

**UNCONVENTIONAL RESOURCES TECHNOLOGY  
ADVISORY COMMITTEE  
(URTAC)**

SEPTEMBER 19, 2013  
TWENTY-THIRD MEETING

**MEETING MINUTES**

UNCONVENTIONAL RESOURCES TECHNOLOGY ADVISORY COMMITTEE  
23<sup>RD</sup> MEETING; SEPTEMBER 19, 2013; WEB MEETING

I hereby certify that this transcript constitutes an accurate record of the Unconventional Resources Technology Advisory Committee meeting held on September 19, 2013.



---

Elena Melchert  
Acting Designated Federal Officer

9-23-13

---

Date

**UNCONVENTIONAL RESOURCES TECHNOLOGY ADVISORY COMMITTEE  
23<sup>RD</sup> MEETING; SEPTEMBER 19, 2013; WEB MEETING**

**ATTENDEES:**

**Committee Members**

James Dwyer, Acting Chair  
Nancy Brown  
Wayne Camp  
Chris Hall  
Robert Kleinberg  
Fletcher Lewis  
John Martin  
Greg Mason  
Shahab Mohaghegh  
Briana Mordick  
Gary Nilson  
Ken Oglesby  
Don Sparks

**U.S. Department of Energy**

Elena Melchert,  
Acting Designated Federal Officer  
Ray Boswell, Technology Manager,  
National Energy Technology Laboratory  
Gary Covatch, Project Manager,  
National Energy Technology Laboratory  
Alexandra Hakala, Technical Coordinator,  
National Energy Technology Laboratory  
Olayinka Ogunsola, Committee Manager  
Michelle Rathbun, Meeting Recorder, IBM  
Eric Smistad, Technology Manager,  
National Energy Technology Laboratory

**RPSEA**

Kent Perry, Vice President, Onshore  
Programs  
Bob Siegfried, President

**DISCUSSION:**

**Committee Business**

- The meeting was opened at 1:08 p.m. EST by Elena Melchert, Acting Designated Federal Officer.
- Ms. Melchert took roll call and announced that a quorum was present.
- She then gave opening remarks about DOE's Office of Fossil Energy.

**Research Portfolio Presentations**

- Mr. Perry presented RPSEA Onshore Program Overview (Attachment 4).
- Dr. Hakala presented EAct Complementary Program Unconventional Resources (Attachment 5).
- Dr. Boswell presented NETL-SCNGO Oil and Gas R&D Program (Attachment 6).
- Mr. Smistad presented NETL Oil Technology R&D Portfolio (Attachment 7).

**Overview of the DRAFT 2014 Annual Plan**

- Ms. Melchert explained the contents of the draft plan and the process for URTAC to review the portfolio, discuss general thoughts, and to establish subcommittees (Attachment 3).
- The Committee discussed themes from the research portfolio.

**UNCONVENTIONAL RESOURCES TECHNOLOGY ADVISORY COMMITTEE  
23<sup>RD</sup> MEETING; SEPTEMBER 19, 2013; WEB MEETING**

**Establishment of Subcommittees**

- The Committee established four Subcommittees.
  - Policy Subcommittee: Gary Nilson (Chair), Jessica Cavens, James Dwyer, Chris Hall, John Martin, Greg Mason
  - R&D Subcommittee: John Martin (Chair), Nancy Brown, James Dwyer, John Harju, Fletcher Lewis, Shahab Mohaghegh, Don Sparks
  - Technology Transfer Subcommittee: Chris Hall (Chair), James Dwyer, Fletcher Lewis, Greg Mason, Gary Nilson
  - Environment Subcommittee: Briana Mordick (Chair), Nancy Brown, Wayne Camp, Robert Kleinberg
- Ms. Melchert reviewed the process and next steps.
- There were no public comments.
- Acting URTAC Chair, Mr. Dwyer, moved for adjournment and the meeting was adjourned at 3:58 p.m.

**ATTACHMENTS:**


<b>Number</b>	<b>Description</b>
Attachment 1	Delegation of Acting Designated Federal Officer
Attachment 2	Meeting Agenda
Attachment 3	URTAC Overview
Attachment 4	RPSEA Onshore Program Overview
Attachment 5	EPAct Complementary Program Unconventional Resources
Attachment 6	NETL-SCNGO Oil and Gas R&D Program
Attachment 7	NETL Oil Technology R&D Portfolio



Department of Energy  
Washington, DC 20585

MEMORANDUM FOR FILE

**TO:** UNCONVENTIONAL RESOURCES TECHNOLOGY ADVISORY  
COMMITTEE

**FROM:** GUIDO DEHORATIIS   
DESIGNATED FEDERAL OFFICER  
UNCONVENTIONAL RESOURCES TECHNOLOGY ADVISORY  
COMMITTEE

**SUBJECT:** **Acting Designated Federal Officer**

I hereby designate Elena Melchert, Division Director, Oil and Gas Safety and Environmental Sustainability, to serve as the Acting Designated Federal Officer for all remaining meetings of the Unconventional Resources Technology Advisory Committee.





**Department of Energy**  
Washington, DC 20585

**23<sup>rd</sup> Meeting of the Unconventional Resources Technology Advisory Committee**  
**Thursday, September 19, 2013**

Online Meeting: <https://usdoe.webex.com/usdoe/mc>  
Meeting Number: 997 437 247  
Meeting Password: password  
Call-in toll-free number: 1-888-426-6840  
Access code: 1837498

**Agenda**

- 12:45 pm *Registration*  
Member Login; Speaker Login
- 1:00 Call to Order, Member Roll Call, Welcome  
Administrative topics  
  
Opening Remarks by the Designated Federal Officer
- 1:15 Overview of the Oil and Gas Research Program  
-DOE-RPSEA portfolio  
-NETL portfolio  
--Section 999 Unconventional Research  
--DOE Unconventional Oil and Gas Research
- 2:45 Overview of the *DRAFT 2014 Annual Plan*
- 3:45 Establishment of ad hoc Review Subcommittees and Chairs
- 4:45 Public Comments, if any  
Next Steps
- 5:00 pm Adjourn

Approved:

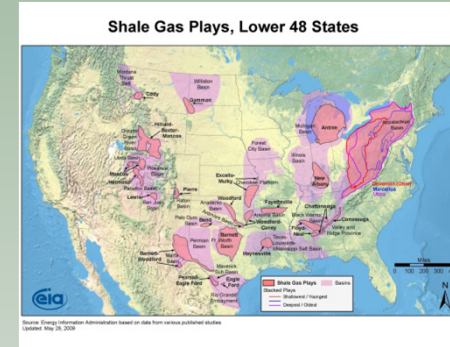
Handwritten signature of Elena Melchert in black ink.

Elena Melchert  
Acting Designated Federal Officer

9-19-13

Date





## Unconventional Resources Technology Advisory Committee

Elena Melchert

Acting Designated Federal Officer

Ultra-Deepwater Advisory Committee

September 19, 2013



U.S. DEPARTMENT OF  
**ENERGY**

Fossil  
Energy

# 2014 Annual Plan Review Process

- September 19, 2013; Web Meeting
  - Overview of DOE Research Program
  - Establish subcommittees
- October 10, 2013; Web Meeting
  - Subcommittees present their reports to URTAC
  - URTAC develops *final* findings and recommendations on the *2014 Annual Plan*
  - Chair appoints Editing Subcommittee to develop URTAC's written report
    - Editing Subcommittee may not change the letter or spirit of the URTAC findings or recommendations
  - Editing Subcommittee begins meeting immediately after the URTAC meeting adjourns





# *2014 Annual Plan Review Process*

- Conference Call Meeting on November TBD
  - URTAC meets via conference call to vote on the Editing Subcommittee report
  - Chair delivers the URTAC final recommendations to the Secretary of Energy via the Designated Federal Officer (DFO)



# Next Steps

- **September 19, 2013:** Begin review
- **October 10, 2013:** Deliberate on recommendations
- **November TBD:** Vote on Editing Subcommittee report





•  
• **Research**  
• **Partnership to**  
• **Secure Energy**  
• **for America**  
•

# **RPSEA Onshore Program**

## ***Overview and Research Highlights***

**Kent F. Perry**

**WebEx Meeting**  
**Thursday, September 19, 2013**

[rpsea.org](http://rpsea.org)

# Mission & Goals

- **Small Producer Mission & Goals**

- Increase supply from mature resources
  - Reduce cost
  - Increase efficiency
  - Improve safety
  - Minimize environmental impact

- **Unconventional Gas Mission & Goal**

- *Economically viable* technologies to allow environmentally acceptable development of unconventional gas resources
  - Gas Shales
  - Tight Sands
  - Coalbed Methane

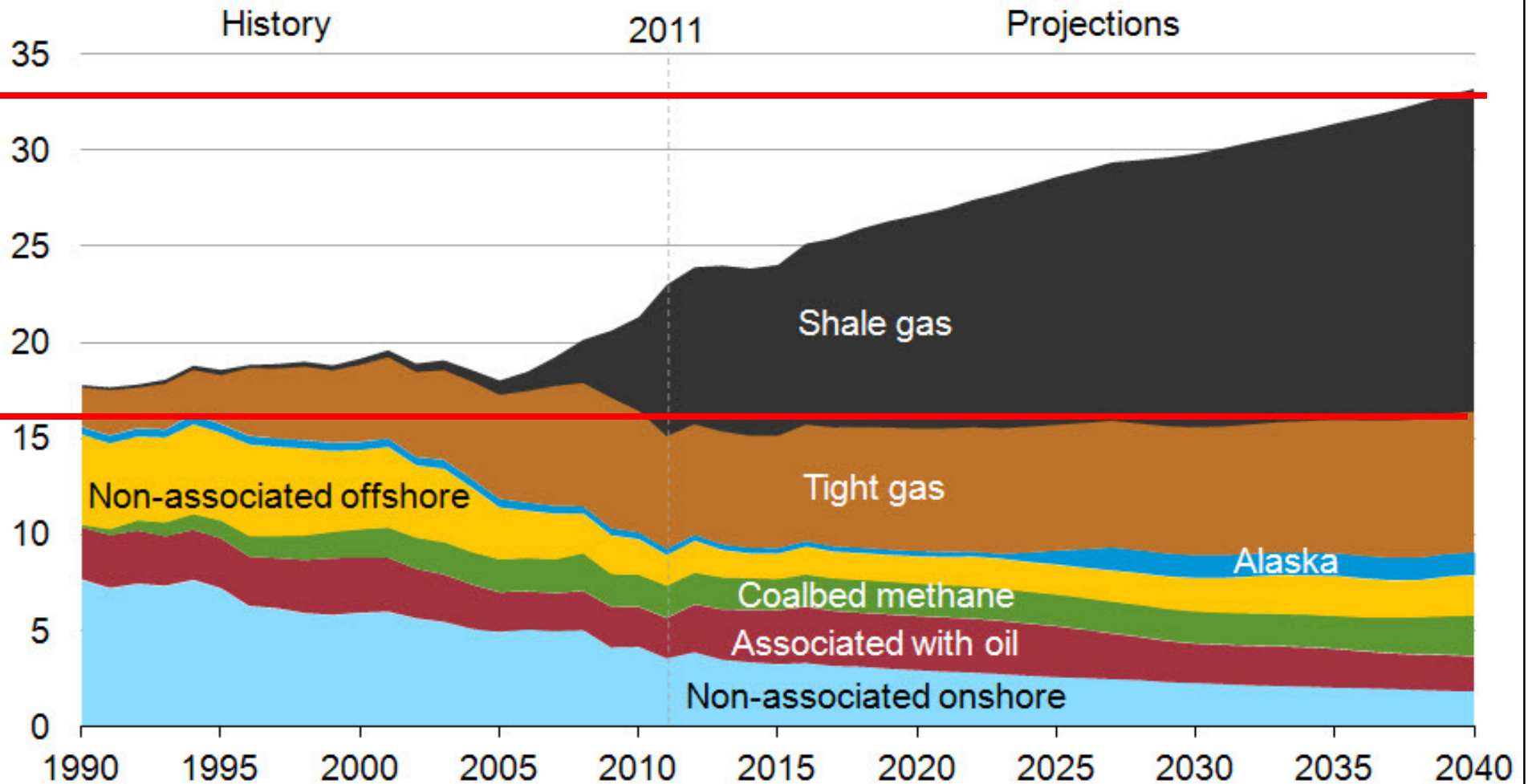
# Environmental Issues

- > Hydraulic Fracturing
- > Land Use
- > Air Emissions
- > Water Usage
- > Water Quality
- > Traffic
- > Road Damage
- > Noise
- > Wildlife
- > Image Deficit



# U.S Gas Production

U.S. dry natural gas production  
trillion cubic feet



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013 Early Release*

# Onshore Projects

## Unconventional Resources

**60 Projects  
27 Completed**

## Small Producers

**30 Projects  
11 Completed**

	Gas Shales	Tight Sands
Integrated Basin Analysis	New Albany (GTI) \$3.4 Marcellus (GTI) \$3.2 Mancos (UTGS) \$1.1 <i>Technology Integration (HARC) \$6.0</i>	Piceance (CSM) \$2.9 <i>Piceance Permeability Prediction (CSM) \$0.5</i>
Stimulation and Completion	Cutters (Carter) \$.09 Frac (UT Austin) \$.69 Refrac (UT Austin) \$.95 <b>Frac Cond (TEES) \$1.6</b> Stimulation Domains (Higgs-Palmer) \$0.39 Fault Reactivation (WVU) \$0.85 <i>Cryogenic Frac Fluids(CSM) \$1.9</i> <i>Geomechanical Frac Containment Analysis (TAMU) \$0.65</i> <i>Frac Diagnostics (TAMU) \$0.76</i> <i>Conductivity of Complex Fracturing in Unconventional Shale Reservoirs(TAMU) \$.88</i> <i>Advanced Hydraulic Fracturing (GTI)\$6.2</i>	Gel Damage (TEES) \$1.05 Frac Damage (Tulsa) \$.22 Foam Flow (Tulsa) \$0.57 Petrophysics and Tight Rock Characterization for the Application of Improved Stimulation and Production Technology in Shale (OSU) \$1.5
Reservoir Description & Management	Hi Res. Imag. (LBNL) \$1.1 <b>Gas Isotope (Caltech) \$1.2</b> <b>Marcellus Nat. Frac./Stress (BEG) \$1.0</b> Frac-Matrix Interaction (UT-Arl) \$0.46 Marcellus Geomechanics (PSU) \$3.1	Tight Gas Exp. System (LBNL) \$1.7 <b>Strat. Controls on Perm. (CSM) \$0.1</b> Fluid Flow in Tight Fms. (MUST) \$1.2
Reservoir Engineering	Decision Model (TEES) \$.31 <b>Coupled Analysis (LBNL) \$2.9</b> Shale Simulation (OU) \$1.05	Wamsutter (Tulsa) \$.44 Forecasting (Utah) \$1.1 Condensate (Stanford) \$.52
Exploration Technologies	<b>Multi-Azimuth Seismic (BEG) \$1.1</b>	
Drilling	Drilling Fluids for Shale (UT Austin) \$0.6	
<b>2007 Projects;</b> <b>2008 Projects;</b> <b>2009 Projects;</b> <b>2010 Projects;</b> <b>2011 Projects</b>		



