

California Environmental Protection Agency



**Air Resources Board**

***The California  
Low Carbon Fuel Standard***

***EPA Workshop***



**June 10, 2009**

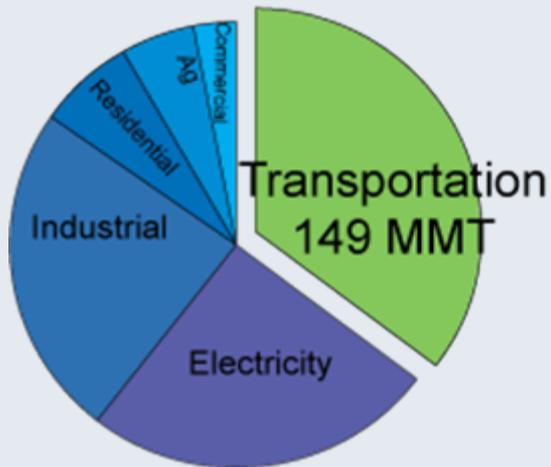
# *Overview*

- **Why California chose an LCFS approach**
- **Importance of lifecycle analysis in our approach**
- **Comparison of LCFS to federal requirements**
- **Next steps**
- **Summary**

# **Why California Chose an LCFS Approach**

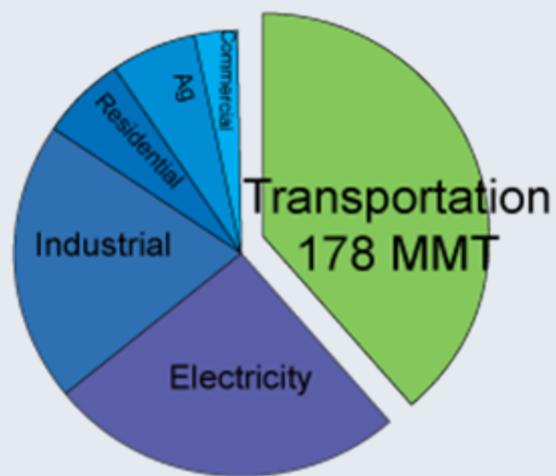
# Transportation Emissions Increasing

1990



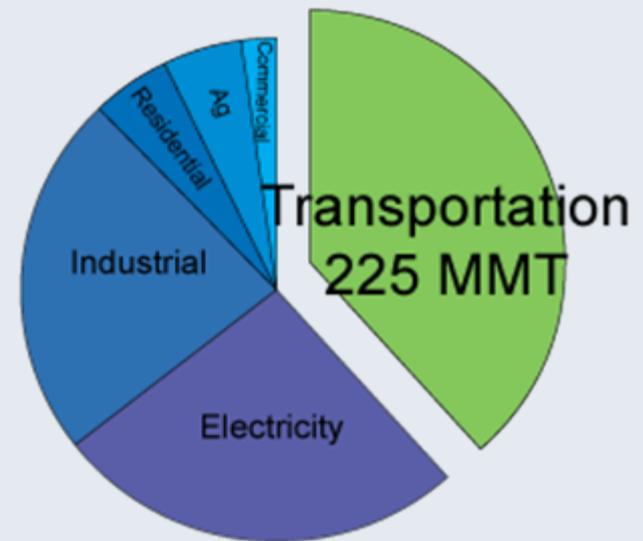
~425 MMT

2004



~469 MMT

2020



~595 MMT

# *Three Ways to Achieve Reductions*

- **Reduce tailpipe emissions**
- **Reduce the number of miles traveled**
- **Reduce the carbon intensity of the fuel**

# ***LCFS Established by the Governor***

- **Governor Schwarzenegger established the LCFS in January 2007**
- **UC completed analysis demonstrating feasibility in the spring and summer of 2007**
- **ARB identified the program as AB 32 discrete early action measure in June 2007**
- **Board approved proposal in April 2009**

# ***LCFS Reduces GHG Emissions***

- **Results in a 10 percent reduction in the carbon intensity by 2020**
- **Reduces 16 MMT GHG emissions from the transportation sector by 2020**
- **Achieves about 10 percent of the total emission reductions required to meet the AB 32 target**

# *Framework for Low Carbon Fuels*

- **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**

# **How the LCFS Works**

# *LCFS Mechanics*

- **Baseline fuel carbon “intensity” is that of 2010 gasoline and diesel fuel**
- **Carbon intensity represents the GHG emissions per unit of energy**
- **Fuel producers achieve 10 percent reduction by 2020**
- **Reduction is gradual and weighted toward later compliance years**

# *Impact on Fuels*

- **Increase use of:**
  - **Low carbon corn or sugarcane ethanol**
  - **Cellulosic ethanol**
  - **Renewable diesel and biodiesel**
  - **Electricity, hydrogen, natural gas**
  
- **And decrease the use of:**
  - **Petroleum**
  - **High carbon biofuels**

# **Importance of Lifecycle Analysis**

# ***Lifecycle Analysis Basis for LCFS***

- **Lifecycle analysis considers the GHG emissions from all facets of fuel production, distribution, and use**
- **Governor's EO directed that ARB consider lifecycle analysis**
- **UC reports confirmed that LCFS needs to be based on lifecycle analysis**

