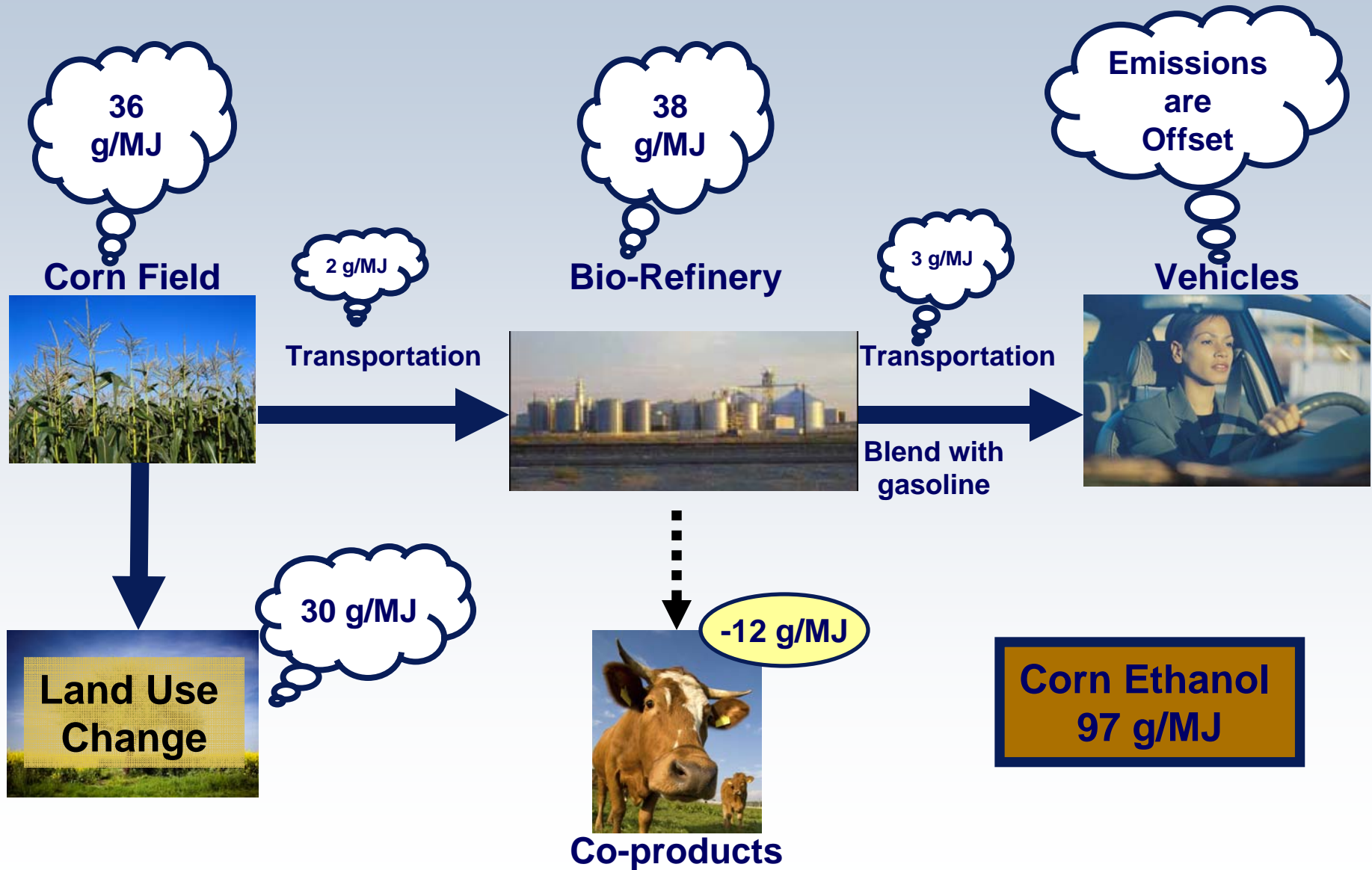
Carbon Intensity of Tomorrow's Fuels



Fuel Lifecycle – Gasoline



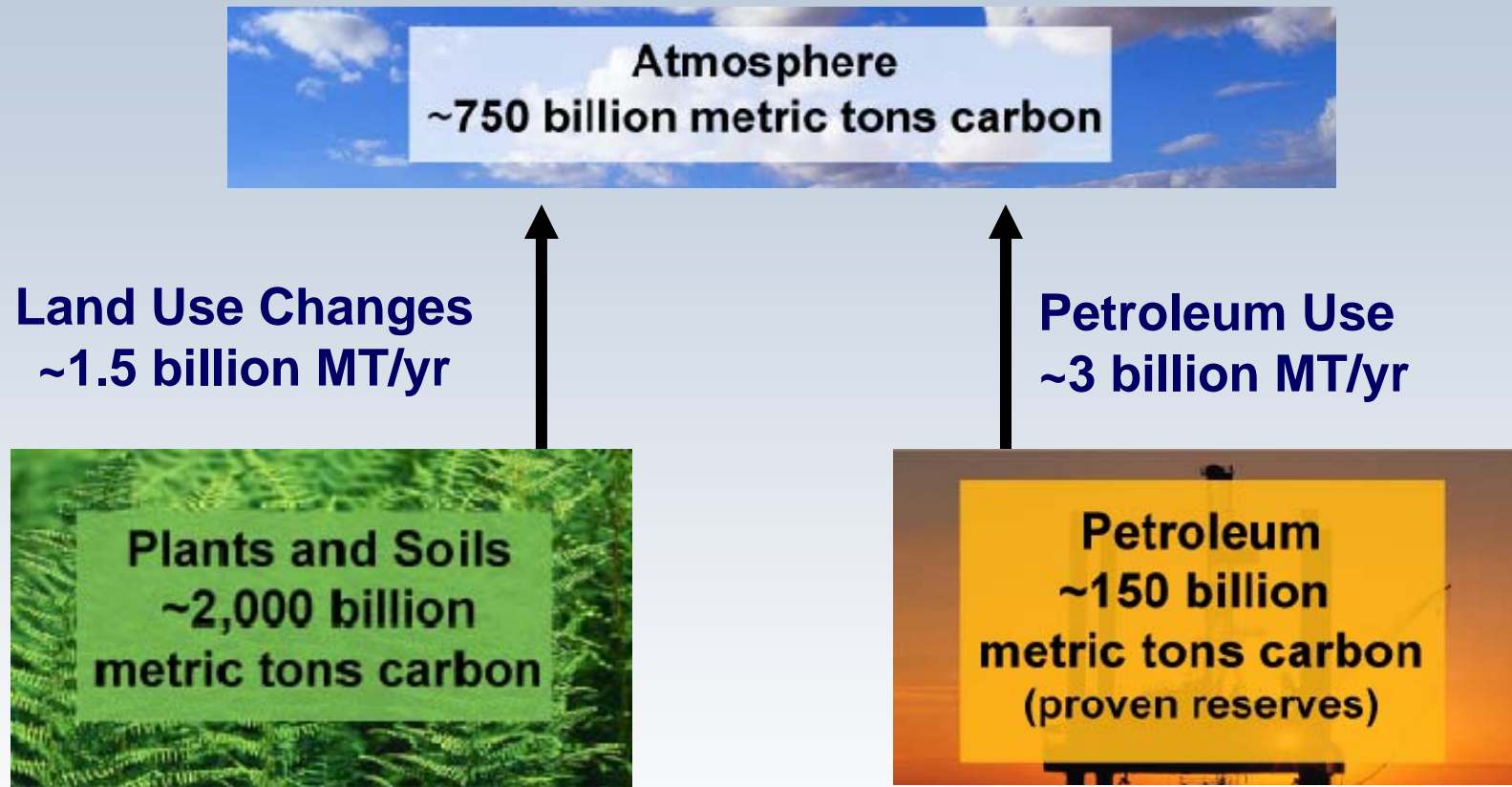
Fuel Lifecycle – Corn Ethanol



Land Conversions Release Carbon

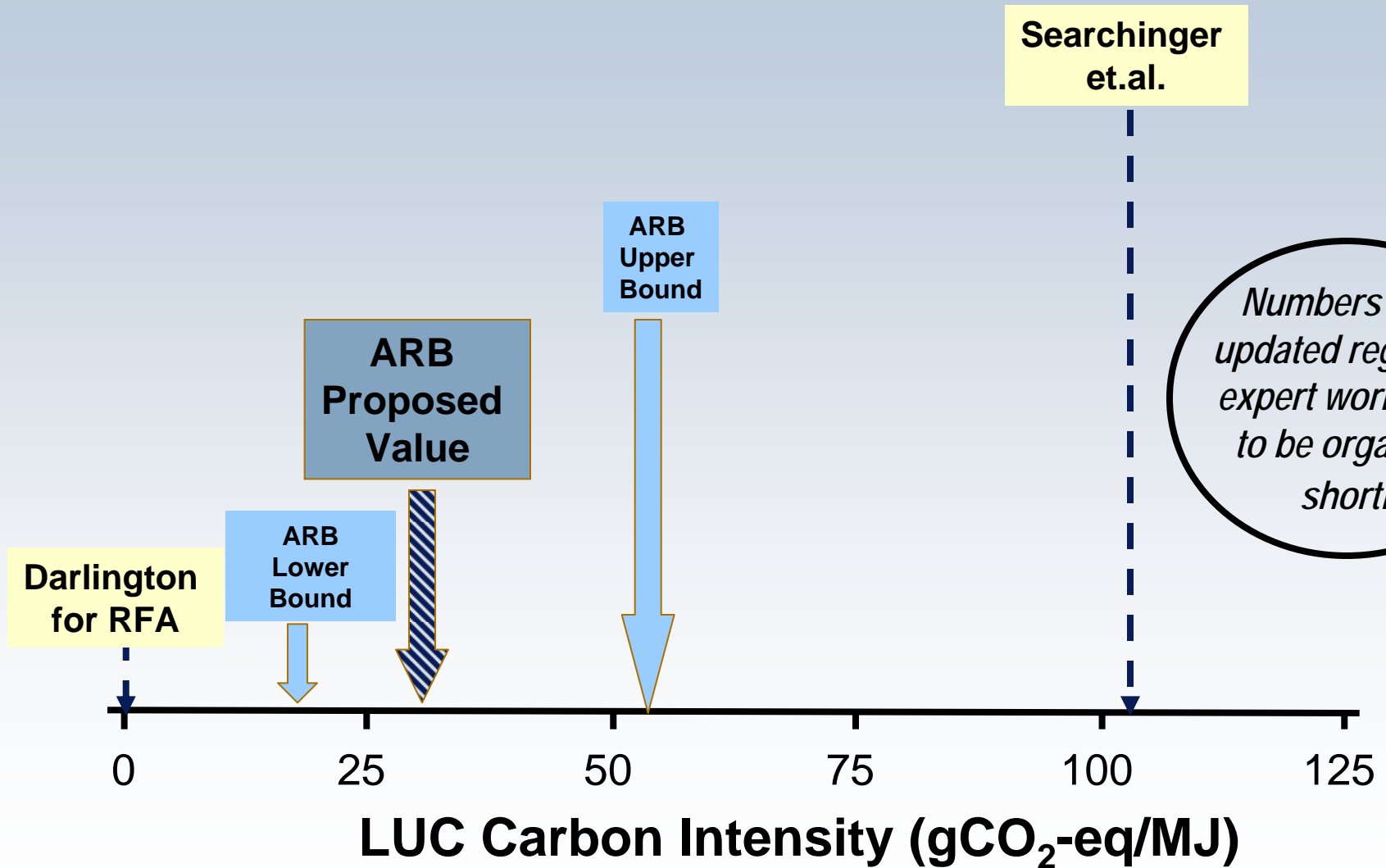
Plants and soil store large amounts of carbon which is released during land conversion

Carbon Storage and Emissions



Plants and soils contain approximately 15 times the carbon in proven oil reserves.

Range of LUC Carbon Intensity Values for Corn Ethanol



Other “Sustainability” Issues

- Biodiversity and ecosystem integrity
- Effects on natural ecosystems, parks, or national forests
- Sustainable use of water
- Agricultural practices (e.g. maintain soil fertility and avoid runoff)
- Invasive species
- Increases in local air pollution from new production facilities
- Economic development in developing and rural regions
- Competition with food and feed

