



# Virginia Bioenergy Production: Policy, Potential, and Economics

Sandridge Lecture, Virginia Association of Economists, March 12, 2009

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# Bottom Line

- Virginia needs a biofuels industry because:
  - We must reduce dependence on oil
  - We must reduce pollution of our environment
  - We should restore economic vitality and long-term viability to our rural areas

# Virginia Renewable Energy Potential Capacity

Renewable Energy Resource	2002 Installed Capacity in Virginia (MW)	Virginia Potential Installed New Capacity (MW)	Capacity Factor
Land-based wind	0.01	1,950	30-45%
Offshore wind	0	28,100	35-40%
Solar PV	0.22	11,000 - 13,000	14%-20%
Biomass combustion	415	760	83%
MSW/Landfill gas	168	30	90%
<b>TOTAL</b>	<b>583.23</b>	<b>41,840 - 43,840</b>	

# Working Terms

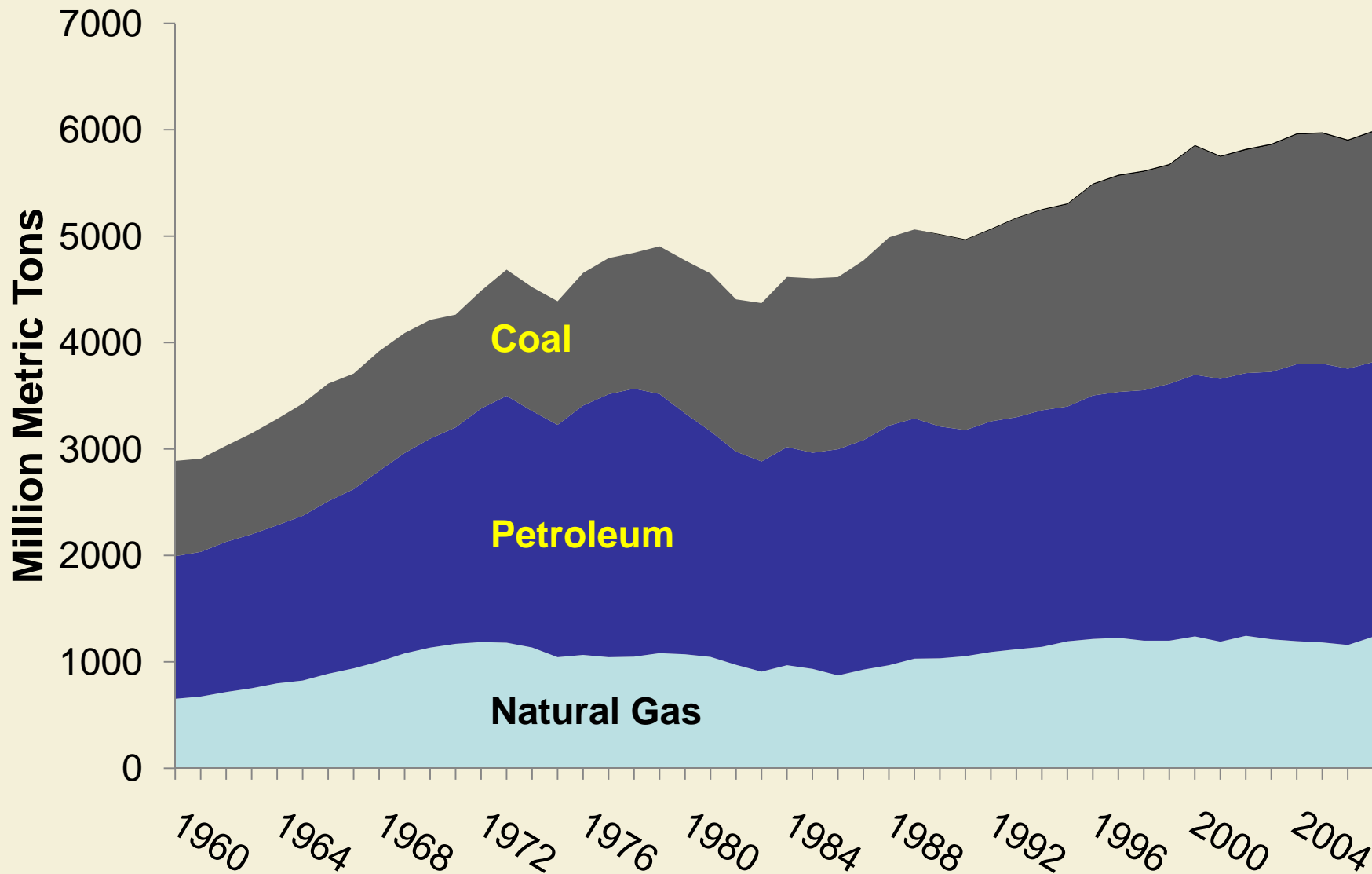
- **Biomass.** Organic material which has stored sunlight in the form of chemical energy, e.g.. wood, wood waste, straw, manure, sugar cane
- **Biofuel.** Solid, liquid or gaseous fuel derived from relatively recently dead biological material, distinguished from fossil fuels, which are derived from long dead biological material
- **Bioenergy.** Bioenergy is renewable energy made available from materials derived from biological sources.

