RFS Implementation & Lifecycle Analyses

Farm, Ranch, Rural Communities Meeting

February, 2009

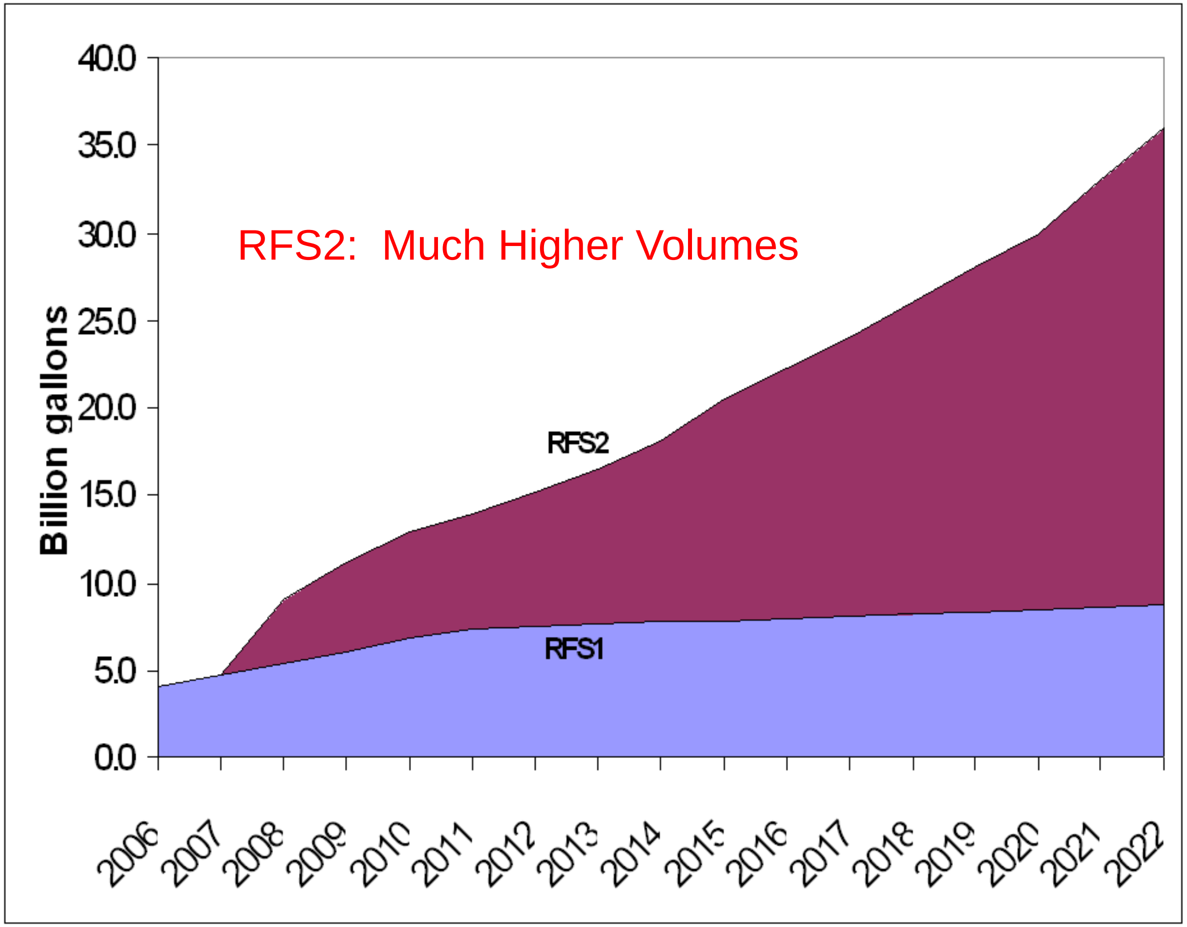
Renewable Fuels Standard

- Final rule signed April 9th
- Requires Growing Renewable Use
  - **From 4 billion gallons per year beginning in 2006 to 7.5 billion gallons per year by 2012**
- Renewable values based on volumetric energy content in comparison to corn ethanol
  - Corn-ethanol: 1.0
  - Cellulosic biomass ethanol: 2.5
    - As specified in EPAct
  - Biodiesel (alkyl esters): 1.5
  - Renewable diesel: 1.7
  - Biobutanol: 1.3
- Sought comment on life cycle energy, petroleum, GHG emissions
- Program officially started on September 1, 2007
- **Passage of the Energy Independence and Security Act significantly expanded volumes, extended the timeframes, and added GHG thresholds…**