# Fuel Lifecycle – Gasoline

7  
g/MJ

Oil Well



1 g/MJ

Transportation



14 g/MJ

Refinery



1 g/MJ

Transportation



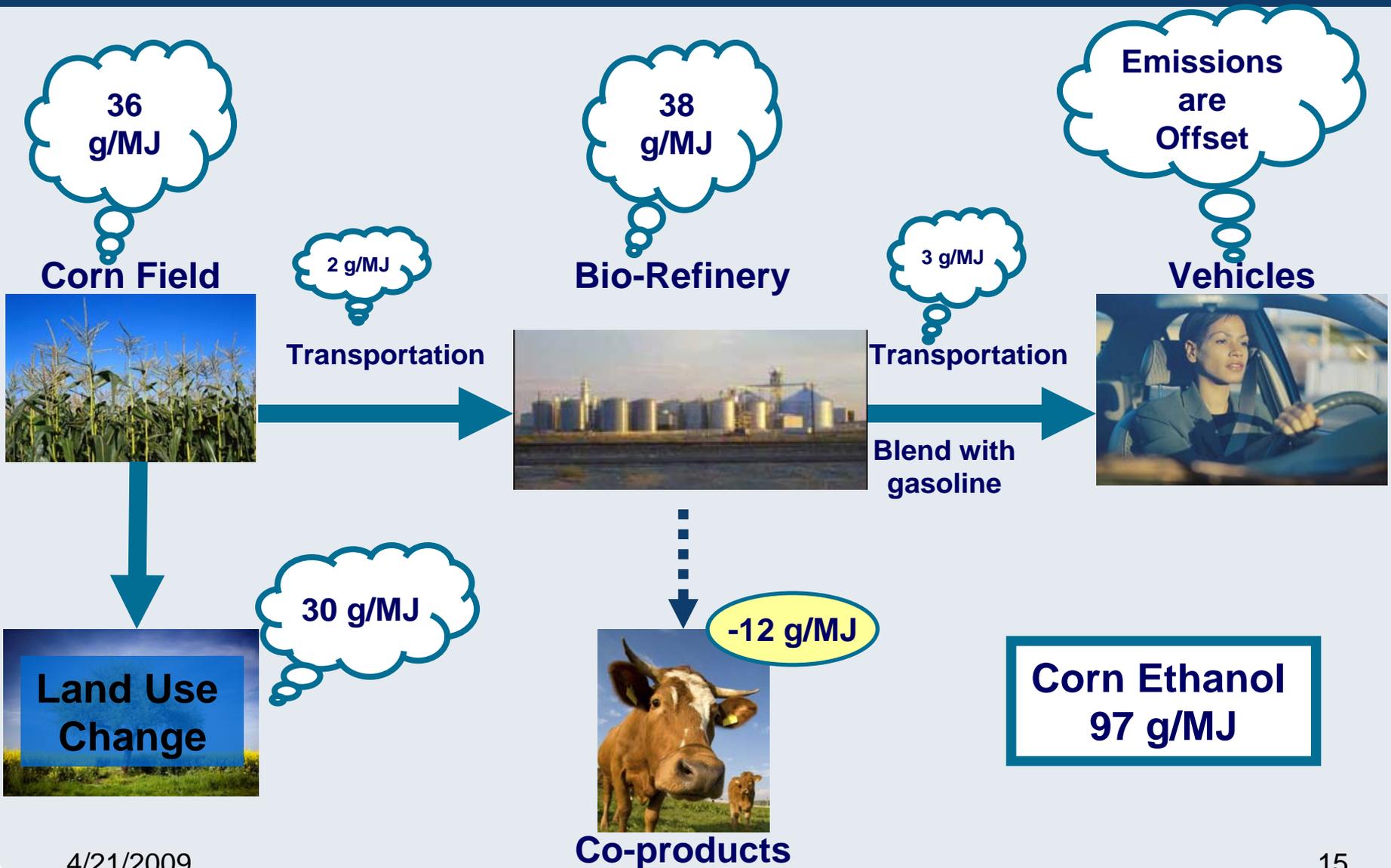
73 g/MJ

Vehicle



**Gasoline**  
**96 g/MJ**

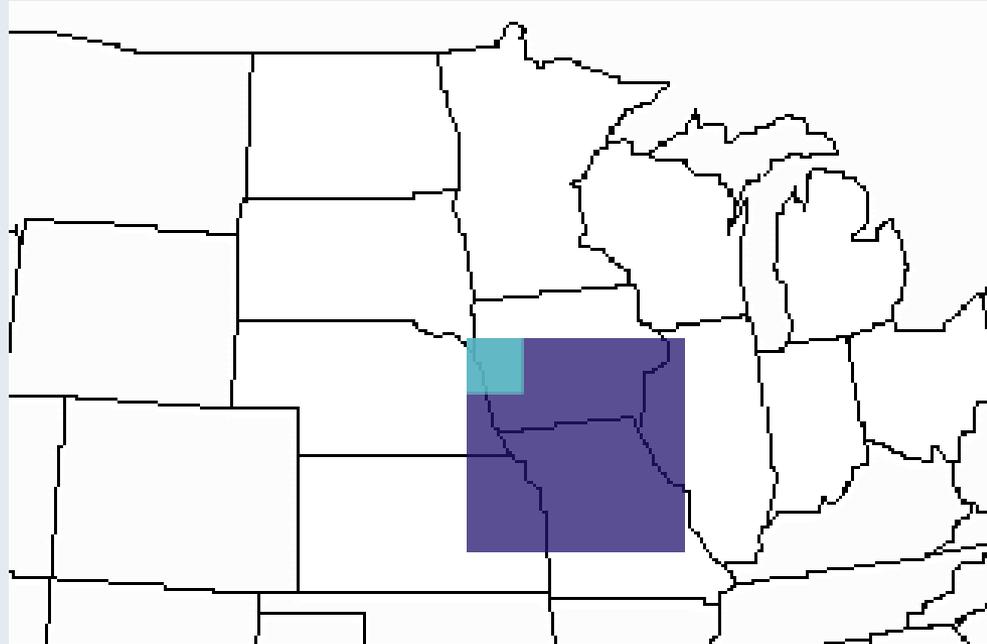
# Fuel Lifecycle – Corn Ethanol



# *Crop-Based Fuels Require Land*

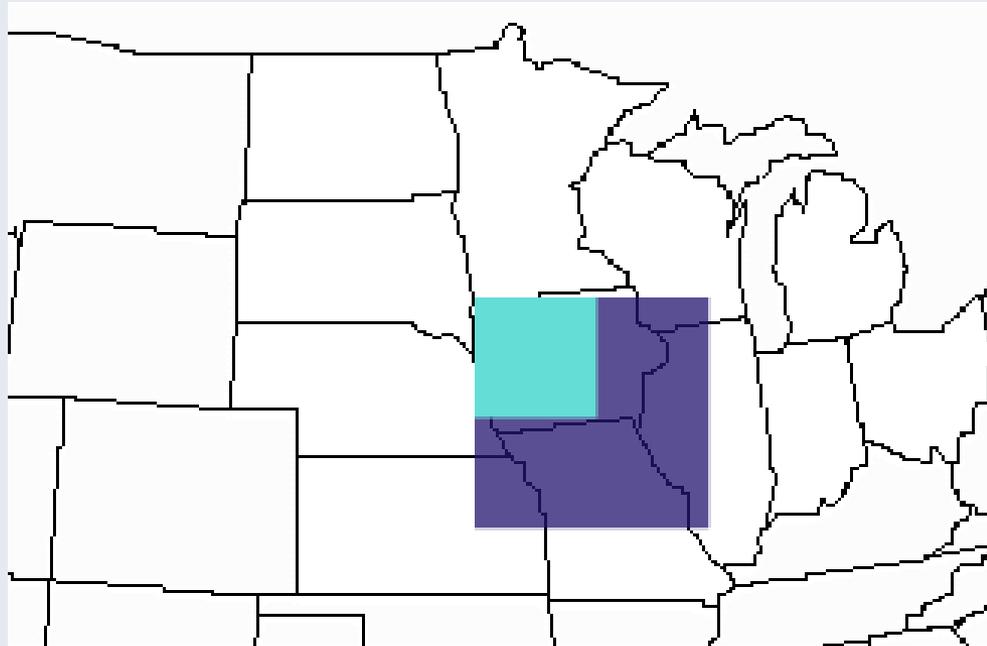
**Using crops for fuel leads to changes in land use**

