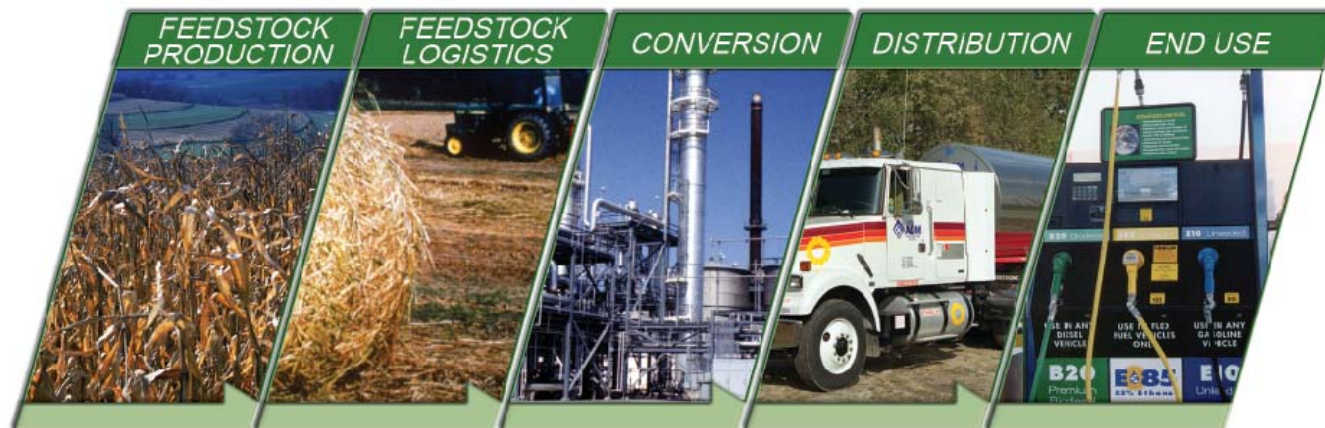
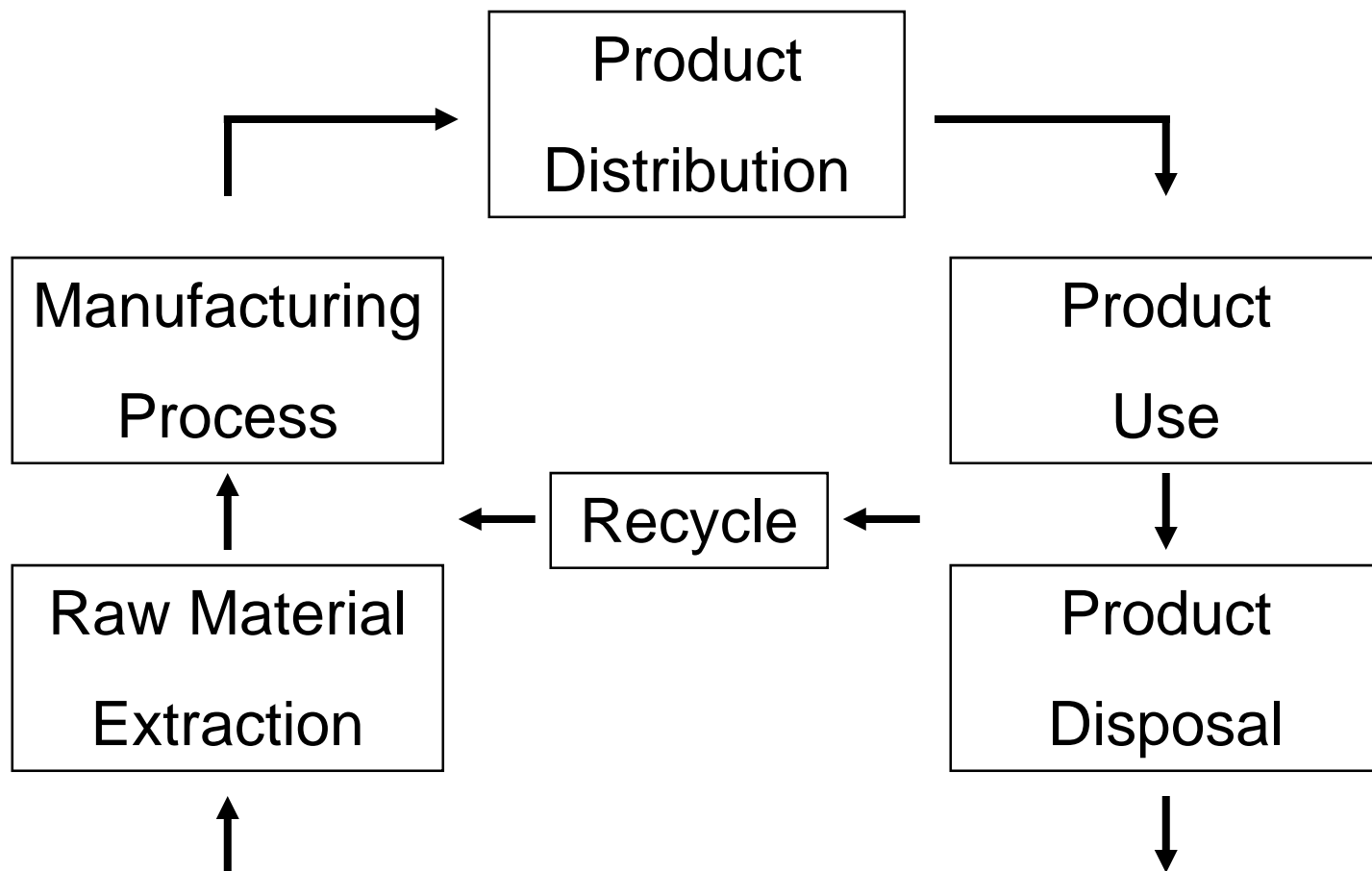


