Energy Demand and Capacity to Adjust in Agricultural Production

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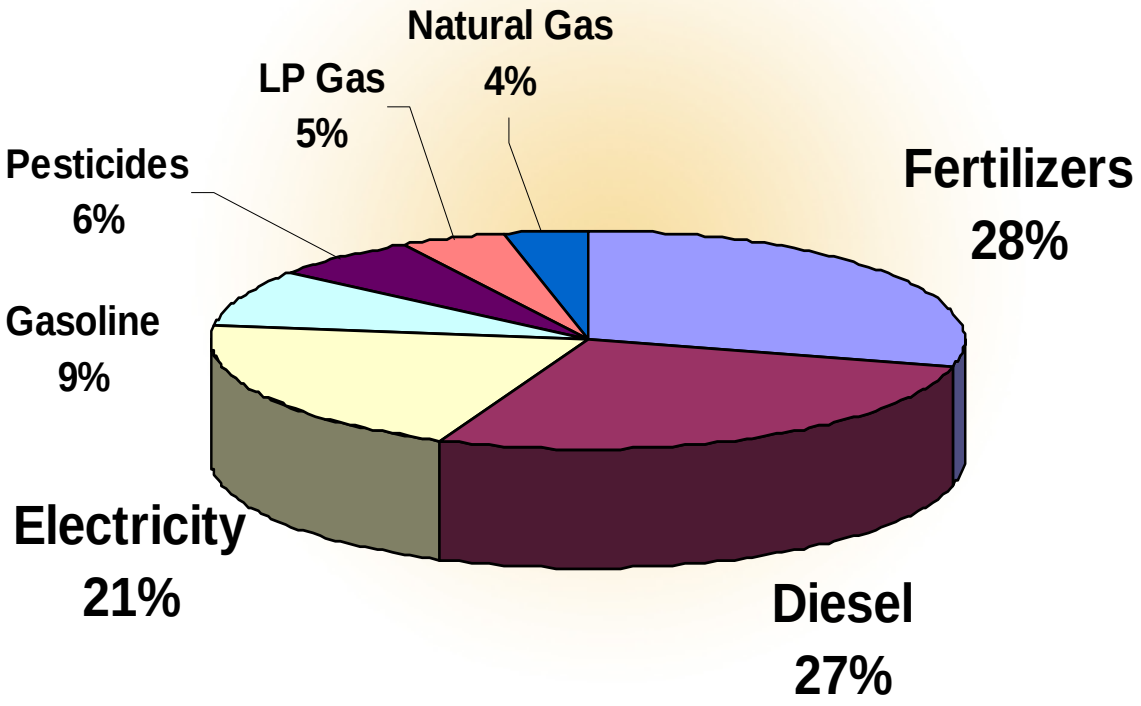
Objectives

- Establish farm energy demand baseline
- Evaluate capacity to adjust to real energy prices and supply disruptions
- Evaluate impacts of productivity growth and technical change on capacity to adjust
- Consider impact of rural energy disruptions and energy security
- Discuss on-farm energy production as option to enhance adjustment capacity

Underlying Issues

- Energy demand is driven by **real** energy prices and relative prices
- Shares of energy expenses impact the capacity to adjust to price increases
- Timing of real price increases is critical to adjustment capacity in production agriculture
- Agricultural productivity growth enhances agriculture's capacity to adjust to energy prices

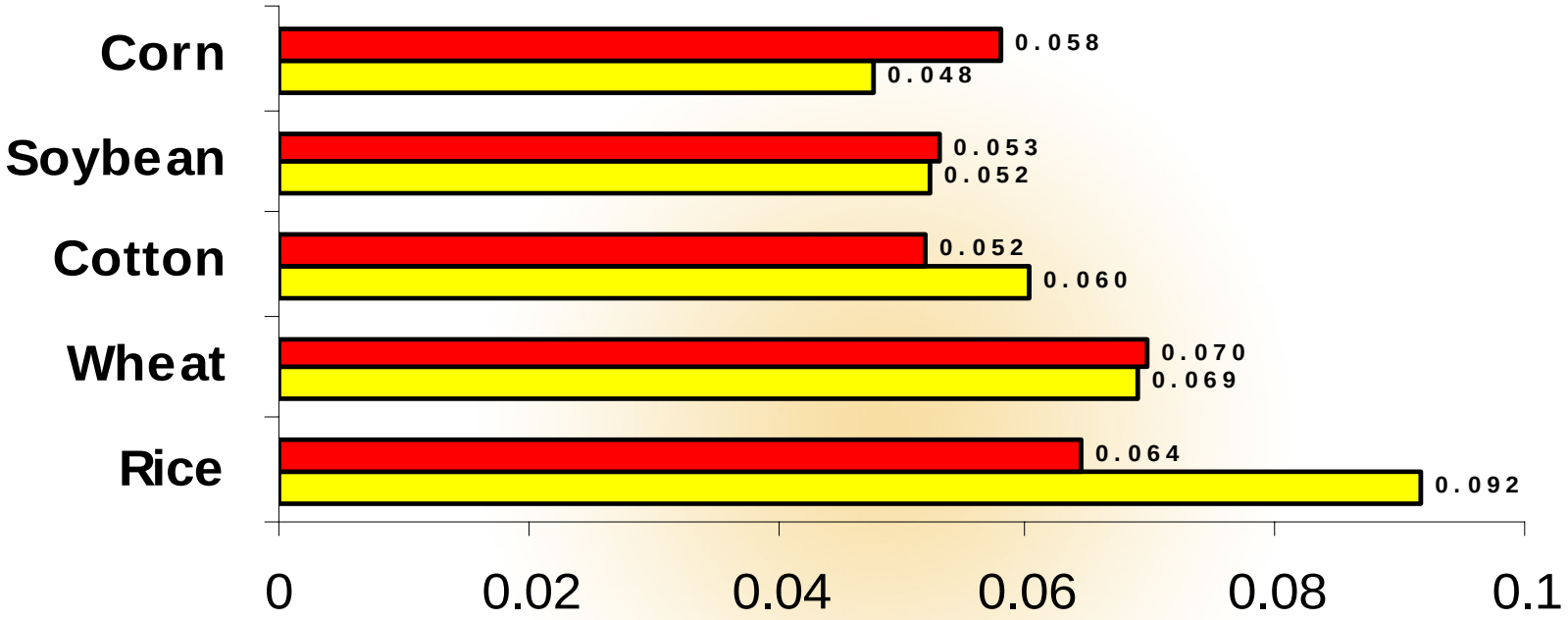
Total Energy Used on US Farms in 2002
Total = 1.7 Quadrillion BTUs