Source: Wikipedia

# Why Bioenergy?

- Energy Dependence
- Cost of Fossil Fuel Energy
- Climate Change

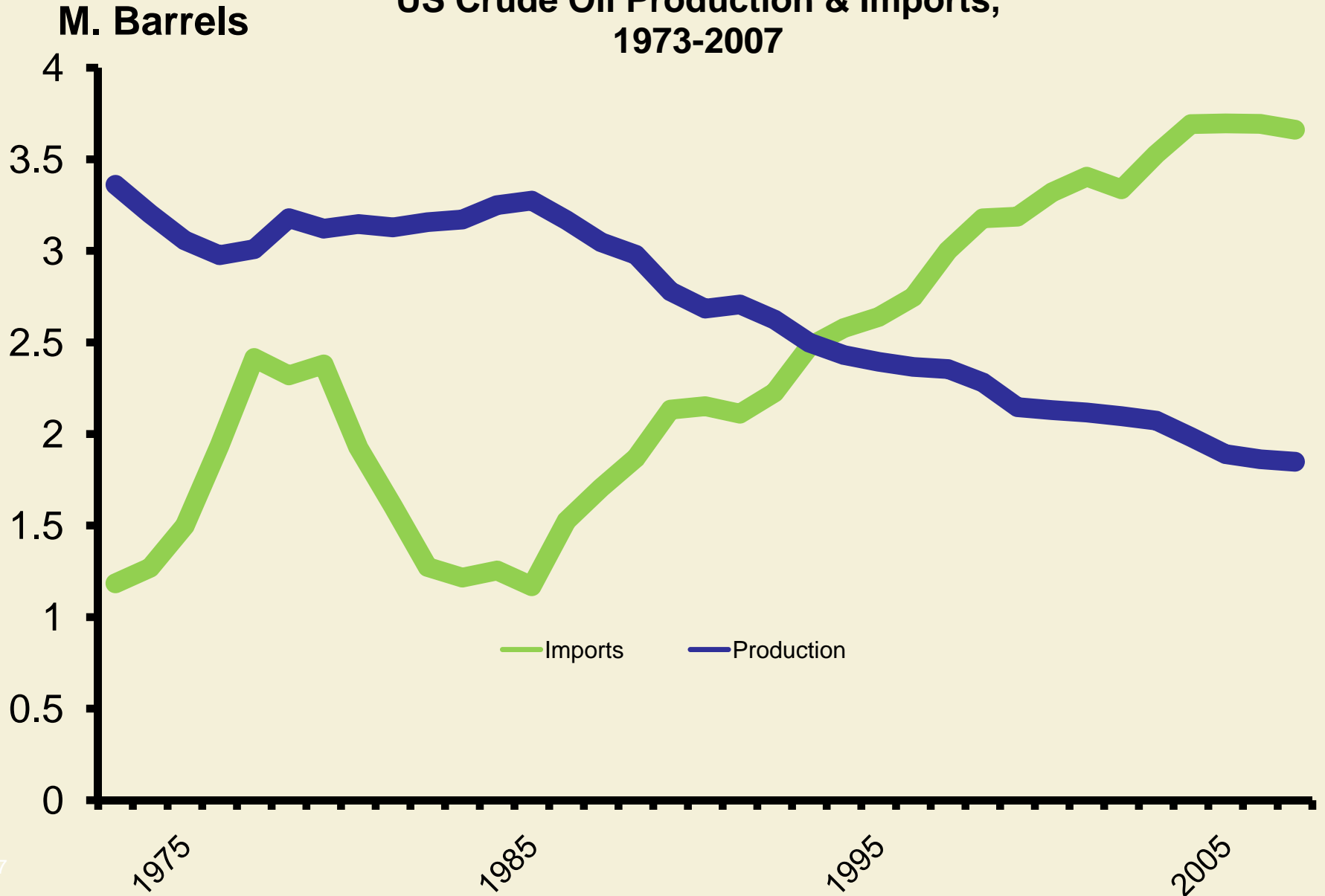
# US CO<sub>2</sub> Emissions by Fuel, 1960-2007F



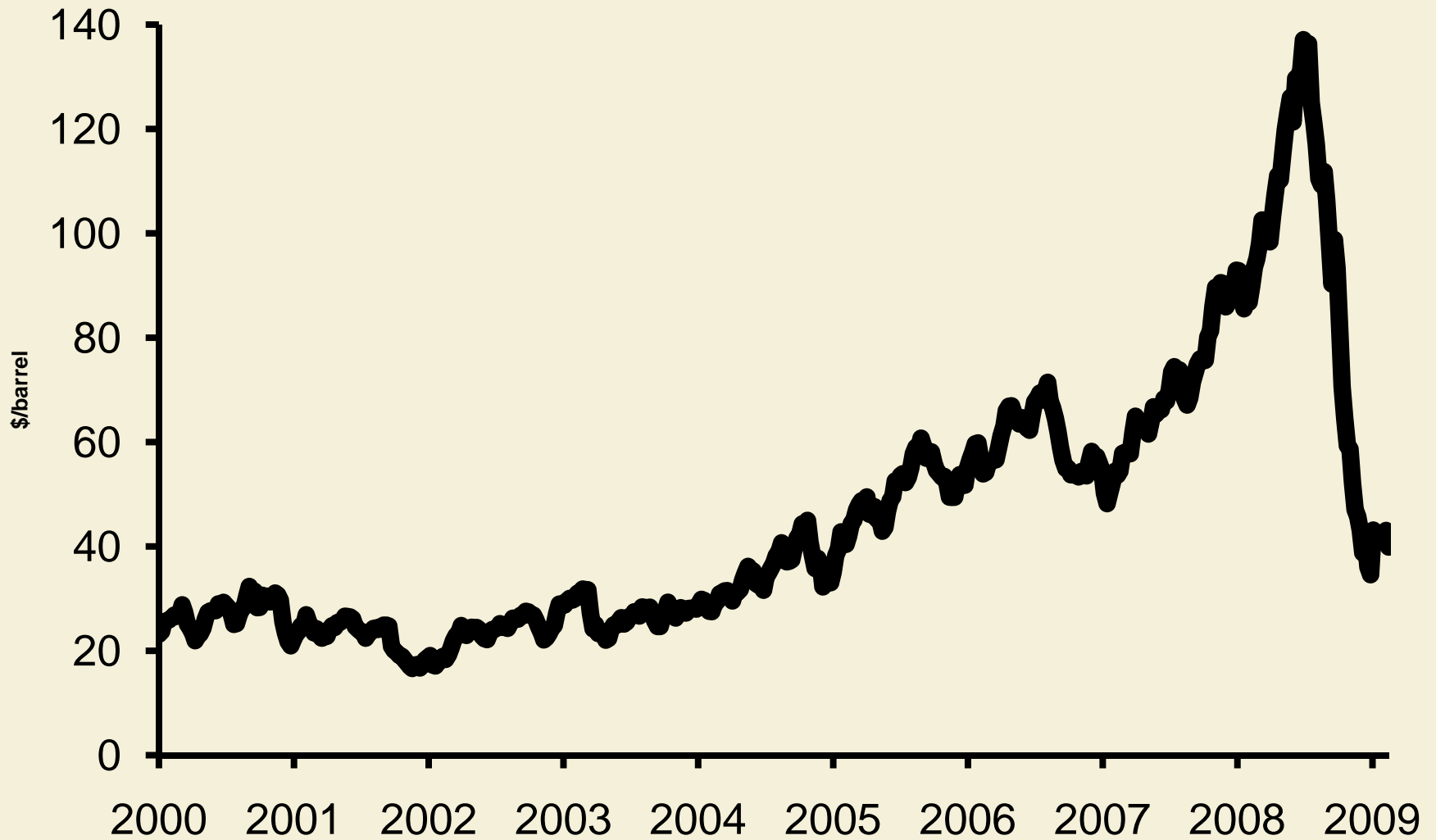
Source: Energy Information Administration/DOE, Feb 2009

