

Corn Ethanol and Land Use: Toward a More Realistic Assessment of GHG Impacts

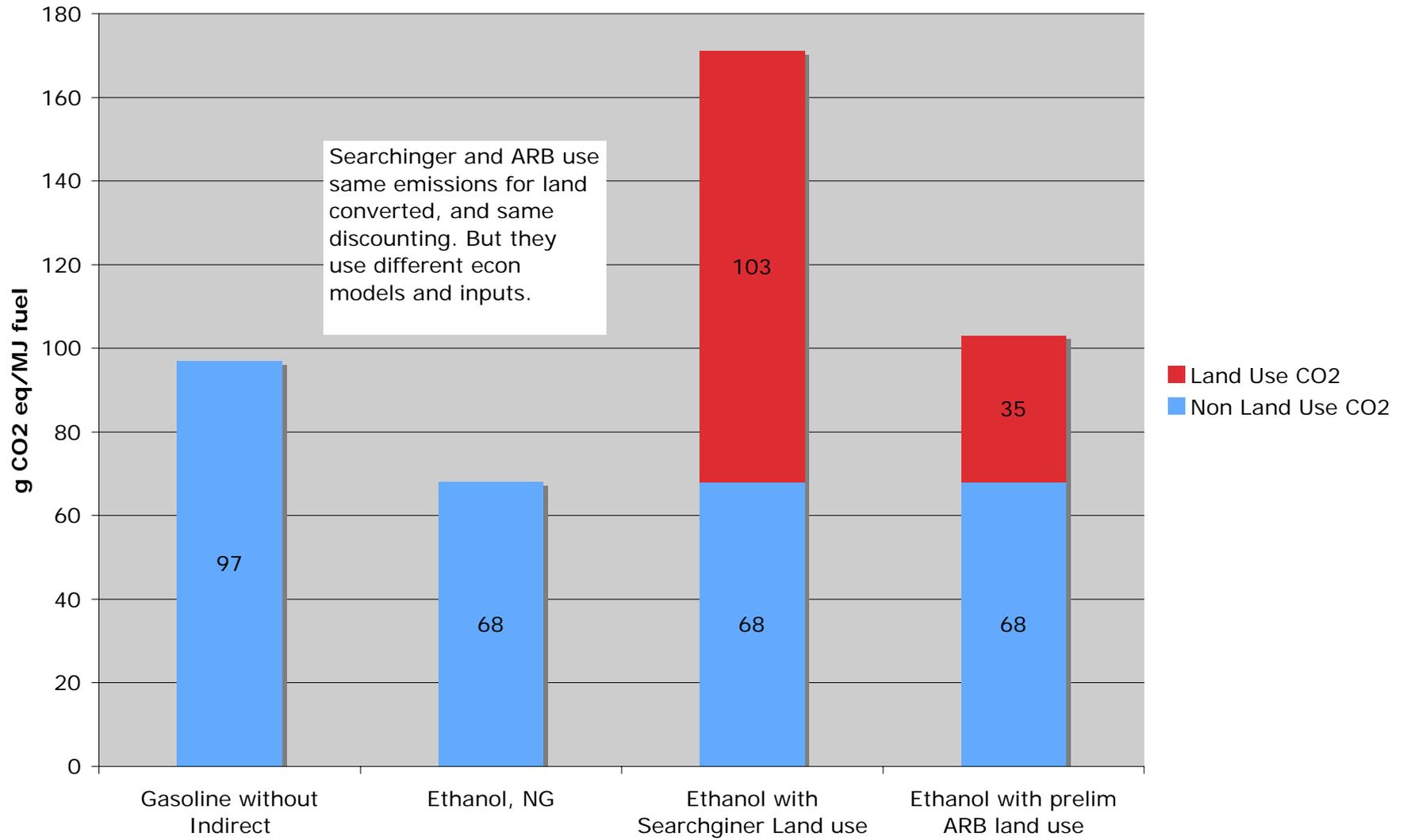
Presentation to: TRB 88th Annual Meeting, Session
#740, January 14, 2009

Tom Darlington, Air Improvement Resource for
Renewable Fuels Association

Overview

- Paper by Searchinger, et al
- ARB work in process
- RFA work in process
- Conclusions

Carbon Intensity (g CO2 eq/MJ fuel)



