EISA Renewable Fuels Provisions & Transportation Fuels GHG Lifecycle Analysis

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Overview

- **The Policy Landscape**
  - Update on the Renewable Fuel Standard (Energy Policy Act 2005)
  - Overview of the new renewable fuel provisions in the Energy Independence and Security Act (EISA)

- **Discussion of EPA's lifecycle analysis methodologies**
  - EPA's ongoing work on lifecycle analysis
  - Review of new lifecycle GHG criteria in EISA

The Policy Landscape

Renewable Fuel Standard (RFS)

- The Energy Policy Act of 2005 (EPAct 2005) required ethanol-equivalent volumes of renewable fuel:
  - Starting with 4.0 billion gallons per year in 2006
  - Reaching 7.5 billion gallons per year in 2012
  - 2013+: Constant %, 0.25 Bgal cellulosic standard

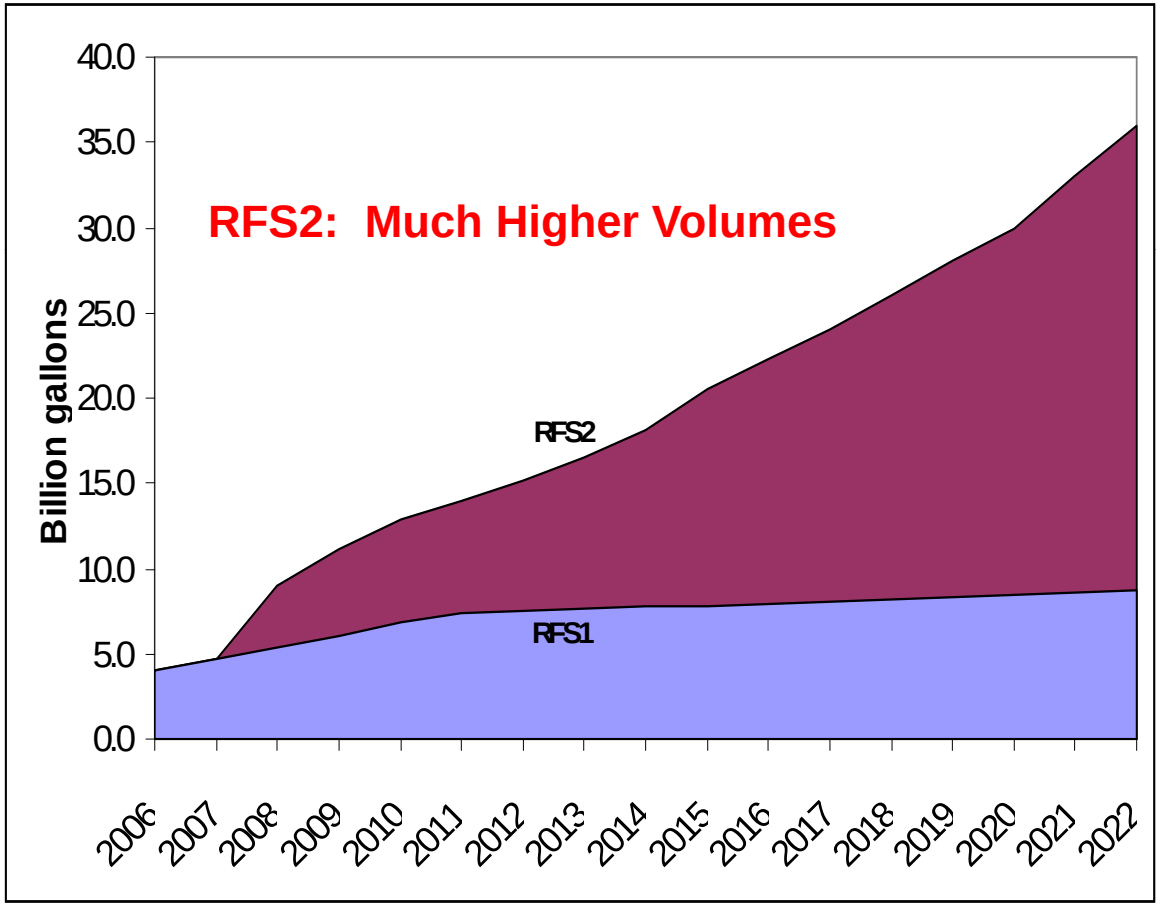
- "Equivalence Value" for various renewables based on volumetric energy content in comparison to ethanol:
  - Corn-ethanol: 1.0
  - Biodiesel (alkyl esters): 1.5
  - Renewable diesel: 1.7
  - Biobutanol: 1.3
  - Cellulosic biomass ethanol: 2.5 (Mandated by Act thru 2012)