# Crude Oil Imports Rising, Production Falling

US Crude Oil Production & Imports, 1973-2007



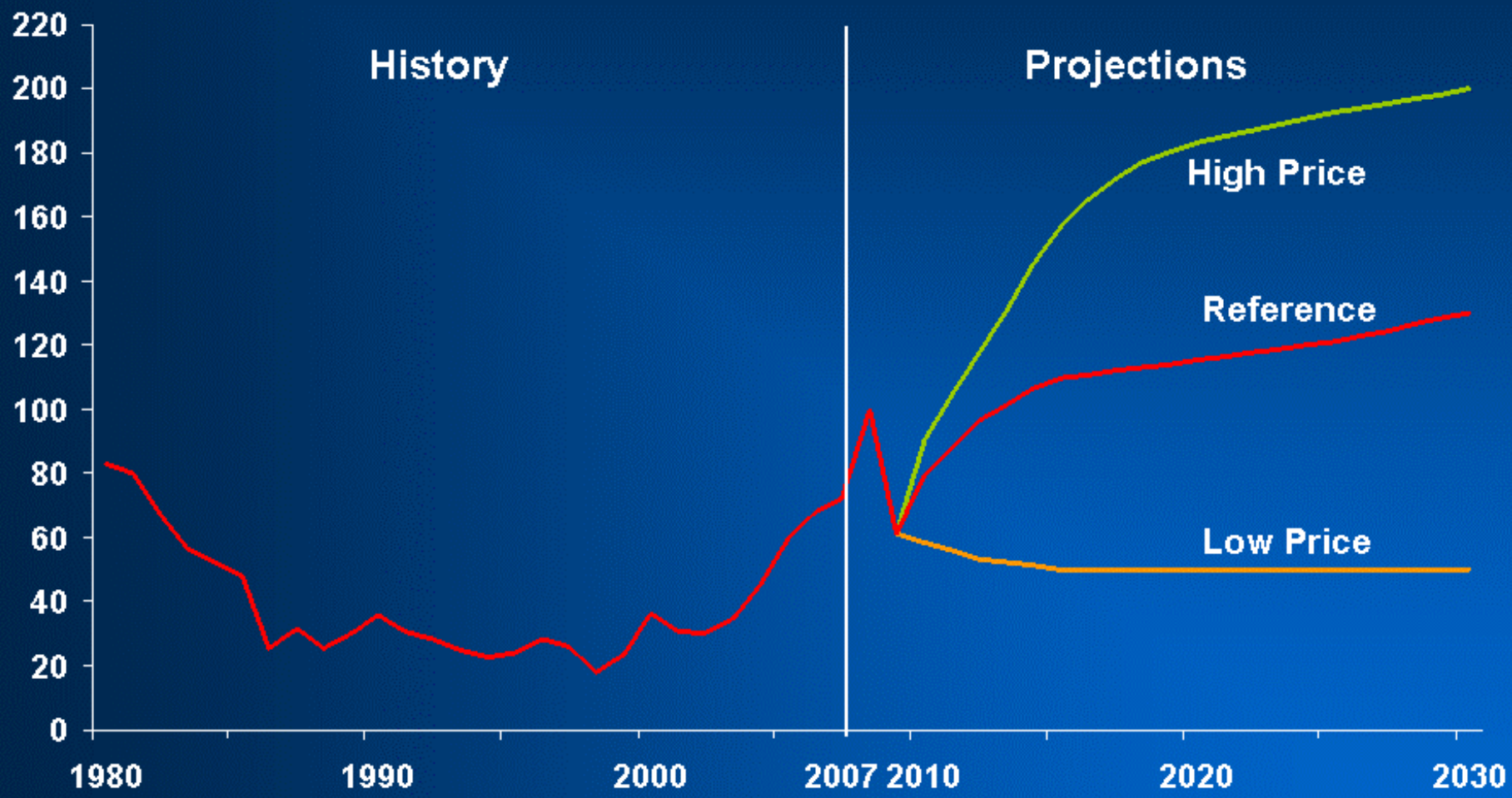
# World Oil Spot Prices, 2000-2009



Source: Energy Information Administration, DOE

# Oil prices in the reference case rise steadily; the full AEO includes a wide range of price cases

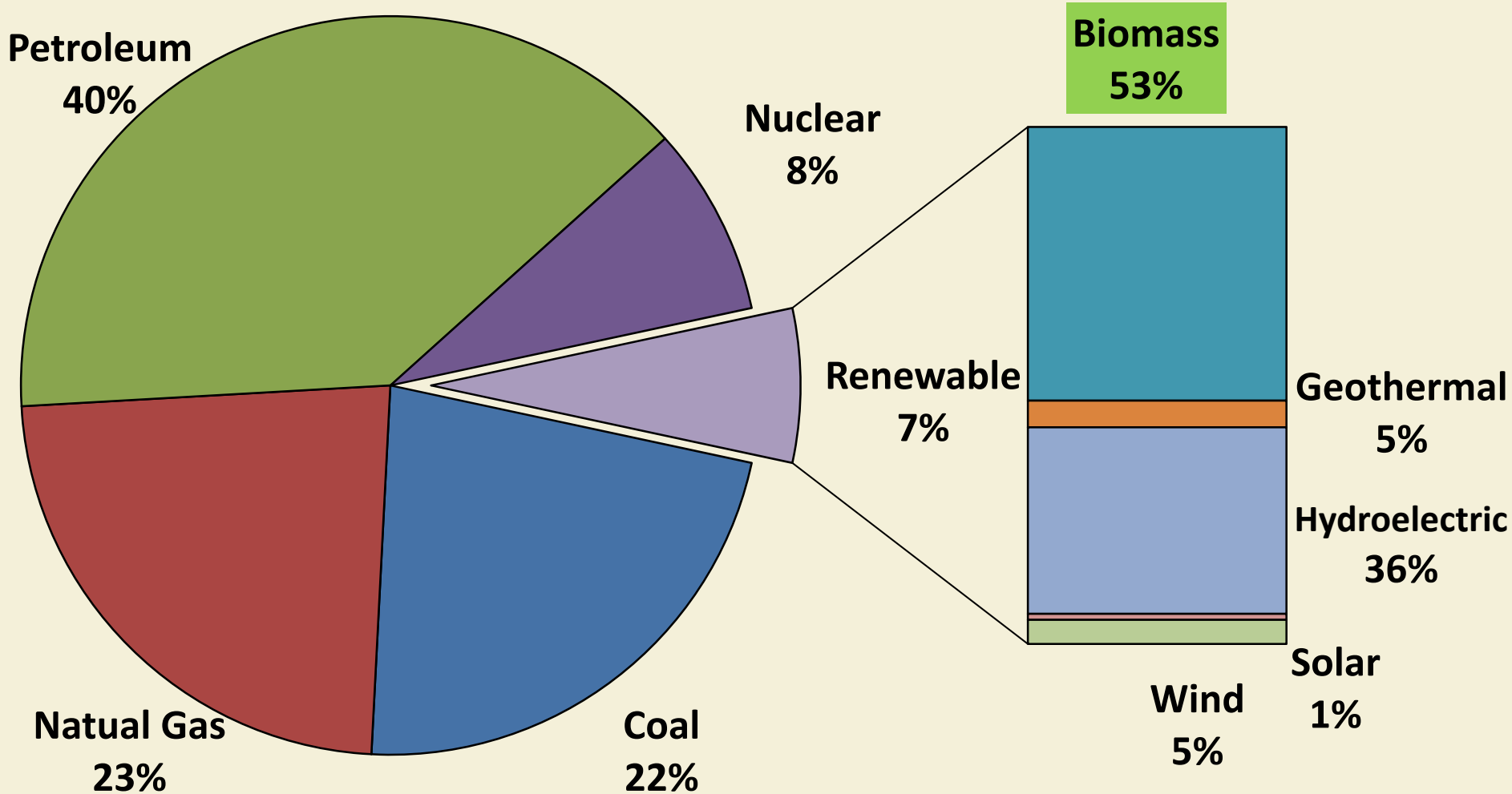
2007 dollars per barrel



# World Energy Outlook to 2030

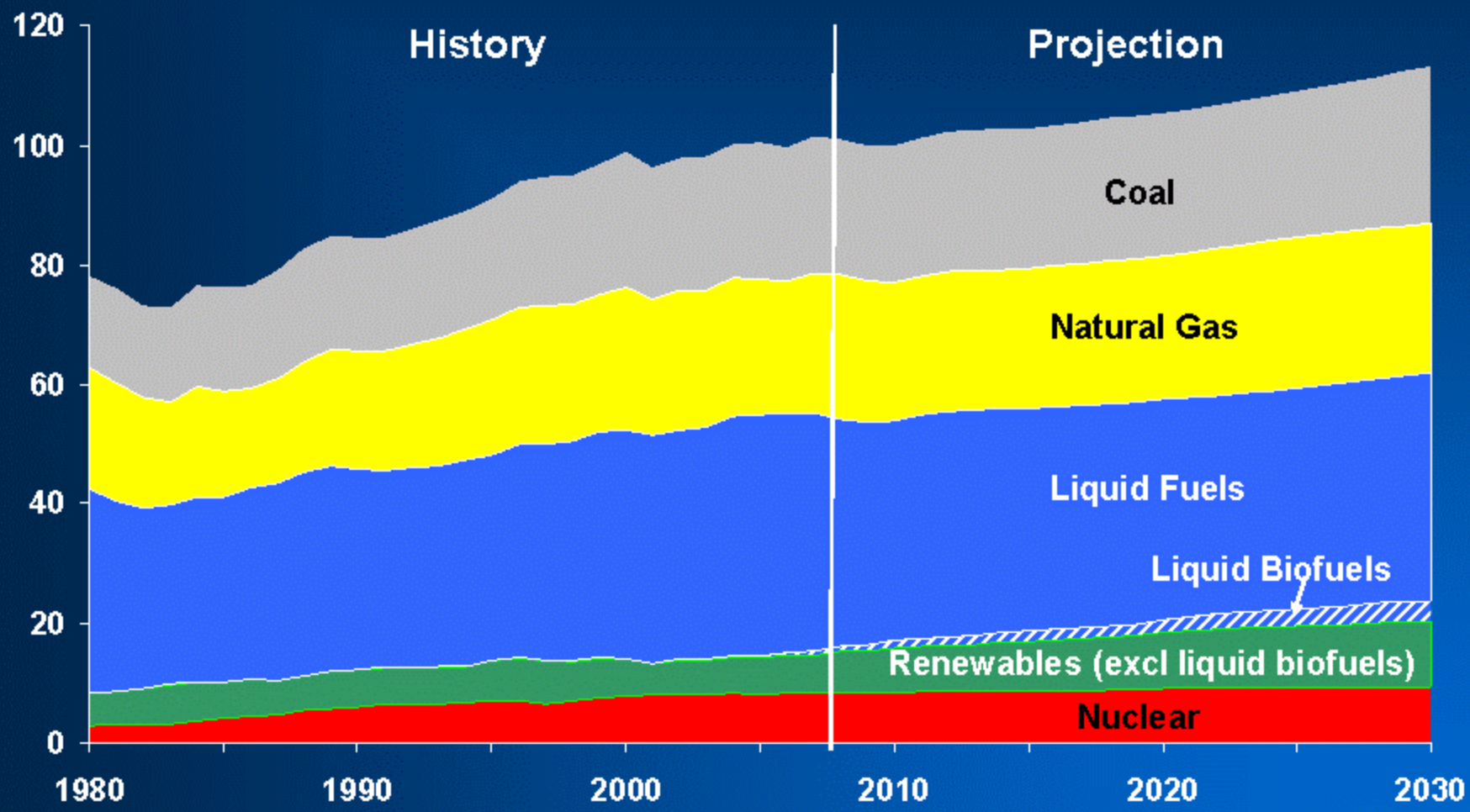
- Energy demand increases 45%
  - More than one-half from India and China
- World oil demand increases from 85 B bbl/day to 106 B bbl/day
- Increased fossil fuel demand mostly from non-OECD countries
- Implies \$1 trillion/year investment

# US Energy Consumption by Source, 2007



# Non-fossil energy use grows rapidly, but fossil fuels still provide 79 percent of total energy use in 2030

quadrillion Btu



# Vision for Bioenergy in the United States

		2000	2010	2020	2030
Biofuels	Market share (%)	0.7	4.0	10.0	20.0
	Consumption (B gallon gas-equivalent)	1.1	8.0	22.7	51.0
Biopower	Market share (%)	3.0	4.0	7.0	7.0
	Consumption (B gallon gas-equivalent)	2.0	3.1	3.4	3.8

Source: Biomass Research and Development Initiative, US Depts. of Energy and Agriculture, 2006

# Principal Types of Biofuels

- Ethanol
  - Corn Grain
  - Biomass (switchgrass, woody residue)
- Biodiesel
  - Soybean oil and other vegetable oils
  - Grease and fats
- Others
  - Biogas (methane)
  - Bio-oil (pyrolysis oil)
  - Syngas (synthesis gas)

