Evaluating Life Cycle Benefits of Soybean Production

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Presented by
James W. Pollack
Co-author
Anne L. Greig
Four Elements Consulting

Omni Tech Int'l., Ltd.

- Based in Midland, Michigan
- Technical and business consulting, ISO training, auditing and LCA services
- Serving the United Soybean Board to:
  - Evaluate bio-based technologies
  - Advise bio-based product developers
  - Facilitate commercial introductions
  - Life cycle modeling of soy products

USB Life Cycle Project Objectives

- Update inventory databases for soy life cycle stages (ag through feedstocks)
- Perform LCIAs on selected feedstocks vs. petroleum counterparts
- Put updated inventories into US LCI Database for public access
- Highlight carbon, GHG & GWP impacts

Project Drivers

- Existing databases were either outdated (soy ag) or based on hypothetical models
- European and US renewable fuel standards required recent Greenhouse Gas (GHG) emission reduction life cycle data
- Allow product marketers to make claims

Key Objectives

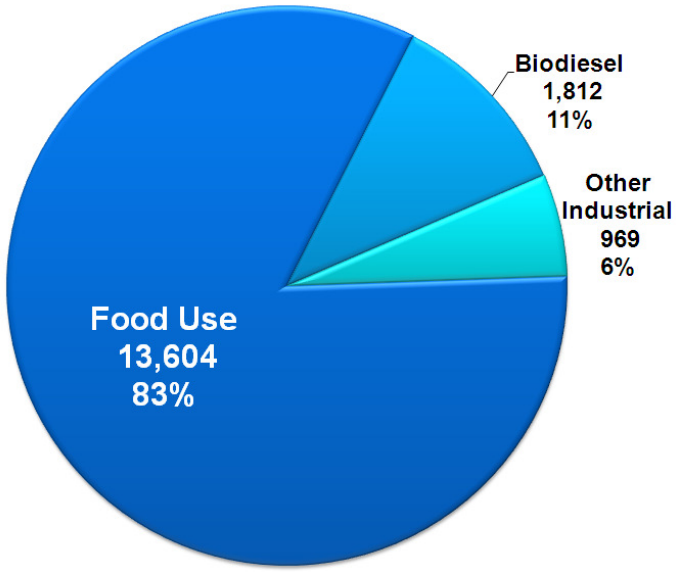
- Gather latest actual data for soy agriculture, processing and conversions
- Follow ISO 14040/44 guidelines and requirements for modeling
- Peer review methodology and results
- Share findings with interested parties

Modeled Feedstocks

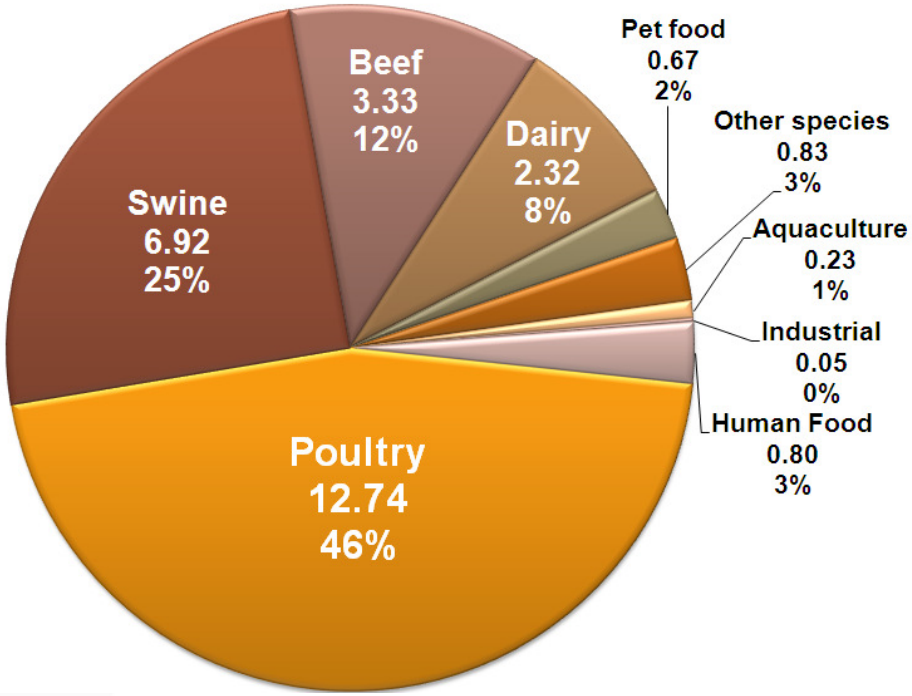
- Soybean oil
- Soy meal
- Methyl soyate (biodiesel)
- Soy polyol
- Soy resin
- Soy lube base stock
- Competitive petroleum feedstocks

