# ENERGY DEVELOPMENTS IN MEXICO – BEST PRACTICES FOR SUSTAINABLE TRANSPORTATION INFRASTRUCTURE

## Unconventional Energy Resources in Texas – Lessons Learned, Strategies, and Opportunities

January 30, 2015, 8:30 AM-Noon
SC Ballroom, Student Center, 2nd Floor
Texas A&M International University, Laredo, Texas

As Mexico embarks on a new era in energy developments, it is strategic to learn from the experience in Texas. One of the critical areas is the relationship between the energy sector and the transportation infrastructure sector. Join us for a half-a-day event where we will discuss lessons learned and explore opportunities for outreach, synergy, and collaboration.

While the energy sector is having a dramatic positive impact on the Texas and U.S. economies, unconventional energy developments tend to generate very high volumes of truck traffic. Many of the affected roads were never designed to carry such high truck traffic volumes or heavy loads. The result has been accelerated pavement degradation, increases in crash and fatality rates, increases in congestion and air emissions, and degradation of roadside infrastructure such as shoulders, clear zones, driveways, and drainage structures. The energy and trucking industries have also been affected because of the accelerated truck fleet wear and tear and dramatic increases in vehicle repair costs. The surge in energy-related activities is also putting pressure on other transportation modes, such as railroads, ports, and pipelines.

In recent years, the Texas A&M Transportation (TTI) has developed a significant amount of expertise in critical areas related to energy developments, ranging from pavement maintenance and repair techniques, development and assembly of massive energy-related databases, analysis of safety trends and countermeasures, commodity flows and supply chain analysis, and coordination with public-sector and private-sector stakeholders. TTI has completed several projects in this area, and is currently undertaking a number of initiatives at the national, state, and local levels. Established in 1950, TTI is the world's largest university-based transportation research organization. TTI's objective is to solve transportation problems through research, technology transfer, and development of diverse human resources. To achieve this objective, the Institute participates in local, state, regional, and national levels in conducting interdisciplinary research programs that extend into the planning, design, construction, operation, maintenance, enforcement, safety, economic, ecological, and social aspects of transportation.

**SPEAKERS**

Cesar Quiroga, Ph.D., P.E., Senior Research Engineer, TTI
(For additional information: Email: c-quiroga@tamu.edu, Phone: 210-321-1229)
David Newcomb, Ph.D., Senior Research Scientist, TTI
Edgar Kraus, P.E., Research Engineer, TTI
Ioannis Tsapakis, Ph.D., Assistant Research Scientist, TTI

**AGENDA**

| Time | Topic |
|---|---|
| 8:30 | **Welcome and Introductions**<br><br>TAMIU Binational Center – Maria Eugenia Calderon<br>Clúster Minero-Petrolero de Coahuila – Rogelio Montemayor<br>City of Laredo – Mayor Pete Saenz<br>Webb County – Judge Tano Tijerina<br>Texas A&M Transportation Institute – Cesar Quiroga |
| 9:00 | **Texas A&M Transportation Institute Overview** |
| 9:10 | **Oil and Gas Developments in Texas**<br><br>Evolution and trends |
| 9:30 | **Recent and Current Research and Technology Transfer**<br><br>Impacts on transportation infrastructure<br>Pavement maintenance, repair, and design<br>Oversize and overweight trucks<br>Transportation policy<br>Funding<br>Ports<br>Water and environmental issues<br>Other |
| 10:15 | **Break** |
| 10:30 | **Breakout Table Discussions**<br><br>The purpose of the breakout discussions is (a) to explore topics and issues of interest to participants in more detail in relation to energy developments and transportation infrastructure in Texas, (b) to identify transportation infrastructure needs in Mexico, and (c) to identify areas of synergy and potential collaboration. Each breakout subgroup will have a leader, who will help coordinate the discussion and assemble notes that will be discussed as a group at the end.<br><br>It is anticipated that three or four breakout groups will be assembled. |
| 11:30 | **Breakout Group Presentations** |
| 11:50 | **Wrap-Up, Next Steps, and Adjourn** |

# Energy Developments in Mexico – Best Practices for Sustainable Transportation Infrastructure

Unconventional Energy Resources in Texas: Lessons Learned, Strategies, and Opportunities

Texas A&M International University, Laredo, Texas, January 30, 2015



## Meeting Objectives

- Examine the relationship between the energy and transportation infrastructure sectors
- Review lessons learned from unconventional energy developments in Texas
- Explore opportunities for outreach, synergy, and collaboration to support sustainable energy and transportation developments in Mexico

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| 9:00 AM – 9:10 AM | TTI Overview | Cesar Quiroga |
| 9:10 AM – 9:30 AM | Oil and Gas Developments in Texas | Cesar Quiroga |
| 9:30 AM – 10:15 AM | Recent and Current Research and Technology Transfer | Several speakers |
| 10:15 AM – 10:30 AM | Break | |
| 10:30 AM – 11:30 AM | Breakout Table Discussions | All participants |
| 11:30 AM – 11:50 AM | Breakout Group Presentations | Several speakers |
| 11:50 AM – Noon | Wrap-Up, Next Steps, and Adjourn | All participants |



# Welcome

- TAMIU Binational Center
  - Maria Eugenia Calderon
- Clúster Minero-Petrolero de Coahuila
  - Rogelio Montemayor
- City of Laredo
  - Mayor Pete Saenz
- Webb County
  - Judge Tano Tijerina
- Texas A&M Transportation Institute
  - Cesar Quiroga

# Introductions

- Your name
- Where do you work?
- Expectations for this meeting?

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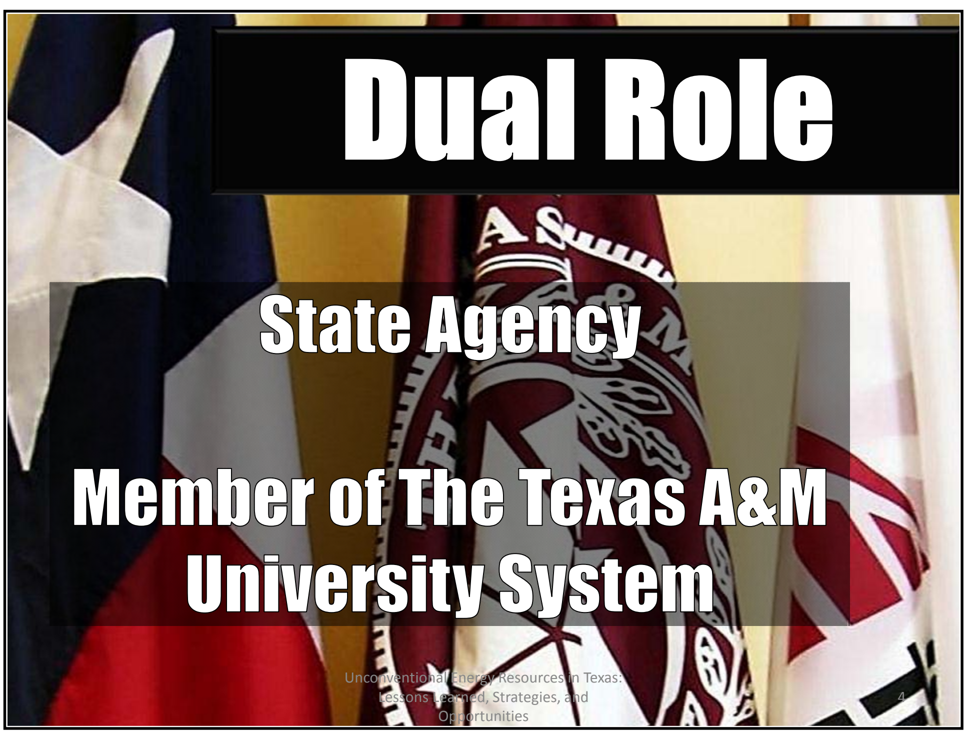
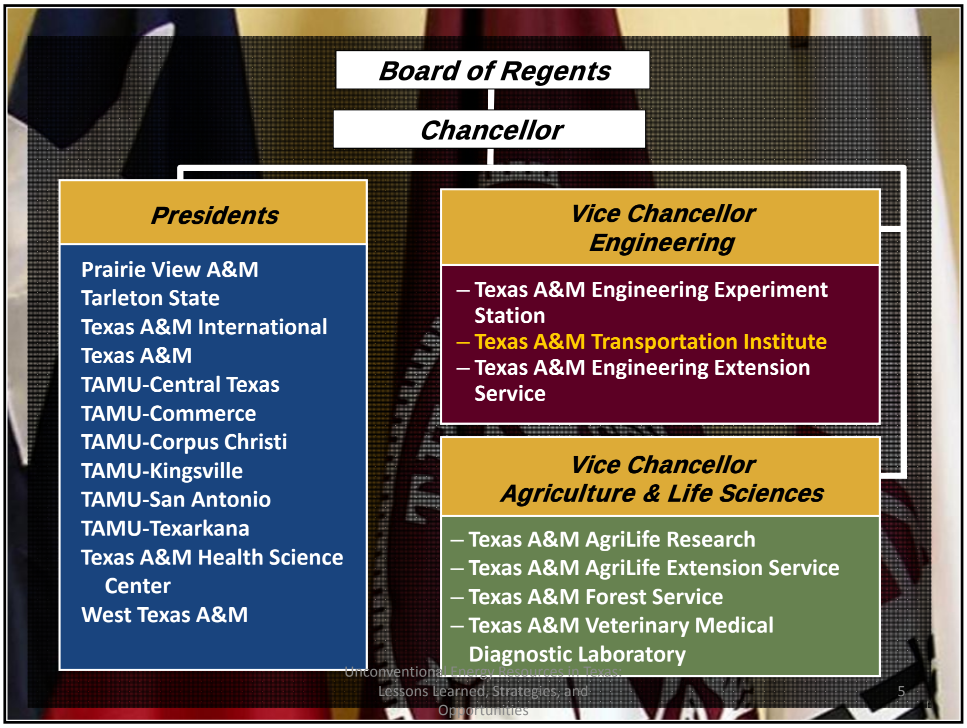
TTI Mission
To solve transportation problems through research
To transfer technology and knowledge
To develop diverse human resources to meet the transportation challenges of tomorrow
Over 60 years of Implementing the U.S.
Land-Grant University Mission in Transportation
Unconventional Energy Resources in Texas:


Dual Role
State Agency
Member of The Texas A&M University System
Unconventional Energy Resources in Texas:
Lessons Learned, Strategies, and
Opportunities
4