Energy Use and Farm Production Expenses

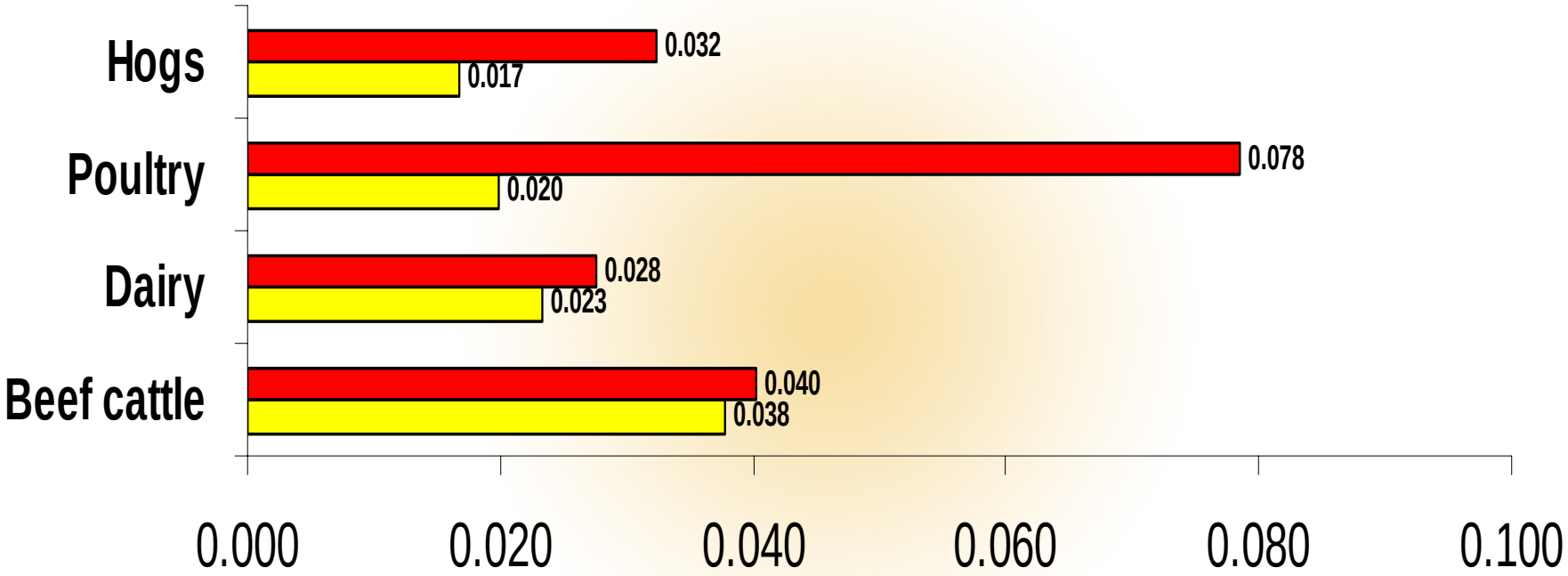
- Direct energy consumes twice as many BTUs as indirect energy, but
- Direct energy accounts for 3-4% of farm cash expenses
- Indirect energy inputs (fertilizer and pesticides) account for 9-10% of farm cash expenses
- How important are energy expenses in crop, animal, and specialty-crop type farms and by regions:

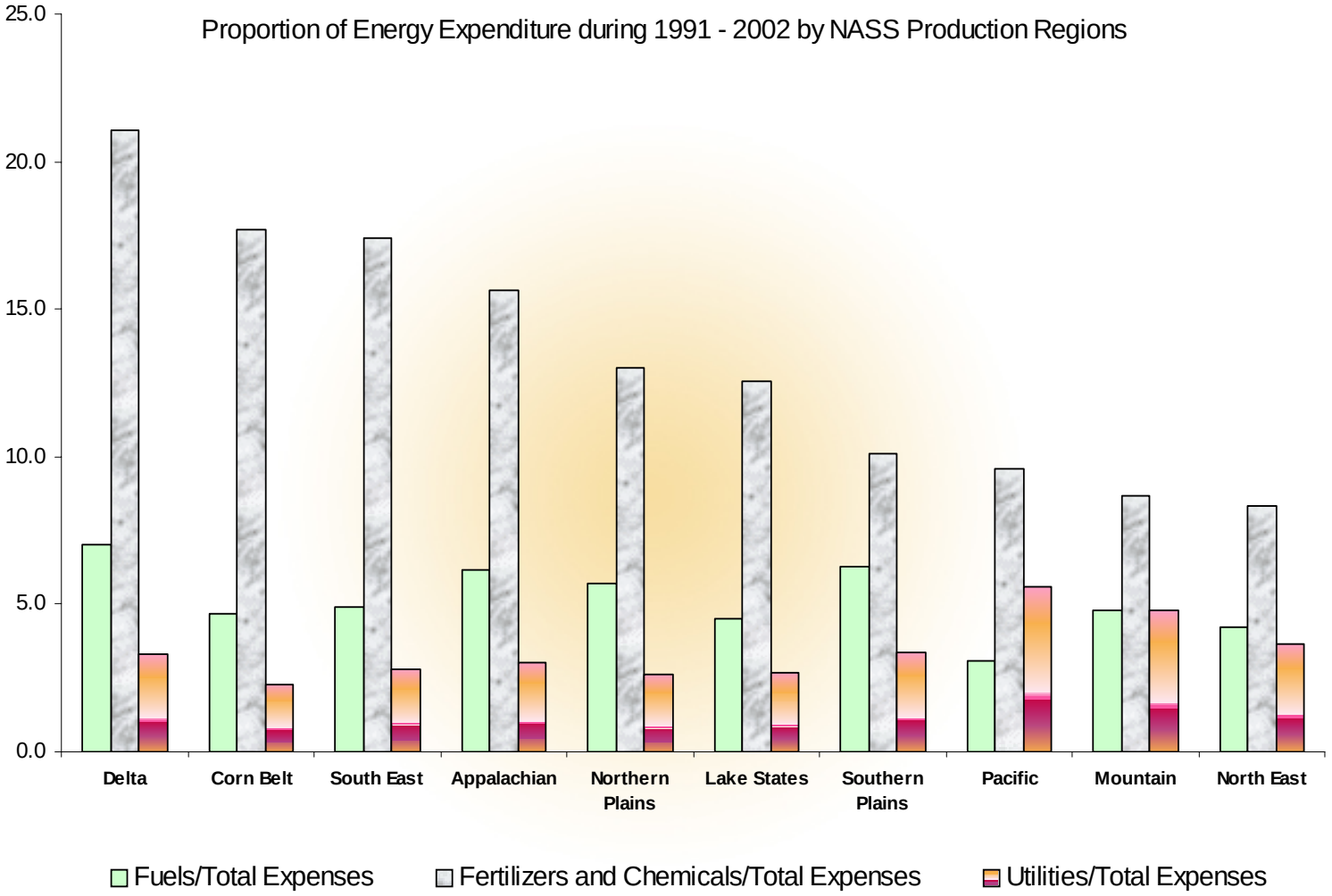
Direct Energy Expenditure per Dollar Expenditure and Output in 2002: Major Crop Farms