**Moonshine!**

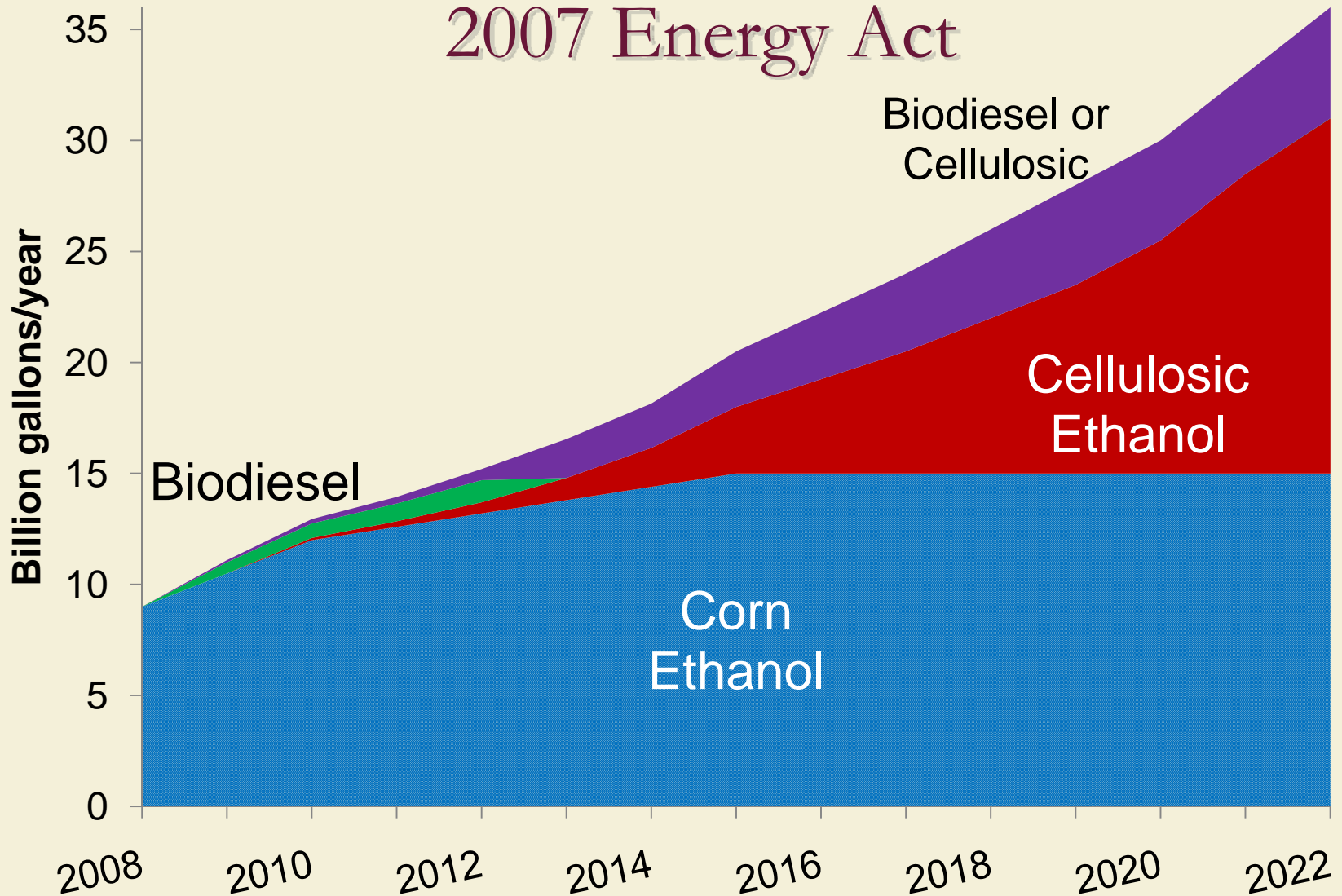
# Growing a Biofuel Industry

- Third US experiment in growing a biofuels industry
- Intersection of increased energy prices and political pressure from corn producers
  - 1<sup>st</sup> generation grain ethanol was a bad (but necessary) first step
  - 2<sup>nd</sup> generation cellulosic ethanol presents both greater promise and greater obstacles
  - 3<sup>rd</sup> generation biofuels will be product of mature biofuels industry

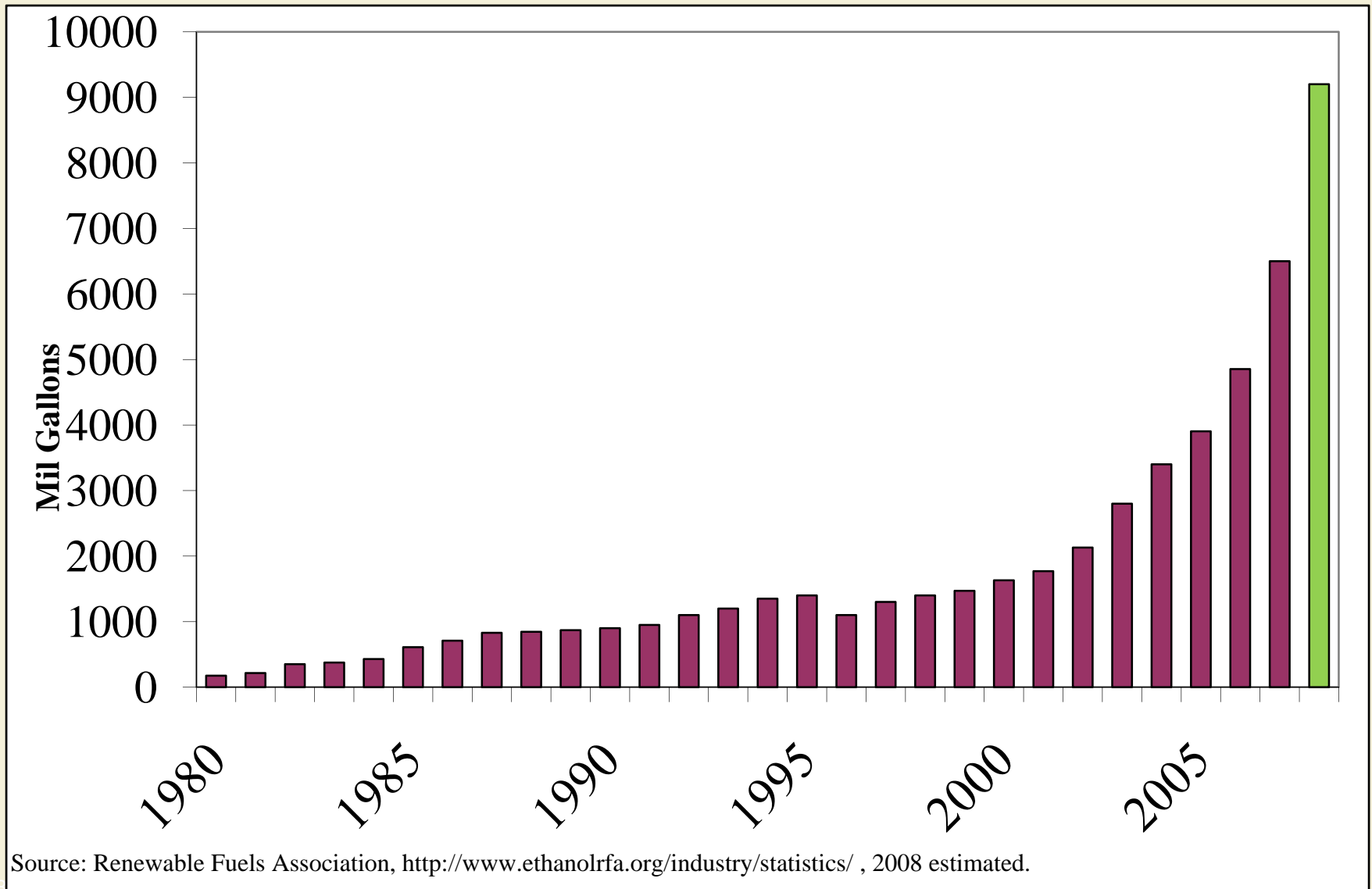
# Volumetric Ethanol Excise Tax Credit (VEETC)

