Weaning off Corn: Crop Residues and the Transition to Cellulosic Ethanol

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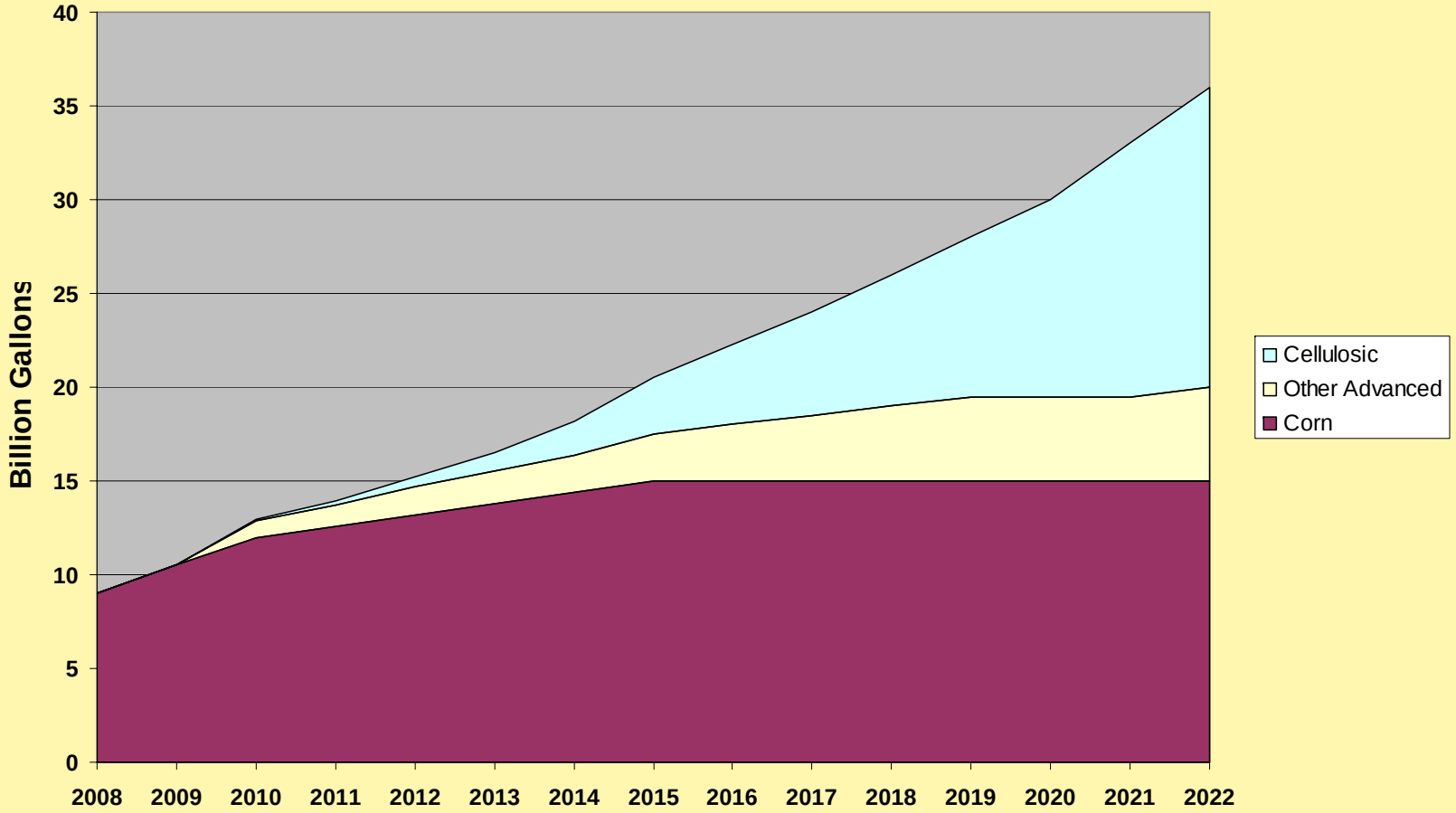
Biofuel Policy

- The Energy Independence and Security Act of 2007 is the latest juncture on a policy pathway to stimulate biofuel production
- Consequently, new markets for agricultural products will be created
  - Indeed, *new agricultural products* will be created

EISA production targets



Feedstock analysis: Why?

