NC State University
North Carolina Solar Center

Biofuels in North Carolina

Presented to the Legislative Commission on Global Climate Change

November 27, 2006

Kurt Creamer, P.E.
Biomass Program Manager, NC Solar Center
Research Associate, Animal & Poultry Waste Management Center
kurt_creamer@ncsu.edu
919-515-4092

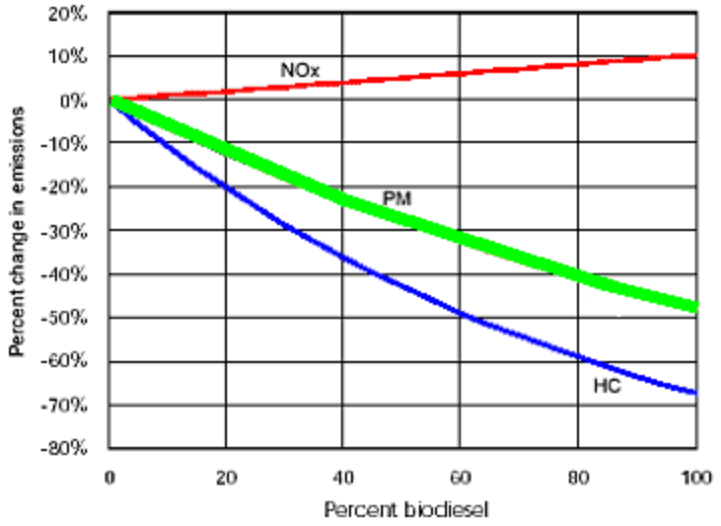
WASTE MANAGEMENT PROGRAMS
COLLEGE OF AGRICULTURE & LIFE SCIENCES

Animal and Poultry Waste Management Center

Benefits of Biofuels

- Economic development if produce biofuels in-state
- Energy security
- Regulated tailpipe emission reductions
- Greenhouse gas emission reductions

Biodiesel emissions relative to diesel emissions



Ethanol from Sugar (sugarcane, sugarbeets, sweet sorghum)

- Can be fermented directly into ethanol
- In US, cost of producing ethanol from sugar crops higher than from corn
- Brazil's produces ethanol from sugarcane at the equivalent of $25 a barrel and energy efficiencies up to 9:1.

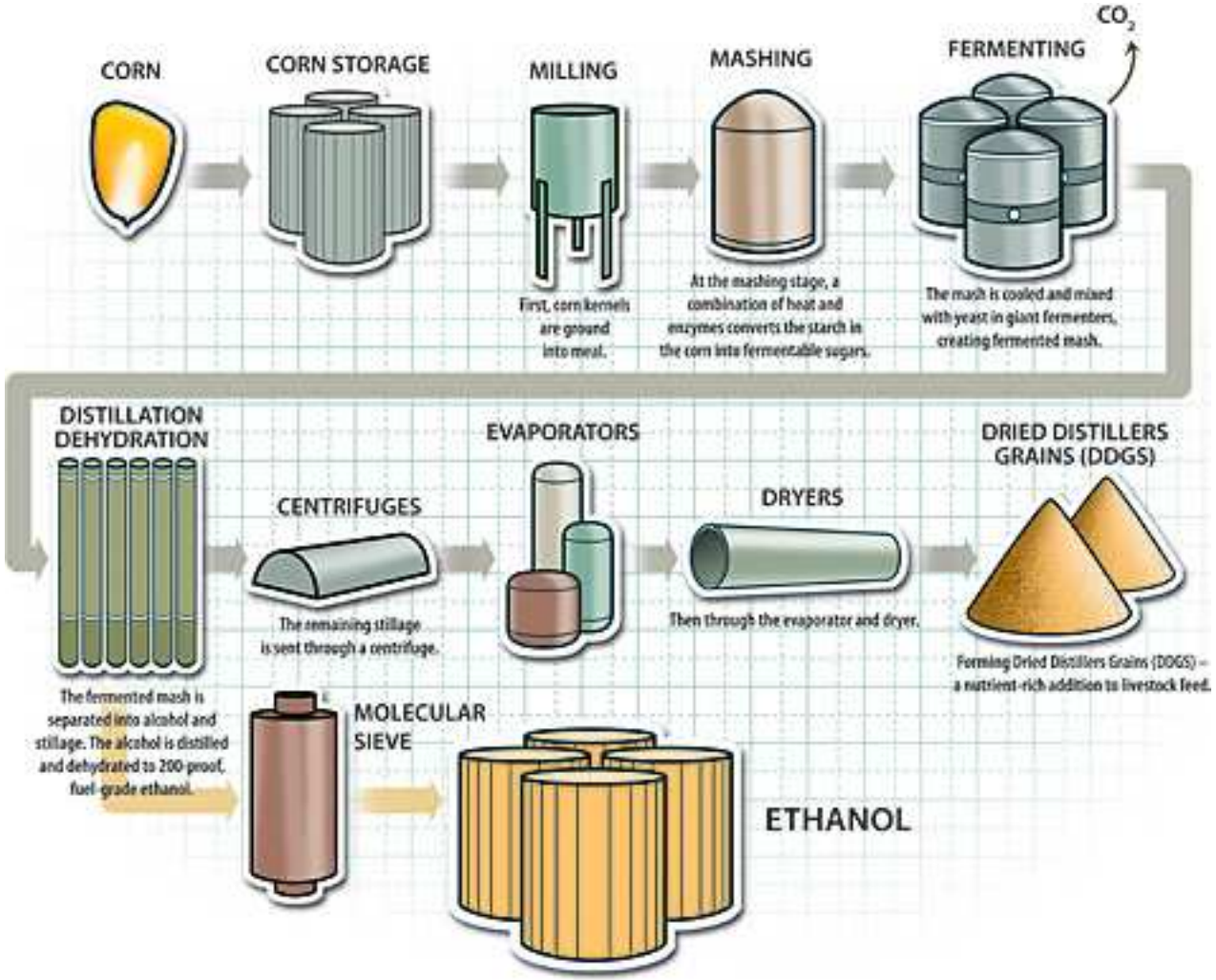
Estimated ethanol production costs

Feedstock	Total Costs*	Processing Costs*
Corn (wet milling/dry milling):	$1.03/1.05	$0.63/0.52
Raw Sugarcane	2.40	0.92
Raw Sugar beets	2.35	0.77
Molasses**	1.27	0.36
Raw sugar**	3.48	0.36
Refined sugar**	3.97	0.36