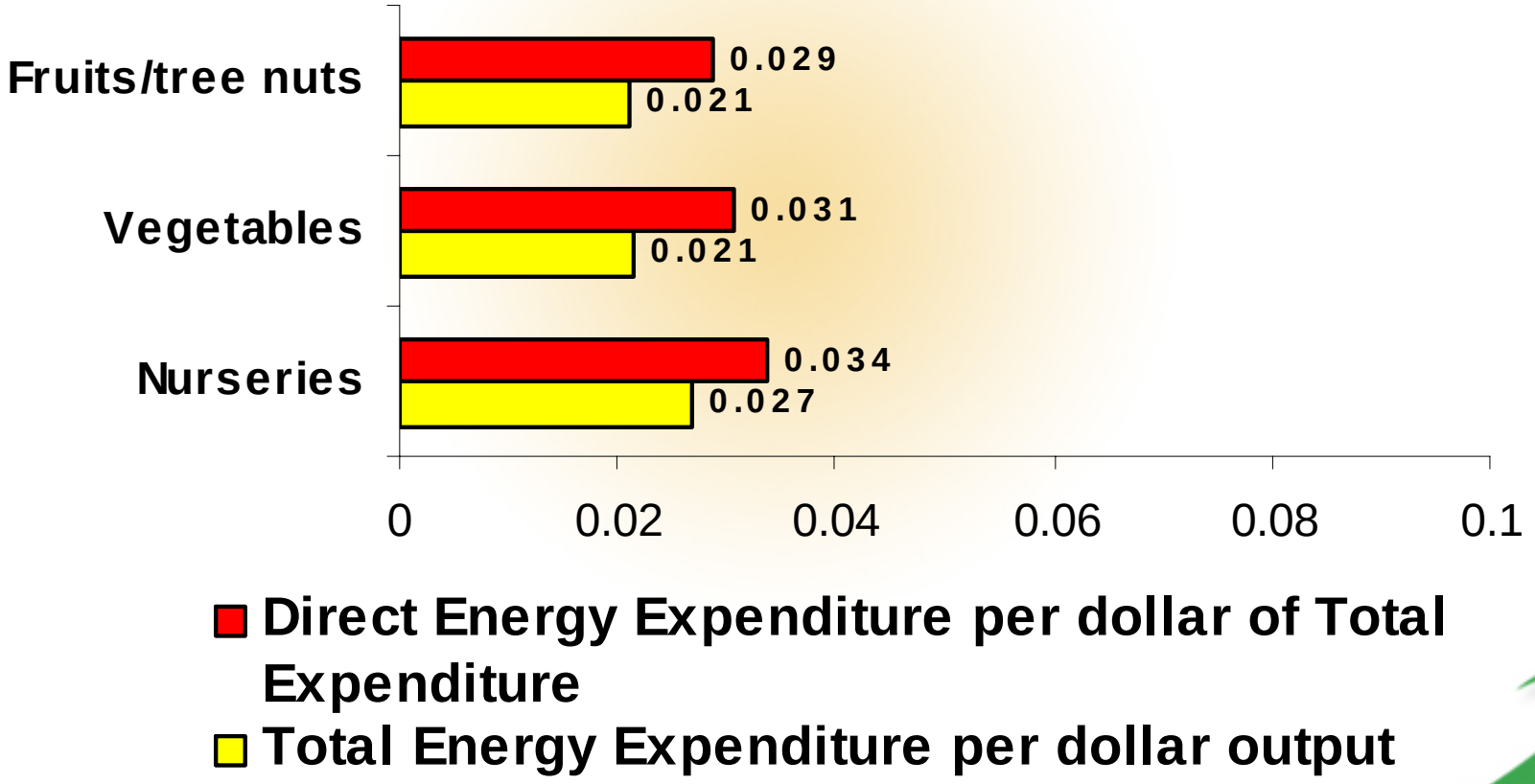
- Direct Energy Expenditure per dollar of Total Expenditure
- Direct Energy Expenditure per dollar Output

Direct Energy Expenditure per Dollar Expenditure and Output in 2002: Livestock




Proportion of Energy Expenditure during 1991 - 2002 by NASS Production Regions
25.0
20.0
15.0
10.0
5.0
0.0
Delta
Corn Belt
South East
Appalachian
Northern Plains
Lake States
Southern Plains
Pacific
Mountain
North East
Fuels/Total Expenses
Fertilizers and Chemicals/Total Expenses
Utilities/Total Expenses

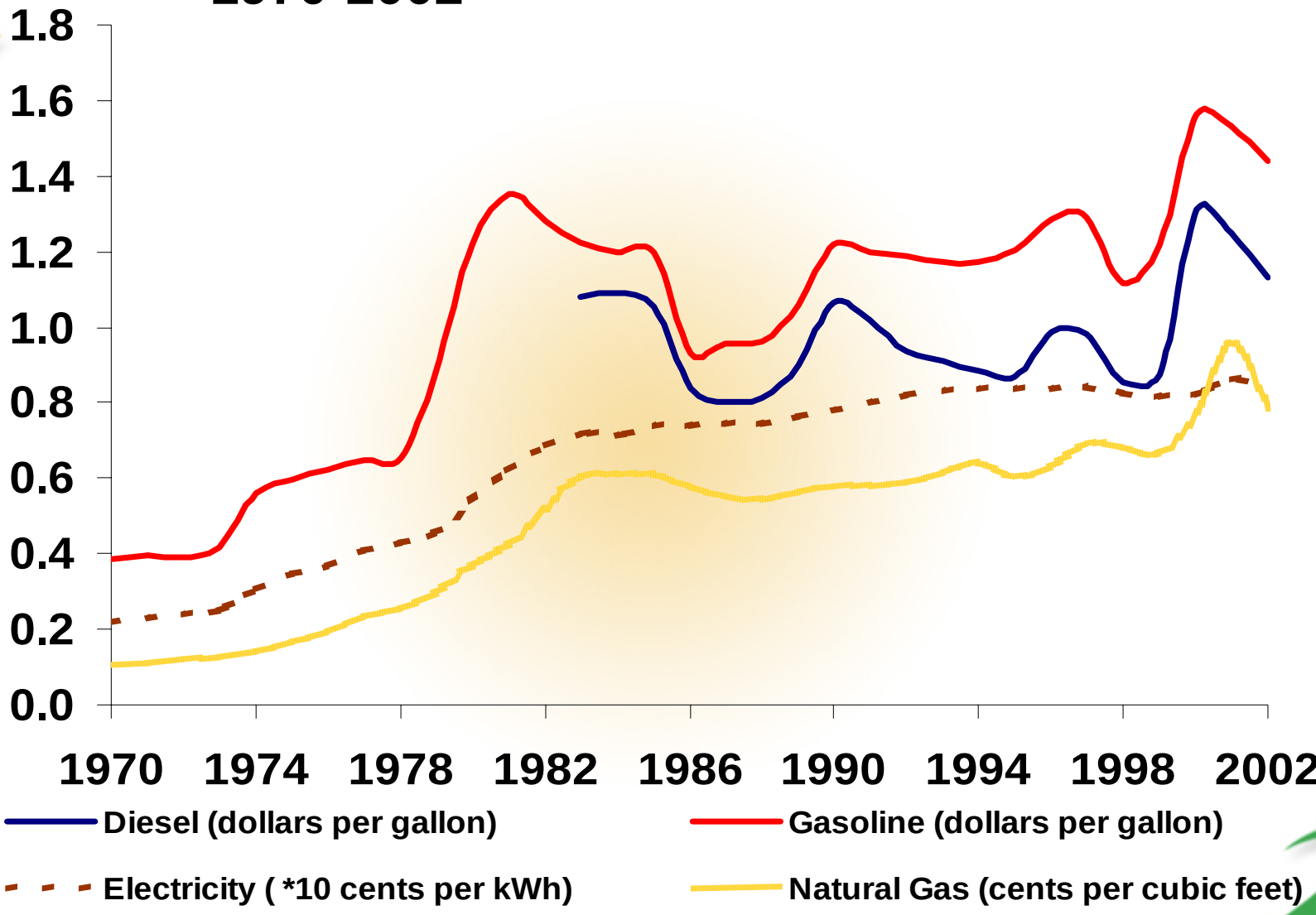
Direct Energy Expenditure per Dollar Expenditure and Output in 2002: Speciality Crops



