Lifecycle Assessment for EPA's Renewable Fuels Program

Presentation to North Central Bioeconomy Consortium (NCBC)

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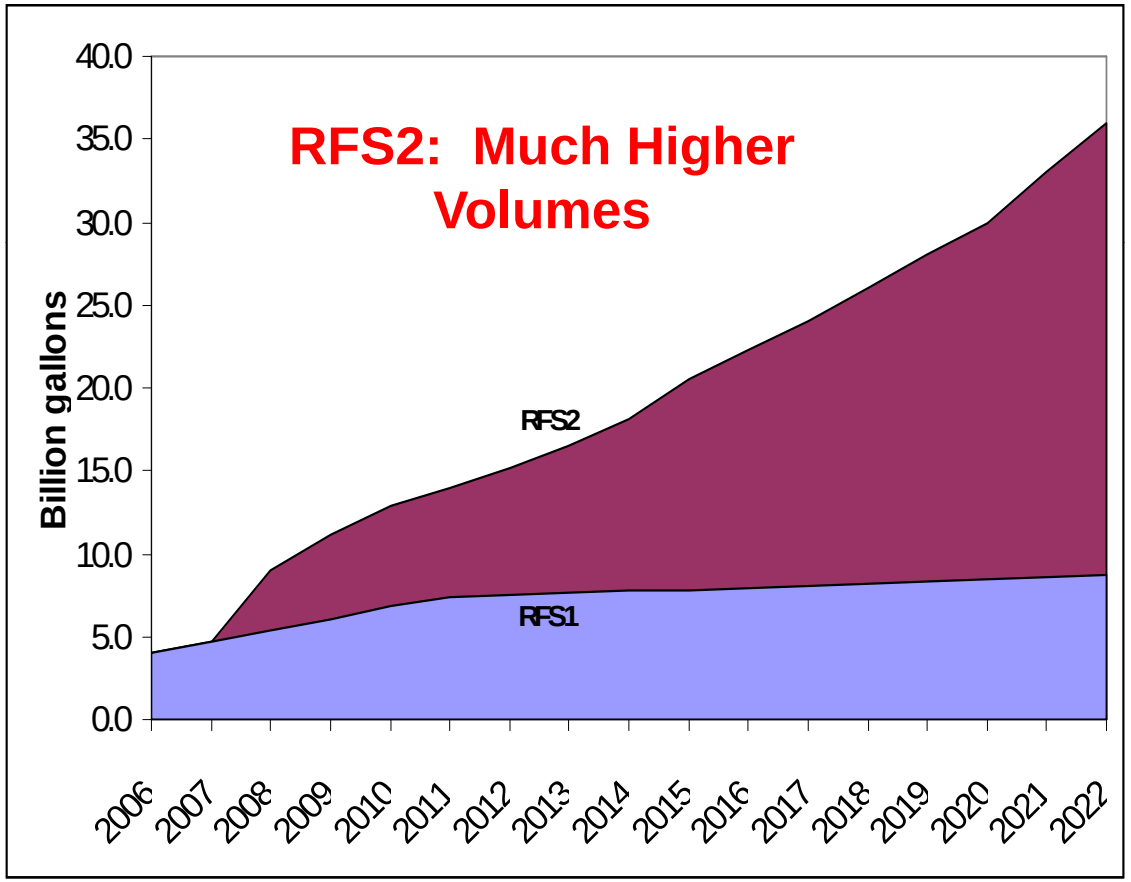
Recent Events

- **August 2005** — **Energy Act – requires 7.5 b gals renewable fuel by 2012**
- **January 2007** — **State of the Union Address—20-in-10 goal**
- **April 2007** — **Supreme Court Decision**
- **May 2007** — **EPA adopts 7.5 b gal renewable fuel regulations**
- **May 2007** — **President's Announcement and Executive Order (35 billion gallons renewable and alternative fuel)**
- **December 2007** — **Energy Independence and Security Act passed by Congress and signed by President Bush, including a 36 billion gallon renewable fuel mandate**

