Agriculture in the climate change and energy price squeeze

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Sources of Support

USDA DOE
USEPA
CSiTE

Background

Biofuels offer a potential way of using abundant agricultural and forest resources to help reduce dependence on fossil fuel

This can contribute to

Improved energy security

Reductions in net greenhouse gas emissions

Possible lower cost on both

Solution to "Farm/rural Income Problem"

Today I will look into motivations for this and reveal a little of my work

Background

So what? Biofuels have been known to society throughout history

Their usage has diminished over the long run (we used a lot of wood in early 1900's) and has not greatly increased in the last few years particularly in unsubsidized forms

This is largely due to the availability of cheap fossil fuels.

Thus for biofuels to serve significant role as GHG offset or energy security enhancement or cost reduction then forces will have to arise that will make them competitive.

What will make Biofuels economic

Rising energy prices due to

- Scarcity and demand growth
- Increased cost of fossil fuel production
- Energy Security
- Trade disruption

Privately realized value placed on Greenhouse Gas offset

Lower costs of delivered feedstock because of higher yields, improved production practices, lower transport needs

Improved energy recovery efficiency

Subsidies

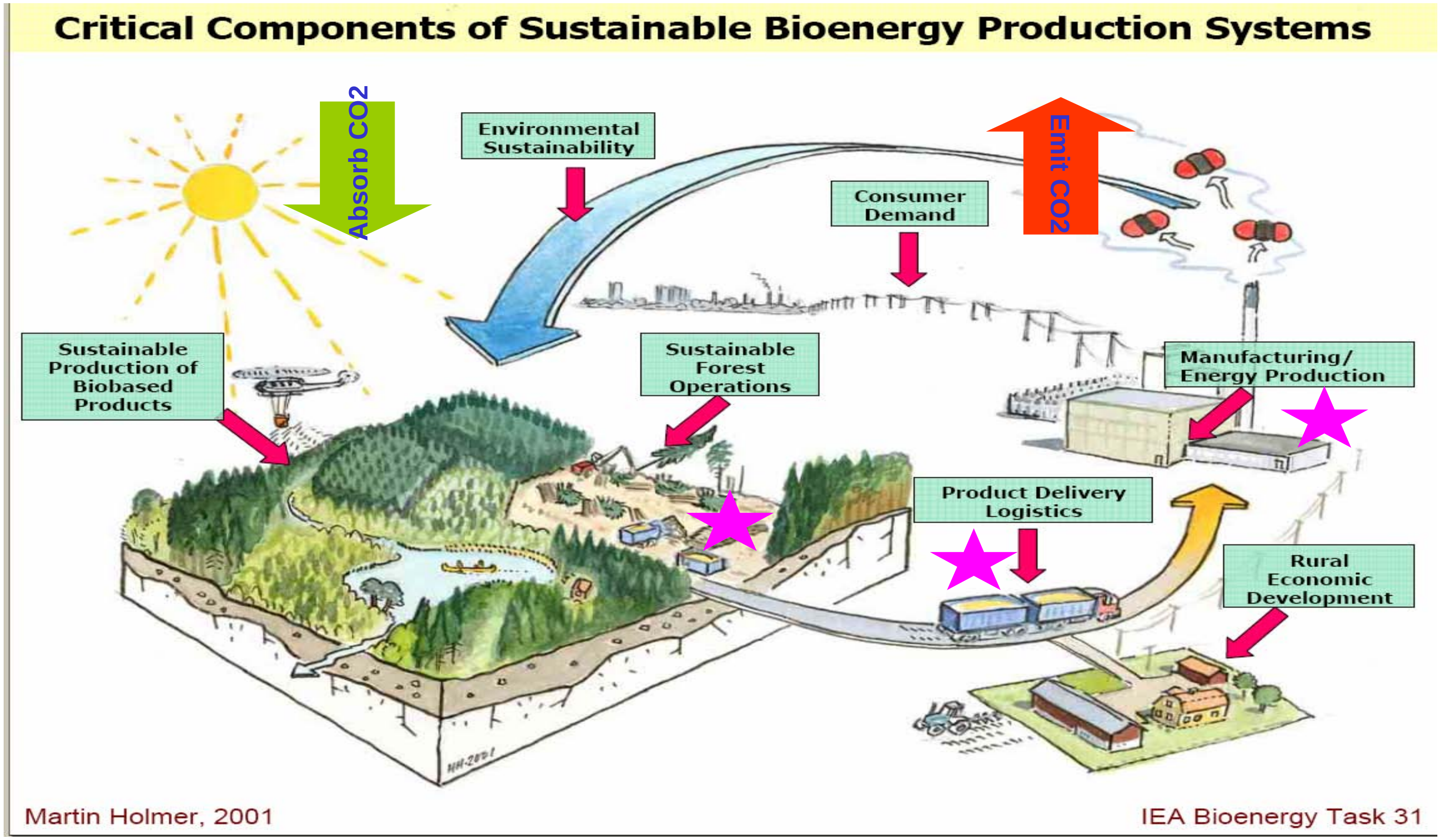
What will make Biofuels economic

Today I will talk about 2 topics

Biofuels as a GHG mitigation strategy

Biofuels and the energy price squeeze

Biofuels and Greenhouse Gasses



Please Pretend the growing stuff includes crops

Feedstocks take up CO2 when they grow

CO2 emited when feedstocks burned or when energy product derivatives burned

But Starred areas also emit

Source of underlying graphic: Smith, C.T. , L. Biles, D. Cassidy, C.D. Foster, J. Gan, W.G. Hubbard, B.D. Jackson, C. Mayfield and H.M. Rauscher, "Knowledge Products to Inform Rural Communities about Sustainable Forestry for Bioenergy and Biobased Products", IUFRO Conference on *Transfer of Forest Science Knowledge and Technology,* Troutdale, Oregon, 10-13 May 2005

Offset Rates Computed Through Lifecycle Analysis

Net Carbon Emission Reduction (%)

Bio feedstock	Ethanol	Biodiesel
Corn	43	11
Soybeans		96
Sorghum	45	
Barley	43	
Oats	39	
Rice	12	
Soft White Wheat	42	
Hard Red Winter Wheat	41	
Durham Wheat	39	
Hard Red Spring Wheat	42	
Sugar	28	

Ethanol offsets are in comparison to gasoline

Opportunities have different potentials

Offset Rates Computed Through Lifecycle Analysis

Net Carbon Emission Reduction (%)

	Ethanol	Electricity
Bio feedstock		
Switchgrass	81	87
Hybrid Poplar	72	89
Willow	74	94
Bagasse	86	95
Corn Residue	84	91
Wheat Residue	79	88
Sorghum Residue	73	76
Barley Residue	56	64
Rice Residue	55	62
Softwood Mill Residue	76	95
Hardwood Mill Residue	76	95
Softwood Log Residue	68	91
Hardwood Log Residue	69	91
Manure		91

Electricity offsets higher when cofired due to Efficiency and less hauling

Ethanol offsets are in comparison to gasoline

Power plants offsets are in comparison to coal.