*Per gallon ** Excludes transportation costs

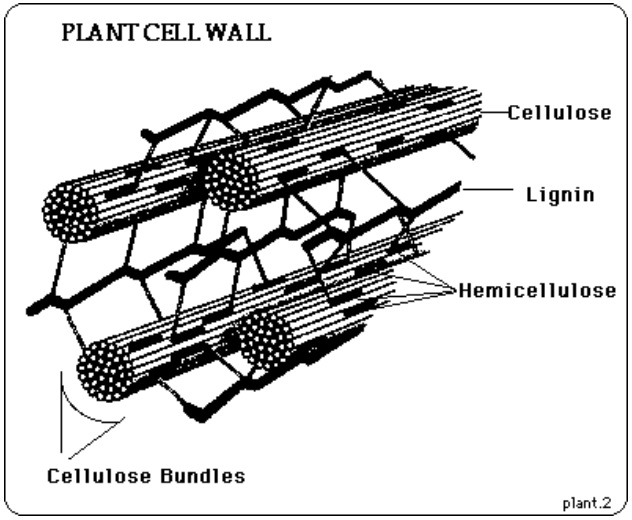
Ethanol from Starch (corn, sweetpotatoes, barley)

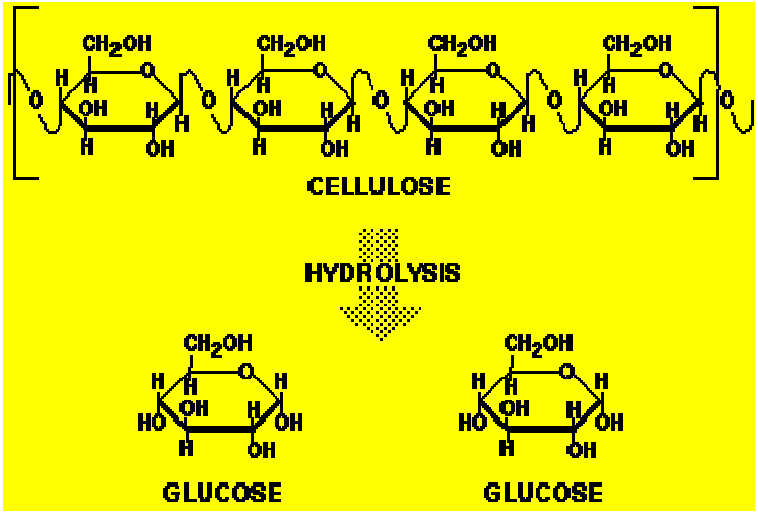
- 97% of ethanol in U.S is made from corn
- 20% of this year's corn crop will go to ethanol production



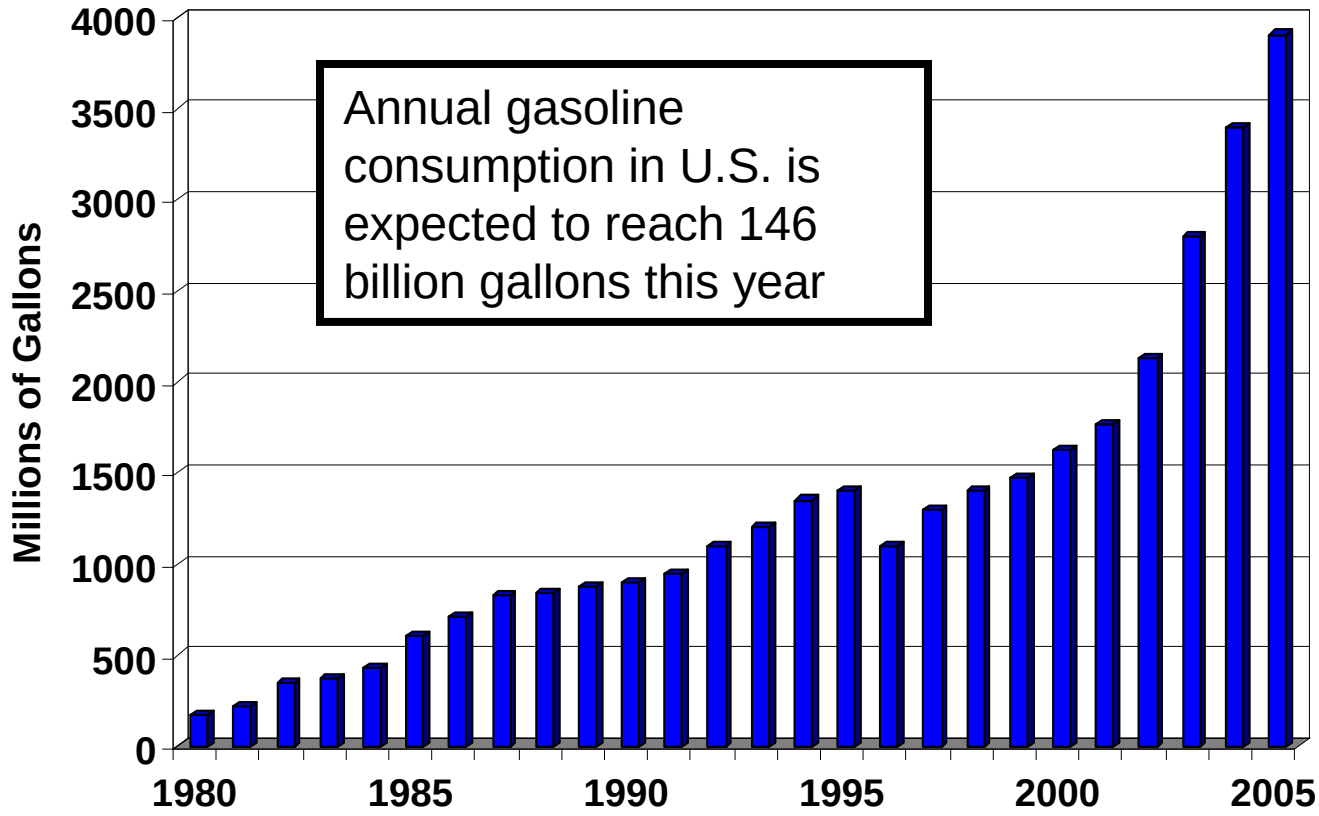
Ethanol from Cellulose (switchgrass, woodchips, corn stover, wheat straw)