- Recent legislation and policy initiatives have made biofuel production and use a focus of the future U.S. energy system
- The majority of feedstocks will come from agricultural land, using both established and newly developed crops and production practices
- This ‘new’ demand will have implications for the agricultural land base, markets for non-bioenergy agricultural products and environmental quality

Conventional Crop Residues

- All major crop residues considered, but they vary in residue to grain yield
- Fraction of residue available for collection varies by tillage regime, and affects soil erosion potential, embodied nutrients, and soil carbon
  - For this analysis, we limit harvest to 50% from no-till, 30% from reduced tillage, and 10% from conventional tillage
  - 17 lbs N per ton of residue needs to be replaced

Feedstock analysis: Where?

- How will crop production respond to biofuel facility location, transportation infrastructure, and land suitability?
  - Geographic distribution
- Implications for land allocation
  - Shifting from traditional crops to biofuel feedstock
  - Reintroduction of idle (possibly marginal) land
  - Conversion of set-aside land

Feedstock analysis: How?

- Land stewardship involves choices regarding:
  - Crop/rotation
  - Tillage/soil management
  - Input use: Water, fertilizer
  - Participation in conservation programs
    - Land retirement
    - Working lands

Feedstock analysis: What?

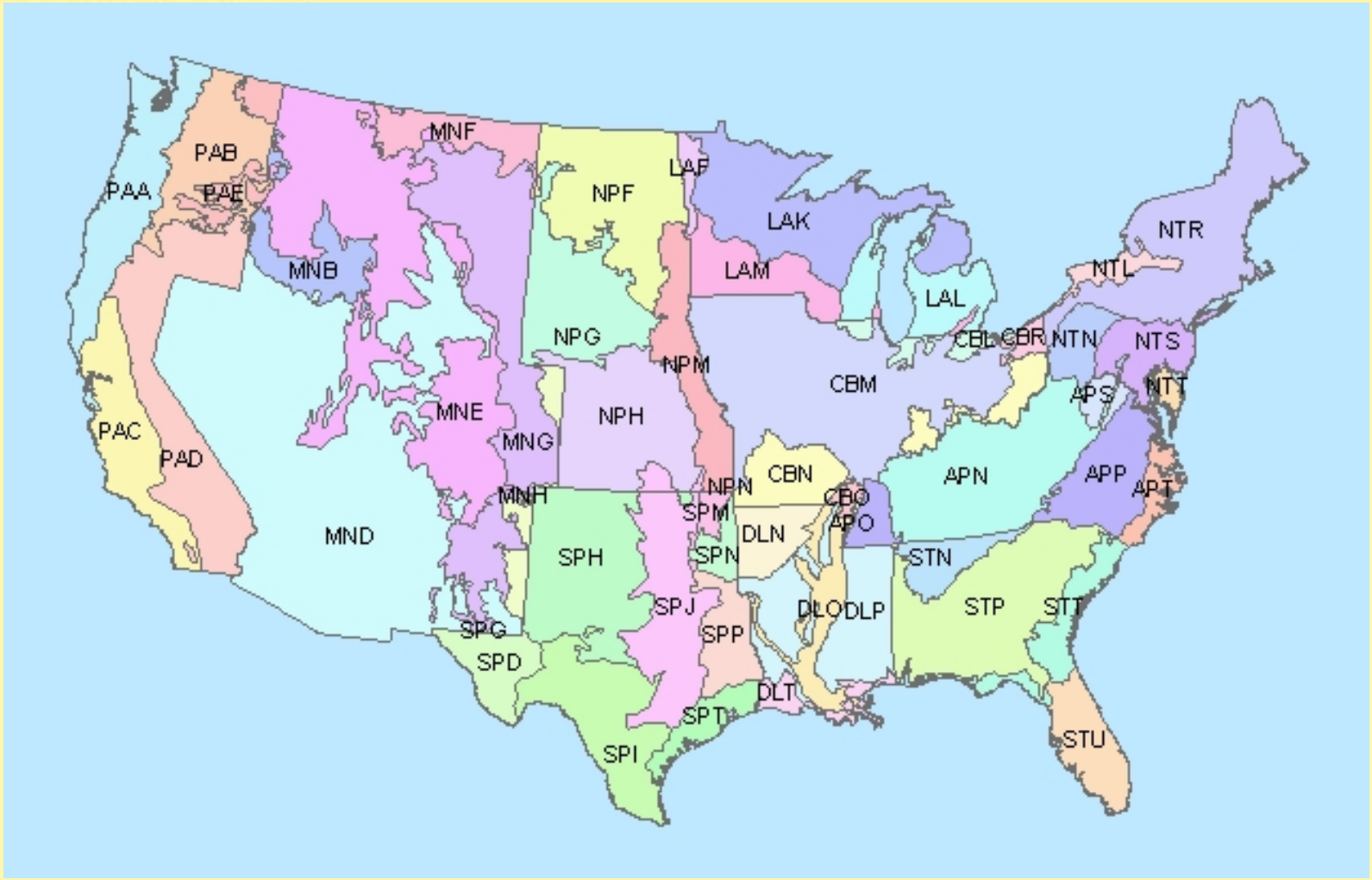
- Changes in production practices lead to changes in fertilizer and pesticide use. These changes, in turn, affect soil, water, and air quality.

