



# Addressing Air Emissions from Marcellus Shale Natural Gas Production



January 30, 2011

Joe Osborne, Legal Director, Group Against Smog & Pollution

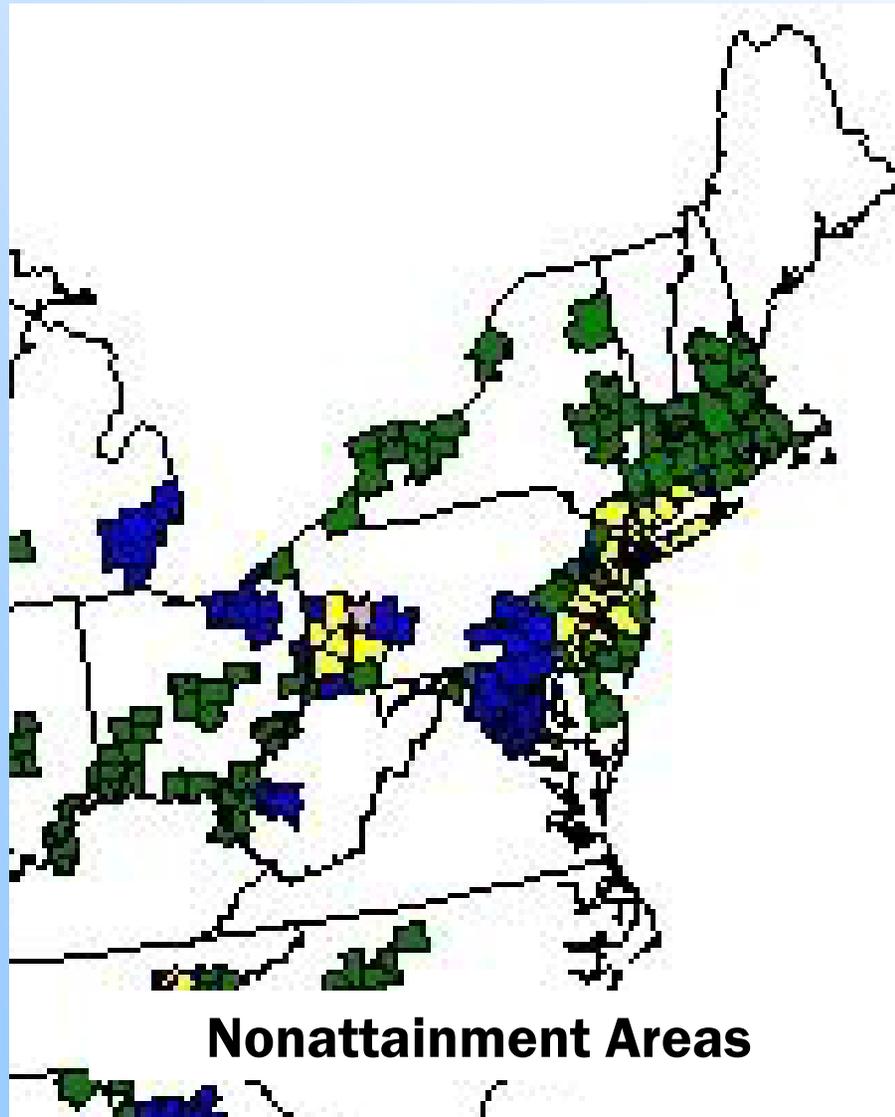


## **The Oil and Gas Sectors' Contribution to Ambient NOx and VOC can be Enormous**

**Consider other areas where drilling is common:**

- **A 2009 Southern Methodist University Study concluded that in the 5-county Dallas-Fort Worth area annual NOx and VOC emissions from the oil and gas sector exceed emissions from all motor vehicles.**
- **A 2008 analysis by the Colorado Department of Public Health and Environment concluded that VOC and NOx emissions from Colorado's oil and gas operations exceed motor vehicle emissions for the entire state.**
- **In 2009 several years of elevated ozone readings (including elevated wintertime readings) lead Wyoming to request its first ever nonattainment designation. Wyoming DEQ states nonattainment "is primarily due to local emissions from oil and gas (O&G) development activities."**