- Like starch, cellulose is just a chain of glucose (sugar) molecules
- But cellulose is more difficult to hydrolyze than starch
- Once hydrolyzed, the glucose is fermented (like any other sugar source) into ethanol





U.S. Ethanol Production



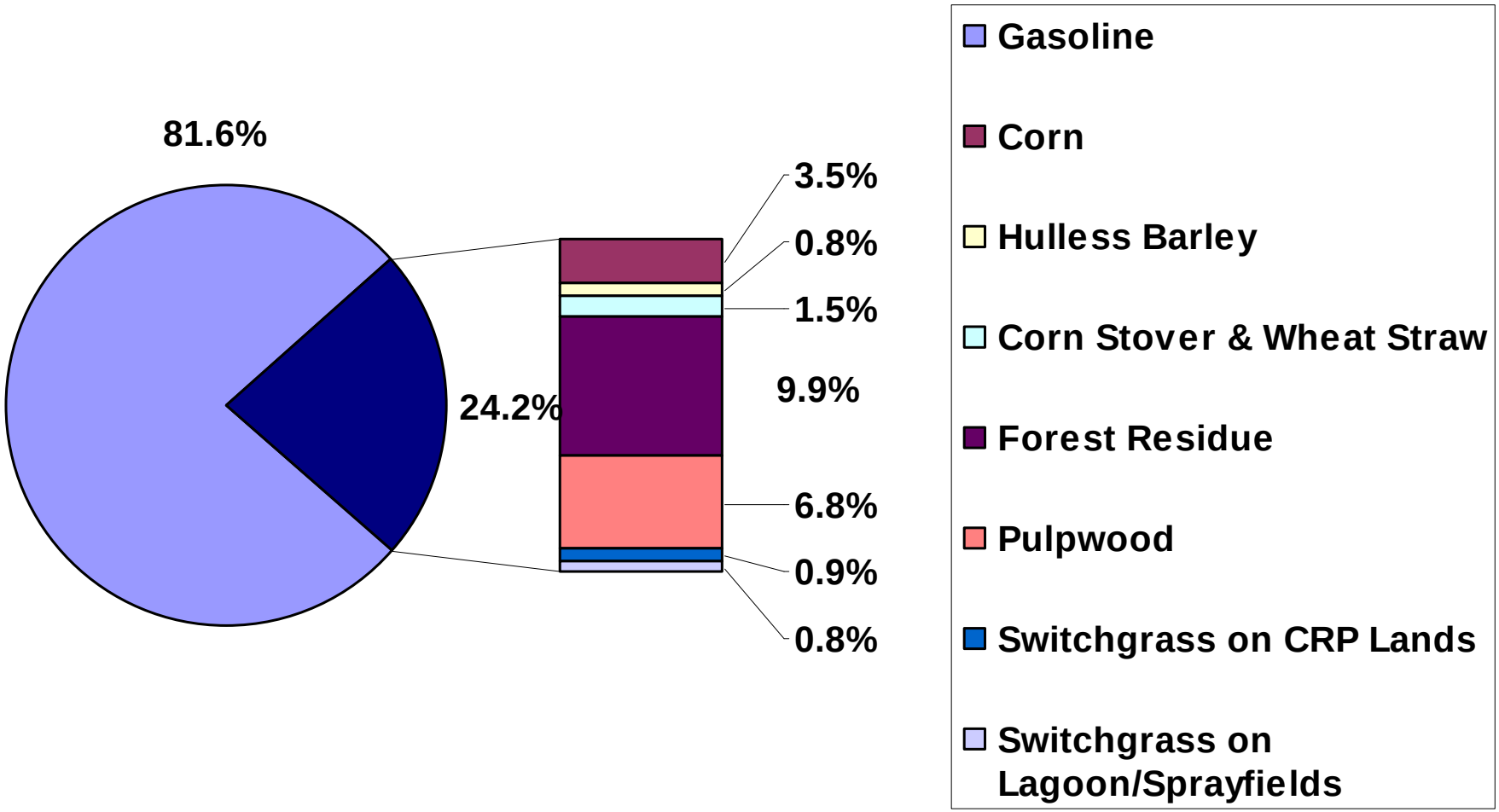
NC Ethanol Usage

- State of North Carolina, Department of Administration, Motor Fleet Management uses approximately 200,000 gallons of E85 and 700,000 gallons of E10
- Found in all three grades of gasoline at Crown stations (E10)
- 10 service stations in NC carry E85 in Shelby, Charlotte, Statesville, Durham, Hickory, Southern Pines & Pinehurst