Life Cycle Assessment for Biofuels

Raymond L. Smith, PhD

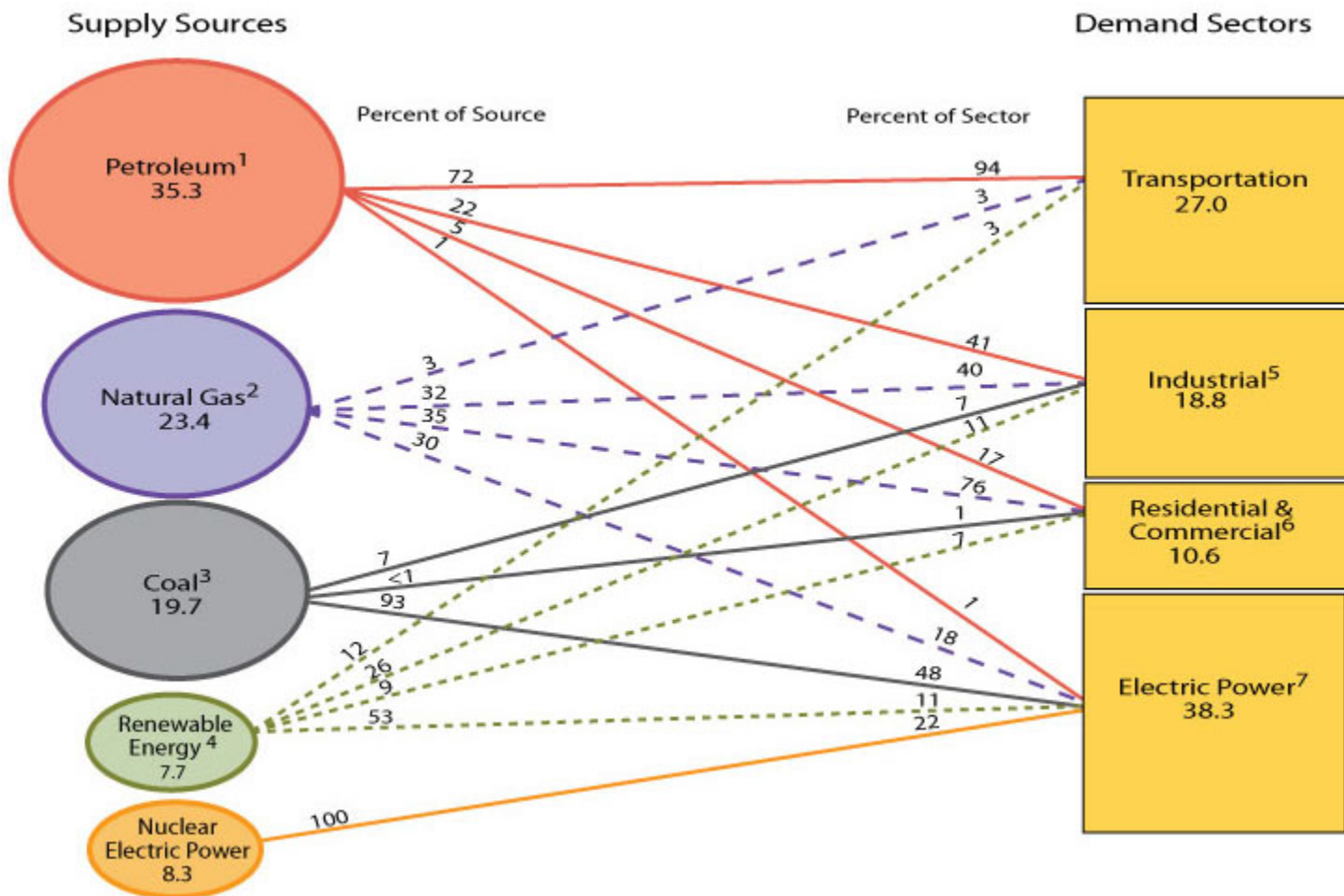


Life Cycle Assessment (LCA)



Environment (Air, Water and Land)