Opportunities have different potentials

Offset Rates Computed Through Lifecycle Analysis

Net Carbon Emission Reduction (%)

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Sugarcane	28		
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Manure		91	

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Opportunities have different potentials

Biofuel feedstocks and products

	Ethanol	Cell Ethanol	BioDiesel	Electricity
Agricultural and forestry products:				
Corn, Wheat, Sorghum, Rice	X			
Sugar Cane	X			
Timber		X		X
Production residues:				
Crop Residue		X		X
Logging Residue		X		X
Manure				X
Processing products and by products:				
Bagasse		X		X
Soybean/Corn Oil			X	
Rendered Animal Fat			X	
Milling Residue		X		X
Yellow Grease			X	
Energy crops:				
Switchgrass		X		X
Willow		X		X
Hybrid Poplar		X		X

Cell ethanol is prospective we don't really have to know how to do at scale

Electricity may neeed to be cofired or we need new handling procedures

McCarl Portfolio Project

- A multi-period analysis of ag potential response in terms of portfolio
- Today agricultural in 30 year setting
- Examines overall and component responses at varying carbon equivalent and energy prices with technology soon
  - Varies coal, carbon and gasoline price
- Simultaneous assessing across all agricultural GHG mitigation strategies including biofuels
- Simultaneous modeling of agricultural markets and other agricultural environmental problems

GHG Activities in Analysis

- **Multiple GHG mitigation strategy setup**
- **Detailed GHG emission accounting**
  - **Forest carbon**
  - **Soil carbon**
  - **N2O**
  - **CH4**
  - **Fuel use carbon emissions**
- **National GHG balance**
- **GWP weighted sum of all GHG accounts**
- **GHG Policy implementation**

FASOMGHG MITIGATION OPTIONS

Strategy	Basic Nature	CO_2	CH_4	N_2O
Crop Mix Alteration	Emis, Seq	X		X
Crop Fertilization Alteration	Emis, Seq	X		X
Crop Input Alteration	Emission	X		X
Crop Tillage Alteration	Emission	X		X
Grassland Conversion	Sequestration	X		
Irrigated /Dry land Mix	Emission	X		X
Biofuel Production	Offset	X	X	X
Stocker/Feedlot mix	Emission		X	
Enteric fermentation	Emission		X	
Livestock Herd Size	Emission		X	X
Livestock System Change	Emission		X	X
Manure Management	Emission		X	X
Rice Acreage	Emission	X	X	X
Afforestation (not today)	Sequestration	X		
Existing timberland Management	Sequestration	X		
Deforestation	Emission	X		

Why not just biofuels

We consider biofuel net contribution to GHG emissions considering carbon dioxide, nitrous oxide and methane not biofuels in isolation

We examine relative desirability as compared to other GHG mitigation strategies

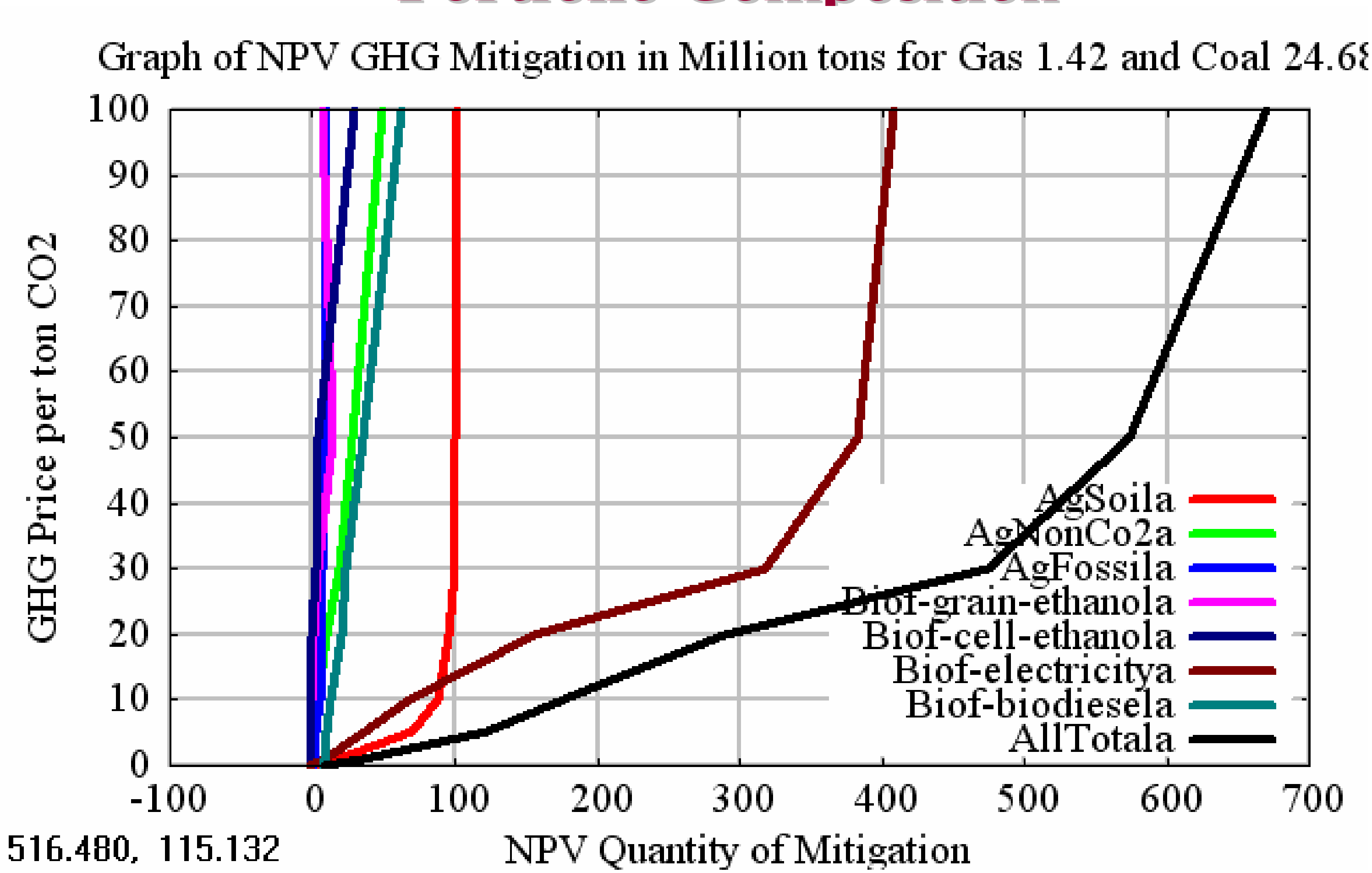
Why?

incredible interrelatedness of ag economy

opportunity cost of resources

Land to crops to feed to cattle all involved with GHG

Portfolio Composition



Note the energy prices are those at zero CO2 price and effective price increases with CO2 price