EISA of 2007: New Challenges and Direction

Modifies Current RFS program beginning in 2008

- **Volumes increase to 9 Bgal/yr in 2008 – escalating to 36 Bgal/year by 2022**
- **Establishes new renewable fuel categories and eligibility requirements, including GHG reduction thresholds!**
- **Provides new waivers and paper credit provisions**
- **Includes new obligation for fuels**
- **Includes new studies and reports**



RFS2: Four Separate Volume Mandates

Year	Conventional Biofuels (Grandfathered or 20% Reduction)	Advanced Biofuel				Total Renewable Fuel
		Biomass-Based Diesel (50% Reduction)	Non Cellulosic Advanced (50% Reduction)	Cellulosic Biofuel (60% Reduction)	Total Advanced Biofuel	
2006	4.00					4.0
2007	7.70					4.7
2008	9.00					9.0
2009	10.50	0.5	0.1		0.6	11.1
2010	12.00	0.65	0.2	0.1	0.95	12.95
2011	12.60	0.80	0.3	0.25	1.35	13.95
2012	13.20	1.0	0.5	0.5	2.0	15.2
2013	13.80	1.0	0.75	1.0	2.75	16.55
2014	14.50	1.0	1.00	1.75	3.75	18.15
2015	15.00	1.0	1.50	3.0	5.5	20.5
2016	15.00	1.0	2.00	4.25	7.25	22.25
2017	15.00	1.0	2.50	5.5	9.0	24.0
2018	15.00	1.0	3.00	7.0	11.0	26.0
2019	15.00	1.0	3.50	8.5	13.0	28.0
2020	15.00	1.0	3.50	10.5	15.0	30.0
2021	15.00	1.0	3.50	13.5	18.0	33.0
2022	15.00	1.0	4.00	16.0	21.0	36.0

Rulemaking Status

- FR Notice for 2008: Completed
  - Volume changed from 5.4 to 9.0 bill gal
- Proposal is complete and awaiting OMB approval
- Also continuing to meet with various stakeholders (e.g. industry, academic experts, CA/EU, environmental organizations, federal and state agencies), particularly with regards to lifecycle analyses…

Other Issues

- Ethanol Blendwall
- Cellulosic Production
- Cropland / Rangeland
- Waivers

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 What We Need

- Need to develop life cycle GHG values for each potential fuel and production pathway, for example:
  - Corn ethanol (dry mill, wet mill, coal, natural gas, etc.)
  - Biodiesel / Renewable Diesel
    - Soybean oil
    - Waste grease
  - Cellulosic Ethanol (enzymatic, thermochemical)
    - Agricultural residue (e.g., corn stover)
    - Forest wastes
    - Switchgrass / other energy crops
  - Imports
    - Sugarcane ethanol

- The components of the analysis are generally the same for all biofuels, but each has own set of assumptions and issues