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**



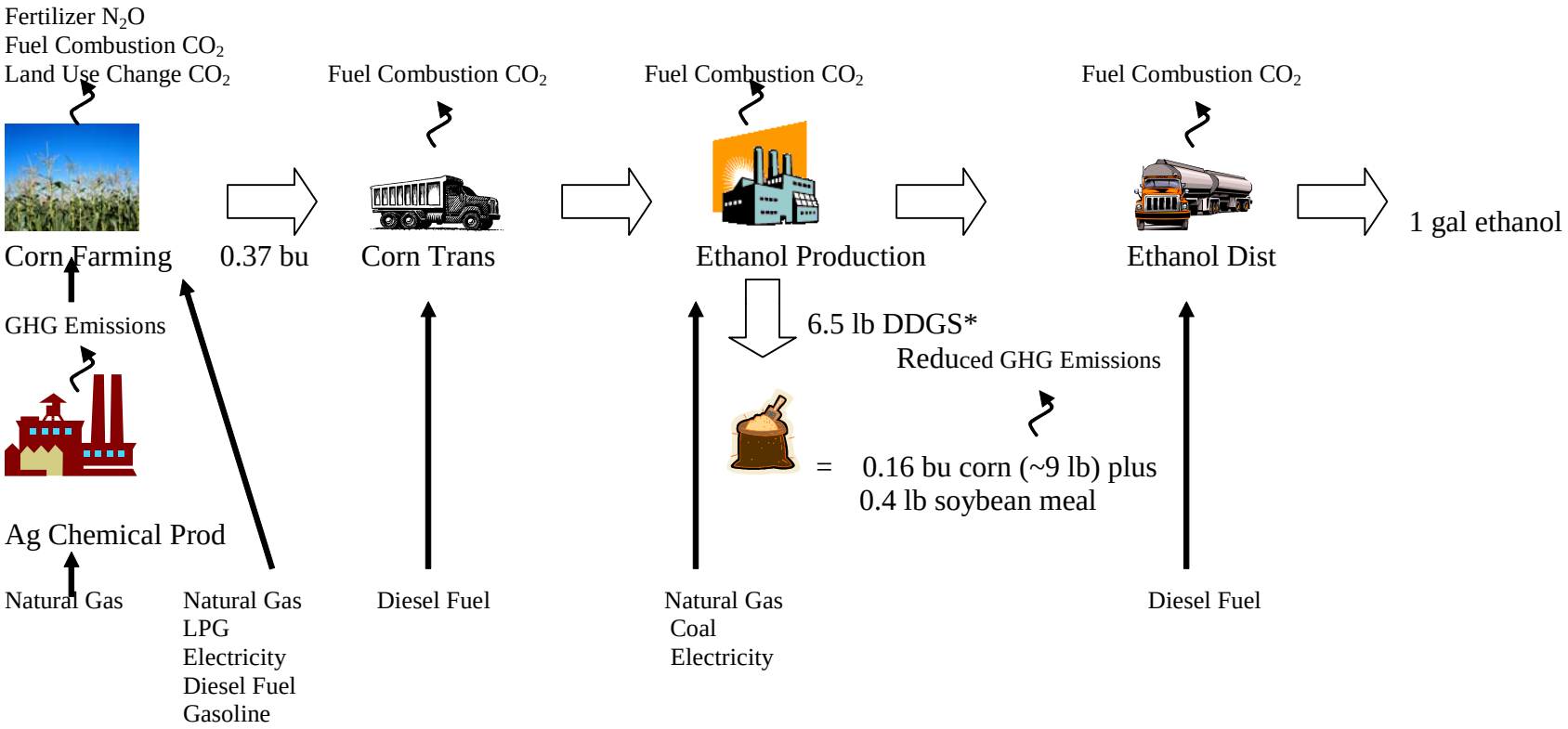
RFS2: 4 Nested Standards

				Total Renewable Fuel
Year	Total Advanced Biofuel			
	Biomass-Based Diesel	Cellulosic Biofuel		
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

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.”

Corn Ethanol Example



* Displacement allocation used, so for entire system new corn production = 0.21 bu and results in 0.4 less soybean meal produced

