5th Annual Forum of the California Biomass Collaborative

Bioenergy Sustainability and Life Cycle Analysis

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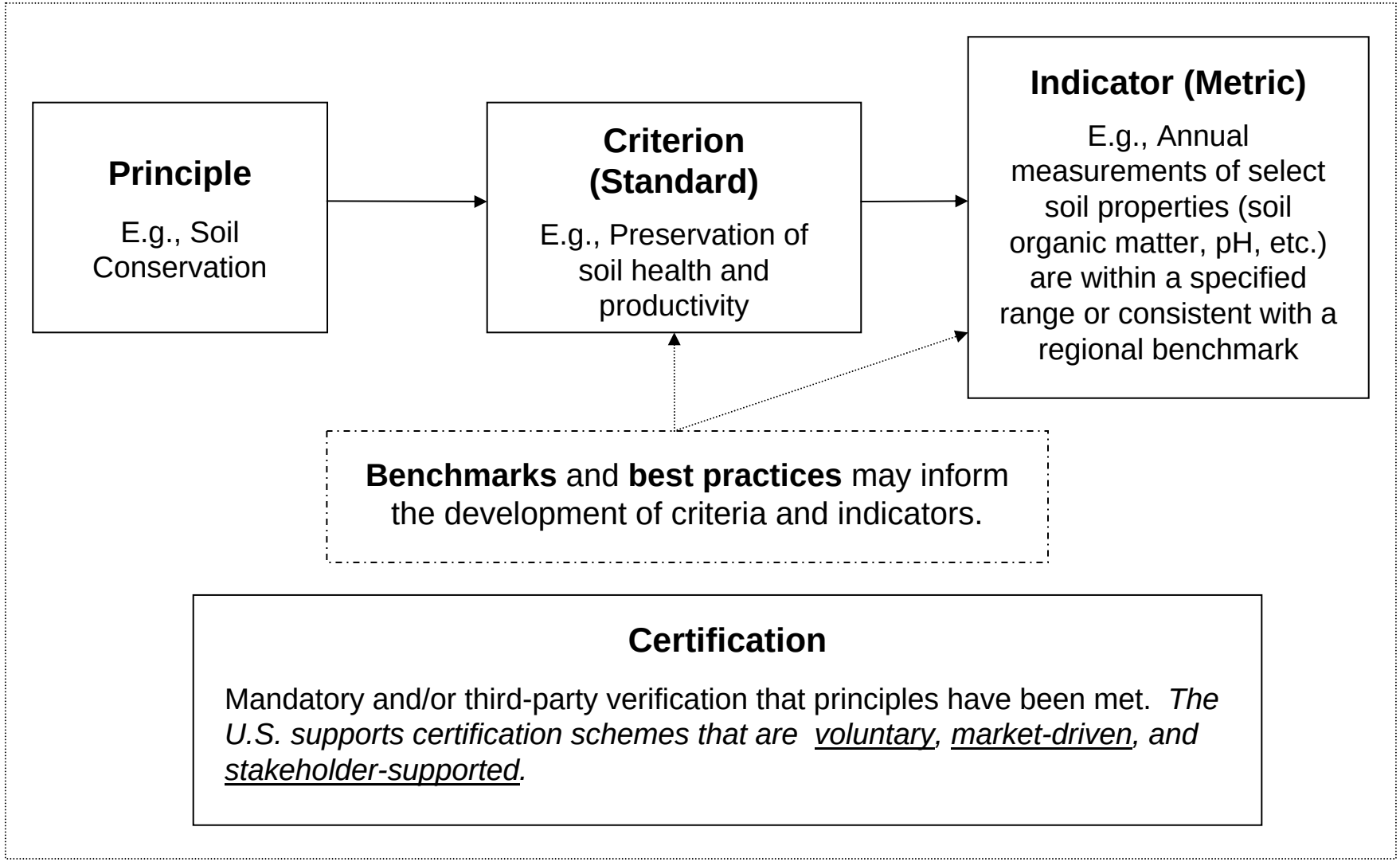
Defining Sustainability and Measuring the Environmental Impact of Biofuels

- Energy security and GHG reductions (through EISA) are major drivers of biofuels
- Need to promote the sustainable production of biofuels
- Need quantitative environmental indicators to track over time
- Hundreds of environmental, economic, and agricultural indicators available
- Need baselines against which to measure impacts
- Need to link practices to indictors