Ag soil goes up fast then plateaus and even comes down

Why – Congruence and partial low cost

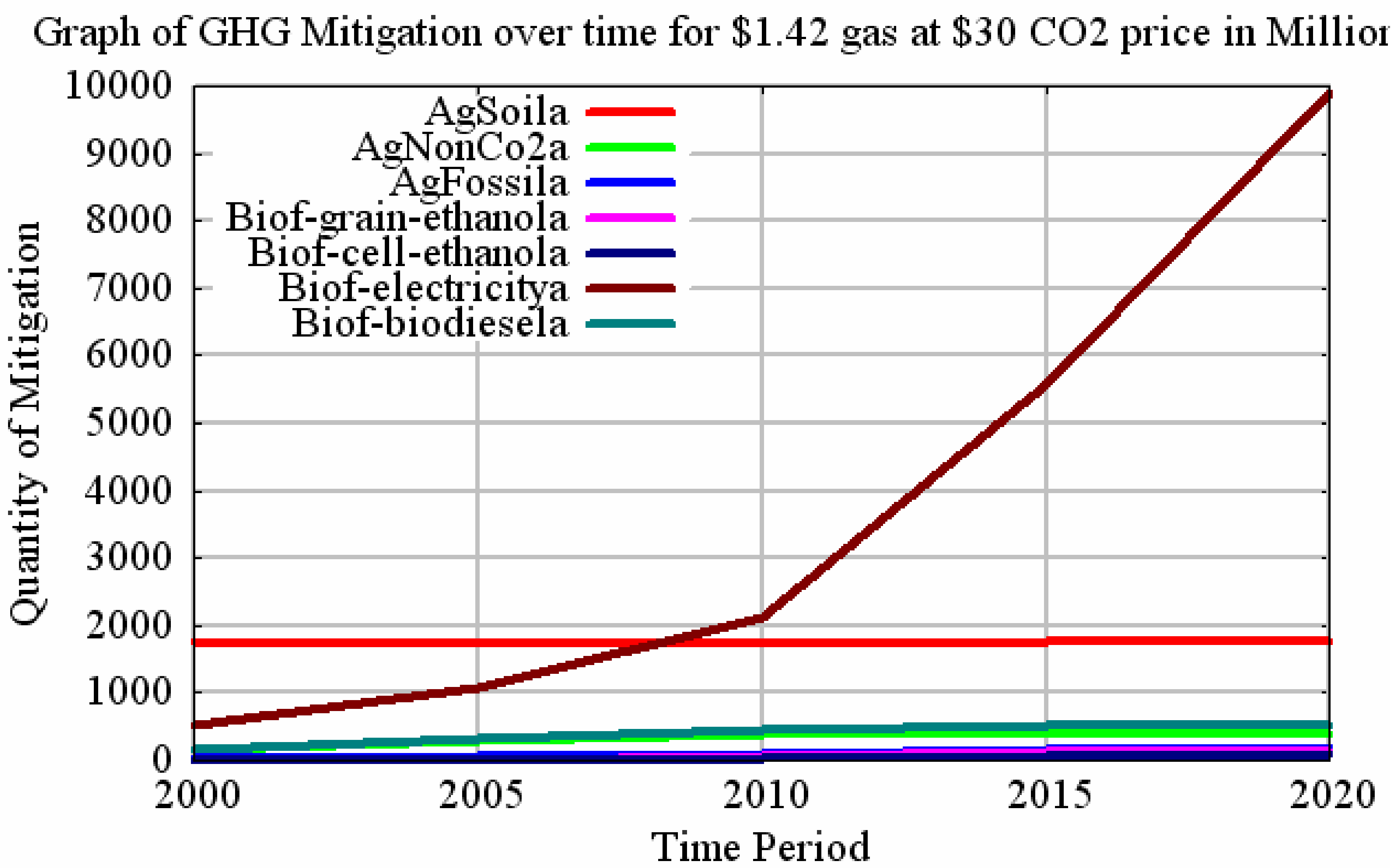
Lower per acre rates than higher cost alternatives

Biofuel takes higher price but takes off

Biodiesel most important liquid fuel increases with carbon proce

Other small and slowly increasing

GHG Over time



What have we learned

Been doing this for 7-8 years

Biofuels always one of big ones compared to other GHG mitigation strategies Other big one \ not addressed to day is afforestation

Why

- **Sequestration saturates, impermanent, uncertain**
  - **non point**
- **Fertilization – we still want food don’t we**
- **Livestock – numbers small**
- **Fossil fuel – numbers small**
- **Measurement and monitoring, transaction cost**

What have we learned

Biofuels avoid some problems

- Permanent (coal and petroleum still in ground
- Measure by volume made at point location
- Large industry numbers
- May not need permits
- Net energy use offset will be right if fossill fuel needs permits

GHG and Money

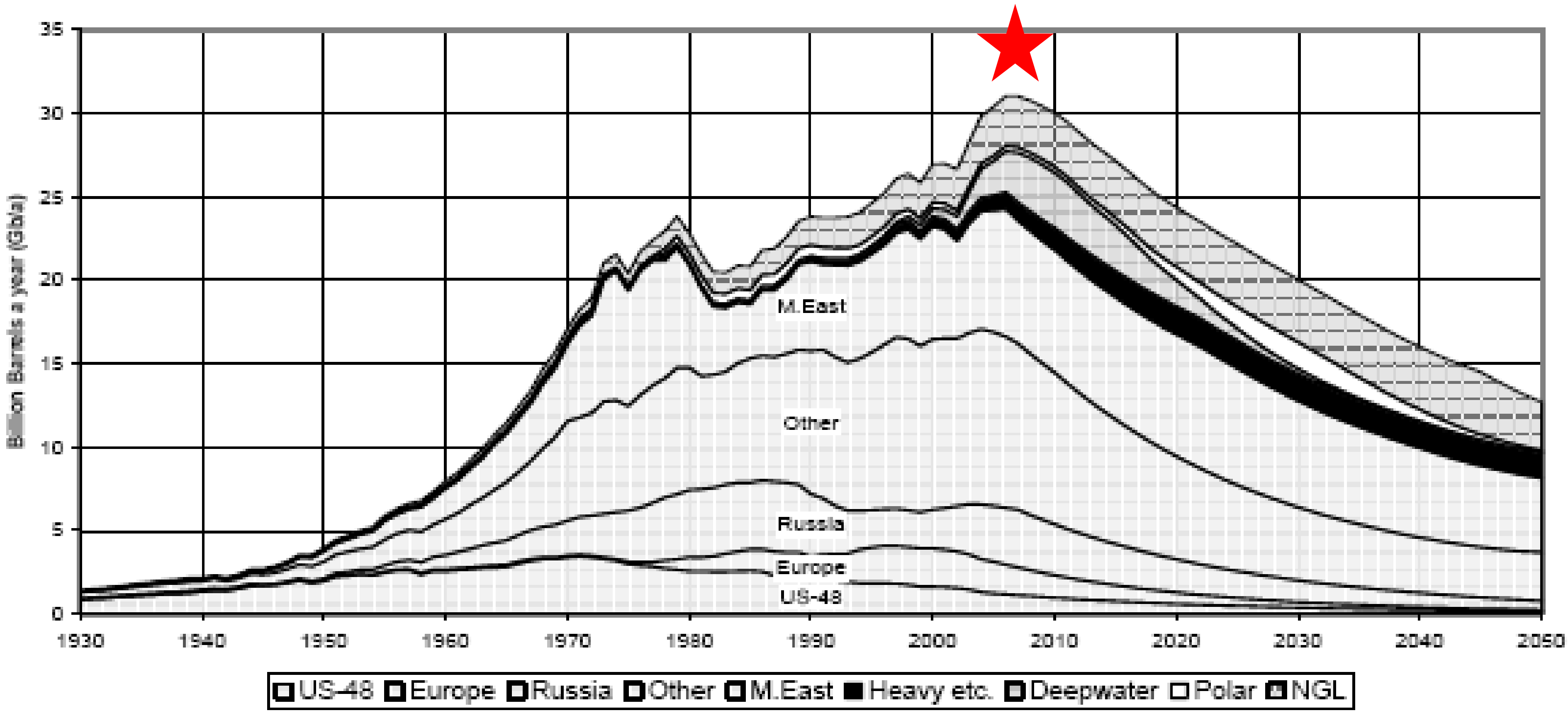
- **If we cap GHG emissions biofuel prices and demand will rise**
- **Biofuels will likely not create items sold in carbon market**
- **Fossil energy production or consumption will require emission permits raising price to consumers of fossil fuel use**
- **Biofuel combustion will likely not require such permits and price will rise on a BTU or other basis to price of fossil fuel**
- **Biofuel manufacturers will have to pay higher price for fossil fuels or use biofuel products in energy production thus offsetting GHG earnings by emissions or reduced production**
- **Money to be made more for larger offsets**
- **Negative emissions with Carbon Capture and Storage**