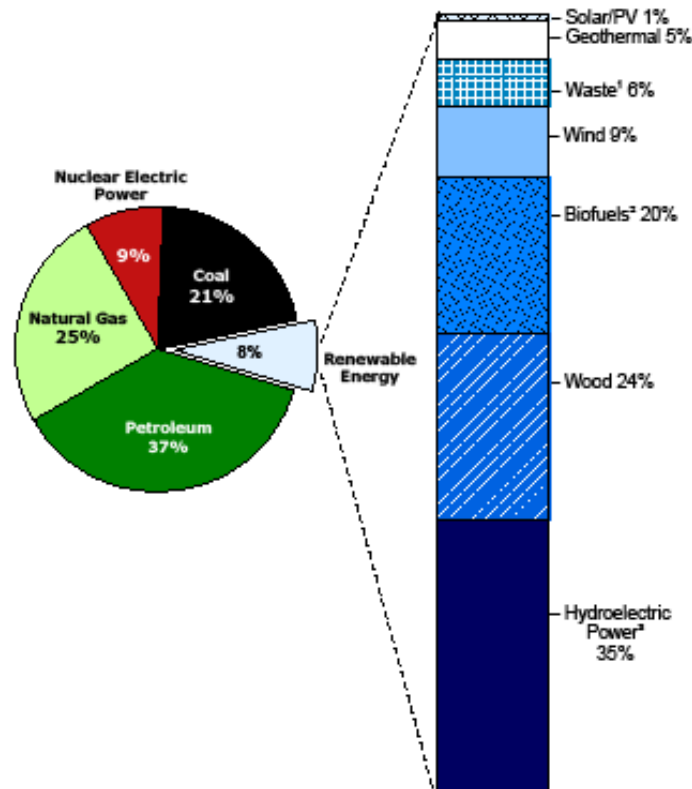
EIA Energy Overview - 2009



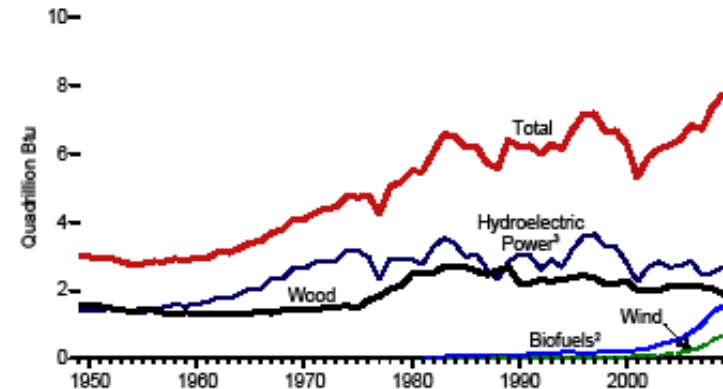
Renewable Energy Consumption

Figure 10.1 Renewable Energy Consumption by Major Source

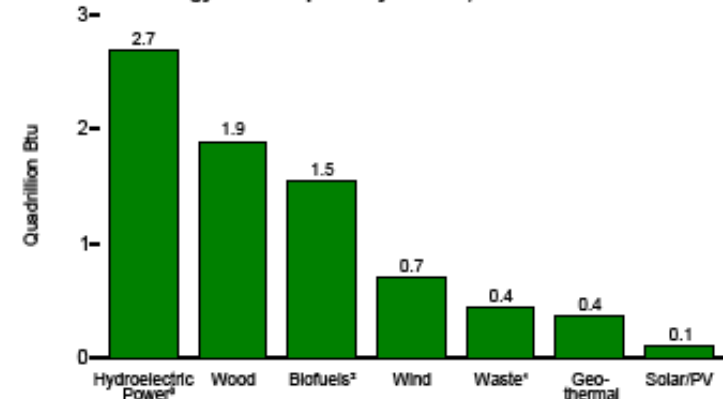
Renewable Energy as Share of Total Primary Energy Consumption, 2009