# The Marcellus Shale Play is Perfectly Situated to Worsen Existing Ozone and PM Nonattainment in the Midatlantic and Northeast



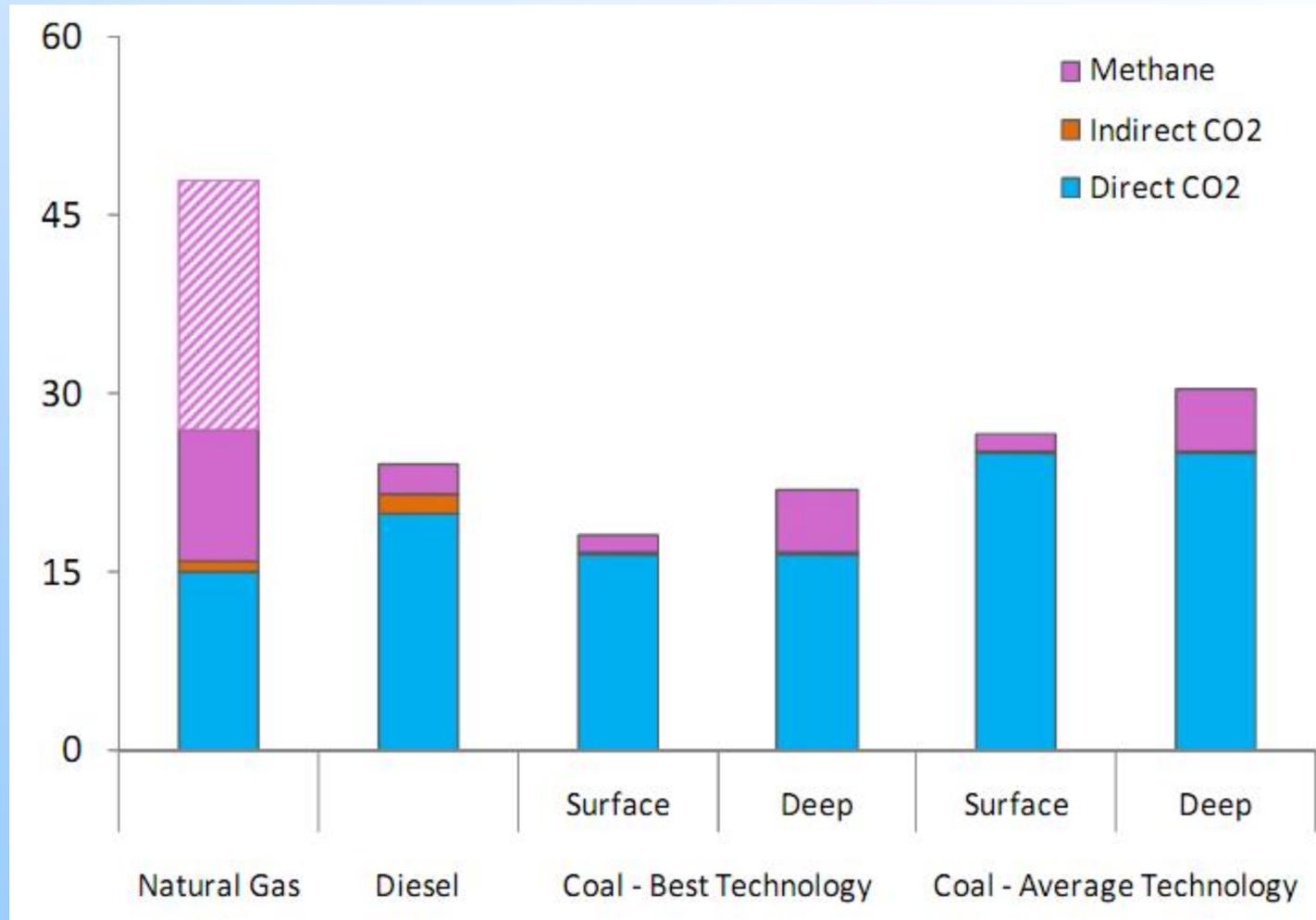
# What Pollutants are Emitted?

