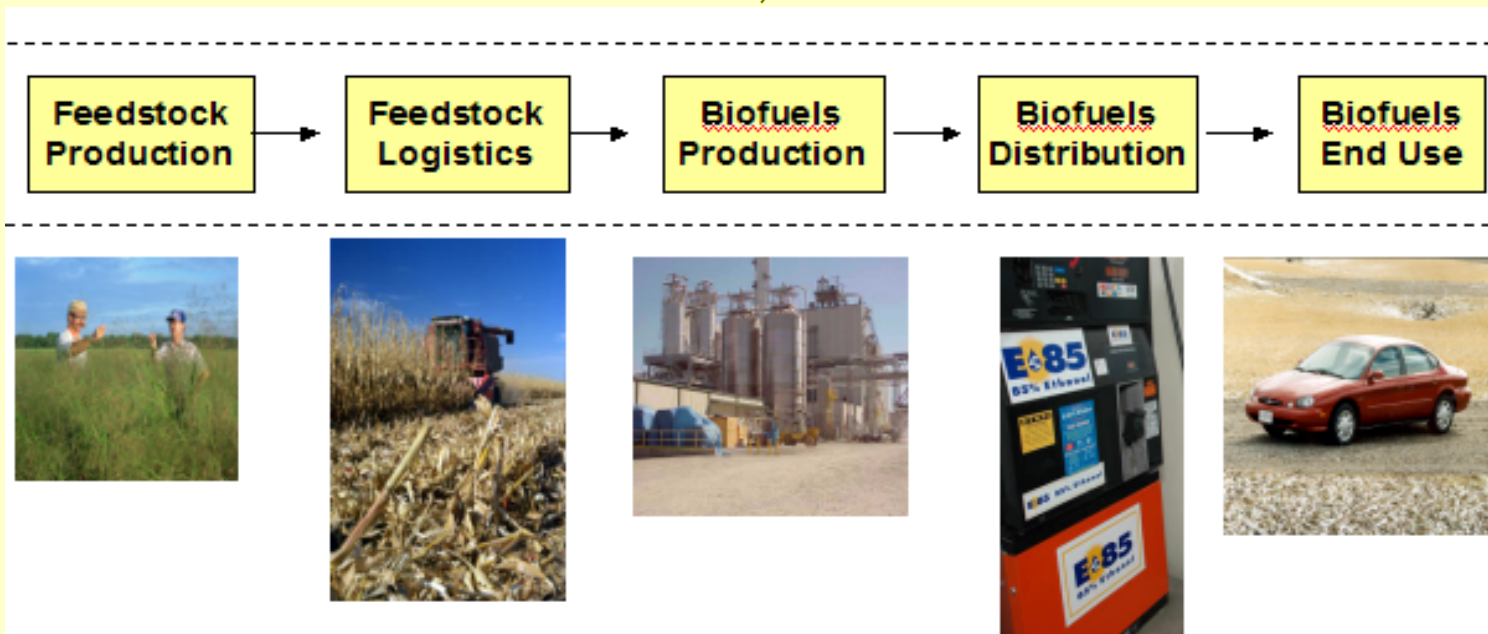


# Sustainable Production of Biofuels



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U.S. EPA  
March 4, 2008





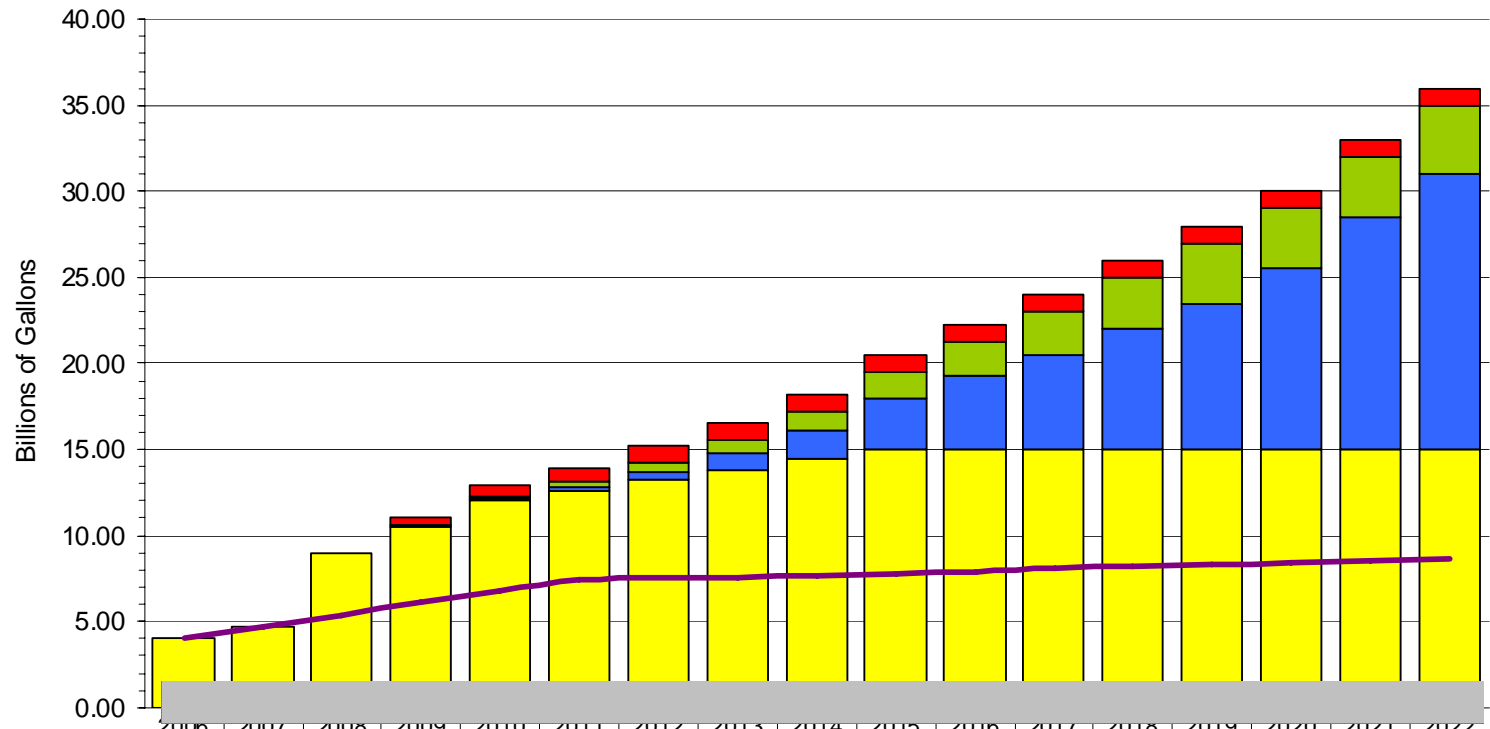
# EPA Perspective

- Sustainable production of biofuels is essential
- 2007 EISA mandates key sustainability approaches, criteria and safeguards
- Key research challenges exists on defining sustainability, LCA and integrated assessments
- International discussions are crucial to defining best practices and setting acceptable sustainability criteria

# Energy Independence & Security Act 2007

Type of Fuel	BGY
<b>Total Renewable Fuels by 2022</b>	<b>36 BGY</b>
<b>Corn Ethanol (Capped at 15 BGY)</b>	<b>15 BGY</b>
<p><b>Advanced Biofuels</b> – Includes imported biofuels and biodiesel. Includes 1 billion gpy biodiesel starting in 2009 All must achieve <math>\geq 50\%</math> reduction of GHG emissions from baseline*</p>	<b>21</b>
<p><b>Cellulosic Fuels</b> – Includes cellulosic ethanol, biobutanol, green diesel, green gasoline All must achieve <math>\geq 60\%</math> reduction of GHG emissions from baseline*</p>	<b>16</b>
<p>*Baseline = average lifecycle GHG emissions as determined by EPA Administrator for gasoline or diesel (whichever is being replaced by the renewable fuel) sold or distributed as transportation fuel in 2005</p>	

