



---

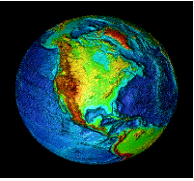
# Tomorrow's Renewable Energy . . . Today

---



**Sigma Capital Group, Inc.**  
**Bruce Woodry, Chairman and CEO**

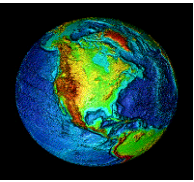
February, 2007



# Sigma Capital Group, Inc.

---

- Today's Agenda
- Sigma Capital
- Primer on Renewable Energy Project finance
- Bio-Refineries in woody, northern climates



# Sigma Capital Team

---

## Who is Sigma Capital:

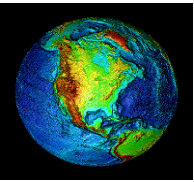
- Sigma Capital is a boutique investment bank, providing advisory and representative investment banking services on \$5-250M transaction
- Primarily to energy and renewable energy project finance.
- My focus: Project finance (private equity and debt) for ethanol and chairman of the Michigan Public Service Commission Renewable Energy Finance Committee.

## Team has over \$30 Billion of Project Finance Experience

- Bruce Woodry (Michigan)
- Marty Walicki, Managing Director (Washington, DC)
- Dan Potash, Managing Director (San Francisco)
- Frank Reed, Vice President (Chicago)
- John Fentum, Vice President (Denver)

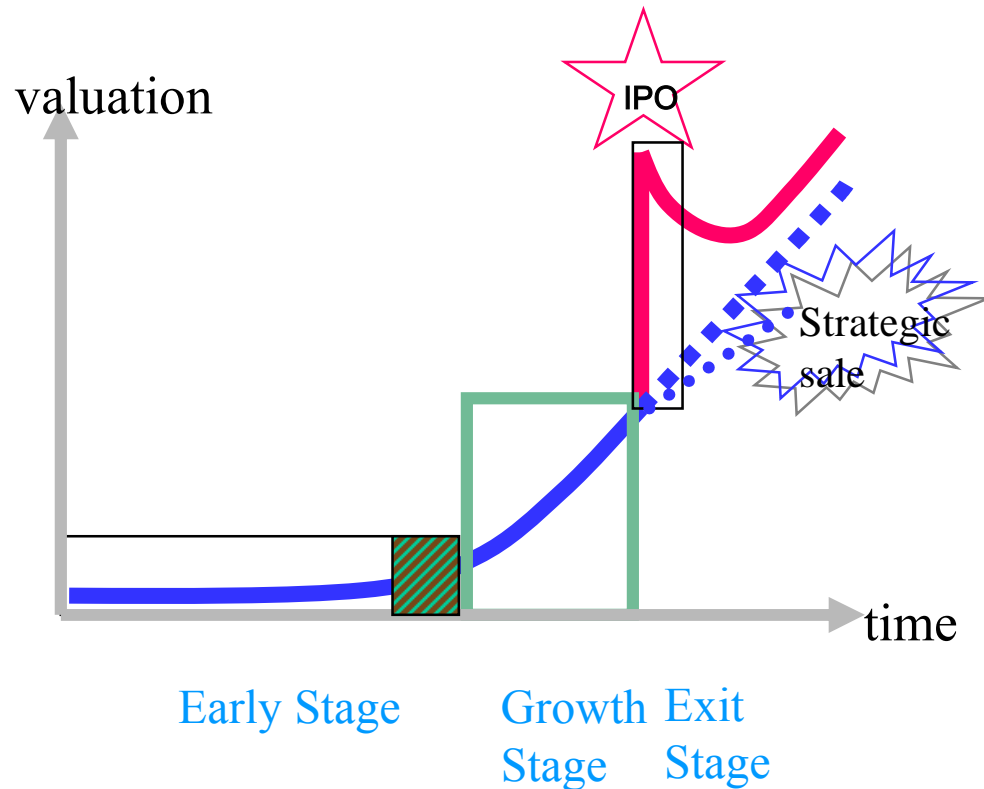
## Sigma Capital principles have participated in the following assignments:

- Ethanol facility, Midwest, \$125 million
- Ethanol facilities, Midwest, \$270 million
- MSW/RDG in Wyoming, \$150 Million
- MSW/RDG in Louisiana, \$125 Million
- CoGen facility, Argentina, \$178 million
- CoGen facility, California, \$100 million
- Coal fired, California, \$96 million
- Gas-fired, 118-MW Industrial, \$100 million
- Solar-thermal, 15-MW, \$62 million
- Solar-thermal, 30-MW, \$96 million

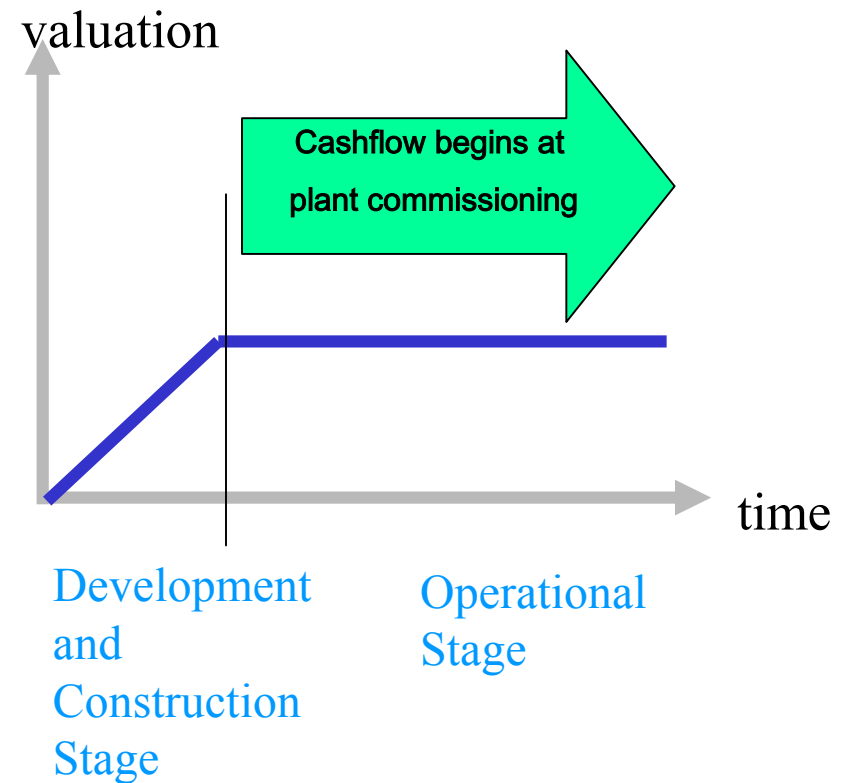


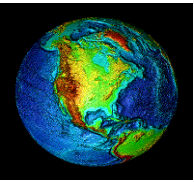
# Growth funding vs. Project Finance

Investor returns derived from the value at exit  
(Large Terminal Value)

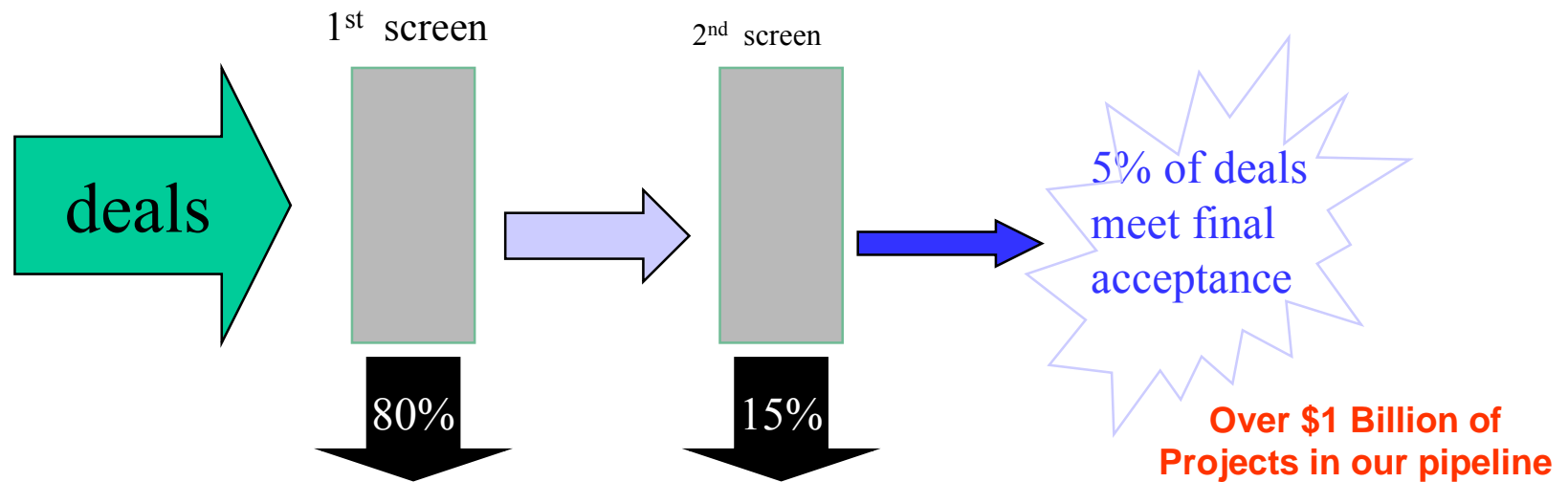


Investor returns derived from project cash flow  
(Small Terminal Value)





# Typical IBank Project Acceptance

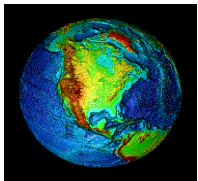


Of 1000-2000 plans/year, select plans which are:

Screen 1:

- deal size, industry, stage of growth, type of funds
- Key management, Board in place, No special situations
- Clear exit strategy; Exit 3-5 y growth, 18-24m project

Screen 2: Business model & IRR consistent with risk, industry



# Project Finance

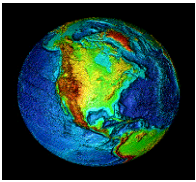
- Cashflow projects
- Proper structuring to cashflow to balance debt and equity can reduce risk & improve returns
- The larger the project, the more complexity & possibilities of improvement through structuring

## Debt

- Construction
- Permanent Finance
- Bonds (taxable and exempt)
- Equipment / Operational Lease
- Mezzanine (limited)
- Grants & government loans

## Equity

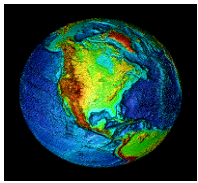
- Private-accredited
- Institutional
- Socially Responsible Investors
- Strategic & Vendor Finances
- Tax investors



---

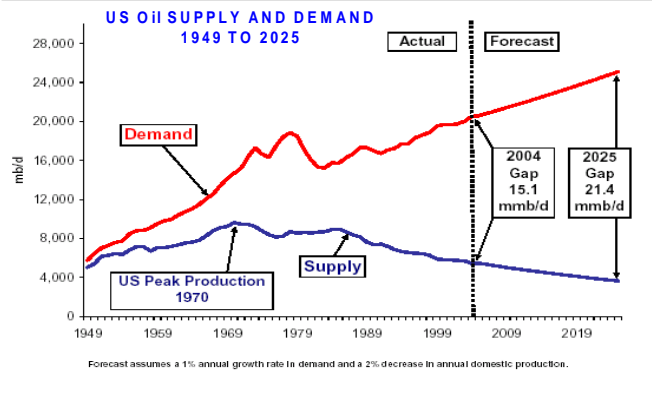
# WHY ARE WE HERE

---



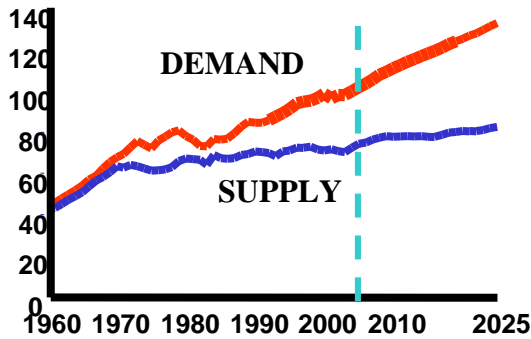
# Energy: Changing industry

## US OIL

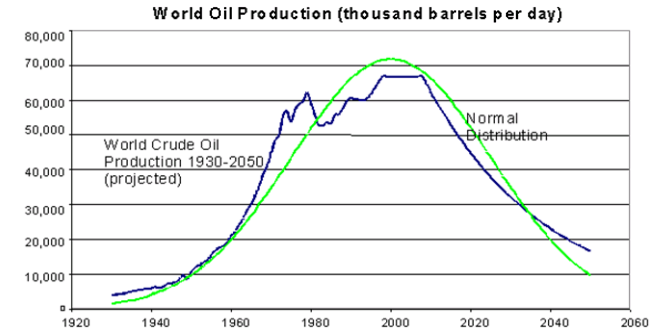


Sources: EIA and RJ Research estimates and analysis

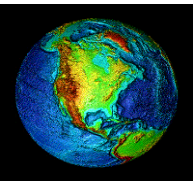
## US NATURAL GAS



## WORLD OIL

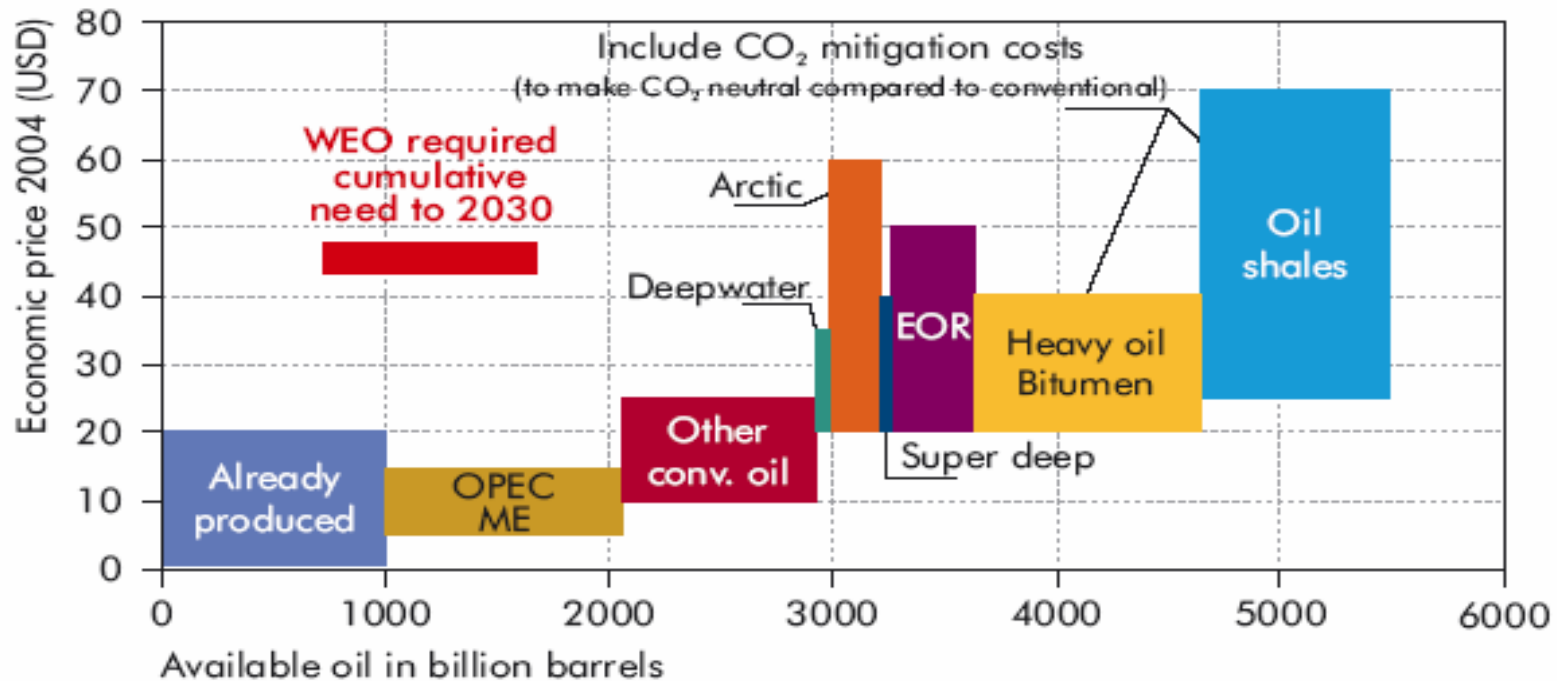


- World oil peaked circa 2000, no major discoveries, existing wells on decline curve
- U.S. Oil
  - Production peak in 1970
  - Today, United States consumes 20 MBBL/day, 76 % imported (2004) going to 25 MBBL/day, (86%) imported (2025)
  - China, #2 at 9MBBL/Day is growing at 9%, competing for scarce supplies
- US Natural Gas
  - Price from \$1.5 to \$14 MCF over past several years
  - Summer/winter shortage
- Concerns over price, supply

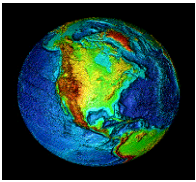


# Cost of future oil...

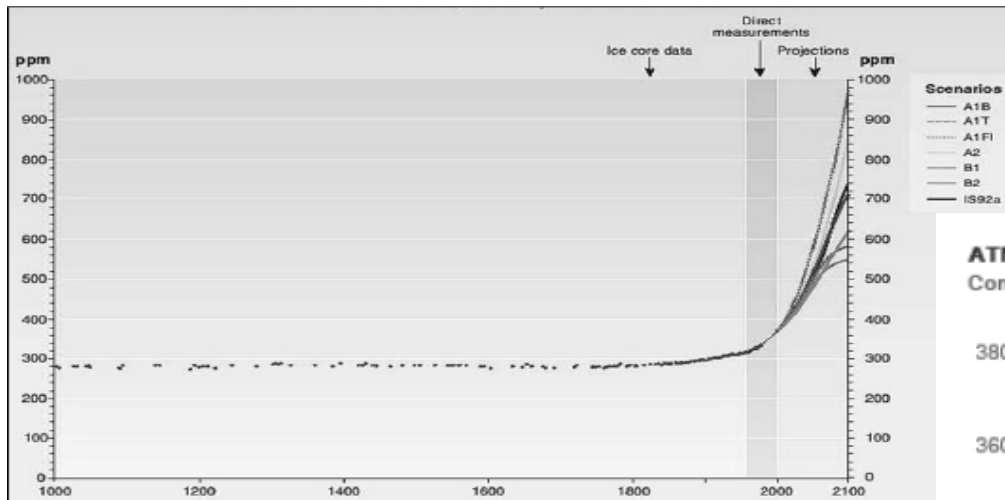
**Figure 7.1 • Oil cost curve, including technological progress:  
availability of oil resources as a function of economic price**



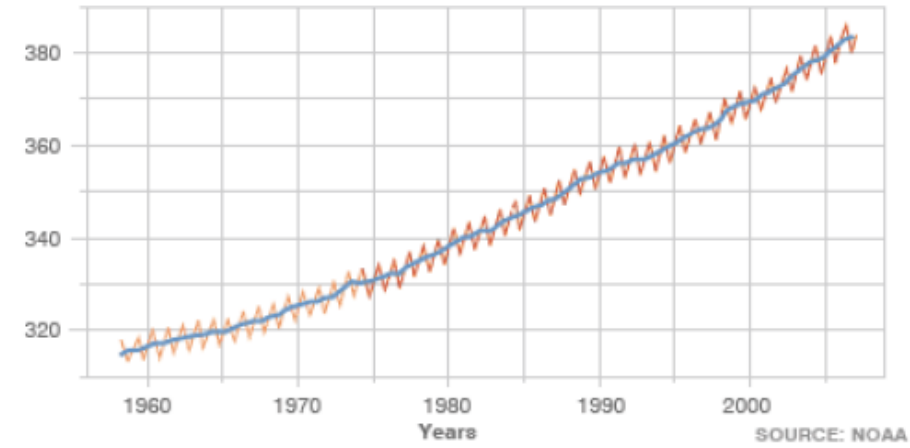
Source: IEA.



