

Energy Developments in Mexico – Best Practices for Sustainable Transportation Infrastructure

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

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:

Lessons Learned, Strategies, and

Opportunities

Mobility

**Economics &
Policy**

Security

**Freight
Movement**

Human Factors

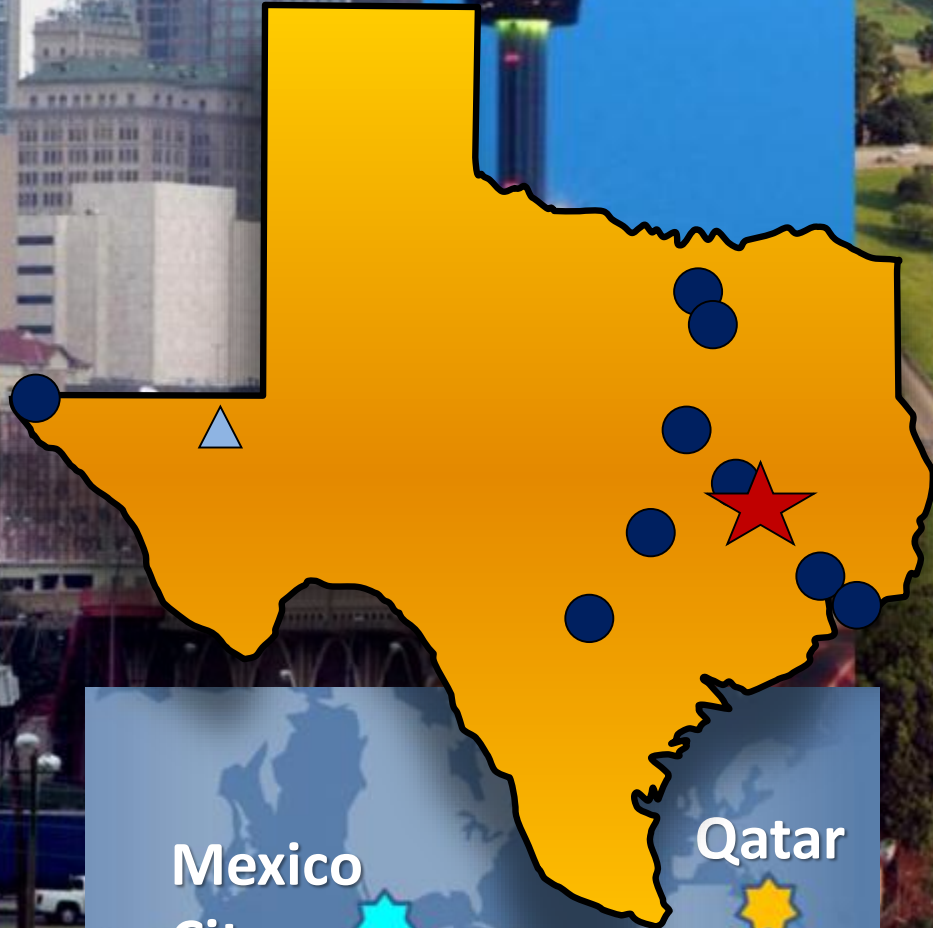
Infrastructure

Environment

Safety

**Workforce
Development**

Statewide Offices



- Arlington
- Austin
- Bryan
- ★ College Station
- Dallas
- El Paso
- Galveston
- Houston
- San Antonio
- Waco