Now Energy Price

Supply of conventional energy

Demand for Energy

Scarcity and Fossil Fuel Cost

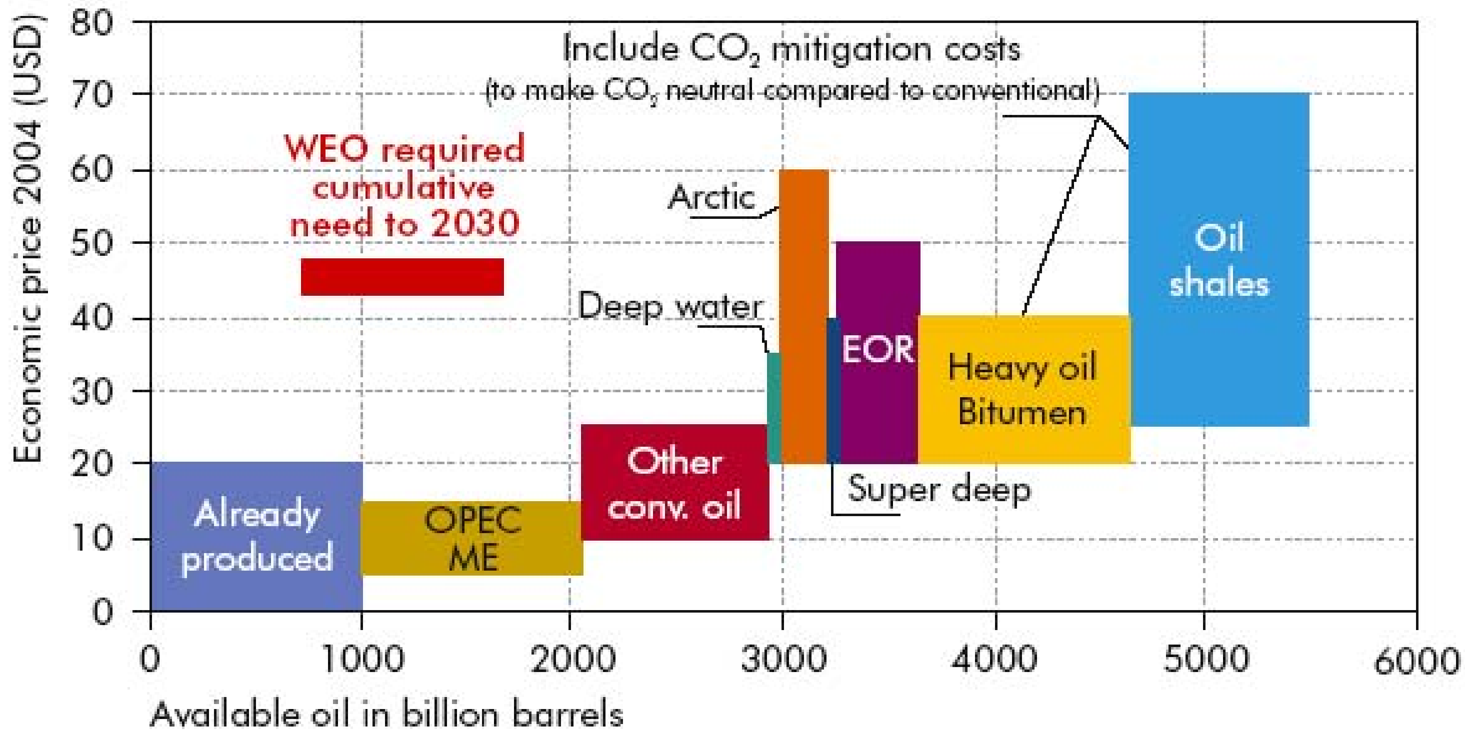


Graph of Oil Production
Source: Colin Campbell of the Association for the Study of Peak Oil and Gas (ASPO) Newsletter as in Wikapedia http://en.wikipedia.org/wiki/Peak_oil

Global Conventional Oil Production May Peak Soon
US has as has Texas

Scarcity and Fossil Fuel Cost

Figure ES.1 • *Oil cost curve, including technological progress: availability of oil resources as a function of economic price*



The x axis represents cumulative accessible oil. The y axis represents the price at which each type of resource becomes economical.

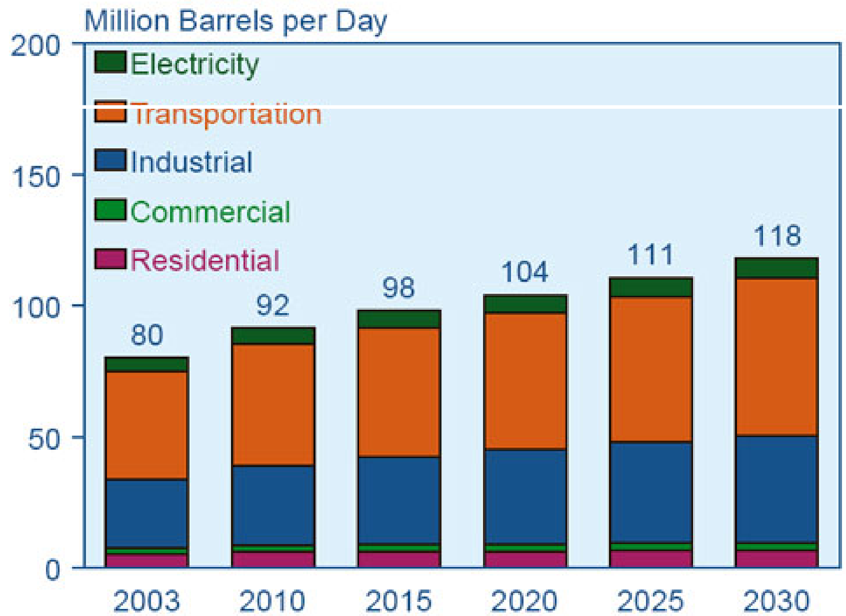
Source: IEA.