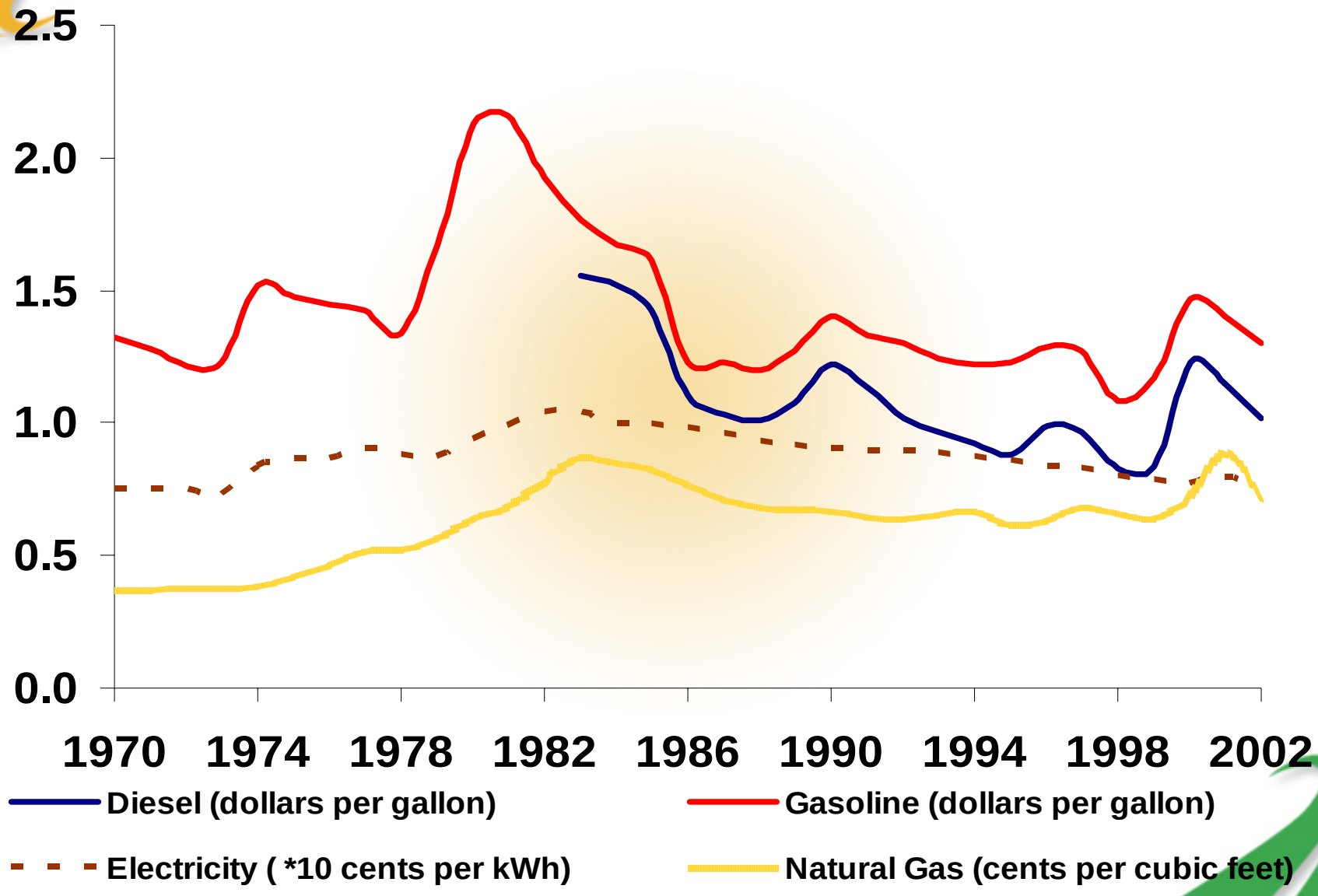
How do Producers Adjust to Energy Price Increases?

- What is happening to nominal and **real** energy prices?
- What adjustments to real energy price increases may we anticipate from producers?
- With relative energy price increases what substitution opportunities are available?

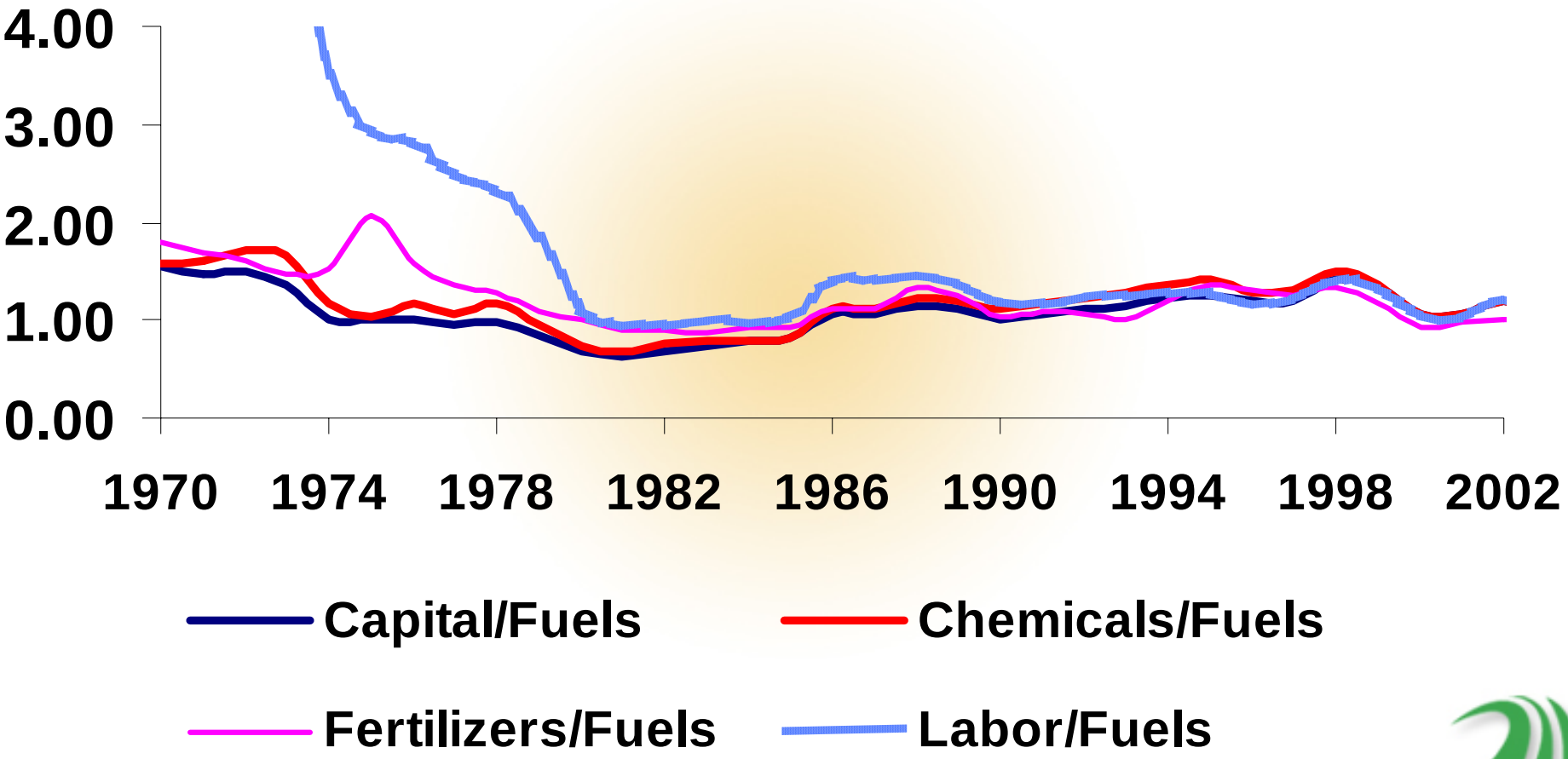
Nominal Prices of major fuel sources: 1970-2002



Real Prices of major fuel sources 1970-2002 (1996 dollars):