# *Ethanol Land Requirements - 2001*



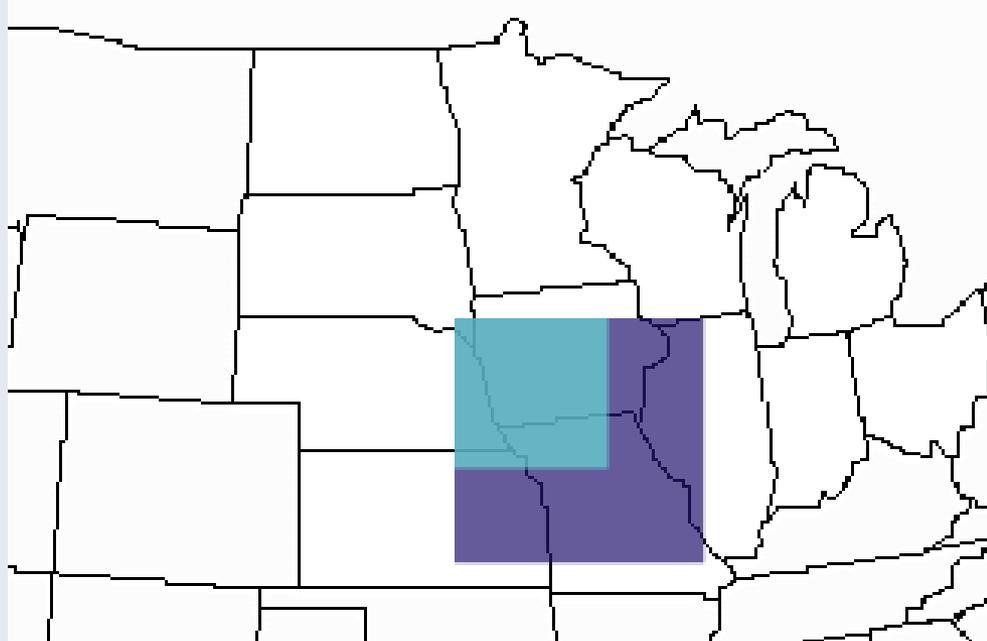
**In 2001, the corn dedicated to ethanol production would have covered about 6% of this area**