Board of Regents
Chancellor
Presidents
Prairie View A&M
Tarleton State
Texas A&M International
Texas A&M
TAMU-Central Texas
TAMU-Commerce
TAMU-Corpus Christi
TAMU-Kingsville
TAMU-San Antonio
TAMU-Texarkana
Texas A&M Health Science Center
West Texas A&M
Vice Chancellor Engineering
– Texas A&M Engineering Experiment Station
– Texas A&M Transportation Institute
– Texas A&M Engineering Extension Service
Vice Chancellor Agriculture & Life Sciences
– Texas A&M AgriLife Research
– Texas A&M AgriLife Extension Service
– Texas A&M Forest Service
– Texas A&M Veterinary Medical Diagnostic Laboratory
Unconventional Energy Resources in Texas: Lessons Learned, Strategies, and Opportunities
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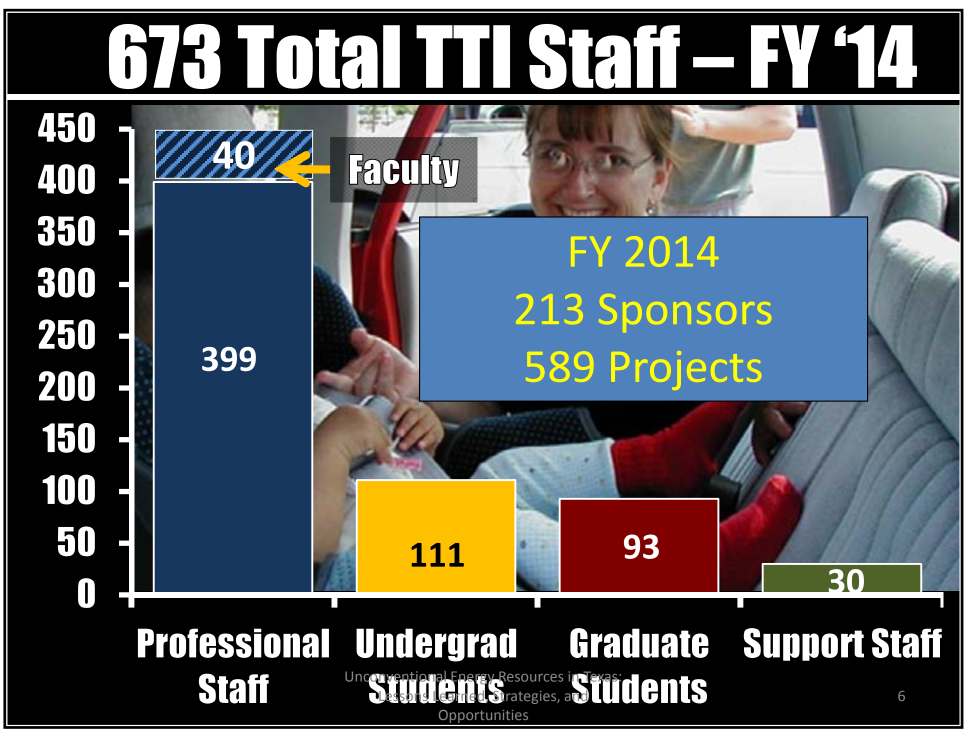
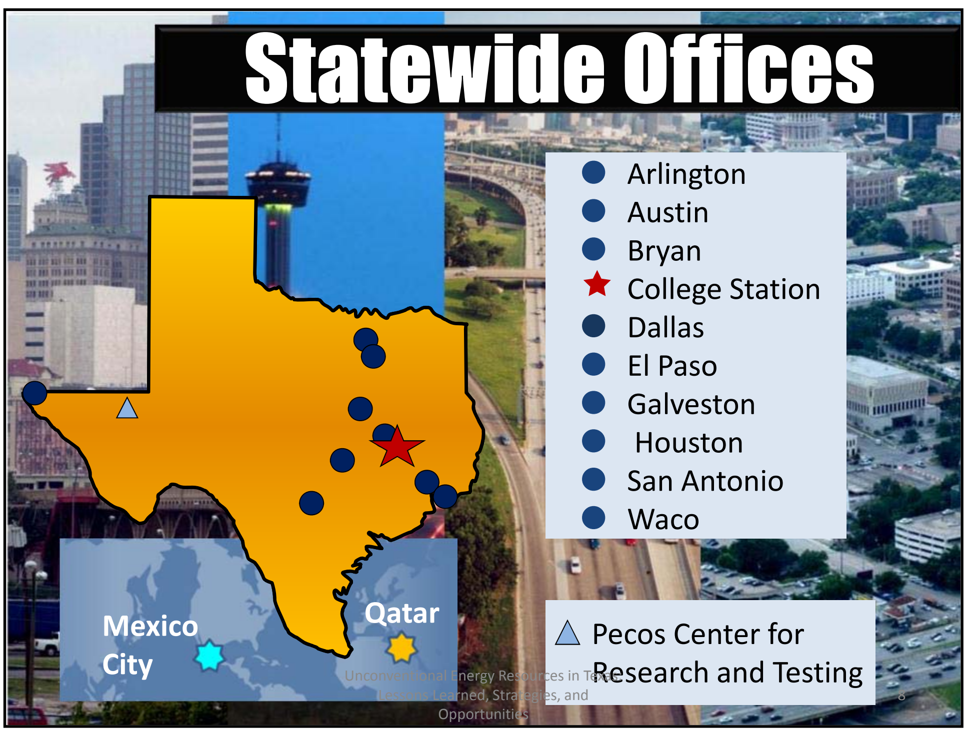
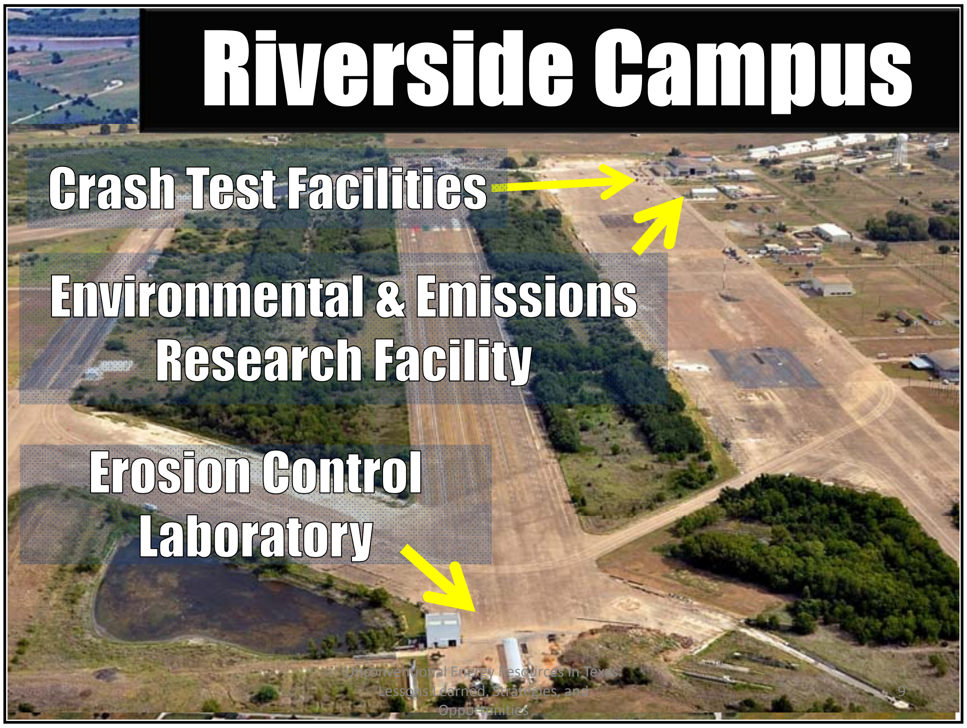

673 Total TTI Staff – FY '14
450
400
350
300
250
200
150
100
50
0
40
Faculty
399
111
93
30
FY 2014
213 Sponsors
589 Projects
Professional Staff
Undergrad Students
Graduate Students
Support Staff
Unconventional Energy Resources in Texas: Lessons Learned, Strategies, and Opportunities
6

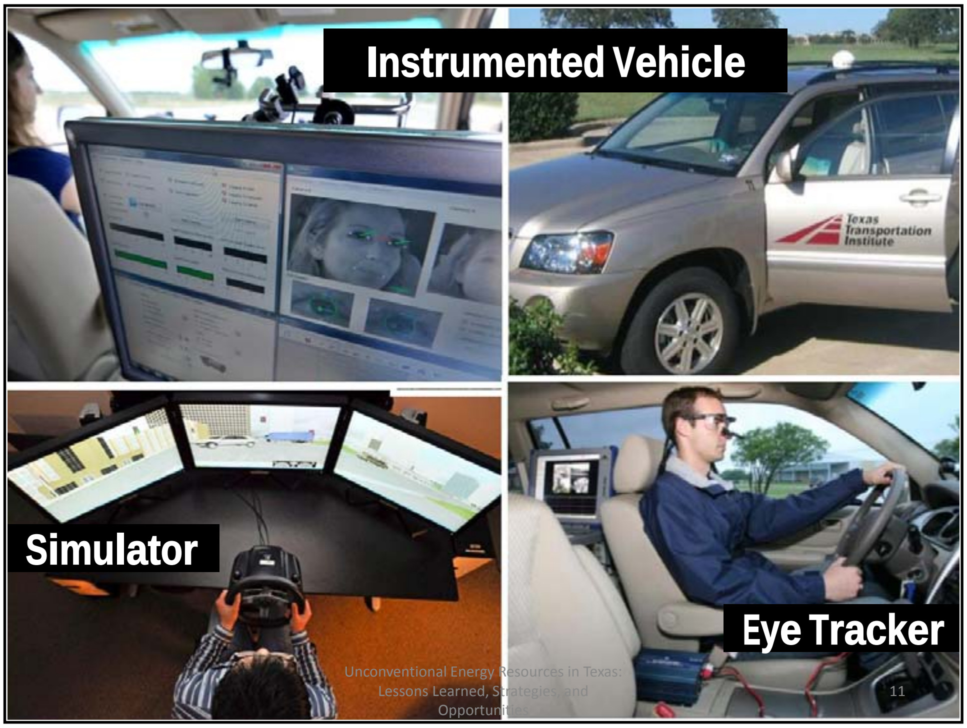
| | | |
|---|---|---|
| Mobility | Economics & Policy | Security |
| Freight Movement | Human Factors | Infrastructure |
| Environment | Safety | Workforce Development |






Riverside Campus
Crash Test Facilities
Environmental & Emissions Research Facility
Erosion Control Laboratory


Visibility Laboratory
STOP
Unconventional Energy Resources in Texas: Lessons Learned, Strategies, and Opportunities
10


Instrumented Vehicle
Texas Transportation Institute
Simulator
Eye Tracker
Unconventional Energy Resources in Texas: Lessons Learned, Strategies, and Opportunities
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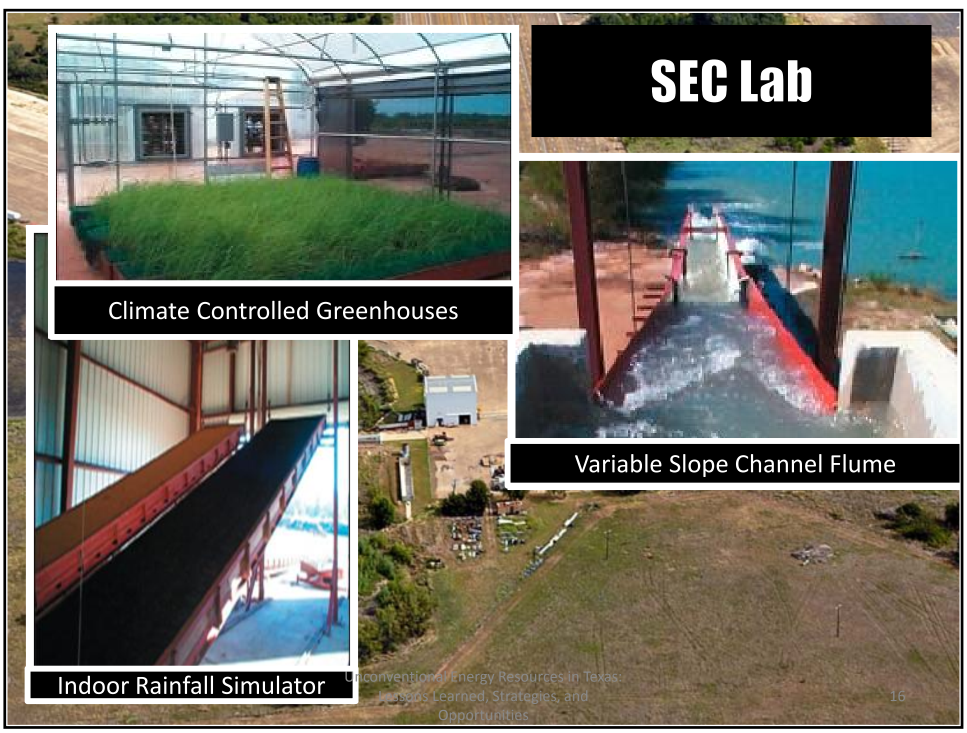
McNew Lab
• Advanced Materials Characterization Lab
• Asphalt Binder and Chemistry Lab
• Asphalt Mixture Testing Lab
• Mobile Laboratory for Asphalt Mixture Testing
• Pavement Non-Destructive Testing Equipment
Unconventional Energy Resources in Texas: Lessons Learned, Strategies, and Opportunities


High-Bay Structural Testing Facility
13


Crash Test Facilities
14


Environmental
Emissions
Research Facility


SEC Lab
Climate Controlled Greenhouses
Variable Slope Channel Flume
Indoor Rainfall Simulator

# Groups Involved in Energy Research

- Materials and Pavements Division
- Freight Program
- San Antonio Office
- Policy Research Center
- Center for Transportation Safety
- …



# Materials and Pavements Division

- Sponsors include
  - TxDOT
  - NCHRP
  - FHWA
  - AASHTO
  - SHRP2
  - Private Industry

# Research Areas

- Pavement design
- Materials
- Asphalt overlays
- Maintenance & rehabilitation
- Pavement evaluation
- Asset management/condition surveys
- Implementation
- Calibration/certification



# Freight Program

- Cross-cutting research program at TTI
- Motor Carriers:  congestion, emissions, size, weight
- Maritime:  inland waterways, port operations
- Border and Trade: border crossing performance measures, freight ITS
- Railroads: safety, infrastructure, markets
- Freight Systems and Planning:  hazardous materials, Freight Shuttle

## San Antonio Office

- Optimization of the project development process
- Energy and transportation sector interactions
- Utility coordination and conflict management
- Planning and operations
- Extensive South Texas coverage
- Support to TxDOT Districts (San Antonio, Laredo, Corpus Christi, Pharr)
- Coordination with local jurisdictions



## Questions?

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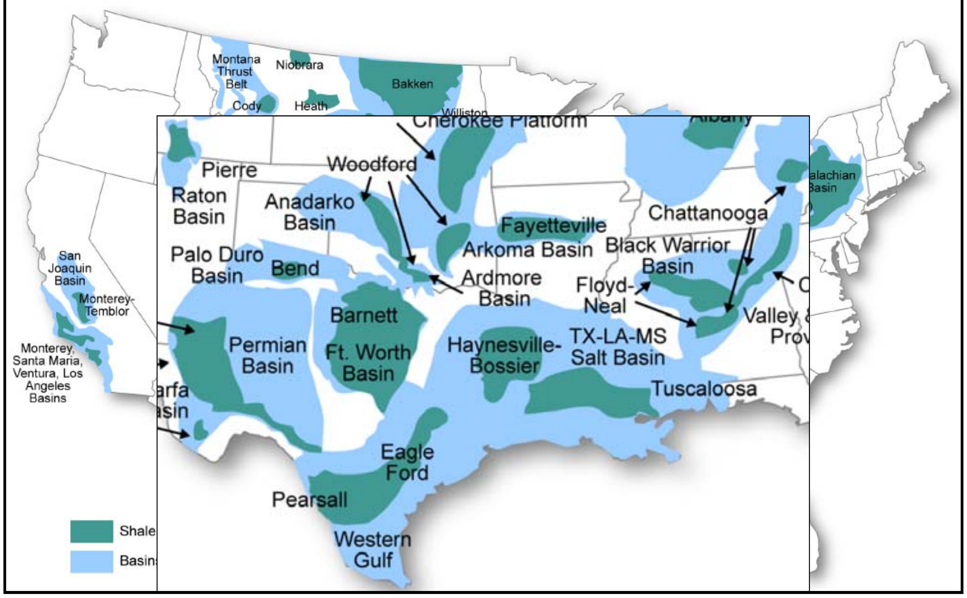
# Oil and Gas Developments in Texas