▲ Pecos Center for
Research and Testing

Mexico
City

Qatar

San Antonio Office

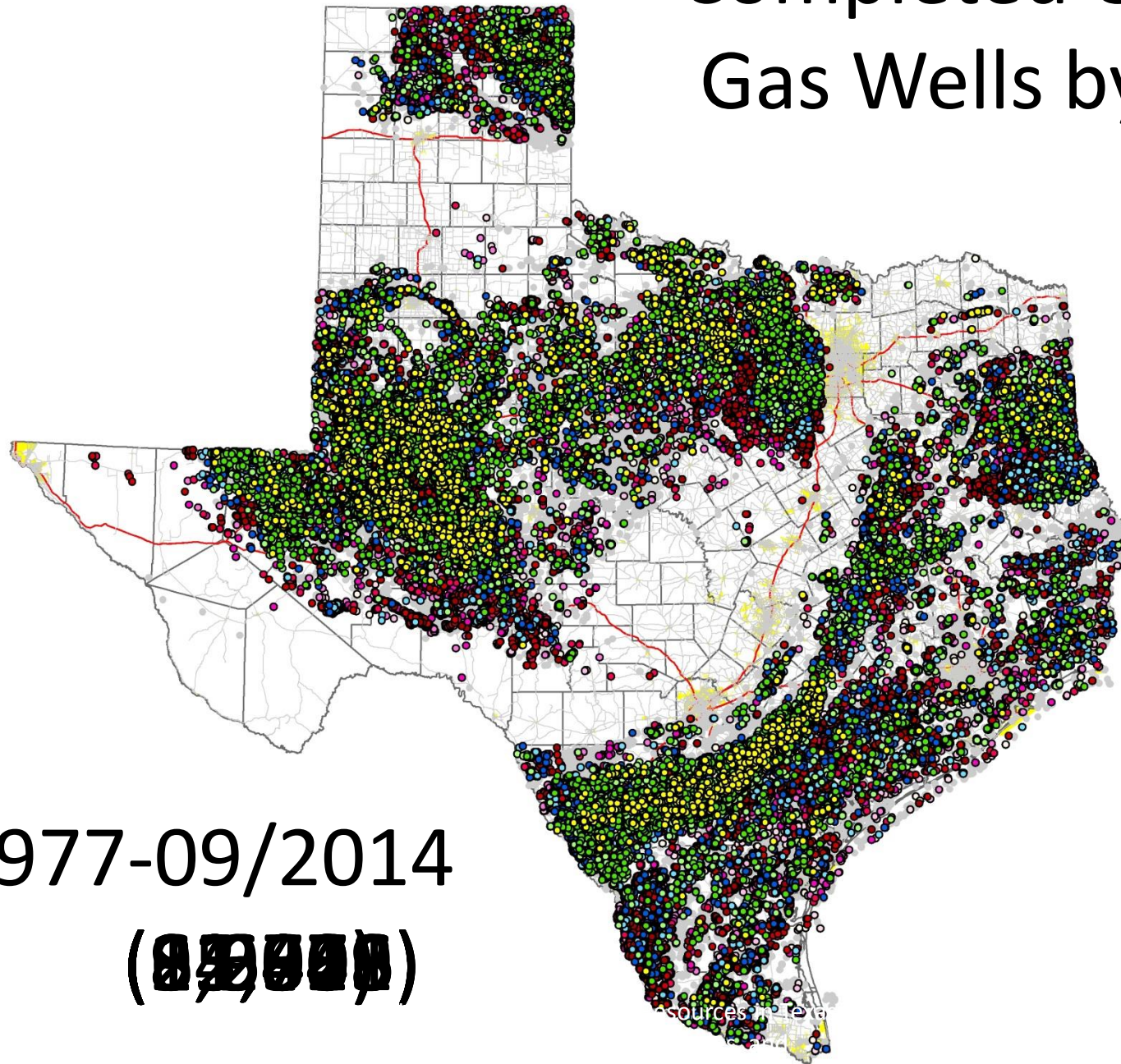
- Optimization of the project development process
- Energy and transportation sector interactions
- Utility coordination and conflict management
- Planning and operations
- Extensive South Texas coverage
- Support to TxDOT Districts (San Antonio, Laredo, Corpus Christi, Pharr)
- Coordination with local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

Oil and Gas Developments in Texas

Unconventional Energy Developments

- Horizontal drilling
 - Late 1980s, Austin Chalk Formation in Texas
 - 1991, Barnett Shale
- Hydraulic fracturing
 - Has been around since the 1940s
- Slickwater fracturing
 - 1996/1997, chemicals added to increase fluid flow
- Horizontal drilling + slickwater fracturing
 - Shale gas extraction became efficient and feasible