- The increase in demand for corn and land will change the equilibrium of other agricultural markets.
  - Feed for livestock

Modeling framework

- Regional Environment and Agriculture Programming (REAP) model
  - Integrated crop, livestock and agricultural product supply/demand model
  - Relationship between production practices and environmental outcomes
- Key assumptions:
  - National market for commodities; no local variation
  - Modest yield growth in row crops

REAP regions



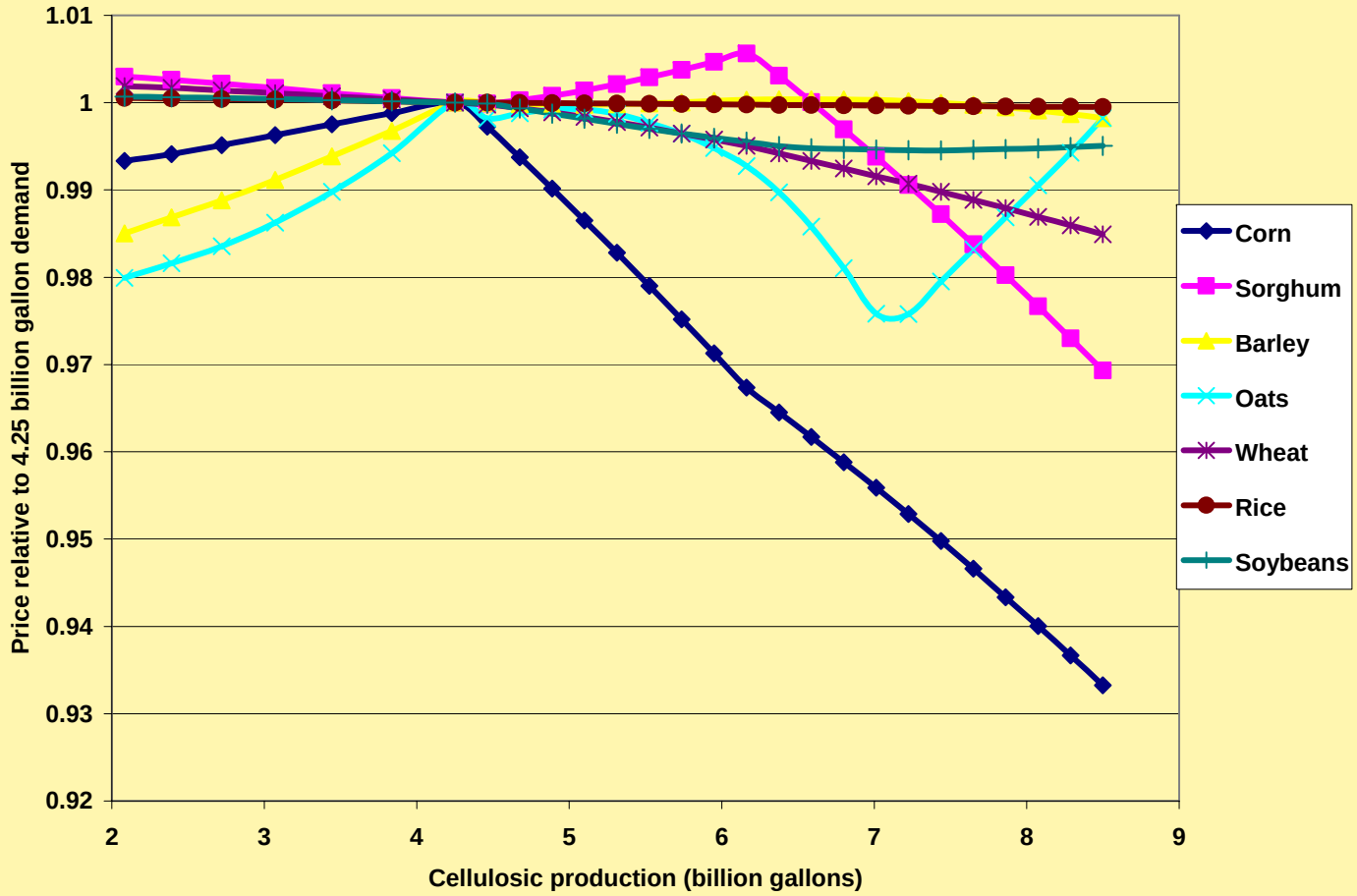
More Cellulosic Capacity -> Less Corn?

- The 15 billion gallon corn ethanol “ceiling” has usually been treated as an immutable fact
- What will be the upside/downside of cellulosic coming on line soon AND being allowed to substitute for corn ethanol as stipulated by EISA?