Lots of Oil But recovery cost will increase

Source: International Energy Agency Resources to Reserves Report
http://www.iea.org/Textbase/npsum/oil_gasSUM.pdf

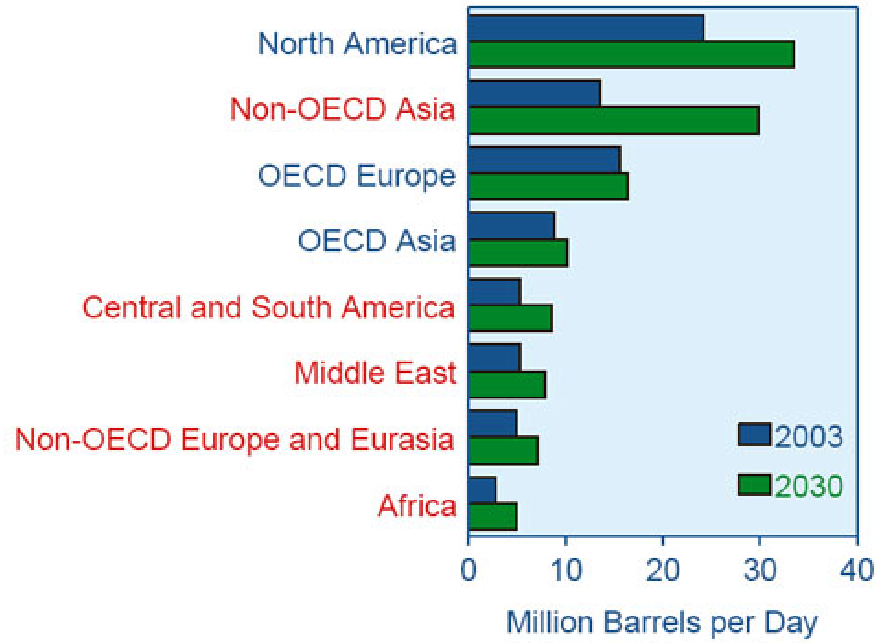
Consumption - Global

Figure 26. World Oil Consumption by Sector, 2003-2030



Sources: **2003:** Derived from Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2006).

Figure 27. World Oil Consumption by Region and Country Group, 2003 and 2030



Sources: **2003:** Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2030:** EIA, System for the Analysis of Global Energy Markets (2006).

Source USDOE, Energy Information Agency, International Energy Outlook 2006 Report #:DOE/EIA-0484(2006)
Release Date: June 2006 , http://www.eia.doe.gov/oiaf/ieo/oil.html

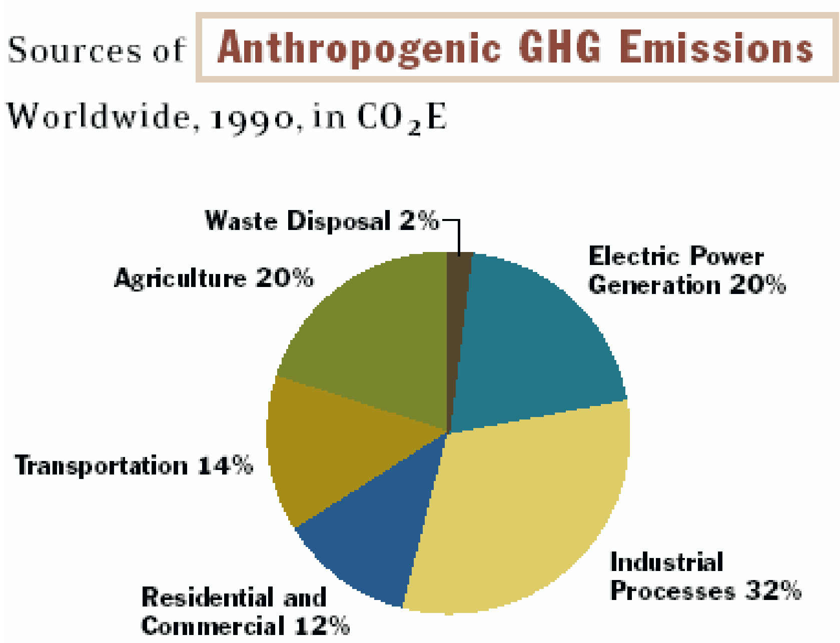
Large demand growth especially in US and Asia – China and India

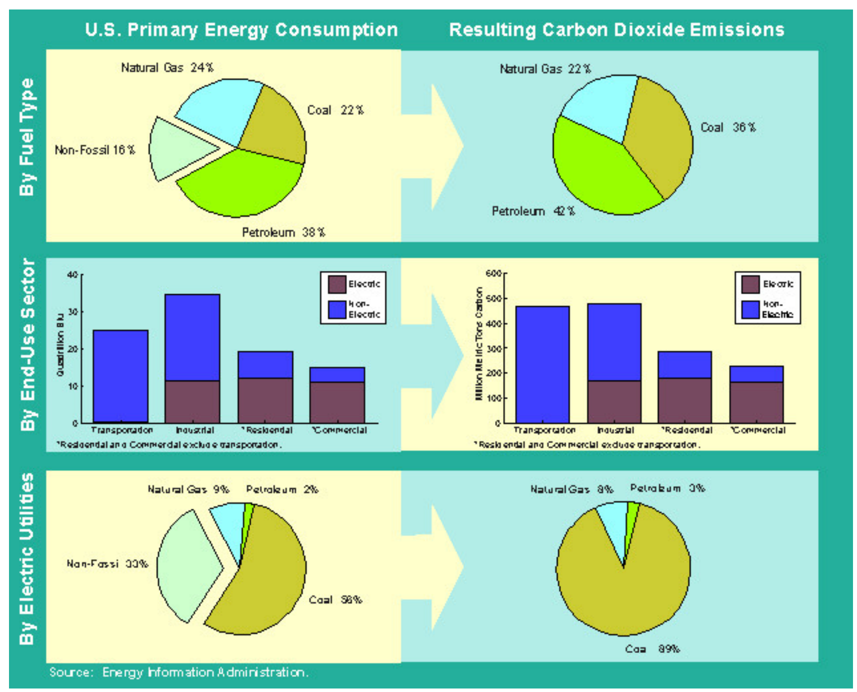
Electricity - Global

- **Large demand growth especially in US and Asia – China and India**

  On electricity side "more power plants in process of development/construction than have been built in all time

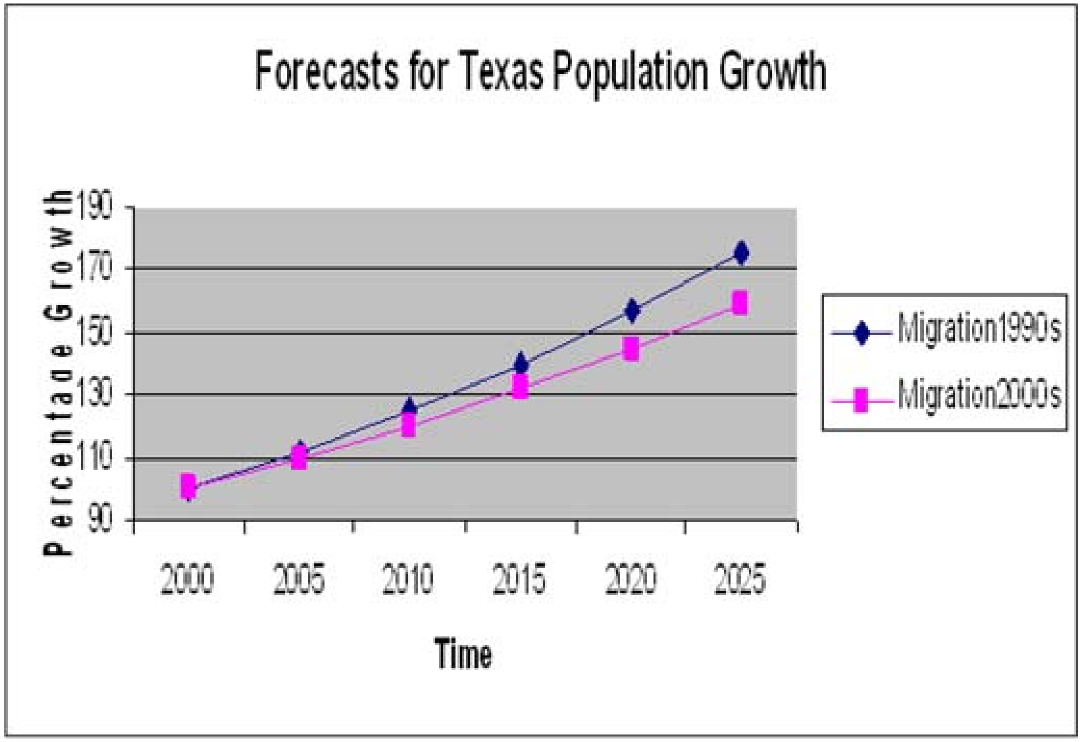
  In US large emissions block from electricity (42%) probably with growing share, globally 34%