RFS Program: Up and Running

- Rule finalized May 2007
- Extensive educational outreach effort
- Program began September 1, 2007
- Registration, Recordkeeping, Reporting
- Growing pains of implementing a new program are beginning to lessen
- RINs (Credits) are becoming valuable
  - 0.25 c/gal to 5 c/gal since December signing of EISA

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 and paper credit provisions
  - Includes new obligated parties
- **Includes new studies and reports**



Process and Timeline

- **Rule required on shorter schedule than under EPAct 2005**
  - Final RFS2 rule required by December 19, 2008
  - Required to be effective January 1, 2009
    - Currently evaluating multiple development and implementation options
- **EISA also increases volume under RFS1 for 2008**
  - Volume changed from 5.4 to 9.0 Bgal
  - Implemented administratively thru new Federal Register Notice
  - No rule changes for 2008 – Use RFS1
- **RFS2 can build off the foundation of RFS1**
  - RIN system may remain virtually intact
  - Intent of legislative drafters
- **Currently working through what EISA will really mean**
  - Several new challenging provisions
  - High volumes make key issues serious
- **Picking up where we left off from RFS1 with our stakeholders**
  - Engage early and often throughout the process

New Obligations and Definitions

- **Standard extended to:**
  - Diesel fuel in addition to gasoline
  - Nonroad fuel in addition to highway
- **Obligated parties now include refiners, importers, blenders of these fuels (gasoline and diesel)**
- **Jet fuel and heating oil aren't covered, but renewable fuel sold into these markets can generate RINs**
- **Definitions significantly changed from RFS1**
- **Creates new categories of renewable fuel**
- **Eliminates some old categories**
  - Waste-derived ethanol
  - "90%" cellulosic ethanol
- **Definitions now include new elements**
  - Lifecycle GHG reduction thresholds
  - Existing cropland criterion

New “Existing Cropland” Criterion

- Renewable fuels must now be produced from renewable biomass harvested from land “cleared or cultivated” prior to enactment of EISA
- Development of this provision will require extensive stakeholder interaction
  - 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?