Definitions

- Land conversion: conversion of grass (pasture) to crops or trees to pasture or crops
- Endogenous yield improvement: a yield improvement related to the price increase of the commodity brought about by the increase in demand for the commodity
 - Example: Agronomic changes (increased inputs like fertilizer)
- Exogenous yield improvement: a yield improvement related to longer term investments
 - Example: Improved seed technology, like “triple stack” seed
- Distillers grain land use credit: Ethanol plants produce co product distillers grain (DGs). These replace some animal feed (corn and soy meal) and therefore have a land use credit to the land used for ethanol

Status of Modeling Science

- Best described as “developing”, and is not at all mature
- Examples:
 - Land use credits for distillers grains only included in GTAP model last May/June, though there were several papers written on biofuels land use impacts before this
 - GTAP researchers have only recently acknowledged the impacts of exogenous yield improvements

Searchinger Analysis

- Used FASOM/FAPRI modeling system
- Evaluated land use impacts of expanding corn ethanol from 15 bgy to 30 bgy

Problems with Searchinger Analysis

- Omitted endogenous yield improvements
- Assumed any exogenous yield improvements on existing corn land were offset by new land with lower productivity
- Utilized older estimates of land use credits for distillers grains
- Estimated significant reductions in U.S. exports, and conversion of land in the U.S.
- And, estimated significant conversion of new land outside of U.S.

Preliminary ARB Results (Nov 16)

- Based on Purdue GTAP model
- Examined impacts of increasing corn ethanol from 1.75 to 15 bgy

Problems with ARB Analysis

- Model relies on a 2001 database
- Model is “shocked” for entire ethanol increase in 1 year
 - Commodity prices increase (not just corn)
 - U.S. exports Pdrop
 - New land gets converted in U.S. and outside of U.S.
 - Converted land assumed to have lower productivity than existing land (no data to validate this assumption)
- Does not include exogenous yield improvements
 - Endogenous yield improvement is only 2-3%
- Uses older distillers grains land use credits
- Does not adequately consider land conversion costs

Conclusions with Existing Analyses

- Current estimates ignore inputs that have a very significant impact on the outputs, so
- Really cannot rely on any of the estimates we have seen so far