2009 Domestic Soybean Market

Oil
(16.4 billion lbs)

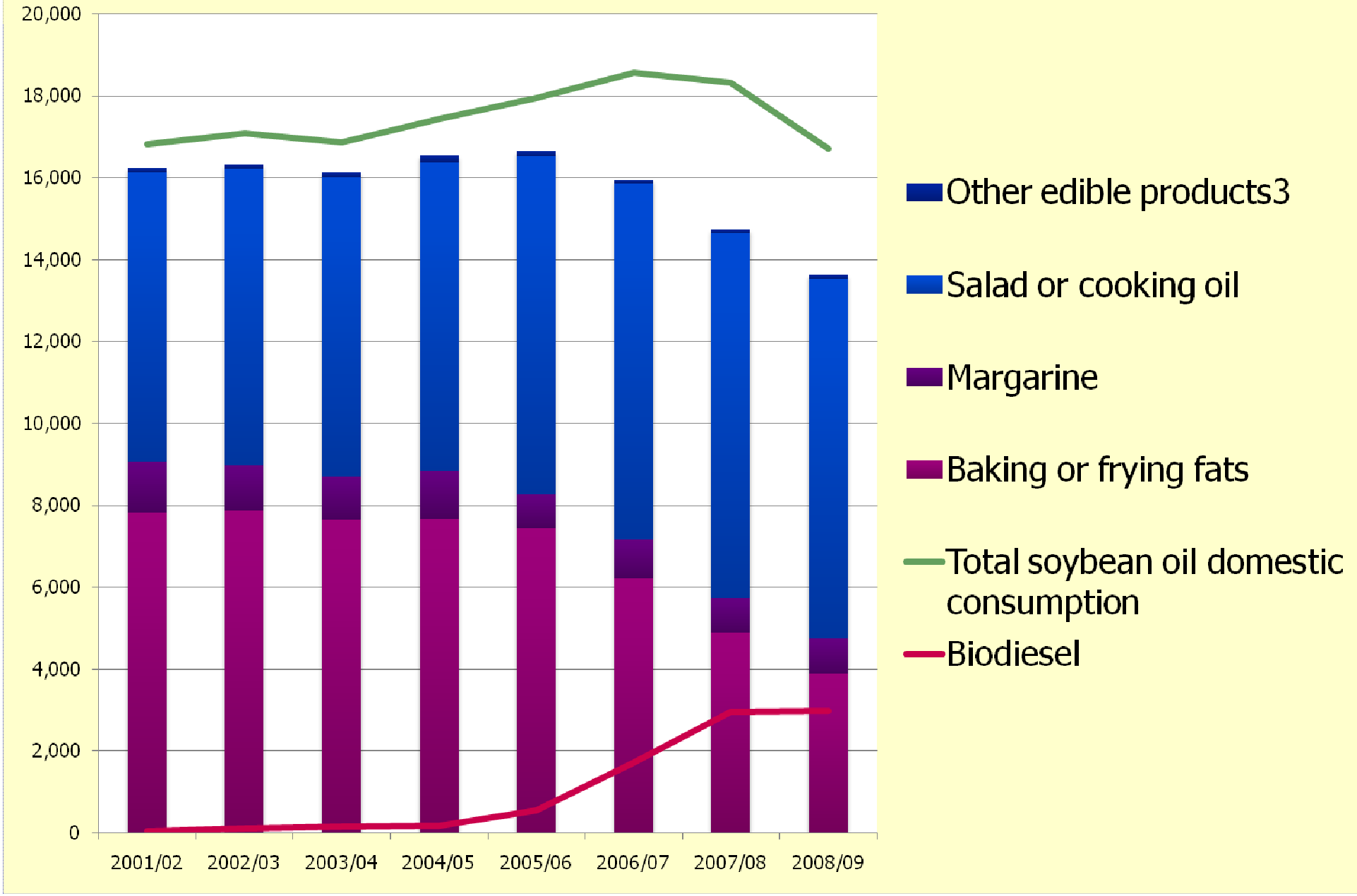


Meal
(27.89 million metric tons)