# We are devastating our climate

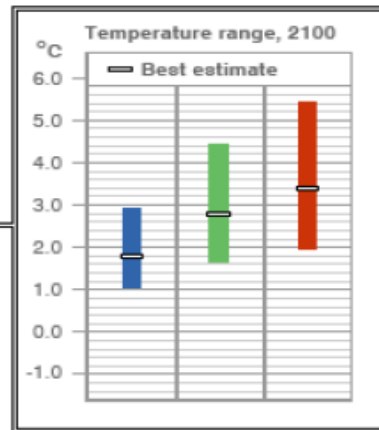
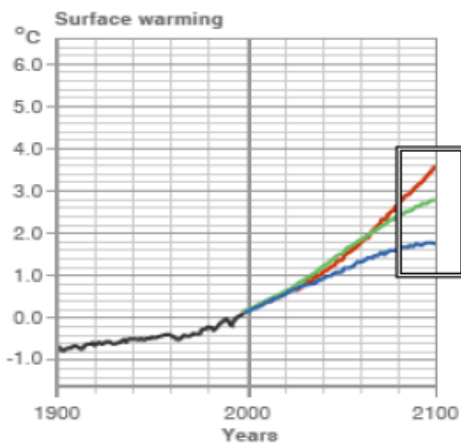


ATMOSPHERIC CO<sub>2</sub> AT MAUNA LOA OBSERVATORY  
Concentration (parts per million)

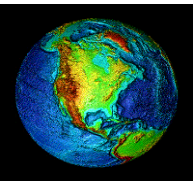


GLOBAL WARMING SCENARIOS

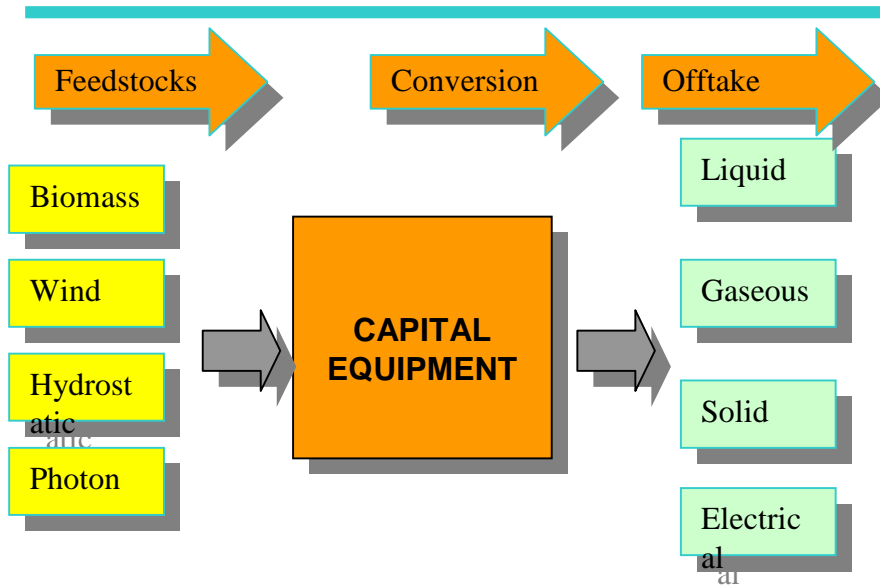
- Scenario A2
- Scenario A1B
- Scenario B1
- 20th century



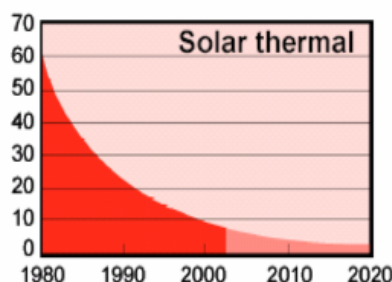
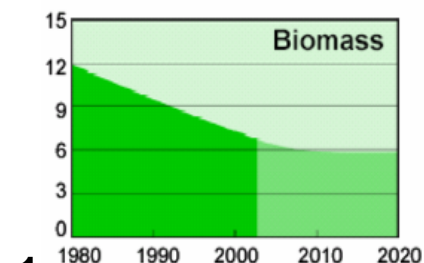
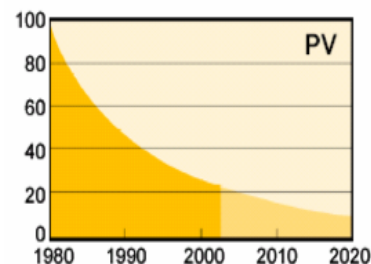
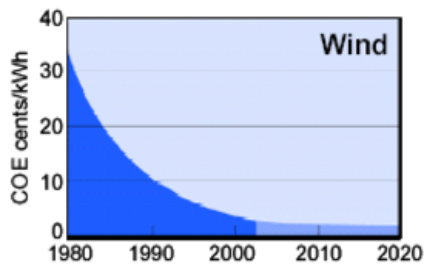
CO<sub>2</sub> Levels are growing dangerously high

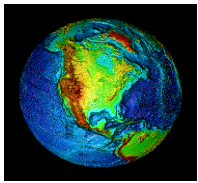


# Renewable Energy Conversion

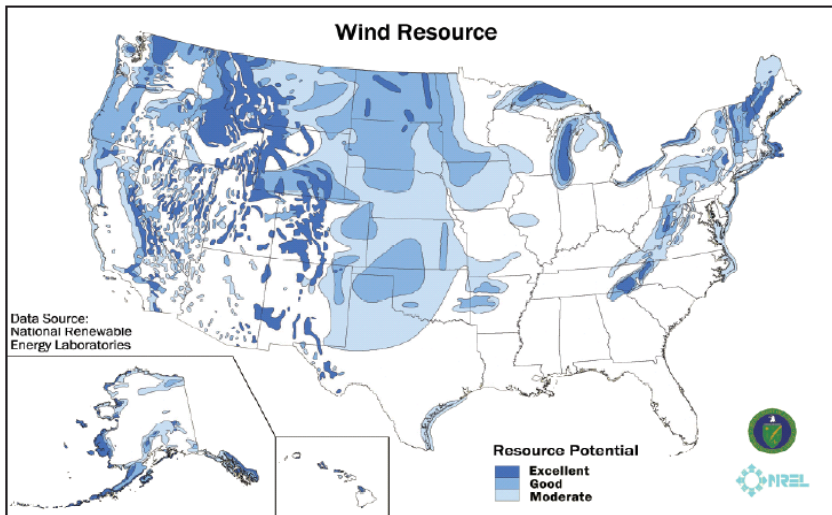


- Renewable energy takes one form of energy (biomass, wind, hydro, sunlight) and converts to another, more usable form (liquid, solid, gaseous, electrical)
- Technology specific to feedstock and offtake: must relate local supply to local need
- Transportation costs critical
- Capex intensive
- Stability of pricing for feedstock and offtake are necessary for financing
- Require substantial financial engineering to complete project finance
- Factors now favorable for RE projects

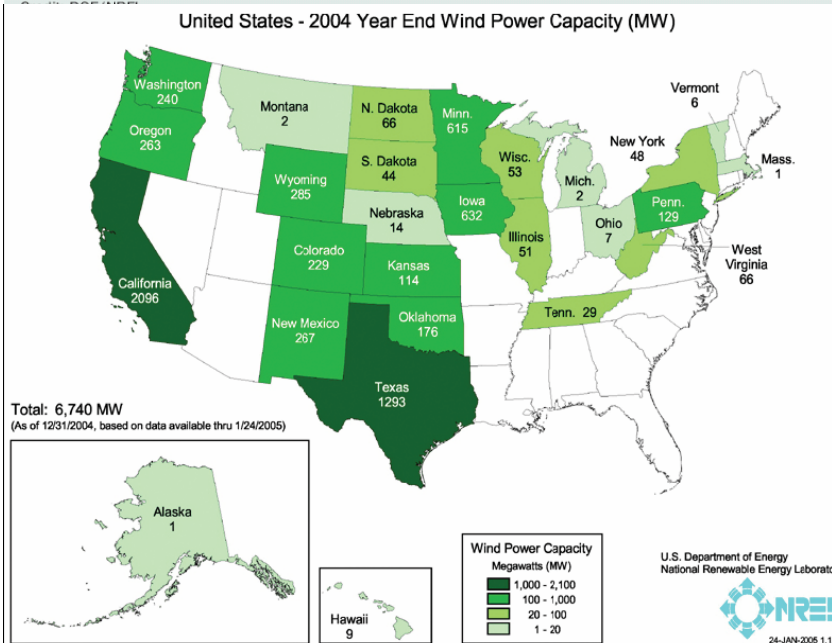




# Wind potential in US



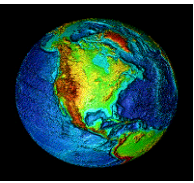
Map shows major U.S. land-based wind power reservoirs on the Great Plains and in mountainous regions.



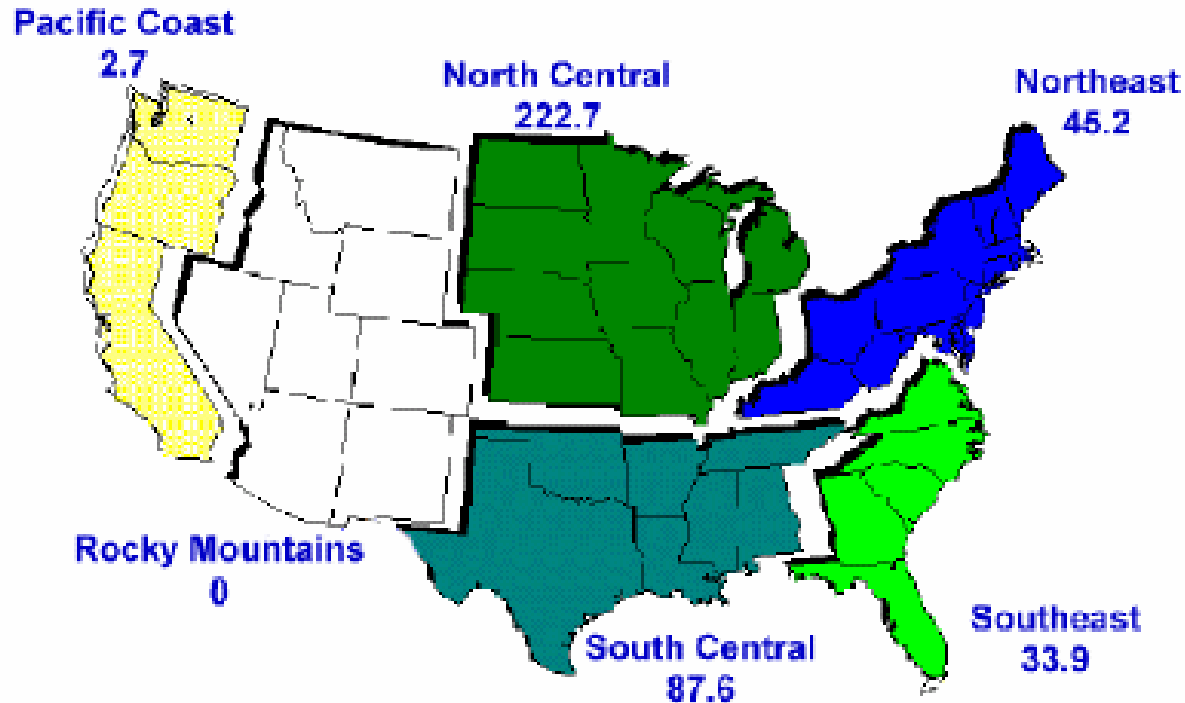
- World Potential: 12% of world's electricity by 2020 - 1,250 gw
- Potential 10-12% of US electric capacity by 2020
- One 2 MW system can run 600 average US homes, or 2.3m US homes under wind power
- US total YE 2005: 9149 MW
  - 25% in 2005
  - \$3b in 22 states
  - 2431 mw in 2005, 35%
- Where:
  - CA: 2150 mw
  - TX: 2150 mw
  - IA 836 mw
  - MN 744 mw
- GE 60% of new US installs
- 2005 installs will pay farmers \$5B

Source: NREL

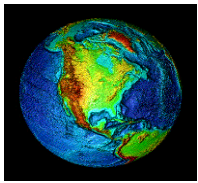




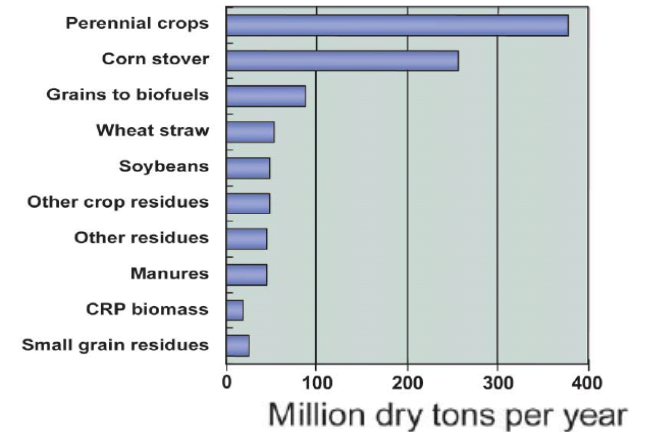
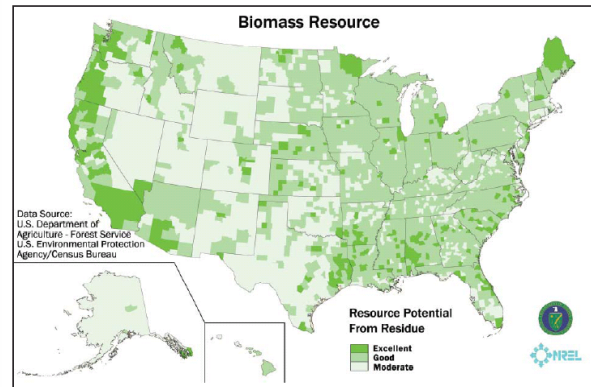
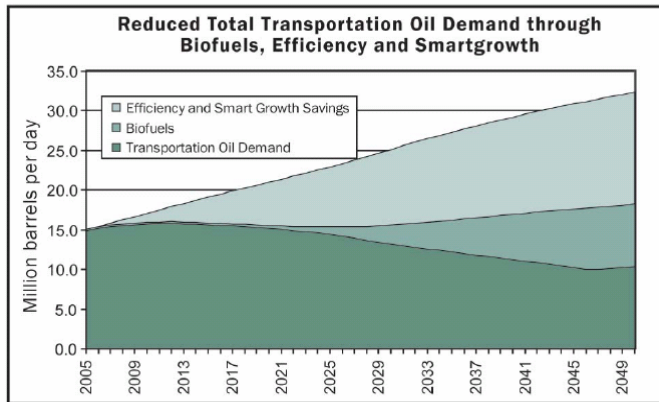
# Midwest: Good for biomass energy



392 million acres of land is potentially suitable for energy crop production

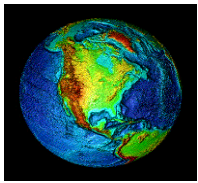


# Biofuels



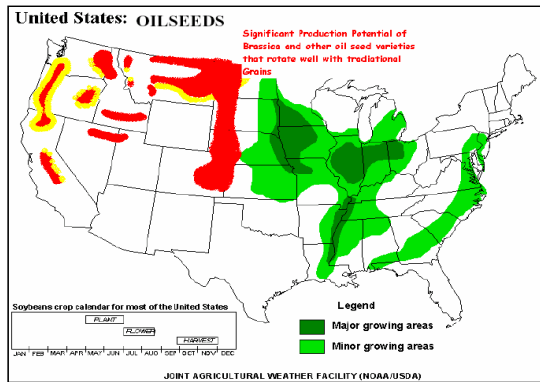
- Today:
  - Ethanol (liquid)
  - Biodiesel (Liquid)
  - Ag-Gas (gaseous)
  - Biomass (electrical power)
- Future
  - Cellulosic Ethanol
  - Ecalalene
  - Butylene