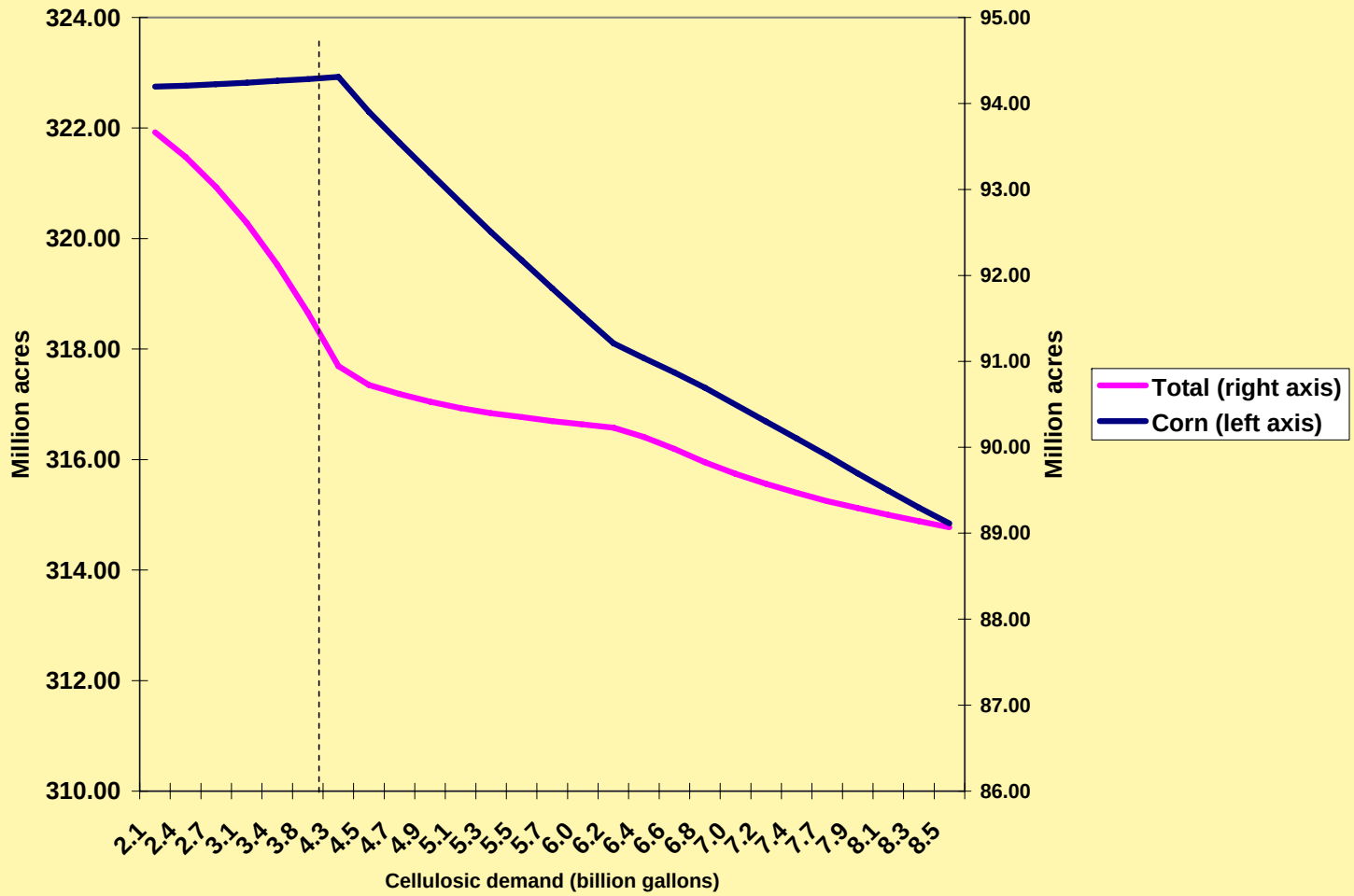
Some Hypotheses

- Less land for corn required
  - although more stover would be needed, there is an ample supply – up to a limit
- Movement into no-till systems
- Environmental impacts would be somewhat offset