<p><b>Water Management</b></p>	<p><b>Barnett &amp; Appalachian (GTI) \$2.5</b>  <b>Integrated Treatment Framework (CSM) \$1.56</b>  <i>NORM Mitigation (GE) \$1.6</i>  <i>Water Handling and Enhanced Productivity from Gas Shales; (USC)\$1.7</i>  <i>Development of GIS-Based Tool for Optimized Fluid Management in Shale Operations(CSU)\$1.1</i>  <i>Advanced Treatment of Shale Gas Frac Water to Produce NPDES Quality Water (SRI)\$1.9</i>  <i>Cost-Effective Treatment of Flowback and Produced Waters via an Integrated Precipitative Supercritical Process(OhioU)\$1.9</i>  <i>Development of Subsurface Brine Disposal Framework in the Northern Appalachian Basin(Battelle)\$1.9</i>  <i>Development of Plasma Technology for the Management of Frac/Produced Water (Drexel)\$1.5</i>  <i>Advancing a Web-Based Tool for Unconventional Natural Gas Development with Focus on Flowback and Produced Water Characterization, Treatment and Beneficial Use(CSM)\$0.28</i></p>	<p><b>Frac Water Reuse (GE) \$1.1</b>  <i>Engineered Osmosis Treatment (CSM) \$1.3</i></p>
<p><b>Environmental</b></p>	<p><b>Environmentally Friendly Drilling (HARC)* \$2.2</b>  <i>Zonal Isolation (CSI) \$3.0</i>  <i>Understanding and Managing Environmental Roadblocks to Shale Gas Development: An Analysis of Shallow Gas, NORMs, and Trace Metals (UTexas)\$1.3</i>  <i>Reducing the Environmental Impact of Gas Shale Development: Advanced Analytical Methods for Air and Stray Gas Emissions and Produced Brine Characterization(GSI Environmental)\$3.4</i>  <i>Development of Methods to Prohibit and Remediate Loss of Annular Isolation in Shale Gas Wells: Prevention and Remediation of Sustained Casing Pressure and Other Isolation Breaches(CSI)\$4.0</i>  <i>Relationships between Induced Seismicity and Fluid Injection: Development of Strategies to Manage Fluid Disposal in Shale Hydrocarbon Plays(UTexas)\$0.96</i></p>	<p>*</p>
<p><b>Resource Assessment</b></p>	<p><b>Alabama Shales (AL GS) \$.5</b>  <b>Manning Shales (UT GS) \$.43</b></p>	<p><b>Rockies Gas Comp. (CSM) \$.67</b></p>