# *Ethanol Land Requirements - 2008*



**In 2008, the corn dedicated to ethanol production would have covered about 27% of this area**

# *Ethanol Land Requirements - 2015*

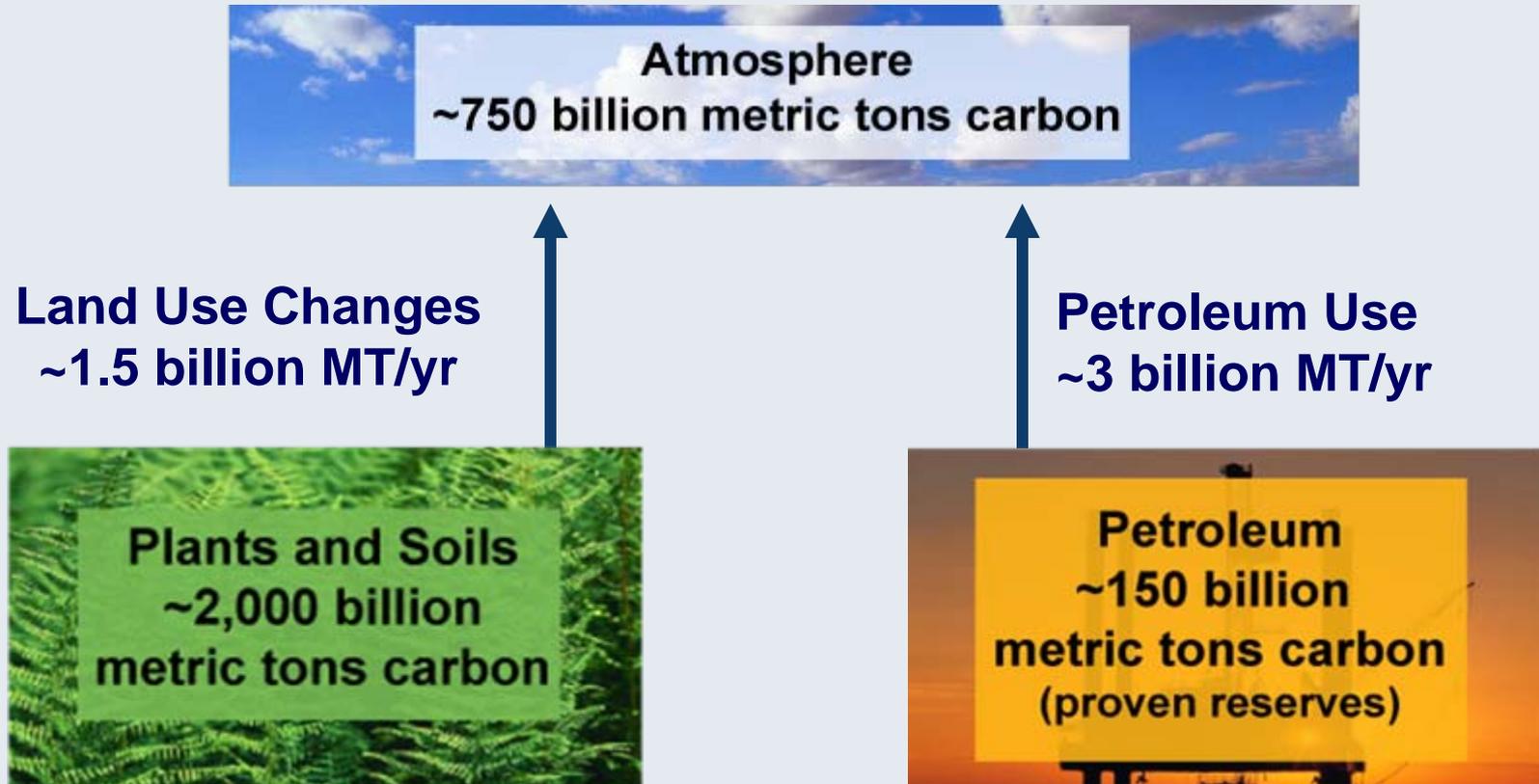


**In 2015, the corn dedicated to ethanol production will cover about 37% of this area**

# *Land Conversions Release Carbon*

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

# Carbon Storage and Emissions

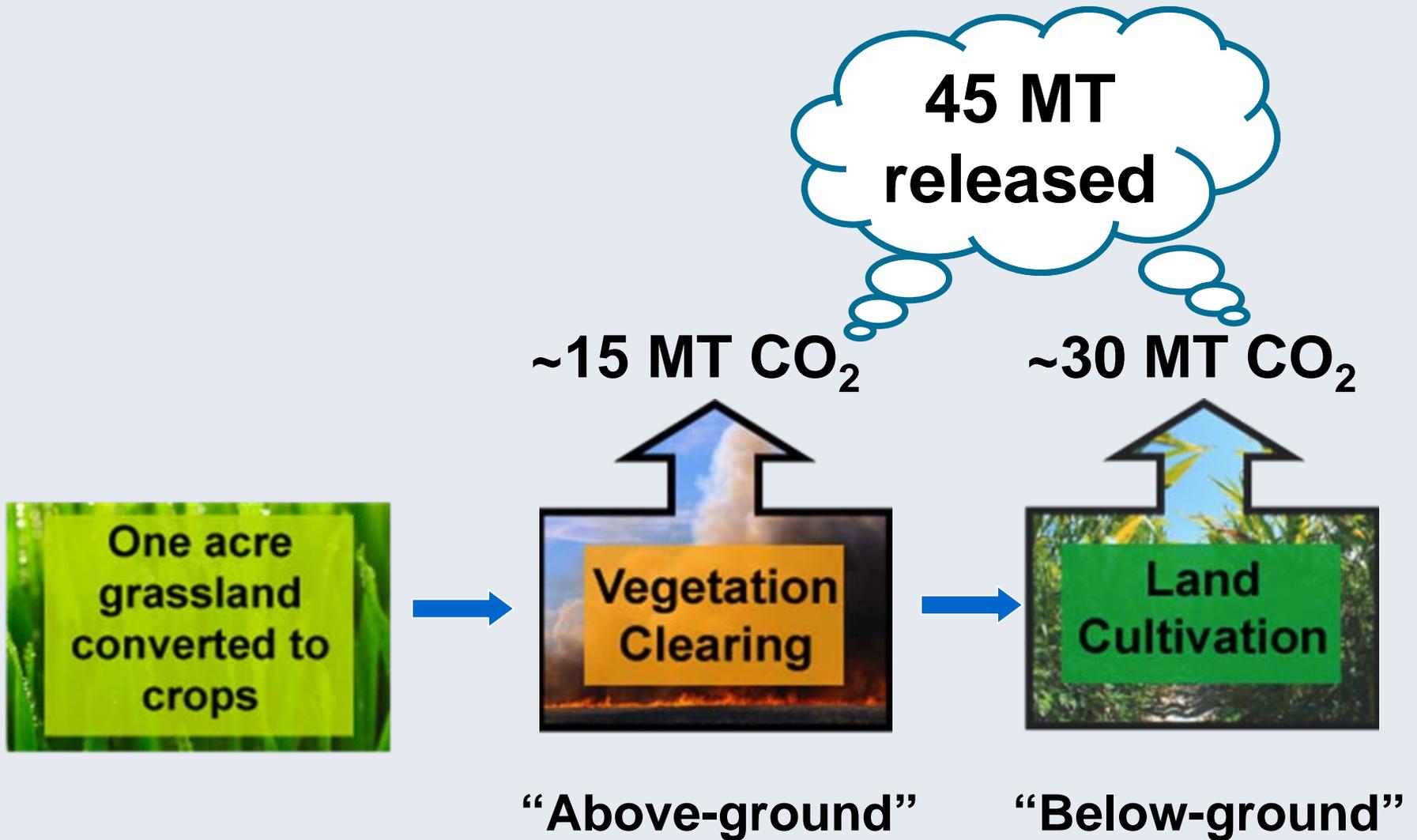


Plants and soils contain approximately 15 times the carbon in proven oil reserves.

