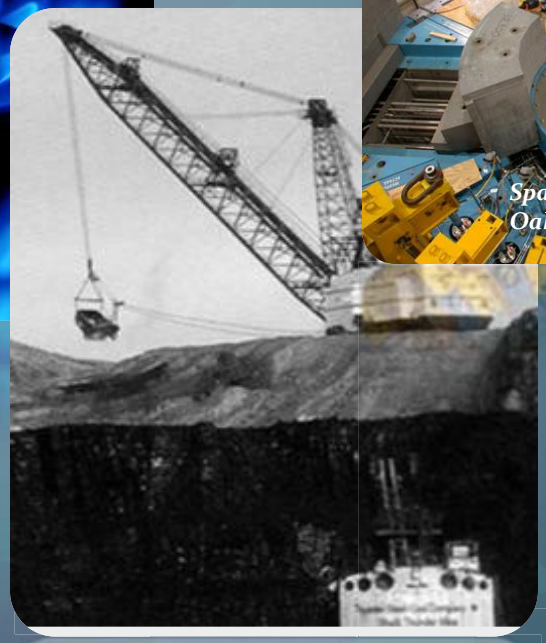
DOE EPSCoR
OAK RIDGE NATIONAL LAB

July 2008



Spallation Neutron Source at Oak Ridge National Laboratory

From *"Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future"**

- **Recommendation B:**
  - "Sustain and strengthen the nation's traditional commitment to long-term basic research that has the potential to be transformational to maintain the flow of new ideas that feed the economy, provide security, and enhance the quality of life." page 6, Executive Summary
- **Recommendation C:**
  - "Make the United States the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and the brightest students, scientists, and engineers from within the United States and throughout the world." page 8, Executive Summary
- **Also from the Executive Summary:**
  - "The committee identified two key challenges that are tightly coupled to scientific and engineering prowess: creating high-quality jobs for Americans, and responding to the nation's need for clean, affordable, and reliable energy." page 4

*The National Academy Press

EPSCOR STATES: SUPPLYING ENERGY TO THE NATION

Total Energy Production: Crude Oil

Quad (1×10^{15}) British Thermal Units

Top Ten Crude Oil

State		Barrels/year	Quad Btu
Texas		387,679,000	2.035
Alaska	EPSCoR	315,418,000	1.656
California		230,293,000	1.209
Louisiana	EPSCoR	75,485,000	0.396
Oklahoma	EPSCoR	62,142,000	0.326
New Mexico	EPSCoR	60,660,000	0.318
Wyoming	EPSCoR	51,626,000	0.271
North Dakota	EPSCoR	35,659,000	0.187
Kansas	EPSCoR	33,823,000	0.178
Montana	EPSCoR	32,857,000	0.172

Crude Oil Facts

- 31 states report crude oil production
- 17 are EPSCoR states
  - 8 of the top 10 crude oil states
- 708,322,000 barrels from EPSCoR states
  - 50.7% of every barrel
- 7 Quads
  - 53.1 % of the Quads

Data from Nick Jones, Wyoming Geological Survey, 2007; using DOE EIA 2005 Data www.doe.eia.gov/

Total Energy Production: Natural Gas

Quad (1×10^{15}) British Thermal Unit

Top Ten Natural Gas

State		MM F^3/year	Quads
Texas		5,985,410	6.057
Alaska	EPSCoR	3,642,948	3.687
Wyoming	EPSCoR	2,003,826	2.028
New Mexico	EPSCoR	1,656,850	1.677
Oklahoma	EPSCoR	1,670,137	1.690
Louisiana	EPSCoR	1,309,913	1.326
Colorado		1,143,985	1.158
Kansas	EPSCoR	378,250	0.383
California		352,044	0.356
Alabama	EPSCoR	317,206	0.321

Natural Gas Facts

- 31 states report natural gas production
- 17 are EPSCoR states
  - 7 of the top 10
- >11.8 million ft^3/year (unit of gas) from EPSCoR states
  - 59.9% of every unit
- 20 Quads
  - 59.9 % of every Quad