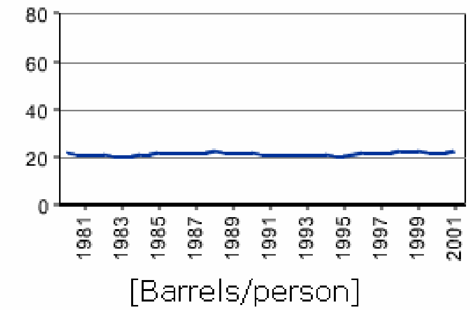
Source : Pew http://www.pewclimate.org/global-warming-basics/facts_and_figures/anthroghg.cfm

Consumption - Texas

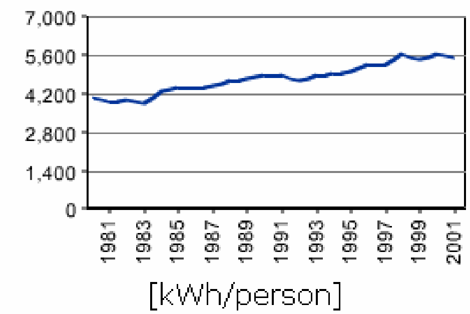


Source: Texas State Demographer
http://txsdc.utsa.edu/tpepp/2006projections/

Texas Per Capita consumption of Petroleum for Transportation, 1980 - 2001



Texas Residential Consumption of Electricity Per Capita 1980 - 2001



Source: USDOE Texas Energy Consumption
http://www.eere.energy.gov/states/state_specific_statistics.cfm/state=TX#consumption

60-80% growth in 20 years

Liquid fuel rises at rate of population, electricity faster

17 coal fired plants in licensing

Energy Economics Conclusion

Growing scarcity of conventional oil

Alternative sources possible at higher cost

= Higher cost future supply

Growing demand for Energy

(electricity and liquid fuels)

Global and Texas

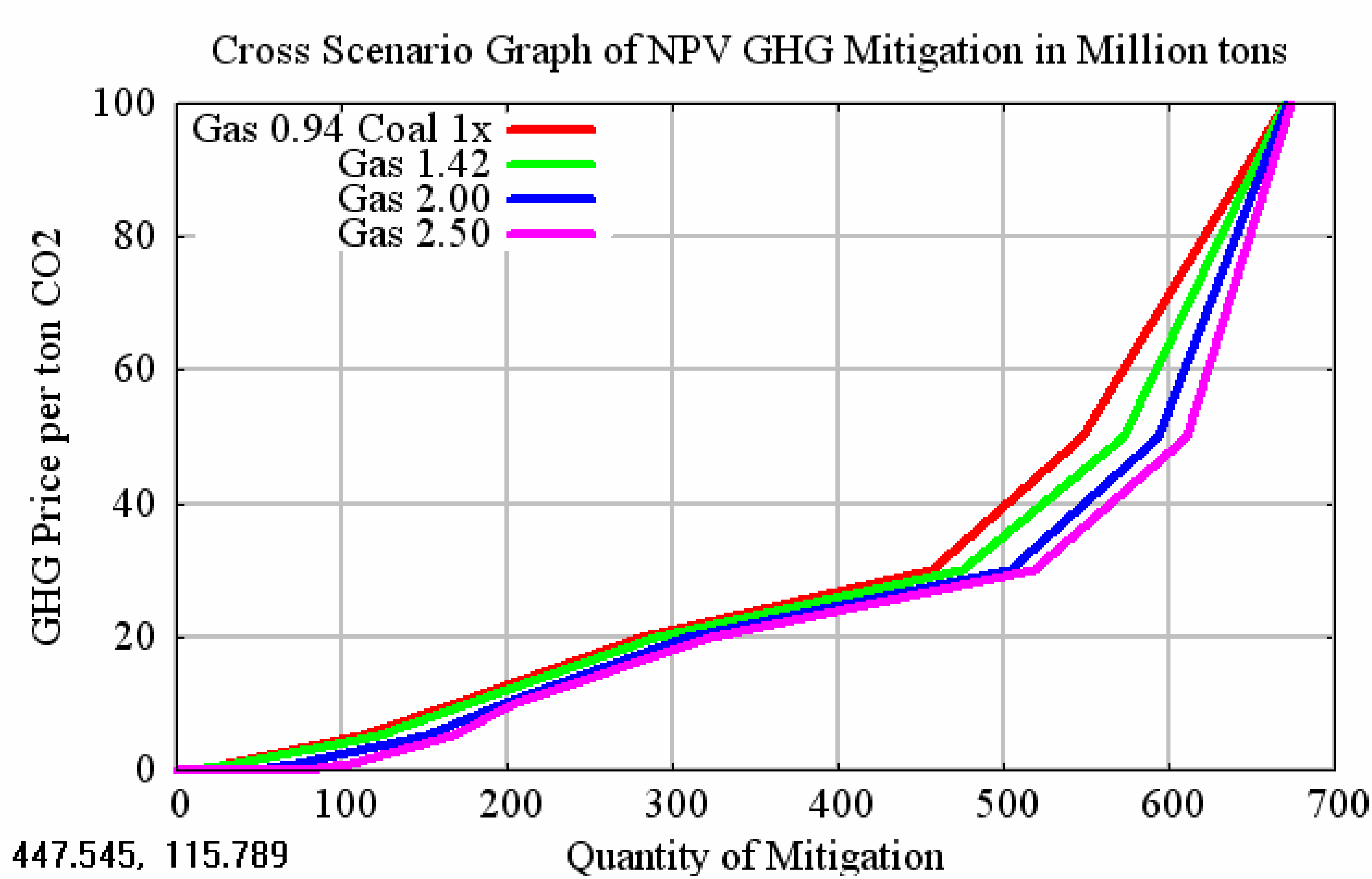
= Higher future demand

Collectively implies

Higher demand for alternative energy

Likely brighter future for renewables and biofuels

GHG CO2 Eq Offset Volume



Note offsets increase with energy price and carbon dioxide price, more with carbon price