# Shale Plays and Basins




# Hydraulic Fracturing ("Fracking")

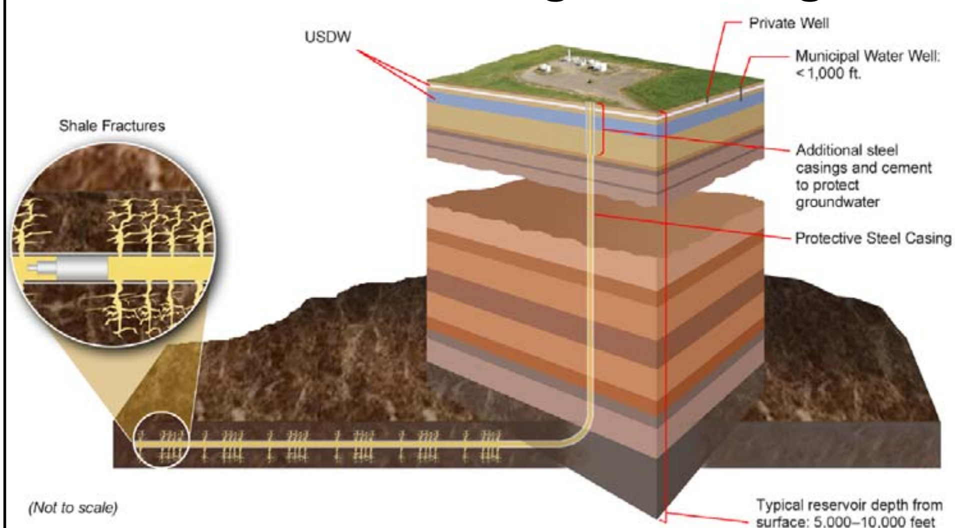
- Rock fracturing using fluid at high pressure
- Water mixed with sand and chemicals
- Small fractures in rock enable gas, petroleum, and water to migrate to the well
- Has been around since the 1940s
- DOE's Eastern Gas Shales Project (EGSP)
  - Research and demonstration project
  - Cost-sharing with industry (1976-1992)

# Hydraulic Fracturing ("Fracking")

- Horizontal drilling
  - Late 1980s, Austin Chalk Formation in Texas
  - 1991, Barnett Shale
- Slickwater fracturing
  - 1996/1997
  - Chemicals added to water to increase fluid flow
- Horizontal drilling + slickwater fracturing
  - Shale gas extraction became efficient and feasible



# Horizontal Drilling + Fracking

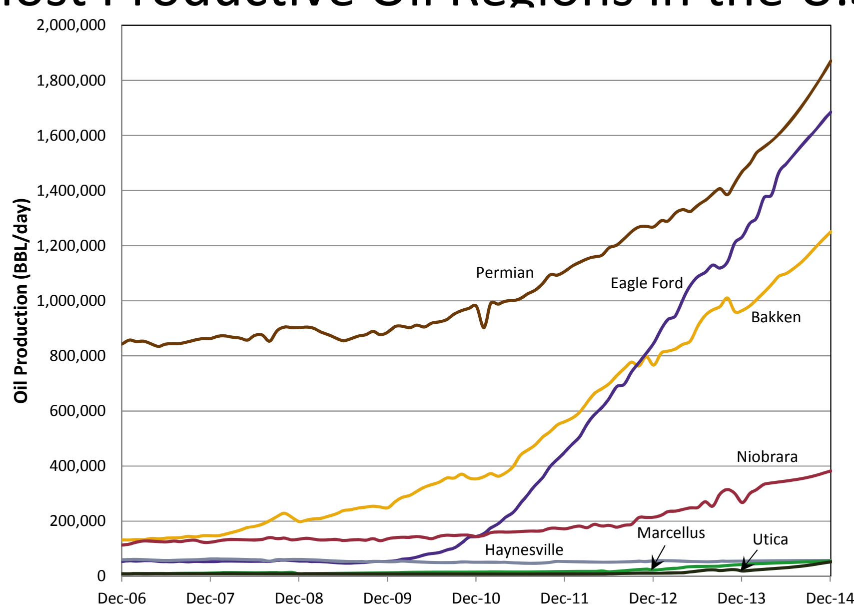


# Number of Rigs (07/2014)

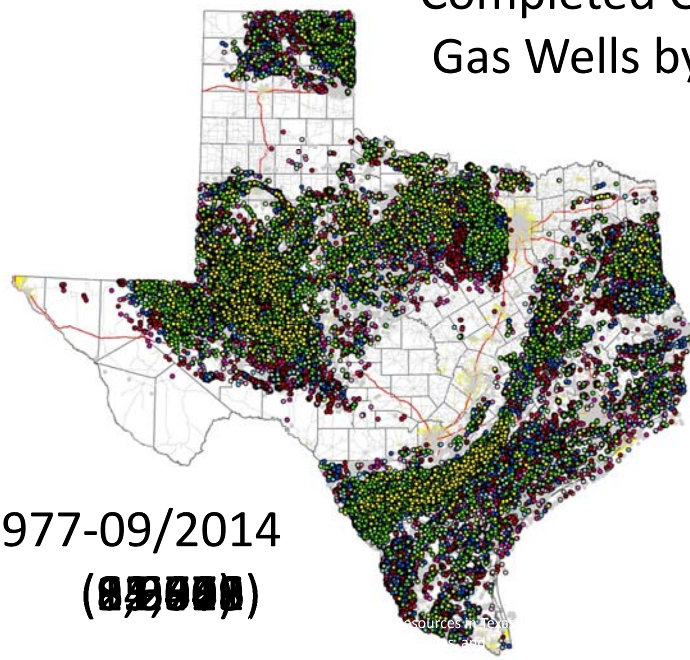
- United States: 1,874 (55% of rigs worldwide)
- Texas: 896 (48%)
- Oklahoma: 209 (11%)
- North Dakota: 171 (9.1%)
- New Mexico: 92 (4.9%)
- Colorado: 68 (3.6%)
- Louisiana (onshore): 57 (3.0%)
- Pennsylvania: 54 (2.9%)
- Wyoming: 51 (2.7%)



# Most Productive Oil Regions in the U.S.



Completed Oil and Gas Wells by Year

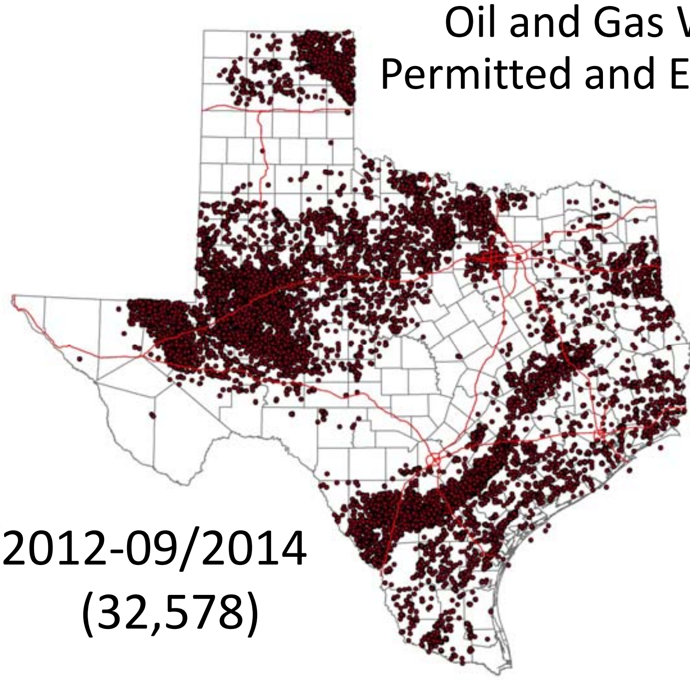


1977-09/2014

([illegible])

N

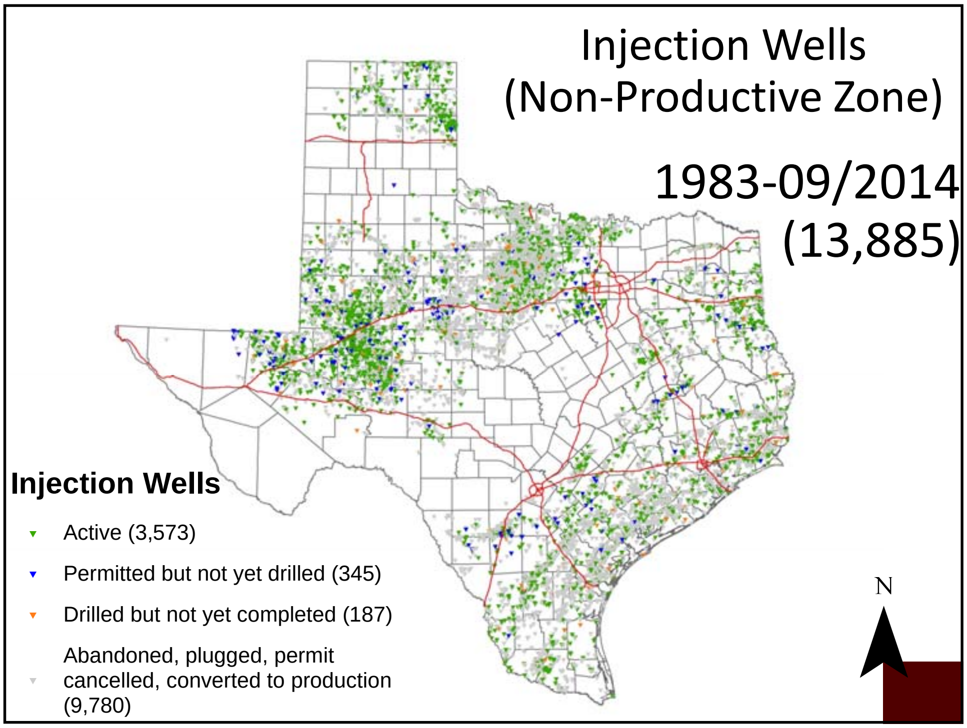
Oil and Gas Wells Permitted and Expected