DDGS = Distiller Dried Grains, substitute animal feed

Can compare to producing an equivalent amount of petroleum gasoline

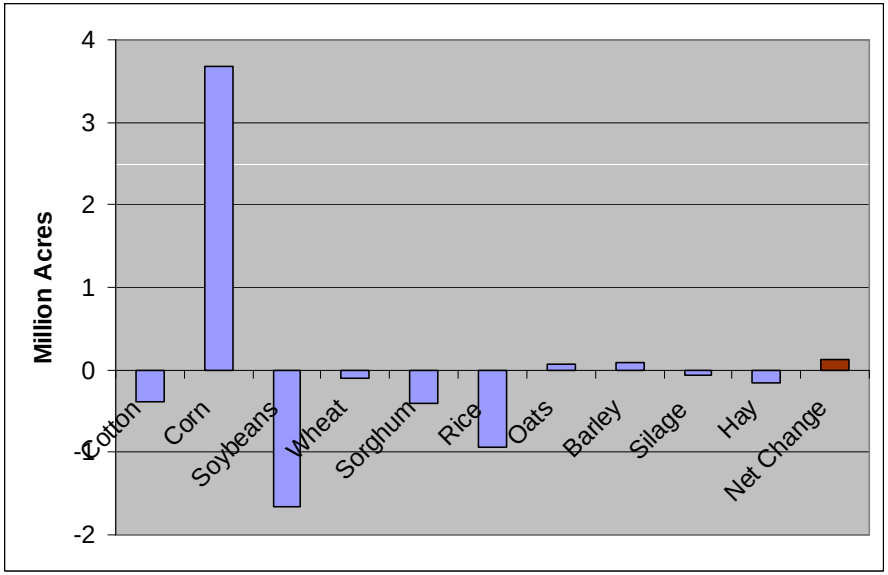
GHG Thresholds

- 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 Impact Discussion

- Looking at domestic impacts only of increased ethanol production results in a net decrease in total GHG emissions
  - Shift in crop production results in little net crop acreage

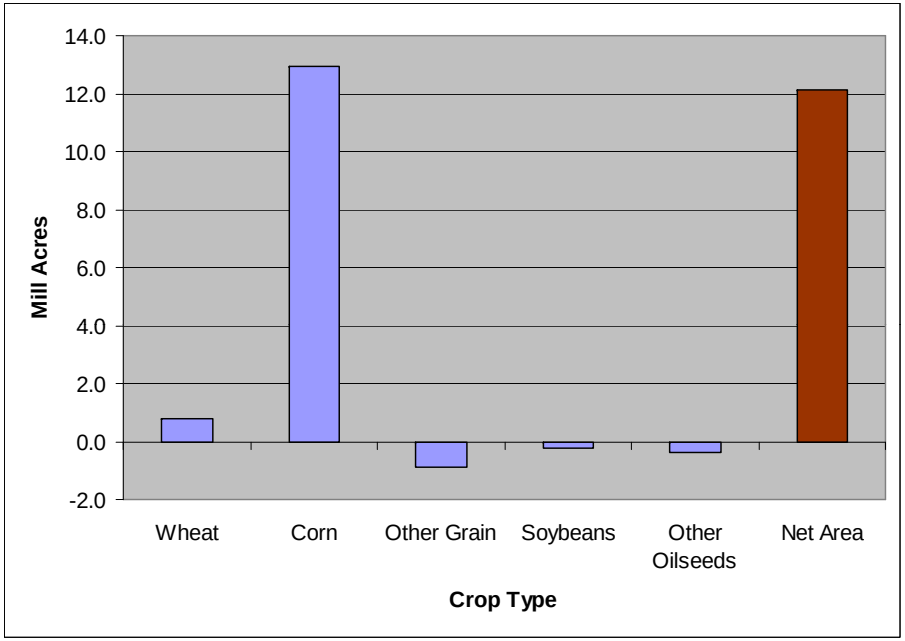
    increase in US
  - Decrease in rice acres and livestock production (due to increased feed prices) results in GHG emission reductions



- 40% of corn used for ethanol comes from reductions in exports (highlighting need to include international impacts)