Relative Input Price Ratios



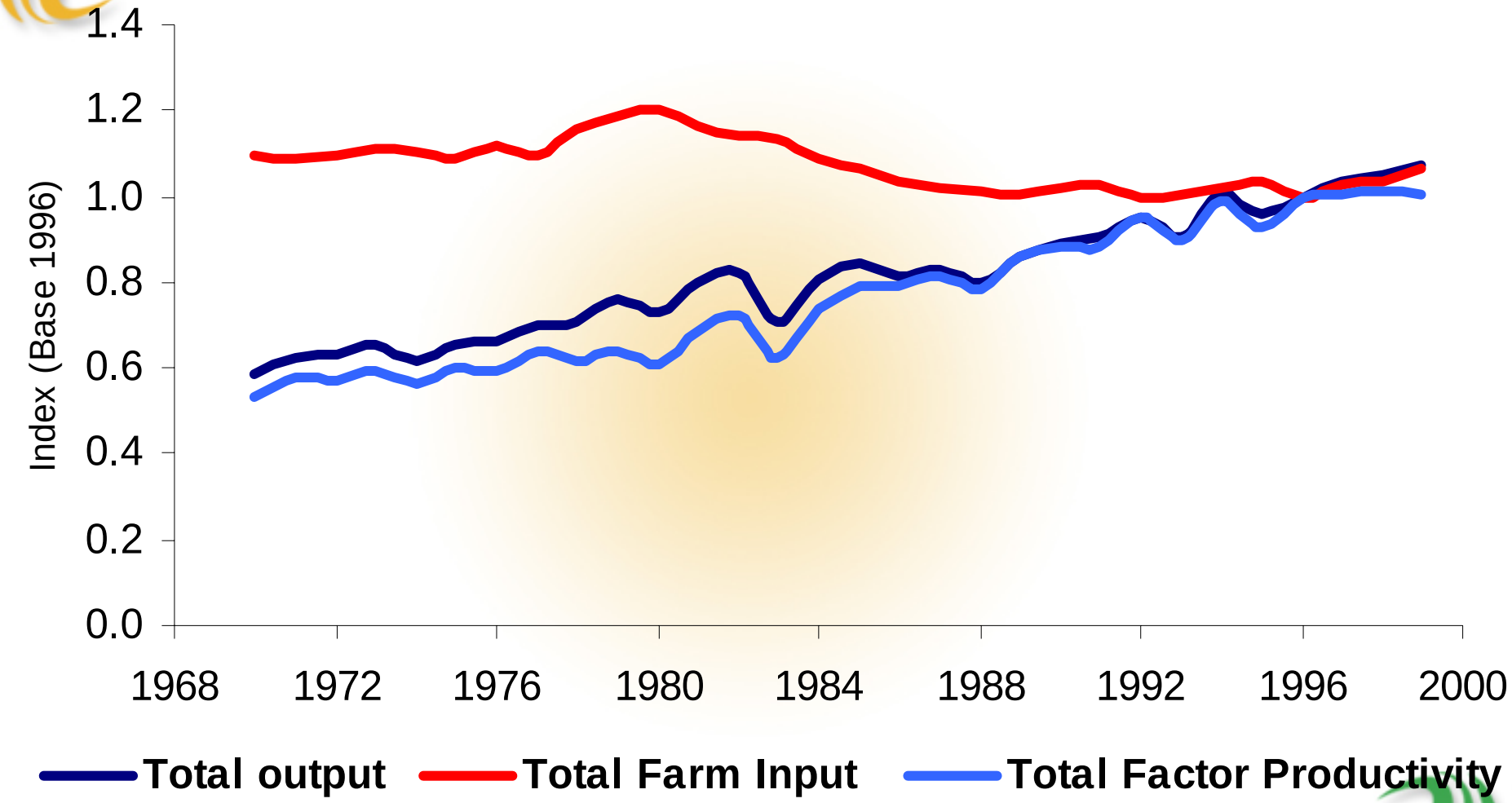
Own Price and Cross Price Elasticity Estimates

- Own price elasticity of direct and indirect energy inputs - -0.5 to -0.9
- A 10% increase in real energy prices will cause a 5-9% decrease in energy input use
- Short verses long-run elasticity estimates and farmer responsiveness
- Cross price elasticity estimates:
  - Energy/capital – 0.8
  - Energy/pesticides – 0.8
- No important input complementarities with energy

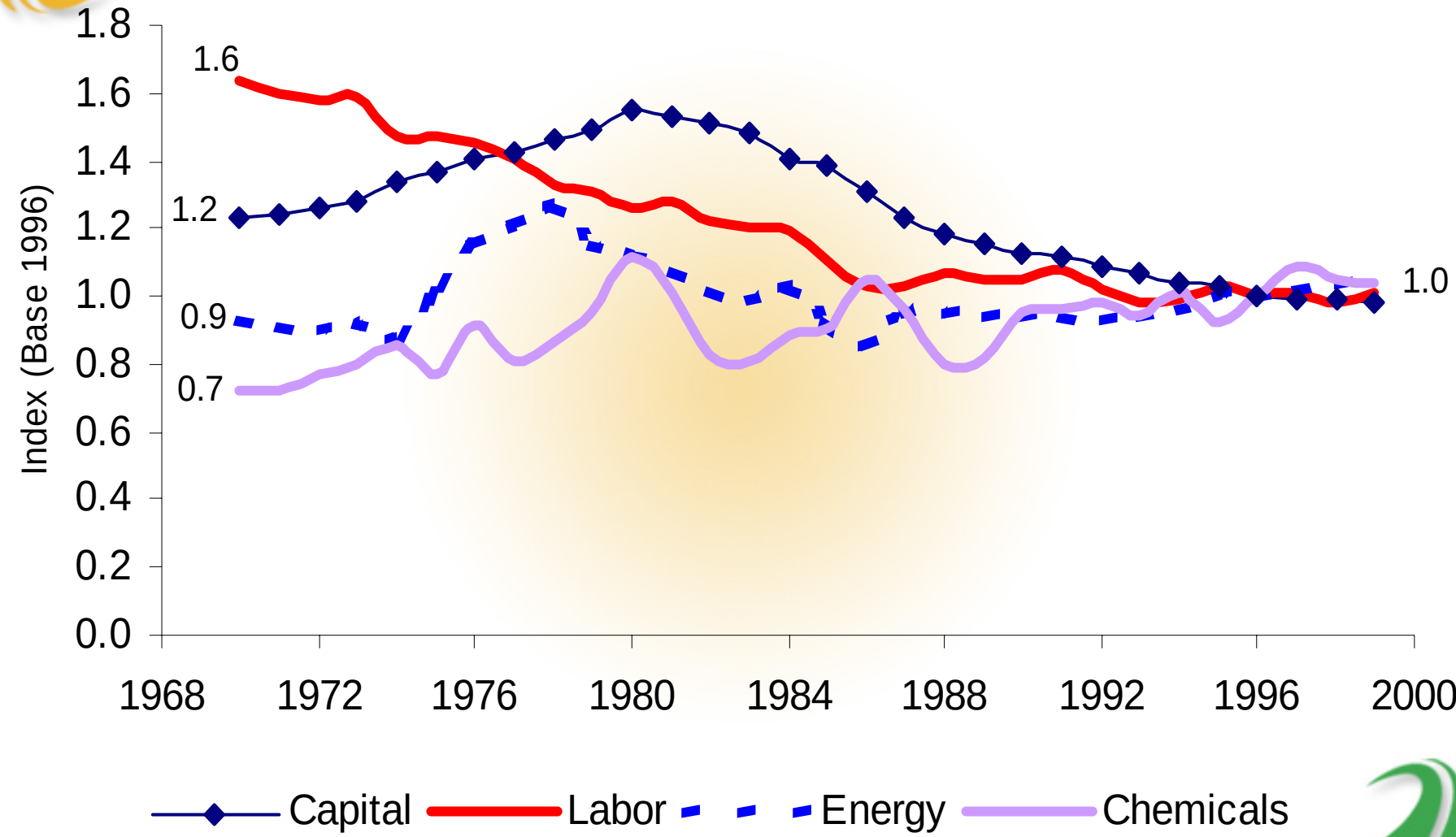
Farm Productivity and Efficiency

- 2% annual productivity growth in production agriculture
- Total input use is flat, but productivity and output are growing
- Individual input use declining except energy and chemicals after early 1990s
- Partial input productivity measures all increasing