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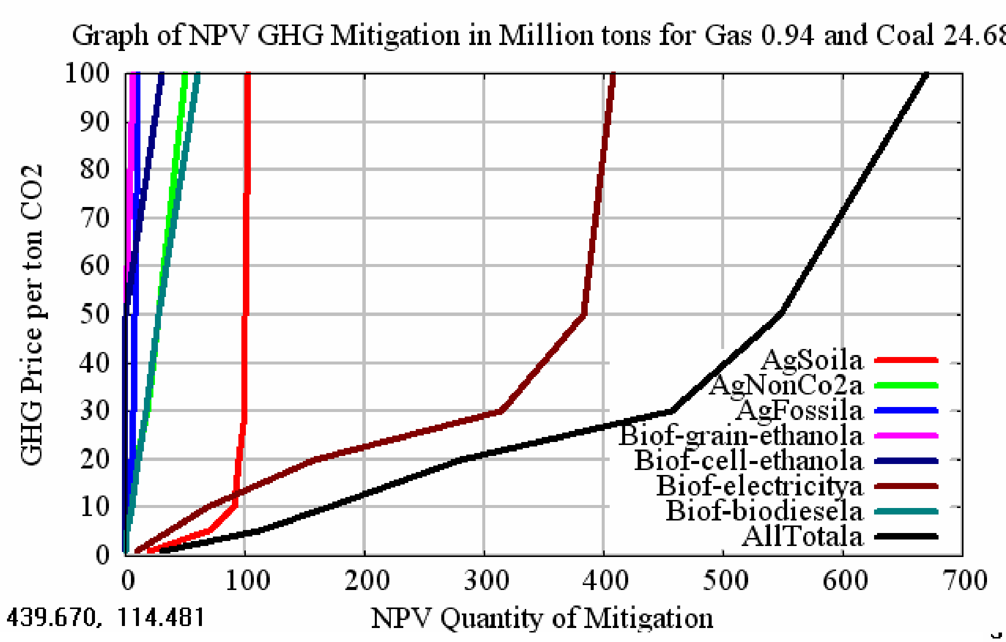
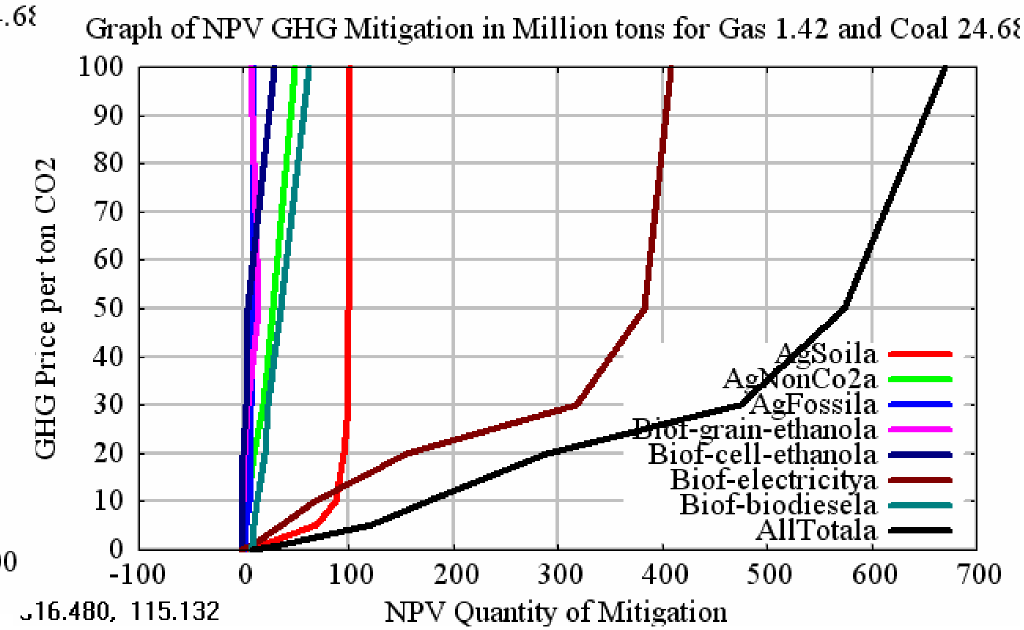
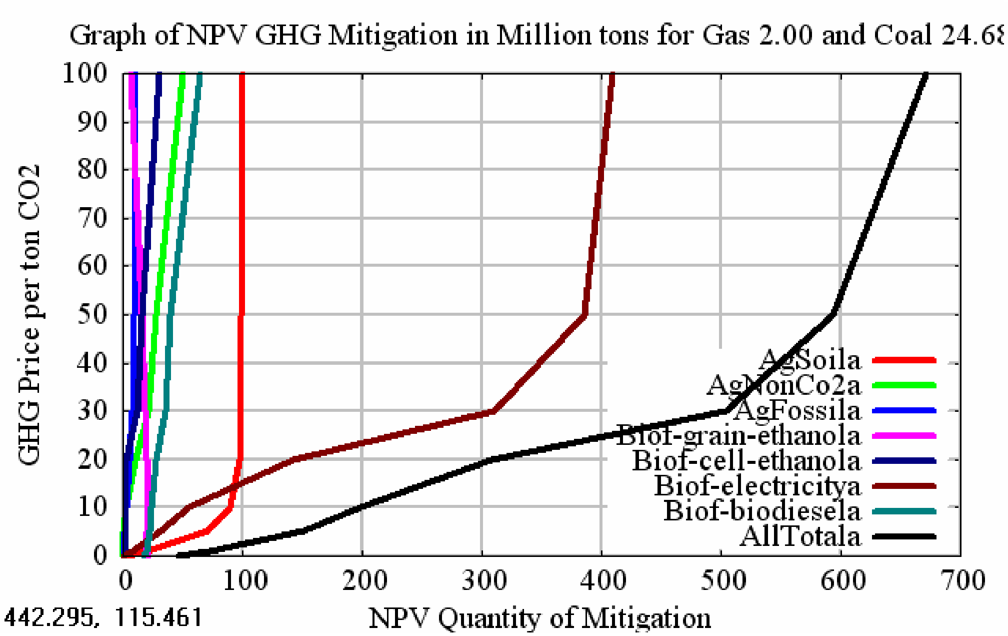
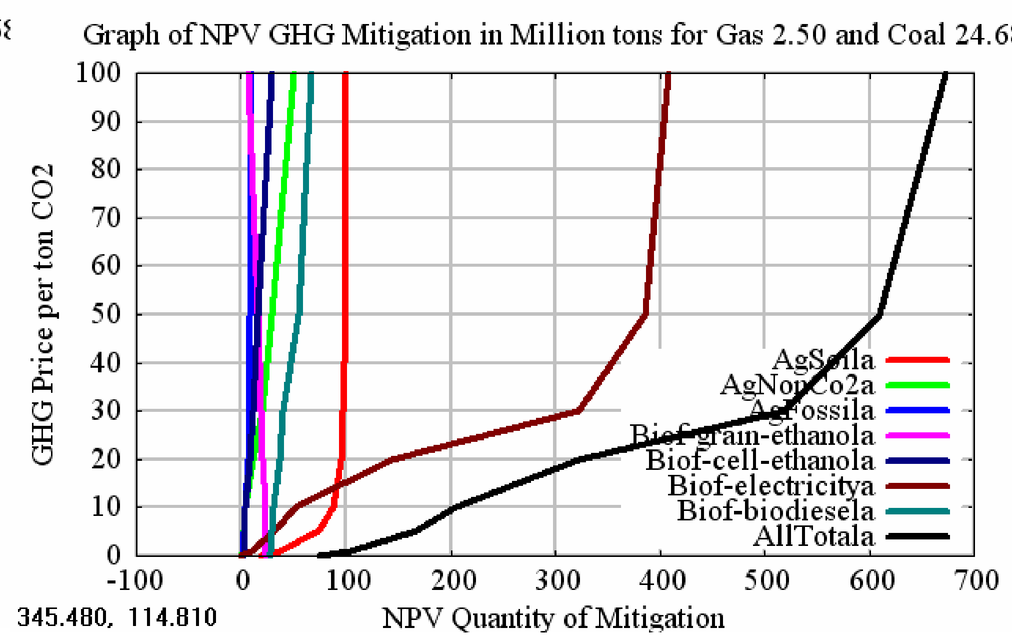
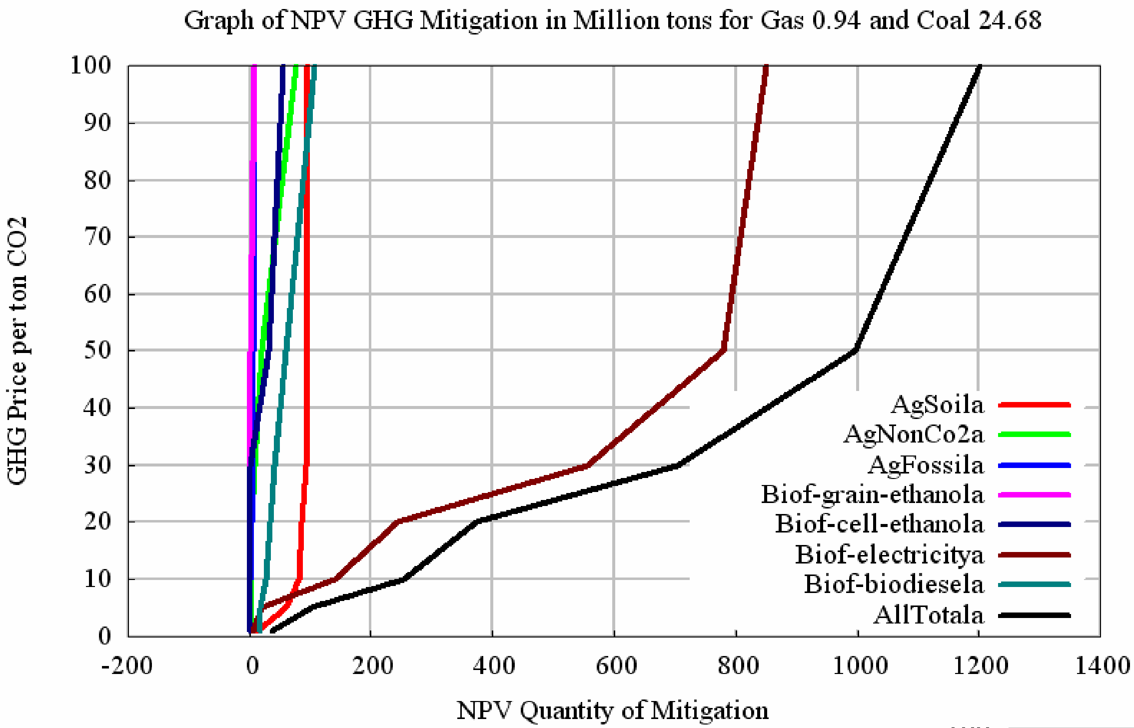