Renewable Energy Total Consumption and Major Sources, 1949-2009



Renewable Energy Consumption by Source, 2009

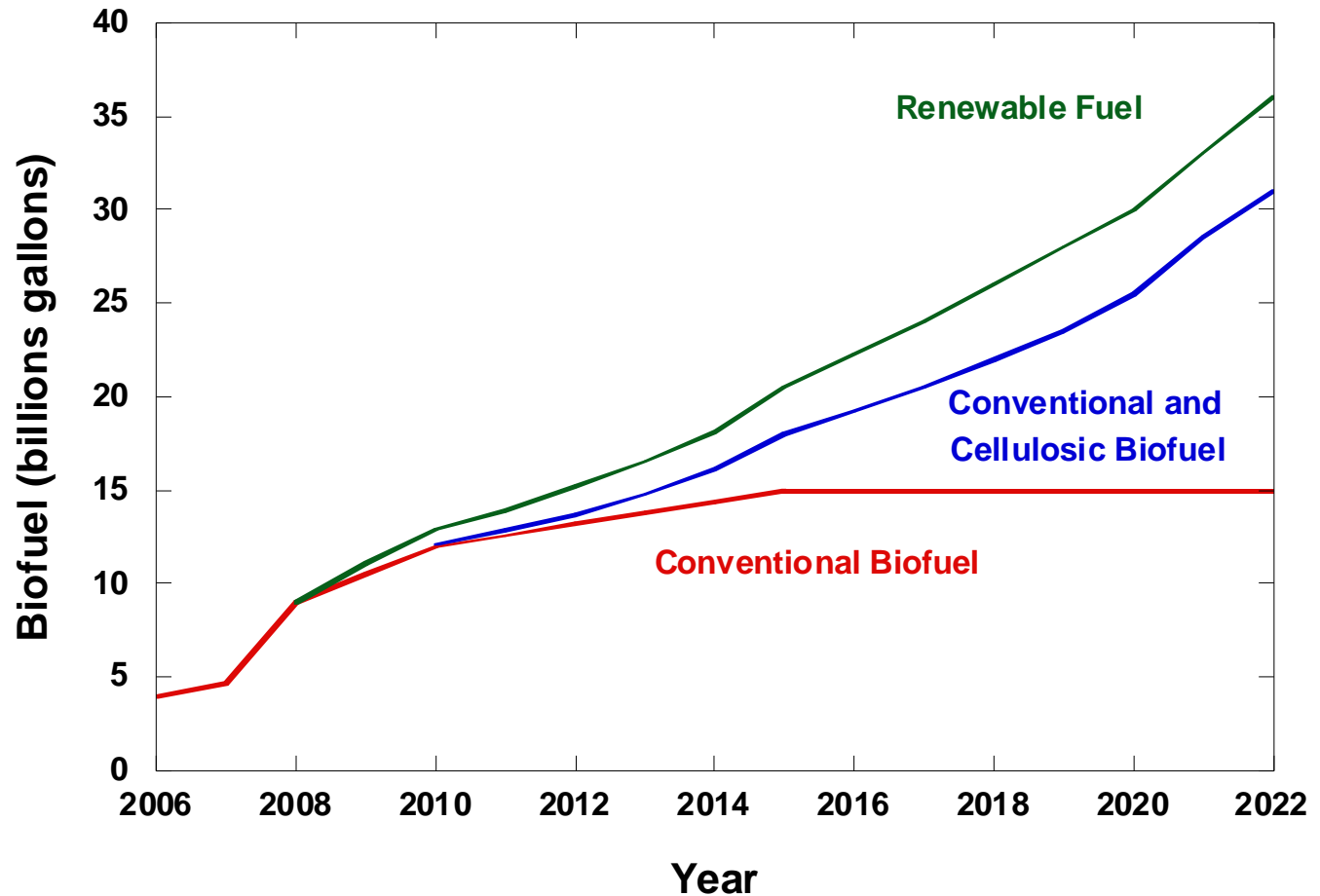


¹ Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass.

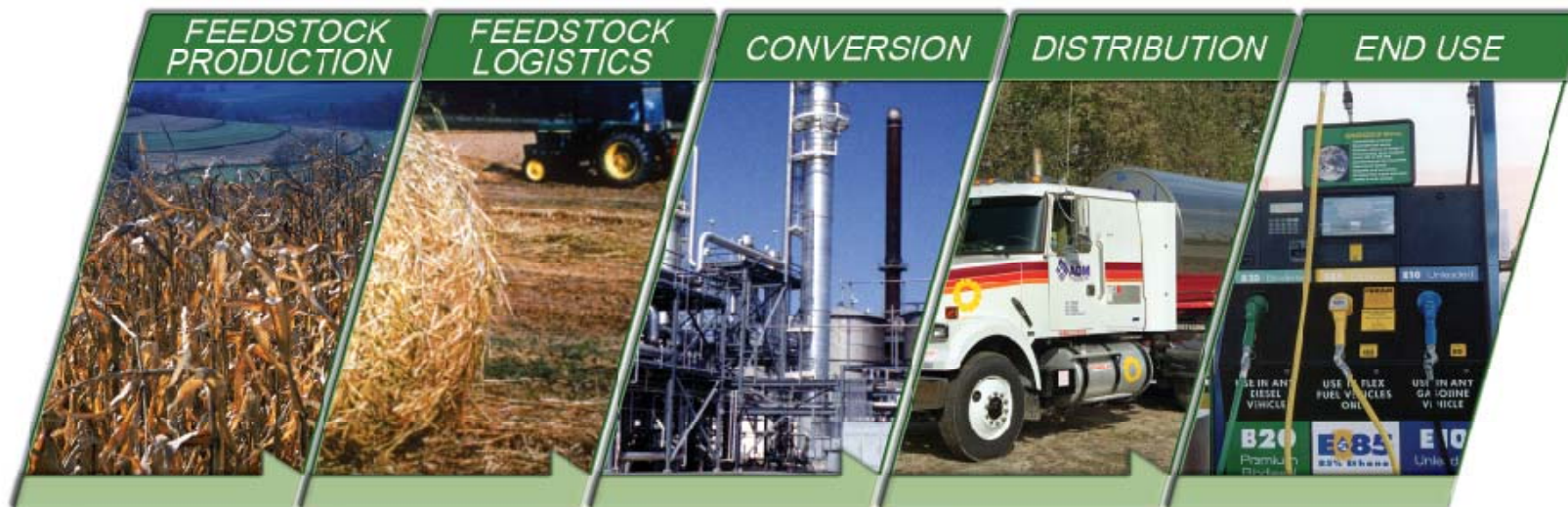
² Fuel ethanol (minus denaturant) and biodiesel consumption, plus losses and co-products from the production of fuel ethanol and biodiesel.

³ Conventional hydroelectric power.
Sources: Tables 1.3 and 10.1.

