

Land Use Change and GHG Emissions:

Panel Discussion on Major Models

FAPRI-CARD Model



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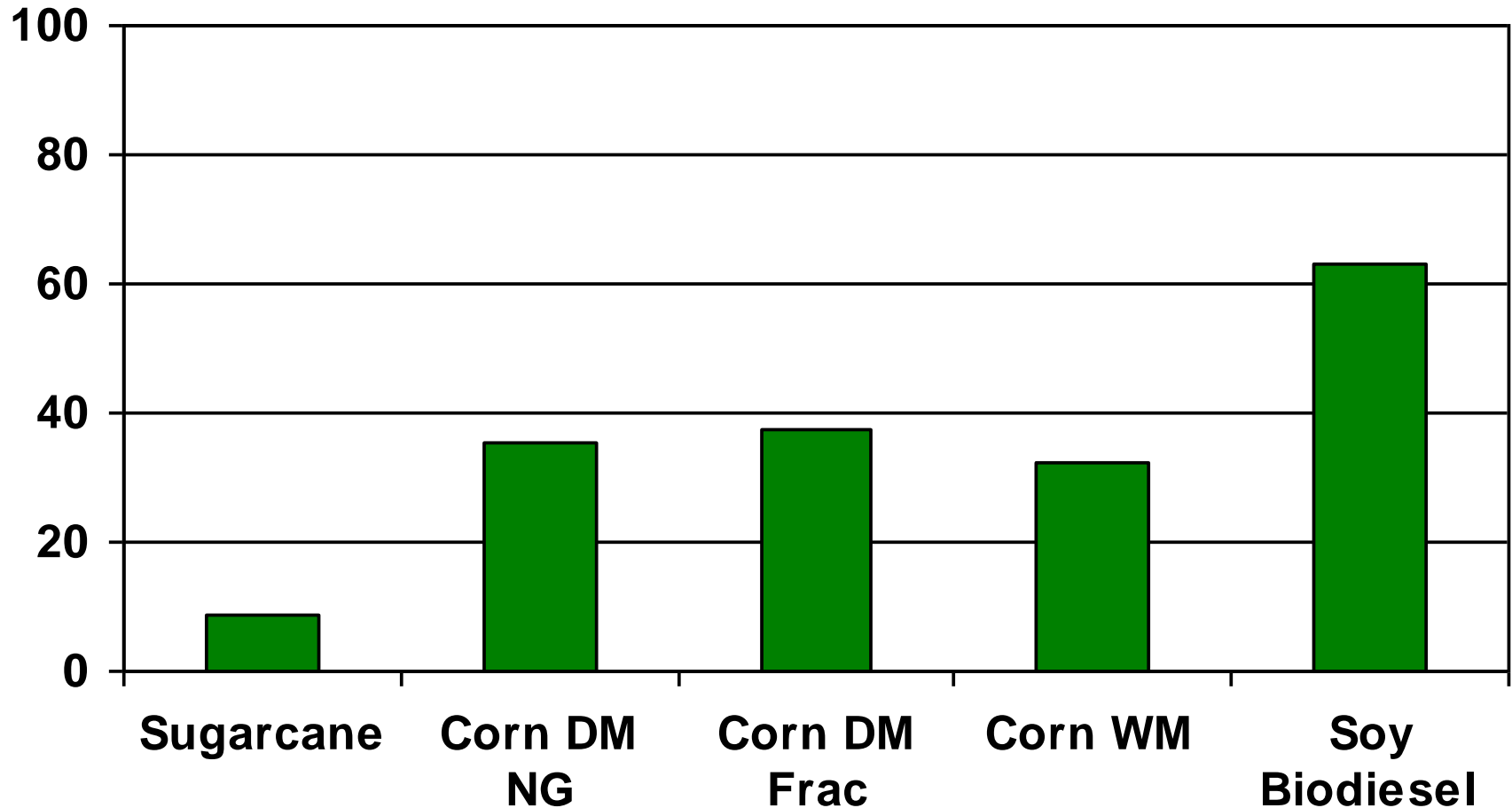
IOWA STATE UNIVERSITY