Data from Nick Jones, Wyoming Geological Survey, 2007; using DOE EIA 2005 Data www.doe.eia.gov/

Total Energy Production: Coal

Quad (1×10^{15}) British Thermal Units

Top Ten States in Coal

State		Tons/year	Quads/ year
Wyoming	EPSCoR	404,319,000	7.207
West Virginia	EPSCoR	153,650,000	3.943
Kentucky	EPSCoR	119,734,000	2.935
Pennsylvania		67,494,000	1.690
Texas		45,939,000	0.680
Montana	EPSCoR	40,354,000	0.716
Colorado		38,510,000	0.885
Indiana		34,457,000	0.763
Illinois		32,014,000	0.709
North Dakota	EPSCoR	29,956,000	0.402

Coal Facts

- 26 states reported coal production
  - 14 are EPSCoR states
- 812,288,000 tons from EPSCoR states
  - 71.8% of every ton
- 24 quads
  - 69% of the quad production

Data from Nick Jones, Wyoming Geological Survey, 2007; using DOE EIA 200 Data www.doe.eia.gov/

Top Energy Producing States
Quad British Thermal Units

Top Ten Energy Producing

State		Quad Btu Produced	Quads Consumed	Net Quads
Wyoming	EPSCoR	9.505	0.454	9.05
Texas		8.773	11.971	-3.20
Alaska	EPSCoR	5.365	0.779	4.95
West Virginia	EPSCoR	4.171	0.821	3.35
Kentucky	EPSCoR	3.042	1.956	1.09
New Mexico	EPSCoR	2.597	0.682	1.92
Colorado		2.163	1.383	0.78
Oklahoma	EPSCoR	2.065	1.485	0.58
Pennsylvania		1.881	4.049	-217
Louisiana	EPSCoR	1.780	3.816	-2.04

Facts

- 3 of top 10 consume more than they produce
- All net energy producing states (except Colorado) are EPSCoR states

Data from Nick Jones, Wyoming Geological Survey, 2007; using DOE EIA 2005 Data www.doe.eia.gov/

Top Net Energy Providing States

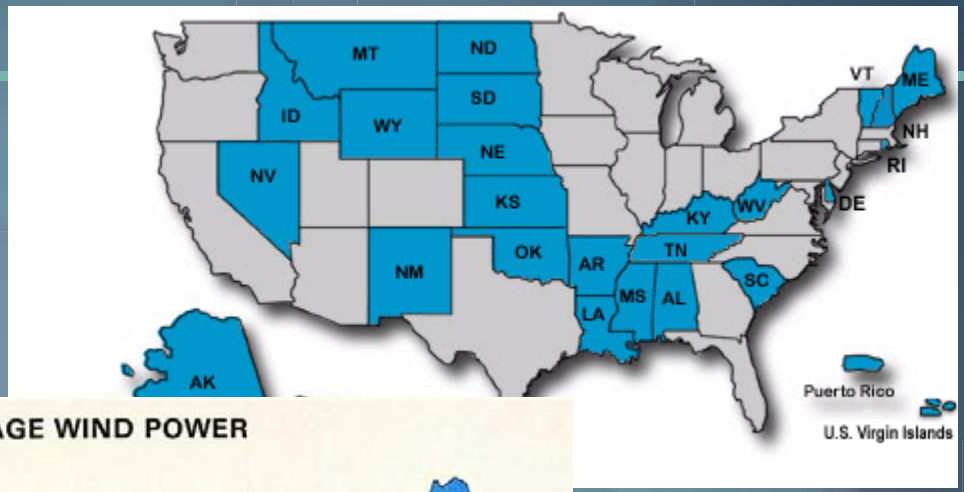
State		Net Energy Produced
Wyoming	EPSCoR	9.05
Alaska	EPSCoR	4.59
West Virginia	EPSCoR	3.35
New Mexico	EPSCoR	1.92
Kentucky	EPSCoR	1.09
Colorado		0.78
Montana	EPSCoR	0.60
Oklahoma	EPSCoR	0.58
Utah		0.25
North Dakota	EPSCoR	0.24