- Feedstock:
  - Starches: corn, sorghum, sugarcane
  - Fats: soybeans & canola oil, animal fats
  - Organic (wood, manure, Corn Stover, etc.)
- Feedstocks: 1.4 billion TPY
- 48-114 million acres (12-25% of U.S. crop acreage)

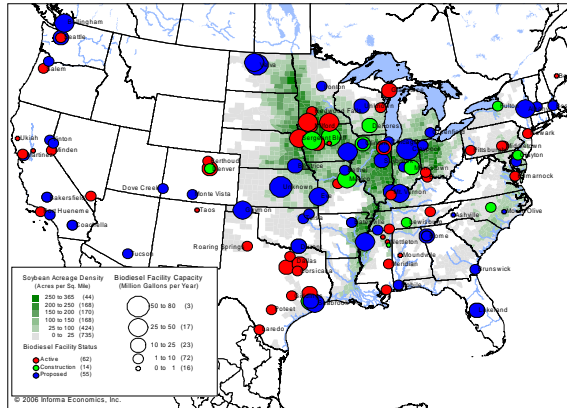


# Biodiesel Production

## Oilseed Growing



## Existing Plants



- Oil Crushing
  - 78 % revenue is meal
  - 22% revenue is oil
  - Meal: oversupply, price is declining
- On- line
  - 53 plants
  - 354 MGPY
- Planned:
  - 44 under construction /expansion
  - 329 mgpy
  - **Total 683 MGPY?**

## Planned Plants

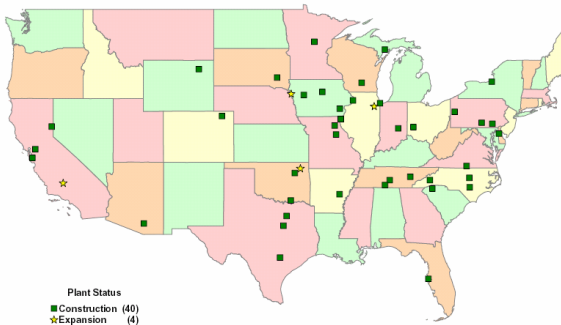


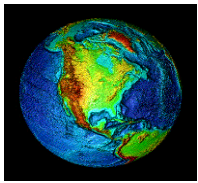
Table 3. Relative Volumes of Biodiesel Production Potential and U.S. Diesel Use

	Typical Year	
Total U.S. Soybean Oil Utilization	18,000,000,000	lbs
Share of Soybean Oil to Biodiesel	20%	
Soybean Oil Used for Biodiesel	3,600,000,000	lbs
Biodiesel Produced from Soybean Oil	459,116,883	Gallons
Total Gallons of Diesel Used in U.S.	58,000,000,000	Gallons
Share of Diesel from Biodiesel	0.79%	



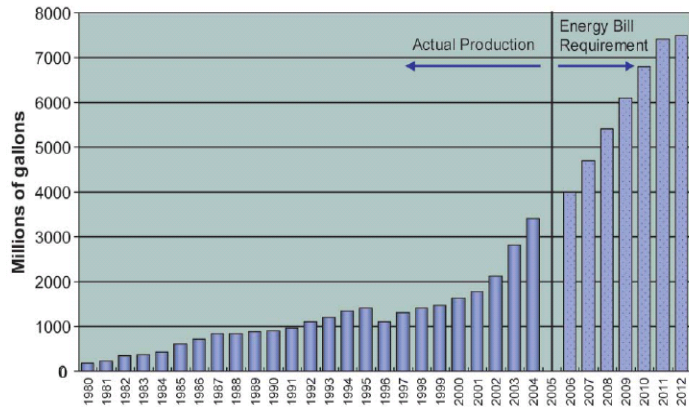
- Biodiesel IS NOT cost competitive at \$.30+/lb (or \$2.15/ gal) oil, plus 30-50c/gal manufacturing cost

**Currently, without subsidies, Biodiesel is not cost competitive with \$1.50/gal wholesale diesel...Stranded Assets???**

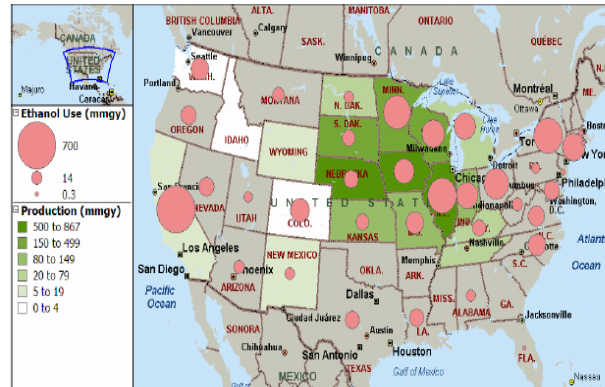


# Ethanol

## CAPACITY

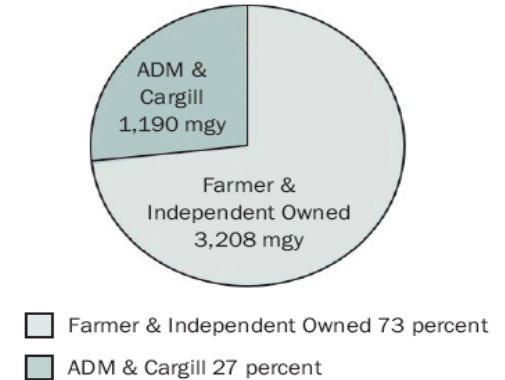


## PRODUCTION AND CONSUMPTION



Source: BBI International

## OWNERSHIP

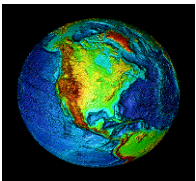


- Capacity: 4.3 BGPY (YE2005)
- 2012 RFS of 7.5 BGPY gallons by 2012
- 11.8 BGPY by YE 2008, incl. current construction
- 8.4% of the 140 million gallons consumed (2005)

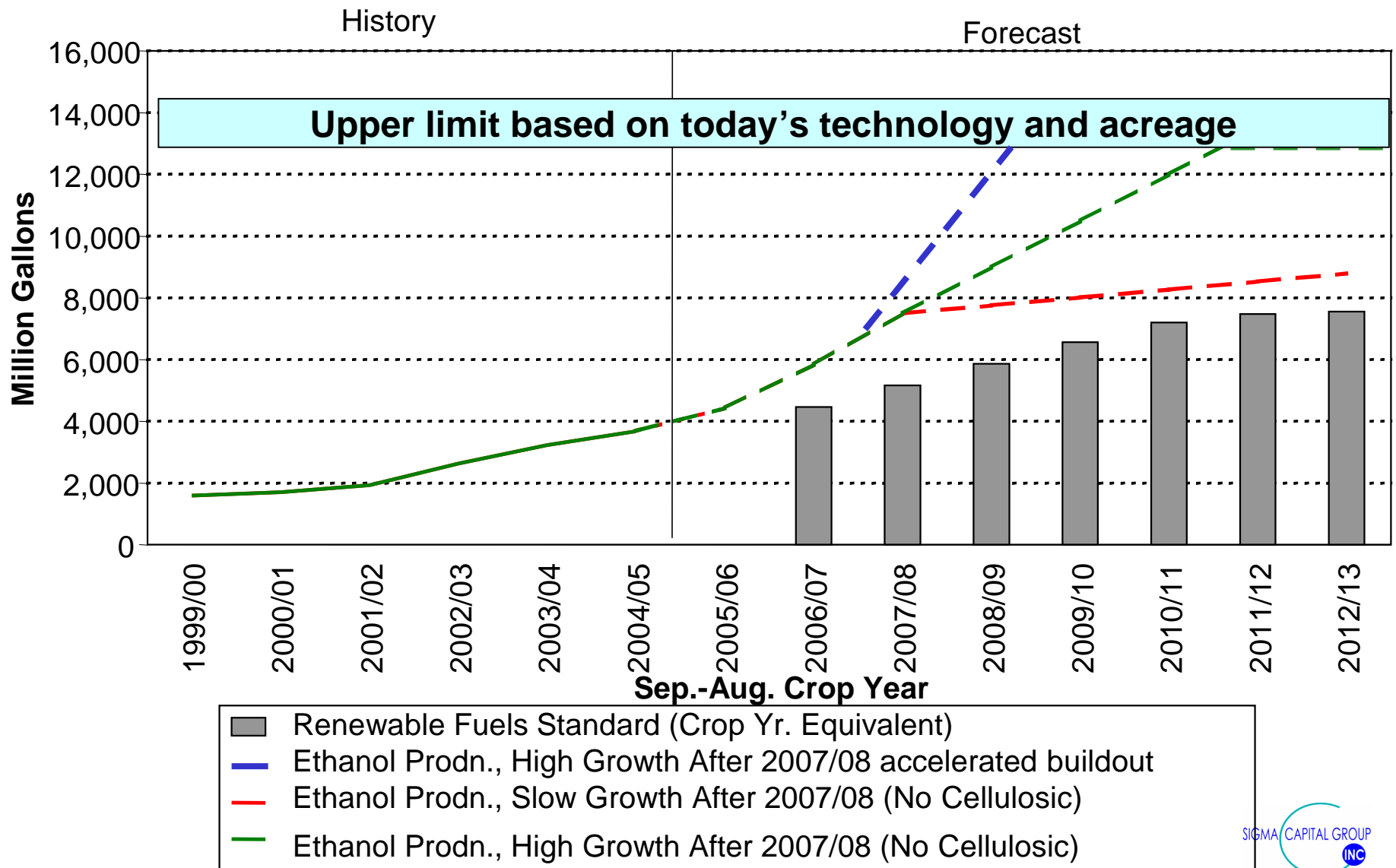
- Ethanol use vs. production
- 40 million gallon plant creates 142 million in local economic activity
- \$56 million/year to local community, 71% to farmers for grain

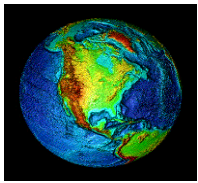
- 2005 Ownership
  - 104 Plants
  - 4.3 billion GPY capacity
  - ADM/Cargill = 27% (1.2BGPY)
  - Farmer & independent 73% (3.2BGPY)

**Net of tax subsidy, ethanol cost is \$2.04/gal vs \$ 1.34 wholesale price of gasoline ... with less energy content**



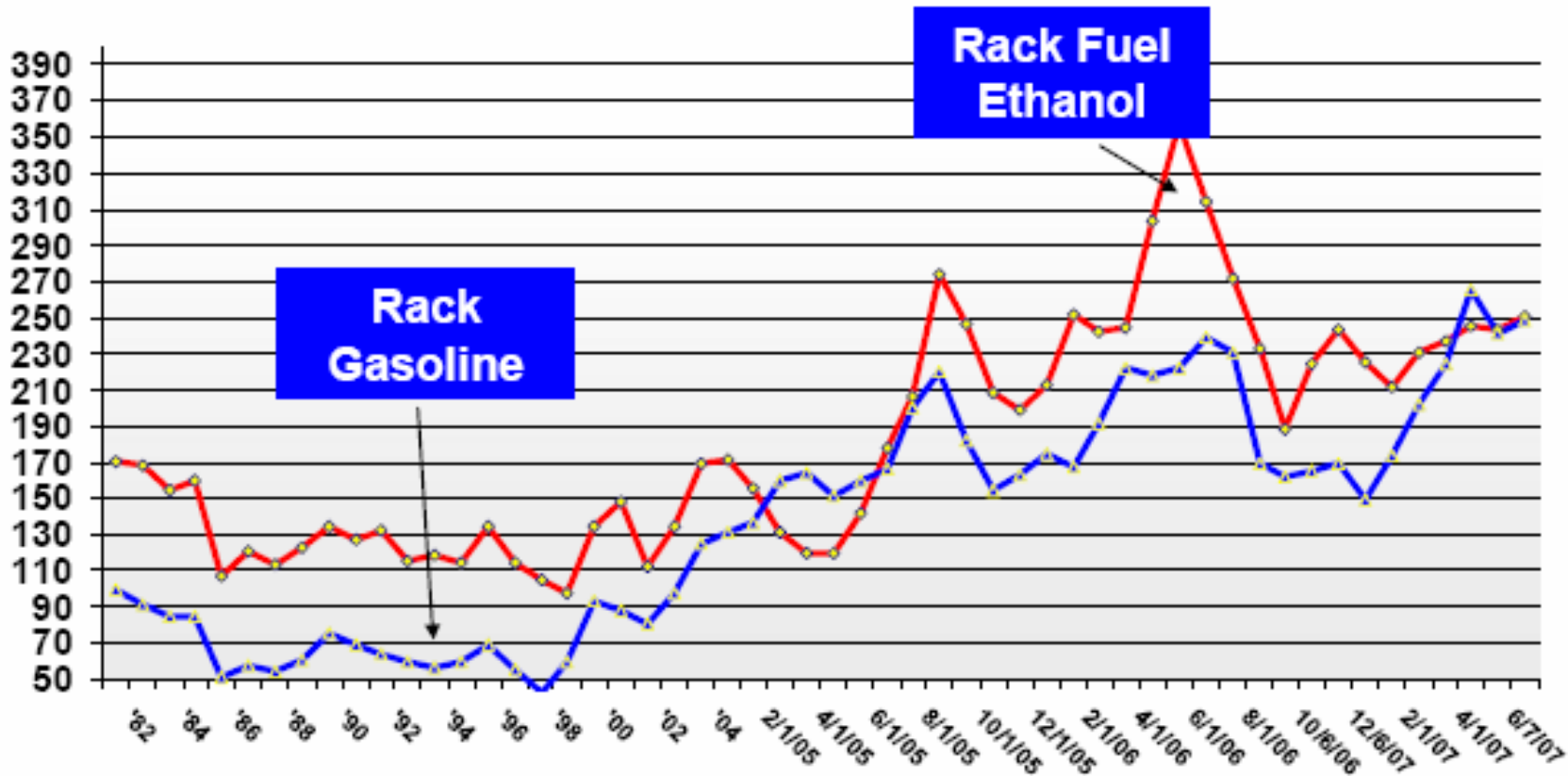
# U.S. Ethanol Volume Trajectory



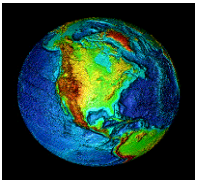


# Ethanol Rack and Gasoline Pricing

Annual average 1982-2004, monthly average starting January 1982  
Omaha, Nebraska (cents per gallon), through previous month

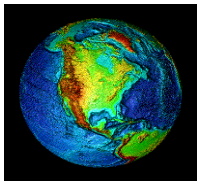


Source: Ethanol Market



---

**What's next?????????**

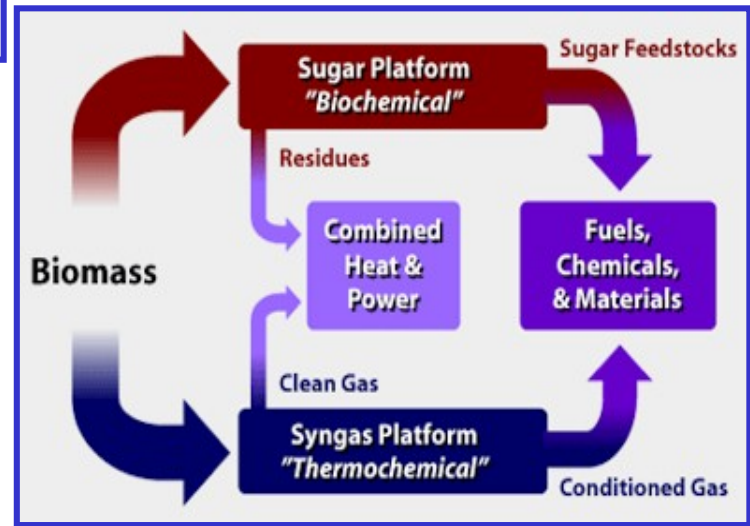


# Breakthroughs...what is the best path??

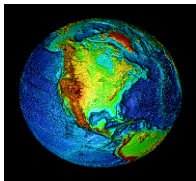
## Sustainability vs. Climate Impact Vs. National Security????

### Coal-to-Diesel Breakthrough Could Cut Oil Imports

Professor Alan Goldman and his Rutgers team in collaboration with researchers at the University of North Carolina at Chapel Hill have developed a way to convert carbon sources, such as coal, to diesel fuel.

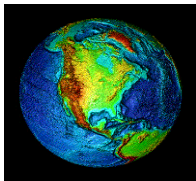


Need to understand what is real, where it fits, costs, timing, etc...