Proposed NC Ethanol Plants

- Agri-Ethanol Products, Aurora (54 MGY in Phase I, 108 MGY in Phase II)
- DFI Group, Jamesville
- Clean Burn Fuels LLC, Hoke County

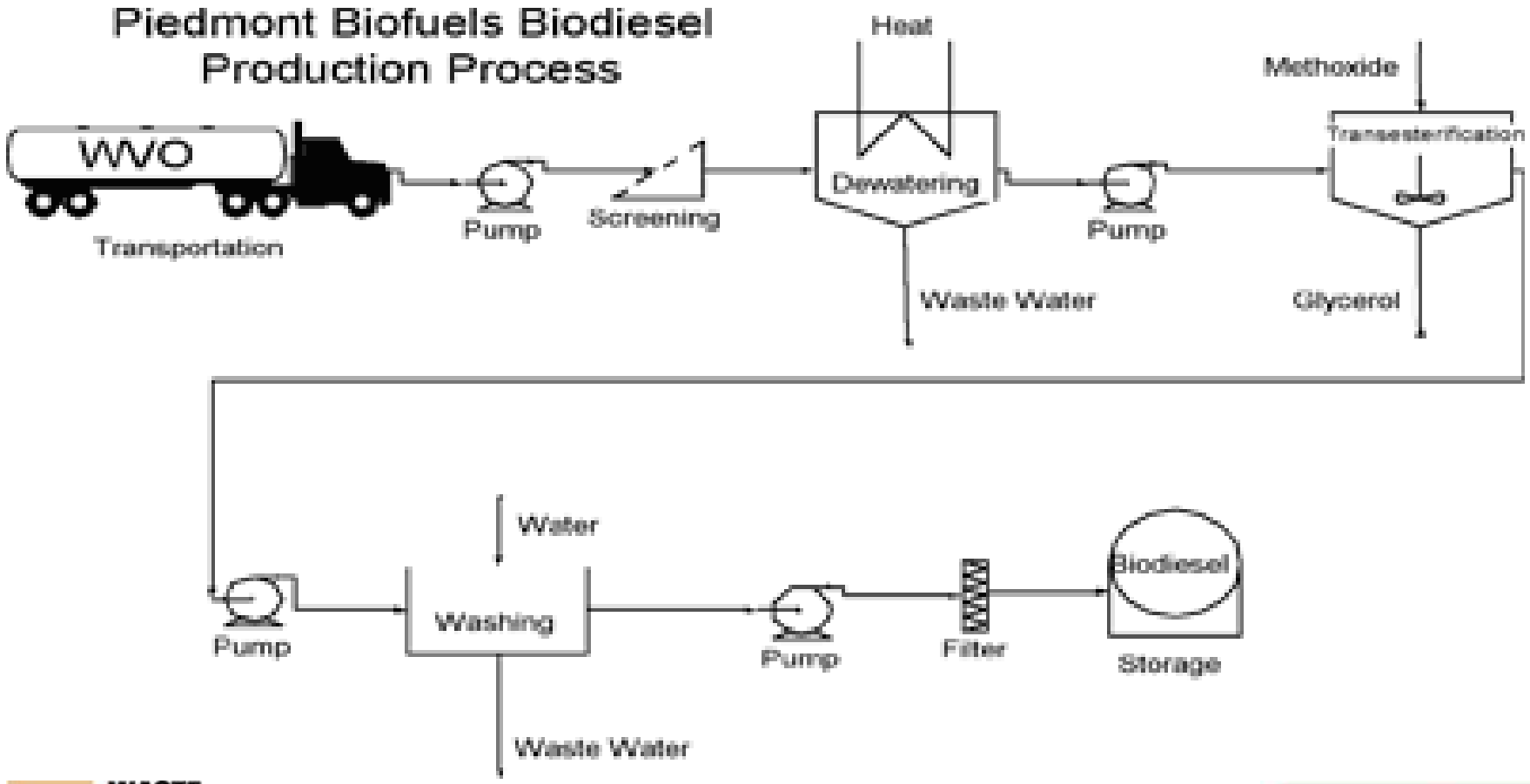
NC Gasoline Displacement Scenario



What is Biodiesel?

- Biodiesel is produced by a chemical reaction between methanol (or ethanol) and an oil or fat.
- 100 lb canola oil + 10 lb methanol
  - ➔ 100 lb biodiesel + 10 lb glycerin
- Potential feedstocks are waste vegetable oil, soy oil, canola oil, other oilseeds, animal fats
- Often used in blend with petroleum diesel (B20, which contains 20% biodiesel)
- Good lubricity, non-toxic, high flash point, lower emissions