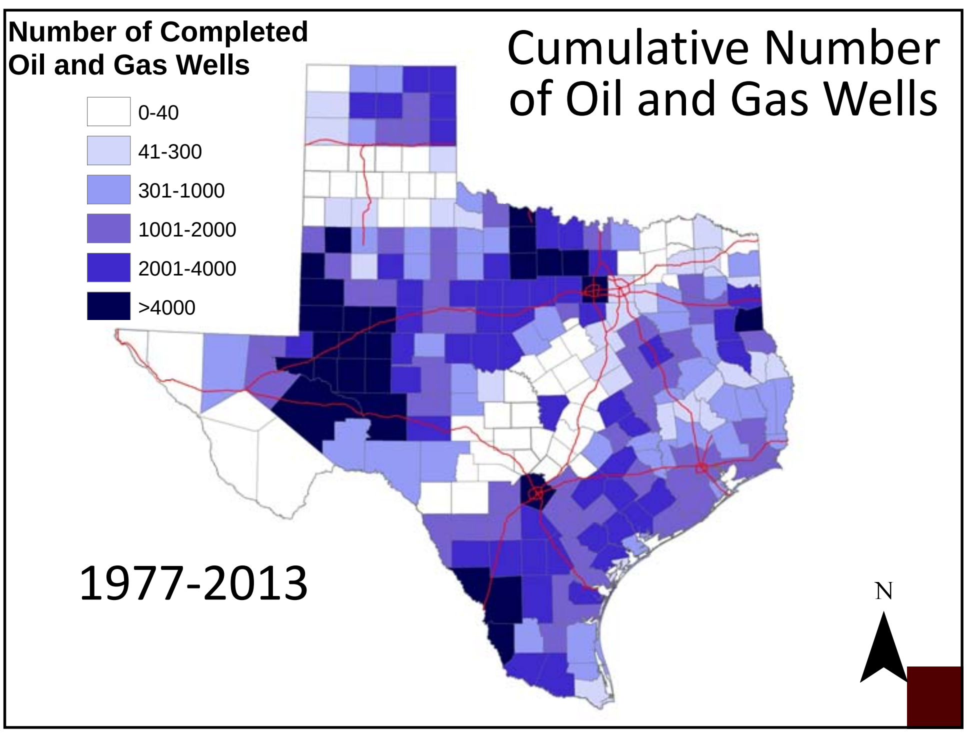


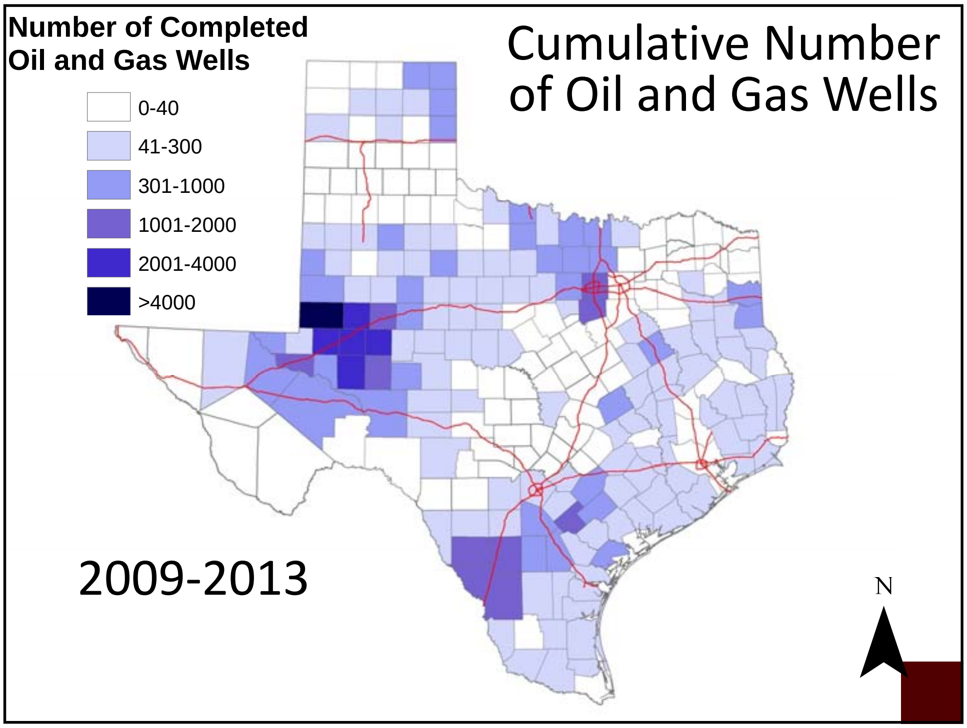
10/2012-09/2014

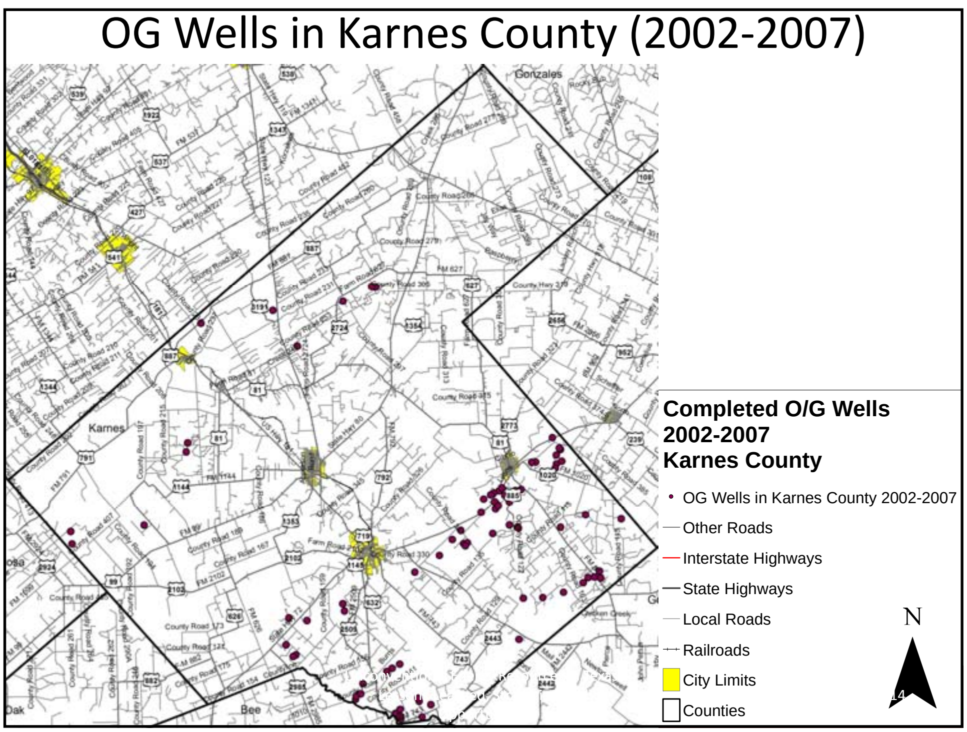
(32,578)

N

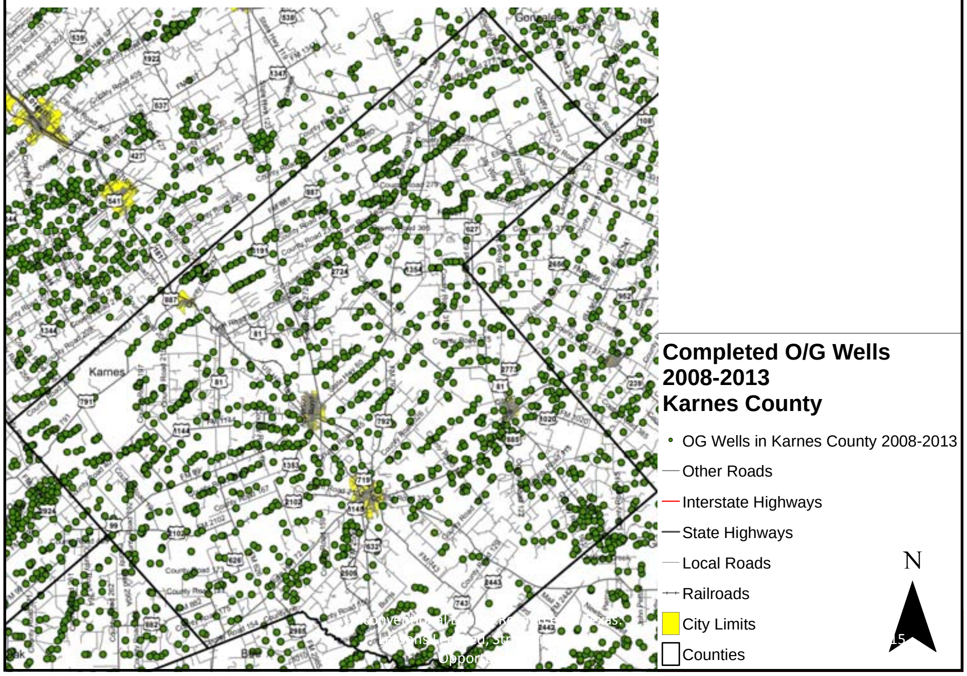

Injection Wells
(Non-Productive Zone)
1983-09/2014
(13,885)
Injection Wells
Active (3,573)
Permitted but not yet drilled (345)
Drilled but not yet completed (187)
Abandoned, plugged, permit cancelled, converted to production (9,780)
N


Number of Completed Oil and Gas Wells
0-40
41-300
301-1000
1001-2000
2001-4000
>4000
Cumulative Number of Oil and Gas Wells
1977-2013
N

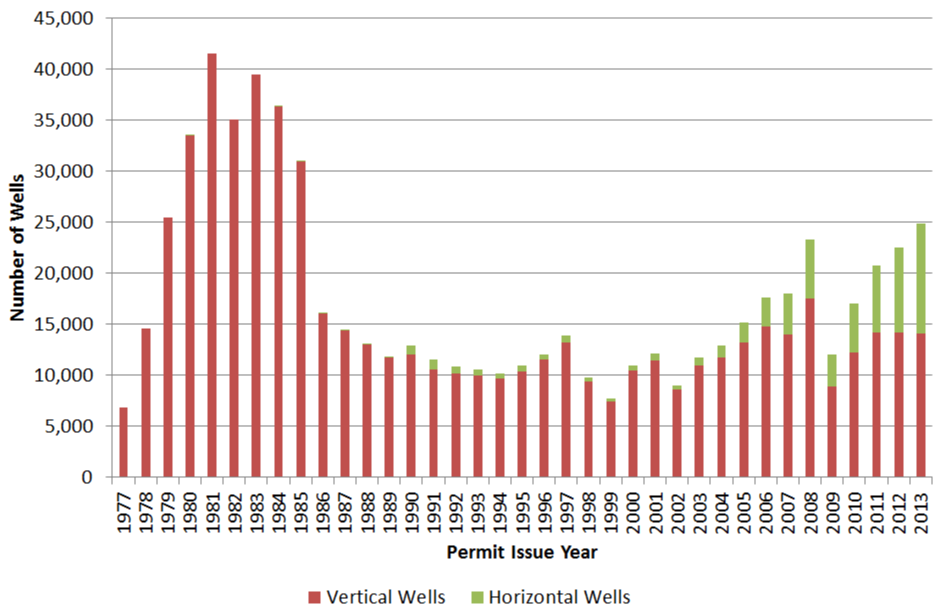

Number of Completed
Oil and Gas Wells
0-40
41-300
301-1000
1001-2000
2001-4000
>4000
Cumulative Number
of Oil and Gas Wells
2009-2013
N

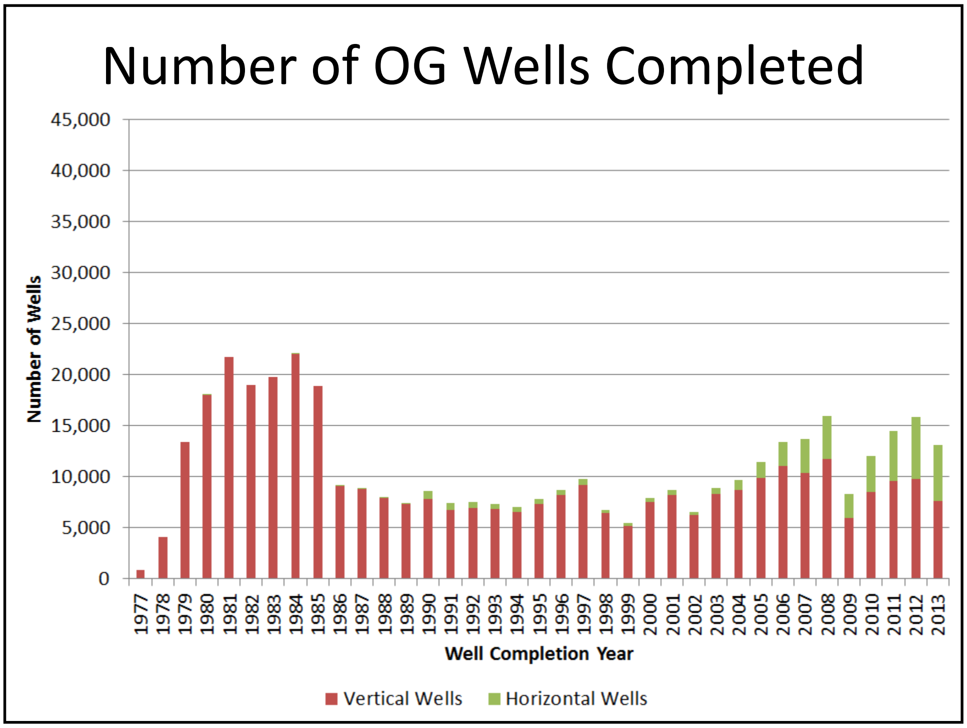

OG Wells in Karnes County (2002-2007)
Completed O/G Wells
2002-2007
Karnes County
OG Wells in Karnes County 2002-2007
Other Roads
Interstate Highways
State Highways
Local Roads
Railroads
City Limits
Counties
N