Completed Oil and Gas Wells by Year

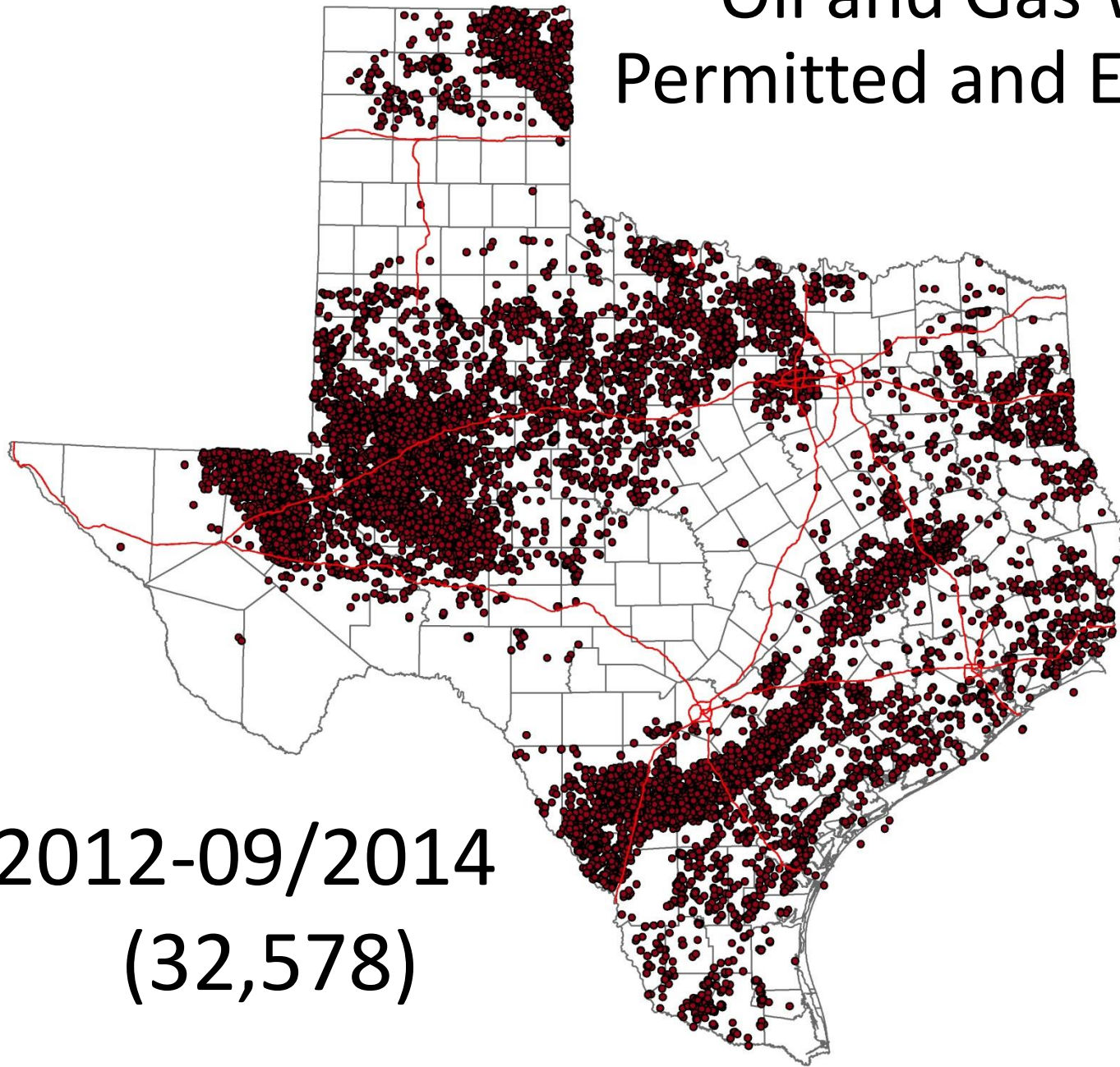


1977-09/2014

(0000000)



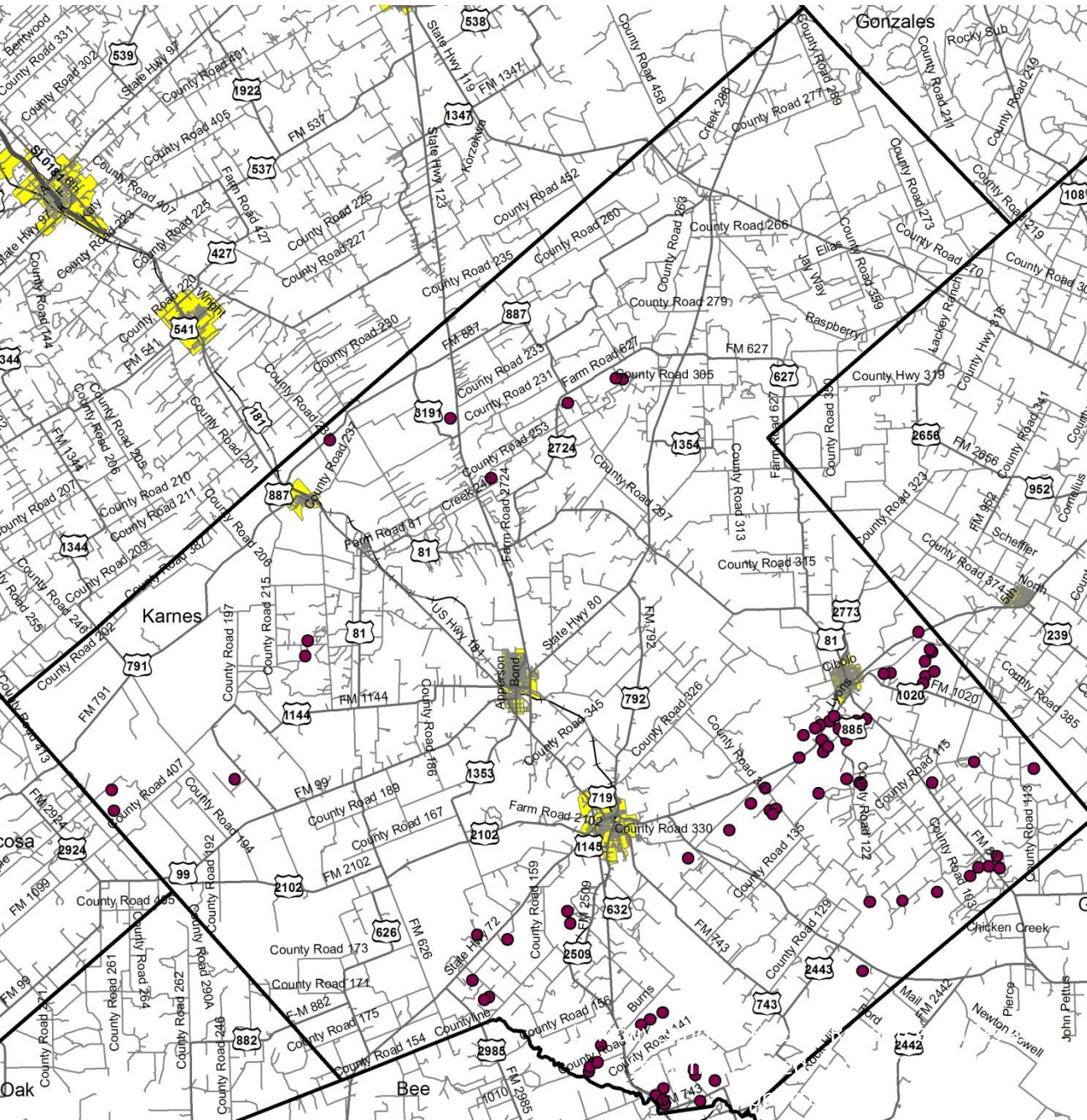
Oil and Gas Wells Permitted and Expected



10/2012-09/2014
(32,578)



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

OG Wells in Karnes County (2008-2013)



Completed O/G Wells 2008-2013 Karnes County

- OG Wells in Karnes County 2008-2013
- Other Roads
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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 1611