Indices of Farm Output, Input Use and Productivity in US Agriculture



Indices of Major Farm Inputs Usage in US



Information and Technology Impacts on Energy Efficiency

- Continuation of productivity growth
- Substituting information for other inputs
- Substituting biotechnology for fertilizer, pesticides, energy, and pharmaceuticals
- Substituting information and knowledge for traditional breeding and husbandry

Rural Energy Security and Energy Supply Disruption Costs

- Energy disruption costs at points in production and processing
  - Specialty crop harvesting
  - Crop processing
  - Animal production
  - Animal harvesting
  - Dairy production
  - Fertilizer production
  - Ethanol production

- Seasonal energy use data would be required to assess such disruption costs

Integrating Farm Energy Demand and Supply

- Wind energy offers opportunities for on-farm or integrated energy production and use
- Bio-fuels have more limited on-farm potential due scale problems unless co-operative effort
- Solar offers potential power alternatives for livestock watering, electric fencing, and lighting in remote areas

Implications for Farm Energy Demand

- Important user of direct and indirect energy in crop and animal production
- Given sufficient time, producers do respond to real energy price incentives and make input and output adjustments
- Productivity growth enhances capacity to adjust
- Vulnerability to energy supply disruptions may be more critical, especially in short run

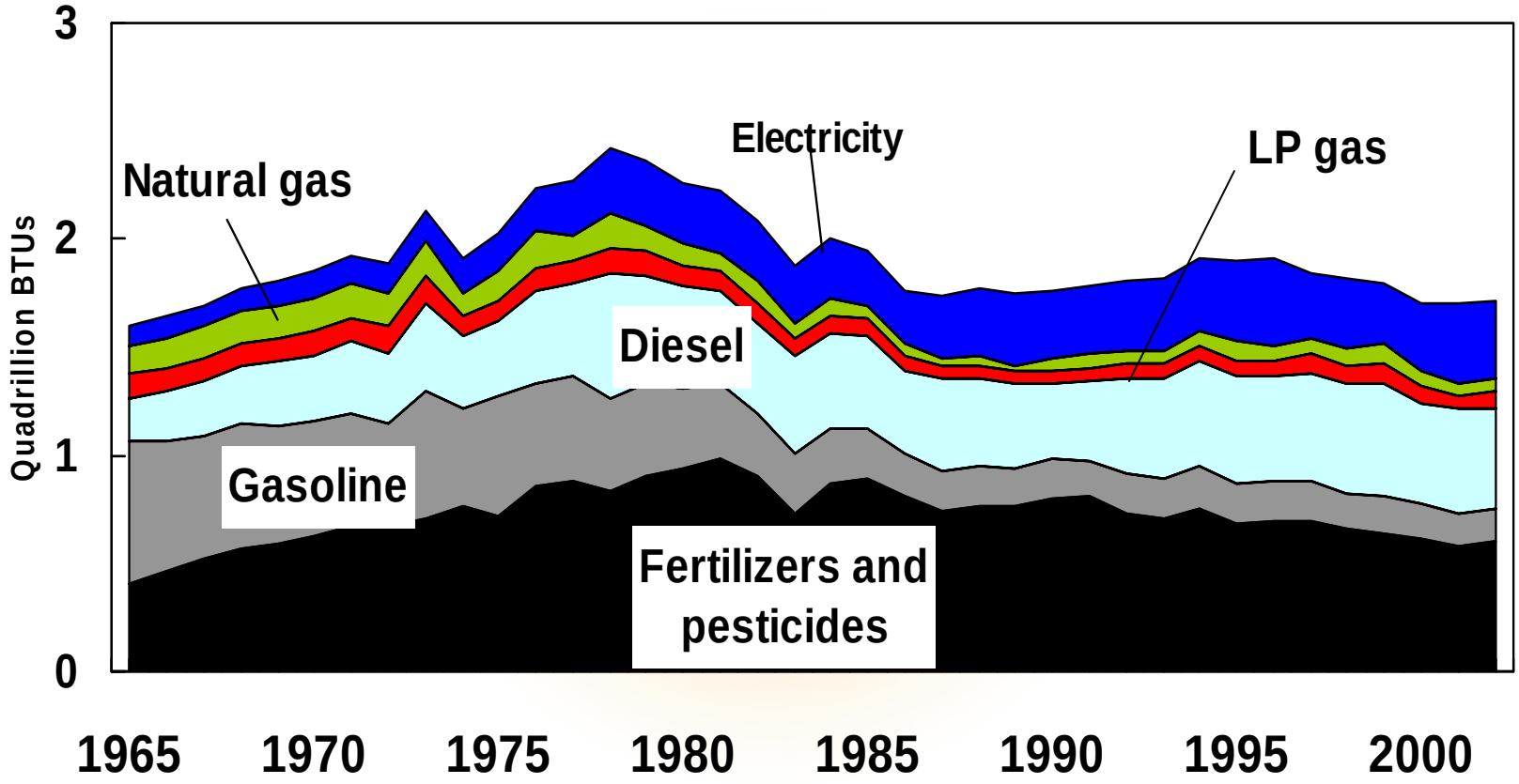
Conclusion

- Producers will mitigate impacts of real energy price increases and supply disruptions by modifying production practices given time to adjust
- Producers may invest in renewable energy and avoidance strategies
- Agriculture is resilient!