# OG Wells in Karnes County (2008-2013)

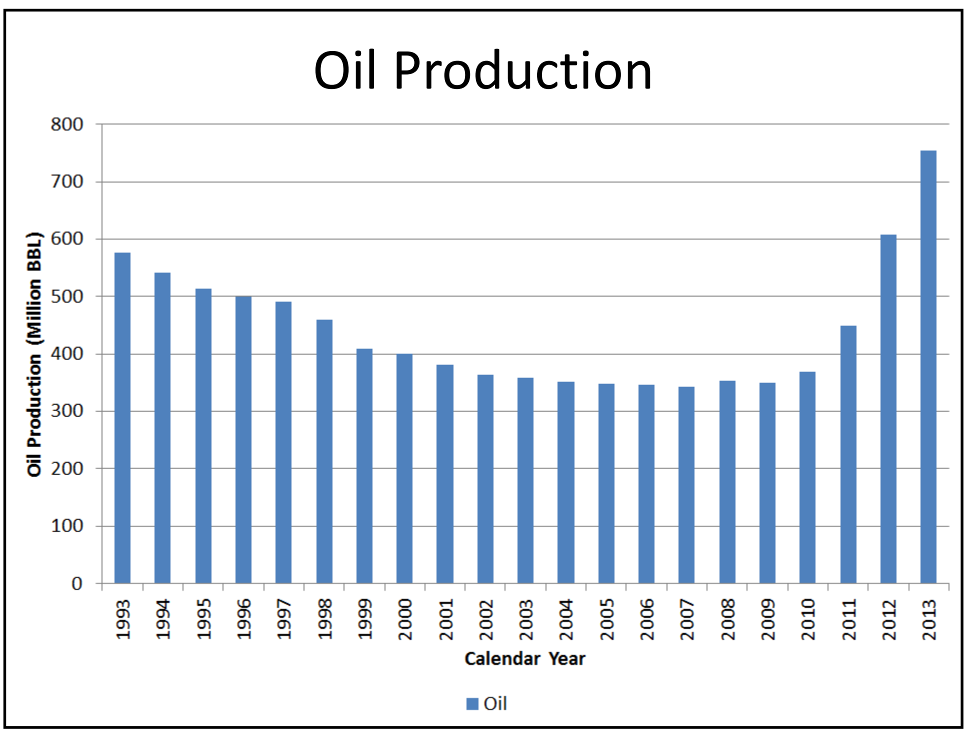



# Number of OG Wells Permitted

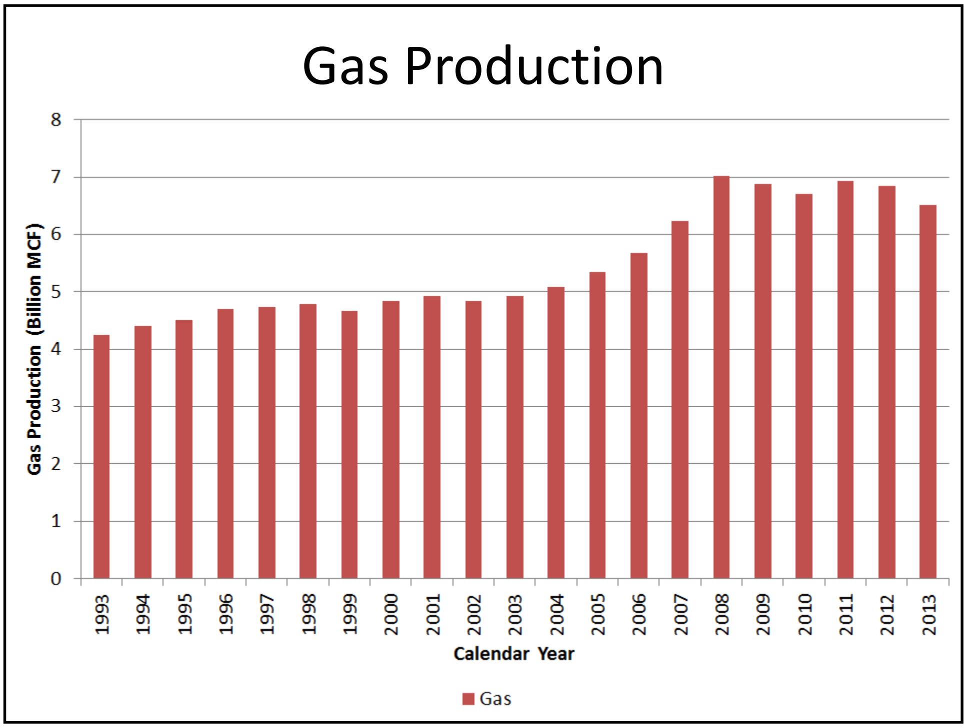


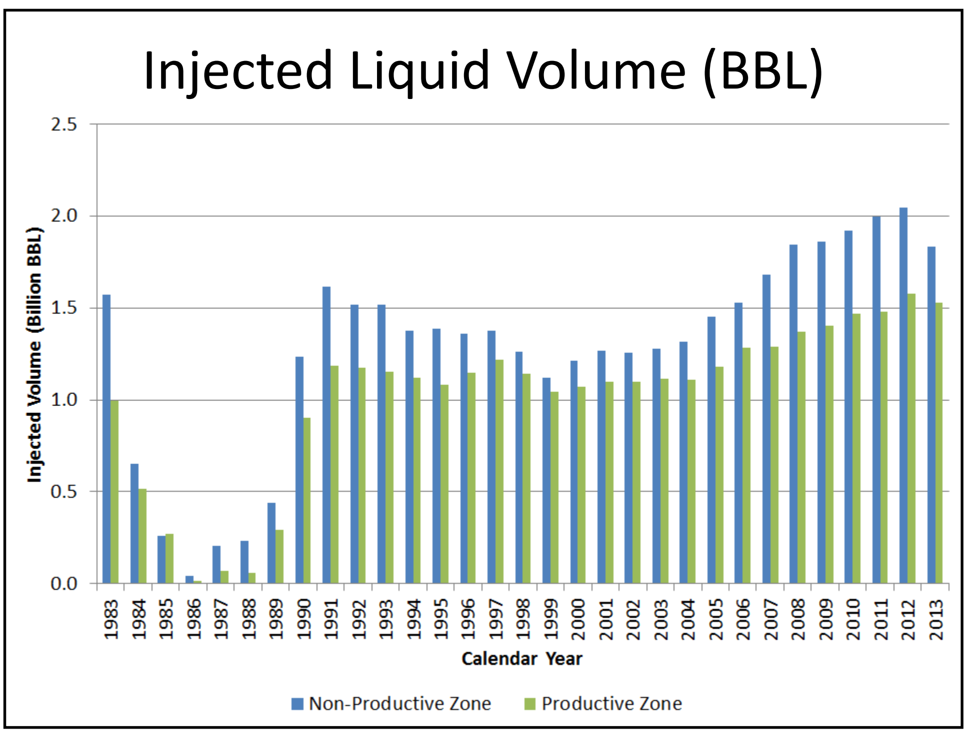


Number of OG Wells Completed
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Number of Wells
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Well Completion Year
Vertical Wells
Horizontal Wells

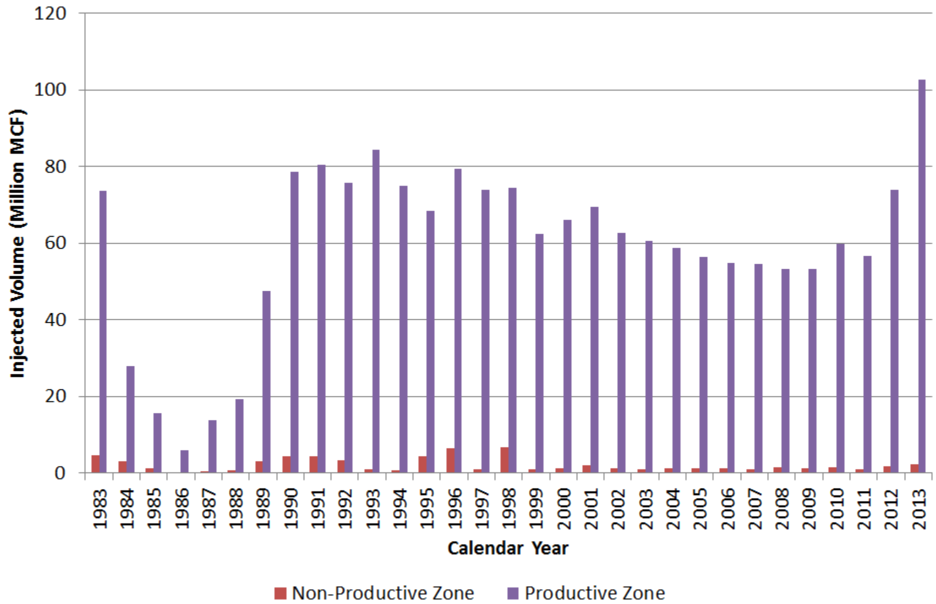



Oil Production
800
700
600
500
400
300
200
100
0
Oil Production (Million BBL)
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Calendar Year
Oil


Gas Production
Gas Production (Billion MCF)
8
7
6
5
4
3
2
1
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Calendar Year
Gas


Injected Liquid Volume (BBL)
Injected Volume (Billion BBL)
2.5
2.0
1.5
1.0
0.5
0.0
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Calendar Year
Non-Productive Zone
Productive Zone

## Injected Air/Gas Volume (MCF)

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# Recent and Current Research and Technology Transfer

# 0-6498 Research Project

- Completed in 2012
- Impacts
  - Pavement impacts
  - Reduction in pavement life
  - Roadside impacts
  - Operational and safety impacts
- Statewide impact
  - $1 billion per year ($2 billion including local roads)



# IH 35W – East Frontage Road

Pavement shoving, loss of surface

Pavement shoving, loss of surface

# FM 2257


County road T-intersection


Shoulder patches, cracked seals



# IH 35W – West Frontage Road


Tire tracks on unpaved shoulder


Tire tracks on safety end treatment

# FM 1611


Drainage problem at driveway


Mud tracking



# 0-6498 Research Recommendations

- Early notification and coordination
  - Improve communication and coordination with energy developers
  - Implement proactive mechanisms to learn about energy developments
  - Implement interagency cooperation agreements with other agencies
- Road maintenance and repair
- Roadside management
- Funding

## Current Initiatives

- TxDOT Maintenance Division Interagency Agreement
- Policy Research Center
- Comprehensive Energy and Transportation Sector Initiative
- Pool Fund Study



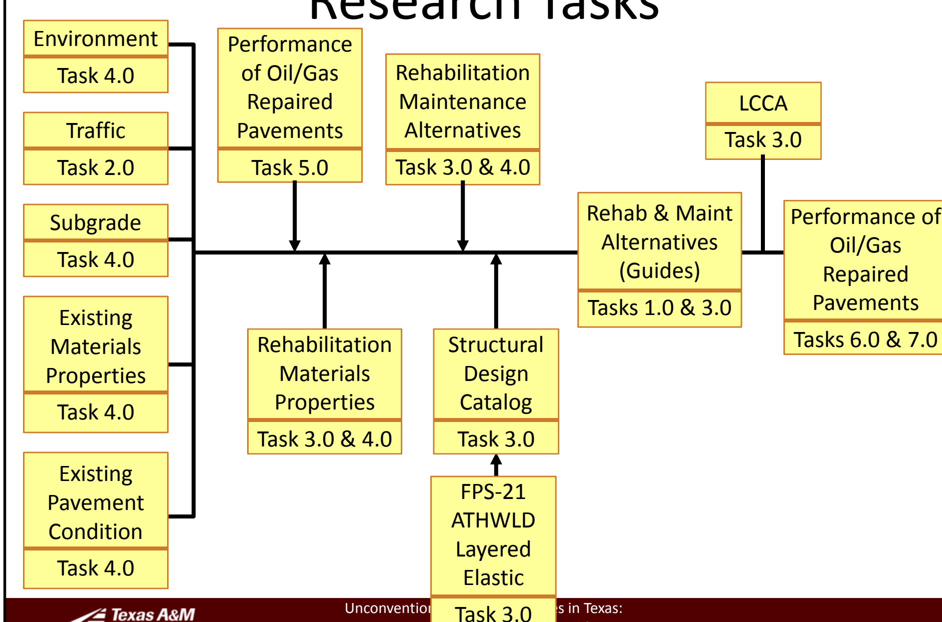
## PAVEMENT DESIGN AND MAINTENANCE

# TxDOT-TTI Joint Effort Tasks

1. Current practices
2. Traffic
3. Guidelines
4. Specific project support
5. Performance
6. Workshops/communication
7. Future impacts



# Research Tasks



# Pavement Conditions



# Pavement Investigation

# Maintenance & Rehabilitation



# ENERGY DEVELOPMENT TRAFFIC CHARACTERIZATION

# Relative Pavement Impact

| Total Weight (lb) | Weight Ratio | EALF Ratio | Weight Ratio | EALF Ratio | Weight Ratio | EALF Ratio |
|---|---|---|---|---|---|---|
| | WRT 4,000 lb | | WRT 35,000 lb | | WRT 80,000 lb | |
| 4,000 | **1** | **1** | | | | |
| 10,000 | 2.5 | 23 | | | | |
| 35,000 | 8.8 | 583 | **1** | **1** | | |
| 80,000 | 20 | 18,009 | 2.3 | 31 | **1** | **1** |
| 84,000 | 21 | 22,210 | 2.4 | 38 | 1.05 | 1.2 |
| 90,000 | 22 | 28,511 | 2.6 | 49 | 1.1 | 1.6 |
| 100,000 | 25 | 42,753 | 2.9 | 73 | 1.2 | 2.4 |



# Energy Traffic Characterization

- Number of truckloads is a function of:
  - Well type and depth
  - Geology
  - Drilling technology
- Water needs for fracking: 2 – 6 million gallons
- Vertical vs. horizontal wells (Marcellus Shale)
  - Vertical well fracking: 20,000 – 80,000 gallons
  - Horizontal well fracking: 2 – 9 million gallons

# Energy Traffic Characterization

- Barnett Shale (North Texas) example:
  - 187 truckloads for pad site preparation, rig mobilization, drilling operations, and rig removal
  - 997 truckloads for fracking (3.7 million gallons or 88,100 barrels of water needed for fracking and saltwater disposal)
  - 353 truckloads per year for maintenance, most of which involves saltwater loads for gas well injections
  - 997 truckloads every few years for refracking