EPA's Lifecycle Analysis Methodologies

Fuel Lifecycle GHG Assessment

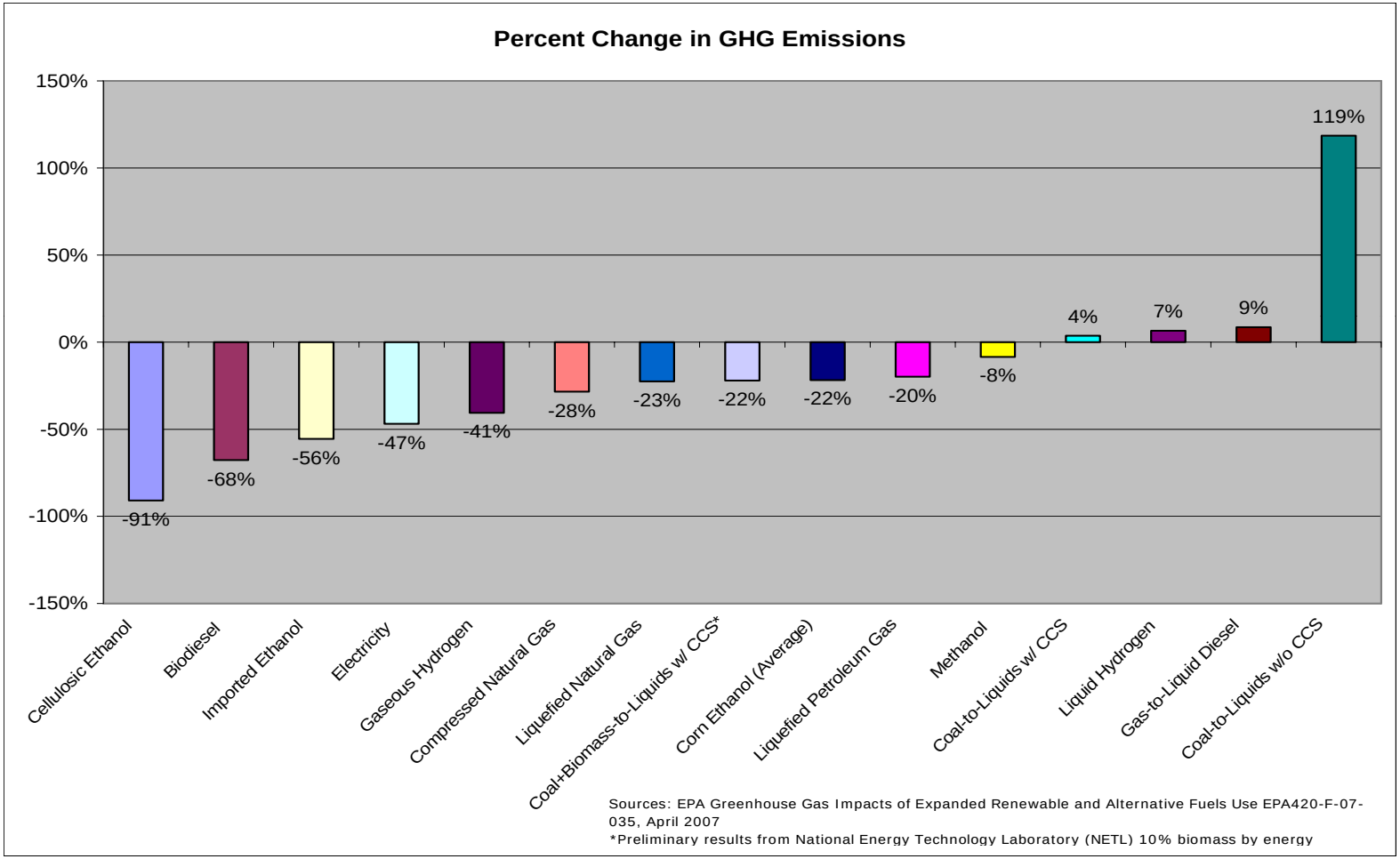
Some background on lifecycle analysis:

- Also called fuel cycle or well-to-wheel analysis, compilation of the GHG impacts of a fuel throughout its lifecycle
  - Production / extraction of feedstock
  - Feedstock transportation
  - Fuel production
  - Fuel distribution
  - Tailpipe emissions
- Can be used to compare one or more fuels performing the same function (e.g., miles driven)

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

GHG Lifecycle Analysis*



*Numbers are based on analysis conducted for the April 2007 RFS final rulemaking– they do not include analysis of indirect land-use changes as required by EISA. EPA is working to update these numbers.

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
  - 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

EISA Requires Lifecycle Assessment

- 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 adjust the lifecycle GHG thresholds by as much as 10%
- Baseline fuel for comparison is gasoline and diesel fuel in 2005

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.