**2007 Projects;**

**2008 Projects;**

**2009 Projects;**

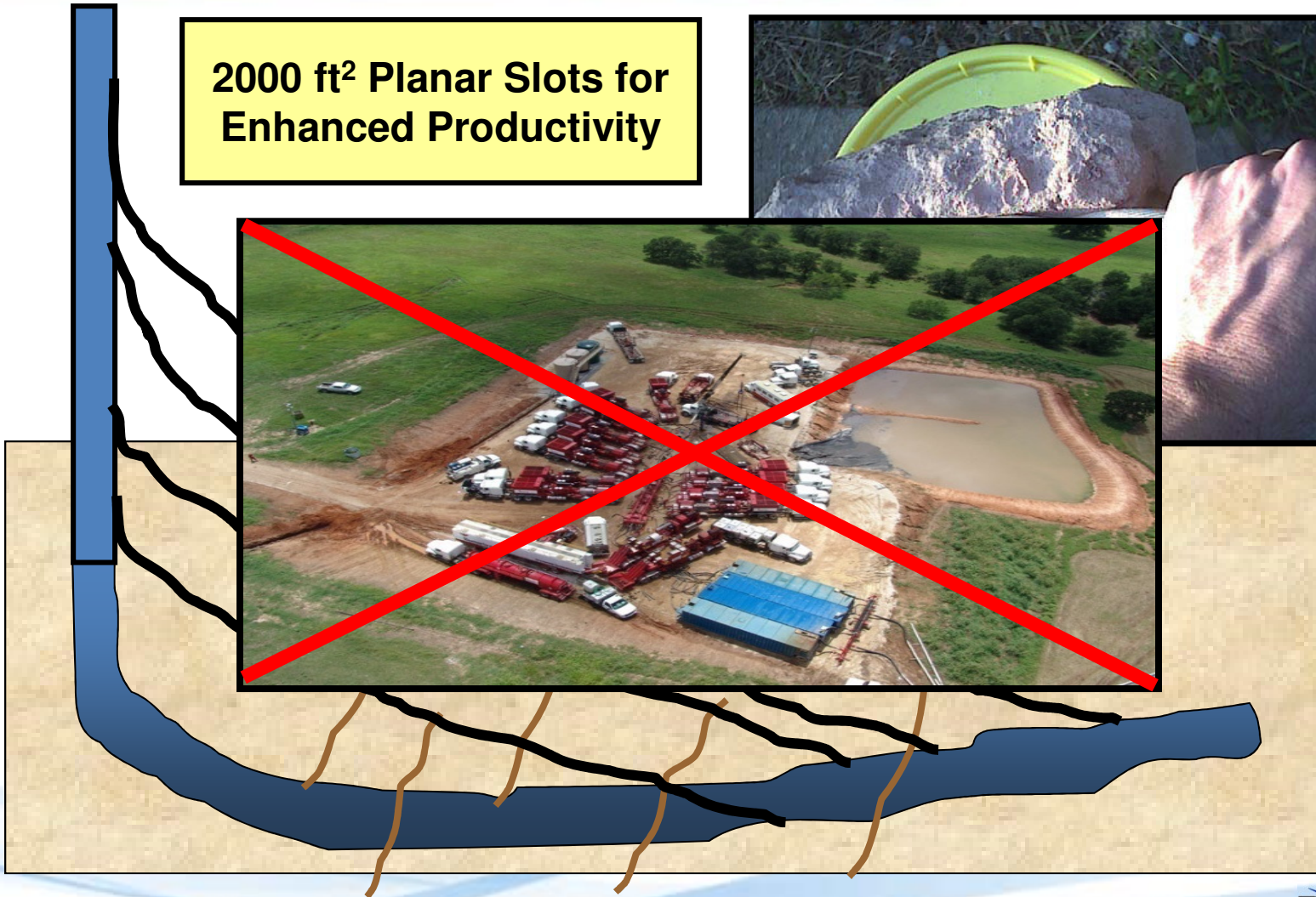
**2010 Projects;**

**2011 Projects**

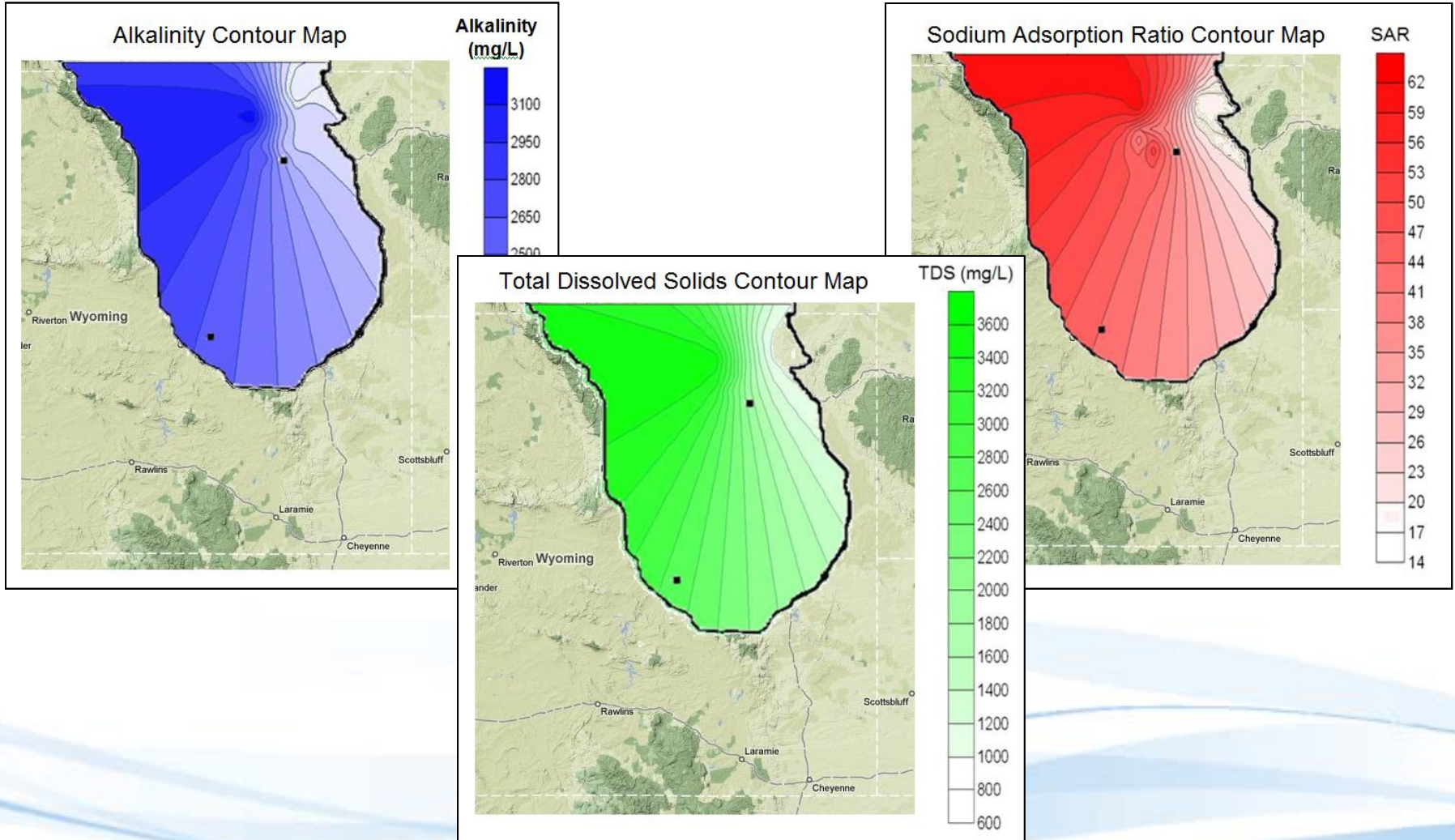
# Selected Program Results

# Cable Saw for Well Stimulation

2000 ft<sup>2</sup> Planar Slots for Enhanced Productivity



# Produced Water Quality: Powder River



# Reservoir Connectivity and Stimulated Gas Flow in Tight Sands “The Piceance Project”



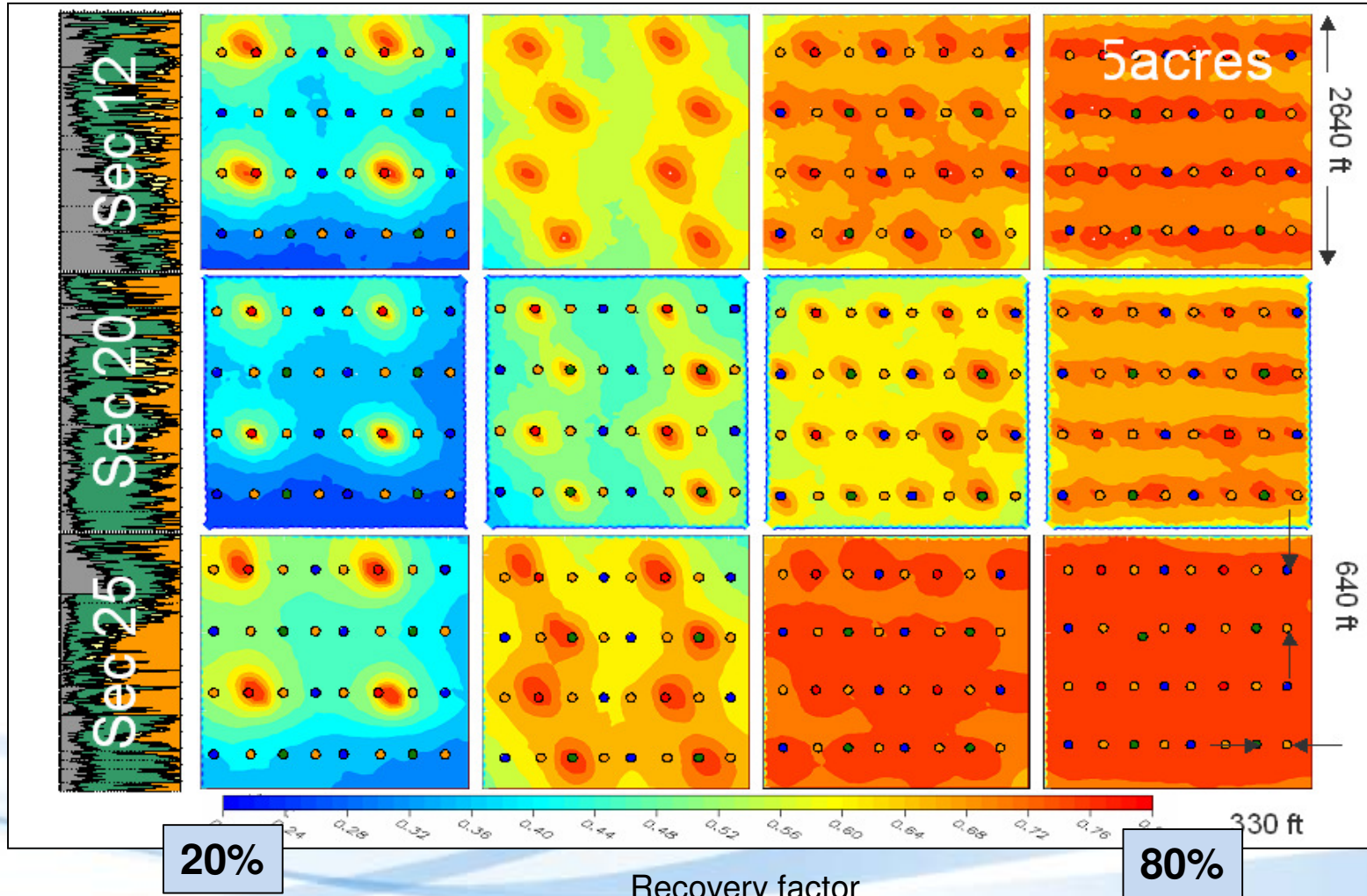
# Reservoir Connectivity - Tight Sands

Well Spacing → 40-acres

20-acres

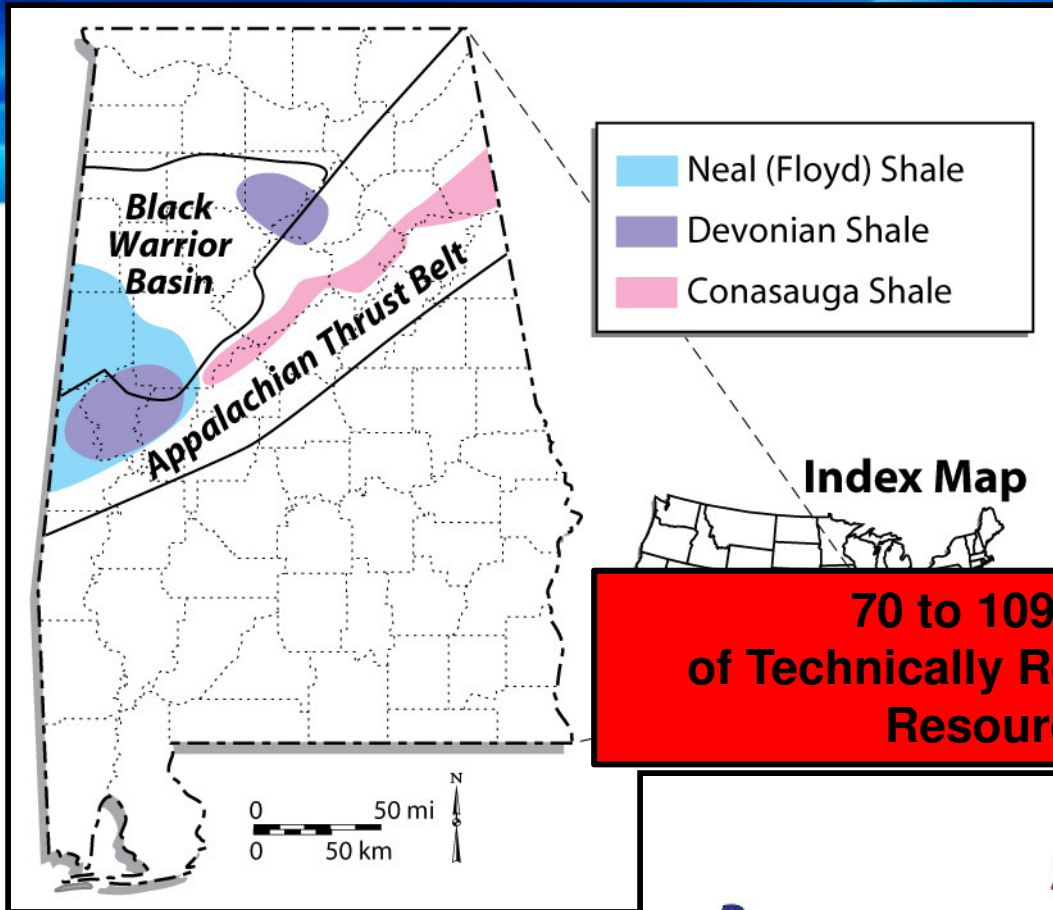
10-acres

5-acres

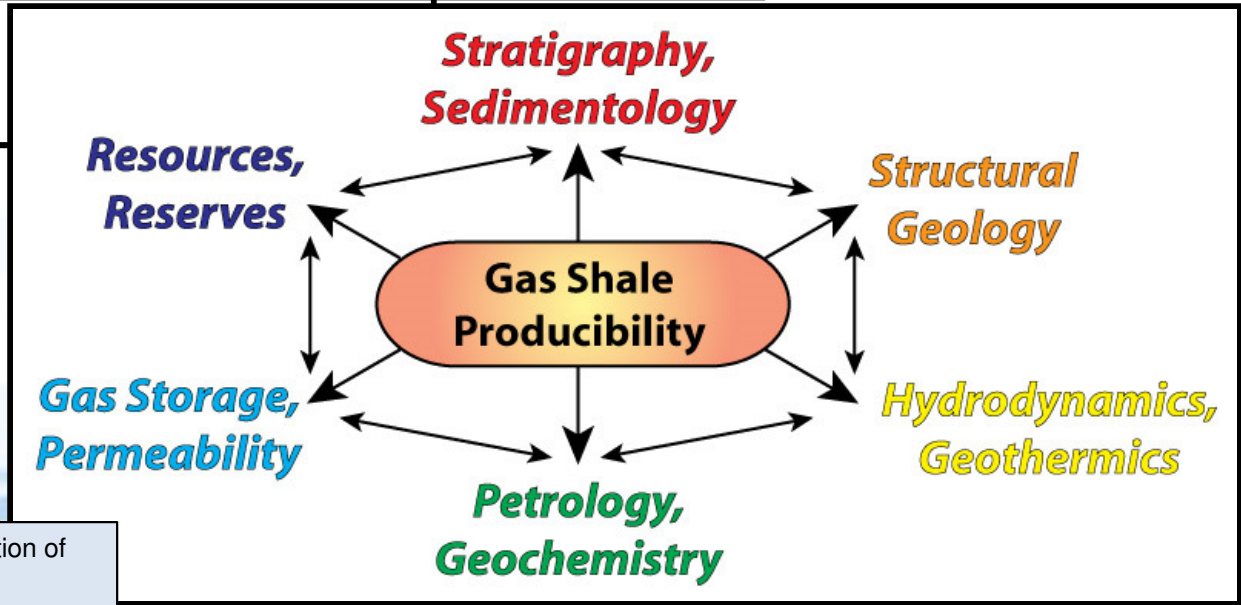


Alabama Geologic Survey

# Shale Play Concepts Alabama Black Warrior Basin

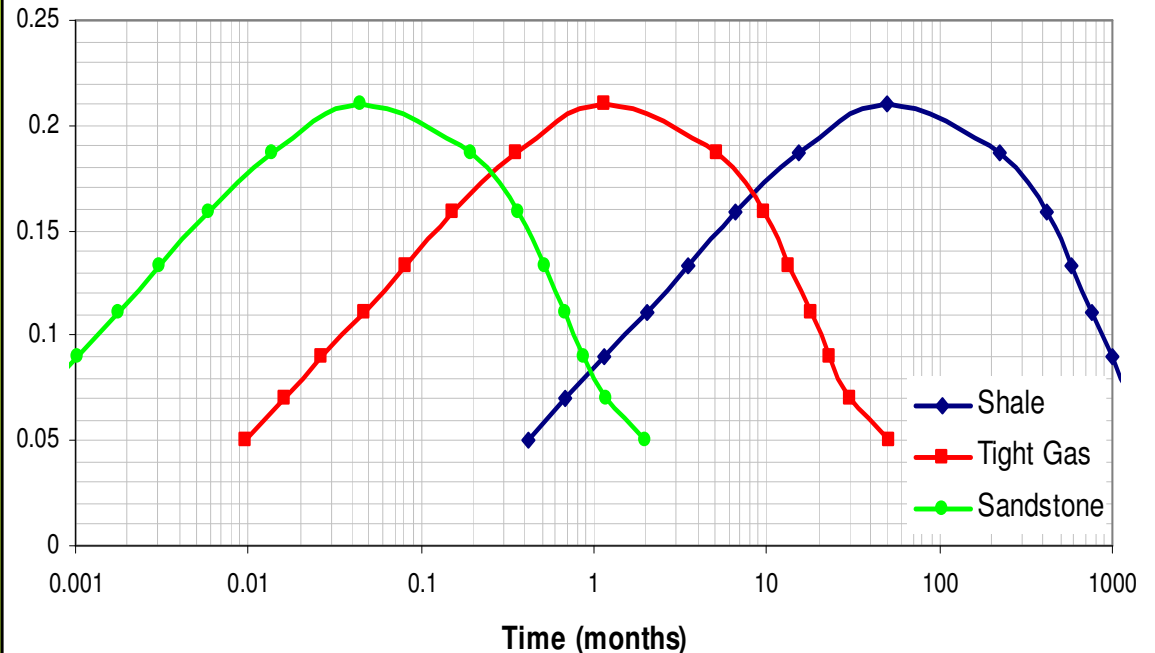


**70 to 109 Tcf  
of Technically Recoverable  
Resource**



# Identification of Refracturing Opportunities

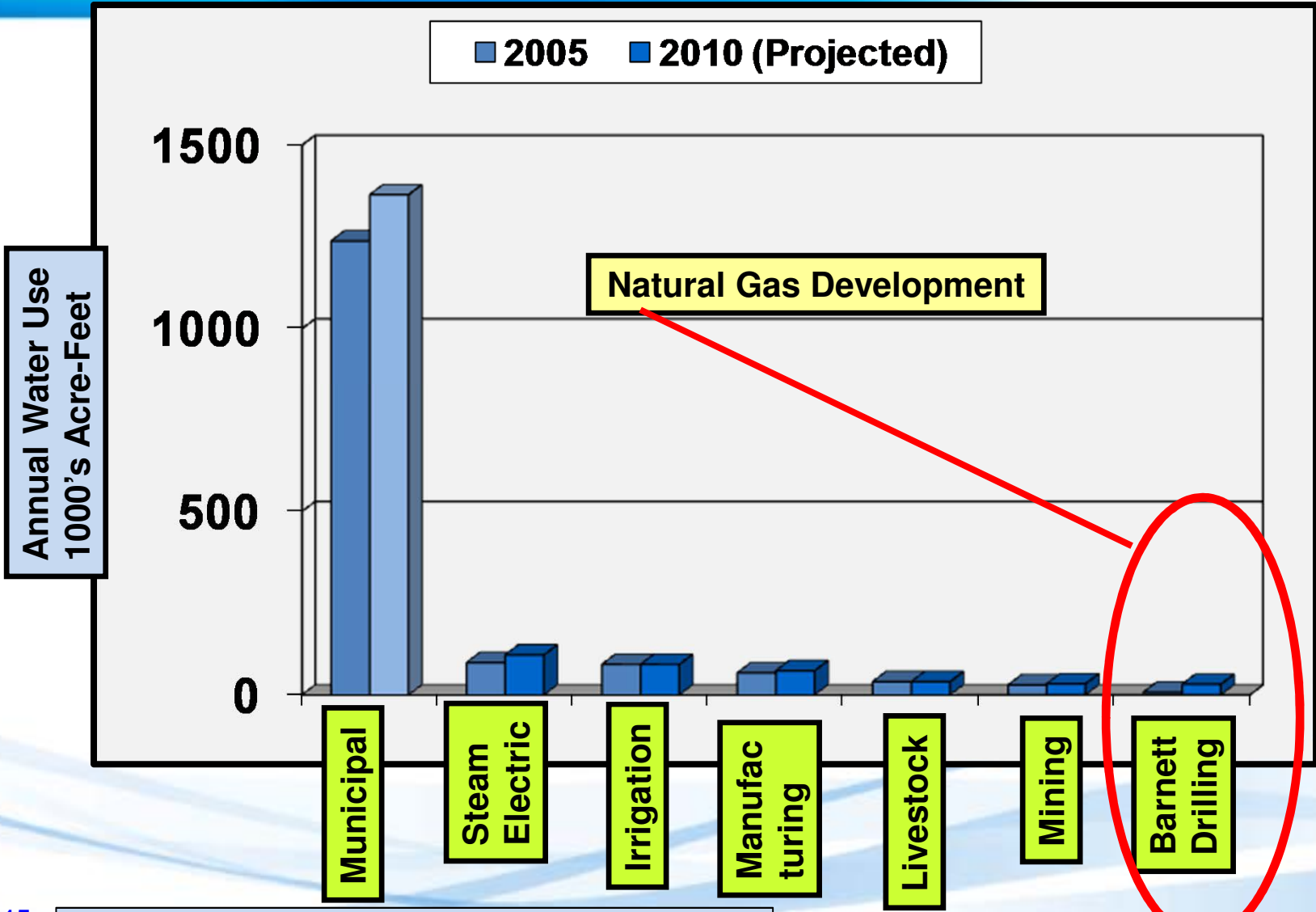
- Methodology for candidate selection based on poro-elastic models and analysis of field data.
- Recommendations for the time window most suitable for re-fracturing
- Re-fracture treatment design for horizontal and deviated wellbores



**Optimum time for re-fracturing**



# Freshwater Users in the Barnett Shale Region



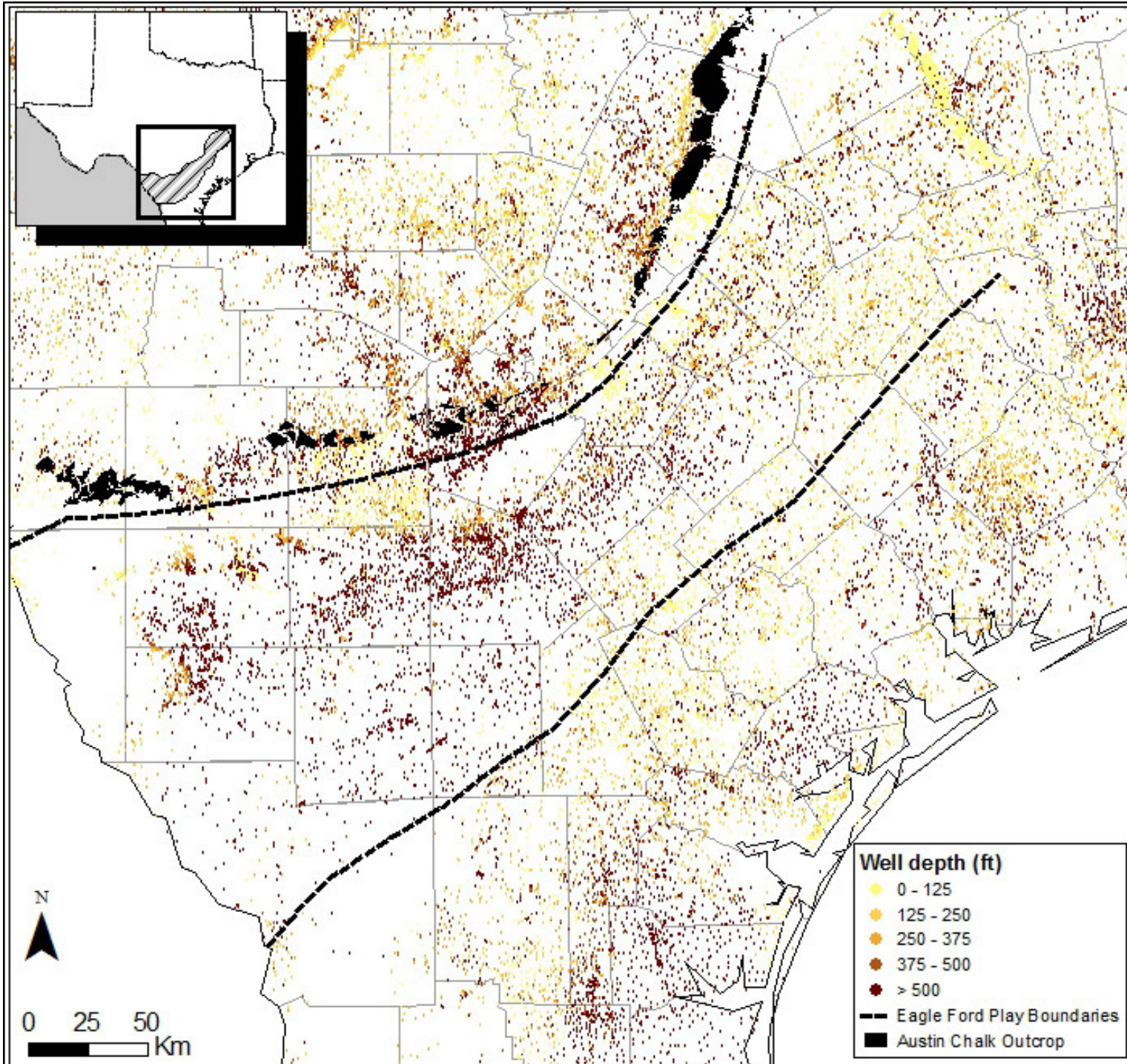
# What Flows Out – Is it a Witch's Brew of Toxins?