Crop prices

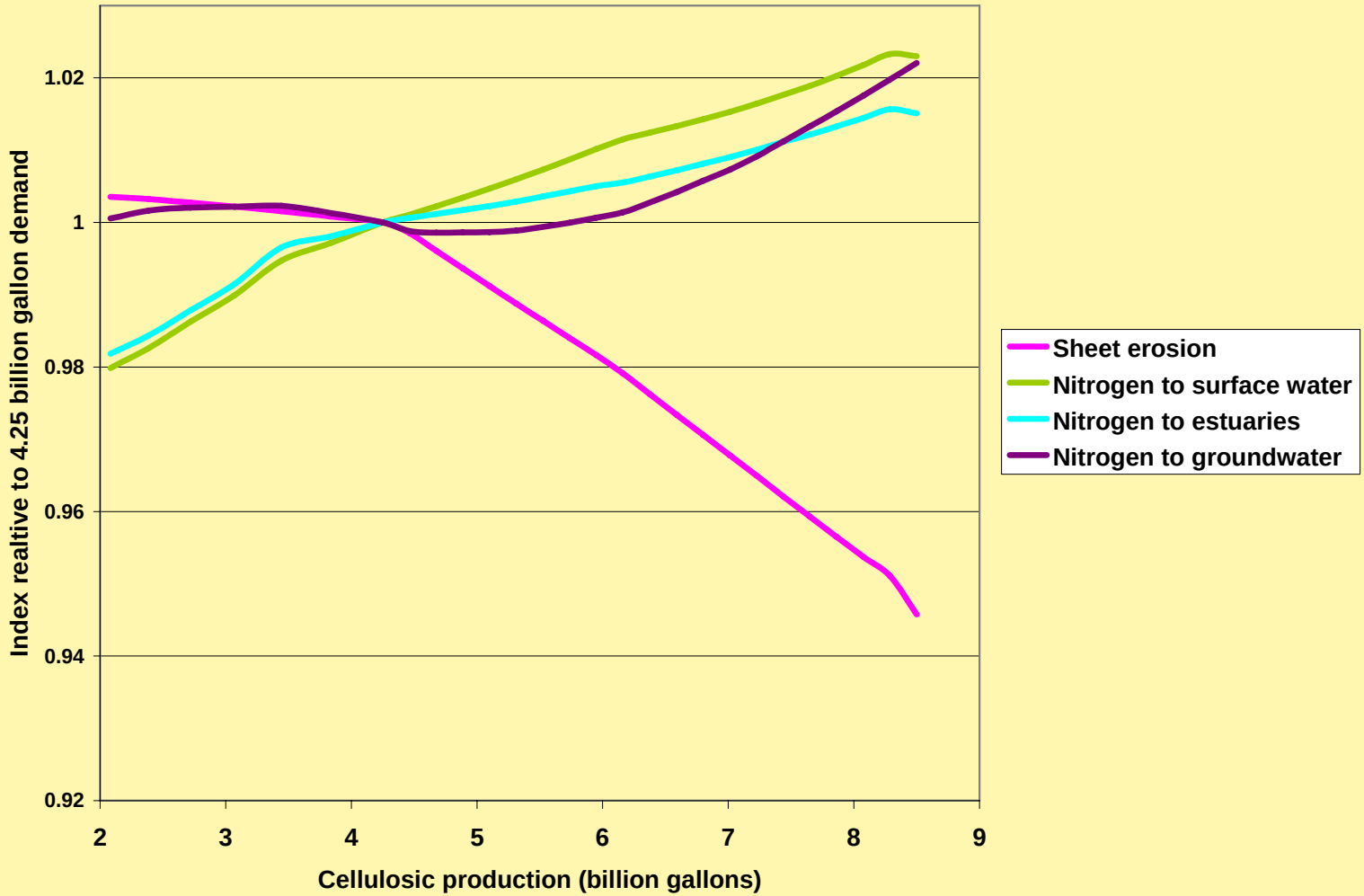

1.01
1
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
Price relative to 4.25 billion gallon demand
2
3
4
5
6
7
8
9
Cellulosic production (billion gallons)
Corn
Sorghum
Barley
Oats
Wheat
Rice
Soybeans