Overview of Updated Approach

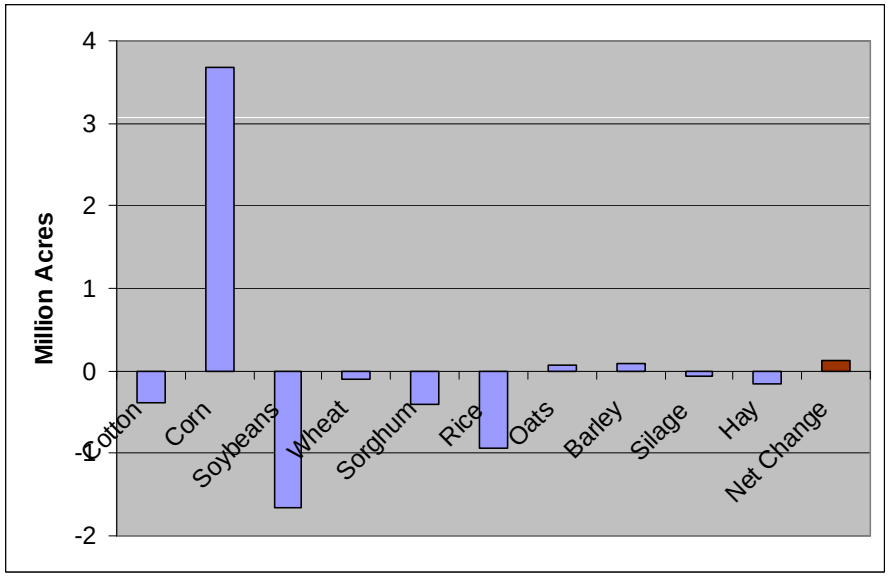
- **Developed an approach that includes all aspects of biofuels life cycle including detailed agricultural sector impacts and land use change**
- **Domestic Agricultural Sector: use comprehensive agricultural sector model (FASOM) to determine sector-wide impacts of increase biofuel production**
  - Accounts for changes in CO2, CH4, and N2O from agricultural activities
  - Tracks carbon sequestration and carbon losses over time
  - Tracks five forest product categories and over 2,000 production possibilities for field crops, livestock, and biofuels
- **International Agricultural Sector: use comprehensive models for worldwide agricultural sector (FAPRI) for a reference case and policy case to determine changes in U.S. exports due to increased domestic biofuel production and international increased corn production, decreases in other crops, changes in total crop acres**
  - USDA's Office of Chief Economist, Congress, and the World Bank have utilized the FAPRI modeling structure to examine agricultural impacts from World Trade Organization proposals, changes in the European Union's Common Agricultural Policy, and the impact of biofuel development in the United States
- **GHG emissions included in FASOM, FAPRI results converted to GHG emissions**
- **Ethanol process emissions based on process models from USDA**
- **Feedstock and ethanol transportation based on DOE Argonne's GREET model**
- **Apply this approach to various fuels and feedstocks**

EPA's Methodology Consistent with Relevant Life Cycle Guidance/Standards

- There have been numerous guidance/standard documents published on lifecycle assessment:
  - **Society of Environmental Toxicology and Chemistry (SETAC)**
    - Consoli, F., et al., 1993. *Guidelines for Life Cycle Assessment: A Code of Practice*. Proceedings of a workshop in Sesimbra, Portugal. SETAC.
    - Fava J., et al. (eds.). 1991. *A Technical Framework for Life-Cycle Assessment.* Washington, D.C.: SETAC and SETAC Foundation for Environmental Education, Inc.
    - SETAC - Europe. 1992. *Life Cycle Assessment*. Brussels, Belgium.
  - **U.S. EPA**
    - OAQPS, 1994. *Life Cycle Impact Assessment: A Conceptual Framework, Key Issues, and Summary of Existing Methods*. EPA/452/R-95/002.
    - ORD, 1993. *Life Cycle Design Guidance Manual*. EPA/600/R-92/226.
    - ORD, 1993. *Life Cycle Assessment: Inventory Guidelines and Principles*. EPA/600/R-92/245
    - EPA, Vigon B., et al. 1992. *Product Life-Cycle Assessment: Inventory Guidelines and Principles*. Battelle and Franklin Associates Ltd. EPA/600/R-92/036.
  - **Most recently, the International Organization for Standardization (ISO)**
    - ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework
    - ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines

Domestic Agricultural Sector Impact

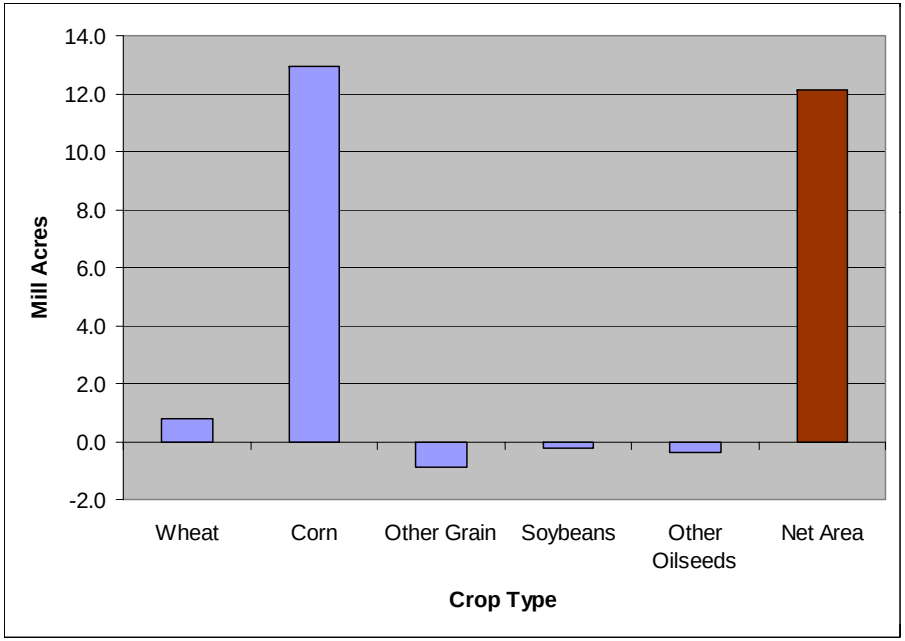
- Looking at domestic impacts only of increased ethanol production could result in a net decrease in total GHG emissions
  - Shift in crop production results in limited crop acreage increase (small increase in agricultural sector inputs)
  - Decrease in rice acres and livestock production (due to increased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

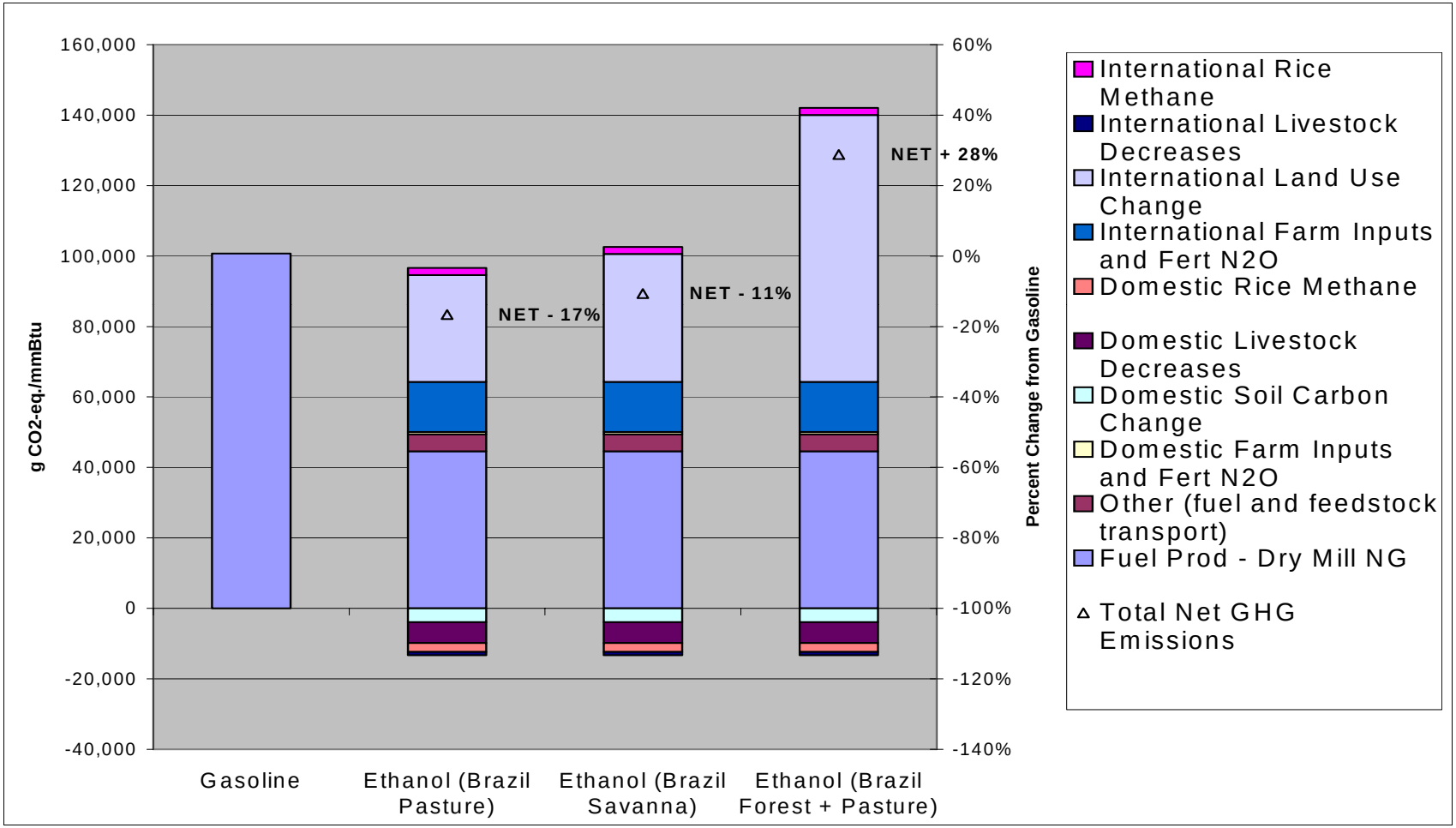
International Agricultural Sector Impact