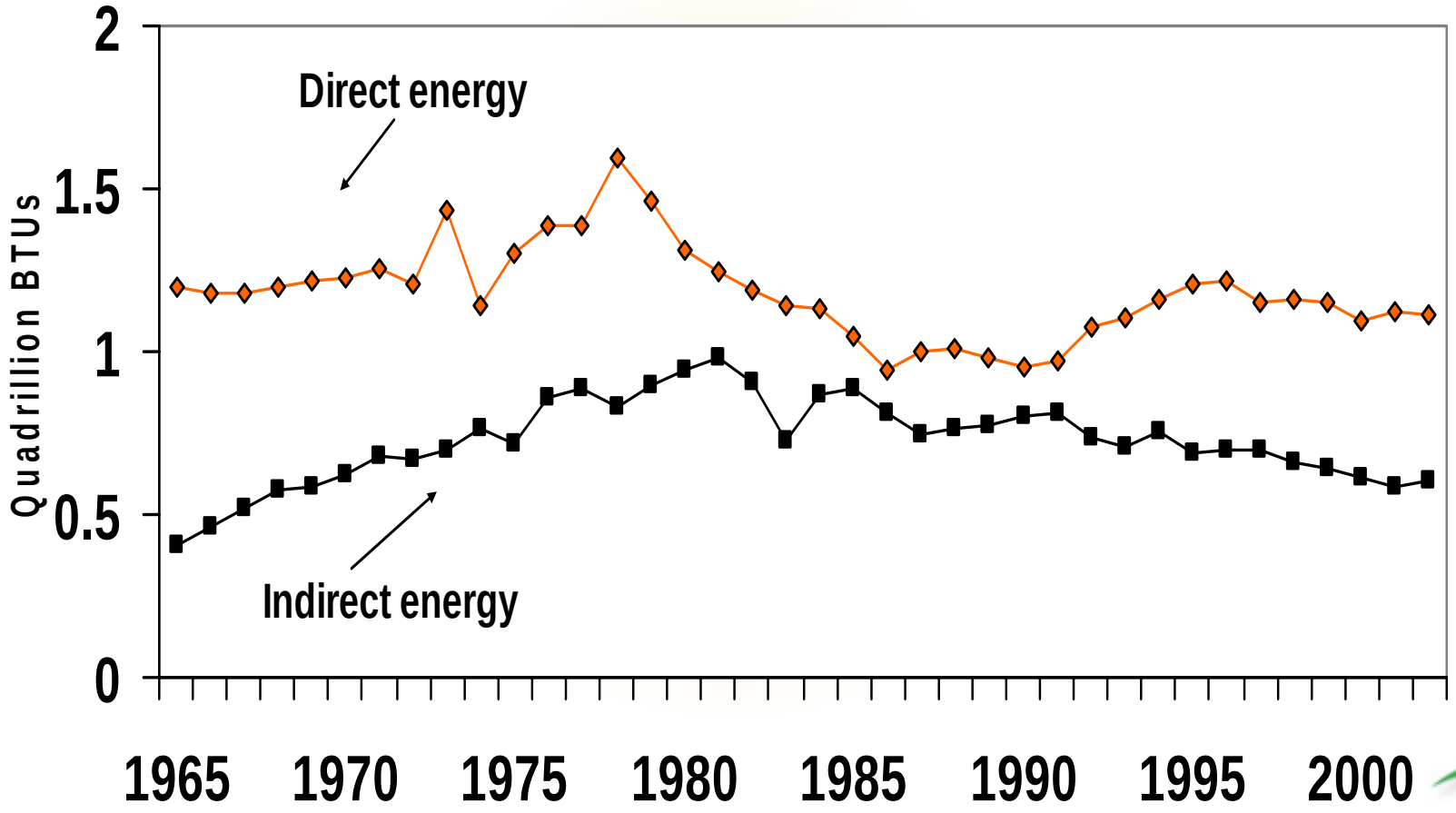
Thank You!

Supporting Slides

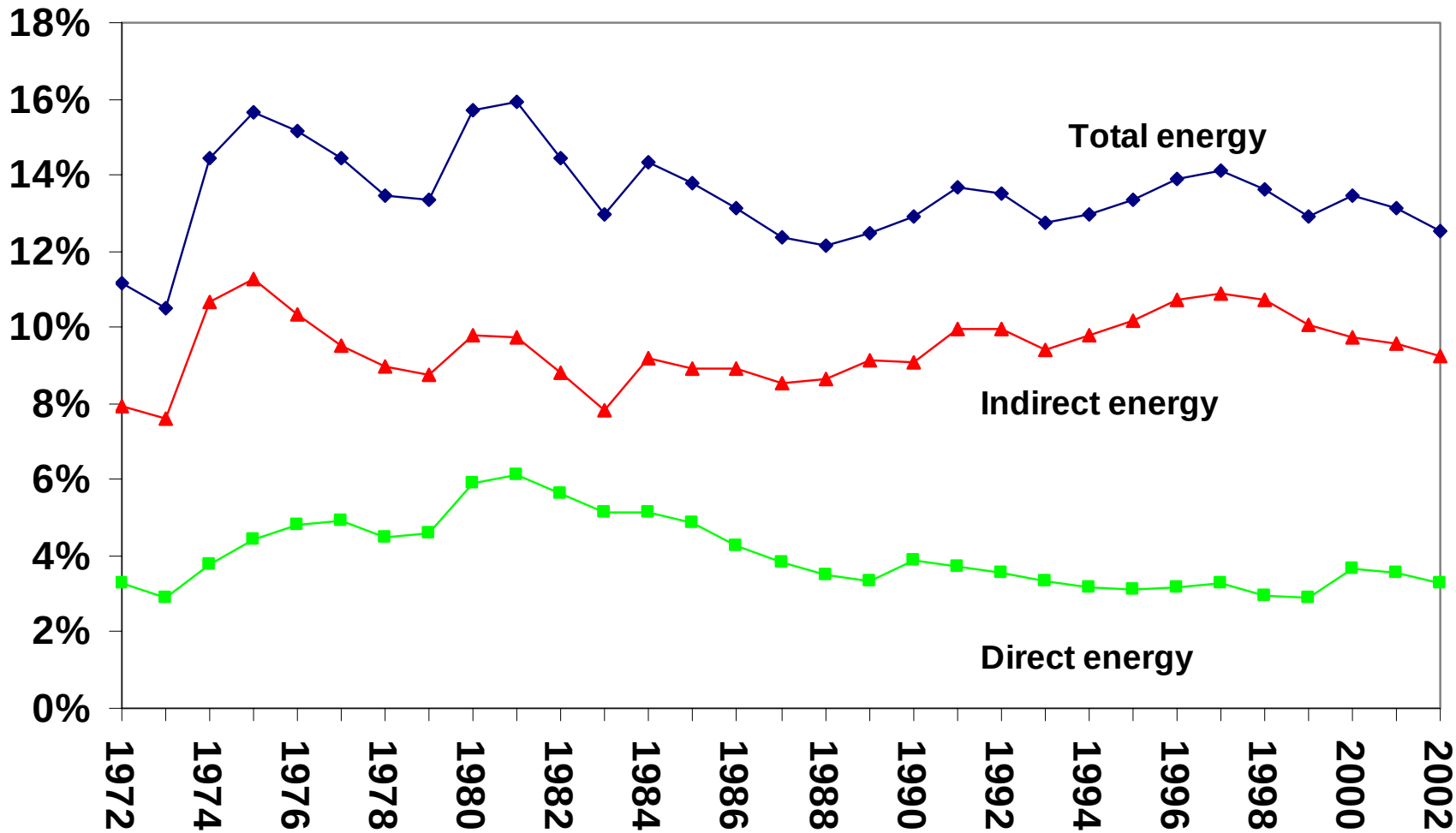
Total Energy Used on US Farms, 1965-2002