# Energy Traffic Characterization

| Activity | NYSERDA | | NYSERDA | | NYSDEC | | NPS | Boulder County | TxDOT | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 | | 2011 | | 2010 | | 2008; 2009 | 2013 | 2014 | |
| | 1 Well | 8 Wells, 2 Rigs | 1 Well | | 1 Well | | 1 Well | 4 Wells | 1 Well | |
| | Marcellus Shale | | Marcellus Shale | | Marcellus Shale | | Marcellus Shale | Niobrara Shale, CO | Eagle Ford Shale | Barnett Shale |
| | | | Trucks Only | Trucks & Pipeline | Trucks Only | Trucks & Pipeline | | | | |
| Drilling pad and construction equipment | 10-45 | 10-45 | 45 | 45 | 45 | 45 | 10-45 | 90 | 318 | 70 |
| Drilling rig | 35-45 | 60 | 190 | 190 | 95 | 95 | 30 | 90 | | 4 |
| Drilling fluid and materials | 25-50 | 200-400 | 360 | 360 | 45 | 45 | 25-50 | 270 | 240 | 15 |
| Drilling equipment: casing, drilling pipe | 25-50 | 200-400 | 90 | 90 | 45 | 45 | 25-50 | 450 | | 48 |
| Completion rig | 15 | 30 | 400 | 400 | 50 | 50 | 15 | 40 | | 4 |
| Completion fluid and materials | 10-20 | 80-160 | 160 | 160 | 20 | 20 | 10-20 | 170 | | |
| Completion equipment: pipe, wellhead | 5 | 10 | 10 | 10 | 5 | 5 | 5 | 10 | | |
| Hyd. frac. equipment: pump truck, tanks | 150-200 | 300-400 | 350 | 350 | 175 | 175 | 100-150 | 320 | 560 | 94 |
| Hydraulic fracturing water | 400-600 | 3200-4800 | 4000 | 480 | 500 | 60 | 100-1000 | 4200 | | 685 |
| Hydraulic fracturing sand | 20-25 | 160-200 | 184 | 184 | 23 | 23 | | 190 | | |
| Flowback water removal | 200-300 | 1600-2400 | 800 | 136 | 100 | 17 | | 1400 | | 214 |
| Final pad preparation and miscellaneous | | | 45 | 45 | 45 | 45 | | | | |
| **TOTAL** | **895-1355** | **5850-8905** | **6634** | **2450** | **1148** | **625** | **310-1365** | **7230** | **1118** | **1134** |
| Well production equipment | | | | | | | | | 2190 | 353 |
| Oil and water removal (per year) | | | | | | | | 580 | | |
| Operations and maintenance (per year) | | | | | | | | 150 | | |
| General maintenance (every 3-5 years) | | | | | | | 25-40 | | | |

# OS/OW Permits – Aug 2011-Jan 2014

| Permit Type | No. of Permits | Percentage |
|---|---|---|
| Annual Permits | 138,843 | 8% |
| Single Trip Permits | 1,494,727 | 80% |
| Other Permits | 230,666 | 12% |
| Total | 1,864,236 | 100% |



# OS/OW Permits – FY 2013

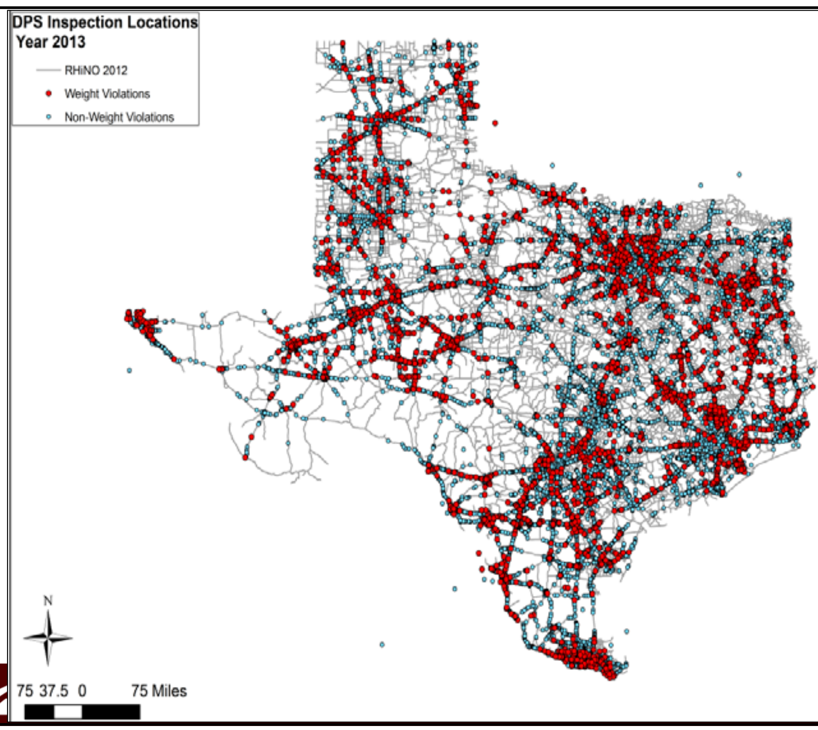
| Industry Type | No. of Permits |
|---|---|
| All Industry Types | 519,206 |
| Oil and Gas Industry Related | 224,500 |
| % Permits Related to Oil & Gas Industry | 43% |

| Oil & Gas Industry Permits | No. Permits | No. Trips |
|---|---|---|
| Annual permits | 16,720 | 4,180,031 |
| Single trip permits | 180,002 | 180,002 |
| Other permits | 27,778 | 27,778 |
| Total | 224,500 | 4,387,810 |

# DPS Commercial Vehicle Inspection Data

- Inspection data: 01/2010 – 06/2013
- Data files:
  - Inspection event data (e.g., location and time)
  - Violation description
  - Vehicle data (e.g., axle configuration)
  - Weight data (e.g., gross and axle group weight)
  - Hazmat data





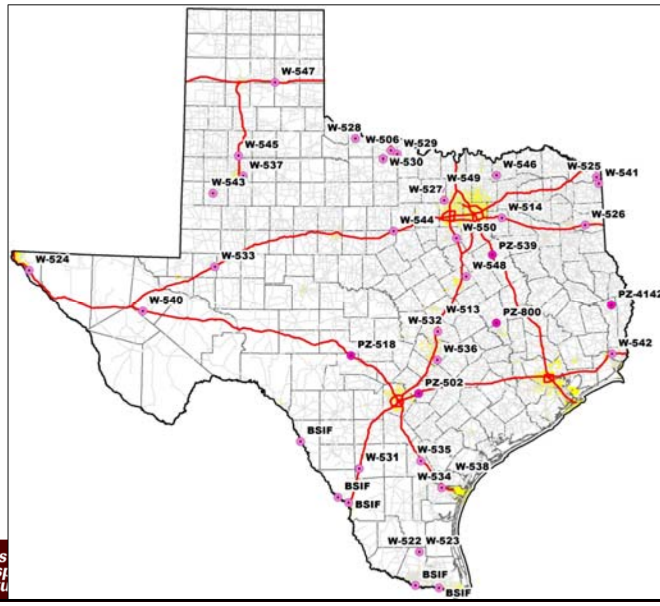
# 10 Highest GVWs for 5-Axle Trucks

| | 2010 | 2011 | 2012 | 2013 (June) |
|---|---|---|---|---|
| 1. | 187,840 | 169,200 | 183,650 | 184,350 |
| 2. | 158,750 | 153,400 | 148,940 | 171,250 |
| 3. | 139,250 | 149,500 | 142,040 | 154,700 |
| 4. | 138,150 | 144,800 | 141,450 | 148,900 |
| 5. | 136,350 | 138,600 | 139,300 | 146,600 |
| 6. | 130,150 | 137,300 | 130,640 | 140,780 |
| 7. | 127,300 | 134,180 | 126,760 | 133,900 |
| 8. | 127,150 | 126,280 | 125,900 | 130,450 |
| 9. | 122,780 | 125,950 | 125,600 | 126,850 |
| 10. | 122,780 | 125,900 | 125,250 | 126,420 |



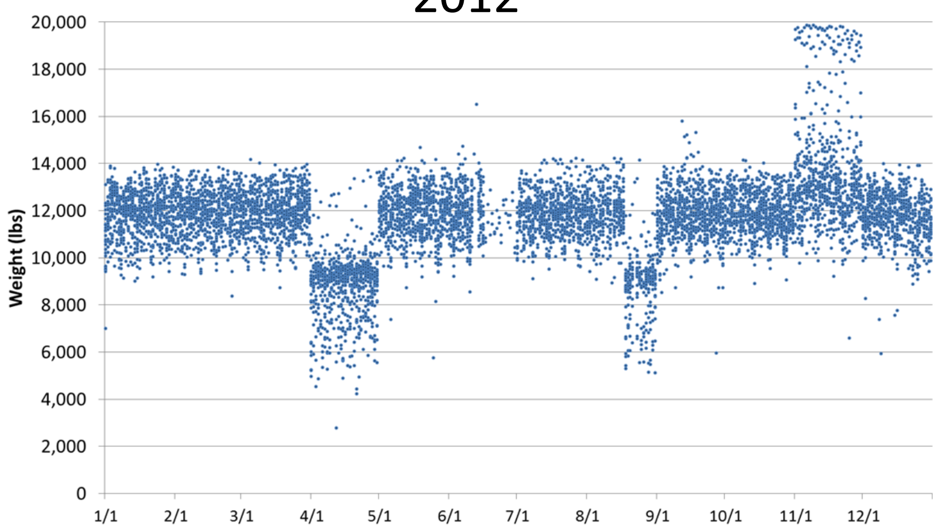
# DETERMINATION OF WHEEL AND SINGLE-AXLE LOADS

# WIM Stations





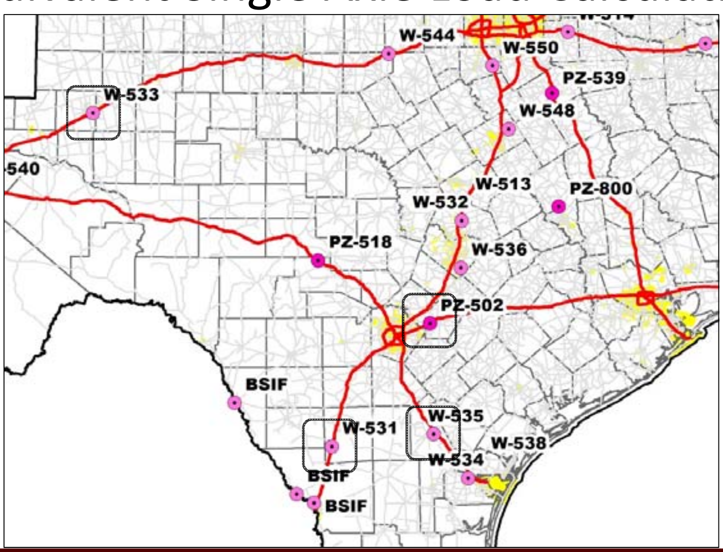

# Average Ten Heaviest Wheel Loads Daily 2012

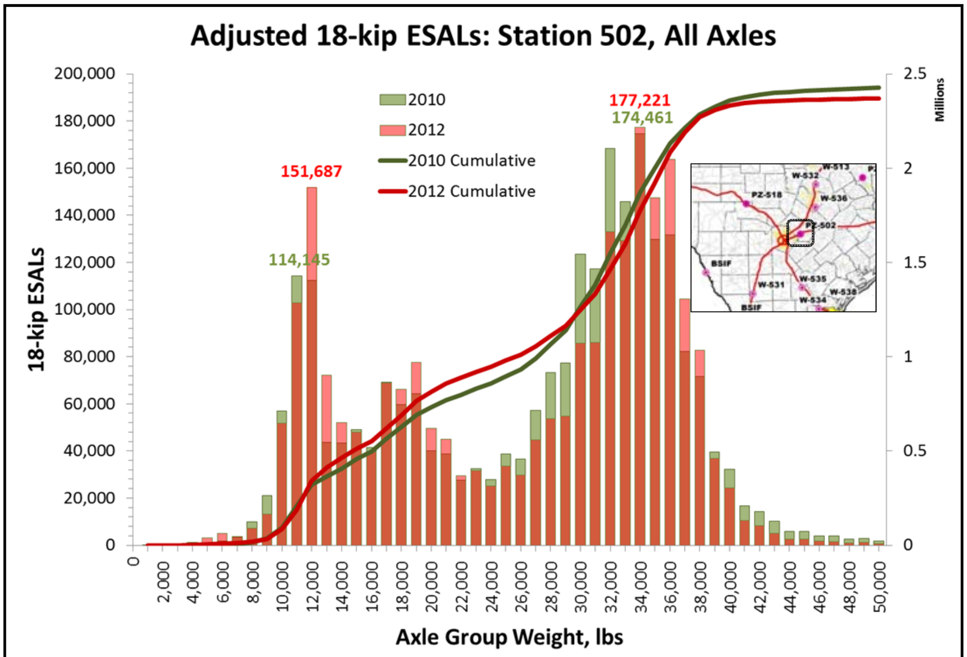


| WIM Station | 2012 ATHWLD Mean (lb) | 2012 ATHWLD Std. Dev. (lb) | 2012 ATHWLD Highest (lb) |
|---|---|---|---|
| 142 | 12,178 | 1,896 | 15,234 |
| 502 | 12,310 | 1,432 | 16,127 |
| 506 | 11,623 | 816 | 13,614 |
| 513 | 12,871 | 2,304 | 19,864 |
| 518 | 12,183 | 1,280 | 16,998 |
| 522 | 11,583 | 1,342 | 16,491 |
| 523 | 11,489 | 1,023 | 13,459 |
| 524 | 11,507 | 1,034 | 13,757 |
| 525 | 11,473 | 1,223 | 13,305 |
| 526 | 11,989 | 1,263 | 14,595 |
| 527 | 12,390 | 2,131 | 19,136 |
| 528 | 11,066 | 1,038 | 13,525 |
| 529 | 11,647 | 993 | 13,426 |
| 530 | 10,267 | 1,545 | 12,765 |
| 531 | 11,755 | 1,286 | 15,190 |
| 532 | 10,689 | 1,580 | 13,294 |
| 533 | 12,644 | 1,421 | 14,231 |
| 535 | 10,794 | 1,454 | 13,702 |
| 536 | 11,222 | 1,591 | 14,121 |
| 537 | 12,267 | 2,681 | 19,809 |
| 538 | 11,488 | 1,093 | 14,716 |
| 539 | 12,715 | 1,584 | 18,298 |
| 540 | 11,552 | 1,921 | 13,922 |
| 541 | 11,110 | 1,656 | 13,636 |
| 542 | 12,131 | 1,284 | 14,297 |
| 543 | 10,178 | 1,389 | 12,985 |
| 544 | 11,765 | 1,070 | 14,286 |



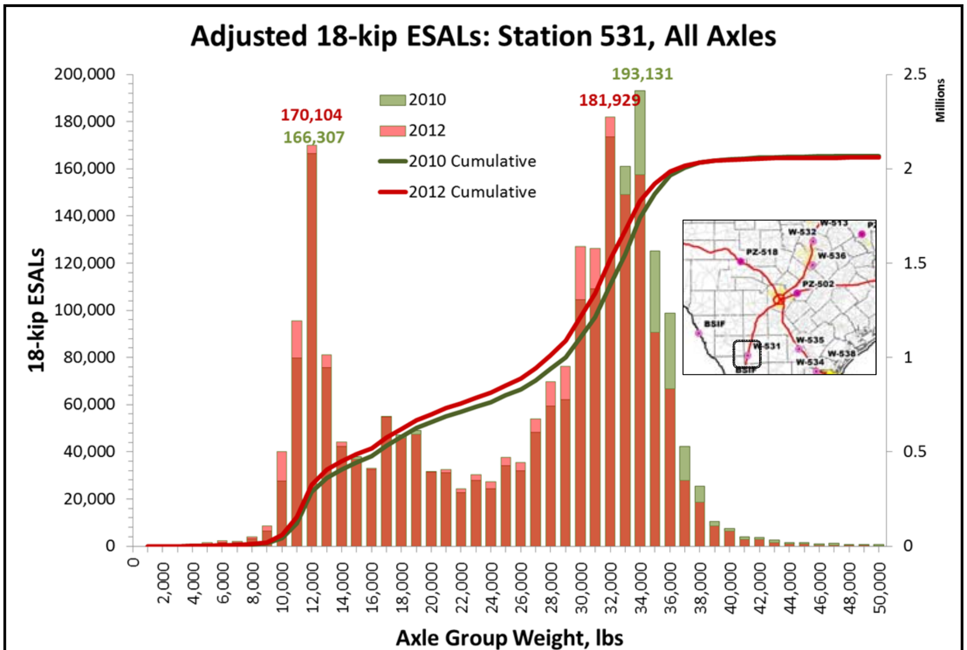
# Equivalent Single Axle Load Calculation





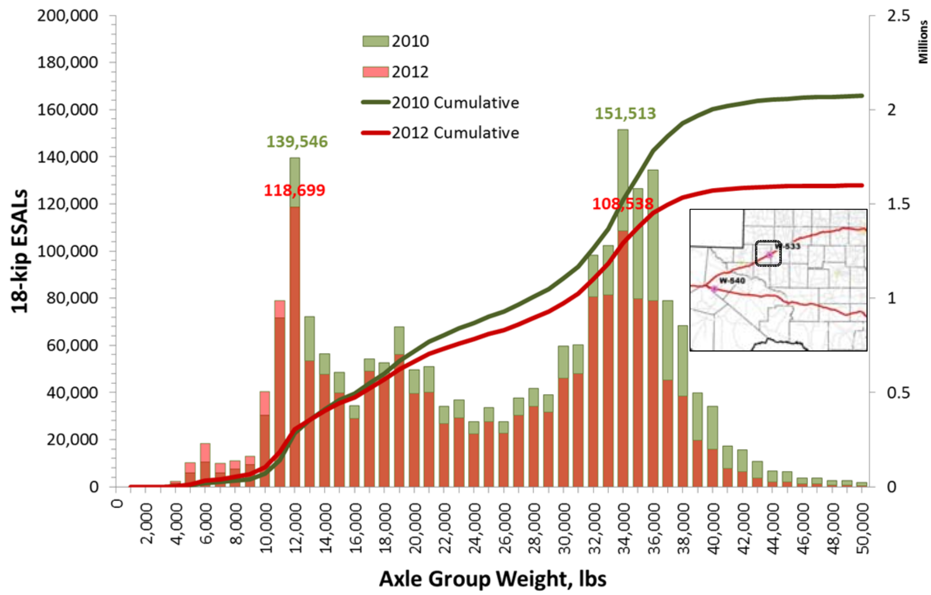
Adjusted 18-kip ESALs: Station 502, All Axles
18-kip ESALs
Axle Group Weight, lbs
Millions
2010
2012
2010 Cumulative
2012 Cumulative
151,687
114,145
177,221
174,461



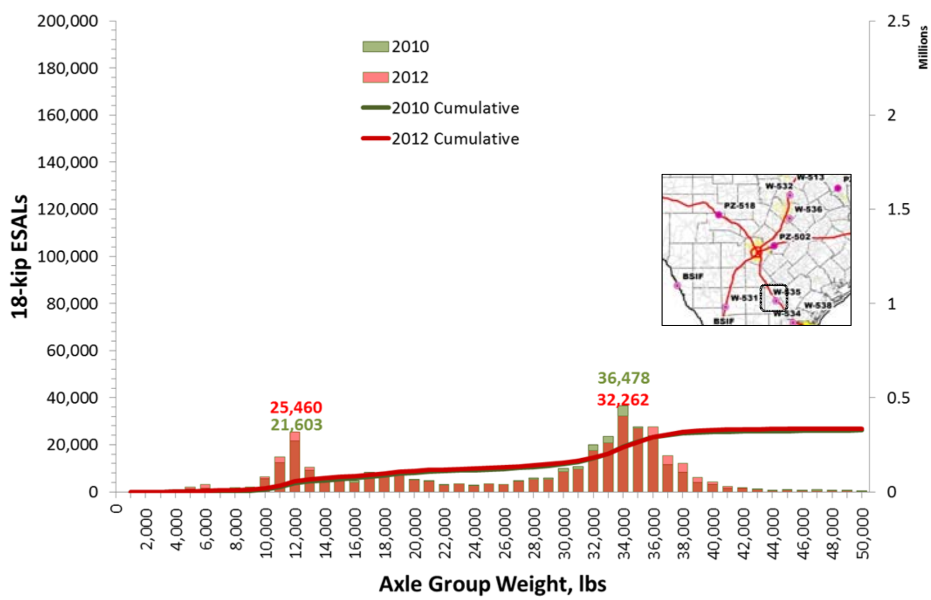
Adjusted 18-kip ESALs: Station 531, All Axles
18-kip ESALs
Axle Group Weight, lbs
Millions
2010
2012
2010 Cumulative
2012 Cumulative
170,104
166,307
193,131
181,929

## Adjusted 18-kip ESALs: Station 533, All Axles






## Adjusted 18-kip ESALs: Station 535, All Axles



## Roadside Impacts

- Roadside impacts
  - Driveway access and permitting
  - Utility accommodation and permitting
    - Crossings
    - Longitudinal installations
    - Gathering lines
    - Temporary lines
    - Easement issues

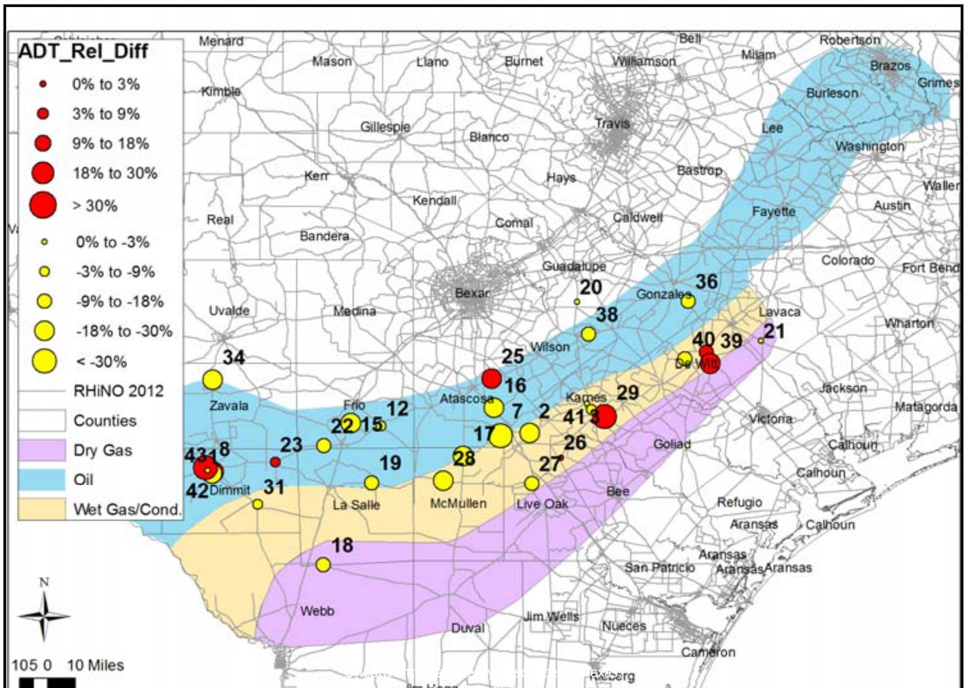


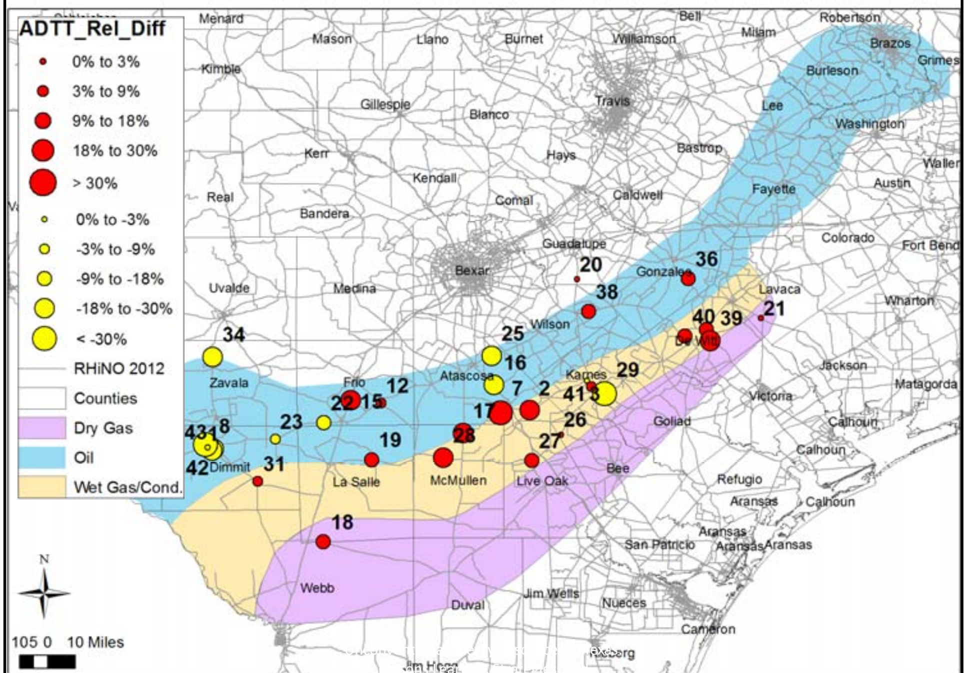
## Other Impacts

- Operational and safety impacts
  - Increase in the number of crashes and fatalities
  - Commercial vehicle safety violations

# Vehicle Crash Statistics

| Region | Category | 2009 | 2013 | Change |
|---|---|---|---|---|
| Eagle Ford | Total crashes | 15,016 | 16,643 | 11% |
| | Crashes involving CMVs | 987 | 2,023 | 105% |
| | Fatal crashes | 140 | 170 | 21% |
| | Fatal crashes involving CMVs | 15 | 52 | 247% |
| Permian Basin | Total crashes | 21,141 | 22,074 | 4% |
| | Crashes involving CMVs | 1,145 | 2,125 | 86% |
| | Fatal crashes | 162 | 252 | 56% |
| | Fatal crashes involving CMVs | 18 | 62 | 244% |
| Statewide | Total crashes | 428,310 | 441,682 | 3% |
| | Crashes involving CMVs | 25,000 | 20,198 | 17% |
| | Fatal crashes | 2,821 | 3,038 | 8% |
| | Fatal crashes involving CMVs | 301 | 452 | 50% |