International Context

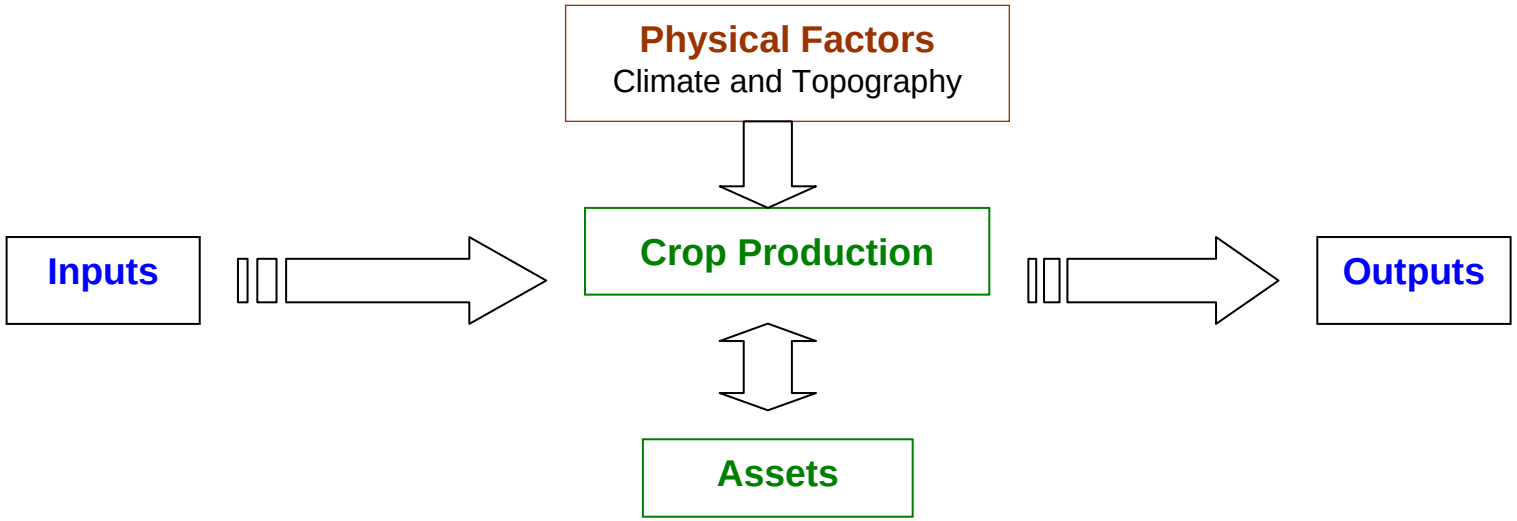
- Many countries are promoting sustainable production of biofuels and best practices, and several have developed sustainability **principals, criteria and/or indicators.**
- International debate is focusing on verification of sustainable production by mandatory and/or third-party **certification** based on criteria for sustainability.
- While most countries agree on general principles for protecting agricultural lands and ecosystems and for reducing greenhouse gas emissions, there is little consensus on measures to assess biofuel sustainability.
- While the U.S. is leading on many sustainability issues, it has not compiled a list of best practices or defined a set of sustainability principles, criteria, or indicators.