# Progress and development

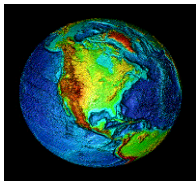
<p><b>The Wide World of Biofuels</b></p>	Fuel	Source	Benefits	Maturity	<p>Most Mature</p> <p>Least Mature</p>
	Grain/Sugar Ethanol	Corn, sorghum, and sugarcane	<ul style="list-style-type: none"> <li>• Produces a high-octane fuel for gasoline blends</li> <li>• Made from a widely available renewable resource</li> </ul>	Commercially proven fuel technology	
	Biodiesel	Vegetable oils, fats, and greases	<ul style="list-style-type: none"> <li>• Reduces emissions</li> <li>• Increases diesel fuel lubricity</li> </ul>	Commercially proven fuel technology	
	Green Diesel and Gasoline	Oils and fats, blended with crude oil	<ul style="list-style-type: none"> <li>• Offer a superior feedstock for refineries</li> <li>• Are low-sulfur fuels</li> </ul>	Commercial trials under way in Europe and Brazil for fuel	
	Cellulosic Ethanol	Grasses, wood chips, and agricultural residues	<ul style="list-style-type: none"> <li>• Produces a high-octane fuel for gasoline blends</li> <li>• Is the only viable scenario to replace 30% of U.S. petroleum use</li> </ul>	DOE program is focused on commercial demonstration by 2012	
	Butanol	Corn, sorghum, wheat, and sugarcane	<ul style="list-style-type: none"> <li>• Offers a low-volatility, high energy-density, water-tolerant alternate fuel</li> </ul>	BP and DuPont plan to introduce butanol fuel in 2007	
	Pyrolysis Liquids	Any lignocellulosic biomass	<ul style="list-style-type: none"> <li>• Offer refinery feedstocks, fuel oils, and a future source of aromatics or phenols</li> </ul>	Several commercial facilities produce energy and chemicals	
	Syngas Liquids	Various biomass as well as fossil fuel sources	<ul style="list-style-type: none"> <li>• Can integrate biomass sources with fossil fuel sources</li> <li>• Produce high-quality diesel or gasoline</li> </ul>	Demonstrated on a large scale with fossil feedstocks, commercial biomass projects under consideration	
	Diesel/Jet Fuel From Algae	Microalgae grown in aquaculture systems	<ul style="list-style-type: none"> <li>• Offer a high yield per acre and an aquaculture source of biofuels</li> <li>• Could be employed for CO<sub>2</sub> capture and reuse</li> </ul>	Demonstrated at pilot scale in 1990s	
	Hydrocarbons From Biomass	Biomass carbohydrates	<ul style="list-style-type: none"> <li>• Could generate synthetic gasoline, diesel fuel, and other petroleum products</li> </ul>	Laboratory-scale research in academic laboratories	



# Biomass Conversion Overview

Biomass Conversion Technologies	Product Thermal Conversion Efficiency (%TE)		%TE with IC Engine(40%), Gas Turbine(GT)(35%), Steam Turbine(ST)(21%)		Fuel Conversion (Gallons/Ton Biomass)	
	Products (SG: Syngas)	Heat Output	Electricity	Combined Heat & Electricity	Ethanol	Diesel
1). Thermal Gasification	70% SG	12%	25% (GT)	42%	Not Determined	Not Determined
2). Thermal Pyrolysis/ Steam Reforming	75% SG	10%	30% (IC)	45%	78	35
3). Thermal Oxidation (Incineration)	Heat	80%	17% (ST)	54%	Not Applicable	Not Applicable
4). Integrated Thermal Gasification/Oxidation	Heat	80%	17% (ST)	56%	Not Applicable	Not Applicable
5). Thermophilic Anaerobic Digestion	30% Biogas	0%	12% (IC)	18%	Not Determined	Not Determined
6). Hydro-gasification/ Steam Reforming	75% SG	10%	30% (IC)	45%	Not Determined	Not Determined

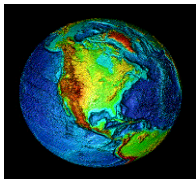
**Research in new technologies is creating greater efficiencies**



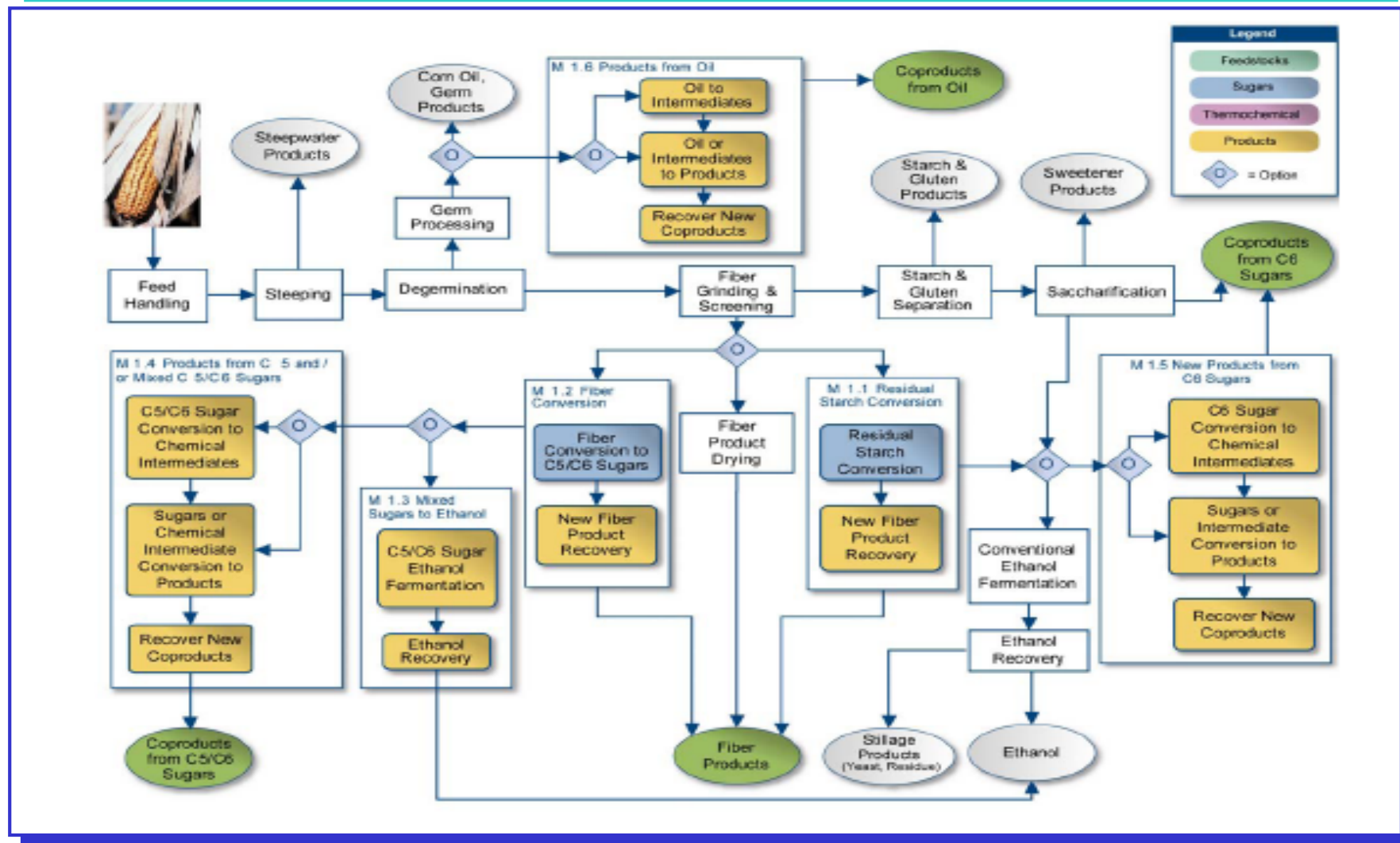
# Current Production Costs

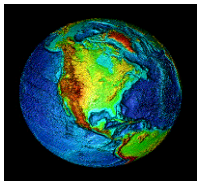
Conversion Product	Wholesale Value	Carbon Content (wgt.%)	Mass Density (lbs/gal.)	Energy Density (BTU/lb)	Yield (Per Ton Biomass)	Economic Value (\$/Ton Biomass)
Electricity	\$0.05/ KWH	-	-	-	1010 KWH	\$51
Diesel (Partially Refined)	\$1.50/ Gallon	88	6.75	18.7	35 Gallons	\$53
Gasoline (Fuel Grade)	\$1.70/ Gallon	84	6.23	18.3	40 Gallons	\$68
Methanol (Fuel Grade)	\$0.90/ Gallon	38	6.54	8.5	102 Gallons	\$92
Ethanol (Fuel Grade)	\$1.60/ Gallon	52	6.60	11.5	78 Gallons	\$125

