Energy Independence and Security Act: Modeling Land Use Impacts on GHG Performance Thresholds

Bob Larson

Associate Director, Transportation and Climate Division

U.S. Environmental Protection Agency

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Previous EPA Biofuel Lifecycle GHG Work

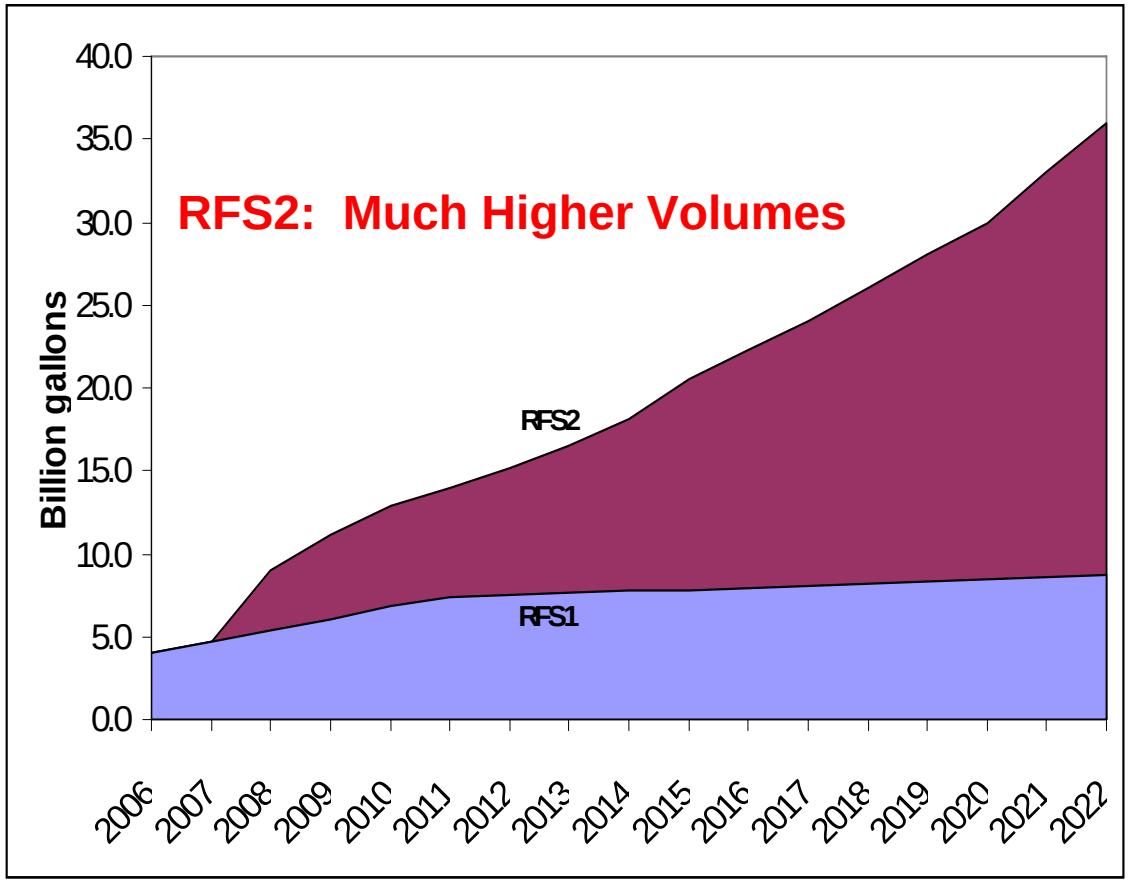
- As part of the Renewable Fuel Standard rulemaking (as required by EPAct 2005), EPA conducted an analysis to determine GHG impact of rule
  - Based on lifecycle GHG factors for renewable fuels (corn ethanol, biodiesel, cellulosic ethanol, imported ethanol) compared to the petroleum fuels they replace
- Primarily based on the Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) model developed by Argonne National Laboratory

Updates to RFS Life Cycle Work

- President Bush's Executive Order in May 2007
  - Tasked EPA and other federal agencies with implementing his "20 in 10" goal, including 35 billion gallons renewable and alternative fuel by 2017, through existing regulatory mechanisms
- Within this process, EPA worked to address some of the concerns with the original RFS life cycle analysis
  - Biofuel production expansion has secondary effects in many different markets which are not traditionally captured in LCA, EPA is working to include these impacts in our analysis
  - In the RFS, the methodology did not fully account for agricultural sector secondary impacts
    - Increased biofuels production changes agricultural commodity prices (e.g., corn) this has impacts on agricultural sector e.g., crop patterns change, livestock production changes
    - These changes have associated GHG impacts
  - Did not adequately account for land use change
    - Land converted into crop production where crops are directly used for biofuels
    - Use of crops that would have gone into other markets, including exports, that cause more crops to be produced internationally for other uses results in indirect land use change from biofuel use