# Renewable Fuel Standard (RFS), 2007-2022



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Biomass-based Diesel				0.50	0.65	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Balance of Advanced				0.10	0.20	0.30	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	3.50	3.50	4.00
Celulosic Advanced					0.10	0.25	0.50	1.00	1.75	3.00	4.25	5.50	7.00	8.50	10.50	13.50	16.00
Conventional Biofuels	4.00	4.70	9.00	10.50	12.00	12.60	13.20	13.80	14.40	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Current RFS PL 109-58	4.00	4.70	5.40	6.10	6.80	7.40	7.50	7.60	7.70	7.80	7.90	8.10	8.20	8.30	8.40	8.50	8.60

# Sustainable and Environmentally Responsible Biofuels (EISA)

## Two Clear Environmental Goals:

- Use of renewable fuels results in significant reductions of GHG emission
  - $\geq 50\%$  reductions over lifecycle, determined by EPA, compared to baseline
  - Includes the full biofuel system
- Biofuel production does not adversely impact the environment or natural resources
  - EPA to assess and Report to Congress on environmental impacts of biofuel system
  - Particular recognition of impacts to water quality, EISA amends the Clean Air Act to integrate *water quality* into a fuel assessment analysis

# Mandates for EPA R&D Collaboration

<b>EISA Section</b>	<b>Agency</b>	<b>Time-frame</b>	<b>Activity Summarized</b>
203-Feedstock Impact Study of RFS	DOE, USDA, EPA, NAS	18 months	NAS shall conduct a <b>study</b> to assess the impacts of RFS on each industry relating to production of feed grains, livestock, food, forest products, and energy
204-Environmental and Resource Conservation Impacts	EPA, USDA, DOE	3 years & every 3 yrs	<b>Report to Congress</b> on current & future impacts of RFS affecting environment and resource conservation issues in the U.S. <u>and</u> abroad
232-Environmental R&D Considerations Modifies Biomass R&D Act of 2000	DOE, USDA, EPA,	Not specified	<b>Directs R&amp;D</b> efforts to include lifecycle GHG emissions, environmental impacts on RFS, and on-farm biofuels production
248-Biofuels Distribution and Advanced Biofuels Infrastructure	DOE, DOT, EPA	Not specified	DOE coordinates with DOT and consults with EPA in carrying out RD&D program to test physical and chemical properties of biofuels as they relate to existing and new distribution infrastructure

# Section 232 Energy Independence and Security Act

“Develop cellulosic and other feedstocks that are less resource and land intensive and that promote **sustainable use of resources**, including soil, water, energy, forest and land, and ensure protection of air, water, and soil.”

# Lifecycle Assessment

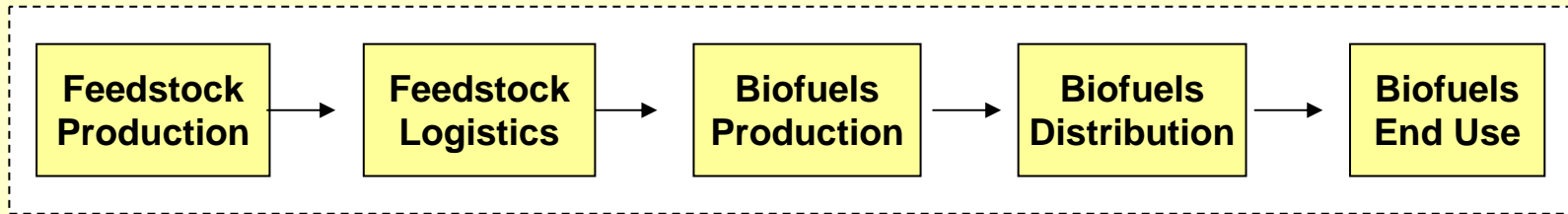
- Lifecycle assessment required to determine which fuels meet mandated GHG performance thresholds compared to petroleum fuel replaced
  - 20% reduction for new facility renewable fuel
  - 50% reduction for biomass-based diesel
  - 60% reduction for cellulosic biofuel
- Lifecycle assessment must include impacts on land use
- Corn based ethanol capped at 15 billion/gallons