- 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



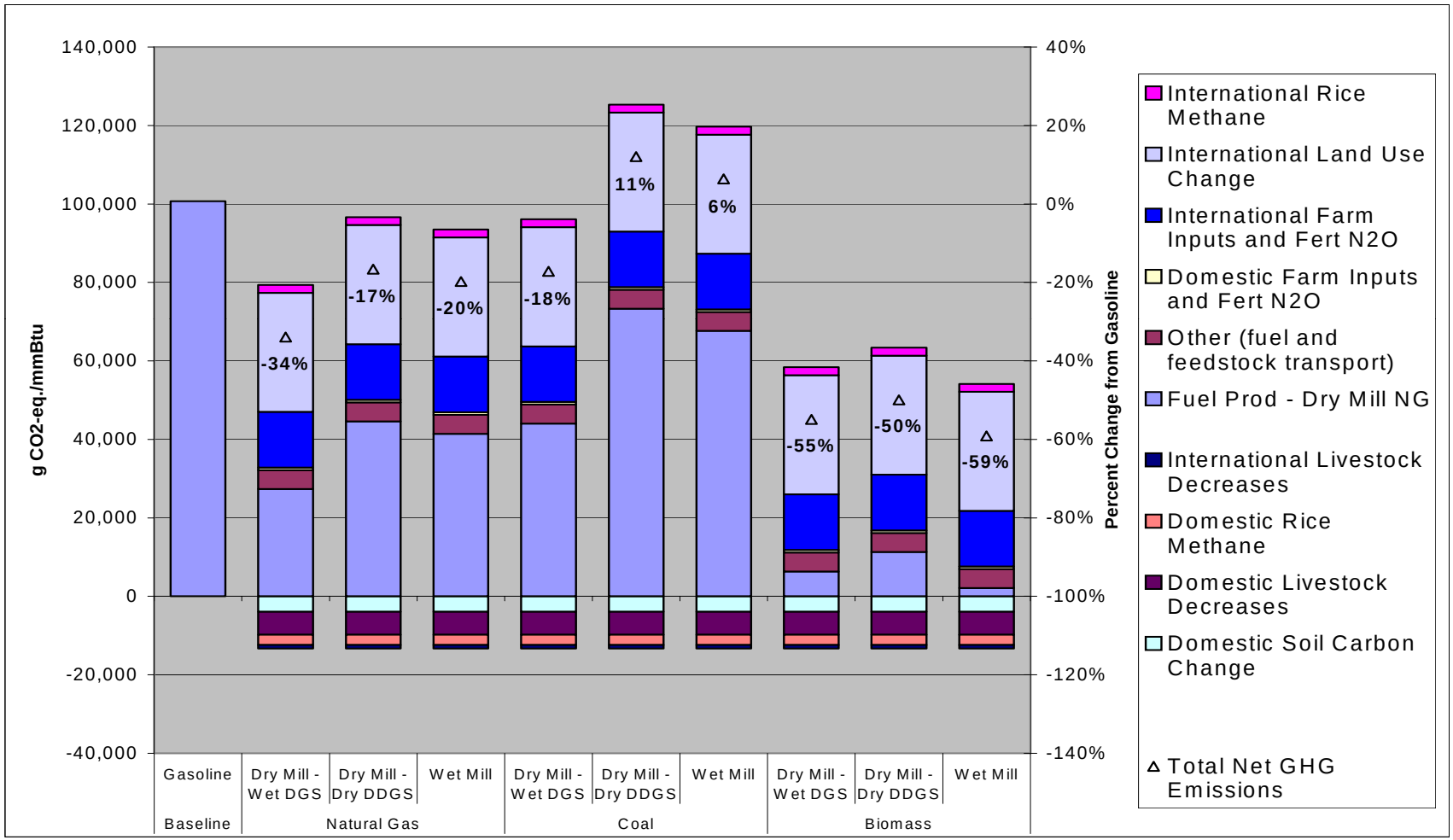
Impact of Land Use Change Assumptions

(Dry Mill, Natural Gas, Dry and Pelletized DDGS)



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

Impact of Ethanol Plant Energy Use
(Pasture Land Use Change in Brazil)



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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
  - CA and EU regulators

EPA's Lifecycle Analysis on Alternative Fuels

- In response to President's Executive Order on May 14, 2007, EPA developed GHG life cycle emission factors for alternative fuels (non-biomass based) in coordination with DOE

- CTL Example:
  - Coordinated with NETL to incorporate their CTL/CBTL process modeling results into EPA's LCA
  - Also met with both CTL plant developers and researchers to discuss potential conceptual plant designs
  - Identified key sensitivities related to plant emissions: CO_2 plant capture rates, plant efficiency, type and amounts of products produced, feedstocks (biomass) used, and the displacement or allocation assumptions

Stakeholder Outreach

Biofuel and Feedstock Producers:

- National Biodiesel Board
- Renewable Fuels Association
- American Coalition for Ethanol