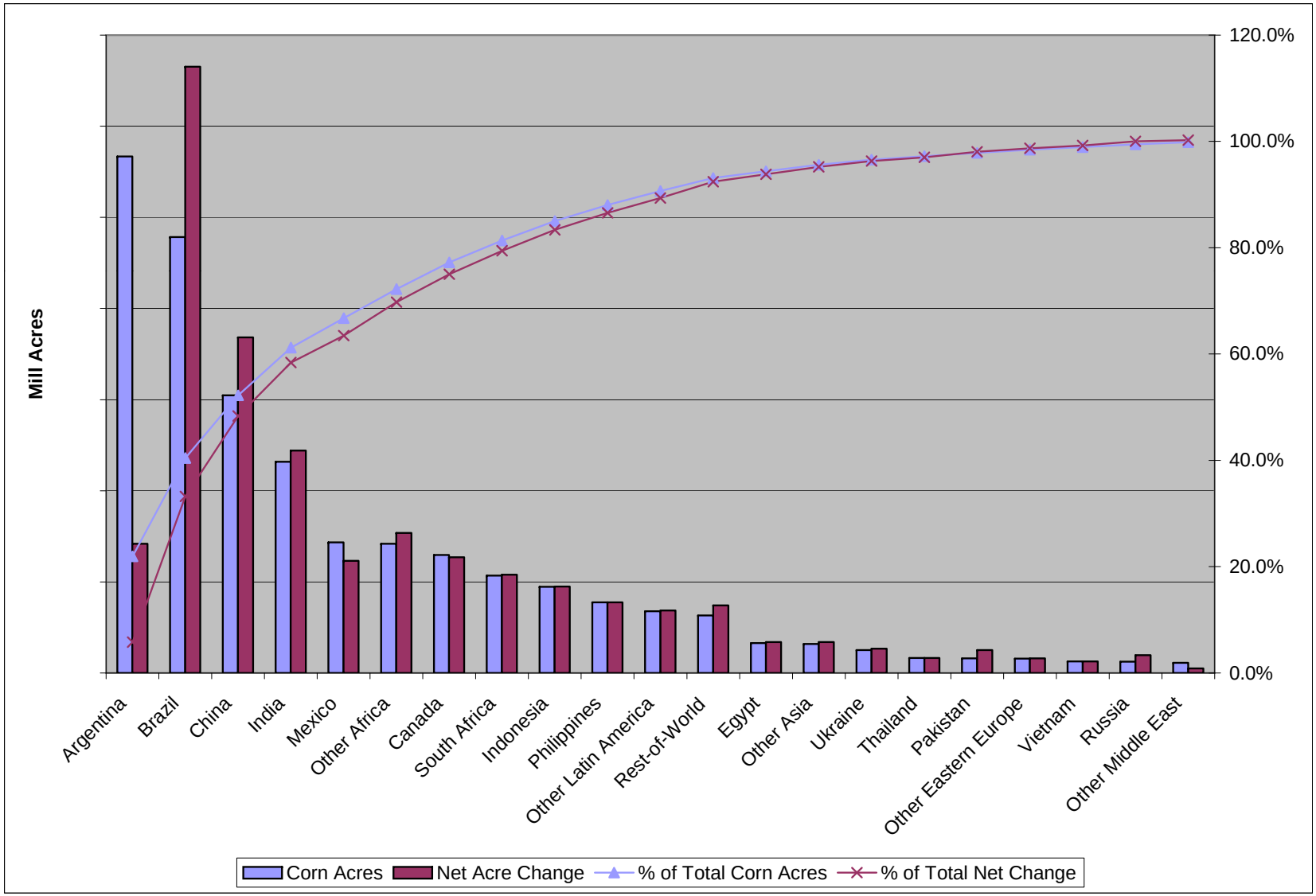
International Agricultural Sector Impact

- 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



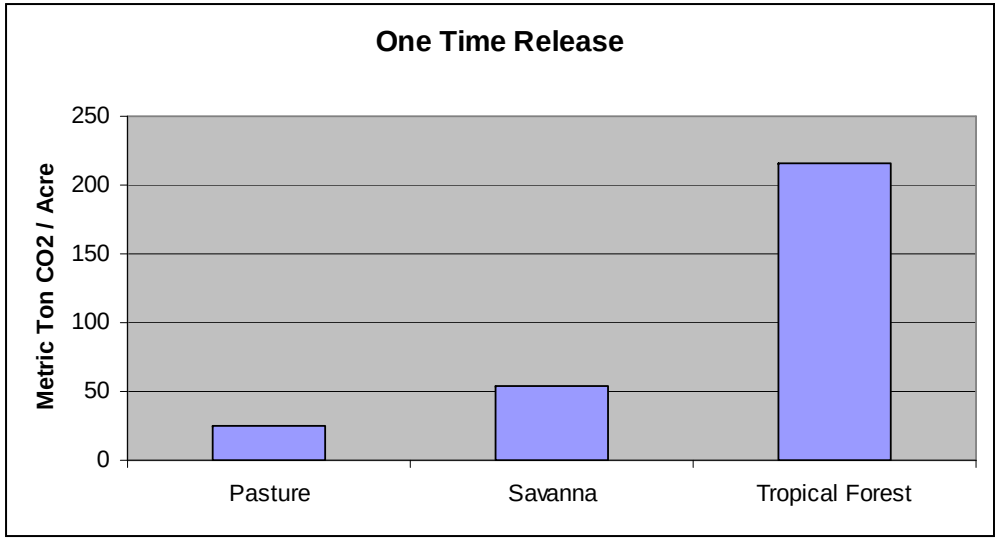
- Changes in crop acres based on yields in different countries
- Net increase in all crop acres results in land use change