# EPA- Rule Making: Renewable Fuel Standards

- EPA Renewable Fuel Standard-1 (Before EISA) analysis assessed first order impacts
  - GHG impacts of corn and soybean acres in US
- RFS-2 (After EISA) more complete assessment of domestic and international impacts
  - Corn and soybeans plus other crops
  - Land use changes
  - International impact of decreased US exports
    - Increased crop production in other countries adds GHG
    - Land use impacts critical

# Research Across the Biofuels System



Ag Crops  
Ag Residues  
Energy Crops  
Forest Residues  
Wastes



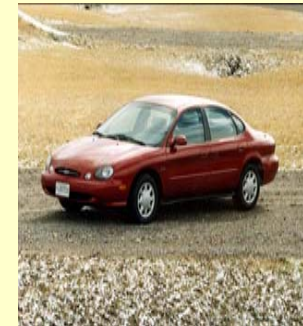
Harvesting & Collecting  
Storage  
Pre-Processing  
Transportation



Fuel types  
Biochemical Conversion  
Thermochemical Conversion  
Anaerobic Digestion

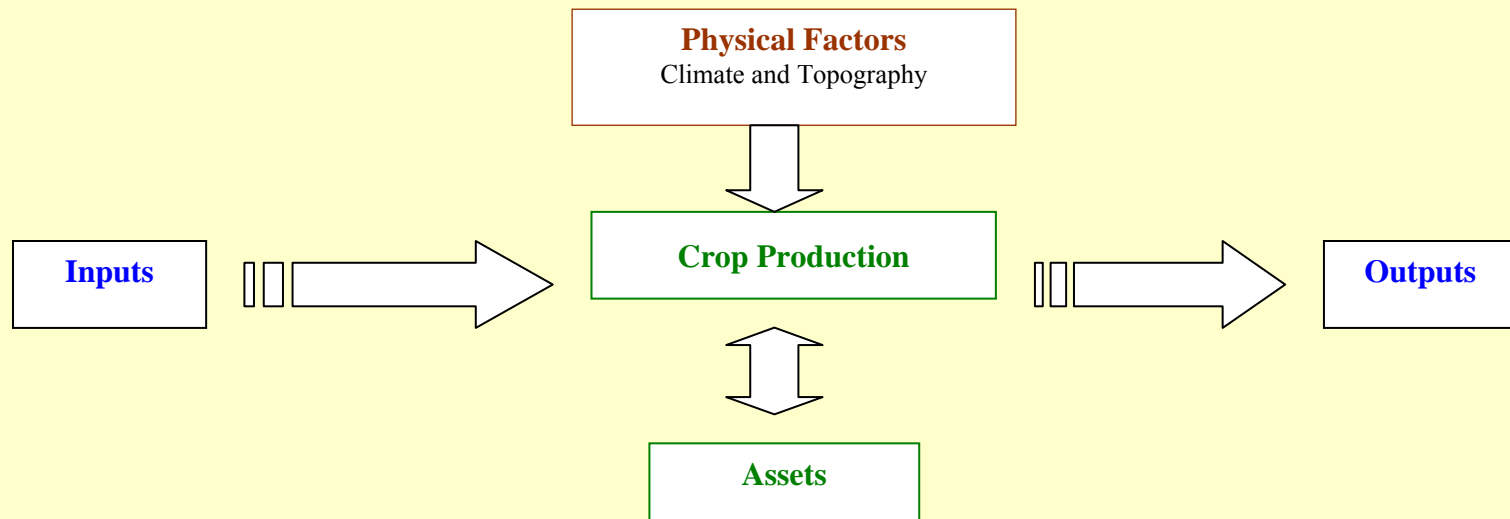


Transportation  
Storage  
Dispensing

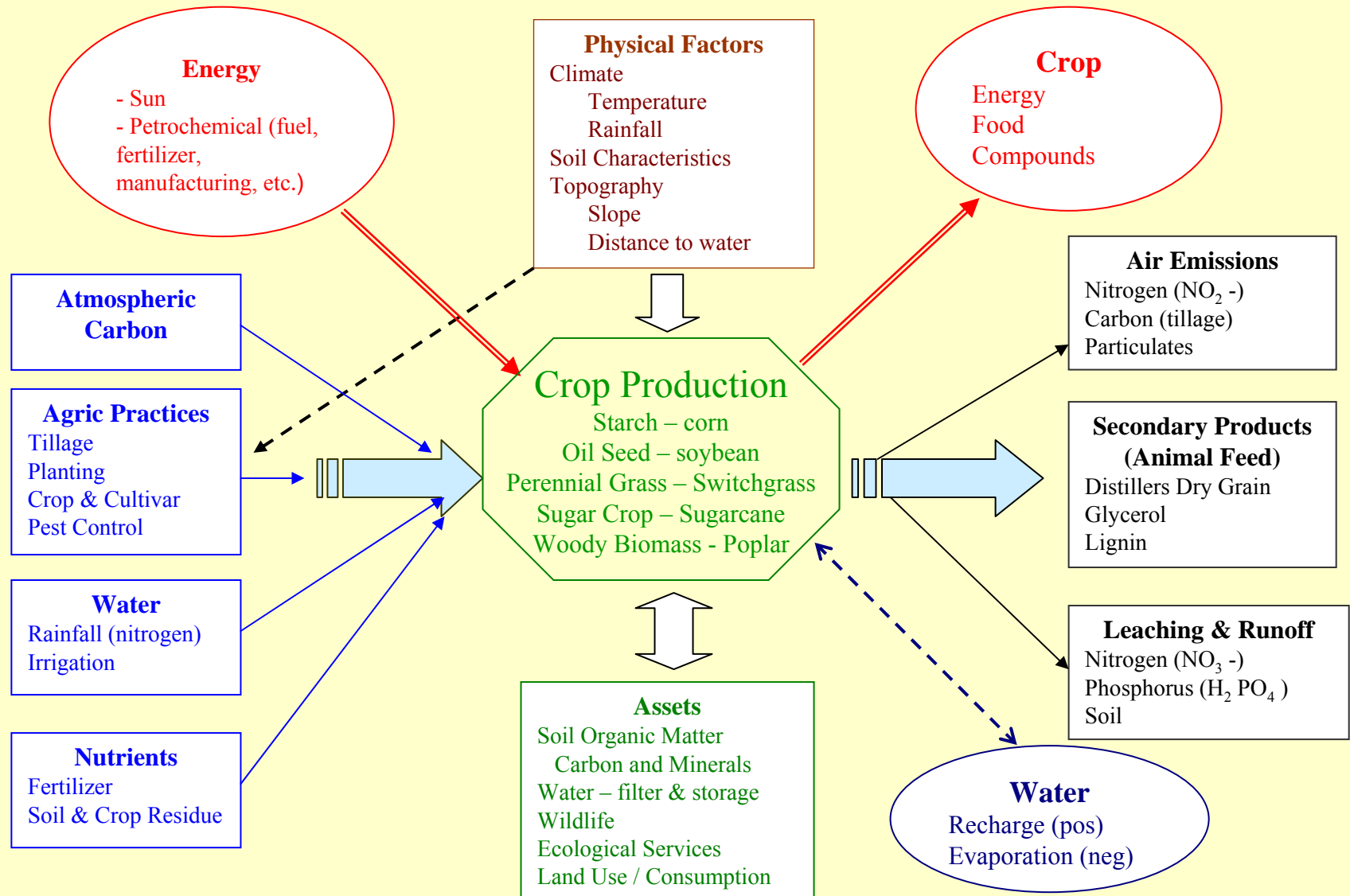


Transportation fuels  
(in light & heavy duty vehicles & trucks, off-road vehicles, locomotives, flight technologies, boats/ships)  
Power & Generators  
Chemical Feedstocks for Manufacturing