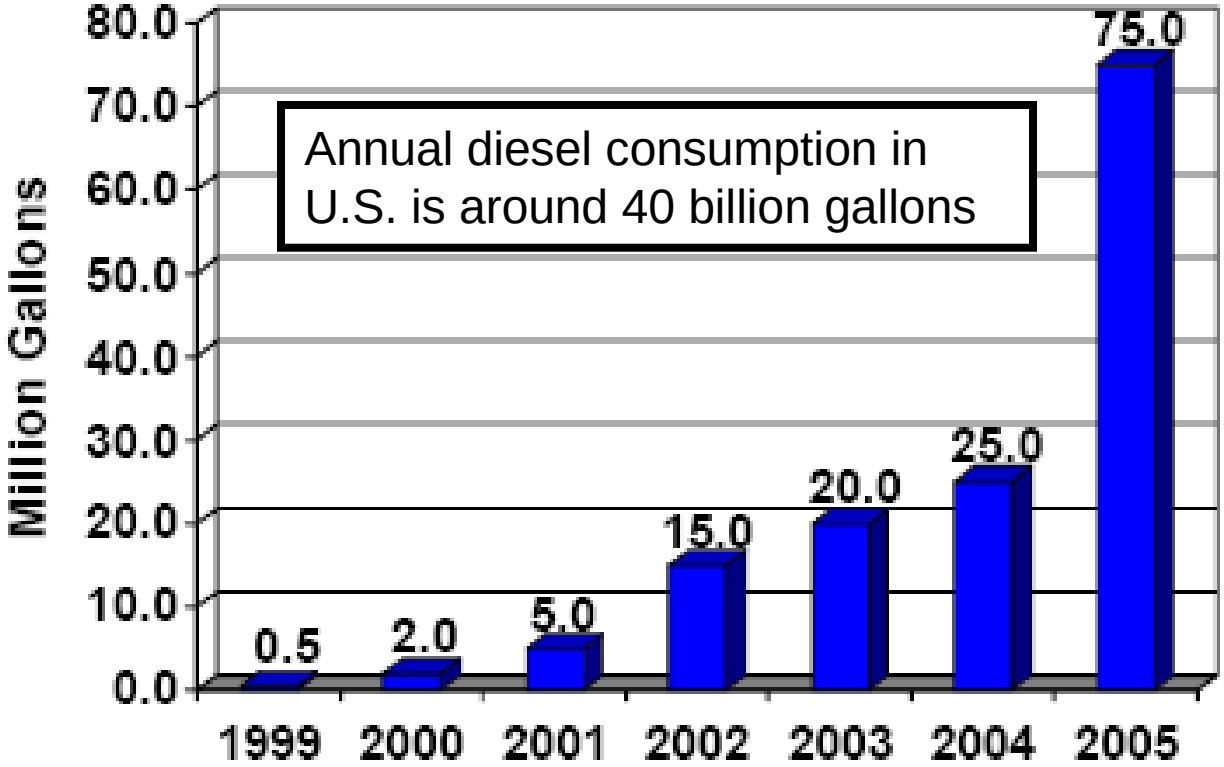
Biodiesel Production



WASTE MANAGEMENT PROGRAMS
COLLEGE OF AGRICULTURE & LIFE SCIENCES

Animal and Poultry Waste Management Center

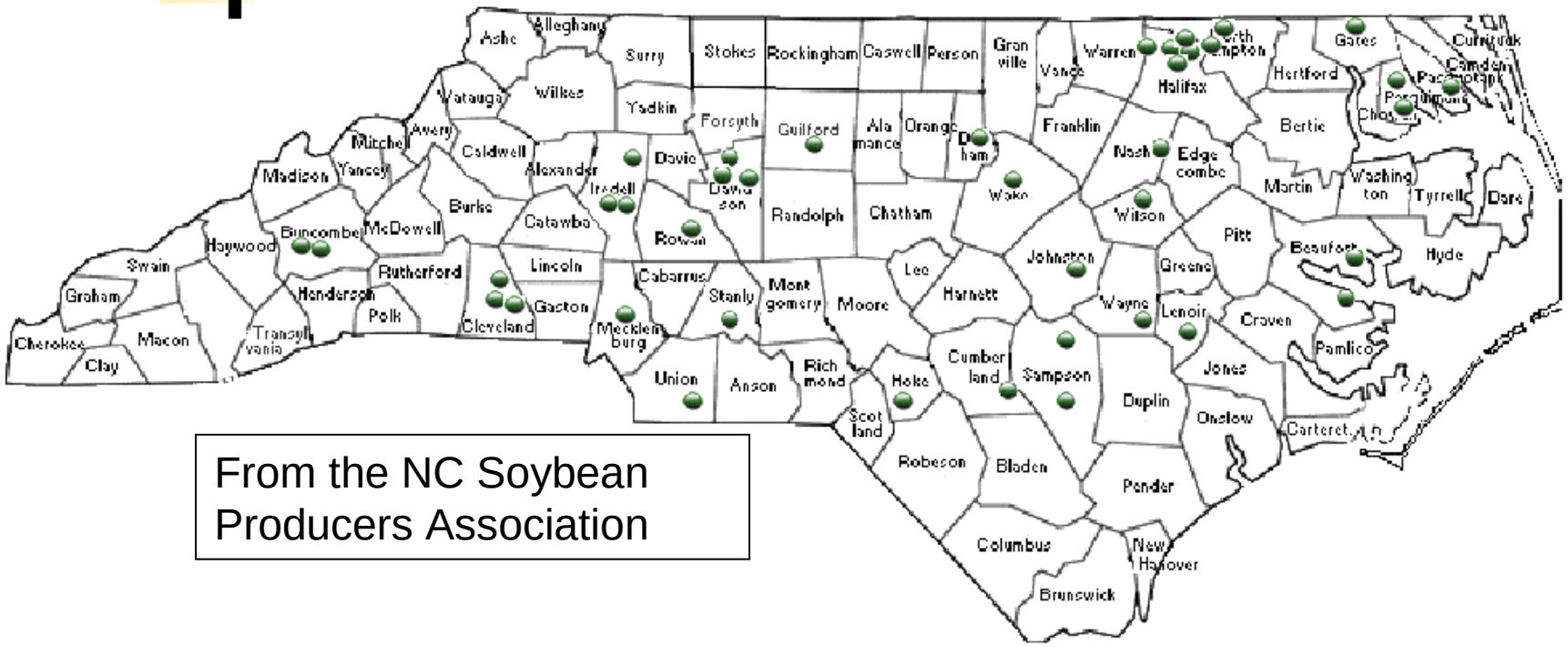
Estimated U.S. Biodiesel Production



NC Biodiesel Usage, 2005

Major Users Include: NC Department of Transportation (DOT), NC Zoo, Camp Lejuene Marine Corps Base, RDU International Airport, Pitt County Memorial Hospital, Durham & Gaston County Schools, UNC-CH, Duke, and NC State, over a dozen municipalities