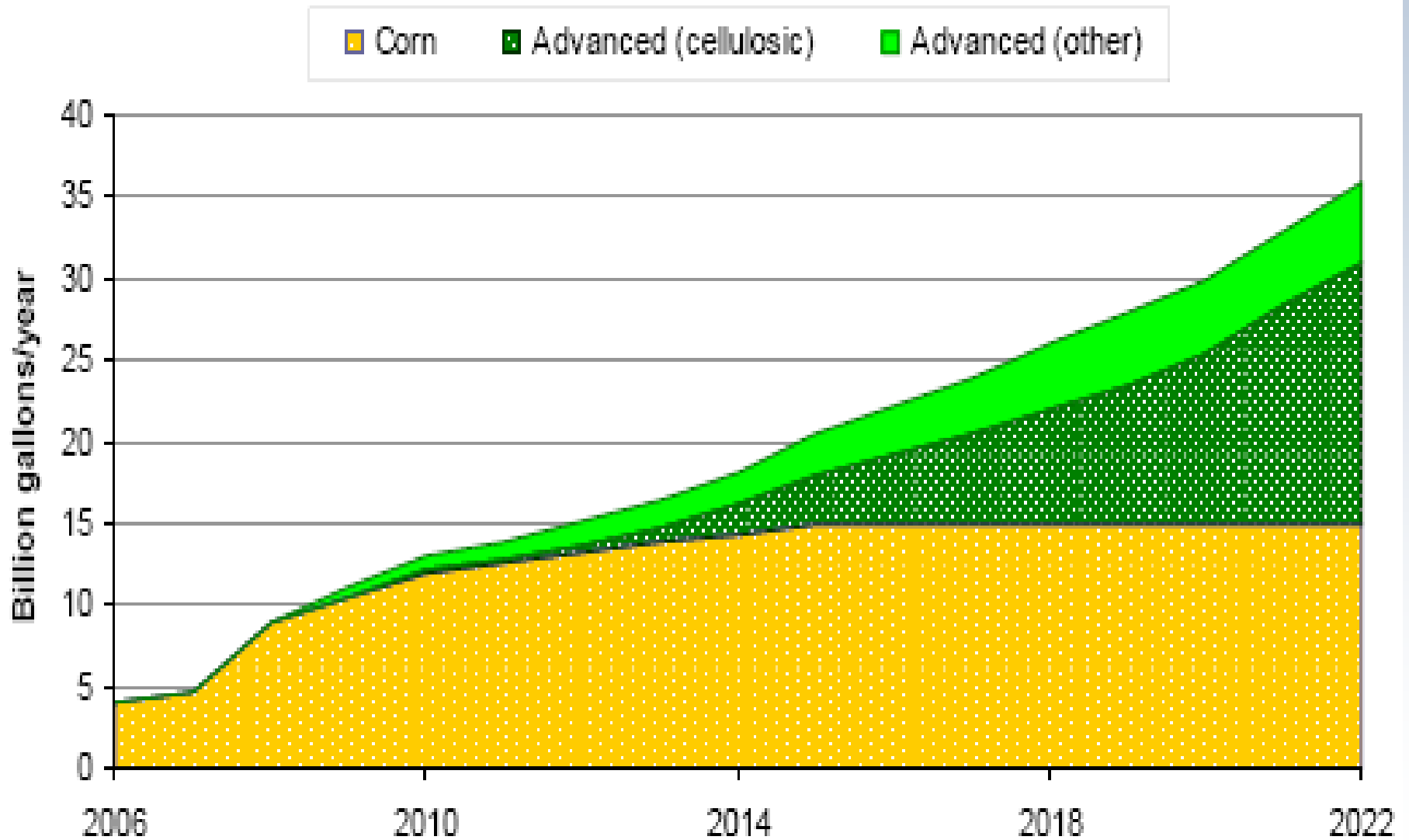
ARB is establishing procedures to address these issues