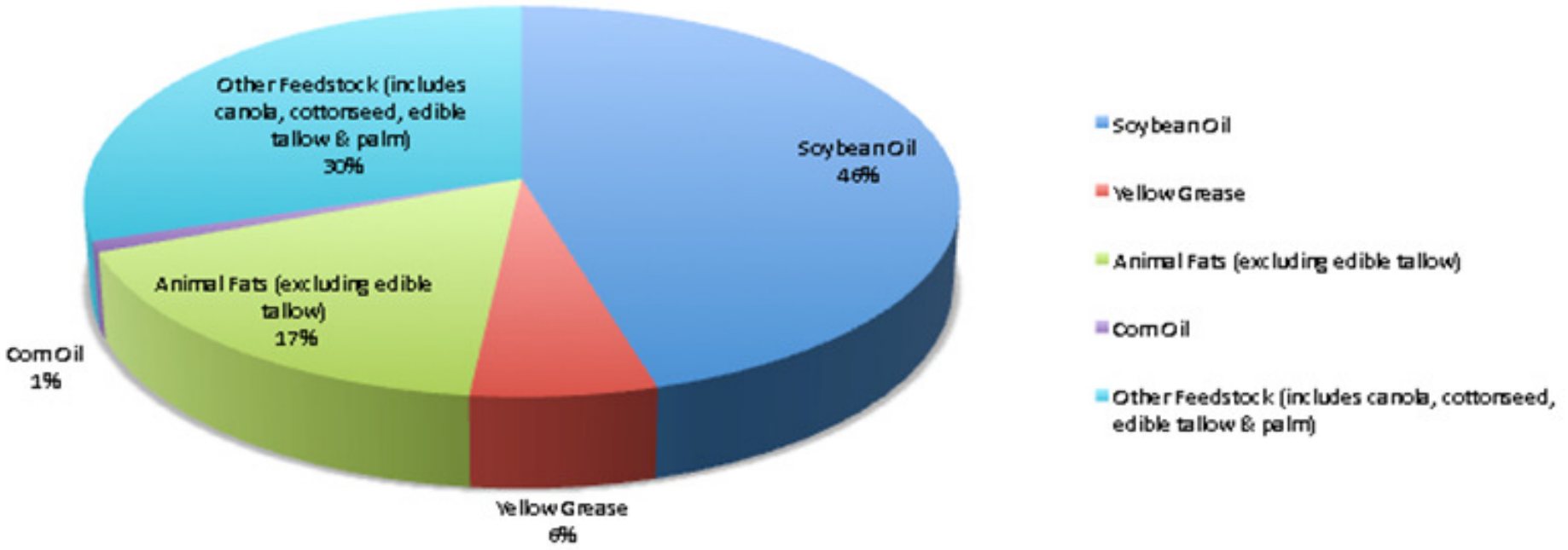


Our soybean checkoff.
Effective. Efficient. Farmer-Driven.