**Food-feedstock price and petroleum escalations are changing the economics dramatically**

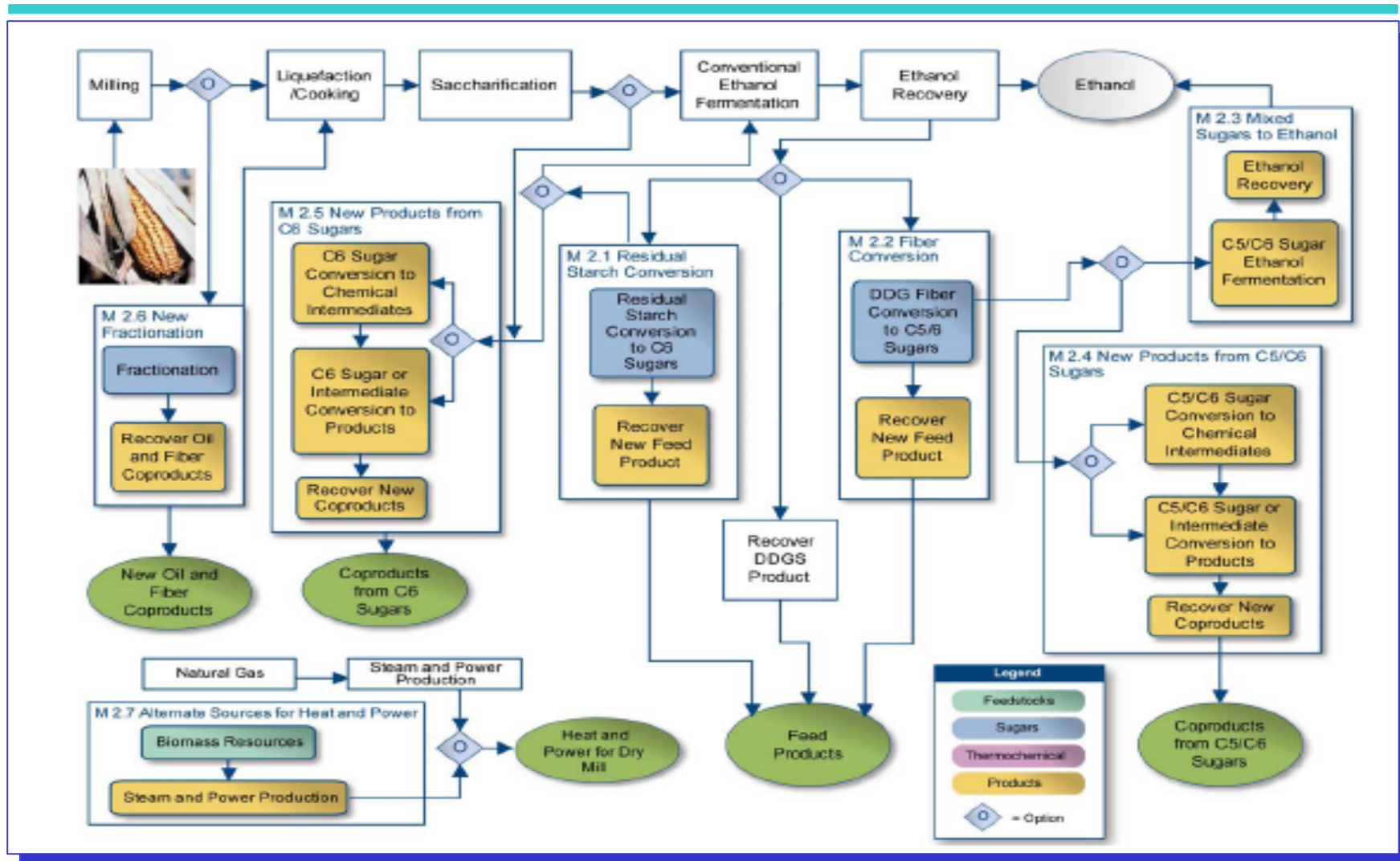


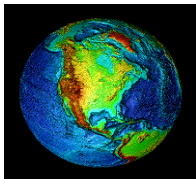
# Corn Milling Improvement Pathway



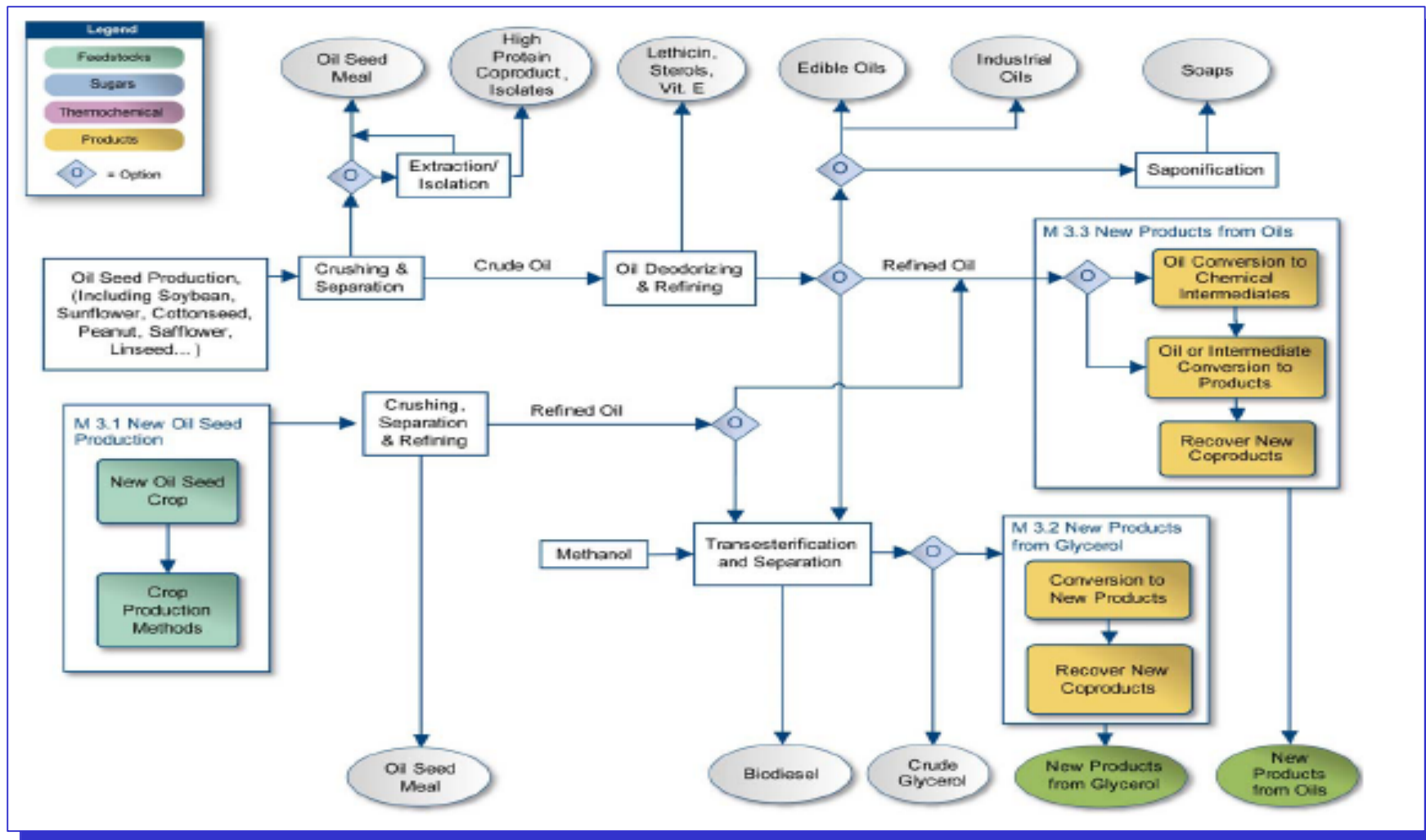


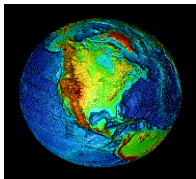
# Corn Milling Improvement Pathway 2



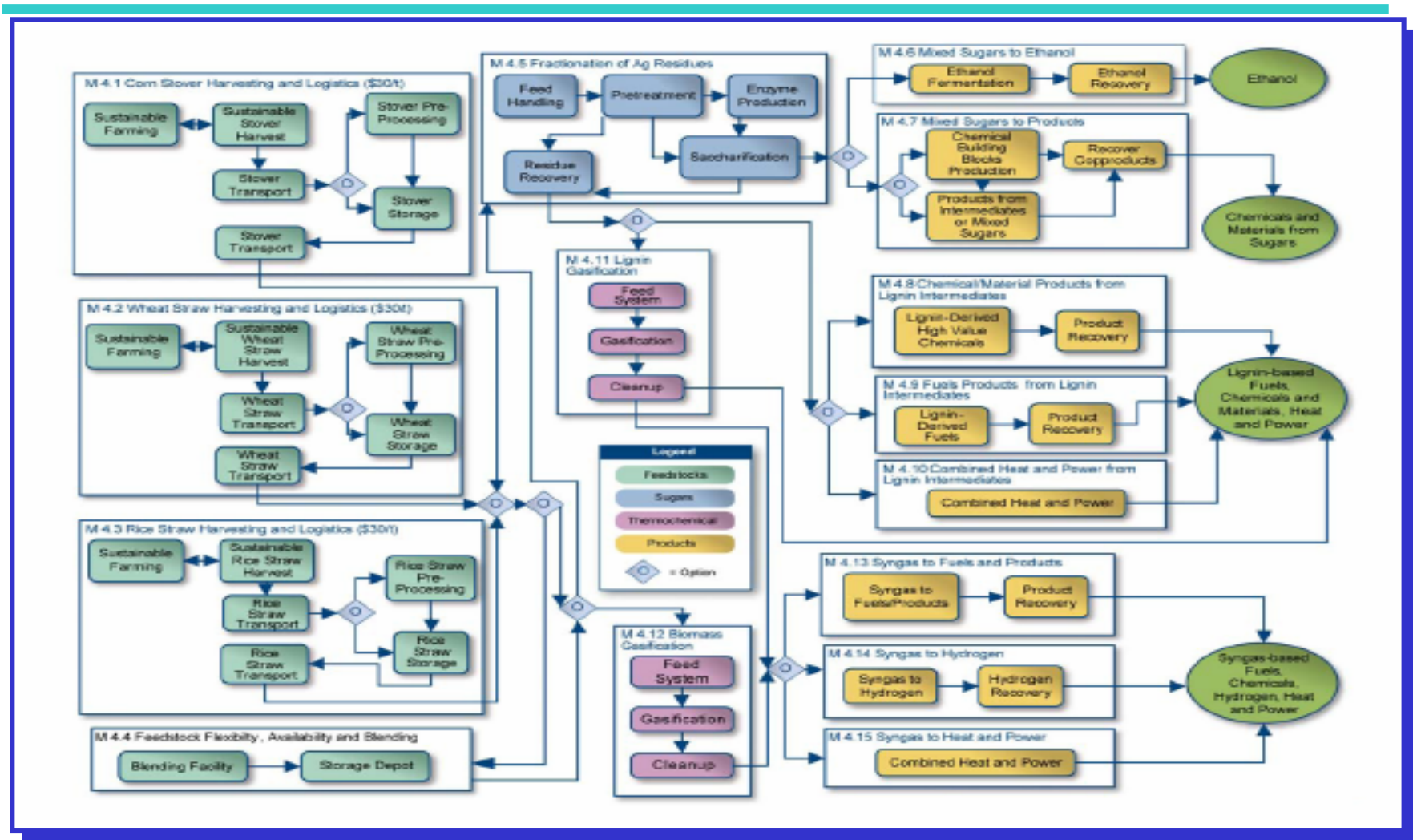


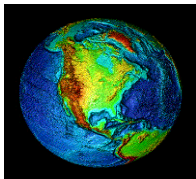
# Seed Oil Path Improvement Pathway



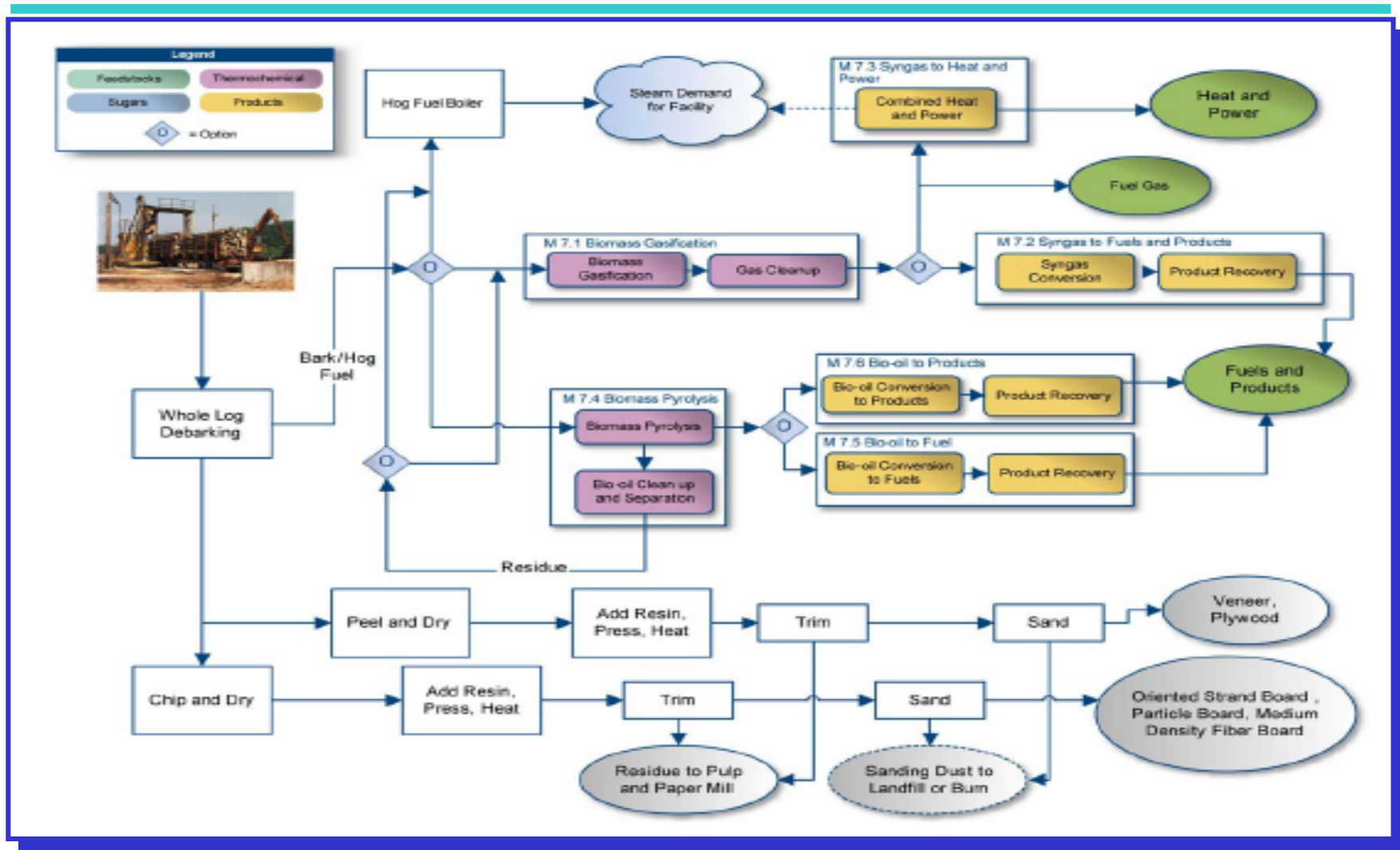


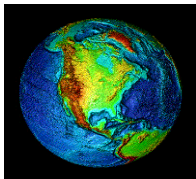
# Ag Residue Improvements Pathway



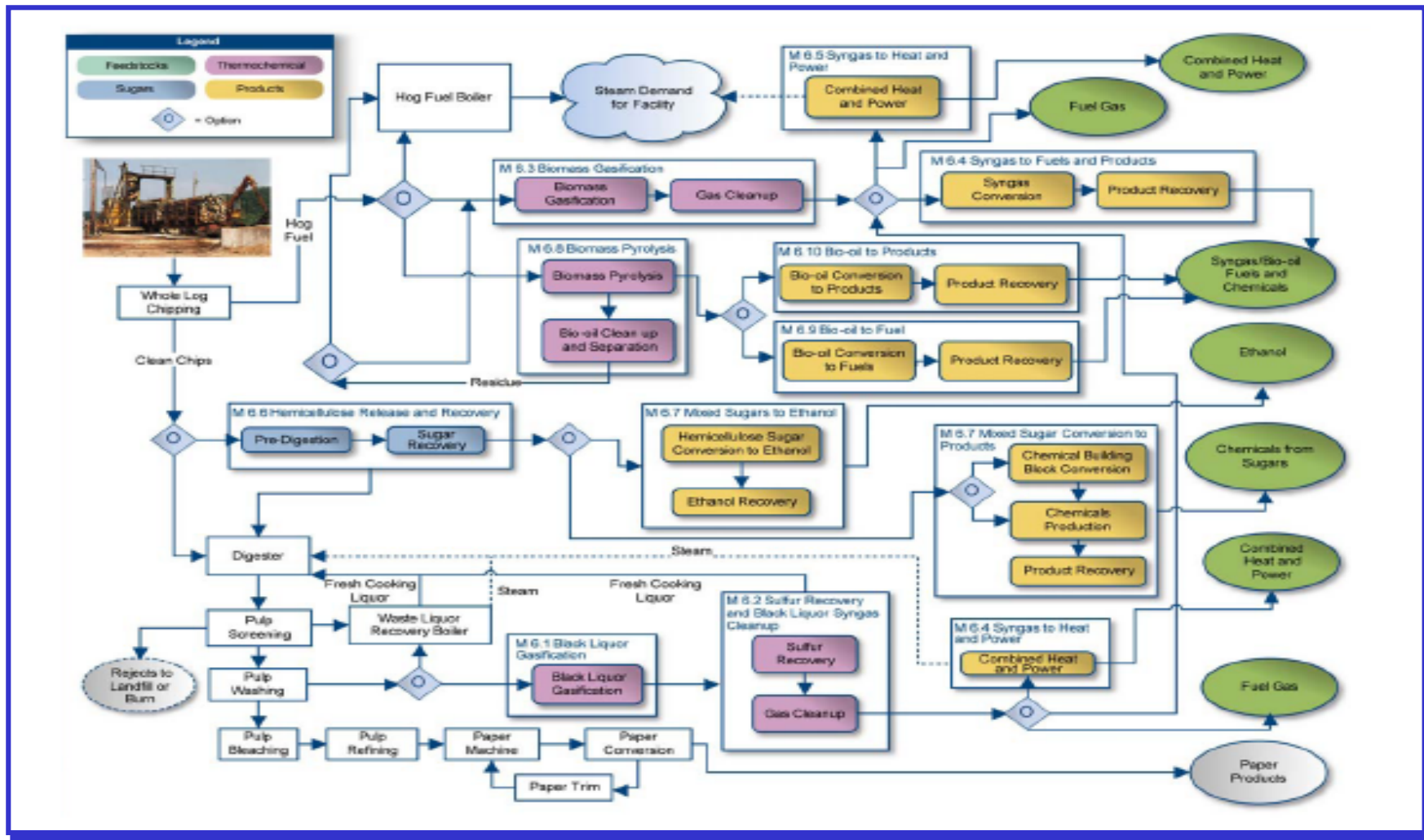


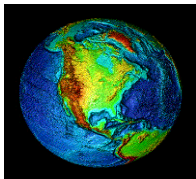
# Forest Products Mill Improvement Path



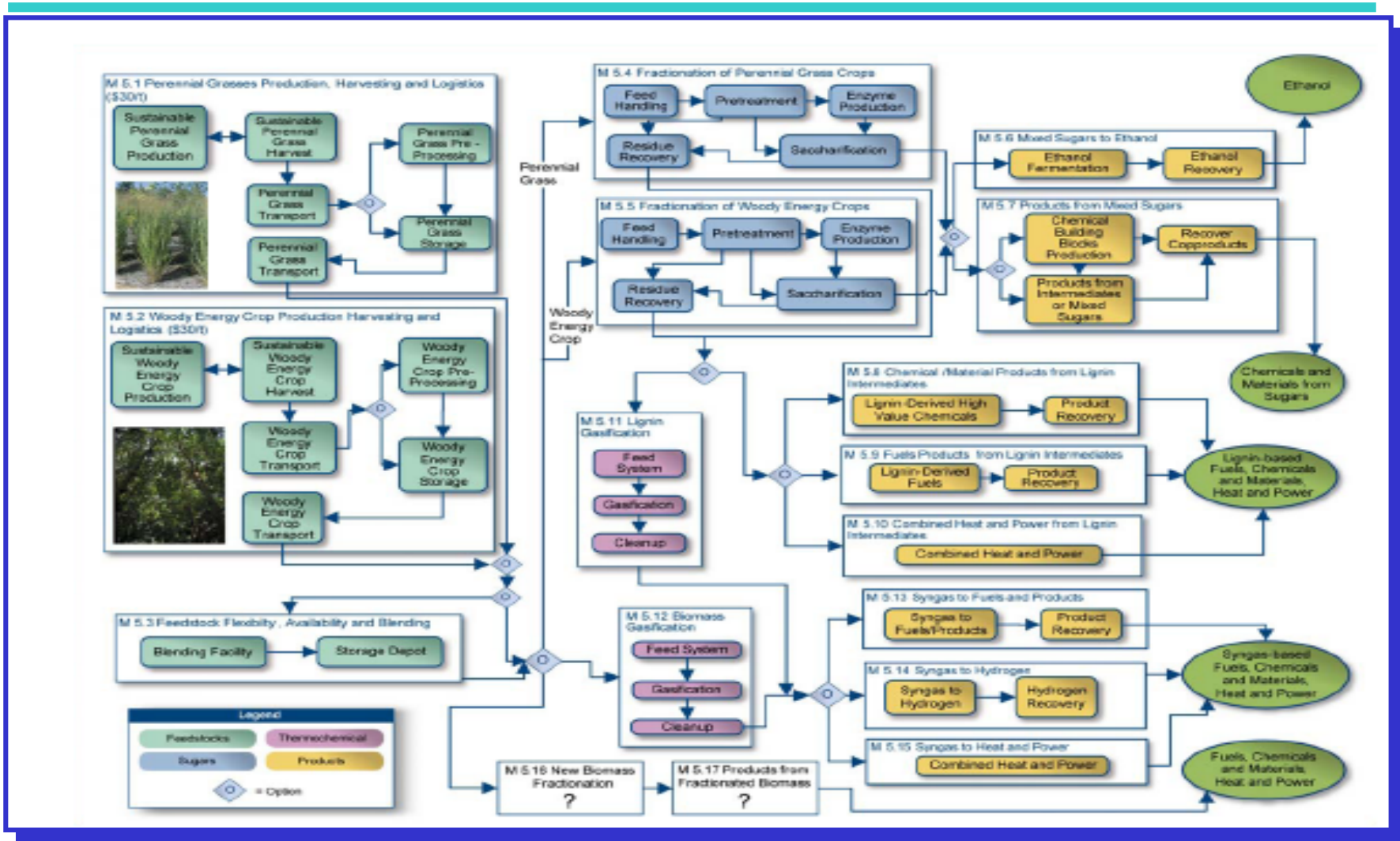


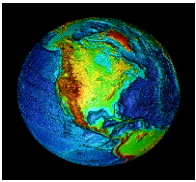
# Pulp and Paper Improvement Pathway





# Woody Energy Crop Improvement Pathway

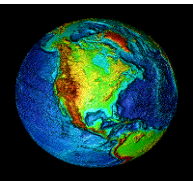




---

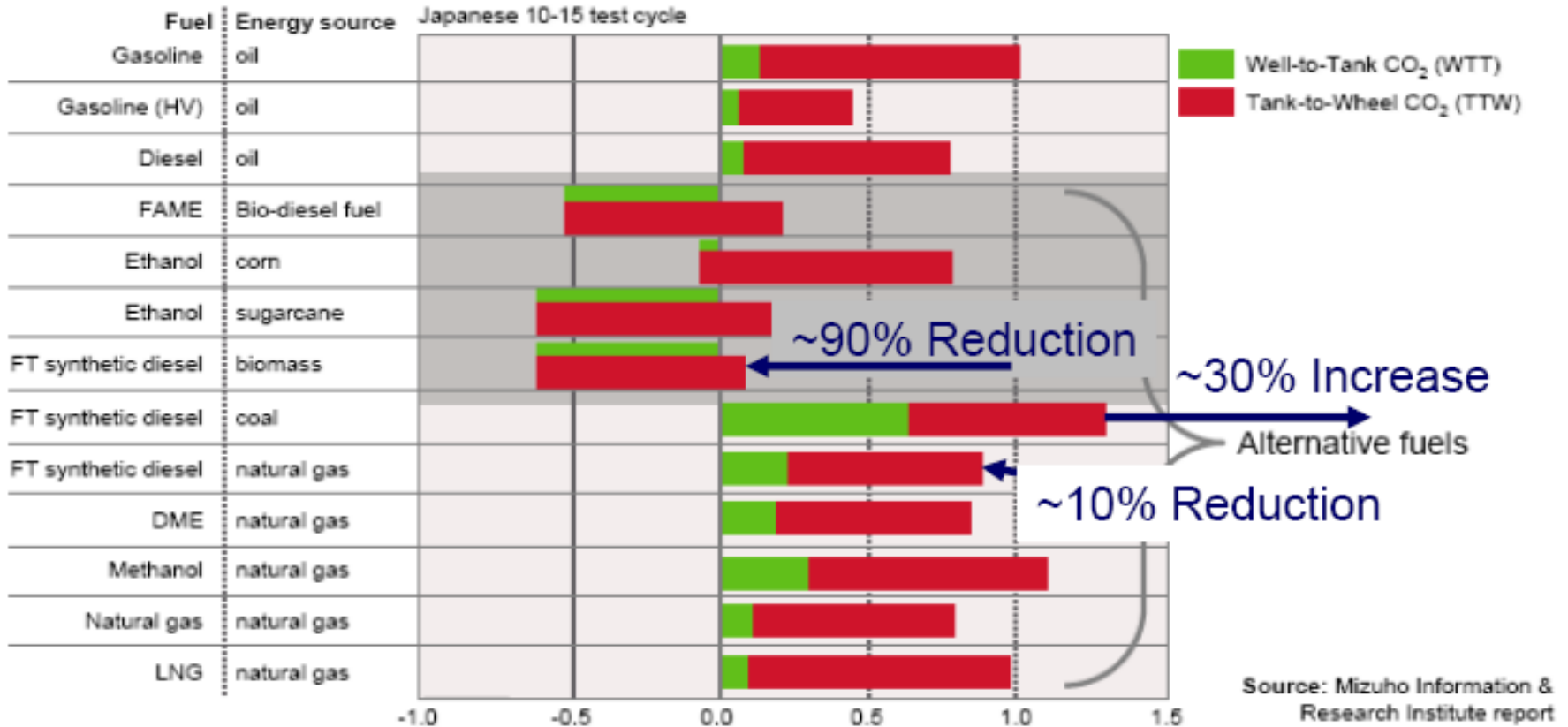
# ACCELERATING PROJECTS

---



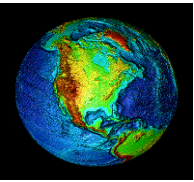
# Well to Wheels CO<sub>2</sub>

Relative CO<sub>2</sub> emissions indexed to gasoline as 1.0

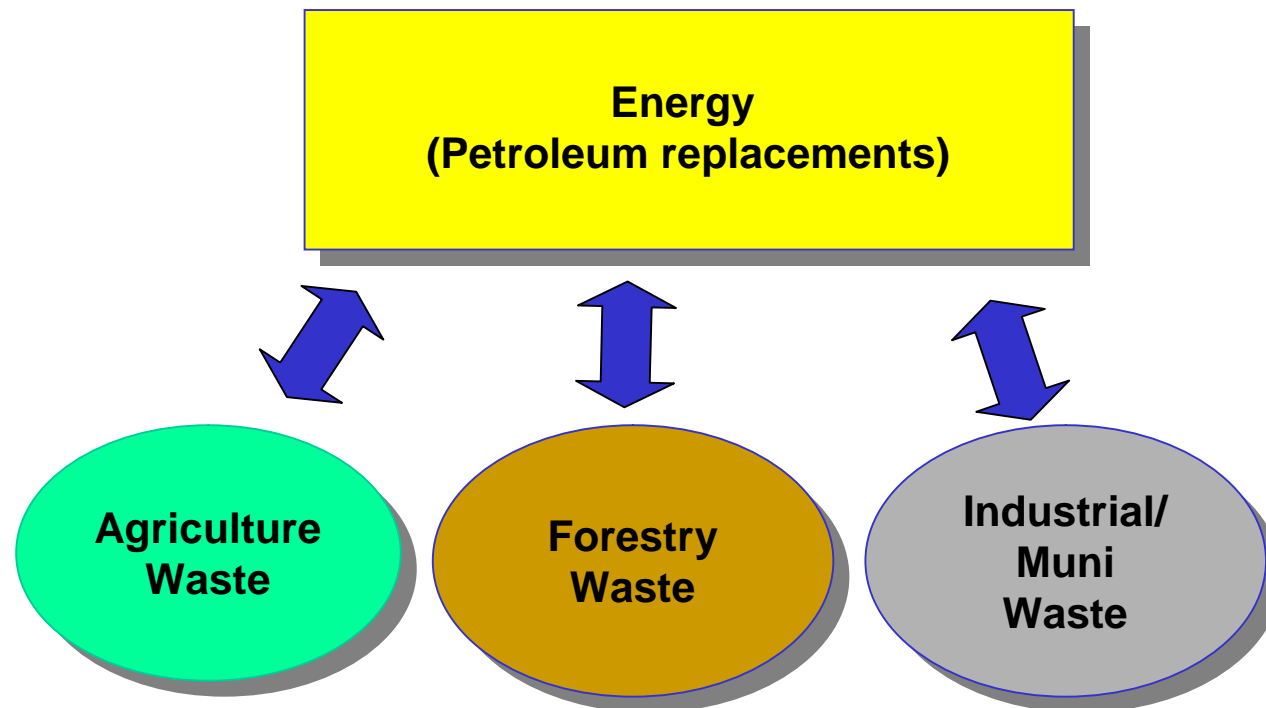


Biofuels have a CO<sub>2</sub> advantage among alternative fuels

CTL facilities must address carbon emissions

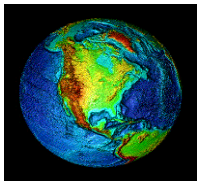


# Scale of the Manhattan Project...without focus

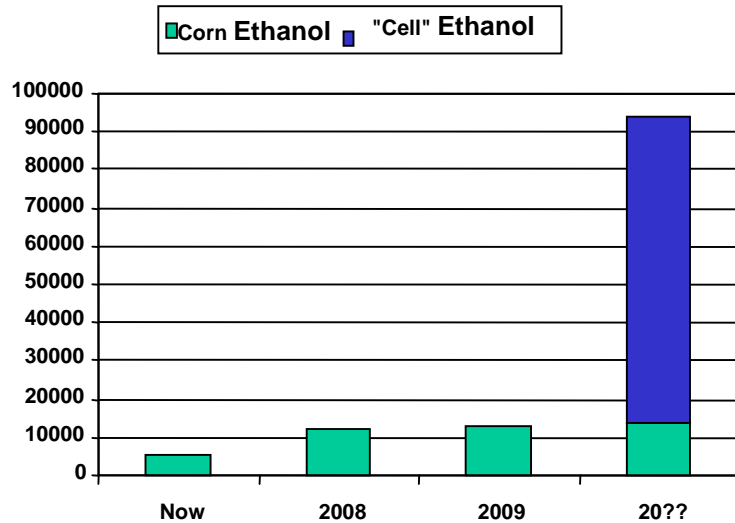


- Few I-Banks understand energy, ag forestry, and environmental ...
- Practical issues are key considerations
  - Business
  - Technology
  - Transport
  - Storage
  - Finance

**Need: a coordinated strategy for implementing RE technology**



# Key challenges ahead, plan and react now

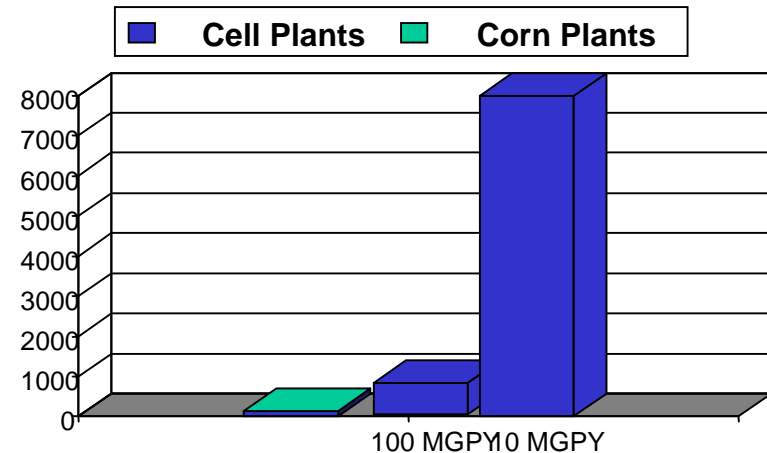


## Corn ethanol

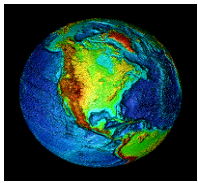
- Ethanol expanded approximately 120 plants in three years
- “Flattened” the developers, EPCs , finance industry
- “Can’t get” steel, piping, tanks, etc.
- Ag transportation infrastructure strained beyond ability to respond

## Cell ethanol

- Require between **4000 and 8000** plants , based on 80 billion gallons new “Cell” ethanol
- Little transportation in rural areas for “Woody” ethanol on a large scale
- Insufficient EPCs, engineering firms, developers, operators, etc.



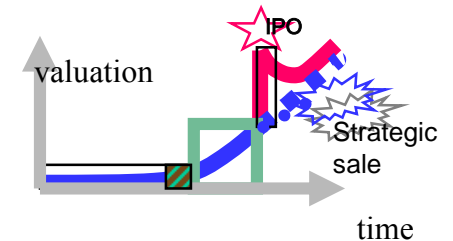
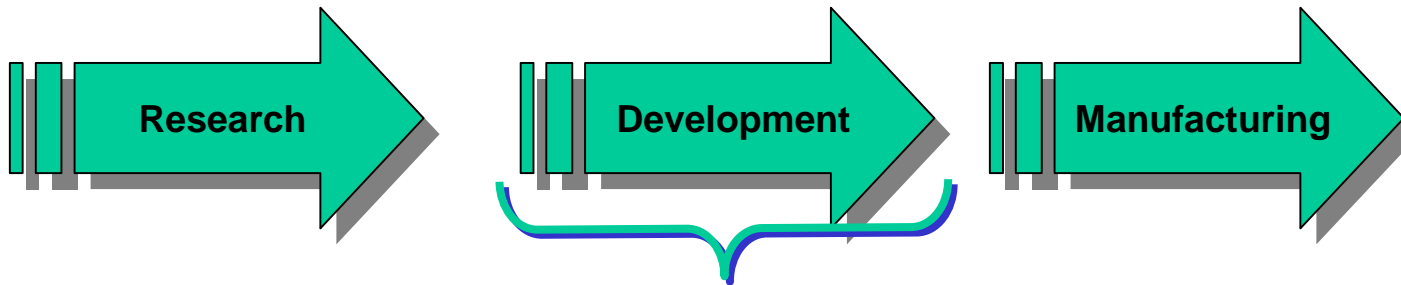
**Historical ways of doing business will not work**



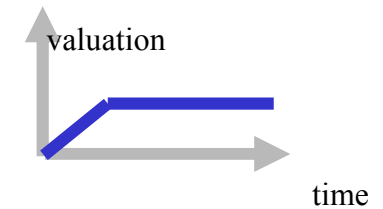