## 1. Methane

- primary constituent of natural gas (~80% by weight)
- potent greenhouse gas (~21 times more powerful than CO<sub>2</sub>)
- explosive
- oil and gas sector responsible for 18% of methane emissions worldwide



# Shale Gas Contribution to Global Warming Potentially Greater than Coal



*Assessment of the GHG Footprint of Natural Gas from Shale Formations*, Robert W. Howarth, Prof. Ecology & Environmental Biology, Cornell University (Nov. 15, 2010)

# What Pollutants are Emitted?

## 2. Air Toxics

- **benzene, toluene, ethylbenzene, xylenes**
  - **benzene is a known human carcinogen**
  - **neurotoxic/reproductive/developmental effects**
- **hydrogen sulfide**
  - **eye nose throat irritation**
  - **brain damage, death at high concentrations**
- **formaldehyde**
  - **possible carcinogen, asthma, coughing, fatigue, allergic reactions**
- **frequently elevated air toxics near natural gas operations**
  - **DISH, TX study selected 7 monitoring locations near natural gas facilities. 5 locations air toxics concentrations exceeded short term ESLs.**

# What Pollutants are Emitted?

## 3. Ozone and PM precursors:

- **Volatile Organic Compounds**
  - broad class of high vapor pressure organics
  - some carcinogenic
  - eye & respiratory tract irritation, headaches, dizziness
- **Nitrogen Oxides**
  - acid rain
  - respiratory inflammation, exacerbates asthma
- **Methane**
- **Carbon Monoxide**