NC BIODIESEL DEALERS

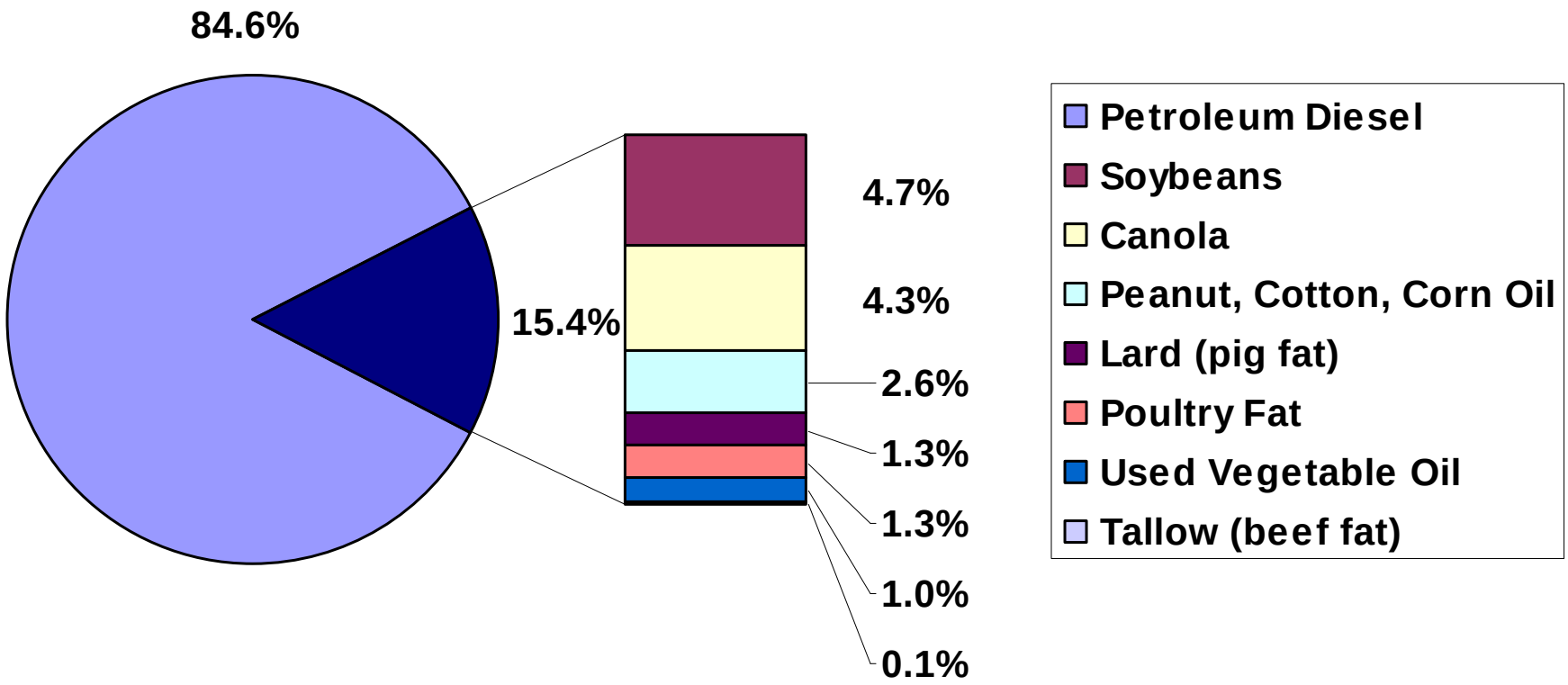


From the NC Soybean Producers Association

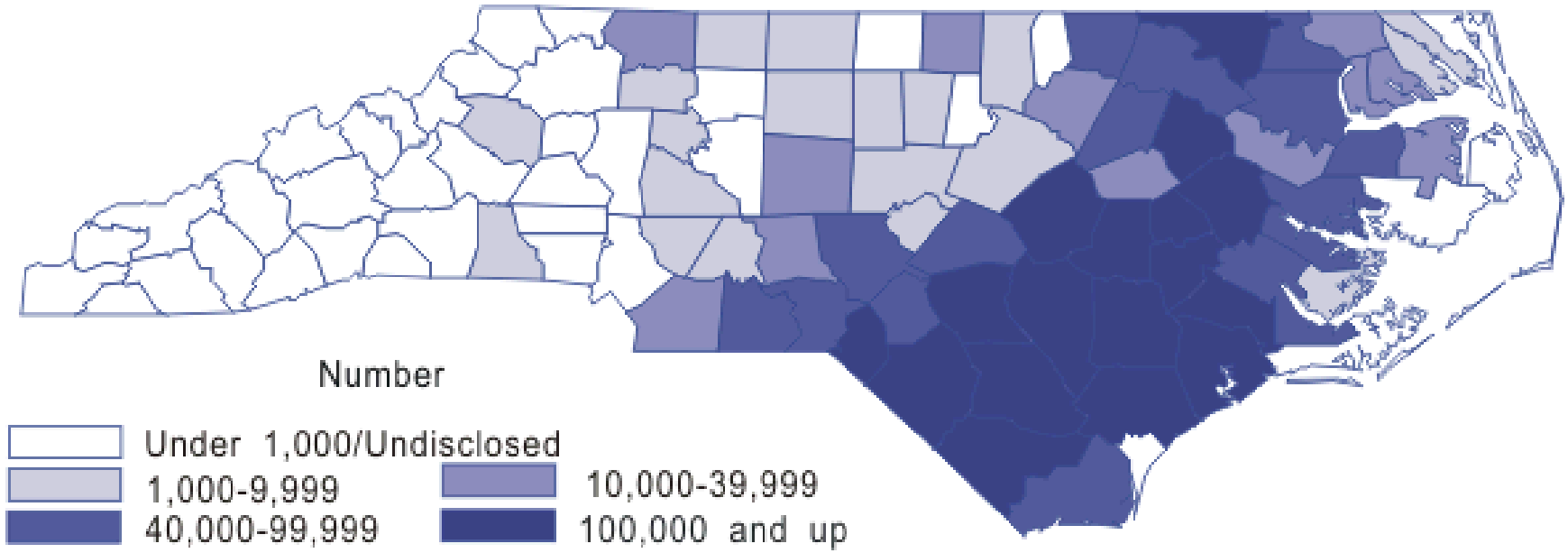
Proposed NC Biodiesel Plants

- Piedmont Biofuels, Pittsboro, 1 MGY
- Grain Growers Coop, Mt. Olive, 30 MGY
- Blue Ridge Biofuels, Asheville, 2 MGY
- Foothills Bio-Energies LLC, Lenoir County, 5 MGY
- Specialty Filter, Autryville, 1 MGY

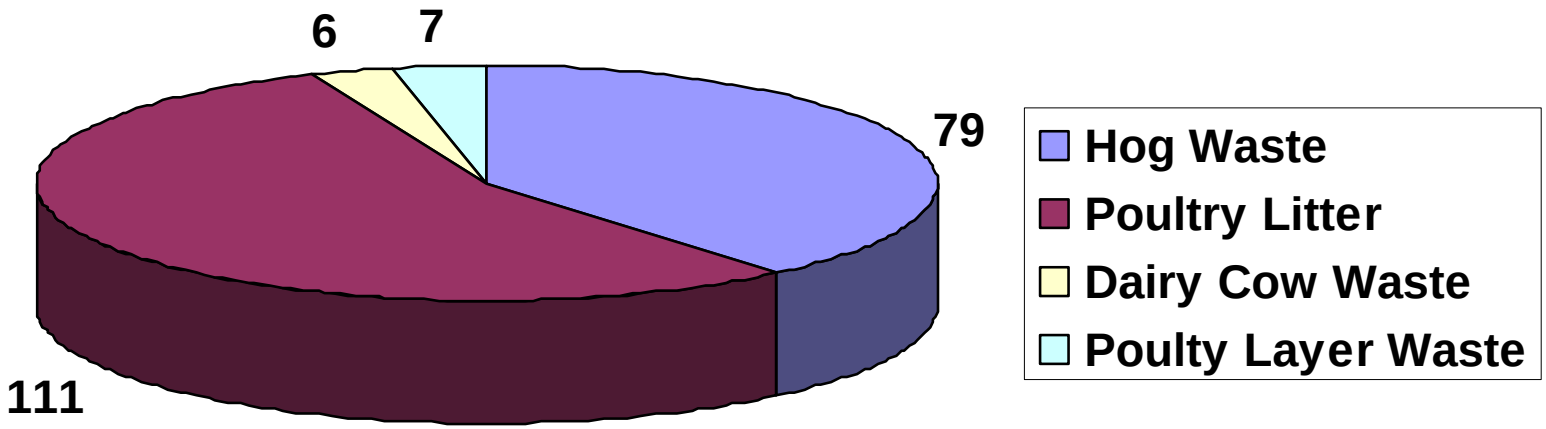
NC Petroleum Diesel Displacement Scenario



Hogs and Pigs: Numbers on Farm, December 1, 2003



Potential Power Generation from Animal Wastes (MW)



WASTE MANAGEMENT PROGRAMS
COLLEGE OF AGRICULTURE & LIFE SCIENCES

Animal and Poultry Waste Management Center

Energy Crops for NC Program

- Evaluate agronomics, economics, processing capacity for:
  - Canola
  - Switchgrass
  - Hulless Barley
  - Coastal bermudagrass
  - Woody biomass

Why Canola in NC?

oduces 2-3 times as uch oil per acre as ybeans

an be grown as a winter ver crop in a corn-canola-ybean rotation in place of heat

as virtually the same ricultural inputs as winter heat and can generate ore farm revenue.

Why Hulless Barley in NC?

- Produces similar starch and ethanol yields as corn.
- Can be grown as a winter cover crop in a corn-barley-soybean rotation in place of wheat.
- Uses around 25% of the energy to produce compared to corn, achieving a higher energy balance.

Why Switchgrass in NC?

erennial grass once native
o the southeast.

roduces an average of 5
ons of biomass per acre,
otentially yielding over 400
allons of ethanol per acre.

ecause it is a perennial, it