Drainage problem at driveway



Mud tracking

Current Initiatives

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

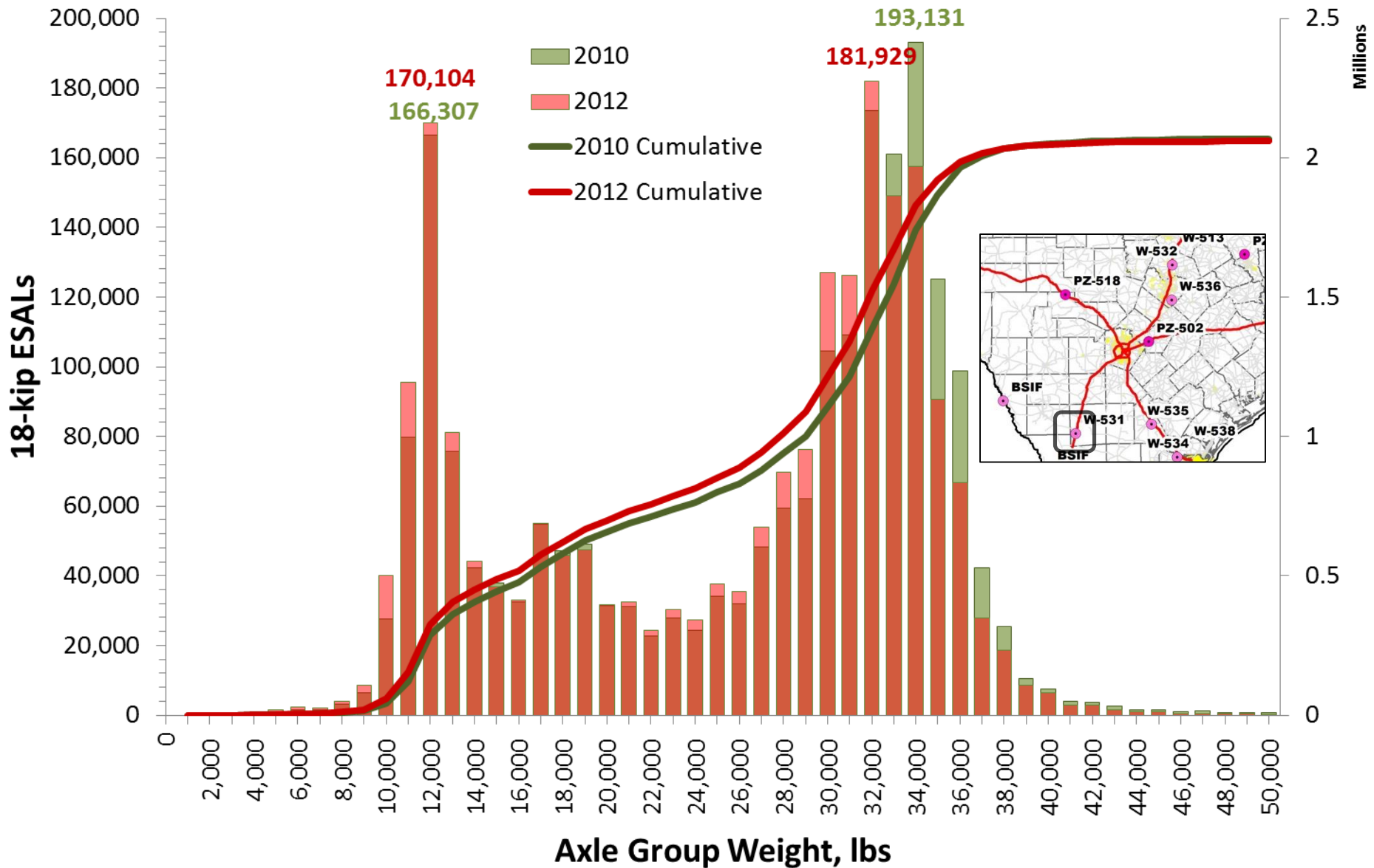
Energy Traffic Characterization

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			

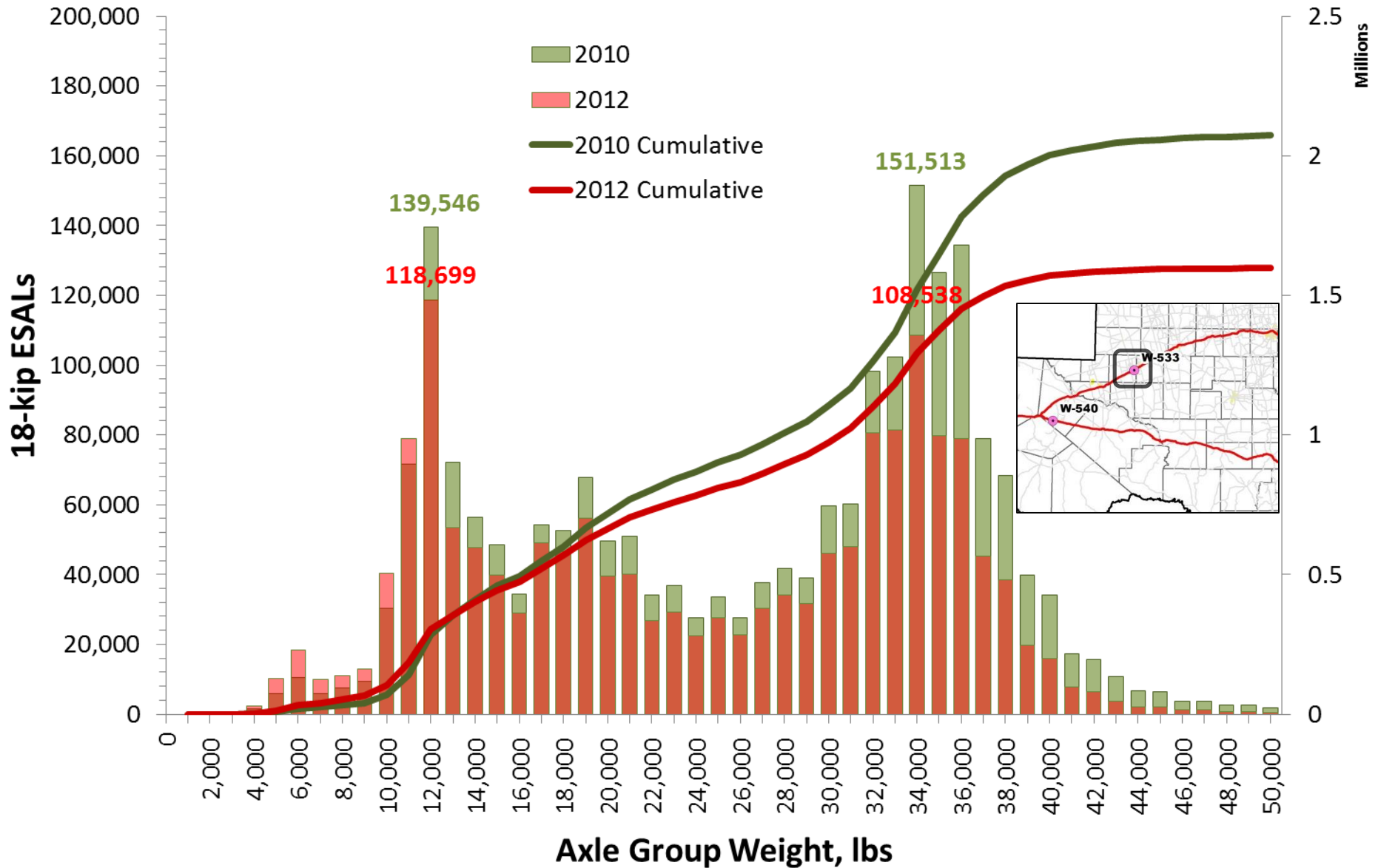
Relative Pavement Impact

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

Adjusted 18-kip ESALs: Station 531, All Axles