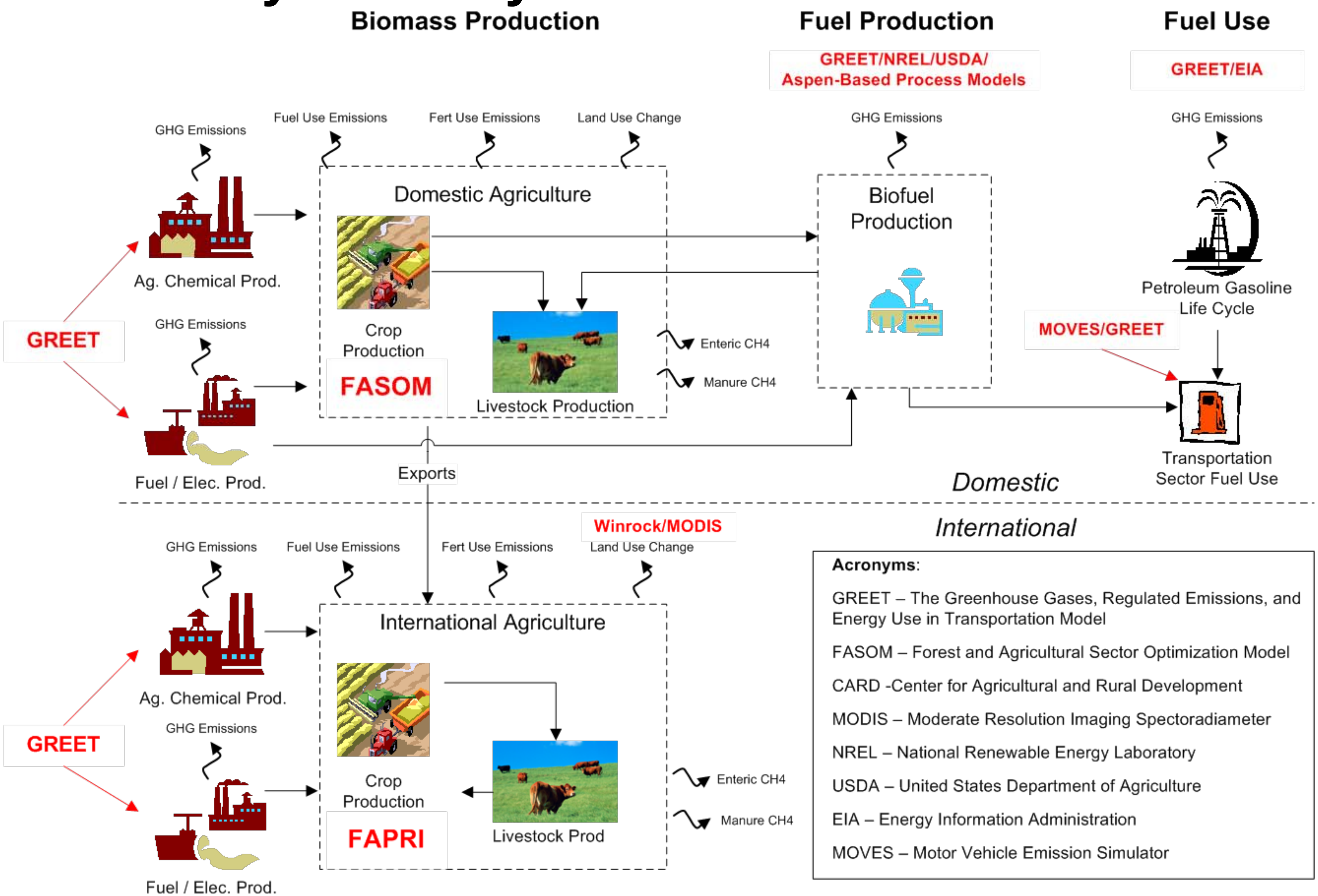
Methodology

- EISA definition requires the use of a number of models and tools
  - Including direct and indirect impacts such as land use change requires analysis of markets
    - Typical life cycle analysis tools are based on process modeling
    - To capture market impacts need to use economic models
  - Conducting our own process and emissions modeling as part of rulemaking

- Scenario Comparison: Run models with different volume scenarios to isolate the impact of specific fuel
  - Consider change between baseline projected fuel volume in 2022 (i.e., without RFS2) and projected RFS2 mandated volume.
  - Held volumes of other fuels constant at RFS2 mandated levels

- For areas of uncertainty, we have tested our primary approach and key assumptions with sensitivity analyses and different methods

EPA Lifecycle Analysis Uses Several Models



Acronyms:

GREET – The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model

FASOM – Forest and Agricultural Sector Optimization Model

CARD -Center for Agricultural and Rural Development

MODIS – Moderate Resolution Imaging Spectoradiameter

NREL – National Renewable Energy Laboratory

USDA – United States Department of Agriculture

EIA – Energy Information Administration

MOVES – Motor Vehicle Emission Simulator

Key Factors in Land Use Assessment

- **This analysis has revealed which factors have the most significant impact on the final results**
  - **What Type of Land is Converted?**
    - For example, historic satellite data suggests that in some countries significant amounts of forest would be converted to cropland
    - However, we are looking at sensitivities around these assumptions that would show varying degrees of forestry impact
  - **Treatment of Time Related Land Use Changes?**
    - Land use change results in stream of emissions that are changing over time
    - We need to define a life cycle GHG value that is applicable to all gallons across time
    - We are looking at a range of approaches for treating the land use changes over time
- **We are conducting additional sensitivity analyses around these factors**