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Policy Research Institute

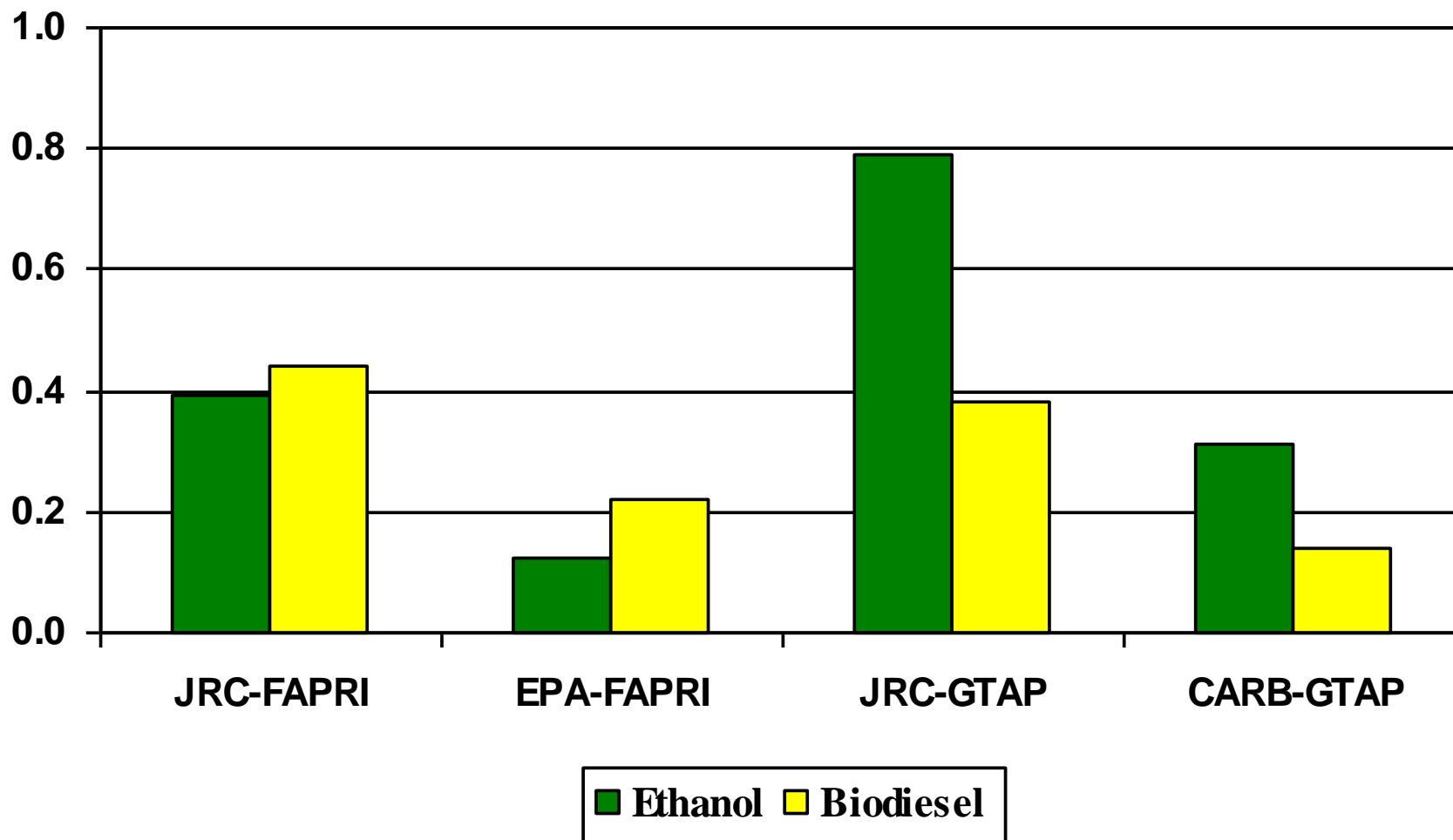
Share of LUC in Increase in Emissions

Percent



LUC for Biofuel

Ha/toe



Issues in LUC Modeling Developments

■ Trend yield estimates

■ Intensification

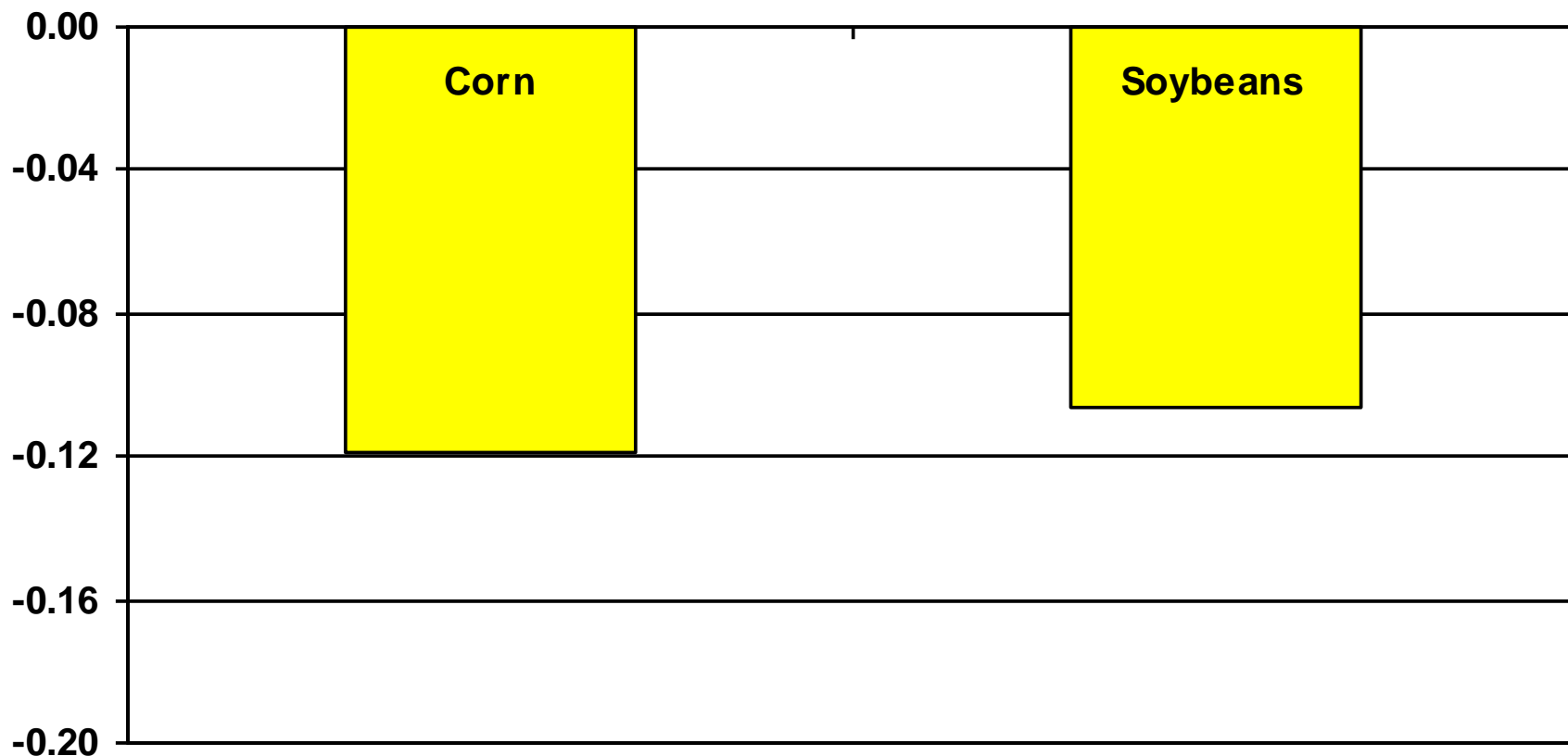
- Second crop
- Livestock stocking rate

■ Co-products

- Feed efficiency gains
- Fractionation
- Displacements

Sensitivity of LUC to Trend Yield

Percent

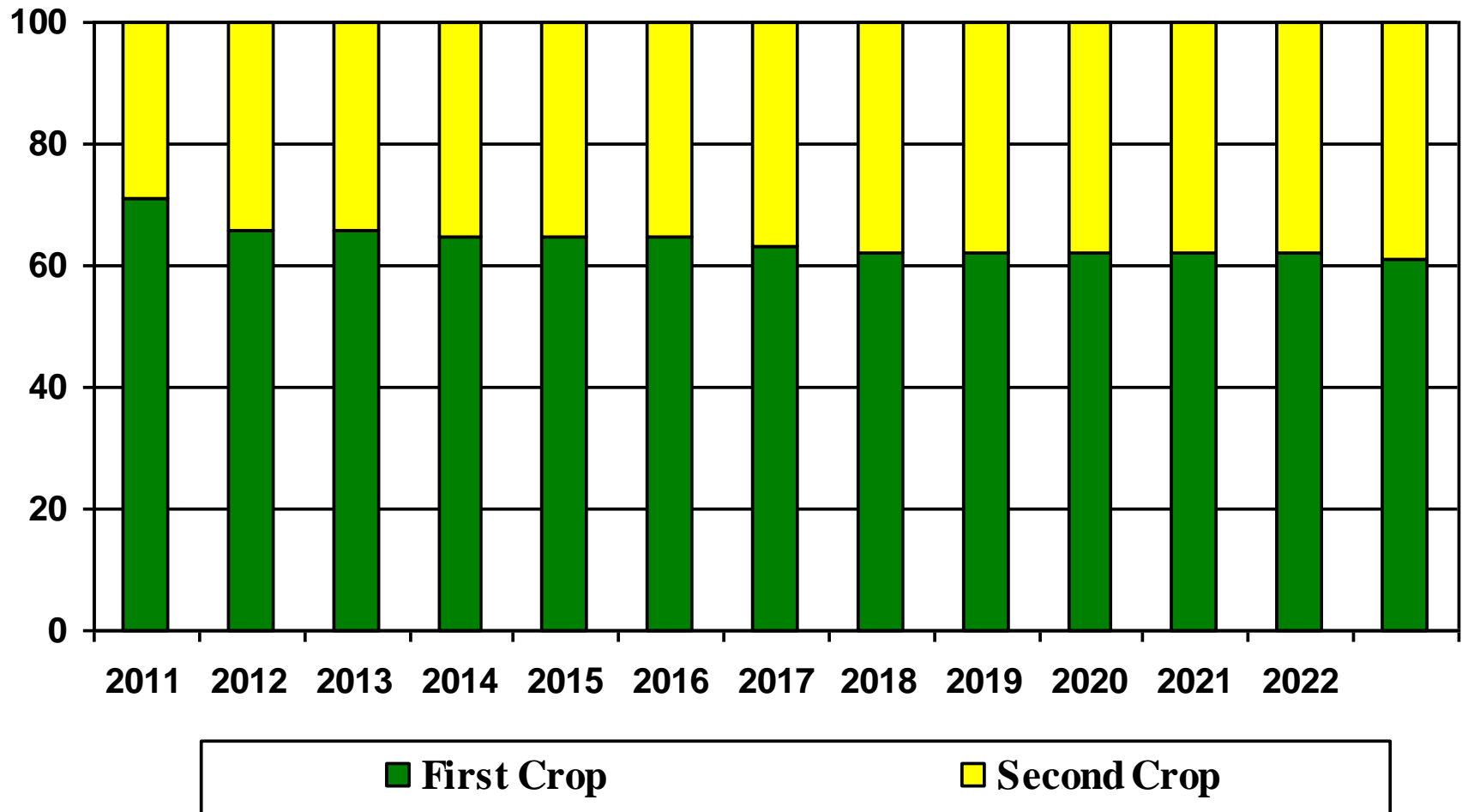


Trend Yield and LUC

Country	1960-1975	1976-1991	1992-2008
	metric ton per year		
Argentina	0.052	0.035	0.194
Brazil	0.017	0.035	0.090
China	0.081	0.130	0.039
India	0.007	0.030	0.036
Mexico	0.013	0.057	0.060
United States	0.125	0.084	0.144