ontrols soil erosion and
rovides habitat for wildlife.

NC State University
North Carolina Solar Center

NC Biomass Council
State Energy Office

- Mission: To promote **economic development**, a **reduction in greenhouse gas and other emissions**, and **energy security** through the utilization of biomass, including both bioproducts and bioenergy, in the State of North Carolina.
- Made up of members from Industry, State Government and Academia

WASTE MANAGEMENT

Animal and Poultry

Recommendations from NC Biomass Council Members

Finance preprocessing facilities necessary for bioenergy production, such as regional oilseed crushing facilities.

Fund an in-state pilot plant that converts lignocellulosic biomass to ethanol on a pre-commercial scale.

Provide a tax credit to biofuel distributors that is equal to the state motor fuels tax.

Create an in-state lab that will conduct efficient and inexpensive ASTM standard testing for all biodiesel producers.

Offer state matching funds to leverage federal funds awarded in programs such as USDA's Renewable Energy and Energy Efficiency Program

2002 Farm Bill, Title IX, USDA Renewable Energy and Energy Efficiency Program

Created by the U.S. Department of Agriculture to assist farmers, ranchers and rural small businesses with energy projects.

Provides grants and loan guarantees for renewable energy and energy efficiency projects. Grant requests cannot exceed 25% of project costs, and total grant and loan must be less than 50% of project costs.

The minimum request for renewable energy projects is $2500 and the maximum is $500,000.

Renewable Fuel Tax Credits (H1636) (North Carolina)

Production/Processing. – a facility for producing renewable fuel is allowed a tax credit equal to twenty-five percent (25%) of the cost of constructing and equipping the facility

Distribution. – a commercial facility for dispensing renewable fuel is allowed a credit equal to fifteen percent (15%) of the cost of construction and installation, including pumps, storage tanks, and related equipment.

2005 Special Budget Provision Section 19.5

- Requires state fleet to achieve a 20% reduction or displacement of current petroleum use by 2010
- Will spur use of alternative fuels, synthetic lubricants and efficient vehicles
- Effects all state agencies, universities and community colleges that have state owned vehicles (any fleet over 10 motor vehicles)
- Agencies must report annually by September 1st to Dept. of Administration (State Energy Office)

Grant Programs

ean Fuel Advanced Technology Project (NC Solar Center)

$2M project funded by NCDOT, State Energy Office and Division of Air Quality

Project components include:

- 3 year education and outreach efforts
- grants for emission reduction projects in 24 eligible counties.
- funds for incremental cost of AFVs, refueling infrastructure, idle reduction technologies, diesel retrofits

First call for projects expected out in Sept- Awards expected in December

Mobile Source Emission Reduction Grants (Division of Air Quality)

- Purpose: to achieve actual reductions from on- and off- road mobile source related emissions in North Carolina
- Applications http://daq.state.nc.us/motor/ms_grants/
- Annual grant deadline December 31, Award announcements March following year

Energy Balance of Biofuels

Sugar Cane Ethanol (Brazil) → 9 : 1

Corn Ethanol (U.S.) → 1.2 : 1

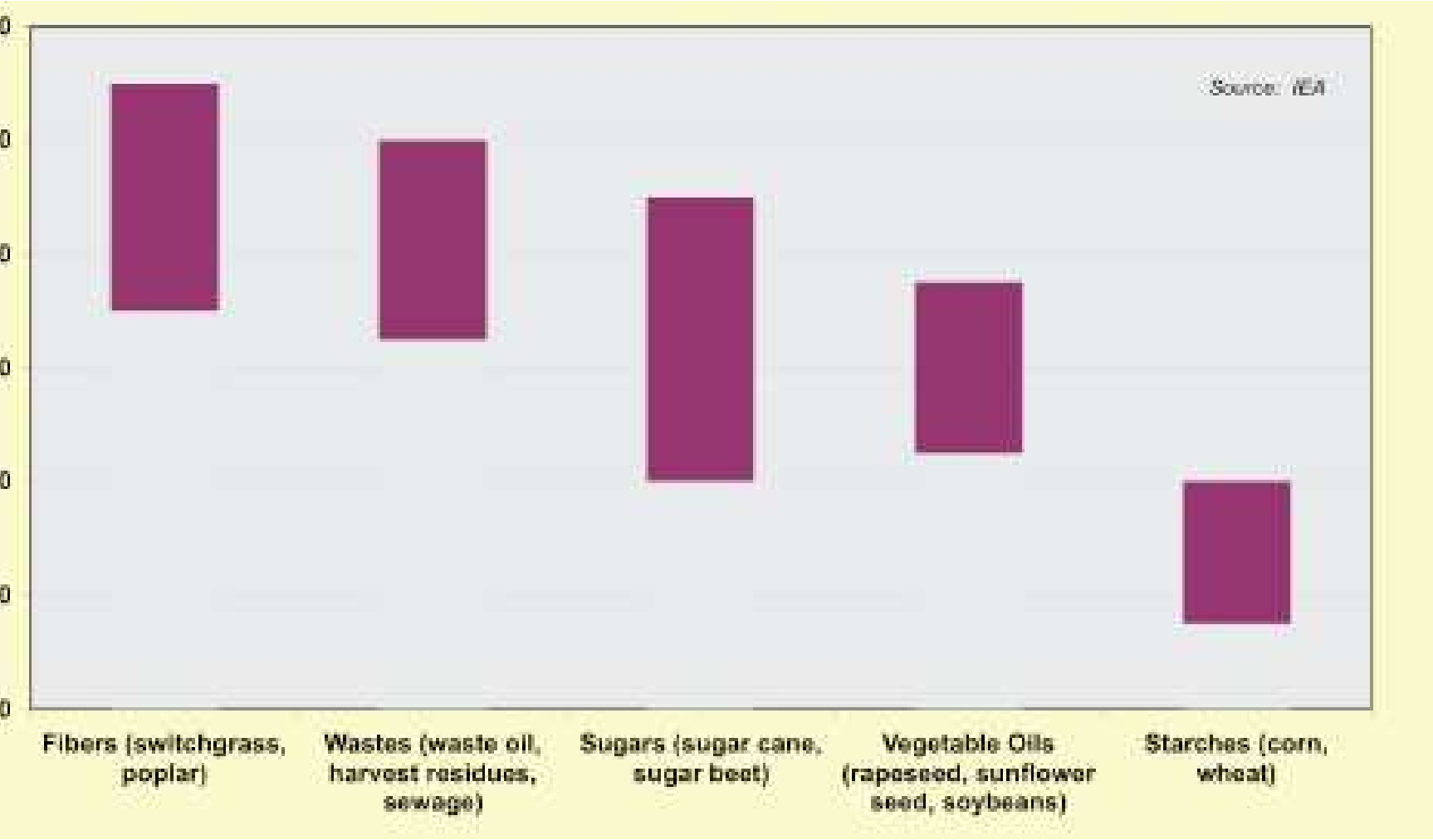
Biomass (cellulose) ethanol → 5 : 1

Soy Biodiesel → 3.2 : 1

Gasoline → .74 : 1

Diesel → .83 : 1

Potential Reductions in Greenhouse Gas Emissions



From “Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century”

Questions?