EISA Biofuel Consumption



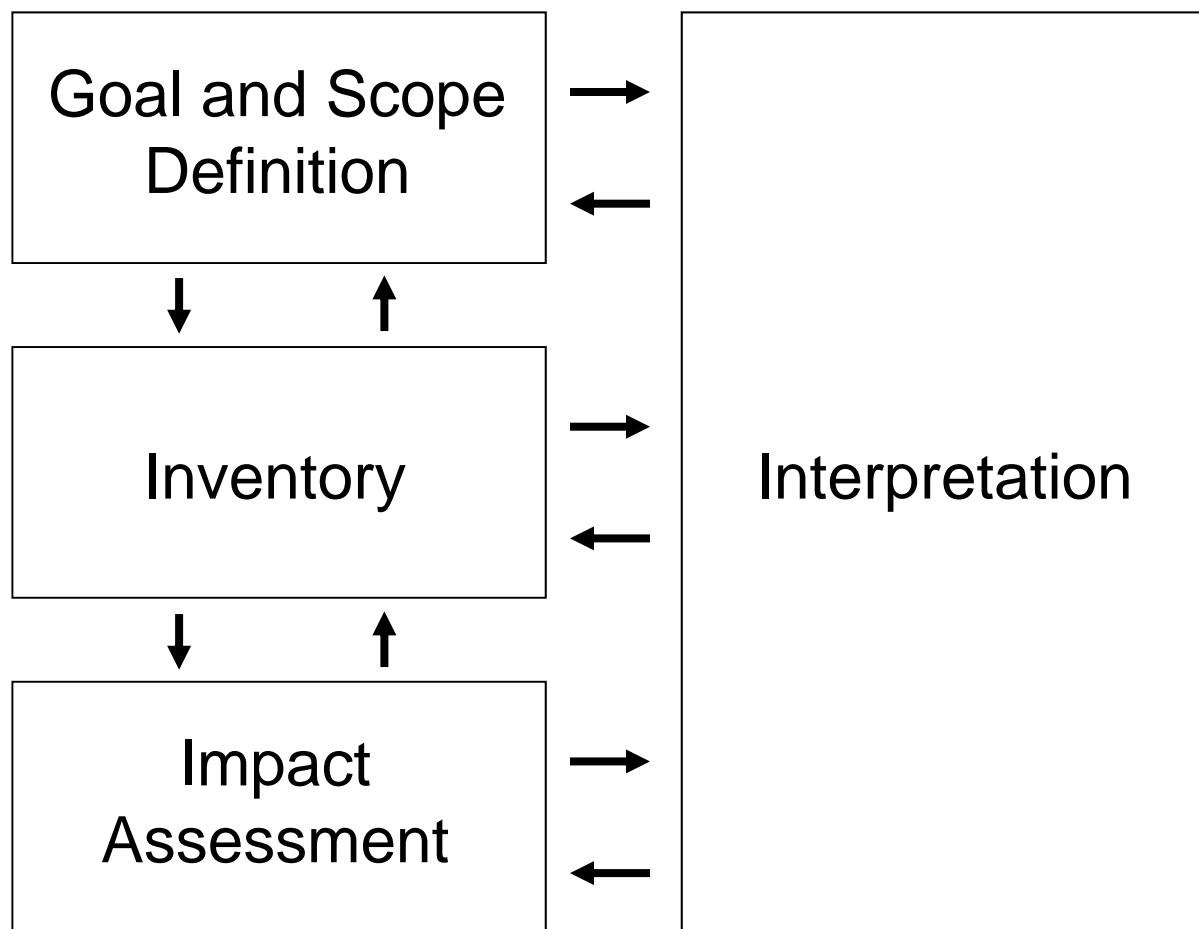
Stages of Biofuel Life Cycle



Biofuels – Some EPA Interests

- OAR has done regulatory impact analysis of the Renewable Fuel Standard, used LCA for GHGs, and reported on other releases
- OSWER created Guidance on Compatibility of UST Systems: E10+ and B20+, interests in leaks and spills
- OW issues such as ethanol extended BTEX plumes, fishkills, water quality, and water availability
- Office of Chemical Safety and Pollution Prevention interests in pesticides and other toxic substances
- Regions, e.g., R7, Environmental Laws Applicable to Construction and Operation of Biodiesel Production Facilities

Life Cycle Assessment



Goal and Scope Definition

What do we want to compare and for what purpose?

Do we want to attribute “hot spots” to certain processes or are we looking to see the consequences of a change?