# Crop Production Generalized Diagram

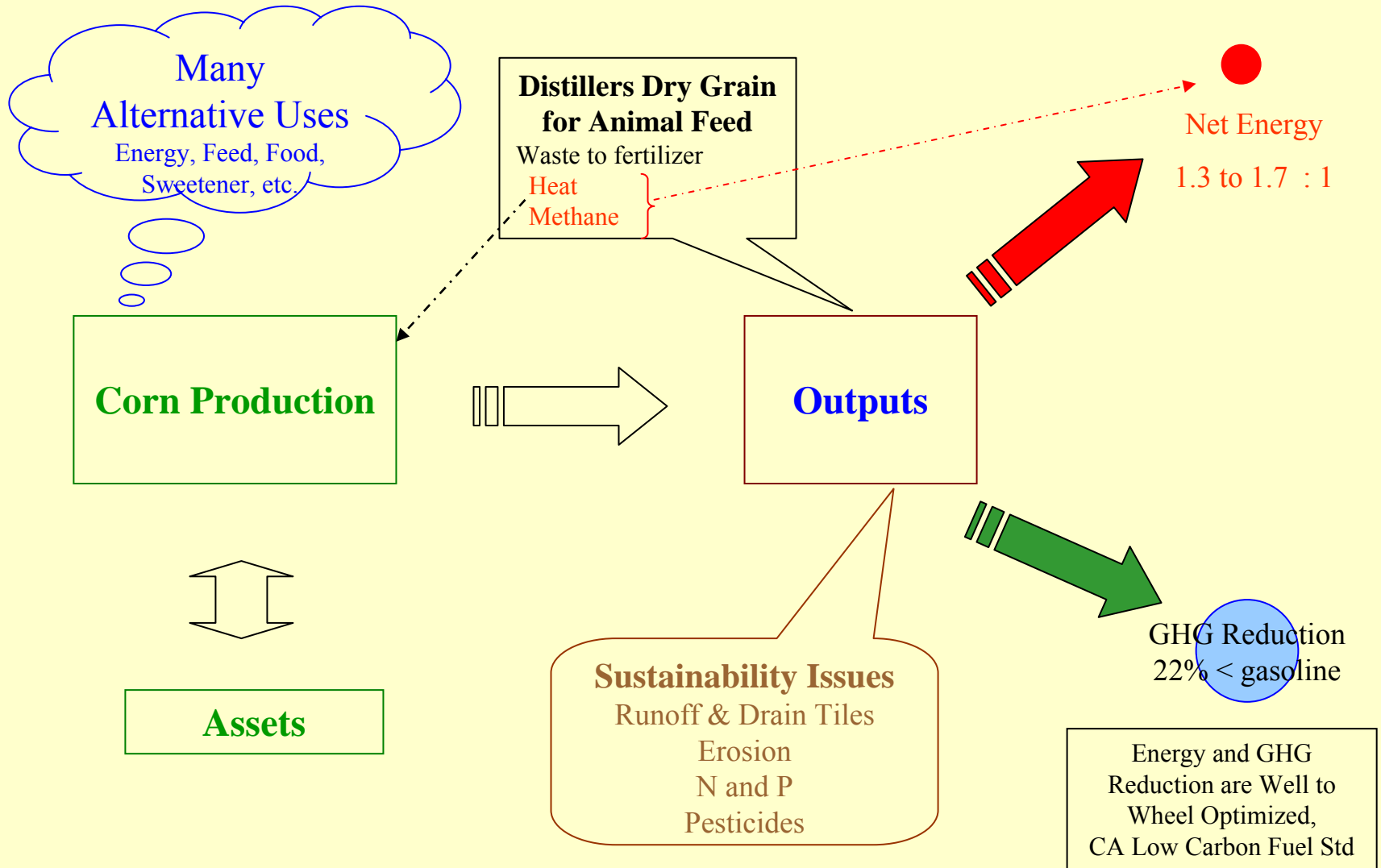


# Inputs and Outputs of Biofuel Crop Production



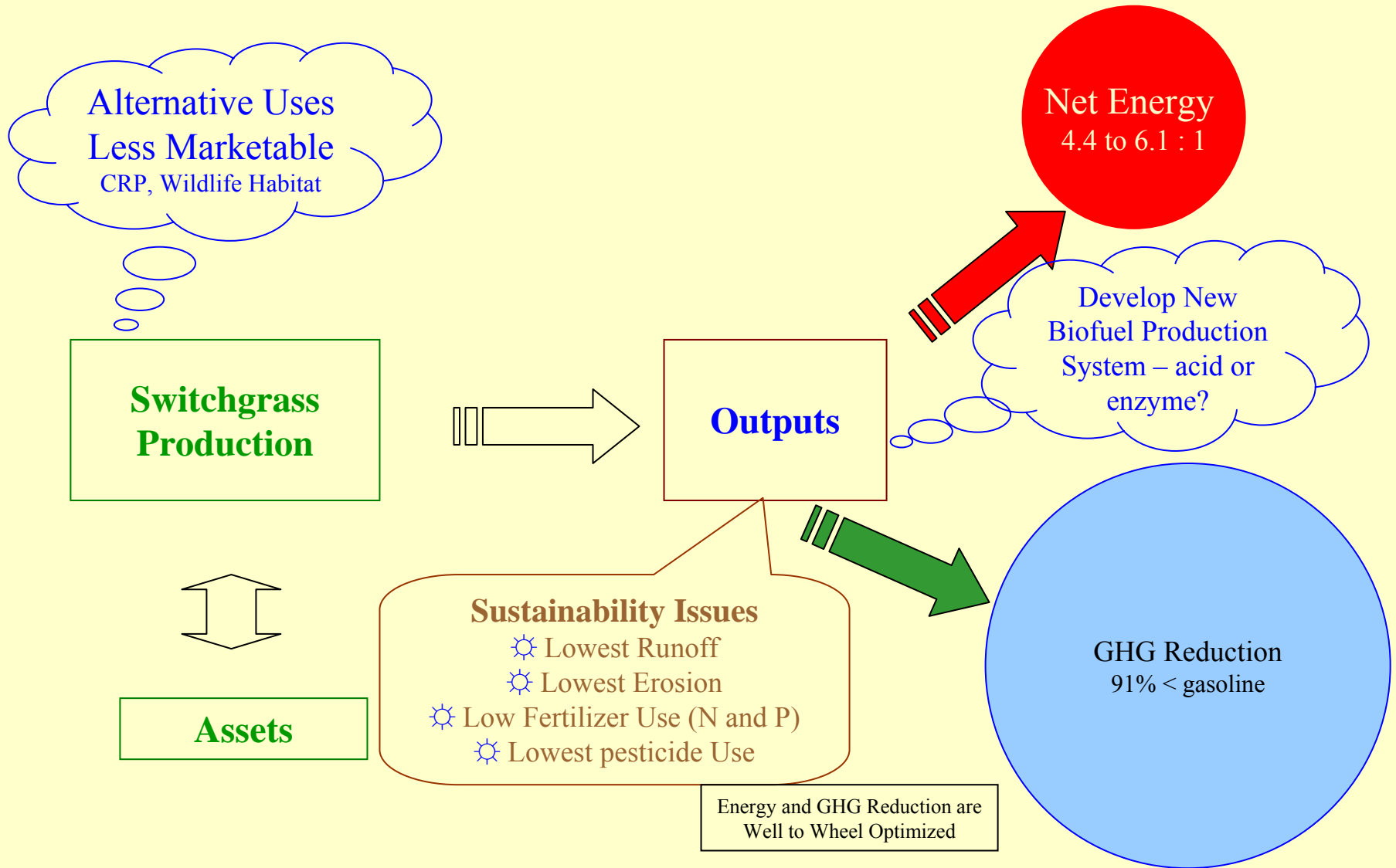
# Starch (Corn) For Ethanol – Outputs

► *low net energy; serious sustainability issues* ◀



# Cellulosic Ethanol (Switchgrass) – Outputs

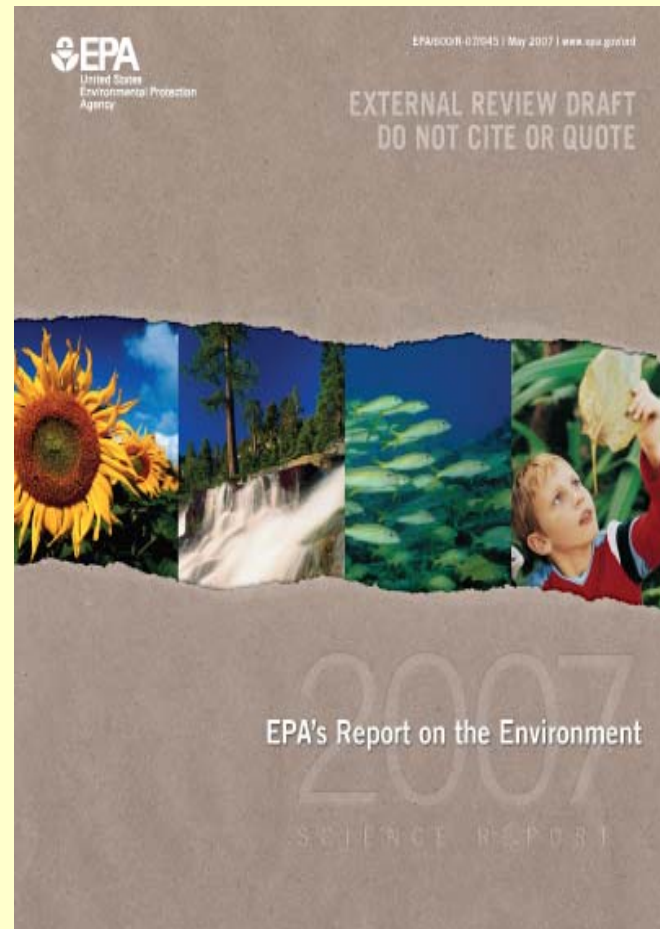
► *higher net energy; sustainability advantages; technical/financial barriers* ◀