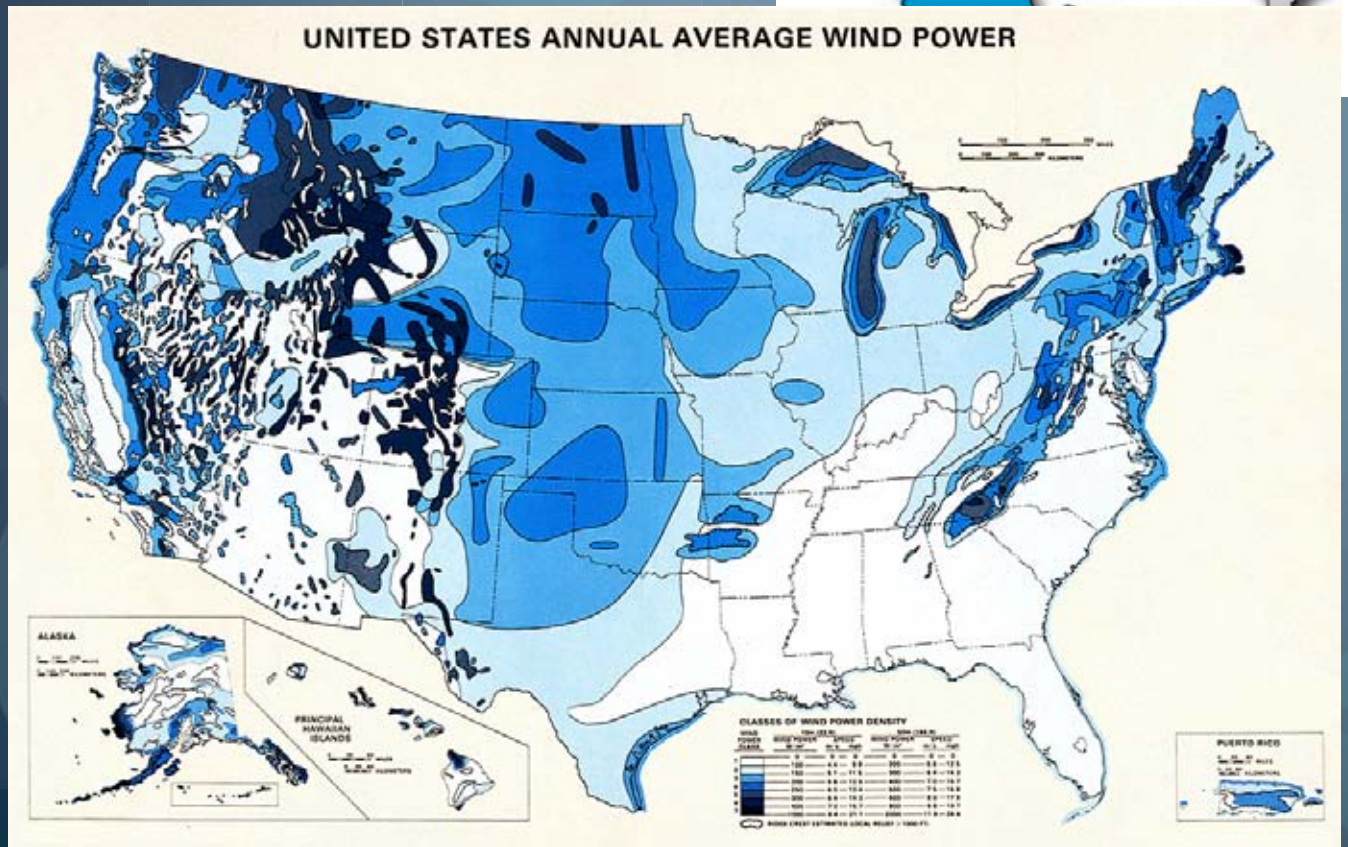
Facts

- 10 states produce more energy than they consume
- 8 of the 10 are EPSCoR states
- 23.26 quad Btu go to the nation from these states
- 21.42 quad Btu are from EPSCoR states
  - 92.1% of every quad is from an EPSCoR state