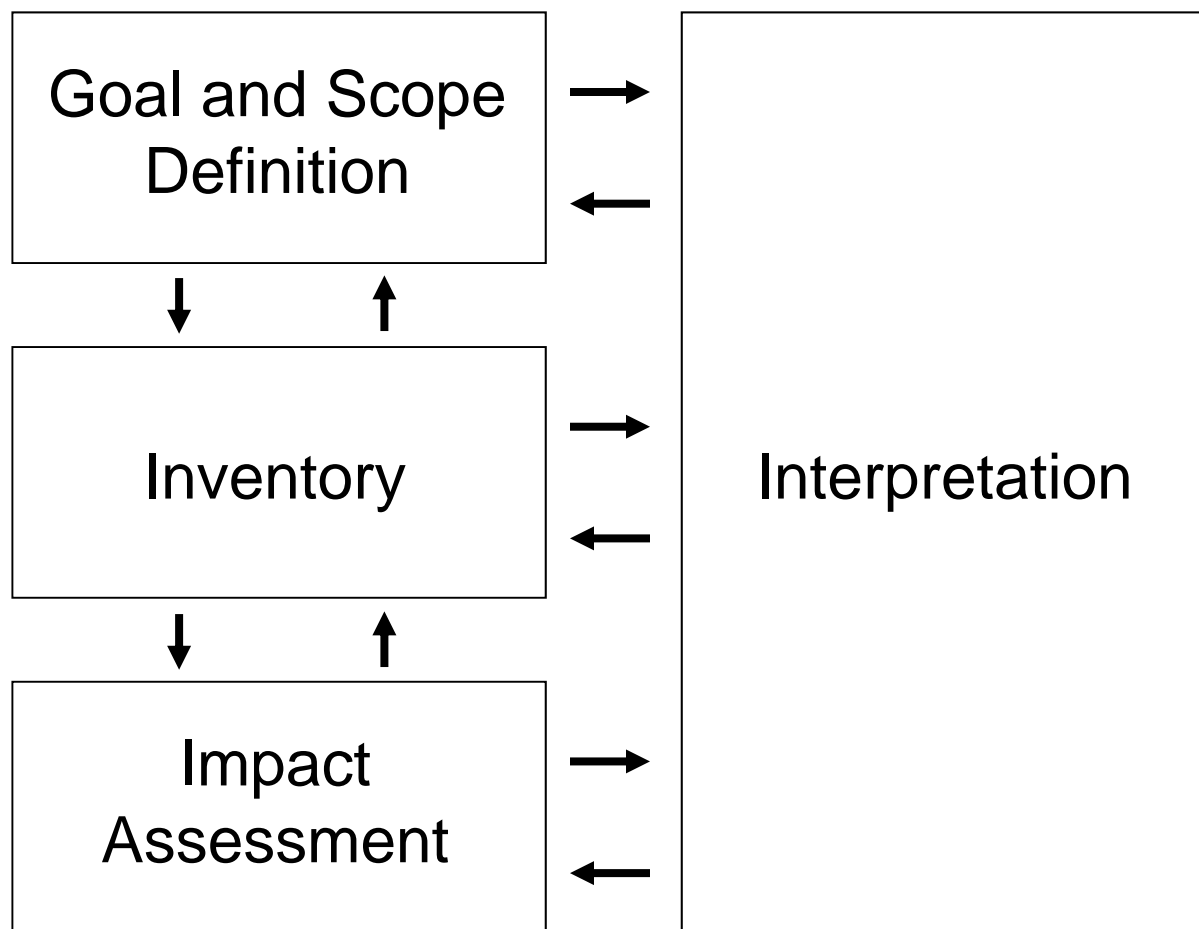
In which impact categories are we interested?

Are the available impact assessment models sufficient?

Are inventory data available or something we can estimate?

What is the equivalent “functional unit” of the study?

Life Cycle Assessment



Life Cycle Inventory



Sources: databases, reports, encyclopedias, books, journals, experts, engineering judgment

Quality: accuracy, precision, representative, completeness

Allocation: mass, energy, value, process subdivision, system expansion displacement

Inventory Allocation for Glycerin

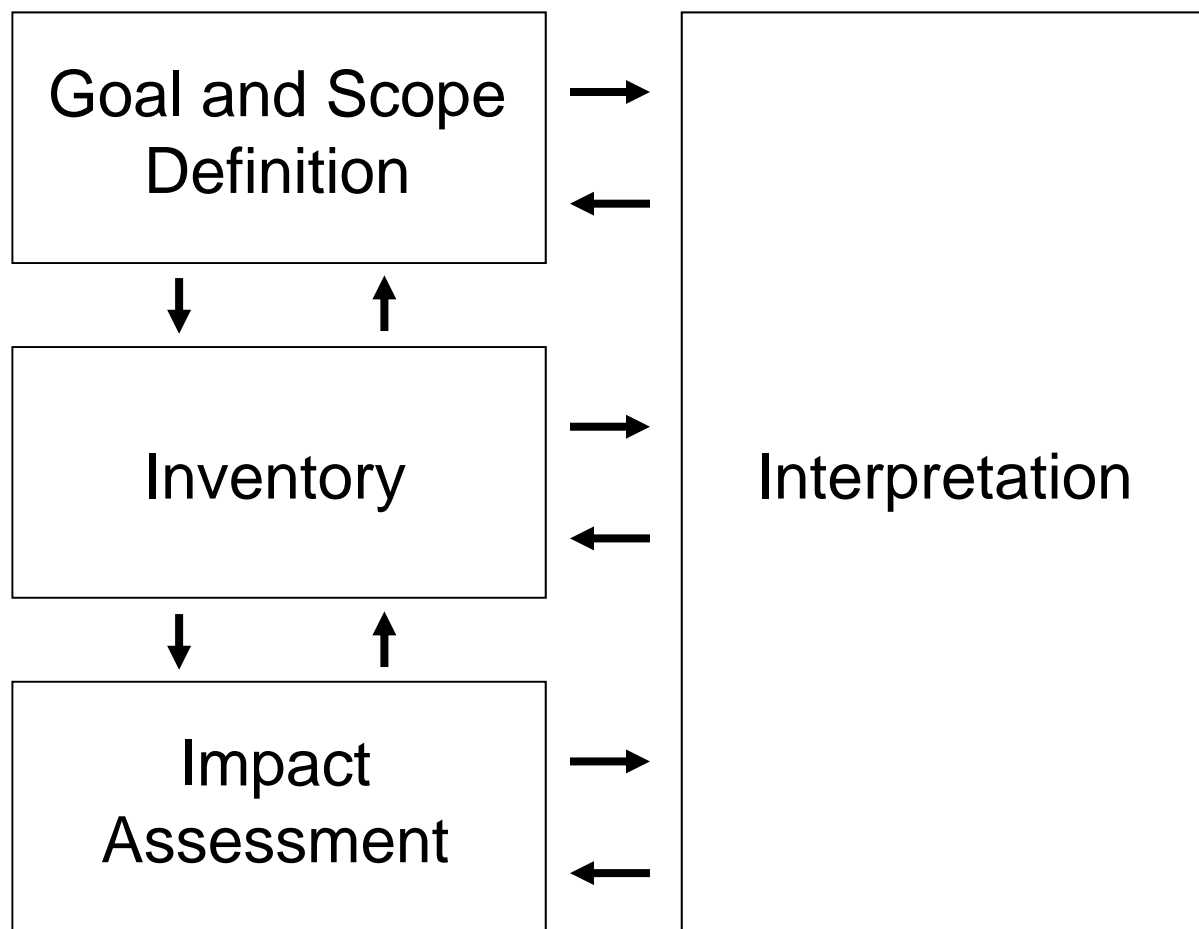
Glycerin (Glycerol) is a byproduct of biodiesel production done through transesterification.