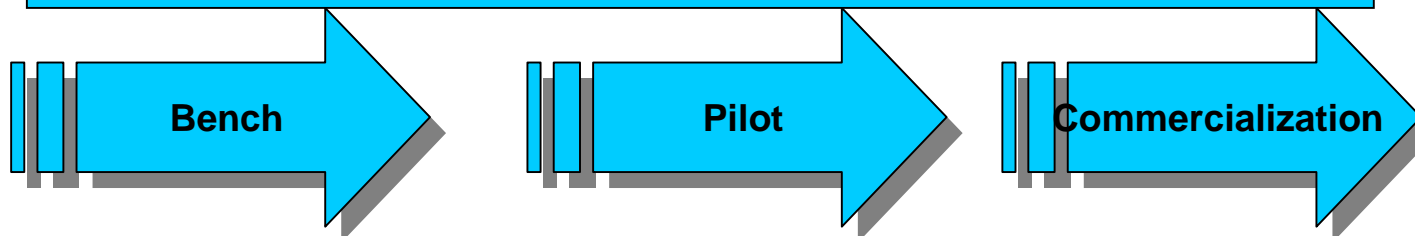
# Renewable Technologies: Dual Challenge

## Two Commercialization Pathways Required

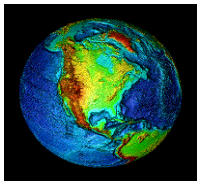
### Products: Growth Company Pathway




### Fuels: Project Development Pathway



- Must link development of new renewable energy technology companies with fuels development
- Commercialization of both required in parallel
- Different management, business models and financing





# Who is accelerating technology???




**150**  
AUBURN UNIVERSITY  
1866 - 2016

Biorefining and Alternative Energy Research  
in  
The Department of Chemical Engineering  
&  
The Alabama Center for Paper and Bioresource Engineering (AC-PABE)

Innovation for Our Energy Future

**From Biomass**



NREL Leads the Way

**to Biofuels**





State University of New York  
College of Environmental Science and Forestry



## Wood-to-Wheels

A Graduate Enterprise in Sustainable Transportation Utilizing Fuels and Co-Products from Forests and Other Biomass Sources

Home | Objectives | Motivation | Initiatives | Funding | Contact Information | Resources

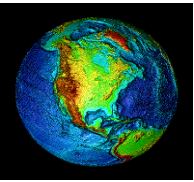
### Objectives

- Improve bioprocesses that will **utilize woody biomass**.
- Improve forest management and apply biotechnology to **increase forest bio productivity/utilization per acre by 65%**
- Demonstrate forest land management, fuels production, and vehicular technology that **close the carbon cycle and stabilize atmospheric CO2 levels**.
- Optimize powertrain technologies that **reduce fossil fuel consumption over cycle by up to 100%** in vehicles that use these technologies.

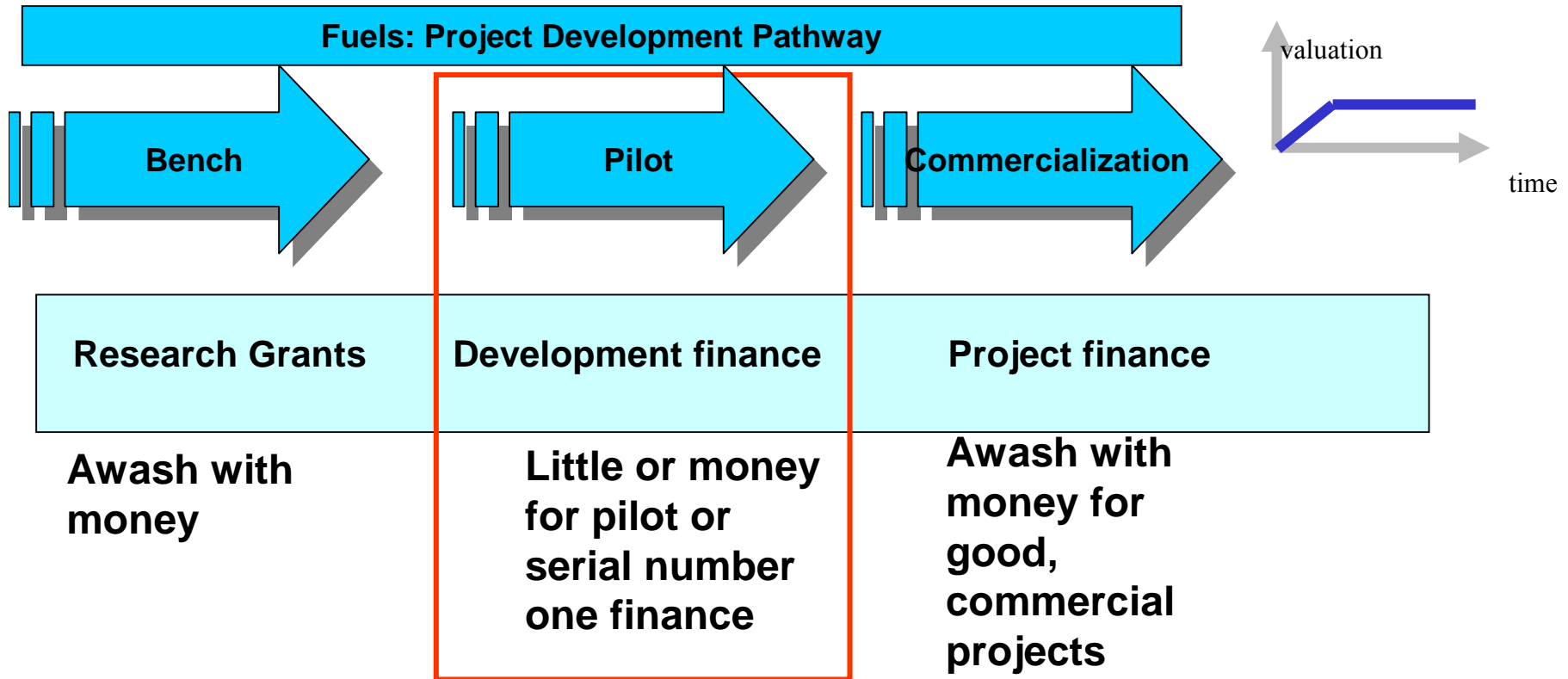
*MichiganTech*

Sustainable Futures Institute  
[www.sfi.mtu.edu](http://www.sfi.mtu.edu)

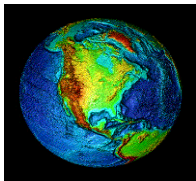
**Plenty of research, limited commercialization...**



# Refocus from Research to Commercialization



**Matching the financing type with Phase and jumping the Development Finance Gap**



# Converting Biomass into Efficient Fuel

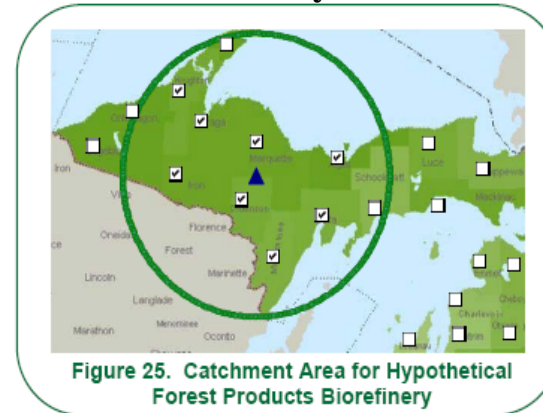
## Biomass

- Biomass Advantages
  - Abundant
  - Accessible
  - Renewable
- Biomass Disadvantages
  - Inefficient to store and transport
  - Low energy density (8000 vs 18.000 BTU/LB)
  - Low energy efficiency
  - Negative environmental impact if not treated

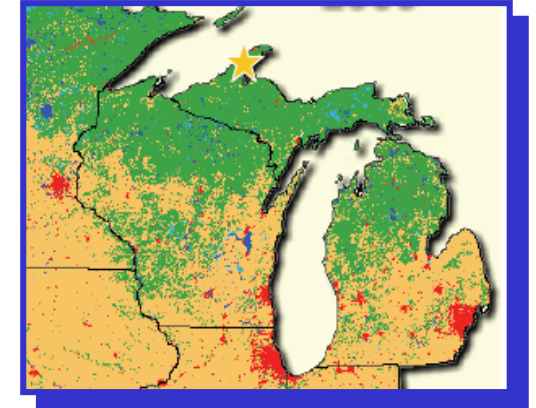
Need to understand Solutions  
(Conversion of Biomass to....?)