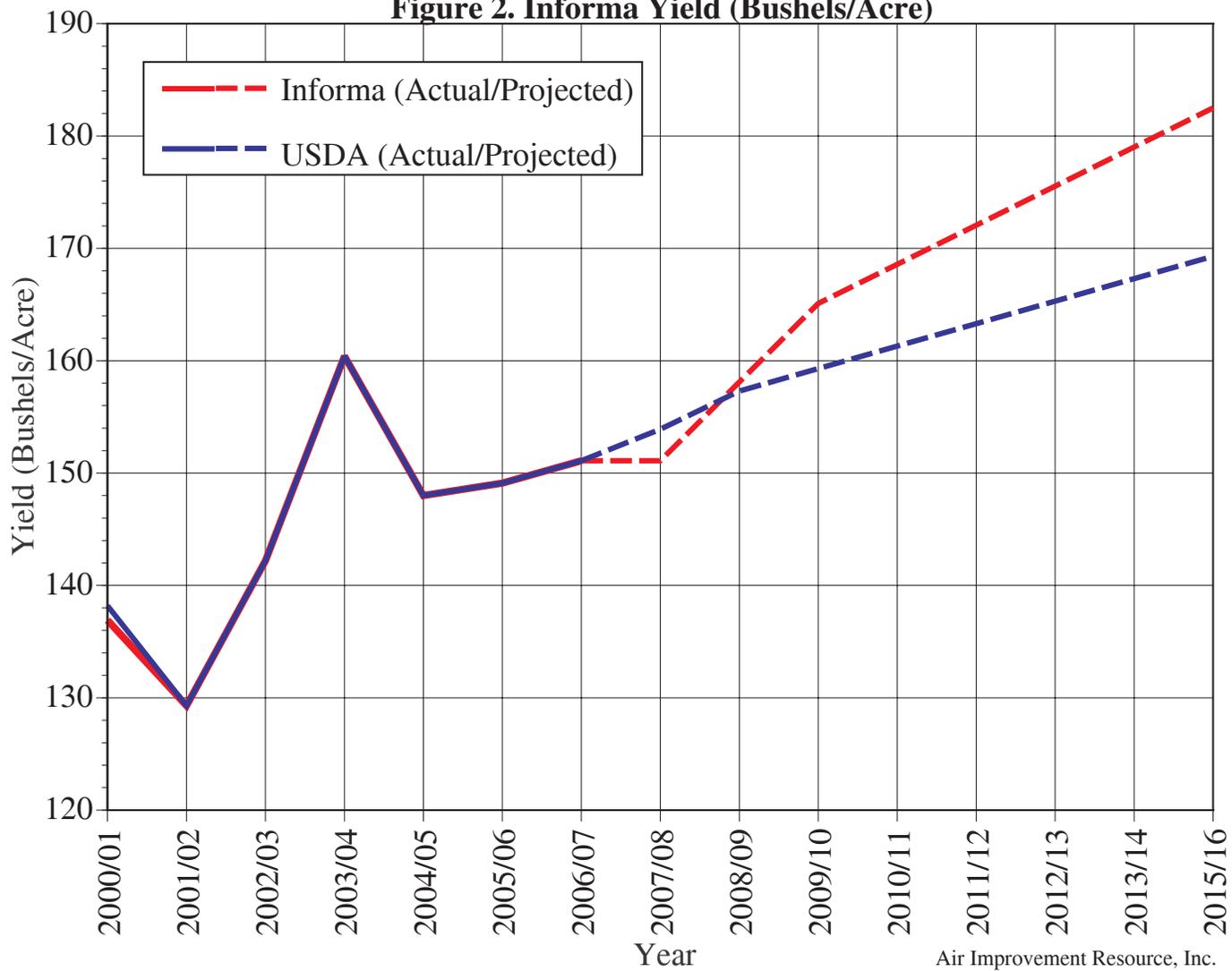
RFA Analysis

- Originally was going to use GTAP
 - FASOM/FAPRI not publicly available
 - GTAP still needs work
- Instead, RFA contracted with Informa Economics to evaluate land needs in U.S. and elsewhere as a result of expansion to 15 bgy by 2015

Informa Macro Assumptions

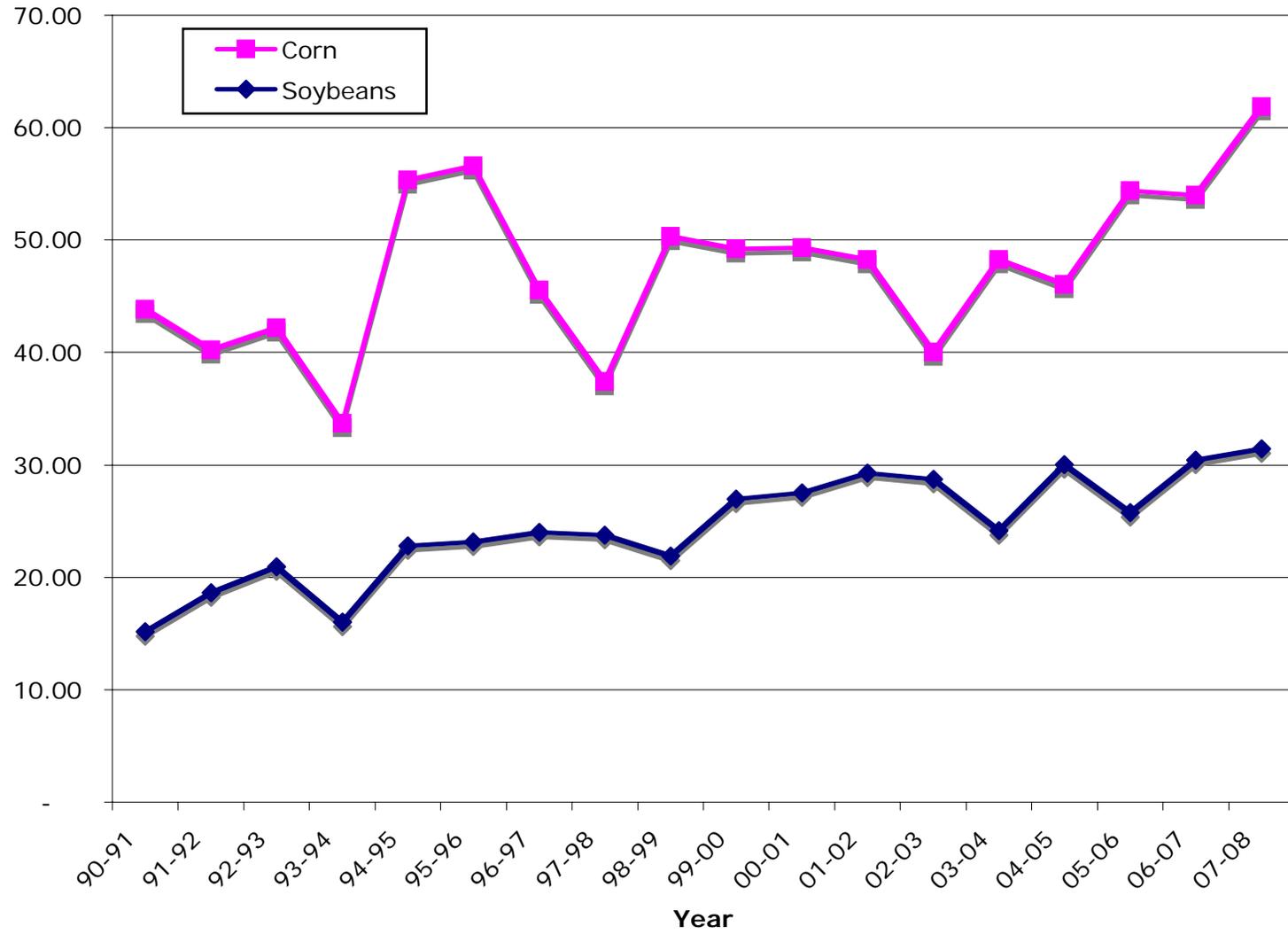
- Yields:
 - Corn yields increase ~2% annually (consistent with recent trends)
 - Soybean yields increase
 - Wheat yields increase by ~0.5% annually
- U.S. Exports
 - Corn and wheat exports remain constant
 - Soybean exports increase
 - Corn supplies outside the U.S. dominantly supply non-U.S. needs
- U.S. Crop Area Decreases
 - Wheat acres decrease somewhat
 - Cotton acres decrease significantly
- Distillers Grains Land Use Credit
 - 31%
- U.S. livestock industry gradually expanding (I.e., no reduction in pasture)