# What are the emissions sources?

## 1. Compressor Engines

- fugitives
- exhaust

### 1200 hp compressor:

**NO<sub>x</sub> – 16 TPY**

**CO – 18 TPY**

**VOCs – 3 TPY**

**HAPs – 0.5 TPY**

**(formaldehyde)**



# Emissions Sources in Marcellus Shale Operations

## 2. Condensate Tanks

a 400 bbl tank might emit 2  
tons/year of VOCs



# What are the emissions sources?

## 3. Production/Transmission Fugitive Emissions

- leaking pipes, valves, flanges

## 4. Gas Processing

- dehydrators

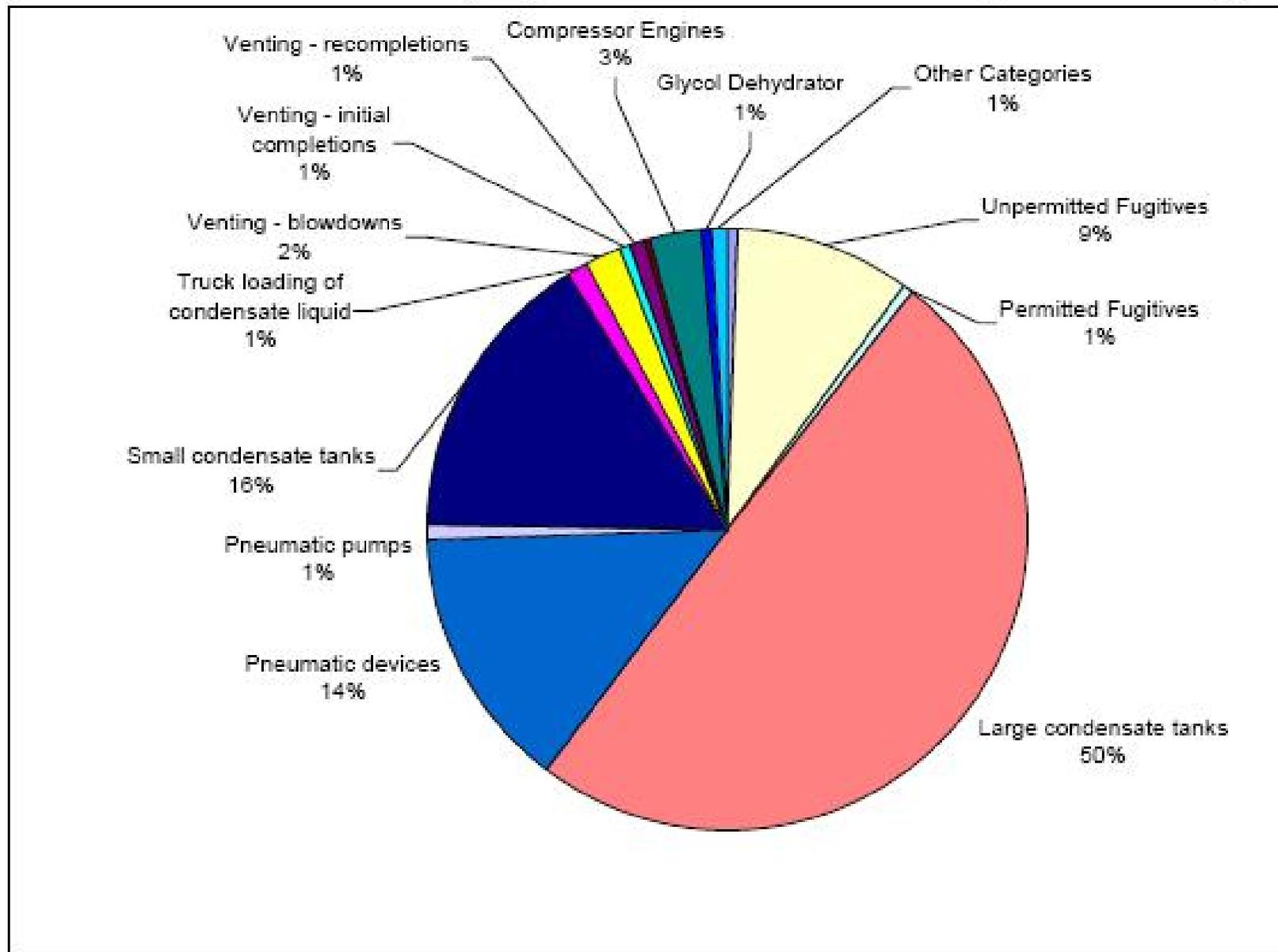


# What are the emissions sources?

## 5. Well Completions

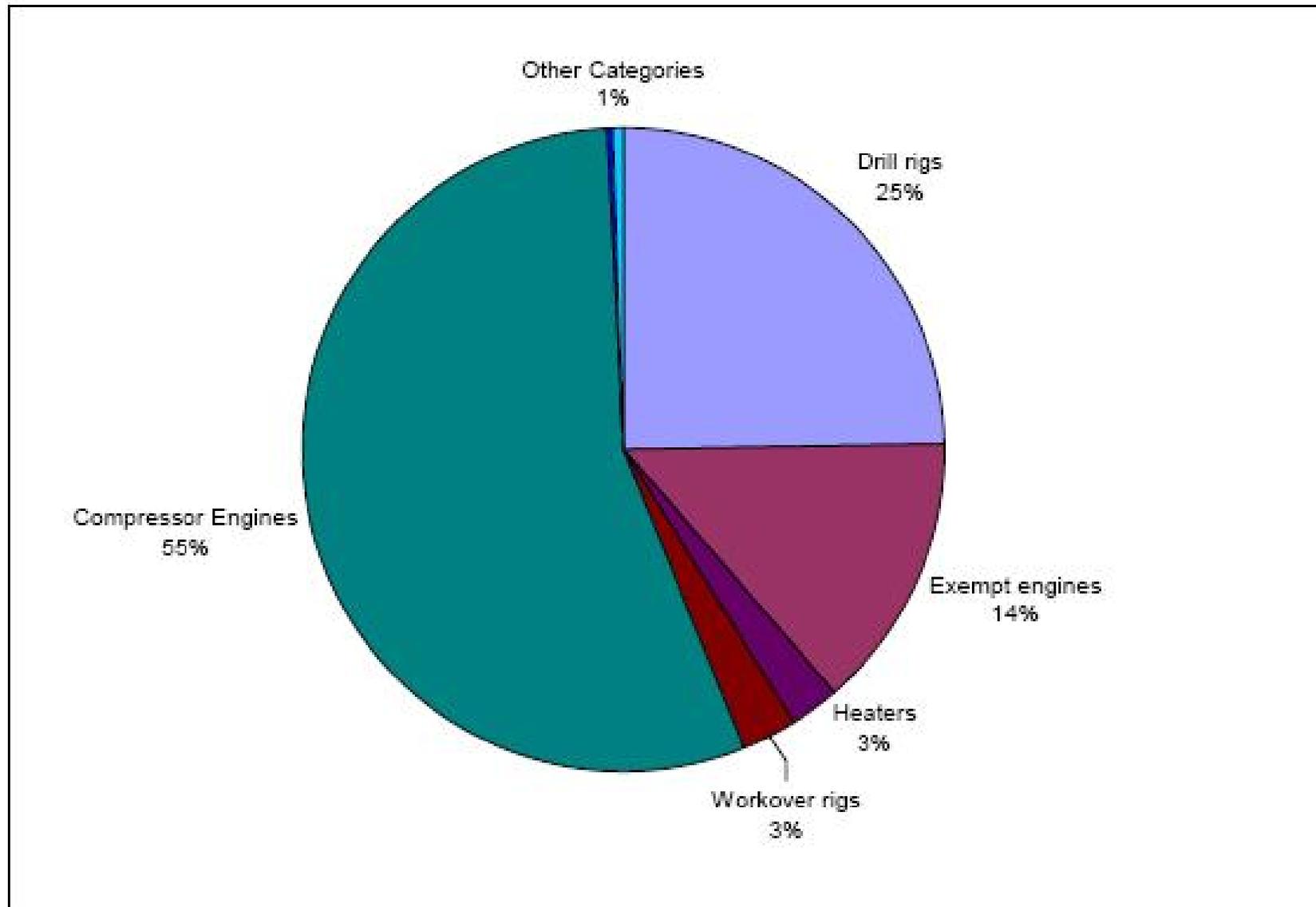


## D-J Basin VOC emissions proportional contributions by source category.



Amnon Bar-Ilan et. al. *Comprehensive Oil and Gas Emissions Inventory for the Denver-Julesburg Basin* (May 2008), available at: <http://www.epa.gov/ttn/chief/conference/ei17/session2/amnon.pdf>

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**Emissions Summary for All Source Categories.**

	2007 Pollutant (tpd)					2009 Pollutant (tpd)				
	NOx	VOC	HAPs	CH4	CO2e	NOx	VOC	HAPs	CH4	CO2e
Compressor Engine Exhausts	51	15	2.7	43	8910	46	19	3.6	61	13877
Condensate and Oil Tanks	0	19	0.39	4.5	95	0	30	0.60	7.0	149
Production Fugitives	0	17	0.40	148	3118	0	26	0.62	232	4884