Energy density (storable/transportable),  
energy efficiency (liquid fuel), yields,  
compatibility with existing fuel  
infrastructure

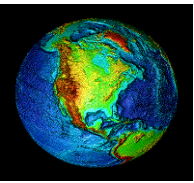
## MSU Study



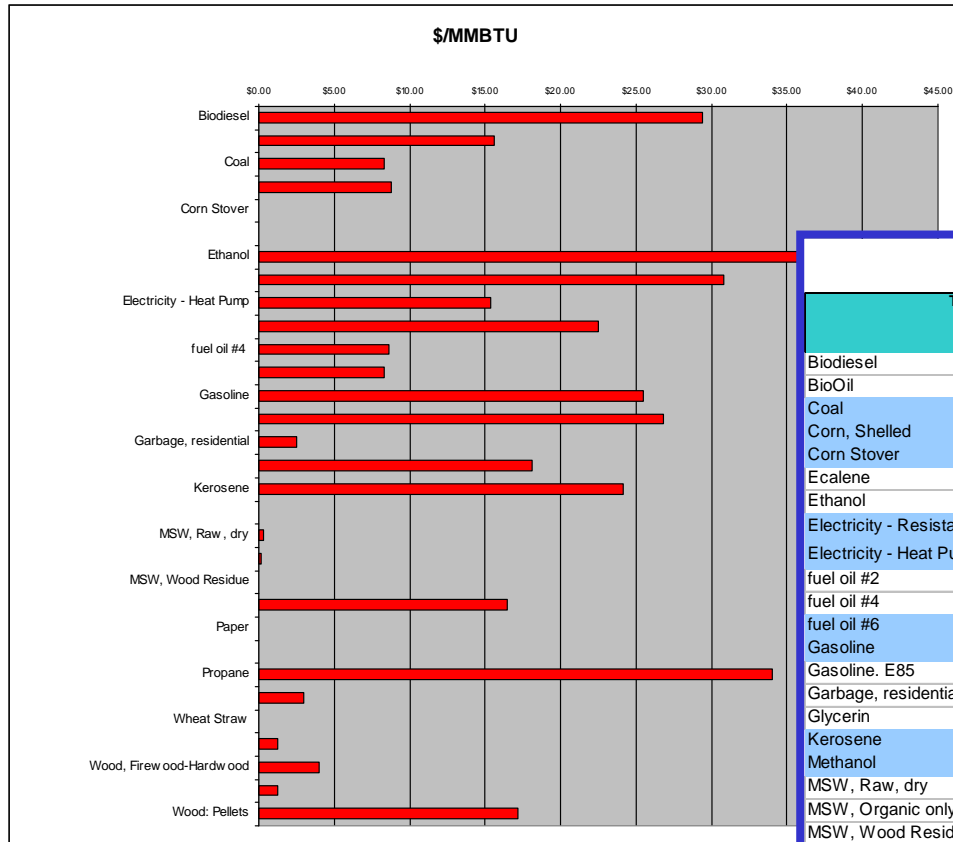
## UP & N. LP Michigan



- **Region not as competitive as ag biomass**
- **Still opportunity for early processing of biomass**
- **Enhancing technology gaps for mixed feedstock would be beneficial**
- **Figuring out bio-conversion of wood is vital**
- **Better models associated with forest preservation for sustainability**

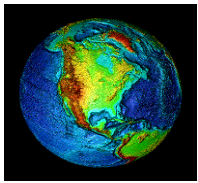


# Cost competitive commodity production



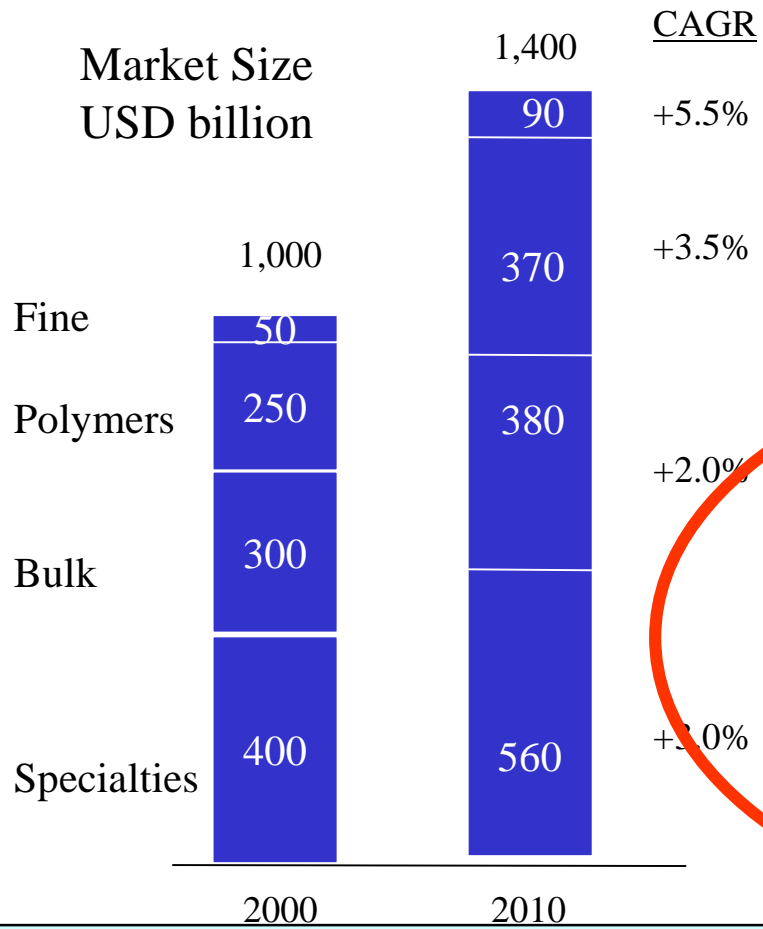
Type	BTU/Unit	Heat Rate	Cost	Unit	Efficiency (%)	Cost/MMBTU
Biodiesel	120,000	BTU/Gal	\$ 2.82	/Gal	80	\$29.38
BioOil	8,000	BTU/LB	\$ 0.10	/LB	80	\$15.63
Coal	13,200	BTU/lb	\$ 165.00	/ton	75	\$8.33
Corn, Shelled	6,800	BTU/lb	\$ 2.50	/bushel	75	\$8.75
Corn Stover	7,587	BTU/lb				
Ecalene		BTU/Gal		/Gal	80	#DIV/0!
Ethanol	76,000	BTU/Gal	\$ 2.48	/Gal	80	\$40.79
Electricity - Resistance	3,412	BTU/kWh	\$ 0.105	/kWh**	100	\$30.77
Electricity - Heat Pump	3,412	BTU/kWh	\$ 0.105	/kWh**	200	\$15.39
fuel oil #2	139,000	BTU/Gal	\$ 2.50	/Gal	80	\$22.48
fuel oil #4	145,000	BTU/Gal	\$ 1.00	/Gal	80	\$8.62
fuel oil #6	150,000	BTU/Gal	\$ 1.00	/Gal	80	\$8.33
Gasoline	125,000	BTU/Gal	\$ 2.55	/Gal	80	\$25.50
Gasoline. E85	118,910	BTU/Gal	\$ 2.55	/Gal	80	\$26.81
Garbage, residential	2,500	BTU/LB	\$ 0.005	/LB	80	\$2.50
Glycerin	6,900	BTU/LB	\$ 0.10	/LB	80	\$18.12
Kerosene	134,000	BTU/Gal	\$ 2.75	/Gal	85	\$24.14
Methanol	9,500	BTU/LB		/LB	85	
MSW, Raw, dry	4,500	BTU/LB	\$ 0.00		80	\$0.28
MSW, Organic only, dry	7,000	BTU/LB	\$ 0.00		80	\$0.18
MSW, Wood Residue	8,304	BTU/LB	\$ 0.00		80	

Need to understand highest and best use of feedstock for offtake market  
(Based on a regional/ site considerations)



# Goal: Replace petroleum derived products with community biomass “high value niches”

\$160 - 280 billion



Biotech Inroads today

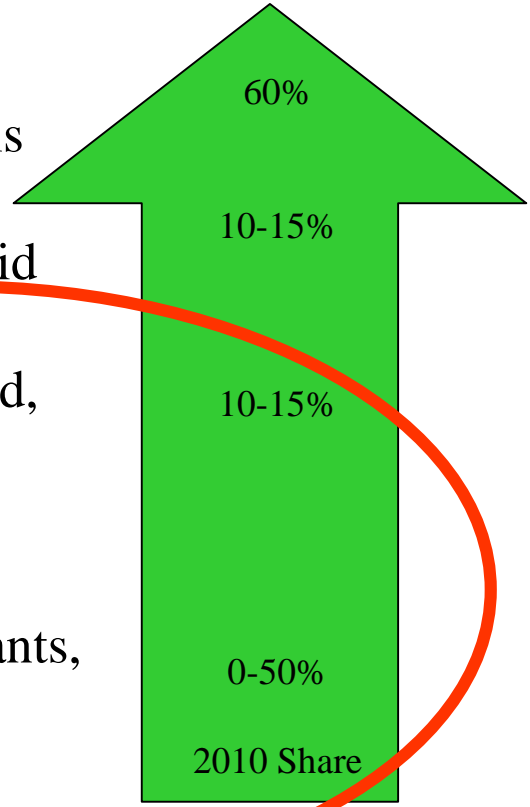
*Examples*

Biopharmaceuticals

3GT, polylactic acid

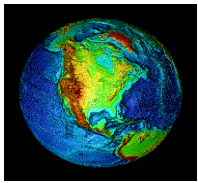
Ethanol, adipic acid, acrylamide

Detergents, lubricants, Fragrances, food chemicals

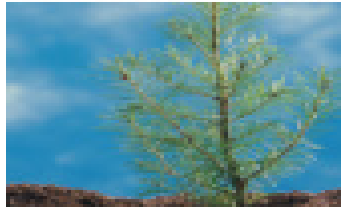


Need to understand which products fit...how to get up the niche value chain

Source: McKinsey and Company, 2003



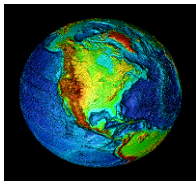
# Needs and Roles



Equivalent of the **Manhattan Project**, but lacks organization and focus across state, federal and private sector

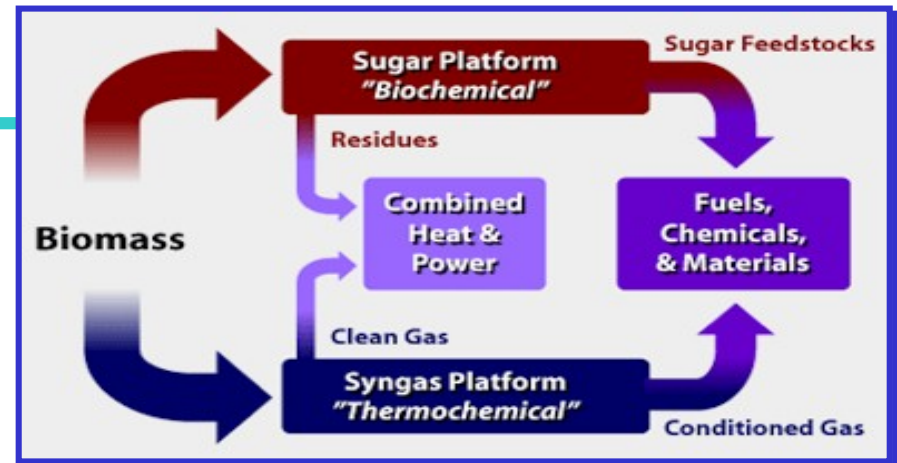
- New and uncomfortable paradigm shift
  - Long Term Mindset
  - Waste is energy too...
  - Winners and losers
  - Aggregation of niche fuels, technologies and waste remediation
  - Complete overhaul of infrastructure (grid, rail, road) in concert with transition to renewable
- “Best Use” Technology for each niche
  - R&D Dependent
  - Acceleration of technologies into a very conservative “project finance” investment framework
  - Practical Engineering in tandem with theoretical
  - “Serial Number One” risk avoidance

**Creating Triple Net Projects: Good Investments, Good Environmental/Social Value, Creates Rural Jobs**

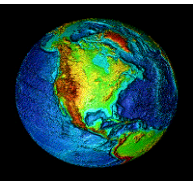


# Areas of Interest

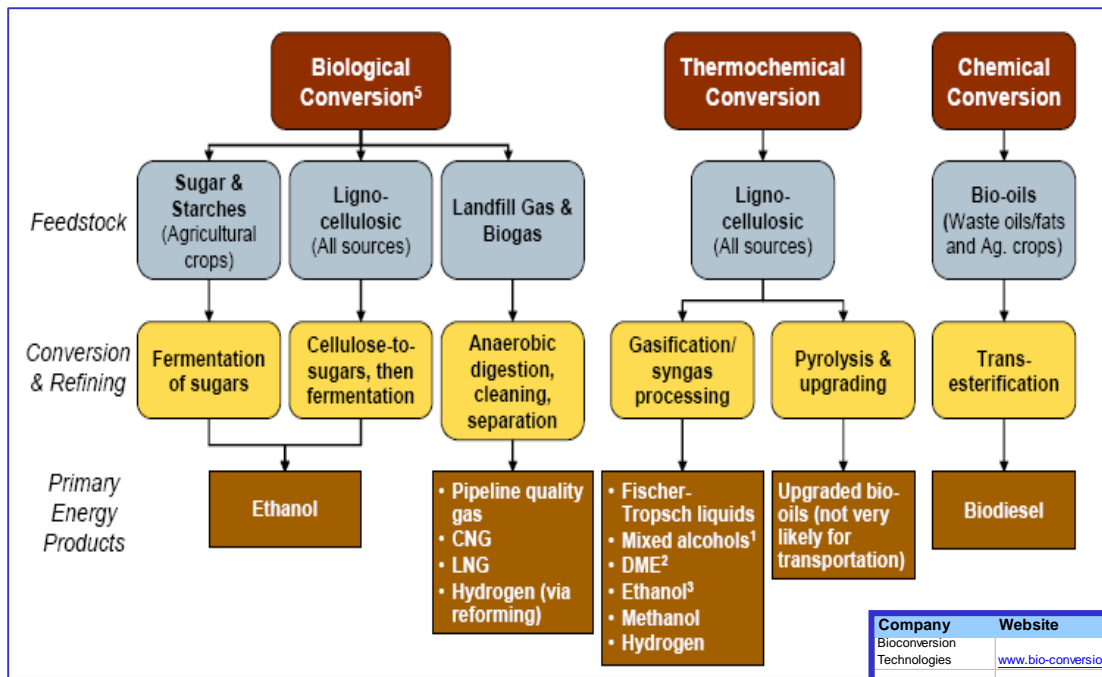
**“Smart” Triple Net Projects:  
Good Investments,  
Good Environmental/Social Value,  
Creates Rural Jobs**



- Biomass: Woody Biomass (300 MTPY of waste first) and MSW based
- Community level projects scaled 100 TPD or less
- Accelerating Commercialization
- Understanding “best of breed”, and highest and best use of feedstocks and high value niche products
  - Thermochemical Track
  - Biochemical Track
- Pilot Projects: practical understanding of how projects go together
  - Community level biodiesel/crusher: CM4861 senior class project
  - Community Level MSW Project: ???
  - Community Level Cell Ethanol Project?



# Process is critical...which is best???

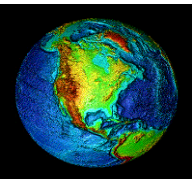


- Feedstock-End product, scaling are all CSFs in selection of the correct process
- Operational considerations not well understood by researchers, need practical experinece

Company	Website	Address	City	State
Bioconversion Technologies	<a href="http://www.bio-conversiontechnologies.com">www.bio-conversiontechnologies.com</a>	6531 North Washington St	Denver	CO
BRI Energy	<a href="http://www.brienergy.com">www.brienergy.com</a>		Fayetteville	AR
Emery Energy	<a href="http://www.emeryenergy.com">www.emeryenergy.com</a>	159 West Pierpont Ave. 615, boul. Rene-Levesque Ouest	Salt Lake City	UT
Enerkem	<a href="http://www.enerkem.com">www.enerkem.com</a>	FUTURE ENERGY GmbH,Halsbrücker Strasse 34	Freiberg	
Nova Fuels	<a href="http://www.novafuels.com">www.novafuels.com</a>	2203 East Dinuba Avenue	Fresno	CA
Primenergy	<a href="http://www.primenergy.com">www.primenergy.com</a>			
Syngas International	<a href="http://www.syngasinternational.com">www.syngasinternational.com</a>	Suite 600, 595 Homby St.	Vancouver	BC
Thermochem	<a href="http://www.tri-inc.net/">http://www.tri-inc.net/</a> & <a href="http://www.tchem.net">www.tchem.net</a>	3700 Koppers Street, Suite 405	Baltimore	MD
Thermogenics	<a href="http://www.thermogenics.com">www.thermogenics.com</a>	7100 F Second St.NW	Albuquerque	NM

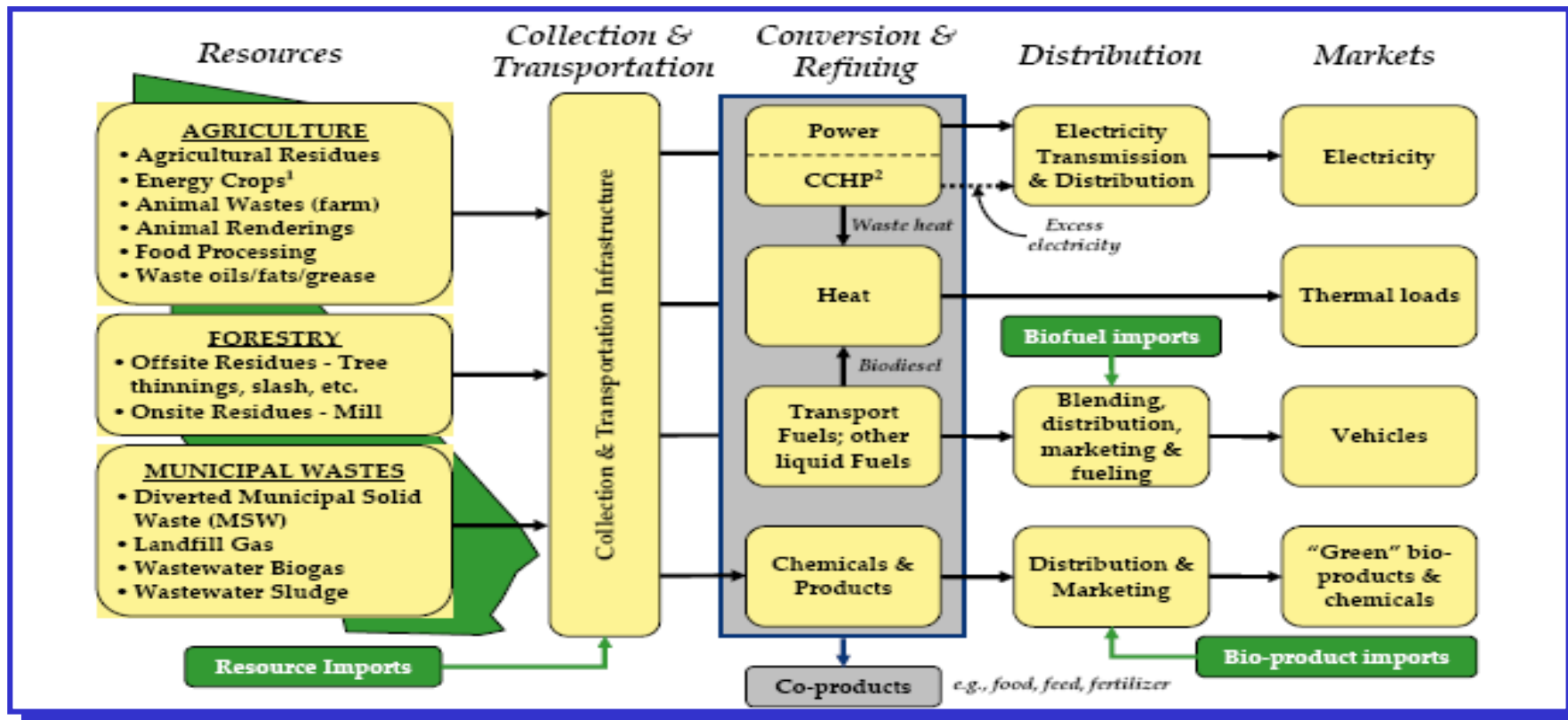
Need to understand and tabulate “best of breed”:  
Process elements, costing and vendors



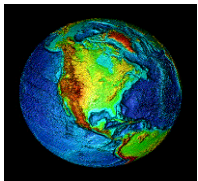


# Application is critical for project economics

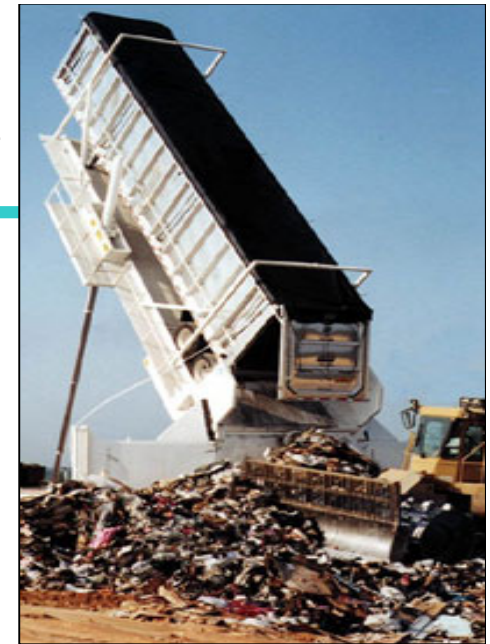
## Sustainability vs. Climate Impact Vs. National Security????