Energy Independence & Security Act

- **Passed by Congress and signed by President in December 2007**
- **Modifies Current RFS program**
  - Volumes increase to 36 Bgal/yr by 2022
    - 5-fold increase from RFS levels
  - Establishes new renewable fuel categories and eligibility requirements
  - Provides new waivers
- **Includes new studies and reports**

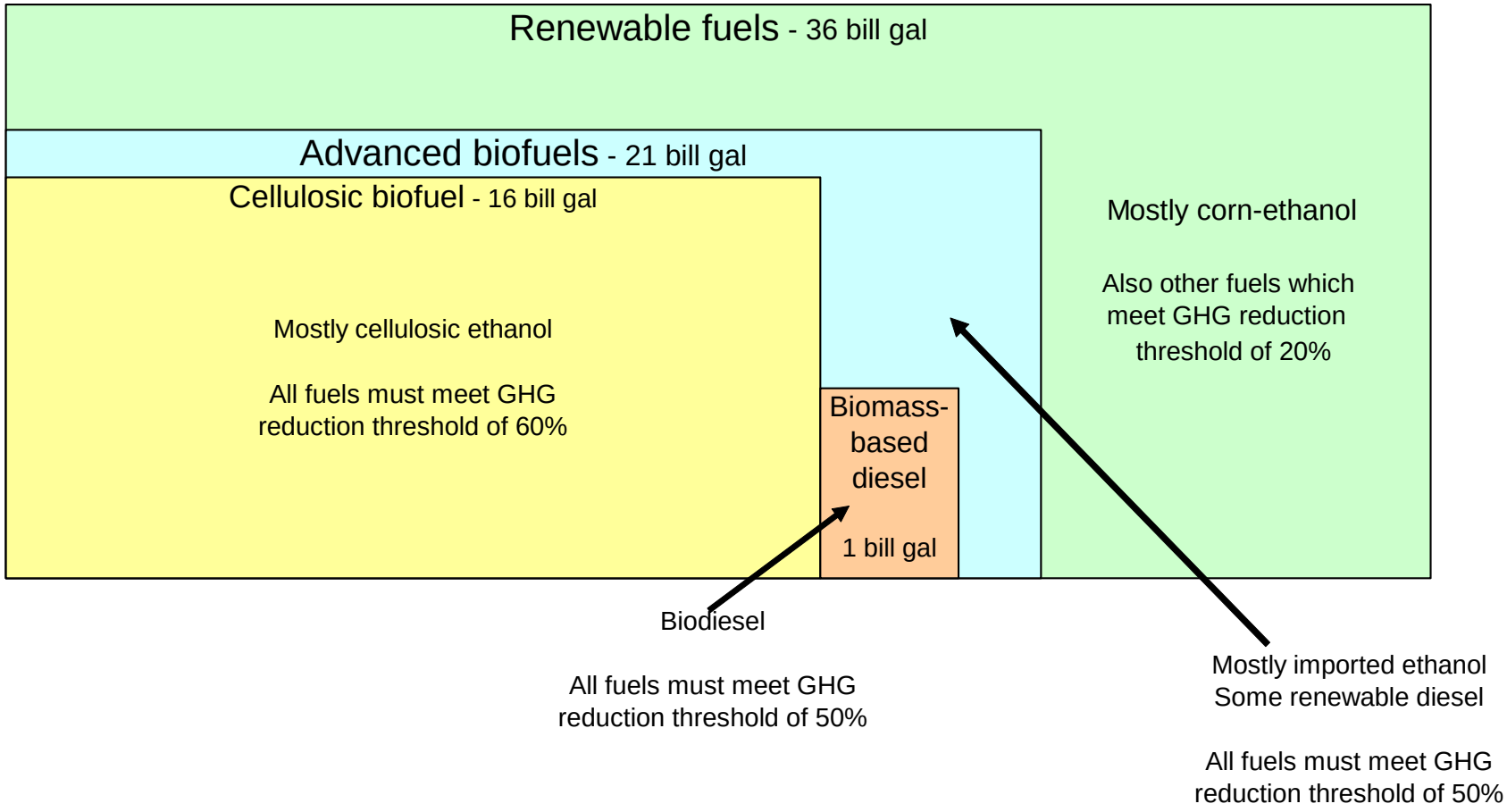


4 Separate Standards

Year	Advanced Biofuel			Total Renewable Fuel
	Biomass-Based Diesel	Cellulosic Biofuel	Total Advanced Biofuel	
2006				4.0
2007				4.7
2008				9.0
2009	0.5		0.6	11.1
2010	0.65	0.1	0.95	12.95
2011	0.80	0.25	1.35	13.95
2012	1.0	0.5	2.0	15.2
2013	1.0	1.0	2.75	16.55
2014	1.0	1.75	3.75	18.15
2015	1.0	3.0	5.5	20.5
2016	1.0	4.25	7.25	22.25
2017	1.0	5.5	9.0	24.0
2018	1.0	7.0	11.0	26.0
2019	1.0	8.5	13.0	28.0
2020	1.0	10.5	15.0	30.0
2021	1.0	13.5	18.0	33.0
2022	1.0	16.0	21.0	36.0

The Standards are Nested

Shown with 2022 volumes



Sustainability Requirements

- **Definition of Renewable Fuels**
  - Must meet lifecycle GHG reduction thresholds
  - Must be produced from renewable biomass:
    - Non-federal lands: Planted trees and thinnings must come from non-federal lands
    - Existing cropland criterion: Both crop and tree material must be harvested from land "cleared or cultivated" prior to enactment of EISA
    - Other sources include animal waste and byproducts, yard and food waste, biomass from immediate vicinity of buildings at risk from wildfire, and algae
- **Environmental and Resource Conservation Impacts Study**