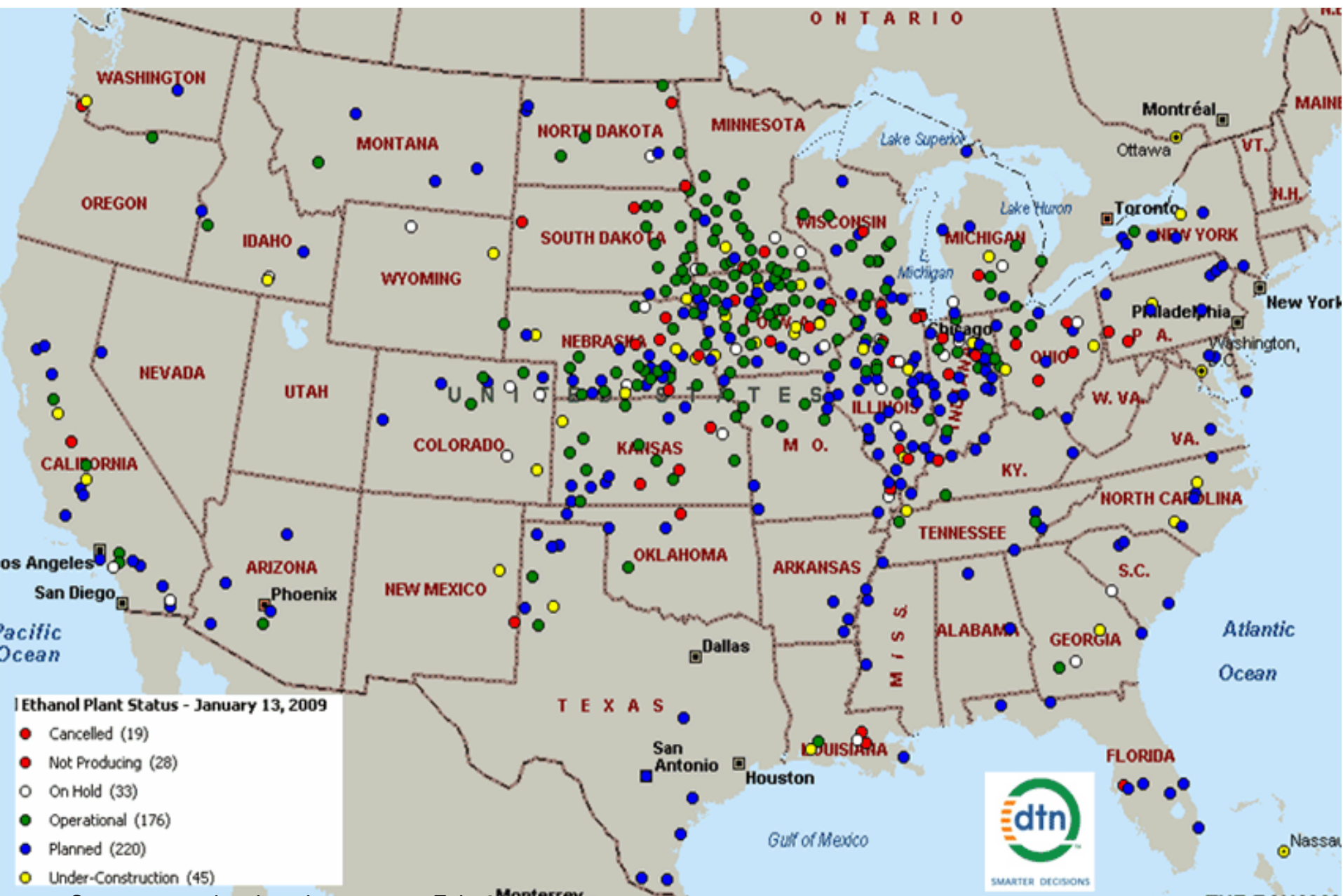
- First pillar of ethanol industry support
- 45 cents/gallon excise tax credit for blender
- 54 cents/gallon import tariff on ethanol

# Renewable Fuels Standards 2007 Energy Act



# U.S. Ethanol Production, 1980-2008



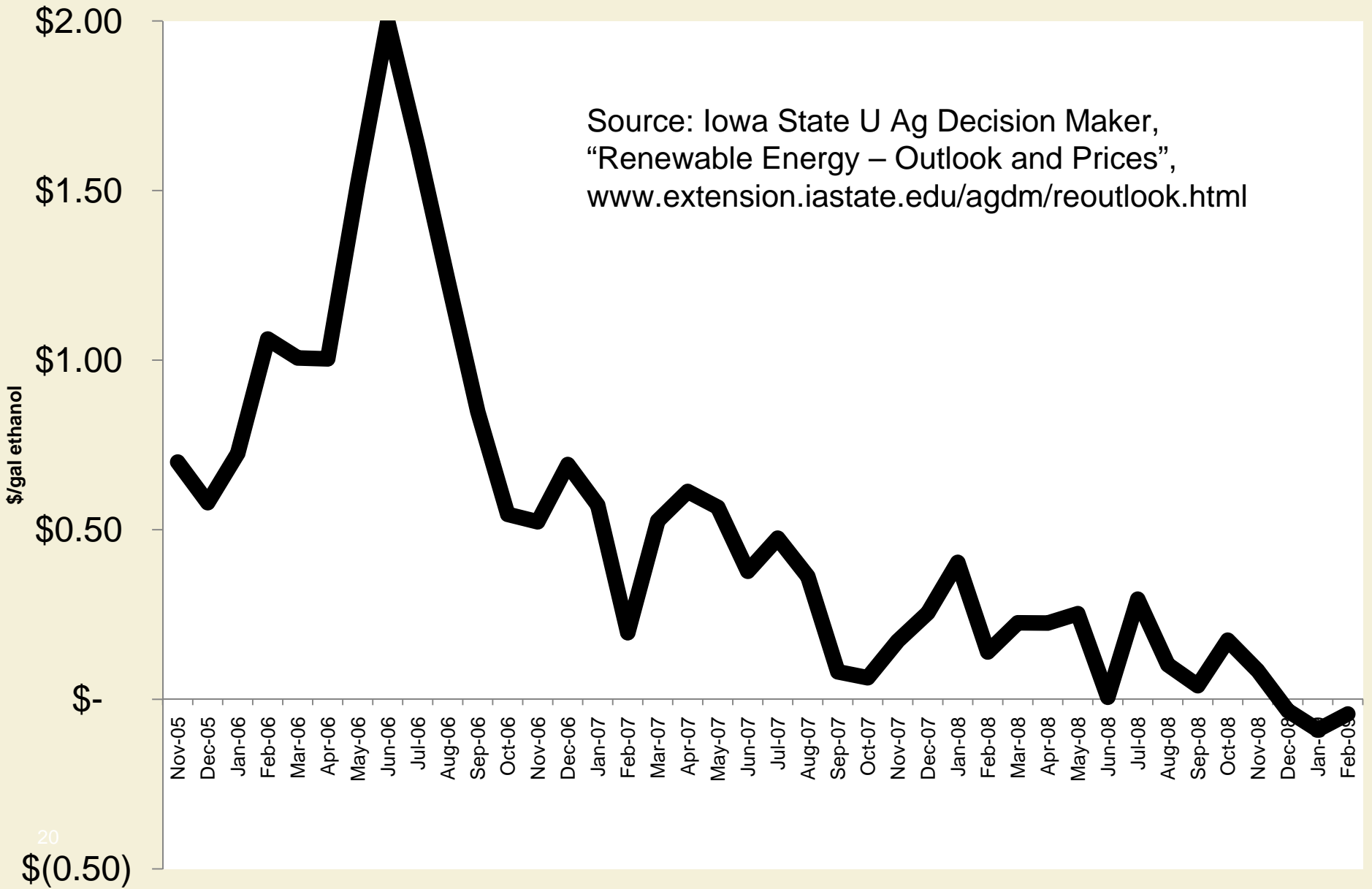


Source: [www.dtnethanolcenter.com](http://www.dtnethanolcenter.com), Feb. 23, 2009

\*Alaska has one ethanol plant in the planning stage

\*Hawaii has one plant in the planning stage and one is on hold

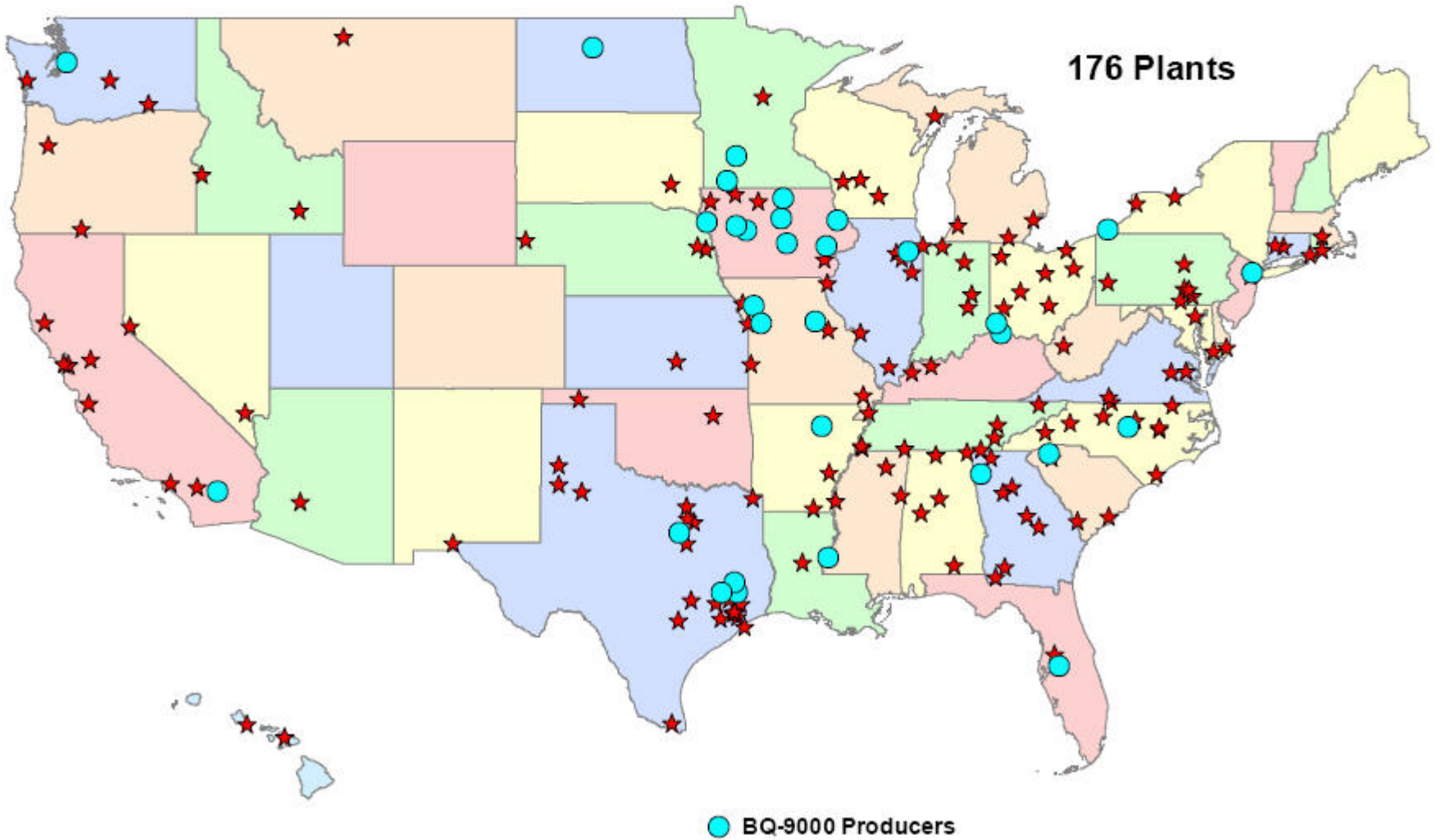
# Corn Ethanol Profits, 2005-2009



# Virginia Disadvantages for Corn Ethanol Production

- Average yields = 70% of Midwest
- Relatively small tracts
- Weather disasters are frequent
- Limited opportunities to shift among row crops
- Limited non-row crop land suitability for corn

Commercial Biodiesel Production Plants (September 29, 2008)



# Virginia Disadvantages for Soybean Biodiesel Production

- Less competitive yields, low double-crop yields
- Relatively small tracts
- Weather disasters are frequent
- Limited opportunities to shift among row crops

# U.S. Commercial Biomass Ethanol Refineries



# Cellulosic Biorefineries, 2008

	<b>Commercial</b>	<b>Demonstration</b>	<b>Pilot</b>
Completed	0	2	3
Under construction	1	3	5
Planning	21	14	6
<b>Total</b>	<b>22</b>	<b>19</b>	<b>14</b>

Source: Environmental and Energy Study Institute, "Cellulosic Biofuels", July 2008

# Cellulosic Ethanol Obstacles

- Cheap oil
- Cellulose processing for fermentation
- Transportation and logistics of feedstock
- Capital financing
- “Valley of Death” to commercialization

# Biomass Feedstock

- Forest
  - Logging residues
  - Thinning, fuelwood
  - Wood processing mill residues
  - Pulping liquors
  - Urban wood residues
  - Perennial woody crops
- Agriculture
  - Crop residues
  - Grains
  - Perennial grasses
  - Animal manures
- Other
  - Food/feed processing residues
  - MSW

# Virginia Advantages for Cellulosic Biomass Production

- Mild winters, rainfall, long growing season
- Inexpensive land
- Few competitive alternatives for land-based production

# Benefits of Distributed Biofuel Production

- Long term economic alternative for Virginia land
- Rural community economic development
- Lower impact on environment
  - Agricultural land use
  - Nonagricultural land use
- Capital investment, production risk distributed throughout state

# How Virginia Can Produce Its Own Energy

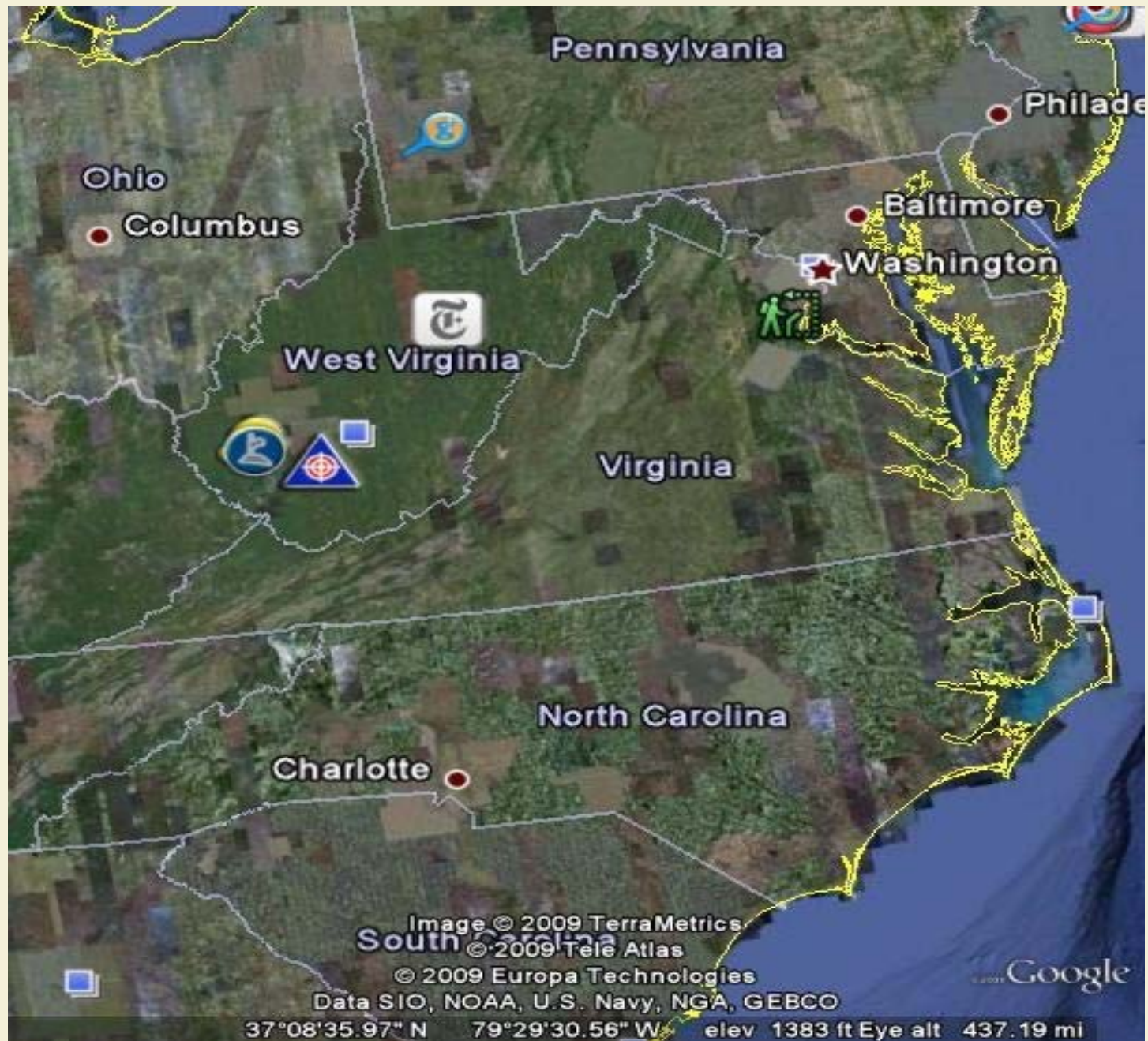
- Forest (65%) and agriculture (24%) are the largest land uses by far of VA's approximately 40,000 sq miles of land area.
  - Mechanizeable hay and pasture acres on farms
  - Accessible woody biomass throughout the Commonwealth

# Biomass Production on Virginia Farm Land

- Crop acres – won't be able to bid this away
- Hay and pasture – '000 acres, amount mechanizeable?
- Existing equipment, density of production, satellite locations, multi-year contracts, small plants for heat/fuel, access to distribution network

# Biomass Production on Virginia Wood Land

- Wood residues
- Fast-growing plantations
- Mechanizeable? Access?
- Small plants for heat/fuel
- 24x7, year-round production.  
Combination with herbaceous feedstock?



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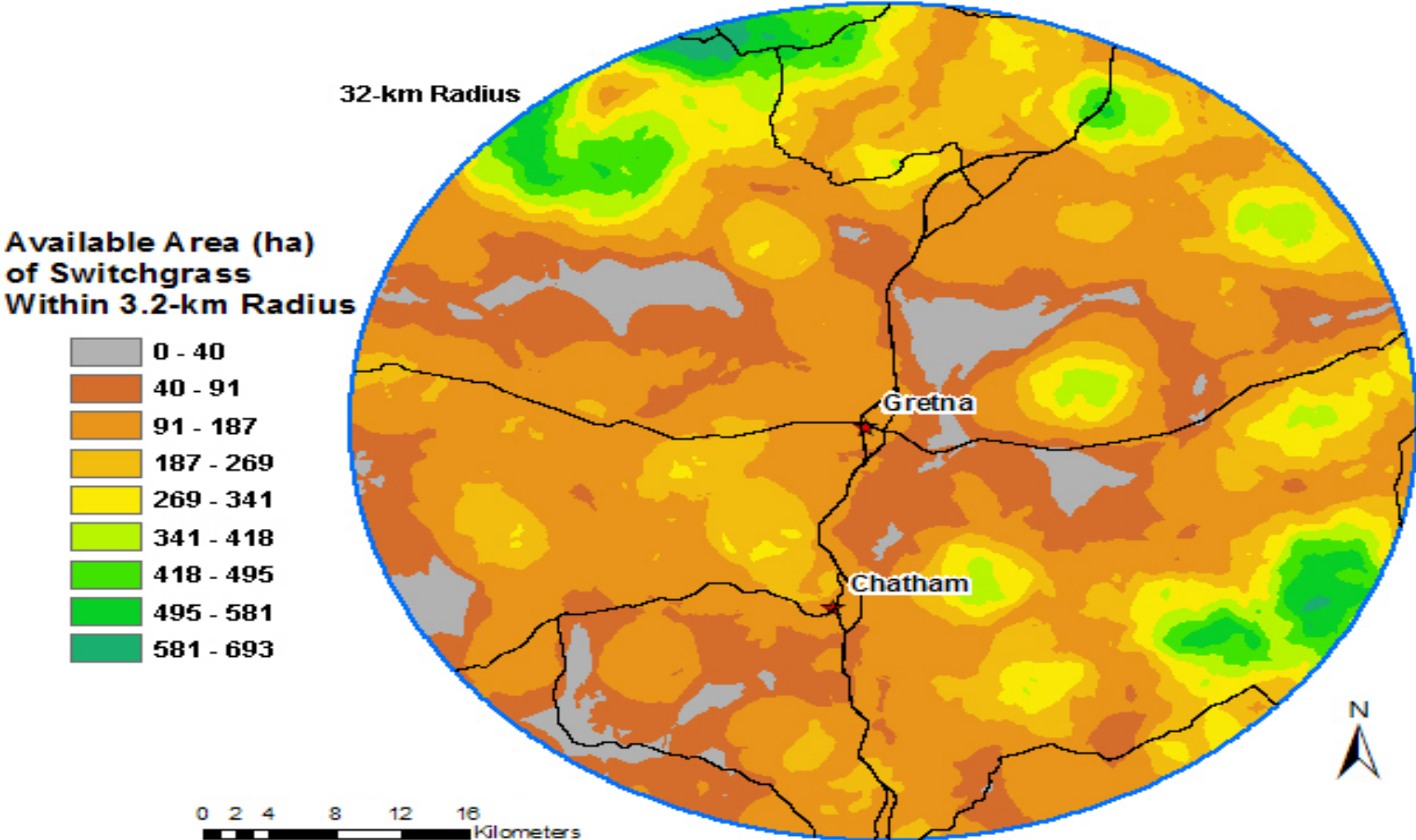
Gretna, VA

© 2009 Tele Atlas  
Image © 2009 DigitalGlobe

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Imagery Dates: Aug 5, 2005 - May 23, 2006 36°57'03.62" N 79°21'55.70" W ele'

# Potential Available Area for Switchgrass, Gretna Virginia



Resop, J. and J. Cundiff. 2008. "GIS Analysis to Identify Potential Satellite Storage Locations for Herbaceous Biomass"

# Policy Initiatives for Fostering Virginia Biofuels

- Protect agricultural/biomass production and transportation
- Encourage biorefinery siting
- Discourage rural residence
- Discourage unprofitable farms



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