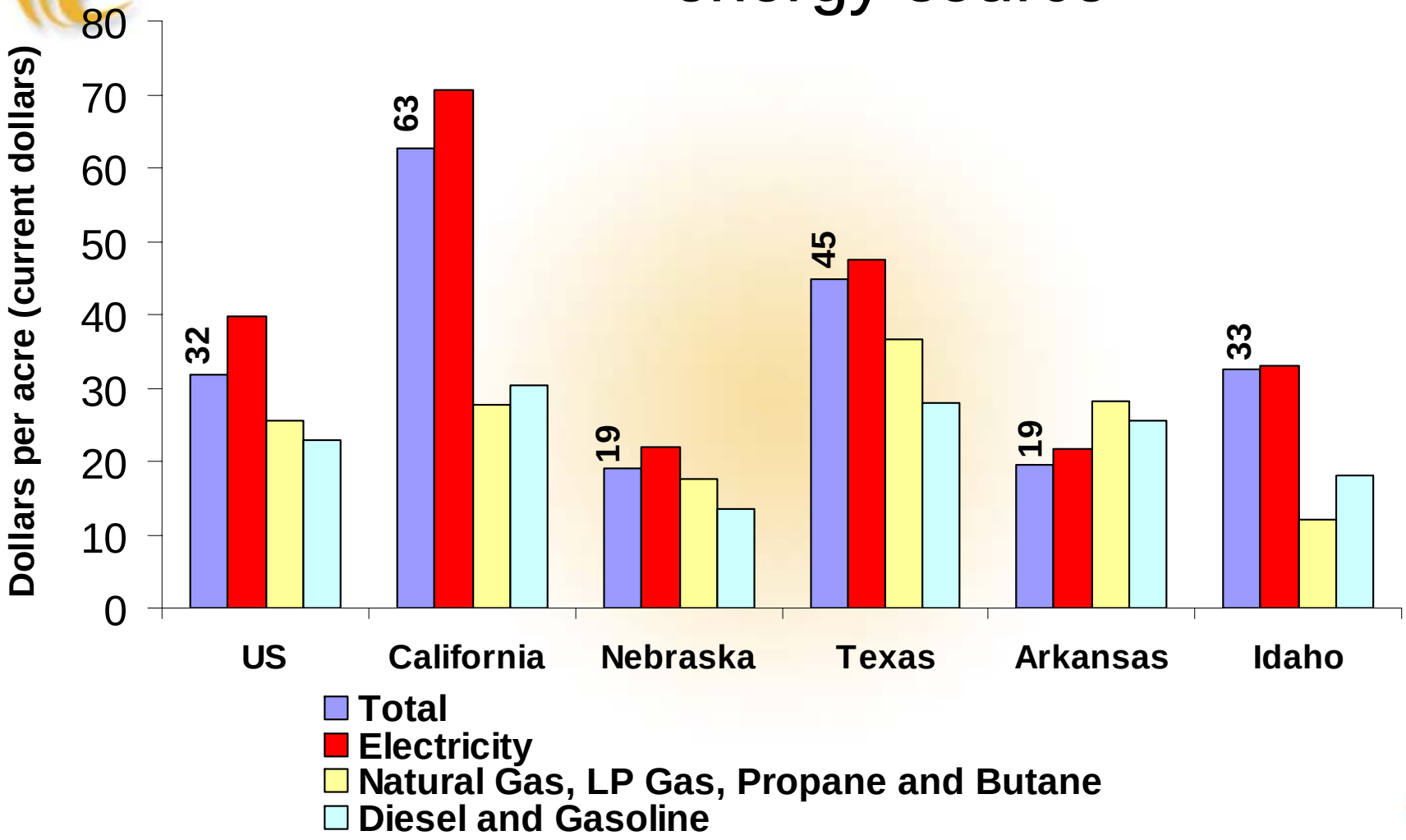
Direct and Indirect Energy Consumed on U.S. Farms, 1965-2002



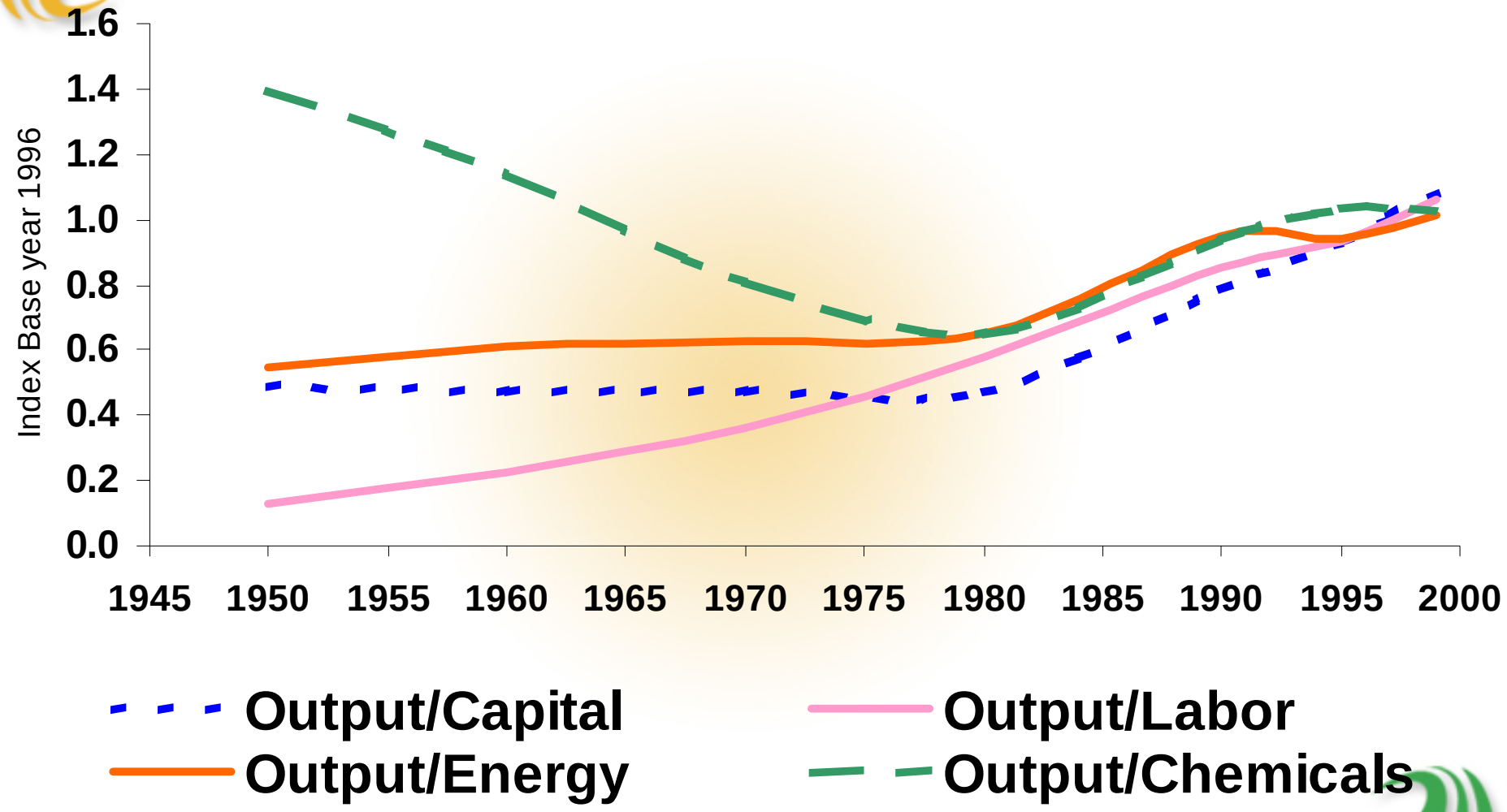
Energy's Share of Farm Production Expenses



Average Irrigation Costs Per Acre – by energy source



Partial Productivity indexes in US Agriculture:



Regional Energy Expense Shares in Farm Production

- Fuels and lubricants (direct)
  - Delta (7.6%) – Pacific (2.8%)
- Electricity (direct)
  - Pacific (5.8%) – Corn Belt (2.2%)
- Fertilizer and pesticides (indirect)
  - Delta (19.1%) – Northeast (6.8%)
- Summing top (32%) – bottom (12%)

Own Price Elasticity and Input Substitution Elasticities

Input	*Land*	*Labor*	*Capital*	*Energy*	*Fertilizers*	*Pesticide*
Land	**-0.28**					
Labor	**-0.27**	**-0.39**				
Capital	**0.73**	**0.65**	**-0.86**			
Energy	**0.35**	**0.59**	**1.13**	**-0.60**		
Fertilizers	***0.20***	***0.82***	***0.97***	***0.60***	***-0.66***	
Pesticides	***0.08***	***0.66***	***0.82***	***0.70***	***1.04***	***-0.53***

Energy Intensity (BTUs consumed per dollar) in US Agriculture, Food Manufacturing, Industry, and U.S. Economy