Well Drilling and Completions	5.5	21	0.49	183	4061	5.5	21	0.49	183	4061
Gas Processing	0	10	0.24	32	674	0	15	0.37	50	1056
Transmission Fugitives	0	18	0.43	262	5517	0	28	0.67	411	8643
<b>Total Daily Emissions (tpd)</b>	<b>56</b>	<b>100</b>	<b>4.6</b>	<b>673</b>	<b>22375</b>	<b>51</b>	<b>139</b>	<b>6.4</b>	<b>945</b>	<b>32670</b>

**Al Armendariz, *Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements* (Jan. 26, 2009), available at: [http://www.edf.org/documents/9235\\_Barnett\\_Shale\\_Report.pdf](http://www.edf.org/documents/9235_Barnett_Shale_Report.pdf)**

# Limitations of Existing Laws

## Many Sources are exempt from Installation & Operating Permit Requirements

- PADEP's Air Quality Permit Exemption List "Category 38" exempts all oil and gas equipment except:
  - compressors over 100 HP
  - major sources
- In July PADEP requested comments on narrowed Category 38 exemptions, establishing emission limits/emission rates. Yet to go into effect
- No need to provide notice of intent to install emission unit to air permitting authority

# **Limitations of Existing Laws**

- **No notice to Air Permitting Authority —▶ No means for permitting authority to verify source meets exemption requirements**
  - **meeting emission rates?**
  - **emission limits?**
  - **employing required control measures?**
  - **under pollution threshold?**