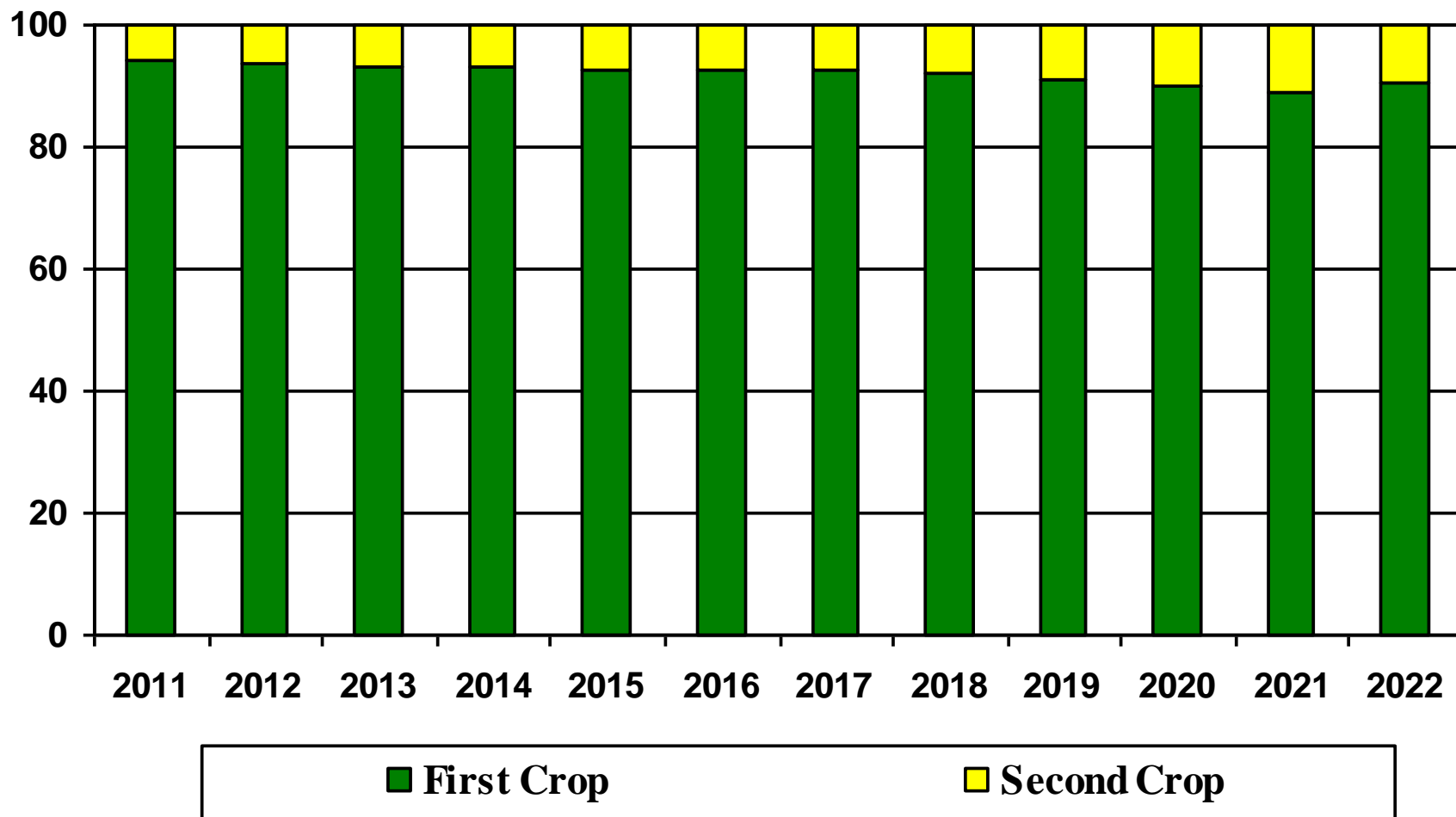
Second Crop and LUC – Brazil Corn

Percent



Second Crop and LUC – U.S. Wheat

Percent

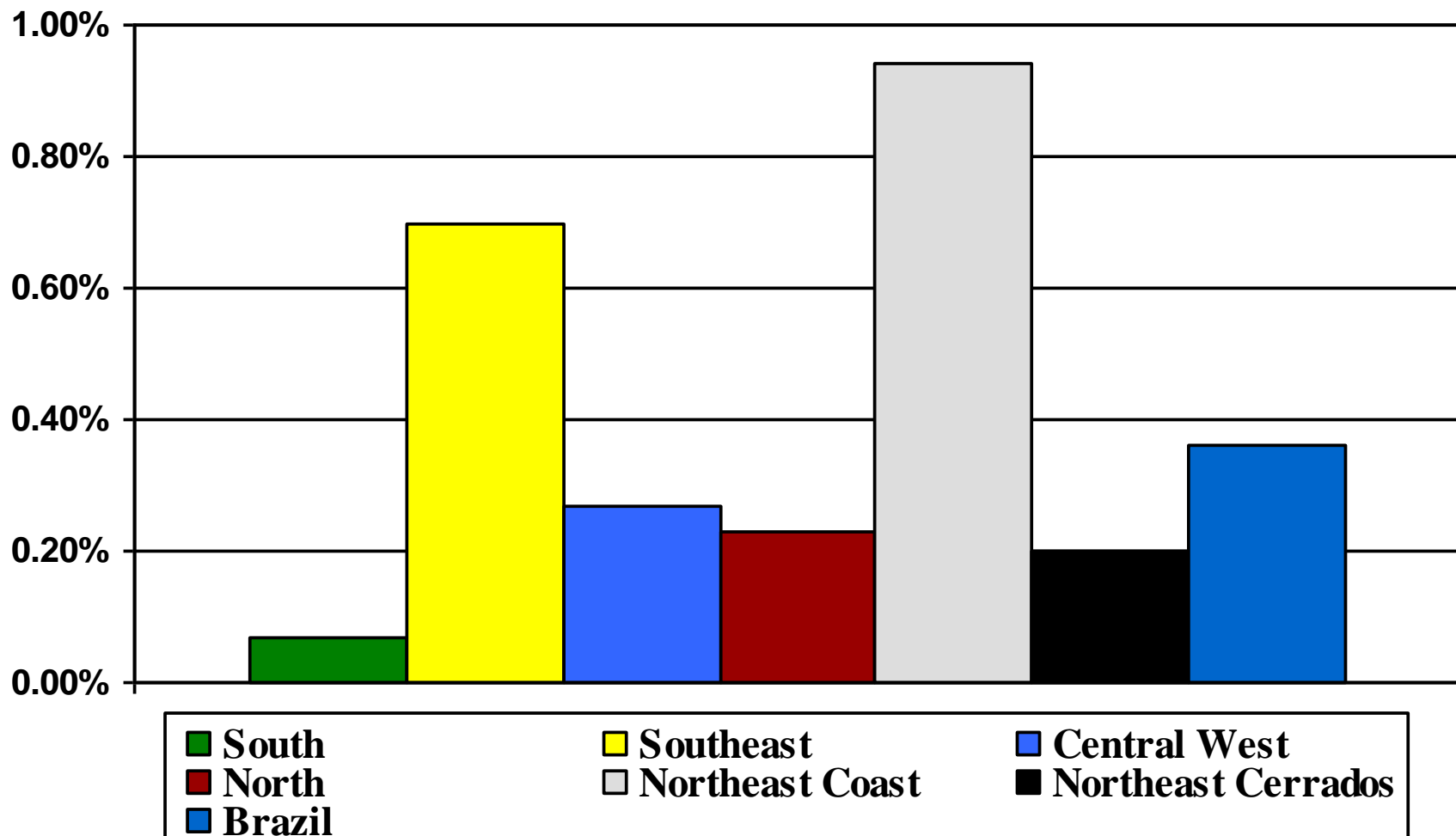


Intensification and LUC – 25% Brazil

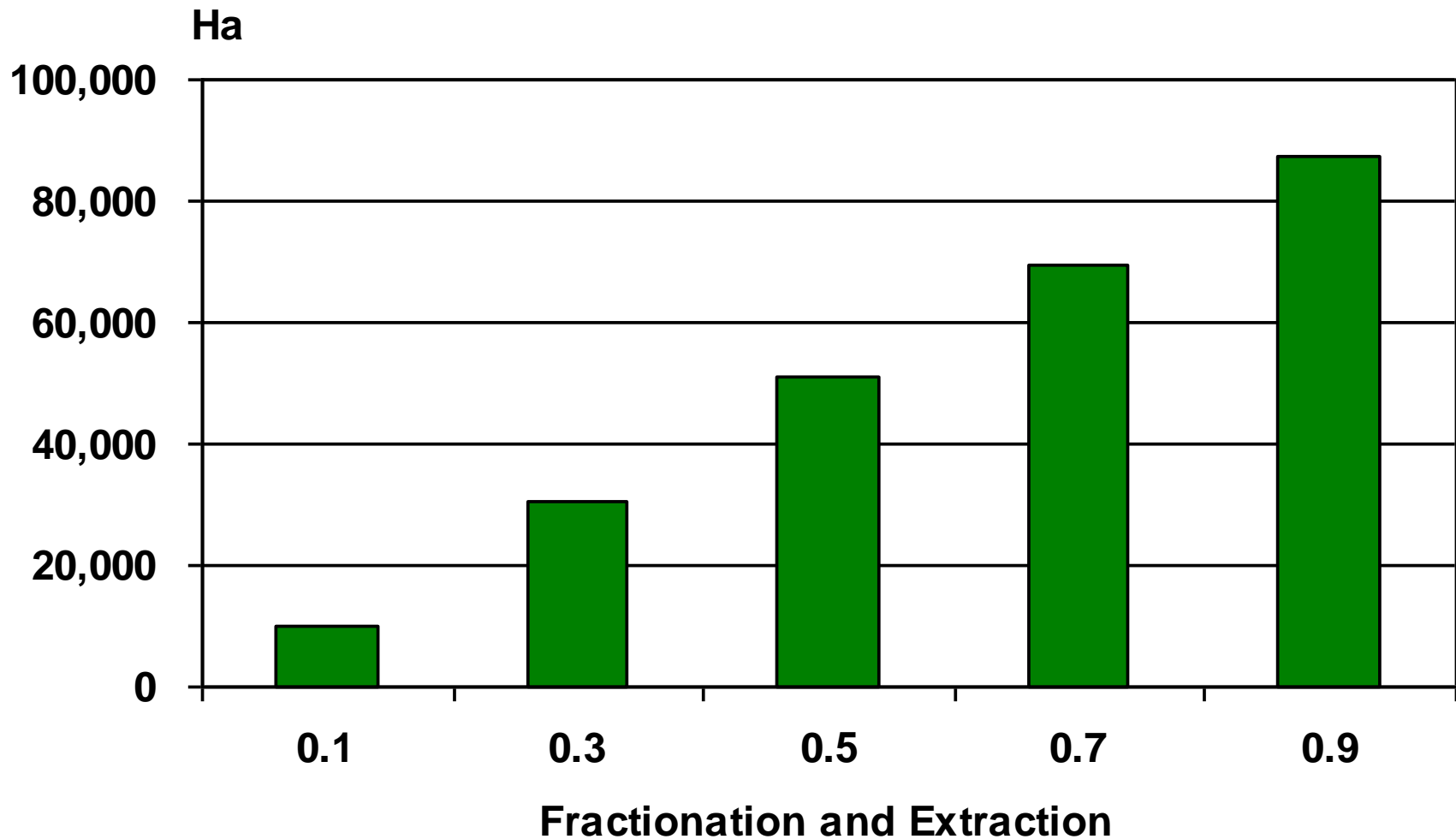
Region	Sugar cane	Other 1 st Crops	2 nd Crops	Area Planted	Pasture	Area Used
South	75	-16	107	165	6	64
Southeast	991	-237	14	768	-377	378
Central West	116	105	103	323	-95	126
North	10	58	3	71	67	135
Northeast Coast	143	37	0	180	-127	53
Northeast Cerrados	17	53	13	83	-24	47
Brazil	1,352	0	239	1,591	-551	802