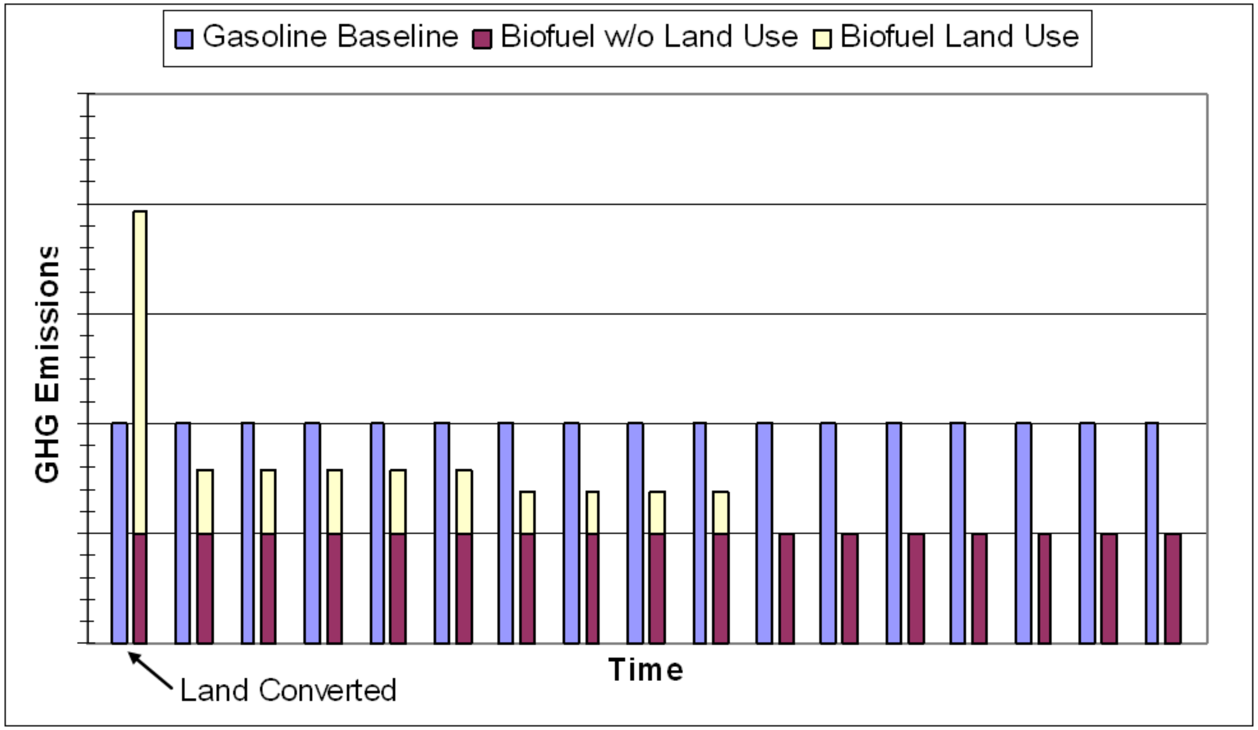
International Agriculture & Land Use Change

- Questions we need to address in this analysis:
  - How much land is converted internationally?
  - What are the emissions trends from international crop production?
  - Where does land use change occur?
  - What types of land are converted?
  - What are the GHG factors from that land conversion?
  - How do we account for the time dimension of GHG releases?
- In order to address uncertainty around these factors, we are performing sensitivity analyses and examining two approaches

Accounting for the Time Dimension of Land Conversion GHG Releases

- Land use change results in stream of emissions that are changing over time
- Need to define a life cycle GHG value that is applicable to all gallons across time
- Aspects to consider
  - Length of program
  - Discount rate

ILLUSTRATIVE EXAMPLE



Biofuel Production Modeling

- Corn ethanol
  - Working with USDA and industry
  - Considering different configurations (fuel source, technologies, carbon capture)
- Cellulosic ethanol
  - Looking at modeling by NREL & GREET that projects use of biomass lignin for process energy, enabling plants to sell electricity to the grid
  - Offsets grid electricity production and results in GHG benefits
- Imported Sugarcane Ethanol Production
  - Like cellulosic, can produce excess electricity from burning bagasse

Petroleum Baseline

- We use updated version of GREET and EIA data
  - Energy efficiency of refining and crude extraction (GREET)
- Assuming 2005 mix of crude
  - Tar Sands
  - Included Venezuela extra heavy and heavy crude
    - Developed emissions factors for those crude types (not currently included in GREET)
- Also considering new DOE/NETL report
  - Similar overall results within 2% of EPA estimates
- Also working to include energy sector impacts

Summary and Next Steps

- In developing the lifecycle methodology, our approach has been to use the best models, tools, and resources available
  - Using sensitivity analysis and examining multiple approaches to address key areas of uncertainty
- The notice of proposed rule-making (NPRM) provides an important opportunity for EPA to present our work and to seek comment on proposed approaches and alternative approaches
  - Planning to hold workshops on lifecycle analysis following release of the NPRM
- Engage experts between proposal and final to ensure expert-level feedback
  - Consulting EPA’s Science Advisory Board (SAB)
  - Plan to conduct formal external peer-reviews of key components
- This input, along with the additional analysis we will be conducting between now and the final rule, will further improve our methodology
- Anticipate 3-5 year cycles for updating the analysis