# Limitations of Existing Laws

- **No permit —▶ No emissions reporting requirements**
  - **2010 University of Texas air monitoring suggests TCEQ Ozone Attainment modeling underpredicted NOx by 20%**

# **Solutions:**

## **1. Notification requirement for all stationary emission units associated with natural gas operations**

- **include process description, emission units list, potential to emit**
- **not as onerous for source operator as a full permit application, most information can be obtained from vendor spec sheets, AP-42**
- **provides Air Program with knowledge of emission units on site without having to perform an inspection**
- **allows Air Program to determine if exemption criteria are satisfied:**
  - **is source major?**
  - **are emission limits/rates, pollution control requirements met?**
- **provides better estimate of emissions for emissions inventory**

# Solutions:

2. Adopt proposed changes to air permit exemption list
3. Amend regulations to establish more stringent emission rates and mandatory pollution controls
4. Control devices for this industry are cost effective.
  - many pay for themselves in a year or less

Control Measure	Up Front Cost	Payback Period
green completions	\$1000-10,000	1 year
vapor recovery units	>\$10,000	<1 year
install low bleed or mechanical valves	<\$1000	<1 year
leak detection program	<\$500	Varies, Gas STAR participant reported payback in <1 year

data derived from:

EPA Gas STAR program, <http://www.epa.gov/gasstar/tools/recommended.html>

Armendariz Report (2009), [http://www.edf.org/documents/9235\\_Barnett\\_Shale\\_Report.pdf](http://www.edf.org/documents/9235_Barnett_Shale_Report.pdf)

# Solutions:

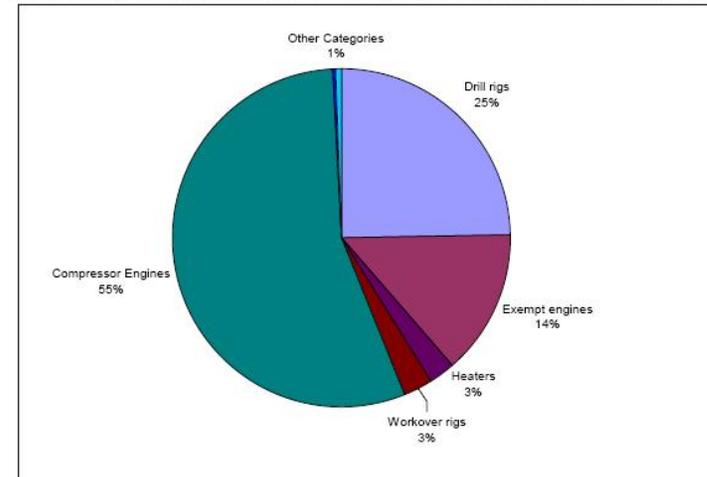
## 5. Conduct marcellus-wide emissions inventory

- quantify current and projected impact
- identify largest sources of emissions, best opportunities for emission reductions

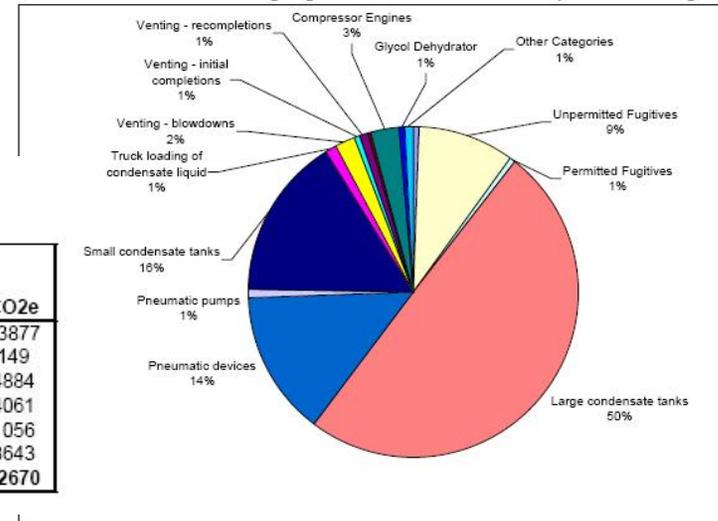
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D-J Basin NOx emissions proportional contributions by source category.