Livestock Intensification and LUC

Percent



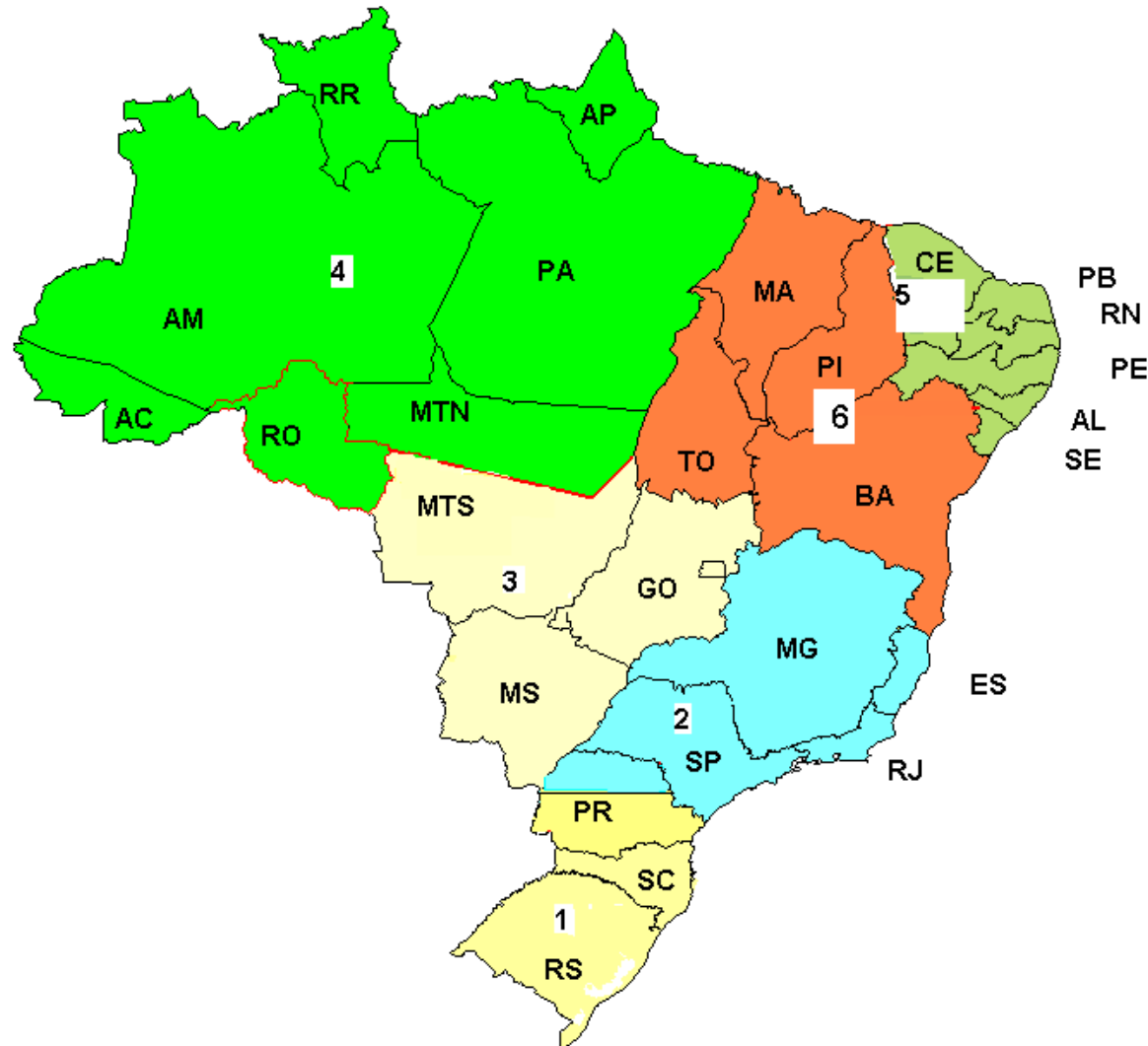
Fractionation and LUC



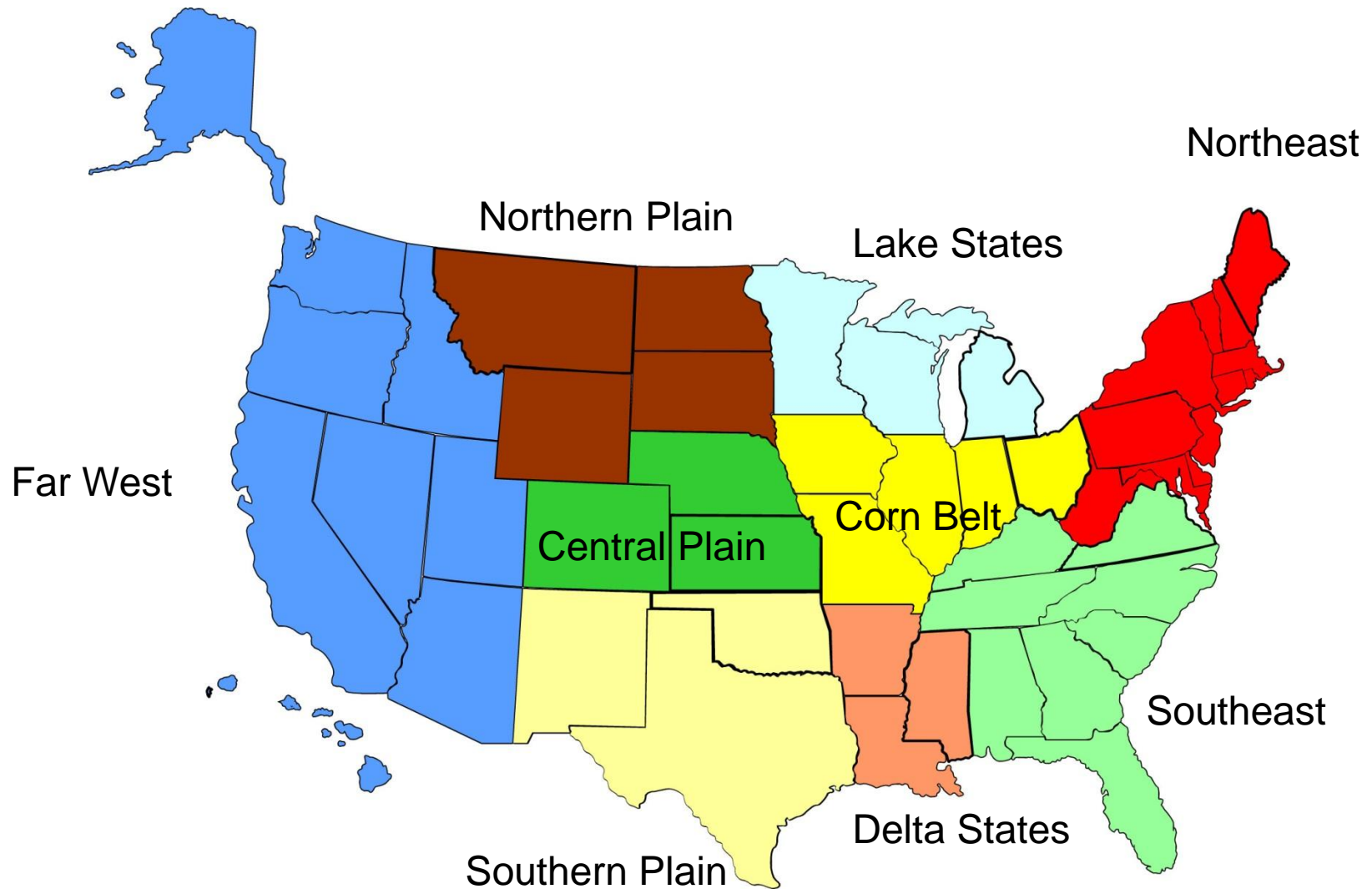
Biofuel co-product displacement

Feed Ingredient	US	EU
Energy Source (Barley, Wheat, Corn)	0.84	0.20
Protein Source (Soymeal, Rape meal, Sunflower meal)	0.14	0.81

Regional Disaggregation of Brazil



Regional Disaggregation of the U.S.



Major Developments in LUC Modeling: FAPRI-CARD Models

■ Area Allocation Specification

- Impose land supply limits with land policy compliance assumption and land suitability consideration
- Theoretical restrictions on elasticity-parameter space
 - Adding-up
 - Homogeneity
 - Symmetry
 - Etc.

Major Developments in LUC Modeling: FAPRI-CARD Models continued ... 1

- Fertilizer Use Model (intensification)
 - By nutrient N-P-K
 - By commodity and By country

- Longrun Equilibrium
 - Supply side - normal profit condition imposed
 - Demand side – ethanol energy-equivalence pricing

- Feedback impact of ethanol on gasoline sector

Convergence or Divergence of LUC Findings

- Divergence factors outside the model
 - Definition and implementation of biofuel scenario
 - Searchinger, et al. - Change in exogenous variable and entire model solved for new equilibrium
 - JRC - Expand biofuel consumption, fixed trade, and model solves for new equilibrium
 - EPA - Exogenize biofuel sector

Convergence or Divergence of LUC Findings

- Divergence factors outside the model
 - Size of shock and non-linearity in the models
 - Elasticity differences in the additive, E-10, and E-85 ethanol markets.

Convergence or Divergence of LUC Findings

■ Divergence factors in the model coverage

- Intensification
- Extensification
- Co-products
- Forestland, pastureland, etc

Convergence or Divergence of LUC Findings

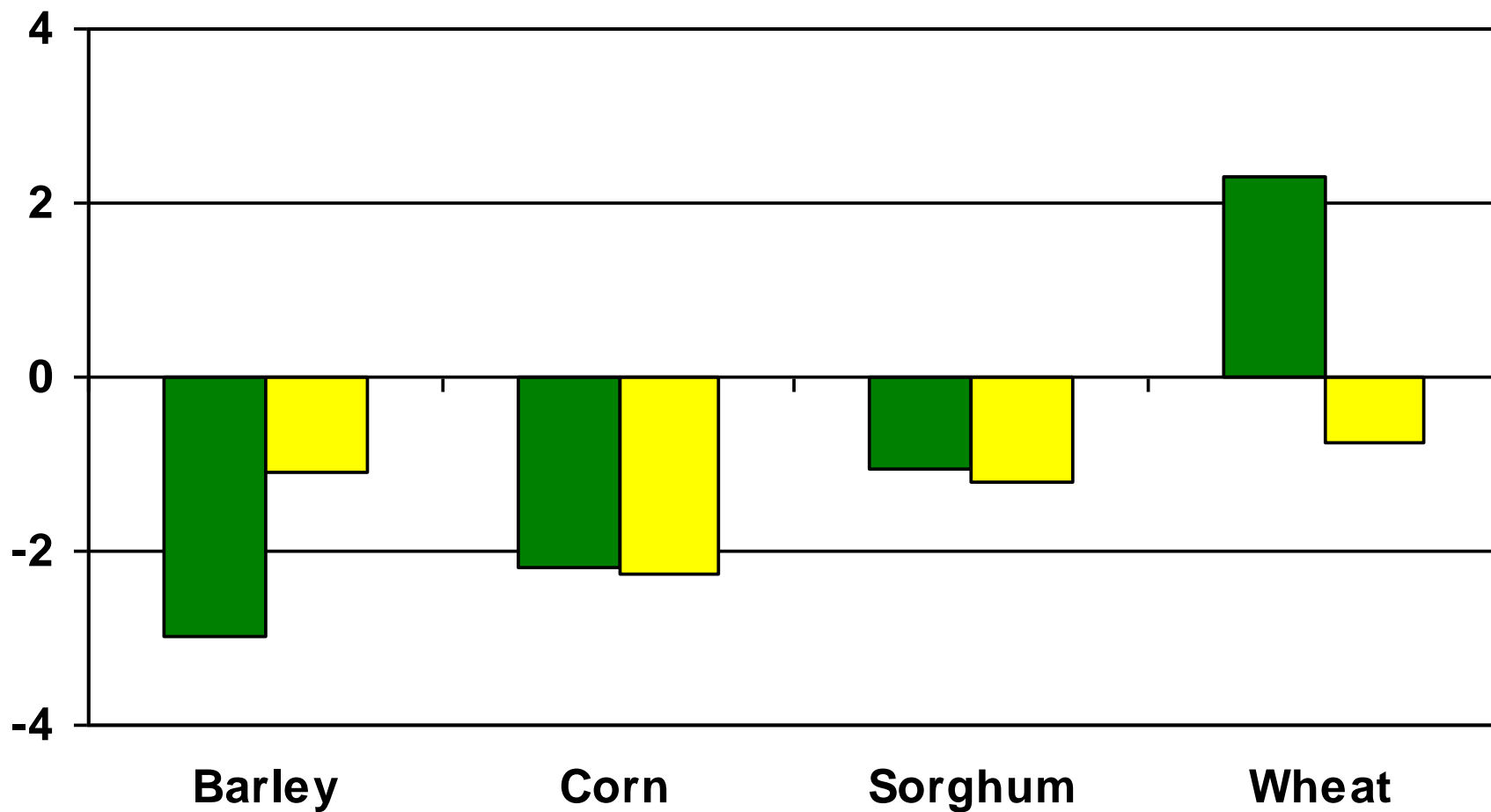
- Divergence factors in the model structure
 - General Equilibrium versus Partial Equilibrium
 - FAPRI's Homogenous Product Single-equilibrium World and GTAP's Armington World

Convergence or Divergence of LUC Findings

- Divergence factors in the model specification
 - Functional form
 - Parameters-elasticities
 - Cross-price elasticities matter

Price Changes in Corn Only Case

Percent



Data and Analysis Needs to Improve Models

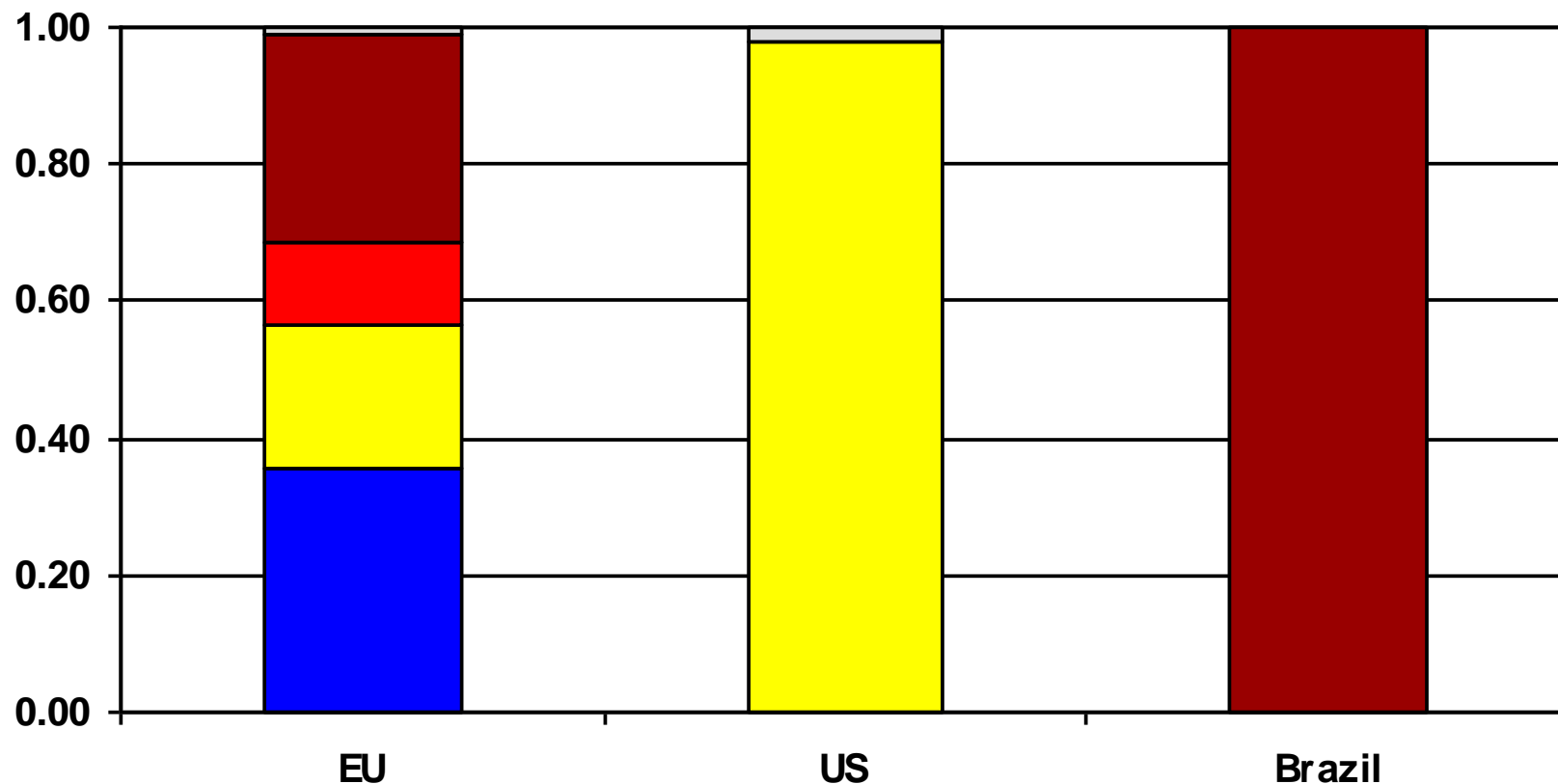
- Livestock and dairy intensification – pastureland data
- Extensification and yield
- Quantification of inputs in yield intensification and associated GHG emissions
- Land availability and suitability

Data and Analysis Needs to Improve Models

- Proper modeling of biofuel feedstocks
- Proper modeling of competing uses of feedstock – especially as feeds for the animal sector
- Proper modeling of cross-price elasticities

Bioethanol Feedstock

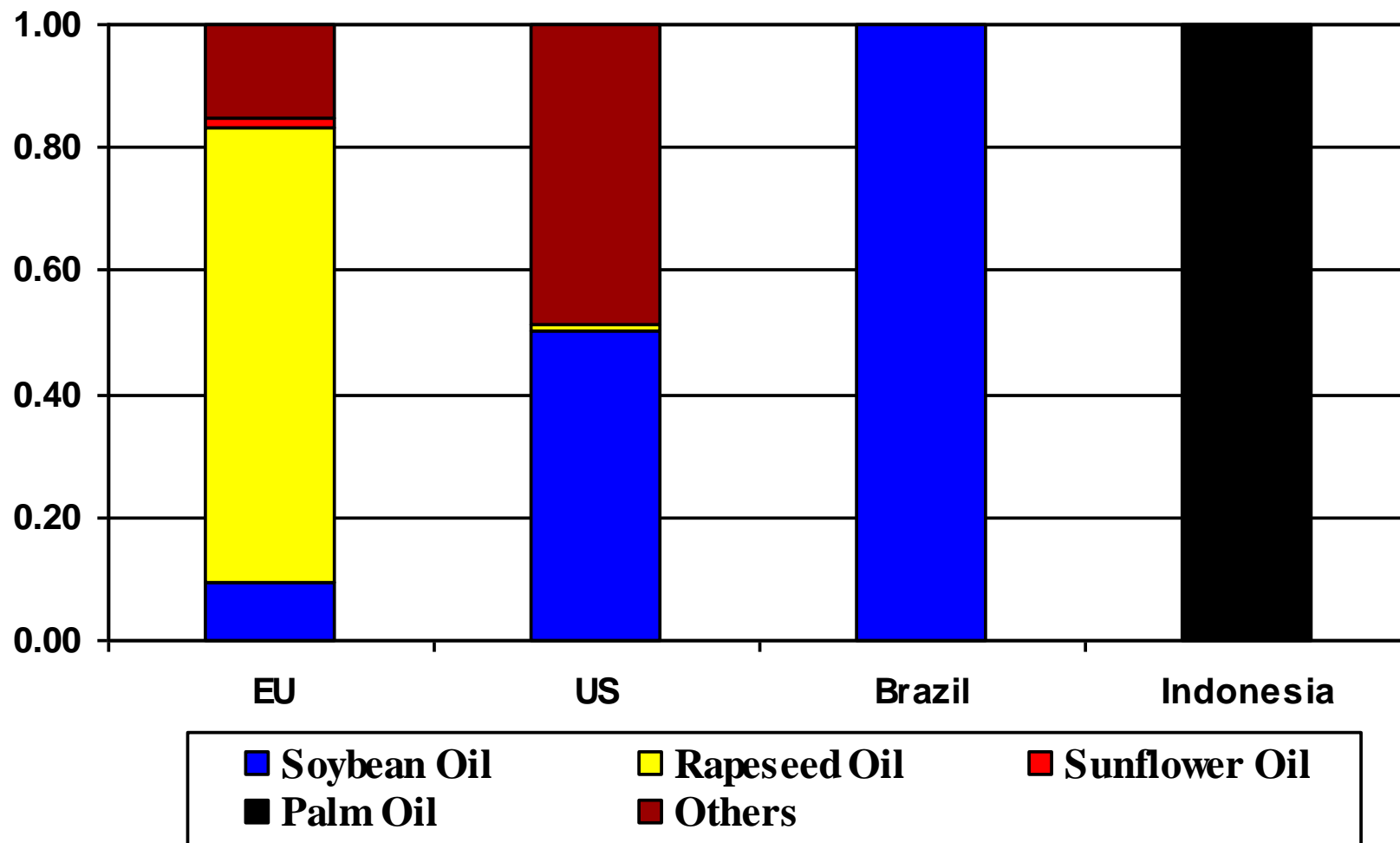
Percent



■ Wheat ■ Corn ■ Barley ■ Sugarcane or beet ■ Others

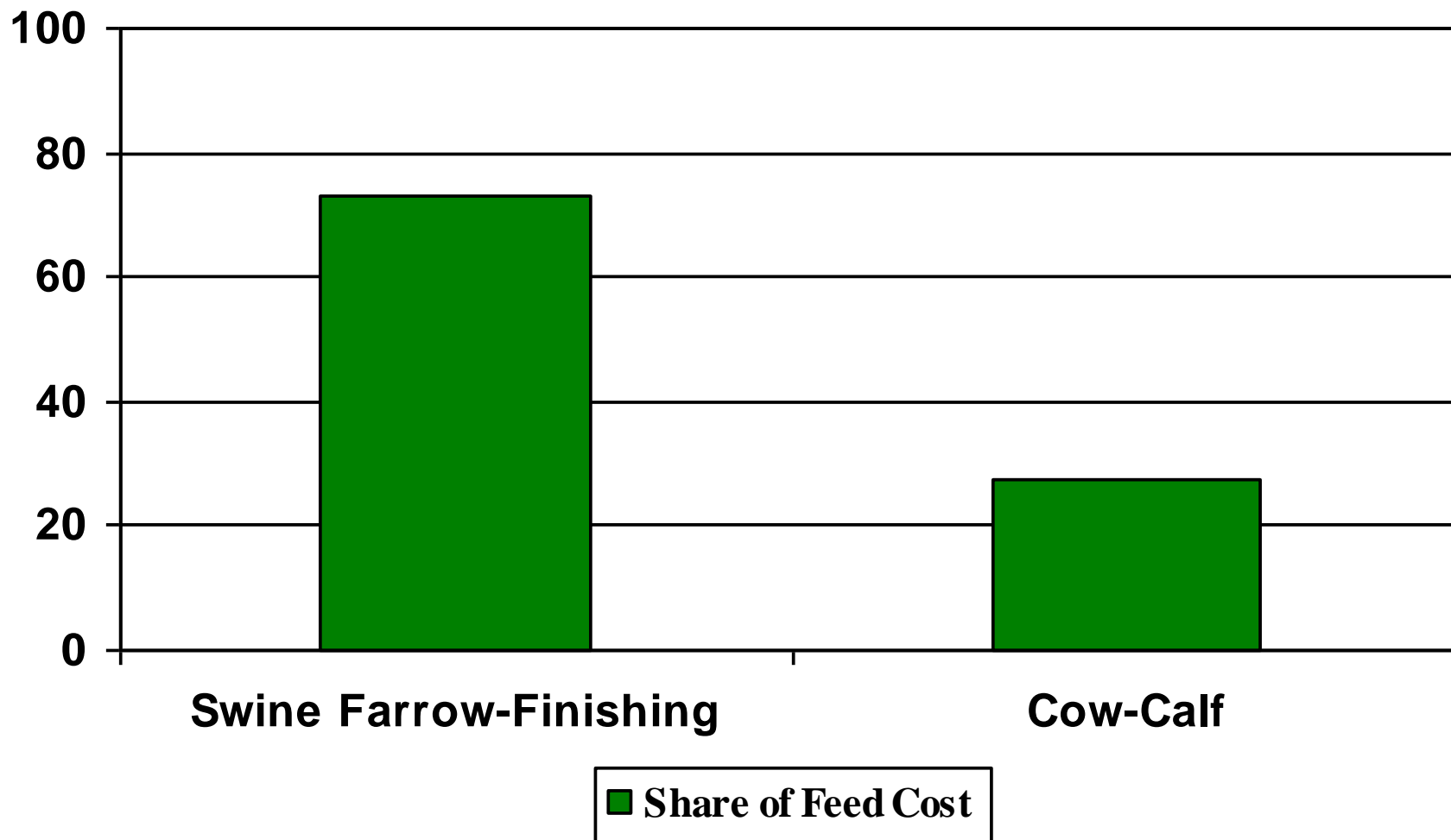
Biodiesel Feedstock

Percent

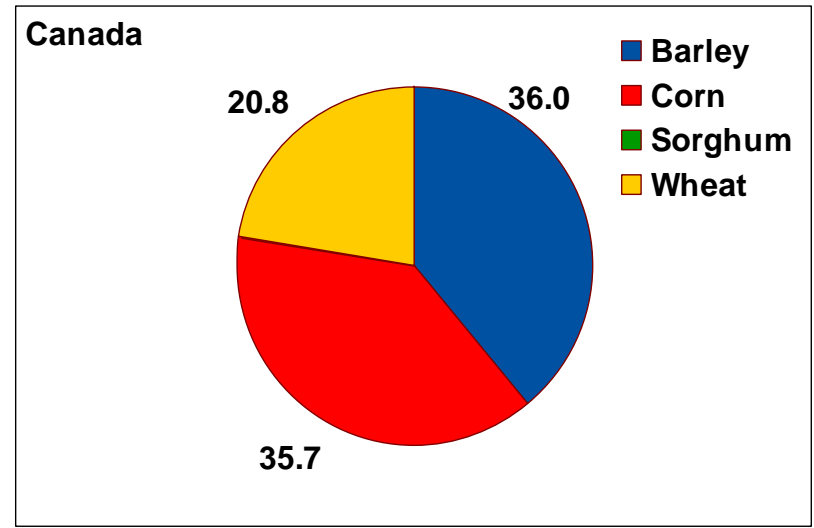
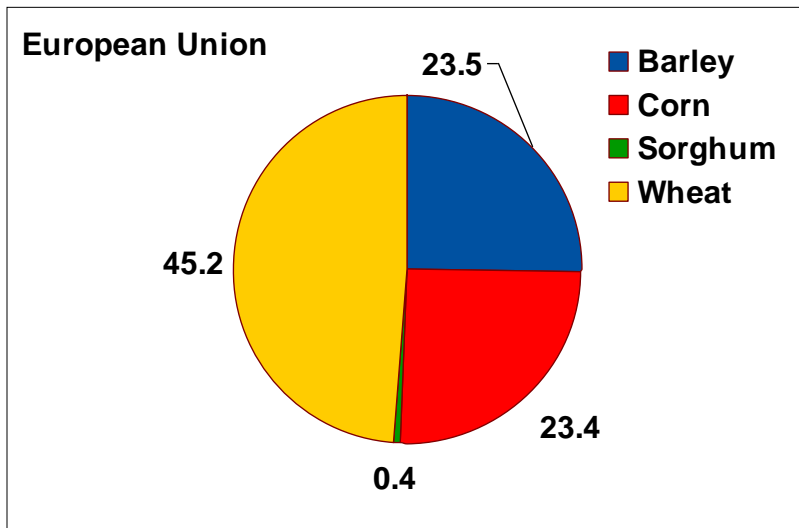
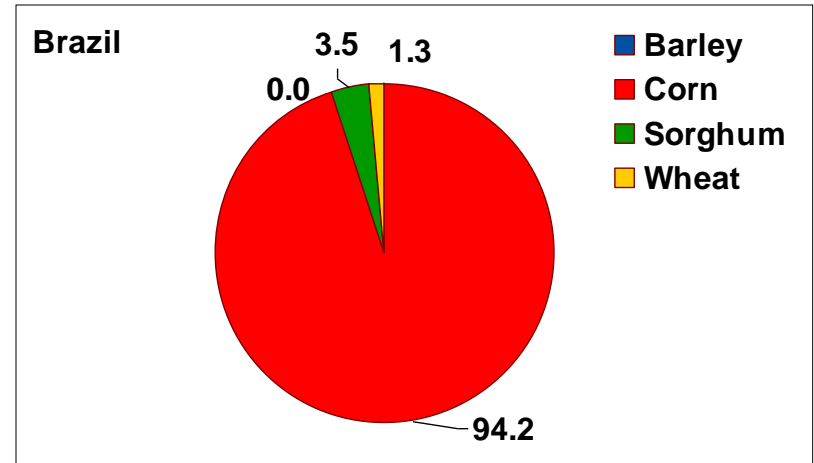