Adjusted Land Use Change - Example

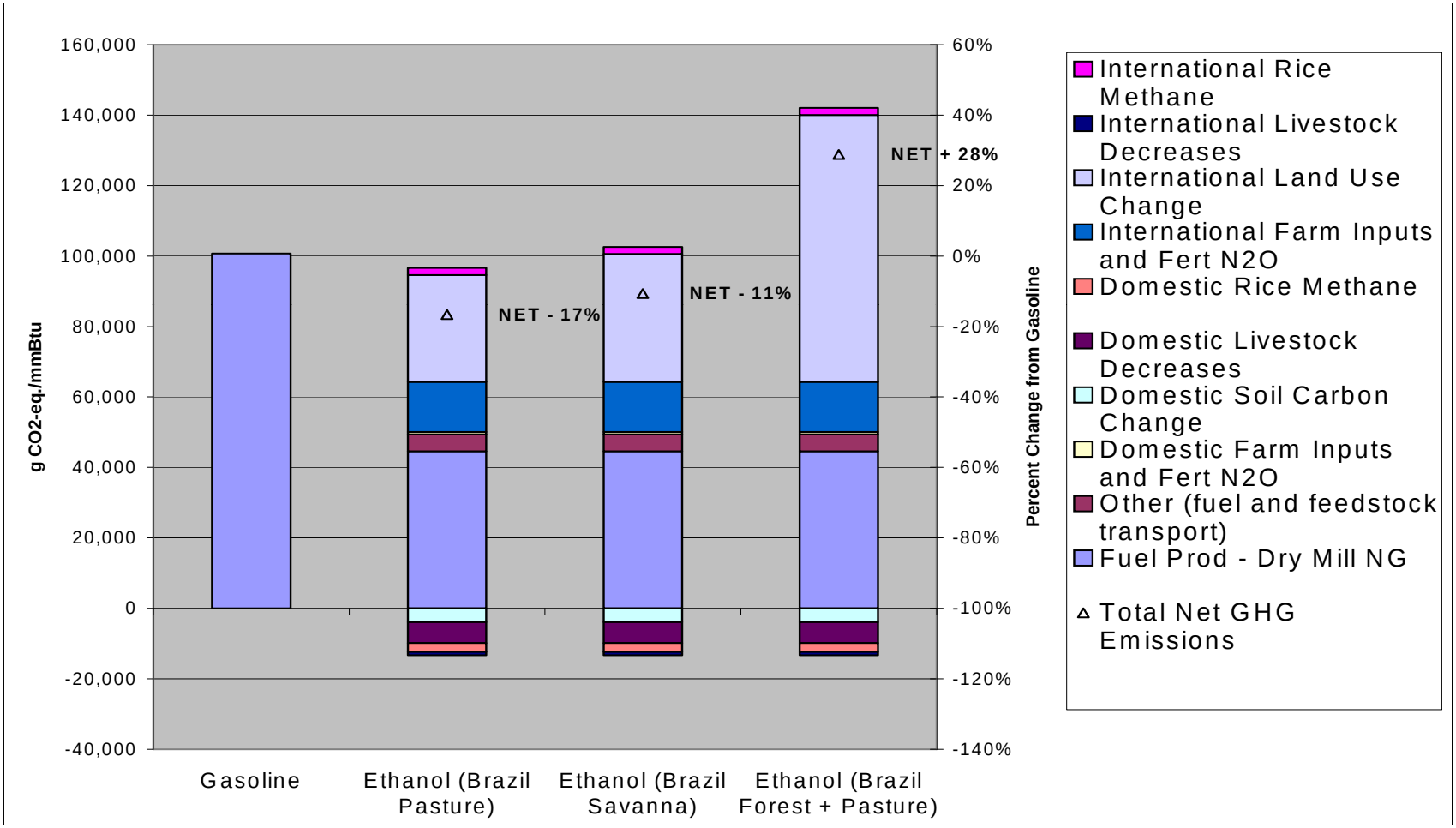


Land Use Change Assumptions

- Need to consider carbon per acre for different land types
- What type of land is converted in different countries, for example:
  - Argentina (Savanna)
  - Brazil Case 1 (Pasture)
  - Brazil Case 2 (Savanna)
  - Brazil Case 3 (Pasture + Tropical Forest)
  - Indonesia (Tropical Forest)



Illustrative Example of Impacts of land Use Change



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