  - EPA shall assess and report to Congress on the impacts to date and likely future impacts of Section 211(o) of CAA (within 3 years, and every 3 years after)
- **Anti-Backsliding Study**
  - EPA to study whether renewable fuel volumes adversely affect air quality as result of changes in vehicle emissions (within 18 months). Includes study of different blend levels. Requires promulgation of fuel regulations to mitigate to greatest extent possible any adverse impacts (within 3 years).
- **Study of the Impact of the RFS**
  - DOE (in consultation with EPA and USDA) to enter into an agreement with NAS to assess the impacts on the production of feed grains, livestock, food, forest products, and energy. Must submit results to Congress (within 18 months).

Definition of Lifecycle GHG Emissions

‘‘(H) LIFECYCLE GREENHOUSE GAS EMISSIONS.—The term ‘lifecycle greenhouse gas emissions’ means the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes), as determined by the Administrator, related to the full fuel lifecycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.”

New “Existing Cropland” Criterion

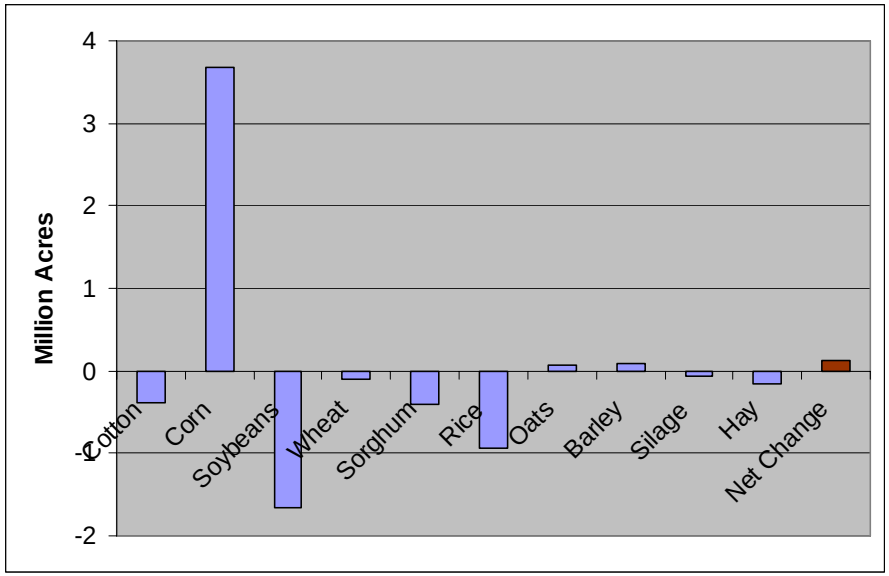
- Renewable fuels must now be produced from renewable biomass harvested from land “cleared or cultivated” prior to enactment of EISA
- Implementation issues
  - Renewable fuel producers usually do not know the source of their feedstocks – enforcement?
  - How far back could it have been cropland – pre-colonial times?
  - How applied/enforced internationally?
- But does not prevent secondary land use impacts
  - Displaced crops or land uses could move to new cropland