Assessing Sustainability of Biofuels



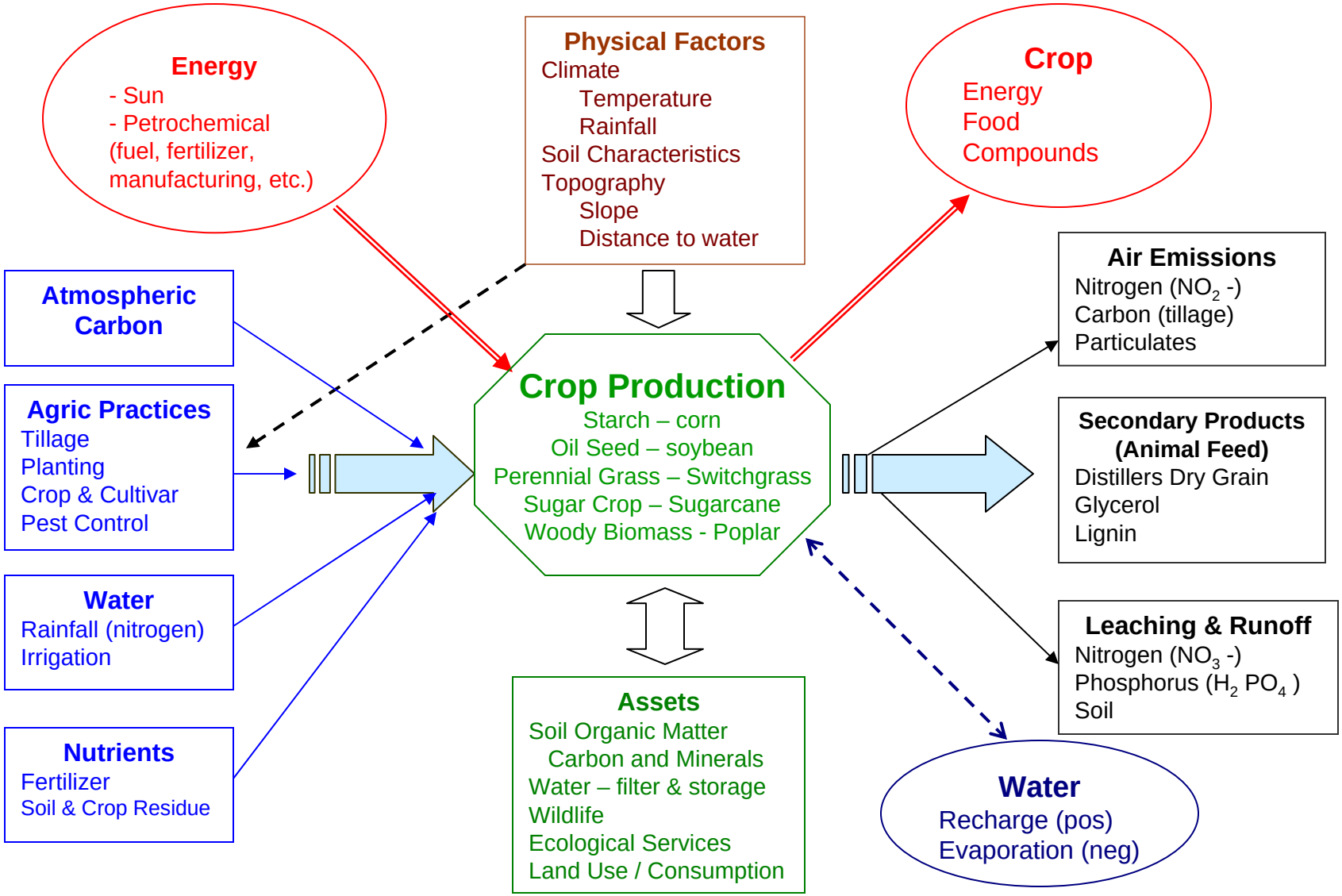
Generalized Diagram:

Crop Production



Source: Bill Chism, EPA/OPPTS

Biofuel Crop Production: Inputs and Outputs



Source: Bill Chism, EPA/OPPTS

Is the Biofuel System Sustainable?

1. Does production of feedstock for biofuel reduce the growth rate of energy consumption and enhance energy security?
2. Do bio-based products and/or co-products enhance economic growth?
3. Does increased production of feedstock for biofuel endanger U.S. and/or global food production?
4. Does production of feedstock for biofuel reduce emissions of greenhouse gas (GHG)?
5. Does increased production of feedstock for biofuel endanger ecosystems and/or biodiversity?

Is the Biofuel System Sustainable? *(Con't)*

6. Does increased production of feedstock for biofuels result in significant loss of soil, carbon, or other nutrients?
7. Do the technologies and products of the biofuel system protect the environment?
8. Do increased production and use of biofuels result in releases of water pollutants exceeding statutory limits?
9. Do increased production and use of biofuels endanger human health, including through releases of chemical pollutants that exceed statutory limits?

EPA
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Criteria for Indicators

- The indicator is useful. It answers (or makes an important contribution to answering) a question in the ROE.
- The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.
- The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.
- The underlying data are characterized by sound collection methodologies, data management systems to protect its integrity, and quality assurance procedures.
- Data are available to describe changes or trends and the latest available data are timely.
- The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

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Source: Denice Shaw, EPA/ORD

Environmental Impacts of Biofuels:

Questions, Criteria, and Indicators – *The Beginning*

Criteria *(Requirements)*	**Indicators** *(Metrics)*
1. Does production of feedstocks for biofuel reduce the growth rate of energy consumption and enhance energy security?	
The choice of technologies and processes throughout the biofuel supply chain must optimize energy efficiency; the biomass system must reduce the use of petroleum-based products.	•Amount of energy used in collection or harvesting of biomass, by MJ/ton •Amount of energy used in converting biomass to fuel, per gallon of ethanol •Amount of energy used in transport of ethanol, per gallon of ethanol •Net displacement of fossil-based energy for transportation fuels
2. Do bio-based products and/or co-products enhance economic growth?	
Biomass products must not have a net negative impact on the economy.	•Economic value of petroleum-based products •Direct value added from bio-based fuels •Industrial absorption and/or consumer acceptance of bio-based products •Quantity (by weight and/or volume) of co-products from biofuel production •Value of co-products from biofuel production

Assessing Impacts of the Biofuel System

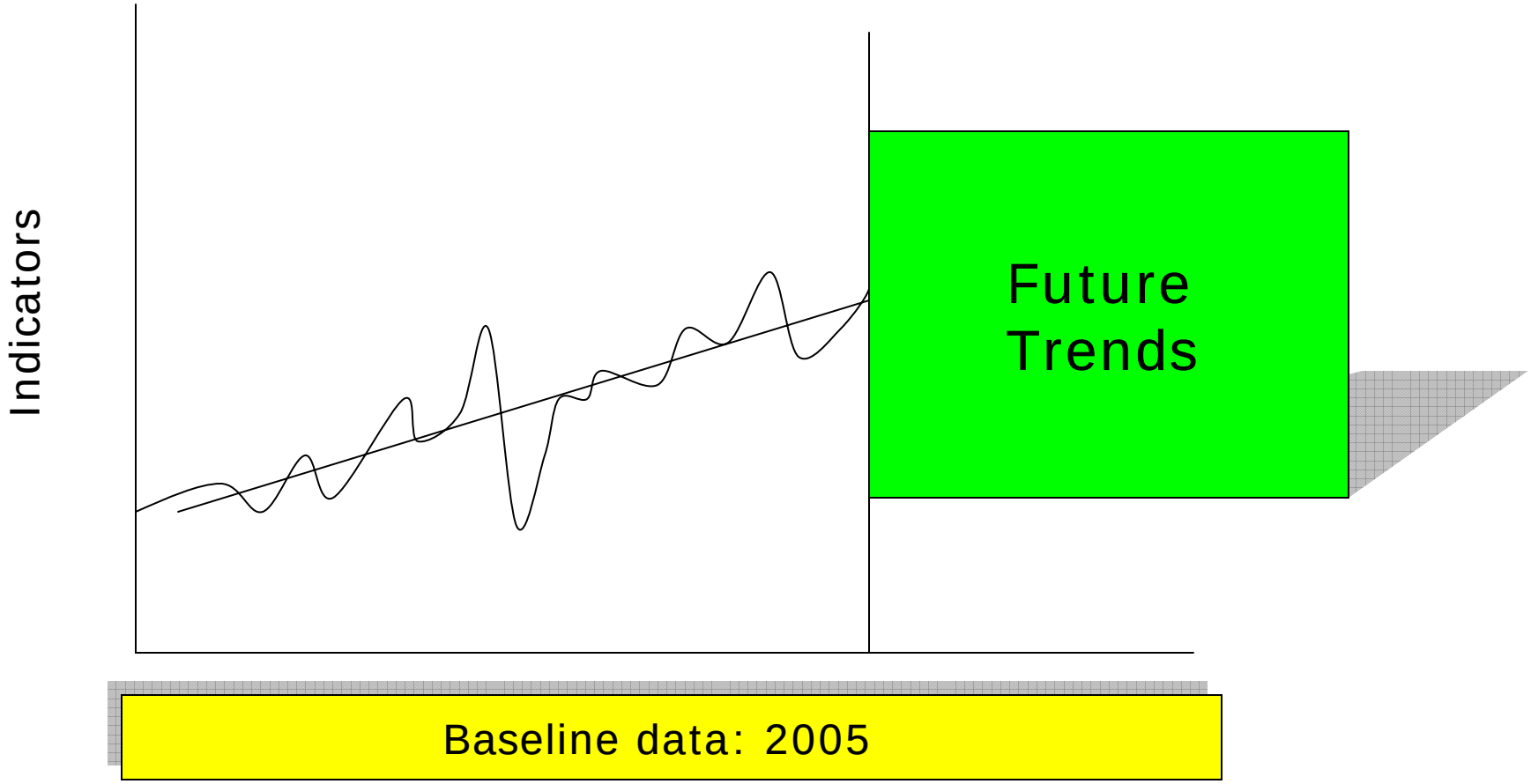
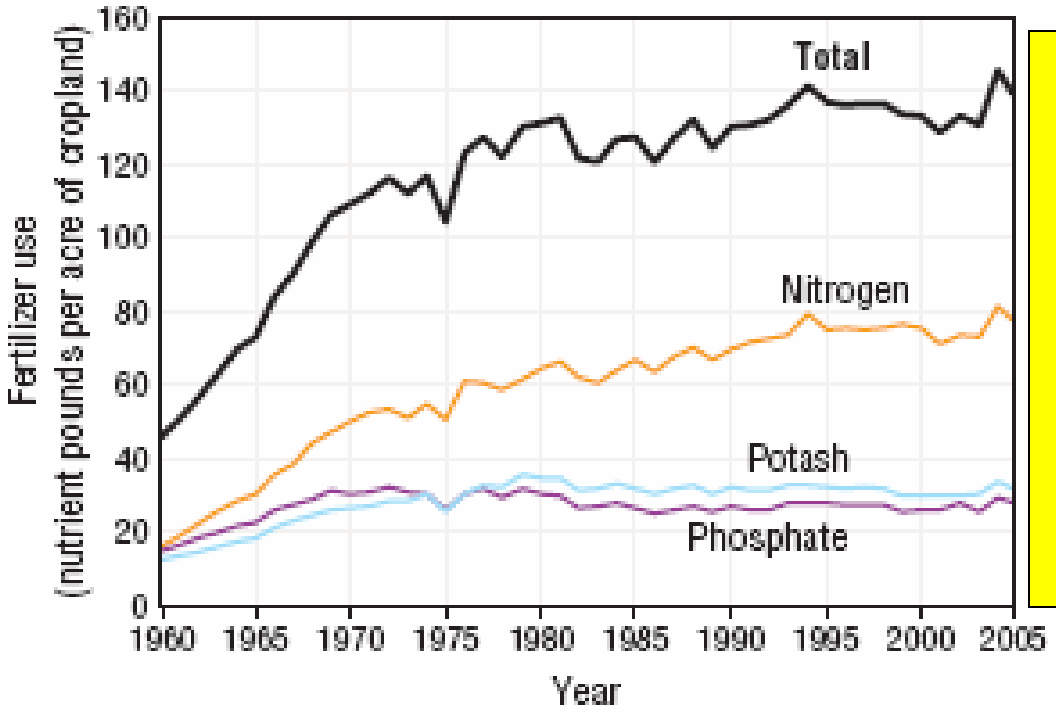