# *Biofuels Affect the Carbon Cycle*

**Carbon is stored above and below ground**

# Grassland Conversion Emissions

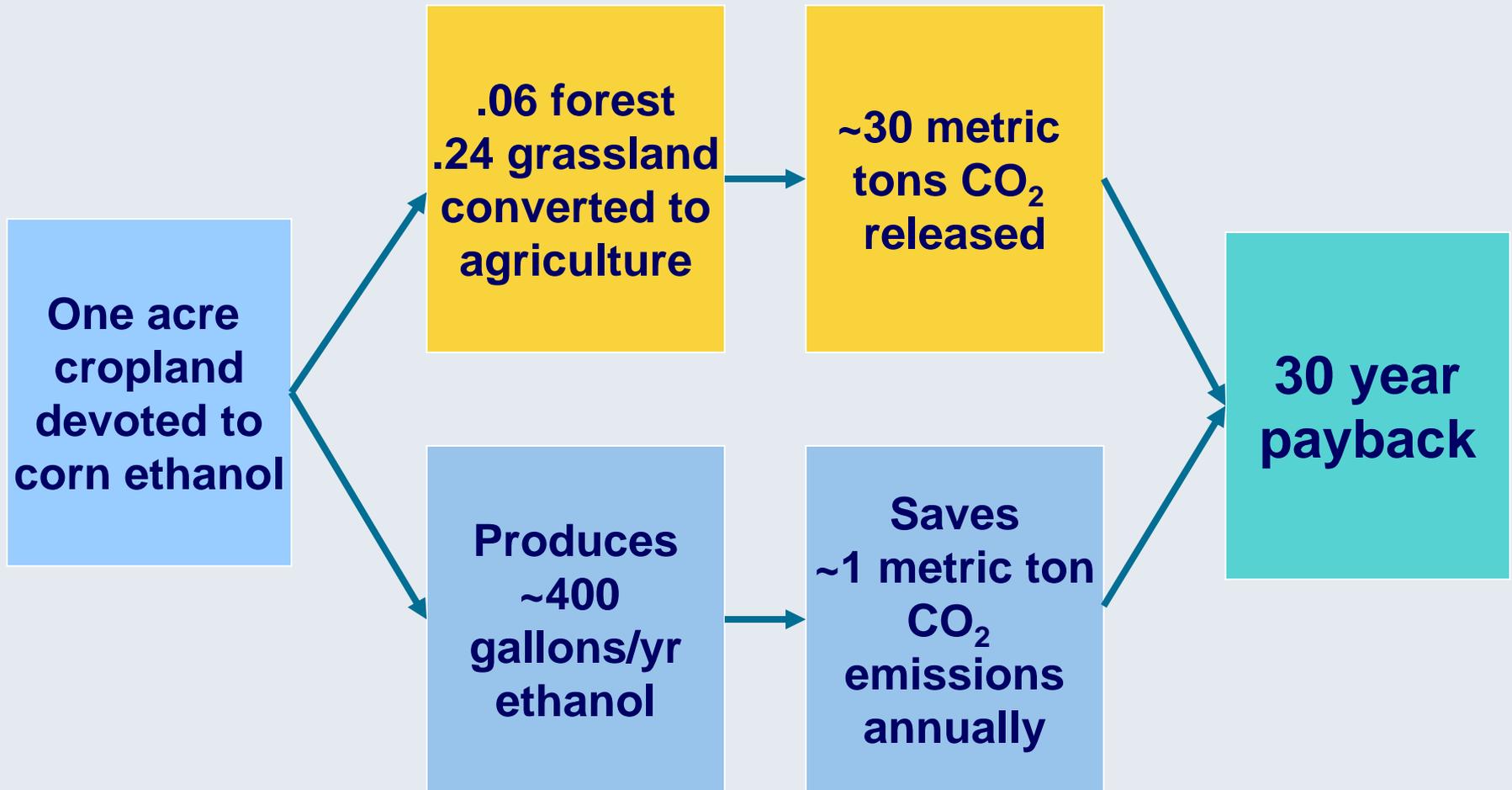


# *Biofuels Affect the Carbon Cycle*

**Current biofuels take decades before there is a net GHG benefit**

# *Time to Payback*

## *Land Use Change Emissions*



# ***GTAP Used For Analysis***

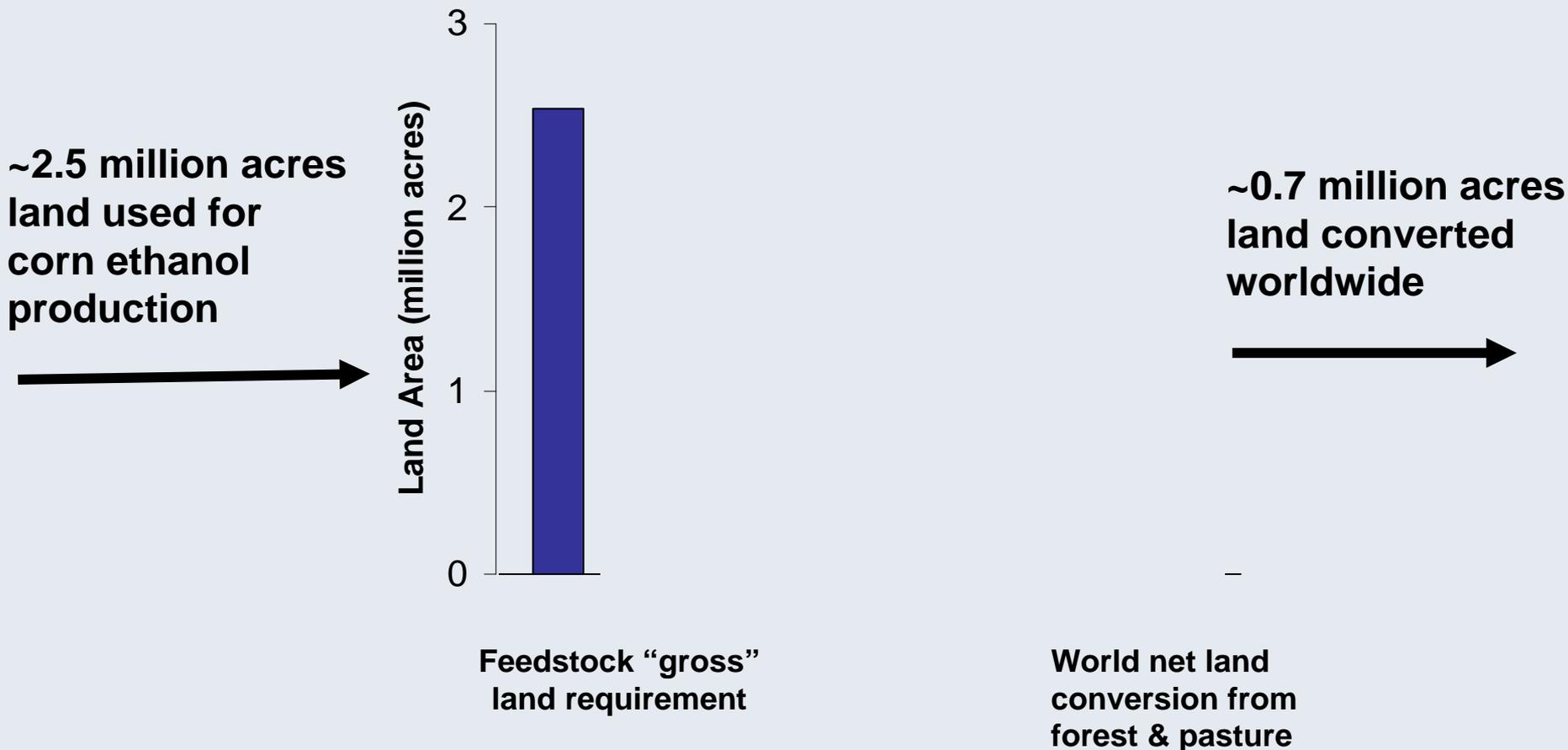
- **GTAP selected as best available model**
  - Well-established, publically available
  - Based in academia (Purdue University)
  - Thousands of GTAP applications
  - 7,500 worldwide individual contributors
  - Supported by 26 core institutions, including USDA and U.S. EPA
- **ARB worked with experts at UC and Purdue to run the model**

# *Determining Carbon Intensities*

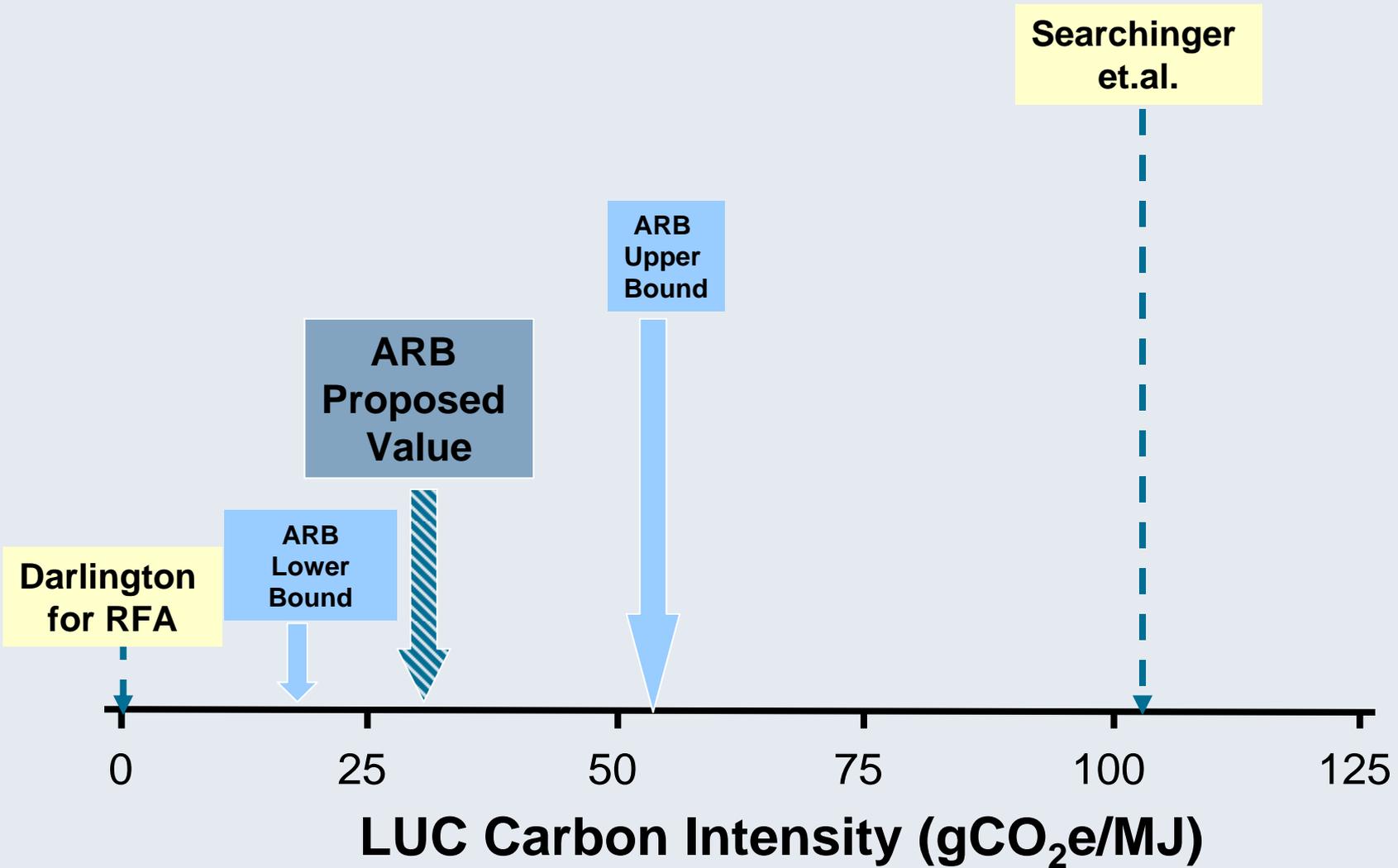
- **Used best available data inputs**
- **Performed multiple sensitivity runs**
- **Presented results at workshops**
- **Determined amount/type of land use changes**
- **Calculated carbon intensity**

# Using GTAP to Estimate LUC

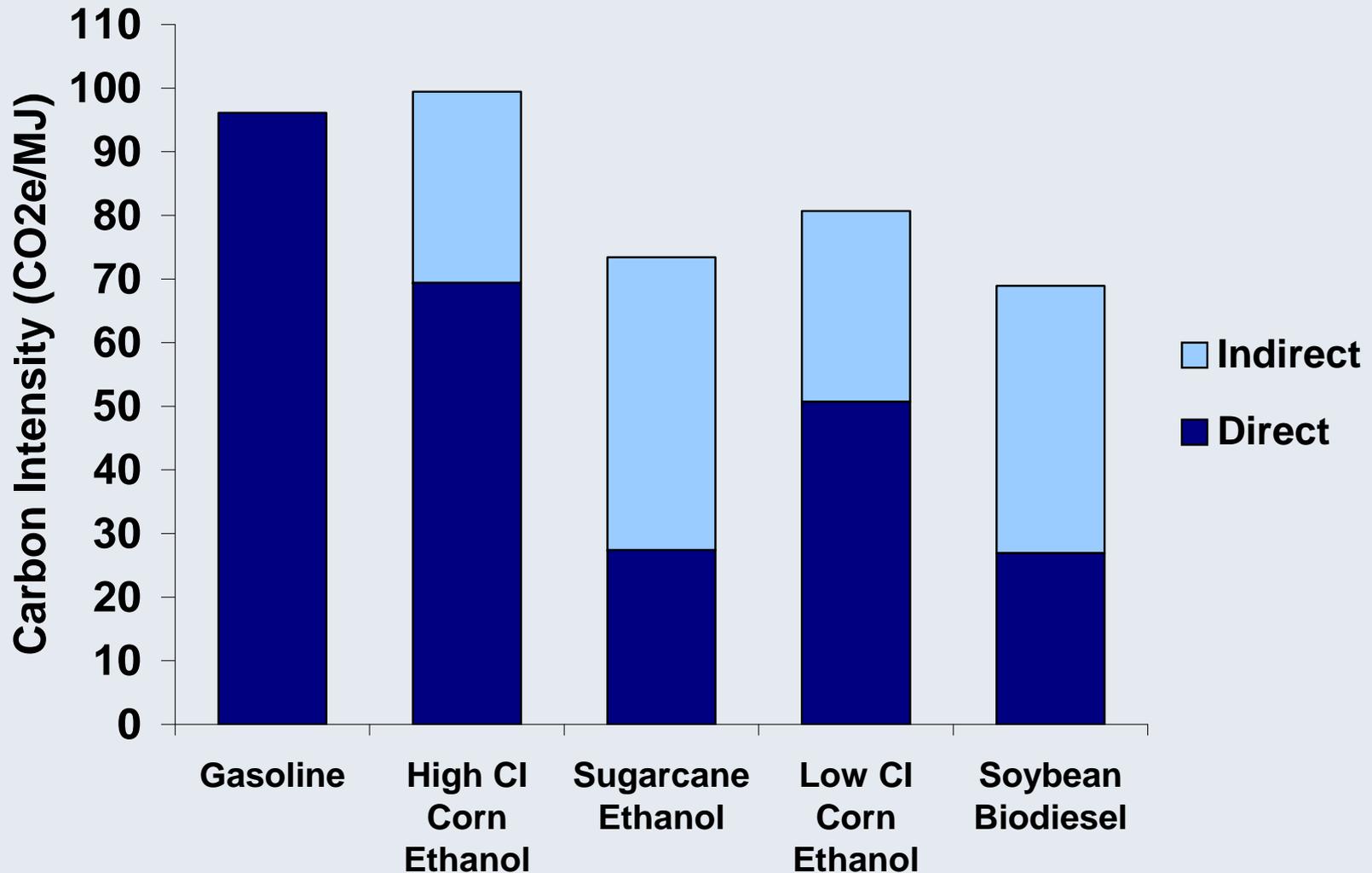
1 billion gallons of corn ethanol produced in U.S.



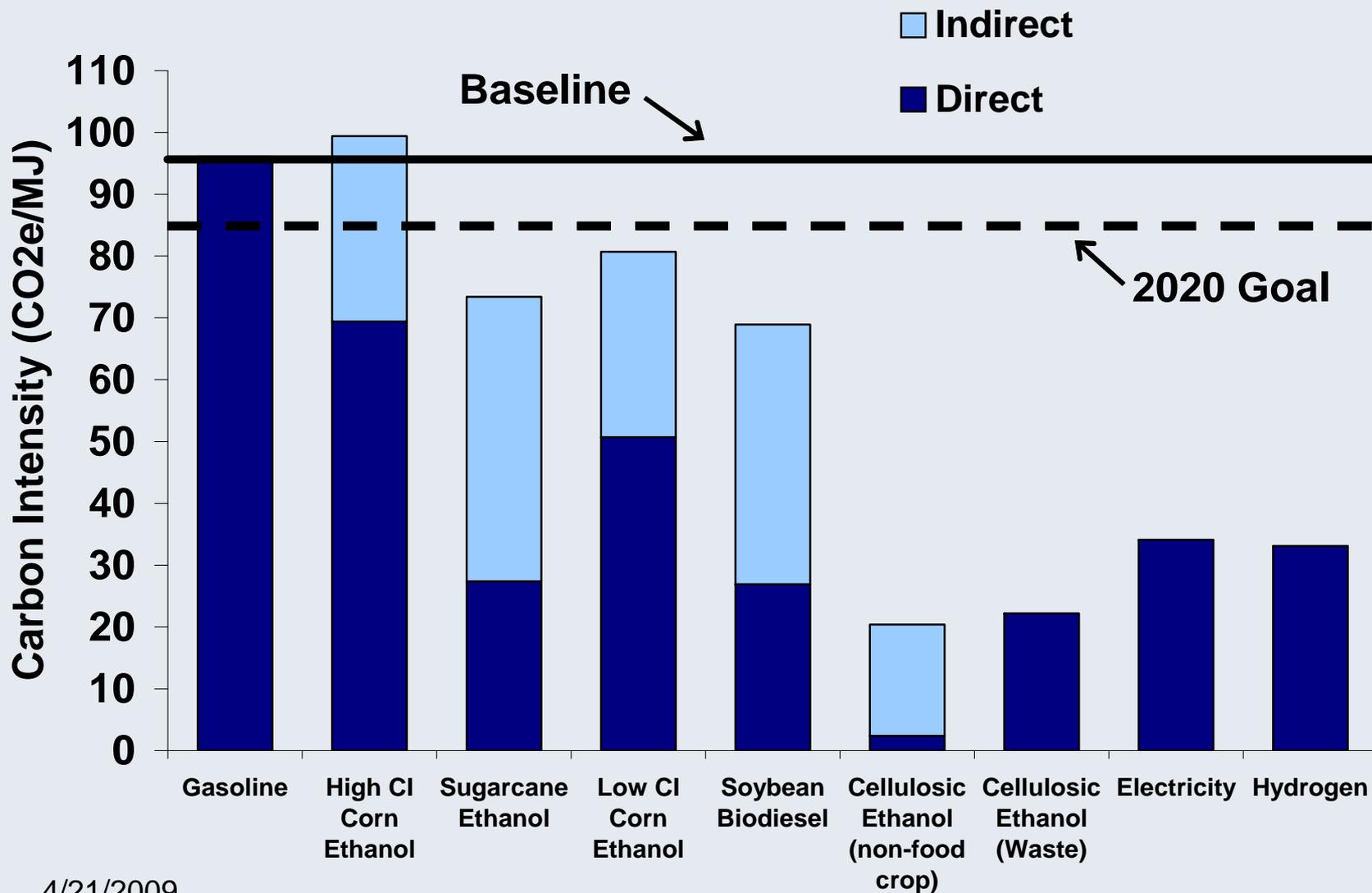
# Range of LUC Carbon Intensity Values for Corn Ethanol