Depending on the needed and produced amounts it is either a co-product or a waste.

In LCA a product (including a co-product) has inputs and releases allocated to it, while a waste is allocated as a release assigned to the product(s).



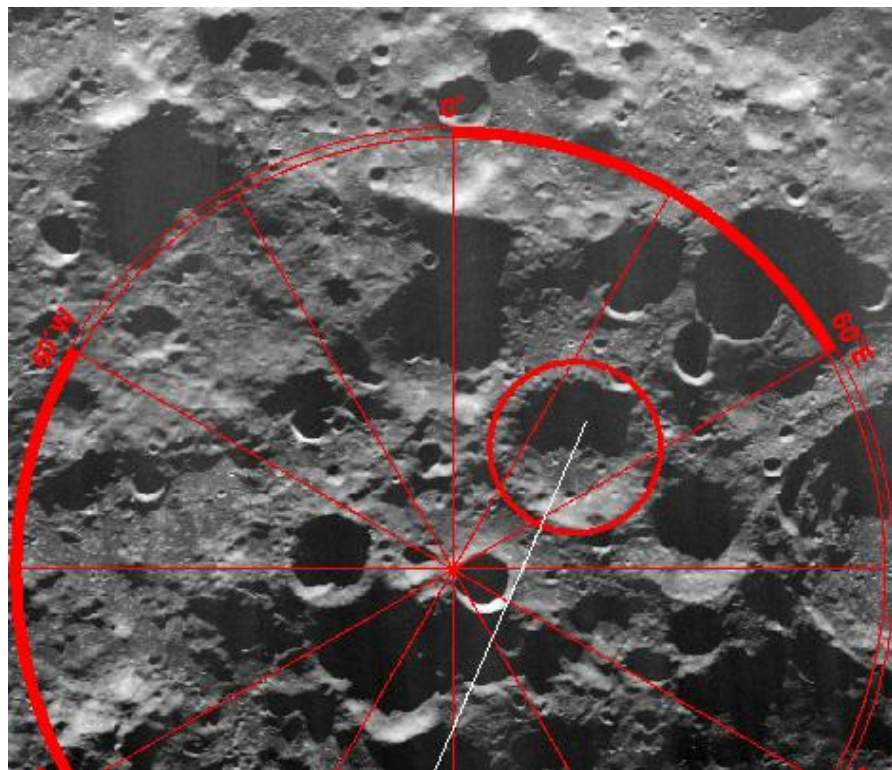
Life Cycle Assessment



Impact Assessment

Categories: global warming, ozone depletion, acidification, eutrophication, ecotoxicity, smog formation, particulate effects, (non-)carcinogen effects, resource depletion, land and water use