## Sampling and Analysis of Flow back Water

- **Sampling from 19 Marcellus Locations.**
- **Includes Chemistry and Analysis of Constituents of Interest.**
- **Lists of Constituents Provided by USEPA, WV-DEP and PA-DEP.**
- **Over 250 Determinations Performed on Samples.**



# Characterizing Ground Water and Eagle Ford Development Impact

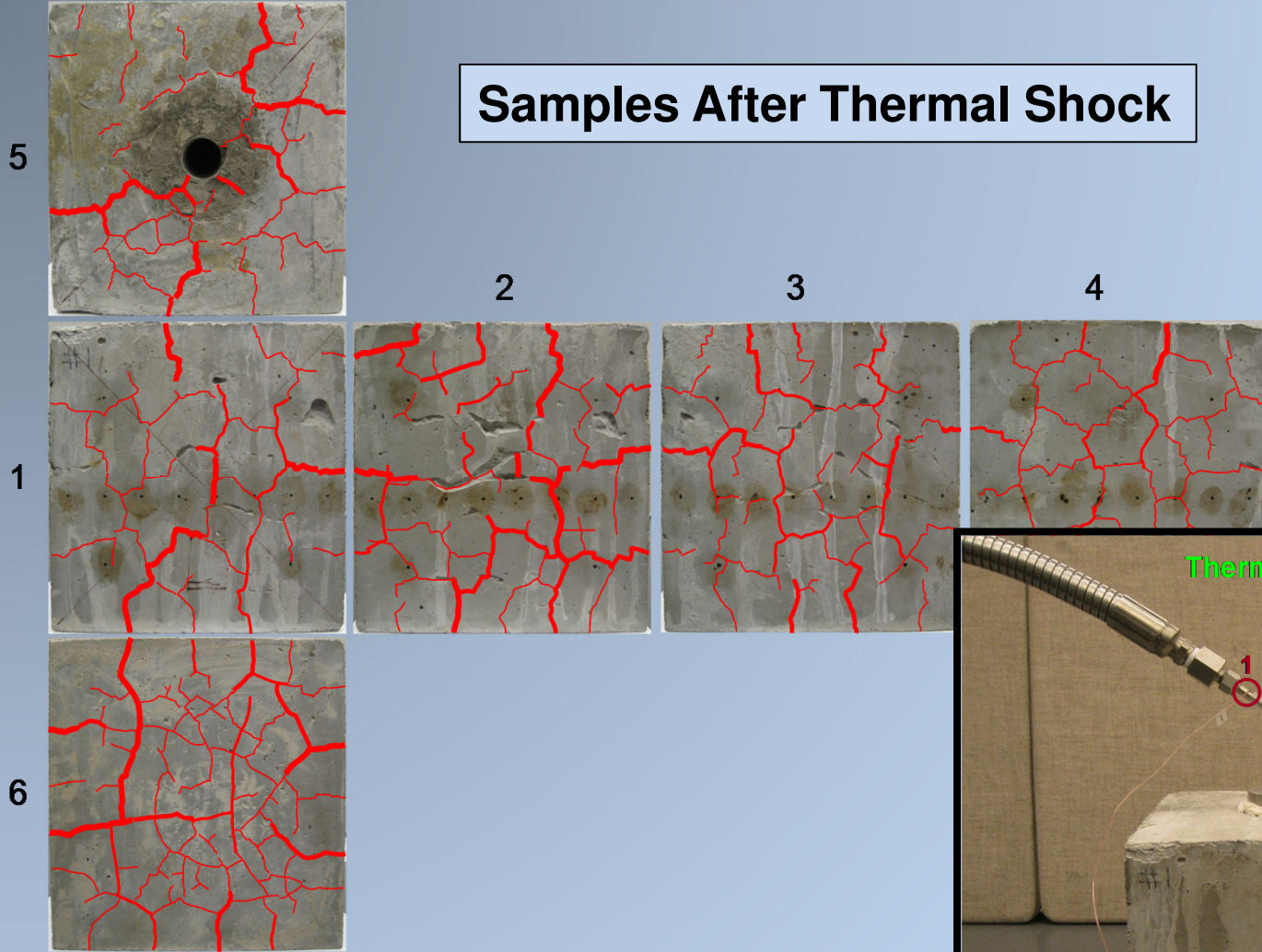


10122-06  
The Technology  
Integration  
Program:  
An Extension of  
the  
Environmentally  
Friendly Drilling  
Systems Program

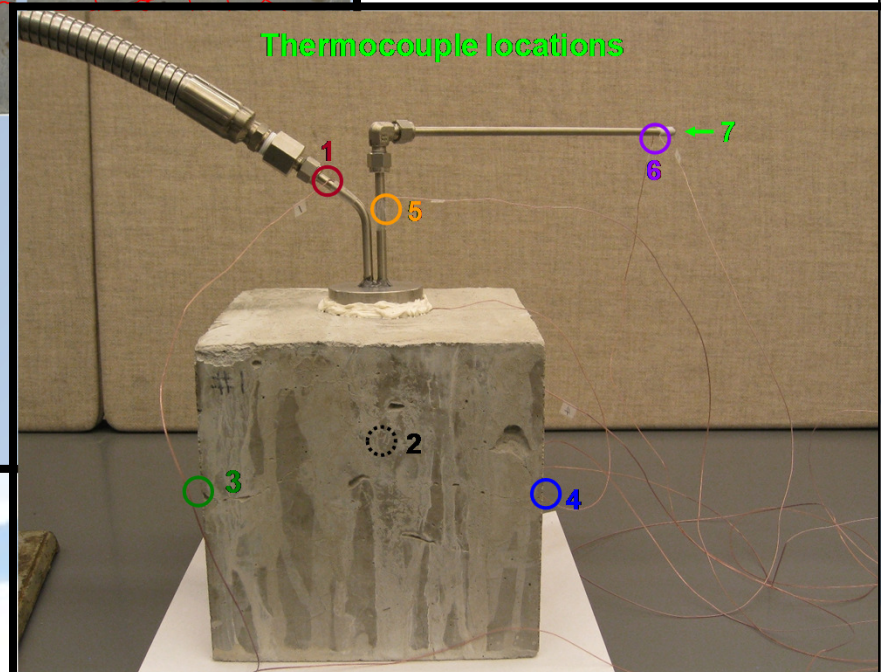


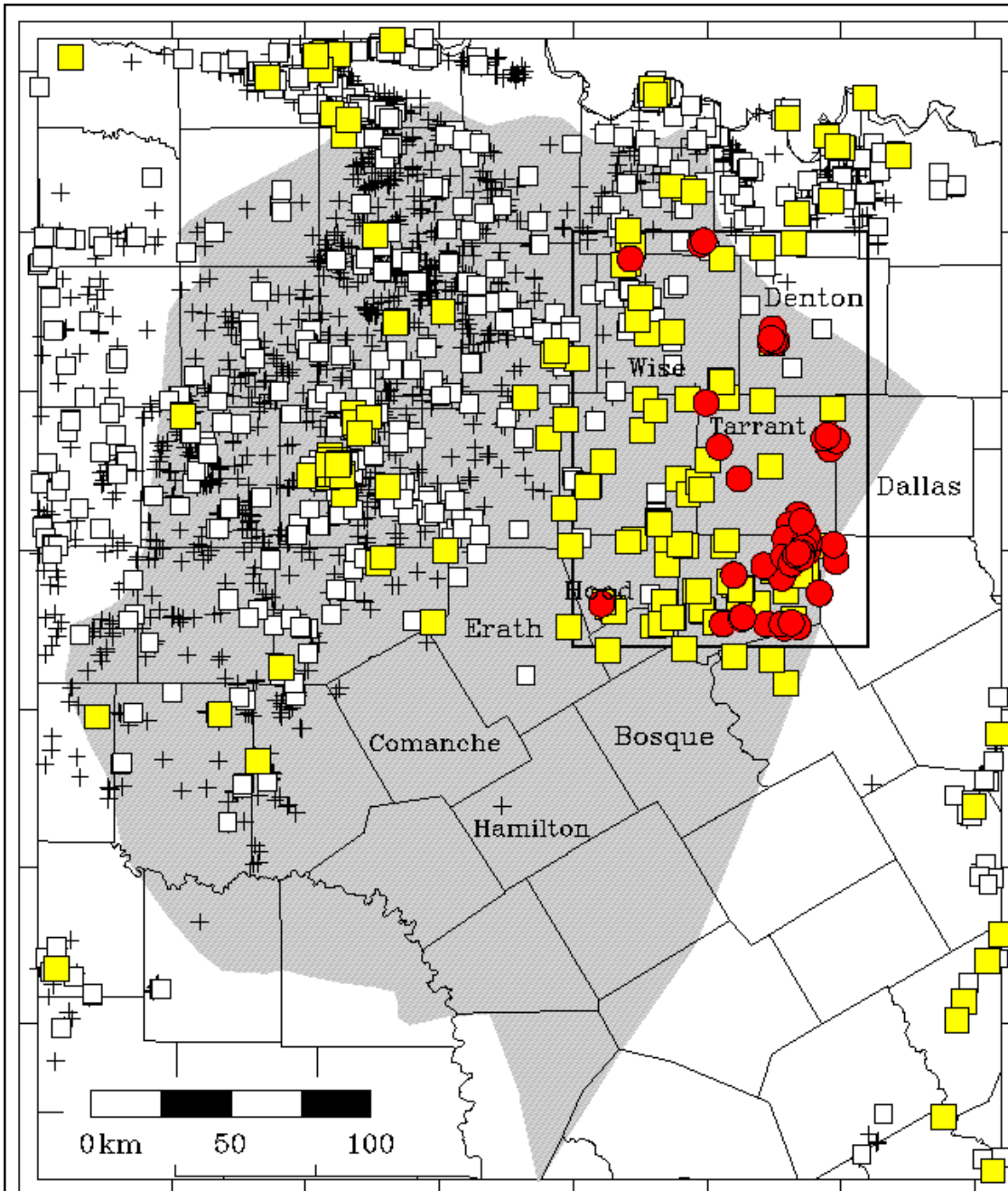
# Cryogenic Fracturing Fluids

Samples After Thermal Shock



Apparatus





## NE Texas Survey

- **Red Circles: Seismic Events**

- **Yellow Squares: High-Volume Wells**

**Events are near wells...  
e.g., Johnson County**

**But many wells/counties  
have no events...  
e.g., Parker County  
Stephens County**

**Will events occur near high-  
volume injection wells  
elsewhere?**

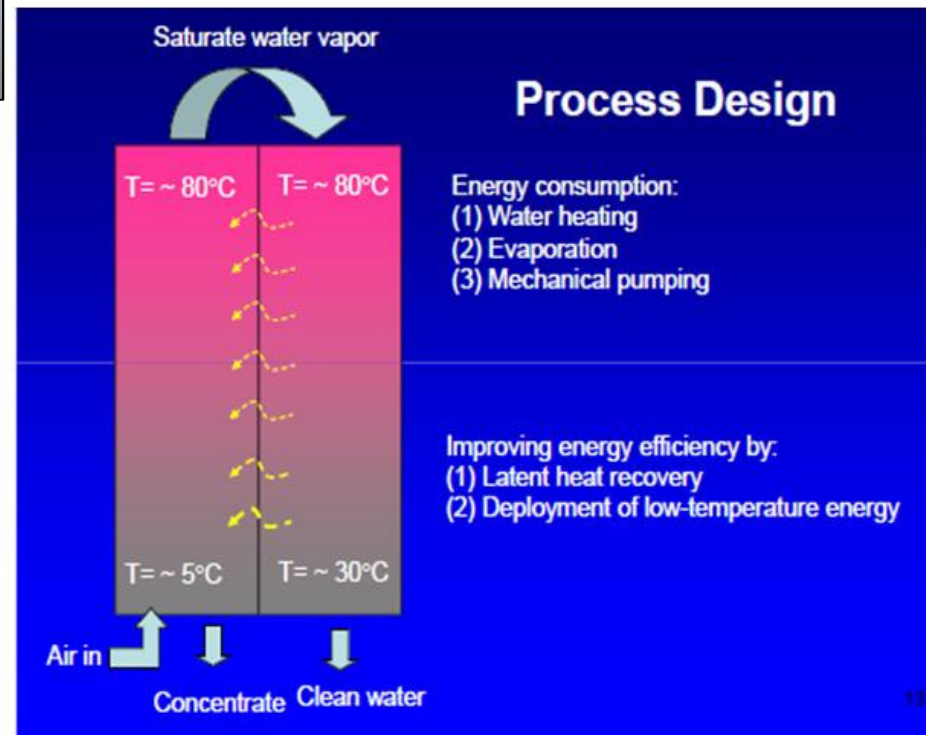
# Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers

## Environmental, Safety and Regulatory

Development of distillation for produced water purification at wellhead.

Prototype design capacity 20 bbl/day

Purified produced water is suitable for alternative uses, such as agriculture, irrigation and industrial processing.



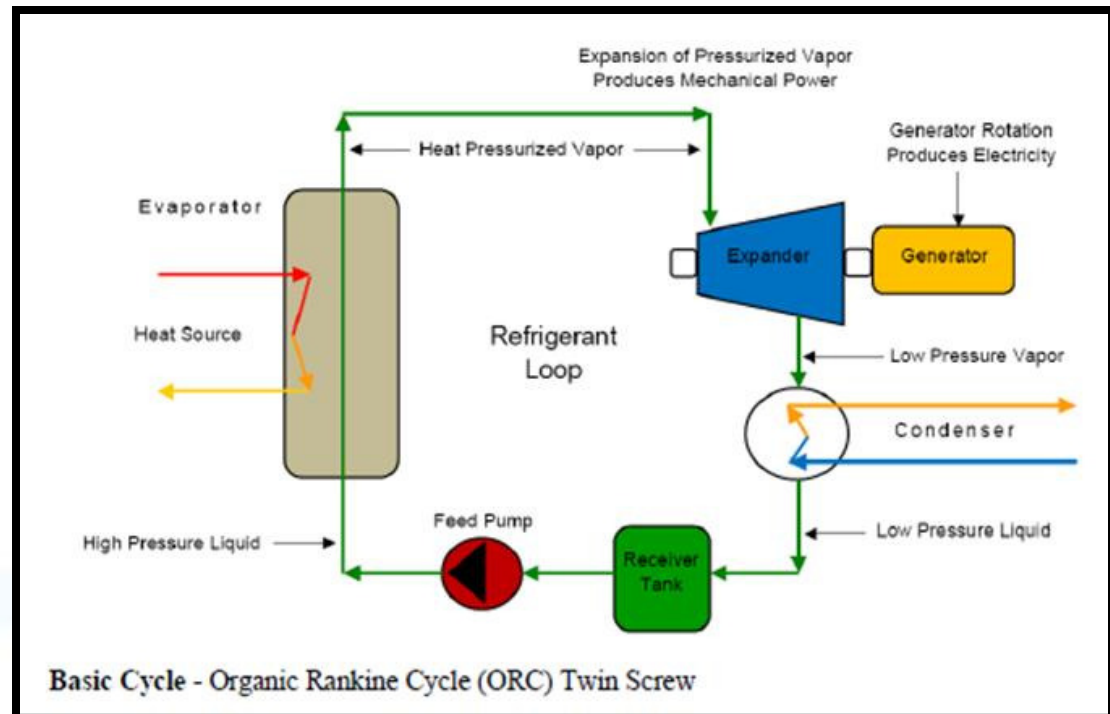
Harvard Petroleum Company

New Mexico Institute of Mining & Technology

# Electrical Power Generation from Produced Water

**Project Goal: using heat in produced water to create electricity.**

**Minimize the environmental impact by creating green electricity using produced water and no additional fossil fuel.**



Denbury Resources, Inc.,

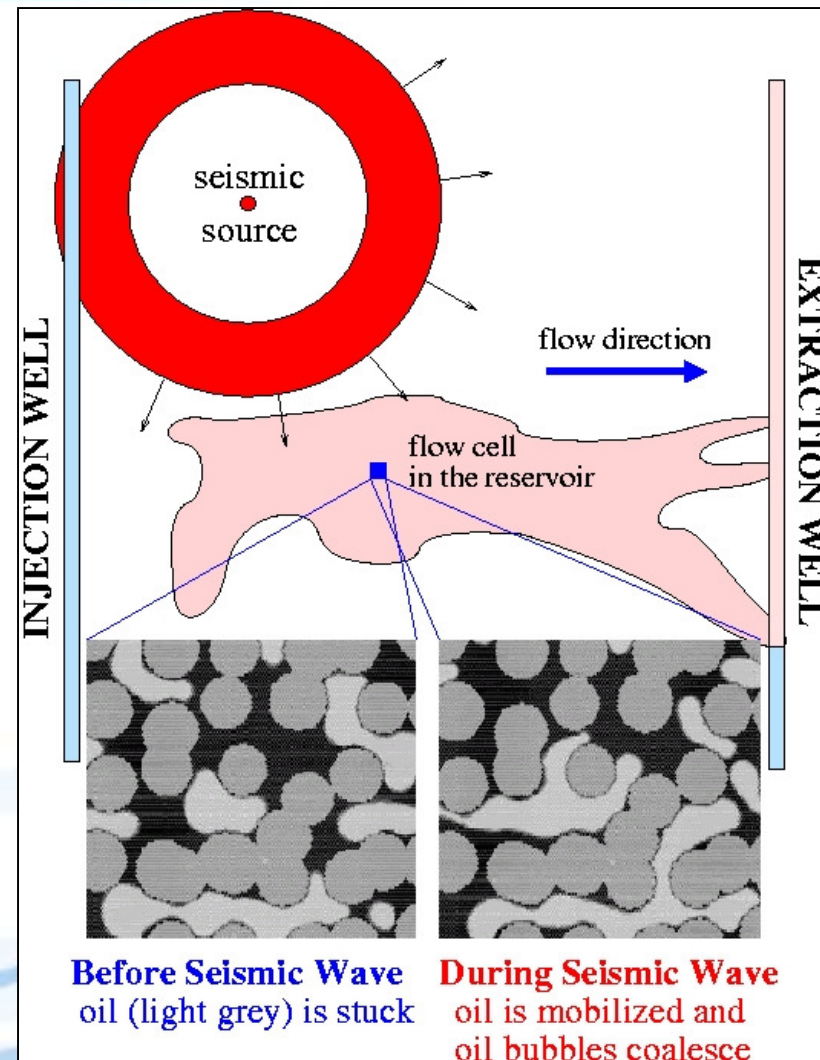
# Seismic Stimulation to Enhance Oil Recovery