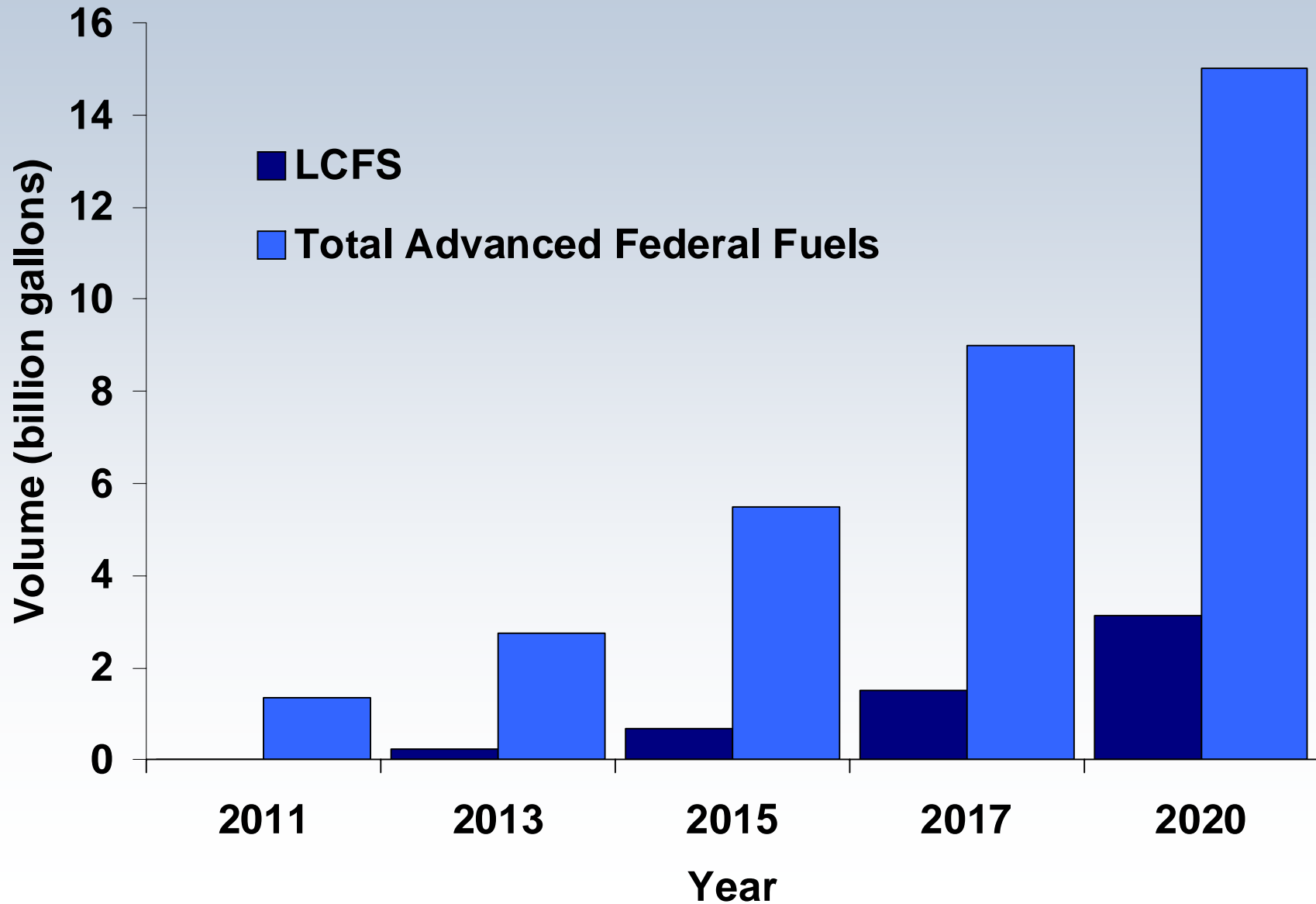
LCFS Builds on Federal Renewable Fuels Std (RFS)

- **RFS mandates volumes of biofuels with less focus on carbon intensity**
 - **Existing corn ethanol, no improvement**
 - **New corn facilities, 20% reduction**
 - **Other biofuels, at least 50% reduction**
 - **Cellulosic biofuels, 60% reduction**
- **Reduces GHGs nationwide by 3 percent**

National Requirements for Biofuels (EISA 2007)



Advanced Biofuel Volumes - RFS vs. LCFS



LCFS Improves Upon the RFS

- All fuels treated the same; no exemptions for existing corn ethanol
- Performance-based (vs. volume mandates for RFS)
- More market incentives
- Provides incentives for continuing improvements
- Includes non-liquid fuels
- Provides 3 times the GHG reduction benefits

LCFS is Going International

- 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
- Waxman-Markey climate bill in Congress contains an LCFS
 - Would operate in parallel to RFS until 2022
 - In 2023, LCFS and RFS rolled together, with 5% GHG reduction target (CO₂-eq/MJ)
 - In 2030, target would increase to 10%

Note that EU and US standards all explicitly require inclusion of iLUC effects in calculating lifecycle GHG emissions.



Next Steps for ARB (and partners)

- Establish credit trading program
- Continue work on carbon intensities
- Refine calculations of iLUC effect
- Determine how to safeguard against adverse environmental effects of biofuels (“backsliding” and “sustainability”)
- Coordinate with regional, national, and international groups on all of the above