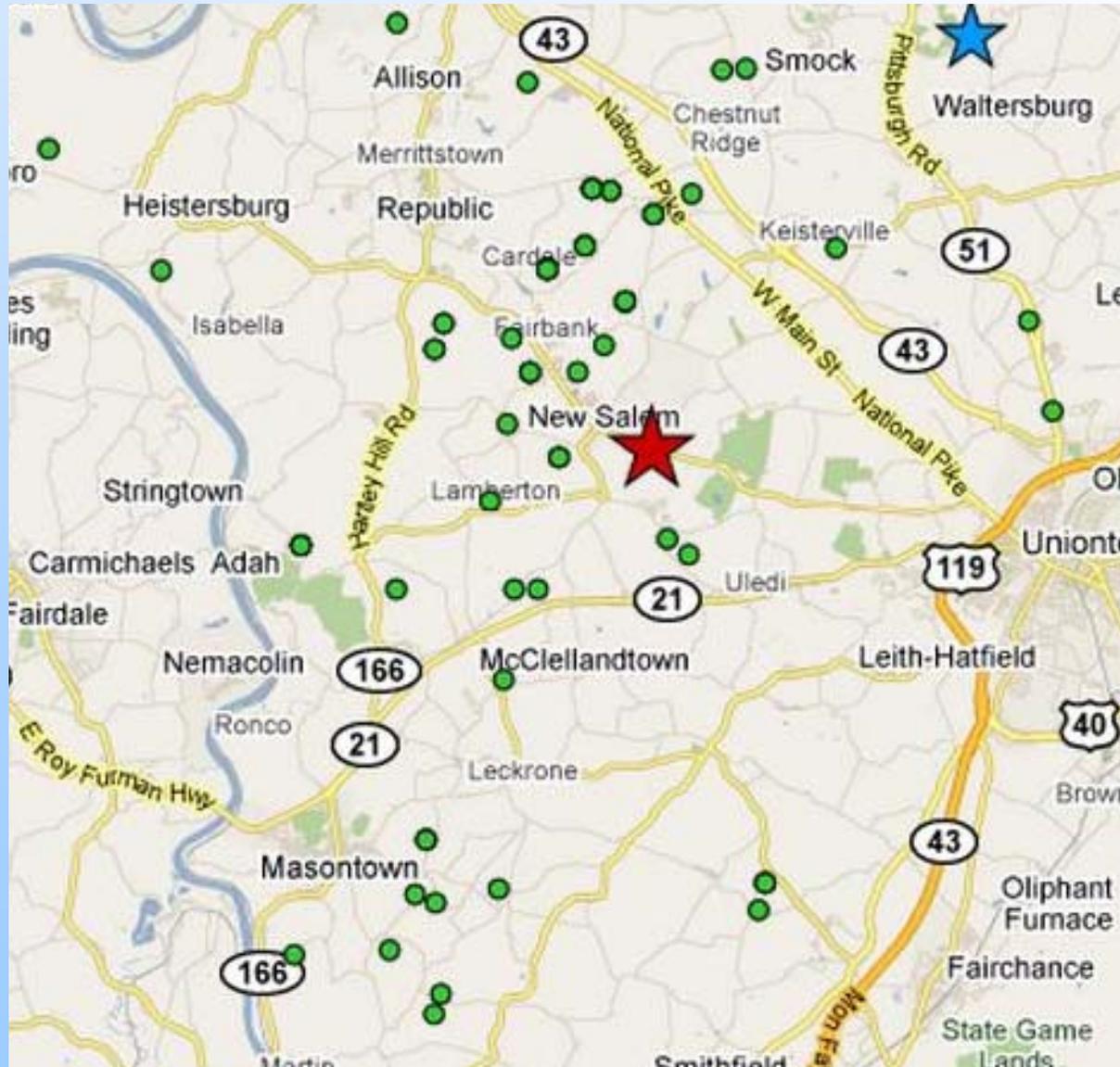


D-J Basin VOC emissions proportional contributions by source category.



# Solutions:

## 6. Enforce aggregation requirements



# Questions?

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