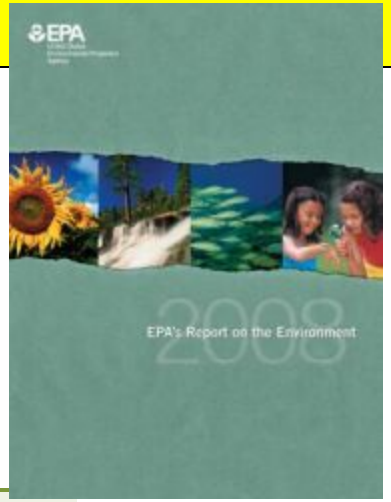
Exhibit 4-16. Commercial fertilizer use in the U.S., 1960-2005[a]



[a]Based on sales data. Per-acre use based on the acreage of harvested or failed cropland, as determined by USDA's National Agricultural Statistics Service.

Data source: *Lubowski, 2006; Wiebe and Gollehon, 2006*

Future Trends



EPA Strategic Framework

Feedstock Production → **Feedstock Logistics** → **Biofuels Production** → **Biofuels Distribution** → **Biofuels End Use**

Ag Crops

Ag Residues

Energy Crops

Forest Residues

Wastes

Harvesting & Collecting

Storage

Pre-Processing

Transportation

Fuel types

Biochemical Conversion

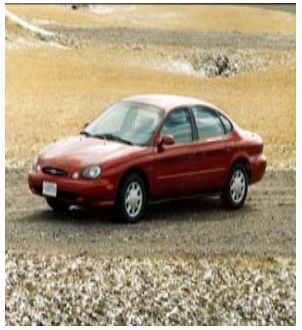
Thermochemical Conversion

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

World Projection of CO_2 Emissions, by Sector **(IEA, 2006)**