Adjusted 18-kip ESALs: Station 533, All Axles



Vehicle Crash Statistics

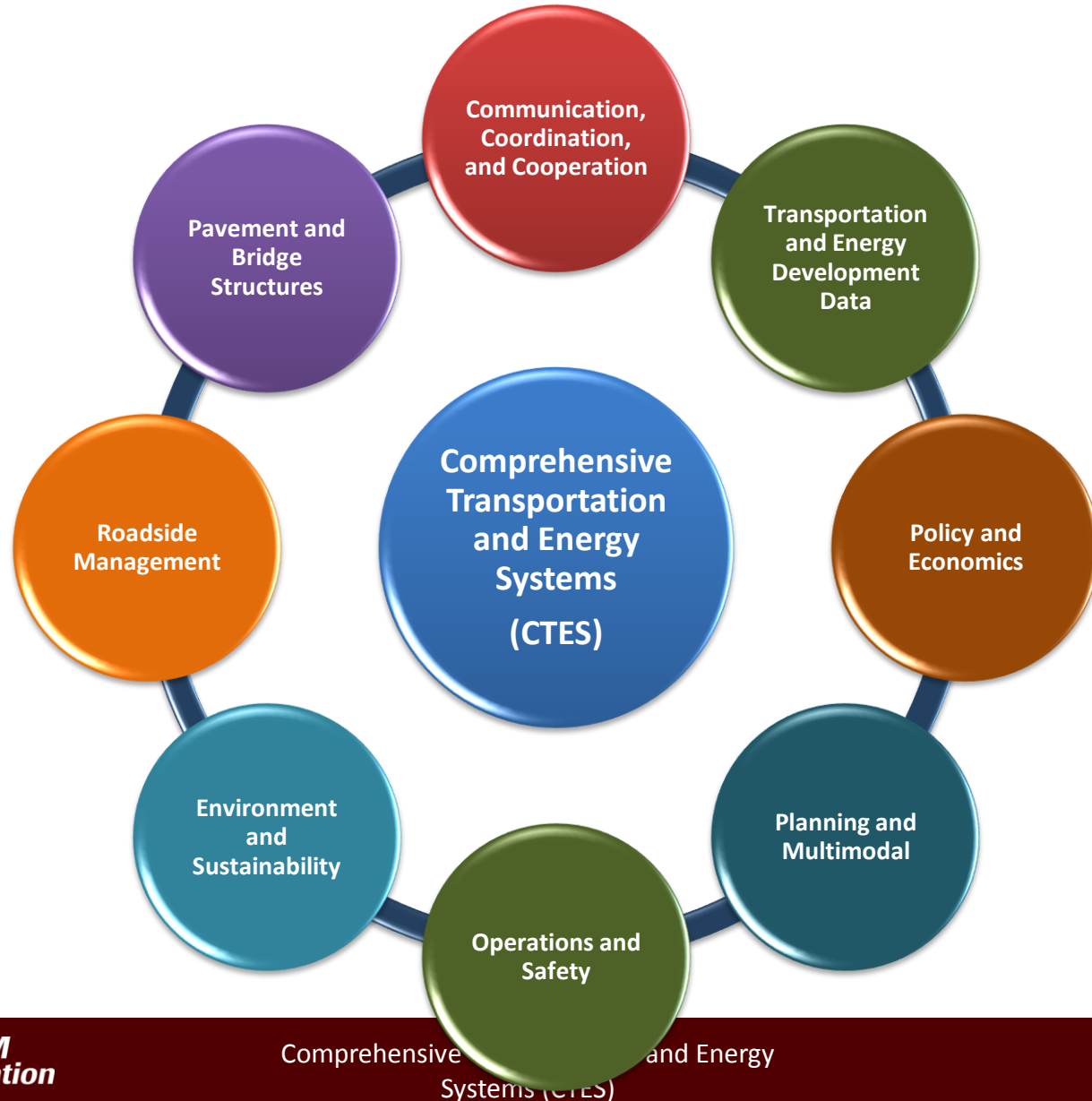
Region	Category	2009	2013	Change
Eagle Ford	Total crashes	15,016	16,643	11%
	Crashes involving CMVs	987	2,023	105%
	Fatal crashes	140	170	21%
	Fatal crashes involving CMVs	15	52	247%
Permian Basin	Total crashes	21,141	22,074	4%
	Crashes involving CMVs	1,145	2,125	86%
	Fatal crashes	162	252	56%
	Fatal 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%

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

Comprehensive Transportation and Energy Systems (CTES) Initiative

Strategic Research Roadmap Framework



Workshop Locations and Dates

- San Antonio (TAMU-SA): 04/03/2015
- Odessa: 04/07/2015 (tentative)
- Fort Worth: 04/14/2015 (tentative)

Thank You!

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