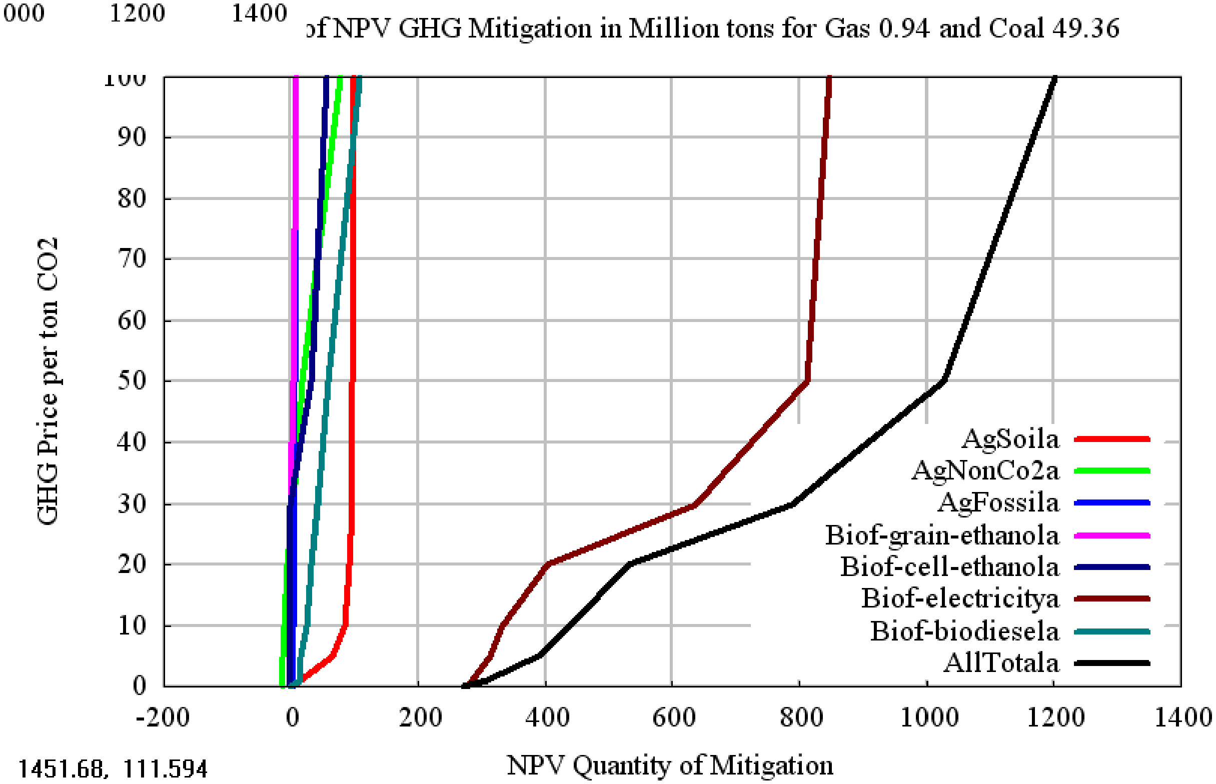






Portfolio Composition





Findings

- Biofuels could play an important part in a GHGE mitigating world if price was above $5 per ton of carbon dioxide or if energy price is higher.
- At low prices opportunity cost of resources exceeds value of feedstocks generated.
- Biofuels not just corn for ethanol.
- Perhaps GHG control should more strongly consider biodiesel, cell ethanol and particularly bio electricity.
- Competitiveness in GHG arena arises because biofuels continually offset fossil fuel emissions in comparison to changing tillage which saturates

Findings

- Tradeoffs with food and fuel and exports if we produce biofuels
- Strong degree of income support
- Raises Consumer Food Costs

- Biofuels also yield other ancillary benefits.
  - Erosion
  - Nutrient runoff
  - Energy security

Big questions

- Will society choose to reward biofuel carbon recycling characteristics?
- Will energy prices remain high in short run?
- Will ethanol and biodiesel subsidies persist?
- When will cellulosic ethanol be producable at scale?
- Can we increase biofuel feedstock yields?
- Can we increase efficiency of recovery of energy from biofeedstocks?
- Would it be sensible to switch farm subsidies to energy or carbon subsidies?
- Will the food technical progress remain high?
- Will we think about this as we plot future of Texas energy?

For more information

http://agecon2.tamu.edu/people/faculty/mccarl-bruce/biomass.html