Data from Nick Jones, Wyoming Geological Survey, Using 2005 U.S. DOE EIA Data www.doe.eia.gov/

EPSCoR States Have a Significant Fraction of the US Wind Resource





Source: NREL

Potential Wind Energy Resources

Top 10 *Potential* Wind Energy Resources

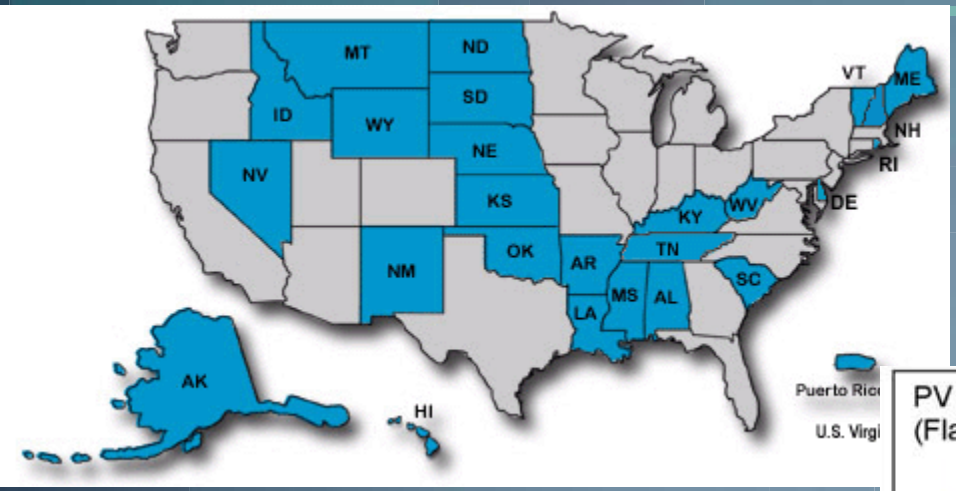
State		Wind energy Potential kW/hrs(109/year)
North Dakota	EPSCoR	1,210
Texas		1,190
Kansas	EPSCoR	1,070
South Dakota	EPSCoR	1,030
Montana	EPSCoR	1,020
Nebraska	EPSCoR	868
Wyoming	EPSCoR	747
Oklahoma	EPSCoR	725
Minnesota		657
Iowa		551