# Carbon Intensity of Today's Fuels



# Carbon Intensity of Tomorrow's Fuels



# ***LCFS Treats All Fuels Fairly***

- **Land use change contributes to carbon intensity of certain biofuels**
- **Staff have not identified any significant indirect effects from non-biofuels, though research is ongoing**
- **Open process; results and assumptions shared with stakeholders**

# *Lifecycle Analysis Summary*

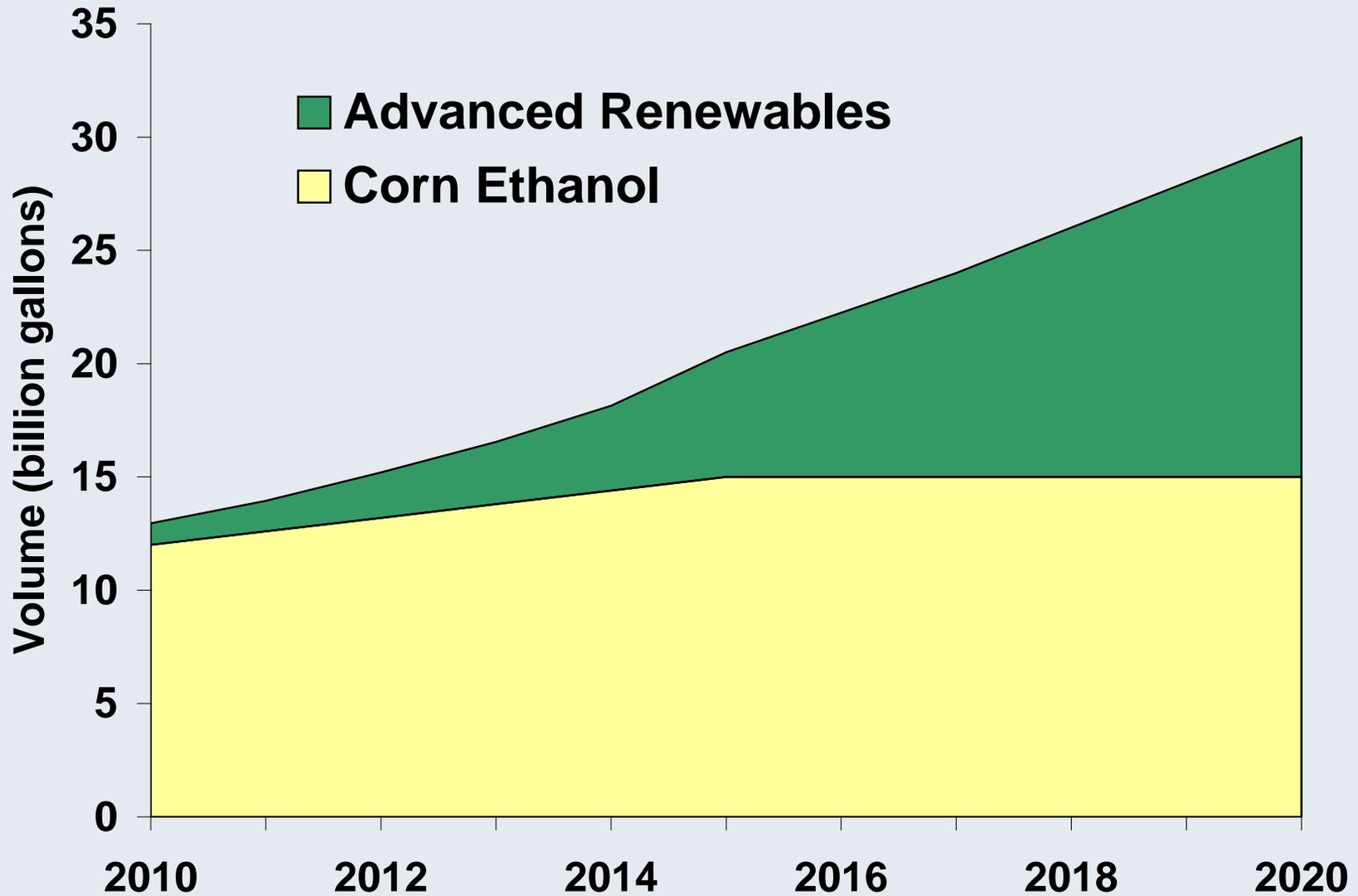
- **Key to identifying & transitioning to low carbon fuels**
- **Must include all significant effects, including land use changes**
- **GTAP uses best available science to estimate land use changes**
- **Peer reviewers generally support analysis**
- **Refine analysis through expert workgroup**

# **Comparison LCFS to Federal Requirements**

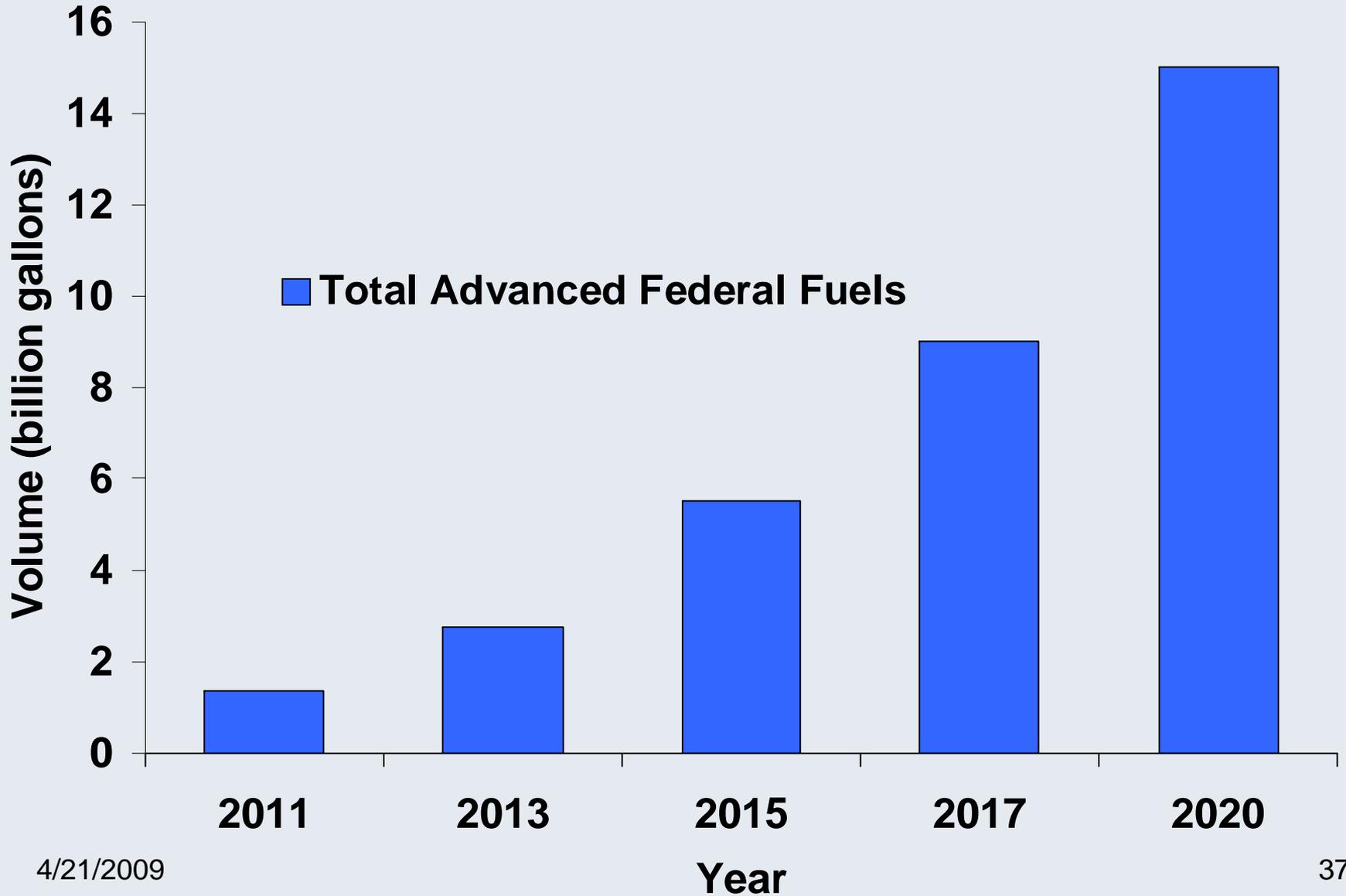
# ***Federal Renewable Fuels Standard***