GHG Thresholds

- Each fuel category required to meet mandated GHG performance thresholds (reduction compared to baseline petroleum fuel replaced)
  - **Conventional Biofuel** (ethanol derived from corn starch)
    - Must meet 20% lifecycle GHG threshold
    - Only applies to fuel produced in new facilities
  - **Advanced Biofuel**
    - Essentially anything but corn starch ethanol
    - Includes cellulosic ethanol and biomass-based diesel
    - Must meet a 50% lifecycle GHG threshold
  - **Biomass-Based Diesel**
    - E.g., Biodiesel, “renewable diesel” if fats and oils not co-processed with petroleum
    - Must meet a 50% lifecycle GHG threshold
    - 20-50% still counts as renewable fuel
  - **Cellulosic Biofuel**
    - Renewable fuel produced from cellulose, hemicellulose, or lignin
    - E.g., cellulosic ethanol, BTL diesel
    - Must meet a 60% lifecycle GHG threshold
- EISA language permits EPA to lower the lifecycle GHG thresholds by as much as 10%
- Baseline fuel for comparison is gasoline and diesel fuel in 2005

Domestic Agricultural Sector Impact

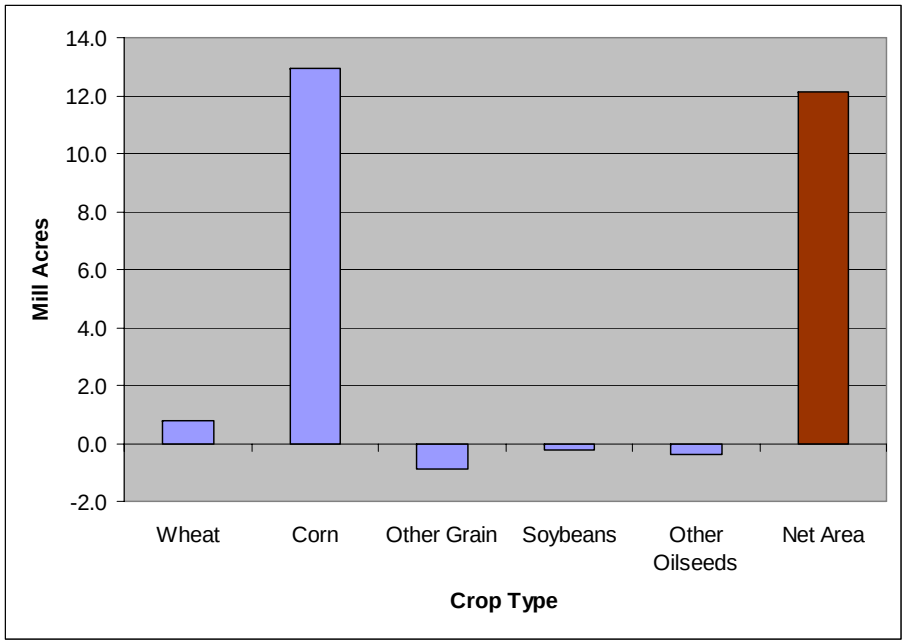
- Looking at domestic impacts only of increased ethanol production could result in a net decrease in total GHG emissions
  - Shift in crop production results in limited crop acreage increase (small increase in agricultural sector inputs)
  - Decrease in rice acres and livestock production (due to increased feed prices) can result in GHG emission reductions



- Significant percentage of corn used for ethanol comes from reductions in exports (highlighting need to include international impacts)