Need to understand the inter-relationship between feedstocks, conversion, products, markets and transport (incoming and outgoing)



# Environmental Waste Conversions



## Municipal Solid Waste

<b>CA MSW TOTAL</b>		<b>6,172,200</b>	<b>100.00%</b>
<b>Breakdown for Waste Processing:</b>			
Total suitable for RDF			68.51%
Metal			6.64%
Inerts for construction bedding			19.23%
Landfill disposal			5.46%
Batteries			0.15%

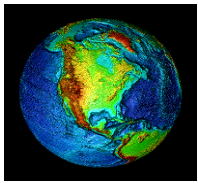
## Farm/AG Manufacturing Waste

Raw material	dm %	odm % odm	average gas yield 500 l/kg of odm	Biogas 17 m <sup>3</sup> /t of substrate
Apple pulp	25	86	700	151
Apple marc	25	65	700	116
Brewing dregs	40	50	615	123
Biological waste	90	80	900	648
Blood meal	30	95	1000	285
Grease trap residues	15	76	615	70
Vegetable waste	15	77	465	54
Chicken manure				

### Considerations

- Optimal Sizing
- Optimal Technology
- Optimal Products
- Optimal Hauling Radius
- CapEx per Ton=?

Need to understand relationship between capex and energy density to offset and hauling (fuel shed radius)?

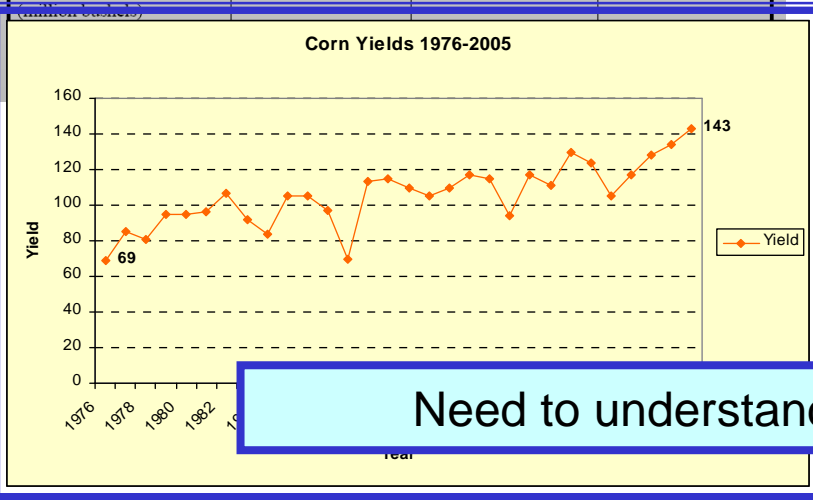


# Agri Energy Crop Growing



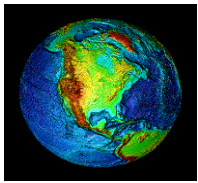
**Corn Market**

	Baseline (2015)	Long-Run Equilibrium	Percentage Change
Corn Price (\$/bushel)	2.56	4.05	58%
Corn Area (million acres)	79.4	95.6	21%
Corn Production (million bushels)	13,040	15,656	20%
Corn Use in Ethanol (million bushels)	3,251	11,103	242%
Corn Feed Use (million bushels)	6,032	4,032	-33%
Corn Exports (million bushels)	2,376	-776	-133%



- Energy value favors corn CORN 129 #/ACRE (78%=103# energy) vs. SOYBEAN 335 #/ACRE ( 18%=60.3 # energy)
- Farmers shift to corn production from other crops or programs.
- Rotation from Soy to Corn causing soybean oil shortage for biodiesel, increase in price from \$.14/ lb-\$.30/lb in past year
- 1 million additional acres = 420 million gallons of ethanol
- Corn production could reach **15 billion bushels by 2015 from 11 billion bushels 2006**
- We will be able to utilize **5.5 billion bushels** for ethanol production or nearly **16 billion gallons** of ethanol (**10 percent** of our transportation fuel needs) **12B in 2008**

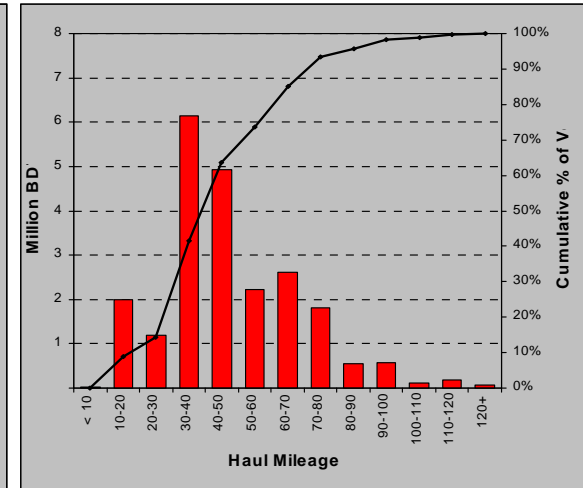
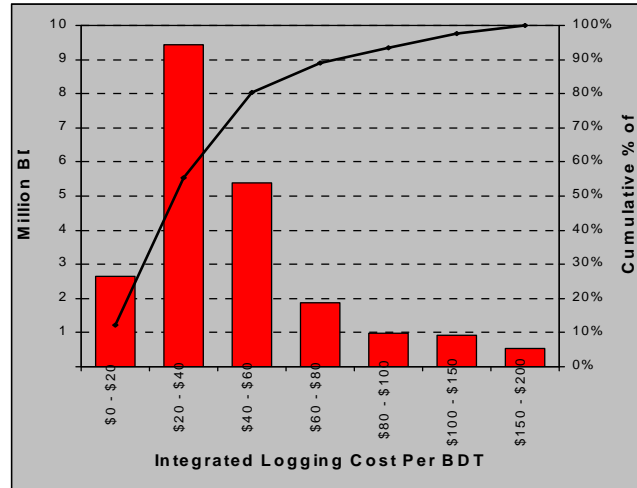
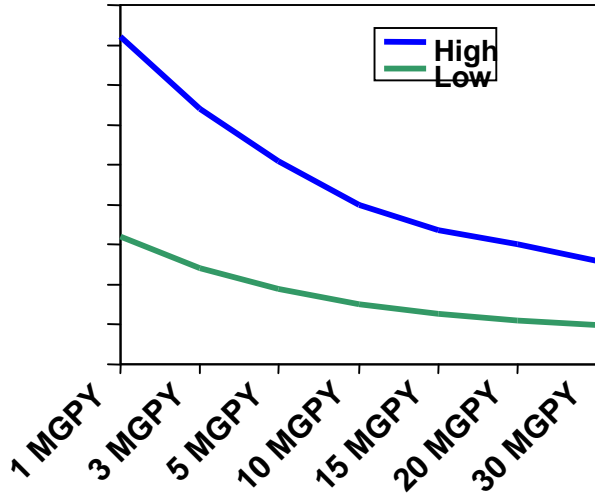
Need to understand food vs fuel vs. sustainable limits?



# Size matters

## Economy of Scale VS. Logistics and Hedging

\$/Gal Capex



MSU Study

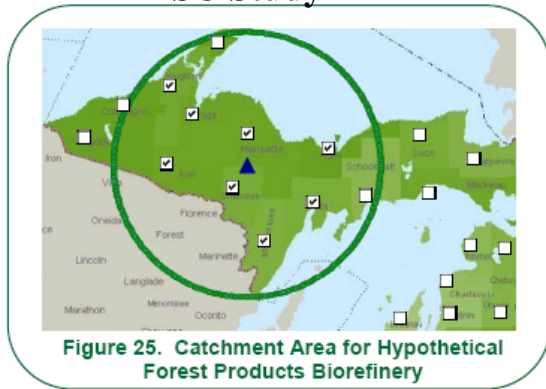
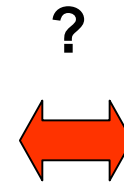
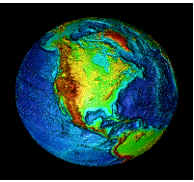


Figure 25. Catchment Area for Hypothetical Forest Products Biorefinery

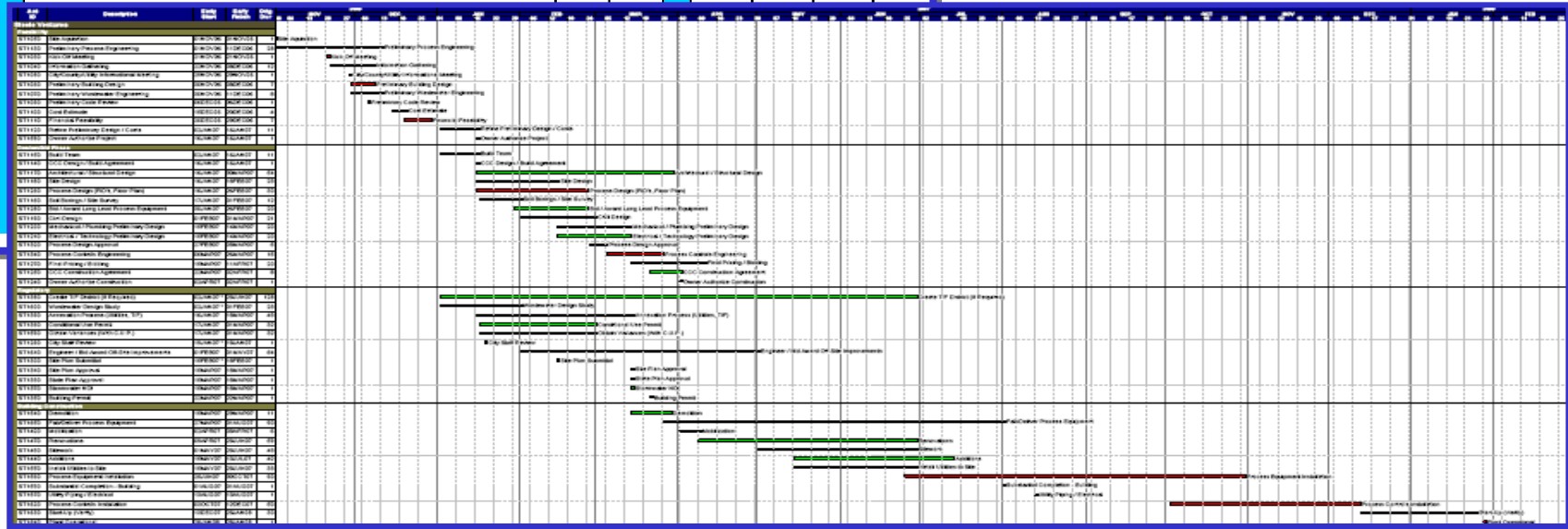
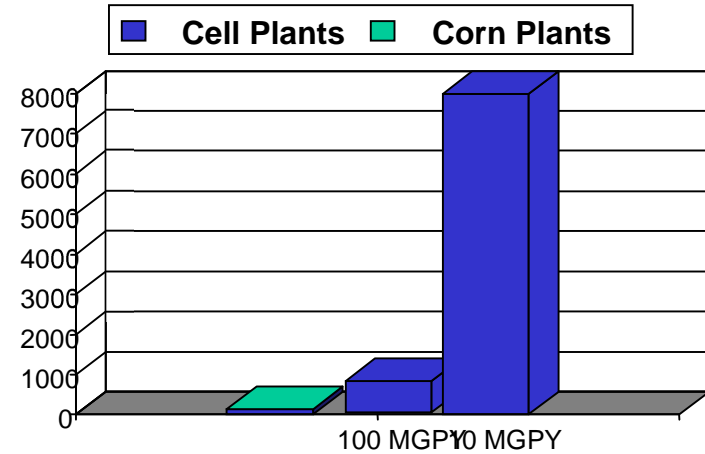


Need rigorous qualification optimize scale for community system



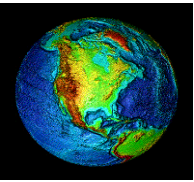
# Practical Project Management

Project Management Roles and Responsibilities		BLUE HARBOR TEAM					
TEAM >		Owner	Design/Build Process Equip	Project Manager	Architect	Structural Engineering	Civil Engineering/Wastewater
<b>PLANNING/FEASIBILITY</b>							
Finalize Responsibilities/Agreements		X	X	X			
Project Development Schedule				X			
Site Plan					X		X
County Approvals							X
DNR Approvals							X



Need: The next generation of project managers

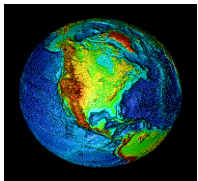




# Leverage our core business

---

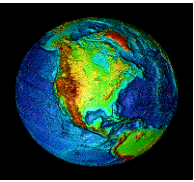
- Technologies:
  - Some off the shelf (Crushers, material handling, tankage, etc.)
  - Some early stage (ThermoTech, Biodiesel Solutions, Reclaim Resources Limited)
  - Some new (Purevision, BCT, Novatech)
- Industry Partners
  - Contractors
  - Engineering firms
  - Next Energy
- Funding
  - Aurora Angels
  - SEDF
  - Discussing with Next Energy for MI Serial Number One Fund
  - Discussing with MPSC energy savings like Wisconsin



# In the End...an uphill battle

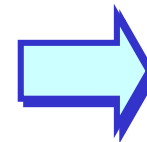
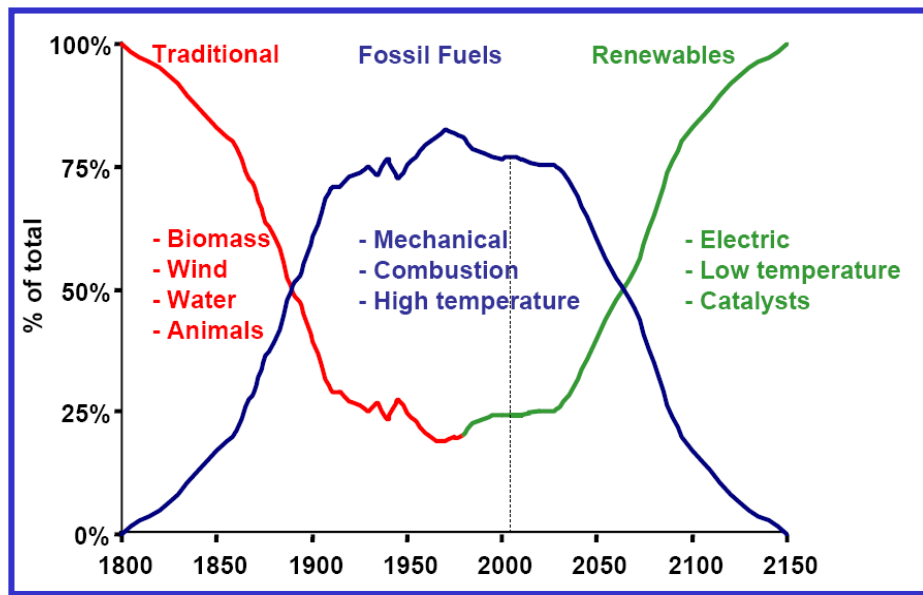


- Extremely Exciting Time for Alternative Energy Industry
  - High Product Interest
  - Strong Governmental Support
  - Bright Future
- Alternative Energy is Still a Business
  - Subject to the Laws of Supply & Demand
  - Regulation
  - Expectations of Shareholders
- Alternative Energy Businesses need to be Sited, Built, Organized and Managed to be Sustainable and Effective in the Long Run



# How can we participate together???

Royal Dutch Shell Vision of the future



**Proactive or reactive?**

**Someone is going to do this...**

**Lets get out in front**

# *Sigma Capital Group*



**SAVING THE PLANET...ONE GOOD PROJECT AT A TIME!**

**Sigma Capital Group, Inc.**  
Bruce Woodry, Chairman and CEO  
Phone: (231) 881-4540  
woodry@sigmacapital.net  
www.sigmacapital.net