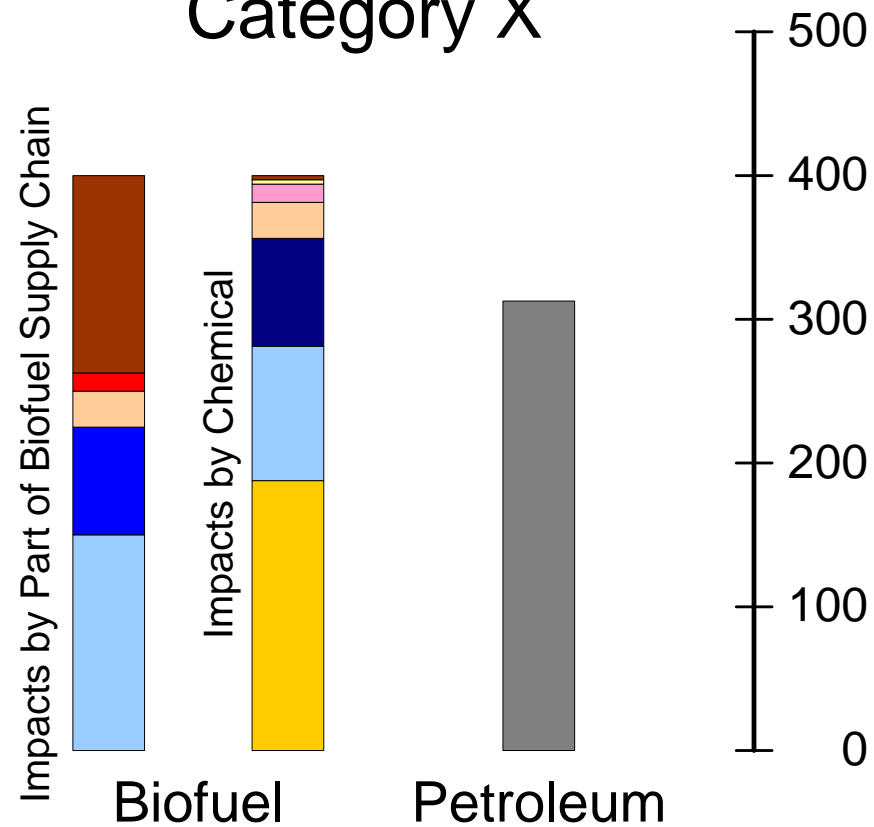
Models: midpoint vs. endpoint, fate and transport analysis, site specificity



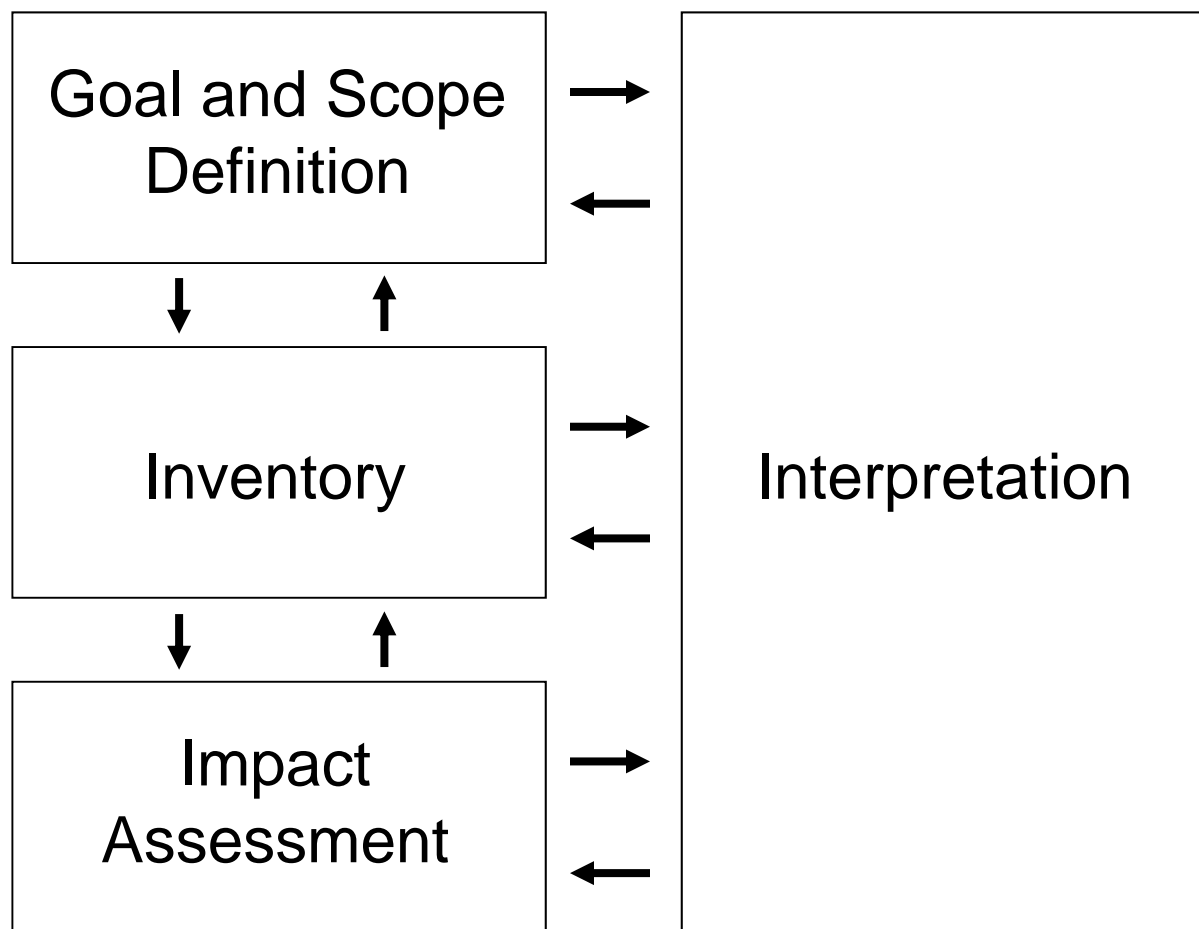
Tools: Waste Reduction (WAR) Algorithm, Tool for the Reduction and Assessment of Chemical and other environmental Impacts (TRACI)

Impact Assessment

Environmental Impacts Category X



Life Cycle Assessment



Interpretation



Questions and Discussion

Please direct questions and discussion to:

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The views expressed in this presentation are those of the author and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency.