

I-81 Bioenergy Initiative: Opportunities for Virginia



Presented to the
Joint Commission on
Technology and Science

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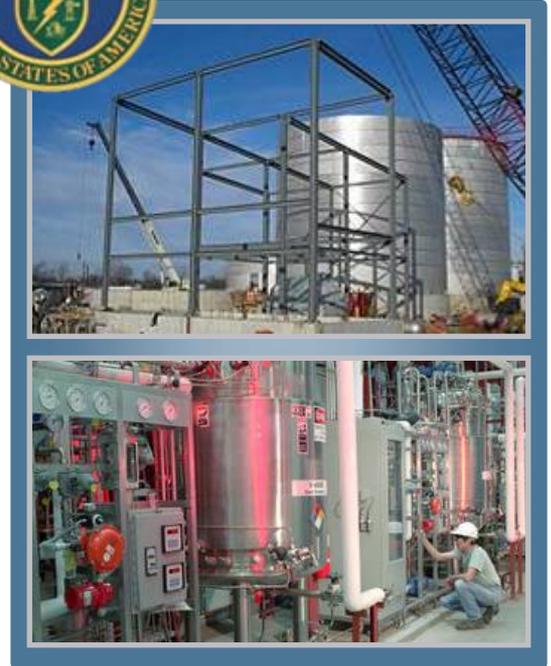
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In 2007 we formed the I-81 BioEnergy Consortium

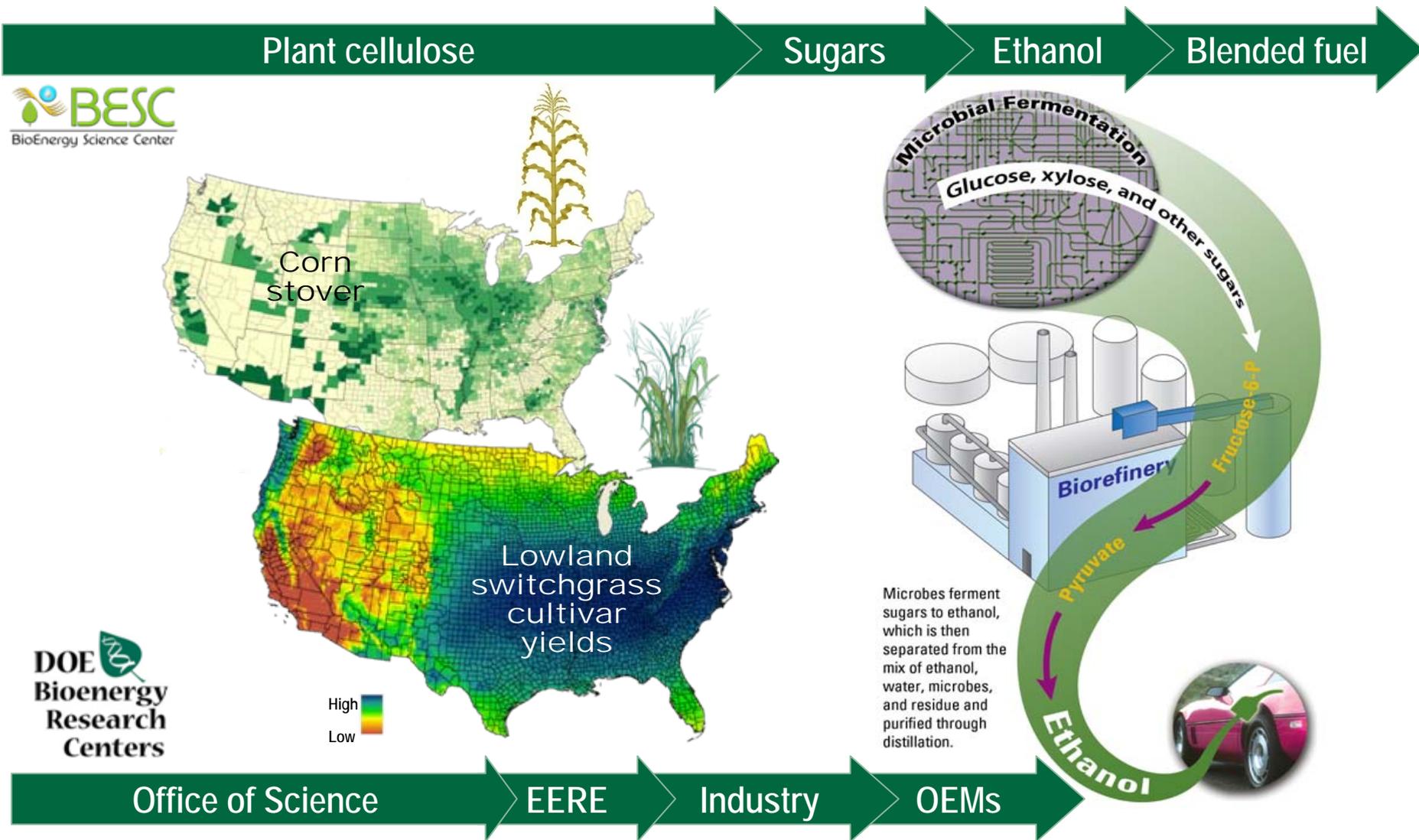


The U.S. Department of Energy has made a major investment in biofuels

- **Develop and transform our renewable and abundant biomass resources into cost-competitive, high-performance biofuels, bioproducts, and biopower**
 - Focus on targeted research, development, and demonstration
 - Support through public and private partnerships
 - Deploy in integrated biorefineries



DOE is investing in bioscience and biofuels



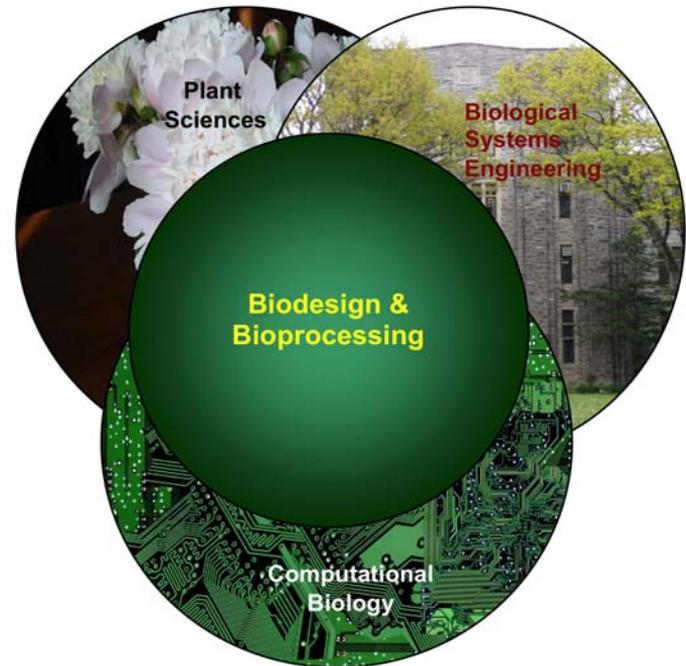
ORNL is DOE's largest science and energy laboratory



- **\$1.3B budget**
- **4,300 employees**
- **3,900 research guests annually**
- **\$350 million invested in modernization**
- **World's most powerful open scientific computing facility**
- **Nation's largest concentration of open source materials research**
- **Nation's most diverse energy portfolio**
- **Operating the world's most intense pulsed neutron source**
- **Managing the billion-dollar U.S. ITER project**

Virginia Tech has extensive biodesign and bioprocessing capabilities

- **Faculty:**
24 investigators
from 3 colleges
- **Facilities:**
2 new laboratory buildings
(184,000+ square feet)
- **Ranking:**
Research ranked 6th
nationally among agricultural
programs (NSF 2007)

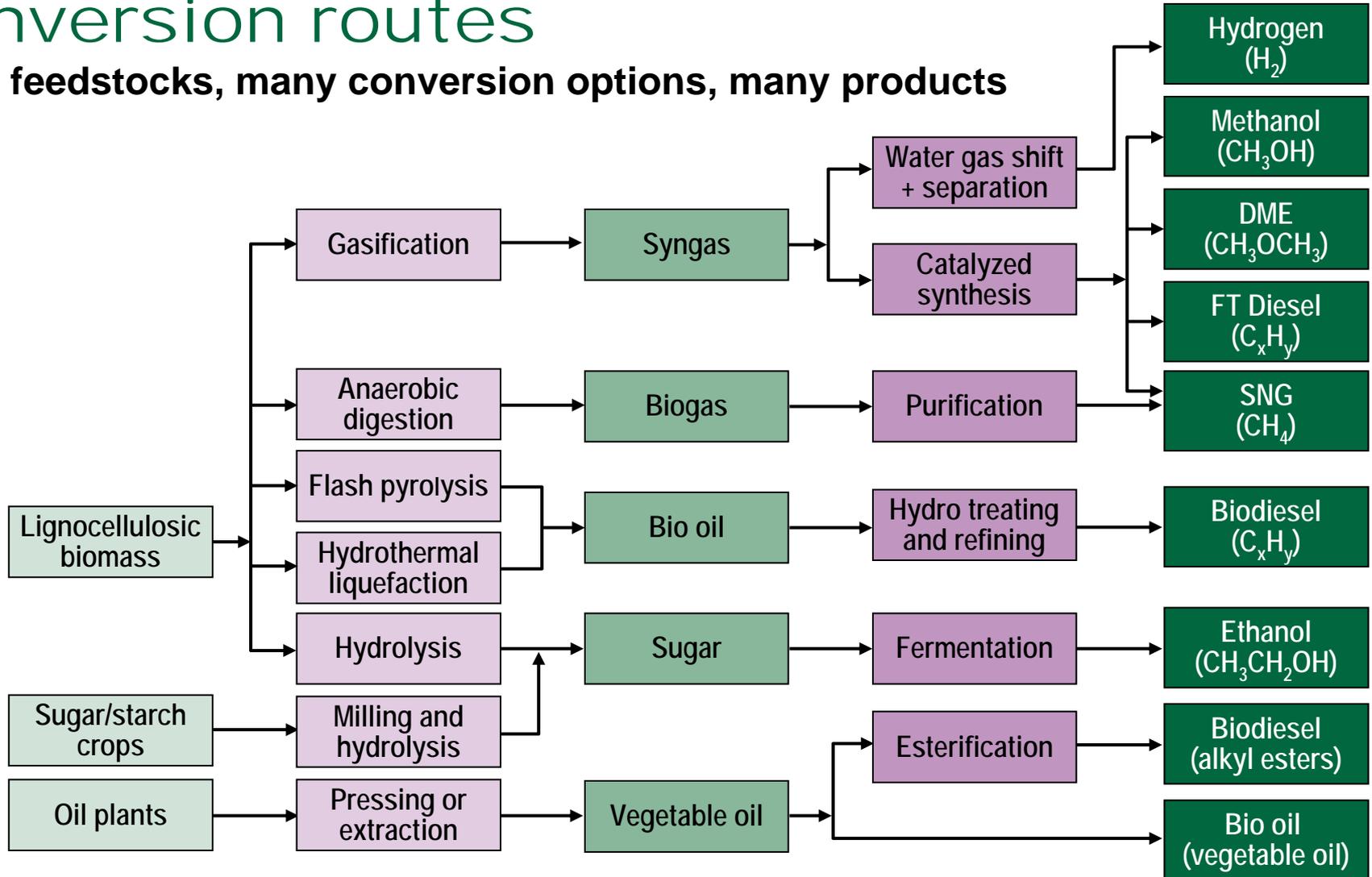


Bioenergy R&D at ORNL is solving supply chain problems for biofuels and bioproducts

Biological and Environmental Sciences	Computing and Computational Sciences	Energy and Engineering Sciences	Physical Sciences	Neutron Sciences
<ul style="list-style-type: none"> • Systems biology of plants and microbes • Bioinformatics • Biophysics • Biomass resource and engineering • Biochemical engineering • Biomass conversion • Climate change impact • Economic analysis and societal implications 	<ul style="list-style-type: none"> • Ultrascale computing • Modeling and simulation 	<ul style="list-style-type: none"> • Biomass characterization • Process engineering • Transportation R&D 	<ul style="list-style-type: none"> • Analytical technologies • Separations science • Catalysis 	<ul style="list-style-type: none"> • Biological applications of neutron scattering and other neutron-based analytical techniques
<ul style="list-style-type: none"> • Sustainability and security of biomass supply • Biomass formation, deconstruction and conversion 				

Biofuels come from several conversion routes

Many feedstocks, many conversion options, many products



Source: Carlo N. Hamelinck, "Outlook for Advanced Biofuels," PhD Thesis, Utrecht University, The Netherlands, 2004

The emerging biofuels industry has challenges

- **Moving renewable fuels into U.S. markets**
- **Agricultural, energy, and environmental markets are interdependent**
- **Economic decision making occurs across competing interests**



**A consortium of institutions,
both public and private, will enhance
our probability of success**

The biofuels puzzle has several pieces

- Feedstock production
- Biorefinery
- Logistics
- Fuels distribution
- Co-products
- Retailing



Solving the puzzle could bring benefits

- **Rural economic development**
- **Increased employment in rural counties**
- **Enhanced land use**
- **Expanded use of lignocellulosics to ethanol**
- **Lower emissions**
- **Other positive environmental effects**



Various factors are driving growth of biofuels

- **National security**
 - America accounts for 25% of oil consumption, but holds 3% of reserves
 - 60% of reserves are in unstable regions
- **Environmental sustainability**
 - Fossil CO₂ emissions from ethanol are 85% lower than gasoline
 - Projected Fossil Energy Ratio of 10.3, compared to 0.81 for gasoline
 - Bioenergy is a renewable resource
- **Price of gasoline**
 - 60% increase since 2006

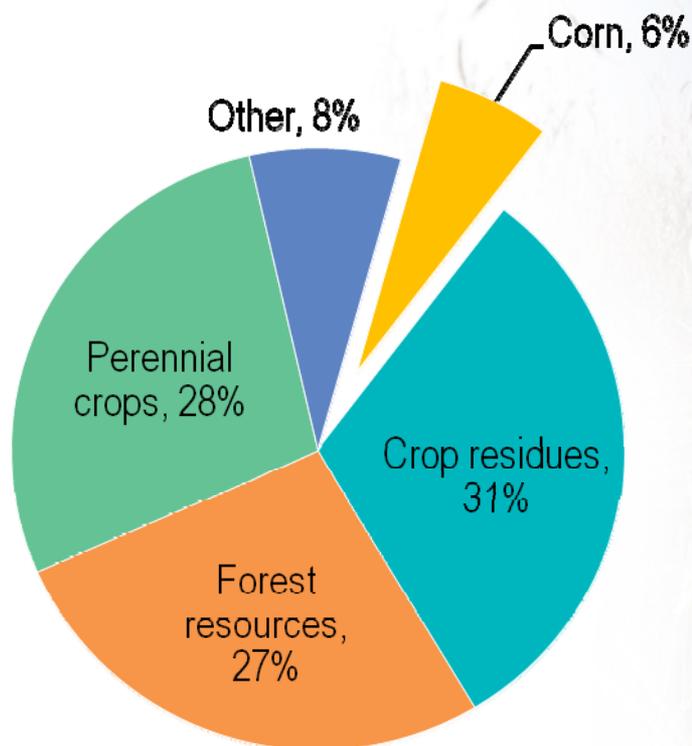


The majority of future ethanol will not come from corn

Cellulosic biomass from various sources will replace corn

- **Agricultural residues**
- **Forestry residues**
- **Terrestrial and aquatic crops and trees grown for energy purposes**
- **Selected municipal, agricultural, and industrial wastes**

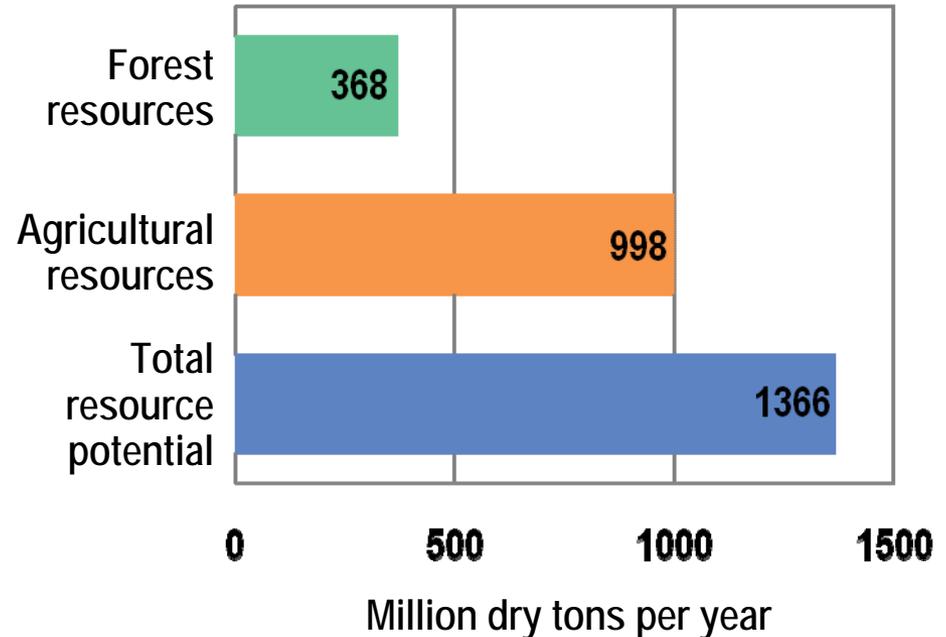
Projected U.S. biofuel sources



Source: *Biomass as Feedstock for a Bioenergy and Bioproducts Industry: Technical Feasibility of a Billion Ton Annual Supply*. 2005. DOE and USDA.

The United States has sufficient biomass resources to replace one-third of petroleum requirements

- **Land resources can provide a sustainable supply of more than 1.3 billion dry tons annually and still continue to meet food, feed, and export demands (USDA baseline)**
- **Realizing this potential will require R&D**



Only about one-third of the land identified in DOE/ORNL study is needed to produce the entire 36 billion gallons required by 2022

The Tennessee Biofuels Initiative has been funded by the legislature

- **A \$70.5M investment**
 - \$40.7M capital in FY08 for demonstration biorefinery
 - \$8.3M in FY08 for switchgrass production
 - \$5.6M in FY09 for farm program, operations, and R&D
 - \$15.9M committed in FY10–FY12
- **Partnership with DuPont Danisco Cellulosic Ethanol, LLC**
- **Developing additional strategic partnerships**
- **Complementary programs**
 - Southeastern SunGrant, \$12M
 - DOE BioEnergy Science Center at ORNL, \$135M
 - UTIA research and education investment, \$5M



Virginia's opportunity is similar to Tennessee's

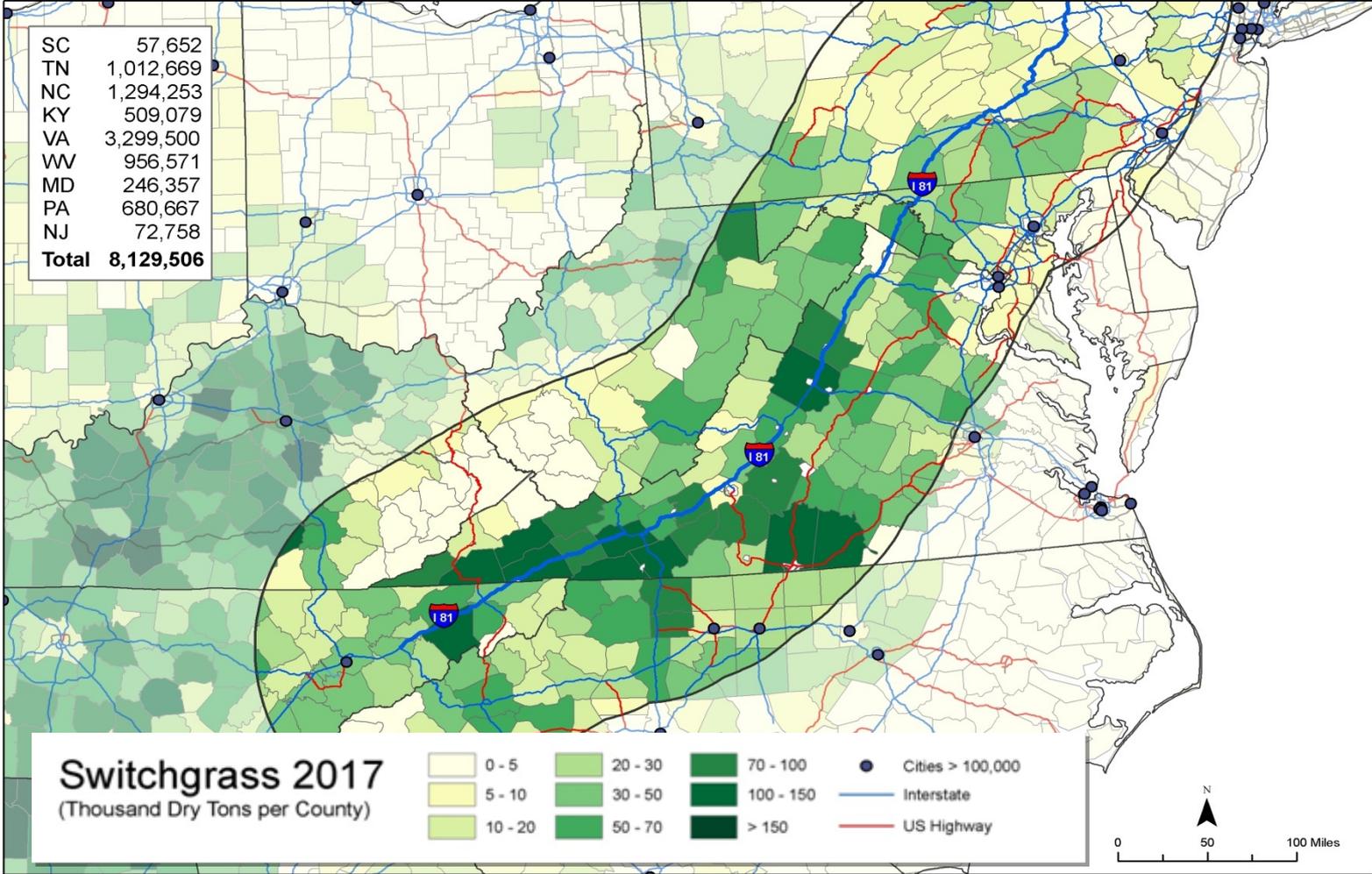
- **Produce and consume at least 1 billion gallons of cellulosic ethanol, at \$1.20–\$1.35 per gallon wholesale**
- **Build and operate new biorefineries in rural Virginia, potentially supporting 4,000 jobs**
 - **Biorefineries owned and operated by local farmer cooperatives, retaining an additional \$40M in local communities**
- **Provide satellite co-product plants creating an additional 3,000 jobs and \$2B in revenue**
- **Potential to add \$100M in new farm revenue as a result of farmers growing dedicated energy crops**

The path forward is the same for both states

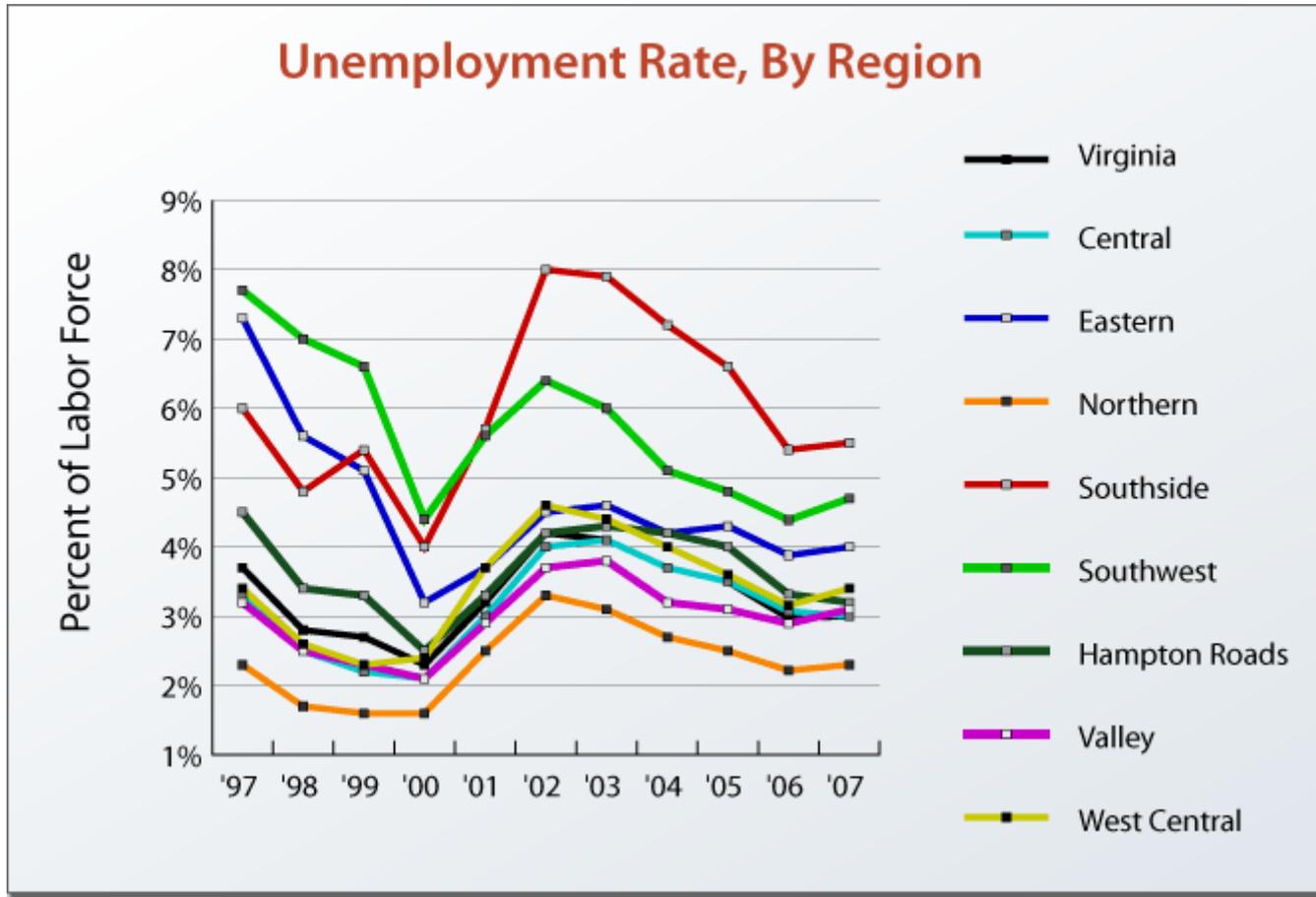
- **Specific quantitative goals**
- **Simultaneously funded activities in place for research and demonstration**
- **Specific transportation logistics along the I-81 corridor**
- **Understanding planting, harvesting, handling, pre-processing, storage, processing, and transportation needs in agriculture and forestry**
- **Understanding production at commercial scale**