## Increased Recovery

Test seismic stimulation in EOR

A seismic wave is to “*shake the stuck oil loose*” and get it flowing again toward a production well.

SandRidge to Field Test





# 2102 Request for Proposals

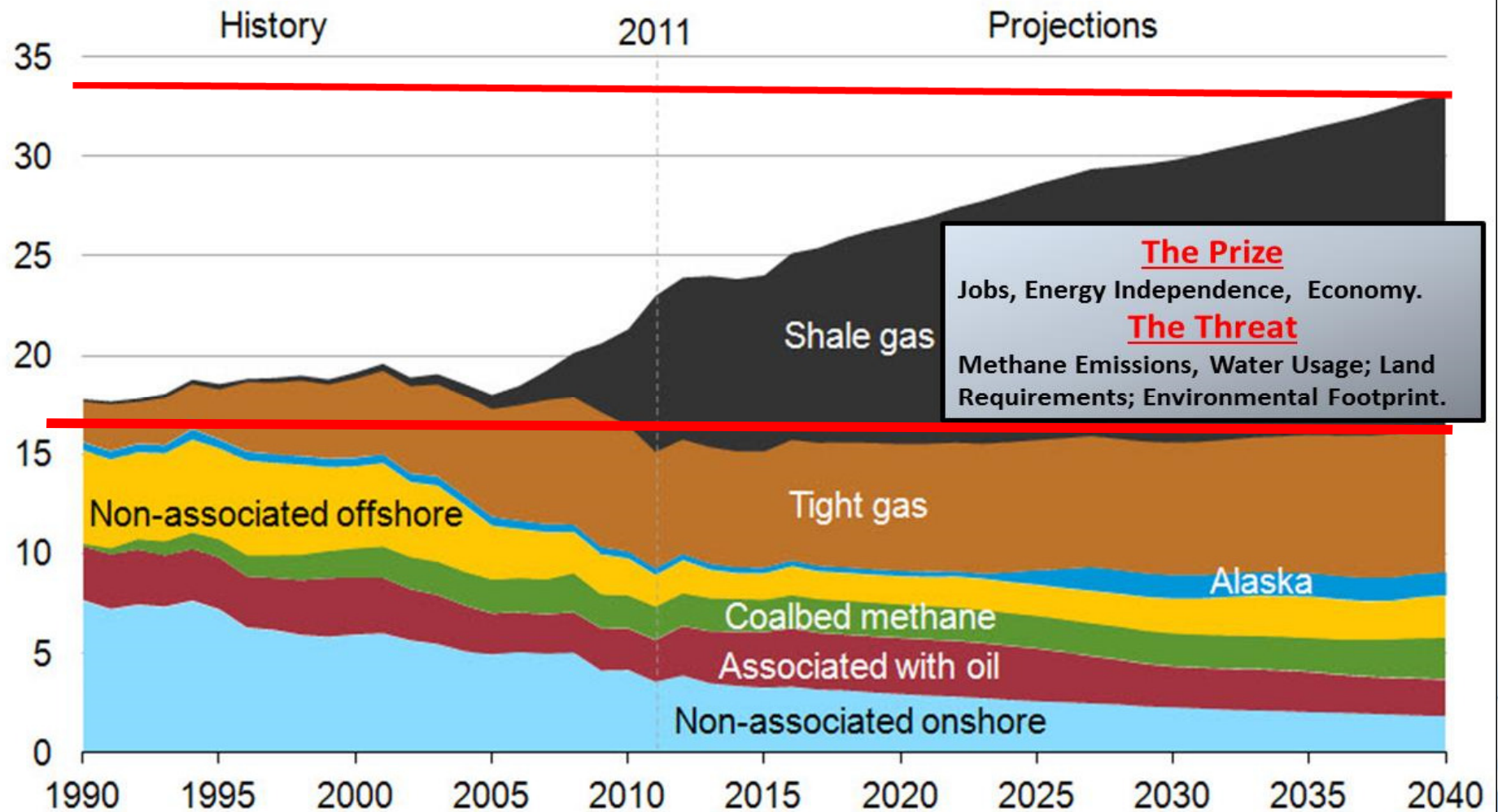
## Status

## **“Specific URTAC Topical Recommendations”**

- ***“Refocus the R&D component of the Subtitle J program to include other unconventional resources such as tight oil, and oil shale.”***
- ***“Research should be conducted to improve well construction that ensures long-term wellbore integrity during and beyond the operational life of the well.”***
- ***“Pursue research and communication among multiple government agencies and industry that addresses air quality concerns specific to the exploration and production of natural gas from shale deposits and other unconventional resources.”***

# U. S. Gas Production- Tcf

U.S. dry natural gas production  
trillion cubic feet

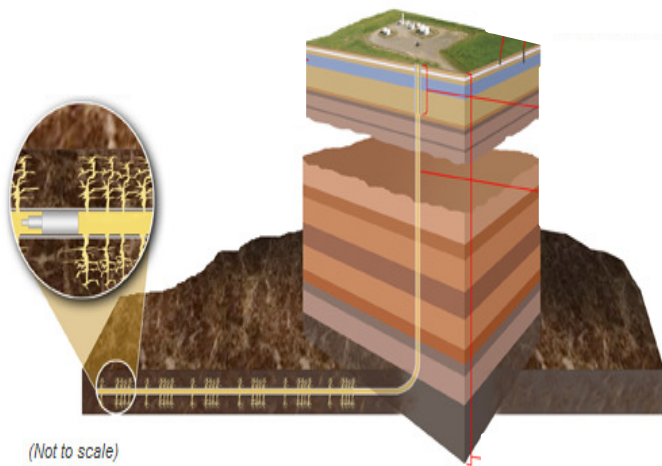


**The Prize**  
Jobs, Energy Independence, Economy.

**The Threat**  
Methane Emissions, Water Usage; Land Requirements; Environmental Footprint.

Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013 Early Release*

**Thank You**  
**Kent F. Perry**  
[kperry@rpsea.org](mailto:kperry@rpsea.org)  
**281-725-1252**



# EPAct Complementary Program Unconventional Resources Technical Advisory Committee Meeting

**Alexandra Hakala**

Shale Gas Technical Coordinator, NETL-ORD

September 19, 2013



U.S. DEPARTMENT OF  
**ENERGY**

National Energy  
Technology Laboratory



# Tech Transfer to Date:



[www.edx.netl.doe.gov/ucr](http://www.edx.netl.doe.gov/ucr)

- 31** Conference Presentations
- 7** Published Articles & Reports
  - Additional manuscripts undergoing internal and external peer review
- 2** Datasets released via EDX
- 2** Data-driven tool/app via EDX



***NOW UPDATED WITH Q3 PUBS,  
PRESENTATIONS, TOOLS, ETC***



# Complementary Program Portfolio – UCR

## Fugitive Emission Factors and Air Emissions

- Fugitive Air Emissions Field Data *(2011 to present)*
- Greenhouse Gas Life Cycle Methane Emission Factor Assessment *(2011 to 2012 -- completed)*

## Produced Water and Waste Management

- Predicting Compositions and Volumes of Produced Water *(2011 to present)*
- Evaluation of the Geochemical and Microbiological Composition of Shale Gas Produced Water and Solid Wastes *(2011 to present)*
- Biogeochemical Factors that Affect the Composition of Produced Waters and the Utility of Geochemical Tracer Tools *(2011 to present)*

## Subsurface Fluid and Gas Migration

- Integrated Field Monitoring – *Gas/Fluid Migration (2011 to present)*
- Gas Flow from Shallow Gas Formations *(2012 to present)*
- Approach for Assessing Spatial Trends & Potential Risks with UCR Systems *(2011 to present)*
- Impacts of Shale Gas Development on Shallow Groundwater *(2012 to present)*
- Subsurface Gas and Fluid Migration Assessment *(2011 to 2012 -- completed)*
- Develop a Suite of Naturally Occurring Geochemical Tracer Tools that Verify the Sources of Fluids in Complex Geologic Systems *(2011 to 2012 -- completed)*

## Predicting Fracture Growth and Ground Motion

- Fracture Propagation and Ground Motion Related to Unconventional Oil and Gas Development *(2011 to present)*
- Integrated Field Monitoring – *Microseismic (2011 to present)*
- Geophysical and Geomechanical Factors that Affect Subsurface Fluid and Gas Migration *(2011 to 2012 -- completed)*



# Complementary Program FY13 Portfolio Unconventional Resources (UCR)

## Fugitive Emission Factors and Air Emissions

- Fugitive Air Emissions Field Data

## Produced Water and Waste Management

- Predicting Compositions and Volumes of Produced Water
- Evaluation of the Geochemical and Microbiological Composition of Shale Gas Produced Water and Solid Wastes
- Biogeochemical Factors that Affect the Composition of Produced Waters and the Utility of Geochemical Tracer Tools

## Subsurface Fluid and Gas Migration

- Integrated Field Monitoring – *Gas/Fluid Migration*
- Gas Flow from Shallow Gas Formations
- Approach for Assessing Spatial Trends & Potential Risks with UCR Systems
- Impacts of Shale Gas Development on Shallow Groundwater

## Predicting Fracture Growth and Ground Motion

- Fracture Propagation and Ground Motion Related to Unconventional Oil and Gas Development
- Integrated Field Monitoring – *Microseismic*





## Fugitive Air Emissions Field Data

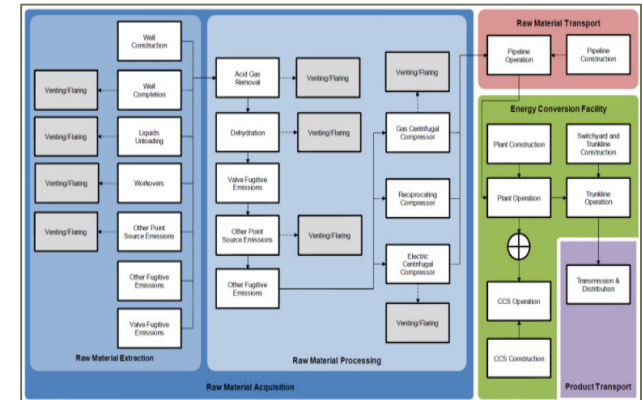
Ambient and point-source monitoring of methane and other emissions

Use of gas-phase isotope tracers and atmospheric dispersion modeling to pinpoint emissions source  
*(new)*

Inputs for emission factors used in greenhouse gas life cycle analyses



Field Measurements with the NETL ambient air quality trailer, and application of the acetylene tracer point source technique



Data processing to provide values in formats useful for LCA calculations



# Complementary Program FY13 Portfolio

## Unconventional Resources (UCR)

### Fugitive Emission Factors and Air Emissions

- Fugitive Air Emissions Field Data

### Produced Water and Waste Management

- Predicting Compositions and Volumes of Produced Water
- Evaluation of the Geochemical and Microbiological Composition of Shale Gas Produced Water and Solid Wastes
- Biogeochemical Factors that Affect the Composition of Produced Waters and the Utility of Geochemical Tracer Tools

### Subsurface Fluid and Gas Migration

- Integrated Field Monitoring – *Gas/Fluid Migration*
- Gas Flow from Shallow Gas Formations
- Approach for Assessing Spatial Trends & Potential Risks with UCR Systems
- Impacts of Shale Gas Development on Shallow Groundwater

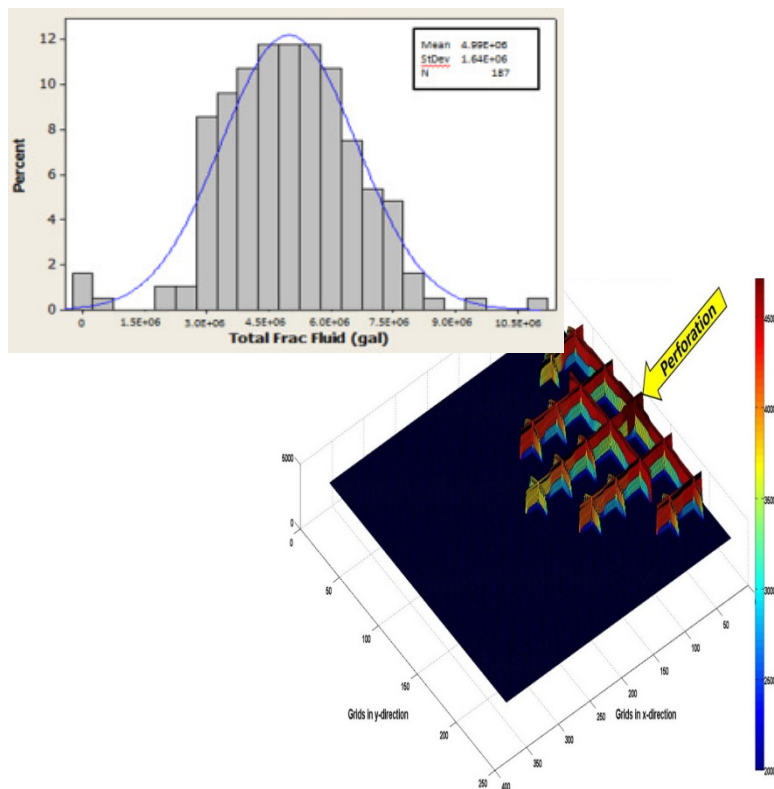
### Predicting Fracture Growth and Ground Motion

- Fracture Propagation and Ground Motion Related to Unconventional Oil and Gas Development
- Integrated Field Monitoring – *Microseismic*

