



# Oil Atlas

## National Petroleum Technology Program

Administered by the National Petroleum Technology Office



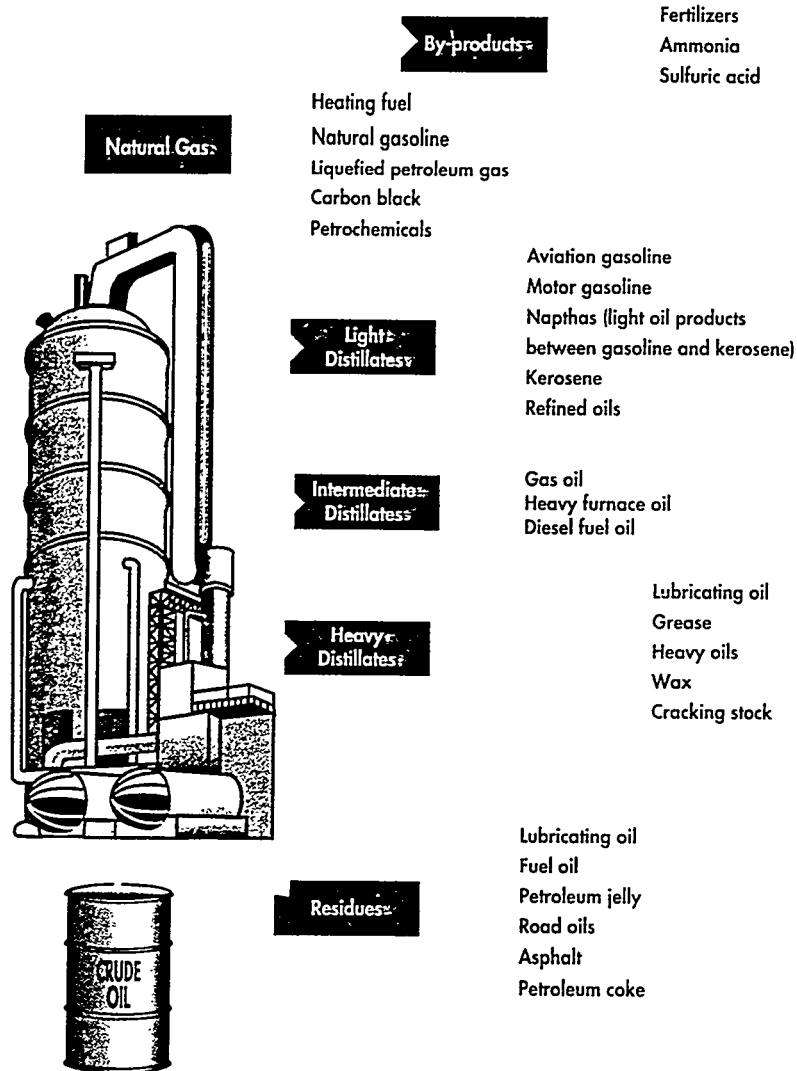
*Finding cleaner, cheaper, smarter ways to fuel America's economy.*



## **DISCLAIMER**

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## From Crude Oil to Products



✓ In 1996, U.S. refineries produced petroleum products valued at more than \$110 billion and employed about 121,000 Americans.

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**MASTER**

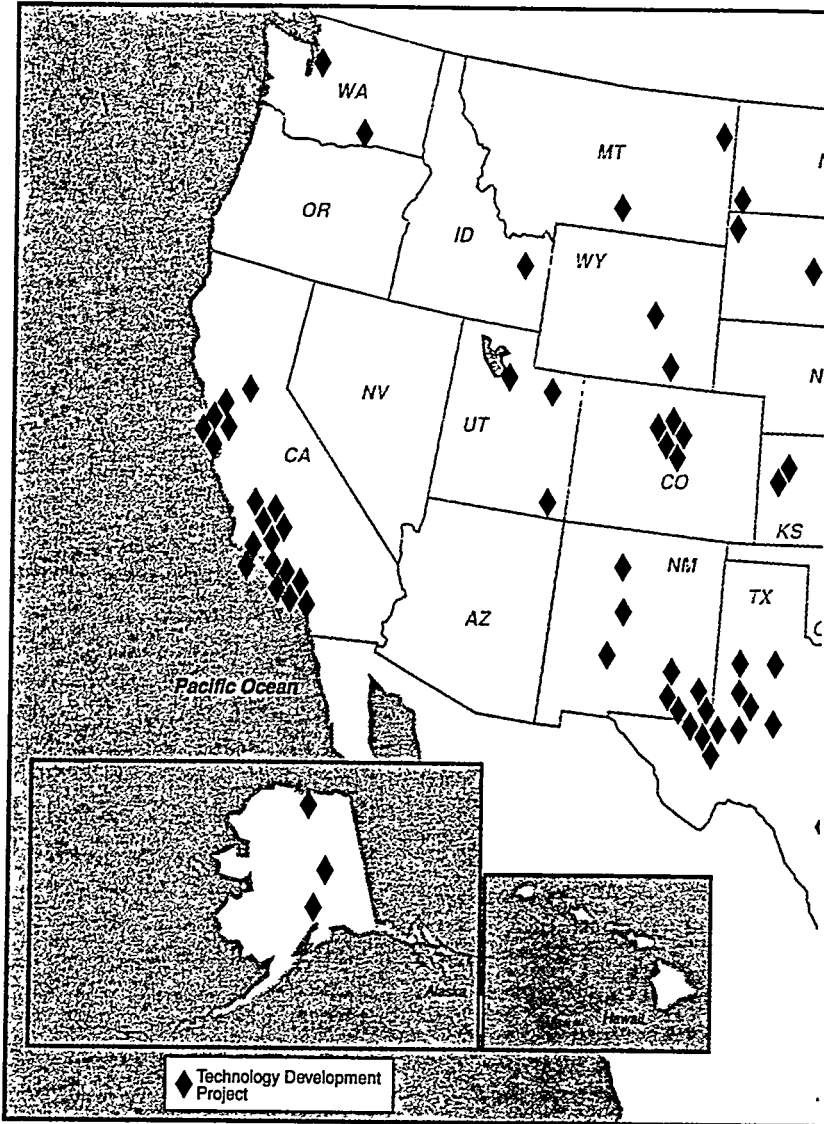
**Oil Atlas**

DOE/FE-98002918

*National Petroleum Technology Office (NPTO)*

*Activities Across the United States*

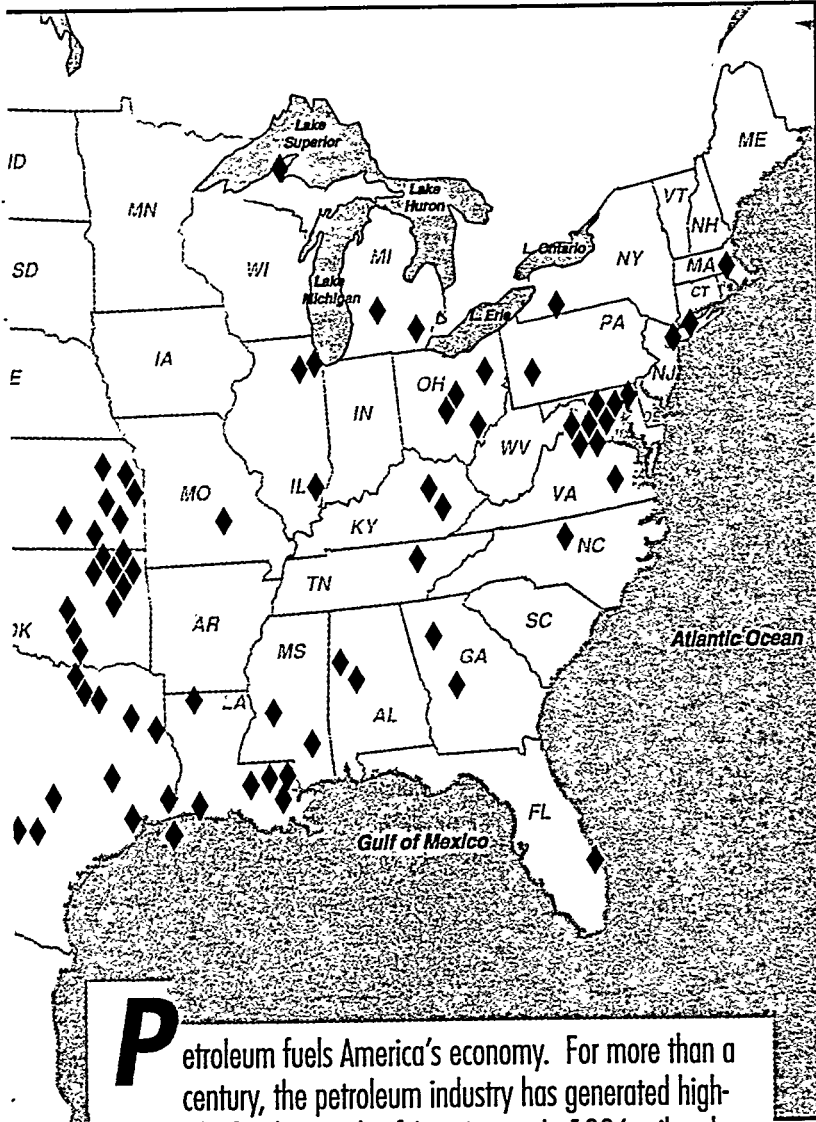
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New Jersey .....	10
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✓ *The National Petroleum Technology Program has 369 active technology development projects in 131 locations.*

*Finding Cleaner, Cheaper, Smarter Ways  
to Fuel America's Economy*



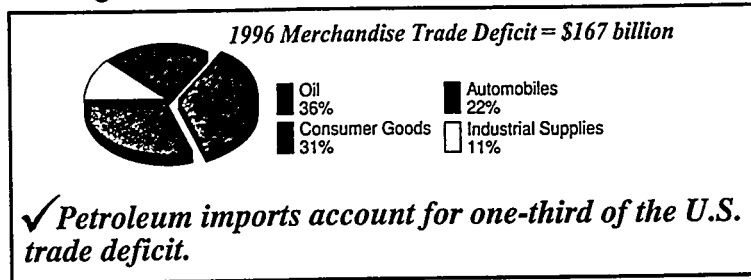


**P**etroleum fuels America's economy. For more than a century, the petroleum industry has generated high-paying jobs for thousands of Americans. In 1996, oil and gas supplied two-thirds of all the energy consumed in the United States. For the next 20 years, 95 percent of the transportation fuel used in America is expected to come from crude oil.

In the United States, the days of "easy petroleum finds" are dwindling. By 1995, domestic oil production dropped to 2.4 billion barrels per year — its lowest point in 40 years — yet

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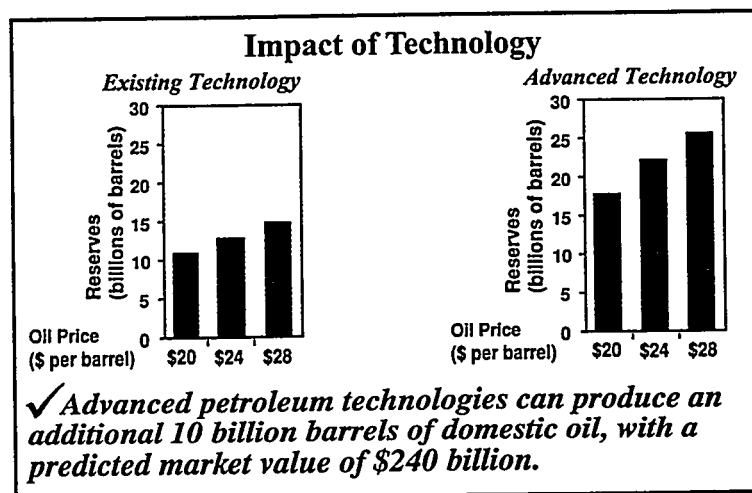
## 4 Program Overview



the nation's demand for oil is stronger than ever. As a result, the U.S. now imports more than half of all the oil it uses. Petroleum imports account for the largest share of the U.S. trade deficit. Over one-third of the 1996 merchandise trade deficit is attributed to imported oil.

The good news is that substantial domestic oil resources, both existing and yet-to-be-discovered, can be recovered using advanced petroleum technologies. The Energy Information Agency estimates that advanced technologies can yield 10 billion additional barrels, equal to \$240 billion in import offsets.

The U.S. Department of Energy's National Petroleum Technology Office works with industry to develop advanced petroleum technologies and to transfer successful technologies to domestic oil producers. This publication shows the locations of these important technology development efforts and lists DOE's partners in this critical venture.



***National Petroleum Technology Office  
Product Lines***

The National Petroleum Technology Office has 369 active technology development projects grouped into six product lines:



***Advanced Diagnostics and Imaging Systems***

Maximize oil production. Lower the costs of operating existing wells and finding new oil fields while protecting the environment. Systems include remote imaging, advanced instrumentation, and computational technologies.



***Advanced Drilling, Completion, and Stimulation***

Reduce the cost of drilling new wells and increase the production of existing wells while decreasing environmental impact. Projects include drilling and related technologies tailored to diverse geological settings.



***Reservoir Life Extension and Management***

Increase oil recovery from known reservoirs that are not producible with current technology, specifically by developing, demonstrating, and transferring federally-funded environmentally-sound technologies to commercial markets.



***Emerging Processing Technology Applications***

Improve operational efficiency and reduce environmental impact when crude oil is refined into petroleum products.



***Effective Environmental Protection***

Ensure compliance with environmental regulatory requirements and help reduce the environmental impact of petroleum production and refining activities.

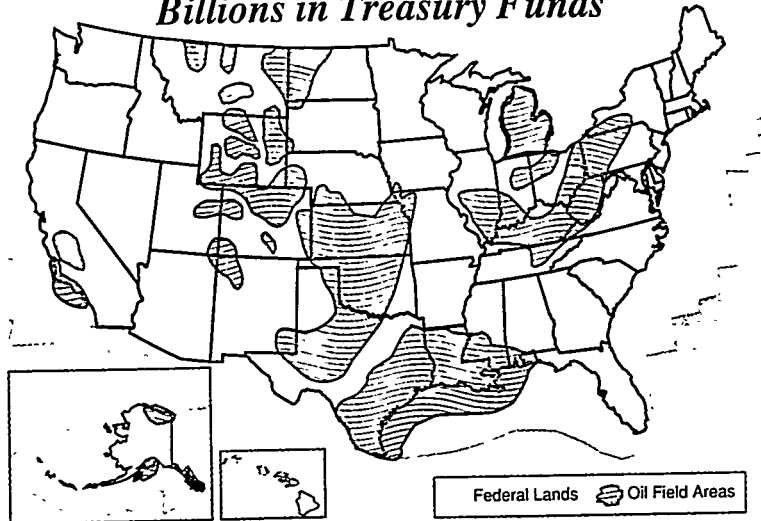


***Crosscutting Program Areas***

Ensure that federally-funded projects are responsive to the needs of the petroleum industry and other stakeholders while maximizing the benefits to the entire Nation.

## 6 Federal Lands

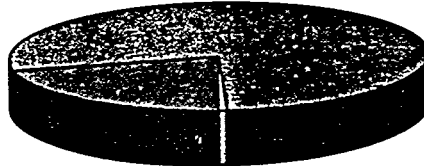
### *Oil Produced on Federal Lands Yields Billions in Treasury Funds*



Several oil field areas lie beneath land owned or controlled by the United States Government. In fact, more than one-fifth of the oil produced in America comes from Federal onshore, offshore, and Indian mineral leases. The Federal government leases sites to commercial oil operators. Revenues from these leases really add up, exceeding \$1.2 billion in 1995 alone.

Where do these revenues go? In 1995, the largest portion (42%) went to the U.S. Treasury to help offset the Federal deficit. The National Park Service used its portion (29%) to buy new park land and acquire national historic sites. The Bureau of Land Reclamation received 10% of the revenues to restore land disturbed by mining operations. Indian tribes received 4% of the total amount. Another 15% went directly to the States where the oil was produced.

■ \$9.3 Billion  
Federal Offshore  
■ \$2.6 Billion  
Federal Onshore  
□ \$0.4 Billion  
Indian Lands



✓ *Federal lands generated \$12.3 billion in Oil royalties, rents, and bonuses (1986-1995).*

## Explanation of Symbols 7 Petroleum Technology Transfer Council

### *Explanation of Symbols*

<ul style="list-style-type: none"> <li>• City (includes towns, county seats)</li> <li>• State Capital</li> <li>↳ National Capital</li> <li>— Highway</li> <li>— Interstate</li> <li>— River</li> <li>— State Boundary</li> <li>— Nation other than United States of America</li> <li>— CANADA</li> <li>N A North arrow</li> <li>— Map scale in miles</li> <li>— Oil Field Area</li> <li>— Offshore Oil Field Area</li> </ul>	<ul style="list-style-type: none"> <li>☆ DOE Oil Facility</li> <li>☆ DOE Federal Energy Technology Center</li> <li>☆ DOE National Laboratory</li> <li>☆ DOE Fossil Energy Research Facility</li> <li>▼ PTTC National Office</li> <li>▼ PTTC Regional Office</li> <li>▲ State Oil Agency</li> <li>1 Research Partner</li> <li>● Refinery</li> <li>* Oil Field</li> </ul>
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The maps in this atlas were created with a platte-carre (equal area) projection.

### *Petroleum Technology Transfer Council*

#### PTTC's Ten Regions

The map displays the United States divided into ten regions, each with a central location marked by a dot. The regions are: Los Angeles (California), Golden (Colorado), Socorro (New Mexico), Austin (Texas), Lawrence (Kansas), Norman (Oklahoma), Baton Rouge (Louisiana), Morgantown (West Virginia), Champlain (New York), and Tallahassee (Florida). A legend at the bottom right shows a white square representing 'Non-oil-producing states'.

The Petroleum Technology Transfer Council (PTTC) is a non-profit organization formed by the U.S. oil and natural gas industry and funded by DOE, State governments, and industry partners. PTTC identifies the problems of domestic oil and gas producers and articulates their needs to the research and development community. PTTC also transfers technology from the R&D community to the oil and gas producers.



Connecticut



Maine

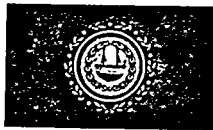


Massachusetts

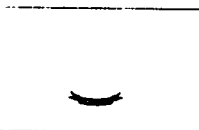
Oil Facts		CT*	ME*	MA*
State-Wide Rank:	Petroleum Consumption	26th	41st	16th
	Crude Production	-	-	-
	Petroleum Consumption, 1996 (million barrels)	77	34	141
	Crude Production, 1996 (million barrels)	-	-	-
	Number of Producing Wells, 1996	-	-	-
	Cum. Total Wells Drilled, through 1996	-	-	-
	Deepest Producing Well (feet)	-	-	-
	Proved Crude Reserves, 1995 (million barrels)	-	-	-
	First Year of Production	-	-	-
	Number of Refineries	-	-	-
	Petroleum Workforce, 1996 (employees)	10,593 <sup>†</sup>	5,264 <sup>†</sup>	20,366 <sup>†</sup>
	Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	-	-	-

\*Non-producing state

<sup>†</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.



New Hampshire



Rhode Island

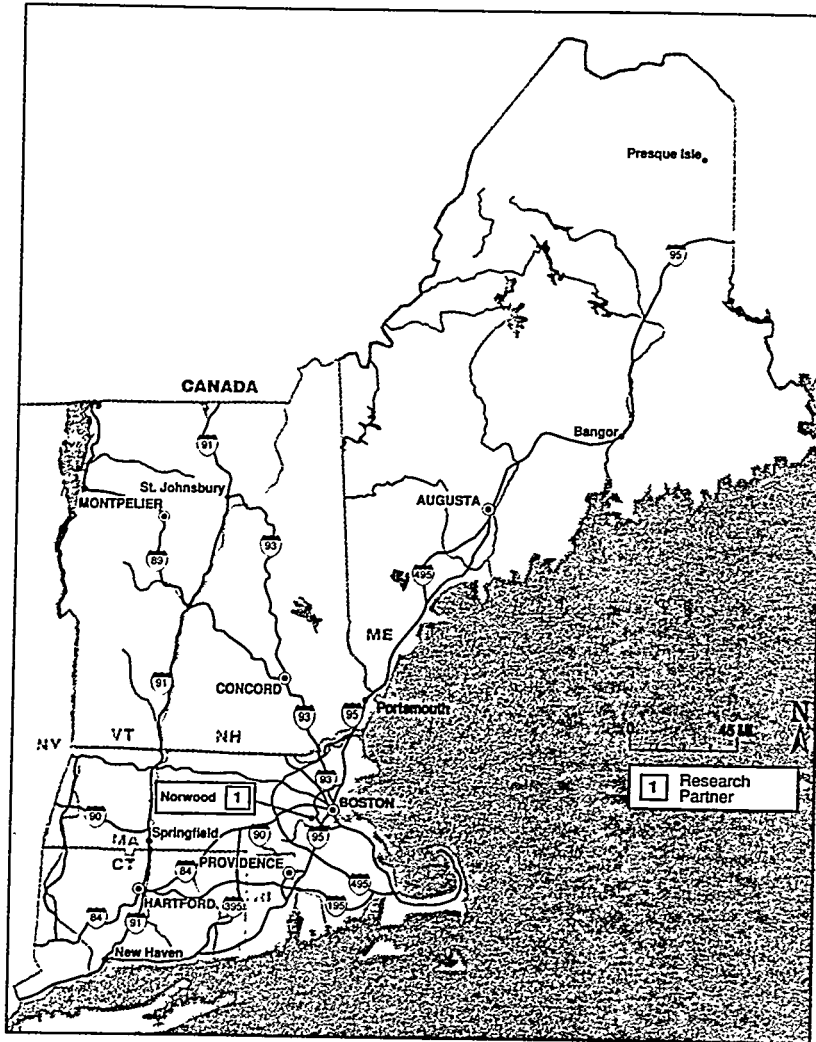


Vermont

Oil Facts		NH*	RI*	VT*
State-Wide Rank:	Petroleum Consumption	43rd	49th	50th
	Crude Production	-	-	-
	Petroleum Consumption, 1996 (million barrels)	28	19	16
	Crude Production, 1996 (million barrels)	-	-	-
	Number of Producing Wells, 1996	-	-	-
	Cum. Total Wells Drilled, through 1996	-	-	-
	Deepest Producing Well (feet)	-	-	-
	Proved Crude Reserves, 1995 (million barrels)	-	-	-
	First Year of Production	-	-	-
	Number of Refineries	-	-	-
	Petroleum Workforce, 1996 (employees)	3,383 <sup>†</sup>	3,071 <sup>†</sup>	2,730 <sup>†</sup>
	Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	-	-	-

\*Non-producing state

<sup>†</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.



**National Petroleum Technology Program**

***Reservoir Life Extension and Management***

- 1 EIC Laboratories, Inc., Norwood, MA
  - Develop a New Class of Cost-Effective Polymers for Enhanced Oil Recovery



*Partners in Developing New Technologies:  
DOE, Industry, Universities, and Government Agencies*



New Jersey



New York



Pennsylvania

## National Petroleum Technology Program

- ★ Brookhaven National Laboratory, Upton, NY
- ★ DOE Federal Energy Technology Center, Pittsburgh, PA

### *Advanced Diagnostics and Imaging Systems*

- 1 Columbia University, New York, NY
  - Test the Concept that Faults in the Gulf of Mexico Provide Pathways for Migrating Oil

### *Reservoir Life Extension and Management*

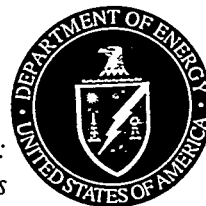
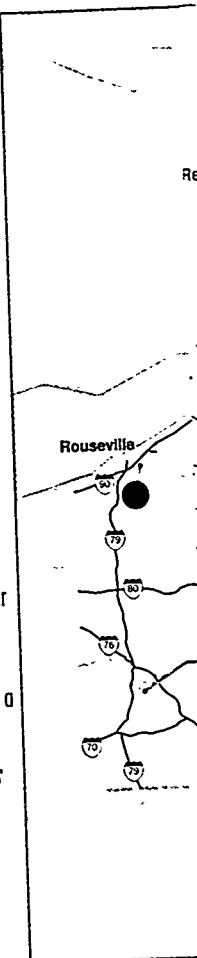
- 1 Columbia University, New York, NY
  - Determine Mechanisms for Surfactant Loss During Chemical Reservoir Flooding
- 5 Hydrocarbon Generation, Inc., Allegany, NY
  - Field Demonstration of Gas Injection to Increase Oil Production from a Mature Reservoir

### *Emerging Processing Technology Applications*

- 3 Brookhaven National Laboratory, Upton, NY
  - Study the Use of Biochemical Refining Processes to Upgrade Heavy Crude Oil
- 4 Design Institute for Physical Properties Research, New York, NY
  - Measure Thermodynamic Properties to Improve Refinery and Petrochemical Processes

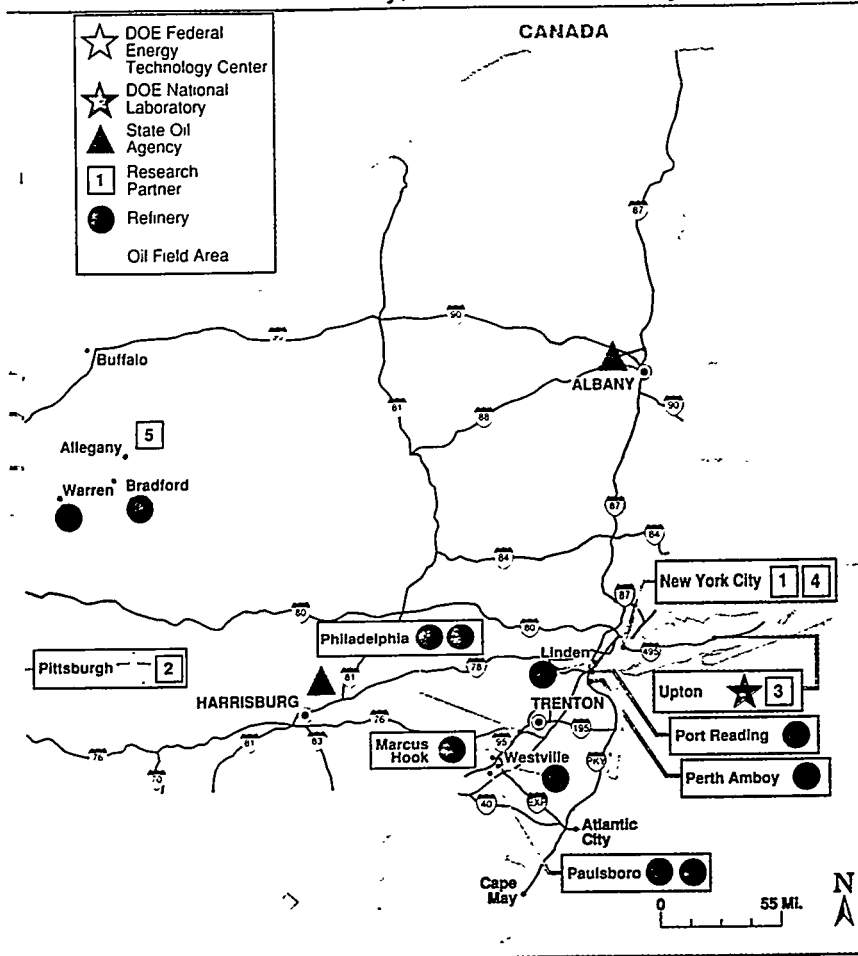
### *Effective Environmental Protection*

- 2 Brandegee, Inc., Pittsburgh, PA
  - Provide Environmental Outreach Material to the Petroleum Industry
- 3 Brookhaven National Laboratory, Upton, NY
  - Health and Environmental Risks of Waste Generated from Oil Exploration and Production



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DOE, Industry, Universities, and Government Agencies*

# New Jersey, New York, Pennsylvania 11



Oil Facts	NJ*	NY	PA
State-Wide Rank: Petroleum Consumption	8th	5th	6th
Crude Production	—	28th	23rd
Petroleum Consumption, 1996 (million barrels)	234	302	249
Crude Production, 1996 (million barrels)	—	0.31	2
Number of Producing Wells, 1996	—	3,041	18,305
Cum. Total Wells Drilled, through 1996	—	9,445	250,492
Deepest Producing Well (feet)	—	4,634	8,484
Proved Crude Reserves, 1995 (million barrels)	—	NA	11
First Year of Production	—	1865	1859
Number of Refineries	6	0	6
Petroleum Workforce, 1996 (employees)	29,008†	39,446	48,481
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	—	\$1.1	\$4.4

\* Non-producing state

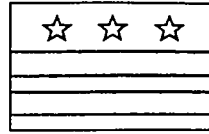
† Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.



Delaware



Maryland



Washington, DC

## National Petroleum Technology Program

- ★ United States Department of Energy - Headquarters, Washington, DC
- ▼ Petroleum Technology Transfer Council, National Office, Washington, DC

### *Advanced Diagnostics and Imaging Systems*

- 1 Science Applications International Corporation, Germantown, MD
  - Geophysical/Geochemical Model for Oil Production from Naturally Fractured Reservoirs

### *Reservoir Life Extension and Management*

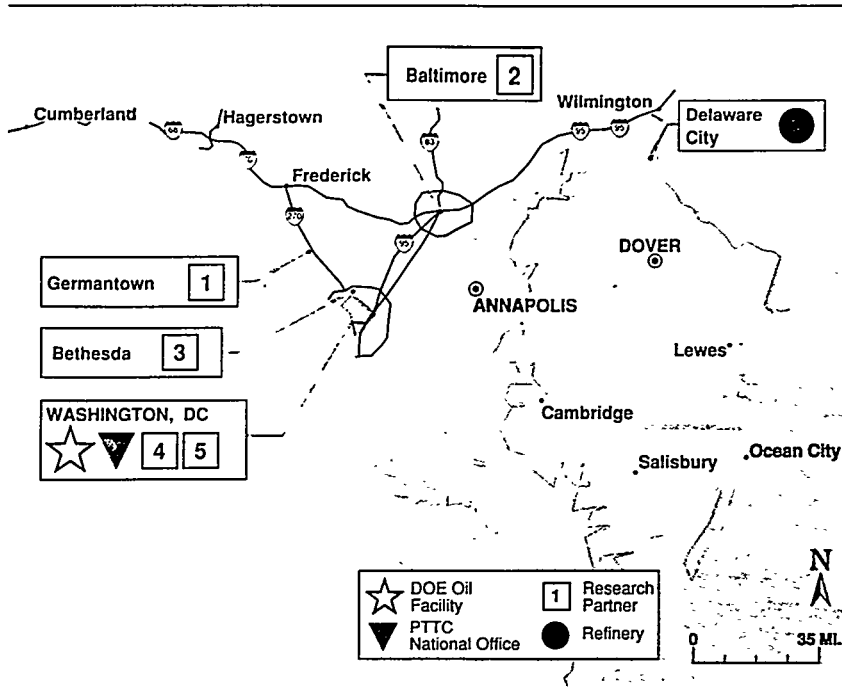
- 2 Morgan State University, Baltimore, MD
  - Develop New Surfactants for Enhanced Oil Recovery of Hot, Light Oil

### *Crosscutting Program Areas*

- 3 The Brashear Group LLC, Bethesda, MD
  - Develop a Plan to Meet the Requirements of the Federal Oil Research Program
- 4 National Academy of Sciences, Washington, DC
  - Assess Earth Sciences Technologies for Their Application to Energy and Environmental Issues
  - Review and Assess the Benefits of the DOE Field Demonstration Program
  - Identify Key Petroleum Exploration Research Problems in the Study of Sedimentary Basins
- 5 Petroleum Technology Transfer Council, Washington, DC
  - Plan and Implement a National Energy Education Program
  - Implement Regional Resource Programs and Outreach to Independent Oil & Gas Producers



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DOE, Industry, Universities, and Government Agencies*



Oil Facts	DE*	MD*	DC*
State-Wide Rank: Petroleum Consumption	44th	28th	51st
Crude Production	—	—	—
Petroleum Consumption, 1996 (million barrels)	27	76	7
Crude Production, 1996 (million barrels)	—	—	—
Number of Producing Wells, 1996	—	—	—
Cum. Total Wells Drilled, through 1996	—	—	—
Deepest Producing Well (feet)	—	—	—
Proved Crude Reserves, 1995 (million barrels)	—	—	—
First Year of Production	—	—	—
Number of Refineries	1	—	—
Petroleum Workforce, 1996 (employees)	2,327 <sup>1</sup>	14,211 <sup>1</sup>	1,306 <sup>1</sup>
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	—	—	—

\*Non-producing state

<sup>1</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.



N. Carolina



Virginia



W. Virginia

### National Petroleum Technology Program

☆ DOE Federal Energy Technology Center, Morgantown, WV

▼ PTTC Appalachia Office, Morgantown, WV

#### *Reservoir Life Extension and Management*

- 2 ARCTECH, Inc., Chantilly, VA
- Develop Microbial (Organisms) Methods to Increase Heavy Oil Production
  - Apply a Microbial (Organisms) Treatment System for Oil & Gas Production Wastewater

#### *Emerging Processing Technology Applications*

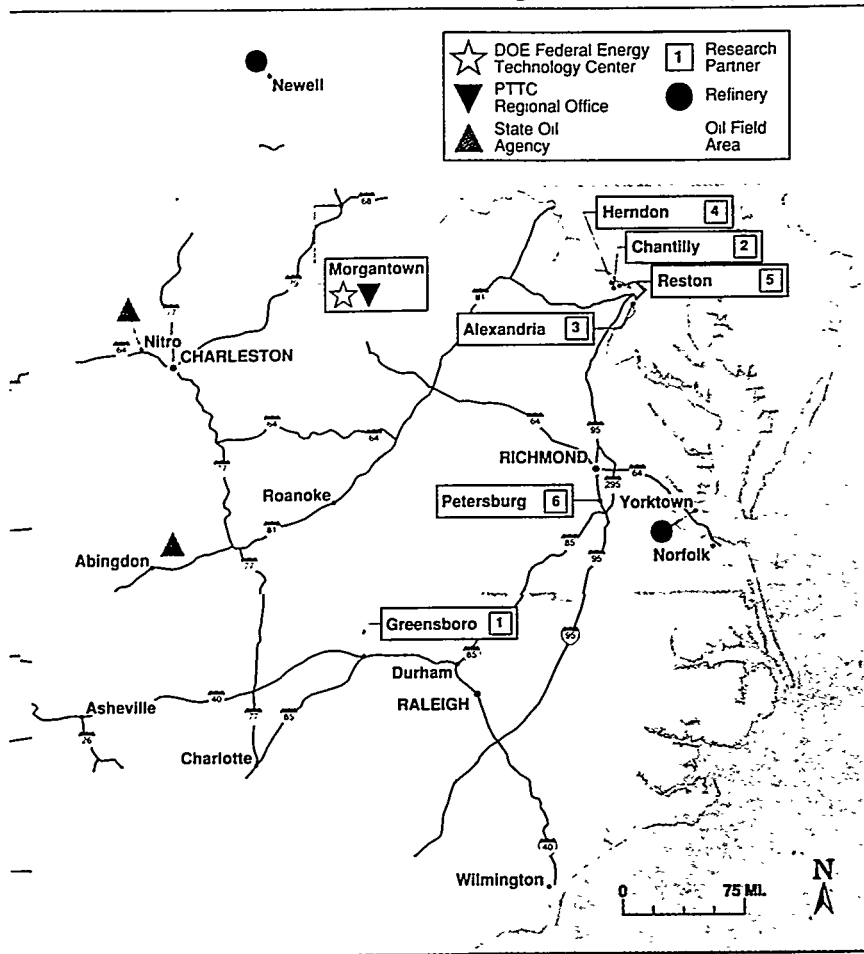
- 1 North Carolina Agricultural and Technical State University, Greensboro, NC
- Optimize Heavy Oil Refinery Yields Using Hydrocracking Processes

#### *Crosscutting Program Areas*

- 3 American Geological Institute, Alexandria, VA
- Implement an On-Line Repository of U.S. Oil Field Geoscience Data
- 4 U.S. Minerals Management Service, Herndon, VA
- Develop an Atlas of Offshore Oil Reservoir Data for the Gulf of Mexico
- 5 U.S. Geological Survey, Reston, VA
- Evaluate Fossil Fuel Energy Sources on Native American Lands
- 6 Virginia State University, Petersburg, VA
- Computer Model to Predict the Impact of Oil Operations on Louisiana Coastal Wetlands

*Partners in Developing New Technologies:  
DOE, Industry, Universities, and Government Agencies*

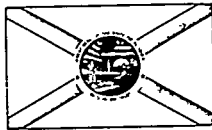




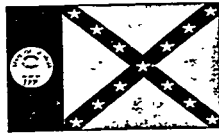
Oil Facts	NC*	VA	WV
State-Wide Rank: Petroleum Consumption	14th	15th	34th
Crude Production	—	31st	24th
Petroleum Consumption, 1996 (million barrels)	152	146	57
Crude Production, 1996 (million barrels)	—	0.01	2
Number of Producing Wells, 1996	—	21	16,869
Cum. Total Wells Drilled, through 1996	—	67	48,013
Deepest Producing Well (feet)	—	5,175	6,785
Proved Crude Reserves, 1995 (million barrels)	—	NA	28
First Year of Production	—	1943	1860
Number of Refineries	—	1	1
Petroleum Workforce, 1996 (employees)	23,823 <sup>†</sup>	29,397	14,918
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	—	\$0.01	\$2.4

\* Non-producing state

<sup>†</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.



Florida



Georgia



S. Carolina

## National Petroleum Technology Program

### *Emerging Processing Technology Applications*

- 2 Clark Atlanta University, Atlanta, GA
- Develop Optimum Design Guidelines for Infrared Burner Manufacturing for Refineries
  - Study Oil Impurities that Interfere with Refining Process Catalysts

### *Effective Environmental Protection*

- 1 Continental Shelf Associates, Inc., Jupiter, FL
- Environmental and Economic Impact of Water/Sand Discharges in Gulf of Mexico Oil Operations

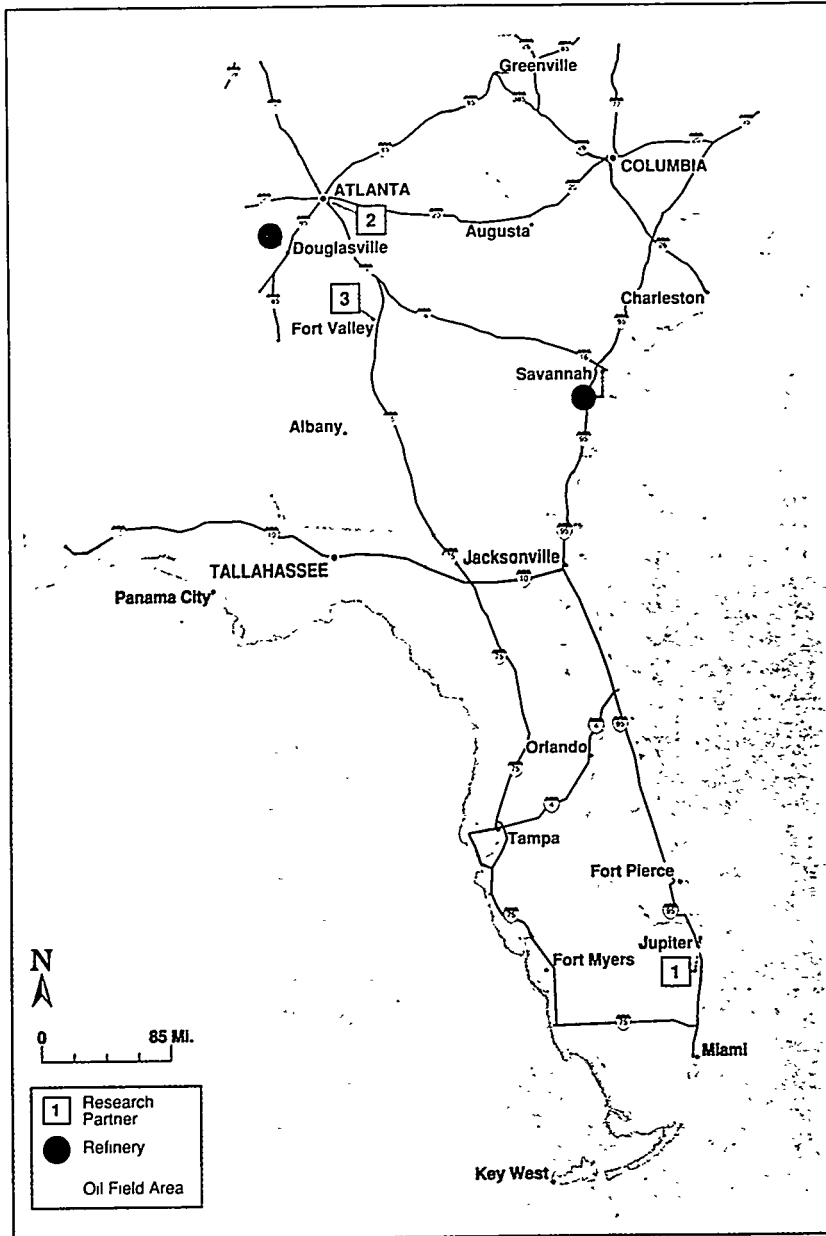
### *Crosscutting Program Areas*

- 2 Clark Atlanta University, Atlanta, GA
- New Technologies to Convert Petroleum Residues into Gasoline and Other Products
- 3 Fort Valley State University, Fort Valley, GA
- Conference to Increase Petroleum Industry Participation in the Geoscience Consortium
  - Develop Geostatistical Techniques to Improve Characterization of Mature Oil Fields
  - Prepare Minority Students for Careers in Science, Mathematics, and Engineering

Oil Facts	FL	GA*	SC*
State-Wide Rank: Petroleum Consumption	3rd	11th	25th
Crude Production	19th	—	—
Petroleum Consumption, 1996 (million barrels)	308	168	82
Crude Production, 1996 (million barrels)	6	—	—
Number of Producing Wells, 1996	92	—	—
Cum. Total Wells Drilled, through 1996	284	—	—
Deepest Producing Well (feet)	16,656	—	—
Proved Crude Reserves, 1995 (million barrels)	71	—	—
First Year of Production	1943	—	—
Number of Refineries	0	2	0
Petroleum Workforce, 1996 (employees)	34,277	28,599 <sup>†</sup>	10,392 <sup>†</sup>
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$8.9	—	—

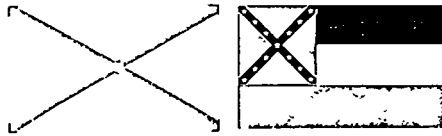
\* Non-producing state

<sup>†</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.



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18



Alabama

Mississippi

## National Petroleum Technology Program

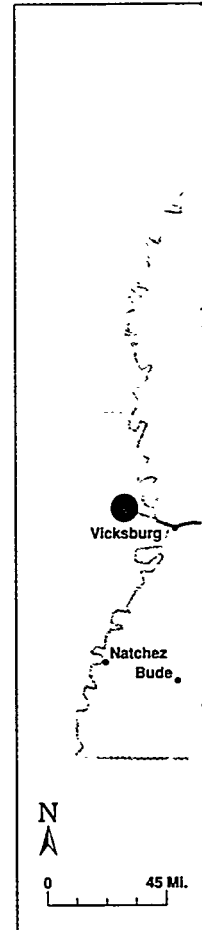
▼ PTTC Eastern Gulf Office, Tuscaloosa, AL

### *Advanced Diagnostics and Imaging Systems*

- 1 University of Alabama, Tuscaloosa, AL
  - Model Petroleum Systems to Identify Promising Exploration Sites in the East Gulf Coast Basin
  - Evaluate the Use of an Imaging (FMI) Log to Characterize a Complex Reservoir
  - Study Reservoir Stress, Strain, and Fractures to Improve Oil Recovery

### *Reservoir Life Extension and Management*

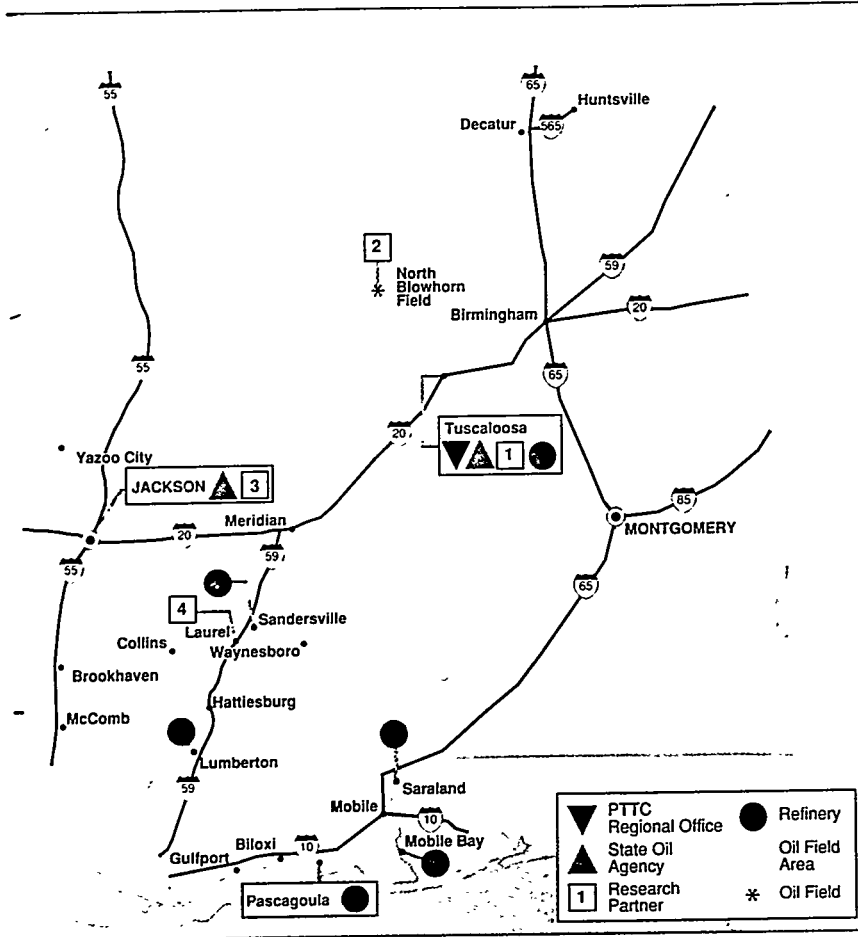
- 3 Hughes Eastern Corporation, Jackson, MS
  - Use Indigenously-Grown Microbes (Organisms) to Increase Oil Recovery
- 2 Hughes Eastern Corporation, North Blowhorn Field, Lamar County, AL
  - Use Indigenously-Grown Microbes (Organisms) to Increase Oil Recovery
- 4 J.R. Pounds, Inc., Laurel, MS
  - Use Downhole Measurement Techniques (Logs) to Identify Leaks in Well Casings
- 1 University of Alabama, Tuscaloosa, AL
  - Optimize Oil Recovery by Applying Reservoir Management Practices



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## Alabama, Mississippi 19



Oil Facts-		AL	MS
State-Wide Rank:	Petroleum Consumption	22nd	24th
	Crude Production	13th	12th
Petroleum Consumption, 1996 (million barrels)		106	87
Crude Production, 1996 (million barrels)		17	20
Number of Producing Wells, 1996		827	1,567
Cum. Total Wells Drilled, through 1996		1,161	7,992
Deepest Producing Well (feet)		18,750	21,533
Proved Crude Reserves, 1995 (million barrels)		43	140
First Year of Production		1944	1889
Number of Refineries		3	4
Petroleum Workforce, 1996 (employees)		21,119	19,881
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)		\$8.8	\$15.8



Kentucky



Tennessee

## National Petroleum Technology Program

★ Oak Ridge National Laboratory, Oak Ridge, TN

### *Reservoir Life Extension and Management*

- 2 Oak Ridge National Laboratory, Oak Ridge, TN
  - Develop an In-Well Oil/Water Separator for In-Situ Recycling of Produced Water
- 3 Sipple Oil Company, Big Sinking Field, Beattyville, KY
  - Field Demonstration of Foam Fracturing to Increase Oil Production

### *Emerging Processing Technology Applications*

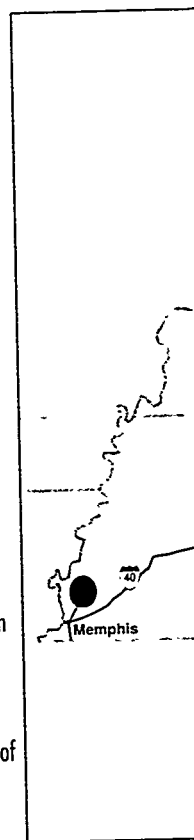
- 2 Oak Ridge National Laboratory, Oak Ridge, TN
  - Use Bioprocessing (Organisms) to Remove Metal Contaminants from Heavy Oils
  - Develop Inorganic Membranes to Produce Hydrogen for Increased Refinery Productivity
  - Bio/Phyto-Remediation Techniques (Microbes/Plants) for Removal of Petroleum in Soil

### *Effective Environmental Protection*

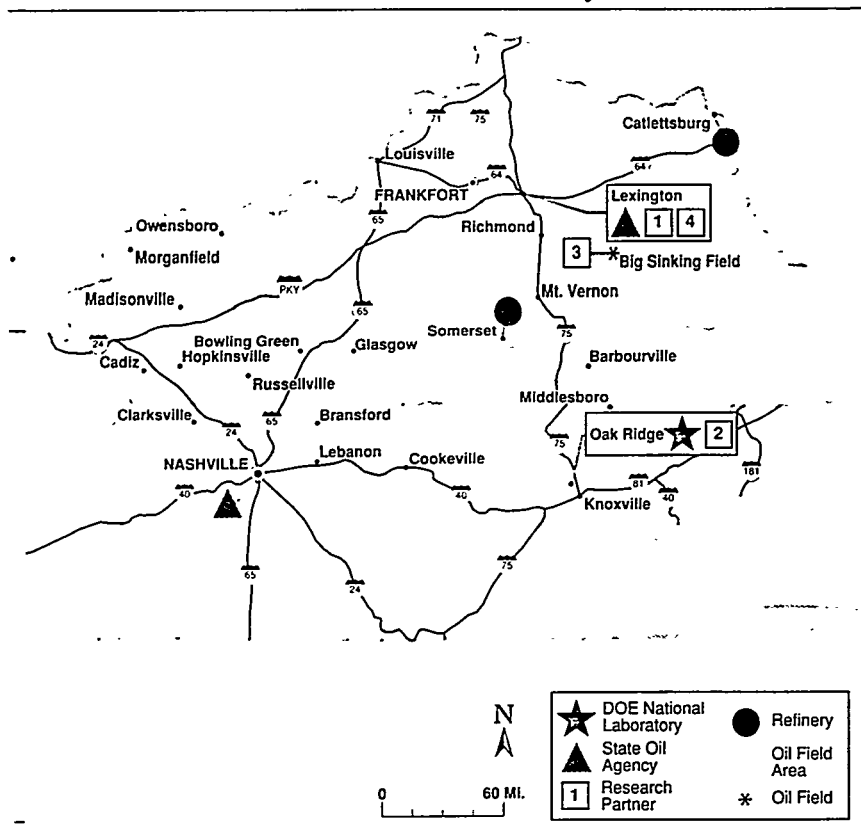
- 1 State of Kentucky, Lexington, KY
  - Create an Environmental Compliance Handbook for Oil Operators in Kentucky

### *Crosscutting Program Areas*

- 4 University of Kentucky, Lexington, KY
  - Compile Data and Study Kentucky Oil Fields to Identify Petroleum Resources



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Oil Facts	KY	TN
State-Wide Rank: Petroleum Consumption	20th	18th
Crude Production	20th	27th
Petroleum Consumption, 1996 (million barrels)	107	120
Crude Production, 1996 (million barrels)	4	0.38
Number of Producing Wells, 1996	23,538	714
Cum. Total Wells Drilled, through 1996	54,652	1,823
Deepest Producing Well (feet)	7,598	10,141
Proved Crude Reserves, 1995 (million barrels)	24	NA
First Year of Production	1860	1860
Number of Refineries	2	1
Petroleum Workforce, 1996 (employees)	23,746	20,280
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$16.8	\$0.3



Indiana



Ohio

## National Petroleum Technology Program

### *Advanced Drilling, Completion, & Stimulation Systems*

- 1 EDCO Producing Company, Mt. Gilead, OH
  - Apply Horizontal Drilling to Recover Bypassed Oil

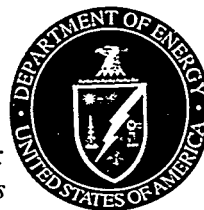
### *Reservoir Life Extension and Management*

- 3 Belden & Blake, North Canton, OH
  - Develop a Comprehensive Reservoir Management Plan for the East Randolph Field (Ohio)
- 4 James Engineering, Inc., Marietta, OH
  - Develop an Automated System to Monitor Oil Well Production
- 5 Belden & Blake, East Randolph Field, OH
  - Develop a Comprehensive Reservoir Management Plan for the East Randolph Field (Ohio)

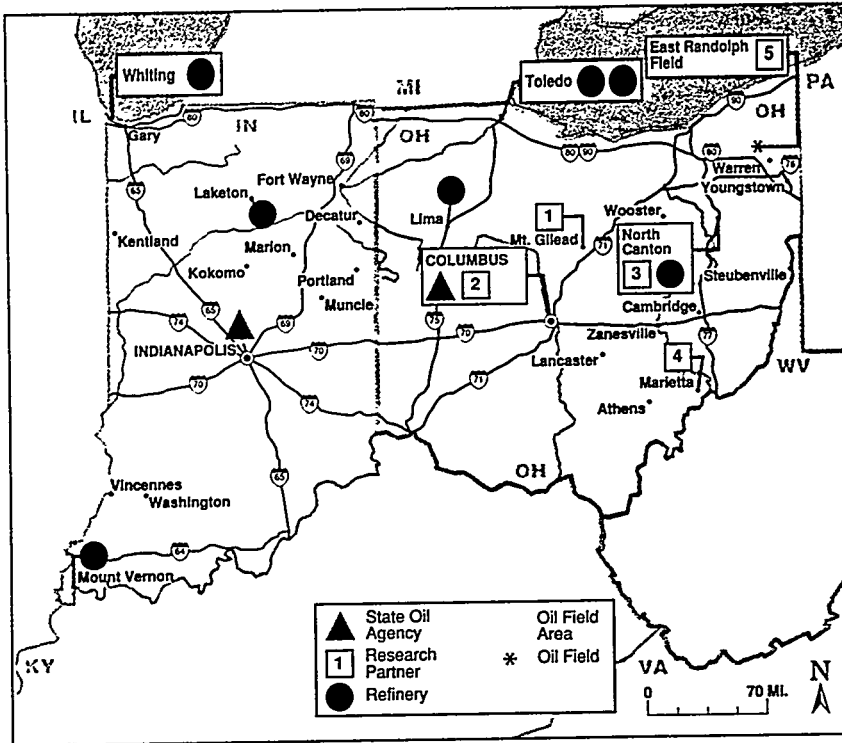
### *Effective Environmental Protection*

- 2 Ohio Department of Natural Resources, Columbus, OH
  - Guidance Manual to Help Ohio Oil & Gas Operators Reduce Their Environmental Compliance Costs

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## Indiana, Ohio 23



Oil Facts	IN	OH
State-Wide Rank: Petroleum Consumption	12th	9th
Crude Production	22nd	18th
Petroleum Consumption, 1996 (million barrels)	161	226
Crude Production, 1996 (million barrels)	3	8
Number of Producing Wells, 1996	5,190	29,622
Cum. Total Wells Drilled, through 1996	38,871	83,161
Deepest Producing Well (feet)	4,508	7,805
Proved Crude Reserves, 1995 (million barrels)	13	53
First Year of Production	1889	1860
Number of Refineries	3	4
Petroleum Workforce, 1996 (employees)	29,642	54,095
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$3.0	\$6.9



Illinois

## National Petroleum Technology Program

★ Argonne National Laboratory, Argonne, IL

▼ PTTC Midwest Office, Champaign, IL

### *Advanced Diagnostics and Imaging Systems*

- 1 Argonne National Laboratory, Argonne, IL
- Quantify Reservoir and Source Rock Distribution to Lower Oil Exploration Risk

### *Reservoir Life Extension and Management*

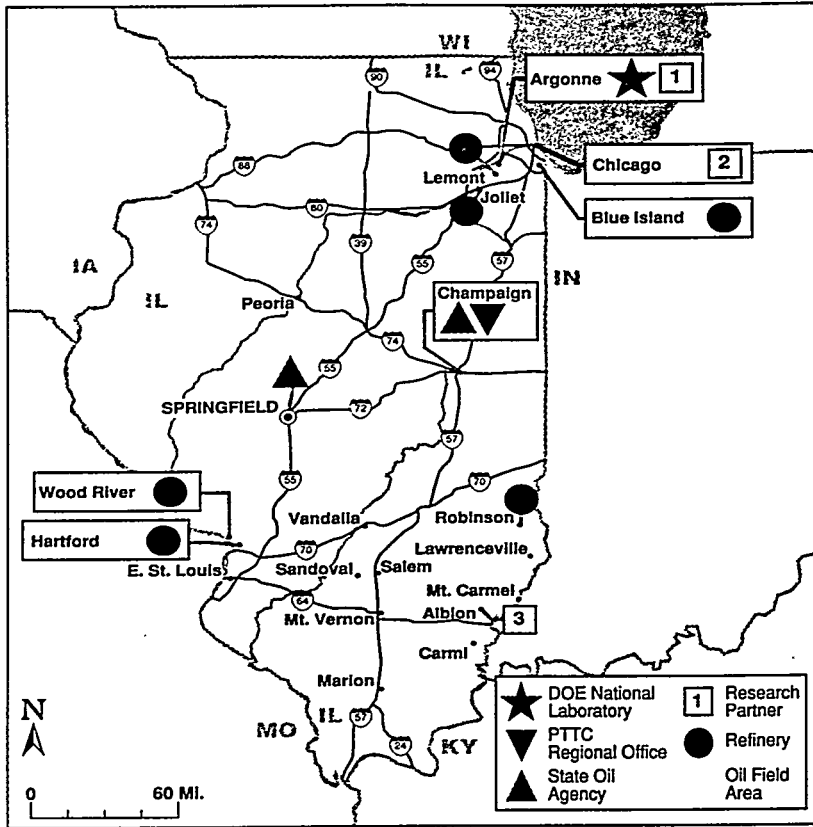
- 1 Argonne National Laboratory, Argonne, IL
- Evaluate the New Technology of Produced Water Injection to Reduce Handling Costs
  - Conduct Basic Modeling Research on Fluid Flow through Porous Rock
- 3 Speir Operating, Albion, IL
- Evaluate Microbial (Organisms) Methods to Remove Precipitates from Oil Wells

### *Emerging Processing Technology Applications*

- 1 Argonne National Laboratory, Argonne, IL
- Develop an On-Line Magnetic Resonance Sensor System to Monitor Heavy Oil Refining
  - Evaluate Methods to Reduce "Fouling" Problems While Processing Heavy Oil and Residue
  - Improve Processes to Upgrade Residual Heavy Oil Remaining after Refinery Distillation
  - Develop a New Fluidized-Bed Method to Upgrade Heavy Oils for Refining
  - Develop Catalytic Processes to Upgrade California Heavy Crude Oil
  - Identify and Remove Corrosion-Producing Acids in Crude Oils
- 2 IIT Research Institute, Chicago, IL
- Automate a Fuel Management System for Stored and Transported Fuels

### *Effective Environmental Protection*

- 1 Argonne National Laboratory, Argonne, IL
- Develop a Prototype Regulatory Approach for Refinery Waste Management
  - Evaluate the Disposal of Naturally Occurring Radioactive Oil Field Wastes into Salt Caverns
  - Analyze the Environmental Risks of Wastewater from Oil Operations
  - Identify Air Regulatory Issues for Oil & Gas Exploration and Production
  - Assess Dosage when Using Landspreading to Dispose of Radioactive Oil Operation Wastes
  - Demonstrate Risk Assessments for the Disposal of Naturally Occurring Radioactive Material



Oil Facts		IL
State-Wide Rank: Petroleum Consumption		7th
Crude Production		15th
Petroleum Consumption, 1996 (million barrels)		235
Crude Production, 1996 (million barrels)		16
Number of Producing Wells, 1996		30,799
Cum. Total Wells Drilled, through 1996		82,096
Deepest Producing Well (feet)		5,405
Proved Crude Reserves, 1995 (million barrels)		119
First Year of Production		1889
Number of Refineries		6
Petroleum Workforce, 1996 (employees)		51,706
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)		\$17.9



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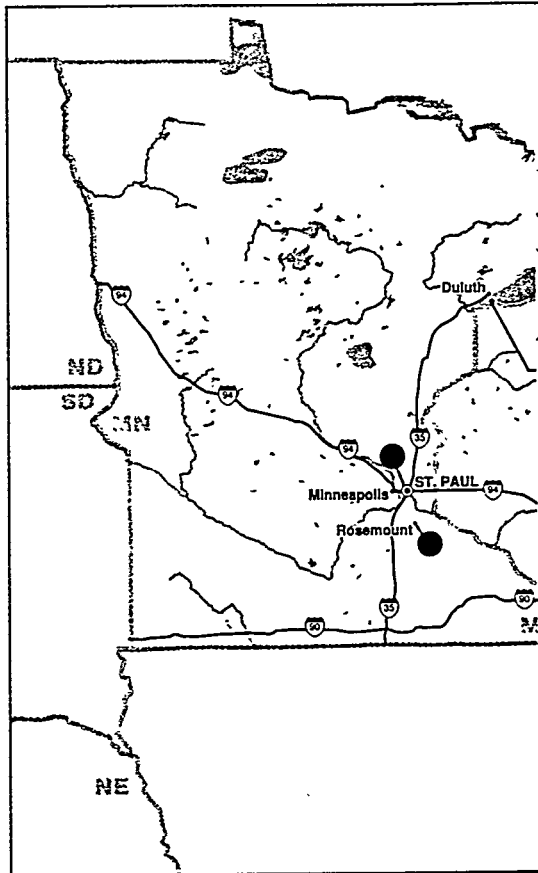
Michigan



Minnesota



Wisconsin



## National Petroleum Technology Program

### *Advanced Diagnostics and Imaging Systems*

- 1 Michigan Technological University, Houghton, MI
  - Demonstrate a Horizontal Well to Recover Bypassed Oil from a Mature Oil Field
- 2 Terra Energy Ltd., Crystal Field, Montcalm County, MI
  - Demonstrate a Horizontal Well to Recover Bypassed Oil from a Mature Oil Field

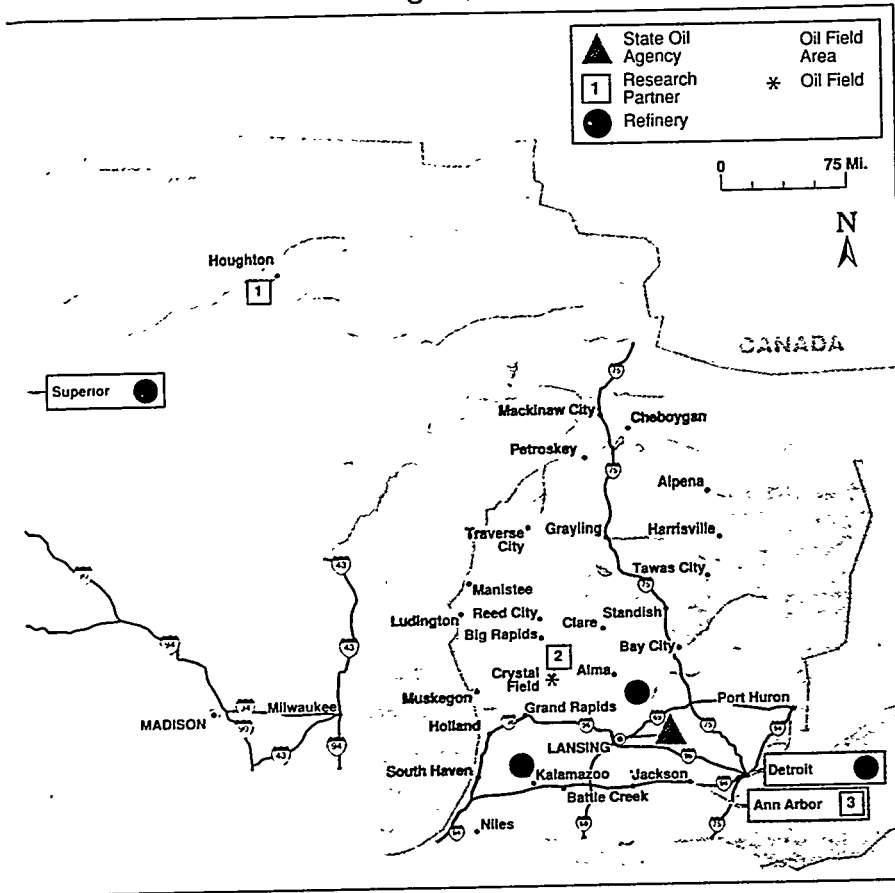
### *Reservoir Life Extension and Management*

- 1 Michigan Technological University, Houghton, MI
  - Develop Low-Cost Computer Graphics Tools for Use by Independent Oil Operators
- 3 University of Michigan, Ann Arbor, MI
  - Design Chemical Treatments to Prevent Wellbore Damage from Paraffin and Asphaltene Deposits

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# Michigan, Minnesota, Wisconsin 27



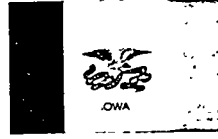
Oil Facts	MI	MN*	WI*
State-Wide Rank: Petroleum Consumption	10th	19th	21st
Crude Production	16th	—	—
Petroleum Consumption, 1996 (million barrels)	189	109	106
Crude Production, 1996 (million barrels)	11	—	—
Number of Producing Wells, 1996	3,746	—	—
Cum. Total Wells Drilled, through 1996	14,531	—	—
Deepest Producing Well (feet)	10,515	—	—
Proved Crude Reserves, 1995 (million barrels)	76	—	—
First Year of Production	1900	—	—
Number of Refineries	3	2	1
Petroleum Workforce, 1996 (employees)	43,000	27,405 <sup>†</sup>	27,828 <sup>†</sup>
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$12.8	—	—

\*Non-producing state

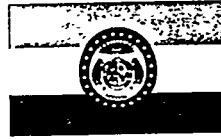
<sup>†</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.



Arkansas



Iowa



Missouri

## National Petroleum Technology Program

### *Effective Environmental Protection*

- 1 University of Missouri-Rolla, Rolla, MO
- Apply an Area of Review (AOR) Variance Methodology to Selected Texas Oil Fields

Oil Facts	AR	IA*	MO
State-Wide Rank: Petroleum Consumption	33rd	32nd	17th
Crude Production	17th	—	29th
Petroleum Consumption, 1996 (million barrels)	58	68	130
Crude Production, 1996 (million barrels)	9	—	0.12
Number of Producing Wells, 1996	7,871	—	394
Cum. Total Wells Drilled, through 1996	18,067	—	721
Deepest Producing Well (feet)	11,804	—	3,680
Proved Crude Reserves, 1995 (million barrels)	48	—	NA
First Year of Production	1921	—	1889
Number of Refineries	3	—	0
Petroleum Workforce, 1996 (employees)	14,677	19,287 <sup>†</sup>	31,240
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$9.2	—	\$0.1

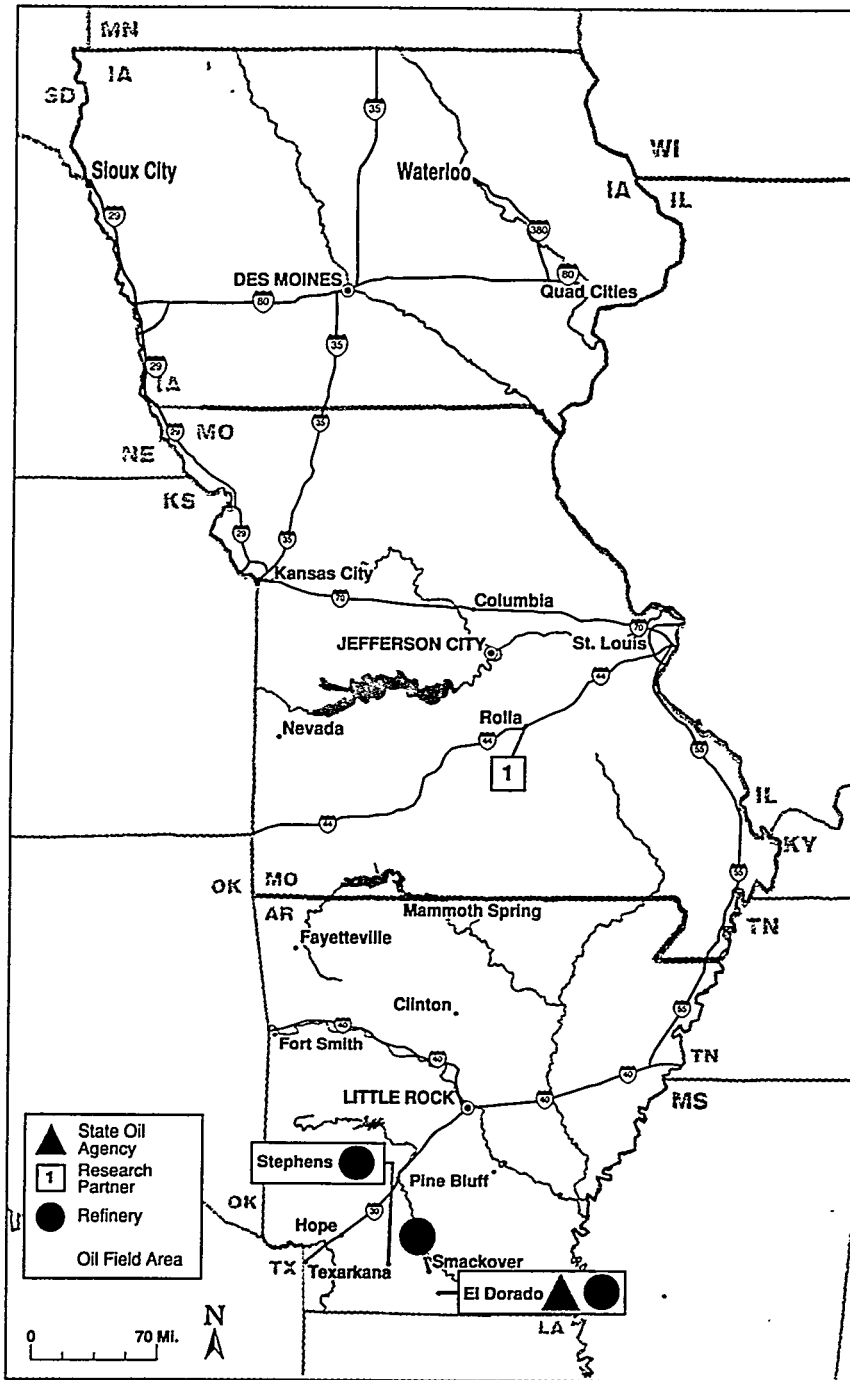
\* Non-producing state

<sup>†</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.

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# Arkansas, Iowa, Missouri 29





Louisiana

### National Petroleum Technology Program

- ☆ Strategic Petroleum Reserve - West Hackberry, Cameron Parish, LA
- ☆ Strategic Petroleum Reserve - Bayou Choctaw, Iberville Parish, LA
- ☆ Strategic Petroleum Reserve - Weeks Island, Iberville Parish, LA
- ▼ PTTC Central Gulf Office, Baton Rouge, LA

#### *Advanced Diagnostics and Imaging Systems*

- 10 Columbia University, Eugene Island Block 330, Federal Offshore, LA
  - Test the Concept that Faults in the Gulf of Mexico Provide Pathways for Migrating Oil

#### *Reservoir Life Extension and Management*

- 5 Amoco Production Company, West Hackberry Field, Cameron Parish, LA
  - Field Demonstration of an Enhanced Oil Recovery Air Injection Process
- 6 Louisiana State University, Baton Rouge, LA
  - Estimate Potential Reserves of Bypassed Oil in the Gulf of Mexico
  - Conduct Studies to Improve Recovery from Gulf of Mexico Reservoirs
- 7 Tenison Oil Co., Claiborne Parish, LA
  - Physical Studies to Remove Calcium Carbonate Buildup in Wellbores
- 8 Texaco Exploration and Production, Inc., New Orleans, LA
  - Horizontal Wells and Gas (CO<sub>2</sub>) Injection to Improve Oil Recovery in Salt Dome Reservoirs

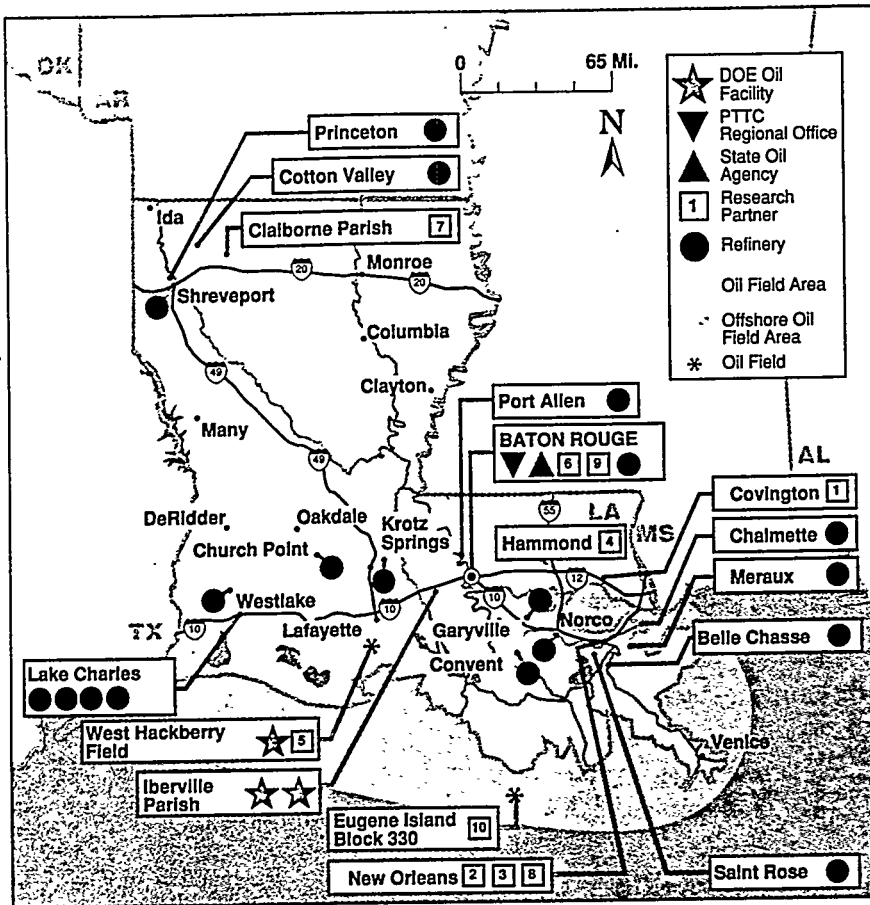
#### *Effective Environmental Protection*

- 1 Engineering Specialties, Inc., Covington, LA
  - Test a New Method for Treating Waste from Offshore Oil & Gas Operations
- 2 MVP Production, Inc., New Orleans, LA
  - Test More Cost-Effective Methods for Water Disposal in Low-Pressure Gas Reservoirs
- 3 Taylor Energy Co., New Orleans, LA
  - Safety & Environmental Management Program for Independent Operators in the Gulf of Mexico
- 4 Wetlands Restoration Laboratory, Hammond, LA
  - Use Indigenous Vegetation to Restore Wetlands Surrounding Oil Wells

#### *Crosscutting Program Areas*

- 9 Southern A&M University, Baton Rouge, LA
  - Computer Model to Predict Naturally Occurring Radioactive Material (NORM) Before Drilling

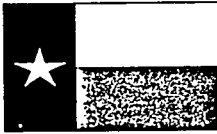
# Louisiana 31



Oil Facts		LA
State-Wide Rank: Petroleum Consumption		4th
Crude Production		4th
Petroleum Consumption, 1996 (million barrels)		303
Crude Production, 1996 (million barrels)		132
Number of Producing Wells, 1996		24,402
Cum. Total Wells Drilled, through 1996		87,295
Deepest Producing Well (feet)		22,856
Proved Crude Reserves, 1995 (million barrels)		637
First Year of Production		1902
Number of Refineries		19
Petroleum Workforce, 1996 (employees)		78,694
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)		\$232.3



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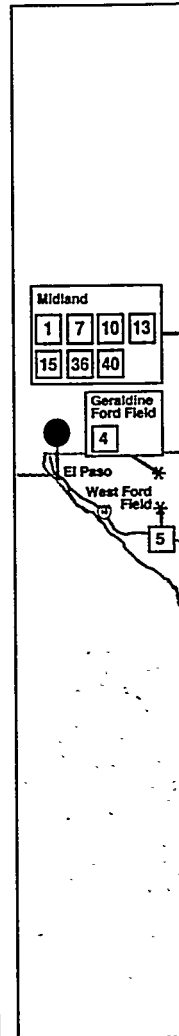
Texas

## National Petroleum Technology Program

- ★ Strategic Petroleum Reserve - Big Hill, Winnie, TX
- ★ Strategic Petroleum Reserve - Bryan Mound, Freeport, TX
- ▼ PTTC Texas Office, Austin, TX

### Advanced Diagnostics and Imaging Systems

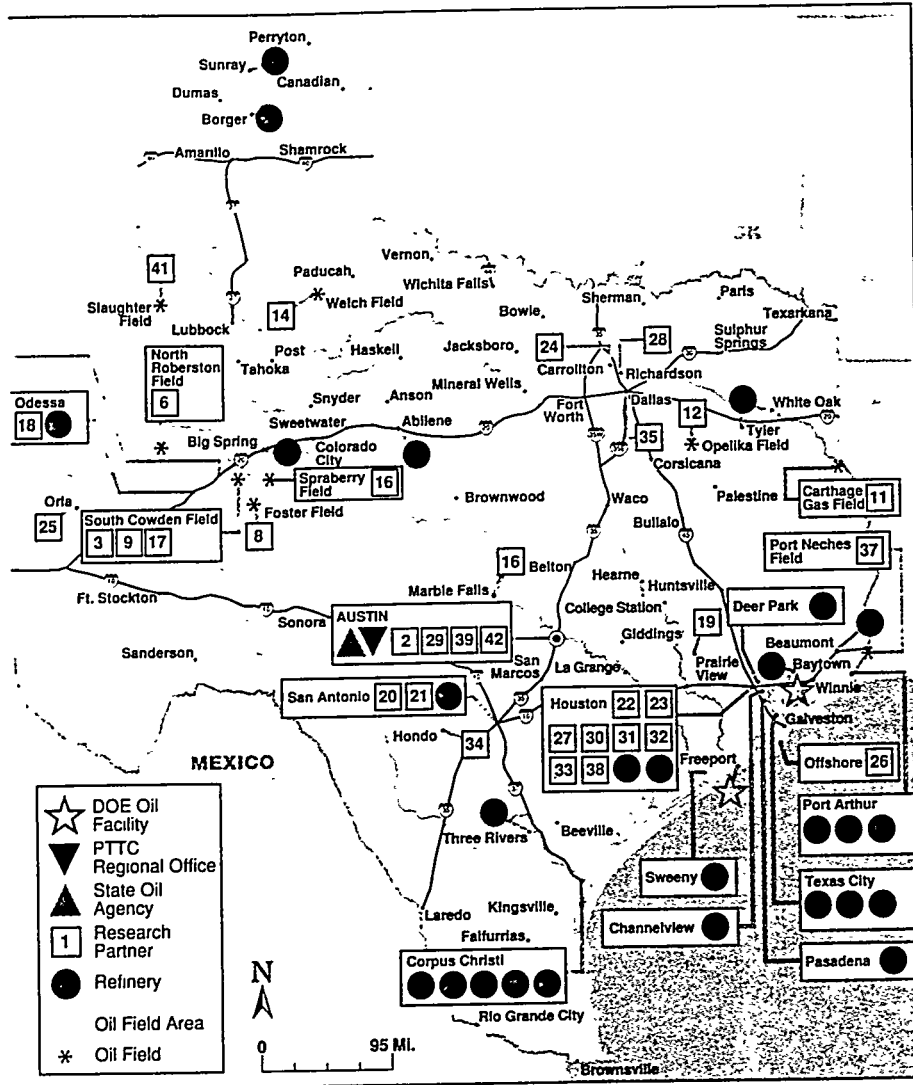
- 1 Brothers Production, Midland, TX
  - Apply and Test a New Seismic Processing and Interpretation Computer Algorithm
- 2 Bureau of Economic Geology, University of Texas at Austin, Austin, TX
  - Develop Cost-Effective Methods to Accurately Describe Reservoir Properties
  - Reservoir Characterization Techniques to Strategically Place Wells to Recover More Oil
- 3 Bureau of Economic Geology, University of Texas at Austin, Ector County, South Cowden Field, TX
  - Develop Cost-Effective Methods to Accurately Describe Reservoir Properties
- 4 Bureau of Economic Geology, University of Texas at Austin, Geraldine Ford Field, TX
  - Reservoir Characterization Techniques to Strategically Place Wells to Recover More Oil
- 5 Bureau of Economic Geology, University of Texas at Austin, West Ford Field, TX
  - Reservoir Characterization Techniques to Strategically Place Wells to Recover More Oil
- 6 Fina, USA, Gaines County, North Robertson Field, TX
  - Reservoir Characterization to Optimize Placement of New Wells in Mature Oil Reservoirs
- 7 Fina, USA, Midland, TX
  - Reservoir Characterization to Optimize Placement of New Wells in Mature Oil Reservoirs



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Oil Facts		TX
State-Wide Rank: Petroleum Consumption		1st
Crude Production		1st
Petroleum Consumption, 1996 (million barrels)		1016
Crude Production, 1996 (million barrels)		543
Number of Producing Wells, 1996		175,532
Cum. Total Wells Drilled, through 1996		530,907
Deepest Producing Well (feet)		18,008
Proved Crude Reserves, 1995 (million barrels)		5,743
First Year of Production		1889
Number of Refineries		28
Petroleum Workforce, 1996 (employees)		253,053
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)		\$445.3

*Advanced Diagnostics and Imaging Systems*

- 8 Laguna Petroleum Corporation, Ector County, Foster Field, TX
  - Integrate 3-D Seismic, Engineering, and Geologic Data to Optimize Well Placement
- 9 Laguna Petroleum Corporation, Ector County, South Cowden Field, TX
  - Integrate 3-D Seismic, Engineering, and Geologic Data to Optimize Well Placement
- 10 Laguna Petroleum Corporation, Midland, TX
  - Integrate 3-D Seismic, Engineering, and Geologic Data to Optimize Well Placement
- 11 Los Alamos National Laboratory, Carthage Gas Field, TX
  - Induce Microearthquakes to Map Natural Fractures and Fluid Flow in Oil Reservoirs
- 12 Los Alamos National Laboratory, Opelika Field, TX
  - Induce Microearthquakes to Map Natural Fractures and Fluid Flow in Oil Reservoirs
- 13 OXY USA Inc., Midland, TX
  - Gas (CO<sub>2</sub>) Injection to Improve the Economics of Oil Recovery in Carbonate Reservoirs
- 14 OXY USA Inc., West Welch Unit, TX
  - Gas (CO<sub>2</sub>) Injection to Improve the Economics of Oil Recovery in Carbonate Reservoirs
- 15 Parker & Parsley Development Company, Midland, TX
  - Evaluate a Gas (CO<sub>2</sub>) Gravity Drainage Process in a Naturally Fractured Reservoir
- 16 Parker & Parsley Development Company, Spraberry Field, TX
  - Evaluate a Gas (CO<sub>2</sub>) Gravity Drainage Process in a Naturally Fractured Reservoir
- 17 Phillips Petroleum Company, Ector County, South Cowden Field, TX
  - Horizontal Gas (CO<sub>2</sub>) Injection Wells to Improve Oil Recovery from a Mature Field
- 18 Phillips Petroleum Company, Odessa, TX
  - Horizontal Gas (CO<sub>2</sub>) Injection Wells to Improve Oil Recovery from a Mature Field
- 19 Prairie View A&M University, Prairie View, TX
  - Experiments and Theoretical Modeling to Understand Fluid Flow in Fractured Reservoirs
- 20 Sandia Operating Corporation, San Antonio, TX
  - Calibrations to Account for Fresh Water Influence in Well Log Data
- 21 Southwest Research Institute, San Antonio, TX
  - Acoustic and 3-D Seismic Technology to Characterize Fractured Oil Reservoirs
- 22 Tomoseis, Incorporated, Houston, TX
  - Use Subsurface Seismic Surveys to Describe Geologic Properties between Wells
- 2 Bureau of Economic Geology, University of Texas at Austin, Austin, TX
  - Study Microscopic Geological Features to Quantify Oil Reservoir Fracture Properties

*Advanced Drilling, Completion, & Stimulation Systems*

- 23 Sandia National Laboratories, Houston, TX
  - Synthetic Diamond Drill Bit Technology to Reduce the Cost of Drilling in Hard Formations

*Reservoir Life Extension and Management*

- 31 Amoco Production Company, Houston, TX
  - Field Demonstration of an Enhanced Oil Recovery Air Injection Process
- 32 BP Exploration, Inc., Houston, TX
  - Identify Optimal Techniques for Recovering Heavy Oil from Prudhoe Bay (Alaska)
  - Determine the Best Methods to Recover Heavy Oil at Milne Point Schrader Bluff (Alaska)
- 2 Bureau of Economic Geology, University of Texas at Austin, Austin, TX
  - Determine Strategies to Find and Produce Unrecovered Oil in Mature Sandstone Reservoirs
- 33 Dowell Schlumberger, Inc., Houston, TX
  - Develop a Fluid Flow Simulator to Improve Gel Polymer Placement
- 34 Klaeger Operating, Inc., Hondo, TX
  - Natural Gas Injection (Repressurization) to Stimulate Oil Production from Mature Reservoirs
- 19 Prairie View A&M University, Prairie View, TX
  - Develop New Low-Cost Surfactants and Biopolymers to Move Oil to Producing Wellbores
- 35 Tenison Oil Co., Dallas, TX
  - Physical Techniques to Remove Calcium Carbonate Build-Up in Wellbores
- 36 Texaco Exploration and Production, Inc., Midland, TX
  - Gas (CO<sub>2</sub>) Injection Techniques to Improve Light Oil Production in Mature Reservoirs
- 41 Texaco Exploration and Production, Inc., Cochran County, Slaughter Field, TX
  - Gas (CO<sub>2</sub>) Injection Techniques to Improve Light Oil Production in Mature Reservoirs
- 37 Texaco Exploration and Production, Inc., Orange County, Port Neches Field, TX
  - Horizontal Wells and Gas (CO<sub>2</sub>) Injection to Improve Oil Recovery in Salt Dome Reservoirs
- 38 University of Houston, Houston, TX
  - Identify Opportunities to Use Composite Materials in Petroleum Operations
- 42 University of Texas at Austin, Austin, TX
  - Develop a Cost-Effective Surfactant-Flooding Process to Increase Oil Recovery

*Emerging Processing Technology Applications*

- 30 M.W. Kellogg Company, Houston, TX
  - Research on Conversions of Refinery By-Products to Increase Refinery Yields of High Value Fuels

*Effective Environmental Protection*

- 24 BPF, Inc., Carrollton, TX
  - Develop the Treatment and Underground Disposal of Naturally Occurring Radioactive Materials
- 25 BPF, Inc., Orla, TX
  - Develop the Treatment and Underground Disposal of Naturally Occurring Radioactive Materials
- 2 Bureau of Economic Geology, University of Texas at Austin, Austin, TX
  - Study the Use of Salt Caverns for the Disposal of Non-Hazardous Wastes from Oil Operations
- 26 Continental Shelf Associates, Inc., Offshore, TX
  - Environmental and Economic Impact of Water/Sand Discharges in Gulf of Mexico Oil Operations
- 27 Greenhill Petroleum Corp., Houston, TX
  - Field Test a Wetland Restoration Technology Using Drilling Waste
- 28 Society of Petroleum Engineers, Richardson, TX
  - Environmental Conference on Oil & Gas Exploration and Production
- 29 Texas Railroad Commission, Austin, TX
  - Environmental Handbooks for Oil Exploration, Production, and Transportation in Texas
- 2 Bureau of Economic Geology, University of Texas at Austin, Austin, TX
  - Generate Detailed Maps of Salt Caverns for Storage and Waste Disposal

*Crosscutting Program Areas*

- 39 U.S. Minerals Management Service, Austin, TX
  - Develop an Atlas of Offshore Oil Reservoir Data for the Gulf of Mexico
  - Maintain a Technology Resource Center for Independent Oil Producers in Texas
- 19 Prairie View A&M University, Prairie View, TX
  - Design a New Surfactant/Polymer Combination for Improved Oil Recovery
- 38 University of Houston, Houston, TX
  - Workshop to Improve the Manufacture of Composite Materials Used in Oil Operations
- 2 Bureau of Economic Geology, University of Texas at Austin, Austin, TX
  - Maintain a Well Core Sample Library to Help Develop Existing Fields and Find New Reservoirs
- 40 University of Texas at Austin, Midland, TX
  - Maintain a Well Core Sample Library to Help Develop Existing Fields and Find New Reservoirs

## *Information Sources for the Oil Atlas*

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### **"1996 Merchandise Trade Deficit" (p. 4)**

U.S. Department of Energy, Energy Information Agency, EIA Monthly Energy Review (Internet), July 1997, Table 1.6.

### **"Impact of Technology" (p. 4)**

U.S. Department of Energy's National Petroleum Technology Office, Total Oil Resource Information System (TORIS), "Technology Price Assessment Output of the TORIS Database for the IOGCC," 1993.

### **"Federal Lands Generated \$12.3 Billion in Oil Royalties" (p. 6)**

U.S. Department of the Interior, Minerals Management Service, "Mineral Revenues 1995," pp. 15, 27, 28.

### **"PTTC's Ten Regions" (p. 7)**

Petroleum Technology Transfer Council, 1997.

### **State Flags (pp. 8-60)**

GallerY2 for PC/Windows, Corel Corporation, 1995 Vol. 1, Version 2.0.

### **Oil Facts (pp. 8-61)**

Independent Petroleum Association of America, The Oil & Gas Producing Industry in Your State, November 1997, pp. 22-90.

U.S. Department of Energy, Energy Information Agency, U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves: Annual Report 1995, November 1996, p. 20.

### **State Maps- Boundaries and Features (pp. 9-61)**

MapArt™ is a trademark of Cartesia Software (formerly MicroMaps Software), 1994.

### **State Maps- State Oil Regulatory Agencies (pp. 11-59)**

American Oil & Gas Reporter, "The American Directory of State Regulatory Agencies," March 1997, pp. 143-152.

### **State Maps- U.S. Oil Refineries (pp. 11-61)**

PennWell Publications, Oil & Gas Journal Data Book 1996, (pp. 229-237).

PennWell Publications, Oil & Gas Journal, March 10, 1997, (p. 23).

### **State Maps- PTTC National/Regional Offices (pp. 13-55)**

Petroleum Technology Transfer Council, 1997.

### **"What a Barrel of Crude Oil Makes" -back inside cover**

American Petroleum Institute, 1995.

### **All Other Information**

U.S. Department of Energy, National Petroleum Technology Office.



Oklahoma

### National Petroleum Technology Program

☆ National Petroleum Technology Office, Tulsa, OK

▼ PTTC South Midcontinent Office, Norman, OK

#### *Advanced Diagnostics and Imaging Systems*

1 BDM-Oklahoma, Inc., Bartlesville, OK

- Develop an Information System to Catalog Mineral Resources on Native American Lands
- Research New Methods to Characterize and Model Petroleum Reservoirs
- Oil Reservoir Imaging, Characterization, and Flow Process Simulation Projects
- Mathematical Correlations to Estimate Fluid Flow Characteristics from Reservoir Rock
- Develop New Imaging Techniques to Study Oil Recovery Processes
- Develop New Methods to Characterize Fractured Oil Reservoirs
- Develop Techniques to Better Predict Oil Production from Fractured Reservoirs
- Conduct an International Conference to Present New Reservoir Characterization Techniques
- Develop New Measurement Tools for Reservoir Characterization
- Research Advanced Technologies for Reservoir Modeling and Simulation
- Computer Models to Improve Gas Injection Technology for Fractured Reservoirs
- Investigate Advanced Technologies to Access Undiscovered Hydrocarbons
- Evaluate Risk-Based Analysis Techniques for Petroleum Exploration and Drilling
- Analyze Geological Formations to Identify Potential Domestic Oil Reserves
- 3-Dimensional Seismic Data Acquisition for Shallow Reservoirs
- Reduce Oil Exploration Risk and Develop Improved Drilling Tools and Methods

3 DLB Oil & Gas Co., Oklahoma City, OK

- Conduct a Shallow Seismic Survey in Osage County, OK

2 Double-Eagle Enterprises, Tulsa, OK

- 3-D Seismic and Surface Microbial (Organisms) Techniques for Oil Exploration in Oklahoma

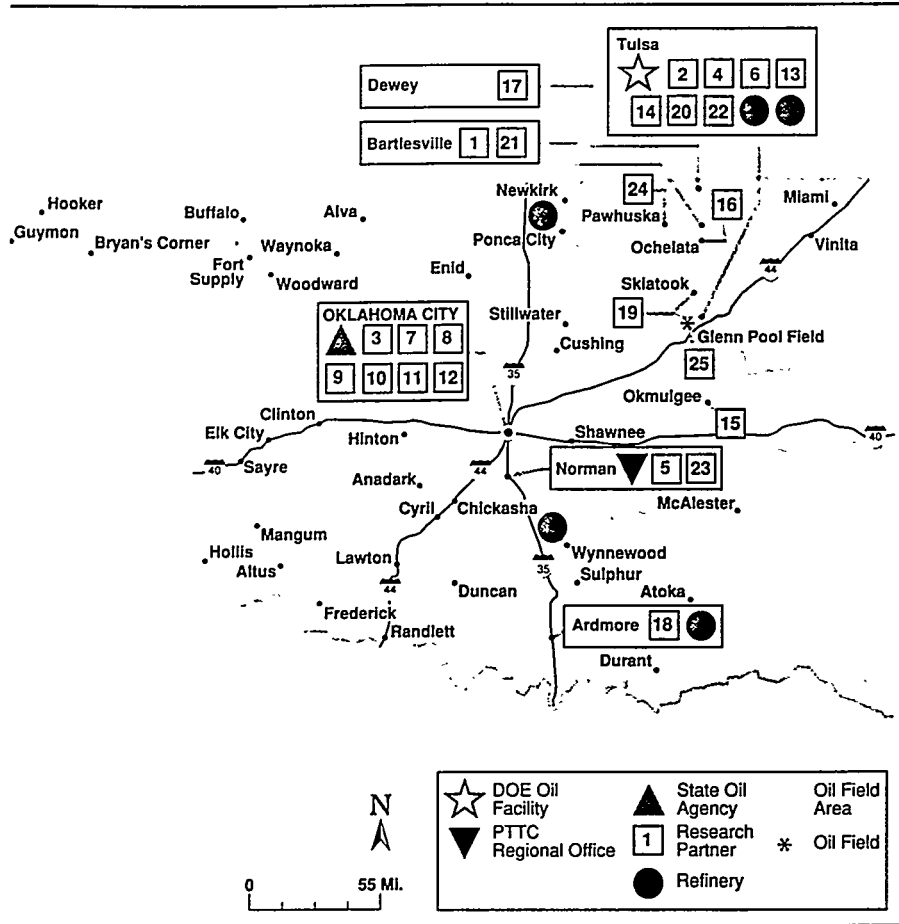


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Boise City



Oil Facts		OK
State-Wide Rank: Petroleum Consumption		23rd
Crude Production		5th
Petroleum Consumption, 1996 (million barrels)		91
Crude Production, 1996 (million barrels)		85
Number of Producing Wells, 1996		90,557
Cum. Total Wells Drilled, through 1996		239,222
Deepest Producing Well (feet)		22,850
Proved Crude Reserves, 1995 (million barrels)		676
First Year of Production		1891
Number of Refineries		5
Petroleum Workforce, 1996 (employees)		53,347
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)		\$84.8

### *Advanced Diagnostics and Imaging Systems*

- 4 Keener Oil and Gas Co., Tulsa, OK
  - Apply Electromagnetic Techniques (Tellurics) to Oil & Gas Exploration
- 5 University of Oklahoma, Norman, OK
  - Develop Advanced Reservoir Characterization Techniques Using Outcrop Data
- 6 University of Tulsa, Tulsa, OK
  - Analyze Crude Oils from Black Mesa, AZ to Determine Time/Temperature of Their Formation
  - Develop Statistical Tools for the Numerical Simulation of Oil Reservoirs
  - Develop Numerical Models for Integration of Seismic and Reservoir Data
  - Develop Models to Predict Relative Permeability from Capillary Pressure Measurements
  - Develop an Expanded, Faster Procedure to Estimate Reservoir Permeability and Porosity
  - Determine the Potential for the Existence of Petroleum in a Mid-Continent Basin
  - Design and Apply Artificial Intelligence Systems to Improve Reservoir Characterization

### *Advanced Drilling, Completion, & Stimulation Systems*

- 7 BDM-Oklahoma, Inc., Bartlesville, OK
  - Continue Development of Promising New Drilling Technologies
- 7 K-Stewart Petroleum Company, Oklahoma City, OK
  - Identify Stimulation Techniques to Increase Oil Production
- 6 University of Tulsa, Tulsa, OK
  - Determine Methods to Minimize Corrosion and Erosion of Oil Field Operations Equipment
  - Investigate Reservoir Damage Caused by Drilling Processes
  - Design and Develop a Model and a Fluid Flow Simulator to Study Oil & Gas Production Systems
  - Design a Research Facility to Evaluate Oil Production Equipment and Systems
  - Develop Models for Drilling Systems Using Advanced Coiled Tubing

### *Reservoir Life Extension and Management*

- 1 BDM-Oklahoma, Inc., Bartlesville, OK
  - Develop Alkaline Flooding Technologies to Improve Oil Recovery
  - Develop New Chemical Processes to Produce Residual Oil
  - Develop Methods to Control, Treat, and Prevent Damage to Reservoir Rock
  - Design and Apply Engineering Methodologies for a Microbial (Organisms) Recovery Process
  - Research to Develop Foams to Improve Oil Recovery from Gas Flooding
  - Field Demonstration of Microbial (Organisms) Methods to Improve Oil Recovery in Single Wells

- Field Test an Alkaline/Surfactant Chemical Process to Enhance Oil Recovery
  - Field Demonstration Using Natural Gas to Repressurize Oil Reservoirs
  - Develop Economical Chemical Processes for Improved Oil Recovery
  - Develop In-Situ Biological Systems to Increase the Efficiency of Heavy Oil Recovery
  - Projects on Chemical, Microbial (Organisms), and Gas Injection Production Processes
  - Develop Processes to Recover Heavy Oil from Prudhoe Bay (Alaska)
  - Research the Use of Thermal Processes to Increase Light Oil Production
  - Research the Use of Thermal Processes to Increase Heavy Oil Production
  - Develop and Update Computer Tools to Assess Domestic Heavy Oil Recovery
  - Develop Standardized Methods for Characterizing Heavy Oil
  - Develop Environmentally-Sound Technology to Produce Heavy Oil in Alaska
  - Determine the Best Methods to Recover Heavy Oil at Milne Point Schrader Bluff (Alaska)
  - Thermal Production, Resource Identification, and Reservoir Characterization Projects
  - Apply Reservoir Management Practices in Cost-Shared Field Projects to Maximize Cost-Effective Oil Production
- 13 Belpport Oil, Inc., Tulsa, OK
- Apply the Injection of Produced Gas to Improve Oil Recovery
- 14 Dowell Schlumberger, Inc., Tulsa, OK
- Develop a Fluid Flow Simulator to Improve Gel Polymer Placement
- 15 Driver Production, Okmulgee, OK
- Field Demonstration of Reinjection of Natural Gas to Increase Oil Production
- 16 Geo-Microbial Technologies, Inc., Ochelata, OK
- Conduct a Field Test of a Microbial (Organisms) Treatment to Remove Deposits from a Wellbore
- 17 Grace Petroleum, Dewey, OK
- Use Cross-Linked Polymers to Improve Oil Recovery and Reduce Wastewater
- 18 Harry A. Spring, Ardmore, OK
- Test a New Method to Dispose of Wastewater Created While Producing Gas
- 19 Kenneth Y. Park, Skiatook, OK
- Apply Gel Polymer to Reduce Water Production in Oil Wells
- 20 Pan Western Energy Corp., Tulsa, OK
- Use Horizontal Wells to Intersect Natural Reservoir Fractures and Improve Production
- 21 Phillips Petroleum Company, Bartlesville, OK
- Develop Microbial Systems (Organisms) to Improve Oil Production
- 5 University of Oklahoma, Norman, OK
- Identify Commercially Successful Oil Recovery Technologies for Use in Oklahoma Reservoirs
- 6 University of Tulsa, Tulsa, OK
- Develop a Model to Predict Paraffin Deposits in Oil & Gas Production Systems
  - Basic Research on the Presence of Solids in Equilibrium with Fluids
  - Develop a Model Relating Paraffin Deposits in Oil & Gas Production Systems

### *Reservoir Life Extension and Management*

- 25 University of Tulsa, Glenn Pool Field, Tulsa County, OK
- Integrated Study to Improve Secondary Recovery Performance at Glenn Pool Field (Oklahoma)

### *Emerging Processing Technology Applications*

- 1 BDM-Oklahoma, Inc., Bartlesville, OK
- Conduct Research to Accurately Measure the Molecular Properties of Heavy Oil
  - Develop Methods to Analyze Heavy Crude Oils to Optimize Refining Processes
  - Develop a Public On-Line Database of Crude Oil Chemical Properties
  - Evaluate a High-Temperature Rapid Reactor to Process West Coast Heavy Crude Oil
  - Develop Economical, Environmentally-Sound Technologies to Produce Light Fuels
  - Research New Additives to Reduce Coke Formation During Heavy Oil Refining
  - Research on Hydrocarbon Chemistry, Refinery Processes, and Fuels/Products

### *Effective Environmental Protection*

- 1 BDM-Oklahoma, Inc., Bartlesville, OK
- Safety & Environmental Management Plans for Small Offshore Operators (Continental Shelf)
  - Develop Programs to Streamline State, Tribal, and Federal Oil Production Regulations
  - Identify Low-Cost Water Treatment Technologies for Offshore Oil & Gas Operations
  - Develop an Area of Review (AOR) Strategy for Oil Producing Properties in Oklahoma
  - Environmental Research to Streamline Oil Production Compliance and Regulation
  - Provide Technical Support to the Nevada Field Office for Nuclear Weapons Complex Clean-Up
- 8 Ground Water Protection Council, Oklahoma City, OK
- Develop an Interface for Waste Injection Well Database Systems
  - Identify the Most Cost-Effective Underground Injection Practices
- 9 Interstate Oil & Gas Compact Commission, Oklahoma City, OK
- Expand the Toxic Release Inventory (TRI) Program to Include the Exploration/Production Industry
  - Develop an International Environmental Technology Transfer Program
  - Promote Cooperation to Address Environmental Constraints in Oil & Gas Production
  - Design a Computer System for On-Line Access to State Regulatory Information and Permits
  - Streamline Federal Land Regulations for Oil & Gas Exploration and Production
- 10 Oklahoma Corporation Commission, Oklahoma City, OK
- Develop a Data Management System for Area of Review (AOR) Variance Analyses in Oklahoma
- 11 Oklahoma Energy Resources Board, Oklahoma City, OK
- Outreach Program to Increase Public Awareness About Oil Field Safety
  - Conduct Environmental Assessments and Remediate Abandoned Oil Wells in Oklahoma
- 12 Underground Injection Practices Research Foundation, Inc., Oklahoma City, OK
- Develop Risk Management Practices for Water Injection During Oil Production

- 6 University of Tulsa, Tulsa, OK
- Determine the Effect of Brine Contamination on Water Quality in the Tallgrass Prairie Preserve

### *Crosscutting Program Areas*

- 1 BDM-Oklahoma, Inc., Bartlesville, OK
- Field Demonstration Program Performance Monitoring - Classes I - III
  - Advance Promising Technologies Identified in NPTO's Field Demonstration Programs
  - Training for Native American Tribes to Manage Their Petroleum Resources
  - Transfer New Technologies to Help Independent Operators Increase Their Oil Production
  - Integrate Oil & Gas Analytical Models to Improve DOE Policy-Making
  - Analyze Crude Oils in the U.S. Strategic Petroleum Reserve
  - Implement a National Petroleum Technology Transfer Program
  - Earth Science Teacher Training and Curriculum Enrichment Related to Oil & Gas
  - College Student Summer Internship Program at DOE Petroleum Labs and Facilities
  - Provide National Oil Program Information at Technical Conferences
  - Technical Materials to Transfer DOE Research Project Results to Domestic Producers
  - Transfer Results from DOE Field Demonstration Projects to Domestic Oil Producers
  - Help Establish an American/Russian Oil & Gas Technology Center in Russia
  - Technical Support to U.S. Companies in the International Petroleum Business
  - Analyses to Expand the U.S. Petroleum Industry's Global Market Share
  - Provide Summer Internships to Science Students from Historically Black Colleges
  - Maintain and Operate the Total Oil Recovery Information System (TORIS)
  - Technical Support for DOE Research Program's Planning & Development
  - NPTO Program Support Including Project Monitoring, Computer Networks, and Finance
  - Technology Transfer Activities Including Education, Conferences, and International Programs
  - Monitor and Evaluate the Performance of DOE's Class Field Demonstration Program
  - Database Systems Management for the National Petroleum Technology Program
  - Reduce Environmental, Health & Safety Hazards at DOE's NIPER Facility
- 22 Dauben International, Tulsa, OK
- Provide Technical Support Services for the DOE Oil Program
- 9 Interstate Oil & Gas Compact Commission, Oklahoma City, , OK
- Evaluate the Effects of State Incentive Programs on the U.S. Petroleum Industry
- 23 Oklahoma Geological Survey, Norman, OK
- Maintain a Natural Resource Information System (NRIS) for the State of Oklahoma
  - Tailor DOE Petroleum Research for Use by Independent Oil Producers
- 24 Osage Tribal Council, Pawhuska, OK
- Technical Support for Petroleum Resource Development on Native Tribal Lands
- 6 University of Tulsa, Tulsa, OK
- Implement an Oil and Gas Technology Center in the Russian Federation



Kansas



Nebraska

### National Petroleum Technology Program

#### ▼ PTTC North Midcontinent Office, Lawrence, KS

#### *Advanced Diagnostics and Imaging Systems*

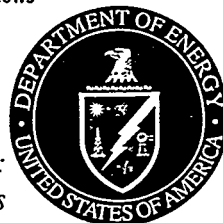
- 1 University of Kansas, Lawrence, KS
  - Reservoir Characterization, Petroleum Engineering Methods to Increase Reserves
- 2 University of Kansas, Schaben Field, KS
  - Reservoir Characterization, Petroleum Engineering Methods to Increase Reserves
- 3 University of Kansas Center for Research, Inc., Lawrence, KS
  - Develop a Spreadsheet-Based Software Package for Well Log Analysis

#### *Reservoir Life Extension and Management*

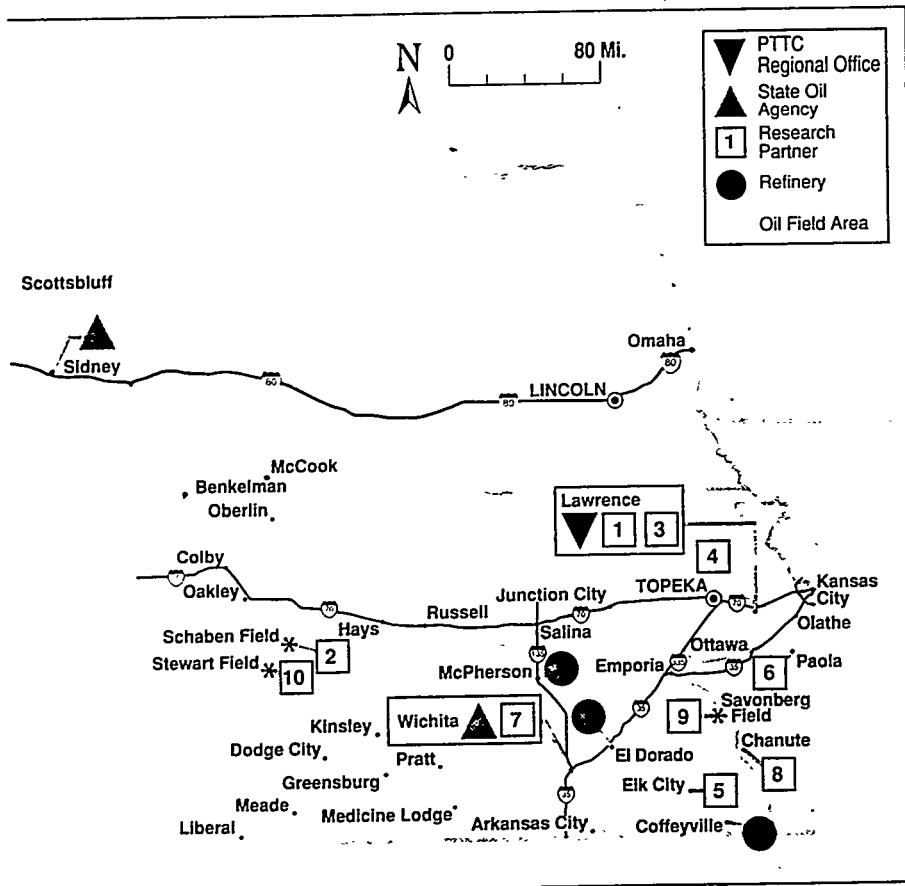
- 5 A.R.&R. Ltd., Elk City, KS
  - Gas Injection (Repressurization) to Increase Oil Recovery from Mature Reservoirs
- 6 Diamond Exploration, Inc., Paola, KS
  - Apply Electricity-Generated Heat to Produce Heavy, Shallow Oil
- 7 Edmiston Oil Co., Inc., Wichita, KS
  - Use Biological Methods (Short-Lived Microbes) to Increase Oil Recovery
- 8 Russell Petroleum, Inc., Chanute, KS
  - Air Flotation Techniques to Treat Wastewater Produced During Oil Production
- 1 University of Kansas, Lawrence, KS
  - Develop Models to Describe the Behavior of Polymer-Gels When Injected into an Oil Reservoir
  - Field Demonstration to Increase Oil Recovery in Fluvial-Dominated Deltaic Reservoirs
  - Compile and Synthesize Information to Expand the Atlas of Mid-Continental Oil Fields
  - Develop the Application of Gelled Polymer Technology to Increase Oil Recovery
- 9 University of Kansas, Savonburg Field, KS
  - Field Demonstration to Increase Oil Recovery in Fluvial-Dominated Deltaic Reservoirs
- 10 University of Kansas, Stewart Field, KS
  - Field Demonstration to Increase Oil Recovery in Fluvial-Dominated Deltaic Reservoirs

#### *Effective Environmental Protection*

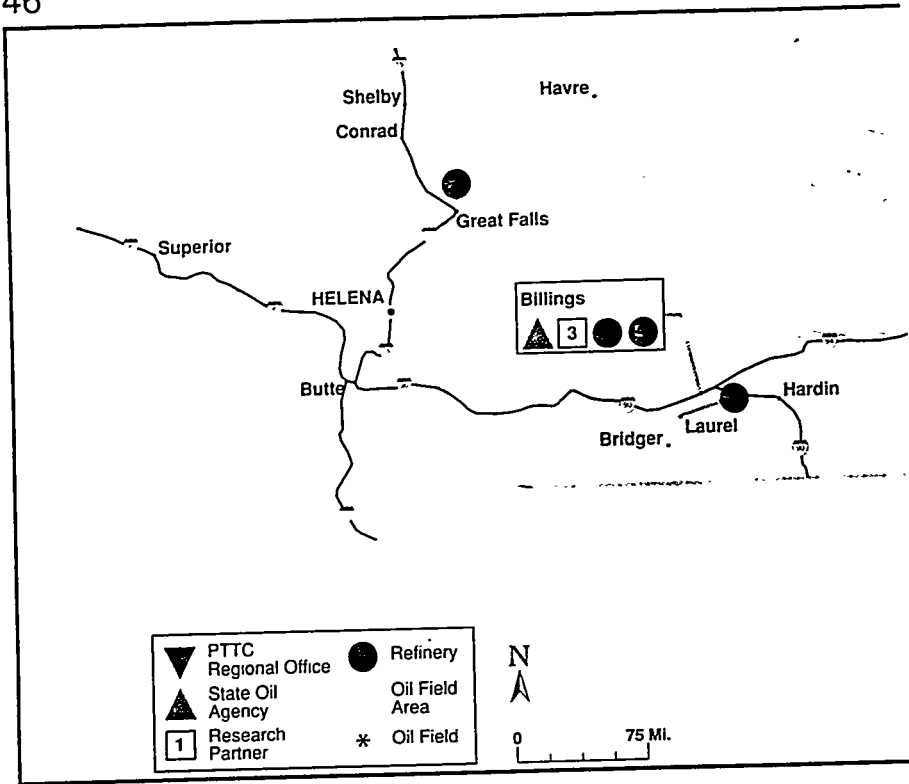
- 4 Kansas Corporation Commission, Topeka, KS
  - Develop a Data Management System to Conduct Area of Reviews (AORs) in Kansas



## Kansas, Nebraska 45



Oil Facts	KS	NE
State-Wide Rank: Petroleum Consumption	27th	37th
Crude Production	8th	21st
Petroleum Consumption, 1996 (million barrels)	77	41
Crude Production, 1996 (million barrels)	42	4
Number of Producing Wells, 1996	44,776	1,445
Cum. Total Wells Drilled, through 1996	127,332	5,492
Deepest Producing Well (feet)	7,400	8,457
Proved Crude Reserves, 1995 (million barrels)	275	25
First Year of Production	1889	1939
Number of Refineries	3	0
Petroleum Workforce, 1996 (employees)	23,652	10,812
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$38.3	\$3.6



Montana                      N. Dakota                      S. Dakota

**National Petroleum Technology Program**

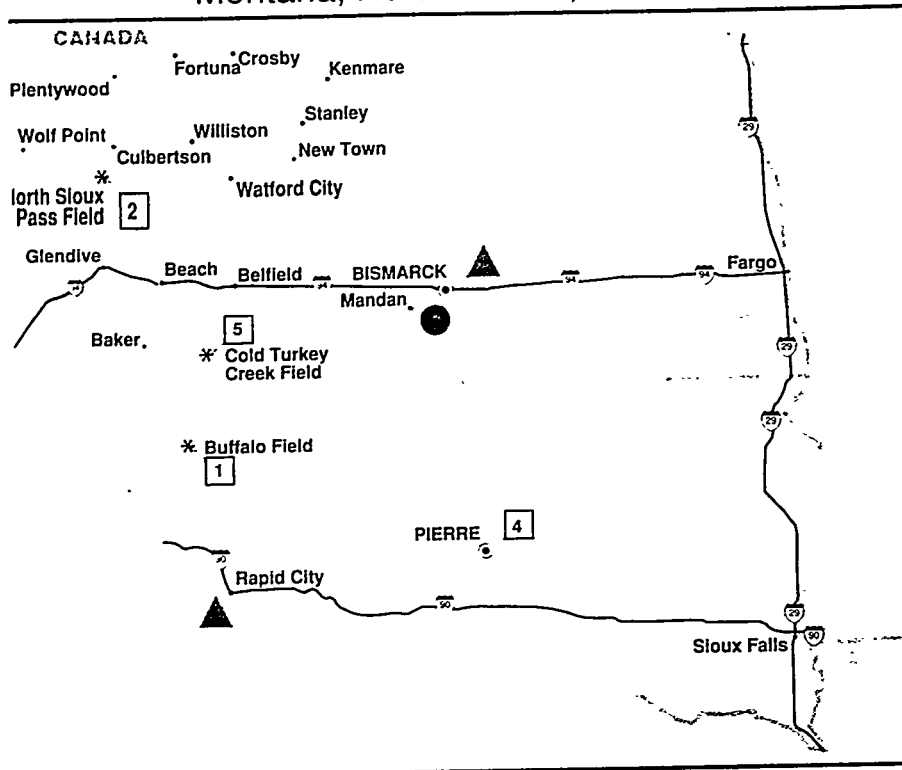
*Advanced Diagnostics and Imaging Systems*

- 1 Luff Exploration Company, Buffalo Field, Harding County, SD
  - Use 3-D Seismic Technology to Improve Reservoir Characterization
- 2 Luff Exploration Company, North Sioux Pass Field, Richland County, MT
  - Use 3-D Seismic Technology to Improve Reservoir Characterization
- 5 Luff Exploration Company, Cold Turkey Creek Field, Bowman County, ND
  - Use 3-D Seismic Technology to Improve Reservoir Characterization
- 3 Montana Bureau of Mines, Billings, MT
  - Assist the Crow Nation to Develop Oil Resources on Tribal Lands

*Reservoir Life Extension and Management*

- 4 Dakota Oil Producers, Inc., Pierre, SD
  - Apply Inert Gas Injection to Increase Reservoir Pressure and Improve Oil Recovery

# Montana, North Dakota, South Dakota 47



Oil Facts	MT	ND	SD
State-Wide Rank: Petroleum Consumption	42nd	47th	48th
Crude Production	14th	9th	25th
Petroleum Consumption, 1996 (million barrels)	29	23	21
Crude Production, 1996 (million barrels)	16	32	1
Number of Producing Wells, 1996	3,040	3,201	145
Cum. Total Wells Drilled, through 1996	11,025	6,319	241
Deepest Producing Well (feet)	13,012	15,380	9,150
Proved Crude Reserves, 1995 (million barrels)	178	233	NA
First Year of Production	1916	1951	1954
Number of Refineries	4	1	0
Petroleum Workforce, 1996 (employees)	9,027	9,140	6,511
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$12.6	\$18.0	\$0.6



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Utah



Wyoming

## National Petroleum Technology Program

- ☆ National Oil Shale Reserve No.2, Vernal, UT
- ☆ Naval Petroleum Reserve No.3, Teapot Dome, Casper, WY

### *Advanced Diagnostics and Imaging Systems*

- 1 TerraTek, Inc., Salt Lake City, UT
  - Develop Advanced Fracture Models to Increase Oil Recovery from Utah Reservoirs
- 2 University of Utah, Salt Lake City, UT
  - Upgrade Steam-Drive Technology to Improve Recovery in Mature Oil Fields
  - Conduct a Detailed Characterization of a Fault- and Fracture-Controlled Oil Reservoir
- 3 Utah Geological Survey, Salt Lake City, UT
  - Develop Detailed Reservoir Models Using a Multidisciplinary Approach

### *Reservoir Life Extension and Management*

- 9 Lomax Exploration Company, Monument Butte Field, Uinta County, UT
  - Demonstrate Waterflooding to Increase Recovery in High-Paraffin Oil Reservoirs
- 5 University of Wyoming, Laramie, WY
  - Understand Variations in Reservoir Quality Before and During Gas (CO<sub>2</sub>) Injection
- 6 Utah Geological Survey, Bluebell Field, UT
  - Improve Well Completion Techniques to Increase Oil Production in Utah Reservoirs
- 7 Utah Geological Survey, Paradox Basin, UT
  - Develop New Recovery Techniques to Increase Oil Production from Small Utah Reservoirs
- 3 Utah Geological Survey, Salt Lake City, UT
  - Improve Well Completion Techniques to Increase Oil Production in Utah Reservoirs
  - Develop New Recovery Techniques to Increase Oil Production from Small Utah Reservoirs

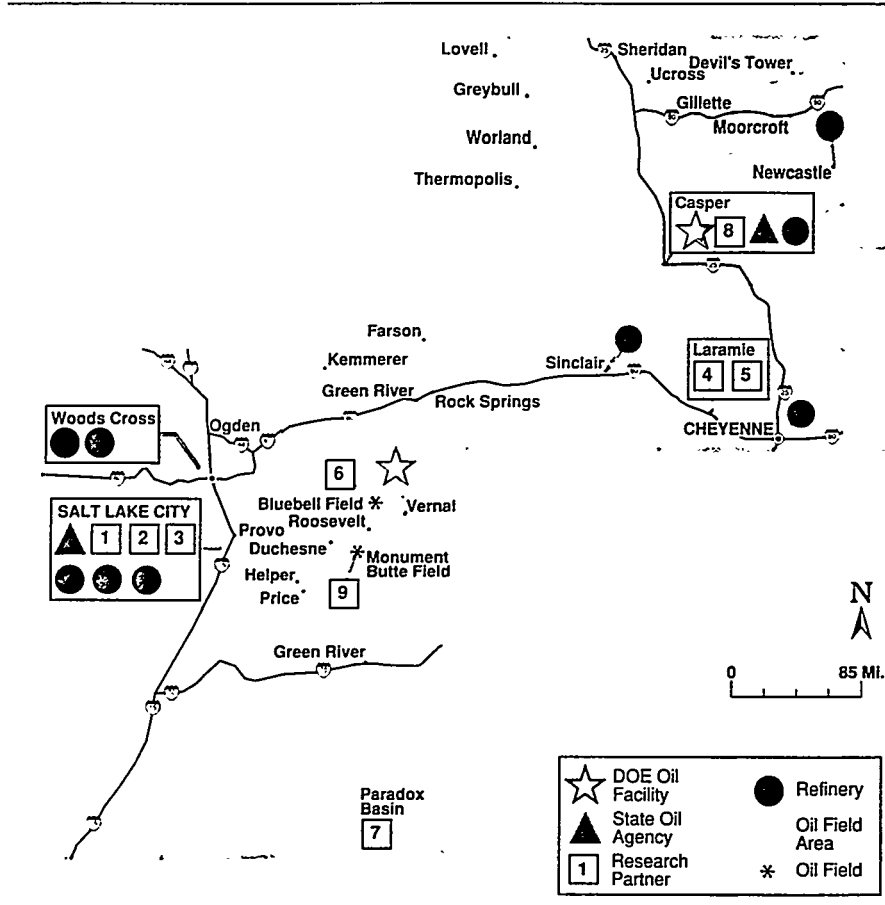
### *Effective Environmental Protection*

- 4 R.T. Corporation, Laramie, WY
  - Evaluate the Freeze-Thaw/Evaporation Process for the Treatment of Produced Waters

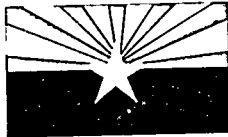
### *Crosscutting Program Areas*

- 8 Fluor Daniel Inc., Casper, WY
  - Conduct Technology Transfer and Training Related to New Petroleum Technologies

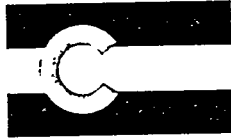




Oil Facts		UT	WY
State-Wide Rank:	Petroleum Consumption	38th	46th
	Crude Production	11th	6th
Petroleum Consumption, 1996 (million barrels)		41	24
Crude Production, 1996 (million barrels)		20	73
Number of Producing Wells, 1996		1,976	10,782
Cum. Total Wells Drilled, through 1996		4,007	27,865
Deepest Producing Well (feet)		17,732	19,612
Proved Crude Reserves, 1995 (million barrels)		216	605
First Year of Production		1907	1894
Number of Refineries		5	4
Petroleum Workforce, 1996 (employees)		13,662	13,893
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)		\$13.5	\$54.0



Arizona



Colorado



New Mexico

## National Petroleum Technology Program

- ☆ National Oil Shale Reserve No.1, Rifle, CO
- ☆ National Oil Shale Reserve No.3, Rifle, CO
- ☆ Los Alamos National Laboratory, Los Alamos, NM
- ☆ Sandia National Laboratories, Albuquerque, NM
- ▼ PTTC Rocky Mountain Office, Golden, CO
- ▼ PTTC Southwest Office, Socorro, NM

### *Advanced Diagnostics and Imaging Systems*

- 1 Bureau of Economic Geology, University of Texas at Austin, Carlsbad, NM
  - Develop Cost-Effective Methods to Accurately Describe Reservoir Properties
- 2 Los Alamos National Laboratory, Los Alamos, NM
  - Test Computational Tools Used in 3-Dimensional Seismic Analysis
  - Conduct Analysis to Refine Seismic Data from Subsalt Reservoirs in the Gulf of Mexico
  - Develop Improved Software to Accurately Map Reservoir Features
  - Conduct a Workshop to Address Problems in Modeling Micron-Scale Reservoir Features
  - Advanced Acoustic System for Borehole Seismic Surveying and Fracture Mapping
  - Induce Micro-Earthquakes to Map Natural Fractures and Fluid Flowing Oil Reservoirs
  - Micro-Borehole Seismic Instrumentation for More Cost-Effective Reservoir Characterization
- 3 Luff Exploration Company, Denver, CO
  - Use 3-D Seismic Technology to Improve Reservoir Characterization
- 4 Sandia National Laboratories, Albuquerque, NM
  - Enhance Single-Well Seismic Imaging of Salt Dome Edges
  - Develop a Wireless Telemetry Tool for Monitoring Production Wells
  - Develop a 3-Component Borehole Imaging Tool to Improve Reservoir Data Collection
  - Assess Effects of Rock Strength and Pore Pressure to Produce More Oil from Mature Fields
  - Develop Low-Cost Single-Well Imaging Systems
- 5 Standard Geological Services, Englewood, CO
  - Develop a Technique to Identify Oil, Oil Chemistry, and Problematic Reservoir Minerals at the Well Site

Kingman

Yuma

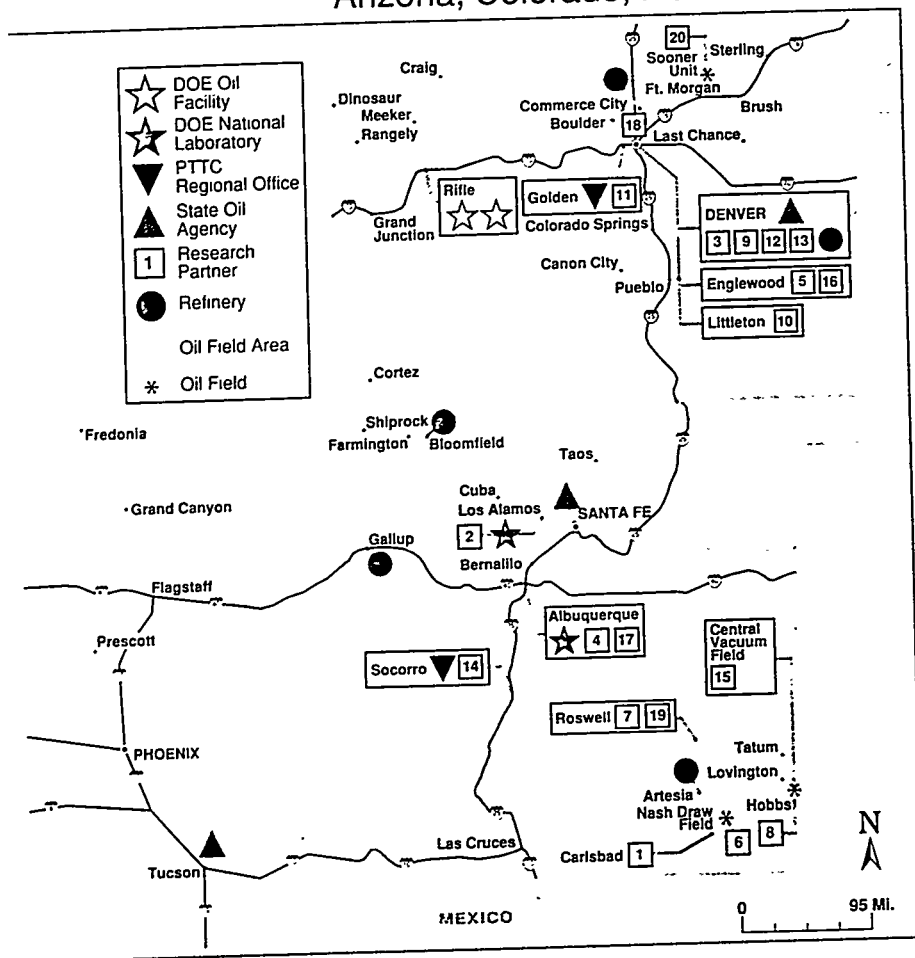


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# Arizona, Colorado, New Mexico 51



Oil Facts	AZ	CO	NM
State-Wide Rank: Petroleum Consumption	29th	30th	35th
Crude Production	30th	10th	7th
Petroleum Consumption, 1996 (million barrels)	73	71	49
Crude Production, 1996 (million barrels)	0.08	25	64
Number of Producing Wells, 1996	23	9,762	18,397
Cum. Total Wells Drilled, through 1996	49	11,787	34,622
Deepest Producing Well (feet)	6,793	12,704	17,652
Proved Crude Reserves, 1995 (million barrels)	0.55	252	732
First Year of Production	1958	1887	1911
Number of Refineries	0	2	3
Petroleum Workforce, 1996 (employees)	13,455	23,726	19,273
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$70.8	\$16.4	\$38.1

*Advanced Diagnostics and Imaging Systems*

- 6 Strata Production Co., Eddy County, Nash Draw Field, NM
  - Advanced Reservoir Management Methods to Improve Oil Recovery in New Mexico
- 7 Strata Production Co., Roswell, NM
  - Advanced Reservoir Management Methods to Improve Oil Recovery in New Mexico

*Advanced Drilling, Completion, & Stimulation Systems*

- 2 Los Alamos National Laboratory, Los Alamos, NM
  - Develop a Fluid Simulator to Help Design Drilling Systems that Minimize Damage to Oil Reservoirs
  - Develop and Field Test a Wireline Ultrasonic Wellbore Cleaning Tool
  - Model Structural Failure Limits of Offshore Drilling Rigs to Predict Mechanical Failures
- 4 Sandia National Laboratories, Albuquerque, NM
  - Conduct Research to Increase the Effectiveness of Hydraulic Fracturing
  - New Synthetic Diamond Drill Bit Technology to Reduce the Cost of Drilling in Hard Formations
  - Basic Research to Understand and Design Fluids Injected into Fractured Reservoirs

*Reservoir Life Extension and Management*

- 11 Colorado School of Mines, Golden, CO
  - Study and Describe Oil Reservoirs Using Interdisciplinary Technical Teams
- 12 Diversified Operating Corporation, Denver, CO
  - Demonstrate Increased Oil Recovery Through Reservoir Characterization and Management
  - Design Polymer Treatments to Increase Oil Production in Waterflood Operations
- 20 Diversified Operating Corporation, Sooner Unit, Weld County, CO
  - Increased Oil Recovery Through Reservoir Characterization and Management
  - Design Polymer Treatments to Increase Oil Production in Waterflood Operations
- 13 Inland Resources/Lomax Exploration Company, Denver, CO
  - Demonstrate Waterflooding to Increase Recovery in High-Paraffin Oil Reservoirs
- 2 Los Alamos National Laboratory, Los Alamos, NM
  - Develop Fast, Easy Mathematical Scale-Up Techniques to Better Predict Oil Recovery
  - Collaborate with Industry to Apply Computational Techniques to Better Predict Reservoir Properties
- 14 New Mexico Institute of Mining and Technology, Socorro, NM
  - Improve Effectiveness of Gas (CO<sub>2</sub>) Injection to Improve Oil Recovery in Complex Reservoirs
  - Study Fluid Interactions with Reservoir Rock to Improve Oil Recovery
  - Develop Methods to Prevent Water Flow into Producing Wellbores
- 4 Sandia National Laboratories, Albuquerque, NM
  - Apply New Production Technology to Extend the Reservoir Life of Marginally Economic Wells
- 15 Texaco Exploration and Production, Inc., Lea County, Central Vacuum Field, NM
  - Gas (CO<sub>2</sub>) Injection Techniques to Improve Light Oil Production in Mature Reservoirs

- 16 X-TRAC Energy Inc., Englewood, CO
  - Apply Recyclable Solvents to Extract Hydrocarbons from Shallow Tar Sands

*Emerging Processing Technology Applications*

- 2 Los Alamos National Laboratory, Los Alamos, NM
  - 3-D Simulations of Petrochemical Flows During the Refining of Heavy Crude Oil
- 4 Sandia National Laboratories, Albuquerque, NM
  - Develop a Software Package to Generate Crude Oil Models for Optimizing Refinery Processes
  - Conduct Studies to Predict the Physical Properties of Hydrocarbons for Refining Optimization

*Effective Environmental Protection*

- 8 BPF, Inc., Hobbs, NM
  - Develop the Systems for Treatment and Underground Disposal of Naturally Occurring Radioactive Materials
- 9 Independent Petroleum Association of the Mountain States, Denver, CO
  - Develop State-By-State Environmental, Health & Safety (EHS) Reference Books
- 10 OPHIR Corp., Littleton, CO
  - Design an Imaging Tool to Measure Natural Gas Emissions from Petroleum Operations
- 4 Sandia National Laboratories, Albuquerque, NM
  - Investigate the Stability of Thin-Bedded Salt Caverns for Oil & Gas Waste Disposal
  - Develop New Techniques to Measure Emissions of Engines Used in Petroleum Operations
  - Develop a Remote-Sensing System for Video Imaging of Leaks in Natural Gas Pipelines

*Crosscutting Program Areas*

- 17 BETA Corporation International, Albuquerque, NM
  - Identify Barriers to the Production of High-Quality Cement for Oil Operations in Russia
  - Support DOE Efforts to Increase U.S. Petroleum Technology Marketshare Worldwide
- 11 Colorado School of Mines, Golden, CO
  - Provide Teacher Training in Earth Science Curricula
  - Develop Oil & Gas Curricula for K-12 Students
- 18 Geological Society of America, Boulder, CO
  - Conduct Workshops to Implement Science Education Standards
- 2 Los Alamos National Laboratory, Los Alamos, NM
  - Assess the Organization of Russia's Gas Production Agency
- 14 New Mexico Institute of Mining and Technology, Socorro, NM
  - Integrate Reservoir Information for Improved Reservoir Characterization
- 19 Pecos Petroleum Engineering, Inc., Roswell Sulimar Queen Unit, NM
  - Integrate Reservoir Information for Improved Reservoir Characterization
- 4 Sandia National Laboratories, Albuquerque, NM
  - Initiate Computer Network Linkages Among Petroleum Industry Organizations



California



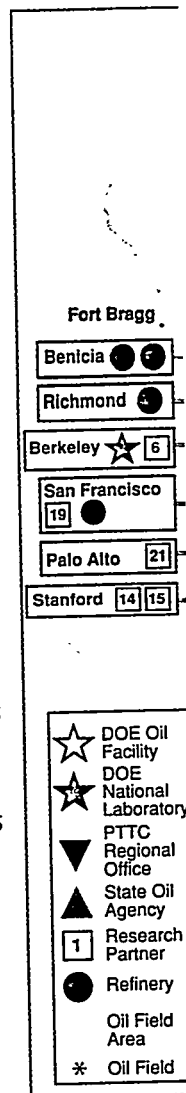
Nevada

## National Petroleum Technology Program

- ☆ Naval Petroleum Reserve No.1 - Elk Hills, Kern County, CA
- ☆ Naval Petroleum Reserve No.2 - Buena Vista Hills, Kern County, CA
- ☆ Lawrence Berkeley National Laboratory, Berkeley, CA
- ☆ Lawrence Livermore National Laboratory, Livermore, CA
- ▼ PTTC West Coast Office, Los Angeles, CA

### Advanced Diagnostics and Imaging Systems

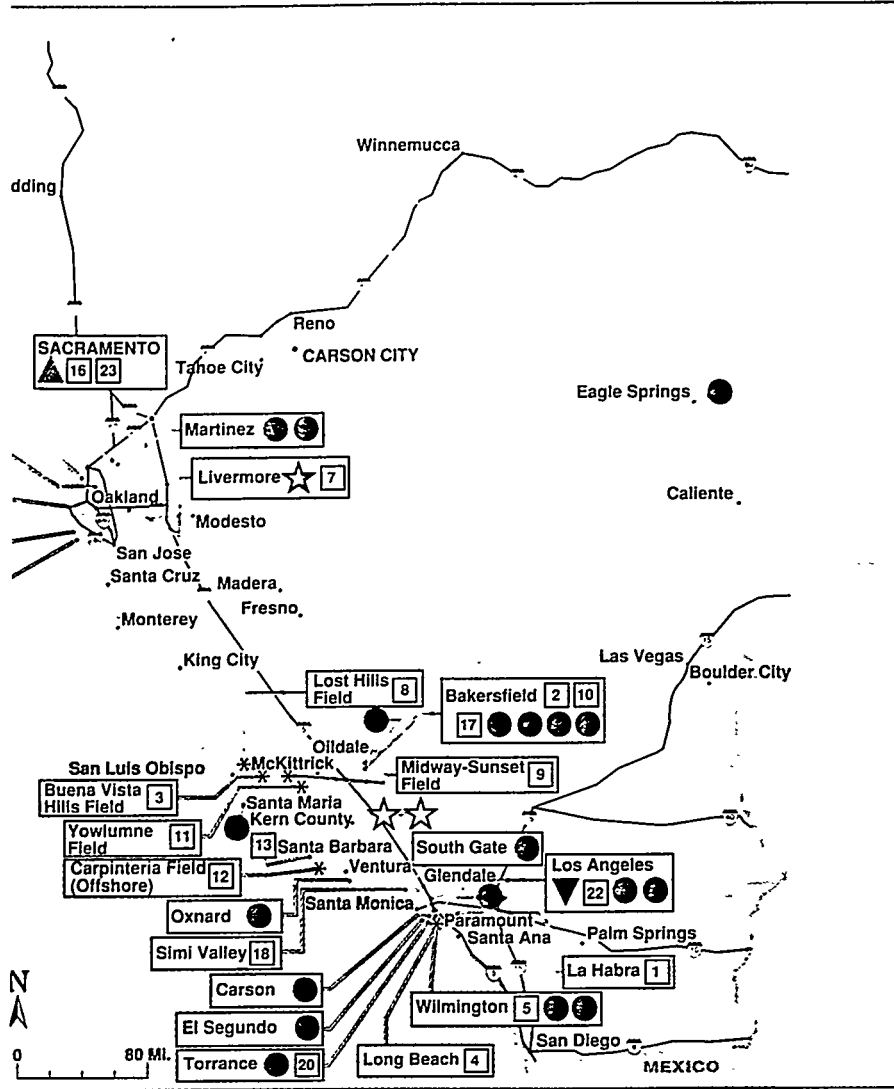
- 1 Chevron USA, Inc., La Habra, CA
  - Develop a 3-Component Borehole Imaging Tool to Improve Reservoir Data Collection
- 2 Chevron USA, Inc., Bakersfield, CA
  - Reservoir Characterization Techniques to Confirm Effectiveness of Gas (CO<sub>2</sub>) Injection
- 3 Chevron USA, Inc., Kern County, Buena Vista Hills Field, CA
  - Reservoir Characterization Techniques to Confirm Effectiveness of Gas (CO<sub>2</sub>) Injection
- 4 City of Long Beach, Long Beach, CA
  - Use Multiple Lateral Wells to Increase Waterflood Reserves
  - Use Advanced Thermal Production Technology to Increase Heavy Oil Reserves
- 5 City of Long Beach, Wilmington Field, CA
  - Use Multiple Lateral Wells to Increase Waterflood Reserves
  - Use Advanced Thermal Production Technology to Increase Heavy Oil Reserves
- 6 Lawrence Berkeley National Laboratory, Berkeley, CA
  - Use Borehole Electromagnetic Imaging Technology to Monitor Oil Recovery Processes
  - Develop Analytical Tools and Operating Strategies to Reduce Well Failures
  - Use High-Resolution Imaging to Map the Path of Steam Flows During Steamfloods
  - Study Fluid Injection Techniques to Produce Oil from Low-Permeability Fractured Reservoirs
  - Develop Single-Well Seismic Imaging Technology



MORE ON  
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Oil Facts		CA	NV
State-Wide Rank: Petroleum Consumption		2nd	40th
Crude Production		3rd	26th
Petroleum Consumption, 1996 (million barrels)		634	35
Crude Production, 1996 (million barrels)		282	1
Number of Producing Wells, 1996		40,531	66
Cum. Total Wells Drilled, through 1996		118,151	100
Deepest Producing Well (feet)		18,876	8,694
Proved Crude Reserves, 1995 (million barrels)		3,462	NA
First Year of Production		1861	1954
Number of Refineries		22	1
Petroleum Workforce, 1996 (employees)		115,686	7,049
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)		\$144.3	\$0.7

*Advanced Diagnostics and Imaging Systems*

- 7 Lawrence Livermore National Laboratory, Livermore, CA
  - Develop a Computer Simulation of Nuclear Well Logging Techniques to Identify New Oil Finds
  - Develop New Electromagnetic Methods to Characterize Oil Fields and Monitor Oil Recovery
  - Study Multi-Frequency Electromagnetic Imaging Techniques to Identify Oil Recovery Processes
  - Develop Tiltmeter Technology to Image Hydraulic Fractures in Deep Wellbores
  - Use Explosives to Improve Seismic Imaging Quality While Reducing Environmental Effects
  - Develop Advanced Diagnostic Equipment for Oil & Gas Operations
- 8 Lawrence Livermore National Laboratory, Lost Hills Field, CA
  - Study Multi-Frequency Electromagnetic Imaging Techniques to Monitor Oil Recovery Processes
- 9 University of Utah, Midway-Sunset Field, CA
  - Upgrade Steam-Drive Technology to Improve Recovery in Mature Oil Fields

*Advanced Drilling, Completion, & Stimulation Systems*

- 10 ARCO Western Energy, Bakersfield, CA
  - Use High-Angle Wells and Multiple Fractures to Improve Oil Recovery
- 11 ARCO Western Energy, Yowlumne Field, CA
  - Use High-Angle Wells and Multiple Fractures to Improve Oil Recovery
- 12 Pacific Offshore Operators, Inc., Offshore CA, Carpinteria Field, CA
  - Use a Tri-Lateral Horizontal Well to Optimize Recovery from an Offshore Oil Field
- 13 Pacific Offshore Operators, Inc., Santa Barbara, CA
  - Use a Tri-Lateral Horizontal Well to Optimize Recovery from an Offshore Oil Field
- 14 Stanford University, Stanford, CA
  - Develop Quantitative Tools to Assess Horizontal Well Performance under Varied Conditions

*Reservoir Life Extension and Management*

- 20 Industrial Technology Management, Inc., Torrance, CA
  - Provide New Solutions to Resolve Oil Producibility Issues
- 6 Lawrence Berkeley National Laboratory, Berkeley, CA
  - Use Injected Foams to Control the Flow of Underground Water and Oil
  - Assess Steam Drive Recovery Methods in a Low-Permeability Reservoir
- 21 Reservoir Engineering Research Institute, Palo Alto, CA
  - Determine Basic Recovery Mechanisms from Fractured Petroleum Reservoirs
  - Study Fluid Dynamics to Improve Oil Recovery from Fractured Reservoirs
- 15 Stanford University, Stanford, CA
  - Develop More Effective Gas Injection Techniques to Increase Oil Recovery
  - Gas Injection Techniques to Improve Oil Recovery from Complex Geological Formations
- 14 Stanford University Petroleum Recovery Institute, Stanford, CA
  - Comprehensive Research Program to Improve Recovery Efficiency from Heavy Oil Reservoirs
  - Research Improved Recovery Mechanisms for Heavy Oil Reservoirs

- 22 University of Southern California, Los Angeles, CA
- Study the Chemical and Physical Factors of Using Steam Injection to Improve Oil Recovery

### *Emerging Processing Technology Applications*

- 18 EDM Services, Inc., Simi Valley, CA
- Develop California Pipeline Database and Analyze Data to Monitor Pipeline Operations
- 6 Lawrence Berkeley National Laboratory, Berkeley, CA
- Computed Tomography and Nuclear Magnetic Resonance Imaging of Pore Scale Features
  - Assess Environmental Impact of Oil Refinery Discharges into San Francisco Bay
  - Study the Human Health Risks of Exposure to Petroleum Products in Soil
- 19 Lawrence Berkeley National Laboratory, San Francisco, CA
- Assess Environmental Impact of Oil Refinery Discharges into San Francisco Bay
- 7 Lawrence Livermore National Laboratory, Livermore, CA
- Develop a Chemical Engineering Process Model for Upgrading Crude Oil by Pyrolysis
  - Develop Improved, Lower-Cost Techniques for Refining Heavy Oil
  - Develop Aqueous Pyrolysis Techniques to Upgrade Heavy Oil for Refining

### *Effective Environmental Protection*

- 23 Aerojet-General Corp., Sacramento, CA
- Demonstrate Technology for Emission Measurement of Natural Gas-Powered Vehicles
- 10 ARCO Western Energy, Bakersfield, CA
- Treat Wastewater Produced During Oil Operations to Make Drinking Water
- 16 California Department of Conservation, Sacramento, CA
- Computer Analysis of Area of Review (AOR) Variance Requests in California
- 6 Lawrence Berkeley National Laboratory, Berkeley, CA
- Analyze Heavy Oil Storage Tank Emissions to Support Regulatory Decision-Making
  - Identify Crucial Air Quality Research Issues for Oil & Gas Exploration and Recovery
- 7 Lawrence Livermore National Laboratory, Livermore, CA
- Catalytic System to Reduce Emissions from Diesel-Powered Generators Used in Petroleum Operations
  - Predict the Transport of Underground Fuel Tank Leaks into the Surrounding Groundwater
  - Develop Software to Evaluate In-Situ Bioremediation of Contaminated Groundwater
- 17 WZI Inc., Bakersfield, CA
- Develop a Clean Air Act Guidance Manual for Independent Oil & Gas Producers
  - Prepare State Manuals for Clean Air Act Regulations to Help Reduce Compliance Costs
  - Provide Environmental Outreach Material to the Petroleum Industry

### *Crosscutting Program Areas*

- 7 Lawrence Livermore National Laboratory, Livermore, CA
- Maintain an On-Line Database Providing Oil & Gas Technical, Regulatory and Permit Information



Idaho



Oregon



Washington

## National Petroleum Technology Program

- ★ Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID
- ★ Pacific Northwest National Laboratory, Richland, WA
- ★ DOE Fossil Energy Research Facility, Albany, OR

### *Advanced Diagnostics and Imaging Systems*

- 1 Golder Associates, Redmond, WA
  - Enhance Computer Modeling of Natural Fractures in Petroleum Reservoirs
- 2 Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID
  - Develop Lower Cost Seismic Acquisition and Processing Systems
  - Use Real-Time Seismic Surveys to Characterize Oil Environments While Drilling
- 3 Pacific Northwest National Laboratory, Richland, WA
  - Improve Computer Predictions of Multiphase Flow in Petroleum Reservoirs

### *Advanced Drilling, Completion, & Stimulation Systems*

- 2 Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID
  - Develop a Conceptual Model to Identify Potential Geopressured Oil Reservoirs

### *Reservoir Life Extension and Management*

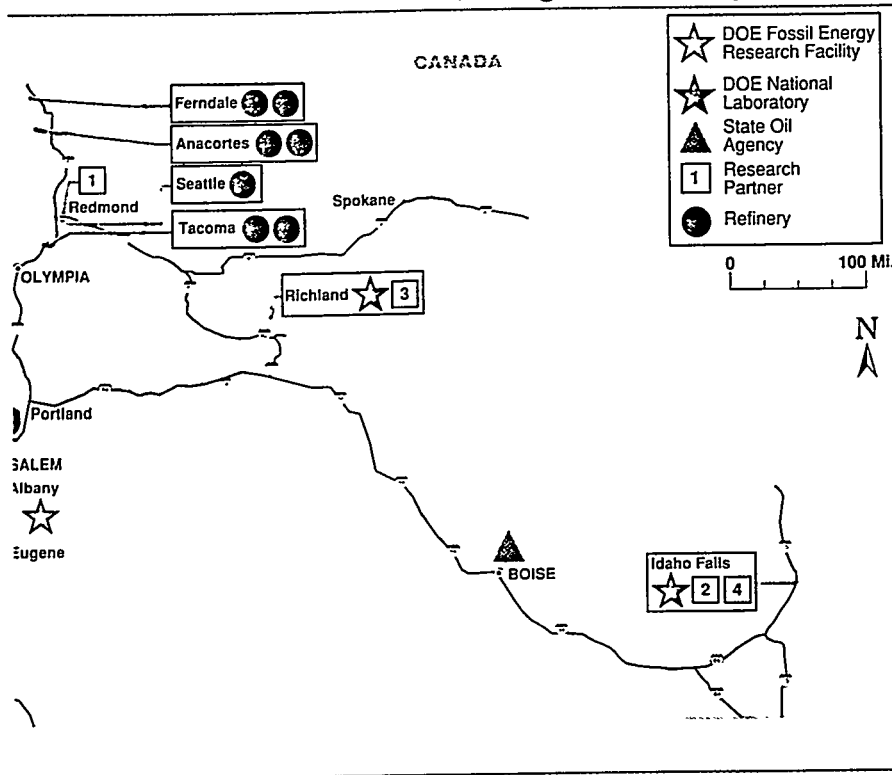
- 2 Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID
  - Investigate Effects of Saline Solutions (Brine) to Enhance Oil Recovery
- 4 Lockheed Martin Idaho Inc., Idaho Falls, ID
  - Conduct Research Using Microbes (Organisms) to Improve the Efficiency of Oil Recovery

### *Emerging Processing Technology Applications*

- 2 Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID
  - Assess Reactive Plasma Processes for More Economical Upgrading of Heavy Oils
  - Use a Catalyst Process During Refining to Increase Yields of High-Octane Gasoline
  - Study Permeable In-Ground Treatment Systems to Control Groundwater Contaminants (BTEX)
- 3 Pacific Northwest National Laboratory, Richland, WA
  - Develop a Method to Separate Metals from Spent Refinery Catalysts Used to Upgrade Heavy Crude Oils
  - Prevent Pollution by Reclaiming Spent Refinery Waste Catalysts

### *Effective Environmental Protection*

- 2 Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID
  - Characterize Naturally Occurring Radioactivity in Fossil Fuel Equipment and Wastes
- 3 Pacific Northwest National Laboratory, Richland, WA
  - Determine the Influence of Soil Characteristics on Oil Biodegradation in Soils
  - Evaluate Lower Cost Procedures for Disposal of Refinery Biosludge



Oil Facts	ID*	OR*	WA*
State-Wide Rank: Petroleum Consumption	45th	31st	13th
Crude Production	-	-	-
Petroleum Consumption, 1996 (million barrels)	25	70	152
Crude Production, 1996 (million barrels)	-	-	-
Number of Producing Wells, 1996	-	-	-
Cum. Total Wells Drilled, through 1996	-	-	-
Deepest Producing Well (feet)	-	-	-
Proved Crude Reserves, 1995 (million barrels)	-	-	-
First Year of Production	-	-	-
Number of Refineries	0	1	7
Petroleum Workforce, 1996 (employees)	4,597 <sup>†</sup>	14,444 <sup>†</sup>	15,543 <sup>†</sup>
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	-	-	-

\* Non-producing state

<sup>†</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.



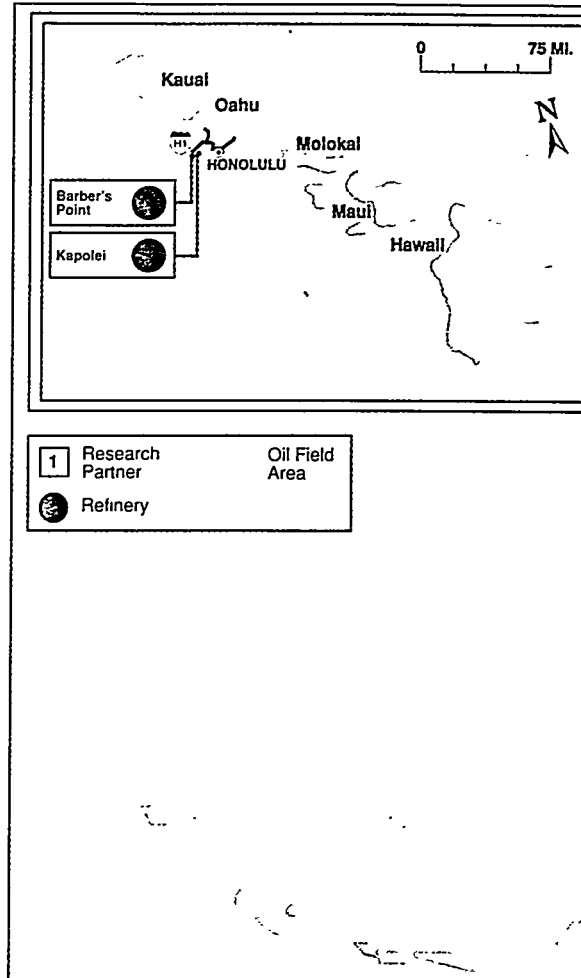
*Partners in Developing New Technologies:  
DOE, Industry, Universities, and Government Agencies*



Alaska



Hawaii



## National Petroleum Technology Program

### *Reservoir Life Extension and Management*

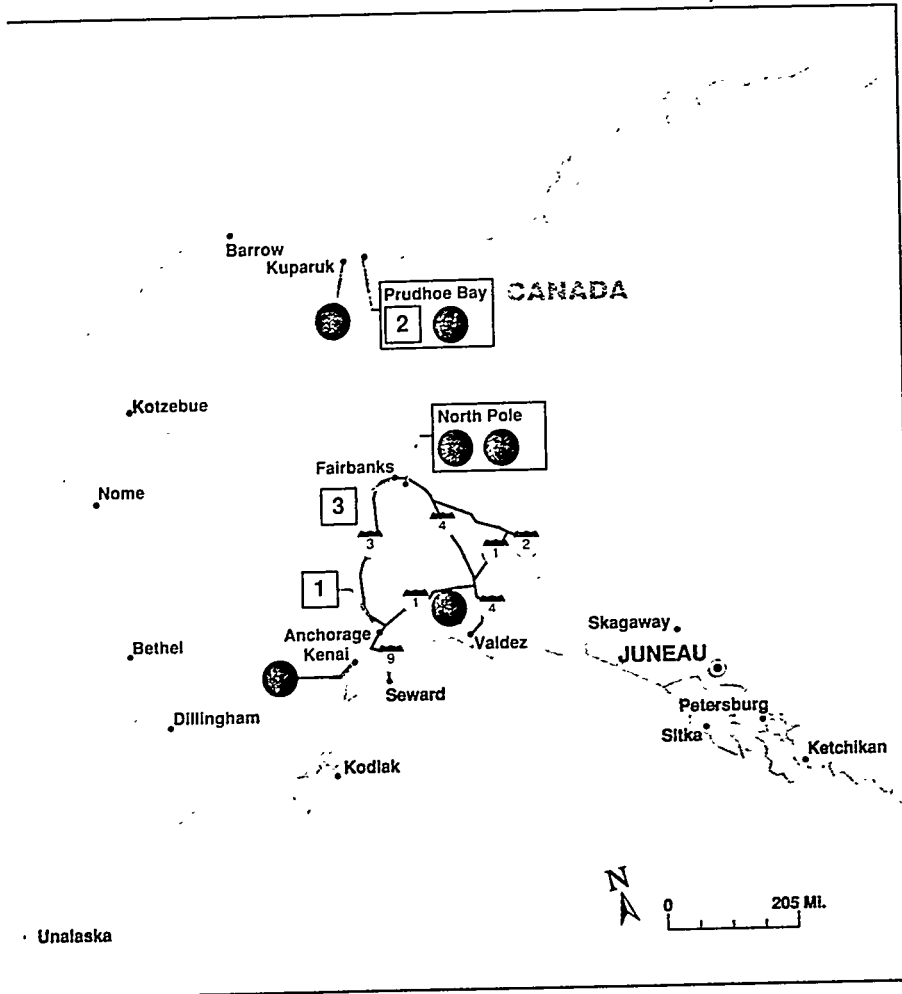
- 1 BP Exploration, Inc., Anchorage, AK
  - Determine the Best Methods to Recover Heavy Oil at Milne Point Schrader Bluff (Alaska)
- 2 BP Exploration, Inc., Prudhoe Bay, AK
  - Identify Optimal Techniques for Recovering Heavy Oil from Prudhoe Bay (Alaska)

### *Crosscutting Program Areas*

- 3 University of Alaska Fairbanks, Fairbanks, AK
  - Maintain a Website on Arctic Oil Production in the U.S. and the Former Soviet Union

*Partners in Developing New Technologies:  
DOE, Industry, Universities, and Government Agencies*





Oil Facts	AK	HI*
State-Wide Rank: Petroleum Consumption	38th	36th
Crude Production	2nd	-
Petroleum Consumption, 1996 (million barrels)	38	45
Crude Production, 1996 (million barrels)	510	-
Number of Producing Wells, 1996	2,128	-
Cum. Total Wells Drilled, through 1996	2,505	-
Deepest Producing Well (feet)	15,021	-
Proved Crude Reserves, 1995 (million barrels)	5,580	-
First Year of Production	1905	-
Number of Refineries	6	2
Petroleum Workforce, 1996 (employees)	12,263	3,764 <sup>†</sup>
Cum. Crude Oil Wellhead Value, through 1996 (\$ billions)	\$153.7	-

\*Non-producing state

<sup>†</sup> Workforce in non-producing states includes those in petroleum refining, oil and grease processing, gas and petroleum product distribution, and gasoline stations.

## Partners in Petroleum Technology Development

Prime partners in NPTO's petroleum technology developments are listed here in bold face text. Their project locations and program descriptions are shown on the state maps on pages 9-61. Subcontractors and third-tier partners, listed here in italics, are not shown on the state maps.

**A.R.&R. Ltd., KS**  
*Advanced Data Solutions, TX*  
*Advanced Geophysical, CO*  
*Advanced Resources International, Inc., CO, VA*  
**Aerofjet-General Corp., CA**  
*Albert Engineering, CO*  
*Amerada Hess, TX*  
**American Geological Institute, VA**  
**Amoco Production Company, LA, TX**  
*Applied Geomechanics, CA*  
*ARCO Oil & Gas, TX*  
*ARCO Western Energy, CA*  
**ARCTECH, Inc., VA**  
*Ardent, NY*  
**Argonne National Laboratory, IL**  
*ARIES Group Inc., CO*  
*Arthur D. Little, MA*  
*Austin Powder Co., OH*  
*Baker Hughes, TX*  
*Baker Oil Tools, CA*  
*Bakersfield Energy Resources, CA*  
*Barrett Resources, CO*  
**BDM-Oklahoma, Inc., OK**  
*BDM Petroleum Technologies, OK*  
**Belden & Blake, OH**  
**Belport Oil, Inc., OK**  
*Berry Petroleum Co., CA*  
**BETA Corporation International, NM**  
*BHP Petroleum, CA*  
*Bolt Technology, CT*  
**BP Exploration, Inc., AK, TX**  
**BPF, Inc., NM, TX**  
**Brandegee, Inc., PA**  
**Brashear Group LLC, MD**  
*Bretagne G.P., KY*  
*Brookhaven National Laboratory, NY*  
**Brothers Production, TX**  
**Bureau of Economic Geology, Univ. of Texas at Austin, NM, TX**  
*Cabot Oil and Gas, TX*  
*Cal Resources, CA*  
**California Department of Conservation, CA**  
*California Division of Oil, Gas, & Geothermal, CA*  
*California Independent Producers Association (CIPRO), CA*  
*Calstart, Inc., CA*  
*Center for Energy and Economic Diversification (CEED), TX*  
**Chevron USA, Inc., CA**

**City of Long Beach, CA**  
**Clark Atlanta University, GA**  
**Colorado School of Mines, CO**  
*Columbia Gas Transmission Corp., VA*  
**Columbia University, LA, NY**  
*Computalog, TX*  
*Conoco, Inc., OK*  
**Continental Shelf Associates, Inc., FL, TX**  
*Coombs & Associates, CA*  
*Care Laboratories, CA*  
*Cornell University, NY*  
*Cray Research, MN*  
*Cronus Development Co., MI*  
*Crutcher-Tufts Production Co., LA*  
**Dakota Oil Producers, Inc., SD**  
**Dauben International, OK**  
*Dougherty Petroleum, KY*  
*David K. Davies & Associates, TX*  
**DBS, CA**  
*Dennis Tool, TX*  
**Design Institute for Physical Properties Research, NY**  
**Diamond Exploration, KS**  
*Digital Petrophysics, Inc., CA*  
**Diversified Operating Corporation, CO**  
**DLB Oil and Gas Company, OK, CA**  
**Double-Eagle Enterprises, OK**  
**Dawell Schlumberger, Inc., OK, TX**  
**Driver Production, OK**  
*Dugan Production, NM*  
*Duke University, NC*  
*Earth Resources Laboratory/  
 Massachusetts Institute of Technology (MIT), MA*  
**EDCO Producing Company, OH**  
*Edison Chouest, TX*  
**EDM Services, Inc., CA**  
**Edmiston Oil Co., Inc., KS**  
**EIC Laboratories, Inc., MA**  
*Engineering Animation Inc, IA*  
**Engineering Specialties, Inc., LA**  
*Enserch Exploration, LA*  
**Exxon Production Company, TX**  
*Farrar Oil, IL*  
**Fina, USA, TX**  
**Flexbar, TX**  
**Fluor Daniel Inc., WY**  
**Foreland, CO**



## Partner List 63

**Fort Valley State University, GA**  
**Gallagher Oil, CO**  
**Gas Research Institute (GRI), IL**  
**GECO-Praklo, TX**  
**Geo-Microbial Technologies, Inc., OK**  
**Geological Society of America (GSA), CO**  
**Geostat Associates, TX**  
**Geotools Corp., TX**  
**Gillette, MD**  
**Golden Geophysical, CO**  
**Golder Associates, WA**  
**Grace Petroleum, OK**  
**Greenhill Petroleum Corp., TX**  
**Ground Water Protection Council, OK**  
**GTE Government Systems, VA**  
**Halliburton Energy Services, CA, TX**  
**Har-Ken Oil Co., KY**  
**HarCor Energy, Inc., TX**  
**Harken Energy, TX**  
**Harry A. Spring, OK**  
**Heat Transfer, TX**  
**Hickman & Associates, TX**  
**Houston Advanced Research Center (HARC)/  
 Rice University, TX**  
**Hughes Christiansen, UT**  
**Hughes Eastern Corporation, AL, MS**  
**Hunt Petroleum, LA**  
**Hydrocarbon Generation, Inc., NY**  
**Hypermedia Corp, TX**  
**IBM Corp., TX**  
**ICF Resources, VA**  
**Idaho National Engineering and Environmental Laboratory, ID**  
**Illinois State Geological Survey, IL**  
**Independent Petroleum Association of the  
 Mountain States (IPAMS), CO**  
**Independent Producers Association of America (IPAA), DC**  
**Industrial Technology Management, Inc., CA**  
**Inland Resources/Lomax Exploration Company, CO**  
**Institute for Improved Oil Recovery, TX**  
**Institute of Material Processing, MI**  
**Intel Corp., CA**  
**Intelligent Engineering Systems Laboratory/  
 Massachusetts Institute of Technology (MIT), MA**  
**Interstate Oil & Gas Compact Commission (IOGCC), OK**  
**ITT Research Institute, IL**  
**J.R. Pounds, Inc., MS**  
**James E. Russell Petroleum, TX**  
**James Engineering, Inc., OH**  
**Jet Propulsion Laboratory (JPL)/Caltech, CA**  
**JNOC, NH**  
**Joshi Technologies, OK**  
**K-Stewart Petroleum Company, OK**  
**Kansas Corporation Commission, KS**  
**Kansas Geological Survey, KS**  
**Keener Oil and Gas Co., OK**  
**Kenneth Y. Park, OK**  
**Kerr-McGee Corp, OK**  
**Keystone Environmental Resources, PA**  
**Klaeger Operating, Inc., TX**  
**Kraft, Inc., IL**  
**Laguna Petroleum Corporation, TX**  
**Landmark Graphics, TX**  
**Lawrence Berkeley National Laboratory, CA**  
**Lawrence Livermore National Laboratory, CA**  
**Leland Stanford Junior University, CA**  
**Lockheed Martin Idaho Inc., ID**  
**Los Alamos National Laboratory, NM, TX**  
**Louisiana Land & Exploration Company, LA**  
**Louisiana State University, LA**  
**Lovelace Research Institute, NM**  
**Luff Exploration Company, CO**  
**Magnetic Pulse, TX**  
**Marathon Oil Company, CO**  
**Mark Products, FL**  
**Maurer Engineering, TX**  
**MI Drilling Fluids, MI**  
**Michigan Technological University, MI**  
**Midland Resources, Inc., TX**  
**Mississippi State University, MS**  
**Mitchell Energy, TX**  
**MI Systems, MA**  
**Mobil Oil Company, TX**  
**Montana Bureau of Mines, MT**  
**Monterey Resources, Inc., CA**  
**Morgan State University, MD**  
**Morrow Drilling Company, MS**  
**Multi Manufacturing, OH**  
**MVP Production, Inc., LA**  
**M.W. Kellogg Company, TX**  
**Nabla Corp., TX**  
**Nalco Chemical, IL**  
**National Academy of Sciences, DC**  
**National Fuel & Gas Supply Corp., PA**  
**nCube, CA**  
**New Mexico Institute of Mining and Technology, NM**  
**New Mexico Petroleum Recovery Research Center, NM**  
**North Carolina Agricultural and Technical State University, NC**  
**North Carolina State University, NC**  
**Oak Ridge National Laboratory, TN**  
**Ohio Department of Natural Resources, OH**  
**Oklahoma Corporation Commission, OK**  
**Oklahoma Energy Resources Board (OERB), OK**  
**Oklahoma Geological Survey, OK**  
**Oklahoma Independent Producers Association (OIPA), OK**  
**OPHIR Corp., CO**  
**Oryx Energy, TX**  
**Osage Tribal Council, OK**  
**OXY USA Inc., TX**  
**OYO Geospace Exploration, TX**  
**Pacific Northwest National Laboratory, WA**  
**Pacific Offshore Operators, Inc., CA**  
**Pan Western Energy Corp., OK**  
**Panenergy Corp., TX**  
**Paradigm Geophysical, TX**  
**Parker & Parsley Development Company, TX**  
**Pecos Petroleum Engineering, Inc., NM**  
**Pelton, UT**  
**Pennsylvania State University, PA**  
**Pennzoil, TX**  
**Pertamina, TX**

## 64 Partner List

Petroleum Technology Transfer Council, DC  
Petrolite Corp, MO  
Petrotek Engineering Corporation, CO  
PGS Tensor, TX  
Phillips Petroleum Company, OK, TX  
Pinnacle Technologies Inc., CA  
Pool Company, Inc., TX  
Prairie Project, IL  
Prairie View A&M University, TX  
Providence Technologies, NM  
R.T. Corporation, WY  
Raytheon E-systems, TX  
Reservoir Engineering Research Institute, CA  
Ritche Exploration, KS  
Rock Island Service Co., VA  
Russell Petroleum, Inc., KS  
Sandia National Laboratories, NM, TX  
Sandia Operating Corporation, NM, TX  
Santa Fe Energy, CA  
Schlumberger Corp., TX  
Schlumberger Well Services, TX  
Schlumberger Wireline Services, CA  
Schlumberger-Dall Research, CT  
Science Applications International Corporation (SAIC), MD  
Scientific Software-Intercomp., Inc. (SSI), CO  
Scott Exploration, NM  
Security Diamond Products, HI  
Sharon Resources, CO  
Shell Development Company, TX  
Sipple Oil Company, KY  
SMACKO Oil, AL  
Society of Exploration Geophysicists (SEG), OK  
Society of Petroleum Engineers (SPE), TX  
Southern A&M University, LA  
Southwest Research Institute, TX  
Speir Operating, IL  
Standard Geological Services, CO  
Standard International, CA  
Stamford University, CA  
Stamford University Petroleum Recovery Institute, CA  
State of Kentucky, KY  
State University of New York at Stony Brook, NY  
Steinle & Associates, LA  
Stim-Labs, Inc., OK  
Strata Production Co., NM  
Stratamodel, Inc., TX  
Sun Microsystems, Inc., CA  
Sun Refining, NJ  
Tannehill Oil Co., CA  
Taylor Energy Co., LA  
Tenison Oil Co., LA, TX  
Terra Energy Ltd., MI  
Terralog Technologies, CA  
TerraTek, Inc., UT  
Texaco Exploration and Production, Inc., LA, NM, TX  
Texas A&M, TX  
Texas Independent Producers and Royalty Owners (TIPO), TX  
Texas Railroad Commission, TX  
TGS Calibre Geophysical, TX  
THUMS Long Beach, CA  
Tidelands Oil Production Company, CA  
Tomoseis, Incorporated, TX  
U.S. Bureau of Land Management (BLM), DC  
U.S. Environmental Protection Agency (EPA), DC  
U.S. Geological Survey, VA, CO  
U.S. Minerals Management Service (MMS), TX, VA  
U.S. Minerals Management Service-Pacific OCS Region, CA  
Underground Injection Practices Research Foundation, Inc., OK  
Unilever, NJ  
Union Pacific Resources Company, TX  
University of Alabama, AL  
University of Alaska Fairbanks, AK  
University of Arkansas, AR  
University of California, Berkeley, CA  
University of California-Davis, CA  
University of California-San Diego, CA  
University of California-Santa Barbara, CA  
University of California-Santa Cruz, CA  
University of Houston, TX  
University of Kansas, KS  
University of Kansas Center For Research, Inc., KS  
University of Kentucky, KY  
University of Michigan, MI  
University of Minnesota, MN  
University of Missouri-Rolla, MO  
University of New Mexico, NM  
University of Oklahoma, OK  
University of South Alabama, AL  
University of Southern California, CA  
University of Texas at Austin, TX  
University of Texas at Dallas, TX  
University of Texas of the Permian Basin, TX  
University of Tulsa, OK  
University of Utah, CA, UT  
University of Utah Research Institute, UT  
University of Wyoming, WY  
Unocal Corporation, CA  
Uplands Resources, OK  
Utah Geological Survey, UT  
Utah Geophysical, Inc., UT  
Vastor, TX  
Virginia State University, VA  
Western Atlas, TX  
Western Geophysical, TX  
Western Michigan University, MI  
Wetlands Restoration Laboratory, LA  
WITCO Chemical, TX  
Wild Oil & Gas, CA  
Woods Hole Oceanographic Institute, MA  
WRT Energy Corp., LA  
WZI Inc., CA  
X-TRAC Energy Inc., CO