- **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**

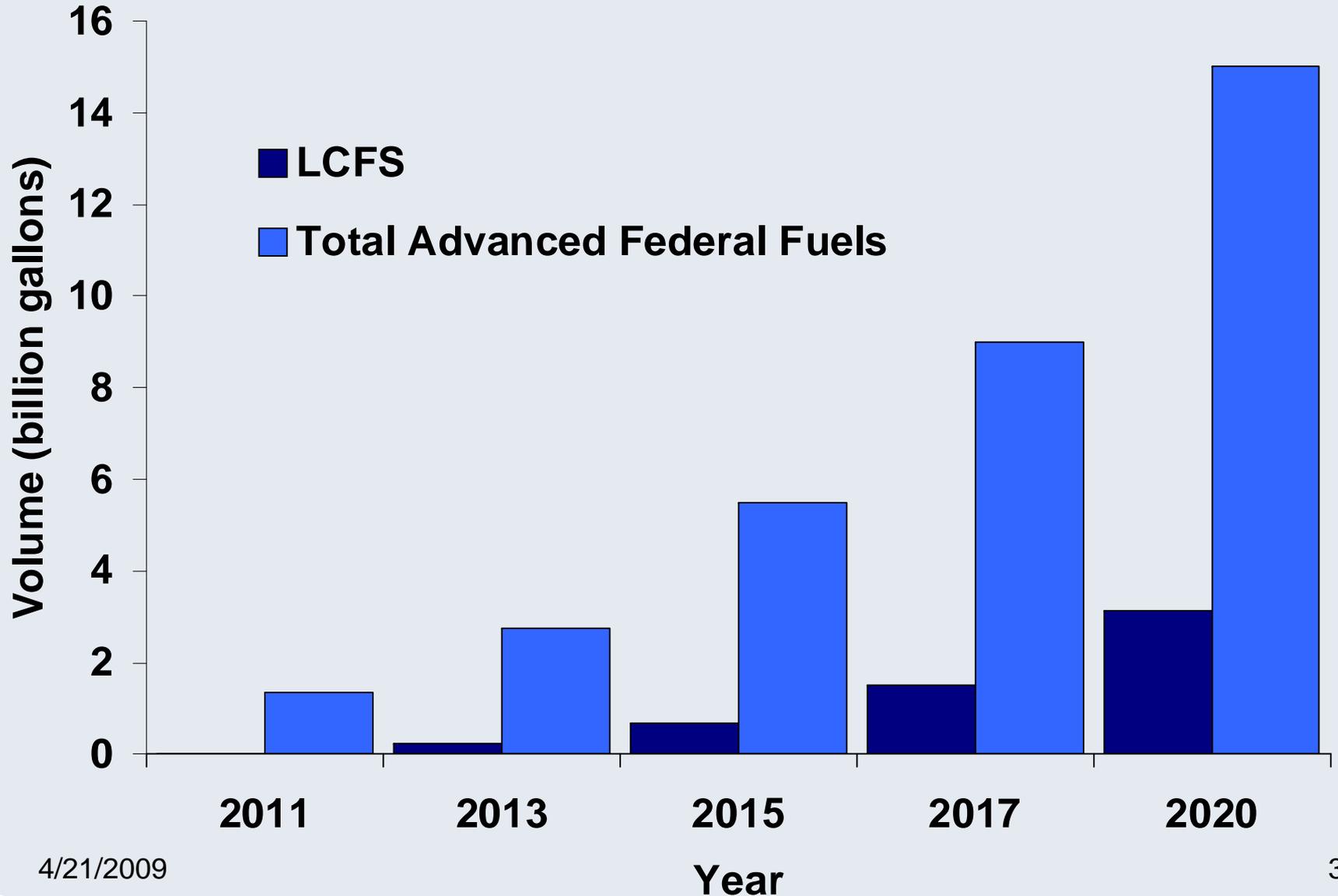
# *Federal Fuel Volumes*



# *RFS Advanced Biofuel Volumes*



# Advanced Biofuel Volumes - RFS vs. LCFS



# ***Builds Upon and Improves the RFS***

- **Still relies on biofuels to provide GHG reductions**
- **All fuels treated the same; no exemptions for existing corn ethanol**
- **Performance-based vs. volume mandates**
- **More market incentives**
- **Includes non-liquid fuels**
- **Provides 3 times the GHG reduction benefits**

# Next Steps

# ***Additional Work Related to Lifecycle Analysis***

- **Expert workgroup for land use change**
- **Guidelines for developing fuel pathways**
- **List of biofuels with no inherent land use change**
- **Prioritized list of additional fuel pathways**
- **Informal screening process for new or modified fuel pathways**

# ***Work to be Completed for Adoption***

- **Public comment period for board-approved changes**
  - Revised regulation language
  - Additional lifecycle pathways
- **Complete administrative record by Oct 09**
  - Respond to public comments
  - Respond to significant environmental impacts

# *Coordination*

- **ARB committed to ongoing coordination with U.S. EPA on lifecycle analysis**
- **Continue to evaluate land use and indirect effects**
- **Coordinate on national and international basis on addressing sustainability**

# Summary

# *Summary*

- **Emissions from land use changes are real, large, and positive and must be included in federal RFS and LCFS**
- **LCFS complements goals set forth by federal mandates**
- **LCFS provides greater GHG benefits than federal program and provides framework for national adoption**
- **LCFS program structured to extend beyond 2020**