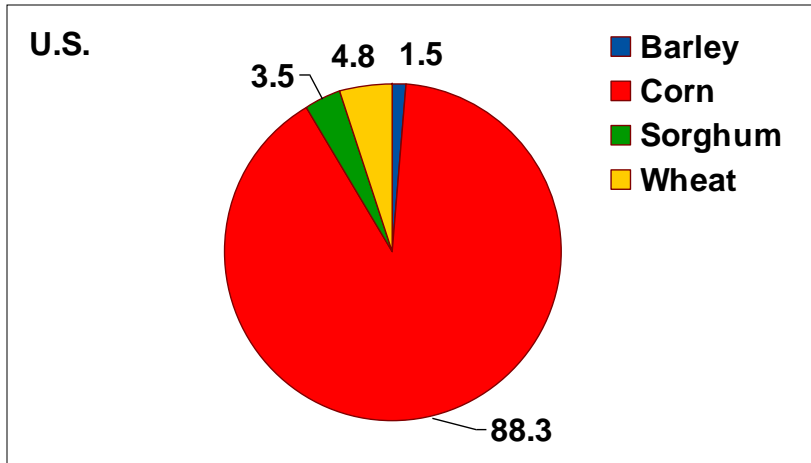


Production Cost Structure

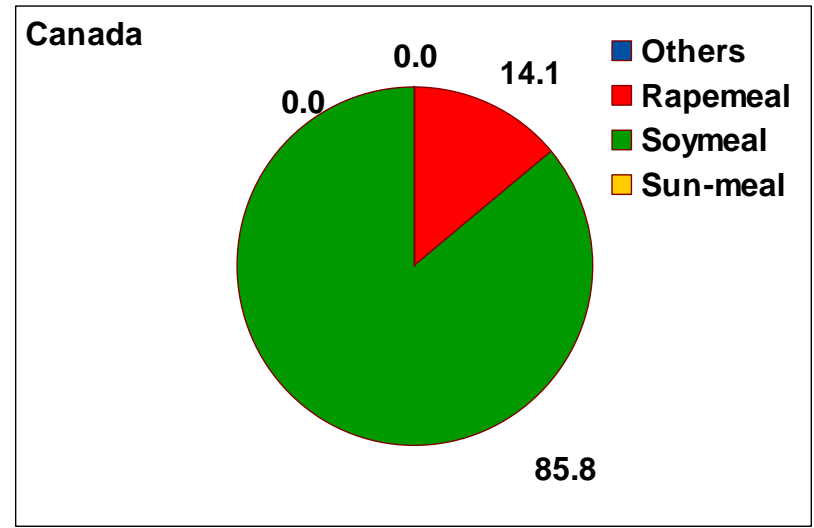
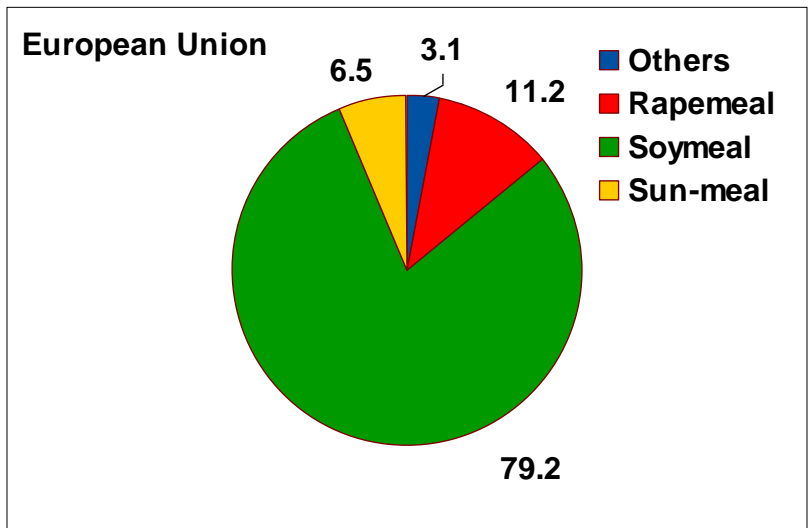
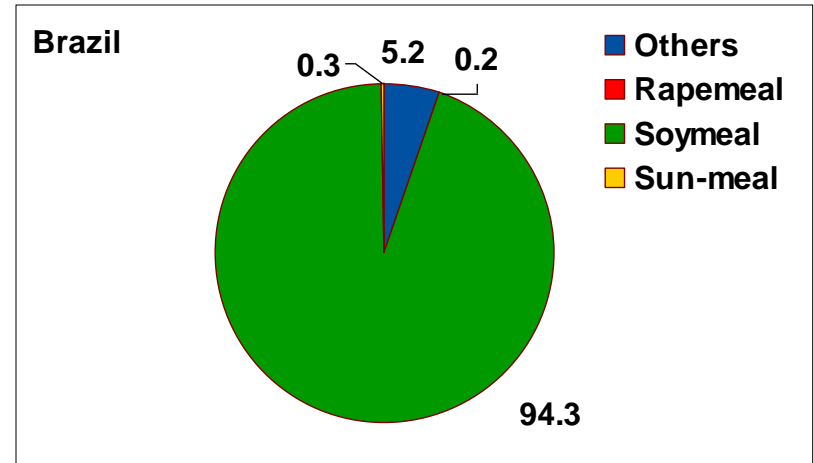
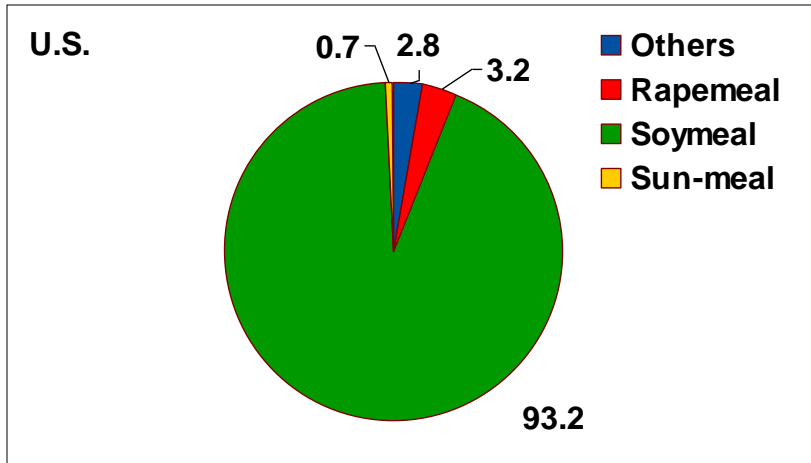
Percent



Feed Ration Energy Sources



Feed Ration Protein Sources



Thanks!