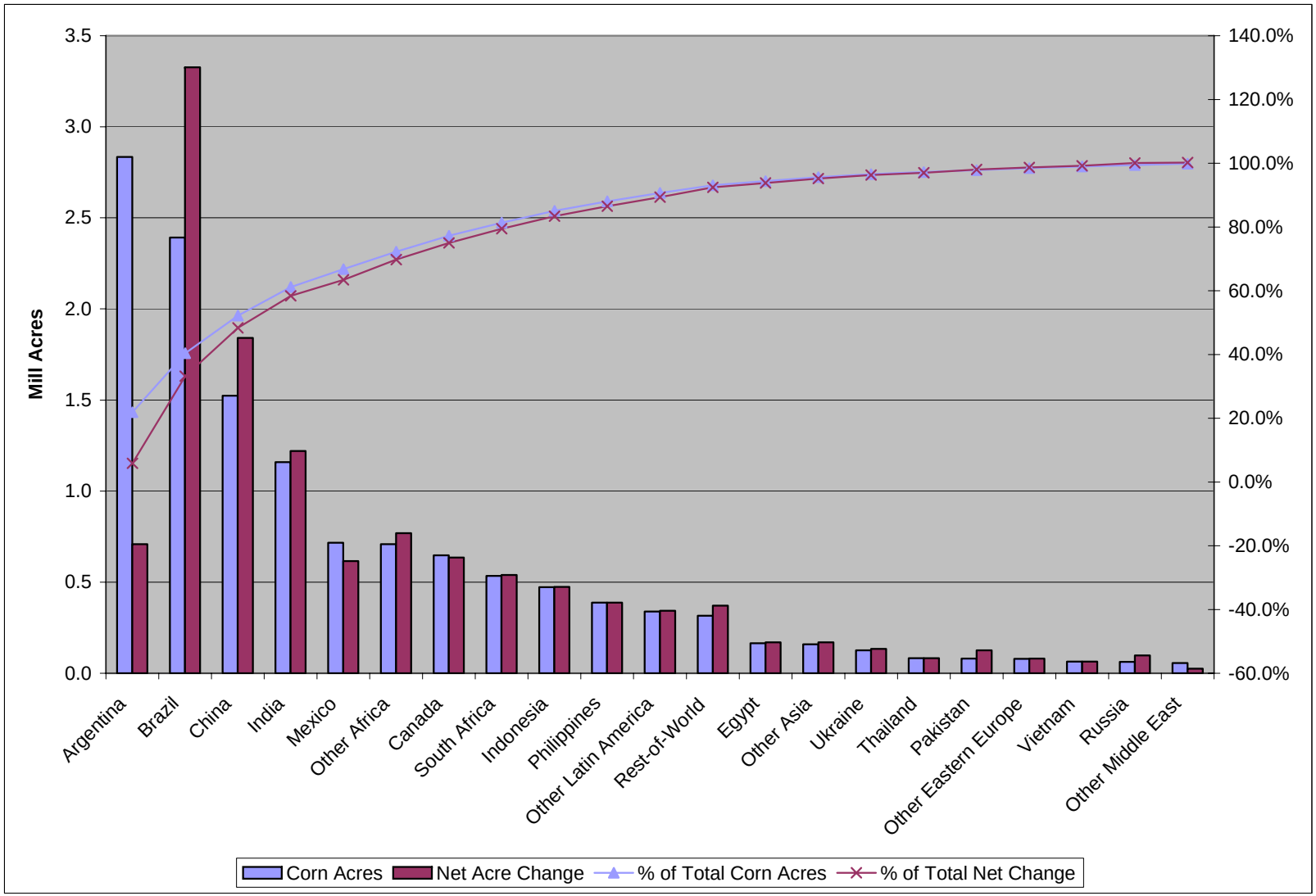
International Agricultural Sector Impact

- Decrease in U.S. exports results in increased crop production internationally
  - Not all export losses are made up with production – shifts in crops and decrease in demand