# Developing Sustainability Indicators

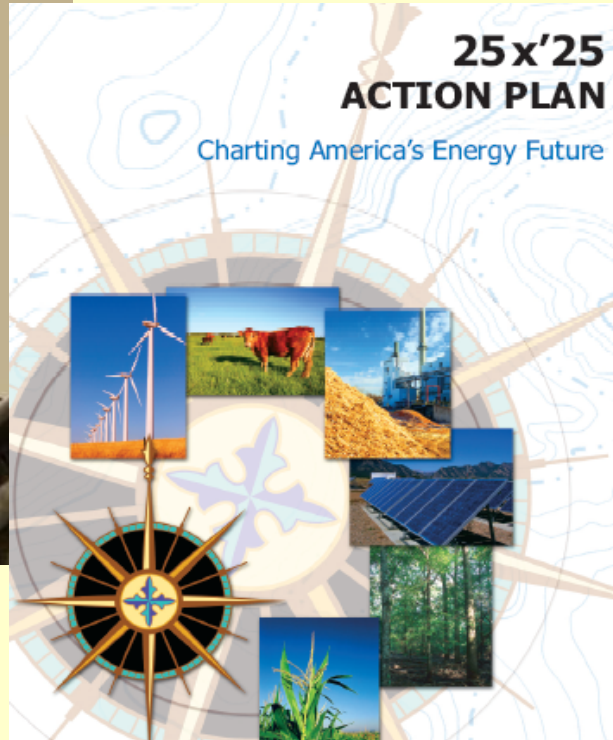
## EXAMPLES:

- Water use/gallon ethanol
- Nitrate and phosphate in watersheds
- Soil thickness
- Feedstock productivity
- Carbon flow/GHG
- Pesticide use



# Biofuels And the Bay

Getting It Right  
To Benefit Farms,  
Forests and the  
Chesapeake



Renewable energy production must conserve, enhance and protect natural resources, and be economically viable, environmental sound and socially acceptable



# Summary

- Sustainability underpins EISA
- U.S. work is underway to develop sustainability metrics
- National/International Sustainability criteria and approaches are evolving
- Best approach is to demonstrate sustainable biofuel production practices for both developed and developing countries