Soybean Oil Use in the US

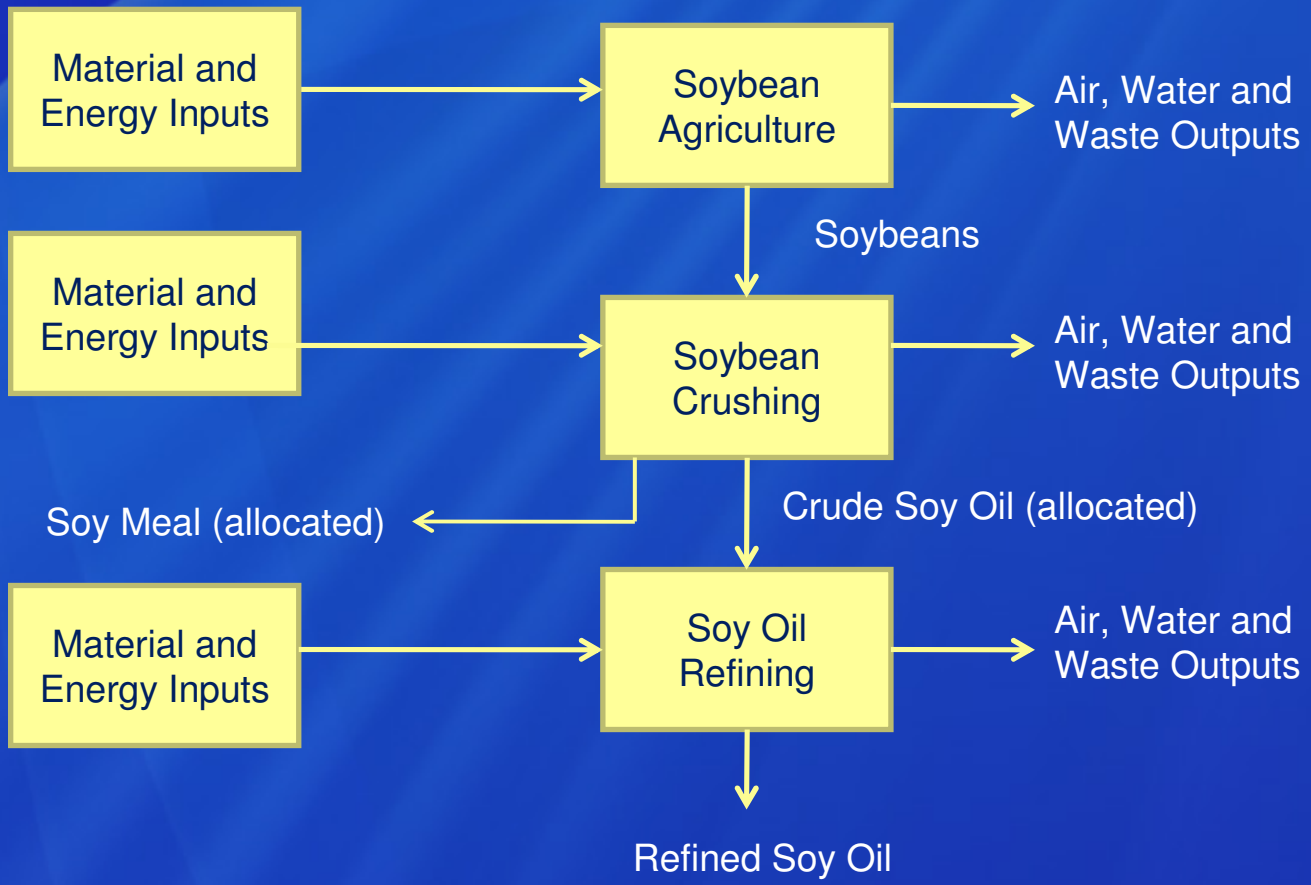


Feedstock Used in Biodiesel Production (Jan 09 to Dec 09)



Source: Estimated from U.S. Census M311K Reporting

Soybean Oil & Meal System Boundaries



Data Sources

- US Department of Agriculture
  - Agricultural Research Service
  - National Agricultural Statistics Service
- National Oilseed Processors Association
- Soy feedstock producers
- Petroleum feedstock producers
- US LCI Database, EcoInvent, SimaPro

Key Data Changes

- Increased soy ag yields – 12%
  (1998-2000 to 2004-2007)
- 20% less fuel to cultivate crop
- Less toxic herbicide applications
- Calculated release of N_2O reduced by 85% (IPCC 2006 data)
- 45% less energy to produce oil and meal
- Water use increased to 10% of acreage

Modeling Methodology

- Mass allocation for baseline analysis
- Economic allocation not favored due to varying market conditions for oil and meal
- System expansion evaluated but results were not useful
- Energy allocation used for EC biofuel analysis

Sequestration of Carbon in Oil and Meal (Per 1,000 kg)

Product	%C	Biomass C (kg)	Biomass $CO_{2(kg)}$
Meal	48	480	1760
Oil	80.6	806	2955

These embedded carbon contents were subtracted from the GWP results

Environmental Impacts per 1000 kg. (Mass allocation)

Impact category	Unit	Refined Soybean Oil	Soy meal
Global warming potential	kg CO2 eq	-2.5 E+03	-1.3E+03
Acidification potential	milmole H+eq	1.7E+05	1.6E+06
Eutrophication potential	kg N eq	3.1E+00	3.0 E+01
Water intake	liters	5.4E+04	5.2E+04
Criteria Air Pollutants	microDALYs	4.9E+01	4.6E+01
Smog Formation potential	g NOx eq	3.0E+03	2.8E+04
Total Fuel Energy	MJ	4.2E+04	3.9E+04

Results

- Soybean oil and meal have favorable GHG and GWP impacts due to CO_2 sequestration
  - -1.3 kg CO_2 eq/kg meal
  - -2.5 kg CO_2 eq/kg oil
- Environmental profile improved changes in agricultural practices and less energy needed for processing

Discussion

- Soybean life cycle profile shows favorable trends due to:
  - More conservation tillage
  - Reduced energy
  - Higher yields – 40% in 10 years
- Soybeans can provide a balance of both food and biobased products based on current projections

Future Actions

- Support USB Sustainability initiatives
- Continue to gather latest data on cultivation and processing
- Work with stakeholders to enhance best management practices
- Communicate findings

To Obtain More Information

www.soybiobased.org/sustainability

"New Life Cycle Profile Shows U.S. Soy Delivers Environmental & Energy Benefits"

www.usbthinking ahead.com food product information

www.soynewuses.org for product guide

jpollack@omnitechintl.com