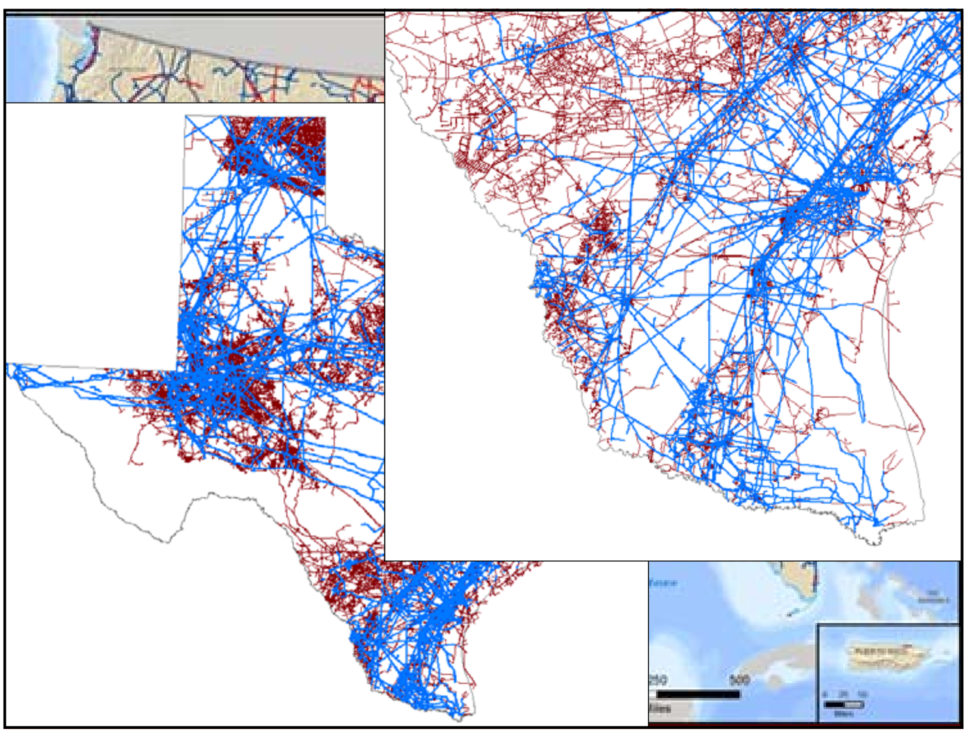

# Hazmat Surveys

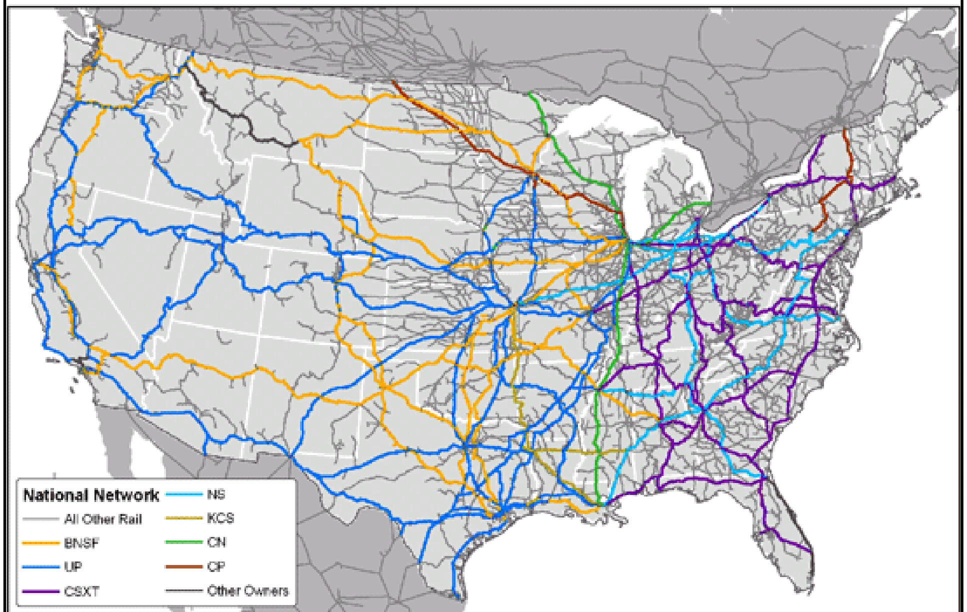
- Truck-based surveys
- Conducted at DPS inspection stations
- Focus on trucks with hazmat placards
- Information gathered:
  - Type of commodity
  - Origin
  - Destination
  - Some surveys conducted in energy development areas

# Pipelines and Railroads

- New developments frequently occur in areas without pipeline or railroad infrastructure
  - Reliance on trucks
  - Truck use decreases as pipeline and railroad infrastructure is built
- Largely handled by private industry
- Little involvement at the state level
  - Permitting and mapping







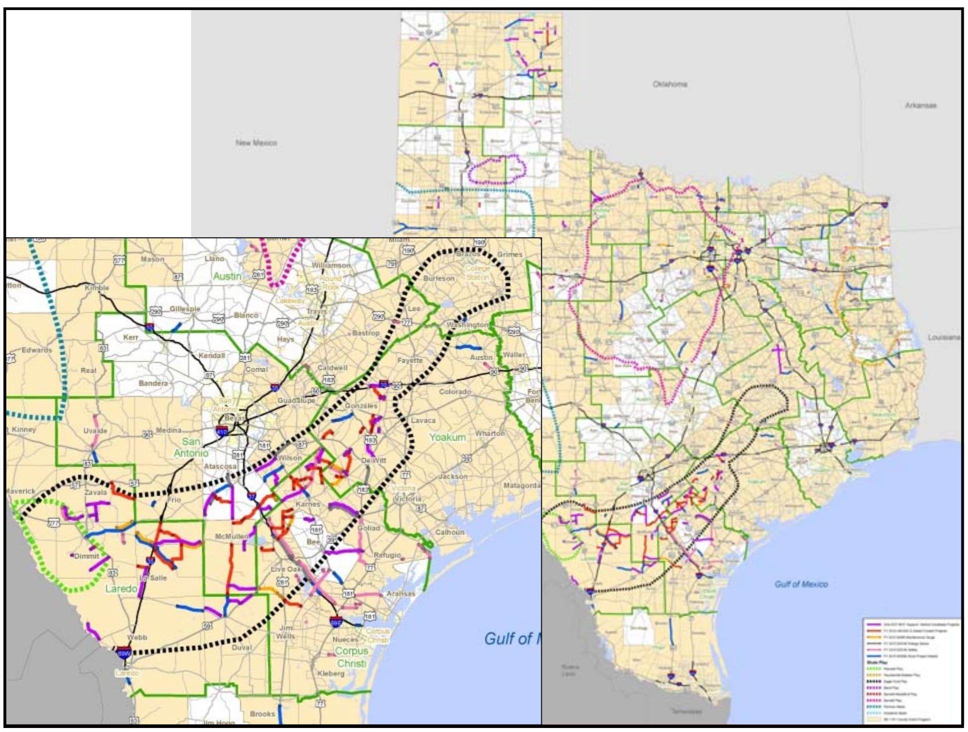



# FUNDING SOURCES AND ISSUES

# Funding Sources (State Level)

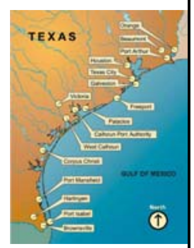
- 2012 Maintenance Funds ($40M)
- 2013 HB 1025
  - $225M for design-build and traditional letting
- 2014 Rural Needs ($500M outside MPOs)
- 2014 Safety, Maintenance, and Energy Sector
  - $200M (safety) and $200M (maintenance and ES)
- 2015 Proposition 1 Funding ($1.74B)
  - $696M (connectivity), $522M (regional corridors), $261M (energy sector), $261M (maintenance)





## Port Developments and Investments

- Port Arthur: Valero and Total refineries have invested ~$2 billion in expansion – Motiva Enterprise refinery is largest in North America
- Houston area: $30 billion committed for construction of refining and petrochemical facilities
- Corpus Christi: Tianjin Pipe Corporation locating $1 billion+ manufacturing facility
- Corpus Christi: Cheniere Energy investing $10 billion in LNG export terminal






## Channel Improvement Projects

| Region/Port | Proposed Depth | Status |
|---|---|---|
| Beaumont/Port Arthur | 48 | Authorized in WRRDA 2014, seeking funding. |
| Brownsville | 52 | Feasibility study completed. Waiting for Congressional authorization. |
| Corpus Christi | 52 | Reauthorized in WRRDA 2014, seeking funding. La Quinta extension (45 ft) built in 2013. |
| Freeport | 55 | Authorized in WRRDA 2014, seeking funding. |
| Houston | 45 | Channel extensions to Bayport and Barbours Cut. Some widening included. Under construction. Will do w/o federal aid. Will be done in 2015. |

# WATER AND ENVIRONMENTAL ISSUES



## Water and Environmental Issues

- Water management
  - Amount of water used for fracking
    - Vertical well fracking: 20,000–80,000 gallons
    - Horizontal well fracking: 2–9 million gallons
  - Disposal
    - Water is a byproduct in hydrocarbon production
    - Transportation and disposal for produced water
  - Best practices

# Water and Environmental Issues

- Fracking chemical components
  - Importance of disclosure
  - Chemical disclosure registry
- Emissions

| Year | Low Development Scenario | | | Moderate Development Scenario | | | High Development Scenario | | |
|---|---|---|---|---|---|---|---|---|---|
| | VOC | $NO_X$ | CO | VOC | $NO_X$ | CO | VOC | $NO_X$ | CO |
| 2011 | 101 | 66 | 50 | 101 | 66 | 50 | 101 | 66 | 50 |
| 2012 | 229 | 111 | 92 | 229 | 111 | 92 | 229 | 111 | 92 |
| 2015 | 347 | 108 | 113 | 417 | 121 | 130 | 512 | 140 | 154 |
| 2018 | 338 | 113 | 113 | 544 | 146 | 160 | 872 | 188 | 226 |

Not included: Projection of mid-stream sources, stack parameters of mid-stream sources, on-road sources, and construction of mid-stream facilities and pipelines



# Questions?

# Meeting Agenda

| Time | Topic | Speaker |
|---|---|---|
| 8:30 AM – 9:00 AM | Welcome and Introductions | Several speakers |
| 9:00 AM – 9:10 AM | TTI Overview | Cesar Quiroga |
| 9:10 AM – 9:30 AM | Oil and Gas Developments in Texas | Cesar Quiroga |
| 9:30 AM – 10:15 AM | Recent and Current Research and Technology Transfer | Several speakers |
| 10:15 AM – 10:30 AM | Break | |
| 10:30 AM – 11:30 AM | Breakout Table Discussions | All participants |
| 11:30 AM – 11:50 AM | Breakout Group Presentations | Several speakers |
| 11:50 AM – Noon | Wrap-Up, Next Steps, and Adjourn | All participants |



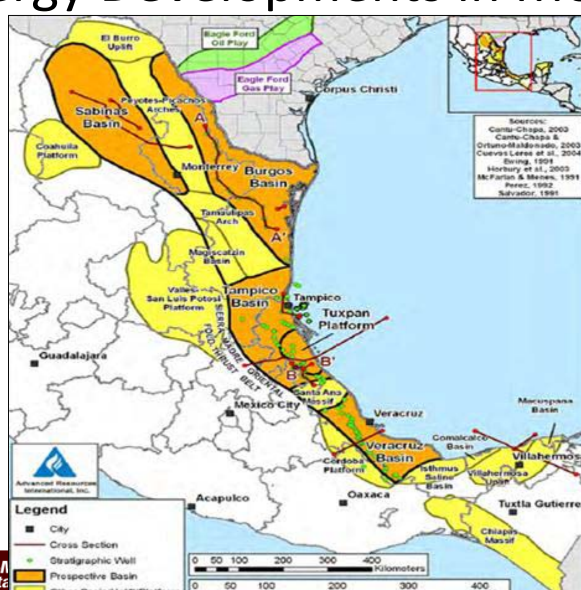
# Breakout Table Discussions

# Purpose and Goals

- Explore topics and issues of interest to participants in more detail in relation to energy developments and transportation infrastructure in Texas
- Identify transportation infrastructure needs in Mexico related to energy developments
- Identify areas of synergy and potential collaboration



# Energy Developments in Mexico



## Topics and Challenges

- Fracking sand
  - Available in Mexico, but properties are not the same
  - Transported by train from the U.S.
- Scarcity of trucks
- Transportation infrastructure
  - Pipelines, railroads, roads, ports
- Professional capacity
  - Public and private sectors



## Topics and Challenges

- Scarcity of water
  - Water is available in South Texas through significant investments in water infrastructure over many years
  - Water infrastructure in Mexico
    - Cost to develop infrastructure to make large amounts of water available at a low cost to developers
- Water is a byproduct in hydrocarbon production
  - Transportation and disposal for produced water
  - Frequently ignored

## Topics and Challenges

- Early notification and coordination
  - Strategies to improve communication, coordination, and cooperation (3Cs) with energy developers
  - Case studies for interagency cooperation agreements



## Topics and Challenges

- Pavement structures
  - Techniques to prioritize repair, rehabilitation, and reconstruction of roadways
  - Region-sensitive truck traffic and pavement impact forecasting tools
  - More accurate, realistic parameters to design pavement structures in energy development regions

# Topics and Challenges

- Safety
  - Safety analysis techniques that focus on roadway characteristics, traffic levels, and crashes
  - Traffic safety countermeasures
- Roadside
  - Best practices for driveway impact assessment and permitting
  - Best practices for saltwater pipeline impact assessment and accommodation



# Topics and Challenges

- Planning, environment, and design
  - Supply chains at different geographic levels
  - Methodology to determine bottlenecks and congestion areas
  - Data-driven parameters for environmental analyses
  - More accurate, realistic parameters to improve geometric design

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