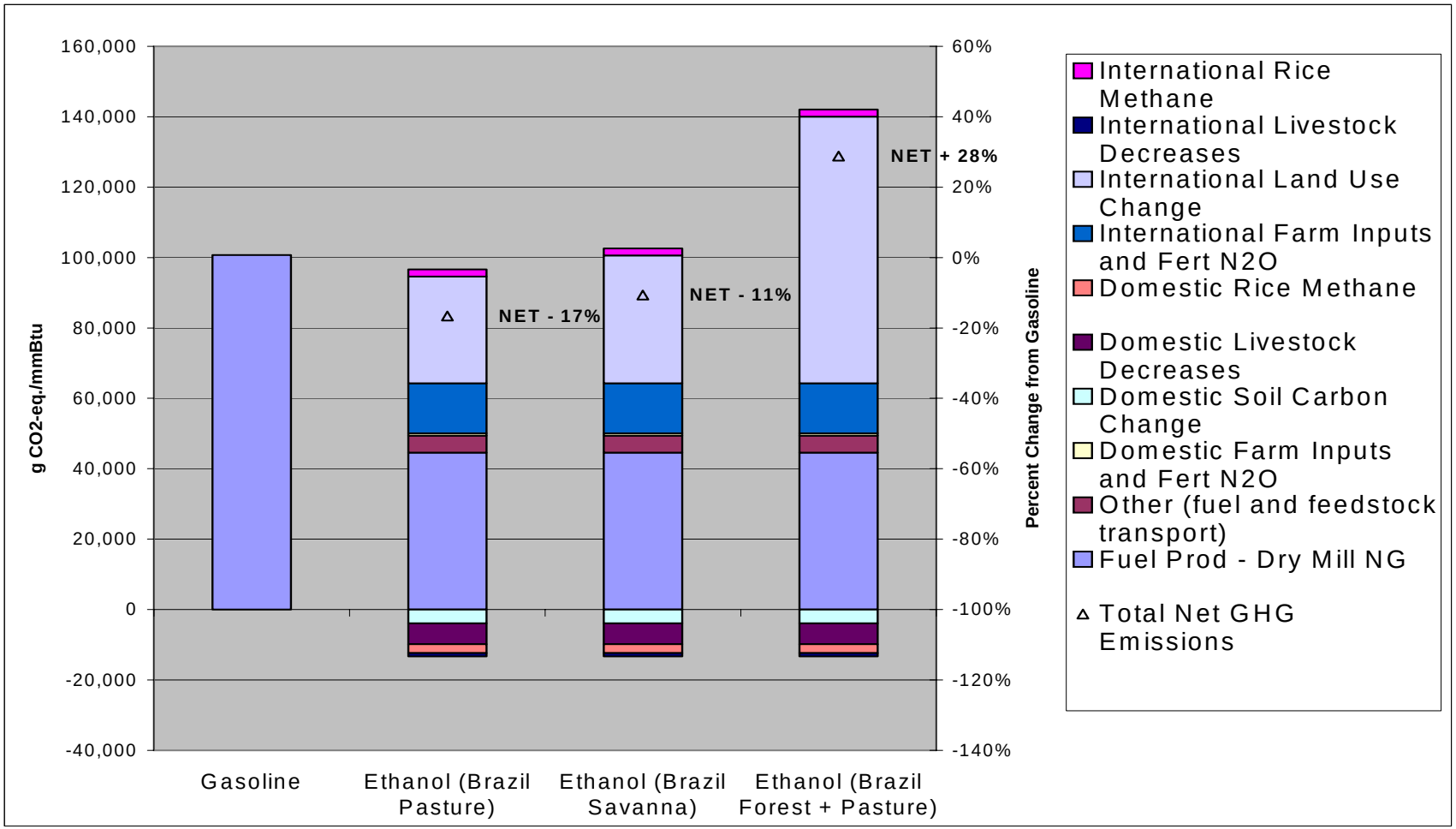


- Changes in crop acres based on yields in different countries
- Assumed net increase in all crop acres results in land use change

International Land Use Change



Illustrative Example of Land Use Change Assumptions



Note: This chart does not represent the lifecycle GHG numbers that will be proposed under EISA. These numbers are for illustrative purposes only.

Land Use Change Assumptions

- Land use change is occurring regardless of biofuel production, need incremental land use change associated with increased biofuel production
  - Where are crops planted
  - Price induced changes (higher crop / land values)
- Assumed representative land types for different countries, performed sensitivity analysis on type of land converted
- We need to develop a specific GHG life cycle reduction value for each fuel (based on a snapshot in time) - need to annualize land use change factors
  - We considered an annualization rate of 30 years

Land Use Change Topics For Discussion

- Total acres of land impacted (intensification vs. extensification)
- What types of land are converted
- What are the GHG factors from that land conversion
- Timing impact of release
  - Annualization (20 vs. 30 years)

Further Work on Life Cycle Modeling

- Specific areas of improvement that we are working on include:
  - Building a consistent modeling framework that captures both domestic and international agricultural sector changes and GHG impacts
  - Working with experts to improve understanding of agricultural N2O emissions
  - Developing country specific GHG emissions factors associated with land use change and agricultural practices
  - Updating petroleum baseline
- Updating biofuel life cycle GHG factors with this approach
  - Corn ethanol
  - Biodiesel
  - Imported ethanol
  - Cellulosic ethanol
- We continue to have discussions with:
  - Industry groups
  - Academics and other experts
  - Other regulators