

# Environmentally Friendly Drilling Systems Program

U.S. Energy Association

February 8, 2011

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[www.efdsystems.org](http://www.efdsystems.org)





# EFD Program History

- **Formed Team in 2005 (6 years)**
- **Texas A&M took lead to obtain U.S. Department of Energy Funding**
- **Formed Joint Industry Partnership to guide and co-fund program**
- **Phase 2 led by HARC with RPSEA funding**
- **Formed University/National Lab Alliance**
- **Initiated EFD-EU**





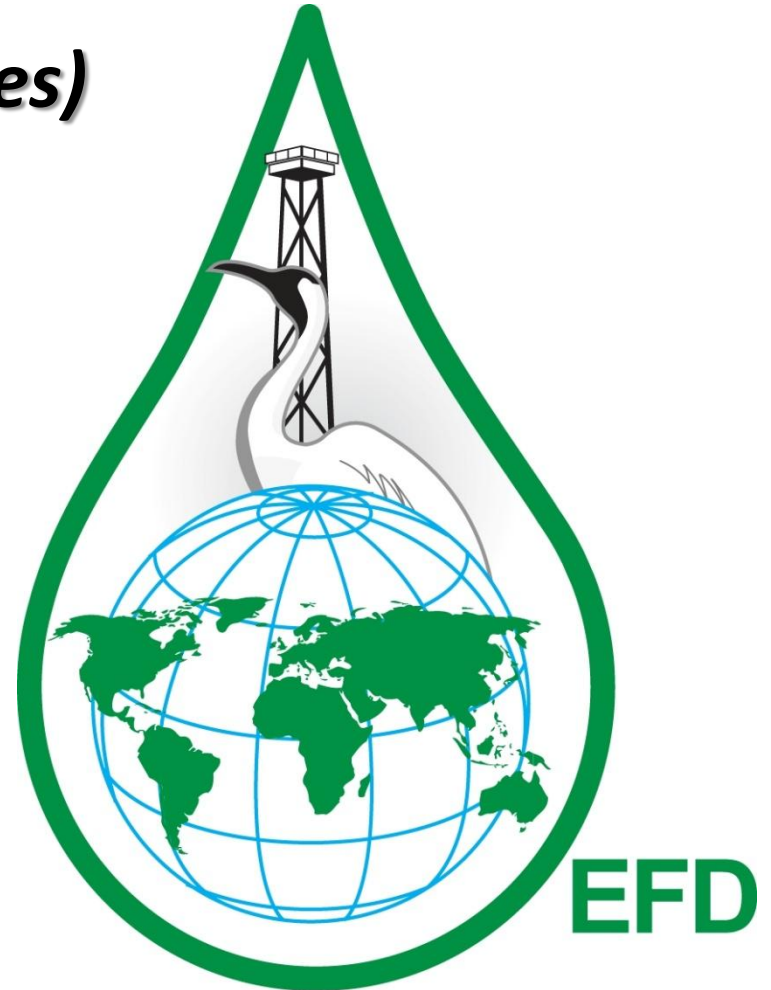


# Under our backyard



# From the Past

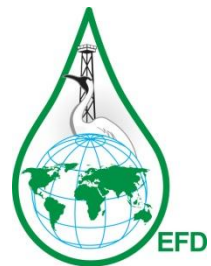
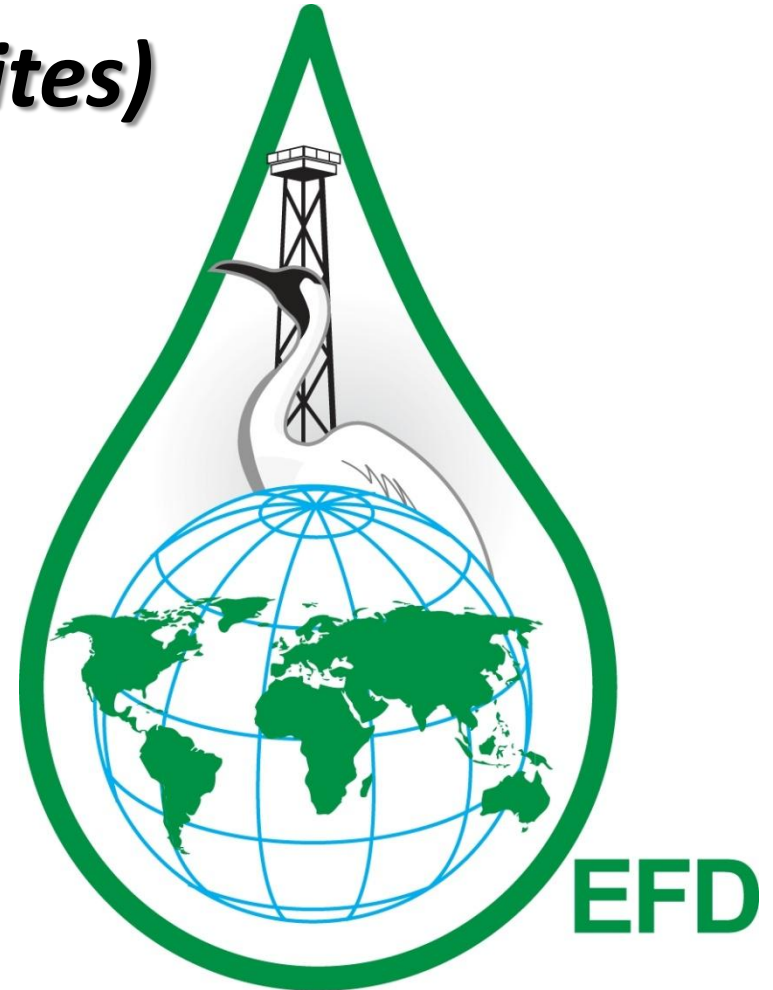
*(multiple wells at multiple sites)*





# To the Present

*(multiple wells at single sites)*





# EFD Program Overview

Focus on technologies for **environmentally sensitive development** of **unconventional energy sources** that can be used to maintain our standard of living and preserve our quality of life.

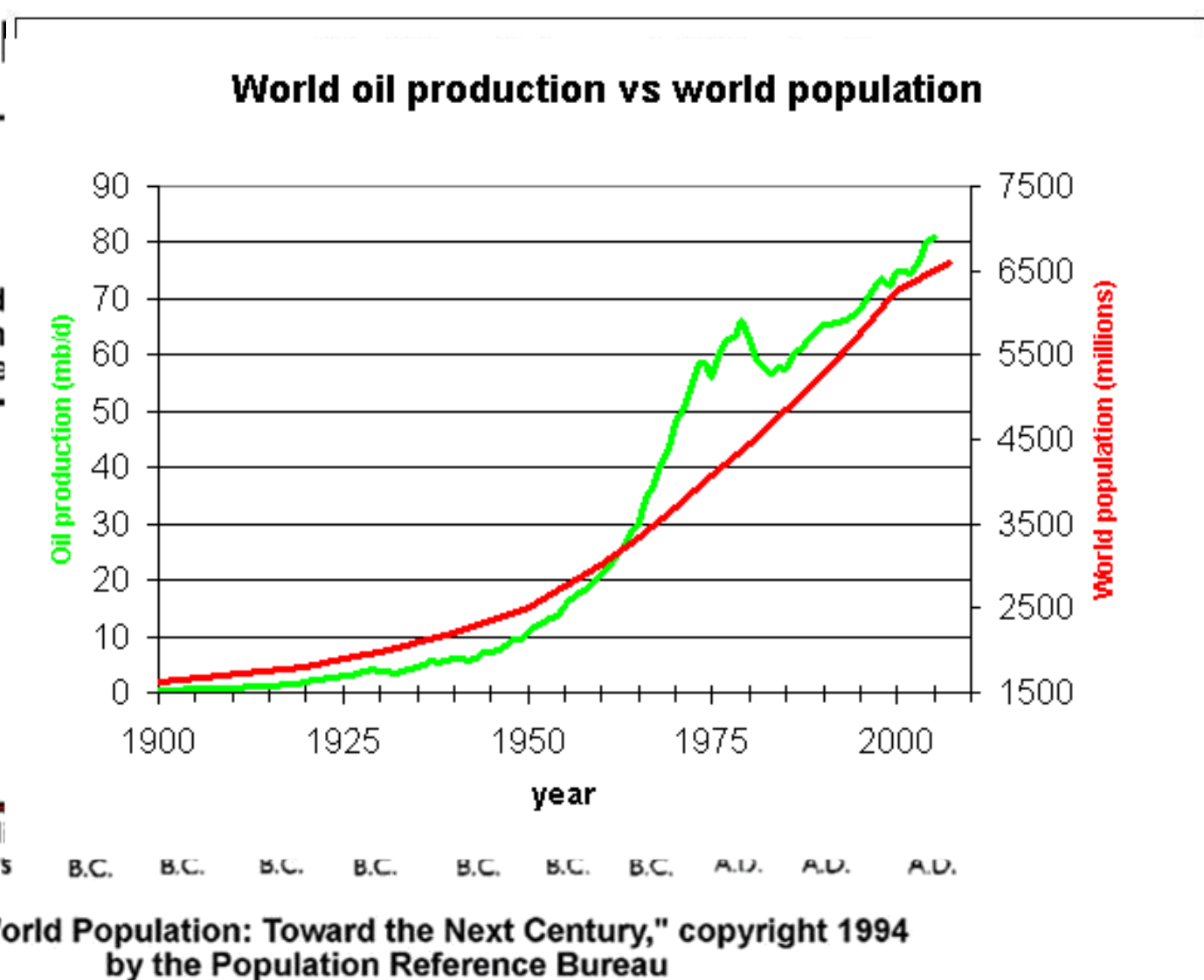
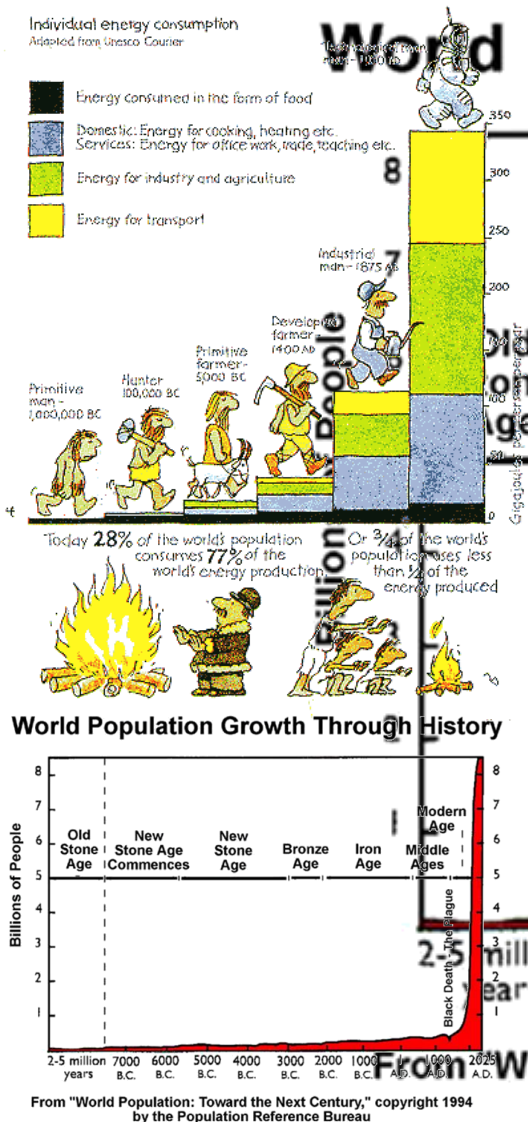
The objective is to **identify**, **develop** and **transfer** critical, **cost effective**, new technologies that can provide policy makers and industry with the ability to develop reserves in a **safe** and **environmentally friendly** manner.

***What gets measured, gets done.  
What gets identified, gets dealt with.  
What gets expected, gets respected.***





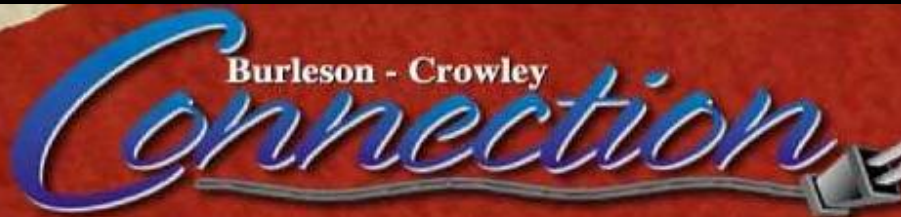
# Population and Energy







# Opposition to O&G Activities



Friday, March 31, 2006 8:44:24 AM

CLICK IT...



Metropolis: Wednesday, October 29, 2008

## LOCAL NEWS

### Developer protests Devon

By Joy E. Cressler/Staff Writer  
Mar 30, 2006, 09:01

BURLESON — A local developer of the Burleson City Council's March 9 development would interfere with pr

The council voted unanimously to take the site, pushing the final decision until

Devon is the owner of a gas lease on Creek Parkway and the Union Pacific Clayton Husband, the city's director

Devon has applied for gas well permit reviewed by the planning and community department and the fire marshal's office

The proposed drill site is a 2-acre area on the southeastern portion of the property

## Un-Well

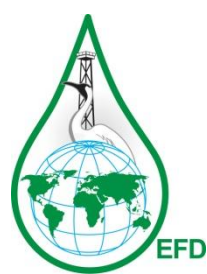
Concerns are mounting over health effects of gas drilling.

By PETER GORMAN

Charles Morgan can't sleep at night. The low-frequency noise from the 11 gas compressors at an Anadarko facility about a mile from his home in the little Freestone County community of Lanely gives him such bad headaches that he frequently has to take a motel room to get away from it. Sometimes he just gets into his pickup or Volkswagen and drives to a country lane elsewhere in the county to get free of it. On other occasions he's found himself in the hospital emergency room.



Ashford: "I just hurt in general, and I find myself getting angry." Photo by Naomi Vaughan.



# The EFD Team

*Co-funded by RPSEA, Industry, Environmental Organizations*

## MANAGEMENT TEAM



## SPONSORS



## ENVIRONMENTAL ORGANIZATIONS



## COLLABORATORS



American Association of Petroleum Geologists

An International Geological Organization



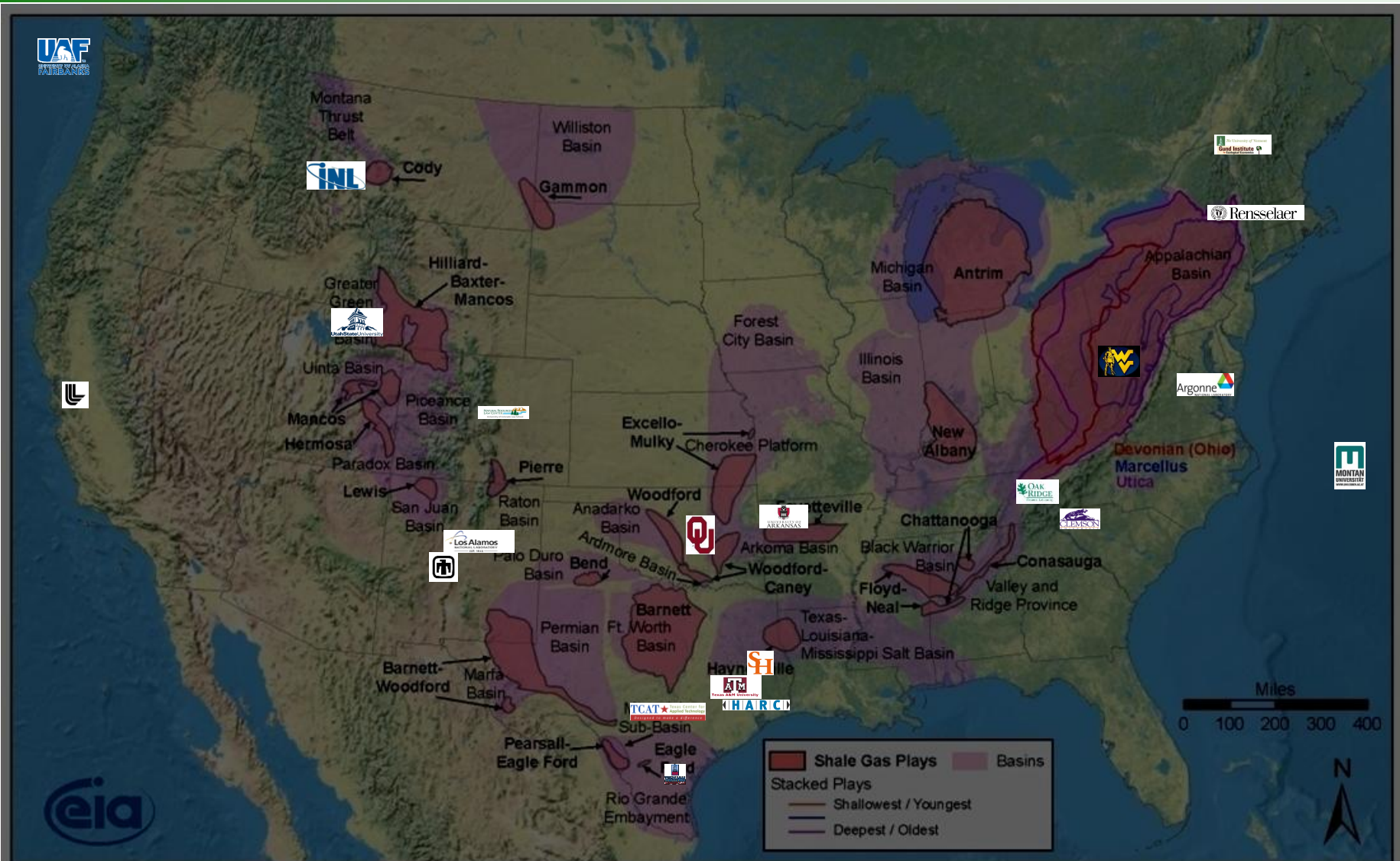
## ALLIANCE MEMBERS







# EFD Alliance



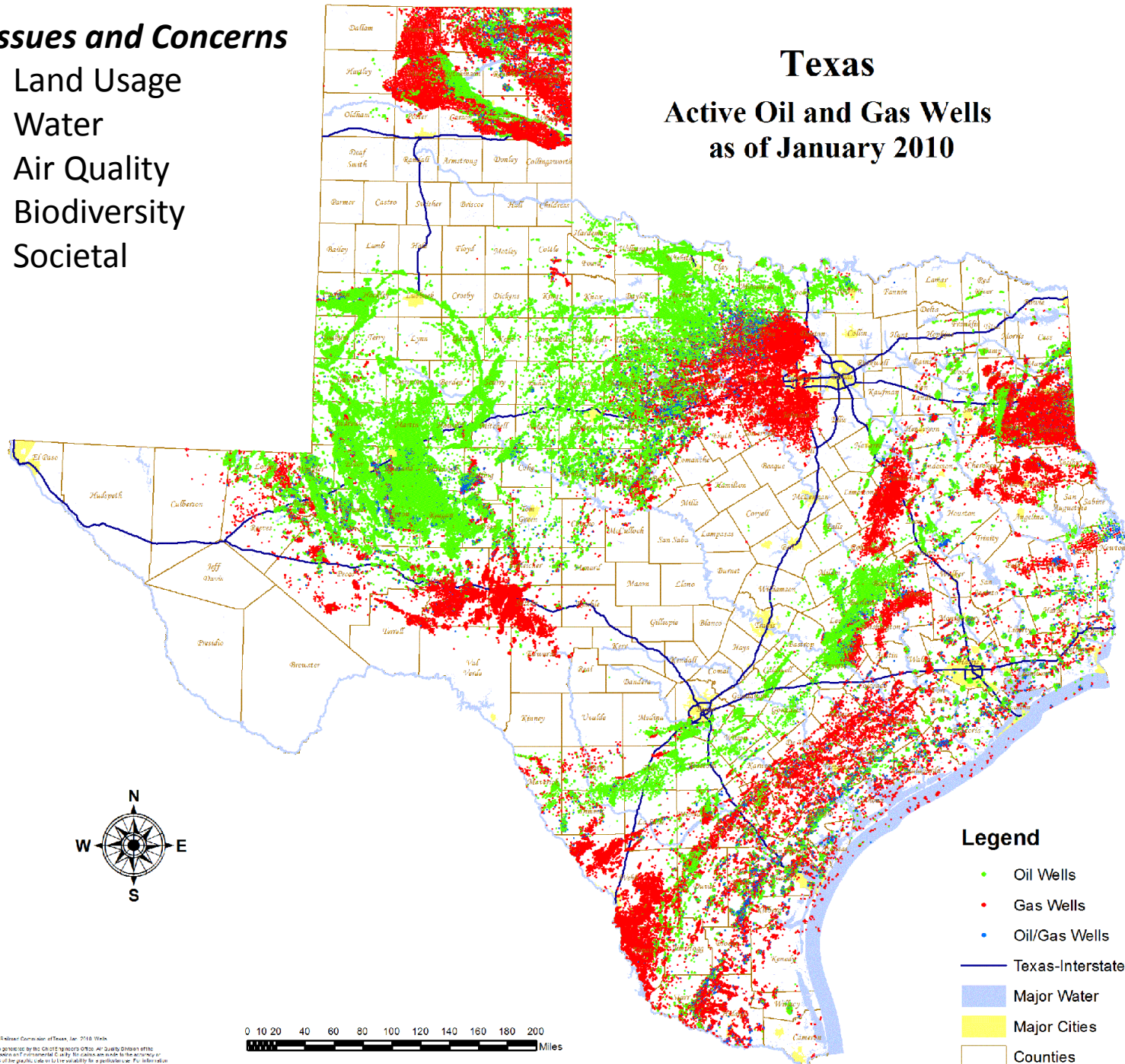


## Issues and Concerns

- Land Usage
- Water
- Air Quality
- Biodiversity
- Societal

## Texas

### Active Oil and Gas Wells as of January 2010



### Legend

- Oil Wells
- Gas Wells
- Oil/Gas Wells
- Texas-Interstates
- Major Water
- Major Cities
- Counties



# Site Access



## Main Components – Rollout Road

- Conformable



- Hinged board segments



***Every site needs a road to link it to the outside world. New technology promises to protect sensitive environments from the damage that putting in a conventional road causes.***

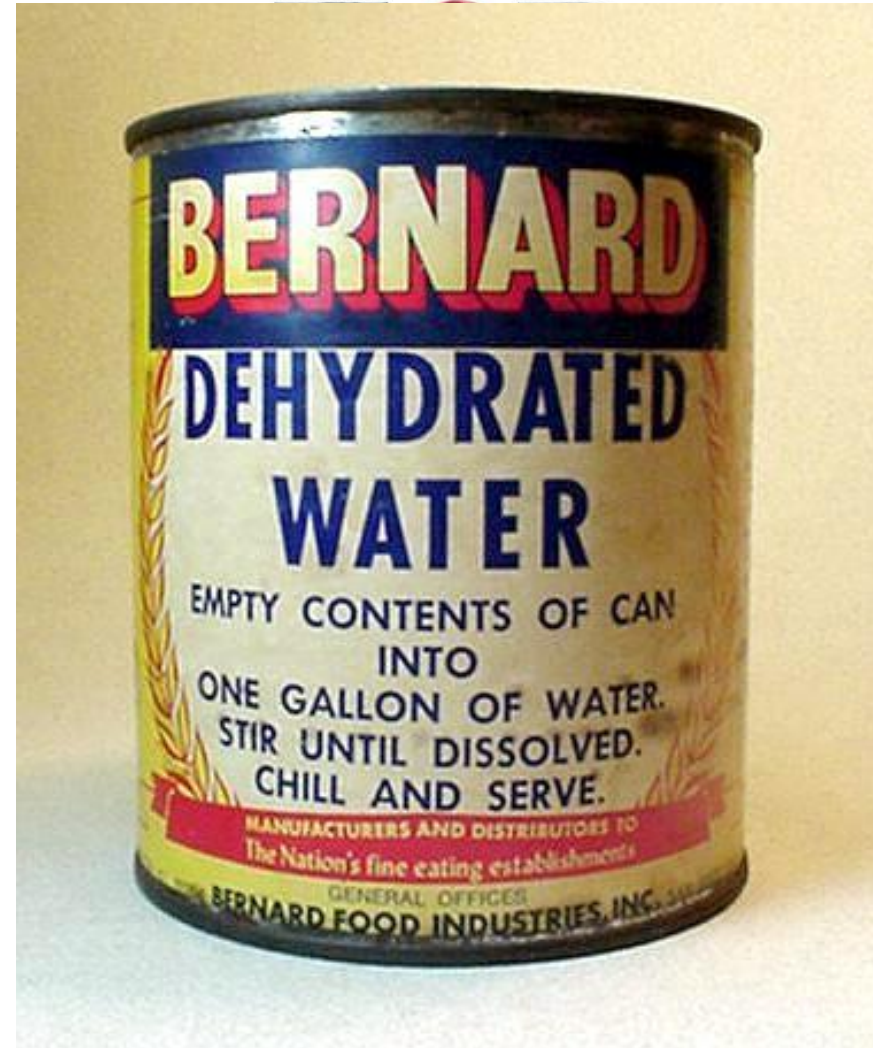




# Water World

- **Life Cycle**
  - Use of non-potable water
  - Produced water management
  - Reuse, reinjection
  - De-watering of wells
  - Cost-effectiveness
- **Regulations/Policy**
  - Offshore discharges
  - Clean Water Act

GLOBAL EXPLORATION & PRODUCTION NEWS • TECHNOLOGY UPDATES • ANALYSIS







# Current Membrane Desalination Projects

- Marcellus Shale NY, PA, WV – pre-treatment
- Central Texas (Luling) – Desalination
- Coastal Texas – Geothermal Desalination
- South Texas (Eagle Ford Shale) – ground water aquifer protection

## MI-SWACO Environmental Solutions

*Applied Research Mobile Water Treatment Units 2009*



*Haynesville Shale – June 2010*





# How Rare is Clean Air?



- **Urban Issues**
  - Non-attainment
  - Permit levels
- **Cold-formed Ozone**
- **Use of Green Completion Technologies**
- **Regulations/Policies**
  - Clean Air Act
  - Greenhouse Gas Issues

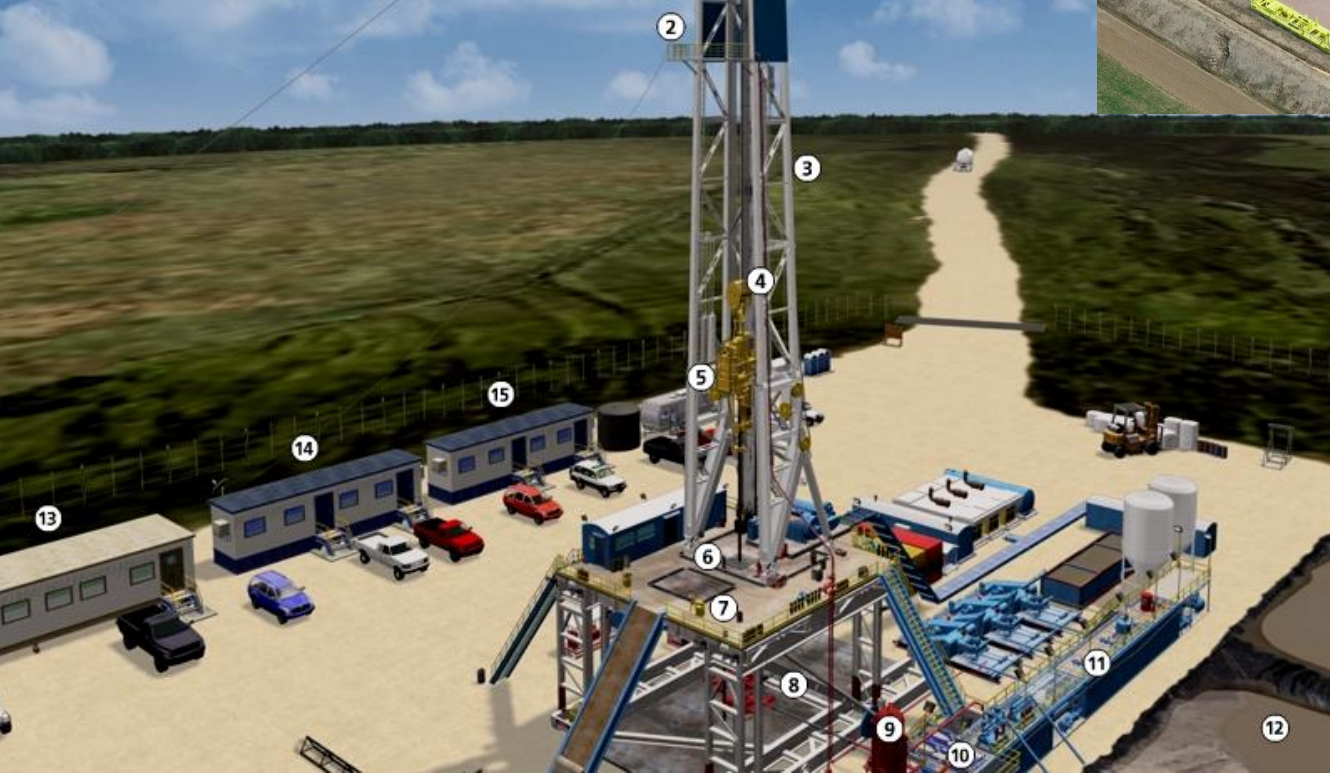
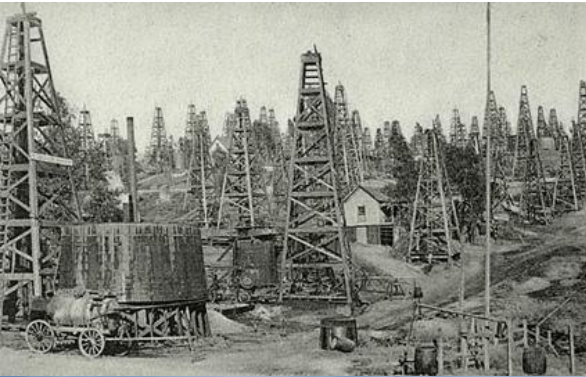


*The EPA estimates that atmospheric emissions of approximately 250 mscf/yr or 100 metric tons of CO<sub>2</sub> equivalent (CO<sub>2</sub>e) of methane per year could be avoided for each high-bleed controller converted.*

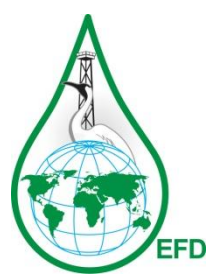




# Rig Evolution







# Hydraulic Fracturing

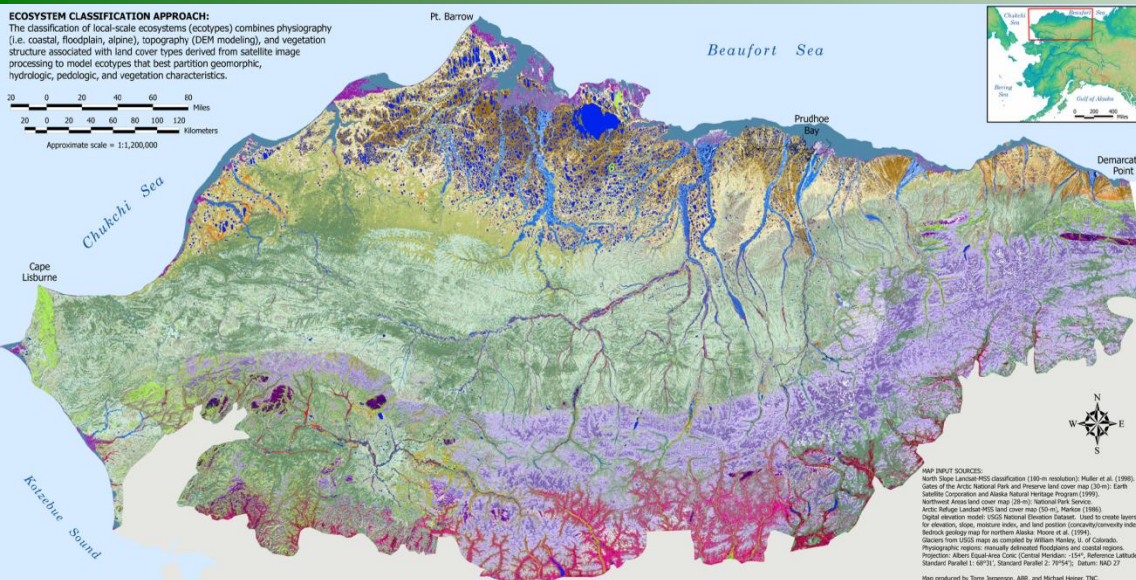
## *Issues*

- Frac fluid formulations
- Fracture containment
- Surface footprint
- Truck traffic
- Frac water flowback
- Frac water recycling





# Ecosystem and Biodiversity Measurement and Assessment



**Develop tools for adaptive ecosystem management to assist integrated management of land, water and living resources that promotes conservation and sustainable use.**

## ***Deliverables***

- Document ecosystem management tools and metrics that may be used in coastal, offshore and Arctic regions and then determine which tool(s) could be most applicable.
- Establish a network of researchers that can collaborate to advance the knowledge/application of ecosystem measurement tools and the understanding of risk management issues.





# Energy Production and the Attwater's Prairie Chicken



**Work with the Nature Conservancy to study the effects of gas production operations on the Attwater's Prairie Chicken**

## ***Deliverables***

- Case study on gas production and the Attwater's Prairie Chicken








# Getting the Word Out

Free-access, searchable,  
database and website for  
best management practices  
(BMPs).

[www.oilandgasbmps.org](http://www.oilandgasbmps.org)

Natural Resources Law Center University of Colorado Law School

## Intermountain Oil and Gas BMP Project




Welcome to the Intermountain Oil and Gas BMP Project Website

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### BEST MANAGEMENT PRACTICES

The Natural Resources Law Center and its partners welcome you to this free-access website of best management practices (BMPs) for oil and gas development in the Intermountain West. The focus of this website is a searchable database addressing surface resources affected by oil and gas development. The database includes both mandatory and voluntary practices currently in use and/or recommended for responsible resource management in the states of Colorado, Montana, New Mexico, Utah, and Wyoming.



The BMP database is not intended to represent a consensus on what the best practices are for specific applications nor to advise users on the current legal requirements for specific locations. Rather, the database describes each practice and documents the source of the practice (who requires or recommends it in what specific applications). The database provides a link to the source of the BMP and, where possible, it provides supplemental information, including construction specifications, illustrations, pictures, maps, monitoring reports, and evaluations of the potential of the practice for mitigating impacts of development. Because practices change over time, database users should check with appropriate authorities to verify the latest requirements and recommendations for your area.

### WORKSHOPS AND TRAININGS

The BMP project hosted its first workshop on October 14, 2009 in Rifle CO: **Best Practices for Community and Environmental Protection**. Almost 60 people participated in a field trip hosted by Williams Production and over 170 attended the sessions at the Garfield County Fairground. For details on the Rifle workshop, go to the [Rifle Workshop Webpage](#) for a copy of the agenda and powerpoint presentations made at the workshop.

### BMP CATEGORIES

The database includes BMPs to address a variety of resources and issues...

- Air quality
- Aquatic/riparian values
- Climate
- Cultural/Historic
- Grazing
- Health/Safety
- Noise
- Other
- Socioeconomic
- Soils/Surface
- Vegetation
- Visual aesthetics
- Water quality
- Water quantity
- Wildlife disruption
- Wildlife habitat

[Browse all](#)

### BMP SEARCH

What management practices are recommended or required for oil and gas development? To find out, use the drop down menus or type Keywords. For a more refined search, click "Advanced Search" or use the [BMP SEARCH](#) button.

**Keywords:**

**Category:**  
Any

**Location:**  
Any


[Advanced Search...](#)

### SEARCH THE BIBLIOGRAPHY

Our searchable bibliography includes over 400 publications, including environmental impact statements, agency guidelines, and many technical reports, websites, and journal articles prepared by government agencies, academics, environmental advocacy groups, and industry. These publications are:

### WHAT'S NEW

Since an informed community is crucial to clear communication and cooperation among interested parties, the new **COMMUNITY** page is intended to provide communities with the resources they need for successful planning, coordination with industry, and navigation of regulations that apply to oil and gas operations.

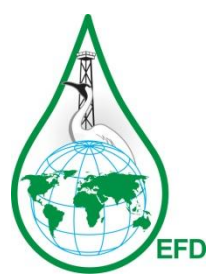


The Intermountain BMP Project is a work in progress. Currently, the database includes BMPs for a variety of resources (see the BMP Categories section) from a range of source documents (see the Bibliography), including project Environmental Impact Statements, Resource Management Plans, state wildlife agency guidelines, and industry and conservation group reports and websites.

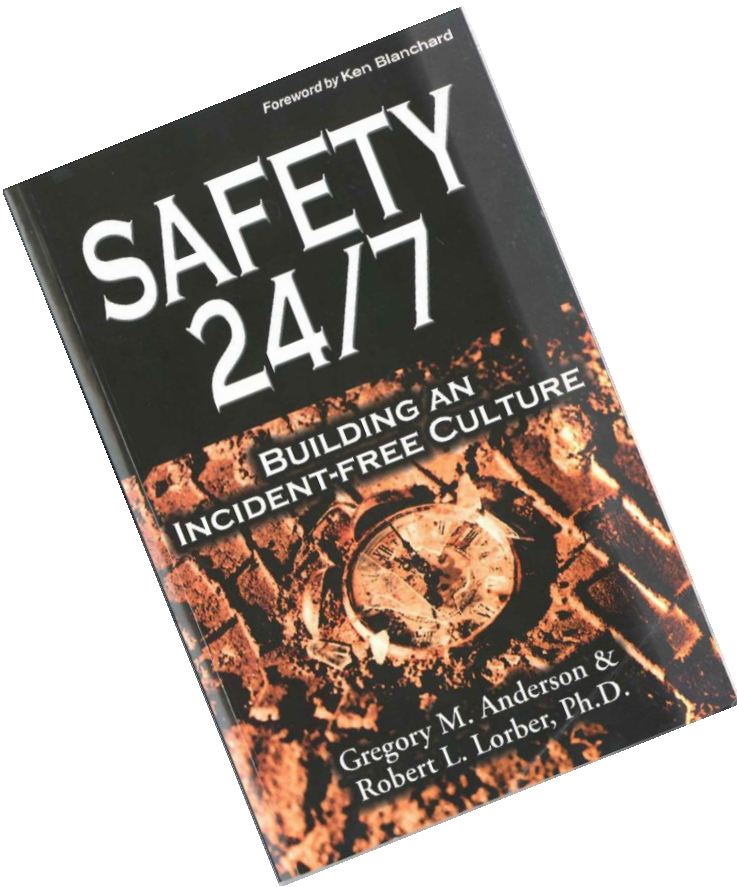
Our newest Resources page additions are **Reclamation** and **Vegetation**. Our newest Database effort is to incorporate cost/benefit analysis data and information on the effectiveness of specific BMPs.

### PARTNERS

The structure and content of this website is being developed in conjunction with project partners and advisors from government,



# Our big challenge: Core Values



- Companies successfully made safety a *core value*.
- Accomplished by leadership, documenting, measuring and training.
- To achieve the same success in environmental performance, will require leaders to also make this a *core value*.



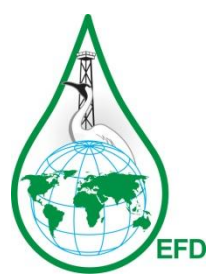


# Scorecard Concepts



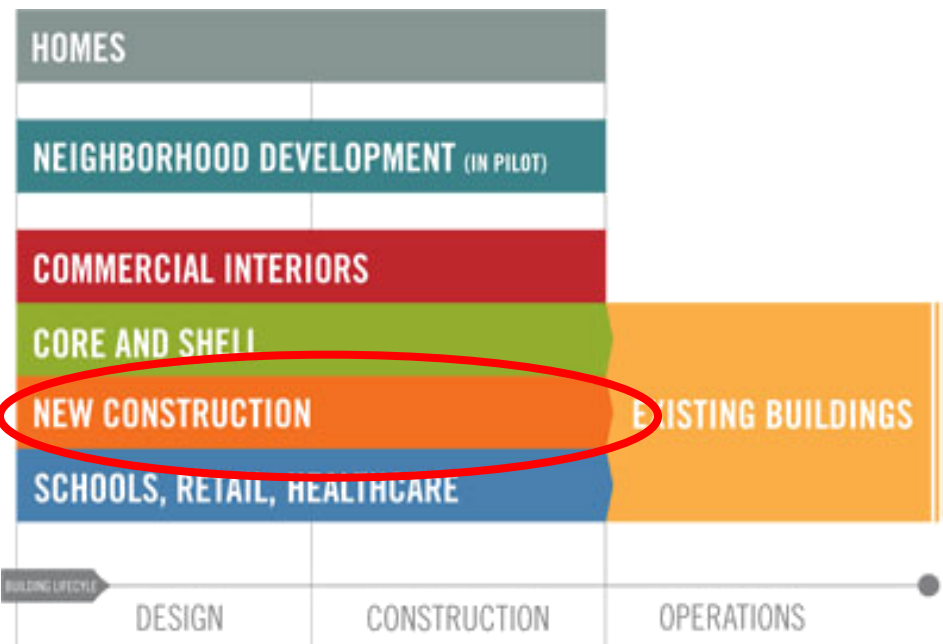
Bldg. 27 Astronaut Quarantine Facility  
LEED® Project # 1486  
LEED Version 2 Certification Level: CERTIFIED  
2/24/2006

Possible Points:	69
Resources	Possible Points: 13
<ul style="list-style-type: none"> <li>Age &amp; Collection of Recyclables</li> <li>ing Reuse, Maintain 75% of Existing Shell</li> <li>ing Reuse, Maintain 100% of Existing Shell</li> <li>ing Reuse, Maintain 100% Shell &amp; 50% Non-Shell</li> <li>struction Waste Management, Divert 50%</li> <li>struction Waste Management, Divert 75%</li> <li>roce Reuse, Specify 5%</li> <li>roce Reuse, Specify 10%</li> <li>led Content</li> <li>led Content</li> <li>Regional Materials, 20% Manufactured Locally</li> <li>Regional Materials, of 20% Above, 50% Harvested Locally</li> <li>ly Renewable Materials</li> <li>ed Wood</li> </ul>	<ul style="list-style-type: none"> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> </ul>
Environmental Quality	Possible Points: 15
<ul style="list-style-type: none"> <li>um IAQ Performance</li> <li>onmental Tobacco Smoke (ETS) Control</li> <li>n Dioxide (CO<sub>2</sub>) Monitoring</li> <li>se Ventilation Effectiveness</li> <li>struction IAQ Management Plan, During Construction</li> <li>struction IAQ Management Plan, Before Occupancy</li> <li>mitting Materials, Adhesives &amp; Sealants</li> <li>mitting Materials, Paints</li> <li>mitting Materials, Carpet</li> <li>mitting Materials, Composite Wood</li> <li>r Chemical &amp; Pollutant Source Control</li> <li>ollability of Systems, Perimeter</li> <li>ollability of Systems, Non-Perimeter</li> <li>al Comfort, Comply with ASHRAE 55-1992</li> <li>al Comfort, Permanent Monitoring System</li> <li>ght &amp; Views, Daylight 75% of Spaces</li> <li>ght &amp; Views, Views for 80% of Spaces</li> </ul>	<ul style="list-style-type: none"> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> </ul>
Design Process	Possible Points: 5
<ul style="list-style-type: none"> <li>ation in Design</li> <li>ation in Design</li> <li>ation in Design</li> <li>ation in Design</li> <li>Accredited Professional</li> </ul>	<ul style="list-style-type: none"> <li>1</li> <li>1</li> <li>1</li> <li>1</li> <li>1</li> </ul>

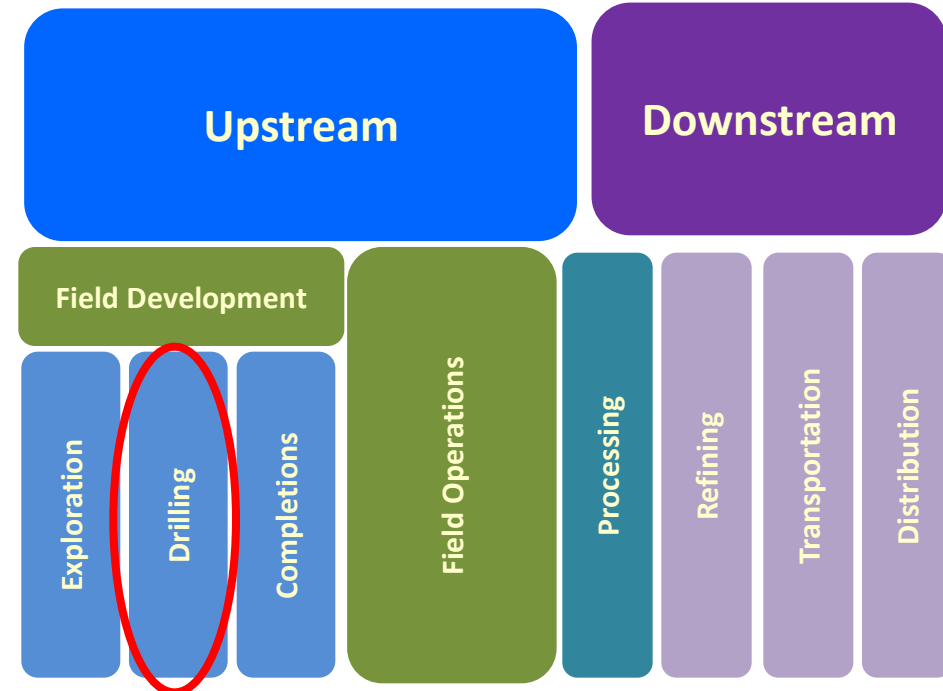


# Focus Scorecard on Operation

## Concept – USGBC LEED Program



## Energy Production *Oil and Gas Operations*





# Stakeholder Engagement is Important!

*Stakeholders are all those who are affected, interested in or have the capacity to influence a project.*

## Academia

- Texas A&M University College Station
- Texas A&M University Kingsville
- University of New Hampshire
- UT Medical Center
- Mississippi State University
- Sam Houston State
- University of South Alabama
- John Hopkins University
- University of Arizona
- University of Texas
- University of Houston

## Environmental Organizations

- Natural Resources Defense Council
- Environmental Defense Fund
- The Nature Conservancy
- Conservation International
- Mercer Arboretum
- Bureau of Applied Anthropology/Arizona
- Clinton Climate Initiative
- Rocky Mountain Clean Air
- McFaddin Ranch

## Industry

- API
- Ballard Exploration
- BP
- Shell
- Chevron
- StatoilHydro
- ConocoPhillips
- Devon
- King Exploration
- Halliburton
- Huisman
- National Oil Well – Varco
- MI Swaco
- TerraPlatform
- T. Baker Smith
- Weatherford
- Derrick Equipment
- Composite Mats
- Ecology and Environmental Inc.
- PTTC
- IADC

## State/Federal Agencies

- US Department of Energy
- Bureau of Land Management
- US Park Service
- Texas Railroad Commission
- Texas General Land Office
- Texas Dept. of Agriculture
- Texas Dept. of Transportation
- US Minerals Management Services
- Texas Parks & Wildlife
- Texas Water Board
- Texas Commission on Env. Quality
- US Environmental Protection Agency
- US Fish and Wildlife
- Argonne National Laboratory
- Big Thicket Preserve
- Idaho National Laboratory





# Tradeoff Scorecard Development

## EFD Facts

Project:

Location:

Ecosystem:

	Max	Score
AIR	10	0
WATER	15	0
SITE	15	0
WASTE MANAGEMENT	20	0
BIODIVERSITY/HABITAT	20	0
SOCIETAL	20	0
	100	0



## Environmentally Friendly Drilling Scorecard

Project:

Location:

Ecosystem: Semi-Arid

Date:

Points Achieved: ★★★★★ 55 - 64 points ★★★★★ 65 - 74 points ★★★★★ 75 - 84 points ★★★★★ 85 - 94 points ★★★★★ 95 - 100 points

Air		Possible Points: 10	Biodiversity/Habitat		Possible Points: 15
Prerq 1	Compliance w/Air Quality Regs		Prerq 1	Species Protection	
Credit 1	Contractual Obligations for Logistics	2	Prerq 2	Habitat Protection/Enhancement	
Credit 2	Site Emissions	2	Prerq 3	Regulatory Requirements	
Credit 3	Dust Suppression	2	Credit 1	Restoration/Interim Reclamation	4
Credit 4	Clean Power	3	Credit 2	Reduction of Surface Disturbance	3
Credit 5	Green Completions	1	Credit 3	Erosion Prevention	2

Water		Possible Points: 20	Societal		Possible Points: 15
Prerq 1	Stormwater Management Plan		Prerq 1	Regulatory Compliance	
Prerq 2	Integrity Testing of Surface Casing		Prerq 2	Communication Plan	
Credit 1	Water Management Plan	9	Credit 1	Public Outreach	3
Credit 2	Setbacks from Streams/Sources	4	Credit 2	Noise and Lighting Control	2
Credit 3	Mitigation Measures/Protect Waters	4	Credit 3	Training of Local First Responders	2
Credit 4	Reduce Water Usage	2	Credit 4	Air Quality Monitors	2
Credit 5	Reuse of Water/Fluids	1	Credit 5	Emergency Response Plan	2

Site		Possible Points: 20	Waste Management		Possible Points: 20
Prerq 1	Regulatory Compliance		Prerq 1	Waste Management Plan	
Prerq 2	Erosion & Sedimentation Control		Prerq 2	Pit Design Pre-site Assessment	
Credit 1	Pre-Existing Site	2	Credit 1	Drilling Fluid Handling System	6
Credit 2	Pad Drilling	2	Credit 2	Lubricants, Fluids, Bulk Materials	5
Credit 3	Protect and Restore Habitat	2	Credit 4	Spill Prevention System	3
Credit 4	Contractor Guidelines	2	Credit 5	Cuttings Reuse	3
Credit 5	Site Restoration Plan	2	Credit 6	Cuttings Reinjection	3
Credit 6	Well Design Considerations	2			
Credit 7	Living Quarters and People	2			
Credit 8	Organic Materials	1			
Credit 9	Pre-Plan for Production	2			
Credit 10	Match Site/Access to Topography	1			
Credit 11	Logistics Plan - Offsite Storage	1			
Credit 12	Planting of Native Vegetation	1			

## EFD Facts

Project:

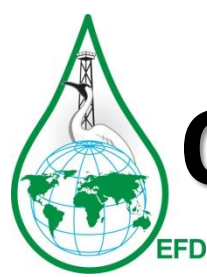
Location:

Ecosystem:

	Max	Score
AIR	10	0
WATER	20	0
SITE	20	0
WASTE MANAGEMENT	20	0
BIODIVERSITY/HABITAT	15	0
SOCIETAL	15	0
	100	0







# Outreach and Technology Transfer

Environmentally Friendly Drilling Systems - Home - Windows Internet Explorer

http://dnn.efdsystems.org/home/tabcd/1253/Default.aspx

File Edit View Favorites Tools Help

Home | Sponsors | Stakeholders | News | Calendar of Events | EFD Research

## Environmentally Friendly Exploration & Production

Program Receives IOGCC Environmental Partnership Stewardship Award

Environmentally Friendly Drilling Systems Program

Upon my return from a visit to Elk H 1 years ago, I stopped for lunch in LA dressed middle-aged couple. My as advised that I was not from Southern and the source of my livelihood, the rigs' were the bane of the earth and noxious chemicals and destroy the

After making a few half-hearted cour remained silent in a cowardly fashio rather than medium. I had to respon know natural gas is the cleanest fue she had any idea how we actually a hesitation, "Well, from a pipeline."

It would be easy to dismiss that pre but in many ways it spoke volumes weaknesses. While there have been industry efforts to be dutiful corporat that it has been a matter of too litt and answer session at the RMI Oil Patterson, vice president of internat acknowledged as much, saying one energy industry today is educating t but also on its enduring efforts to m

An eclectic alliance based in Texas

DECEMBER 2009

Drilling advances

JIM REDDEN, CONTRIBUTING EDITOR

Cost and Risk Management

Cooperative efforts lead to safer operations

Industry and environmental organiza-tions are joining forces to improve operations to significantly reduce the impact of drilling and production activi-ties in environmentally sensitive areas.

Working together  
The Environmentally Friendly Drilling Systems Program (EFD), cofounded by the Research Partnership to Secure Energy for America (RPSE), industry and environmental organizations, seeks to improve advanced technology use with the goal of reducing the impact of petroleum drilling and production on environ-mentally sensitive areas.

The team focuses on technologies for environmentally sensitive develop-ment of unconventional energy sources that can help maintain the present standard of living and pro-duce quality of life. The objective is to identify, develop, and transfer critical technologies to the industry that can provide policy makers and indus-

try with the ability to develop alternative resources in a safe, environmentally friendly manner.

Our member of the EFD, Keri, Inc., has developed an advanced drilling system that reduces repetitive impacts on sensitive areas of drilling. The Keri-Kan Rig System is a Zero-Drill System that can be used in any working envi-ronment to avoid the need for a complex structural modification. The system prevents environmental contamination by containing drilling fluids and preventing pipe connect-

ions from leaking. The Keri-Kan Rig System is a safe and effective, new technologies that can provide policy makers and industry with a safe and environmentally friendly manner.

As seen in the January 2010 issue of

E&P

the ENERGY link

E&P Focus

Environmentally Friendly Drilling Program To Reduce Impact of Operations on Ecosystems

The oil and gas industry has made great strides in protecting the environment, while increasing natural gas production in the U.S. However, the challenges facing producers to cost effectively produce more natural gas in environmentally sensitive areas are daunting. The Houston Advanced Research Center (HARC) and its partners offer a program to reduce the impact of oil and gas operations in environmentally sensitive ecosystems. The Environmentally Friendly Drilling (EFD) program combines new low impact technologies that reduce the footprint of drilling activities, integrates light weight drilling rigs with reduced emissions engine packages, addresses on-site waste management, optimizes the systems to fit the needs of a specific development site and provides tools to enhance industry's stewardship of the environment (Figure 1). In addition, the EFD program offers a way to include industry, the public, environmental organizations, and elected officials in a collaboration that addresses concerns on development of unconventional natural gas resources in environmentally sensitive areas.

Figure 1: Optimizing the footprint of drilling activities is a key goal of the Environmentally Friendly Drilling Program. Photo courtesy of the Houston Advanced Research Center.

## Publications/Articles

## Exhibits

## Presentations

# EFD EU Initiative



- Identify and Transfer Innovation and Cost Effective Best Practices in US and Europe
  - Technology Transfer opportunity
  - EU regulatory requirements that have caused innovation
  - Identify applicable and cost effective practices (US and Europe)
  - Inform respective regulators about certain requirements that have not worked well
- Establish a non-government dialogue
- Gas Shale Play issues are of keen interest
- First International Workshop followed SPE in Florence September 2010



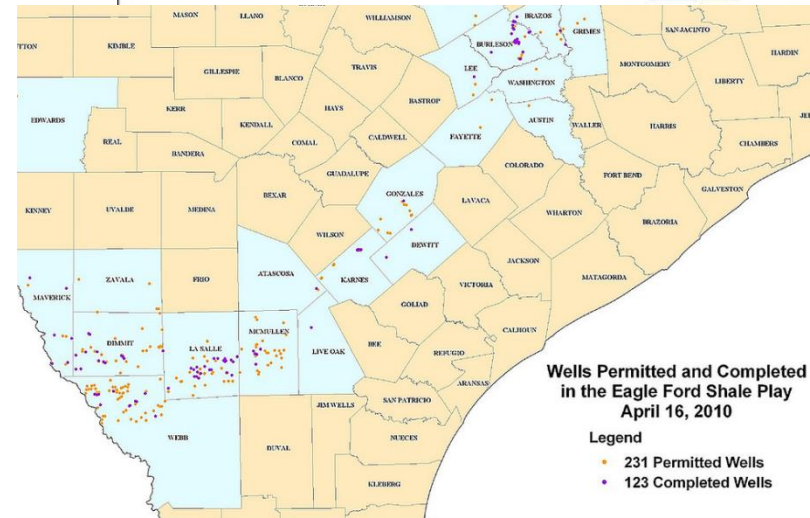
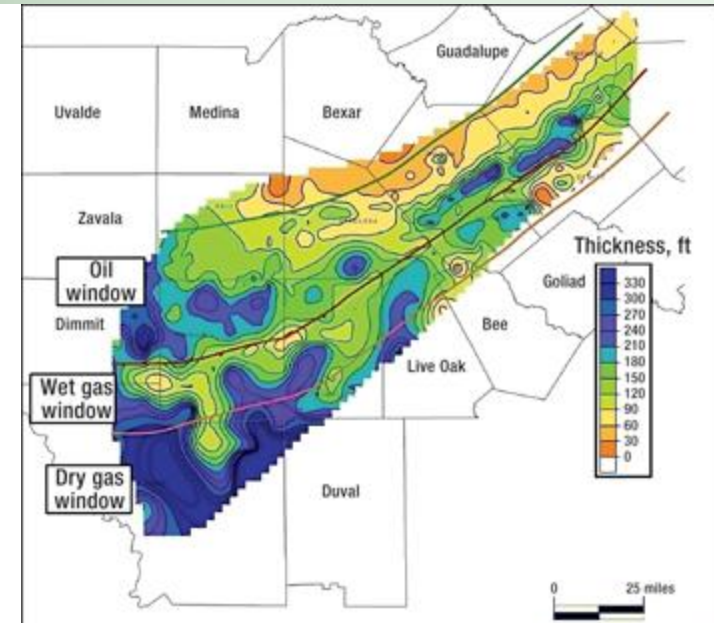
# Next Phase

## *Technology Integration Program*

- Integrated approach for applying new technologies

## Description

- Field Tests in the Eagle Ford
- Web sites for virtual gas developments
- Outreach/Technology Transfer







# Complementary Program

## *Coastal Impacts Technology Program (CITP)*

- Technology Road Mapping
- Environmental Impact Mitigation
  - Studies
  - Field Trials
- Inter-State Collaboration
- Workforce Development
  - Workshops
  - Web Site
  - Outreach efforts





# The Environmentally Friendly Drilling Systems Program

[www.efdsystems.com](http://www.efdsystems.com)

## Environmentally Friendly Drilling Systems Program

*Technology Integration Program*

*Ecosystem and Biodiversity  
Measurement and Assessment*

*Groundwater Monitoring Program*

*Texas Coastal Management  
Performance Measure System*

*Galveston Bay Status & Trends*

*Produced water and frac water*

*Coastal Impacts Technologies Program*

*Disappearing Roads Competition*

*E&P in Environmentally Sensitive Arctic Areas*

*Galveston Bay Freshwater Inflows Group*

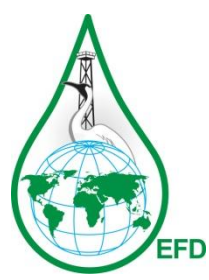
*Land Conservation & Rural Stakeholders*

*Air Quality*

*Water Treatment and Re-use*

*Waste Management*

*Low Impact Roads*



# It's not so hard to be green



Questions?

**Thank you**

[www.efdsystems.org](http://www.efdsystems.org)