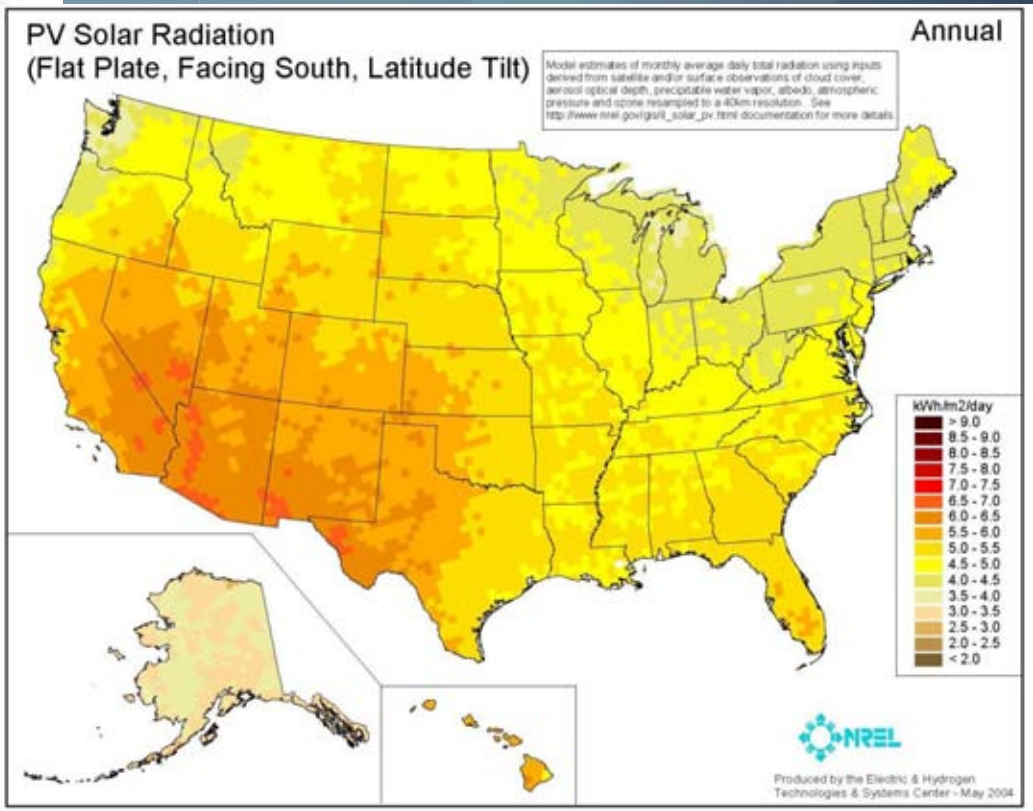
Wind Facts

- 7 of the top 10 states are EPSCoR states
  - 10 of the top 20 are EPSCoR states
- 2 EPSCoR states are in the top 10 in current installed capacity
  - 8 EPSCoR states are in the top 20