Figure 2. Informa Yield (Bushels/Acre)



Air Improvement Resource, Inc.

U.S. Corn and Soybean Exports



**U.S. Results (10⁶ Ha)
(Planted area)**

Crop	2000/01	2015/2016
Corn	32.2	34.6
Soybeans	30.0	34.0
Wheat	25.3	22.5
Cotton	6.3	2.5
Conservation Reserve Program	12.7	12.3
Total crops	142.9	140.0

U.S. 2015 Results (mha)

Harvested corn area in U.S.	31.8
Gross area devoted to ethanol	11.4
Net area devoted to ethanol with DG credit	7.8
Net area devoted to ethanol as % of U.S. cropland (not incl pasture)	5.5%
Net are devoted to ethanol as % of World cropland	0.6%

Brazil Results (mha)

Crop	2000/01	2015/16
Corn	13.0	15.5
Soybeans	13.9	26.4
Total crops	33.4	50.9

Global Harvested Area (mha)

Country	2000/01	2015/16
U.S.	95	94
EU-27	61	62
China	110	110
India	132	136
Africa and ME	113	135
World	828	903

Preliminary Conclusions

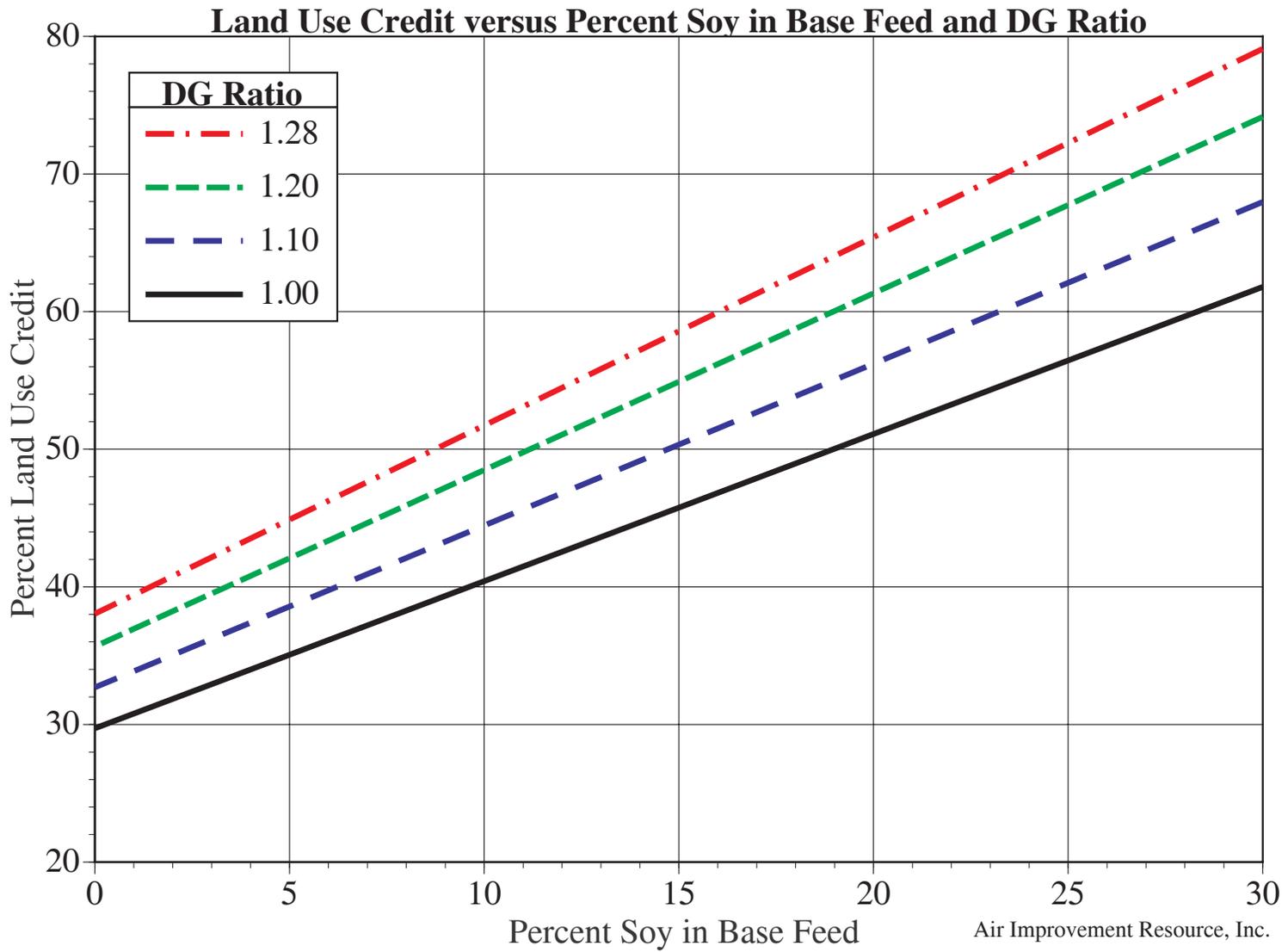
- Some econ models are ignoring major positive land use drivers
- Informa analysis indicates 15 bgy ethanol volume can be met without decline in exports (soybean exports increase)
- It is not appropriate to charge corn ethanol with other international land use changes that may be required to expand food supply if U.S. exports are *constant or increasing*
- Yield improvements in various crops show that there is little need for additional cropland in the U.S.
 - Informa estimates small amount of CRP land needed
- Results indicate little or no conversion of new pasture or forest land for 15 bgy ethanol from corn

Discussion

- Some would say that without corn ethanol, exports could have increased more, reducing international land use pressures (i.e., Brazil)
 - Not sure this would really have happened, but assuming it would have, is this the only “valid” use of yield improvements?
 - Likely that some of the exogenous yield improvements are the result of increased demand for corn, and without ethanol, there would be less long-term investment in yields
 - The technology developed in the U.S. can be transferred to other nations, greatly reducing land use pressures there
 - This was the recent experience in Malawi, where yields doubled in one year

New Information on Distillers Grains Land Use Credits

- Distillers grains are a co-product of dry mill ethanol plants
- These are fed to animals (beef, milk cows, and swine)
- Much higher in protein and fat than “normal” rations
- They reduce the land use impact of corn ethanol because the “normal rations” are corn meal with some soy (other ingredients as well)
- Two factors: how much soy, and whether DGs replacement mass ratio is greater than 1
- Recent research by Argonne indicates
 - 25% of replacement meal is soymeal
 - DG/meal ratio is 1.28/1



Contact Information

- tdarlington@airimprovement.com
- 248-380-3140