- Illinois Corn Growers Association
- National Sorghum Growers
- National Corn Growers Assoc.
- American Forest & Paper Assoc.
- Iogen
- ADM (4/10)

Petroleum Industry:

- American Petroleum Institute
- National Petroleum Refiners Assoc.
- Shell
- BP/Dupont (4/8)

Environmental NGOs:

- Natural Resources Defense Council
- Union of Concerned Scientists
- Environmental Defense
- World Resources Institute

Federal/State Agencies

- EPA ORD
- EPA NCEE / OPEI
- OSTP
- DOE including national labs such as NREL, NETL, ORNL, Argonne, and PNNL
- USDA
- CARB

Other Technical Experts

- UC Davis (Farrell, Delucchi)
- Michael Wang
- Various conferences and workshops

International

- ICCT
- GBEP
- EU

Next Steps

- EISA language significantly alters existing RFS program
- Advanced biofuels, especially cellulosic ethanol, will make up a substantial portion of future volumes
- Lifecycle GHG emissions of all new fuels will need to be considered
- Other environmental impacts need to be studied and addressed

- Rulemaking process
  - FR Notice for 2008: Completed
    - Volume changed from 5.4 to 9.0 bill gal
  - EPA is actively engaged in the rulemaking process for 2009 and beyond, and is meeting with stakeholders on an ongoing basis