Source: American Wind Energy Association; 2008

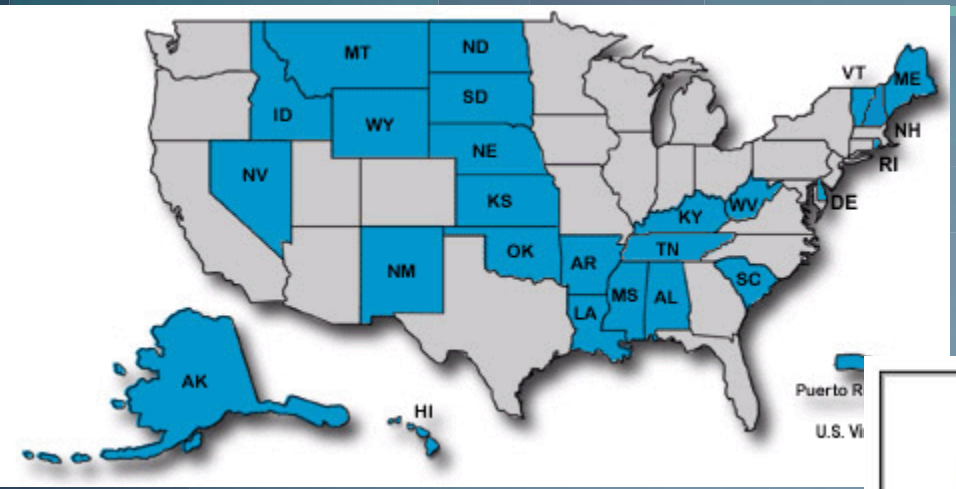
EPSCoR States Solar Radiation

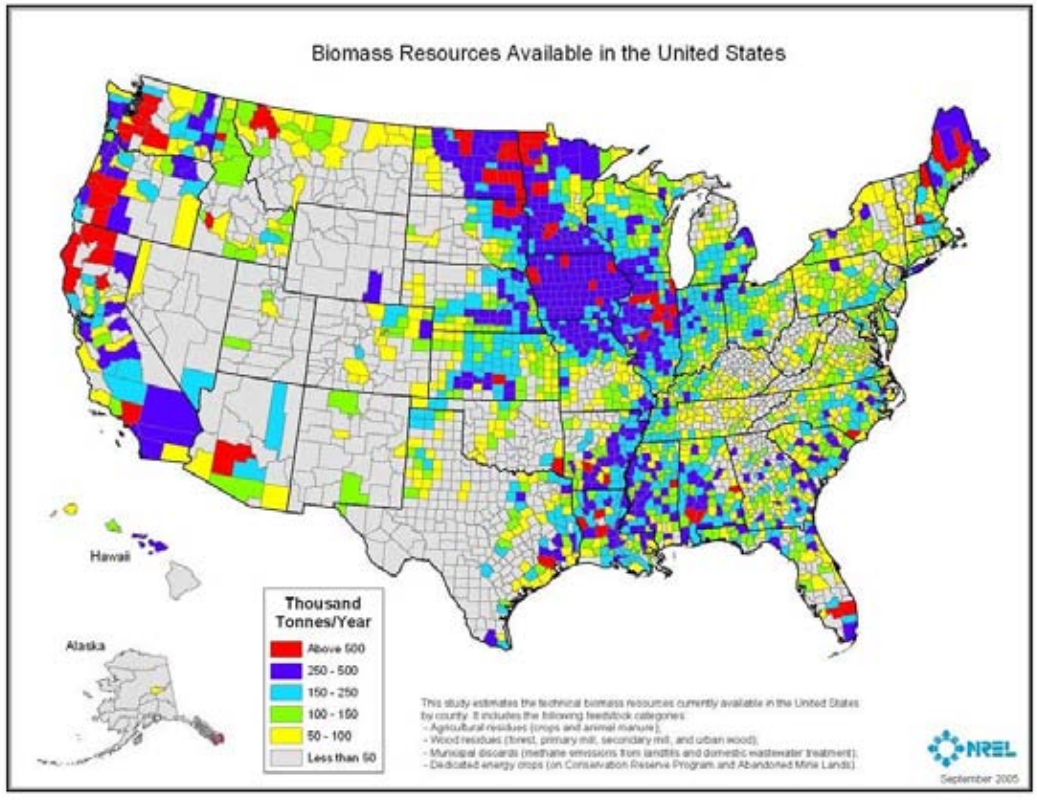




•Source: NREL

EPSCoR States Biomass





- Source: NREL

R&D IN EPSCOR STATES: A DIFFERENT STORY

EPSCoR States Need to be More Than Energy Colonies to the Nation

- EPSCoR states are important because of the energy they supply
- They must diversify their economies
- State legislators and Governors support EPSCoR because of the promise of diversification through R&D
- For EPSCoR states, developing a technology-based business economy is not only important it is required
  - Supporting R&D is essential to economic diversification

All R&D is Lagging in EPSCoR States

- **By definition, EPSCoR states receive <0.75% of the NSF R&D budget**
- **It is estimated* that EPSCoR states receive $24,304 million from all sources**
  - **This is 8.6% of the total national R&D expenditure**
  - **And it is 9.5% of what non-EPSCoR states receive**

Source: *Science and Engineering Indicators 2008; www.nsf.gov

R&D Expenditures: A Tale of Disparity

Reported Industrial R&D Expenditures 2005	
Designation	Funding in $ Millions
EPSCoR	$7,955
Non-EPSCoR	$192,659
Total	$200,614

4% of the reported industrial R&D occurs in EPSCoR states

Source: NSF – SRS report 07-335, Table 5. www.nsf.gov/statistics/infbrief/nsf07335

Federal University R&D Expenditures 2005	
Designation	Funding in $ 1,000s
EPSCoR	$3,383,538
Non-EPSCoR	$25,722,143
Total	$29,105,681

11.6% of the federally funded university R&D occurs in 23 EPSCoR states

Source: NSF Statistics 08-300 Table 20. www.nsf.gov/statisitcs/nsf08300

Industry Performed R&D as a Share of Private Industry Output 2005

- **Industrial R&D is low in EPSCoR states**
  - **17 EPSCoR states are in the bottom half of industrial R&D**
  - **Bottom 17 are all EPSCoR states**
- **When all R&D/GSP is considered the**
  - **bottom 10 are EPSCoR states and**
  - **15 of the bottom 25 are EPSCoR states**
- **R&D performed as a percent of GSP is 1.59% in EPSCoR states and 2.53% in non-EPSCoR states**
  - **National average 2.44%**

Source: NSF Science and Engineering Indicators 2008, Table 8-35. www.nsf.gov/statistics/seind08/

Engineers and Scientists in the Workforce

- 8 of the bottom 10 are EPSCoR states
- 1 of the top 10 is an EPSCoR state
- Bachelor's degrees in natural sciences and engineering
  - 5 of the top 10 are EPSCoR states
    - Presence of large amounts of federal land requiring biologists
  - 7 of the bottom 10 are EPSCoR states
- EPSCoR and non-EPSCoR states produce scientists and engineers at the same rate
- EPSCoR states export Bachelor's degrees in science and engineering to other states

Source: NSF, Science and Engineering Indicators, 2008. Tables 8-28, 8-29. www.nsf.gov/statistics/seind08/

High Tech Business Information

- High tech business start-ups occur in EPSCoR states
  - 3 of the top 10 states for high tech business formations as a percent of all business establishments are EPSCoR states
  - 11 of top 25 are EPSCoR states
  - The rate of high tech business establishment is essentially the same in non-EPSCoR (0.168%) and EPSCoR states (0.126%)
- Because EPSCoR states lag they must create high tech businesses at a higher rate to catch up
  - Once again, R&D funding is necessary

Source: NSF, Science and Engineering Indicators, 2008. Tables 8-42. www.nsf.gov/statistics/seind08/

SBIR, etc

- 9 of the bottom 10 states receiving federal SBIR $ are EPSCoR states
- 22 of the bottom 25 are EPSCoR states
- No EPSCoR states are in the top 10
- SBIR funding per million of GSP
  - 6 of the bottom 10 are EPSCoR states

    however,
  - 5 of the top 11 are EPSCoR states
- EPSCoR states receive 9.7% of federal SBIR $
  - Alabama (14) and New Mexico (21) may reflect the presence of federal laboratories or other installations

Significant Energy R&D Infrastructure and Research Exists in EPSCoR States Universities

- Infrastructure
  - Louisiana State University - Center for Advance Microstructures and Devices
  - Montana State University – Center for Bio-inspired Nanomaterials
  - North Dakota State University – Center for Advanced Computing
  - South Dakota – Sanford Laboratory at Homestake
  - University of Nebraska – Center for Electro-Optics
  - University of Nevada-Reno – Great Basin Center for Geothermal Energy
  - University of Kentucky – Center for Applied Energy Research
  - University of Wyoming – School for Energy Resources
- Research
  - Home for 3 of 7 carbon sequestration partnerships
  - Most of the 70 research universities in EPSCoR states have peer-reviewed DOE research

Summary Comments

- **EPSCoR States:**
  - Provide the majority of domestic energy to the nation
  - Plays an important role in the Nation's energy research
  - Has the ability to do more if our research infrastructure were improved and there were more resources
  - We look forward to an increased role in energy research with the U.S. Department of energy

How DOE Can Help

- Involve EPSCoR states in early planning regarding research initiatives at the DOE
  - Direction setting and visioning workshops and symposia
- Involve researchers from EPSCoR states in all levels of DOE research including:
  - Peer review panels for all Department of Energy research divisions
- Help EPSCoR states expand their economies by examining how DOE SBIR funds are used in EPSCoR states
- Continue to spread the concept of EPSCoR throughout all DOE divisions and laboratories

THANK YOU!