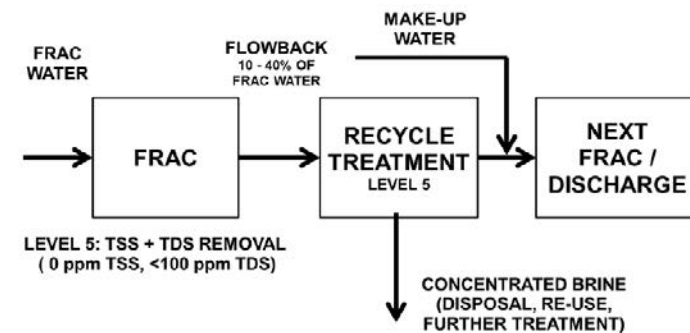


# Predicting Compositions and Volumes of Produced Water

Couple existing data and simulations to predict **amount and salinity of fluid** produced during hydraulic fracturing



Use supply chain modeling to identify means for **optimizing the treatment, recycling, and disposal of produced water** with a focus on minimizing waste

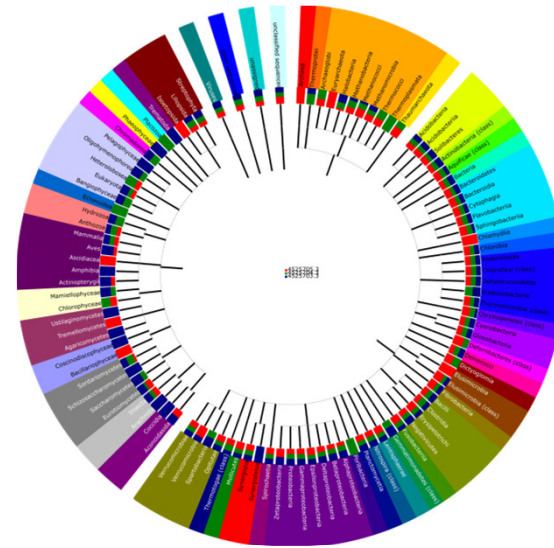


*Schematic from Slutz et al, SPE 157532*

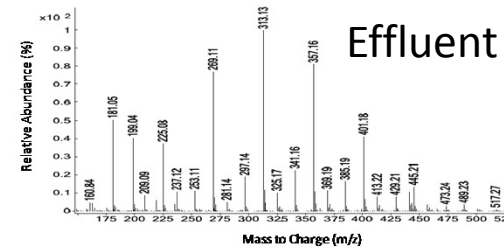


# Evaluation of the Geochemical and Microbiological Composition of Shale Gas Produced Water and Solid Wastes

Characterize chemistry and microbiology in produced waters (*new*: and solid residuals)  
 \*Focus on surface processes\*



Microbial ecology



NORM,  
Organics,  
and  
Metals

Data from Carter (2013)

Figure 5. Mass spectrum of a) influent and b) effluent samples collected at a water treatment facility used specifically for the treatment of produced waters.





# Biogeochemical Factors that Affect the Composition of Produced Waters and the Utility of Geochemical Tracer Tools

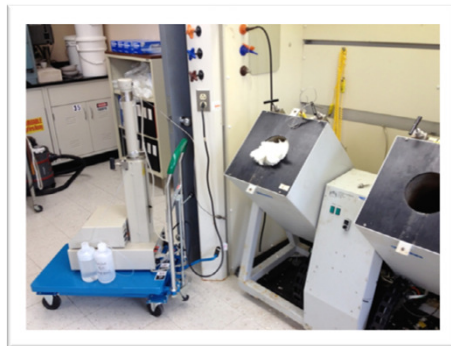
**\*Focus on downhole processes and monitoring tools\***

Sources and behavior of potential tracers and contaminants

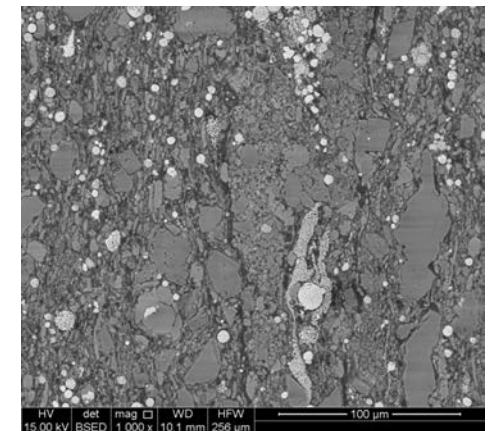
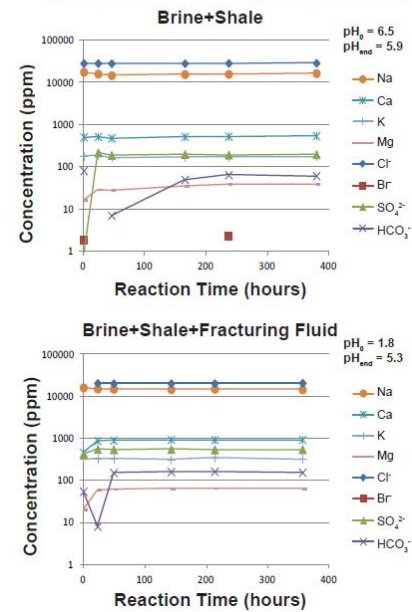
Shale reactivity under stimulation conditions

Fate of fracturing fluids

Changes to shale physical-chemical and mechanical properties



**Major Elements Released (Autoclave Experiments)**





# Complementary Program FY13 Portfolio

## Unconventional Resources (UCR)

### Fugitive Emission Factors and Air Emissions

- Fugitive Air Emissions Field Data

### Produced Water and Waste Management

- Predicting Compositions and Volumes of Produced Water
- Evaluation of the Geochemical and Microbiological Composition of Shale Gas Produced Water and Solid Wastes
- Biogeochemical Factors that Affect the Composition of Produced Waters and the Utility of Geochemical Tracer Tools

### Subsurface Fluid and Gas Migration

- Integrated Field Monitoring – *Gas/Fluid Migration*
- Gas Flow from Shallow Gas Formations
- Approach for Assessing Spatial Trends & Potential Risks with UCR Systems
- Impacts of Shale Gas Development on Shallow Groundwater

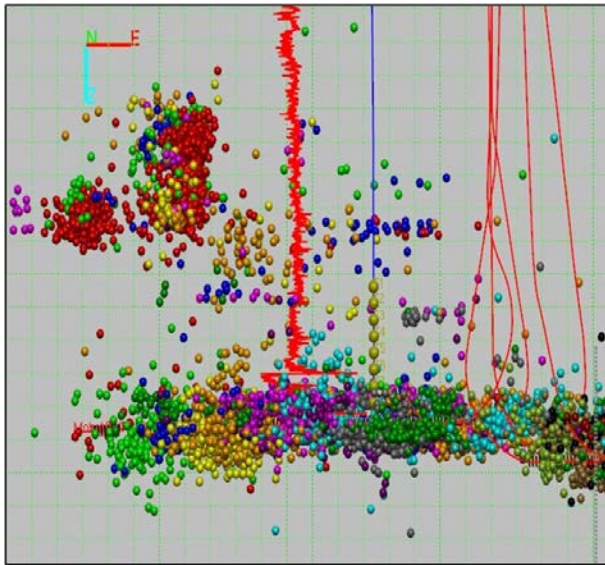
### Predicting Fracture Growth and Ground Motion

- Fracture Propagation and Ground Motion Related to Unconventional Oil and Gas Development
- Integrated Field Monitoring – *Microseismic*



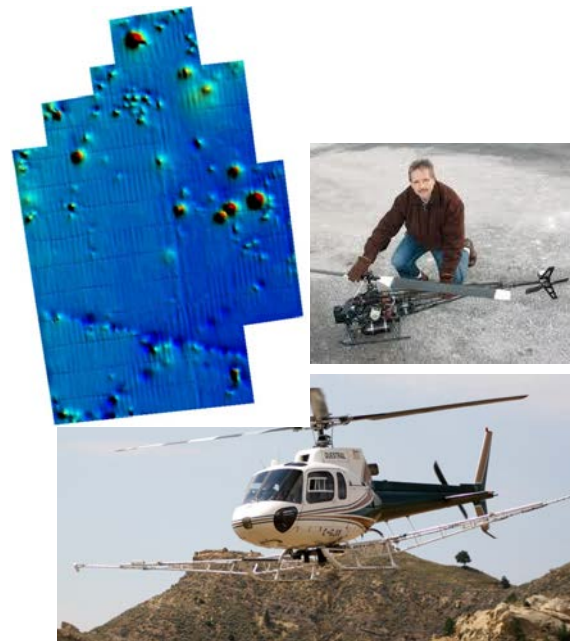
# Integrated Field Monitoring – Fluid/Gas Migration

Evaluate fracture growth, ground motion, and potential pathways for gas/fluid migration



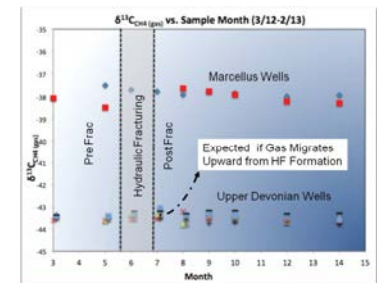
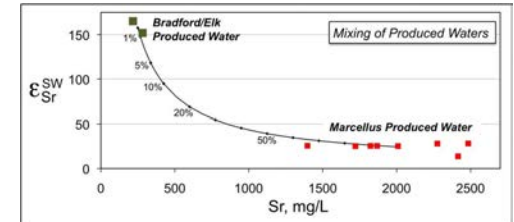
Field microseismic data to evaluate fracture behavior during stimulation

Identify wellbore locations and areas affected by surface spills.



Use airborne and ground surveys to locate existing wells and potential produced water spills

Identify sources of gases and fluids.

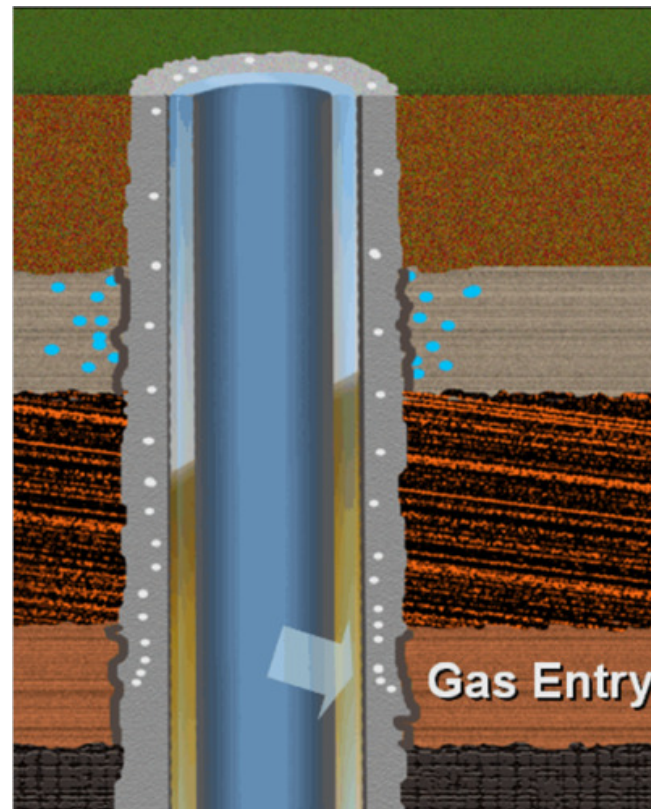


Use synthetic and natural geochemical tracers



## Gas Flow from Shallow Gas Formations

Evaluating wellbore risks requires knowledge about existing and newly-cemented wells



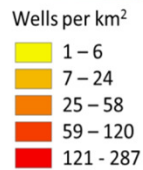
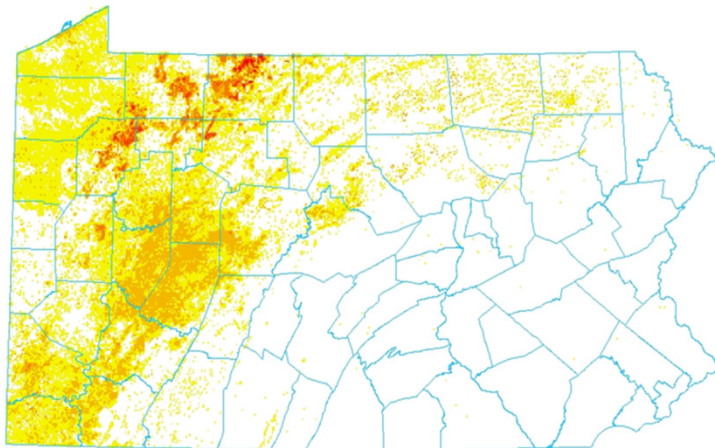
Develop laboratory and modeling techniques to evaluate shallow gas effects on well cement hydration





# Approach for Assessing Spatial Trends & Potential Risks with UCR Systems

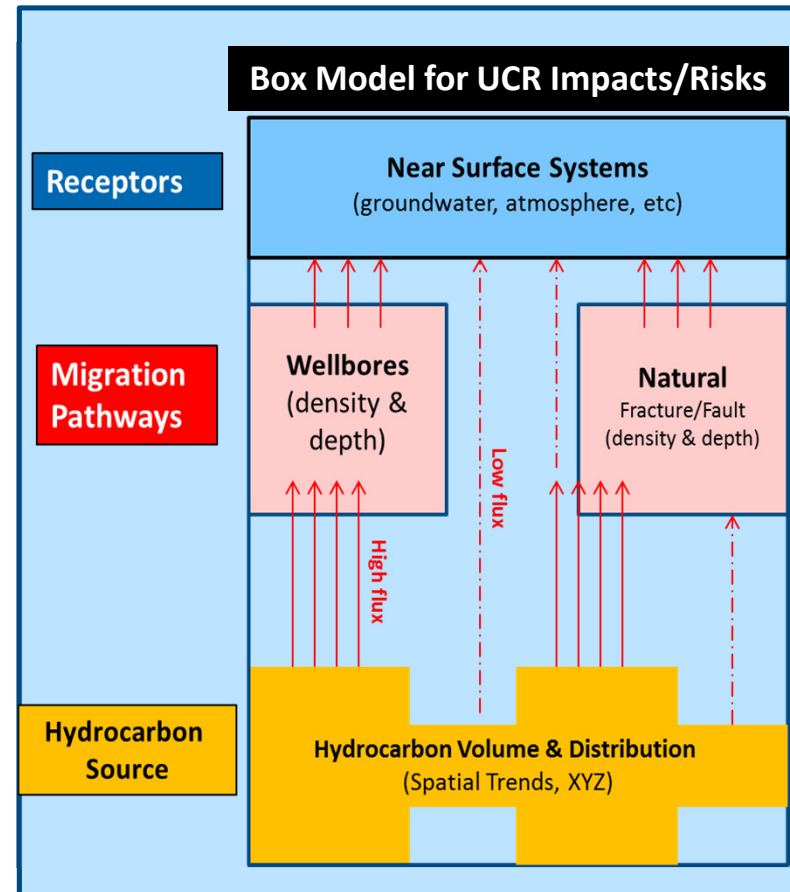
Use of spatial data sets to evaluate potential risks during shale gas development



50 25 0 50 Kilometers



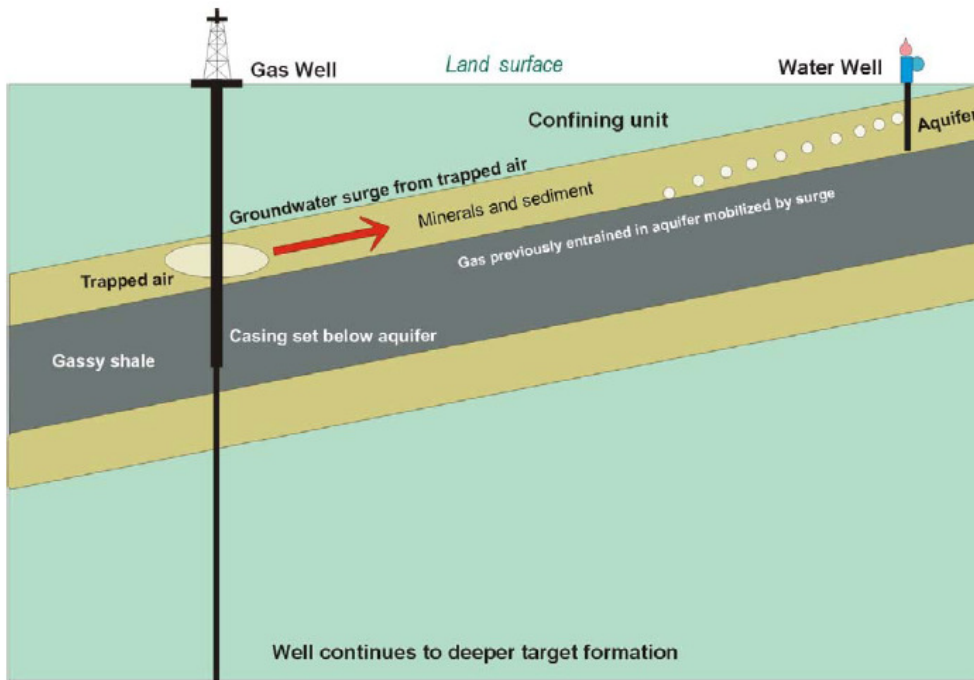
Existing wells in PA (PA IRIS database)





# Impacts of Shale Gas Development on Shallow Groundwater

Potential for drilling to affect shallow groundwater hydrology



*Schematic hypothesis of how shallow gas may migrate during drilling*

Potential for natural processes to mitigate groundwater issues (*natural attenuation – new*)

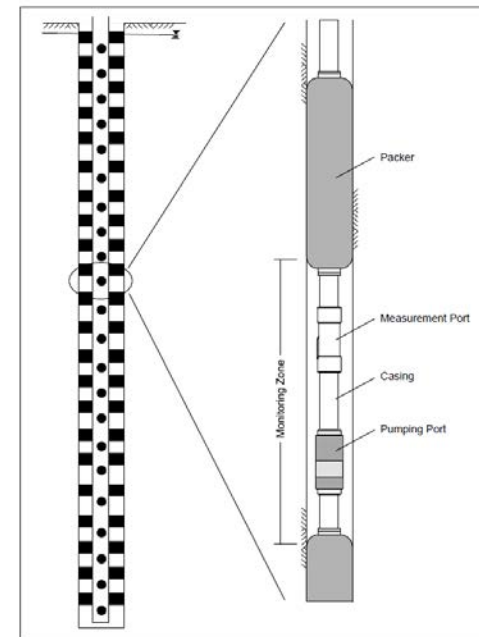


Figure 1. Westbay System with monitoring zones isolated by packers.

Schlumberger Water Services

*Field monitoring, laboratory investigation, and modeling*





# Complementary Program FY13 Portfolio Unconventional Resources (UCR)

## Fugitive Emission Factors and Air Emissions

- Fugitive Air Emissions Field Data

## Produced Water and Waste Management

- Predicting Compositions and Volumes of Produced Water
- Evaluation of the Geochemical and Microbiological Composition of Shale Gas Produced Water and Solid Wastes
- Biogeochemical Factors that Affect the Composition of Produced Waters and the Utility of Geochemical Tracer Tools

## Subsurface Fluid and Gas Migration

- Integrated Field Monitoring – *Gas/Fluid Migration*
- Gas Flow from Shallow Gas Formations
- Approach for Assessing Spatial Trends & Potential Risks with UCR Systems
- Impacts of Shale Gas Development on Shallow Groundwater

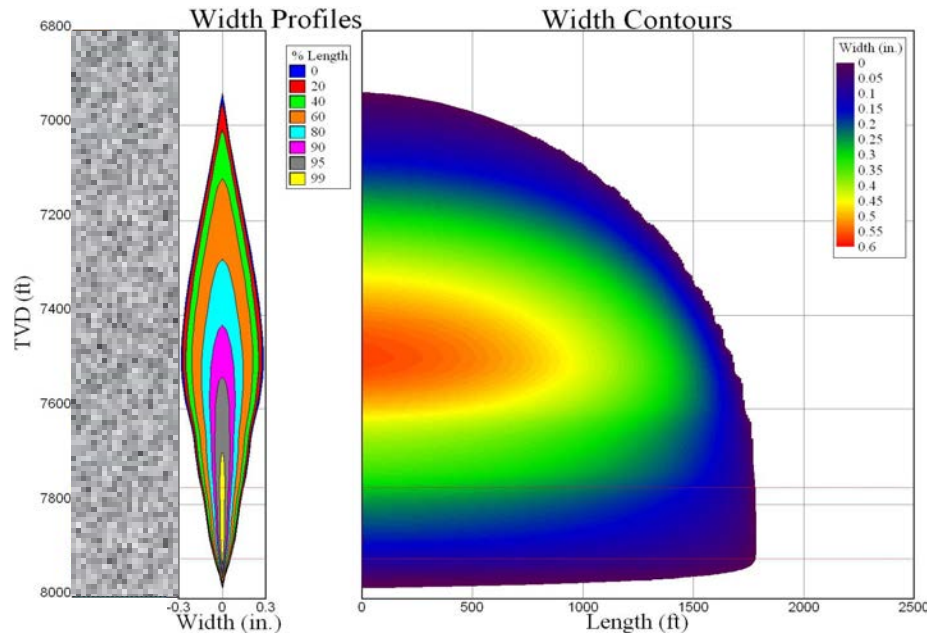
## Predicting Fracture Growth and Ground Motion

- Fracture Propagation and Ground Motion Related to Unconventional Oil and Gas Development
- Integrated Field Monitoring – *Microseismic*



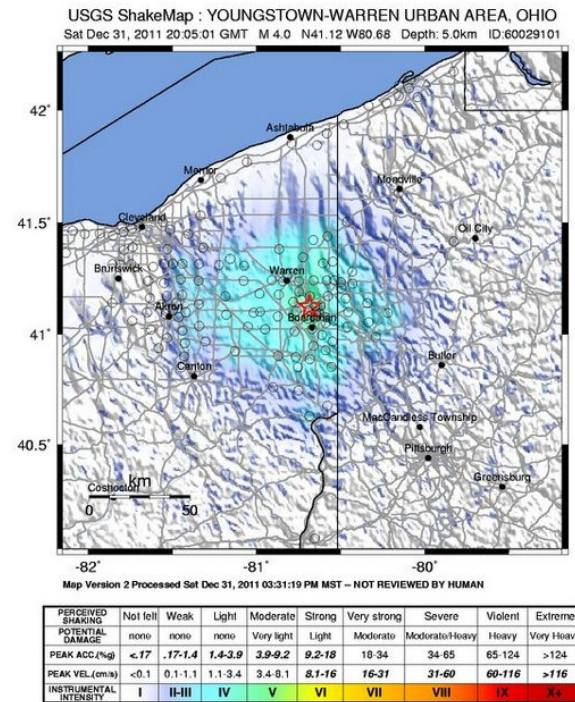
# Fracture Propagation and Ground Motion Related to Unconventional Oil and Gas Development (Lead: Bromhal)

Complete evaluation of **vertical fracture extent based on heterogeneous rock properties** for the Appalachian Basin



*Train models with field and laboratory-generated data to develop realistic predictions.*

Identify the causes behind **induced seismic events caused by wastewater and frackwater disposal**



*Evaluate case studies and develop models for predicting ground motion.*

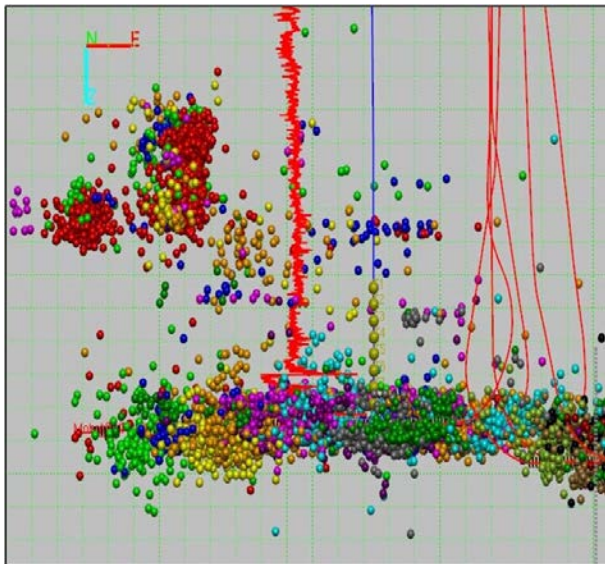




# Integrated Field Monitoring – Microseismic

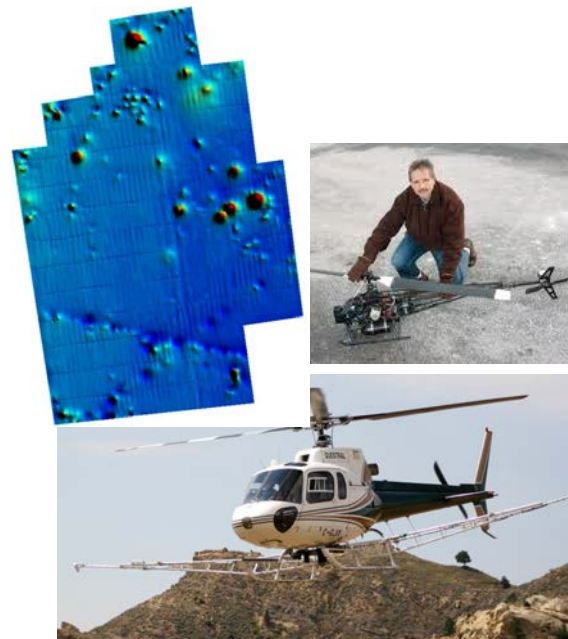
(Lead: Hammack)

Evaluate fracture growth,  
ground motion, and potential  
pathways for gas/fluid migration



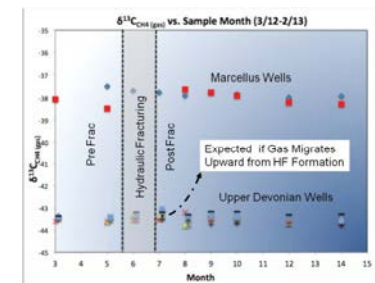
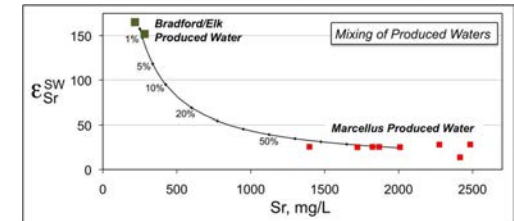
Field microseismic data collected during stimulation

Identify wellbore locations and  
areas affected by surface spills.



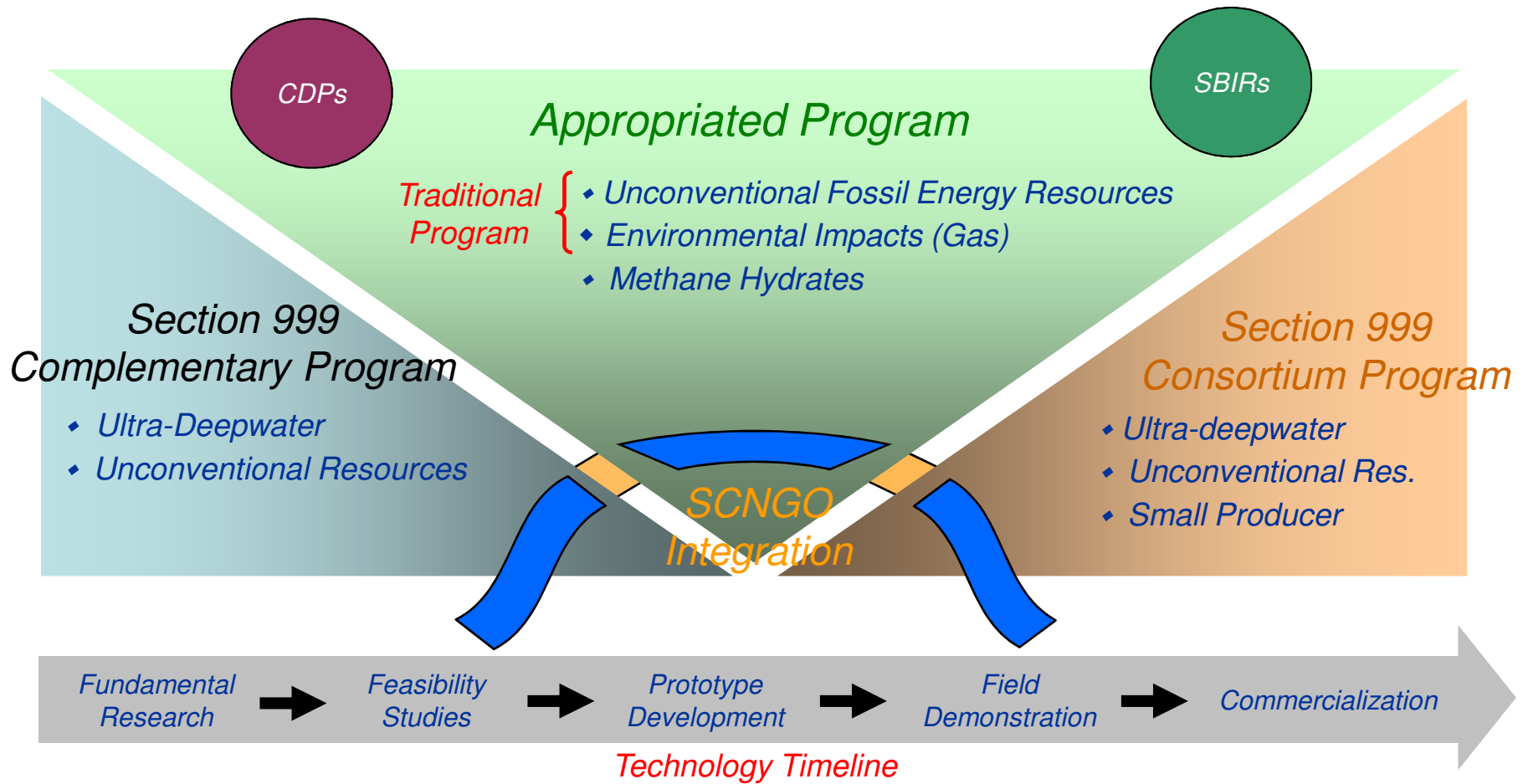
Use airborne and ground surveys to locate existing wells and potential produced water spills

Identify sources of  
gases and fluids.