Planted acreage

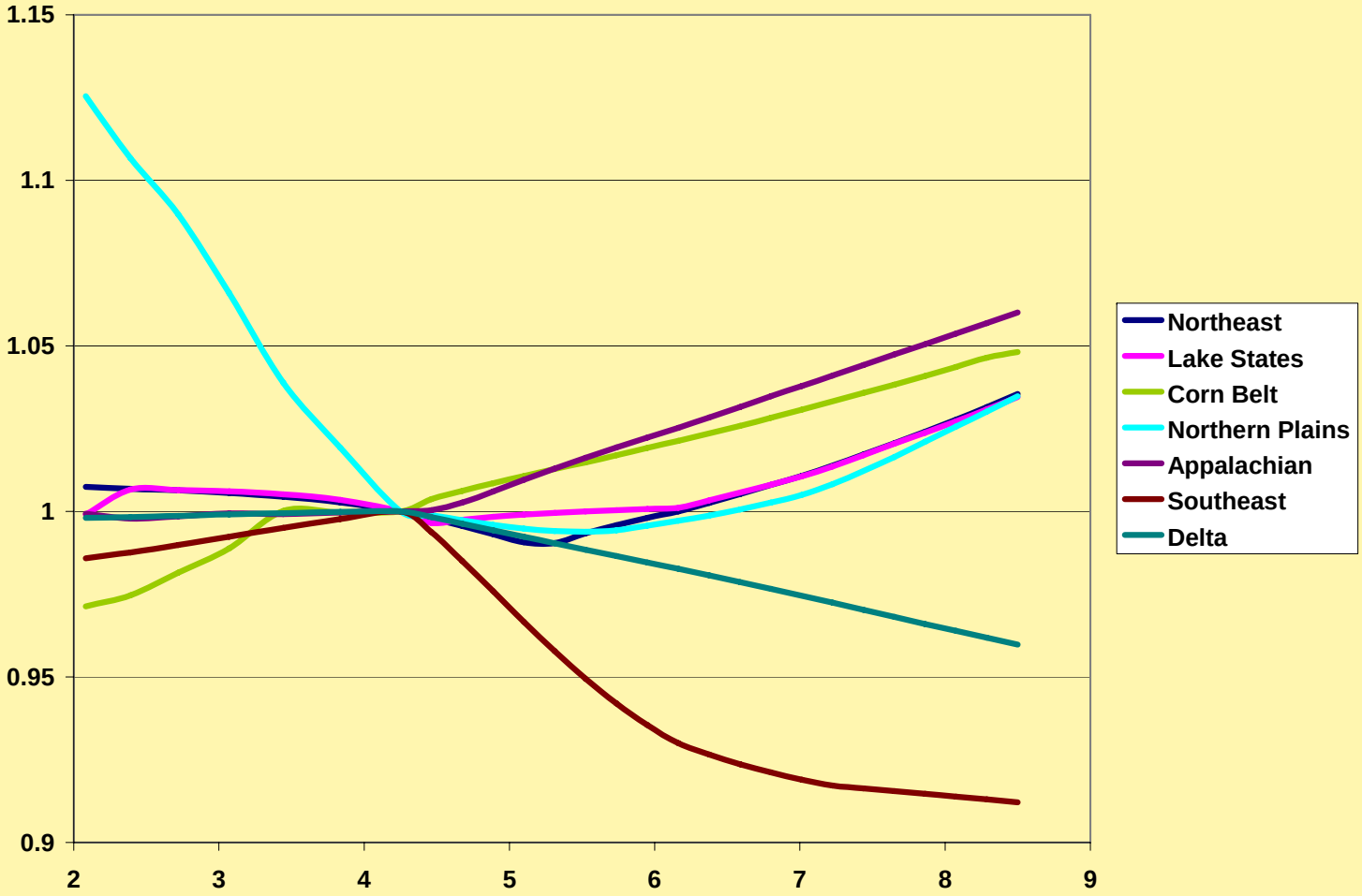


Regional acreage effects

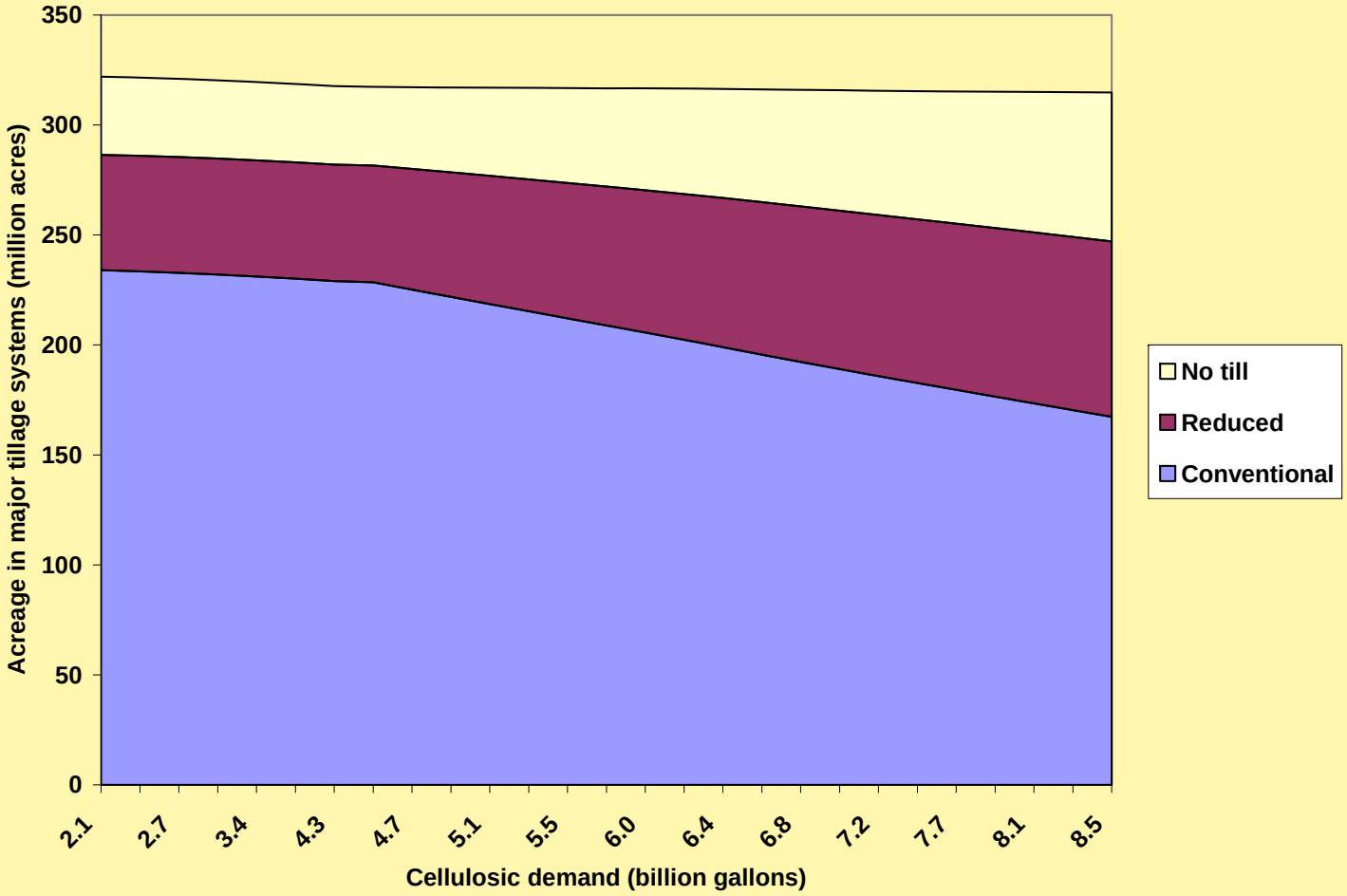
National environmental effects



Regional environmental effects



Change in tillage practice



Summary

- The transition to cellulosic will have benefits because of the existence of an essentially “free” good – crop residue
  - Carbon storage not considered
- Replacing some corn ethanol capacity with cellulosic will ease some of the pressure of agricultural land
- There does not seem to be a need to rush into switchgrass; this can wait until cellulosic technology becomes “proven” with residue

Summary

- Environmental effects are mixed as a result of added fertilizer application
- Producers that can market residue along with grain will see a boost in revenues, but producers where crop residues cannot be sold will take a hit from lower crop prices
- As value of residue increases, there is incentive to harvest more than is sustainable, potentially increasing environmental consequences