The I-81 corridor has a high biomass potential

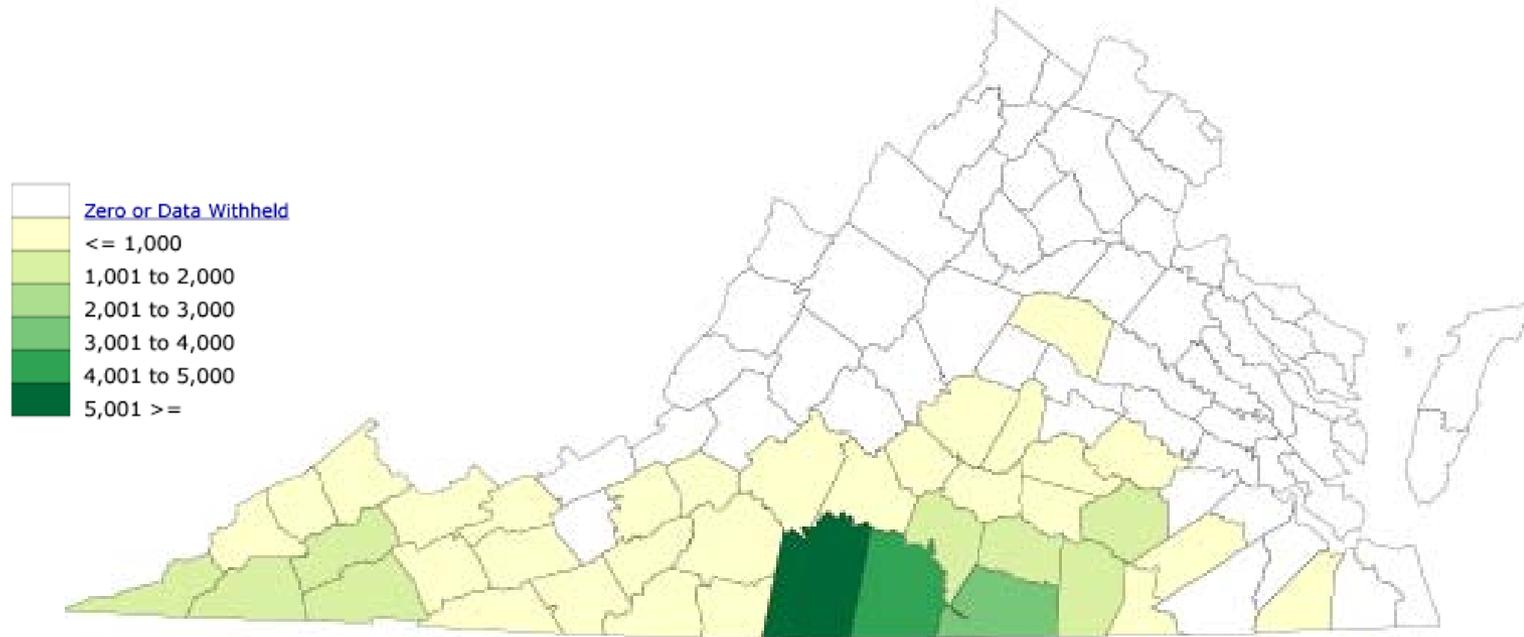


Unemployment in Virginia

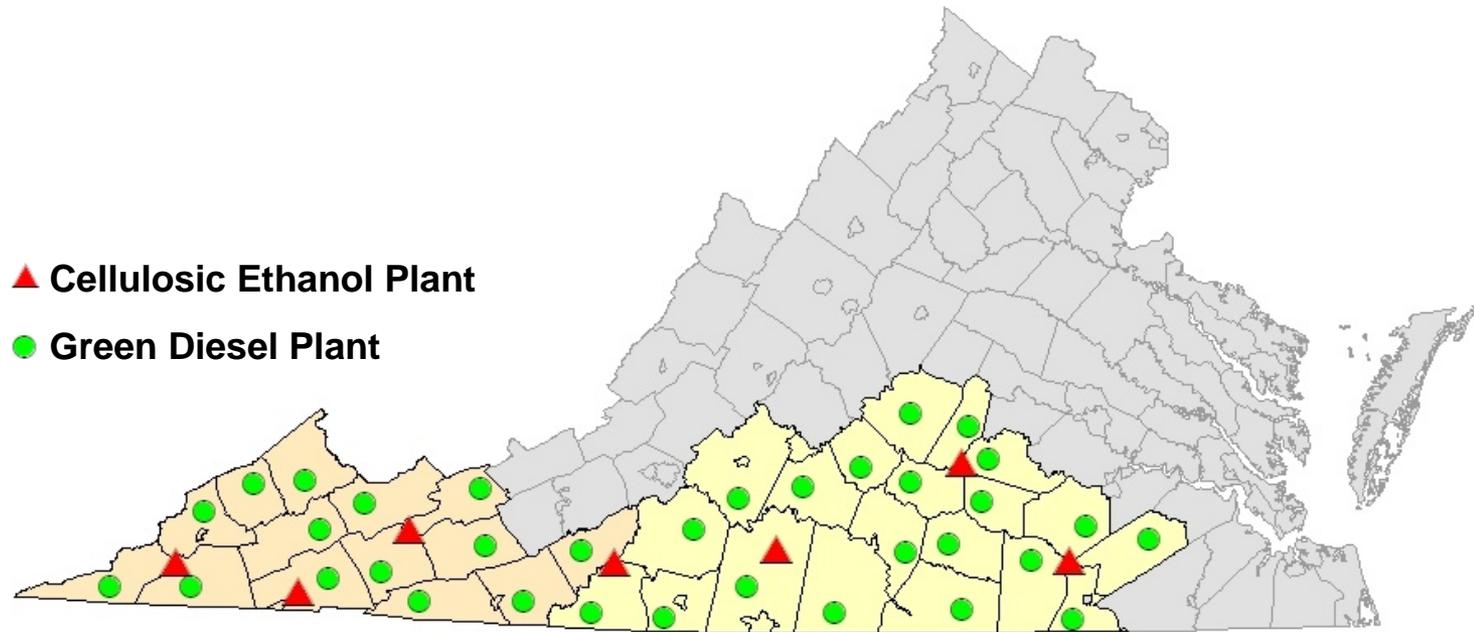


<http://vaperforms.virginia.gov/i-unemployment.php>

The past: Tobacco producing counties



The Future



At least 1 biorefinery in each of the 34 Tobacco Commission counties, producing 546–1,177 MGY of value-added fuels with an annual wholesale value of \$1.7B to \$2.6B (expressed in 2008 dollars)

The I-81 BioEnergy Initiative presents an opportunity for rural Virginia