Use synthetic and natural geochemical tracers

# NETL-SCNGO Oil and Gas R&D Program



# Multi-agency Collaboration

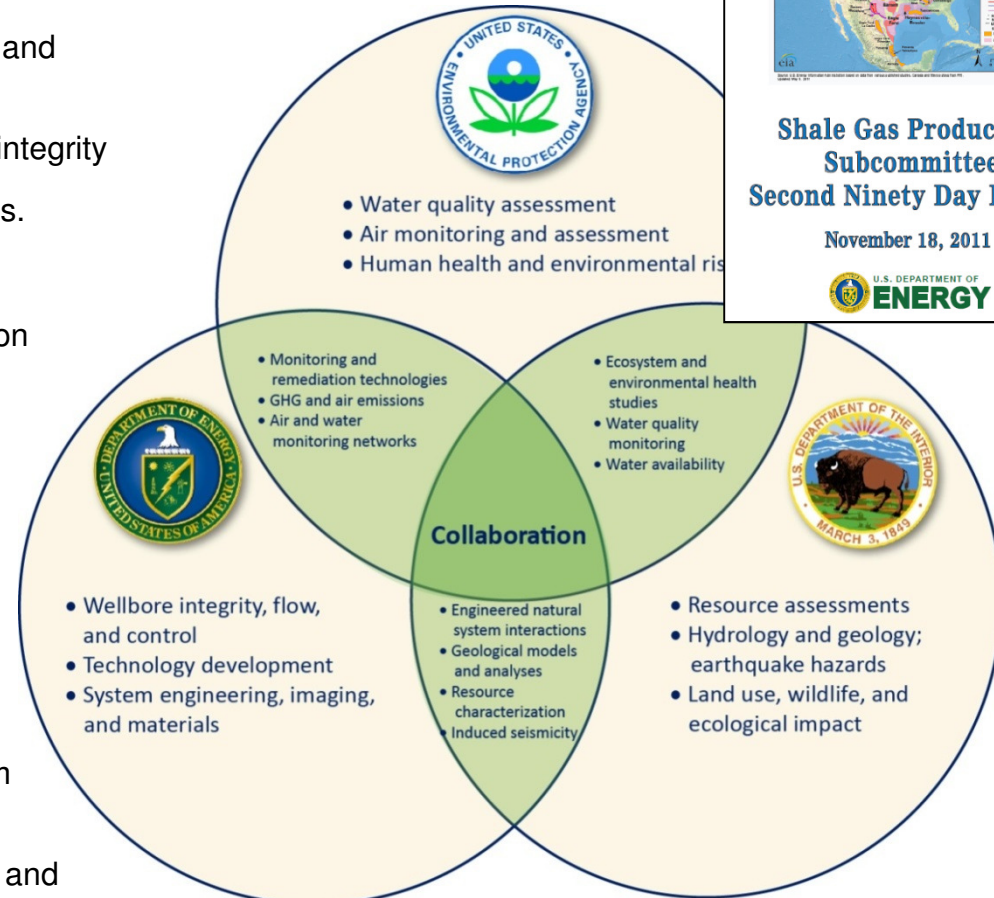
## *Multi-year plan in development*

### Minimizing the EHS impacts of shale gas development

- Resource Characterization: nature, variability, and linkages to EHS impacts
- Water Quality: treatment, disposal, well-bore integrity
- Water Quantity: smart use, alternative sources.
- Air Quality/GHG: traffic, fugitive emissions.
- Induced Seismicity: during wastewater injection
- Ecosystems: fragmentation, noise, light
- Human Health: topics still under discussion

### DOE Focus

- Development and implementation of Technological Solutions (impact avoidance and mitigation)
- Analyses of various aspects of energy system performance and subsurface modeling
- Scientific contributions to field data collection and interpretation, including laboratory studies



### Secretary of Energy Advisory Board



### Shale Gas Production Subcommittee Second Ninety Day Report

November 18, 2011

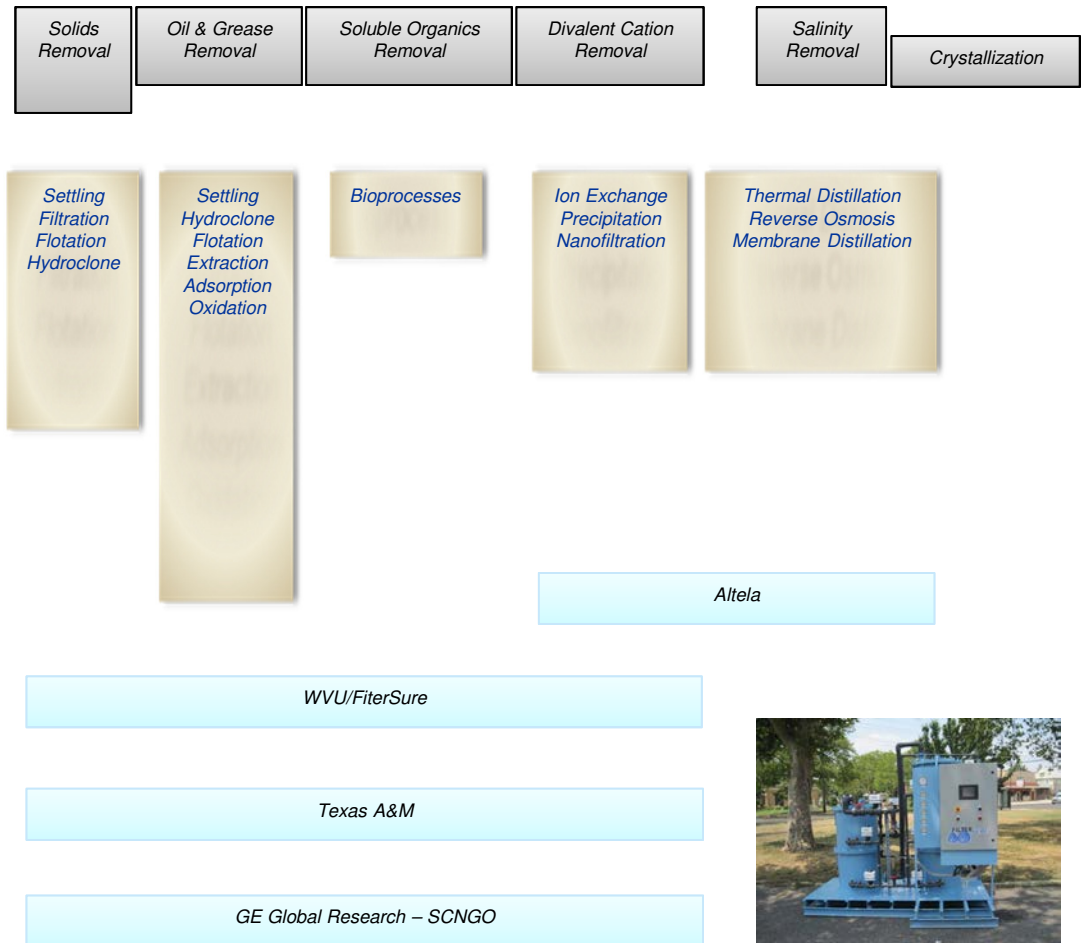


# Extramural R&D Portfolio

## Natural Gas (Environmental) Program through 2012

- **Implement cost effective and environmentally benign water management practices (supply, handling, treatment, and disposal)**

- Ensure that fresh makeup water supplies are acquired in an environmentally benign manner
- Minimize the volume of fresh water required through recycling of fracturing water
- Design water supply/handling systems that are both cost efficient and environmentally benign
- Cost-effective cleaning of flowback or produced water for re-use or surface disposal





# GroundWater Protection Council

- Developing reporting and data collection tools available to a wide range of users
- **Risk Based Data Management System (RBDMS) – Hydraulic Fracturing module**
  - *Well completions, casing, cementing, fracturing fluids*
  - *Linking well locations to water-relevant data*
  - *22 states use RBDMS to aid reg. agencies and provide information to the public*
- **FracFocus website (w/ IOGCC)**
  - *11 states require reporting through FracFocus*
  - *37,000 disclosures on frac fluid composition*
- **Facilitate STRONGER reviews**
- **Expanded coordination with EIA; further connectivity between RBDMS and FracFocus**



**FracFocus 2.0**  
 HUNDREDS OF COMPANIES. THOUSANDS OF WELLS.

Looking for information about a well site near you?



Search for nearby well sites that have been hydraulically fractured to see what chemicals were used in the process.

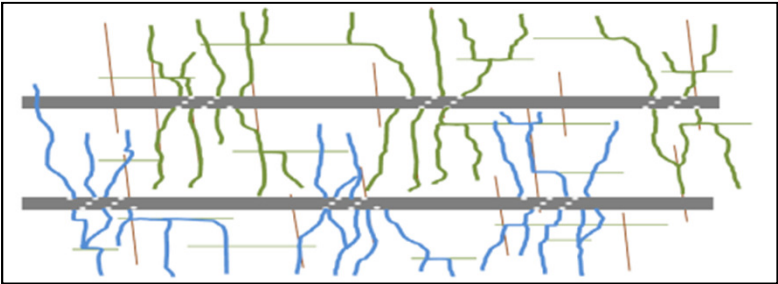
TOTAL WELL SITES REGISTERED **5 2 4 4 6**

# FY2012 Projects

Two projects added and underway

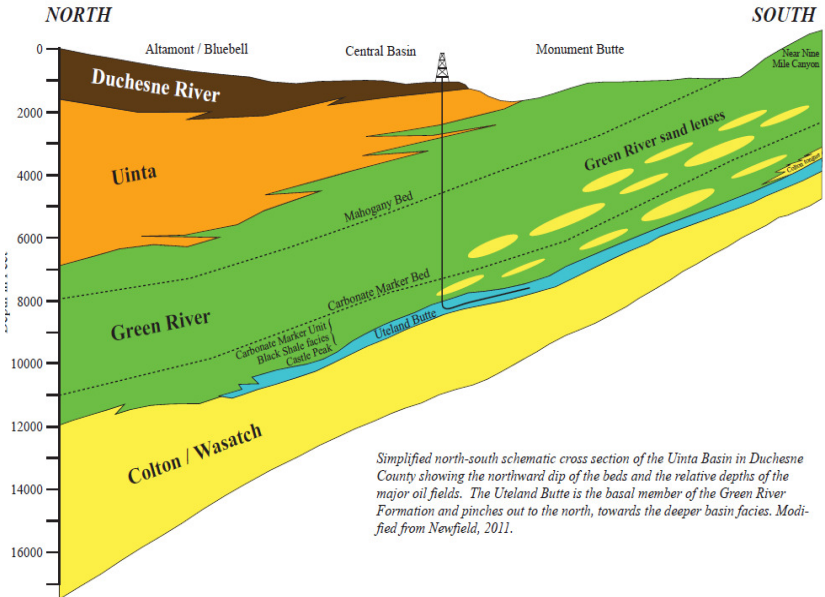
- **New Generation Hydraulic Fracturing Model for Horizontal Wells.**

- U. Texas-Austin
- Model the generation of non-planar fractures from multiple perforations: provide more robust realizations of SRV for reservoir simulation and development planning (spacing, timing, etc.)
- Oct. 2012 to Sept 2016
- \$1038K DOE



- **Liquid-rich Shale Potential of Utah's Uinta and Paradox basins**

- Utah Geological Survey
- Geologic/Geomechanical characterizations of the Green River formation (ex. Uteland Butte Mbr) and Cane Creek Fm (PB)
- Oct 2012 to Sept 2015
- \$738K



Simplified north-south schematic cross section of the Uinta Basin in Duchesne County showing the northward dip of the beds and the relative depths of the major oil fields. The Uteland Butte is the basal member of the Green River Formation and pinches out to the north, towards the deeper basin facies. Modified from Newfield, 2011.

## FY2013 Natural Gas (Environmental) FOA

- **General**

- *~\$7,000,000 available*
- *Selections coordinated with RPSEA*
- *Final Announcements and Notifications of awards are still pending.*

- **Topic Areas**

- *Area 1: Reduced Footprint of UOG Development*
- *Area 2: Assuring, Monitoring, and Mitigating Issues Related to Methane Emissions, Wellbore Integrity, and Zonal Isolation (Protecting shallow groundwater resources)*
- *Area 3: Reducing Water Usage and Resource Degradation through Smarter and Less Water-Intensive Unconventional Resource Stimulation*





# NATIONAL ENERGY TECHNOLOGY LABORATORY



## NETL Oil Technology R&D Portfolio

---

Eric Smistad/DOE/NETL

Unconventional Resources Technology Advisory Committee

September 19, 2013



# Current Portfolio Structure

- Research focus “Next Generation” CO<sub>2</sub> EOR R&D
- Eleven on-going projects
- Total value of \$20.8 million (average research partner cost share of 33%)
- Spread across four general topical needs:
  - Mobility Control Enhancement
  - Improved Flood Conformance
  - Monitoring Technology Enhancement
  - Planning and Evaluation Enhancement

## Current Projects Focus Matrix

Project	Performer	Improved Mobility Control	Improved Flood Conformance	Enhanced Monitoring	Enhanced Modeling, Planning	Demo to Accelerate Application
SPI Gels	Impact Tech.	X	X			X
Nanoparticle Foams 1	U. Texas (Austin)	X	X			X*
Optimize ROZ	U. Texas (PB)			X	X	X
Seismic Monitoring	White River Tech.			X	X	X
Surfactant Foam	U. Texas (Austin)	X	X			X*
Nanoparticle Foams 2	New Mexico Tech	X	X			
Advanced Simulator	U. Texas (Austin)				X	
Planning Software	NITEC				X	

\* *Industry field test planned, not part of project*

## Current Projects Focus Matrix (con't)

Project	Performer	Improved Mobility Control	Improved Flood Conformance	Enhanced Monitoring	Enhanced Modeling, Planning	Demo to Accelerate Application
Surfactant Concepts	NETL	X	X		X	X*
CO <sub>2</sub> Thickeners	U. Pittsburgh	X	X		X	X*
Citronelle Demo	U. Alabama Birmingham					X

*\*Industry field test planned, not part of project*

# Current CO<sub>2</sub> EOR Projects Listing

- **Improved Mobility Control in CO<sub>2</sub> Enhanced Recovery Using SPI Gels (Impact Technologies LLC)**
- **CO<sub>2</sub>-EOR and Sequestration Planning Software (NITEC LLC)**
- **Case Studies of the ROZ CO<sub>2</sub> Flood and the Combined ROZ/MPZ CO<sub>2</sub> Flood at The Goldsmith Landreth Unit, Ector County, Texas (U. Texas – Permian Basin)**
- **Engineered Nanoparticle-Stabilized CO<sub>2</sub> Foams to Improve Volumetric Sweep of CO<sub>2</sub> EOR Processes (U. Texas - Austin)**
- **Novel CO<sub>2</sub> Foam Concepts and Injection Schemes for Improving CO<sub>2</sub> Sweep Efficiency in Sandstone and Carbonate Hydrocarbon Formations (U. Texas - Austin)**
- **Nanoparticle-Stabilized CO<sub>2</sub> Foam for CO<sub>2</sub>-EOR Application (New Mexico Institute of Mining and Technology)**
- **Development of an Advanced Simulator to Model Mobility Control and Geomechanics During CO<sub>2</sub> Floods (U. Texas - Austin)**
- **Novel Surfactant-Based Concepts for Improved Mobility Control of CO<sub>2</sub> Floods (NETL-RUA)**
- **Small Molecule Associative Carbon Dioxide (CO<sub>2</sub>) Thickeners for Improved Mobility Control (University of Pittsburgh)**
- **Real Time Semi-Autonomous Geophysical Data Acquisition and Processing System to Monitor Flood Performance (White River Technologies , Inc.)**
- **Carbon-Dioxide-Enhanced Oil Production from the Citronelle Oil Field in the Rodessa Formation, South Alabama (University of Alabama at Birmingham)**